REPORT AND RECOMMENDATIONS

ON A

COMPREHENSIVE RAPID TRANSIT PLAN

FOR THE CITY AND COUNTY OF

LOS ANGELES

To the City Council of the City of Los Angeles and
the Board of Supervisors of Los Angeles County

KELKER, DE LEUW & CO.
CHICAGO

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ENGINEERS
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LETTER OF TRANSMITTAL

April 10th, 1925.

TO THE HONORABLE,
THE PRESIDENT AND MEMBERS OF THE
CITY COUNCIL OF THE CITY OF LOS ANGELES, AND
THE PRESIDENT AND MEMBERS OF THE
BOARD OF SUPERVISORS OF LOS ANGELES COUNTY.

Gentlemen:

We have the honor to submit herewith a Report on a Comprehensive Rapid Transit Plan for the City and County of Los Angeles.

This Report contains the general plan for a transportation system adequate to meet the demands of a city of 3,000,000, with data and discussion of its legal and financial phases. The fundamental principles of the problem have been stated and, wherever possible, descriptive detail has been omitted, so that the entire plan is presented in a manner that will aid the officials of the City in formulating a "comprehensive elevated railway and subway plan" as required by the provisions of the new City Charter. The Report also deals with the entire metropolitan district and it is believed that it will prove of value to the Board of Supervisors in providing for the transportation needs of one of the largest counties in the United States.

A clear cut recognition of the fundamental relationship of transportation to the growth of a city is essential to the determination of a sound development policy. A City Plan is incomplete without a Transit Plan. The conception of transit planning as a public duty and responsibility must be accepted before Los Angeles can insure for itself a complete and workable City Plan and a continuance of its unique type of community development.

The representatives of the City and of the County, Hon. E. F. Bogardus, President of the Board of Public Utilities, and Mr. J. E. Rockhold, County Surveyor, have been untiring in their interest. The information and advice received from them has been of great value in the preparation of this Report as well as in conducting the work in an economical manner.

The whole-hearted support of the City Council, the Board of Supervisors, the members of the Board of Public Utilities and their various technical staffs has been

most gratifying; and on legal matters the City Attorney and County Counsel, and their staffs, have made valuable contributions. In fact, on every hand, our work has been aided by organizations and individuals who joined with us in the single aim of giving to Los Angeles a transportation plan that would meet the present and future requirements of the metropolitan center of Southern California.

Good transportation is one of the greatest assets a community can have — it greatly increases and stabilizes property values, improves housing conditions and standards of living, beneficially affects business activities of all kinds and insures an orderly development.

However, a transit plan is no more self-constructing than is a statute self-enforcing. Therefore a report containing an outline of a physical plan, accompanied with descriptions of design, estimates of costs and statements of fundamental principles, surrounded by pertinent and interesting facts is, of itself, an inert manuscript. Additional energy and time must be spent upon such a plan in order to secure for Los Angeles and its Metropolitan Area the benefits of a complete system of transportation suitable to its present needs and capable of expansion as the future may require.

Good transportation is essential and vital to a great community. Every city is the guardian of its future. Plan broadly for tomorrow, build wisely for today!

Respectfully submitted,

KELKER, DE LEUW & CO.,

Consulting Engineers

SUMMARY OF THE REPORT AND RECOMMENDATIONS

General

Los Angeles has become a large metropolitan center and it is of vital importance, at this time, that transportation facilities be planned upon a scale commensurate with the present and prospective development of the City and County. The phenomenal growth in population and industrial activity, together with the tremendous increase in street traffic, makes the construction of rapid transit lines not only necessary but imperative if an adequate, quick and convenient means of public transportation is to be provided and traffic conditions are to be improved.

Until recent years the local street railway facilities were adequate and the interurban railways serving the cities, towns and communities in metropolitan Los Angeles had facilities to supply service far in excess of the traffic demands. The unprecedented increase in population during the past few years has reversed this situation, and both the local and interurban lines are experiencing more and more difficulty in getting into and out of the central business district because of traffic congestion.

At the present time all classes of traffic move on the same plane (the street surface) and consequently there are frequent delays and interruptions. The segregation of traffic by providing separate planes is essential to permanent improvement and this best can be accomplished by the construction of rapid transit lines. Rapid transit lines may be constructed either above the street on elevated structures; or beneath them in subways, tunnels, or in open cuts with bridges at street intersections. Such a separation of traffic planes is a permanent improvement of the highest character; it establishes a right-of-way upon which trains can be operated without being interrupted by or causing interruption to vehicular and pedestrian traffic. In addition, the operation of trains on railroads free from grade crossings is the best means yet developed for furnishing mass transportation. The need for rapid transit has been recognized in the drafting of the new City Charter, as it contains a provision which enables the City to adopt a comprehensive elevated railroad and subway plan. Upon the adoption of such plan the City may proceed, either directly or indirectly, to construct such portions of the comprehensive plan as are required from time to time to keep pace with growth in industry and population.

RAPID TRANSIT IN OTHER CITIES

The experience of all large cities shows that after a certain growth had been attained the construction of rapid transit lines became an essential to their continued development.

Early Rapid Transit Systems

The elevated railroads in New York City (Manhattan Island) were completed substantially as they exist today by the year 1880 (population, 1,200,000); the greater part of the elevated system in Brooklyn, New York, was built by 1890 (population, 850,000); and the construction of rapid transit in Chicago, consisting entirely of elevated roads, was commenced about 1890 (population, 1,100,000) and completed, with the exception of a few extensions, by 1900 (population, 1,700,000). Subways became necessary in Boston in 1893, and a part of Boston's present rapid transit system was completed in 1898, when the population was approximately 400,000. In Philadelphia the first rapid transit line was completed in 1907, at which time the population was about 1,450,000.

Use of Public Funds

It is evident from the experience of other large cities that rapid transit lines cannot be constructed and operated on a self-sustaining basis at a low rate of fare, unless the territory to be served is an area with an extremely dense population and the number of rides per capita (riding habit) is high.

Greater New York has an average density of population of about 31 persons per acre (161 persons per acre in the Borough of Manhattan) and the number of rides per capita is very high. While the major portion of the rapid transit system was constructed when price levels were much below those of today, it was necessary to use public credit, and today the City of New York has an investment of over $300,000,000 in rapid transit subways. The earnings of the operating corporations although large are insufficient to meet the interest charges on all of the City's investment. This is one of the chief reasons why it is possible for these private corporations to furnish service on a 5-cent fare.

The City of Boston has a population density of 27 persons per acre—a comparatively high density—and a good riding habit. While the elevated railroads were financed by private capital, the subways for rapid transit trains and for street cars were constructed by the use of public funds, amounting to $44,500,000. Both the elevated railroads and subways were largely constructed when price levels were low. Even with this situation—comparatively dense population, good riding habit and part of the rapid transit system financed by the public—the Board of Public Trus-

tees has found it necessary to maintain rates of fare which average 8.8 cents, in order to provide a sufficient return on the public and private capital invested in the property.

Part of the rapid transit system in Philadelphia (the Frankford Elevated Railway) was built some years ago by the City at a cost of $16,000,000. The population density today is 22 persons per acre and the riding habit is excellent. These conditions should lend themselves to the furnishing of service at a low rate of fare. The fare, however, is 8 cents cash or 7½ cents when tickets are purchased.

The rapid transit system in Chicago consists entirely of elevated railroads and was financed and constructed solely by private capital, at comparatively low price levels. Although Chicago has a population density of 22 persons per acre, the rapid transit riding habit is not high, for the reason that rapid transit lines serve only 20% of the city's area. It is becoming increasingly apparent that if the much needed additional rapid transit lines are to be constructed in Chicago a large portion of the cost will have to be borne by the City, which now has a cash fund of over $40,000,000 which can be used for this purpose. The rapid transit fare in Chicago is, at present, 10 cents cash or 8 1/3 cents when tickets are purchased.

It will be apparent from the foregoing that the principle of aiding or subsidizing the construction of rapid transit lines was resorted to by some cities long before the traffic problem became acute. If the use of public credit was necessary to promote the growth and development of cities under the traffic conditions of those days, there is a still greater necessity for the adoption of similar measures at the present time.

ELEMENTS OF A METROPOLITAN TRANSPORTATION SYSTEM

The growth and development of Los Angeles, as with all other large cities, has been largely due to the facilities provided and service afforded by electric railways. This interdependence is likely to be more important in the future than in the past, and therefore a modern transportation system, properly co-ordinated, and adequate to meet the needs of a much greater Los Angeles, must be provided.

This transportation system should comprise:

(a) *Rapid transit lines,* providing high speed service with few stops—for long haul traffic between the central business district and the intermediate and outlying sections of the urban area;

(b) *Interurban lines,* providing high speed train service between the centers of the various cities in the metropolitan district;

(c) *Street railway lines,* providing local service and serving as feeders to the rapid transit lines; and

(d) *Motor bus lines,* providing local service and serving as feeders to street car and rapid transit lines, and also providing extensions of transportation service in sparsely settled districts and along boulevards.

All of the above services should be co-ordinated and operated by one management.

Rapid Transit Lines

Rapid transit lines should be the backbone of the transportation system of a metropolitan city. They furnish facilities for high speed train service and make possible the transportation of large numbers of people over great distances in short periods of time. Such railroads necessarily must be operated on tracks which are separated from street grades, in subways, on elevated structures, or in open cuts, so as to be free from the interference of all classes of street traffic. In order to insure train operation at high speed, it is necessary that the number of stops be limited—the less frequent the stops, the greater the over-all speed. On the other hand, if the rapid transit service is to be made conveniently accessible the distance between stations must not be too great.

The tendency in cities of this country has been to increase the distance between stations and, at the present time, the best practice prescribes that stations be located about one-half mile apart except in and near the heavy delivery districts where the stations must be located at more frequent intervals in order to provide for the proper distribution of passengers.

Interurban Lines

Every large city is the center of a metropolitan area, which extends miles beyond the boundaries of the city proper and includes many smaller cities and towns. It is highly important that these suburban communities be connected with the center of the metropolitan area by interurban railway lines. In most cases, such lines are located on private rights-of-way and trains are operated at a high rate of speed between the limits of the urban areas.

In the urban area of Los Angeles* (see foot-note) as well as in the urban area of each of the cities in the metropolitan district, the interurban lines operate for the most part over city streets, and hence their scheduled speed in such areas is reduced to that of street cars. Such operation results in an interurban service which is unsatisfactory with respect to the average rate of speed.

*For the purposes of this Report, the urban area of Los Angeles has been assumed to be all of the territory where there is a continuous development from the center of the city outwards. It can be roughly circumscribed by a circle having a radius of six miles measured from Pershing Square and includes portions of some separate municipalities such as Vernon, Huntington Park and Glendale.

Facilities for high speed operation of interurban trains in urban territory are essential and can be supplied in Los Angeles, without duplication of expenditure, by constructing additional tracks on the structures of the proposed urban rapid transit system. Such improvements within the urban areas, coupled with the elimination of grade crossings at the important highways in the territory between them, will make possible the maintenance of high speed service.

Street Railway Lines

The function of street railway lines is to provide local service throughout the city as well as to serve as feeders to the rapid transit lines.

A well designed street railway system will have lines radiating from the center of the city, connecting that center with the various sub-centers, and a number of cross-town routes extending longitudinally and transversely across the city. It also should be designed to intersect the rapid transit lines near stations so that the rapid transit service will be made easily accessible to the majority of people. The existing street railways in Los Angeles, with the additions and extensions herein recommended, will meet substantially all the foregoing requirements.

Motor Bus Lines

The most recent development in the transportation field is the motor bus. Buses can be best utilized to furnish a supplemental service on boulevards and to serve as feeders for street railway and rapid transit lines. They are also well adapted to providing extensions of service in sparsely populated territory where the volume of traffic is not sufficient to warrant the expenditure necessary for the construction of street railway tracks.

Co-ordinated Operation

Although each of the four elements of transportation (rapid transit trains, interurban trains, street cars and motor buses) provides a separate and distinct service, they are all closely related and can be made to function much more efficiently and economically if properly co-ordinated.

The ideal transportation system is one which combines all these methods of transit under a single management within the urban area. In addition to the benefits in improved service which the public receives from such a system, it is possible for the management to have each of these facilities supplement the others and to eliminate wasteful competition and duplication of service. In order to place the facilities afforded by these public transportation agencies within the convenient reach of the public, it is not only necessary to have a single operating management,

but also to grant transfer privileges between the feeder lines and rapid transit lines. In this way, and only in this way, can the advantages of rapid transit and all the benefits of a unified system be obtained.

The operating expense per car mile is appreciably less for rapid transit service than for street car or motor bus service. The granting of transfers between street cars, motor buses and rapid transit lines will provide better service and at the same time effect an economy in operation. The long haul riders are carried at a loss by any surface street car company serving a large city on a flat fare. If, however, these long haul riders can be transferred to rapid transit lines, an operating economy can be effected.

SOCIAL ASPECTS OF RAPID TRANSIT

It frequently has been said that transportation is a social problem in addition to being a financial and engineering problem. Surely there is nothing which more vitally affects housing conditions and standards of living in cities than does the transit system. Los Angeles is most fortunate in having the lowest density of population of any large American city. It has maintained and probably will continue to maintain first place among our cities in this respect. The desire of the average citizen to own his own home has caused the single family dwelling to predominate and the absence of large apartment buildings is noticeable. Such a condition is very desirable, but it is one of the prime factors which makes the construction and operation of rapid transit lines on a self-sustaining basis, a difficult financial problem.

UNDERLYING FACTORS

From an extensive survey of the present transportation facilities and traffic conditions, and after a careful study of the available transportation and traffic data, it is evident that a Comprehensive Rapid Transit Plan for the City and County of Los Angeles must be in accord with the following factors:

(1) The *future orderly development* of Los Angeles requires the construction of *rapid transit lines* and the extension and expansion of other transportation facilities;

(2) If the city's *unequalled position,* when compared with other large cities with respect to the number of families per dwelling, is to be maintained, it must continue to spread and this spreading can be accomplished only by providing rapid transportation *at a reasonable rate of fare;*

(3) If the car rider is required to pay a fare sufficient to support all of the capital required for rapid transit construction, either the fare must be substantially increased or the rapid transit system must be quite limited;

(4) If the cost of rapid transit construction is shared by
   (a) *The car riders,*
   (b) *The property benefited, and*
   (c) *The public at large,*
   then the extent of the rapid transit system may be proportionately increased;

(5) Only by the adoption of a *comprehensive plan* can a sound and economical *construction program* be prepared;

(6) The *unification and operation by a single management* of all of the public transportation services within the urban area (an area circumscribed by a circle having a radius of approximately six miles) is essential to first-class service;

(7) *Existing facilities should be utilized* in the greatest measure consistent with the development of the transportation system;

(8) The services rendered by *rapid transit, interurban, street railway and motor bus lines* should be *co-ordinated,* insofar as this is practicable;

(9) The extension and expansion of street railway and bus systems should include *cross-town lines* which will make the rapid transit lines easily accessible;

(10) *Grade separation* at important highway crossings on the high speed lines in the outlying areas should accompany the construction of the proposed rapid transit lines, and *additional highway crossings* should not exceed the minimum number required to meet the public needs; and

(11) The *alignment of principal thoroughfares* should be improved wherever possible by *eliminating off-sets* and *the radii of curb corners* should be increased, in order to facilitate the movement of all street traffic.

RAPID TRANSIT STRUCTURES

Rapid transit operation requires the building of railroad structures either above or below the grade of streets. Elevated railroads provide the facilities for travel in natural light and open air and are particularly adapted to the climate of Los Angeles. There has been a vast improvement in the design of elevated structures since the first elevated railroads were built in eastern cities. Elevated railroads can be designed which are attractive in appearance, such as the one recently built in Philadelphia.

From the viewpoint of noise, street traffic obstruction and the appearance of a city, subways unquestionably have an advantage over elevated railroads, but it must

be borne in mind that the service which can be provided in subways is no better than that which can be provided on elevated railroads and service, after all, is of greatest interest to the public.

While there is no difference in the service which can be rendered by elevated railroads and subway lines, there is a decided difference in their construction costs. The least expensive type of subway is from two to four times more costly than elevated railroad structures. The type of structure used, therefore, must necessarily depend in a large measure upon financial limitations.

Conclusions have been reached on the adaptability of certain types of structure to the various recommended routes. It must be remembered, however, that modifications, in specific instances, of either type or alignment may be considered when detailed plans and specifications are being prepared in order that a transportation system best adapted to the local conditions may be constructed.

RECOMMENDATIONS

A Comprehensive Rapid Transit Plan for a unified transportation system to meet the needs of Los Angeles when its population has reached 3,000,000 is contained in the Report (see Chapter VI). Maps have been made to show the outline of this Plan for the Metropolitan District (see Plate 1), the Urban Area (see Plate 2) and the Central District (see Plate 3).

The present day needs are pressing and therefore it is recommended that certain parts of the complete plan be constructed immediately. These parts are outlined under the caption FOR IMMEDIATE CONSTRUCTION. (See Plates 4 and 5.)

Future development of the system will be made by providing additional rapid transit facilities in the Central Business District; constructing extensions to and branches from the initial rapid transit lines; separating grades on the interurban railroads, and enlarging the street railway and bus systems. These items are grouped under the caption FOR FUTURE CONSTRUCTION.

I.

FOR IMMEDIATE CONSTRUCTION

A. RAPID TRANSIT LINES

(1) *Moneta-Broadway-Pasadena Avenue Line*

A rapid transit line to extend through the city, from Manchester Avenue on the south to Avenue 64 on the north. This line will consist of an ele-

vated railroad with the exception of the section between Washington Street and Sunset Boulevard, where a subway is recommended. (See Figure 30, page 100.)

(2) *Hollywood-Vineyard Line*

A rapid transit line to connect the north and northwest with the west and southwest sections of the city, following approximately the present Hollywood-Vineyard route of the Pacific Electric Railway. This line will consist of an elevated railroad and subway in Pico Street, the Broadway subway, the Hollywood tunnel, an elevated railroad on Glendale and Sunset Boulevards and a subway in Hollywood Boulevard. Physical connections will be made near Vineyard Junction with the Venice and Sawtelle lines, and at Glendale Boulevard and Montrose Street with the Glendale line. (See Figure 31, page 104.)

(3) *San Fernando Valley Line*

At present the interurban service between the central business district and points in the western portion of the San Fernando Valley is provided by trains operating through the Cahuenga Pass. A new line, which will reduce the traveling time between these points and at the same time provide service to a greater portion of the valley, is recommended. This line will extend northwesterly on private right-of-way from a connection with the existing tracks of the Glendale line of the Pacific Electric Railway just west of the Los Angeles River, to the Burbank-Chatsworth branch of the Southern Pacific Railroad and thence westerly to a connection with the existing Pacific Electric Railway line at Lankershim. It will consist of an elevated railroad between Glendale Boulevard and Los Feliz Boulevard and a rapid transit railroad at grade from Los Feliz Boulevard to Lankershim with elevated construction at important streets in order to eliminate grade crossings. (See Figure 31, page 104.)

(4) *Third-Seventh-Whittier Boulevard Line*

A rapid transit line to extend across the city from Larchmont Boulevard on the west to Indiana Street on the east. This line will consist of a subway in Third Street, Vermont Avenue and West and East Seventh Street and private right-of-way from Larchmont Boulevard to Stanford Avenue, and an elevated railroad along private right-of-way and Whittier Boulevard from Stanford Avenue easterly to Indiana Street. (See Figure 32, page 108.)

B. SURFACE LINES

In order to provide an adequate system of feeders to the rapid transit lines and at the same time extend the local service it is recommended that surface line extensions be made in the following streets:

(1) *Street Railway Lines*

Street	*From*	*To*
Downey Road	Ninth Street	Fifty-fifth Street
Euclid Avenue	Whittier Boulevard	Ninth Street
Fifty-fifth Street	Central Avenue	Downey Road
Fifty-fourth Street	Moneta Avenue	San Pedro Street
Fifty-fourth Street	South Park Avenue	Central Avenue
Florence Avenue	Western Avenue	Pacific Boulevard
Marengo Street	Daly Street	Soto Street
Melrose Avenue	Larchmont Boulevard	Vine Street
Ninth Street	Hooper Avenue	Downey Road
Soto Street	Marengo Street	Wabash Avenue
Vermont Avenue	Monroe Street	Los Feliz Boulevard
Vernon Avenue	Angeles Mesa Drive	Arlington Avenue
Vernon Avenue	Dalton Avenue	Vermont Avenue
Vernon Avenue	Pacific Boulevard	Downey Road
Vine Street	Melrose Avenue	Hollywood Boulevard
Wabash Avenue	Soto Street	Evergreen Avenue

(2) *Bus Lines*

(a) *Plymouth-Norton-Seventh Avenue*

A bus route on Plymouth Boulevard, Eighth Street, Norton, Sixth and Seventh Avenues, from Third Street to Exposition Boulevard.

(b) *Manchester Avenue*

A bus route on Manchester Avenue from Western Avenue to Alameda Street.

(c) *Hollywood-Pasadena*

A bus route on Western Avenue, Los Feliz Boulevard, Central Avenue in Glendale, Colorado Avenue and Colorado Street, from Franklin Avenue to Fair Oaks Avenue in Pasadena.

C. Equipment

Rapid transit cars, additional street cars and buses, sub-stations, shops, yards, garages and terminal facilities will be required and have been provided for in the estimates of cost.

D. Pacific Electric Railway Expansion

The lines of the Pacific Electric Railway are important factors in providing freight, interurban and local street railway service. The freight traffic on the lines of this Company, as they exist on the east and south sides of the city, prevents their co-ordination with the proposed rapid transit system. In order that these lines also may be utilized for urban rapid transit, it is recommended that the Pacific Electric Railway make certain improvements, the major portion of which it now has in contemplation. These improvements will provide facilities for urban rapid transit service in the northeast and southeast sections of the City (see Figure 33, page 114), as well as for interurban service and freight service, and are as follows:

(1) *Pacific Electric Terminal Line*

The construction of a terminal elevated railroad easterly from a connection with the Main Street station elevated structure to a point just east of the Los Angeles River and thence northerly paralleling the river to Aliso Street, with a branch extending southerly from a point near Seventh and Alameda Streets to a connection with the Watts line near 14th Street.

(2) *Watts Line*

The elevation of the Watts line from Ninth Street to Manchester Avenue; and

(3) *Pasadena Short Line*

The construction of two additional tracks on a short section of the Pasadena Short Line.

II.

For Future Construction

The immediate construction program just outlined will provide, when completed, a transportation system adequate to meet the *present and near future* needs of Los Angeles. It must be borne in mind, however, that this initial program provides but the framework on which must be built a complete system to serve the much

greater metropolitan center now in prospect. Future construction, therefore, to round out and complete the initial portion of the comprehensive plan is recommended.

The location of the routes recommended for future construction is based on present data and forecasts of future growth. Conditions change, however, and new and unexpected situations may arise, consequently modifications may be necessary when the time for actual construction arrives. Such modifications, if any, can be made without impairing the usefulness of the initial routes and without duplicating expenditures.

The various units for the future construction program are outlined below:

A. RAPID TRANSIT LINES

(1) *Moneta-Broadway-Pasadena Avenue System*

The initial north and south route will be expanded by the construction of:

(a) A third track on the Broadway-Pasadena Avenue Elevated from Sunset Boulevard to Avenue 64 and an elevated railroad extension north to the heart of Pasadena;

(b) A third track on the Broadway-Moneta Avenue Elevated from Washington Street to Manchester Avenue and an elevated railroad extension south along Moneta Avenue to a connection with the existing Gardena line of the Pacific Electric Railway at 118th Street; and

(c) An elevated railroad branch line westerly along Santa Barbara Avenue and private right-of-way from Moneta Avenue to Inglewood and south to a connection with the Pacific Electric Railway below Hawthorne.

The two south branches of the system will connect with the two-track interurban railway lines at 118th Street and Hawthorne and serve San Pedro and Redondo Beach, respectively. The elimination of grade crossings on these interurban lines is also recommended.

(2) *Hollywood-Vineyard System*

The comprehensive plan provides for the expansion of this system by the construction of:

(a) A subway in Olive Street extending through the central business district;

(b) Two additional tracks on the Venice Short Line so as to provide a four-track railroad, elevated at street crossings, from Vineyard Junction to Culver Junction;

(c) The works necessary for the separation of grades at street crossings on the Sawtelle line from Vineyard Junction to Sherman Junction;

(d) An elevated railroad on Sunset Boulevard from the Olive Street subway to a connection with the elevated railroad in Sunset Boulevard at Rosemont Avenue; and

(e) The works necessary for the elimination of grade crossings by the elevation of tracks at important highways on the existing lines of the Pacific Electric Railway, from Culver Junction to Playa Del Rey Junction and also to Venice.

(3) *Glendale and San Fernando Valley Lines*

It is planned to improve and expand the San Fernando Valley Lines by the construction of:

(a) An elevated railroad in Glendale Boulevard from a connection with the Sunset Boulevard Elevated to Fargo Street; a third track along Allesandro Street and the private right-of-way of the Pacific Electric Railway from Fargo Street to the junction of the San Fernando Valley line just west of the Los Angeles River; and an elevated railroad from the Los Angeles River to Arden Junction in Glendale to replace the existing two-track surface railroad;

(b) An elevated railroad from Vineland Avenue to Pacoima Avenue in Lankershim; an additional track and elevation of the tracks at important highway crossings from Pacoima Avenue in Lankershim to El Nido Street in Van Nuys; and an elevated railroad from El Nido Street to Van Nuys Junction;

(c) An additional track from Van Nuys Junction to Webb Street in San Fernando, and elevation of the tracks at important highway crossings; and an elevated railroad from Webb Street to Porter Avenue in San Fernando; and

(d) An additional track from Van Nuys Junction to Etiwanda Avenue and elevation of the tracks at important highway crossings; an elevated railroad from Etiwanda Avenue to Vanalden Avenue, an additional track from Vanalden Avenue to Hermosa Avenue in Owensmouth and elevation of the tracks at important highway crossings; and an elevated railroad from Hermosa Avenue to Topango Canyon Road in Owensmouth.

(4) *Third-Seventh-Whittier Boulevard System*

The initial east and west route will be expanded by the construction of:

(a) A third track for the Third-Seventh Street subway from Larchmont Boulevard to Burlington Avenue and a subway extension west from Larchmont Boulevard to La Brea Avenue;

(b) A third track on the Whittier Boulevard Elevated from Boyle Avenue to Indiana Street and an elevated extension from Indiana Street to Montebello;

(c) An elevated extension on Third Street and private right-of-way from La Brea Avenue to Wilshire Boulevard in Beverly Hills; and

(d) The works necessary for the separation of grades at important highways on the Sawtelle line between Beverly Hills and Sawtelle and a two-track elevated line from Sawtelle to Santa Monica.

B. SURFACE LINES

The street railway lines and bus routes comprising the surface system will be expanded by constructing street railway lines or establishing bus routes on the following streets:

1. *Street Railway Lines*

Street	*From*	*To*
Baker Avenue	Maywood Avenue	California Avenue
California Avenue	Baker Avenue	Florence Avenue
Fairfax Avenue	Sunset Boulevard	Pico Street
Fifty-fifth Street	Downey Road	Maywood Avenue
Florence Avenue	Redondo Boulevard	Western Avenue
Florence Avenue	Pacific Boulevard	Wilcox Avenue
La Brea Avenue	Hollywood Boulevard	Exposition Boulevard
Maywood Avenue	Fifty-fifth Street	Baker Avenue
One-hundredth Street	Hawthorne Avenue	Alameda Street
Tweedy Avenue	Alameda Street	Wright Road
Western Avenue	Third Street	Manchester Avenue

2. *Bus Lines*

(a) *Manchester Avenue*

An extension of the proposed bus line on Manchester Avenue from Western Avenue to Redondo Road; and

(b) *Manchester-Lincoln Avenue*

An extension of the proposed bus line on Manchester Avenue easterly on Manchester Avenue and Lincoln Avenue from Alameda Street to Wright Road.

C. EQUIPMENT

Rapid transit cars, street cars and buses, sub-stations, shops, yards and terminals will be required for the expanded system.

D. PACIFIC ELECTRIC RAILWAY EXPANSION

When the capacity of the Pacific Electric Terminal line is reached then additional facilities will be required in the central business district as well as on the lines serving the areas lying to the northeast, southeast and south. These facilities can be provided by the construction of:

(1) *Ninth-Main-Aliso Street Line*

A rapid transit line through the central district to connect the Watts line and the Pasadena Short Line, consisting of a subway in Ninth, Main and Aliso Streets, and elevated railroad connections in Ninth Street and in Aliso Street;

(2) *Long Beach and Wilmington Lines*

Improvements to the Long Beach and Wilmington lines consisting of track elevation; two additional tracks from Watts to Dominguez Junction; and an elevated railroad structure in Long Beach;

(3) *Southeast Lines*

Improvements to the southeast lines, which include elevation of tracks to eliminate important grade crossings on the Whittier and Santa Ana lines; and

(4) *Northeast Lines*

The elevation of the four-track Pasadena Short Line along Huntington Drive; the separation of grades at important highway crossings on the San Bernardino and Monrovia-Glendora lines; the construction of two-track elevated railroads in Alhambra, San Gabriel and Sierra Madre; and an additional track where necessary to provide double-track railroads on these important lines.

SUMMARY OF ESTIMATES OF COST

I.

FOR IMMEDIATE CONSTRUCTION

A.	RAPID TRANSIT LINES	
	1. Moneta-Broadway-Pasadena Avenue Line	$ 33,043,000
	2. Hollywood-Vineyard Line	31,359,000
	3. San Fernando Valley Line	4,678,000
	4. Third-Seventh-Whittier Boulevard Line	28,951,000
B.	SURFACE LINES	4,006,000
C.	EQUIPMENT	
	Cars, Buses, Sub-stations, Shops, Yards, etc.	18,200,000
D.	PACIFIC ELECTRIC RAILWAY EXPANSION	13,148,000
	TOTAL	$133,385,000

STATEMENT OF

TRACK MILEAGE OF THE COMPREHENSIVE TRANSPORTATION SYSTEM*

Miles of Single Track

	Existing or Under Construction	For Immediate Construction	For Future Construction	Total Construction	Unified System Totals
Subways and Tunnels	1.8	26.1	15.4	41.5	43.3
Elevated Railroads and Depressed Track	14.5	85.3	155.0	240.3	254.8
Total Rapid Transit Lines	16.3	111.4	170.4	281.8	298.1
Street Railways	572.3	41.6	62.7	104.3	676.6
TOTAL MILEAGE	588.6	153.0	233.1	386.1	974.7

*Within an area circumscribed by a circle having a radius of eight miles from Seventh Street and Broadway.

CHAPTER I

THE CITY AND COUNTY OF LOS ANGELES

It may appear that a report on a comprehensive rapid transit system should be confined entirely to those matters which affect transit problems more or less directly, but since Los Angeles has had such an unusual history we believe a brief general description of the City and County will afford a better understanding of the transportation problem.

The City

The City of Los Angeles was founded in 1781 through the efforts of Felix De Neve, the Military Commander of the California Mission settlements, who brought eleven families overland from Sinaloa, Mexico, in order that they might engage in agriculture and furnish a supply of provisions to the mission establishments, which were so remote from their base of supplies at San Blas on the west coast of Mexico. These settlers, mostly Indians and Mulattoes, built a group of adobe houses near the present Plaza and cultivated small parcels of ground lying between it and the Los Angeles River. A tract of four square Spanish leagues, or thirty-six square miles, had been set aside for the colony and the portion not cultivated was used as a community pasture. This original designation of six miles square was later incorporated (in the year 1850) as the Municipality of Los Angeles and a portion of its eastern boundary still remains the limits of the present city.

Stock raising flourished in the new community under the influence of the Missions; trade with the eastern part of the United States gradually grew up through the medium of Yankee trading vessels and a number of Americans had settled in Los Angeles during the decade before the forces of Fremont and Stockton entered the City in August, 1846.

The early growth of Los Angeles was slow and the activities of the population of the surrounding area were more pastoral than agricultural. The rush of gold-seekers into the northern part of the State during the early fifties created a good market for fruit. The territory surrounding Los Angeles then began to expand as a district of orchards and vineyards, and grapes and citrus fruits were conveyed to San Pedro by wagon and thence to San Francisco in small boats.

In 1876 a railroad from San Francisco was completed, forming the first all-rail route to Los Angeles. This somewhat accelerated the growth in population, but a greater impetus to this growth came in 1885 upon the completion of the Santa Fe Railroad. During the years immediately following, advertising coupled with low railroad rates brought a great influx of tourists and homeseekers to Southern California. A great deal of real estate speculation then occurred causing a land boom and an inflation of values. This was followed in 1889 by a collapse of the

boom, but in spite of this reaction the city had a marked growth from this time onward. From a population of 11,093 in 1880 the city grew to 102,479 in 1900; 319,198 in 1910 and 576,673 in 1920, when it became the tenth city in the United States. The growth since 1920 has been at a much faster rate than that prevailing during the previous decades and the population is now estimated at over a million.

An orderly development has been assured by the enactment of a zoning ordinance, which prevents the construction of industrial, commercial and residential buildings in districts other than those designated for their respective use. An ordinance limiting the height of buildings to 150 feet, or approximately thirteen stories, tends to spread and decentralize the business area, thereby preventing undue concentration of traffic. It has been stated frequently that Los Angeles lacks a uniform street system. This criticism is more or less warranted, due largely to the fact that for many years there was no regulation of land subdivision. During those years, each subdivider laid out such streets as his fancy dictated with little or no thought for making proper provision for through streets. This practice has been discontinued and the creation of the City Planning Commission, which now supervises the street layout of all subdivisions, insures against its recurrence. The Regional Planning Commission of Los Angeles is performing a noteworthy work in planning for the orderly development of the Metropolitan District.

The Municipality owns its water system, which consists of an aqueduct supplying 38 reservoirs and a distribution system having more than 2,000 miles of pipe. Because of a continued drouth in 1904, and a rapid growth in population, the City was obliged to seek a source of water supply to augment the flow pumped from wells and water galleries in the bed of the Los Angeles River. In 1907 the construction of the Los Angeles Aqueduct was started and the work was completed in 1914 at a cost of about twenty-four million dollars. The point of diversion is in Inyo County and is more than 250 miles from the city. The tributary watershed in the Sierra Nevada Range includes some of the highest mountains in the United States. There is sufficient fall along the line of the aqueduct to develop a large amount of power. Five hydro-electric plants have been constructed by the City with an installed capacity of 100,000 horsepower. Los Angeles also owns an electric distribution system covering most of the city and supplements the power generated at its aqueduct plants by purchase from the Southern California Edison Company.

THE COUNTY

Los Angeles County was organized in the year 1850 and a year later the boundaries were definitely established; being Tehachapi Pass on the north, the Colorado River on the east, San Juan Capistrano on the south, and the Pacific Ocean on the west. The assessment roll for the year 1850 showed the County's total wealth to be $2,234,451.

Los Angeles County now ranks tenth in size in California, having an area of 4,115 square miles. Its topography is rugged, the elevations ranging from sea level

at the southern end to 10,000 feet at the summit of Mount San Antonio and then receding to the plateau of the Mojave Desert at the northern extremity where the average elevation is about 2,500 feet. Most of the mountainous area of the county is within the National Forest. Almost all of the population is located within the valley and the coastal plain areas lying south and southwest of the Santa Monica and the San Gabriel Mountains. The northern part of the county is arid and lacking in streams while the coastal plain, which has an average annual rainfall of about fifteen inches at Los Angeles, is crossed by two streams, the Los Angeles and the San Gabriel Rivers. These water courses are steep in slope and for short periods during the rainy season carry large volumes of turbid water. The flood flows are of short duration and during the summer months the entire flow disappears in the gravel beds and re-appears in small quantities at certain points where dikes intercept the underground water-bearing strata. These water-bearing gravels underlying the southern portion of the county form the principal source of water supply for the highly developed horticultural districts in this region.

The area between the mountains and the ocean is very fertile and productive. The soil and climate are conducive to the production of fruits, vegetables and other produce in great variety and abundance. Los Angeles County leads all of the counties in the United States in value of agricultural products, which value amounted to $82,246,269 in 1923. It is also wealthy in mineral resources, chief among which is petroleum. About one-sixth of the nation's annual petroleum output is produced in Los Angeles County and the oil wells of the Signal Hill and Santa Fe Springs districts are at present the leading producers of the country. Immense quantities of petroleum and petroleum products are shipped from Los Angeles Harbor, and these exports in 1923 amounted to 142,719,023 barrels.

The following table shows the assessed valuation of the County of Los Angeles at various intervals during the past sixty years:

TABLE 1

ASSESSED VALUATION OF LOS ANGELES COUNTY

Year	*Valuation*
1864	$ 16,223,701
1889	93,647,086
1894	79,495,921
1904	201,509,786
1914	849,991,595
1920	1,207,687,344
1924	2,638,389,980

POPULATION

The growth of population in the City and County has been somewhat parallel in rate, as is shown in the tabulation of U. S. Census Bureau figures on page 21:

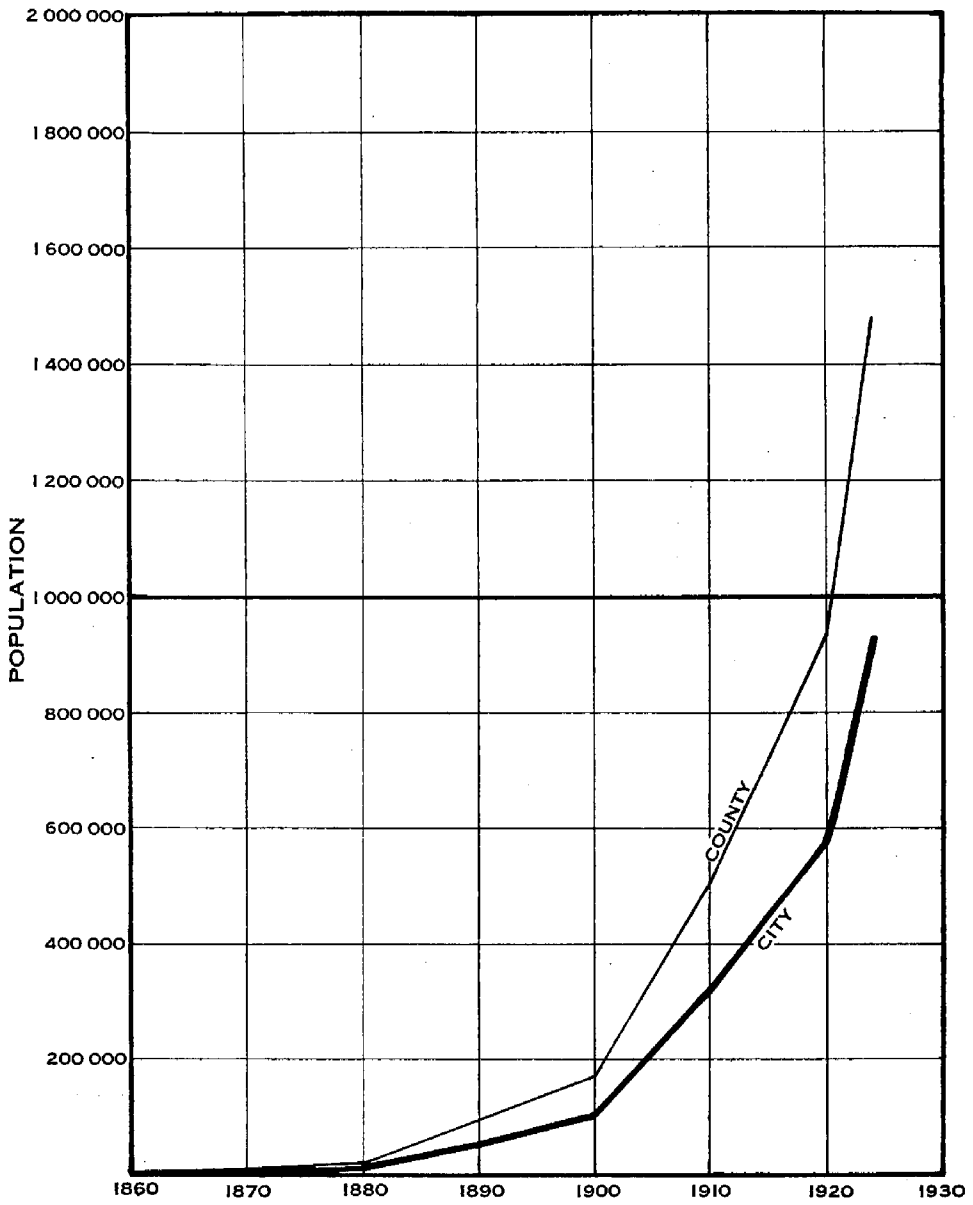

FIGURE 1. *Population of the City and County of Los Angeles by decades (U. S. Census)*

TABLE 2

POPULATION

Year	*County*	*City*	*Ratio*
1880	20,000	11,093	1.81
1890	101,454	50,395	2.01
1900	170,298	102,479	1.66
1910	504,131	319,198	1.58
1920	936,438	576,673	1.62

Figure 1 shows population curves for the City and County of Los Angeles.

During the last five years the average daily attendance for June in the Los Angeles City School District has been as follows:

TABLE 3

SCHOOL ATTENDANCE—LOS ANGELES CITY DISTRICT

Year	*Daily Average*
1920	77,674
1921	90,609
1922	103,607
1923	121,003
1924	147,867

The ratio of attendance in 1924 as compared with 1920 is 1.90. By applying this ratio to the population of Los Angeles in 1920, namely 576,673, we arrive at a total population of approximately 1,090,000 in June, 1924, or an average increase of about 130,800 per annum for these four years.

The population figures for the city as reported by the United States Census Bureau for the year 1920 have been criticised, in Los Angeles, as being inaccurate. We find that the U. S. Census Bureau enumeration includes only those persons who maintain a permanent residence. This is a fair basis for counting the population of most localities, and it is also fair for Los Angeles when the basis of the count is generally understood. Los Angeles is unique among American cities in that it has a large number of residents who maintain their legal and permanent homes elsewhere. They live in Los Angeles for six or eight months of the year, perhaps, but nevertheless are not considered permanent residents by the U. S. Census Bureau and are not included in the Census figures. For the purpose of estimating transportation requirements, however, the total number of residents of the city regardless of their permanency must be considered.

Basis of Forecast

Los Angeles has enjoyed a period of unprecedented prosperity in the last five years and during this time the population has almost doubled. This growth has

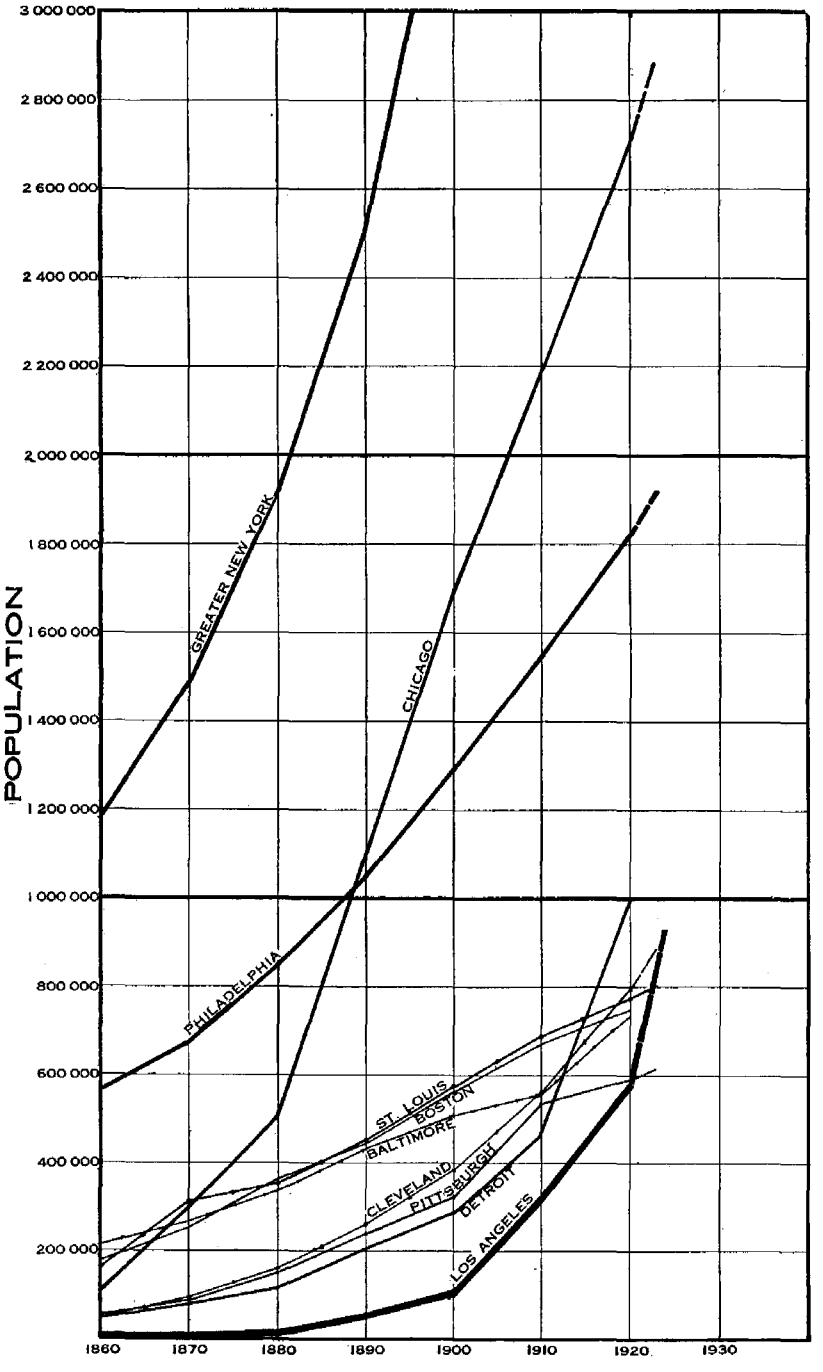

FIGURE 2. *Population of the ten largest American cities by decades (U. S. Census)*

necessitated a very careful study of the 1924 population data in order to arrive at an accurate basis for forecasting the future transportation requirements. In this study we have utilized largely the data gathered independently by the Los Angeles Railway and by the Southern California Telephone Company, both of which companies maintain a fully equipped statistical bureau. These data were supplemented by surveys made by our own investigators and the resulting information plotted in the form of a population spot map covering the urban area (see Plate 6). Each spot on this map indicates the location of 100 people regardless of the permanency of their residence. Transients, however, have not been included. The total number of people in the City of Los Angeles was estimated to be 1,100,000 as of August 1, 1924. This estimate includes only those persons living within the corporate limits of the City of Los Angeles and excludes all of those living in nearby towns. It is well known throughout the United States that the City of Los Angeles has been extended over a wide area. It is not so well known, however, that there are a number of separate municipalities, such as Vernon, Maywood, Huntington Park, Glendale and other towns which lie within and are a part of the urban area, but are outside of the city limits of Los Angeles. As a matter of fact, the combined population of these towns, which are essentially a part of urban Los Angeles, is practically balanced by that of the outlying parts of the City such as San Pedro, Wilmington and the San Fernando Valley towns, which are outside of urban Los Angeles although within the city limits. The total population of the urban area, as shown on Plate 6, is 1,052,000.

The methods used by the statistical bureaus of the Southern California Telephone Company and also of the Los Angeles Railway in determining the present population of the city are of interest. The Telephone Company has a policy of taking a complete census of families at seven-year intervals. Its last census was taken in the year 1922, at which time an actual count of all the families in the city and the surrounding territory was made by its enumerators. Combining this count with a close study of the then existing conditions and an intimate knowledge of the entire community, including the relative activity in different sections thereof, a forecast was made for each of the 479 districts covered by the count. This forecast shows the estimated number of families in each of the 479 districts for the year 1929. We have taken the figures of the Telephone Company for 1922 together with its forecast for 1929 and interpolated figures for August 1, 1924, for each district.

To determine the population from the figures obtained by the Telephone Company it was necessary to establish the average number of persons per family. The 1920 Federal Census found this average to be 3.6 persons per family in Los Angeles and, for the purpose of this Report, this average was reduced to 3.55 and applied to the number of families estimated for August 1, 1924.

The Los Angeles Railway has pursued a somewhat different method. This Company is primarily interested in the number of people to be served by its lines regardless of the number of residences and dwelling houses. For this reason

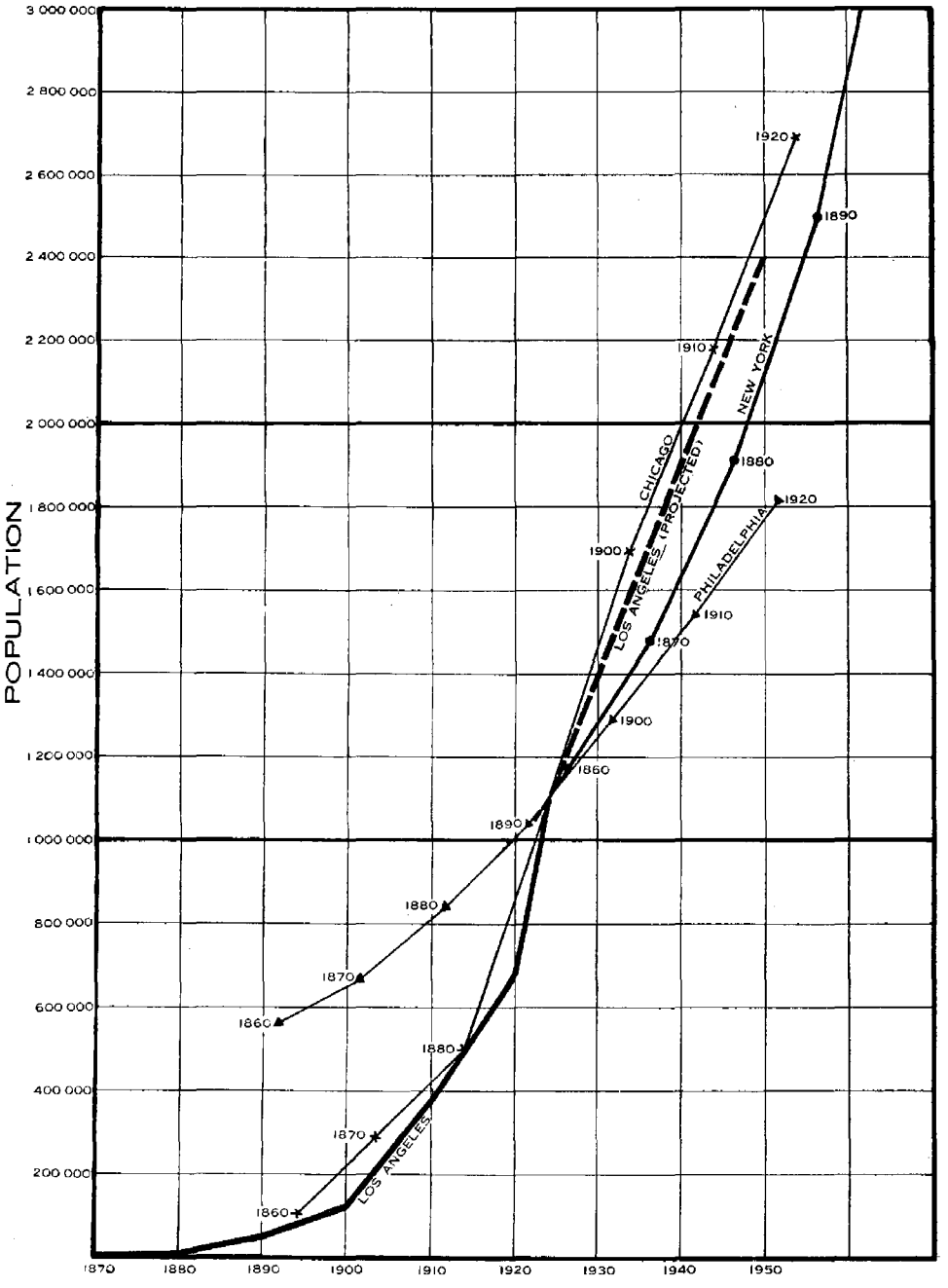

FIGURE 3. *Population forecast for the City of Los Angeles compared with growth of New York, Chicago and Philadelphia after these cities had attained the present population of Los Angeles (1,100,000).*

its census, which was completed in December, 1923, was made by a house-to-house canvass of some 190 districts into which urban Los Angeles was divided. We have projected these figures on a straight line basis to August 1, 1924, to establish an estimate of the actual number of residents in each of the districts in the city. The totals arrived at by using the data of these two separate statistical bureaus were remarkably close. In some of the outlying areas where there has been marked activity in the last six months, investigators from our office checked the distribution of population in the field.

A comparison of the past growth in Los Angeles with the growth in population of other large American cities is essential to a careful forecast of the future population of Los Angeles. Therefore the development of the cities of New York, Chicago, Philadelphia and Boston has been carefully considered. Curves of the growth in population of these and other American cities are shown on Figure 2, page 22. These curves indicate that since the time these cities reached a population of about one million their growth has been generally uniform.

There are various factors which influence the growth of a metropolitan center. The prime factors are rail and water transportation and the extent and character of the territory which contributes to the development of a city by reason of geographical and topographical influences.

There are a number of outstanding reasons for the unparalleled development of Los Angeles. It is the natural center and outlet for the vast Southwest with its tremendous agricultural and mineral resources. The opening of the Panama Canal and the development of the Los Angeles Harbor have caused a phenomenal increase in the city's commerce and all indications point to a continued increase. The climatic conditions, the abundant supply of labor and the excellent railroad and water transportation facilities all combine to insure a steady increase in the industrial development of Los Angeles.

In comparing Los Angeles with other large cities we find the closest analogy in the city of Chicago. Chicago, like Los Angeles, is the center of a vast agricultural territory, and the principal factor in bringing about its rapid growth was the construction of a large number of railroads serving this territory and terminating in Chicago. Los Angeles is the terminus of three transcontinental railroads and in addition has the advantage of a splendid harbor.

Taking all the foregoing factors into consideration we have made a forecast of the future population of Los Angeles, which is shown on Figure 3. This forecast is predicated upon an increase of 50,000 people per annum and indicates a population of 1,400,000 in 1930, and 2,400,000 in 1950. Population curves for New York, Chicago and Philadelphia are also shown on Figure 3, and the curves for these cities are superimposed on that of Los Angeles at a common point of population (1,100,000) in order to compare the growth of the older cities with the estimated growth of Los Angeles. On this Figure the years as shown at the bottom of the

chart apply only to the City of Los Angeles; the years for the other cities being indicated along the curves.

Density

A careful study of the distribution of population in the urban area was made, not only in the different districts of the city, but also by mile zones measured from the intersection of Seventh Street and Broadway. The result of this study is shown on Figure 4. The density of population in the inner zones will probably be more or less constant in the future. The population is increasing and will continue to increase in those zones lying two miles or more from the center of the city. Los Angeles has at present the lowest density of population of any of the large American cities. The density for the entire municipal area is 4.2 persons per acre and for that portion of the urban area shown on Plate 6 it is 10.2 persons per acre. The San Fernando Valley, lying north of the Santa Monica Mountains, and other outlying areas are sparsely settled, and as a consequence the number of persons per

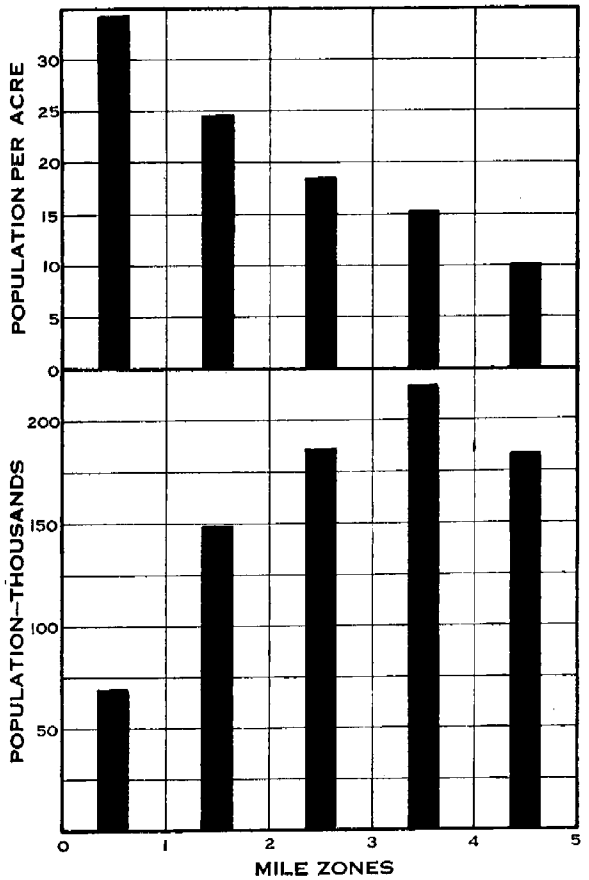

FIGURE 4. *Density and distribution of population in concentric mile zones, measured radially from Seventh Street and Broadway, July, 1924.*

acre based on the entire corporate area does not form a reasonable basis for comparison with the number of persons per acre in other large cities of the country. As is shown graphically on Figure 5, Los Angeles also has the distinction, when contrasted with large American cities, of having the lowest average in persons per dwelling. Single family dwellings on wide lots, with lawns and gardens, predominate in the residential districts. The wide distribution of the population and the

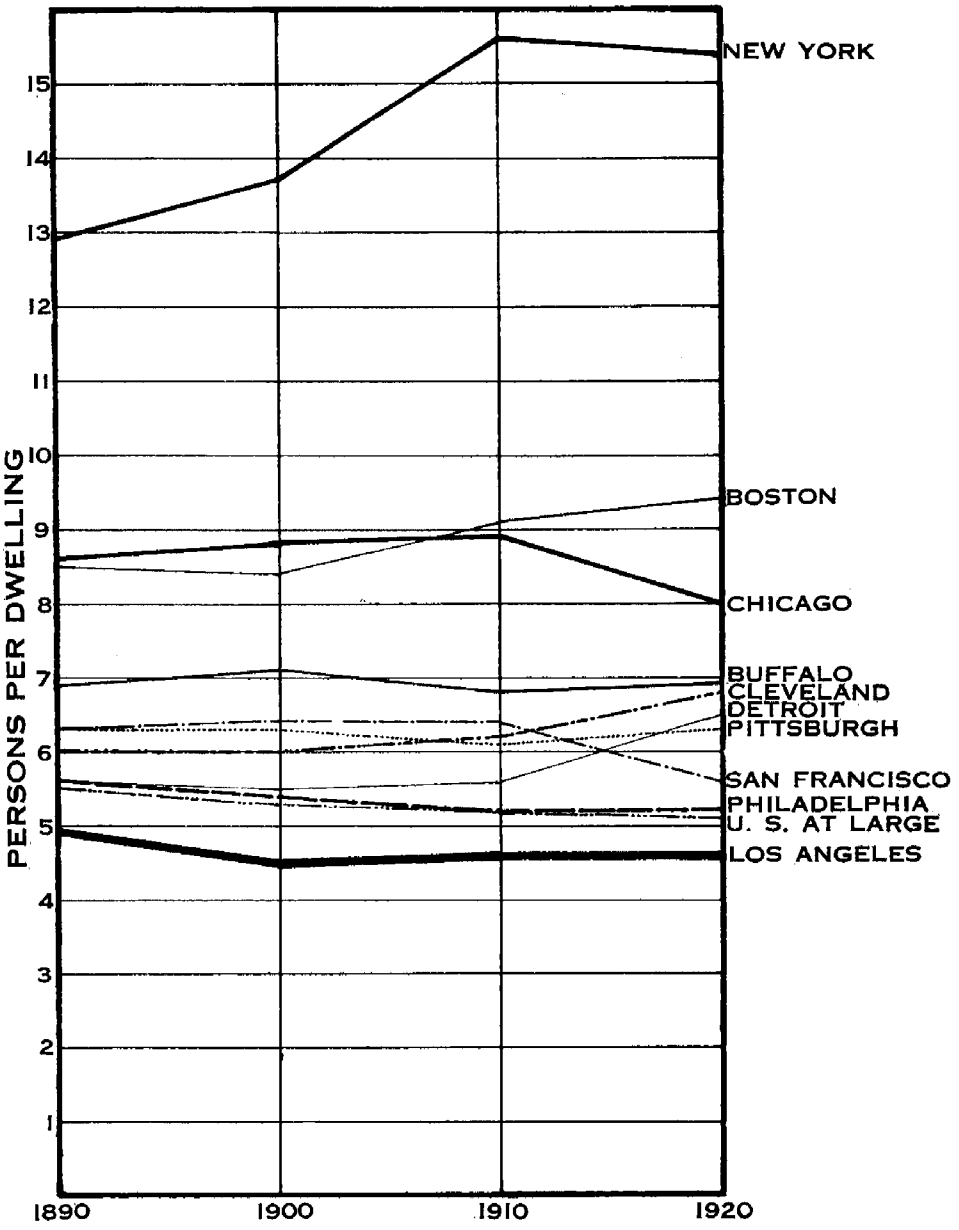

FIGURE 5. *Number of persons per dwelling in various cities (U. S. Census).*

small number of persons per dwelling are large factors in the excellent housing conditions which prevail.

GROWTH IN AREA

The territorial growth of the City of Los Angeles is unparalleled. Within the last eighteen years the corporate area has increased more than nine-fold, expanding from

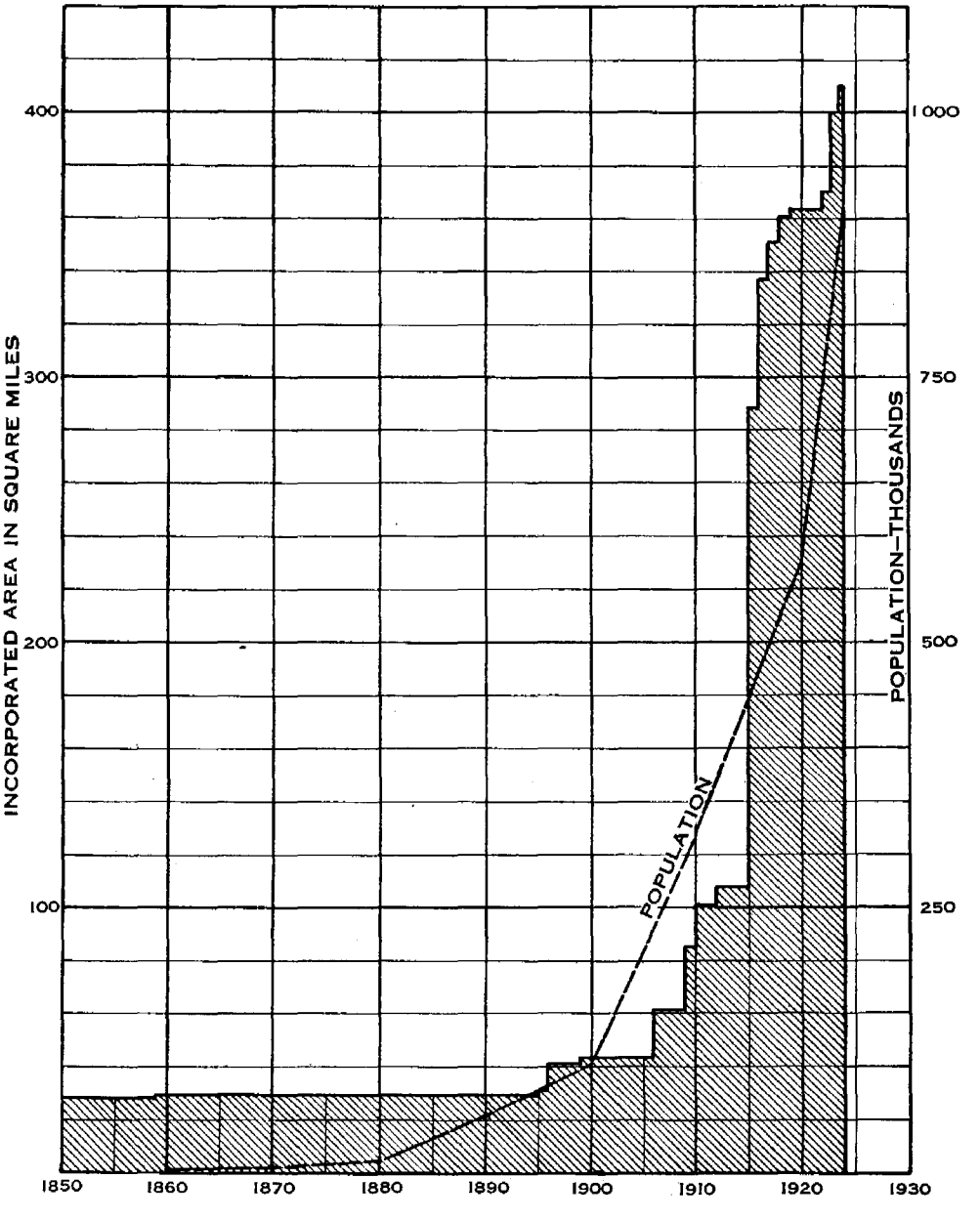

FIGURE 6. *Growth of area and population of the City of Los Angeles compared.*

43 to 410 square miles. This enormous territorial expansion was primarily due to the development of harbor facilities and water supply. Plate 7 shows the Los Angeles Metropolitan District. The area of the City of Los Angeles is shown in color, as is also the municipal area of each of the suburban cities. Plate 8 shows the original area of the city together with all of the additions and extensions.

The development of a harbor at San Pedro prior to the year 1906 consisted altogether of minor dredging operations and the construction of the breakwater by the U. S. Government. The limited resources of the cities of San Pedro and Wilmington prevented the raising of sufficient capital to finance a full development of the port. This situation was recognized by Los Angeles and about the year 1906 the City took steps to effect the development of the San Pedro Harbor. By the annexation of the so-called "Shoestring Strip" in 1906 and the municipalities of Wilmington and San Pedro in 1909, the resources and credit of Los Angeles became available for extensive harbor improvements.

In 1914 the Los Angeles aqueduct was completed with a capacity far in excess of the needs of the City at that time. In order that a loss of diversion rights might not ensue, through lack of beneficial use, a large territory comprising nearly all of the San Fernando Valley was annexed in 1915. This agricultural area furnished an opportunity for the use of the surplus water, which was at first used for irrigation purposes, but more recently for both irrigation and the domestic needs of the San Fernando Valley cities and towns.

The West Coast Addition was made to permit the construction of an outfall sewer and sewage disposal works at Hyperion on the ocean.

Reasons similar to the above were the governing factors in the annexation of several other districts. Many of the adjacent communities came into the City in order to secure the benefits of a dependable water supply and the policy of the City in the past seems to have been to favor these annexations when an adequate supply of water could be furnished. The city's growth in population is compared graphically with its growth in area in Figure 6.

COMMERCIAL ACTIVITIES

The Port

The City of Los Angeles has a deep water harbor created by an expenditure of $8,500,000 by the Federal Government and $23,000,000 by the City. An additional $6,000,000 of the City's funds is available for further improvements. At present there are about sixteen miles of wharves, of which more than six miles are owned and operated by the City. Other municipal improvements consist of a large six-story reinforced concrete warehouse, more than a mile of transit sheds and twenty-eight miles of belt line railroad tracks.

Los Angeles Harbor has become the most important seaport on the Pacific Coast of the United States. The aggregate tonnage handled at the port during the fiscal year ending June 30, 1924, was in excess of 25,000,000 tons. Vessels to and from Los Angeles Harbor are now paying more than half of the total Panama Canal tolls. There are sixty-five steamship lines carrying general cargo in addition to forty oil tank lines and a large number of lumber carriers.

A recent statement published by the United States Shipping Board placed Los Angeles second among American ports on the basis of tonnage handled. The following table shows the tonnage for the leading American ports for 1923, as reported by the Chief of Engineers, U. S. Army:

TABLE 4

TONNAGE FOR LEADING AMERICAN PORTS, 1923

Port	*Tonnage**
New York	117,115,976
Los Angeles	27,154,550
Philadelphia	19,600,546
Baltimore	17,797,452
Boston	15,217,663

*There is some additional tonnage such as car ferry, general ferry and cargoes in transit in all ports except Los Angeles.

The growth of traffic through the Port of Los Angeles has been phenomenal, as is evidenced by the following table:

TABLE 5

GROWTH OF COMMERCE THROUGH LOS ANGELES HARBOR

(By Fiscal Years Ending June 30)

Year	*Total Tonnage*	*Valuation*
1912	1,776,832	Not Available
1913	1,904,168	Not Available
1914	1,882,794	Not Available
1915	1,639,548	$ 88,674,070
1916	2,051,785	76,549,742
1917	2,312,387	69,553,873
1918	2,236,535	98,953,652
1919	2,380,622	86,481,470
1920	3,528,280	153,919,010
1921	4,296,254	188,067,509
1922	6,533,589	284,399,404
1923	18,875,887	559,788,915
1924	25,488,016	634,939,403

An interesting analysis of the commerce of Los Angeles Harbor during the calendar year of 1922 was made jointly by the research department of the First National Bank of Los Angeles and the University of Southern California and is presented in the following tabulation:

TABLE 6

ANALYSIS OF COMMERCE THROUGH LOS ANGELES HARBOR IN 1922

	Tonnage	*Value of Cargoes*
DOMESTIC		
Coast to Coast		
Outbound	510,376	$ 24,827,350
Inbound	680,033	159,188,288
TOTAL	1,190,409	$184,015,638
Coastwise		
Outbound	5,682,826	$ 83,404,177
Inbound	2,089,763	87,358,534
TOTAL	7,772,589	$170,762,711
Total Domestic—Outbound	6,193,202	$108,231,527
Total Domestic—Inbound	2,769,796	246,546,822
TOTAL	8,962,998	$354,778,349
ALASKAN AND HAWAIIAN	153,477	$ 5,525,917
FOREIGN		
Imports	240,307	$ 16,850,155
Exports	736,493	18,851,781
TOTAL	967,800	$ 35,701,936
TOTAL FOR HARBOR	10,093,275	$396,006,202

Post Office Receipts

The Post Office receipts of the city (see Table 7, page 32) increased from $1,476,942 in 1910 to $7,068,875 in 1923, or 379 per cent.

Bank Clearings

Bank clearings for 1923 amounted to $7,024,888,783, against $811,377,487 in 1910, an increase of 765 per cent. Except for a slight falling off in the years 1914, 1915 and 1916, the early part of the World War, the growth was fairly regular until 1919, when a sharp upward trend began. In that year the clearings were $2,339,401,197, an increase of $792,336,146 over the preceding year. (See Table 7, page 32.)

Building Construction

The yearly estimated cost of building construction, which declined during the war period from $31,641,921 in 1913 to $8,678,862 in 1918, shows a remarkable increase since the war. The estimated cost for 1923 was $200,133,181. (See Table 7.)

Statistics

Table 7 shows Post Office receipts, bank clearings and building permits for the years 1910 to 1923, inclusive.

TABLE 7

Year	Post Office Receipts	Bank Clearings	Building Permits	
	Amount	*Amount*	*Number*	*Cost*
1910	$1,476,942	$ 811,377,487	10,738	$ 21,684,100
1911	1,646,001	942,914,424	12,498	23,004,185
1912	1,906,398	1,168,941,800	16,455	31,367,995
1913	2,152,749	1,211,168,989	16,442	31,641,921
1914	2,215,114	1,145,167,110	9,979	17 361,925
1915	2,241,992	1,048,090,667	7,845	11,888,662
1916	2,437,356	1,292,961,997	7,565	15,036,045
1917	2,640,202	1,502,250,332	6,699	16,932,082
1918	3,070,760	1,547,065,051	6,381	8,678,862
1919	3,269,134	2,339,401,197	13,344	28,253,619
1920	4,190,660	3,994,280,520	25,555	60,023,600
1921	4,919,348	4,211,196,797	37,206	82,761,386
1922	5,813,139	5,152,311,839	47,397	121,206,787
1923	7,068,875	7,024,888,783	62,548	200,133,181

In order to give a clear idea of the development of commercial activities when compared with the growth in population Figures 7 and 8 have been prepared. Figure 7 shows the trend of population and commercial activities, as expressed by ratios, taking the statistics for the year 1910 at 100%. Figure 8, page 34, shows graphically the increases in population and commercial activities; the last available statistics being compared with those for the year 1910.

Industries

Los Angeles is changing rapidly from an agricultural and tourist center to a modern business and industrial community, as is illustrated by the remarkable growth in the value of manufactured products. The estimated value of these products was $1,100,000,000 in the year 1923. Manufacturing establishments now number 5,100 and employ 170,000 workers.

TABLE 8

VALUE OF MANUFACTURED PRODUCTS

Year	*Value*
1909	$ 68,586,000
1914	103,458,000
1919	208,184,000
1920	788,652,000
1921	800,926,000
1922	959,806,000
1923	1,100,000,000

NOTE:—The figures for the years 1920 to 1923 inclusive were obtained from the Chamber of Commerce and include motion picture products, which are not included in the U. S. Census figures used for the previous years.

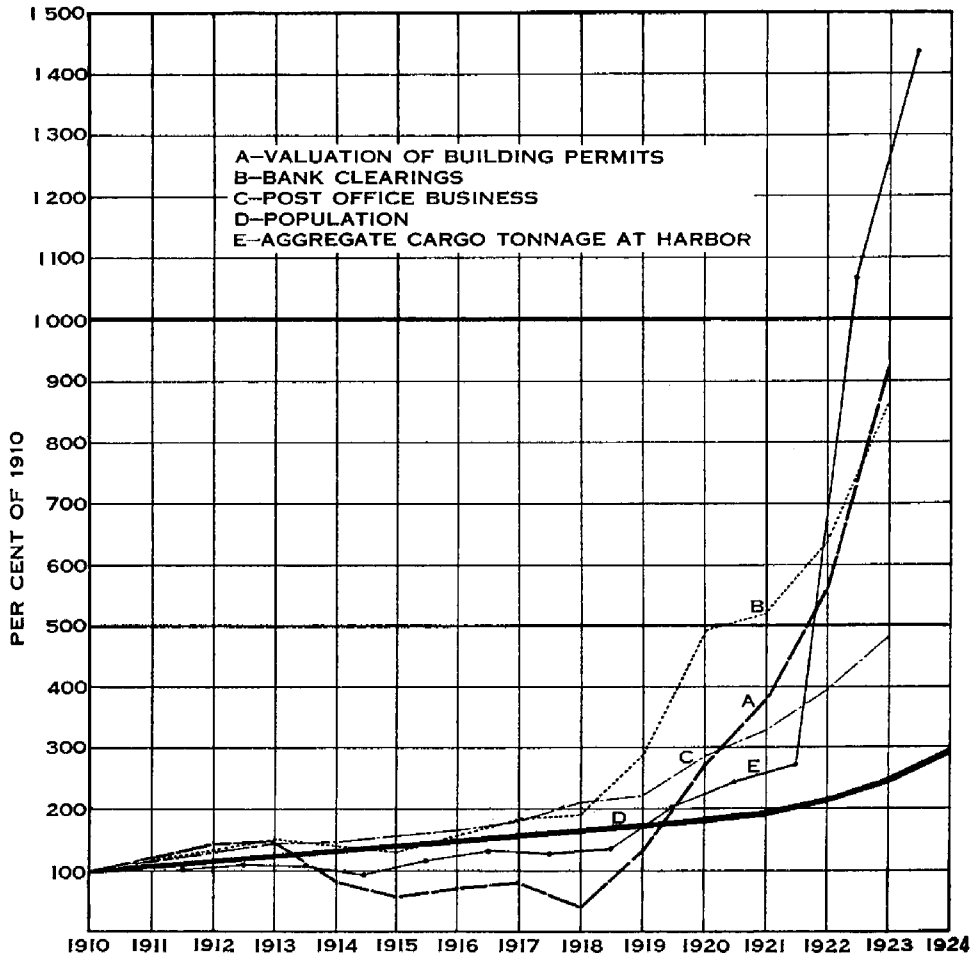

FIGURE 7. *Trend of population and commercial activities in the City of Los Angeles (Figures for the year 1910 being taken at 100 per cent).*

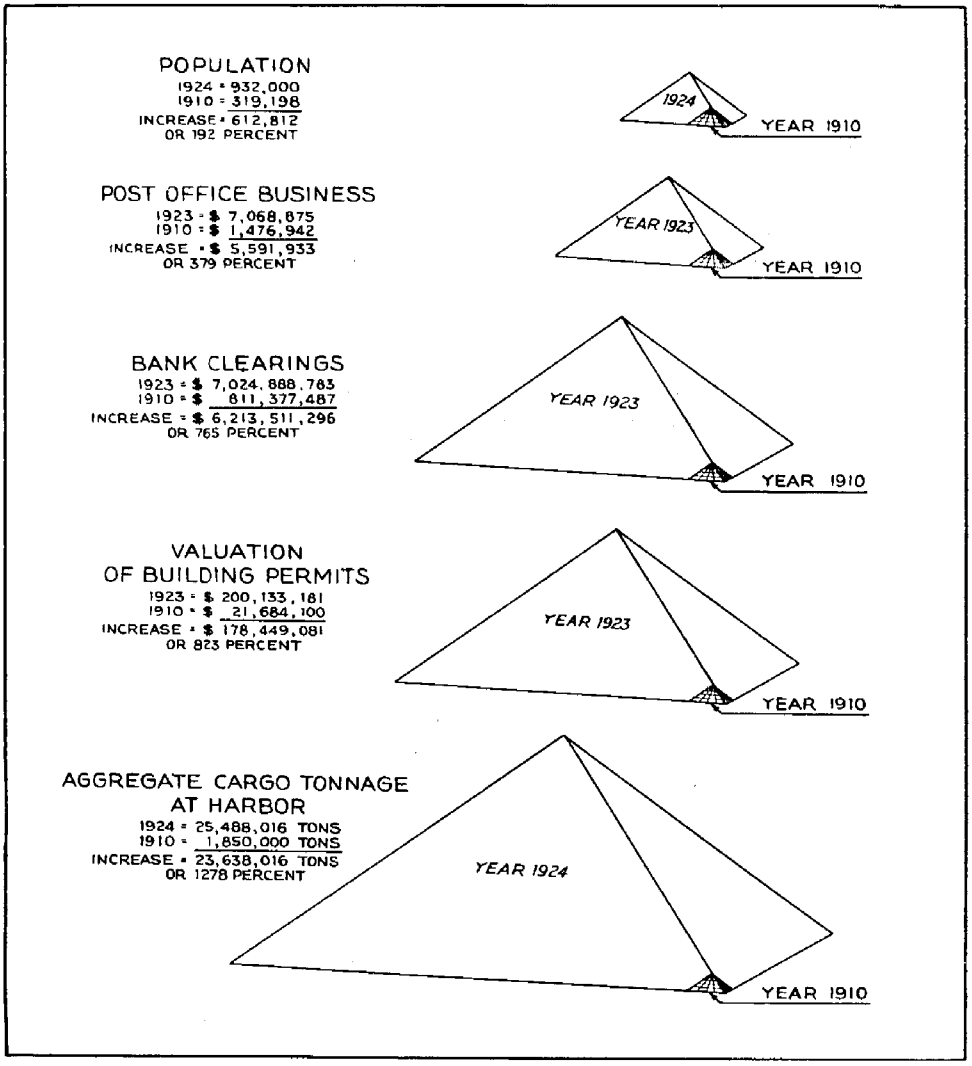

FIGURE 8. *Increase in population and commercial activities in the City of Los Angeles (latest statistics compared with those for the year 1910).*

Plate 9 shows the location of the more important industries in the urban area. The approximate location of an industry is indicated by a circle, and the number of employees by the area of the circle. In addition to the industries shown on the plate there are many industries located in various other parts of the Metropolitan District, particularly in the vicinity of the Harbor.

New industries are being constantly established because of the advantages afforded. Many raw materials are available close at hand, and good rail and water transportation brings others within easy reach. Cheap power is available. Excellent housing conditions and high standards of living are made possible by the low cost of many necessities.

CHAPTER II

STREET TRAFFIC

Motor Vehicles

The use of the passenger automobile in California as a means of transportation to and from places of business and employment, as well as for recreational purposes and pleasure riding, is without parallel in any other state. While this is true of the entire state, it is particularly true of the City and County of Los Angeles, and can be attributed to

(1) Climatic conditions favorable for automobile riding throughout the year,

(2) A system of well maintained streets and highways which promotes free circulation,

(3) The wide distribution of population and the building up of numerous communities in the outlying sections and suburbs remote from rail transportation service, and

(4) The fact that homes are generally built upon lots large enough to provide convenient storage for automobiles, together with the fact that there still remains a liberal amount of free and pay parking space in and near congested centers.

Figure 9, page 36, shows the motor vehicle registration for the County of Los Angeles, and also the total for the State of California for the years 1908 to 1924, inclusive. It will be seen that in the year 1924 the number of vehicles in the County reached the surprising total of 530,000, of which approximately 461,000 were passenger automobiles. This is an average of one automobile for every 4 persons in the County. No further evidence is necessary to illustrate the important part that automotive transportation has assumed in Los Angeles and vicinity.

The central business district of Los Angeles is spread over a comparatively large area because of the wise restrictions in building heights. The city also has more and wider streets outside of the central district than a great many cities that are confronted with traffic problems. Notwithstanding these facts, there is intense traffic congestion due largely to the unusual use of the automobile.

With the favorable climatic conditions and excellent street and highway system, it is probable that the increase in the use of the passenger automobile will continue in Los Angeles indefinitely. The restricted parking spaces, however, particularly in the central business district, impose limits to the increase in the use of passenger automobiles for traveling to and from places of business and employment. It is

likely, therefore, that the total number of vehicles used in the central business district will increase from year to year but at a diminishing rate.

The plans of the Major Highway Committee of the Traffic Commission, and also of the Regional Planning Commission, offer a splendid program for street widening and opening, which, when carried out, will do much to ameliorate existing street congestion; but regardless of all that may be done toward obtaining the greatest measure of relief through street widening and opening, there is good reason for the opinion that the traffic saturation point in the streets of the central business district will eventually be reached.

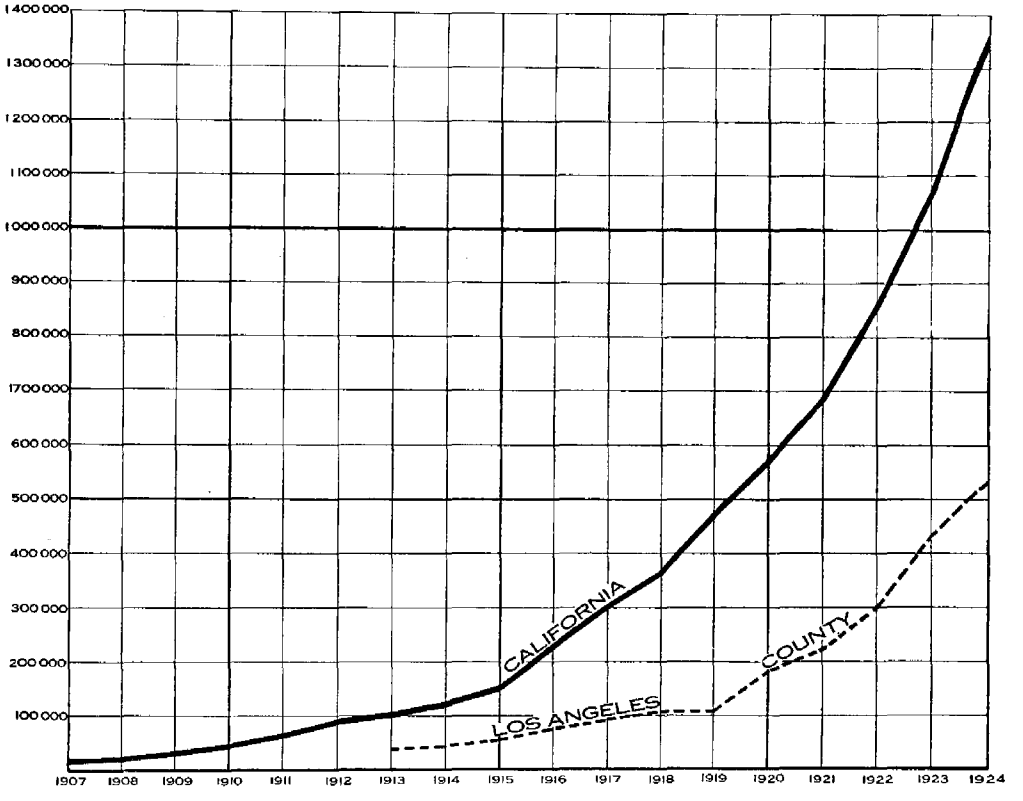

FIGURE 9. *Motor vehicle registration—1908 to 1924.*

Before this time arrives people will resort more and more to the public transportation agencies for transportation to and from business and employment. As an indication of the rapidity with which the City of Los Angeles is approaching this saturation point, a summary and analysis of a traffic count made by the Los Angeles Railway in January, 1924, is here presented. This count included all traffic crossing the streets bounding the congested district between the hours of 6:00 A. M. and 7:00 P. M. on a normal week day.

TABLE 9

COUNT OF VEHICLES CROSSING BOUNDARIES OF CONGESTED DISTRICT

	Figueroa Street	*Los Angeles Street*	*Temple and Market St.*	*Pico Street*	*Total Count*
Street Cars	4,440	7,231	4,685	4,285	20,641
Passenger Automobiles	92,047	64,370	41,584	63,946	261,974
Commercial Vehicles	14,272	20,825	6,701	9,500	51,298
	110,759	92,426	52,970	77,731	333,913

COUNT OF PASSENGERS

	Total Vehicles	*Per Cent*	*Total Passengers*	*Per Cent*	*Average Per Vehicle*
Street Cars	20,641	6.2	741,124	61.3	35.9
Passenger Automobiles	261,974	78.4	393,322	32.5	1.5
Commercial Vehicles	51,298	15.4	74,252	6.2	1.4
	333,913	100.0	1,208,698	100.0	....

It will be noted that 6.2% of the vehicles, namely, the street cars, accommodated 61.3% of the passengers carried, while 78.4% of the vehicles were passenger automobiles and accommodated only 32.5% of the passengers carried. Commercial vehicles numbered 51,298, or 15.4% of the total.

In addition to these facts the figures show that with the derived loading (35.9 passengers per street car and 1.5 passengers per passenger automobile) only 11,000 additional street cars would have been required to accommodate all the passengers carried by passenger automobiles, whereas it would have required approximately 494,000 additional passenger automobiles to accommodate the passengers carried by street cars.

The number of vehicles operated into and out of the congested district of Los Angeles during thirteen hours has reached the approximate total of 334,000 (see Table 9). Similar counts for the central business district of Chicago made in 1923 show a total of 330,000 for a twenty-four-hour period. This is very remarkable, when it is considered that Chicago has a population two and one-half times that of Los Angeles.

Street Congestion

The number of motor vehicles used for commercial purposes can be expected to increase in proportion to the increase and expansion of business and industry; the number of passenger automobiles entering the central business district will

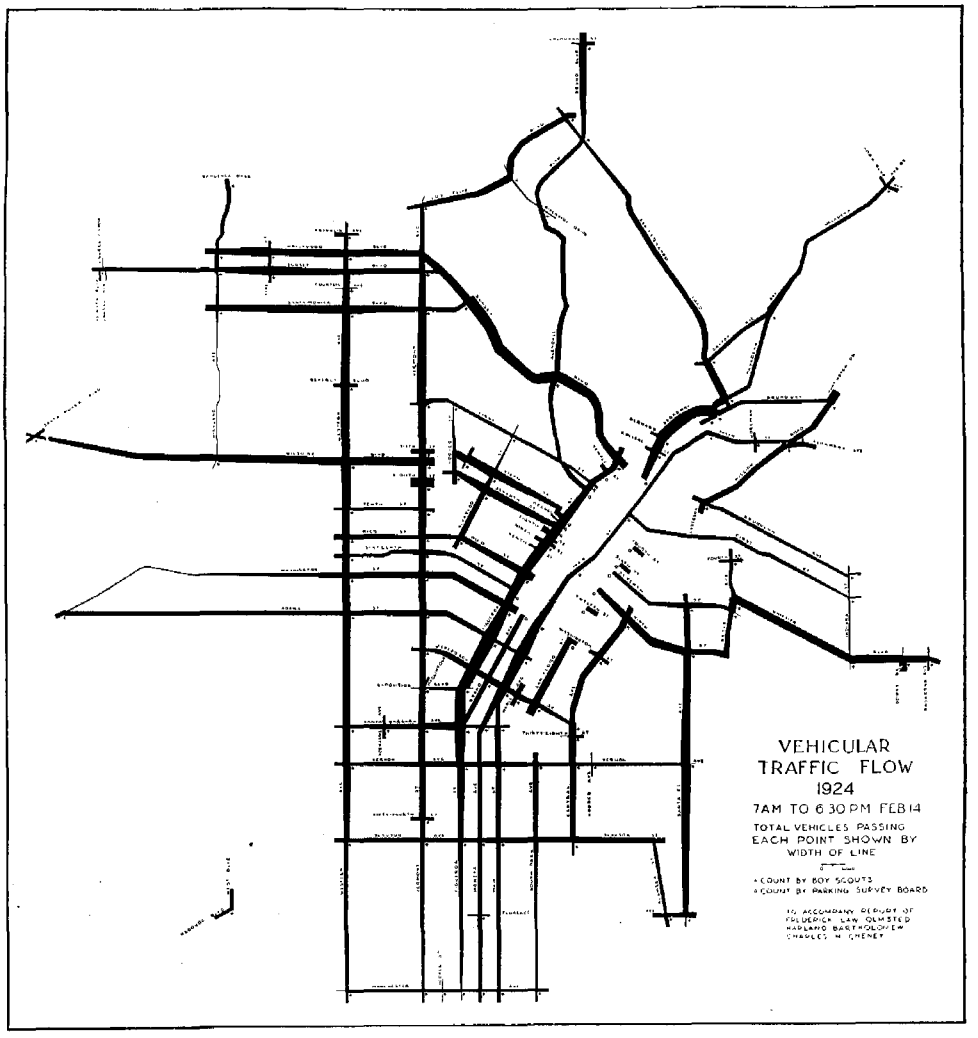

FIGURE 10. *Vehicular traffic flow on principal streets of Los Angeles—1924.*

continue to increase until the street saturation point is reached; and the number of public transportation conveyances must increase in order to keep pace with the needs of the rapidly increasing population. All of which indicates that with these different classes of traffic operating upon the surface of the streets the time when traffic congestion will reach an intolerable state cannot long be delayed. This is true despite any program for street widening which may be carried out within reasonable economic limits. Horizontal street widening projects are essential and should be encouraged; however, vertical expansion of streets by the construction of subways, tunnels or elevated railroads will provide more relief from congestion in the central business district and defer the time when the traffic saturation point will be reached.

The necessity for such a separation of traffic planes can be more fully appreciated after a brief study of Figures 10 and 11, which are presented here through the cour-

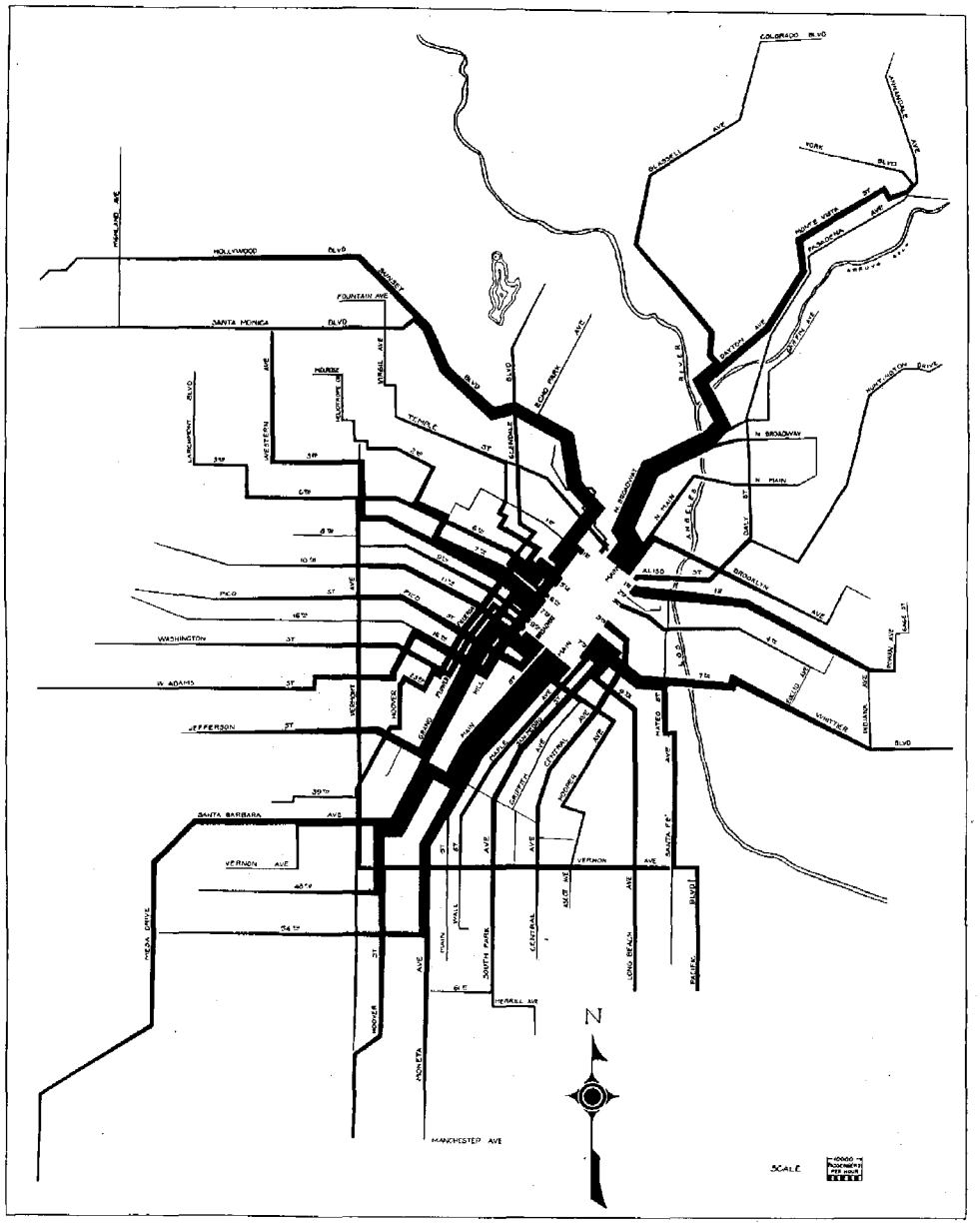

FIGURE 11. *Passenger flow from congested area during maximum hour of P.M. rush—Typical week day, 1924—on Pacific Electric Railway (Local Lines) and Los Angeles Railway.*

tesy of the Traffic Commission of the City and County of Los Angeles and the Los Angeles Railway. Figure 10 shows the volume of vehicular traffic flow on the more important traffic arteries of the city. Figure 11 indicates the location of the street car lines and the volume of passenger traffic outbound in the evening rush hour on a typical week day.

It is noteworthy that, with but few exceptions, the arteries carrying the largest volume of street railway traffic are identical with the arteries carrying the largest volume of vehicular traffic.

Unfortunately a count of pedestrian traffic in the central business district was not made with the vehicular traffic count heretofore described, but it should be obvious to even the most casual observer that pedestrian traffic adds to street congestion. It can be safely assumed that nearly all of the people who enter the central business district, by whatever means of transportation, eventually become pedestrians. It is therefore essential that pedestrian traffic on the streets be reduced to and kept at a minimum if congestion is to be relieved. This best can be accomplished by separating the public transportation plane from the vehicular and pedestrian plane insofar as such separation is physically and economically possible.

Street System

In some respects the existing street system in Los Angeles is one that does not lend itself to the free flow of traffic. It is highly probable that many of the subdivisions in the urban territory were made with no regard for future traffic requirements. To a large extent streets were laid out with the sole purpose of having the landscape of one subdivided tract outclass that of another. While such planning has aided greatly in beautifying the city, it has resulted in a deficiency in the number of through streets now required.

The Traffic Commission of the City and County of Los Angeles has made a detailed study and a report on a Major Traffic Street Plan, which is replete with recommendations for the correction of the street system in order to remove existing traffic congestion and provide against its recurrence. The City by popular vote has recently adopted the Major Traffic Street Plan prepared by the Traffic Commission and also approved a $5,000,000 bond issue to pay the public share of the cost of initial projects. The improvements selected for initial construction are as follows:

Street	*From*	*To*
East Adams Street	Compton Avenue	Pacific Boulevard
East Fifteenth Street	Griffith Avenue	Central Avenue
East Fourth Street	First Street Bridge	Indiana Street
Eighth Street	Figueroa Street	Arden Boulevard
Figueroa Street	First Street	Broadway
Fremont Street	Exposition Blvd.	Alpine Street
Griffith Avenue	Stanford Avenue and East Pico Street	Fourteenth Street
Hoover Street	Exposition Blvd.	Los Feliz Boulevard
Macy Street	Howard Street	Sunset Boulevard
Olive Street	College Street	Pasadena Avenue

Street	*From*	*To*
Riverside Drive	Dayton Avenue	Crescent Avenue
Santa Barbara Avenue	Angeles Mesa Drive	East Adams Street
Trinity Street	Myrtle and Fifteenth Sts.	Sixteenth Street
West Fifteenth Street	Figueroa Street	Hope Street
West Third Street	Figueroa Street	Santa Monica Boulevard

The elimination of off-sets at the following street intersections:

East Eighth Street and San Pedro Street.
Fifteenth Street and South Main Street.
Fifteenth Street and San Pedro Street.
Myrtle Street to Wall Street at Pico Street.
North Hill Street and Temple Street.
Pico Street and South Main Street.
Sixteenth Street and Figueroa Street.
Sixteenth Street and Hope Street.
South Main Street and East Third Street.
West Ninth Street and Figueroa Street.
West Sixth Street and Figueroa Street.

In addition to the above, many street widening and opening improvements were initiated prior to the approval of the Major Traffic Street Plan, and are now in progress. A few of the more important of these are listed below:

Street	*From*	*To*
Angeles Mesa Drive	Adams Street	Sixtieth Street
Broadway	Pico Street	Moneta Avenue
Crenshaw Boulevard	Wilshire Boulevard	Adams Street
Florence Avenue	South Park Avenue	Vermont Avenue
La Brea Avenue	Franklin Avenue	Wilshire Boulevard
Manchester Avenue	East City Limits	West City Limits
Pico Boulevard	Crenshaw Boulevard	West City Limits
San Fernando Road	Broadway	North City Limits
Slauson Avenue	Figueroa Street	West Boulevard
Sunset Boulevard	Normandie Avenue	Laurel Canyon
Tenth Street	East City Limits	Country Club Drive at Burck Place
Vermont Avenue	Manchester Avenue	165th Street
Washington Street	Figueroa Street	Mines Avenue

When all of the above work is completed many additional through streets and boulevards will have been provided and, if concurrently with this work the con-

struction of rapid transit lines has progressed to a point where it has overtaken the city's transportation requirements, the traffic problem will no longer be a controlling factor in retarding the city's natural growth.

Grade Crossing Elimination

The extensive use of automobiles, the number of improved streets and highways, and the original construction at grade of practically all of the steam and electric railways, combine to make the grade crossing problem of great importance to Los Angeles. The elimination of all grade crossings in the metropolitan area is greatly to be desired and should be the common goal of all.

The cost of eliminating all grade crossings would be staggering, and it undoubtedly would be too great a load to be borne by the railroads and the public, if the entire program were to be carried out at one time. A County bond issue of $5,000,000 to pay the public share of the cost of various grade separation projects throughout this area has recently been proposed. A similar step in this direction has been taken in the city through an agreement reached between the City and the various interested corporations to construct six bridges and viaducts over the Los Angeles River and the adjacent railroad tracks.

In 1923 the Los Angeles Grade Crossing Committee was organized on the initiative of the Automobile Club of Southern California. This committee includes representatives from the City, the County, the State and County Highway Departments, the California Railroad Commission, the Regional Planning Commission, the Automobile Club and all of the railway companies. While this committee is entirely unofficial, it has done a splendid work in studying and planning for the solution of the many perplexing grade crossing problems.

SUGGESTIONS FOR TRAFFIC IMPROVEMENT

While the development of a rapid transit system and an adequate system of major highways will be of great benefit in clearing up traffic congestion, several years must necessarily elapse before such work can be carried to completion. In the meantime some measure of relief may be obtained by the following changes and improvements, none of which will involve heavy cost nor require a great length of time for their consummation.

Broadway Tunnel

The use of the Broadway Tunnel for street railway as well as vehicular traffic would afford a large measure of relief of street congestion in the downtown district

and at a low cost. The cars on several of the lines which are now required to operate over Main Street between Temple Street and Sunset Boulevard could then be routed through the tunnel. This would eliminate the present necessity of overloading Main Street and at the same time the congestion now caused by street cars making left and right hand turns in order to get to and from Main Street would be eliminated. Another advantage would be a lessening of the congestion caused by vehicles and street cars interfering with each other at the north end of the Business District. Traffic counts show that the Broadway Tunnel has sufficient capacity for the street cars and also a much larger number of automobiles than now use it.

Street Railway Routing and Prohibition of Left Hand Turns

A plan for the rerouting of street railway lines designed to eliminate left hand turns of street cars within the district bounded by Sunset Boulevard, Los Angeles Street, Tenth Street and Flower Street should be prepared. When such a plan is made effective, consideration may be given to the prohibition of left hand turns for all vehicles in the most congested portion of the district mentioned. The improvement in traffic movements which these changes would effect would be very beneficial.

Vermont Avenue and Western Avenue

Vermont Avenue and Western Avenue are among the most important through streets west of the Central Business District and carry a large volume of traffic. For this reason there are several points of severe congestion which are growing worse. Immediate relief can be obtained by the opening and the widening of Hoover Street, Normandie Avenue, Van Ness Avenue and Arlington Avenue, as recommended in the Major Traffic Street Plan.

Traffic Signals

Automatic signals should be installed at all intersections in the outlying districts where heavy lines of vehicular traffic cross. These traffic signals should be as nearly uniform in type as practicable, and, in any event, they should be placed in the same relative location (whether this be in the street, on the curb, or suspended over the center of the intersections) so that they will not escape the notice of transient autoists. Because of the immense volume of vehicular traffic in Los Angeles, such traffic signals are not only indispensable as traffic regulators, but they provide a measure of safety, which should not be lost sight of, for both autoists and pedestrians.

Traffic Segregation

The exclusive use of a tunnel or bridge for one particular class of traffic is a contributary cause of congestion. The best evidence of this may be observed at the south end of the Hill Street Tunnels, where there is unnecessary crossing of street car and vehicular traffic because each class of traffic is separated while operating through the tunnels. Another illustration may be seen at the Macy Street Bridge, where these two classes of traffic are separated while passing over the Los Angeles River.

It is therefore suggested that the effect on traffic be given full consideration before any plan is approved for a bridge, tunnel or viaduct which provides for a separation of street cars from other vehicles on the same level in order that either one or the other class of traffic may have an exclusive right-of-way.

CHAPTER III

EXISTING TRANSPORTATION FACILITIES

The Los Angeles Railway

Historical Development

The development of the Los Angeles Railway is similar to that of like properties in other large cities. In 1872 the first horse car line was constructed and about fifteen years later the first cable railroad was operated. Many small lines were promoted and, with the spreading of the city, horse and cable car lines were extended throughout its area. These lines served the community until 1890, at which time the population was about 50,000. In that year the Los Angeles Consolidated Electric Railway Company was organized and began the construction of electric railways paralleling the cable lines.

In 1898 the Los Angeles Railway Company was organized by Mr. H. E. Huntington, who purchased and merged the Consolidated Electric Railway Company with the other principal street railway properties. At that time there were 72 miles of track and 103 cars were in operation. The new company, stimulated by a close connection with real estate development, made many extensions until, in the year 1910, the system comprised 344 miles of track and 550 cars. The population in 1910 was 319,000 and there is no question but that the liberal policy of the company in the matter of extensions was a very important factor in the development of the city.

While there have been but few extensions of street railway lines from 1910 to date the number of cars operated has been doubled. During the period from 1914 to 1917 inclusive "jitney" competition caused severe financial losses. The era of high prices following the war caused additional losses and the management was faced with the alternative of effecting important operating economies or increasing the rate of fare. The former course was chosen and in 1920 a radical change in routing was made which resulted in economies in operation and made possible the continuance of the five-cent fare. The marked increase in population in the area served by the various lines has since enabled the company to provide service without increasing the rate of fare. It is one of the few large street railway companies in the country which has accomplished this result.

The Los Angeles Railway Corporation was incorporated November 7, 1910. It owns all the property which was in existence at the date of its incorporation and is the lessor of all subsequent extensions and additions.

The City Railway Company of Los Angeles was organized December 1, 1910, and has since its organization financed practically all of the additions to and exten-

sions of the lines of the Los Angeles Railway Corporation. All of the property owned by the City Railway Company of Los Angeles is leased to the Los Angeles Railway Corporation.

The Los Angeles Railway was organized November 29, 1913, and owns no property. It was organized for the purpose of effecting a financial re-organization of the above named companies in order to better meet the service requirements of the City of Los Angeles.

In July, 1924, these three corporations made application to the California Railroad Commission for authority to merge and form a single company to be known as the Los Angeles Railway with authority to incur a bonded indebtedness of $100,000,000.

The major portion of the urban area of Los Angeles is served by the lines of the Los Angeles Railway. This corporation now operates 370 miles of single track and 1,172 passenger cars, and also 20 miles of bus routes and 42 buses.

The total track mileage has not been increased appreciably during the past ten years for the reason that extensions and additions to the property had been made far in advance of the city's needs; and for the further reason that since the growth of the city has overtaken and passed the development of street railway lines, supplementary bus lines have been established which in a manner offset the lack of street railway extensions.

During the year 1924 the street railway lines operated by the Los Angeles Railway carried 250,195,388 revenue and 96,017,853 transfer passengers, a total of 346,213,241. The bus lines, most of which were established during the latter part of the previous year to supplement the street railway service, carried 2,205,685 revenue and 1,155,921 transfer passengers, a total of 3,361,606 in the year 1924.

Routing and Traffic

The lines have been planned and built and the cars have been routed in a manner designed to best serve the patrons, as nearly all lines have been routed to and from the central business district, thus serving the majority of people without the necessity for transfer. There is a practical limit to this method of operation, however, which is determined by the track capacity and traffic conditions in the central business district. This limit has been almost reached as the space available for street cars in the most important traffic streets in the downtown area is being fully utilized. Figure 12 indicates the number of cars scheduled to operate over each street during the maximum traffic hour of the P. M. rush. The principle of through routing has been developed in an unusual degree and, owing to variations in the growth of the different areas served, an unbalanced service demand adds to the cost of operation. As the population increases and the city expands, cross-town lines must be established to serve as feeders to the trunk lines operating to and from the central business district in order to provide better circulation and to relieve congestion in the downtown streets.

Figure 13, page 48, shows the present routing of the Los Angeles Railway lines. It should be noted that cross-town service is limited to that provided by the "J," "V" and Evergreen Avenue lines. The limiting feature of the routing in the congested area is the concentration of lines at two throats on Main Street, one at the north and

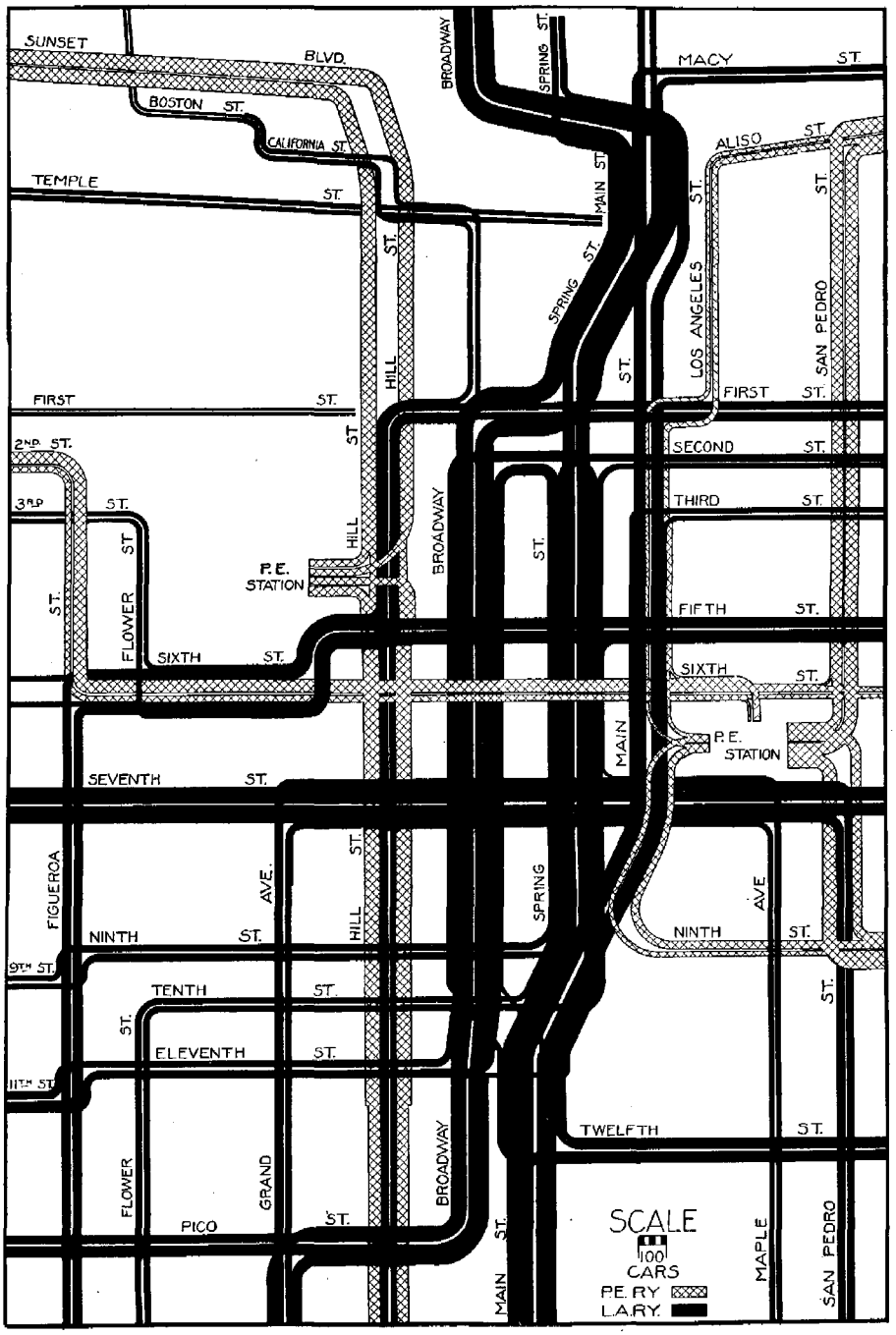

FIGURE 12. *Flow chart of scheduled street cars in the downtown area—5 to 6 P. M., April 1, 1924.*

one at the south end of the central business district. Figure 14, page 50, shows the total passengers carried into and out of the downtown area on all lines for each twenty-minute period of a normal week day. The peak loads, for which service must be provided during the morning and evening rush hour periods, present one of the difficult problems in furnishing adequate transportation.

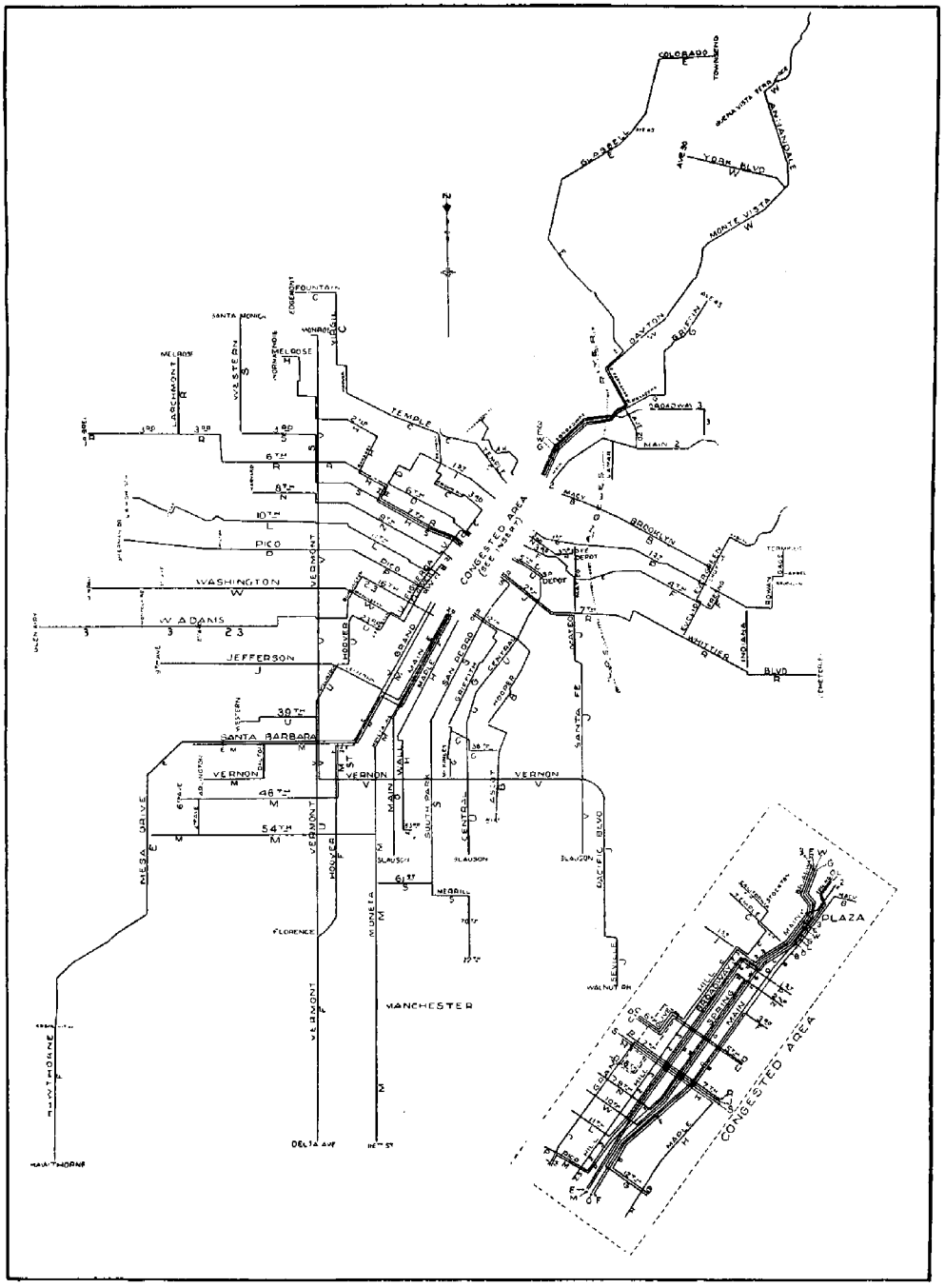

FIGURE 13. *Map of the routes of the Los Angeles Railway.*

There has been a consistent upward trend in the passenger traffic of the Los Angeles Railway, as is shown by Figure 15, page 51, and the following table:

TABLE 10

LOS ANGELES RAILWAY

ANNUAL REVENUE AND TRANSFER PASSENGERS, YEARS 1912-1924

Year Ending June 30	PASSENGERS		
	Revenue	*Transfer*	*Total*
1912	122,702,682	35,312,622	158,015,304
1913	135,784,507	40,710,038	176,494,545
1914	140,019,381	50,929,850	190,979,231
1915	125,939,865	42,965,583	168,905,448*
1916	121,574,028	42,821,099	164,395,127*
Year Ending Dec. 31			
1916	117,336,924	41,947,160	159,284,084*
1917	123,074,300	43,218,851	166,293,151*
1918	130,358,704	46,277,933	176,636,637
1919	145,424,597	48,715,139	194,139,736†
1920	179,227,041	63,170,139	242,397,180
1921	200,878,652	70,443,847	271,322,499
1922	219,022,470	76,975,544	295,998,014
1923	247,607,235	85,853,807	333,461,042
1924	250,195,388	96,017,853	346,213,241

* Affected by "Jitney" operation July, 1914, to September, 1917.
† Affected by strike of trainmen in 1919.

The traffic carried by the Los Angeles Railway during the year 1923 may be allocated to the various divisions of the city as follows:

TABLE 11

	Revenue and Free Passengers	
	Number	*Per Cent*
West Division	93,402,642	36.6
South Division	84,950,222	33.3
East Division	47,659,936	18.6
North Division	29,305,000	11.5
	255,317,800	100.0

The divisions used in this table are as follows:

West Division includes territory served by all lines operating on the west side of the city between Fountain Avenue on the north and Jefferson Street on the south.

South Division includes territory served by all lines operating on the south and southwest sides of the city between 39th Street on the north, Hawthorne on the west and Ascot Avenue on the east.

East Division includes territory served by all lines operating on the east side of the city between Santa Fe Avenue on the west and Brooklyn Avenue on the north.

North Division includes territory served by all lines operating on the north side of the city between North Main Street (extended easterly) on the south and Glassel Avenue on the west.

The delay due to the ever-increasing vehicular traffic has lengthened the time necessary to travel to and from the outlying sections on street cars and has been no

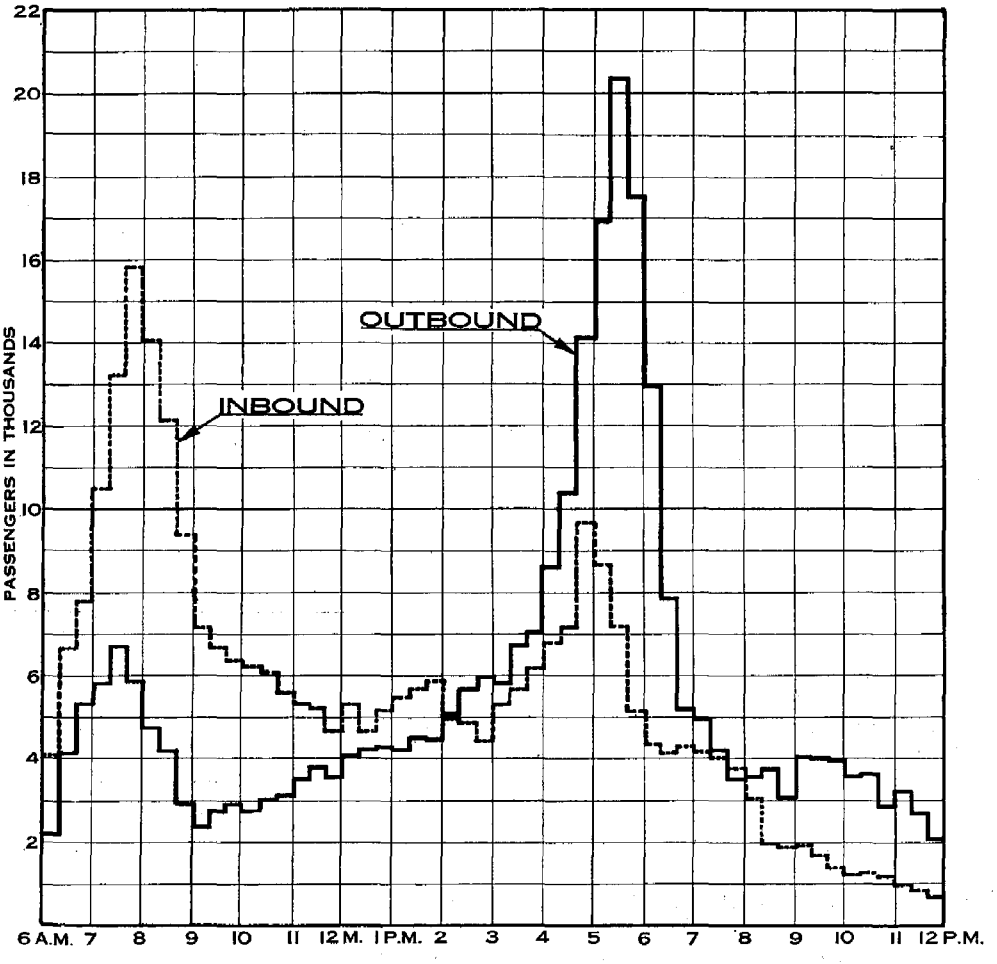

FIGURE 14. *Total passengers entering and leaving congested area on Los Angeles Railway cars—twenty minute periods—on a normal week day, 1924.*

small factor in increasing the costs of operation, which are shown in the following table:

TABLE 12

LOS ANGELES RAILWAY

OPERATING EXPENSES* PER CAR MILE

Year Ending June 30	*Cents*
1912	16.523
1913	17.480
1914	16.029
1915	14.949
1916	14.043
Year Ending Dec. 31	
1916	13.558
1917	14.950
1918	17.440
1919	21.350
1920	24.170
1921	27.380
1922	25.879
1923	27.740
1924	28.370

* Exclusive of taxes.

Time Zones and Scheduled Speed

Plate 10 shows graphically, by 10-minute time zones of different colors, the time required for travel to various parts of the urban area on the lines of the Los Angeles

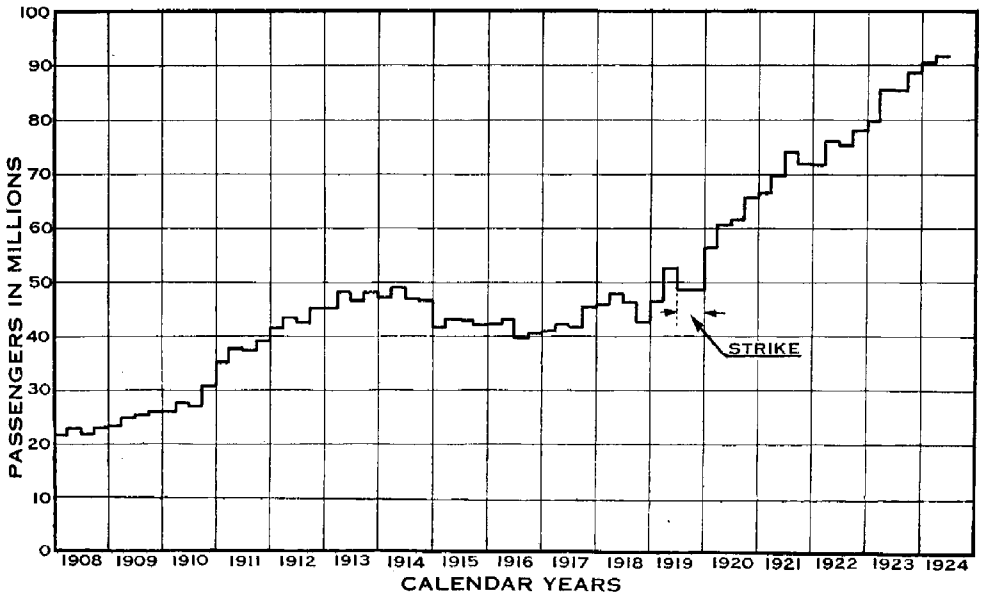

FIGURE 15. *Revenue passengers—Los Angeles Railway—Charted in three-month periods to show seasonal variations—1908 to 1924.*

Railway, the Pacific Electric Railway and the Los Angeles Motor Bus Company. The intersection of Broadway and Seventh Street has been selected as the point of origin. In computing the traveling time, the scheduled running time during the non-rush hours was used. The most direct route to all points has been chosen and the use of a transfer has been assumed where such use would reduce the traveling time. An arbitrary allowance was made of one minute for a transfer and the rate of walking was assumed to be three miles per hour. A study of these zones shows clearly the influence of topography as well as irregularities of the street system.

The scheduled speed in miles per hour for a few of the more important lines is shown on Figures 16, 17, 18 and 19, pages 52 to 55. The heavy black line on each

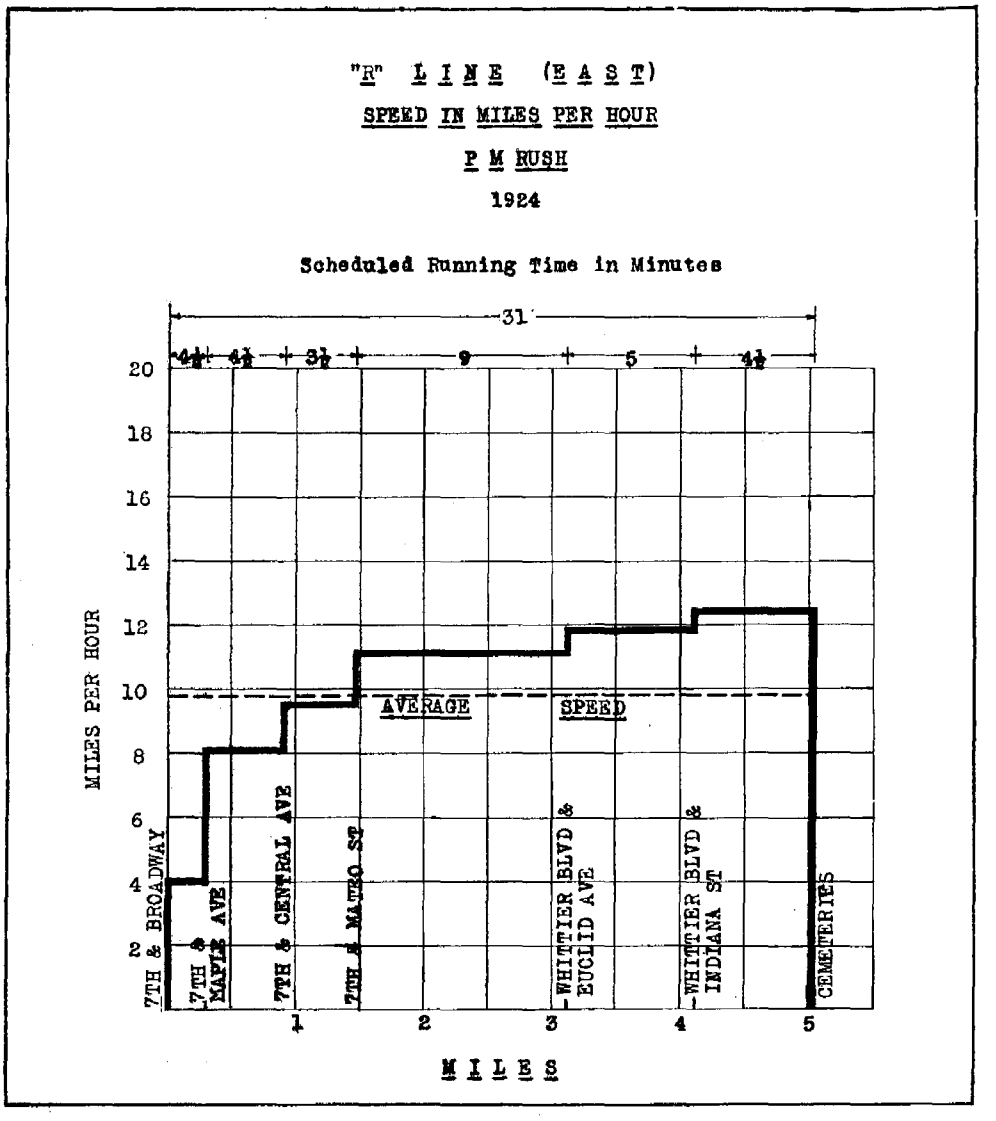

FIGURE 16. *Chart of the scheduled speed of the "R" Line (east) of the Los Angeles Railway.*

figure indicates the speed in miles per hour between time points. The low speeds in the congested areas show clearly the adverse effect which vehicular traffic has upon the speed of street cars. For the entire system, the average scheduled speed appears to be as high as considerations of public safety permit.

Tracks and Cars

The track gauge of the Los Angeles Railway is three feet and six inches. It is one of the few large street railway properties in the country having narrow gauge tracks. The capacity of the cars operated is necessarily less than the larger type which can be operated on standard gauge track. The cars are well adapted to the climatic conditions, having an open section on either end with a closed section in the middle, but the loading and unloading time is somewhat greater than it would be if cars of a different design could be operated.

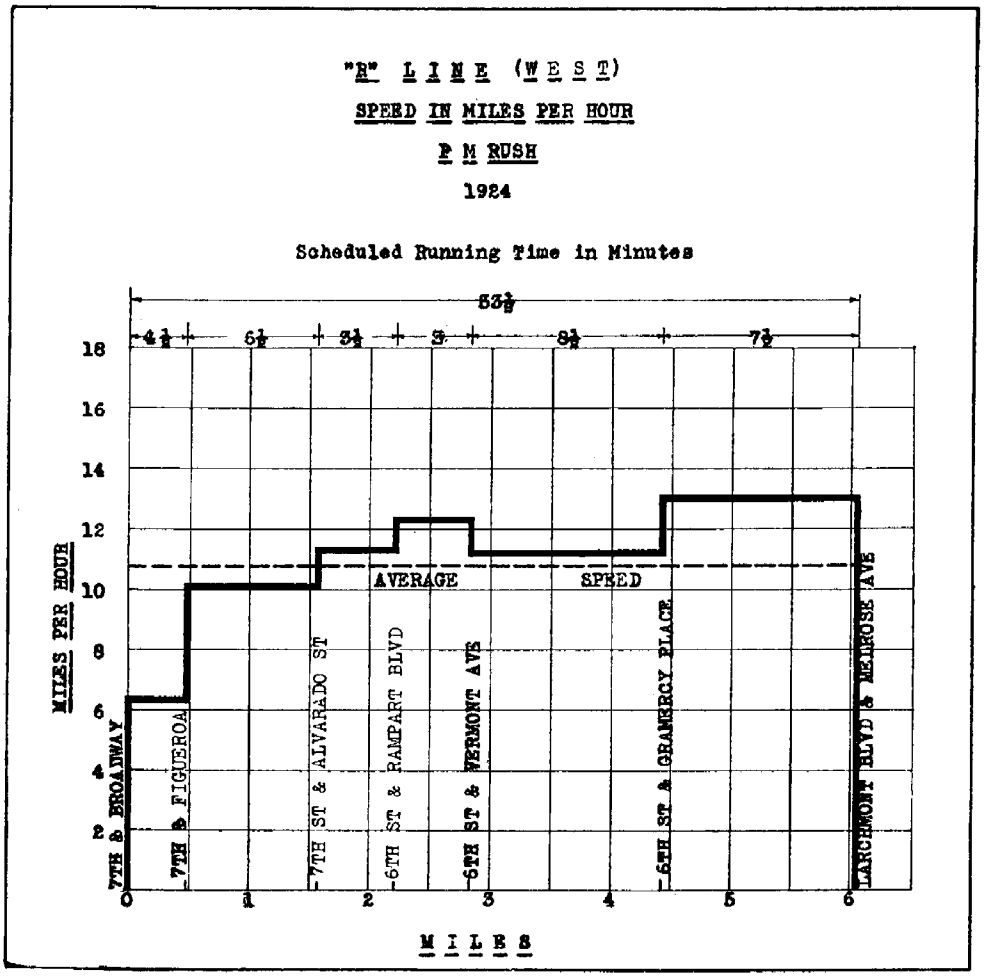

FIGURE 17. *Chart of the scheduled speed of the "R" Line (west) of the Los Angeles Railway.*

On the whole the condition of the property is excellent and the system has a capacity sufficient to provide transportation for a somewhat larger population than it is now serving, but it is not fitted to meet the requirements of the excessively heavy and long haul city traffic which it must carry if rapid transit lines are not constructed. The logical function of this system in the future will be to provide a local service and inter-communication between the various centers; and to serve as feeders to and distributors from rapid transit lines.

Service and Fares

A five-cent fare is charged for a ride in the same general direction anywhere on the system except on a few lines of great length as follows:

On the "E" line where an additional five-cent fare is collected north of

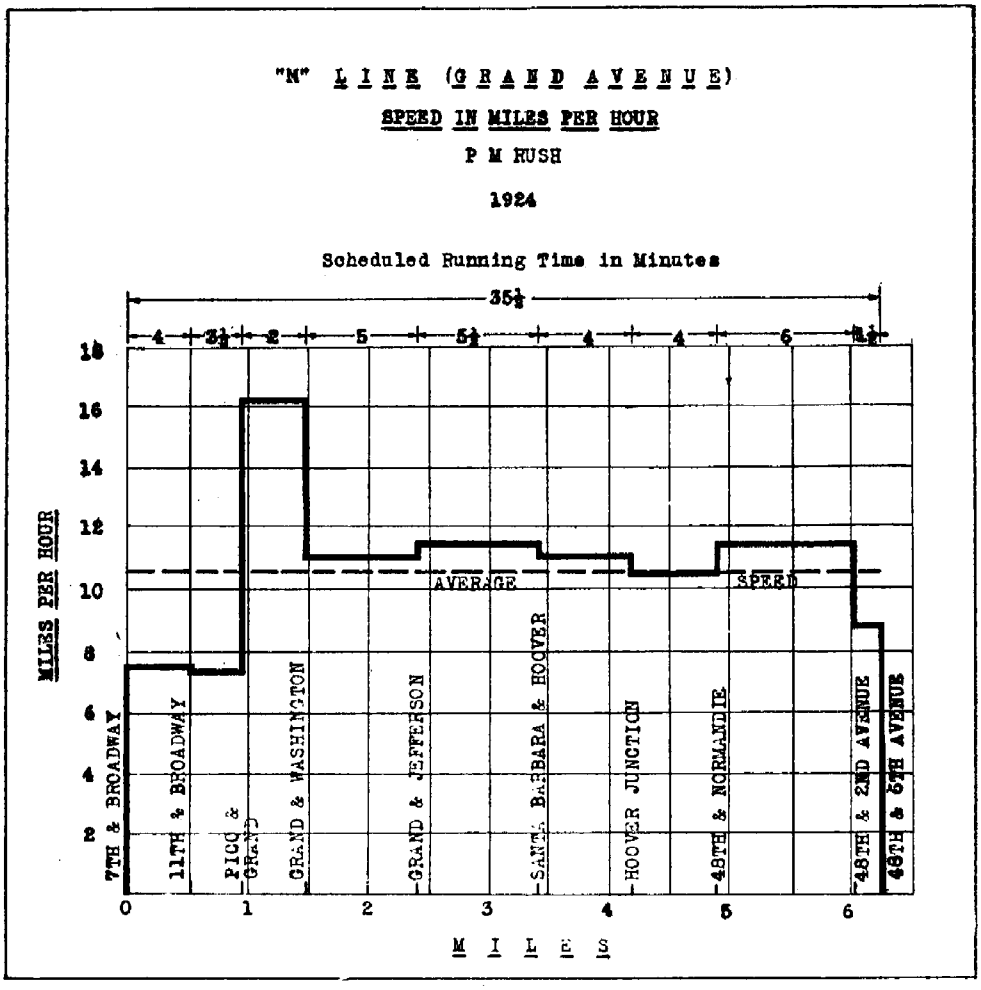

FIGURE 18. *Chart of the scheduled speed of the "M" Line (via Grand Avenue) of the Los Angeles Railway.*

Avenue 45 and south of 54th Street on the north and south end of the line, respectively;

On the "F" line where an additional five-cent fare is collected south of Manchester Avenue and a second additional five-cent fare between 114th Street and Fairmont Heights, and

On the "M" line where an additional five-cent fare is collected south of Manchester Avenue and a second additional five-cent fare is collected between 114th Street and 116th Street.

The fare zones are shown graphically on Plate 12. A commutation ticket is sold, however, which reduces the above described additional fares by five cents.

The lines of the Los Angeles Railway are operated under term franchises which have been granted from time to time by the City Council. Service matters are under the supervision of the Board of Public Utilities of the City of Los Angeles and the regulation of fares is under the jurisdiction of the California Railroad Commission.

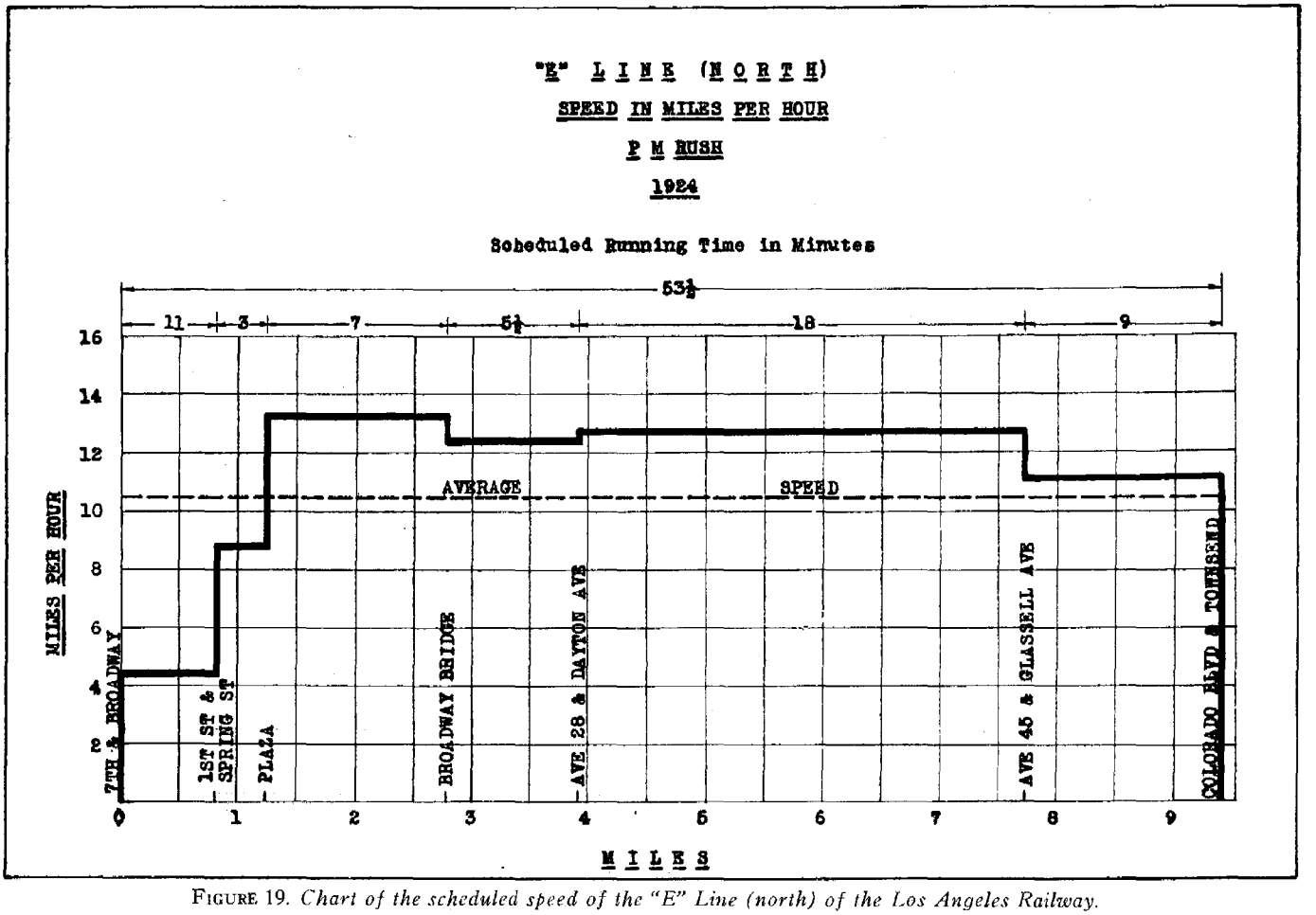

FIGURE 19. *Chart of the scheduled speed of the "E" Line (north) of the Los Angeles Railway.*

PACIFIC ELECTRIC RAILWAY COMPANY

Historical Development

The Pacific Electric Railway Company comprises the following companies which were incorporated under the laws of the State of California between the years 1886 and 1911:

Pacific Electric Railway Company,
Los Angeles Interurban Railway Company,
Los Angeles Pacific Company,
Los Angeles and Redondo Railway Company,
San Bernardino Interurban Railway Company,
The Riverside and Arlington Railway Company,
The San Bernardino Valley Traction Company, and
The Redlands Central Railway Company.

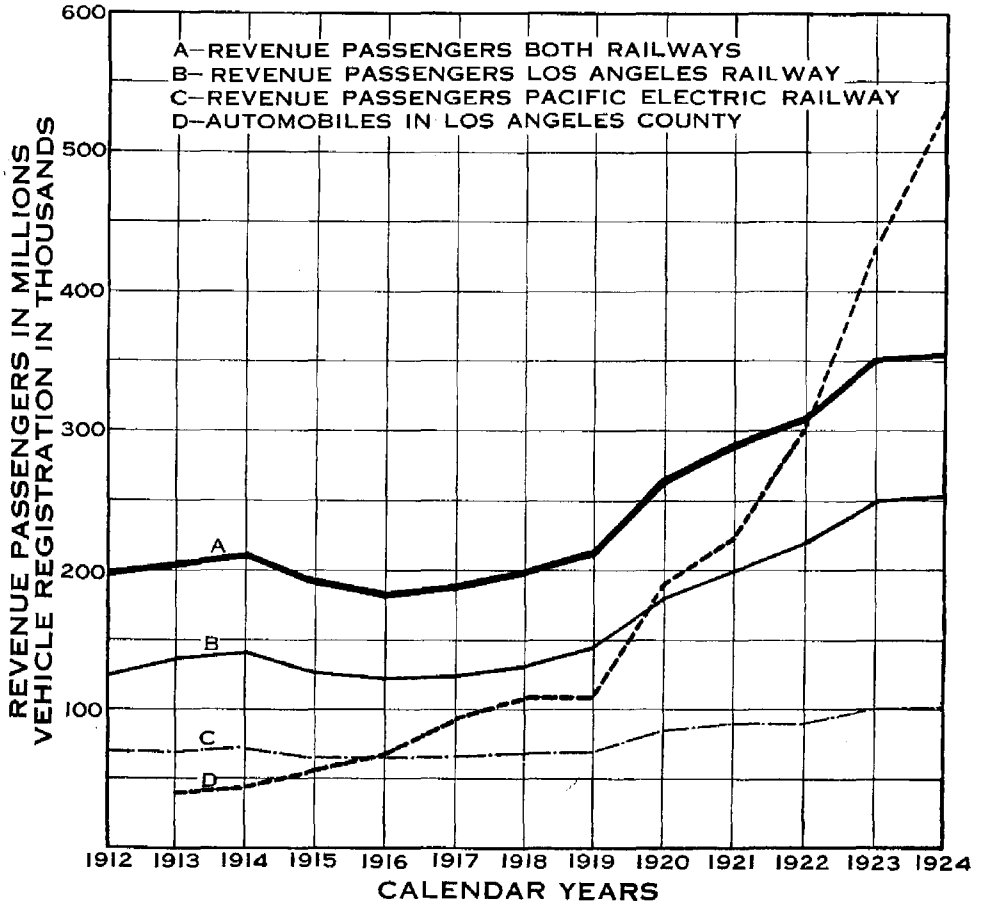

FIGURE 20. *Annual revenue passengers carried by the electric railway lines serving Los Angeles compared with automobile registration.*

The lines of the Pacific Electric Railway Company as well as those of the various units of the constituent companies were built by pioneering enterprise. The present system, which forms a network of city, suburban and interurban standard gauge trolley lines, was evolved from narrow and standard gauge horse car, cable, steam and electric lines. As most of the individual lines now comprising the system were pioneer railroads it appears likely that the facilities provided by them were in excess of the traffic demands for a number of years. It also appears fair to assume that the full utility of these lines was not obtained by the City of Los Angeles and the various cities and towns in the metropolitan area until they were consolidated by the Pacific Electric Railway Company in the year 1911 and operated as a unit. At the present time the system has a large latent capacity for high speed electric railway service which can be fully utilized by the construction of a sufficient amount of rapid transit structures in congested areas to remove the operation of trains and cars from the streets.

The total number of passengers carried on this system for the year 1923 was 106,963,592, consisting of 100,073,544 revenue and 6,890,048 transfer passengers. We estimate that of the total revenue passengers 39,784,000, or 39.8%, were Los

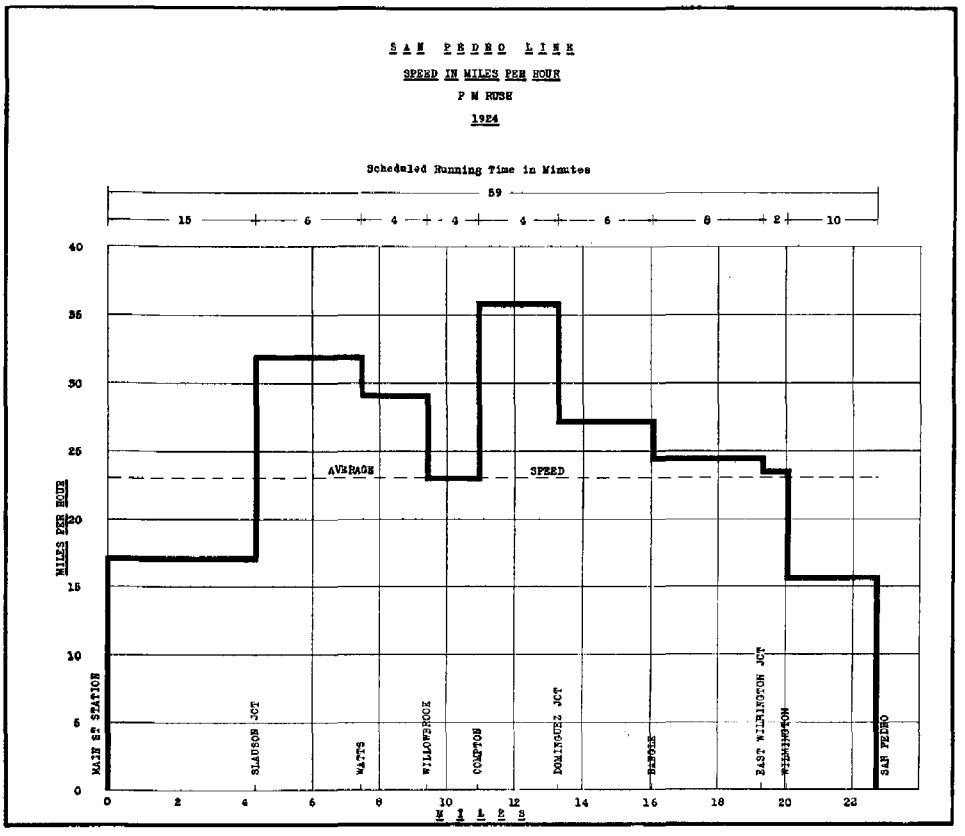

FIGURE 21. *Chart of the scheduled speed of the San Pedro Line of the Pacific Electric Railway.*

Angeles local passengers; 38,668,000, or 38.6%, Los Angeles interurban passengers, and 21,622,000, or 21.6%, were passengers carried in and between other cities, towns and communities. In addition to the revenues received from this large volume of passenger traffic the gross revenue from freight and express service amounted to approximately $6,700,000.

The Pacific Electric Railway Company is the largest interurban electric railroad property in the world. It operates approximately 1,114 miles of single track (including 13 miles owned by the City and operated in connection with the Los Angeles Harbor), and 4,000 cars of which 879 are passenger cars. It also operates 164 miles of bus routes and 125 motor buses, which serve as feeders to the rail lines and provide local service in several of the cities in the metropolitan area.

The property and its equipment is in first-class physical condition and as the various lines provide the shortest and best rail routes, giving frequent high speed service between the center of the city and the surrounding cities and towns, the value of the system to the Los Angeles of the future cannot well be over-estimated. The

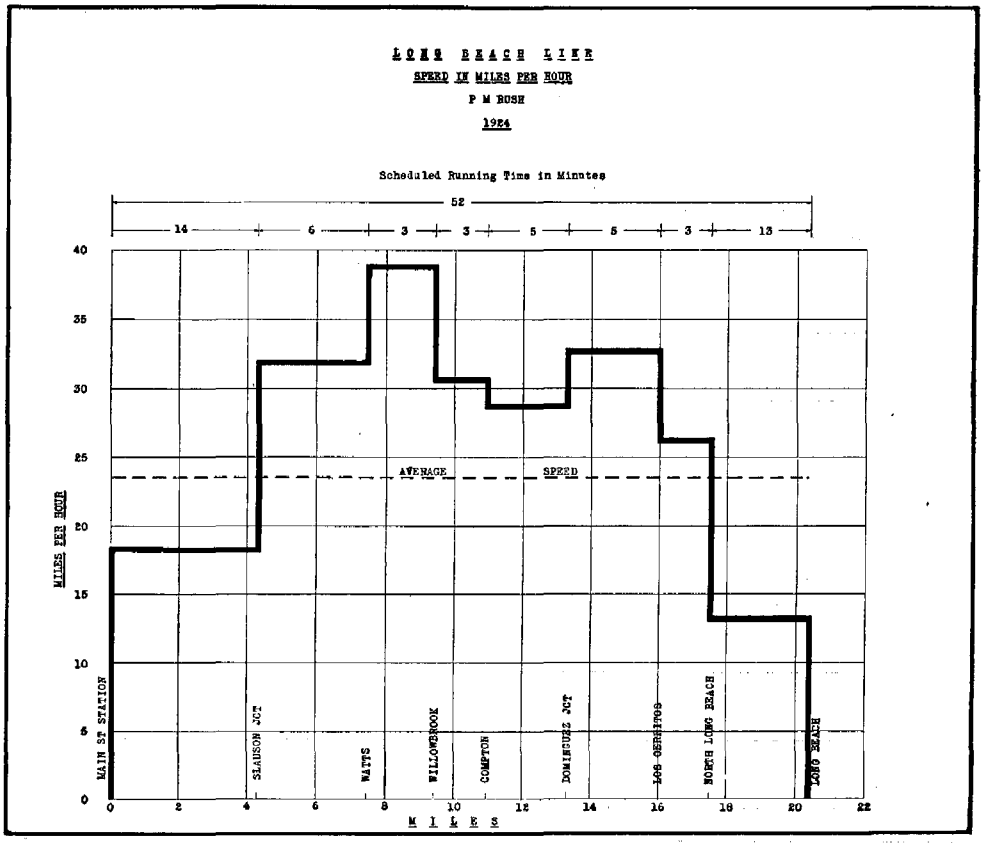

FIGURE 22. *Chart of the scheduled speed of the Long Beach Line of the Pacific Electric Railway.*

California Railroad Commission found the value of the properties of the Pacific Electric Railway Company as of December 31, 1919, to be as follows:

	Operative	*Non-Operative*	*Total*
Historical Cost	$63,412,675	$7,782,084	$71,194,759
Less Depreciation	50,752,455	5,619,641	56,372,096

Traffic

Figure 20, page 56, and the following table show the passenger traffic by years and its relative increases.

TABLE 13

PACIFIC ELECTRIC RAILWAY COMPANY

ANNUAL REVENUE AND TRANSFER PASSENGERS, YEARS 1912-1924

	Passengers		
Year Ending June 30	*Revenue*	*Transfer*	*Total*
1912	60,841,521	5,100,000*	65,941,521
1913	68,686,203	6,000,000*	74,686,203
1914	70,678,719	7,400,000*	78,078,719
1915	64,719,754	7,372,776	72,092,530†
1916	63,530,501	7,709,532	71,240,033†
Year Ending Dec. 31			
1916	61,861,184	7,460,131	69,321,315†
1917	65,028,315	7,276,972	72,305,287†
1918	67,915,099	6,669,637	74,584,736
1919	68,379,676	5,480,749	73,860,416‡
1920	84,492,579	6,855,690	91,348,269
1921	88,639,486	7,503,208	96,142,694
1922	88,124,305	5,988,939	94,113,244
1923	100,073,544	6,890,048	106,963,592
1924	100,917,063	8,278,587	109,195,650

* Transfer passengers estimated.
† Affected by "Jitney" operation July, 1914, to September, 1917.
‡ Affected by strike of trainmen in 1919.

Motor vehicle registration in Los Angeles County increased from approximately 40,000 in the year 1913 to approximately 530,000 in the year 1924 and although the privately owned automobile and the stage coach have somewhat affected the traffic on the interurban lines, these lines are still showing a substantial increase in traffic and are maintaining their place of importance as transportation agencies between Los Angeles and the various cities in the metropolitan district, as is shown in the following table:

TABLE 14

PACIFIC ELECTRIC RAILWAY COMPANY

ANNUAL REVENUE PASSENGERS ON INTERURBAN LINES ONLY

THE YEARS 1914 AND 1923 COMPARED

	Revenue Passengers			
Lines	*1914*	*1923*	*Increase*	*Per Cent*
Alhambra and San Gabriel	1,369,442	1,586,959	217,517	15.4
Covina, San Dimas, Pomona and San Bernardino	1,556,985	2,188,102	631,117	40.6
Monrovia and Glendora	911,534	978,037	66,503	7.3
Pasadena, Sierra Madre, Sierra Vista and Mount Lowe	6,700,464	7,905,770	1,205,306	18.0
Glendale and Burbank	2,678,388	4,167,715	1,489,327	55.7
Owensmouth and San Fernando	33,184	878,935	845,751	256.0
Santa Monica, Venice and Sawtelle	7,522,336	8,213,151	690,815	9.2
Redondo, El Nido, El Segundo and Hawthorne	2,610,046	2,212,839	*397,207**	*15.2**
San Pedro	3,487,930	5,330,950	1,843,020	52.8
Long Beach	2,544,562	4,465,191	1,920,629	75.5
Newport Beach and Balboa	602,640	734,433	131,793	21.9
Santa Ana	994,823	950,445	*44,378**	*4.5**
Whittier, Fullerton and La Habra	1,176,812	1,304,225	127,413	10.8
	32,189,146	40,916,752	8,727,606	27.1

* Decrease.

The annual freight revenue has shown a notable increase in the same period, growing from $1,204,000 in 1914 to $6,057,000 in 1923, or an increase of 403%.

Operating Conditions

The traffic carried by the Pacific Electric Railway lines serving Los Angeles averages about 245,000 passengers daily, of which approximately 131,000 are served by the local lines and 114,000 by the interurban lines. In order to provide service for this large number of passengers it is necessary to operate 1,459 interurban trains consisting of 2,172 cars, together with 2,668 local movements–a total of 4,840 scheduled trips–into and out of the central business district during the twenty-four hours of each week day. These cars are routed as follows:

	Number of Trips	*Per Cent*
Via Aliso Street	1,143	23.6
Via Sixth Street	667	13.8
Via Ninth Street	1,113	23.0
Via Hill Street	1,917	39.6
Total for District	4,840	100.0

Figure 12, page 47, shows the streets used by the Pacific Electric Railway trains and cars in the congested area and indicates the flow of cars over each street on week days during the maximum hour of the P. M. rush period.

The length of time required for the operation of trains on the interurban lines into and out of the congested portions of Los Angeles and those in the other cities served is rapidly increasing. This is caused by the spreading of the built-up areas and the ever-increasing pedestrian and vehicular traffic. Operation on the streets with vehicular and pedestrian traffic is becoming more and more difficult within the limits of the built-up sections of all of the cities served, and the expansion of these cities together with the introduction of additional highway crossings at grade is gradually decreasing the free running territory.

A few illustrations should suffice to develop this point clearly. For example, on the Venice Short line the average scheduled speed within the built-up portion of Los Angeles is about 14 miles per hour, with comparatively few stops for passengers; the average scheduled speed between the edge of the built-up section of Venice and the terminal at Utah Avenue in Santa Monica is about 12 miles per hour, and the average speed through Culver City and Palms is about 17 miles per hour; while in

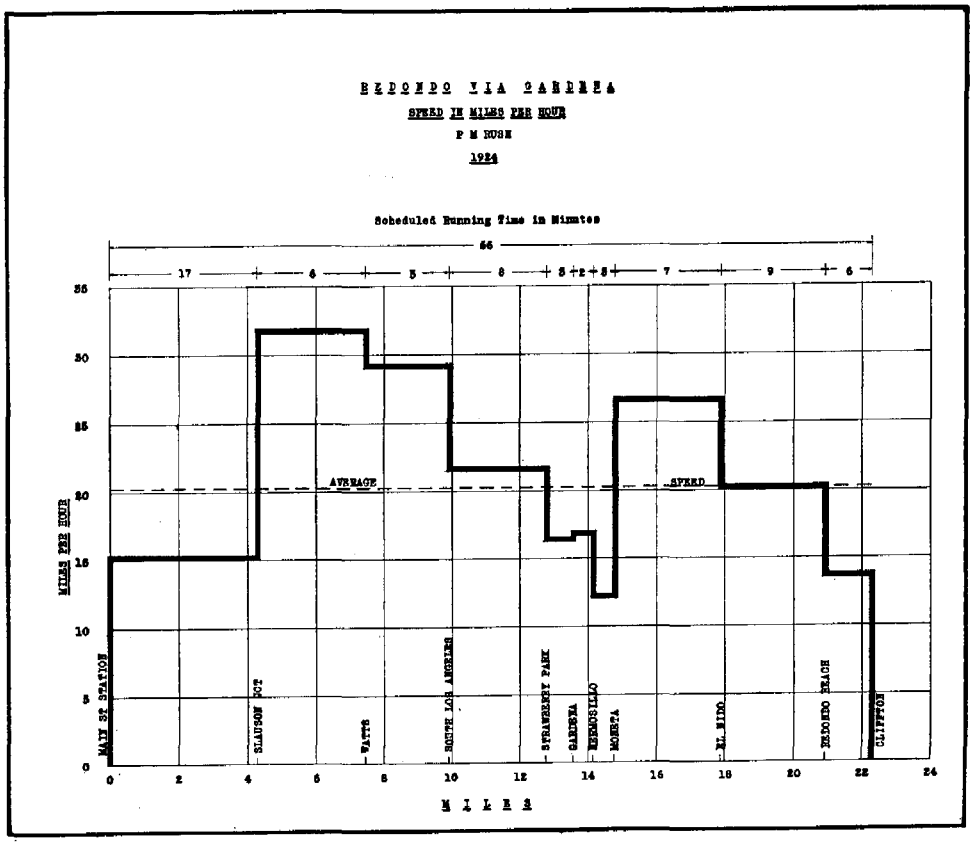

FIGURE 23. *Chart of the scheduled speed of the Redondo (via Gardena) Line of the Pacific Electric Railway.*

the free running territory between the limits of the urban areas of the cities mentioned the scheduled speed varies from 25 to 35 miles per hour. The total length of this line is 16.99 miles, only 7.60 miles or 45% of which can be termed as free running territory.

On the Sawtelle line the scheduled speed through the built-up sections of Los Angeles, Santa Monica and Venice is about 14, 12 and 11 miles per hour, respectively. This line is 19.33 miles in length, and upon only 7.82 miles, or a little over 40%, can an average scheduled speed as high as 22 miles per hour be attained.

Nearly all the interurban lines operating into and out of Los Angeles are confronted with conditions identical with those just mentioned and unless rapid transit structures free from grade crossings and vehicular and pedestrian interference are provided, the speed on these lines will gradually decrease until it approximates that of urban street railways for the entire distance. The scheduled running time in minutes and the average speed in miles per hour between time points, together with the average speed over the entire route during the P. M. rush hour, are shown graphically for some of the principal interurban lines on Figures 21 to 28 inclusive, pages 57 and 58 and 61 to 66. It will be seen that the average speed between time

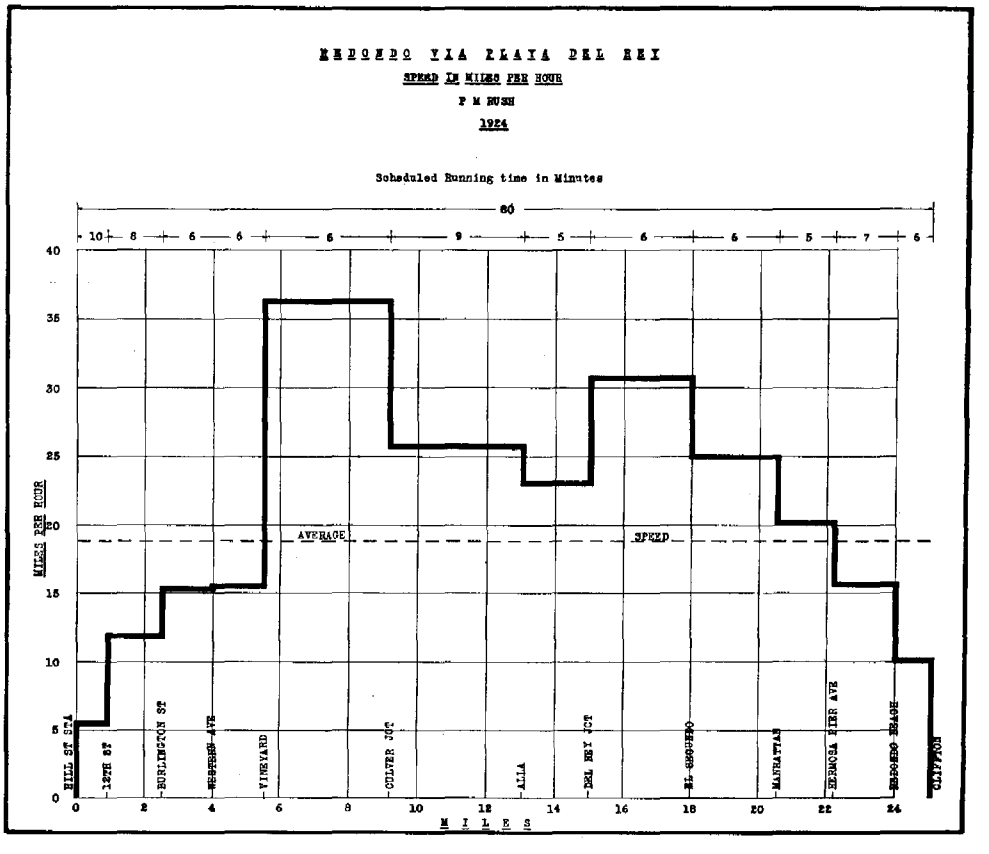

FIGURE 24. *Chart of the scheduled speed of the Redondo (via Playa del Rey) Line of the Pacific Electric Railway.*

points on these lines ranges from 6 to 36 miles per hour, and that the average speed between terminals ranges from 14 to 23.5 miles per hour.

Grade Crossings

If the interurban lines which now operate at a high average rate of speed are to continue to give such service; and if the service is to be improved with respect to speed on the lines which now operate at a low average rate of speed; then rapid transit facilities must be provided between the center and the edge of the built-up section of the cities in which any appreciable portion of an interurban line is operated. These facilities should be extended concurrently with the spreading of the urban areas. The introduction into free running territory of additional highway crossings at grade should not exceed the minimum number required for the needs of the motoring public and grades should be separated at all crossings where, from the point of view of providing faster transportation or promoting safety, such separation is desirable.

In this connection the following excerpts taken from the Annual Report of the Board of Public Utilities for the year 1913 are of interest:

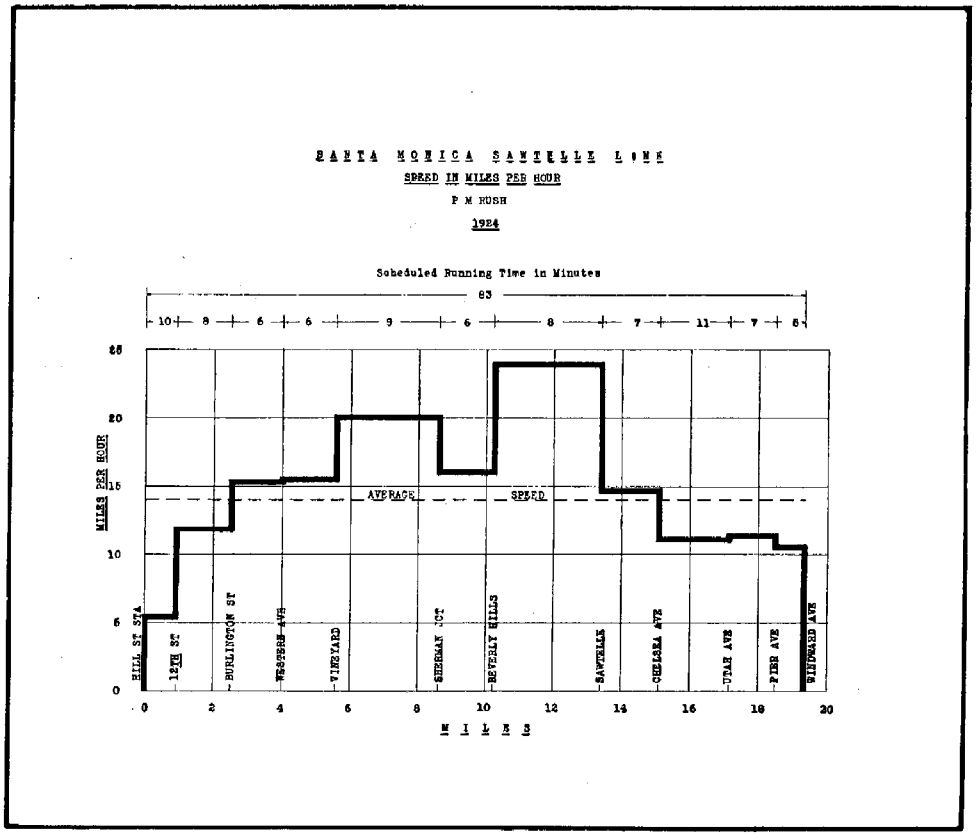

FIGURE 25. *Chart of the scheduled speed of the Santa Monica (via Sawtelle) Line of the Pacific Electric Railway.*

"The grade crossing situation on the interurban lines has reached the point where active steps must be taken toward grade separation."

"A few crossings may be treated separately, but the general problem of grade crossing elimination on all the high speed electric lines must be considered for the whole city."

"For some of the lines located on city streets the only solution is the removal of the high speed tracks by constructing new lines on private right-of-way, or building elevated railways or subways either on private right-of-way or in the streets themselves."

If it was apparent that separation of grades was essential to the relief of congestion, faster transportation and safety of operation more than ten years ago, the necessity for such separation can hardly be questioned today when the population has trebled, the number of interurban cars entering and leaving the city has greatly increased and the number of motor vehicles in Los Angeles County has increased from 40,000 to 530,000.

Traffic delays in the urban areas and the diminution of free running territory are

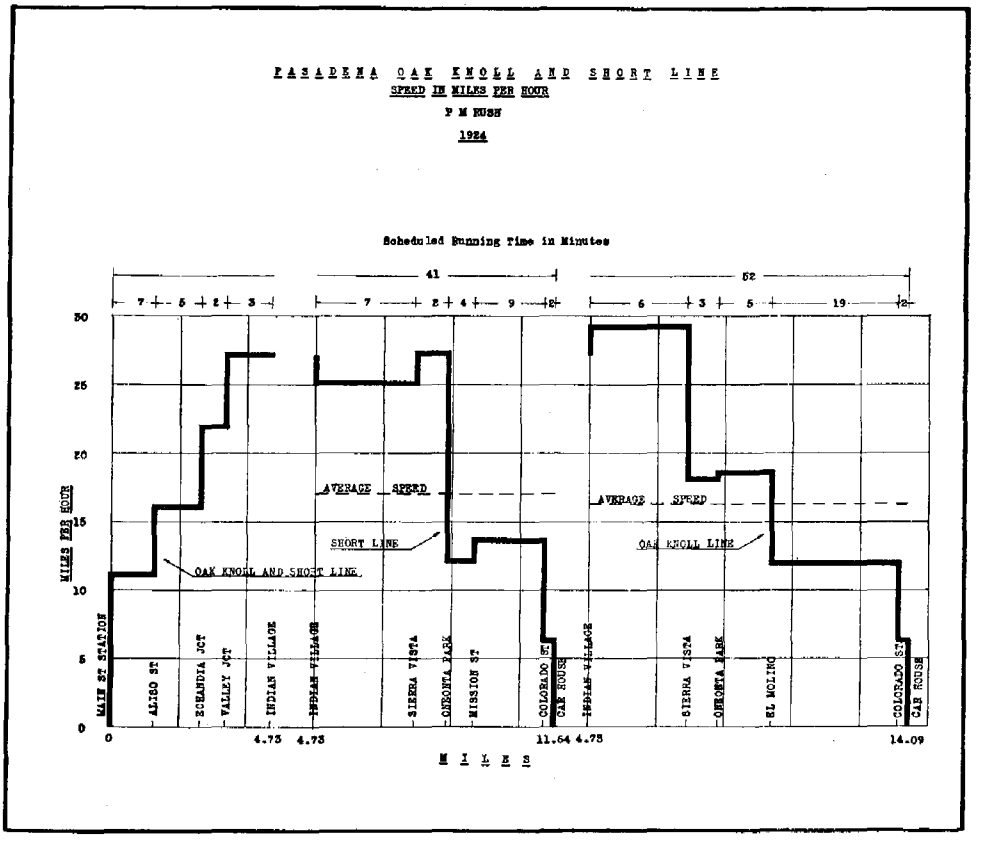

FIGURE 26. *Chart of the scheduled speed of the Pasadena Short Line and Oak Knoll Line of the Pacific Electric Railway.*

reflected in operating costs, and a portion of the increases indicated in the following table can be allocated to these causes.

TABLE 15

PACIFIC ELECTRIC RAILWAY COMPANY

OPERATING EXPENSES* PER CAR MILE

Year Ending June 30	*Cents*
1912	21.047
1913	20.728
1914	21.514
1915	19.241
1916	19.099
Year Ending Dec. 31	
1916	18.843
1917	19.258
1918	24.267
1919	32.773
1920	35.610
1921	37.864
1922	39.099
1923	40.343

*Exclusive of taxes.

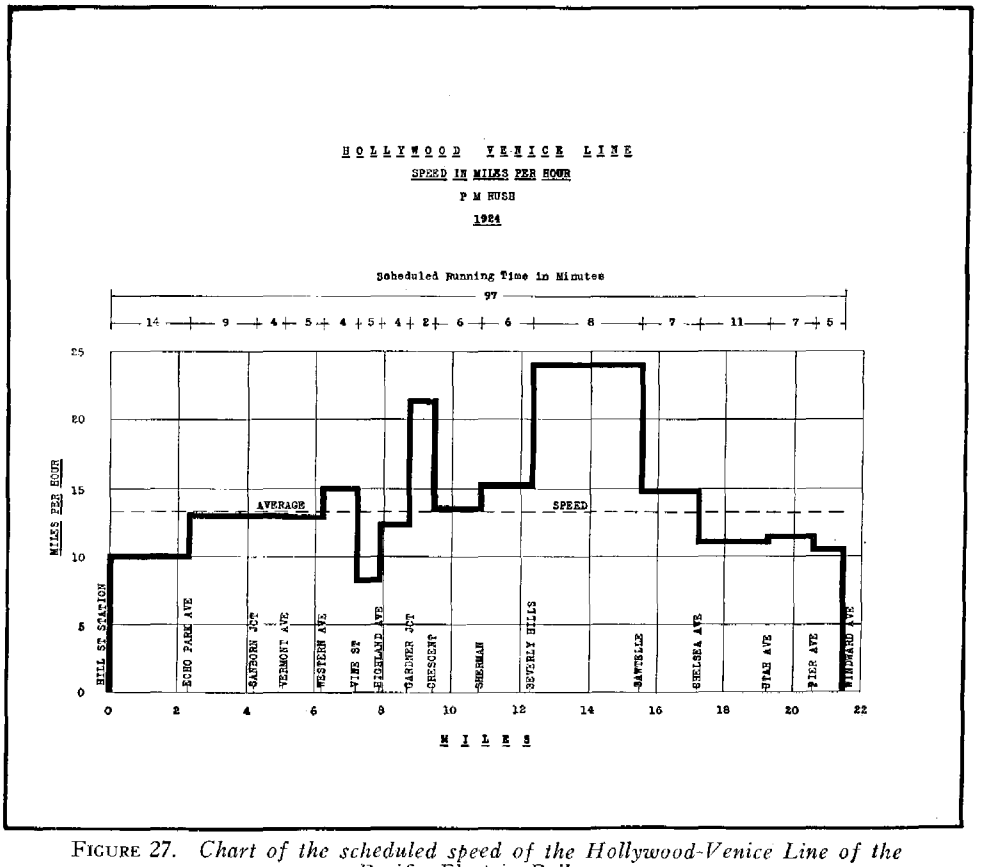

FIGURE 27. *Chart of the scheduled speed of the Hollywood-Venice Line of the Pacific Electric Railway.*

Current and Proposed Improvements

It is estimated that upon the completion of the tunnel now being constructed, from First Street and Glendale Boulevard to the Hill Street Station, 760 of the cars now using Hill Street and 300 of the cars now using Sixth Street will be routed through it, thereby materially reducing traffic congestion on Hill Street and on Sixth Street.

When the elevated railroad extending from the Pacific Electric terminal at Sixth and Main Streets was completed in the year 1917 it furnished a means for rerouting the cars of a number of the interurban lines which greatly relieved traffic congestion on Main Street. The Pacific Electric Railway Company now plans to extend this elevated road easterly to the east bank of the Los Angeles River, and thence northerly to a connection with its existing tracks at Aliso Street; with a branch extending from a point near Seventh and Alameda Streets to a connection with the Watts line at or near Fourteenth Street and Long Beach Avenue. These additional facilities, when constructed, will make possible a substantial relief in congestion on Aliso, Los Angeles, First, Main, Ninth and San Pedro Streets.

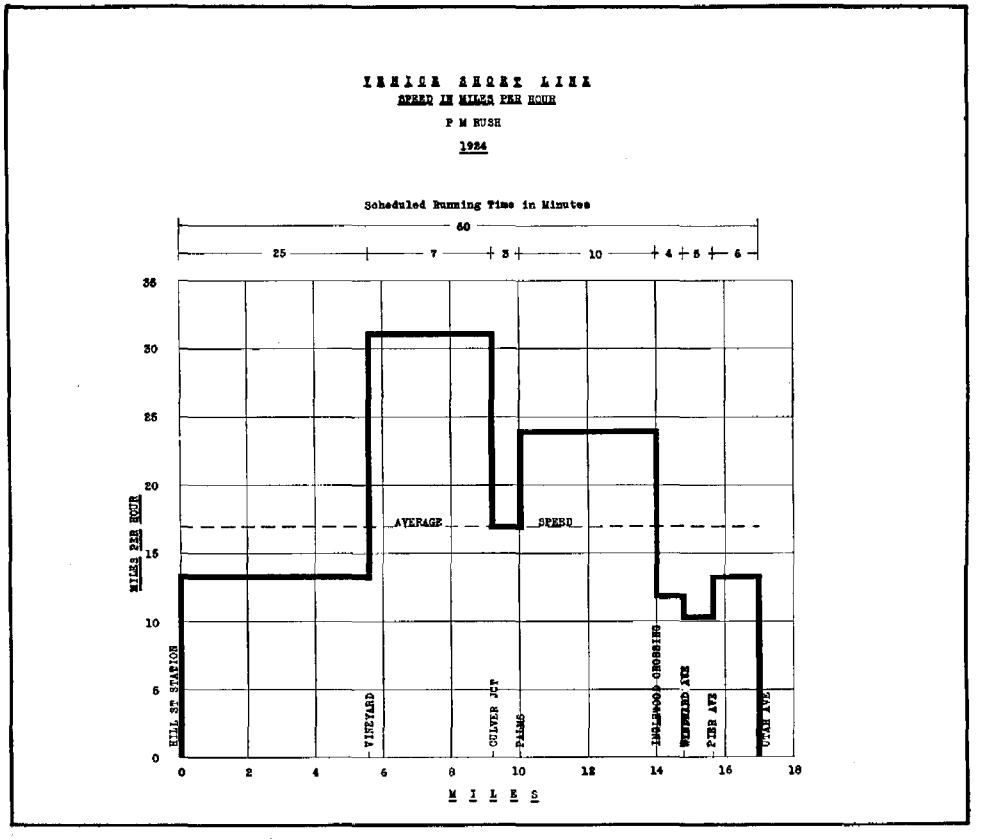

FIGURE 28. *Chart of the scheduled speed of the Venice Short Line of the Pacific Electric Railway.*

Rights-of-Way

Our examination of the property of this company shows that the operating officials in the early days exercised unusual forethought and judgment in providing rights-of-way for the future expansion of the system. As the property developed all of these rights-of-way have been utilized with the exception of an important stretch of property a part of which is along the Sacatela Storm Drain which soon is to be straightened and built by the City of Los Angeles. This right-of-way extends from Hill Street between Fourth and Fifth Streets to a point near Fifth Street and Vermont Avenue and then southwesterly in a nearly direct line to Vineyard Junction.

In developing the comprehensive rapid transit plan herein recommended every effort was made to use this right-of-way, but it was concluded that it is not suitably located to fit into the plan of unified operation, which plan contemplates the use of the proposed rapid transit structures for both urban rapid transit trains and interurban trains. If it were only necessary to provide facilities for the operation of interurban trains through the urban area, this right-of-way would provide an excellent route, but, in our opinion, it lies too far to the north for an urban rapid transit line which is needed to serve the populous territory lying between the south end of the central business district and Vineyard. The Pico Street route, which is described in detail in Chapter VI, has been selected and recommendations have been made accordingly. The recommended plan is based upon a policy which would avoid unnecessary duplication in construction. In the event that this policy is not adopted and it is found desirable that the present companies continue to operate independent systems, then the construction of an interurban line along this right-of-way, or possibly a modified plan using Ninth, Tenth or Eleventh Streets and a portion of it, would be of great benefit to those who could use the service. Should it be found either undesirable or impractical to construct the recommended Pico Street line and that an alternate route must be found then such part of the Sacatela right-of-way should be used as is found desirable. By reason of its location it appears that tracks could be depressed in an open cut from Eighth and Irolo Streets to a point near Vineyard Junction, as the topography is extremely favorable to such construction and the character of the territory served warrants such expense. This method of construction would at once provide a means for opening many of the streets which now are closed by this right-of-way.

Rates of Fare

The passenger fares on the interurban lines are based upon a mileage rate and commutation tickets are sold which afford a material saving to the daily patrons of the lines. Special week-end rates are made on the lines serving the beaches.

Plate 12 shows the fare zones in the Los Angeles Metropolitan District. The zones are based on the minimum week day commutation rate. The Los Angeles

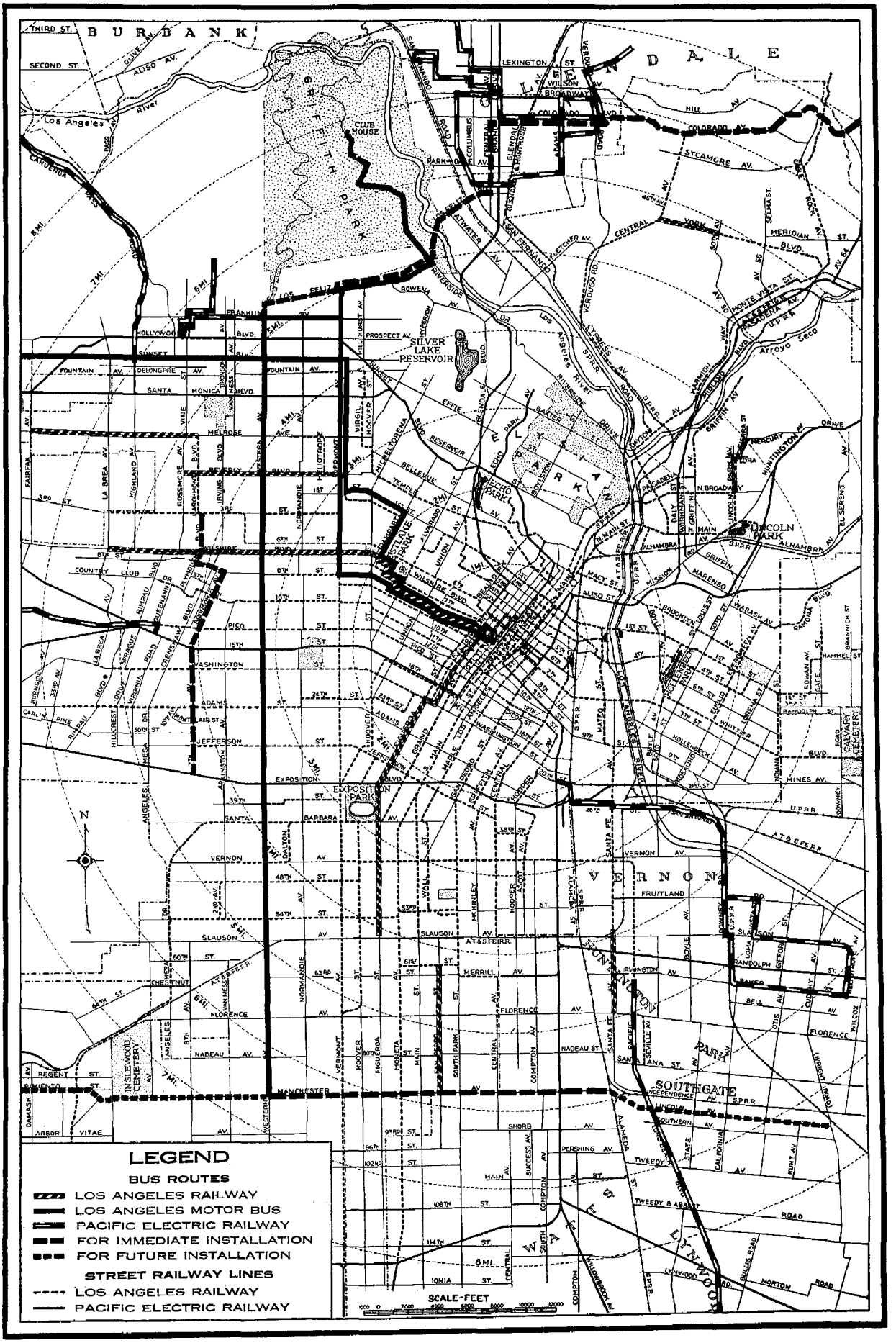

FIGURE 29. *Map of the existing and proposed bus routes in the urban area.*

local lines of the Pacific Electric Railway are operated on a zone fare basis; the fare being six cents in each of the two zones into which the urban area is divided. An inter-zone fare of ten cents is maintained which, however, permits a transfer to the lines of the Los Angeles Motor Bus Company.

MOTOR BUSES

Routes

In addition to the motor bus routes operated by the Pacific Electric Railway and the Los Angeles Railway, there are three motor bus routes operated by the Los Angeles Motor Bus Company, which is owned jointly by the Pacific Electric Railway Company and the Los Angeles Railway.

The Western Avenue route is not operated in direct competition with street railway lines as it extends from Hillhurst Avenue to Manchester Avenue along Franklin and Western Avenues.

The other two routes (the Sunset Boulevard and the Vermont Avenue-Griffith Park routes) parallel street railway lines for the major portion of their length. The Sunset Boulevard route extends from Sunset Boulevard and Laurel Canyon Drive to Grand Avenue and Seventh Street along Sunset Boulevard, Vermont Avenue, First Street, Rampart and Wilshire Boulevards, and Parkview, Seventh, Lake, Eighth, Hope and Seventh Streets. The Vermont Avenue-Griffith Park route extends from the Field House in Griffith Park to Grand Avenue and Seventh Street along Upper Road, Los Feliz Boulevard, Vermont Avenue and Eighth, Hope and Seventh Streets.

Figure 29 shows the bus routes operated by the Los Angeles Motor Bus Company, the Pacific Electric Railway Company and the Los Angeles Railway and their location with relation to street railway lines. The motor bus routes operated by the Pacific Electric Railway Company excepting those shown on this Figure are nearly all located in various suburban cities and towns in the Metropolitan District of Los Angeles.

Service

The combined length of the routes operated by the Los Angeles Motor Bus Company is 32.65 miles, and service is at present supplied by 54 single deck and 24 double deck buses operated by one and two men, respectively. The rate of fare on the urban lines is six or ten cents, depending largely upon the distance traveled. There is a limited transfer permitted to street railway lines and other bus lines. The total traffic on the lines of this company is at present an average of 25,000 passengers daily.

The scheduled headway (time interval between buses), and the average scheduled speed during the P. M. rush hour period on these routes is as follows:

Route	*Headway in Minutes* A. M. Rush	Base	P. M. Rush	*Miles Per Hour*
Sunset Boulevard	5	7½	3	11.69
Western Avenue	4	7½	4	11.60
Vermont Avenue-Griffith Park	10	15	10	12.00

The Los Angeles Motor Bus Company began operating August 18, 1923, and although the operation of the lines is more or less in the experimental stage, a comparison of some of the operating statistics of this company with those of the Los Angeles Railway lines may be of interest and are here presented.

TABLE 16

OPERATING STATISTICS OF LOS ANGELES RAILWAY AND LOS ANGELES MOTOR BUS COMPANY CONTRASTED

	Street Cars	*Buses*
Average fare per revenue passenger (cents)	5.02	6.87
Average fare per revenue and transfer passenger (cents)	3.72	6.58
Transportation revenue per car mile or bus mile (cents)	37.58	19.66
Operating expenses per car mile or bus mile (cents)	28.30*	20.70*
Net revenue per car mile or bus mile (cents)	9.28*	*1.04*†*
Revenue passengers per car mile or bus mile	7.49	2.86
Transfer passengers per car mile or bus mile	2.60	0.12
Total revenue and transfer passengers per car mile or bus mile	10.09	2.98
Average number seats furnished per car mile or bus mile	46	30

* Before taxes.
† Deficit.

These figures are derived from the operating statistics of each company for the first six months of the year 1924. These months were selected for the reason that the number of route miles operated by each company remained practically unchanged during this period.

OBSERVATIONS OF PASSENGER TRAFFIC

Traffic Count

The Street Railway Survey, under the direction of the California Railroad Commission, the City of Los Angeles, the Pacific Electric Railway Company and the Los Angeles Railway, included an origin and destination count of the passengers carried on the city lines in the period between February 14 and April 4, 1924. A count of this character necessarily involves considerable expense and as it was available we have utilized some of the data collected in order to avoid duplication of expenditures.

The count was made on Tuesdays, Wednesdays, Thursdays and Fridays and covered all bus lines, all of the lines of the Los Angeles Railway and the local lines of the Pacific Electric Railway (except the Sierra Vista and Watts lines). Inspectors riding the cars observed all passengers traveling inbound, toward the central business district, from 6:00 to 10:00 A. M. and from 3:00 to 6:00 P. M. An identification slip was given to each passenger boarding the car and upon this slip the passenger indicated the point of transfer, if any, and final destination. These slips were collected before the passenger alighted from the car, and upon completion of the check the slips were classified, grouped and sorted.

The Street Railway Survey divided the city into several hundred small zones for the purpose of making detailed studies in connection with its work. In our study of the origin and destination of passengers we have divided the city into nineteen districts of origin and five groups of districts of destination. Plate 13 shows these districts and an analysis of the data collected in graphical form. The number of passengers (included in the count) originating in each district on a typical week day is shown by the area of the circle. The sectors in each of the circles show the proportion of passengers traveling to the various groups of districts. A summary of the data used in the preparation of this plate is shown in Tables 17 and 18, pages 72 and 73.

The most striking feature of this tabulation and its graphical representation (Plate 13) is the preponderance of travel to the central business district (District I), which is 55% of the total passengers observed. In only two districts (A and G) is the proportion of traffic to all other parts of the city greater than that traveling to the central business district. The need for cross-town service which will permit the flow of passengers from one outlying district to another without going through the central business district, as at present, is apparent.

The importance of cross-town lines in the development of a city is plainly illustrated in the growth of Chicago. In 1907 nearly all of the important street railway lines terminated in the downtown district, as they now do in Los Angeles, and over 50% of the traffic was to and from the downtown area. Through unification, the establishment of universal transfers and the construction of many cross-town lines this volume of travel has been materially changed and at the present time less than

TABLE 17

DAILY MOVEMENT OF INBOUND PASSENGERS FROM 6 A. M. TO 10 A. M. AND FROM 3 P. M. TO 6 P. M. AS SHOWN BY COUNT MADE BY THE STREET RAILWAY SURVEY DURING EARLY PART OF 1924.

ORIGIN			DESTINATION BY DISTRICTS																	
DISTRICT	PASSENGERS OBSERVED	PER CENT OF TOTAL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
A	17,918	8.6	4,201	647	292	19	101	454	341	119	8,578	1,372	544	423	105	63	101	325	193	40
B	18,890	9.0	595	1,192	380	25	143	666	1,034	224	10,590	1,944	81	363	238	171	276	785	134	49
C	14,837	7.1	382	562	491	20	288	1,851	745	327	8,163	312	31	323	235	79	71	693	207	57
D	1,939	0.9	31	21	108	233	21	227	36	31	992	31	4	59	18	17	6	74	24	6
E	11,318	5.4	89	144	200	24	696	1,986	298	249	6,025	286	28	171	147	61	87	494	270	63
F	32,550	15.6	334	544	424	58	396	4,443	1,200	1,084	17,212	1,301	80	709	502	332	443	2,514	806	168
G	12,177	5.8	220	340	142	24	149	945	977	417	6,658	748	68	226	212	130	140	509	216	56
H	3,593	1.7	71	92	19	1	16	119	51	48	2,354	191	55	89	87	85	68	192	33	22
J	25,733	12.3	193	375	201	35	218	1,121	710	287	16,698	2,400	151	906	361	219	350	1,193	213	102
K	6,336	3.1	116	69	27	..	17	103	66	70	4,603	297	323	266	34	35	65	199	40	6
L	2,238	1.1	16	54	42	19	23	157	58	41	1,091	132	8	330	52	26	43	119	20	7
M	8,986	4.3	71	163	168	23	138	478	246	122	4,375	329	40	1,106	719	150	272	458	81	47
N	11,874	5.7	93	153	65	22	76	288	212	147	6,717	215	28	731	1,112	1,213	107	596	72	27
O	16,487	7.9	101	294	112	20	92	546	240	131	9,641	438	39	746	444	146	1,116	2,147	182	52
P	13,719	6.5	142	340	327	56	272	923	402	175	7,092	857	77	699	303	262	318	1,208	187	79
Q	6,097	2.9	57	113	155	35	187	1,051	305	62	2,198	216	8	219	85	65	148	668	485	40
R	4,455	2.1	39	54	67	7	79	407	79	52	2,244	111	16	94	58	42	66	532	295	213
TOTAL	209,147	....	6,751	5,157	3,220	621	2,912	15,765	7,000	3,586	115,231	11,180	1,581	7,460	4,712	3,096	3,677	12,706	3,458	1,034
Per Cent.	.....	100.0	3.2	2.5	1.5	0.3	1.4	7.5	3.3	1.7	55.1	5.3	0.8	3.6	2.2	1.5	1.8	6.1	1.7	0.5

NOTE—The count included all bus lines, the lines of the Los Angeles Railway and local lines of the Pacific Electric Railway (except the Sierra Vista and Watts Lines).

TABLE 18

DAILY MOVEMENT OF INBOUND PASSENGERS FROM 6 A. M. TO 10 A. M. AND FROM 3 P. M. TO 6 P. M. AS SHOWN BY COUNT MADE BY THE STREET RAILWAY SURVEY DURING EARLY PART OF 1924.

ORIGIN		DESTINATION BY GROUPS OF DISTRICTS									
		1		2		3		4		5	
DISTRICT	PASSENGERS OBSERVED	CENTRAL BUSINESS DISTRICT		DISTRICTS K, L, M & N		DISTRICTS E, F & H		DISTRICTS O, P, Q & R		DISTRICTS A, B, C, D, G & J	
		Passengers Observed	Per Cent of Total	Passengers Observed	Per Cent of Total	Passengers Observed	Per Cent of Total	Passengers Observed	Per Cent of Total	Passengers Observed	Per Cent of Total
A	17,918	8,578	47.8	1,135	6.3	674	3.8	659	3.7	6,872	38.4
B	18,890	10,590	56.0	853	4.5	1,033	5.5	1,244	6.6	5,170	27.4
C	14,837	8,163	55.1	668	4.5	2,466	16.6	1,028	6.9	2,512	16.9
D	1,939	992	51.2	98	5.0	279	14.4	110	5.7	460	23.7
E	11,318	6,025	53.2	407	3.6	2,931	25.9	914	8.1	1,041	9.2
F	32,550	17,212	52.9	1,623	5.0	5,923	18.2	3,931	12.1	3,861	11.8
G	12,177	6,658	54.7	636	5.2	1,511	12.4	921	7.5	2,451	20.2
H	3,593	2,354	65.5	316	8.8	183	5.1	315	8.8	425	11.8
J	25,733	16,698	64.9	1,637	6.3	1,626	6.3	1,858	7.2	3,914	15.3
K	6,336	4,603	72.6	658	10.4	190	3.0	310	4.9	575	9.1
L	2,238	1,091	48.8	416	18.6	221	9.8	189	8.4	321	14.4
M	8,986	4,375	48.7	2,015	22.4	738	8.2	858	9.6	1,000	11.1
N	11,874	6,717	56.6	3,084	26.0	511	4.3	802	6.7	760	6.4
O	16,487	9,641	58.5	1,375	8.3	769	4.7	3,497	21.2	1,205	7.3
P	13,719	7,092	51.6	1,341	9.8	1,370	10.0	1,792	13.1	2,124	15.5
Q	6,097	2,198	36.0	377	6.2	1,300	21.3	1,341	22.0	881	14.5
R	4,455	2,244	50.4	210	4.7	538	12.1	1,106	24.8	357	8.0
TOTAL	209,147	115,231	55.1	16,849	8.1	22,263	10.6	20,875	10.0	33,929	16.2

25% of the traffic on the street railway lines of Chicago is to and from the central business district.

The effect of developing a system of cross-town lines on the traffic condition of the Central Business District is readily apparent from the foregoing.

Residential Distribution of Employees

An analysis of the traffic movements of a large city presents an extremely complex problem. While certain characteristics of traffic flow may be derived from traffic counts, such counts should be supplemented by a study of the residential location of employees of the larger industrial and commercial establishments. This latter data is very essential to the proper formulation of a rapid transit plan and again considerable expense would have been involved had not the Los Angeles Railway, which had just completed a comprehensive survey of this nature, placed its data at our disposal. This information was obtained by the statistical bureau of the Los Angeles Railway from 650 industrial and commercial establishments having a total of 80,000 employees. The plants of these industries were visited by representatives of the company who procured lists of addresses. A card was prepared for each employee showing the location of employment and residence, together with the customary method and route of travel to and from work.

The statistics thus obtained were used to prepare charts of occupational and residential location of employees. The location of the industrial establishments in the urban area is shown on Plate 9. For convenience the area which contains the majority of the industrial and commercial establishments was divided as follows: The North Side, the East Side and the Vernon Industrial Districts, and the Central Business District. The residential location of the employees in these four districts is shown on Plates 14, 15, 16 and 17.

The outstanding feature of these four plates is the widespread distribution of the homes of the employees in each district. This has probably been made possible by the general use of the automobile and indicates a healthy social condition. The condition which exists in many of the large eastern centers where the residences of employees are clustered in the immediate vicinity of the large industries is noticeably absent in Los Angeles. The automobile will continue to be used by many workers, but additional public transportation facilities should also be provided. The data shown here indicates clearly the need for cross-town service which will be described in detail in Chapter VI. Cross-town surface lines will carry many riders direct to their destinations without requiring them to travel through the congested downtown streets.

CHAPTER IV

TRANSPORTATION SYSTEMS IN OTHER CITIES

New York, Chicago, Philadelphia and Boston are the only American cities which have rapid transit lines. These older cities have developed their systems of transportation along different lines under varying physical, legal and financial conditions; and Los Angeles, as well as other cities contemplating rapid transit construction, has the opportunity to profit by their experiences.

For this reason each of these cities and its transportation system is briefly described. In order to aid in making comparisons, outline maps of the metropolitan district of each city and also of Los Angeles, drawn to the same scale, have been prepared and are shown on Plate 18. On these maps the municipal area (the territory within the city boundaries) is shown in color, and concentric circles of five, ten, fifteen, twenty and twenty-five miles radii are laid down and centered upon the central business district in each case. A line drawing showing the routes of the rapid transit system of each of the four cities has been superimposed upon a map of urban Los Angeles (see Plates 19, 20, 21 and 22) in order that a conception of the extent of each system may be had. In each instance the focal point of the rapid transit system has been located at Seventh Street and Broadway in Los Angeles. These maps are of interest in that they show the amount of rapid transit development which has been necessary to even partially relieve traffic congestion and improve transportation in these four cities. Additional subways are at present under construction in both New York and Philadelphia; Boston has recently converted several miles of street railway subway into rapid transit subway and Chicago is contemplating a large expansion of its rapid transit system.

New York City

The City of New York, which is composed of five boroughs (Manhattan, The Bronx, Brooklyn, Queens and Richmond), has an area of 299 square miles. The population in the year 1920 was 5,621,000 and the average density of population 31

persons per acre. The following table shows the population of each of the boroughs of New York City for the years 1820, 1870 and 1920, and also the density per acre in 1920:

TABLE 19

POPULATION OF NEW YORK

Borough	*Years*			*Population Per Acre*
	1820	*1870*	*1920*	*1920*
Manhattan	123,000	942,000	2,284,000	163
Brooklyn	11,000	420,000	2,018,000	46
The Bronx	....	....	733,000	27
Queens	22,000	74,000	469,000	7
Richmond	6,000	33,000	117,000	4

The intensive development of Manhattan Island is well known throughout the country. The heights of office and apartment buildings are such that there is now the equivalent of five or six cities in an area ordinarily occupied by only one city. This great concentration of population with its resultant large volume of traffic places New York in a better position to support a comprehensive and independent subway system than any other city. The Borough of Manhattan (Manhattan Island) with an area of only 22 square miles has almost the same population as has Chicago with an area of 205 square miles. The population density of Manhattan Island in the year 1923 was 161 persons per acre compared with a density of only 22 per acre in Chicago.

Rapid Transit Lines

There has been intensive rapid transit development in New York City in order to provide transportation for its unusual concentration of population (see Plate 19). The City of New York owns practically all of the subway structures and a part of the elevated system. The operating companies own the equipment including track, distributing and lighting systems, cars, signals, etc. There is a total of 591 miles of single track in the New York rapid transit system, of which 221 miles are in subways, and 370 miles on elevated railroads.

The first rapid transit lines in New York were elevated railroads, built on Manhattan Island over fifty years ago. This was followed later by the construction of elevated lines in Brooklyn. These early rapid transit projects were financed, constructed and operated by private corporations. The first subway was completed and placed in operation in 1904. It was financed by the City and was constructed, under the supervision of the Rapid Transit Board, by a private corporation which

leased it at an annual rental equal to the interest on the bonds issued by the City for construction, plus one per cent for a sinking fund to retire these bonds at maturity. The lease was for a fifty year period with a provision for a twenty-five year extension with a readjustment of rental.

Some years after the completion of the first subway line its capacity was reached and the increasing need for transportation led to insistent demands for additional rapid transit facilities. With an investment of about $50,000,000 in the original subway, the City had nearly exhausted its bonding power. By an amendment of the State Constitution in 1910, bonds, which had been issued for rapid transit and harbor purposes, were exempted from the debt limitations of the City. The Rapid Transit Act as amended in 1912 gave the Public Service Commission authority to negotiate for the construction and operation of rapid transit lines. The Commission then negotiated with the companies operating the rapid transit lines in Manhattan and in Brooklyn, and as a result the contracts for the Dual Subway System were made.

Under these contracts, which were negotiated in 1913, the City of New York built large additions to the first subway in co-operation with the Interborough Rapid Transit Company and also additional subways, independent of the Interborough Company, which were leased to the New York Municipal Railway Corporation (now the Brooklyn-Manhattan Transit Corporation) to be operated in connection with the elevated lines in Brooklyn.

At the same time new leases were drawn to run for 49 years from the beginning of operation of the Dual System. There is no stipulated rental but it is provided that after deductions for taxes, operating expenses, maintenance and depreciation, interest on money invested by the companies and interest on the bonds issued by the City, from the gross receipts, the surplus shall be divided equally between the City and the companies. The total investment in rapid transit construction in New York is $640,000,000, of which the City has expended over $308,000,000. The lines are operated on a five-cent fare, and because of the attempt to preserve this rate of fare, notwithstanding the higher costs of labor and material, the City's share has fallen far short of the sums required to meet the interest on the City's investment.

There are two operating companies: the Interborough Rapid Transit Company and the Brooklyn-Manhattan Transit Corporation. The Interborough operates most of the rapid transit lines in Manhattan and The Bronx with one line extending into Brooklyn. The Brooklyn-Manhattan operates practically all of the rapid transit lines in Brooklyn and Queens as well as about one-half of the street railway lines in Brooklyn. Some of its lines also extend into Manhattan including the Broadway subway from the south end of the Island to 59th Street. A free transfer is permitted between elevated lines and also subway lines of each company, but no transfer is granted between the Interborough and the Brooklyn-Manhattan systems, nor to any of the surface lines.

A distinguishing feature of the New York rapid transit system is the large amount of express service which is made possible by a number of four-track lines upon which a speed of 25 miles per hour or more can be maintained. During the rush hours ten-car trains are operated on the lines of the Interborough Company and eight-car trains on those of the Brooklyn-Manhattan Company. The latter company has adopted a large car as a standard. This car has a seating capacity of 90 passengers. With forty trains per hour about 80,000 passengers can be carried out of the congested district on a single track of the Brooklyn-Manhattan system.

The elevated railroads are largely of the open deck, steel type; the structural features of most of them being characteristic of the pioneer period of design. The subways for the most part are of the high level design, and have been constructed largely by the cut and cover method, (see Plate 23). While there has been considerable rapid transit development in the boroughs of Manhattan, The Bronx and Brooklyn, the Borough of Richmond has no rapid transit lines, and in the Borough of Queens there is but little rapid transit mileage. The importance of the rapid transit lines as a transit factor in New York City is shown by the fact that 1,612,000,000 revenue passengers were carried during the year ending June 30, 1924, or about 59.0 per cent of the revenue traffic of the city.

Street Railway Lines

The surface lines in New York are operated by over thirty separate companies independent of and somewhat in competition with the rapid transit lines. They comprise 1,131 miles of single track, but notwithstanding the fact that their mileage is more than double that of the rapid transit lines they carried only 38.9 per cent of the total city traffic for the year ending June 30, 1924. The rate of fare is five cents and transfer privileges are limited.

Bus Lines

The Fifth Avenue Coach Company operates the majority of the bus routes in New York City. Approximately 300 buses are operated over about 25 miles of route. The rate of fare is ten cents and transfers are issued between main and branch routes. During the fiscal year ending June 30, 1924, these bus lines carried 57,000,000 revenue passengers, or a little over 2 per cent of the total city traffic. In addition to the routes operated by the Fifth Avenue Coach Company there are a number of municipal bus routes operated under the direction of the Department of Plant and Structures, City of New York. Most of these routes, we are advised, are comparatively short and a five-cent fare is charged without transfer privilege.

Suburban Lines

The suburban traffic carried to and from New York City on the various steam and electric lines totalled 257,000,000 revenue passengers in the year 1923. This includes 56,000,000 passengers carried on the ferries and 43,000,000 carried by the Hudson-Manhattan Railroad in and out of New York City.

CHICAGO

The City of Chicago has an area of 205 square miles. The estimated population in the year 1923 was 2,886,000, and the average density was 22 per acre. The municipal area is shown in color on the map on Plate 18. The Central Business District of Chicago is located at its extreme eastern edge on the shore of Lake Michigan. There are only three directions in which the city may expand, and therefore the more densely populated sections extend to greater distances from the downtown district than would be the case if the city were of a circular type, as is Los Angeles.

Coincident with the era of skyscraper construction, congestion has increased in Chicago's downtown streets. For many years the building height limit was 260 feet and this made possible the construction of 22-story buildings. This limit was reduced to 200 feet for a short period; but recently, following the enactment of a zoning ordinance, buildings 264 feet in height are allowed without a setback and with certain restrictions as to the area and volume above the 264-foot level a much higher building is permitted. As a consequence huge buildings over 300 feet in height are now being constructed, some of which provide office space for as many as 15,000 people. This has brought about an unnatural concentration of activities in the commercial district.

Rapid Transit Lines

The rapid transit system in Chicago (see Plate 20) consists entirely of elevated railroads which were constructed by five different private corporations in the period between 1892 and 1902. The existing system is practically the same as that first constructed except for several branch lines and extensions which were added in the years 1906, 1907 and 1908. The various lines were unified as far as operation and service is concerned in 1912 and in 1924 the several corporations were merged into one corporation—the Chicago Rapid Transit Company.

There are four main lines, all of which converge on the Union Loop, a double track railroad encircling a portion of the downtown district. These main line railroads have two, three or four tracks. Express service is operated on the lines which have third and fourth tracks. The capacity of the system for mass transportation is

somewhat restricted because of the inadequate track capacity in the downtown district (a total of thirteen tracks converging into two at the Union Loop) and also because the station platforms were constructed with a length sufficient only to accommodate five-car trains. During the past few years, however, a number of the platforms on part of the system have been lengthened so as to permit the operation of six and eight-car trains. The speed of the local trains is 17 to 18 miles per hour, and that of the express trains varies from 22 to 27 miles per hour.

The elevated lines were operated for many years on a five-cent fare and only a few of the lines proved to be fairly profitable to their owners. During recent years, however, because of concentration of population in the territory served by the system, together with unified and efficient operation, there has been a marked increase in the return on the original investment. At present ten cents is charged for a single fare, with three tickets for twenty-five cents, and a free transfer is granted between all lines of the rapid transit system. With its financial condition improved the Company is now proposing the construction of various additions and extensions within the city.

The main lines of the rapid transit system extend from the downtown district to the north, west and south sides of the city. Owing, however, to lack of extensions the system serves directly only about 20 per cent of the area of the city and about 40 per cent of its population. On account of the limited track capacity heretofore described, and the keen competition offered by the surface lines, the rapid transit system carries only about 20 per cent of the annual revenue traffic of Chicago. The value of this system as a transportation factor in Chicago, however, is evidenced by the fact that during the maximum traffic hour of the P. M. rush on week days it carries over 80,000 passengers out of the central business district, and 204,000,000 revenue passengers were carried during the year 1923.

Street Railway Lines

The Chicago Surface Lines comprise 1,070 miles of single track and 3,540 cars. It is the largest street railway system in the world under one management. The tracks have been constructed from time to time on section and half section line streets, as well as on the important radial streets, presenting a nearly uniform development of trunk and cross-town lines.

Because of the limited rapid transit development in Chicago, the average length of ride on the surface lines is 4.5 miles, which is probably longer than that in any other city. The average operating speed of the surface cars between terminals is about 11 miles per hour, varying from a speed of five miles per hour in the congested areas to a speed of 15 miles in some of the outlying districts.

The importance of the surface lines system in Chicago's local transportation field is shown by the fact that of the total revenue passengers in the year 1923 the surface lines carried 825,000,000, or about 78 per cent. In addition, 601,000,000 transfer passengers were carried. A cash fare of seven cents, with 3 tickets for twenty cents, prevails at present.

Bus Lines

Bus lines are becoming increasingly important as a transportation factor in Chicago. Service was inaugurated on the north side in 1916 with a total of ten route miles. In the year 1923 bus lines were extended into the south side and in 1924 into the west side, and they now serve practically the entire territory contiguous to the park and boulevard system. The Chicago Motor Coach Company which provides the service operates over 100 route miles and 412 buses. A flat ten-cent fare is charged with no transfer from the buses operated in one division of the city to those operating in another, nor to the surface or elevated railway lines. In the year 1923 the bus lines carried 22,000,000 revenue passengers, or about 2 per cent of Chicago's total revenue passenger traffic. Due to the installation of many additional routes the number of passengers carried in the year 1924 reached 49,000,000.

Suburban Lines

There are five surface electric lines serving the suburbs immediately adjacent to the city. In the year 1923 they carried approximately 33,000,000 revenue passengers. In addition, there are two high speed electric interurban railroads which have access to the heart of the city through an operating agreement with the Chicago Rapid Transit Company by which their trains are operated over the elevated railroads to the Union Loop. In the year 1923 these two lines carried 19,500,000 revenue passengers.

Chicago is the terminus of a large number of steam railroads which operate into it from all directions. Many of these railroads maintain suburban service and four of them carry a considerable volume of suburban traffic. The total suburban traffic carried by all steam railroads in the year 1923 was about 72,000,000 revenue passengers.

PHILADELPHIA

The City of Philadelphia had a population of 1,824,000 in the year 1920. The total municipal area was 128 square miles, and the average density of population was 22 per acre. The city is semi-circular in shape, lying on the west bank of the Delaware River and like Chicago, its central business district is located near its east-

ern boundary. The growth of Philadelphia has been very uniform; its annual increase in population being the most regular of any of the large American cities.

There are no topographical barriers nor has there been any artificial limitation to the natural expansion of the downtown district, as in the case of New York and Chicago. The construction of 20-story buildings is permitted, however; which, coupled with the extremely narrow width of most of the downtown streets, has caused traffic congestion for many years.

Rapid Transit Lines

The first step in the development of rapid transit facilities in Philadelphia was taken in 1907 when the Market Street Subway-Elevated was placed in operation (see Plate 21). The construction was financed and the road is operated by the Philadelphia Rapid Transit Company, which operates all the street railway lines in Philadelphia. This double-track rapid transit line extends west from the Delaware River through the downtown district to the western limits of the city, a distance of a little more than seven miles. A portion of this line two miles in length is in a subway extending through the downtown district and the remainder is on an elevated structure.

Further development of rapid transit in Philadelphia was delayed until means of public financing were made available. The provision of the necessary capital involved an increase in the bonding limit of the City, and this was made possible by a Constitutional Amendment approved in 1915 (see Appendix F). The City, having procured additional borrowing capacity, began the construction of the Frankford Elevated Railway in the year 1918 and it was placed in operation in 1922. The Frankford Elevated Railway extends northerly and northeasterly, from a connection with the Market Street subway to Bridge Street, a distance of about six miles. It is a double track elevated railroad of excellent design. It was leased to the Philadelphia Rapid Transit Company for a term of five years at a rental of one per cent of the cost of construction and equipment for the year 1923. The rental is increased by one per cent per annum until it reaches five per cent for the last year of the lease. The City is now constructing additional rapid transit lines.

The Philadelphia Rapid Transit Company permits transfer from some of its outlying surface lines to the high speed lines. The rate of fare on the rapid transit lines is eight cents or four tickets for thirty cents. In the year 1923, there was a total of 87,000,000 revenue passengers carried on the rapid transit lines.

Street Railway Lines

The street railway system comprises 557 miles of single track and about 1,700 cars are operated. A number of the important West Philadelphia lines are operated

on the four-track Market Street Elevated-Subway from 32nd Street to Broad Street at the City Hall. The street car system has been extended from time to time somewhat in keeping with the city's growth, and has played its part in the development of Philadelphia. The importance of the surface lines as a transportation agency is shown by the fact that in the year 1923 the full fare and three-cent transfer passengers combined reached a total of 645,000,000. An eight-cent cash fare is charged with four tickets for thirty cents. There is a limited free transfer privilege, and a charge of three cents is made for transfers at certain designated points.

Bus Lines

Bus lines have but recently been established in Philadelphia. Motor bus service is furnished by a few lines in the outlying districts with a total of ten route miles. In the last quarter of 1923 these lines carried a total of 626,000 revenue passengers. In October, 1923, a little more than five miles of trackless trolley lines were put into operation, with seven trackless trolley cars. In the last three months of 1923 these trackless trolley routes carried about 238,000 revenue passengers. Where bus lines intersect street car lines a charge of three cents is made for a transfer, but where these routes are extensions of street railway lines a free transfer is permitted. The cash fare on motor buses is ten cents and on the trackless trolleys it is seven cents. (Figures for the year 1924 are not yet available.)

Suburban Lines

The suburban districts in the metropolitan area are well served by the various steam and electric railroads. The service rendered is excellent, and these lines are a relatively important factor in handling traffic to and from Philadelphia. In the year 1923 they carried upwards of 35,000,000 revenue passengers.

BOSTON

Boston is one of the few large American cities whose municipal boundaries have not been extended so as to include all of the urban area within the city limits. As a consequence, municipal Boston extends over an area of only 43 square miles. In this limited area there was a population of 748,000 in the year 1920, or an average density of population of 27 per acre. Near Boston and lying practically within its urban area are such important cities as Cambridge, Somerville, Chelsea, Everett, Medford, Malden, Watertown and Brookline. The Federal Census of 1920 found the total population of the metropolitan district of Boston to be 1,772,000. This district comprising an area of 570 square miles was assumed to include all the territory lying within ten miles of the City Limits, giving a population density of five per acre. The same census also shows an average of 9.4 persons per dwelling in

the municipal area, indicating a greater congestion as regards housing than any other large American city with the exception of New York.

Boston has a street system which somewhat resembles that of European cities. The downtown streets are narrow as a rule, and very crooked, and this irregular street layout led to congestion in the downtown area long before the advent of the automobile. There are unusual topographical conditions which have influenced the development of Boston. The city proper is almost surrounded by water, the Boston Harbor lying directly to the east. East Boston, an island, lies to the northeast, and South Boston, which is separated from the mainland by the South Bay, lies to the southeast. Cambridge, Charlestown, Somerville, Everett and Chelsea lie to the west, northwest and north, and are cut off from the main portion of the city by various bodies of water.

Rapid Transit Lines

The Boston Elevated Railway Company constructed the first rapid transit line, an elevated railroad extending north and south through the city from Guild Street to Sullivan Square in Charlestown. This elevated line has since been extended southerly to Forest Hills and northerly across the Mystic River to Everett, and at present it is about ten miles in length.

In 1908 the Washington Street tunnel (1.23 miles in length) was built by the City of Boston. This tunnel is connected with the elevated structure near the North Station and extends through the central part of the city to another connection with the elevated line near Broadway. The main line elevated trains between Everett and Forest Hills are now operated through this tunnel. The Washington Street tunnel was leased to the Boston Elevated Railway at an annual rental of 4½% of the construction cost.

The East Boston tunnel which crosses under Boston Harbor was built by the City in 1904 and leased to the Boston Elevated Railway at an annual rental of 4½% of the construction cost. It originally extended from Maverick Square in East Boston to Scollay Square in the heart of the city, but in 1916 it was extended to Cambridge Street and now has a total length of two miles. This tunnel was designed for the exclusive use of street cars, and was so used until recently, when the Boston Elevated Railway remodeled it to provide for the operation of six-car rapid transit trains. With this change the capacity was increased from 121 cars to 640 cars in the maximum hour.

The construction of the Cambridge-Dorchester route was next undertaken jointly by the City and the Boston Elevated Railway. This rapid transit line extends from Andrew Square in South Boston to Harvard Square in Cambridge and consists of a tunnel under Fort Point Channel, an elevated over the Charles River,

a subway through the central business district and a subway in Cambridge from the Charles River to Harvard Square. The City financed and constructed all underground work in the City of Boston and the balance of the route was built by the Company. The portion of the line owned by the City was leased to the Boston Elevated Railway at an annual rental of 4½% of the construction cost. The length of this route is 5.75 miles.

The rapid transit system (see Plate 22) now comprises approximately 50 miles of single track and 25 miles of route, of which nine miles are subways or tunnels and sixteen miles elevated railroads.

During the year 1923 the rapid transit lines carried 80,000,000 revenue passengers, which was 21% of the total traffic carried by the rapid transit, surface and bus lines.

Street Railway Lines

Years ago the need for improved traffic conditions and better transport in the heart of Boston presented a serious problem. This need was met in part by the construction of the Tremont Street subway in 1897-98. This subway was constructed by the City of Boston under the supervision of the Boston Rapid Transit Commission, which commission had been created to design and supervise such construction several years prior to the commencement of the work. The Tremont Street subway was designed for the exclusive use of street car lines and, upon its completion, it was leased to the street railway company at an annual rental of 4½% of the construction cost.

The Boylston Street subway, which is an extension of the Tremont Street subway, was built by the City of Boston and leased to the Boston Elevated Railway at an annual rental of 4½% of the construction cost. This subway like the Tremont Street subway was designed for and is exclusively used by street cars. The combined length of the Tremont-Boylston subway route is 3.3 miles.

The Board of Public Trustees for the Boston Elevated Railway operates the street railways in Boston. The street car system comprises 484 miles of single track, 8.5 miles of which are in the Tremont and Boylston Street subways. The total number of cars operated is 1,680, and during the year 1923 there were 299,800,000 revenue passengers carried on the surface lines.

The rate of fare is ten cents with free transfers which permit a person to travel from any point on the system to practically any other point. A free transfer is also permitted between surface cars and rapid transit trains at nearly all elevated, subway and tunnel stations. A few years ago a five-cent fare with no transfer privilege was established on a number of short haul lines. The popularity of this service is evidenced by the fact that about one-fourth of the total revenue passenger traffic in the year 1923 was carried on the five-cent fare lines.

Bus Lines

The Boston Elevated Railway now operates nine bus routes with a total of 34 route miles. There are 59 buses operated, and in the year 1923 a total of 2,100,000 revenue passengers were carried. A five-cent fare is charged with no transfer privilege, but a fare of ten cents entitles the passenger to a free transfer to the rail lines.

Public Operation

Due largely to the rental the Boston Elevated Railway was required to pay the City for the use of transit structures the company (which in 1897 had entered into a 25-year agreement with the City to operate on a five-cent fare) suffered severe losses in the years preceding and during the World War. Its hopeless struggle to furnish service on a five-cent fare led to the suspension of dividends and finally to virtual abandonment of maintenance. In 1918 the situation had become desperate and in order to meet it the State Legislature passed a bill known as the Public Control Act, which became operative on July 1st of that year.

This Act was to be operative for a ten-year period and contains a provision for extensions. It provided for a Board of Public Trustees, five in number, to be appointed by the Governor, and empowered these Trustees to take over on a rental basis all of the properties of the Boston Elevated Railway and all of the subway structures owned by the City of Boston. The Trustees were further directed by the Act to put the properties in first-class condition and to fix a rate of fare that would make the service self-supporting. In order to rehabilitate the properties the Trustees issued new preferred stock in the amount of $2,000,000. The Commonwealth provided a reserve fund of $1,000,000 to meet any deficits from operation and by the provisions of the Act all deficits in excess of $1,000,000 were to be met by taxation in the cities and towns served; the amounts of such tax levies to be repaid from subsequent surplus earnings.

A seven-cent rate was established in August, 1918, superseded in October by an eight-cent fare which after a trial also proved inadequate. At the close of the year ending June 30, 1919, receipts had failed to meet expenses by approximately five million dollars, which amount was raised by taxation in the cities and towns served, and the ten-cent fare now in force was established in July, 1919. Losses under it continued for two months, but at a decreasing rate, and in September the ten-cent fare began to produce revenue sufficient to meet expenses and eventually to absorb the earlier deficits. On June 30, 1920, the Trustees were able to report that operating receipts for the year had met operating costs, all fixed charges and a reserve for depreciation. The properties are now on a sound financial basis, and recently a five-cent fare has been put into effect on some of the short haul surface lines. The average fare over the entire system (rapid transit and surface lines combined) was 8.81 cents for the year 1923.

The investment in transportation facilities in Boston as of January 1, 1924, is summarized as follows:

Investment of	*Rapid Transit Lines*	*Street Railway Lines*	*Total*
City of Boston (structures only)	$25,817,937	$10,780,706*	$ 36,598,643
Commonwealth of Massachusetts	7,868,000	.....	7,868,000
Boston Elevated Railway	63,000,000	41,534,357	104,534,357
Total Investment	$96,685,937	$52,315,063	$149,001,000

*Street car subways.

STATISTICS

For the purpose of comparison the following tables have been prepared:

TABLE 20

REVENUE PASSENGERS FOR THE YEAR 1923.

CITY	RAPID TRANSIT LINES		SURFACE LINES		BUS LINES		TOTAL
	Passengers In Millions	% of Total	Passengers In Millions	% of Total	Passengers In Millions	% of Total	Passengers In Millions
New York (a)	1,612	59.0	1,061	38.9	57	2.1	2,730
Chicago	204	19.4	825	78.5	22	2.1	1,051
Philadelphia (b)	87	11.9	645	88.0	1	0.1	733
Boston	80	21.0	300	78.5	2	0.5	382
Los Angeles	...	....	287 (c)	99.3	2	0.7	289

(a) For the fiscal year ending June 30, 1924.
(b) Pay transfer passengers are included in the Philadelphia figures.
(c) Includes Pacific Electric Railway Local Passengers.

TABLE 21

PASSENGER REVENUE FOR THE YEAR 1923.

CITY	RAPID TRANSIT LINES	SURFACE LINES	BUS LINES	TOTAL
New York (a)	$80,589,000	$53,926,000	$5,868,000	$140,383,000
Chicago	17,037,000	56,951,000	2,200,000	76,188,000
Philadelphia	5,379,000	38,870,000	76,000	44,325,000
Boston	7,903,000	25,260,000	135,000	33,298,000
Los Angeles	.....	15,369,000 (b)	89,000 (c)	15,458,000

(a) For the fiscal year ending June 30, 1924.
(b) Los Angeles Railway $12,465,000
Pacific Electric Local Lines (estimated) 2,904,000
(c) Los Angeles Railway 32,000
Los Angeles Motor Bus Company 57,000

TABLE 22

Rapid Transit Statistics

City	Approximate Investment In Rapid Transit*	Miles of Single Track			Number of Tracks	Maximum Train Length In Cars	Transfers with Surface Lines
		Elevated	Subway	Total			
New York	$640,000,000	370†	221	591	2, 3 & 4	10	None
Chicago	86,000,000	163	None	163	2, 3 & 4	8	None
Philadelphia	40,000,000	24	4	28	2	6	Limited
Boston	97,000,000	32	18	50	2	7	Unlimited

*These investments are taken from reports of the Transit Commission of New York, the Illinois Commerce Commission, the Department of City Transit of Philadelphia and Board of Public Trustees of the Boston Elevated Railway, and are published in this Report for the purpose of comparison only.

†Includes depressed tracks.

TABLE 23

Data on Street Car and Bus Lines

City	Street Car Lines				Bus Lines			
	Miles of Single Track	Unified Operation	Cash Fare	Free Transfer	Miles of Route	Number of Buses	Operation	Fares
New York	1,131	No	5c	Very Limited	25 (a)	300	Independent	10c
Chicago	1,070	Yes	7c	Yes	101	412	Independent	10c
Philadelphia	557	Yes	8c	Limited	15	18	By Railways	7–10c
Boston	484	Yes	10c (b)	Yes	34	59	By Railways	10c
Los Angeles	451 (c)	No	5, 6 & 10c	Yes, on each	53 (d)	120 (d)	By Railways	5–6–10c

(a) Fifth Avenue Motor Coach Company.

(b) A five cent fare is charged on a number of the lines, with no transfer privilege.

(c) Los Angeles Railway, 370; Pacific Electric Local Lines, 81.

(d) Not including 164 miles of route and 125 buses operated by the Pacific Electric Railway Company largely in the suburban cities.

CHAPTER V

A CO-ORDINATED TRANSPORTATION SYSTEM FOR LOS ANGELES

Los Angeles, having passed through various stages of development, has become a metropolitan center and now requires rapid transit facilities in its urban area not only to meet present needs but to prepare the city for the growth of future years. Moreover, rapid transit facilities for the extensive interurban system which now serves the metropolitan district must also be provided. If two independent rapid transit systems, one for urban rapid transit and another for interurban service, were to be constructed, where one would suffice, there would be economic waste and the burden upon the car riders using these systems would be practically doubled. In a like manner the burden becomes greater, either in the form of higher fares or poorer service, where there is duplication of street railway lines or bus lines.

The interests of the city as well as those of the entire metropolitan district can best be served if all the public transportation agencies within the urban area are co-ordinated, either by consolidation or by agreement, and then operated by a single management.

By the construction of a single rapid transit system and the consolidation of all services the following benefits would accrue to the public:

(a) The facilities of the rapid transit system would be utilized for urban rapid transit trains, carrying passengers between the center and the intermediate and outlying sections of the city in much less time than at present and in about half the time that street cars may be expected to do so in the future with street traffic congestion increasing at the present rate;

(b) The facilities of the same system would also be used by interurban trains which would reduce the time of travel between the edge of the built-up sections and the center of the city to the great benefit of people using the suburban and interurban services;

(c) The street railway and bus lines would be relieved of a large part of their long haul traffic and thus enable those living close in to secure better accommodations without the necessity of taxing the streets in the downtown district beyond their reasonable capacity in the future;

(d) The street railway and bus lines would be co-ordinated with the urban rapid transit lines as well as the interurban lines, thus making both of the high speed lines conveniently accessible to those who are required to travel long distances to and from their places of business or employment; and

(e) As the operating and overhead expenses would be appreciably less with the properties under one management, the savings would be reflected in better service.

ELEMENTS OF A TRANSIT SYSTEM

A co-ordinated public transportation system should be operated by a single management and comprise:

(a) Rapid transit lines providing high speed train service with limited stops;

(b) Interurban lines providing high speed train service between the various cities in the metropolitan district;

(c) Street railway lines providing local service and serving as feeders to the rapid transit lines; and

(d) Motor bus lines providing local service and serving as feeders to street car and rapid transit lines and also providing extensions of transportation service in sparsely settled districts and along boulevards.

Rapid Transit Lines

Rapid transit lines, whether they can or cannot be provided on a self-sustaining basis, are nevertheless essential and valuable, in the broader sense, to any large city because

(a) They provide the quickest and most convenient means yet developed for transporting large numbers of people;

(b) The time saved by their use is of inestimable value to the citizens and to business and industry generally;

(c) They make large outlying areas easily accessible and available for home sites, thereby maintaining proper housing and social conditions;

(d) They make streets safer for pedestrian and vehicular traffic; and

(e) They are the greatest single factor in the relief of traffic congestion.

A rapid transit system can more nearly approach a self-sustaining basis when

(a) The density of population in the territory contiguous to the rapid transit lines is high;

(b) The riding habit produces a volume of traffic sufficiently large during the entire day to warrant a frequent service;

(c) The lines of the system are well located and afford convenient means of travel between a large number of points;

(d) The rate of fare is low enough to encourage riding;

(e) There is no duplication of rapid transit facilities or unnecessary competition offered by other transportation agencies;

(f) The equipment, alignment of track and distance between stations are such that a high rate of speed can be maintained with safety; and

(g) The initial lines are well located and are extended as and when the traffic demands and operating conditions warrant.

Interurban Lines

The interurban lines operating into and out of the City of Los Angeles have provided a measure of urban service in addition to interurban service. Their principal function, however, is to provide a service between the central business district and the cities, towns and communities in the metropolitan area. As these centers grow and the area of the city expands, the interurban railroads will be used to a greater and greater degree for purely interurban service and they must have facilities which will make possible a high rate of speed through the built-up sections of cities. Duplication of facilities can be avoided if, in the development and construction of urban rapid transit lines, trackage for the operation of interurban trains is provided.

Nearly all of the interurban systems in the United States have been designed to carry both passenger and freight traffic. The interurban lines, in general, have been losing rather than gaining in recent years with respect to volume of passenger traffic. On the other hand, the freight traffic has increased in importance and, in many cases, it has become a prominent factor in producing revenue. While it is quite essential that both classes of service be maintained, the operation of freight trains should be carried on in such a way as to prevent any interference with the operation of passenger trains. Wherever possible separate tracks should be provided for the operation of freight trains and when this cannot be done freight trains should be moved either in the off-peak or the early morning hours.

Street Railway Lines

Street railway lines have been, are and will continue to be important factors in the growth and development of cities because they provide the least expensive means of public transportation and afford a convenient means of circulation throughout a city.

As a city expands and the population is distributed over a larger area the length of ride and the time of travel increases so that it becomes necessary to supplement the street railway lines with rapid transit lines, utilizing the street railway lines for a purely local service and to serve as feeders and branches of a comprehensive transportation system.

Bus Lines

Motor buses have become a factor in the transportation field in recent years. They have an advantage when compared with street railway lines in that the initial

investment in plant and equipment is smaller, chiefly because it is not necessary to provide a right-of-way or construct and maintain a roadway. On the other hand, they cannot, with safety, operate at an average rate of speed much in excess of street cars for the reason that their speed is limited, as is that of street cars, by other vehicles and pedestrian traffic.

RAPID TRANSIT, STREET RAILWAY AND BUS LINES CONTRASTED

Rapid transit lines are essential to any large city which is growing and expanding for the reason, among others, that high speed is necessary to offset the time required for the increasing length of ride between the residential areas and the commercial and industrial districts.

The operation of trains is essential if large numbers of people are to be provided with efficient urban transportation accommodations. Rapid transit railroads afford the facilities for such operation in large cities. Short trains of three or more cars can be operated on street railway lines; but the number of safety measures necessary for such operation, the interference with other traffic and the difficulty or impossibility of providing loading platforms make such operation impracticable, at a rate of speed commensurate with the needs of a city covering a large area. Motor buses in their present stage of development cannot be operated in trains, and even if development in the future, which cannot be foreseen, makes possible their operation in trains, such operation will be just as undesirable as is the case with street cars. It follows, therefore, that the rapid transit railroad stands alone in providing facilities for the operation of long trains at a safe and rapid rate of speed.

Rapid transit trains can be operated safely at more than twice the speed of street cars or urban motor buses, and their capacity for handling mass transportation is far greater. With modern rapid transit equipment each track of a rapid transit line affords a capacity for the operation of 400 cars per hour as against 180 street cars per track.

Each of the methods of transportation just discussed is an agency of vital importance to a large city even when operated as a separate system. Their real value to a city and their greatest efficiency is not attained, however, until through coordination they are made to function as one comprehensive system.

Costs of Operation

Although the cost of rapid transit service is greater than for street railway service, when interest on the large investment required for construction of rapid transit lines is included in the cost, still long haul rapid transit service can be furnished at a lower cost than that of the slower street car or motor bus service if the rider is relieved of the burden of paying interest on a part of the rapid transit investment.

In general a street railway company is granted the use of the public streets for its right-of-way and therefore it is only necessary to invest in tracks, equipment, and rolling stock.

Motor bus lines are granted the use of the public streets and the only investment necessary is that for rolling stock.

A comparison of the operating costs of rapid transit and street railway lines clearly shows the advantage of rapid transit operation. Operating costs of the rapid transit lines in both New York and Chicago covering a long period of years are available. A comparison of these costs with those of the street railway lines in those cities shows that the operating expenses per car mile on the rapid transit lines are from 25 to 35 per cent lower than those on the street railway lines. This is due to the greater speed of rapid transit trains and to the labor-saving made possible by the operation of trains instead of the single or two-car units, to which the street railways are limited. The following tabulation (taken from Volume 64, No. 1, of the Electric Railway Journal) gives some very interesting comparative statistics of the operation of street railway and rapid transit lines. Of the six companies classed as rapid transit, only three operate rapid transit lines exclusively, and therefore the statistics include the results of both rapid transit and surface line operation for the other three companies. The average operating ratio for the year 1923 of the three systems operating rapid transit lines exclusively was 68%, compared with 72.4% for all six properties and 82.9% for the six street railway systems. This affords a fair indication of the relative operating ratios of street railway lines and rapid transit lines.

Car Mile and Car Hour Statistics on Twelve Large Electric Railways

(Six Surface Roads and *Six Rapid Transit Roads*)

	1919	1920	1921	1922	1923
Transportation Revenue					
Per Car Mile in Cents					
Surface	38.9	44.7	47.8	47.8	48.3
Rapid Transit	*33.1*	*38.0*	*38.0*	*40.8*	*39.4*
Expenses and Taxes					
Per Car Mile in Cents					
Surface	32.5	37.6	43.2	43.2	43.4
Rapid Transit	*25.9*	*30.6*	*33.4*	*31.1*	*32.3*
Operating Ratio in Per Cent					
Surface	83.06	87.45	85.08	83.34	82.87
Rapid Transit	*74.00*	*77.26*	*77.92*	*71.63*	*72.40*

STREET CAR SUBWAYS

The only justification for the construction of subways for the sole use of street cars is the necessity of improving street traffic conditions by the removal of street car operation from the streets in a congested area. The great cost, when compared to the utility of such subways, limits their location to the most congested areas of large cities. It follows that the subway route mileage would constitute only a small proportion of the route mileage of the street car lines operated through them, and, as the cars would be subject to all the delays incident to street car operation for the major portion of their routes, these delays would be reflected in irregularities of the service in the subways.

Again, it would be impracticable to construct subway stations at every street intersection and the small amount of time which the rider would save by the use of the comparatively short subways would be more than offset by the inconvenience of walking to stations two or more blocks apart. Furthermore, it would be necessary to operate a large number of individual street car lines through a subway in order to utilize its capacity and this would necessitate a routing plan which would cause congestion at and in the vicinity of the subway portals. These lines in all probability would be operated to serve different sections of the city and, because of the multiplicity of cars with various destinations, car loading would be difficult.

Notable examples of such street car subway terminals are found in Boston at the Park Street station of the Tremont Street subway and in Philadelphia at the City Hall Loop station. At both of these locations elaborate control and dispatch systems have been devised in order to secure the greatest possible convenience for the car riders and the most modern mechanical devices have been installed to inform the public of the stopping places of the cars on the various lines. Notwithstanding this painstaking care on the part of the operating officials, the congestion and confusion inherent in the loading of cars at these stations cannot be entirely eliminated.

With modern equipment the time per car for a station stop in a heavy loading district decreases rapidly as the length of train increases. A single car would require approximately ten seconds, whereas a ten-car train would require only thirty seconds or less than one-third the amount of time per car.

It has often been suggested that the capacity of a street car subway could be fully utilized by coupling the single cars into trains at the subway portals. The loss of time in coupling added to the delay in waiting for the succeeding car or cars would more than offset any possible saving in running time that might be gained by operation underground. In practice such an attempt would require the establishment of classification yards at subway portals with switchmen to carry on this work. The delays incident to such operation would cause just complaint on the part of car riders and would largely discount any benefits that might be derived from the operation of street cars in subways.

Street car subways may be resorted to when other means of relieving street congestion have failed and the question of the cost of constructing them for such relief becomes a secondary consideration. In this event such subways would form an addition to that portion of the street devoted to traffic purposes; in short, they would be a form of street expansion in a vertical direction instead of by the usual lateral method. When street widening is impossible or impracticable because of the expense involved, then the construction of street car subways may be warranted. The cost of this method of street widening, however, is a burden that should be carried only in a small part by the car riders as such, who ought to contribute to such cost only in proportion to the benefit derived by them.

We fully recognize the necessity of relieving the downtown streets, in so far as possible, of the obstruction caused by street car operation, so that the activity and growth of the business of Los Angeles may be neither restricted nor retarded; and as the plan herein recommended is developed a material improvement in traffic conditions can be economically secured.

Fares

Rates of fare have an important bearing not only on the development of physical, legal and financial plans for a modern transportation system, but also on the social development of cities.

There are two points of view from which rates of fare must be considered: The viewpoint of the seller of transportation on the one hand, and the purchaser of the service on the other. The seller is interested in obtaining revenue sufficient in amount to pay operating expenses and fixed charges as well as a return on his investment. In order to encourage sufficient riding to produce this revenue the rate of fare must be reasonable and the method of collection simple and convenient.

The seller of transportation naturally wants the rate of fare to be proportional to the length of ride and the character of service rendered. This has resulted in the development of the mileage rate which is in general use on the interurban and steam railroad lines in the United States and a zone fare system like that in effect in many of the older European cities and a few American cities.

The buyer of transportation, on the other hand, is interested in securing good service, and also in getting as long a ride as possible for a minimum expenditure. This desire has resulted in the demand for and the securing of flat fares on most of the street railway systems in America. These systems have generally complied with the public demand for extensions of the flat fare zone so that the typical street railway collects but a single fare for travel within the municipal area and usually permits free transfers.

It is interesting to contrast the effect of the zone and flat fare systems in the social development of cities. The zone fare has a tendency to limit the expansion

of urban development. People naturally reside in a locality where transportation to and from their places of employment can be procured at a minimum cost. An additional fare charged for riding beyond a given zone retards the development of the outlying areas. Evidence of this is clear in the development of the large European cities where the use of the zone fare system is common. There in almost every instance one finds greatly congested districts near the center of the metropolitan area and frequently residences are grouped in the vicinity of the larger industries with the outlying areas sparsely settled. While this situation is not entirely attributable to zone fares or the transportation system, there can be no question but that the zone fare system has been a large factor in creating it.

In the American cities where the flat fare system is in almost universal use on the urban transportation lines, we have decentralization—sub-centers throughout the municipal area—and, when compared with European conditions, a low density of population and better housing conditions. Take New York for example: Except for Manhattan Island, where intensive development was caused largely by topographical barriers, the major portion of the metropolitan area has a fairly uniform distribution of its population. The population of Manhattan Island actually decreased during the last decade while that in the other boroughs showed a substantial increase. The principal factor in this decentralization was the operation of rapid transit lines which overcame distance with speed and enabled many workers to live in uncongested districts and work in the heart of the city.

The development of Chicago also is interesting. The population is in general well distributed over its area of 205 square miles, with the outlying sections well developed and but few sections having an excessively high density of population. This widespread development can be attributed largely to the fact that local transportation has been provided on a flat fare for many years. When there were a number of independent street railway companies a single fare on the lines of each was charged. Through consolidations and mergers the single fare areas were increased until by the year 1907 the flat fare had been extended to cover almost the entire city. In 1914 the four remaining street railway companies joined, under an operating agreement, to provide transportation between any two points within the municipal area for a single fare. In 1912 the four rapid transit companies entered into a similar agreement and since that time transportation between any two points on the rapid transit lines in the municipal area has been provided for a single fare, and in some instances the flat fare zone extends beyond the city limits.

The best interests of a city are served as a rule by the establishment of a flat fare within the urban area. As the urban area extends the average length of ride is correspondingly increased and this results in an increase in operating expenses. When this additional expense reaches a certain point the operators of the railway system must either operate at a loss or increase the rate of fare. When the fare must be raised owing to the increased length of ride an injustice is done the short rider. Consequently for large areas some compromise must be effected between the flat fare and the zone fare systems.

In most cities an arbitrary limit to the extension of the flat fare zone is reached at the corporation boundaries. This limitation is undesirable unless the corporation boundaries conform with the boundaries of the urban area. If a city has not extended its limits to include all of the urban area a hardship is worked on those living immediately beyond the city limits who are required to pay an extra fare. This places an artificial barrier to the territorial growth of the urban area, causes undesirable living conditions in the city and therefore should be avoided. On the other hand, in cities where the municipal boundaries are far beyond the limits of the urban zone, an unfair burden is placed on some of the patrons if the company is required to give service throughout the entire municipal area for a single fare.

The ideal for which large cities should strive is a unified transportation system consisting of rapid transit and surface lines designed to serve the entire urban area and to provide satisfactory service for a single fare.

The advisability of providing rapid transit railroads after a city has attained the characteristics of a metropolis has already been discussed. If such railroads are to fulfill their proper function, which is to afford quick, convenient and comfortable transport and at the same time remove the necessity for the transportation of large masses on the street surface, their facilities must be made easily accessible to the entire riding public. To make them directly available to all of the residents, rapid transit railroads would have to be constructed at intervals of about one mile throughout the urban area so that they could be reached by walking an average distance of less than one-half mile. Obviously this would entail such expenditure as to make it utterly impracticable. The only alternative is to provide rapid transit trunk lines and supplement them with a system of surface lines, permitting a transfer from the street cars or buses to rapid transit lines and vice versa, thereby making the rapid transit facilities directly or indirectly available to all.

Every large city is the center of a metropolitan district which includes growing suburban cities. These suburban cities are individual in their development, having their own business centers and industrial areas. Their growth is directly affected by the development of the parent city and for this reason it is important that a means of convenient communication be maintained between them and the parent city. It is also important that convenient transportation be maintained between the suburban centers themselves and that each suburb has an adequate local transportation system. On the local transportation system of each suburb a flat fare should be maintained as such a fare arrangement is fully as important in the development of a suburban center as it is in the development of the metropolitan center.

In such a metropolitan district, each city would have a flat fare on its local transportation lines. The fare zones thus created in the district would vary in size and, in general, would be circular in shape. Interurban railroads would articulate the entire metropolitan area, connecting the centers of the various cities, and on these interurban lines the rate of fare would be based upon the distance traveled.

In Los Angeles the corporate boundaries (for reasons discussed in Chapter I) have been extended in some directions far beyond the present limits of urban development. The present city limits extend to San Pedro on the south, Chatsworth on the northwest and Hyperion on the west, and include some 410 square miles within the municipal area. On the other hand such important districts as Vernon, Huntington Park and Belvedere, which are well developed, lie but three and four miles from the heart of Los Angeles, but are outside of the city limits. For these reasons the creation of a flat fare zone covering the entire municipal area would be entirely impracticable and the existing city limits should be disregarded in the establishment of a flat fare zone for any unified transportation system designed to serve the urban area of Los Angeles.

Population studies (see Plate 6) indicate that at present practically all of the area which is continuously built up from the central business district outward, and which may be termed the urban area, can be included within a circle having a radius of six miles. As the success or failure of a flat fare rate is largely dependent upon the development or lack of development in the territory served it appears that this area is all that can be considered for inclusion in a flat fare zone at the present time.

In each of the suburban cities in the metropolitan area a flat fare zone should be established. This flat fare zone should be extended as far from the business center in each case as it is practical within economic limits to extend it. The rate of fare on the interurban lines should be based upon the distance traveled, as at present.

CHAPTER VI

THE PHYSICAL PLAN

The preparation and adoption of a physical plan for a co-ordinated transportation system adequate to meet the present needs of Los Angeles without giving full consideration to the City's future transportation requirements would not only be a grave error, but would ultimately prove very costly. Piecemeal planning of rapid transit facilities is very apt to lead to expensive relocation or abandonment of the initial works. Underground structures in the downtown delivery district must be carefully planned and located so as to insure against their becoming barriers to the logical future development of transit facilities in this area. After a thorough study and analysis of available data, and careful consideration of the underlying principles of construction and operation of transportation systems, a comprehensive physical plan for a unified transportation system for Los Angeles, adequate to meet the needs of the City when its population has reached 3,000,000, has been prepared.

The present day needs are pressing and therefore certain portions of the complete plan have been selected and recommended for immediate construction. These portions are described hereinafter under the caption FOR IMMEDIATE CONSTRUCTION and their initial construction will insure the uniform development of the entire plan. The future development of the plan contemplates the construction of extensions to and branches from the initial rapid transit lines, the separation of grade crossings on the various interurban lines, the enlargement of the surface line feeder system and the construction of additional rapid transit structures in the downtown delivery district. Such recommendations are co-ordinated and grouped under the caption FOR FUTURE CONSTRUCTION.

The new transportation facilities outlined together with the existing facilities will provide a comprehensive co-ordinated transportation system for Metropolitan Los Angeles. Plates 1, 2 and 3 show the comprehensive plan on maps of the Metropolitan District, the Urban Area and the Central District, respectively.

Because of the widespread distribution of the population in Los Angeles and the need for rapid transit service throughout the city, extreme care had to be taken to guard against planning a system of rapid transit lines that would be a burden to the city and its citizens because of too great an investment in costly structures. It is impracticable to finance lines sufficient in number to make rapid transit service directly available to all, but it is possible to finance successfully a sufficient number of rapid transit lines, to make the service directly or indirectly accessible to all, when properly co-ordinated with the street railway and bus lines. The location of the lines, and the structural design of the proposed rapid transit system, is based upon this premise, as well as upon the assumption that the interurban trains will operate, in the urban area, over structures provided for the urban rapid transit trains.

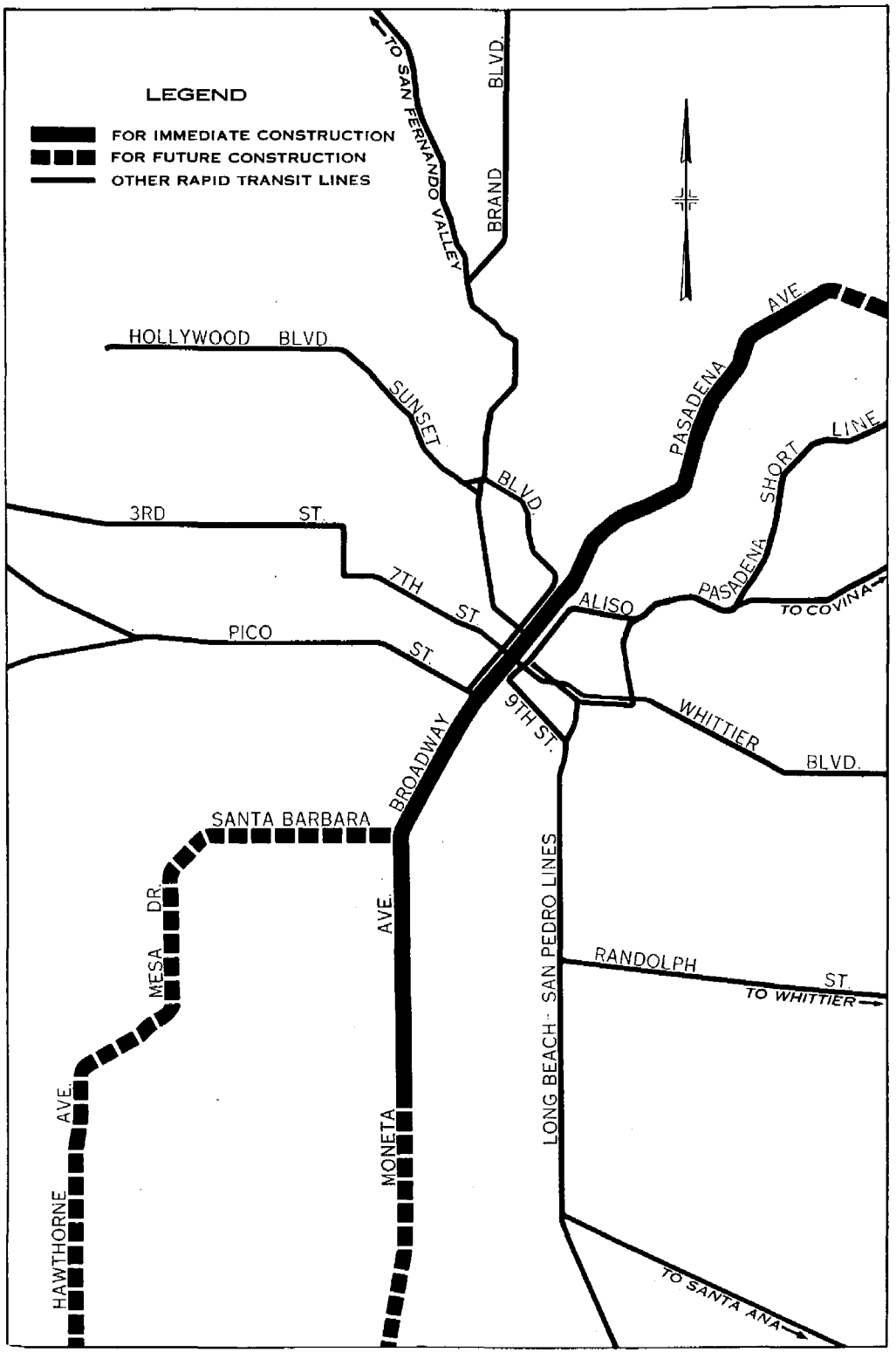

FIGURE 30. *The proposed Moneta-Broadway-Pasadena Avenue Rapid Transit Lines.*

The rapid transit lines and the additional street railway and bus lines have been located with a view to serving impartially all sections of the city and its metropolitan district. The lines proposed for immediate construction are located so that they will form main trunk lines to which may be added in the future branches and extensions serving the entire territory of Greater Los Angeles.

I.

FOR IMMEDIATE CONSTRUCTION

Plate 4 shows the rapid transit lines (subway and elevated) and surface lines recommended for immediate construction, together with the existing lines. Plate 5 shows in greater detail those portions of the proposed subway and elevated lines which lie in the central part of the city.

A. RAPID TRANSIT LINES

1. Moneta-Broadway-Pasadena Avenue Line

The relation of this line to the other lines of the unified transportation system is shown on Figure 30. (Wherever the phrase "concrete steel elevated" is used in the following descriptions, it is intended to mean a steel elevated structure encased in concrete.)

(a) Broadway-Moneta Avenue Elevated

A three-track concrete steel elevated railroad (only two tracks to be laid immediately) on Broadway (as extended) and Moneta Avenue from a connection with the Broadway subway at a portal just south of Washington Street to the south line of Manchester Avenue. The estimated cost including the incline is ..... $ 9,396,000

(b) Broadway-Pasadena Avenue Elevated

A three-track concrete steel elevated railroad (only two tracks to be laid immediately) on Broadway and Pasadena Avenue from a connection with the Broadway subway at a portal near the south line of Sunset Boulevard to a connection with the existing tracks of the Pacific Electric Railway at grade on private right-of-way just east of Avenue 64. The estimated cost including a new bridge over the Los Angeles River and including the incline is..... $10,003,000

(c) Broadway Subway

A two-track subway in Broadway and in private right-of-way from a portal near the south line of Washington Street to a portal near the south line of Sunset Boulevard, including a single track terminal loop subway in Second, Spring, First and Hill Streets, and also a single track terminal loop subway in 14th Place, Main, 14th and Hill Streets (the portions in First Street and in 14th Street to be low level subways so as to avoid grade crossings). The estimated cost not including the private right-of-way is.....$13,644,000

This construction will provide a through north and south rapid transit line extending from Manchester Avenue on the south through the center of the city to Avenue 64 on the north, a distance of 13 miles. The southern end of the line will consist of a concrete steel elevated structure extending along Moneta Avenue and Broadway (as opened and extended) from Manchester Avenue to a portal to be located just south of Washington Street. From this portal it will extend through the terminal district in a high level subway under Broadway to First Street. The tracks will be placed in a tunnel from First Street to Sunset Boulevard. This tunnel will be under the street from First Street to California Street, where it will be deflected to the east so as to avoid any disturbance to the existing Broadway tunnel. The north portal of the Broadway subway will be located just east of the north portal of the existing Broadway tunnel near the southerly line of Sunset Boulevard, at which point the rail grade will be approximately twelve feet above pavement grade. The northern end of the line will consist of a concrete steel elevated railroad extending along North Broadway and Pasadena Avenue from a connection with the north portal of the Broadway subway to a connection with the existing South Pasadena line of the Pacific Electric Railway just east of Avenue 64, at which point the rails will be at the present grade.

This rapid transit railroad will provide a through north and south service, connecting the rapidly developing territory contiguous to Moneta Avenue with the equally important territory along the Arroyo Seco, and bringing both of these sections of the city close in point of time to the downtown district. When co-ordinated with the proposed and existing street railway and bus lines this route will serve large areas which will become greater in their extent as the distance between the center of the city and the outlying sections increases. On the north end the existing surface lines on York Boulevard, Eagle Rock Avenue and Avenue 64, and on the south the proposed Vernon Avenue, 54th Street, Florence Avenue and Manchester Avenue crosstown lines, will act as feeders to this rapid transit route, making its facilities available to many residents in both the northern and the southern sections of the city. Upon the completion of the Pasadena Avenue elevated the existing service on the South Pasadena route of the Pacific Electric Railway should be discontinued, as the service requirements can be met by the north end of the "W" line

of the Los Angeles Railway, which parallels Pasadena Avenue throughout most of its length, and this discontinuance of service is recommended.

In and adjacent to the central business district the Moneta-Broadway-Pasadena Avenue rapid transit line will be operated through a subway about 2 1/3 miles in length. This provides for a broad terminal district, which, with an adequate number of stations, will insure the delivery of passengers to points near their destinations and prevent undue concentration of loading and unloading. There is no question but that the service which can be provided in a subway extending north and south throughout the downtown area will attract many short riders, and such a convenient means of traversing the business district should remove some of the congestion now caused by pedestrian traffic on both the roadway and sidewalks. It should also be noted that this rapid transit line is only 800 feet from the Plaza. In the event, therefore, that any one of the proposed sites near the Plaza is selected for a Union Station it will be conveniently served by rapid transit facilities.

Further, in the operation of this rapid transit line through service can be supplied in so far as the traffic demands warrant, by trains operating from Fair Oaks Avenue and Mission Street in South Pasadena on the north to Manchester Avenue on the south. In order to provide for tripper service during the rush hours and for the turning back of trains in the event that the respective traffic demands do not warrant the through routing of all trains, two loops are included in the Broadway subway. One of these will be located near the north end of the business district on Second, Spring, First and Hill Streets. The First Street section of this loop will be a low level subway so that trains using the loop can pass under the trains operating in the Broadway subway. The other loop will be located south of the downtown district, on 14th Place, Main, 14th and Hill Streets, with a low level subway in 14th Street to provide for separation of subway grades.

2. *Hollywood-Vineyard Line*

The relation of this line to the other lines of the unified transportation system is shown on Figure 31, page 104.

(a) Pico Street Elevated

A three-track concrete steel elevated railroad on private right-of-way and on Pico Street from a connection with the Venice branch of the Pacific Electric Railway near Mineral Avenue to a portal just west of Union Avenue; also a two-track concrete steel elevated railroad on Pico Street and on private right-of-way from a connection with the Pico Elevated at Mullen Avenue to a connection with the Sawtelle branch of the Pacific Electric Railway near La Brea Avenue. The estimated cost including the inclines but not including the private rights-of-way is.....$ 8,288,000

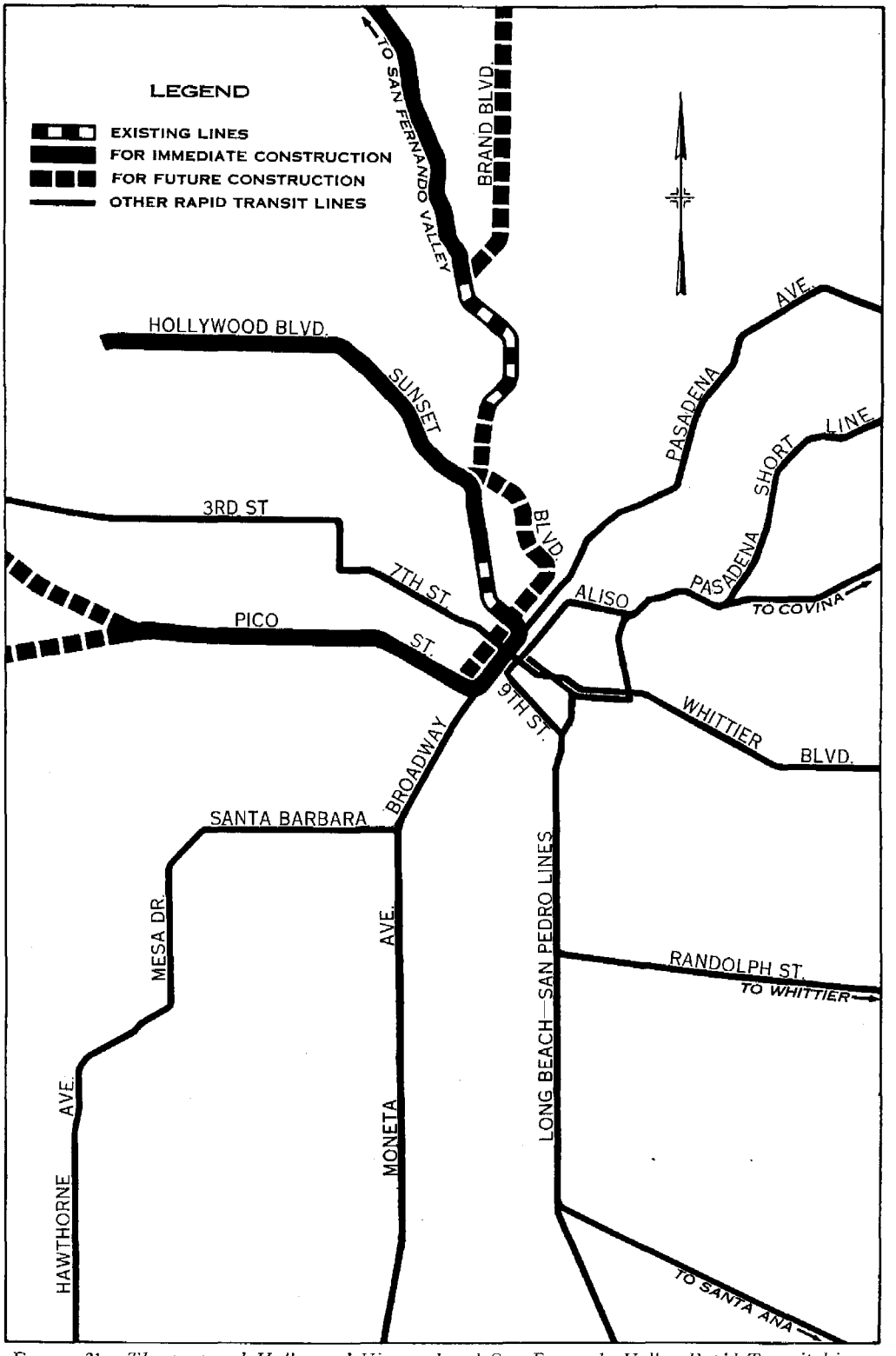

FIGURE 31. *The proposed Hollywood-Vineyard and San Fernando Valley Rapid Transit Lines.*

(b) Pico Street Subway

A two-track subway in Pico Street from a connection with the Pico Elevated at a portal near Union Avenue to a connection with the Broadway subway. The estimated cost is.....$ 4,745,000

(c) Broadway Subway

To be used also by the Moneta-Broadway-Pasadena Avenue lines. See page 102 for description and estimate.

(d) Hollywood Tunnel

It is planned to extend the Hollywood tunnel easterly to a connection with the Broadway subway and westerly to a connection with an elevated on Glendale Boulevard, and utilize it as a part of the Hollywood-Vineyard line. The easterly extension will be a two-track subway in private right-of-way from a connection with the Hollywood tunnel at Hill Street to a connection with the Broadway subway. The westerly extension will be a two-track railroad (open cut and subway) on private right-of-way and on Glendale Boulevard from the portal of the Hollywood tunnel of the Pacific Electric Railway to a portal just northerly of West First Street. The estimated cost not including the private rights-of-way is .....$ 1,025,000

(e) Glendale Boulevard Elevated

A two-track ballasted deck steel elevated railroad on Glendale Boulevard from the portal of the Hollywood tunnel as extended to a connection with the existing tracks of the Pacific Electric Railway on Glendale Boulevard near Sunset Boulevard. The estimated cost including the inclines is.....$ 1,530,000

(f) Sunset Boulevard Elevated

A two-track single column ballasted deck steel elevated railroad along Montrose Street, private right-of-way, Sunset Boulevard and Hollywood Boulevard from a connection with the Glendale Boulevard Elevated at Montrose Street to a subway portal on Hollywood Boulevard east of Vermont Avenue. The estimated cost including the incline but not including the private right-of-way is.....$ 3,646,000

(g) Hollywood Boulevard Subway

A two-track subway in Hollywood Boulevard, Marshfield Way and private right-of-way from a connection with the Sunset

Boulevard Elevated at a portal east of Vermont Avenue to a connection with the existing tracks of the Pacific Electric Railway at grade on private right-of-way west of La Brea Avenue. The estimated cost including the incline on the west is..$12,125,000

The foregoing facilities when combined will form a U-shaped rapid transit line following in general the route of the present Vineyard-Hollywood line of the Pacific Electric Railway, and extending from Vineyard Junction to a point just south of Hollywood Boulevard near La Brea Avenue. The main line will comprise the following units: the Pico Street Elevated, the Pico Street subway, the Broadway subway, the Hollywood tunnel and its extensions east and west, the Glendale Boulevard Elevated, the Sunset Boulevard Elevated and the Hollywood Boulevard subway. A substantial portion, therefore, of the expensive subway construction necessary for the operation of the Moneta-Broadway-Pasadena Avenue line will be utilized for the operation of the Hollywood-Vineyard rapid transit route during the early years of its operation and in addition the Hollywood tunnel already constructed will be utilized.

The Hollywood-Vineyard rapid transit line will provide through service from Vineyard to Hollywood with adequate terminal facilities in the downtown district as far as the present traffic requirements and those of the immediate future are concerned. When co-ordinated with the existing and proposed street railway and bus line feeders it will provide facilities to care for the immediate and future needs of the northwest and southwest sections of the city. Rapid transit trains can be operated through the downtown district to Sherman and to Vineyard Junction.

In addition to providing facilities for the operation of rapid transit trains serving the urban area this line will be invaluable in affording facilities for the operation of high speed interurban trains. The interurban trains serving the various cities on the west beaches and intermediate points can be operated over the existing Pacific Electric lines and thence over the southwest and central sections of the Hollywood-Vineyard rapid transit line to the terminal now under construction at Hill Street between Fourth and Fifth Streets. The terminal loops of the Broadway subway will be available for turning back some of the urban rapid transit trains during the rush hours in case of unbalanced service demands; the Vineyard turnback trains being routed through to the loop at First Street, and the Hollywood turnback trains being routed to Fourteenth Street.

3. San Fernando Valley Line

The relation of this line to the other lines of the unified transportation system is shown on Figure 31, page 104.

A two-track railroad on private right-of-way extending northwesterly parallel to the Southern Pacific Railroad from a con-

nection with the tracks of the existing Glendale route of the Pacific Electric Railway just west of the Los Angeles River to the Burbank-Chatsworth branch of the Southern Pacific Railroad, thence westerly along that branch to a connection with the existing tracks of the Pacific Electric Railway at Lankershim; to be on a ballasted deck steel elevated structure from Glendale Boulevard to Los Feliz Boulevard and elsewhere at grade with solid fill elevated construction at streets so as to eliminate all grade crossings. The estimated cost not including private right-of-way is.....$ 4,678,000

A new high speed service between San Fernando Valley points and the downtown district of Los Angeles will be provided by the proposed new valley route. This line is located to minimize the number of highway crossings and a fast schedule can be maintained at the outset. A connection will be made with the tracks of the Glendale route of the Pacific Electric Railway just west of the Los Angeles River. The new line will extend northeasterly, on an ascending grade, over a new bridge to be located between the existing Pacific Electric Railway bridge and the Glendale Boulevard bridge, from the junction with the Glendale route to a connection with a two-track ballasted deck steel elevated railroad. This elevated will extend along private right-of-way northwesterly from Glendale Boulevard to a point just north of Los Feliz Boulevard. The topographical conditions, from this point north to Sonora Avenue, will permit the construction of a railroad at grade along a line just skirting the edge of Griffith Park and generally parallel to the River. From Sonora Avenue the line will extend along private right-of-way westerly of and parallel to Lake Street in Burbank to the Burbank-Chatsworth branch of the Southern Pacific Railroad and thence westerly to a connection with the Pacific Electric Railway near Vineland Avenue in Lankershim. That part of the railroad north of Griffith Park is to be built with elevated tracks at highway crossings.

Trains will be operated over this new route, the private right-of-way of the Glendale branch of the Pacific Electric Railway, Glendale Boulevard, the Glendale Boulevard Elevated and the Hollywood subway to the downtown area.

4. Third-Seventh-Whittier Boulevard Line

The relation of this line to the other lines of the unified transportation system is shown on Figure 32, page 108.

(a) Third Street Subway

A two-track subway (so located in the street as to provide space for an additional track in the future) in Third Street and Vermont Avenue from Larchmont Boulevard to Seventh Street. The estimated cost is.....$ 9,349,000

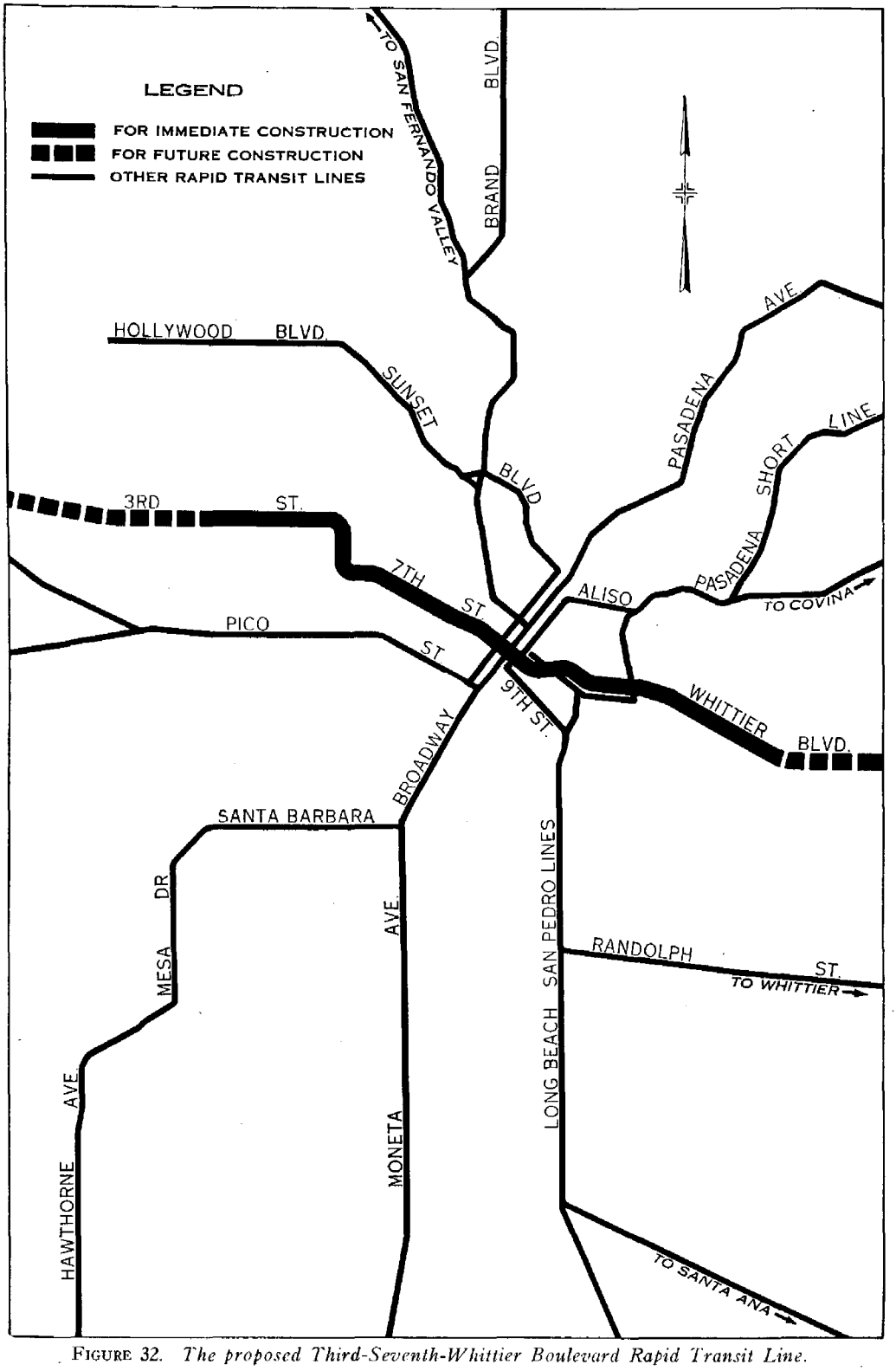

FIGURE 32. *The proposed Third-Seventh-Whittier Boulevard Rapid Transit Line.*

(b) Seventh Street Subway

A two-track subway (so located in the street, west of Burlington Avenue, as to provide space for an additional track in the future) in Seventh Street from Vermont Avenue to San Pedro Street, thence along private right-of-way to a portal near Stanford Avenue. (To be constructed to cross under the other subways proposed.) The estimated cost not including the private right-of-way is $15,061,000

(c) Whittier Boulevard Elevated

A two-track ballasted deck steel elevated railroad along private right-of-way just north of the Pacific Electric Railway terminal line from a portal near Stanford Avenue to Boyle Avenue and Whittier Boulevard and a three-track ballasted deck steel elevated railroad (only two tracks to be laid immediately) on Whittier Boulevard from Boyle Avenue to Indiana Street. The estimated cost including the incline and the bridge but not including the private right-of-way is ..... $ 4,541,000

This is a through east and west rapid transit route, extending from Larchmont Boulevard on the west to Indiana Street on the east, and passing through the approximate center of the intensively developed portion of the city. It forms the complement of the north and south Moneta-Broadway-Pasadena Avenue line, thus providing the city with four principal arteries of travel meeting at a common point in the heart of the business district.

The topographical conditions in the territory to the east of the central business district and the congestion caused by the large volume of automobile and motor truck traffic are such that public transportation at a reasonable rate of speed is almost impossible. Recently there has been a large increase in activity on the east side and rapid transit will encourage a much greater development.

The Third-Seventh-Whittier rapid transit route approximately bisects the highly developed Wilshire district which lies between the Hollywood and Pico Street districts. It also extends through Boyle Heights and the populous east side areas, and while it does not bisect the present center of population east of the Los Angeles River, it has been located in what will be the center of the future residential district of the east side. Future expansions of this route will provide for suburban service extending west to Santa Monica and also east to Montebello.

Some of the immediate and future benefits which will be afforded by the through service on this route are as follows: People living either on the west or the east side of the city will be provided with rapid transportation either downtown or to the other side of town; residents of the Wilshire district desiring to travel to the industrial centers along the River may do so directly and expeditiously, and this

travel will not be on the street surface, adding to congestion; and the residents of the Belvedere district, which is one of the more densely populated districts, will be supplied with rapid transit service to the downtown district and to the park areas on the west. An east and west rapid transit route, in the location recommended, complementing the north and south rapid transit route will be conducive to the natural and logical expansion of the central business district. Property values will be stabilized as they have been in other cities and the business center can spread along these main axes thus preventing an abnormal fluctuation in these values.

The proposed Third-Seventh-Whittier rapid transit line will be approximately eight and one-half miles in length, and in its operation it is proposed to through route the trains. The various street railway and bus lines intersected by this rapid transit line will serve as feeder lines and in addition to this transfers can be made direct to the rapid transit trains operated in the Broadway subway. Such transfers made underground will lessen street and sidewalk congestion. As the route is located just one block south of the Arcade Station of the Southern Pacific Railroad, a convenient rapid transit service will be placed at the disposal of the patrons of that station.

B. SURFACE LINES

Plate 4 shows the existing system of surface lines as well as the street railway and bus routes recommended FOR IMMEDIATE CONSTRUCTION.

The existing system of surface lines is made up largely of street car and bus routes radiating from the business center of Los Angeles to the various residential and industrial districts in the urban area. These lines extend in general to a distance of 4½ or 5 miles from the downtown district. There is but little crosstown service at present and, generally speaking, people wishing to go from one part of the city to another on the street cars are required to travel through the congested downtown streets. Lack of track capacity in the downtown district places a limitation on the amount of service which the street railway system can supply and future increase in traffic demands must be met in part by rapid transit lines. The additional surface routes recommended will provide much needed crosstown service, and at the same time serve largely as feeders to the rapid transit lines.

1. Street Railway Lines.

(a) Vermont Avenue

A two-track narrow gauge street car line on Vermont Avenue from a connection with the existing tracks at Monroe Street to Los Feliz Boulevard. The estimated cost is.....$ 314,000

This extension will permit the operation of a north and south crosstown line reaching from the extreme southern to the northern section of the city and intersecting three of the proposed rapid transit routes.

(b) Vine Street

A two-track narrow gauge street car line on Melrose Avenue from a connection with the existing tracks on Larchmont Boulevard to Vine Street and on Vine Street from Melrose Avenue to Hollywood Boulevard. The estimated cost is.....$ 256,000

This construction, with the existing tracks on Larchmont Boulevard, will provide facilities for the operation of a street car line, intersecting the rapid transit routes on Third Street and on Hollywood Boulevard and giving north and south local service.

(c) East Side Crosstown Line

A two-track narrow gauge street car line on private right-of-way and Marengo Street from the intersection of Daly Street and Mission Road to Soto Street; in Soto Street from Marengo Street to Wabash Avenue and in Wabash Avenue from Soto street to Evergreen Avenue; also in Euclid Avenue and along private right-of-way from Whittier Boulevard to Ninth Street; in Ninth Street from Euclid Avenue (extended) to Downey Road and in Downey Road from Ninth Street to 55th Street; also the reconstruction of the Daly Street line from Pasadena Avenue to Mission Road. The estimated cost not including private right-of-way is.....$ 997,000

The utilization of that part of the Griffin Avenue route lying easterly of Pasadena Avenue, the existing tracks on Evergreen Avenue, Fourth Street and Euclid Avenue, together with the new construction just described, will provide a crosstown street railway route on the east side of the city which will not only feed the Whittier Boulevard rapid transit line, but afford a means for traveling between the southeast and northeast sections of the city without the necessity, which now exists, of passing through the congested central district. This crosstown line will also make it possible to provide service from the northeast, east and southeast sections direct to the Stock Yards and Central Manufacturing District.

(d) Ninth Street

A two-track narrow gauge street car line on Ninth Street from Hooper Avenue to Euclid Avenue (extended), and an additional rail on the existing Pacific Electric Railway tracks on Ninth Street from Main Street to Hooper Avenue. The estimated cost is.....$ 352,000

This line will provide a short route between the Central Business District and the Stock Yards and Central Manufacturing District. It will also afford facilities for a through line operating between the west and east sides when the traffic demands warrant such operation.

(e) Vernon Avenue

A two-track narrow gauge street car line on Vernon Avenue from Angeles Mesa Drive to Arlington Avenue, and from Dalton Avenue to Vermont Avenue, also on Vernon Avenue and private right-of-way from Pacific Boulevard to Downey Road. The estimated cost not including the private right-of-way is..$ 500,000

A crosstown service is now maintained on Vernon Avenue between Vermont Avenue and Pacific Boulevard, and there are tracks on this street between Arlington Avenue and Dalton Avenue. The additional construction recommended will provide tracks for the operation of an east and west crosstown line extending from Angeles Mesa Drive to Downey Road, intersecting the rapid transit routes proposed for Moneta Avenue and Long Beach Avenue, and providing through service between the Southwest Side and the Vernon Manufacturing District, the Stock Yards and the Central Manufacturing District.

(f) 54th Street-55th Street

A two-track narrow gauge street car line on 54th Street from Moneta Avenue to San Pedro Street and from South Park Avenue to Central Avenue, also on 55th Street and along private right-of-way from Central Avenue to Downey Road. The estimated cost not including private right-of-way is.....$ 715,000

Slauson Avenue is the next important east and west street to the south of Vernon Avenue. It is a through street but is not suitable for street car operation for the reason that a freight line of the Atchison, Topeka & Santa Fe Railroad is located practically on its north line and parallels it for a distance of about three miles. The facilities afforded by this freight line have caused a number of industries to locate along Slauson Avenue and will undoubtedly attract many more in the future. It can therefore be safely predicted that Slauson Avenue will eventually be crossed by many industrial tracks which would interfere seriously with the operation of street cars. In considering alternate locations for a crosstown street car line, 54th and 55th Streets were selected for the reason that they are close enough to Slauson Avenue to serve the important territory contiguous to it and for the further reason that there already exists three miles of track on 54th Street which can be utilized.

(g) Florence Avenue

A two-track narrow gauge street car line on Florence Avenue from Western Avenue to Pacific Boulevard. The estimated cost is .....$ 872,000

Florence Avenue is located one mile south of Slauson Avenue and affords a logical location for a through crosstown street car line. This line with the future extensions proposed will provide a direct connection between Inglewood on the west and Huntington Park and Maywood on the east. It will also intersect two of the proposed rapid transit lines and fulfill a very useful function as a feeder to them.

2. Bus Lines

(a) Norton Avenue

A bus route in Plymouth Boulevard, Eighth Street, Norton Avenue, Sixth Avenue and Seventh Avenue from Third Street to Exposition Boulevard.

North and south service about one mile west of Western Avenue will be required upon completion of the Third Street and Pico Street rapid transit lines. The street layout in this area is quite irregular and, because of the lack of through north and south streets adaptable to the operation of street cars, a bus line is recommended.

(b) Manchester Avenue

A bus route along Manchester Avenue from Western Avenue to Alameda Street.

The territory contiguous to Manchester Avenue is rather sparsely settled at the present time. It is anticipated that this district will be fully developed in the not distant future, at which time the people living in it will require some mode of public transportation. If there were no factors other than these to consider, Manchester Avenue would be a splendid location for a crosstown street car line. It is, however, now used largely as an artery for vehicular traffic, and this use will greatly increase in the future. Manchester Avenue can be opened and connected at both ends with county highways and it appears to be a logical location for an east and west boulevard through the southern portion of the city. This street should be set aside for motor traffic, and therefore a bus line for the convenience of the public is recommended. The service which can be rendered by such a line will be useful not only in providing local transportation along Manchester Avenue, but in making two of the proposed rapid transit routes conveniently accessible.

(c) Pasadena-Hollywood

Bus service is at present maintained between Pasadena and Hollywood by an independent company. The anticipated growth of these centers and that of intervening districts requires the rendering of service by a transportation line that is a part of the unified transportation system of Los Angeles. To meet this need a bus route has been projected on Colorado Street, Central Avenue, Los Feliz Boulevard and Western Avenue from Fair Oaks Avenue in Pasadena to Franklin Avenue.

C. EQUIPMENT

New cars for the operation of the initial urban rapid transit lines, as well as new substations, shops, yards and terminal facilities will be required. It has been assumed that the most modern type of rapid transit car will be used but we have not

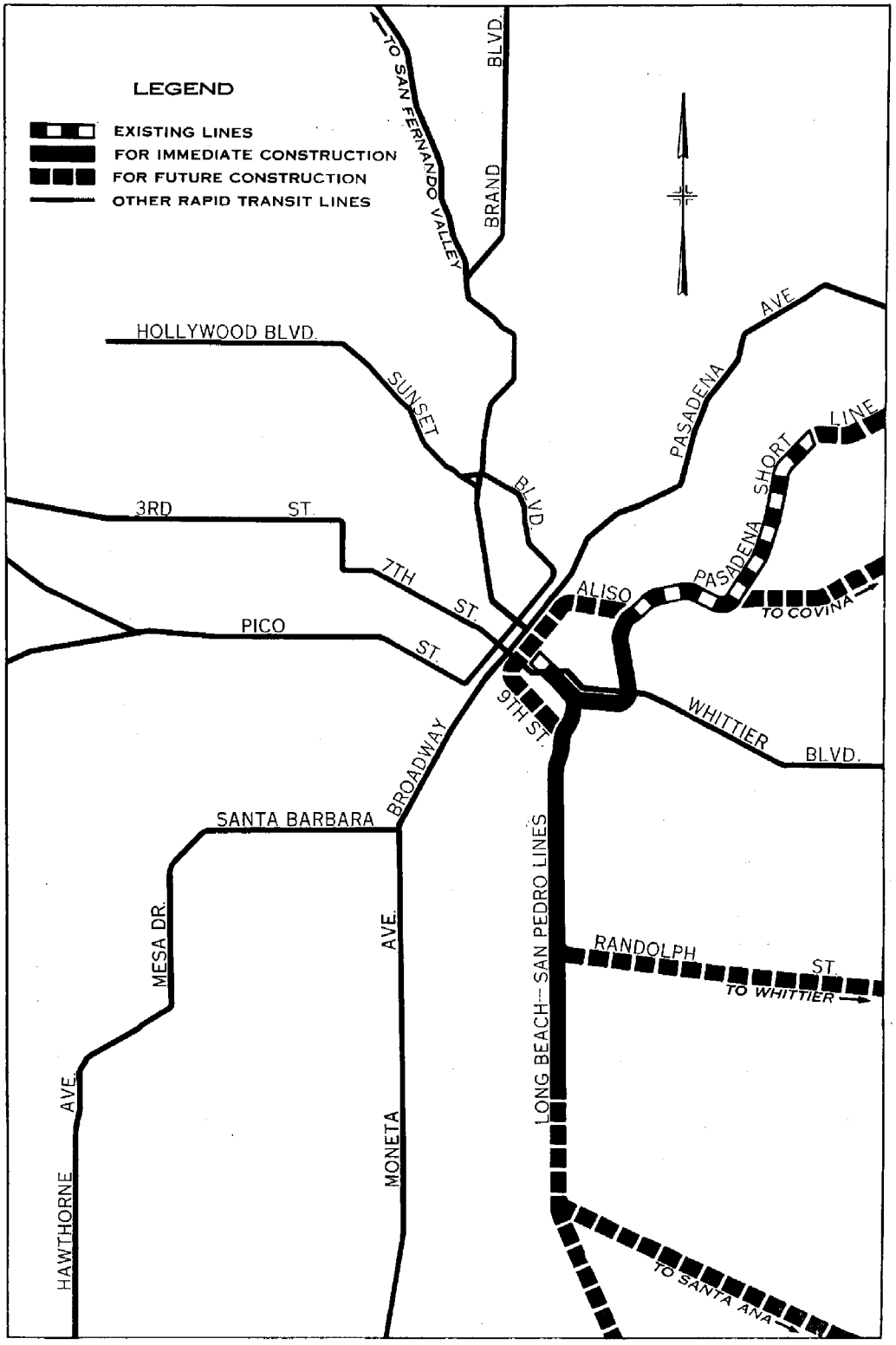

FIGURE 33. *The proposed Pacific Electric Railway Expansion, Northeast-Southeast Rapid Transit Lines.*

located nor made detailed designs of auxiliary facilities, believing that such work can best be undertaken at the time the contract drawings are prepared. The estimated cost of cars and auxiliary facilities is as follows:

500 modern cars to equip adequately the rapid transit system, with the substations, shops, yards and terminals necessary to the economical operation of the lines	$15,000,000
200 street cars and buses, with the necessary substations, shops and yards	$ 3,200,000

D. PACIFIC ELECTRIC RAILWAY EXPANSION

The service rendered by the lines* of the Pacific Electric Railway on the east and south sides of the city is quite different from that rendered by its lines* on the west. On the west side a strictly interurban and urban passenger service is maintained while on the south and east sides facilities for freight traffic in addition to the urban and interurban passenger service are necessary. For this reason the urban and interurban lines operating through the west and northwest portions of the city can use the proposed rapid transit facilities in Pico Street, Broadway, Glendale, Sunset and Hollywood Boulevards. On the other hand, because of the necessity for the operation of freight service, the Watts line and Pasadena Short line cannot be as readily utilized for urban and interurban passenger service without additional facilities for freight service in the terminal district.

Freight facilities are essential but, as the provision of them is more or less aside from the provision of rapid transit passenger lines, they (the freight facilities) should be provided separately. It is proposed, therefore, that the Pacific Electric Railway Company finance and construct such facilities as are necessary to provide for freight service, leaving the Watts line and the Pasadena Short line free, in the terminal district, for the operation of passenger trains. The company has well matured plans for obtaining this result and, as the facilities proposed will fit in with the comprehensive rapid transit plan contained in this Report, such construction, as is outlined below, is recommended.

1. Pacific Electric Terminal Line

The relation of this line to the various lines of the urban rapid transit system is shown on Figure 33.

A two-track ballasted deck steel elevated railroad on private right-of-way connecting the existing Main Street Station elevated structure with the Pasadena Short line just north of Aliso Street, with a branch connecting the Watts line to the terminal line. The estimated cost not including private right-of-way is	$ 3,818,000

*Herein recommended as a part of the Comprehensive Rapid Transit system.

This terminal line will consist of an extension of the existing elevated, from a point just west of San Pedro Street, easterly over private right-of-way to the east bank of the Los Angeles River. From thence the route will extend northerly along the east bank of the river to a connection with the existing tracks of the Pacific Electric Railway on private right-of-way just north of Aliso Street. The Watts line of the Pacific Electric Railway will be connected with this terminal line by means of an elevated railroad extending southerly from a point near Seventh and Alameda Streets to a point near 14th Street and Long Beach Avenue.

The operation of interurban trains on the downtown streets of Los Angeles is one of the most objectionable traffic conditions existing today. The Pacific Electric Railway has been making improvements to meet this situation during recent years, by the construction of the existing elevated structure from the Sixth and Main Street terminal to San Pedro Street and the Hollywood-Glendale tunnel. These two improvements, together with the proposed terminal line, over which passenger trains can be operated until such time as rapid transit facilities are provided in Ninth Street, Main Street and Aliso Street, will eliminate train operation in practically all of the downtown streets.

2. *Watts Line*

The relation of this line to the various lines of the urban rapid transit system is shown on Figure 33, page 114.

The elevation of the existing four-track railroad on private right-of-way from 14th Street to Manchester Avenue to an average of twelve feet above the present grade by placing the tracks upon an earth fill held in place by concrete retaining walls, and erecting suitable bridges at necessary street crossings. The estimated cost not including the depression of the street surface at intersecting streets is ..... $ 8,980,000

The utilization of the existing Watts line of the Pacific Electric Railway as a part of the comprehensive rapid transit system presented a very difficult problem. This line is a four-track railroad at grade and on private right-of-way, but from Ninth Street to Slauson Avenue, a distance of about three miles, a roadway has been partly opened on either side of the right-of-way. In addition to the high speed interurban trains, a large volume of freight traffic is carried, and spur tracks serving nearby industries cross the adjacent roadways at frequent intervals. The present operation of high speed trains at grade cannot be continued indefinitely and as service must be supplied to the industries, a study of the best means of eliminating the grade crossings has been made.

There are three practicable solutions, as follows:

(a) Elevate the two inside tracks for the use of through interurban trains, leaving the outside tracks at grade for street car service and freight

trains. This solution would prevent the use of this line as a part of the urban rapid transit system.

(b) Elevate all four tracks on a steel structure and construct two additional tracks on the surface. This would provide a rapid transit railroad with accommodations for urban and interurban passenger trains, as well as for through and local freight trains, but in this solution grade crossings would not be eliminated, and

(c) Elevate all four tracks to a grade about twelve feet above the present street grade, thereby providing urban and interurban rapid transit trackage, and at the same time readjust the industrial tracks to the new grade.

The merits of each of the three solutions have been considered and it was concluded that the elevation of the Watts line as outlined in solution (c) is the best treatment for this line in order to make it a part of the comprehensive transportation system of Los Angeles.

Under this plan the grade of important intersecting streets must be lowered a sufficient distance to provide proper clearances. As these streets intersect at intervals of one-quarter to one-half mile, this method of elevation will effect a considerable saving in construction costs over those involved in the elevation of the tracks to a grade sufficiently high to permit the retention of the existing street grades.

As previously stated the elevation of the Watts line is complicated by the fact that there are industrial tracks serving various plants located adjacent to it. These tracks will have to be readjusted, the treatment of each depending upon the local conditions. While the necessity of maintaining service to these industries is recognized, there is no reason for a further postponement of a track elevation program solely on this account. A very complete track elevation program has been carried out in Chicago during the past twenty years involving the same problem of maintaining service to industries located adjacent to the railroads. The fact that some 972 miles of steam railroad tracks have been elevated and 964 grade crossings eliminated within the limits of Chicago indicates that it is entirely practicable to elevate and still maintain satisfactory service on industrial tracks. The estimate of the cost of elevating the Watts line includes only the cost of raising the four main line tracks. The Pacific Electric Railway will be put to considerable expense in the rearrangement of industrial tracks, but no estimate has been made because a detailed survey of each track and industry would be required before an estimate could be prepared.

3. Pasadena Short Line

The relation of this line to the other lines of the urban rapid transit system is shown on Figure 33, page 114.

The construction of two additional tracks at grade from Echandia Junction to Indian Village. The estimated cost is.....$ 350,000

The Pasadena Short line of the Pacific Electric Railway provides facilities for both urban and interurban traffic. With the exception of the terminal tracks between Anderson and Aliso Streets and the Main Street station this line as now constructed practically provides a permanent rapid transit route. The terminal line heretofore recommended will provide additional terminal tracks. The capacity of the existing line should be increased by the construction of two additional tracks from Echandia Junction to Indian Village, which will greatly facilitate train movements on this section of the line where the operation of freight trains now causes delays to passenger trains more or less frequently. The construction of these two additional tracks and the subsequent elevation of tracks east of Canto Drive will provide a high speed four-track line from Anderson Street to El Molino, a distance of about eight miles.

4. Grade Crossing Elimination

The elimination of grade crossings in the urban area of Los Angeles has been previously discussed. It is important that grades be separated at the intersection of the heavy traffic lines of the Pacific Electric Railway with the important vehicular arteries. This work should be undertaken at an early date. However, the rate of progress will depend entirely upon the ability of the railroads and the public to finance the work.

FOR IMMEDIATE CONSTRUCTION

SUMMARY OF ESTIMATES OF COST

A.	RAPID TRANSIT LINES		
	1. Moneta-Broadway-Pasadena Avenue Line		$ 33,043,000
	2. Hollywood-Vineyard Line		31,359,000
	3. San Fernando Valley Line		4,678,000
	4. Third-Seventh-Whittier Boulevard Line		28,951,000
B.	SURFACE LINES		4,006,000
C.	EQUIPMENT		
	Cars, Sub-stations, Shops, Yards, etc.		18,200,000
	TOTAL		$120,237,000
D.	PACIFIC ELECTRIC RAILWAY EXPANSION		
	1. Pacific Electric Terminal Line	$3,818,000	
	2. Watts Line	8,980,000	
	3. Pasadena Short Line	350,000	
	TOTAL		$ 13,148,000
			$133,385,000

ESTIMATES OF COST OF ALTERNATE TYPES

In the development of a construction program, conditions may arise that will require modification with respect to the recommended type of structures. Financial

limitations may also impose restrictions. Consequently alternate estimates have been made.

In the left-hand column of Table 24 are shown the estimated costs of the recommended types of structure for units of the rapid transit routes where alternate types of structure may be considered. In the parallel columns the estimated costs of alternate types are given for the purpose of comparison.

TABLE 24

ESTIMATES OF COST OF RAPID TRANSIT LINES FOR RECOMMENDED AND ALTERNATE TYPES OF STRUCTURES

LINES	RECOMMENDED TYPES	ALTERNATE TYPES			
		ELEVATED STRUCTURES			SUBWAYS
		Concrete Steel	Ballasted Deck Steel	Open Deck Steel	
MONETA-BROADWAY PASADENA AVENUE					
Broadway Subway	$ 13,644,000	$ 4,318,000	$ 3,767,000	$ 2,905,000	$13,644,000
Broadway-Pasadena Avenue Elevated	10,003,000	10,003,000	8,070,000	5,238,000	25,308,000
Broadway-Moneta Avenue Elevated	9,396,000	9,396,000	8,013,000	4,959,000	25,089,000
Total	$ 33,043,000	$23,717,000	$ 19,850,000	$13,102,000	$64,041,000
HOLLYWOOD-VINEYARD					
Pico Street Elevated	$ 8,288,000	$ 8,288,000	$ 7,042,000	$ 4,663,000	$20,457,000
Pico Street Subway	4,745,000	1,655,000	1,375,000	1,004,000	4,745,000
Hollywood Tunnel	1,025,000	415,000*	347,000*	244,000*	1,025,000
Glendale Boulevard Elevated	1,530,000	1,721,000	1,530,000	1,025,000	3,702,000
Sunset Boulevard Elevated	3,646,000	4,479,000	3,646,000	2,732,000	8,630,000
Hollywood Boulevard Subway	12,125,000	4,875,000	4,020,000	2,720,000	12,125,000
Total	$ 31,359,000	$21,433,000	$17,960,000	$12,388,000	$50,684,000
SAN FERNANDO VALLEY					
Total	$ 4,678,000†	$13,751,000	$11,055,000	$ 7,320,000	$27,058,000
THIRD-SEVENTH-WHITTIER BOULEVARD					
Third Street Subway	$ 9,349,000	$ 4,850,000	$ 4,090,000	$ 2,650,000	$ 9,349,000
Seventh Street Subway	15,061,000	5,523,000	4,618,000	3,203,000	15,061,000
Whittier Boulevard Elevated	4,541,000	5,683,000	4,541,000	3,027,000	13,852,000
Total	$ 28,951,000	$16,056,000	$13,249,000	$ 8,880,000	$38,262,000
PACIFIC ELECTRIC RAILWAY EXPANSION					
Pacific Electric Terminal Line	$ 3,818,000	$ 4,700,000	$ 3,818,000	$ 2,457,000	$ 9,706,000
Watts Line	8,980,000‡	12,380,000	10,150,000	6,770,000	25,483,000
Pasadena Short Line	350,000§	350,000§	350,000§	350,000§	350,000§
Total	$ 13,148,000	$ 17,430,000	$ 14,318,000	$ 9,577,000	$35,539,000
TOTAL	$111,179,000	$92,387,000	$76,432,000	$51,267,000	$215,584,000

*For comparative purposes only—alternate construction not practicable.
†Portion to be at grade with provision for grade separation at intersecting streets
‡Earth fill held in place by concrete retaining walls.
§Two additional tracks on portion of existing right-of-way.

LOCATION AND TYPE OF STRUCTURES

The location of the proposed rapid transit lines has been determined after a very careful study of the city's transportation needs. Likewise the selection of the type of structure for the different portions of the rapid transit system has been made after full consideration of the cost of construction; and the type of structure recommended, in our opinion, is that best adapted to the various physical and financial requirements. If, in any case where elevated construction has been recommended, the property owners prefer subways, and are willing to pay the additional cost of underground construction, there is no reason why subways should not be built. Alternate locations, which will not seriously affect the general plan, are available for a few of the proposed lines.

Pico Street

It may be argued that Pico Street is destined to become one of the heaviest vehicular traffic arteries in the western section of the city and for this reason it should not have been selected for the location of a rapid transit line. It is pointed out in this connection that the elevated columns can be located so as to cause little or no interference with street traffic. Pico Street is the most centrally located of any of the streets in the area which the new rapid transit line is designed to serve and, in addition, it has the best alignment. In the event that there may be some objection to the construction of an elevated railroad on this street, the transportation needs of the public can be as well supplied by a subway, but the property owners in the vicinity should, in all fairness, share the difference in the cost. In case there is objection to the construction of a rapid transit line of any type on Pico Street, 16th Street may be selected for this route, as it has almost the same advantage of location.

Sunset Boulevard

The possibility of objection to an elevated structure on Sunset Boulevard has been considered. This rapid transit line could be placed underground if the additional expense is borne by the property owners. It appears that the possibility of sound objection to any type of rapid transit construction on Sunset Boulevard between Glendale Boulevard and Hollywood Boulevard is remote. In the event, however, that an objection arises, West First Street is suggested as an alternate location. This street has been widened as far west as Vermont Avenue, and the Major Traffic Street Plan shows its extension into the heart of Hollywood to serve as a major highway and as a rapid transit artery. If this recommendation is adopted by the city and such a street is opened all the way to Sunset Boulevard and Cahuenga Avenue, it would afford a very satisfactory rapid transit route. In case First Street is not extended beyond Vermont Avenue, the alternate route could extend north on Vermont Avenue to Hollywood Boulevard, and thence westerly on Hollywood Boule-

vard. The Glendale and Sunset route is much to be preferred, however, because it would serve a section of East Hollywood which otherwise might be without rapid transit facilities for all time to come.

Third Street-Vermont Avenue-Seventh Street

Attention is directed to the recommendation for subway construction on West Third Street, Vermont Avenue and West Seventh Street. This type of structure will be required in our opinion for the reason that Third Street west of Western Avenue, as well as all other east and west streets between Pico Street and Melrose Avenue, has been zoned for residential development. The proposed route extends through a high class residential district, one of the finest in the city, and for that reason a subway has been recommended. Inasmuch as the property owners in the Wilshire district will receive the benefits resulting from rapid transit service, they should be willing to assume a share of the additional cost which the construction of a subway rather than elevated will involve.

Pasadena Avenue

The possibility that the Union Pacific Railroad and the Atchison, Topeka and Santa Fe Railroad may make an agreement whereby each of these companies will abandon part of its right-of-way between Los Angeles and Pasadena and use but one right-of-way for the trains of both companies has been called to our attention. Both the right-of-way of the Union Pacific and that of the Santa Fe parallel, for quite a distance, the proposed Pasadena Avenue rapid transit route.

These rights-of-way have been examined and, in the event the railroad companies agree to consolidate their facilities before the proposed Pasadena Avenue rapid transit line is constructed, the utilization of part of the rights-of-way which are abandoned should be considered. The plan which has been generally proposed is that the right-of-way of the Union Pacific be utilized by both railroads between Avenue 36 and Avenue 61, and that the Union Pacific be connected with the Atchison, Topeka and Santa Fe right-of-way at the bridge across the Arroyo Seco. From this point easterly and northerly the Santa Fe right-of-way would be used by the steam railroads. This would leave the Santa Fe right-of-way available for a rapid transit route between Avenue 36 and Avenue 61, at which point a connection could be made with the abandoned Union Pacific right-of-way along Pasadena Avenue. The rapid transit route could then follow the present right-of-way of the Union Pacific Railroad from Avenue 61 to Glenarm Street in Pasadena, thence east to Broadway and north on Broadway to a suitable terminal near Colorado Street.

Whittier Boulevard Elevated

In the recommended plan the portion of this line lying between Stanford Avenue and the east bank of the Los Angeles River has been located adjacent to and just

north of the proposed Pacific Electric Railway Terminal line. This effects some economies in construction, and also permits the construction of at least one station with facilities for the transferring of passengers between the Terminal line and the Third-Seventh-Whittier line. The Terminal line is to be located on a private right-of-way sufficient for a two-track railroad, and can be so located without serious damage to abutting property. When detailed location surveys are made it may be found that, due to the damage to abutting property, the cost of procuring a right-of-way of sufficient width for the tracks of both the Terminal line and the Whittier Boulevard Elevated will more than off-set the saving in construction costs. In this event Sixth Street is recommended as an alternate route for the portion of the Whittier Boulevard Elevated mentioned above.

II.

FOR FUTURE CONSTRUCTION*

The construction program which has been described provides for a transportation system to serve the immediate needs of Los Angeles. Space has been provided for the construction of additional tracks which may not be required for some time in the future; but in this connection it must be borne in mind that the initial construction is but the framework of the larger system which must be built to serve a much greater metropolitan center than exists today. Future construction, therefore, to round out and complete the comprehensive plan is recommended. No prophecies are made as to the dates when the various units will be required. Traffic changes frequently occur and the transportation requirements of a city are constantly shifting. In the location of the various routes the present character of development, and also, in each case, a study of the probable future development, has governed. It is not only possible but probable that in some cases the character of the respective communities to be served by future construction may be altered; that unforeseen factors may appear which will divert industrial, commercial and residential growth to new and unexpected locations. In that event, and to that extent, the recommendations for future construction must be considered as somewhat elastic.

The various units in the future program are as follows:

A. RAPID TRANSIT LINES

1. *Moneta-Broadway-Pasadena System.*

   The relation of the lines of this system to the other rapid transit lines is shown on Figure 30, page 100.

*Detail estimates of cost of the work outlined under this heading are not published for the reason that building costs may be appreciably changed at the time the construction work is undertaken. However, the cost involved at today's price levels would be about $190,000,000.

(a) Broadway-Pasadena Avenue Elevated

1. A third track on the elevated structure on Broadway and Pasadena Avenue from the south line of Sunset Boulevard to Avenue 64.

2. A two-track single column ballasted deck steel elevated railroad on private right-of-way, Mission Street and Fair Oaks Avenue from Avenue 64 to a terminal just north of Holly Street in Pasadena.

(b) Broadway-Moneta Avenue Elevated

1. A third track on the elevated structure on Broadway and Moneta Avenue from a point just south of Washington Street to Manchester Avenue.

2. A three-track concrete steel elevated railroad on Moneta Avenue and private right-of-way from Manchester Avenue to a connection with the existing two-track line of the Pacific Electric Railway at 118th Street.

3. The elevation of the two-track railroad of the Pacific Electric Railway between 118th Street and Gardena at necessary highway crossings.

(c) Inglewood-Hawthorne Branch

1. A three-track concrete steel* elevated railroad on Santa Barbara Avenue and private right-of-way from a connection with the Broadway-Moneta Avenue Elevated to Arbor Vitae Street in Inglewood.

2. A two-track single column ballasted deck steel elevated railroad along private right-of-way from Arbor Vitae Street to Rosecrans Avenue in Hawthorne.

(d) Interurban Lines

1. One additional track where necessary to provide a two-track railroad from Gardena to the 5th Street terminal in San Pedro, with track elevation at necessary highway crossings.

2. One additional track where necessary to provide a two-track railroad from Rosecrans Avenue in Hawthorne to Francisca Avenue in Redondo Beach with track elevation at necessary highway crossings.

3. A two-track ballasted deck steel elevated railroad along Diamond Street from Francisca Avenue to a terminal near Pacific Avenue and Emerald Avenue in Redondo Beach.

In connection with possible extensions to the north, careful study has been given to the future transportation needs of the Pasadena district. It is anticipated that at some time in the future the existing four-track main line of the eastern division of the Pacific Electric Railway will be inadequate to supply the traffic demands of both Pasadena and the entire San Gabriel Valley. With this in view it is recom-

* Solid fill, concrete retaining wall type is contemplated on a portion of this line.

mended that the Pasadena Avenue Elevated be extended along the line of the present South Pasadena route of the Pacific Electric Railway to Fair Oaks Avenue in South Pasadena, and thence northerly on Fair Oaks Avenue to a terminus just north of Holly Street.

The completion of this extension and the Moneta Avenue extension will make possible the operation of through rapid transit trains between Pasadena and Athens. The two terminal loops to be constructed as a part of the Broadway subway during the initial period will provide for operation of turn-back service in the event that traffic is unbalanced.

The extensions and improvements outlined for the southern part of the city will make possible the operation of interurban trains from the Harbor District over the Moneta Avenue route, thereby diverting a considerable load from the Watts-Long Beach route and providing rapid and convenient service between the heart of Los Angeles and its Harbor District. It is likely that such interurban trains will be routed to the terminal at Hill Street, but in the event that such routing is not desirable, they can be through-routed or turned back at the terminal loop.

The section of the city lying west of Western Avenue and south of Exposition Boulevard is largely gently rolling land quite suitable for residential development and therefore may have a large population in future years. At the present time this district is dependent upon a few street car lines for transportation. A branch of the rapid transit system is projected to serve a large part of this territory and it will also provide a route for interurban trains to Redondo Beach and the Palos Verdes.

The probable method of operation of this line has been considered and estimates show that there will be ample track capacity in the central business district to accommodate the trains to be operated therein. The interurban trains can be operated either to the Hill Street terminal or routed through to Pasadena.

2. *Hollywood-Vineyard System*

The relation of the lines of this system to the other rapid transit lines is shown on Figure 31, page 104.

(a) Olive Street Subway

A two-track subway in Olive Street from a connection with the Pico Street subway to a portal near the south line of Sunset Boulevard.

(b) Vineyard-Culver Line

Two additional tracks with track elevation at street crossings so as to provide a four-track railroad on private right-of-way from Vineyard Junction to Culver Junction.

(c) Vineyard-Sherman Junction Line

The separation of grades at street crossings on the existing two-track railroad on private right-of-way from Vineyard Junction to Sherman Junction.

(d) Sunset Boulevard Elevated

A three-track concrete steel elevated railroad on Sunset Boulevard from a connection with the Olive Street subway at a portal near the south line of Sunset Boulevard to Glendale Boulevard, and a two-track single column ballasted deck steel elevated railroad from Glendale Boulevard to a connection with the two-track elevated railroad on Sunset Boulevard at Rosemont Avenue.

(e) Interurban Lines

1. The elevation of the existing two-track railroad on private right-of-way at necessary highway crossings between Culver Junction and Windward Avenue in Venice.

2. The elevation of the existing two-track railroad at necessary highway crossings between Culver Junction and Playa Del Rey Junction.

It is estimated that the service demands of the Moneta-Pasadena System will eventually require the entire capacity of the Broadway subway. In anticipation of this time, it will be necessary to provide new terminal tracks in the downtown district for the use of the Hollywood-Vineyard rapid transit trains, and as Olive Street provides the logical location, the construction of a subway in that street is recommended.

The Olive Street subway will consist of a high level structure from Pico Street to Fifth Street. It will pass over the Seventh Street subway, but will be lowered somewhat at Sixth Street to go under the existing storm drain in that street. From Fifth Street to the portal at Sunset Boulevard, the tracks will extend through a tunnel passing over the Hollywood-Glendale tunnel of the Pacific Electric Railway and under the existing Third and Second Street tunnels. Stations can be placed in that portion of the line between First Street and Fifth Street which can be made accessible by means of entrances extending to Hill Street.

At about the same time that the point of saturation is reached in the Broadway subway it is probable that the Hollywood tunnel will also have reached its capacity, making necessary the construction of an auxiliary line to provide additional tracks for the operation of the Hollywood and Glendale trains. The proposed Sunset Boulevard Elevated line will supply the track capacity necessary to meet this situation.

The territory west of Vineyard Junction served by the existing Venice Short, Playa Del Rey and Sawtelle lines of the Pacific Electric Railway, is undoubtedly destined to share largely in the city's future development and it is likely that the urban area of Los Angeles will extend to Culver City in the not distant future. With this in mind, the reconstruction of the Venice Short line to provide a four-track rapid transit railroad from Vineyard Junction to Culver Junction has been planned. There is no necessity for the elevation of the entire line, but the grade of the railroad should be raised at its intersection with important streets, and this is recommended. It is possible that the requirements of the public will eventually necessitate the opening of a considerable number of streets across this line, in which case the tracks will have to be raised for the entire distance.

Between Culver Junction and Venice the existing tracks of the Venice Short line will be utilized as part of the rapid transit facilities serving the territory described, and it is proposed to elevate the tracks at important highway crossings. The double track line of the Pacific Electric Railway extending from Culver Junction to Playa Del Rey Junction will also be utilized to provide high speed interurban service and for this reason the tracks should be elevated at the intersection of all important highways.

That portion of the Sawtelle line of the Pacific Electric Railway between Vineyard and Sherman Junctions extends through a rolling territory on private right-of-way, and only requires the separation of grades at intersecting highways to make possible the maintenance of a high speed service. This line will be utilized to provide facilities for the operation of Santa Monica interurban trains until such time as the Third-Seventh-Whittier route is extended to Sherman Junction. Thereafter it will be available for the operation of such interurban trains as the traffic demands may require, and also to serve as a branch of the Hollywood-Vineyard rapid transit system.

It is recognized that the portion of the Sawtelle line mentioned above extends through a high class restricted residential district and therefore there may be objections to the most economical method of separating grades, namely, the elevation of the railroad tracks. For example, the elimination of the grade crossing at Wilshire Boulevard by depressing the tracks would be very costly, involving a serious drainage problem. The depression of the tracks at this point is possible, but it should be pointed out that such a method of grade separation from the viewpoint of the car rider would be very uneconomical. The elevation of the tracks would serve the purpose of public transportation just as well as depression, and in the event that the tracks must be depressed for aesthetic or other reasons, the difference between the cost of elevation and the cost of depression should be borne largely by the adjacent property owners, who would receive the benefit.

The probable future operation of the Hollywood-Vineyard system is briefly outlined as follows:

Urban rapid transit trains will operate from Culver City via the Pico Street

route to and through the new Olive Street subway and along the Sunset-Hollywood routes to a terminus at Sherman.

Upon the completion of the Glendale-Sunset route the urban rapid transit trains will be through-routed via the Glendale, Olive and Pico routes to Vineyard and points beyond. Suburban trains may be through-routed to Venice or other beach points, or operated to the terminal at Hill Street, as the traffic demands require. In the event that the future urban traffic is unbalanced, it may be necessary to construct terminal loops similar to those proposed for the Broadway subway. Such terminal loops have not been recommended at this time as their need is problematical.

Adequate provision has been made for interurban service which is highly important on these particular lines. Interurban trains serving Venice and Playa Del Rey will also serve the territory between the beaches and Culver City, operating from Culver City to downtown Los Angeles on the inside express tracks, thus assuring a fast and convenient service between Los Angeles and the beaches. The suburban trains can be operated into the Hill Street terminal or through-routed to San Fernando Valley points as the future service requirements warrant.

3. Glendale and San Fernando Valley Lines

The relation of these lines to the other rapid transit lines is shown on Figure 31, page 104.

(a) Glendale Line

1. A three-track concrete steel elevated railroad on Glendale Boulevard and private right-of-way from a connection with the Sunset Boulevard Elevated to Fargo Street.

2. One additional track on Allesandro Street and on private right-of-way from Fargo Street to the proposed San Fernando Valley Line Junction just west of the Los Angeles River.

3. A two-track single column ballasted deck steel elevated railroad on private right-of-way and on Brand Boulevard in Glendale from the proposed San Fernando Valley Line Junction to Arden Junction in Glendale.

(b) Van Nuys Line

1. A two-track single column ballasted deck steel elevated railroad on private right-of-way from Vineland Avenue to Pacoima Avenue in Lankershim.

2. One additional track on private right-of-way from Pacoima Avenue in Lankershim to El Nido Street in Van Nuys with track elevation at necessary highway crossings.

3. A two-track single column ballasted deck steel elevated railroad on private right-of-way and Sherman Way from El Nido Street to Van Nuys Junction (the Junction of the Owensmouth and San Fernando lines).

(c) San Fernando Line

1. One additional track on private right-of-way and Brand Boulevard from Van Nuys Junction to Webb Street in San Fernando with track elevation at necessary highway crossings.

2. A two-track single column ballasted deck steel elevated railroad on Brand Boulevard from Webb Street to Porter Avenue in San Fernando.

(d) Owensmouth Line

1. One additional track on private right-of-way from Van Nuys Junction to Etiwanda Avenue with track elevation at necessary highway crossings.

2. A two-track single column ballasted deck steel elevated railroad on private right-of-way from Etiwanda Avenue to Vanalden Avenue.

3. One additional track on private right-of-way from Vanalden Avenue to Hermosa Avenue in Owensmouth with track elevation at necessary highway crossings.

4. A two-track single column ballasted deck steel elevated railroad on private right-of-way from Hermosa Avenue to Topango Canyon Road in Owensmouth.

The Glendale and Burbank districts are among the most rapidly growing sections in the Los Angeles metropolitan area. These important areas will receive a measure of rapid transit service following the construction of that portion of the Glendale Boulevard Elevated which is recommended for initial construction. The extension of this rapid transit line through Glendale is contemplated as a part of the comprehensive plan.

Investigation indicates that the Glendale and Burbank districts as well as the entire San Fernando Valley are rich in their potentialities, and that at some future date they will be densely populated. Rapid transit facilities, therefore, must not only be provided for Glendale and Burbank, but also for the other San Fernando Valley cities.

The Valley route to be constructed as a part of the initial program will provide a trunk line for the San Fernando Valley traffic. Heavy traffic is to be expected on this route in the future and, with this in mind, it is planned to divert the load to the proposed Sunset Boulevard Elevated by means of a connection at Glendale and Sunset Boulevards. From this connection a three-track elevated railroad will extend northerly on the present route of the Pacific Electric Railway to the junction of the proposed Valley line and the Glendale line. For a major portion of this distance

the existing railway is on private right-of-way of sufficient width to accommodate three tracks. This right-of-way extends for some distance along Glendale Boulevard and on this section the use of a three-track concrete steel elevated railroad is recommended. Where the tracks diverge from this Boulevard the use of solid fill elevated construction is proposed where elevation is necessary. From the junction with the Valley line the Glendale line has been projected northerly along the existing Pacific Electric Railway route to Arden Junction in Glendale. For this section a two-track ballasted deck single column steel elevated railroad is recommended. The express track provided on the Sunset-Glendale route will assure adequate express facilities for the suburban trains serving the San Fernando Valley. These trains will make limited stops in the more important centers in the San Fernando Valley until they reach the limits of the urban area, from which they will give express service to the center of Los Angeles.

The utilization of the existing Pacific Electric Railway lines extending from Van Nuys to San Fernando and to Owensmouth as a part of the proposed new San Fernando Valley rapid transit system is recommended. These lines to be elevated at their intersections with the important traffic highways as and when such elevation is essential to the maintenance of high speed transportation to the western and northern portions of the San Fernando Valley. Single column ballasted steel elevated structures are proposed through the urban areas of the various centers. That portion of the existing Van Nuys line extending through Cahuenga Pass from Lankershim to Hollywood Boulevard can be utilized as a feeder line connecting the new Valley line and the Hollywood Boulevard subway.

4. Third-Seventh-Whittier Boulevard Line

The relation of this line to the other rapid transit lines is shown on Figure 32, page 108.

(a) Third Street and Seventh Street Subway

1. The construction of a bore for a third track in the Third Street, Vermont Avenue and Seventh Street subway from Larchmont Boulevard to Burlington Avenue.

2. A three-track subway in Third Street from Larchmont Boulevard to a portal just west of La Brea Avenue.

(b) Whittier Boulevard Elevated

1. The construction of a third track on the Whittier Boulevard Elevated from Boyle Avenue to Indiana Street.

2. A two-track single column ballasted deck steel elevated railroad on Whittier Boulevard from Indiana Street to First Street in Montebello.

(c) Beverly Hills Elevated

A three-track concrete steel elevated railroad on Third Street and private right-of-way from the subway portal just west of La Brea Avenue to Wilshire Boulevard.

(d) Santa Monica Line

1. The separation of grades at necessary highway crossings on the existing two-track railroad on private right-of-way from Wilshire Boulevard to 100th Avenue in Sawtelle.

2. A two-track single column ballasted deck steel elevated railroad on Santa Monica Boulevard from 100th Avenue in Sawtelle to Third Street in Santa Monica and on Third Street and Utah Avenue to a suitable terminal near Ocean Avenue.

There is every indication that in future years there will be a full development of the western area lying between the Baldwin Hills and the Santa Monica Mountains. When such development does materialize, the traffic will require two principal arteries of travel to and from the center of Los Angeles. The proposed Venice branch of the Hollywood-Vineyard route supplies one and it is recommended that the second be supplied by the extension of the Third-Seventh-Whittier route westerly to Santa Monica. This line is projected in Third Street and private right-of-way from Larchmont Boulevard to a connection with the existing Sawtelle route of the Pacific Electric Railway at Sherman Junction. From Sherman Junction the proposed route will follow the private right-of-way of the Pacific Electric Railway and Santa Monica Boulevard to a terminal near Ocean Avenue in Santa Monica.

A three-track line will be provided from the central business district to Wilshire Boulevard in Beverly Hills for express service and limited stop interurban trains. From Wilshire Boulevard to the western terminus a two-track line is recommended. The existing railroad from Wilshire Boulevard to Sawtelle provides a satisfactory rapid transit line, in the main, but should be entirely free from grade crossings. This section of country is rolling, and the separation of grades can be made at a moderate cost. In Sawtelle and Santa Monica where the route extends along Santa Monica Boulevard an elevated structure is recommended.

The construction of the eastern branch of the Third-Seventh-Whittier route as a part of the initial program will undoubtedly foster a very material growth in the Belvedere district, and there will probably be a great demand for an extension of service along Whittier Boulevard. This has been anticipated and the comprehensive plan makes provision for an extension of the Whittier Elevated to Montebello in the future.

This construction will permit the through operation of urban rapid transit trains between Belvedere and Beverly Hills and of interurban trains between Montebello and Santa Monica.

B. SURFACE LINES

A complete plan for the future Los Angeles must include not only extensions to the rapid transit system, but also extensions to the surface lines in the urban area of Los Angeles and the various suburban communities. It is possible to project a number of these now, and the routes described below are included so that the complete future transportation system may be indicated as fully as possible.

1. Street Railway Lines

(a) Western Avenue

A two-track standard gauge street car line on Western Avenue from Third Street to Manchester Avenue and an additional rail on the existing tracks between Santa Monica Boulevard and Third Street.

A bus line has been in operation on Western Avenue for some time. It has proven to be such a useful line that service on a three-minute headway during the rush hours is required to accommodate the traffic. The street car line proposed should be built if and when the residents along Western Avenue desire street car service instead of bus service.

(b) La Brea Avenue

A two-track standard gauge street car line on La Brea Avenue from Hollywood Boulevard to Exposition Boulevard.

This route lies approximately two miles west of Western Avenue and will eventually be needed to supply crosstown service. It will also feed three rapid transit routes.

(c) Fairfax Avenue

A two-track standard gauge street car line on Fairfax Avenue from Sunset Boulevard to Pico Street.

(d) Florence Avenue

The construction of a street car line along Florence Avenue from Western Avenue to Pacific Boulevard is recommended as a part of the initial program. This street car line should later be extended west to Redondo Boulevard and east to Wilcox Avenue.

(e) 100th Street

This street lies one mile south of Manchester Avenue and provides a satisfactory location for an additional crosstown street car line. It is not at present opened all of the way across the urban area, but will undoubtedly

be opened and improved before the construction of a street car line is required. When the future transportation requirements warrant it, a street car line should be built on 100th Street, extending from Hawthorne Avenue to Alameda Street. On the east it may be extended along Tweedy Avenue to Wright Road.

(f) East Side Crosstown Extension

A two-track narrow gauge street car line on 55th Street, Maywood Avenue, Baker Avenue and California Avenue, as opened and extended, from Downey Road to Florence Avenue.

(g) Other Surface Lines

Undoubtedly other street car and bus lines will be necessary to furnish adequate transportation to the local centers in the future. Such lines cannot be located now, because the probable growth and the direction of development of each of these centers is more or less uncertain at present. Future service requirements may necessitate a somewhat closer spacing of street car lines than has been proposed in what are now considered the outlying districts. When this necessity arises, the additional lines required should be constructed, in general, so as to intersect the rapid transit routes.

2. Bus Lines

(a) Manchester Avenue

The operation of a bus route on Manchester Avenue from Western Avenue to Alameda Street has been recommended as a part of the initial program. This service should later be extended west through Inglewood and east along Lincoln Avenue as far as Wright Road.

C. EQUIPMENT

New cars will be required for the rapid transit and surface lines recommended for future construction. Additional car houses, yards, terminal facilities and substations will also be required from time to time. Location and design of such facilities can best be made when needed.

D. PACIFIC ELECTRIC RAILWAY EXPANSION

The relation of the lines of this system to the other rapid transit lines is shown on Figure 33, page 114.

1. Ninth-Main-Aliso Street Line

(a) Ninth Street Elevated

A two-track concrete steel elevated railroad on Ninth Street from the sub-

way portal at Stanford Avenue to a connection with the four-track Watts line.

(b) Main Street Subway

A two-track subway in Ninth Street, Main Street, private right-of-way and Aliso Street from a portal in Ninth Street at Stanford Avenue to a portal in Aliso Street just east of Alameda Street.

(c) Aliso Street Elevated

A two-track concrete steel elevated railroad on Aliso Street from the subway portal just east of Alameda Street to a connection with the four-track railroad on private right-of-way near Anderson Street.

The construction of the Pacific Electric Terminal line as a part of the initial construction program (described in detail on page 115) will provide terminal facilities for the suburban and interurban trains operated over the Watts and Pasadena Short lines for a number of years. As the Main Street terminal affords but a single entrance to the downtown area it will be a factor in adding to the congestion of the streets in its vicinity. The date when the track capacity of the terminal will be reached is largely dependent upon the growth of the areas served by trains entering and leaving the downtown district via the Watts line and the Pasadena Short line. In anticipation of this condition the necessary additional facilities have been recommended and outlined in the preceding descriptions.

The proposed Ninth-Main-Aliso Streets rapid transit line will provide adequate capacity in the central business district for the urban rapid transit trains operated over the Watts and Pasadena Short lines, as well as for a limited number of interurban and suburban trains. With the development of the south, southeast and northeast sections of the city there is no question but that these additional terminal facilities will be required. This line will do much toward preventing the continued growth of street and sidewalk congestion in the vicinity of Sixth and Main Streets, by distributing passengers to the various stations located along Main Street. It should be noted that the Aliso Street subway is located near the Plaza, and will therefore be convenient to the Union Station if located in that vicinity. This rapid transit line will aid in the natural spread and development of the central business district. Transfers to and from the Seventh Street subway, as well as to all intersecting surface lines, are contemplated so that the patrons will be afforded convenient transportation to any part of the city.

2. Long Beach and Wilmington Lines

(a) Watts Line

The elevation of the existing four-track railroad between Manchester Avenue and Watts Junction by placing the tracks upon an earth fill held in place by concrete retaining walls.

(b) Watts-Dominguez Line

Two additional tracks to provide a four-track railroad on private right-of-way between Watts Junction and Dominguez Junction with elevation of tracks so as to provide grade separation at all necessary highway crossings.

(c) Dominguez-Wilmington Line

The elevation of the existing double track railroad so as to provide separation of grades at all necessary highway crossings between Dominguez Junction and B Street in Wilmington.

(d) Dominguez-Long Beach Line

The elevation of the existing two-track railroad from Dominguez Junction to American Avenue and Willow Street in Long Beach, so as to provide for separation of grades at necessary highway crossings.

(e) Long Beach Elevated

A two-track single column ballasted deck steel elevated railroad on American Avenue and Ocean Avenue from Willow Street to a terminal at Pacific Avenue and Ocean Avenue in Long Beach.

The increase in traffic on the Watts, Long Beach and San Pedro lines of the Pacific Electric Railway in recent years, together with the opportunity for development in the territory served by these lines, warrants the conclusion that railroads without crossings at grade will eventually be required extending to Long Beach, San Pedro and Wilmington. For this reason, the elevation of the four-track Watts line from Manchester Avenue to Watts Junction on a solid fill has been included in the comprehensive plan. Provision has also been made for a four-track railroad between Watts Junction and Dominguez Junction, with grade separation at the necessary highway crossings. These improvements will provide a four-track main line with adequate facilities for both high speed suburban and urban rapid transit trains, and also for freight service.

The present routes of the Pacific Electric Railway between Dominguez Junction and Long Beach and between Dominguez Junction and Wilmington are as direct as any that could be selected. It has been recommended, therefore, that the existing double track line from Dominguez Junction through Wilmington to the Harbor be elevated at its intersection with necessary highways and also that the existing double track line serving Long Beach be elevated from Dominguez Junction to Ocean Avenue, with the provision that this railroad be placed on a two-track single column ballasted deck steel elevated structure along American Avenue in Long Beach.

The engineers for the Greater Harbor Committee of 200 have been engaged in a detailed study of the Harbor District and have practically completed plans for

comprehensive rail and dock facilities which will be ample to provide for the needs of the Harbor for many years to come. These plans are based on a unification of all existing railroad facilities and will require the co-operation of all the railroad companies for their fulfillment. The plans have been examined and it appears that ample provision has been made for both local and interurban passenger traffic.

In the event of the adoption of the plans of the Greater Harbor Committee by the municipalities and the four railroads at interest, the plans herein recommended should be modified to conform. This would require a change in the Dominguez-Wilmington line, which would be diverted from the existing right-of-way at a point near Carsen Avenue, extending thence almost due south along private right-of-way and west of proposed freight yards to a point north of Terminal Island, thence westerly north of the proposed main line freight tracks to a connection with the existing right-of-way near the West Basin. The alignment from this point south to 5th Street in San Pedro would be improved somewhat in connection with proposed alterations in the vicinity of the West Basin. While longer than the existing route, this route would permit the eventual separation of grades at a somewhat lower cost than the use of the existing right-of-way, inasmuch as the number of intersecting streets would be reduced. These plans further include provision for local street car service on Terminal Island and other portions of the Harbor District. In the event that any existing right-of-way is abandoned by reason of change of alignment fair compensation should be made to the Pacific Electric Railway Company.

3. Southeast Lines

(a) Santa Ana Line

The elevation of the existing two-track railroad from Watts Junction to the county line so as to provide for separation of grades at the necessary highway crossings, with concrete retaining walls through Watts and Lynwood.

(b) Huntington Park-Maywood-Whittier Line

The elevation of the existing two-track railroad on Randolph Street and on private right-of-way from Slauson Junction to Sorenson Avenue in Whittier so as to provide for separation of grades at necessary highway crossings, with concrete retaining walls through Huntington Park and Maywood.

(c) Whittier Elevated

A two-track single column ballasted deck steel elevated railroad along Whittier Boulevard and Philadelphia Street from Sorenson Avenue to a terminal at Greenleaf Avenue in Whittier.

The anticipated future growth of the Huntington Park and Maywood districts will warrant rapid transit service in addition to that which will be supplied by the Watts line and its feeders. The existing route of the Pacific Electric Railway on private right-of-way and Randolph Street offers a splendid location for a rapid transit line to serve these districts more directly and a two-track solid fill elevated railroad on this route extending from a connection with the four-track main line at Long Beach Avenue to Walker Avenue has been recommended. Trains on this line would be routed over the four-track Watts line and they could provide express service from Slauson Avenue to the downtown district.

The existing Pacific Electric Railway interurban line offers an excellent location for a line to Whittier. The grade crossings should be eliminated on this line wherever such elimination is essential to the maintenance of high speed service. This railroad should be placed on a single column ballasted deck steel elevated structure through the urban area of Whittier.

The location of the Pacific Electric Railway line between Watts and Santa Ana provides excellent alignment between these two points. Between Watts Junction and the Los Angeles River this line extends through a territory which eventually will be solidly built up, and therefore we have recommended that the tracks be placed on a solid fill through Watts and Lynwood. Such elevation of existing tracks as may be necessary to provide separation of grades at the necessary highway crossings on the remainder of the line is included in the complete plan. These improvements will make possible the operation of urban rapid transit trains on that portion of the line west of the Los Angeles River and the retention of high speed interurban service between Los Angeles and Santa Ana.

4. Northeast Lines

(a) San Bernardino Line

One additional track where necessary to provide a two-track railroad on private right-of-way from Valley Junction to San Dimas Junction with separation of grades at necessary highway crossings.

(b) Pasadena Short Line

The elevation of the existing four-track railroad by placing the tracks upon an earth fill held in place by concrete retaining walls, so as to provide for separation of grades at necessary highway crossings from Canto Drive and Huntington Drive to El Molino, except from Harriman Avenue to Locke Avenue.

(c) Alhambra-San Gabriel Elevated

The elevation of the existing two-track railroad from Sierra Vista to Raymond Avenue in Alhambra by placing the tracks upon an earth fill held in

place by concrete retaining walls, and a two-track single column ballasted deck steel elevated railroad along Main Street from Raymond Avenue in Alhambra to Mission Drive in San Gabriel.

(d) San Gabriel-Temple Line

One additional track so as to provide a two-track railroad along Las Tunas Drive from Mission Drive in San Gabriel to the terminal at Kaufman Avenue in Temple with elevation of tracks by placing them upon an earth fill held in place by concrete retaining walls.

(e) Monrovia-Glendora Line

One additional track from Azusa to Glendora to provide a two-track railroad from El Molino to the terminal at Glendora with separation of grades at necessary highway crossings.

(f) Sierra Madre Line

One additional track from Lamanda Park to Sierra Madre Avenue in Sierra Madre so as to provide a two-track railroad from San Marino to Sierra Madre Avenue with elevation of tracks by placing them upon an earth fill held in place by concrete retaining walls, and a two-track single column ballasted deck steel elevated railroad along Central Avenue from Sierra Madre Avenue to Baldwin Avenue in Sierra Madre.

The San Bernardino line serves an important territory in the San Gabriel Valley, and is suitable for high speed interurban service. The continued operation of high speed service is largely contingent upon the elimination of highway grade crossings, therefore the separation of grades at the principal highways is included in the comprehensive program. Inasmuch as this railroad extends through rolling country, the grade crossings may be eliminated on some sections by the elevation and on others by depression of the tracks.

The present activities in the territory served by this line are such as to warrant the prediction that the urban area of Los Angeles will extend in the future almost as far as El Monte. As this development progresses urban rapid transit service can be extended to meet the traffic demands and trains can be operated over the portion of the line where urban service is necessary and through the Main Street subway. Interurban trains from points east of El Monte will in all probability continue to be operated to the Sixth and Main Street terminal.

Branches to Alhambra and San Gabriel, Sierra Madre and Oak Knoll diverge from the existing four-track main line of the Pacific Electric Railway. Urban rapid transit trains will eventually be operated on all of these branch lines, thence over the four-track main line and through the Main Street subway. Interurban trains serving Monrovia, Glendora and intermediate points will probably be routed

to the Sixth and Main Street terminal over the proposed Pacific Electric elevated terminal line.

The Oak Knoll branch which serves the eastern portion of Pasadena presents a difficult problem as regards the provision of a high speed rapid transit line. The territory contiguous to it is almost completely developed and the present or probable future traffic does not warrant the provision of expensive rapid transit structure. Considering the short length of this branch it would appear that satisfactory service can be afforded by continuing the present operation of local trains on the surface. However, such trains could operate on the express tracks between El Molino and the downtown district of Los Angeles.

In the separation of grades at necessary street crossings on all the lines of the northeast division of the rapid transit system, except the Alhambra-San Gabriel line and the Sierra Madre line, elevation of tracks by placing them upon fills is contemplated. As the Alhambra-San Gabriel and Sierra Madre lines extend along streets in the commercial districts of Alhambra, San Gabriel and Sierra Madre, respectively, it is recommended that these lines be reconstructed and placed on a two-track single column ballasted deck steel elevated structure where they are located in important streets in these cities.

The existing Monrovia-Glendora line of the Pacific Electric Railway is well adapted for high speed service in the territory contiguous to it. As in the case of the El Monte-Covina line, separation of grades at all necessary highway crossings on the Monrovia-Glendora line will be essential to the future operation of high speed trains.

CHAPTER VII

DESIGN OF RAPID TRANSIT STRUCTURES

Rapid transit operation requires the construction of railroad tracks either above or below the grade of streets. From the standpoint of speed and operating costs it is immaterial whether the rapid transit lines are all subways or all elevated, or part one and part the other, provided that heavy grades and traffic interruptions are avoided. Not these, but other considerations must determine the choice between the two. The speed that can be attained is largely dependent upon the frequency of station stops and the alignment of tracks. In the suburban areas, where the highways intersect at infrequent intervals, rapid transit operation may frequently be secured by merely separating grades at these points. In the built-up sections of the city, however, where there are eight or ten street crossings per mile which the public interest requires to be maintained, the elevation or depression of the entire length of the track structure is necessary.

In American cities which have rapid transit railroads, with the exception of Chicago, both underground and elevated structures have been used. In all of these cities the majority of the mileage has been of the elevated type. Rapid transit tracks are generally placed in subways in the downtown and congested areas and on elevated railroads in the outlying districts, the inclines from elevated to subway structures being located at convenient points outside the central business district. In Chicago all of the rapid transit construction consists of elevated railroads at present, but subways are planned for the central and congested areas.

Rapid Transit Express Service

In New York and Chicago, where the rapid transit lines are of considerable length, provision was made for the operation of express trains by the construction of three or four-track railroads on many of the routes. With four tracks it is possible to furnish express service in both directions at all hours of the day. With three tracks, however, express trains can be operated in only one direction at a time. Three-track operation is practical, and provides the majority of the long haul riders with express service, as there is a preponderance of traffic towards the downtown district during the morning hours, with a corresponding heavy load outbound to the residential districts during the afternoon and evening hours. Trains are loaded in the morning by stopping at every station in the outlying districts and when filled they run on the express tracks to the heavy delivery districts. In the afternoon and evening this operation is reversed. One or two additional stops are provided at intermediate points so that persons may transfer from local to express trains, and vice versa, as their convenience requires.

In a metropolitan city where large numbers must be transported daily and carried considerable distances, it is not wise to construct either subway or elevated lines without provision for express service, operated upon separate tracks, for a consider-

able portion of the route. The advantage of separate tracks for express service is found not only in the saving of time between the points of origin and destination, but in the fact that it is less expensive to transport passengers without stops when once the train is filled than it is to make repeated stops and thus reduce the average speed. The use of two-track rapid transit lines precludes any possibility of express service except such as may be obtained by skip-stop operation. On two-track lines trains making station stops at one-half mile intervals can maintain an over-all scheduled speed of about eighteen miles per hour. By means of skip-stop operation this can be increased to over twenty miles per hour. However, express trains can be operated, where a separate track is provided, at an over-all speed of twenty-five miles or more, depending upon the spacing and arrangement of express stations.

A four-track structure providing express service in both directions is undoubtedly the ideal structure for rapid transit railroads in large cities, but such construction generally presents important structural difficulties. A four-track elevated railroad is about fifty feet in width and requires either a private right-of-way of this width or a very broad street. One drawback to the construction of a four-track elevated railroad in a narrow street is that a portion of the light is shut off from the abutting buildings. On a street one hundred feet in width, however, such a structure offers no serious obstruction to the passage of light. In the construction of a four-track subway a clear width of eighty feet is required at express stations and if the street in which the four-track subway is to be built is less than one hundred feet in width, construction difficulties may arise. The adjacent buildings must be underpinned and sometimes easements under buildings must be secured which increases the cost. An express station on a three or four-track subway requires the use of either an underpassage or a mezzanine floor. When an underpass is used longer stairways are necessary and consequently the mezzanine floor type of station construction is much to be preferred. In this construction, however, the tracks must be lowered about ten feet at each station and this adds materially to the total cost.

Special conditions in the various cities where rapid transit railroads have been built have influenced the designers in their selection of type of structure.

SUBSURFACE STRUCTURES

Typical sections of various tubes and subways used both in foreign and American cities have been reproduced on Plate 23. The City of London was the pioneer in rapid transit construction, and the rapid transit system is composed almost entirely of tubes or tunnels. These tunnels were driven through the soft clay soil which underlies most of London and which is adapted to this economical method of underground construction. The tracks are at a considerable depth varying from twenty to almost two hundred feet below the surface of the street and therefore, in many cases, either elevators or escalators are required in order to make the stations accessible to the patrons of the system.

In Paris a rapid transit system, consisting largely of tunnels and subways, has been in operation for many years. The larger portion of the structure is a high

level subway placed as close as possible to the surface of the street. This type of structure is the one with which most Americans are familiar, being quite similar to many of the subways in this country.

New York City has constructed many miles of subway, most of which was built through solid rock. As this rock is hard and tunneling operations difficult the high level subway has been found to be the most satisfactory and economical type of construction for New York conditions and practically all of the subways have been constructed by the cut and cover method. Interference with traffic is kept at a minimum during construction as the openings in the streets are covered promptly with decking under which the work of building the subway structure is carried on. Steel I-beam frames spaced at frequent intervals are employed in the standard type of subway adopted by New York, and it has been found that this type of structure greatly facilitates the work of maintaining the decking on the surface of the street.

DEPRESSED TRACKS

The least costly of all subsurface structures is the depressed track type, where the tracks are laid below the street grade in an open cut. In suburban areas, where a private right-of-way of sufficient width can be secured, the earth is allowed to stand at its natural slope. Such construction is simply heavy grading and may be done with steam shovels.

Where any route is located so that a right-of-way must be of a minimum width, as may be expected within the urban area of a city, the earth must be held in place by masonry retaining walls. A typical section of this type of structure is shown on Figure 34, page 142. Bridges are placed at street crossings and the tracks are built at the same level below street grades as those in a high level subway. The estimated cost of a double track structure with masonry retaining walls is $3,500,000 per mile, exclusive of right-of-way. This cost is somewhat less than that of a two-track high level subway. In the built-up urban areas either a private right-of-way is required or a portion of valuable street space must be sacrificed if a depressed track structure is used. Open cut construction requires an ample storm water drainage system as heavy rainfalls of short duration may occur during the winter season.

HIGH LEVEL SUBWAYS

A subway consisting of structural steel frames, set on five-foot centers, with walls, roof and floor of concrete is recommended. The great advantage of this type lies in the fact that traffic can be maintained during construction at a relatively small expense as the structural steel frames may be used to support temporary street decking and car tracks.

The subway structures will be placed as closely as possible to the surface of the street so that the stairways leading from street surface to station platform will be as short as possible. High level subways will be so placed that in general there

will be but four feet of cover between the top of the structure and the surface of the street. The use of a third rail conductor instead of an overhead trolley wire is recommended for rapid transit lines. This type of conductor will necessitate less head-room and thus permit the construction of a relatively shallow structure. A typical section of a two-track high level subway is shown on Plate 24, and it will be noted that clearance above rail grade is thirteen feet. At the time the contract drawings are prepared careful studies should be made of the type of equipment to be operated through the subways, and modifications of subway design should be made to conform with the type of interurban cars which will be used. If interurban cars

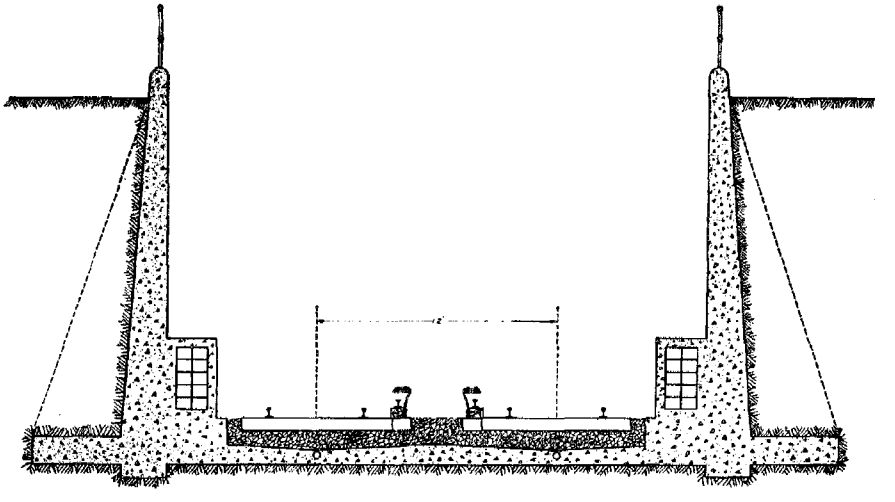

FIGURE 34. *Open cut—Depressed tracks—Typical cross-section.*

similar to those now in use should be adopted as a standard for interurban service an additional clearance of two feet, or a total clearance of about 15 feet, will be required.

Two estimates of cost of two-track high level subways have been prepared; one estimate for the downtown district, and the other for the residential districts. These respective estimates are $4,600,000 and $4,150,000 per mile. (See Table 25, page 162.) The high level subway is the most expensive of all structures herein described, and for this reason it is recommended that its use be limited largely to the downtown area.

LOW LEVEL SUBWAYS

The shales which underlie most of the hilly territory in Los Angeles are well adapted to the construction of low level subways by tunneling. A thorough study

of the possibilities of employing the tunneling method of construction on a large portion of the proposed rapid transit system has been made and it has been concluded that it is quite practicable and will provide the most economical underground construction. The use of this method where underground construction may be required in the residential districts is recommended. The track grade will come close to the surface of the ground at and near stations, at which points the high level subway structure will be used. Estimates of cost based upon a combination of tunnel and high level subway construction show that a two-track subway (high level at stations) can be constructed for $3,500,000 per mile, or $650,000 less than the cost of double track high level subway construction.

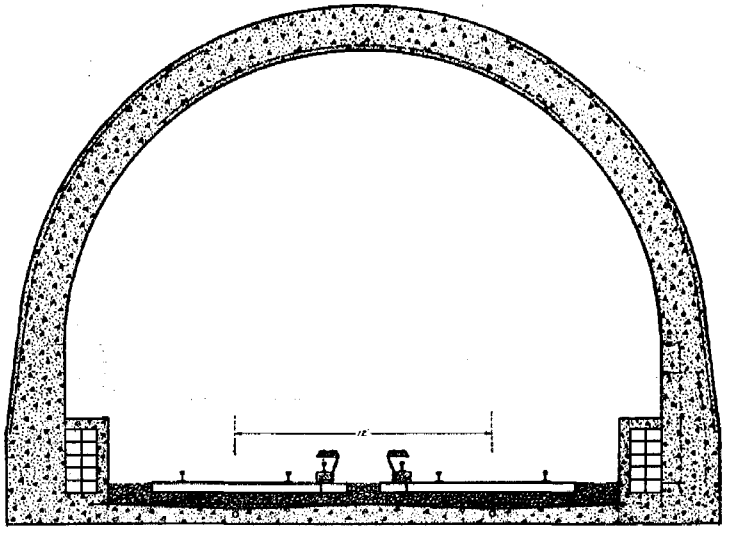

FIGURE 35. *Semi-circular type tunnel—Typical cross-section.*

Typical sections of double track tunnels are shown on Figures 35 and 36, pages 143 and 144. The semi-circular type is adapted to plain concrete construction—steel reinforcing being required for temperature stresses only—while the semi-elliptical type requires the use of heavy reinforcing. Either type is suitable for use in Los Angeles. The section shown on Figure 35 is similar to that of the Hollywood-Glendale Tunnel of the Pacific Electric Railway now under construction.

In addition to the factor of lower cost, tunnel construction has further advantages in that there will be but little interference with the utilities and drainage structures in the streets, and but very slight interference with street traffic. From the point of view of the public there is less nuisance in tunneling than in the construction of large buildings. Ordinarily the only visible evidence of low level subway

construction is the shafts which are required for the removal of the spoil and the delivery of construction materials. These shafts may be located at points along the street where they will cause little or no inconvenience.

Stations

Stations on the rapid transit lines have been tentatively located on a general basis of one-fourth mile spacing in the heavy loading zone of the central business district and one-half mile spacing in the intermediate and outlying districts. A plan of a typical station for a two-track subway in the downtown district is shown

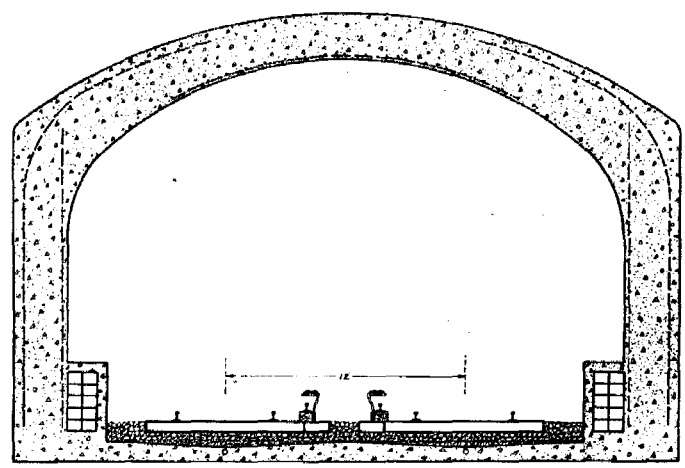

FIGURE 36. *Semi-elliptical type tunnel—Typical cross-section.*

on Plate 24. In general, the downtown stations should be designed so that entrances may be located on cross streets. It may be desirable to have some entrances leading to abutting property, and in this connection it is interesting to know that in a great many instances in New York City contracts have been made with abutting property owners so that entrances and exits are made through stores and other buildings. Stations should be designed so that the platforms may be extended eventually to a length of five hundred feet.

The subways proposed for the downtown area are double track lines, so that only side platforms will be required. At express stations on the three and four-track lines island platforms will be required, and a mezzanine floor or underpassage is contemplated to afford access to and egress from the island platforms.

It is recommended that particular care be given to the architectural, decorative and lighting features of the subway stations and that every effort be used to make

them attractive in appearance. Figure 37 shows an entrance to a station in Hamburg, Germany, and indicates the possibilities of architectural treatment for such structures. The stations should be provided with necessary toilet facilities, rest rooms and news stands. The cost estimates cover all of these features and provide for the construction of adequate and artistic stations.

Soil Conditions

A great many borings have been made throughout the Los Angeles area which determine the character of the underlying strata. In the level areas along the val-

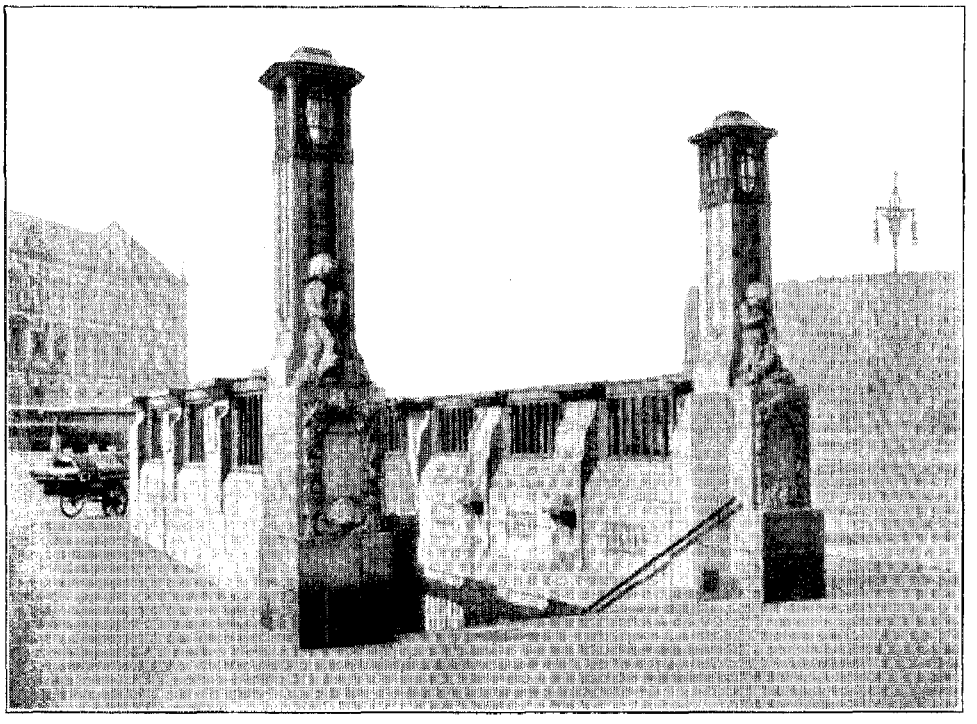

FIGURE 37. *Entrance to a rapid transit station—Hamburg, Germany.*

leys adjacent to the Los Angeles River and the Arroyo Seco, and also bordering the mountains in the Hollywood district, the top soil is underlaid by the deposits of clays and gravels of the Quaternary Period. The hills bordering the downtown district on the north and northwest are largely of the Fernando sandstone and shale formations of the Pliocene Period. In the old oil district lying between Lafayette Park and Elysian Park and also in other hilly sections of the city the underlying strata consist of Upper Puente Shales of the Miocene Period. These sandstones and shales are adapted to economical methods of excavation as many of them can be readily handled by steam shovels without the use of explosives. These materials also stand on an almost vertical slope for a period of time. Therefore underground

lines can be constructed on some of the recommended routes at a cost which will not be prohibitive although in excess of the cost of elevated construction.

Investigations indicate that there is nothing in the physical conditions in the Los Angeles area which prevents subway construction; in fact in many parts of the city the soil conditions are quite favorable to it. The bulk of this construction is planned for the downtown area where the surface is underlaid with alluvial soil containing sand and gravel.

Maintenance of Traffic

The requirements of the public may necessitate the maintenance of traffic during construction, and subway construction obviously must extend over a considerable

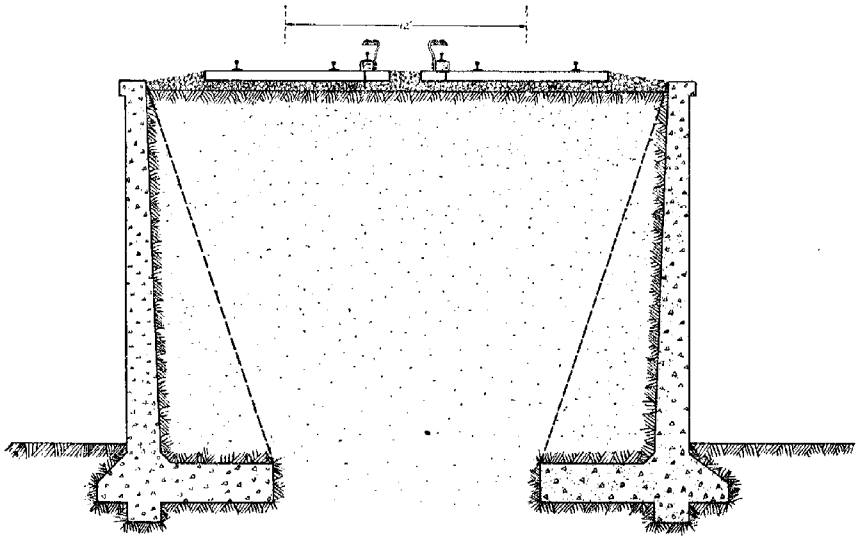

FIGURE 38. *Solid fill elevated—Typical cross-section.*

period of time. The cost of constructing a subway under traffic is much greater than would be the case if the contractor were permitted to close the street during the construction period. There are localities in Los Angeles where streets could be closed and the traffic diverted to adjacent streets. The saving which would result from this procedure would amount to nearly 20% of the cost of the work. The estimates of cost (see Chapter VI) are based upon the maintenance of street traffic by the use of decking. It is suggested that careful study be given to the possibility of rerouting traffic when the contracts are prepared so that the expense of maintaining traffic can be reduced wherever possible.

Building Protection

There will be comparatively little expense in underpinning the buildings adjacent to the proposed subways, due to the favorable soil conditions. It is likely that underpinning will only be required at the stations where the side walls of the subway structure may come within a few feet of the foundations of the buildings. Most of the large buildings have been erected on foundations which are somewhat below the depth of the proposed high level subways. Estimates include the cost of underpinning where, in our opinion, it will be required.

Underground Utilities

An investigation has been made of the extent of the underground utilities. In the downtown district there exists the usual network of conduits, pipe lines, sewers,

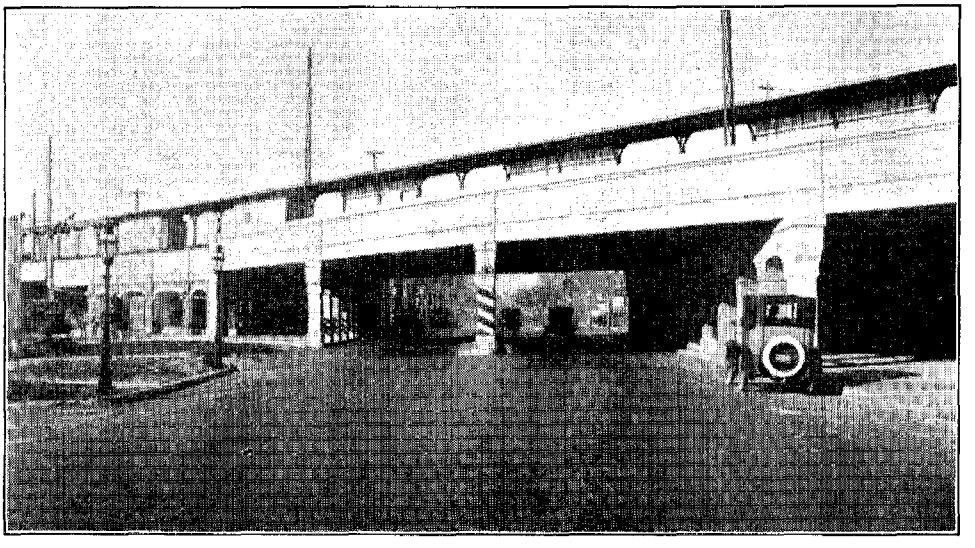

FIGURE 39. *Station on the Northwestern Elevated Railway in Chicago.*

etc., under the roadways of the streets. As the ground does not freeze, most of these utilities are located close to the surface of the street. This will greatly facilitate temporary re-location and maintenance of service during the construction period. A number of large underground transformer vaults are located in some of the streets for which subways are proposed. A few of these will have to be relocated. Pending actual subway construction, it is suggested that additional underground structures of this character be restricted to those streets in which no subways are to be constructed. The location of sanitary sewers will offer certain obstruction and some changes in the existing sewers may be necessary at the time the subways are constructed. While detail surveys have not been made, allowances for this work have been included in the estimates.

Storm Sewers

There are a number of existing storm sewers which may offer some obstruction to high level subway construction. The Los Angeles practice of constructing inlets with no catch basins for the collection of silt and street washings; the intensity of rainfall, combined with steep slopes both of the streets and of the sewers; the friable

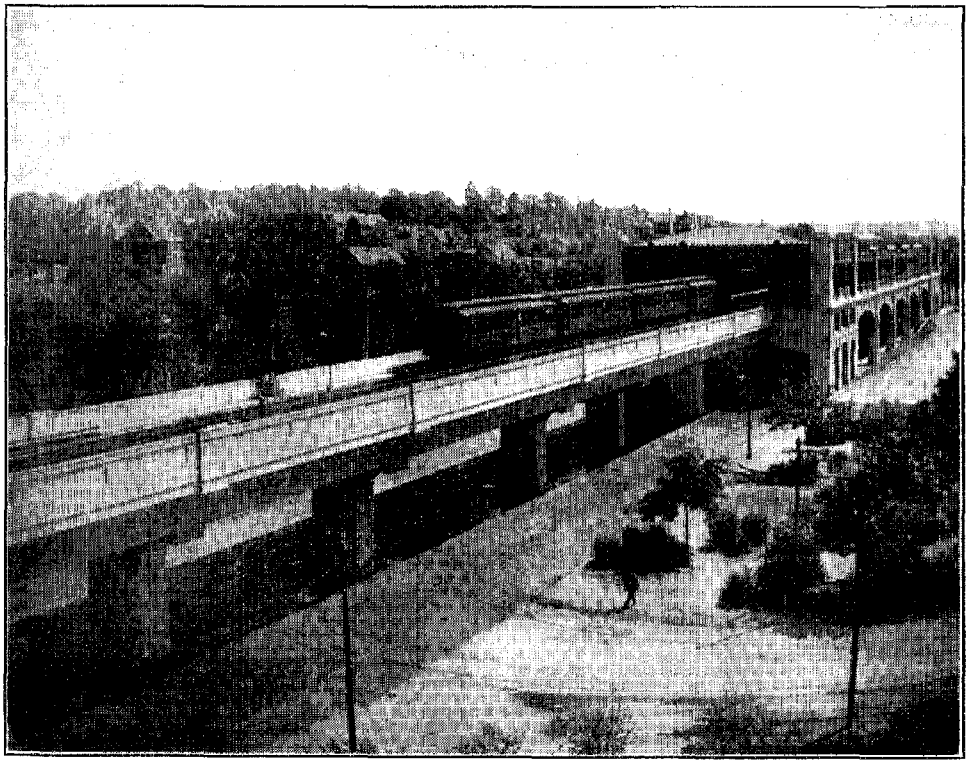

FIGURE 40. *Concrete elevated structure at Forest Hills, Boston.*

quality of the top soil; all insure the presence of large quantities of matter in suspension in the storm sewage. It follows that alterations in storm sewers which may affect the velocity of flow or change any other existing hydraulic conditions must be made with great care and only after close study. In general, the proposed subways can be constructed so as to avoid any disturbance of grades of the existing and proposed storm sewers.

A study was made of data on file in the City Engineer's office concerning storm sewers extending either along or across the proposed subways. Many of the existing and proposed drains are relatively close to the street surface and offer no obstruction whatever. However, a few of the larger sewers are at such a depth as to require special treatment.

There is only one storm sewer in the central business district which will interfere to any extent with subway construction. This sewer extends along Figueroa,

Fourth, Flower, Sixth, Mateo and Seventh Streets, to an outlet at the Los Angeles River. The portion along Sixth Street intersects the proposed subways at Olive Street where it is 4.4 feet in diameter and the invert is about 14 feet below street grade; at Broadway where it is 5.5 feet in diameter and the invert is about 14 feet below street grade; and at Main Street where the diameter is 6.2 feet and the depth to the invert is about 18 feet. It is planned to construct the proposed subways under this storm sewer.

In the residential districts the most important drain crossed by a proposed subway is the Sacatela Storm Drain. The plans for the improvement of the existing storm sewer system show a box sewer 7 feet by 10 feet crossing Vermont Avenue between Fourth and Fifth Streets, the invert being approximately 15 feet below the existing street grade. The proposed subway can be located above this new storm sewer by raising the grade of the street for a short distance on either side or, if this is not practicable, the subway can be carried below the proposed storm sewer.

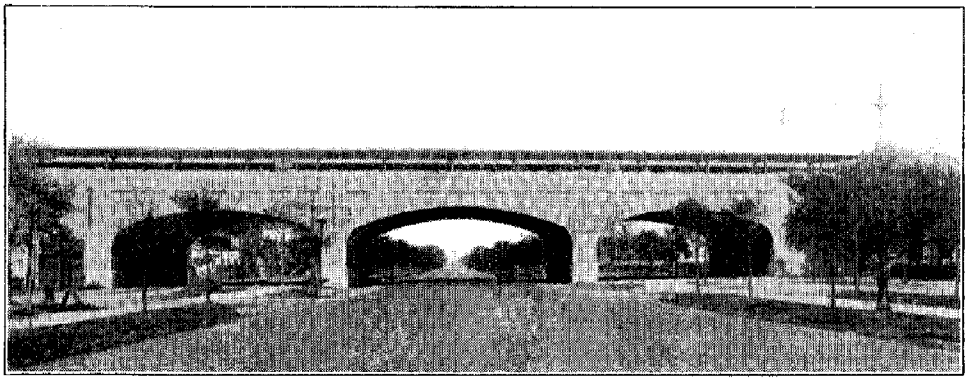

FIGURE 41. *Reinforced concrete elevated structure in New York.*

ELEVATED STRUCTURES

The usual type of elevated construction in the urban areas of cities is that which permits the use of the space beneath the elevated structure for other traffic. Steel or concrete, or steel encased in concrete is used in the construction of this type. The supporting columns may be placed on the curb with girders spanning the entire width of the roadway; or they may be placed directly under the structure in a double or single row. An open deck with the ties laid directly on the steel structure, or a solid floor with the ties laid either in concrete or ballast, may be used. Architectural treatment can be applied where an artistic appearance is desirable or plain structural steel can be used.

TRACKS ON SOLID FILL

A solid fill structure is probably best adapted to the suburban areas where land is relatively cheap and where a right-of-way, of sufficient width to contain an earth embankment with slopes conforming to the angle of repose of the material used in

the fill, may be purchased at moderate cost. This type is used in steam railroad work; it is simple in construction, relatively inexpensive and no particular engineering problem is involved other than the design of suitable bridges at highway crossings.

In areas where land is expensive it is generally more economical to confine the fill by masonry retaining walls to a restricted right-of-way than to purchase the additional land necessary to permit the materials to assume their natural slope. This is the most substantial type of an elevated railroad, requiring no maintenance other than ordinary track work, and affording a roadbed over which trains can operate with a minimum of noise. Moreover, it lends itself to decorative and architectural

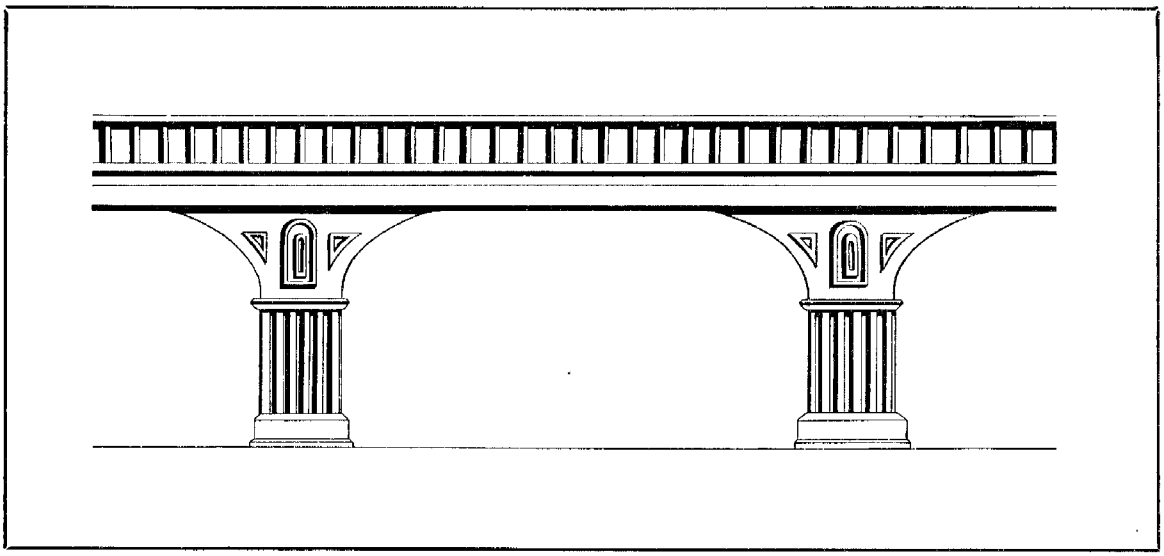

FIGURE 42. *Suggested concrete-steel elevated structure for Los Angeles.*

treatment. This type is somewhat expensive on account of the cost of constructing retaining walls; the estimated cost, exclusive of private right-of-way, being $1,500,000 per mile of double track. Figure 38, page 146, shows a section of a solid fill elevated structure with masonry retaining walls.

Where the highways to be crossed are one-half mile or more apart it is possible to modify this type in a manner that will materially reduce the cost. By lowering the track grade between the intersecting highways, a reduction in height to ten or twelve feet may be secured over a large part of the railroad. This modified type of elevated railroad is recommended for the elevation of the four-track Watts line of the Pacific Electric Railway. The location of stations at the summits is a material operating advantage in the deceleration of trains on approaching stations and in the acceleration of trains in leaving them. The estimated cost of a two-track elevated railroad on a solid fill with masonry retaining walls ten to twelve feet in height between stations is $1,300,000 per mile, exclusive of right-of-way. Many examples of solid fill track elevation are to be seen in the eastern cities where considerations

of safety and economical operation have led to the elevation of many of the tracks of the steam railroads. This type of structure has also been used on rapid transit railroads in both New York and Chicago. Figure 39, page 147, is a view of a station on the four-track solid fill elevated railroad through Rogers Park, a residential district of Chicago.

STEEL AND CONCRETE STRUCTURES

The usual type of elevated structure requires the erection of columns to support a deck upon which the tracks are laid. The structure may consist entirely of struc-

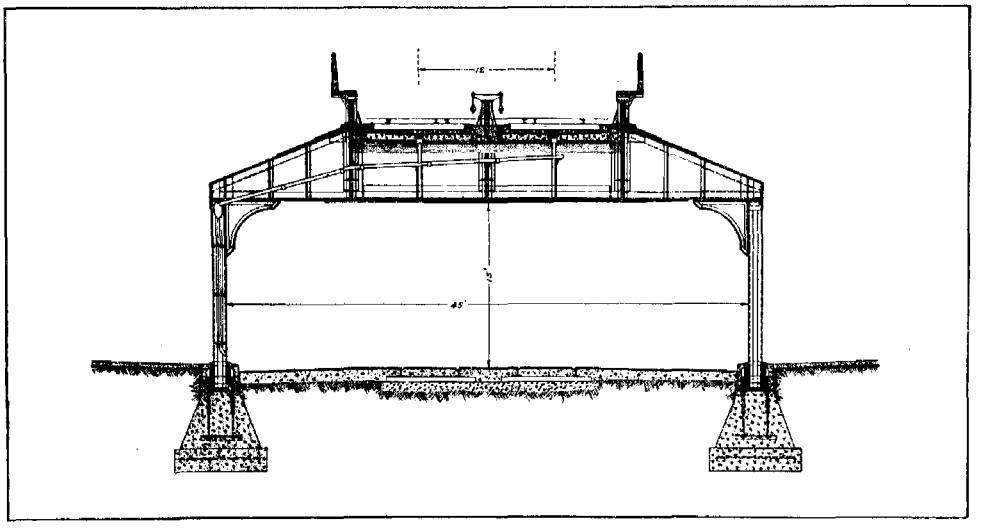

FIGURE 43. *Double column ballasted deck elevated railroad—cross-section between stations (Philadelphia type).*

tural steel or of structural steel encased in concrete, or it may consist altogether of reinforced concrete.

In residential sections the use of a ballasted deck steel encased in concrete structure is suggested. The advisability of using reinforced concrete structures has been considered and it was concluded that the steel encased in concrete type would be more attractive than the simple reinforced concrete structure, as the reinforced concrete structure is massive in appearance and shuts off a considerable amount of light from the abutting property.

The use of ballasted tracks on a steel elevated railroad structure minimizes the noise. By using concrete and steel it is possible to construct an elevated railroad which will harmonize with the appearance of the adjacent and neighboring buildings and there are a number of places in the Los Angeles area where such construction could be utilized. Figures 40 and 41, pages 148 and 149, show concrete elevated railroads in Boston and in New York, and convey an idea of the appearance of concrete elevated structures. An elevation of a steel encased in concrete elevated railroad structure suggested for Los Angeles is shown on Figure 42, page 150.

Location of Columns

The longitudinal spacing of columns, at and adjacent to street intersections, is somewhat dependent upon the width and location of intersecting streets. Between intersections the general practice is to provide a spacing of about fifty feet. With a two column structure the columns should be placed on the sidewalk at the curb line of the roadway if possible. With such an arrangement there will be no interference with street traffic as no part of roadway space will be occupied by columns. Figures 43 and 44, pages 151 and 152, show typical sections of a double column ballasted deck elevated structure with the columns located at the curbs.

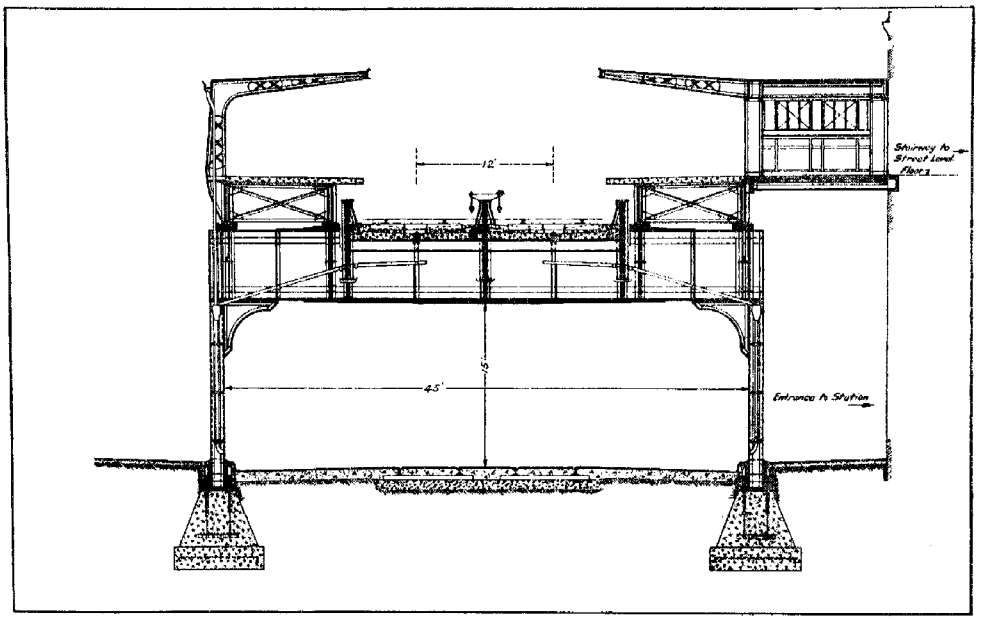

FIGURE 44. *Double column ballasted deck elevated railroad—cross-section at station (Philadelphia type).*

When the width of the roadway is more than fifty feet the distance between curbs requires transverse girders of great weight and depth. In such cases it may become necessary to place the columns in the roadway directly beneath the structure. While this is undesirable, interfering to some extent with the free movement of vehicular traffic, the columns may be spaced from twenty to twenty-four feet transversely, thereby providing space for two lanes of moving vehicles between them. Figure 45 shows a typical section of a three-track double column ballasted deck structure with columns located in the roadway.

The single column structure has been devised to meet the objection to the double line of columns in the roadway. The column consists of structural members and is about six feet in over-all width at the street level. Figure 46, page 154, shows a typical section of a two-track ballasted structure with single columns. This is an

excellent type for two-track railroads but it is not, in our opinion, adapted to three-track railroads. A photograph of the Frankford Elevated Railway in Philadelphia is shown in Figure 47, page 155, and gives an idea of the appearance viewed from the street. The estimated cost of single columns with ballasted deck varies but little from the double column type, being $1,350,000 per mile of double track.

For most of the three-track railroads the use of curb columns is contemplated, in order to avoid any interference with street traffic. However, where three-track lines are necessary and the roadway width is so great as to make the use of curb columns impracticable, the placing of columns just outside the street railway right-of-way is

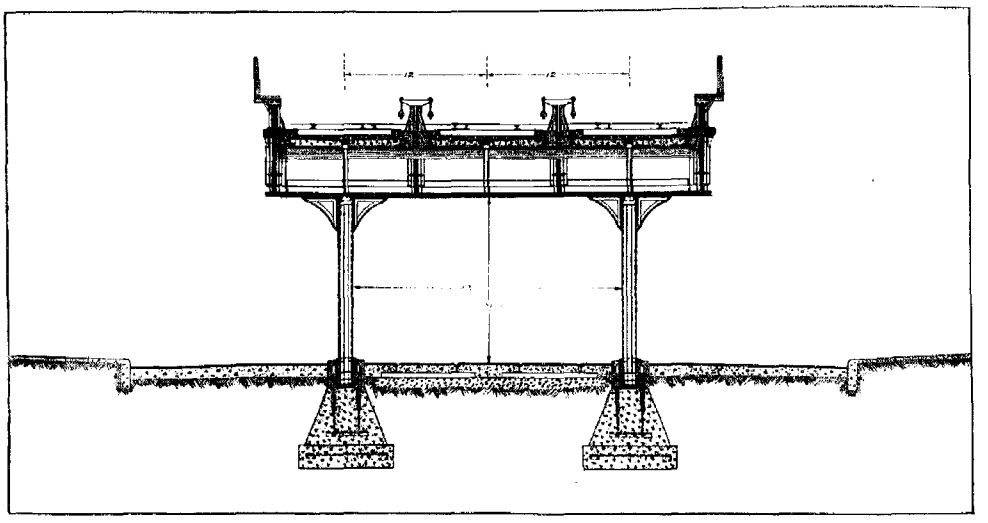

FIGURE 45. *Three-track ballasted deck elevated railroad with double columns in roadway—cross-section between stations.*

the most economical type of construction and is recommended. On double track lines the use of the single column type is recommended in most cases as it is much more pleasing in appearance than is the structure which spans a part of the street.

Ballasted Decks

One of the best examples of modern elevated railroad construction is the Frankford Avenue Elevated Railway in Philadelphia, which was placed in operation in the year 1922. This structure is built with solid decking throughout. Figure 48, page 156, shows the ballasted track and the balustrades. Figure 49, page 157, shows the ties embedded in concrete near the station platform. This construction simplifies the problem of cleaning as it permits flushing the top of the structure at the stations. Figure 50, page 158, presents a view of a portion of the railroad between stations.

The ballasted deck type of elevated can be constructed of plain structural steel, structural steel encased in concrete, or it may be constructed entirely of reinforced concrete. The arrangement of columns is the same as that for the open deck struc-

ture. The solid deck permits the laying of tracks in either rock ballast or in concrete. Ballasted track has the advantage of being comparatively free from noise, can be readily surfaced and has excellent riding qualities. When the ties are set in concrete a good riding track is secured of unusual permanence, which in itself reduces maintenance costs.

The estimated cost of a two-track double column ballasted deck steel elevated railroad is from $1,200,000 to $1,250,000 per mile and that of the same type constructed of steel encased in concrete is from $1,500,000 to $1,600,000 per mile.

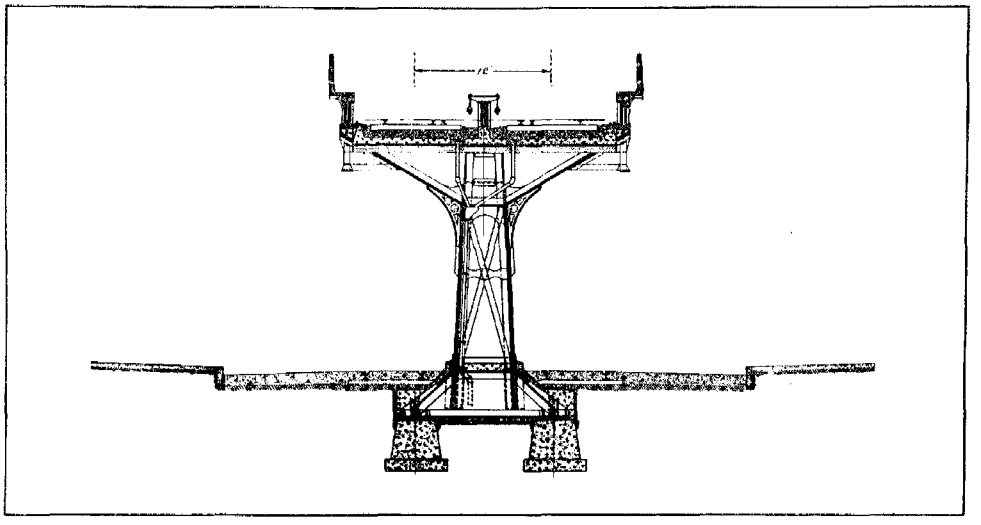

FIGURE 40. *Single column ballasted deck elevated railroad—cross-section between stations (Philadelphia type).*

Open Decks

The open deck type of elevated is constructed of structural steel and consists of supporting columns, cross girders and longitudinal track girders. The ties and rails are laid directly on the track girders. This is the type which was used in the original construction of elevated railroads in this country—first in New York and later in Chicago. In the construction of the early elevated railroads little attempt was made to secure freedom from noise or to design an attractive structure; and these more or less unsightly structures, some of which were built fifty years ago, are largely responsible for the prejudice which the average person has against the construction of elevated railroads.

The open deck structure has little to commend it except its comparatively low cost. It requires frequent painting and the operation of trains at high speed results in excessive noise. No structures of this type are recommended for Los Angeles. For the purpose of comparison, however, the cost of an open deck elevated railroad

in Los Angeles is estimated at from $800,000 to $850,000 per mile of double track. (See Table 25, page 162.)

Stations

The elevated stations should be located at points of intersection with street railway and bus lines in order to facilitate an interchange of passengers. In general they should be approximately one-half mile apart so as to make them readily accessible to the residents of the districts served. It is recommended that the stations be

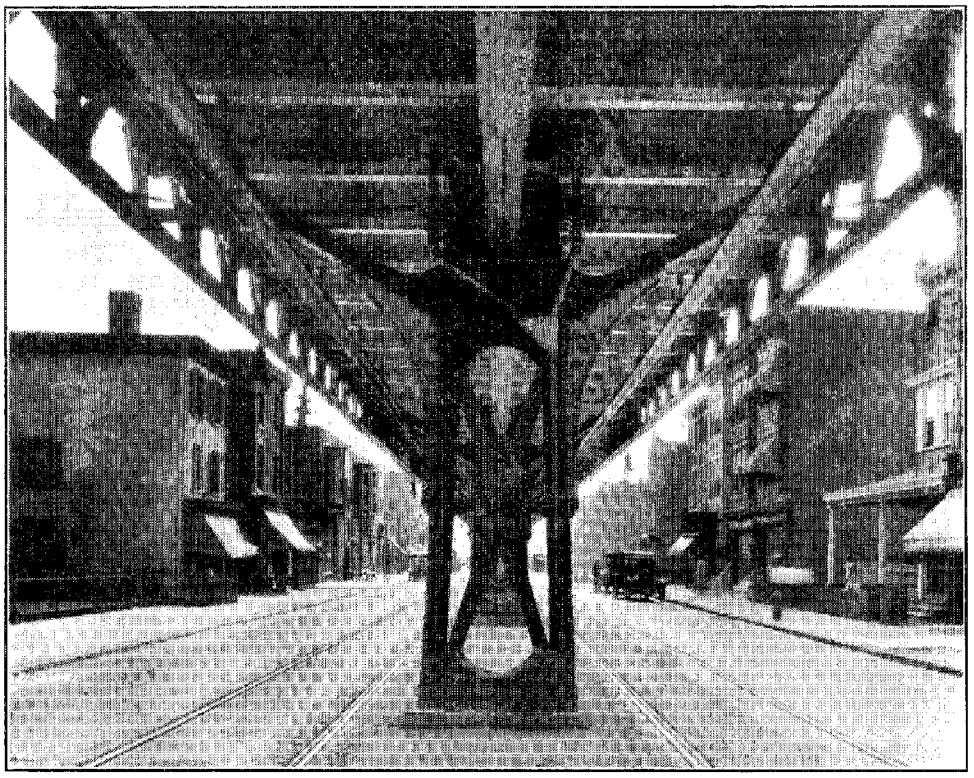

FIGURE 47. *Single column solid deck construction on the Frankford Elevated Railway in Philadelphia.*

constructed of concrete and that the interior and exterior finish be in keeping with the architectural standards of Southern California. The platforms and the canopies over the platforms should be of reinforced concrete and of durable construction. Space should be provided in all of the elevated stations for necessary rest rooms, comfort stations and news stands. Photographs of the exterior and interior of stations on the Frankford Elevated Railway in Philadelphia are reproduced (Figures 51 and 52, pages 159 and 160) to show the possibilities of attractive station design. Figure 53, page 161, shows the interior of one of the newer stations on the lines of the Chicago Rapid Transit Company.

BRIDGES

There are a number of points where the elevated railroads herein recommended will intersect important traffic arteries and boulevards. Especial care should be given to the design of the structure at such points. Allowances for architectural treatment have been included in the estimates of cost. Also, where viaducts and bridges are necessary, as in the vicinity of the Los Angeles River and the Arroyo Seco, the construction of substantial structures with some decorative treatment is recommended. The view of the Cambridge Bridge in Boston on Figure 54, page 162, shows the possibilities of decorative treatment for such structures.

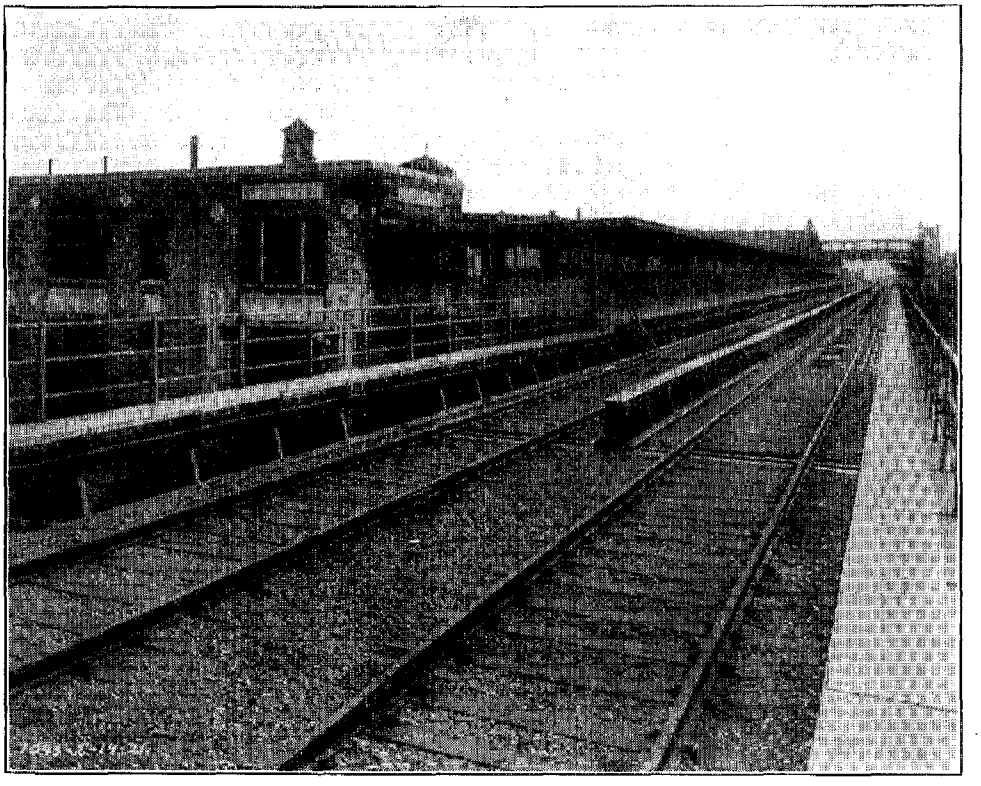

FIGURE 48. *Ballasted deck construction on the Frankford Elevated Railway in Philadelphia.*

SUBSURFACE SIDEWALKS

The serious traffic congestion on sidewalks resulting from the concentration of people in a very limited area is a problem which has become the subject of much discussion in large cities. The construction of large buildings is one of the factors contributing to this congestion, and additional sidewalk facilities above or below the streets have been proposed. In Chicago the construction of elevated sidewalks at the second floor level in a portion of the downtown area has been suggested. While such a plan may be impracticable, the construction of subsurface sidewalks in con-

nection with rapid transit facilities is entirely feasible and practical. Such sidewalks connecting Broadway with Spring and Hill Streets, so as to make the stations of the Broadway subway directly accessible to these parallel streets, and at the same time reduce travel on the sidewalks, should receive careful consideration when plans are being prepared for the Broadway subway. Such subsurface sidewalks may be built at a relatively small cost inasmuch as they will be near the street surface, probably directly underneath the existing sidewalks.

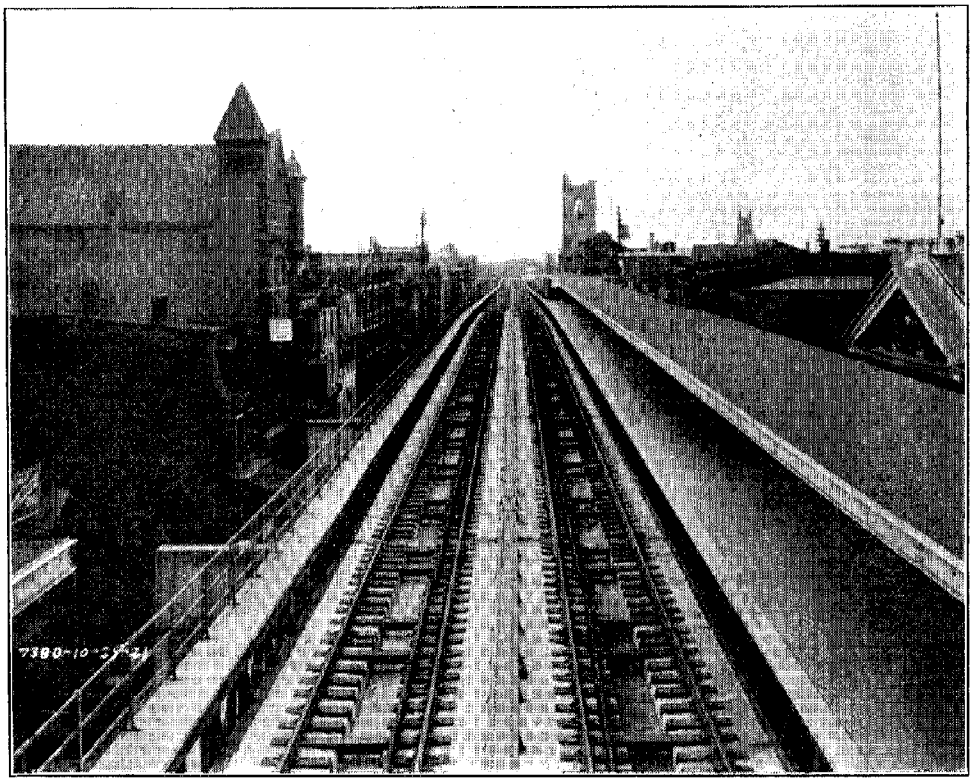

FIGURE 49. *Concrete track construction at station on the Frankford Elevated Railway in Philadelphia.*

EQUIPMENT

Tracks

The use of standard gauge tracks on all the lines of the proposed rapid transit system is recommended. The ties should be embedded in concrete at stations (see Figure 49), so as to facilitate cleaning, regardless of the materials used for ballast elsewhere. The use of the third rail is recommended in the urban area, either the over or under-contact type properly protected whichever may be selected as standard for the system. Particular care should be taken in surveys so as to secure good track alignment at the time of initial construction as the correction of faulty alignment is costly after a line is in operation. The rapid transit routes have been laid

out to serve certain districts and deviations of six hundred or eight hundred feet from the alignment proposed will not impair their usefulness as far as service considerations are concerned. It may be found in some cases that a private right-of-way could be secured, adjacent to some of the streets on which a rapid transit route is proposed, which would permit better alignment and reduce the cost of construction. Should such a situation arise a suitable modification of the recommended route should be made. Particular attention should be given to curvature in the line and,

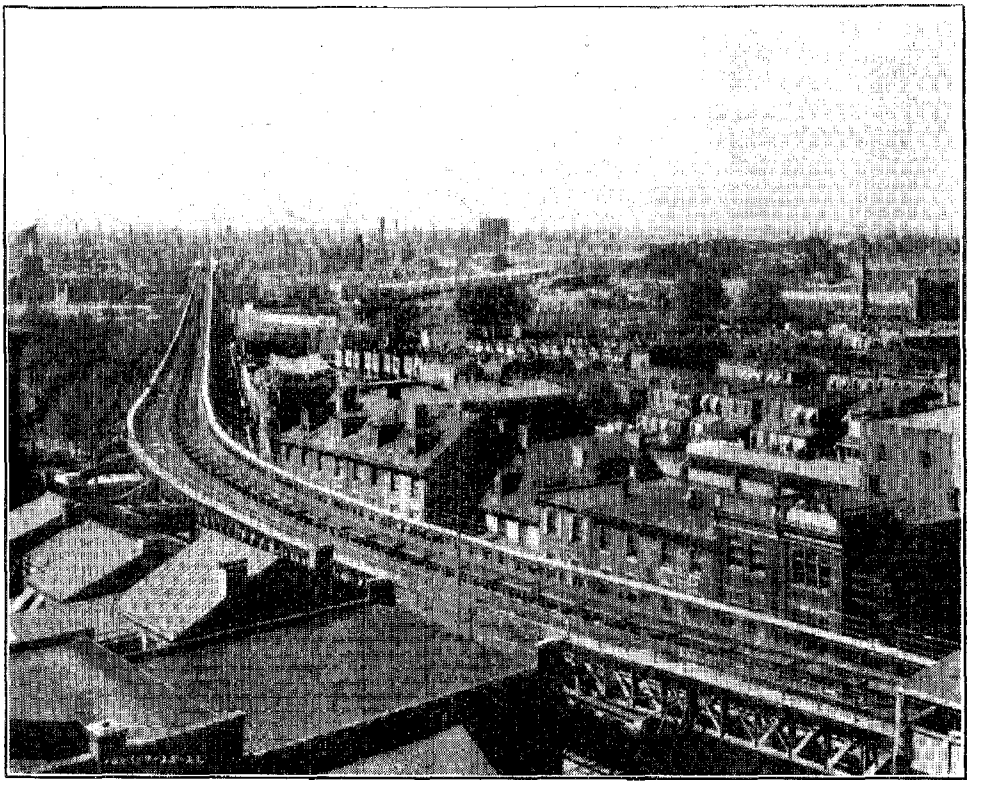

FIGURE 50. *The Frankford Elevated Railway in Philadelphia—between stations.*

as far as is consistent with cost consideration, the curves should be such as to permit safe operation of trains without a material decrease in speed.

Cars

Cars of all steel construction and of modern design are recommended for the proposed rapid transit system. These cars should be equipped with side doors, mechanically operated, located at the center and at quarter points, and with end doors so that passengers may pass from one car to another. The use of mechanically operated side doors facilitates the loading and unloading of passengers and diminishes delay at stations. The present standard car on the Brooklyn-Manhattan Transit System in New York City should be considered when adopting a standard car. This

car is about ten feet wide and sixty-seven feet long, and has a seating capacity of over ninety.

The type of equipment in use on rapid transit systems has been gradually changing. In the first years of operation trains were made up of motor cars and trailer

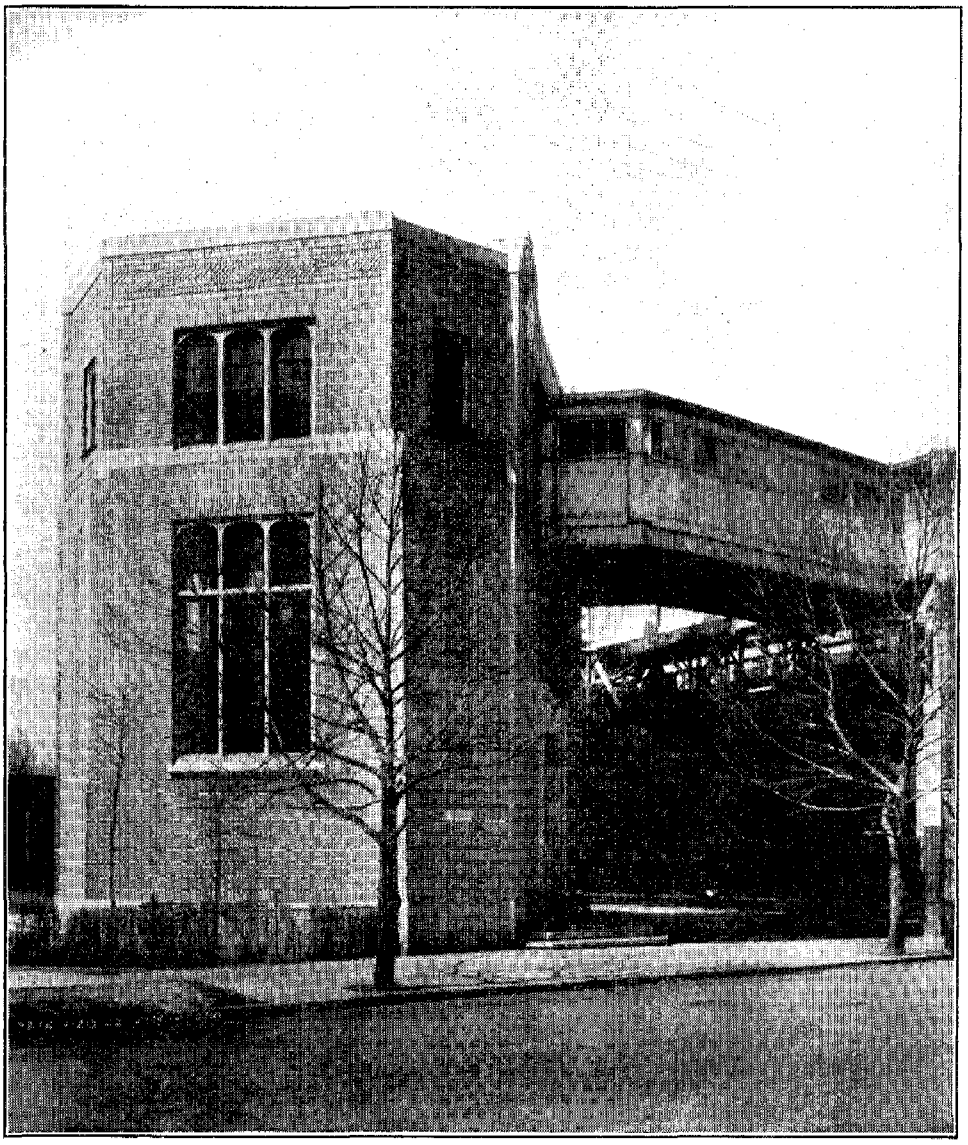

FIGURE 51. *Exterior of station on Frankford Elevated Railway in Philadelphia.*

cars and in some instances they consisted of half of each. The Brooklyn-Manhattan Transit Company has in recent years adopted the use of full motor equipment on all of its rapid transit trains. This permits a somewhat faster operation and is excellent insurance against the stalling of a train in case of temporary failure of one set of motors. On a rapid transit system this is of primary importance and the utili-

zation of full motor equipment on all the urban rapid transit lines of the proposed system is recommended.

Changes will be required in the present type of passenger cars used on the interurban lines which will operate through subways in the urban area. As several years

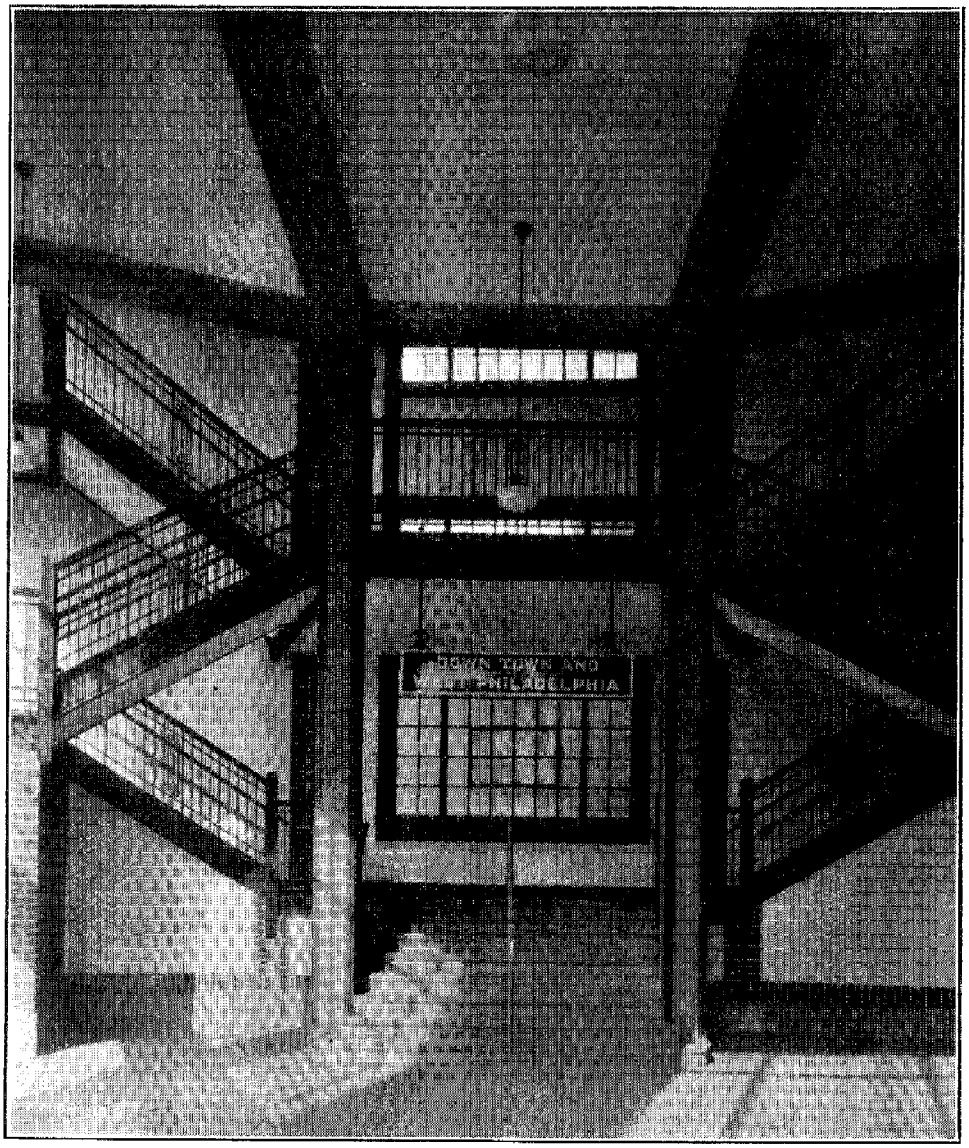

FIGURE 52. *Interior of station on Frankford Elevated Railway in Philadelphia.*

must elapse before any of the proposed subways can be completed, there will be ample time for changing equipment on the interurban lines. The cars now in use can be transferred to the interurban lines which will not operate in subways and new cars can be provided which will be suitable for operation both on the interurban lines and in the urban rapid transit subways. (See *High Level Subways,* page 141.)

Yards and Shops

Storage yards and repair shops as well as terminal facilities will be required for the proposed rapid transit lines. Allowances for these facilities are included in the estimates of cost but, as it is impracticable to make any definite location of them at this time, such location, as well as the design, should be a part of the construction program.

Power

The purchase of power is recommended and therefore no allowance for power plants is included in the estimates of cost. Substations, with the required electrical distribution system, have been included in the estimates of cost.

FIGURE 53. *Interior of station on the Northwestern Elevated Railway in Chicago.*

Signals and Interlocking Plants

Automatic block signals and interlocking plants are necessary to insure safety of operation and to facilitate the operation and dispatching of trains. It is recommended that all switches under control of interlocking plants be operated by electro-pneumatic mechanisms of approved design.

COMPARATIVE ESTIMATES OF COST

For the purpose of convenient comparison the estimated costs of the various structures, per mile of double track, which have been stated under various headings in this chapter, are presented in Table 25, page 162.

TABLE 25

Comparative Estimates of Cost

Double Track Rapid Transit Structures
Including Two Stations Per Mile and Excluding Right-of-Way

Subsurface Structures	*Cost Per Mile of Road*
Depressed track (with retaining walls)	$3,500,000
High level subway (downtown district)	4,600,000
High level subway (residential district)	4,150,000
Subway (tunnel construction between stations)	3,500,000
Elevated Structures	
Solid fill elevated (with retaining walls)	1,500,000
Steel Encased in Concrete	
Ballasted deck, double columns at curb	1,600,000
Ballasted deck, double columns in roadway	1,500,000
Steel	
Ballasted deck, double columns at curb	1,250,000
Ballasted deck, double columns in roadway	1,200,000
Ballasted deck, single column in roadway	1,350,000
Open deck, double columns at curb*	850,000
Open deck, double columns in roadway*	800,000

* None recommended.

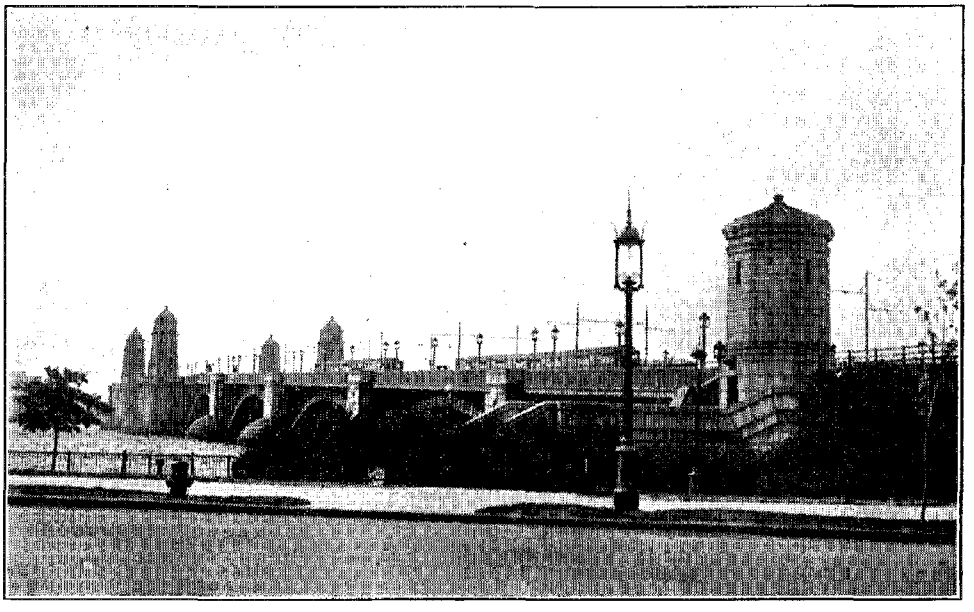

Figure 54. *Cambridge Bridge over the Charles River—Boston Elevated Railway.*

CHAPTER VIII

METHODS OF FINANCING

Riding Habit

The number of revenue passengers carried on the local lines of the Pacific Electric Railway has been estimated and added to the number of revenue passengers carried by the Los Angeles Railway for each year. This total was then divided by the population of the area served in each respective year in order to determine the number of rides per capita. The results are shown in Table 26.

TABLE 26

Annual Revenue Passengers in Los Angeles

Years 1912-1923

For the Year	*Pacific Electric Railway*	*Los Angeles Railway*	*Total Revenue Passengers*	*Rides Per Capita*
1912.....	21,300,000	129,200,000	150,500,000	367
1913.....	22,800,000	137,900,000	160,700,000	376
1914.....	22,000,000	133,000,000	155,000,000	350
1915.....	20,400,000	123,800,000	144,200,000	314
1916.....	19,400,000	117,300,000	136,700,000	272
1917.....	20,300,000	123,100,000	143,400,000	262
1918.....	21,600,000	130,400,000	152,000,000	258
1919.....	24,000,000	145,400,000	169,400,000	267
1920.....	29,600,000	179,200,000	208,800,000	308
1921.....	34,500,000	200,900,000	235,400,000	302
1922.....	36,200,000	219,000,000	255,200,000	284
1923.....	40,900,000	247,600,000	288,500,000	283

It will be seen that the period for which local statistics are available is not of sufficient length to establish any definite trend and for this reason it is necessary to compare the rides per capita in Los Angeles with those of other cities. Curves for the cities of Chicago and Philadelphia (1895-1923) together with a curve for Los Angeles have been plotted on Figure 55, page 167.

In the year 1895 the population of Philadelphia was about the same as the present population of Los Angeles and the riding habit was 194 revenue rides per capita. The general trend of the Philadelphia curve has been consistently upwards and in 1923 the rides per capita had reached 380. The effect of the improved street railway service and the use of the initial rapid transit line is clearly shown by the upward trend of the Philadelphia curve after 1910.

The Chicago curve indicates a similar increase in riding habit. The population was about 1,400,000 in 1895, at which time the annual revenue passenger traffic developed only 190 revenue rides per capita. Since 1895 the number of rides per capita increased steadily, reaching 357 in 1923. A forecast of the revenue rides per capita, which was made for Chicago in 1915, has since proved to be remarkably close. This Chicago forecast is also shown on Figure 55, page 167.

The experience of all large cities has developed the fact that the revenue rides per capita increase at a greater rate than does the population, as a result of the multiplicity of activities. As a city grows in population it also grows in size and throughout its area various industrial, commercial and cultural centers are developed. All of these factors tend to accelerate the growth in passenger traffic. Climatic conditions, unusual activity or depression in business, changes in rates of fare and improvement or deterioration of service affect the volume of passenger traffic and are therefore reflected in the number of rides per capita.

Some of the variations in the curves on Figure 55, page 167, may be traced to changes in fare rates. Revenue rides per capita decrease when the rate of fare is made higher and increase when it is lowered. This fact is very well established by the statistics of street railway properties in cities where fares have been changed. In several instances fares have fluctuated so that it is possible to make close estimates of the effect produced by increasing or decreasing the rate of fare.

In estimating the probable trend of riding habit in Los Angeles the following factors have been considered:

1. The uniformity of climatic conditions throughout the year;
2. The improvement in service which will result from the provision of rapid transit facilities and their co-ordination with existing street railway and motor bus lines;
3. The maintenance of a flat fare on the lines of the co-ordinated system; and
4. The fact that any material increase in fare, either by increasing the rate itself or by making a charge for transfers, will cause a decrease in passenger traffic.

With these and other factors in mind a forecast of the riding habit in Los Angeles (shown on Figure 55, page 167) has been prepared, based upon a uniform increase of two rides per capita per annum. This increase is, in our opinion, warranted by Los Angeles conditions, is similar to the Chicago forecast and generally compares to the riding habit of other large cities.

PROBABLE NET REVENUES OF PROPOSED UNIFIED SYSTEM

Any plan for the financing of rapid transit lines must necessarily be predicated upon careful estimates of future revenue and expenses. In the following discussion,

it is assumed that all of the local transportation facilities within the urban area of Los Angeles will be unified and co-ordinated.

Utilizing the forecast of riding habit and the forecast of population growth which was discussed in Chapter I, estimates have been made of the probable transportation revenues of the unified system. Estimates of net revenues based on five-cent fares and on eight-cent fares, with free transfers in both cases, have been made for each year up to and including the year 1950.

An estimate of operating expenses of the system should properly include an adjustment for the lower cost of operation on rapid transit lines. Since Los Angeles is without rapid transit lines it is necessary to use the statistics of rapid transit systems in other cities in estimating car mile costs. Operating costs of the rapid transit lines in both New York and Chicago covering a long period of years are available. A comparison of these costs with those of the street railway lines in those cities shows that the operating expenses per car mile on the rapid transit lines are from 25 to 35 per cent lower than on the street railway lines.

Statistics show that each of the rapid transit systems in this country carries fewer revenue passengers per car mile than do the surface lines in the same city. This is a direct result of the longer average ride on the rapid transit lines. With the same seating capacity and standard of loading, the doubling of the average length of ride will reduce the number of revenue passengers per car mile by half. But the rapid transit car has much greater capacity than the street car. The rapid transit car suggested for Los Angeles has nearly double the seating capacity of the average Los Angeles Railway car, so that the average ride on rapid transit trains can be much longer than that on the surface lines and, with the same standard of loading as at present, the number of passengers per car mile will remain practically constant. Assuming a condition where one-half of the traffic is carried on rapid transit trains, the average length of haul can be substantially increased without increasing the operating ratio.

The relative proportion of traffic on the surface lines and on the rapid transit lines cannot be predicted until Los Angeles adopts a transit policy and outlines a construction program. If no rapid transit lines are constructed and transportation must continue to be supplied by surface lines only, the average length of ride will increase, and in that event the number of revenue passengers per car mile operated will probably decrease. On the other hand, if Los Angeles builds rapid transit lines which are properly co-ordinated with the various surface lines so as to make a city-wide unified transportation system, then a large number of passengers will be carried on the high speed lines which will practically overcome the increasing length of ride with larger cars and tend to keep the operating ratio of the entire system more or less fixed.

The operating expenses per car mile, exclusive of taxes, on the Los Angeles Railway system covering the period from 1912 to 1923 are given in Table 12, page 51. This table shows that the costs increased in the years of high prices following the War to a peak in the year 1921. Since 1921, they have remained practically station-

ary and the indications are that the high point has probably been reached. As the Pacific Electric Railway accounts show the result of the combined operation of street railway, interurban and freight traffic, they cannot be used as a basis for estimating future operating costs of the proposed urban system. It has been concluded, therefore, that the operating cost per car mile, exclusive of taxes, on the street railway lines will be maintained at about $0.28 (the present level) and this figure has been used as a basis for estimating the probable expenses on the surface lines.

As pointed out above, the operating expenses per car mile are less on rapid transit railroads than on street railways, and therefore when a substantial portion of the load is transferred from surface to rapid transit lines the average cost per car mile over the entire system should be reduced. It is our opinion that, with flat fares and free transfers and with improved service, the initial operating ratio of the proposed unified transportation system will not exceed 80%, and that the initial ratio will then decrease.

Estimates of the net revenues of the proposed unified system in the urban area based on a five-cent fare with free transfers have been carefully computed and the results are given in Table 27.

TABLE 27

ESTIMATED NET REVENUE OF THE PROPOSED UNIFIED SYSTEM
FIVE-CENT FARE WITH UNIVERSAL TRANSFER

Calendar Year	*Net Revenues*
1926	$3,580,000
1927	3,750,000
1928	3,930,000
1929	4,110,000
1930	4,290,000
1931	4,480,000
1932	4,660,000
1933	4,850,000
1934	5,040,000
1935	5,230,000
1936	5,430,000
1937	5,620,000
1938	5,820,000
1939	6,020,000
1940	6,220,000
1941	6,430,000
1942	6,640,000
1943	6,840,000
1944	7,060,000
1945	7,270,000
1946	7,480,000
1947	7,700,000
1948	7,920,000
1949	8,140,000
1950	8,370,000

An increase in the fare rate to eight cents (or 60%) will likely result in a decrease in riding habit of 20% or more. However, there are a number of items whose totals will remain constant, such as taxes, depreciation on structures and superintendence. With a decrease in the number of car miles operated (resulting from the decreased riding habit) the unit car mile costs will be increased; in addition, it is highly probable that the public will require and should obtain an improved standard of service when paying an eight-cent fare. The estimates of net revenues have been prepared after full consideration of these factors. Table 28 shows the estimated net revenues of the proposed unified system based on an eight-cent fare.

TABLE 28

ESTIMATED NET REVENUES OF THE PROPOSED UNIFIED SYSTEM
EIGHT-CENT FARE WITH UNIVERSAL TRANSFER

Calendar Year	*Net Revenues*
1926	$ 8,840,000
1927	9,340,000
1928	9,760,000
1929	10,220,000
1930	10,690,000
1931	11,120,000
1932	11,600,000
1933	12,030,000
1934	12,530,000
1935	13,030,000

The foregoing estimates relate exclusively to the unified system for the urban area of Los Angeles. The construction of express track facilities for interurban

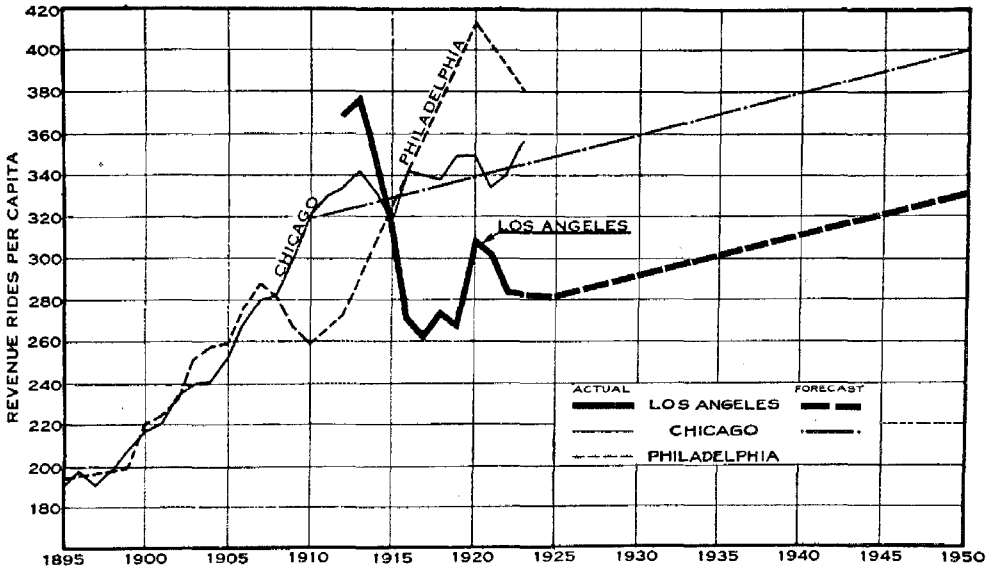

FIGURE 55. *Rides per Capita in Chicago, Philadelphia and Los Angeles.*

railway trains entering and leaving Los Angeles will bring about an appreciable saving in the running time on these routes. Obviously, there will be substantial operating economies and an estimate has been made of the annual saving in operating expenses on all of the interurban lines so affected. It has been assumed for the purpose of preparing these estimates that the major portion of the initial construction program, as far as the lines accommodating interurban trains are concerned, will be completed by the year 1930. In preparing these estimates, it has also been assumed that the increase in service on the interurban lines will be proportionate to the increase in revenue traffic in the urban area. A tabulation of these estimates is shown in Table 29.

TABLE 29

ESTIMATED ANNUAL OPERATING ECONOMIES
ON INTERURBAN RAILWAY LINES
FROM REDUCED RUNNING TIME THROUGH URBAN AREA

Calendar Year	*Annual Savings in Operating Expenses*
1930	$310,000
1931	320,000
1932	340,000
1933	350,000
1934	360,000
1935	370,000
1936	390,000
1937	400,000
1938	410,000
1939	420,000
1940	440,000
1941	450,000
1942	460,000
1943	480,000
1944	490,000
1945	500,000
1946	520,000
1947	530,000
1948	540,000
1949	560,000
1950	570,000

These savings in interurban operation should be used by the Pacific Electric Railway Company to support the capital required for additions to its properties in the urban area, which will be used jointly by the rapid transit trains of the unified system and the interurban trains.

THE FINANCIAL PROBLEM

Funds Required

The estimated costs of the work recommended FOR IMMEDIATE CONSTRUCTION

are in Chapter VI. The following statement shows a distribution of these estimates:

	Structure Only	*Tracks and Appurtenances*	*Equipment*	*Total*
RAPID TRANSIT LINES				
Subways	$49,773,000	$ 6,176,000	$ 4,350,000	$ 60,299,000
Elevated Railroads	32,925,000	9,157,000	10,850,000	52,932,000
	$82,698,000	$15,333,000	$15,200,000	$113,231,000
SURFACE LINES				
Street Railways	.....	$ 4,006,000	$ 1,800,000	$ 5,806,000
Bus Routes	.....	.....	1,200,000	1,200,000
UNIFIED SYSTEM TOTAL	$82,698,000	$19,339,000	$18,200,000	$120,237,000
PACIFIC ELECTRIC EXPANSION				13,148,000
Total				$133,385,000

Valuations of Existing Properties

The Street Railway Survey has furnished the following tentative estimates of the "Historical Cost of Reproduction" which is the element of value often used by the California Railroad Commission as a basis for determining rates:

Properties	*Historical Cost of Reproduction*
Pacific Electric Railway Local Lines (see Figure 56, page 170)	$ 12,000,000*
Los Angeles Railway	39,100,000†
	$ 51,100,000
Hollywood Tunnel (Estimated Cost)	3,900,000
Total	$ 55,000,000

* As of May 31, 1924.
† As of June 30, 1924.

In the absence of other authoritative data, $55,000,000 is taken as the value of existing properties which would compose the original unified system. The carrying charges are estimated at $3,300,000 which sum must be deducted from the net operating revenues in order to determine the amount available to support the capital required for the development and expansion of the initial system. We have been advised that the interest rate which the private companies would have to pay for additional capital would be at least seven per cent. For estimating interest requirements on the new investment, this seven per cent rate has been assumed.

Interest Requirements

The estimated investment in the unified system after the completion of work described FOR IMMEDIATE CONSTRUCTION, together with the annual interest charges,

is as follows:

	Investment	*Interest*
Existing Properties	$ 55,000,000	$ 3,300,000
Street Railway and Bus Lines	7,006,000	490,420
Rapid Transit Tracks, Appurtenances, Equipment, etc.	30,533,000	2,137,310
	$ 92,539,000	$ 5,927,730
Elevated Railway Structures	32,925,000	2,304,750
	$125,464,000	$ 8,232,480
Subway Structures	49,773,000	3,484,110
Total	$175,237,000	$11,716,590

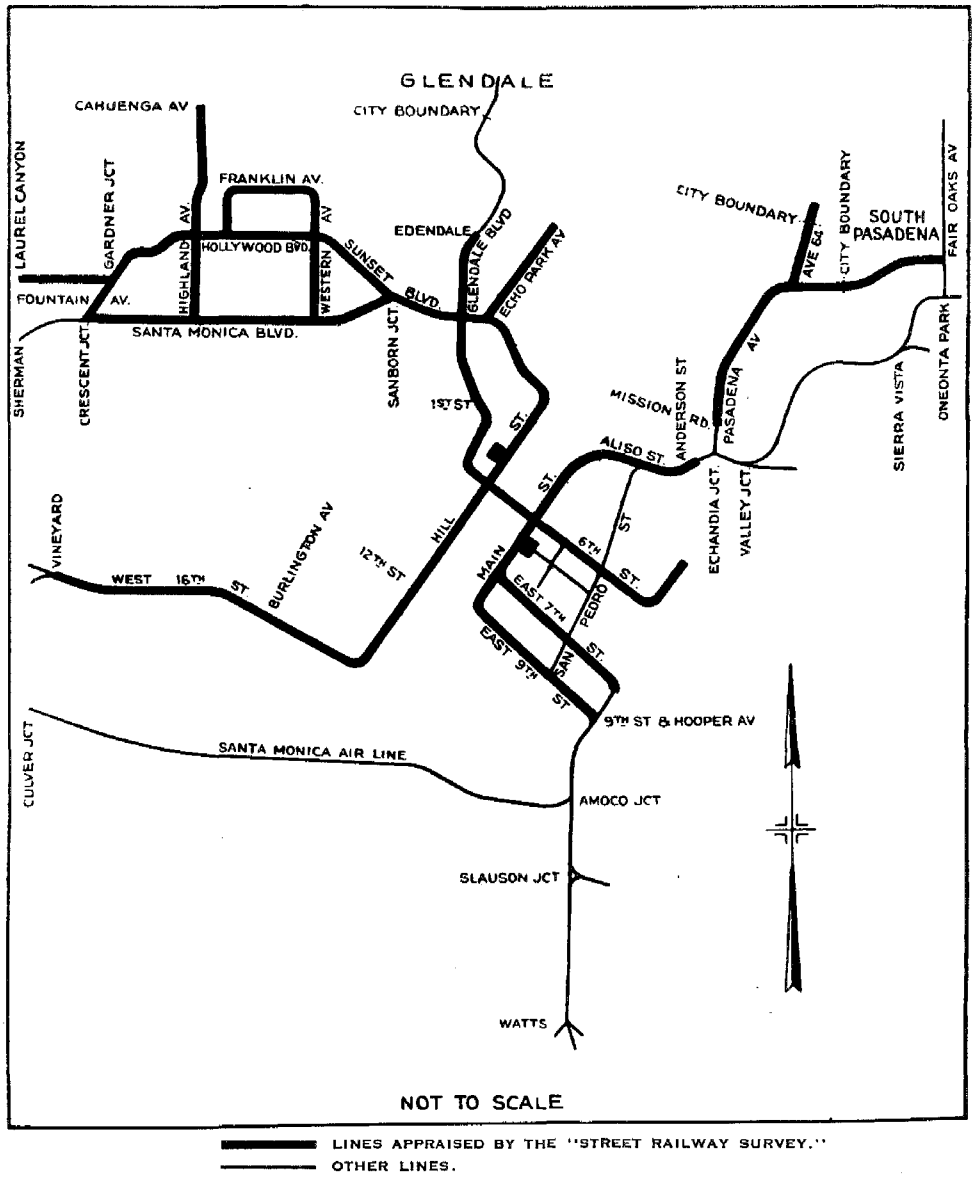

FIGURE 56. *Local Lines of the Pacific Electric Railway as used in this Report.*

In a sound financial plan, adequate provision must be made for sinking funds to retire indebtedness at maturity and an allowance in the rate of fare should be made for this purpose. Such sums must be added to the above figures in making the final computations.

FINANCING BY PRIVATE CAPITAL

Relation of Earnings to Additional Capital

It is estimated that about ten years will be required to complete the work recommended FOR IMMEDIATE CONSTRUCTION. At the end of this period (1935) the annual net revenues have been estimated on different rates of fare, as follows:

Fare	*Net Revenue*
5 cents	$ 5,230,000
6 cents	7,350,000
7 cents	9,850,000
8 cents	13,030,000

From the foregoing it is at once seen that the seven-cent fare is insufficient and that an eight-cent fare is required to support the investment in the properties as expanded, should the entire program of expansion be carried by the car riders. Such a rate of fare is not recommended and if placed in effect would likely prove harmful to the city as a whole.

The six-cent rate is sufficient to carry the investment in street railway and bus lines, as well as the tracks and cars, with necessary appurtenances, required for all the rapid transit lines; but insufficient to support the investment for the subway and elevated structures themselves. Therefore, if these permanent structures are provided by use of public funds, the revenues at six cents can equip them and operate the entire system. As the average fare today is about 5.3 cents, an increase to six cents is not excessive when the great improvement in service is considered. However, if the present rates of fare are continued it appears that the revenues will support the existing system, and provide for some expansion of street railway and bus facilities and for the equipment of a more modest program of rapid transit construction than is recommended. The conclusion is that a part of the work proposed herein must be financed by public means.

The operating economies which will result from facilitating the movement of freight traffic on the Pacific Electric Railway northeast-southeast system will be largely dependent upon the volume of that traffic. It is to be noted, however, that the economies in operating expenses of the interurban trains, which will operate over the proposed rapid transit structures, will support an investment of over $5,000,000 by the year 1935. These savings in interurban operation may be used by the Pacific Electric Railway Company to support the capital required for additions to

its properties, in the urban area, which will be used by the rapid transit trains of the unified system. It is expected that the operating economies in handling freight traffic will be sufficient to warrant the assumption by the Pacific Electric Railway Company of the share of the construction program ($13,148,000) which has been allocated to it in this Report.

FINANCING BY PUBLIC FUNDS

Public funds may be made available for financing rapid transit construction by:

(a) Issuance of general bonds with interest and principal paid from general tax funds;

(b) Issuance of general bonds for revenue-producing purposes with interest and principal paid out of the earnings of the proposed transportation system; and

(c) Issuance of special assessment bonds and payment of interest and principal by special assessment of the property benefited.

GENERAL BONDS

The limitations imposed by state laws fix the amount of bonds the City can issue for corporate purposes. The assessed valuation (one-half of the actual value) of all property in the city as of December 31, 1924, was $1,374,750,565. For non-revenue purposes the bonding limit is three per cent of the assessed valuation. Therefore, on December 31, 1924, the authority for such indebtedness was $41,-242,000 and the value of all bonds, outstanding or authorized, was $33,634,000. Consequently the City can issue but $7,608,000 additional corporate bonds at this time.

The bonding limit for bonds for revenue-producing purposes is twelve per cent of the assessed valuation or $164,970,000. On December 31, 1924, the total of such bonds outstanding or authorized was $87,268,000. The balance permissible under the California law, therefore, is $77,702,000.

The total requirements of the proposed unified transportation system to the year 1935 are:

For Structures Only	$ 82,698,000
For Tracks and Equipment	37,539,000
Total	$120,237,000
Present Investment	55,000,000
Total	$175,237,000

At present the City can issue $85,310,000 in general bonds, of which $7,608,000 may be for non-revenue purposes, and $77,702,000 for revenue-producing purposes.

The legal limit, at this time, is just over the estimated cost of the structures. The increase in total assessed valuation will raise the bonding limit to a much higher figure by 1935. However, there are many demands on the City's financial resources for water works, power, light, sewers, street openings, the civic center and similar projects. The authority for the issuance of full faith and credit bonds of the City is insufficient to care for both transit and other needs. It is our opinion, therefore, that general bonds of the City can be used only to pay a portion of the cost of the transit system.

SPECIAL ASSESSMENT

Special assessment districts or special tax districts may be created, in the opinion of Counsel, to pay all or a portion of the cost of rapid transit structures. Opinions as to the legality of such method of financing have been given by both the City Attorney and the County Counsel, who state that there is no constitutional inhibition to such procedure. It is likely, however, that some modification of existing assessment laws will be required. (These opinions are quoted in Appendix A.)

In considering such procedure it is well to remember that the principles adopted for the financing of the first rapid transit lines will likely be used in the future. Therefore the initial work should be undertaken on a sound and equitable basis with a well matured plan for charging a proper proportion of the cost to all of those directly benefited by the undertaking. These direct benefits flow to three distinct groups: the car riders, the property owners within the zone of the improvement, and the general public (the City itself). A fundamental principle of public financing is that the cost of an improvement shall be paid by those benefited and that the amounts paid by the various beneficiaries shall be proportional to the respective benefits.

The Car Riders

All investments made by transportation companies for transit improvements must be supported by the fares paid by the car riders. The fares collected must be sufficient to pay all costs of operation, including renewals and depreciation, interest and sinking fund charges, a fair return to the stockholders, and no more.

The principal direct benefit which the car riders receive will be a saving of time, as the higher speeds made possible by the operation of the rapid transit lines will enable them to travel in less time between the intermediate or outlying points and the downtown district or to other districts in the city. This saving is described in Appendix B.

There is another benefit from rapid transit which the car riders receive indirectly. This is the increased operating efficiency resulting from elimination of the delays and interruptions to service incident to operating on the street surface. The operating costs (not including interest on investment) on rapid transit railways are much less than those on street railways. This saving is susceptible to close estimate and fairly represents the interest on the capital which the street car companies could furnish for the construction and equipment of the rapid transit system.

Increase in Real Estate Values

That transportation is a most important factor in creating real estate values has been proven in every city in America and the citizens of Los Angeles do not need

FIGURE 57. *Vicinity of Lawrence and Kimball Avenues, Chicago, before elevated railroad construction.*

to go beyond their own limits to find ample proof of the fact. In Los Angeles, however, the transportation lines up to the present time have been surface lines exclusively and if these lines have produced increases in the values of the property in the neighborhoods which they serve, it is certain that rapid transit lines will bring about far more substantial increases. This has been proven in every instance in the cities where rapid transit structures have been built. The experiences of New York, Philadelphia and Chicago are of particular interest in this connection, and show clearly the financial benefit to the property owners in the districts served by new lines. Extracts from reports describing the increases in real estate values in New York and Philadelphia shortly after the opening of the new transit lines are given in Appendix C.

The construction of a five-mile branch line of the Chicago Rapid Transit Company affords an excellent opportunity for measuring the enhancement in property values in outlying territory which results from rapid transit construction. This branch line runs westerly through a sparsely settled area in the southern part of Evanston for two miles and continues westerly about three miles further passing through truck farms and touching the village of Niles Center, whose population was but 763 in 1920.

Following the announcement of the plans for this rapid transit extension in the summer of 1923 there came a period of vigorous activity in real estate. Lands within a mile of the new line were subdivided, placed on the market and readily sold within a year's time at figures many times the original cost.

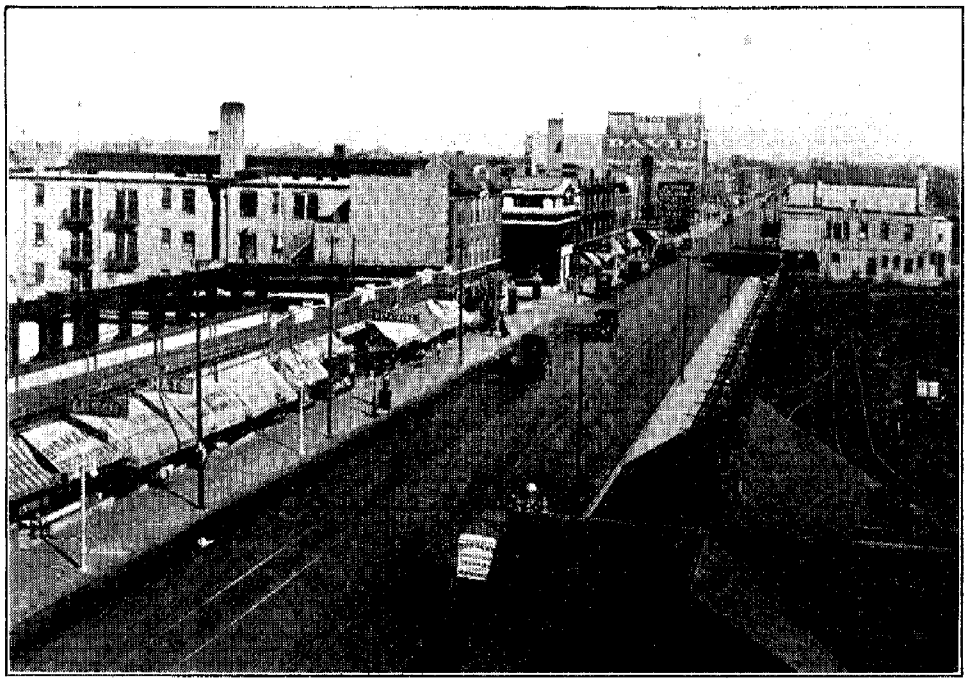

FIGURE 58. *Vicinity of Lawrence and Kimball Avenues, Chicago, after elevated railroad construction.*

A careful survey of the district affected by this new rapid transit line was made in the summer of 1924. The average value of unsubdivided land in Niles Center in 1923 was but $1,500 per acre. A year later the average value of land within a half mile of the new route was approximately five times this amount. The value of lands lying from one-half to one mile distant from the new route as well as the value of the adjacent subdivided property in Evanston was doubled in a year's time. In both Niles Center and Evanston the greatest increase in value has been in the vicinity of the proposed stations and from these points the values shade off until at a distance of about one mile there has been but little change.

A conservative estimate showed that the increase in real estate values during the single year (from the summer of 1923 to the summer of 1924) was more than $20,000,000, or about $4,000,000 per mile of route. The cost of the construction work was about $3,000,000, so that the profit to the land owners, if they had paid all of the cost, would have been in excess of $17,000,000, or about six times the construction cost. This is a striking example of the effect of rapid transit construction on undeveloped and on partially developed areas. Figures 57, 58, 59, 60, 61 and 62, pages 175 to 179,

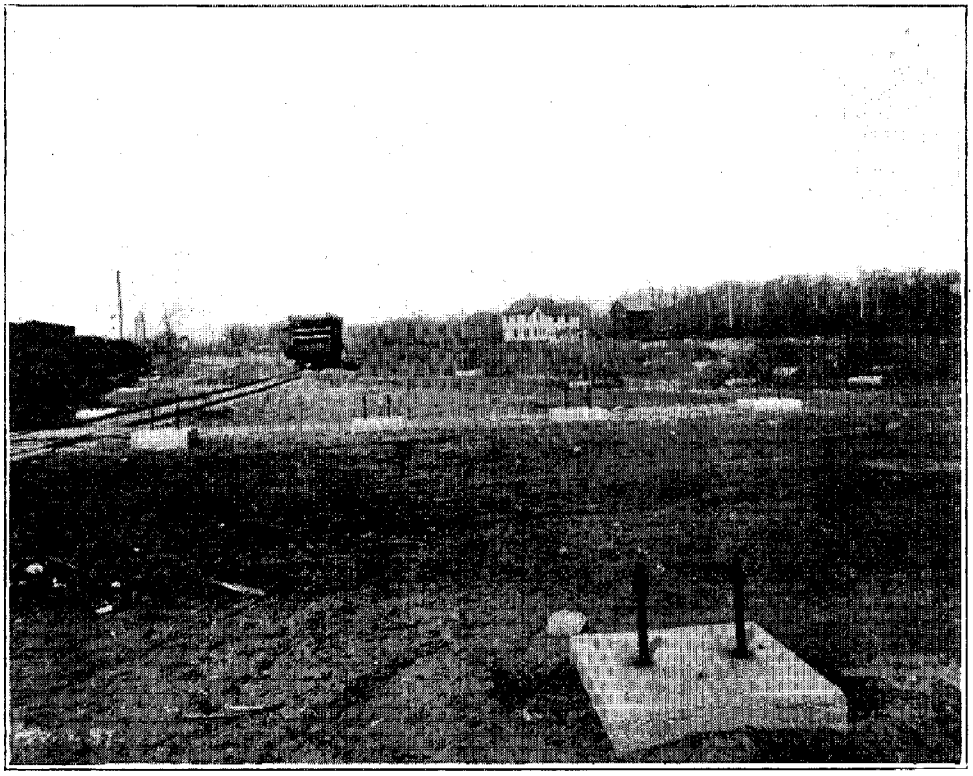

FIGURE 59. *Vicinity of Broadway and Wilson Avenue, Chicago, before elevated railroad construction.*

show photographs of three localities in Chicago before and after rapid transit construction.

The Ability of the Local District to Share in Costs

In addition to the foregoing many examples of the benefit to local districts resulting from the construction and operation of rapid transit lines could be cited, but the example in Chicago should be sufficient to demonstrate the ability of the districts benefited to assist in financing transportation lines.

In the residential districts the property in the immediate vicinity of the stations will receive the greatest benefit. The benefits will diminish in proportion to the

distance from each station. The width of the strip of land on each side of the rapid transit lines in which the value of real estate will be affected will depend upon local conditions. In some of the more remote areas it is likely that the benefit will extend for a mile or two. Assuming, however, that the assessment district will extend only one-half mile on either side of the rapid transit line, then the average assessments for various types of rapid transit structures, based upon the assumption that three-

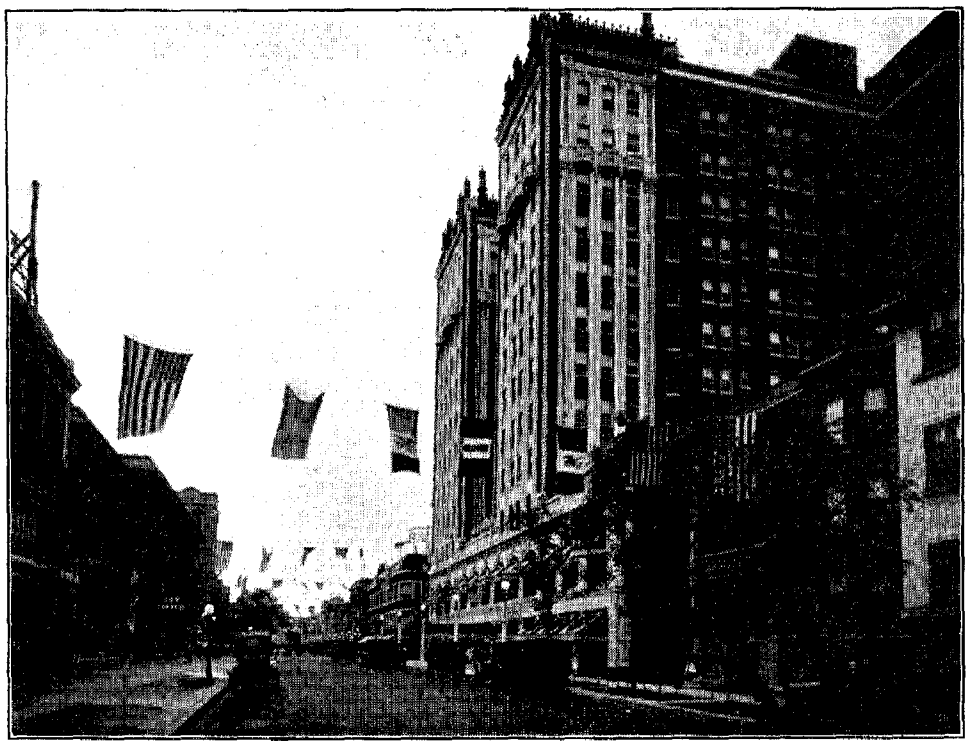

FIGURE 60. *Vicinity of Broadway and Wilson Avenue, Chicago, after elevated railroad construction.*

fourths of the cost of the structure is carried by the special assessment district, would be as follows:

	Average Assessment per Square Foot
Ballasted deck steel elevated structure	3.9 cents
Concrete steel elevated structure	5.3 cents
Low level subway (tunnel construction between stations)	12.4 cents
High level subway	14.9 cents

The average assessment on a lot 150 feet in depth would be $5.85, $7.95, $18.60 and $22.35 per front foot respectively. The assessment could be divided into a limited number of annual installments payable during the construction period so as to provide a pay-as-you-go plan, similar to the one recently adopted in Detroit, and thereby save interest charges, or it could be spread over a long period and there-

by decrease the annual payments. The assessments should be spread with decreasing rates proportional to the distance from stations.

The method of spreading an assessment for rapid transit in the downtown business district would, of course, be governed largely by local conditions. The construction of sub-surface sidewalks leading from stations to adjacent parallel streets would seem to make it equitable to spread a portion of the cost to adjacent streets.

The Community at Large

There is no question of the benefit that rapid transit brings to the city at large. A rapid transit system removes large numbers of people from the surface of the streets

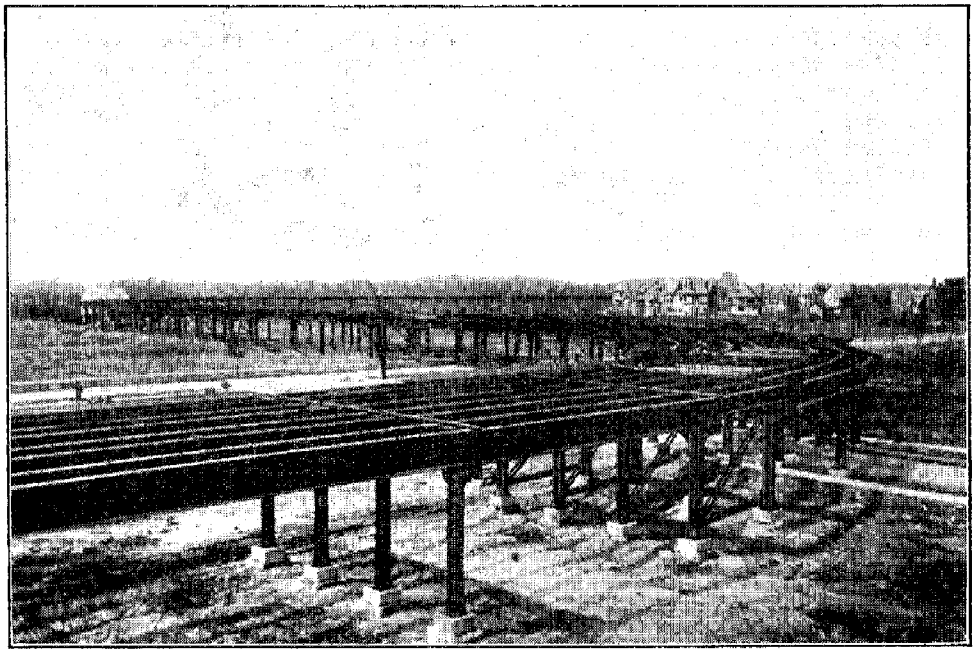

FIGURE 61. *Vicinity of Sheridan Road and Irving Park Boulevard, Chicago, during elevated railroad construction.*

and provides additional space for the use of vehicles and pedestrians. It enables the city to expand and prevents undue concentration of great masses of people in a small area. Rapid transit provides a means for traveling conveniently and rapidly to and from the various places of business, employment, amusement and recreation and, in short, it is essential to the proper development of any large metropolitan center.

It also provides a convenient means for traveling to and from the various suburban centers surrounding the urban area, assisting these centers in their growth and producing a healthy development in the entire metropolitan area. In almost all ways rapid transit is an aid to proper civic development, and it seems only fair that the public at large should share in the cost.

Every citizen receives a benefit from the operation of rapid transit lines regardless of whether or not he uses the facilities they afford. This fact has been recognized by the cities of New York, Philadelphia and Boston and rapid transit construction has been aided in those cities by the appropriation of sums running into millions. Detroit has recently adopted a financial plan in which it is provided that the community at large is to assume, as its share, one-fourth of the cost of the rapid transit structures.

In Los Angeles the ability of the community at large to share in the cost of rapid transit construction is governed by the outstanding indebtedness, and the pre-

FIGURE 62. *Vicinity of Sheridan Road and Irving Park Boulevard, Chicago, today.*

ceding discussion shows that a sufficient amount in general bonds can be issued within the legal limit to pay the share of the cost of the proposed improvements which may be charged to the public.

The construction of rapid transit structures, either subways or elevated railroads, may be considered as an expansion of the existing street facilities; the principal difference being that instead of the customary horizontal widening this expansion is made in a vertical direction. Whether the additional space thus created is utilized for public transportation of some variety or for vehicular traffic is immaterial; it is to be utilized by the general public and, as far as the public at large is concerned, rapid transit construction is an improvement very similar to that of street widening, with which Los Angeles is quite familiar. In nearly every instance, in

Los Angeles as well as in other cities, the cost of street widening improvements has been borne largely by the property especially benefited by the improvement. In such projects however a small portion of the cost is classed as public benefit and paid by the entire community. It is fair that the general public should share in the cost of rapid transit. The exact proportion to be paid by the local district and by the public at large must necessarily be determined by local conditions and type of structure.

It is recommended that the public share in the cost of rapid transit. Whether this should take the form of a contribution by the City of Los Angeles only, or jointly with other municipalities benefited, must be determined at the time of the construction of each line. The entire metropolitan district will unquestionably benefit by the plan for rapid transit which has been recommended herein and it is suggested that the County in like manner also contribute toward the financing of the work.

Type of Structure Affects the Division of Cost

From the viewpoint of those using the service, elevated lines are much preferable to underground lines because they provide transportation in the natural light and open air. On the other hand, elevated lines shut off a certain amount of light from abutting buildings, their columns may be considered to be an obstruction either in the roadway or on the sidewalk, and the operation of trains causes a certain amount of noise. Subways, which eliminate these objections, are preferable from the viewpoint of the abutting property owners. However, it must be remembered that underground lines are much more costly than elevated railroads.

The chief beneficiary, therefore, when subways are constructed where elevated roads would be feasible, is the property owner in the local district along the route and it is entirely logical that the local district should assume the additional cost. There are districts in Los Angeles where subways will be required and if the additional cost of constructing these subways is borne by a special assessment district, the cost will be distributed in the most equitable manner.

Experience in other cities has shown that the property owners may vigorously advocate subway construction when they are required to share no portion of the cost of the structure. However, if they are given their choice as to type of rapid transit structure with the knowledge that the cost is to be borne largely by the local district, then they are in a better position to appraise the respective advantages and disadvantages of underground and elevated construction.

Advantages of Special Assessment Plan

The financing of rapid transit construction by special assessment has three dis-

tinct advantages which should make it evident that it is the most logical and equitable plan which can be adopted, namely:

(a) The property owners in each local improvement district contribute only a small portion of the direct benefit which accrues to them from the construction and operation of rapid transit lines;

(b) It places the selection of type of structure to be built on each route squarely up to the district affected; and

(c) It presents the only method of financing all of the work necessary to provide transportation facilities adequate to meet the present and future needs of Los Angeles.

RECOMMENDATIONS ON A TRANSIT POLICY

It is recommended that the plan of transit development herein outlined be considered by all parties at interest, so that, with such modifications as are thought desirable, it may be adopted; thereby complying with the provisions of the new City Charter. After this is done, it is suggested that the City (or the City and County acting jointly) create a Transit Committee* (see footnote) to report upon, preferably in ordinance form, the following matters:

1. A definite construction program;
2. The boundaries of a flat fare zone;
3. The consolidation, or joint operation, of all transportation properties (existing and proposed) within such zone;
4. A plan for financing the proposed unified system and additions by private or public funds, or by both;
5. A method of accounting for the investments made by public and private capital, and a basis for the possible purchase by the City;
6. A basis for determining the rates of fare, transfer privileges and disposition of net receipts; and
7. A plan for managing and operating the unified system, and for the construction of additional transit facilities.

The proposed Transit Committee could be dissolved after the acceptance of its report. If this or a similar plan be adopted, then Los Angeles will be assured of the

*The Transit Committee, if a small number be thought desirable, could be composed of a representative of the City, the County, the California Railroad Commission, the Los Angeles Railway and the Pacific Electric Railway Company. However, should a larger Committee be desired, then representatives of the various civic bodies, labor organizations and banking institutions might be added.

benefits that will result from the construction and operation of a complete system of transportation.

APPENDICES

A number of appendices, relating to transit matters in other cities, have been prepared, as follows:

Appendix D

Charter amendment creating the Rapid Transit Commission of Detroit,

Appendix E

Abstract of the duties of the Transit Commission of New York, and

Appendix F

Abstract of legislation providing for rapid transit construction in Philadelphia.

APPENDIX A

LEGAL OPINIONS

In the course of preparing this Report questions of a legal nature arose which were fully discussed with the City Attorney, Mr. Jess E. Stephens, and with the County Counsel, Mr. Edward T. Bishop. In order to further the work Mr. C. B. Penn and Mr. Robert L. Hanley, Deputy City Attorneys, and Mr. Everett W. Mattoon, Chief Deputy County Counsel, were assigned to assist. On the most important matters written opinions were prepared and they are quoted below.

Opinions of the City Attorney

"In considering the application of the proposed plan for a Comprehensive Rapid Transit System for Los Angeles, the following legal points present themselves:

1. *Can rapid transit structures be legally constructed within the corporate limits of Los Angeles?*

Section 2, subsection 11 and subdivision (m) of subsection 11 of the new Charter provides,

> 'Sec. 2. The City of Los Angeles, in addition to any other rights and powers now held by it, or that hereafter may be granted to it under the constitution or laws of the state, shall have the right and power, subject to the restrictions in this charter contained.'
>
> * * * * * * * *
>
> '(11) Among the rights and powers which may be exercised by the City of Los Angeles are the following, this enumeration being a partial enumeration and in no sense a restriction or limitation upon the rights and powers of the city;'
>
> * * * * * * * *
>
> 'to provide for the acquisition, construction, improvement or alteration, maintenance, use and control of streets, tunnels, subways, rights of way, public places, harbors, sewers, storm drains, and other public or local improvements on, above, or below the surface of the land or water.'

Hence, under the future organic law of the City, it will be legally possible to construct a rapid transit system in Los Angeles provided that there shall first be adopted by the City a comprehensive elevated railway and subway plan for the development of rapid transit into, out of and through the City, as provided by subsection 9 of Section 3 of the new Charter, which is as follows:

> 'No franchise, permit or privilege shall be granted across or along public streets or ways, or on a private right of way for street, interurban, or other railroads, operated on or suspended from elevated structures, or through subways, until after the adoption by the city of a com-

> prehensive elevated railway and subway plan for the development of rapid transit into, out of and through the city, and the city shall have selected that part of such plan, if any, that it may desire to own and control, operate or lease; but after such selection made by said city, it may make grants not in conflict with such plan for the operation through or over such parts of said plan as are selected by said city, or for the construction and operation of such parts not so selected, or of additional subways, or elevated railways, or approaches to and connections with that part owned and controlled by said city, at such elevations, grades and alignment as shall be approved and fixed by ordinance. No subways or elevated railways shall be so constructed as to cross at grade.' "

2. *Can special assessment districts be formed to bear all or a portion of the cost of construction of rapid transit structures?*

A consideration of the power of the City to create special assessment districts to bear all or a portion of the expense entailed by the construction of rapid transit structures calls into application the general principle of opening and widening streets. The purpose of rapid transit is to provide modern transportation facilities, either along, above or below the surface of the ground, hence affording an additional traffic lane for the transportation of people and commodities. If elevated or subway structures are constructed above or below the surface of an existing street, such construction is legally tantamount to increasing the capacity of such street in a vertical instead of the usual horizontal manner.

As was said in the case of RE *New York District Railroad Company,* 14 N. E. Reporter 187:

> 'When the work is all done, the street will consist of two stories or surfaces, one carrying the ordinary traffic and movement lessened by so much as is diverted to the swifter transit of the city, and the both together will do what one alone did to the extent of its capacity.'

The right of the city to construct additional traffic levels, either above or below the surface of an existing street, has been upheld by the Supreme Court of this State in the case of *Hayes vs. Handley,* 182 Cal. 273, and on Page 282 the following language is used:

> 'Where the city undertakes to occupy the space above or below the surface of the street for any purpose within the scope of the public uses to which highways may be put, the use of the owner of the fee must yield to the public use." It is well settled that the manner and extent of such public use is not limited by any standard of methods of use in vogue at the time of dedication. "On the contrary," said this court, in *Montgomery v. Santa Ana etc. Co.,* 104 Cal. 186, 191 (43 Am. St. Rep. 89, 25 L. R. A. 654, 37 Pac. 786, 788), "we affirm that when a public street in a city is dedicated to the general use of the public, it involves

> its use subject to municipal control and limitations for all the uses and purposes of the public as a street, including such methods for the transportation of passengers and freight as modern science and improvements may have rendered necessary, and that the application of these methods, and, indeed, of those yet to be discovered, must have been contemplated when the street was opened and the right of way obtained, whether by dedication, purchase, or condemnation proceedings, and, hence, that such a user imposes no new burden or servitude upon the owner of the abutting land."' * * *

Further, it is immaterial that such additional traffic lanes are for a specialized mode of transportation, namely, rapid transit. In Los Angeles numerous special assessment districts have been created to finance improvements that are available for special types of transportation, notable examples being the Second Street Tunnel and Mulholland Highway, both being for vehicles exclusively. As was said in the case of *Larsen vs. The City and County of San Francisco,* 182 Cal. pages 8 and 9:

> 'The appellant contends that no assessment for the cost of a tunnel for such purposes can be made upon private property; that such a railroad must be the property of a private corporation or of a municipal corporation acting in its proprietary capacity; that if it belongs to a private corporation the tunnel would not be for the public benefit, but would be for the benefit of such corporation, which is a purpose for which a special assessment upon private property cannot lawfully be made, while if the railroad belongs to the municipal corporation, the tunnel would be for the general benefit of the municipality and the expense thereof could lawfully be met in no other way than by a general ad valorem tax upon all property within the city.'
>
> * * * * * * * *
>
> 'It cannot be successfully contended that such a tunnel is not a public improvement, or that its use is not for the benefit of the public, or that it is not a public use. A public way is for the general public benefit, although not open to all modes of travel, provided it is open to the general public for travel thereon in the manner to which it is adapted.'

In this connection it may be well to point out the general rule of law that if a district is created to finance a public improvement the property therein is assessed upon the basis of the benefits received from such improvement. The warrant for the imposition of special assessments upon private property in order to construct a public improvement is that such property receives a special benefit in the increased value, aside from the general benefit to the community. As was said in the case of *Spring Street Co. vs. City of Los Angeles,* 170 Cal. page 24 at page 30:

> 'The improvement must have a certain public character, and this we find conspicuously in street improvements, and less conspicuously in reclamation district assessments. Were it not for this recognized char-

> acteristic, it would be justifiable to order any owner of any vacant lot to build thereon and to build a prescribed structure, since under the theory of benefits it could successfully be urged that the enhanced value of the land covers the cost of the structure compulsorily imposed upon it. It may be said that the interest of the public would demand that a building lot in the heart of a business district of a city should not be left vacant, its improvement tending to increase business and to enhance the values of surrounding property in which the public is interested. But so far such a public interest has not been considered adequate in support of such an exaction. That the return to the property owner by way of benefit is, under our system of government, the basic foundation upon which this right rests, becomes apparent from the consideration that if we are not able to say that the owner for the specific charge imposed is compensated by the increased value of the property, then most manifestly we have a special tax upon a minority of the property owners, which tax is for the benefit of the public and which tax is special, unequal and ununiform.'

Hence, if special assessment districts are created in order to finance rapid transit construction it must be shown that there will be a resulting special benefit to the property included within such districts.

In order to create special assessment districts to finance or to aid in financing rapid transit construction, the City of Los Angeles could, under subdivision (p) of subsection 11 of Section 2 of the new Charter adopt a procedure ordinance for that purpose, or it could make use of one of the special assessment statutes of California. As to the latter, however, amendments would doubtless be necessary to cover the specific question of rapid transit construction. Subdivision (p) of subsection 11 of Section 2 is as follows:

> 'The City of Los Angeles, in addition to any other rights and powers now held by it, or that hereafter may be granted to it under the constitution or laws of the state, shall have the right and power, subject to the restrictions in this charter contained:'
>
> * * * * * * * *
>
> 'Among the rights and powers which may be exercised by the City of Los Angeles are the following, this enumeration being a partial enumeration and in no sense a restriction or limitation upon the rights and powers of the city;'
>
> * * * * * * * *
>
> 'to establish offices, departments, procedures, procedure ordinances, special bond districts or special tax districts, or other instrumentalities for municipal government and for carrying out the powers conferred by this charter, not in conflict with the provisions of this charter, and any such procedure ordinance shall be additional or alternative to any procedure established by state law.' "

OPINIONS OF THE COUNTY COUNSEL

"The opinion of this office has been requested upon the three following legal points involved in your report: First, *whether the construction of subways or tunnels and of elevated structures beneath and above a public street to be used by street railways for rapid transit constitutes a use comprehended within the public use permitted by the dedication of a street to the public, without imposing an additional servitude upon the land of abutting owners;* Second, *whether the construction of such subways or elevated structures would constitute a public improvement for the use and benefit of the public;* and, Third, *whether the plan to assess lands in a district found to be benefited by such improvement according to the benefits to be derived therefrom is legal.*

1. The answer to the first question is, we believe, an affirmative one. In *Hayes v. Handley,* 182 Cal. 273, our Supreme Court held that the construction of a tunnel for traffic purposes beneath a public street was within the right of a city as acquired under the dedication of the ground for street purposes. The following quotation from said decision illustrates the attitude assumed and the trend of the authorities relied upon:

> 'This court said in *Colegrove Water Co. v. City of Hollywood,* 151 Cal. 425, 429, 430, (13 L. R. A. (N. S.) 904, 90 Pac. 1053, 1055): "The right of the abutting owner is, of course, always subordinate to the rights of the public. In city streets the easement of the public is, as a result of the condition of urban life, more extensive than in roads through sparsely inhabited regions. In cities it is customary to devote not only the surface of the street and the space above the street to public use, but the municipality may, and frequently does, occupy the soil beneath the surface for the accommodation of sewers, gas and water pipes, electric wires, and conduits for railroads. Where the city undertakes to occupy the space above or below the surface of the street for any purpose within the scope of the public uses to which highways may be put, the use of the owner of the fee must yield to the public use." It is well settled that the manner and extent of such public use is not limited by any standard of methods of use in vogue at the time of dedication. "On the contrary," said this court, in *Montgomery v. Santa Ana etc. Co.,* 104 Cal. 186, 191, "we affirm that when a public street in a city is dedicated to the general use of the public, it involves its use subject to municipal control and limitations for all the uses and purposes of the public as a street, including such methods for the transportation of passengers and freight as modern science and improvements may have rendered necessary, and that the application of these methods, and, indeed, of those yet to be discovered, must have been contemplated when the street was opened and the right of way obtained, whether by dedication, purchase, or condemnation proceedings, and,

hence, that such a user imposes no new burden or servitude upon the owner of the abutting land." '

In deciding that a tunnel for traffic purposes is a reasonable use the court quoted with favor from a Massachusetts case, as follows:

'Our system, which leaves to the land owner the use of the street above or below or on the surface, so far as he can use it without interference with the rights of the public, is just and right, but the public rights in these lands are plainly paramount, and they include, as they ought to include, the power to appropriate the street above or below the surface, as well as upon it, in any way that is not unreasonable, in reference either to the acts of all who have occasion to travel or to the effect upon the property abutters. The increase of requirements for the public within the streets of our large cities has probably equaled, if it has not surpassed, the increase of requirements for business along the streets. The legislature, the guardian of public interest and of private rights, has determined that the space below the surface of certain streets in Boston is needed for travel. The question is, whether action under the statutes involves an acquisition of a new right as against the land owner, or only an appropriation and regulation of existing rights. It hardly can be contended that this is an unreasonable mode of using the streets in reference either to travelers or abutters. If it is not an unreasonable mode of using them, the mere fact that it deprives abutters of the use of vaults and other similar underground structures in the streets, which they have heretofore maintained, is of little consequence. Abutters are bound to withdraw from occupation of streets above or below the surface whenever the public needs the occupied space for travel. The necessary requirements of the public for travel were all paid for when the land was taken, whatever they may be, and whether the particulars of them were foreseen or not. The only limitation upon them is that they shall be of a kind which is not unreasonable. In the present case the travel which is being provided for is from place to place within the city. There are stopping places on the subway at convenient points. In that respect it is different from a tunnel designed only or chiefly for travel for long distances. The new method is a substitution in part of a subterranean use of the streets for the use of their surfaces for the same general purposes. It is impracticable to have direct communication between the premises of abutters and the cars in the tunnel, but by going a short distance access to them may be had from any place. We are of the opinion that this use of the streets is within the purposes for which the lands were taken, and that no additional servitude is created by it. (Sears v. Crocker et. al., 184 Mass. 586, (100 Am. St. Rep. 577, 69 N. E. 327).)' *Hayes v. Handley,* 182 Cal. at 283-4.

The reasoning presented in the Massachusetts case as to the reasonableness of the mode of using the streets by the construction of subways or tunnels thereunder, applies with almost equal force, in our opinion, to the construction of elevated structures thereupon. True, this utilization of space above a street would result in greater inconvenience, possibly, from noise and the shutting off of some of the light and air otherwise enjoyed by abutters, but we think it is reasonable to believe that our courts would find this to be another example of a use included within the scope of those contemplated by the dedication to which the abutting owner whose rights are subordinate to those of the public must yield in deference to the increased requirements and necessities of the public.

2. The question as to whether the construction of such subways or elevated structures for the purposes stated would constitute a public improvement for the use and benefit of the public, assuming that such structures constitute a "reasonable" use of a public street, can also, we believe, receive an affirmative answer. In *Larsen v. San Francisco,* 182 Cal. 1, our Supreme Court passed upon this question with reference to a tunnel for street car travel exclusively underneath the Twin Peaks ridge. The only apparent limitation imposed was that its use be available to the general public. The following is taken from the language of said decision:

> 'It cannot be successfully contended that such a tunnel is not a public improvement, or that its use is not for the benefit of the public, or that it is not a public use. A public way is for the general public benefit, although not open to all modes of travel, provided it is open to the general public for travel thereon in the manner to which it is adapted.'

3. The concluding question is as to the legality of the plan to levy special assessments upon the property in a district found to be benefited by such improvements, in accordance with the benefits derived therefrom. Having decided that the construction of the subways and elevated structures contemplated constitute public improvements, there remains no question but that private property may be assessed to contribute toward the cost of such improvements in proportion to the benefits received. As stated in *Larsen v. San Francisco,* supra,

> 'It must be conceded that where there is a peculiar benefit from a public improvement to the property assessed, the power to levy a special assessment for its cost exists.' At p. 9.

In that case the court held that by reason of the construction of the tunnel, and the operation of a street car line through it, the inhabitants of the district served had a ready and speedy means of access to the city and that the resulting benefit to their property was apparent.

In conclusion, it is our opinion that there is no inherent or constitutional objection to the plan as outlined and that the same may be accomplished if appropriate and adequate statutory provision therefor is made available."

APPENDIX B

TIME SAVINGS

There will be important time savings in the urban area due to the operation of the proposed rapid transit lines which will enable the car rider to travel from intermediate and outlying points to the downtown district or to other parts of the city at average speeds of from eighteen to twenty-five miles per hour, or double the speed of surface cars. This will shorten the time consumed in traveling to the downtown district from various points by from five to fifteen minutes. A graphic representation of this is shown on Plates 10 and 11. Plate 10 shows present time zones and was described in Chapter III, on page 51.

Plate 11 shows graphically by time zones of different colors, the time which will be required to travel to various parts of the urban area on the lines of the unified transportation system after completion of the work recommended FOR IMMEDIATE CONSTRUCTION. The intersection of Seventh Street and Broadway has been selected as the point of origin. In computing the time required for travel from the point of origin to various points in the urban area, the present non-rush hour scheduled speed of the surface lines was used and the speed of the rapid transit trains was carefully estimated for the different routes based on the operating conditions which will exist after the completion of the initial rapid transit program. An arbitrary allowance of *two* minutes for transfer from rapid transit trains to surface lines and *one* minute to transfer from one surface line to another has been made, and walking at the rate of three miles per hour has been assumed.

A comparative study of Plates 10 and 11 will give a fair idea of the savings in time which will be made possible in various parts of the city. Attention is called to the greatly increased areas within the boundaries of the twenty and thirty minute zones, respectively. In addition to the saving in time the patron of the rapid transit line will receive the benefit of a more comfortable ride and a service practically free from interruptions.

Substantial savings in time on the interurban routes will be effected when the comprehensive plan is completed.

The following tabulation shows the savings in time that will be effected when the immediate construction program is completed:

STATEMENT OF TIME SAVING BETWEEN THE CENTRAL BUSINESS DISTRICT OF LOS ANGELES AND CITIES IN THE METROPOLITAN DISTRICT AFTER COMPLETION OF THE WORK RECOMMENDED FOR IMMEDIATE CONSTRUCTION

FROM LOS ANGELES DOWN TOWN TERMINAL TO	TIME IN MINUTES		
	RUNNING TIME		SAVING
	Existing Interurban Lines	*Proposed Rapid Transit System*	*Rapid Transit over Existing System*
Van Nuys	75	48	27
Lankershim	59	32	27
Glendale	41	26	15
Burbank	62	47	15
South Pasadena (via Pasadena Short Line)	30	23	7
Pasadena (via Pasadena Short Line)	39	32	7
Alhambra	37	27	10
Monrovia	49	42	7
Echandia Junction	12	6	6
Whittier	53	43	10
Long Beach	55	48	7
San Pedro (via Dominguez Jct.)	60	52	8
Redondo (via Gardena)	61	51	10
Watts Junction	20	13	7
Venice (via Short Line)	49	35	14
Redondo (via Playa Del Rey)	74	57	17
Santa Monica (via Venice Short Line)	60	46	14
Sawtelle	48	33	15
Culver City	32	19	13
Beverly Hills (via Sawtelle Line)	41	26	15
Vineyard Junction	25	11	14

APPENDIX C

INFLUENCE OF RAPID TRANSIT ON REAL ESTATE VALUES IN NEW YORK AND PHILADELPHIA

NEW YORK CITY

(Extracts from a memorandum addressed to the Board of Estimate and Apportionment and the Public Service Commission of New York City by the City Club of New York, October, 1908)

"For many years the city has deemed it just to assess upon abutting property the cost of opening streets and building sewers. The theory of such a tax upon property is that it receives almost the exclusive benefit from the construction of a street or sewer adjacent to it. The question naturally arises, does not a transit line, by the benefit that it confers, fall in the same class as new streets and sewers? If a street railroad or rapid transit line be extended into an undeveloped territory, is it not built primarily for the purpose of furnishing transit facilities to future residents in that section? People will buy this property primarily because it has good transit facilities and the value placed upon it is largely based upon its accessibility. THIS BEING TRUE AND UNIVERSALLY ADMITTED, WHY SHOULD NOT THE PROPERTY THUS ENHANCED IN VALUE BY THE EXTENSION TO IT OF A RAPID TRANSIT LINE PAY FOR THE CONSTRUCTION OF SUCH LINE, TO THE EXTENT THAT THE INCREASED VALUE WARRANTS IT, INSTEAD OF RECEIVING SUCH INCREASED VALUE AS A PRESENT FROM THE CITY. This principle, in a modified and unofficial form, is operated in Berlin. The assessment is not collected by the city, but the street car company when extending a line to outlying territory requires the owners of the property benefited to guarantee to the company a certain return upon the cost of such extension.

"To throw light upon the above question, the City Club has been making some painstaking investigations, extending over several months, of the rise in value of land along the present subway. The method of arriving at these values was as follows: Assessment values, as given by the Department of Taxes and Assessments, were taken for the year of 1900 on vacant lots on a basis of 60 per cent. of full value for the district from 79th Street to the Spuyten Duyvil; 65 per cent. between Central Park and Harlem River, and 60 per cent. in The Bronx. These were compared with the assessment values of 1907 on a 90 per cent. basis for all these districts, and in each case the full value was obtained by raising the assessment figures to 100 per cent. In the districts which were largely built up all vacant lots were listed. Where there were few buildings, as in the extreme northern portion of Manhattan, a sufficient number of such lots were taken to show the general land values, and from these was figured the total value for this district. To ascertain the proportion of the increase in land value attributable to the building of the subway, it was necessary to deduct from the total rise what might be termed a normal rise, or the increase that would have taken place through the natural growth of the city without the added stimulus of a new transit line. The only basis of arriving at a judgment of what such a normal rise probably was is to ascertain the rise for a period of equal length under normal conditions. Accordingly the increase in value of the same land during the preceding seven years from 1893 to 1900 was determined. It was found that values rose during this period of seven years on an average of about 50 per cent. in the district on the west side below 135th Street, and on an average of about 43 per cent. from this point northward to the Spuyten Duyvil. These percentages, then, may be taken in these districts as the best basis ascertainable for a judgment as to the normal rise for a period of this length, and if subtracted from the rise which took place along the subway from 1900 to 1907, should indicate the effect of the subway on land values during the latter period.

"By applying this method it was discovered that the land from 79th up to 110th Street and between Central Park and North River had increased on an average about 45 per cent., which is about the expected normal rise. In the district along the Lenox Avenue line south of the Harlem River the average increase was about 43 per cent., which would indicate that land had not increased in value due to the building of the subway. The explanation of this

unexpected condition is no doubt that an elevated road already existed which gave fair service to these districts, so that the additional facilities had little effect on land value, except in the immediate vicinity of subway stations.

"The rise in land value along the Broadway branch from 110th to 129th Street was much more noticeable, averaging about 70 per cent., but the locating of Columbia University at this point affected values to an extent that makes it quite impossible to arrive at any reliable conclusions as to the proportion of rise that should be attributed to the subway.

"The situation from 135th Street northward, however, is entirely different. Between 135th Street, 115th Street, Convent Avenue and North River the land increased in value between 1900 and 1907 about $17,825,000. Although the elevated road paralleled this district, yet owing to the topography the road was of little service, so the subway added very materially to the transit facilities of the locality.

"The district between the Harlem and North Rivers from 155th to 178th Street increased in value about $22,450,000; from 178th to Dyckman Street the increase was about $15,925,000; from Dyckman Street to the Spuyten Duyvil the increase was about $13,100,000. The aggregate rise in this land from 135th Street to Spuyten Duyvil was about $69,300,000. If an estimated normal rise of $20,100,000, based upon the rise of the previous seven years, be subtracted from this, it leaves a rise of about $49,200,000, apparently due to the building of the subway, which is 104 per cent. increase on the value of 1900.

"The rise in land values of The Bronx is likewise very noticeable. Taking a district along the subway extending in width about a half mile on either side, the increase in land values was somewhat as follows: From the Harlem River to Willis and Third Avenues the rise was about $9,200,000; from that point to Prospect Avenue, about $22,100,000; from the latter point to Bronx Park, about $13,500,000. The aggregate rise in land values for this district from the Harlem River to the Bronx Park was about $44,800,000. Subtracting from this an aggregate normal rise of $13,500,000, it leaves an increase of $31,300,000, due to the building of the subway.

"Since this property has been so enhanced in value by the building of the subway by the city, could it not have contributed largely toward the expense of constructing the line and yet have reaped a good increase in addition to such assessment? As previously stated, the aggregate rise in land value above 135th Street in Manhattan caused by the subway was $49,200,000. The cost of building the subway from this point to 230th Street was $7,375,000, or but 15 per cent. of the actual rise caused by the new line. The property owners could have paid the entire cost of this portion of the line and yet have had a net profit on their land of 89 per cent., or an aggregate of $41,825,000 for the district.

"In The Bronx the situation was in most respects similar. The aggregate increase in land value (of a district extending about a half mile either side of the subway), due to the building of the subway, and in excess of a normal rise of $13,500,000, was about $31,300,000. The cost of the line from 143rd Street to Bronx Park was about $5,700,000. Had the property which was benefited borne this expense through the form of an assessment, after paying such assessment, there would have remained an aggregate profit of $25,600,000 in excess of the normal rise in values since 1900. This would be a profit of 77 per cent. on that property caused by the increased transit facilities of the subway.

"It will be noted that the aggregate rise in land value in Manhattan from 135th Street to the Spuyten Duyvil, and in The Bronx, due to the building of the subway, was $80,500,000. The cost of the entire subway from the battery to the Spuyten Duyvil and the West Farms branch to Bronx Park was but $43,000,000. The property benefited, in the districts above noted, could have paid this entire cost, and yet have had a net profit, due solely to its construction and operation, of over $37,500,000. Had it paid only for the portion running through its own territory, there would have remained a profit of over $67,425,000. In view of this fact, would it not be reasonable to require property benefited in outlying districts to pay for the cost of a rapid transit line built to serve it?"

PHILADELPHIA

The report of A. Merritt Taylor, Transit Commissioner of the City of Philadelphia, in the year 1913, contains an analysis of the effect of the construction of the Market Street Subway-Elevated Line on real estate values. As the comparisons are very illuminating extracts from the Report follow:

"In order to determine the effect of the construction of the Market Street subway upon the assessed valuation of real estate in the central business district where this line delivers its passengers collected from West Philadelphia, the assessed valuation of the real estate fronting on Market Street, from Thirteenth Street to the Delaware River, was compiled for the same years —1900, 1906 and 1912—together with that for a similar distance on Arch and Chestnut Streets, which are parallel and one block away.

"Summarized, these figures are as follows:

ASSESSED VALUATION OF PROPERTY ON PRINCIPAL DELIVERY DISTRICT STREETS PRIOR AND SUBSEQUENT TO THE CONSTRUCTION OF THE MARKET STREET SUBWAY LINE

	Property between Thirteenth Street and Delaware River Fronting on		
	Market Street	*Arch Street*	*Chestnut Street*
ASSESSED VALUATION			
1900	$29,958,000	$11,022,000	$39,668,000
1906	47,460,000	12,245,000	47,635,000
1912	68,184,000	15,283,000	49,850,000
INCREASE (AMOUNT)			
1906 over 1900	$17,502,000	$ 1,223,000	$ 7,967,000
1912 over 1906	20,724,000	3,038,000	2,215,000
1912 over 1900	38,226,000	4,261,000	10,182,000
INCREASE (PER CENT.)			
1906 over 1900	58.4%	11.1%	20.1%
1912 over 1906	43.7%	24.8%	4.6%
1912 over 1900	127.6%	38.7%	25.7%

(The values for the year 1900 are those just prior to the announcement that the line would be constructed, the values for the year 1906 are those just before the completion of the line and the values for the year 1912 are those which existed a few years after the inauguration of service on the new rapid transit line.)

"The Market Street Subway began operation from the City Hall to Second Street in August, 1908. As shown above, for this 12-year period the Market Street valuation increased by $38,226,000, or 128%, while during the same period similar real estate on Chestnut Street increased by $10,182,000, or only 26%, and that on Arch Street by $4,261,000, or 39%. This difference was due in large part to the construction of the Market Street Subway-Elevated Line. From the standpoint of the real estate owner in the business district there is no question of the desirability of the location of a rapid transit line in the street on which his property fronts.

"As stated above, in Philadelphia, building improvements are assessed with the land, and consequently the increased assessments, shown above as resulting in large part from the construction of the Market Street rapid transit line, include the expensive building improvements corre-

sponding with the large population development. The effect on land values alone may be seen, however, from the following compilation of assessed values of unimproved property in the Forty-sixth Ward, which adjoins Market Street on the south from Forty-fifth Street to the City Line.

ASSESSED VALUATION OF UNIMPROVED PROPERTY IN THE FORTY-SIXTH WARD, WEST PHILADELPHIA, PRIOR AND SUBSEQUENT TO THE CONSTRUCTION OF THE MARKET STREET SUBWAY-ELEVATED LINE

		Increase in Six Years		*Increase in Twelve Years*	
Year	*Assessed Valuation*	*Amount*	*Per Cent.*	*Amount*	*Per Cent.*
1900	$ 675,000	$		$	
1906	1,887,000	1,212,000	180%		
1912	4,361,000	2,474,000	131%	3,686,000	546%

"This shows the enormous enhancement of value of land only, in outlying districts, due in large part to the rapid transit line, amounting in twelve years in this ward to $3,686,000, or over 500%, to the great benefit of the owners, and also for the City in point of assessable values and tax returns.

"On the other hand, it has been stated that the construction of an elevated railway decreases realty values along the street on which it is located. The opposite result has usually been experienced, however, as shown, for example, by similar figures compiled for Market Street in West Philadelphia, from Thirty-second Street to the City Line, the Market Street Elevated Railway having begun operation on this portion of the street in March, 1907. The following table shows the larger increases of assessed valuation of property fronting on Market Street, upon which the elevated railway is located, compared with increases on Arch Street and Chestnut Street, which are parallel and one block distant:

ASSESSED VALUATION OF REAL ESTATE ALONG MARKET, ARCH AND CHESTNUT STREETS IN WEST PHILADELPHIA PRIOR AND SUBSEQUENT TO THE CONSTRUCTION OF THE MARKET STREET SUBWAY-ELEVATED LINE

	Property betweeen Thirty-second Street and City Line Fronting on		
	Market Street	*Arch Street (Powelton and Lancaster Aves.)*	*Chestnut Street*
ASSESSED VALUATION			
1900	$4,159,000	$2,015,000	$5,157,000
1906	4,916,000	2,095,000	6,291,000
1912	7,671,000	2,197,000	8,721,000
INCREASE (AMOUNT)			
1906 over 1900	$ 757,000	$ 80,000	$1,134,000
1912 over 1906	2,755,000	102,000	2,430,000
1912 over 1900	3,512,000	182,000	3,564,000
INCREASE (PER CENT.)			
1906 over 1900	18.2%	4.0%	22.0%
1912 over 1906	56.0%	4.9%	38.6%
1912 over 1900	84.4%	9.0%	69.1%

"The total increase on Market Street from 1900 to 1912 was $3,512,000, or 84%, while on Chestnut Street it was $3,564,000, or 69%, and on Arch Street, $182,000, or 9%. Therefore the construction of the elevated railway not only caused no decrease of values, but actually stimulated the increase beyond that on neighboring streets."

APPENDIX D

ABSTRACTS FROM THE DETROIT CHARTER AMENDMENT

"Section 7. There shall be a board of five members called the Rapid Transit Commission appointed by the mayor; the term of the first member shall be one year, of the second two years, of the third three years, of the fourth four years and of the fifth five years; at the end of these terms, the term of all shall be five years. Any vacancy shall be filled for the balance of the term by a like appointment. They shall execute and file with the City Clerk a bond in a sum to be determined by the mayor conditioned as is prescribed for City officers, also the oath of office prescribed for city officers; they may be removed from office by the mayor for cause. The board, from its membership, shall name a president and secretary. It shall have plenary power to engage officers, attorneys, engineers and engineering assistants, but its other employes shall be chosen under the provisions of the City Charter pertaining to civil service whenever applicable. Its action in this respect shall rest solely in its discretion and no other limitation and qualification for office shall be placed on the members of this commission or any of its employes except as in this Chapter provided. All contracts, leases and purchases made by the Commission shall be in the name of the City of Detroit. All expenditures made by it shall be paid out of the fund created for that purpose unless the money is otherwise provided."

"Section 19. The city's annual assessment or tax roll, when any subway bonds hereunder have been issued, shall show in a separate column any increase hereafter in the assessment placed on any property because of said subway, also in said separate column the assessment placed on any property built, constructed and acquiring its assessable value because of said subway. Assessment in said separate column shall not be discontinued while any bonds issued therefor are outstanding and unpaid and while any expense thereafter incurred in connection with the construction of said subway is unpaid."

"Section 23. When any subway bonds hereunder have been issued, the fiscal officers of the city shall have the right to demand from every tax collecting officer and agency and it shall be their duty to demand and to place in the subway funds all taxes or assessments on any property in the city which are cast, levied and collected because of the assessment placed in the separate column as herein provided, said taxes to be cast at rates current for other property and the property as represented by the assessments in said separate column shall constitute a special assessment district to contribute toward the cost of constructing said subway, and while so included and contributing and to the extent of its assessment in said separate column, shall be exempt from every other tax assessment except as herein provided, and any such tax or assessment which for any reason is declared void may be reassessed against the property."

"Section 27. The city is authorized, in lieu of the subway and elevated railways herein provided for, to own, construct, equip, maintain and operate a rapid transit system, consisting of a tunnel, subway, surface or elevated system or any combination and qualification of these in and through said city and in and through any city, village or township, for a distance of ten miles beyond its limits.

"Section 28. And in addition to the other powers herein granted, in order to provide for the economic construction, equipment and maintenance of said rapid transit system and to make its operation effective and efficient, the Commission is authorized to acquire, by purchase, condemnation or otherwise, any property, publicly or privately owned, that is reasonably necessary to the construction and operation of the routes approved, and, upon the approval of the Common Council, to open and widen and extend any street or highway so as to provide for a system of major thoroughfares and superhighways, that is streets or highways having a width ranging from 120 feet to 204 feet or more, except that in special instances the Commission may, upon the approval of the common council, permit a width of

not less than 106 feet, within and without said city and to such distance beyond said city as may be agreed upon between it and the constituted authorities of the territory into and through which said system may be established, and the cost of such openings and widenings within the city of Detroit, approved by the Common Council, shall be distributed over the property benefitted and upon the city at large in the manner determined by the Common Council in such cases."

"Section 30. The Rapid Transit Commission may occupy with the right of way and appurtenances of said system any portion of any street at, above or below the grade thereof, and designate what streets at, above or below the grade thereof, and designate what streets may cross said right of way and whether above or below the grade. The street or portion selected, the location thereon of the right of way, the designation of what streets may cross the right of way and the grade thereof in doing so shall be as the commission herein provided for may determine. Whenever the grade of any street is changed as herein provided and whenever the right of way of said system shall be placed above or below the grade in such manner that it occupies exclusively a portion of the surface of said street, it shall be the duty of the Common Council upon the request of said commission in the name of the city to institute judicial proceedings to determine the damage, if any, sustained by any private property abutting the said street affected as aforesaid; said proceedings shall be instituted, carried on and completed within and, except as herein otherwise provided, in the manner specified for fixing damages by Act No. 92 of the Public Acts of 1893, as amended. This provision, however, shall not apply to entrances, exits or other appurtenances of said system, which may occupy a portion of the surface or any street.

"Section 31. No plan of route or routes of said rapid transit system shall be adopted unless the same has been approved by the electors of the city at a general or special election and after said approval the commission shall prepare an estimate of the cost of constructing and equipping said system over said route or routes and communicate its findings to the common council of the city and thereupon it shall be the duty of the budget making authorities, when requested to do so by said commission, to place in the annual budget for the current fiscal year and for each year of the construction period thereafter such sum of money as said commission may designate but the total of the sums so placed and designated shall not exceed twenty (20) per centum of the total estimated cost of said system. This sum annually appropriated as aforesaid, or any part thereof, may be raised by an issue of bonds in lieu of taxation. Said bonds shall be issued in the name of the City of Detroit, in the same manner as other city bonds, denominated General Public Improvement Bonds and shall be classed with those bonds which the city is otherwise authorized to issue annually.

"Section 32. After the approval by the electors as aforesaid, the common council from time to time, upon the request of the said commission, may create by resolution one or more local or special assessment districts embracing in each only such real estate as in its judgment will be specially benefitted by the improvement. It shall describe the district with reasonable certainty by well known boundaries, so that all persons owning real estate therein may readily ascertain the facts. It may include in one or more districts the same parcel of real estate, if in its judgment said parcel, because of the benefit to be received, warrants its inclusion in more than one district. It may levy on said district so much of the estimated cost of said system as it shall determine the real estate in said district, exclusive of improvements, will be benefitted by said system. The sum so estimated and determined shall be assessed upon the owners or occupants of said real estate by levying on each parcel such proportion of that sum as will equal, as near as may be, the amount said parcel will be benefitted by said system, and in determining the amount which each parcel will be benefitted, any rule or standard of measurement, by square, or lineal foot, or otherwise, may be adopted which is deemed just and equitable. Zones or areas of real estate within certain distances from said system may be created within any district, and the rule or standard of measurement as aforesaid changed for each of said zones or areas. The rule or standard of measurement when applied and as often as applied shall be uniform throughout such zone or area; but at no time and in no situation shall the amount levied on any parcel exceed the amount by which that parcel will be benefitted by reason of said system, and at no time

and in no situation shall any piece of property be subjected to this assessment and also to that assessment provided for by Sections 19 and 20 hereof.

"Section 33. If the amount originally assessed upon any parcel should not be sufficient to pay its fair proportion of the costs and expenses of said system as aforesaid, and the amount levied should not equal the amount of benefit to be received by said parcel from said system, a new re-assessment for the amount of such deficiency may be made upon said parcel if the total levy on said parcel shall not exceed the benefit to be received from said system, also, if any assessment shall be declared by any court of competent jurisdiction to be illegal to provide for a new or re-assessment upon such parcel. If the amount originally assessed upon such parcel should be more than sufficient to pay its fair proportion of the costs and expenses of said system, the amount in excess of this shall be refunded to the owner or occupants of said real estate in the same proportionate manner as the original assessment was made.

"Section 34. The preparation of the assessment or re-assessment roll, the notice of its completion by publication or otherwise, the hearing thereon, the collection and payment of assessments and the penalties to be imposed for non-payment, the lien on real estate and the manner of enforcing it shall be as is provided in this charter for the assessments for the paving and grading of streets, except that said assessment or re-assessment may be in such parts as the commission, with the approval of the common council, may determine, each being as near equal to the other as may be, and interest on any part, which shall be at six (6) per centum per annum, shall not be charged or collected until thirty days after said part is due.

"Section 35. The common council, by resolution or otherwise, shall have the power and it shall be its duty, when and in the manner and terms requested by the commission, to issue certificates of indebtedness in an amount exclusive of interest not to exceed the total amount of assessments levied on the real estate described in the assessment roll and unpaid at the expiration of sixty days from the date when due. They shall be sold at public or private sale and may be recorded and registered and shall, when paid, be cancelled and destroyed.

A fund shall be created into which shall be paid as collected the proceeds of the delinquent assessments and the charges thereof. The city treasurer shall use said fund to pay the holders of said certificates, each, as near as may be, his proportionate share thereof. Said payments shall be made once in every period of six months until the whole amount due thereon has been paid to the holder thereof. The city shall be liable to the holder of each certificate for the sums collected as aforesaid and paid into said fund, and not otherwise. Said certificates shall be exempt from taxes.

"Section 36. Whenever the funds from the annual appropriation and the special assessments herein provided for have been exhausted, no other or further charge shall be made in connection with said system upon the tax payer by said city. Said commission may buy on credit, or lease with an option to buy, or otherwise use any form of contract. It may issue promissory notes or other evidence of indebtedness, but when any of the obligations contracted under this section shall fall due they shall be paid out of the income of said system and tolls and charges and fares shall be made sufficient to meet them and the commission, without qualification or hindrance, shall be empowered to raise tolls, charges and fares to accomplish this end.

"Section 37. After the approval of the plan by the electors as aforesaid, no permit shall be issued by any public official for the erection of any structure any part or all of which will lie within sixty (60) feet of the center line of said rapid transit line except on terms and conditions provided by said Commission."

APPENDIX E

ABSTRACT OF THE DUTIES OF RAPID TRANSIT COMMISSION, NEW YORK

The New York Rapid Transit Act of 1891, after providing for the continuation in office of certain commissioners (who had theretofore been appointed as commissioners under the act of 1875), required that if, after investigation, such commissioners should deem that the construction of a rapid transit railroad was necessary, they should proceed to:

(1) Adopt the routes and general plan of construction of such railroad;

(2) Obtain the consent to the construction and operation of such railroad by the local authorities and the property holders affected, or, if the consent of the property holders should be withheld, then the substituted consent of the General Term of the Supreme Court;

(3) Adopt detailed plans for the construction and operation of such railroad, and

(4) To sell the right to construct and operate such railroad to a corporation to be formed under the terms of such act, for such a period of time as they should deem advisable and upon such terms as they should be able to exact.

A section of the Rapid Transit Act also conferred upon the Commissioners a very large power to grant additional franchises to existing railroad corporations.

Practically all the rapid transit subways and considerable of the elevated rapid transit lines have been constructed by the Rapid Transit Commission pursuant to the Rapid Transit Act of 1891 and the various amendments and supplements thereto.

The Rapid Transit Act imposed certain duties connected with the construction of rapid transit lines upon the Commission, the Board of Estimate and Apportionment and the Mayor and the Corporation Counsel. In general the Commission selects the route through which a proposed rapid transit line is to be built, makes the maps and plans for the subway or elevated line desired, obtains the consent of property owners or of the Appellate Division of the Supreme Court to the building of the road, prepares forms of contracts, holds hearings thereon, advertises for bids, lets the contracts and supervises the construction. The route and general plan must be approved by the Board of Estimate and Apportionment and the Mayor. The contracts must be approved as to form by the Corporation Counsel, and after execution approved by the Board of Estimate and Apportionment and, if the City is to pay for the work, appropriations therefor must be made by the Board of Estimate and Apportionment, after which the contracts are executed by the Commission.

The steps necessary from start to finish are as follows:

1. Preliminary survey of streets to be traversed.
2. Preparation of route maps and resolutions.
3. Application to and approval by Board of Estimate and Apportionment.
4. Consent of property owners or of Appellate Division of the Supreme Court.
5. Survey of surface and subsurface structures.
6. Preparation of contract plans.
7. Preparation of form of contract.
8. Public hearing on form of contract.
9. Approval of form of contract by Corporation Counsel.
10. Advertisement for and receipt of bids.
11. Acceptance of bids and submission to Board of Estimate and Apportionment for approval and appropriation.

12. Execution of contract and commencement of work.
13. Preparation of working plans.
14. Preparation of record plans.
15. Arbitration of disputed items of cost.

Preliminary surveys are necessary to show the location of building lines and the physical structures in and under the surface of the streets. These surveys are made by the engineers of the Commission. Then it is necessary to take photographs of the street and the structures standing along the street before work begins, so that the contractor may be held to a restoration of the surface as it was before work began, and also that property owners may not successfully prosecute unjustifiable claims on account of damages. The Commission employs an official photographer to do this work, and it has large files of photographs showing the previous condition of every street in which subway work has been undertaken.

The work of obtaining consent of property owners is of no small magnitude. The law provides that before a rapid transit railroad is built in any street the Commission shall obtain the consent of holders of property owning a majority in value of the property along the proposed line, and if that is impossible, an order from the Appellate Division of the Supreme Court, holding that the building of the proposed road will be a public benefit. In some cases, after diligent canvassing by representatives of the Commission, the consent of property owners is obtained; in others, the Commission is compelled to apply to the Appellate Division for the appointment of a commission to determine whether the proposed road shall be built. When this commission reports the Appellate Division approves the report, and if it is favorable, this approval serves in lieu of the consent of property owners.

APPENDIX F

ABSTRACT OF THE PHILADELPHIA MILL TAX AND PENNSYLVANIA CONSTITUTIONAL AMENDMENT

By an act of the Legislature of the Commonwealth of Pennsylvania (June 17, 1913, P. L. 507) a one mill tax on personal property was surrendered by the state to the city as a practical subsidy in aid of rapid transit development. This act enabled the city to increase its borrowing power by upwards of $40,000,000. The constitutionality of the act was upheld by a decision of the Supreme Court of Pennsylvania filed May 12, 1914. (No. 691 Miscellaneous Docket No. 2.)

By an amendment to Section No. 8 of Article IX of the Constitution of Pennsylvania proposed by a joint resolution of the General Assembly during session of 1913, and passed by the Legislature of 1915, the city's borrowing capacity for transit and port development was again increased by over $67,000,000. This amendment was submitted to a vote of the people on November 2, 1915, with the following result:

For amendment	360,449
Opposed to amendment	189,687

"The main particulars in which this amendment furthers the city's undertakings in establishing transit and port facilities are embodied in the following provisions:

"INCREASES THE BORROWING CAPACITY OF PHILADELPHIA FOR THE SPECIAL PURPOSES ONLY OF TRANSIT AND PORT DEVELOPMENT BY AN AMOUNT EQUAL TO THREE PER CENT. OF THE ASSESSED VALUATION OF TAXABLE PROPERTY.

"Based upon city controller's figures of October 1, 1914, of assessed valuation of taxable property in Philadelphia for 1915, the increase in borrowing capacity will be upwards of $67,000,000.

"THAT WHEN TRANSIT AND PORT DEVELOPMENTS HAVE BEEN ACQUIRED OR CONSTRUCTED BY THE CITY OF PHILADELPHIA, AND WHEN THEY HAVE BEEN PLACED ON AN INCOME PRODUCING BASIS, SUCH PORTION OF THE BONDS ISSUED THEREFOR AS ARE THEN SUPPORTED (AS TO ANNUAL INTEREST AND SINKING FUND PAYMENTS ACCRUING THEREON) BY ANNUAL INCOME PRODUCED BY THE DEVELOPMENTS MAY BE EXCLUDED FROM THE INDEBTEDNESS OF PHILADELPHIA IN CALCULATING ITS BORROWING CAPACITY.

"This provision will enable this city to recover from time to time such portion of the borrowing capacity so utilized for transit and port development as may then be represented by the par value of bonds outstanding which are sustained as to interest and sinking fund out of the net earnings of the facilities. In order that the terms of this provision may apply it will not be necessary, as it is under the now existing terms of the constitution for each facility to earn the annual interest and sinking fund payments on bonds representing the total cost thereof. But SUCH PORTION of the bonds issued therefor as are sustained as to the interest and sinking fund requirements out of the net earnings produced thereby may be excluded from the city's debt in calculating its borrowing capacity.

"ENABLES PHILADELPHIA TO ISSUE 50-YEAR BONDS FOR TRANSIT AND PORT DEVELOPMENT INSTEAD OF 30-YEAR BONDS, THEREBY REDUCING THE ANNUAL SINKING FUND REQUIREMENTS FROM 2¼ PER CENT. ON THE PAR VALUE OF BONDS ISSUED, TO 1 PER CENT. ON THE PAR VALUE OF BONDS ISSUED.

"On a $50,000,000 issue of bonds this will reduce the annual payments required, in addition to interest, for sinking fund purposes by 1¼ per cent.—a saving in such an issue of $625,000 per year.

"IT PERMITS GRADED SINKING FUND INSTALLMENTS ON SUCH BONDS TO BE ESTABLISHED.

"Thus, in the early years the sinking fund payments may be made normal, increasing annually with the producing capacity of the facilities constructed, so that in the early years of operation the sinking fund charge in addition to interest accruing on the bonds issued therefor will be kept down to a minimum.

"IT AUTHORIZES THE CAPITALIZATION OF INTEREST AND SINKING FUND PAYMENTS ACCRUING ON SUCH BONDS DURING THE PERIOD OF CONSTRUCTION AND DURING THE FIRST YEAR OF OPERATION.

"Thus Philadelphia will be enabled to finance and construct rapid transit facilities and port improvements, and have the same in complete operation for one year before the interest or sinking fund payments on the bonds issued therefor become a charge against current revenues.

"THIS CONSTITUTIONAL AMENDMENT WILL GIVE PHILADELPHIA ADEQUATE BORROWING CAPACITY FOR BOTH TRANSIT AND PORT DEVELOPMENTS; WILL RELIEVE CURRENT INCOME FROM TAXATION OF THE INTEREST AND SINKING FUND CHARGES ON BONDS ISSUED FOR SUCH DEVELOPMENTS UNTIL AFTER THE SAME ARE IN ACTUAL OPERATION AND PRODUCING INCOME, AND WILL ALSO ENABLE PHILADELPHIA TO FINANCE THESE IMPROVEMENTS IN AN ECONOMICAL MANNER BY REDUCING THE ANNUAL SINKING FUND PAYMENTS WHICH ARE REQUIRED TO BE MADE AS ABOVE STATED. IT WILL ENABLE PHILADELPHIA TO ENLARGE ITS BORROWING CAPACITY FROM TIME TO TIME AUTOMATICALLY AS THE FACILITIES BECOME PARTIALLY OR ENTIRELY SELF-SUPPORTING."

The above quotation is taken from the report of the Department of City Transit of Philadelphia, for 1915.

PLATES