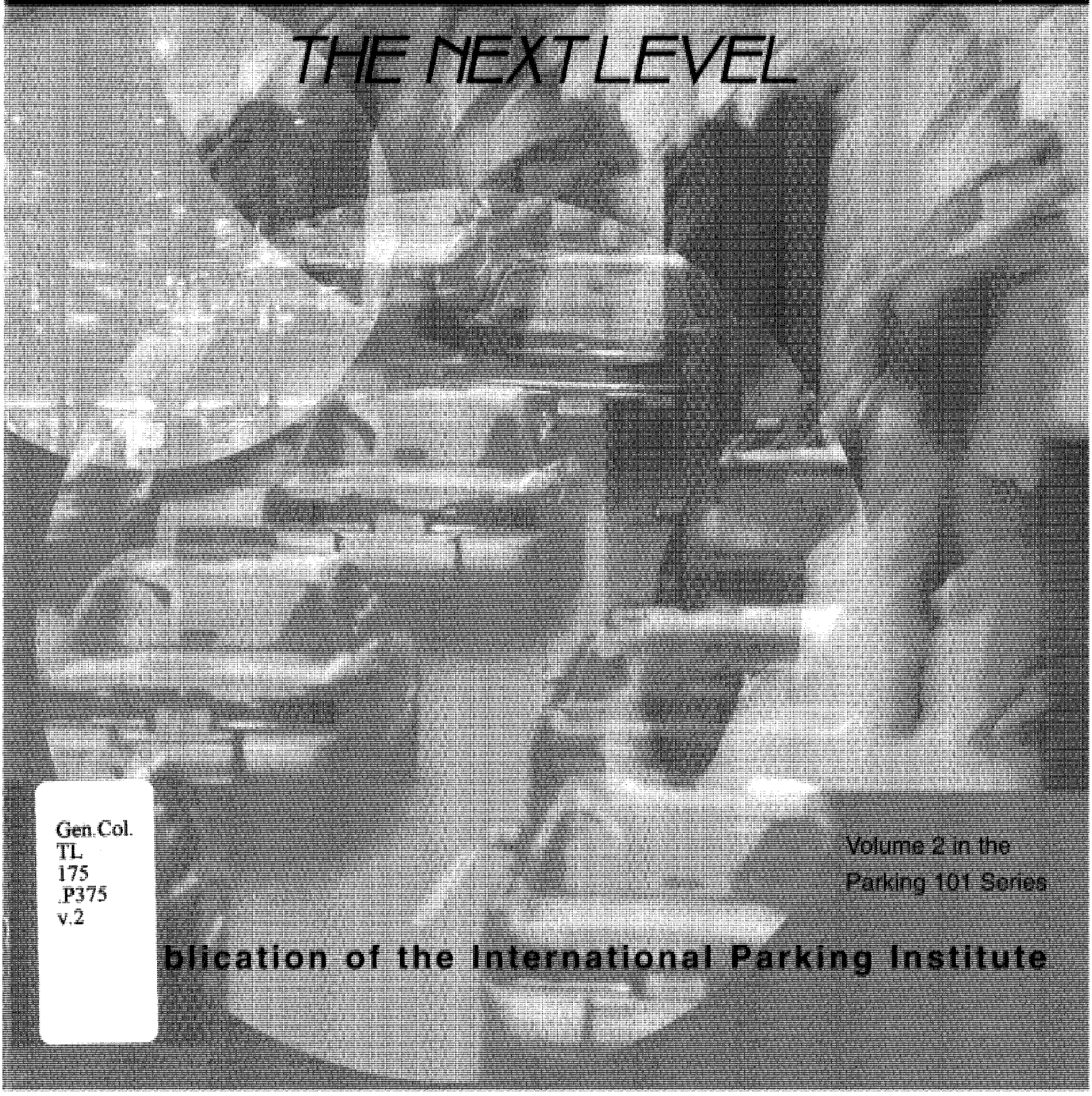
PARKING MANAGEMENT –

THE NEXT LEVEL



Volume 2 in the Parking 101 Series

...blication of the International Parking Institute

PARKING MANAGEMENT —

THE NEXT LEVEL

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A Publication of the International Parking Institute

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ACKNOWLEDGEMENTS

PARKING MANAGEMENT – THE NEXT LEVEL, the second publication in the Parking 101 Series, would not have been possible without the dedication and assistance of many individuals. I would like to acknowledge the contributing authors to this publication; each of them committed time and energy to writing excellent chapters that could very well stand on their own. The experience in the parking industry that they have shared with the reader is invaluable.

Another group of people were integral to the success of this publication – those who were generous enough to review several chapters of this publication. Although their role is less public, they provided a service to the reader and the International Parking Institute that is necessary for a viable and accurate representation of the variety of topics presented. The following individuals should be recognized for their efforts:

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I would like to offer my greatest thanks and sincere appreciation to all who contributed on behalf of the International Parking Institute.

Timothy H. Haahs, P.E.
Chief Editor

INTRODUCTION

The International Parking Institute is pleased to present the second publication in the Parking 101 Series, **PARKING MANAGEMENT – THE NEXT LEVEL.**

This publication is designed to serve as a continuation and deeper exploration of basic topics covered in the first publication, **PARKING 101 – A PARKING PRIMER.** This publication was designed to logically follow the content presented earlier, and to serve as a resource to those involved in the parking industry. The chapters are written as part of a "handbook" series for those new to the parking industry.

To provide the most valuable resource possible, we have organized the content of the volume by topic. These topics include:

- Legal Issues and Regulations
- Planning and Management
- Financing, Revenue, and Cost
- On Street Programs
- Payment Systems, Enforcement, and Control
- Off Street Facilities
- Institutions and Special Venues
- Transportation Issues

We sincerely hope that the reader finds this publication to be informative and representative of topics that affect the parking industry today. We look forward to building on the foundation we have started with **PARKING 101 – A PARKING PRIMER** and **PARKING MANAGEMENT – THE NEXT LEVEL**, to provide our members and others in the parking industry with further publications and resources in the future.

On behalf of the International Parking Institute, I would like to thank everyone who assisted in the development of this publication. I invite you to explore the topics addressed within, and further develop your personal understanding of the issues that affect our industry today.

Timothy H. Haahs, P.E.
Chief Editor

The material contained in this book is solely the responsibility of the author(s) of each chapter. The International Parking Institute is not responsible for the content, opinions, and ideas expressed in this publication.

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Introduction

In addition to providing parking facilities for civic and public uses in downtown areas, local government is responsible for the regulation of off-street parking facilities on private property and other lands. This regulation is accomplished through municipal land use planning and development codes including comprehensive planning, sub-area development plans, zoning ordinances, and in some cases in Canada, through property standards bylaws.

Privately-owned developments as well as most public or institutional developments are required to adhere to municipal planning policies and zoning regulations regarding parking in designing, building, and operating projects. In some instances, higher level federal and state government agencies legally do not have to comply with municipal land use regulations, but they may do so to maintain government cooperation and public image.

An understanding of municipal regulations regarding parking is important, as they affect decisions of the property developer/builder/owner in land use planning, parking design, and facility operation. It is especially important to understand these regulations if a variance will be required. While specific policies and regulations will differ in each location, there are general similarities as described below.

Local Development Regulations

Parking is an essential part of the overall transportation and land development system and an important means of achieving community development objectives, such as land use efficiency, good urban design, and economic vitality. If parking is over-supplied or under-utilized, it is costly, visually unattractive, and may negatively impact good land use planning objectives. If it is under-supplied or over-utilized it may create overspill onto adjacent areas, which may result in a loss of business, traffic congestion, and decreased economic efficiency. Striking the right balance in providing sufficient and effective parking is an important community-planning objective.

Parking facilities are developed by both the public and private sectors. Public sector projects are generally government owned and operated and serve municipal buildings, sports and tourism facilities, municipal transit systems, educational institutions, and airports. Another significant public sector role often occurs in the downtown areas of municipalities where the government is involved in the provision of general use public parking facilities that serve a wide variety of public and private sector uses in the downtown. This involvement includes surface lots, on-street parking, and multilevel parking structures, often under a pay-parking system of operation. This type of government involvement is often pursued to foster economic development in the downtown area. In some cases, it also serves an urban design role in terms of fostering parking lot consolidation and good aesthetic design. Government involvement in providing public-use parking is also used in larger cities to influence transportation demand management by controlling the availability and price of parking with a view to encouraging public transit use and car/van pooling.

Private sector parking facilities are often intended primarily for use by a specific development project, often located on the same site as the parking. Examples include office buildings, medical clinics and hospitals, hotels, financial institutions, retail centers and stores, and service providers, as well as churches and residential developments.

There are also examples of joint public-private developments, especially related to the redevelopment of older urban areas. These projects typically involve government assistance in the financing of public-use parking for the development; or government construction, ownership, and operation of the parking facilities to encourage private sector participation.

There are typically three types of government regulation regarding the provision of parking facilities in urban areas. These include the comprehensive plan, sub-area development planning, and zoning approval. Each of these is discussed in the following sections.

Comprehensive Plan

Most jurisdictions have formally adopted a city comprehensive plan (sometimes referred to as an Official Plan or Master Plan) for the community, which is intended to serve as a general guide for land use and development. This plan usually includes an inventory of existing conditions, an assessment of future needs, and a strategic level outline of urban planning goals and objectives that are intended to guide and direct the development of housing, commercial, industrial, retail, and institutional uses. This plan may also designate sub-areas for special development purposes, such as downtown areas, higher density mixed-use developments, or transit oriented development nodes located near major transit stations or along major transportation corridors.

The specific details of development in the sub-areas are usually set out in Sub-Area Plans (sometimes referred to as Secondary Plans or Neighborhood Plans). When a Comprehensive Plan is developed, development and redevelopment proposals should be in conformance with its provisions. General policy statements that affect the provision of parking may be found in these plans. Such statements might include commentary regarding the provision of sufficient parking to ensure or mitigate the potential for spill over parking onto adjacent properties, or in contrast, the provision of parking at reduced levels which would encourage transit use. Specific details regarding parking are usually left to sub-area development planning and zoning.

Sub-Area Development Planning

Sub-area development plans provide more detail regarding the intention of the municipality regarding the provision of parking. For example, if the sub-area is the downtown of a municipality or adjacent to a transit station like a major bus terminal, transit center, or commuter rail station, the plan may encourage the use of lower parking supply requirements for various land-use types than in the rest of the city or town. The sub-area plan may also encourage or propose the joint use of strategically located parking facilities that can be shared by different developments. If significant municipal involvement in providing parking is envisioned for an area, the sub-area plan will highlight this role, identify the need for new public parking facilities, and the options for providing them. It may also assess the various options and suggest general or specific locations for municipal public parking and private parking facilities as well as an implementation plan.

The parking professional will often become involved at the sub-area development plan phase or at the implementation phase when specific parking management options are being assessed. This work will often be conducted in cooperation with other professionals in the areas of urban planning, economic development, transportation planning, traffic engineering, and development planning.

Zoning Ordinance

Zoning controls are used to ensure that adequate parking is included as part of new developments or major renovations of existing buildings. The zoning ordinance is the most detailed regulatory level of planning that is adopted by municipal government. Zoning is defined as the division of a jurisdiction into districts (zones) within which permissible uses are prescribed and restrictions on building height, bulk, layout, and other requirements are defined. The purposes of zoning include protection of the public's health, safety, morals, and general welfare. Protecting the public safety is the basis for zoning control of traffic access and parking – to lessen congestion in the streets; provide adequate measures for protection against physical danger, particularly fire and explosion; and provide protection against common law nuisances including noise, vibration, air pollution, etc.

Zoning regulations are drafted to reflect the policy planning intent of the comprehensive plan and the more detailed conceptual development planning for each sub-area. The zoning ordinance typically specifies the uses that are allowed in a district, as well as the details regarding building setbacks, heights, floor area ratios, lot coverage, landscaping requirements, vehicular access guidelines, and other items. The zoning ordinance also specifies the amount of parking that is required for each type of development. It will also set out requirements regarding the layout and design of parking facilities such as the minimum width and length of a parking space, the minimum aisle width, landscaping and setback requirements and in some cases, locational criteria such as prohibition of front yard and or side yard parking for urban design reasons.

Zoning and the comprehensive plan are inexorably tied to each other. Zoning should be consistent with the community comprehensive plan. Zoning is perhaps the most potent means of land use plan implementation.

The Zoning Ordinance

Local governing bodies adopt zoning ordinances as regulatory tools to ensure that development and redevelopment occurs in accordance with the community's adopted comprehensive plan and development objectives. The zoning ordinance is comprised of regulations, regulations incorporated by reference, administration and enforcement procedures, and the zoning map. The zoning ordinance designates zoning districts and specifies the uses permitted in each district. Zoning also establishes standards such as setbacks, building height, and floor area rations to control the scale of development. With regard to parking, the zoning ordinance seeks to ensure that sufficient on-site parking spaces will be available for each use, so that reliance is not placed on scarce or non-existent parking on local streets. Therefore, the zoning ordinance provides specific regulations relative to the number of parking spaces that must be provided for specified uses. Zoning standards also regulate the layout of parking facilities, particularly surface parking facilities. In addition, the local government may impose standards for parking facilities relating to the size of spaces, aisle width, required landscaping, and other features.

Parking Requirements

A zoning ordinance typically sets forth parking requirements for specific land uses. These parking requirements are expressed in a variety of terms to treat each use in a fair and meaningful manner. Minimum space requirements for off-street parking are specified for different land uses. Some ordinances also include maximum parking limitations intended to avoid creating an oversupply of parking that would serve as a disincentive for use of public transit or other alternative modes to the automobile. The combination of minimum and maximum parking requirements is intended to encourage utilization of transit and ridesharing.

Parking requirements are set forth in zoning ordinances primarily to ensure that sufficient off-street parking is available for residents and patrons of various establishments or uses. Parking receives much attention in zoning regulations because a considerable amount of land is devoted to automobile use and storage. Parking regulations also have considerable effect on the choice of travel mode between the single occupant vehicle and other options such as public transit and ride sharing. Some zoning ordinances provide exceptions to parking requirements for certain areas such as the Central Business District (CBD), depending instead on commercial parking to serve the high density of parking demands.

Parking Needs for Land Uses

There are wide variations in parking demands for individual uses. Even similar uses can vary significantly in parking demands because of differences in building occupancy, employee auto ownership, ride-sharing, transit service availability, and varying business trip generation. Mixed-use developments generate "shared" parking demands the further complicate the determination of parking needs. Zoning ordinances contain a parking requirements matrix identifying land use classifications and specific parking requirements for each land use. Computation of spaces required is based on the type of use, applicable parking requirements rate(s), and size of the proposed development. For further information on parking requirements for specific land uses, refer to the references listed at the end of this article.

Minimum Parking Requirements

Minimum parking requirements for off-street parking are typically included in zoning ordinances in an effort to ensure that sufficient parking is available for residents, employees, and visitors/patrons of various developments.

Examples include the following:

- **Residential Uses**
  - Single Family dwelling – a minimum of 2.0 spaces per unit.
  - Multi-family dwellings (i.e. apartments) – a minimum of 1.5 spaces per unit. A separate requirement for on-site residential visitor parking is often set out for high-density apartment projects (e.g., 0.25 stalls per unit for visitors).

- **Commercial Uses**
  - Shopping centers – four to five spaces per 1000 square feet of gross leasable area depending on size.
  - Offices – three spaces per 1000 square feet of net or gross floor area.
  - Restaurants – one space per every four seats or ten spaces per 1000 square feet of gross floor area.
  - Hotels – one space per room plus additional spaces for restaurant/banquet facilities, meeting and rooms.

  The number of spaces required will vary from city to city and will be influenced by the level of public transit access provided. For example, three spaces per 1000 square feet of office space may be required in suburban areas of a city, but may be substantially reduced in the downtown area (e.g., 1.5 to 2.0 spaces per 1000 square feet) to reflect increased public transit service.

Sources for Parking Requirements

Most municipalities review research conducted by other municipalities or various professional or trade organizations regarding parking needs when formulating their own ordinances (bylaws). These organizations include the Institute of Transportation Engineers (ITE), American Planning Association (APA), Urban Land Institute (ULI), International Council of Shopping Centers (ICSC), Eno Foundation for Transportation, National Parking Association/Parking Consultants Council (NPA/PCC), International Parking Institute (IPI), and Canadian Parking Association (CPA).

In some cases, these organizations utilize data from detailed surveys conducted by parking consultants at actual building sites to determine parking utilization patterns and develop recommended parking requirements. ITE published the comprehensive Parking Generation[1] manual to provide parking standards information based on empirical research studies of parking demand for specific land uses. The ICSC and ULI collaborated to research and produce two reports regarding shopping center parking requirements.

[1] Institute of Transportation Engineers. Parking Generation, Second Edition. Washington, D.C.

They also produced a report on Shared Parking for mixed use developments. APA published Off Street Parking Requirements[2] and other studies through its Planning Advisory Service (PAS) including a paper regarding flexible parking requirements.

Some larger municipalities conduct their own research into the parking needs of various land use types, by conducting surveys of existing parking patterns and occasionally conducting detailed questionnaires of people using parking facilities or specific land use types. Many smaller municipal areas have not yet revised old parking ordinances to reflect modern trends and have minimum parking requirements that are not accurate. When these requirements substantially exceed the parking that is actually required, excess land and resources are wasted. In many cases, this leads to numerous requests for variances in the ordinance.

Locally Determined Parking Requirements

Off-street parking requirements of zoning ordinances should be realistically related to actual local experience. Local circumstances vary and each community has unique characteristics such as the availability of transit service and land use patterns, that impact the amount of parking needed for each particular use. Although some excellent empirical research has been conducted on parking demand, such national averages should be evaluated for local relevance. Local jurisdictions frequently use the national studies as a guide and tailor their off-street parking requirements to meet local needs.

Loading Requirements

Truck, taxi, bus, and passenger loading zone requirements are also established by the zoning ordinance. Loading spaces required for each use, the method for computing requirements, and dimensional standards are specified.

Flexibility in Parking Requirements

There are several factors which may significantly influence the amount of parking that may be required for an individual land use type that have increasingly been recognized over the last decade. Where appropriate, these factors all serve to increase the efficiency of parking use and reduce the amount of total parking supply that might be needed to serve a sub-area consisting of many different land use types. Each of these factors is discussed briefly in the following sections.

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[2] Bergman, David, Editor. Off-Street Parking Requirements. American Planning Association, Chicago, IL, Planners Advisory Service Report No. 432. May 1991.

Shared Parking

Mixed-use developments containing two or more different uses with different parking demand characteristics may present an opportunity for shared parking. Parking requirements for such developments may allow for parking reductions based on the overlapping requirements of the joint uses, to the extent that the parking demands for the mixed uses will occur at different times of day, allowing some spaces to serve the joint uses.

Most ordinances set out the minimum parking requirements for specific land use types, such as residential, office, retail, shopping center, hotel, etc. In most cases, the amount of parking required to serve each land use type will vary significantly by time of day and sometimes by time of week and month.

For example, the peak demand for shopping center parking typically occurs during the evenings and on weekends, whereas the peak demand for office parking typically occurs during the standard nine to five weekday work day. At night and on weekends, most office parking facilities are much underutilized. If office buildings and shopping centers could share a common pool of parking, together they would require less parking than if they each independently supplied their own needs. A 600,000 square foot shopping center might be required to provide 3,000 parking stalls by a local zoning ordinance (a rate of five spaces per 1,000 square feet) while an 100, 000 square feet office building would require 300 stalls. The shopping center parking requirement would only be fully utilized on a Saturday in December. During the nine to five weekday work period, 2,400 of the shopping center parking stalls would be utilized at most. If an office building of 100,000 square feet were constructed immediately adjacent to or on the same property as the shopping center, very little, if any office parking would be required, as the office employees could make use of the 600 vacant shopping center stalls from Monday to Friday.

Another form of shared parking occurs when a significant number of people visiting one land use type originate from a nearby adjacent land use, walking from one use to the other, eliminating the need for a parking space. Restaurants in large office developments or in downtown areas are a good example of this condition. During the daytime, a substantial portion of the restaurant patrons comes from adjacent office buildings, so that very little parking is actually required. During the evening and on weekends, when a large number of restaurant patrons come from outside the office buildings, the restaurant use reaches its maximum parking demand point. However, during the weekend and evening periods, the office parking is largely vacant. If the restaurant use could share the office parking, it would need to provide very little parking of its own.

Shopping centers represent a form of shared parking, in that dozens of stores and services located in a shopping center share a common pool of parking. Many of the stores and services require different parking needs at different times. In addition, by grouping the stores together, a customer can visit many stores on one parking trip without having to travel to separate locations.

This generally results in the need for less parking than if each individual store provided its own parking. It also allows for the changing of uses within the shopping center without calculating individual parking requirements.

Downtown areas in many cities, which contain a diversity of uses, may take advantage of shared parking opportunities due to temporal or customer sharing factors. They are perfect candidates for joint use – centrally located parking facilities, when combined with on street municipal parking, maximize the efficient use of the overall parking supply.

Off-Site Parking

When existing buildings are renovated or redeveloped for new uses, there may not be sufficient land area to provide required off-street parking. Off-site parking at a separate but nearby location may be considered as meeting parking requirements in certain circumstances. Criteria for off-street parking include the walking distance from the use(s) served, ownership, and guarantees for long-term availability of the off-site parking.

Independent off-site parking can be similar to shared parking, except that the users sharing the parking are not located on the same site. For example, the owners of an office building could arrange with a church to use some of its parking for employee use Monday to Friday, when the church does not need most of its parking. In return, the church could make use of the office parking on weekends and for special evening events when its own supply might be strained. To ensure that each use will have access to sufficient parking over the long term, the municipality should require a long-term lease between the two parties. The two uses and their parking supply should also be within reasonable walking distance of each other (e.g., 600 to 1000 feet). This type of arrangement often requires a special zoning ordinance or variance to the existing ordinance to meet legal requirements, unless the municipality has regulations that allow off-site parking under specific conditions.

Strategically located public parking facilities are excellent examples of off-site parking. Some municipalities have opted to take a major role in providing shared public parking in downtown areas to encourage development, improve the efficient use of downtown land, and achieve urban design objectives. In these cases, most commercial development is exempted from providing on site parking, and in some cases, from providing any parking at all. The municipality takes on the responsibility of providing sufficient parking to serve the area and usually funds a large portion of the cost through user fees.

Fee-in-Lieu of Parking

Another form of off-site parking often included in ordinances is the payment of cash in lieu of the regular parking requirement by a builder/owner. Payment of parking fees in lieu of providing on-site parking provides an option for developments that cannot physically accommodate sufficient off-street spaces to satisfy parking requirements. Fee-in-lieu is usually associated with a parking district. Under this process, the proponent calculates the amount of parking required for the development according to the bylaw, and makes a payment to the municipality for the amount that cannot be provided on site.

The city will then let the development proceed, on the assumption that the cash received will be used by the municipality to fund the construction of public parking that could be used by employees or visitors of the development. In some cases, the required amount of parking already exists in a municipal facility and new parking is not required, however a payment is still received by the city to fund future new parking facilities. The value of the cash in-lieu payment varies widely, depending upon the cost of providing such parking and the municipal policy attitude towards assisting development. The value is often based upon the average cost of the existing municipal supply or the expected cost for the next municipal parking facility. However, this cost can be discounted to reflect the fact that it is shared and not exclusively guaranteed to a specific user that pays cash in lieu and the fact that the municipality will receive some revenue to offset costs if it is paid parking.

Reductions for Decreased Auto Use

Municipalities with substantial public transit systems often promote the location of new developments in close proximity to transit stations or along major transit corridors in an effort to promote transit use and reduce traffic congestion. To encourage such development, cities will reduce the parking requirements from those applied in locations with significantly less transit accessibility. This reduction can be a set amount specified in the zoning ordinance or a specifically negotiated number contained in a development agreement with the developer. The reductions are based on the assumption that people provided with safe and convenient access will decide to use public transit and reduce the need for parking reducing automobile travel and improving congestion.

In larger, very urban areas, some jurisdictions have imposed maximum parking supply limits in their zoning ordinances in an attempt to limit the use of automobile travel into downtown core areas or major employment centers. Although this is relatively rare at present, the use of maximum parking supply limits is likely to increase in the future as development increases and intensifies in larger cities.

Other Transportation Demand Management (TDM) initiatives may also reduce the need for parking. These include employer sponsored car and van pooling, flexible working hours, compressed work weeks and more recently, the trend towards telecommuting (i.e., working at home and away from the office for extended periods). Some municipalities allow for some reduction in standard parking requirements where an employer or developer has created a specific TDM program and agrees to sustain it. Other municipalities will allow a parking supply reduction only after monitoring has shown the TDM program to be effective in reducing auto demand.

Parking Space Dimensional Standards and Design Requirements

In addition to specifying the amount of parking required for development, municipalities also set out standards regarding the layout, operation, and appearance of parking facilities.

Most jurisdictions specify a minimum parking stall width and length as well as an aisle width. These dimensions will vary from location to location. Typical dimensions would be 8.5 to 9.0 feet for stall width and 17 to 18 feet for stall length. Separate specifications will be provided for stalls to serve people with disabilities. These stalls are larger than standard stalls and require special identification and signage. The ordinance will also specify the percentage of the total parking supply that will be designed and designated for people with disabilities.

The access aisle would typically range from 20 to 24 feet in width for ninety degree parking. In surface lots where columns are not a factor, the important dimension is the aisle width and one parking space length, which is typically 40 feet for ninety degree parking. The aisle width for angled parking will vary according to the angle used.

Some municipalities have allowed for the use of small car parking spaces by specifying a reduced size and percentage of stalls allowed. However, a mixture of parking stall sizes is often subject to misuse and the long term trend has resulted in larger vehicles being reduced in size while smaller cars have increased in size, such that the difference between large and small vehicles is much less than in prior periods. This has increased the desire to provide for a single universal stall size that will accommodate most vehicles at a reasonable level of service in terms of manuvering and spacing between vehicles.

When parking is provided in garages, the location and size of columns can have a significant impact on the manuvering and ability to open doors once parked. Some jurisdictions have provided specific requirements in their ordinances to deal with this issue. Examples include locating columns a minimum distance back from the edge of the aisle or specifying a range of locations for columns so that they do not significantly impact manuvering space and door access.

Some ordinances will also specify standards regarding the slope of parking areas and ramps within garages in an effort to maintain comfortable and safe driving conditions. For example, surface parking lot slopes might be limited to four or five percent, while sloped floor parking garages might be limited to six percent. Interfloor ramps without parking might be limited to 12 or 15 percent slopes. In some cases, minimum slopes are also specified to provide for proper drainage.

Although rare, some ordinances will specify the use and location of aisle end islands to provide for proper turning maneuvers and visibility at intersection points.

Site Planning and Urban Design Issues

Good site planning and urban design principles are increasingly being applied to parking facilities, especially in urban areas, to make them more attractive, user friendly, safe, and secure.

Parking lot landscaping is often provided to soften hard surfaces and absorb storm water runoff. Landscaping might consist of perimeter plantings and grass areas, as well as internally on larger islands and between long rows of parking.

The requirement to provide landscaping in zoning ordinances varies widely from location to location, but is generally becoming more prevalent. Some jurisdictions specify a simple percentage of the lot area that must be landscaped while other standards require specific types and locations of landscaping, or require a subjective design review by internal municipal staff. Landscaping need not be confined to traditional greenspace, especially in urban areas where the perimeter treatment might consist of fencing or walls in combination with shrubs.

Landscaping may also be required around the perimeter and on the top of parking structures. In some cases the perimeter may take the form of hard landscaping such as paving stones, planters, and street furniture, rather than grass strips and berms.

Pedestrian access to, through, and around surface and structured parking facilities is receiving substantially more attention in recent years in an effort to improve pedestrian convenience, safety, and security. Emphasis might be placed on giving pedestrians priority over drivers, minimizing pedestrian-vehicular conflicts, and providing well-lit and highly visible pedestrian routes.

Crime Prevention through Environmental Design (CPTED) principles are increasingly being applied to parking facilities, especially structures. Some locations have specific standards that must be met, while others publish guidelines that should be followed. Minimum lighting standards are usually included in these guidelines.

Larger, urban municipalities will often include many of the urban design items just mentioned in a set of guidelines or requirements that are appended to the zoning ordinances.

In addition to the number of spaces, parking requirements may include dimensional standards and design requirements that address the entire breadth of the parking environment. Space needs, loading, dimensional requirements, circulation, safety, lighting, aesthetics, and landscaping may be included.

Parking standards are based on rational analysis of physical and operational requirements and reflect community values. Standards are objective and quantifiable.

- **Space Size** – Minimum dimensions for standard and compact size parking stalls.
- **Parking Angle, Aisle Width, and Horizontal/Vertical Clearances**
- **Paving, Lighting and Landscaping** – Standards for surfacing, striping, wheel stops, boundary controls, and signage may be included. Lighting standards may address illumination levels, security lighting, and limits on reflection on adjacent land uses. Landscaping requirements may include setbacks, screening, and planting standards for perimeter and interior areas. Landscaping standards unique to parking lots and garages may be included in parking design requirements. General landscaping requirements found elsewhere in the municipal code of ordinances may be incorporated by reference.
- **Parking Access** – Public transit, bicycle, and motorcycle accommodations may also be addressed as design requirements. For example, on-site provisions for bike racks or bus turnouts for transit stops may be included.
- **Architectural Standards** – Such standards for architectural treatments, inclusion of ground level commercial space, and massing are part of parking structure zoning requirements in many urban cities today.
- **Accessible Parking for Disabled Persons** – The Americans with Disabilities Act (ADA) of 1990[3] imposed guidelines and restrictions on virtually all new and remodeled buildings and facilities available to the public. Final guidelines were published by the federal government in 1991 and took effect on January 26, 1992. In general terms, ADA requires the following:
  - Public accommodations must be accessible to persons with disabilities;
  - Auxiliary aids and service must be provided in public accommodations for the use by disabled individuals;
  - Physical barriers in existing public accommodations must be removed, if possible; and,
  - New construction and alterations of public and commercial facilities must be designed and constructed to accommodate persons with disabilities.

  ADA Title II applies to public entities. ADA Title III applies to private enterprise. Generally, the provisions are similar; however, Title II is slightly more stringent. ADA Accessibility Guidelines (ADAAG) were developed by the Architectural and Transportation Barriers Compliance Board (ATBCB) and are the generally accepted design requirements.

[3] The Americans with Disabilities Act of 1990 (42 U.S.C. 12181) prohibits discrimination on the basis of disability by public accommodations and requires places of public accommodation and commercial facilities to be designed, constructed, and altered in compliance with the accessibility standards established in accord with the Act.

With respect to parking facilities, ADAAG provides specifications for such items as the number of Accessible spaces, wider van spaces, overhead clearance for vans (8'-2"), and the provision of wider doors and curb ramps for wheelchairs.

Application of ADAAG has moderate room for interpretation. The 8'-2" overhead clearance requirement could apply to only one floor of a facility if all van spaces are grouped on that level. Also, the overhead clearance requirement may not have to be met in a remodeled structure. It is important to note that accessible spaces can be grouped in a facility to enhance accessibility. However, these spaces cannot be placed on any floor surface with a slope of greater than two percent. A four-foot wide clear path with grades of two percent or less needs to be provided to the outside of the facility. Accessible space requirements are shown in Table 2.

Required accessible parking dimensions are an eight-foot-wide space with an adjacent five-foot accessible aisle. Two spaces can be grouped on each side of one aisle to make two spaces. The number of van-accessible spaces is directly related to the above accessible spaces, with one van space for each eight accessible spaces. ADAAG requires van-accessible spaces to have an eight-foot-wide access aisle.

Table 1: ADAAG Requirements for Accessibility of Parking Spaces

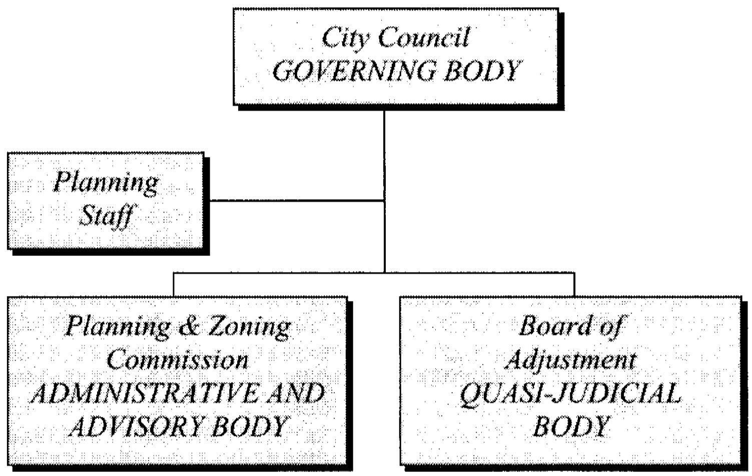
TOTAL PARKING SPACES IN FACILITY	MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2 percent of total
1,000 and over	20 plus 1 for each 100 over 1,000

SOURCE Architectural and Transportation Barriers Compliance Board ADA Accessibility Guidelines.

Zoning Administration Process

Procedures for zoning administration vary among individual states and municipalities, depending on their enabling legislation and local zoning ordinance. Participants in zoning administration are shown in Figure 1 on the following page.

Figure 1: Participants in the Zoning Process



Zoning Administrator – The zoning administrator or zoning official is a city employee, usually operating under the supervision of the city manager, as assistant to the manager, the community development director, the city planner, or city engineer. The zoning administrator performs several important functions including filing and processing applications for zoning amendments, special permits, and variances. As the individual who has most direct contact with the general public in zoning matters, the zoning administrator reacts to informational needs of the planning department, planning commission, zoning commission, board of zoning adjustment, and other municipal departments and agencies. He is observer, reporter, clerk, and research specialist.

Zoning Commission – The zoning commission is an appointed board composed of residents of the city. The zoning commission has several responsibilities to the municipality in the performance of its assigned role. The commission's primary responsibility concerns implementing the land use section of the city's comprehensive plan, as well as the municipal policies pertaining to that plan. The zoning commission and planning commission are frequently the same body in some municipalities, although they are separate functions.

Board of Zoning Appeals or Adjustment – The board of zoning appeals or adjustment has the following roles and responsibilities:

1. To hear appeals from individuals contesting the decision of a zoning administrator or zoning enforcement official.

2. To hear and decide special exceptions to the zoning ordinance where the city governing authority has placed this function in the hands of the board as opposed to the zoning commission. (The term "special exception" is synonymous with the term "conditional use permit.")

3. To grant variances from the terms of the zoning ordinance where unusual conditions make its literal enforcement unjust.

Unlike the planning and zoning commission, the board of zoning adjustment serves in a quasi-judicial capacity. In this regard, it is much like a court of law.

City Council – The city council is the legislative body of a municipality. It creates city laws by adopting ordinances. In most municipalities, the City Council's responsibility in zoning is to adopt the zoning ordinance and to approve subsequent amendments to the ordinance.

Planned Unit Developments, Overlay Zoning, and Incentive Zoning

Planned unit developments (PUDs) allow deviations in zoning standards to permit innovative designs or to address environmental conditions that would otherwise not be possible with conventional zoning. Overlay zones provide an additional layer of regulations, such as parking waivers in a Central Business District. Incentive zoning encourages development that exceeds minimum standards, such as a density bonus in exchange for making additional parking available for public use.

Zoning Variances, Exceptions, and Conditional Uses

Variances allow exceptions to zoning requirements and standards where, because of conditions on a site, strict adherence would deprive a property owner from using the site in a manner like other similarly zoned properties. Special requirements may be placed on conditional uses to mitigate conflicts with surrounding land uses.

A process exists in every municipality whereby a variance in the zoning regulations can be requested from the municipality. In most cases, a minor adjustment is requested by a building owner or developer or their agents for building setbacks, landscaping requirements, and height limitations that would allow a project to proceed without a major change in the ordinance. A request to vary the standards contained in a zoning regulation, such as the number of parking stalls required, or the size of the stall and aisle width, as well as any locational requirements for parking could also be requested.

The key word in this process is that the variance request should be minor in nature such that the granting of the request would not alter the general intent and purpose of the comprehensive and sub-area plans or zoning bylaws. It should also be desirable for the development of the property in an appropriate fashion. Examples include:

- Minor reduction in landscaping requirements to allow for the addition of a modest amount of parking that is required to meet the zoning ordinance.
- Reduction in stall width from 9.0 feet to 8.5 feet for many or a few parking spaces to provide the required number of stalls.
- Reduction in the number of stalls required based upon utilization surveys of an existing use.
- Analysis conducted by a professional planning consultant that provides a compelling rationale for a reduction in the number of stalls based upon the use of shared parking either on or off site.
- Use of tandem parking (one stall directly behind the other and accessible only with moving of a parked vehicle) to meet the number of parking stalls required.

In some cases, more than one variance is requested. However, the probability of rejection generally increases with the number of variances sought.

In most jurisdictions, a quasi-judicial body called a Board of Adjustment or Zoning Appeals Board is appointed to deal with minor variances in zoning regulations. This body will meet as needed or on a regular time schedule. To request a variance, the applicant is required to submit a formal application setting out the details of their request and the reasons for it. This request is then reviewed by members of the appointed body and comments are provided by the professional planning staff employed by the municipality. Notices are usually posted on the property and/or advertised in the local media notifying the public at large that a variance is being requested. The appointed body will then conduct a public hearing so that the applicant can elaborate on their request, answer questions and the public in the immediate vicinity of the property can express any concerns or support that they have for the variance.

The appointed body will then approve, approve with modifications or deny the variance request. Whether or not a variance is approved will depend on the nature of the request, the degree of hardship for the applicant to comply with the requirement, the age of the ordinance being varied, the history of prior applications for the same site, how successful similar approvals have proven to be after implementation and the nature and strength of any arguments against the variance that are presented by staff of the municipality and other affected property owners.

It is also possible that the applicant will be notified that the variance request is too major for the reviewing body to consider. This would then require that the proponent request a zoning ordinance amendment that is a much more extensive and time-consuming process.

It is emphasized that the variance process is time consuming and uncertain in terms of success and the proponent should first make a strong effort to comply with the existing regulations. Typically, the variance process will take a minimum of two months from application to hearing. If a study from a professional consultant is required to support the request, the time and cost of this work must be added to the time frame.

Repeated requests that are approved for similar variances over time is a strong indication that the municipality should consider revising its zoning ordinances to reflect current conditions and eliminate the bureaucracy that builders/owners must navigate.

In some cases, where specific land use types are relatively limited and may vary depending upon individual characteristics, local ordinances may provide for administrative discretion in determining the amount of parking required. Examples include airports, colleges and universities, sports arenas, and hospitals. In these examples, the zoning ordinance would specify that the number of stalls required would be based upon a detailed analysis prepared by an outside consultant and/or planning department staff. The ordinance might specify the parameters that would be used such as anticipated attendance or occupancy loads for visitors and employees, and the provision of TDM measures such a transit subsidies and car/van pooling programs.

Zoning Amendments and Rezoning

Amendments to the zoning ordinance may be proposed to address desired changes in standards, procedures, enforcement provisions, or development standards. Adoption of amendments entails the same process as the original adoption of the ordinance, which typically requires staff review, public notification, review and approval by the Zoning Commission, multiple readings before the City Council, public hearing(s), and adoption of the amended ordinance by the City Council.

Rezoning is the process for adjusting zoning district boundaries, changing zoning district designations for specific properties, or designating new or consolidated zoning districts. The process for adoption of a rezoning or zoning change is set forth in the zoning ordinance. It typically includes filing of a zoning change request by the applicant, staff review, public notification including mailing a notice to nearby property owners, review, and approval by the Zoning Commission, multiple readings before the City Council, public hearing(s), and approval of the rezoning by the City Council.

Nonconforming Uses

The adoption or amendment of zoning regulations creates nonconforming uses, structures, lots, and site improvements including parking. Nonconforming parking is a frequent problem. Nonconforming uses, structures, and lots were legally established under the zoning regulations in effect at the time of their creation. Despite their noncompliance, they continue as legally established uses. Nonconforming use regulations are intended to limit future expansion and may eliminate a nonconformity after an amortization period.

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THE TOP TEN MOST COMMON ADA MISTAKES IN PARKING LAYOUTS

Michelle Wendler

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Introduction

The American's with Disabilities Act (ADA) has been around for over ten years, yet there are some common mistakes made when laying out parking structures and lots. Many owners may have existing parking structures and lots that have not been brought into compliance. In this chapter we will not repeat the entire text of the ADA, but examine the most common mistakes and how owners can perform a brief evaluation of items that could easily be brought into compliance with the law.

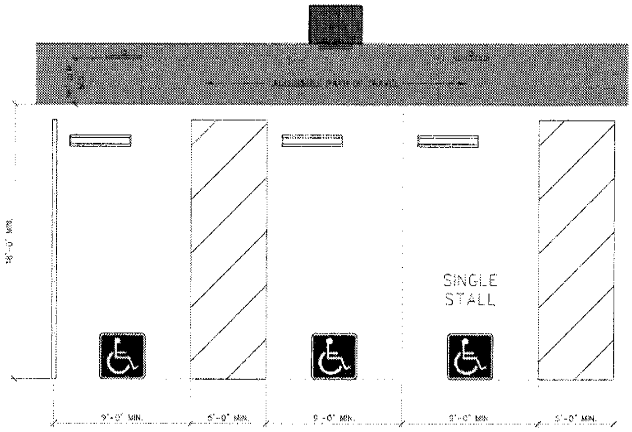
1. Accessible Stall Location

Accessible parking spaces serving a particular building shall be located on the shortest accessible route of travel from adjacent parking to an accessible entrance. In a parking structure, this requirement is often met by putting all accessible parking spaces on the ground level. This is not the only way. Accessible parking spaces may be located on every floor of the parking structure, as long as they are adjacent to an elevator, and meet the clearance requirements.

2. Sharing the Loading Space

Where single accessible parking spaces are provided, the loading and unloading access aisle should be on the passenger side of the vehicle. Usually the most efficient way to provide accessible parking spaces is to have two spaces share one access aisle. However, there may be an odd number of stalls required, leaving a single stall. The location of these access aisles for single stalls is often overlooked. Please refer to Figure A on the following page.

Figure A



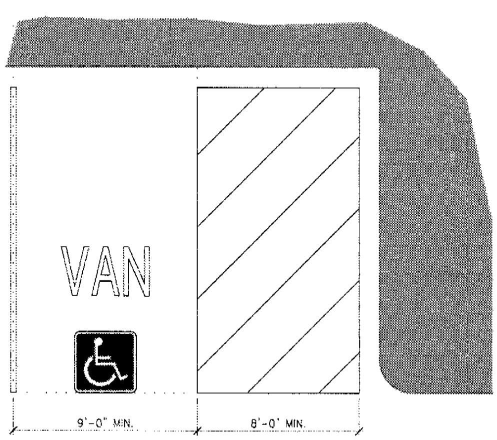
3. *Path of Travel*

Accessible parking spaces should be located so that persons with disabilities are not compelled to wheel or walk behind parked cars other than their own. An accessible path of travel should be located at the front of stalls to prevent people from walking behind other vehicles. This path of travel must be kept clear. Vehicles must have some type of barrier/wheel stop to prevent them from driving into the path of travel. It should be noted that raised wheel stops can be a tripping hazard, and other options should be reviewed for compliance, such as bollards.

4. *Van Accessible Spaces*

Just because an accessible parking space is designed as "Van Accessible" does not preclude other vehicles requiring an accessible space from using them. The space was not intended to be restricted only to vans.

Figure B



5. *How Many Accessible Stalls are Required?*

Many people ask how many accessible parking spaces need to be provided in a parking structure. Many people use a 2% rule of thumb, but this is not always correct. The percentage may be higher for smaller garages, and lower for very large garages. The chart should be carefully followed. Also, if the garage serves a medical facility, the number could increase dramatically. The percentages range as high as 10-20% of the spaces required for certain uses. Another consideration is how to perform the actual calculation. If there are several garages that serve one facility, you may be able to use the cumulative number of spaces instead of calculating them separately. The bottom line is that an owner must develop a written approach to ADA compliance, and apply it consistently. An owner must have at least attempted to comply with the guideline in a reasonable interpretation, and be willing to change quickly if challenged. Please refer to Figure C.

Figure C

Total Parking in Lot	***Required Minimum Number of Accessible Spaces***
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 450	9
501 to 1000	2 percent of total
1001 and over	20, plus 1 for each 100 over 1000

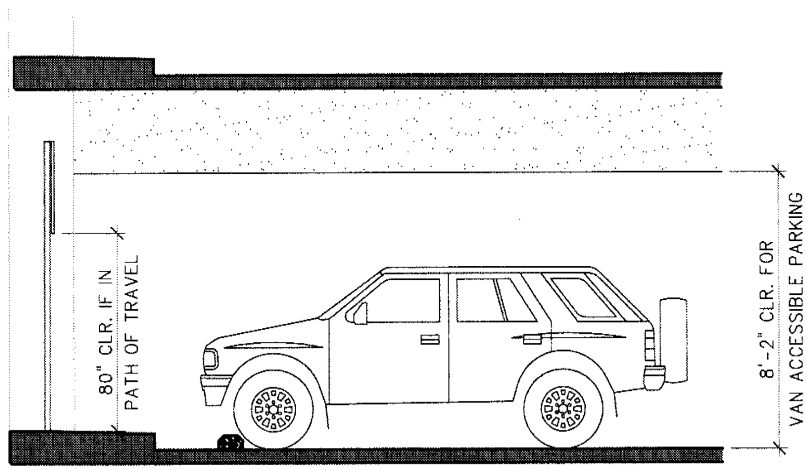
6. *What Size Should the Stall be?*

Accessible parking spaces need to be at least 9'-0" wide by at least 18'-0" long, regardless of the size of the other spaces throughout the garage. If an 8'-6" wide unistall is used, the accessible parking space still needs to be 9'-0" wide. If the other spaces are larger than 9'-0" x 18'-0", then the larger stall should be used for the accessible stall; this would provide equal facilitation. Please refer to Figure A on the preceding page. Some jurisdictions require wider accessible spaces, so always check local regulations.

7. *Head Height Clearance*

Head height clearance is important for accessible parking. A minimum of 98 inches (8'-2") needs to be provided for van accessible spaces at both the parking spaces, as well as the drive aisles leading to and from them. It is not sufficient to provide this clearance just at the space, if the patron cannot drive there. Pipes, lighting fixtures, mechanical vents, and sprinkler lines should not encroach into this clearance, even at the front of the space. Some states (like California) actually require the 98 inches for all accessible stalls, so it is important to check state codes as well. Please refer to Figure D.

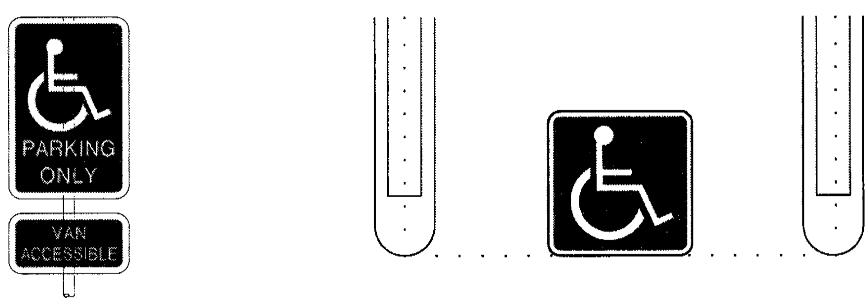
Figure D



8. *Stall Signage*

Accessible parking signs need to be provided at each space (no sharing). These need to be mounted high enough so that they can be visible even when a vehicle is parked in the space. The International Symbol of Accessibility also needs to be painted on the ground at each space, and should be 36 inches long by 36 inches wide.

Figure E



9. *Valet Parking*

Facilities that use valet parking do not need to provide accessible stalls, but do need to provide accessible passenger loading zones. These need to be at least 60 inches wide and 20 feet long and adjacent and parallel to the vehicle pull-up space. As a reminder, valet parking is not always usable by individuals with disabilities. For instance, an individual may use vehicle controls that render regular controls inoperable, or the driver's seat in a van may be removed. In these situations, another person cannot park the vehicle. It is recommended that some self-parking spaces be provided at valet parking facilities for individuals whose vehicles cannot be parked by another person, and that such spaces be located on an accessible route to the entrance of the facility.

10. *Other Accessible Issues Beyond the Stalls*

Making a parking facility accessible does not just mean the stalls. Stairs, elevators, handrails, and many other components to the facility must comply. Make sure you know what you mean when you ask that your facility be in compliance with ADA.

GRAPHICS AND SIGNAGE

Scot D. Martin

Scot D. Martin is the Corporate Director of Parking Consulting for Carl Walker, Inc. Scot has 12 years of experience as a parking consultant and is a specialist in parking studies and the functional design of parking facilities. His functional design experience includes parking planning, facility configuration, parking geometrics, access design, graphics and signage, and ADA compliance.

Introduction

Parking facilities can be very large, complex, and confusing. A well-designed graphics and signage system will effectively communicate necessary information to patrons, reduce confusion, improve safety, and enhance the overall user experience. The importance of a coordinated signage system in a parking facility cannot be overstated. Graphics and signage can be the difference between an inviting and busy parking facility and one that people avoid.

Signage meets the needs of several parking facility functions. The first is to direct the driver to the parking facility entrance and then to an available parking space. Identification signage provides the parking patron with the location of their parked vehicle. Signage then provides the pedestrian with the most convenient direction to access elevators, stairs, skywalks, or ground level routes to adjoining streets. After returning to the parking facility, vehicle signage provides guidance and direction to the facility vehicular exit.

Design Considerations

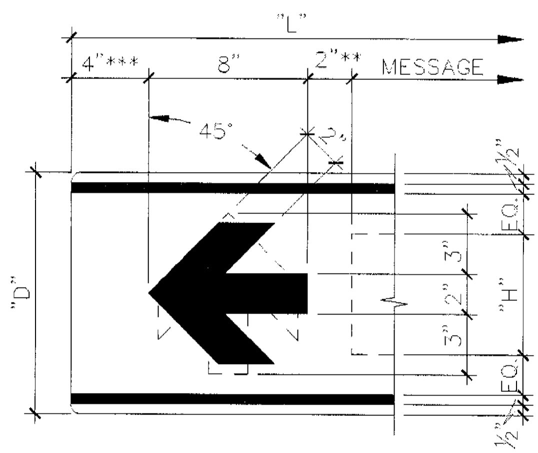
Effective signage is a combination of form and function. Placement, lighting levels, message content and length, typeface, letter size and spacing, the use of uppercase and lowercase letters, and background and copy colors all influence the readability and legibility of signs.

It is important to place signs at consistent heights and locations throughout a parking facility. The average eye level is 4'-0" for a driver and 5'-6" for a pedestrian. The reader should also have an unobstructed view of any sign. Lighting levels should be sufficient to distinguish letters and colors. Letters should be a minimum of one inch for every 30 feet of viewing distance.

Messages should be simple and succinct. Messages on signs that are to be read quickly, such as vehicular signs, should be no more than 30 characters and six words in length. A driver in a parking facility is maintaining control of their vehicle while either looking for an available parking space or attempting to exit the parking facility. Being confronted with long and complicated sign messages can be confusing and distracting. Too many signs can also be a problem. Keep the signage program as simple as possible.

The typeface used should be simple and easy to read, such as **Helvetica**, **Univers**, **Futura**, **Gill Sans** or **Arial**. There is a general preference for Helvetica medium in the parking industry. Signs with lower case letters and initial caps are most easily read. Letter spacing should be consistent, and is equal to the vertical stroke width of the letters.

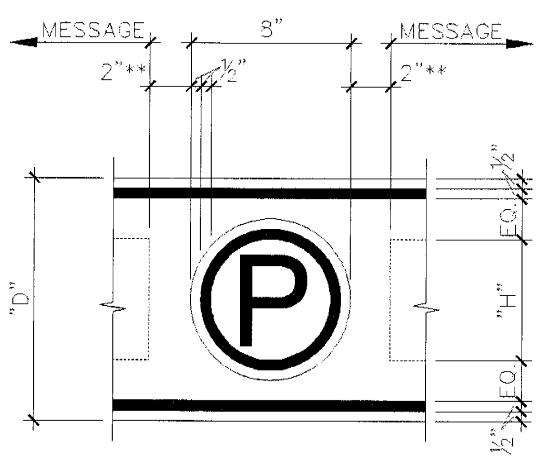
The simple block arrow is recommended for parking signs. If a left turn is required, the arrow should be placed on the left side of the sign. The opposite is true for a right turn. Arrows pointing upward indicate straight ahead. Arrows pointing downward usually indicate a particular lane, such as this lane to exit. Arrows placed at 45 degrees indicate up and down.

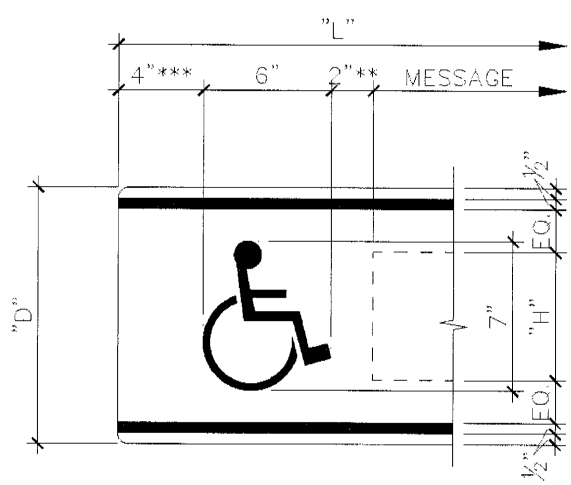


The simple block arrow is recommended for parking signs.

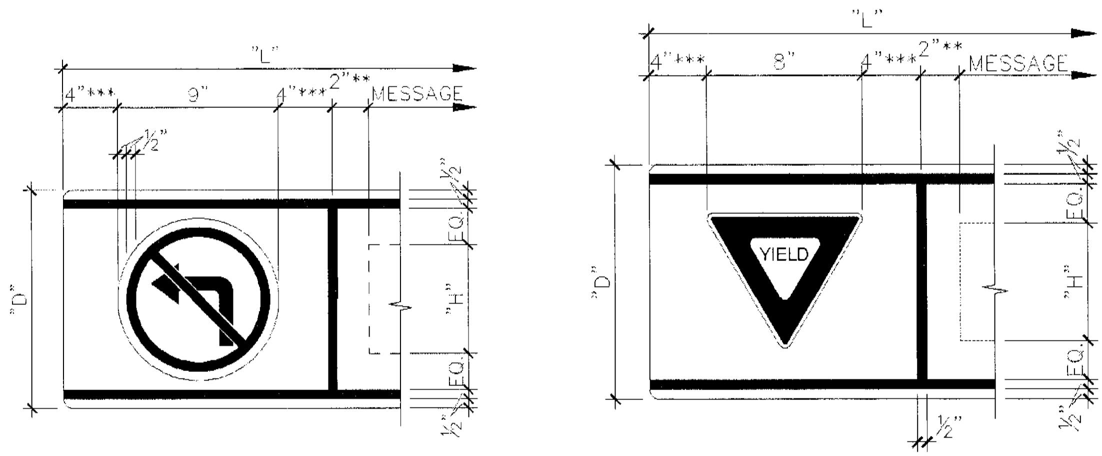
Standard symbols are used effectively in signs but generally not alone. Signs with text messages and symbols are more effective than signs with only text messages. Commonly used symbols are shown below and on the following page.

Commonly used symbols in parking signs.





Commonly used symbols in parking signs.



In parking structures signs with a dark background and white letters are more easily read than signs with a white background and dark letters. The opposite is true in surface lots, where signs with white background and dark letters are better. There should be minimum 75% reflectance difference between copy and background colors. A black background with white letters provides a reflectance difference of 96%. By comparison, an orange background with white letters provides a reflective difference of only 68%.

Types Of Signs

Vehicular Signs

Examples of vehicular signs include "Park" and "Exit" directional signs. In parking structures these signs are typically 0.08-inch thick aluminum and should have white copy on a dark painted background using a matte or flat paint. Copy should be die cut reflective letters. It is generally recommended to avoid red, yellow, and orange as background colors because of the association with standard regulatory and warning signs.

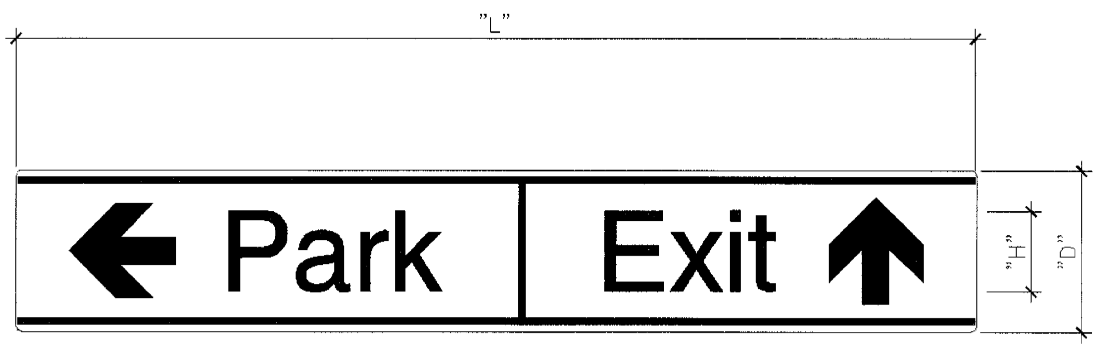
Vehicular signs are ten or twelve inches in height with six or seven inch letters. Ten-inch signs are recommended for precast structures where sign visibility can be a problem. Cast-in-place parking structures generally accommodate twelve-inch signs. Three-inch letters can be used if a message is presented in two lines, although one-line messages with larger letters are preferred. Directional arrows used on vehicle signs should be eight inches in height. Directional signs should be legible from at least 60 to 75 feet. This requires a minimum text height of 2 to 2.5 inches based on one inch high per 30 feet of viewing distance, although larger text is preferred.

Vehicular signs should be centered over the drive lane or centered over the drive aisle when signs are mounted back-to-back. Overhead signs should not be mounted directly in front of light fixtures. Light fixtures should be used to help illuminate the sign.

Overhead signs should be mounted at least two inches above the posted vertical clearance.

"Exit" vs. "Out"

When guiding vehicles to the facility exit, both "Exit" and "Out" are used. There are two schools of thought regarding this term. Those who prefer "Out" do not want confusion between pedestrian and vehicle exits. "Out" is a short and distinct message, and there is no question as to what the message means. "Exit" also gives a direct, short, and distinct message. The word "Exit" is a mainstay in guiding traffic on our highways. In addition, "Exit" is used for regulatory signs such as "Fire Exit."



Vehicle sign directing patrons to "Park" and "Exit."

Pedestrian Signs

Examples of pedestrian signs include "Level #," "Remember Level #," "Row #,"and "Stair" and "Elevator" identification and directional signs. Pedestrian signs can be all one color or be color-coded by level. Pedestrian signs should be clearly distinguishable from vehicle signs so as not to interfere with vehicular traffic. Pedestrian signs in parking bays are most effective if located perpendicular to traffic flow, and they should be placed at the rear of parking stalls.

Color-Coding

Color-coding is used to help patrons find their vehicles. It is not necessary to provide color-coding in parking facilities that are three levels or less. When color coding, it is recommended to use primary and secondary colors including red, blue, yellow, orange, purple, and green. If there are more than six levels that need to be color-coded, it is recommended to use white, brown, and black. Confusing colors such as turquoise (blue or green?) and taupe (brown, tan, or gray?) should be avoided. Top levels open to the sky do not need to be color-coded. Level numbers and color-coding should not be used on sloping floors. Color-coding is primarily recommended for pedestrian destinations, such as stair and elevator lobbies. When color-coding is used, use the same color codes for elevator call buttons. Color keys are also helpful in elevator and stair lobbies.

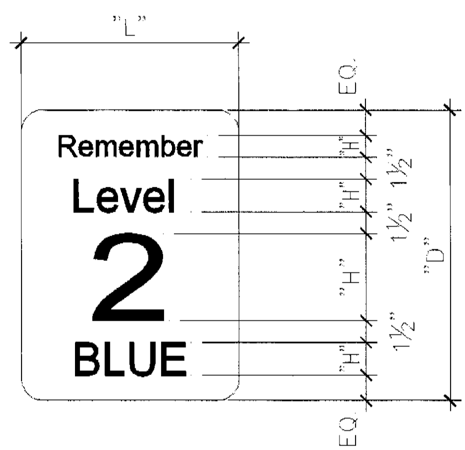
Floor Numbering

All floors in a multi-level parking facility should be numbered. For above-grade parking facilities, the numbering system should start with either "G" or "1" at the grade level and proceed with 2, 3, 4, etc. for the upper levels. For parking facilities that have below and above grade levels, use "G" for the at-grade level and proceed upward with 2, 3, 4, etc. The below grade levels should be numbered consecutively downward using a B1, B2, B3, etc. numbering system. For parking facilities that are inter-connected or adjacent to non-parking buildings, it is recommended to use the prefix "P" or "G" in front of the facility numbering system. The letter "P" is a designation for "Parking. "The letter "G" is a designation for "Garage." "P" is more commonly used than "G."

Level Designation Signs

Level designation signs are used to help patrons remember the level on which their vehicle is parked (see below). These signs are generally located at the head of parking stalls, at the end of parking runs, inside and outside of stairs, and in elevator lobbies. As a patron leaves their parked vehicle, there should be an ample number of level designation signs along pedestrian paths. Another approach to level designations is to use a "theme" for each level. There are an infinite number of themes that can be used. Some of the more common themes used are animals, sports, fruit, and vegetables. The use of music on each level (different tunes) can be useful in identifying a floor level.

Level signs can be field painted using a silkscreen process. This may save on overall signage costs. The paint should be exterior latex enamel. If it is preferred to use mounted signs they can be 3/16-inch polycarbonate (reverse painted), acrylic Plexiglas with a non-glare matte finish, or 0.08-inch aluminum. Aluminum pedestrian signs should have a painted background with white reflective letters. Black letters should be used on signs with yellow or orange backgrounds. It is important that signs be properly dimensioned to fit on the surface to which they will be attached. This is particularly important if signs are mounted on columns or next to stair and elevator doors.



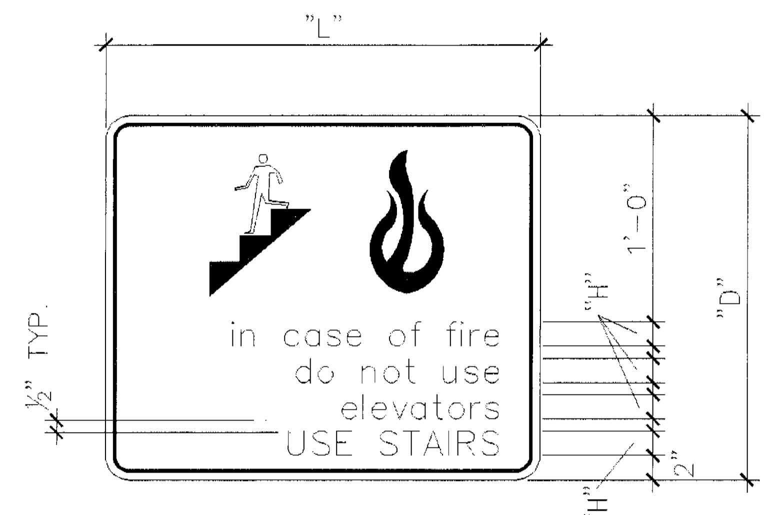
Remember Level Number sign.

Stair and Elevator Lobbies

The elevator core area provides an excellent location to utilize super graphics. A super graphic is defined as a graphic that covers a large area and is generally painted on a vertical surface, such as painted walls or elevator doors, with level designation incorporated. If stairs are enclosed, the same type of super graphic can be incorporated. As a minimum, a level designation sign should be placed in the elevator lobby at a location where a patron can see it as the elevator door opens. All stairs should have level signs both inside and outside of the core. Some local codes require stair towers to include a fire department sign that indicates stair designation, number of levels, exit to grade location, and level numbers. All stair towers should be identified by number, letter, or location. Common designations are 1, 2, 3, etc., or A, B, C, etc., or North, South, East, and West. It is preferred to use a letter designation to avoid conflict with floor levels if they are individually identified.

Super graphic on elevator doors at 15th and Pearl AutoPark in Boulder, CO.

A sign is required at elevator locations stating that elevators are not to be used in case of fire. These signs show a person symbol going both up and down stairs. Normally, this sign is mounted directly over the elevator call buttons. The available space to mount this sign may dictate the dimensions of the sign. It is important to coordinate the location of these signs with locations of level designation signs.



The "In case of fire..." sign is required at all elevator locations.

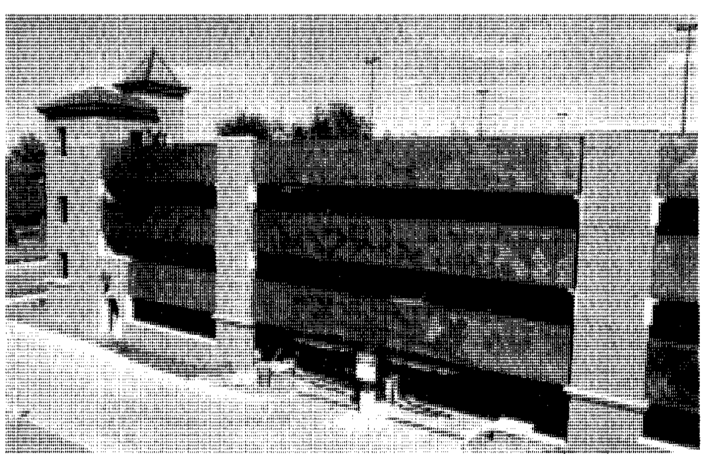
Entry/Exit Signs

Emphasizing the entrance to a parking facility is important. Large illuminated signs are often used to emphasize the facility entry and attract patrons. These signs often spell out "Parking" or use the international symbol for parking. Architectural features, such as an arch, canopy, or some different treatment of the façade, are often used to highlight the entry area as well.

Vehicle entry at the Bijou/Cascade garage in Colorado Springs, CO.

When entry and exit lanes are located at the same area, it is important to provide signage to direct the entering vehicles to the correct lane(s). Cast aluminum letters are often used at the entrance location to designate the entry and exit lanes. The letters have a baked enamel finish over aluminum. It is also possible to utilize cast aluminum backlit letters. The signs should be coordinated with the façade treatment at the entry locations. Illuminated signs are often used to designate entry and exit lanes when reversible lanes are utilized. It is also common to place "Do Not Enter" signs over the exit lane(s). In all instances, the entry and exit signs should be coordinated with the height clearance bar(s).

A height clearance bar is required for all parking structures, including the top (surface) level of below-grade facilities to prohibit overweight vehicles. Generally, the height clearance bar is located at the facility entrance(s). There may be instances when the clear height in a parking structure changes from one level to another (for example, a higher ground level than typical level to accommodate ADA vans), which may require additional height clearance bars within the facility itself. Generally, the height clearance bar is an eight-inch PVC pipe with die cut or computer cut letters. The PVC pipe is suspended from the structure above (spandrel, etc.) by chains or cables. The chains or cables should not be more than two feet long or the signs will sway too much in the wind. There may be instances when the height clearance bar is to be mounted further out from the face of the structure. This will require a separate structure to support the height clearance bar and other signage.



A separate structure for the height clearance bar at the Denver University College of Law garage in Denver, CO.

The clearance dimension that is placed on the height clearance bar should be the final actual clearance in the facility. This must be confirmed after the structure is erected and before the signage is installed. The final clear height must include clearance to structural elements, signs, pipes, lights, etc. Do not place a clearance dimension that is less than the actual clear height in the facility. Other common entry/exit signage includes parking rate and facility "Full" signs.

Regulatory Signs

Regulatory signs are often used in parking facilities. Examples include "STOP," "YIELD," "ONE WAY," "NO PARKING" "DO NOT ENTER," and accessible parking signs. It is imperative that they comply with local and federal requirements. The *Manual of Uniform Traffic Control Devices* (MUTCD) provides examples of standard highway signs. It is not necessary for a "designer" to reinvent the "STOP" design. Most parking facilities contain accessible parking spaces. Accessible areas in parking facilities must be identified by the International Symbol of Accessibility. ADA guidelines call for brailed signs to identify permanent rooms and stair and elevator cores.

Illuminated Signs

Illuminated signs are becoming more and more common in parking facilities. Technology has advanced significantly in recent years and illuminated signs have become more reliable. Generally, illuminated signs are used for the following parking applications:

- Entry and Exit Lanes (open in green/closed in red)
- Facility Full
- Stop (red)/Go (green)
- Level Space Capacity
- Directional Control
- Fee Display
- Space Count Systems
- Variable Message Signs

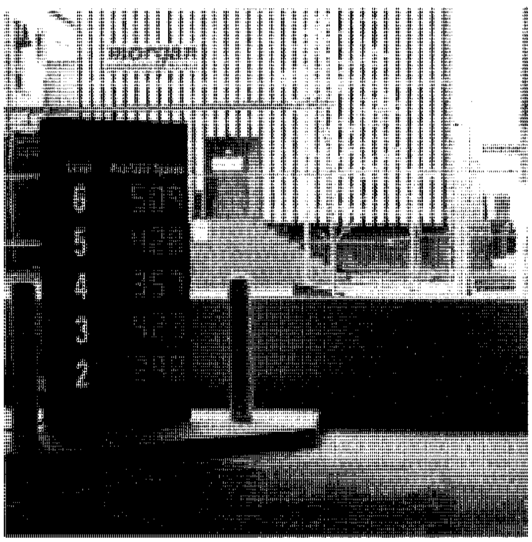
In specifying illuminated signs, the following issues must be addressed:

- Easy to read message
- Unbreakable message panel
- Corrosion resistant
- Long-life bulbs
- Maintenance free
- Impact resistant
- Tamper proof
- Glare resistant (sun shade)

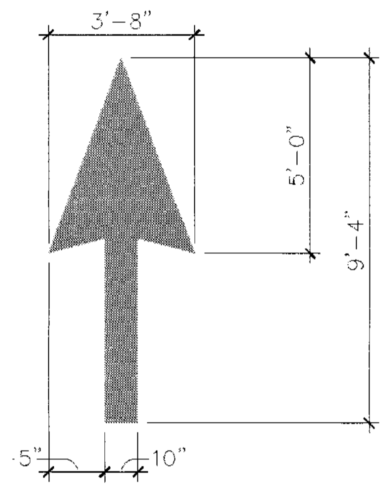
In designing and specifying illuminated signs, it is critical that there be coordination with the electrical engineer for power and control requirements. When illuminated signs are used for space counts, lot full signs, or other variable items dependent on parking activity, there must be close coordination and tie-in with the parking access and revenue control equipment.

Illuminated signs will generally be one of the following technologies:

- LED (Light Emitting Diode)
- Incandescent Lamp
- Reflective (Rotating Electromechanical Pixels)
- Fiber Optic



LED sign indicating the number of available spaces by Daktronics.



Painted traffic arrow.

The placement of the illuminated sign is important. This has an overall affect on the ability to read the message. Equally important is selecting the character size, which is impacted by the viewing distance and the speed at which the audience may be traveling. The following table provides general guidelines for illuminated signs. The speeds and viewing distances listed in the table are greater than those typically found in parking facilities.

VIEWING RANGES FOR ILLUMINATED SIGNS (APPROXIMATE)

Use this table to help determine the appropriate character size for a display based on viewing distance and the speed at which the audience may be traveling.

Character Height in Inches	Max. Viewing Distance in Feet	Viewing Exposure in Seconds				
		20 MPH (29.3)	30 MPH (44.0)	40 MPH (58.7)	50 MPH (73.3)	60 MPH (88.0)
9	450	15.4	10.2	7.7	6.1	5.1
15	750	25.6	17.0	12.8	10.2	8.4
18	900	30.7	20.5	15.3	12.3	10.2
24	1200	41.0	27.3	20.4	16.4	13.6
30	1500	51.2	34.1	25.6	20.5	17.0
36	1800	61.4	40.9	30.7	24.5	20.5
42	2100	71.7	47.7	35.7	28.6	23.9
48	2400	81.9	54.5	40.0	32.7	27.3
60	3000	102.4	68.2	51.1	40.9	34.1

Notes:

1. *The general rule of 50 feet of distance for each inch of character height is recognized as a typical industry standard for illuminated signs. If the sign is directly in view, the distance applied. If there is considerable setback from the road, the distance should be the hypotenuse.*
2. *The feet traveled per second is indicated in parentheses.*
3. *The data in the columns at the right is viewing exposure in seconds for moving vehicles.*

Miscellaneous Signs and Messages

There can be additional signage required for a parking facility including room designations, the display of parking rates, and instructions on how to use revenue control equipment. Room designation signs are typically engraved plastic laminate with brailed letters. Parking rate signs are usually located at the entrance on the front of the ticket issue machine. Rate signs should be designed to accommodate changes in the rate structure. If possible, these signs should have the same design approach as that used for the signage throughout the facility. Sign messages are also critical to successful operations of revenue control equipment. This is a specific concern with central pay stations and pay-on-foot machines. The messages, generally in the form of instructions, must be clear, concise, and placed at numerous locations. Text can be supplemented with visual instructions.

Sign Mounting

The mounting of signs and their locations are important to the overall success of the signage package. It is imperative that the signs be mounted so that no part of a sign is located below the designated clearance in the facility if the sign is mounted overhead from the structural system. It is essential that all signs be mounted so as not to interfere with structural components. This includes prestressing steel in horizontal members and vertical reinforcing in columns. Generally, a 1-1/4 inch embedment length will suffice.

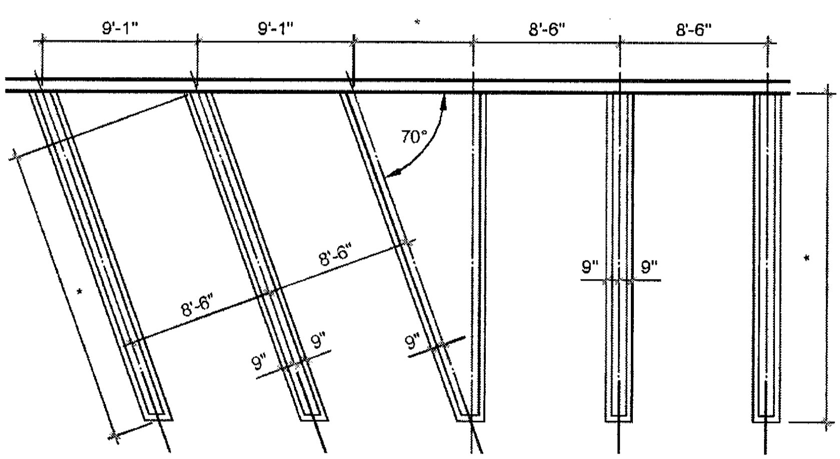
Sign mounting should always be coordinated with the project engineer. Signs should not be rigidly mounted overhead. They should be able to swing or rotate if hit by a vehicle or a vehicle rack. This will minimize damage to the sign and vehicle. As mentioned, signs should also be coordinated with lighting so that they are not blocking lights or vice-versa. Signs should be located so that the lighting illuminates them. While parking facility signage is usually designed in advance, it is often recommended that the final location of each sign be checked in the field before the final sign contract is let. If signs are placed at the exact location shown on drawings, they have a tendency to wind up behind a drainpipe or in some other location where they cannot be seen. Signs should also be cleaned occasionally.

Pavement Markings

Pavement makings should conform to MUTCD or local standards. MUTCD specifies that white paint be used for markings for traffic flow in the same direction and yellow paint used for traffic flow in opposite directions, which implies a warning.

Pavement markings can be an effective way to direct and control traffic flow in a parking facility. However, pavement markings must be re-applied due to wear and deterioration from vehicular traffic. Pavement arrows may enhance traffic flow. They are often utilized on surface lots or the top level of parking structures where overhead directional signage is not possible. Traffic arrows are also commonly used in facilities with a combination of one-way and two-way traffic flow.

In two-way traffic bays, a 4-inch yellow painted stripe in the longitudinal direction of the parking module should be considered. This painted stripe is to be in the center as a divider between each direction of traffic flow. The painted stripe should extend through the turns at each end of the parking bay. Pavement markings such as traffic arrows and pedestrian crosswalks are generally painted white.



Double line striping of parking spaces.

Parking stall stripes can be painted either white or yellow. Yellow paint is more visible over time and is preferred by many designers. Double-striped parking stalls help parkers center their vehicles between stripes, maximizing the space between vehicles and minimizing conflicts between door openings. Some states require the use of blue paint for marking accessible stalls. All pavement markings, including parking stall striping, should be coordinated with the proposed signage.

Conclusion

A well-designed graphics and signage system will enhance the user's parking experience and help create a positive impression of a parking facility. Effective signs and pavement markings will also improve driver and pedestrian safety in a parking facility. The patron who has had a positive parking experience will return. Repeat business will increase revenues, benefiting the owner and operator of the parking facility.

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WRITING AN EFFECTIVE REQUEST FOR PROPOSAL (RFP) FOR PARKING FACILITIES

J. R. "Jeff" Jeffrey

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This chapter is based on a presentation given by the author to the IPI Annual Conference attendees on May 20, 2003, titled "Developing Your Essential Parking Documentation – New Ways to Look at the RFP Process."

Introduction

The RFP/Proposal process can, as most of us know, be very painful. To paraphrase A. A. Milne from his famous Winnie the Pooh series, the RFP/Proposal process is akin to coming downstairs on the back of your head all the time. Edward Bear, a.k.a. Winnie the Pooh, although a bear of very little brain, understands pain and when there ought not to be any, and we as providers and responders to RFPs ought to understand how to avoid pain as well. This chapter is intended to give you some "food for thought" when you make time to think about stopping the pain.

> *"Here is Edward Bear coming downstairs now, bump, bump, bump, on the back of his head, behind Christopher Robin. It is as far as he knows, the only way of coming downstairs, but sometimes he feels that there really is another way, if only he could stop bumping for a moment and think of it."*
>
> *A. A. Milne, "The Wonderful World of Pooh", page 6, 1926.*

We will discuss ways to alleviate some of the pain inherent in the RFP process and make the experience profitable for both the agency and the respondent. We will discuss what I call the ten pretty good rules of RFP preparation.

As almost always with rules, even the Ten Commandments, there are usually more rules than initially stated. In this case, I said there are ten rules but there are actually eleven beginning and ending with the overriding golden rule concerning the schedule. In addition to schedule considerations we will discuss the following points, which form the guts of the ten pretty good rules:

1. Getting Help Forming the RFP
2. Outlining the Proposal
3. Forming the Evaluation Criteria
4. Displaying the Requirements
5. Telling the Respondent What You Want in the Response
6. Providing the RFP to Prospective Proposers
7. Finding the Answers to All Your Concerns
8. Ensuring a Pleasing, Useful, and Easy to Write and Evaluate Document
9. Providing Adequate Time to Answer the Respondents' Questions
10. Managing the Terms and Conditions Puzzle

It may take you weeks, months, and sometimes years to construct a useful RFP. Making sure the RFP is useful to the respondents is the most powerful way of ensuring the usefulness of the proposal requested by your agency. The rules discussed herein will help you in that process.

The basic premise on which most respondents and consultants work is that they want and need to deliver an outstanding proposal to you to ensure:

- even a modest chance of winning, and
- a good chance of succeeding in program execution.

Respondents want to do good work for you, you want them to do good work for the agency, and one way of ensuring that both goals are satisfied is to provide a good RFP process for the respondents.

Most of the sections in this chapter have examples, taken from real RFPs and used in the aforementioned presentation, of how badly written RFPs affect the process. Comments on how to improve the RFP so negatives effects are mitigated are provided.

Instead of ending with the Golden Rule, I will begin with it since it is of overriding importance.

The Schedule

Golden Rule: Publish a schedule with adequate time and stick to it.

Remember that you are asking the respondent to write in a month or so a response to an RFP that took you several times that long to prepare. Preparing responses to RFPs costs people and money. The respondent generally does not have subject matter experts (SMEs) whose only job is to respond to agency RFPs. Their SMEs are working on many things running from program startups to fixing things that have gone bump in the night. The SMEs and editorial talent necessary to write the response to your RFP must be pulled off other work to write the proposal in response to your RFP.

If the respondent cannot schedule these SMEs but must pull them on a moment's notice, it increases the cost of operation and ultimately the price to you of performing on your contract. So it behooves you to set a schedule and stick to it if for no other reason than ensuring you get slightly less expensive contracts in the end.

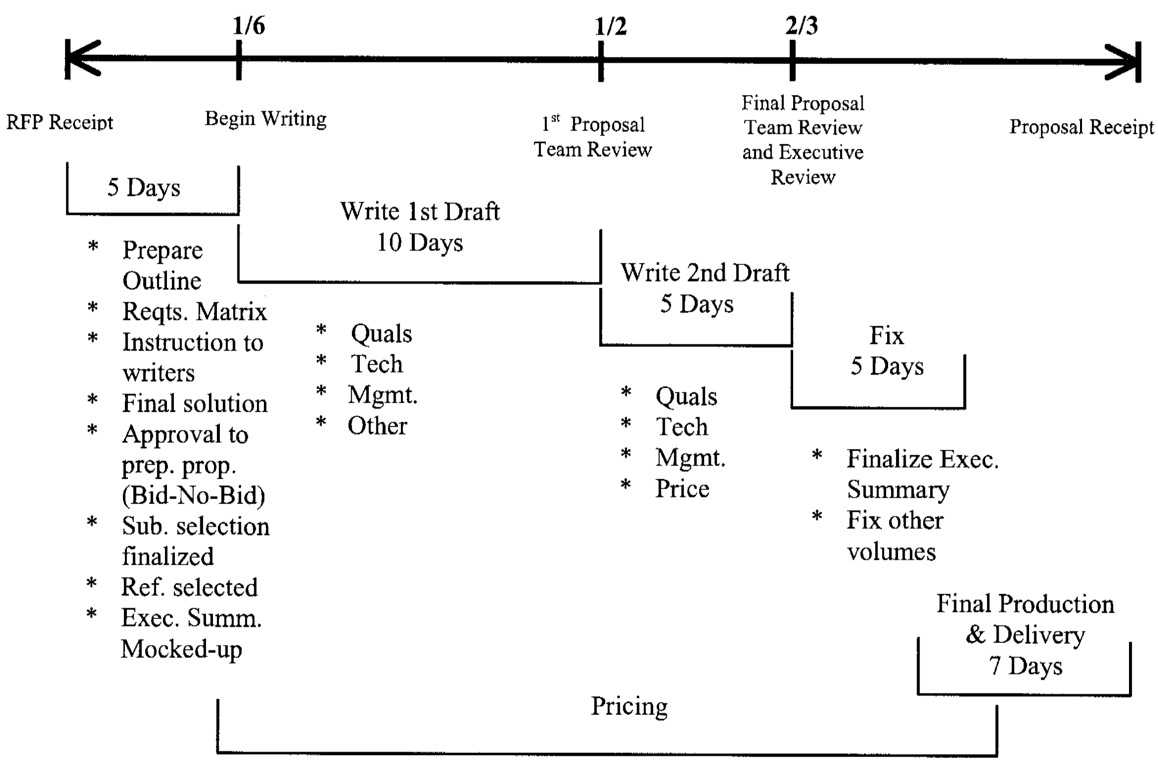
Each response schedule has the potential to have negative timing events attendant to it. We will discuss a few of these ugly events and how they affect the response to your RFP.

Things that fall into the ugly category are:

- RFPs released immediately before holidays
- Due dates immediately after holidays
- Extensions in general
- Extensions granted then withdrawn
- Modifying amendments received after the due date

The folks working on the response to your RFP have personal lives too. Releasing RFPs just before holidays causes these people to work across the holiday, since they generally have very little time to respond to your RFP. So my guidance is to schedule all releases so they do not immediately precede holidays so that respondent personnel can get a running start at your RFP response without consuming their family time across a holiday. If you release the RFP on 23 December, the respondent personnel will get about a half day (Christmas morning) off between your release date and the second of January, because the due date will be a seriously constraining factor. You will almost surely get requests for an extension if you release an RFP just before a holiday, especially Christmas. Likewise if you schedule a response due date to immediately follow a holiday, like December 29, or January 5, respondent personnel will be forced to work right through the holiday to deliver you a good product.

How does the respondent schedule proposal work? The proposal schedule is set up like the schedule for a military parachute air drop. Air drop scheduling starts at the objective on the ground and works backward to take off time, while proposal scheduling starts with the agency receipt of the proposal and works backward to the release of the RFP. A 30-day schedule only leaves about half the time to write even if you publish a milestone schedule well before RFP release that gives the respondent time to set up a team and solution before the RFP arrives. An ideal 30-day schedule is shown below.



There are no weekends or holidays in a 30-day schedule.

The above schedule assumes the respondent knows the RFP release date and you don't miss it. Also, note from the above schedule that there is no slack time. Many 30-day schedules result in a request for extension for a variety of reasons, some of which will be discussed later.

Given the vagaries of the process, extensions are common. However, they cause confusion in the respondent ranks and they destroy your well-conceived plan to get to an operational system on time. Many things cause extensions, but the most common is a confusing RFP. Confusing RFPs cause the respondents to generate many questions that you must answer. If the schedule is ill-conceived, just responding to the questions might destroy your ability to get to an operational system as scheduled.

As bad as extensions are, withdrawing one or reducing the length of one after respondent notification is truly ugly (and it happens). Withdrawing an extension or reducing its time length is usually grounds for protest, so be careful. In fact, it is best not to grant an extension in the first place.

To avoid all the bad schedule events and ensure you get good win-win proposals from the respondent community follow the golden rule: Publish a schedule with adequate time and stick to it.

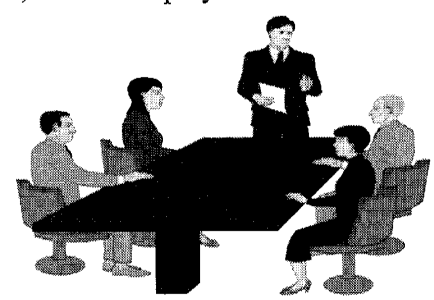
Publishing a schedule before RFP release usually means you have had contact with the respondent community. It also means that you know who is likely to propose, and because of this contact have a good idea what they are likely provide in the proposal.

Remember the respondent wants to provide you with a win-win proposal – a good schedule with adequate time helps.

Getting Help Forming the RFP

Pretty Good Rule 1: Get industry help in forming the RFP.

Having a good idea of what the respondents are likely to provide in their responses allows you to make better estimates for use in your approval cycles, allows you to write an RFP to which the respondent community can respond, and it keeps you out of trouble with your boss. Probably the worst thing that can happen if you have no contact with the respondent community is that everyone is surprised by the responses, even you. The respondents are most assuredly surprised and may do things in the responses that may cause you to have to throw out the procurement and start all over again. For example, all the respondents' costs may be so high that you can't justify using any of the responders, or they may tell you that what you want is impossible (usually a schedule issue).



Talk to your likely respondents.

An example of such a schedule problem is shown below. This example was extracted from the instructions to proposers and statement of work sections of a real RFP.

3.0	**Instructions to Proposers**	
	3.7.2.2	Proposals are due 3:00 PM EST on October 1, 2001.
	3.7.2.4	Contract will be awarded on December 1, 2001.
4.0	**Statement of Work**	
	4.6.3.9	Contractor will hire all agency personnel below manager level. There are currently 300 personnel below manger level.
	4.3.6.10	No discussions are allowed with agency employees until contract award.
	4.3.6.11	Facility will be operational on January 1, 2002.

Besides being confusing about who really gets hired (Really everyone? Or does the contractor have the right to be selective? What are you going to do with the management staff?), the schedule is on the face of it impossible for the contractor to accomplish. To begin with, the contractor must hire a program manager, who then must interview each employee who will be hired. And, remember this is across the holiday season and will cause major disruption to the agency and its current employees.

Another likely problem that may be caused by no contact with the respondent community (or with only one respondent) is that the procurement may appear to be wired because the solution you ask for may be essentially identical to only one respondent's solution.

To avoid surprises and other problems employ rule number one: Get industry help in forming the RFP.

After you get industry help in forming the RFP, you must begin writing it. As we discussed earlier in schedule considerations, the best way to begin is by designing what you want the final product (i.e., the proposal) to look like. The easiest way to do this is by building a high-level proposal outline.

Outlining the Proposal

Pretty Good Rule Number 2: Provide a high level outline for the proposal in the RFP.

What? You thought this chapter was about RFPs and here I am talking about outlining the proposal for the respondent. Isn't that the respondent's job? Well, yes and no.

Remember that the result of an RFP is supposed to be a contract, and the best way to that contract is a proposal that <u>you</u> can use. So, the best way to get a useable product is to tell the respondents what you want. This process will require you to think about the proposal to ensure its efficacy.

Suggested topics are shown in the chart to the right, where the "xxxxxx" represent the next level of the outline. There are usually many more subsections than shown here.

Program XYZ
Executive Summary
- o xxxxxxxxxxxxx
- o xxxxxxxxxxxxx

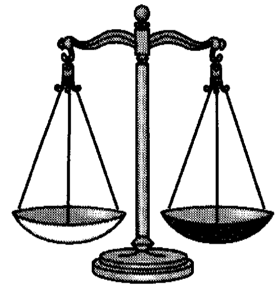
Management
- o xxxxxxxxxxxxx
- o xxxxxxxxxxxxx

Technical
- o xxxxxxxxxxxxx
- o xxxxxxxxxxxxx

Qualifications
- o xxxxxxxxxxxxx
- o xxxxxxxxxxxxx

Price
- o xxxxxxxxxxxxx
- o xxxxxxxxxxxxx

A sample outline



The evaluation process is a balancing act.

The real reason for the outline is to ensure that you receive the necessary response to all your requirements in an order that allows you to evaluate them. The evaluation process is a balancing act. There are many ways to do it. Some of them are good, some bad, and some extremely ugly. Lets talk about a few of them.

In the really ugly category is a statement in your instructions to proposers like the following from a real RFP:

> **3.0 Instructions to Proposers**
>
> 3.3 Order of response. The contractor shall respond to the requirements in the order they are displayed in the RFP.

What this really means to the respondent is that he must start at the front of your RFP and respond to every single paragraph, sentence, and clause that even resembles a requirement, even the items in information only sections. Given this guidance most respondents will start with your paragraph number one and will go paragraph by paragraph throughout the RFP and build their outline using your exact RFP section and paragraph numbers and headers including background and information only sections. This usually ends up with extreme duplication and a very large document.

You really don't want the respondent to respond to your background and information only sections, since they are intended to describe the past history of program, the environment in which the respondent will eventually engage the program, and other things such as current location and number of employees. Many times your phraseology in these sections leads the respondent to believe that he must respond to them.

By the way, a useful means of letting the respondent know what is and what isn't a requirement is to use words like shall or will in the requirement phraseology. "Shall" means the respondent is responsible and must respond. "Will" means that this is your responsibility and the respondent must be aware that you are responsible but need not respond.

Another bad way to tell the respondent the order of the response is not to even mention it. Provide no outline and in the instructions to proposers don't even allude to a preferred sequence for the response. Under this mechanism the respondent will be forced to make up the response order, and build an outline that may or may not be what you need.

Even if you give the respondent an outline, he will generally go down one or more levels below your outline titles. This extension of your outline allows the respondent to pick up all the nuances in your RFP. Extending the outline down a level or two also provides a means of excluding the things for which you don't want a response and a way of including the things you do want.

The respondents' proposal development staff will read every word of your RFP many times over. The intent is to pick up every nuance of every sentence. So if you don't mean it, don't say it. Strive to be clear and unambiguous. The respondents' people will spend many days trying to decide what you really meant by your words.

If you don't give the respondent any guidance each will develop guidance on his own, probably asking many questions along the way. This self-generated guidance will usually put you in the position of having several responses with different structures, which generally means you have no means to compare the responses one to the other, hence, you can't evaluate them.

I have already stated what I believe you should do, but let me summarize the rule and reasons therefore, so it will be clear. Provide a proposal outline to at least the second level of indenture in the RFP. This provides you the means of finding the responses to your requirements for evaluation purposes, and it provides the respondent with a place to put everything without guessing or having to ask a lot of questions. The writing becomes easier for the respondent and evaluation becomes easier for you.

I have mentioned evaluation several times in this section. So, what really constitutes good evaluation instructions in the RFP and how do you form those criteria?

Forming the Evaluation Criteria

Pretty Good Rule Number 3: Make your evaluation criteria explicit and tell the respondents what they are.

Remember, you asked the respondent community to sell you some good or service via your RFP. One or more of the respondent community will respond with a sales document, a.k.a. a proposal. How do you make that process as painless as possible on you and the respondent? What do you tell the respondent about how their firm will be evaluated?

Many RFPs don't provide evaluation criteria even in a generic sense, but expect the respondent to respond as if he knew how her proposal is to be graded. Remember this is the adjudication part of the effort and you are the judge. A respondent with no knowledge of the evaluation criteria may assume that you have already made up your mind and might not submit a proposal believing you have already selected someone. He may also believe that if things don't go his way he will have a perfect right to protest. With no evaluation criteria provided you can rest assured that there will be many questions to which you will have to respond. These questions will begin during the proposal process but may not end there. They may continue to be asked even in a court of law.

You are the judge.

There are many bad and ugly ways to handle evaluation. A few of them from real life are shown in the examples below. I have already described what is probably the worst scenario (i.e., provide no evaluation criteria at all). The next level up from that, and it too is ugly, is to use wholly subjective criteria as shown below.

Evaluation Criteria Example 1

> **Section 3.0 Criteria for Evaluating Proposals**
>
> - Respondents must provide a complete and correct:
>   - Transition Plan
>   - Understanding of Services
>   - Cost of Services
>   - Qualifications and Experience of Personnel
>   - MBE/DBE/WBE Participation

In Example 1, above, what is shown was the entire evaluation criteria. No explanation was given for any of the contents. The agency did not explain what constitutes a "Transition Plan" or what the agency meant by "Understanding of Services," nor was an explanation given for any of the other criteria. But worse than no explanation, no point score was attached to any of the criteria. Was MBE/DBE/WBE (minority business enterprises/disadvantaged business enterprises/women owned business enterprises) Participation more important than Cost of Services or vice versa? So the respondents ended up with no choice but to ask dozens of questions, which drove the agency into a reissue of the RFP, taking several more months.

Evaluation Criteria Example 2

> **Section 3.0 Criteria for Evaluating Proposals**
>
> Selection of the potential contractor will be based upon a determination that the vendor chooses to enter contract negotiations; is a responsible vendor whose proposal meets the requirements, specifications, terms and conditions and RFP instructions; and upon the consideration, that all factors, including price, shall be most favorable to the agency.

Example 2 is my favorite truly ugly way to tell the respondent that you have already chosen a vendor, probably the incumbent, or that you will make up your mind about how to evaluate the proposals after you see them and find the one you like. This indicates that you really don't know how to score the proposals but you'll know a good one when you see it. Again this "evaluation criteria" paragraph was unaccompanied by any point score or explanation of its contents. This also resulted in withdrawal of the RFP after many weeks of back and forth questions and answers. A RFP rewrite was required.

In summary of this rule, there are a few simple things you can do to ensure you receive a proposal you can evaluate.

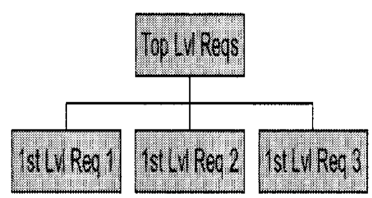
1. Explicitly define your criteria to yourself so you know you can evaluate the proposals when you receive them.
2. Tell the respondents what these criteria are so they know how they will be evaluated.
3. Tell the respondents what each criterion is worth so they will know where to expend the most effort and correctly orient responses.
4. If you don't plan to evaluate all of the things you ask for, then why ask for them? Eliminate unnecessary items from the RFP.

To form the evaluation criteria, you need to know what you will require of the successful respondent. The requirements you put forth will also form the basis of the contract and will be the real response mechanism employed by the respondent. A good proposal will respond to each and every requirement in the RFP.

Displaying the Requirements

Pretty Good Rule 4. Keep your requirements to a minimum and put them all in one place preferably in evaluation criteria order.

The respondent will read every word in your RFP many times and will attempt to respond to anything that even looks like a requirement. He expects to see the requirements laid out in a hierarchical fashion with requirements falling logically together so that he may address them in classical proposal fashion. Some RFPs have huge numbers of requirements placed in every conceivable corner of the RFP. This multiplicity of requirements is usually accompanied by vague wording and redundancy, so the respondent may not understand what you are asking for and might be forced to ask large numbers of questions. An example should suffice to demonstrate some bad ways requirements have been displayed.



Requirements Example 1

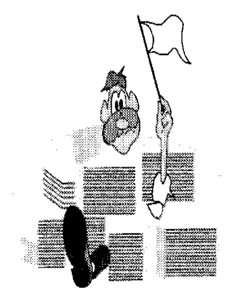
Section 4.4.4 Project Staffing

A. Furnish an organization chart showing individual names, title, relationship, etc., for all phases of the project
B. Furnish a functional organizational chart for this project
C. Furnish a person/hour chart for performing the tasks/activities/services described in this RFP
D. Furnish résumés and related job descriptions for all staff who will be responsible for task activities in this project

There were over 3,800 requirements in this fixed price RFP. The requirements were distributed throughout the RFP, even in the supposedly information only sections. The project staffing section shown above was just one of many paragraphs stating the staffing requirements. Note subsection D. The agency really did mean all staff. Another example of an impossible task, since not all the staff were even in the respondent companies. Needless to say the agency was buried in paper. The proposal I worked on in response to this RFP was in excess of 5,000 pages long.

Several improvements that would help the respondent trying to respond to this set of requirements would be:

1. Place all the requirements in the body of the RFP and not in the executive summary or information only paragraphs.
2. Reduce the number of requirements to a manageable level.
3. Place the requirements in evaluation criteria order, which essentially means in the order of the proposal outline you provide in the RFP.
4. Identify the requirements with specific wording such as "shall" or "must" for things the respondent is responsible for and "will" for things the agency is responsible for.



Be careful what you ask for, you might be buried in it.

A minimum number of requirements, properly worded, make the RFP easy to use and the proposal easy to evaluate. Be careful what you ask for, you might get it. An excessive number of poorly written requirements might result in you being buried by paper.

Many times a RFP will require the respondent to provide things other than the means and methods with which he plans to execute the contract. You may ask for plans, schedules, hardware and software lists, etc.

Telling the Respondent what you want in the Response

Pretty Good Rule 5. Provide a proposal data requirements list in the RFP.

The problem with asking for items like plans in the RFP is that the request is many times accompanied by ambiguous wording. The respondent must then guess whether the client wants the items submitted with the proposal, or after award, or at all. Sometimes the client tells the respondent that the item is to be submitted with the proposal or after the proposal at some milestone in the execution of the contract, like 30 days after award. The respondent must search through the RFP to ensure he has identified all extra items to be submitted and almost always misses one or more of them.

A better way to tell the respondent what is to be submitted with the proposal, or for that matter, when and what is to be submitted throughout the execution of the contract, is to provide a comprehensive list tied to the contract schedule. The respondents call this list a proposal data requirements list. A list like this comes in many forms the most comprehensive of which is a proposal data requirements matrix as shown below.

This matrix shows the respondent (and you) when each plan and the compliance matrix is to be submitted (i.e., with the proposal, or 30 or 60 days after contract award) and in what form you expect to see the referenced document (i.e., draft or final).

Proposal Data

Item	Draft with Proposal	Final With Proposal	Final 30 Days After Contract Award	Final 60 Days After Contract Award
Compliance Matrix		X		
Management Plan	X		X	
Transition Plan	X			X
QA Plan		X		
Marketing Plan	X			X
Disaster Recovery Plan	X			X

A proposal data requirements matrix provides you and the respondent with a comprehensive list of items to be submitted with the proposal and during contract execution.

Knowing precisely what the client wants keeps the respondent from guessing and or asking unnecessary questions. All of this information needs to be provided to the respondent at the time you release the RFP, so what better form than in the RFP itself.

You've finally prepared your RFP. It looks good. It's jumped through all its staffing hoops and passed its legal scrutiny. It's lying on your desk in all its glory. How do you get it to the prospective proposers?

Providing the RFP to Prospective Proposers

Pretty Good Rule 6. Provide an electronic copy of the RFP in word processing format to the respondents on the World Wide Web.

Although there has lately been a trend toward providing the respondents with an electronic copy of the RFP, it is still not the norm. One of the reasons I have been given for not providing an electronic copy of the RFP to the respondent community is that the agencies are afraid that the respondents will change the RFP to suit themselves. If a respondent deliberately does that, disqualification on the current and succeeding bids should result. There are several ways in which RFPs are provided to the respondent community.

The most used way to provide the respondent community with the RFP is still snail mail, the slowest possible way. The next most common way is to have the respondent's point of contact in the local area physically pick up the RFP from the agency after finding the notice of release in the agency's procurement journal or on their web site.

Do it on the web:
www.agency.org

Many times the agency will provide no electronic copy and the provided paper copy is at best a poor hard copy. Many of these same agencies require the bidder to fill out forms using the copy provided. The following was a requirement in a recent RFP.

5.0	**Instructions to Proposers:**
5.8.9	Do not retype the required forms. Forms that have been retyped or altered are cause for rejection of the bid by the agency

The problem with section 5.8.9 is that the forms in the RFP required the proposer to use a typewriter. The respondent might not even be able to find a typewriter in her organization. Finding someone who can write legibly is also a problem. In this age of computers and word processing, it is far better to fill in forms electronically. Also, the blocks on the forms often do not allow enough space to respond manually.

The solution to this problem is a subset solution for Pretty Good Rule 7. Provide your forms electronically so they may be filled in using word processing software. Put a restriction on alteration (e.g., forms that have been substantially altered by the proposer are grounds for rejection of the bid). Alteration of documents can be determined electronically using comparison software. So, even if the respondent was stupid enough to change the RFP, the respondent may be easily caught and punished.

Most respondents prepare several useful tracking documents using the provided RFP. If the RFP is not in electronic form, then the respondent must either rekey appropriate sections, or scan and clean up the scanned version so it can be used electronically. Both are extremely time consuming. The two things the respondent usually uses the electronic copy for are generation of an outline (using your provided outline as a start point) and preparing a compliance tracking matrix (to ensure he has replied to all your requirements). We have already discussed the outline in some detail and will discuss the compliance matrix in the next section.

Needless to say, having an electronic copy of the RFP makes building outlines and compliance/requirement tracking matrices much easier and more foolproof.

Finding the Answers to All Your Concerns

Pretty Good Rule 7. Require the respondent to submit a compliance or requirements tracking matrix.

This is a rule you should love because it makes it easy on you. This rule provides a means for you to determine in check-a-block fashion whether or not the respondent has responded to every one of your requirements. It even provides you a way to determine if the respondent has found all the requirements. It might even provide you a means of determining where all the requirements are (if perchance you ignored Pretty Good Rule 4, "Keep your requirements to a minimum and put them all in one place preferably in evaluation criteria order.")

Most RFPs do not require a compliance/requirements map (matrix) because the agency is not familiar with them. Many respondents don't build a compliance map because they don't bother to check to see if they have answered all the mail due to time constraints.

The respondent also may not provide you a compliance map because the page constraints are too tight (or you didn't require one). If a compliance map is not provided, then you might not be able to tell where the respondent addressed each requirement.

Having a huge number of requirements and no electronic copy of the RFP makes generating a compliance map very difficult, so the respondent probably won't provide you a compliance map if you don't ask for it. If you have a large number of requirements, then a compliance map is a must, especially if the requirements are not hierarchically organized and/or are spread throughout the RFP. With a large number of requirements and no compliance map, you almost certainly will not be able to tell where the respondent responded to your requirements in her proposal. Note, also, that a compliance/ requirements map may be used after contract award to monitor respondent performance on each requirement.

If you decide to require a compliance/requirements map, then you should limit the number of requirements (as discussed earlier you should do this anyway) and establish a format so each bidder's map will be similar.

The following matrix is a simplified compliance map for a small part of a RFP/Proposal combination. Notice the number of things you can discern by having such a map. The first is that the proposer did not comply with every requirement, but gave you a valid reason for not having done so. The second is that RFP sections 3.3.6 and 3.3.8 are discussed in two different locations. And the third is that he complied with all but section 3.3.6. Use of this matrix makes it easy on you and it helps the proposer.

Compliance Map for RFP Section 3

RFP Section	Requirement	Proposal Section	Comply [C]/ Exception [E]
3.3.6	Install security barriers at each collection booth	3.4.7 and 4.5.7	E – Collection booths 3 and 5 already have security barriers
3.3.7	Install bullet proof screens at each collection booth	4.5.8	C
3.3.8	Install panic buttons in each collection booth	3.9.6 and 4.5.9	C
3.3.9	Provide two way radio links with central office in each collection booth	4.5.10	C

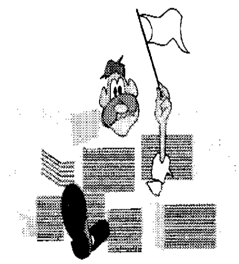
A compliance map makes it easy for you to determine where the bidder discussed each element of your RFP.

In addition to the compliance matrix there are other things you can do to make your RFP user friendly, the proposal easier to write, and make the resulting set of proposals evaluation friendly.

Ensuring a Pleasing, Useful, and Easy to Write and Evaluate Document

Pretty Good Rule 8. Page constrain the response, but allow some formatting latitude.

Most RFPs are published with no constraints on page count. A 500 page RFP will amount to a proposal of at least 2,500 pages if no page constraints are mandated. Proposal page count is a function of RFP size. My rule of thumb is that if no page limits are set the proposal will be five to eight times the size of the RFP.



The proposal page count rule is that a proposal will be five to eight times the size of the RFP if unconstrained.

Sorry to repeat the same graphic, but do you want to buried in paper? How do you avoid this ugliness? How can you evaluate such a mound of paper?

To avoid the mound of paper, the first rule is to reduce the number of requirements in your RFP. Ask yourself if you really need to require so many things of the respondent? If not, then cut out the unnecessary requirements. If you really need to require a huge number of things of the respondent, then find a graphical way of asking for a response. Perhaps, build a table that states the requirement, asks the respondent if he can perform the requirement, and a one or two sentence response about how he will accomplish the requirement. If the respondent is left to his own devices he will write at least one half a page per requirement, even if is just to say "Yes, I can do this."

However, you can be really ugly about page constraints. For example, a recent 125-page RFP with over 1,000 requirements had this statement in the instructions to proposers:

Section 3.3.7.

The proposal format shall be as follows. The proposal shall be no more than 20 pages including the executive summary and graphics. It shall be double spaced, in 12-pitch font with one-inch margins all on sides. All requirements will be addressed in detail.

This is a test paragraph in Times New Roman, 12-point font.

```
This is a test paragraph in Courier, 12-pitch font.
Pretty ugly isn't it? It also takes up more space than a
proportional space font like the Times New Roman font. *
```

So be careful what you ask for, you may get it.

* *For definitions of pitch, point, and font see* http://www.harmonize.com/probe/aids/manual/typography.htm.

It was patently impossible to provide a meaningful proposal to this agency. You can't even list out the requirements themselves in 20 pages with a simple yes for each one. They got a set of meaningless proposals, which were judged on the basis of the cost with no real thought about whether or not the proposers could actually do the work.

You can, of course, chose not to page constrain the proposal at all. The respondents will write until they drop, and you will get a hernia just from lifting the proposals. In addition, many page constraining efforts result in the requirement that the proposal be in a font no smaller then 10 point.

If the only font allowable is a 10 point or above font, the respondent will have to go to extreme measures just to make graphics presentable, which costs a lot of time and money. A far better way with graphics is to allow 6-point font or above on the actual graphic. With 6-point font or above, complex graphics can actually include all the information needed and they will be readable and look good for you to use in your selection presentation to your board.

Another page constraining technique is to force all graphics to be placed on 8½ by 11-inch paper. This results in horrible compression of most graphics. A better technique is allowing graphics to be placed on 11 by 17-inch paper. You could even tell proposers that each 11 by 17 page constitutes two letter-sized pages. But the respondent is able to present flow diagrams and large systems diagrams so they make sense.

A better way to page constrain your respondents' proposals is to be reasonable about the number of requirements you put in the RFP and constrain the proposers to an adequate page count of 100-200 pages. Use a single space format and 10 to 12-point, proportional space font with one-inch margins all around. Exclude some things from the general page constraints like the executive summary and cost volume. Keep the executive summary at no more than ten pages and the cost volume at five to ten pages plus your required pricing forms. Allow some graphics to be placed on oversized paper (11X17). And, lastly, be aware of the state of the computer software in the marketplace. If you really need an electronic copy of the proposal, you can help the respondent and yourself by asking for it in a software package that is commercially available.

A final formatting example - the following requirement was found in an RFP in 2000.

> Submit a signed original and 10 copies in a sealed container. In addition, submit a copy of the proposal on 3.5" floppy disk in WordPerfect, Version 8 format, in the same sealed container.

Problem: At that time WP 8 was no longer commercially available so a question was asked as follows.
Question: WordPerfect Version 8 is no longer commercially available. May we submit the proposal in MS Word, or WordPerfect 2000, or in Adobe Acrobat *.pdf format?
Answer: No.

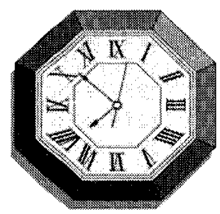
Result: The respondent built the proposal in MS Word, then translated it to WordPerfect 2000. From WordPerfect 2000 they saved it in WordPerfect V8. They had to purchase copies of WordPerfect 2000. Because of incompatibilities between the three word processing packages, reformatting was required. The proposal was over 1,000 pages. Over one hundred hours plus the cost of the software was incurred to meet this one requirement.

Many of the above problems result in questions from the prospective respondents. These questions can push you up against the schedule wall. You may not be able to answer all the questions in the remaining time.

Providing Adequate Time to Answer the Respondents' Questions

Pretty Good Rule 9: State and stick to a reasonable cutoff to questions and answers.

Many RFPs allow questions right up to the day before the proposal is due. This causes many problems. In fact, a cutoff anywhere between 0 and 5 days before the proposal is due usually ends up causing so many problems that you are forced to extend the due date (or not answer late arriving questions). Remember everyone is working against the clock, your clock. I break the question and answer process into three periods.



Everyone is working against the clock.

1. An ugly cutoff timeline of between 0 and five days before submittal. This I consider to be no cutoff at all (see the ideal 30-day schedule shown in the Golden Rule). This results in you being unable to answer late arriving questions, in the proposer being unable to respond to your answers should you be able to answer the question, and it might force an extension.

2. A better but still bad cutoff timeline of between 5 and 14 days before submittal. Again see the ideal 30-day schedule. Under this scenario, you might not be able to answer the questions, and the proposer still might not be able to respond to the answer, especially if it forces a change to the solution or program schedule.

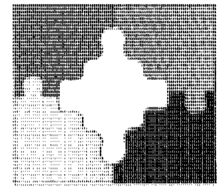
3. The best way I have found to handle question and answer cutoff is to state that no questions will be allowed after submittal date minus 14 days. You should actually put a date and time in the RFP beyond which you will not accept proposer questions. I would also make sure that I answer all questions from bidders not later than the submittal date minus ten days to allow the respondent time to make appropriate changes.

In addition to the many mundane things that proposers ask about, such as formatting, they also ask some really hard questions about your terms and conditions (T&C). In many cases, the T&C differ from what you have said elsewhere in your RFP and can become confusing and contradictory.

Managing the Terms and Conditions Puzzle

Pretty Good rule 10: Keep the terms and conditions non-onerous and to a low number.

Probably the hardest thing for both you and the proposer is to solve the T&C puzzle. Many times it is because the agency inserts large numbers of T&C some of which are onerous. Onerous T&C truly cause respondents heartburn.



T&C puzzle is the hardest of all RFP issues to solve.

In many cases the T&C differ from requirements found elsewhere in the RFP. This causes massive confusion and lots of questions. The proposer is required for his own safety to match requirements and T&C, which is a very large problem if there are a huge number of both.

Some T&C require the respondent to sign up to all T&C with no negotiation. You've all seen it; maybe you've even done it. Most respondents agree to this blanket T&C sign-up since that is the only way to get their proposal evaluated. Even a short sentence like "Although we agree to all T&C in the RFP, there are a few that we would like to discuss with the agency" might get the bidder disqualified. (I've seen this happen within the last year). Some respondents just refuse to submit under these circumstances.

Some truly ugly T&C make the respondent liable for everything. This really incenses the respondents' lawyers and boards of directors. These T&C cause a lot of questions and, if not resolved before submittal, cause many respondents to drop out of the race before it is fairly begun. Let me give you some examples of truly onerous T&Cs. Underline emphasis is provided by me.

T&C Example 1

"Contractor accepts <u>all</u> risks in connection with its timely performance of the installation work, without entitlement to additional compensation or additional time for performance."

What this T&C does is make the contractor liable for everything even acts committed by you or God over which the respondent has no control. Furthermore, it provides that even if you are responsible for a delay, no additional schedule adjustment or monetary compensation is allowed.

T&C Example 2

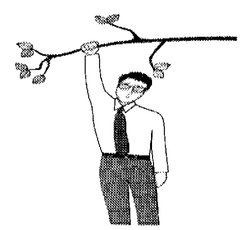
> "Contractor shall grant to the Authority a perpetual, non-exclusive, irrevocable, royalty-free license to use the software … in both source and object code … with respect to the installation, operation and maintenance of the system. The Authority shall have the right to contract with others for software maintenance services."

This statement says that the contractor is bound to give the agency any pertinent software (even that developed on the contractor's nickel) and the agency has the right to give it to another contractor to maintain. Giving someone else your source code is like opening the bank vault and walking away. The person to whom it is given might in the end incorporate your software into their software without having to spend a penny of their own development money. Intellectual property rights are the subject of a large number of lawsuits and this could easily become a bone of contention and the subject of litigation.

T&C Example 3.

> "Contractor shall bear the risk of loss, damage to, or interruption of use of the system (including government requisition, condemnation, or confiscation of the system and all component parts thereof) from any and every cause whatsoever prior to system operational acceptance."

This is probably my favorite onerous T&C. It makes the contractor liable for everything, even if it results from the agency seizing the contractor's assets. The legal staff went absolutely berserk over this one.



Avoid the risk of onerous T&C.

Even allowing negotiation after contract award about the T&C is really not sufficient to solve these problems. What is really needed is a statement in the RFP that the agency requests suggested language changes to T&C that will be part of the negotiation process pursuant to contract award.

Some T&C cannot be accepted by the respondent because they violate intellectual property rights, underwriter's or federal or state insurance rules, are impossible to comply with for schedule reasons, etc. Onerous T&C put everyone at risk.

Avoiding ugly things in your RFP lessens both your risk and the respondent's angst. I think you will agree that it is better to have minimum risk. To achieve that minimum risk you need to start with an achievable procurement schedule.

Once Again the Schedule

Golden Rule: Publish a schedule with adequate time and stick to it.

I can't say enough about maintaining schedule. Letting the respondent community know what your schedule is well before the RFP is released and holding to it shows your commitment to the project. It also allows both you and the respondent to program personnel use and to retain some sense of sanity in this otherwise insane process.

All the respondents want to win. You want the best one to win. Providing a manageable schedule to which you are committed helps fulfill your desire to acquire the best respondent for your project.

Conclusion

Remember the respondent wants to provide you with the best possible proposal. To do that the respondent needs you to provide the best RFP possible. Both of you need a win-win situation to result from the RFP/Proposal process. The rules enumerated in this chapter provide a good starting point for a great relationship with the winning respondent, while giving all the respondents a fair shot at winning your business.

The rules are:

Golden Rule: Publish a schedule with adequate time and stick to it.

- Pretty Good Rule 1: Get industry help in forming the RFP.
- Pretty Good Rule Number 2: Provide a high level outline for the proposal in the RFP.
- Pretty Good Rule Number 3: Make your evaluation criteria explicit and tell the respondents what they are.
- Pretty Good Rule 4. Keep your requirements to a minimum and put them all in one place preferably in evaluation criteria order.
- Pretty Good Rule 5. Provide a proposal data requirements list in the RFP.
- Pretty Good Rule 6. Provide an electronic copy of the RFP in word processing format to the respondents on the World Wide Web.
- Pretty Good Rule 7. Require the respondent to submit a compliance or requirements tracking matrix.
- Pretty Good Rule 8. Page constrain the response but allow some formatting latitude.
- Pretty Good Rule 9: State and stick to a reasonable cutoff to questions and answers.
- Pretty Good Rule 10: Keep the terms and conditions non-onerous and to a low number.

Use these rules to your advantage, remembering that the most important of them is the **Golden Rule: Publish a schedule with adequate time and stick to it.**

EMPLOYEE TRAINING: CUSTOMER SERVICE IMPROVES PERFORMANCE

Kim E. Jackson, CAPP

Kim E. Jackson, CAPP is vice president of the International Parking Institute and has been with the association since 1995. She works with educational programming, technical services, and edits The Parking Professional magazine. She served as the first director of parking and transportation at Rutgers University where she conducted operations at every level of the university's parking system. She is a 1977 graduate of Rutgers with a degree in management. As IPI's lead trainer, her classes have reached more than 6,500 parking employees. She was a member of the original analysis team and has been instrumental in developing and continuing the IPI training initiative.

An organization is only as good as its employees, especially those employees who interact with your customers. And who are your customers? Your external customers include everyone who parks in your facilities and on your streets, calls your office, or stops your staff to ask a question or directions. Your internal customers are not only other department members, but any other internal departments your employees interact with daily. For an organization to produce professional career-minded employees, an investment has to be made in training and education. Giving employees all the tools to do their job is essential.

Building strong customer relations starts with increasing the understanding and importance of the role front-line employees have in fostering excellent customer service, and influencing the perception the public holds of the parking profession. We are now a service-oriented society and, in parking, "service" is what we do best. An investment in customer service training will increase the quality of service provided to the public and foster the professionalism of front-line employees.

When fostering professionalism, employees need to:

- Examine their values and attitudes regarding their roles and the impact of these values and attitudes on their interactions with others.
- Identify their core role contributions and gain a better understanding of the relationship of these contributions to their departments overall parking management philosophy.
- Discuss strategies for effectively resolving community relations problems and minimizing negative interactions with the public.

- Explore the importance of communication skills in fostering successful community relations practices.
- Determine essential community relations practices, assess their performance against these elements, and identify opportunities for performance improvement.
- Make a personal commitment to engage in positive community relations practices and support the department's parking management philosophy and community relations efforts.

Examining Values and Attitudes

What is the "perception" an employee holds of the job, especially when explaining to someone else what they do for a living? Do they truly understand the valuable service they provide to the public every day? My guess is they don't!

Most front-line employees have little or no idea of their true value to the organization, other than to generate funds. And in most cases they do not know how those funds are spent. Rarely do they understand that parking is a business. Like your customers, your employees see what they do as a necessary evil, forcing people to pay for a "service" that the public does not recognize as such. They have a thankless job. In most cases, parking employees are at the lowest pay scale and other service departments give them no respect. Hence, they perceive a lack of value.

Adding to this perceived lack of value, when was the last time you personally spoke to a front-line employee, recognized them not for their extra effort, but the efforts they give daily? If your answer is "it's been a while," then, unwittingly, you are reducing their value as an employee.

Front-line employees in our industry must work twice as hard as some other service industries, because facing the same sort of people and problems day after day can deaden your heart and dull your senses. All customers begin to look and sound alike. Their job is not as easy as some would like to think.

Everyone needs to know and hear they are doing a good job, especially from the "big" boss. Often our organizations are so large that as administrators and/or managers, we are several layers removed from our employees, and they never even see us.

It is very important that as a manager your employees feel a sense of value. Poor attitude, from a feeling of not being valued, leads to poor performance. Your customers - both internal and external - will be on the receiving end of an employee's poor attitude. A typical response from employees when asked the simplest of questions could be "I am just doing what I'm told," or "No one tells me anything, I am just doing my job." Both responses will leave a negative impression with your customer. In some instances an employee may simply not respond. Your employees may have an "I don't care" attitude because they don't believe the organization cares about them. In their mind, the organization only cares about the revenue and the numbers, not the people.

Identify Core Role Contributions

We all have a job title that should explain what we do. When you look at front-line employees these titles may include parking enforcement officer, ticket agent, cashier, booth attendant, meter technician, meter collector, etc. When asked, that is exactly what employees say they do! In most cases in the parking industry, these titles do not accurately explain what that individual truly does, and most of your employees do far more than these titles might reflect.

For employees to better understand what is expected of them daily, they must look at their core role contributions and the relationship those contributions have to their department's parking management philosophy.

To examine what an employee does on a daily basis, let's look at the examples of an enforcement officer and a cashier. Both roles go far beyond just writing a ticket or collecting money based on time parked.

Your employees are often the first and last impression a customer has of your city, university, airport, hospital, parking garage, etc. They perform in a variety of roles, including:

- Serving as an ambassador for your operation
- Providing safety and security both directly and indirectly
- Providing informational and directional resources
- Assisting with traffic flow and congestion
- Assisting motorists
- Clearing the streets for other services
- Performing minor maintenance and computer repairs
- Working special events
- Delivering customer service

By identifying these role contributions we begin to see that our front-line employees do much more than write tickets or collect money. There is greater value to these positions than is often credited by managers. Yet how can they perform their roles well, if no one has acknowledged all they do, as well as the importance of their role to the organization?

Do your employees know that what they say and do affects other employees within the department? Do they know the mission statement of the department and what impact they have on that statement? Do they know what the department's goals are for the upcoming year?

If your customer service goals are "excellence" and you want a more "professional" staff, than these questions must be addressed with your employees. They need to know and understand the "whole picture" or vision for the department.

Customer service is heavy duty work because of the psychological energy it consumes. Day after day there is a lot of mental and emotional energy invested in working with your customers. Customer service makes heavy demands of the spirit. Each customer feels he is special, different, and deserving of your staff's best efforts.

Minimizing Negative Interactions with the Public

When looking at customer service there are some basic questions we should be concerned with. Perhaps one of the most important is "How many interactions do my employees have with the public on a daily basis?" Then, "What impression might that interaction leave with the public? Is it positive or negative?" Often we are not concerned about the positive interactions, because we rarely hear about them. It is always the negative ones that create a reaction from customers.

First, determine what those interactions are, no matter how trivial they may seem. These interactions include:

- the citation left on someone's vehicle
- the greeting the public receives from employees (i.e., how a telephone is answered)
- attention given when any employee is addressed in person
- the tone of a letter
- the maintenance of your facilities
- the cleanliness of employee uniforms
- condition of equipment and vehicles
- the appearance of administrative offices
- the cleanliness of employee's work stations

The number of interactions will be in the thousands. Then ask yourself how many of these make a positive or negative impression.

Consider the appeals person, the person in your organization that handles monthly accounts, or the person who issues permits. Perhaps that individual's desk is cluttered with paper, and you, as the customer, need to drop off your paper work. Do you feel good about leaving your paperwork with that person? Are you concerned that you, too, will end up in the paper abyss? If the answer is yes, you feel uneasy about how long the processing time may be and what your response will be. The negative impression begins! The customer came in contact with your organization, no matter how remote, and formed an opinion of quality and service.

If contact is managed well, you'll achieve a higher level of service than if it is managed poorly. However, if the customer believes a process is taking longer than it should, when you or the department contacts them, hostility may be present. Their treatment and manners towards any employee may be disrespectful, curt, or even hostile. The worst result is that they think not only that the employee is inept, but also that the entire department is inept – and they intend on telling everyone they know! It's often not the details of an experience, but the importance attached to them.

When you think in terms of your customers and what their "perception" could be, you realize how something seemingly insignificant can have a negative impact on your operation. And you would never know, because most customers don't complain to you, they just go away, complaining to others.

Think back to the number of interactions you have in a day. Negative impressions are lasting impressions. To minimize what customer service experts call "coffee stains", you need to ensure that all employees understand this concept. Your goal is to have all interactions – at least most – be positive interactions or "moments of truth". Employees should always remember to smile, even with their voices; employees need to understand the importance of picking up that paper or cup lying on the ground; replacing burned out lights in a timely manner; and replacing missing signage. And employees should *always* remember to say thank you.

Remind your front-line employees that customer service means treating people the way they like to be treated when they are the customer. When you take the initiative and act positively, you put psychological pressure on the customer to react in a positive fashion. Getting rid of negative impressions is everyone's responsibility, not just management. Management needs to remember that this applies to them and not just staff. Be part of the solution, not part of the problem. Have employees be proactive, not reactive!

Explore the Importance of Communication

Communication happens in a variety of forms. We speak, write, read, and listen. These days, we use e-mail as a preferred way of communicating with our internal and external customers. Of these four forms of communication, listening is perhaps the most important, but also seldom taught and therefore difficult. Listening to customers is everyone's business. For your front-line personnel the challenge of listening is filtering out the noise of bias and defensiveness. As managers, it is important to listen to your front-line employees to learn customers' changing needs and expectations.

Listening – to be more precise, "effective listening" – can only be accomplished by engaging your mind as well as your ears. Front-line employees are asked to listen to customers daily. Most of their conflicts arise when they do not know how to effectively listen, they take things personally by getting defensive, or they know that when they cannot resolve the issue, it is better to get the supervisor involved (rather than continue a discussion that is going nowhere).

In any business where the public is the customer, a lack of internal communication is much more damaging than most people believe. It can, and will, have long-term damaging affects on your employees' external communication. Once internal communication breaks down, or worse, does not really exist, then you are facing major personnel challenges, but customer challenges arising from your personnel as well.

Experts have said only seven percent of our communication is verbal; 38 percent comes from the tone of voice, and 55 percent through body language. Employees must understand the impact their tone and gestures have on their communications with customers.

People learn more from observation than conversation. If your management style is hands-off, minimizing interaction with front-line employees and supervisors, limiting verbal communication and staff meetings/functions – your supervisors may be employing a similar management style. If that is true, you can be guaranteed numerous complaints and problems. Your complaints and problems will be based on front-line employee attitudes created from lack of communication and interaction.

Your employees are human and cannot do their job in a vacuum. They need face-to-face contact with their supervisor and manager. They need to hear information first hand. They need to be verbally recognized for doing a job well. They need to be able to give input into the organization about what they do and how they are doing it. Remember, our business changes all the time. Policies and procedures need constant review, and who better to give input than the people who actually do the work.

The most frequent complaints from employees is that communication in their department could improve, that bosses never ask for their input regarding their jobs or changes that affect their jobs, and that they are not given any recognition for a job well done. Subsequently, they think you don't care, they don't have hope of any change, and often they don't have the courage to take any risks by thinking independently. You need to create an environment of integrity, trust, and respect to make absolutely certain that everyone is treated fairly, listened to, and respected regardless of the differences they may have with each other and their supervisors/managers.

Communication with your external customers is imperative to knowing how your organization is doing, what could be done better, what improvements they would like to see, etc. Just as you should encourage feedback from your customers, you should encourage it from your employees. They need to know how to give as well as receive feedback. Skills in fostering successful community relations practices, and increasing customer feedback are:

- Be assertive in soliciting customer feedback
- Encourage front-line employees to ask for feedback
- Address complaints face to face, whenever possible
- Treat complaints as an opportunity for growth
- Use negative feedback to improve performance, not as a punishment weapon

Reviewing your organization's communication strategies, and working to improve those strategies that may be barriers to your organization, are the beginning of a smoother functioning work environment. Complaints will eventually be reduced and you will have a more motivated, positive staff.

Determine Essential Performance Elements

Customer service excellence is achieved only when you are able to go beyond someone's expectations. As part of a service-oriented society, we need to establish performance standards of service. We need to communicate what those standards are to all employees and assess their performance by identifying opportunities for improvement.

Often the *standards* of performance impact an individual's *actual* performance and are not always in sync. Frequently managers measure performance on one thing, while expecting employees to perform to others.

For example, the average number of citations employees write per shift is a standard of performance. If everyone is measured solely on that number and are unclear of your expectations, than any employee who drops below that average is not doing their job and performing poorly. However, if your organization is striving for improved customer service and has stressed this to all employees, then is an employee who may have dropped below the average number of citations performing poorly? What if that employee has had the least amount of complaints filed, had customers praise them on their "customer service skills" and their professional manner, and is viewed by others in the organization as a team player? Is that measuring up to your performance standards, or not?

Managers must remember that emotions have a great effect on performance. How well do people perform when they are anxious, frustrated, fearful, or angry? My observation is they do not perform well. Many organizations are recognizing that what worked yesterday as a performance measurement does not necessarily work today.

Involve your employees in setting achievable standards of performance. Ensure they know and understand that their performance will be assessed against those performance elements, but also by their identifying opportunities for improvement during a review process. Encourage them to stretch their knowledge and skills, to raise the bar higher. Create an environment where mediocre work is not acceptable. Make sure you earn the right to hold others to high standards by meeting them yourself.

Conclusion

All organizations need to create an environment of integrity, trust, and respect. This atmosphere helps to ensure that that everyone is treated fairly. Employees need to make a personal commitment to engage in positive community relations practices supporting the department's parking management philosophy and community relations efforts.

An investment in customer service training creates a more "focused" and capable workforce with clear role expectations, a greater sense of purpose, and the tools they need to deal with the public. If supported by sound supervisory and management practices, this training should result in enhanced morale and self-esteem for front-line employees and better community relations, as evidenced by fewer conflicts and complaints.

Truly developed employees are major assets to an organization. Those employees will value their jobs; will come to work on a daily basis, demonstrating enthusiasm and a positive attitude to give a full day's work for a full day's pay. The commitment they have for their jobs will be clearly evident in job performance and attendance.

A great leader will say, when asked how their company flourishes and continuously provides customer excellence: "It is a team effort, everyone has been given the tools to succeed, and they enjoy what they do."

SHUTTLE BUS OPERATION

Richard T. Klatt, P.E.

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Introduction

Ideally, parking should be located near one's destination, but in many situations this is not practical, desirable, and/or economically feasible. Remote parking may provide the solution. Remote parking can create a need for some form of transportation to move people from their parking location to their destination. Many institutions, airports, hospitals, colleges, entertainment venues, etc. now provide a shuttle system. Those shuttle systems may consist of trains, light and heavy rail, moving sidewalks, personal rapid transit, etc. However, the majority of vehicles used consist of van/bus type of vehicles that operate on public or private roadways. Many parking operators are contemplating starting or upgrading a shuttle bus system. They, along with their consultants, need basic shuttle bus information. This chapter on shuttle bus operation focuses primarily on a shuttle bus operation that provides remote parking facilities to supplement other close proximity parking for colleges, airports, and office complexes. It is not directed at special event remote parking, though many of the principals presented here are applicable for special events.

Definition of Terms

Alighting – Passengers exiting the shuttle vehicle.

Average Vehicle Speed – Total route length divided by the time to complete the route expressed in miles per hour. Includes time for passengers to board and to alight the shuttle vehicles as well as dwell time.

Boarding – Passengers entering the shuttle vehicle.

Commercial Drivers License (CDL) – A state-issued license authorizing its legal holder to drive a certain class of commercial vehicle, motor vehicle, or vehicles.

Dwell Time – The time a shuttle vehicle is physically present at one route location. The dwell time provides for driver breaks, route schedule adjustments, and boarding and alighting time.

Headway – The time (usually in minutes) between two successive shuttle vehicles as they pass a fixed point on the roadway in the same direction. If a shuttle vehicle is fully occupied and cannot be boarded, this is usually considered to be the average length of time that a pedestrian must wait for the next shuttle vehicle.

Independent Variable – A physical measurable, or predictable unit describing the route, vehicle size or passenger demand that can be used to predict the value of the dependent variables such as annual cost, number of vehicles required, etc. Some examples of independent variables used in this chapter are shuttle bus capacity, route length, and desired headway.

Minibus – Vehicle up to 25 ft. long, propelled by an gasoline or diesel engine, with a capacity of more than 15 persons.

Park-and-Ride Lot – A remote parking facility not located in close proximity to their destination (greater than 1.5 miles) that may be located a number of miles away. Typically located in an area where the origin of the parkers live or would pass-by on their way to their destination. These lots may or may not be served by a transit vehicle.

Shuttle Bus Lot – A remote parking facility located on-site or in close proximity to the site (within 1.5 miles) where patrons park and then are transported to their final destination via a shuttle bus.

Shuttle Vehicle – Any vehicle used for the purpose of transporting passengers from their parking location to their destination, including vans, minibuses, and transit buses.

Transit Bus – Vehicle more than 25 ft. long (40 ft. is a typical dimension), usually propelled by a diesel engine. It is designed for frequent-stop service with front and center doors. This is the type of bus most often used by municipally-owned and operated bus systems.

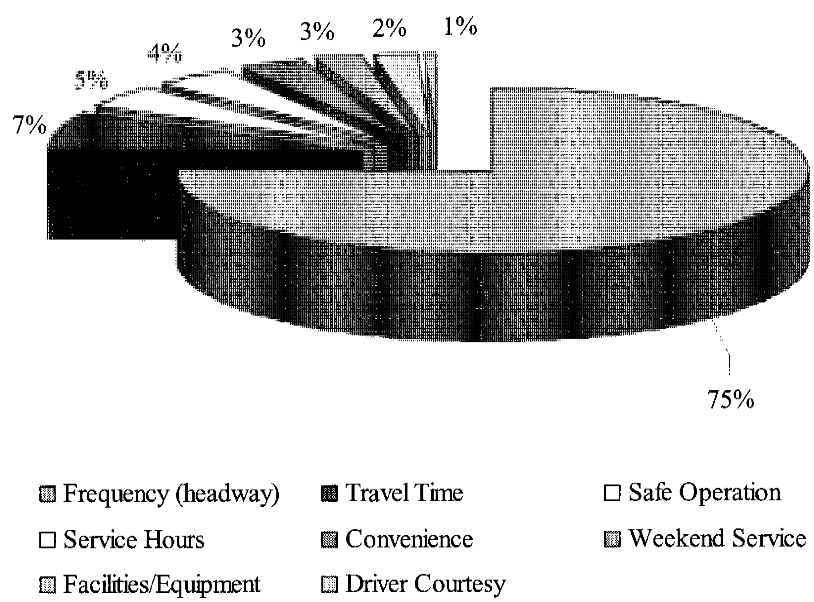
Van – passenger vehicle or an automobile or light-truck chassis, propelled by a gasoline or diesel engine, with a capacity for six to 15 persons.

Measurements of Service

The two basic measurements of service for shuttle bus riders are: how long do I have to wait for a shuttle bus and how long (time) is the shuttle bus trip going to take? The time waiting for a shuttle bus is a function of the headway, and the ability of the shuttle system to maintain that headway (schedule). The trip time is dependent upon the length of the route, number of stops and prevailing traffic conditions. It appears that from the users' perspective, the more important of these two measurements are the time waiting for the shuttle bus.

The Student Government at the University of Texas at Austin (UT) conducted a General Shuttle Bus Survey. One of the questions asked respondents (mainly students) was to rank a set of eight criteria, which included frequency (headway) and travel time. Overwhelmingly, 75% of the respondents chose frequency with travel time being a distant (seven percent) second. Their response is illustrated in Figure 1.

Figure 1: Shuttle Performance Criteria



Obviously, from the perspective of UT students, the time waiting for a shuttle bus is very important. The question then becomes what is an acceptable headway? Table 1 presents suggested shuttle-bus headways from personal experience of the author.

Table 1: Desirable and Maximum Headways

Time Period	Headway (minutes) Desirable	Maximum
Peak Periods (1)	5	15
Non-Peak Hours (2)	10	30
After Hours (3)	15	30

(1) Morning and evening peak hours

(2) Mid-Day

(3) After evening peak hours

The peak hours will vary by the type of institution. Hospitals may experience morning and evening peak hours prior to the typical peak hour of the street, due to the large portion of its employees working a 7:00 a.m. to 3:30 p.m. shift. University students will more likely have their morning peak hour after the typical peak hour of the street, and their evening peak hour before the evening hour of the street due to class scheduling. Parking facility entry/exit data needs to be collected as part of a bus-shuttle planning study. Parking facility entry/exit characteristics are discussed under Shuttle Demand.

Selecting the shuttle-bus headways is very important when planning for a shuttle-bus system. Headways should not just happen randomly but need to be designed for and maintained as part of the scheduling for the shuttle bus system. It is electronically feasible to provide a real-time active sign that would indicate, "next shuttle bus will arrive in "x" minutes". NextBus Information Systems, Inc. and BBN each provide a system that tracks bus locations. An electronic network of signs tells passengers exactly when a bus will arrive, down to the minute. Such a system is installed in San Francisco and in the process of being installed at the University of South Florida, Tampa.

Vehicles

A variety of vehicles are now in use as shuttle-buses including conventional vans with a capacity of up to 14 passengers, to city transit vehicles that can hold up to 90 passengers with standees. A conventional van with sliding passenger doors has some limitations as a short haul shuttle-bus vehicle for several reasons:

- Conventional vans are difficult and time consuming to board and alight.
- Conventional vans are not convenient for passengers carrying objects such as luggage, school supplies, etc.

Conventional vans used as shuttle-bus vehicles could be appropriate for longer haul shuttles, such as hotel shuttles, where the driver needs to exit the vehicle to assist passengers with their luggage.

Conventional vans are sometimes used because the driver typically does not need a commercial driver's license, and therefore commands a lower hourly wage, representing a cost savings to the owner. It is desirable, however, to use more highly trained drivers with a commercial driver's license

The typical capacities for shuttle-bus vehicles, vans, minibuses, and transit buses are shown in Table 2. Capacities vary from 6 to 90 passengers. The costs of shuttle buses can vary considerably from $20,000 to over $400,000, as shown in Table 2.

Table 2: Characteristics of Typical Shuttle-Bus Vehicles

	Typical Capacity (1)					
Type of Vehicle	Length (ft)	Width (ft)	Seats	Standees (2)	Total	Price
Minivan	13-16	6.0-6.6	6	0	6	$20-30,000
Full-Size Van	18.7	6.6	7-14	0	7-14	$25-35,000
Minibus	18-30	6.5-8.0	15-29	0-15	15-44	$35-65,000
School Bus	34-40	8.0	65-83	0	65-83	$80-100,000
Transit Bus (high floor)	29	8.0-8.5	35	19-25	54-60	
	35	8.0-8.5	39	25-33	64-72	$100-150,000
	40	8.0-8.6	43	32-47	75-90	
Transit Bus (low floor)	29	8.0-8.5	30	19-25	49-55	
	35	8.0-8.5	34	25-33	59-67	$200-420,000
	40	8.0-8.6	38	32-47	70-85	

Notes: (1) In any transit vehicle the total capacity can be increased by removing seats and making more standing room available, or vice-versa.
(2) Higher figures denote crush capacity; lower figures, schedule-design capacity.

Source: Institute of Transportation Engineers, *Transportation Planning Handbook, 2nd Edition*, 1999, & cars.com

(In Table 2, listed capacities exclude the driver of the vehicle.)

School buses are also used as shuttle-buses and these are typically 34 and 40 feet in length and carry 65 and 83 passengers, respectively.

Wheelchair Access

With the passage of the Americans with Disabilities Act (ADA), all transit vehicles in the United States require wheelchair accessibility. This is provided in various ways:

- For buses, the vehicles are high-level and the platforms are low-level, and special devices are needed to lift the wheelchair patron from the sidewalk or platform to the floor of the vehicle.
- Modern bus operations are increasingly moving toward low-floor vehicles that obviate the need for a lift or special platform.

In the case of minibuses, if Federal funding is involved, these also have to be wheelchair accessible. If not Federally funded, minibuses do not have to be wheelchair accessible.

Gasoline vs. Diesel

Most transit buses have diesel engines. Minibus engines can either be gasoline or diesel. In the total upfront cost of the vehicle, a diesel engine is more expensive than a gasoline engine, however, the cost difference of these engine types is typically less than five percent. A diesel gets better gas mileage and will last longer, thus the life cycle cost is typically less. Diesel engines used to be difficult to start, especially in cold weather, but that problem has been overcome. The only good application for a gasoline-powered vehicle would be for a vehicle that was used infrequently and therefore not subject to a lot of daily wear and tear. An example might be a gasoline-powered mini or full-size van that is used one to two days per week by a church or civic organization. For a daily shuttle-bus application, diesel engines are recommended.

Due to air quality concerns, increasing numbers of North American transit operators are moving toward the use of alternative fuel buses (e.g., compressed natural gas, liquefied natural gas). Other emerging technologies include zero-emission fuel cell buses that convert hydrogen into electricity without combustion and without pollutants (demonstration initiated in Chicago in 1997). Also, ethanol-powered buses have been tested in Peoria, Illinois, while West Covina, California has plans to deploy hybrid buses that use natural gas engines to generate electricity for an electric motor[1].

Operating Costs

The annual operating costs for a shuttle system includes labor, vehicle maintenance, fuel, oil, etc., annualized capital costs, and administration costs. The total annual cost should be divided by the total vehicle hours for the year to arrive at an hourly cost. Hourly costs can range from $20.00 to over $60.00 per hour. For planning purposes, the following hourly schedule is suggested:

Vehicle Type	Hourly Rate
Minivan	$20.00
Full-size Van	$30.00
Minibus	$40.00
Transit Bus	$55.00

[1] Institute of Transportation Engineers, *Transportation Planning Handbook, 2nd Edition, 1999*, pp. 449.

The best sources for local hourly cost data are the local transit company and/or private bus companies.

Shuttle-Bus Demand

As stated previously in this chapter, ideally parking should be located near one's destination, however, this may not be practical. Therefore, parking may be located some distance from the final destination. Estimating shuttle-bus demand can be both an art and science. The trial and error method of estimating shuttle-bus demand should not be acceptable, given the capital resources that are typically at stake. Ideally, a shuttle bus system can be effectively designed so that it needs only minor tweaking during the initial implementation process. A number of independent variables need to be determined, measured or estimated before a shuttle-bus route can be planned. Those independent variables include:

- Shuttle-bus capacity
- Route length
- Average vehicle speed
- Headway
- Shuttle-bus cost per hour
- Passenger peak hour
- Peak hour ridership factor (PHRF)
- Vehicle occupancy

Shuttle Bus Capacity

This would be an independent variable, if the type and size of vehicle has been selected or there is already an existing fleet. Or, the shuttle bus capacity could be a dependent variable, if the size of vehicle needs to be selected to meet passenger volume demands and/or a desired headway.

Route Length

The total length in feet or miles of one complete route (circuit).

Average Vehicle Speed

An existing system's average vehicle speed can be measured by boarding a vehicle and timing a number of runs to arrive at an average. The timing needs to take into account prevailing traffic conditions, time for vehicle stops, and dwell time. If there is not an existing system, potential routes can be driven and timed, again allowing for stops and dwell time. It is desirable to have shuttle-buses adhere to a schedule; therefore, the average speed should be estimated conservatively.

Headway

Headway, as discussed above, should be an independent variable, i.e., design criteria set in advance.

Shuttle Bus Cost per Hour

Total cost including labor, fuel, maintenance, and capital costs. For out-sourcing, potential providers should be contacted and asked to provide their hourly rates.

Passenger Peak Hour

The shuttle-bus system should be designed to handle the peak hour demand adjusted by the Peak Hour Ridership Factor (PHRF). How do you determine the passenger peak hour? Assuming that the shuttle-bus system is serving a definable parking capacity, estimated arrival/departure characteristics can be applied to the number of parking spaces. The best way to determine arrival/departure characteristics is to conduct a traffic count at an existing parking facility that will have similar arrival/departure characteristics as the proposed facility. An example would be to study an existing university commuter student parking facility to project arrival/departure characteristics to be used at a remote commuter student parking facility. The peak morning and evening arrival/departure characteristics are determined as a percentage of the peak occupancy. Arrival and departure characteristics can vary considerably for different user groups, thus it is very important to use or collect traffic data from a similar user group. An example of potential variation of arrival/departure data for two different university user groups is presented in Figures 2 and 3 for faculty staff and commuter students at Illinois State University (ISU).

These two figures illustrate the need to know the entry/exit characteristics of the proposed remote shuttle lot. At ISU, the peak faculty/staff arrival is between 7:00 and 8:00 a.m., when 40% of vehicles arrive; while the commuter student's peak arrival is between 9:00 and 10:00 a.m., but only 23% of the vehicles arrive during this hour.

Figure 2: Arrival and Departure Times – Faculty/Staff

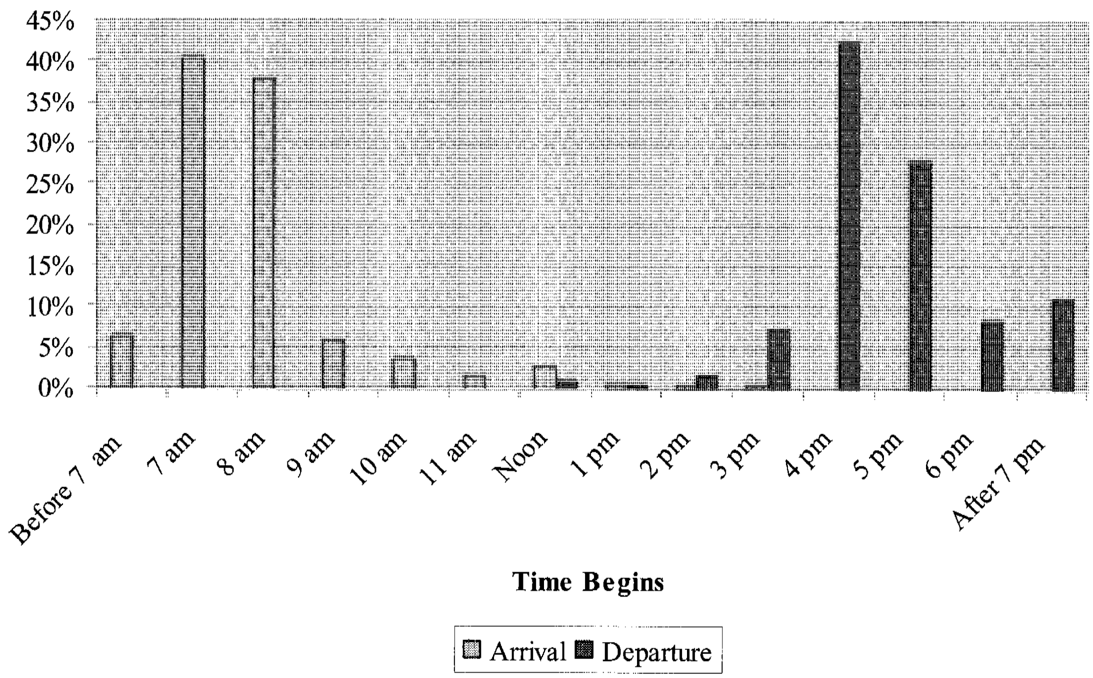
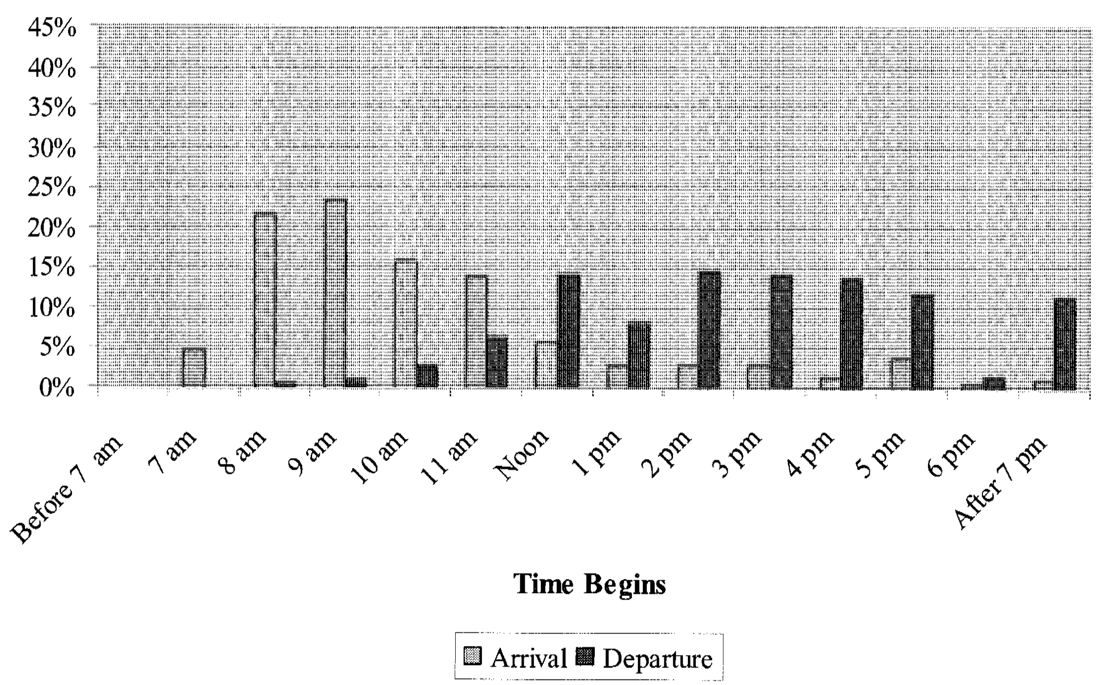


Figure 3: Arrival and Departure Times – Commuter Students



Peak Hour Ridership Factor (PHRF)

This is similar to the peak hour factor for traffic volumes. PHRF is defined as the peak hourly passenger volume divided by the peak 15-minute passenger volume rate within the peak hour; a measure of passenger demand fluctuation within the peak hour.

$$\text{PHRF} = \frac{\text{peak hourly passenger volume}}{4 \times \text{peak 15-minute passenger volume}}$$

The peak hour ridership factor is always less than 1.0 and should be measured in the field.

Vehicle Occupancy

Each vehicle arrival equates to something greater than one shuttle bus rider and can vary considerably. Sporting events can be as high as 3.0 persons per vehicle, while employees and students have rather low vehicle occupancy in the range of 1.1 to 1.5 persons per vehicle. 1990 vehicle occupancy rates derived from household travel surveys[2] yielded the following vehicle occupancy rates:

Trip Purpose	Vehicle Occupancy
Home-Based Work	1.095
Home-Based College	1.164
Total Trips (includes recreational and shopping trips)	1.299

A good local source for average vehicle occupancies is the local metropolitan planning organization.

To test different shuttle-bus scenarios quickly, a spreadsheet shuttle bus model should be developed. An example is shown in Table 3.

[2] Metropolitan Transportation Commission, Oakland, CA, "Travel Forecasting Assumptions '98 Summary", August 1998.

Table 3: Example Shuttle Bus Model

Time From	Time To	R'dtrip Travel Time (max.) min.	Shuttle Bus Capacity Passengers	Round Trips/ hour/ Bus	Shuttle Buses R'qd. for 10 minute Headway	Actual Average Headway min.	Hourly Ridership Capacity with 0.9 PHRF
7:00 AM	8:00 AM	17.0	25	3.5	2	8.6	158
8:00 AM	9:00 AM	17.0	25	3.5	2	8.6	158
9:00 AM	10:00 AM	17.0	25	3.5	2	8.6	158
10:00 AM	11:00 AM	17.0	25	3.5	2	8.6	158
11:00 AM	12:00 PM	17.0	25	3.5	2	8.6	158
12:00 PM	1:00 PM	17.0	25	3.5	2	8.6	158
1:00 PM	2:00 PM	17.0	25	3.5	2	8.6	158
2:00 PM	3:00 PM	17.0	25	3.5	2	8.6	158
3:00 PM	4:00 PM	17.0	25	3.5	2	8.6	158
4:00 PM	5:00 PM	17.0	25	3.5	2	8.6	158
5:00 PM	6:00 PM	17.0	25	3.5	2	8.6	158
6:00 PM	7:00 PM	17.0	25	3.5	2	8.6	158
7:00 PM	8:00 PM	17.0	25	3.5	2	8.6	158
8:00 PM	9:00 PM	17.0	25	3.5	2	8.6	158
9:00 PM	10:00 PM	17.0	25	3.5	2	8.6	158

Input Data (2):

Shuttle-Bus Capacity =	**25**	passengers
Route Length =	**15,000**	feet 2.8 miles
Average Vehicle Speed for Route =	**10**	mph
Required Headway =	**10**	minutes
Peak Hour Ridership Factor (PHRF) =	**0.9**	
Shuttle-Bus Cost =	**$40**	/hour
Passenger Peak Hour =	**150**	passengers
Number of Days of Operation (1)	**250**	/year

Results:

Vehicle capacity Requirements =	167	passengers
Round Trip Travel Time =	17.0	minutes
Shuttle Buses Required for a 10 min. Headway =	2	
Daily Cost =	$1,200	
Yearly Cost for 250 days of Operation	$300,000	

Notes: (1) Example assumed to be a University
(2) Independent variables shown in bold

Source: Walker Parking Consultants

In the example presented above, the independent variables were:

- Shuttle bus capacity
- Route length
- Average vehicle speed
- Headway
- Peak ridership factor
- Hourly shuttle bus cost
- Passenger peak hour
- Number of days of operation per year (250 days account for no service during holidays and semester and summer breaks, but seven day service at other times)
- Hours of operation per day (7:00 am to 10:00 pm)

The model then calculated the following:

- Two 25-passenger shuttle bus vehicles required to maintain a maximum headway of 10 minutes
- Actual headway of 8.6 minutes
- Each vehicle makes 3.5 circuits per hour (schedule could then be determined)
- Hourly ridership capacity of 158 passengers
- Daily cost of $1,200
- Yearly cost of $300,000

In-House vs. Out-Sourcing

In this section we will discuss the advantages and disadvantages of self-operation and a service contract agreement.

An institution's prime mission is to provide a primary service and ensure that adequate support services are provided. To meet this end, an institution's responsibility is to provide adequate infrastructure for these necessary support services. Among these support services could be the management and operation of the shuttle system. As minimum, an institution could be involved in the following basic elements relating to shuttle system management.

- Determination of policies
- Determination of service, operation and management standards, and criteria
- Enforcement; monitoring and evaluation of directives; and standards, rules and regulations relating to the provision of quality transportation
- Oversight of expenditures (if under self-operation)

If an institution elects to self-operate a shuttle bus system, in addition to the above elements, it must also perform operational responsibilities. If an institution elects not to self-operate, a professional shuttle bus operator would perform operational responsibilities.

Self-Operation of The Shuttle System

Self-operation is generally an appropriate action when providing a shuttle system is the prime mission of an agency or institution. A regional transit system is an example of an agency, which has the prime mission of managing transportation resources. When shuttle bus operations are not the prime mission of an institution, but rather, a support service, the self-operation alternative may be less desirable because it creates a disproportionately large commitment to a single element of the institution's overall focus and mission.

Table 4 portrays the advantages and disadvantages of self-operation versus outsourcing under a service contract.

Table 4: Self-Operation Vs. Service Contract

Self-Operation

Advantages:
- Highest level of control
- Most flexible in resource allocation
- Low turnover in personnel

Disadvantages:
- Most administrative time for institution
- Highest personnel costs
- Less focus on the prime mission of the institution
- Risk to administration

Service Contract

Advantages:
- Minimal institutional involvement
- Guaranteed maximum fee
- Less risk for the institution
- More time to focus on the institution's prime mission

Disadvantages:
- Less control by the institution
- Agreement must be extremely specific
- Operator is tempted to operate too lean

Management by a Service Contract Agreement – Under a service contract type agreement, the concessionaire provides all of the necessary labor and services for the operation of the shuttle bus system in return for a mutually agreed upon level of compensation. Although the rate of compensation may vary, it is usually based on the total hours of operation, ridership characteristics and headway requirements.

Advantages of Professional Shuttle Services – Professional shuttle service operators have distinct advantages over self-operation. One advantage is that the cost per employee is less. This includes both base wages and benefits. Also, due to the large labor pool available to them, fewer employee hours are incurred due to their increased ability to supply personnel for partial shifts.

Since a professional shuttle operator's sole function is to provide this service, the size and consistency of their shuttle fleet also supports economies of scale. For example, professional shuttle operators have dedicated staff for the purpose of maintaining their fleet. Additionally, due to the consistent use of their equipment, a spare parts inventory is needed for a limited number of makes and models.

Much like the car rental industry, which disposes of vehicles with fewer odometer miles than the private car owner to avoid the exposure to major repairs, the professional shuttle bus operator is more likely to retire shuttles earlier than those who self-operate their fleet. This reduces the average age of vehicles in service. Also, since shuttle operators often purchase large volumes of shuttle buses, they can typically procure vehicles at lower prices.

Administrative Responsibilities With Outsourcing – One should not be lulled into the belief that the procurement of a shuttle bus service contract places transportation concerns "out-of-sight, out-of-mind." A transportation service contract does address certain issues well. It absolves the institution of the responsibility to operate the transportation system. However, it does not absolve the institution of the need to direct and oversee compliance with the contract. Therefore, in addition to a professional shuttle operator, we recommend that the institution electing to outsource a shuttle service should assign the responsibility of overseeing the shuttle contract to an individual who is experienced with contract compliance and familiar with transportation issues. This individual should have the responsibility to field legitimate transportation complaints and concerns, determine reasonable courses of action to abate the concerns, and coordinate with the professional shuttle operator to implement necessary changes and/or solutions.

If an institution elects to out-source its shuttle systems, it may be more desirable to operate its shuttle system by out-sourcing it through a service contract agreement. A service contract agreement rather than a management agreement is desirable. The administrative responsibility would be to monitor the concessionaire's adherence to established service criteria. Under a management agreement, repairs to shuttle buses are typically a reimbursable expense. Therefore, there may be insufficient motivation to provide proper care of vehicles without proper monitoring. Additionally, under a management contract, the institution must monitor expenses incurred by the operator.

Procurement of an Out-Source Shuttle Bus Contract

The institution may or may not be subject to governmental guidelines and regulations, which govern the procurement of contracts. Under public procurement, professional shuttle bus operators, which are qualified on paper, yet not qualified by reputation, are permitted to participate in a competitive bid process. A private institution has the ability to either select bid participants, or to enter into direct negotiations with a single concern. For either a public or private institution to be successful, it is imperative to:

- Check references and other qualifications.
- Verify that the professional shuttle operator has experience with other similar operations.
- Verify that the professional shuttle operator is financially sound.
- Set specific performance criteria.

Proposals should include the following elements for review.

- *Company Description* – It should be the responsibility of the professional shuttle operator to provide a description of the complete team, i.e. company, franchise, owner, operator and financial source. The legal form of organization should be specified.

- *Company References* – Professional resumes should be presented for each team member. Of specific interest is the resume(s) of the on-site shuttle supervisor(s)/manager(s). Resumes should include experience relevant to the proposed operation and management of the shuttle system, as well as operation/management of similar projects.

- *Organizational Chart* – The proposed should be required to present an organizational chart, indicating who would be responsible for each component of the management of the shuttle bus operation. The institution should require that a project manager be designated who would take the lead role in communicating with the institution and coordinating contract negotiations.

- *Financial Data and Requirements* – The institution should require a financial statement for the entity of record or ownership. The financial statements should be considered totally confidential and treated as such. In addition to the already mentioned financial reporting requirements, the institution should require the professional shuttle operator to provide:

    - A list of total outstanding loans as of the date the proposal is submitted.
    - A statement indicating if any surety or bonding company has been required due to the operator's default and a description as such.
    - A statement indicating detailed information of any pending litigation, liens, or claims involving any firm's member that could impact the decision of the institution. The institution should require a certified check, cashier's check, or bid bond payable to the institution in the amount of five thousand dollars ($5,000) to serve as security that if the proposed is selected, the contract will be entered into and performed as negotiated. The institution should not pay interest on the deposit. In the case of failure of the proposed to enter into contract, the check or bond should be forfeited. Checks or bonds of proposing organizations that are not selected should be promptly returned after the selected proposed has been qualified and approved by the institution.
    - Project Operations and Management Program – The proposed should be required to present a summary of an implementation program for the management and operational aspects of the shuttle bus systems. The summary should, at a minimum, adequately address the following aspects of the company's proposed management and operation strategy:

        - Staffing Plan/Personnel Management

- Equipment Maintenance/Operation
- Customer/Public Relations Strategies
- Employee Training Program
- Fee Proposal

The institution should state issues of concern to the professional shuttle operator. The primary issues are as follows:

- The shuttle system must be operated with safety as a prime objective.
- The proposing company should show evidence of ongoing Driver Safety Training and Awareness program.
- Qualified, courteous, well-trained, uniformed drivers should staff the shuttle system.
- The proposing service provider should provide performance records of proposed drivers with any criminal violations and/or traffic/moving violations.
- The processional shuttle operator should be required to provide patrons with easy access to the shuttle system manager/supervisor.
- The proposing service provider should provide well defined insurance coverages in compliance with the owner's disability requirements for the period of the proposed contract.
- The professional shuttle system operator should be required to meet headway requirements established by the institution.
- The proposing service provider should identify the age and service records of vehicles proposed for useage.

Responsibilities of the Operator

The institution should require the professional shuttle operator to provide consideration and prompt response to all inquiries concerning the operation of the shuttle bus system.

The institution should require the professional shuttle bus operator to procure all licenses and permits necessary for the operation of the shuttle bus system. Additionally, the institution should require the professional shuttle bus operator to provide qualified drivers licensed to drive commercial vehicles.

Conclusions

A well planned and operated shuttle bus system can provide an acceptable parking solution when close proximity parking is not practical, desirable, and/or economically feasibility. It may also provide a temporary solution as more permanent parking solutions are constructed. An acceptable shuttle bus operation does not just simply happen, but requires careful planning and an organization committed to providing a superior shuttle bus system.

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SUCCESSFUL MANAGEMENT OF A VALET OPERATION

Richard Raskin

Richard Raskin joined Walker Parking Consultants in April 2000. He had previously worked for the Beverly Hilton Hotel in the capacity of Director of Guest Services for four years. Among his duties was the operation of the valet parking department and a 500-space self-park garage. The valet operation was responsible for hotel guest parking, as well as valet parking for over 200 major events a year. These events included The Golden Globe Awards, and the Carousel of Hope – the largest charity ball in the world. The valet department at the Beverly Hilton was consistently judged to be one of the most courteous and efficient operations in the nation. The parking department earned in excess of $2,400,000 in annual gross revenue. Richard had worked for Standard Parking as a Senior Manager from 1991 through 1997. He ran several high-profile office building parking facilities, before assuming the task of managing the valet operation, which numbered over 120 employees, at the Century Plaza Hotel in Los Angeles.

Richard's parking experience include the selection and installation of parking access and revenue control systems; auditing and maintaining cash controls; financial planning; personnel selection and training; facility maintenance; self-park, attendant-assist and valet operating environments; office, retail, hospitality and event demands; due diligence studies; operational reviews; marketing; and traffic flow planning.

Introduction

Perhaps arguably, the three greatest innovations of modern civilization are air conditioning, the computer chip, and valet parking. Historians and academics may debate the merits of the former two and offer dissenting views. But anyone who has ever driven up to a restaurant on a bitter cold evening and discovered that a well-mannered and uniformed professional will rush to their vehicle, open their door, and cheerily wish them a good evening, will go to their last days believing that the latter is truly the pinnacle of the modern world.

Parking can be broken down into basic practices. The most prevalent method is self-parking, where patrons park their own vehicles and the parking operator's responsibility is usually limited to collecting revenue and ensuring adequate lighting and service levels. Another approach, and the focus of this chapter, is valet parking.

Valet parking differs from self-parking in that the parking operator has the ultimate duty and responsibility to park and secure the patrons' vehicles. With this responsibility a variety of additional needs and tasks are required of the operator. Service and performance are judged quite differently than in self-parking, and both the operator and the parking patron have heightened expectations. There are far more risks and exposure to expense in managing a valet operation. We will explore these in the sections ahead.

When To Implement a Valet Operation

Valet operations are best employed in settings when an enhanced level of service is desired, or in parking operations in which an operator or facility owner needs to optimize use of limited or undesirable parking.

To best identify situations in which to establish a valet operation, we must first define what is meant by valet parking. True valet parking is defined by the parking patrons' use of a single drop-off and pick-up point for their vehicles. This site is referred to as the porte cochere ("pOrt-kO-'sher"), a French term describing a porch large enough for a carriage to pass through. However, in valet parking it refers both to the spot where patrons claim their vehicles, often a podium, and to the vehicle staging area in the vicinity. A porte cochere can have several lanes for both traffic and parking.

Portes cocheres are typically placed at the spot where it is most convenient for patrons both to leave their vehicle and gain access to their destination, and then, when their business has concluded, to return to claim their vehicle. In the case of a hotel or restaurant, portes cocheres are more often than not located adjacent to the front door. At hospitals, they are normally situated by the main entrance. Office buildings will sometimes offer their valet service at the foot of the visitor entrance ramp, closest to the elevators.

Valet parking is often confused with an "attendant assist" operation. Attendant assist parking is utilized in facilities where the space configuration consists of tandem parking spaces. There is no single drop off point; instead, parkers will self-park and allow the attendants access to their vehicles' keys. This enables the attendants to have the ability to move vehicles as needed to allow patrons, whose vehicles are blocked by others, to exit. This operation works best in office buildings with several floors of tandem spaces. Attendants are stationed throughout the facility, without regard to a single drop-off area. Attendant assist is recommended when there is a substantial portion of tandem spaces, as well as when there are opportunities to increase capacity by utilizing the aisles for additional parking.

The chief advantage to offering valet services is to give parking patrons an alternative to finding their own space and walking the distance from and back to that space.

Valet services are thus useful in the following situations:

- Hospitals and medical centers, in which patrons are often unable or unwilling to walk any distance.
- Hotels and resorts, so that guests can take their luggage directly into the lobby.
- Restaurants, allowing clientele to enjoy dining without the travails of searching for what may be inconvenient parking.
- Special events, such as weddings or banquets, in which attendees are usually in formal dress and a long walk from parking is tiresome and sets a poor standard.
- Where a parking facility is too dangerous for visitors to use. Land costs in downtown urban areas such as San Francisco, New York, Boston, and others do not allow for spacious, well-designed parking facilities, and so parking is often in older, inhospitable structures originally designed for other uses than parking.
- Both on and off-airport parking operations, saving frequent business travelers the time involved in hunting for available parking and then finding their way to the terminal. Upon returning, travelers can call from the arrival gate and have their vehicle waiting for them before they get out of the terminal.
- Establishments with parking that is exposed to extreme heat, rain, or snow, and that wish to avoid making their customers walk in these conditions.

Providing valet service has its disadvantages, as well. The operator has the burden of increased expenses, primarily in labor and insurance. Other factors are a higher proportion of damage claims, bona fide or not; customer dissatisfaction with wait times, pricing, or care afforded their vehicles; and the need for the operator to thoroughly manage the operation with much more detail than self parking would entail. In office building environments, valet parking is less successful when an option. This is due to the primary clientele being visitors who usually prefer self-parking because they are in the business mode, prefer not having to leave their keys and don't especially want to tip (as it is often not an expense account item).

Calculating Level of Service

Valet parking has its own levels of service that do not approximate those in the rest of the parking industry. Gone are queue times, turning bay radii, and the like. Instead, the only service level that makes a difference is the time that the patron has to wait. And each valet patron has his or her own way of gauging time; but almost invariably they estimate two minutes as ten, and five minutes as a half-hour. They also maintain that the other valet patrons, who came out after they did, got their vehicles back first.

As valet parking is more of a service than it is anything else, service levels should be built on foundations established in the service industry.

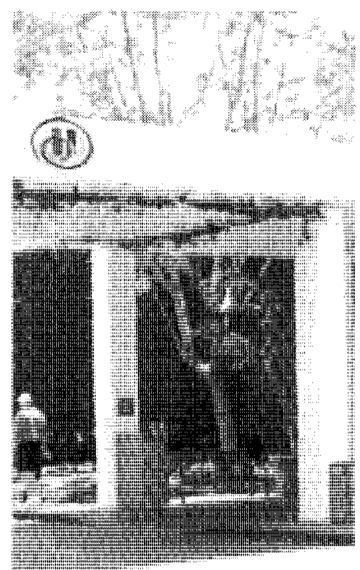
The following are ideal levels of service (LOS) for wait times when claiming vehicles:

Table 1: Valet Wait Times -- Level of Service (LOS)

LOS	Wait Time (1)
A	Less than 4 minutes
B	4 - 6 minutes
C	6 - 8 minutes
D	8 - 10 minutes
F	Exceeds 10 minutes

(1) From presentation of ticket to return of vehicle to porte cochere.

Arriving patrons, on the other hand, must not be made to wait in their vehicles for any substantial length of time before they are greeted and attended to.



A key factor in wait times, for establishing a service good level, is the distance between the porte cochere and the location of the parked vehicles. If the area where the vehicles are parked is over six minutes away, the LOS can never be better than a C. And, unfortunately, none of the valet patrons will ever be convinced that they only waited six minutes. Valet operations with remote parking areas are sometimes best operated by radio or telephone dispatch to help cut down on wait times.

In addition to enhancing service, locating parking spaces close to the porte cochere saves on labor costs, as fewer valets are required to move vehicles. (Staffing calculations will be explored in the next section.)

The better portes cocheres are large enough to hold a lot of vehicles, thus allowing peak arrival periods to be smoothed out. In addition, short-term VIP parkers can be accommodated by keeping their cars parked nearby in the porte cochere area.

Staffing Guidelines

Another key factor in maintaining service is staffing. Valet parking is labor intensive and the largest line item on any valet operation pro forma budget will be labor cost. It is thus crucial to the success of the operation that the staffing level be appropriate – too many valet attendants and the operation is a financial sinkhole; too few, and the service level is unsatisfactory.

Planning the staff size is essential. We will review how to do this, but it is also important to recognize that a valet operation has several different positions. Regardless of whether the operation is curbside at a restaurant or attending to a large banquet at a five star hotel, the set-up is the same. There should always be someone assigned to greet the arriving vehicles, open the vehicles' doors, and hand over the claim ticket to the patron. In small operations, this task can be accomplished by rotating valet attendants; in larger operations, it usually is a specific assignment and often referred to as the point or drive position. In addition, there should always be someone assigned to the porte cochere whose duty it is to meet the departing patrons and take their claim tickets. This person is responsible for beginning the vehicle retrieval process and collecting any charges associated with the valet parking. Some very large valet operations, such as those for special events, airports, or sizeable hotels, have additional positions such as checkers, who verify the locations of parked vehicles; key dispatchers, who arrange for the vehicles to be retrieved; and greeters, whose responsibilities include opening passenger doors and assisting with arriving patrons. Finally there is the position of valet attendant, whose responsibility it is to park and retrieve patrons' vehicles. This is the position that requires the greatest attention in planning and scheduling.

Scheduling valet attendants should be based on the following two factors:

- Hourly activity levels for both arriving and departing patrons, and
- Time needed to park and to retrieve vehicles.

The following is a sample operation:

1. A hotel operation averages 50 departing guests' vehicles per hour in the morning hours.
2. There are generally about 15 vehicle arrivals per hour during the same period.
3. It takes a valet 5 ½ minutes to park a vehicle and return to the porte cochere.
4. It takes 4 ¼ minutes to retrieve each vehicle and bring it to the awaiting guests.

The table below provides calculations for staffing the attendants for the morning shift at this hotel.

Table 2: Valet Attendant Staffing Calculation

Activity		Activity Time	Total Time
Arriving Vehicles	15	5.50 Minutes	82.5 Minutes
Departing Vehicles	50	4.25 Minutes	212.5 Minutes
Totals	65		295.0 Minutes

In this scenario there are almost 300 minutes of parking and retrieving vehicles per hour. Assuming that each valet attendant works 50 minutes per hour, an adequate staffing level would require six attendants. There are some variances to be aware of. Often, in busy times, valet attendants are able to reduce times and improve efficiencies by driving a recently arrived vehicle, parking it close to the spot where a claimed vehicle is already parked, and then getting into that vehicle to return to the porte cochere and to the patron. However, to be safe, and avoid understaffing and service shortfalls, it is always preferred to base calculations on the parking and retrievals necessitating valets to make one leg of the trip on foot.

Special attention needs to be paid in the hiring, training, and supervision of valet attendants. Hiring should consist of more than the cursory "Can you drive a stick?" or the hoped for possibility that the applicant can fit into the uniform of the last guy. It is strongly suggested that applicants submit proof of their driving record, available from the state. Additionally, background checks and, if permissible, drug tests, should be routinely performed. Valet applicants should be tested as to their driving abilities, and also to determine if they are physically fit to run the distances required in parking and retrieving vehicles. While it is against the law, and morally objectionable, to preclude any applicant based on physical appearance, it is important to consider the following three facts:

1. The average height of an adult American male is 5'9".
2. The average height of an adult American female is 5'4".
3. One of the most common complaints that valet patrons have is that their seat has been moved.

Ideally, a valet operation should employ a staff that rarely needs to move the seats. It is recommended that an employee handbook be created and made available to each new hire. Training is an essential component of the operation. The initial phases of the training should contain thorough explanations and examples of the following:

- Behavior – both expected and unacceptable
- Dress Code
- How to greet, address and thank customers

- Proper responses to a variety of queries
- How the parking rates are structured (if appropriate)
- How to handle an angry, belligerent or intoxicated customer
- How to handle damage claims or requests for refunds
- Attendance and on-time policy
- Job performance standards
- Emergencies
- Safety
- Filling out paperwork

Employees should be made aware that while management desires and hopes that no vehicle in their care will ever even be scratched, they recognize that the inevitable will happen. Therefore, it is crucial that the valets be comfortable enough to tell management when they have damaged a vehicle, no matter how slight and possibly unnoticeable.

Appearance codes are a necessary tool in managing a valet operation. Patrons are usually reluctant to entrust their vehicles to someone whose presentation is unkempt or unclean. Body odor, strong cologne, or on-the-job smoking leave unpleasant reminders in patrons' vehicles. Gum chewing or any type of eating on the job will cause patrons an uneasy feeling. Large rings or loose metal wristwatches can inadvertently cause scratches. Often, valets will extend a hand to assist a patron in exiting their vehicle. It is highly preferable that these hands have a manicured or cared-for appearance. Valets should be instructed that while sneezing is sometimes unavoidable, it can distress a patron to see it done in a their vehicle.

Surprisingly, something as inconsequential as tips can generate tremendous controversy within a valet operation. Typically, valet attendants earn minimum, or just above minimum, wage. Their income is vastly dependent on tips. Now there are two schools of thought concerning tipping. Many operations require their valets to pool their tips; at shifts' end, this fund is evenly divided up. The reasoning behind this is that it is believed that an equal disbursement will foster teamwork and prevent undesirable competition for the "big tippers". Other operations allow individual valets to retain their own tips, believing that this encourages superior service. Each practice can cause disputes, ranging from valets avoiding parking incoming vehicles at certain times to be there when their favorite patrons come out, to valets failing to put all of their tips into the pool. We make no recommendation here, other than that the best practice is probably to allow the operation's own members to decide on how they want tips to be handled.

Procedures

There are extra risks for a parking operator when managing a valet parking program. Each time a customer is given a claim ticket and leaves his or her keys with the valets, a bailment is created, making the operator legally responsible for the customer's vehicle.

To minimize the risks involved with this responsibility, there are several procedures that the valets should adhere to.

Whenever possible, valets should back vehicles into spaces. This practice allows retrieving valets, who are usually more rushed, to be able to look forward as they leave the parking space, which is much safer than backing out. As many vehicles are equipped with automatic locking devices, it is advisable to teach valets always to remove keys before closing the doors of the vehicle. Radio volumes should be lowered and then the radio turned off so that the retracting antennas will lower. The purpose of lowering the volume is to avoid startling customers when they turn on the radio after claiming their vehicle.

Tickets should always be filled out completely by the valet attendants. Typical tickets have blank spaces for the location of the parked vehicle, the license plate, color, make, and model. Valets are often hurried and choose to ignore some of the information, but it can be worrying for a patron to wait and wait while valets look for their vehicle, and even more disquieting to be asked, after a while, to describe their vehicle.

A claim check is handed to each patron when dropping off his or her vehicle. This claim check should have a unique, pre-printed number that corresponds to the portions of the ticket that goes with the vehicle. The claim check should have an area where the valet can note pre-existing damage. Whenever possible, each vehicle should be visibly inspected for damage while the patron is dropping it off. Damage should be noted, both verbally to the customer and on the ticket (in reality, this is rarely done). In operations where there is a great amount of activity and operational logistics preclude pre-inspection, valets should still do an inspection after they have parked the vehicle.

Upon bringing a customer's vehicle to the porte cochere, valet attendants should turn off the lights, shut off the ignition, and remove the keys. They should then wait by the vehicle with the driver's door opened. As the customer approaches the vehicle, the valet should help them into the seat, verify the claim ticket (by matching the number to the identifying number on the other portion of the ticket that was retained with the vehicle), and hand the keys to the customer. This is done so that the customer does not inadvertently turn the ignition key to an already idling vehicle, causing ignition damage.

Risk Factors to Eliminate

We previously discussed procedures to reduce the risks involved in managing a valet operation. There are also several conditions and practices that should be reviewed and considered.

As the valet operation is responsible for the vehicles in its care, hazards need to be evaluated and eliminated to make that responsibility easier. Parking facilities should be thoroughly swept daily to get rid of nails, screws, or other sharp objects that could cause a flat tire. Low pipes and exhaust ducts should be clearly marked and flagged so that valets will not hit them with their vehicles. Columns should be wrapped and ramps kept dry.

Employees should also be well advised and supervised with the aim of reducing carelessness. Valets must not use vehicles as writing surfaces. Valets should be reprimanded for excessive speed or reckless driving. And they should never move a vehicle with a door even partially open, not even for a short distance.

Unsafe vehicles should not be brought into the parking facility. If the brakes or clutch seem faulty, it is the best practice to move the vehicle to a safe parking place in the porte cochere.

Pedestrian accessways should be designed to provide minimal opportunities for pedestrians and vehicles to cross paths.[1] And valet paths for running to and from the parking facility should be planned so as not to become a hazard.

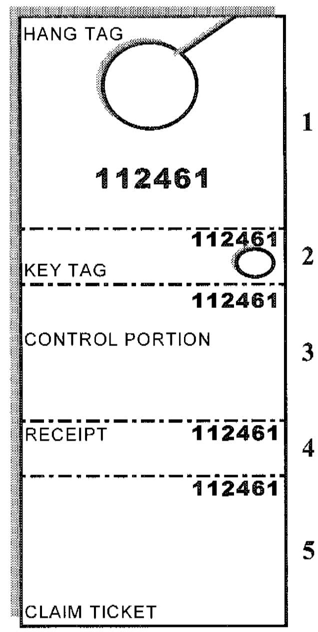
Disclaimers should be printed on the claim portion of the tickets specifying both the operator's and the vehicle owner's responsibilities.

Rigorous defense of damage claims is a must. Many valet patrons rarely look closely at their vehicle until after a valet attendant has driven it. And that's when they first notice what may well be pre-existing damage. Popular culture, particularly movies and television, has conditioned society to associate valet parking with all sorts of misfortune, from glove compartments being rifled to vehicles being taken on joy rides. The public's perception of valet parking is a difficult one to overcome and it, at times, is the source of mistrust and claims. While managing a valet operation at a major Los Angeles hotel, I was confronted by a patron who was livid that her vehicle had been driven by my valets while she was in the hotel. She had apparently recorded her mileage when she had arrived and, according to her calculations, an additional 350 miles were now on her odometer. I was very disappointed with the behavior of my staff until I learned that she had only arrived at the hotel about an hour and an half before. Unfortunately, no amount of explaining and summarizing of the laws of motion and time could convince her that nothing had happened.

[1] There is a hotel in Los Angeles that had a pedestrian walkway that cut across the lanes valets took to park the vehicles. On one rainy November evening, a valet was not able to stop quickly enough to avoid hitting one of the guests. The guest was struck by his own vehicle.

Supplies

A valet operation should be set up with the following supplies:



- *Podium* – A tasteful looking podium with a self-locking cabinet and drawer should be positioned at the porte cochere. The look should reflect the type of property the valet operation is serving, i.e., elegant for a hotel, modern and utilitarian for an office building.
- *Five-part tickets* – The drawing at right represents a typical five-part ticket used in most valet operations. Each section is identically numbered and the bottom part (5) is separated from the ticket and handed to the valet patron to serve as their claim ticket. The valet attendant takes the entire ticket with the vehicle and parks. The top portion (1) is separated and hung from the mirror, numbered side facing out. The key tag portion (2) is secured to the vehicle's key ring. The control portion (3) is filled out with the vehicle description, the location that it is parked in, and any damage is noted. The control portion and receipt (4) are then brought, still attached, to the porte cochere. Upon claiming a vehicle and after paying any fees, the receipt (4) is separated and handed to the customer. The claim ticket (5) and control portion (3) are stapled together and retained at the porte cochere. The valet who has retrieved the vehicle must verify that the hang-tag (1) matches the receipt (4) that the customer has.
- *Uniforms* – Valet uniforms need to be professional in appearance but comfortable. Avoid fancy coats and hats as these can interfere with a valet's ability to easily get in and out of vehicles. It is recommended that the uniform have few, or preferably no, pockets. Every valet manager can, unfortunately, tell the same story about the one time their best valet left early, with keys belonging to a VIP unknowingly in one of his pockets. There is never a happy ending.
- *Pens* – It can be surprising how such a minor thing as the type of pen used can save so much time. But in valet operations, when speed and efficiency are so important, a pen with a click top is the best. Valets can actually use one hand to activate their pen and fill out tickets. Pens that twist to open or have removable caps can be nuisances.
- *Emergency equipment* – Invest in jacks and vehicle trolleys, tire pumps, and air compressors, oil absorbent, and fire extinguishers. Have the numbers of several qualified locksmiths available.

Preparing for Large Events

A true test of any valet operation lies in the handling of a large event. Hotels and special event venues often have occasions in which hundreds and perhaps, thousands of attendees are invited and anticipated to show up. Valet staffing for these events is accomplished in the same fashion as explained earlier. Assumptions for the number of vehicles to expect are based on the following:

1. Average vehicle occupancy is 2 ¼ persons.
2. In venues where there is convenient, and more economical, self-parking, expect that 45% of the attendees will choose valet parking.
3. In venues where there is convenient, but similarly priced, self-parking, expect that 65% of the attendees will choose valet parking.

The table below provides a summary of the quantities of vehicles to expect for events and the breakdown by valet and self-parking.

Table 3: Parking Breakdown for Events

		Valet at a Premium		Identical Pricing	
Attendees	Vehicles	Valet Vehicles	Self-Park Vehicles	Valet Vehicles	Self-Park Vehicles
2,000	941	424	518	612	329
1,500	706	318	388	459	247
1,000	471	212	259	306	165
750	353	159	194	229	124
500	235	106	129	153	82
400	188	85	104	122	66
300	141	64	78	92	49
200	94	42	52	61	33
100	47	21	26	31	16

The above demonstrates that there can be a significant quantity of valet vehicles generated by an event of some size. Invariably, large events, such as weddings and banquets, have receptions, or arrival times, of one hour or less. This can place an enormous burden on the valet staff as over 500 vehicles arrive at the porte cochere in less than 60 minutes. In cases such as these it is advisable to augment the operation by providing shuttle vans to quickly return valet attendants to the porte cochere and to provide radio communication at several key points to facilitate the parking process.

As an exercise, we will plan, staff and manage a large event (on paper). Let's use the same hotel as in the previous section on Staffing Guidelines and we'll stage a 2,000-attendee banquet in which the cost for valet parking will be $10 higher than self-parking. Additionally, there will be a 45-minute reception for this event.

Table 3, above, provides us with an expected 424 vehicles to be valet parked. The following table details our needed staffing, using the same guidelines as discussed earlier, with the exception of the time it takes to park the vehicles. The time is reduced to 3 ½ minutes per vehicle because we'll be using shuttles to pick up and bring back the valet attendants.

Table 4: Parking Time Requirements for 2,000-Attendee Event

Activity		Activity Time	Total Time
Arriving Vehicles	424	3.50 Minutes (1)	1,484.0 Minutes
Departing Vehicles	50	4.25 Minutes	212.5 Minutes
Totals	474		1,696.5 Minutes

(1) Reduced parking time as a result of shuttles being utilized to ferry valet attendants.

In our exercise, there are only 45 minutes to handle the arrival of the attendees, so we will have to divide the 1,697 minutes needed by the 45 minutes available, resulting in a valet staff of 38 attendants. In addition to the parking staff, we will need a minimum of three shuttles and drivers, a point or drive person to pass out tickets and direct incoming traffic, two supervisors (one on the front drive and one at the parking location), and two other attendants to handle the sorting of the tickets and keys. Thus, an event of this size will require a staff of 46 to effectively conduct this process.

As mentioned earlier, there are advantages to having the location where the vehicles are parked as close as possible to the porte cochere. In our example, every additional minute required to park a vehicle, and the additional time adds up the farther away the parking area is, would require an additional nine or more attendants to handle this event.

Figure 1 provides a layout of how to stage for a large event. In our example, the porte cochere has three lanes. As vehicles arrive, the drive, or point person, directs them down lanes 2 and then 3, where valets are stationed to stop the vehicles, open doors and greet the attendees. Lane 1 is considered a drive lane and it, or either of the other two, must be kept clear at all times. If necessary, arriving vehicles should be held up until a lane can be cleared for them. Blocking all three lanes is a fire and safety violation, as well as an operational failure. The attendants are lined up in one lane as the vehicles arrive and move to take the arriving vehicles to the parking facility and then return to the back of the line.

Figure 1: Staging for a Large Event

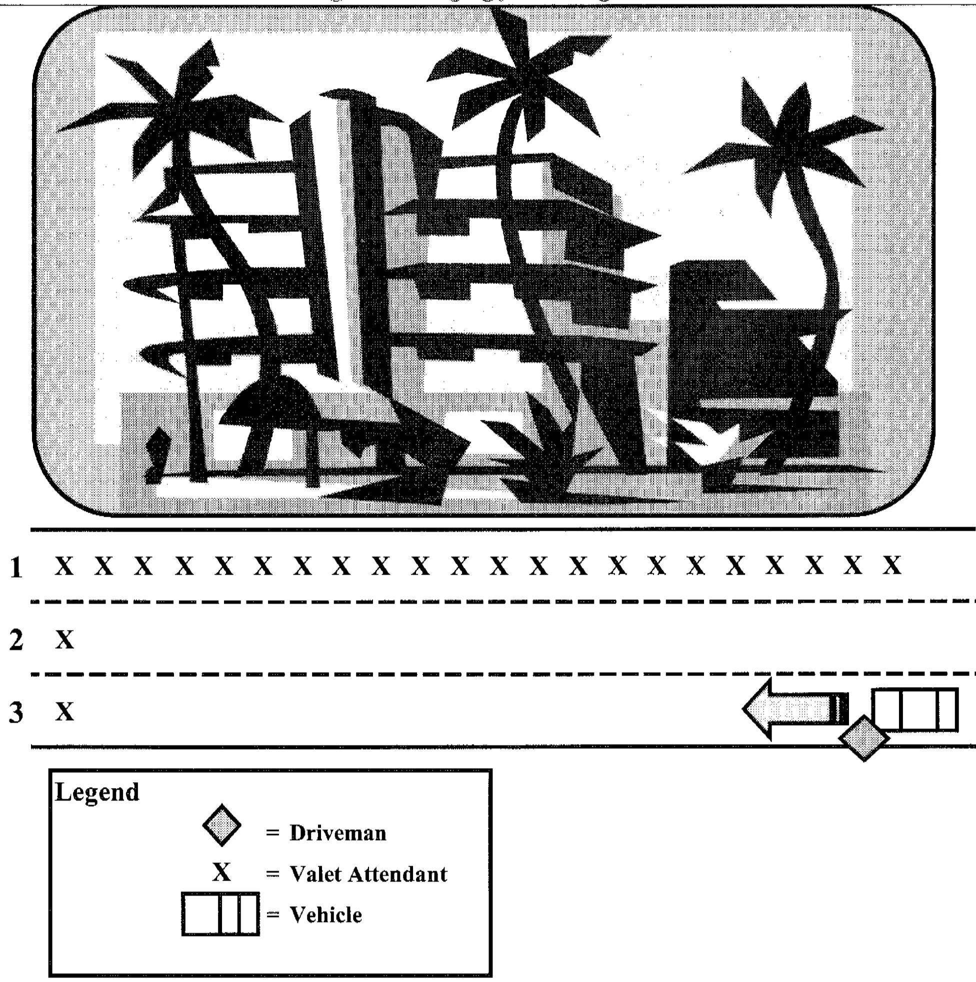
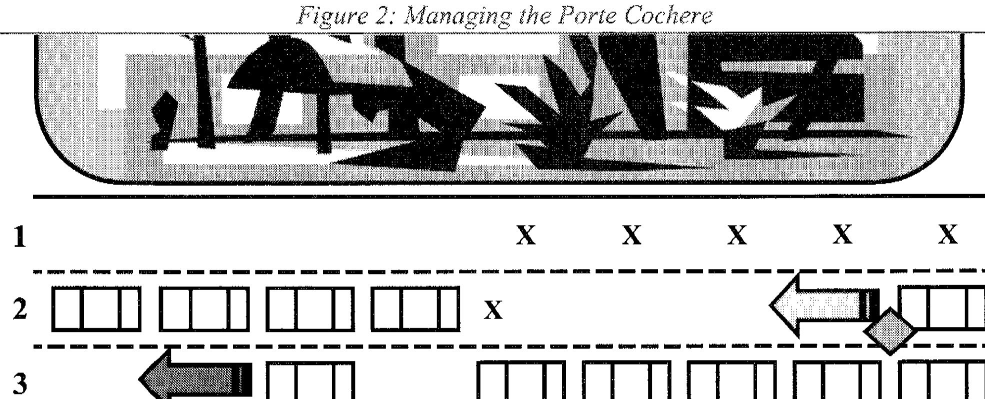


Figure 2 shows the porte cochere area as the vehicles continue to arrive. Valet attendants are taking the vehicles in lane 3 to the parking area from the front of the lane (represented by the red arrow), while attendees are being directed, by the driveman, to the back of the other staging lane (green arrow) in lane 2. Lane 1 continues to remain open. When Lane 2 fills, and just as Lane 3 empties, the drive person can direct vehicles down Lane 1, as long as Lane 3 then remains open.

Figure 2: Managing the Porte Cochere



After all of the attendees have arrived, the tickets and keys must be balanced. There should be a set of keys for every ticket issued and a ticket for every parked vehicle. Sorting this out before the event concludes is imperative.

Pricing

Competitive rate surveys should be performed quarterly to ensure that the valet operation is at market rate. An important factor to consider, beyond what the competitive set is charging, is that of meeting costs. Valet operations are far more labor intensive than self-parking operations, and the reality of legal responsibility for the care of the patrons' vehicles results in high insurance premiums. Valet rates should be at a premium to both cover budgeted expenses, and to dissuade a portion of the parking public from valet use and reducing service levels.

There are instances when a valet program may be marketed at a loss to encourage use. In office buildings where there are space constraints, offering a limited and lower cost valet service, can induce monthly parkers to utilize the program, freeing up valuable self-park spaces.

Trends

There are far more valet operations than ever before and many new applications. Years ago, valet parking was strictly the realm of high-end hotels, country clubs, and select restaurants. Today, one can find valet operations flourishing at airports, hospitals, and even shopping malls. As the need to provide better service continues to be a goal of most industries, we can expect valet operations to be able to grow right along side.

Technology is also growing up with valet parking. Today's parking equipment comes with interfaces that allow hotel valet operations the ability to attach charges directly to a guest's room before they've even checked in at the front desk. There is also equipment on the market that will take digital photos of all four sides of a vehicle as it is being brought into and out of the parking garage, allowing the valet operator to have irrefutable proof of pre-existing damage to a vehicle. Some hotels have kiosks in the lobby with which a guest can arrange, by touch screen, to have their vehicle retrieved and waiting for them.

But it's service that counts. That well-mannered valet in front of the restaurant on a bitter cold evening is what makes valet patrons feel special.

DESIGN & BUILD DELIVERY SYSTEMS

H. Carl Walker, P.E.

H. Carl Walker, P.E. has been creating innovative parking planning and design solutions for more than 40 years. He is one of the nation's foremost parking consultants and structural engineers. His entrepreneurial spirit built two of the most respected parking consulting organizations in the United States. He is a member of the Board of Directors at Timothy Haahs & Associates, Inc. Mr. Walker has personally been involved in a multitude of multi-level parking projects throughout the country. He has authored numerous articles on parking, and served as past Chairman of the Parking Consultants Council of the National Parking Association.

Introduction

There are numerous ways to carry out the design and construction process to achieve the Owner or Developer's goal of constructing a new parking structure. For the purposes of this chapter, we will assume that the Owner (or Developer)---the person or entity paying the bills for the new construction---performed a Site Selection Study and has selected and/or purchased a construction site. Also the Owner has performed a Supply-Demand Study and knows how many parking spaces that he wishes to add to the site. In addition, a Financial Feasibility Study has done. Arrangements have been made via a bond issue or mortgage to provide the funds for the design and construction of the parking structure. (With municipal or public projects, often the bonds are not sold until the project has been bid and the construction cost is known.)

This chapter will discuss how to develop a project from the commencement of design to the completion of construction using various project delivery methods from the traditional Design-Bid-Build approach which is totally prescriptive to using the "the back of an envelope" Performance approach and methods in between.

Definitions

Design Team - The design team is composed of a lead professional that is a Parking Consultant, Structural Engineer, or Architect. Sometimes two or all of these functions are in the same office. All three are needed to put together a meaningful project—one of them must be the leader.

Parking Consultant - A parking professional who has demonstrated competency in the design of parking facilities including circulation patterns, parking space layouts, signage, parking access/revenue control equipment and passive security design features.

Structural Engineer - A licensed professional engineer who has demonstrated competency in the structural engineering design of parking structures who has knowledge and experience in the unique structural design and durability requirements of parking structures.

Architect - A licensed professional architect who has demonstrated competency in the architectural design of parking structures.

Electrical Engineer - A licensed professional engineer with competency in the design of lighting and power systems for the parking structure. The electrical engineer should also know how to design security systems, communication systems, and stand-by power systems.

Mechanical Engineer - A licensed professional engineer with competency in the design of heating and air conditioning, drainage, water, fire suppression, and waste water systems for the parking structure.

Specialists - Other specialists that may be on a design team could be a civil engineer for the roadway systems, landscape architect, elevator consultant, and a graphics specialist for signage.

Owner - The entity that pays the professional fees for the design and construction review and pays the builder for the cost of construction.

Operator - The entity that operates the parking facility on day-to-day basis. Often the Owner and Operator are the same entity.

Builder or General Contractor - The entity that is responsible for constructing the parking structure according to the plans and specifications developed by the Design Team.

Sub-Contractor - A specialty contractor that works for the General Contractor. These include Excavator, Mechanical Contractor, Electrical Contractor, Roofer, Ready Mixed Concrete supplier, Precast Concrete Manufacturer, Elevator installer, Mason, Painter, etc.

Construction Manager - An entity that is a specialist in administrating and coordinating the construction project generally without doing any or very little of the construction work. The CM can work on a no-risk or at-risk cost basis.

Design-Build Team - A team of design professionals and a builder or CM that work together as an integrated team. Sometimes, the design team is an in-house team on the payroll of the builder. Other times, the team is a group of individual specialty firms that join together to perform a specific project.

Getting Started

Regardless of whether the Owner plans to develop its parking project using traditional or design-build project delivery methods, unless the Owner is an experienced project developer, it is wise for the Owner to retain a Project Representative for guidance; at least until a professional design team is retained. Once the design team or design-build team is on board, the Owner can decide whether the Project Representative should continue on the project as an extra set of eyes and ears.

The Design Process

There are five or six phases of the traditional design process of a parking structure. These phases follow the standard American Institute of Architects design phases detailed in the AIA Owner-Architect Agreement.

1. **Programming (Optional)** - This is an optional phase to develop the design criteria for the project including the number of parking spaces, site constraints, and the architectural style, to name just a few. Also, the Owner may establish a budget at this time.

2. **Schematic Design** - Studies are made of the functional layouts of the parking structure. Often design charettes are held with the Owner so the Owner can participate in the conceptual design process. Exterior architectural options are also studied. An outline specification and an estimate of probable construction cost are developed.

3. **Design Development** - During this phase, the Schematic Design is refined. The structural system—precast concrete, cast-in-place concrete, or structural steel—is selected. Architectural materials are evaluated. Then the outline specification and cost estimates are refined.

4. **Construction Documents** - The working drawings and specifications to be used by the builder are developed. Any design alternates are defined. The final estimate of probable construction cost is made.

5. **Bidding** - The Construction Documents--Drawings and Specifications—are issued to the bidders. On public projects, there is usually a formal procedure of advertising for bidders and distributing the documents. On private projects, the Owner has the option of allowing any qualified builder to bid, or limiting the bidding to a select few. Often, the Owner, whether public or private, may ask for bidders to be pre-qualified. The AIA has a procedure for this. For a typical parking project, four weeks is usually ample time for the contractors to develop their bid price. Thursday is the best day of the week to receive bids as it allows the builder three standard working days in the bid week to work out final details with subcontractors and suppliers. Never receive bids on Monday or on the weekend.

   Often, about one week into the bidding period, a prebid meeting is held with the Owner, design team, and bidders to answer any questions that the bidders may have regarding the design intent and the Owner's desires. The design team may issue Addendums with changes to the drawings and specifications during the bidding period. If an addendum is extensive, an extension of the bidding period may be required. Once the preferred bidder is identified—usually the low bidder, a contract is signed and the construction work proceeds.

6. **Construction Administration** - During construction, the design team observes the work to help assure that it is being done in general conformance with the drawings and specifications. Shop drawings are reviewed, materials approved, and pay-requests administered. During this phase, there may be change orders that are initiated by the Owner, design team or contractor. Upon completion of construction and beneficial occupancy of the structure, a one-year warranty period commences. However certain construction items, such as sealants, may have a longer warranty period.

The AIA has a complete library of documents explaining in detail the design and construction process. This library also has a number of standard legal agreements that are commonly used in design and construction.

Specifications

The specifications are the "cook book" for the construction project. There is a broad continuum of specification types ranging from prescriptive to performance.

The prescriptive specification is very detailed - "do it this way." Prescriptive specifications are typically used with the traditional design, bid, and build process. These specifications can be quite voluminous and allow the contractor little leeway in how things are to be done on the project. The contractor, however, should always have the responsibility of the means and methods and equipment used for construction.

The performance specification describes the end result of the project—550 parking spaces, for example, and allows the contractor the option of how it is going to provide the required parking spaces.

Often, specifications will be a combination of prescriptive and performance specifications. For example, masonry and brickwork could be specified prescriptively while structural precast concrete could be performance specified.

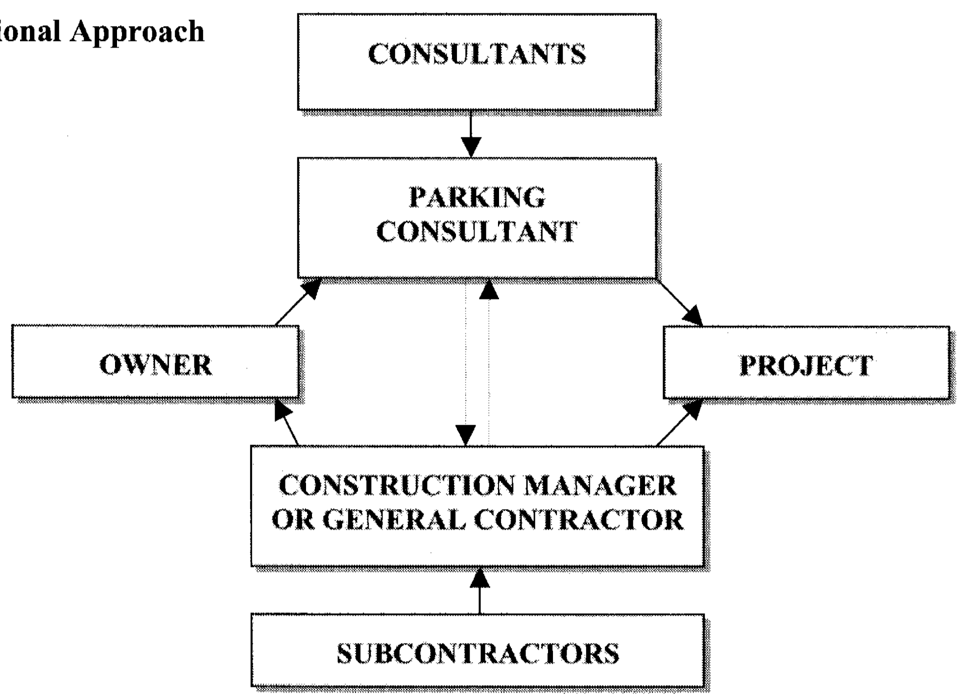
Performance specifications offer the contractor the greatest flexibility to be creative and reduce the construction cost, but they reduce the Owners control over the project. The following paragraphs will discuss in greater detail the advantages and disadvantages of various design and building processes.

Project Delivery Methods

There are two typical project delivery methods – the traditional design, bid, and build method; and the design-build method – with many variations.

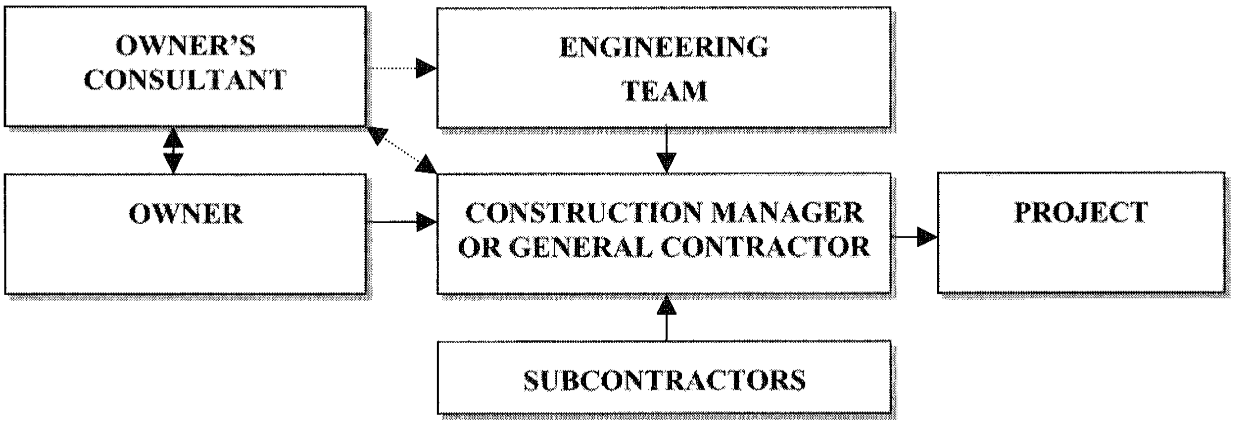
With the traditional design, bid, and build method, the Owner retains a parking consultant (or structural engineer) who forms a design team. Please refer to Figure 1. The design team goes though various phases to design the project and "put it out for bid." Contractors bid on the project with the lowest bidder usually becoming the builder. The design team follows the project through construction to help assure that the project is built in a quality manner. This approach provides the Owner with maximum control over the outcome of the project.

Figure 1: Traditional Approach



With the design-build method, design-build teams composed of a design team and a contractor submit proposals to design and build the project for the Owner. Please refer to Figure 2.

Figure 2: Design-Build Approach



For either project delivery method, construction costs for the project can be obtained by several contractors bidding the project, or by negotiation, normally with one contractor.

Traditional Project Delivery Method I - Design-Bid-Build

With the traditional design, then bid, then build project delivery method; the Owner retains a Design Team. Often this is done utilizing the RFQ (Request for Qualifications) and RFP (Request for Proposals) approach.

For the RFQ, the project is advertised for design teams or lead designers to submit a packet of qualifications for review by the Owner and his project representative. Then, four to six of the submitters are selected and sent a RFP for them to submit a detailed proposal and to give an interview presentation to the Owner regarding how the design team proposes to perform the design, bidding, and construction administration phases of the project.

Design team fees are often negotiated after the preferred team is chosen to keep the team's qualifications the primary selection criteria. However, sometimes the proposers are asked to submit fees along with their written proposal. Another method, which seems fairer, is the two-envelope system where after the interviews are completed, the teams are rated on the basis of the interviews. Then the fees are separately evaluated. The final selection is made and an Owner-Design Team Agreement is negotiated. Often this is the Owner-Architect Agreement. If the Owner and the selected Architect cannot reach agreement, then the negotiations with that Architect are terminated and the second design team is asked to negotiate.

The AIA Owner-Architect Agreement is a standard agreement that most designers, whether architects or engineers, are familiar. It can be used by Engineers or others by inserting an explanatory statement, such as, "When the word Architect is used in this agreement, it shall mean John Doe, Professional Engineer. This does not mean to construe that John Doe is practicing architecture."

The time for all of the design functions for this approach from programming through bidding would be six to eight months. The design time could be greater for complex projects. Construction time depends on the size of the project.

The design, then bid, then build approach provides the Owner the most control over the "end product."

Traditional Project Delivery Method II - Design-Bid-Build with Specified Alternates

This is the same as the Traditional Project Delivery Method I except alternates such as changing specifications of materials, or adding or deleting a floor, are specified to be part of the bidding package. Often this is done when the design team is unsure of the probable construction cost estimate for the project. Alternates can either be "add" or "deduct". Designers are cautioned not to specify too many alternates as the alternates can create much confusion during the contractor's final hours of bidding.

Alternates may add to the time required to complete the design phases.

Traditional Project Delivery Method III - Design-Bid-Build with Voluntary Alternates

This is the same as Traditional Project Delivery Method I except alternates such as changing specifications of materials are submitted voluntarily by the bidders, with the objective of saving the Owner money while maintaining the intent of the quality of the project. Often this is called Value Engineering. The voluntary alternates can be specified in the Instructions to Bidders and should not add to the total design time. However, the bidding phases might have to be extended to allow the bidders additional to evaluate savings possibilities. Bidders should always submit a base bid without voluntary alternates; then the voluntary alternates are applied to the bidder's base bid.

With this approach, the Owner maintains control of the quality of the project. However, it has the economic advantage that it allows bidders to submit time and/or cost saving alternates that may not have been considered or known to the design team.

Traditional Project Delivery Method IV - Design-Bid-Build with Alternate Structures

This is the same as Traditional Project Delivery Method I except alternate structures such as precast prestressed concrete and cast-in-place post-tensioned concrete are designed by the design team. The functional design will be the same for both structures. The architectural facades, foundations, and column spacing may be different. This promotes competition between structural systems. A structural steel frame with cast-in-place post-tensioned slabs could be another design alternate. Bid evaluations should be on the basis of low bid even though there may be differences in long-term maintenance of each of the structural systems.

Because two or more structural systems are being designed, the time for the design phases should be extended accordingly. Also, the bidding time should be extended. Because of the additional design work, the design team fees will be higher, however, because of the competition between structural systems, savings often accrue which more than offset the additional design cost.

If the column spacing is critical architecturally, this approach may cause the design team to compromise the economics of one system to accommodate the other. In other words, the optimum bay spacing for one system may not be the best spacing for the other system.

This method still offers the Owner much control over the project.

Design-Build Method I - Bid Criteria Drawings & Performance Specifications

With this approach, the design team develops drawings that define the desired functional design, location on the site, and façade architecture. Civil engineering topographic and utility plans of the site and a geotechnical report including foundation recommendations are obtained. Performance specifications define the basic requirements of the structure, drainage systems, lighting layouts, and other requirements such as graphics, interior finishes, waiting rooms, offices, storage facilities, operating equipment, etc. Instructions to Bidders should outline the evaluating criteria that will be used to award the project.

The bidders form design-build teams of a builder, specialty subcontractors such as a precast concrete manufacturer, structural engineer, possibly an architect and other consultants. Often the mechanical contractor and electrical contractor do their own engineering for the bidding.

After bidding, drawings and specifications for construction are developed by the winning design-build team prior to construction for approval by the Owner or his appointed representative. Sometimes projects are "fast tracked" with the foundation design being completed and construction commencing prior to the completion and approval of the design of the superstructure.

With this approach, the professional designers for the builder become the "engineer and/or architect of record." The mechanical and electrical contractors must submit sealed drawing and specifications and they become the engineers of records for their work. Usually the Owner's design team or Owner's Representative continues with the project through completion of construction to assure that the Owner's desires are met.

The design fee for this approach is lower since the design team does not complete a full set of traditional drawings and specifications. However, the cost of the final design (construction documents) is included in the contractor's bid.

With this approach, the Owner gives up some control for, hopefully, a lower price. Negotiations prior to signing the construction contract will help ensure that the lowest bid is responsive to the Owner's expectations.

Design-Build Method II—Performance Specification

First, civil engineering topographic and utility plans of the site and a geotechnical report including foundation recommendations are obtained. Then, performance specifications are developed to define the basic requirements of the parking structure including the number of parking spaces, location on the site, acceptable structural systems, drainage systems, lighting layouts, and other requirements such as graphics, interior finishes, waiting rooms, offices, storage facilities, etc. Since the façade architecture is not defined graphically in this approach, the bidders are often asked to submit an architectural rendering along with their cost proposal. The Instructions to Bidders should outline the evaluating criteria that will be used to award the project. The remainder of the project delivery is carried out similar to the Design-Build II delivery system.

There may be not up-front design fees for this approach as all of the design costs are in the builders bid. However there will be Owner's Representative fees. It usually takes about four to six weeks for the Owner's Representative to put together the bidding documents for this approach including obtaining a site survey and geotechnical recommendations.

When the Contractor's proposals are submitted, the Owner will receive different designs as well as costs to consider. This method gives the Owner the least control over the project, but may result in least cost. Often the most desirable design submitted does not result in the most economical cost.

Construction Contracts

There are several types of construction contracts that include:

- Lump Sum
- Cost plus Fixed Fee.
- Cost plus Percentage Fee
- Cost plus Fix Fee plus Unit Prices

Often, "cost plus" contracts will have a guaranteed maximum total amount provision added to them. The "guaranteed maximum" is subject to change during the course of a project due to change orders and other possible cost adjustments that would be in the contract.

Sometimes, a guaranteed maximum contract will have a "share of the savings" clause such as 25% of the savings to the contractor, and 75% to the Owner. The savings are the cost amounts below the guaranteed maximum amount. If the costs exceed the guaranteed maximum, the contractor usually must absorb those over-runs.

An attorney familiar with the construction process should write contracts. With cost plus contracts, defining what contractor's costs are included in the project costs and what costs are included in the contractor's fee is important..

For public projects, the builder is usually selected through the bidding process with the lowest responsive bidder being awarded the construction contract usually on a lump sum basis.

Private owners have the option of bidding the project as discussed above, or selecting one or more contractors to bid the projects and negotiate a contract.

In the opinion of the writer of this chapter, the Cost plus Fixed Fee with a Guaranteed Maximum, but without a Share of the Savings clause is the fairest approach to all concerned. The contractor is guaranteed his fee while the Owner has a total cost ceiling.

Other Concerns

Sometimes, the Owner, such as a municipality or large parking operator, may have other parking facilities that it operates. To minimize operating and maintenance options, it is often wise to have the Owner purchase the operating equipment, and sometimes light fixtures, separately from the bidding process to ensure product continuity on his various facilities. The Owner purchased equipment is then assigned to the Contractor to install in the project. In this manner, the Owner is able to keep equipment and fixtures similar to its other projects, if it wishes.

Low first cost often is not the lowest life-cycle costs. Life-cycle costs are first costs plus life of the structure operating and maintenance costs which all should be considered when choosing cost options for a new parking facility.

The Owner should always engage a professional parking consultant.

DEVELOPING AN ANNUAL PARKING REPORT

L. Dennis Burns

Dennis Burns is Vice President and Director of the Studies and Operations Consulting group for Carl Walker, Inc. Mr. Burns has over 24 years of parking operations, management and consulting experience.

Mr. Burns' particular expertise is in parking master planning and operations consulting. He is the author of over 100 parking studies. His particular areas of expertise include: parking and transportation master planning, supply/demand analysis, parking revenue control and operational audits, and organizational analysis.

Melinda Anderson, CAPP

Melinda S. Anderson, CAPP is director of the Office of Parking Management at the Medical University of South Carolina in Charleston and has 25 years of experience in university and hospital/medical center parking. Her responsibilities at MUSC include managing the student, employee, and public parking systems. A member of the International Parking Institute since 1985, Anderson was a member of IPI's charter Certified Administrator of Public Parking class and received her CAPP in 1994. She currently serves as Chairman of the Board of IPI.

Why an Annual Parking Report?

The reasons for developing an Annual Parking Report are numerous, but the perhaps the most basic purpose of such a document is to educate those who only have a limited exposure to parking as to the complexity and importance of this critical support system and the skills required to create and sustain an effective parking program. Sometimes administrators, board members, finance directors, etc. who do not direct responsibility for parking do not grasp the intricacies of managing a parking program. This is not meant disrespectfully. Even for those of us who are in the parking profession, keeping up with new technologies, management innovations and best practices can be a challenge.

Another key reason to develop an Annual Parking Report is to raise the level of awareness of the critical issues affecting the parking program and to encourage support for new program initiatives and budget requests.

An observation I have made over the years is that parking professionals should do a better job of promoting and celebrating their accomplishments. We don't "toot our own horns" enough (and when is the last time someone tooted it for you?). An Annual Parking Report can be a tool that builds appreciation of the parking program and its staff. It can generate respect and enhance the credibility of the department. It can also highlight how the parking program is supporting the vision and mission of the larger institution. This in turn underscores the benefits of including parking in strategic and master planning processes. When done well, an Annual Parking Report can also be an effective career advancement tool. Many more reasons for developing an annual report will become apparent as we progress through this essay.

A common question that comes up when this concept has been presented around the country has been: "Where will I find the time to take on a project like this?" We will address this concern near the end of the chapter in the "Getting Started" section. The bulk of this chapter will review the recommended content of an Annual Parking Report.

As a final introductory comment, we have added five "side bars" in this chapter which are essentially "mini-case studies" of programs that have successfully implemented an Annual Parking Report as part of their program. We have chosen these programs to represent a variety of organization types (municipalities, universities, medical centers, authorities, etc.) and also because of each program has approached the concept a little differently. The recommended content we will review is intended only as a guideline. While many of the basic content topics will be common to most environments, we recommend that you craft your Annual Parking Report to specifically address the current needs of your institution.

Annual Parking Report - Recommended Contents

The following are general sections recommended for inclusion in an Annual Parking Report.

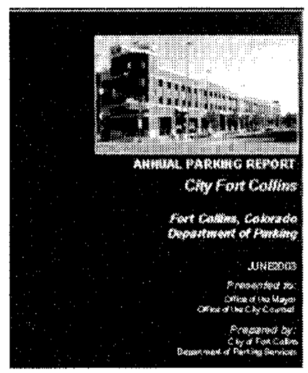
Introduction/Overview

A brief "Introduction/Overview" section is recommended. In this section, discuss the objectives you hope to achieve with the report. If it is your first annual report, it may be appropriate to spend a little extra time discussing the history of the parking program. How did it become what it is today? Research and quantify as much as possible, the growth of parking resources over time. This may require talking to staff who have been around the institution longer than you, as documentation of this type is typically hard to find. Even if not exact, you will eventually be able to piece together a chronology of parking system development.

In my first annual report, I developed a timeline of parking development going back fifteen years that showed how parking stair-stepped its way from 1,500 spaces up to the 5,700 spaces we had at the time. Most of the dates came from musty, yellowed site plans of parking lot expansion and new structure projects unearthed from the basement of the engineering department.

City of Fort Collins, CO
The Annual Report is worth its weight in gold!

Downtown Fort Collins, Colorado, is a thriving, collection of quaint, locally-owned retail shops, restaurants, and entertainment establishments. Nestled under the nearby Rocky Mountains, the picturesque historic buildings and wide streets in Old Town welcome residents and visitors alike. But before you hop in your vehicle and head Downtown, think about Parking – it may be hard to find a space when you get there.



Recently, the City and Carl Walker, Inc. completed a comprehensive Downtown Parking Plan to address the parking problem. Among the recommendations is a call for the City to begin producing an Annual Report. Says Parking Services Manager Randy Hensley, "It's a great way to highlight your program for the public and the decision-makers. An annual report provides a chance to publicize successes and emphasize needs." In addition to being a great marketing tool, the annual report can become a repository of valuable information over time. By including space inventories, turnover data, and occupancy rates, an annual report can quickly become a source for trends and a basis for making plans.

Fort Collins will produce its first annual parking report in 2004, using much of the data captured as part of the recent study effort. The staff of the Parking Services division is already excited about the possibilities, including using the annual report as the basis for budget requests to implement other recommendations in the Downtown Strategic Plan. For more information, contact Mr. Hensley at rhensley@fcgov.com or (970) 416-2058.

Another important element of this section might be a discussion of the parking program's vision/mission. If you do not have department specific vision or mission statements, this could be a good opportunity to develop them. It is important to reinforce how the departmental vision/mission supports the larger institution mission. Beyond a vision/mission, this is a good opportunity to develop or reiterate any parking specific guiding principles that form the basis for operational practices.

Finally, this might also be an appropriate place to review the organizational structure of the department, highlight key staff and their accomplishments or to discuss staffing or organizational challenges and issues such as recruitment, retention, needed new skills, increasing staffing needs, etc.

Parking Inventory

Documenting the current parking inventory is a basic component of an annual parking report. For reference and contextual purposes, you may want to provide a historical summary of parking inventory. Of particular importance is to summarize changes to the parking inventory from the previous year. It is highly recommended that you document your parking inventory on a site plan or parking map.

Beyond documenting the overall parking supply, it is important to break down the inventory into the various types of parking available. These break downs typically include categories such as structured parking, surface lot parking, on-street parking, leased parking, remote parking, etc.

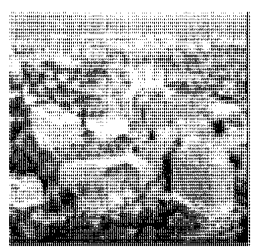
MUSC
MEDICAL UNIVERSITY
OF SOUTH CAROLINA

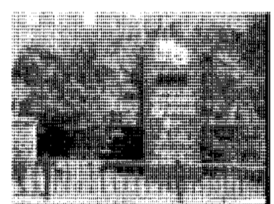
The Medical University of South Carolina is a major regional medical center with a three-fold mission: teaching, research, and patient care. The MUSC parking system's reason for being is to do work that contributes to the success of the university enterprise. The product we deliver is customer service in a parking environment.

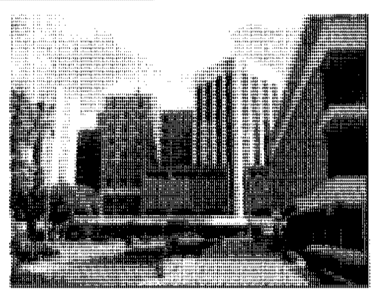
A parking operation usually receives more criticism than praise. The criticism is often unjustified because it is based on inadequate or incorrect information. The MUSC parking operation has chosen a strategy to combat this that uses a parking annual report as an educational and marketing tool.

This strategy has been successful in bringing about better understanding not only of Parking's challenges but of its accomplishments. As a result the parking operation is recognized as a team player, a problem solver, a solution finder, and, most importantly, as a contributor, not an inhibitor, to the success of the MUSC enterprise.

For more information on our parking program or our annual parking report feel free to contact: Melinda S. Anderson, CAPP, Director of Parking Management at andersme@musc.edu.







Parking Resource Allocation

Another key annual parking report element is a detailed overview of the parking allocation plan. How the parking resources controlled are allocated goes to the heart of the parking program because of the prioritization required. The parking allocation plan would typically identify the various user groups served, and what resources are allotted for their use. Some examples are noted below.

On-Street Spaces

Off-Street Spaces

- Transient (Short-term) Parking
    - Visitor Parking
    - Patient Parking
    - Clergy Parking
    - Drop-off/Pick-up Parking
- Monthly (Employee/Contract) Parking
    - Reserved Parking
    - Faculty Parking
    - Physician Parking
    - Student Parking
    - Residential Parking
    - Medical Office Building Parking
- Special Use Parking
    - Accessible (ADA) Parking
    - Loading/Unloading
    - Police Parking
    - Maintenance Parking
    - Volunteer Parking

Parking Utilization

Of particular interest to most administrations is the degree to which existing resources are being effectively utilized. When discussing parking resource utilization some education may be needed. Defining concepts such as peak demand periods, design day demand, effective parking supply, oversell percentages, etc. can help administration and planners better understand and appreciate some of the more subtle dimensions of parking management.

In this section of the Annual Report, the following topics are recommended:

Off-Street Spaces – Utilization by Facility

- Peak Demand Periods
- Utilization at Peak Demand Periods (By Lot/Deck)
- Oversell Percentages (By Deck/Lot)
- Overall Utilization

On-Street Spaces - Utilization by Area or Zone

- Peak Demand Period(s)
- Turnover

To conclude this section, an assessment of "Current Parking Adequacy" may be appropriate. This analysis might be user-group based, for example: "employee parking is adequate; however, patient/visitor parking exceeds the current supply at peak demand times". When stating a specific problem, it is advisable to also offer potential solutions.

Anticipated Changes to Current Parking Inventory

One the more important sections of an Annual Parking Report for those institutions that are facing expansion or major development projects is documentation of anticipated changes to the current inventory. In addition to documenting projected losses in parking supply (usually through the loss of existing surface lots) it is also critical to evaluate the overall impacts of proposed development projects, including anticipated increases in parking demand, the creation of special parking needs, changes to the parking dynamics and parking mix, etc.

This is also a good place to discuss planned parking additions.

Future Parking Demand Projections

This section provides an opportunity to discuss and evaluate future parking needs. If a recent parking supply/demand study has been conducted by a parking consultant, this is a good opportunity to summarize the findings of the study. It should be noted that this section is considered advanced and may require the assistance of parking planning professionals. Some of the concepts that are recommended for discussion include:

- Design Day Conditions
- Effective Supply
- Projected Parking Demand
- Projected Parking Adequacy

Design-day parking conditions attempt to represent typical peak activity that may be exceeded only occasionally during the year. "Effective Supply" reflects a cushion factored into the total parking supply to account for improperly parked vehicles, minor construction, and the time required to search for an available parking space. When calculating parking adequacy, design-day parking demand is compared to the effective parking supply.

This section might also address the recommendations to meet the projected future parking needs as well as the estimated costs to implement the recommended alternatives.

Toronto Parking Authority

The Toronto Parking Authority exists to provide safe, attractive, self-sustaining, conveniently located and competitively-priced off-street and on-street public parking as an integral component of Toronto's transportation system. We operate over 200 off-street carparks with 35,570 spaces and over 18,000 on-street meters.

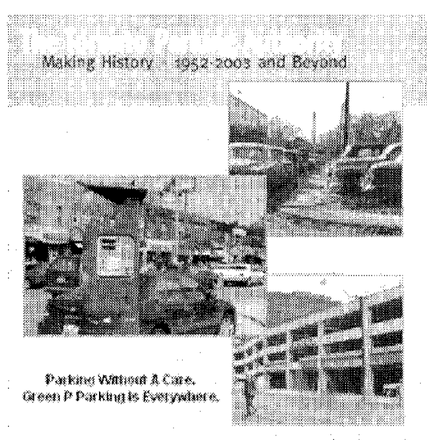
Through our Annual Parking Report for following key issues are addressed:

- Gross and net revenues compared to previous year.
- Increase in on-street zones and expansion of off-street facilities.
- New technologies implemented are briefly discussed.
- Any new programs that are citywide and new policies that impact parkers.
- Environmental initiatives such as cycling initiatives, landscaping programs, etc.

Based on our experience, producing an annual parking report helps us realize the following benefits:

- Once a year opportunity to report successes (or failures) to our shareholder, the City.
- Summary of the past year in a few pages for future reference.
- Promote the Authority within the City.
- Summarizes in a few pages the past year contributing to employee's feeling of accomplishment and success.
- Adds a professional perspective to the organization.

Samples of our Annual Reports are available on our website at www.GreenP.com.



Competitive Environment

Staying abreast of what your competitors and peers are doing can help you stay one step ahead and potentially make your operation more responsive to your customers needs. What exactly are we looking for when we survey competitors? The answer is anything that could translate into a competitive advantage. This could mean identifying weaknesses in a competing operation or it could be that your peers are implementing a new program such as central cashiering or pay-on-foot systems.

With peers, where there is less of a competitive atmosphere, the process can be more open. Establish a regular program of information sharing or even volunteer to do a program "peer review". Typically a peer review would be a reciprocal process where both parties benefit from a "fresh set of eyes" on their operation.

At a minimum, it is recommended that you be aware of the following items in regard to peers or competitors.

- Parking Rates – Conduct a biannual rate survey
- Marketing Initiatives and Strategies – Collect newspaper ads, brochures, take photos of banners/signs, monitor websites, etc.
- Implementation of New Technology – What is new? How is it working? How are customers responding? Were there any mistakes made during implementation you should learn from?

Parking Management Initiatives

This section gives you the opportunity to clearly state the challenges you are dealing with on a day-to-day basis. Equally important is the opportunity to explain or recommend new parking management initiatives. One of the things most people don't appreciate about parking management is its complexity and the far-reaching impact of policies. The following is a brief list of areas that could be addressed:

- New or Revised Polices and Procedures
- Parking Benchmarking
- Revenue Control Overview / Audit Report Summary
- Parking Technology Upgrades
- Customer Service Initiatives
- Parking Marketing Initiatives
- Safety and Risk Management Issues
- Communications / Interdepartmental Relationships
- Outsourced or Purchased Services
- Parking Operational Peer Reviews
- Opportunities to Improve Parking Utilization or Efficiency

Parking System Financial Overview

Some annual reports place more emphasis on this topic and others less. For those parking organizations, such as Authorities and Universities, that are often mandated to report financial performance either to a board or the communities they serve, this section can be of greater importance. If parking is operated as an enterprise fund, this section can also be extremely important.

At the hospital where I created my first Annual Parking Report, this section was less important because the administration felt comfortable with the level of financial reporting already in place on a monthly basis. However, even in that environment, a brief review of financial issues was provided.

Although the financial overview can be extensive if this is a priority of your organization, at a minimum the following topics should be reviewed:

- Revenue by Type
- Expenses by Major Categories
- Significant Variances (actual to budget)
- Debt Service Obligations
- Net Profit/Loss
- Recommended Rate Increases

Parking Facility Maintenance

Few things make a greater impression on first time visitors than the cleanliness and maintenance of your parking facilities. Beyond first impressions, however, few areas provide a greater potential return on investment than a comprehensive parking system maintenance program.

Parking facility maintenance is one the most overlooked areas in parking management. It is also the most likely to have budget items cut or "deferred". Addressing facility maintenance issues as part of an annual parking report helps build support for this important area and is also a good forum to discuss the other implications of maintenance projects such as the potential impacts to customers, temporary loss of spaces, revenue, etc.

If a parking facility condition appraisal has recently been conducted, the Annual Parking Report is an excellent forum to summarize the results of the report. At a minimum, it is recommended that the Parking Facility Maintenance section contain the following sub-sections.

- Parking Maintenance Issues Overview
- Summary of Parking Facility Condition Appraisals
- Prioritized List of Maintenance Projects
- Projected Cost of Maintenance Projects

Parking System Safety, Security and Risk Management

Depending on recent events in your facilities, security may be either an almost forgotten issue or it could be the highest priority. As parking professionals, part of our responsibility is to insure that security issues do not get ignored. The safety and security of our customers is not something we can afford to take for granted. Whether real or just perceived, security or safety concerns can harm not only the parking facility's reputation (and revenue streams), but also those businesses that depend on the parking facilities for support. Like it or not, statistically, parking facilities have a higher percentage of crimes than other areas.

One excellent practice that can help keep parking security issues in focus is to establish a standard parking facility security audit process and conduct the audits on a regular basis. As part of this process, monitoring general campus or downtown crime statistics, with a special tracking process for incidents that occur in parking areas, can provide a valuable context for discussing parking facility security concerns.

Another area that can be of critical importance, from a potential liability perspective, falls into the category of risk management. Items such as trips and falls, pedestrian/vehicular conflicts, gate arm damage to vehicles, valet parking, etc. can expose the larger institution to significant liability and needs to be managed proactively.

When addressing security, safety and risk management issues as part of your annual parking report the following general areas are suggested.

- Parking Security Issues Overview
- Summary of Significant Parking Related Security Incidents
- Review of Current Security Measures (Both Passive and Active)
- Summary of New or Proposed Security Initiatives

Parking Enforcement

An overview of the parking enforcement issues should begin with a restatement of the philosophy that informs your program. Some programs see enforcement as just a necessary program to insure compliance with published rules and regulations. Other programs focus on objectives such as the promotion of on-street space turnover to support uptown businesses. Still others see parking enforcement primarily as a revenue generation opportunity.

The annual report can be an opportunity to promote proposed or document new or revised enforcement policies and procedures. It can also be an effective forum for introducing new technologies that can enhance your overall enforcement program efficiency and effectiveness. This could include discussions of outsourcing certain aspects of the enforcement process, such as citation collections, etc.

A review of parking enforcement revenues and expenses is also appropriate, including a discussion of how enforcement revenues are distributed. If they are kept in the Parking Department, how are they being used?

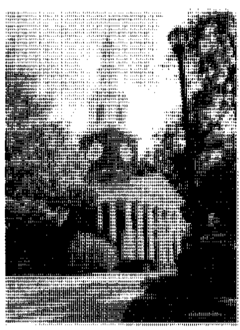
Another area for discussion could be a review of key parking enforcement operational benchmarks. Examples might include:

- Number of citations issued per enforcement officer
- Citation collection ratio
- Average revenue per citation collected
- Administrative cost per citation

The University of Kentucky

Parking @ Kentucky
University of Kentucky Parking & Transportation Services

Parking and Transportation Services is one of the few, if not the only, Auxiliary Service or Department at the University of Kentucky that provides a detailed public report on yearly accomplishments, budgetary information and future plans.

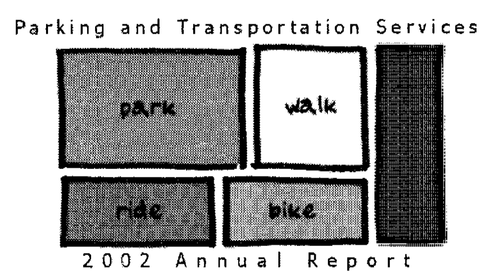


We decided to provide this service because of the large demand for such information from students conducting research and other colleges and universities performing benchmarking studies. We feel that publishing an annual report on our website also provides an opportunity to proudly share our accomplishments and outline the many challenges that we face.

As a service provider we feel a sense of responsibility to provide detailed information to our customers about how their permit fees are being spent. The annual report gives our customers a place to get the facts directly from the source.

Our openness has led to some surprising results. Over the past few years, we have observed a gradual change in attitude toward campus parking from hostility and frustration to that of understanding and cooperation. We attribute a large part of this change to our public relations efforts, spearheaded by our annual report. Our willingness to open our department files and share our successes, challenges, statistics, and finances with our customers has established an environment where we must be accountable and fair.

Producing an annual report is a difficult and time-consuming process. Gathering, organizing, and presenting the information takes a substantial time and resource commitment; however, the long-term benefits of our work have proven well worth the time investment.



Parking Shuttle Operations

If a parking shuttle operation is part of your current program, provide an overview of the program and define the scope and intent of the operation. Is this an on-going, long-term program or just a temporary measure to get you by until a new deck is completed or until facility master planning strategies are better defined?

Typical elements discusses in this section might include:

- Equipment / Vehicle Issues
- Service Levels (Amenities Provided, Headways, etc.)
- Security Issues
- Ridership Statistics
- Revenue/Expense Review

Parking and Transportation Demand Management

It is important that discussions of parking not be divorced from the larger context of overall transportation issues. Development of a set of integrated parking and transportation alternatives is essential to creating a balanced system and reducing overall parking demand.

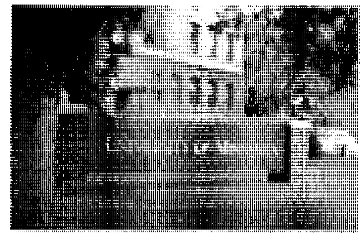
In this section we recommend that parking demand management initiatives be discussed. Limiting parking supply and/or increasing parking rates in conjunction with the provision alternative transportation options can be effective strategies. Another concept not always considered in this area might include the relocation of certain departments out of high parking demand areas. This relocation strategy can have the duel benefit of freeing up existing parking supply as well as reducing the parking demand.

Other more traditional transportation demand management initiatives include:

- Subsidized Transit Pass Programs
- Car Pool and Van Pool Programs
- Preferred Parking for Car Pools / Van Pool Programs
- Guaranteed Ride Home Programs

University of Minnesota
Parking and Transportation Services

When I browse annual reports, I look for the facts. I generally glance right over flowery or boastful text, erring for information that is programmatically driven. Consequently, our annual reports are business oriented. They contain roughly 50 percent text and 50 percent graphs, charts, and tables. Text is mostly bulleted, highlighting specific issues, programs, and events integral to our operations. Graphs, charts, and tables are used to clearly, quickly convey statistical information in a visual format. Sections of our annual report include:



- **The Year in Review**: A brief, bulleted summary of events and accomplishments.
- **Staffing**: A summary of major personnel changes including new hires, promotions, and staff reductions.
- **Staff Development**: A list of the number of employees who attended and the number of hours of training and development within the fiscal year.
- **Partnerships**: A short discussion of various partnering relationships the department has with other agencies outside the University (transit providers, city, D.O.T., county, community agencies, etc.)
- **Technology**: A summary of technological initiatives and enhancements that have lead to greater customer service or improved efficiencies and cost reductions.
- **Capital Projects:** A brief listing of all capital projects over $100,000 completed during the fiscal year.
- **Diversity**: A summary of methods through which the department supports diversity in our internal operations as well as through our programs and services.
- **Comparative Statistics**: A historic comparison of items such as revenue versus net margin, staffing levels, and revenue per full-time equivalent.
- **Tables and Graphs**: A visual description of our use of funds, space inventory, transit ridership, Motorist Assistance Program calls, special event volume, etc.

Bob W. Baker, Executive Director
University of Minnesota, Parking and Transportation Services

Annual Report Benefits

Development of an Annual Parking Report can provide a variety of benefits to the parking administrator and the parking program overall. A brief summary of these benefits are noted below:

- Keeps administrators informed of critical parking issues.
- Promotes initiatives that are in the best interest of the parking department and the institution as a whole.
- Builds support for parking operating and capital budgets.
- Generates confidence and trust that the parking department is well managed.
- Focuses attention on the parking program and reinforces its significant contributions and results.

- Is useful as an archived reference for program performance from previous years.
- Creates a documented institutional history of the parking program.
- Is useful in media and marketing program development.
- Provides information for distribution to customers, peer institutions and other stakeholders.
- Is an effective means of communicating parking issues and promoting parking system accomplishments
- Provides a flexible mechanism for addressing specific areas of concern such as
    - Current issues
    - Special interest groups
    - Areas of misunderstanding
    - Upcoming challenges

Getting Started

A detailed template of an annual parking report based on the outline above (in Microsoft Word format), is available upon request from the International Parking Institute.

It is suggested that you use the template as a guideline. Customize it for your particular needs and focus on the issues that are important to you. Don't be intimated at the scope of the outline. It is OK to start small and build up over time. Remember, the first year is the most difficult and each successive year will become easier.

Another tip is to create a folder for each section you intend to have in your annual report. As you come across information throughout the year that could be incorporated into the report, simply drop it in the appropriate folder. You will be surprised how much information you will have to work with when the time comes to start writing.

Get your staff actively involved. Don't make this just your project, make it project for the whole department. Not only will this make your job easier, but it will generate pride in the department's accomplishments. You can also use the report to highlight team member accomplishments and give your staff some well deserved recognition.

Finally, carefully consider the timing of the issuance of the annual report. One strategy is to issue the Annual Parking Report one or two months prior to the commencement of the annual budget process. In this way the issues will be fairly fresh in the minds of the administration.

A Final Thought: The Decision No One Asks You to Make

Dr. Lawrence J. Peter, author of *The Peter Prescription: How To Make Things Go Right,* wrote as Peter Prescription #41, Watch for the Decision No One Asks You to Make. The author writes, "The most fleeting of all things is opportunity. It rarely knocks twice and sometimes does not knock at all."

Developing a parking annual report is an opportunity that does not announce itself with bells and whistles or a loud knock at the door. It enters silently, and – if noticed at all – can be easily ignored. Schedules are tight. One wonders how to add anything more to an already heavy workload.

Consider carefully the benefits of developing a parking annual report. Recognize the opportunity an annual report presents for you and your organization's advancement. Capture the fleeting opportunity. Act now.

RECRUITMENT, TRAINING, AND RETENTION OF PARKING PERSONNEL

Lynne Schumal, MPM and Kirsten Dolan

Lynne Schumal and Kirsten Dolan are the owners of Advanced Parking Solutions LLC, which provides advisement and training to owners and operators of all types of parking assets. Prior to Advanced Parking Solutions, Central Parking System employed both Kirsten and Lynne where they worked at the regional level for the company on the West Coast. With more than twenty years of parking experience, Kirsten and Lynne understand the skills needed to recruit, train, and retain parking personnel that will operate parking facilities to meet a client's needs.

Introduction

Finding and keeping quality employees is a task in the parking industry. No university or college currently offers a degree program in parking management. How many prospective parking managers come to the parking industry looking for a job because that's the industry they've always wanted to work in? The attractiveness of the industry to quality management candidates is less than desirable. New managers must work odd shifts, in a less than comfortable office environment in the middle of a parking lot or garage. Salaries are less than competitive, and frankly, many people don't think that someone has to manage a parking lot to get it to operate effectively! As you know, it does take someone to operate the parking facility effectively, and these managers are few and far between given obstacles such as low salary, undesirable working conditions, etc. In this chapter, you will find some effective tools to recruit, retain, and train parking management personnel, as well as hourly parking personnel. These topics are some of the most important to make your parking operations a success: finding the right people, training them, and most importantly, keeping them employed with you.

Hourly Personnel Recruitment

The recruitment of hourly parking personnel is similar to the recruitment activities of hourly personnel of any retail or cash based business. There are two important topics related to effective recruitment of these hourly employees: the development and use of realistic skill set requirements, and successful techniques to recruit for these positions in your organization.

Skill Set Requirements

There are five different hourly personnel categories that will be addressed: cashiers, valets, maintenance persons, shuttle drivers and auditors/bookkeepers. These categories represent the main job responsibilities in the majority of operated parking facilities. A chart has been included below that outlines the Essential (E) and Desired (D) skills for each job category, along with those skills that are Not Needed (N) for certain job categories.

	VERBAL COMMUNICATION SKILLS	CUSTOMER SERVICE SKILLS	MATHEMATICAL APTITUDE	MECHANICAL APTITUDE	CLEAN DRIVING RECORD	CLEAN BACKGROUND CHECK	COMMERCIAL DRIVER'S LICENSE	ABILITY TO WORK INDEPENDENTLY	DETAIL ORIENTED	WRITTEN COMMUNICATION SKILLS	ACCOUNTING SKILLS
Cashier	*E*	*E*	*E*	*N*	*N*	*E*	*N*	*D*	*N*	*N*	*N*
Valet	*E*	*E*	*N*	*N*	*E*	*E*	*N*	*D*	*N*	*N*	*N*
Maintenance	*D*	*D*	*N*	*E*	*D*	*E*	*N*	*E*	*D*	*N*	*N*
Shuttle Drivers	*E*	*E*	*N*	*N*	*E*	*E*	*E*	*D*	*D*	*N*	*N*
Auditors/Bookkeepers	*E*	*E*	*E*	*N*	*N*	*E*	*N*	*E*	*E*	*E*	*E*

Skill Set Matrix for each Hourly Parking Job Category

The overall listing of skills is as follows, with a short description of the desired skills that would complement the employee's skill set to indicate higher success rates:

- *Verbal Communication Skills* – The prospective employee should be able to communicate well verbally. This should also include the use of proper English, without the use of profanity or slang.

- *Customer Service Skills* – The prospective employee should be able to demonstrate the ability to handle situations where customers have questions or complaints. This can be demonstrated by involving the applicant in some predetermined role-playing situations during the interview process, or the applicant should have job experience that included a high level of customer interaction.

- *Mathematical Aptitude* – The prospective employee should have the basic math skills to handle cash in a fast paced environment. This may be ascertained through testing applicants with a short math calculation test. This test should include questions pertaining to giving the correct change back to a customer, and calculating parking tickets manually using an established parking rate structure.

- *Mechanical Aptitude* – A prospective maintenance person should have the ability to make small repairs around the parking facility. The hiring manager should check the applicant's job history to ascertain if he has had previous employment that required mechanical aptitude, or be able to ascertain mechanical aptitude through some sort of testing during the interview process.

- *Clean Driving Record* – A steadfast requirement for all applicants applying for a valet or shuttle driver position should be a clean driving record. Typically, this record should be entirely free of any accidents, Driving While Intoxicated (DWI) citations, or other moving violations. Applicants may be asked to provide their driving record from their local Department of Motor Vehicles.

- *Clean Background Check* – To the extent of local legislation, prospective applicants may be asked to provide a background check as part of the job application process. These background checks normally cover convictions locally. More in depth background checks can be procured from firms that specialize in such services and extend the background check to a credit check as well.

- *Commercial Driver's License* – Shuttle drivers, if required by local laws, should have a current Commercial Driver's License upon hire, and should be able to provide the prospective employer with a copy of the license. There are differences in local laws that may preclude your shuttle drivers from having to be licensed commercially. Check your local legislation to assure that your shuttle program is in compliance.

- *Ability to Work Independently* – Prospective employees who are applying for the auditor/bookkeeper positions in your organization should have the ability to work independently. These positions in the parking facility often staff the parking facility's office and must be able to complete their work without much supervision. It is desirable that shuttle drivers and maintenance persons can function without supervision as well.

- *Detail Oriented* – Prospective auditors/bookkeepers should possess detail orientation. The job responsibilities for this category depend on being able to be detail oriented. It is desirable that shuttle drivers and maintenance persons be detail oriented also, given their independent work responsibilities that lend themselves to success with detail orientation skills.

- *Written Communication Skills* – Prospective employees applying for auditor/bookkeeper positions should posses written communication skills. This should include the proper use of written English; preferably these candidates should have the ability to write a professional business letter with good use of their written language skills. Applicants could write a business letter during the interview process to assess skills in this area.

- *Accounting Skills* – Prospective employees applying for an auditor/bookkeeper position should possess basic accounting skills. This should include the ability to understand the differences between assets and liabilities, and revenues and expenses. Successful candidates should have accounting experience that involved the Accounts Payable (A/P) or Accounts Receivable (A/R) processes within their previous job experiences.

Techniques to Effective Recruiting

Recruiting quality hourly personnel can be a difficult task; in many cities the unemployment rates have been low, leaving fewer qualified candidates interested in parking positions. These positions may require individuals to work in the elements, odd shifts, or in a situation with little advancement opportunity. As an individual charged with the responsibility for hiring hourly personnel, compile a resource list specific to your city or area, and refer to it throughout the hiring process. There are six effective recruiting sources that have historically been beneficial to the parking industry. Each is discussed in detail below.

Community Colleges/University Work Study Programs – Students are a great source for parking positions. Many times they are interested in part time positions, odd hours, and slow shifts or locations where they have the ability to study. If you are new to the area, check the Yellow Pages for colleges nearby, and call to determine the correct contact numbers and information for recruitment. Colleges often maintain bulletin boards available for the posting of positions. This can be an economical way to recruit a pool of individuals.

Internet – The Internet is a valuable resource for posting hourly positions; sites such as www.EmploymentGuide.com cater to all areas of the country. These sites allow employers to post openings through their own "Employer Centers." These centers provide the required information to assist individuals with the posting process.

Print Advertising – Most people think of newspaper ads when they think print advertising. They also shudder at the potential cost associated with those ads. Beyond the newspaper, print advertising can take on a whole new meaning and actually be just as economical and effective as other methods. Smaller publications like "Help Wanted," "The Employment Guide," or periodicals targeted toward certain communities or ethnic groups are a good start. Again, these possibilities may be found in the yellow pages under Newspapers, Internet, or by walking around your area to determine what's out there.

Competitors or Other Employers – How many times have you received good service from someone at a competitor's location, a McDonalds, a Starbucks, or a hotel? These customer service individuals are potential candidates for open positions. Managers should be encouraged to give out business cards (or a contact name and phone number) at ANY time they come across great service. This includes times when the manager is not on duty. Every service contact in a restaurant, movie theatre, or retail outlet should be considered if the individual shows excellent service skills. If you have five managers and they each hand out three cards, the potential applicants just multiplied to fifteen. Just think, these are fifteen people who have been observed actually providing good service.

Community Service Agencies – Some of the most reliable employees have come from retirees and disabled groups. Most cities have organizations like the AARP that will help firms get in touch with and advertise positions to these groups. Search the yellow pages or on the Internet to determine how to get involved in your area.

Refer a Friend Program – This program is a successful way of involving the current employee base. Employers can offer a "reward" for those individuals that recruit another employee that stays on for a specific period of time. The reward could be monetary or otherwise, and should be periodically advertised to the employees through posters and paycheck stuffers. Keep the program simple, and ensure that the person administering the program is timely in providing the reward to the recipient.

Hourly Personnel Training

Training Topics

Once the hourly individual is hired, it is important to provide an orientation explaining basic company policies. In addition, each employee should receive training specific to the position. Just as the importance of skills has been discussed earlier, it is also critical to continue reinforcing skills through employee training.

Many times managers do not provide proper training because they are in desperate need of placing individuals to work immediately. Although this cannot always be prevented, it is advisable to put together a strict training regime that is a requirement for every employee. These training requirements should be also be given a required completion time line. This enables mangers to operate in a realistic environment, where an individual can be put to work quickly, but still sets the training bar.

Math skills review – Even though many locations are automated and do not require cashier time calculations, every cashier must have the ability to accurately calculate times and rates. Inevitably, equipment goes down or power goes out, leaving the individual to determine what to charge the customer. There are also locations that are still not automated, but utilize time clocks for calculations, thereby requiring the attendant to understand how to calculate the rate manually. Furthermore, it is important for management to cross utilize employees from location to location. For these reasons, all employees must periodically review the math skills needed to accurately calculate the customer charge.

The training provided can begin with simple time calculations, including some exercises in military and standard time. Multiple day calculations should also be covered. After explanation and some example exercises, a test to check for understanding should also be administered. During this math skill review training, the trainer should use practical exercises such as subtraction of beginning and ending ticket numbers, totaling and any other items on a typical cashier report.

Customer service – Customer service training needs to occur often and be repetitive. Parking employees working in association with hotels, restaurants, or other institutions that have their own set of service classes need to participate as a team member in those training classes. Internal customer service programs should be designed around a generic program that is taken and tailored to the parking industry. One way to get started is to send one or two managers to generic customer service training, and make them responsible for bringing back information and applying to the parking operation.

Valet training – Valet training must be completed prior to allowing a new individual to work alone. Valets must be provided written rules and operational tips prior to the first day on the job. The operational tips should include the following:

- Key starting tricks for various car makes and models
- Procedure for keys locked in a car
- Procedure for missing keys
- Procedure for missing cars
- Damage occurring prior to receiving vehicle
- Damage occurring after receiving vehicle
- Handling customer claims of stolen items

In addition to the referenced reading material, all valets must be provided hands on training. This means physically working with another valet for at least two days prior to ever "handling" a vehicle. After the valet trainee has observed for two days, he should switch places with the mentor. Not all employees should be mentors, only those possessing the desired experience and safety record.

Maintenance training - This position is usually one of the most neglected positions in terms of training. Whether maintenance personnel have responsibilities in cleaning the facility or fixing equipment, these individuals still require guidance and training. Too many times maintenance people are left on their own to determine what needs to be done at a facility. Each week the individual should be given clear direction on which items are to be accomplished for that workweek. In addition, the person should be shown the best techniques for handling any of the new tasks on the list. The more experienced maintenance person should be shown how to do basic equipment maintenance such as cleaning the readers, clearing dust from the ticket issue machine(s), synchronizing the machine clock to the fee computer, and adjusting the sensitivity of the lane loops. Hiring an individual with mechanical aptitude will make this training fairly straightforward.

Auditing training – Facility auditors are positions where the least of amount of training typically takes place. Even though these individuals have the ability to potentially save the company several thousands of dollars in theft, usually little time is devoted to the proper training. Auditors need to learn more than ticket auditing. They should also be made aware of the proper way to perform card audits, permit reconciliation, and validation audits. The most difficult part is finding a person within the organization that really knows the proper method to accomplish all of these types of auditing. It may be necessary to go outside of the organization to meet the training needs of this group.

Accounts Receivable (A/R) training – Training specific to the type of A/R program should be given to those individuals responsible for billing. The software maker usually is willing to offer training at a price, and this training may be worth it to get the most out of your software package. In addition to the technical training provided by the vendor, the individual must be exposed to an operational trainer within the organization to get the most practical education on the system and its application.

Shuttle Driver Training – Shuttle driver training is much like valet training in that there should be a written policy provided to all drivers. Topics include vehicle maintenance, required OHSA or permit paperwork, and internal company paperwork. Drivers should also be required to team up with another driver for a specified period of time, and then be observed by the mentor prior to driving on their own. Continuous training for shuttle drivers should be given that covers safety issues, customer complaints or feedback, projected passenger load levels, and any other concerns specific to the location.

Training Delivery Methods

As technology continues to improve, training delivery methods also continue to improve. Below is a listing of delivery methods and their respective advantages and disadvantages for each one:

Classroom

- *Advantages*
  - Good way to do 'mass training' of personnel all at once.
  - Encourages networking of attendees after the class (attendees may not have known each other previously if combined with others from different shifts).
  - Gives the instructor the ability to utilize different types of presentations to address attendee's differing learning styles.
- *Disadvantages*
  - An appropriate location must be found. If you work for a small company, you may have difficulty finding a room to accommodate your staff.
  - May have to be taken off site to accommodate all attendees, which would affect attendees by increasing travel time, traveling to an unfamiliar site, etc.

- Attendees may feel uncomfortable in the group setting to ask questions or ask for clarification on the material presented.

Hands on Field Training

- *Advantages*
  - Aids in trainer assessment of overall performance of employees at the tasks addressed.
  - Enables the attendees to 'practice' trained tasks in a simulated environment.
  - Helps to develop an environment where the trainer is established as a mentor, eliminating the constraints of the 'teacher/student' relationships enforced by other delivery methods.
- *Advantages*
  - May be hard to find a practice area, free from 'live' customer interactions to conduct this type of training.
  - May be difficult to keep the attention of all attendees if practice area only enables one attendee to practice at a time.
  - Difficult to assess trainee's knowledge base prior to this delivery method, may increase 'over training' for certain accelerated performers.

Manuals
- *Advantages*
  - Gives written procedures and policies that the employee can refer back to for questions.
  - Only requires the trainer to 'give' the training once.
  - Keeps policies and procedures standardized so that employees aren't trained differently with each training session.
- *Disadvantages*
  - Takes a lot of time to prepare.
  - This delivery method doesn't address all types of learning style preferences.
  - This delivery method cannot address soft skills training, only hard skills training topics.

Online
- *Advantages*
  - Gives trainees time to complete the training at their own pace.
  - May address all types of learning style preferences by varying the way information is disseminated to the trainee.
  - May be accessed from a variety of locations in an independent fashion.
- *Disadvantages*
  - Will not be the method of choice for those trainees who are not computer/Internet savvy.
  - May be cost prohibitive for smaller companies depending on the complexity of technology utilized to deliver the training online.
  - Takes a lot of time to prepare training for presentation.

Videos

- *Advantages*
  - Gives standardized training to trainees every time.
  - Has the ability to address soft skills training such as customer service training topics.
  - Trainer's time is not utilized during actual training, only during production of videos.
- *Disadvantages*
  - May become obsolete quickly if procedures and policies change often.
  - Expensive to produce videos for smaller companies.
  - This delivery method doesn't address all types of learning style preferences.

One-on-One Mentoring

- *Advantages*
  - Helps trainee get comfortable enough to ask questions during training delivery given the individual attention.
  - Aids in motivating the mentor to truly train the trainee.
  - Can help to train individuals who have a longer learning curve.
- *Disadvantages*
  - May take the mentor's time away from their operational duties.
  - Trainees may rely too much on their mentors to complete their job duties.
  - May not get the desired results if mentor and mentee have personality conflict.

Hourly Personnel Retention

Effective Motivation Techniques

Once individuals have been hired and trained, it is important to retain them for continuity and cost reasons. Five techniques for aiding in retention of employees are discussed below.

Performance Appraisal System – In many organizations, management does not take the time to provide employees with feedback on their performance. Good employees don't understand their value to the company, and bad employees just get worse. For this reason, a performance appraisal system must be put into place and be given to the employees on an expected and continuous timeframe. Performance appraisal systems need not be complicated, but should ensure that there is an understandable ranking system.

Employee Benefits – Even though the monetary compensation of a position is important, potential employees are also looking for benefits to support their families. Providing insurance, employee stock purchase programs, subsidized transportation, retirement, and the like may be the deciding factor on which company an employee chooses for the long term. An employee considering leaving for another position may not make the move if he has a lot at stake in terms of benefits, even if the money is better in the other position.

For companies that are locked in to a certain benefit structure on insurance, retirement, etc., management must get creative in putting together other "perks" such as assistance with bus tokens or other modes of transportation.

Providing Challenge – Many times employees leave positions because they are bored and do not feel challenged or appreciated. It is the job of management to ensure that all employees are utilized to their full capacity. For example, a cashier may be able to help provide administrative or data work that is needed for analysis by management. This work may not get completed due to time constraints of office personnel, while a person in the booth sits idly waiting for the next car to exit the facility. Look at each person's position, shift, and workload for untapped talent. Another good way to do this is to have managers cross analyze locations, so that there is a new perspective on an old method of doing business. The objective is to do more with what is already in place, and to keep employees challenged.

Employee Incentive Programs – Employees need to participate in the success of the facility and to understand that in bad times everyone participates as well. This means putting a program into place that will "bonus" employees when goals are met (and will not when goals are not met). Example programs that have been successful include using the following goals as targets for employees

- No valet accidents/safety
- Good customer service ratings on surveys
- Recognition by customers
- Financial targets
- Benchmarks specific to the position (i.e., number of trips for shuttle drivers)

It is important that the program be evaluated objectively and that the requirements of the program are communicated clearly and frequently to participants.

Training Programs – Employees naturally feel more motivated when given training. It shows that the company and management take an interest in them, and that they are a valuable part of the team. Training annually in a generic format is not sufficient. Employees need to have the ability to provide feedback on topics they would like to see and questions they would like answered. Training should not be simple lecture style sessions; they should include role-playing, hands on exercises, and thought provoking exercises requiring involvement from the participants to address employee's different learning style preferences.

Management Personnel Recruitment

Skill Set Requirements

"Due to the specialization of the parking industry, and the lack of knowledge of the opportunities within it, recruiting talented individuals to managerial jobs is difficult.[1]" Companies need to determine the skill set requirements for their positions and ensure that these are communicated throughout the organization. This prevents confusion when a selection is made. "There are a variety of opinions as to what makes a successful parking manager, but the ability to grow with an employer and take on increasing responsibilities still rank at the top. Both degreed and non-degreed candidates can succeed in this industry, and they each have their own strengths. Degreed or not, when recruiting entry-level parking management candidates, make sure they possess the following:

- Good written and verbal communication skills
- Management or supervisory experience, preferably in a cash-based industry
- Basic accounting skills and a mathematical aptitude
- Experience with word processing and spreadsheet software
- Good customer service skills and a professional demeanor[1]"

Techniques in Effective Recruiting

To better attract candidates with this skill set, offer a competitive salary to draw them away from other industries. The following sources are recommended recruitment pools.

College/University Career Centers – Colleges and University Career Centers are a good source of management candidates, and information is usually provided at no cost to the employer. Many graduates do not have experience and are looking for opportunities that provide growth. College career centers can put you in touch with a prescreened pool of applicants based on criteria you provide. Interviews can be conducted at the college for student convenience, and the school will provide complete packets on each individual. It is important that the interviewer convey an appropriate message about the position, exuding professionalism, but being realistic about the nature of the position itself.

Parking Conferences – Attending parking conferences puts you in touch with a variety of individuals that are already in the industry, and understand the expectations of working in a parking facility. The three main parking magazines and their websites typically list the upcoming conferences a year in advance. Attend those that are economically feasible. Hand out and collect business cards of potential management candidates, even if you do not have a need today. Keep these cards for future reference and stay in touch with candidates, even when you do not have positions available. This lets the candidates know that they are important to you and gives you an advantage over other firms.

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[1] Dolan, Kirsten and Lynne Schumal, "Management Level Recruitment and Retention in the Parking Industry." Parking 42.5 (2003): 21-22.

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Internet – As discussed earlier, the website for The Employment Guide at www.EmploymentGuide.com is an excellent source for posting jobs for hourly employees. They also have postings for management positions as well. Other sites are www.monster.com and www.careerbuilder.com; these sites are geared toward salaried positions and serve all areas of the United States. For industry specific information, national and regional parking association websites are an effective resource as well.

Print advertising – Management positions may be posted in the largest circulated newspaper for the area. While ads can be costly, they usually generate several hundred leads per ad. Many of these leads, however, may not result in experienced or interested candidates. Any and all individuals seeking a management position will apply – many with no interest in the parking industry. "Ad placement in an industry magazine…is also effective, and will give the position national exposure[1]". The key to successful print advertising is how the advertisement is written. Leaving out key points or benefits in an attempt to cut ad line costs may can result in an ineffective ad. A Human Resource professional may assist with the creation of the ad, avoiding costly mistakes.

Networking – The person in charge of hiring management personnel must be in touch with other organizations related to the parking industry or other related groups. The recruiter can meet more potential candidates by partaking in social events and industry networking events. The recruiter should also network with the current management staff. References from current employees may be one of the easiest ways to recruit individuals who will fit into the industry.

Diversity Issues

There are many advantages to proactively recruiting a diverse workforce, especially in terms of management personnel. Categorically, hourly parking employees as a group, are more diverse than the management personnel pool in the industry. The largest advantage in creating and maintaining a diverse management pool is to increase the company's ability to recruit minorities to the management ranks. Typically, minorities will recruit other minorities, aiding a parking operator by illustrating diversity to a client that is relative to the diversity of the parking facility's customer base. The more diverse the employees are, the easier it is to match the customer base of any prospective location.

[1] Dolan, Kirsten and Lynne Schumal, "Management Level Recruitment and Retention in the Parking Industry." Parking 42.5 (2003): 21-22.

Management Personnel Training

Training Topics

As with hourly parking personnel, training and orientation upon hire and continuing throughout the employee's career is penultimate to retaining management personnel. Below is a review of different training topics essential for the success of parking management personnel, and what should be covered for each topic.

Accounting Skills Review – Accounting review and training is a very important part of management personnel training. One of the most critical items reviewed by the management account client of a parking operation is monthly management reporting. Even though the parking operator's accounting department may prepare this report, a client expects that the manager of the location understands each part of the revenues and expenses as if he or she has prepared the report in its entirety. One of the best ways for a manager to understand the reporting process to the client is to have the manager complete the monthly management report, including those parts normally prepared by others in the organization. In addition, if the manager is not responsible normally for the A/R or A/P functions of the location, it is vital that the manager understand the procedures and process to complete those functions. Again, solid training of these functions normally requires the new manager to carry out these functions for a specific period of time to understand the process. All of these small parts are integral to a new manager's understanding of the back-of-the-house accounting used in the parking facility.

Word Processing and Spreadsheet Software Training – It is safe to say that word processing and spreadsheet software training may make or break a new parking manager. Even though most new managers find themselves staffing a parking booth or fixing a jammed ticket spitter, the new manager must realize that the administrative expectations of a parking manager still exist. At a minimum, new parking managers should be tested on their understanding of the word processing and spreadsheet software used by your company soon after their hire. Once their understanding level has been assessed, a training program should be prepared to ensure that their administrative skills are acceptable. Most generic training companies offer various levels of software training for the most popular titles of word processing and spreadsheet software. Successful use of these software programs enables you and your parking managers to prepare professional deliverables to your colleagues, superiors, customers and most importantly, your clients.

Customer Service –The more customer service training you give to your line managers, the less complaints reach you as a middle or upper manager. Successful customer service training allows line managers to proactively repair a customer complaint at their level. Customer service training and reviews should concentrate on giving the line manager the resolution skills needed to ensure that customer complaints don't grow and reach the upper levels of the company. Make sure that customer service training for all managers happens at least annually as a review for everyone.

Professional Writing Skills – While new managers should be able to write a professional letter upon hire, continuing to improve writing skills is always helpful. Skill improvement in this area will usually take place with on-the-job writing assignments that are reviewed by superiors for content, style, and grammar. Training, per se, will happen as the writing assignments become more extensive, until the manager can produce writing that doesn't need to be reviewed.

Presentation Skills Training – Especially for smaller operators, presentation skills may come into play early in a new manager's career. He may have to be approved by the location's client prior to beginning their employment with the parking operator. Clients look for managers that can speak within a small group, identifying those candidates who will be able to deal with parking customers and other groups within the project. As a manager's career grows, so should their presentation skills. Managers should have opportunities to present to their peers and superiors, in formal and informal settings internally, to help them gain confidence. Managers should present often and be able to present in client situations as their career dictates. Employees whose presentation skills are not equivalent to their management level should be remedially trained to increase their skills to an equivalent level.

Client Service – Second to a manager's accounting skills, their ability to service their client is most important. The two most important client service skills that need to be developed in a new manager are: improvement of their proactive mindset, and the ability to assess the needs of the client accurately. One proven technique to improve a manager's proactive skills is for the manager to complete a weekly activity memo to his or her client. This memo should be addressed to the client and copied to the manager's superior(s). In this memo, the manager should review the items that were completed and discuss the items to be completed for the next week. The items that should be communicated to the client are the things that will improve the operation of the location *from the client's perspective.* By completing this communication every week, it will enforce the proactive mindset that is expected by a client and the manager's superiors. Within a few weeks, a manager will have to be creative in his or her tasks to keep moving the location forward and improving the operation. This will also improve client communications, and keep the manager's superiors updated weekly on the progress of the manager and location happenings.

To assess the needs of the client, a manager should rely on his superiors to assist in developing his abilities in this area. A manager should not be afraid of the client, but should stay involved with the client daily to understand what the client needs and wants. Effective communication skills aid in assessing the needs of the client.

Training Delivery Methods

Training delivery methods and their advantages and disadvantages have been covered earlier in this chapter, and relate to hourly as well as management personnel. Below is a review of how learning style preferences of individuals are defined, and should be addressed when developing training for all of your employees.

Learning Style Preferences

- Visual Learners
  - Form pictures in their heads and work from "the big picture"
  - Take notes as pictures
  - Like analogies
  - Like overheads and on-screen presentations
  - Have trouble listening if they cannot tell where something is going

- Visual Learning Tips
  - Use graphics to reinforce learning – films, slides, illustrations, charts, etc.
  - Color code to organize notes
  - Written directions
  - Write out everything for quick and frequent visual review

- Auditory Learners
  - Need to hear all the facts
  - Hear words and sounds
  - Like details, statistics, and facts
  - Like audio tapes and presentations

- Auditory Learning Tips
  - Use tapes for reading and for class and lecture notes
  - Verbally review lectures and training with a friend
  - Learn by interviewing or by participating in discussions

- Kinesthetic Learners
  - Learn by doing
  - Like to ask questions
  - Like small group discussions
  - Like hands-on practice
  - Like to take breaks so they can move around
  - Keep their hands engaged during presentations

- Kinesthetic Learning Tips
  - Experiential learning (make models, do lab work, and role play)
  - Frequent breaks in study periods
  - Use a computer to reinforce learning through a sense of touch
  - Write out facts to be learned several times

About 40-60% of all learners are visual learners; auditory learners compose 20-30% and kinesthetic learners make up 10-20% of all learners. Since most learners are visual, it is recommended that most training be developed to address this type of learner. A variety of activities is important so that all learning style preferences are addressed within a training session. This will guarantee that you get your point across to your trainees, and your training time can be used most effectively. Use the tips above to help you define your training. You will find that your employees will be excited to be trained when their learning style preferences are taken into consideration.

Management Personnel Retention

Effective Motivation Techniques

Just as it is important to keep hourly employees motivated, it can be even more costly if management turns over due to a lack of motivation. Experience suggests that the following methods can help prevent management demotivation and increase retention efforts.

Continuing education – "One of the most effective motivation techniques for the new employee is to offer continuing education throughout their career. This can take many forms depending on the size and scope of the employer. Continued education through an in-house training program provides employees at all levels with increased parking operation knowledge. These programs are especially helpful with new employees who have little or no parking operations experience.[1]" Some programs that can provide managers the parking specific education needed are as follows:

> CPFM – The National Parking Association offers the CPFM (Certified Parking Facility Manager) program. This program is a practical, comprehensive curriculum designed to assist managers in performing their duties in an effective and professional manner. For more information contact the National Parking Association or go to their website at www.npapark.org.
>
> CAPP – The International Parking Institute administers the CAPP (Certified Administrator of Public Parking) program. This program offers two-day and five-day sessions of comprehensive seminars along with administration of a certification exam. For more information contact the International Parking Institute or go to their website at www.parking.org.

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[1] Dolan, Kirsten and Lynne Schumal, "Management Level Recruitment and Retention in the Parking Industry." Parking 42.5 (2003): 21-22.

OTHER TRAINING PROGRAMS – There are other training programs available from private organizations. Dale Carnegie and Padgett Thompson provide more generic management topics, but do not focus their applications to the parking industry. Companies providing industry specific training may be found on parking magazines' websites under vendors, and then training.

Performance appraisal system – Every employer should ensure that a performance appraisal system is in place for all management personnel. For the system to be successful, it must address a quantitative rating system along with written and verbal feedback on improvements to be made by the employee so they may achieve a higher level of job responsibility.

Mentoring programs – These programs pair more experienced managers with new incoming managers. It provides a two-way benefit in that the experienced manager takes responsibility for their trainee, and the trainee benefits from the knowledge of a person who has already been in their position.

Sincerity about advancement – Management employees can become disenchanted with a company or a position if they feel their career is not advancing as quickly as they originally expected. Many times, an overzealous recruiter may lead a management candidate to believe that their growth potential is greater, or can happen faster, than is really known at the time of hire. Once a person has been on board for a certain period of time, a realistic assessment of the individual's career path and timeline should be determined. It should also be discussed candidly with the individual to prevent demotivation. Management should remember that keeping a person "hanging on" by making unrealistic promises only results in a person leaving eventually, and probably at a higher cost and a greater loss of time by the company.

Provide challenge – Like hourly employees, management employees need to be challenged and pushed beyond the scope of their current position. This motivates the individual and gives management an indication of their potential to advance. Individuals that are not interested in challenge may also be identified, and little time should be spent on trying to train or move those identified to the next level.

PARKING FACILITY ECONOMICS AND APPROACHES TO FINANCING

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Introduction

Parking facilities often make important contributions to the success of an aviation facility, a cultural attraction, a healthcare center, a higher center of learning, a real estate development, and/or an urban center. Parking is often the first and last experience of a visitor patronizing a particular place. From an owner's perspective, this chapter contains good news and bad news. First, the bad news is that most structured parking facilities are not self-supporting. By this, we mean that operating revenues are often insufficient to cover operating expenses and debt service. Because of this reality, it is often not possible for an owner to obtain 100 percent financing on their parking project without subsidies of some kind. Now, let us discuss the good news. There are a number of proven strategies that have been successfully used to fund parking facility capital projects. The most common methods of subsidizing parking projects include federal grants, tax-increment financing, taxes from business improvement districts or parking tax districts, and net revenues from other facilities.

Owners often need to engage a specialty consultant in the conduct of a market and financial analysis study. The purpose of such a study is to quantify the projected demand and revenues of a proposed parking facility project and the extent to which these revenues are projected to cover operating expenses and debt service. If during the course of such study it is determined that operating revenues are projected to adequately cover operating costs and debt service, then there is no need to identify additional funding sources. However, for those projects that do not "pencil out," a subsidy is required. This subsidy may be defined and quantified through this study process.

The purpose of this chapter is to provide a primer covering the cost and economics of parking improvements and the most common approaches to funding these improvements.

Readers of this chapter may have the following questions:

- How much does a parking facility cost to develop?
- How much does a parking facility cost to operate?
- What are the most common methods for financing parking facilities?

Let us begin with a discussion of parking facility costs.

The Cost of Parking

Development and operating costs of parking facilities vary widely. Land acquisition costs, construction costs, soft costs, and operating expenses are types of costs that should be considered during the planning phase of a parking project.

Land Acquisition Costs

Land costs are often not included during the preparation of a parking project's economic analysis. In many cases, the institution that is planning a parking facility, an airport, hospital, municipality, university, etc., already owns the land that serves as the site for the proposed parking facility. However, in those cases where land costs do need to be recouped, land acquisition costs become a significant part of the equation. There is no rule of thumb for typical land acquisition costs. These vary significantly from one locale to another and depend on a multitude of issues including access, density of development, surrounding land uses, income potential, etc. Land acquisition costs can often add from $15 to $100 or more per square foot of land area to the overall project cost.

Construction Costs

The most significant variable impacting construction or "hard" costs is the type of parking improvement. Surface parking lots can be constructed for as little as $1,000 per space or less for a basic paving and striping project, and as much as $3,000 or more per space for a grander project featuring an elaborate drainage systems, premium light fixtures, signage and graphics, and landscaping.

Structured parking costs, which represent comparatively higher costs per space than surface parking, typically range anywhere from $8,000 to $30,000 or more per space, depending on the project particulars. The low end of this range will likely buy a simple concrete parking structure with limited aesthetical appeal. Characteristics of a facility at the high end of this range would likely include extensive architectural treatments, the construction of an inefficient facility on a difficult site, and/or the construction of a facility below grade. Costs closer to the low end of the range are more common. An owner's desire to develop an architecturally significant structure and/or a structure that functions at a high level of service will spend more on a parking structure than an owner unconcerned with architecture and/or function.

Construction costs vary based on geographic area because of differences in labor rates, materials, and construction methods. Table 1 demonstrates geographic variability in parking structure costs per square foot for several metropolitan areas. The source of this data is R.S. Means, a nationally recognized cost service.

Table 1: Parking Structure Construction Costs

	Cost/Space		Cost/Sq. Ft.		'01 – '02
Metropolitan Area	325 s.f./sp.	375 s.f./sp.	2002	2001	Change
New York City	$13,868	$16,001	$42.67	$41.36	3.20%
San Francisco	$12,815	$14,786	$39.43	$37.70	4.60%
Boston	$11,850	$13,673	$36.46	$35.36	3.10%
Chicago	$11,538	$13,313	$35.50	$34.26	3.60%
Philadelphia	$11,456	$13,219	$35.25	$34.26	2.90%
Minneapolis	$11,219	$12,945	$34.52	$34.32	0.60%
Los Angeles	$11,157	$12,874	$34.33	$33.36	2.90%
Detroit	$10,972	$12,660	$33.76	$32.66	3.40%
San Diego	$10,901	$12,578	$33.54	$32.69	2.60%
Portland	$10,901	$12,578	$33.54	$32.81	2.20%
Seattle	$10,858	$12,529	$33.41	$32.10	4.10%
St. Louis	$10,611	$12,244	$32.65	$31.73	2.90%
Cleveland	$10,582	$12,210	$32.56	$31.64	2.90%
Pittsburgh	$10,478	$12,090	$32.24	$31.18	3.40%
Kansas City	$10,374	$11,970	$31.92	$30.75	3.80%
Denver	$9,818	$11,329	$30.21	$29.27	3.20%
Washington, D.C.	$9,737	$11,235	$29.96	$29.15	2.80%
Baltimore	$9,428	$10,879	$29.01	$28.26	2.70%
Atlanta	$9,230	$10,650	$28.40	$27.40	3.60%
Phoenix	$9,211	$10,628	$28.34	$27.46	3.20%
Houston	$9,097	$10,496	$27.99	$26.97	3.80%
New Orleans	$8,808	$10,163	$27.10	$26.35	2.80%
Dallas	$8,778	$10,129	$27.01	$26.14	3.30%
Miami	$8,769	$10,118	$26.98	$26.48	1.90%
Winston-Salem	$7,768	$8,963	$23.90	$23.34	2.40%
Mean	$10,409	$12,010	$32.03	$31.08	3.05%

Source: R.S. Means, 2002

(1) *Cost per space figures are calculated based on 2002 dollar per s.f. numbers.*

(2) *Costs are for the basic building, and do not include special site work, land, development, specialty finishes or equipment. Square foot costs vary significantly from project to project because of differences in quality, complexity, and economic climate.*

The table above includes two columns that provide construction costs on a per space basis. This was derived by assuming an average efficiency of 325 or 375 square feet per space, and then simply multiplying the building costs per square foot by these assumed efficiency rates. The lower end of this range represents a reasonable expectation for an efficiently designed parking structure. To realize 325 square feet or less per parking space, the site needs to be at least 120'-0" x 270'-0". Smaller sites typically result in less efficient designs and higher costs per square foot.

The R.S. Means parking structure construction cost data shows a three percent average marginal increase for Year 2002 over 2001. The highest reported increase was in San Francisco, where square foot costs rose 4.6 percent. Seattle came in second, with a 4.1 percent jump, followed by Houston and Kansas City, where costs reportedly inched up 3.8 percent. On the lower end were Minneapolis (0.6%) and Miami (1.9%). In general, the average cost increase tends to be similar to increases in the Consumer Price Index (CPI).

At $42.67 per square foot, New York City reportedly had the highest construction costs. San Francisco and Boston grabbed the second and third slots, with square-foot costs of $39.43 and $36.46, respectively. Of the cities surveyed, the lowest square foot construction cost of $23.90 was found in Winston-Salem.

Table 2 is a matrix demonstrating that parking facility construction costs are a function of structure design efficiency. Unit costs represent a wide range of possible costs for a parking project. The design efficiency is presented in terms of square feet per space using the most probable range featured by designs.

Table 2: Construction Cost per Parking Space

		S.F. / Space				
	$/S.F.	275	300	325	350	375
Pkg. Lot	$5.00	$1,375	$1,500	$1,625	$1,750	$1,875
	$7.50	$2,063	$2,250	$2,438	$2,625	$2,813
	$10.00	$2,750	$3,000	$3,250	$3,500	$3,750
Above Grade P.S.	$20.00	$5,500	$6,000	$6,500	$7,000	$7,500
	$22.50	$6,188	$6,750	$7,313	$7,875	$8,438
	$25.00	$6,875	$7,500	$8,125	$8,750	$9,375
	$27.50	$7,563	$8,250	$8,938	$9,625	$10,313
	$30.00	$8,250	$9,000	$9,750	$10,500	$11,250
	$32.50	$8,938	$9,750	$10,563	$11,375	$12,188
	$35.00	$9,625	$10,500	$11,375	$12,250	$13,125
	$40.00	$11,000	$12,000	$13,000	$14,000	$15,000
Below Grade P.S.	$50.00	$13,750	$15,000	$16,250	$17,500	$18,750
	$60.00	$16,500	$18,000	$19,500	$21,000	$22,500
	$70.00	$19,250	$21,000	$22,750	$24,500	$26,250
	$80.00	$22,000	$24,000	$26,000	$28,000	$30,000
	$90.00	$24,750	$27,000	$29,250	$31,500	$33,750
	$100.00	$27,500	$30,000	$32,500	$35,000	$37,500

Source: Walker Parking Consultants, July 2003

Soft Costs

To derive a total project cost, other costs must be added to the construction and land costs. These additional costs are referred to as "soft" costs, and may include items such as a construction contingency, architectural/engineering fees, soils and materials testing, debt service reserve funds, legal fees, and financing costs. Soft costs can vary significantly but typically fall within 15 to 35 percent of construction costs.

Operating Expenses

Operating expenses of parking facilities also vary dramatically. Variations are due to geographical location, size of facility, staffing patterns, method of operation, and local legal requirements. These expenses include the cost of utilities, supplies, daily maintenance, cashiering, management and accounting services, on-site security, structural maintenance, and insurance. Types of insurance coverage include comprehensive liability, garagekeeper's legal liability, fire and extended coverage, workers' compensation, equipment coverage, money and security coverage (theft occurring on the premises), blanket honesty coverage (employee theft), and rent and business interruption coverage (structural damage resulting from natural phenomena). Annual operating expenses for structured parking facilities typically range from $200 to more than $800 per space. These figures exclude parking, property, and sales taxes. Table 3 summarizes a typical distribution of expenses by category:

Table 3: Typical Distribution of Parking Garage Operating Expenses

Cashiering	23%
Management	16%
Security	14%
Utilities	12%
Structural Maintenance	10%
Insurance	8%
Snow Removal/ Washdowns	1%
Parking Equipment Maintenance	5%
Elevator Maintenance	5%
Routine Maintenance	4%
Supplies	2%
TOTAL	100%

Source: Walker Parking Consultants

Parking, property, and sales taxes can be significant expenses and also need to be accounted for during the planning of a parking facility. Several states require a sales tax on parking. For example, the State of Florida levies a seven percent tax on all parking transactions. Property taxes can be expected to run at least 1-3 percent or more of the total property value (land + improvements).

Table 4 provides a list of cities and their various parking tax rates.

Table 4: Parking Tax Rates for Selected U.S. Cities

City	**Parking Tax Rate**
Bainbridge Island, WA	12% of revenues
Bremerton, WA	6% of revenues
Mukilteo, WA	North of Harbour Pointe – 25% of revenues South of Harbour Pointe – 8% of revenues
Burien, WA	$1.00 per transaction
SeaTac, WA	$1.00 per transaction
Tukwila, WA	5% of revenues
Baltimore, MD	$15.00 tax on monthly parking contract plus 12% of revenues for transient patrons
Chicago, IL	Ranges anywhere from 0% to 45% for each transaction, depending on transaction amount
Los Angeles, CA	10% of revenues + 0.591% of revenues for City Business tax = 10.591%
Miami, FL	20% of revenues + State and County sales taxes of 6.5%
New Orleans, LA	3% of revenues + 4% of revenues for State parking tax + 5% of revenues for City sales tax = 12% of revenues
Philadelphia, PA	15% of revenues
Pittsburgh, PA	31% of revenues
San Francisco, CA	10% of revenues + $25 or $150 business registration fee (depending on size of business) + 1.5% payroll tax if total payroll is greater than $166,666
Sandusky, OH	8% of revenues
Santa Monica, CA	10% of revenues
Washington, D.C.	12% of revenues

Source: Parking Tax Analysis – An Assessment of the Potential Implications of Implementing a Commercial Parking Tax in the City of Seattle, Berk & Associates, September 2002 and Walker Parking Consultants.

As shown in Table 4, the City of Pittsburgh, the city with the highest known parking tax rate in the U.S., levies a 31 percent tax on parking revenues. This equates to a 23.664% tax on gross revenues (0.31 tax ÷ 1.31 = 23.664%).

The Economics of Parking

To assess a parking facility's ability to support itself from only revenues it generates, it is necessary to project the facility's average annual debt service payment and then gauge whether or not parking revenues are anticipated to be sufficient to cover not only this debt service, but also the operating expenses previously mentioned.

Projected Debt Service Payment

The debt service payment for a proposed parking facility considers three variables – principal, interest rate, and term. To determine the principal amount, land acquisition costs (if any), the cost of construction, a construction contingency, architectural and engineering fees, and financing costs are included in the total principal amount (assuming 100 percent financing).

Since few parking projects are paid for in cash, the cost of financing becomes an important factor. Some publicly-financed parking projects are financed at fixed interest rates with little or no equity. The interest rate is determined by the debtor's credit history, the amount of collateral, and sometimes the amount of insurance purchased to secure the loan. Currently, parking projects are being financed as both tax-exempt and taxable facilities at rates ranging from five percent to more than eight percent. The customary term for most loans is 20 to 25 years and no longer than 30 years.

Debt Service Coverage Ratio

A debt service coverage ratio is a measure of solvency that is used to determine the project's degree of debt financing. The debt service coverage ratio is computed by dividing net operating income (operating revenues less operating expenses) by the required annual debt service payment (debt service is not defined as an operating expense). The debt service coverage ratio is intended to represent the parking facility's ability to meet its debt obligations. Generally speaking, in comparison to projects with low solvency ratios, projects exhibiting comparatively high solvency ratios suggest that these operations have a greater ability to weather changes in the market or any other unforeseeable financial obstacles. A projected debt service coverage ratio of less than 1.00 means that net operating income is projected to be insufficient to meet the debt service payments. Prior to underwriting a project, an underwriter requires that parking revenue projections for any given year cover debt service by at least 1.25 times and as high as 1.75 or more times.

Examples

Table 5 presents two different scenarios to illustrate the dynamics involved in whether a parking facility may be self-funding or not. Scenario 1 represents a relatively inefficient design and operation while Scenario 2 represents an efficient and cost effective design, as well as a comparatively moderate operating cost of $500 per space annually. Scenario 1 features land costs of $30 per square foot while Scenario 2 assumes no land costs. Parking, property, and sales taxes have been omitted from this analysis.

Table 5: Parking Structure Economics

	Scenario 1 Inefficient Design W/ Land Cost	Scenario 2 Efficient Design W/O Land Cost
Assumptions		
Parking capacity =	130	445
Dimensions =	120'-0" x 120'-0"	120'-0" x 270'-0"
Number of levels =	4	5
Building area =	57,600	149,400
Land area =	22,500	0
Land costs (per s.f.) =	$30	$0
Construction costs (per s.f.) =	$25	$25
Soft costs (% of construction) =	25%	25%
Interest rate =	5%	5%
Term of loan (yrs.) =	20	20
Operating expenses (/space/yr.) =	800	500
Principal		
Land acquisition costs	$ 168,750	$ -
Construction costs	1,440,000	3,735,000
Soft costs	360,000	933,750
	$ 1,968,750	$ 4,668,750
Annual Debt Service	$157,978	$374,633
Required Monthly Income/Space		
+ Monthly debt service/space	$101	$70
+ Monthly op. expenses/space	$67	$42
= Total monthly cost/space	$168	$112
/ Required debt service coverage	1.50	1.50
= Req'd. monthly income/space	$252	$168

As shown by the two examples in the previous table, the required monthly income necessary for a project to achieve the target debt service coverage ratio is $252 per space for the project burdened by a relatively inefficient design (or site) and land costs. This figure decreases to $168 per space for the project featuring a relatively efficient design and no land costs.

It is a rare feat for a parking structure to command revenues approaching $300 for every space each month during the course of one year. Facilities can generate the $168 per space monthly on average, however, many locations exhibit market parking rates that are relatively modest, and therefore do not even permit this more modest level of revenue generation.

Breakeven Matrix

Table 6 presents a matrix that may be used to quickly determine the monthly income required for a parking facility to reach its breakeven point. The breakeven point represents the point in which gross parking revenues are sufficient to cover annual operating expenses and amortized development costs. This analysis assumes that the development costs are amortized over a 20-year period at a six percent interest rate.

Table 6: Monthly Income Required to Breakeven

Project Development Costs Per Space	Annual Operating Expense Per Space									
	$150	$200	$250	$350	$450	$550	$650	$750	$850	$1,000
$1,000	22	26	30	38	47	55	63	72	80	92
$3,000	40	44	48	56	65	73	81	90	98	111
$5,000	58	62	66	75	83	91	100	108	116	129
$8,000	85	89	93	102	110	118	127	135	143	156
$9,000	94	98	103	111	119	128	136	144	153	165
$10,000	103	107	112	120	128	137	145	153	162	174
$11,000	112	117	121	129	137	146	154	162	171	183
$12,000	121	126	130	138	146	155	163	171	180	192
$13,000	131	135	139	147	156	164	172	181	189	201
$14,000	140	144	148	156	165	173	181	190	198	210
$15,000	149	153	157	165	174	182	190	199	207	220
$16,000	158	162	166	174	183	191	199	208	216	229
$17,000	167	171	175	184	192	200	209	217	225	238
$18,000	176	180	184	193	201	209	218	226	234	247
$19,000	185	189	193	202	210	218	227	235	243	256
$20,000	194	198	202	211	219	227	236	244	252	265
$30,000	285	289	293	302	310	318	327	335	343	356
$40,000	376	380	384	392	401	409	417	426	434	447

As shown in Table 6, development and operating costs together determine the revenue necessary for the project to generate a positive or breakeven cash flow. The monthly revenue needed to reach the break-even point usually ranges from $22 to $447 per parking space, depending on development and operating costs.

The purpose of this exercise was to demonstrate the difficulty that many parking projects have generating income levels that are sufficient to cover operating expenses and debt service. Most parking facilities are not self-supporting. Parking facilities frequently are not profitable ventures, and therefore must often be subsidized.

Public Versus Private Financing

To determine if a parking project is going to qualify as a public or private development, we must first review how the Internal Revenue Code classifies organizations that borrow funds. There are two general classifications, public and private. Public organizations are commonly classified under section 501(c)(3) of the Internal Revenue Code as a non-profit organization. As a non-profit organization, no part of the net earnings may contribute to the benefit of any private individual. This organizational structure offers the borrower tax-exempt status that is granted by the Internal Revenue Service. Private organizations are defined as for-profit, taxable businesses.

How does the legal operating structure (public or private) of an entity impact project financing? First, the ability of public/non-profit entities to access below-market interest rates means that there is more money available for project costs. This makes some parking projects financially viable that would not otherwise be viable if conventional debt was obtained to fund the project. Second, Federal law allows tax-exempt bonds issued by a public/non-profit organizations to finance capital expenditures, including land, acquisition, construction, and capital equipment, provided these bonds are used to further the IRS-approved non-profit's mission. These advantages alone are enough for a private organization to actively pursue a public partnership when developing a new parking facility.

When parking facilities are financed through the issuance of tax-exempt bonds, as with many hospitals, universities, and municipalities, continued treatment of the bonds as tax-exempt depends on proper use of the facilities. For bonds to be qualified as tax-exempt, 90 percent of the proceeds must be used for exempt purposes. In other words, not more than 10 percent of the tax-exempt bond proceeds can be subject to "private business use." It also currently appears that where a facility is built partially from funds other than tax-exempt bonds, a favorable ruling may be possible in some cases where there is "private business use" exceeding 10 percent.

"Private business use" in regard to tax-exempt bond financing is defined as use of tax-exempt bond proceeds or bond-financed parking facilities to serve a non-public unit. The use does not have to result in unrelated business income to be considered private business use. Examples of private use include contracts for parking facility management, privately reserved or nested parking spaces within a public facility, use by private organizations such as sports and entertainment groups, residential communities, and corporations.

Another tax-exempt financing issue is the effect on the tax-exempt status of bonds when there is a change in use of the bond financed facilities. Disqualified private use may not exist on the date of issuance, and change in use may endanger the tax-exempt status of the bonds. If a change in use situation is encountered, the borrower should seek consultation with bond counsel.

Conventional Debt Financing

When an established public or private entity needs capital to fund a parking project, a bank or conventional loan may first come to mind. Conventional loans are loans that are not insured or guaranteed by a government agency. This method of obtaining funds for a capital improvement project involves a lending process that is often rigorous, and may result in higher financing costs incurred by the borrower. Banks want to lend to parties that have a clear record of profitable operations, that generate a cash flow sufficient to repay the loan, and that have enough collateral or assets to secure the loan. Conventional financing requirements include a clean credit record and no bankruptcies or foreclosures.

General Obligation Bonds

General obligation bonds will obtain the lowest possible interest rate or cost of borrowing for any given municipality. Because the full faith and credit of the municipality is pledged to such bonds, the rate of interest will reflect the best that the community has to offer. The primary way for a municipality to improve on its own full faith and credit pledge to a bond issue is to purchase municipal bond insurance.

The following definition of general obligation bonds is offered by www.muni-bonds.com: "(G.O.) A bond secured by a pledge of the issuer's taxing powers (limited or unlimited). More commonly the general obligation bonds of local governments are paid from ad valorem property taxes and other general revenues. Considered the most secure of all municipal debt. Limited in California by Proposition 13 to debt authorized by a vote of two thirds of voters in the case of local governments or a simple majority for state issuance."[1]

Care must be taken when issuing general obligation bonds to finance parking facilities. The public purpose provisions of the tax law must be observed to preserve the tax-exemption of the bond issue. Moreover, the issuance of general obligation bonds results in at least one significant implication. Most states have laws that restrict the amount of general obligation debt that can be issued by municipalities. General obligation bonds count towards the outstanding statutory debt of the municipality. Therefore, prior to issuing general obligation bonds for a parking project, the municipality must determine

[1] http.www.muni-bonds.com/glossary.html

whether the available bonding capacity is sufficient to fund the parking project and also to support any outstanding bonding requirements which the community may be facing. Other competing priorities may dictate that the municipality's management must seek parking project funding other than general obligation bonds.

Revenue Bonds

When revenue bonds are issued to finance a parking project, the bond issuer pledges to the bond holders the revenue generated by the parking project. Revenue bonds are payable only from specifically identified sources of revenue, including pledged revenues derived from the operation of the financed parking facility, grants, and excise or other taxes. Parking revenue bonds secured solely by the revenues from a single, stand-alone, municipality-owned parking facility are acceptable at a reasonable tax-exempt rate only when irrefutable evidence is presented to indicate the existence of a stable demand generator that is anticipated to produce a suitable debt service coverage from net revenues. Municipalities and other public organizations often benefit from issuing parking revenue bonds since the full faith and credit of the issuer is not pledged. However, revenue bonds traditionally carry a higher interest rate than general obligation bonds. Revenue bonds also differ from general obligation bonds in that general obligation bonds are backed by a city's ability to levy taxes. In comparison, user fees back revenue bonds. Special authorities are frequently created for the purpose of issuing parking revenue bonds.

Alternative Financing Strategies

The purpose of this section of the chapter is to provide an overview of the most commonly used strategies for financing parking facilities, most of which fall short of generating operating revenues that are sufficient to cover operating expenses and debt service. The following strategies are addressed:

- Federal Grants
- Tax-Increment Financing
- Business Improvement Districts
- Parking Tax Districts
- Development and Lease Agreements
- Creation of an Auxiliary Enterprise Fund
- Creation of a Parking Authority

Federal Grants

At least two potential funding sources are available at the federal level. Location, intended use of the facility, and availability of grant money are the variables that typically govern whether a project receives federal grant money. The U.S. Department of Transportation offers two types of grants that may be applicable to a parking project: Federal Transit Capital Investment Grants and Federal Transit Formula Grants.

Administered under the Federal Transit Administration (Department of Transportation) under authorization of the 49 USC 5309, Federal Transit Capital Investment Grants exist "to assist in financing the acquisition, construction, reconstruction and improvement of facilities, rolling stock and equipment for use, by operation, lease, or otherwise, in mass public transportation service and in coordinating service with highways and other transportation in such areas."

This capital grant can be applied to virtually any infrastructure improvement pertaining to the establishment or improvement of mass transit systems. Eligible projects include: fixed guide-way systems, rolling stock for transit systems, establishing or improving mass transit facilities, and any other development or capital cost associated with establishing or improving mass transit service. Consideration may also be given to projects which enhance urban economic development; establish new or enhanced coordination between transit and other transportation; enhance the effectiveness of a transit project; or other non-vehicular capital improvements that the Secretary of Transportation may decide would result in increased transit usage in the corridor.

Qualified applicants include: public agencies, states, municipalities, public corporations, boards and commissions, and private agencies through contractual agreements with a public agency grantee. Qualifying parties must submit an application in which the following documentation is included:

- Proof of the project's inclusion in the local transportation improvement program (TIP);
- Proof of the project's inclusion in the state transportation improvement program (STIP);
- Approval of the project by the Federal Transit Administration (FTA) and Federal Highway Administration (FHWA);
- A statement of labor and relocation pertaining to the project;
- An environmental impact statement on the effect of the project;
- A legal opinion on the validity of the project;
- Proof of the project's inclusion in the coordinated regional plan;
- A valid maintenance certification; and
- An affidavit of certifications and assurances as compiled in the FTA's Annual List of Certifications and Assurances.

The basic grant rate may be up to 80 percent of the total project cost, with the applicant being responsible for the remaining 20 percent. In FY 2000, the distribution of capital grants ranged from $9,450 to $1,636,000,000, with an average value of approximately $7,000,000. Previously awarded projects include:

- 13 CNG buses in St. Louis;
- Gateway Intermodal Center in Los Angeles;

- Constructed Portsmouth, Virginia ferry docking facility (Norfolk-Portsmouth);
- LRT security system and power substation in Sacramento; and
- Dallas North Central Light Rail.

FTA Formula Grants, also administered under the Federal Transit Administration (Department of Transportation) under authorization of the 49 USC 5307, exist "to assist in financing the acquisition, construction, cost-effective leasing, maintenance, planning, and improvement of facilities and equipment for use by operation, lease, contract, or otherwise in mass transportation service, and for urbanized areas with populations under 200,000, to assist with the payment of operating expenses to improve or to continue such service by operation, lease, contract or otherwise."

This formula grant can be applied to virtually any infrastructure improvement pertaining to the establishment, operation or improvement of mass transit systems. The Secretary of Transportation may make grants under this section for capital projects to finance the planning, acquisition, construction, lease, improvement, and maintenance of equipment and facilities for use in transit subject to regulations. One percent of the funds apportioned to urbanized areas with a population of at least 200,000 shall be made available for transit enhancements. For urbanized areas with populations under 200,000, the Secretary may also make grants under this section to finance transit-operating costs. Recipients of these grants are required to make information available to the public and to publish a program of projects to afford affected citizens opportunities through public hearings to submit comments on the proposed program and the performance of the recipient.

Qualified applicants include publicly owned operating companies of mass transportation services. Funds are made available to urbanized areas (as defined by the Bureau of the Census) through designated recipients which must be public entities and legally capable of receiving and dispensing Federal funds. The state governor, responsible local officials, and publicly owned operators of mass transportation services must jointly designate the recipient(s) for urbanized areas of 200,000 or more in population. Recipients must submit a program of projects to the FTA; submit a program application to the FTA; enter into formal agreements with the FTA; and certify that public notification has been conducted.

Qualifying parties must submit an application in which the following documentation is included:

- Proof of the project's inclusion in the local transportation improvement program (TIP);
- Proof of the project's inclusion in the state transportation improvement program (STIP);
- Approval of the project by the FTA and FHWA;
- A statement of labor and relocation pertaining to the project;
- An environmental impact statement on the effect of the project;

- A legal opinion on the validity of the project;
- Proof of the project's inclusion in the coordinated regional plan;
- A valid maintenance certification; and
- An affidavit of certifications and assurances as compiled in the FTA's Annual List of Certifications and Assurances.

Funding is apportioned on the basis of legislative formulas. For urbanized areas with population of 200,000 and greater, the formula is based on a combination of bus revenue vehicle miles, bus passenger miles, fixed guide-way revenue miles, and fixed guide-way route miles as well as population and population density. The basic grant rate may be up to 80 percent of the total project cost, with the remaining 20 percent being the responsibility of the applicant. In FY 2000, the FTA issued $3.2 billion in formula grants. Previously awarded projects include:

- Construction of the Kansas City Union Station Intermodal Facility;
- Renovation and expansion of bus maintenance facilities for the Flint (MI) Mass Transportation Authority;
- Replacement of 48 buses and purchase of a ferry vessel on behalf of the Golden Gate Bridge, Highway, and Transportation District;
- Creation of park-and-ride lots for Southwest Ohio Regional Transit Authority; and
- Construction of rail lines, terminals and facilities for the Southeastern Pennsylvania Transportation Authority.

The FTA grants described above are apportioned to each state and specific departments and agencies within each state. These funds are applied to specific programs that the departments and agencies oversee. The role of these departments and agencies is to determine the ability of the proposed project to meet the requirements of a specific program and the portion of the project that will be funded. If a specific program will not supply the entire 80 percent of funds for the project, other programs may be applied for to satisfy the 80 percent. Keeping in mind that each will be treated as a separate project and will require 20 percent local funding. Applications for the several types of programs must be completed by the local government and submitted to the proper governmental departments and agencies. These departments and agencies generally have a specific time window for the submission of applications, or a "Call for Proposals."

Often there are timing issues that a municipality will wish to circumvent. In general, the application and approval process takes over six months, with projects being approved for a budget that may be several years away. This may cause problems if studies and conceptual drawings are done prior to application and approval. Current demand and projected demand are often time specific and determine when the funds are needed. Physical changes to abutting property or roadways over time may affect the accuracy and usefulness of conceptual drawings. With this particular issue in mind, a municipality may issue bonds specifically based on the approval of an application for federal funds. These bonds are known as Grant Anticipation Notes ("GAN"). These bonds are backed by the approved funds from the Federal Government. The Federal Register recently recorded the following discussion in regards to GANs:

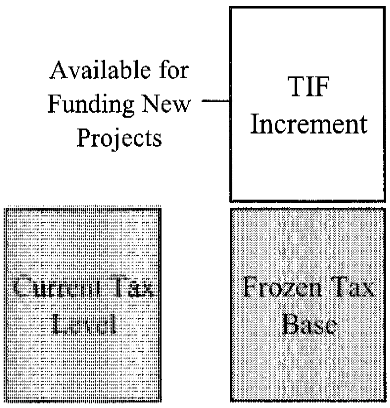
> Public transportation grantees are reminded that with interest rates at currently low levels it may be cost-effective to leverage their projected grant receipts, and thereby accelerate the acquisition of needed rolling stock or completion of essential infrastructure. FTA encourages grant recipients to examine all leveraging options at their disposal, including the use of grant anticipation notes (GAN) secured with Formula Capital, Fixed Guideway Modernization, and New Starts funds. To date, over $1.7 billion in grant anticipation notes have been issued, allowing major projects to be completed early and at lower cost. FTA will provide information and other assistance to grantees that wish to examine financing options during their project development process. For additional information, contact Paul L. Marx, Office of Policy Development, at (202) 366-1675.

Tax-Increment Financing

Another common financing mechanism employed by municipalities is the implementation of a tax increment finance ("TIF") district. Tax increment financing is a way to use tax revenue growth produced by an increase in the tax base of a specified area to repay the costs of investing in the area. While many cities rely on general tax revenue to fund improvements, tax increment financing, or TIF, is an increasingly viable solution to funding the development of needed infrastructure, including structured parking. Tax increment financing legislation enables a local government to finance redevelopment projects through an anticipated increase in the area's property tax revenues. TIF districts do not generate tax revenues by increasing tax rates. Rather, as shown in Figure 1, the TIF district generates revenues by permitting the municipality to temporarily capture the tax revenues generated by the enhanced valuation of properties resulting from the various redevelopment projects. In a TIF-funded project, the local government permits the developer to use a portion of these new taxes to support financing for the proposed parking project. Since a portion of the financing is repaid solely from the dedicated taxes, TIF effectively functions like a grant from the standpoint of the developer.

The premise of TIF is that real estate development generates new real estate and sales taxes above and beyond the taxes generated by land in its undeveloped state. The TIF system relies on the appreciation in value of the land and buildings in a TIF district. If a development is profitable, then the costs will be paid for in the growth of property tax revenue. If the property fails to increase in value, the improvement costs fall back on the general taxpayer. This risk makes some governments wary of employing TIF's. Such concern, while important, must be weighed against the alternative.

Figure 1: Tax Increment Financing (TIF)



Business Improvement Districts

Some municipalities and county governments use business improvement districts ("BIDs") and parking tax districts as a means to generate income to fund parking facility capital improvements and operating expenses. Both business improvement districts and parking tax districts can be used to finance the acquisition of land; the construction, operation, and maintenance of surface parking lots and parking structures; as well as the costs of engineers, attorneys and other professionals needed to complete the project.

BIDs number over 1,200 in the U.S. and are much more common than parking tax districts. BIDs, which are most often formed at the request of their member businesses, typically address a wide variety of issues not all related to parking. Common issues addressed include marketing, transit, beautification, signage, lighting, parking, street and public space maintenance, unarmed security patrols, "customer service representatives" or "ambassadors" to provide information and assistance to tourists and shoppers, etc. The collection of assessments tend to be applied uniformly on a square foot, gross receipts, or assessed value basis because benefits are universally recognized by all property owners. Typically, no exemptions or tax credits are provided to property owners who provide all or a portion of their required parking.

The Bayside District, located in Santa Monica, California, is an example of a BID. This BID was established in 1986 and has allowed the BID to secure the bonded indebtedness associated with various improvements in 1989. Improvements included a transformation of the old Santa Monica Mall into the Third Street Promenade and surrounding Bayside District. Specifically, this provided for additional parking and certain alley, signage, and circulation improvements.

The Santa Monica BID has three zones, each with its own tax rate: Zone 1 - $0.8096 per building square foot; Zone 2 - $0.3346 per building square foot; and Zone 3 - $0.2342 per building square foot.[2] Tax bills appear on property owner's tax bills and are collected through the County Assessor's Office. The Treasurer of the City of Santa Monica administers the BID fund.

At the same time this BID was created, an ordinance was passed requiring a parking developer fee; this fee creates a fund for additional parking improvements as new square footage is added (if the developer does not provide parking to meet the demand of the new development). The formula for this parking developer fee is equal to $1.50 per square foot per year for each new square foot of building space added since 1986 for which parking is not provided.

Parking Tax Districts

A parking tax district typically addresses a narrow selection of issues directly related to parking. In cases where the municipality is the sole provider of parking, the collection of parking taxes tends to be applied in a uniform manner on an assessed value basis or as a fee per space based on zoning parking standards or requirements, and typically with a partial exemption for parking spaces provided above a threshold percentage. Typically, no commercial property is 100 percent exempt unless its owner provides 100 percent of the parking requirements mandated through the zoning ordinance within the district. Single-family residential property is usually exempt, but multi-family apartments usually are not exempt.

There are several precedents for a parking tax district in the United States. Existing parking tax districts are located in the states of California, Maryland, Nebraska, and Oregon, with the majority of parking tax districts concentrated in California. The State of California has passed enabling legislation, including the Parking District Law of 1951, Mello-Roos Community Facilities Act of 1982, and the Parking and Business Improvement Area Law of 1989. The California office of the Controller reports 26 Special Parking Districts that are registered by the state. Of these districts, a Board of Supervisors governs three and a City Council governs 19. Four of these districts are governed by other means.

Following is a summary highlighting several parking tax districts in the U.S.:

- ***Montgomery County, Maryland*** - Parking District Services of Montgomery County manages parking districts in Bethesda, Montgomery Hills, Silver Spring, and Wheaton. Some of the tasks performed by Parking District Services are the management of off- and on-street parking facilities within its districts. Parking District Services is responsible for revenue collection and control, maintenance, safety and security, the funding of parking facility capital improvements, and ongoing operating and maintenance expenses. To generate the funding necessary for ongoing parking operations, each parking district collects taxes based on the assessed value of land and improvements.

[2] Rates shown are for the 1999 Property Tax Year

A similar tax for unimproved non-residential properties is taxed at 50 percent of the improved rate. Several exemptions or percentage reductions from the tax are provided by the ordinance. For example, public off-street parking lots and facilities are exempt from the tax, provided that this parking is made available for general public use, or for the use of the customers of the establishment for which the exemption is claimed. Any property owner or lessee who provides the entire zoning requirements for parking is exempt. Property owners providing a portion of their parking are exempt from a portion of the tax bill in accordance with a formula that varies depending on the land use. For example, if a "retail establishment" provides between 60% and 99.9% of the general retail zoning parking requirement, the credit is 60%. At less than 60%, the credit is zero. At 100% or more, the property is exempt. (Please refer to the "Case Studies" section at the end of this chapter for a more comprehensive discussion of this parking tax district.)

- ***Tualatin, Oregon*** - Our research reveals that the city of Tualatin, OR has a Special Core Area Parking District Tax and Impact Fee. In Year 2003, property owners are required to pay an annual tax of $120.55 for each required parking space. The required number of parking spaces varies depending on the land use and the parking requirements as specified in the city's zoning ordinance. A formula is used to determine whether an owner qualifies for a tax credit. This tax credit for providing on-site parking spaces is calculated by defining "A" as the number of spaces provided by an owner, divided by the number of spaces required by the zoning ordinance. If "A" is greater than or equal to 1.0, the credit is 50 percent. If A is less than 1.0, the credit is equal to 50 percent of "A" ("A" x 50%). Thus, everyone pays at least 50 percent of the parking district tax. A developer within the Tualatin parking district may buy down up to 25 percent of the required number of parking spaces by paying an impact fee. The impact fee (payment in lieu) is determined by the number of zoning required spaces not supplied, multiplied by the $3,500 fee per space. This fee appears to support only surface parking development, as this amount is insufficient to support the cost of structured parking.

- ***Norfolk, Nebraska*** – This city manages a Vehicle Parking Tax District. The municipality provides most parking. The tax is billed on the assessed value of the property, regardless of any parking on-site. The 2002-03 property tax levy approximately equals the maximum $0.35 levy allowed by Nebraska statutes based on the 2001 valuation.

- ***Covina, California*** has a Vehicle Parking District Tax. This tax is assessed only on the difference between the number of spaces provided and the number required by the zoning ordinance. There are no exceptions to this tax for owners who provide parking.

- ***Alhambra, California*** includes parking within a Business Assessment District Tax. This tax is assessed uniformly on all commercial property based on the gross receipts of the business. Because this tax supports functions other than parking, such as beautification, cleaning, signage, etc., there are no exceptions for parking provided.

- In ***San Bernardino, California*** developers are allowed to make a payment in lieu, which is determined by the number of spaces required by zoning but not supplied by the replacement cost of a structured parking space, which is reappraised annually. The vehicle parking district tax is assessed as an ad valorem property tax, but a prorated credit is allowed based on the difference between the number of spaces provided and the number required by the zoning ordinance. Spaces paid in lieu are counted as though constructed.

- ***Fullerton, California*** owns almost all of the off-street parking within the city, and all businesses within the parking district were assessed a parking district tax to retire bonds for the construction of parking. No exemptions were offered as almost no properties supplied their own parking needs. Because the bond debt was retired several years ago, the parking tax district was also retired.

- ***Long Beach, California*** maintains the Belmont Shore Parking Commission, which exists as an approved city commission and enterprise fund. The commission receives parking revenue from existing facilities and tax revenue from the Parking and Business Improvement District (PBID) for the purpose of parking. This PBID has the power to impose a self-assessment of property owners and businesses, subject to a 50 percent protest vote that can terminate it at any time. The most recent assessment was approximately $0.06 per SF, but has been reduced to $0/SF pending the selection of a new set of goals and criteria. Because the PBID pertains to more than parking, the tax rate is applied across the board, with no exemptions for owners who provide their own parking.

- The Vehicle Parking District of ***Pomona, California***, provides public parking for the entire downtown district. Businesses are not required to pay for parking credits or apply for parking variances. There is essentially no room for new parking. Parking is currently self-sustaining, as parking revenue from existing lots is sufficient to fund current obligations. As there are no ongoing parking structure development obligations, there is no additional parking district tax.

Payment in Lieu

In cases where a developer is allowed to pay a fee in lieu of construction of parking spaces, the number of spaces that can be deferred is limited, and the amount of the fee in lieu is based on the actual average cost of development of structured parking spaces within the district. However, spaces paid-in-lieu are counted as though constructed in determining the number of parking spaces provided by a developer.

Development and Lease Agreements

Municipal and corporate leaders are increasingly faced with the issue of whether or not they should enter into the parking business by constructing, financing, and operating their own parking facilities. In most cases, the capital required to develop and operate a parking facility is the prevailing barrier to entry. The financial paradox faced by decision-makers is the need to allocate funds for core operation improvements to sustain and grow demand, while at the same time, fund parking expansion projects that are needed to operate. More often than not, funding a parking expansion project is determined to be subordinate to core operation improvements.

Faced with parking issues, many industry leaders are recognizing the advantages of eliminating parking from their balance sheets and focusing on their core business. This is accomplished through a development leaseback agreement that provides an alternative method of ownership, investment, financing, and risk allocation to organizations that need parking, but face financial limitations. It is a financial tool that can allow a business or agency to expand parking operations, reduce long-term risk, and redirect capital funds from parking to core operations.

When a local agency enters into a development leaseback arrangement (thereby becoming the leasee), it may lease a facility from another public agency, a nonprofit corporation set up for that purpose, a bank or private leasing company or a joint powers authority. This lessor assigns all its rights in the leased parking facility to the lessee or trustee and acts as an intermediary between the local agency and the investors. The trick to leasing is finding someone who is willing to invest in the return from the agency's lease payments. This may be a single investor or, more frequently, a group of investors who have purchased undivided shares of the lease obligation (these shares are called "certificates of participation"). The lessee is given use of the property as though he owned it, without having capital invested in it.

The lease is typically a long-term "net" lease[3], with the leasee having the option of repurchasing the parking facility at a later time. The tenant, who previously owned the property, normally has the right at any time during the lease to buy back the parking facility, based upon a predetermined value or method of valuation. However, it is most advantageous to do so at the end of the lease, when the purchase price could be a nominal amount. Terms usually are for 15 to 20 years with options to include up to four five-year renewal periods.

Development leaseback agreements offer several advantages over other financing methods. First, an agency can obtain a parking facility without a large initial investment. Second, a lease can be used to spread the cost of a parking facility over a long period of time. Third, lease agreements do not add to agency debt. Fourth, in many cases voter approval is not a requirement as it would be with special taxes and some types of bonds. Fifth, leaseback deals can also provide the leasee with additional tax deductions, if

[3] A property lease in which the lessee agrees to pay all expenses which are normally associated with ownership, such as utilities, repairs, insurance and taxes. Also called a closed-end lease.

applicable. The leasor benefits in that they will receive stable payments for a specified period of time.

Using lease financing is not without its drawbacks. The agreements necessary to finance public and private parking facilities are complicated, and involve numerous players such as bond counsel, underwriter, and trustee. Leasing, because of the uncertainties of the market and annual allocation of payments, may require higher debt payment than bonds to attract investors. Additionally, because leases are designed to be tax-exempt investments, their popularity and marketability is susceptible to changes in federal or state tax law. Also, it may be difficult to find creditworthy investors for some leases. Unlike special assessments or taxes, a lease by itself does not generate funds on its own and requires another source of income, such as user fees, to retire any debt.

Creation of an Auxiliary Enterprise Fund

Universities and municipalities often create auxiliary enterprise funds. These resources are then used to fund parking project capital improvements. By definition, an auxiliary enterprise fund is self-sustaining. This means that the auxiliary enterprise fund generates a revenue stream that is sufficient to cover ongoing operating expenses and outstanding debt service obligations.

Auxiliary enterprise funds have their own operating budgets. This operating budget is separate from the municipality's or university's general fund. These operating budgets include a stream of revenues collected from a variety of sources, including the following:

Municipalities
- Monthly leases
- Parking meter revenues
- Parking violation revenues
- Transient revenues

Universities
- Permit sales
- Parking meter revenues
- Parking violation revenues
- Transient revenues
- Transportation fees
- Reserved parking spaces

Although revenues generated by a new structured parking facility may not be sufficient to fund both the operating expenses and debt service of that particular improvement, revenues from other facilities and sources are pooled together. This revenue pool is sufficient to generate an income stream that permits the solvency of the auxiliary enterprise.

Budgeted expenses include the operating costs associated with ongoing parking operations. This may include the labor costs associated with maintenance, security, parking enforcement, revenue collection, management, and administration. Other operating costs may include utilities, supplies, and equipment.

The lifespan of a parking structure can often range from 40-50 years or more. However, because the development costs for such a structure are capitalized over a 20-30-year period, there is significant useful life remaining after all debt is retired. This remaining life means that revenues may still be generated by this debt-free facility and that these revenues may be available to offset any new debt service payments that are required to fund new parking projects.

There are many parking system auxiliary enterprise funds in operation throughout the U.S. Following are some of these funds:

Municipalities

- City of Cedar Rapids, Iowa
- City of Lincoln, Nebraska
- City of Detroit, Michigan
- City of Tampa, Florida
- City of Denver, Colorado

Universities

- Florida State University
- University of South Florida
- Penn State University
- University of Oklahoma
- University of New Mexico

Two of these auxiliary enterprise funds, the one for the City of Lincoln, Nebraska, and the one representing Florida State University, are featured in the "Case Studies" section at the end of this chapter.

Creation of a Parking Authority

Parking authorities offer similar advantages gained through the creation of an auxiliary enterprise funds. One similarity is that parking authorities are self-supporting, meaning they generate operating revenues sufficient to cover both operating expenses and the debt service associated with any capital improvements. Parking authorities have many of the same responsibilities similar to a municipal or a university parking and transportation department. Following are some of the responsibilities of a parking authority:

- To hire and compensate staff and manage authority-owned facilities.
- To set parking rates and collect revenues from authority-owned facilities.
- To establish and manage a budget.
- To acquire property through negotiations and if necessary, through eminent domain.
- To acquire existing parking facilities.
- To contract with third parties for services and the sale of real property.
- To sue and be sued.
- To fund parking facility capital improvements.
- To design, construct, and renovate parking facilities.
- To demolish and rebuild parking facilities.
- To develop and implement master plans for municipal parking.
- To define and implement parking management strategies aimed at improving traffic flow and parking conditions.
- To issue and retire debt.

Many states have enabling legislation that provides for the creation of a parking authority. Some states have legalized the formation of a parking authority in any city, regardless of size. Other states permit the establishment of a parking authority only in specific classes of cities. Following are some states that have parking authorities: Alabama, Alaska, California, Connecticut, Delaware, Florida, Maine, Maryland, Massachusetts, New Jersey, New York, Oklahoma, Pennsylvania, Tennessee, Virginia, Washington, and West Virginia. New York and Pennsylvania are the states with the greatest number of parking authorities.

To create a parking authority, first, enabling legislation must be in place legalizing the formation. In most cases, this enabling legislation allows a city to create a parking authority. Once the parking authority is created, most laws provide for the municipality's mayor to appoint board members. The board of directors then governs a parking authority.

Parking authorities have several distinguishing characteristics that make them different from municipal and university parking departments, including the following:

- Parking authorities are empowered to issue their own debt.
- Parking authority debt does not count toward the debt capacity of the municipality or university.
- Parking authorities can take action without approval from city government; they can be completely independent and autonomous of city government.

Following are some of the most significant advantages and disadvantages of a parking authority:

Advantages

- Can issue own debt and not count against bonding capacity of city
- Provides a structure with a sole focus on parking-related issues
- Significantly reduced political pressures compared to city parking department
- Not subject to annual budget considerations of city government or politics
- Self-sustaining

Disadvantages

- Redundant costs of management and administration
- Higher rates of borrowing than a city issuing general obligation bonds
- Authority has power that is beyond the immediate control of the citizens

Case Studies

Montgomery County, Maryland

Parking District Services of Montgomery County manages nearly 19,000 parking spaces within parking districts in Bethesda, Montgomery Hills, Silver Spring, and Wheaton. Each of the Parking Lot Districts is required by law to be a self-sufficient enterprise. This means that the operating expenses and debt service of Parking District Services must be supported by revenue from that district. Total annual revenue approximates $19 million and comes from the following four major funding sources: 1) ad valorem taxes (taxes according to value), 2) parking receipts, 3) enforcement revenues, and 4) income from investments.

The mission of Parking District Services is to:

- Support the role of public parking in commercial areas throughout the County. Parking management is growing in importance as a tool for achieving public objectives of economic development and transportation management.
- Support the comprehensive development of the Bethesda, Montgomery Hills, Silver Spring, and Wheaton central business districts and promote their economic growth and stability by supplying a sufficient number of parking spaces to accommodate that segment of the public demand that is neither provided for by developers nor serviced by alternative travel modes.
- Promote and complement a total transportation system through the careful balance of rates and parking supply to encourage the use of the most efficient and economical transportation modes available.
- Develop and implement parking management strategies designed to maximize the usage of the available parking supply in order to enhance the economic development of specific central business districts.

Parking District Services of Montgomery County provides the following functions:

1. *Parking Facility Operations* includes the management, collection, sorting, and deposit of revenue from all individual meters, electronic computerized pay stations, monthly parking permits, and cashiered parking facilities, plus all revenue collected by the Ride-On-Bus program.
2. *Parking Facility Maintenance* provides the maintenance of all parking facilities, including snow removal, housekeeping, equipment maintenance, elevators, electrical, HVAC, repairs, vandalism, and groundskeeping.
3. *Parking Facility Security and Safety* provides security services for parking facilities to protect against theft, vandalism, and threats to personal safety through the use of county law enforcement agencies, contract security guards, and the Service Corps (in Silver Spring and Wheaton, only.)

4. *Parking Management* is responsible for establishing and monitoring policy and expenditure levels to support the current and future operating and capital costs of Parking District Services while maintaining fund levels to ensure compliance with revenue bond covenants and to protect the fiscal integrity of the Parking District Funds. This program is also responsible for parking programs throughout the County that support mixed-use developments in the central business districts, fiscal analysis, financial management for the Parking Districts, and coordination of parking programs with the County's other transportation policies and programs.
5. *Parking Facility Engineering* supports the design and construction of new parking facilities, mixed-use parking projects, renovations, and improvements; collects information and provides analysis necessary for evaluating and solving parking problems; maintains inventories of public and private parking spaces; and maintains a land use inventory for projecting parking needs. It also provides responses to inquiries from citizens and governmental and private organizations.
6. *Fixed Costs Management Program* contains cost items that involve long-term funding commitments, independent of the annual scope of program costs, such as utility payments, insurance, and long-term operating leases.
7. *Debt Service Management Program* provides the annual payment of principal and interest on bonded indebtedness for the construction of parking facilities. Debt service is a function of current program decisions, interest rates, and the amount of bonds to be issued. The Bethesda and Silver Spring Parking Districts are the only Parking Services' districts with debt obligations. The historical amortization period for these debt obligations is 20 years. The minimum required debt coverage ratio is 1.25.
8. *Administration* provides direction, support, and decision-making on parking policy for Traffic and Parking Services. This includes preparation and monitoring of the division operating budget, portions of the capital improvement plan, and revenues; personnel management, training clerical support, automation, and liaison and correspondence with citizens, and elected and appointed officials.

Montgomery County is authorized by ordinance to acquire by purchase, lease, condemnation, or otherwise, land for the purpose of providing, operating, and maintaining off-street parking facilities. The county may utilize any property acquired with parking lot district funds for purposes other than off-street parking, or may sell, lease, or otherwise dispose of property or portions of property, including mineral rights, air rights, and easements.

Each parking district collects special taxes based on the assessed value of land and improvements used in whole or in part for commercial, industrial, or general business purposes. A similar tax is levied on the assessed value of all personal property located on such land or within such improvements. A similar tax for unimproved land within the same district that is zoned for commercial, industrial, or general business purposes is taxed at 50 percent of the improved rate. No tax is levied on any property, which on the effective date of this chapter, is improved by a residence of permanent construction, so long as such property is used exclusively for non-transient residence purposes.

Several exemptions or percentage reductions from the tax are provided by the ordinance. Public off-street parking lots and facilities are exempt from the tax, provided that this parking is made available for general public use, or for the use of the customers of the establishment for which the exemption is claimed. Any property owner or lessee who provides the entire zoning requirements for parking is exempt. If the following land-use parking requirements are supplied with parking at the following minimum percentages, the following percentage is allowed as the maximum exemption:

Exemption Threshold and Maximum Exemption

General Retail	60%
Hotel, Motel, or Inn	75%
Restaurant or Food Service	50%
Recreational Commercial Establishment, other than a Theater, Auditorium, or Stadium	40%
Indoor or Legitimate Theater	40%
Multiple-family Dwelling	60%
Mixed Use	50%
For all other individual uses, including Office	100%

For example, if a "retail establishment" provides between 60% and 99.9% of the general retail zoning parking requirement, the credit is 60%. At less than 60%, the credit is zero. At 100% or more, the property is exempt.

For a mixed use, where any land or building is used for two or more purposes, the total number of parking spaces required is the sum of the separate requirements for the individual land uses. To qualify for an exemption, the off-street parking facilities must be located within 500 feet of the entrance to the establishment to be served by such facilities.

To encourage the construction of off-street parking facilities in buildings and structures, to relieve traffic congestion in parking lot districts, and to provide parking spaces for the benefit of the general public and the property owners in the districts, a parking building or other parking structure that provides off-street parking facilities, public or private, is totally exempt from the tax. The exemption applies only to the building or other structure, and not to the land on which it stands. If the off-street parking facilities are part of a structure used for other purposes, or are under a structure used for another purpose, this exemption applies only to that portion of the building structure or improvement used for off-street parking purposes. Land under the building or structure, and portions of the building or structure used for purposes other than off-street parking, are not exempt from the tax unless the owner or lessee otherwise complied fully with the provisions of the ordinance relating to exemption. A space for the storage, sale, or display for sale of new or used automobiles, or a space used to repair automobiles does not qualify for an exemption.

Pittsburgh Parking Authority

Formed in 1947 by the City of Pittsburgh, the Pittsburgh Parking Authority ("PPA") was one of the first parking authorities created in the U.S. As such, the PPA is responsible for the administration of the city's parking facilities. Pursuant to the Parking Authority Law of Pennsylvania, Act of June 5, 1947, P.L. 458, as amended and supplemented, 53 P.S. SS 341 et seq., the PPA was created to perform the following activities:

> "The necessary research activity to maintain current data leading to efficient operation of on-street parking facilities, and is authorized by law to plan, design, locate, acquire, hold, construct, improve, maintain and operate, own and lease, either in the capacity of lessor or lessee, land and facilities to be devoted to the parking of vehicles of any kind; to borrow money; to make and issue bonds and to secure the payment of such bonds or any of its revenues and receipts; and to make such agreements with the purchasers or holders of such bonds, or with others in connection with any such bonds, as the Authority shall deem advisable."[4]

Although the PPA has no taxing power, the PPA does have the power of eminent domain. All PPA property is exempt from real estate taxes except those portions of its facilities that are used for commercial business purposes. The PPA may sell or lease air rights or space above its facilities for the use of commercial businesses and subject to real estate taxes.

A five-member board, appointed by the Mayor of the City of Pittsburgh, governs the PPA. These board members serve without compensation for a staggered term of five years. PPA staff members are employed to carry out the PPA's charge and implement board decisions.

The PPA's parking system consists of ten parking structures, 37 off-street surface parking lots, two parking plazas, and all on-street metered parking spaces located in the City of Pittsburgh. Eight of the ten parking structures are located within the city's central business district. Four are self-managed. A third-party parking operator manages six of the facilities. These parking locations represent about 13,400 spaces – about 7,500 off-street spaces and 5,900 on-street spaces. In fiscal year ending September 30, 2002, the PPA generated nearly $28 million in revenues.

The PPA owns most of its facilities free and clear of all debt. Revenues generated from its 13,400 parking spaces cover debt service payments. Facilities owned free and clear of all debt help subsidize those newer facilities that are not owned free and clear of debt.

The last facility financed and built by the PPA is the First Avenue Garage, a 1,243-space parking structure. It opened in May of 2001 and was financed through the issuance of parking revenue bonds. Revenues from the PPA parking system were pledged toward the debt service associated with this project.

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[4] http//www.city.pittsburgh.pa.us/pghparkingauthority/history_and_purpose.html

City of Lincoln, Nebraska

The Public Works and Utilities Department manages the parking operations for the City of Lincoln. These operations include on-street and off-street spaces throughout the city. The City's parking manager position, through the Business Office Division (a sub-group of the Public Works and Utilities Department), works with a contracted parking operator to oversee the daily operation of off-street parking facilities in the form of parking structures and surface lots within the Central Business District.

Figure 2 on the following page illustrates the organizational structure concerning the city's parking operations.

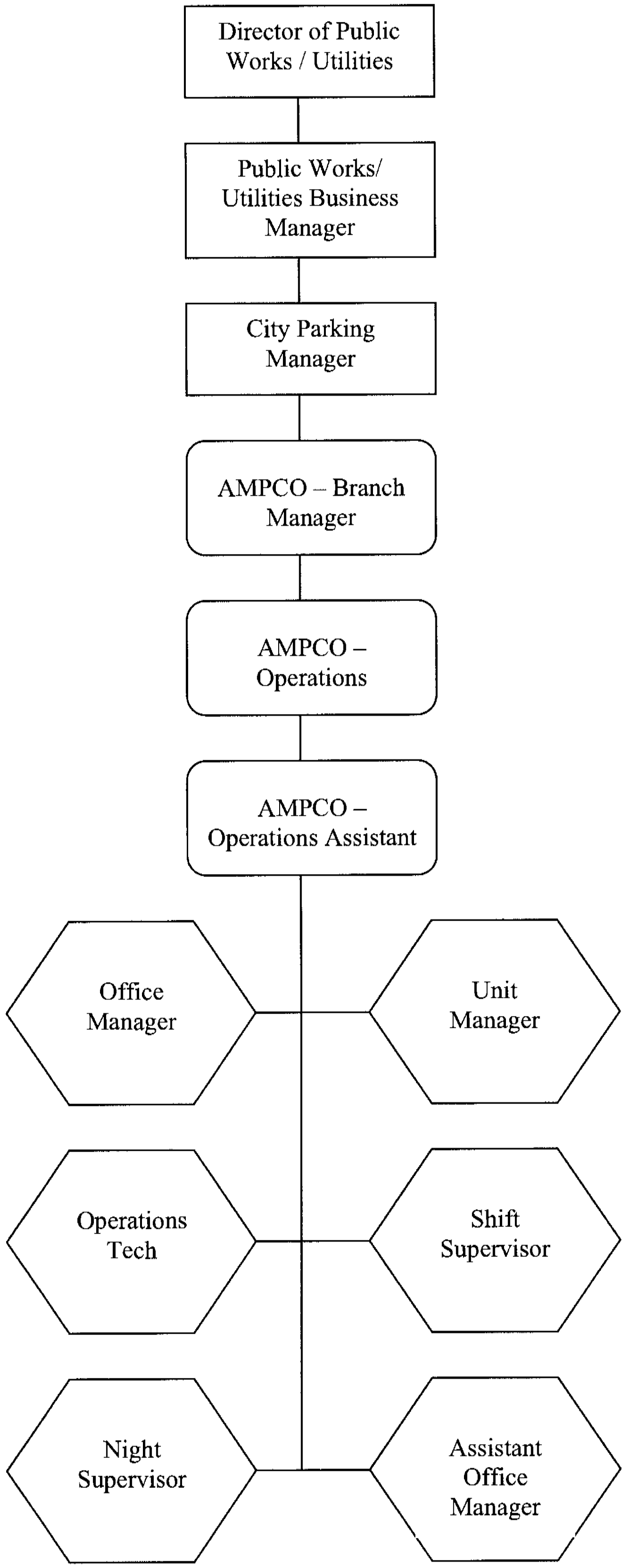
Of the more than 22,000 parking spaces located in downtown Lincoln, the City of Lincoln controls approximately 8,200. These spaces are distributed amongst the following categories: 3,812 spaces in parking structures, 316 spaces in surface parking lots, and 4,073 spaces on-street. Of these on-street spaces, about 2,180 spaces are metered.

The following is a list of city-owned structured parking facilities, their locations, capacities and dates of opening.

City of Lincoln Structured Parking Facilities

Name of Facility	Location	Capacity	Year of Opening
Que Place Garage	1111 Q Street	783	1995
University Square Garage	101 N. 14th Street	431	1990
Cornhusker Sq. Garage	1220 L Street	425	1984
Carriage Park Garage	1128 L Street	700	1996
Center Park Garage	1120 N Street	1,048	1978
Market Place Garage	10th & Q Street	400	2000
Haymarket Garage	9th & Q Street	410	2003
County/City Parking Garage	10th & K Street	386	NA
TOTAL			

Figure 2: Parking Operations Organizational Chart



Each of the city-owned structured parking facilities uses an identical parking rate structure. Parking rates were increased in August of 2001. The following is a five-year history of the city's parking rates:

Historical City Parking Rates

Category	*1997*	*1998*	*2000*	*Effective Aug 2000*	*Effective Aug 2001*
Garages	$0.75	$0.75	$0.75	$ 1.00	$ 1.00
First Hour	0.55	0.60	0.60	0.75	0.75
Additional Hours	4.60	4.95	4.95	5.50	5.50
All Day	52.50	55.00	55.00	60.00	60.00
Regular Monthly	62.50	65.00	65.00	70.00	70.00
Reserved Monthly	67.50	70.00	70.00	75.00	75.00
Secured Monthly					
Lincoln Station Lots					
All-Day (Iron Horse North)	N/A	N/A	1.00	1.00	1.00
Monthly	30.00	32.50	32.50	40.00	45.00
Lumberworks Lot					
Evenings/Weekends	0.50	1.00	1.00	1.00	1.00
Monthly	30.00	32.50	32.50	40.00	4500
Metered Spaces (per hour)	0.25	0.25	0.25	0.50	0.50
Special Event (flat rate)	5.00	6.00	7.00	7.00	8.00

The City of Lincoln has issued parking revenue bonds on numerous occasions to fund its parking facilities. Revenues from its parking enterprise fund are pledged as collateral to support the bond issue. The parking rate table above demonstrates that the city has been able to keep parking rates relatively low. For example, regular monthly parking rates at its structured parking facilities are $60.00. This is considerably lower than the cost to provide this parking. The only way the city can provide structured parking at this cost is through its parking enterprise fund. The operating expenses and debt service for new parking facilities are covered by parking lot, meter, and enforcement income as well as older, revenue-producing parking facilities that are owned free and clear of any debt.

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PARKING SUPPLY AND DEMAND ANALYSES

William L. Surna

William Surna, a Senior Parking Planner with Graef, Anhalt, Schloemer & Associates, has over 25 years experience providing parking consulting services. He has successfully provided consulting services to municipalities, airports, hospitals, universities, and private developers. Bill's expertise includes supply / demand studies, financial feasibility studies, preliminary facility design, and revenue / access control systems.

Objectives

An analysis of parking supply and demand is a critical process in the development of a parking facility or group of facilities. Supply / demand analyses may be prepared for a single land use, such as an office building, for a mixed use environment like a Central Business District (CBD), or for a large institution. A supply / demand study typically assesses the ability of an existing supply to meet existing peak demand, projects future demand, and identifies future deficits or surpluses of spaces. In addition, parking supply / demand studies can be useful to determine if specific user groups or areas have a deficit of spaces.

The availability of parking spaces, or lack thereof, is often an emotional issue. In many instances the perception of a shortage of spaces does not match the actual conditions. The empty spaces may not be the most convenient, but spaces are often available. Documenting the parking supply and demand is often an important part of determining the financial feasibility of proposed facilities. A supply / demand study may also be beneficial in formulating management strategies to better utilize a limited supply of spaces.

General Methodologies

The time, resources, and level of effort used in estimating parking demand should match the purpose of the study. Sometimes just developing a general estimate of the peak period demand is sufficient, and simply using data from a published table may be a valid approach. However, if the demand estimate is used to help project revenue for a financial pro forma, a more detailed study may be warranted.

A study with a limited scope often estimates parking demand using "standard", "published" or "nationally accepted" parking demand ratios. Parking demand ratios are expressed in total spaces per unit statistic, such as spaces per employee, spaces per room, spaces per seat, etc. A single demand ratio may be used to estimate demand for an entire facility. This approach may be satisfactory for an entirely new freestanding development. Calibrating these demand ratios to coincide with observed peak occupancy patterns will provide more accurate estimates of existing demand at redevelopment locations. However, if portions of the parking demand generator are expected to grow at different rates, while others may even decline, a more comprehensive study may be more appropriate.

Table 1 Typical Parking Demand Ratios

Typical Ranges of Total Peak Parking Demand

Land Use	Peak Demand Factor	Unit
Shopping Center >60,000 s.f.	4.5 to 5.0 Spaces	per 1,000 s.f. GLA
Shopping Center <60,000 s.f.	4.0 to 4.5 Spaces	per 1,000 s.f. GLA
Office	1.0 to 3.0 Spaces	per 1,000 s.f. GLA
Office	.10 to .80 Spaces	per employee
Medical Center	.75 to 4.5 Spaces	per bed
Medical Center	.10 to .75 Spaces	per employee
Industrial	.65 to 3.5 Spaces	per 1,000 s.f. GLA
Industrial	.35 to 1.6 Spaces	per employee
University / College	.10 to .50 Spaces	per student
University / College	.50 to .80 Spaces	per employee
Cinema	10 to 85 Spaces	per screen
Hotel	.20 to 1.5 Spaces	per room
Restaurant	5 to 25 Spaces	per 1,000 s.f. GLA
Residential	.20 to 2.0 spaces	per unit

Reference: adapted from ULI-the Urban Land Institute and NPA-National Parking Association, *Dimensions of Parking*. Fourth Edition, Washington, D.C.:ULI, 2000

Data Sources

Additional sources of parking demand ratios include:

- *Parking Generation*, 2nd Edition, Institute of Transportation Engineers, Washington, D.C., 1987
- *Shared Parking*, Urban Land Institute, Washington, D.C., 1983
- *Dimensions of Parking*, Fourth Edition, Urban Land Institute and National Parking Association, Washington, D.C., 2000
- *Parking*, Eno Foundation for Transportation, Westport, CT, 1990
- *Parking Requirements for Shopping Centers*, 2nd Edition, Urban Land Institute, Washington, D.C., 1999

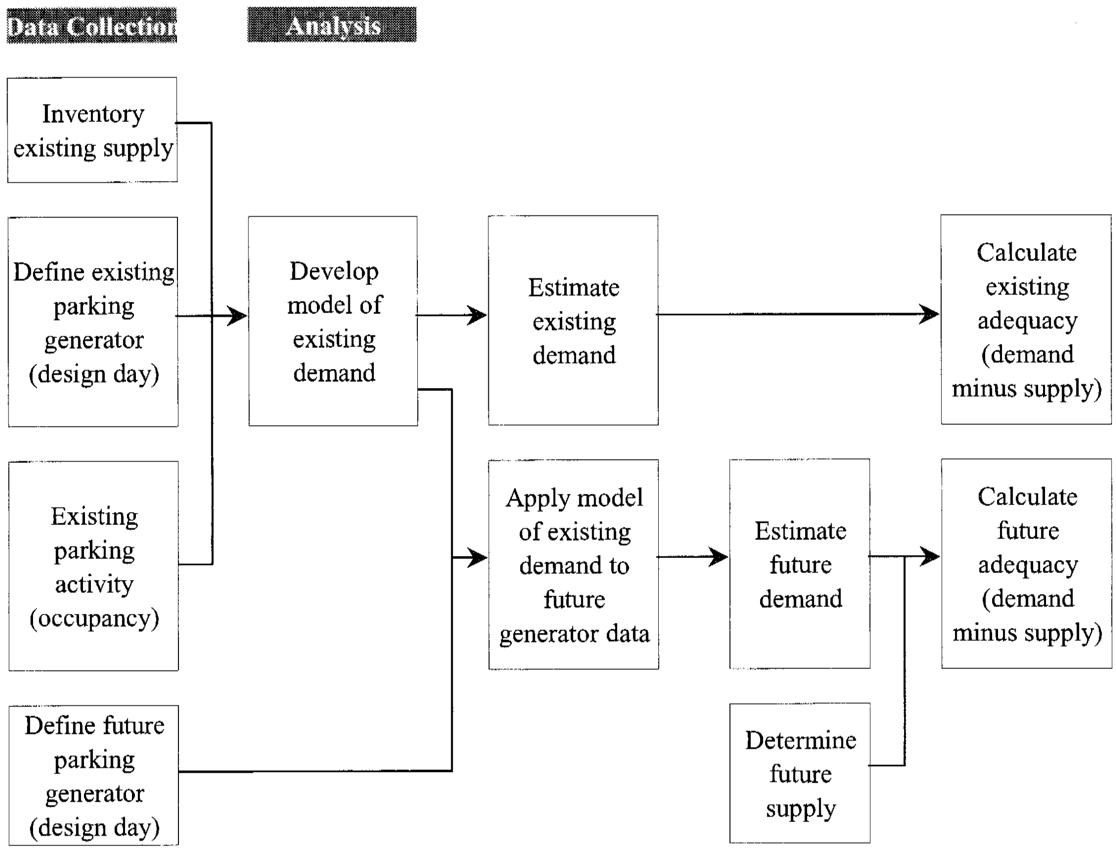
A more comprehensive study includes detailed data collection and a more thorough analysis on the data. Parking demand ratios for each portion of the demand generator at a specific site are developed for a comprehensive study. For example, parking demand generated by a hospital is more accurately expressed as: X spaces per employee, **and** Y spaces per physician, **and** Z spaces per outpatient, **and** A spaces per occupied bed (for visitors to inpatients), **and** B spaces per emergency department visit, etc. The demand ratios developed for a specific site in a comprehensive study should, however, be compared against published data for reasonableness. If the study is to be used to help secure financing for a parking structure, the lenders will require documentation of all projections.

Design Day Conditions

Comprehensive parking supply / demand analyses are generally based upon "design day" activity levels. At most locations, it would be inappropriate to construct a parking system with enough spaces to accommodate the absolute busiest day of the year. During the other days there could be a substantial number of empty spaces. Likewise, if the parking capacity were based upon median or average activity, during half the year there would be a shortage of spaces. Defining the "design day" activity in the 85th to 90th percentile of peak activity is usually appropriate. Traffic engineers typically use a similar approach to define "design day" conditions for roadway and intersection designs.

Data describing the "design day" conditions will vary depending on the location for the study. For a hospital or medical center, the design day activity level should be defined by a combination of: number of occupied beds, number of outpatients, number of visits, number of physicians, number of employees, etc. Land use data, usually expressed in Gross Leasable Area (GLA), is often used to describe the "design day" level for a CBD supply / demand study.

Table 2 General Methodology Comprehensive Parking Supply / Demand Analysis



Supply Considerations

Parking Inventory Documentation

Compiling an inventory of the existing supply of parking spaces is the first step for most supply / demand studies. Collecting the inventory data is relatively simple for single institutions and limited study areas. The inventory process is more difficult for large study areas and where access into facilities may be difficult. Un-marked on-street spaces, un-marked off-street spaces, and facilities where vehicles are parked bumper to bumper are also difficult to accurately inventory.

Parking inventory data is often summarized on a block-by-block basis for a study area. The inventory data of selected blocks can then be combined to form logical zones encompassing a large study area. Breaking a large study area into zones makes it easier to interpret and logically analyze the data. The zonal boundaries should consider both natural and perceived barriers within the study area. The zones are typically set to reflect acceptable walking distances in a specific location. Steep topography, rivers, railroads, and expressways will all tend to limit the acceptable walking distance.

In most cities, the maximum acceptable walking distance from a parking facility ranges from 400 feet to about 1,000 feet. Local climate can influence the acceptable walking distance, and the resulting influence area for a parking facility. In addition, a longer walk is tolerated in areas with high parking demand. For these reasons, the study area or influence area surrounding a proposed parking facility is generally set at about one to two city blocks in each direction.

The inventory should also contain information about any restrictions on the use of spaces. Restrictions limiting spaces to certain users, restrictions by time of day, and time limit restrictions should all be considered. For example, spaces with a 30-minute limit are of little use for employee parking. In addition, the inventory should consider whether the spaces are public spaces open to anyone, or private spaces for use by customers and/or employees.

Effective Supply

Consideration should also be given to the concept of "effective supply" or "practical capacity". A parking facility usually operates at optimum efficiency when occupancy is at 85% to 95%. If this cushion of empty spaces is not provided, there will likely be a perception of a parking shortage even though there are some vacant spaces. If an adequate cushion is provided, it will be easier to locate open spaces. If the cushion is too large, the most inconvenient spaces will be rarely filled. This cushion of spaces also allows for factors such as inefficiencies created by restricting lots to specific users, improperly parked vehicles, minor construction, spaces lost due to snow cover, the dynamics of moving vehicles into and out of spaces, and to reduce the time needed to search for the last few available spaces.

For these reasons, it is a standard practice to have a parking supply approximately 10% to 15% over the actual parking demand, depending on the intended users of a specific area. To build in this cushion, the "effective" supply of spaces is used to determine the adequacy of the parking supply, rather than the actual inventory of spaces. Generally, facilities used every day by employees can have a higher effective supply factor than a facility intended for infrequent visitors.

Sometimes it is appropriate to artificially increase demand to account for the effective supply cushion. However, it is more appropriate to use the effective supply approach for multi-facility studies. Each facility may have a different effective supply factor based upon the capacity, usage, and user assignments in the facility. The total effective supply for a multi-facility parking system is a combination of the effective supply of each facility.

Occupancy – Data Collection

Collecting good occupancy data for a parking supply / demand study is an important issue. Normally parking occupancy is recorded hourly. However, for a large study area or a study with a limited scope, spot counts several times per day can be appropriate. Hourly counts are appropriate for high turnover visitor facilities, while spot counts may be appropriate for long-term employee parking facilities. Occupancy data can be collected from manual counts, aerial photography, or from counting equipment at entrance and exit lanes. In the end, the analysis will focus primarily on the peak demand period(s).

Parking demand is typically based on the activity levels for a "design day". This approach is similar to standard traffic engineering practice. Ideally, parking occupancy data would be collected on a "design day". It is nearly impossible, however, in most situations, to determine in advance when a "design day" will occur. Therefore, parking occupancy data should be collected in conjunction with another set of data that describes daily activity, such as the number of visitors. In this way the parking occupancy data collected for any particular day can be adjusted to reflect "design day" conditions.

Frequently, people question the number of occupancy counts necessary to prepare a parking supply / demand study. Conducting multiple counts on successive days is no guarantee that the collected data will represent "design day" conditions. Usually, people familiar with the area or institution can identify the busiest day of the week in advance. The data for that day can be adjusted to reflect "design day" conditions. However, in some instances there may be no data readily available to define the "design day" or the typical busy day may not be known. In those cases, counts over multiple days may be necessary.

Parking occupancy counts simply record the number of vehicles that are parked at the time of the survey. Additional data is collected to calculate the turnover of on street spaces, off street lots, or off street structures.

Table 3 – Example Occupancy Table

Survey Date: 11/11/03

		Cap.	**8am**	**9am**	**10am**	**11am**	**noon**	**1pm**	**2pm**	**3pm**	**4pm**	**5pm**	**Avg. Occ.**	**Peak Occ.**
On-Street Spaces														
Block 1	Main St.	13	7	9	8	11	13	12	11	9	5	6	70%	100%
Block 1	1st Ave.	6	2	2	2	5	6	6	4	3	2	2	57%	100%
Block 1	2nd Ave.	8	4	4	4	4	5	4	4	4	4	3	50%	63%
Block 1	Front St.	15	6	7	10	12	14	14	10	10	9	9	67%	93%
	subtotal	42	19	22	24	32	38	36	29	26	20	20	63%	90%
Off-Street Spaces														
Block 1	Lot 1-1	123	50	55	65	89	95	93	75	77	68	63	59%	77%
Block 1	Lot 1-2	345	157	167	188	200	245	300	322	289	281	200	68%	93%
	subtotal	468	207	222	253	289	340	393	397	366	349	263	66%	85%
	TOTAL	**510**	**226**	**244**	**277**	**321**	**378**	**429**	**426**	**392**	**369**	**283**	**66%**	**84%**

Parking Turnover

Parking turnover for a facility is calculated by dividing the total number of vehicles using the facility for the survey period by the total number of available spaces. Turnover data is particularly useful for projecting potential revenue. In addition, turnover data is useful for determining the average length of stay, violations of time limits, and assessing enforcement efforts. Typically license plate numbers of parked vehicles, or portions of plate numbers, are collected hourly to determine the number of vehicles using a facility during the survey period. More frequent turnover survey intervals may be appropriate for extremely high turnover situations.

Obviously collecting good accurate occupancy data helps ensure the accuracy of a parking supply / demand study. Manual occupancy and turnover surveys are hard work involving a lot of walking, sometimes in inclement weather. Manual counts for a large study area can also be expensive. A large number of reliable surveyors may be needed to cover large study areas. Even so, because of the time it takes to count a survey route, a data shift of nearly one hour may occur for facilities counted near the end of a long survey route. Aerial photography can be used to gather simultaneous occupancy data. However, aerial photography cannot be used to survey parking structures. Shadows and tree cover may also obscure some smaller parking locations.

It can be difficult to find reliable people to conduct the occupancy surveys. Transportation costs often preclude using the parking consultant's staff exclusively. Using a temporary employment agency often brings mixed results. Some of the temporary workers are diligent and reliably complete their assignments; others simply walk off the assignment or fake the data. Often the client's own personnel are the best source of reliable and motivated survey personnel. Using people from a non-profit community group can be successful, although scheduling personnel for a complete day can be problematic.

Defining the Parking Generator

A parking generator is the land use that draws people driving vehicles to a given location. Defining the existing size of the parking generator is an important step in preparing a parking supply / demand study, especially if the generator is expected to grow in future years. Defining the size of the generator is integral to defining the "design day" for the study. Choosing the best defining statistics to use is also related to the scope and purpose of the study. A comprehensive study may require a number of statistics to define existing and future activity. Fewer or even a single statistic may suffice for a cursory supply / demand assessment.

Again, the accuracy of the parking supply / demand assessment is dependant on using accurate data. The data describing the existing size of the generator must also be as accurate as possible. A parking consultant that is preparing a supply / demand study will have a great deal of expertise concerning parking. However, the parking consultant's expertise usually does not include projecting the future activity levels for the parking generator. For example, hospital administrators and hospital planners can provide more accurate forecasts of patient volumes, number of employees, etc. A successful and accurate parking supply / demand study requires a substantial effort from the client / owner to provide accurate data concerning existing conditions and to develop future growth scenarios.

Estimating Peak Demand

After analyzing the inventory and occupancy of the existing parking facilities, including both on street and off street facilities within the study area, parking demand ratios are developed to model existing parking demand. Standard ratios are typically used as a starting point and several iterations are necessary to adjust the ratios up or down to reflect "design day" conditions. Some professional judgment must be employed to make sure that the resulting ratios are reasonable. Spreadsheet software programs are commonly used to assist in the calculations of existing demand, and allow for quick iterations. But powerful software is not a substitute for accurate data and good professional judgment.

Typically demand estimates are prepared for the peak periods expected for "design day" conditions. However, sometimes certain parking user groups with segregated parking areas generate peak parking demands outside of the overall peak within a study area. Consideration must be given to accommodating these secondary peak demand periods for segregated parking facilities.

Future parking demand is estimated by applying the parking ratios that model existing demand against the projected future activity levels. This approach to forecasting demand builds in an assumption that the existing transportation patterns will remain largely unchanged in the future. If changes to the transportation system in the area cause an increase or decrease in the percentage of people that drive to the generator, the estimate of demand will be inaccurate. If changes to percentage of people arriving by automobile (also known as the transportation modal split) are anticipated, the parking demand ratios can be adjusted accordingly.

Considerations must also be given to feasibility of shared parking within the study area. In a mixed-use environment, the actual parking demand may be significantly lower than the simple addition of the estimated peak demand for each particular land use. Each land use may have peak parking demand periods that occur at different times.

In addition, there may be a "captive market" at the development, thereby reducing the parking demand. For example, a restaurant located in an office building may serve primarily office tenants during the lunch hour; the separate demand for parking generated by the restaurant could be quite low. For a complete description of shared parking, see the Urban Land Institute publication *Shared Parking.*

Parking Adequacy – Needs Analysis

Parking adequacy is the ability of the parking supply to meet the peak parking demand. It is simply calculated by subtracting the demand for parking spaces from the supply. To incorporate an effective supply cushion, the effective supply rather than the actual supply of spaces should be used in the calculation. The future demand for spaces is often compared against the existing supply to identify the number of spaces that will be needed to accommodate future demand. If the existing supply is expected to change, the projected future supply should be used to calculate future adequacy.

Sometimes there are other constraints and factors that influence parking demand. Local zoning ordinances may not permit reductions due to shared parking. Segregated parking facilities large enough for the ultimate peak demand period, such as physician parking areas at hospitals, may be required. Unusual site conditions, the lack of transit, safety and security concerns, and peculiarities about the generator may all influence demand and the resulting number of spaces needed to satisfy the demand.

Summary

The scope for a parking supply / demand analysis should be tailored to fit the purpose of the study. A "one-size fits all" approach may not yield cost effective answers to the questions at hand. Using published data to estimate demand may suffice in some instances. In other situations, a detailed comprehensive approach is warranted. Obtaining and using accurate data in conjunction with a thorough understanding of the development and/or existing conditions will yield the most meaningful and reliable parking supply / demand analyses.

PARKING ACCESS AND REVENUE CONTROL SYSTEMS (PARCS)

Alan J. Cruickshank

Alan Cruickshank is recognized as a leading authority in parking revenue control systems throughout the U.S. and Canada. Mr. Cruickshank was involved in the first magnetic-ticket based parking revenue control system that included an on-line Computerized Parking Control System (CPCS). He has acquired the reputation of introducing a number of innovative concepts for parking revenue control systems over the years. Many of these innovations have subsequently become commonplace throughout the parking business. His parking experience over the past 34 years includes all phases of access and revenue control system analysis, development, implementation, and contract management. He has provided services that ensured smooth project implementation from system concept through final acceptance and warranty. This has included defining the necessary access and revenue controls, developing training and testing programs, and designing effective auditing procedures for parking systems. He is at the forefront of new system design concepts for the industry. Based on his experience with operational needs, his advice has been taken on what new functions are required to be included in the systems to meet the growing needs of the industry.

Introduction

In *Parking 101 - A Parking Primer*, the two basic categories of access and revenue control systems, Ungated Systems and Gated Systems, are described. Each of these basic systems is designed to address specific operational needs, based on facility demographics, such as physical layout, number of spaces, and enforcement capability. As a refresher, a summary of the two basic parking systems is provided below:

- *Ungated Systems* - These types of systems do not employ parking gates and allow vehicles to park within a facility without access and egress control. These systems typically incorporate their equipment either at each space (such as with parking meters), at a central location (such as with pay/display machines or slot boxes), or use manually-based cash systems (where tickets are handed out to the customer upon entry and cash is collected prior to exit). At unattended facilities where there are no attendants present to collect fees, manual enforcement is a necessity.

- *Gated Systems* - These types of systems include parking gates in the entry and exit lanes to restrict access to and egress from the facility. A parking customer must pay a fee, use a token, take a ticket or use a permit (a card) or other type of media to gain entry to, as well as exit from, the facility. These systems usually incorporate access and revenue control equipment within the lanes. Manual enforcement at these facilities is only necessary if a reserved parking area is provided, since the equipment monitors and keeps track of facility use.

For each of these two basic PARCS categories, there are a number of different operational types that may be considered.

Types of Systems

All PARCS may be placed into one of the two basic categories identified above, but there are a number of different types of systems that may be incorporated at a facility to meet the parking facility's operational needs, as well as the particular requirements of the facility owner. For revenue control, these operational types are influenced by the choice of payment location and methodology employed:

- Payment is made when entering, on foot, or upon exiting; or
- There are on-site personnel to collect fees and/or verify permits, or machines are provided for payment (with or without on-site personnel).

Transient Parking Systems

The philosophy behind collection of parking fees is predominately based on whether the fee is flat or time-based. Pay at entry systems require a flat parking rate; pay on foot and pay at exit systems can accommodate any type of rate schedule. There are other factors, such as whether the facility is ungated or gated, that impact the type of system that can be employed. A brief discussion of the various types of PARCS that may be used for pay at entry, pay on foot, and pay at exit follows, with an at-a-glance summary provided in Figure 1. Additional information for some of the systems identified in this chapter may be found in Chapter 14 of *Parking 101.*

Figure 1

System Type	Pay at entry	Pay at exit	Pay on foot	Flat Fee	Grad. Fee	Gated
Slot Box	N	N	Y	Y	N	N
Parking Meter	N	N	Y	Y	Y	N
Pay-by-Space	N	N	Y	Y	Y	N
Pay/Display	N	N	Y	Y	Y	N
Entry Lane Cashiering	Y	N	N	Y	N	Y/N
Exit Lane Cashiering	N	Y	Y	Y	Y	Y/N
Credit Card In/Out	Y	Y	N	Y	Y	Y
Central Cashiering	N	Y	Y	Y	Y	Y

Slot Box

This is often a metal box, usually installed on a post or a wall with a separate slot for each parking space in the facility. The parking spaces are numbered. The parking customer inserts the cash for the parking fee into the slot. Enforcement requires opening the slot box and verifying that for each parking space with a vehicle, there is a corresponding correct payment.

Parking Meter

A parking meter is the most familiar parking fee collector in the world (other than a human being). One meter is provided per each parking space. Customers may use coins, smart cards, or smart "fobs" to pay the parking fee. The customer decides the duration of stay and pays the required amount. While this does provide a "graduated parking fee payment," unintentional over- and under-payment are commonplace. This system has no special physical facility requirements.

Pay-by-Space

This system requires each parking space to be numbered. Payment machines are provided at convenient locations within the facility, usually at or near pathways, or on sidewalks for on-street parking. The number of the parking space would be entered, then the duration of stay. Payment may be made with coin, bill, credit card, ATM card, smart card, smart "fobs", magnetic stored value cards, or other payment methods. Enforcement is performed using a report issued by the pay machine that shows payments for each space to verify that a valid payment has been made for each vehicle parked.

Pay/Display

This system is similar to the Pay-by-Space system, except that spaces need not be numbered. Once the payment has been made, the customer must return to their vehicle and place the payment receipt on the dashboard or other specified location. Enforcement requires each parking space to be visited and the date and time on the receipt verified as not expired - similar to a parking meter.

Entry/Exit Lane Cashiering

These types of PARCS are very flexible and can be used in gated or ungated systems, with either pay at entry or pay at exit. Vehicles enter and exit the facility through designated lanes (gated or ungated). Cashiers use cashier terminals for fee computation and accountability. For Exit Lane Cashiering, tickets issued upon entry with date, time, and entry location information are verified to allow the fee to be computed. Figure 2 provides a summary of these systems.

Figure 2

System Type	Flat Fee	Grad. Fee	Manual	Equipped	Comments
Pay at Entry	Y	N	Y		Fee collected upon entry by cashier
Pay at Entry	Y	N		Y	Fee collected upon entry by pay machine
Pay at Exit	Y		Y		Fee is collected upon exit by cashier. (Daily fee is known by cashier).
Pay at Exit	Y			Y	Fee is collected upon exit by pay machine
Pay at Exit		Y	Y		Fee is calculated by cashier terminal and collected upon exit by cashier.
Pay at Exit		Y		Y	Fee is calculated by exit reader and fee collected by pay machine.

There is no need for additional enforcement for these types of systems, as the cashier is responsible for verifying that the correct parking fee is paid by each customer, as well as collecting the fee payments. For this system to work effectively, however, every facility access and egress point must have space for a booth or equipment.

Central Cashiering

This type of system (also a part of what is known as a Pay On Foot System) provides an alternative or substitute for Exit Lane Cashiering. The customers are advised by very visible signage (placed at both the entry points and in parking areas, as well as at pedestrian walkways used after leaving their vehicle), that they must take their ticket with them. Upon returning to the parking facility, the parker must use the central cashiering operation to pay the required parking fee. The cashiering operation may be provided by cashiers, Pay Machines, or both. The system employs a machine-readable ticket issued upon entry that is modified upon payment to allow unattended exit from the parking facility within a reasonable time after payment. The customer inserts the ticket into a reader at the exit lane, and the gate is raised to allow the customer to exit. *This is a fully gated system and requires central locations to install pay machines for the customers to use.*

Pay Machine

The use of a Pay Machine in a Central Cashiering System provides the greatest control and revenue security for a PARCS. All entry and exit lanes are gated. Fee payment is via a machine, which automatically calculates the fee, accepts payment, and gives change. All revenues are stored securely in vaults within the pay machine. As this operation can run unattended (at the facility), surveillance equipment is sometimes utilized to provide an additional level of security for the customers.

Credit Card In/Out

Another system that is available is one that accepts a credit card inserted by a customer in an entry machine (often the ticket issuing machine). This PARCS permits a customer to use their credit card system to enter a facility rather than pulling a ticket. Once the credit card is verified as valid, data is encoded on one track of the credit card and the customer enters the facility. Account verification is performed upon entry of the vehicle into the facility. When the customer is ready to leave, the credit card is inserted into the exit reader unit, the data written to the credit card is removed and the vehicle then exits. The fee to be paid is then charged to the credit account.

In the discussion above for the various transient systems, each of the systems was identified as either normally staffed or unstaffed. This is summarized in Figure 3.

Figure 3

System Type	Staffed	Unstaffed	Comments
Slot Boxes	N	Y	Normally unstaffed
Parking Meters	N	Y	Normally unstaffed
Pay/Display	N	Y	Normally unstaffed
Pay-by-Space	N	Y	Normally unstaffed
Credit Card In/Out	N	Y	Normally unstaffed
In-Lane Cashiered	Y	N	Staffed at either the entry lane or exit lane, but not both.
Pay Machine	N	Y	This is normally unstaffed but can include a customer assistance person.
Central Cashiering	Y	N	This is normally staffed but can operate as both, depending upon time of day

Permit Parker Systems

In addition to the systems to handle transient customers, there are systems for frequent customers - those who pay a lump sum for a specific period and are able to enter and exit a facility as many times as desired. As with transient customers, there are both automatic and manual systems that are used by the customers. These systems are all unstaffed and enforcement requirements vary.

Hang Tags

This PARCS requires the customer to purchase a hang tag each month (or for some other period of time). The hang tag is hung from the rear view mirror so that the validity information is viewable from the exterior of the car. This is an ungated system and enforcement is the same as for the Pay/Display system.

Card (AVI) System

This type of PARCS is a gated system that requires the customer to have a machine-readable card (usually plastic). This card may be coded with validity information, or with a simple card number. At the entry lane, the information on the card is read and compared with a list of valid cards. Valid cards allow facility access. A similar process is performed at the exit lane. Each facility accommodates at least one entry lane and one exit lane. Some systems do not require the customer to use a card, but provide free exit. Enforcement is not required for this type of system, as all validity verifications are automatic.

Automatic Vehicle Identification

This type of PARCS is a gated system that employs a transponder which is unique and is attached to each vehicle. This is similar to the types of systems which are common on many toll roads, parkways, and turnpikes. The transponder is tied to an account (either pre-paid or billable). Pre-paid accounts require a deposit to be made with a minimum balance maintained (to cover a lost transponder and typical usage fees). The customers pass through the entry and exit lanes of the parking facility "hands-free", with all accesses and egresses tracked in a manner similar to the card systems. Manual enforcement is not required.

Facility Design Implications

In general, the more equipment that is installed at a parking facility, the more data that is generated and requires collection/transfer. The majority of the PARCS identified thus far generate data which is collected, stored, and captured (see Figure 4).

Figure 4

System Type	Data Stored	Data (1) Retrieved	Data (2) Transferred	Comments
Slot Boxes	N	N	N	
Parking Meters	Y	Y	N	Value of fees only, by method of payment
Pay/Display	Y	Y	Y	Fees (transactions), alarms, events
Pay-for-Space	Y	Y	Y	Fees (transactions), alarms, events
Credit Card System	Y	Y	Y	Fees (transactions), alarms, events, bad cards, authorization problems, etc.
In-Lane Cashiered	Y	Y	Y	For the non-manual systems
Pay Machine	Y	Y	Y	Substantial data of all types, including transaction records for usage/payments

System Type	Data Stored	Data (1) Retrieved	Data (2) Transferred	Comments
Central Cashiering	Y	Y	Y	Substantial data of all types, including transaction records for usage/payments
Hang Tags	N	N	N	
Card System	Y	Y	Y	Substantial data of all types, including transaction records for usages
AVI System	Y	Y	Y	Substantial data of all types, including transaction records for usage.

(1) *This indicates that a device is taken to the item of equipment and the data transferred directly to that device, rather than transferring the data over communications lines.*

(2) *This indicates that the data stored is transferred via some communication network to a central location.*

In addition to the restrictions and requirements identified above to accommodate the various types of PARCS at a facility, there are basic infrastructure needs for some types of PARCS which need to be taken into consideration before contemplating their implementation. For example:

- All gated systems must have at least one entry and one exit lane.
- All staffed systems must have a location at the facility for an individual to be situated.
- All AVI systems must have sufficient space to detect and read the transponder.
- All credit card systems must be able to connect to a clearinghouse.
- All slot box and Pay-for-Space systems must have their parking spaces numbered.

For a parking facility to accommodate a particular type of system, the ability of that facility to meet basic physical and infrastructure needs must be assessed.

System Needs

The basic questions that need to be answered for PARCS are:

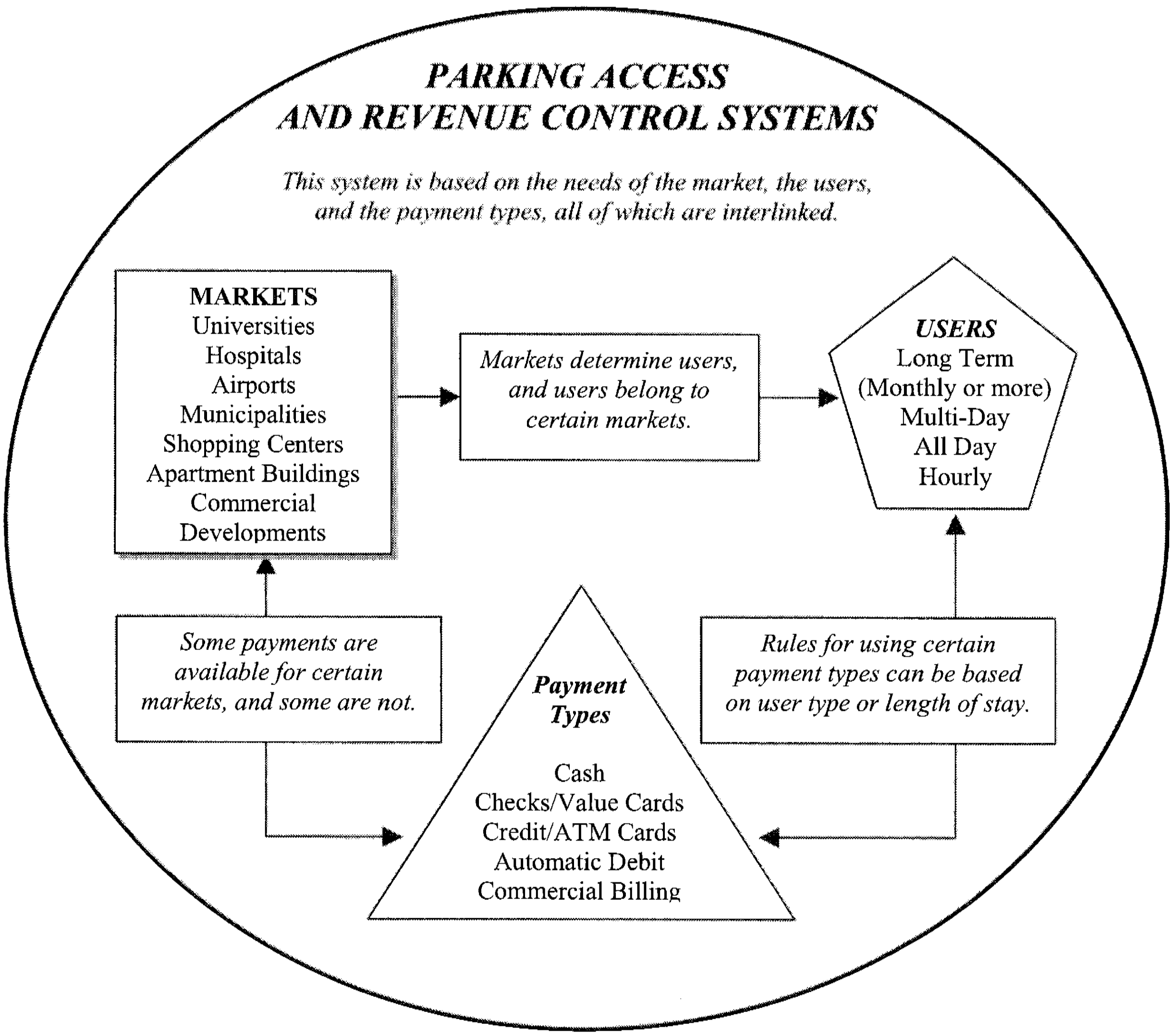
1. What are the operational needs or the facility?
2. What are the needs that the PARCS must accommodate?

To answer these questions, it is necessary to first review what decisions have to be made. That is, identify those detail items that must be decided to provide a solid understanding of the actual needs of the system, the options addressed, and the actual functions clearly defined.

With such an array of PARCS being employed in diverse parking facilities and operations, what is the most appropriate system that should be employed? The following factors influence the choice of system:

- Market (Establishment/Business)
- Users (Customer needs - event, short term, all day, etc.)
- Payment Types (Cash, credit, ATM, loyalty cards)

Figure 5



All of these factors are interlinked (see Figure 5). Other factors that influence the choice of system are type and size of facility (garage or lot and number of spaces) and access egress constraints (approach and departure roads). For all PARCS it is important to identify the management tools and information necessary to properly manage the facility. These factors are discussed in detail below.

The markets served by a parking facility are generally based on its location and the types of business, commercial, scholastic, and other establishments that are found in the surrounding area. A few examples of the various markets typical in a municipal setting are listed in Figure 6.

Figure 6

MARKETS

Universities
Hospitals
Airports
Municipalities
Shopping Centers
Apartment Buildings
Commercial Developments

The markets for a parking facility are generally easy to identify, as they are readily recognizable businesses and other establishments in the area surrounding the parking facility. This makes the customers to be served easier to identify with regard to the types of parking that they would use. Location of the parking facility is the first factor which is reviewed in identifying potential markets. In addition to the easily identifiable markets, there are others which may be "hidden," and based on such factors as time of day, day of week, or a combination of both. For example:

- Community colleges may have evening/weekend activities; or
- Adult education classes may be held at an office complex.

Both of these situations could easily lead to adding staff or keeping staff on for an additional time period. Or, if the facility presently accommodates only the frequent customers (hang tag/permit customers), then the facility could be staffed for a short period of time and entry payments collected.

The general types of markets which exist and are served by parking facilities are as follows:

- *General Use* - These types of facilities cover those parking facilities that are not dedicated to a specific purpose, and are not generally focused on serving only a few types of customers. These types of parking facilities can usually be found in areas where they serve a mix of different customers from a number of different businesses and other establishments, including shopping areas, transit stations, and apartment buildings. These types of facilities are usually found in downtown areas of municipalities and make up the majority of parking facilities.

- *Specific Use* - These are the parking facilities which are ***primarily*** designated for a specific business, use, or building. The majority of the parking space in these facilities is for targeted customers. Parking by other individuals within the facilities is tolerated, but not encouraged. This includes facilities located at some shopping centers, commercial developments, and universities. In most cases there is ample parking and these "other" customers bring in extra revenues.

- *Dedicated Use* - These parking facilities are ***solely*** for the use of specific individuals and customers. Parking by individuals who are not patronizing the business, offices, or other establishments designated are not permitted to park. For these types of facilities, space is usually at a premium and the occupancy at the facilities is usually very high and there is little or no surplus. These types of facilities are typically found at airports, rail stations, hospitals, and apartment buildings. In addition, these facilities are usually dedicated to the type of user – visitor versus employee – each with a different type of sub-system installed.

Understanding and identifying the primary markets to be served by your facility should be the first step in identifying the needs of the PARCS that you employ. Determining the secondary markets, and its customers should be the second step. In all cases, remember that a flexible system is the best defense against decreased demand for the facility, due to shifts in the habits of the identified primary users.

Users

Identifying the users (customers) who will use the facility closely follows the identification of the markets. In fact, once the market components have been identified, then identifying the users is a simple and straightforward activity. When you think of customers, try to think of their habits and what they might use the parking to accomplish. For example, a customer visiting a store for shopping and a customer visiting the doctor's office would have primarily the same need – the ability to park for a limited period of time on an occasional basis. While there are two different user types, the needs of both are the same. Therefore, they are actuality the same type of customer.

There are five different types of customers who are typically served by parking facilities:

- *Long Term, Frequent Customers* - These individuals park in the facility day in and day out, usually as a result of their employment in the area. This type of user may expect a break on the parking fees that they pay, and are not usually willing to accept the need to pay for their parking on a daily basis. These are frequent customers whose habits do not change much from day to day, and require a "guaranteed" place to park within the PARCS.

- *Long Term, Infrequent Customers* - These are customers who park for extended periods of time on occasion, not every day or necessarily even every week, such as airport customers and hotel guests who park for a few days. Their needs are very different. Paying for parking is an occasional activity and convenience of PARCS use is imperative.

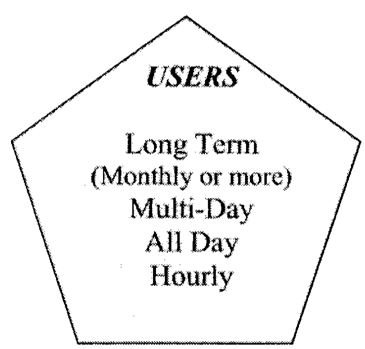


Figure 7

- *Daily Customers* - These are individuals who typically park for an entire day and need the convenience of parking. As with the long term infrequent customer, convenience is their main concern. These are typically day trippers on vacation, clients of business in the surrounding area, and other similar users. They are not necessarily familiar with the area, do not know what other parking is available within the area, and need a secure and easy-to-use system.

- *Hourly Customers* - These are by far the most common type of customer who would use a parking facility as they park for an hour or a few hours each time. Their needs range greatly. Some are price sensitive, some need convenience, many want both. They typically know the area, know what parking is available, and are not "brand faithful," i.e., if your facility does not meet their needs, they would not hesitate to find another place to park (very flexible PARCS usage). These individuals are typically shoppers, restaurant patrons, and visitors to professional buildings. The operative term is "visitor" - they are visiting somewhere in the area to achieve a short term objective.

- *Others* - One fact which is often forgotten is that not all individuals who access your facility are customers. Some, like policemen, tow trucks, and emergency vehicles, need to enter your facilities for other reasons - at various times during the day. This is one group of "customers" that is common to almost all parking facilities. While there is no revenue from these individuals, theirs is an important need to provide within your PARCS.

Payment Methods

Cash (and checks) are out - plastic is in. Plastic does not just mean credit cards, it also encompasses:

- ATM Cards
- Loyalty Cards
- Stored Value cards
- Smart Cards
- Account-based AVI tags

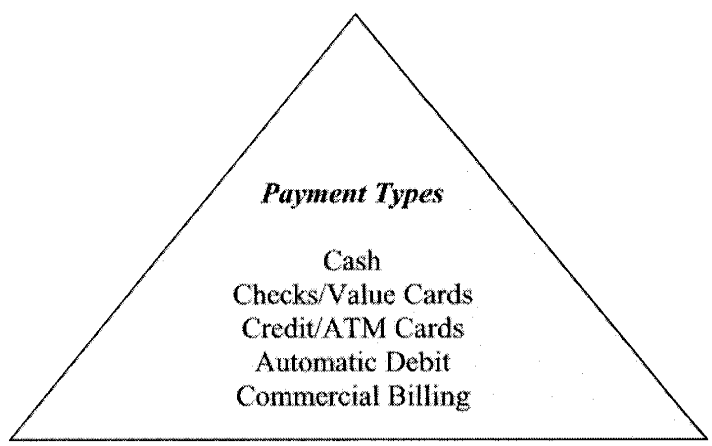


Figure 8

Payment of parking fees covers a wide range of technologies, systems, networks, and media. Gone are the days when you simply handed your cash to the cashier to pay the fee. Today's systems offer a range of services which serve everyone's payment needs. The present trend is the use of account-based systems to track usage and obtain payment once a threshold is reached, rather than collecting payment each time a customer parks. Common and emerging payment methodologies are described below.

- *Cash* - The most popular method to pay a parking fee.

- *Checks* - While not unpopular as a method for paying parking fees, there are drawbacks to check usage. The time factor for writing and accepting a check is a disadvantage, and the exposure to an uncollectable check normally rests squarely with the parking operator. Newer systems are now incorporating check verification which provides authorization quickly, minimizing the risk of accepting a check. These are a favorite, and effective, method of payment for customers who purchase monthly permits, where there is less of a risk taken by the parking operator when accepting a check for this type of payment.

- *Credit/ATM Cards* - This is the wave of the future - these are being accepted everywhere for everything. Credit cards, which used to be reserved for the purchase of goods and services over a specific amount, are used for purchases of very low cost. The authorization network has become very reliable and stable. In addition, new parking subsystems which provide for a connection to the authorization network operate extremely quickly. (There are few which still require a longer connect time, even before the authorization occurs.) This revolution has been very quick, and will probably overtake cash (over time). Most automated systems either accept credit/ATM cards or can be modified easily to accept them. Staffed locations, and pay machines in unattended operations, and many Pay/Display and Pay-for-Space machines accept credit cards. The risk and exposure to theft are low, and reliability is relatively high. This fits well with the parking industry's needs – at present and for the future.

- *Commercial Billing System* - This is a software system integrated into the PARCS which permits the establishment and management of commercial accounts for permit customers. The system allows accounts for both businesses and individuals to be established. Establishment of these accounts would be based on providing an initial balance in the account, which could be drawn down with each parking facility use. The customer would have a permit (card, AVI tag, etc), which serves to identify their account. This permit could store the entry information or be used in tandem with a ticket pulled upon entry. Replenishing the balance in the account would be performed through the use of a credit card number on file or automatic debt to a bank account. At the end of a defined period, the customer would be provided with an accounting of all uses and replenishments of the account. This is similar to what is presently done with many toll roads.

- *Stored Value Cards* - Stored value cards (SVCs) have been in use in the parking industry for at least 15 years. Initially these were paper or plastic credit card-sized cards, which included a balance stored on the card. The SVC was then used like cash to pay a parking fee. The SVC is still a very powerful tool for your customers, especially with the emergence of smart cards as multi-use payment media. The transit industry has been quick to use SVCs (NYC, Washington, D.C., Chicago, San Francisco), but slow to transition to smart cards. However, there are several new projects in large urban areas transitioning to smart card use. Partnering with local transit agencies, and accepting their SVC (whether smart card or magnetic) would provide additional payment options for your customers.

Not all types of payment are suitable for all types of customers. Planning for the types of customers to accommodate will go a long way to identifying what types of payment you will accept and under what circumstances.

Facility Types

There are only three different types of parking facilities - surface lots, garages (also called parkades), and combination surface lot/garage.

- *Garages/Parkades* - These are multi-level structures that may be above ground, below ground or both. Entry to and exit from these parking facilities is through clearly delineated, designated access points (lanes) from the surrounding roadways. The garages provide a fairly well protected environment and protect the customers, the employees, and the equipment to a reasonable degree. Most types of PARCS operate successfully in these types of facilities.

- *Surface Lots* - These are open-air, single level facilities located at street level. Entry to and exit from these facilities is also via access lanes, but may be through simple curb cuts (in some cases there are no identifiable access points). As open-air facilities, employees, vehicles, customers, and equipment are subject to the elements and potentially harsh environments. Most types of PARCS also operate well in surface lots, but the need for restricted access (i.e., clear access and egress points) is essential to their proper operation. Equipment installed at these locations will need to be robust, environmentally protected, and very reliable.

- *Combination Facilities* - This facility incorporates a garage on one portion of the site and a surface lot on another. Unlike either of the other two facility types, it is common for each portion to operate differently, e.g., the garage could be for short term customers (who would pay more for the privilege) and the surface lot for the long term customers. They may also operate as a single facility. The strength of this configuration is the potential for "market differentiation". For example, the surface lot could accommodate a flat, daily fee, the interior of the garage could accommodate the hourly (short term or visitor) parking, and the top tier of the garage could be used for employees with permits.

Impediments to install one or more types of PARCS at any specific type of facility are not apparent, other than that identified for the surface lot. However, as many surface lots are small, the implementation of a pay machine PARCS may appear less than advantageous. While a credit card system may operate very well at an unattended surface lot, if problems emerge there is no one available to assist the customer, and problems would ensue. The local support available to assist customers in the event of a problem is also important and must be made part of the overall equation.

Summary

A customer driven approach for the PARCS will provide a convenient and satisfactory experience for the customers. The PARCS must handle customers efficiently, and promptly. The right choice of system will accomplish these objectives by considering the inter-relationships between the markets, customers, and payment methods, and how these impact the different types and configurations of parking facilities.

Parking facilities have unique qualities which need to be taken into account when planning the best way to collect parking fees. In addition to the size and type of facility, there are a number of other elements which need to be considered. There are three main questions which need to be answered during the design stage, or even at the planning stage, of the facility:

1. What markets will my parking facility serve?
2. Who are my customers (parkers)?
3. How will the parking fees be collected?

These three questions are at the heart of all PARCS implementations. With these three questions guiding you, ensuring that your facility operates properly becomes a much easier task. It is the focus and goal of this chapter to demonstrate how the answers to these three questions:

- Affect different types of facilities and their PARCS.
- Impose requirements on PARCS.
- Reflect on and impact each other.
- Help define suitable PARCS solutions.

Parking facilities all over the country are beginning to operate longer hours and serve more than just one type of customer, in an effort to maximize their return on investment. The need to capture as much revenue as possible from time-expired assets (like parking spaces) is growing. PARCS will continue to evolve to meet these additional needs. The critical questions are:

1. What are these needs?
2. What system can best meet these needs?

BASICS OF AUDITING

Manuel Rubio

Manuel Rubio is a Principal of Walker Parking Consultants. He is serving as Director of Operations for the Burbank office. He has been actively involved in the project management of parking studies. These studies include researching, analyzing, and recommending solutions to parking problems through the performance of parking supply/demand, market and financial feasibility, operations audits, and revenue control studies. Manuel has worked as a consultant in the parking industry for 15 years.

Introduction

There are few businesses in the world today that deal primarily with cash. The largest one that comes to mind is the casino industry. Most are aware of the checks and balances involved in that industry. In just about every other business, owners require an annual audit of the books.

When it comes to parking, however, auditing is sometimes the last thing on an owner's mind. As long as the revenues keep rolling in, everything is fine. But the question that the owner should be asking is, "Am I getting all the revenue that my parking facility is generating?" Sometimes, the owner may have an unknown partner that is taking a share of the revenues prior to the money being deposited in the bank!

Parking revenue passes through many hands: the customer, parking cashier, supervisor, manager, parking operator, and finally the owner. As the revenue passes through each step, there is a potential of revenue misreporting or even theft. This chapter will discuss some of the audit procedures that may be performed to ensure that no revenue is being lost along the way to the bank.

There are two types of parking facilities that will be discussed here: traditional parking equipment locations and cigar box operations (or operations without parking revenue control equipment). There are other types of parking operations, as well as modifications of the two types listed above.

Traditional Equipment Locations

A traditional equipment location refers to a parking facility that has gate arms at both the entry and exit lanes, a ticket dispenser and/or a card reader at the entry lane, and a cashier booth with a fee computer and/or a card reader at the exit.

How It Operates

The daily parker is issued a time-stamped ticket from a dispenser. When the parker pulls the ticket, the entrance barrier gate is activated (or opened). The parker then proceeds to park. When the parker is ready to exit the parking facility, the parker drives up to the exit lane where the ticket is handed to the cashier. The cashier inserts the ticket into the ticket reader/validator, which automatically calculates the fee owed. In some systems, the cashier must manually enter the entry time into the fee computer. If the ticket contains a validation, the cashier enters the type of validation into the fee computer, which automatically subtracts the value of the validation from the fee owed. The cashier then collects the amount owed and gives the parker any change. Once the transaction is completed, the exit barrier gate is activated.

Monthly parking is monitored by an access control system. (This system may be part of the revenue control system, or may be a separate stand-alone system.) All monthly parkers are issued individual access cards, which activate the entry and exit gates. The parker inserts the card into the reader (or swipes the card through the reader), which determines if the card is valid. Once the access system determines that the card is valid, the system opens the entry/exit gate. The system usually has the ability to print and/or store, in memory, all card usage activity.

Audit of Daily Tickets

The first step is to reconcile the parking tickets to the individual cashier reports. In this type of facility, a system generated cashier report is generally available, however a manual cashier report is also kept. A physical count of all tickets, by increment and type, should be done for each cashier. This procedure should be performed daily, but could also be performed on a randomly selected day. The test day should not be a slow day. If audits are randomly selected, and time allows, a two or three-day sample is desirable. Any discrepancies should be noted.

Next, a ticket time check should be performed. A random sample of tickets, from each cashier, should be selected. This procedure requires the recalculation of the parking fee based on the entry and exit times. Any discrepancies should be noted. Is the entry time printed by the fee computer the same as that of the entry time printed by the ticket dispenser? Do all validated tickets contain the appropriate validations?

Next, an analysis of all void and "no charge" tickets should be performed for each cashier. This procedure is useful for developing trend analysis. (A single day of data may not mean much, but comparing it to historical data will show developing trends.) A worksheet should be developed that lists all the various types of void and no-charge tickets (grace period, monthly parker, spitter void, deliveries security, management, etc.) and the quantities of each type, for each cashier shift. This indicates the types of void/no-charge tickets that are being processed by each cashier. Are all tickets clearly documented with the reason, name of the parker, and signature? Does one cashier seem to have more void/no charge tickets than the others? Does a cashier have a large number of a certain type of void/no charge tickets? Any odd trends in void or no charge tickets should be noted.

Lastly, an uncollected (missing) ticket analysis should be performed. These are tickets that are lost by visitors, or not collected when the visitor leaves (e.g. vehicles leaving after hours, etc.) This is a time-consuming process, but will prove valuable in determining the approximate entry time of each uncollected ticket. All tickets for the day should be combined together. Then each ticket sequence should be arranged in numerical order (lowest number to highest). A worksheet should be developed which lists each uncollected ticket and the entry time of the ticket prior to the missing one.

The industry average for a typical facility that closes in the evenings (gates left open after closing) is 2% or fewer tickets uncollected. For a facility that is operated 24 hours per day, the percent drops to 1% or less. A facility that only offers valet parking should have no missing tickets, since a ticket is required by the valet to retrieve a vehicle.

A large number of uncollected tickets early in the morning indicates a possible problem with monthly parkers pulling a ticket to enter and using their access card to exit. A large number of uncollected tickets just prior to closing indicates that customers realize that after closing time, they can exit for free. Extending hours on a trial basis and performing a cost/benefit analysis can be used to determine if the additional revenue generated is more than the additional labor cost. Tickets missing throughout the day indicate other issues and will require further investigation.

Other items that can be examined include non-resettable lane, gate, loop and transaction counters. Ideally, all these counters should be recorded on a daily basis and reconciled to each other, as well as the number of tickets collected for the day. Any variances should be noted and investigated further.

Audit of Monthly Parking

The most important item in auditing monthly parking is to obtain an active key-card list (from the card access system) for the period being audited. Without this list, it is impossible to audit monthly parking for a past period; only the current period can be audited. Once the parking manager knows that an audit is going to be performed, the element of surprise is gone and this provides the parking manager with time to “clean up” the records.

The other items needed to conduct the monthly parking audit are an accounts receivable schedule from the start of the test month and the end of the month, a list of all cards billed for the test month, a list of any no-charge cards, and payment records listing all individuals and companies paying for monthly parking during the month.

The first audit procedure should be to reconcile payments received to billings. The beginning accounts receivable schedule should be used to ensure that all payments are credited to old balances first, rather than the current billing. Any differences should be noted.

Once all payments have been reconciled, an accounts receivable schedule should be created based on the accounts that remain unpaid from the above audit procedure. This schedule should be compared to the ending accounts receivable schedule provided by the parking manager. Any differences should be noted and investigated further. Were there "write-offs" that occurred? Were the reasons for the write-offs documented? Were the write-offs clearly noted on the monthly management report? Who approves the write-offs?

A schedule of all discounted monthly parkers should be created based on the billing information provided. This schedule should then be reviewed to ensure that all the discounts are in agreement with lease agreements or other written agreements. Also, a second schedule should be produced listing all no-charge monthly parkers. The list should be reviewed to ensure that all individuals are authorized to receive free monthly parking.

The next audit procedure is to reconcile the active card list to the paid, no-charge, and outstanding key cards. Please refer to Figure 1 below. Any differences should be noted and the appropriate action taken: an invoice could be issued for the unbilled card(s), or the unknown card(s) could be de-activated from the card access system.

Figure 1: Key Card Reconciliation

Active Key Cards (June 1)		352
Paid (June)	304	
Pre-Paid	6	
No Charge	17	
Accounts Receivable	4	331
Difference		**21**

Audit of Validation Sales

Validation stamps are also known as validation coupons or stickers. These are pre-paid stamps that are sold from the parking office. The stamps usually come in a book with ten sheets, each sheet containing ten stamps. Each book is pre-numbered and typically has the name of the garage pre-printed on the stamp. The stamps can be either a dollar value or time value (i.e., $1 stamp or 1-hour stamp). The time value is the most often used.

The book purchaser uses the stamp to validate his/her visitors parking ticket. The appropriate number of stamps are affixed to the ticket. Upon exiting, the cashier enters the number of validation stamps into the fee computer, which automatically deducts the amount of the validation stamps from the amount owed.

The audit of validation sales consists of auditing the sales of the books and verifying the inventory on hand. The audit of the sales consists of reconciling the validation sales log to the payments received. Any differences should be noted.

A copy of the invoice showing the validation books sold over the past year should be obtained. The invoice will list the number of books printed and the serial numbers. Next a physical inventory of the books should be performed. The inventory should then be compared to the invoice to ensure that all books are either reported as sold, or are still in inventory. Any discrepancies should be noted.

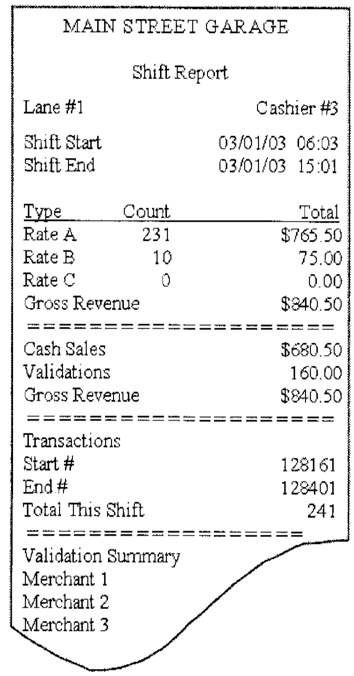
A second type of validations frequently used in the parking industry are rubber stamps. These are ink stamps that may be an address stamp, name stamp, or one that says "parking validation". The office tenant stamps the back of the ticket, which provides free or discounted parking. Other times the stamp indicates to the parking operator that the parking charges are to be billed back to the tenant. This type of validation is known as a "charge validation." At the end of the month, the parking manager must manually separate all charge validated tickets by tenant, and manually calculate the amount to be invoiced back to the tenant. There are several drawbacks to this type of validation. They include the ease the stamps can be duplicated at a local stationary store and increased labor required to prepare invoices, invoice disputes, and outstanding receivables. Facilities that use this type of validation should consider discontinuing accepting rubber stamp validations and switch users to validation stickers.

The Paper Trail – Part 1

The paper trail is divided into two sections: the paperwork that is typically performed on-site in the booth and in the parking facility office, and the paperwork that is performed off-site.

A cashier report is prepared by each cashier at the end of his or her shift. The report lists the tickets collected, by type, and the amount of cash collected. Also, at the end of the shift, a closeout tape from the fee computer is generated. Please refer to Figure 2. This tape lists all the transactions processed through the fee computer and contains a total of transactions and dollars collected.

Figure 2 - Fee Computer Close-Out Tape


MAIN STREET GARAGE

Shift Report

Lane #1		Cashier #3
Shift Start		03/01/03 06:03
Shift End		03/01/03 15:01
Type	Count	Total
Rate A	231	$765.50
Rate B	10	75.00
Rate C	0	0.00
Gross Revenue		$840.50
==================		
Cash Sales		$680.50
Validations		160.00
Gross Revenue		$840.50
==================		
Transactions		
Start #		128161
End #		128401
Total This Shift		241
==================		
Validation Summary		
Merchant 1		
Merchant 2		
Merchant 3		

The first procedure in this phase of the audit is to reconcile the cashier report to the fee computer closeout tape. Not only should the total dollars agree, but also the number of transactions should equal the number of ticket turned in by the cashier. Also, the closeout tape should have a non-resettable counter for the number of transactions processed. (In Figure 2, the non-resettable counter is located in the Transaction section.) This number represents a total of all of the transactions performed by the cashier. The ending non-resettable counter from the prior shift should equal the current starting non-resettable counter. If they do not, then a second shift and closeout was processed which was not reported. Some revenue control systems also provide a non-resettable cash total, which can be used in the same fashion.

The next procedure is to reconcile the cashier report to the daily report. The daily report is a summary of all the cashier activity for a particular day plus any other revenue received. Please refer to Figure 3 on the following page. The monthly parking payment log and the validation payment log should also be reconciled to the daily report. Any differences should be noted.

Some (if not many) operators perform a complete ticket audit for each cashier, comparing the number of tickets (by transaction type and amount) to the totals recorded on the cashier report and system generated report when the cashier closes.

The Paper Trail – Part 2

Once the parking manager completes the daily report, it is then forwarded to the parking operator's main office or to the accounting department. From here, it is entered into the accounting system, which at the end of the month generates a monthly management report (MMR). Most accounting systems are capable of generating an interim report, sometimes referred to as a revenue summary. Please refer to Figure 3. This report details the various revenues by type and by day received.

Figure 3: Sample Daily Report

DAILY REPORT

MAIN STREET GARAGE

Monday, March 1, 2003 — Prepared by: J. Smith

DAILY SALES SUMMARY

	First Shift		**Second Shift**		**Third Shift**		**Totals**	
	Qty	**$ Amount**	**Qty**	**$ Amount**	**Qty**	**$ Amount**	**Qty**	**$ Amount**
TICKETS								
$1.00	15	$15.00	18	$18.00	0	$0.00	33	$33.00
$2.00	32	64.00	132	264.00	0	0.00	164	328.00
$3.00	40	120.00	1	3.00	0	0.00	41	123.00
$4.00	15	60.00	8	32.00	0	0.00	23	92.00
$5.00	85	425.00	34	170.00	0	0.00	119	595.00
$10.00	3	30.00	37	185.00	0	0.00	40	215.00
OTHER	0	0.00	1	8.50	0	0.00	1	8.50
TOTAL	190	$714.00	231	$680.50	0	$0.00	421	$1,394.50
VALIDATIONS								
Grace Period	5		8		0		13	
Deliveries	3		4		0		7	
Security	1		3		0		4	
Restaurant	88		61		0		149	
Theater	3		85		0		88	
Other	0		0				0	
Total Validations	100		161		0		261	
MONTHLY								
MONTHLY	174	$26,100.00						$26,100.00
CARD DEPOSITS	1	20.00						20.00
OTHER	0	0.00						0.00
Total Monthly	175	$26,120.00						$26,120.00
VALIDATION SALES								
30 Minute Books	1	100.00						100.00
1 Hour Books	0	0.00						0.00
All Day Books	1	1,000.00						1,000.00
Total Validations	2	$1,100.00						$1,100.00
TICKETS ISSUED								
	Lane 1		Lane 2		Lane 3			
Starting Number								
Ending Number								
Total Issued								
GRAND TOTAL	467	27,934	392	681	0	0	682	28,615

The first audit procedure in this phase of the audit process is to reconcile the daily reports for a test month to the revenue summary. Note any differences. The next procedure is to reconcile the summary to the MMR, noting any differences.

The next audit procedure is to reconcile the deposit slips to the daily report. Depending on how the deposits are made (either each cashier makes a deposit or there is one deposit for all revenues), this can be performed by cashier shift report or by daily report. After all deposits have been verified, then the deposit slips need to be reconciled to the bank statement. Any differences should be noted.

The last step is to perform a cash composite analysis. A common source of fraud occurs when cash is taken from transient revenues and replaced with a check for monthly parking or validations. It is not only necessary to verify that the total revenue deposited is equal to the amount reported, but also the composite of each deposit must be verified to ensure that the amount of cash deposited is equal to than the total daily revenue. A deposit that is greater than or less than the daily revenue should be thoroughly investigated. For a sample cash composite analysis, please refer to Figure 5 on the following page.

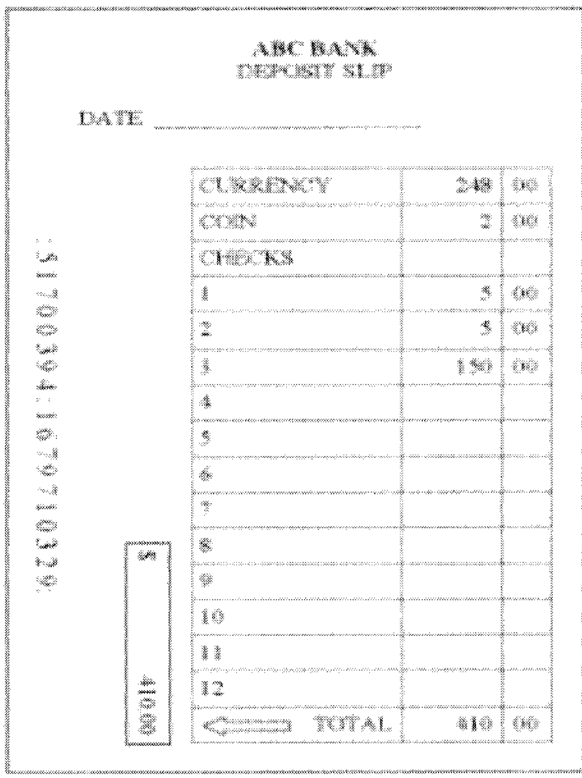
Suppose that according to the daily report your revenue from a particular day, say $410, is solely from daily parking. Referring to Figure 4 and 5, if you only verified the total deposit amount, there appears to be no problem. But if you look at the composition of the deposit, you will notice that there is a $150 check included, when there is only daily revenue reported. This is a sign that there are bigger issues that have not yet been discovered.

Figure 4: Sample Revenue Summary

		Transient	Monthly	Validation	Over/ Short	Total
1-Mar	M	183.00	7,570.00	0.00	0.00	7,753.00
2-Mar	T	276.00	33,672.00	0.00	2.00	33,950.00
3-Mar	W	160.00	4,310.00	0.00	0.00	4,470.00
4-Mar	T	346.00	2,760.00	0.00	0.00	3,106.00
5-Mar	F	327.00	0.00	1,500.00	(1.00)	1,826.00
6-Mar	S	0.00	0.00	0.00	0.00	0.00
7-Mar	S	0.00	0.00	0.00	0.00	0.00
8-Mar	M	143.00	750.00	0.00	0.00	893.00
9-Mar	T	119.00	0.00	0.00	0.00	119.00
10-Mar	W	236.00	0.00	0.00	1.00	237.00
11-Mar	T	192.00	500.00	0.00	0.00	692.00
12-Mar	F	177.00	0.00	0.00	0.00	177.00
13-Mar	S	0.00	0.00	0.00	0.00	0.00
14-Mar	S	0.00	0.00	631.00	0.00	631.00
15-Mar	M	206.00	0.00	0.00	0.00	206.00
16-Mar	T	95.00	0.00	0.00	1.00	96.00
17-Mar	W	214.00	0.00	0.00	0.00	214.00
18-Mar	T	373.00	0.00	1,500.00	0.00	1,873.00
19-Mar	F	200.00	0.00	0.00	0.00	200.00
20-Mar	S	0.00	0.00	0.00	0.00	0.00
21-Mar	S	0.00	0.00	0.00	0.00	0.00
22-Mar	M	166.00	0.00	0.00	0.00	166.00
23-Mar	T	222.00	0.00	0.00	(1.00)	221.00
24-Mar	W	280.00	0.00	0.00	0.00	280.00
25-Mar	T	250.00	0.00	0.00	0.00	250.00
26-Mar	F	410.00	0.00	2,575.00	0.00	2,985.00
27-Mar	S	0.00	0.00	0.00	0.00	0.00
28-Mar	S	0.00	0.00	0.00	0.00	0.00
29-Mar	M	182.00	0.00	0.00	0.00	182.00
30-Mar	T	278.00	0.00	0.00	0.00	278.00
Total		**5,035.00**	**49,562.00**	**6,206.00**	**2.00**	**60,805.00**

Figure 5: Cash Composite Analysis

$410.00	Transient Revenue
(248.00)	Currency on Deposit Slip
(2.00)	Coin on Deposit Slip
160.00	
(10.00)	Small Checks on Deposit Slip
$150.00	**Difference**



ABC BANK
DEPOSIT SLIP

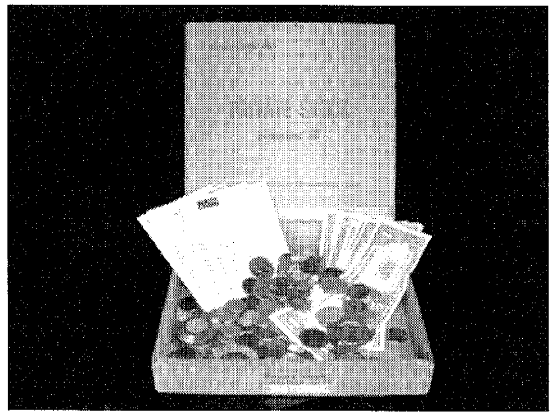
DATE ______________

CURRENCY	248	00
COIN	2	00
CHECKS		
1	5	00
2	5	00
3	150	00
4		
5		
6		
7		
8		
9		
10		
11		
12		
TOTAL	410	00

$ 410.00

51700394 1679710329

Cigar Box Operations



A Cigar Box facility refers to the early days of the parking industry where the attendant used a cigar box as a cash register, since the technology of fee computers was not available. This type of location consists of a time clock and either a basic cash register or a "cigar box". This type of operation offers a lower level of revenue accountability.

How It Operates

When a vehicle enters the facility, the attendant manually stamps (clocks in) a two-part parking ticket with the entry time. One portion of the ticket is given to the customer and the second is placed under the windshield wiper. The window stub is used to identify the vehicle when parked as a transient parker. When the customer is ready to exit, the ticket is surrendered to the attendant, who stamps the ticket with the exit time (clocks out) and manually calculates the parking fee owed. The customer pays the attendant and then exits the facility. Monthly parkers are issued a hang tag, which is placed on the rear view mirror of the vehicle. The hang tag identifies the vehicle as a current monthly parker.

The day following the inventory, obtain the tickets, cashier reports, and hang tag log. The first procedure is to reconcile the tickets to the cashier report. Next is to time check all the tickets. Once all tickets have been time checked, arrange them in numerical order. Starting with the lowest ticket number, ensure that the entry time on each subsequent ticket is a later time than on the previous ticket. Any discrepancies should be noted. With the tickets still in sequential order, check the entry and exit times on the tickets against the times of the unannounced inventory worksheet. Are there any tickets that were clocked out prior to the start of the inventory, yet the vehicle was still parked during the inventory? Are there any tickets that were found during the inventory, but not clocked in until later in the day? Either of these two situations may be signs of attendant/cashier ticket manipulation.

The hang tags found during the inventory should be checked against the hang tag log to ensure that all hang tags issued have been properly recorded as sold on the hang tag log. Any differences can indicate that the attendant is issuing hang tags without recording the sale, or that counterfeit hang tags are being used.

Unannounced Inventory

The key to building a house is a sound foundation. The same is true with an audit. The paperwork that is received from the garage manager may look great, but is it an accurate account of what is taking place at the parking facility? Since a cigar box operation has no revenue control, an auditor must first ensure that the paperwork is sound.

The first step is to perform an unannounced (surprise) inventory. This is performed to ensure that all vehicles are identified properly. Any unidentified vehicle could mean lost revenue. At the start of the inventory, the time and the next ticket number should be recorded. Then the license plate number and the daily ticket number or monthly hangtag number of every vehicle in the facility should be recorded. At the end of the inventory, the ending time and the next ticket number should be recorded.

Any vehicle with no ticket or hang tag should be noted. Once all vehicles have been recorded, the attendant or manager should be asked to explain any vehicles that are not identified. All explanations should be noted.

Unannounced inventories could also be used in auditing a valet parking operation. Most valet operations still operate using the cigar box method.

Things to Watch Out For

During the inventory, special care should be taken to ensure the parking attendant does not issue parking tickets to vehicles already parked in the facility. Since the vehicles were already parked prior to the start of the inventory, they should have been issued tickets.

License plate numbers (the last three digits, at a minimum) should be written on the window stub. The auditor should randomly check to ensure the number on the stub matches the vehicle license plate. Writing the license number on the window stub prevents the ticket from being re-issued to a second customer.

Ensure that all monthly parkers have a current month hang tag properly displayed on their vehicle. When purchasing hangtags, it is a good idea to change the colors each month. This ensures that the hangtags cannot be easily duplicated using a scanner and a printer.

ANATOMY OF A PARKING GUIDANCE SYSTEM

Carl E. Blanchard

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Introduction

Each day people come in contact with some type of guidance or wayfinding application, ranging from something simple like signs hanging at the end of supermarket aisles, to more complex applications like variable message signs suspended over highways warning of accidents or identifying alternative routes. These wayfinding instruments are designed to provide information to assist people to their varying destinations. In some instances, they are even designed to influence decision making and ultimately behavior. The same concept applies to parking guidance. A parking guidance system (PGS) is a wayfinding application that is geared specifically to parking. Through the use of signage, PGS applications help drivers effectively and quickly locate available parking. PGS also helps parking professionals operate, control, and maximize the capacity of their facilities.

The rapid growth of the parking industry will put existing infrastructure to the test. It is becoming more important to carefully consider any tool or technology that may more efficiently utilize parking infrastructure and assist in operational management. Increasing parking inventory capacity is only part of the equation. Granted, adding more spaces can resolve a host of problems, but effectively *operating* and *controlling* this increased capacity will be a key factor in determining if growing demand can be properly satisfied. As with many other industries, parking has turned to technology to add increased efficiency and control to our parking programs and operations.

Purpose and Conceptual Design

What is PGS?

A parking guidance system is an array of electronic signage, controlled by a software application, that guides and controls vehicle flow to parking facilities and spaces. Depending on the provider the software application can perform and provide a wide variety of functions and features. At its core, the software is able to count and identify space utilization within a facility or group of parking facilities and send that information out to signs that display information to parkers.

The parking guidance concept can be approached by the "layering" of technology and infrastructure. While the basic concept of PGS remains the same (getting drivers to available parking efficiently), the systems vary widely in their complexity and design. Each level of sophistication provides the driver with additional parking information when passing through the system. Each of the designs described work as individual systems or may be combined or "layered" to provide a more complex and robust system.

The variations and combinations of the types of PGS deployment that could be designed are broad, but there are two primary conceptual designs: *Outside the Facility PGS* and *Inside the Facility PGS*. The outside the facility design reaches beyond parking facilities to provide information to parkers before they reach the facility and to guide them to a specific location. An inside the facility PGS differs in that the parker is already inside the facility, and is receiving guidance information to find available spaces.

Outside the Facility PGS

This is the broadest configuration where the parker is informed of the status of a facility before reaching the location. The concept is to engage the parker before reaching the facility and provide information pertaining to available parking. For this application a total facility count is tracked and monitored by software. All of the entries to and exits from the facility are monitored against total capacity. This could be applied to either a structure or surface lot. In many instances, this information is available from parking access and revenue control systems. For facility guidance, only two scenarios can exist: the facility has available space, or the facility is full. This information would be displayed on an electronic sign located outside the facility, informing drivers of the facility status before they reach the entry area. Depending on the type of signage utilized it could simply state that the facility is "full" or "open," or provide more precise information such as exactly how many spaces are available. The design layout of the sign may be customized to the specific needs of the parking provider. Ideally, the signage should be strategically located to provide drivers with the information prior to commitment to the facility. This will lessen traffic impact, backout situations, and general confusion.

This application works particularly well for parking operations that have multiple parking facilities within the same general geographic area. The system tracks the inventories of multiple garages and posts the data on signs. This would provide the parker with valuable information about the status of available parking for multiple locations in the area. Drivers would then be guided to the available parking. The advantage to the parker is that it saves time and increases the ease of use of the facilities. The operator gains from directing patrons directly to unused space, eliminating problems that stem from random searching behaviors.

Inside the Facility PGS

This is the most commonly known version of PGS where the parker is provided information pertaining to available space once inside the garage or on the lot. This system configuration counts available space by level in a multiple story garage or by zone in a large surface lot. Each level or zone is monitored and tracked based on available space. This information is then sent to signs guiding the parker through the facility to available parking spaces.

Typically, the signs are located on the entry and exit ramps for a multi level garage and at entry and egress points of predetermined zones. A parking structure's physical characteristics and restricted traffic flow make PGS by level easily adaptable. Surface lots can be more challenging in the sense that zones must be established through physical barriers and specific entry and egress points. Surface lots must be of significant size to properly utilize a PGS framework.

The signs located at each entry point would indicate if the level or zone has available parking and/or to proceed to a specific location. Again, depending on the sign type an array of messages and information can be displayed. This benefits the parker by quickly guiding them to available parking and not forcing them to randomly search the facility for the closest space. The operator gains a significant amount of control as to how the facility should be filled.

The internal parking guidance system can be taken to the next level of sophistication by "layering" on more technology and functionality. This is the case with single space monitoring. This is the most advanced and sophisticated parking guidance application and reaches the pinnacle of functionality to date. The system monitors every single space within the garage. This is accomplished by sensors that are installed in each of the facility's spaces.

Generally, PGS systems using space guidance have been restricted to garages and indoor structures. This application usually exists in combination with level or zone guidance. Space guidance takes the parking guidance principle to the next step by guiding parkers directly to the space. The concept is that in addition to informing the parker that there are X number of spaces on level 2, it will guide them directly to those available spaces. A series of lights are deployed on the ceiling down an aisle adjacent to each space. The light will be green indicating an open space or red signifying an occupied space. For the parker, the available spaces can be identified from quickly from a distance. This system utilizes radio-frequency (RF) and infrared (IR) technology for space detection and occupancy.

Matching your Operation – Where should PGS be Used?

Stand Alone Garage Operation

A multiple level garage structure is the most common application for a parking guidance system. In this configuration the level or zone type of system described above is used.

The basic process flow begins with drivers entering a facility through a controlled point of entry. A larger facility may have multiple entry and egress points. Each point of entry and egress would be equipped with detection hardware to sense and essentially count vehicles. Vehicle detection is normally accomplished by a standard inductive loop and loop detector, although more exotic detection and count monitors such as RF and IR are available. If a parking access revenue control system is already installed at a location, chances are that inductive loops are already in place at the entry and exit areas to operate lane equipment. This infrastructure may be used for PGS. In addition to detection devices at the main entry and exit points, detection apparatus is also used at all entry and exit points for each level. A standard bi-directional ramp or helix configuration tends to work best, but other garage designs and layouts can certainly be accommodated. The deployment of all these detection devices is designed to count vehicles entering and exiting each level and the facility. This data is passed on to the PGS computer where software compiles and tracks facility inventory by level or zone in real time. For example, the PGS software is able to calculate that out of the 150 spaces available on level 2, 100 of those spaces are occupied and 50 are available. This is done for every level of the garage by accurately detecting vehicles moving in and out of the specific areas. The result is that the entire facility is monitored in real time, and the inventory of spaces automatically tracked.

The PGS software then controls a series of signs that are strategically located at the entry and egress points of each level. The signs can quickly provide parkers with information pertaining to the available spaces on that level, or a simple full signal depending on the sign type and sophistication of the system. In some instances a barrier gate is installed in conjunction with the sign to close and block the entry point when the area is at capacity and to open when spaces free up. The final outcome is that the driver is guided through the facility to a level or area that has available parking without randomly searching the facility. The operator is able to achieve a higher level of efficiency regarding space utilization and move patrons in and out of the facility more quickly.

A simplified version of this configuration should be considered by parking operations that are limited financially. Instead of deploying signs on every level, a single "poster board" style of sign can be located at the main entry point of the garage. A poster board style sign is a large sign that lists all the levels and areas of the garage and the associated available number of spaces or a simple open / full. This configuration reduces infrastructure requirements and the number of signs needed to accomplish some level of guidance. While effective, this configuration can only provide information to the driver upon entry and does not provide continuous guidance information.

Multiple Garage & Surface Lot Operation

Linking multiple garages is central to the overall PGS concept and can be traced back to its beginnings. Widely utilized throughout Europe, parking guidance systems are used to help drivers navigate to available parking facilities in a city, town, or business district. This design is based on the outside configuration discussed earlier.

The flow process begins with the driver entering an area that has multiple garages or parking facilities. The drivers will normally enter a city or business district through specific points of entry and egress, commonly referred to as gateways. These gateways represent the primary access points and control the lion's share of passage. Poster board style signs are located at these points, indicating the general direction to the specific facility and the available number of parking spaces. Again, the poster board signs would list several facilities that are in relative close proximity to the gateway point. The configuration would be repeated for all identified gateways for a specific urban area.

Each facility would have a detection infrastructure at the entry and egress points to determine total inventory. The data would be complied and monitored by a local PGS server / computer and then sent to a PGS central server that would link and oversee all facilities. The central PGS server would then control the signage and provide real time data to drivers entering the area from multiple points of access.

Sign types can vary but a dynamic or variable message style of sign is desirable. This type of sign would not limit the type of information that could be sent or displayed. Generally, the number of spaces available for a specific facility is displayed. The signs themselves would communicate with the central server via a network connection. Depending on the location and environmental conditions, a multitude of communication and power options are available. For example, a sign could communicate via a wireless network connection and be powered by a solar panel. These options are discussed in more detail later in this chapter.

The multiple facility configuration may be used in conjunction with the internal PGS system discussed earlier, providing parkers with continued guidance reference once in the desired facility. This is what was referred to earlier as the "layering" of technology. One PGS application may be added to another to provide an increased level of guidance.

This application can display the power and effectiveness of a parking guidance system, and is not only a tool for parking operators, but also for transportation and urban engineers. The ability to control traffic flow and efficiently guide drivers to specific areas and parking can be of great advantage to a downtown business or event district that is undergoing redevelopment. Municipalities, institutions, and any other parking operator that controls multiple garages may find this PGS design useful.

Single Surface Lot Operation

A parking guidance system application for a surface lot is somewhat rare and often overlooked as a viable means wayfinding. Surface lots do not have the traffic flow restrictions and specific circulation patterns parking garages offer. To effectively utilize and justify a guidance system, the lot would require some degree of zoning or segmenting. That being said, the lot would have to be of considerable size, and have demonstrated congestion and inefficient utilization. This might apply to a theme park, commuter parking, conference center, or university parking lots.

The parking lot would be segmented into multiple areas with specific points of entry and egress where detection apparatus would count vehicles going in and out. This can be accomplished with artificial and/or natural barriers. Landscape architects can help and be very effective in sub-dividing a large surface lot, while maintaining aesthetics and minimizing the loss of available parking spaces.

The data collected from the detection equipment would be transmitted to a central PGS server where the information would be complied and tracked. The server would then control a deployment of signs that would be located throughout the lot indicating available parking. Generally, a poster board sign would be utilized at the main entry point indicating where space is available. For example, Blue – OPEN, Green – FULL, Yellow – FULL, etc. This would be reinforced with smaller signage deployed within the lot guiding patrons to specific areas.

This is a useful application for parking operations that provide event parking, and require the use of parking personnel to flag or essentially guide patrons to available parking in a specific order to more effectively utilize space. Note: A surface lot configuration must be carefully evaluated for feasibility and conceptual design.

The Bigger Picture

Intelligent Transportation Systems (ITS) are rapidly becoming a necessity in metropolitan areas worldwide. These sophisticated systems are providing transportation and traffic engineers with technological tools to better control and guide vehicle flow. Frequently, you can see large variable message signs (VMS) and CCTV cameras being installed on highways and freeways around major metropolitan areas. These are essentially traffic guidance and information systems. As these large ITS systems continue to advance and become more sophisticated, they will start interfacing with other traffic and wayfinding systems to provide more functionality and control. PGS will be an important component of these ITS systems of the future.

Technology and System Architecture

Networking & Data Communications:

A parking guidance system is relatively versatile in that it can be scaled to accommodate a wide range of parking operations. From large scale to small operations a PGS application can be designed to match specific needs. Therefore, depending on the size and complexity of the PGS system there are several different options when configuring the communications network. Networks can be as simple as several signs wired together and communicating with a single computer, or as complex as dozens of signs and hundreds of detectors communicating to a central computer.

Although it is possible to have a sophisticated signage work in a stand-alone mode, any sizable parking guidance application will require some level of communication networking. Think of it as a simple computer network. Each sign and detection area is a node on the network and communicates to a central computer or control center. The signs and detection apparatus can be networked via a wired or wireless communication network. For implementations where the signs and detection equipment is confined to a consolidated area such as a parking garage, a wired network is possible. However, for a city-wide system a wireless network may be more practical. Depending on the PGS manufacturer or vendor, communication network hardware and configurations vary. It is important to determine which communication network and configuration is best for the operation. It is important to note that wireless communication networks have an ongoing monthly cost for the life of the network.

The parking guidance system operates with standard networking communication protocols and infrastructure. The data being transmitted to the facility or central PGS server is generally numerical and not a significant in terms of size. However, the timing and frequency of communication requires a viable and reliable infrastructure. A basic Ethernet network with standard protocols such as SNMP or TCP/IP generally suffices for most parking guidance applications. A fiber network can also be utilized for larger and more complex designs.

Power

Depending on the sign type and size the power requirements could vary from a simple 120VAC or 240VAC hardwired circuit for each sign. This works well for applications where power is available and easy to reach such as a parking garage. However, for larger city-wide applications power can be drawn from existing power sources and infrastructure such as light poles, traffic signals, crosswalks, etc. If properly planned and installed, supplying a power circuit to each sign can be relativity easy.

In some cases power is not available through a wired power source. Therefore, sign manufacturers have developed and modified signs to utilize solar power. For a small initial capital expenditure, a solar panel can be affixed to remote signage, allowing the sign to be placed or positioned anywhere the system architect deems necessary.

With the advancements in solar power, the unit can draw power from any light source including streetlights; it is not just limited to sunlight. As a backup measure to the solar panel, the signage should have a battery installed. The unit is constantly operating from the battery while the solar panel is continuously charging the battery. When the solar light source may be low, the unit is able to operate from the battery. In the wired example, the battery is strictly for backup operations. In case of power loss, the battery has the ability to operate the sign for an extended period of time. Many signs being manufactured are designed and engineered with components that provide energy consumption economy. Again, depending on the type of sign, energy consumption can vary drastically, but generally speaking a PGS signage deployment can be designed to operate with some level of power efficiency.

Vehicle detection is an important component of the overall system. It is the data collection arm of the system – accumulating and monitoring entry and exit counts from controlled areas. Vehicle detection is accomplished through the use of a standard inductive loop or sometimes something more sophisticated such as infrared (IR) or radio frequency (RF). The standard inductive loop is simply a twisted piece of copper wiring that is installed in the surface of the pavement. These wires are connected to a loop detector or controller, which can detect a vehicle passing over the magnet field of the loop. These are widely used in all types of parking equipment and traffic management systems. The more sophisticated methods of detection like RF do not require loops but rather a small device that can be easily mounted overhead or below the surface. These more sophisticated devices can communicate via wireless communications and ultimately require less infrastructure and maintenance. The initial cost may be slightly higher than the traditional inductive loop; however, there are distinct advantages to their flexibility and accuracy. Regardless of the detection method that is utilized, it must be of sound design and provide a high level of accuracy and dependability.

Standard off the shelf computers may be utilized to operate the system.

Software

The PGS software is the engine that drives and controls the detection, signage, and networking pieces that work together to form a complete working system. The software package is usually a PC-based application that runs in Windows and has a graphic user interface (GUI) or a familiar point and click design. Data should be archived / stored in a recognized and reputable database framework and in a format that allows for the easy exchange of information. This is commonly referred to as open system architecture. When evaluating a parking guidance system determine which vendor has the best software to match your parking operation. It is also critical to determine how the software is updated and upgraded. As with any computer-based system, software updates are necessary. Choose the most efficient and cost effective method of upgrade for your operation.

In addition to controlling and compiling data, the software package should provide the operator with *reporting* and *control* functionality. Both of these functions are necessary and valuable tools for operational control.

A good software package will provide a standard reporting and statistics package. The reports may vary from system to system, but should provide statistics that cover occupancy and inventory levels, space utilization, and turnover rates. The reports allow the operator to not only utilize parking guidance as a service to the patrons, but as a management tool to identify methods to better utilize space and improve vehicular circulation. More sophisticated systems may offer an ad hoc reporting function. Generally, a third party report writer subsystem is used to allow the operator to create informal reports on demand.

The second functionality that should be present in a quality software package is control. This means that the operator has some level of control and configuration over the system. The operator should be able to monitor individual signage, change messages or display manually, perform remote diagnostics, and work any associated peripheral equipment remotely from a single workstation. Configuration ability will allow the user to change the parameters and thresholds of the system. This is an important function of a parking guidance system. This provides the ability to decide when a level is considered full, or how to direct traffic for different circumstances.

For example, once a facility or level is 100 percent occupied, a threshold would be established for when the system would indicate available space. It would not be feasible to switch the signage based on when a single space becomes available. This would cause the sign to continuously cycle between full and available space, and ultimately confuse patrons. Therefore, a threshold is determined, such as remaining in full status until 10 spaces become free, and then to signal the signage to indicate available parking. By providing control over the parameters of the system, the operator is able to establish utilization scenarios. You could set the system up to fill the garage or lot in a specific pattern based on a special event or scenario. In effect, the software should be fully automated, but provide for manual control and configuration.

It was briefly mentioned earlier that the parking guidance system software should be designed and incorporate a standardized framework or open architecture. This is essential for the integration into other systems such as parking access and revenue control system or a city-wide intelligent transportation system. Make sure to evaluate the system software package and standard architecture for integration restrictions and expansion possibilities.

Sign Types

As mentioned throughout this chapter, there are a multitude of signage types and configurations that can be used to display messages to parkers. The parking guidance system goes beyond the standard wayfinding signs to provide parkers with real time information and guidance. For this, electronic signage provides a wide range of options.

Static

A static sign is a sign that displays a constant and continuous message or image. They cannot be changed or manipulated. These signs can be externally or internally illuminated and utilize a number of more advanced illumination techniques for high visibility, but essentially do not change or contain any mechanical features. They are generally much less expensive than the more feature rich and technologically advanced VMS signs. A PGS system can incorporate these types of signs or use them in combination with dynamic technology.

Dynamic

A dynamic design is a sign that is capable of changing between messages or displays, often referred to as a variable message sign (VMS). This may involve a mechanical procedure or the illumination of pixels in a matrix. There are a wide range of signs that utilize different technologies such as LED, LCD, prism / drum, shutter, and fiber optic illumination.

- LED – a light emitting diode is a single light source that is turned on and off. The diodes are arranged in a matrix and illuminated in a pattern to display a message.
- LCD – a liquid crystal display is a self-contained screen or area that contains crystals that can be activated with a very small amount of energy. This basic technology can be found on a common wristwatch.
- Prism or Drum – a multi-sided message display that rotates in a housing. The display moves to display a single side and the desired message. A modified version of this application is a panel design where panels are flipped to display different messages. These signs typically use internal or external illumination.
- Shutter – a matrix that is comprised of many small shutters that flip open or closed. When closed the shutter is black, and when open a high visibility reflective material. These shutters act as pixels in the matrix and are flexible. These are commonly seen on portable highway signs and other roadway applications.
- Fiber Optic – a matrix with pixels made up from a fiber optic strand. Each pixel is a separate fiber illuminator. Each fiber or grouping of fiber can be illuminated to provide a flexible and variable message sign. Fiber optics is commonly used because of excellent illumination, low maintenance, and reliability.

Applications

Who should use PGS?

There are many application sites for a parking guidance system. As a scalable system, PGS may be designed to meet the needs of any installation or operation. However, parking guidance is most effective for parking operations that have high turnover and volume, and that utilize multiple garages, large surface lots, and high demand.

Business District / Urban

Recent trends indicate that downtown redevelopment and revitalization projects are on the increase. A significant factor in this redevelopment is the transportation infrastructure including available parking. PGS can provide advanced parking solutions. As mentioned earlier, signage can be placed at gateways into the business district guiding parkers quickly to facilities and specific locations. The PGS system allows operators to engage the patron before reaching a specific facility.

Once inside the garage, a PGS deployment could guide the parker to available space. This works well in urban areas where parking garages and lots are owned and/or operated by a municipality or parking authority.

Universities and Business Campuses

Universities and business campuses are situations where parkers are familiar with the parking infrastructure and have the tendency to seek out the most convenient parking location. With high volume during peak hours, this can create chaotic traffic patterns and parking behaviors. A PGS can guide commuters and visitors to available parking. Depending on the physical layout of the property, a PGS system can be deployed on the perimeter indicating where space is available. If a facility is full, a sign indicating so should prevent that driver from going to that facility and allow him to choose an alternative. Large corporate campuses experience a high degree of volume during relatively short durations. Getting employees and visitors to available parking can be a challenge, and parking guidance is one way of alleviating traffic and unpredictable parking behaviors.

Arenas and Theme Parks

Arenas and theme parks are continuously challenged to efficiently utilize parking space. Not only should the inventory of spaces be utilized to maximum capacity, but also how the space is filled is paramount to an operation. Often personnel are used to move drivers into specific areas and locations to fill the space in an efficient pattern. A parking guidance system can provide automation and computer control of this process. A single operator could theoretically manage a signage array to move vehicles to specific locations. A predefined program could be utilized to automatically guide parkers and fill the available space in a planned and coordinated fashion. PGS can provide a very useful and powerful tool for operators who encounter massive demands on parking infrastructure.

Event and Conference Centers

Event and conference centers can utilize parking guidance to direct traffic flow more effectively to designated parking areas. PGS provides the ability to reach out to highway ramps, roadway intersections, etc. and provide guidance information. With most of the patrons being visitors and unfamiliar with the area, parking guidance can provide patrons with a helpful tool. Operators can gain by sending parkers to locations that may previously been underutilized and increase revenue.

Airports

PGS are a natural fit for many airport parking operations and facilities. Due to the significant demand placed on airport parking facilities, and the growth projected for the future, the critical success factor is to utilize every single space available. Many facilities are expanding by adding infrastructure and spaces to handle the increased demand. Parking guidance provides a valuable tool to assist in effectively and efficiently utilizing all available space. It is critical to get patrons to empty spaces. Knowing that you have available space at certain locations is only half the battle; you must be able to guide parkers to these spaces to realize any benefit.

Conclusion

Parking guidance is not a new concept. We have always attempted to provide the parker with signage and wayfinding tools to better utilize our parking facilities. Modern parking guidance systems have pushed this concept to the next level by utilizing technology in the form of electronic signage, software, and automation. The result is an advanced system that not only provides patrons with increased service and ease of use, but the operator with a valuable tool to better capitalize on underutilized space or use over-capacitated space more wisely.

Municipal parking operators, airports, and private business are beginning to take a very close look at the advantages of PGS and how it fits into their strategic planning. With many parking access and revenue control systems being upgraded, more and more parking guidance systems are being specified and installed.

You might ask: "What is wrong with my current signage and why do I need something so complex?" The answer is that you may not. Your current wayfinding scheme may work well for your parking operation, and the advantages of an electronic parking guidance system may not be so obvious. But there are many parking operators that could benefit from PGS technology. Make sure to investigate what different parking guidance system vendors are offering. Work with a reputable consultant to help determine the right system for you. Chances are you will find a system that meets your needs and budget.

SIMPLIFY WITH TECHNOLOGY – MULTI-SPACE METERING

Carl E. Blanchard

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Introduction

With the recent surge in downtown revitalization projects, getting the community reenrolled in business and activity in downtowns across North America is becoming essential. In virtually every downtown environment throughout North America is the presence of on / off street, metered parking. Recently, multi-space metering technology has started to replace the traditional and familiar single space meter throughout many large and small cities. Why? Multi-space meters offer expanded functionality and flexibility for both parking operators and patrons.

For many years the single space meter has served on/off street parking well. However, with the steady growth of the transportation industry and revenue generated from parking, operators around the world are turning to more sophisticated systems to manage metered parking. The multi-space systems are equipped with tools that allow operators to manage metered parking efficiently while providing an increased level of convenience to the patrons. From one simple meter installed in a municipal parking lot to hundreds implemented throughout a large city, multi-space meters are welcomed by both parking operators and patrons alike.

Definition of Multi-space Meters

A multi-space parking meter is a computer-based machine that electronically manages multiple parking spaces. For on-street applications, multi-space meters usually manage from one to twelve spaces. For surface lot applications, a single multi-space meter can manage hundreds of parking spaces. Each meter is equipped with: a display to instruct patrons; one or a combination of coin, banknote, credit card or smart card acceptors; a cashbox and/or bill vault to securely store money; and user interface buttons/keypad. Depending on the specific application and manufacturer the meter can be configured for use in two modes of operation: Pay and Display or Pay by Space.

Pay and Display

In Pay and Display mode, patrons approach the parking meter, insert payment and receive a ticket to be displayed on the dashboard of their automobile. The ticket indicates the duration, location, machine number and end time for which the vehicle has paid. Citation officers can quickly move through cars to see if the parking time for each vehicle has expired. Pay and Display meters are typically used in on-street applications.

Pay by Space

In Pay by Space mode each parking space in the parking area is numbered. Patrons approach the parking meter, enter the parking space number in which their vehicle is parked, and insert payment. There is no parking ticket for this application, but there can be a receipt for proof of transaction. Citation officers simply determine which occupied spaces have expired by reading the meter display. Alternatively the meter can communicate which spaces are expired to a handheld device carried by citation officers. Pay by Space meters are typically used in applications where spaces can be easily numbered using signs or surface paint.

Purpose of Multi-space Metering Technology

When considering a multi-space metering system, it is important to identify the factors that are most important to the parking application and the problems, if any, the meter system will improve. Multi-space systems can range from very simple to very complex and they address a broad range of operational issues. The application and operation will help determine the complexity of your system. The overall purpose of the multi-space system is to solve operational issues and increase the revenue generated by metered parking.

One of the greatest benefits of a multi-space system is that it allows the operator to "resell" parking spaces. Frequently, when patrons pay for metered parking they purchase too much time. When they leave, other patrons can park in the same space without inserting more money. In a multi-space operation the parking procedure and system does not allow the patron to take advantage of someone else's paid time for the parking space. This directly leads to an increase in revenue and a more lucrative metered parking operation.

Increased revenue is also accomplished using the advanced technology of multi-space meters. Through increased control and the availability of a communications network, multi-space meters experience less out-of-service time and are more efficient to maintain. The more time the meters are in service, the more revenue they collect.

Technology / System Architecture

We should not go much further without talking about the technology and how the system works. With the advancements and availability of technology the multi-space meter is able to solve the operational problems of metered parking identified by both the operator and the patron. With the use of a communications network, often wireless, operators are able to gain control the meter system and receive real time alarms when the unit has a maintenance issue, is out of service, vandalized, or needs collection. In some cities, multi-space meters are configured to send out of time messages to handheld citation units carried by enforcement officers. This allows the city to effectively and efficiently issue parking citations.

Let's not forget about the patrons. Multi-space meters can be configured to accept multiple payment options such as; coins, bills, credit cards and smart cards, or any combination thereof. Multi-space meters can be configured and used in conjunction with other parking programs throughout the city. For example, smart card programs can be developed using one consolidated card for on street parking, off street parking, subway and other parking applications. City token programs and validations can also be configured to encourage the use of on street parking while visiting downtown. Frequent parker cards and residential cards can also be used for mixed-use applications. This flexibility makes it convenient for the public to use and encourages non currency transactions. Credit cards and debit cards for example provide a pure electronic transaction without the manual intensive procedures needed to handle cash. Cashless systems are emerging everywhere and parking systems are taking notice.

Below is an explanation of the primary technical capabilities of a multi-space meter system.

Communications

Multi-space meters are versatile. They were designed for both small scale and large scale parking operations in mind. Depending on the size and complexity of the metered system there are several different options when configuring the communications network. Systems can be as simple as one stand-alone meter or as complex as hundreds of meters communicating to a central computer.

The simplest of applications is the stand-alone meter. Multi-space meters do not need to communicate to a central server or be networked at all. They can simply operate in stand-alone mode, independent of each other. This is the easiest of applications and operations are very similar to single space meters. In stand-alone mode, the unit does not lose any of its base functionality. All of the same base features exist minus some of the bells and whistles or automation that comes with a full scale network.

Operationally, parking personnel would maintain each meter as usual, performing regular collections and maintenance. In addition, the personnel can carry a handheld device that downloads data from each meter such as; revenue reports, statistics, maintenance and collection information. This information and data can be downloaded to a central computer from the handheld and compiled for reporting purposes.

As the parking application becomes larger and more complicated networking the multi-space meters is an option. This networked concept allows revenue, operational and statistical data to be called up and evaluated directly within the central parking system. Think of it as a simple computer network. Each meter is a node on the network and communicates to a central computer or control center. Meter transactions, alarms and events can all be accessed from central computer. The meters can be networked via wired or wireless communication network. For implementations where the meters are confined to a consolidated area a wired network is possible.

However, for a citywide system a wireless network is more practical. Depending on the meter manufacturer or vendor, communication network hardware and configurations can vary. It is important to determine which communication network and configuration is best suited for your parking operation. It is also important to note that wireless communication networks have an ongoing monthly cost for the life of the network.

Power

The largest obstacle multi-space technology had to overcome in order to be accepted was the power problem. Unlike single space meters, 120VAC was necessary to operate one multi-space meter. For a citywide application it is very costly to install that type of power network. As a result the multi-space meter industry developed several options for powering the meters.

This first and most obvious option is just a simple 120VAC circuit to each unit. This works well for smaller applications where power is available and easy to reach. However, for larger on street city applications power can be drawn from power sources that already exist on city streets, i.e. light poles. If properly planned and installed, supplying a power circuit to each meter can be achieved.

In some cases power is not available through a wired power source. Therefore, multi-space meters have made solar power somewhat of an industry standard and an economical benefit. For a small initial capital expenditure, a solar panel can be affixed to each meter allowing to the meter to be placed or positioned anywhere the operator chooses. With the advancements in solar power, the unit can draw power from any light source including street lights; it is not just limited to sunlight. For large applications, there is no ongoing power cost to operate the system.

In addition, there can be a battery installed in each meter. In the case of the solar panel, the unit is constantly operating off of the battery while the solar panel is continuously charging the battery. When the solar light source may be low, the unit is able to operate from the battery. In the wired example, the battery is strictly for backup operations. In case of power loss the battery has the ability to operate the meter for an extended period of time. The multi-space meter is designed and engineered with components that require minimal power draw while in use and little to no power draw while not in use.

Multiple Payment Methods

The most convenient technological advancement for the patron is multiple payment options. Depending on the design of the meter, multiple payment options are available on multi-space meters. This of course provides multiple and convenient options for patrons using the meters. Multi-space meters accept any combination of coins, banknotes and/or credit cards/smart cards.

The unit can be equipped with coin and banknote validators that can each accept multiple denominations. The unit can also include a credit card and/or smart card reader. Coins and banknotes are stored in secure cash boxes that are locked separate from maintenance areas. If networked, credit card transaction data can be automatically downloaded to a clearinghouse or if the system is not networked, handheld devices can be used to collect the credit card data and transfer it to a clearing computer.

In addition to the above payment capabilities, most multi-space meters can be programmed to accept city tokens, frequent parker/customer cards that can be issued by the parking operator. The multi-space meters can be programmed in an area or citywide to accept parking programs such as validations for downtown shopping, special tokens for city events or frequent parker cards for employees of area businesses. The multi-space technology is flexible enough to adhere to your operations and unique requirements.

Software

Like many other aspects of the multi-space system, software descriptions and functionality differ between manufacturers. There are, however, some basic similarities that can be discussed in multi-space systems. When discussing software it is important to differentiate between the software installed in each individual meter and the software installed on the central server or control center.

Meter Software

Without getting into too much detail about how and where the software is stored on each unit, a description of some basic software functionality will be provided. Again, unit functionality can differ between meter vendors, but most have similar base software functionality between them.

Software internal to the meter that is pretty much standard across the industry includes:

- Multiple Languages – Meters have the ability to operate in multiple languages if programmed. Either one language is programmed internal to the unit, or the user can select from several languages in which the unit operates using the unit's interface buttons.
- Blacklist Storage – Each meter can contain a bad credit card file. Known bad card numbers are stored internal to every unit and are updated regularly.
- Programmable Coin/Cash Acceptance – Meters are able to accept multiple coin and cash denominations. Depending on the coin/banknote acceptors these are often programmable.
- Diagnostic Controls – Meters include diagnostic or maintenance controls. During meter maintenance operators are able to operate and test the unit in maintenance mode.
- Programmable Display – Meters are equipped with programmable displays. Operators can display custom messages on all or individual units.
- Report Generation – Units should be able to run and print reports. These reports can include revenue, statistical, inventory and event logs.
- Data Storage – Unit should store financial and revenue data for a set period of time.
- Programmable Rate Structure – The meters rate structure can be programmed to accommodate progressive, regressive or flat rate. Different rates can be programmed depending on the time of day or week or even location.

Central Server Software

For more sophisticated networked multi-space systems, system management software will be available from a central location or central server. Again, software functionality and specifications are different across the industry depending on the manufacturer; the following are just some characteristics that are common among systems.

- Alarms – The management software is equipped with alarm management. Each unit will notify the management software when an alarm occurs. Alarms are usually programmable, but can include, cash box full, receipt paper low, cash box security compromised, vandalism, out of service, maintenance or low power.
- Report Generation – The management software can run reports on the entire multi-space system. Reports include revenue, statistical, event and inventory reports. Reports are generated from database fields and can be programmable based on the operation.
- Control – Meter functions can be controlled from the management software. Programmable rates, displays and service can all be managed.

- Data Storage – System data is stored and can be called up from the management software. Revenue, statistical, inventory and event data is stored for a set time period. Archiving can also be included for long term storage and retrieval.

Unit / system software is an important component of any metering system. It provides flexibility and is the backbone of the primary user interface for both the operator and the patron. It can not be stressed enough that when choosing a multi-space meter determine which vendor has the best software to match your parking operation. It is also very important to determine how the unit software is updated and upgraded. Like any other computer system, software updates are necessary. Choose the most efficient and cost effective method of upgrade for your operation.

Comparison with Traditional Single Space Meters

How do multi-space meters compare with single space meters? Why alter an existing operation to incorporate multi-space technology? Why begin a new operation with multi-space technology? There are a number of reasons, namely improved control, maintenance, collection/enforcement, function, flexibility and aesthetics.

Control

The top priority for most parking operations is revenue control. Multi-space meters give the operator the ability to gain increased revenue control with the ability to generate real time revenue reports. When networked, the operator can determine both the operational status of each meter and the amount of revenue each unit is generating. Since some metered systems generate millions of dollars a year, it is important to gain control of the revenue and the devices that collect it.

In addition to revenue control, multi-space technology provides the operator with a level of functional control. Unlike conventional single space meters, when a multi-space system is networked, parking operators have the entire metered system at their finger tips. The parking operator can determine which meters are out of order, in need of service, need to be emptied of money, or need to be refilled with paper. In addition, the operator can change the operational function of the unit. The operator can automatically change the rate structure or tariff for functions or events or change the display on the unit to inform patrons of special parking instructions. With a networked meter system the operator can simply monitor and control hundreds of meters from the central server.

Maintenance

Maintenance is an integral part for parking operations that use meters. Out of service conditions for metered parking can be a constant struggle. Countless revenue is lost daily from out of service meters. In larger cities there are simply not enough personnel to attend to every out of service single space meter. An extended period of time can go by with a bank of meters out of service.

Multi-space meters can send an alarm or message to a central computer, cell phone or handheld device indicating when a meter is out of service. In some cases, the meter is able to warn the operator in advance of a problem, i.e. the cash box is full or the receipt paper is low. The operator is able to quickly and effectively dispatch maintenance staff.

Theft in single space meters can lead to several problems. Often theft or vandalism of meters lead to out of service conditions which lead to revenue loss. Almost all multi-space meters are equipped with a secure cash box reinforced with a larger housing that can be cemented to the ground. This alone makes it more difficult to rob or vandalize. Multi-space meters are also equipped with vandalism alarms. As soon as the meter senses it is being vandalized or the cash box is compromised without going through the proper collection procedures, an alarm is sent to a central computer or other remote device. Security personnel can be dispatched immediately to stop the theft and/or repair the meter.

The sub-assemblies of the meters are modular in construction to provide easy servicing through on site plug-in replacement of parts. An inventory of key spare parts can be kept and replaced as necessary. One of the most comforting aspects of modular construction is independent component failure. This does not apply to all components of the meter, but when components such as the coin acceptor fails, the bill acceptor and credit card reader continue to operate. This keeps the meter in service and collecting revenue. A single failure does not debilitate the meter. Operators will notice an immediate reduction in out of service conditions with a multi-space system.

Collection / Enforcement

Collecting change from every single space meter for every parking space takes much longer than collecting money from one multi-space meter for a multiple number of spaces. Also, many of the transactions may have been with a credit / debit card or frequent parker card and are cashless. Operators of a networked multi-space system know exactly how much money is in each meter. From this they can determine if and when a collection is necessary. The backend system can compile reports to determine the most efficient collection schedule. Specifics on multi-space collection procedures differ from vendor to vendor. Careful consideration should be given to determine which procedure best matches an operation.

As previously mentioned, most multi-space meters have a reinforced vault for all money. Cash boxes are separate from maintenance areas and have a different lock and key. Multi-space meters also have the advantage of accepting credit cards, resulting in less money in the meter, less money in the hands of personnel, and less money for theft and/or loss. Security features such as personnel cards and PIN pads can be part of the meter collection procedure to record who collects and when a collection occurs. Automatic collection and revenue reports can be generated at the central server as well as at the individual meter for settlement comparison. The amount of revenue collected from metered applications continues to increase year after year, and it is important that the revenue stream is secure and traceable.

Function

From a patron's point of view, the more options the better for metered parking. Coin-only single space meters deter patrons who are parking for a period of time over fifteen minutes. Multi-space technology offers expanded functionality and multiple payment options. This functionality includes the ability to accommodate the following: multiple payment options, frequent parker programs, mixed-use zones and validations. With the ability to accept coins, banknotes, credit cards and/or smart cards, multi-space meters offer more options than the traditional single space meter. In addition, operators have the ability to configure the multi-space system to accept special frequent parker cards for regular customers or employees of downtown businesses or even start a monthly parking program with programmable magnetic stripe or smart cards. The ability to program the meters to accommodate such parking "programs" makes multi-space metered facilities very convenient for patrons.

From an operator's point of view, the same sentiment applies. The advanced functionality allows the operator to configure the metering program to meet the ever-changing needs of the downtown environment. The operator can offer validations for heavy retail environments or resident programs for mixed-use environments. The operator also has the ability to pull real time revenue and statistical reports from the multi-space system. The functional tools of the multi-space system enable the operator to utilize the metered system to its fullest potential.

Flexibility

Multi-space technology does more than solve the basic metered operational issues. A multi-space infrastructure allows the operator - whether it a city, hospital or university - the ability to expand capabilities in the future. Single-space vehicle sensing, smart card programs, payment using cell phones and the internet, integration to off street parking systems; citywide parking guidance systems and citation systems are all possible with multi-space meters. Applications such as intercom and video communications are additional creative opportunities possible with multi-space technology.

Aesthetics

Many downtowns across the United States are making great efforts in cleaning up their streets, widening and laying brick sidewalks, and planting trees and flowerbeds in an effort to revitalize urban and business districts. Multi-space meters can be a good tool to use in these revitalization efforts - they take up less visual space than single space meters and can be easily worked into the streetscape architecture.

With one meter for every twelve spaces for on street applications, multi-space technology greatly reduces the visual affect meters have on streetscapes. In addition to the reduction in numbers, equipment owners can choose from a number of colors and designs. Also, for areas with inclement weather a multi-space configuration reduces the number of meters that need to be cleared of snow and debris. Meters can be custom designed, maps and advertising can be attached, and some meters have graffiti-proof finishes. The parking operator is able to choose the meter that best fits their particular streetscape.

Application

Where is multi-space technology most effective? Who is multi-space technology most beneficial to and why? These are basic questions when implementing any technology. Is it really useful for your operation? Multi-space technology was designed to accommodate the smallest metered operation to large-scale urban parking operations. Although on-street city applications have been discussed in this chapter it is important to note that multi-space technology is useful in off street metered applications as well.

On Street

Multi-space meters are being implemented largely for on-street metered applications, since most metered parking occurs on-street. Multi-space meters can be applied to small scale operations where a few may be placed on Main St. in a small town or they can apply to the largest of operations where hundreds of meters are installed throughout an urban city.

It is important to understand that the scale of the parking operation does not necessarily determine whether or not multi-space meters should or can be utilized. This is a misconception that comes with the advanced technology. The scalability of multi-space technology makes it convenient for the full range of parking operations. It is rather the operational aspect of the parking environment, such as maintenance, collection or control of the system that determines the usefulness of multi-space meters. If these aspects of the parking operation need to be improved, multi-space technology should be carefully considered.

Off Street

Although most commonly identified with on street parallel parking in most towns and cities, multi-space meters have found a niche in the off street lots as well. Multi-space meters are an excellent application for small to large public municipal lots where single space meters are utilized. In these applications one multi-space meter can replace hundreds of single space meters. Depending on the size and layout of the lot, meters can be strategically placed throughout. If there are intuitive entry and exit points to the lot, meters can be placed in those locations as people exit the lot. Operators can choose from pay and display or pay by space configurations to match the layout and overall dynamics of the lot.

Another off street venue where multi-space meters have an excellent application is train station / commuter parking lots, where there may be hundreds of metered parking spaces for commuters. In these parking lots, everyone moves from their car to the transit platform, usually through a central point. Pay by space meters can be placed on or before the train platform and patrons can pay for parking before boarding the train. The parking operator, in this case, can set up a smart card or frequent parker program for regular commuters to prepay for parking.

Integration with Other Parking/Transportation Systems

The solutions to metered parking problems demand integral concepts. This means that multi-space technology is becoming an integral part of modern parking space management and design. Rather than representing an isolated object, multi-space systems can be integrated into other city wide parking networks and programs. The systems are designed as open architecture systems ensuring that investments made today are able to reach into the future. Some integration possibilities include:

Gated Arm Systems and Other Transportation Systems

Like many gated parking systems and metro fare collection systems, the multi-space meter system can be configured to accept smart card technology. Operators can set up special frequent traveler / parker programs in which transportation smart cards are issued and usable for all of a patrons parking and transportation needs. City operators are able to distribute the smart cards and patrons can deposit funds to the smart card at the multi-space meters. This can also be accomplished with magnetic stripe cards. This is an effective tool for operators to publicly promote multi-space systems.

Payment Options

Multi-space meters are also migrating towards easier payment methods and options. With advancement in cell phone payment capability and payments over the internet, the multi-space meter system can be configured to accept remote payments.

Single Space Monitoring

Single space sensors can be used to provide real time information as to available parking for specific streets or zones. The sensors monitor the presence of a vehicle and reports to the multi-space system the status of the space. This feature offers the owner the ability to "resell" the space even if a patron leaves the parking space before their time has expired. This feature has proven to increase revenue flow and efficiency. In addition, this feature provides for a variety of advantages to parking enforcement departments and city planners.

Parking Guidance Systems

Multi-space metered system can be incorporated into existing off street parking facilities and can provide valuable parking information to a dynamic parking guidance system. The system would involve the strategic placement of dynamic signage around the city to assist drives and "guide" them to available on-street and off-street parking. This feature provides the operator with the ability to fully utilize parking resources and efficiently by guiding patrons to specific locations and facilities.

Handheld Device and Citation System

Wireless handheld devices can communicate with the multi-space metering system to issue on street parking citations. The multi-space meter can be configured to send a real time alarm or out of time message to the wireless handheld unit to alert the user of expired parking spaces. This makes enforcement more efficient. The meter can also send alarms and important error messages to the handheld device to alert the operator. This is useful for out of service and security purposes. This handheld device can also be utilized to retrieve meter reports and transfer credit data for credit card processing.

Conclusion

When considering a multi-space metering system parking operators should involve their communities from the beginning. Get public feedback in the form of surveys and public outreach meetings. For all applications, it is important to understand the usage of the parking area, and configure the system around the specific requirements. A reputable consultant can help assist you in this process and provide overall design criteria.

Multi-space systems are very different from traditional systems; operators need to educate the public so they are comfortable with the transition to the multi-space system. Ways to do this include advertisements on local television programs and posters on buses and other public transportation. Use of these media helps convey to the public that a new technology is coming and educates them on how to use it. Community involvement from the start will lead to a smooth transition.

The multi-space meter offers the best of both worlds for metered parking applications. It provides patrons more opportunities to use metered parking in the downtown environment while securing maximum revenue for the operator. In the re-emergence of the downtown, metered parking has become even more vital. It is important to send a message to businesses, residents and the entire community that metered parking is convenient to use and that it benefits everyone.

Multi-space metering can be a powerful and useful tool to municipal parking operators. While providing patrons with increased functionality, the operator gains control and efficiency over revenue and operations. Multi-space parking is an example of how technology can improve a reliable and proven parking legend, the single-space parking meter.

CITATION PROCESSING, ADJUDICATION AND COLLECTION

Joseph Spencer

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Introduction

Many parking citation recipients have a negative impression of parking enforcement: they view citation issuance solely as a revenue generator and the hearing process (regardless of the setting) as a "kangaroo court" intended to "bring in the bucks."

This is unfortunate because the vast majority of parking programs—whether municipal or college—perform their roles in a fair, professional manner. Experienced parking professionals understand that the goal of citation processing is to establish the credibility of citation issuance as an effective deterrent to illegal parking. This can only be done if the organization(s) responsible for processing and adjudicating citations provide both an accessible and fair forum for those who feel unfairly ticketed and a well designed program to collect fines that are imposed.

The processing, adjudication and collection functions have one overall goal—the legitimate satisfaction of all open citations, whether through payment or dismissal of the charge. For that reason, managers in charge of processing and adjudication must operate with an "arm's length" relationship from enforcement personnel, even if they are within the same department.

This chapter provides basic information on the key steps that must be taken to adjudicate and process parking citations once issued; various options open to managers of parking programs in choosing processing software and establishing their customer service operations; collection strategies for citation recipients who ignore their tickets or fail to pay imposed fines; and key ways in which parking managers can measure and evaluate their programs.

Adjudication

The key factor in how parking managers approach the processing of citations is the legally-mandated adjudicatory framework under which they operate. Many decisions regarding the features of the processing system and the service options offered to customers are driven by the way ticket recipients must/may contest the charges.

There are many variants in the specifics of each parking program's adjudicatory process, but most programs follow one of two basic approaches—civil/administrative and criminal or judicial, based on local ordinance or state statute. Some programs, however, use a hybrid approach with primary reliance on an administrative process, but also providing an appeal to the courts after the aggrieved registered owner has exhausted his administrative options.

Civil/Administrative Adjudication

In the past 25 years the vast majority of parking programs have benefited from the "decriminalization" of parking infractions—that is, state legislation has made such violations civil rather than criminal in nature, and they can be heard before an administrative body (usually a parking violations bureau or parking department). This shift in approach has proven beneficial to all parties. Citation recipients no longer need to appear in court at a scheduled hearing; they can usually admit the violation ahead of time by mailing in the established fine, or can submit a challenge to the charge by mail or in a less formal hearing before a hearing officer or reviewer. Because the matter is no longer criminal, the parking program gains the ability to "default" the recipient if he fails to respond by the required date. This means he is legally liable for the base fine and late penalties that may be established by law. In addition, in most administrative venues, when the recipient does appear for a hearing, it is not necessary for the enforcing agency to provide the issuing officer—his signature on a properly completed citation form represents a "prima facie" case which the cited vehicle's registered owner must now contest.

Municipal Settings

Most municipal programs operating under civil jurisdiction now offer a two stage process. Ticketed individuals can first submit a request for an "administrative review" to the processing agency. This type of review is most appropriate for consideration of claims that a citation is technically flawed (e.g., the officer omitted critical data) or that the citation was issued as a result of a parking program deficiency (e.g., a meter was broken or a sign was missing). The review can often be conducted by trained clerical staff using well documented standards and official records (such as a meter database which lists all repairs).

In most programs, administrative reviews are "without prejudice," that is, if the claim is denied the registrant retains the right to request a hearing before a hearing officer. Some programs require that the citation recipient post the set fine for the alleged infraction, with the money being returned if the ticket is dismissed.

Almost all programs provide yet another level of adjudication. Some do so by establishing an appeals process by which a panel of several hearing officers will review the case, with the right to reverse the earlier decision if they believe an error of law or fact was made. For some programs, the appeal stage involves formal review by a court.

California, for example, adopted a three level adjudicatory process in the early 1990's, which citation recipients must follow. The first stage is an administrative review, which can usually be conducted by mail. The second involves a formal hearing by a hearing officer who is an employee or contractor of the processing agency, with payment of the fine required. The third stage available to an aggrieved motorist is a hearing in court before a judge. Court costs must be paid by the citation recipient only if he is unsuccessful in challenging the charge.

Programs vary widely in their qualifications for hearing officers. Some examples: New York City uses attorneys hired on a per diem basis; Washington, D.C. uses attorneys who are permanent employees; Los Angeles uses non-attorney employees; and, Boston uses third year law students. All of these approaches work well; the key is in training the adjudicators to be fair, weigh all evidence carefully, and be as consistent as possible in their decisions.

College and University Settings

Institutions of higher education often use a variation of the procedures found in cities. A first level of review and/or hearing is provided within the parking or transportation office, but appeals are generally heard by a panel of students, faculty, and school administrators. This process is often more streamlined than that found in cities, but parking managers can sometimes have difficulty finding sufficient volunteers to staff the panels required to hear appeals in a timely manner.

Core Requirements of a Sound Adjudicatory Process

While the organizational and operational characteristics of the adjudicatory process may vary from program to program, certain core features should always be present:

Separation of Responsibilities

It is important that there be no real or apparent conflict of interest between those responsible for reviewing or adjudicating citations and the enforcement staff. For example, it would not be appropriate for the individual supervising the parking enforcement officers to play a direct role in the review or adjudication of citations. This is usually not a problem in large municipal parking programs, where enforcement personnel are often in another department or division of. In small programs, especially colleges, with simpler organizational structures and smaller staffs, it is more difficult to avoid conflicts. In such situations, it is necessary for senior managers to guarantee that the persons responsible for adjudication are truly independent and not subject to internal pressures to support issuing officers.

Written Procedures

Regardless of a program's size, those reviewing or adjudicating parking citations should do so based on detailed written procedures. The Review and/or Hearing Manual should clearly state the right of the citation recipients to a fair decision (including the obligation of reviewers or hearing officers to proactively dismiss legally deficient citations), the established procedure under which hearings or reviews will be conducted, the overall standard of proof to establish a violation, the specific aspects which must be sustained to support each violation type, and format of the formal decision, which should be in writing.

Levels of Review

As noted above, most programs offer at least one level of review beyond the first hearing stage, so that citation recipients who feel the initial decision was unfair have the option to appeal. To do so, one is often required to pay (or "post") the imposed fine, but ideally, the first level of appeal should be at little or no additional cost to the vehicle owner. An appeal process helps guarantee fairness and allows citation recipients to feel they are not vulnerable to an arbitrary decision at a lower level.

Reasonable Access

A key aspect of a fair hearing process is accessibility. If the process is overly cumbersome or restrictive in terms of the location and times for scheduled hearings, citation recipients will rightly question the goals of the program, and elected officials or senior university management may find reason to support such grievances. On the other hand, when citation recipients find it convenient to challenge the ticket, their initial feelings of frustration are assuaged and they are more willing to pay any imposed fine. Likewise, senior officials overseeing the program are more willing to stand behind a process that is demonstrably fair.

Options which can be employed to make access to hearings and reviews more convenient are:

- *Reviews/hearings by mail* in which one can present his challenge in writing.
- *Reviews by e-mail* which are similar to mail-in protests, but are often more efficient, especially in a college environment in which all members of the community have access to the network.

- *Walk-in hearings* (i.e., without a scheduled hearing date/time) which allow customers to come in at their convenience. This strategy works best in large municipal programs where it produces a regular, predictable level of hearings.

Citation Processing Software

Once a parking citation is issued, it is critical that the responsible agency processes it in a timely manner. While thirty years ago such processing was often manual, parking managers now have excellent processing software options regardless of their parking environment or citation volume. For large cities and even some larger universities, stand-alone systems, whether supplied by a vendor or developed or managed by an in-house IT department, are often beneficial. Other firms focus on software for the college/university environment, with dedicated permit modules and interfaces with registrar and bursar databases. In addition, many suppliers of hand-held issuance devices also sell citation processing software with an interface to their hardware, suitable for environments with lower citation volumes such as small cities or towns, or universities. Regardless of the type of citation processing software, all must have certain core features to meet common parking management functions.

Adding New Citations to the Citation Database

New citations should be added to the database as soon as possible after issuance. This is usually not a problem with citations issued with a hand-held device, since most vendors' current technology permit the violations from a previous shift to be uploaded while the units are recharging. If enforcing agencies also issue handwritten tickets, tickets must be manually keyed. In high volume environments, this is best done through dedicated batch data entry operations, which offer the benefit of lower cost and timely processing. If an agency has lower volumes, the tickets can often be directly entered into the system by program staff or student aides, in an educational setting.

Regardless of how citations are entered into the system, it is critical that the process include three key elements:

- *Acceptance of skeletal transactions:* In some situations—most frequently in the case of handwritten tickets—it is possible for the ticket recipient to initiate contact with the parking management office before the ticket data is entered into the database. A common example is a person who receives a ticket and immediately visits the Parking Office to pay before the parking control officer has completed his/her shift. The processing software should create a "skeletal" citation record based on a payment or hearing result, even if the citation data has not been entered into the system[1]. Once the citation data is uploaded, it can be matched with the payment or hearing result and the record synchronized. If the processing

[1] This is referred to as a skeletal record because it holds only limited data (such as a payment or hearing decision) and must still be "filled out" once the citation is submitted by the issuing officer.

system does not have this capability, willing customers cannot be helped; rather they must be told to "return in a few days' or "call back tomorrow."

- *Quality control edits:* These should prevent the update of tickets with invalid violation codes, fine amounts, violation dates, etc. In addition, edits should flag tickets missing critical data as exceptions (for example, tickets citing a meter violation but missing a meter number). One advantage of using handheld devices for citation issuance is that such edits may be built into the hardware, so that a ticket cannot be issued with invalid or illogical entries or without critical pieces of data.

- *Batch controls:* The software should provide the ability to control update transactions (such as new tickets or payments) to the database by batch, with reports that indicate the number of items and dollar value of each batch updated to the database in a given cycle. This capability helps staff ensure that the number and value of all items processed matches those updated to the system, and that no transactions were lost.

Violator Identification

Because the vast majority of parking citations are issued to unoccupied vehicles, the parking program must later identify the registered owner, who is presumed by law to be the responsible party. This is usually done using several strategies, several of which may be unique to the program's venue:

- *Interface with In-State Department of Motor Vehicles (DMV):* The majority of tickets are usually issued to vehicles registered in the program's "home" state, so a link to that DMV will yield the registrant names and addresses required to follow-up on most cases. This information can be obtained via direct exchange of files with the DMV, local police (if volumes are not high), or third party vendors.

- *Interface with Out-of-State DMV's:* To varying degrees, all parking programs must deal with citations issued to vehicles registered in other states. Because of the difficulty in establishing such interfaces with numerous DMV's, most programs use a vendor for this function. This is especially the case for cities or larger universities which use vendors for citation processing; the DMV interfaces should be included and considered a critical service component.

- *Pre-registration of Commercial Fleets:* Many large cities also establish programs in which companies with large commercial fleets (such as rental car companies or package delivery services) can pre-register vehicles in the processing system's database. This strategy has advantages for both parties. The company receives a consolidated "bill" on a set schedule (even if drivers do not hand in the citations) and usually can schedule consolidated hearings, and can pay with a single monthly check. The parking program does not have to mail individual notices, and has a single point of contact at the company. It should also be noted that in many states, rental companies are protected by law from liability for parking violations issued to their vehicles as long as they provide the local parking program with the renter's name and address within a specified timeframe.

- *Interface with Institutional Databases*: For colleges and universities, the majority of citations will be issued to vehicles owned by members of the institutional community—students, faculty and staff. Software used by these programs should incorporate data on issued parking permits (or link to such a database) and should also have a link to the Registrar's database. This allows the parking program to readily identify the violator. Nevertheless, some percentage of tickets will be issued to "off-campus" owners, so interfaces with DMV's will also be necessary.

Payment Application

The citation processing software must be capable of accepting updates to reflect payments and other financial transactions such as late penalties and adjustments (i.e., the reversal of payments for which the a check has been returned for insufficient funds).

Since parking managers wish to achieve high payment and closure rates, the program should offer customers as many payment options as is practical. This is especially crucial in today's environment in which customers are increasingly sophisticated and cognizant of what constitutes "acceptable" service. The range of possibilities include:

- *Walk-in payments at cashiering locations.* In a small city or college, it is sufficient to offer a cashiering location within the parking office. Many large cities or universities, however, offer several locations so citation recipients will not have to travel long distances to satisfy their financial obligations.

- *Mail-in payments*: Many ticket recipients find it most convenient simply to write a check for the fine and mail it to the parking office. Once again, the scale of the parking program usually dictates how such payments are processed. For small programs, the payments can be directed to the parking office and staff can apply them directly to the system. Larger cites which receive tens of millions of dollars in fines annually often use banks or other "Lockbox" contractors to process their mail-in payments. Such facilities generally offer high speed remittance processors within secure, controlled-access facilities.

- *Credit card payments by telephone and internet:* In the last decade, many programs have implemented Interactive Voice Response Systems (IVRS) for telephone payments and/or internet web pages which accept customer payments. This technology offers several advantages:

    - It replaces more costly service by live customer service staff with customer self-service.

- The technology is available on a seven day, 24-hour schedule, allowing customers to make payments at their convenience.
- Customers who access the service to pay a single ticket are usually informed of other violations and often chose to pay all of their outstanding charges.

- *Other Options*: Many programs are now offering additional payment options, such as Western Union, Check by Phone, and installment payment plans.

While it is important to offer as many payment options as possible, it is even more critical that all payments are applied in a timely basis. As discussed later in this chapter, sound parking programs utilize a variety of strong collection tools (such as booting and towing, vehicle registration holds, and filing of outstanding financial obligations with credit bureaus). Failure to apply payments in a timely manner may expose customers to enforcement sanctions after they have paid.

Adjudication Support/Case Advancement

As noted at the outset of this chapter, citation recipients must be considered innocent (technically not-liable) until they admit the charge by voluntary payment or are found liable as a result of adjudication. The program's citation processing software should adequately support the adjudication function. For small programs such support can be rudimentary, but for high volume programs, sophisticated tools are necessary.

- *Presentation of original citation information and prior case history:* When the citation is undergoing an adjudication (whether an administrative review or formal hearing) the adjudicator must have access to, at a minimum, the data from the original issued citation and a record of any subsequent activity on the case.

- *Acceptance of hearing decisions*: Once a decision is rendered, the system must accept a transaction which records its essentials (including the date of the adjudication, the decision, any financial change to the balance due, and the name/ID of the adjudicator). Ideally, the system should produce a written record of the decision which can be provided to the responsible party.

- *Scheduling*: If the parking program holds a high volume of hearings, it is also very helpful if the processing software includes a scheduling module. This allows customer service staff to identify days and times available for hearings, schedule a hearing for the customer, link the hearing to the appropriate citation record, and generate a hearing notice is required.

- *Calendaring/Issuing officer availability:* For very large volume operations, the scheduling function should also allow flexible allocation of dates and time slots. It should produce Hearing Calendars for staff to prepare for upcoming workloads, and if the issuing officer is required, coordinate hearing requests with a schedule of officer availability.

- *Case advancement:* Since most parking infractions are now handled as civil matters, the parking program and/or adjudicatory body usually has the legal right to default citation recipients who fail respond by their hearing date. This means that the registered owner can be found liable for the infraction and the appropriate fine and any late penalties. The system should initiate such action automatically, with out clerical intervention. Other enforcement sanctions, such as the application of any additional late penalties or eligibility for booting/towing, should also be applied automatically. It is also critical, however, that staff can intervene and suspend such automatic steps if appropriate. For example, if a customer responds to a delinquent notice with a claim that he has previously paid the ticket, the staff should be able to suspend action until the customer has an opportunity to submit proof of payment.

- *Noticing:* The generation of notices to customers with a scheduled hearing, delinquent accounts, seized vehicles, etc., is a critical requirement of proper citation processing. Once again, the processing software should be able to perform this function in an automated manner based on the number of elapsed days since a previous event, and business conditions established by the parking program. For example, if a case is referred to DMV for registration hold, the system might automatically generate a notice informing the registered owner.

Enforcement Support

While noticing is the first and often most effective method of pursuing delinquent accounts, parking programs require other tools to satisfy the cases of more recalcitrant violators. These tools are discussed in more detail below. In this context, however, it should be noted that the processing software must support such enforcement activities:

- *Interface with home state DMV's:* A number of states (such as California, New York, Massachusetts, and Arizona) now restrict a motorist's rights to renew a vehicle registration and/or driver's license if he is a scofflaw. This makes interaction with the parking program's home DMV essential if this tactic is available. Not only must "holds" be filed with the DMV, but such holds must be immediately cleared is the violator satisfies his outstanding obligations.

- *Booting and Towing:* The system should monitor plate records so that when a registered owner's account reaches a certain debt or ticket threshold, the plate becomes boot and/or tow eligible. Such information should then be downloaded into the handhelds being used to issue tickets, so that scofflaw vehicles can be immediately identified and a boot/tow crew called. As an alternative, in some large cities, dedicated boot/tow crews patrol with handhelds or mobile digital computers searching for scofflaw vehicles. In the most sophisticated programs, the hardware uses wireless communications to identify scofflaws based on real-time access to the citation database. One advantage of such an approach is that when violators pay their outstanding balance in person or via the web, the payment is immediately reflected on the database and boot/tow eligibility is immediately removed. This removes the possibility of embarrassing situations in which a customer is towed one or two hours after having paid his parking debt.

- *Interface with permit data:* While parking permits are a major tool for parking regulation on college campuses, many cities (Boston, San Francisco, Los Angeles, Philadelphia) also offer some type of residential parking permits which protect local residents from the impact of outside parking generators (such as hospitals, mass transit hubs, etc.) Most parking programs with permit parking have found that denial of permits to scofflaws is an effective enforcement tool. Thus it is critical that the permit function works closely with the citation database. Today's most sophisticated systems fully integrate the two functions, so that permit renewal notices include the outstanding fines that must be paid before the customer can obtain a new permit, and new permits cannot be issued if the customer has delinquent citations.

- *Application of other sanctions:* Finally, the processing software should have the ability to interface with other parties as required to apply whatever sanctions might be available to the parking programs. These include third party collection agencies, credit bureaus (for listing of citation debt), and, in the university environment, links to the Registrar so that scofflaws cannot register for courses, or obtain grades or transcripts.

Controls

To be truly effective, a citation processing system must have sufficient controls to prevent unauthorized access, ensure the completeness and accuracy of data, and support proper auditing. Since citation records represent receivables, and violator data is often protected by state or local law, these requirements must be taken seriously. Features should include:

- *Security*: All systems, regardless of the program's size and complexity, should have password-based access control, including requirements for the periodic changing of passwords. Parking managers who allow a common password taped to a monitor are asking for serious trouble. More sophisticated software serving larger programs will often have multiple levels of security which allow appropriate levels of access based on the users' job requirements; thus some staff will have inquiry-only access, others will have update capability, and only supervisors or managers will be able to make accounting adjustments, such as waiving late penalties.

- *Batch and on-line controls:* All systems, regardless of the program's size, should have solid controls to ensure that all transactions (new citations, payments, hearing results, etc.) are updated to the system. This requires controls at all key points of the processing stream. For handwritten tickets, for example, managers should compare the number of physical tickets delivered by the issuing agency daily with both the number of ticket records keyed in and the number of records updated to the database. If all three are in balance, one can be confident that tickets are not being lost.

- *Complete citation history:* Ideally, the processing system should capture a complete citation history including all transactions entered to the database (including the date, time, location, and user ID of the person entering the transaction). The system should not permit the deletion or overlaying of transactions. This will ensure complete accountability and is essential to ensure that the system can withstand audit.

Reporting

Citation processing software should provide parking professionals with the management reports they need to ensure operational effectiveness. This includes both standard reports covering stable aspects of the operation as well as ad-hoc reporting tools which allow quick responses to elected officials, senior managers, and the media.

- *Security reports:* As discussed above, it is essential that the integrity and confidentiality of citation data be protected. The software should provide reports on attempted security breaches and detailed listings of all system transactions, so program managers can monitor access to the system for accuracy and appropriateness.

- *Control reports:* As also noted above, the system should provide all reports necessary to ensure that all transactions have been updated to the system in a timely, complete and accurate manner.

- *Violations by type and result:* Since the deterrence of violations is a key goal of parking managers, one needs reports on citation issuance by violation code/type, including the payment and adjudication outcomes, so that trends in violator behavior can be determined.

- *Issuing officer reports*: Managers with responsibility for enforcement personnel should insist on reports detailing the activities of their staffs, including issuance by violation code and outcome (i.e., the percentage of citations paid and dismissed). "Gap reports," which track excessive periods of time between citations, are also helpful in maintaining productivity. Such reports should be reviewed with enforcement staff regularly.

- *DMV hit rate*: As noted above, parking programs often rely on Divisions of Motor Vehicles to identify the registered owner of a vehicle to which a citation is issued. The processing software should provide reports showing the percentage of citations for in- and out-of-state plates for which a name and address was obtained.

- *Citation closure/Open Accounts:* The system should provide a series of reports showing the number of cases and percent satisfied by payment, satisfied by dismissal, and remaining open. Ideally, such data should also be aged, so trends are identified.

- *Adjudication results:* Likewise, the system should offer reports on the results of reviews and hearings, broken out in several ways: by issuing officer, reviewer/hearing officer, and by violation code.

- *Geo-based reporting:* Some cities are now plotting citation data (with outcomes) on geo-based maps. This technique has several benefits, including the ability to show activity by election or enforcement district, and identify the most likely location of scofflaw vehicles.

Choosing the most appropriate citation processing software may be a daunting task for many program managers. It can be done successfully by following several key steps:

1. Honestly and carefully evaluate the program's needs. Do not buy technology for its own sake; rather, understand the features you need and the cost implications of your needs.
2. Gain an accurate view of the marketplace (using IPO publications or visiting vendors at parking association meetings).
3. Talk to your peers about the software they currently use or previously used and their satisfaction level with the software, vendor, and cost.
4. Make sure that your procurement document (usually a Request for Proposal) accurately reflects your needs. (Note: Even if the program is developed in-house, perform steps 1-3 to make sure that a third party system is not a viable alternative.)

Collection of Delinquent Accounts

In the vast majority of parking programs, fewer than half of all citation recipients voluntarily admit liability and pay the fine, or contest the charge in a timely manner. Pursuing the remaining delinquent motorists represents one of the key challenges for any program. Parking administrators have a number of tactics at their disposal, which, used properly, can substantially increase their programs' satisfaction rates (i.e., the percentage of citations brought to a satisfactory conclusion). Each tactic must be appreciated in its own right, but more importantly, program managers must combine the available sanctions into a logical enforcement program. The sanctions should be applied in a regular, progressive manner that reinforces the credibility and effectiveness of the program. It is virtually impossible to tell what causes any particular violator to respond; experience does indicate, however, that repeated application of escalating sanctions will increase the satisfaction rate. The following tactics have proven effective in many parking programs and should be considered.

Additional Noticing

Most programs operate under legislative requirements or institutional rules which mandate that the program send a certain number of "reminder" and/or default notices (most often two) to the citation recipient, prior to using powerful sanctions such as booting, towing, or registration holds. Such notices are often linked to the imposition of late penalties, and have proven highly effective in bringing forward those who initially ignored their citations.

Governmental Sanctions

A number of states currently allow local parking programs to file records of outstanding parking citations with various enforcement or regulatory bodies so that certain governmental benefits can be denied to vehicle who fail to meet their obligations.

- *Registration Holds:* Several states (including New York, California, Ohio, Massachusetts, and the District of Columbia) restrict the ability of owners to renew their vehicle registrations if they meet a threshold of outstanding parking citations. In some situations, Massachusetts will also restrict the renewal of driving privileges. To take advantage of this sanction, the parking program must have the ability not only to request a "hold" at the state's Motor Vehicle Department (MVD) once the requisite number of citations has reached delinquent status, but must also be prepared to issue timely hold releases to MVD as soon as the registrant satisfies his outstanding obligations.

- *Tax Intercept:* Several states (such as California and Arizona) have introduced programs which allow local parking programs to "intercept" the tax refunds or lottery winnings of scofflaws. This requires that the program obtain the registrant's social security number (SSN), which may be available from the DMV or third party data sources such as credit bureaus. This tactic has produced varying results, but may be worthwhile if other strategies have failed.

- *"Clean Hands" Programs:* Finally some cities and towns have adopted "Clean Hands" or "Indebtedness" programs which deny governmental benefits (such as business permits or professional licenses) to those who owe debts to their regulatory or enforcement agencies, including parking programs. While such programs can be effective, it is often difficult to find good matching criteria (such as SSN or Federal Tax ID) common to all enforcement entities.

Institutional Sanctions

Many institutions, particularly colleges and universities, have a major advantage in enforcing parking citations—their customers require the benefits provided by the institution on a regular, ongoing basis. Therefore most such organizations link their citation database with other systems such as the Registrar and Bursar, and block those members of the community with delinquent citations from one or more of the following: registration for new courses, receipt of grades, receipt of transcripts, and application for new parking permits. These sanctions are very effective against current members of the institution. For departed students, faculty or administrators, however, other tactics discussed in this section must be applied.

Booting and Towing

Booting and towing are serious sanctions that prove most effective against repeat violators who are invulnerable to tactics such as noticing and vehicle registration non-renewal. Thus when a "scofflaw" vehicle is found by enforcement personnel, it is immobilized in place with a boot applied to a wheel, or towed to a secure location until the registered owner comes forward. In many programs (particularly in urban settings), the two are used in conjunction—vehicles which remain booted for a certain period, such as 24 or 48 hours, are towed for safekeeping. The use of booting in particular has a significant ancillary benefit: it is very helpful for other residents of the city or campus to see that the parking program is successful in apprehending scofflaws. This helps maintain compliance with the parking regulations and timely response by those who do receive citations.

In performing booting and towing activities, several program components must be in place and operate in an accurate and timely manner:

- *Provision of timely information to enforcement personnel:* Whether parking control officers or members of dedicated boot/tow crews, staff assigned to identify scofflaws must have up-to-date information on plate accounts. This usually involves nightly downloads of boot or tow eligible plates to the handhelds used for enforcement. In the case of large scale program, the better solution is use of radio communications in which mobile terminals are linked real time to the database, so that when a vehicle is screened, payments which might have been made only minutes before are reflected and vehicles are not inappropriately towed.

- *Boot removal procedures:* Once a vehicle is booted, it is imperative that the registered owner be able to secure its release in a timely fashion. This usually involves the opportunity to pay (via cash, money order or credit card at a relatively convenient cashiering location) followed by radio communication between the cashiering location and a boot crew which then returns to the vehicle and removes the boot.

- *Adequate and professional tow lots:* One must deal with a number of logistical challenges in running a successful towing program. The first is the provision of a tow lot sufficient to handle a reasonable turnover of vehicles. While the majority of towed cars are redeemed within 48 hours, many may never be redeemed and will have to be auctioned (especially if the "blue book" value is less than the fines owed). Most colleges and many cities contract out the towing function and require the vendor to provide the tow lot. It is also critical that the tow operation provide good, courteous customer service, including relatively long business hours so owners who satisfy their citation debt can redeem their vehicles within a reasonable time. Lastly, it should be noted that towing vehicles raises a number of legal issues which can increase the financial liability of the program, such as damage to vehicles and loss or theft of items in vehicles. Parking managers are well advised to talk to legal staff within their own organization as well as peers who already operate such programs before starting their own towing operation.

Use of Collection Agency Strategies

Many paring programs, regardless of size, have found it beneficial to utilize collection agency strategies against delinquent accounts. This can be done either by contracting directly with a collection agency or by incorporating the same services into a full service processing contract. Service providers usually charge a contingency fee, i.e., a percentage of what they collect, but absorb all costs of collection. This can be beneficial to the program since it incurs no cost unless it receives increased revenues. Successful strategies include:

- Additional noticing: Once the program has sent all legally required notices, the collection service provider will send additional notices on its own letterhead.
- Skip tracing: If the account has return mail, the vendor can access third party databases for a more recent address and resume mailing to the vehicle owner.
- Credit Bureau Listing: The three major credit reporting services (TransUnion, Equifax and Experion) now accept reports of delinquent parking ticket debt. This is often an effective sanction against the most recalcitrant violators.
- Judgment Filing/Execution: When a scofflaw's outstanding balance is sufficiently large to warrant the cost, some collection service providers will take legal action in the form of garnishing wages or attaching bank accounts. This can be a cumbersome and time consuming process—acquiring employment or banking information and court filings—and is not practical to use on a regular basis. But when used to collect from a chronic scofflaw, and coupled with sufficient media coverage, it can have a favorable, indirect effect on overall collection rates.

Customer Service

Parking professionals should never forget that all citation recipients should be treated professionally and courteously. As stated above, a citation is simply a charge, or allegation, that the registered owner violated a parking regulation. The cited individual has an obligation to respond, but also has a right to obtain additional information prior to his hearing or response date, and should be granted easy access to a hearing or review if he wishes to dispute the charge. Underlying this right is the fact that the parking program's main mission is the resolution or satisfaction of every citation, whether through payment or adjudication. The more options the program can provide citation recipients, the greater the chances of an appropriate, timely response. Conversely, the more difficult it is for a vehicle owner to contact the program, obtain information or schedule a hearing, the more entitled he will feel to refuse payment or ignore the citation.

The key elements to providing good customer service in a parking environment are similar to most other customer service operations.

- *Full information on rights and obligations:* Customers must have easy access to information about their alleged violation(s) and how they can respond. These needs are met in a variety of ways.

    - *Citation Form*: The citation form must invariably meet certain legal standards of notice—i.e., the date, time and place of the violation, the specific infraction, a description of the offending vehicle (at a minimum the state/plate, make, registration expiration, and sometimes also color and body type), the date by which the recipient must respond, the fine amount that may be voluntarily paid if the owner does not wish to contest the charge, and any late penalties that may be imposed for failure to respond in a timely manner. It is advisable, however, to also list a telephone number and web-site (if offered) for inquiries, payment instructions, and hours of operation for both walk-in and telephone customer service operations.

    - *Telephone*: The required sophistication of the telephone customer service facility is usually dictated by the volume of citations processed. In small town or college programs, a single phone line may suffice. For larger operations, especially major cities, the telephone unit will often be served by an Interactive Voice Response System (IVRS) which allows customers to obtain general information (payment instructions, hours of operation) as well as specific information about their citations via direct interaction with the database, without speaking to a CSR. The most sophisticated systems allow customers to schedule hearings or request a review for such claims as broken meters, missing signs. For customers who wish to speak to a Customer Service Representative (CSR), automated call distributors (ACD's) route calls in the order received. Phone systems serving high volume programs should allow supervisors to dynamically monitor call volumes and waiting times and reassign staff as required, and should provide daily and monthly summary reports with key performance statistics including total calls received, average wait time at various times of day, and the number and percentage of callers who hang up before receiving service. Such reports allow program managers to assess staffing needs or, if the service is contracted out, determine if the vendor is meeting mandated service levels.

- *Web-site*: Web-sites are playing an increasingly important role in parking management customer service programs. As discussed above, such sites are useful for accepting credit card payments. Most also provide general program information and detailed instructions on how to contest a citation. In the near future, however, they will increasingly serve as the main tool for various forms of customer self-service in which owners can file claims, have e-mail or interactive hearings, renew permits, etc.

- *Brochures*: Although web-sites and telephone systems often handle most customer inquiries, it is also useful to offer informational brochures which supplement these other sources, or focus on specific issues such as what to do when one's vehicles has been towed. Brochures can also be used to offer information in additional languages used in the community.

- *Hearing/Review Decisions*: Program managers should remember that review/hearing decisions are not just legal documents; they also serve an important customer service role. As such they should be clear and concise while conveying the hearing officer's decision, any fines and penalties now owed, additional evidence of compliance which may be required (such as proof of inspection or registration renewal), the due date(s) by which payment or compliance is required. Accepted methods of payment and office locations and hours should be repeated on decision forms (even if such information is readily available elsewhere) since this is the document which vehicle owners are most likely to retain.

- *Convenient access to adjudication*: It is in the mutual interest of both citation recipients and parking managers for the program to offer broad access to reviews and hearings. Options like hearings by mail and e-mail and walk-in hearings (i.e., with out prior scheduling) appeal to customers, permit efficient use of program staff, and contribute to higher rates of citation closure.

- *Convenient payment options*: The key point to be remembered is that it is mutually beneficial to both the program and citation recipients if varied payment options are offered. Today, many programs of varying size and nature are offering the option credit card payments via telephone and the internet, and the percentage of such payments is rising rapidly. At the same time, access to walk-in payment locations and use of such tools a "check by phone" will appeal to those without credit cards.

- *Timely response to written inquiries*: While web pages and sophisticated phone systems handle an increasing share of customer inquiries, written correspondence continues to represent a significant share of any programs workload and remains a critical task. The turnaround time on correspondence should be kept to a minimum—never more than several days. Long delays in answering correspondence reduce cash flow and add to workload, since frustrated customers will send in a duplicate request if their initial inquiry is not answered in a reasonable period.

- *Adherence to standards and procedures*: All staff dealing with customers—whether CSR's, managers, or hearing officers—should do so based on written standards and procedures. This is advisable for several reasons: 1) Citations are receivables and their processing is usually governed by state, municipal, or institutional guidelines; 2) The program has a vested interest in maintaining a reputation for fairness and evenhandedness. The public must be assured that penalties are not waived or charges dismissed in an arbitrary manner.

- *Documentation of contacts/interactions*: To ensure that procedures are followed, the program should maintain a complete history of all actions affecting a citation. This is usually achieved in the citation processing system which should capture a complete citation history including all transactions entered to the database, and prevent the deletion or overlaying of transactions. This will ensure accountability. In addition, many large scale programs are moving toward the imaging of customer correspondence. This allows the storage and easy retrieval of all documentation related to a case for audit or research purposes, while reducing storage costs.

Program Measurement and Self-Evaluation

Parking managers should measure the performance of their programs on a regular basis with two goals in mind. First, it is important to see trends within the program, e.g., are payment and closure rates rising or falling, etc. Second, managers can use internal measurements, in conjunction with industry benchmarks such as those provided by IPI's *Benchmarking the Parking Profession: The Statistical Guide to Parking*, to determine how their program compare with both industry averages and "best practices".

Identifying the critical measurements or statistics obviously depends on the program's scope. Most, however, will fall into the following categories.

Citation Closure

Payment and Satisfaction Rates: Since the major goal of citation processing and collection efforts is to bring every parking citation to a satisfactory resolution, this is the most critical performance indicator. The citation processing system should produce monthly reports which show the number and percentage of total issuance satisfied by payment, administrative review (if applicable) and/or adjudication. Such reports should have an aging capability, so that managers can see changes in the payment/satisfaction rates over time. This enables one to determine if collection strategies applied to older delinquent cases are working, and should also indicate changes in the flow of payments.

If that is the case, there should also be an increase in the rate of timely, voluntary compliance as customers realize that they gain nothing from ignoring their citations.

Municipal parking programs generally achieve satisfaction rates (i.e., paid and dismissed cases as a percentage of TOTAL issuance) in the 60-85% range. Results will vary depending on several factors including the percentage of citations issued to out-of-state plates, the sanctions available (e.g., does the state restrict registration renewals of scofflaws) and the technology used to issue citations. Colleges and universities will often have high satisfaction rates given the fact that they usually have internal databases with vehicle owner information and also have additional, powerful sanctions (such as the power to block the release of grades or transcripts) if citations remain open.

The author believes it essential that all such rates be computed using 100% of citation issuance, without excluding any categories. Some programs report extremely high case closure rates, but upon further review, they have excluded certain citations from the calculations, such as cases for which no registrant information is available. Use of such numbers can misrepresent the program's effectiveness and may divert attention from solving important issuance or processing problems. However, in certain settings, particularly colleges, in which large numbers of citations are waived as a mater of policy (such as in the first week of the academic year or for first time visitors to campus), such data should be tracked separately from dismissals based on the merits of the case.

For larger scale programs, it is also advisable to break out issuance and payment/satisfaction data by violation code, home-state violators versus out-of-state, and other subcategories which help to identify specific trends in issuance or processing results.

A second layer of reports should also provide information on critical processes which can contribute to high satisfaction rates.

Identification and Contact of Responsible Parties: For municipal parking programs, Departments of Motor Vehicles serve as the primary source of registered owner names and addresses. In a university setting, internal databases covering students, faculty and staff will provide most of the necessary data. The processing system should provide detailed reports on the "hit rate" for all sources accessed. Inquiries to a home state DMV should yield good results in excess of 95%; results from other DMV's should exceed 80%, although the results vary from state to state and may depend on the percentage and mix of citations issued to out-of-state plates. Colleges and universities should achieve higher rates of responsible party identification, although rates can also vary based on the extent of outside visitors. DMV interfaces are also key for colleges to obtain such information.

Program managers should also ensure that return mail is updated to the system and regularly examine bad/no address rates. Lack of good mailing addresses obviously impacts the collection rate and also often indicates a problem with the interface with the DMV or other databases. If the rate of return mail is high, program managers should consider use of "skip tracing" services, either directly or through their software or collections vendor.

Adjudication Volumes and Results

Few areas of parking management are more misunderstood than the measurement of adjudication results. Members of the public, elected officials, and many judges or hearing officers believe that any effort to monitor decision patterns signifies improper pressure. Nothing could be farther from the truth. Experienced parking managers appreciate that some reasonable percentage of citations will be contested and some subset of those should indeed be dismissed. As a general rule, it is not unusual to find that 15% of all citations are disputed, and of these, one third are dismissed. Equally important, however, is that they understand the bell curve of dismissals for their particular program, and are thus able to quickly identify any unusual or problematical trends before they reach a critical level.

Essentially, the program should produce statistics on the number and percentage (of total issuance) of citations disputed and ultimately dismissed. This data should be broken out as follows:

- *Overall percentage of citations contested and dismissed:* These are the most basic program-wide indicators and serve as a baseline for the program over time. It is also advisable to talk to peers and review IPI publications to get sense of norms for similar programs. A very high rate of disputed citations can be a sign of poor issuance practices, problems with poor or missing signage, widespread weaknesses in the meter inventory, or regulations that are unrealistic in the context of the local parking environment. For example, a high volume of issuance for parking over the time limit at meters, coupled with a high contest rate, may suggest that the time limits have been set too restrictively and do not properly support the types of businesses where meters are located.

- *By violation code:* Certain types of violations are more amenable to successful dispute than others (e.g., it is easier to claim successfully that a meter was broken than it is to dispute a citation for parking at a fire hydrant). But aside from the intrinsic characteristics of individual violations, parking managers should look at violation types with below or above average dispute and dismissal rates. Such results can indicate various types of program deficiencies. For example, a high rate of meter dismissals can indicate poor meter maintenance. Wide discrepancies can also indicate problems with signage or in the overall training of enforcement staff.

- *By reviewer/hearing officer/judge:* Any reasonable size parking program which utilizes more than a handful of adjudicators will show a healthy variation in decision patterns; it is to be expected that some will be more strict, others more lenient. However, managers should be alert to any adjudicator who is significantly above or below average and should schedule the individual for additional observation and/or retraining. Although many citizens will not believe it, the adjudicator who finds an abnormally high percentage of citation recipients liable is actually the greatest threat to the programs reputation.

- *By issuing officer:* Similarly, a officers whose citations exhibit abnormal rates of default, challenge or dismissal, especially if centered in one or two particular violation types, may require retraining.

Customer Service

As noted above, it is vital that program staff have a customer service orientation. Citation recipients are presumed not liable prior to their hearing or response date, and even if found liable or in default, have a right to professional, courteous service. A solid performance management strategy should consider the same basic indicators of good customer service as one would for any type of customer-focused program.

Waiting Time For Walk-in Customer Service: It is often sufficient to measure this indicator on a periodic basis providing the timeframes are consistent—such as the second Wednesday of every month. There are several valid ways to determine how long customers wait for walk-in service. Some programs have measured waits after the fact using surveillance cameras. Another approach is to have a staff member time stamp a form or stub and hand it to the customers as they enter the facility, then collect it and time stamp it again as the customer exits. The key is to assess the total time required for service; if you only measure the time it takes a customer to reach a cashier or CSR, you are missing half of the process. While the initial wait can be the most frustrating, the real issue is how much time must a citation recipient invest in getting the service he requires.

Telephone Statistics: It is also advisable to regularly determine how long customers who call the parking program must wait for service. Fortunately, for larger programs for which this type of data is critical, modern phone systems usually provide a wide range of valuable reports. Key indicators to watch are:

- *Total calls*: The total number of calls should be tracked to determine trends and also to measure telephone access as a percentage of all
- *Percentage of calls handled by the IVR*: A well designed IVR program should handle at least 50% of all incoming calls without requiring intervention by a live CSR. With fine tuning, this figure can be increased even higher.
- *Average wait in the ACD*: This is perhaps most critical. Once a customer has chosen to speak with a CSR, he should ideally not have to wait more than one minute. Waits in excess of three minutes should be viewed as excessive and efforts efforts applied immediately.
- *Dropped calls (and hold times before drop)*: Managers should know how many customers grow frustrated and hang up before they speak to a CSR (both the gross number and as a percentage of all calls coming in to the program). It is also helpful to see a percentage distribution in terms of seconds on hold before

customers hang up. One would expect dropped calls to increase as average waits increase.

- *Average length of call*: The speed with which CSR's can handle service requests should also be measured. This figure can be added to average wait in the ACD and the length of time it takes to get through the IVR message to determine an average total time for phone service.

In general, customers should be able to reach a live CSR in an average of three minutes or less. This time should be calculated as a combination of the time one must spend in the IVRS before being permitted to request a live operator plus the average wait in the ACD. As average waiting time grows beyond three minutes, the number of dropped calls can be expected to increase.

Turnaround time for correspondence: The third component of the customer service triad is correspondence processing (whether by mail or e-mail). Management must know how long it takes staff to process and answer various types of written service requests. While intrinsically important as a measure of service quality, it should also be kept reasonable to minimize duplicate service requests. That is, if customers must wait too long for a response, some percentage will mail in duplicate requests, further contributing to the program's workload.

A related indicator is "oldest item in-house." While the average processing time for correspondence may be good, one must also ensure that individual items are not "falling through the cracks" while customers get frustrated.

Customer Satisfaction Surveys: While statistics, when wisely chosen and correctly measured, can reveal a lot about a program, it is also wise to periodically ask customers directly whether they are satisfied with the service they are receiving. Many programs hand out surveys at their walk-in customer service facilities, and others mail out surveys to customers who have sought service by mail or phone. Such surveys should be constructed so that they elicit responses on specific aspects of service rather than proving a forum for general complaints about the receipt of a ticket. If properly conducted, surveys can reveal valuable insights about program quality and alternative methods of service. Survey results are also a useful balance against more anecdotal or biased complaints submitted to elected officials or senior managers overseeing the parking program.

Conclusion

To successfully process and adjudicate parking citations and collect the resulting fines and penalties, parking managers must keep two key goals in mind: providing fairness to all parties and achieving a satisfactory resolution—through payment of fines or dismissal--in the highest percentage of cases possible. These goals can be attained by offering broad, convenient access to a professional, even-handed adjudicatory process, providing excellent customer service, and putting in place firm and effective strategies for pursuing delinquent accounts. By doing, one can make a major contribution to his local parking program.

Over the past 25 years, the majority of parking programs—whether municipal or academic—have greatly increased their efficiency, effectiveness and professionalism. Parking professionals seeking to build a new program or improve upon an existing operation, can now benefit from cooperative, knowledgeable peers and a wealth of information available from IPI, other national trade groups and their state and regional parking associations.

DESIGN CONSIDERATIONS FOR MIXED USE FACILITIES

John G. Burgan, P.E.

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Introduction

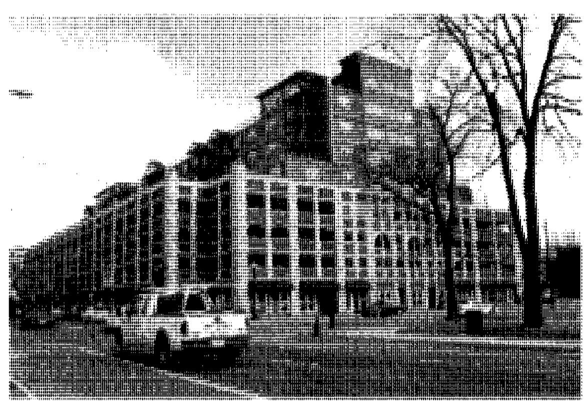
Mixed use facilities, by definition, combine more than one use in a common building footprint. Besides parking, uses may include restaurant, retail, office, hotel, and housing. Although less common, mixed uses may also include plazas or athletic fields on the top level of parking structures.. Almost any building use can be combined with parking.

The purpose of this chapter is to introduce readers to conditions leading to the need for mixed use structures, and explain design considerations unique to this type of facility.

The Need for Mixed Use Facilities

Economics drive the need for mixed use facilities. Parking in combination with other uses is almost always more expensive than stand alone parking. Mixed use facilities are considered when:

- The best use of the land is determined to be a use other than stand-alone parking.
- The cost of adjacent parcels that could be used for parking is too high.
- Shared use of adjacent parking facilities is not feasible.



Facility with retail at base, parking, and housing.

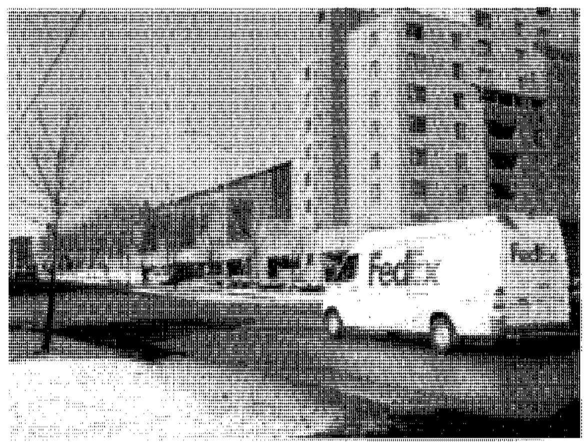
Readers are encouraged to seek shared use of adjacent parking facilities whenever feasible. However, owners must keep in mind that the availability of this supply may cease if leases can be broken or facilities are demolished for other uses.

The following sections discuss design considerations that are unique to this type of facility.

Vertical Stacking

One of the first decisions to be made in design is how different uses will be stacked vertically within the facility. Many options have been implemented, but the following trends are prevalent:

- For retail plus parking, the retail element is located at grade level with parking above.
- For office plus parking, the parking is located below the office. Parking can be above or below grade.
- For housing plus parking, the parking is typically located at grade with housing above, but parking can sometimes be provided on the same level as the housing.



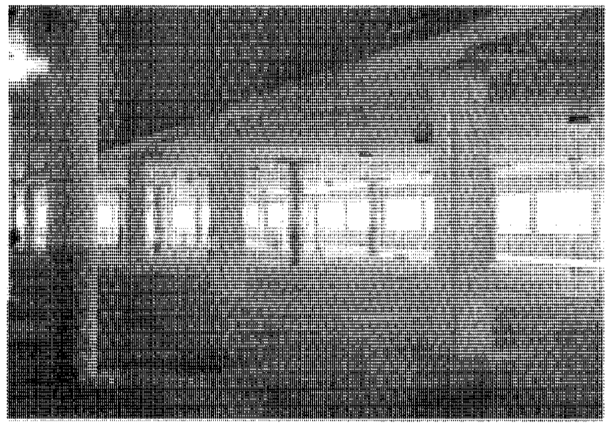
Facility combining parking and housing.

As noted in the introduction, many uses can be combined in one facility. If retail is included, it is almost always at street level.

Geometric Design Criteria

Geometric design criteria define the size of parking spaces, drive aisles, and turning areas. These are important because the cost per space in a mixed use facility may be significantly more expensive than the cost per space in a stand alone parking facility.

Column locations must be studied. The long spans common in stand alone structures do not match those used for typical buildings; therefore, most mixed use facilities have many more columns than stand alone structures. Typically, columns are located at the ends of parking spaces.

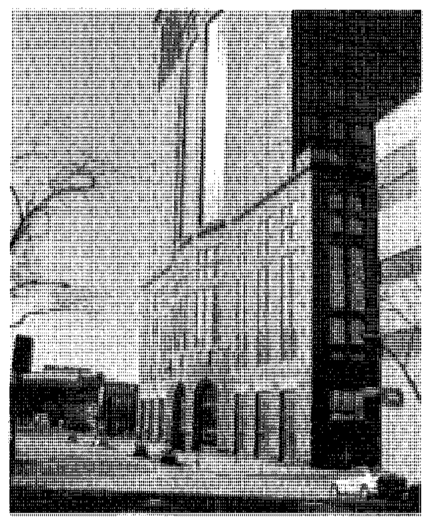

Congested column layout

The introduction of these columns raises several questions:

- What is the impact on efficiency and vehicle circulation?
- Is angled or perpendicular parking more efficient? How does the overall site geometry impact traffic flow?
- What is the cost impact of adding or removing columns on the cost of parking and other uses?
- What is the impact on sight lines and overall visibility?

Consideration of the types of users is important. Frequent users such as office workers can adapt to smaller spaces and drive aisles, while providing a higher level of service for transient users, such as shoppers, is often desirable.

Mixed use facilities commonly have smaller spaces and less room to maneuver than stand alone facilities. This is often the result of two factors, the higher cost of parking and the columns added to support the building component of the project. The higher cost is a result of poorer overall efficiency due to added columns and walls. This may be acceptable, but should be reviewed as the project proceeds.

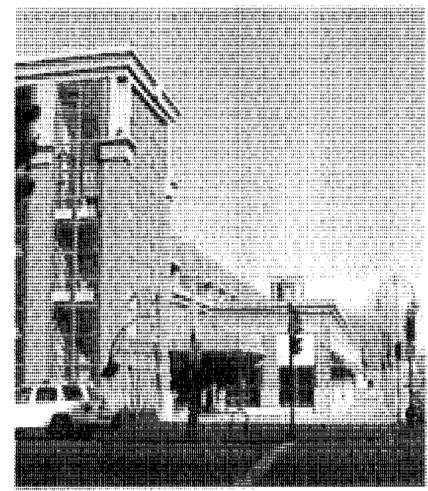

Retail at perimeter base, parking and office space above.

Aesthetics

The trend of city planners is to ask owners to consider the upgrade of parking elements in mixed use facilities. Typical parking facades may not be permitted in downtown or urban settings. As a result, parking elements are often clad in materials that mirror those used in the local area, to match the facility to the surrounding area. These requirements are often included in zoning ordinances or required through conditional approvals.

As owners and designers develop a building design, they should consider the impacts of the façade design, including:

- Enclosing parking may result in the need for mechanical ventilation and sprinklers.
- The cladding will decrease the amount of daylight, detracting from the feeling of overall security, and lessening the ability of users to orient themselves in the structure.
- The pattern of lighting after dark needs to be studied. The high levels of light desired in parking structures are very visible from streets and adjacent facilities.



Parking with retail

Designers also need to study the location of vehicle ramps. In this discussion, ramps are the areas of sloped concrete used to move vehicles from level to level. The placement of ramps on exterior drive aisle will result in angled elements that may be difficult to incorporate in the façade.

Safety, Security and User Orientation

The design of typical mixed use facilities may decrease the user's feeling of safety and security. This is a result of additional columns, walls, and stairs that decrease sight lines and obscure visibility, a condition that can lead to the perception or reality of an unsafe condition. The desire to minimize cost and overall building height may lead to minimal floor-to-floor heights.

Designers may include the following elements to enhance safety, security, and orientation:

- Panic stations and closed circuit television.
- Signs directing users to stairs and elevators, as well as locators for people returning to their vehicles.
- Painting interior surfaces white. This results in a brighter space and a perception of a larger space.
- Increased lighting, especially walls. The lighting makes it harder for individuals to hide, improving security. Designers should use fixtures that illuminate the ceiling.
- Increased floor-to-floor height. The additional height improves sight lines, signage placement options, and creates an overall perception of a more open space.

Vertical Pedestrian Circulation

Vertical pedestrian circulation includes stairs and elevators. Stairs and elevators are typically located in exterior corners of stand alone facilities; however, it is unlikely these locations will work for mixed use facilities. The more common location is well inside the non-parking use.

Interior locations often reduce parking efficiency and complicate vehicle flow. Enclosing walls decrease sight lines, impacting security, and increasing the likelihood of accidents.

Designers must carefully consider exit paths. Non-parking uses often require fire rated exit paths, resulting in enclosed paths to the exterior of the structure. This can be difficult to incorporate in the design.

Stand alone facilities typically use glass backed elevators and glass in stairs to increase security. The glass backs allow views into the elevators and stairs from outside the facility. This may not be feasible in mixed use facilities. Designers should consider the inclusion of closed circuit television in stair and elevators.

Vehicle Entrances and Exits

Entry and exit points on stand alone facilities are often designed to be highly visible from a distance. This allows users to find the access points safely. Designers of mixed use facilities may find this desire to be detrimental to the overall design of the facility. A toned down design may be appropriate if the facility is used primarily by long-term users, but if shoppers and restaurant users frequent the facility, a more visible entrance is desired.

Access points may be governed by traffic flow on adjacent streets. Parking consultants and traffic engineers will be helpful in studying the best access points. Revenue control equipment is often needed. Location is critical. Booths or card readers need to allow for necessary queues. Vehicles should not need to queue on streets.

Sight lines at exits are also critical. The desire to minimize the visual impact of exits combined with building façade elements can obscure the vision of drivers. The front end of vehicles often project onto sidewalks before drivers can see streets and sidewalks. This condition endangers pedestrians and must be avoided. Many owners have added alarms and lights that are activated as vehicles exit a structure to alert pedestrians to potential conflicts.

Service and Deliveries

The introduction of non-parking uses into a facility forces the need to add spaces for service delivery. Truck docks are common. The docks may require additional floor-to-floor height, as well as depressed floors for the docks. The docks should be located near a service elevator. Paths from the docks to the businesses will be necessary.

Designers will need to include space for refuse containers, as well as means for pickup vehicles to access the containers.

Space will be needed for electrical service, likely including a generator. Utility companies will need access to these spaces for maintenance and repair.

Design of Building Spaces Under Parking

Occupied spaces under parking have special needs. They include:

- Waterproofing of the parking above. Special treatment is needed to limit the leaks from the structure, especially in precast concrete structures.
- Vertical clearance is critical. Clear heights of seven to eight feet typically found in parking facilities is not sufficient for retail or commercial spaces.
- Parking and other uses have different fire ratings. The ratings may influence the overall design and needs to be considered early in the design process.

Conclusion

The demand for mixed use facilities is increasing. The need is fueled by city's desires to limit or eliminate the addition of stand-alone parking facilities to their downtowns. Increased density of urban areas decreases the availability of land, economically limiting the ability of owners to develop stand alone facilities. The increase in mixed use facilities is expected to continue.

The design of mixed use facilities presents unique challenges to owners and designers. The challenges can and have been overcome. Mixed use facilities should be encouraged and embraced by cities, owners, and designers.

The need for mixed use structures is often driven by the private sector. Funding is often an issue. Municipalities may find that participating financially increases a project's chance of success.

PARKING FACILITY LIGHTING DESIGN, MEASUREMENT & MAINTENANCE

Donald R. Monahan, P.E.

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1. Introduction

Adequate lighting is one of the most important design features in a parking facility. Bright lighting increases user comfort, security and safety, which enhances utilization and increases revenue. A poorly lit facility may result in vehicle or pedestrian accidents, and may invite criminal activity resulting in vehicle and personal property thefts, as well as violent crimes such as assaults, kidnapping, rape, and murder. The monetary damages from personal injury lawsuits from accidents or criminal activity can be in the hundreds of thousands or millions of dollars. In this chapter, we will cover factors that influence your lighting decisions with the focus on safety, security, visibility and quality of light. Design criteria, equipment, energy efficiency and maintenance considerations will also be included in this analysis. Finally, various configurations and calculations will be provided which will help you better understand and plan your lighting system in accordance with not only code requirements, but also to create a user friendly environment.

2. *Lighting Basics*

Illuminance (light level) is the quantity of light falling on a surface and consists of direct light from a light source plus inter-reflected light from room surfaces. Horizontal illuminance is the amount of light falling on a horizontal surface such as a table, floor, or ceiling, and is measured by placing the light meter flat on the horizontal surface. Vertical illuminance is the amount of light falling on a vertical surface such as a wall, a pedestrian, a sign, etc, and is measured by placing a light meter flat against the vertical surface.

Luminous Flux, measured in lumens, refers to the gross amount of light generated by a source, irrespective of the intensity of light in a given direction. One can calculate the average illuminance on a surface by dividing the number of lumens falling on the surface by the area of the surface. If the area is measured in square feet, the average illuminance is in footcandles. If the area is in square meters, the average illuminance is in lux. One footcandle equals 10.56 lux or an approximate ratio of 1:10.

Candlepower is the measure of the intensity of a light source in a given direction, measured in candelas. The candlepower distribution curve describes the intensity and direction of light radiation for a luminaire or light source. It is determined by measuring the lighting intensity in a spherical pattern around the luminaire at numerous vertical and horizontal angular increments. One can then calculate the illuminance incident at a point (E) by dividing the candlepower of the light source toward the point (I) by the square of the linear distance between the luminaire and calculation point (d^2), times the cosine of the angle between the light ray and a line normal (90 degrees) to the surface, or $E = (I/d^2)\text{Cos } \theta$. Note that the illuminance at a point is the sum of the contribution of light from each luminaire in the space. In addition, light reflected from ceilings and walls contributes to the illuminance at a point, which requires the use of sophisticated computer software to make that calculation. To determine the average illuminance, one totals the illuminance values at a grid of points at equal spacing on a surface and divides that sum by the number of points. One can also determine the lighting uniformity by dividing the maximum illuminance at any point by the minimum illuminance at any point for that surface or grid of calculations.

The illuminance on a clear day in June can be as high as 10,000 footcandles (100,000 lux). On a cloudy day, the illuminance drops to approximately 1,000 footcandles (10,000 lux). Conversely, the illuminance under a full moon is approximately 0.01 footcandles (0.1 lux). The human eye can adapt to a range of approximately two log steps of illuminance, or 0.1 to 10 fc, 1 to 100 fc, 10 to 1000 fc, etc. Transition lighting is necessary when traversing lighted environments that exceed those ranges.

3. *Types Of Parking Facilities*

Lighting dynamics are distinctly different for covered versus uncovered parking facilities. Uncovered parking facilities consist of surface parking lots and roofs of parking structures. In the outdoor environment at night, our eyes are adapted to very low ambient light levels due to the dark background of the night sky, and thus require very little illumination of objects for adequate visibility. Covered parking facilities are the enclosed portions of parking structures. The concrete surfaces of the parking structure have moderately high reflectance such that any amount of electric lighting will result in ambient light levels that are 100 to 1000 times that of the night environment outdoors. Higher light levels and more contrast are then required in covered parking facilities versus uncovered parking facilities for adequate visibility. In addition, the indoor environment of a parking structure is much more cluttered with potential obstacles such as columns, walls, bollards, wheel stops, curbs, landings, etc. The structural system and the low ceiling heights of parking structures inhibit visibility of one's destination, requiring overhead directional signage to exit the facility. Adequate lighting is necessary to read and react to the signage as a pedestrian or a driver. Therefore, the illumination criteria for covered parking facilities is distinctly different than for uncovered parking facilities.

4. *Factors Influencing Parking Facility Lighting Needs*

Factors influencing the design of the lighting system consist of Visibility, Safety, Security, Adaptation, Glare, Light Trespass, and Color of Light.

4.1. Visibility

4.1.1. Visual Field

Vision is greatest along the direct line of sight, called the fovea, defined as a 2-degree cone from the pupil (Two degrees is about two thumb widths at arms length). Peripheral vision occurs outside the direct line of sight allowing us to see about a 120-degree field of view (60 degrees each side of the direct line of sight). Word and symbol recognition occur within a 60-degree field of view. Driver's eye level is typically taken at 45 inches above the drive surface. The overhang of the roof of a vehicle typically limits the upward field of view to 15 degrees above the horizontal line of sight. The driver's line of sight is typically at a downward angle of approximately one degree for roadway driving conditions, but may be slightly greater at the slower speeds of the more congested environment in a parking structure. The pedestrian's line of sight is approximately 5'6" above the walking surface with the normal line of sight at a 10-degree downward angle.

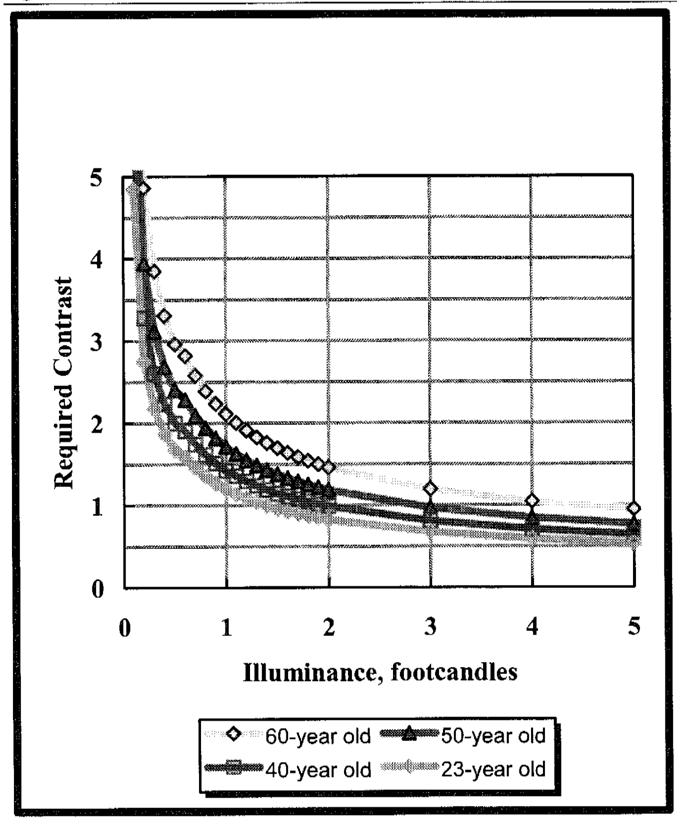
4.1.2. Visual Tasks

Most visual tasks in a parking facility consist of identifying or recognizing vertical objects such as curbs, steps, signs, walls, columns, pedestrians, other vehicles, etc. Therefore, vertical illuminance (the amount of light falling on a vertical surface) is often more important than horizontal illuminance (the amount of light falling on a horizontal surface). The human eye does not see illuminance; the eye only sees light reflected from a surface or object, called luminance. In concrete parking structures (reflectance equals 35 to 40%), the luminance in candelas per square meter is approximately equal to the illuminance in footcandles. Luminance contrast is required for adequate visibility of objects and hazards.

4.1.3. Contrast

Object detection is dependent upon the light level and contrast of the hazard against its background. Figure 1 indicates the amount of contrast required at different light levels for a 90% probability of object detection. Note that older people require more light or higher contrast for adequate visibility than younger people due to deterioration of the eye with age. The amount of light reaching the retina in a 60-year old person is approximately 1/3 that of a 20-year old person.

Figure 1. Contrast vs. Illuminance for Object Detection



Contrast is defined as the luminance of the target or object minus the background luminance, divided by the background luminance, or $(L_t - L_b)/L_b$. Since luminance equals illuminance times reflectance divided by pie ($L = E\ \rho/\pi$), one can determine contrast from the difference in reflectance, i.e. $(R_t - R_b)/R_b$. The reflectance can be determined from Pantone color charts (available from www.pantone.com) or from Munsell color charts. Tables 1 and 2 indicate typical values.

For example, one can calculate the contrast of a concrete wheel stop on an asphalt pavement. Concrete has a reflectance of approximately 0.4 (40%) while asphalt has a reflectance of approximately 0.07 (7%). The contrast is then 4.7 [(0.4-0.07)/0.07]. In accordance with Figure 1, an illuminance of approximately 0.2 footcandles should provide adequate illuminance of that wheel stop.

However, a concrete wheel stop on a concrete floor would have little or no contrast. In order to enhance the visibility of the wheel stop, it is necessary to paint the wheel stop yellow. The contrast would then be approximately 0.85. Approximately 2 footcandles of illuminance is then required for adequate visibility of the painted wheel stop.

Table 2. Reflectance versus Color

Color	Reflectance
White	90%
Yellow	74%
Pink	53%
Gray	41%
Orange	29%
Green	20%
Brown	19%
Red	18%
Blue	11%
Purple	11%
Black	4%

Table 1. Reflectance versus Munsell Value

Value	Reflectance, %
10.0	100
9.5	87.8
9.0	76.7
8.5	66.7
8.0	57.6
7.5	49.4
7.0	42.0
6.5	35.3
6.0	29.3
5.5	24.0
5.0	19.3
4.5	15.2
4.0	11.7
3.5	8.8
3.0	6.4
2.5	4.5
2.0	3.0
0	0

Similarly, contrast is an important consideration for the visibility of signage. Generally, the illuminance at the sign face should be on the order of 1 to 2 footcandles in addition to utilizing high contrast color combinations for adequate visibility of the sign message. High intensity reflective sheeting is recommended for the sign message to enhance visibility at low ambient light levels.

4.2. Safety

Safety is the protection of vehicles, patrons and attendants from injury due to accidents. Inadequate lighting is the most common contributing factor cited in personal injury claims. In addition, previous studies indicate that approximately 75% of all personal injury claims are due to slip and fall or trip and fall. Therefore, designers should provide enhanced lighting at curbs, wheel stops, stairs and other hazards to minimize the accident potential. Designers should also provide enhanced lighting at vehicle-pedestrian conflict areas and vehicle-vehicle conflict areas.

The following table indicates the illuminance levels for safety as recommended by the Illuminating Engineering Society (IES):

Table 3. Illuminance Levels for Safety

Source: Ready Reference, Publication RR-03 Fourth Edition, Illuminating Engineering Society of North America, NY, NY 2003, Figure 55, page 97

Hazards Requiring Detection	**Slight**		**High**	
Activity Level	**Low**	**High**	**Low**	**High**
Illuminance, Lux	5.4	11	22	54
Illuminance, Footcandles	0.5	1	2	5

The above values represent absolute minimum illuminance at any time and location where safety is related to visibility. However, in some cases higher levels may be required such as where security is a factor.

Security

Security is the protection of the premises, patrons and attendants from criminal activity, often by third party intruders. Assaults, robbery and vehicle theft are the most prevalent crimes in parking facilities. Bright lighting is a deterrent to potential criminals due to the increased risk of recognition and increased probability of apprehension. Further, patrons feel safer if the lighting is bright enough to identify potential assailants at a sufficient distance to take evasive action or call for help.

Table 4. Average Illuminance for Security

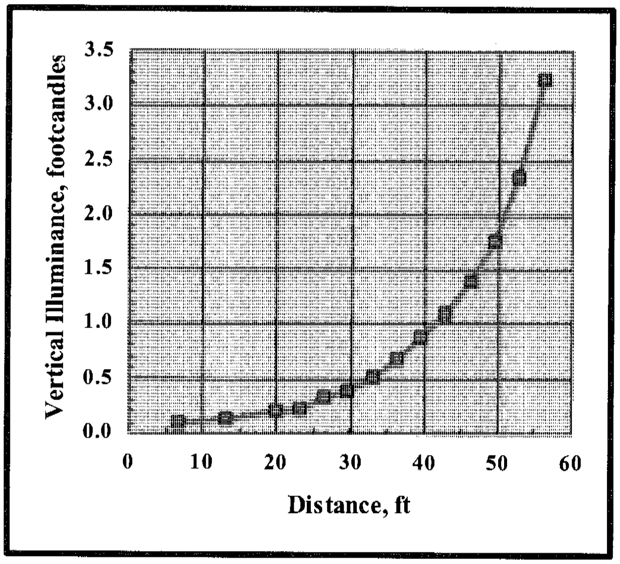
Source: Guideline for Security Lighting for People, Property, and Public Spaces, Publication G-1-03, Illuminating Engineering Society of North America, NY, NY, 2003

Location	***Illuminance on Pavement[1]***	***Vertical Illuminance[1, 2]***	***Avg/Min Uniformity Ratio***
Covered Parking Areas	60 (6.0)	5-8 (0.5-0.8)	4:1
Uncovered Parking Areas	30 (3.0)	5-8 (0.5-0.8)	4:1
Stairs, Elevators, Ramps	50 (5.0)	5-8 (0.5-0.8)	4:1

1. Average Lux (footcandles)
2. Interior lighting should allow for safe movement and easy detection of hazards to a distance of at least 9.1 m (30 ft).

Figure 2 indicates the vertical illuminance on a person's face necessary for confident facial recognition at various distances. Security experts suggest that a minimum distance of 30 feet provides adequate distance to take evasive action. At that distance, a minimum vertical illuminance of 0.5 footcandles is required (see Figure 2). Note that the research indicated that confident facial recognition (90% probability) was not possible beyond a distance of 57 feet. At that distance, a vertical illuminance of approximately 3.3 footcandles is required.

Figure 2. Vertical Illuminance vs. Distance for Confident Facial Recognition



4.3. Adaptation

Adaptation is the process by which the eye adjusts to the ambient light or brightness within the field of view. Many people are familiar with the inability to see as one enters a dark cinema, however, after some time inside the cinema seating area, one can see again as the eyes adjust to the darkness. An otherwise well-lit parking structure may look dim during a sunny day due to the bright sunlight coming through the perimeter window openings. Since the eye adjusts to the brightest light in the field of view, the interior of the parking structure appears dim by comparison. Driving or walking through large variations of light and dark areas can be disturbing to the eye and can affect visual performance. Therefore, it is important that light patterns overlap sufficiently to provide uniform light levels. The Illuminating Engineering Society specifies an upper limit on the uniformity ratio, expressed as the maximum illuminance (brightest area) divided by the minimum illuminance (darkest area), of 20:1 for parking lots and 10:1 for covered parking structures.

One must provide transition lighting when entering a parking structure from bright sunlight, or conversely, when leaving a brightly lit parking lot (or gas station) into the dark surrounding area at night. It takes significantly longer for the eye to adjust going from bright to dark, than dark to bright. The IES recommends a minimum illuminance of 50 fc (combination of electric lighting and daylight infiltration) for a distance of 60 feet inside the entrance of a parking structure during the daytime to allow for the transition from bright sunlight to the darker parking structure. The width of the transition lighting should include the width of the drive lane plus a sufficient distance on either side of the drive lane to see and react to pedestrians and other vehicles approaching from either side.

One should also provide daytime transition lighting at the roof of the parking structure where patrons drive into the covered parking levels. Conversely, the supplemental daytime lighting must be turned off at night to lower the brightness so that there is not a problem transitioning from the brighter parking structure into the dark area outside the parking structure. While some people may provide bright lighting in a parking lot for safety and security, over-lighting the parking lot or parking structure may create a hazard with transitioning to the darker surrounding area as one leaves the parking lot or structure at night.

4.4. Glare

Glare is caused by an unusually bright light source in the field of view compared to the ambient lighting, and is classified as Disability Glare or Discomfort Glare. Disability Glare occurs when the light source is so bright that vision is obscured, such as when one looks into the sun. Discomfort Glare occurs when the light source is bright enough to cause a sensation of pain or annoyance, but not so bright as to obscure one's vision. When the glare source is more than 10 degrees laterally from the direct line of sight, the sensation of glare is greatly reduced.

Ian Lewin conducted a study of discomfort glare and concluded that the vertical illuminance at the eye perpendicular to the line of sight toward the luminaire should not exceed the following values:

Table 5. Maximum Vertical Illuminance for Discomfort Glare

Source: Light Trespass: Research, Results and Recommendations, Publication TM-11-00, Illuminating Engineering Society of North America, NY, NY, 2000

Environmental Zone	Pre-Curfew Limitations*	Post-Curfew Limitations*
E1	1.0 (0.1)	0.0 (0)
E2	3.0 (0.3)	1.0 (0.1)
E3	8.0 (0.8)	3.0 (0.3)
E4	15.0 (1.5)	6.0 (0.6)

*Lux (footcandles) values on plane perpendicular to the line of sight to the luminaire(s).

The environmental zone classifications in the above table relate to the ambient lighting typically present in a given area as follows:

E1: Areas with intrinsically dark landscapes such as national parks
E2: Areas of low ambient brightness such as outer urban and rural residential areas
E3: Areas of medium ambient brightness such as urban residential areas
E4: Areas of high ambient brightness such as urban areas with a high level of night time activity

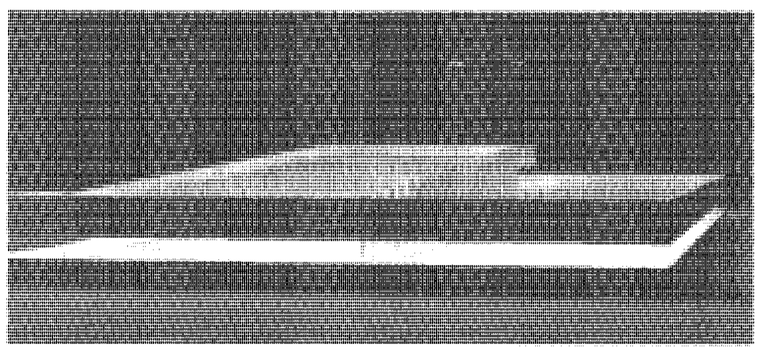
The curfew limitation indicated in Table 5 refers to the time after which activity is greatly diminished and only security lighting may be required. A curfew in the range of 10:00 to 11:00 pm is common.

The peak light output from an area luminaire is typically at approximately 65 degrees from a vertical line through the luminaire. If the mounting height of the luminaires are set such that the direct line of sight of an observer standing at the property line to the luminaire is less than 15 degrees above horizontal (equals 75 degrees from vertical), then the glare will be minimized. For light standards set a minimum of 60 feet inside the property, this recommendation results in a pole height of approximately 21 feet.

4.5. Light Trespass

Light trespass is unwanted light falling on an adjacent property. It is often referred to as spill light. Light trespass is controlled by using "cutoff" luminaires and by positioning the fixtures sufficiently inside the property and at a low enough mounting height that spill light does not occur. Cutoff luminaires by definition control the amount light above an 80-degree angle from a vertical line through the fixture to less than 10 percent of the total light output from the luminaire. A "full cutoff" luminaire also limits the amount of light above a 90-degree angle (horizontal line through the fixture) to zero.

Figure 3. Light Spill Rendering



Computer software is available to model the parking structure three-dimensionally and calculate the amount of spill light from the roof level lighting as well as from the covered level lighting. A rendering of such a calculation is illustrated in Figure 3.

4.6. Color of Light

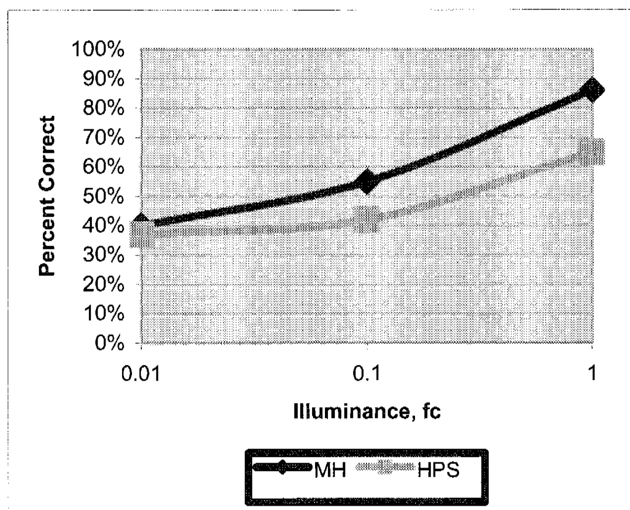
The ability to accurately identify colors is important in certain settings such as health care facilities where it is important to observe subtle changes in skin tones, or in the food industry where color discrimination is important to assessment of the quality of the product, or in the textile industry where color matching is an essential function. Color discrimination in parking facilities does not have a high degree of importance. The ability to identify one's car or identify the color-coding of floors for wayfinding is likely the most important color-related tasks in a parking structure.

Our eyes can interpret colors across most of the visible spectrum; however, we are most sensitive to light in the green-yellow portion of the visible spectrum (wave length of 550 nanometers) for foveal vision. Recent studies have shown enhanced peripheral vision under bluish-white light sources at low light levels (less than 0.1 fc). Colors are affected not only by the color of the light source, but also by the colors nearby that reflect light. Red-colored surfaces for instance reflect red light and absorb other colors.

The two indexes used to determine the color rendering properties of different light sources are the color rendering index (CRI) and correlated color temperature (CCT) in Kelvin (K). Fluorescent lamps are typically specified according to their CCT. The higher the CCT, the whiter the light. A 3000K fluorescent lamp is considered a warm lamp. A 4100K fluorescent lamp is considered a cool lamp or whiter lamp. The CRI is determined by calculating how a particular light source makes things appear compared to a reference or "ideal" source of the same CCT. The higher the CRI, the better the color rendering properties. For example, cool white fluorescent sources have a CRI of 62; standard metal halide, 65-79; high-pressure sodium, 22; and low-pressure sodium, 0. New technology fluorescent lamps now have CRI's in the range of 70 to 90. The CRI of daylight is 100.

The color naming accuracy of metal halide lamps versus high-pressure sodium lamps is illustrated in Figure 4. Note that there is no appreciable difference in color naming accuracy at very low light levels. The difference at one footcandle is small. The hue of blues and greens is more difficult to identify under HPS light sources than other colors.

Figure 4. Color Naming Accuracy



5. *Lighting Design Criteria*

The Illuminating Engineering Society of North America (www.IESNA.org) is considered the authority for setting lighting standards in the United States. The lighting standards for parking facilities are contained in their publication RP-20-1998, "Lighting for Parking Facilities". The lighting standards for parking lots and roofs of parking structures are segregated from the lighting standards for covered parking structures because of the significant difference in background lighting conditions. The dark background of outdoor facilities requires less lighting for visibility than the higher ambient lighting in concrete parking structures.

5.1. Uncovered Parking Areas

The IES recommended practice for lighting of uncovered parking facilities (surface parking lots and roofs of parking structures) is indicated in the following table:

Table 6. Recommended Maintained Illuminance for Uncovered Parking Areas

Source: Lighting for Parking Facilities, Publication RP-20-98, Illuminating Engineering Society of North America, NY, NY 1998

		Basic[1]	Enhanced Security[2]
Minimum Horizontal Illuminance[3]	Lux[4]	2	5
	Fc[2]	0.2	0.5
Uniformity Ratio, Maximum/Minimum[6]		20:1	15:1
Minimum Vertical Illuminance[7]	Lux[8]	1	2.5
	Fc[5]	0.1	0.25

[1] For typical conditions. During periods of non-use, the illuminance of certain parking facilities may be turned off or reduced to conserve energy. If reduced lighting is to be used only for the purpose of property security, it is desirable that the minimum (low point) value not be less than 1.0 horizontal lux (0.1 hfc). Reductions should not be applied to facilities subject to intermittent night use, such as at apartments, hospitals and transportation terminals.

[2] If personal security or vandalism is a likely and/or severe problem, a significant increase of the Basic level may be appropriate. Many retailers prefer even higher levels, with a specification of 10 lux (1 fc) as the minimum value.

[3] For preliminary design, an *average* value of 10 horizontal lux (1 hfc) for basic, or 25 horizontal lux (2.5 hfc) for enhanced illuminance may be calculated. The minimum points (or areas) and maximum point are then calculated and the uniformity ratio checked for compliance with the Table 1 values. *Note*: a 5:1 average-to-minimum ratio is the first step toward directing the design to achieve the maximum to minimum ratios presented in Table 1.

[4] Measured on the parking surface, without any shadowing effect from parked vehicles or trees at points of measurement.

[5] Rounded conversion of lux to footcandles.

[6] The highest horizontal illuminance point divided by the lowest horizontal illuminance point or area should not be greater than the values shown.

[7] Facial *recognition* can be made at levels as low as 2.5 lux (0.25 fc). The IESNA Security Lighting committee recommends that for facial *identification*, the minimum vertical illuminance should be 5.0 lux (0.5 fc).

[8] Measured at 1.5 meters (5.0 ft.) above parking surface at the point of lowest horizontal illuminance, excluding facing outward along boundaries.

5.2. Covered Parking Areas

The IES recommended practice for lighting of covered parking facilities is indicated in the following table:

Table 7. Recommended Maintained Illuminance for Covered Parking Areas

Source: Lighting for Parking Facilities, Publication RP-20-98, Illuminating Engineering Society of North America, NY, NY 1998

		Minimum Horizontal [2]		**Maximum/Minimum Horizontal Uniformity Ratio** [3]	**Minimum Vertical** [5]	
		Lux	**Fc** [4]		**Lux**	**Fc** [4]
Basic [1]		10	1.0	10:1	5	0.5
Ramps [6]	**Day** [7]	20	2.0	10:1	10	1.0
	Night	10	1.0	10:1	5	0.5
Entrance Areas [8]	**Day** [7]	500	50		250	25
	Night	10	1.0	10:1	5	0.5
Stairways		20	2.0		10	1.0

[1] For typical conditions. While these values are intended to address personal security issues, some retailers may increase them to further offset perceived concerns. Top levels of garages open to the sky should use the "Enhanced Security" column of Table 1 (see Section 4.1 and Section 4.3). Research has shown that, under certain conditions of limited contrast (such as concrete wheel stops on a concrete garage floor), that this level is needed to provide good visibility of the wheel stop.

[2] Measured on the parking surface, without any shadowing effect from parked vehicles or columns. For preliminary design, an *average* value of 50 horizontal lux (5 hfc) for basic (and equivalent for other conditions) may be calculated.

[3] The highest horizontal illuminance area, divided by the lowest horizontal illuminance point or area should not be greater than the ratio shown.

[4] Rounded conversion of lux to footcandles.

[5] Measured at 1.5 meters (5.0 ft.) above parking surface at the point of lowest horizontal illuminance, excluding facing outward along boundaries.

[6] Applies to clearway ramps (no adjacent parking) but not to sloping floor designs.

[7] Daylight may be considered in the design calculation.

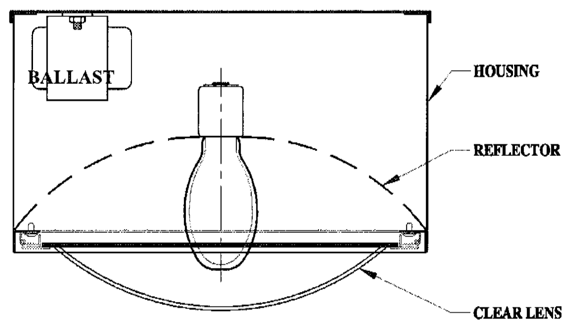
[8] A high illuminance level for about the first 20 meters (66 ft.) inside the structure is needed to effect a transition from bright daylight to a lower internal level.

6. Lighting Equipment

6.1. Luminaires

The centerpiece of the lighting system is the light fixture, or more properly called the luminaire. The luminaire consists of the housing, lens (also called refractor), reflector, lamp, lamp socket, ballast and mounting device (see Figure 5).

Figure 5. Cutoff Luminaire Section



The housing is usually made of steel or aluminum and provides the base of the luminaire for connection of all other components. In a cutoff or semi-cutoff fixture (see definition below), the housing totally covers the lamp with a transparent lens of glass or clear plastic enclosing the bottom or open end of the housing. In a non-cutoff fixture, the lamp hangs below the housing and a cylindrical lens or refractor surrounds the lamp. The lens may have prisms cut into the lens that bend the light to produce a pre-engineered pattern on the surface below the luminaire. This type of lens is called a prismatic refractor. Prismatic refractors are also used to direct the light output of the luminaire away from the driver's line of sight. This feature requires installation of the luminaire at the correct orientation to the drive lane.

The lamp inside the luminaire may be oriented vertically with the base up, or it may be oriented horizontally. The operating position of the lamp is important because the lumen output of metal halide lamps is less in the horizontal position than in the vertical position. Horizontal lamps also often result in "hot spots" directly below the luminaire and may adversely affect the uniformity of the lighting system. Vertical lamps generally result in better vertical illumination.

The luminaire may or may not have a reflector. The reflector is positioned above the lamp. The purpose of the reflector is to redirect the up light from the lamp back down to the surface under the luminaire. The reflector has an engineered shape with segmented portions bent to a particular angle to redirect light in a specific direction to enhance the light distribution under the luminaire.

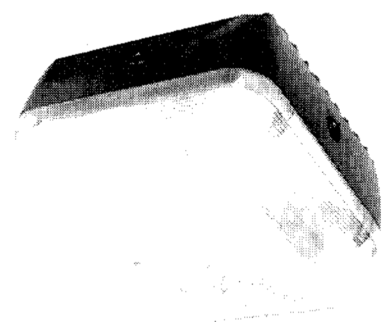
The connection of the lens to the housing not only includes the fasteners, but also includes gaskets that keep out dirt, bugs, and moisture. Parking garage luminaires should be watertight because of potential exposure to water leakage through the floors, but also to allow pressure washing of ceiling surfaces as well as the luminaires. Gaskets may be made of silicone, EPDM, EPT and a variety of other plastic/rubber compounds.

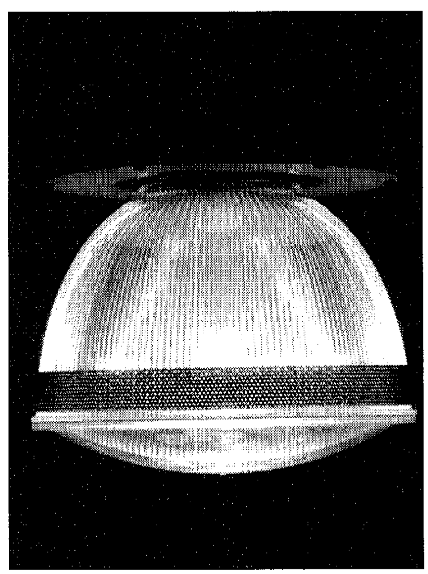
Since the lamp generates heat when it is operating, the selection of the gasket must consider the operating temperature of the luminaire and the ability of the material to retain its resiliency with heating and cooling. The quality of the luminaire construction is often determined by the quality of the gasketing. Gaskets often become brittle with age and need to be replaced.

In a covered parking structure, luminaires are typically flush-mounted to the ceiling. However, where the structural beams are at a close spacing, such as with a precast double tee parking structure (22-inch deep tee stems at a 5-foot spacing), one should mount the luminaires on a pendant hung from the ceiling. The bottom of the luminaire must be level with the bottom of the tee stems to prevent excessive blockage of light.

For uncovered parking facilities, the luminaires are mounted on steel or aluminum poles. To prevent damage of the light poles from vehicles, a 2 to 3-foot high concrete pedestal is recommended. In order to avoid light spill beyond the limits of the parking facility or property on which it is located, the light poles are typically located on the interior of the parking area. Depending on the design of the luminaire, the light spread for a minimum illuminance of 0.5 footcandles is typically approximately twice the mounting height. Therefore, a mounting height of approximately 30 feet is required to provide adequate light distribution across a 60-foot parking module. Light poles would then be spaced a maximum of 60 feet from the perimeter of the parking area with a spacing between light poles of approximately 120 to 150 feet.

Figure 6. Non-cutoff Luminaires



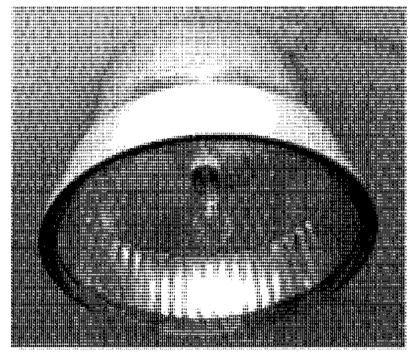


Luminaires are engineered to control the lateral and vertical light distribution with reflectors and refractors as described previously. In order to assist in luminaire selection, luminaries are classified to describe the light distribution characteristics of the luminaire. The vertical light distribution from a luminaire may be classified as cutoff, full cutoff, semi-cutoff, or non-cutoff. The classification describes the light output at certain angles above a vertical line through the luminaire. The point directly below the luminaire at zero degrees is referred to as nadir. The definitions per the Illuminating Engineering Society of North America are as follows:

Cutoff: The light output above a 90-degree angle above nadir (horizontal line through the luminaire) shall not exceed 2.5 percent of the total light output, and shall not exceed 10 percent of the total light output above a vertical angle of 80 degrees above nadir.

Full Cutoff: Same as cutoff except that the light output above a 90-degree vertical angle from nadir (horizontal line) shall be zero.

Figure 7. Semi-cutoff Luminaire

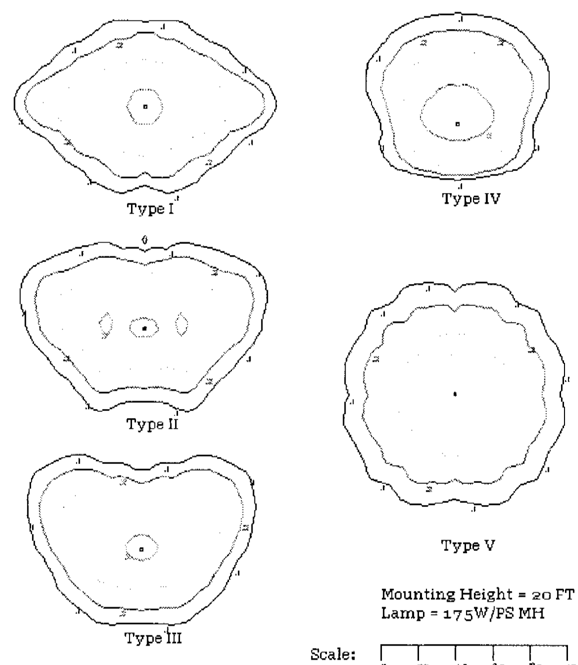


Semi-cutoff: The light output above a 90-degree vertical angle above nadir shall not exceed 5 percent, and shall not exceed 20 percent above an 80-degree vertical angle above nadir. (See Figure 7.)

Non-cutoff: No limitation on the vertical light output. (See Figure 6)

The lateral light distribution of a luminaire is classified as Type I, II, III, IV or V (see Figure 8). The classification system was derived for pole-mounted luminaires used in roadway lighting. The area forward of the luminaire is termed the "street side" while the area back of the luminaire is termed the "house side". The luminaire may contain an opaque shield on the backside to prevent light trespass, and is termed a "House-side Shield". Since the technical definition of each classification is rather complicated, a simplified description of each follows.

Figure 8. Luminaire Light Distribution Classification



A Type I lateral distribution is parallel to the street and very narrow perpendicular to the street. A Type II distribution is not as wide parallel to the street as Type I, but throws the light farther into the street. A Type III distribution is not as wide as Type II parallel to the street, but throws the light farther yet into the street.

A Type IV distribution is also termed "Forward Throw". As the name implies, light is cast much farther across the street and not very wide parallel to the street. A Type V classification is a symmetrical distribution of light all around the luminaire. The symmetrical distribution is further classified as Type VS if the light pattern is square. If the light pattern is more round, the distribution is classified Type VR.

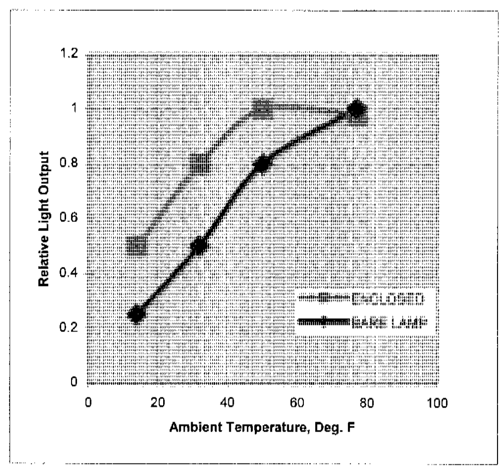
6.2. Lamps

Typical lamp types utilized in parking facility lighting consist of the following:

- Fluorescent
- High-Intensity Discharge
  - Mercury
  - High-Pressure Sodium
  - Metal Halide
  - Low-Pressure Sodium
- LED Lamps
- Induction Lamps

Fluorescent lamps consist of a long glass tube (usually 4 feet or 8 feet long) with a diameter of approximately 1 inch and pin connections at each end. The inside of the glass tube is coated with phosphors that glow when power applied to the electrodes vaporizes a small amount of mercury in the tube. Because of the mercury in the fluorescent tube, disposal of the tubes must meet environmental regulations for hazardous materials.

Figure 9. T8 Fluorescent Light Output vs. Temperature



The bulb-wall temperature of the glass tube affects the light output of the phosphors (see Figure 9). At 32 degrees Fahrenheit, the light output of a bare fluorescent lamp is reduced approximately 50 percent. If the light fixture utilizes a wrap-around lens, the lens captures heat from the lamp such that the reduction in light output at freezing is only 20 percent. Therefore, fluorescent fixtures are not preferred where the winter temperature frequently falls below freezing during normal operating hours of the parking facility. If fluorescent lamps are used where the temperature frequently falls below 40-degrees F, a wrap around lens or a jacketed lamp is recommended.

Fluorescent lamps with electronic ballasts use considerably less energy than other lamp types. A luminaire with four, T8 lamps will produce the equivalent average maintained illuminance as a 150-watt MH fixture. However, the fluorescent fixture will utilize approximately 110 lamp plus ballast watts while the metal halide fixture utilizes 190 lamp plus ballast watts, representing a savings of 42 percent in energy cost for the fluorescent fixture. Since the energy cost is typically 65 to 75 percent of the total life cycle cost of the lighting system, fluorescent lamps are by far the most economical light source in warm climates. If fluorescent fixtures are used in cold climates, a light loss factor should be included to account for the reduction in light output in cold weather.

High intensity discharge lamps consist of a small quartz or ceramic tube inside the glass enclosure that contains electric discharges of vaporized metals operating at relatively high temperatures and pressures. The light output of HID lamps is not affected by temperature, and therefore, they are an excellent light source choice for outdoor environments in cold climates. There are three main types of HID lamps: mercury, metal halide (MH), and high-pressure sodium (HPS).

Mercury lamps became widely used for roadway lighting in the 60's. Mercury vapor lamps have long life (24,000+ hours), but relatively low lumen output. The color-rendering index is also low (CRI = 15). Mercury vapor lamps have largely been replaced by metal halide or high-pressure sodium lamps.

Metal halide lamps have largely replaced mercury vapor lamps because of better color-rendering (CRI = 65) and better light output per watt of energy. Standard metal halide lamps with wattages of 150 to 250 watts have a lamp life of approximately 10,000 hours in the vertical position and 6000 hours in the horizontal position. The lumen output is approximately 67 lumens per watt in the vertical position and 58 lumens per watt in the horizontal position compared to about 40 lumens per watt for mercury lamps.

In the last five years, pulse-start metal halide lamps have largely replaced the standard metal halide lamps. Pulse-start lamps are designed to use an external starting circuit and eliminate the third starting electrode which improves lumen maintenance, color stability, lumen output and lamp life. The lumen output is increased approximately 20 percent and the lamp life is increased 50 percent to 15,000 hours for 150 to 250-watt lamps.

Metal halide lamps are prone to violent rupture if operated continuously. For this reason, an enclosed fixture is required or a shielded arc tube can be provided. Manufacturers recommend turning off metal halide lamps for 15 minutes each week to minimize violent ruptures.

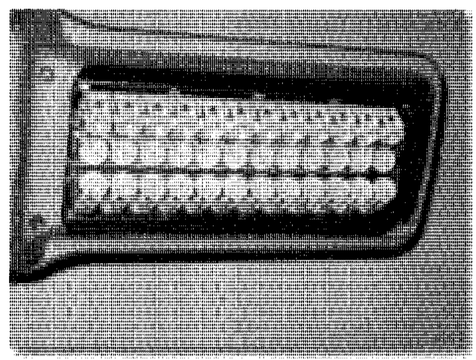
High-pressure sodium lamps are the most cost-effective light source in cold climates for parking facility lighting. The lumen output per watt is 85 or approximately 25 percent higher light output than metal halide lamps. The lamp life is 28,000 hours, or almost triple the lamp life of standard metal halide lamps, and almost double the lamp life of pulse-start metal halide lamps. HPS lamps are not sensitive to the operating position of the lamp. However, HPS lamps have a yellow-white appearance compared to the white light of metal halide lamps.

The color-rendering index of an HPS lamp is 22 compared to a CRI of 65 for metal halide lamps. Color-improved HPS lamps are available, however, the lamp life and lumen output are reduced compared to standard HPS lamps such that MH lamps then become a better choice. Studies have shown that brightness perception is higher with MH lamps than for HPS lamps. Approximately 40 percent higher light levels are required with HPS lamps to produce the equivalent brightness perception as MH lamps. In addition, recent research indicates that peripheral vision at low light levels (less than 1 footcandle) is better under MH lighting than HPS lighting. Therefore, many owners and designers are choosing MH light sources despite the additional life cycle cost.

Low-pressure sodium lamps produce a monochromatic, yellowish-orange light with very poor color rendering (CRI = 0). While they have high light output per watt and relatively long lamp life (18,000 to 20,000 hours), the poor color rendering limits their application to security lighting, roadway lighting, tunnel lighting and similar applications where color rendering and appearance are not of concern. LPS lamps are the preferred light source for outdoor lighting within the light-controlled perimeters of astronomical observatories because one can easily filter out the narrow-band color to result in enhanced telescope images.

Light-emitting diodes (LED) are solid-state electronic devices that generate light via the transformation of electric energy to radiant energy within the crystalline structure of a semi-conductor material. LED's are physically small (the light-emitting element or "chip" is a fraction of a millimeter in size) and they are packaged like other solid-state devices in small plastic enclosures. LEDs operate on low-voltage direct current. The lamp life of LEDs is extremely high, in the range of 50,000 to 100,000 hours. However, the light output is rather low at approximately 20 lumens per watt.

Figure 10. LED Luminaire



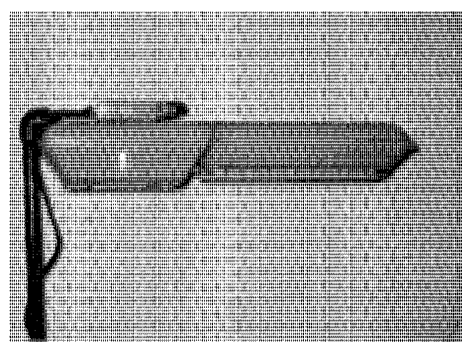
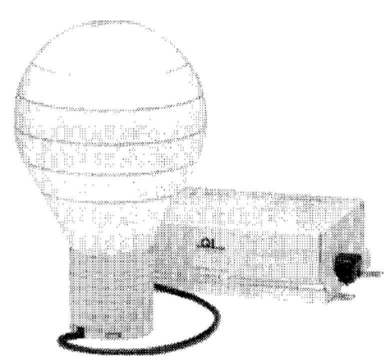


Figure 11. Philips QL Induction Lamp



The LED luminaire illustrated in Figure 10 consists of 36 super-bright LEDs producing 900 lumens using 55 watts of power. Because of the low lumen output, their use has typically been for tunnel lighting and security lighting.

Induction lamps are relatively new technology that provide very long lamp life (rated life of 100,000 hours or approximately 25 years if operated only at night). Induction lamps are electrode-less fluorescent lamps, although they are not shaped like a typical fluorescent lamp (see Figure 11). Current passing through an induction coil generates a magnetic field, which excites mercury atoms in the glass fill of the bulb. The ionized mercury emits ultraviolet radiation. When struck by UV radiation, fluorescent phosphors coating the inside of the glass bulb emit light. The initial light output of a 165-watt QL induction lamp is approximately 12,000 lumens. Comparative initial light output for a 150-watt MH lamp is 15,000 lumens. However, the lumen depreciation at the end of the long lamp life results in very low light levels. Approximately 50% more induction lamp fixtures are required to produce the same maintained illuminance as 150-watt MH fixtures.

6.3. Ballasts

Fluorescent lamps and high-intensity discharge lamps require a ballast to start and operate the lamp. Old ballast technology consisted of electromagnetic core and coil ballasts. Newer technology consists of solid-state, high frequency electronic ballasts, which were first developed for fluorescent lighting systems. High-frequency electronic ballasts are more energy-efficient than magnetic ballasts resulting in a 30-40 percent reduction in power consumption without the loss of light output. One ballast can operate several fluorescent lamps. Electronic ballasts are also increasingly used for HID lamps, which improve lamp performance over the life of the lamp. However, HID lamps do not become significantly more efficient when operated at high frequency power, so electronic HID ballasts typically operate at the usual 60 Hz. The power consumed by the ballast must be added to the lamp watts to determine the total power consumed by the luminaire.

7. Energy Conservation

Lighting accounts for 19 percent of energy used in the United States according to the Department of Energy. However, energy used for lighting could be reduced dramatically if more efficient products were used. Further, electric utility costs are the second highest expense behind labor costs for a cashiered parking facility, and the highest expense for a non-cashiered parking facility.

The National Energy Policy Act of 1992 (EPACT) set new lighting efficiency standards that were effective on October 31, 1995. EPACT also mandated compliance of all Federal projects with the ASHRAE/IESNA Standard 90.1 and encourages all states to adopt this energy standard. The current edition is 2001. These standards are also included in the 2003 International Energy Conservation Code. One can review the status of adoption of energy legislation by various states at www.bcap.energy.org. ASHRAE/IESNA 90.1-2001 limits the lighting power density of parking structures to 0.3 watts per sf. This criterion effectively creates an upper limit on the maintained average illuminance for parking structure lighting of approximately 10 footcandles for HID lamps and 12 footcandles for fluorescent lamps.

There are many effective ways to minimize electric utility costs for the lighting system. Lights can be circuited by level to turn off the lights on those parking levels that are not utilized after hours or during periods of low utilization. Automatic controls can be utilized such as astronomic timers to turn lights on or off at certain times of the day, or photocells to turn lights on at night or off during the day. One can also control luminaires to turn off when adequate daylight infiltration exists in the parking facility. Computer software is available to calculate the amount of daylight infiltration that will be available on cloudy, partly cloudy or sunny day at different times of the year. Figure 12 illustrates daylight infiltration for a three-bay wide parking structure on a sunny day in Boston at noon in June.

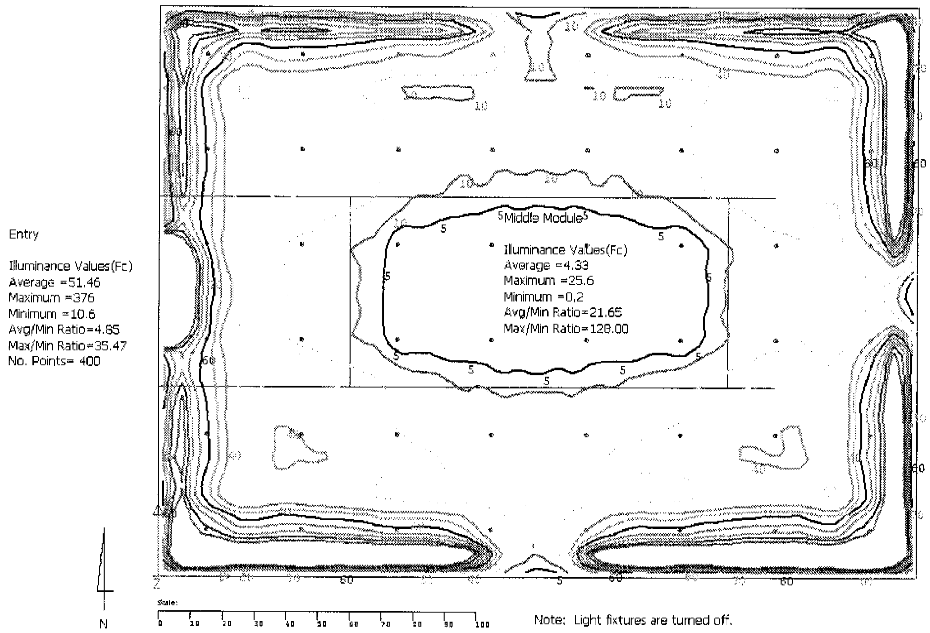
The illuminance within 30 feet of a perimeter wall opening from daylight infiltration only is over 30 footcandles. Therefore, luminaires within that zone can typically be turned off during the day. Even a cloudy day will have adequate daylight infiltration within 30 feet of the perimeter wall. The illuminance from daylight infiltration at 30 to 60 feet from a perimeter wall opening is over 5 footcandles on a sunny day. One can install an adjustable photocell on an interior column at approximately 60 feet from an exterior wall that controls the lights in the zone from 30 to 60 feet from a perimeter opening to turn off when adequate daylight infiltration exists. Luminaires that are more than 60 feet from a perimeter wall opening should be on during normal operating hours.

Dimming the light fixtures during periods of inactivity is also a method for reducing energy cost. The lamps are dimmed by reducing the voltage to the fixture with a transducer. For HID lamps, the light output is reduced at a greater proportion than the voltage reduction. Therefore, dimming below 50 percent is not recommended. In addition, one can install occupancy sensors that automatically detect someone in the parking structure and restore the lamps to full power.

Figure 12. Iso-footcandle Contours of Daylight Infiltration in a Parking Structure

Daylight Only Calculations
Boston, MA
June 23, 2003
Noon

Numeric Summary							
Project: All Projects							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Typical_Floor	Illuminance	Fc	37.23	376	0.2	186.15	1881
Outside Entry	Illuminance	Fc	9625	9625	9624	1.00	1.00



8. *Maintenance Considerations*

8.1. General

Lighting maintenance consists of cleaning the luminaires, replacing expired lamps, replacing worn out gaskets, and replacing failed ballasts. Luminaires accumulate dirt and bugs over time, which reduces light output. Luminaires are typically cleaned when the lamp is replaced. The life of the luminaire is approximately 25 years, which is approximately the time that gaskets become brittle and the ballasts are failing regularly. At that time, it is generally more economical to replace the luminaires than repair the luminaires. The maintenance cost is approximately 5 to 15 percent of the total life cycle cost of the lighting system and primarily is a function of the lamp life.

The rated life of a lamp is determined by testing a large sample of lamps. The rated life is the number of operating hours at which 50 percent of the lamps have expired. However, 50 percent of the lamps survive beyond the rated life and the light output continues to depreciate.

To maintain the illuminance at or above industry standards, owners should measure the illuminance on the floor directly below the luminaire on an annual or semi-annual basis, and replace the lamp if the illuminance falls below a certain pre-determined value based on the illuminance calculations.

In calculating illuminance, it is the designer's responsibility to anticipate factors that reduce light output and to compensate for them. Usually this means providing higher light levels with the initial installation so that when normal age and dirt conditions occur, the lighting system will still provide adequate lighting for the users of the space. The illuminance just prior to fixture cleaning and lamp replacement is referred to as the maintained illuminance. The designer must then include light loss factors (LLF) in the calculation that when applied to the initial illuminance results in maintained illuminance that meets minimum industry standards.

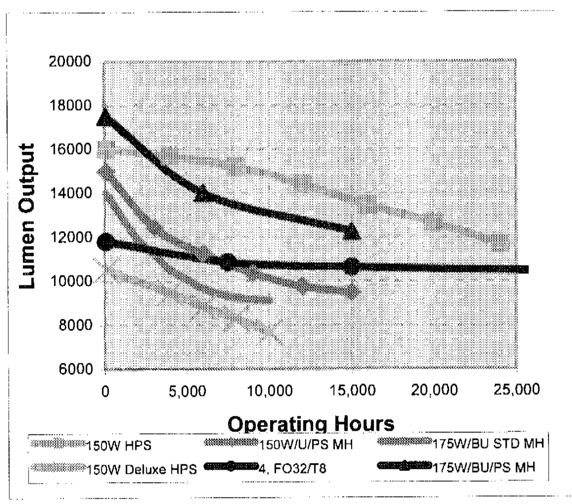
8.2. Light Loss Factors

The light loss factor is a ratio of the relative light output to the initial light output of a luminaire. A light loss factor of 0.9 represents a relative light output of 90% or a light loss of 10%. Light loss factors (LLF) consist of the following:

Lamp Lumen Depreciation (LLD)
Luminaire Dirt Depreciation (LDD)
Ballast Factors (BF)
Temperature Factors (TF)
Equipment Factors (EF)

The above light loss factors are multiplied together to determine the total light loss factor to utilize in the illuminance calculations.

Figure 13. Lamp Lumen Depreciation



8.2.1. Lamp Lumen Depreciation

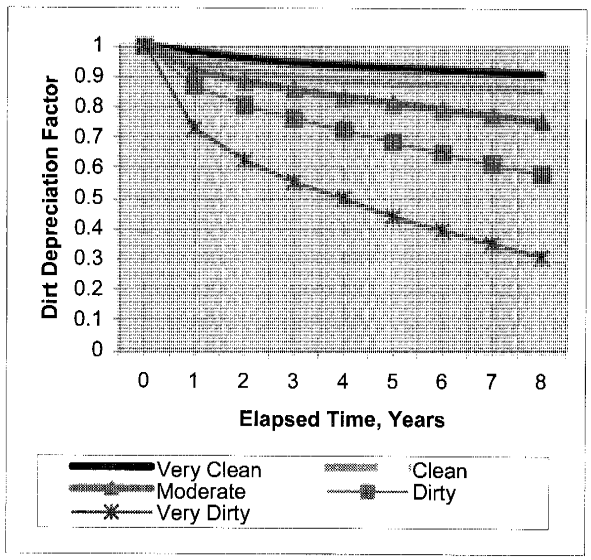
All lamps lose light output with age. This phenomenon is known as lamp lumen depreciation. Manufacturers publish graphs of relative light output versus operating hours. This graph is called the lumen maintenance curve. When calculating the illuminance, one needs to include a light loss factor that represents the relative light output at the time the lamp is replaced. If the lamps are not replaced prior to when they expire, then the end of life lumen depreciation should be used. The lumen depreciation versus operating hours for different lamps is illustrated in Figure 13. The end of each line is the rated life of the lamp.

8.2.2. Luminaire Dirt Depreciation

Luminaires often accumulate dirt and bugs over time, particularly if the gasketing of the luminaire is of poor quality or poor design. It is common that the inside of the luminaire is not cleaned unless an expired lamp is replaced. The lighting designer must then include a light loss factor for dirt depreciation. The IES publication DG-4, *Roadway Lighting Maintenance*, contains recommended luminaire dirt depreciation (LDD) factors as illustrated in Figure 14. The environmental classifications are based on the particulate matter in the air as follows:

Very Clean – No nearby smoke or dust generating activities and a low ambient containment level. Light traffic. Generally limited to residential or rural areas. The ambient particulate level is no more than 150 micrograms per cubic meter.

Figure 14. Luminaire Dirt Depreciation



Clean - No nearby smoke or dust generating activities. Moderate to heavy traffic. The ambient particulate matter is no more than 300 micrograms per cubic meter.

Moderate – Moderate smoke or dust generating activities nearby. The ambient particulate level is no more than 600 micrograms per cubic meter.

Dirty – Smoke or dust plumes generating by nearby activities may occasionally envelope the luminaires.

Very Dirty – As above but the luminaires are commonly enveloped by smoke or dust plumes.

Most parking structures would fall in the clean to moderate category.

The elapsed time in years for a particular lamp to expire is determined by dividing the rated life of the lamp by the number of lamp operating hours per year. If the luminaire is operated 24 hours per day all year, the annual operating hours is 8,760 hours.

A 150-watt pulse-start metal halide lamp has a rated life of 15,000 hours or approximately 1.7 years for continuous operation. The luminaire dirt depreciation factor from Figure 14 for a moderately clean environment is then approximately 0.90. A 150-watt HPS lamp has a rated life of 28,000 hours or approximately 3.2 years for continuous operation. The luminaire dirt depreciation factor for an HPS lamp is then approximately 0.86. A T8 fluorescent lamp operated continuously has a lamp life of 30,000 hours or 3.4 years if operated continuously. The LDD for a fluorescent lamp is 0.85.

8.2.3. Ballast Factors

The light output of the lamp also depends on the ballast characteristics. The ballast must be compatible with the type of lamp that is used. Manufacturers publish the light loss factor for each particular ballast. For HID lamps, the ballast factor (BF) is typically close to one. For fluorescent lamps, there are a whole array of different ballasts that result in different light output characteristics. Typically the ballast factor for T8 fluorescent lamps with a high-frequency electronic ballast will be approximately 0.9. Some electronic ballasts actually increase the light output and will have a ballast factor greater than one.

8.2.4. Temperature Factors

HID lamps are not affected by ambient temperature conditions. Therefore, the temperature factor (TF) for HID lamps is one. The light output of fluorescent lamps is affected by temperature as illustrated previously in Figure 9. The lighting designer should use the light loss factor for temperature indicated in Table 8 for fluorescent lamps at the indicated ambient temperature conditions anticipated during normal operating hours.

Table 8. Light Loss Factor Due to Temperature for T8 Lamps

AMBIENT C	TEMP F	BARE LAMP	ENCLOSED FIXTURE
-10	14	0.25	0.5
0	32	0.5	0.8
10	50	0.8	1
25	77	1	0.98

8.2.5. Equipment Factors

The actual illuminance measured in the field may deviate from the theoretical calculations due to normal tolerances or imperfections in the manufacture of the luminaire. In addition, there is variation in the lumen output within the same lamp type and wattage. These factors are accounted for in this category called equipment factors (EF). GE Lighting actually recommends a design factor for metal halide lamps due to manufacturing variations of 0.8.

Based upon field measurements of illuminance for different lamp types, the following equipment factors are recommended:

150-200W/PS Metal Halide	0.8
150W HPS	0.9
32W, T8 Fluorescent	1.0

8.2.6. Total Light Loss Factor

The total light loss factors for the most popular lamps in parking facilities are indicated in Table 9.

Table 9. Total Light Loss Factors

Lamp	LLD	LDD	BF	TF	EF	LLF
150-400W/PS MH	0.65	0.90	1.00	1.00	0.80	0.47
150W-400W HPS	0.73	0.86	1.00	1.00	0.90	0.57
32W, T8 Fluorescent	0.90	0.85	0.88	0.80	1.00	0.54

The most common mistake in illuminance calculations is utilization of the incorrect light loss factor. Parking facility designers and owners should review the computer calculations of illuminance to make sure that the light loss factor is indicated in the calculations and that it conforms to Table 9.

8.3. Maintenance Log

Maintaining a log of lighting maintenance for each luminaire is very important in order to provide documentation that the lighting system has been maintained properly in the event of a personal injury claim where poor lighting or poor lighting maintenance is alleged to be a contributing factor in the incident. In addition, it is very important to measure the illuminance under the luminaire periodically to determine that the design light output is maintained. Maintenance staff should also document those measurements. The illuminance just prior to lamp replacement and fixture cleaning is referred to as the *maintained* illuminance.

9. Lighting Applications

This section will provide examples of typical luminaire configurations for parking structures and parking lots, provide a graph of maintained horizontal illuminance on the pavement versus luminaire spacing for different lamp types and wattages, and discuss how to perform lighting measurements.

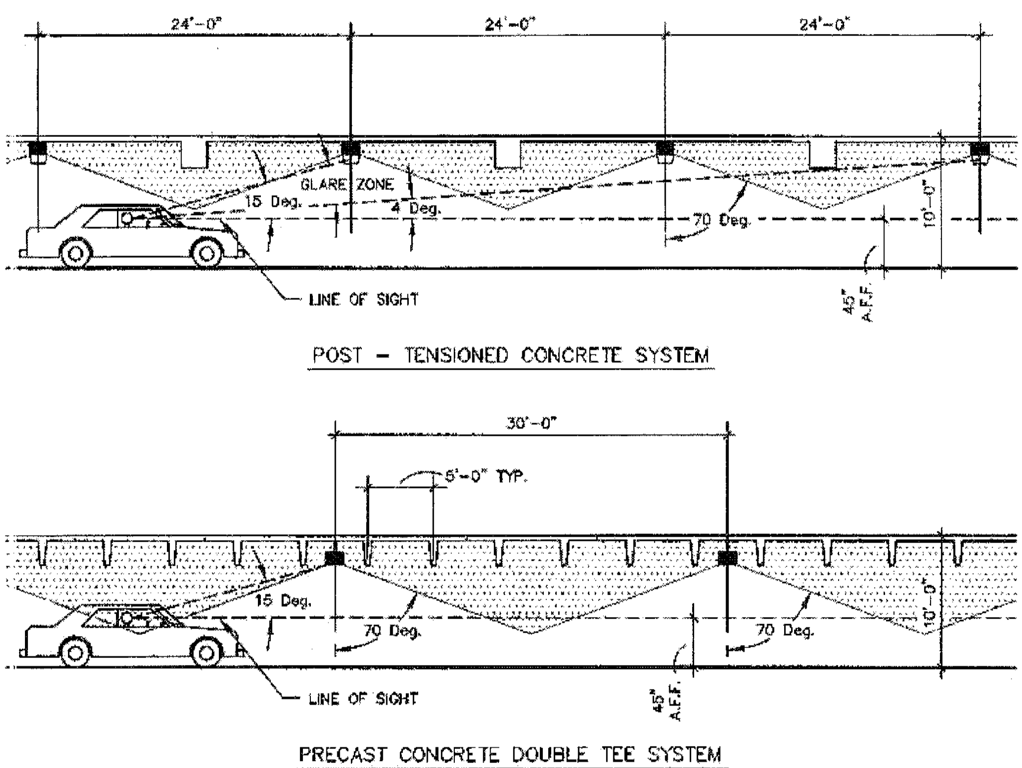
9.1. Luminaire Configurations

9.1.1. Covered Parking Areas

Luminaire configurations in covered parking structures depend on the configuration of the structural beams and columns. Luminaires are typically centered between beams and the fixture spacing is then modular with the beam spacing (see Figure 15). Precast concrete parking structures have double tee stems at a 5 to 6-foot spacing. Post-tensioned concrete parking structures typically use an 18 to 24-foot beam spacing.

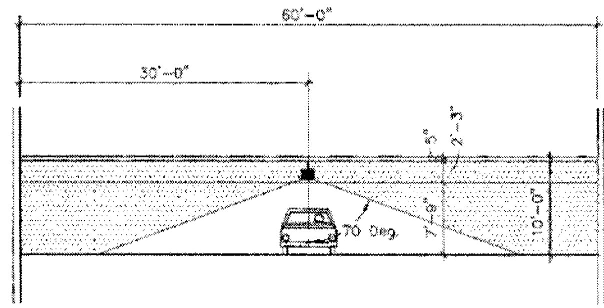
The luminaire mounting height is a function of the floor-to-floor height of the parking structure. A typical parking structure floor height is 10 feet. The floor thickness for a post-tensioned structural floor is typically 5 to 6 inches resulting in a 9'6" ceiling clearance. Luminaires are typically on the order of 12 to 13 inches high. Therefore, the luminaire mounting height to the bottom of the fixture is approximately 8'6" for a post-tensioned garage. In a precast concrete garage, the luminaires should be mounted level with the bottom of the tee stems. The double tees are typically 24 inches deep with 3 inches of concrete topping. The clearance to the bottom of the tee stems is then approximately 7'9" for a ten-foot floor height.

Figure 15. Structural System Impact on Luminaire Configuration



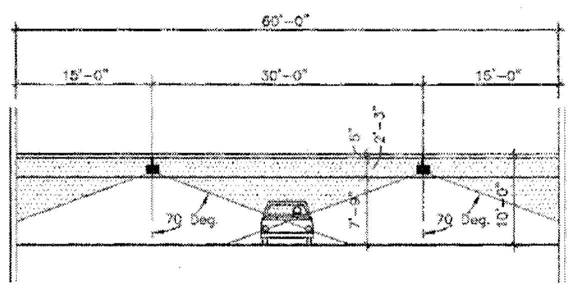
The luminaire spacing is also a function of the lamp wattage. Larger lamp wattage results in larger luminaire spacing. Larger luminaire spacing results in fewer luminaires and consequently less cost. However, because of glare considerations as well as physical limitations on light spread at low mounting height, lamp wattages for covered parking facility lighting are limited to a maximum of 150 to 200 watts.

Figure 16. Single Row Luminaire Configuration



Illuminance calculations indicate that minimum IES standards are achieved for 150-watt MH or HPS lamps when the floor area per fixture is approximately 1000 square feet per fixture. Parking modules are typically 52 to 62 feet wide. If a single row of luminaires is located down the drive aisle centerline (see Figure 16), then the longitudinal fixture spacing along the drive aisle centerline must be approximately 16 to 19 feet. If two rows of fixtures are provided (see Figure 17) that illuminate each half of the parking module (i.e. transverse fixture spacing of approximately 30 feet), then the longitudinal fixture spacing of each row should be 32 to 38 feet. A common fixture grid in a covered parking facility is approximately 30-ft by 30-ft for precast concrete garages, and 30 by 36 feet for post-tensioned concrete garages with an 18-ft beam spacing.

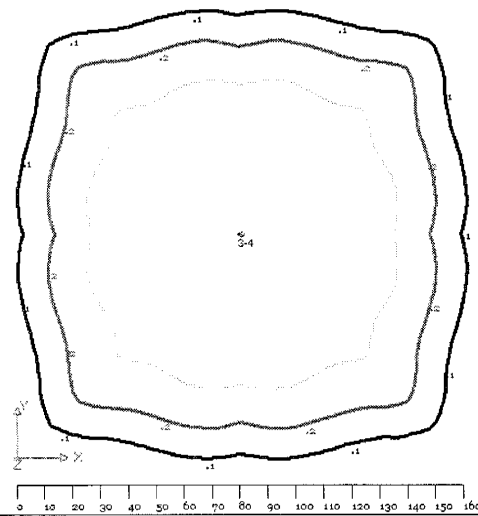
Figure 17. Double Row Luminaire Configuration



9.1.2. Uncovered Parking Areas

In order to minimize glare and light trespass, this section assumes that all pole lights are mounted to the interior of the surface parking lot, or on the interior columns of the roof of a multi-level parking structure. The fixture configuration in an uncovered parking area then depends upon the lamp wattage, light distribution pattern and mounting height. Figure 18 indicates an iso-footcandle plot for a Lithonia KVE luminaire with a 400-watt metal halide vertical lamp at a mounting height of 20 feet. To achieve a minimum illuminance of 0.2 footcandles at the perimeter of a parking lot, one must locate the fixture within 70 feet of the perimeter curb or corner (see Table 10). For a minimum illuminance of 0.2 footcandles between two fixtures, each fixture contributes half the illuminance, or 0.1 footcandles. The distance from the fixture to the 0.1-footcandle contour is 80 feet. The total distance between fixtures is then 160 feet.

Figure 18. Pole Fixture Isoline Plot



Luminaire Schedule						
Project: All Projects						
Symbol	Qty	Label	Arrangement	Lumens	LLF	Description
	1	Single 400	SINGLE	44000	0.526	Lithonia KVE 400W/PS MH Type V

For a minimum illuminance of 0.5 footcandles, the maximum distance to the perimeter is 55 feet, and the maximum interior spacing is approximately 135 feet. If the width of the parking module is 60 feet, then a higher mounting height or higher wattage lamp will be required to achieve a minimum of 0.5 footcandles at the perimeter of the parking area with the pole located on the first interior bumper line.

Note that the maximum illuminance for this 400-watt metal halide fixture at a 20-foot mounting height is 3.4 footcandles. The uniformity ratio will then be 17 for a minimum illuminance of 0.2 footcandles, which barely meets the IES standard of less than 20:1. If two, 400-watt fixtures were used on one pole at a 20-ft mounting height; the maximum illuminance at nadir (i.e. on the pavement directly below the fixture) is 6.9 footcandles, which requires a minimum illuminance of 0.35 footcandles in order not to exceed the uniformity criteria. This fixture has a vertical lamp. A comparable fixture with a horizontal lamp will have a higher maximum illuminance, and will require higher minimum illuminance and closer pole spacing to meet the uniformity criteria.

Table 10. Pole Light Spacing vs Illuminance

Distance (feet) from Luminaire to Iso-footcandle Contour

Mounting Height =	20 ft			
Nadir Illuminance =	2.0	4.0	3.4	6.9
Iso-footcandle Contour	Single 250W MH	Double 250W MH	Single 400W MH	Double 400W MH
0.1	72	82	80	92
0.2	61	72	70	80
0.5	46	57	55	65
1.0	23	46	44	56

Mounting Height =	30 ft			
Nadir Illuminance =	0.9	1.8	1.6	3.2
Iso-footcandle Contour	Single 250W MH	Double 250W MH	Single 400W MH	Double 400W MH
0.1	88	105	80	118
0.2	71	88	86	100
0.5	28	66	44	80
1.0	NA	47	27	63

9.2. Illuminance Calculations

Figure 19. Average Maintained Illuminance on Pavement

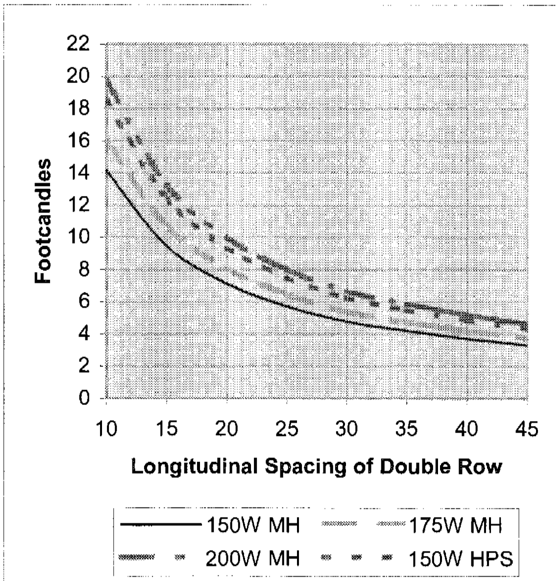
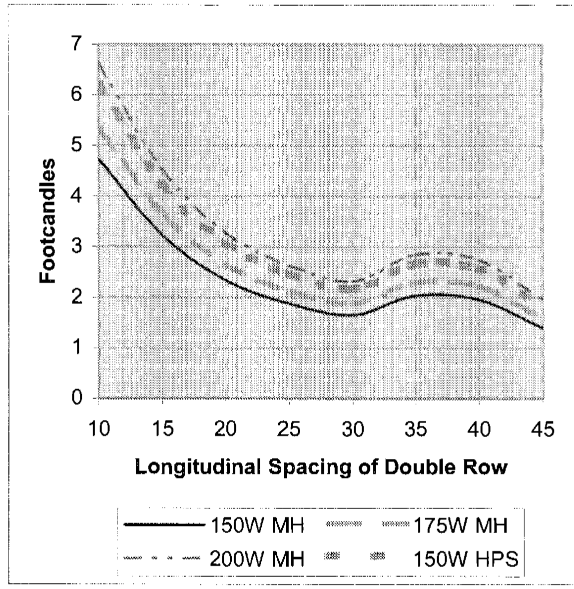


Figure 20. Minimum Maintained Illuminance on Pavement



Illuminance calculations have been performed for a typical parking structure lighting configuration consisting of a 60-foot wide parking module by 300-ft long with a double row of light fixtures. Each row of light fixtures is located at the quarter points of the parking module (i.e. 15 feet from the bumper line of the stalls or 15 feet to each side of the drive aisle centerline). The lateral fixture spacing across the drive aisle is then 30 feet. The mounting height is 8.5 feet. An unpainted, flat ceiling is assumed at 9.5 feet above the floor (reflectance equals 35%). The floor reflectance is assumed at 20%. Calculations are performed for a grid of points at 2.5 feet in each direction.

The calculations are an average of the results from three different light fixtures consisting of a Lithonia PGR, Kim PGL4, and Gardco Quadra GP1. Four lamp types were considered consisting of 150-watt, 175-watt, and 200-watt pulse-start metal halide (MH), and 150-watt high-pressure sodium (HPS). The light loss factors utilized in the calculations are per Table 9. The results of the calculations for average maintained illuminance on the pavement are illustrated in Figure 19. The results of the calculations for minimum illuminance on the pavement are illustrated in Figure 20.

Prior to adoption of the 1998 edition of the IES RP20, *Lighting for Parking Facilities*, an average maintained illuminance of at least 5 footcandles was the standard. Although the standard was changed to a minimum of 1 footcandle anywhere on the pavement in the 1998 edition, most parking facility lighting designs still target an average maintained illuminance of at least 5 footcandles. The maximum longitudinal fixture spacing to achieve a maintained average illuminance of 5 footcandles for each lamp type is indicated in Table 11 for an 8.5 foot mounting height, 9.5-foot ceiling height, and 60-ft wide parking module.

Table 11. Maximum Longitudinal Spacing by Lamp Type

Lamp Type	Spacing
150W/PS MH	28.9 ft
175W/PS MH	32.8 ft
200W/PS MH	41.6 ft
150W HPS	38.8 ft

Note: Lateral spacing equals 30 ft.

9.3. Illuminance Measurements

The procedure for illuminance measurements is specified in publication LM-64-01, *IESNA Guide for the Photometric Measurement of Parking Areas*. To determine compliance with the IES standard for minimum horizontal illuminance, one only needs to measure the darkest areas on the floor in the parking facility, which must meet a minimum of one footcandle. The IES standard also specifies a maximum uniformity ratio of 10 for the maximum illuminance divided by the minimum illuminance. Therefore, one also needs to determine the maximum horizontal illuminance on the floor. The maximum illuminance typically occurs directly underneath the luminaire. Since there will be some variation in light output between luminaires, it is suggested that one measure the illuminance under at least 10% of the luminaires.

Determining compliance to the IES standards for vertical illuminance is more complex. The vertical illuminance must be measured with the light meter facing sideways at a height of five feet in all four compass directions (North, South, East and West) at each location. Although the minimum horizontal illuminance occurs approximately halfway between fixtures, the minimum vertical illuminance with the light meter facing a luminaire occurs at the farthest distance from the luminaire just prior to passing under the next adjacent luminaire. Typically, the minimum horizontal illuminance will occur in a corner or along a perimeter wall, halfway between fixtures. The minimum vertical illuminance will be near a luminaire.

If one desires to determine the average horizontal illuminance, one needs to layout a uniform grid of points in a typical area containing at least two luminaires. For instance, if the fixture spacing is 30 feet by 30 feet, the measurement area should be at least 30 feet by 60 feet, with the border of the measurement area half way between fixtures. The test area must also include a perimeter wall along at least one of the borders. Several representative test areas at the interior and exterior of the parking facility should be measured with at least one area in a corner.

The maximum point spacing should approximate half to two-thirds of the mounting height of the luminaires (i.e. 4.5 to 6-ft spacing for an 9-ft mounting height). Measurements should be taken at least 1 foot away from walls. The grid should be configured so that one of the grid points is directly underneath the luminaire. Computer calculations with lighting software should be similarly configured, although it is recommended that the calculations include grid points over the entire floor area. Further, the lighting software should have the capability to model beam and wall obstructions.

10. Lighting System Economics

There are many lamp types and fixture manufacturers to choose from for your lighting system. In order to compare alternatives, the designer should evaluate each system based upon its life cycle cost at equivalent illuminance.

The useful life of the luminaires is approximately 25 years as that is the point at which gaskets become brittle and are no longer effective at sealing the luminaire. In addition, ballasts begin to fail on a regular basis. Plastic lenses gradually yellow with age and may need to be replaced. At this point, it is about as cost effective to replace the luminaire rather than retrofit the luminaire with new ballasts, gaskets, and lenses.

The total life cycle cost consists of the initial cost or construction cost of the lighting system, the maintenance cost, and operating cost.

10.1. Initial Cost

The initial cost of the lighting system consists of the luminaire, wiring, conduit, and electrical service (transformers, switch gear, and distribution panels). This cost is typically in the range of $1.25 to $1.75 per sf (2004 dollars) for an average maintained illuminance of approximately 5 footcandles. The cost is proportionately higher for higher illuminance (i.e. $2.50 to $3.50 per sf for an average maintained illuminance of 10 footcandles). The luminaire cost is approximately $175 to $225 for an HID luminaire typically used in covered parking facilities, and approximately $125 to $175 for an 8-ft long fluorescent fixture with four, T8 lamps and electronic ballast. The initial cost is typically less than 15 to 20 percent of the total life cycle cost. Therefore, it is not cost-effective to use a low quality luminaire.

10.2. Maintenance Cost

The maintenance cost consists primarily of replacement of expired lamps and fixture cleaning. Fixtures are usually cleaned at the time the lamps are replaced. Ballasts and gaskets may need replacement on a limited basis for the first 25 years depending on the number of operating hours annually. The number of lamps replaced annually is prorated based on the life of the lamp compared to the number of annual operating hours. For a lamp life of 15,000 hours (pulse-start, MH lamps) and 24-hour per day operation (8,760 hours per year), fifty percent of the lamps will expire in 1.7 years (Note that the rated life of the lamp is the number of operating hours at which 50% of a large population of lamps have failed). The annual maintenance cost is then based upon replacing 29 percent of the lamps annually (50% divided by 1.7 years). For a 28,000-hour life (HPS lamps) and 24-hour operation, the maintenance cost is based upon replacing 16 percent of the lamps annually. One then determines the number of hours to replace one lamp in a luminaire and multiplies the replacement time times the hourly labor cost for the personnel to replace the lamp and clean the fixture. The cost of the lamp is then added to the labor cost to determine the maintenance cost for one fixture and then multiplied times the number of lamps replaced annually to determine the annual maintenance cost. The annual maintenance cost is typically in the range of 5 to 15 percent of the total life cycle cost.

10.3. Operating Cost

The annual operating cost consists of the electric utility cost to operate the luminaires. The total power consumed by a luminaire is the lamp watts plus the ballast watts, which is approximately 190 watts for a 150-watt lamp. One then multiplies the total wattage of each luminaire times the number of operating hours annually (8,760 hours for 24/7 operation) times the number of luminaires times the operating cost per kilowatt-hour (kWh). The operating cost per kWh ranges from approximately $0.06 to $0.12 across the United States and averages approximately $0.08 per kWh. The operating cost is approximately 65 to 75 percent of the total life cycle cost. Therefore, the efficiency of the lighting layout and efficiency of the luminaire in producing the best light distribution for the required illuminance will determine the best lighting system.

10.4. Life Cycle Cost

An example calculation of life cycle cost for a 3900-car garage in Las Vegas is provided in Table 12. This table compares three lighting systems: (A) an 8-ft long fluorescent fixture with four, T8 lamps, (B) a Kim PGL4 fixture with a 150-watt, pulse-start metal halide lamp, and (C) a Kim PGL4 fixture with a 165-watt induction lamp. Each of these three systems is evaluated for two different lighting configurations. Configuration #1 consists of a double row of fixtures with a longitudinal spacing of 36 feet and a lateral spacing of 30.5 feet. Configuration #2 consists of three rows of fixtures in each 61-ft parking module at a lateral spacing of 20.33 feet and longitudinal spacing of 36 feet. The center row is at the drive aisle centerline and is staggered 18 feet longitudinally with respect to the rows on either side of the drive aisle centerline.

The average maintained horizontal illuminance on the pavement for the fluorescent and metal halide fixtures in configuration #1 are equivalent (Options 1A and 1B). However, the induction lamps require 50 percent more fixtures to achieve equivalent illuminance (Option #2C).

The annual life cycle cost (LCC) for the fluorescent lighting system is $0.18 per sf compared to $0.28 per sf for the metal halide lighting system, and $0.35 per sf for the induction lighting system. The LCC for the fluorescent lighting system is 36 percent less than the pulse-start metal halide lighting system and 49 percent less than the induction lighting system.

Table 12. Life Cycle Cost Comparison of Parking Facility Lighting Systems

Lighting System Information						
System ID	Option #1A	Option #1B	Option #1C	Option #2A	Option #2B	Option #2C
Lamp	4, T8 Fluor	150W MH	165W QL	4, T8 Fluor	150W MH	165W QL
Longitudinal Spacing, ft	36	36	36	36	36	36
Lateral Spacing, ft	30.5	30.5	30.5	20.33	20.33	20.33
Ceiling Height, ft	11.083	11.083	11.083	11.083	11.083	11.083
Mounting Height, ft	10.75	10.00	10.00	10.75	10.00	10.00
Covered Floor Area, sf	939,754	939,754	939,754	939,754	939,754	939,754
Number of Luminaires	900	900	900	1350	1350	1350
Area/Luminaire, sf	1044	1044	1044	696	696	696
Lamp Burnouts/Year	526	263	39	788	394	59
Illuminance Calculations						
Horizontal Illuminance on Pavement						
Average	5.9	5.9	3.9	8.6	8.8	5.1
Maximum	3.9	9.5	7.0	14.9	12.8	8.3
Minimum	2.2	3.3	2.0	4.5	5.2	2.8
Avg/Min Ratio	2.7	1.8	2.0	1.9	1.7	1.8
Max/Min Ratio	1.8	2.9	3.5	3.3	2.5	3.0
Total Life Cycle Cost:						
Operating Cost	$2,872,278	$4,704,593	$4,085,568	$4,308,417	$7,056,890	$6,128,352
Maintenance Costs	$744,074	$854,659	$290,562	$1,114,698	$1,280,366	$439,559
Initial Cost	$711,500	$1,079,500	$1,155,000	$1,067,250	$1,619,250	$1,732,500
Total Life Cycle Cost	$4,327,852	$6,638,753	$5,531,130	$6,490,365	$9,956,506	$8,300,411
Amortized Annual Cost	$173,114	$265,550	$221,245	$259,615	$398,260	$332,016
Annual LCC per SF	$0.18	$0.28	$0.24	$0.28	$0.42	$0.35
Operating Cost	66%	71%	74%	66%	71%	74%
Maintenance	17%	13%	5%	17%	13%	5%
Initial Cost	16%	16%	21%	16%	16%	21%

11. Code Requirements

Code requirements for lighting generally consist of energy codes and building construction codes.

11.1. Energy Codes

There is a wide variety of energy codes and standards. These range from national model energy codes, which must be adopted by a state or local jurisdiction to have the force of law, to locally developed and adopted standards. There are three national model energy codes that are widely used by states and local jurisdictions. These are the ASHRAE/IESNA 90.1-1999, its older edition 90.1-1989, and the International Energy Conservation Code (IECC) by the International Code Council. The IECC adopts the ASHRAE/IESNA Standard 90.1 by reference. The IECC is also adopted by reference in Chapter 13 of the International Building Code 2003. Some states publish their own energy codes such as California, Washington, Oregon, Minnesota, and Florida.

11.2. Building Codes

The predominant building code in the United States is the International Building Code 2003 (IBC 2003). There are no building code provisions for general area lighting of parking facilities. Some municipalities will have specific zoning ordinance requirements for lighting of parking facilities and surface parking lots or may adopt the IESNA publication RP-20-1998 by reference. However, there are code provisions for Means of Egress Illumination in Section 1006 of the IBC 2003. Section 1006.2 states that the means of egress illumination level shall not be less than 1 footcandle (11 lux) at the floor level. This requirement is consistent with the general parking area requirement of IESNA publication RP-20-98 for a minimum illuminance of 1 footcandle in a covered parking facility. There is also a requirement for emergency lighting along the means of egress. Section 1006.4 requires that the emergency lighting system be arranged to provide for an average of at least 1 footcandle initial illumination and a minimum of 0.1 footcandles measured along the path of egress at floor level. Illumination levels shall be permitted to decline to 0.6 footcandles average and a minimum of 0.06 footcandles at the end of the emergency lighting time duration of 90 minutes. A maximum to minimum illumination uniformity ratio of 40 to 1 shall not be exceeded. Section 1011.5.2 requires that Exit signs be illuminated to not less than 5 footcandles (54 lux).

12. Summary

The lighting for covered parking facilities is distinctly different from uncovered parking facilities (surface lots and roofs of parking structures) due to the dark-adapted, night environment of uncovered parking areas.

Industry practice generally indicates that the average maintained illuminance on the pavement for covered parking facilities should meet or exceed 5 footcandles (50 lux). Energy codes limit the lighting system to a maximum of 0.3 watts per square foot for covered parking areas, which limits the average maintained illuminance on the pavement to approximately 10 footcandles. The minimum maintained illuminance on the pavement for covered parking facilities is 1 footcandle according to standards of the Illuminating Engineering Society (IES). The IES also limits the range from maximum illuminance to minimum illuminance on the pavement to a maximum ratio of 10:1 for covered parking areas. Owners may choose to exceed the minimum illuminance standards in order to provide for enhanced safety and security of their covered parking facilities.

For uncovered parking areas, the standards of the Illuminating Engineering Society require a minimum maintained illuminance on the pavement of 0.2 footcandles. For enhanced security, IES recommends a minimum illuminance on the pavement of 0.5 footcandles for uncovered parking areas. The upper limit on the maximum to minimum illuminance on the pavement is 20:1. For enhanced security, IES recommends an upper limit of the maximum to minimum ratio of 15:1 for uncovered parking areas.

The lamp of choice in northern climates for covered parking areas is generally pulse-start, metal halide lamps due to the greater brightness perception of the white light versus the yellowish light of high-pressure sodium lamps. In southern climates, the lamp of choice is T8 fluorescent because it is 40% more energy efficient than either metal halide or high-pressure sodium lamps, while providing a white light source. Fluorescent lamps are not well suited to northern climates because of loss in light output in cold weather.

For covered parking facilities, a common lighting system configuration consists of luminaires spaced at approximately 30 ft by 30 ft throughout the floor areas for 150-watt metal halide or high-pressure sodium fixtures. A fluorescent light fixture with four, four foot T8 lamps will provide equivalent maintained illuminance as 150-watt metal halide fixtures. Mounting heights typically range from 8 to 10 feet.

For uncovered parking areas, pole mounted fixtures are typically utilized at mounting heights of 20 to 30 feet. Fixtures should be located a distance of at least two mounting heights to the interior of the parking area to minimize glare and light trespass. The spacing between fixtures is typically equal to 4 to 5 times the mounting height. The luminaires typically consist full cutoff, Type V fixtures with 250-watt or 400-watt metal halide or high-pressure sodium lamps oriented in the vertical position.

Vertical illuminance may be a more important consideration in both covered and uncovered parking facilities for detection of trip hazards and other objects. The IES vertical illuminance criteria measured at 5 feet above the pavement is 50 percent of the horizontal illuminance criteria on the pavement for both covered and uncovered parking facilities.

Maintenance of the lighting system is extremely important in order to assure that adequate illuminance is provided throughout the life of the parking facility. Owners should have maintenance staff measure the illuminance on the pavement directly under each luminaire every 6 months to determine that the light output of the lamps meets the design criteria. When the illuminance on the pavement under the luminaire falls below a predetermined value determined from the lighting calculations, then the lamp should be replaced even if it has not expired. Proper design and maintenance of the lighting system will minimize the risk of liability claims due to accidents or criminal activity in your parking facility.

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PARKING STRUCTURE MAINTENANCE

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Introduction

Proper maintenance is a key factor in determining whether a parking garage will remain a valuable asset or sadly deteriorate into a liability for the owner. Parking garages are exposed to aggressive environments that can dramatically shorten their useful service life. The durability of a parking garage, therefore, is directly related to the level of preventative maintenance it receives. The length of time before implementing an effective maintenance program in a new parking garage will also affect its long-term durability. The longer one waits to start a maintenance program the more costly the repairs will be in the not too distant future. Owners of newly constructed parking garages should be provided with a commissioning report and maintenance manual prepared by the Contractor. If these documents are not available and are not within the specified scope of the Contractor's work, then the Owner should request that these documents be prepared by the Contractor or the design consultants and include a life-cycle cost analysis of the parking garage. This will yield useful information with respect to operating procedures and the preparation of yearly budgets for the parking garage.

Older parking garages with deferred maintenance can be rehabilitated and then maintained to economically extend their useful service life. Thorough understanding of the root cause of the deterioration however is essential. Only in this way can durable repairs be made and operations or systems modified to enhance durability. Maintenance repairs to the structure of a parking garage can take many forms and can be minor or extensive in scope. Before undertaking maintenance repairs it is best to formulate an overall plan for the parking garage with the aid of a life cycle cost analysis. For example a maintenance plan may call for major repairs to be done every 5 to 10 years with portions of the parking garage taken out of service for the duration of the repair work; or alternatively the plan may call for less extensive but more frequent repair work, which will not significantly disrupt the operation of the parking garage. The available budget, the parking operations and the requirements of the parking demand generator, i.e. public, private commercial, private residential, institutional, government, etc., will all influence the overall plan.

Developing a Maintenance Program

Since all parking garages serve the same basic function, conventional wisdom might lead one to believe that they are all pretty much the same and they can be maintained in a similar way. In reality no two parking garages are exactly alike and often the differences vastly out number the similarities. For this reason every parking garage should be considered unique and maintenance programs should be tailored to each facility.

The following are some of the factors to consider when developing a maintenance program:

- Location of the parking garage – climate, municipality's use of roadway de-icing salt, proximity to coastal shores (see Figure 1)
- Age of the parking garage – present condition, service history and repair history
- Exposure – stand alone above grade, below grade heated or unheated garage
- Structural system
- Presence of moisture and/or corrosion control systems
- Parking demand generator – university, hospital, retail, office complex public or private

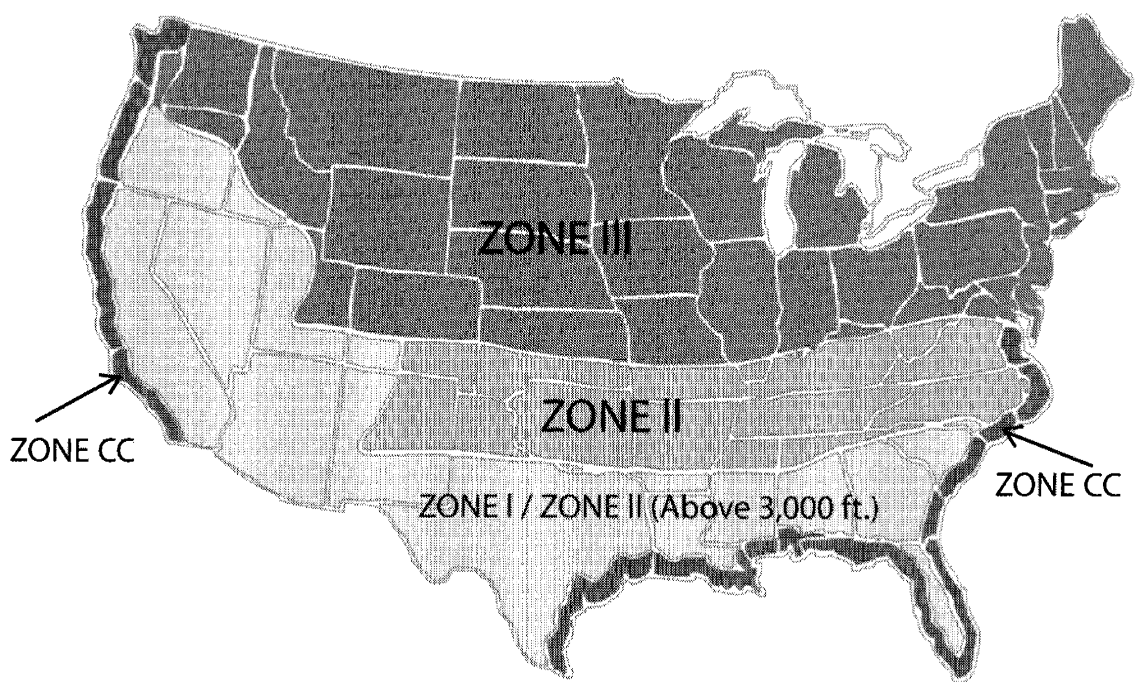


Figure 1: Zone Map; American Concrete Institute ACI 362.1R-97

Notes to Zones Map, Figure 1

For durability of concrete structures, ACI 318 defines several exposure conditions and sets durability measures for each. These exposure conditions are:

- Concrete intended to have low permeability when exposed to water. This is interpreted to apply to all parking structures not covered by the subsequent crtieria.
- Concrete occasionally exposed to moisture prior to freezing and where no deicing salts are used.
- Concrete exposed to deicing salts, brackish water, sea water, sea water spray from these sources and may or may not be subject to freezing.

To assist in identifying these exposure conditions, five exposure zones are defined and approximately illustrated on the map.

- Zone I represents the mildest conditions where freezing is rare and salt is not used. *7his area is generally defined as all areas south of Zone II and south and west of Zone III except those areas above an elevation of 3000 feet where freezing occurs.*
- Zone II represents areas where freezing occurs and deicing salts are not or rarely used. *7his area is generally defined as the area south of Zone III and within 100 miles south of interstate highway 40 from the Atlantic Ocean west of the Continental Divide, plus all areas in Zone I above an elevation of 3000 feet and below an elevation of 5000 feet, plus areas in the State of Oregon and Washington west of the Cascade Range except for those areas above an elevation of 5000 feet.*
- Zone III represents the areas where freezing and deicing salts are common. *7his area is generally considered to be areas north of and within 100 miles south of Interstate Highway 70 from the Atlantic Ocean west to Interstate Highway 15, then north to Interstate Highway 84, then northwest to Portland, Oregon then west to the Pacific Ocean plus areas with Zones I and II above an elevation of 5000feet when deicing salts are used.*
- Coastal Chloride Zone I (Zone CC-I) represents areas with Zone I and within 5 miles of the Atlantic Ocean, Gulf of Mexico, Pacific Ocean, and the Great Salt Lake.
- Coastal Chloride Zone II (Zone CC-II) is areas within zones I and II and within one half mile of the salt water bodies described in Zone C-I.

Condition Surveys and Audits

The first step in developing a maintenance plan is to determine the present condition of the parking garage by conducting a baseline condition survey and audit. This is best accomplished by a team approach. The composition of the team will depend on the abilities of the in-house property management/maintenance staff, which in turn will determine the need for specialist help. General cleaning affecting the appearance and functions of entrance and exit ramps, lobbies, stairwells, elevator cabs, mechanical/electrical rooms, washrooms and property management offices can typically be surveyed and reported on by the in-house maintenance staff. Unless a certified electrician is on staff, a professional electrical engineer should review, lighting and electrical power systems. For enclosed parking garages a professional mechanical engineer should review the heating and/or ventilating systems, water distribution, drainage systems, the fire sprinkler system and carbon monoxide (CO) monitoring systems. Property management staff in conjunction with the equipment manufacturer representatives or a third party maintenance contractor should review revenue control and security equipment.

Elevators are usually maintained via service contracts with the elevator manufacturer or third party contractors. The management staff or owner of a parking garage should carefully review the elevator maintenance contract for exclusions, e.g. buried pistons and casing of hydraulic drive elevators. Advice should be obtained on the maintenance contract and on excluded items from an independent elevator consultant.

It is recommended that an engineer experienced in the design, investigation and rehabilitation of parking structures survey and report on the condition of the structure and the moisture and corrosion control systems. This is because an experienced professional can detect signs indicating hidden deterioration or latent defects in materials and systems that are not readily apparent to an untrained observer. All or some of the following tasks may be included in the survey depending on the specific parking garage under consideration:

- Structural and architectural drawing review
- Review existing condition survey reports
- Interview with property management/maintenance staff with knowledge of the service history of the parking garage and current operations
- Comprehensive visual review including handrails and guards, miscellaneous metals and bearing pads
- Flood test to locate leaking cracks, control joints and expansion joints and to determine the effectiveness of the drainage system
- Chain drag and/or hammer tap testing. These are simple but effective acoustic test methods to detect deteriorated concrete using hand tools
- Concrete coring and laboratory testing to determine level of chloride ion contamination, level of carbonation, air void system and compressive strength
- Half-cell corrosion potential testing to determine the likelihood of reinforcing steel corrosion
- Expose and test a representative number of unbonded post tensioning tendons. We note that special expertise is required to survey the condition of unbonded post tensioned concrete parking structures due to the difficulty determining the condition of the typically large number of post tensioning tendons.
- Concrete sealer testing to determine its effectiveness and the need for re-application
- Moisture protection membrane testing to determine its effectiveness and the need for re-application
- Review effectiveness of cathodic protection system (cathodic protection is an electro-chemical method of controlling corrosion of reinforcing steel embedded in concrete that has been contaminated with chloride ions, e.g. roadway de-icing salt.)

Building Code Compliance

Although not part of routine maintenance it is recommended that a building code consultant review the existing fire protection and life safety measures consisting of fire separations, hazards detection, annunciation (alarms), egress and fire suppression systems for compliance with the local Building Code as well as barrier free provisions for compliance with the Americans with Disabilities Act (ADA). This information is useful for strategic planning purposes.

Maintenance Policy

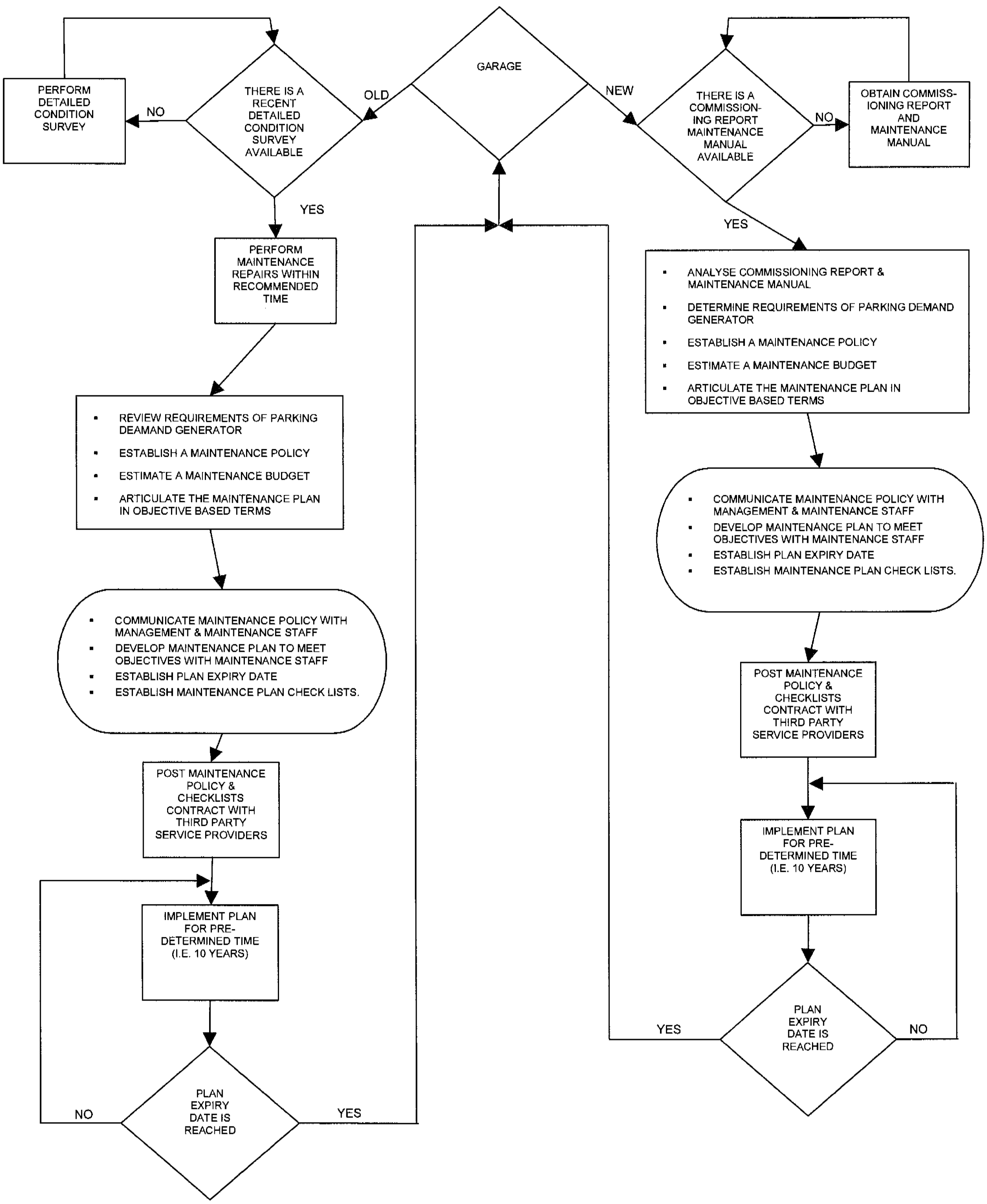
When the results of the base line survey are available and the condition of the parking garage is known with a greater degree of certainty, a maintenance strategy can then be developed for the parking garage. The following factors will influence the maintenance strategy:

- Available budget
- Demands of the parking garage users and public
- Current perception of the facility within the community and the willingness to change that perception
- The owner's short term and long term plans for the facility.

A maintenance policy should then be written in simple objective based terms that is clear and can be easily understood by all staff involved in the maintenance of the parking garage. The maintenance policy should be posted and regularly reviewed with the maintenance staff.

A flow chart showing the development of a maintenance program is shown in Figure 2 on the following page.

Figure 2: Flow Chart For Development of a Maintenance Program



Elements of Maintenance Programs

The implementation and management of any maintenance program is easier if the program is broken down into clearly definable elements or parts. In this regard a maintenance program for a parking garage is readily divided amongst the following general categories:

- Aesthetics – general house keeping
- Structural systems
- Moisture control and corrosion protection systems
- Architectural systems
- Mechanical systems
- Electrical systems
- Revenue control and security systems

Aesthetics – General House Keeping

Entrance and exit ramps should be inspected and kept free of debris. Special attention should be given to trench drains as these tend to become quickly blocked with road sand and silt, leaves and other debris. Lobbies should be swept and garbage bins emptied daily. Stairwells should also be inspected and kept free of debris and windows washed. Broken glazing should be replaced as soon as possible. Offices, washrooms, waiting areas, pay booths and mechanical and electrical rooms should be kept neat and tidy. Parking floors should be swept and washed on a regular basis. Prior to introducing water and cleaning chemicals, however, professional advice should be obtained with respect to recommended procedures and compatibility of chemical cleaning agents. All horizontal surfaces should be cleaned of dust and soot and vertical surfaces washed. Signage and lighting fixtures should be cleaned and repaired on a regular basis.

Structural Systems

The following are the most common structural systems used in the construction of parking garages:

- Cast-in-place reinforced concrete
- Cast-in-place post-tensioned concrete
- Precast, prestressed concrete
- Structural steel frame (beams and columns) with cast-in-place or precast concrete floors

Each system has its strengths and weaknesses with respect to durability. Regardless of the structural type used, the structure of a parking garage represents approximately 70% of the total construction cost and is the owner's greatest capital investment in the facility excluding in some cases land acquisition costs.

Repairs to a parking garage in Zone III or Zone CC I & II that has been neglected for a relatively short time (5 to 8 years) are very disruptive to the operations of the facility and can easily run into the hundreds of thousands of dollars.

Parking garages are often located below major commercial or institutional buildings and may share some of the vertical load bearing elements such as columns, shearwalls, and foundations. Significant deterioration of these critical structural elements will have implications beyond the parking garage and may affect the safety of the building above. The repair of shared vertical load bearing structural members is problematic due to the temporary shoring required to support the building as well as the parking garage loads during repairs. In view of these facts one can see that the importance of maintaining the structure of a parking garage cannot be overstated.

A professional engineer with extensive experience in the design, investigation and rehabilitation of parking structures should conduct an annual inspection of the structural systems. This can be in the form of a comprehensive visual review with some limited non-destructive testing; e.g. chain-drag and hammer tap. Coupled with the base line condition survey discussed under *Condition Surveys and Audits* above, the results of these annual inspections will identify significant deterioration mechanisms early in the deterioration process and also track the rate of deterioration. An estimate of the deterioration rate is useful when determining repair budgets and timing of major repairs. Required minor repairs can be done annually, which will preclude the need for major repairs and disruption in the future.

Moisture Control and Corrosion Protection Systems

Moisture control systems consist of concrete sealers, waterproof membranes, joint sealants and expansion joint seals. These are the first line of defense against the ingress of chloride ion (salt) contaminated water into the concrete. When the concentration of chloride ions in concrete surpasses a definable threshold amount (in the range of 0.025% by weight of concrete) unprotected reinforcing steel will corrode in the presence of moisture and oxygen. This corrosion leads to cracking and spalling of the concrete (portions of the concrete surface breaking away from the rest of the concrete and often exposing the corroded reinforcing steel). The other basic function of moisture control systems is to prevent leaks through the structure that can damage the paint finish on cars, which is a nuisance problem.

Due to traffic patterns and relatively tight turn radii in parking garages, waterproof membranes and their traffic wearing courses experience uneven wear. In high traffic areas such as ramps, around ticket booths, turn areas, etc. these moisture protection systems should be checked annually for signs of deterioration. Repairs should be done as soon as possible to avoid more general and more rapid deterioration. Concrete sealers also wear out more quickly in high traffic areas and should be reapplied more frequently in these locations.

In our experience we have occasionally seen expansion joints in some parking garages with the underside of the joint filled or where a trough is installed below the expansion joint. These arrangements can create problems since the filler at the underside of the expansion joint will tend to trap water and the trough will catch any water bypassing the top joint filler and drain it away. These are not good practices from a durability and maintenance point of view. In both cases water, which is often contaminated with roadway deicing salt, bypasses the top joint filler and will eventually cause deterioration of the concrete or steel structure adjacent to the expansion joint. This deterioration will often be hidden until major repairs are necessary. It is much better to have one filler for the expansion joint located at the top of the joint. If this joint leaks it s readily detected and repaired before more serious concrete damage occurs.

Snow removal using snow plough blades and front-end loaders on top decks of parking garages often result in damage to the moisture protection membrane, expansion joint fillers and joint sealants. To mitigate this common problem snow removal equipment can be fitted with heavy rubber blade guards to keep the metal of the blade from tearing the moisture protection membrane or catching the edges of expansion joints. Also, to reduce damage to expansion joints, snow removal equipment should approach the expansion joint as close as possible to parallel with the joint. Piling of snow at designated areas on top decks is not good practice due to the difficulty in controlling where and how much snow is piled and consequently the potential for overloading the top deck. If there are no snow chutes or gates at the top deck, then snow should be moved to the perimeter and thrown over the side with a front-end loader. Care must be taken not to damage the sidewalls, handrails, and concrete curbs with the front-end loader bucket.

Architectural Systems

Parking garages vary widely with respect to the level of their architectural detailing. Mixed-use, freestanding parkades at some college and hospital campuses have many architectural features, which are similar to the institutional buildings they serve. Other parkades are utilitarian in nature with little in the way of architectural embellishments. In all cases, however, the proper maintenance of the architectural systems will enhance the public perception of any facility.

Exterior walls and guards should be inspected annually for signs of deterioration. Painted finishes should be kept in good repair and sealants replaced as necessary. Doors and doorframes should be checked for proper operation, corrosion and condition of finishes; similarly windows and window frames. Any graffiti should be removed as soon as possible.

Exit stairs should be inspected. Damaged or deteriorated stair treads should be repaired as these are unsightly and are trip hazards. Handrails should be kept in good repair.

Exterior landscaping should be well maintained as this provides the first impression of the facility and brightens the appearance of the neighborhood. Overgrown landscaping can create accident hazards for pedestrians, or limit driver visibility at entry and exit points. It can also create a refuge for undesirable or criminal activity.

Parking garage signage and floor striping should be kept in good repair, and kept current in terms of regulatory requirements.

Mechanical Systems

A properly functioning drainage system will significantly enhance the durability of a parking garage particularly in Zone III and Zone CC I & II. Therefore, all floor drains, drainage pipes, sumps and sump pumps should be inspected and serviced regularly.

Unheated parking garages in northern climates will often have dry type fire sprinkler systems. These systems are more prone to corrosion of the sprinkler pipes and should be regularly checked.

Enclosed parking garages will often have a CO monitoring system that activates the ventilation fans when carbon monoxide gas is detected above a threshold level. This system, as well as all related ventilation fans and grills, should be regularly checked.

Ramp heating systems should be inspected in the fall season and again in the spring.

Electrical Systems

Area lighting and emergency exit lighting should be inspected daily to maintain garage function and customer satisfaction and enhance customer security and safety. Light fixtures should be re-lamped immediately and depleted battery packs in emergency lighting units should be replaced expeditiously.

Exposed electrical conduit should be inspected for damage or corrosion due to leaking through floor slabs. Deteriorated or damaged sections of electrical conduit should be replaced. It is noted that electrical systems with exposed conduit is easier to maintain than systems with embedded electrical conduit due to the possibility of hidden corrosion of the embedded conduit. In Zone III and Zone CC I & II consideration should be given to replacing old embedded conduit systems with surface mounted electrical conduit in a phased preventative maintenance program.

Revenue Control and Security Systems

Similar to elevators revenue control equipment is best maintained via a service agreement with the equipment manufacturer or a third party contractor. In order to maintain smooth day-to-day parking operations, however, the parking garage maintenance staff should be trained to perform minor repairs and simple component replacements.

Replacement parts should be kept on hand to speed the repairs. A maintenance log including records of all repairs should be kept for the various pieces of revenue control equipment. In this way the reliability of the equipment can be quantitatively determined.

Parking garage maintenance staff should check active security systems such as CCTV, emergency-telephones and alarms frequently; repairs should be performed immediately to maintain security and avoid liability in the event of criminal activity. Yearly inspection by third party specialist firms should be performed.

Schedule of Recommended Maintenance

As noted above, all parking garages are unique facilities and the most effective maintenance programs are the ones tailored to a parking garage's specific conditions and requirements. In general, however, a maintenance program can be subdivided into the following three broad categories:

- Aesthetics
- Operations
- Structure

Aesthetics deals with general housekeeping of interior spaces and exterior landscaping. Operations deals with mechanical and electrical systems, signage, cleaning, revenue control and security systems, and snow removal. Structure involves not only the structural frame of the parking garage, but also the moisture protection systems and the metal guards and other miscellaneous metals. The example below is a maintenance schedule adapted from *Parking Structures Planning, Design, Construction, Maintenance and Repair* by Anthony P. Chrest, Mary S. Smith and Sam Bhuyan.

Figure 3. Schedule of Recommended Maintenance

	Frequency			
Description	***Monthly***	***Annually***	***As Required***	***Comments***
Aesthetics				
Landscaping			✔	Remove debris, mow grass, tend flower beds and prune shrubs
Cleaning			✔	Lobbies, stairwells, offices, washrooms, pay booths, mechanical and electrical rooms: sweep, empty garbage bins, wash floors
Window and doors			✔	Replace broken glazing. Repair or replace broken hardware.
Painting		✔		Perform more frequently if necessary to deal with graffiti
Operations				
Sweep parking decks	✔			
Wash parking decks		✔		More frequent washing is recommended in Zone III and Zone CC, i.e. at least once in the spring and again in the fall.
Snow removal			✔	Piling of snow on top decks is not recommended
Drainage systems	Inspect		✔	
Elevators	Inspect		✔	As per maintenance contract with service provider
Ventilation equipment	Inspect		✔	
Fire protection systems	Inspect		✔	
General lighting	Inspect		✔	
Exit and emergency lighting	Inspect		✔	
Emergency generator	Inspect		✔	
Revenue control equipment	Inspect		✔	As per maintenance contract with service provider
Security equipment	Inspect		✔	As per maintenance contract with service provider
Safety checks	✔			
Graphics and striping		Inspect	✔	
Structure				
Independent expert inspection		✔		Detailed baseline condition survey should be done first and expert inspection should be done annually thereafter.
Visual inspection: ▪ Floor slabs (top	✔		✔	In-house staff should visually inspect and report any defects or deterioration.

	Frequency			
Description	***Monthly***	***Annually***	***As Required***	***Comments***
and bottom) ▪ Beams and bearing pads ▪ Columns ▪ Walls ▪ Precast concrete connections ▪ Stairs ▪ Guards and handrails Maintenance repairs of above note elements				Perform repairs required to maintain structural integrity as soon as possible. Follow stated maintenance strategy for all other repairs.
Moisture protection membrane		✔		Budget for complete replacement after 10 to 15 years.
Sealer		✔		Budget for reapplication every 3 to 5 years.
Expansion joint fillers		✔		Budget for replacement after 10 years.
Deck joint sealants			✔	Replace joint sealants at leak locations when reported. Budget for complete replacement after 5 to 7 years.
Crack routing and sealing		Inspect	✔	
Check cathodic protection system		✔		
Exposed structural steel		Inspect	✔	

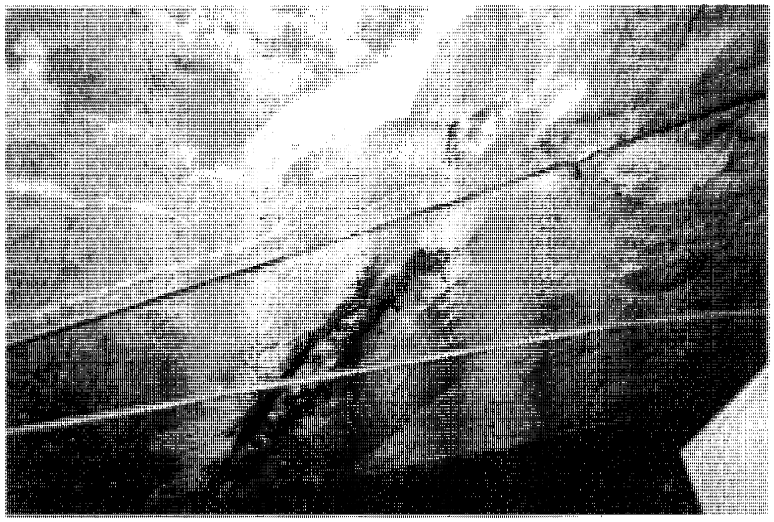
Repair Maintenance

The following section will discuss typical maintenance repairs encountered in parking garages.

Reinforced Concrete Parking Structures

Reinforced concrete is a very robust and durable building material. The embedded reinforcing steel is naturally protected against corrosion by a passive film that develops around it due to the normally high alkaline environment (pH 12-13) of the surrounding concrete. When, however, reinforced concrete is contaminated by chloride ions from roadway deicing salt, however, the passive protection layer breaks down and the reinforcing steel corrodes in the presence of moisture and oxygen. The corrosion product (rust) occupies two to three times greater volume than the reinforcing steel from which it came causing large tension forces in the concrete. These tension forces are large enough to crack the concrete, which allows even more moisture and salt to enter and exacerbates the problem. If left untreated the concrete spalls, i.e. pieces or sections of concrete break away. This leaves behind a void in the concrete that often exposes the reinforcing steel and weakens the structure (photographs 1 to 3). Remedial work ranges from simple local concrete patch repairs to complete replacement of the concrete member depending on the severity and location of the concrete deterioration (photographs 4 to 9). It should be noted that concrete patch repairs do not solve the salt induced deterioration problem. Deterioration will continue at a rate that is affected by many factors. An engineer who is experienced in the rehabilitation of parking structures should be consulted with respect to options for repairs, opinions of repair costs and short and long term maintenance costs associated with each option. Under no circumstances should asphalt be used to fill the void left by spalled concrete at the top surface of floor slabs. Asphalt is not a structural material and is water permeable. Asphalt patches will allow more contaminated water to reach the reinforcing steel and mask further concrete deterioration and will not restore the structural capacity of the weakened slab.

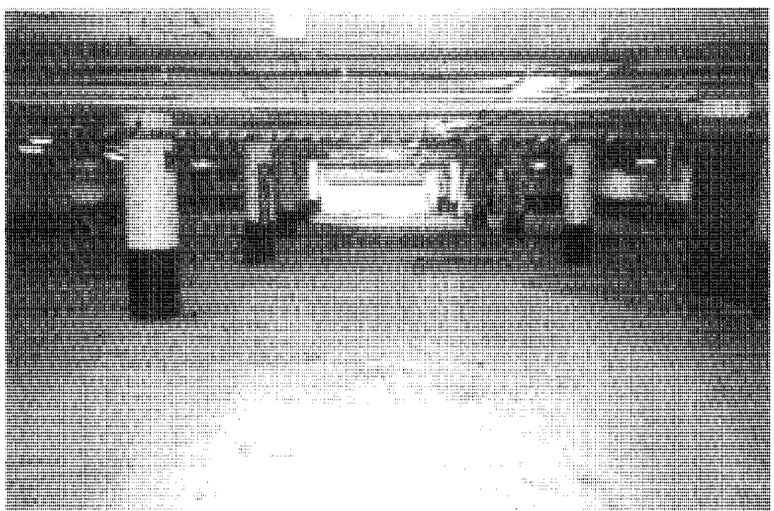
Scaling of the concrete floor is another form of deterioration characterized by pitting and flaking of the concrete at the top surface (photograph 10). For scaling to occur temperatures must cycle below and above freezing in the presences of moisture. Scaling is often referred to as freeze-thaw damage. Building codes require that concrete, which will often be subjected to freezing and thawing in the presence of moisture, contain between 5 to 8% of entrained air. Entrained air provides the concrete with an internal air void system. This allows for water to freeze within the internal air void system and not crack the concrete. To repair scaling the top surface of the concrete slab is removed until sound concrete is reached and replaced with a compatible bonded concrete topping (photograph 11). The concrete topping will have entrained air and low water permeability characteristics.



Photograph 1:

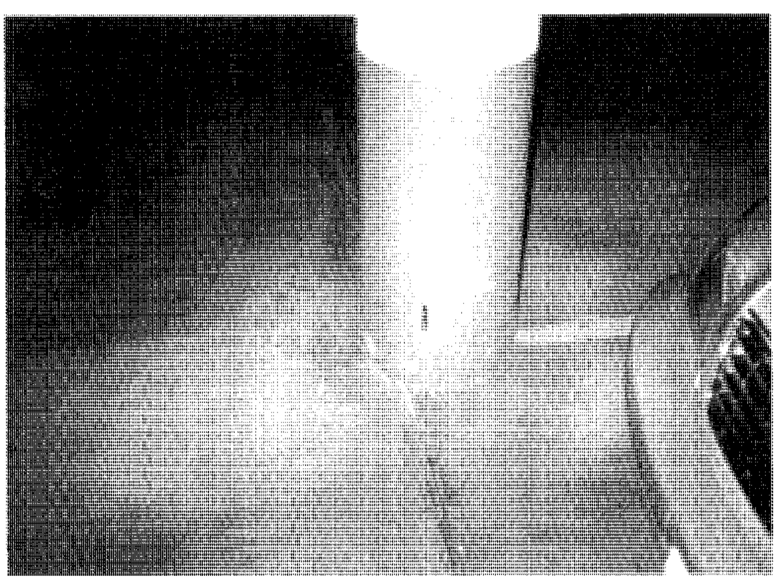
Concrete delamination at underside of parking slab.

Note corroded reinforcing steel and electrical conduit.



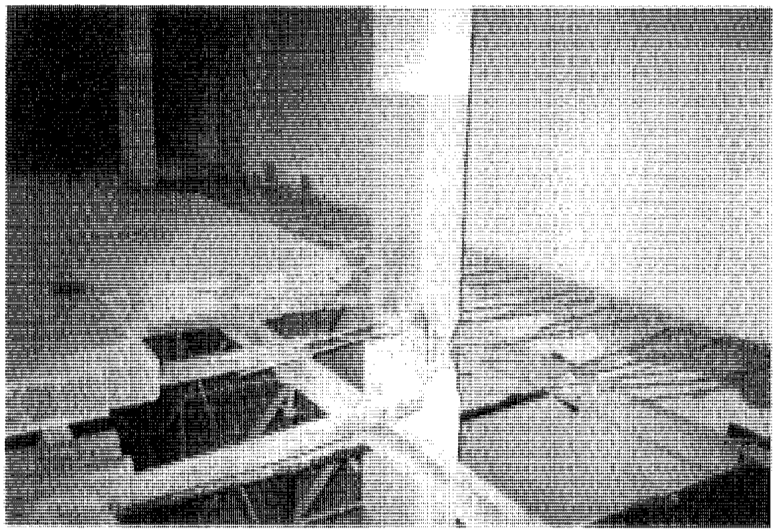
Photograph 2:

Concrete delamination at top surface of parking slab.



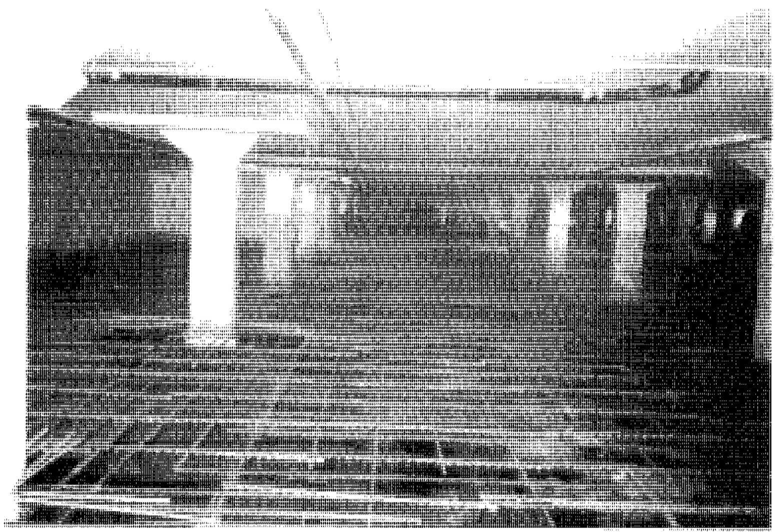
Photograph 3:

Concrete delamination at column.



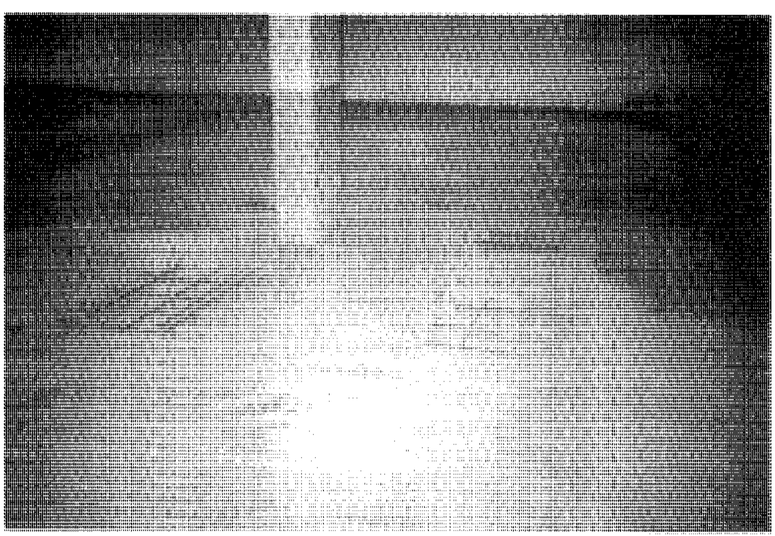
Photograph 4:

Complete slab replacement.



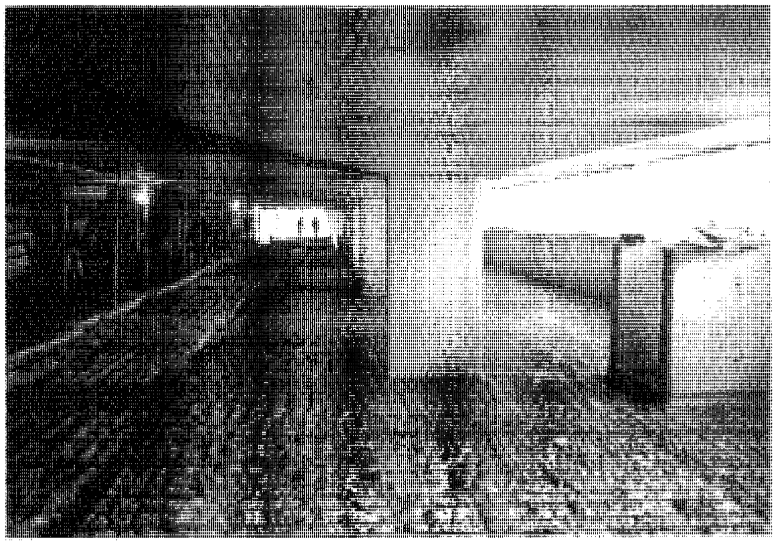
Photograph 5:

Parking slab removal.



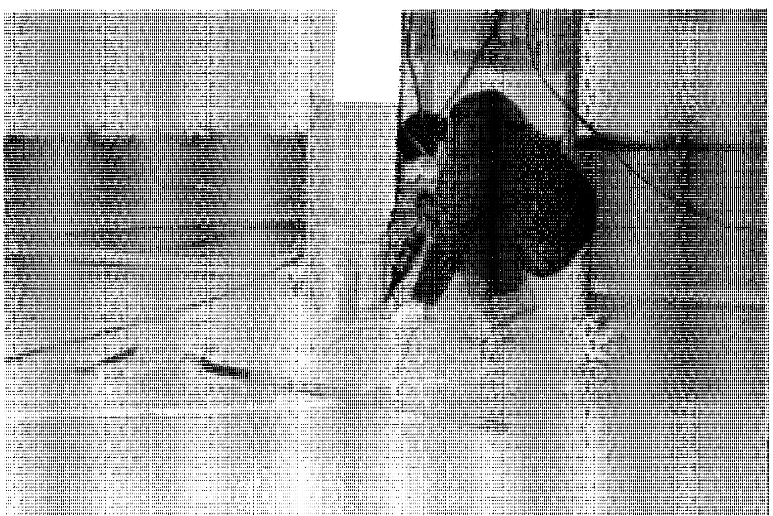
Photograph 6:

Concrete slab top surface patch repairs.



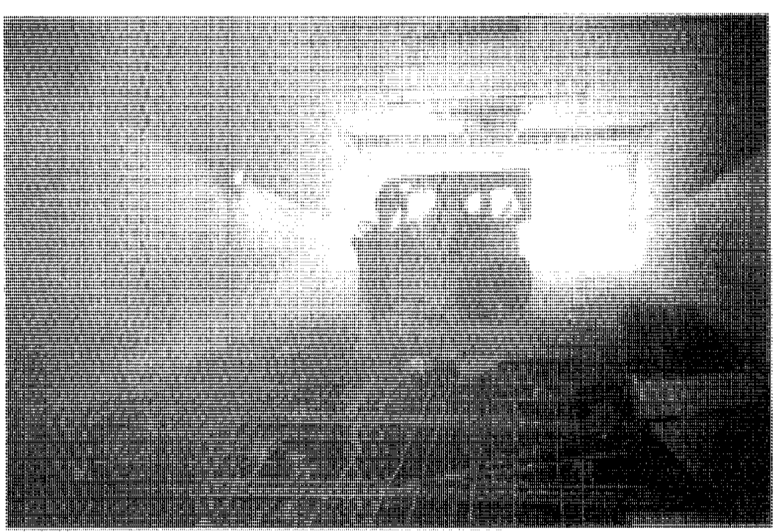
Photograph 7:

Concrete slab surface removal and replacement.



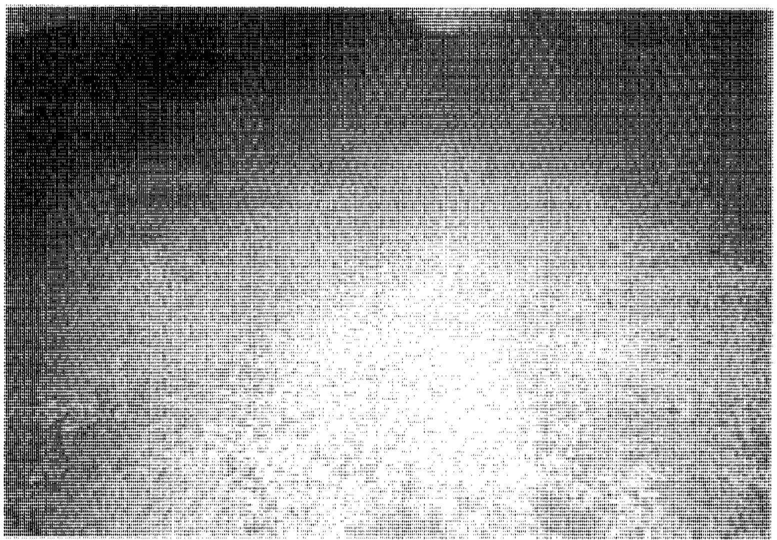
Photograph 8:

Concrete column repair.



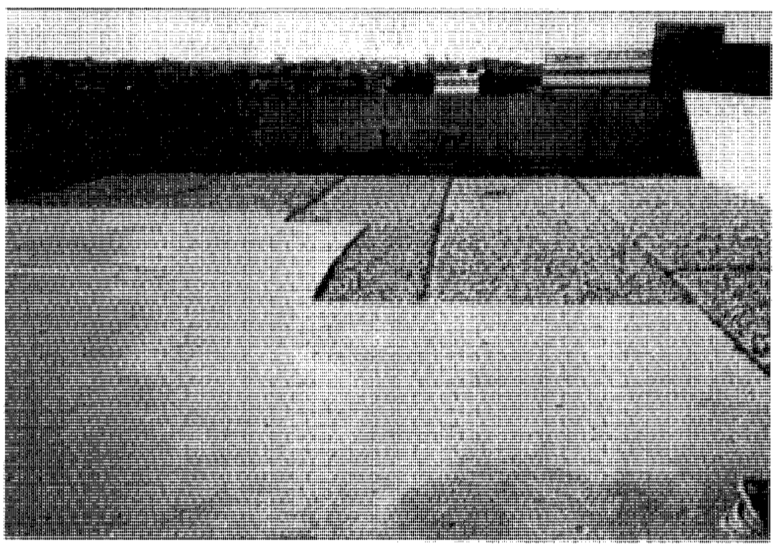
Photograph 9:

Parking ramp removal.



Photograph 10:

Scaling of top surface of concrete parking slab.



Photograph 11:

Repair of scaled concrete.

Waterproofing membranes are used to bridge cracks and prevent water and chloride ions from entering the concrete. They are generically classified as either thick system or thin system membranes. Thin system membranes are approximately 30 mils (thousands of an inch) thick (photograph 12). They are composed of either layers of polyurethane material with grit aggregate in the top layer for vehicle traction and anti-skid or a combination of neoprene or rubber bottom layer with an epoxy and grit top layer. Thin membranes are usually very resistant to chemical attack; e.g. oil and gasoline spills; however, they are prone to uneven wear at drive aisles, ramps and turning areas (photograph 13). Thin membranes should be inspected yearly and worn out areas repaired. Thick membranes usually consist of a rubberized asphalt waterproof membrane approximately $^1/_8$" thick with an asphalt-wearing course approximately $1^1/_2$" thick (photographs 14 and 15). Thick membrane systems are very resistant to traffic wear, however, due to their bituminous base they are not very resistant to oil or gasoline spills. This is often noticeable at parking stalls where leaks from parked vehicles are concentrated (photograph 16). Thick membranes if not properly applied tend to shove or displace under the wheels of heavy vehicles with power steering (photograph 17). As with thin membranes, thick membranes should be inspected yearly and damaged areas repaired.

Precast Concrete Parking Structures

Precast concrete parking structures typically have many sealed joints due to their modular construction (photograph 18). These joints should be inspected on a regular basis by in house staff and repaired as soon as possible.

Guard rails and parapets are usually bolted to the main structure. These elements should be inspected for vehicle impact damage and all connection bolts and anchor plates should be inspected for tightness and corrosion (photograph 19). Corroded bolts and anchor plates should be cleaned and painted with a corrosion inhibiting zinc rich paint or replaced as necessary.

Elastomeric bearing pads distribute the load from concrete beams to the supporting structural member. If the bearing pads are deteriorated, i.e. overly compressed, displaced, brittle and cracked or if the concrete in the vicinity of a bearing pad is cracked an experienced engineer should be consulted (photograph 20).

Post Tensioned Concrete Parking Structures

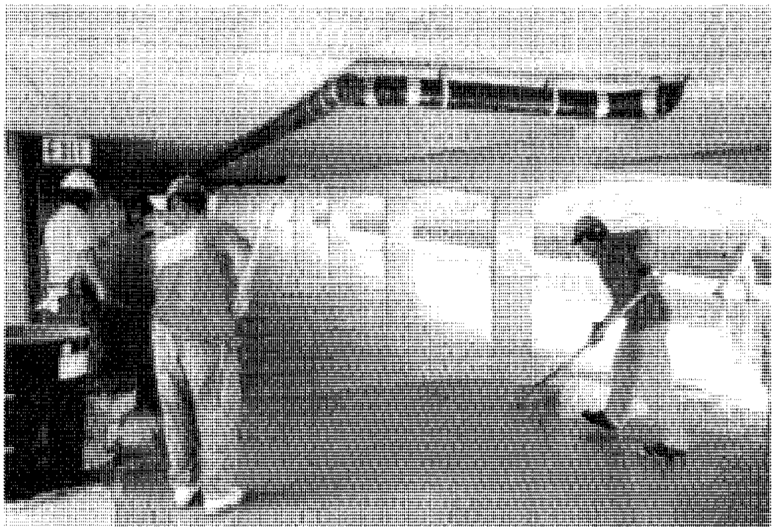
Unbonded post tensioning technology has greatly improved over last the ten years. Cast-in-place post tensioned concrete parking structures have the advantage of fewer cracks as a result of the pre-compression forces applied to the concrete without the disadvantage of the many joints found in precast prestressed concrete parking structures. Early unbonded post tensioning systems used high strength steel strands or tendons wrapped in paper (buttonhead system). Later systems used prefabricated plastic sheaths with grease filling the space between the tendon and the inside of the sheath (push through system) to protect them against corrosion (photograph 21). In many parking garages these early systems did not achieve their durability potential since moisture found its way into the sheaths or through the paper wraps causing corrosion and breakage of the tendons. The moisture was from various sources including rain during construction, and rain post construction through unprotected end anchorages. It is important to note that the moisture in this case does not have to be contaminated with chloride ions in order to promote corrosion, since the tendons are not in direct contact with the concrete no natural passive protection layer can develop around the tendon. This means that corrosion problems can occur in post tensioned parking garages located in parts of the country that are inland and not subjected to roadway deicing salt (Zone I and Zone II Figure 1). Modern unbonded post tensioning systems have improved corrosion protection systems including encapsulated anchorages and extruded plastic sheaths over greased tendons. Extruded plastic sheaths significantly reduce the free space between the tendon and the inside of the plastic sheath, which makes it much more unlikely that water will enter the sheath (photographs 20 to 23).

In parking structures tendon eruptions from the concrete have occurred due to tendon breakage as a result of corrosion. The eruptions have occurred within the slab spans and also projecting through the slab edges.

In addition to tendon breakage and eruption through the concrete, the following are some more subtle warning signs of possible tendon corrosion problems:

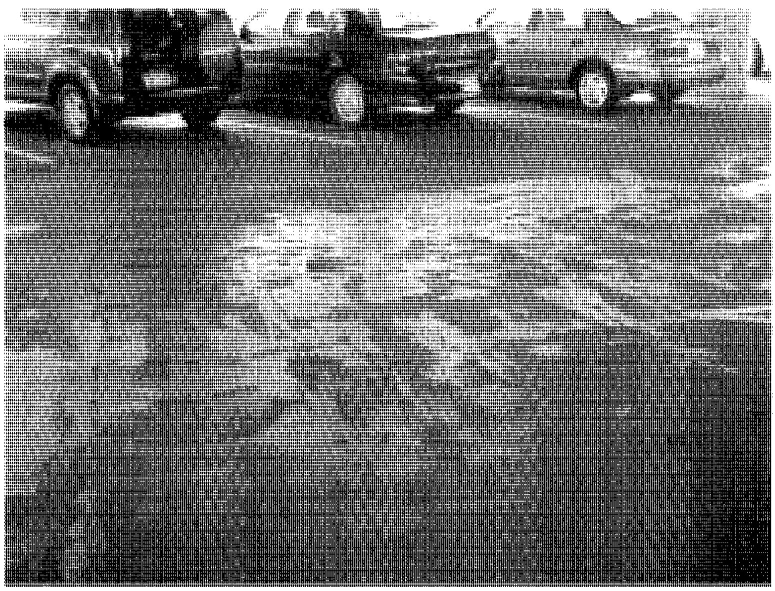
- Cracks at the underside of concrete slabs where rust staining or oil staining is visible (to photograph 24)
- Unusually large cracks in the concrete at the bottom or top of the slab
- Spalled concrete at slabs, beams or columns (photograph 25)
- Exposed and/or deteriorated tendon anchor grout pockets at the concrete slab edges (photographs 26 and 27)
- Poor drainage details in the parking garage, including areas with ponding water, leaks around drains, water draining over slab edges (photograph 28)

The investigation of the structural condition of cast-in-place post tensioned concrete parking garages is very difficult due to the large number of tendons involved and their restricted accessibility. Very often a reasonable sample size of tendons is investigated and a statistical approach is taken with respect to estimating the overall condition of the post tensioning tendons. Destructive and non-destructive testing techniques are available for the investigation of unbonded tendons. An engineer with specific experience in the investigation of unbonded post tensioned concrete parking garages can provide guidance with respect to the most appropriate testing program for the cast-in-place post tensioned concrete parking garage under consideration.



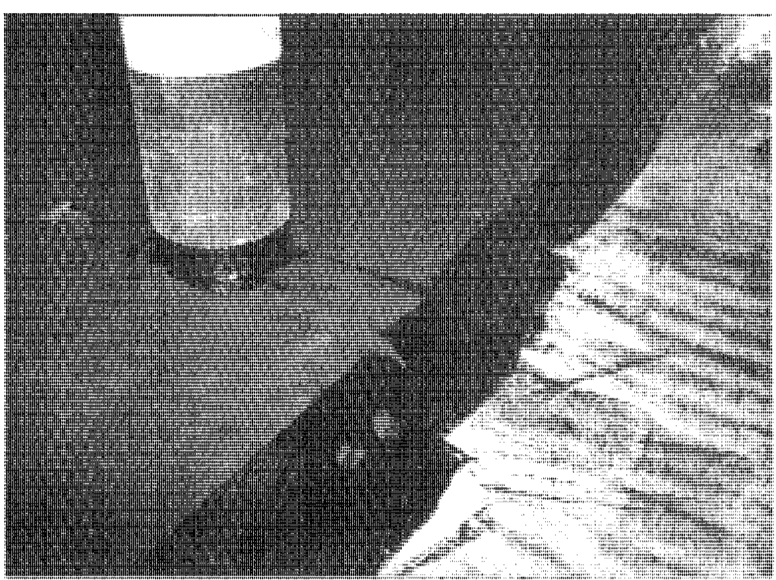
Photograph 12:

Installation of thin system waterproofing.



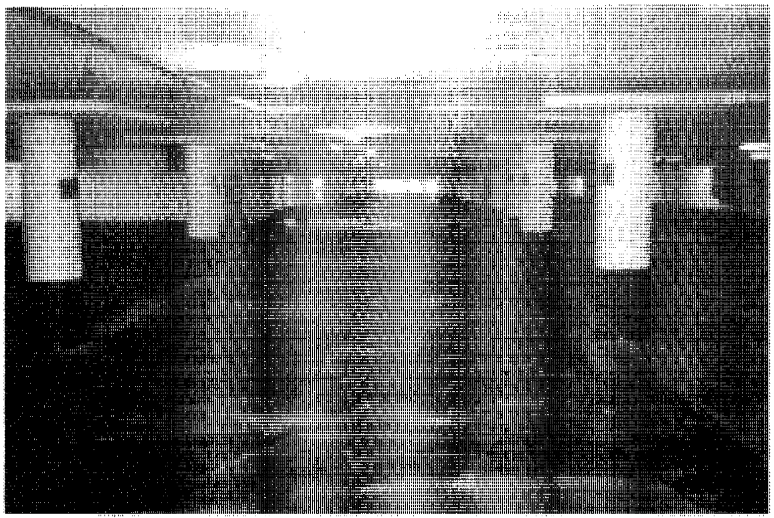
Photograph 13:

Worn thin system waterproofing membrane.



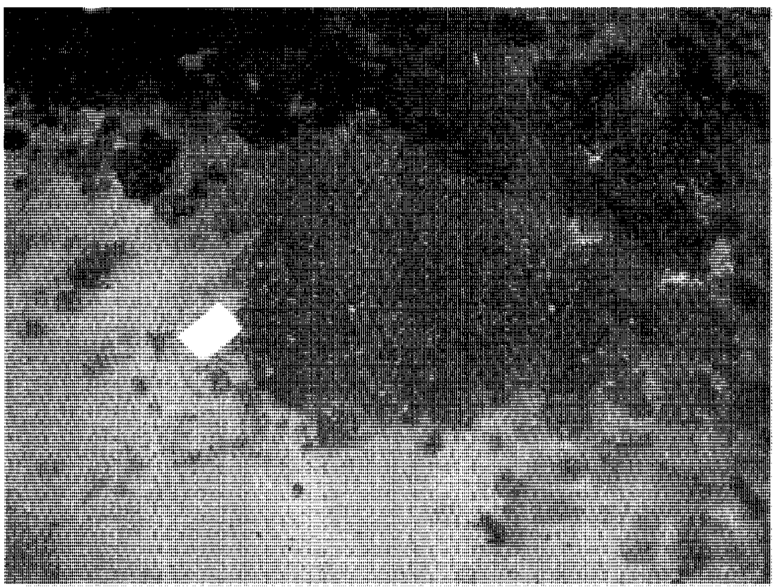
Photograph 14:

Parking ramp removal.



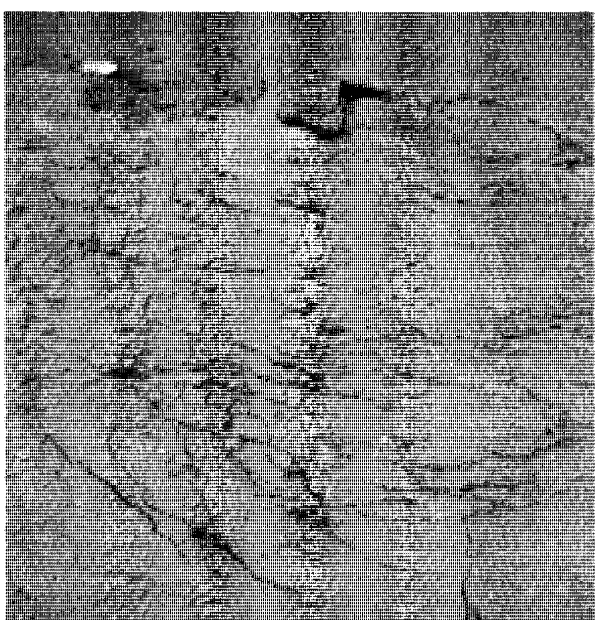
Photograph 15:

Completed thick system waterproofing membrane.



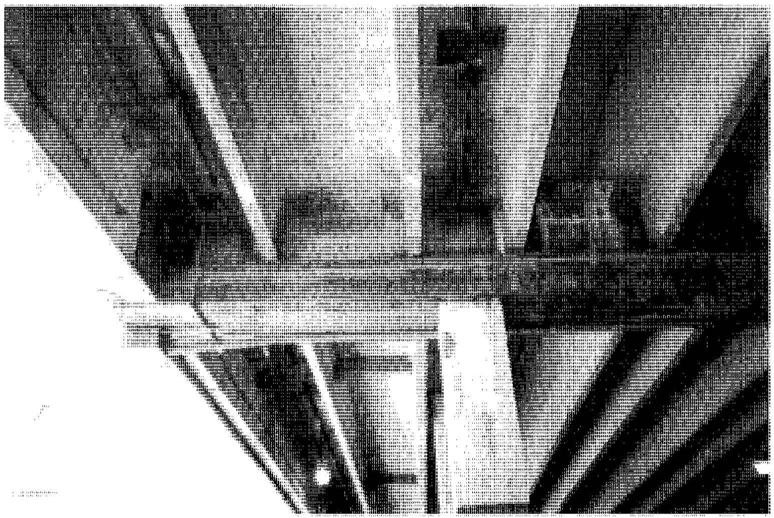
Photograph 16:

Deterioration of thick system waterproofing due to oil spill.



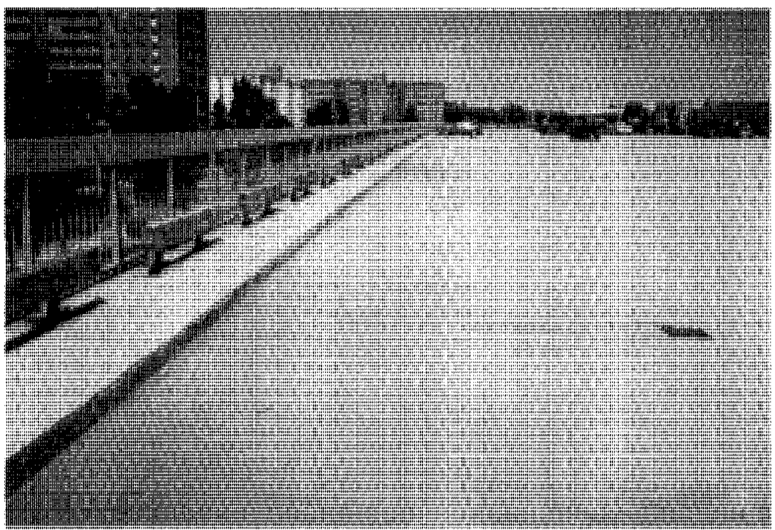
Photograph 17:

Displaced thick system waterproofing membrane due to concentrated wheel turning.



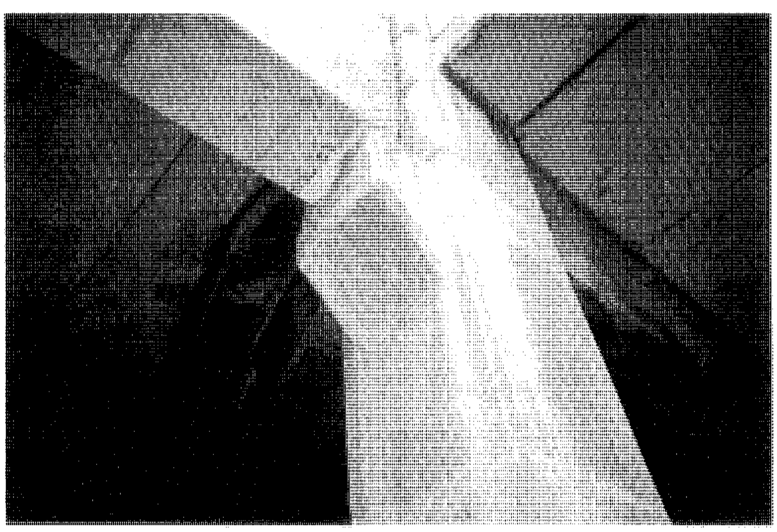
Photograph 18:

Leaking joints between precast doube-tees.



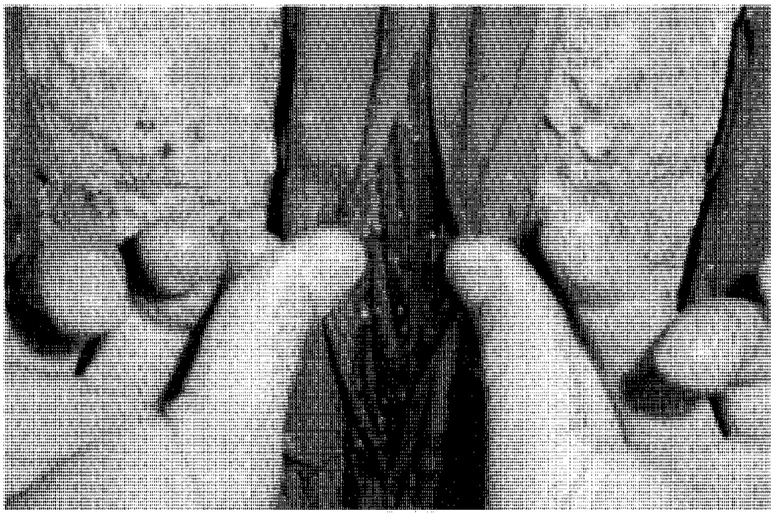
Photograph 19:

Railing posts and bumper guards.



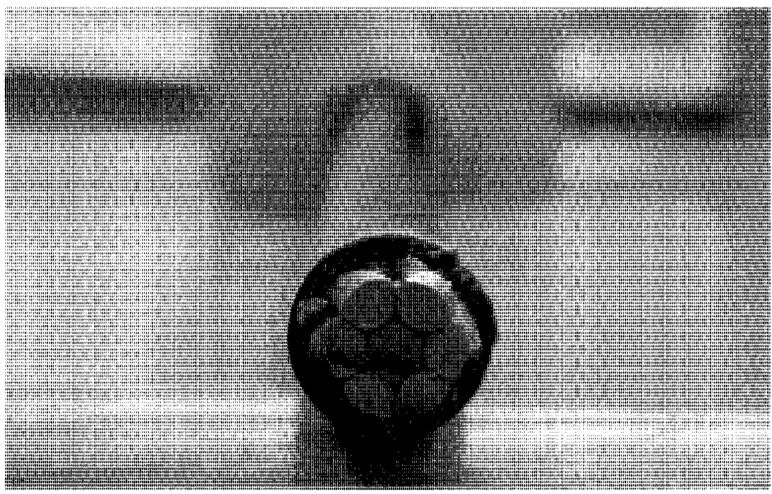
Photograph 20:

Spalled concrete at concrete corbel.



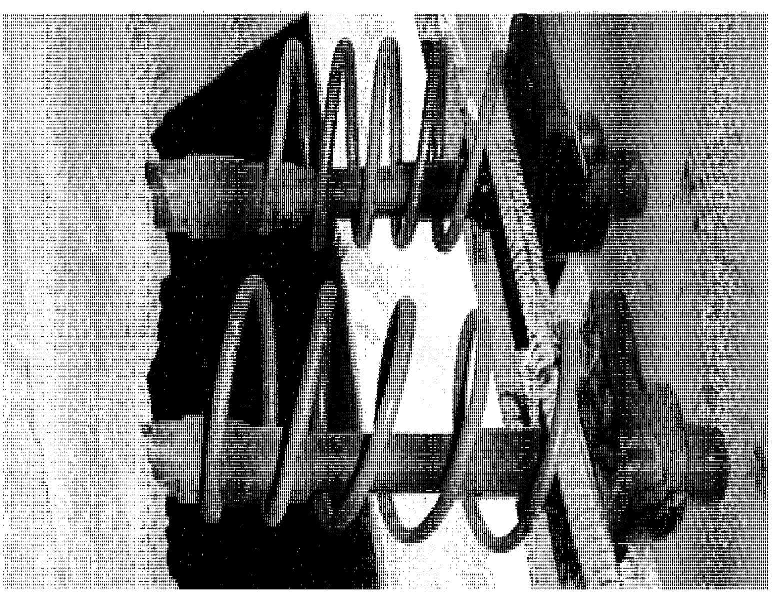
Photograph 21:

Unbonded post tension system tendon.



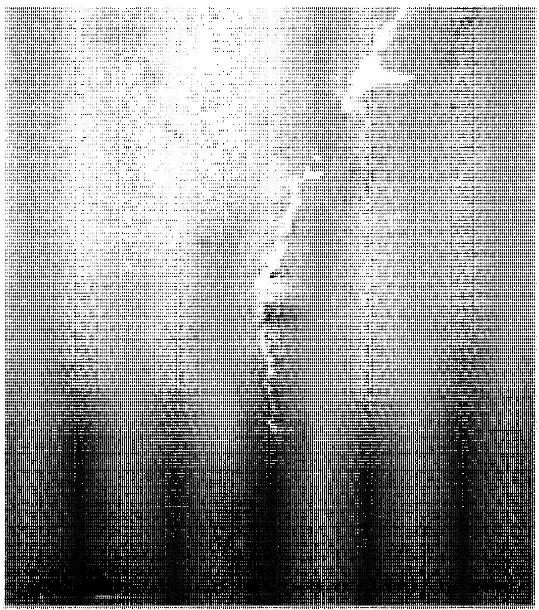
Photograph 22:

New post tension tendon.



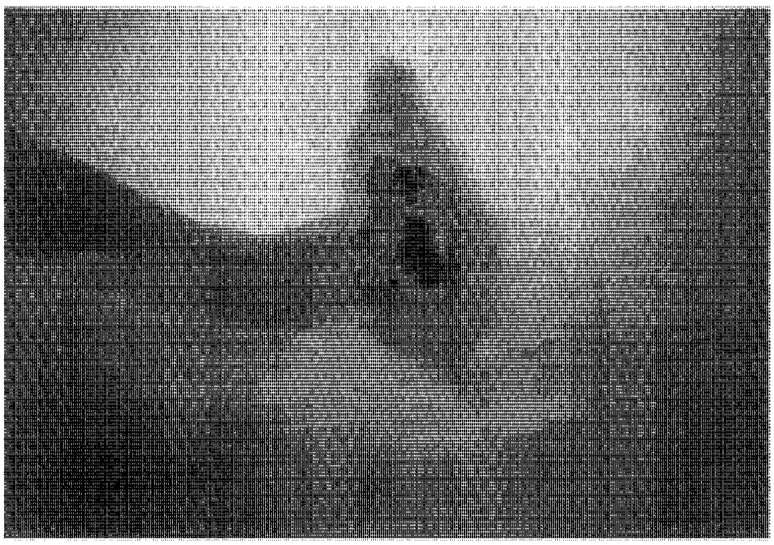
Photograph 23:

Replacement of post tension tendon anchors at slab edge.



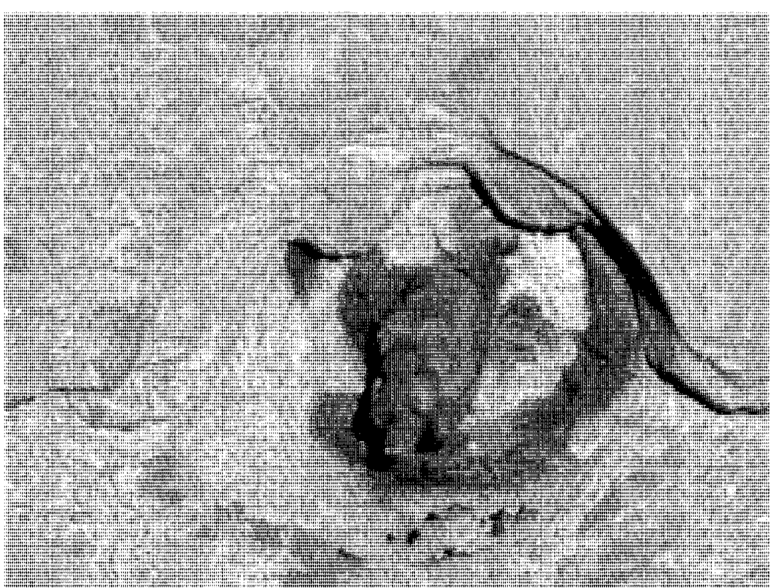
Photograph 24:

Slab crack with efflorescence.



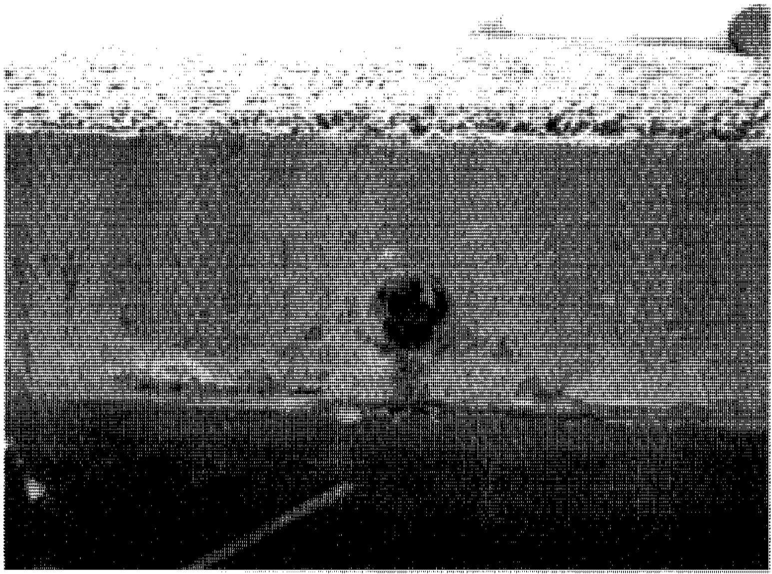
Photograph 25:

Spalled concrete at slab.



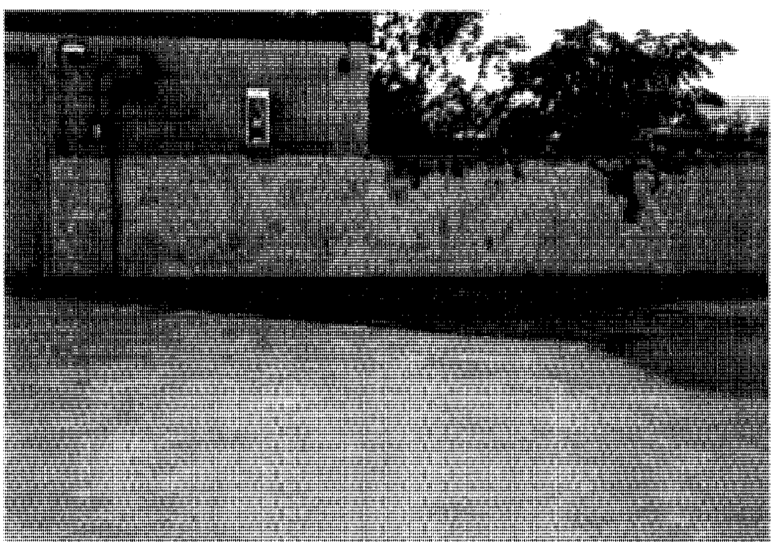
Photograph 26:

Deteriorated tendon anchor pocket at concrete slab edge.



Photograph 27:

Deteriorated tendon anchor pocket at concrete slab edge.



Photograph 28:

Poor drainage at the edge of post tensioned slab.

PARKING DESIGN CHECKLIST

I. Paul Lew, P.E., R.A., CAPP

I. Paul Lew is Senior Vice President and Principal of LZA Associates located in New York City. He is a Registered Architect, Professional Engineer and Certified Administrator of Public Parking. Surface and structure parking and intermodal facility design are just some of the areas in which he has developed an expertise. His creative and innovative designs have solved parking problems for transit agencies, municipalities, hospitals, universities and corporate clients. Mr. Lew has authored numerous technical papers and articles including: "A Parking Checklist", "Parking and Environmental Protection", "Commonly Accepted Parking Standards", "Planning and Guidelines for Intermodal Parking." An Adjunct Associate Professor at the New York Institute of Technology since 1980, Mr. Lew is a member of the PCI Committee on Parking Structures, National Parking Association, Parking Consultants Council, International Parking Institute, the New York State Parking Association, the Connecticut Association of Parking Agencies, and the Association of Parking Authorities of the State of New Jersey.

The "Design Guide for Parking Facilities" is a convenient source of information to the parking industry. A parking structure is a unique type of building. Although it has many of the same issues that a conventional building has, its design is complicated by the severity of the conditions it faces. Typically a parking structure is exposed to the elements and subject to the full range of temperature change.

A parking structure stores a vehicle that gives off toxic fumes and carries flammable fuel. As a result, fire protection and ventilation are a major factor in the cost of the facility, and designs that minimize these factors are more economical. The parking structure also has significant environmental issues. The issues are particularly manifested in aesthetics, traffic, air, noise and water quality.

A parking structure is the interface between the vehicle and the pedestrian. Both the driver and the pedestrian must be accommodated, even if their needs conflict. The parking structure is a storage structure that for most of the day has little pedestrian activity. As a result, security issues are significant to its operation.

In designing a parking structure certain parameters are either unique to it, or magnified in significance. In an effort to outline these parameters the following checklist was developed. This parking design checklist is **parking-specific**. It is assumes that normal and customary architectural and engineering design is being provided by professionals, and only those items that need special attention in a parking structure are highlighted in this checklist. The parking design checklist is concerned with the execution of a parking design, rather than functional planning for parking for which other sources are available.

Site Criteria

One of the greatest considerations in parking design is the site and site-related criteria. Points of access for pedestrians and vehicles are key to circulation both inside and outside the parking structure. Such issues as topography are useful in providing multiple level access, and depending on the footprint of the parking structure, what the appropriate circulation system should be. Furthermore, site zoning criteria such as setbacks and yard clearances are factors impacting the parking structure footprint.

These items dictate the shape and characteristics of a parking structure. If they are not addressed early in the design, the resulting parking structure may be untenable.

Site Functional Requirements

Typical rules of thumb for locating points of entry:

1. If possible, enter and exit at corners of the parking structure to avoid internal circulation conflicts.
2. Enter and exit away from corners of streets to avoid traffic bottlenecks (75 feet minimum, 150 feet preferable).
3. Determine the amount of traffic from each direction, and if traffic will have to cross other traffic to enter the parking facility.
4. Separate entries and exits will avoid many vehicular conflicts.
5. Entry/exit should be at least 75'-0' apart (150 feet preferable), if separated.
6. Counter clockwise internal circulation prevents entry and exit traffic from crossing each other at combined entry/exits.

The number and size of entry portals depends on entry controls and the peak traffic demands. Typical rules of thumb include:

1. For traffic, one unrestricted paired entry/exit per 600 cars per hour.
2. If gated controlled access, one paired entry/exit per 300 cars per hour.
3. Where there is a cashier booth with variable parking rates at exit, service rate is 150 cars per hour per booth.
4. If gated entry/exit has three lanes, they can handle 600 cars controlled access (middle lane reversible) without cashiering.

Special Zoning Issues Related to Parking

- Emergency vehicle access – Fire lanes or permanently open spaces may be required by code to construct large parking structures.
- Environmental assessment or impact statement may be required. Check with local authorities.
- Department of Transportation permits may be required for curb cuts. Start this process early.
- Easements for utilities – 14'-6' headroom clearance may be required for trucks.
- Storm drainage:
    - Oil water separators or sand filter requirements.
    - Increased drainage volume if originally unpaved lot.
    - Will interior floor drainage be considered sanitary whereas roof considered stormwater?
    - Is site in a coastal management zone or other environmentally sensitive area?
    - Temporary storage of storm runoff ("controlled flow") may be required.
- Are all yards, easements, and setbacks accounted for, including those needed to allow the structure to remain an open parking structure, i.e., fire distance separations and fire lanes?
- Water run-off quality:
    - Effect on adjoining property water quality.
    - Stream routing or culverts on property.
    - Typically no storm water runoff to adjacent property or street allowed.

Topography and Subsurface Conditions

- Location of ground water. Are contamination issues a possibility?
- Adjacent structures, foundations, basements. Is underpinning required?
- Underground utilities and easements.
    - Utility easements – headroom requirements for servicing.
    - Relocation potential.
- Toxic substrates – Disposal excavated toxic materials may result in excessive cost.
- Archaeological sites (e.g. artifacts, burial grounds) may stall or stop project.
- Capitalize on topography to provide multiple level access.

Classification of Construction

The fire classification under prevailing code is a key element to the economy of a parking structure. This is determined by whether the parking structure is an open or enclosed structure under the governing building code, and what fire rating, fire protection, and mechanical systems are required. In general, open parking structures do not require ventilation or sprinklers although the local fire marshal may overrule the State Building Code. An enclosed structure will typically require both fire ratings and sprinklers. Furthermore, an open parking structure typically has a lower fire rating requirement than an enclosed garage for the same footprint.

The following determines whether a parking structure is an open or enclosed structure and what fire classification it requires.

Open Parking Structure or Enclosed Structure

Figure 1 on the following page illustrates the issues involved in determining whether a parking structure is open or enclosed, and the determination of maximum allowable area and height:

- Number of sides or perimeter classified as open based on fire distance separations and percent of façade openness (typically at least two sides must be open).
- Street frontage – increases in allowable area due to additional street frontage or access ways (i.e., fire lanes).
- Increase in allowable area due to sprinklers and/or higher fire rating of construction.
- Usage
    - Autos only.
    - Autos and trucks – structure enclosed unless trucks fire separated from parking.
    - Vehicular servicing – enclosed unless fire separated from parking.
    - Mixed use (retail, residential, office) – Typically considered enclosed if other use is above, but may remain open if parking above or adjacent. Fire separation is critical. Some codes allow open parking below if properly fire separated.

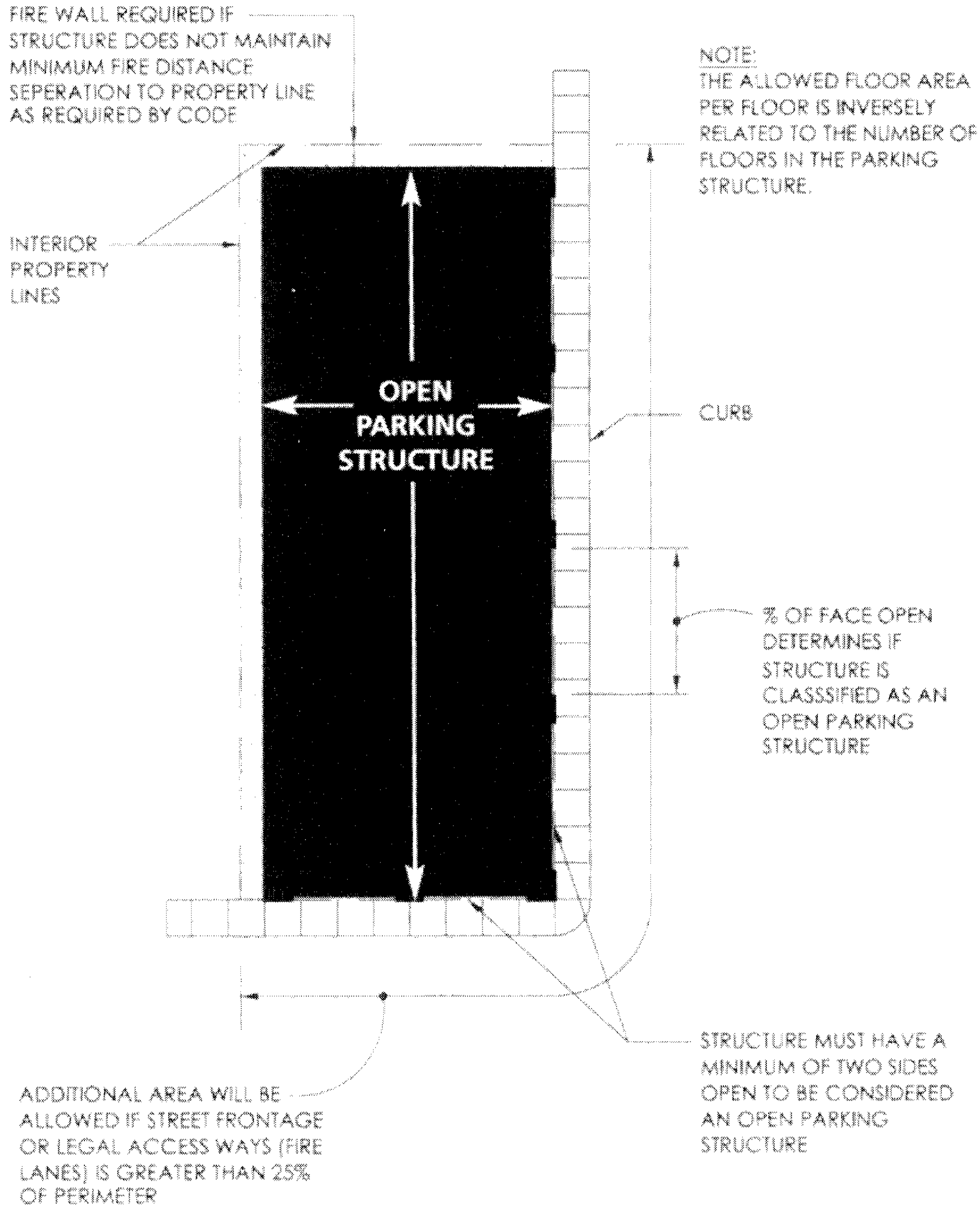


FIGURE 1

REQUIREMENTS FOR OPEN PARKING STRUCTURES

Construction Type Based on Fire Classification

- Minimum fire rating for size of floor footprint and height of facility – the most economical systems will be available with unrated (fire resistant) structures only such as precast and steel.
- Exterior façade or fire wall construction rating based on fire distance separations to property lines or adjoining buildings.
- Mixed use fire barriers including vertical separation to upper level uses.
- Basement or cellar levels have special requirements:
    - Determination of story above grade (in general a basement is less than halfway below grade and a cellar is more than halfway below grade level).
    - May require higher fire ratings and sprinklers if below grade.
    - May require ventilation if the level does not meet the definition of an open parking structure (typical for a cellar) but also could be for basement.

Vehicular Requirements

Designing for vehicular requirements must be the basis of any parking facility. These aspects include the exit and entry layout, together with the internal ramping and circulation within the parking structure. This checklist is concerned with the execution of a parking design once the parking stall, aisle size, and parking system are decided. There are many standards including those mandated by local codes available for parking stall sizes and aisle dimensions. The choice of parking system is subject to property footprint and circulation needs, and is subject to individual preferences.

Parking Standards

The following parking standards must be checked against the code for compliance.

- Are stall sizes, aisle widths, and angles mandated by zoning/building code?
- Choice of average car or standard and compact cars.
- What are the size, number, and location of the accessible stalls and the accessible van spaces (requiring more headroom as well as space) required by code?
- What are the percentage of spaces that can be compact according to the local code and user requirements?

Entry/Exits

Figure 2 addresses the planning of an entry/exit.

- Turning lanes.
- Queuing area.
- Reservoirs at Exits.
    - Do not allow entry and exit traffic to cross.
    - Can entries and exits be separated?
- Provide unobstructed sightlines from exit to street and sidewalk and minimize slopes at exit.
- Provide a minimum 20 foot flat area inside parking structure at entry/exit.
- Distance to street intersections (75 feet minimum, 150 feet preferred).
- Try to allow queue room at exit after gates to allow exiting traffic not to remain at gate.

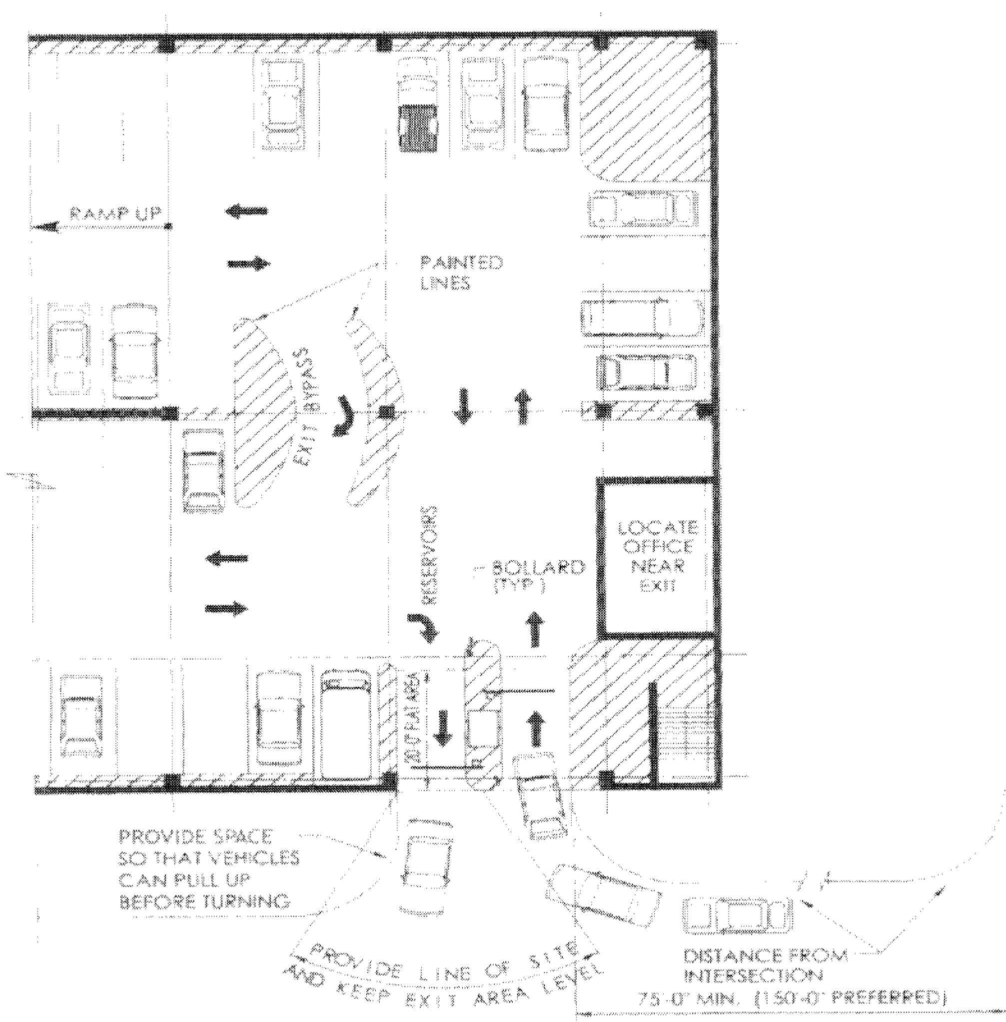


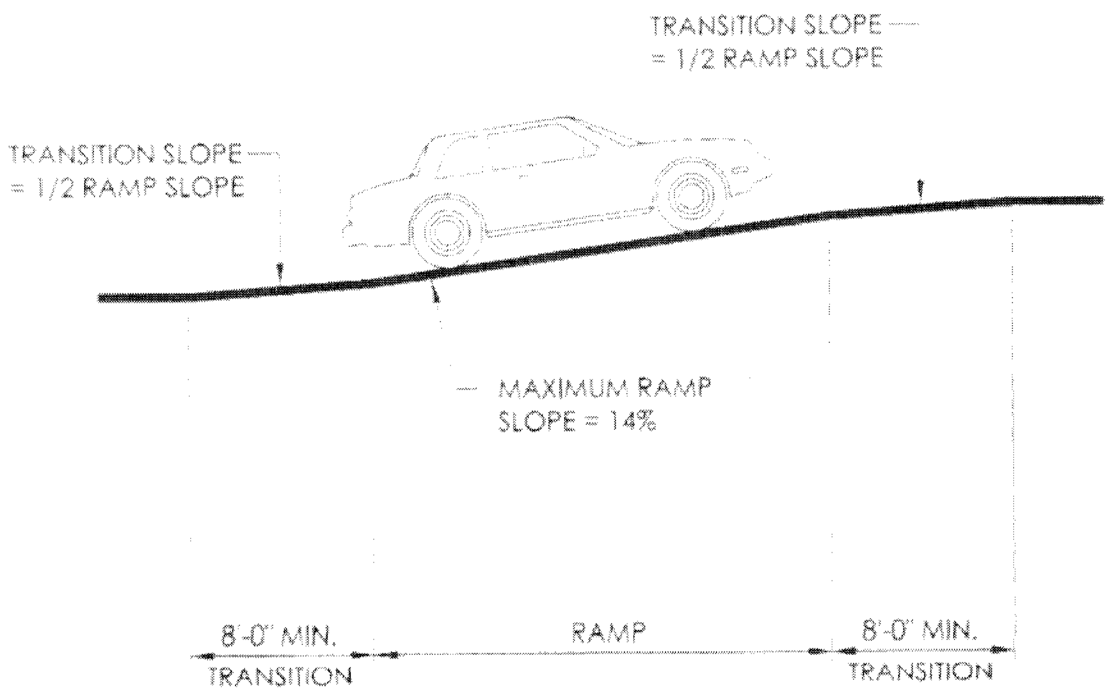
FIGURE 2
ENTRY/EXIT PLAN

Circulation and Ramping

The number of vehicle ramps are a part of parking planning. Rules of thumb are that one self-park ramp can serve up to 600 cars (where there is a bottom exit only) and no more than six 360-degree turns should be performed to get to top level. The choice of parking system is a function of the parking facility's footprint and whether there is access available at multiple levels. These are site-related issues. This checklist is concerned with the execution of a parking facility, once an appropriate parking system is chosen. There are many sources available to help in the selection of the appropriate parking system. However, minimizing ramping and creating the maximum level area is desirable both from a user and security perspective (although it may slow circulation unless express ramps without parking are used). Express ramps are typically used in larger parking structures to facilitate circulation but add cost to the parking structure since no cars are parked on the ramp.

- Turning radius (inner wheel) 15 feet minimum (20 feet preferred).
- Provide clearance for turn-around at dead-end.
- Slope of ramping
    - Self Parking: 6% maximum (5% preferred).
    - Vehicle circulation only: 10% maximum (9% preferable and 8% maximum if pedestrians use ramp with appropriate handrails) unless transition slope provided (14% maximum recommended with 8 foot, 7% transition zone at each end). Figure 3 illustrates express ramping for vehicles only. (Please refer to the following page.)
    - Break-over angle and transition ramps: Transition slopes are one-half main slope for ramp slopes over 9% for 8 foot minimum length at each end.
- Cross-slopes: 3% percent maximum – 2% preferable (required in accessible parking area).
- Spiral ramps (35 foot inner diameter with 15 foot width strong preference to circulate counterclockwise – driver on inside radius one lane traffic). Where clockwise is used a wider ramp (20 ft. +) is required.
- Pedestrian ramps limit slopes to 8% (10% with handrails non-accessible) and 5% for accessible slopes (see ADA code) unless special provisions are provided, then 8% accessible ramps allowed. It is advisable to provide a separate path for pedestrians on a steep no-parking vehicle ramp than have a combined vehicular/pedestrian ramp.

THE MAXIMUM RAMP SLOPE SHOULD BE 14%. FOR SLOPES OVER 9% A TRANSITION IS RECOMMENDED. THE TRANSITION MUST BE AT LEAST 8 FEET LONG AND SHOULD BE PROVIDED AT EACH END OF THE RAMP AT ONE HALF THE SLOPE OF THE RAMP ITSELF.



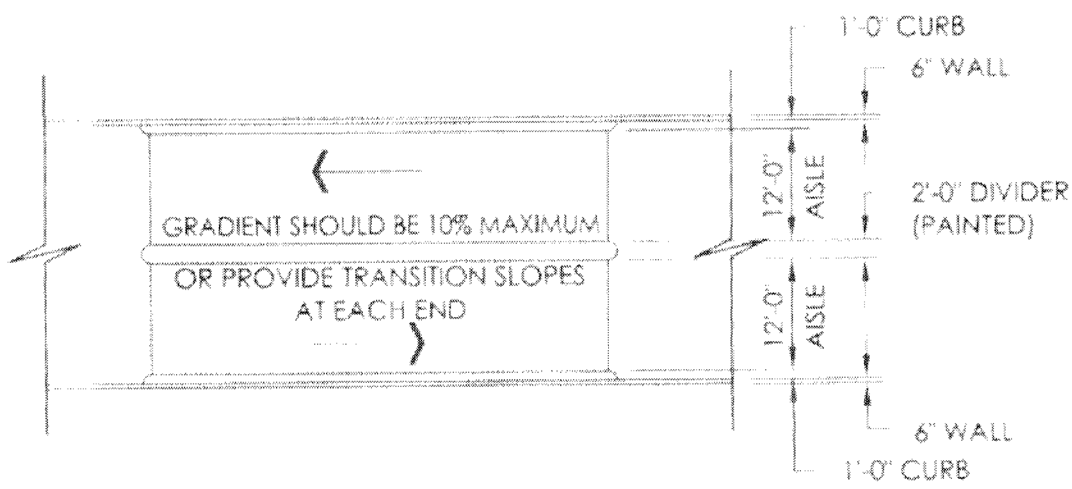


FIGURE 3
RAMP SLOPES

Pedestrian Requirements

The ultimate user of a parking structure is the pedestrian. The ease of access of the pedestrian to the destination will determine whether he will use a parking structure or not. The choice and design of the location of stair and elevator towers greatly affects the efficiency of the parking structure. In addition, the sense of security and actual security of the pedestrian is an important element of a parking structure. Finally, accessibility provisions are an important element of any parking design.

Entry/Exit Locations

- Adjacent to the pedestrian's destination.
- Locate stairs and elevators at corners of the parking facility. This will minimize the loss of parking spaces.
- Travel distances to required exits under the building code must be satisfied.
- Freestanding stair towers can provide additional glass exposure for security and provide an attractive design feature.

Elevators

Figure 4 on the next page illustrates typical elevator considerations:

- Hydraulic elevators are economical, but are typically limited to six stories in height. Traction elevators are faster but more costly.
- Accessibility requirements.
- Glass-backed exterior walls (safety glass) are used where security concerns warrant. To be an effective security measure, make sure view is to areas of pedestrian/vehicle activity on grade.
- Vandal resistant.
- Is elevator for exterior use? Sump pits are required for flooding but sump pumps can typically only be activated or even installed only when water is present.
- Lobby enclosures or open lobby (better for security if open).
- Ventilation of shafts and machine rooms:
    - Hydraulic machine rooms at bottom along side elevators shaft.
    - Traction machine rooms at top.
- Heating elevator machine rooms required by some manufacturers.
- Provide rooftop lobby enclosures to prevent snow and water accumulation.
- Make sure ground access to the elevator is protected from vehicular travel (5'-0" minimum pedestrian path recommended).
- Are two elevators necessary for maintenance or in the event of malfunction?
- Connection to emergency power and recall to ground level in event of a power failure.

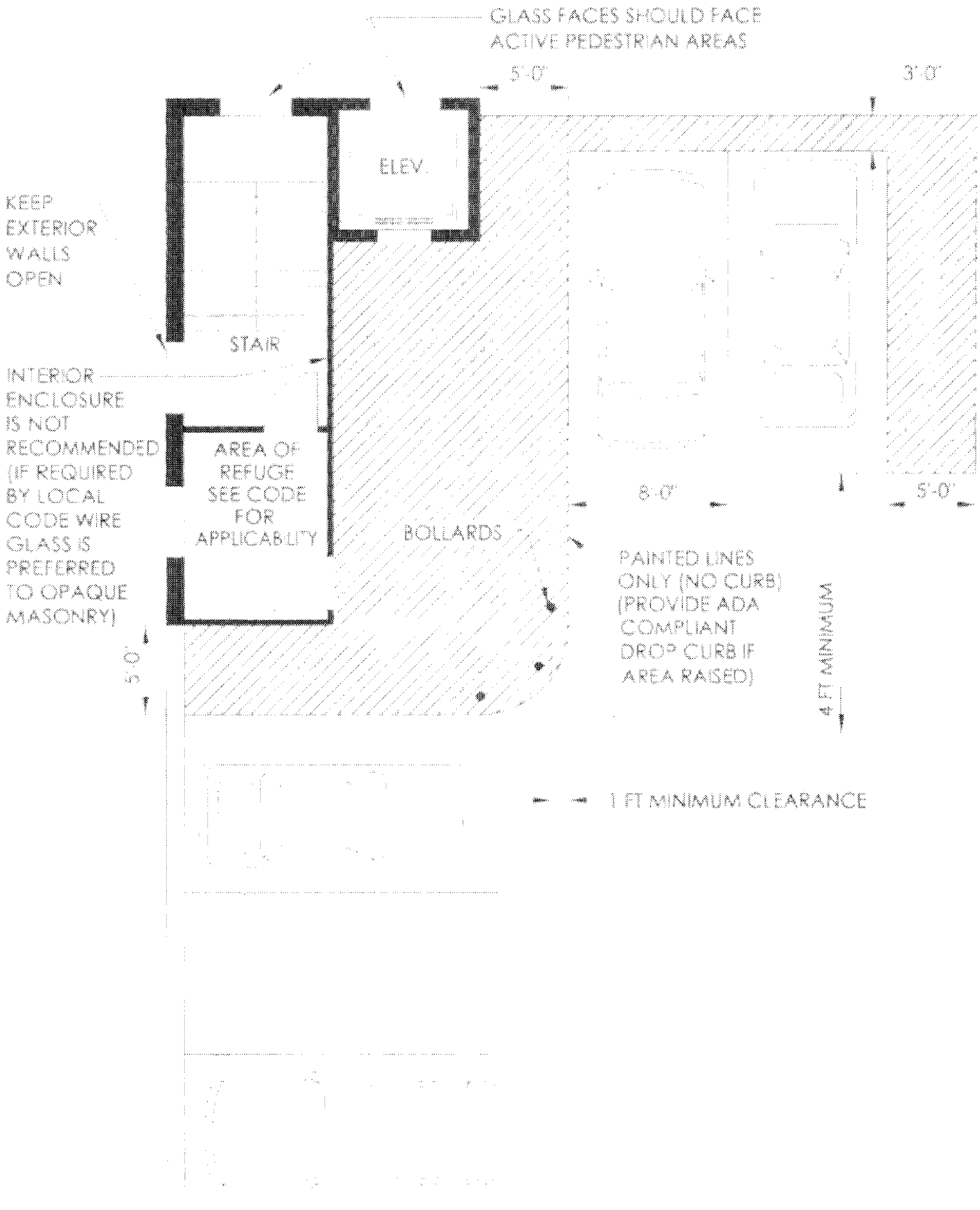


FIGURE 4

STAIR AND ELEVATOR ISSUES

Stairways

Figure 4 on the previous page illustrates typical stair issues including areas of refuge.

- Open or enclosed (check building code). If enclosed, try to provide maximum amount of glass (such as fire rated wire glass, even it if requires code variance) to enhance security.
- Number of exits controlled by exit travel distance in code. This travel distance based on location.
    - Below grade (smallest travel distance).
    - On grade (largest travel distance).
    - Above grade (basic travel distance).

Typically at least two exits per level are required (use of vehicle ramp as one exit is typically limited by code unless pedestrian path is provided). Exits should be as far apart as possible.

- Roof stair/elevator lobby enclosure must prevent snow accumulation and provide unencumbered access to exits.
- Exterior screen for snow accumulation prevention on stairs is recommended (if glass walls use safety glass).
- Close off potential concealment areas at bottom and top of stairways.
- Does the fire department require enclosed stairways to be pressurized during a fire?
- Enclosed emergency exit stairs should be alarmed if they are not part of main pedestrian access path.
- Direct pedestrians to stairs and elevators intended to be part of pedestrian access path.

Security Aspects of Design

- Short span construction is not recommended (columns between car stalls near rear wheels) unless there is a mixed used facility above the parking structure which requires close column spacing, such as a residential building. This construction type provides hiding spaces behind columns. However, it may be an overriding economic parameter to use short span construction when there are mixed-use buildings above the parking. Appropriate additional security measures should be taken where warranted.
- Eliminate hiding spaces (under stairs, etc.).
- Security fencing, if necessary, at grade should not be climbable. One story fencing minimum height, two stories where warranted.
- Landscaping should not provide hiding spaces or means of climbing to upper levels or obscure sight lines at exit portals.
- For lighting and security equipment see lighting/electrical section.

- See Elevators and Stairways for additional measures.

Accessible Parking

Typical Americans with Disabilities Act (ADA) code accessible parking issues are illustrated in Figure 5.

- Use ADA Code unless more stringent accessibility measures required by local code.
- Try to provide accessible parking spaces on grade to facilitate providing accessible route to destination.
- Locate spaces adjacent to elevators if above grade.
- Requirements for van access:
    - Larger space.
    - Higher headroom.
- Area of refuge for the disabled – is it required above grade by code? (Typically limited to where there are enclosed structures).
- Accessible parking spaces must be on slopes that are less than 2% in any direction.

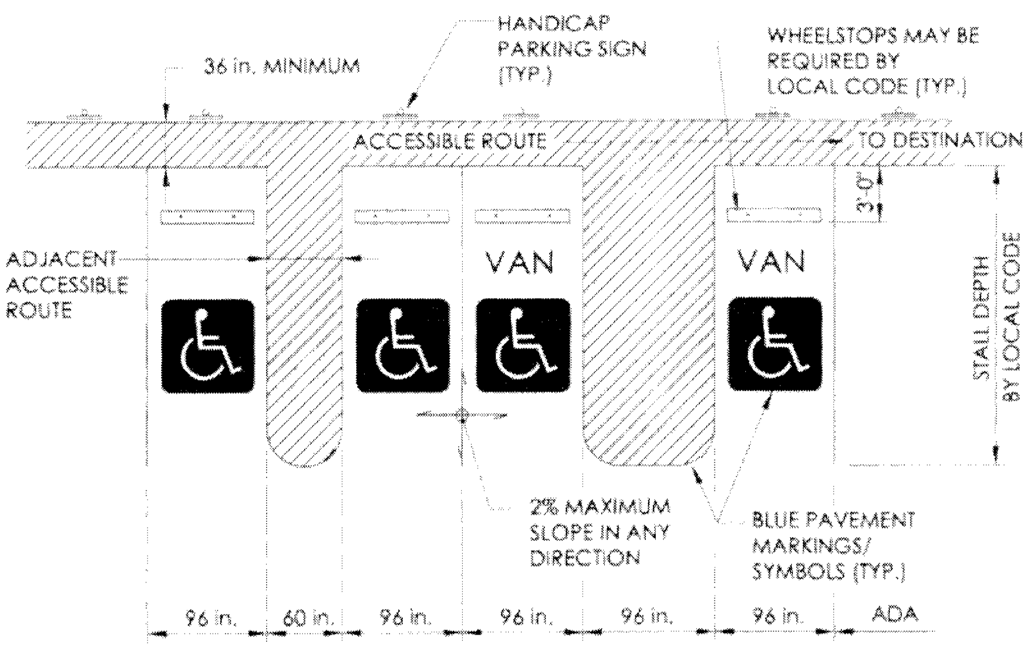


FIGURE 5

ACCESSIBLE SPACES

(Note: Local codes may require higher headroom for vans, additional signage and/or wider accessible aisles

Headroom

- Determine minimum headroom by code (7'-0" or 7'-6" typically). Remember parking is not a habitable space but it is an occupiable space.
- Accessible van requirements: Headroom is normally higher (8'-2" in ADA, local codes may be higher) for van parking. Vehicular path to and from van space must have same headroom as van parking space.
- If there is an accessible pedestrian loading zone, the headroom under the ADA is 9'-6". Local code may require higher headroom.
- Headroom clearance can affect structural loads. If excessive headroom is provided, floors must be designed for truck by code. (About 250 per square foot (psf) or more versus 50 psf for parking only).
- Are mechanical interferences reducing headroom (piping, etc.) extant? Locate mechanical piping as close to ends of parking bays as possible, or run through beams (typical for electrical conduits), and provide additional clearance for sprinklers if required.
- Headroom restrictors (head knockers) at entries. (Mandated by many codes to prevent truck access).
- Provide additional clearance at grade for fire standpipe interconnects or provide means for piping to go through beams. Drainage pipes should be connected below grade.
- Make sure all levels have same slopes and drainage. Where there are changes between floors, check headroom carefully for conflicts.
- Higher headroom has positive affect on user comfort level and signage visibility.
- Lighting should not normally protrude below beams, or have light cut off by closely spaced beams. Conduits can be sleeved through beams if conduit location can be coordinated.

Drainage

Drainage is one of the keys to the durability of a parking facility. Standing water will penetrate floors and if it contains salt from snowmelt (deicing salts carried in from the street on the auto chassis), corrosion will follow. Standing water will also turn to ice in winter. Designing for proper drainage goes beyond just sloping the floors to finding environmentally acceptable means of discharging the drainage water. Figure 6 on the following page provides a plan of typical drainage, plumbing, and fire protection systems in a parking facility.

- Minimum slopes and maximum drainage areas.
    - Slopes: 2% preferable (1% is used typically in precast and is based on the use of quality sealer on surface and the denser type of concrete normally associated with precast).
    - Area: 10,000 square foot maximum/6,000 square foot preferred.

- Provide drainage on all floors, not just roof.
- Is curbing required by code at openings?
- Conflicting drainage slopes on different levels reduce headroom. Try to maintain same slopes on all levels including on grade.
- Provide swales or curbs at edges of slab to channel water flow away from edges.
- Curbs are tripping hazards; swales are preferred.
- Avoid horizontal runs in drainage system pipes above grade to avoid water freezing in pipes unless pipes heat traced.
- Must roof drainage (storm) and floor drainage (sanitary) be separated according to local requirements?
- Include deflection and camber of beams in determining low points and slopes of levels.
- Make sure all drain leaders and pipe risers and protected against car vehicle impact.

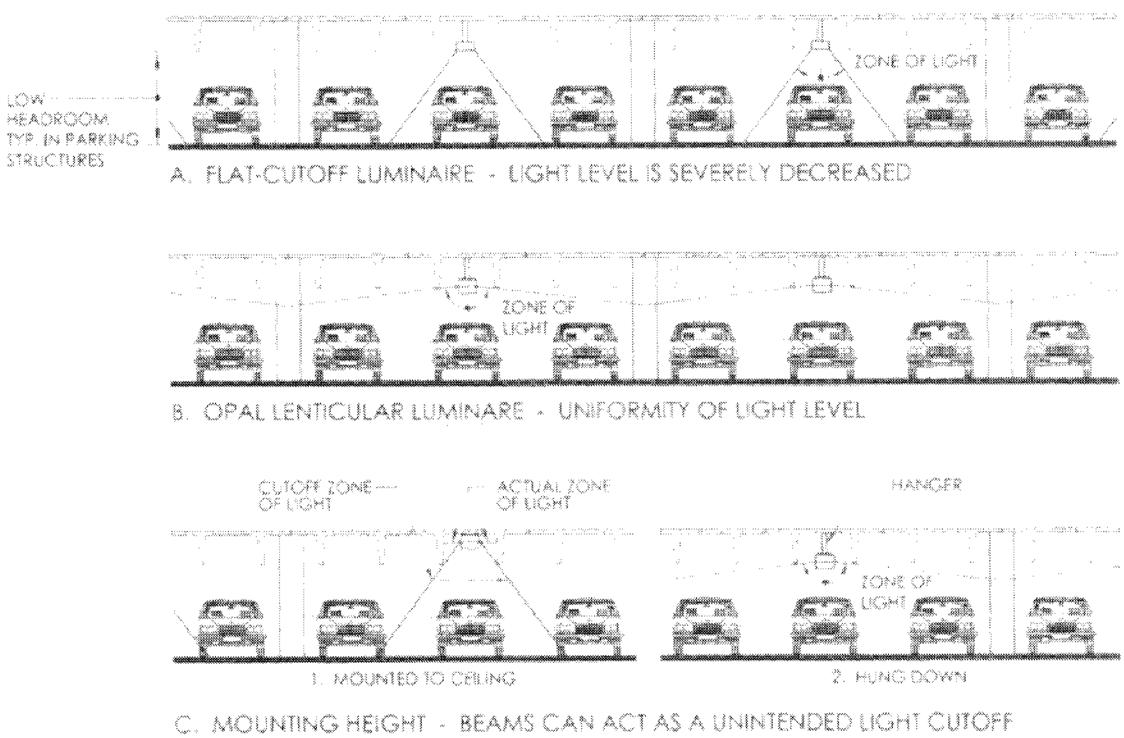


FIGURE 6

TYPE AND MOUNTING HEIGHT OF LUMINAIRES

Lighting, Electrical and Security Systems

One of the most important factors imparting a feeling of comfort and security within the parking structure is the lighting. Lighting systems, however, should not be a community eyesore. Lighting should have back-up systems, preferably including generators in case of emergency. Furthermore, there are various security systems that can be used to provide a crime deterrent within the parking structure.

- Lighting levels (I.E.S. Standards is a guide). Minimum 10 lux floors (roof 2 lux). Note: average on floors 50 lux. See IESNA RP-20-98. Provide higher lighting levels when circumstances warrant.
- At ramp entries, stairways, lobbies 20 lux. (500 lux at entry/exit during day).
- Check mounting height and beam shadows (depends on structural system).
- Use curved lens (opal lenticular fixtures to better distribute light within parking levels).
- Paint ceilings white to increase lighting levels via reflectivity.
- Isolux or point-by-point study on plans for lighting intensity are to be expected. All levels uniformity ratio 10 to 1 or less (max/min).
- Light fixture selection – high-pressure sodium provides good economic choice with fluorescent being acceptable in warmer climates. Metal halide provides truer light spectrum and is becoming more common.
- It is preferable to provide light over cars and not aisles. This is where pedestrians are most vulnerable.
- Lights in aisles increase glare to drivers.
- For economy, perimeter lights can be photoelectric switch to shut/off during daytime.
- Light spillage can be a community annoyance.
- Proper choice of light fixture with cut-off points to minimize light spillage.
- Emergency lighting systems:
    - Utilization: emergency lights mandated by code (Emergency Exit lights) and general lighting levels.
    - Use of back up emergency generators (preferable) or battery packs (requires insulation and heating in cold environments).
- Emergency lighting must be tested daily to ensure it is operational.
- Access control systems: Provide empty conduit for access control equipment (See equipment section).
- Communication network for monitoring cashiers at management office or central office (via modem).
- Security systems.
    - Screech alarms.
    - Motion detectors.
    - Panic alarms.

  - Video cameras with tape backup (VCR or digital). Must be monitored or gives false sense of security.
    - Located at entries; at lobbies, elevator cabs, and stairways; and in aisles.
    - Focusable and directional (pan/tilt/zone particularly effective on roof where headroom is not as limited).
    - Installation of cameras requires a major commitment of resources and must be carefully evaluated.
  - "Bluelight" Intercoms (two-channel, two-way, hands-free operation).
  - Make sure security is a visible deterrent.
- Vandal resistant lighting.
- Alarmed emergency only exit doors.
- Fire alarms.
- Uniformed patrol services where warranted.

Mechanical and Plumbing

Mechanical and plumbing systems are minimized in parking structures but still provide a crucial role in fire control. Ventilation is essential in a parking facility that is not open to the outdoors on any level that the building code would not classify as open.

Plumbing

- Sprinkler requirements are typically avoided in open parking structures, but mandatory in enclosed parking (use dry sprinkler system and vertical risers only, no horizontal runs, to avoid freezing).
- Standpipes and interconnects are normally required by code (use dry system).
- Hydrants or siamese connections for Fire Department. Coordinate location, size, and connections with local fire and water departments.
- Restrooms (public and/or employee only) and utility sinks. Public toilets are major security problem and should be avoided. ADA and local accessibility codes apply where provided.
- Hose-down requirements (1½" line recommended but smaller lines used) with access at each level for wash-down of floors. Provide freeze protection and drain out capability.
- Provide additional headroom for pipes unless location adjacent to walls. Many pipes cannot be sleeved through beams effectively due to slopes for pipes to drain.

Mechanical

- Ventilation required if enclosed parking structure.
- Carbon monoxide monitors (underground or enclosed garages).

Structural Loadings Specific to Parking

Parking structures are unique structures. Their primary loads come from vehicles rather than people. All the floors in a parking structure are exposed to the elements. As a result of these factors a parking structure must carry a unique set of loads that may not be fully described in the building codes.

Usage

- Parking only (typically 50 psf).
- Trucks (may be mandated by code if excessive headroom) use AASHTO design specifications.
- Snow on roof additive to Live Load.
- Snow Storage on roof (Five times snow load suggested).

Railing Design and Vehicle Impact

- Car impact (by code) or use 10,000 lbs. Ultimate load per vehicle at 18" above floor level (if not covered by code).
- Truck impact (if applicable, use AASHTO).
- Pedestrian railings typical 3'-6" high with 4" spacing of rails to prevent children from getting stuck. Pedestrian loading typically 50 lbs./ft. or 200 lbs., whichever is greater. See codes for pedestrian railing loads. Based on new interpretation in some building codes, railings may have to be vertical and not horizontal to prevent ladder-like condition.
- Wheel stop requirements – wheel stops are a maintenance problem for sweepers and tripping hazard, but may be required by code.
- Will façade or walls take vehicle impact (provide bumpers to distribute impact)?
- Use bollards to protect equipment and pedestrian areas (make sure they are properly anchored to structure, and structure is designed for the load).
- If barrier cables are used, cables should be galvanized or have a protective wrapping for its entire length to its anchorage. Properly anchoring barrier cables and resisting anchor forces requires specific engineering.

Snow Loads

- Must be added to parking live load (not in lieu).
- Designated roof snow storage areas require heavier loads (Five times snow load suggested).
- Snow removal instead of storage areas, options:
    - Melting.
    - Chutes.

- Removal by pick-up trucks.
- Damping over side, where permitted.

Future Expansion

- Vertical expansion – present design must include allowance for wind (or earthquake) load for future levels as well as the future gravity load.
- Horizontal expansion – preferable if enough land is available (façade panels at interface must be removable).

Thermal Forces

- Parking structures experience the full range of thermal temperatures. Resisting thermal forces is difficult; releasing them is recommended via expansion joints.
- Provide expansion joints at:
  - 200 foot maximum to minimize forces (maximum 300 feet with pour strip) for cast in place concrete. For untopped precast systems not in the direction of prestress precast expansion joints may be spaced at 300 feet and at 225 feet in direction of prestress.
  - At abrupt changes in plan.
- Put stiff elements only at center of resistance of each sector between expansion joints to allow free expansion at ends.
- All facades must breathe – provide slip connections at one end of each panel unless part of structural system.

Construction Quality and Details

The quality of construction and construction details are keys to the longevity of a parking facility. Parking structures are in a hostile environment due to the elements and waterborne salts. As a result, great care should be exercised both in selection of systems and details.

Concrete Criteria

- Air entraining (4 to 6%) well dispersed.
- Corrosion inhibitors can be used but under strict guidance from supplier.
- Microsilica (Silica Fume) cement decreases permeability of the concrete.
- Epoxy-coated reinforcing reduces corrosion but requires longer lengths of steel reinforcing due to reduced bond to concrete. Epoxy coating is one of the first options used because it is passive protection, but care must be used in

construction not to damage the coating. Corrosion may actually be accelerated where the epoxy coating is damaged.

- Pre-stressed and post-tensioned concrete are strongly preferable to conventionally reinforced because they precompress the concrete and prevent cracking.
- Precautions in protecting tendons in post-tensioning:
    - Encapsulation of tendon and anchors.
    - Anti-corrosion grease.
- Increase concrete top cover to reinforcing in snow areas (minimum 2" unless epoxy-coated reinforcing or anti-corrosion additive in concrete).
- Crack prevention follow American Concrete Institute (ACI) cover and spacing specifications.
    - Provide minimum ACI reinforcing for shrinkage or use prestressed/post-tensioned concrete.
    - Elimination of restraints mandatory. Place structural lateral resisting elements near center of resistance of system. Isolate stiff towers away from corners or make towers flexible.
    - Construction joints should be caulked.
    - Avoid building slabs integral with foundation walls (this prevents slab movements). This is critical in post-tensioned concrete and prestressed concrete. Use perimeter shrinkage strips where isolation from wall is not reasonable for conventionally reinforced slabs and leave as much time as possible for slab to shrink before pouring shrinkage strips.
- Low water/cement ratio (0.4 or lower).
- Embedded steel must not promote galvanic action.
- Additional criteria are available in the American Concrete Institute guides.
- Use of polypropylene fibers in the concrete helps prevent plastic shrinkage cracking.

Expansion Joints

- Number and location (see Thermal Forces).
- Durability of joint system.
    - Edge preparation.
    - Snow plow damage (rubber tipped plows should be used).
    - Can cross movements (parallel to joint) of structure be accommodated?
    - Ultraviolet light deterioration and aging characteristics.
- Expected movement: Factors to consider include:
    - Thermal.
    - Shrinkage.
    - Elastic and creep concrete movement.

    - Structural movement-wind and earthquake.
- Center of expansion may not be center of structure. (Find center of rigidity of structure).
- Use temporary shrinkage strips to reduce movements to be considered.
- Tripping hazards.
    - Expansion joints/control joints particularly in untopped precast can be tripping hazards-limit differential elevations on each side of joint to ¼" to meet ADA code.
    - The actual expansion joint system may create a tripping hazard for high heel shoes and should be investigated. Sliding plates over expansion joints are sometimes used particularly with larger (seismic joints).

Surface Treatments

- Curing – moist curing is the most effective.
- Floor sealers are typically required and need periodic resealing.
- Membranes
    - Above commercial space.
    - At high traffic areas.
    - In non-prestressed or non-post-tensioned systems.
    - For additional protection plaza membrane system are used which are below a protection slab.
- Finishes – broom finish typical.

Aesthetics and Community Involvement

Parking structures have an image problem. They are considered utilitarian buildings that are often unsightly. As a result of this image problem, parking structures can experience significant resistance from communities in seeking approval for their construction. Certain approaches have been successful in overcoming this image problem and creating an aesthetically acceptable solution. Some aesthetic approaches are outlined below:

Aesthetics

- Horizontal facades preferable. (Ramps on exterior-facades generally have a negative visual impact).
- Retail use of ground floor street frontage.
- Stair and elevator towers can provide aesthetic impact for relatively low cost (can be treated as a glass jewel tower).
- Landscaping and berms.

- Suitability to community (regional materials).
- Limit height of rooftop light-poles and put rooftop light-poles out of street line of sight.
- Rooftop landscaping.
- As a result of reductions in the amount of openness required in new building codes, it is possible to have a façade with windows versus the typical horizontal band openings of parking structures.

Graphics and Signage

- Use universal symbols together with text.
- Wall and ceiling signs.
    - Check line of sight to sign, particularly an issue with precast structural systems which have beams very closely spaced (4-6 feet on center).
    - Check level of lighting of sign.
    - Size of letters: 6" minimum height if to be read by occupants in vehicle.
    - Style: Helvetica most common.
    - Short single messages. Do not have sign congestion.
- Floor signage: directional arrows, compact, and accessible space signs.
- Floor striping.
    - Stripe short of full car depth (typically – 2 ft.) so car pulls all the way in.
    - Stripe accessible areas in blue and accessible aisle and path between accessible spaces.
- Backlight signage at entry/exit is common.
- Differentiate between signs to be read in vehicle (6" lettering) and as pedestrian (3" letters as per ADA for overhead signs).

Maintenance

- Pigeons love architectural edges: their wastes are destructive. Consider preventive measures and designs, including spikes and grating over areas where they would roost.
- In hostile environments (air pollution) choose materials that weather gracefully.
- Water borne debris leaves residues and streaks. Façade design should not channel water.

Office/Booth Requirements and Equipment

The operation of a parking facility depends on its employees, the equipment and the maintenance of the facility. Each of these factors requires special concern in the design of a parking facility.

Office and Booth Requirements

- Equipment – monitoring booths, registers (revenue control systems) and modem to central office.
- Security (safes, drop safes, panic alarms (foot or buttons), cash counting rooms).
- Restrooms (public or private).
- Mechanical/electrical rooms/elevator machine rooms.
- Telephone rooms/communication conduits.
- Files.
- Storage of maintenance equipment (sweeps, snow melting materials, etc.).
- Air conditioning (becoming more prevalent in booths), heating and ventilation.
- ADA booths (first booth must meet ADA).
- Security equipment/monitor room (provide visible deterrent) and preferably provide a separate locked tape recorder room with limited employee access.
- Booths should be air conditioned, heated, and preferably bulletproof.
- Video cameras in booths provide security and deter theft.

Equipment

Depending on the type of operation, there are many suppliers to help in the selection of access control and revenue collection equipment. The following is a list of typical equipment used in a parking operation:

- Ticket Issue Machine (Ticket Spitters).
- Card readers.
- Cashier booths (including ADA compliance).
- Gates.
- Loop Detectors/Treadles.
- Prepay systems.
- Meters (single, dual, master meters).
- Fire extinguishers (normally stolen).
- Proximity readers (including Automatic Vehicle Identification).
- Electronic variable message signing.
- Traffic control equipment.
- Electronic space locations.

As the parking industry enters the new century, many of the basic design considerations remain the same. However, technology moves ahead and its impacts on parking need to be addressed. This paper affords the reader with a checklist of basic issues to be aware of regarding parking structure design in the 21^{st} century.

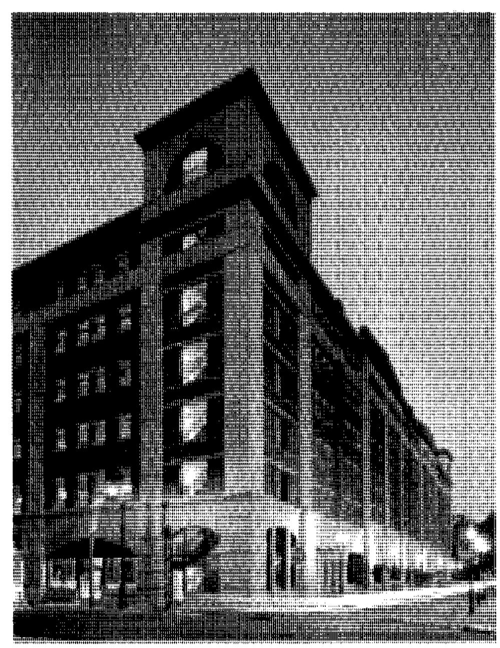
STRUCTURAL SYSTEM SELECTION – WHICH IS RIGHT FOR YOU?

Gary Cudney, P.E.

Gary Cudney, President of Carl Walker, Inc., has extensive parking consulting experience including parking studies and investigations, site evaluation/feasibility for parking expansion and economic evaluation, functional design, parking planning, security, revenue and operating control systems, and structural design. His experience in structural engineering includes the design of cast-in-place post-tensioned, precast concrete, and steel framed structures utilizing state-of-the-art technology for design of durable, low maintenance parking facilities.

Introduction

What structural system is right for a new parking structure? The answer is ...IT DEPENDS! This chapter will compare the primary structural systems used in parking structures so owners, parking professionals, structural engineers, and architects can be better informed to make this important decision. This investment decision is crucial because the structural elements make up about two thirds of the cost of a new parking structure, and a significant portion of the maintenance budget. Several alternative structural systems are described below and their advantages and disadvantages are presented. Key factors that should be considered when selecting the structural system are also presented.



Modern parking structures are often architecturally enhanced.

The primary structural systems used in parking structures today include:

- Cast-in-Place Post-Tensioned Concrete Systems
- Precast Concrete Systems
  - Field Topped Double Tees
  - Pretopped Double Tees
- Steel Framed Systems
  - Cast-in-Place Post-Tensioned Concrete Floor Slabs
  - Precast Concrete Floor System

The Ideal Structural System

The structural system is one of the most important components of a parking structure. The structural engineer typically recommends what structural system should be selected to the owner, who then must decide which system best meets his objectives. The ideal structural system should have good quality, be highly durable with low maintenance costs and would have the following characteristics:

- Meets owner preferences
- Product and labor availability
- Suitable to achieve project objectives
- Economical first cost and low life cycle maintenance cost
- Minimal construction schedule
- Addresses user acceptance issues
- Achieves structural engineering requirements

Meets Owner Preferences

Many owners have existing parking structures or have some knowledge of parking structure construction, so they have developed a preference for a specific structural system. They may have had a good or a bad experience with a particular system that influenced their opinion. Further, previous experience with one structural system may lead an owner to prefer to build a new structure using the same system for consistency. Owner preferences should be determined at the beginning of the project.

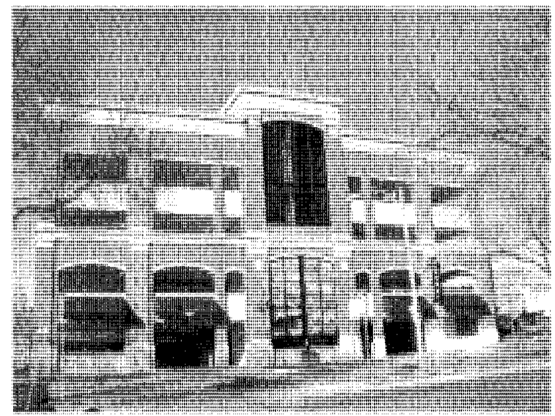
Product and Labor Availability

Product and labor availability are two of the most critical issues in selecting the structural system. Product availability usually is a critical issue with precast concrete. Precast concrete may not be economical for the geographic region of the project if there are no precast plants in the area. Further, other large precast projects in the area may have local plants booked solid. In this case, the owner may receive no bids at all, or if bids are received, they may be too costly for the budget. Labor availability usually is a critical issue with cast-in-place concrete, since large concrete projects in the area may have all qualified concrete workers employed. In this case, the owner would most likely receive bids for the work, but the quality of the finished product may not be acceptable. Also, there may not be qualified contractors in the area to install post-tensioning tendons or to place and finish quality cast-in-place concrete.

Suitable to Achieve Project Objectives

Whether the structural system is suitable to achieve project objectives can take many forms. Questions to consider include:

- Is the system capable of long spans for both efficiency and functionality?
- Is there access room for a crane suitable to erect precast concrete?
- Is the site accessible by trucks carrying the large precast concrete members?
- Is the structure's shape too irregular for precast concrete?
- Does the material meet the architectural treatment goals?
- Is the garage part of a multi-use facility with occupied space above?



Attractive architectural treatment is often a project objective.

The list could be longer, but each of these questions may expose a "fatal flaw" that should be given strong consideration in the structural system selection.

Economical First Cost and Low Life Cycle Maintenance Cost

The cost of the project takes two forms: first cost and long term costs for maintenance. First cost is the cost of construction. Depending on the geographic location, the first cost may be lower for one system over another. In many areas of the country where the cost of labor is high and trade unions are strong, precast concrete is more economical. There are other regions where strong cast-in-place concrete contractors have invested in formwork and efficient production processes so that cast-in-place post tensioned concrete is more economical.

Some owners are more driven to select the lowest first cost structure and are less concerned about the long-term maintenance costs. This is often true if the owner does not intend to own the property for an extended period. It is also sometimes true for owners who intend to hold the parking structure for its entire life, but desire to keep costs to the absolute minimum. Unfortunately, a lower first cost structure may result in maintenance costs that far exceed the initial savings compared to building a higher quality, more durable structure.

Life-cycle maintenance cost is the total cost over the life of the parking structure for maintenance. When comparing alternative structural systems, a life-cycle maintenance cost analysis may be used in combination with the estimate of construction cost to determine the most economical system over the long term. Often the lowest first cost structure does not have the lowest life-cycle maintenance cost. This analysis can also be used to evaluate which durability features to include in a new parking structure based strictly on a cost benefit assessment.

The analysis must be specific to the project and address local conditions that effect availability, suitability, cost, quality, schedule, etc. We are often asked how long a parking structure should last? Today, a new parking structure designed with quality and durability in mind and effectively maintained should have a life span of about 50 years before major structural repairs are necessary. Thus, life-cycle maintenance costs should be determined over the 50-year life and brought back to present value costs for comparison with alternative structural system costs.

Minimal Construction Schedule

The axiom that "time is money" is typically true for construction projects. Thus, the structural system selection is often heavily influenced by its construction schedule. This is often the case when a parking structure is being constructed on an existing surface parking lot and the goal is to minimize the time span where the parking is lost at that location. The project schedule may also be driven by tenant occupancy dates, the start of school, the beginning of the holiday season, or the need to be complete before winter. The time of the year when construction starts may also influence the structural system selection. Winter concrete construction is more difficult and costly in cold regions, and summer concrete construction is more difficult and costly in hot regions.

Addresses User Acceptance Issues

Parking facility users are more accepting of parking structures that are easy to drive through without obstructions from walls or other concrete elements. Interior walls that block visibility and openness are also a negative. Users prefer facilities with a higher perceived vertical clearance from the floor to the bottom of the concrete beams so that it doesn't seem like they need to duck every time they drive or walk beneath a beam. The vertical clearance and spacing of the beams also affects the visibility of signage and distribution of lighting. The structural system also affects user acceptance if there is perceptible vibration of the floors and puddles of water due to poor drainage. Another structural impact on user acceptance is the spacing of columns. They should be located so that they are not between parking spaces encumbering vehicle access in and out of the stall, interfering with door opening clearance, or blocking the walking path between parked cars.

Achieves Structural Engineering Requirements

The structural system must achieve the engineering requirements in an efficient and cost effective manner. This might include the following:

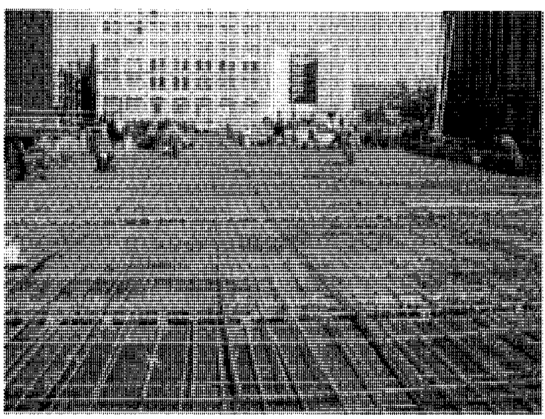
- Ability to provide longer spans for column-free parking modules.
- Ability to support the floor loads. This is more of an issue if there are heavily loaded areas integrated into the parking structure such as loading docks, fire truck access, bus access, etc.
- Meet the depth requirements for beams to achieve required vertical clearance.
- The lateral load resisting system must withstand wind and seismic forces, and for underground parking structures it may need to carry lateral forces from the earth retaining walls. New code requirements have made the design for seismic loads much more complex than in the past. Moment frames typically carry lateral loads in cast-in-place post-tensioned concrete structures. These frames use the same beams and columns used to carry gravity loads. However, shear walls typically carry lateral loads in precast concrete structures. The shear walls can be problematic because if they are located at the exterior of the structure, they affect the architecture. If they are located at the interior they can affect openness and visibility, reduce the parking space count, and interfere with vehicular turn clearances.
- The structural system must meet the durability criteria for the project. Parking structures are like bridges in that they are exposed to freezing conditions, extreme heat from sun exposure, rain and snow, and deicing salts. Durability elements include:
    - Positive drainage
    - Either prestressed or post-tensioned concrete to minimize concrete cracks
    - Corrosion protection of reinforcing bars and connections
    - Minimal water penetration through slab cracks and joints
    - Quality concrete to resist freezing conditions
- Maintain floor vibration within acceptable limits for user comfort.
- Attain code required fire resistance ratings of structural elements.

By now, you are probably wondering to what extent each of the primary parking facility structural systems achieve the ideal structural system characteristics described above. In the following section each of the systems is described in no particular order and their advantages and disadvantages are presented.

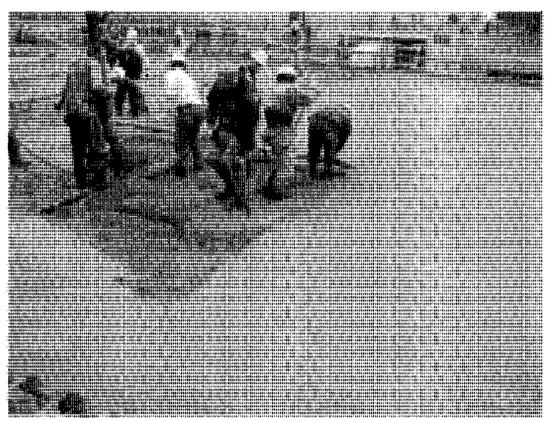
Cast-in-Place Post-Tensioned Concrete

Concrete truck and concrete pump at cast-in-place jobsite.

Cast-in-place post-tensioned concrete refers to a structural system where the concrete is delivered to the job site in concrete trucks, placed into wood and steel forms in which the rebar and prestressing tendons are installed, and then the concrete floor slab is finished to create a uniform broom finish, and lastly the concrete is cured until it reaches the required strength. Two or three days after placement, the concrete strength is sufficient to post-tension the prestressing tendons. "Post-tensioned" means that the tendons are stressed after the concrete is placed, resulting in the concrete being precompressed to mitigate tensile stresses and cracking. Post-tensioning tendons are typically isolated from the concrete by a plastic encapsulation assembly filled with corrosion resisting grease. This assembly must provide a waterproof environment for the tendon in areas where freezing whether occurs. The columns, beams, and floor slabs are monolithic so there is only a small quantity of sealant joints. Typically, the columns and beams are spaced between 20 and 27 feet and slabs are six to seven inches thick. Cast-in-place post-tensioned concrete has the following advantages and disadvantages when compared to the other primary parking facility structural systems.



Plywood formwork, epoxy coated rebar, and tendons on cast-in-place deck.



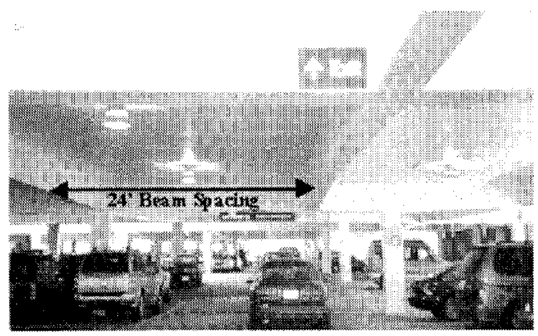
Placing and finishing of cast-in-place concrete parking structure

Cast-in-Place Post-Tensioned Concrete Advantages

- Monolithic construction so fewer sealant joints
- Positive drainage is easier to achieve
- Floor vibration generally imperceptible
- Post-Tensioning forces reduces cracking in slabs
- Flexible column spacing of 20'-27'
- Generally no shear walls except in high seismic zones or very tall structures.
- Lower maintenance costs due to less joint sealant upkeep
- Wider beam spacing creates a more open feeling with higher perceived head room, better signage visibility, and more uniform lighting distribution
- More accommodating for unique structures with irregular shapes, circular helix ramps, underground parking structures, or parking structures beneath other buildings.
- Can be performed by local subcontractors in many cities

Cast-in-Place Post-Tensioned Concrete Disadvantages

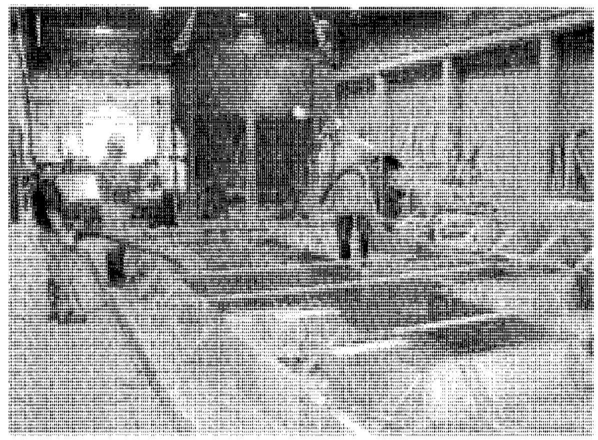
- Potentially higher construction cost in some regions of the country, particularly in areas where field labor costs are high
- Quality control is more difficult to attain due to exposed weather conditions
- May require architectural cladding to improve exterior aesthetics
- Slightly longer on-site construction schedule
- Less adaptable to winter construction in freezing climates
- Closer expansion joint spacing
- Congestion of tendons and rebar at beam column joints
- Slightly larger on-site staging requirement



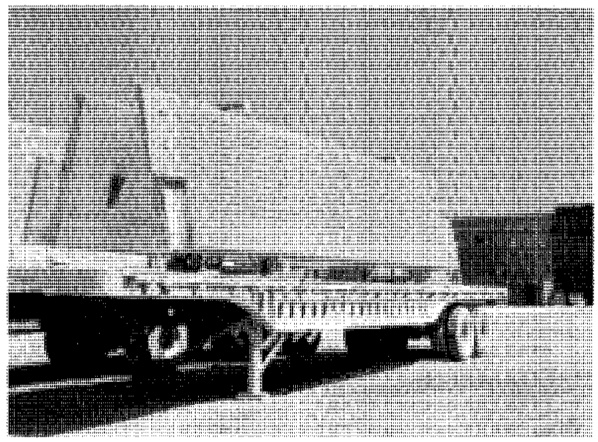
Open, well lit, painted cast-in-place parking structure.

Precast Concrete

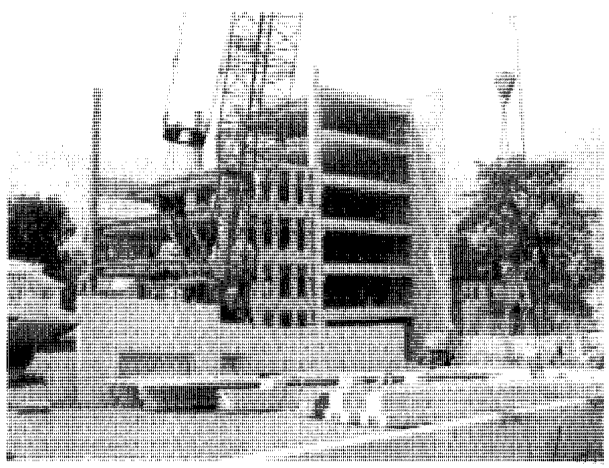
Precast concrete refers to concrete members that are fabricated in a plant and shipped by truck to the project site where the individual members are erected to provide a complete structure. The precast members commonly consist of columns, beams, spandrels, shear walls, lite walls, and double tees. The double tees are the floor deck members, which in appearance look like two T's side by side when viewed from the end. The top, horizontal surface of the double tee is called the flange and the vertical legs are called the stems (please refer to diagram below). The double tees are "pretensioned", meaning that the prestressing tendons are stressed before the concrete is placed in the forms. The double tee floor deck can be either field topped or pretopped. Most precast concrete producers offer either a 10 or 12 foot wide tee, although there are a few producers who produce a 15 foot wide tee. Column spacing is most economical when a multiple of the tee width is used such as 30 feet for 10 foot tees or 36 feet for 12 foot tees. Precast concrete has the following advantages and disadvantages when compared to the other primary parking facility structural systems.



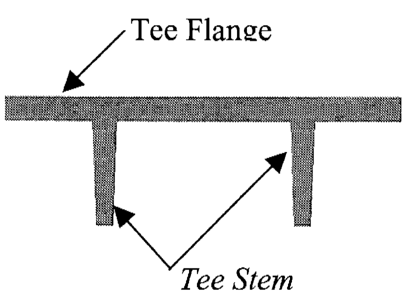
Precast concrete member fabrication at the precast plant.



Precast concrete members ready to be trucked to the job site.



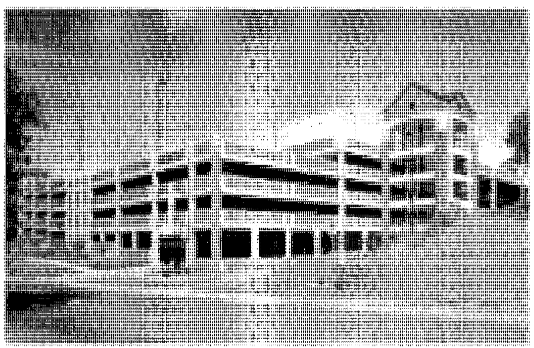
Precast concrete parking structure being erected at the job site.



Precast concrete double tee viewed from the end.

Precast Concrete Advantages

- Quality control because members are fabricated at a plant that should be certified by the Precast/Prestressed Concrete Institute
- Potentially lower construction cost in some regions
- Shorter on-site construction schedule
- Greater expansion joint spacing (i.e. up to 300 feet)
- More adaptable to winter construction
- Architectural façade spandrels also serve as structural load bearing elements

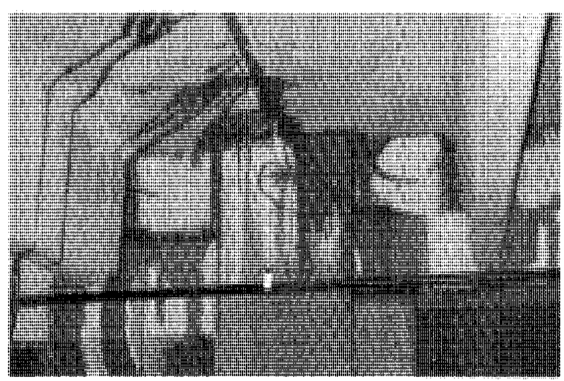


Precast concrete parking structure with load bearing façade spandrels.

Precast Concrete Disadvantages

- More propensity for leaking at the joints between tee flanges (i.e., every 10 to 12 feet)
- Higher maintenance cost for sealants
- The tee stems (vertical elements) are spaced five to six feet on center and are generally just over seven foot clear above the floor. The close spacing of the tee stems creates the perception that the ceiling height is lower and the stems can block visibility of signage and interfere with lighting distribution
- Wind and seismic lateral loads are resisted by shear walls or shear frames. At the exterior of the structure they affect the architecture. At the interior they can reduce the number of parking spaces achieved, reduce visibility and openness, and interfere with vehicular turning maneuvers.
- Reduced drainage slopes
- More bird roosting ledges
- Might not be performed by local subcontractors in many cities

Field topped double tees typically have a two inch thick flange and then a three-inch thick cast-in-place concrete topping is placed over the tee at the project site after the precast is erected. The topping becomes the top surface of the floor. Many owners, engineers, and precast concrete manufacturers prefer field topped systems over pretopped tees because of the advantages offered as shown below, even though it may have some cost and schedule implications.



View of underside of a leaking precast structure caused by failed joint sealants.

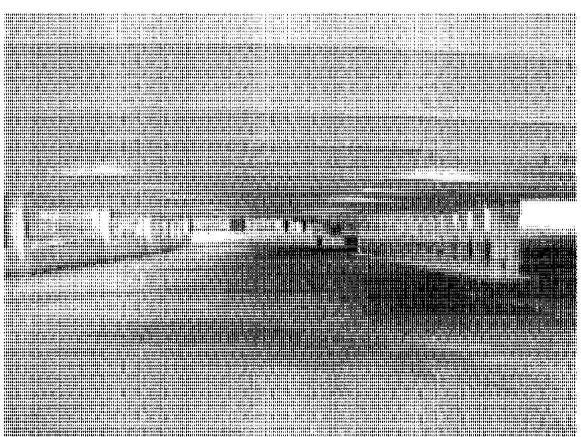
Field Topped Double Tee Advantages
- Better drainage achieved
- Less floor vibration
- More forgiving during erection to correct problems with misaligned connections, repair of cracked tee flanges, or differential member camber
- More consistent and durable tee to tee joint sealants as they are tooled into the topping
- Lower maintenance costs

Field Topped Double Tee Disadvantages
- Potential in some regions of the country to have a higher construction cost
- Slightly longer construction schedule

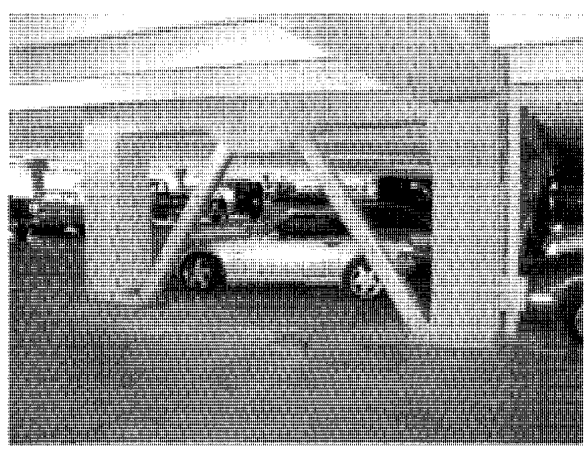
Pretopped double tees typically have a four-inch thick flange. The top of the pretopped flange is the top surface of the floor. Commonly there is a cast-in-place concrete pour strip around the perimeter of the floor to cover connection hardware or to create sloped drainage washes. Many owners, engineers, and precast concrete manufacturers prefer pretopped systems because of the potential cost and schedule advantages compared to field topped precast despite the disadvantages shown below.

Pretopped Double Tee Advantages
- Potential in some regions of the country to have a lower construction cost, particularly in areas where field labor costs are high
- Slightly shorter construction schedule
- Higher quality control as there is little on-site concrete work

Pretopped Double Tee Disadvantages
- Positive drainage is more difficult to achieve
- More noticeable floor vibration
- Less forgiving during erection to correct problems with misaligned connections, repair of cracked tee flanges, or differential member camber
- Less consistent and less durable tee to tee joint sealants with a higher propensity for leaking
- Higher maintenance costs due to joint sealant upkeep



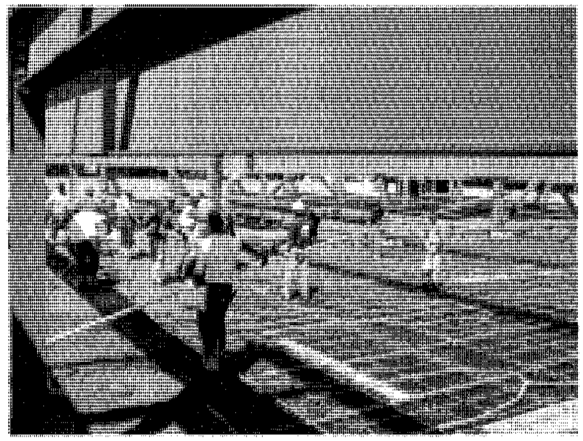
Interior view of painted precast concrete parking structure.



Precast shear frame at interior of parking structure.

Steel Framed Systems

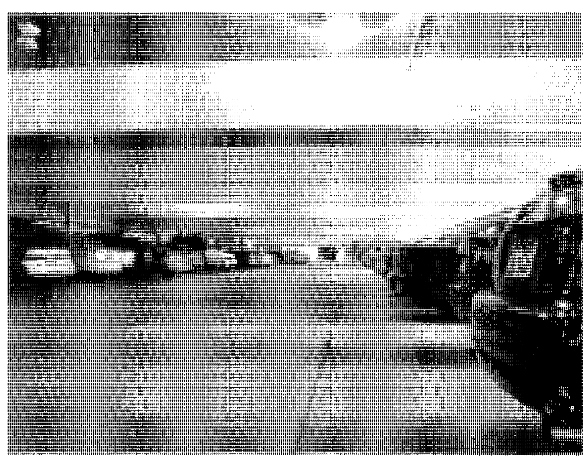
A steel framed system refers to a structural scheme where the columns and beams are constructed of steel sections and the floor slab is of cast-in-place or precast concrete. Typically, the columns and beams are spaced between 18 and 22 feet. The most common slab systems are:



Construction of steel framed parking structure with a cast-in-place post-tensioned slab.

- Composite cast-in-place post-tensioned concrete where headed steel studs attached to the top of the beam are cast into the concrete slab to provide a stiff beam system with less vibration and less deflection.
- Precast concrete double tees (either field topped or pretopped).
- Solid precast plank with a field topping. The author does not typically recommend this system due to the difficulty in keeping the floor system from leaking.

Steel framed parking structures with a cast-in-place post-tensioned concrete slab have similar advantages and disadvantages as listed above for the cast-in-place post-tensioned concrete system. Also, the precast double tee floors would have similar advantages and disadvantages as listed above for the precast concrete option. The cast-in-place post-tensioned concrete slab system with the steel frame may sometimes be preferred over a precast double tee floor. The slab is monolithic with less potential for leakage than with precast floors and because it creates a more open feeling structure with higher perceived head room, better signage visibility, and more uniform lighting distribution. However, the potential cost and schedule advantages of the precast floor may be preferred in other cases. A steel framed system has the following advantages and disadvantages when compared to the other primary parking facility structural systems.



Interior view of steel framed parking structure with a cast-in-place post-tensioned slab.

Steel Framed System Advantages

- Flexible column spacing of 18'-22'
- Generally no shear walls except in high seismic zones or very tall structures
- Can be performed by local subcontractors in many cities.
- Speed of construction is faster than for a completely cast-in-place system
- Potentially lower construction cost
- Easily accommodates vertical expansion

Steel Framed System Disadvantages

- Erection concerns due to mixing foundation, steel, and precast subcontractors.
- Steel painting for corrosion protection
- Maintenance of steel paint system
- Steel delivery times can fluctuate
- Not recommended where the steel is required to be fire rated by the building code.
- Extensive bird roosting ledges on the beam flanges
- Depending on code requirements, steel structure may need to be fireproofed

Interior view of steel framed parking structure with braced frames, but no shear walls.

There are many other potential structural systems for parking structures than the most common ones described above. Typically, the other potential structural systems are more prone to durability problems and more rapid deterioration, thus they are not generally recommended.

- **Cast-in-place Concrete – Mild Reinforced (not post-tensioned):** Typically, a cast-in-place concrete system with only mild reinforcement is used with short-span construction, meaning there are columns between the parked vehicles. Generally, the floors are two-way flat slabs or pan joist systems. Because the concrete is not prestressed, the floors are prone to cracking. A short span, mild reinforced, cast-in-place concrete floor is sometimes used when parking is located beneath an office, hotel or other building use. Thus, because the parking is the foundation for the other building, it is very important that a waterproof traffic bearing membrane be used on the floor to keep the cracks from leaking and to prevent deterioration.

- **Composite Metal Deck on Steel Frame:** Composite metal deck (or any other type of metal deck) is generally a poor choice of material for the exposure conditions of a parking facility, because the decking tends to trap water between the slab and the metal deck. Corrosion of the decking will occur with no outward indication of problems until such time that serious problems exist.

- **Bar Joist With Metal Deck on Steel Frame:** Steel bar joists are not recommended in parking structures. This system generally consists of a relatively thin slab on light-gage metal form deck with closely spaced bar joists supported by steel girders. Although this system is well suited for general office and retail occupancies, it has proven to be a poor choice of material for the loading and exposure conditions of a parking facility.

  Bar joists floor systems tend to exhibit unacceptable differential deflections when subjected to large concentrated loads (i.e., automobile wheel loads) that cause the thin slabs to deteriorate. This condition was recently documented as part of a due diligence evaluation of a parking facility that was only three years old. The cracking and deterioration was so extensive that the owner/developer who was selling the property, was forced to take a considerable loss due to "diminished value" of the parking facility portion of this complex.

- **Filigree Slab Soffits on Steel Frame:** Filigree slabs are ideal for load-bearing masonry construction and this product is used quite extensively in multi-family housing projects. The system is a hybrid composite design, which utilizes prestressed concrete for positive bending and mild reinforced concrete for negative bending, and has good depth/span characteristics. However, the product has two disadvantages that may make this material an undesirable choice for parking facilities.

  First, to achieve economical span ratings, the slab panels must be shored during construction. A typical design might be a 5-1/4" Filigree slab (2-1/4" panel + 3" topping) spanning 22' to 24', supported on W27 or W30 steel girders. After the topping is placed, the shores are removed, which causes the floor panels to deflect, and it is not unusual to see a significant amount of flexural cracking in the mild-reinforced topping in the negative bending zone.

  Second, because of the tendency for cracking of the topping, Filigree slabs are prone to leaking and require more maintenance to maintain joint sealants.

  Alternatively, Filigree slabs can be used in a hybrid system with a cast-in-place concrete frame for garages beneath office buildings.

- **Hollow Core Slabs on Steel (or Concrete) Frame:** With water intrusion being such a problem with durability, voided (hollow) systems are generally not recommended for exposed floors of parking facilities.

- **Keystone Joist with Beam Soffits:** Keystone joist with beam soffits are somewhat common in certain parts of the country such as Florida where there are several producers of the system. The precast joists come in nominal depths of 8, 12, 16, and 24 inches and may be used with either mild-reinforced or post-tensioned slabs. The system is a hybrid composite design, which utilizes prestressed concrete for positive bending and mild reinforced concrete for negative bending and has good depth/span ratios. However, there are some peculiarities of the system that make it less desirable than the more common systems.

With so many options, each with a relatively long list of advantages and disadvantages, you may be wondering how the decision is ever made on which structural system is best for a particular project. Each project is unique and the structural system selection should be given careful consideration by the owner, parking professional, structural engineer, and architect. As described in more detail above, the decision is often made considering the following:

- Owner preferences
- Design team preferences
- Schedule
- Construction cost budget
- Owner's tolerance and budget for maintenance
- User acceptance criteria such as openness, perceived headroom, light distribution, sign visibility, floor vibration, and leakage potential
- Ability to achieves structural engineering requirements specific to the project
- Local availability of product and labor

Because of the complexity involved in the proper selection and design of the structural system, it is highly recommended that owners retain a specialty-parking consultant as the structural engineer on parking structure projects. This will help ensure that the most economical and durable structure is provided consistent with the owners' goals. Achieving the balance between an economical first cost and a durable low maintenance cost parking structure requires special expertise often not commonly understood by engineers who do not specialize in parking structure design. It is also recommended that parking structures be designed in accordance with the American Concrete Institutes (ACI) Guide for the Design of Durable Parking Structures, as published in ACI 362.1R-1997.

PEDESTRIAN PLANNING

James M. Hunnicutt

James M. Hunnicutt has been in the parking and traffic profession for more than 50 years. Currently he serves at a parking consultant and has done so for the past 37 years. Prior to becoming a consultant, he served as executive director of two parking authorities. He is a graduate of Auburn University in Civil Engineering and completed his graduate studies at the Yale University Bureau of Highway Traffic. He is a Founder of the International Municipal Parking Congress, now the International Parking Institute (IPI). He is a past President of IPI. In 1976, IPI voted him Parking Man of the Year. In 2002, Auburn University presented him with its Outstanding Alumnus Award for Civil Engineering. The American Society of Civil Engineers, Alabama Chapter, in honor of its 150th Anniversary, named him one of the top ten engineers from the State.

Introduction

Parking planning requires more than garage or surface parking lot layouts to accommodate vehicles. However, many people neglect to plan for, or do not understand, the need to provide for pedestrians. Designs must consider pedestrians as well.

Once the vehicle is parked, all of the people get out and become pedestrians, a completely different issue than dealing with factors such as traffic flow characteristics, parking requirements, and parking layout design. There are specific concerns involving the pedestrian, which include elevators, stairs, escalators, moving sidewalks, distance to destination, comfort, ease of understanding directions, and safety and security. Accessibility design is also pedestrian-oriented.

Designers who do not understand these factors often make serious mistakes. At one airport there were 3,600 cars on top of the terminal. The designers only provided five elevators to service these parking spaces. The peak hour of the week occurred on Sunday afternoon. A huge surge of people arrived in the baggage claim area. As a result, there were waits as long as 25 minutes to 30 minutes. The problem was so serious the airport had to close two of the levels of the parking garage, because the elevator capacity was completely insufficient to handle the crowds.

Along the same line, a major football stadium had a parking lot for several thousand cars. The parking lot was separated from the stadium by a major roadway. The designers included an underpass for the patrons to walk under the roadway to and from the stadium. After the game, when everyone left the stadium to go back to the parking lot, the underpass was so narrow that there was a 10 to 12 minute wait to get through.

As a result, a number of people scrambled up the bank and across the busy highway, a serious safety problem, and an interference with traffic. The designers failed to understand the width of passageway needed to carry the number of people coming out of the football stadium in surges.

The purpose of this chapter is to introduce parking professionals to planning for pedestrians. It will give the procedures and data needed, and how to analyze the data to determine what is needed. While the design professional will be responsible, it is the parking professional's duty to make sure it is done correctly and to understand the procedures and analyses required.

Get The Facts

Before designing for any type of pedestrian facility, it is necessary to get the facts and understand the issues. The first thing to understand is how many people are moving, how many cars are involved, and where to accommodate the vehicles. In addition, what time of day, day of the week, and month of the year will the maximum flow of people occur? If a garage or lot can handle the peak traffic flow at the peak surge, it will accommodate off-peak times.

One of the primary concerns in the design for pedestrians is to determine how many people are in each car. This number varies widely, based on the purpose of the trip. At a normal office building the average number of people per car is only about 1.1. At a football game, stadium, or concert, the number of people per car may approach 3.1.

Knowing how many cars are expected is insufficient. Designers must be concerned about how many people are arriving.

To establish the number of people it is necessary to consider the types of operations that the parking facility will support. For example, in a parking garage at an airport, there are a variety of different operations that the parking garage may support. Each operation may have a different number of people per car. It is necessary to determine the number of people per car for each different use. Most large airport garages have a short-term parking area. They also may have a mid-term parking area and a long-term parking area. The number of people per rental car is different from most other parking uses.

Valet parking within an airport garage has been popular. Many airport garages have a premium parking area, which provides extra services for extra fees. All airports have tenants who rent space. Many airports give the station managers of the airlines, or others, VIP parking. Finally, some garages at airports have employee parking. This list is representative of the different types of parking uses in many garages. The mix of uses must be studied to understand how many people arrive in each car.

The same is true in figuring out the number of people who will use a parking garage and pedestrian areas at hospitals and medical centers. There are normally three shifts at a hospital and the number of pedestrians per car varies. There are doctors, hospital administrators, office staff, outpatients, visitors, and business services. While studying the pedestrians in a possible hospital garage, all of these users should be reviewed to determine how many people per car, and how many cars there are for each user group.

College parking garages also have a variety of users. There are short-term and long-term students, professors, staff, and other officials of the university. Almost all colleges have visitors who make business calls to the administration building. College campuses have a variety of evening uses such as libraries, concerts, and social events. Football games, basketball games, baseball games, and other events really fill up parking on a campus. The peak periods of pedestrian activity at college parking are almost always associated with sporting events, when everyone leaves the stadium.

Preparing For The Design

Before starting, it is necessary to establish what constitutes the peak operating condition. Good designers try to identify the average month of activity and the peak hour of the average month. Some facilities have several peak hours in a day. As an example, airport parking garages may have seven peak hours a day, from 7:00 in the morning to 11:00 at night, approximately every two to three hours. These peak hours are determined by airline scheduling. The airport garage owner has little control over it. But the designer must determine what the peak hours are and how many people get on and off the airplanes at those times.

Hospitals generally have three or four peak hours a day. Most often, the afternoon peak, when nursing shifts change and daytime medical staff gets off, is the peak period. The other peak hours occur when the visitors come, and depending on how the hospital works, there may be a heavy outpatient flow in the early morning.

Colleges and universities probably have the least number of peak hours during regular periods of operation. The typical workday peak at college campuses is 11:00 am, and happens on Tuesdays, Wednesdays, and Fridays. The peak hours on most college comes on the weekend when there is some kind of sporting event or during the evening at a basketball game or similar activity. Fortunately, the peak hours for sporting events normally do not come at peak periods of classroom and normal school activity.

Elevator Calculations

This section examines elevator planning using a hypothetical 1,500-parking garage for a college campus as an example.

During the normal week time periods, the garage will serve faculty, staff, students, and others in normal college activity. We have to plan for football games on the weekends and for nighttime activity such as basketball games. We will assume the garage is in the center of the campus and will accommodate all of the activities mentioned. Table 1 lists a number of characteristics for the garage.

Table 1: Elevator Requirements

Garage Capacity (Assume garage is full)	**1500 CARS, 5 LEVELS**
People per car	3.1
Design exit time	45 MINUTES
Total people to be exited from garage in 45 minutes	4650
Assume garage is full	
First floor *All persons can walk directly to car*	0
Second floor *40% of people will use stairs, walk to 2nd floor 3.1 people/car x 300 cars/floor= 930 less 40% who will walk*	558
Third floor *10% of people will walk up two floors* *930x10%=93 930-93= 847*	847
Fourth floor *Assume all will use elevators*	930
Fifth floor *Assume all will use elevators*	930
Total pedestrians expected to use elevators	**3265**

From our analysis we have determined that a football game on a Saturday afternoon will fill the garage completely. We have observed people coming to football games and have determined that average car occupancy is 3.1 people per car.

A term used by some designers is "dump-time". We have assumed the garage must be completely empty approximately 45 minutes after the football game is over. (We must design the internal ramps to have sufficient capacity to get all 1,500 cars out in approximately 45 minutes).

With a 1500-car garage, full, with 3.1 people per car, this means we will have 4650 people in the garage within a 45-minute period.

Next, we establish how many people we have to accommodate in the elevators. On the ground level we expect everyone will walk to their cars. On the second floor, studies have shown that 40% of people will walk up one flight of stairs, provided that the stairs are well designed and convenient. With that reduction, 540 people will travel in the elevators. On the third floor, studies have shown approximately 10 to 20% of the people will walk two levels if the stairs are well designed and convenient. That means 810 people will ride the elevators for the third floor. Everyone on the fourth and fifth floor will use the elevators. Consequently, we must plan for 3150 people to use the elevators over a 45-minute period to get to their cars and leave.

However people do not come in a nice even stream over the 45-minute period, they come in surges. We must design for surges. The common way to design for a surge is to estimate the number of people you expect to arrive during the average 15-minute period, and double it to allow for the surge effect. The peak period 15-minute surge is equal to approximately 30 minutes of average traffic. In our example we can expect 2,100 people to arrive in a peak 15-minute surge and this is the number of people who must be carried by the elevators to the upper floors.

Elevator Calculations

We now know that the 1500-car garage during its peak surge period after a football game, will probably have to carry approximately 2,100 people and distribute them to the upper parking levels.

Calculating to the number of elevators depends on a number of factors, such as operating characteristics, speed, dwell times, cab size lobby design, directional loading, and door opening, and closing times. Actual elevator numbers are based on the number of people carried and these factors. The calculation is usually done by computer simulation and can be done by an elevator planner or the firm that manufactures the elevators.

Stairways

Some of the most poorly designed features in parking garages are stairways. Most designers think of stairways as items required by the fire and building codes. They don't expect anyone to use them. They spend little or no time trying to make them attractive and useable. This is wrong. Many parkers will use stairways if they are well designed. The main stairways must be near the elevators so that inter-floor travel by either is convenient.

To be useable, stairs cannot be located in a remote location that is inconvenient or out of the way.

When standing at the top of the stairs, the user should be able to see the next floor, whether it is up or down, and to see his ultimate destination. This gives the illusion of closeness. If it seems to be close, it must be easy to get to, and people are willing to walk and use the stairs.

Most fire and building codes do not require heavy steel doors in parking garages and they should be left off.

A major consideration of stairs is they must be well lighted and bright. The light level in the stairs and pedestrian areas should be approximately 20-foot candles.

The physical design of stairs should be good and user friendly. Most stairs used as fire exits are too steep, too narrow, and the individual steps are too high. This combination of stair quality makes then difficult to use and unattractive to most pedestrians.

Finally, stairs should be glass enclosed or open. Unfortunately many assaults against people occur in stairways. If the stairs are completely glass enclosed (as well as the elevators) a crime can be seen from the outside or from of the street, and reported. Open stairs are acceptable in good weather but can be poorly used in rain or inclement weather. In northern climates, ice and snow can be a problem, and open stairs can become slippery and dangerous.

Table 2: Stair Design Criteria

Travel speed - down direction	140 feet/minute
Travel speed - up direction	110 feet/minute
Stair tread	12" wide
Stair riser	6" high
Slope	27° angle
Width	Wide enough for 2 people to pass each other
Stair width need	Approx 6'-0 (3'-0/passenger)
Door	No heavy door to open
Light level	20 foot candles
Interior walls	Painted white or other very light color
Maximum flow	19 pedestrians per minute per foot of stairway width

Special-use stairs have different values. It is unlikely that airport patrons with luggage are going to carry baggage up and down stairs. They will wait for elevators. On the other hand, travelers with only light baggage such as a brief case or shoulder bag will use stairs. Extra width stairs should be provided to allow users to pass easily while carrying small luggage.

Airport elevators also require more space because of luggage. In an elevator the average pedestrian standing on the floor occupies approximately 7-10 square feet. Because of luggage, golf clubs, duffle bags, baggage carts, baby strollers, the area per pedestrian should be increased by 50%. Airport elevators need as much as 10-15 square feet per person.

The same can be true at other locations such as garages serving football stadiums. Patrons bring blankets, cushions, food coolers, beverage coolers, and other items that take up elevator floor space.

Walkways and Corridors

To get to stairways or elevators, it almost always necessary to use a corridor or walkway. All features of pedestrian flow must balance out or there will be congestion at some point. Airports or other large complexes may have moving sidewalks and escalators, but they are all served by corridors or walkways. How fast people walk and how much room they take up as they walk depends on a number of variables.

Some of these: age of the walker, going up or down, luggage, male or female, trip purpose, traffic, obstructions, and crowded conditions. All affect pedestrian flow. The following are standard values that are used for designing walkways and corridors.

Table 3: Walkway Corridor Capacities

Average walking speed	240-250 feet/minute
Speed	Average 250 feet/minute
Area/pedestrian occupies approximately an area of 5'x5' at walking speeds	25 square feet/per minute
Design volumes walkway width	10 pedestrians per foot of width of walkway

The above values are basic and there are many factors which can affect them, including walls, columns, newspaper stands, and light poles. When calculating the walkway width needed to accommodate a given pedestrian flow, these factors, as well as the number of people coming in the opposite direction, must be taken into account.

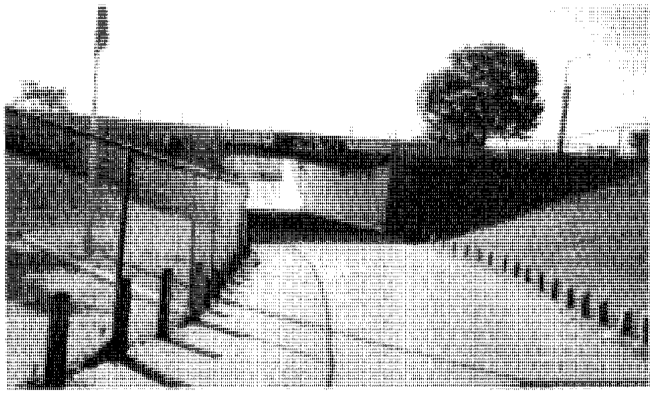
Pedestrian Safety

A parking garage or lot can provide a series of obstacles to pedestrians after they get out of their cars. One of the most common causes of injury in lots and garages is the trip and fall. Wheel bumper blocks, curbs, and steps are the primary cause of falls and personal injuries in parking lots and garages. The parking designer should make designs to overcome these problems.

Good Pedestrian Safety Practices

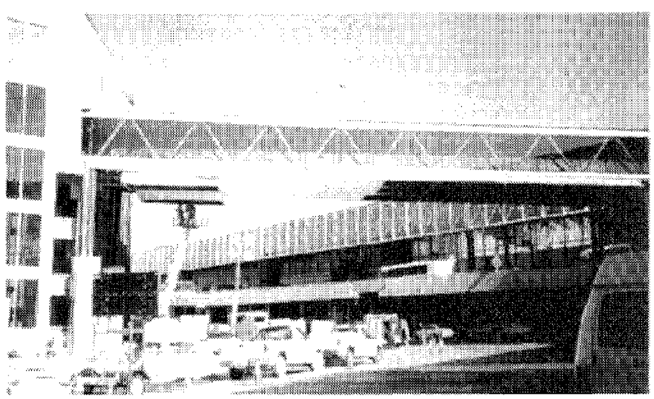
1. Use plenty of light so people can see – 15-foot candles for garages. 20 foot candles in pedestrian areas.
2. Don't leave nooks, walls, or other places where criminals can hide and are not seen. The bottom riser on a stair is a hiding place that can be eliminated.
3. Provide marked walkways and cross walks in lots and to delineate pedestrian areas. Notify drivers by signs of floor areas for pedestrians.
4. Don't use concrete or plastic bumper blocks on the floor as wheel stops or barriers. They are a major cause of trip and fall injuries.
5. Don't use a step or curb up to elevator landings or stairways. Instead, use sloped ramps. Use bollards or other obstructions to keep cars out of unauthorized areas.
6. Follow the American with Disabilities Act (ADA) guidelines for persons in wheel chairs and on crutches. Check any local or state regulations.
7. Keep walkway slopes and ramps to a grade that does not exceed 5%.
8. Make sure all hand rails and grills are designed in such a way that a child cannot climb through the rails and fall. Any rail opening should be so small that a child cannot stick his head through and get caught.
9. Do not use stretched steel cables as barriers or railings.
10. Keep all landscaping around the lot or garage to a height or no more than 2-3 feet. This way, it is difficult for a criminal to hide.
11. Provide perimeter fencing for lots and design garages so that it is impossible for unwanted persons to enter or leave the facility unseen. For garages it is wise to have roll up doors and barriers so that the garage can be closed and locked to keep out unauthorized persons.
12. Keep ramps, entrances and exits that have the most vehicular traffic away from pedestrian activities such as overpasses, entrances, exits, stairs, and elevators. Pedestrian traffic should not have to cross main traffic aisles. Reduce conflicts between cars and pedestrians to a minimum.
13. Pedestrians should exit the lot or garage in a location where they can see their primary destination. As an example, when a pedestrian leaves a garage at a college football game, the stadium should be in plain view. This helps in keeping good pedestrian orientation.
14. Even in relatively small garages, there should be two elevators as a minimum and a back up if one elevator is out of service.

Figures



This pedestrian underpass beneath a busy four-lane street connects a lot to a large football stadium. The size of the underpass must accommodate large surge flows of pedestrians and separate them from vehicular traffic flow.

This complex consists of two seven level garages, an AMTRAK Station, kiss and ride parking, a shuttle bus service to a nearby major hub airport, taxi stand and a drop-off and pick up curb. In such a location the pedestrian areas, walkways, load areas, bus routes, etc. must be carefully thought out to keep down traffic and pedestrian conflict.



This 5,600-car airport garage has seven connectors between the garage and the terminal. There are three overpasses, three at grade crossings and one underpass. Each connector must be precisely calculated for pedestrian capacity so that all facilities such as overpass width, elevators, and stairwell match.

SAFETY AND SECURITY IN PARKING DESIGN

Tryst M. Anderson

Tryst Anderson has 25 years experience in the parking industry and has provided parking consulting services to municipalities, hospitals, universities, and airports. His innovative approach to parking studies and planning initiatives has resulted in several quality improvement awards. He is a frequent speaker at IPI national and regional meetings and has authored articles for industry trade publications. Tryst is currently the Vice President of Client Development for Timothy Haahs & Associates, Inc.

Charles E. Hahl, P.E.

Mr. Hahl is a Professional Engineer with over 20 years of consulting engineering experience concentrating in fire protection, physical security and the management of engineering services. He has built and managed a fire protection and security engineering organization with Net Service Revenues of over $3.5 million. Mr. Hahl has a long and successful career in the execution of professional services, financial performance, contract formulation, and review, quality control and business development activities. Mr. Hahl's portfolio includes numerous major fire alarm and security system design projects for a wide variety of clients including the Smithsonian Institution, the National Archives, the Architect of the Capitol, the International Monetary Fund, Intelsat, the World Bank and the Saturn Corporation. He is active in the fire protection and security communities and is the immediate past-Chairman, and current member, of the NFPA Committee on Premises Security (NFPA 730 and 731).

Introduction

Providing safe and secure parking facilities is good business and good for the business of the parking industry. The need for a Federal Department of Homeland Security notwithstanding, the parking industry's focus on security has increased over the last ten years. Changing demographics have had something to do with it. Women over 50 years of age are the fastest growing group of drivers in the United States and more women than ever are in the workforce. Therefore, the preferences of women customers have had an impact on parking design.

Perception is the key. A facility that is dark, with limited signage, and walled stair/elevator towers makes a patron feel less secure than one that is well lit, open, and features glass-backed stair/elevator towers.

Most customers will not tell an owner about feeling unsafe in a parking facility. They simply vote with their pocketbooks and find another place to park. This has caused owners to enhance security features. In addition, as more parking structures were built, crime and injuries associated with those facilities increased. Since litigation is the end result of perceived owner negligence, owners of parking structures have been doing more to improve security for customers. It is a proactive approach that is cheaper than settling claims and paying lawyers.

Owners have a duty to prevent crime on their property. The Occupation Health and Safety Administration (OSHA) now requires employers to provide a safe workplace. Vicarious liability covers negligence and requires owners/agents to act on the knowledge that violence or accidents could happen. This is based on criminal activity or personal injuries that have happened in the past.

A risk assessment is needed to determine what level of risk your facility has or would have, if a parking project is in the planning stage. This assessment is usually done in conjunction with local law enforcement agencies, but can be done independently, if the owner knows how to obtain pertinent data, or with the assistance of a security consultant or parking consultant with security expertise. The risk may be high, medium, or low. Each level requires a different combination of active and passive security features.

What level of security should an owner provide?

There are basically two types of security in a parking structure or surface parking lot:

- Passive
- Active

If your risk assessment indicates a low level of security, you might be able to rely on passive security features alone.

Passive Security Systems

Passive security follows the theme of Crime Prevention through Environmental Design (CPTED). In other words, the actual design of the facility works to improve security. There are inherent features of parking structures and lots that may contribute to potential criminal activity:

- Cars themselves can be hiding places and also block light distribution.
- Ramps in a parking structure limit visibility.
- Access to most parking facilities is open to the public .
- Criminals have a number of escape routes and may use a car to leave the scene of the crime.
- Customers may not easily be able to determine the fastest safe exit route if in distress.

Passive security in a parking structure includes glass-backed stair and elevator towers, long span, open interior space, appropriate lighting intensities, limited access points, well signed pedestrian exit routes and first-level security screens. Passive security features in a surface parking lot would include interior and perimeter lighting, limited use of interior landscaping materials, low-level perimeter bushes, perimeter fencing, and limited access points.

Parking facilities that have high levels of activity adjacent to them are likely to feel more secure and deter some criminal activity compared to isolated facilities that are largely vacant. Grade level commercial space in garages would promote high activity levels.

Lighting

In either type of parking facility, lighting is the first priority for improving security. No one feels safe when it is dark. Therefore, high light intensities are needed. The chapter on lighting will provide more detailed information on the proper level of illumination needed on the interior of a parking structure and the transition lighting required at entrances and exits.

However, the following list indicates some recommended average lighting levels:

- 10 foot candles on ramps
- 50 foot candles at entrances and exits
- 10-20 foot candles in stairwells
- 5-10 foot candles in general parking and pedestrian areas

Lighting for a surface parking lot will vary on the type of lot, location, city and county ordinances, and local building code requirements. The minimum level for a surface parking lot is 2 to 5 foot candles.

Ingress/Egress

Ideally, there should be a single set of entrance and exit lanes in and out of a parking structure, and they should be parallel to each other. The fewer access points in the parking structure, the fewer opportunities there are for unauthorized people to gain entry. Ground-level doors at stair towers should be marked "EMERGENCY EXIT ONLY" with a panic bar to restrict access. This is especially important if the doors are not in the sightlines of cashiers, or if the facility does not have cashiers. The doors usually can't be locked because they must comply with fire codes.

Active Security Systems

The results of a vulnerability assessment may suggest that an active electronic security system be considered to improve security and deter criminal intent. The major systems that can be deployed together or separately include:

- Panic Alarm and Two-Way Communication Systems
- Closed Circuit Television and Recording
- Access Control
- Regular Security Patrols

It is also a good idea to provide signage explaining to garage patrons that active security measures are in place. Signage should include an explanation of who is monitoring the systems and when monitoring is being conducted. Do not use signage to create a false sense of security. For example, if CCTV cameras are not routinely monitored and recorded, it should be stated as such on the signage. In some cases, providing active and highly visible TV screens at pedestrian and vehicular access points which exhibit the actual image from monitoring equipment, may serve to deter criminal activity.

Panic Alarm and Two-Way Communication Systems

For both urban and suburban parking garages, state of the art security practices are more frequently including the use of panic alarms. Many include provisions for two-way communication between the panic station and a central monitoring station. Large mushroom type alarm buttons characterize these panic alarm stations. When these buttons are pushed, an alarm is transmitted to a continuously attended monitoring station. The operator monitoring these alarms should be capable of summoning assistance and/or providing information or other aid. These systems may activate a blue strobe light at the alarm location and may sound an audible alarm.

Panic alarm stations should be placed in prominent locations and pedestrian walkways within the parking area. Typically, they should be within a 100 foot (30 meters) travel distance from anywhere in the parking area. Other appropriate locations include elevator cars, elevator lobbies, the interior of stairwells (landing areas), and inside cashier booths. Panic alarms should be marked with high visibility signage and distinctive colors, and could possibly include lighting at a 6 to 7 foot level to readily identify their locations.

Quite often, panic stations include two-way communication intercoms. These should be "hands-free" type intercoms and should allow the monitoring operator to communicate with those in distress or, at a minimum, "listen-in" when activated. Alternately, although considered less effective, would be an emergency phone communication system. In some cases, depending on controls and design, audible alarms on panic stations can interfere with two-way communication systems. Any audible alarms provided should be controllable and turned off when two-way communication is enabled.

Design and engineering of these systems should incorporate the *Americans with Disabilities Accessibility Guidelines* (ADAAG) available through the ADA Access Board (www.access-board.gov).

Parking attendants or independent commercial station operations can monitor panic alarms and intercoms. Whoever is responsible must provide 100% monitoring of the alarms whenever the parking facility is in operation and open to the public.

Closed Circuit Television and Recordings

Installation of Closed Circuit Television (CCTV) systems can be a major deterrent to criminal activity in parking garages. Garage security is heavily dependent on access control. If the entrances and exits are well secured, CCTV can be employed to record the faces and license numbers of the vehicles entering and leaving.

From this point, CCTV can be extended to monitor stairwells, elevator cars, elevator lobbies, walkways, parking areas, and garage entrances and exits (both vehicular and pedestrian). Although initial costs for CCTV can be expensive relative to other security measures, it extends the resources of the security staff and can often reduce the number of security personnel required to patrol a facility. This has proven to be a significant benefit in jurisdictions such as Pittsburgh, Pennsylvania and Vancouver, British Columbia that now require active patrols and surveillance of enclosed parking garages.

As mentioned earlier, signage should be provided indicating what areas are under surveillance. This in itself can be a major deterrent to crime.

Likewise, fake cameras should never be used. Parking facilities should not create a false sense of security for their patrons that may be used against them in potential legal proceedings in the event of security incident.

State of the art designs now utilize color CCTV cameras and recording systems. Although still available, black and white cameras are becoming obsolete. In addition, the ability to procure black and white camera repair parts has become much more difficult. One advantage to the black and white CCTV cameras however, is that they require less light to operate. In fact, some color cameras revert to black and white operation in low light environments.

Proper CCTV system design requires that adequate lighting be provided. Color CCTV is especially sensitive to proper lighting levels. Surface reflectance of walls, floors, and ceilings also must be considered. Lighting around cashier plazas, involving the recording of driver and license plate information, should be at least 15-20 foot candelas (160 to 215 LUX). The same relative levels should be provided in stairwells, elevators cabs and lobbies, and near panic stations. For other areas, and in general parking areas, 3 to 5 foot-candles (30-53 LUX) should be provided for adequate CCTV surveillance, assessment and recording. The better the light levels, the better the video image recorded will be. Consistent lighting without shadows and large deviations is also very important. Additional information on lighting design can be obtained from the Illuminating Engineering Society of North America (IESNA).

Improving lighting levels can often be as simple as cleaning the floors, walls, and ceilings of garages. Painting with highly reflective colors is very effective. For new construction, color additives to improve reflectance can be added to concrete during the pouring operation.

Fixed mounted cameras are preferred over pan-tilt zoom (PTZ) mounts. PTZ mounts are inevitably in the wrong position to "catch" incidents and require too much operator attention. The design intent should be more "alarm" or "event" oriented. Operators should be alerted, and recording initiated, upon motion or other alarm activity. Some examples include doors opening, elevators called, panic alarms initiated, or cars approaching.

Video recording is now almost exclusively based on digital video recording (DVR) techniques. Although many VHS videotape systems are in operation and are still sold today, new systems are now almost exclusively being designed around digital recorders for a variety of reasons. Primary among these are there are no tapes to change and store. VHS tapes wear out and failure is progressive. DVR utilizes hard drives; and there is not a slow degradation in recording quality. Systems can also be specified with redundant back-up hard drives. Redundant Array of Independent Disk (RAID) arrays and RAID arrays with hot swap out are standard options that virtually assure no loss of data in the event of hard drive failure.

In addition, DVR allows remote monitoring of the video; and it is easier to print, store, and e-mail images. Remote monitoring utilizing internet protocol (IP) is especially useful for parking garage operations particularly those unmanned locations.

The video signals are recorded to computer controlled hard drives, usually in groups of 16 cameras with time stamps, search, and archive capabilities. Incidents may be recorded to permanent storage media such as Compact Disc (CD), most prevalent, or Digital Video Disc (DVD) media. When purchasing these systems, it is important to specify the recording capacity to match the applications. A typical capacity specification might be 15 or 30 days and 7 to 15 frames per second. An alarm triggered recording activity might be 2 to10 seconds per alarm and 5 to 60 seconds or more post alarm depending on the scene or application. For example, a door opening might have a shorter record duration than a panic station monitor.

To the best of the authors' knowledge, digital recording has not been challenged so far in court. Design of systems must anticipate protecting the video data from possible tampering. Systems designs should utilize a first-in/first-out (FIFO) type memory. Systems should be tamper resistant with the data protected to the highest authorized levels. This is one system that should not be consumer friendly and must be specifically designed for commercial recording and as possible evidence that could be used in legal proceedings. Based on the applications, watermarks may be applied to the recorded images that would allow detection of file tampering. This requires special display equipment usually proprietary to the manufacturer and must be carefully specified. Standard recording to a compact disk deletes the file watermark.

Access Control

Access control into enclosed parking garages should be controlled at all times of operation. This may be accomplished through the use of alarm systems, electronic based access control systems, lock and key, CCTV, or verifiable security patrols. All vehicular and pedestrian entrances/exits should be monitored. Whenever possible, vehicle entry and exit should be limited to one location.

Electronic access control systems range from simple token or card based systems to "speed pass" long-range, hands-free reading systems. Careful specification of these systems is required to match equipment procured to the desired operation. With the extensive array of technologies and systems on the market, equipment is available for almost any conceivable requirement or operation.

There are a number of critical areas that need to be addressed when specifying security/access control systems. Some of these include:

- Capacity, size, number of readers
- Speed of credential verification
- Archival records
- Supervision
- Ease of administration/programming
- Token type
- Security level required
- Locking arrangements

Locking of exit doors should be carefully designed to comply with local building codes. Most often, installation of access control and locking systems requires construction permits and inspections from local building officials.

Security Patrols

The use of visible security patrols through garages and surface lots on a random, but regular basis can be an effective active security measure, particularly where an increase in criminal activity has been noted in an area. Such patrols are best accomplished on foot or bicycle, supplemented by vehicle patrols where necessary. Patrols through and around the perimeter of a parking facility will serve to identify potential undesirable activity and deter it as well.

WRITING MANUALS FOR PARKING OPERATIONS

Charles J. Cullen, CPFM, CAPP

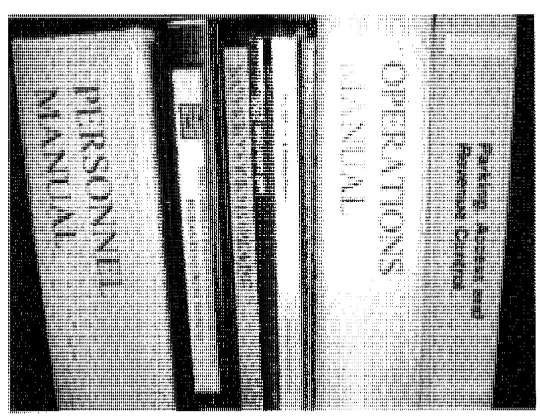
Chuck Cullen is the Assistant Director of Parking and Transportation Planning for The Consulting Engineers Group, Inc. (CEG). He manages the firm's Cincinnati Office. Prior to joining the CEG team, Mr. Cullen spent 30 years in municipal parking, managing both on-street and off-street operations. Mr. Cullen has been a Certified Administrator of Public Parking (CAPP) since 1994, and a Certified Parking Facility Manager (CPFM) since 1999. He is a member of the International Parking Institute (IPI), National Parking Association, American Society of Civil Engineers, Association of Certified Fraud Examiners, and American Concrete Institute. Since 1995, Mr. Cullen has served as an instructor to candidates enrolled in IPI's CAPP program. He has also made numerous presentations on parking topics at conferences and seminars throughout the country.

Introduction

In any business, knowledge is power. The parking business is no exception. Knowledge of the job provides the means to transfer parking employees into exceptional service providers. When employees know how to perform their duties, they are able to provide faster service to customers (no more delays recalling the procedures for a Lost Ticket) and equipment experiences less downtime for repairs (since it is properly maintained). While knowledge is obtained primarily through training and experience, manuals reinforce verbal instructions, eliminating guesswork.

Too often, the task of writing a manual appears overwhelming. Creating a manual also requires considerable time, and for that reason, many will avoid writing a manual. It is important, however, to view the process of manual creation as an investment that will repay substantial dividends for your parking operation.

This chapter provides a strategy for writing a manual for your parking operation. It contains useful tips to assist the parking administrator in creating effective manuals. By following the guidelines provided, you can overcome many common obstacles and write effective manuals for your parking operation.



Typical Manuals for Parking Operations

Successful parking systems often have several manuals, one each for different aspects of their operation. Listed below are manuals commonly found in parking facilities.

- *Policy* – This type of manual outlines guiding principles for the parking operation. It usually states "what" is to be done.
- *Operating Procedures* – An Operating Procedure Manual provides instructions on "how" and "when" policies are to be implemented.
- *Safety* – This category of manual provides guidance to prevent injury.
- *Maintenance* – A Maintenance Manual supplies instructions for preventive maintenance procedures and repair.
- *Cashier* – This type of manual offers detailed instructions for the operation of parking equipment and informs cashiers how to perform their duties during their shift.
- *Supervisor* – A Supervisory Manual provides instructions for supervisors and guidance on managing employees.
- *Auditing* – With an Auditing Manual, the reader is given specific steps regarding revenue collection verification, ticket auditing, and report reconciliation.
- *Personnel* – This type of manual provides overall information on important issues such as hiring, discipline, benefits, training, etc.

What a Manual Will and Will Not Do

Manuals serve primarily as a valuable training tool for your organization since they contain essential information and instructions. They also offer other benefits. Manuals may be written to emphasize qualities (attendance, customer service, safety, etc.) important to the organization, and reinforce the mission and purpose of the organization itself. They also assist in the application of disciplinary action by eliminating the "no-one-told-me" excuse.

Manuals, however, will not replace good supervision. No document can replace the need for a supervisor to observe job performance, interact with customers and employees, complete reports, and ensure compliance with the organization's rules and regulations. Manuals should not serve as the sole training source. A manual serves this purpose best as part of a comprehensive training program. Adults learn best by listening, observing, and performing. A manual reinforces the instructions - it does not replace them. Finally, a manual will not solve organizational morale problems. The level of customer service is often reflected in the level of job satisfaction of the employees within the organization. A manual will not replace feelings of resentment over what appears to be an inequity on the job.

Who Should Write the Manual?

Ideally, the person most knowledgeable about the subject matter should be assigned the task of writing the manual. Since the time required to write, edit, and print a manual can be considerable, the best qualified person may not be available or may only be able to contribute a limited amount of time. In those instances, set aside a certain number of hours each week for the employee(s) to devote to the project.

Some other options for writing a manual include:

- hiring a student from a local university or an intern to organize and write a draft document using available material,
- asking for volunteers within the organization,
- reviewing the personnel files to discover an employee on staff who has previous training or experience in writing similar documents and assigning that employee to the task, or
- utilizing the services of a parking consulting firm with experience in manual preparation.

Regardless of the author, it is critical that the head of the organization review the manual to ensure compliance with company policies and objectives. It is also a good idea to have Personnel Manuals reviewed by an attorney who has knowledge of your organization and labor law.

Preparing to Write a Manual

Few individuals can sit in front of keyboard and commence writing a manual. Usually, hours of preparation are necessary. It may seem that there is so much to include in the manual that even getting started brings on a feeling of anxiety. Here are some tips to get started.

- Use 3" by 5" index cards to jot down topics that should be included in the manual. The cards can later be sorted and placed into a logical order. With the topics listed on the cards to refresh your memory, writing them is easier. Keep a few cards with you at all times so you can record topics as they come to mind.
- Keep a logbook; this is similar to the note cards except that the topics are listed on pages. Every time you think of something to be included in the manual, just write it in the book. You must remember, however, to keep the logbook handy at all times.
- Like the previously mentioned methods, carry a small tape recorder to record topics. Play the tape back while creating an outline or typing the first draft.

- For additional topics to include in the manual, tour your operations. Observe employees performing their jobs and customers using your parking services. Note topics based upon your observations.
- Schedule a meeting or a series of meetings with employees from all levels of your organization. Inform the attendees that the purpose of the meeting is to gather topics for the manual. At the meeting(s), allow each employee to offer suggestions and take notes of each. Be sure to thank everyone for their suggestions and offer them an opportunity to provide additional input up to a specific deadline. Any subjects not appropriate for the manual may be dismissed later, but let the employee know that their topic was considered but rejected along with the reason for the rejection.
- Refer to other manuals. Chances are, similar organizations have manuals that may be borrowed. Here is where networking with professionals at parking conferences/seminars plays an important role. Review the manual for potential topics and organization, but do not copy the manual. The procedures within the manual may be based upon policies not appropriate for your organization or equipment not installed at your facilities.
- Review operating instructions or maintenance instructions provided by equipment manufacturers. These documents contain valuable information on proper operating procedures and safety precautions that should be taken while using and/or maintaining equipment.

Once you have developed a fairly comprehensive list of topics, gather all your material and create a simple outline. This outline is nothing more than a list of all the topics to include in your manual, in the order you want them presented. The outline may be changed numerous times over the next few days or weeks. With an outline, begin assembling all relevant documents and notes, following the order of the outline.

PERSONNEL MANUAL

Chapter 1 Hiring

Chapter 2 Benefits

PERSONNEL MANUAL

Chapter 1 Hiring
- Application
- Testing
- Medical Examination

Chapter 2 Benefits
- Health Insurance
  - Eligibility
  - Cost
- Vacation
  - Approval
  - Earning Rate

As the process continues, you will likely recall other topics that must be included in the manual. Add them as they occur to you, edit the outline as necessary, and delete redundant or unnecessary topics.

Once the simple outline is completed, it is often useful to expand it and add more fine points related to the topic. This detailed outline helps ensure that important elements of the topic are not omitted.

The First Draft

With a detailed outline in hand, the task of writing the manual is not as intimidating. Just follow the outline and explain in detail each note you made. Don't be overly concerned about grammar, spelling, and formatting. The important thing at this point is to write everything about the topic that you wish to convey to the reader. There will be plenty of time in the future to edit and polish the document. The following are some helpful hints to consider while writing the first draft.

- Take a break every two or four pages and read out loud what you have written. Listen carefully to your words and make any changes necessary.
- As you read it, verify that each topic is appropriate for the manual. A Policy Manual will place a great emphasis on "what" should be done. A Procedure Manual will inform the reader "how" to do something and "when" it should be done.
- Many manuals include procedures and behavior expectations for employees. If appropriate, the potential consequences for failure to comply with the steps in the manual should be included.
- Use only terminology that will be understood by all intended readers. If a new term is introduced, be sure a complete explanation of that term is included.
- If the procedures call for the completion of a form, make sure the forms are available at the facilities. Likewise for maintenance manuals, be sure to have the recommended tools available to complete the required work.
- For a manual containing operating instructions, follow the procedures step-by-step to ensure they are safe and adequate for the employees.
- Allow others to read and/or test the procedures.

At the conclusion of the first draft, create a Table of Contents. This will enable employees to quickly find topics of particular interest to them. Some software programs will do this automatically but if you are not familiar with this feature, your outline will serve as a guide.

Throughout the process of writing the first draft, changes are inevitable. Remember that each edit will only improve the final product.

Pictures, Illustrations, and Color

Using pictures and illustration often reinforce the written material. Be sure that they are high resolution or quality. A "fuzzy" picture will only get fuzzier as it is reproduced. Color pictures should be used only if the copies are to be in color. If the copies are to be in black and white, use a photo-editing program to convert the color picture to a grayscale picture. This will usually improve the quality of the picture in the copies.

In a conversation, we use our tone and/or volume to convey items of importance. In writing, other tools are available to emphasize a point. These formatting techniques include a different color font, *italics*, CAPITALIZATION, underlining, font size, and **bold type.** The use of these methods to express important words should be consistent throughout the manual. For example, if new terms are italicized, then avoid italicizing words that are not new.

Color fonts should be avoided unless all copies of the manual are to be printed in color. A font color like yellow will likely not appear in a black and white copy. Red will appear as black so the impact of that color font will be missed. So unless all copies are to be in color, use the methods previously mentioned to stress important items.

Consistency is also important is the formatting of the document. Margins, line spacing, chapter headings, and page numbering should be consistent throughout the document.

Page numbers should not be consecutive throughout the entire document. When new chapters are added or revised, it will be extremely difficult to match the consecutive numbering without re-printing the entire document. It is strongly suggested that each chapter begin with its own page numbering.

The Final Version

After the reviews, it is time to complete the manual. Here are some steps to include while you prepare the final version of the manual.

- Review all feedback received from the draft version to verify that all corrections and additions have been completed.
- Take one more opportunity to review the entire document for any omissions.
- Check for spelling mistakes. Most word processing software has a spell check function, but do not rely solely on this method. Electronic spell checkers will locate spelling errors but they will not inform you that you used the incorrect word.
- Check for proper grammar. While the actual content of the manual is more important than the use of correct grammar, every effort should be made to comply with basic rules of grammar. Good grammar adds a professional touch to the document, supporting its credibility. A manual riddled with spelling and grammatical errors may cause the reader to question the reliability of the contents. Two important items to check are punctuation and agreement between the subject and verb. For more information on grammatical points, refer to the *MLA Style Guide* or another grammatical reference.

- For manuals, nearly every sentence should end with a period (.). The exclamation point (!) should only be used to end a sentence that contains critical information related to a serious safety hazard. Question marks (?) are rarely used in a manual since their purpose is to transmit information, not pose questions to the reader.
- Review the document to verify that all chapters start on a new page. This will enable you to insert future changes without altering the entire document.
- Verify page numbering.
- Update the Table of Contents to reflect revised page numbering and any new chapters added during the editing process.

With the reviews completed, you are now ready to send the manual to the printer. Here you will be faced with several choices.

Color printing is more expensive, but the impact may be worth the price. One way to reduce the higher cost is to place all color pictures and illustrations in one section and have only that section printed in color.

For most manuals, a standard 20-lb paper is adequate, particularly when using black ink. If the manual has numerous color illustrations, however, the use of a 28-lb paper should be considered.

Many organizations incorporate programs that encourage the use of recycled materials and minimize paper. Paper that is produced with 20% post-consumable goods is readily available. Requesting double-sided copies can reduce the total number of pages.

The final item is the binding. For manuals, avoid comb, tape, and wire binding. These methods will require a special machine to insert addendums and revised chapters in the future. Manuals are well suited for a three ring binder so have the pages punched accordingly. Three ring binders come in a variety of colors and designs so it is possible to select one that will meet the needs of a particular manual. Another advantage of the three ring binder is that individual pages can easily be removed for copying. These binders also offer better protection of the pages than a plastic cover sheet that is usually used with other binding methods.

Distribution and Training

It is not sufficient to write a manual and send it to the facilities. If the manual is to be effective, employees must understand its contents and know where to find it when necessary. The best method of ensuring that employees are aware of the manual content is to conduct training immediately after the release of a manual. The extent of the training will vary with the contents of the manual. A new manual or an updated one with many changes will require more training than one with a few updates.

Allow enough time during the training sessions for questions from employees, and be prepared to give examples that relate to everyday work experience. At the conclusion of the training session, have the employees sign an acknowledgment of the training. This signature page serves an excellent defense against the universal excuse: "No one ever told me."

A copy of the manual should be in every worksite where employees who will rely on its contents work. If the manual is supplied to facilities in electronic format, protect the document so an unauthorized person cannot alter it.

Updates

A manual will not last forever. Eventually, revisions and updates will be necessary. An annual review is the best policy for ensuring the applicability of the manual. When new equipment is installed, manuals will need to be updated. Likewise, any changes in the policies of an organization may require changes in procedures.

Summary

Manuals are a valuable resource of information that improve the level of service in parking facilities. When it comes time to write a manual, start by collecting notes and related documents that you will use for reference. Use the notes to form an outline and then expand upon that outline to include important topics to be included in the manual. Using the expanded outline, prepare a first draft. Review and edit the draft until you are satisfied with its contents. Make a final check for spelling and grammar. Produce copies of the manual using a three ring binder. Send a copy of the manual to all work sites and conduct training sessions to ensure employees are familiar with its contents.

Congratulations, your manual is complete and you can take pride in a job well done. Remember, however, to review and update the manual annually (at a minimum).

OFF STREET FACILITIES: AN INTRODUCTION TO STEEL-FRAMED OPEN-DECK PARKING STRUCTURES

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Parking Structures – An Introduction

During the past several decades, the open, above-ground, multi-level parking structure has been increasingly dotting the country's urban and suburban landscape. The scarcity and cost of urban sites for inefficient grade-level parking lots together with the growth of large suburban malls and office parks have propelled structured parking to a prominent position in the nation's building inventory.

Open parking structures typically provide multi-level parking for a least 150 vehicles and have at least two sides that are a minimum 40 percent open to the outside (per the latest code). Open parking structures are preferable to enclosed structures in that they do not require mechanical ventilation and specialized fire protection systems. Open structures also create an increased sense of security for the patron and are easier and less expensive to construct. A vehicle is designed to be exposed to weather conditions and is ideally suited to the environment of an open deck structure.

Open-deck parking structures have two major structural systems: the framing system that forms the skeleton of the structure, and the deck system upon which the vehicles drive and park.

There are three basis material choices that owners and developers have for framing systems:

- Structural steel frame with various concrete deck options.
- Cast-in-place concrete framing (concrete forms, poured and cured on the construction site) post-tensioned.
- Precast/prestressed (manufactured off-site) concrete framing using long-span double tees for deck.

Three deck options are generally utilized:

- Precast systems utilizing long-span double tees (50 ft. to 60 ft. long concrete sections that have two "T" stems extending down from the deck).
- Cast-in-place floor slabs with conventional steel reinforcing utilizing stay-in-place steel deck.
- Cast-in-place post-tensioned floor slabs utilizing steel cables to compress the slab after curing by placing the cables or tendons in tension.

The steel-framed parking structure provides the opportunity to use any of the three concrete deck systems, a major advantage in choosing structural steel for a parking structure. Before discussing the important factors to be considered in designing and building an open, steel-framed parking structure, it is worthwhile to review many of the advantages of structural steel framing.

General Considerations for Open-Deck Parking Structures

There are many parameters that parking structure developers, municipalities, and consultants must consider in planning and designing a new facility. Organizations such as the National Parking Association (NPA) and the International Parking Institute (IPI) publish guidelines for the planning, design and construction of parking structures.

In recent years, firms specializing in open parking structure design have emerged across the country to satisfy a growing demand for this expertise. However, a parking structure consultant may prefer a certain type of deck or framing system, and the owner should confirm the consultant's familiarity with local market and environmental conditions where the facility is to be built. Regional differences in market conditions, contractor expertise, and availability of materials may influence selection of the concrete deck system for a parking structure.

The initial costs of a parking structure are determined by the selection of a site, subsurface conditions, the choice of a framing and deck system, local labor and material prices, and financing costs during the construction period.

The speed of design and construction is particularly critical to revenue-generating parking structures, or in situations where an adjacent office building or similar structure cannot be fully leased until adequate parking is provided. The parking designer should take each of these factors into account in the original budget provided to the owner. Cost reductions can be accomplished through the choice of structural framing systems, optimizing bay sizes for optimal parking capacity, and the evaluation of various façade options.

The expenses of ownership of a parking structure do not end when the first car is parked. Ongoing maintenance programs are critical to the long-term life of the parking structure. A regular program of preventive maintenance at a reasonable annual cost can avoid the future expense of major renovation. The cost of these preventive maintenance programs and the anticipation of future remedial actions must be taken into account when evaluating the true cost of ownership and the life-cycle cost of the structure.

Closely related to the life cycle costs is the evaluation of the long-term structural durability of the structure. Concrete decks and structural members deteriorate as a result of chloride migration compromising the structural integrity of the parking structure. This may necessitate the removal and replacement of deck slabs or the need to structural reinforce the columns and beams.

Maintenance of life-cycle costs are directly impacted by the ease of maintenance of the parking structure. Ease of maintenance should be considered in the initial design of the structure. Similarly, the ease of construction will have a direct bearing on the construction costs of the project.

In seismic regions the design of the parking structure must take into account lateral forces due to seismic (earthquake) loading. In seismic design, the dead load, full live load, and the seismic loads are combined, and the structure is designed for combinations of these effects.

For most buildings, the exterior façade is both a major architectural feature and part of the envelope that protects the interior from weather. For the above-grade open parking structure, the façade is the primary architectural feature that often incorporates the exterior safety barrier and acts as a screen to block the viewing of parked cars. Perhaps the major decision for the owner and designer is whether the facility should be identifiable as a parking structure to the prospective patron or if it should not appear to be a parking structure at all.

The selection of the façade treatment on a parking structure is important from a security, aesthetic and cost standpoint. Parking structure owners and developers are now realizing that the first impression a visitor receives of their organization is often conveyed by the parking structure. Many municipalities are now requiring that parking structures blend into the architectural aesthetics of the neighborhoods in which they are located. For these reasons the choice of a façade treatment can be a critical choice for the structure. Façade systems are available to create literally any exterior treatment desired by the owner.

Background of Steel-Framed Parking Structures

The primary disadvantage of structural steel framing for open parking structures until the early 1970s was the cost and disruption of structural fire protection required by the model building codes. In 1972 the steel industry sponsored the full-scale Scranton Fire Test, the results of which finally put the fire safety issue to rest.

The test showed that a car fire in the open parking structure does not spread to fully involve adjacent vehicles, and temperatures of unprotected steel during this exposure are well below those at which the strength of structural steel begins to diminish (Gewain, R.; "Fire Experience and Fire Tests in Automobile Parking Structures", *Fire Journal*, 1973). As a result of intense building code and education activity during the 1970s and 1980s by local and national steel industry organizations, acceptance and application of "unprotected" steel in open parking structures accelerated quickly.

Today, under the International Building Code and other model building codes, including the National Fire Protection Association (NFPA) 5000, open, detached parking structures 70 to 80 ft. high can be framed with unprotected steel in most jurisdictions. In fact, studies by the Parking Market Research Company have shown that less than $55,000 of structural damage has occurred in over 400 recent parking structure fires ("Parking Garage Fires", D. Denda. Parking Market Research Company, McLean, Virginia, 1992).

With the fire safety question resolved, attention was focused on the issues of deterioration and maintenance of exposed structural steel, especially in middle and northern tier states where road salts are used. Concrete was portrayed as "maintenance-free," while structural steel was said to corrode and require frequent repainting. The steel industry's response was to encourage development of improved coating systems, which are now available for the steel framing systems including highway bridges. Experience has also alerted owners to the extent to which leakage of water and chlorides have taken their toll on parking structures framed in concrete. Today's reality is that regular preventative maintenance is important for every parking structure; and it is widely recognized today that steel-framed parking structures can resist deterioration as well as concrete systems.

Coupled with the impact of the severity of the corrosive environment, there has been a lack of appreciation that the open parking structure demands closer attention to floor system design, construction and inspection than the typical building regardless of whether the parking structure is steel or concrete framed. Minor imperfections in construction that are acceptable and expected in concrete floor slabs in office or residential buildings (such as hair-line shrinkage cracks) cannot withstand the severe open structure environment prevalent in many areas of the country. Once chloride corrosion of embedded reinforcing steel begins, there appears to be no way to totally halt the process, short of deck replacement or costly deck reconstruction with cathodic protection achieved by applying a permanent electric charge to the reinforcing steel. Remedial work will, at best, only extend the life of the deck. The good news is that the importance of deck design, corrosion protection, construction quality, and maintenance has become recognized. Techniques required to build and maintain durable concrete decks are available. Converting recognition and availability into reality, by convincing the owner/developer to invest in sound design and construction practice, is another matter.

Features of Steel-Framed Parking Structures

- **Construction costs.** Structural steel construction is very competitive with beam-and-column systems constructed with cast-in-place or precast/prestressed concrete. Typically, steel-framed systems can be constructed at a cost comparable to a concrete alternative. Structural steel fabricators (firms that prepare steel framing for assembly into a building) representing wide geographical areas can compete for open deck parking structure work around the country. More than 500 structural steel fabricators now participate in the American Institute of Steel Construction's (AISC) Quality Certification program, many of which have experience in parking structure fabrication. This range of savings in construction cost include the coatings (either high performance coatings or galvanizing) that are required for long term durability.

- **Parking efficiency.** Steel columns require 80 percent less floor space than the equivalent concrete columns providing more parking spaces in the same building footprint. When coupled with the opportunity to use long-span steel beams, smaller columns provide the owner with the most flexibility in layout, capacity and efficiency. Wide-flange steel beams as shallow as 24 in. can span up to 60 ft. in a passenger vehicle parking structure. Although in some long span conditions this may be considered minimal, the smaller column size will still be perceptively smaller and therefore make the floor appear more open and spacious.

- **Early occupancy.** Often the timely completion of a parking structure is keyed to the opening of a commercial, residential or public facility. Unlike most buildings, the occupancy date of a parking structure is often governed by the speed of construction of the framing and floor system alone. One structural system combines the speed of prefabrication and erection of structural steel with precast long-span double tees and offers the fastest erection time for any type of open-deck parking structure. The framing systems for steel-framed parking structures are fabricated off-site and are ready for erection upon delivery. The process of assembling the steel framing for a parking structure consists of bolting proper steel segments together in a prescribed sequence. Because of the smaller member sizes, the use of steel framing simplifies erection in locations with limited delivery or construction access and allows construction in cold weather conditions. A steel framing system can be erected in a matter of weeks.

- **Maintenance costs.** Life-cycle cost is the average annual maintenance and repair costs to be expected over the life of the parking structure. Structural engineers and others who have studied life-cycle costs conclude that steel-framed structures are usually less expensive (J. Englot, and Davidson, R.; "Steel-Framed Parking

Garages Take Off at JFK and Newark International Airports", *Modern Steel Construction*, April 2001). Parking industry experts have indicated that over a 50-year life, the cost to maintain a precast concrete deck and frame system will be between \$0.05 and \$0.08 per square foot, while the cost to maintain a post-tensioned deck on a steel frame will be between \$0.03 and \$0.05 per square foot, a savings of 40 percent. High-performance coatings (paints), galvanizing, and metalizing systems are demonstrating superior long-term corrosion protection for exposed structural steel. If deterioration of the concrete deck itself occurs, a steel-frame supporting that deck will minimize the cost and time required for rehabilitation of the slab and may even save the facility from demolition and total reconstruction.

- **Durability.** Innovative techniques have revolutionized the corrosion-resisting capabilities of structural steel. Structural steel-frames that are coated with a high-performance, multi-coat paint system using a zinc-rich primer can be expected to perform well with little maintenance for 25 to 30 years. When properly applied over a prepared surface, a three-coat paint system can provide over 30 years of corrosion protection. Recent studies have shown that after 15 years less than one half percent of the surface area of the steel has required any form of maintenance attention (Pope, G.; "Coatings for Parking Structures", *Modern Steel Construction*, April 2001). Some parking structure owners have chosen to protect their structures by using galvanized steel. This process, which cleans steel in an acid bath followed by dipping in a hot zinc bath, can provide effective protection from corrosion in excess of 40 years. Galvanized surfaces can be painted for aesthetic purposes and enhanced durability.

- **Aesthetic expression.** The ability of a steel-framed parking structure to easily accommodate a façade (the visible exterior of the structure) of exposed steel, concrete, precast concrete, masonry, glass, fiber-glass reinforced concrete (EIFS), aluminum, etc. – or combinations thereof – allows aesthetic flexibility. Unlike concrete structures where the façade system is integral to the structural system, facades on steel-framed structures simply attach to the frame allowing total freedom of choice of material and configuration. This feature is increasingly important with the advent of sustainable design and architectural scrutiny by public agencies, neighborhoods, and preservation or historical groups.

- **Design Flexability.** Steel-framed parking structures allow for well-controlled drainage systems and pipe locations. Embedded conduits, ceiling-mounted light fixtures, and optimal signage placement is simplified for a tight, efficient and well-constructed parking structure with neat, clean lines. In fact, electrical conduit and other ceiling-mounted fixtures can be run through holes drilled in the steel beams.

- **Simplified maintenance procedures.** Exposed beams, girders, and columns permit direct inspection, evaluation, accessibility of the frame, and ease of maintenance of steel surfaces. Localized breakdown of a coating system on a steel beam is a good indication of a developing problem with the concrete deck above, such as water or chlorides (road salts) leaking through a crack or a joint. Early detection of deck leakage permits timely corrective measures to be implemented. The "sacrificial" aspect of most concrete decks on steel beams means that major deck repair and rehabilitation can be accomplished with minimum disruption and cost. Many state bridge departments appreciate steel structures for this reason.

- **Adaptability to irregular sites.** Steel framing systems are easily adaptable to non-rectangular configurations that may be difficult to address with cast-in-place or precast framing systems. Smaller column footprints with the associated gain in parking efficiency allow the designer to provide efficient parking solutions tailored to sites where traditional solutions may be unworkable.

- **Reduced foundation requirements.** A steel structure can weigh up to one quarter less than a concrete structure, often an important factor in controlling seismic design, foundation, and erection cost and construction schedule. This weight saving can allow steel-framed parking structures to be built economically even in areas with marginal soil conditions.

- **Seismic resistance.** As more jurisdictions adopt building codes requiring structural design and detailing for earthquake loads, the ductility (ability to flex without permanent deformation), durability, and reliability of structural steel framing provides this material with distinct advantages over concrete alternatives.

- **Inherent quality control.** Shop fabrication of steel framing eliminates weather as a factor and minimizes the difficulties in quality control inherent with labor-intensive, on-site placement of reinforcing steel and forming and casting of concrete columns and beams. The selection of a steel fabricator, as well as the concrete deck subcontractor or precast/prestressed deck fabricator, should be based on experience, reputation, AISC certification, capability and the quality systems that are in place and being implemented.

Specifying A Steel-Framed Parking Structure

If you are an owner or a developed, how do you avoid the pitfalls inherent in parking structure construction for your next parking structure? And more importantly, what steps do you need to take to ensure that you will obtain a quality steel structure?

1. Select a designer familiar with the intricacies of parking structure design and the use of steel framing systems. Indicate that you want to explore the benefits that steel will bring to your project. If you choose to approach your next project on a design-build basis, several firms are prepared to provide both design and construction services for steel-framed parking structures. References are available through the Steel Solutions Center at 1.866.ASK.AISC.

2. Working with your designer, identify an AISC Certified steel fabricator who will be able to work with you on the design, detailing, fabrication, and erection of your new parking structure.

3. Select the proper deck system that meets your durability, performance, and financial criteria. Make sure the deck design provides a proper slope for drainage and correct placement of drains and stormwater discharges. A discussion of non-structural design criteria for parking structures can be found in Appendix B.

4. Specify a high performance coating or galvanizing system to provide long-term corrosion protection for your structure. Follow the guidelines of the coating system manufacturer with respect to surface preparation, number of required coats and application. For galvanizing, specify the minimum zinc thickness (generally at least 4 mils).

5. During construction ensure that care is taken in the fabricating and erecting process. No field welding should take place and galvanized bolts should be used. Any erection damage should be immediately addressed by properly cleaning the area. The multi-coat system or metalizing compound should then be applied.

6. After the completion of construction, institute a regular program of preventative maintenance as outlined in Appendix A including regular visual inspection of the parking structure and the touch-up on the minimal areas in need of maintenance.

Additional information regarding steel-framed parking structures, assistance in locating a certified steel fabricator or experienced design-builder of parking structures, the development of a conceptual solution for your parking structure and technical support during design and construction is available by contacting the AISC Steel Solutions Center at 1.866.ASK.AISC or solutions@aisc.org.

Appendix A: The Structural Maintenance of Parking Garages

A regular maintenance program is crucial to preserving the garage, providing a satisfactory level of service, and meeting service-life expectation, without premature deterioration, undue repair expense, interrupted service, inconvenience to patrons, or loss of cash flow. Neglected problems can lead to safety hazards for users, increased liability for owners, and necessitate expensive repairs in the long run.

Preventive Maintenance

Preventive maintenance will reduce repair expenses in the long run and extend the service life of the structure. Maintenance activities should include:

- *Snow removal.* Chlorides, which are in road salt are carried into the garage via vehicles, can be a garage owner's worse enemy because of the damage they do to concrete. Guidelines for deicing the garage are:
    - Clean, plow and scrape off ice and snow without use of any deicing agents. Take care not to damage joint sealants, deck coatings, or the concrete deck elements themselves.
    - Use sand to increase traction; when washing down the deck, be sure to protect the drainage system with temporary burlap or straw filters.
    - Deice with urea or CMA (a proprietary nonchloride deicer).
    - Use a mixture of sand and calcium or sodium chloride, but protect the drainage system from sand.
- *Cleaning.* A good maintenance program will include regular wash-downs with water to remove debris. This is especially important in the spring to remove dust, debris, and road salt, which contains harmful chlorides.
- *Repairs and restoration.* When potential problems are identified, a specialty contractor should be retained to perform corrective measures. Typical work includes repair of deteriorated concrete, sealing of cracks and joints, repair of expansion joints, and application of sealers and traffic deck membranes. Sealants have a finite life, so even the most effective will need to be replaced periodically.

Annual Inspections

A walk-through inspection should be conducted at least once a year. Do this in conjunction with a wash down of the structure, so that any active leakage can be noted and its source identified. Look for cracks, leaks, joint sealant failures, and general surface deterioration.

Using plan sheets of each floor, proceed with the inspection, walking through the entire garage and marking on the plan sheets any areas where problems are observed. It is helpful to use a code system to denote problems and their locations, for example, "L" for leak, "C" for corrosion, "J" for joint deterioration, and so on. Use lines to show where cracks exist and their sizes. Take photos of any deteriorated areas to serve as a record of the damage. It is important – and cost-effective – to take care of cracks, leaks, and joint deterioration early on, before the problems grow.

Sometimes concrete may become damaged, even though there are no visible cracks or surface deterioration. A simple "chain-dragging" survey can help evaluate suspicious areas. Drag a length of chain over the concrete wherever a problem is suspected. A hollow sound indicates that the concrete is delaminating and a significant problem may be developing. A hammer or metal rod may also be used; simply tap on the concrete and listen. If the chain-dragging survey reveals a problem, or if there are noticeable cracks on the faces of concrete columns or on beams, particularly near bearing areas, an engineer with experience in structural forensics should be consulted for follow-up.

Five-Year Inspections

Every five years or so – or whenever structural problems are suspected – consult a structural engineer with experience in the type of framing system utilized in the garage, concrete restoration/repair and waterproofing technology to conduct a comprehensive inspection. These experts know what to look for and can provide the information needed to make sound recommendations as to what corrective measures should be considered. It may also be appropriate to do some physical testing of the structure as part of this inspection to establish baseline performance or to better evaluate potential problems. A specialty contractor with experience in concrete restoration/repair and waterproofing technology can also conduct this type of survey, and will usually do so at no cost to the garage owner. The contractor can also do the required repairs and develop a maintenance budget for the structure.

Summary

Ultimately, it is the parking garage manager's or owner's responsibility to keep an eye out for problems, document these problems and call in engineers and contractors when necessary to perform maintenance and repairs. Implementing a maintenance program and following through with inspections and repairs can increase service life, decrease costs, and prevent small problems from becoming big repair bills.

Appendix B: Non-Structural Design Criteria

Decks

- Are there any cracks? Do they leak?
- Is the surface sound, or are there areas of surface scaling?
- Does a chain-dragging test reveal a hollow sound in any areas?
- Is there any evidence of concrete delamination?
- Is there any evidence of corrosion of reinforcing steel or surface spalling?
- Are there any signs of leakage? Describe conditions and not locations.
- If there is a traffic bearing membrane, does it have any tears, cracks or loss of adhesion?
- Are there low spots where water ponding occurs?
- Is water ponding present – poor drainage, clogged drains?
- Are there water stains on the underside (soffit) of the deck?
- Has the concrete been tested for chloride-ion content? When was it last tested?

Exposed Steel

- Are there any signs of corrosion on the beams or columns? Is the corrosion a surface effect or is there a significant loss of section?
- Is there any other exposed steel (handrails, door frames, barriers, cable, exposed structural connections) where corrosion is visible? Is it surface corrosion or is there significant loss of section?
- Is repainting required?
- What is the condition of the interface or attachment point between the steel and the surrounding concrete?
- Is there any staining that would indicate deck leakage adjacent to the steel member?

Stair and Elevator Towers

- Are there any signs of a leaking roof?
- Are there any cracks in the exterior finish?
- Are there any signs of corrosion-related deterioration of stairs or railings?
- Are any other corrective actions required?

Expansion Joints

- Are there leaks through isolation-joint seals?
- Are leaks related to failure of the seals or the adjacent concrete?
- Could the cause be snowplows?
- What type of isolation joint/expansion joint seal is installed?

- Who is the manufacturer?
- Is there a warranty in force?
- Consult the manufacturer for repair recommendations if applicable.

Joint Sealants

- Are there any signs of leakage, loss of elastic properties, separation from adjacent substrates or cohesive failure of the sealant?
- Are there failures of the concrete behind the sealant (edge spalls)?

Drains

- Are drains functioning properly? When were they last cleaned?
- Are the drains properly located so that they receive the runoff intended?
- Are seals around the drain bases in good condition?

Previous Repairs

- Are previous repairs performing satisfactorily?
- Are the edges of previous patches tight?
- Do the patches sound solid when tapped?

Abridged from "The Structural Maintenance of Parking Garages." Parking, November 2001
By Mr. David Monroe, President, Carl Walker Construction, Pittsburgh, Pennsylvania

Expansion of Parking Structures

Ease of expansion and conversion. Structural steel simplifies future expansion, or the conversion of a parking structure to a different use. Designing for future *vertical expansion* is a desired feature for many new parking structures. Vertical expansion can be easily accomplished in a steel-framed structure through the splicing of existing columns and the placement of steel members with readily available cranes. In most cases only the top level of the existing parting structure needs to be taken out of service. The remainder of the parking structure can remain open. Steel framing facilitates the incorporation of tenant space.

Sustainability of Parking Structures

Utilization of a recycled resource. More than 95 percent of structural steel manufactured in the United States is fully recycled from previously used steel materials. At the end of its useful life, the steel framing system of a parking structure can be recycled into new structural steel for new buildings and other applications.

Safety and Security of Parking Structures

Safety and Security. Small columns, bright finishes, long spans, relatively flat ceilings and braced or moment frames make a steel-framed parking structure easier to illuminate and secure. This feeling of openness, particularly in walkways, creates a positive feeling of passive security. Users often comment on how "open and bright" the decks of a steel-framed garage are. In contrast, concrete structures often require solid interior shear walls in order to resist lateral (horizontal) loads, which create visual obstructions and a "closed-in" feeling.

AIRPORT PARKING: CURRENT ISSUES AND CHALLENGES

Winfrid 'Win' Beltran

Mr. Beltran has over a decade of 'hands on' experience in the management of parking and ground transportation systems. His duties have included a variety of tasks such as contract administration, financial auditing, operations management, computer system administration, and maintenance oversight. At Parsons, Mr. Beltran specializes in all aspects of parking and ground transportation services to include studies and analyses, revenue control technical specifications, project management, and facility planning.

Paul Spero Kitsakos

Mr. Kitsakos has over twenty years of experience in all aspects of parking and transportation, including planning, design, construction, and operations. He has worked in all major market sectors including airports, stadiums/arenas, campuses, malls/retail, and municipal parking facilities throughout the United States, as well as, Europe, the Middle East and Asia.

Introduction

Airports are not just about airplanes. Airport's parking and ground transportation facilities are as important as ticket counters and aircraft gates. It is probably more accurate to think of airports as transportation nodes where passengers transition between the air transportation system and the surface transportation system. Inadequate ground access can severely limit the development and operation of a major airport. Changes in how Americans travel and use airports have challenged long held notions about the relationship between landside facilities (roadways and parking) and airside facilities (runways, boarding gates, etc.). Airport planners have had to adjust to this reality and modify airport development programs accordingly.

Airport parking is also crucial to the financial stability of major airports throughout the United States. It is not unusual for airport parking revenue to be among the three top revenue sources at major airports. Parking revenue can account for 30 to 40 percent of an airport's total operating income. At the world's busiest airport, Chicago O'Hare International Airport, gross annual parking revenue is approximately 100 million dollars and is the single largest contributor to the airport's revenue budget.

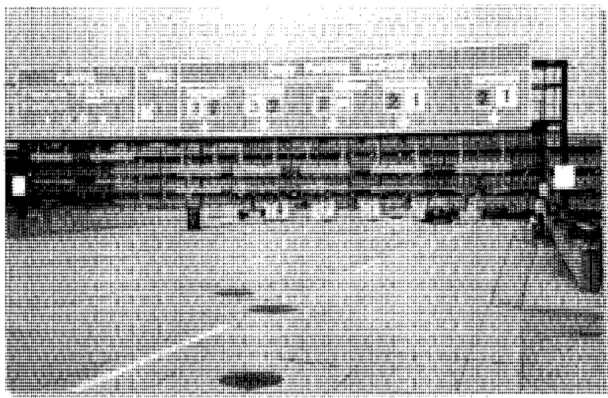

Figure 1: Terminal Parking Entry Plaza at Chicago-O'Hare International Airport

Source: Parsons Inc.

Although largest in gross revenue, O'Hare is not unique in terms of parking revenue generation. Airports such as Hartsfield Atlanta and Dallas-Fort Worth also generate average annual parking revenues of $75 to 85 million dollars. There are no less than 20 major U.S. airport parking operations that generate more than $25 million dollars in annual revenue. To generate and protect such large revenue streams, airports have developed large facilities (often exceeding 20,000 parking spaces), and installed highly complex, specialized parking access and revenue control systems (PARCS) that distinguish them from other parking market segments. Understanding how airport parking operations evolved requires some background on the history of commercial aviation in the United States.

A Brief History of Airports and Airport Parking

The history of airport parking parallels the development of U.S. airports and the airline industry, and the primary focus of this discussion is the on-airport parking market segment at major airports. Both airplanes and automobiles became commercially viable about the same time, so it seems natural that their development would be somewhat similar. However unlike the decentralized nature of road building and the auto industry, the commercial aviation industry grew slowly at first.

Two key historical events have revolutionized airport parking and the way we use it. These two pivotal events were the deregulation of the airline industry and the 9/11 terrorists attacks. These two events forever changed the airline industry, the airports that serve it, and divide the history of airport parking into three distinct eras.

The first time period begins with the birth of commercial aviation and ends with the Airline Deregulation Act of 1978. The so-called legacy airlines such as American, Delta, and United have their roots in this era. Beginning in the 1920s, these airlines developed from small regional carriers that hauled more mail than passengers. After some initial development, government regulation, poor infrastructure, the Great Depression, and World War II limited the growth of commercial aviation.

The post-World War II economic boom of the 1950s and 1960s led to a marked increase in commercial air travel. During this period airlines served primarily business travelers who sought convenience of air travel in an increasingly interconnected national economy. More leisure travel was undertaken, but was still a rare event in most Americans' lives. The Civil Aeronautics Board (CAB), an agency of the federal government, strictly controlled routes and cities served. Airlines grew into major enterprises in this highly regulated environment.

During this period airport parking was often a somewhat informal affair. Parking was usually provided at no cost and not subject to regulation. However, during the latter part of this period, increasing automobile ownership and additional growth in airline passenger traffic generated the demand for larger parking facilities. This trend made paid parking at airports increasingly common. The airport parking industry recognizing these trends developed specific parking operations for airports and specialized commercial airport parking operators such as APCOA (now APCOA/Standard) soon developed.

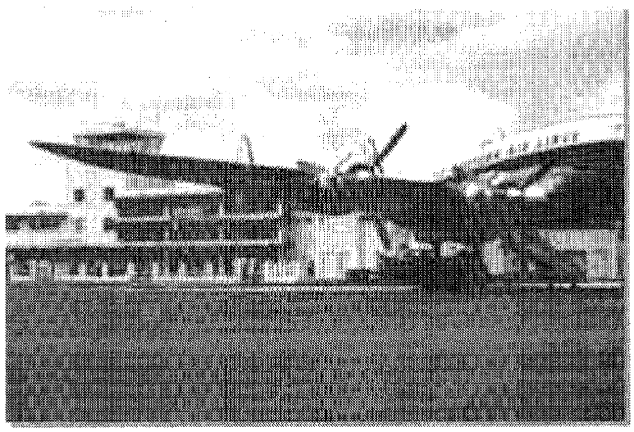

Figure 2: The Early Days of Commercial Aviation

Source: Greater Orlando Aviation Authority

Airline deregulation changed the orderly nature of the air travel system. Throughout the 1980s and 1990s increased competition led to lower airfares and an explosion in air travel. Business travel expanded rapidly as the economy went global and leisure travel boomed. The realignment of the airline industry began during this period and continues through today. New low cost carriers such as Southwest Airlines blossomed, while venerable industry giants like Eastern Airlines and the original Pan American Airlines ceased to exist.

Airport parking also went through an explosive growth period as airports struggled to build sufficient capacity to accommodate demand. Rapid expansion and consolidation by the major airlines led to creation of new routes and a hub and spoke air network. This development was closely followed by substantial growth among low cost carriers. The impact of this growth could be immediate and dramatic. The growth was not limited to major airports in large metropolitan areas. Designation as a hub airport in the major airlines' hub and spoke route systems led to rapid growth of other airports located in mid-sized cities like Cincinnati, Raleigh-Durham, Charlotte, and Salt Lake City. Airports at smaller cities grew even more dramatically.

Between 1997 and 1999 the arrival of Southwest Airlines in the Manchester, N.H. (convenient to Boston) market caused passenger enplanements to triple. Similar if less dramatic growth was occurring at other secondary or reliever airports (a second airport serving a major metropolitan airport) throughout the country.

Airports quickly began planning and building new parking facilities and many airports found that land constraints made rapid expansion challenging. The planning, design, financing and construction of this type of infrastructure took years, with some parking facilities only recently completed. In the interim, full lots and temporary parking facilities were common. The relative scarcity of parking led to higher fees and rapid growth in gross revenues. The key market segment for the major airlines, the busy business traveler, seemed willing to pay just about any price for convenient at-terminal parking. Full service valet operations were implemented at many airports to cater to these high-end patrons. . Fees of $40 or $50 per day were not uncommon and the lots stayed full.

Scarcity also led to competition from the private sector. Off-airport parking operators, once small in scale, developed large, quality facilities with high levels of customer service, near most major airports. Though not a new phenomenon, off-airport parking grew in size and sophistication. National companies with multi-level parking structures, Internet-based reservation systems, and brand new shuttle fleets served not only leisure travelers, but business travelers as well. Air travel and airport parking demand peaked along with the economy in Year 2000 but a year later was crippled in the wake of the 9/11 attacks.

Already affected by the economic downturn, the 9/11 tragedies were even more painful for airport parking operations throughout the country as parking revenues continued to decline. The effects of the terrorists' attacks are still reverberating t at airports generally and in airport parking specifically. Real on-airport parking revenue has yet to recover to Year 2000 levels at many airports. Decreased demand, shifts in usage patterns, increased off-airport competition, and increased security costs have all affected the bottom line. .

Airport Parking in the Post 9/11 Environment

In the immediate aftermath of the terrorist attacks, the air transportation system shut down for several days and as such the airport parking revenues essentially ceased. Once airports reopened, parking operators (especially on-airport) faced some difficult constraints. Foremost amongst these was the so-called "300 foot rule" which stated that no unattended vehicle would be allowed with 300 linear feet of an airport's terminal buildings. The impact of this rule was significant. . Airports lost the use of thousands of parking spaces and usually the short-term parking spaces that generated the highest revenue. Many older airports immediately sought waivers because the 300-foot barrier effectively closed all at-terminal parking facilities.

Constant security patrols and intrusive vehicle inspections were also implemented, further amplifying costs and decreasing net revenues. Airports also were forced to consider expensive structural changes to parking structures based on explosive blast analyses. Continued inspection regimes, protective blast walls, and shatter proofing of glass areas addressed most of the federal government's security concerns. Most restrictions have since been relaxed but the continued terrorist threat makes it likely that airports may have to implement such actions again in the future.

The high cost of security enhancements coupled with increased off-airport competition have caused airports to reexamine their cost structures. Airport managers, their commercial parking operators, and the parking revenue control equipment industry have all been challenged to address labor costs; the largest direct operating expense. Many airports have implemented or are studying pay-on-foot machines, express parking, or prepaid parking solutions as a way to reduce labor expenditures.

Relationships between airports and their commercial parking operators have also been strained. The drop in revenues after 9/11 led some operators to seek contract renegotiation, especially in percentage of gross profit contracts. In extreme cases, revenues were not even covering operating expenses and led operators to abandon some locations. The constant pressure to reduce operations and maintenance costs also strained the relationship between the operators and airport management. The operators were placed in a difficult position of greatly reducing staff while asking a smaller staff to do more. The staff reductions also have had detrimental impacts on parking employee morale, retention, customer service and labor relations.

Along with reducing costs, airports also have had to address continually dwindling revenues. Not only were fewer people traveling, they were also choosing less expensive parking alternatives. Remote or economy lots and off-airport parking became viable alternatives to the business travelers that were still flying. This shift from one parking product to another had tremendous revenue implications. Since economy parking rates were typically half the cost of at-terminal parking transaction revenue yield dropped dramatically. Many airports reacted by increasing parking fees, but that sometimes was counterproductive, further alienating airport patrons and reducing total revenue.

Along with this shift in parking product demanded further changes in customer behavior occurred. Where once patrons might use a short-term parking lot, they now often circled the airport incessantly, waiting to pick up passengers at the terminal curbside. Patrons that would once self-park would now use another mode of transportation. . These patrons seemed to be alienated by the prospect of intrusive vehicle searches and increasing parking rates. In response many airports have resorted to an increase in short-term parking grace periods (further reducing revenues) to relieve traffic congestion on terminal roadways.

Average parking durations were shorter as the number of days for business trips was reduced. Many business travelers found that security checks in the terminal parking garages and in the terminals extended processing times to the point that the time advantage of flying over driving had dwindled to nothing. While many of these issues have been addressed and many restrictions have been relaxed, air travelers have been slow to return to parking. Like high airline last minute business airfares, high at-terminal parking fees continue to be a hard sell.

Parking Supply and Capacity Issues

Not long ago airports were faced with a lack of parking capacity, now the problem became too many empty parking spaces. The "Southwest effect" which describes the rapid growth in air passenger traffic generated by a low cost airline entering a new market led many airports to invest heavily in parking infrastructure. In order to stay competitive the major airlines also undertook major expansions that required airports to make even greater investments. It seemed that this growth would go on forever and because of the long lead times associated with airport development funding and construction, airports built facilities sized in anticipation of continued long-term growth.

At Orlando International Airport, for example, nearly $250,000,000 was invested on roadway and parking improvements just before September 11th. As a hub for Delta Airlines and a key low cost carrier destination this airport experienced rapid growth throughout this period. Given that this airport, which was less than twenty years old at the time, required this type of investment is a testament to the surge in traffic the airport experienced and was expecting. Figure 3 describes those improvements related to public parking. Many of these facilities now await a recovery in parking demand.

Public Parking Improvements at Orlando International Airport (1997-2000)	
Terminal Parking	Expansion of A and B Garages (3400 spaces)
Terminal Parking	Terminal Top Parking Access Bridge
Terminal Parking	New A and B Garage Access Ramps
Terminal Parking	Roadway Access and Entry Plaza Upgrades
Terminal Parking	Exit Plaza Capacity Upgrades
Satellite Parking (Economy)	Satellite Blue Lot (3000 spaces)
Satellite Parking (Economy)	Satellite Red Lot (4500 spaces)
Satellite Parking (Economy)	New Shuttle Bus Fleet
Terminal & Satellite Parking	New Parking Administration and Maint. Office Bldg.
Terminal & Satellite Parking	New Revenue Control System
Hotel Valet Parking	Office and Circulation Improvements

Figure 3: Public Parking Infrastructure Investments at Orlando International Airport
Source: Greater Orlando Aviation Authority Records

The 9/11 attacks caught many airports in the middle of their construction cycles. At airport like Minneapolis-St Paul and Raleigh Durham, new parking facilities have opened just recently or have yet to open. Among the most affected airports is San Francisco International where ground access improvements have built tremendous capacity at a time when the Silicon Valley technology bust and the Asian SARS epidemic have further reduced air travel demand. At airports throughout the nation parking capacity continues to be created at a time when parking occupancy at some facilities remain below Year 2000 levels.

While parking demand will eventually recover in some fashion, airports may be faced with a mismatch between capacity and demand. The shift of business travelers to economy lots and even off-airport could mean that partially empty at-terminal garages will remain so for the foreseeable future. Meanwhile, economy or remote parking demand continues to grow requiring additional terminal transportation services, additional staffing, and even additional capacity. This trend will be exacerbated during the "super peak" periods for airport parking (Thanksgiving and Christmas). More and more travelers will demand less expensive remote parking.

Revenue Control

Large complex parking revenue control systems have become a distinguishing characteristic of major airport parking operations. The latest in parking technology including online license plate inventory (LPI), license plate recognition (LPR), automatic vehicle identification (AVI) access, prepaid parking debit accounts, and integrated toll road/airport parking payment systems are now commonplace. While smaller airports may have systems that are more similar to urban applications, major airport revenue control systems are significantly different and much more complex. . The figure below illustrates the revenue control system at one exit plaza of one parking lot at a major airport parking facility.

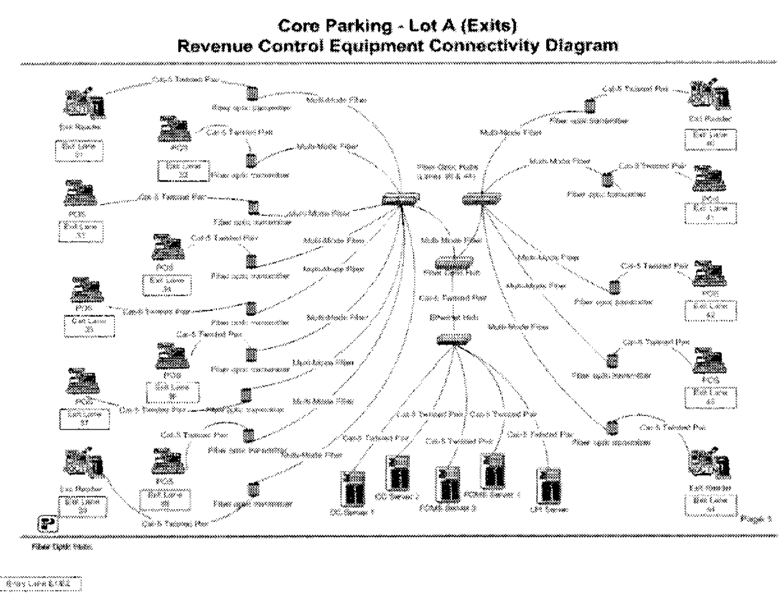

Figure 4: Complex Revenue Control System (Exit Connectivity Diagram) for Lot A at Chicago-O'Hare Int'l Airport

Source: Parsons Inc.

Why the difference? It's about the money! The large number of long-term vehicles (overnight inventory) and high dollar value of the typical parking transaction means that fraud prevention is crucial to optimize the airport's return on the capital investment required to construct their parking facilities. Given these potential high revenues at stake, airports go to great lengths to close holes in their revenue control system. Airports have also invested heavily in parking technology.

At most large airports every exit transaction is checked against an up-to-date license plate inventory database. The collection of the license plate inventory (LPI) is laborious. Each night, usually after midnight, parking employees use hand held computers to record the location and license plate of every vehicle in every parking facility. Overnight inventories on peak nights can sometimes exceed 10,000 vehicles. The LPI process can also be a valuable customer service tool that can be used to assist patrons that cannot locate their vehicles in the huge parking facilities. The effort can pay for itself if it saves just a couple of percentage points of gross revenues. Many airport parking operations can account for 99.5+% of their issued tickets with LPI.

These complex revenue control systems are extremely accurate because they focus great attention on exception tickets. Lost tickets are easier to process correctly because the system knows the location and entry date of every vehicle that has been in the parking facilities for more than one night. Similarly, attempts to defeat the system through stolen or swapped tickets are easily detected and defeated. Comprehensive audit trails and centralized facility management systems also address the problem of employee fraud.

As noted earlier airport parking revenue control systems are growing more complex every day. Parking equipment vendors are applying the latest computer, video and networking technology to solve major challenges facing airports. Many parking equipment vendors now offer license plate recognition (LPR) software that can automate some of the LPI collection and matching functions. Some also offer vehicle-mounted systems that aid in cataloging vehicle locations. New, more powerful pay-on-foot machines, automated entry and exit processing, and improved count systems are improving the customer experience while reducing operating cost. The imaging systems originally intended to automate the LPI process can now be combined with cutting edge biometric software and law enforcement databases to improve physical security. Parking revenue control equipment vendors are also exploring wireless parking applications to reduce installation costs, and Internet-based affinity and reservation programs to increase customer loyalty.

Still, these systems will remain in a niche market. This type of technology is as expensive as it is effective. Millions are spent to procure these systems and annual maintenance costs can be hundred of thousands of dollars. At Dallas-Fort Worth International Airport (DFW) a replacement revenue control system is estimated to cost between 20 and 30 million dollars. Unique structural issues at DFW have increased the cost of that system but expenditures of 5-7 million dollars at other airports are not uncommon.

Such investments are only appropriate for the largest airports. Airports with smaller annual revenues find it more cost-effective to use less complex systems that balance potential losses against the cost of preventing them.

New Parking Products

The pressures to control costs and increase revenues have led airports to try innovative new parking products to meet customer needs. New parking equipment technology has also made it easier to implement these new programs. Although many of these programs have been around for some time and are popular at many off-airport locations, they haven't been widely implemented on-airport. Overflowing with vehicles, on-airport parking operators have had little incentive to provide new services. The new realities have forced on-airport operators to take a serious look at products like Prepaid Parking, Frequent Parking Programs, Reserved Parking, Valet Parking, and Allied Services.

New technology has allowed all parking operators, including airports, to get better acquainted with their customers. Frequent parkers are now sought after much like airlines value frequent fliers. Frequent Parker programs and Prepaid Parking programs using prepayment cards or automated vehicle identification (AVI) technology help expedite entry and exit. Reserved parking programs, often Internet-based, have also been implemented to assure valued customers that a parking space will be available when needed. . Automated Parking Guidance Systems (PGS) which guide patrons to the nearest vacant parking space, especially in VIP or Frequent Parker areas, are also becoming more prevalent to improve customer service.

Reserved parking programs are often combined with Valet Parking and Allied Services. Valet Parking programs provide the ultimate level of service for core business travelers that are willing to pay a premium for these services. Valet Parking operations are most popular at airports with significant business clienteles. Allied Services build on the valet experience by offering value added services such as oil changes, car washes, and dry cleaning to these premium customers.

Conclusion

This chapter began with a brief history of commercial aviation and airport parking. The narrative then described the three distinct periods of that history. From a modest beginning, airport parking boomed after the deregulation of the airline industry. The massive revenue streams, complex revenue control systems, and huge parking space inventories that became characteristics of major airport parking operations all evolved during this period.

The third era, Post 9/11, is still evolving. Like the remaining legacy airlines, major on-airport parking operators have adjusted to a new competitive environment. Increased security costs and declining or stagnant revenues have led to massive pressures on the on-airport parking industry. That pressure has affected all aspects of parking from contractual relationships between airports and their parking operators to employee morale and retention.

Changes in customer behavior and shifts in parking demand threaten to make many of these negative effects permanent and have had a significant revenue impact. Having recently built substantial infrastructure to accommodate continuing growth, many airports must now address overcapacity or a mismatch between parking capacity and parking demand. The mismatch in capacity has mainly resulted from a significant shift by business travelers to less expensive parking products or alternate modes of transportation.

The largest airport parking facilities are looking for creative solutions to address issues such as cost reduction, improved security, improved customer service, and increased customer loyalty. Most hope to meet these challenges through new technology and new parking products. New technology including LPR, AVI, and expedited transaction processing (pay-on-foot, credit card in/out, etc.) is being deployed to increase revenues and provide a higher level of service to airport patrons. These technological improvements are expensive and at this time only seem economically feasible at the largest airport facilities.

All airport parking facilities, large and small, on or off-airport, are looking at new products to meet customer needs. Many of these products including Reserved Parking and Frequent Parking Programs are common at off-airport facilities and are now receiving serious consideration from on-airport operators. Similarly, established products such as Prepaid Parking, Valet Parking and Allied Services are attracting new interest. Operators are looking to improve customer satisfaction, customer loyalty and per transaction revenue by offering these premium services.

The future of the airport parking industry is dependent on how successful the new challenges airports face are addressed. Lower parking fees, improved PARCS technology and increasing airline traffic should help but parking operators will need to be innovative to significantly increase revenues.

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HOSPTIAL/MEDICAL CENTERS – PARKING NEEDS AND MANAGEMENT PROGRAM

Robert P. Jurasin, P.E.

Mr. Jurasin is Senior Vice President and Northeast Region Manager of Wilbur Smith Associates. He has over 30 years experience in traffic engineering, transportation planning and parking. His expertise in the parking field includes parking needs and location studies for downtown/central business districts, mixed-use development, special events, sports stadium, and civic/convention centers, educational facilities/universities, hospital/medical centers, and other land uses; economic feasibility and financial analysis of parking structures; functional design and operations; parking program operations and management; parking research and traffic impact studies. Mr. Jurasin is the author of "Traffic Impact and Site Access of The Dimensions of Parking," 4th Edition, 2000, published by the Urban Land Institute and National Parking Association.

Introduction

Parking is a commodity and a necessity for the success of a business. Residential developments need parking for residents, office buildings need parking for employees and visitors, shopping centers need parking for customers, and on and on. Hospital and medical centers are no exception.

Relative to hospital/medical centers, there is a uniqueness not found in other general land use categories. Most other land use categories need to respond to one type of user (i.e., residential parking or employee parking), or at most two types of users (i.e. employees and visitors). Hospital/medical centers need to respond and provide parking for the following:

- Employees, usually in three shifts, with an overlap of the working hours between shifts. The employees include medical staff such as resident physicians and nurses as well as administrative personnel.
- Physicians, arriving on a random basis, and quick access into the hospital is mandatory.
- Special events, seminars, etc.
- Emergency vehicles.
- Volunteers.
- Students.
- In-bed patients.
- Patient/outpatient activity.
- Visitors.
- Vendors/Suppliers.

Each of these typical daily users has their own parking needs during the course of a day. Length of stay as well as their location within the facility is different for each user. The uniqueness does not stop there. Over the past decade, changes in insurance reimbursement, demographics and technology have changed the way hospitals deliver services.

These changes have resulted in the rise of other medical facilities such as health care centers, walk-in medical facilities, congregate housing, and nursing homes. The impact on parking in general, and parking planning specifically, is significant. The healthcare parking model has changed from bed census to outpatient. Another issue affecting parking planning are hospitals located in residential areas where hospital users have access to the adjacent on-street residential parking supply. It is difficult to differentiate between neighborhood users and hospital users.

In planning for these healthcare facilities, the number of parking spaces is usually calculated by using local municipality zoning regulations and/or national parking standards. Relative to hospital/medical centers, there are several reference documents related to general parking needs available from the Institute of Transportation Engineers, Urban Land Institute, ENO Foundation, and others.

A municipality usually has parking rates typically based on a per-bed and/or per number of employee basis, (i.e., one space per two employees plus one space per three beds). National parking guidelines are periodically updated based on the research in the profession. Local zoning regulations are also updated, but on a less frequent basis.

Few guidelines consider out-patient activity as a parameter in developing parking requirements rates. This is one of the reasons that existing hospital/medical facilities are experiencing parking shortages in today's environment, where such shortages did not exist years ago.

It is also important that the hospital/medical center provides the right mix and location of its parking facilities for its users. The use of national standards or even the local municipal parking regulations/codes are no longer sufficient. The uniqueness and the rapid changing technology of hospital services require up to date research and action.

Parking Needs Study

A Parking Needs Study evaluates the parking characteristics of an existing hospital/medical center and determines the parking needs of the existing facility, by user group, as well as the parking implications of planned changes and expansions of the facility. The second part of such a study is to recommend the number and location of parking spaces for each of the identified users. The general step-by-step objectives of such a study are as follows:

- Determine present parking supply/availability both on hospital property and on the adjacent street system. (It should be noted that neighborhood on-street parking can be designated a "Resident Permit Zone", if neighbors object to parking by others).
- Determine existing parking demand, by user group.
- Determine existing parking needs, and surpluses/deficiencies by user group.
- Determine projected future facility expansion and/or modifications.
- Project anticipated future parking needs, and surpluses/deficiencies, by user group.
- Develop a Parking Management Program that includes the parking requirements by user group, location of parking spaces by user group, and an overall sufficient and efficient Parking Plan for the hospital/medical center.

To develop a Parking Management Program, it is important to first understand the magnitude of each user group on a daily basis, and their associated arrival/departure times to the extent possible. For an existing facility, there should be information relative to the number of daily employees and their working shifts, average number of daily outpatient activity and arrival/departure times, average number of daily physicians, the activity associated with volunteers and students, and the number of daily visitors.

Field surveys are required to detail parking accumulation by user group and in total. All existing hospital parking facilities, along with the on-street parking areas on the adjacent street system, should be surveyed in 30-minute intervals over the course of an entire typical weekday. License plates of these vehicles are recorded within each parking area designated for a specific user (i.e., physicians, visitors, employees).

Relative to physicians, employees, volunteers/students, and outpatients, a parking and transportation-related questionnaire/survey should be distributed to these users. Information such as arrival and departure times, carpooling activity, frequency of travel to the facility, and duration of stay are ascertained. Visitors should be requested to participate in a similar interview/questionnaire survey. Survey 1 is for out-patients and visitors and Survey 2 is for employees and volunteers/students. A similar survey would be developed for physicians. As noted, the surveys also contain attitude questions so as to understand the parking issues, as perceived by each user group. Please refer to the following page for Surveys 1 and 2.

SURVEY 1

Survey Date: ____________

WILBUR SMITH ASSOCIATES

Out-Patient/Visitor Traffic/Parking Survey

INSTRUCTIONS: We are taking a survey to evaluate parking conditions. Could you please answer a few questions about your trip to the hospital and where you parked? Your answers will help parking and traffic conditions around the hospital.

1. Why did you come to the Hospital today?

1 ☐ Visit a patient	5 ☐ Pay a bill
2 ☐ Medical appointment	6 ☐ Drop off/pick up patient
3 ☐ Checking in or out	7 ☐ One-Day Surgery
4 ☐ Business	8 ☐ Other ____________

2. Please indicate the time you arrived and will depart from the hospital today. If you made more than one trip to the hospital, please indicate the arrival and departure times for each trip.

Arrival Time ____________ Departure Time ____________
Arrival Time ____________ Departure Time ____________

3. How did you get to the hospital today?

1 ☐ Drove an automobile or van, parked	6 ☐ Walked
2 ☐ Passenger in auto or van, parked	7 ☐ Motorcycle
3 ☐ Passenger in auto or van, dropped off	8 ☐ Bicycle
4 ☐ Bus	9 ☐ Taxi
5 ☐ Other: ____________	10 ☐ Train

NOTE: If you came in a vehicle that parked at or near the hospital, please answer the remaining Questions #4 through #10. If not, interview is complete. Thank you for your assistance.

4. How many people (including yourself) came in your vehicle?

1 ☐ One	4 ☐ Four
2 ☐ Two	5 ☐ Five or more
3 ☐ Three	

5. Where did your trip to the Hospital begin, today?

City/Town ____________ Zip Code: ____________

6. In general, what is your opinion of the present parking conditions at the hospital?

1 ☐ Good	3 ☐ Poor
2 ☐ Fair	4 ☐ No opinion

7. Where did your vehicle park?

1 ☐ Hospital Garage/Lot	4 ☐ Palmer Ave Garage
2 ☐ Emergency Room Lot	5 ☐ Curb (Name Street):
3 ☐ Milburn Street Lot	6 ☐ Other: ____________

8. Did you have any problems finding a space to park today?

1 ☐ No problems
2 ☐ Some problems
3 ☐ Very difficult to find a space

9. Where would you prefer to park?

1 ☐ Where vehicle is now	3 ☐ In an off-street lot
2 ☐ On the street, closer	4 ☐ In hospital garage

10. What is the reason for your preference in Question #9?

1 ☐ Satisfied w/present location	3 ☐ Safety/Security
2 ☐ Too far to walk	4 ☐ Other: ____________

Thank you for your assistance.

SURVEY 2

Survey Date: ____________

WILBUR SMITH ASSOCIATES

Employee/Volunteer Traffic/Parking Survey

INSTRUCTIONS: This survey is being conducted to evaluate parking conditions. Please answer the questions as accurately as possible with only one response per question. You should fill in the form for your travel on the survey date above. Return this form to your department manager today. Thank you for your assistance.

1. In what capacity do you work?

1 ☐ Employed Physician	5 ☐ Clerical
2 ☐ Nursing	6 ☐ Volunteer
3 ☐ Administration	7 ☐ Service & Maintenance
4 ☐ Other Professional/Technical	8 ☐ Other ____________

2. What are your normal shift hours on ____________
Date

____ AM/PM to ____________ AM/PM

3. How often do you work at the Hospital?

1 ☐ One day/week	5 ☐ Five days/week
2 ☐ Two days/week	6 ☐ Six days/week
3 ☐ Three days/week	7 ☐ Seven days/week
4 ☐ Four days/week	8 ☐ Less than once/week

4. Where did your trip to the Hospital begin, today?

City/Town: ____________ Zip Code: ____________

5. Please indicate the time you arrived and departed from the hospital today. If you make more than one trip to the hospital, please indicate the arrival and departure times for each trip.

Arrival Time ____________ Departure Time ____________
Arrival Time ____________ Departure Time ____________
Arrival Time ____________ Departure Time ____________

6. How did you get to the hospital today?

1 ☐ Drove an automobile or van, parked	6 ☐ Walked
2 ☐ Passenger in auto or van, parked	7 ☐ Motorcycle
3 ☐ Passenger in auto or van, dropped off	8 ☐ Bicycle
4 ☐ Bus	9 ☐ Taxi
5 ☐ Other: ____________	10 ☐ Train

NOTE: If you came in a vehicle that parked at or near the hospital, please answer Questions #7 through #11. If you did not, you are finished. Please return this form to your department offices, today.

7. How many people (including yourself) came in your vehicle?

1 ☐ One	4 ☐ Four
2 ☐ Two	5 ☐ Five or more
3 ☐ Three	

8. Where did your vehicle park?

1 ☐ Hospital Garage/Lot	4 ☐ Palmer Ave Garage
2 ☐ Emergency Room Lot	5 ☐ Curb (Name Street): ____________
3 ☐ Milburn Street Lot	6 ☐ Other: ____________

9. Where would you prefer to park?

1 ☐ Hospital - on site	4 ☐ Public Lot
2 ☐ Private Garage	5 ☐ On-Street
3 ☐ Private Lot	6 ☐ Other: ____________

10. If you park in one of the Hospital lots, how do you pay for parking?

1 ☐ Payroll deduction	4 ☐ Do not pay
2 ☐ Pay Daily Employee Rate	5 ☐ Other: ____________
3 ☐ Pay Visitor Parking Rate	

11. What is your opinion of the present parking situation at the Hospital?

1 ☐ Good	3 ☐ Poor
2 ☐ Fair	4 ☐ No position

Thank you for your assistance.

The information obtained from the administration of the hospital/medical center, data obtained through the field surveys of parking accumulation and turnover, and information obtained through the questionnaire/interviews are summarized and calibrated together to understand the physical needs of the individual parking user.

In a recent example of a parking needs study, an existing hospital had the following characteristics:

- 281 in-patient beds
- 1,000 employees with 535 employees on a typical peak weekday, in three shifts
- 200 physicians in which 150 physicians visit the hospital daily
- 200 volunteers with about coming to the hospital on a typical peak weekday
- 100 daily outpatients
- 750 daily visitors

Figure 1 illustrates the arrival and departure patterns for the physicians, with the peak arrival occurring in the morning (8:00 A.M.) and peak departure in the afternoon (5:00 P.M.). There are significant hourly fluctuations of in/out patterns throughout the day. Please refer to Figures 1 through 4 on the following page.

Figure 2 illustrates the arrival and departure patterns for employees/volunteers, with the peak arrival in the early morning (7:00 A.M.) and departure in the afternoon (4:00 P.M.). The graphic clearly shows the arrival/departure activity and overlap during the 2:00-4:00 P.M. shift.

Outpatient activity peaks in the morning (8:00 A.M.) and 12:00 P.M. time periods as illustrated in Figure 3. Visitor activity, which is graphically depicted in Figure 4, is fairly significant from 1:00 P.M. to 9:00 P.M., with peak arrivals at 1:00 P.M., 3:00 P.M., and 7:00 P.M.

It is important to understand the parking needs for each user but it is critical to understand the cumulative effect generated by all users. In the example, Table 1 is a summary of the parking space needs for each user, in 30-minute periods throughout the day. The peak parking demand occurs during the 1:00-1:59 P.M. time period when 524 parking spaces are being used. This number represents the parking space demand by the existing hospital.

Each user group has its own peak parking requirements. Table 2 highlights the peak parking demand for each user group. Employee parking peaks at 1:00 P.M. and is fairly consistent throughout the day. Volunteer parking peaks at 9:00 A.M. while visitor parking peaks at 1:00 P.M. and 2:00 P.M. Out patient parking peaks at 8:00 A.M. and is fairly consistent from 8:00 A.M. to 12:00 Noon. Physician parking peaks at 10:00 A.M.

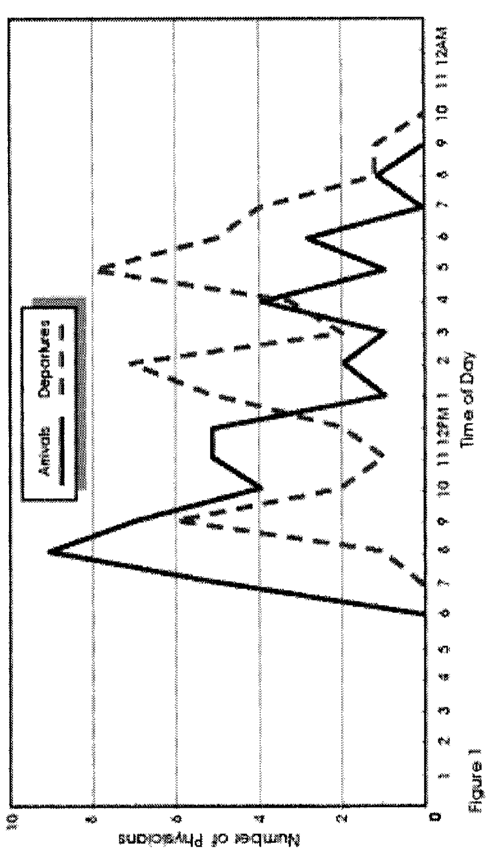

Figure 1

PHYSICIANS ARRIVAL ANE DEPARTURE PATTERNS

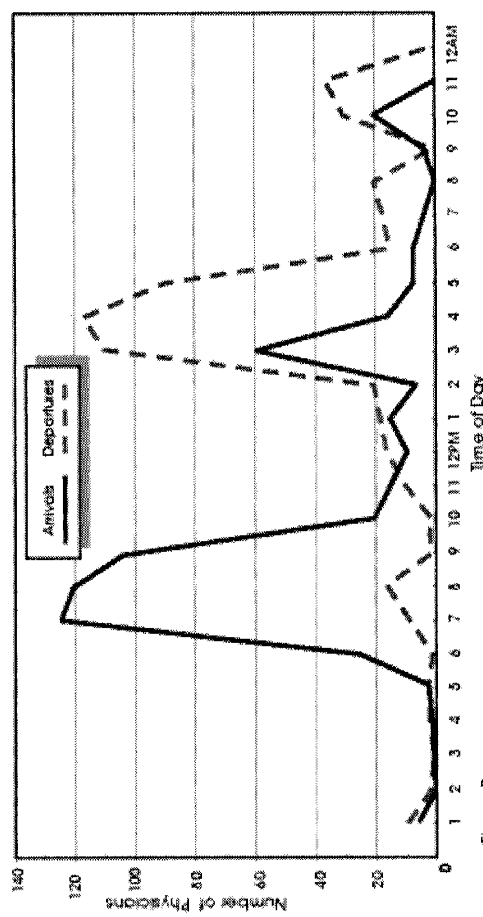

Figure 2

EMPLOYEE/VOLUNTEER ARRIVAL/DEPARTUE PATTERNS

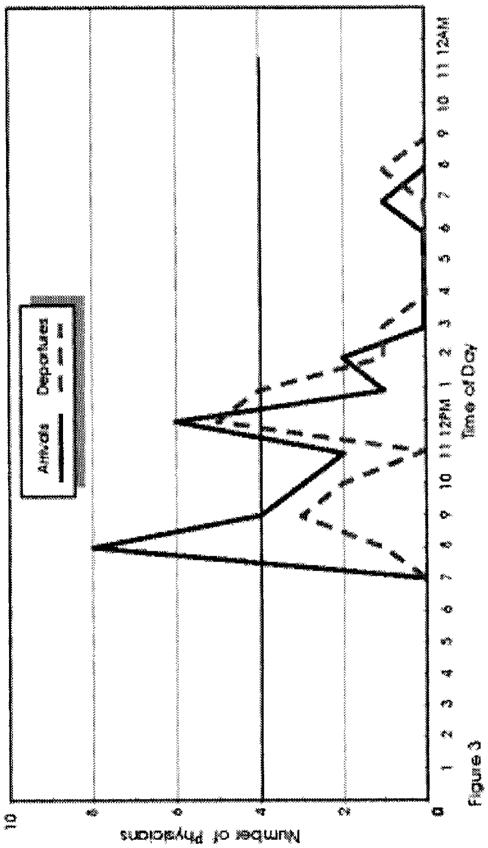

Figure 3

OUTPATIENT ARRIVAL AND DEPARTURE PATTERNS

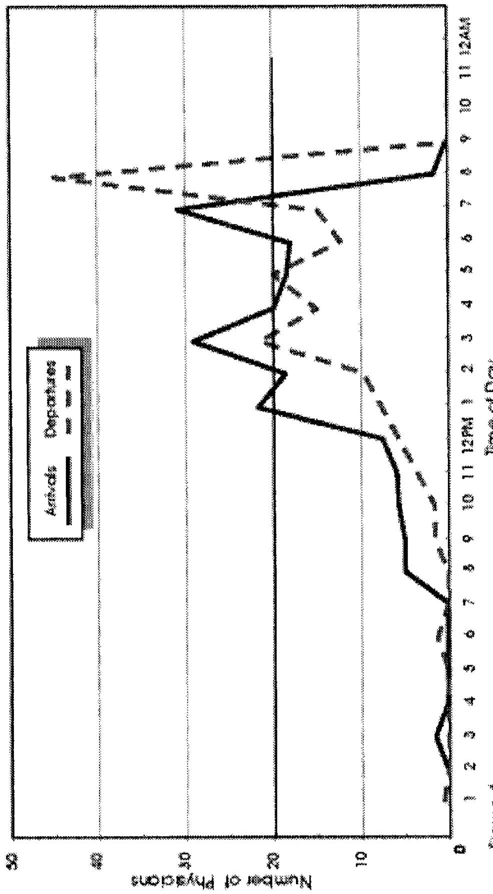

Figure 4

VISITOR ARRIVAL AND DEPARTURE PATTERNS

Table 1
TOTAL HOURLY PARKING ACCUMULATION/NEEDS

TIME	(1) VISITORS	EMPLOYEES	VOLUNTEERS	OUTPATIENTS	PHYSICIANS	TOTAL ACCUMULATION
5:00 - 5:59 A.M.	-	1	-	-	-	1
6:00 - 6:59 A.M.	-	19	-	-	3	22
7:00 - 7:59 A.M.	-	137	2	6	36	181
8:00 - 8:59 A.M.	-	219	10	30	74	333
9:00 - 9:59 A.M.	-	279	14	25	85	403
10:00 - 10:59 A.M.	-	287	2	24	101	414
11:00 - 11:59 A.M.	-	293	8	19	93	413
NOON - 12:59 P.M.	24	294	2	15	80	415
1:00 - 1:59 P.M.	143	295	12	13	61	524
2:00 - 2:59 P.M.	143	288	8	9	56	504
3:00 - 3:59 P.M.	108	224	-	4	40	376
4:00 - 4:59 P.M.	85	152	-	1	-	238
5:00 - 5:59 P.M.	131	90	-	-	-	221
6:00 - 6:59 P.M.	140	88	-	-	-	228
7:00 - 7:59 P.M.	122	77	-	-	-	199
8:00 - 8:59 P.M.	-	66	-	-	-	66
9:00 - 9:59 P.M.	-	61	-	-	-	61
10:00 - 10:59 P.M.	-	66	-	-	-	66
11:00 - MIDNIGHT	-	32	-	-	-	32

NOTE: Supply remains constant at 529 parking spaces.
(1) Visitor and Outpatient accumulation increased by a 15 percent efficiency factor.
SOURCE: Wilbur Smith Associates.

Table 2
PEAK-HOUR PARKING SUPPLY-DEMAND COMPARISON

USER	PARKING-DEMAND (HOUR BEGINNING) 8:00 A.M.	9:00 A.M.	10:00 A.M.	1:00 P.M.	2:00 P.M.
Employees	219	279	287	295*	288
Volunteers	10	14*	2	12	8
Visitors	-	-	-	143*	143*
Outpatients	30*	25	24	13	9
Physicians	74	85	101*	61	56
TOTAL	333	403	414	524	504
Supply	529	529	529	529	529
SURPLUS SPACES	196	126	115	5	25

* Peak Demand Hour by user.
SOURCE: Wilbur Smith Associates.

A reasonable assignment as to the number of parking spaces and their locations for each user can be determined. The hospital need not provide 583 parking spaces (the sum of peak demands for each user group), but rather 524 parking spaces (the aggregate peak parking demand), to accommodate the peak parking demand at 1:00 P.M. One parking space can be used for an employee during the 1:00-3:00 P.M. time period, for a visitor at 7:00-8:00 P.M., and for an out-patient at 8:00-9:00 A.M. and 12:00 P.M.-1:00 P.M. The cost-savings are significant.

Once the cumulative effect is known, the parking needs by user, and in total, can be developed to maximize the efficiency of the available parking supply. When parking demand exceeds parking supply, more parking is needed. Surpluses/deficiencies of each user group would be identified and addressed.

Future Parking Needs

The specific parking rates, as developed for each user group under existing conditions, can then be used as guidelines for future programs. Hospitals are expanding and renovating their facilities to keep up with technology and meet current patient demands. The number of beds are decreasing but the number of out-patients are increasing with the overall need for more parking.

Traditional parking guidelines/standards would call for a decrease in the number of parking spaces if beds are decreasing, and not recognize the out-patient parking needs.

With the proper parking rate by individual user group, future parking needs can be projected to accurately respond to the hospital's anticipated operations. The parking issue would be addressed up front, in the planning process of the hospital/medical center expansion/renovation program. The need to solve "after-the-fact" problems would be reduced, and significant cost savings realized in the long term.

Parking Management Program

Upon determining existing and/or future parking needs by user groups, a Parking Management Plan should be developed and advanced. Key components include, but are not limited to:

- Location of parking for each user (walking distances and priority parking are critical for physicians, nurses, out-patients).
- Self-sufficiency of hospital/medical center parking versus use of on-street parking or public off-street parking.
- Provision of on-site hospital/medical center surface parking versus parking decks and the economic feasibility of such facilities.
- Pay-for-parking versus free-parking needs and evaluations (for visitors and/or employees).

- Joint use of parking spaces to maximize parking efficiency (i.e., out-patient parking/visitor parking, employee parking/visitor parking).
- Inclusion of physician office space within the hospital/medical center complex.
- Pedestrian accessibility between the parking facilities and the hospital/medical center facility.
- Need for additional parking for infrequent but scheduled activities such as conferences.
- Parking Efficiency Factors.
- Issues such as parking-related security, maintenance, operations, vehicle access, and traffic impacts.

Each of these parking issues is dependent upon each other and all relate to the overall operations of a Parking Program.

The Parking Management Plan would generate an Action Plan, to provide a proper and efficient Parking Program for the facility. Such a parking needs process and program is essential to the overall success of the hospital/medical center in serving the community.

NEIGHBORHOOD IMPACTS OF PARKING

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Introduction

This article provides a brief review of techniques used to reduce the extent of problems with spillover parking from the downtown, institutional, and other non-residential areas onto nearby residential streets. Alternative solutions to spillover parking impact on neighborhood areas are examined including implementation considerations.

Residential and non-residential uses compete for scarce on-street parking in Sausalito, CA.

Description of Neighborhood Parking Impacts

Spillover of parking from the Central Business District (CBD), other commercial districts, university or institutional campuses, entertainment districts, recreation facilities, and special events facilities to nearby residential neighborhoods is a significant problem in many communities. Spillover parking in residential neighborhoods is symptomatic of a long-term parking deficiency in the adjacent CBD, institutional campus, or other non-residential area. Excess demands are met by using nearby parking spaces on residential streets. Daytime spillover parking problems are caused by workers parking in on-street spaces located in residential neighborhoods within walking distance to their workplace, either due to a local parking deficiency or to avoid the cost of pay-parking in lots or garages.

Spillover parking problems frequently occur in neighborhoods adjacent to a university or medical center with insufficient parking for students, staff, and patients. Similarly, spillover-parking problems occur in neighborhoods bordering entertainment districts or recreation areas lacking sufficient off-street parking spaces for patrons.

The impacts of spillover parking on the quality of residential neighborhoods are often overlooked as a transportation problem, until citizens bring the effects to the attention of local government officials. Increasing levels of automobile ownership, longer trip lengths, insufficient long-term parking, and increasing cost of parking in the central city and high-density employment areas result in diversion of parking to residential streets in nearby neighborhoods. Excessive numbers of vehicles parked on residential streets during the workday or evening hours prompt resident concern and protest.

Parking on residential streets by workers, students, and visitors (non-residents) with destinations in adjacent CBD, institutional campus, or other non-residential areas can be a very divisive issue. Residents complain that on-street parking is not available because non-residents are using residential streets to park. Residents are forced to walk longer distances after finding a parking space, often carrying groceries, etc. Non-residents consider that the streets are public right-of-way and not for exclusive parking by residents. Furthermore, some residents have converted off-street parking areas to other uses exacerbating the parking problem. In addition, paying for a residential parking permit may not be well accepted by residents. In mixed-use neighborhoods, residents and business owners have conflicting interests in the availability and use of on-street spaces, especially if the non-residential uses rely on curb spaces to accommodate their clientele.

While regulations restricting non-resident parking in residential areas has been demonstrated as an effective strategy for controlling spillover-parking problems, it is a challenging task from a political and institutional standpoint. Regulatory techniques that prove appropriate and successful in one context may not be appropriate for application in a different setting. The success of spillover parking control is dependent more on coalition-building and citizen involvement than on the technicalities of parking permit programs.

Impacts of Spillover Parking on Residential Neighborhood Areas

Although most residents of urban and suburban areas are accustomed to the presence of traffic in their living environment and enjoy the mobility afforded by the automobile, many residents are discontented with the impacts of spillover parking and traffic in their neighborhoods. Parked cars lining residential streets have a pervasive effect, dominating the streetscape, increasing traffic noise and fumes, and posing safety hazards to children and pedestrians.

Impacts of parking on residential areas include the following effects:

- **Parking Availability** – Older residential neighborhoods near the CBD typically include higher density development with small lots, narrow streets, and little or no off-street parking in driveways and garages. Many inner city neighborhoods developed before minimum parking requirements were introduced. Lacking sufficient off-street spaces, residential parking relies on available spaces located in the street right-of-way and in alleyways. Spillover parking from adjacent commercial areas further decreases the availability of limited on-street parking for use by neighborhood residents.

- **Traffic Noise** – Street noise is perceived as an undesirable characteristic by neighborhood residents. Noise levels increase with traffic speeds and traffic density.

- **Pedestrian Safety** – Increased traffic volume and speed are strongly related to occurrence of motor vehicle-pedestrian accidents on residential streets. Children and the elderly are particularly vulnerable to traffic hazards. Parental concern over child safety is a common motivation for residents' protesting cut-through traffic and spillover parking on residential streets.

- **Air Quality** – Motor vehicle emissions include carbon monoxide, nitrogen oxides, sulfur dioxide, hydrocarbons, and lead compounds than can cause human health problems at low levels of concentration.

- **Neighborhood Integrity** – Excessive on-street parking in residential areas adversely effects residents' and visitors' perception of the neighborhood. To retain or add to the vitality of neighborhoods, parking should support but not overwhelm the street.

- **Property Values** – Neighborhoods with the presence of spillover parking problems may experience deteriorated property values, decreasing the tax base of the community.

Residential Parking Permit Programs

A residential parking permit program is intended to limit the use of on-street parking in residential neighborhoods by commuters and other non-residents. Many cities of all sizes throughout the United States and Canada have implemented residential parking permit programs to eliminate or reduce spillover-parking problems, preserve residential character and property values, and enhance the quality of life in particular residential neighborhoods by reducing noise, pollutant emissions, traffic hazards, and litter.[1]

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[1] Innovations in Parking Management, U.S. Department of Transportation, January 1982.

Use of parking permits to regulate parking in residential neighborhoods dates back to the early 1960s when the City of Toronto adopted a permit program providing nighttime parking in residential areas with no alternative parking facilities.[2] Use of residential parking permit programs to regulate on-street parking in residential areas adjacent to large traffic generators increased significantly after the U.S. Supreme Court ruled in favor of such programs in 1977.[3] Prior to that decision residential permit parking was commonly challenged on the basis of discrimination against non-residents. Today, residential parking permit programs are used in many cities of all sizes, wherever residential areas are located in proximity to a large traffic generator.[4]

The structure of a residential parking permit program should be carefully thought out prior to implementation. Important features include the following elements:

- Process and eligibility criteria for designation of residential parking permit areas, including consideration of mixed residential and non-residential neighborhoods.
- Signs and other delineation of residential parking permit areas.
- Parking restrictions/prohibitions applicable for residential parking permit areas, including either time limit restrictions or no parking prohibition with effective hours and days.
- Number of permits allowed per household.
- Cost of permits.
- Consideration of residences with no off-street parking.
- Permits for residential guests and visitors.
- Permits for rental housing units.
- Permits for short-term (less-than-a-day) versus long-term (multiple days) parking.
- Accommodating service visitors (repairmen, household workers, etc.).
- Accommodating special events (weddings, funerals, etc.).
- Permit application and verification procedures.
- Renewal of permits (annually, biannually, etc.).
- Enforcement of residential parking permit regulations including fines and penalties, along with booting and towing for multiple offenses.
- Conduct periodic audits of residential permit areas.
- Process and criteria for withdrawal of designation of residential parking permit areas.

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[2] "Permit Parking Operation," *ITE Journal*, August 1979: p. 28.
[3] *County Board of Arlington County, Virginia, et al. v. Rudolph A. Richards, et al.*
The Court held that a community may restrict the use of on-street parking to reduce air pollution and other adverse environmental effects and that, "a community may reasonably restrict on-street parking available to commuters, thus encouraging reliance on carpools and mass transit.
[4] "Residential Permit Parking" Informational Report, Institute of Transportation Engineers, 2000.

Establishment and operation of a residential parking permit program is governed by terms of enabling legislation and adoption of an ordinance by the municipality. While there is no universally accepted procedure, a typical process and criteria for establishing a residential parking permit zone or district includes requiring a petition signed by a majority of households in the area. After validating the petition signatures, the municipality conducts a parking survey to determine if it meets eligibility criteria. Eligibility criteria vary among communities, but examples are 75 percent or more of on-street parking is occupied during the peak period, and 50 percent or more of on-street spaces are occupied by non-resident vehicles during the peak period.

A proposed area must meet both criteria to be eligible for designation as a residential permit zone. Criteria may include a minimum size for establishing a new permit area, ranging from one block face, to ten or more block faces. Designation of a small zone is likely to cause the displaced parkers to move to nearby blocks.

If the designation criteria for a residential parking permit zone or district are met, a public hearing is scheduled and advertised, and affected households are individually notified. The City Council holds the public hearing and votes on designation of the zone. If designated, the residential parking permits go into effect 60 days following the notice to affected households. Notice to residents of designation should include the existence, location, and designation of the zone.

Designated permit parking areas should be identified by official city signs posted curbside at set intervals. Residents of households in the zone may apply for a permit valid for parking a specific vehicle in the specified zone, contingent on proof of current state motor vehicle registration, proof of residency in the zone, and payment of the permit fee. Windshield decal or hangtag permits are typically valid for a period of one year and automatically revoked upon termination of residency in the zone. Vehicles parked curbside in the zone must display a valid permit. Households may also apply for one free visitor-parking permit, valid for one year. Vehicles without a permit are either prohibited or restricted to a limited parking duration during certain hours of the day. Delivery and service vehicles are typically exempt from parking permit requirements within certain limitations, such as parking duration of four hours or less. Police should be empowered to issue temporary vehicle parking permits when justified by unique circumstances. Fines for parking without a valid permit or fraudulent use of permits should be set by the ordinance establishing the residential parking permit program, including provisions for towing or booting of vehicles for multiple offenders/scofflaws.

Innovations in Parking Permit Programs

Recent innovations in residential permit parking include placing limitations on the number of permits issued, and increasing the amount of permit fees according to the market value of a parking space. When the number of permits issued is not limited by the number of curbside spaces, a residential parking permit program is of little use when the number of permits issued exceeds the availability of scarce on-street parking in a designated zone. In such cases, a permit is little more than a "hunting license" for limited spaces. Recognizing this problem, some municipalities are limiting the availability of new parking permits according to the number of available on-street spaces and charging permit fees in line with the market value of fees charged for rental of similar parking spaces. Under such programs, the revenue collected in excess of program administrative costs is allocated for neighborhood and transit improvements. Some programs allow for sale of excess on-street capacity to businesses or commuters, with revenue going to a neighborhood benefit fund or transit improvements.[5] Nevertheless, it is arguable that permit programs penalize low-income households and others who tend to own fewer cars.

Carpool Permit Parking Programs

A different approach to relieving spillover parking on neighborhood residential streets was initiated in San Francisco in the 1980's.[6] The Carpool Permit Parking Program gives preferential on-street parking to certified carpools in designated "carpool permit parking areas" adjacent to participating workplaces or institutions. On-street parking in the designated area is restricted to neighborhood residents and eligible carpools.

Adequate CBD parking supply that is convenient and reasonably priced must be provided before implementing a residential parking permit program. Without a reasonable alternative, restricting on-street parking in residential areas will likely result in the problem simply moving to another area. Unless the residential parking permit program includes all nearby residential areas, the problem may simply move to residential streets that are not included in the program. Effective resolution of the problem requires the implementation of a comprehensive, long-term plan to reduce traffic and parking congestion within impacted areas by expanding and improving transit service, satellite parking lots, improved parking regulations and enforcement, and expanded and improved commuter education.

Parking Permit Program Implementation

Establishment and implementation of a residential parking permit program has certain administrative and financial implications for the municipality. In most cities, the parking or traffic department is the agency most likely responsible for planning and administering the program. Enforcement responsibility typically falls on the police or some other parking and traffic-related department. Additional enforcement staff may be required depending on the magnitude of designated zones. The number of enforcement personnel required depends on the number of parking areas and number of permits issued in the city. "No Parking - Residential Permit Zone" signs must be purchased and installed at the municipality's expense. Program administration costs and the costs conducting parking surveys for proposed zones must also be considered. Although cities vary greatly, most permit programs are relatively small in nature, averaging about eight zones

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[5] Toronto limits permit numbers in line with capacity, while West Hollywood allows the sale of surplus spaces to businesses and commuters, and San Francisco is considering revising its Residential Parking Permit program to include space limitation, market rates, and sale of excess spaces.
[6] Carpool Permit Parking Program was approved as an Article of the San Francisco Parking Code on December 18, 1980.

per city and fewer than 1,000 permits annually.[7] The portion of program costs recovered from permit fees and fines will depend upon the amount of permit fee costs and fine amounts set by the ordinance, and the size of designated parking permit areas.

Residential parking permit programs indirectly subsidize and encourage car ownership and driving, which may be contrary to other programs for congestion mitigation and fostering transit-oriented development. The municipality's street network is one of its most valuable assets and the primary purpose of streets is to carry traffic. The land value represented by an on-street parking space typically is far greater than the annual cost of a parking permit.

Conducting a Neighborhood Parking Study

Resident and parking surveys include a variety of ways to assess and quantify the residential spillover problem:

- Parking surveys to determine occupancy and turnover of on-street parking in residential areas, as well as the extent of spillover parking.
    - Record partial license plate numbers for both midday and evening for all vehicles parked on the residential streets in spillover areas.
    - Compare vehicles parked during both periods. Vehicles parked at both midday and evening probably belong to either residents or guests. Vehicles parked midday but not during the evening likely represent parkers with business in the CBD who found it convenient to park on the residential streets.
    - Exceptions may include residents who park at midday but are out for the evening; non-residents who work late; and non-residents who park in the evening for entertainment or shopping in the CBD.
- Resident surveys to determine the average number of off-street parking spaces per residence, number of registered vehicles per residence, and number of registered vehicles parked in off-street spaces on a regular basis.
- Employee survey to determine parking patterns for workers in non-residential areas contributing to spillover parking.
- GIS surveys and field counts to determine total number of residences and other land uses.
- Estimation of number of off-street spaces available.
- Number/percentage of registered vehicles that can be accommodated in off-street spaces.

[7] Op. Cit., "Residential Permit Parking."

Neighborhood parking surveys typically include the following steps.

1. **Estimate On-Street Spaces Available in Neighborhood Areas** – The number of available on-street spaces in neighborhood areas represents the existing supply. A field inventory of available spaces including both on-street and off-street parking will serve to quantify the available parking supply. Existing land uses (residential and non-residential) should be identified at the same time.

   On-street parking on residential streets may be either parallel or angled parking spaces, but there are typically no markings to delineate the individual spaces. To estimate the number of on-street spaces available, a curb length of 23 feet per vehicle should be assumed for parallel parking and 12 feet for angle parking. Driveways and setbacks from intersections and driveways should be taken into consideration when estimating available spaces.

   Many residences in neighborhood areas also have some off-street parking available in driveways, carports, and garages. Determining the number of vehicles that can be accommodated and the number that are regularly parked in off-street spaces is a related consideration in determining the need for on-street parking.

2. **Conduct Parking Utilization Survey** – A license plate survey of parked vehicles occupying on-street spaces at different times during typical weekdays or weekends should be conducted to identify parking utilization. Vehicles that remain all day or are present only during the nighttime are presumably owned by residents. Vehicles present only during the daytime (or evening hours for entertainment districts) are indicative of spillover parking. Occupancy counts should be made at various times to determine the accumulation of parked vehicles and identify the peak period for parking demands.

3. **Determine Spillover Parking Impact on Residential Parking Needs** – The number of on-street spaces needed to satisfy residential parking demands can be determined based upon results of the utilization survey, or estimated based on the number of parking spaces required by the municipal zoning code for residential uses (deducting the off-street spaces in residential driveways, carports, and garages).

Summary and Conclusion

Residential parking permit programs are an effective means of resolving certain types of spillover parking problems within neighborhood areas. A parking permit program may relieve congestion and reduce parking problems at the neighborhood level in areas impacted by non-resident parking.

Involving citizens in planning the residential parking permit program is essential. Affected neighborhoods must be informed regarding all aspects of the proposed program and should be encouraged to participate in program planning.

Enforcement is key to the success of a residential parking permit program. Lax enforcement will encourage spillover-parking problems.

Communities considering the establishment or expansion of residential permit parking should consider such a program in conjunction with other transportation and parking management programs and actions. These include traffic calming measures, transit service improvements, carpool and vanpool programs, and pedestrian facility improvements. Coordinated development and implementation of these programs will enable more effective use of existing and future parking supply, and reduce neighborhood parking impacts; while promoting transportation, environmental, air quality, energy conservation, and community/regional planning objectives. While a residential parking permit program may improve the environment of a particular neighborhood, the consequences may extend beyond the area, and therefore must be understood in the context of its effect on the overall transportation system.

Adopted residential permit parking programs should be monitored and periodically evaluated in terms of their effectiveness in relieving spillover parking impacts on the designated neighborhood areas.

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EVENT PLANNING

James M. Hunnicutt

James M. Hunnicutt has been in the parking and traffic profession for more than 50 years. Currently he serves at a parking consultant and has done so for the past 37 years. Prior to becoming a consultant, he served as executive director of two parking authorities. He is a graduate of Auburn University in Civil Engineering and completed his graduate studies at the Yale University Bureau of Highway Traffic. He is a Founder of the International Municipal Parking Congress, now the International Parking Institute (IPI). He is a past President of IPI. In 1976, IPI voted him Parking Man of the Year. In 2002, Auburn University presented him with its Outstanding Alumnus Award for Civil Engineering. The American Society of Civil Engineers, Alabama Chapter, in honor of its 150th Anniversary, named him one of the top ten engineers from the State.

Introduction

Normally, when one thinks of a large parking lot or garage, one assumes that the facility will be used on a daily basis with some turnover of spaces, and that the same people will use it day after day. This will be true at a shopping center, apartment house, office building, or college campus. However, the purpose of this chapter is to explore types of parking which only occur on a non-repetitive basis.

One of the main reasons for this type of parking would be sporting events. The largest uses of parking spaces, by far, are NFL football games and NASCAR racing events. In addition to football, baseball, basketball, and other sporting events, there are a large variety of activities, such as concerts, religious revivals, and circuses, which are considered event parking. This primary focus of this chapter will be football stadiums.

Is it estimated that, from 1990 to 2003, approximately 45 major football stadiums were built in the United States. Each of these, whether they were for professional or college football, required substantial parking and traffic planning. Most college football stadiums are built on the campus, which means that many of those who will be attending will be students and faculty. Many of them walk to the game. However, there are literally thousands of fans that come from as far as 150 miles on game day and specific plans must be made where they are going to park and how they are to get to and from the stadium.

In the case of a professional football team, there is a different problem. They have to locate in a metropolitan area, somewhere which is easily accessible to their fans. The owner's most important decision is whether the stadium should be in a downtown location or in a suburban location.

When a new football stadium is planned for a professional team, the site must be well chosen. With 80,000 to 100,000 arriving at the stadium on game days, traffic access and parking allocation can be monumental problems.

Although land may be cheaper and readily available in a suburban location, other problems may exist. The first one is access. Even if it is possible to find a piece of land large enough to place the stadium and a number of parking facilities at the intersection of two major expressways, there may still be a serious traffic problem to solve. Even where two expressways cross each other, there are normally only four off-ramps that can be used to get to the stadium, assuming traffic coming from all four directions. A typical access ramp coming from an expressway only has a capacity for about 1200 to 1500 cars per hour. It is not uncommon for as many as 30,000 cars to show up at a professional game. This means that, with all exit ramps operating at peak capacity, it can take as long as three or four hours to exit off the ramps and into the parking areas. A similar problem occurs in reverse after the game is over.

At least one professional football park requires waits in line of two to three hours to get off an expressway and into its parking lots. Traffic and news reports on the radio indicate that backups can extend for 10 to 12 miles in both directions. Fans must leave early on a Sunday morning to be in their seats by game time.

One of the best alternatives, that many cities have found, is to locate new football stadiums in a downtown, rather than a suburban location. First, many of the expressways in the community have access to the downtown. Traditionally, arterial streets in a community go into the downtown area. So, traffic coming to the downtown has many more travel options than the suburban expressway system, which is the only solution in the suburbs.

A primary advantage of a downtown location is that, if the city has a subway system or major transit operation, there is rail and bus service to the downtown area. The opportunity to use mass transit to get to the stadium may not be available in a suburban location.

Existing parking supply is another advantage for locating downtown. Many downtown parking lots and garages are not used at nights and on the weekends, and are available to be used by stadium parkers.

Another problem with a building a stadium in a suburban location is that all of the land available for parking is not near the stadium site. One stadium which has approximately 30,000 parking spaces for fans has as many as a dozen different lots, which makes wayfinding and good parking operations very difficult. Many people have to use shuttle buses to get to and from the stadium. Some lots are as far as four or five miles away, requiring a shuttle ride of 20 minutes or more. Parking prices can run as high as $25.00 dollars for this type of service.

It is not uncommon for some lots to be as far as 1 mile or 1.5 mile from the stadium with no shuttle service, a long walk in each direction. Pedestrians are often required to walk down roadways, since there are no sidewalks, and to cross very busy roads and intersections.

With extremely long waits to get off an expressway, long walks from parking lots to the stadium, and long waits to get back on the expressway to go home, many people have turned in season tickets at suburban stadiums.

College Stadiums

Even though many college stadiums are now in the size range of 100,000 seats or more, they have a different problem in accommodating their traffic and parking. First, the campus street network is not normally laced with wide arterial streets. Nor is there plenty of nearby parking. Rather, there are narrow streets, lined with trees, with college buildings fairly close to each other so students can walk back and forth to their classes.

Many college campuses are now being faced with the reality of having to provide parking garages on campus. While the primary purpose of these garages is to provide parking spaces for the students, faculty, and staff, they should also be designed to accommodate parkers on busy football weekends. The spaces in these garages can be sold to alumni or other fans at premium prices.

Around the football campus, every open field may be considered for parking. This means athletic fields, or any other fields with a surface that will support an automobile. All existing parking lots for students as well as garages may be used. In college campuses where shuttle bus services are available, the shuttle buses for the campus can be used to pick up fans at remote locations such as church parking lots, factory and industrial parking lots, or other parking areas that may not be in use on game days.

In many parts of the country, going to college games is a social event that may last for several days. Some fans come in recreation vehicles (RVs) and park near the campus, set up operation and have friends and classmates in for meals and entertaining. "Tailgating" fans like to set up in a parking lot with a grill and socialize with friends. Providing adequate space and establishing rules and regulations is difficult for these types of activities.

On some college campuses RVs arrive as early as Wednesday, set up operation, and stay for three or four days. Some RV owners arrive, park their vehicle, go home, and come back game day, recognizing that to get a space they have to be there early.

Football Parking Analyses

For any football stadium, the primary consideration is to determine approximately how many spaces will be needed. Not everyone is going to drive to the stadium and park their car. There will be some other ways of getting there. An analysis has to be made of the anticipated modal split. Once an estimate has been made of how many parking spaces will be required, a judgment must be made as to how many can be provided, where they will be located, how they can be paid for, and how they will be operated. After all the parking decisions are made, traffic and pedestrian flow analyses are needed to determine how people will get to and from the stadium.

Figure 1 shows a downtown area and a site for a proposed football/baseball stadium. An analysis was made of all the existing traffic flow on the city streets. To this was added the traffic generated by the stadium after an event. With such a study, the traffic capacity can be checked for adequacy and a dispersal plan determined.

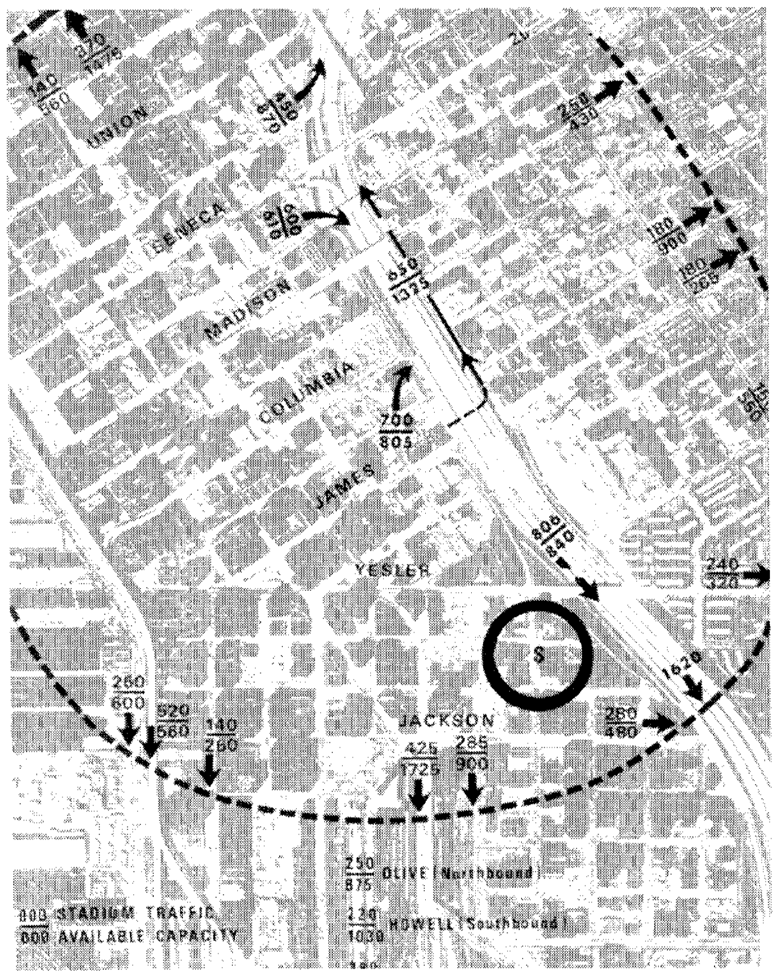


Figure 1

Table 1: Stadium Parking Requirements

Assume:	60,000 seats
Walk to stadium	College 12,500 –15,000 fans (students, faculty, staff) City 500 fans (depends on location)
Transit use	College 3,000-5,000 fans (college bus system) City 15, 000 fans (subway, light rail, buses)
Private buses, charters, vans, rv, taxi, etc.	2,000-3,000 fans (both college & city)
DRIVE AND PARK (Av.3 people/car)	COLLEGE 45,000 FANS CITY 42,000 FANS
Parking spaces needed	College 15,000 spaces City 14,000 spaces

Table 1 illustrates the parking demand analysis for a hypothetical new stadium of approximately 60,000 seats on a college campus or a professional team in a large to medium size city. In Step 2, approximately a quarter of the seats in a college stadium will be occupied by students, faculty, or staff. On the other hand, at a stadium located in the suburbs of large to medium sized city, only about 500 people could walk from their homes or nearby office areas to the stadium. This number would increase if the stadium were located in the downtown.

Step 3 illustrates the estimation of modal split. Most college campuses have some type of transportation system to serve remote parking lots from which students are picked up and brought to the campus, interconnecting with major classroom buildings. This system can be configured on football game day to operate between parking facilities and the stadium. The buses can also be used to go to other areas such as church lots, industrial areas, or similar locations to pick up fans to bring them to the stadium.

In metropolitan areas the principal transit service will be the bus system or subway system. A stadium should be near a subway station if one is available.

A number of cities have large private bus fleets which go to the stadium. These private buses are sponsored by country clubs, restaurants, bars and taverns, and social clubs. The clubs meet on game day, have a social activity, board the bus, and go to the game. After the game the bus brings them back to their starting location. At some stadiums in the United States, it is necessary to provide as many as 200 parking spaces for these buses. Many private buses come from remote places and from cities up to 20 or 30 miles away from the stadium. In addition to these buses, space must be made available for vans, RVs, taxis, etc.

The final element of parking demand is the person who drives to the stadium, parks, watches the game and drives home. Many of these trips may be for 100 miles or more. Based on counts made at the entrances at major parking lots near football stadiums most football parkers have 3 to 3.5 people to the car.

As can be seen from Table 1 that a stadium of 60,000 seats may need 14,000 to 15,000 parking spaces.

Traffic

For a college or professional football stadium to be attractive it must have the necessary street and highway capacity to accommodate all of the traffic. At grade intersections with traffic signals can only pass about 1,800-2,000 cars per lane per hour of green time. There must be sufficient street lanes available to deliver vehicles to and from the game.

A dispersal plan must be developed for getting the traffic away after a game is over. As an example, all traffic coming out of a particular parking lot or garage may be required to turn left on exiting. Even though the driver does not want to go left he may be required to go left to keep traffic conflicts to a minimum. Drivers prefer to be continually moving rather than be stalled in traffic even though they may not be going in the exact direction they want to go.

Stadium Problems

Many problems arise in planning for parking for large stadiums.

1. There may not be enough land to accommodate all of the parking that is needed close to the proposed stadium. A 60,000-seat stadium may require as many as 15,000 parking spaces. 15,000 parking spaces in surface lots require as much as 150 acres of land. There is virtually no place around a college campus or in a downtown or a suburban area which has 150 acres of readily available land (not including the space taking up by the stadium itself), even with shuttle buses from more remote locations.

2. Often there is a lack of will among the developers or governmental agencies building a stadium to provide adequate parking. There is a general belief that, somehow, parking and traffic will take care of itself. They do not have to build everything that they know will be required, based in the initial plans.

3. Nearby residents and businesses generally complain that a new stadium and the resulting traffic and parking will adversely affect their homes and businesses. Representatives appear at the public meetings and go the press and media and complain about the traffic and parking problems that will be caused by the new stadium.

4. Poor planning for stadiums sometimes results from the fact that planning teams consist of owners, city officials, architects, engineers, police, and highway department officials. All too often, skilled and experienced traffic engineers and parking professionals are left off the team.

5. Often there is considerable resistance from city officials, highway departments, citizens groups, and others to providing supportive infrastructure including new sidewalks, street widenings, pedestrian's over-passes, intersection re-designs, and new specialized traffic control signals. The common argument is that money spent on these items is not well used, because the stadium may only be in use 10 to 12 times a year.

6. Parking and traffic improvements are usually the last to be built. When the cost of the stadium exceeds the budget, to save money, some of the parking and traffic improvements are dropped or canceled for lack of funds.

Baseball Parks

Virtually the same rules for baseball parks apply as for football stadiums. Though there are differences in size and use, they are similar. Professional major league baseball teams play 162 games a year, half of them at home. A professional football team or college team may play about 8 to 10 games a year at home.

Most baseball parks have a smaller seating capacity. Baseball parks being built today have a seating capacity range of 40,000 to 60,000 seats.

Baseball schedules games for nights and weekends to avoid normal traffic congestion. Some cities, such Kansas City and Baltimore, have built new separate football and baseball parks adjacent to each other. There is virtually no chance that both stadiums will be in use at the same time. So the parking can serve for the two stadiums, year round.

Many of the characteristics for both types of stadiums are similar. For football games, the car occupancy can be as high as 3 or more people per car. For baseball games occupancy is less, in the range 2.25 to 2.5 persons per car. In planning parking for a stadium, it is desirable to perform car occupancy studies to determine the number of people in cars.

Baseball fans are typically less tolerant of traffic and parking delays than football fans. After a baseball game is over all parking facilities should be cleared in about 25 minutes. This period is sometime referred as "dump time". Because there are more football fans at a game and they come to games less often, football fans are more tolerant of delays and dump time may be as long 45 minutes.

Basketball and Ice Hockey Arenas

These arenas are much smaller in seating capacity than either football or baseball parks. The larger arenas may have approximately 20,000 seats. Car occupancy varies from about 2.5 to 3 people per car. Arenas of this type may have as many as 175 to 225 events per year. It is not uncommon to have a professional ice hockey game on Saturday afternoon and a professional basketball game in the same arena that night. These arenas also have other events, such as college basketball games, ice hockey, boxing matches, concerts, conventions, boat shows, circus, and stage shows.

Figure 2 is a photograph of a 20,000-seat arena that serves both a professional ice hockey team and a basketball team. It has 4,350 parking spaces with an overflow lot adjacent. The main lot was designed to be divided into four different quadrants to help wayfinding. The arena is circular and people have a tendency to become disoriented. Each parking lot quadrant was given a name and different graphics to identify it from the others.

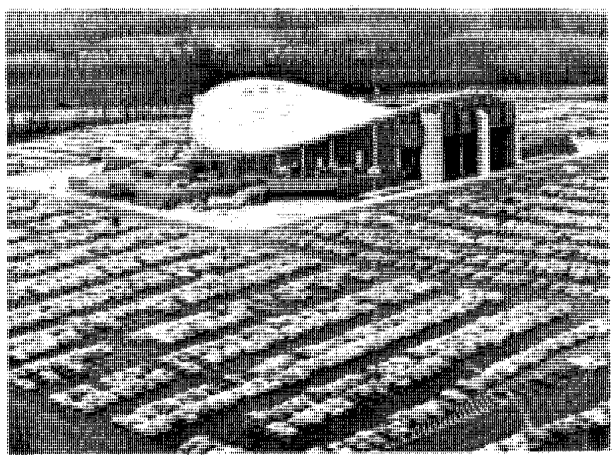


Figure 2

The VIP or skybox patrons, who pay the maximum fee for their seats are allowed to purchase a certain number of close-in parking spaces (located right next to the elevators going to the upper level boxes). Skyboxes may vary in size from 4 seats to 40 seats.

There are two main points of entry from the expressway and arterial road system. Six lanes of traffic come into the lot and traffic is directed in a counter-clockwise pattern. After an event is over, all of the one-way roads coming into the lot are reversed. Parkers go out the same way they came in.

After this arena was in full operation, studies were conducted to find out how long it took the stadium parking lots to empty from a full house, the lot emptied completely in 23 minutes.

Other Events

There are a number of other types of events. These events also require well thought-out advance planning as to how many cars will need to park, how they will get there, police and traffic control, signing, and publicity. Typical of these are air shows, golf tournaments, fairs, out door concert halls, patriotic shows, parades, theme parks, and carnivals. All of these events generate large volume of traffic and parking.

In each case the planning requires an analysis of the particular event. They have different arrival patterns, departure patterns, vehicle occupancies, street networks, available parking facilities, etc. The parking design professional must consider all of these factors, analyze them, and devise a solution so that can patrons can come and go without excessive delay.

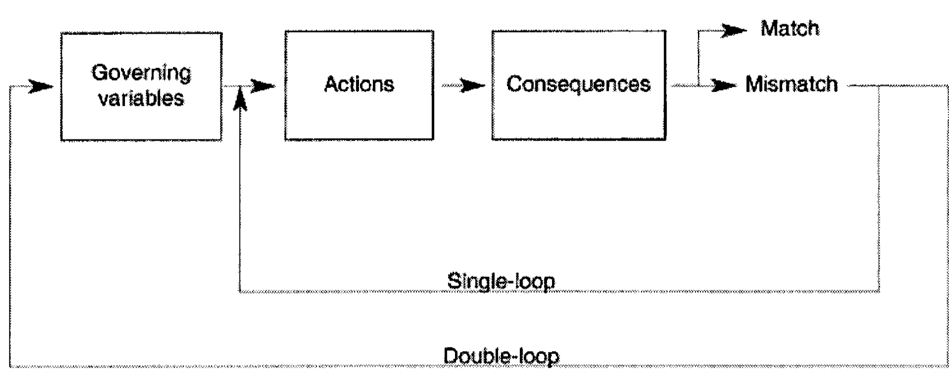
ONE STOP SHOPPING AND THE USE OF NEW TECHNOLOGY

Michael T. Klein

Michael is in his 25th year of service in the Parking and Transportation field. During this time he has worked at Syracuse University, The University of North Carolina at Chapel Hill, and Stony Brook University. One of the most unique and interesting challenges he encountered was participation in the creation and implementation of the Syracuse University Transportation Management Plan, an access system for up to 50,000 people attending sporting events and concerts at the Carrier Dome. He has created, maintained, and renovated many parking facilities, developed intermodal transportation systems, and made use of technology to improve customer service. He is a past President of the Carolina's Parking Association, an Executive Board member of the New York State Parking Association, a member of the Board of Advisors of the International Parking Institute, and he has been a Board member for the National Parking Association and The Association for Commuter Transportation. Mike has had numerous articles published in The Parking Professional, Parking Magazine, and Commuter Transportation.

Introduction

Living as we do, in the Information Age, it is more critical then ever we adapt and learn, in order to be healthy and grow, not only as individuals but also as organizations. "Model one" single loop thinking (popularized by Chris Argyris in his landmark book, On Organizational Learning) will tend to fail. In contrast, use of the double loop approach – incorporating technology and management theory advances – allows us to effectively manage change, which is occurring at an ever increasing rate. his is shown graphically in the following diagram:



A simple example of single loop thinking is use of the temperature setting, thermostat, and clock timer on an oven. Once we set the oven to bake our chicken at 350 degrees for the predetermined time, we are assured that the baking will be for the right temperature and duration. However, in the case of double loop thinking, wouldn't it be nice if the oven "knew" why it was set at this time and temperature? Then when one failed to put the chicken in the oven, incorrect action would be avoided.

While adopting every new "bleeding" edge technology would be disastrous, adopting more proven technology early is often desirable. By way of example, if the Swiss had accepted digital technology as the future of timekeeping they might still be leaders in this field. Defensive concepts such as finding ways to make analog watch production more efficient or adding more jewels for accuracy are usually not tenable positions in the 21st century.

To embark upon these types of change, one must be able to reflect upon the existing system, integrate this with a larger worldview, consider the situation in an open and non-defensive way, and manage knowledge as well as people. Being willing and able to transform an organization, overcome people's tendency to resist change, and develop new systems and processes are integral to success in the workplace.

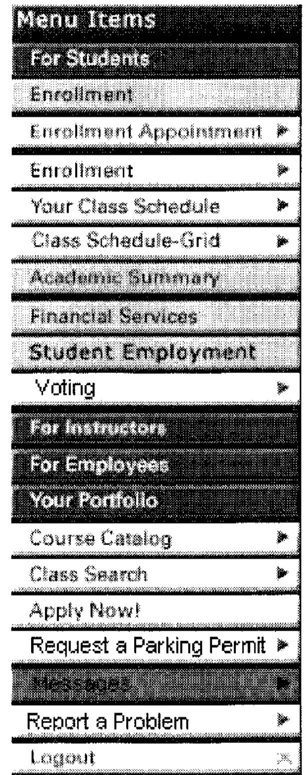
Rather than route people from place to place, and require them to wait in line, it is in everyone's interest to allow people to serve themselves, or at least to be served at a single venue. Not only does the customer have a more pleasant experience and save their time, but management also achieves efficiencies, thus saving time and money while better satisfying people's needs.

Critical elements supporting organizational change and development in the 21st century include use of new technology to improve customer service, better information management, and reduction of staff time on redundant tasks. Core aspects of this evolutionary process include: using the World Wide Web and "E-business" to send, receive, and analyze information; issuing parking permits and collecting fees; and developing new ways to provide services to customers. By leveraging new technology we can work faster, smarter, and cheaper. With the collapse of the "dot coms," it appears that a blend of the "brick and mortar" traditional workplace with information technology business models is the path to success.

One Stop Shopping

We've all had the unpleasant experience of getting the "run-around." Perhaps you called a major corporation and were transferred three times, only to end up back at square one, or worse, you were disconnected. Or perhaps after waiting in line at the Motor Vehicle Bureau, you then had to sit and wait for several additional transactions along the way.

Businesses that adopt the "one stop shop" must move to a more integrated form of customer service. By using double loop thinking, these organizations have changed their



assumptions about how to do business. These new assumptions typically result in physical changes to the environment where customer transactions occur, new processes and procedures, streamlining of bureaucracy, a unified approach, and well trained staff. In many situations, the use of web applications and electronic forms completely reshapes the physical "shopping environment" into a virtual one. For example, the days of contacting a travel agent to buy airline tickets, and waiting to receive them via "snail mail" are gone.

In the university environment, parking permit issuance and ticket payment used to be individual steps in an arena-style procession, where students paraded from line to line to discharge "registration holds" such as parking tickets, library fines, and dorm damages. They could then register for classes and be eligible for a parking permit. However, by then they would likely be advised that the handful of good permits were sold out, and they could get on a waiting list (which would likely never be exhausted). It could be an exercise in frustration.

It is not that we didn't manage our resources well; there were sensible eligibility criteria for the lots, well thought out oversell ratios, substantial investment in facilities, staffing, and computerization. The problem remained that our customers were faced with challenges and irritants, long before the first time they parked their car on our lots. Often, the processes were so intimidating or time consuming that some customers went over to the dark side - they became scofflaws and never even applied for a permit. It was time to redesign the workplace into a "one stop shop" and create a new approach to improve customer satisfaction.

By incorporating the permit registration process into the class registration process, and making both of these available via web applications, there are tremendous labor reductions and more efficient and effective customer service. An example of what this interface looks like to the customer is shown above. This is an actual snapshot of our University class registration website – the "SOLAR System."

When the student, faculty, or staff member selects the "Request a Parking Permit icon they move to an application which draws information from broad institutional databases as well as Parking Services records to determines if there are outstanding tickets to be addressed before registering for a permit, and also only permits for which the applicant is eligible will be offered. As one proceeds through the menu choices, there are edits to clean the data, opportunities to review information such as maps, rates, and alternatives such as carpooling, use of mass transit, and so on. Confirmations, newsletters, status on waiting lists, and other communications are automatically generated and processed via email.

Process Analysis

To move the customer service tasks from the traditional Parking Services counter to another location such as Student Accounts, The Bursars Office, The Registrar's Office, or to a virtual environment, it is first necessary to identify all the tasks which are currently being performed at the current customer service location(s). Although the people that know this in a detailed way are the staff at Parking, it may be helpful to perform a process review with the Audit Department, Accounting, and with peer review.

The goal of this research is to identify ways to streamline workflow, reduce steps, automate redundant tasks, eliminate unnecessary work, and segregate what can be done in a back office setting versus required points of customer contact. Further, where possible the goal should be to create a self-serve environment to allow quick, easy access to customers and minimize staff time consumed when providing goods, services, and information.

Following are examples of task divisions from one such analysis:

Parking Services
- Process Web applications for permits
- Process Freshman/Sophomore Petitions
- Create or modify permit issuance algorithm criteria
- Order permits and decals

Bursar
- Enter walk in customer info to MIS
- Algorithm determines permit eligibility
- Scan appropriate permit tag onto system
- Collect payments for permit
- Issue Permit

Student Accounts
- Bill students for permit fees added to student account
- Distribute permits held for pickup
- Post charges for web permits

Departmental Coordination and Change

To make this concept work it is necessary to cross some traditional boundaries. Specifically, it will be important to be able to work in a cross functional way with student service areas that may be on the finance side of Business and Finance, such as the Bursar's Office, Registrar, Student Accounts, or other areas. This requires one to not only have support, likely from the VP or Presidential level, but also relationships with people responsible for these functional areas.

Once this "political" need is met, there is still the issue of space. Often people are territorial, and there may be resistance to either giving up or sharing space. However, if one is fair and creative, these pitfalls may be overcome. If Parking Services can give up its customer contact location and instead make use of a remote location this may well pave the way for getting some space where the customers are best served. Similarly, staff members may need to be transferred between departments, and issues of supervision and funding are likely to arise.

Regardless of the individual challenges the broad topic is one of managing change. To do so, one must be able to look beyond the short term and enunciate a vision of the future. Rather than getting bogged down in egos or issues of dominance, keep the focus on what is best for the customer and the institution. Rather than being drawn into a battle of wills or test of power, focus on the ways to work together to make things better for everyone.

Information Technology

Unlike decades of "cigar box" parking operations, creating successful Management Information Systems to manage parking operations is not as intuitive as just collecting money for time parked, while making sure that the bills and any profit or overhead recovery are satisfied.

Let us consider the concept how an information system will improve a parking operation, and also drill into the nature of the changes we are considering.

The first thing one must do is evaluate the current situation and determine what level of change is needed. This is a three-step continuum, with the first and least complex approach being to seek improved efficiency via Business Process Automation (BPA). A more evolutionary approach is Business Process Improvement (BPI). Finally, the most radical change would be Business Process Reengineering (BPR).

In the basic BPA approach, one looks for repetitive manual tasks and then replaces them with automation to relieve workers of tedious tasks and perform work more efficiently. An example would be use of hand held ticketing devices rather than paper tickets. In this way we save office-based data entry, ticket filing, and the need to consult hard files when dealing with secondary functions such as appeals. Savings are realized in both time and money, and accuracy is also improved.

The middle ground of BPI takes this a step further. In this change strategy, one achieves additional improvements in quality, cost, speed, service, and so on. An example would be to incorporate bar coding and scanners into a parking permit system to improve point of sale processing, as well as adding utility and features for improved customer service. A bar coded permit would not only demonstrate that a car is valid at a facility, but would allow access into a gated facility and provide entry/exit data with which to better manage supply/demand needs.

The most evolutionary approach is Business Process Reengineering (BPR). This radical and drastic change harkens back to the single loop versus double loop thinking. In this arena one must rethink and redesign business process in a fundamental way. A newly exploited example of this is to eliminate to a significant degree the old "brick and mortar" front counter approach. By replacing this with the use of E-business, we allow customers more direct access to services and are able to serve more people with less staff. Hence we are able to reallocate staff to other missions, and create the "One Stop Shop" which is the cornerstone of this chapter.

In the public, private, and non-profit sectors we are challenged to create competitive advantage and to sustain that advantage over the long term. We need to find ways to work faster, smarter, and cheaper. In one word, this means that we need to provide value, and the information age gives us the ability to do this in new and unprecedented ways.

One of the places that we may add value is by developing an integrated management information system (MIS). This MIS must be perceived positively by customers; efficiently match customers with products; assist with marketing, communications and sales; and reduce transaction time and cost. If the system is sufficiently robust, it may also assist with inventory management, resource allocation, occupancy level analysis, and staffing/scheduling needs. Moreover, information management will assist with a range of activities, such as monitoring oversell capacity at each facility on a real time basis, or when and where enforcement is needed. It is not far fetched to have an enforcement staff member paged with a meter number when it has expired and a car is parked in the space!

The information this type of system provides will be invaluable when one is involved in more complex activities such as master planning. Along the way, identification of routine needs such as sign replacement, restriping, trimming of shrubs, and routine cleaning should be built into the system. In an ideal MIS system, information such as this would be entered onto a handheld device (many PDA formats are now available) by enforcement or other staff, and this may generate a "to do" list or even a purchase order to perform the desired work. Wouldn't you like to have information or even purchase orders printed out for your review and authorization based upon the recommendations from your field staff with no wasted time or expense?

Incorporation of more sophisticated MIS approaches with current management theory move away from the pyramidal hierarchy, the classic, "command and control" approach which is still in place in most organizations today. By improving information and having more of a "digital backbone" in business, we are able to flatten the hierarchy, reduce levels of management, empower staff throughout the organization, and ultimately become a "networked organization". In this last stage the circumstances determine the approach, and decisions are made as close to the customer as possible based on knowledge common to all. Records will show who made what decision, and allow for staff development and feedback – a great opportunity for catching someone doing something right as well as providing advice for better future decisions. This is much more efficient than the old approach of moving through a rigid hierarchical bureaucracy until reaching a suitable level of management.

Additional value derived from a well designed MIS is that the system is easy to use for both internal and external customers. It automatically processes financial transactions in a secure environment; and provides reports that assist in the management of resources, tasks, and staff time. Mountains of paper and armies of clerical staff are no longer needed.

It is easy to create permit issuance algorithms, or to specify that people with outstanding balances may not be issued a permit. However, when it comes to creating programs and systems to carry these concepts into practice, there are few parking professionals that have the requisite knowledge of programming to do so. As such, we need to partner with IT professionals. With their understanding of the institution's database and programming ability, along with our knowledge of parking policy and procedures, we are positioned to succeed. Neither group working independently has the formula for success, but together we can develop a system that satisfies our institutional needs.

On a related topic, we are the people that understand the concerns which our customers and staff bring with them. Hence, the final responsibility for determining how the system appears and performs for both internal and external customers must reside with Parking Services. We should marry our many experiences in the parking field and life in general towards creating a basic understanding of what our customers want, deserve, and need. Once we do this, we may create processes and flowcharts with the IT staff, and evaluate the proposed "demos" towards optimizing the proposed system.

If it takes too many steps to process a permit request, ticket payment or appeal, petition, or other customer service, we must be ready to reexamine the process to reduce confusion. By the time we completed our process review we had drastically reduced the steps in the permit issuance process. At this stage, it is literally as simple and quick as one, two, three.

E-Business

If our goal is to automate work processes and allow customers to satisfy their needs in a self service environment, there is no better medium that that of the World Wide Web. Growth of these applications throughout the broader marketplace, not only for purchase of goods and services, but also to research and compare information is unparalleled. By incorporating the information contained in the institutions database we have a powerful tool at our disposal.

By way of example, here is a snapshot of our permit issuance website, which is linked to our "SOLAR System":

On-line Parking Permit Application

Welcome to the Online Parking Permit Application. You may use this system to apply for the following types of parking permits:

- Commuter Permits
- Faculty/Staff and Affiliate Permits
- Public Life Sciences Metered Lot Permits
- Public ESS Metered Lot Permits
- Resident and Apartment Permits
- Stadium Lot Permits

To begin Step 1 of the permit application process, please follow this link to the next page... (https://www.parking.sunysb.edu/permits/permit.plx)

More information about Parking can be found here... (http://www.parking.sunysb.edu/parking/)

Please submit questions or problem reports to parking@stonybrook.edu, or call (631) 632-AUTO.

Lessons Learned

The most challenging aspect of this evolutionary process is to deal with how people tend to resist change. The transition of staff between old and new office environments, trading off office space, and working ever more closely with IT professionals brings us into new relationships and each requires nurturing.

Outreach to both staff and customers is critical. Use marketing techniques such as AIM – build Awareness of the change, develop Interest in what is going on, and Motivate people to act in a positive way. Communications to all concerned need to be positive, eye catching, and interesting.

In all systems it is critical to have a feedback loop to monitor performance. To do so in an efficient way it is helpful to incorporate a customer feedback system right on the website, typically at the end of the purchase process so we may gather subjective "customer" input. This combined with objective data such as number of permits and tickets issued, lot capacity counts, and other "hard" data, allows for a balanced view of our performance. What percent of permits were requested via website? At this point our metric is 70%, and we're sure to raise that bar next year. How long did people wait in line for a permit before and after this system implementation? Our wait times have dropped by a factor of three. Have the benchmark numbers changed? Yes, our community has grown and our permits sell quicker and in greater numbers than in the past. Have permit sales, ticket issuance, and/or appeal numbers changed; if so what is the judgment of the results, and where do we go from here? All are up, and this is a mixed blessing. We are doing more with less, and this does place stress on staff members.

Finally, recognize that this is an evolutionary process, and the only thing that is assured is that change is inevitable.

TRAFFIC ENGINEERING AND PARKING DESIGN

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How many parking spaces do I need? How many parking spaces should I build? How big should the spaces be? There are a number of engineering considerations behind safe and effective parking design, and a parking design expert's participation in a parking project is very important. These experts are typically hired in support of a parking project to calculate or verify parking demand, to provide guidance with regard to the amount of parking that should be supplied, to design the access to and circulation around parking lots, and to apply design principles to on-street parking.

Parking Demand and Parking Supply

Parking supply is the number of parking spaces available for parking in a given area. It is important that the parking supply include a sufficient cushion in excess of the necessary spaces (parking demand). If there are too few spaces provided, drivers will circulate around the parking area – primarily in the area closest to their destination – resulting in traffic congestion and pedestrian hazards, and creating the potential for parking area gridlock and a poor first impression of the destination. This section will cover the techniques used in calculating parking demand and determining parking supply.

Calculating Parking Demand

There are three general approaches in calculating parking demand for a garage or lot project.

- Applying accepted standards
- Performing detailed site analysis
- Conducting similar-use studies

Where there is a mix of uses to be supported by parking – ground level retail with office and residential, for example – the calculation of parking demand may be complex. All three approaches may be combined in putting the pieces of the demand puzzle together.

1. Applying Accepted Standards

Land-use is the single most significant factor in predicting the demand for parking. In most cases, the land-use will fall within a major development category such as office, restaurant, or movie theater. There are a number of resources that quantify the parking demand for specific land-uses, and it is these resources that are consulted as a first step in demand determination.

- *Shared Parking* is a resource manual produced by the Urban Land Institute (ULI) that provides parking characteristics for six major land-uses (office, retail, restaurant, cinema, residential, and hotel).

- ULI has also documented its study entitled *Parking Requirements for Shopping Centers, Second Edition*, focusing on shopping centers ranging from 25,000 to 600,000+ square feet of development.

- A ULI / National Parking Association joint publication entitled *The Dimensions of Parking, Fourth Edition*, provides parking demand estimates for land uses including shopping centers, offices, medical centers, industrial uses, university/college facilities, cinemas, hotels, and restaurants.

- *Parking Generation, 2nd Edition* published by the Institute of Transportation Engineers (ITE) documents parking demand estimates for over 64 land uses.

These reference documents are consulted to determine the appropriate parking rates for the intended use. For example, shopping centers ranging in size from 400,000 to 600,000 square feet have a parking demand requirement of 4.0 to 4.5 spaces per 1,000 square feet (Reference: *Parking Requirements for Shopping Centers, Second Edition*).

In some cases a land-use, such as a corporate campus facility, is not listed specifically in one of these references. The situation will need to be evaluated to determine how the specific land-use functions. Then the general category that best matches the intended function must be selected. In this example, depending on the size and scope of the facility, parking demand ranges for either "office park" or "campus" may be most appropriate.

The studies prepared by ULI and others provide general ranges for parking demand. The high-end of the parking demand range coupled with the size of the development project provides a quick estimate for parking demand. These quick estimates are useful for due diligence studies that seek to roughly quantify the cost of parking for structured parking applications or the land area requirements for surface parking applications.

2. Performing Detailed Site Analysis

The general parking demand ranges that result from applying accepted standards are frequently not sufficiently accurate. In these cases, the parking demand calculation as determined by accepted standards must be adjusted due to project-specific details such as environment, adjacent land-use, and peak period consideration.

The environment supporting and surrounding a project influences the demand for parking. In a built-up urban area, for example, the availability and use of public transportation has a major influence on the travel patterns to the facility. A majority of the travel to an office development located within an urban core could result from bus, transit, or pedestrian modes of travel, therefore reducing the parking demand requirements otherwise predicted by applying accepted standards.

Another contributing factor to parking demand is the character of adjacent land-uses in the surrounding development area. For instance, a restaurant facility located within an office park will require less parking than a restaurant located on an isolated development site. The restaurant within the office park will draw patrons from the tenants within the office park, in addition to others arriving from outside the immediate area. These combinations of complementary uses are taken into account and the standard parking estimates for retail adjusted by reducing the demand estimate. This is called a shared-use parking analysis.

Land-uses experience their peak parking demand periods at different times. This includes hourly, daily, and seasonal variations. As an example, retail land-uses typically observe peak parking demand during the holiday season (Thanksgiving to New Years Day), on weekends (typically Saturday), and between the hours of 10:00 am and 2:00 pm. A hotel/convention facility will often experience peak parking demand during a period of heightened activity at the facility, independent of season, day of the week, or time of day. It could occur when the highest attended event is scheduled at the facility. Information, such as a program of events for a hotel/convention facility, is collected and studied to determine the design day. Data are charted so that a review of the variations in parking will show the peak periods. Another important consideration is the difference between user groups.

3. Conducting Similar Use Studies

Comparable facilities are studied to determine one project's projected parking demand based on actual parking demand at a similar facility. Surveys of existing parking can be done thorough aerial photography of parking fields, manual inventories of facilities on foot, or through the use of parking access systems that measure the accumulation of cars into a facility throughout the day.

This approach is desirable if the facility is a unique nature and the empirical data provided through industry studies does not provide adequate similarities. It is important to understand that this represents just a "snapshot" in time, and may require more detailed analysis.

4. Putting It All Together

The most time consuming but most accurate method of determining parking demand is a combination of all three activities described above. After a thorough review of the land use and the surrounding environment has been completed, the next step will be to translate the proposed uses into their related parking demand estimates. This step involves a review of parking generation information published in the data sources identified to determine base parking demand rates. These rates need to be adjusted, if appropriate, to reflect any factors contributing to a reduction in parking demand. The rates are then summarized to reflect hourly and daily variations.

The final result of the parking analysis is a matrix summarizing the land use, the independent variable (i.e. for retail, development square feet.) and the time periods of the day. The parking demand will vary throughout over the course of the day. If the facility contains multiple land uses, the matrices will be combined to reflect the total parking demand for the facility, with a determination made as to the peak period.

Figure 1 provides a parking demand example for a mixed-use development in table form, with the data displayed graphically in Figure 2.

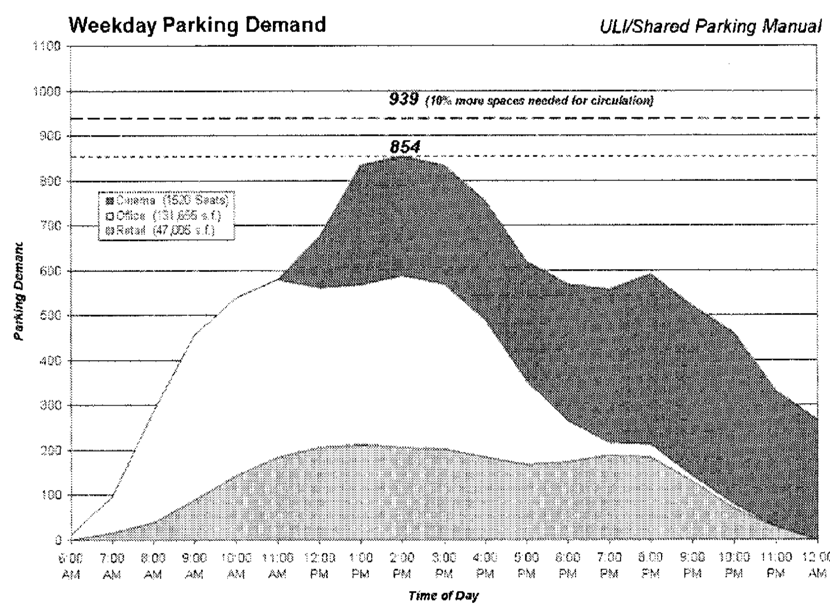
Figure 1: Mixed-use parking demand by land-use and time of day in tabular format.

Shared Parking

ULI Numbers

	WEEKDAY						
	OFFICE		CINEMA		RETAIL		COMBINED DEMAND
	1000 SqFt.	131.655	# of Seats	1520	1000 SqFt	47.005	
	Peak Space Factor	3.0	*Peak Space Factor*	0.25	*Peak Space Factor*	4.5	
	spaces per 1000		*spaces per*		*spaces per 1000*		
Hour	Sq.Ft.	Office (131,655 s.f.)	Seat	Cinema (1520 Seats)	Sq.Ft.	Retail (47,005 s.f.)	(Park. spaces)
6:00 AM	0.09	12		0		0	12
7:00 AM	0.60	79		0	0.36	17	96
8:00 AM	1.89	249		0	0.81	38	287
9:00 AM	2.79	367		0	1.89	89	456
10:00 AM	3.00	395		0	3.06	144	539
11:00 AM	3.00	395		0	3.92	184	579
12:00 PM	2.70	355	0.08	114	4.37	205	675
1:00 PM	2.70	355	0.18	266	4.50	212	833
2:00 PM	2.91	383	0.18	266	4.37	205	854
3:00 PM	2.79	367	0.18	266	4.28	201	834
4:00 PM	2.31	304	0.18	266	3.92	184	754
5:00 PM	1.41	186	0.18	266	3.56	167	619
6:00 PM	0.69	91	0.20	304	3.69	173	568
7:00 PM	0.21	28	0.23	342	4.01	188	558
8:00 PM	0.21	28	0.25	380	3.92	184	592
9:00 PM	0.09	12	0.25	380	2.75	129	521
10:00 PM	0.09	12	0.25	380	1.44	68	460
11:00 PM		0	0.20	304	0.59	27	331
12:00 AM		0	0.18	266		0	266

Figure 2: Mixed-use parking demand by land-use and time of day in graphical format.



Determining Parking Supply

The parking demand estimates provide the hourly and seasonal changes in parking demand and an estimate for the number of vehicles anticipated to be generated by the facility. The amount of parking ultimately supplied often varies from the parking demand. Factors contributing to the final determination of parking supply are summarized below.

- *Zoning Requirements*: Government zoning requirements often provide parking estimates that differ from the calculated demand. In an attempt to reduce vehicular travel in a built up urban area, the underlying zoning may reduce the parking requirement for a facility, in turn reducing the number of vehicles that need to be accommodated on site. Other times, the ordinance may not reflect the synergy associated with complementary uses (for instance, retail and office), resulting in requiring more parking spaces at a facility (than otherwise required by the demand calculations).

- *Market Factors*: The presence of an overcrowded parking facility serving an office park may appear as a negative to office space brokers searching for tenant space. Responding to the desire to provide more than ample parking, developers may wish to provide more parking than required by demand calculations to meet market requirements, employing a larger "cushion" of spaces. The use of existing office space may change as well, with more employees utilizing the same facility.

- *Circulation*: A parking area that provides the exact number of spaces to meet the projected parking demand will exceed capacity during peak design periods. This is the primary reason for building a "cushion" of extra parking spaces. If the "effective supply" is five to ten percent higher than demand, users will not have to search the entire facility for the last open spaces.

- *Parking Facility*: The type of facility serving the intended use could impact the supply requirements. If there is a long term plan to convert the parking lot to a pay parking facility, a few spaces will be lost to provide space for revenue control equipment. In addition to the nature of the facility, pay parking or free parking may have an impact on parking demand, driving it up or down depending on the fee structure.

Parking Traffic System Design

Getting motorists to and from a parking facility smoothly, and circulating them around the facility and into a space safely and quickly is key to the success of any parking project. This success or failure can have a significant impact on the overall viability of the land-use served by the parking facility. Time-tested access, circulation, and parking space design principles are applied to ensure safe and effective parking operations.

Parking Access Principles

Parking access refers to how a motorist arrives at and departs from a parking facility, or a parking space (in the case of on-street facilities). There are a number of key parking access design principles, the first of which is a successful signage and wayfinding system. External signage is important to get motorists to their destinations as quickly as possible to reduce the amount of traffic circulating on the roadway system. Several other principles that parking design experts apply when working with roadways adjacent to parking facilities are described below.

1. Roadway Hierarchy

Good planning practice consists of establishing a hierarchy of roadways that transition motorists from highways and freeways to major arterials, to collector and local roadways, before accessing parking facilities. Roadways should not serve dual purposes. For example, a major collector that is a commuting route should not also serve local residential trips. Figure 3 is an example of the roadway hierarchy at a university campus. Major arterials feed the collector roadways that feed the circulator roadways that feed the penetrator, or local, roadways. Each roadway type serves a different function, is a different size in terms of lane numbers and widths, has a different design speed, and has different design guidelines such as spacing between intersections.

The type of roadway that a parking facility will have direct access onto varies depending on the size and use of the facility. For example, a large parking structure serving a football stadium will typically have direct access to multiple collector and local roadways. However, a small surface parking lot serving an office might have only one access point to a local roadway.

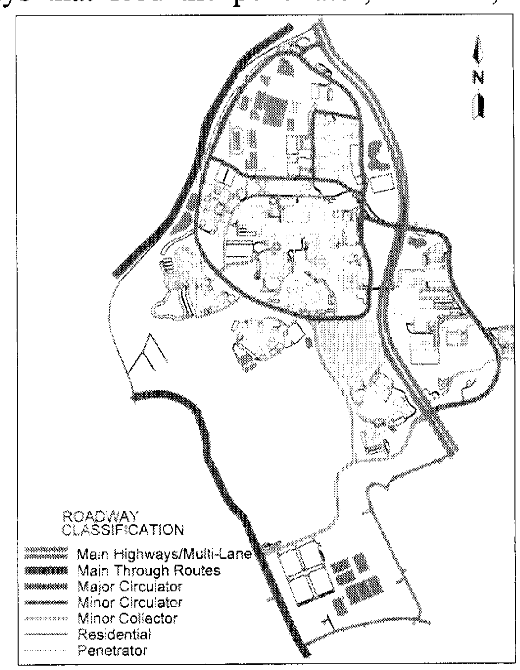


Figure 3: Campus roadway hierarchy

On-street parking is generally reserved for local or minor collector roadways where vehicle speeds are low. The type of road off which a parking facility is located and the number of access points is largely driven by the expected inbound and outbound traffic flows.

2. Access and Egress Points

The volume of inbound and outbound traffic flows is the key variable in determining the number and location of access and egress points, and these volumes can vary considerably from land-use to land-use. Office land-uses have two defined peak periods when most motorists arrive and depart, whereas retail trips are spread more evenly throughout the day. The number of access and egress points will be based on the traffic flow during peak hours and the capacity of the adjacent roadway system to absorb this traffic.

Typically, the capacity of the intersections of the driveways with the adjacent roadway network dictates the overall capacity of the system. However, in some instances the limiting factor for getting vehicles into and out of a parking facility is the control equipment in the facility itself. One example is a visitor parking facility that requires cash booths upon exiting. Cash booths may only be able to process 200 vehicles per hour, whereas a traffic signal at the driveway might process 500 vehicles per hour. A similar situation may exist at the entrance. A ticket spitter or card reader may only be able to process 300 to 500 vehicles per hour, but the intersection feeding the entrance may process 700 vehicles per hour. In these situations, multiple lanes, additional access and egress points, or both are needed to alleviate or prevent queuing problems.

Depending on the size of the parking facility, more than one access and egress point may be needed. Local and/or regional zoning regulations may dictate access requirements. The location of the driveways is critical in facilitating traffic flow within the facility as well as on the surrounding roadway network. The overall goal of locating driveways is to distribute the traffic throughout the facility and adjacent roads, so that one intersection or road is not burdened with all of the entering and exiting motorists. Better distribution ensures easier access and more efficient operation on adjacent roads and intersections. For structures, consideration should be given to creating entrance and exit points from different levels, if possible, to facilitate traffic flow internally.

3. Turning Movement Design and Traffic Control Devices

The operations at the intersections leading to and from a parking facility are extremely important in the overall 'success' of the facility. These are the points on the roadway network where the impacts of the parking traffic are manifested. The type of traffic control that is required and the turning movement design are the primary issues.

The need for a traffic control device (traffic signal, stop sign, etc.) depends on the number of turning vehicles at a specific intersection. The levels of service and queue lengths at these locations are analyzed as the first step towards determining the need for traffic control devices. Typically, for moderate to large-scale facilities, traffic signals are required.

When designing turning lanes at intersections, there are several considerations:

- Multiple inbound turning lanes should turn into the same number of lanes on the driveway. There should be adequate time for motorists to change lanes before they come to a decision point.
- The inbound and outbound traffic flow follows a pulse-pattern corresponding to the green signal phases. If control equipment is present, the capacity of the equipment must match or exceed the capacity of the green phase of the traffic signal, so traffic does not queue back through the intersection. For the outbound movement, there should be enough stacking space between the exit control equipment and the intersection to ensure the green phase for the driveway allows as many vehicles through per cycle as possible. This protects the efficiency of the traffic signal.
- Pedestrians are typically present on the streets surrounding parking facilities. Therefore, good design accommodates pedestrian crossings and activities in the traffic signal phasing and driveway designs, to minimize potential conflicts.

Regardless of the traffic control device used at a parking facility, the design of the turning radii and lane widths should reflect the design vehicle. The owner or manager of the facility will know what types of vehicles will use it. Frequently bus routes run through surface parking lots and loading docks are located within a parking garage or surface lot. The access and egress points should be designed for these vehicles. It may be cost efficient to restrict large vehicle use to specific entrances and exits, if possible.

Circulation Principles

There are two primary goals of good circulation design for parking facilities:

1. Create a clear and safe circulation pattern for vehicles; and
2. Minimize the number of vehicle/pedestrian conflict points.

To create an effective circulation pattern, the following should be taken into account:

- Reinforce the hierarchy of roadways. In medium to large-scale facilities, it is appropriate to have several access driveways leading to a circulator road that then leads to parking aisles.
- Design roadway intersections at right angles and in accordance with recognized standards of roadway design.

- Avoid four way intersections within parking lots whenever possible.
- Develop a comprehensive sign system for motorists that leads them to major building entrance locations, parking lot exit locations, and drop-off/pick-up destinations. Signs must be designed taking into consideration the speed of vehicles, sight lines, effects of landscaping, and the need to have legible signs in all weather and light conditions.
- Design the layout of parking spaces so that parking maneuvers do not cause drivers to back into main circulation roadways.

Minimizing vehicle/pedestrian conflict points involves applying intersection design, signing and wayfinding, and parking layout design principles.

- Pedestrian walkways should be incorporated into any parking lot design, to minimize the need for pedestrians to walk in driving aisles. If that is not possible or cannot be introduced into existing lots, parking aisles should be oriented so that persons can walk *along* aisles to their destinations rather than across aisles.
- Where pedestrians cross roadways, either at intersections or mid-block, there should be appropriate striping and signing alerting motorists to the presence of pedestrians. The *Manual of Uniform Traffic Control Devices (MUTCD)* should be referred to for specific design standards.
- If possible, the primary circulator road(s) within a parking facility should be located away from major pedestrian activity. They should not be located at the front door of the destination where pedestrians are crossing the street.
- Driving aisles should be two-way, if possible, so motorists are not forced to use the road at the front door of the destination where there is heavy pedestrian activity. Two-way circulation allows motorists to arrive and depart drive aisles from the same direction, so there is less potential for conflicts.

Parking Space Design Principles

Surface and Structured Parking Facilities

For surface parking lots, there are typically very few obstructions that limit the parking layout options. Many times the parking layout is mandated by the owner. In other instances, the shape of the parking area leads to a clear choice of layouts. The bottom line is that there are many options, from one-way angled aisles to two-way perpendicular aisles. A good reference for geometric design standards is "*The Dimensions of Parking, Fourth Edition*" by the Urban Land Institute and the National Parking Association. It is always important to check the local zoning regulations because they may require specific geometrics.

Structured parking has greater limitations than surface parking. The column grid is generally the limiting factor when it comes to laying out parking. The columns will dictate everything from parking space size to module width. "*The Dimensions of Parking, Fourth Edition*" also includes sections on these design specifics.

Regardless of the type of facility, the needs and goals of the owner must be considered. If the land-use being served is an office building or a long-term parking facility, there may be more opportunities for compact car spaces, for example. If the land-use being served is an upscale retail destination, then the priority of the owner might be to provide larger spaces, rather than to maximize the parking supply.

On-Street Parking (Parallel vs. Angled)

The provision of on-street parking along the frontage of businesses is appealing for owners and patrons. However, parking provisions must be considered in the context of maintenance of traffic flow, the minimization of traffic hazards, and the economic well-being of the greater business community.

On-street parking has an impact on traffic flow and accidents. ITE's 1999 *Traffic Engineering Handbook* discusses the relationship between curbside parking, accidents and traffic flow. This does not preclude the use of on-street parking, however, and it can be effectively integrated into a community's transportation system, when balanced with traffic flow and incident considerations.

For years, the traffic engineering profession has produced accident studies comparing parallel versus angle parking and the conclusions were essentially the same: angle parking generated 1.5 to 3 times the accidents of parallel parking [John Edwards, *ITE Journal*, February 2002; Paul Box, *ITE Journal*, March 2002]. In recent years, those conclusions have been questioned by some in the profession that suggest that angle parking generally experiences similar accident rates as that for parallel spaces. Accident rates, notwithstanding, the consideration of on-street angled parking should include a review of:

- Street classification and function
- Street width
- Traffic volume and speed
- Pedestrian activity and walking environment
- Frontage land activities
- Availability of parking

The factors that stand out in the consideration of any conversion of parallel spaces to angle spaces are: 1) the estimated increase in on-street parking; 2) the loss of street width due to the conversion to angle parking spaces; and 3) the increase in traffic congestion due to back-up maneuvers, coupled with the loss of street width.

Transportation Master Planning

Transportation makes development viable. Yet it is often overlooked and added to land use plans as an afterthought. The fact is that transportation master planning should be done in conjunction with the overall master plan, not afterwards. A transportation master plan should accomplish the goals of the owner of the master plan, such as reduce vehicle trips or increase the parking supply, while adequately serving the land uses.

Transportation master planning involves the consideration of all available modes of transportation including vehicles, bicycles, pedestrians, and transit. These modes should work together to form an efficient and coordinated transportation system that feed the surrounding land uses. Whether the master plan involves a university campus, a medical district or a mix of uses, the steps to complete a successful transportation master plan are the same.

Determine the Regional Context

The first step to developing a transportation master plan is understanding how the planning area fits into the region surrounding it. As an example, take a medical district that is spread over several square blocks in an urban area. It may have a main commuting route through its center carrying motorists from the suburbs to the downtown and the reverse. The transportation plan for the medical district must accommodate the commuting function, while accommodating those vehicles destined for the district. In other words, the master plan area is part of a larger region that may have different issues and needs. It is important to understand the transportation and parking issues for the region and not to isolate the master planning area.

Identify the Existing Transportation and Parking Conditions

Before planning for the future, the existing transportation and parking conditions need to be investigated. What are the land uses and how are they distributed? Is all of the traffic funneling onto one access driveway? Is there enough parking and is it in the right location relative to the land uses? Are there security restrictions at the access points that might affect traffic flow? What are the main travel routes and what modes of transportation are available? These are the types of questions that need to be considered. In addition, the roadway hierarchy must be identified as discussed in the "Parking Traffic System Design" section. The function of the roadways become evident and provides an excellent base from which to make planning recommendations.

Transportation master planning may also include some data collection. Traffic volumes and parking supply/demand are important factors that planners use to establish existing operating conditions, utilization, and to identify or substantiate concerns. This data may be available either through the property owners/managers or through local agencies including planning departments and departments of transportation.

Identify the Transportation and Parking Needs and Goals

Many planners forget to ask the client what they are trying to accomplish. Are they trying to expand in population, venture into new services or development types, annex additional property, or just update a master plan? Coordination with the client is extremely important in the planning process to clearly outline the goals of completing a transportation master plan. The rest of the planning process should then be focused on fulfilling these goals.

The final product should clearly represent how the client's needs and goals are met in the plan. In addition, the plan should always include an implementation section. This section should clearly lay out the steps that need to be taken to implement the plan. Steps include investigating potential funding sources, identifying further studies that need to be completed for approval processes, and setting up meetings with key individuals and/or agencies.

General Transportation Master Planning Guidelines

There are some general guidelines that should be considered when completing a transportation master plan. They are organized and generally described in the following categories:

- *Transportation.* Transportation refers to the interaction between all transportation modes including vehicles, transit, pedestrians, and bicycles. Typically, one objective is to encourage the use of the non-vehicular modes to decrease vehicular traffic and minimize the amount of parking required. This can be done by changing transit routes, increasing the number of transit stations, creating bike routes, limiting the number of parking permits distributed, and a multitude of other methods.
- *Circulation.* Circulation refers to maintaining a well-organized road hierarchy on which the function of the road serves the motorists in similar ways. A major through route does not also serve as a driveway for service vehicles accessing loading areas, for example. In addition, circulation refers to how vehicles access the area and move through it. Access points should be well distributed so that all vehicles are not concentrated at one intersection. Those access points should then lead to organized circulating roadways that will circulate motorists around the area efficiently. The layout of the circulating roads will differ depending on the land uses served and the expected interaction between the land uses.
- *Parking (garages, surface lots, on-street).* Parking is a very important element of almost every transportation master plan. The location of parking facilities is especially vital because it determines both the ending and starting points for vehicles. It is where the 'vehicle to pedestrian' or 'vehicle to transit' mode change occurs. Parking is often located on the perimeter of the area to minimize the amount of vehicular traffic in the core and reduce the vehicle miles traveled.

Parking projects are rarely initiated outside of some larger planning context, and are often undertaken as part of a broader master planning effort.

THE LINK BETWEEN PARKING AND TRANSPORTATION DEMAND MANAGEMENT

Ralph Bond

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Parking is not just a place to leave your vehicle, it is also an important ingredient in good urban design, economic development, and Transportation Demand Management (TDM).

By carefully planning the location of parking facilities, and including good quality standards and well thought out design features, the facilities can be used to set an example for development, and an image for the area the facility serves. For example, a proliferation of open surface lots with little visual attractiveness, poor lighting, and no thought to pedestrian routes produces an uninviting image and encourages the wasteful use of land. In contrast, strategically located and consolidated parking facilities that include attractive landscaping, lighting, signage, and well designed pedestrian routes instil a sense of pride, safety, and security and present a positive image.

The provision of well designed and strategically located parking facilities serves to facilitate economic development by allowing multiple users and property owners to benefit from economies of scale, and efficient use of parking and land resources. In many instances it will also allow the municipal government to provide financial support in terms of financing, operating, and maintaining parking facilities for the common good.

In larger urban areas, parking can also be a powerful tool in Transportation Demand Management (TDM).

As transportation planners and government officials have increasingly realized, there is a limit to the amount of road and freeway infrastructure that can be constructed from a financial and environmental sustainability perspective. More emphasis must be placed on developing effective transit service and on efficiently managing transportation infrastructure through TDM policies and techniques. The provision of parking services is an important component in this process.

Parking-related TDM policies and techniques include:

- Providing specially designated car and van pool stalls in convenient locations.
- Providing of parking stalls for bicycles and motorcycles.
- Reducing parking fees for car/van pooling.
- Full cost pricing for parking facilities at the individual user level.
- Parking cash out and reduced cost transit benefits.
- Parking pricing that is the same or higher than transit fares.
- Construction of parking facilities for shared use by many users.
- Cash in lieu of parking provision payments.
- Implementing parking supply limits in zoning ordinances.
- Coordinating parking supply strategies with transit initiatives.
- Policies that encourage the use of structured parking and minimal stall sizes to conserve resources and create a compact urban form.

Each of these policies and techniques will be briefly explored in more detail in the following pages.

Parking policy and management is becoming more integrated with transportation planning and demand management efforts at the regional, municipal, and large institutional level. Parking personnel at the mid- to upper management level need to understand the broader issues of transportation planning and demand management, if they are to effectively participate in this process. At the institutional level, some parking managers who have broadened their understanding of these issues have become transportation managers in charge of car/van pool programs, shuttle bus service, and transit service coordination. At the regional and municipal level, Transportation Management Associations (TMAs) have been formed to deal with all aspects of transportation, including parking development and management, in a coordinated fashion. These organizational and management trends will probably accelerate over the next ten years, especially in rapidly growing urban areas.

Significant costs are incurred to purchase land for parking, build structures and lots, and maintain and operate them. When parking is provided to the user free of cost, the driver is not able to fully appreciate the real cost of the service. Like most goods and services, demand for parking will not be restrained if it is free or very low in cost. The actual cost of parking to the driver is often hidden or subsidized through the rents that are charged for retail, office, and residential space. In the case of retail space, the higher rents that result are passed onto the consumer in the prices for goods in the store. In the case of office space, the cost is passed on in the form of higher prices for the service provided, or if government offices, in the form of higher taxes. In some cases, free parking discourages the owner of the parking to spend the money that is necessary to provide well designed, maintained, and operated facilities.

Free and abundant parking encourages people to drive alone rather than car or van pool, be dropped off or picked up, walk, cycle or take transit. When parking is provided free of cost to the user, but public transit is not, public transit is at a substantial marketing disadvantage.

To encourage car/van pooling, walking, and transit use, the use of parking should be moderated in terms of supply and through visible parking costs that the user pays for directly. To encourage efficient use of parking resources, reserved parking should be minimized, if not eliminated. Where provided, it should command a premium price.

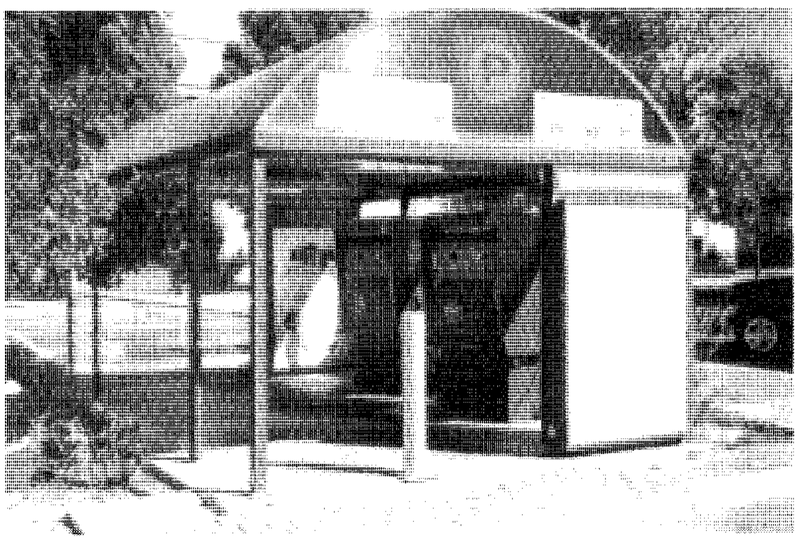
One way to reduce parking supply need and peak hour vehicles on the road is to provide a significant number of designated car and van pool stalls in place of (not in addition to) parking stalls for single occupant vehicles. If these specially designated stalls are more conveniently located, attractively designed, and strictly enforced for use by multiple occupant vehicles only, people will be encouraged to consider car or van pooling. To facilitate the coordination of vehicle sharing, large employers, parking facility owners, and/or municipal government agencies should provide personnel and computer software to match people up in terms of cost, time, and travel route. There are many good software programs available to assist in this process. The program should be marketed in brochures, advertisements, and human resources presentations. Where parking charges are in place, an additional powerful incentive to use car/van pooling stalls would be to offer such parking at substantially reduced rates or even free of charge.

Van Pools reduce parking demand.
Source: Colin McConnell/Toronto Star

Specially designated and conveniently located parking stalls for bicycles and motorcycles should also be provided to encourage people to use these alternative transportation modes. Similar to car/van pool stalls, these parking spaces should be provided instead of, not in addition to, normal parking stalls. Where parking charges are in place, reduced rates should apply to motorcycles and parking for bicycles should be provided free of charge.

To provide public transit with a marketing advantage, the price of a parking stall to the actual user should be at least the same as the cost to use public transit. For example, if transit fares are $2.00 each way, then parking costs should be at least $4.00 per visit, preferably more. If a monthly transit pass is $60, then the cost of monthly parking should be at least $60 as well, preferably more. It is also important to make sure that public transit service is competitive with the car in terms of hours of operation, frequency of service, and geographic coverage, or the benefits of parking pricing may not be fully realized.

In many cases, the actual cost of building and operating parking will be higher than the cost of a public transit trip. When this is the case, the full or higher actual cost of providing the parking should be charged directly to the user, and not subsidized at the expense of the transit rider, walker or car/van pool user.

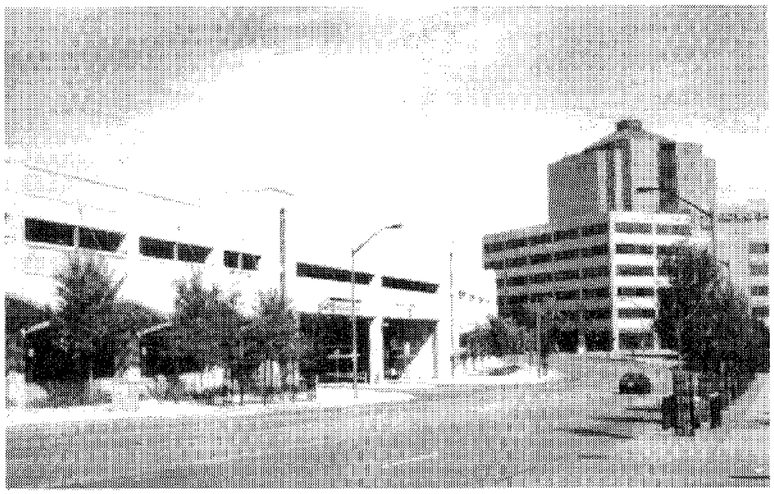


Paid Parking is a TDM tool.

In environments where parking is typically provided free of charge, employers could offer employees the option of cashing out the benefit of free parking. For example, the actual cost of providing parking could be calculated on a monthly or annual basis and this amount could be provided to an employee who elects to take transit. Alternatively, employers could offer transit passes free of charge or at subsidized rates to encourage transit use.

In general, the use of consolidated or shared parking facilities rather than many individual facilities will usually result in more efficient use of the parking and reduced capital and operating costs. It will also facilitate the provision of ancillary services such as car washes, minor auto maintenance, dry cleaners, coffee and snack vendors, car rentals, and other services.

Multi-level parking structures will also minimize the consumption of land and facilitate more compact urban development, that can in turn be made more pedestrian-friendly and easier to serve with public transit. Parking stall sizes can also be minimized to conserve space and capital resources, especially parking that is used solely for long term employee use.



Shared Parking Facilities reduce costs.

To promote the use of strategically located and shared parking facilities, municipal planning policies and zoning bylaws should at least allow, and preferably encourage, builders to provide a cash payment to the municipality in lieu of providing parking for a building on the same site. This will reduce the proliferation of many small parking facilities, facilitate the intensification of building sites, and promote good urban design.

Zoning bylaws should also allow the use of off-site parking within reasonable walking distance (usually 600 to 1200 ft.) so that builders can independently create agreements for sharing parking on another site that has surplus parking, or which can provide new parking more efficiently than the subject site.

Municipalities also have the ability to limit the amount of parking that is allowed for each development, although this statutory power is rarely exercised except in very large and densely built up urban areas. Limiting the supply of parking will encourage people to use car/van pooling, walk, take transit, or bicycle. It will also encourage the use of parking fees to ration the use of the limited supply. However, when access to parking is limited by supply and or price, it is extremely important that effective alternatives to driving are in place and they are customer service focused to avoid driving businesses out of an area. This is where Transportation Management Associations or organizations can be effective as described below.

Transportation Management Associations (TMAs) can be an important force in facilitating the delivery of transportation alternatives for employees, business owners, and visitors to urban areas, particularly when the stakeholders are concentrated in a geographically defined area. TMA members usually consist of large private and public employers, area (downtown) business associations, merchants groups, and educational institutions. Examples include hospitals, colleges, universities, large corporations or building landlords, municipal, and state/provincial governments located in a specific area. Large groups then elect a board of directors to represent their interests. Some TMAs simply act as a coordinating body for car/van pooling on behalf of many members. Other TMA's act as the member's representative in advocating for transportation improvements serving an area, particularly new public transit services, so that dependence on automobile travel can be reduced. More sophisticated TMAs perform many functions, including:

- Car/van pooling coordination and operation.
- Transit pass sales including discounted bulk purchases for large groups.
- Providing consolidated transportation information.
- Research into employee travel needs including the identification of and planning. For new transit routes and increased services.
- Research and planning for improved pedestrian linkages and bicycle facilities.
- Providing emergency ride home and short term car rental services.
- Acting as parking sales brokers for members who have surplus parking available (e.g., churches, small business/store owners).
- Operating parking facilities.
- Development and ownership of parking facilities.

Although many TMAs originate through government initiative, its is desirable that area businesses and employers become active participants in the association and eventually take ownership of the management for the organization. TMAs are usually funded by a combination of government grants, commissions on transit pass sales, fees for operating/managing parking facilities, and membership dues.

TMAs provide one stop shopping for transit pass sales, car rentals, parking passes, ridesharing coordination, and emergency ride assistance; they act as a broker for building owners who have surplus parking that could be shared by many users. Many of these services can be provided in a web-based interface via the internet.

TMAs can act as a strong voice for employers and employees in advocating for new or modified transit services, road improvements, and parking facilities. Active organizations conduct detailed research on an annual basis into the transportation requirements of their members. This information is then used to request new transit routes, increased service levels or alterations in existing services, all with the goal of increasing commute options and improving the commuting experience. TMAs can often arrange for substantial discounts on monthly transit passes through bulk purchases. Large employer members can then offer to reduce the cost further or subsidize the entire cost of the pass so that it is offered free to employees as an incentive to take transit. In large settings, TMAs can arrange or operate shuttle bus services to remote parking facilities that offer reduced rate parking. They can also develop and operate short term car rental services, so that members can obtain the use of a vehicle for a few hours or days, usually at a lower price compared to commercial rental firms. This in turn will encourage people to car or van pool or take transit, with the comfort that they can access a vehicle when necessary.

More sophisticated organizations could actually build and operate paid parking facilities, mostly for short term parkers and use the revenues to help fund their operations and/or transportation initiatives.

Good Transit Service reduces Parking Demand.

The ultimate goal of Transportation Demand Management is to provide a well coordinated access system which provides competitive transportation options for commuters and visitors. This will increase the productivity of an area by making the commute more convenient, cost effective, and less stressful, as well as improve the environment by reducing congestion. It will also facilitate more efficient use of land and effective urban design. The chances of success will increase when all transportation services are planned and coordinated as a whole, preferably through one umbrella organization like a TMA. Parking planning, design, management, and operation are critical elements of this system. Parking professionals who understand how they relate to the entire transportation challenge will have a stronger voice at the transportation planning level, and may find that their skills can be applied to non-parking issues as well.

PARKING AND TRANSIT

William E. Hurrell, P.E.

Bill Hurrell is Regional Vice President of Wilbur Smith Associates, and has 30 years of professional transportation planning and engineering experience. He specializes in multimodal transportation planning. He has extensive experience with projects involving the planning and implementation of light rail, commuter rail, inter-city rail, mass transit, personal rapid transit, and bus rapid transit. Mr. Hurrell has managed comprehensive parking studies and facility feasibility analyses in the numerous cities. Many of his projects have involved Park-and-Ride including a state-wide park-and-ride study for California, and studies for San Diego, Seattle, Honolulu, and Sacramento. He conducted a comprehensive station parking and access study for the entire Bay Area Rapid Transit (BART) system. In 1996 he was named "Parking Professional of the Year" by the California Public Parking Association. Many of his projects involve highly controversial issues and include significant public involvement efforts.

Introduction

Historians often note that in the 1950s and 60s, the rapid expansion of the nation's highway system and the explosion in automobile ownership brought about the demise of transit systems throughout the country. Indeed, during this time the few remaining privately owned transit systems had to be converted to the publicly owned and supported systems that we accept as commonplace today. Over time, however, a mutually supportive relationship has developed between the automobile and public transit services.

Typical Suburban Park-and-Ride Lot in California

The purpose of this chapter is to explain and examine the role of parking as a means of access to public transit. This means of access (commonly referred to as "park-and-ride" or "intercept" parking) is vital to the operation of the major bus and rail transit services in the country. Park-and-ride parking can be an important tool for addressing the overall parking and transportation needs for metropolitan areas. Providing parking in a location removed from the urban core of a city is a means of satisfying the demand for parking in the core, while reducing vehicle miles of travel and providing users with a low cost alternative to parking in the core of our cities. The users of park-and-ride avoid having to pay for parking at their urban destination and traffic congestion.

The provision of park-and-ride parking is a major element of federal, state, and local transportation programs. For example in California, Caltrans oversees a network of over 400 park-and-ride lots, with over 29,000 spaces located throughout the state. In addition to the facilities provided by Caltrans, there are extensive park-and-ride facilities provided by transit operators throughout the state. The Bay Area Rapid Transit District (BART) alone provides over 46,000 parking spaces at its stations. Park-and-ride parking facilities range from a small paved area near a freeway interchange to large parking structures which are integral to a transportation terminal or transit station. The new airport extension of the BART system provides a 3,000 space parking garage at the Millbrae Station, its new southern terminus.

Types of Park-And-Ride Parking

Parking for park-and-ride takes many forms. The following are common examples of park-and-ride facilities:

- **Freeway Corridor Park-and-Ride** – Many state departments of transportation, counties, and cities have developed park-and-ride facilities serving major freeway and expressway corridors. Typically these facilities are surface parking lots located near an interchange or a major intersection. The lots are often served by public transit, typically express bus services which will pick up persons at the park-and-ride lots along the route and take them to a downtown area or major center of employment in the area. These lots may also be used for car-pooling. These lots can be located a distance of 5 miles, to as many as 60 miles, from the intended destination, although most are located in the 10 to 20 mile range. Those lots not served by transit are used by individuals forming carpools or vanpools.

Freeway Park-and-Ride Lot in Houston, Texas with a direct transit ramp connection.

- **Transit Station Park-and-Ride** – These park-and-ride facilities are designed to provide direct access to a transit station or transit center. They are often owned and operated by the transit provider. Users park their cars in the parking lot or structure and then enter the station to board the transit system. The transit system may require the payment of a parking fee or otherwise restrict the use of the parking to those persons who will actually use the transit system.
- **Fringe or Peripheral Parking** – Many major cities have experimented with the concept of creating park-and-ride lots on the outer edge or fringe of the downtown area, and then providing a shuttle transit service to link the lots or structures to the downtown. The lots are located 5 miles or less from the downtown; in fact, some peripheral lots are within walking distance of the downtown. This concept has met with mixed success because in many cities commuters are not willing to fight their way through all the congestion to get downtown only to then have to park a long way from their destination and wait for a shuttle to pick them up.

In addition to these major types of park-and-ride facilities there are three different ways of providing park-and-ride opportunities:

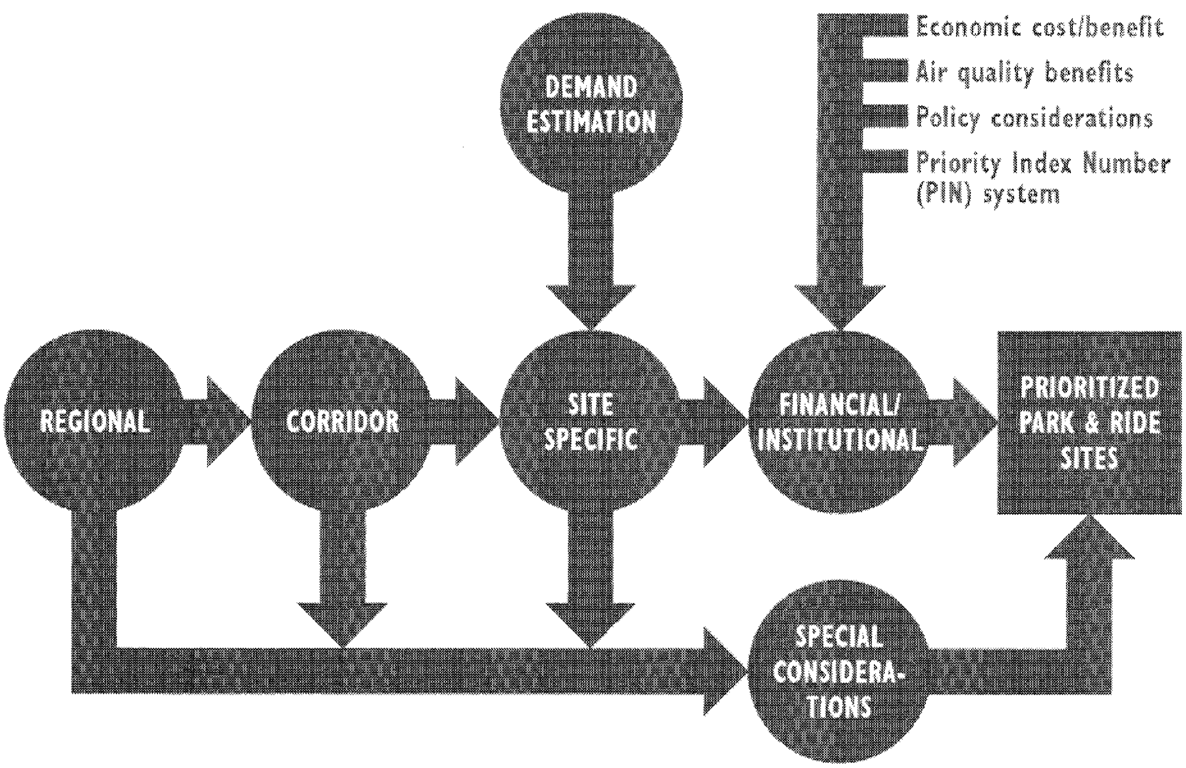
- **Dedicated Park-and-Ride** – This is the most common type of park-and-ride facility where a parking structure or lot is constructed strictly for park-and-ride use.
- **Shared Use Park-and-Ride** – An inexpensive and very efficient way to provide for park-and-ride parking is to work out a shared parking agreement with an existing use. For example, churches, stadium/arena parking lots, and shopping centers all make good candidates for shared use with park-and-riders. Church parking lots are ideal, as during the weekday work hours commuters can park in the lot without conflicting with evening and weekend church activities. Some states and public agencies actually have developed standard agreements where they gain the formal permission to use some or all the parking for park-and-ride in exchange for maintenance of the lot and provision of liability insurance.
- **Informal Park-and-Ride** – In locations where there is a transit station or stop, or a convenient place for forming carpools, commuters will often find someplace to park-and-ride even if there is no formal designated site. Along almost any freeway in a major urban area, clusters of parked cars will be seen near interchanges and transit stops; this is evidence of informal park-and-ride activity. In planning park-and-ride facilities, the identification of where people now park informally is a good guide to the best locations of new park-and-ride facilities.

Planning and Locating Park-And-Ride Facilities

Various studies have identified a number of site selection criteria as important factors in gauging the locational feasibility and demand potential of proposed park-and-ride sites. Some of these factors can be measured or assessed quantitatively, while others are more qualitative or subjective in nature. These site selection criteria include broad regional factors which take into account multi-jurisdictional planning, congestion management, and air quality attainment goals and objectives, as well as localized corridor level, site-specific, and financial/institutional factors.

Ideally, the location and selection of a site would involve a process which starts at the regional level and then focuses on increasing levels of detail and site specificity. The figure below depicts the overall relationship of the different levels of evaluation criteria. Relevant criteria in each of these categories are described briefly in the paragraphs which follow.

Relationship of Proposed Evaluation Criteria Levels



Regional Criteria

These factors determine whether or not park-and-ride makes sense for a given region. If the area under consideration does not have one or more of these characteristics, park-and-ride is not likely to be successful. The key factors to consider are:

- **CBD (Central Business District)/Activity Center Parking Cost** - The higher the parking costs either in the CBD or at major employment sites, the greater the demand is likely to be for park-and-ride parking facilities. The tolerance level for parking cost is relative depending, for example, upon whether the region is urban or rural; it is also influenced by other factors such as parking supply and overall congestion levels. If the parking cost in the CBD is considered low, then the likelihood that park-and-ride parking will succeed will also be low.
- **CBD/Activity Center Parking Supply** - CBDs or major employment centers with limited parking supply are also candidates for park-and-ride lots.
- **Levels of Congestion** - Urban areas with significant levels of congestion on the major highways are candidates for park-and-ride. To be most effective, park-and-ride lots should be upstream of congestion bottlenecks. Delays on the major commute routes need to exceed 10 to 15 minutes as compared with free-flow conditions.
- **Air Quality Condition** - Areas that have severe or serious air quality non-attainment records are likely candidates for rideshare incentives such as park-and-ride lots.
- **Population** - Research indicates that park-and-ride lots are most effective if sited in areas with a population of at least 200,000.

Corridor Criteria

If the area where park-and-ride is being considered satisfies the regional criteria above, then the following corridor related factors should be considered:

- **Relation to Congestion** - Park-and-ride lots should be located upstream of, or along congested corridors.
- **Transit Service** - The siting of park-and-ride lots should be coordinated with existing and proposed transit service. Good transit service, both during the peak and off-peak periods, with reasonable levels of comfort and convenience enhances the effectiveness of park-and-ride lots.
- **Availability and Use of Other Park-and-Ride Lots in Corridor** - If existing lots in the vicinity are used to capacity, another lot or expansion of existing lots is called for. Overspill parking or parking on the streets parking near bus stops is another indicator of demand. Sometimes people even park illegally in parking reserved for private businesses or other uses near a transit station or stop.

- **Distance to Activity Centers** - Research indicates that to be most effective, park-and-ride lots should be sited to maximize the rideshare distance, i.e., 75 to 80 percent or more of the trip should be shared or in a transit vehicle. For example, studies show that the lot is more likely to be successful if the rideshare distance is between 15 and 20 miles. However, if CBD parking prices are high or there are tolls involved, a successful rideshare distance could be as little as 10 miles.
- **Concentration and Size of Employment Centers** - Corridors accessing one or more major high density employment sites are prime candidates for park-and-ride lots, as opposed to smaller dispersed employment nodes.

Site-Specific Criteria

If both the area and the selected travel corridor appear suitable for park-and-ride, then consideration of specific sites should be initiated. The following factors should be considered:

- **Demand Potential** - Virtually 90 percent of park-and-ride use is for peak period work trips to major employment centers. Therefore, the most successful park-and-ride lots tend to be along densely populated, heavily traveled corridors drawing upon a large number of workers commuting long distances. The number of residents employed in the CBD, their economic status, the number of cars per household, and occupations are all important demand estimation factors. Rough estimates of demand potential typically take place early in the site selection process to highlight areas of opportunities or constraints. Prime candidate locations are then evaluated in more depth during later stages of the process. Methods for estimating demand are discussed later in this chapter.
- **Community Acceptability** - Neighborhood intrusion should be minimized, particularly in terms of overspill parking and traffic on adjacent local streets. Lots located where some mixed use is already in place will have less of a negative impact than lots located in the midst of primarily residential areas.
- **Joint Use Potential** - Sites that can accommodate multiple uses can result in economic advantages as well as increased security.
- **Site Visibility** - To be most effective, park-and-ride lots should be visible from the adjacent freeway or roadway to attract demand as well as to provide security.
- **Accessibility** - Site should be readily accessible for all user groups, including pedestrians, bicyclists, elderly and disabled and local feeder bus users. Site layout and design should be consistent with Americans with Disabilities Act (ADA) specifications. Driveway access and egress should be relatively straightforward: the route to and from the freeway should be no more than ¼ mile with few signals to impede travel time. Although not a prerequisite for a park-and-ride site, direct linkage to major bicycle routes can enhance lot use.

- **Security** - Security is always an important issue when rating potential sites. Therefore, clearly visible joint use sites, such as within or adjacent to high volume retail uses, transit centers or layover points, schools or churches tend to be more secure than isolated sites attracting little traffic during the midday.
- **Traffic Impacts** - Roadways adjacent to the park-and-ride lot should be able to accommodate projected traffic. Any required roadway improvements should be factored into the development cost of the park-and-ride lot.
- **Availability and Lot Size** – The best sites are vacant and already publicly owned; if not, land/relocation costs and availability are a big question. A successful park-and-ride lot needs to be large enough to accommodate peak period demand of those who drive to the lot and park. However, parking spaces are not required for those arriving by bus, on foot, or by bicycle. A good design guideline for park-and-ride lot sizing is 400 sq. ft/car or 100 spaces/acre which includes the provision of a drop-off area and a bus loading area. Parking structures are a good solution where land availability is limited or land costs are high.
- **Environmental Impacts** - Prospective park-and-ride sites should not generate significant environmental impacts as measured by the National Environmental Projection Act (NEPA) and state environmental regulations, such as the California Environmental Quality Act (CEQA) checklists. Floodplain, wetlands, and toxic impacts are particularly important.
- **Distance to Lot** - The use of park-and-ride lots is optimized if they are sited within 5 miles or 10 minutes of major residential areas. Studies indicate that between 50 and 90 percent of all park-and-ride users drive less than 5 miles to a lot from their residence; virtually all (98 percent) drive less than 10 miles to a lot. About 50 percent live less than 10 minutes away from a park-and-ride lot; 75 percent live less than 15 minutes away. The trip to the park-and-ride lot should average no more than ¼ of total trip to destination. Out of direction travel should be avoided.

Benefits

Ultimately a decision as to whether to develop a park-and-ride facility should be based on the potential benefits of the facility as compared with its costs. Following are some criteria commonly used to measure effectiveness.

- **Vehicle Miles Traveled (VMT) Saved** - Overall congestion reduction can be measured in terms of the reduction in VMT or average vehicle occupancy (i.e., the number of persons moved).
- **Congestion Relief** - Bottleneck relief can be measured in terms of vehicles per hour removed from the congestion point.
- **Parking Relief** - CBD or activity center parking relief can be measured in terms of the number of freed-up parking spaces in the CBD.

- **Emission Reduction** - Relative impacts on corridor and localized emissions need to be assessed. While overall regional or corridor level emissions may be reduced as a result of a reduction in vehicle miles traveled, emissions in the immediate vicinity of the park-and-ride lot may be adversely impacted as a result of increased vehicle traffic to the site.
- **User Benefits** - Cost and time savings can be measured using the cost of the entire trip for each mode, including tolls, parking, transit fares, etc.

When considering the costs of the park-and-ride facility the capital development costs – costs related to property acquisition and the construction of the facility need to be considered. Often the annual costs of maintenance and operation of these facilities are overlooked, but they need to be considered.

Park-and-Ride Facility Design

When asked which factors most influenced their decision to use a park-and-ride facility, the number one response was that there was good transit service available. The second most important factor was security; the sense that it was safe to park in the facility from a personal safety standpoint and that their vehicle would be there and unharmed when they returned. The planning and design of all park-and-ride facilities needs to take into account these two factors:

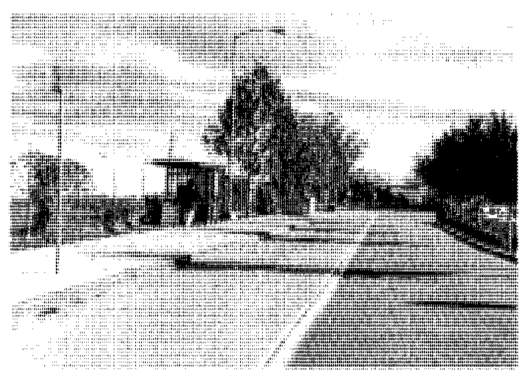
- The most successful park-and-ride sites are those that are served by transit; preferably with express, frequent service to the most popular regional destinations. Park-and-ride sites should be selected with this in mind, and the design of the park-and-ride facility should provide a convenient, effective interface with transit.
- Park-and-ride facilities have inherent security and public safety problems. They are often in insolated, remote locations. It is clear that the cars parked there will be unattended for most of the day, and then their owners will be returning late in the day often after dark.

Transit Amenities

The design of the facility should consider the needs of the transit user and the transit operator. These needs are as follows:

User Needs

1. A comfortable, secure, well-lit place to wait for the transit vehicle that affords protection from the weather. This can range from a simple shelter to a full covered or enclosed transit station.
2. The availability of transit service information regarding the route(s) of the service, the destinations served, the schedules, the fares, and how to purchase a ticket or pay the fare. Besides the provision of static information in the form of information displays and maps, there is growing interest and use of electronic information systems which can provide users with real time information such as how long until the next transit vehicle will arrive.
3. Availability of a pay phone so users can call to obtain information, arrange for alternative travel should the transit service be delayed, or seek other assistance. An emergency phone or call box with a direct line to emergency services should also be considered.
4. The location of the transit stop should be as close as possible to the parking area.
5. An area should be provided for users to be picked-up and dropped off by another driver. This activity; called "kiss-and-ride" is very common. While dropping someone off only takes a few seconds, the act of picking someone up can involve waiting for some time in the parked car. The design should account for these needs.



Bus Stop Shelter in a Park-and-Ride Lot

6. Some individuals will walk to the site and others will ride bicycles. The design needs to include convenient walking routes to nearby streets and uses, and should include bicycle parking racks or lockers.
7. Restrooms are desirable where there will be large numbers of people, but only in situations where they can be properly maintained and kept safe and secure.

Transit Operator Needs

1. The facility should be designed so that transit vehicles can move quickly in and out, minimizing the time spent to access and egress the park-and-ride facility. Every minute wasted getting in and out of the facility adds to the expense of operating the service and discourages users from taking the service.
2. The facility should be designed to accommodate the number and type of transit vehicles that will use it. Some vehicles may just stop briefly to pick up or discharge passengers; while others may layover, allowing for the vehicle operator to take a break or for a new operator to take over.

Security and Safety

The security and safety of a park-and-ride facility can be greatly enhanced with some relatively simple precautions:

1. Design the facility to be as visible from the surrounding roads and land uses as possible; strive for openness in all aspects of the design.
2. Provide adequate lighting.
3. Provide a pay phone or preferably an emergency phone with a direct line to law enforcement personnel.
4. Arrange for periodic security checks by public or private law enforcement or security personnel.

By far the most effective security measure is to arrange for a compatible shared use on the park-and-ride site. Nothing deters potential wrongdoers more than the presence of other people. Examples of these uses would be a convenience store or snack shop, a newspaper stand, a flower stand, a non-profit activity such as a recycling center, or a formal use such as retail, commercial offices, or other similar uses.

Estimating Park-and-Ride Demand

The questions of whether or not to build a park-and-ride facility and what size to build, foster the need for a methodology for estimating the potential parking demand. This is a complex subject. Numerous techniques exist which offer varying levels of confidence in forecasting park-and-ride demand. In real life, the demand is a function of many different factors, only a few of which can be reasonably understood and quantified.

Most major urban areas now have regional travel demand models. These models which are usually established and maintained by the metropolitan planning organization (MPO) for the area provide forecasts of future travel demands on the area's street and highway system. Many of these models include the ability to forecast transit system ridership and park-and-ride demand. The ability of these models to accurately forecast demand varies and the results should be given a thorough critical review. A good way to validate the results coming from such a model is to conduct a few reality checks using currently available information. This approach can also be used to provide a ballpark estimate of park-and-ride demand in a case where an actual model is not available, or where the model isn't set up to produce park-and-ride demand.

The Market Capture Method

The answer to the question, "If you build a park-and-ride lot, will they come?" can be considered in relatively simple terms. If you place a park-and-ride lot in a given location then it is posed to capture a certain percentage of the travel market it will serve. For example if the site is located on an Interstate highway 10 miles east of downtown along an express bus route, then it is positioned to serve people traveling downtown. The most likely people who would park there would be those who desire to go downtown and who live close enough to the park-and-ride site to use it conveniently. This area is typically the area included in a half circle with a radius of five miles. The circle would be drawn on a map with its center on the park-and-ride site and positioned so the actual half circle is positioned in the direction furthest away from the downtown. The area of map enclosed by this circle is the "primary capture area" of the park-and-ride site, the area where most of the users will come from. This is because:

- Most users won't want to drive more than five miles to get to the park-and-ride site.
- Most users won't drive much out of their way to get there (this is the reason for the half-circle)

Once the primary capture area is drawn then the next step is to determine the number of people that live within the half circle. Again, this is information that can be obtained from the MPO or directly from U.S. Census data.

If your region has other park-and-ride lots you should pick one or more that are similar to your site in terms of distance from the downtown, the type and quality of transit service provided, the amount of congestion and delay that will be experienced. You would then calculate the primary capture area population for this site. Because it is an existing park-and-ride site you can determine how many cars currently park there, either from available records or from actual observation.

Then you may estimate the park-and-ride demand of your new site by:

1. Calculate the ratio of the number of cars parked at the existing site divided by the primary capture area population.
2. Divide the result of this ratio into the capture area population of your new site.
3. The result is an estimate of the demand at your new site in terms of the number of parking spaces needed.

It is best if possible to do this for a number of existing sites and calculate a range of demand. If there are no sites in your area or none that seem comparable, you would have to seek this information from other cities. It is important to find cities that are similar to yours in terms of total population, the size of the downtown (employment) and the availability of transit. This is a very crude demand estimation technique, but it will provide some basis for deciding if a site is likely to attract a reasonable amount of demand.

Summary/Further Information

There is a very strong relationship between transit and parking. Park-and-ride facilities allow commuters and other travelers to access transit and avoid the major congestion that is typical on the highways of many of our cities. These travelers also avoid paying for parking at their destination and by reducing their daily vehicle miles of travel they help to reduce air pollution and improve regional air quality. This chapter provides general guidelines as to the planning, location selection, and design of park-and-ride facilities.

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