REPORT NO. UMTA-VA-06-0042-78-1

Auto Restricted Zones [ARZ]

Background and Feasibility

Service and Methods Demonstration Program

Final Report
December 1977

Volume I.

U.S. DEPARTMENT OF TRANSPORTATION
Urban Mass Transportation Administration

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-VA-06-0042-78-1		

4. Title and Subtitle

Auto Restricted Zones
Background and Feasibility

5. Report Date
December 1977

6. Performing Organization Code

8. Performing Organization Report No.

7. Author(s)
William S. Herald

9. Performing Organization Name and Address

Alan M. Voorhees & Assoc., Inc.
7798 Old Springhouse Road
McLean, Virginia 22101

10. Work Unit No. (TRAIS)

11. Contract or Grant No.
DOT-TSC-1057

13. Type of Report and Period Covered
Final Report
July 75 - December 77

12. Sponsoring Agency Name and Address
U.S. Department of Transportation
Urban Mass Transportation Administration
Office of Transportation Management & Development
Washington, D.C. 20590

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report was prepared as part of the Auto Restricted Zone/Multi-User Vehicle Systems Study of the Service and Methods Demonstration Program of the Urban Mass Transportation Administration.

The purpose of the study is to (1) investigate existing experience with auto restricted zones and multi-user vehicle systems, (2) evaluate their feasibility as concepts applicable to urban transportation systems, (3) identify and evaluate potential sites for demonstration, and (4) design demonstration programs.

This volume examines the concept of auto restriction, investigates its application in both Europe and the U.S. Auto restricted zones were found to be feasible for application to U.S. cities, and a number of key factors were identified in their successful implementation.

17. Key Words	18. Distribution Statement
Auto Restricted Zones Feasibility Assessment, Pedestrian	Document is available to the U.S. public through the National Technical Information Service, Springfield, Va. 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

* U. S. GOVERNMENT PRINTING OFFICE : 1973 725-504/328

AUTO RESTRICTED ZONE/ MULTI-USER VEHICLE SYSTEM STUDY

DOT-TSC-1057

FINAL REPORT

VOLUME I

AUTO RESTRICTED ZONES: BACKGROUND AND FEASIBILITY

Prepared for
U.S. DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION

By
ALAN M. VOORHEES & ASSOCIATES, INC.
Westgate Research Park
7798 Old Springhouse Road
McLean, Virginia 22101

In Association With
CAMBRIDGE SYSTEMATICS INC.
and
MOORE-HEDER ARCHITECTS

December 1977

This report is prepared as part of the Auto Restricted Zone/Multi-User Vehicle System Study for the Urban Mass Transportation Administration of the U.S. Department of Transportation.

The purpose of the study was to (1) investigate existing experience with auto restricted zones and multi-user vehicle systems, (2) evaluate their feasibility as concepts applicable to urban transportation systems, (3) identify and evaluate potential sites for suitable demonstrated projects, and (4) design demonstration and evaluation programs for selected sites.

This particular report documents the investigation of existing experience and evaluation of key factors and overall feasibility of auto restricted zones. The complete listing of final report documents includes:

- Volume I — Auto Restricted Zones: Background and Feasibility
- Volume II — Multi-User Vehicle Systems: Feasibility Assessment
- Volume III — Auto Restricted Zones: Plans for Five Cities
- Volume IV — Demonstration Site Selection
- Boston Auto Restricted Zone: Technical Appendix
- Burlington Auto Restricted Zone: Technical Appendix
- Memphis Auto Restricted Zone: Technical Appendix
- Providence Auto Restricted Zone: Technical Appendix
- Tucson Auto Restricted Zone: Technical Appendix

Table of Contents

List of Tables, Continued

List of Figures

List of Tables

EXECUTIVE SUMMARY

This volume reports on the first phase of the Auto Restricted Zone/Multi-User Vehicle System Study undertaken on behalf of the Urban Mass Transportation Administration of the United States Department of Transportation. The purpose of the study is to (1) investigate existing experience with auto restricted zones and multi-user vehicle systems, (2) evaluate their feasibility as concepts applicable to urban transportation systems, (3) identify and evaluate potential sites for suitable demonstration projects, and (4) design demonstration programs for selected sites. This particular report documents the investigation of existing experience, the evaluation of key factors and the overall feasibility of auto restricted zones.

The term "auto restricted zone" or ARZ can apply to almost any land area where vehicular travel is regulated, controlled or restricted in some manner. Thus, although we seldom think of it in this way, all of our urban areas are already functioning as ARZ's, for vehicular traffic is presently subject to a wide range of controls. The underlying characteristics of an ARZ as discussed in this study, then, is that of a district or zone distinguished by a higher degree of control over vehicular traffic than the surrounding area.

The justifications for the consideration of programs for the restraint of road traffic are based on the essential incompatibility of automobile traffic and human activity in urban centers. It is undeniable that the automobile has conferred unparalleled freedom of movement on the American people and that it is now and will remain a vital mode of transportation within urban areas; but it is also clear that the automobile's impact on the environment and requirements for valuable urban land can constrain human activities in densely developed urban areas. Thus the study investigated the potential contributions of auto restriction to the preservation and enhancement of urban vitality and overall environmental quality as well as to the utilization of non-auto modes of transportation.

A wide array of techniques for traffic restraint have been identified and categorized as physical, operational, economic, and regulatory control measures. Options range

from the complete closure of streets and the prohibition of all traffic to such measures as parking controls, area permits, turn restrictions and exclusive use lanes or streets. Within the focus of this study on physical and operational measures of restraint, the techniques identified are already in common use and are therefore familiar and available for immediate implementation.

The investigation of existing experience with ARZ focused on European cities where the concept is most advanced. Over 130 European cities have instituted some form of auto restriction, including such major cities as Copenhagen, Amsterdam, and Vienna. Among these European examples are many ARZ's that have succeeded in creating pedestrian circulation and public transport systems that are simultaneously functional and enjoyable elements of the city center. An array of characteristics and impacts of European auto restricted zones are identified and tabulated, covering such items as size, type of restriction, costs, merchant attitudes, and pedestrian volumes. Analysis of European success with ARZ shows that an environment favorable to traffic restraint exists in these cities as a result of a variety of physical, cultural, and economic characteristics.

In the United States, experience with the ARZ concept has been more limited. Aside from special use districts, such as college campuses, parks, and amusement/recreation areas, experience with auto restricted zones in American cities has been confined to downtown pedestrian and transit malls. Although these malls are highly restricted, they are essentially one-dimensional commercial strips, offering few of the opportunities of their European counterparts. Among the reasons identified for this limited application of ARZ techniques in U.S. cities are the role and vitality of downtowns, the attractiveness of public transit services, and the patterns of ownership and use of personal automobiles.

Analysis of both European and American experience with auto restricted zones has led to the identification of a number of key factors in their success. Foremost of these are area levels of activity and accessibility. Clearly the reduction in traffic is motivated by a desire to use areas formerly dominated by auto traffic for other purposes. Without sufficient downtown activity to generate street life and vitality in these areas, a vacuum of dead urban space would develop. Thus

areas considered for ARZ treatment must be active places with a mix of residences, employment, shopping, eating and entertainment opportunities concentrated within walking range. The important dimensions of accessibility are access to and within the auto restricted zone. Regional transportation linkages for all modes must be maintained or improved to attract more activity to the ARZ. Within the restricted area itself, a carefully planned circulation network, including a functional and pleasant pedestrian circulation element, is critical to the maximum utilization of area resources.

The investigation into the background and feasibility of auto restricted zones indicated that there are substantial opportunities for ARZ in American cities. Among other conclusions:

- City size is not critical to ARZ success.
- A strong activity base is required.
- Complete prohibition of traffic is not the only option.
- ARZ size determines transportation impacts.
- Accessibility must be maintained.

Analysis of two ARZ prototypes indicates that impacts on travel time will have primary effect on discretionary shopping trips. Thus, significant increases in the attractiveness of the area may be necessary to counter the additional impedance of such ARZ impacts as a slightly longer walk to the point of final destination. Severe restrictive measures, such as the complete prohibition of auto traffic over a wide area, must be fully balanced by compensating improvements in transit level of service if area attractiveness and activities are to remain downtown in the long term.

Chapter I
Introduction

CHAPTER I
INTRODUCTION

Over a period of some 70 years, the automobile and its attendant facilities have become increasingly significant factors in our society, both for the positive benefits and opportunities provided as well as the negative impacts imposed. The automobile is certain to continue to play a dominant role in the functions of society if for no other reason than the level of investment, both present and planned, which is directly and indirectly tied to it. To suggest a major reversal in direction for the auto-oriented society of today does not address the realities of a free social order and the constraints that it represents.

During recent years, however, attention and resources have increasingly been directed away from the expansive highway programs of past decades and into efforts to achieve a more balanced transportation system through more effective utilization of existing elements of the system. Principal factors contributing to this change include increasing economic constraints, a recognized need for energy conservation, and concern over environmental and social issues coupled with a realization that the continued provision of new facilities could not keep pace with demand within the level of physical, economic, social, and environmental impacts which people are presently willing to accept.

The continuous increase in the number and usage of automobiles coupled with an increasing awareness by society of the implications of public policy have elevated the negative impacts on the urban environment attributed to the automobile to prominence in the thinking and action processes of society. Policies, which in the past have provided ever-increasing facilities to better serve traffic and which in turn have shaped the basic structure of the urban environment to the needs of the automobile, are no longer taken as given. A number of cities are following a course pioneered by San Francisco and other cities where additional freeway construction within the city has been halted, and alternative means of addressing transportation requirements are being instituted. Concern over environmental issues and energy consumption has increasingly challenged the unrestrained role of the automobile,

consumption has increasingly challenged the unrestrained role of the automobile, particularly in dense urban areas where the associated impacts are most intense.

The emphasis of funding programs related to transportation are being directed toward programs to improve the utilization of existing facilities through better traffic management and improved service and utilization of mass transit. The U.S. Department of Transportation has designated Transportation Systems Management (TSM) as the statutorally required short-range element of the continuing multimodal regional transportation planning process. Federal support for TSM represents a concern for finding a more cost-effective means of improving transportation-related conditions in the urban environment. Management strategies based upon low-cost solutions which capitalize on the potential of the existing transportation infrastructure through the efficient operation of urban transportation systems are certain to receive increasing attention.

An increasing amount of redevelopment and new construction of commercial, industrial, and residential areas are designed to exclude or restrict traffic within specified areas in order to minimize the evident incompatibility of traffic with human activities and its effect on the quality of the urban environment. Commercial super block redevelopment, suburban shopping malls, new town residential areas, recreation and amusement parks, and college campuses are indicative of efforts to restrict traffic, either totally or partially, within particular areas and thereby provide opportunities to enhance the environmental quality. As more and more of these types of areas have developed, the obvious benefits they offer in terms of environmental quality and overall attractiveness have become increasingly evident, particularly when compared to areas where the automobile continues to assume a dominant position in its effect on the environment, disproportionate to its functional role.

In recent years, increasing interest and attention has been directed toward the preservation and enhancement of existing urban centers. The potential rise or decline of center city areas is an intricate maze of cause and effect relationships which preclude the identification of simple remedial actions. The deterioration of downtown areas experienced in most U.S. cities is closely related to a series

of public policies instituted during the three decades following World War II. Housing policies responding to public demand encouraged single-family development in outlying areas and were reinforced by highway programs which provided extensive road networks in suburban areas.

The rapid development of the outlying areas was partially at the expense of the urban centers. The desirability of low-density suburban housing resulted in a corresponding decline in demand for urban housing. Across the country, cities evolved into concentrations of low-income residents surrounded by wealthy suburbs. The resulting dilution of the CBD retail markets led to the migration of business to the suburbs and the consequent deterioration of the CBD economic base.

Recent years have evidenced some shift from further development of outlying areas to more dense development of existing areas. In the case of center city areas, the poor quality of the environment is commonly recognized as a serious impediment to potential opportunities for revitalization. In an effort to enhance existing attributes and improve the deteriorated image of the center city, an active program to improve the urban environment is essential. Such an effort is seen as a first step in providing the catalytic force required to generate other development programs and actions.

This present study addresses the issue of improving the urban environment of center cities by reducing the impacts of the automobile and encouraging the use of transit while at the same time providing better pedestrian facilities and urban design features.

WHAT IS AN AUTO RESTRICTED ZONE?

An Auto Restricted Zone (ARZ) most simply defined is a geographic area in which one or more factors place limitations upon vehicular traffic. The concept of restricting traffic is not new. Traffic has always been subjected to a variety of controls which have, in fact, become increasingly restrictive over time. European cities have made significant advances toward restricting traffic within segments of their urban centers. On a generally more limited scale, the downtown malls

built in U.S. cities during the last decade created auto restricted zones. Traffic operation measures such as turn prohibitions, parking restrictions, preferential lanes for transit, and circulation and access controls are techniques in common use which place restrictions on traffic. Many elements of the management strategies being developed as part of TSM programs will include additional controls and restrictions on traffic as a means of achieving more cost-effective urban transportation systems.

A review of existing information and experience showed a wide variation of concepts and applications of what are referred to as "auto restricted zones." In an effort to define and categorize the general concept of an ARZ beyond that of "an area in which vehicular traffic is prohibited or restricted," alternative ARZ approaches, based upon the type, density, and structure of existing land uses, were defined. These alternative approaches are identified and characterized in Table 1.

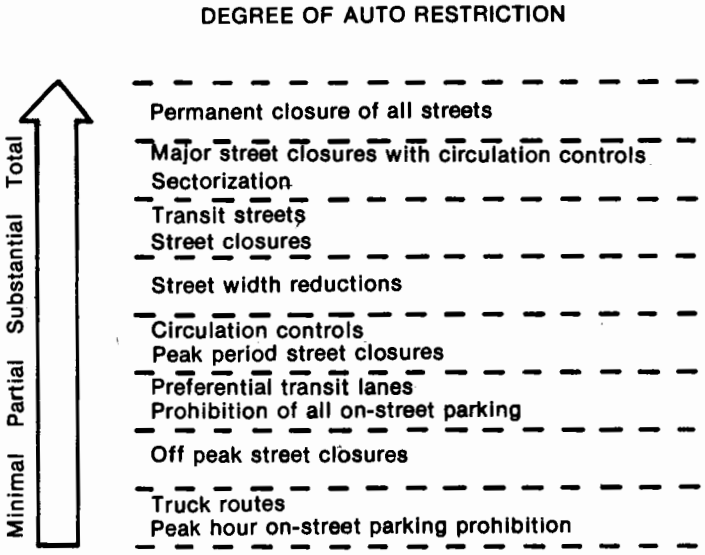
Because of the evident wide range of goals, associated problems and many types of land use situations for which ARZ's have been advanced, the scope of the current study was directed to the downtown center city area. It was felt that the urban center is the place of greatest potential as well as need for the particular objectives of the demonstration program.

Current interest in the creation of Auto Restricted Zones in urban centers represents an effort to move one step beyond present programs, which have tended to be somewhat piecemeal in nature, and address the issue of environmental improvements and traffic restriction in a coordinated and comprehensive way over a major segment of a city center.

In its broadest context, the degree of restriction which can be instituted varies over a wide range of opportunities for which an area ban of on-street parking represents a minimal degree of restriction, and total exclusion of autos or the creation of "auto free zones" represents the most restrictive situations.

Table 1. General Characteristics Of Alternative ARZ Approaches

Alternative ARZ Approaches	Common Goal	Associated Land Uses	Geographic Area of Application	Operation
Retail-Centered Pedestrian Mall	Increase retail sales; make downtown CBD competitive with suburban shopping centers	Central business district (CBD) retail stores	Generally one to five blocks long, often with intersecting streets	Auto traffic usually totally excluded; access for emergency and service vehicles maintained; pedestrian movement is emphasized; landscaping and special events and activities
Retail-Centered Bus Malls	Increase retail sales; make downtown CBD competive with suburban shopping centers	Central business district retail stores	Usually longer than pedestrian malls, up to ten blocks	Similar to retail-centered pedestrian malls but bus lanes included
Office Districts	Provide visual and user amenities for employees and visitors	Office buildings, CBD or office parks; smaller employee-oriented retail uses may front an area	One or two block square area	All traffic excluded; parking, service, and emergency access to buildings in other locations; second level or underground areas are common
Mixed Use Development Cells	Provide visual and user amenities for range of land uses found in MUD or PUD	Mix of uses—office, residential, retail, hotel, hospital, or other institutions; usually quite high density node of new development	One to four or five square block area	Pedestrian connections and plazas among buildings; parking service and emergency accessibility carefully planned and built in; second level or underground areas are common
Residential Cells	Provide access for local traffic while preventing through traffic penetration	Residential often low to moderate density	Variable size and shape	Provide access to local and service traffic; prevent access by through traffic, movement and/or parking
Historic Cells	Preserve integrity and amenity of historic district or area	Any land uses—residential, retail, office, old factory—which have been judged to be of historic significance	Variable size and shape	Total or partial traffic restriction; provide access to local and service traffic; prevent access by through traffic—movement and/or parking
University Cells	Reduce student-vehicle conflict; provide pleasing environment	Classroom and dormitory buildings; open space	Variable size and shape	Total or partial traffic restrictions; provide access to local and service traffic; prevent penetration by through traffic
Recreation Cells	Prevent vehicular intrusion on recreational activities	Parks and open space	Variable size and shape	Total or partial traffic restriction; provide vehicular access to but not within area
Entertainment Cells	Reduce vehicular-pedestrian conflict; improve environment	Night clubs; rides and games	One to three streets long or a few block square area; variable size and shape	Total or partial traffic restriction; often variable with time of day
City Cordon or Sectors	Prevent circulation of traffic between identified cordons	Variable—any city land uses	Linear and/or cross streets in CBD or larger area	Buses usually permitted to circulate between cordons; other vehicular traffic has access only from outer side of sector
Unique Land Use Mix Cells	Preserve integrity and unique flavor of area	Residential, retail, office, entertainment, and other; some may be historic or tourist attraction	Variable size and shape	Total or partial traffic restrictions; may vary by area or time of day; public transit may often be permitted



The nature of the restrictions or the measures utilized are as variable as their degree of application. They can be grouped into four basic categories:

- Physical measures — which utilize design, engineering, and physical layout to control traffic
- Operational measures — which utilize signs, signals, or mechanical devices to control traffic
- Regulatory measures — which utilize enforcement of regulations and guidelines to control traffic
- Economic measures — which utilize monetary disincentives such as tools to limit traffic

This fourth category, economic measures, includes some of the most innovative traffic restraint techniques. The Singapore area licensing scheme, which requires the purchase of a license for the use of an auto in the central city during certain hours of the day, has achieved significant results. Not only has the area licensing scheme increased the use of transit and ride-sharing, but its limited daily hours have also served to spread the former peak-hour traffic over a longer period, thus reducing congestion. Other economic measures to restrict traffic include congestion pricing and parking taxes or surcharges. All of these economic measures, as well as other monetary disincentives to auto use, are being investigated in

July 10, 1987

John Richeson, Chairman
New Services Review Board

S. T. Parry ORIGINAL SIGNED STEPHEN T. PARRY

DRAFT FEASIBILITY REPORTS -
BUS INTERCEPT PROGRAM & PERIPHERAL PARKING PLAN

Attached for your information are two reports: 1) the Proposed Los Angeles Central Business District Bus Intercept Program; and 2) the Feasibility Assessment of District's Role in Downtown Los Angeles Peripheral Parking Plan. These reports address alternatives for improving bus operations in downtown Los Angeles as outlined in Element 14 of the General Manager's Performance Action Plan.

The peripheral parking report evaluates the District's ability to utilize existing capacity to accommodate added commuters from the peripheral parking program developed by the Los Angeles Community Redevelopment Agency (CRA) and the City of Los Angeles Department of Transportation (LADOT). The bus intercept report is a feasibility study which involves developing a downtown shuttle bus network to distribute passengers transferring from regional bus lines terminating at the edge of the city.

I would appreciate any comments you may have concerning these reports and their status within the next month. A final draft will be prepared for distribution among interested parties and agencies and will reflect your recommendations.

cc: A. Perdon
M. Butler
R. Korach
A. Leahy
L. Bailey

CS:ad
SRPN 51, 1.18
7/10/87 Fri

separate research efforts, notably the UMTA Congestion Pricing Project currently in progress. In order to avoid duplication of effort, the scope of the ARZ Study reported on here, was confined to the categories of physical, operational, and regulatory measures.

The Auto Restricted Zones concept cannot be clearly categorized into a group of standard units to be uniformly matched to existing real-life situations. Urban areas are unique, constituting conglomerations of special situations which must be dealt with on a site specific, condition specific basis. Auto restriction policies must be tailored to local area conditions in coordination with existing policies and objectives to solve specific local problems and provide opportunities for environmental enhancement.

OBJECTIVES OF AN ARZ

Within the highly auto-oriented society in which we function, the concept of placing increasing restrictions on automobile traffic is viable only if there are corresponding benefits. These benefits serve as tradeoffs to what people perceive as the disbenefits, both real and imaginary, associated with any change, particularly with respect to an individual's mobility.

The same person who accepts and easily adapts to the concept of auto restriction as he encounters it in new construction or redevelopment areas and, in fact, admires the level of environmental quality which has been achieved, is likely to voice strong reservations about the implementation of similar concepts in areas in which he is presently accustomed to using his automobile. It is clear that, whether real or perceived, the issue of implementing auto restriction policies is particularly sensitive to the associated benefits and disbenefits, and that in sum, the elements of the program must produce significant positive impacts if the policies are to warrant serious consideration and public support.

The goals and objectives of ARZ concepts are distinct for different types of areas. Since the current study is directed primarily toward center city areas where the need is most apparent and the potential most promising, the goals and objectives

identified are appropriate to a CBD situation. Clearly, the same concepts applied to a residential, commercial, or other areas would achieve somewhat different objectives, both in content and emphasis.

The primary goal of instituting ARZ policies in designated areas of the CBD is to add impetus to the preservation, enhancement, and revitaliztaion of established urban centers and to emphasize the role of transit as the most efficient mode of access to and within the center city. The specific goals related to implementation of ARZ policies are identified as the following:

- To preserve and enhance the vitality of urban centers
- To improve the environmental quality in urban centers
- To encourage the utilization of non-auto modes of transport

Improvements in the environmental quality of CBD areas through reduction of traffic impacts, improved urban design features, and better pedestrian facilities can be used to protect and preserve existing attributes and encourage revitalization measures which can alter the image of the center city. The CBD represents the best transit market, and efforts to preserve and enhance this area will reinforce this market and broaden the base from which increases in transit usage can be realized.

It would be overly optimistic to suggest that efforts to reduce the impacts of traffic, increase transit usage, improve pedestrian circulation, and improve the environmental quality of the area are adequate in themselves to reverse the general decline experienced by many city centers during the past three decades. There are a number of other significant factors which have equal or greater impact on the vitlity and potential for city centers. Redevelopment policies, market potential, retail sales, public and private investment, image, and function are issues that can have major significance in determining the future role of city centers. The form and dynamic nature of CBD activity is the combined result of many individual forces of which the environment and transport are significant components.

The strongest downtown areas thrive in spite of the negative impacts of auto traffic and a poor environment. In the weakest downtown areas, major emphasis on

the environment, transit, and traffic is not likely to have significant effect by itself. It is in those numerous city centers in the middle of this spectrum that improvements in environmental quality and transit service, coupled with reductions in the negative impacts of automobile traffic, produce the highest potential for achieving the goals and objectives of ARZ policies.

The level of effectiveness which ARZ concepts can realize in addressing these goals is the measure to which they can achieve positive results in a number of specific objective areas related to ARZ planning. These objectives are grouped into the following four general categories:

- Transportation factors
- Social factors
- Economic factors
- Functional and physical factors

Within each of these categories are a number of specific objectives which are impacted to ARZ techniques and which, in turn, address the broad goals previously stated. The specific objectives related to each category are identified as follows:

- Transportation factors
  - Reduce congestion on streets
  - Reduce travel times
  - Maintain accessibility
  - Improve transit services
  - Maintain service to goods movement
  - Encourage shift to non-auto travel modes
  - Reduce parking requirements
  - Reduce energy requirements
  - Reduce accidents
- Economic factors
  - Stimulate market potential
  - Encourage private investment
  - Enhance tax base structure
  - Minimize public service costs
  - Reduce roadway construction and maintenance costs
- Social factors
  - Create perceptible improvements in the environment
  - Stimulate community cohesion

- Improve perception of personal security
- Increase public use of areas

- Functional and Physical factors
  - Stimulate mutually reinforcing mix of facilities and activities
  - Enhance pedestrian space
  - Encourage re-use and preservation of physical resources
  - Encourage a diversity of activities
  - Improve air, noise, and visual qualities

The degree to which ARZ policies are able to attain these objectives is subject to a number of factors, some only indirectly related to ARZ planning concepts. These elements, however, can serve as catalysts and as an impetus for a direction and commitment to maintain and enhance city centers. Thus, auto restriction will probably be most effective if it is implemented as one part of a comprehensive set of policies and programs intended to increase the vitality of the area.

Chapter II
ARZ Techniques

CHAPTER II
ARZ TECHNIQUES

From observation of existing applications in both European and North American situations, it is evident that Auto Restricted Zones have evolved in a variety of ways, shapes, and sizes. The unique character of an ARZ in a specific location within a city requires an implementation plan and program tailored to the needs and constraints of the particular situation. While a large number of alternative techniques can be identified, some are appropriate only for certain types of auto restricted zones; others are appropriate only in certain geographic or institutional circumstances. Following are a number of general techniques which are commonly employed:

- Traffic restriction — The higher degrees of auto restriction are realized through circulation controls with only limited interference to basic access.
- Traffic diversion — Provision is made to divert through traffic out of the area and local traffic around the area.
- Transit service — Concerted efforts are made to provide a high level of transit service to and within the area to serve as an attractive alternative mode.
- Pedestrianization — Provisions are made for providing and upgrading pedestrian facilities and linkages between facilities.

Technqiues which are used to supplement auto restriction once it has been achieved include:

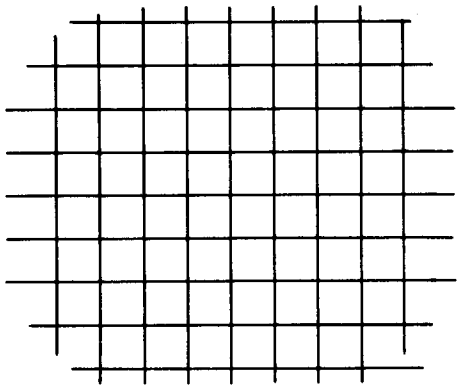
- Urban activity — programs and events which provide cultural, social, and recreational activities within the zone.
- Urban design — features which make the area more attractive, easier for people to maintain orientation, and re-use spaces for pedestrian scale activities.

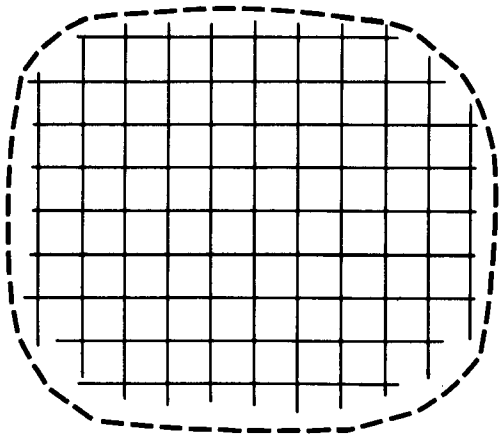
BASIC ELEMENTS OF AN ARZ

Recognizing the unique character of individual ARZ's, the following scenario was developed to illustrate the manner in which basic elements of an ARZ are interrelated to define a comprehensive ARZ scheme.

Basic Street Element

The street network illustrated is a grid system representative of many North American street patterns. Other types of patterns include radial, irregular, and discontinuous patterns.



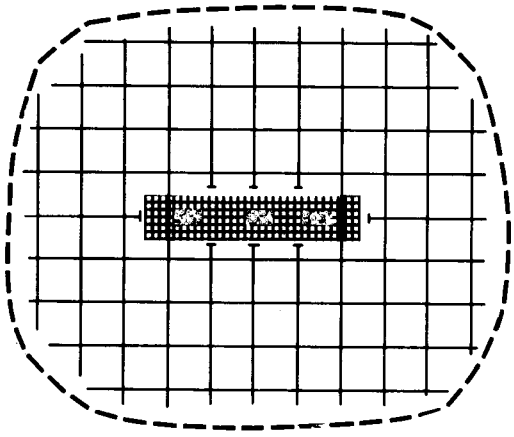


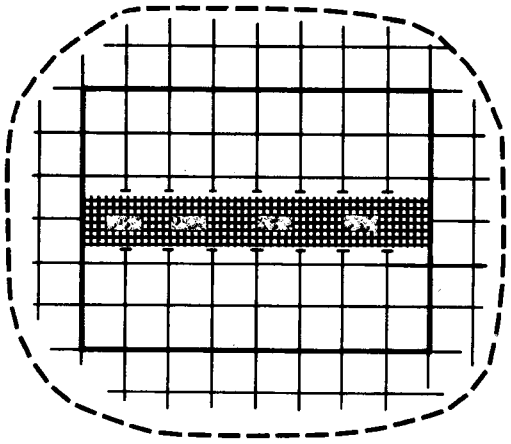
Outer Diversion Element

Alternative facilities are required for traffic presently passing through the central area, but with neither origin or destination within it. Facilities for the diversion of through trips can be an expressway loop, but need not necessarily be that substantial. The designation of major arterial streets or identification of selected existing bypass routes may serve equally well. The location of such facilities may or may not be in close proximity to the central area.

Initial Core Element

An initial core element is identified typically taking the form of a pedestrian mall, transit mall, or some type of features which de-emphasize the automobile and emphasize transit/pedestrian accomodation. Variations may include linear or two-dimensional characteristics and singular or multiple elements. Features typically include improved pedestrian facilities and urban design features, some street closures, and improvements in transit service.



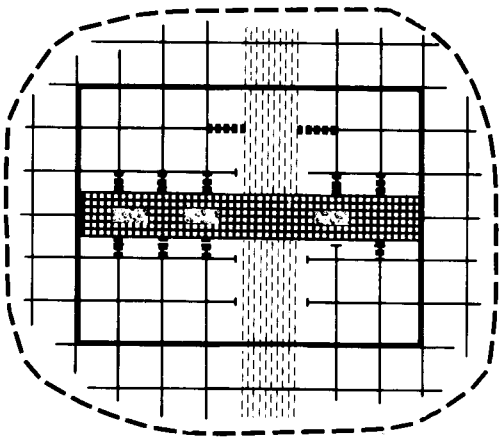


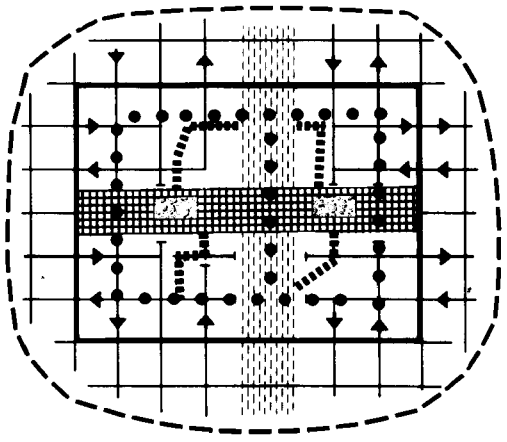
Inner Circulation Element

An inner circulation system is established to serve local area trips required to move about the area. Its purpose is to serve a basic circulation function for the immediate area. The system can be a one-way loop or a one-way couplet utilizing selected existing streets and often requiring some traffic operation improvement measures. Other features would include additional street closures and reinforcement of pedestrian facilities and transit preference measures.

Expanded Core Element

The core element(s) is expanded to a multi-directional system. The nature of the secondary element may be a pedestrian mall, transit mall, transit preference, or non-auto oriented streets. Features would include additional street closures and circulation controls, re-use of selected street segments, initial linkages of a pedestrian network, additional urban design improvements, significant reduction in automobile impacts, and major effort to improve transit service and image.





Reinforcing Element

Supportive measures are taken to reinforce commitment to ARZ concepts. Internal circulation elements include expansion of pedestrian linkages, possible local area shuttle/tram/people-mover system and additional street closures and circulation controls. Urban design and activity measures, coupled with improvements in environmental quality, can be used to enhance the intrinsic attractiveness of the area and provide the necessary inducement to stimulate efforts toward revitalization of the central area. Transit programs are developed to provide a level of service competitive to the automobile.

While the nature of the end product and the emphasis placed upon particular elements are subject to substantial variation from the above scenario, the issues addressed and techniques employed are conceptually representative of most ARZ applications. Figure 1 illustrates a range of the different types of ARZ development which might occur from a variation of emphasis on specific ARZ techniques. Starting with a basic grid system with an existing shopping mall and selected parks, open spaces and other public areas, four distinct ARZ plans are illustrated which reflect in turn a pedestrian emphasis, transit emphasis, arterial preference emphasis and traffic operations emphasis. The development of auto-restricted zones has been more evolutionary than revolutionary in nature. As such, ARZ's tend to be shaped over a period of time by the continuous implementation of specific measures which better accommodate pedestrian and transit travel and provide increasing disincentives to the use of the private automobile.

ARZ IMPLEMENTATION MEASURES

Once the fundamental policy issues are resolved, the implementation is realized through a series of individual actions which, in concert, constitute an ARZ. Restricting the movement and placement of automobiles within an area is realized through a series of auto control measures which fall into the following four basic categories detailed in Table 2.

Physical Measures

Physical measures are defined as those actions which depend upon design, engineering, and physical layout to control traffic movement and parking. The specific techniques grouped under physical measures range from the simple action of a street barricade, such as placing a wooden saw horse across the entrance to a street, to a ring road/bypass, which constitutes a major planning, design, and construction project. Of the many types of auto control techniques, the ten physical measures are probably the most generally used, although sometimes for other purposes in cities and towns of all types and sizes.

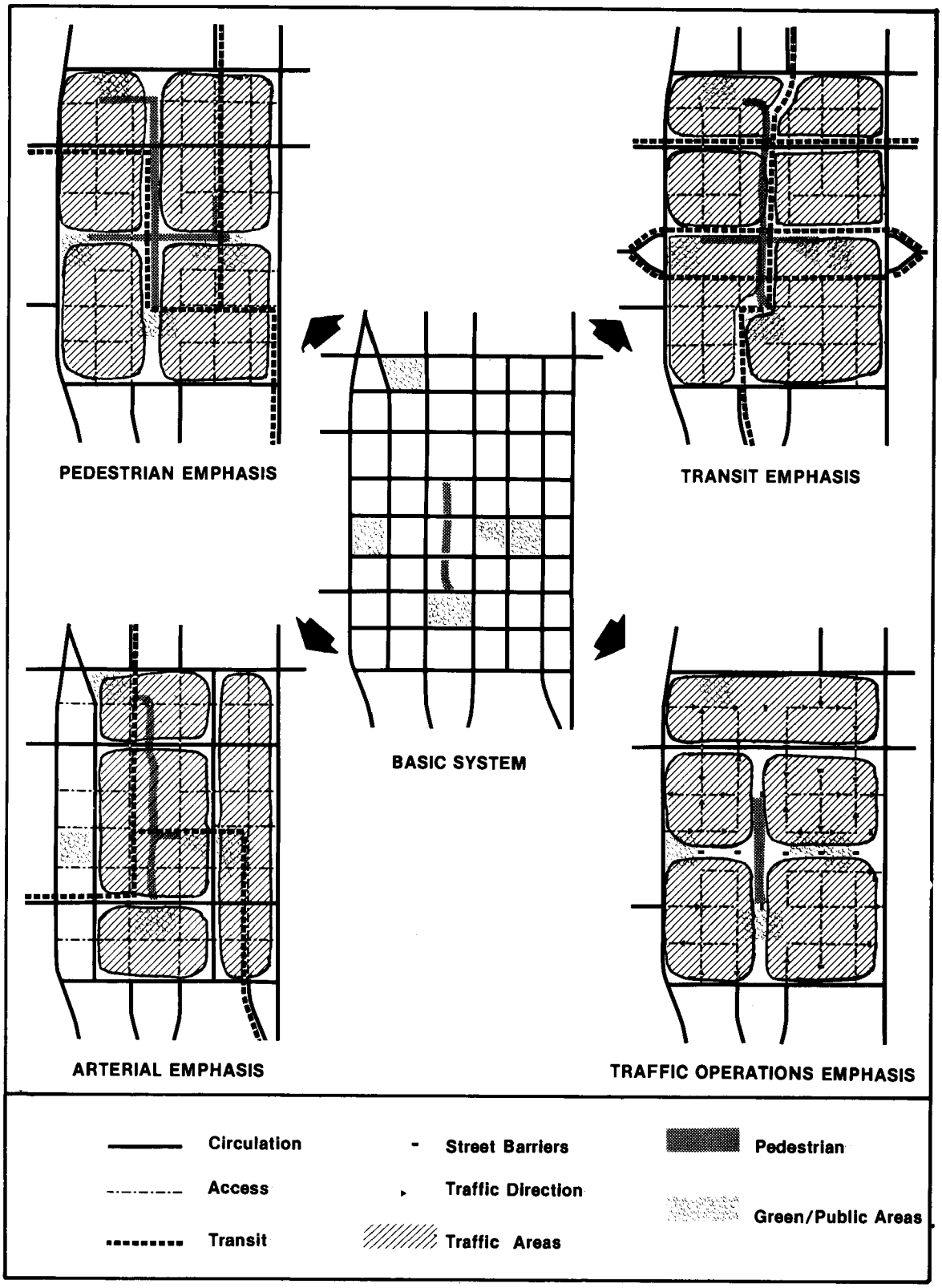


Figure 1
ARZ Variations

Table 2
ARZ Auto Control Implementation Measures

I. PHYSICAL MEASURES • Street closing • Street barricade • Street width reduction • Low design speeds • Cul-de-sacs • Placement of parking facilities • Number of parking spaces • Ring road/bypass • Medians	III. REGULATORY MEASURES • Area permits • Loading/unloading • Parking restrictions • Vehicular regulations • Staggered work hours • Land use regulation • Regulation of ownership
II. OPERATIONAL MEASURES • Signalization systems • Ramp meters • Variable route signing • Turn restrictions • Special use lanes/ streets • One-way streets	IV. ECONOMIC MEASURES • Area license • Parking price/tax • Tolls • Congestion pricing • Fuel tax • Gas rationing

Unless special provisions are made, physical measures, due to their permanent nature, affect most types of vehicular trips in the same manner. Different socio-economic groups are also affected equally. Although somewhat inflexible, physical measures are probably the most effective way to control vehicular movement and parking. Once in place, they generally present few administrative or enforcement problems. The public understanding and acceptance of many of the physical measures is usually quite high due to current, widespread use.

Operational Measures

Operational measures are those which depend upon mechanical devices to control traffic movement and parking. The four major techniques grouped under this category rely on the existing technology of traffic signals and signs. Operational measures tend to control the movement of traffic once it is on the existing road, rather than discouraging the generation or destination of traffic.

Operational measures are flexible in their application. Different types of vehicles can be selectively controlled as for example, signing for a truck route. Operational measures are also quite easily changeable by time of day or other time periods. While operational measures such as stop signs, traffic signals, and others are now institutionalized by criminal penalities for disobedience, other measures such as no parking zones require the constant vigilance of the police. The measures directly related to safety, such as stop signs, traffic signals, and one-way street signs are self-enforcing to a degree because of the potential of accident for the violator.

Public understanding and acceptance of most operational measures exists. Ramp meters and variable route signing generally require some form of advance publicity for their optional operation. However, certain other operational measures, such as signing for restricted lane use, e.g., buses and carpools only, are still relatively new. Without either visible occupancy by permitted vehicles or constant enforcement, these newer measures tend to be violated by unknowing or uncaring drivers.

Regulatory Measures

Grouped in this class are a series of measures which have been proposed from time to time to regulate vehicular demand or to limit the use of an area to specific vehicles. Of these, loading and unloading restrictions are some of the more commonly used measures. In some cities, it takes the form of prohibiting all deliveries during certain hours of the day while in others the size of trucks is limited. In new developments, loading and unloading facilities are provided away from pedestrian areas and also away from streets and parking used by autos.

Staggered work hours have been used successfully in large cities (notably New York and Philadelphia) to reduce peak-hour travel. While it is not a form of auto restriction in the sense that fewer autos are allowed to travel, it does reduce pedestrian and transit conflicts with autos during peak periods and thereby achieves somewhat the same result. Also, since a large part of peak-hour pedestrian movement is made up of workers walking between their job site and parking, staggered hours can reduce crowding on pedestrian facilities.

Other regulatory measures include land use diversities and design controls, area permits, and even limitations on automobile ownership. The former are, of course, widely used and often the decisions are based on the traffic implications. However, as presently used in the United States land use controls usually only attempt to avoid intolerable congestion or the introduction of new traffic into low density neighborhoods.

Economic Measures

Economic measures are those which depend upon pricing and people's market responses to control the generation, movement, or placement of traffic.

While the focus of this study is not on economic measures, they are often closely interrelated with the other categories of control measures and will be dealt with briefly here. In fact, a comprehensive ARZ implementation program would probably include some form of economic measures.

Economic measures are an indirect form of auto control. They depend upon people's response to price to, in turn, control vehicles. For this reason, many of the economic measures are discriminatory for the lower socioeconomic groups. However, some pricing measures can be used selectively in terms of vehicle type and time of day. The potential for public acceptance of economic measures is probably the lowest of any of the categories of auto control. Legislative actions, local, state and even Federal will be required for implementation of some economic measures. For these reasons, the timing of implementation for economic measures is lengthy. Economic measures also require an extensive backdrop of administrative support and enforcement actions.

Table 3 identifies the effectiveness of the individual control measures cited previously relative to a number of trip categories by mode and purpose. These measures providing for the control and restriction of traffic can be coupled with a complementary program of alternate mode incentives to maintain mobility and accessibililty. With creative program of urban design features and activity functions, a program is created which can remold the image of the CBD and induce the commitment of other resources necessary for its enhancement and revitalization.

Table 3
Methods of Control by Mode and Trip Purpose

Types of Trips Which Contribute To Congestion			Physical Measures									Operational Measures				Economic Measures							Regulatory Measures								
			Street Closing	Street Barricade	One-Way Streets	Low Design Speeds	Cul-de-Sacs	Placement of Parking Facilities	Number of Parking Facilities	Ring Road Bypass	Medians	Signalization	Metering	Variable Route Signing	Signing	Area License	Parking Price	Congestion Pricing	Tolls	Fuel Tax	Mileage Tax	Gas Rationing	Regulate Ownership	Land Use — Density and Type	Staggered Work Hours	Vehicular Regulation	Loading/Unloading Restrictions	Parking Restrictions	Area Permits	Communications	Coordinated Home Goods Delivery
	Vehicular-Auto	Auto-Work — Alone	●	●	●	●	●	●	●	—	●	●	●	●	●	O	O	O	O	O	O	O	V	O	O	●	—	●	●	V	—
		Auto-Work — Pool	●	V/●	V/●	●	●	●	V/●	—	●	V/●	V/●	●	V/●	V/O	V/O	V/O	V/O	O	O	O	V	O	O	V/●	—	V/●	V/●	V	—
		Auto-Shop	●	●	●	●	●	●	V/●	—	●	●	●	●	●	V/O	V/O	O	O	O	O	O	V	O	—	●	—	V/●	V/●	V	—
		Auto-Recreation	●	●	●	●	●	●	●	●	●	●	●	●	●	V/O	V/O	O	O	O	O	O	V	O	—	●	—	●	●	V	—
		Auto-Medical	●	●	●	●	●	●	V/●	—	●	●	●	●	●	V/O	V/O	O	O	O	O	O	V	O	—	●	—	V/●	●	V	—
		Auto-Business	●	●	●	●	●	●	V/●	—	●	●	●	●	●	V/O	V/O	O	O	O	O	O	V	O	O	●	—	V/●	V/●	V	—
		Auto-Social	●	●	●	●	●	●	V/●	—	●	●	●	●	●	V/O	V/O	O	O	O	O	O	V	O	—	●	—	V/●	V/●	V	—
		Auto-School	●	●	●	●	●	●	V/●	—	●	●	●	●	●	V/O	V/O	O	O	O	O	O	V	O	O	●	—	V/●	V/●	V	—
		Auto-Across Zone	●	●	●	●	●	—	—	●	●	●	●	●	●	●	—	O	●	O	O	O	V	—	—	●	—	—	●	V	—
		Auto-Through City	●	●	●	●	●	—	—	●	●	●	●	●	●	●	—	O	●	O	O	O	V	—	—	●	—	—	●	V	—
		Auto-Resident	●	●	●	●	●	V/●	V/●	—	●	●	●	●	●	V/●	V/O	●	●	O	O	O	●	O	—	●	—	V/O	●	V	—
	Vehicular-Other	Transit Bus	V/●	V/●	V/●	●	●	—	—	●	●	V/●	V/●	●	V/●	—	—	—	—	O	O	O	—	O	O	—	—	—	—	V	—
		School Bus	●	V/●	V/●	●	●	—	—	●	●	V/●	V/●	●	V/●	—	—	—	—	O	O	O	—	O	—	—	—	—	—	V	—
		Taxi	V/●	V/●	V/●	●	●	—	—	●	●	V/●	V/●	●	V/●	V/●	—	●	V/●	●	●	●	V	O	—	●	●	—	V/●	V	—
		Truck-Local Delivery	V/●	V/●	●	●	●	—	—	●	●	●	V/●	●	●	V/●	—	●	●	●	●	●	—	O	—	●	●	—	V/●	V	●
		Truck-Across Zone	●	●	●	●	●	—	—	●	●	●	●	●	●	●	—	●	●	●	●	●	—	O	—	●	—	—	●	V	●
		Truck-Through City	●	●	●	●	●	—	—	●	●	●	●	●	●	●	—	●	●	●	●	●	—	—	—	●	—	—	●	V	—
		Emergency Vehicles	V/●	V/●	V/●	●	●	—	—	●	●	—	—	—	—	—	—	—	●	●	●	●	—	O	—	—	—	—	—	—	—
	Other Modes	Motorcycle	●	●	●	●	●	●	V/●	—	●	●	●	●	●	V/O	V/O	V/O	V/O	O	O	O	V	O	O	●	—	V/●	V/●	V	—
		Bicycle	V/●	V/●	V/●	●	●	●	V/●	—	●	V/●	V/●	●	V/●	V/O	—	—	V/O	—	—	—	V	O	O	●	—	V/●	V/●	V	—
		Walk-Work	—	—	—	—	●	—	—	—	●	V/●	—	—	V/●	—	—	—	—	—	—	—	—	O	O	—	—	—	—	V	—
		Walk-Shop, Recreation	—	—	—	—	●	—	—	—	●	V/●	—	—	V/●	—	—	—	—	—	—	—	—	O	—	—	—	—	—	V	—

● Direct effect — controls movement or storage of vehicle
O Indirect effect — influences incentives and demand for driving
V Variable effect — may or may not prohibit, depending on application
— No relationship between measure and type of trip

Chapter III
Existing Experience

CHAPTER III
EXISTING EXPERIENCE

The phrase "Auto Restricted Zones," or "ARZ's," has recently become increasingly common in the vernacular of the planning and transportation professions. While the terminology may be of recent vintage, the concept is not new. The historic cores of a number of European cities have always been restricted to cars. The best known example is the City of Venice. More recently, a number of major European cities have gradually instituted and expanded auto-free and auto-restricted areas in their historic cores. Munich and Nottingham typify situations where major actions have been taken over a relatively short period of time, while Stockholm and Vienna represent a more conservative, but similarly directed approach. Experience in the United States, while frequent in occurrence, has been more limited in scope. The downtown malls which have been built during the last two decades are typical of ARZ concepts as they have been applied in the U.S.

EXPERIENCE IN U.S. CITIES

At present, over 70 U.S. cities of varying sizes have instituted some form of auto restriction. The technique predominately utilized has been the closure of the downtown shopping street and its conversion to a pedestrian area with a high degree of emphasis placed upon improved urban design features. The Burdick Mall in Kalamazoo, Michigan, and the Fulton Mall in Fresno, California, typify this approach.

The primary purpose of these pedestrianization schemes in U.S. cities has traditionally been to enhance and revitalize the major retail shopping street in an effort to compete more effectively with developing suburban shopping centers and reverse a situation of declining retail sales for the downtown area. The traditional form has been a long linear element with only limited closure of selected streets transecting the mall. The results generally represent an effort to improve the pedestrian environment on a selected street with only a minimal effect on traffic.

Table 4 identifies selected characteristics for a sample of auto restricted zones which are fairly representative of U.S. situations.

An alternative approach which is lately receiving increasing emphasis is the conversion of the downtown shopping street to a transit mall. As part of the CBD plan to create a mall area, a principal shopping street is typically closed to automobiles, with transit vehicles (buses, taxis, and possibly light-rail vehicles) continuing to use the street. This scheme is generally characterized by widening of sidewalks and improved pedestrian facilities and urban design features. The Nicollet Mall in Minneapolis, Minnesota, is a typical example of this particular approach.

The reactions to the mall concept have been mixed, but the overall trend of continuing mall construction indicates that they are seen as an effective response to a need for which an alternative means of resolution has not been identified. The experiences and effects associated with each of the ARZ's identified in the previous table are presented in Table 5. From this sample, it is evident that merchants' attitudes are generally favorable, and retail sales have risen since completion of the mall. The amount of new construction which has occurred within the area is variable but significantly positive.

More recently, a number of cities have been moving toward a more comprehensive approach to traffic reorganization, transit emphasis, and environmental improvements. Boston, for example, has a number of completed projects which, when considered individually, have limited local impact. As their number increases, however, and linkages between individual elements are formed, a comprehensive picture begins to emerge. Figure 2 illustrates the extent of existing and proposed plans for auto-controlled areas in downtown Boston.

Portland, Oregon, is building the Fifth and Sixth Avenue Transit Mall. Harbor Drive has been removed from the Columbia River's edge and is to be replaced by a park. Major redevelopment within the CBD is free of normal traffic. A street classification system identifying an extensive network of streets within the CBD as non-auto-oriented facilities and an effective program for increasing transit usage plus other related actions form the nucleus of a program that is certain to restructure the

Table 4
Characteristics of U.S. ARZ's

Auto Restricted Zones U.S.A.	SIZE	TYPE of RESTRICTION	COST & FINANCING	ALTERNATE TRANSPORTATION
ALLENTOWN, PA. Hamilton Mall 1973	2400' length of major downtown retail st.	Roadbed narrowed to two lanes serving all traffic. Sidewalks widened.	Construction by City and State funds. Maintenance by assessment district.	
ATCHISON, KANS. 1963	2½ blocks of downtown retail street	Fully pedestrianized. Traffic on two cross streets.	$300,000 City funds.	
BURBANK, CA. Golden Mall 1968	6 blocks of downtown retail street; 80' wide	Fully pedestrianized.	$973,000 Bond issue, owner and merchant assessment.	Mini buses along the mall (have been discontinued).
DANVILLE, ILL. 1967	2 blocks of downtown retail street; 80' wide	Fully pedestrianized.	$112,000 City funds, owner and merchant voluntary subscription.	
FRESNO, CA. Fulton Mall 1964	2800' length of major downtown retail st.; 80' wide	Fully pedestrianized, including one-block length of three cross streets.	$1,841,000 77% city funds, 23% merchant assessment.	
HONOLULU, HA. Fort & Hotel St. 1969	1800' length of downtown mixed retail street; 50' wide	Transitway for buses. Two cross streets carry traffic. Three others dead end at mall.	$1,336,000 City funds and Special assessment.	
KALAMAZOO, MICH. Burdick Mall 1959	1200' length of downtown retail street; 66' wide	Fully pedestrianized. Traffic on two cross streets.	$120,000 City funds and Special assessment.	Excellent bus service on the two cross streets. Pedestrian train service on mall.
LOUISVILLE, KY. River City Mall 1973	3 blocks of major downtown retail street	Fully pedestrianized.	$1,500,000 City funds and Special assessment.	
MIAMI BEACH, FL. Lincoln Rd. Mall 1960	8 blocks of major retail street; 100' wide	Fully pedestrianized. Traffic on six cross streets.	$600,000 Bond issue.	Pedes-Train service on mall.
MINNEAPOLIS, MINN. Nicollet Mall 1968	8 blocks of major downtown retail street; 80' wide	Two-lane transitway for buses and cabs. Cross streets open to all traffic.	$3,875,000 Federal funds, Bond issue, Assessment.	Consolidation of bus routes into transitway - approx. 100 buses during peak periods.
OAKLAND, CA. Washington St. 1961	5 blocks of neighborhood shopping street; 100' wide	Sidewalk widening; all traffic allowed on one-way, two-lane roadbed.	City funds and Assessment.	
POMONA, CA. Pomona Mall 1962	3000' length of downtown retail street; 70' wide	Fully pedestrianized. Traffic on cross streets.	$640,000 Assessment and Bond issue.	Overabundance of parking around mall creates barrier for nearby walking population.
PROVIDENCE, R.I. Westminster Mall 1965	1000' length of downtown retail street	Fully pedestrianized. Traffic on cross streets.	$530,000 Federal grant, City funds, Assessment.	One of the cross streets is reserved for buses.
RIVERSIDE, CA. Main St. Mall 1966	4 blocks of downtown retail street 80' wide	Fully pedestrianized.	$720,000 Assessment.	
SALISBURY, MD. Downtown Plaza 1968	900' length of downtown mixed retail street 30' wide	Fully pedestrianized. Side street pedestrian plazas give additional depth.	$150,000 City funds and Assessment.	Traffic loop with peripheral parking garages.
WASHINGTON, D.C. F St. Mall 1966	2 blocks of downtown retail street 90' wide	Sidewalk widening. Narrowed roadbed serves all traffic.	HUD funds.	

Table 5
Impacts of U.S. ARZ's

ARZ Effects U.S.A.	MERCHANT'S ATTITUDES		RETAIL SALES		PEDESTRIAN VOLUMES	NEW CONSTRUCTION	SOURCES
	Before Construction	After Construction	During Construction	After Construction			
ALLENTOWN, PA. Hamilton Mall 1973	n.a.	n.a.	n.a.	n.a.		+ Extensive new development and renovation downtown.	Fulton Arcade Report
ATCHISON, KANS. 1963	n.a.	n.a.	n.a.	+ 25%		+ $4 million.	SOM Study Barton-Aschman Report "Building Downtown Malls"
BURBANK, CA. Golden Mall 1968	− Strong opposition.	+ Almost all in favor.	+ improved	+ 22%		+ Little new construction; lowest vacancy rate since 1939.	SOM Study Pittas Study Barton-Aschman Report
DANVILLE, ILL. 1967	+ Merchants main force behind mall.	+ Almost all in favor.	0 no loss	+ 10-19%		+ Remodelling, storefront improvements, expansions.	SOM Study Pittas Study "Building Downtown Malls"
FRESNO, CA. Fulton Mall 1964	+ Merchants main force behind mall.	+ Almost all in favor.	− some loss	+ 25% (+ 43% first 2 yrs)	+ 60%	+ $41 million. Some banks & hotels replacing retail.	SOM Study Pittas Study "Building Downtown Malls"
HONOLULU, HA. Fort & Hotel St. 1969	n.a.	+ Almost all in favor.	− 5-10%	+ 7-20%		+ New retail space added.	SOM Study Pittas Study Barton-Aschman Report
KALAMAZOO, MICH. Burdick Mall 1959	n.a.	n.a.	n.a.	+ 15%	+ 40%	+ $16 million. 84% of stores remodelled.	Barton-Aschman Report "Building Downtown Malls"
LOUISVILLE, KY. River City Mall 1973	+ Businessmen played major role in planning.	n.a.	n.a.	+ 15-25%		+ 2.5 million sq. ft. of new construction.	Fulton Arcade Report
MIAMI BEACH, FL. Lincoln Rd. Mall 1960	n.a.	n.a.	n.a.	+ 10-26%	+ 50%	n.a.	Barton-Aschman Report "Building Downtown Malls"
MINNEAPOLIS, MINN. Nicollet Mall 1968	+ Businessmen initiated mall proposal.	+ Great support.	+ gains up to 65%	+ 14-30%		+ $250 million directly adjacent or within ½ block.	SOM Study Pittas Study Barton-Aschman Report
OAKLAND, CA. Washington St. 1961	− Merchants opposed.	− Apathetic.	− some loss	+ up first few years, then level.		− Area slated for renewal. 3 blocks cleared; no new construction.	SOM Study Pittas Study
POMONA, CA. Pomona Mall 1962	+ Merchants main force behind mall.	+ Optimism waned, but returning.	− 10%	+ 16%	+ 73%	+ $7.7 million. Small stores closing, dept. stores expanding.	Pittas Study Barton-Aschman Report "Building Downtown Malls"
PROVIDENCE, R.I. Westminster Mall 1965	n.a.	+ Many in favor.	0 no loss	− 1.5% (- 20% rest of city.)		n.a.	SOM Study Pittas Study "Building Downtown Malls"
RIVERSIDE, CA. Main St. Mall 1966	+ Mostly in favor.	+ Almost all in favor.	− some loss	0 no losses (rest of city had losses)		+ Office and bank construction planned.	SOM Study Pittas Study
SALISBURY, MD. Downtown Plaza 1968	+ Merchants main force behind mall.	+ 100% happy.	0 no loss	+ up every year.		+ New businesses attracted.	Pittas Study Barton-Aschman Report
WASHINGTON, D.C. F St. Mall 1966	+ Most in favor.	+ Most in favor.	n.a.	+ 4.8% (- 5.4% rest of city.)	+ 23%	n.a.	Pittas Study HUD Study (1968)

1. GLC Study Tour:
   Greater London Council
   Pedestrianized Streets
   GLC, London. 1973.

2. OECD Proceedings:
   Organisation for Economic Cooperation and Development
   Better Towns With Less Traffic
   OECD Conference Proceedings, Paris. 1975.

3. OECD "Streets for People":
   Organisation for Economic Cooperation and Development
   Streets for People
   OECD, Paris. 1974.

4. SOM Study:
   Skidmore, Owings, and Merrill
   Survey of American and European Auto-Free Zones. 1975.

KEY TO SYMBOLS: + Positive − Negative

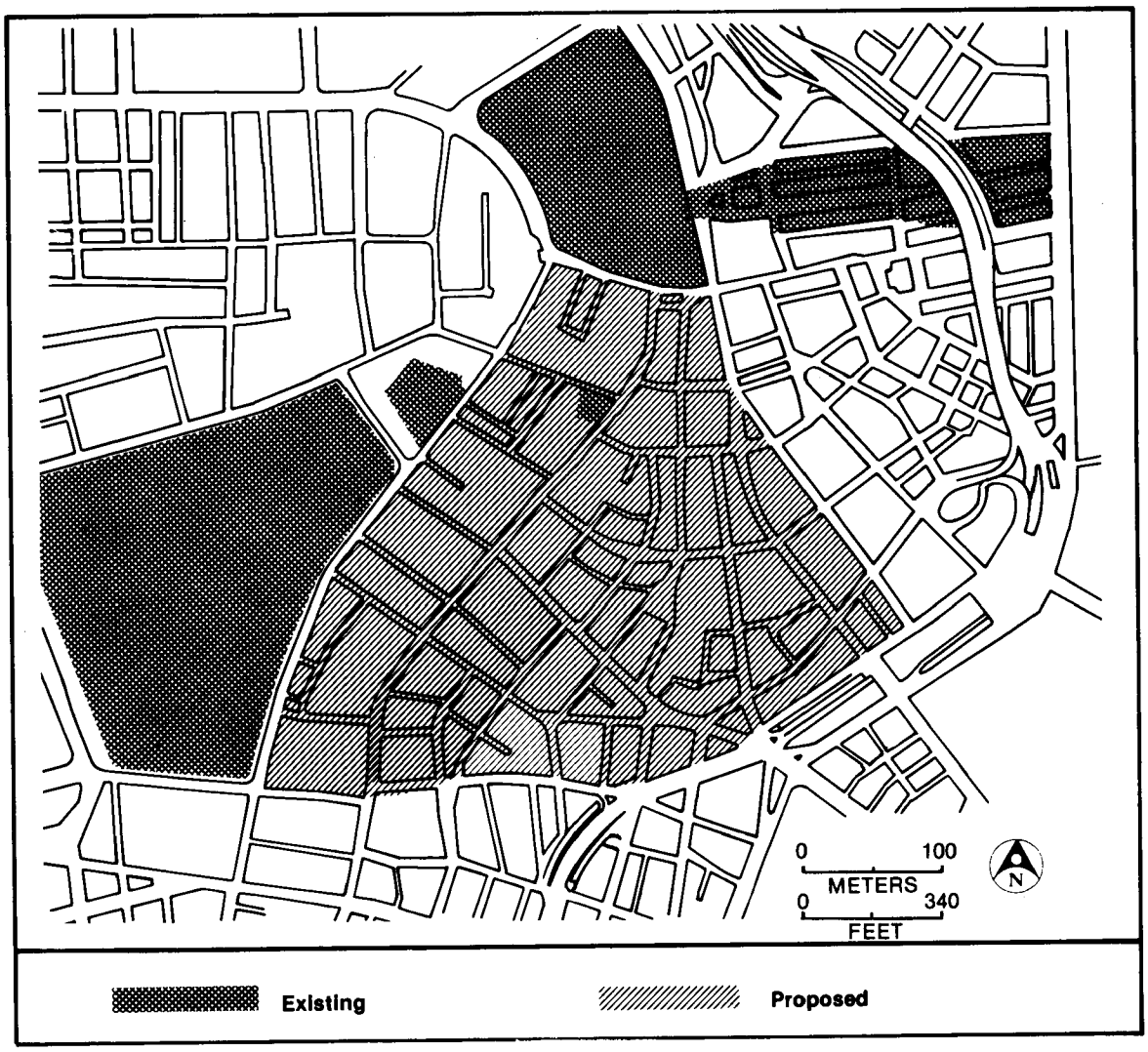


Figure 2
Areas Of Traffic Control — Boston, MA

balance among the auto, transit, and pedestrian within the CBD. Figure 3 illustrates how such individual elements when combined form a comprehensive program in downtown Portland.

Madison, Wisconsin, and San Francisco, California, have for some time been employing a variety of creative measures and actions which, in effect, de-emphasize automobile travel to the CBD, encourage the use of transit, and provide a better pedestrian environment in the downtown area. Such measures include strong support of transit systems, parking regulations, and carpooling incentives. These are but a few of a number of U.S. cities that are pursuing such programs. The next five years may see significantly increasing commitment as the effects of these measures become more evident and the benefits more obvious.

EUROPEAN EXPERIENCE

The concept of "auto restricted zones" takes on an added dimension within the European context in terms of numbers, physical size, and advanced level of implementation. Well over 130 cities have instituted some form of auto restriction. Most European cities have had pedestrian shopping streets for a number of years, examples include the Stroget in Copenhagen, the Kalverstratt in Amsterdam, and the Karntner Strasse in Vienna. A matrix of characteristics of pedestrian areas in a number of European cities is presented in Appendix B of this report. More recently, increasing attention has been directed toward a comprehensive approach to restructuring the balance between auto and non-auto modes within the central city. The history of auto restraint programs in a number of these cities exhibit somewhat similar patterns:

- The prosperity of the early 60's created a dramatic rise in automobile ownership which in turn produced a sharp increase in travel demand by private automobile to the central area where most essential functions continued to occur.
- The capacity of the historic city centers to accommodate the increased demand was severely limited with street congestion and parking shortages reaching intolerable levels.
- The initial response included building new and improved roadways, more parking facilities, and traffic operation measures to facilitate

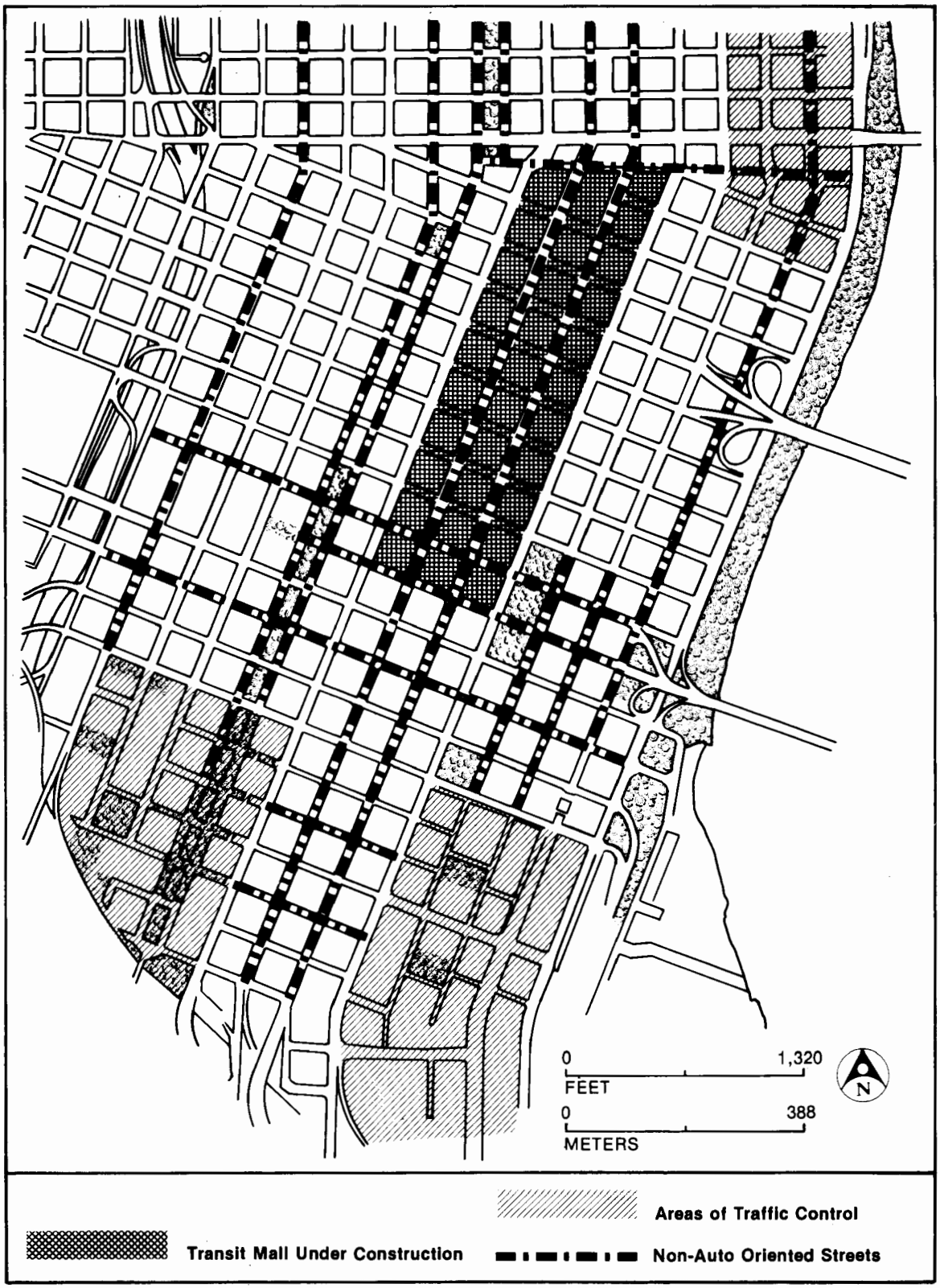


Figure 3
Areas Of Traffic Control — Portland, OR

the flow of traffic. Often, these measures had detrimental effects on other functions of public space.

- These programs proved to be costly both in terms of expenditures and the environmental, social, and political problems they created and could not keep pace with increasing demand.

- Simultaneously, environmental concerns about the noise, the air, the conflicts between pedestrians and vehicles, the deterioration of public transit services, and general decay of functionally and symbolically important parts of the historic center city area became popular issues.

- Initially, some historic shopping streets (where problems were the most intense and actual traffic-carrying functions minimal) were closed to traffic, often on an experimental basis. As popular support grew and the benefits became evident, the changes were made permanent.

- As the advantages and impacts of auto restraint became known, the scope of the program was broadened to eliminate through traffic from the city center. This was achieved in two basic ways: (1) the extension of pedestrian streets and the closure of cross streets until the core area was effectively divided into two or more separate traffic cells with few or no through connections as in Munich, Essen, Copenhagen, and (2) a more deliberate program to create such traffic cells by the use of one-way streets, "bus or tram only" streets, and street closings at key points as in Gothenburg, Nottingham, Bologna, and Bremen.

- A necessary complement to the restriction of traffic within the central area was improved traffic flow on what have been called inner ring or loop roads. These facilities served the diverted through traffic as well as providing access to the separate traffic cells. The ring road concept was costly and damaging where it did not already exist, and new effects to try and meet demand were scaled down to providing a basic level of circulation and access.

- Currently, a number of cities are shifting their attention to areas outside the central core. Restricted areas are being established by directing through traffic to major roads on the area periphery and not allowing it to filter through the area, while at the same time providing incentives for a shift to transit.

Figures 4 through 7 illustrate the approaches to auto restriction taken in several European cities. It is clear that the concept of auto restraint as developed within European cities no longer simply reroutes traffic, but actually discourages auto usage, as well as providing incentives for public transit. In order to maintain

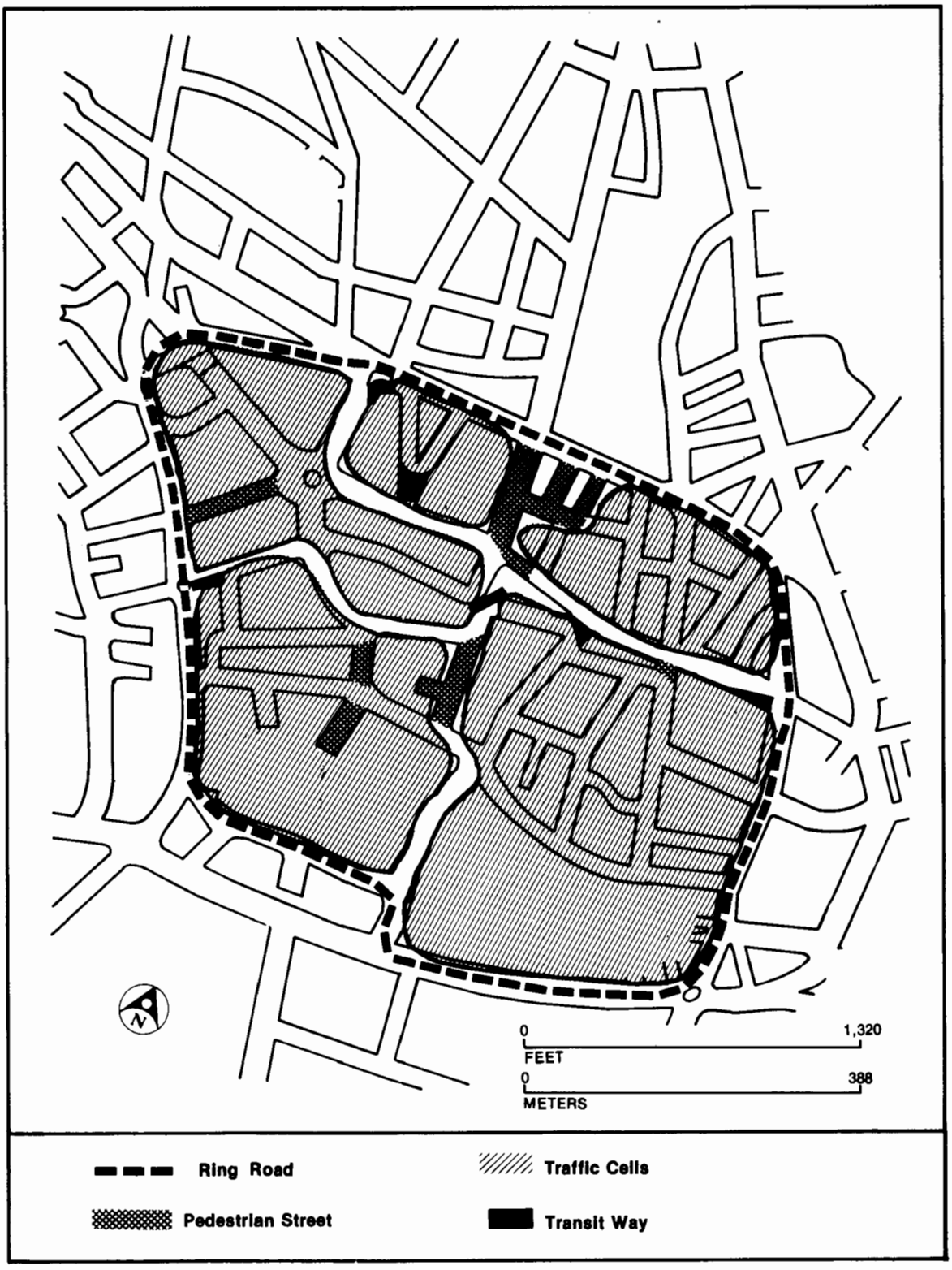


Figure 4
Auto Restricted Zone — Nottingham

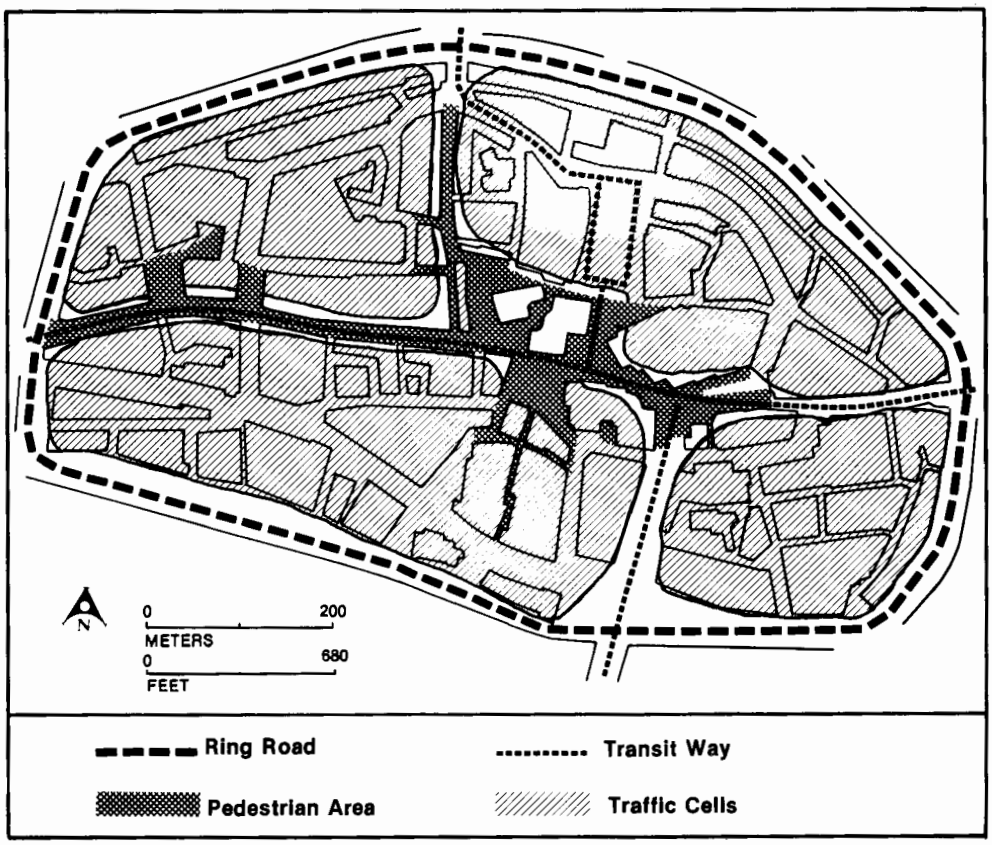


Figure 5
Auto Restricted Zone — Bremen

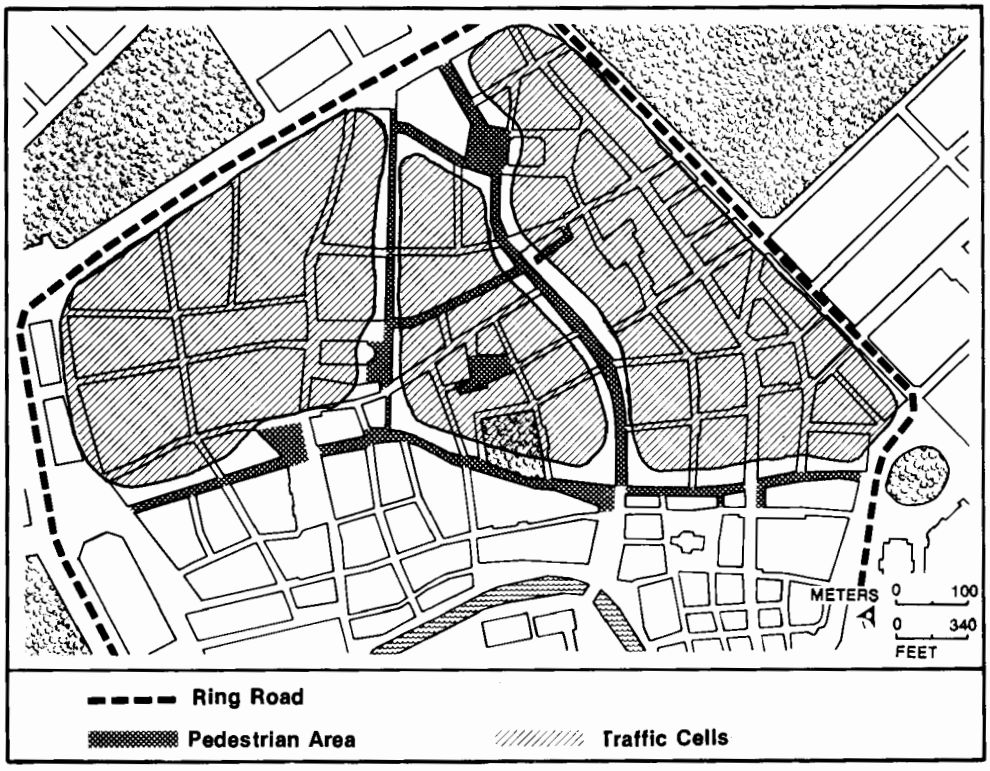


Figure 6
Auto Restricted Zone — Copenhagen

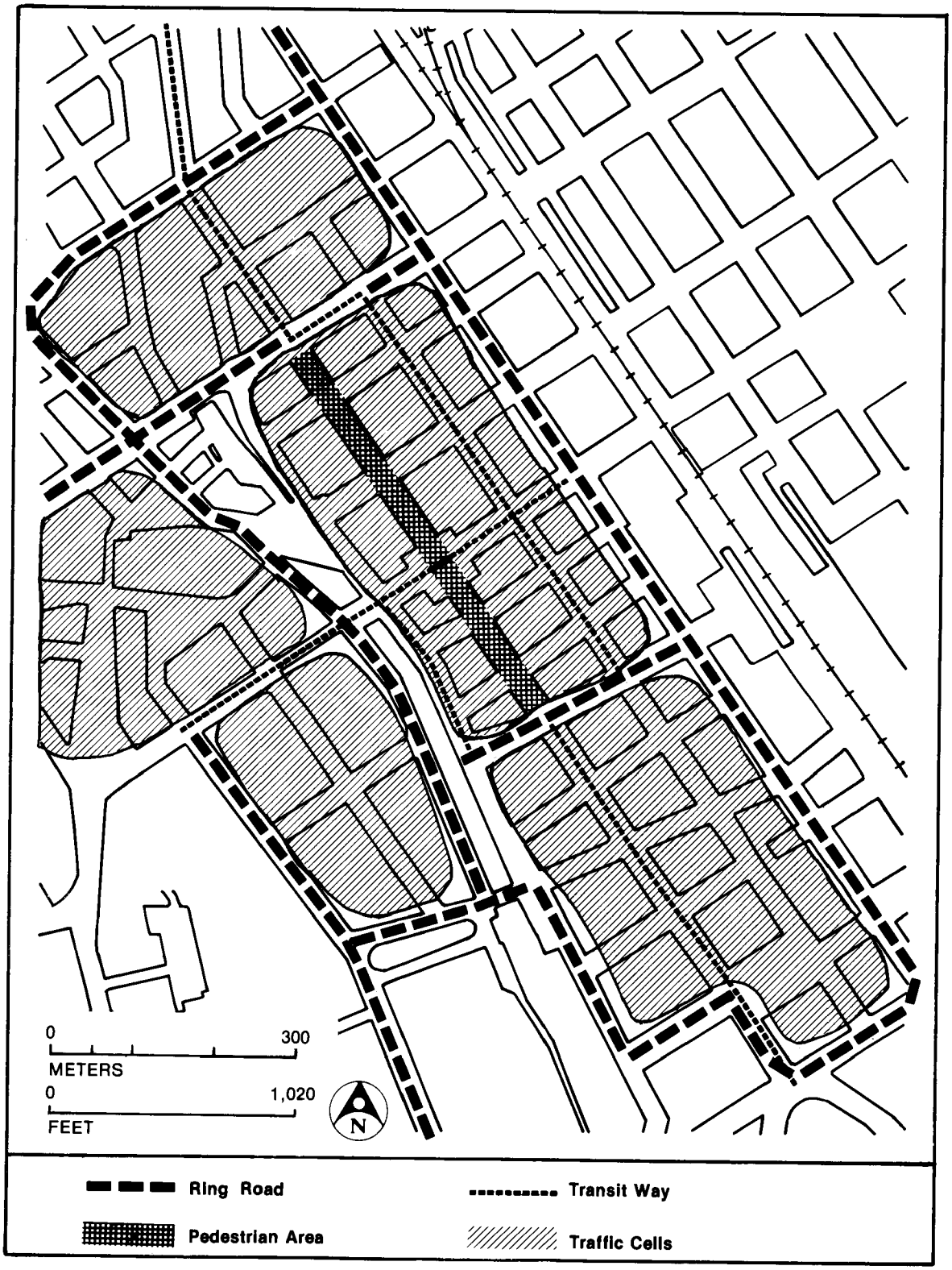


Figure 7
Auto Restricted Zone — Uppsala

overall accessibility, major emphasis has been directed to alternative forms of transportation.

Public transit has always been a major mode of travel in Europe, and increased resources are being directed toward its improvement. Munich has a new subway system; many cities have comprehensive systems of buses and trams which provide a high level of service to the central area. Nottingham has provided a free bus service on two figure-eight loops in the city center to improve mobility and accessibility. In Amsterdam and Uppsala, bicycle lanes taken from the roadway provide facilities which reinforce the use of this significant mode and actually seem to serve more people than did the automobiles using the same facility.

In some cities, a remarkable degree of integration has been achieved between pedestrian areas and public transport systems. Especially noteworthy are the central areas of Bremen and Essen, among other cities, where pedestrians and light-rail transit share the same right-of-way. Unlike steady, fast-moving streams of auto traffic, the electric trolleys or similar light-rail vehicles are not incompatible with even heavy pedestrian volumes as the transit vehicles pass only occasionally and are easily seen and heard as they move slowly through the crowded streets.

While individual problems continue to arise, the general response to auto restriction and pedestrian/transit improvements has been favorable; the best evidence of which is the increasing number of cities instituting such programs, as well as the continuous expansion of ongoing programs. Nearly all of the cities have initially experienced a reluctance toward such programs, particularly from merchants, but after a period of experimentation, adaptation, and evaluation, a consensus of favorable support is evident.

Table 6 identifies the basic characteristics of a select number of ARZ's in European cities and provides an overview of the size, nature, and costs of such areas. It is important to note that all of these experiences have included major transportation-related elements including minibus-type services, special transit facilities, better transit service, additional parking garages, and traffic operations improvements. Some of the impacts associated with these same sites are presented in

Table 6
Characteristics of European ARZ's

Auto Restricted Zones Europe	SIZE	TYPE of RESTRICTION	COST & FINANCING	ALTERNATE TRANSPORTATION
BESANÇON, FRANCE 1974- Center City	2500' x 2500' area of downtown core auto restricted.	Downtown core divided into 4 cells with inter-cell through auto movement prohibited.	$7,000,000 Approx. cost of traffic reorganization & transit improvements plan. National and city funds.	New mini-bus and public taxi service to fringe park & ride facilities.
BOLOGNA, ITALY 1972- Center City	1 SQ. MI. area of historic downtown core auto restricted. Extensive pedestrian areas in core.	Ranking of downtown streets to primary traffic network or secondary traffic-protected cells, with pedestrianization within cells.	n.a.	Reserved bus and tram lanes. Free transit service at rush hour.
COLOGNE, WEST GERMANY 1959- Hohe Str, Schildergasse, etc.	5,000' of downtown streets pedestrianized, 50'-60' average width.	Two major perpendicular shopping streets and Cathederal Sq. fully pedestrianized. All cross streets dead end at pedestrian areas.	$ 120,000 Approx. cost of Hohestrasse pedestrianization (1400'). City funds and merchant assessment.	Bus and tram service. RR station at end of pedestrian way.
COPENHAGEN, DENMARK 1962- Strøget, Fiolstraede, etc.	10,000' of downtown streets pedestrianized, 30'-40' average width.	Network of 8 streets in downtown fully pedestrianized. Effectively divides the core into 8 traffic cells with few trough connections.	n.a.	Bus service - some bus priority linkages. Suburban rail service to ends of pedestrian network.
DUSSELDORF, WEST GERMANY 1957- Schadow Strasse, etc.	4,500' of downtown streets pedestrianized, 30'-45' average width.	Network of 8 streets in downtown core fully pedestrianized.	n.a.	
ESSEN, WEST GERMANY 1945- Limbecker Str, Kettwiger Str, etc.	8,000' of downtown streets pedestrianized, 30'-45' average width.	Network of 8 streets in downtown fully pedestrianized. Effectively divides the core into 3 traffic cells with few through connections.	n.a.	Tram service only on ring road. RR station at end of pedestrian way.
GOTHENBURG, SWEDEN 1962- Center City, Kungsgatan, etc.	4000' x 2500' area of downtown core auto restricted. 3,000' of downtown streets pedestrianized, 45' average width.	Downtown core divided into 5 cells with inter-cell through auto movement prohibited. Network of 3 streets in downtown fully pedestrianized.	$ 220,000 Approx. cost of traffic zone system in the core. City funds and merchant assessment.	Exclusive bus and tram lanes in core. Monthly passes for transit use.
LEEDS, ENGLAND 1970- Bond St., Kirkgate, etc.	6,000' of downtown streets pedestrianized, 30'-45' average width.	Network of 6 streets in downtown core fully pedestrianized.	$ 300,000 Approx. capital costs of pedestrianization scheme. City funds.	Bus priority lanes in core.
MUNICH, WEST GERMANY 1971- Neuhauser Str, Kaufinger Str, etc.	6,000' of downtown streets pedestrianized, 30'-60' average width. Market Square, Cathederal Square & City Hall Squares pedestrianized.	Network of 5 streets in downtown fully pedestrianized. Effectively divides the core into 3 traffic cells with few trough connections.	$4,000,000 Approx. cost of pedestrianization scheme. City funds and merchants' voluntary contributions.	Subway system, parking and underground servicing built together with major pedestrian streets.
NOTTINGHAM, ENGLAND 1973- Center City	2500' x 1500' area of downtown core auto restricted. Extensive pedestrian & bus only links downtown.	Through auto traffic restricted in downtown core by creation of traffic cells. Pedestrian ways & bus routes connect directly through the auto restricted zones.	n.a.	2 free bus loops downtown. Bus priority routes and linkages; improvements in bus operations. New garages at ring road.
UPPSALA, SWEDEN 1972- Center City	5000' x 2500' area of downtown core auto restricted. 2,500' length of downtown st. pedestrianized.	Downtown core divided into 6 cells with inter-cell through auto movement prohibited. Major shopping st. fully pedestrianized.	$ 100,000 Approx. cost of experimental phase of traffic reorganization scheme.	Street on either side of pedestrian way and major cross street reserved for buses. Subsidies to reduce bus fares. Extensive bikeway.
VIENNA, AUSTRIA 1971- Karntner Strasse, Graben, etc.	12,000' of downtown streets pedestrianized, 45' average width.	Network of 12 streets in downtown core fully pedestrianized.	n.a.	

Table 7. It is clear that the results have been generally positive with a complete shift from initial opposition to positive support after implementation.

In concluding this section on European experience, it is important to highlight a number of relevant factors:

- These programs have not occurred overnight. Most of them are in a building process, some more rapidly than others, but nevertheless, phased over time.
- Automobiles have not been totally eliminated from the restricted areas. Circulation within the area is severely restricted, but basic access by auto to areas within walking and shuttle bus distance of most destinations is generally maintained.
- A high degree of accommodation and compromise has been necessary in most cities. Goods deliveries, service vehicles, emergency vehicles, and access to certain facilities have been suitably dealt with in a number of ways that are appropriate to the particular situation.
- The pedestrian linkages which are created within the restricted areas serve the movement of people and create a pleasing shopping environment. People favor a pedestrian street over a normal traffic street for walk trips when movement between two points is their only interest.
- Finally, the severe opposition and reservations which initially confronted these programs in most cities has generally been replaced with strong support after an initial 6 to 12 month period of adjustment.

DIFFERENCES AND SIMILARITIES

Those who have visited European cities to observe their programs for enhancement of the city center and the role that improved pedestrian and transit facilities coupled with a reorganization of traffic has played, are favorably impressed by what has been done and what has been achieved. Clearly, the overall effects are positive as evidenced by the continuing support given to such efforts. Having observed what can and is being done and judging it as favorable, a logical question is how can this experience be related to the U.S. situation. Clearly, there are differences of a substantial nature between the European and U.S. situations, and the implementation and results of auto restriction as well as the basic concept itself may be distinctly different.

Table 7
Impacts of European ARZ's

ARZ Effects Europe	MERCHANT'S ATTITUDES		RETAIL SALES		PEDESTRIAN VOLUMES	NEW CONSTRUCTION	SOURCES
	Before Construction	After Construction	During Construction	After Construction			
BESANÇON, FRANCE 1974- Center City	n.a.	Merchants very pleased.	increase	increase		n.a.	OECD Proceedings
BOLOGNA, ITALY 1972- Center City	Opposition; Dissatisfaction.	Strong support.	n.a.	n.a.		n.a.	OECD Proceedings
COLOGNE, WEST GERMANY 1959- Hohe Str, Schildergasse, etc.	All opposed.	Strong support.	n.a.	25-35%		Major reconstruction and rehab of historic area, oriented to tourism.	SOM Study GLC Study Tour
COPENHAGEN, DENMARK 1962- Stroget, Fiolstraede, etc.	Mostly opposed.	Almost all in favor.	n.a.	25-40%	35-45%	Change in character of retail toward specialty, youth and torist orientation.	SOM Study GLC Study Tour OECD "Streets for People"
DUSSELDORF, WEST GERMANY 1957- Schadow Strasse, etc.	All opposed.	All in favor.	n.a.	40%	60%	n.a.	SOM Study GLC Study Tour
ESSEN, WEST GERMANY 1945- Limbecker Str, Kettwiger Str, etc.	Fierce opposition.	Strong support.	initial decline	15-30%		Major post-war reconstruction. Large new commercial projects on edge of downtown built and in construction.	SOM Study GLC Study Tour OECD "Streets for People"
GOTHENBURG, SWEDEN 1962- Center City, Kungsgatan, etc.	n.a.	Predominantly positive.	loss	0		Major new in town center ('69-'74) shifted business activity. Residential reconversion on East side.	SOM Study GLC Study Tour OECD "Streets for People"
LEEDS, ENGLAND 1970- Bond St., Kirkgate, etc.	n.a.	Majority in favor.	n.a.	20%		n.a.	SOM Study GLC Study Tour
MUNICH, WEST GERMANY 1971- Neuhauser Str, Kaufinger Str, etc.	n.a.	92% of merchants approve.	n.a.	20-40%	up to 200% on peak days.	Major new underground shopping area built. Extensive building rehab & reuse.	GLC Study Tour OECD Proceedings
NOTTINGHAM, ENGLAND 1973- Center City	Initial opposition.	Strong support.	n.a.	n.a.	10%	30% increase in retail floor space in two major new centers. Extensive rehab.	OECD Proceedings
UPPSALA, SWEDEN 1972- Center City	Strong opposition.	Favorable.	n.a.	0.1-5.0%		n.a.	OECD Proceedings
VIENNA, AUSTRIA 1971- Karntner Strasse, Graben, etc.	n.a.	Very favorable.	n.a.	25-50%		n.a.	SOM Study GLC Study Tour OECD "Streets for People"

1. SOM Study:
   Skidmore, Owninge, and Merrill
   Survey of American and European Auto-Free Zones. 1975.

2. Pittas Study:
   Pittas, Michael J.
   "Downtown Malls, U.S.A."

3. Building Downtown Malls:
   Alexander, L.A., et. al.
   Building Downtown Malls
   Downtown Idea Exchange, New York, New York. 1973.

4. Barton-Aschman Report:
   Barton-Aschman Associates, Inc.
   Auto-Free Zones: A Methodology for Their Planning and Implementation
   Department of Transportation, Washington, D.C. July 1972.

KEY TO SYMBOLS: Positive Negative

Issues Favoring Auto Restriction in Europe

Identification of these differences as well as similarities is an important first step in capitalizing on the experience gained in European cities and relating it to United States conditions. Some of the principal issues which favor auto restriction in the European setting are noted below:

- City centers are more tightly structured and walkable with a good mix of land uses and activities, including attractive historic spaces and buildings.
- An urban tradition of maintaining the city center as a symbolic focus and repository of civic pride is strongly evident.
- The street system in the central city is unable to serve significant amounts of automobile traffic.
- Public transportation is an attractive and desirable alternate travel mode offering frequent and convenient service at reasonable costs.
- Pedestrian volumes in the center city are heavy and create constant and obvious pedestrian/auto conflicts.
- Car ownership rates are lower.
- Adaptation of urban functions to auto access is less.
- There are less serious problems with vandalism and street crime in the city center.
- Tourism is a major center city industry and clearly profits from a higher level of pedestrianization.
- Most cities have stronger planning controls for directing public and private development.

Within this group of issues which favor auto restriction in European cities, the ones which appear to be most critical are the intrinsic attractiveness of the area, low capacity street system, high level of public transport, and strong planning controls.

Issues Favoring Auto Restriction in U.S.

A comparison of the differences between European and U.S. situations also suggest a number of issues that may favor auto restriction in the U.S.

- Serious concern, support, and financial resources are being directed at environmental quality issues.
- A prevailing concern about the impact of traffic and auto-related facilities and willingness to consider pragmatic alternatives is increasingly evident.
- Local governmental institutions are responsive to tides of popular sentiment.

The most significant of these issues which favor the concept of auto restriction in the U.S. situation center on the overall level of resources that can be brought together to support priority programs and the increasing awareness of the impacts of traffic and related facilities.

Similarities Supporting Auto Restriction in Europe and the U.S.

While obvious differences do exist between European and U.S. situations, there are also a number of relevant similarities which are noted below.

- In Europe, the boom in the early 60's brought about major adaptations to the private auto that followed the U.S. example: suburbanization, major road building, dispersion of commercial centers. This trend was only reversed recently by: (a) economic slowdown, (b) breakdowns in the system (particularly of traffic) and environmental concerns about road building and street widening, and (c) deliberate, politically-established counter-policies. These same reversals are occurring in the U.S. at the present time.
- Car ownership in some European countries such as Sweden and Germany approaches that of the U.S. and is growing faster. The symbolic role of the car as representing freedom and prosperity may even be stronger there.

- The central authority to accomplish planning objectives by decree has been eroded by active interest groups in Europe and much of the recent auto restriction and pedestrianization planning were accomplished through public consultation and careful constituency-building similar to that required in the U.S.

- Many of the individual techniques used in Europe, ranging from devices for traffic metering to pedestrian pavement design, from public information processes to free bus systems, seem potentially applicable to U.S. conditions even though they may require different scales, timing, and combinations.

- Some of the opportunities realized in European cities through auto restriction and pedestrianization are present in U.S. cities, though not as obviously: festivities and celebrations both for the city as a whole and for various neighborhoods, tourism, renewed interest in in-town living, and revitalization of some historic spaces and buildings.

SUMMARY

From visiting selected U.S. and European cities and reviewing materials from a large number of U.S. and European cities, it is evident that much is being done to improve and protect the environment of downtown areas through urban design features, pedestrian facilities, and improved transit services coupled with a reorganization of traffic through more controls and better management.

Auto restriction and environmental improvements cannot by themselves reverse a situation or trend of decay in downtown areas that are no longer viable centers for functions which have relocated elsewhere. However, they have been shown to be an effective tool in protecting and enhancing downtown areas that are reasonably viable and indeed have served as an impetus toward changing the image of the city center. Where aggressive programs have been pursued, the image of the downtown area is visually more pleasing and economically more viable. Transit services are also well developed and utilized and can compete more effectively with the automobile as a means of transport. This experience is common to both U.S. and European situations.

Chapter IV
Key Factors

CHAPTER IV
KEY FACTORS

The analysis of existing experience with the concept of traffic restraint has identified a set of key factors of prime importance in the planning and implementation of an ARZ. This wide-ranging set of key factors constitutes an identification of important issues and a guideline on how to address them for the successful implementation of an ARZ. These key factors are grouped into the following categories:

- Urban Activity Patterns
- Urban Design Issues
- Maintaining Accessibility
- Size of the ARZ
- Transportation Policy Impacts
- Institutional and Legal Factors

To a large extent, whether an ARZ succeeds or fails depends on the preexisting characteristics of the area, the type of auto restriction measures that are implemented and the resulting magnitude and distribution of impacts experienced. Previous sections of this report have detailed the various types of restrictive measures available and have illustrated how some of these techniques can be applied. This chapter explores the two remaining areas:

1. The existing situation — Particularly significant are downtown activity patterns, the regional function of the CBD as an employment and shopping center, and the supply of transportation services including street capacities, transit services, and parking availablility

2. How the area reacts to ARZ — The impacts of ARZ on travel behavior for both work and shop trips are projected for ARZ's of different sizes and types.

The chapter concludes with a discussion of key institutional and legal factors that unless fully considered could unexpectedly emerge as major obstacles to successful ARZ implementation.

URBAN ACTIVITY PATTERNS

To implement a successful auto restricted zone, an urban area has to possess some basic vitality and strength in its activity patterns. Activity patterns refer to both basic activities such as living, working, and shopping in the city, as well as immediate visible social characteristics such as mix, density, and quality of street life. An ARZ may be very appropriate as a means of preventing deterioration of current activity or as a complement to other policies generating basic new activity. It is, however, not a promising technique as a first step in bringing vitality to an area that is now drained of essential activities. Thus, in judging the appropriateness of an ARZ program for a particular city and district, it is important to assess the current state and current trends of its activity patterns.

Basic Vitality

Most American cities have experienced some deterioration in their central areas. Most have attempted to combat such problems by a variety of redevelopment, renewal, or economic revitalization programs. The particular programs of revitalization pursued by a city strongly affect the feasibility and appropriateness of an ARZ as part of such efforts. For example, if a city has committed itself to attracting massive new office and retail development to its core area in the near future and it has not yet developed an effective public transportation system, it will then be committed to additional auto-oriented facilties, roadways, and parking, and will thus have more limited potential as an ARZ. By contrast, if a city approaches downtown revitalization by promoting a strong early emphasis on public transit, incremental redevelopment, and the maintenance or creation of pedestrian-scale activity, then an ARZ program could be strongly complementary to its aims and thus be likely to succeed.

In judging the vitality of center city areas, the most commonly used indicator is the amount of retail sales. The shift in retail patterns, the decline in retail sales, and the quality of shops have been used to describe the level of decay in downtown. In some cities, the conclusion was reached that since retail trade was being lost to surburban centers, the way to compete successfully against these centers was

to emulate them: provide equally good auto access, an "upgraded" new image, and small, insular shopping mall environments, separated from the problems and complexities of the rest of the city. These attempts have sometimes become commercially successful but have not in any instance succeeded in really revitalizing the city around them; the results were sometimes the opposite—a kind of domino effect of decay and need for more redevelopment.

A more sophisticated approach is now emerging in a number of cities, one which seeks to take advantage of the unique resources of a center city area. These resources are richness and variety, accessibility and continuity. A variety of activities within easy reach allow for quite a different pattern of living, working, socializing, or having fun than those available in a suburban setting. While the suburban living environments continue to retain their particular advantages and suburbanites continue to use the city as an employment, speciality shopping, and service center, the city can develop its own constituency of "urbanites" that chose its life-style. If a city can regain or develop such a constituency that is reasonably balanced among social and income groups, then it can maintain or regain its basic vitality. It is the local constituency that is most likely to maintain stability and environmental quality and management; this in turn will help in attracting a suburban clientele. While the character of retail activity is an important component in this process, the provision of living and working environments in-town, the maintenance of basic urban industries (including universities, government, and services) and the preservation or enhancement of historic and natural resources are equally important in the long run.

These points are important relative to the development of a program of auto restriction. Historically, the debate about auto restriction has generally focused on its effect on retail establishments, and, although the evidence of constructed projects around the world overwhelmingly shows that pedestrian malls have usually helped retail areas, skepticism still prevails. But if the above-described broader approach to renewal is considered, it can be seen that auto restriction is an important component in creatng an environment where a growing constituency of urbanites can form the stable core of city activities. A program of auto restriction dedicated to rebalancing the use of public spaces between automobiles and other

users is particularly timely in a city that has already successfully embarked on such a renewal program.

Street Life

One way to consider auto restriction is as a program for a more equitable distribution of public space and investment among its various users: pedestrians, bicycles, and private and public vehicles. From this point of view, the clearest rationale for auto restriction exists where there are large numbers of pedestrians already actively using a public space and where restriction or prohibition of automobiles would materially improve conditions for them. Similarly, where there are large numbers of public transit vehicles which would experience a significant increase in mobility through restriction or prohibition of automoibles using the same streets such a rebalancing is clearly justified.

Somewhat more complex questions arise when an area has some potential for pedestrian and transit oriented activity, but this activity is not strong at the present. These cases need to be critically and specifically examined to determine whether the benefits of restraining traffic and adding pedestrian amenities outweigh the costs of doing so. It is likely that in most cases other programs such as special transit, new employment, housing, department stores, or special events need to be combined with auto restriction before an ARZ can be filled with street life. The costs, benefits, and timing of such programs must then be compared to local objectives and renewal strategies.

There are several reasons why "street life" is an important ingredient of a successful ARZ. In retail areas, the pedestrian activity on the streets is closely related to sales. In working or living areas, major crowds may be no asset, but a steady level of street activity can promote a sense of life and security. It is important for social and community life that public spaces be not only for "passing through," but also for "being in." That they accommodate the more leisurely activities of people watchers, teenagers, and flower vendors, as well as the more purposeful and hurried pace of workers and shoppers. Without such street life, urban streets

become desolate at best, frightening and dangerous at worst. If ARZ areas come to be perceived in this way, they are sure to be judged failures by the people using them.

The private activities that open onto the public spaces play an important role in determining the quality of street life. Between them, the public and private spaces create an activity setting, a kind of local "eco-system" of activities. Department stores, discount stores, and fast food restaurants work well with downtown crowds while speciality shops, cafes, and restaurants would favor special districts and a wealthier, more leisurely clientele. Housing may supply stoop-sitters and people-watchers as well as night and weekend activity. Universities help create active, youth-oriented public environments. Office and government buildings with under-used ground floor lobbies can make even busy public spaces seem desolate. Yet the employees working in these buidings can be major participants in street activity and contribute significantly to retail sales. There is a mutually reinforcing, progressive relationship between auto restricted areas and the adjacent activities: ARZ's will be most successful where small-scale, varied, day, week, and year-round activities already exist, and once ARZ's are successful, they will further encourage the development of such activities. A critical factor is that a sufficient "start-up" level of activity with the physical potential for accommodating further growth of such activity already be present.

When considering the projected activity fabric of an ARZ, issues of scale, density, and variety become very important. The implication of these issues for the design of different types of public space is discussed in the following section. In an ARZ, the functions of movement within an area and the activities of "being there" such as shopping, strolling, eating, watching, and socializing can merge and reinforce one another. Growing out of these complex functions, the urban design criteria have to relate to both the patterns and needs of movement and the factors that enhance the experience of being there.

URBAN DESIGN ISSUES

The previous section on Urban Activity Patterns begins to suggest the primary design criteria for auto restricted zones. The most important general criterion

is that the purpose of auto restriction is not simply to eliminate autos from city streets but to create functional pedestrian and transit preference networks. Such networks will function best if they tap the whole range of existing and potential non-auto-dependent activities in the city or district and reinforce them by creating better connections and a more attractive environment.

Functional Design Objectives

In designing such pedestrian and transit preference networks, a kind of "ecological base" must be surveyed and analyzed. The designer must locate the generators of activity such as places of work and residence, places of transit interchange, major parking areas, recreational and tourists uses, major shopping patterns, etc. By identifying and quantifying such elements on a map, the designer can then analyze them and relate them to the potential transit/pedestrian networks. The analysis should take into account daily and weekly variation of activities and generate a coordinated program for planning the local pedestrian and transit network. Special patterns, such as commuting from railroad and suburban bus stations at a.m. and p.m. peak hours, noon-time shopping connections, connections throughout the day from residential to business areas, evening and entertainment events, must be considered together from the points of view of transit and pedestrian demand and as generators of street life. The primary task of the urban design scheme is to meld these components into a synergistic pattern.

In choosing locations for the components of such a network, it may be reasonable to consider three levels of need and potential:

1. Existing areas with intense use by pedestrians and transit vehicles whose environment and functional operation need to be improved; i.e., major shopping streets, primary downtown bus routes, etc.

2. Existing strong activity areas, close together, and with potential for functional interaction but where pedestrian or transit connections are inadequate. For example, shopping and office areas where intervening roadways and traffic now form a barrier but improved connections are likely to lead to more use.

3. Potential activity areas that could be supported by a pedestrian/transit preference network; such as, residential conversion of older commercial structures or tourist activities in historic districts.

These three levels of potential suggest a strategy in which the initial components of a network should facilitate primary existing patterns with longer-range plans and subsequent phases focusing on the latent activity and development potential. When dealing with retail businesses, the possibility of tapping nearby markets through pedestrian and transit connections is the most attractive initial impetus, and action in this area may appropriately precede any major auto-restrictive action.

In addition to the design of the pedestrian/transit networks, the streets that remain in vehicular use or are redesigned as bypass traffic routes will benefit from careful urban design treatment. Without attempting to define all the criteria for the physical design of city streets, it can be pointed out that the main urban design issues are clarity of route in relation to destination, clear signing, buffering of other activities from traffic impacts (by space, planting, materials, building design), pedestrian crossing of roadways, and simple legible access to parking. The most important long-range urban design objective in this area is the location of auto-related land uses and major parking facilities near the primary trafficways and outside of the pedestrian/transit preference districts.

General Physical Design Criteria

The physical design considerations must relate directly to the above functional and locational objectives. Only some very general physical requirements can be listed since actual designs will have to be molded to local conditions:

- The most general physical design requirement is that local conditions must be assessed and interpreted before any design prototypes for malls, transitways, or other elements are applied. These may vary considerably in terms of climate, physical and use patterns, users' habits, styles of local public space operation and management, laws and codes, safety and vandalism issues, etc.

- Physical scale is a difficult problem in the design of pedestrianized streets and includes issues of richness and variety as well as absolute size. Few U.S. city streets have the dimensions or character that can easily be converted into a pleasant pedestrian environment.

Bland linear spaces usually need to be interrupted with landscaping or activity areas. Visual and functional features of interest such as shops, restaurants, and sitting areas must be substantially increased and reinforced to make walking on a street an attractive experience. The overall walking range of pedestrians must be taken into account, probably ranging from 3 to 15 minutes, depending on the purpose of the trip and the type of person. Within this range there must be sufficient variety of experiences to make the walk worthwhile. These criteria should influence both the selection of streets as major pedestrianways and the subsequent development policies for such streets.

- Continuity of pedestrian and transit networks is required to reinforce their use and image. At present, the only truly continuous element in U.S. cities is asphalt pavement—streets, driveways, parking lots, gas stations, and expressways form an uninterrupted network. By contrast, pedestrian areas are broken at every block and transit stops are most often nothing more than isolated sign posts. In Europe, on the other hand, some of the more successful pedestrian/transit networks enable pedestrians to circulate with little or no interruption over large districts and transit buses receive consistent preference in the allocation of road space. The pedestrian areas are carried through by character of paving, lighting, seating areas, planting, and other street furniture, as well as essential services such as restroom facilities, telephones, and trash cans. The transit stops are sheltered, well-signed, and well-coordinated. The continuous presence, and even dominance, of these elements throughout a city district has a psychological impact much beyond their utility in encouraging movement on foot or by transit. Aids to crossing major roads such as escalators, overpasses, and underpasses work well as part of such a continuous system while they tend to fail in isolation.

- A variety of activity niches needs to be provided in order to enrich street life and avoid monotony or conflict. Busy shopping streets need to be complemented by quieter areas for relaxation, such as restaurants, cafes, or street parks. Vendors and street musicians add a great deal of life and some streets may have the potential for a whole range of market functions. Older people as well as teenagers may spend a great amount of their free time on the street and need niches where they are comfortable. This is often determined by the other adjacent facilities as well as physical design. In general, major pedestrian spaces should be designed as settings for the public life of all members of the community.

- Policing and maintenance of public spaces is a serious problem, particularly for the larger U.S. cities. The designs must create "defensible space" with built-in surveillance by regular users as well as particular safety and maintenance procedures. Materials and techniques must be sturdy and simple. A realistic assessment of what the place may look like five years after it is completed is sobering but absolutely necessary.

- Transit coordination and information are a serious lack in many cities with bus transit systems. The new pedestrian/transit networks must make a major impact in providing clear information regarding stops, routes, and schedules; coordinating transfers, and locating major interchange points where they are visually and functionally accessible from primary activity areas.

- Basic services such as telephones, restrooms, lockers, and trash receptacles are essential elements of any useable public space system. Some of these are seen as major management problems for the public authorities. But if these services are grouped and located at major activity nodes, as they consistently are in European cities, their management can be simplified and coordinated.

- Special events can greatly enhance the viability of public spaces which depend on regular, spontaneous use. These include festivals, concerts, special markets, etc. Appropriate spaces at the right scale and location must be provided for such events; for example, a sizable band concert on a retail street on Saturday may interfere with the other activities but may complement the shopping areas if located on an adjacent square or park.

Physical Design Elements

The public spaces contained in a pedestrian/transit network are defined by a range of physical design elements: underground utilities, pavement, lighting, planting and landscaping, bus shelters, information kiosks, seating, canopies or other weather protection, vendor stands, display cases, public event structures such as stages and bandstands, services such as restrooms, phones, mail boxes, and trash cans, fountains, works of art, and other decorative elements. In addition, the adjacent public or private buildings play a major role in defining the character and use of the spaces: shops and shopfronts, restaurants, signs, building facades, building masses and the shadows they cast, arcades, doorways, balconies, and stairs. Design criteria and performance standards need to be defined for all of these elements. All too often they are designed as isolated objects rather than as a support system for enriching the activities. Cataloging such elements is beyond the scope of this report, but it may be useful to highlight a few points here:

- Utilities and below-grade work as part of the street reconstruction must be carefully evaluated at an early feasibility phase since the expense can often be more than 50 percent of project costs, and thus impose constraints on the physical design. Major cost components

include reconstruction of old utility lines and connections, building over or rebuilding old storage vaults, constructing above steam or subway tunnels, maintaining access to utilities after construction.

- Seating in U.S. cities, i.e., public benches, is often placed randomly where there is room rather than where people want to sit. Pleasant sitting places can be created by placing benches so that people can look at something interesting, be protected from noise and traffic, be next to something pleasant such as flowers, be in sunlight when it is cool and in shade when it is hot, and by creating groups of benches or seats around tables as well as more private spots. If we consider seating areas as public social spaces, living rooms, or places of repose, the designs will become more intelligent. An ideal scheme is one of movable, individual chairs, used in some German cities, but these probably would not survive in most American public places. Carefully placed benches with a variety of character and setting can serve the same purpose.

- Planting must be designed with a built-in maintenance program. In Munich, seasonal plants and flowers are replaced four times a year. Trees and bushes tend to be more effective when they are used in groups to define specific places rather than individual objects in separate planters. The species must be appropriate to the climate and sturdy enough to survive.

- Lighting needs to be continuous but not too bright. The fixtures must be unbreakable but should not be massive or prominent.

- The adjacent shop fronts should be designed to minimize barriers between public and private spaces. Shops can use part of the publicways for open air displays. Restaurants can be encouraged to extend seating into the public space.

- Vendor stands or locations for movable carts are also important contributions to the street environment. They can create some conflicts both in terms of blocking pedestrian traffic and by being perceived as competition to the more established shops, but these problems can usually be negotiated and resolved.

- Canopies for climate protection are most useful next to buildings with shop fronts (arcades serve well for this). If these are built as public structures, the legal and technical problems in attaching them to private buildings can be considerable. It may be preferable to provide incentives such as tax breaks or public grants to the private owners to provide their own canopies with some public design controls to insure continuity.

- Public art projects should be commissioned to enhance important areas of the pedestrian/transit network. Preference should be given to works that involve the passersby and respond to the specific local

environment, such as fountains and works relating to local character, history, and events over formal, monumental pieces.

- Bus shelters must provide protection against the primary local climate problems like rain, wind, snow, or hot sun. They should provide information as well as shelter and should allow the user to participate in the street life while waiting for the bus. The inside should be visible from the activity areas for safety and the approaching bus should be visible from the shelter for convenience.

Most of these observations should seem like fairly simple common sense, yet there are few public spaces in the U.S. where these concerns have been consistently observed and responded to. Public spaces could be living rooms for the community, but more often they appear like no man's land, uncared for and unused. Such failures can only be rectified through a careful combination of design, maintenance, enforcement, and education programs.

TRANSPORTATION INFRASTRUCTURE

Existing ARZ's have been implemented in large as well as small cities in both Europe and the United States. However, significant differences in key factors related to the transportation infrastructure do exist among cities of different sizes. These have implications for the type and amount of transportation-related improvements necessary and the impacts resulting from implementing auto restrictions. These differences include:

- Regional Function of the CBD
- Highway versus Transit Levels of Service and Degree of Congestion
- Local CBD Street Congestion
- CBD Parking Characteristics

To analyze the relationships of the first three of these differences with urban area size, it is useful to look at differences in travel patterns.

Travel Patterns

The number, purpose, and modal split for trips entering a city's CBD relative to the total regional trip making pattern provides an indication of the basic function

of the CBD and its accessibility by auto relative to transit. General relationships between size of urban area and per capita trips to the CBD for a number of U.S. cities indicate that for larger cities, the "uniqueness" of the CBD as an activity center is somewhat diminished relative to the rest of the urban area. Relationships between CBD trip purpose and urban area size indicate that it is the decrease in attractiveness of the CBD as a shopping/entertainment/recreational center that accounts for the largest proportion of the reduction per capita trips, while the percent of the relatively capitve travelers, workers traveling to the CBD, increases significantly for larger cities.

A different mix of land use activities also exists for cities of different size, primarily retail trade and services for smaller cities and work-related for larger cities. The implication is that for smaller areas, the viability of the CBD as a retail center is more dependent on trips made primarily for shopping while for larger areas, a large market for CBD retail activities consists of workers employed in the CBD making 'noon-hour' trips. This suggests that in evaluating alternative ARZ policies for smaller areas, maintaining accessibility to the ARZ is of prime importance while for larger areas, accessibility within the ARZ is more critical.

Generalized relationships between modal split for CBD oriented trips and urban area size indicate the accessibility of transit relative to auto increases with city population. The implications of this relationship for an ARZ in larger cities are twofold:

- A smaller proportion of those traveling to the ARZ will be directly affected
- For those that are affected, a reasonable alternative to the auto exists

Another aspect of urban area travel patterns that affects an ARZ is the proportion of traffic within a proposed ARZ that travels through the area with both origin and destination outside of the ARZ. If the percentage of these through trips is significant, additional capacity will be required on streets surrounding the ARZ to accommodate these trips.

Smaller cities, with relatively few alternative routes for getting from one side of the CBD to the other, would tend to have a higher proportion of trips through the CBD than larger cities having several bypass routes. For those cities with bypass routes, however, the percent of through traffic varies by city. Indications are that for cities with adequate bypass routes through trips in the CBD range from 10 to 25 percent. For cities without bypasses, the percentage of through trips is usually higher, sometimes as high as 30 to 40 percent of CBD vehicular travel.

Parking

The key parking related factors in an ARZ context include:

- Number and Type of Parking Spaces
- Turnover Rate
- Occupancy Rate
- Walking Distance to Final Destination

As one would expect from the differences in travel patterns described earlier, these parking-related factors also vary with city size. The positive relationship between parking space demand factors (spaces per CBD trip by car) and urbanized area population reflects the fact that in larger cities proportionately more trips to the CBD are work related, having a lower turnover rate than trips for other purposes. Thus, in larger cities, a higher proportion of available parking would be for long-term use. The relationships of CBD parking spaces by type of facility (curb, lot, garage) relative to urbanized area population indicates that larger cities with denser CBD's must devote more off-street space to parking in order to accommodate the higher demand for parking spaces.

The occupancy rate of parking facilities serves as an indication of the availability of excess parking in the CBD which could be used to replace parking spaces lost as a result of implementing an ARZ. CBD parking space occupancy rates tend to increase with urbanized area population suggesting that for larger areas, there is proportionately less available excess parking to absorb spaces eliminated by ARZ policies than in smaller cities. Equally important is the fact that curb parking which is most vulnerable to ARZ policies is proportionately higher in smaller

cities then in large urban areas. While on a generalized scale, the two situations tend to compensate each other, the particular tradeoffs at specific sites can be in a state of imbalance.

The existing walking distance from parking space to final destination is one of the most significant parking related factors in determining people's choice of mode and destination. If existing walk distances are relatively long (500 - 1,000 feet) implementing an ARZ may cause very little change in walk distance, which would tend to minimize the disincentive aspect of an ARZ. If, however, existing walk distances were very short (100 - 500 feet), an ARZ could significantly increase walk distance, causing changes in travel patterns to the CBD. The positive relationship which exists between walk distance and urban area population suggests that CBD destined auto travelers in larger areas experience longer walk distances. This is supported by more recent empirical evidence in several U.S. cities where walking distances as high as 4,000 - 5,000 feet to relatively inexpensive parking lots have been experienced.

Therefore, while city size is not a key determinant to a successful ARZ, the transportation infrastructure and the mix of activities and function of the CBD, which is related to city size, play an important role in determining the nature of a particular ARZ and what steps are necessary to maintain accessibility. In the next section, the factors affecting accessibility are discussed, and various methods for maintaining accessibility to an ARZ are presented.

MAINTAINING ACCESSIBILITY

From a transportation perspective, the most critical factor in determining the success or failure of an ARZ is accessibility. If accessibility to and within an ARZ is not maintained, the short term will see a drop in the number of discretionary trips (shopping, entertainment, etc.) to the ARZ, while in the long run many activities may relocate to more accessible sites within the urban area. Because an auto restricted zone is restrictive by nature in terms of accessibility, this implies that some sort of transportation policy "incentives" are needed to counterbalance the inherent "disincentives" of an ARZ.

Factors Determining Accessibility

The accessibility to an ARZ is affected by several factors. The more important of these include:

- Capacity and level of service of major highway and transit links to the ARZ
- Capacity and degree of congestion on local streets surrounding the ARZ
- Parking availability and cost

Typically, the restrictions imposed by an ARZ would noticeably affect only the latter two of these factors, parking and local streets. The extent to which an ARZ would influence these factors depends on the specific characteristics of the ARZ and surrounding area. For example, if a very large ARZ were implemented in a highly auto-oriented CBD with very high parking occupancy rates, accessibility would be substantially reduced. On the other hand, implementing a relatively small ARZ in a city well serviced by transit would have a minor impact on accessibility. Similarly, an ARZ that reduces street capacity in an already congested CBD would only aggravate the situation by causing a substantial increase in travel time on local streets in the vicinity of the ARZ unless traffic operations improvements were also provided. If the streets surrounding the ARZ have sufficient capacity or are linked together and combined with other traffic management improvements, the impact on accessibility would be minimal. The factors affecting accessibility within an ARZ include:

- Spatial distribution of parking facilities and activities
- Type of internal distribution system provided

The primary impact of an ARZ on internal accessibility would be to increase the walking distance between parking facilities and final destination for those traveling to the ARZ. The degree to which this will impair accessibility will depend primarily on the specific location of parking facilities and the amount of excess capacity available in parking facilities within and surrounding the ARZ. For example, if

travelers originally were able to park very close to their destinations, implementing an extensive auto free zone would result in a significant perceived decrease in accessibility. A less restrictive ARZ plan creating traffic cells which permit penetration to parking garages within the restricted area would have less impact on accessibility. Also, if people originally had to park relatively far away, the actual increase in walk distance would be negligible if adequate parking is available within the ARZ or near its perimeter.

The spatial distribution of activities within an ARZ would also determine the extent to which noon-hour trips would be affected by auto restriction policies. If office buildings, restaurants, and shops were located at opposite ends of the CBD, thereby requiring auto access, auto restrictions could seriously impair accessibility for noon-hour trips. On the other hand, if these diverse activities were located in close proximity, auto restrictions could actually improve accessibility for these trips by allowing freer pedestrian movement.

Another factor affecting accessibility within an ARZ is the availability of an internal distribution system as an alternative to walking between parking and activities. If such a system were available, the decrease in accessibility resulting from increased walk distances would be offset to a certain extent. This internal distribution system could also have a significant impact on the generation and distribution of noon-hour trips by making available to workers many alternative destinations that were previously inaccessible due to the relatively short time that can be allocated to such trips.

An additional important improvement resulting from an ARZ that cannot be overemphasized is the increase in pedestrian accessibility. This, in conjunction with auto restriction measures, allows a freer flow of pedestrian movement, and is an attraction mechanism for more trips in itself.

Impacts of Reduced Accessibility

Unless accessibility to an ARZ is maintained, significant shifts in travel patterns in the area can occur. The type and magnitude of these shifts will be different

for various trip purposes. Workers, for whom trip frequency and destination are relatively fixed in the short term may shift from auto modes to transit for their work trip. While this certainly could be considered to be a desirable impact in light of today's energy and environmental concerns, unless accessibility is restored in the longer term, activities may begin to relocate in more accessible areas. For more discretionary types of trips such as shopping, social-recreation, entertainment, etc., the impact of reduced accessibility will be much more pronounced in the short term since the choice of frequency and destination, as well as mode, is quite flexible from day to day. Additionally, because these trips are more discretionary in nature, they will be much more sensitive to changes in level of service. For these trips, the short term impact of reduced accessibility would be a shift to alternative destinations that are more accessible and a reduction in the total number of trips being made, as well as a shift in mode for trips still destined to the ARZ. Thus, it is particularly important that accessibility to and within an ARZ be maintained if the area is to remain viable as a retail center.

Possible Methods for Maintaining Accessibility

Accessibility to and within an ARZ can be maintained in a number of different ways:

- Parking (additional spaces, rate structure, short term vs. long term)
- Improved regional transit service to ARZ (coverage, frequency, park/ride lots, fare structure)
- Improved distribution system within the ARZ (fixed route shuttle bus, demand responsive service, etc.)
- Increased capacity on local streets surrounding the ARZ

The most effective method for maintaining accessibility will vary from city to city depending on the transportation infrastructure and ARZ characteristics. In large, transit-oriented cities, where service is good and transit usage to the CBD is high, transit-related improvements would probably prove most effective in maintaining accessibility. With excess rapid transit capacity, extensions of local bus

service lines into the CBD, and/or possibly a downtown feeder-distribution bus network connecting up the parking garages, accessibility can be maintained at its current level and perhaps even improved. In an intermediate sized auto-oriented city, implementation of a significantly improved regional transit service oriented toward the CBD plus a downtown distribution system can reduce core area auto traffic and increase transit ridership both to and within the area. For other types of auto-oriented cities where transit potential is more limited, selected improvements in parking availability and street capacity could be more useful in maintaining accessibility.

SIZE OF THE ARZ

While city size is only indirectly related to the success or failure of an ARZ, the size of an ARZ does appear to have an effect. In fact, the extent to which travel patterns will change as a result of implementing an ARZ is highly dependent on the size of the area subjected to auto restriction. The most obvious reason for this is that for a city of any given size, larger ARZ's will usually directly affect a larger proportion of the population. However, ARZ size also has a direct effect on the characteristics of transportation supply, which in turn directly affects travel patterns. Those changes in the transportation system related to ARZ size include:

- Parking
- Walk distance
- Volume/capacity of local streets

Parking

Implementing an ARZ typically results in a decrease in the number of parking spaces available in the downtown area by directly and immediately eliminating on-street parking. In addition, access to off-street parking facilities within the ARZ may also be affected in some instances. In general, the larger the area of restriction, the more parking spaces that will be lost. The impact of this reduction in parking will depend on several factors. One is the availability of replacement parking, in the form of either excess capacity in existing facilities within and

surrounding the ARZ or the construction of new facilities. Another factor is the initial mode split to the ARZ. If a majority of people travelling to the area use transit, the impact would be much less than if auto were the primary means of access.

Walk Distance

By limiting parking in an ARZ, people with destinations in the area must find substitute parking which, in most cases, would result in some increase in walk distances. In general, the larger the ARZ, the greater the increase in walk distances. It should be noted that this increase is a function of ARZ configuration as well as absolute size. For example, consider two ARZ's of identical area, one square or circular in shape, the other a long rectangular shape. Assuming that replacement parking is available along the perimeter of the ARZ in both cases, the square or circular shaped ARZ would have a larger increase in walking distance associated with it relative to the rectangular shaped ARZ. The amount of increase is also a function of the walk distance experienced prior to ARZ implementation. If, at present, people are able to park very close to their destination, the effect would be greater than if walk distances were fairly long to begin with. The creation of traffic cells in which traffic penetrates the ARZ for access to parking garages would minimize the impact on walk distance.

Volume/Capacity on Local Streets

The creation of pedestrianized areas and transit facilities in ARZ's is generally accomplished at the expense of a reduction in the capacity of the street network in the downtown area. In general, the larger the ARZ, the larger this reduction in capacity and the higher the potential for severe congestion problems. The impact of closing certain streets to automobiles depends on the number and destination of vehicles originally using the streets. If most of the traffic is destined for the ARZ, the effect of this reduction in street capacity would be minimal. If, however, heavily used through streets were severed by the ARZ, then through (whether CBD through or local through) traffic would be directed onto alternative routes bypassing

the ARZ. If these alternative routes were not able to handle this increased volume, severe congestion could result.

The exact impact of ARZ size on travel patterns will, of course, vary from city to city depending on specific characteristics of the particular area. However, it is possible to develop a general set of relationships between ARZ size and various aspects of travel patterns. For example, for work trips, one would expect that increased ARZ size, without any other local improvements, would result in a decrease in the number of autos used for commuting as a result of reduced parking availability, increased walk distances, and increased congestion on streets immediately surrounding the ARZ. Similarly, a shift in mode from auto to transit, would also be expected for shop trips. Impacts of an ARZ on the number of shopping trips made to the area, however, are difficult to forecast. Because shop trips in general are highly sensitive to any loss of "convenience," an ARZ could serve to discourage shopping trips through increases in travel times or walk distances. This negative effect, however, could be countered by a substantial improvement in the ARZ's shopping environment, which could attract more shoppers to the area. "Noon-hour" trips (trips made by workers during the day) within the area would also increase as a result of increased attractiveness of the area.

Preliminary analysis of two sites as typical cities strongly support these generalizations. The results of analyses of various transportation policies as well as ARZ size for these case studies are presented in the next section.

TRANSPORTATION POLICY IMPACTS

As discussed in the previous section, an important factor in determining the success or failure of an ARZ is accessibility to and within the area affected. This accessibility, in turn, is a direct result of the type of transportation policy implemented in conjunction with the ARZ. Because of this, it is important that a number of transportation policy options be analyzed thoroughly before implementing an ARZ.

A wide range of options exist for implementing both auto restriction disincentives and transportation improvement incentives associated with an ARZ. For auto restrictions, these options include:

- Type of restriction (total exclusion, sectorization, parking ban, etc.)
- Vehicles restricted (all vehicles, all autos, all single occupant autos, etc.)
- Duration of restriction (all day, peak period, noon hour, etc.)

For transportation improvements, these options include:

- Internal distribution system (fixed route bus system, demand responsive service, etc.)
- External accessibility (areawide improvements in transit service to ARZ, park-ride facilities, ring road, etc.)
- Parking (provide more spaces, prohibit/discourage long-term parking, shift long term to short term use, reduce parking fees, etc.)

The optimal combination of incentives and disincentives for implementing an ARZ will depend on the motivation for creating the ARZ and the characteristics of the transportation infrastructure for the specific city.

Policy Alternatives

A preliminary analysis of a limited number of transportation policies and ARZ sizes was undertaken for two cities. The purpose of this analysis, made during the site selection phase, was twofold. First, the analysis was used to test the validity of the approach as a planning tool for later use in the design of actual ARZ demonstration plans. Second, the analysis was intended to determine the general direction and magnitude of the impacts of different levels of auto restriction on a variety of potential ARZ configurations.

The two cities used as test sites were distinctly different. City A is a large city with good transit service and heavily used downtown parking. City B is smaller with relatively poor transit service, excess downtown parking, and a large amount of low cost fringe parking which is used by downtown workers.

While other city types might have been chosen, these two cities were selected because actual data were available for the demand models. The transportation

planning data, recently collected in the two cities designated A and B, was used in this analysis in order to provide a realistic picture of probable impacts of a variety of ARZ's on tripmaking and mode choice.

The policy alternatives that were analyzed for three different ARZ sizes within each city include:

- Policy 1 — Total exclusion of autos for the entire day with no transportation improvements implemented
- Policy 2 — Total exclusion of autos for the entire day for a fixed route bus system provided for internal distribution
- Policy 3 — Total exclusion of autos for the entire day with a fixed route bus system and areawide transit improvements to the ARZ
- Policy 4 — Total exclusion of autos during peak periods only with no transportation improvements implemented

Before presenting the results of this analysis, it would be useful to first examine exactly how different individuals would be affected by each of these four policies. In the base case, individuals traveling by auto to the CBD drive to one of a number of parking facilities, park, and walk the relatively short distance to their final destination. Those using transit, ride to the stop nearest their destination and walk the remaining distance.

With Policy 1 (auto exclusion, 24-hour, no improvements), the parking facility originally used by the auto traveler is no longer accessible as a result of auto exclusion, requiring the auto users to park further away from their ultimate destination and walk a longer distance. Additionally, the decreased street capacity resulting from Policy 1 would undoubtedly cause increased congestion on streets surrounding the ARZ. The individual using an auto for his work trip has only two choices in the short run:

- Tolerate the decreased level-of-service and continue to drive/ride to work
- Switch to transit for the work

The shopper, however, has several options available. Not only can he change modes in response to reduced auto level of service, he could also choose to shop in more accessible areas, or to shop less frequently.

Policy 2 (auto exclusion, 24-hour, internal transit) represents an attempt to improve upon the relatively poor auto level-of-service resulting from Policy 1 by implementing a fixed route fare-free CBD distributor bus system, connecting the parking facilities and circulating throughout the downtown area. This system improves the accessibility to the CBD over the base case by providing an alternative to the long walk distances imposed by total auto exclusion. Thus, for many auto users, a large portion of the time that would be spent walking as a result of Policy 1 would be replaced by time waiting for and riding in a minibus. The extent to which such a system would increase auto or transit usage relative to the base case and Policy 1 will depend on the characteristics of the proposed system and the spatial distribution of parking facilities, transit stops, and activity sites within the urban core.

In Policy 3 (auto exclusion, 24-hour, areawide transit improvements), areawide regional improvements in transit service to the ARZ are added to the scenario described for Policy 2 as another measure toward maintaining or improving accessibility in conjunction with the ARZ. In this case, however, rather than enhancing auto level-of-service, the improvements are aimed at providing an alternative to auto.

Policy 4 (auto exclusion, peak-hour, no improvements) is comprised of the same basic set of auto restrictions included in Policy 1 except that in this case the restrictions are imposed only during peak periods. Therefore, the impact on workers will be basically the same as for Policy 1 with possible exceptions that there will be less competition for parking in areas surrounding the ARZ during the peak period. This is due to the fact that shoppers and other off-peak travelers using auto will find it much easier to find a parking space close to their final destination and, therefore, will actually experience an increased level-of-service. The results of the analysis of these four policies for the two prototypical cities for three different sized ARZ's are discussed in the following sections.

City A: Case Study

For this larger city (SMSA population 3,000,000), with good transit service and a downtown employment population of 275,000, the response to Policy I (auto restriction, 24-hours, no transportation improvements) has a number of significant impacts. Figure 8 shows the three different sized ARZ's and number of base work and shop trips for each. The proposed ARZ's are centered around existing CBD shopping malls. For each of the three ARZ's, there is an absolute increase in transit ridership for work trips as many auto users, faced with increased walk distances and congestion on local streets, switch to transit rather than tolerate a decrease in auto level-of-service as shown in Figure 9. As one might expect, this shift to transit increases non-linearly with ARZ size. For the smaller sized ARZ, this increase is on the order of 750 over a base of 2,115 transit work trips. For the largest ARZ, this has grown to nearly 7,000 additional transit trips over a base of 21,125 transit work trips. This increase is primarily the result of two factors:

1. Increased walk distance for auto modes as workers must park farther and farther away from their ultimate destination

2. Increased number of workers that are directly affected in larger ARZ's

Unlike workers, for whom the number and destination of work trips are relatively fixed in the short term, shoppers have considerable flexibility in deciding how often, where, and by what means they will make shopping trips. With this in mind, it is not surprising that the response to this policy of complete auto restriction with no transportation improvements is a decrease in the total number of shopping trips to the ARZ (Figure 9). For the smaller area, the decrease is in the order of 300 on a base of 3,132 shop trips by transit. For the larger area, the decrease amounts to 3,000 trips on a base of 7,513 transit shop trips. However, for those that do make the trip to the CBD, there will be a shift in mode from auto transit as shown in Figure 9. This overall decrease in total trips is the result of shoppers selecting more accessible retail centers and/or shopping less frequently. As expected, the magnitude of this drop in shopping trips increases with ARZ size and decreasing accessibility. Comparing the shift in mode from auto to transit for work and shop trips, as expected, we see an increasing shift for workers which

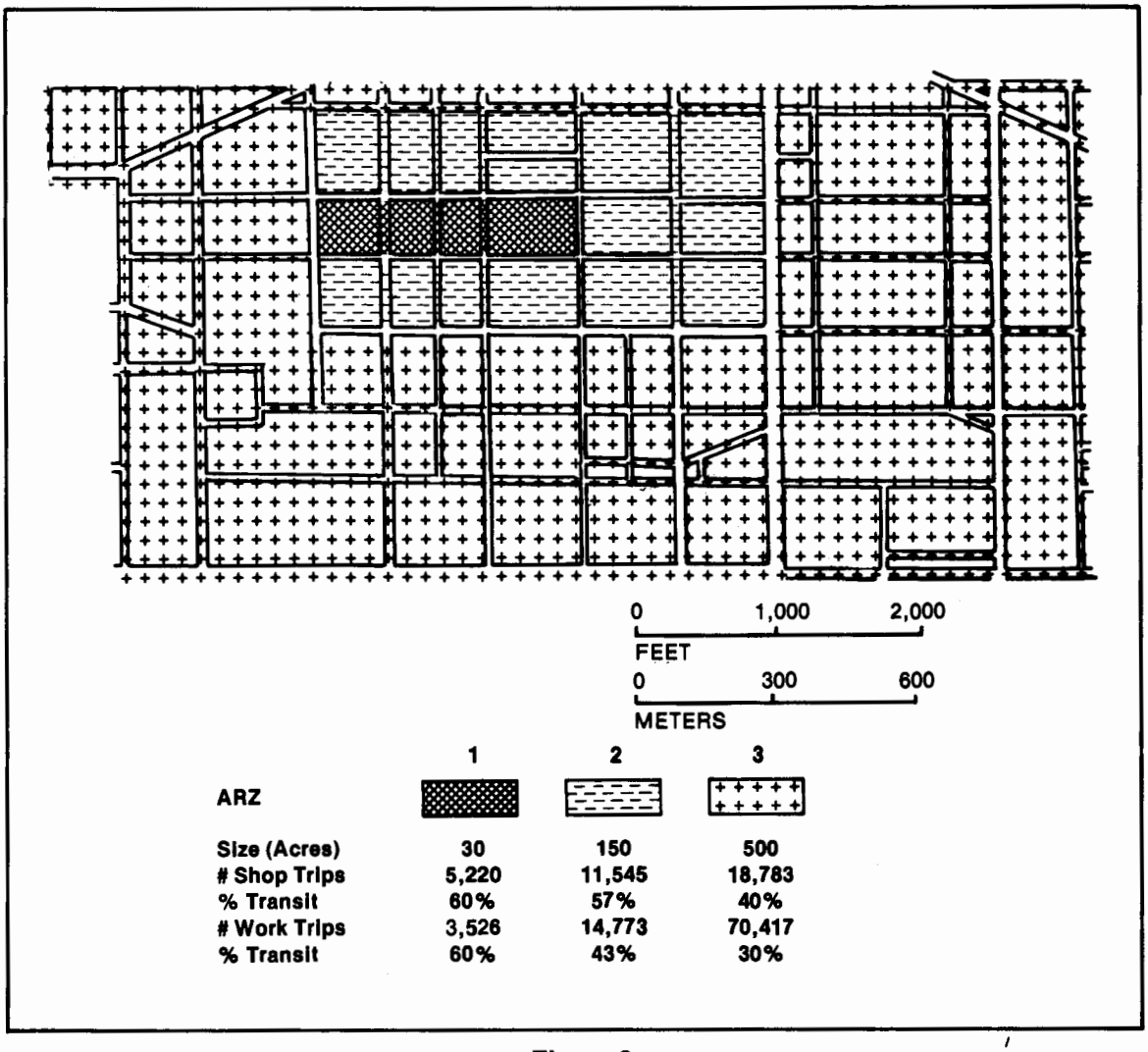
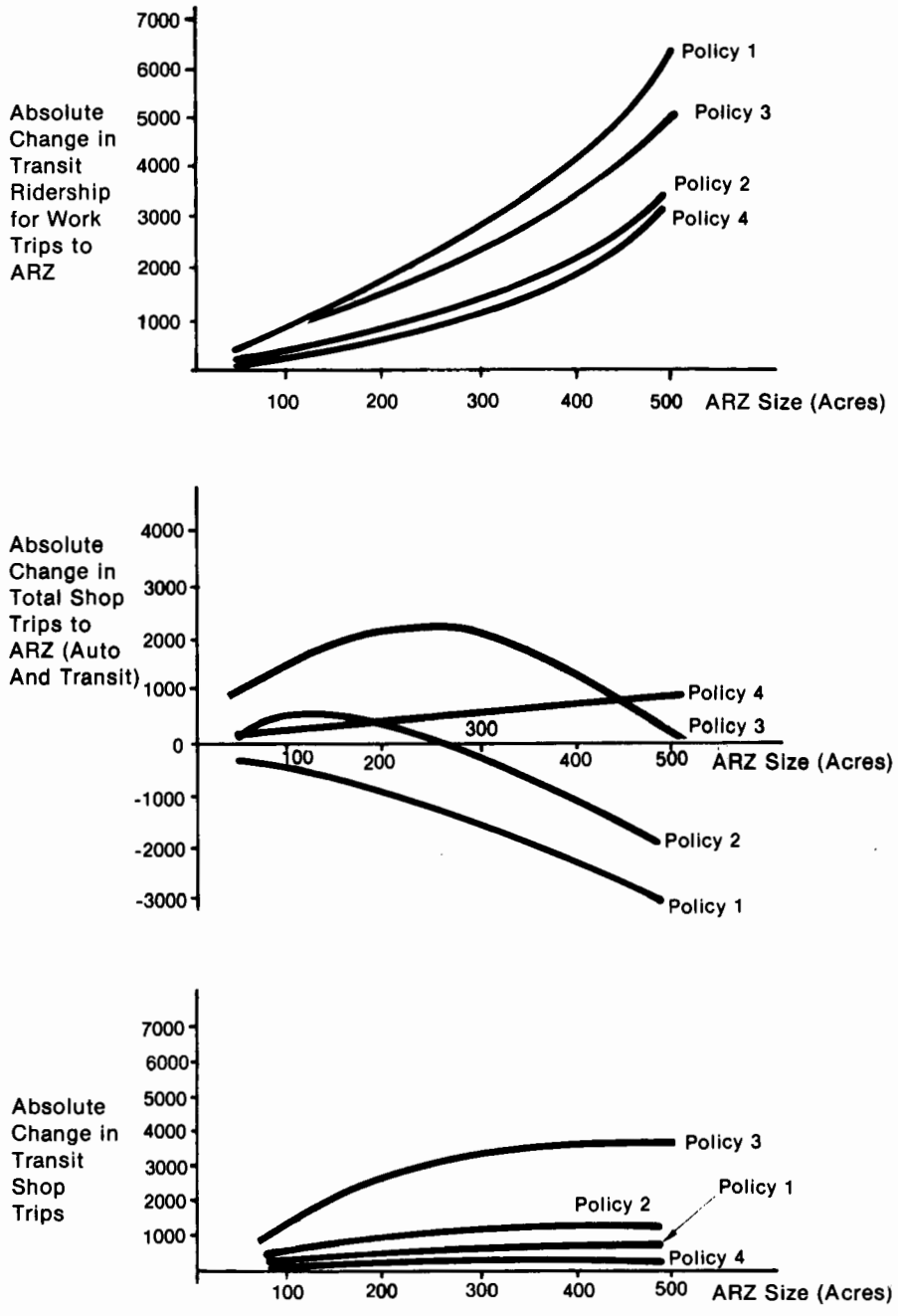


Figure 8
City A: Three Prototype CBD ARZ's



Policy: 1 — Auto exclusion, 24 hrs., no improvements
2 — Auto exclusion, 24 hrs., internal transit
3 — Auto exclusion, 24 hrs., areawide transit
4 — Auto exclusion, peak hour, no improvements

*Changes given in absolute terms to illustrate effects of changing ARZ size

Figure 9
Travel Pattern Changes — City A

increases faster than ARZ size increases. For shop trips, a smaller absolute increase because shoppers (both auto and transit) have now chosen not to come, but for those that do switch modes, it is an increasing function of ARZ size but at a decreasing rate.

Under Policy 2, fixed route bus service would be provided between parking lots and the ARZ as well as within the ARZ. The increased walk distance experienced by auto users originally parking within the ARZ is partially replaced now by wait and in-vehicle travel time for the bus system. In addition to these auto users directly affected by an ARZ, others may benefit from this distribution system. For example, it is conceivable that auto users with destinations in the ARZ but originally parking outside the area, as well as transit users, may experience an improved level of service above that existing prior to auto restriction as a result of the internal distribution system. Therefore, it is possible to identify three distinct categories of individuals traveling to an ARZ in terms of expected changes in level-of-service resulting from such a distribution system:

1. Auto Users Originally Parking Within the ARZ — This group is directly affected by auto restrictions; since most individuals in this group probably parked very close to their destinations before auto restrictions were imposed, it is doubtful that any distribution system could provide the same level of service.

2. Auto Users Originally Parking Outside the ARZ — This group is indirectly affected by auto restrictions through increased competition for parking; in general, an internal distribution system could provide a better level of service than that experienced prior to ARZ implementation.

3. Transit Users — In general, this group could experience better level of service.

The overall impact of an internal distribution system on all trips to the ARZ will depend on the extent to which such a system will benefit any particular group and the relative size of each group, which in turn depends on the specific spatial configuration of the distribution system, parking supply, and transit system.

In this case study, the fixed route CBD distributor service implemented under Policy 2 is used primarily by auto users directly affected by auto restrictions and

those using regional transit lines that pass through the ARZ. For workers originally using auto, this results in a significantly improved level-of-service relative to Policy 1, although still not equal to that existing prior to auto restriction, and many of those switching to transit as a result of Policy 1 would consider switching back to auto. However, because transit level-of-service is improved as well, some of these workers originally using auto would continue using transit as a result of Policy 2. The end result of these two effects under Policy 2 is the moderate shift back from transit to auto over Policy 1 but with still a positive transit shift. The result of this analysis indicates that for smaller ARZ's providing an internal distribution system has no significant impact on work trips. This undoubtedly results from the fact that very little increase in walk distance is experienced with small ARZ's, and in many cases, workers could reach their final destination faster by walking this relatively short distance rather than waiting for and riding in a minibus. For larger ARZ's, however, the relatively large increases in walk distances make the internal distribution system relatively more attractive.

A similar situation exists for individuals shopping in the ARZ for Policy 2. For example, none of the three groups mentioned earlier is significantly affected for small ARZ's. For larger ARZ's, however, the same two groups are affected as were for work trips: auto users originally parking within the ARZ boundary and transit users. However, it is apparent that for mid-sized ARZ's under Policy 2 there is actually a gain in total shopping trips resulting from the improved level-of-service for transit users, which more than offsets the drop in trips by auto shoppers directly affected by the ARZ. For large ARZ's, however, proportionately more auto shoppers are directly affected by auto restrictions and the decrease in number of trips by this group dominates.

In Policy 3, areawide improvements (frequency, travel time) in transit service to the CBD are implemented along with auto restrictions and fixed route distribution system described in Policies 1 and 2. These improvements are represented in the analysis by assuming the frequency on all regional transit lines is increased such that wait time for vehicles was 1/2 of the original value. As expected and shown in Figure 9, compared to Policy 1 and 2, there is a significant shift to transit because of improved service, whereas the similar shift resulting from Policy 1 alone

is caused by a disincentive of workers being forced away from the auto as a result of decreased level of service. On the other hand, it should also be pointed out that Policy 3 will be more costly to implement but is perhaps more reasonable than complete restriction under Policy 1. In addition, while the short-term effects on work trips for both Policies 1 and 3 are similar, it seems reasonable to expect that the long-term impacts would be quite different.

The addition of areawide improvements in regional transit service has a much more pronounced impact on shoppng trips than does other policies. As described earlier, these trips are more discretionary in nature than work trips, allowing much more flexibility in responding to change in accessibility. Thus, it is not surprising that Policy 3 results in a significant increase in the total number of ARZ-destined shopping trips. As shown in Figure 9, the number of these trips increase with ARZ size at a decreasing rate up to a point, and then begins to decrease. Here again, the total number of trips is the result of two factors working against each other. For this policy, the number of transit trips increases with ARZ size (Figure 9) while at the same time more and more auto shoppers are lost as walking distances become longer and longer. Analysis indicates that the increase in transit trips dominate for smaller ARZ's, while for larger sizes, the decrease in auto trips dominates.

In Policy 4, total exclusion of autos during peak periods only with no transportation improvements, the effect on work trips is similar to that of Policy 1. Since work trips occur primarily in the peak period, there is little difference for work trips under these two policies. However, under Policy 4, because the restriction is for peak periods only, there is less competition for parking in areas surrounding the ARZ, and as a result, the impact on walk distances and transit mode choice is not as significant. In fact, the impact on work mode split under Policy 4 is closer to Policy 2 than either Policy 1 or Policy 3. For shoppers using autos, the competition for parking facilities is decreased significantly since spaces previously used by workers in the ARZ are now available. The result is an increase in the number of auto shoppers. Table 8 identifies the absolute change as well as the percentage change in transit work trip for each policy alternative and ARZ size. Table 9 identifies similar statistics for shopping trips for City A.

Table 8
Travel Pattern Changes — City A Work Trips

		ARZ Sizes		
		30 Acres	150 Acres	500 Acres
Base Data	Total Work Trips	3,526	14,773	70,417
	Percent Transit	60	43	30
	Transit Work Trips	2,116	6,352	21,125
Policy 1	Change in Transit Trips	+17	+1,019	+7,112
	Percent Change	1	16	33
Policy 2	Change in Transit Trips	+17	+930	+4,436
	Percent Change	1	14	21
Policy 3	Change in Transit Trips	+107	+1,214	+4,787
	Percent Change	5	19	22
Policy 4	Change in Transit Trips	+17	+964	+4,436
	Percent Change	1	15	21

Table 9
Travel Pattern Changes — City A Shopping Trips

		ARZ Sizes		
		30 Acres	150 Acres	500 Acres
Base Data	Total Shop Trips	5,220	11,545	18,783
	Percent Transit	60	57	40
	Transit Shop Trips	3,132	6,580	7,513
Policy 1	Change in Total Trips	-84	-350	-3,821
	Percent Change	-2	-3	-20
	Change in Transit Trips	0	+208	+545
	Percent Change	-	3	7
Policy 2	Change in Total Trips	-84	+307	-2,629
	Percent Change	-2	3	-14
	Change in Transit Trips	0	+623	+1,315
	Percent Change	-	9	18
Policy 3	Change in Total Trips	+784	+2,057	-393
	Percent Change	15	18	-2
	Change in Transit Trips	+872	+2,385	+3,588
	Percent Change	28	36	48
Policy 4	Change in Total Trips	+118	+254	+518
	Percent Change	2	2	3
	Change in Transit Trips	0	0	0
	Percent Change	-	-	-

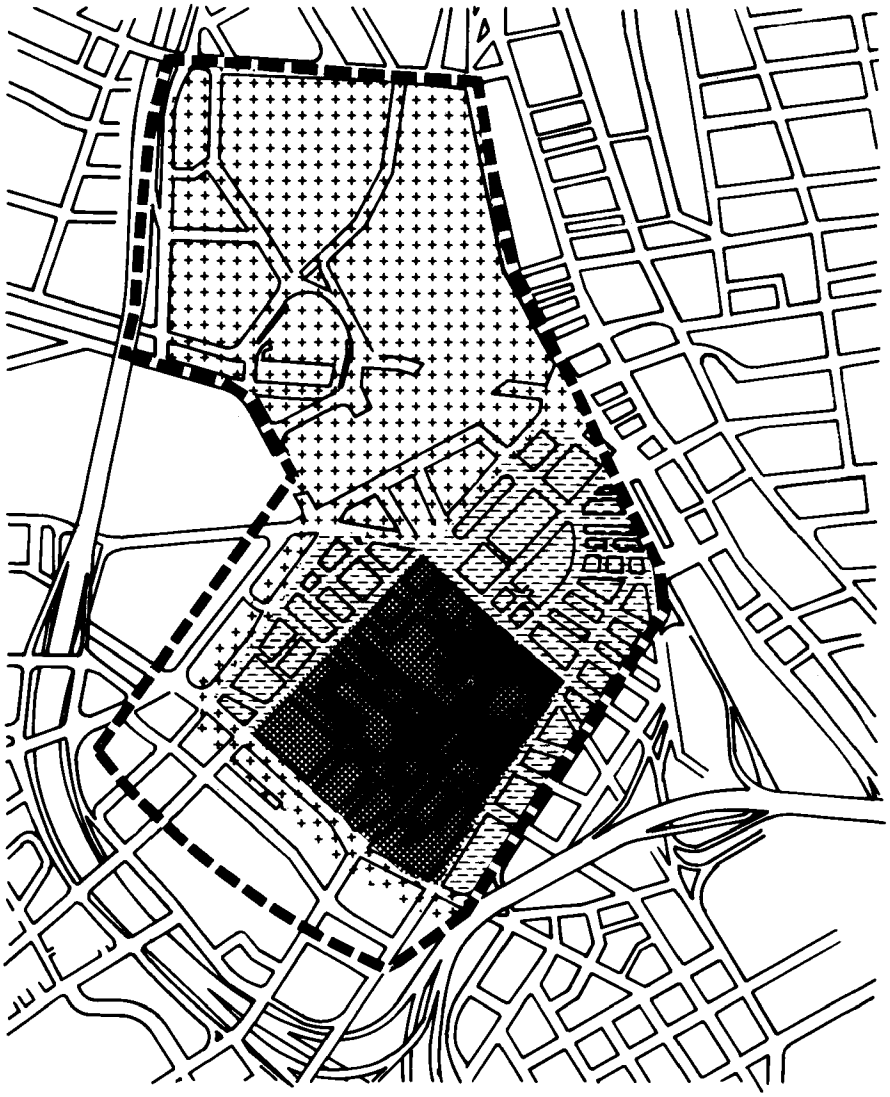
City B: Case Study

This prototype, by contrast to City A, is much smaller (city population 292,000, SMSA 906,000) with a more compact CBD and poorer transit service. It has a total CBD employment of 20,000, a daytime population of 55,000, and 11,000 total parking spaces. Figure 10 identifies the three different size ARZ's for City B and the base travel characteristics for each.

The impacts of Policy 1 (auto exclusion, 24-hour, no improvements) on both work and shop trips in this case are very similar to those predicted for City A as shown in Figure 11. The primary differences are only one of scale. Transit ridership for the work trip increases, total shopping trips decrease, and shopping trips by transit increase just as in City A.

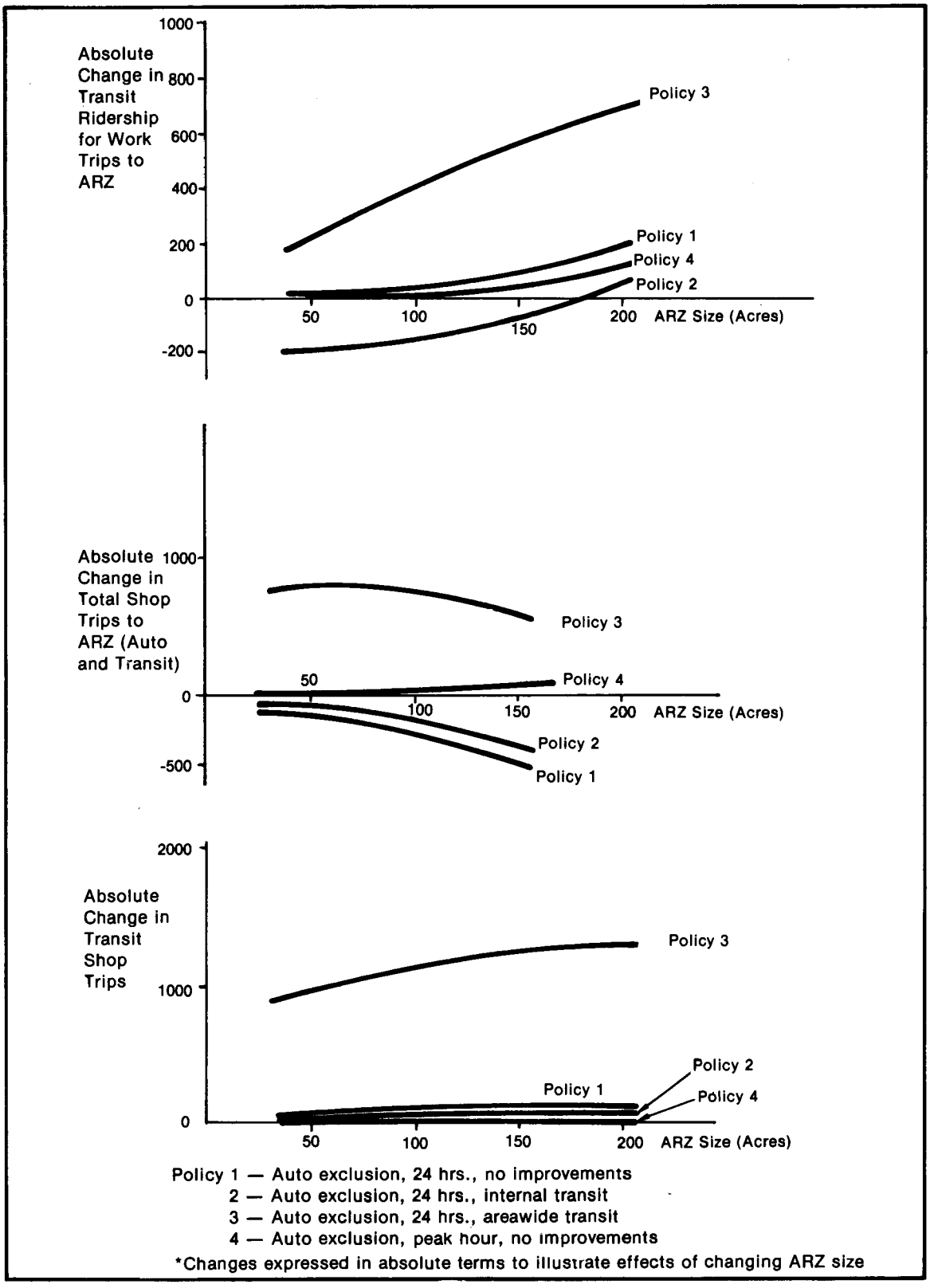
Similarly, the availability of an internal distribution system under Policy 2 results in a shift from transit back to auto for work trips. Unlike the larger city, however, most of those auto users working in the ARZ in City B originally parked outside the area, and therefore, are not directly affected by auto restrcitions for the two smaller ARZ's. This, together with the fact that workers using transit benefit very little from the fixed route system, results in a very large shift away from transit back to auto. The fixed route system actually results in more workers choosing auto than did prior to implementing auto restrictions. This is a direct result of the significant improvement in auto level of service that results from providing an alternative to the very long walk distances from parking facilities experienced by most CBD workers prior to auto restrictions. For very large ARZ's, however, most workers using auto are directly affected by auto restrictions, and the situation is similar to that in the larger sized city.

The availability of an internal distribution system for small ARZ's has very little effect on total shopping trips. Unlike City A, however, shoppers using transit do not benefit as much from the internal distribution system, and the impacts of auto shoppers directly affected by auto restriction dominate. Therefore, there is no gain in the number of transit shoppers to offset the drop in auto shoppers, resulting in a constant decrease in total shopping trips as ARZ size increases.



	1	2	3
ARZ			
Size (Acres)	34	97	206
#Shop Trips	6,132	6,900	7,665
% Transit	50%	50%	50%
# Work Trips	10,000	14,120	20,172
% Transit	20%	20%	20%

Figure 10
City B: Three Prototype CBD ARZ's



Policy 1 — Auto exclusion, 24 hrs., no improvements
2 — Auto exclusion, 24 hrs., internal transit
3 — Auto exclusion, 24 hrs., areawide transit
4 — Auto exclusion, peak hour, no improvements

*Changes expressed in absolute terms to illustrate effects of changing ARZ size

Figure 11
Travel Pattern Changes — City B

The Policy 3 addition of areawide improvements in transit service to the ARZ has the expected impact on work trips of significantly increasing transit ridership. Figure 11 indicates that the relationship between ARZ size and transit ridership for this policy is similar to that predicted earlier, i.e., as ARZ size increases, transit ridership increases. Unlike City A, however, the percentage increase resulting from this policy relative to Policy 1 is much greater in the smaller city. This is because most of those auto users who work in the ARZ are not affected by the auto restrictions of Policy 1 and as a result very few switch to transit. The transit incentives of Policy 3, however, apply to all ARZ workers, several of whom change modes to transit. In the first case study, however, practically all ARZ workers are affected by the auto restrictions of Policy 1, resulting in a significant shift to transit for that policy.

The effects of these transit improvements on shopping trips to the ARZ relative to ARZ size are similar to those predicted for the large metropolitan area; the increasing number of transit shoppers results in an increasing number of total shopping trips up to a point where the decline in auto shoppers begins to dominate.

The effects of Policy 4, auto exclusion during peak periods with no transportation improvements provided, are very similar to those predicted for City A. Workers using auto experience an improved level of service above that provided by Policy 1 since there is less competition for parking in areas surrounding the ARZ, resulting in a slight shift from transit back to auto relative to Policy 1. Shoppers using auto who now have a better selection of parking spaces within the ARZ could probably park closer to their final destination than in the base case, resulting in an increase in the number of auto shoppers. Because the number of transit shoppers remains unchanged for all practical purposes, the total number of shoppers to the ARZ increases. Table 10 identifes the absolute change as well as the percentage change in transit work trips for each policy option and ARZ size alternative. Table 11 identifies similar statistics for shopping trips for City B.

INSTITUTIONAL AND LEGAL FACTORS

The primary issue of ARZ planning that must be recognized in the consideration of legal and institutional factors is that the implementation of an ARZ is basically

Table 10
Travel Pattern Changes — City B Work Trips

		ARZ Sizes		
		34 Acres	97 Acres	206 Acres
Base Data	Total Work Trips	10,000	14,120	20,172
	Percent Transit	20	20	20
	Transit Work Trips	2,000	2,824	4,034
Policy 1	Change in Transit Trips	+2	+3	+262
	Percent Change	.1	.1	65
Policy 2	Change in Transit Trips	-200	-147	+32
	Percent Change	-10	-5	1
Policy 3	Change in Transit Trips	+153	+321	+644
	Percent Change	7	11	16
Policy 4	Change in Transit Trips	0	0	+101
	Percent Change	-	-	3

Table 11
Travel Pattern Changes — City B Shopping Trips

		ARZ Sizes		
		34 Acres	97 Acres	206 Acres
Base Data	Total Shop Trips	6,132	6,900	7,665
	Percent Transit	50	50	50
	Transit Shop Trips	3,066	3,450	3,833
Policy 1	Change in Total Trips	-86	-297	-644
	Percent Change	-1	-4	-8
	Change in Transit Trips	+3	+7	+15
	Percent Change	-	-	-
Policy 2	Change in Total Trips	-60	-152	-516
	Percent Change	-1	-2	-7
	Change in Transit Trips	+1	+3	+11
	Percent Change	-	-	-
Policy 3	Change in Total Trips	+722	+732	+476
	Percent Change	12	11	6
	Change in Transit Trips	+818	+922	+1,030
	Percent Change	26	26	27
Policy 4	Change in Total Trips	0	0	0
	Percent Change	-	-	-
	Change in Transit Trips	0	0	0
	Percent Change	-	-	-

a political decision. Because ARZ's are a form of traffic restraint, it implies regulation and restriction of the flow of vehicular traffic. The needs of the pedestrian are elevated to a more prominent position with respect to the once dominant automobile. This realignment of planning objectives is certain to encounter political and institutional resistance from established auto-oriented sectors within the community and its government.

Local Leadership

The creation of an ARZ depends upon the successful negotiation of the political process of consensus building, with the quality of local leadership being a primary consideration. Two characteristics are most important. The implementation of an innovative proposal such as an ARZ is bound to create a certain amount of status-quo oriented opposition. The local leadership must have the political strength and interest to support and, in fact, lead the way in implementing ARZ proposals. A local leader without a clear public mandate and a secure power base will be less likely to commit municipal resources to innovative and potentially controversial approaches to city problems. Secondly, the political strength of local leadership is small benefit without high level support and commitment to ARZ objectives. Clearly, leadership's commitment and enthusiasm for ARZ potential greatly assists the process of planning and consensus building with municipal agencies.

Interagency Cooperation

Because of the multidisciplinary nature of ARZ's, a number of different governmental agencies must be involved in planning and implementation. The ability of these various authorities to work together is critical to the successful implementation of an ARZ. A list of the relevant local and state agencies would include:

- Planning department
- Traffic engineering
- Police
- Fire department
- Transit authority
- Regional transportation study

- Public works
- State highway department
- Federal agencies

These groups cover a broad spectrum of municipal affairs. Their acceptance of an ARZ strategy of traffic restraint will probably be a function of how ARZ would affect their own direct areas of concern. It can be expected, therefore, that ARZ policies will be strongly supported in some areas of local government and find only weak support or even opposition in other departments. The enthusiastic support of the local leadership for ARZ policies can minimize such opposition and provide a basis for cooperation among agencies. Without the cooperative effort of all municipal agencies, the chances for a successful ARZ implementation are significantly reduced.

Organizational Change

One potential institutional obstacle involves the organization of municipal resources for ARZ implementation. What organizational changes are necessary to plan, implement, and administer an ARZ? It appears that major organizational change is not necessary for successful ARZ implementation. Some organization adaptation, such as the creation of a temporary task force, would be adequate in most cases. Major organizational realignments would also not be required in the administration and enforcement of an auto restriction strategy and would probably be counterproductive. Administration and enforcement of the elements of the ARZ could be accomplished by the existing functional municipal line agencies. Some changes in emphasis may be required, such as a more vigorous anti-litter effort in pedestrianized areas or a police campaign to enforce traffic regulations critical to circulation around the ARZ. Continuing municipal responsibility over the ARZ is best accomplished through a low-level monitoring effort conducted by the departments of planning and traffic engineering rather than by a special ARZ commission requiring major organizational readjustment.

Planning Compatibility

Any discussion of auto restraint within an urban center must recognize the existence of previous plans. The degree of compatibility of ARZ with local institutions such as the comprehensive development plan, the zoning ordinance, and the metropolitan 3-C transportation plan, is critical to successful implementation. At the very least, previous planning efforts must not entirely "close the door" to the concept of traffic restraint if ARZ is to have any probability of official acceptance. In the best case, ARZ planning in specific subareas will be coupled with regional transportation system management (TSM) planning with resulting complementary regional effects. If the urban form concept design embodied in the comprehensive plan envisions a nodal form of development featuring dispersed activity centers, the potential for the dense pedestrian activity necessary to an ARZ is seriously diminished. In a similar way, if the zoning ordinance and the downtown development plan encourages the provision of more and more CBD parking spaces, the concept of auto restriction would be in direct opposition. If the basic objectives of traffic restraint are not reflected in the Federally-approved transportation planning process through measures to encourage the use of public transit, the potential for a successful ARZ is virtually negated.

From the institutions of local government, then, several factors emerge as critical to the development of an ARZ. First, the ends and the means of traffic restraint must find acceptance with both elected officials and the staffs of a variety of municipal agencies. Second, these agencies must have the demonstrated ability to work together to make the project a reality, without detrimental effects of interagency power struggles. Lastly, the objectives and techniques of auto restriction must be grounded on a firm theoretical and practical base in the existing planning efforts of the community.

Public Participation

In addition to these institutions of the public sector, institutions from the private sector are also key factors in ARZ success. Like any major urban policy change, planning for an ARZ must be conducted with full public participation. Strong

public support and participation can be the single most decisive factor in speeding ARZ implementation. Among those expected to be concerned are:

- Chamber of Commerce
- Downtown Merchants Association
- Downtown Neighborhood Organizations
- Auto commuters
- Transit riders
- CBD shoppers

Public reaction can be expected to range from enthusiastic support to full opposition. Despite the evidence to the contrary, CBD merchants may fear that the removal of auto traffic from certain streets will result in a loss of sales. Auto commuters may resent ARZ policies as an interference with their established travel patterns. On the other hand, CBD shoppers and workers will probably support the creation of a new pedestrian-oriented environment that frees them from the domination of the auto and its attendant social costs. Similarly, transit users may support auto restriction because of the concomitant improvements in transit services and travel times.

Opposing sectors of the general public will only be won over to supporting ARZ through public information programs, hearings, and participation. If merchants can be assured that their interests are reflected in the objectives and methodologies of ARZ planning, their support can be instrumental in moving the general public and local government towards ARZ as an innovative solution to problems of urban congestion and pollution.

Legal Considerations

Legal factors are also of primary importance in the creation of an ARZ. Two legal questions are most relevant:

1. Is the community legally empowered to create an ARZ?
2. Must compensation be paid to businesses alleged to be damaged by the creation of an ARZ?

The question of enabling powers cannot, of course, be given a general answer due to the varied nature of state and local law in the U.S. The legal validity of any traffic restraint strategy depends upon the degree and scope of restraint exercised. As detailed previously in this report, techniques of auto restriction may range from the complete ban of all vehicles to selective or temporal prohibition, to simple adjustments of parking supply and traffic circulation. The legality of an ARZ depends largely upon the methods of restriction employed.

Although the use of public highways has been found to be the inalienable right of every citizen, this right is subject to the proper exercise of the police power of regulation. Two principal issues are concerned: the delegation of police power to the state and the proper exercise of that authority in creating an ARZ. In some states, law prevents the validity of a local ordinance banning all traffic. Thus, creation of an ARZ through regulation may not be valid, and other options, such as discontinuance of the street, must be employed. In many states, however, the trend has been to pass special enabling legislation to permit communities to close off streets entirely, under certain specified conditions. In any case, the validity of a ban on private autos depends on the existence of a proper delegation of authority to the municipality by the state. Validity further depends upon the proper exercise of that authority. Basically, the power to prohibit must be exercised in a reasonable fashion.

The second major question is whether the closing of a street will result in a compensable taking of the property of abutting merchants, especially in the case of auto-oriented users such as parking garages or service stations. The issues involved here are the right of access to property and the consideration of access itself as property. In general, it has been established that compensable property rights include the right of a property owner to have direct access to a public street abutting his property and to view, light, and air over the street. Courts have found, however, that the interests of an abutting property owner in a public way are subject to reasonable interference by regulatory action without compensation. Again, here, reasonable regulatory action must be based on the protection of the health, safety, or general welfare of the public. Although the particular facts of each case are of the highest importance in considering legal validity, it appears that

the right of access does not necessarily imply the right of access by automobile. This suggests that owners of parking garages within an ARZ may not be entitled to compensation for loss of business if the prohibition of auto traffic is grounded on the protection of the public health and safety. In apparently similar situations, it has been found that although an ordinance did prevent a profitable use to which a piece of property had been devoted, if there was no evidence that the regulation would reduce the value of the lot, which could be used for something else; no compensation was required.

Without the facts of a particular case and a specific set of laws that would apply, however, such arguments are speculative. One thing is certain, and that is that Auto Restricted Zones which completely prohibit auto access to uses such as parking garages will be challenged if provisions are not made to satisfy the property owner. In order to limit unnecessary delays in implementation, ARZ planners should seek reasonable opportunities for accommodation and avoid confrontations that can only be resolved in the courts. As has been discussed earlier in this report, the complete prohibition of auto traffic is only one option, the most extreme one, from a wide range of available techniques to restrain traffic and reduce its impacts. If the ARZ framework is successfully established and supported with official policies and plans, non-conforming uses can be gradually eliminated over time as the area evolves into a primary transit and pedestrian district.

Chapter V
Summary And Conclusions

CHAPTER V
SUMMARY AND CONCLUSIONS

The concept of Auto Restricted Zones for congested urban areas has been presented, illustrated, and explored here in great detail. The analysis has related ARZ goals and objectives to a variety of techniques for implementation and sifted through a mass of existing experience with ARZ concepts to identify key factors in their success. In review, it may be useful to examine the principal points and briefly discuss their significance in a broader context.

Overall, it must be recognized that this examination of the utility and feasibility of introducing measures of traffic restraint takes place within a larger institutional framework. This framework is the Transportation Systems Management (TSM) approach, the required short-range element of the multimodal regional transportation planning process. Transportation Systems Management seeks to identify more cost-effective means of improving transportation services in urban areas. Traffic restraint is one type of control strategy within the TSM approach that seeks to optimize the supply of transportation services to all modes, including auto, transit, and pedestrian.

GOALS AND OBJECTIVES

Within the transportation-related aims of the TSM thrust to make more efficient use of existing facilities and lower cost short-range improvements, the goals and objectives of ARZ plannng and implementation relate to the quality of life in urban areas and the movement of people and goods, not just vehicles.

Goals

ARZ program goals are directed toward an idealized end state reflecting the social values expressed in national transportation policy and the objectives of state and local governments. These general goals of traffic restraint include:

- The preservation and enhancement of the attractiveness and vitality of urban centers
- The improvement of environmental quality of urban areas
- The increased utilization of non-auto modes of transport

Objectives

The objectives of traffic restraint are goal-based targets formulated so that the degree of attainability can be measured. Over 20 specific objectives for ARZ were identified and grouped into four categories. Transportation objectives include maintenance of accessibility, improvement in transit services, reduction of land requirements for parking, and decreased consumption of energy resources. Social objectives range from increased community interaction and cohesion to better perception of personal security. On the economic and environmental side, ARZ policies seek to stimulate local economic growth and investment while simultaneously reducing exhaust emissions for improved air quality. The restraint of traffic in towns can achieve measurable effects in a number of broad impact areas represented by these objectives. Quantifiable benefits can be achieved in transit patronage, air quality, retail sales, municipal tax base, and a variety of other areas of critical urban concern.

ARZ TECHNIQUES

In Chapter II, a wide range of ARZ techniques were identified and discussed. The basic fact of primary importance is that each urban area is unique. As a result, there is no single approach to auto restriction that can be constructed, described, and universally prescribed. The creation of an ARZ must be founded on the careful analysis of the particular characteristics of the situation and the application of selected techniques to achieve certain objectives within the limits of local constraints.

The basic elements of an ARZ were identified and illustrated. These elements include diversion and circulation routes as well as fundamental, expanded and reinforcing core attractiveness features. Four distinct ARZ schemes are diagrammed,

illustrating a pedestrian emphasis, transit emphasis, arterial preference emphasis, and traffic operations emphasis.

Implementation Measures

A taxonomy of over 30 ARZ techniques was presented in tabular form. Techniques were grouped into four categories:

- Physical Measures — street closures, parking supply, street width reduction
- Operation Measures — signalization, signs, metering
- Regulatory Measures — area permits, parking restrictions, delivery restrictions
- Economic Measures — area licensing, congestion pricing, parking surcharge

The first three categories comprise the focus of this research effort. Economic measures are being investigated in a separate study and have been, therefore, outside the scope of this report. Physical, operational, and regulatory measures all focus on the supply side of the transportation equation and are the techniques in general use for traffic restraint throughout the world.

EXISTING EXPERIENCE

Chapter III surveyed the existing experience with ARZ in Europe and the United States. Selected characteristics such as size, type, pedestrian volumes, and cost of construction were presented for 16 representative American pedestrian malls. American efforts in auto restriction have been confined almost entirely to linear pedestrian malls, but illustrations of Boston and Portland show that a new more extensive type of ARZ is beginning to develop here.

The best examples of the benefits of traffic restraint, however, are European. The extremely limited capacity of historic center city areas to accommodate increasing demands for roads and parking space forced many European cities to

examine the option of auto restriction long ago. Maps of several of these cities illustrate the extensive pedestrian networks, transit facilities, and traffic circulation systems that have evolved as planners, officials, and citizens learned that auto restriction could be an economic, environmental, and aesthetic success.

KEY FACTORS

Chapter IV examined key factors in the successful implementation of an ARZ. The identification and discussion of these key factors amounts to a guide to ARZ planning and a consideration of potential obstacles which could hamper success. The key factors include:

- Urban activity patterns
- Urban design issues
- Transportation infrastructure
- Maintaining accessibility
- Size of the ARZ
- Transportation policy impacts
- Institutional and legal factors

The key factors of prime importance can be generalized as attractiveness and accessibility. High levels of both must be created and maintained to make ARZ success a reality. This become clear in the consideration of the impacts of alternative ARZ's and transportation services for two prototypical urban areas. These impacts are characterized in Table 12 according to their magnitude and timeframe.

Table 12
ARZ Impacts on Travel Patterns

	Short Term	Long Term
Route	Primary	
Traffic Flow	Secondary	
Mode Choice		Primary
Trip Distribution		Secondary

CONCLUSIONS

The performance of the Phase I tasks documented in this report has led to a set of basic conclusions about ARZ planning and implementation. These conclusions are:

1. There are substantial opportunities for ARZ in American cities — Although European cities have led the way in identification and utilization of ARZ techniques, some American cities, such as Boston and Portland, have demonstrated their successful application in the auto-dominated U.S. urban environment. Moreover, the level of interest in ARZ in the U.S. is building rapidly among both local administrators and the general public.

2. City size is not critical to ARZ success — The review of existing European and American experience clearly shows that the techniques of auto restriction can be successfully applied in urban areas of different sizes.

3. A strong activity base is required — Although ARZ can assist in the revitalization of a CBD, it cannot be expected to produce activity where none existed before. Any area proposed for ARZ treatment must have a stable base of attractiveness as the medium for incubating renewed urban vitality.

4. A wide range of techniques are available — Not only are state-of-the-art physical, operational, and regulatory measures adequate for the job, but these techniques are also already familiar to planners and traffic engineers throughout the country. Moreover, many of these measures can be applied at only moderate cost.

5. The complete prohibition of auto traffic is not the only option — The available techniques offer a complete range of restriction. A broad spectrum of choice exists that enable planners to restrain traffic in some areas and direct the flow to alternative routes. ARZ techniques can achieve worthwhile reductions in auto traffic without completely closing an area to auto use, as it may be necessary to maintain some auto access.

6. ARZ size is a key determinant of transportation impacts — The extent of transportation impacts, of course, is directly related to the degree of restriction imposed and the transportation infrastructure of the area. It is clear that as an ARZ expands, the measures of restraint affect more origins and destinations as well as major traffic-carrying streets. As a result, as ARZ size expands effects on tripmaking and mode choice will be more pronounced. Most important, the size of an ARZ is closely related to the degree of restriction imposed. The complete ban of auto traffic could only be

instituted within a compact area, but measures of partial restriction could be applied over a broad area. Overall, ARZ impacts on transportation are especially marked on discretionary trips.

7. The key transportation factor is maintaining accessibility — The supply of transportation services in a given CBD area is made up of a variety of services and fixed facilities related to transit, automobiles, and the pedestrian. In addition to the transportation supply within an area, accessibility to a proposed ARZ is equally important. Adjustments in any component of this transportation supply, such as auto restriction, must be balanced by corresponding increases in the other elements. In particular, ARZ can result in improved traffic circulation facilitating trips to and around a CBD area. Parking supply and location can be adjusted so as to actually improve auto accessibility. In a similar way, transit level of service must be improved in order to maintain accessibility. First of all, transit vehicles may be exempted from the restriction measures. Additional routes and shorter headways may be required to facilitate access to and within the ARZ area. The creation of an ARZ presents other access opportunities, as well. In an environment where auto traffic is reduced, major pedestrian improvements are possible which can transform the walk trip into a functional travel mode.

   For the complete auto traffic prohibition situation, the prototype cities analysis demonstrates that severe traffic restraint measures must be balanced by transit incentives. Without compensating transit services, discretionary shopping trips decrease sharply in the short term and it is postulated that over the long run, work trips would also decline in number as jobs relocated to more accessible locations. Alternative transit service improvements, such as those tested, however, can provide an equivalent or superior level of access which can maintain the viability of ARZ activity centers.

This report documents the results of work performed under Phase I of the Auto Restricted Zone/Multi User Vehicle System Study. Tasks completed and reported on here include the investigation of existing experience, key factors, and a feasibility assessment of Auto Restricted Zones. Volume II documents the results of the feasibility assessment of Multi-User Vehicle Systems as an innovative mode of urban transportation. In Volume III, plans for auto-restricted zones in five American cities are presented and illustrated in detail.

Appendix

APPENDIX A

BIBLIOGRAPHY

BIBLIOGRAPHIES

- Auto Free Zones—General
- Pedestrianization—General
- Transportation Control Plans
- Traffic Restraints—General and Specific by City

BIBLIOGRAPHY
AUTO FREE ZONES
GENERAL

Baldwin, Greg, Horner, Nancy, and Williams, Joan. "Survey of American and European Auto-Free Zones." Study developed by Skidmore, Owings and Merrill, Portland, Oregon, Spring 1975.

Barton-Aschman Associates, Inc. "Auto Free Zones: A Methodology for Their Planning and Implementation," Action Plan for Improvements in Transportation Systems in Large U.S. Metropolitan Areas. Prepared for U.S. Department of Transportation, Office of the Secretary. Report No. DOT-05-10192. Washington, D.C.: U.S. Department of Transportation, July 1972.

Klein, Norman. "Auto-Free Zones: Giving Cities Back to People," City (March/ April 1972), pp. 45-52

Klein, Norman. "Auto-Free Zones: Giving Cities Back to People," Ekistics, Vol. 37, Number 19, February 1974.

Kuhnemann, Jorg and Witherspoon, Robert. Traffic-Free Zones in German Cities. Paris: OECD, August 1972.

Lane, R. "Some Effects of Excluding Traffic from an Existing Residential Area." Paper presented at the 12th International Study Week -- Traffic Engineering and Safety, Belgrade, Yugoslavia, September 27, 1974.

"Legal Aspects of Banning Automobiles from Municipal Business Districts," Columbia Journal of Law and Social Problems, Vol. 7, 1971.

Liebermann, William. "Environmental Implications of Auto-Free Zones." Draft paper submitted to the Highway Research Bord, Washington, D.C., August 24, 1973.

Northeastern University. The Impacts of an Auto-Free Zone on an Urban Metropolitan Area: Methodology and Case Study. Report for U.S. Department of Transportation, Urban Mass Transit Authority, Boston, Massachusetts, Interdisciplinary Transportation Advisory Committee, April 1974, Draft Report.

Organisation for Economic Co-Operation and Development. Streets for People. Paris: Organisation for Economic Cooperation and Development, 1974.

Orski, C. Kenneth. "Car-Free Zones and Traffic Restraints: Tools of Environmental Management," Highway Research Record No. 406. Washington, D.C.: Highway Research Board, 1972.

Orski, C. Kenneth. "Vehicle-Free Zones in City Centers." Paper presented at the OECD Symposium on Techniques for Improving Urban Conditions by Restraints of Road Traffic, Cologne, October 25-29, 1971.

Petrillo, Paul C. "Banning the Car in the Central Business District." Papers from the Forty-Second Annual Meeting, Institute of Traffic Engineers, New York, September, 1972.

"Spring to Bring New York De-Motorized Zone," Passenger Transport, Vol. 30, No. 1 (October 13, 1972), p. 6.

Rudofsky, Bernard. Streets for People: A Primer for Americans. New York: Doubleday and Co., Inc, 1964.

"Vehicle-Free Zones in City Centers -- The European Experience," Hud International Brief No. 16, June 1972.

BIBLIOGRAPHY
PEDESTRIANIZATION--GENERAL

Alan M. Voorhees, Ltd. City Bus Market Research Study. London: Alan M. Voorhees, Ltd., April 1973.

Alexander, Lawrence A. Building Downtown Malls. Downtown Idea Exchange, New York, New York, 1973.

American Automobile Association. Manual in Pedestrian Safety. Washington, D.C.: American Automobile Association, 1964.

Antoniou, James. "Plannng for Pedestrians," Traffic Quarterly, XXV (January 1971), pp. 55-71.

Benepe, Barry. "Pedestrian in the City," Traffic Quarterly (January 1965), pp.28-42.

Biehl, B.M. "Pedestrian Safety ," OECD. Paris, 1970.

Bolger, F. T. Studies of High Activity Density Area Circulation Systems: A Bibliography. Cambridge, Ma.: MIT Urban Systems Laboratory, 1972.

Breines, S. and Dean, W. The Pedestrian Revolution: Streets Without Cars. New York: Vintage, 1974.

Douglass, Lathrop. "Revitalizing Downtown Shopping Centers," Architectural Record. July 1969.

Downtown Research and Development Center. Downtown Malls: Feasibility and Development. New York: Downtown Research and Development Center, 1974.

Fee, Mrs. Julie Anna, Federal Highway Administration. European Experience in Pedestrian and Bicycle Facilities. Reprinted from the International Road Federation Annual Report 1974. Washington, D.C.: USDOT, FHWA, April 1975.

Foote, Robert S. "Helping Pedestrians in Urban Areas." Papers presented at the 12th International Study Week — Traffic Engineering and Safety, Belgrade, Yugoslavia, September 2-7, 1974.

"Forgotten Man in the City," Architectural Forum, Vol. 128, No. 2 (January-February 1968), pp. 79-85.

Fruin, J. J. Pedestrian Planning and Design. Massapequa, New York: Maudep Press, 1971.

Fruin, John J. "Pedways Versus Highways—The Pedestrian's Rights to Urban Space." Presented at the 51st Annual Meeting of the Highway Research Board. Washington, D.C., January 1972.

Gantvoort, J. T. "Pedestrian Traffic in Town Centres," Traffic Engineering and Cntrol, pp. 12:9 (January 1971), 454-6.

Garbrecht D. Pedestrian Movement: A Bibliography. Monticello, Illinois: Council of Planning Librarians. (no date)

Gray, John G. Pedestrianized Shopping Streets in Europe. Endinburgh: Pedestrian's Association for Road Safety, 1965.

Greater London Council. Pedestrianised Streets: GLC Study Tour of Europe and America. London: Greater London Council, 1973.

Gruen, Victor. The Heart of Our Cities. New York: Simon and Schuster (1964), p. 223.

Highway Research Board. Pedestrian Protection: 5 Reports, Highway Research Record No. 406. Washington, D.C., Highway Research Board, 1972.

Highway Research Board. Pedestrians: 6 Reports, Highway Research Record No. 355. Washington, D.C., Highway Research Board, 1971.

Institut for Center Planlaegning. By center menneske (Pedestrian areas in towns). Lyngby, Denmark, 1965.

Institute of Public Administration. "Pedestrian Needs and Accommodations: A Study of Behavior and Perception." Prepared for FHWA, Office of Program and Policy Planning, Socio-Economic Studies Divison, U.S. Department of Transportation, January 1975.

International City Managers' Association. The Pedestrian Mall and the Central Business District. Management Information Service Report Number 187. August 1959.

"Les Pietons Dans La Ville," Le Monde, November 12, 1970.

Levinson, Herbert S. "Planning for Pedestrians." Paper presented at the annual conference--New England Section, Institute of Traffic Engineers, Nashua, New Hampshire, December 5, 1972.

Lewis, David (ed.). The Pedestrian in the City. Princeton, New Jersey: D. Van Nostrand.

Lindstrom, June. "New Approaches to Pedestrian Problems," Public Safety Systems, November/December, [illegible].

Lovemark, Olof. "New Approaches to Pedestrian Problems," Jouirnal of Transport Economics and Policy, VI:1, January 1972. (London School of Economics and Political Science.)

Luthmann, Harold. Pedestrian Zones in German Cities. Koln: Deutschen Gemeindaverlog-Verlag W. Kohlhammer, 1972.

Lynch, K. The Image of the City. Cambridge: M.I.T. Press, 1960.

More Streets for People. The Italian Art and Landscape Foundation, 1974.

Morris, Peter. "Pedestrianization of a Busy Shopping Street," Surveyor, June 1971.

Morris, R. L. and Zisman, S.B. "The Pedestrian, Downtown and the Planner," Journal of the American Institute of Planners (August 1962), pp.152-158.

"New Street Scene," Architectural Forum. January-February 1969.

Onibokan, Adepoju. "A Comprehensive Evaluation of Pedestrian Malls in the United States," The Appraisal Journal, Vol. XLIII, No. 2 (April 1975), pp 202-218.

Prokopy, J. C. Manual for Planning Pedestrian Facilties. Office of Research and Office of Development, Federal Highway Administration (U.S. Department of Transportation, Washington, D.C.) Implementation Package 74-5. June 1974.

Pushkarev B., and Zupan J. "Pedestrian Travel Demand ," Highway Research Record No. 355

Pushkarev, B., and Zupan J. Urban Space for Pedestrians. Cambridge: M.I.T. Press, 1975.

Richards, B. "New Movement in Cities." Studio Vista, London, 1969.

Richards B. "Pedestrian Movement Systems. The Missing Link in Transport," Bau No. 4-5, London, 1970.

Ritter, Paul. Planning for Man and Motor. London: Pergamon Press, 1964.

Rudofsky B. Streets for People, A Primer for Americans. New York: Doubleday and Co., 1969.

Stuart, Darwin G. "Planning for the Pedestrian," Journal of the American Institute of Planners, January 1968, p. 37-41.

U.S. Department of Transportation. Pedestrian and Bicycle Safety Study. Washington, D.C.: U.S. Department of Transportation, March 1975.

Walsh, Stuart P. "Checkpoints for Downtown Malls," Urban Land. October 1966.

Walsh, Stuart P. "Malls and Their Problems," Traffic Quarterly, July 1968, pp. pp. 321-328.

Wolfe, M. R. "Shopping Streets and the Pedestrian Rediscovered," Ekistics. Vol. 14, December 1962, pp. 294-297.

Wood, A. A. "Foot Streets: Managing the Environment," Traffic Engineering and Control, 11:10, February 1970.

BIBLIOGRAPHY
TRANSPORTATION CONTROL PLANS

Advisory Committee on Highway and Air Quality. Highways and Air Quality. Washington, D.C.: Highway Research Board, 1973.

Alan M. Voorhees & Associates, Inc. and Ryckman, Edgerley, Tomlinson and Associates. A Guide for Reducing Automotive Air Pollution. Westgate Research Park, McLean, Virginia: Alan M. Voorhees & Associates, Inc., November 1971.

Alan M. Voorhees & Associates, Inc. An Analysis of the Economic Impact of Motor Vehicle Use Restrictions in Relation to Federal Ambient Air Quality Standards. Westgate Research Park, McLean, Virginia: Alan M. Voorhees & Associates, Inc., September 1973.

Alan M. Voorhees & Associates, Inc. Short-Range Planning for Reduced Vehicle Miles of Travel in the SCAG Region. Los Angeles: Alan M. Voorhees & Associates, Inc., June 1974.

Alan M. Voorhees & Associates, Inc. Transportation and Urban Planning. Westgate Research Park, McLean, Virginia: Alan M. Voorhees & Associates, Inc.

Argonne National Laboratory and American Society of Planning Officials. Interagency Cooperation in Comprehensive Urban Planning and Air Quality Maintenance. Washington, D.C.: United States Government Printing Office, March 1974.

Bellomo, Salvatore J. "Providing for Air Quality and Urban Mobility," Paper presented at the Fifth Annual Summer Meeting of the Highway Research Board, Madison, Wisconsin, July 31-August 2, 1972.

Bellomo, Salvatore J., Dial, Robert B., and Voorhees, Alan M. "Factors, Trends, and Guidelines Related to Trip Length," National Cooperative Highway Research Program Report No. 89. Washington, D.C.: Highway Research Board, 1970.

Capitol Region Planning Agency. Air Pollution Study of the Capital Region. Hartford, Connecticut: TRC Service Corporation, 1967.

Ellis, Raymond H., DiRenzo, John F., and Borlick, Robert L. Impacts of Transportation Control Plans on Travel Behavior in San Diego. August 1974.

GCA Corporation. Transportation Controls to Reduce Motor Vehicle Emissions in Baltimore, Maryland. Washington, D.C.: United States Government Printing Office, December 1972.

GCA Technology Division. Measuring the Effectiveness of Transportation Controls. U.S. Environmental Protection Agency, 1975.

GCA Technology Division and TRW, Inc. Transportation Controls to Reduce Motor Vehicle Emissions in Major Metropolitan Areas. Research Triangle Park, North Carolina: United States Environmental Protection Agency, 1972.

Hagevik, George, ed. The Relationship of Land Use and Transportation Planning to Air Quality Management. New Brunswick, New Jersey: Rutgers University Press, May 1972.

Harbridge House, Inc. Report on the Economic and Land Use Impact of Regulations to Review New Indirect Sources of Air Pollution Prior to Construction. Report for United States Environmental Protection Agency, October 1974.

Hawthorn, Gary C., et al. "The Future Transportation and Air Quality Legislative Interface." Paper presented at the International Conference on Transportation and the Environment, Washington, D.C., May 31, 1972.

Horowitz, Joel L. "Transportation Controls are Really Needed in the Air Cleanup Fight," Environmental Science and Technology, Vol. 8 No. 9 (September 1974), pp. 800-805.

Horowitz, Joel L. "Cost-Effectiveness Analysis of Alternative Strategies for Reducing Emissions from Motor Vehicles," Proceedings of the Third International Clean Air Congress, VDI Verlag, GmbH, Dusseldorf, Federal Republic of Germany (1973), pp. F35-F36.

Institute of Public Administration, Teknekron, Inc., and TRW, Inc. Evaluating Transportation Controls to Reduce Motor Vehicle Emissions in Major Metropolitan Areas. Washington, D.C.: United States Government Printing Office, November 1972.

LaPlante, John N. "Pollution Control in the CBA," Midwest Engineer (April 1975), pp. 7-8.

Metropolitan Washington Council of Governments. "Parking Management Policies and Auto Control Zones." United States Department of Transportation, February 1976.

Mikolowsky, William; Stanley, William; and Goeller, Bruce. "The Effectiveness of Near-Term Tactics for Reducing Vehicle Miles Traveled: A Case Study of the Los Angeles Region," Rand Corp., Santa Monica, California, December 1974.

Natural Resources Defense Council, Inc. Transportation Controls for Clean Air. New York: NRDC, no date.

Peat, Marwick, Mitchell & Co. Evaluation Vehicle Use Restraint Measures for Air Pollution Control in San Diego, California. Washington, D.C.: Peat, Marwick, Mitchell & Co., March 1975.

Peat, Marwick, Mitchell & Co. Socioeconomic Impacts of Alternative Transportation Control Plans for the San Diego Air Quality Control Region. Report for USEPA, July 1974.

Pelle, William J., Jr. "Bibliography on the Planning Aspects of Air Pollution Control," Washington, D.C., 1964. (mimeographed).

Planning Environment International. Application for Indirect Source Review and California Transportation Control Plan Parking Facility Review. Westgate Research Park, McLean, Virginia: Planning Environment International, November 1974.

Planning Environment International. Evaluation of the Need for Transportation Control Strategies in the Central and Northeastern Oklahoma Air Quality Control Regions. Westgate Research Park, McLean, Virginia: Planning Environment International, December 1974.

Planning Environment International. Baltimore Transportation Control Plan Impact Analysis. Westgate Research Park, McLean, Virginia: Planning Environment International, May 1975.

Planning Environment International. Transportation Management Tactics for Air Quality Improvement in the San Diego Region—Incorporating Parking Management and Indirect Source Review Analysis—Preliminary Draft. Los Angeles: Planning Environment International, May 1975.

Roberts, John J., ed. Long-Term Maintenance of Clean Air Standards. Conference Proceedings. Pittsburgh, Pennsylvania: APCA, 1975.

Rydell, C. Peter and Collins, D. "Air Pollution and Optimal Urban Form." Paper presented at the 60th Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967.

TRW, Transportation and Environmental Operations. "Institutional Constraints to the Implementation of State SIP's. Westgate Research Park, McLean, Virginia: TRW, May 1973. (unpublished)

TRW, Transportation and Environmental Operations. "Socio-Economic Impacts of the Proposed State Transportation Control Plans: An Overview." Redondo Beach, California: TRW, November 1973. (Unpublished)

U.S. Department of Transportation, Transportation Systems Center. A Comparison of Methods for Evaluating Urban Transportation Alternatives. Cambridge, Massachusetts, November 1974.

U.S. Environmental Protection Agency. Guidelines for Air Quality Maintenance Planning and Analysis, Volume 4: Land Use and Transportation Considerations. Research Triangle Park, North Carolina: U.S. Environmental Protection Agency, August 1974.

U.S. Environmental Protection Agency. Transportation Controls to Reduce Automobile Use and Improve Air Quality in Cities--The Need, the Options, and Effects on Urban Activity. Washington, D.C.: United States Government Printing Office, November 1974.

U.S. Statutes at Large. The Clean Air Act Amendments of 1970. P.L. 91-604, December 1970. Subsequent regulations to implement the Act.

Willis, Byron H. "The Hackensack Meadowlands Air Pollution Study Summary Report." Submitted to the State of New Jersey Department of Environmental Protection by Environmental Research and Technology, Inc., August 1972.

Witherspoon, Robert. "Motor Vehicle Restraints for Clean Air--Some Implications for Air Pollution Control Policy." Institute of Public Administration. Unpublished paper, no date.

Transportation Control Plans for:

Fairbanks, Alaska
Phoenix, Arizona
Tucson, Arizona
Los Angeles, California
San Francisco, Califonia
Sacramento, California
San Diego, California
San Joaquin, California
Denver, Colorado
Chicago, Illilnois
Baltimore, Maryland
Boston, Massachusetts
Springfield, Massachusetts
Minneapolis, Minnesota
Washington, D.C., Metropolitan Area
New York City Metropolitan Area
Philadelphia, Pennsylvania
Pittsburgh, Pennsylvania
Camden, New Jersey
Newark, New Jersey
Trenton, New Jersey
Portland, Oregon
Houston, Texas
Dallas-Ft. Worth, Texas
San Antonio, Texas
Salt Lake City, Utah
Provo, Utah
Seattle, Washington
Spokane, Washington

Air Quality Maintenance Plans for:

San Diego, California -- TRW Inc.
St. Louis, Missouri -- Alan M. Voorhees & Associates, Inc.
Baltimore, Maryland -- Engineering Sciences, Inc.
Denver, Colorado -- GCA Corporation

BIBLIOGRAPHY
TRAFFIC RESTRAINTS
GENERAL

"Better Towns With Less Traffic," Traffic Engineering and Control, (June 1975), pp. 287-292.

Buchanan, Colin. "Critique of Max Feldman's Transportation." OAP, March 1968.

Buchanan, Colin. Traffic in Towns: A Study of the Long Term Problems of Traffic in Urban Areas. London: Her Majesty's Stationery Office, 1963.

Cryer, A. J., Deputy City Engineer, City of Westminster, London. Management of Traffic to the Aid of Urban Environment. Prepared for the VI World Highway Conference, International Road Federation, VI World Highway Conference, Montreal, Canada, October 4-10, 1970. London: Westminster City Council, 1970.

Elmberg, Curt M. "Compartmentation as a Tool to Reduce Traffic Congestion and Improve the Environment." Paper presented at the 7th Summer Meeting, United States Academy of Engineering Sciences, Transportation Research Board, Jacksonville, Florida, August 5-7, 1974.

Gray, George E., Watkin, Robert O., and Kirchner, Fred F. Can Vehicle Travel Be Reduced 20 Percent in the South Coast Air Basin? (Draft). Prepared for California Air Resources Board by California Department of Public Works, Sacramento, California, 1973.

Hawthorn, Gary and Manheim, Marvin L. "Guidelines for Implementing a Comprehensive Policy of Traffic Restraints." Paper prepared for the OECD Conference "Better Towns with Less Traffic," Paris, April 14 16, 1975.

Ministry of Transport. Better Use of Town Roads. The Report of a Study of the Means of Restraint of Traffic in Urban Roads. London: Her Majesty's Stationery Office, 1967.

Organisation for Economic Co-Operation and Development. Policy Towards the Creation of Vehicle-Free Areas in Cities. Statement of conclusions adopted by the sector group on the Urban Evironment at its 2nd meeting, Paris, October 2, 1972.

Organisation for Economic Co-Operation and Development. Proceedings of the OECD Conference Better Towns with Less Traffic. Paris, France, April 14-16, 1975.

Organisation for Economic Co-Operation and Development. Proceedings of the Symposium on Techniques of Improving Urban Conditions by Restraint of Road Traffic. Cologne, Germany, October 25-27, 1971. Paris: OECD, 1973.

Organisation for Economic Co-Operation and Development Study Group on Motor Vehicle Restraint Evaluation Manual. Drafts on "Economic Impacts of Vehicle-Free Zones," "Pedestrian Impacts and Safety," and "The Traffic and Economic Consequences of Traffic-Free Zones and How to Measure them." January 12, 1973 memo from Robert Witherspoon.

Organisation for Economic Co-Operation and Development. "Reducing Vehicle Activity in Cirtical Urban Locations," The Impact of the Motor Vehicle on the Environment (Draft), Paris, 1971.

Orlob, Lloyd C. "Traffic Diversion for Better Neighborhoods," Traffic Engineering, Vol. 45, No. 7 (July 1975), pp. 22-25.

SCAFT Research Group. Principles for Traffic Re-Planning with Respect to Road Safety. Report 55. Gothenburg, Sweden: Chalmers University of Technology, Institute for Urban Planning, 1972.

Taylor, S. S., General Reporter. "Public and Private Transport in Towns." Papers presented at the 12th International Study Week, Traffic Engineering and Safety, Belgrade, Yugoslavia, September 2-7, 1974.

"The Ban-the-Car Movement," Newsweek, January 4, 1971.

Thomson, J. M. "An Evaluation of Two Proposals for Traffic Restraint in Central London," Journal of the Royal Statistical Society (September 1967), pp. 327-367.

Thomson, J. M. "Methods of Traffic Limitation in Urban Areas," OECD, 1972.

Thomson, J. M. "Traffic Limitation In Towns." Paper with no date.

Wigan, M. R. "Traffic Restraint as a Transport Planning Policy I: A Framework for Analysis," Environment and Planning, Vol. 6 (August 1974), pp. 565-601.

BIBLIOGRAPHY
TRAFFIC RESTRAINTS
SPECIFIC BY CITY

Elmberg, Curt M. "The Gothenburg Traffic Restraint Scheme," Transportation. Amsterdam, Netherlands: Elsevier Publishing Co. (no date)

Elmberg, Curt M. "The Gothenburg Traffic Restraint Scheme." Paper presented at the International Conference on Transportation Research, College of Europe, Bruges, Belgium, June 18-21, 1973.

Harrison, G. S. "People and the Park: Reactions to a System of Public Transportation in Mt. McKinley National Park, Alaska," Journal of Leisure Research, Vol. 7, No. 1 (1975), pp. 6-15.

King, R.H. and Eagland, R.M. "Gloucester's Traffic and Transport Plan," Traffic Engineering and Control, 12:9 (January 1971), pp. 456-9.

Kurp, A. "Traffic Restraints in the Central Area of Bremen." Presented at OECD Symposium on Road Traffic Restraints, Cologne, October 25-29, 1971.

"Motor Vehicle Traffic Restraints in Central Copenhagen." Digested from a paper prepared by Kai Lemberg. HUD International Brief 16, June 1972.

Nottingham City Council. Zones and Collars -- Suggested Traffic Control Measures for Peak Travel in Nottingham. Nottingham, England: The Publicity and Information Department, November 1973.

Watson, Peter L. "Report on the Introduction of the Area License Scheme in Singapore." International Bank of Reconstruction and Development, July 16, 1975. (office memo)

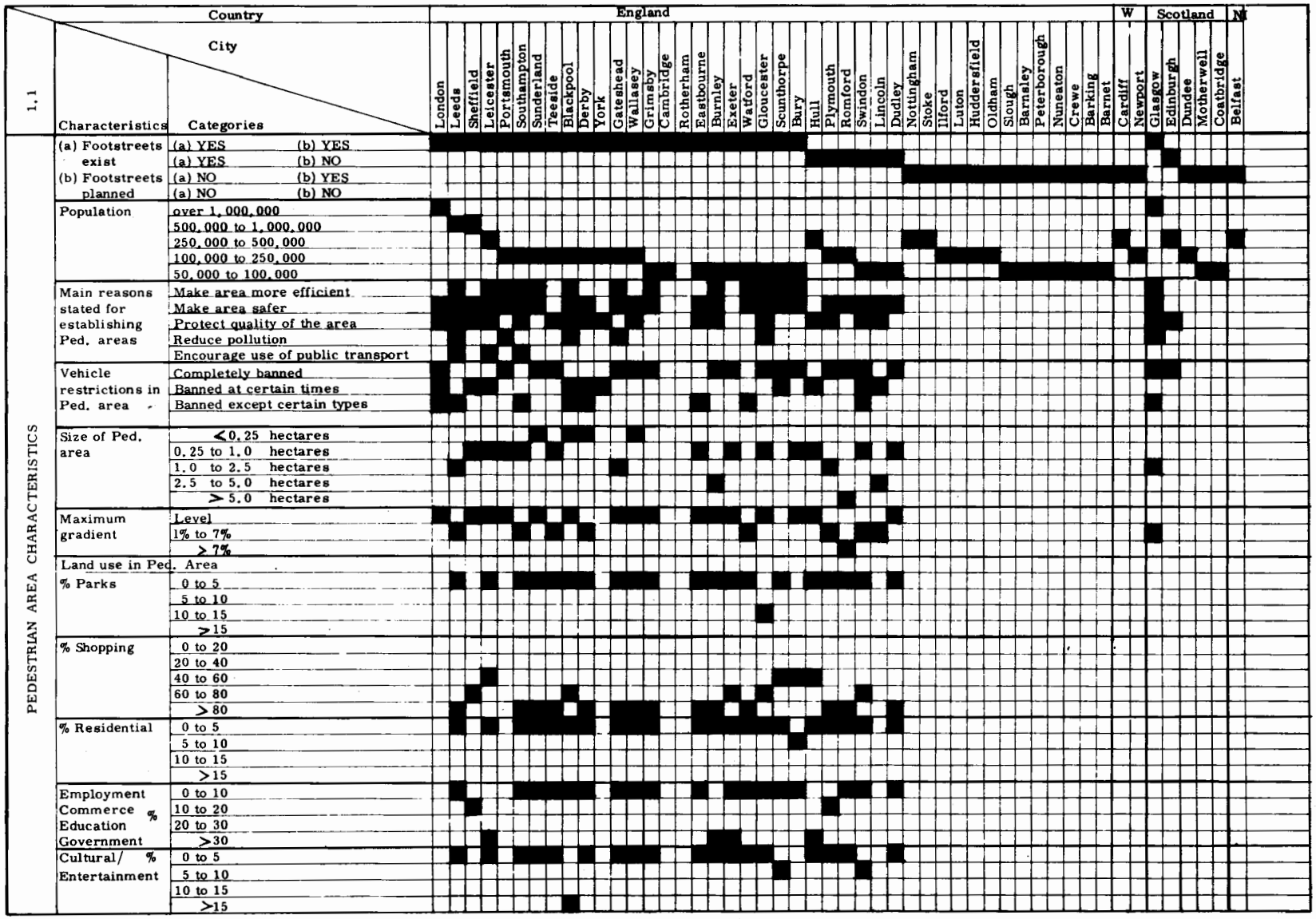
APPENDIX B

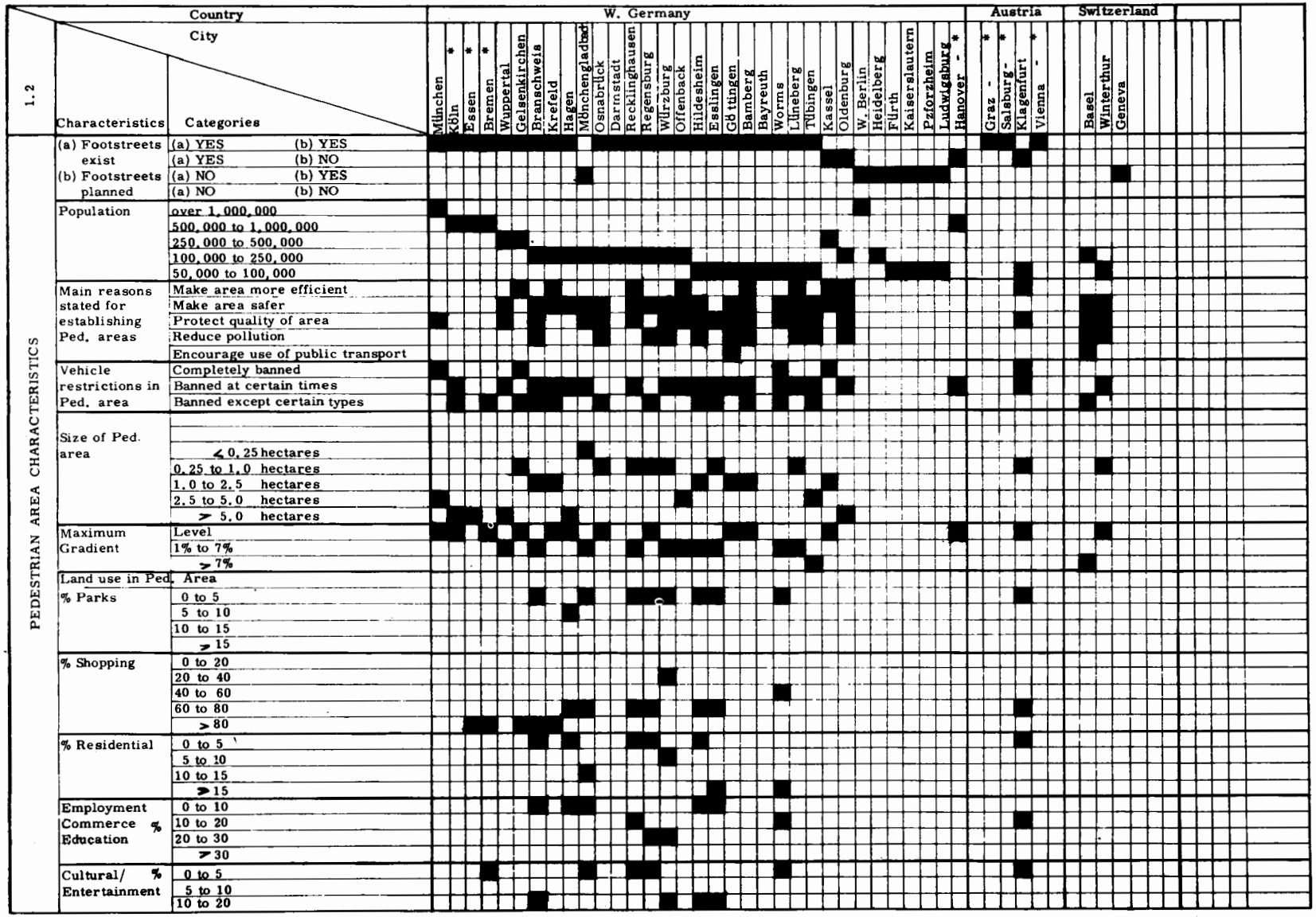
CHARACTERISTICS OF PEDESTRIAN AREAS IN EUROPEAN CITIES

APPENDIX B
CHARACTERISTICS OF PEDESTRIAN AREAS IN EUROPEAN CITIES

The information contained in this appendix is taken from data collected by AMV Ltd. in pursuance of a study commissioned by Steyr Daimler Puch.

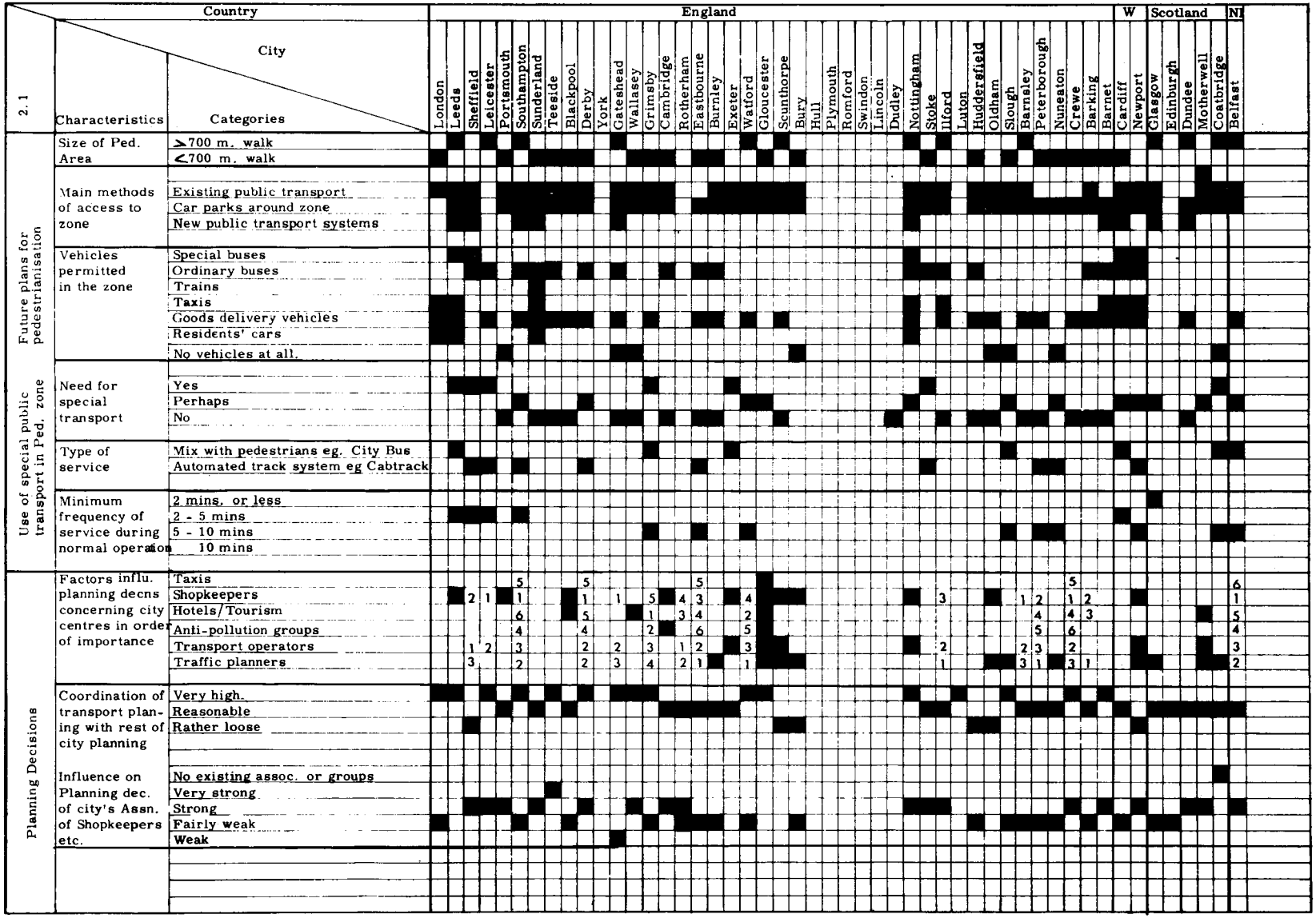
A questionnaire was sent to city planning authorities in all cities in western Europe with over 50,000 population. Information received from approximately 130 responses are presented in the matrices which follow. The information presented is for the end of 1972.

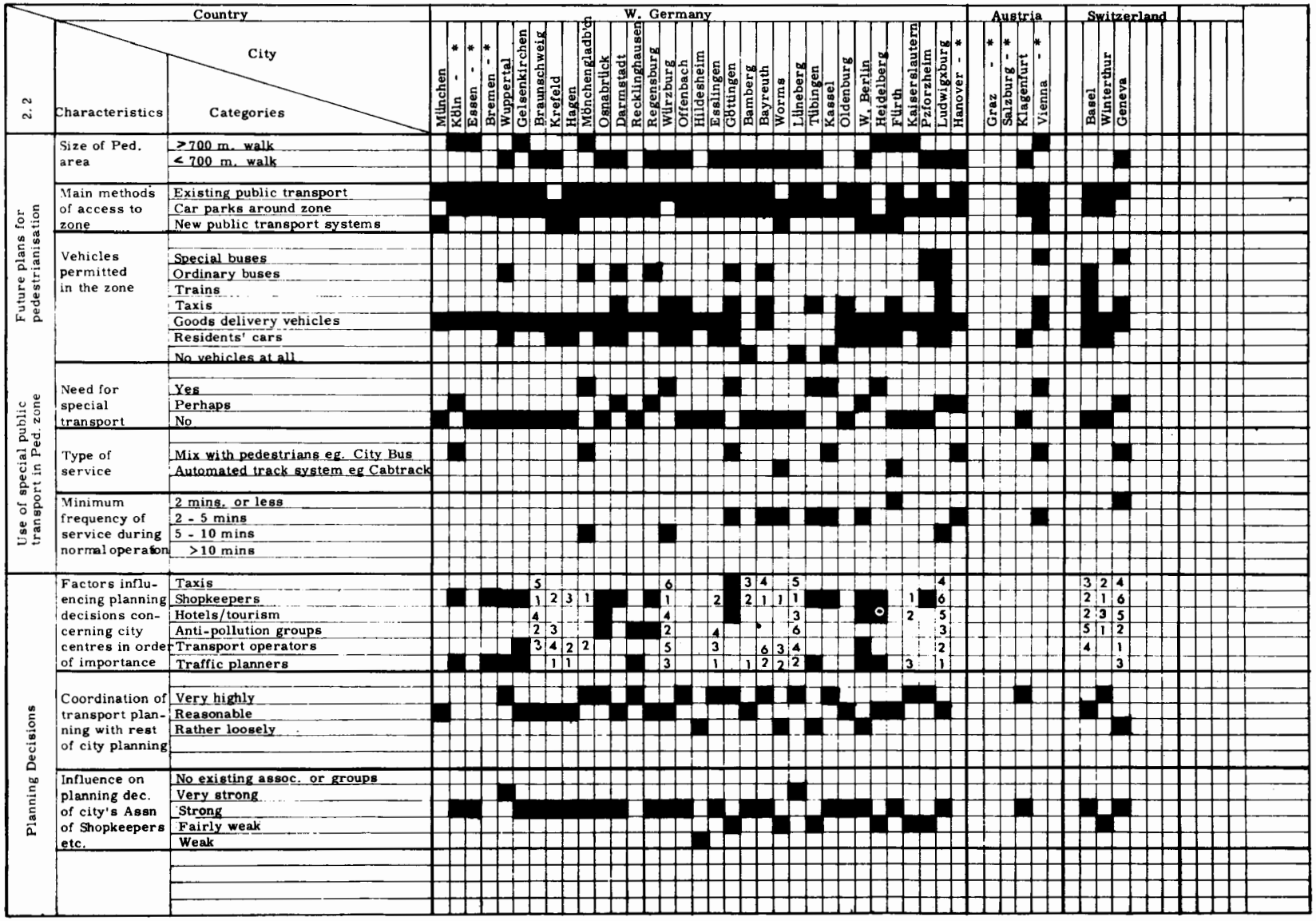

Country
City
England
W
Scotland
NI
1.1
Characteristics
Categories
London
Leeds
Sheffield
Leicester
Portsmouth
Southampton
Sunderland
Teeside
Blackpool
Derby
York
Gateshead
Wallasey
Grimsby
Cambridge
Rotherham
Eastbourne
Burnley
Exeter
Watford
Gloucester
Scunthorpe
Bury
Hull
Plymouth
Romford
Swindon
Lincoln
Dudley
Nottingham
Stoke
Ilford
Luton
Huddersfield
Oldham
Slough
Barnsley
Peterborough
Nuneaton
Crewe
Barking
Barnet
Cardiff
Newport
Glasgow
Edinburgh
Dundee
Motherwell
Coatbridge
Belfast
PEDESTRIAN AREA CHARACTERISTICS
(a) Footstreets exist
(b) Footstreets planned
(a) YES (b) YES
(a) YES (b) NO
(a) NO (b) YES
(a) NO (b) NO
Population
over 1,000,000
500,000 to 1,000,000
250,000 to 500,000
100,000 to 250,000
50,000 to 100,000
Main reasons stated for establishing Ped. areas
Make area more efficient
Make area safer
Protect quality of the area
Reduce pollution
Encourage use of public transport
Vehicle restrictions in Ped. area
Completely banned
Banned at certain times
Banned except certain types
Size of Ped. area
< 0,25 hectares
0,25 to 1,0 hectares
1,0 to 2,5 hectares
2,5 to 5,0 hectares
> 5,0 hectares
Maximum gradient
Level
1% to 7%
> 7%
Land use in Ped. Area
% Parks
0 to 5
5 to 10
10 to 15
>15
% Shopping
0 to 20
20 to 40
40 to 60
60 to 80
> 80
% Residential
0 to 5
5 to 10
10 to 15
>15
Employment
Commerce %
Education
Government
0 to 10
10 to 20
20 to 30
>30
Cultural/ Entertainment %
0 to 5
5 to 10
10 to 15
>15

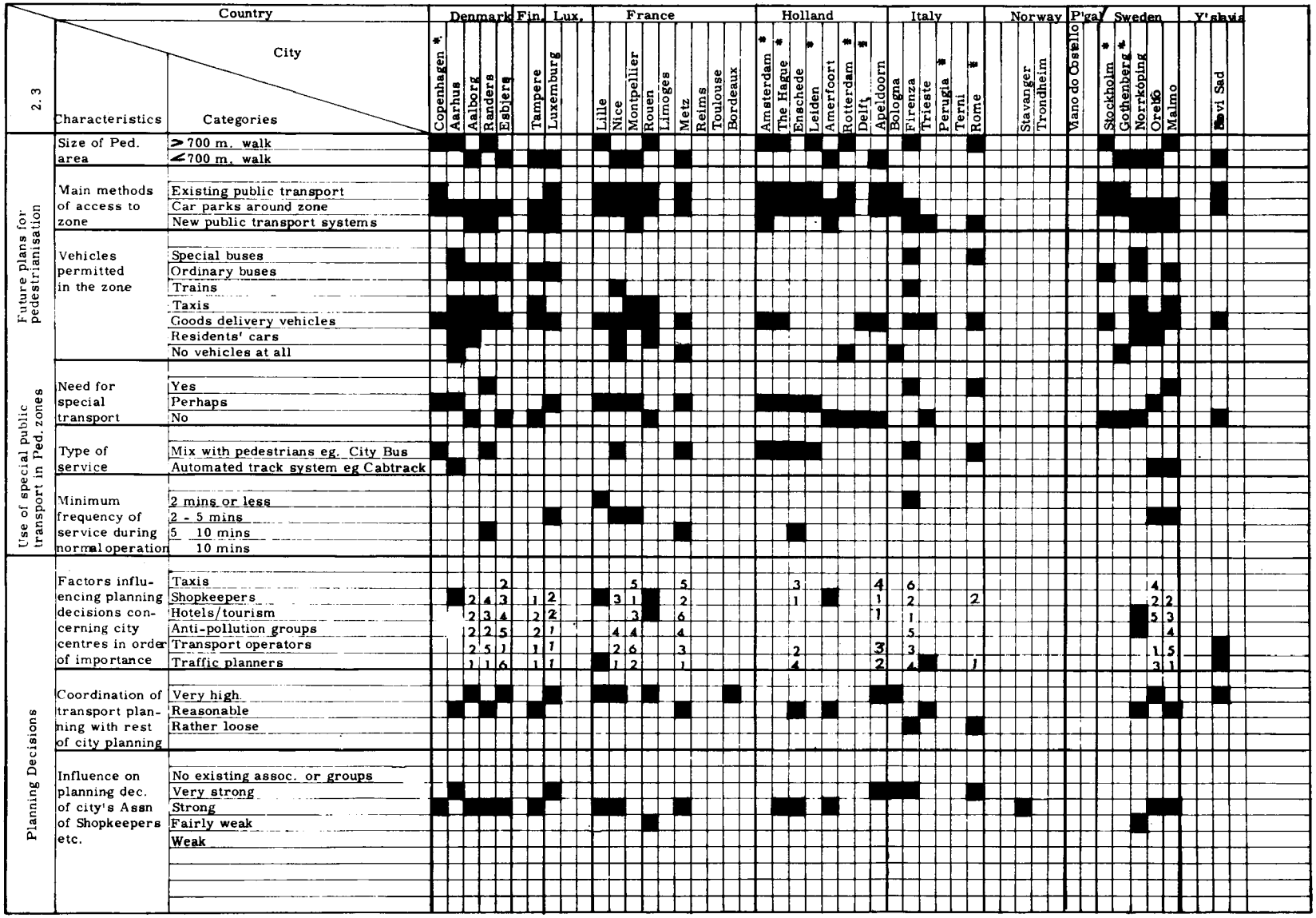

Country
City
Characteristics
Categories
1.2
PEDESTRIAN AREA CHARACTERISTICS
W. Germany
Austria
Switzerland
München *
Köln *
Essen *
Bremen *
Wuppertal
Gelsenkirchen
Branschweig
Krefeld
Hagen
Mönchengladbach
Osnabrück
Darmstadt
Recklinghausen
Regensburg
Würzburg
Offenbach
Hildesheim
Esslingen
Göttingen
Bamberg
Bayreuth
Worms
Lüneberg
Tübingen
Kassel
Oldenburg
W. Berlin
Heidelberg
Fürth
Kaiserslautern
Pforzheim
Ludwigsburg
Hanover - *
Graz - *
Salzburg - *
Klagenfurt *
Vienna -
Basel
Winterthur
Geneva
(a) Footstreets exist
(b) Footstreets planned
(a) YES (b) YES
(a) YES (b) NO
(a) NO (b) YES
(a) NO (b) NO
Population
over 1,000,000
500,000 to 1,000,000
250,000 to 500,000
100,000 to 250,000
50,000 to 100,000
Main reasons stated for establishing Ped. areas
Make area more efficient
Make area safer
Protect quality of area
Reduce pollution
Encourage use of public transport
Vehicle restrictions in Ped. area
Completely banned
Banned at certain times
Banned except certain types
Size of Ped. area
≤ 0.25 hectares
0.25 to 1.0 hectares
1.0 to 2.5 hectares
2.5 to 5.0 hectares
> 5.0 hectares
Maximum Gradient
Level
1% to 7%
> 7%
Land use in Ped. Area
% Parks
0 to 5
5 to 10
10 to 15
> 15
% Shopping
0 to 20
20 to 40
40 to 60
60 to 80
> 80
% Residential
0 to 5
5 to 10
10 to 15
> 15
Employment
Commerce %
Education
0 to 10
10 to 20
20 to 30
> 30
Cultural/ Entertainment %
0 to 5
5 to 10
10 to 20

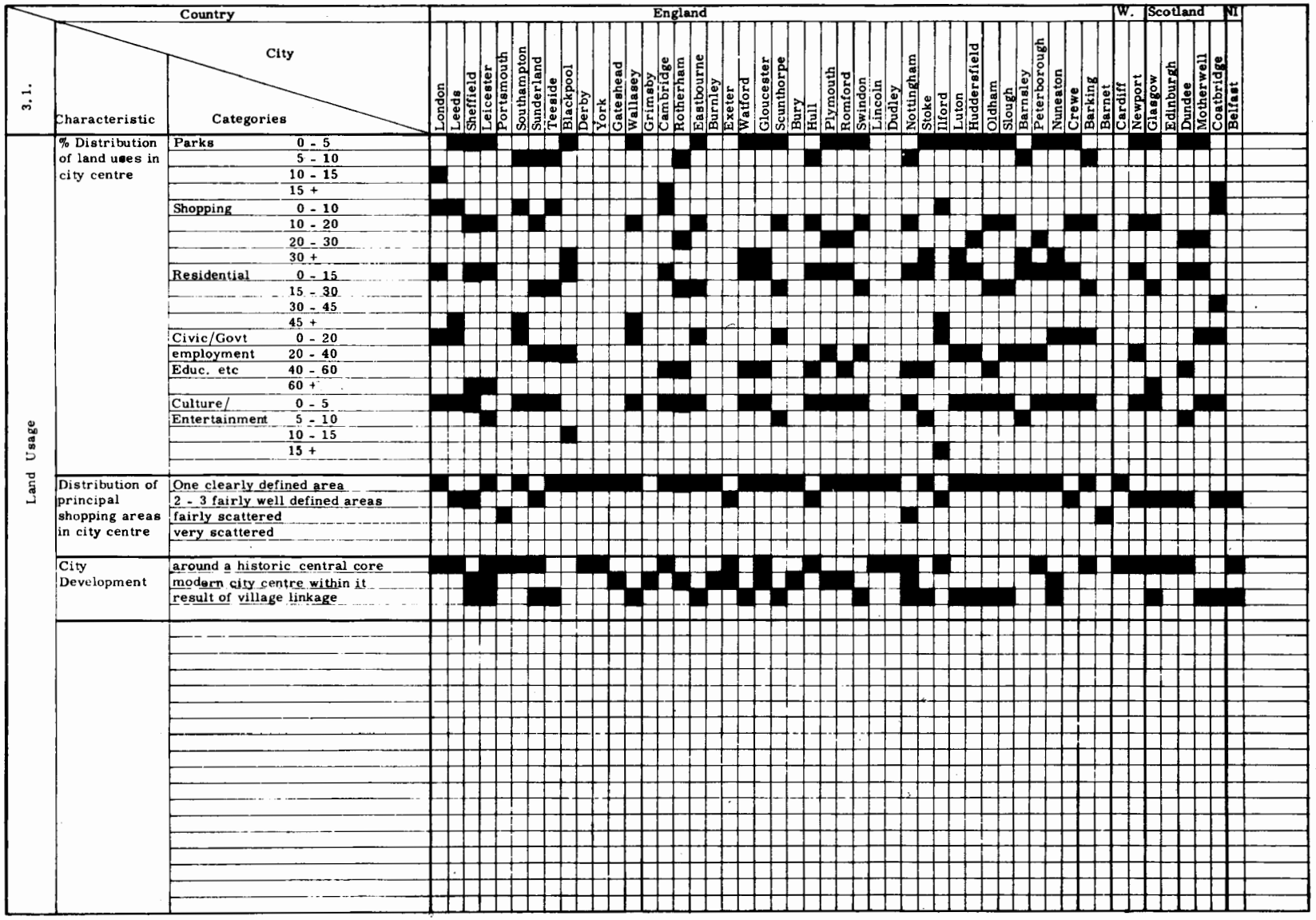
1.3 PEDESTRIAN AREA CHARACTERISTICS

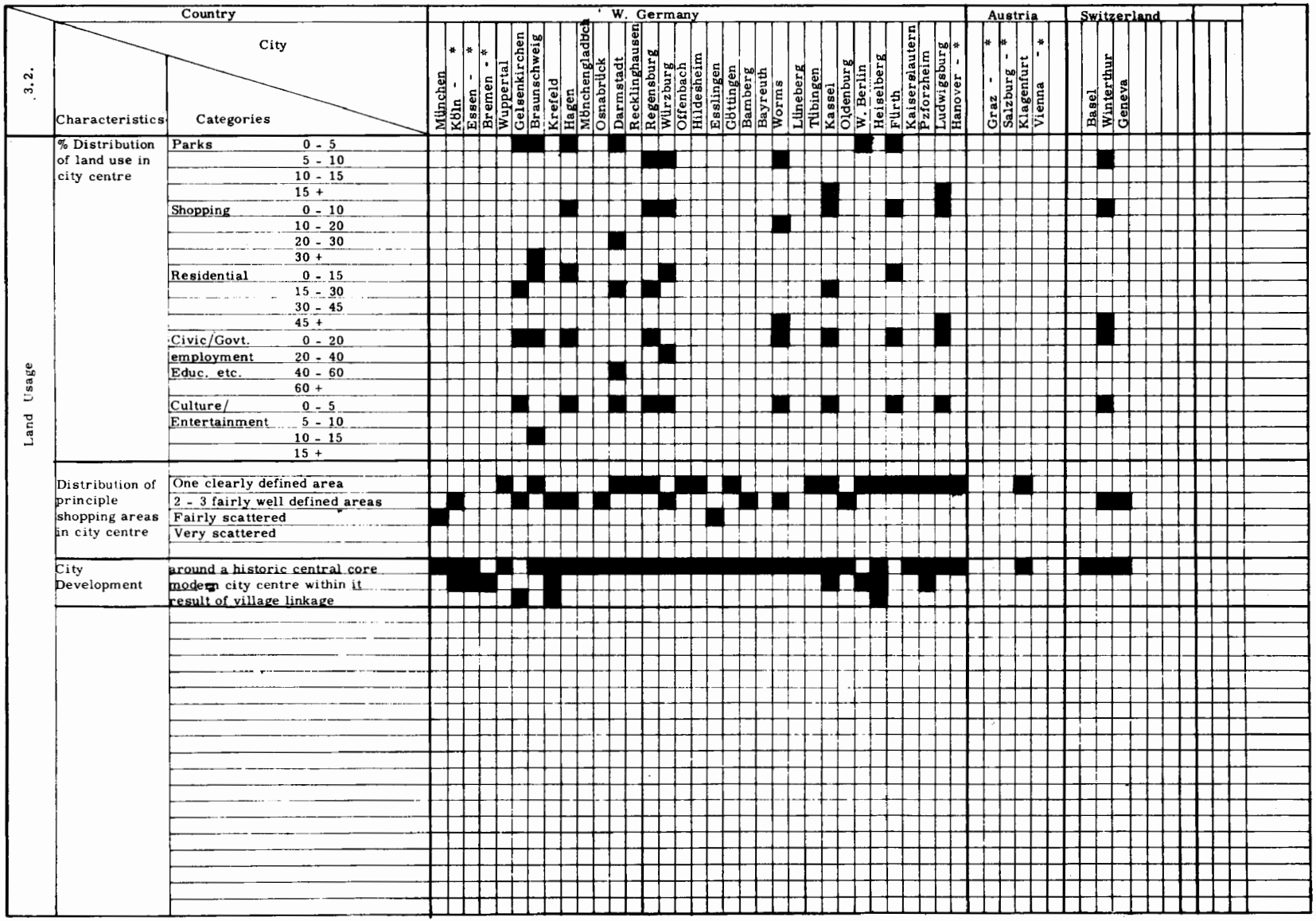
Country		Denmark					Fin.	Lux.	France									Holland								Itay						Norway		P'gal	Sweden					Y'slavia
Characteristics	**Categories** (City)	Copenhagen *	Aarhus	Aalborg	Randers	Esbjerg	Tampere	Luxemburg	Lille	Nice	Montpellier	Rouen	Limoges	Metz	Reims	Toulouse	Bordeaux	Amsterdam *	The Hague *	Enschede	Leiden *	Amerfoot	Rotterdam *	Delft *	Apeldoorn	Bologna	Firenza	Trieste	Perugia	Terni	Rome *	Stavanger	Trondheim	Viana do Costello	Stockholm *	Gothenberg *	Norrkoping	Orebö	Malmö	Novi Sad
(a) Footstreets exist (b) Footstreets planned	(a) YES (b) YES	■	■	■	■			■	■	■	■	■						■	■		■	■			■	■	■	■			■	■			■	■	■	■		■
	(a) YES (b) NO												■										■						■			■	■	■						
	(a) NO (b) YES					■	■							■	■																				■				■	
	(a) NO (b) NO															■	■							■																
Population	over 1,000,000	■																													■				■					
	500,000 to 1,000,000																	■	■				■																	
	250,000 to 500,000									■						■	■									■	■	■								■				
	100,000 to 250,000		■				■				■	■	■	■	■						■								■	■									■	
	50,000 to 100,000				■	■																■										■	■	■		■	■	■		■
Main reasons stated for establishing Ped. areas	Make area more efficient		■		■			■			■	■	■									■			■							■				■				■
	Make area safer				■			■	■			■	■									■			■		■									■	■			■
	Protect quality of area			■	■			■		■		■						■							■	■	■	■	■		■	■	■			■		■		■
	Reduce pollution				■			■																			■										■			
	Encourage use of public transport							■	■																															
Vehicle restrictions in Ped. area	Completely banned		■								■	■								■		■				■		■			■					■				
	Banned at certain times	■		■	■			■	■	■			■					■	■		■		■									■			■					
	Banned except certain types	■																■	■		■				■		■						■		■		■	■		■
Size of Ped. area	< 0.25 hectares							■														■			■															
	0.25 to 1.0 hectares		■	■	■				■			■														■		■									■			
	1.0 to 2.5 hectares																																							
	2.5 to 5.0 hectares	■																■													■					■				
	> 5.0 hectares									■									■				■				■											■		■
Maximum Gradient	Level	■			■				■									■	■		■					■	■	■	■		■		■							■
	1% to 7%			■				■				■											■												■		■	■		
	> 7%		■							■																						■								
Land use in Ped. Areas																																								
% Parks	0 to 5			■	■					■			■															■					■							
	5 to 10																																							
	10 to 15																																							
	> 15																																							
% Shopping	0 to 20																																							
	20 to 40			■						■																														
	40 to 60																																							
	60 to 80				■																												■			■				
	> 80												■												■															
% Residential	0 to 5												■															■					■							
	5 to 10																																							
	10 to 15				■																																			
	> 15			■						■																														
Employment Commerce Education Government %	0 to 10				■								■																											
	10 to 20									■																							■							
	20 to 30																																							
	> 30			■																								■												
Cultural/ % Entertainment	0 to 5			■						■			■																											
	5 to 10																																■			■				
	10 to 15				■																																			
	> 15																											■												

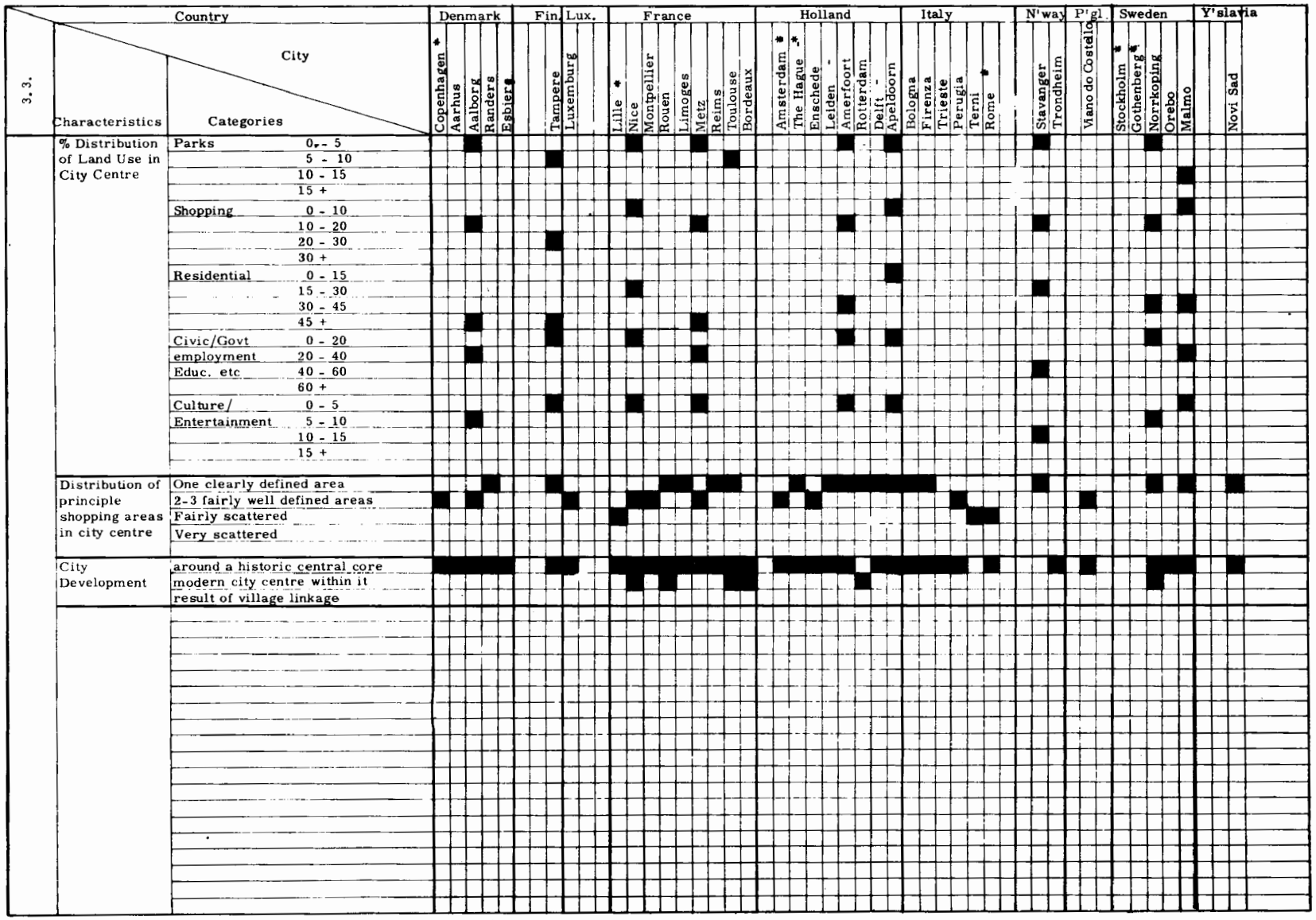

Country
City
Characteristics
Categories
England
W
Scotland
NI
2.1
London
Leeds
Sheffield
Leicester
Portsmouth
Southampton
Sunderland
Teeside
Blackpool
Derby
York
Gateshead
Wallasey
Grimsby
Cambridge
Rotherham
Eastbourne
Burnley
Exeter
Watford
Gloucester
Scunthorpe
Bury
Hull
Plymouth
Romford
Swindon
Lincoln
Dudley
Nottingham
Stoke
Ilford
Luton
Huddersfield
Oldham
Slough
Barnsley
Peterborough
Nuneaton
Crewe
Barking
Barnet
Cardiff
Newport
Glasgow
Edinburgh
Dundee
Motherwell
Coatbridge
Belfast
Future plans for pedestrianisation
Size of Ped. Area
≥700 m. walk
<700 m. walk
Main methods of access to zone
Existing public transport
Car parks around zone
New public transport systems
Vehicles permitted in the zone
Special buses
Ordinary buses
Trains
Taxis
Goods delivery vehicles
Residents' cars
No vehicles at all.
Use of special public transport in Ped. zone
Need for special transport
Yes
Perhaps
No
Type of service
Mix with pedestrians eg. City Bus
Automated track system eg Cabtrack
Minimum frequency of service during normal operation
2 mins. or less
2 - 5 mins
5 - 10 mins
10 mins
Planning Decisions
Factors influ. planning decns concerning city centres in order of importance
Taxis
Shopkeepers
Hotels/Tourism
Anti-pollution groups
Transport operators
Traffic planners
Coordination of transport planning with rest of city planning
Very high.
Reasonable
Rather loose
Influence on Planning dec. of city's Assn. of Shopkeepers etc.
No existing assoc. or groups
Very strong
Strong
Fairly weak
Weak

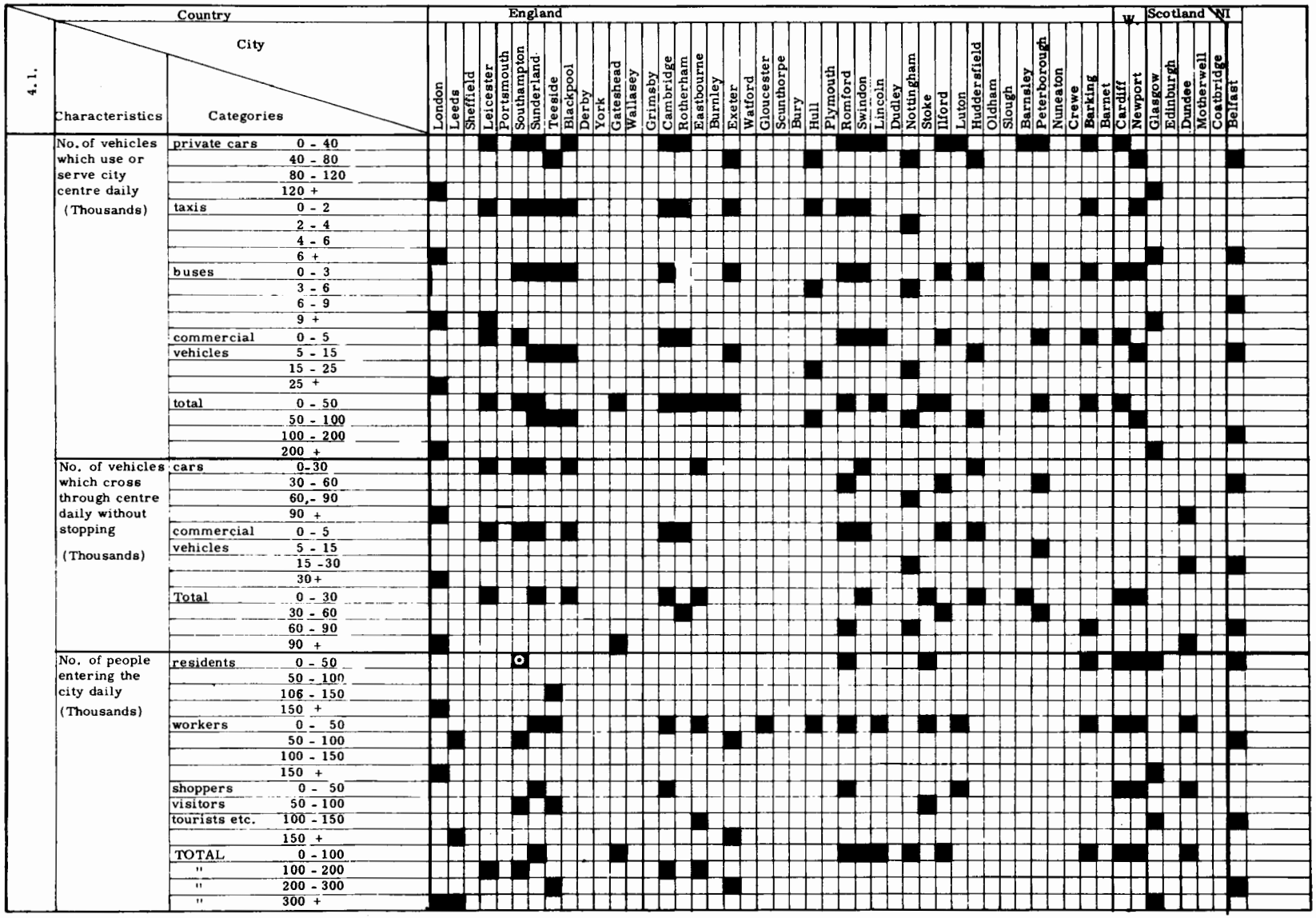

Country
City
Characteristics
Categories
2.2
W. Germany
Austria
Switzerland
München
Köln - *
Essen - *
Bremen - *
Wuppertal
Gelsenkirchen
Braunschweig
Krefeld
Hagen
Mönchengladbach
Osnabrück
Darmstadt
Recklinghausen
Regensburg
Würzburg
Offenbach
Hildesheim
Esslingen
Göttingen
Bamberg
Bayreuth
Worms
Lüneberg
Tübingen
Kassel
Oldenburg
W. Berlin
Heidelberg
Fürth
Kaiserslautern
Pforzheim
Ludwigxburg
Hanover - *
Graz - *
Salzburg - *
Klagenfurt
Vienna - *
Basel
Winterthur
Geneva
Future plans for pedestrianisation
Size of Ped. area
> 700 m. walk
< 700 m. walk
Main methods of access to zone
Existing public transport
Car parks around zone
New public transport systems
Use of special public transport in Ped. zone
Vehicles permitted in the zone
Special buses
Ordinary buses
Trains
Taxis
Goods delivery vehicles
Residents' cars
No vehicles at all
Need for special transport
Yes
Perhaps
No
Type of service
Mix with pedestrians eg. City Bus
Automated track system eg Cabtrack
Minimum frequency of service during normal operation
2 mins. or less
2 - 5 mins
5 - 10 mins
>10 mins
Planning Decisions
Factors influencing planning decisions concerning city centres in order of importance
Taxis
Shopkeepers
Hotels/tourism
Anti-pollution groups
Transport operators
Traffic planners
Coordination of transport planning with rest of city planning
Very highly
Reasonable
Rather loosely
Influence on planning dec. of city's Assn of Shopkeepers etc.
No existing assoc. or groups
Very strong
Strong
Fairly weak
Weak

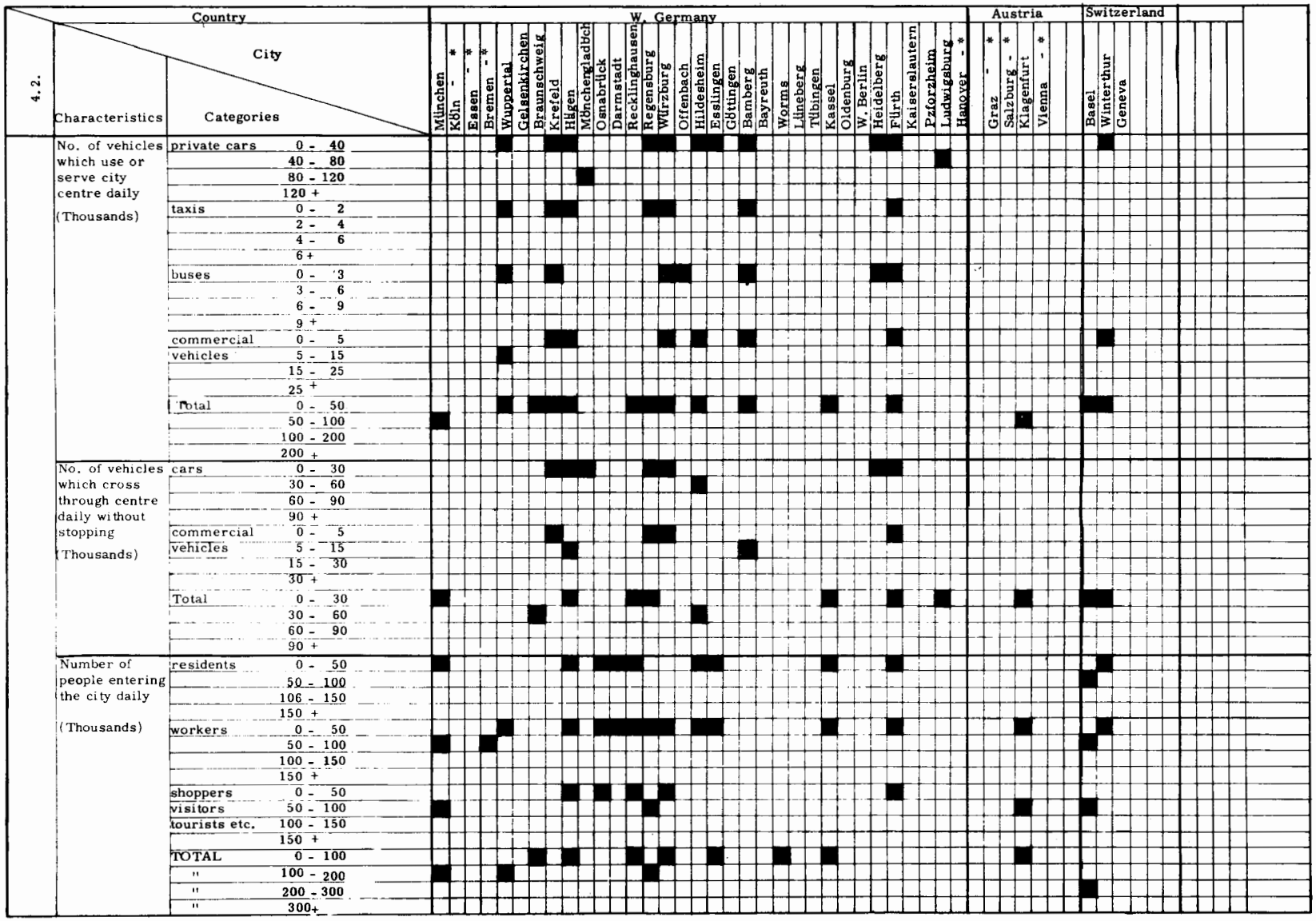

2.3
Country
City
Characteristics
Categories
Denmark
Fin.
Lux.
France
Holland
Italy
Norway
P'gal
Sweden
Y'slavia
Copenhagen *
Aarhus
Aalborg
Randers
Esbjerg
Tampere
Luxemburg
Lille
Nice
Montpellier
Rouen
Limoges
Metz
Reims
Toulouse
Bordeaux
Amsterdam *
The Hague *
Enschede *
Leiden
Amerfoort *
Rotterdam *
Delft *
Apeldoorn
Bologna
Firenza
Trieste
Perugia *
Terni
Rome *
Stavanger
Trondheim
Manodo Osello
Stockholm *
Gothenberg *
Norrköping
Orebro
Malmo
Novi Sad
Future plans for pedestrianisation
Size of Ped. area
≥ 700 m. walk
≤ 700 m. walk
Main methods of access to zone
Existing public transport
Car parks around zone
New public transport systems
Vehicles permitted in the zone
Special buses
Ordinary buses
Trains
Taxis
Goods delivery vehicles
Residents' cars
No vehicles at all
Use of special public transport in Ped. zones
Need for special transport
Yes
Perhaps
No
Type of service
Mix with pedestrians eg. City Bus
Automated track system eg Cabtrack
Minimum frequency of service during normal operation
2 mins or less
2 - 5 mins
5 10 mins
10 mins
Planning Decisions
Factors influencing planning decisions concerning city centres in order of importance
Taxis
Shopkeepers
Hotels/tourism
Anti-pollution groups
Transport operators
Traffic planners
Coordination of transport planning with rest of city planning
Very high
Reasonable
Rather loose
Influence on planning dec. of city's Assn of Shopkeepers etc.
No existing assoc. or groups
Very strong
Strong
Fairly weak
Weak


Country
City
England
W.
Scotland
NI
3.1.
Land Usage
Characteristic
Categories
London
Leeds
Sheffield
Leicester
Portsmouth
Southampton
Sunderland
Teeside
Blackpool
Derby
York
Gateshead
Wallasey
Grimsby
Cambridge
Rotherham
Eastbourne
Burnley
Exeter
Watford
Gloucester
Scunthorpe
Bury
Hull
Plymouth
Romford
Swindon
Lincoln
Dudley
Nottingham
Stoke
Ilford
Luton
Huddersfield
Oldham
Slough
Barnsley
Peterborough
Nuneaton
Crewe
Barking
Barnet
Cardiff
Newport
Glasgow
Edinburgh
Dundee
Motherwell
Coatbridge
Belfast
% Distribution of land uses in city centre
Parks 0 - 5
5 - 10
10 - 15
15 +
Shopping 0 - 10
10 - 20
20 - 30
30 +
Residential 0 - 15
15 - 30
30 - 45
45 +
Civic/Govt 0 - 20
employment 20 - 40
Educ. etc 40 - 60
60 +
Culture/ 0 - 5
Entertainment 5 - 10
10 - 15
15 +
Distribution of principal shopping areas in city centre
One clearly defined area
2 - 3 fairly well defined areas
fairly scattered
very scattered
City Development
around a historic central core
modern city centre within it
result of village linkage

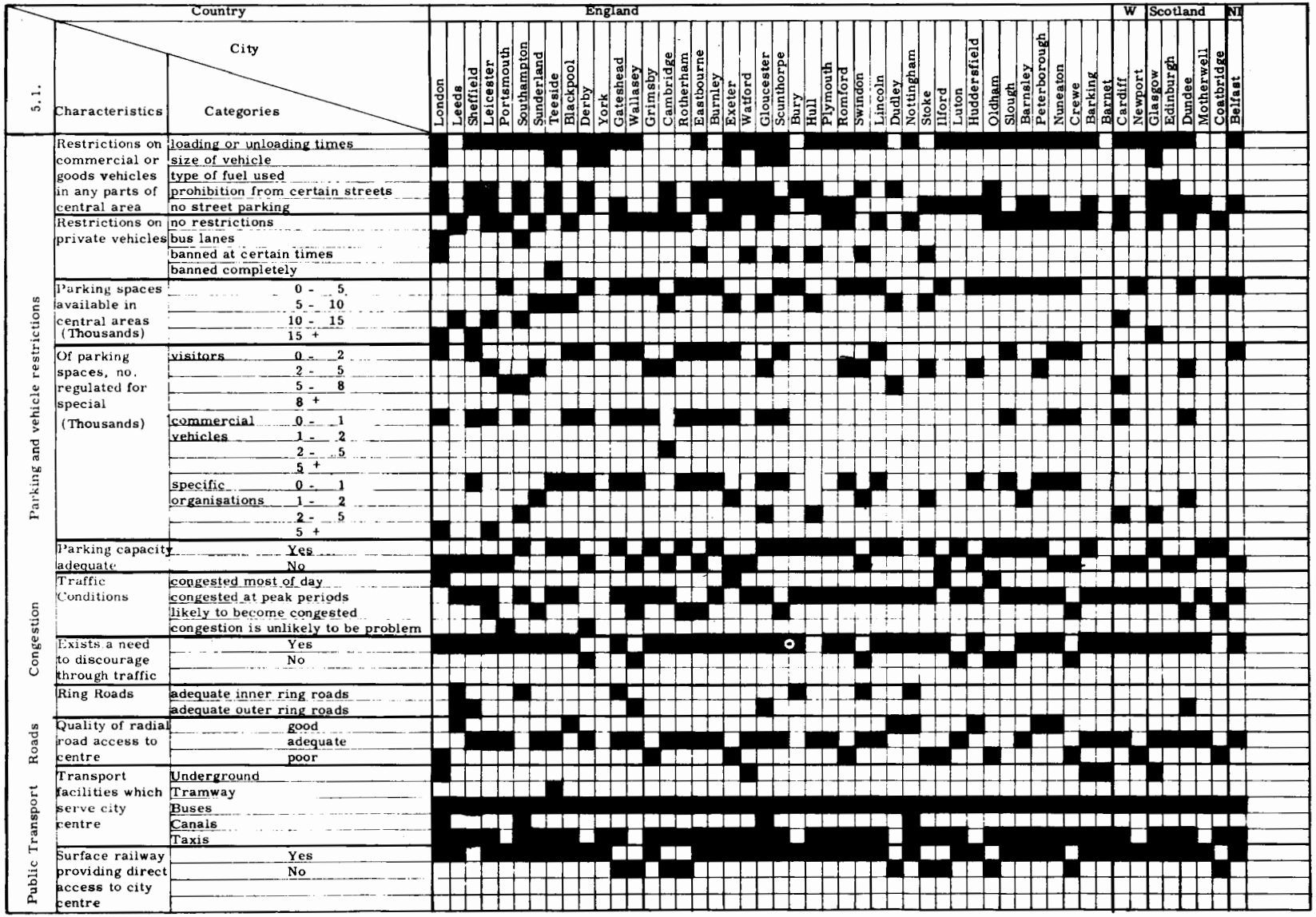

Country
City
Characteristics
Categories
3.2.
Land Usage
% Distribution of land use in city centre
Parks
0 - 5
5 - 10
10 - 15
15 +
Shopping
0 - 10
10 - 20
20 - 30
30 +
Residential
0 - 15
15 - 30
30 - 45
45 +
Civic/Govt. employment
Educ. etc.
0 - 20
20 - 40
40 - 60
60 +
Culture/ Entertainment
0 - 5
5 - 10
10 - 15
15 +
Distribution of principle shopping areas in city centre
One clearly defined area
2 - 3 fairly well defined areas
Fairly scattered
Very scattered
City Development
around a historic central core
modern city centre within it
result of village linkage
W. Germany
München
Köln - *
Essen - *
Bremen - *
Wuppertal
Gelsenkirchen
Braunschweig
Krefeld
Hagen
Mönchengladbach
Osnabrück
Darmstadt
Recklinghausen
Regensburg
Würzburg
Offenbach
Hildesheim
Esslingen
Göttingen
Bamberg
Bayreuth
Worms
Lüneberg
Tübingen
Kassel
Oldenburg
W. Berlin
Heiselberg
Fürth
Kaiserslautern
Pforzheim
Ludwigsburg
Hanover - *
Austria
Graz - *
Salzburg - *
Klagenfurt
Vienna - *
Switzerland
Basel
Winterthur
Geneva

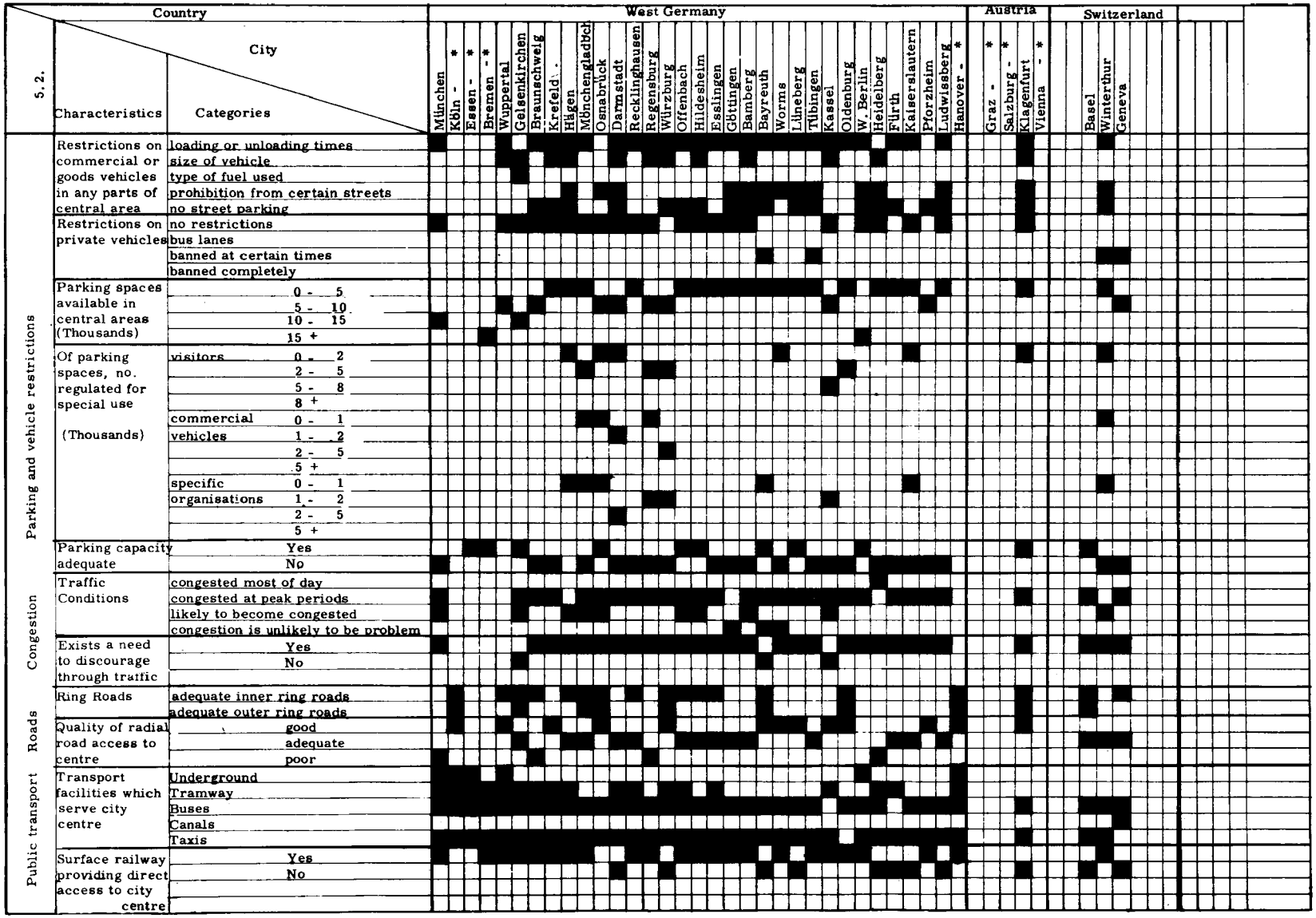

3.3.
Country
City
Characteristics
Categories
Denmark
Copenhagen *
Aarhus
Aalborg
Randers
Esbjerg
Fin.
Tampere
Lux.
Luxemburg
France
Lille *
Nice
Montpellier
Rouen
Limoges
Metz
Reims
Toulouse
Bordeaux
Holland
Amsterdam *
The Hague *
Enschede
Leiden
Amerfoort
Rotterdam
Delft
Apeldoorn
Italy
Bologna
Firenza
Trieste
Perugia
Terni
Rome *
N'way
Stavanger
Trondheim
P'gl.
Viano do Costelo
Sweden
Stockholm *
Gothenberg *
Norrkoping
Orebo
Malmo
Y'slavia
Novi Sad
% Distribution of Land Use in City Centre
Parks 0 - 5
5 - 10
10 - 15
15 +
Shopping 0 - 10
10 - 20
20 - 30
30 +
Residential 0 - 15
15 - 30
30 - 45
45 +
Civic/Govt 0 - 20
employment 20 - 40
Educ. etc 40 - 60
60 +
Culture/ 0 - 5
Entertainment 5 - 10
10 - 15
15 +
Distribution of principle shopping areas in city centre
One clearly defined area
2-3 fairly well defined areas
Fairly scattered
Very scattered
City Development
around a historic central core
modern city centre within it
result of village linkage

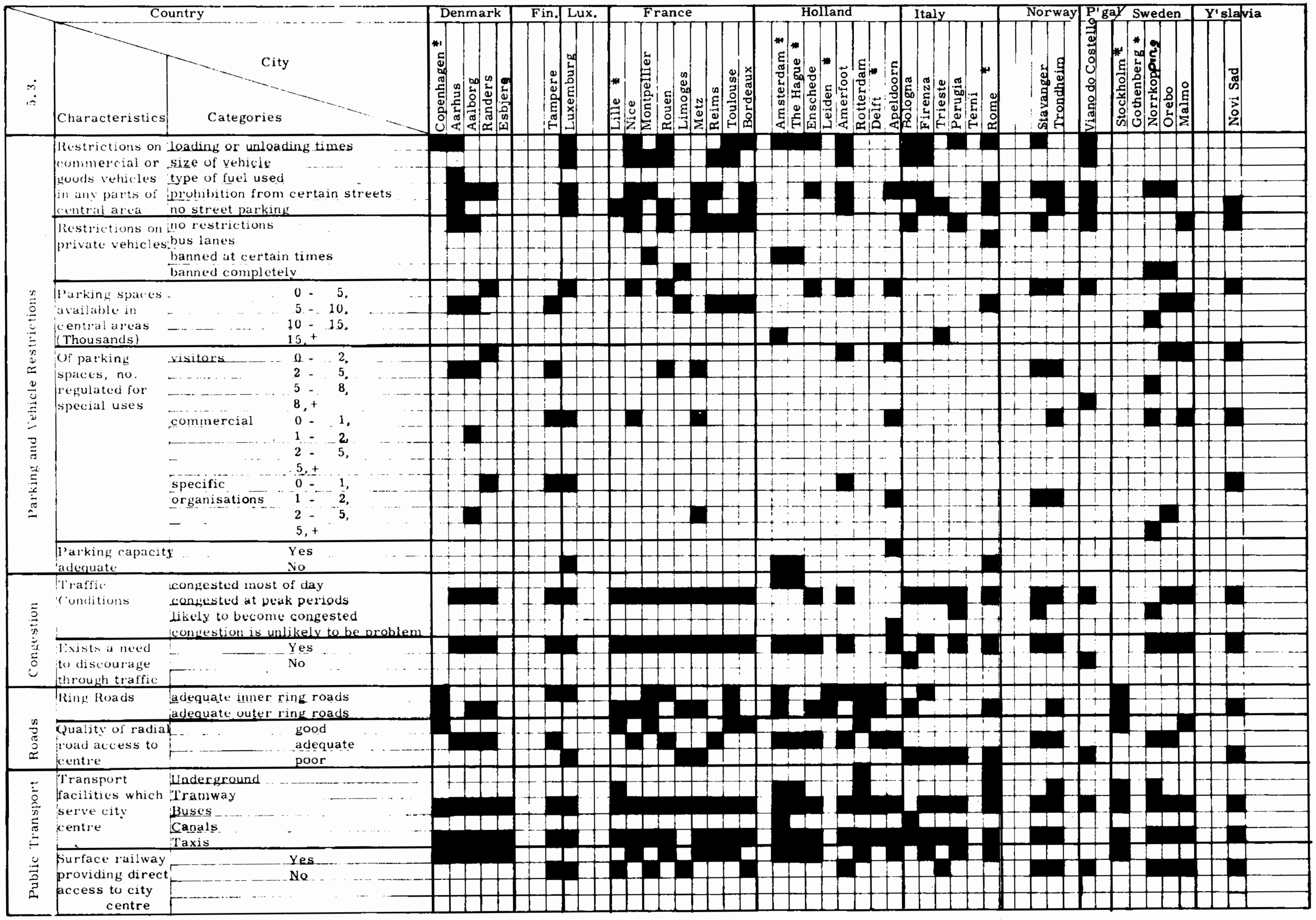

Country
City
England
W.
Scotland
NI
4.1.
Characteristics
Categories
London
Leeds
Sheffield
Leicester
Portsmouth
Southampton
Sunderland
Teeside
Blackpool
Derby
York
Gateshead
Wallasey
Grimsby
Cambridge
Rotherham
Eastbourne
Burnley
Exeter
Watford
Gloucester
Scunthorpe
Bury
Hull
Plymouth
Romford
Swindon
Lincoln
Dudley
Nottingham
Stoke
Ilford
Luton
Huddersfield
Oldham
Slough
Barnsley
Peterborough
Nuneaton
Crewe
Barking
Barnet
Cardiff
Newport
Glasgow
Edinburgh
Dundee
Motherwell
Coatbridge
Belfast
No. of vehicles which use or serve city centre daily (Thousands)
private cars 0 - 40
40 - 80
80 - 120
120 +
taxis 0 - 2
2 - 4
4 - 6
6 +
buses 0 - 3
3 - 6
6 - 9
9 +
commercial vehicles 0 - 5
5 - 15
15 - 25
25 +
total 0 - 50
50 - 100
100 - 200
200 +
No. of vehicles which cross through centre daily without stopping (Thousands)
cars 0-30
30 - 60
60,- 90
90 +
commercial vehicles 0 - 5
5 - 15
15 -30
30+
Total 0 - 30
30 - 60
60 - 90
90 +
No. of people entering the city daily (Thousands)
residents 0 - 50
50 - 100
100 - 150
150 +
workers 0 - 50
50 - 100
100 - 150
150 +
shoppers 0 - 50
visitors 50 - 100
tourists etc. 100 - 150
150 +
TOTAL 0 - 100
" 100 - 200
" 200 - 300
" 300 +


4.2.
Country
City
Characteristics
Categories
W. Germany
Austria
Switzerland
München
Köln - *
Essen - *
Bremen - *
Wuppertal
Gelsenkirchen
Braunschweig
Krefeld
Hagen
Mönchengladbach
Osnabrück
Darmstadt
Recklinghausen
Regensburg
Würzburg
Offenbach
Hildesheim
Esslingen
Göttingen
Bamberg
Bayreuth
Worms
Lüneberg
Tübingen
Kassel
Oldenburg
W. Berlin
Heidelberg
Fürth
Kaiserslautern
Pforzheim
Ludwigsburg
Hanover - *
Graz - *
Salzburg - *
Klagenfurt
Vienna - *
Basel
Winterthur
Geneva
No. of vehicles which use or serve city centre daily (Thousands)
private cars 0 - 40
40 - 80
80 - 120
120 +
taxis 0 - 2
2 - 4
4 - 6
6 +
buses 0 - 3
3 - 6
6 - 9
9 +
commercial vehicles 0 - 5
5 - 15
15 - 25
25 +
Total 0 - 50
50 - 100
100 - 200
200 +
No. of vehicles which cross through centre daily without stopping (Thousands)
cars 0 - 30
30 - 60
60 - 90
90 +
commercial vehicles 0 - 5
5 - 15
15 - 30
30 +
Total 0 - 30
30 - 60
60 - 90
90 +
Number of people entering the city daily (Thousands)
residents 0 - 50
50 - 100
100 - 150
150 +
workers 0 - 50
50 - 100
100 - 150
150 +
shoppers 0 - 50
visitors 50 - 100
tourists etc. 100 - 150
150 +
TOTAL 0 - 100
" 100 - 200
" 200 - 300
" 300+

4.3. Characteristics	Categories		Denmark					Fin.	Lux.	France									Holland								Italy						Norway		P'gal	Sweden					Y'slavia
		City	Copenhagen *	Aarhus	Aalborg	Randers	Esbjerg	Tampere	Luxemburg	Lille *	Nice	Montpellier	Rouen	Limoges	Metz	Reims	Toulouse	Bordeaux	Amsterdam *,	The Hague -*	Enschede	Leiden *	Amerfoot	Rotterdam	Delft -*	Apeldoorn	Bologna	Firenza	Trieste	Perugia	Terni	Rome -*	Stavanger	Trondheim	Viano do Costello	Stockholm *	Gothenberg *	Norrkoping	Orebo	Malmo	Novi Sad
No. of vehicles which use or serve city centre daily (Thousands)	private cars	0 - 40,				■		■					■								■		■			■			■				■	■				■	■	■	■
		40 - 80,		■											■																										
		80 - 120,									■																	■													
		120, +																																							
	taxis	0 - 2,		■				■							■			■								■								■				■	■	■	
		2 - 4,																																							
		4 - 6,																																							
		6, +																																							
	buses	0 - 3,		■				■							■						■		■			■	■		■				■	■				■	■	■	■
		3 - 6,																																							
		6 - 9,																																							
		9, +																																							
	commercial	5 - 15,				■															■		■			■												■	■		■
	vehicles	15 - 25,		■				■							■													■					■	■							
		25, +																																							
	TOTAL	0 - 50,						■						■									■						■				■	■				■	■	■	■
		50 - 100,		■											■																										
		100 - 200,									■																	■													
		200, +																																							
Number of vehicles which cross through centre daily without stopping (Thousands)	cars	0 - 30,						■			■		■		■						■					■			■					■					■	■	
		30 - 60,																																							
		60 - 90,																																							
		90, +																																							
	commercial	0 - 5,						■			■				■						■					■								■					■		
	vehicles	5 - 15,																																							
		15 - 30,		■																																					
		30, +																																							
	TOTAL	0 - 30,						■							■																		■	■					■		
		30 - 60,									■			■																											
		60 - 90,																																							
		90, +																																							
Number of people entering the city daily (Thousands)	residents	0 - 50,	■		■			■			■				■											■			■				■	■				■	■	■	
		50 - 100,																										■													■
		100 - 150,																																							
		150, +																																							
	workers	0 - 50,			■			■																					■				■	■				■	■	■	■
		50 - 100,	■								■				■													■													
		100 - 150,																																							
		150, +																																							
	shoppers	0 - 50,						■							■													■	■				■					■	■	■	■
	visitors	50 - 100,									■																							■							
	tourists etc.	100 - 150,	■																																						
		150, +																																							
	TOTAL	0 - 100,						■							■													■	■				■					■	■	■	■
		100 - 200,	■	■							■																							■							
		200 - 300,																																							
		300, +																																							


Country
City
England
W
Scotland
NI
5.1.
Characteristics
Categories
London
Leeds
Sheffield
Leicester
Portsmouth
Southampton
Sunderland
Teeside
Blackpool
Derby
York
Gateshead
Wallasey
Grimsby
Cambridge
Rotherham
Eastbourne
Burnley
Exeter
Watford
Gloucester
Scunthorpe
Bury
Hull
Plymouth
Romford
Swindon
Lincoln
Dudley
Nottingham
Stoke
Ilford
Luton
Huddersfield
Oldham
Slough
Barnsley
Peterborough
Nuneaton
Crewe
Barking
Barnet
Cardiff
Newport
Glasgow
Edinburgh
Dundee
Motherwell
Coatbridge
Belfast
Parking and vehicle restrictions
Congestion
Roads
Public Transport
Restrictions on commercial or goods vehicles in any parts of central area
loading or unloading times
size of vehicle
type of fuel used
prohibition from certain streets
no street parking
Restrictions on private vehicles
no restrictions
bus lanes
banned at certain times
banned completely
Parking spaces available in central areas (Thousands)
0 - 5
5 - 10
10 - 15
15 +
Of parking spaces, no. regulated for special (Thousands)
visitors
0 - 2
2 - 5
5 - 8
8 +
commercial vehicles
0 - 1
1 - 2
2 - 5
5 +
specific organisations
0 - 1
1 - 2
2 - 5
5 +
Parking capacity adequate
Yes
No
Traffic Conditions
congested most of day
congested at peak periods
likely to become congested
congestion is unlikely to be problem
Exists a need to discourage through traffic
Yes
No
Ring Roads
adequate inner ring roads
adequate outer ring roads
Quality of radial road access to centre
good
adequate
poor
Transport facilities which serve city centre
Underground
Tramway
Buses
Canals
Taxis
Surface railway providing direct access to city centre
Yes
No


Country
City
5.2.
Characteristics
Categories
West Germany
Austria
Switzerland
München *
Köln -
Essen - *
Bremen - *
Wuppertal
Gelsenkirchen
Braunschweig
Krefeld -
Hagen
Mönchengladbach
Osnabrück
Darmstadt
Recklinghausen
Regensburg
Würzburg
Offenbach
Hildesheim
Esslingen
Göttingen
Bamberg
Bayreuth
Worms
Lüneberg
Tübingen
Kassel
Oldenburg
W. Berlin
Heidelberg
Fürth
Kaiserslautern
Pforzheim
Ludwissberg
Hanover - *
Graz - *
Salzburg - *
Klagenfurt
Vienna - *
Basel
Winterthur
Geneva
Parking and vehicle restrictions
Congestion
Roads
Public transport
Restrictions on commercial or goods vehicles in any parts of central area
loading or unloading times
size of vehicle
type of fuel used
prohibition from certain streets
no street parking
Restrictions on private vehicles
no restrictions
bus lanes
banned at certain times
banned completely
Parking spaces available in central areas (Thousands)
0 - 5
5 - 10
10 - 15
15 +
Of parking spaces, no. regulated for special use
visitors
0 - 2
2 - 5
5 - 8
8 +
commercial vehicles
0 - 1
1 - 2
2 - 5
5 +
specific organisations
0 - 1
1 - 2
2 - 5
5 +
Parking capacity adequate
Yes
No
Traffic Conditions
congested most of day
congested at peak periods
likely to become congested
congestion is unlikely to be problem
Exists a need to discourage through traffic
Yes
No
Ring Roads
adequate inner ring roads
adequate outer ring roads
Quality of radial road access to centre
good
adequate
poor
Transport facilities which serve city centre
Underground
Tramway
Buses
Canals
Taxis
Surface railway providing direct access to city centre
Yes
No



*U.S. GOVERNMENT PRINTING OFFICE : 1978 0-721-580/762