Report on the Union elevated railroad of Chicago

Charles Keagle Mohler, Loop protective association

REPORT

on the

Union Elevated Railroad
of Chicago

Covering

CAUSES OF CONGESTION
NOISE IN OPERATION
UNSIGHTLY APPEARANCE
OBSTRUCTION TO LIGHT

and

SUGGESTED REMEDIES

Submitted to the

LOOP PROTECTIVE ASSOCIATION
(Incorporated)

By
CHARLES K. MOHLER
October, 1908

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Transport

LOOP PROTECTIVE ASSOCIATION.

(Incorporated.)

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April 6, 1908.

Mr. Charles K. Mohler,
Consulting Engineer,
401 *Heyworth Bldg.,*
Chicago.

Dear Sir:

In taking up the work of making a report to this Association on the Union Elevated Railroad "Loop" of Chicago, it is desired that you investigate and report to us, what in your judgment are the causes of, and what can best be done to remedy, in whole or in part, the following objectionable features of the Union Elevated Railroad "Loop" and its operation.

1st. The congestion and delay in handling traffic.

2nd. The noise resulting from the operation of trains over the structure.

3rd. The unsightly appearance of the structure and obstruction to light.

The matter is of such importance that we wish you to take whatever time may be necessary for a thorough investigation of the problem. We do not wish to impose any limitations on your recommendations except those which the problem itself necessitates; that is to say, changes may suggest themselves to you which would materially improve the appearance of the structure and reduce the obstruction to light and air, but which would interfere with the efficiency of the road and thereby increase congestion.

In like manner, changes might be made to relieve con-

gestion which would increase the unsightly appearance of the structure or add to the obstruction to light and air.

From preliminary reports we are led to believe that congestion and delay may be largely eliminated without adding to the nuisance features, and in like manner the noise and other nuisance features may be greatly reduced or eliminated in a manner which would increase rather than decrease the efficiency of the structure as a means of transportation.

There is now pending in the Circuit Court a suit to which the City and many members of the Association are parties, which seeks to have all the Elevated Loop ordinances held invalid and the franchises claimed under them declared void. Many substantial property owners believe that the only solution of the Loop problem is the entire removal of the Elevated Loop structure; others have felt that by changes as indicated above, which would not interfere with the Loop's efficiency, it might be largely relieved of the nuisance features and made tolerable, and that, without additional interference with light and air, it might be rendered more efficient.

We have secured through the action of the City Council, the removal of the advertising billboards from the structure, and, through the action of the same body have obtained two reports from engineers on the Loop problem. Personally, I should be greatly pleased if the result of the investigation might lead to the adjustment of the whole problem to the mutual benefit of the City, the property owners, and the Elevated Roads.

Yours very truly,

JAMES F. BOWERS,
President, Loop Protective Association.

To the President and Members of the
Loop Protective Association.

GENTLEMEN:

In compliance with your letter of April 6, 1908, stating the features in connection with the Union Elevated Railroad "Loop" and its operation, upon which you wished a report, I beg to submit the following synopsis and detailed report.

In the synopsis the leading features of the report are as briefly stated as consistent with clearness.

In some particulars, such as through routing to increase the capacity and relieve congestion, the conclusions reached are in general accord with those of previous reports on the situation. The most noticeable disagreement with previous reports is that relating to the advisability of platform extension.

Noise in operation can be very largely reduced; mainly by reconstructing the roadbed in order to interpose stone ballast or some other inelastic medium between the structure and rail supports. Longer rails and better joints would still further eliminate the noise.

The unsightly appearance and obstruction to light can be largely remedied. A large factor in the accomplishment of that result would be the reconstruction of stations, so as to dispense with the buildings above the platforms.

Acknowledgment is made to Mr. William S. Twining, Chief Engineer of the Philadelphia Rapid Transit Company, for plans of construction used by that road, and to such others as have lent assistance in furnishing information or data.

Respectfully,

Charles K. Mohler,

215 Wabash Ave. *Engineer.*
Chicago, Ill., October 20, 1908.

THE UNION ELEVATED RAILROAD "LOOP."

Location.

The Union Elevated Railroad "Loop" comprises about two miles of double-track elevated structure in the business district of Chicago, occupying Lake Street from Fifth Avenue to Wabash, Wabash Avenue, from Lake to Van Buren, Van Buren Street, from Wabash to Fifth Avenue and Fifth Avenue, from Van Buren to Lake Street.

Stations.

There are eleven double stations for each track, located as follows; at Clark and Lake, State and Lake, Randolph and Wabash, Madison and Wabash, Adams and Wabash, State and Van Buren, Dearborn and Van Buren, La Salle and Van Buren, Quincy and Fifth Avenue, Madison and Fifth Avenue, and Randolph and Fifth Avenue.

Roads Using It for a Terminal.

At the present time it serves as a "Loop" terminal for; the South Side Elevated Railroad, entering and leaving at Wabash and Van Buren, and the Metropolitan West Side Elevated Railway, entering and leaving at Van Buren and Fifth Avenue, operating on the inner track. On the outer track are operated the trains of the Chicago and Oak Park Elevated Railroad and the Northwestern Elevated Railroad, both entering and leaving at Fifth Avenue and Lake Street.

The South Side line is comprised of five branches; the Metropolitan of four branches; the Chicago & Oak Park of one line; and the Northwestern of two branches, one of which includes the Evanston extension.

All of the above roads, with the exception of the Northwestern, have stub-terminals outside of the "Loop" which are in service for a time during rush hours. The Northwestern has recently been granted a franchise for establishing an outside stub-terminal.

Transportation Facilities Afforded.

At the time the promotion of the enterprise was started, the probable demands for future increased facilities for rapid transit in the City of Chicago appear not to have been fully recognized. As a means of delivering or receiving passengers from the various lines of the elevated railroads, to the limited area of the loop district, in the non-rush-hours, the facilities are fairly satisfactory when considered merely from the standpoint of a terminal. In handling rush-hour traffic and lending itself to expansion and growth, it has long since proven lamentably inadequate. *It should be said that as a fundamental principle of urban transportation, anything in the nature of a terminal in a congested district should be avoided if possible.*

Design of Structure.

In the design of the Union Elevated Railroad structure, there was little or no attention given to the *elimination* of the objectionable appearance of the structure, obstruction to light or traffic, or the prevention of noise.

Some of the objectionable features in design and construction are as follows:

1st. Obstruction to Traffic.

Placing the columns in the roadway, and especially at points of street intersection, forms an obstruction and danger both to vehicle and street railway traffic.

2nd. Obstruction to Light and Unsightly Appearance.

One of the most notable examples of the lack of attention to the elimination of objectionable features is shown in the construction of station buildings over the roadway at street intersections. All loop stations except those on Lake street cover the entire roadway of the intersecting streets and some are over 100 feet wide. This was unnecessary, either for operating facilities or for the convenience of the public. It appears to the writer that the most suitable design of station would have been with island platforms, and ticket offices and waiting rooms beneath the tracks and platforms. This would have placed the canopies and platforms, which are the highest parts of the structure, in the center of the street, where they would offer the least obstruction to light on the sidewalks and fronts of adjacent buildings.

The structure as designed shows little effort was made to get pleasing outlines and relieve the bare angular appearance. On the other hand, ornamentation, which shows itself to be no essential or integral part of a structure, is possibly worse in some cases than the barest outline.

3rd. Noise in Operation.

In the matter of noise resulting from the operation of trains no provision was made for lessening this objectionable feature. The rails rest directly on the ties

and the ties directly in the decks of the girders. This form of construction allows the noise producing vibration set up by the passage of trains to be carried into the structure itself, and set up in the broad thin plates and members under tension, thereby increasing the volume and intensifying and carrying the sound to long distances.

As a structure serving to carry traffic, it is well designed, and in some respects a distinct advance over elevated structures previously built. If removed from the city streets to a locality where its objectionable features would not constantly obtrude upon the attention of the community, it would be open to little, if any, criticism.

IMPORTANCE OF URBAN RAPID TRANSIT.

Transportation is one of the greatest problems with which municipalities have to deal at the present day.

The tendency in modern city growth to concentrate the business and commercial center in a very limited area, and at the same time for the residential area to be widened and extended into the outlying districts, has produced demands for transportation and rapid transit facilities with which few, if any, cities have kept pace.

THE RAPID TRANSIT SITUATION IN CHICAGO.

Chicago, with a total area of over 190 square miles, and drawing from a large suburban territory, has its main business center or "Loop" district confined to less than one square mile. The area inside the "Loop" belt is less than one-quarter square mile.

If the concentration in the business district, made possible by the erection of steel frame buildings with elevator service is to go on, the problem of taking care of the growth of the rush-hour traffic, demanding rapid transit facilities, is one which will demand heroic measures to meet and dispose of. If every possible device should be employed in connection with the present elevated loop structure for relieving congestion, it would only be a short time until conditions were again in practically as bad shape as at present. It is needless to say, that make-shifts and expedients, will fall far short of meeting the problem in its wider scope.

SYNOPSIS.

Features of the Report Briefly Stated.

DELAY AND CONGESTION.

The aggregate delay approaching and getting around the "Loop" may amount to fifteen minutes or more per trip during the rush-hours 7:45—9:15 and 5:00—6:30.

A large per cent. of the trains have delays outside of the "Loop" before entering, ranging from a slow-down to a wait of ten minutes or more. This is a large factor in aggregate delay.

Rush-hour trips.

The average time for rush-hour trips *on the "Loop"* is about 15 minutes and 40 seconds; the longest trip recorded took 19 minutes and 45 seconds; the shortest, 11 minutes and 58 seconds.

Non-rush-hour trips.

The average time for non-rush-hour trips is about 12 minutes and 30 seconds. The longest trip of the record took 14 minutes and 29 seconds; the shortest, 10 minutes and 30 seconds.

The average excess time for rush-hour trips over non-rush-hour on the "Loop" is about 3 minutes and 10 seconds, made up of:

1st. Junction Delays.

A record of trips on the outer track during rush-hours shows only 5 per cent. of the junction crossings were made without delays; during non-rush-hours 32 per cent. On the inner track during the rush-hours 31 per cent. were made without delay; in the non-rush-hours

about 54½ per cent. The record includes that part of the trip between the first station preceding and following the junction. Junction influence delays occurring back of the station preceding the junction are not shown, though they frequently occur. The junction delays will amount to from *70 to 90 per cent.* of the rush-hour delay.

2nd. Delays at the first station after entering.

3rd. Delays from handling longer and heavier trains.

4th. Delays from longer station stops on account of: crowded cars; insufficient number and width of gates and doors; trains not having proper and sufficient signs to show destination and class.

SUGGESTED CHANGES FOR INCREASING THE OPERATING CAPACITY.

1st. Through Routing.

Through routing to the greatest degree practicable, would increase the number of trains which could be passed through the "Loop" nearly 100 per cent. Six or seven car trains could be loaded at the present platforms; the seven-car trains making an increased car capacity of 40 per cent. *Through routing seven-car trains would give a total increase in car capacity of 130 to 140 per cent.* Through routing and operating longer trains are clearly factors of first importance for increasing and improving the elevated rapid transit service of Chicago, and has been included as a leading feature in the reports of Mr. Arnold, Messrs. Ford, Bacon and Davis, and Mr. Weston.

Among the most practical through routings suggested are:

A. THE NORTHWESTERN WITH THE SOUTH SIDE LINES.

Three methods have been proposed:

1st. Through route the north-bound and south-bound trains over Wabash avenue and Lake street.

2nd. Alternate one south-bound train on one side of the "Loop" and the next on the other; north-bound trains alternating likewise.

3rd. Through route *north-bound* trains on *one* side of the "Loop" and *south-bound* trains on the *other*.

Through routing as mentioned in "3rd" is considered preferable, as it would interfere less with the satisfactory operation of the West Side lines.

B. INTER-ROUTE THE TWO SYSTEMS OF THE WEST SIDE.

Connect the Logan Square and Humboldt Park branches of the Metropolitan to the Chicago and Oak Park line where they cross near Paulina street. Build a third track on Lake street from the junction to the "Loop." Route the Humboldt Park and Logan Square branches over the Chicago and Oak Park and around three sides of the "Loop" via Lake, Wabash and Van Buren, and out the Douglas and Garfield Park. Route the Douglas and Garfield Park branches over the Fifth avenue side of the "Loop" out Lake street to the Logan Square and Humboldt Park.

The Logan Square and Humboldt Park branches would save three-quarters of the mileage now required to traverse the distance from Van Buren to Lake four times each round trip. The saving for the Garfield and Douglas Park would be once the distance from Van Buren to Lake and twice the distance from Fifth Avenue to Wabash.

If the service on the Chicago and Oak Park could not be made to balance with the Metropolitan, it could operate as at present.

The Douglas and Garfield Park passengers wishing to ride to the Lake, Wabash and Van Buren sides of the "Loop" could transfer at the proposed station at Lake and Franklin. The Logan Square and Humboldt Park passengers wishing to ride to Fifth avenue points could transfer at Van Buren and Franklin to the in-bound Garfield and Douglas Park trains.

In General.

By through routing part of the trains and sending the remainder around the "Loop" each road would be enabled to accommodate passengers at all stations. The number of trains on the side of the "Loop" over which through routed trains passed would be increased in proportion to the number of trains through routed. If half the trains now operated on a "Loop" track were through routed that would leave room to increase the number of trains for any line on the side of the "Loop" over which they through routed by 50 per cent. and reduce the time interval between trains 33 per cent. The "Loop" trains on the opposite side of the "Loop" from the through route for that line would be reduced to half the present number and the amount of the time interval between trains would be doubled.

The present platforms are long enough to accommodate seven-car trains under unified operation or with methods of loading suggested below.

The saving in time and mileage and the increase in capacity and encouragement of short-haul traffic by through routing should more than off-set the *loss* of *one fare* from the through traffic which now pays two.

During the non-rush-hours all trains could still be sent *around* the "Loop" as at present if desired.

2nd. Changes in "Loop" stations.

Stations to be abandoned; or replaced by others in new location.

Dearborn street station might be abandoned or merged with State street for all lines.

Randolph and Fifth avenue station for the Chicago and Oak Park and Northwestern lines should be abandoned. A station at Lake and Franklin streets for the Chicago and Oak Park and one for the Northwestern at Fifth avenue and South Water street should be built.

The Metropolitan should abandon the Quincy street station. The Fifth avenue terminal and Franklin and Van Buren main-line station afford the necessary facilities.

For the South Side the State and Van Buren street station *might* be abandoned. Its place would be taken by the Congress street stub-terminal and main-line station. (For reasons see page 53.)

3rd. Changes in Station Stops so as to Load Longer Trains.

A. To Load Eight-Car Trains by Alternate End Loading.

Eight-car trains could be loaded at the present independent platforms by making the stops so as to load five cars from the front of the train at one station and five from the rear of the train at the next. By making the stops alternately in that way the train would be evenly loaded throughout. The incoming traffic during the evening rush-hour is light and could best be taken care

of by requesting incoming passengers to ride on the center cars of the long trains. Eight-car trains would increase the capacity of the "Loop" from 50 to 60 per cent. Seven-car trains could unload at the present platforms during the morning rush-hours. As now operated trains stop at either end of the platform in the morning as found convenient. It is believed that the proportion of seven-car trains for the morning rush-hour and eight-car trains for the evening rush-hour service on the same schedule would more nearly meet requirements than using the same number of cars in both.

There is perhaps no expedient for relieving congestion which could be adopted with as little delay or complication. It is not suggested as a means of fulfilling the transportation needs of the city in the larger measure.

B. To Load Six or Seven-Car Trains by Alternate Station Stops.

Another means that has been suggested (which is stated here by request) for increasing the capacity of the "Loop" is that of giving up every other station to the exclusive use of one of the two roads *during rush-hours.* The saving on account of station stops would perhaps amount to about 5 per cent. of the time to make a "Loop" trip. The station being given up to one road, would accommodate seven-car trains, giving an additional increase of 40 per cent. The total increase would probably amount to about 40 or 45 per cent.

Fifty per cent. of the rush-hour patrons of each road would be uneffected by such a change. The other fifty per cent. of the rush-hour patrons would have to walk an average of one block farther than they do at present. The gain in rapid transit and the relief to congestion with the saving in time on the "Loop" would probably

be considered ample compensation for the additional walk. The non-rush-hour patrons would be uneffected.

4th. Changes in Car Doors and Train Signals.

The use of wider sliding end doors and center side doors, with electric door signals for starting trains, would save time in making station stops to load and unload passengers and getting the train started.

5th. More Complete System of Train Signs.

(*a.*) Train signs should be placed at *each car entrance* to give *destination* and *class* of train.

(*b.*) Movable display signs should be used at each station platform to indicate before the arrival of the train its destination and class.

(*c.*) If the waiting rooms are moved to the space beneath the tracks and platforms, illuminated signs and signal bells should be installed in the waiting rooms to *indicate* the approaching trains.

6th. Improved Brake Hangers.

Brake hanger attachments should be employed of such design as to allow train brakes to be applied to their maximum efficiency. The hangers in use allow an unsteady, jerky motion when the train is coming to a stop, and a dangerous backward lurch at the instant the forward motion ceases.

7th. Protection of Contact-conductor (Third) Rail.

Protection of contact-conductor (third) rail should be employed to insure more reliable service during winter rain and sleet storms. (It would also be the means of reducing the danger to passengers where in case of accident they are compelled to leave the trains and walk on the structure.)

8th. Universal Transfers.

The adoption of universal transfers probably would not effect the operating capacity of the "Loop," but it is believed that they would increase the efficiency of the service and that the roads would ultimately gain by their adoption. They should properly be adopted under such limitations as to prevent abuse of the privilege as far as possible.

STATION PLATFORM EXTENSION AND STUB TERMINALS.

1st. Station Platform extensions.

Extension of platforms has long been advocated. The results of this investigation show the advantages to be gained are very small and would not warrant adoption on the grounds which have been advocated. Extensions called for in the recent report to the Committee on Local Transportation would mean 6,000 feet, or over a mile of added new platform.

As previously mentioned, the total length of the station platforms on the Loop are long enough to load seven-car trains with little if any extension, and with through-routing and unified operation would be ample for present requirements.

On account of trains on the different roads not being equal in number, and those of the same road entering in groups of twos and threes, less than 31 per cent. of the total number of trains arrive in the required *order* to load as *double-units,* or *two trains at the same station at the same time.* About 11 per cent. of the total number of trains arrive within the *time interval* to allow establishing of *double-units.* If one minute less time per rush-hour trip, under ideal conditions, were taken with ex-

tended platforms it would mean 6.5 per cent. time saved or increased capacity. The *order grouping would reduce that to 2 per cent.* The *order-time-grouping to 0.7 per cent.*

If three minutes were allowed, ideal conditions would give 20 per cent increase. Order grouping would reduce that to 6 per cent; *order-time grouping to 2 per cent.* increased capacity.

In order-time grouping all trains arriving at the station 20 seconds or less after the preceding train starts, are credited as double-units and saving the *full* amount of time in loading. *One-half* the trains shown as establishing double-units under *order-time* grouping of twenty seconds interval and saving full time would be more nearly correct. *Double units after being once established may be separated in passing crossing junctions.*

2nd. Outside "Stub" Terminals.

Terminals in congested districts for rapid transit should be avoided if possible. They only afford limited facilities to the patron near that part of the "Loop" where the road enters and leaves.

NOISE IN OPERATION.

Noise results from:

1st. The movement of trains on the tracks.
2nd. Motor gears.
3rd. Train air-brake exhaust.
4th. Rattling of loose parts.
5th. Slipping of wheels around curves.
6th. The exhaust from the pneumatic interlocking.
7th. Crossing junction and switch frogs.
8th. Screeching and chattering of brake shoes.

SUGGESTED REMEDIES TO REDUCE NOISE.

1st. Roadbed, Track and Structure.

The road-bed should be of stone ballast, or equally effective construction, to break up and dissipate the noise producing vibration. The mass of the supporting bed should be large to still further absorb the vibration.

Sixty-foot rails should be used instead of thirty, reducing the number of joints to half. The joints are responsible for most of the noise caused by the trains moving over the track. An improved splice bar should be used for the rail joints. They should carry the wheel over the joint without the instant reversal of shear when the wheel passes from one rail to another.

2nd. Noise resulting from the motor gears can be remedied in part by the ballasted road-bed. Housing the gears and motors should give some relief. The gears should be well maintained. In some cases it may be necessary to bolt creosoted planks to parts of the structure, or cover them with some such material as concrete to reduce the noise.

3rd. Noise from air-brake exhaust can be entirely eliminated by the use of properly designed exhaust ports and mufflers.

4th. Rattling of loose parts can be largely prevented by proper maintenance.

5th. The screeching of wheels over the curves can be prevented to some extent by the use of a lubricant on one rail.

6th. Noise from the interlocking exhaust can be prevented by mufflers.

7th. The noise from crossing and switch frogs at the

junctions can be eliminated in part by the use of solid floor construction and stone ballast.

8th. Screeching and chattering of brake shoes can be largely prevented by using a shoe of the proper combination of metals and properly hung.

OBSTRUCTION TO LIGHT, AND UNSIGHTLY APPEARANCE.

1st. Stations on Wabash, Van Buren and Fifth Avenue are unnecessarily large and obtrusive.

2nd. The exit stairs are unsightly and very little used.

3rd. The structure is unsightly for lack of proper maintenance and painting.

4th. The electric lamp brackets attached to the structure are in no sense ornamental.

SUGGESTED CHANGES TO REDUCE OBSTRUCTION TO LIGHT AND REMEDY UNSIGHTLY APPEARANCE.

1st. Stations.

The stations on Wabash, Van Buren and Fifth Avenue should be reconstructed by removing the ticket offices and waiting rooms from the present level, and placing them beneath the tracks and platforms on the level now occupied by the cross-over footways. *This would reduce the width of some of the stations from over* 100 *feet to about* 50 *feet and leave no part of the station above the platforms.* Those on Lake Street, being without waiting rooms or crossover footways, should be reconstructed on the same plan.

The conopies over the platforms should be replaced by others preferably of saw-tooth design, and the height

reduced at the center about four feet. Wire glass could be used for covering. For lighting the interior of the station as well as the street below sidewalk prism glass could be used in part for the station platforms.

2nd. "Exit Only" Stairs.

The present "exit only" stairs serve but little purpose. In their use three-quarters of the passengers would be taken away from their destination. "Exit only" stairs on Fifth Avenue are not required under present operation. *Entirely useless "exit only" stairs* are those for *south-bound* trains for the South Side line at Congress and Wabash.

At stations where congestion occurs additional stair facilities could be provided, as follows:

a. At *congested points* where stairs are used for both entrance and exit they could be built wider than those now in use.

b. Some exits might be made through business houses.

c. Exit stairs, if necessary at any point, could be built directly above the entrance stairs to serve as a covering, and glass canopies used over the higher stairs.

3rd. Care and painting.

The structure would be greatly improved in appearance by proper maintenance, and painting some sightly color.

4th. Added utility, improved appearance, etc.

If brackets of suitable design for carrying electric lights and their feed wires were attached to the outside of the posts the structure would not only have added utility, but would thereby have its outlines modified and made less unsightly. The design of the lamps should be

made to largely harmonize with the structure. During daylight the outlines of the brackets, and curves produced by the sagging wires, would serve to relieve the straight angular outlines of the structure. The arrangement of the lamps should be such that at night the roadway would receive a high degree of illumination, while the main part of the structure would be left in shadow.

The suggested new stations should be made as structurally ornamental as possible, to harmonize with the main structure as a whole.

REPORT IN DETAIL.

THE CAUSE OF DELAY AND CONGESTION OF TRAINS DURING RUSH-HOURS.

Time Taken for Rush-Hour Trips.

From a record recently taken of thirty-eight train trips around the "Loop" during the rush-hours, twenty of which were made in the morning covering a period of an hour and thirty minutes, from 7:45 to 9:15; and for eighteen trips in the evening, covering a like period, from 5 o'clock to 6:30, the average time for the thirty-eight trips was 15 minutes and 39 seconds per trip. The time is for the actual trip, center of the train approximately at the junction point both entering and leaving. In Table No. 1 the time for the recorded trips in both the rush and non-rush-hour are given.

Plate No. 10 shows the longest rush-hour and a short non-rush hour trip of the record, plotted for time-distance curves. (See Plate 10 last page.)

The horizontal lines are spaced to represent intervals of 1,000 feet. The wide spaced vertical lines represent one minute of time, while the close spaced lines represent 10-second intervals. The stations and junctions are marked by heavy dots and dashes.

The non-rush-hour trip without delay took 11 minutes and 46 seconds. The rush-hour trip with delay 19 minutes and 45 seconds. It is 7 minutes and 59 seconds longer than the non-rush trip, and 4 minutes and 6 sec-

TABLE NO. 1.

TIME TAKEN FOR TRAINS TO MAKE "LOOP" TRIPS, (FROM ENTERING TO LEAVING AT JUNCTION.)

RUSH-HOURS.

	Northwestern		Chi.& Oak Park		Metropolitan		South Side	
	A. M.	P. M	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
	7:45 to 9:15	5:00 to 6:30	7:45 to 9:15	5:00 to 6:30	7:45 to 9:15	5:00 to 6:30	7:45 to 9:15	5:00 to 6:30
	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
	14 33	15 00	15 11	18 15	16 32	17 00	19 40
	16 46	17 03	19 45*	14 45	14 35	15 26	16 24
	15 48	18 10	14 52	15 28	13 00	13 58	15 41
	14 09	13 15	13 25	13 28	15 37	14 14	15 54
		16 33			16 52		
		16 34			14 55		
		13 49					
		11 58					
		14 36					
		14 22					
		18 12					
		19 23					
Sum	61 16	188 55	63 13	61 56	91 31	60 38	67 39
Average	15 19	15 45	15 48	15 29	15 15	15 09	16 55

A. M. Average—15m. 34s. P. M. Average—15m. 45s. Total—15m. 39s.

NON-RUSH-HOURS.

A. M.	P. M.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
	11 47	12 15	11 46*	12 45	10 58	13 31	11 54
	14 29	14 04	12 19	11 35	12 27	11 02	13 01
		12 35	13 12		13 12		10 30
		12 39	12 52				12 54
		13 37					
Sum	26 16	65 10	50 09	24 20	36 37	24 33	48 19
Average	13 08	13 02	12 32	12 10	12 12	12 16	12 04

Total Average—12m. 31s.

* Trip plotted on Plate 10 for time-distance curves.

NOTE:—Many of the non-rush-hour trips were taken just before or just after the rush-hours. Trips taken well out of the rush-hour influence show a shorter average time for the loop trip.

onds longer than the *average* rush-hour. Both are P. M. trips.

Station stops for the non-rush-hour average 9.6 seconds and total 1 minute 46 seconds. Station stops for rush-hour total 2 minutes 5 seconds and average 11.4 seconds. The curves show a marked similarity until Randolph and Wabash are passed, when slow running shows on the rush-hour trip as a result of junction influence, delay extending north of Madison and Wabash station. Very slow running and frequent stops occur until Quincy is passed.

The dead stops between stations amounted to 2 minutes and 19 seconds. The excess time, over the average without delay, taken to pass from Adams to State was 1 minute and 47 seconds, and from La Salle to Quincy 1 minute and 21 seconds; total, 3 minutes and 8 seconds.

For detail of trips see table No. 2. The slow running and stops from Quincy to Randolph and Fifth Avenue were probably caused by backing a Northwestern train into Randolph Street station, and a Chicago and Oak Park train entering over the crossing junction.

The above rush-hour trip, taking 19 minutes and 45 seconds, on the outer track, began about 5:30 P. M. Another trip, on the inner track, beginning about 5:45 P. M., consumed 19 minutes and 40 seconds. The shortest rush-hour trip consumed 11 minutes and 58 seconds, and was on the outer track, beginning about 9:05 A. M., being partly outside the rush-hour period.

Time Taken for Non-Rush-Hour Trips.

The average time for a trip around the "Loop" in the non-rush-hours, as shown in a record taken of twenty-two trips, shows an average of 12 minutes and 31 seconds per trip. The record for the shortest non-rush-hour

TABLE No. 2.

RUNNING TIME BETWEEN STATIONS AND LENGTH OF STATION STOPS FOR CHICAGO AND OAK PARK TRAINS ON OUTER TRACK. ONE RUSH-HOUR AND ONE NON-RUSH-HOUR TRIP.

STATIONS.	Station Stop		Running time from Preceding Station.		Excess Time for Rush-hour Trip		Running Between Stations.					
							Rush-hour		Non-rush-hour		Total Time of Stops	
	Rush-Hour	Non-rush-Hour	Rush-Hour	Non-rush-Hour	Sta. Stop	Running Time	No. of Stops	Slow Downs	No. of Stops	Slow Downs	Rush-Hour	Non-rush-Hour
	Sec.	Sec.	m. s.	m. s.	Sec.	m. s.					m. s.	m. s.
Jct. 5th and Lake.....												
Clark.....	9	12	38	40	—3	—2						
State	5	11	50	43	—6	7						
Randolph	10	9	1 17	1 04	1	13		Slow				
Madison.....	16	11	1 12	47	5	25		Slow				
Adams.....	14	12	1 51	47	2	1 04		Slow				
State	14	10	3 11	1 21	4	1 50	2	Slow			59	
Dearborn.....	15	6	36	34	9	2						
La Salle.....	10	8	2 10	41	2	1 29	3	Slow			24	
Quincy.....	12	7	2 43	1 17	5	1 26	2	Slow			44	
Madison and 5th.....	9	11	1 11	58	—2	13		Slow				
Randolph and 5th	11	9	1 36	52	2	44	1	Slow			12	
Jct. 5th and Lake.....			25	16		9						
Total.....	125	106	17 40	10 00	19	7 40	8				2 19	
Average.....	11.4	9.6										

Length of Rush-Hour Trip 19 m., 45 s., begun about 5:32 p. m., May 7. Non-rush-Hour, 11 m., 46 s., begun about 6:52 p. m., April 21.

NOTE:—Trips Plotted on Plate No. 10 for Time-Distance Curves.

Excess time for Rush-Hour over non-Rush-Hour Trip on account of:

Junction Delays between Adams and State, and La Salle and Quincy, 3 min. and 16 sec.

Junction Influence Delays Extending Back of Adams, 1 min. and 42 sec.

Junction Influence Delays Extending Back of La Salle, 1 min. and 29 sec.

Junction Influence Delays Extending Back of Randolph and Fifth Ave., 57 sec.

Total Delay Chargeable to Junction Crossings, 7 min. and 24 sec.

Total Difference in Length of Trips, 7 min. and 59 sec.

trip was about 10 minutes and 30 seconds, being made by a two-car South Side local, about 7 P. M. The longest trip, in the record from which the average was derived, was 14 minutes and 29 seconds, made by a Northwestern train about 4:50 P. M.

Rush-Hour Delay Outside the Entrance Junctions to the "Loop."

On a morning trip recorded for a Chicago & Oak Park train the time from leaving Canal Street Station to passing the entering junction was over 12½ minutes, or over 11 minutes more time than is required without delay; for 5 trips in the evening the average delay per train was five minutes and a quarter.

On an evening trip recorded for a South Side train, the time taken from leaving Twelfth Street to passing into the "Loop" at the junction was nearly 14 minutes. These delays, to a greater or less amount, are of daily occurrence on all the roads entering the "Loop."

These records may be taken as fairly representative of the operation of trains around the "Loop." The time record for rush-hour trips was taken mostly in April and May, 1908. The rush-hour trips may consume more time at some seasons of the year than when the record was taken.

The Main Cause of Delay and Congestion.

Delays result principally from:

1st. Junction crossings.

2nd. Delay at the first station after passing the entering junction.

3rd. Longer and heavier trains to be handled than in the non-rush hours.

4th. Longer station stops for loading and unloading trains.

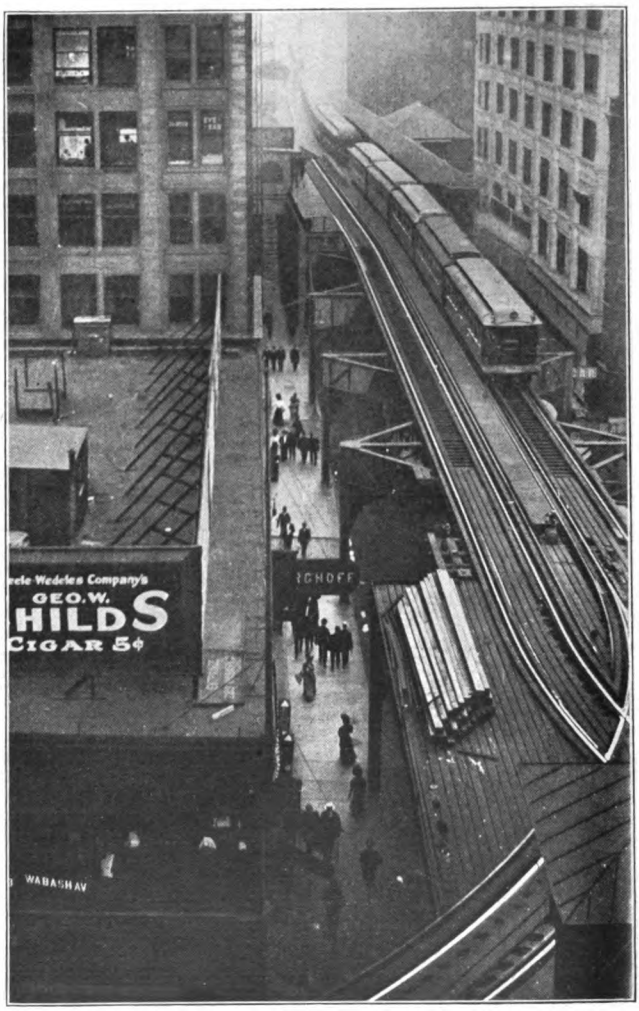


PLATE 2.* Looking West on Van Buren from Wabash. Outer Track Empty on Account of Trains Being Held Back on Wabash as Shown in Plate 1, for South Side Trains to enter and leave. Trains shown are on Inner Track.

*Plate 1 is Placed on the Page Following to Face Plate 2 so as to Show the Tracks Roughly in their Relative Position.

PLATE 1. Looking North on Wabash from Van Buren. Blockade of South Bound Trains on Outer Track Caused by Waiting to Get Past the Junction.

Detail of Factors Entering into Delay and Congestion.

1. Junction Delays.

From the various observations and data obtained in train-trip records, the most serious single item of delay is shown to be that caused in approaching and getting past junction points.

The marked effect of junction delays is well shown in the photograph, Plate 1, taken from Wabash and Van Buren looking North. This was taken about 5:30 in the evening, and shows a solid block of trains on the outer "Loop" track brought about by trains passing in and out of the inner "Loop" track and crossing the outer.

Owing to haze and smoke the full extent of the blockade is not clearly shown.

Plate 2, also taken at Wabash and Van Buren, looking West on Van Buren, at about 5:40 P. M., shows the outer track almost clear of trains, while the inner track is nearly filled. The trains on the outer track have been held back at the junction while the South Side trains were being passed in and out. The same condition takes place repeatedly not only at Wabash and Van Buren, but at Fifth Avenue and Van Buren.

Conditions such as shown exist to a marked degree throughout the rush-hours both in the morning and in the evening. It is also common for a train to have to slow down or to stop and wait to get past junctions even during non-rush hours. In fact, as shown below, delay occurred at over fifty per cent. of the junction crossings made in the non-rush-hour trips of the record.

Table No. 3 shows parts of train trips on the "Loop" giving the time taken from leaving a station to arriving at the next, where crossing junctions intervene.

For twenty train trips, the average time per trip to pass from Adams to State on the outer "Loop" was 2 minutes and 29 seconds when delay occurred; for four trips without delay the average time between these same stations was 1 minute and 24 seconds. That shows an average of 1 minute and 5 seconds difference in time between train trips with delay and those without, in passing from one station to the other on account of junction waits and delays.

The average time per trip for eighteen trains on the outer "Loop" to pass from La Salle to Quincy, during the rush-hours, was 2 minutes and 5 seconds when delays occurred; the average time for five trains without delay was 1 minute and 16 seconds. That shows an average of 49 seconds extra time per train consumed on account of junction delay for the 18 trains passing from La Salle to Quincy.

The average delay per train trip for both junctions on the outer track amounts to a total of 2 minutes and 4 seconds, or over 13% of the average time for rush-hour trip. This, of course, does not include the stops, waits and slow running which frequently occurs as the result of junction delay influence extending back of the above stations.

The average time taken for seven Metropolitan trains on the inner "Loop" to pass from State to Adams during the rush-hours, in which delays occurred, was 2 minutes and 15 seconds; the average time taken for five train trips without delays was 1 minute and 18 seconds. This shows an average delay of 57 seconds chargeable to the junction at this point.

TABLE NO. 3.

PARTS OF TRAIN TRIPS ON THE "LOOP." SHOWING TIME TAKEN FROM LEAVING ONE STATION TO ARRIVING AT THE NEXT WHERE A CROSSING JUNCTION INTERVENES.

RUSH-HOUR (7:45 to 9:15 and 5:00 to 6:30.)

With Delay

	Northwestern		Chi. & Oak Park		Metropolitan		South Side	
	Adams to State	LaSalle to Quincy	Adams to State	LaSalle to Quincy	State to Adams	Quincy to F'klin	Quincy to LaSalle	State to Congress
	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
	1 55	1 55	2 26	2 06	2 44	1 41	1 36	1 23
	3 14	2 04	2 21	2 01	3 09	1 40	2 09	1 15
	2 05	2 24	2 43	1 30	2 37	2 04	3 06	
	2 17	2 18	1 55	1 26	2 15	1 16	1 41	
			2 31	2 09	1 48	1 11	1 58	
			3 04	2 02	1 19	1 27		
			1 36	2 08	1 54	2 20		
			1 36	2 06		1 12		
			2 35	1 43				
			1 55	2 18				
			3 44	2 23				
			3 36	1 40				
			3 14	2 43*				
			3 11*	2 29				
			1 53					
			1 57					
Sum.	9 31	8 41	40 17	28 44	15 46	12 51	10 30	2 38
Average ..	2 22	2 10	2 31	2 03	2 15	1 36	2 06	1 19

Without Delay

				1 10	1 15	1 10	1 15	1 09
				1 17	1 26	1 04		1 01
					1 24			1 10
								58
Sum				2 27	4 05	2 14	1 15	4 18
Average				1 13	1 22	1 07	1 15	1 04

NON-RUSH-HOUR

With Delay

	2 17	1 47	1 39	1 50	1 56	1 24	1 16	1 18
			2 05	2 15	1 23		2 08	1 05
			1 22	1 30	1 38		1 33	1 19
			1 46	1 39				
			1 50	1 58				
			2 23	1 40				
				1 28				
Sum.	2 17	1 47	11 05	12 20	4 57	1 24	4 57	3 42
Average ..	2 17	1 47	1 51	1 45	1 39	1 24	1 39	1 14

Without Delay

	1 22	1 12	1 21*	1 17*	1 02	1 02	1 18	1 12
			1 26	1 27	1 24	1 03	1 15	57
			1 27			1 05	1 08	1 13
						1 03		
Sum.	1 22	1 12	4 14	2 44	2 26	4 13	3 41	3 22
Average ..	1 22	1 12	1 24	1 22	1 13	1 03	1 14	1 07

* Trip plotted on Plate No. 10, for time-distance curves.

For five "delay" trips of the South Side, from leaving Quincy to arriving at La Salle, the average time was 2 minutes and 6 seconds; the average for four trips without delay was 1 minute and 14 seconds. The above shows an average of 52 seconds extra time per trip consumed on account of junction delays between these points.

Delays and waits were also occasioned to trains operating on the inner track in getting out of the "Loop." Those for the Metropolitan being between Quincy and Franklin and those for the South Side between State and Congress.

The longest single junction delay shown in the record, above the average time required for the same distance without delay, was 2 minutes and 20 seconds in passing from Adams to State on the outer track. The junction delay for the same train in passing from La Salle to Quincy was 1 minute. The total *delay* in getting from Adams to State and La Salle to Quincy past the two junction points was 3 minutes and 20 seconds.

This trip was made by a Chicago and Oak Park train entering at about 8:12 and leaving at 8:30 A. M.

In this particular trip delays occurred in addition between Madison and Adams, State and Dearborn, and Dearborn and La Salle. The length of the entire trip from entering to leaving the "Loop" was 18 minutes and 12 seconds, or a total of 5 minutes and 41 seconds more time than required for the average non-rush-hour trip. The record shows that about 2 minutes and 11 seconds extra time was taken between the above stations on account of junction blockades. That together with the delay of 3 minutes and 20 seconds between Adams and State, and La Salle and Quincy, makes up all but 10 seconds of the difference between this trip and the

average for a non-rush-hour trip of 12 minutes and 31 seconds.

While notes were taken from which a statement could be made up showing the additional amount of delay caused by junction blockades extending beyound the limits above shown in Table 3, the conditions as shown for the above trip on the Chicago and Oak Park may be taken as fairly representative of rush-hour delay, excepting for this trip the station stops were unusually short. (See also trips in Table 2.)

The longest station stop on this trip was 16 seconds; the shortest, 4 seconds. The entire time consumed in station stops was 1 minute and 32 seconds, or an average of 8.4 seconds per station.

Table No. 4 is a set of totals and averages made up from the record of train trips around the "Loop," being compiled and condensed from Table No. 3, and shows the average time taken from leaving one station to arrive at the next where intervening crossing junctions are passed. The table shows: The total number of trips in both the rush and non-rush hours of the record; the average time taken both in the rush and non-rush-hour trips for each road in passing the junctions with the average total. Column one gives the total number of rush-hour trips; column two, the rush-hour trips with delay; column three, the number of rush-hour trips without delay; column four, the total non-rush-hour trips; column five, the number of non-rush-hour trips with delay; column six, without delay.

Under "Average Time," column seven gives the average rush-hour time with delay; column eight, without delay; column nine gives the average non-rush-hour time with delay; column ten, without delay; column eleven

TABLE NO. 4.

PARTS OF TRAIN TRIPS AROUND THE "LOOP." TOTALS AND AVERAGES.

Data showing the average time taken by trains from the time of leaving one station to the arrival at the next, where intervening junctions are crossed.

1st. TRAIN TRIPS ON THE OUTER "LOOP" TRACK.

NUMBER OF TRAINS						AVERAGE TIME (From Leaving to Arrival).					
Rush-Hour { 7:45 to 9:15 / 5:00 to 6:30			Non-Rush-Hour			Rush-Hour		Non-Rush-Hour		Total	
Total	With Delay	Without Delay	Total	With Delay	Without Delay	With Delay	Without Delay	With Delay	Without Delay	With Delay	Without Delay
Northwestern—FROM ADAMS TO STATE.											
						m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
4	4		2	1	1	2 22		2 17	1 22	2 21	1 22
Chicago & Oak Park—FROM ADAMS TO STATE.											
16	16		9	6	3	2 31		1 51	1 24	2 20	1 24
Northwestern—FROM LASALLE TO QUINCY.											
4	4		2	1	1	2 10		1 47	1 12	2 06	1 12
Chicago & Oak Park—FROM LASALLE TO QUINCY.											
16	14	2	9	7	2	2 03	1 13	1 45	1 22	1 57	1 18
TOTAL NUMBER OF JUNCTIONS CROSSED						AVERAGES OF TIME.					
40	38	2	22	15	7	2 17.7	1 13	1 49.9	1 21.7	2 09.8	1 19.9

2nd. TRAIN TRIPS ON THE INNER "LOOP" TRACK.

Metropolitan—FROM STATE TO ADAMS.

10	7	3	5	3	2	2 15	1 22	1 39	1 13	2 04	1 18

FROM QUINCY TO FRANKLIN.

10	8	2	5	1	4	1 36	1 07	1 24	1 03	1 35	1 05

South Side—FROM QUINCY TO LASALLE.

6	5	1	6	3	3	2 06	1 15	1 39	1 14	1 56	1 14

FROM STATE TO CONGRESS.

6	2	4	6	3	3	1 19	1 04	1 14	1 07	1 16	1 06

TOTAL NUMBER OF JUNCTIONS CROSSED.						AVERAGES OF TIME.					
32	22	10	22	10	12	1 54.5	1 11.2	1 30	1 08.5	1 46.4	1 09.7

Total average excess running time for ALL trains between the above stations per train trip on account of junction delay.

Outer Track, **Rush-hour** 2 m. 2.5 sec., **Non-Rush-hour** 38 sec.

Inner Track, **Rush-hour** 1 m. 5 sec., **Non-Rush-hour** 20 sec.

REMARK—To obtain the above averages the averages of the tables were reduced by the per cent of trains not meeting with delay.

gives the *total* average time *with* delay; and column twelve gives the *total* average time *without* delay between the different stations for the four roads.

Out of a total of 20 trains on the outer track, making 40 junction crossings, only 2 crossing were made without delay during the rush-hours, amounting to 5 per cent. of the total. Out of 11 trips during the *non-rush-hours,* making 22 junction crossings, 7 crossings or 32 per cent. of the total were made without delay.

On the inner "Loop" for 10 trains of the Metropolitan, making 20 junction crossings, during the rush-hours, 5 were made without delay. For the 5 trains making 10 junction crossings during the non-rush-hours, 6 were made without delay between the designated stations.

For the South Side, out of 6 trains, making 12 junction crossings, during the rush-hours, 5 crossings were made without delay. For 6 trains during the *non-rush-hours,* making 12 junction crossings, 6 were without delay.

On the inner track 31 per cent. of the junctions were crossed without delay during the rush-hours. In the non-rush-hour 54.5 per cent. of the crossings were made without delay.

"With" or "without delay" is only counted between the stations each side of the junction. As a matter of fact, as previously mentioned, junction influence delays frequently extend beyond these stations. In the record trips these delays occurred in a number of cases when they did not occur between the stations shown in Table No. 3.

In some of the trips in the above record, the time spent actually waiting at or approaching junction points in a dead stop, is shown to be as high as 2½ minutes, with slow running as well. No trip recorded during the rush-

hours, was free from actual junction stops or influence of junction delays. In some instances junction delays became so cumulative as to cause blockade influence to extend past the second station from the junction over more than half the length of the long side of the "Loop." It is not uncommon for both tracks on the South end of the "Loop" to be almost wholly blocked with trains principally on account of junction delays.

2. Delay at First Station After Entering.

There is delay to many of the trains at the first station after entering the "Loop" on account of two, or even more, trains of the same road being passed through the junction points closely following each other. When the trains are admitted through the junction points alternately, the train using the front platform will have had time to reach the first station and discharge and take on its load without causing more than a few seconds or possibly no delay to the train using the rear portion of the platform. The time taken to change the interlocking so as to admit the following train, and the time taken for accelerating, is usually more than that required for the preceding train after clearing the junction to reach and make its station stop and get under way. When there is a wait or slow-down of this kind, it is usually so slight as to be a very small factor in operating delay. Delays of this kind are longer in the morning rush-hours on account of the first station stop being longer. The average time taken, after the signal is set, for a waiting train to get under way, and clear the interlocking detector bar, is about 30 seconds. That, with about 5 seconds for throwing the interlocking, makes about 35 seconds, as the least time for the half cycle interlocking movement and entry at a trailing switch junction. The time taken for

a train to reach a station from the time of passing through the junction is from 30 to 40 seconds, depending on the distance.

When a train using the front of the platform is entered closely following the one using the rear portion of the platform it is subject to longer delay on account of the train using the rear platform being stopped nearer the entrance junction.

Under normal conditions, after the first station is passed, the following train is not required to stop a second time, or to slow down for the train ahead, unless the leading train has to make longer station stops than the following, or unless it is from cumulative delays at some heavy loading station, or when approaching or getting past a junction point.

3. Longer Trains.

The longer and heavier rush-hour trains require more time and caution in their movement than the non-rush hour trains.

4. Longer Station Stops In Rush-Hours.

More time is consumed at the stations loading and unloading passengers. A train taking more time to make its station stops than the average, will delay and bunch the trains back of it and cause cumulative delays. Delays of that kind are very noticeable where, for instance, a light three-car local train follows a heavy five-car express train taking on its load. The average time for station stops for the light train will be 9 to 10 seconds, while for the heavy train it will be from 14 to 15 seconds and even more. The average time for a station stop during the non-rush hour is about 10 seconds. The average for the first three station stops on the "Loop" in the morning rush-hour is about 14 seconds, while about

the same time is taken for the last stops in the evening. The *heavy* loading station stops in the rush-hours are nearly twice as long as the average non-rush hour station stop. The average increased length of station stop for a trip during the evening rush-hour is from 2 to 3 seconds per station. That makes nearly half a minute more time consumed for station stops in the evening rush-hour trips.

The causes for longer station stops during rush-hours are as follows:

(*a.*) On account of more passengers having to be unloaded or loaded during the rush-hour, even with the best facilities possible to provide, more time will be required for station stops.

(*b.*) With the present cars, the gates and doors are entirely too narrow for the free movement of passengers either unloading or loading. This is especially the case when a car is filled to a standing and platform load on which the narrow entrance and swinging gates are used.

(*c.*) Some of the roads operating different branches, do not use signs on their cars indicating as fully and precisely as they should the destination and class of train. Neither are they located where they can be seen by a passenger at any and all times before entering the train.

SUGGESTED CHANGES FOR INCREASING THE OPERATING CAPACITY AND EFFICIENCY.

It is needless to say that the different roads using the Union Elevated Railroad "Loop" as a terminal at the present time are delivering to it more rush-hour trains than it has capacity to handle. When a train, after more or less delay, is once entered in the "Loop," the extra time consumed in making the trip amounts in some cases to as much as 50 per cent. of the entire time required to make a trip during the non-rush hours and in some cases even more. The loss of time in getting trains on to and around the "Loop" very seriously limits the capacity of the different roads for handling traffic. The consequent loss in revenue to the roads is certainly very considerable. *The most serious feature of the whole situation, however, is the inconvenience and loss of time to the traveling public.*

It is believed that if the following changes were made in the routing of traffic over the structure, with some additions and changes in the structure itself, and in the equipment operating thereon, the capacity of the Union Elevated Railroad "Loop" could be so materially increased as to entirely remove the present congestion and delay. Owing to the rapid growth of the city it is not to be expected that the suggested changes will take care of the future rush-hour traffic for a great length of time.

The changes suggested for adoption are as follows:

1. Through Routing.
2. Changes in "Loop" Stations.
3. Changes in Car Doors and Signals.

4. A More Complete System of Train Signs.
5. Improved Brake Hangers.
6. Protection of Contact-Conductor (Third) Rail.
7. Adoption of Universal Transfers.

1. Through Routing.

There is no one change which could be made in connection with the present operation on the "Loop" structure in the business district, which would afford the amount and immediate relief which could be obtained by through routing of trains, and dispensing with 50 per cent. of the mileage and time now required for the slow trip around the "Loop" during rush hours. While this change might involve some problems to be taken care of by the different transportation lines, now using the "Loop" terminal, such as the proper distribution of revenue collected on the "Loop" territory, responsibility in case of accident, difference in equipment, different rules and requirements, etc., it is believed that there are none but what could be satisfactorily provided for. The matter of one road operating with its equipment and employees over a foreign road is something that is done every day on steam road service as well as on electric surface lines.

In addition to being able to pass nearly twice as many trains over the "Loop" structure as at present, it would be possible to load six and seven car trains at the present stations, making an increase of 20 *to* 40 *per cent. in car capacity with little, if any, extensions to the platforms. If that were done and all lines through routed to the greatest degree practicable, the capacity should be increased from* 130 *to* 140 *per cent. more cars than are handled over it at the present time.*

Through-routing would not only relieve delay and con-

gestion on the "Loop," by reducing the number of cars on the "Loop" now making useless mileage, and increasing the efficiency of those still operated, but it would also tend to moderate congestion by promoting a healthy extension of the business district beyond the present restricted and arbitrary limits. It is for both these reasons that the through-routing principle should be made the prime factor in the improvement of transportation facilities as against the *terminal* principle which characterizes the present system.

The simplest and most logical method of through routing would be:

A. The Northwestern and South Side lines.

B. Inter-routing of the West Side lines.

(A) Northwestern with South Side Lines.

At least three methods of routing these lines over the "Loop" structure have been proposed:

1st. To through route north-bound and south-bound trains over the Wabash Avenue and Lake Street portion of the "Loop."

2nd. To alternate the south-bound trains—one south-bound train on one side of the "Loop" and the next south-bound train on the other; north-bound trains alternating in the same manner.

3rd. To through route the north-bound trains on one side of the "Loop" and south-bound trains on the other.

1st. Via Wabash and Lake.

The method of through routing as designated in "1st" (above) would be advantageous to the North Side and South Side lines. A serious objection to this method is that the service on Van Buren Street would have to be

taken care of by a shuttle service or a stub for the Metropolitan, which is a very unsatisfactory method of delivering traffic in the congested district. Another objection is that the West Side lines could not be operated over the "Loop" east of Fifth Avenue, and would be excluded from the Wabash Avenue delivery. This would be a very serious inconvenience to the patrons of the West Side lines. On account of the resulting loss of revenue, the West Side lines would hardly be willing to submit to that arrangement.

2nd. Alternate Routing.

The arrangement for alternate through routing as proposed in the report of Messrs. Ford, Bacon & Davis to the Northwestern Elevated Railroad Company, and as mentioned by Mr. Weston in his report to the Committee on Local Transportation, would make a most favorable arrangement, if only the Northwestern and South Side lines and their patrons were to be considered. If this service were installed without the elimination of grade crossings, it would so thoroughly tie up and interfere with the operation of the Chicago & Oak Park line as to be a serious inconvenience to their patrons. The Metropolitan would be left in little, if any, better shape in operating over the "Loop" than at the present time. Even if the grade crossings were eliminated there would probably be such an excess of traffic thrown on the outer "loop" track as to cause congestion. As it would serve to benefit only the Northwestern and South Side lines, while at the same time it would act as a detriment to the Chicago and Oak Park line, and the Metropolitan in part, it does not appear to be the best arrangement that could be adopted.

3rd. North-bound via one and south-bound via the other side of the "Loop."

To through-route Northwestern and South Side north-bound trains on one side of the "Loop" and south-bound trains on the other, may at first sight seem to have some objectionable features. It can be shown, however, that objections which may be raised to this method of through-routing are more apparent than real.

When the actual conditions of loading and unloading passengers for the North Side and South Side trains as they operate at the present time are taken into consideration, there would appear to be no special reason for alternating the trains of these lines in through routing as has been recommended. In making observations of these trains as at present operated, it will be seen that for the Northwestern, during the morning rush-hours, nearly all the passengers will have been discharged by the time Dearborn and Van Buren station is reached. On the South Side lines, the morning load is nearly all discharged by the time of leaving Randolph and Fifth Avenue. In the evening nearly all of the loading for the North Side lines is done on Wabash, Van Buren and Fifth Avenue. That for the South Side lines is perhaps a little more evenly distributed on the four sides. This goes to show that a passenger, in order to save time in the morning, will get off at the first station stops and walk a distance possibly the entire width of the "Loop" or more extra. The same is evident in the evening from the fact that such a large portion of the loading is done on the last two sides of the "Loop" traversed by any trains making the trip. The heaviest loading on Wabash in the evening occurs a few minutes after the close of the shopping hours. Fewer passengers would take trains on Wabash during the rush-hours than do

now, if it were not for the crowded condition of the trains on the last part of the trip. A passenger can usually get a seat by taking any of the "Loop" trains on Wabash Avenue. If south-bound trains used only one side and north-bound trains the other for through routing, the average of accommodation for patrons of the lines running either North or South would not be so materially different from what the passenger imposes upon himself at the present time. For example: a passenger patronizing the South Side line, and having his place of business near Madison and Wabash, would have to walk either to or from Madison and Fifth or State and Van Buren (or to Congress Street station if State and Van Buren is abandoned), either in the morning or in the evening, depending on which side the South Side line were routed north. For the other trip he will take or leave the train at Wabash and Madison. As has just been pointed out, passengers do practically the same thing at present when they have facilities for riding much nearer to their destination than they evidently do.

It is my belief that very satisfactory results could be had by through routing north-bound express trains on one side and south-bound express trains on the other. By using this arrangement for express service, and sending a certain portion of the local trains around the "Loop'," the express trains carrying the long haul passengers, would be fully as well patronized when through routed north-bound on one side and south-bound on the other, as they would be if they made the complete circuit as they do now or were routed alternately. The locals being lighter as a rule than the expresses, would not cause nearly so much congestion and delay as the longer heavier loaded express trains. The local trains making the cir-

cuit of the "Loop" could take care of the passengers by transfer who would not wish to walk to a distant station to get an express train. The locals would also be a most important factor in furnishing convenient transportation facilities for what may be termed the "short haul competitive traffic." If trains were all through-routed passengers could still get delivery to and from all points of the loop as at present by transferring at the first station outside the loop and riding back. If passengers are required to walk a long distance and climb a stair for a short trip on the elevated, they will ordinarily take the surface lines in preference. On the other hand, passengers living well out, depending on express service, will not mind a comparatively long walk once a day to get the accommodation and would have little reason to complain, for they could get the same delivery as at present, by making one transfer a day.

This arrangement on the whole should be preferable to that of alternating the north-bound and south-bound trains on both sides of the "Loop." If, in the operation of trains, through routing of lines with each other is confined to the same track of the "Loop," the present platforms will give ample room for loading seven-car trains with little, if any, further extension.

If through routing of the North and South side lines were done on the alternate plan, it would not only make through routing of the West Side lines very difficult, but would very seriously handicap their operation even under the present method. It would be necessary to maintain and operate the double stations for each track as at present. To get loading facilities at double stations for seven-car express trains would require a very objectionable increase in length of platforms.

Probably one obstacle in the way of the Northwestern and South Side lines coming to an agreement on through routing is that relating to the detail of *which* shall route in-bound or out-bound over Wabash avenue, that being the most valuable traffic territory.

(B) Inter-Route the Two Systems of the West Side.

If the rapid transit facilities of the city are to have anything like a satisfactory arrangement made for taking care of the present traffic and any considerable amount of future growth, it is very desirable that provision should be made for taking care of the West Side traffic, better than would be possible with the present independent "Loop" terminal operation.

By the construction of a third track on Lake Street and a connection to the Logan Square and Humboldt Park branches of the Metropolitan from where they cross the Chicago & Oak Park line, to a connection with the "Loop," the service of the Logan Square and Humboldt Park branches of the Metropolitan could be routed via Lake Street to the "Loop," and on three sides of the "Loop" via Lake, Wabash and Van Buren, and out the Douglas and Garfield Park branches. The Douglas and Garfield Park branches of the Metropolitan could be routed on the Fifth Avenue side of the "Loop" out Lake Street over the Logan Square and Humboldt Park branches. That would save three-quarters of the present mileage now required to traverse the distance from Van Buren to Lake four times by the Logan Square and Humboldt Park branches in making a round trip. The saving for the Garfield Park and Douglas Park branches, by through-routing, would be once the distance from Van Buren to Lake, and twice the distance from Fifth Avenue to Wabash on each trip.

To accommodate passengers coming in on the Douglas Park and Garfield Park branches, wishing to reach points on Lake, Wabash or Van Buren, they could transfer at the proposed new station at Lake and Franklin Streets to the other route and reach their destination in that way. Passengers of the Humboldt Park or Logan Square branches wishing to ride to points on Fifth Avenue could transfer to the Garfield or Douglas Park lines at Van Buren and Franklin.

The obstacle of trains being excluded from Wabash Avenue is probably one of the largest factors in the objections which the Metropolitan have to raise against through routing. They, of course, could adopt a plan of sending some of the locals around the "Loop" for transfer and accommodating short haul traffic, features of which would be similar to those recommended for the North and South side lines. However, as has been recommended, if two branches of their lines are operated over Lake Street and through routed, only the through routing from Douglas Park and Garfield Park lines would be excluded from Wabash Avenue. With that arrangement the Metropolitan would be giving service to its patrons which should cause little complaint.

As a matter of fact, the possibilities for increasing and giving better rush-hour express service on the Metropolitan by routing the Logan Square and Humboldt Park branches via a third track on Lake Street would be a very decided advantage for the West Side lines. As the Metropolitan is operated at present *its express service is very limited* and is a more or less serious obstacle in the way of developing traffic in the outlying districts served by this road The operation of the trains of the Chicago & Oak Park would be in no way interfered with, as the Chicago & Oak Park operate their express

service from Ashland to Halsted on the same track with the locals. *The rush-hour local service and non-rush-hour traffic* could be handled over the Metropolitan lines as now operated if deemed more desirable.

Unification of West Side Lines.

There is no logical reason apparent why the rapid transit systems of the West Side should be separately operated and maintained on a competitive basis. The amount of fare is the same in any event, and the only basis on which competition between the lines is operative is that of service rendered. As that could be very materially improved by unified operation, thereby encouraging the development of new traffic and securing much competitive traffic which would otherwise go to the surface lines, there seems to be good reason for unification, from the investor's standpoint as well as the traveling public and the larger interest of the City of Chicago as a whole.

In General.

It would seem that the gain from the short haul competitive traffic which would result, from facilities such as would be afforded by the method outlined, would go a long way toward offsetting any loss resulting from inability to make direct delivery on Wabash avenue by all lines. Taking into account the long and tedious delay in getting onto the "Loop" in the morning rush-hours, and getting around and off in the evening rush-hours, the loss in revenue from short haul competitive traffic going to the surface lines is certainly very considerable. In this connection the policy of the roads in making new extensions in the outlying districts and getting long-haul traffic which they are not able to take care of, and neglecting facilities which should encourage the

more profitable short-haul traffic, seems to be open to criticism from the investors' standpoint, if not that of the traveling public.

Unified Operation.

The unified operation of the elevated roads under one management would go a long way toward the solution of the rapid transit difficulty with which the City of Chicago is at present confronted.

As previously pointed out, through routing of itself would save considerable useless mileage. A large saving could be made in general office expense, operating, maintenance, etc. Under separate ownership and management, the roads have separate organizations throughout, with separate power stations, repair and maintenance departments, machine shops, etc., to be maintained.

On account of the general saving in expense, with interests harmonized so as to secure the best results in operation and service to the public, there would seem to be every argument in favor of unified operation and the abolition of the present conflicting interests.

To mention a single item as effecting operation on the "Loop" under unification, there would no longer be any need of maintaining double stations. That would dispense with twenty-two of the ticket offices, with the attendant expense of from twenty to twenty-five thousand dollars a year which is now required.

2. Changes in "Loop" Stations.

Stations to be abandoned or replaced by others in new location.

It is believed that very material saving in schedule

time and increase in capacity could be had by the following changes in stations:

a. Dearborn street station might be abandoned or merged with State street station for all lines.

b. For the Northwestern and Chicago and Oak Park lines, the Randolph street and Fifth avenue station should be abandoned. A station for the Northwestern at Fifth avenue and South Water street, and one for the Chicago and Oak Park at Lake and Franklin streets should be established instead.

c. For the Metropolitan line the Quincy street station should be abandoned.

d. For the South Side line the State and Van Buren street station might be abandoned.

Reasons for Suggested Changes.

(*a*) The Dearborn street station could be abandoned to advantage in operating elevated trains without undue inconvenience to the public, for the reason that the stations on Van Buren street are unnecessarily close together.

(*b*) The advantages to be gained by abandoning Randolph street and Fifth avenue station for the Northwestern and Chicago and Oak Park lines are as follows:

In the morning rush-hours most trains approaching junction points on the "Loop" are subject to more or less delay. This delay could be utilized to advantage by a station stop and unloading passengers on the *outside,* while now all passengers are compelled to wait on the train until reaching the first station *on* the "Loop." The first station is almost invariably the heaviest unloading station stop in the trip around the "Loop." During the evening rush-hours Randolph and Fifth is among the heaviest loading stations, and as the trains

are already well filled, they usually consume more than the average amount of time loading. If the stations were moved to the points designated, trains would leave the "Loop" without this delay and take on their loads at the separate stations outside. Another reason for recommending the abandonment of these stations is, that the trains have discharged all of their loads in the morning before reaching Randolph street, and the few passengers to be accommodated in taking the trains out in the morning could be just as well served from the proposed new locations outside the "Loop."

(*c*) The reason for recommending the abandonment of the Quincy street station of the Metropolitan is that the road has stub-terminal and main line stations within a short distance of that station. In the morning rush hours the loads on the train have been discharged before reaching this station. It answers no purpose whatever in handling the morning rush-hour traffic. On account of the crowded condition of the trains when reaching this station in the evening, traffic should logically be handled at the Fifth avenue stub-terminal and Franklin street main line station of the road, and save the extra delay on the overworked "Loop."

(*d*) The State and Van Buren street station for the South Side line could be abandoned on the same ground as that stated for the abandonment of Quincy street station for the Metropolitan. The traffic would then have to be taken care of at the Congress street main line and stub-terminal stations. On account of State and Van Buren street station being in the shopping district and further from the "outside" stations the reasons for its abandonment are not so strong as for the other stations mentioned.

The saving in station stops on the "Loop," if all the suggested changes were made, would be two for each road, or eight in all. That amounts to 18 per cent. of the present station stops. Reduced to saving in time in making a trip in the rush-hours it amounts to about 7.5 per cent.

The above recommendations are made on the basis of the present method of operation. For through routing the recommendations will still hold, with slight modifications.

3rd. Changes in Station Stops so as to Load Longer Trains.

A. To Load 6, 7 or 8 car Trains by Alternate End Loading.

Without any change from the present method of operating trains around the "Loop" other than the position of the train for station stops, governed by the location of markers or train stop signs, it would be possible to load six, seven or eight car trains at the present independently operated station platforms. The method which could be employed is as follows:

At one station the train stop signs could be so arranged as to bring the *five cars from the front of the train* opposite the station platform for loading.

At the next station the train stops signs would be arranged so that when the stop is made the *five cars from the rear of the train* would be opposite the station platform, for that road, to load. While loading in either position gates at the end of the train overlapping the platforms used by the other road would be kept closed.

By alternating the stop signs for the stations that way, trains could be evenly loaded throughout.

On account of the incoming traffic during the evening rush-hours being light, there should be no special difficulty in the unloading of passengers under this arrangement. If the rear end of the train will overlap the other line's platform and the gates are to remain closed at the following station, the guards would notify the passengers in the rear cars to move far enough ahead in the train to reach the proper platform for getting off in case they wished to stop at that station. If through a mistake or a misunderstanding a passenger did not move ahead, he could alight at the next following station. The same conditions would apply, of course, to passengers in the front cars of the train. Under the most unfavorable condition a passenger would have to move through four car lengths for an exit from the extreme front or rear of an eight-car train, or be carried by one station. The public would soon become accustomed to the arrangement and on boarding incoming long trains arriving during the evening rush-hours take the cars most convenient for their station stop. As an additional precaution, signs could be placed on the interior of the cars, reading: "This car stops at Clark, Randolph and Wabash, Adams, La Salle, Madison and Fifth, etc."

It might possibly be the better method to admit passengers on long incoming trains in the evening rush-hours to the center cars of the train only.

If any of the companies would not find it expedient to build extensions to their platforms for handling more than five-car trains for all their stations, this arrangement could be put into execution for the express service, and local service handled with five-car trains. Additional extensions for outlying express station platforms would not be unreasonably burdensome.

Making allowance for extra length of train to handle,

extra space taken up on the "Loop," longer time to pass through the junctions, etc., it is believed that the use of six-car trains instead of five, would increase the present capacity, fully 15 per cent.; for seven-car trains, 30 to 35 per cent., and for eight-car trains, probably not far from 50 per cent. The theoretical increase in capacity over five-car trains would be for six-car trains 20 per cent., seven-car, 40 per cent., and eight-car 60 per cent.

In the morning rush-hours the unloading for seven-car trains could be done at the present platforms. As now operated trains unload at either end of the platforms, as found convenient.

As the evening rush-hours are relatively shorter and more congested than the morning, it is believed there would be some advantage to gain by running eight car trains in the evening and seven in the morning.

One advantage of operating more cars in a train is that a large increase in capacity can be obtained without changing the operating schedule. An over-crowded schedule is relatively slower and more dangerous in operation.

The above suggestion is not made with the idea of its filling transportation needs in the larger sense, but rather as an expedient which could be adopted by all of the roads with very little delay or expense.

B. To Load 6 or 7 Car Trains by Alternate Station Stops.

Another method which has been suggested (and is here included by request) for increasing the service capacity of the present "Loop" (and still serve the traveling public, in that the saving of time is a very important factor in the whole situation) is that during the rush-

hours every other station be given up to the exclusive use of one of the lines operating on each track of the "Loop."

I am unable to say positively how much time could be saved by making half the station stops on the "Loop" trip which are now made. It is believed that it would be between one and one-half and two minutes, per trip, from the omission of the stops alone. On the other hand, the stops that were made would be somewhat longer, on account of the greater number of passengers to be loaded and unloaded. The added time taken at the stations at which stops were made would probably amount to about one-half minute per trip. That would leave the time saved not far from an average of one minute and fifteen seconds, or about 8 per cent. less time to make the trip than when all stops are made.

The platforms would be long enough to accommodate seven-car trains with little, if any, extension, which would mean an increase in carrying capacity of the trains of about 40 per cent. This would be reduced slightly, however, on account of taking more time to pass the longer trains through the junction points, and would require more time and care in handling. The total amount of increased capacity by this arrangement would possibly amount to about 40 to 45 per cent.

As related to the patrons of the elevated roads, 50 per cent. of those taking trains during the rush-hour would be unaffected in any way by the suggested method of operation. The other 50 per cent. of the rush-hour patrons would have to walk an average of one block further than they do now in order to get trains during the rush-hour period. The increase in walk of a block, which at first thought might seem objectionable, is in reality no serious obstacle when taking into consideration the in-

creased capacity and saving of time which would be made possible by being able to load longer trains. During the non-rush-hours patrons of the roads would have the full measure of the frequent station stop service.

4th. Changes in Car Doors and Signaling.

Doors.

Cars with center side doors and wider end doors than those at present in service should be installed.

With the crowding incident to rush hour traffic, the present narrow doors and swinging gates are poorly adapted for the rapid loading and unloading of trains.

In Table No. 5 the average time of station stop is given for a number of train trips around the "Loop" during both non-rush and rush-hours for the different roads, and from which are derived the final averages which follow.

The average length of station stop in the non-rush hour is about 10 seconds. The average in the evening rush-hour is about 12.5 seconds; and that for the morning rush-hour is about 10.2 seconds.

The average length of *first* station stop in the morning rush-hour is about 17.6 seconds. The average for the *first three* stops in the morning rush-hour is about 14 seconds and that for the *last three* stops on a "Loop" trip is about 6.5 seconds.

The average for the longest station stops during the evening rush-hour is about 16.2 seconds, while the average for the shortest stop is about 9 seconds.

The above figures show that for the heaviest unloading station in the morning rush-hour an average of about 11 seconds more time is taken for the station stop than for the lightest unloading. In the evening an aver-

TABLE NO. 5.

AVERAGE LENGTH OF STATION STOPS IN SECONDS, FROM TRAIN TRIP RECORD.

Record Taken during April and May, 1908.

OUTER TRACK—Northwestern, Chicago & Oak Park.

NORTHWESTERN.

Clark	State and Lake	Randolph and Wabash	Madison and Wabash	Adams	State and VanBuren	Dearborn	LaSalle	Quincy	Madison and Fifth	Randolph and Fifth	Average of All
RUSH-HOUR—5:00 to 6:30 P. M. (4 Trips)											
Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds	Seconds
10	11.8	12	12.5	14.5	10.5	11.8	15.3	15.8	13.5	8.5	12.4
NON-RUSH-HOURS. (2 Trips)											
9.5	7.5	9.5	11.5	8.5	10	7	11	8.5	12	9.5	9.5

CHICAGO & OAK PARK.

RUSH-HOURS—7:45 to 9:15 A. M. (12 Trips)											
18.6	9.8	10.7	13.1	13.9	10.6	8.6	9.3	5.8	5	6.2	10.1
5:00 to 6:30 P. M. (4 Trips)											
12.8	7.3	8.8	13.3	15	12.8	12.3	8.5	8.5	10	8.8	10.7
NON-RUSH-HOUR—A. M. (5 Trips)											
17	7	9.6	8.8	9.6	12.2	9	8.6	6.4	5.8	7.4	9.2
P. M (4 Trips)											
8.5	7	8	13	9.5	11.5	5.6	8.3	7	11.5	10	9.1

INNER TRACK—Metropolitan, South Side.

METROPOLITAN.

LaSalle	Dearborn	State and VanBuren	Adams	Madison and Wabash	Randolph and Wabash	State and Lake	Clark	Randolph and Fifth	Madison and Fifth	Quincy	Average of All
RUSH-HOUR—7:45 to 9:15 A. M. (4 Trips)											
15.8	14.5	13.8	13.8	12	12	8	9.8	8	7	5.8	10.9
5:00 to 6:30 P. M. (6 Trips)											
11.2	10.7	12.8	14.7	15.2	14.2	12.8	13.5	11.5	16.8	10.3	13.1
NON-RUSH-HOUR—A. M. (2 Trips)											
14	11.5	14	10.5	14.5	8	5.5	10.5	6.5	7.5	6.5	9.9
P. M. (3 Trips)											
11.3	11	13	12.7	12.7	9.7	10.33	12	11.33	14	11	11.7

SOUTH SIDE.

Adams	Madison and Wabash	Randolph and Wabash	State and Lake	Clark	Randolph and Fifth	Madison and Fifth	Quincy	LaSalle	Dearborn	State and VanBuren	Average of All
RUSH-HOUR—7:45 to 9:15 A. M. (4 Trips)											
17.3	15.8	9.3	7.3	9.3	12.3	10	8.5	4.8	5.8	7.3	9.8
5:00 to 6:30 P. M. (4 Trips)											
14	12	10.8	8.5	10.3	12.8	16	19.5	13	14.5	16.8	13.5
NON-RUSH-HOUR—A. M. (2 Trips)											
13.5	9	8.5	7	11.5	10.5	7.5	9.5	5.5	8	6	8.8
P. M. (4 Trips)											
12.5	12.5	10.3	8.5	12	10.3	11.8	9	10	10	10	10.6

age of a little over 7 seconds more time is taken for the heaviest loading than for the lightest loading station stops.

While there were not enough train trip records taken to give absolute averages for the present method of operation, enough were taken to show the general conditions. In fact, in data from another source (see Table No. 6). the length of stop for all roads at the first station shows an average of over nineteen seconds. Other variations are also shown, but on the whole agree with that used.

The data shown in Table No. 6 was made up from the record of station stops at Clark, Madison and Wabash, Adams, La Salle, and Madison and Fifth avenue. The averages show somewhat longer station stops than that given by train trips in Table No. 5. This is accounted for largely from the fact that the table is comprised mostly of a record for the heavier traffic stations, and covers an hour, including the greatest congestion of the rush-hour period.

The reason for the average rush-hour station stop being but little longer than the average for the non-rush hour, is due to the work of the platform men and that the trainmen are more alert during rush-hours in facilitating the loading and unloading of passengers and handling the trains.

Considerable saving of time should be effected during the critical period of rush-hour service by using sliding doors and increasing the number and width for loading and unloading on the "Loop." The new cars of some of the roads have wide sliding end doors, operated by compressed air.

TABLE NO. 6.

AVERAGE LENGTH OF RUSH-HOUR STATION STOPS, FROM ORDER AND TIME RECORD OF TRAINS AT STATIONS.

8 TO 9 A. M.

Station	Northwestern	Chi. & Oak Park	Metropolitan	South Side
	Sec.	Sec.	Sec.	Sec.
Clark	19.47*	20.04*	10	10.35
Madison and Wabash	15.16	14.38	15.42	16.18
Adams	18.26	14.66	14.22	20.75*
La Salle	14.21	8.6	17.59*	8
Madison and Fifth Ave.	9.5	6.6	9.2	11.2

5 TO 6 P. M.

Station	Northwestern	Chi. & Oak Park	Metropolitan	South Side
Clark	11.1*	12.48*	12.7	12.6
Madison and Wabash	17.73	15.7	18.38	16.24
Adams	20.12	14.27	16.4	13.58*
La Salle	19.71	11.13	13.25*	14.21
Madison and Fifth Ave.	24	13.4	18.5	14.8

AVERAGE OF LINES.

A. M.

	15.2	13	13.2	13.27

A. M. Average of All 13.7

P. M.

	18.4	13.3	16	14.3

P. M. Average of All 15.7

A. M. and P. M. Average of All 14.7

*First station reached on the "Loop."

Figure No. 1 (reproduced from the Street Railway Journal) is a cut of the Hudson and Manhattan Railroad Company car, with end and center doors. They are operated in tunnels under the Hudson River between New York City and points in New Jersey. The old "bridge cars" of the New York and Brooklyn bridge had end and center side doors. More passengers were handled at that crowded terminal than at any other terminal in the world.

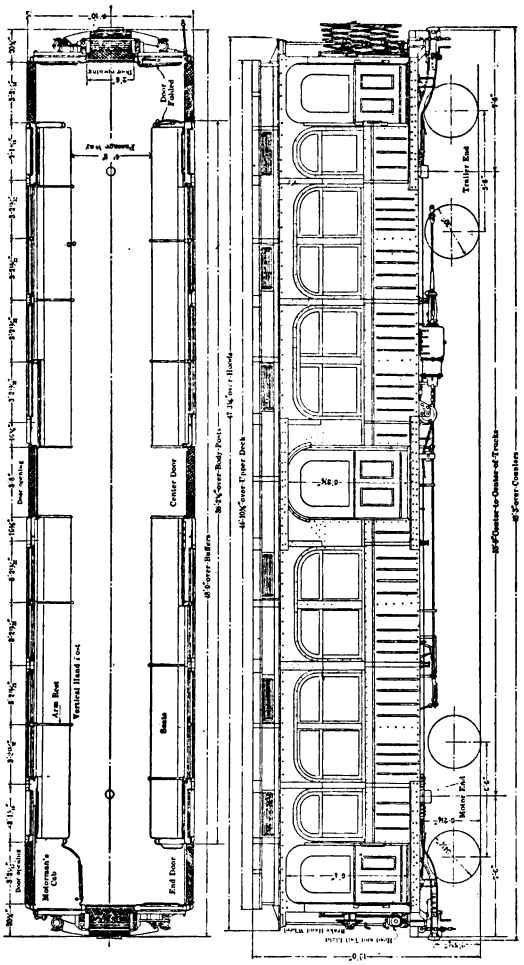


Fig. No. 1. Car of the Hudson and Manhattan Railroad ("McAdoo Tunnel Lines") with End and Center Side Doors. Plan and Elevation.

Signaling.

It is believed that time could be saved at every station, whether the train is crowded or not, by the use of electrical door signals, such as those used on the cars of the Hudson and Manhattan Railroad Company, instead of the present bell-cord method of signaling. With the bell cord each guard has to wait until he receives the signal from the guard next behind, when he passes the signal to the next. With a long train this consumes more time than is ordinarily appreciated. For instance, the worst condition is when the last passenger to board the train is at the platform where the rear guard is stationed. In that case the time consumed for passing the signal from one guard to another is absolutely lost time in getting the train started. With the electrical door signal the arrangement is such that as soon as the last passenger is on, and all the doors are closed, the signal is instantly and automatically given to the motorman to start. Another advantage of the electrical door signal is that there is no danger of the train being started before the passengers are safely aboard.

5th. A More Complete System of Train Signs.

Full and concise signs showing destination and class of trains operating on the "Loop" should be installed.

A. Signs Carried On the Trains.

At times confusion and delay are caused from the fact that all trains are not properly "signed." Signs, showing *destination* and *class* of train, should properly be put on at every car entrance, so that the passenger can tell at a glance if it is the train he wishes to take. The present method used on some of the roads, carrying the destination sign on the front of the train only, is not satisfactory.

B. Train Signs at Station Platforms.

The Boston idea of using movable display signs announcing the class and destination of a train before its arrival at the station could be adopted to very good advantage. These signs should be so located, and of such size, that they can be distinctly seen and read by the passengers from any point on the platform. They could be operated so as to show the line or branch and destination and class. Their use would tend to facilitate the loading of trains. The present method of platform men calling out the destination and class of train is not fully satisfactory for the reason that passengers some distance away on the crowded platform are not able to hear and understand the announcement on account of the noise and confusion. With the announcement sign it would be possible for a passenger to assure himself at any time, without crowding up to the car door, whether or not the train is the one he wishes to take.

C. In Station Waiting Rooms.

With the proposed arrangement of having the waiting rooms below the tracks and platforms, it would be desirable to have signs in the waiting rooms to indicate the approaching trains before they reach the station. *An illuminated sign and signal bell could be arranged to operate in connection with the proposed display signs on the platform of the station from which the train is leaving.* When the train leaves the platform of the preceding station, and the sign for that train is returned to its housing, the lights back of the waiting room sign corresponding to the approaching train would be turned on and the bell rung automatically. By that means the passengers would be warned of the approach of their train in plenty of time to reach the platform before its arrival.

6th. Improved Brake Hangers.

It is believed that by the adoption of positive or fixed brake hangers, attached in some way to the equalizing bars of the trucks, a quicker stop could be made with trains than can be made to advantage with the present form of hanger attachment. The adoption of a hanger of this form would prove to be of greater comfort and safety to passengers. With the present hanger attached to the truck frames, when the brakes are applied and grip the wheels, one of the truck springs is compressed and the other is released a corresponding amount. The springs are held in this position until the instant at which the forward movement of the car ceases; then the reaction of the springs rotate the wheels backward, giving a disagreeable, and at times even dangerous, backward lurch to the train. In addition, when the train is coming to a stop, on account of the "balance" between the compression of the springs and the grip of the brakes on the wheels, any increase or decrease of the grip on the wheels, has a tendency to produce a jerky motion to the car as soon as the brakes are applied. In order to prevent in a measure the disagreeable backward lurch at the instant after the forward motion stops, it is ordinarily the practice to begin releasing the brakes before the train has come to a stop, thus consuming more time in bringing it to rest.

Another feature of the jerky motion and severe backward lurch of the train, as affecting operation and causing delay, is that passengers in many cases cannot with comfort or safety leave their seats to be at the door ready to alight at the instant the train stops, and as a result remain seated until it is actually at rest. If a uniform and safe retarding motion is given to the train

there is no reason why passengers could not be ready to alight as soon as the train is stopped.

If a positive hanger were employed it would be possible to keep the brakes applied to their maximum efficiency until the full stop could be made and not produce the disagreeable backward lurch at the instant of stopping or surging before the stop is reached.

7th. Protection of Contact-Conductor (Third) Rail.

To make the service on the Union Elevated Railroad "Loop" and the roads using it as a terminal more reliable and efficient during the winter sleet and rain storms, some form of covered or protected contact-conductor (third) rail should be used.

With the protected rail the danger from the electric current is also largely reduced, not only to employes of the roads who have to work about the structure, but to passengers as well, where in case of accident they are compelled to leave the cars and walk on the structure to a station. In view of the advantages to be gained and the moderate expense involved, it seems that this improvement should long since have been made.

8th. Adoption of Universal Transfers.

It is my belief that Chicago is the only city in the country having elevated roads on which transfers are not effective for reaching the different parts of the city. In Boston practically universal transfers are given from the elevated to the surface lines and from one part of the elevated system to the other. In Philadelphia transfers between the elevated line and the surface lines are given at a limited number of points. In Brooklyn transfer is given from one elevated line to another and in some

cases from the elevated to the surface lines. In New York transfers are effective between the various lines of the elevated at points of intersection, and to the subway at one point.

While the adoption of universal transfers would not materially increase the operating capacity of the present "Loop,' it would in some cases facilitate and simplify the movement of traffic. One of the main advantages to be gained by universal transfers would be to enlarge the delivery in the business district and encourage the extension of the business center of the city. It is reasonable to believe that it would be the source of additional revenue to the roads rather than a loss, for the reason that there would be so much more short haul through riding than at present, where two fares are demanded. As a result the through traffic is being taken care of by the surface lines unless it is a very long haul. On account of the through routing and adoption of transfers by the surface lines, transfers by the elevated lines would in all probability, as a matter of policy, be adopted upon their own initiative, without any pressure being brought to bear by the city. The adoption of universal transfers should hardly be considered under the circumstances as a matter of barter or trade.

STATION PLATFORM EXTENSION AND STUB TERMINALS.

1st. Station Platform Extensions.

The extension of platforms has been repeatedly recommended in reports and strenuously fought for by the elevated railroads. In making a close analysis of the probable advantages to be derived therefrom, it appears that these will be so limited as to in no sense justify their adoption in view of the general objectionable features and great amount of obstruction to light which they would entail. If platforms for ten stations were to be extended (the amount called for in the recent report to the Committee on Local Transportation) it would mean, as previously stated, the building of over a mile or 6,000 feet of new platform on the present "Loop" structure. That would mean a very serious additional obstruction to light on all streets occupied by the structure, and especially on Van Buren street.

Wabash Avenue is 100 feet wide, Lake Street and Fifth Avenue 80 feet, and Van Buren Street 66 feet. The present structure, including platforms beyond the stations on Wabash Avenue, is about 49 feet over all and takes up about 49 per cent. of the width of the street. On Lake Street it is about 34 feet wide and takes up 42.5 per cent. of the width of the street. On Fifth Avenue it is about 49 feet wide and takes up about 61.2 per cent.; while on Van Buren it is 42 feet wide and takes up 63.6 per cent. of the entire width of the street. The above widths, however, do not include the widths of the canopies which overhang the outer edge of the platform in some cases about three feet. That would make the per cent. of width of structure to street 55 per cent. in Wa-

bash and 68.8 per cent. in Fifth Avenue, and corresponding amounts in the other streets. The width over all of the structure obstructing light where there are no platforms is about 20 feet. The width over all at the station buildings is greater than the width of the street, with the exception of those on Lake Street, which have no waiting rooms.

The great obstruction to light by the platforms, in comparison to that of the structure beyond, is thoroughly impressed on one when standing on the sidewalk opposite the end of the platform, by looking first in the direction away from the station, then turning and looking toward the station.

"Platform shadow" is well shown on Plate 5. (See page 99.) The line between the little obstructed light and "platform shadow" is clearly seen a little beyond and to the right of the exit stairs and a little beyond the foot of the post in the foreground.

While Plate 5 shows the shadow cast mostly by the platforms, Plate 4 (see page 98) shows the shadow cast by the station building and platforms, together at the street intersection. Plate 3 (see page 98) shows the same feature to a less degree.

To derive any material benefit in the saving of time and increasing the capacity of the "Loop" by the extension of platforms, to allow the train using the rear portion of the platform to move up and take on the whole or part of its load before the leading train had cleared, would require that *the number of trains on each road should be very nearly equal and that they should arrive in the proper order and time intervals.* These important facts seem to have been lost sight of very largely.

A set of eleven records, for morning and evening

rush-hour periods, were taken at five different "Loop" stations, showing the *order* and *time* of trains as they passed these various points. It appears that during an hour and a half rush-hour period in the morning (7:45 to 9:15), and a like period during the evening (5:00 to 6:30), only an average of about *30.7 per cent.* of the total number of trains as now operated arrive in the proper *order* to admit of loading as *double-units,* or "two trains at one platform at the same time."

In Table No. 7 is given the record of trains passing "Loop" stations during rush-hour periods of 1 hour and 30 minutes. In this is given the number of trains per hour, total number of trains, possible double-units, etc.

Column 1 gives the station at which record was taken; column 2, date; column 3, time of rush-hour.

Under "trains per hour", column 4, shows trains on the outer track; column 5, trains on inner track; column 6, total on the "Loop". (Table No. 7, page 79.)

Under "number of trains", column 7 gives number of Northwestern trains; column 8, number of the Chicago & Oak Park trains; column 9, number of Metropolitan trains; column 10, number of South Side trains; column 11, trains on the outer track; column 12, trains on the inner track; column 13, total trains on the "Loop" passing the stations in the given time.

Under "possible double-unit grouping", under "order" the number of trains on the outer track arriving in proper order to establish as double units is given in column 14; inner track, column 15; total, column 16.

Under "per cent. of whole" the per cent. is given for the outer track in column 17; inner track, column 18; total, column 19.

Under "order-time" (20 seconds interval) the number on the outer track is given in column 20; inner track, column 21; total, column 22.

"Per cent. of whole" is derived by dividing the number of trains that would form the rear portion of the double-unit by the total number of trains on the corresponding track or on the loop.

Under "per cent. of whole" the outer track is given in column 23; inner track, column 24; total, column 25.

A number of observations of the time taken by a waiting train to move up and stop at its position at the platform, after the preceding train had started, show that the average is less than 18 seconds. When the following train merely slows down and does not stop the time is a few seconds less for reaching its position and stopping. If in the record more than 20 seconds has elapsed from the time the preceding train leaves until the following train has stopped it may be safely assumed that the following train did not "catch up." That being the case a following train with an interval of over 20 seconds can hardly be considered able to save any time on account of "extended platforms" in making its station stops. The number of trains arriving in the proper order and within 20 seconds of the leaving of the preceding train, averages about 11 per cent. of the whole number of trains.

The basis of 20 seconds interval between leaving of the preceding train to the arrival of the following, in crediting trains to establish as double-units, is very liberal for the South Side trains. On account of having motors on nearly every car the acceleration is much more rapid than that for the Chicago & Oak Park. The actual average interval in moving up to its position at

the platform after having stopped for the train ahead would probably average considerable less than 20 seconds.

As mentioned elsewhere in this report, the average length of time for a "Loop" trip during the non-rush-hour is about 12 minutes and 31 seconds. For the rush-hour it is about 15 minutes and 39 seconds. That is for the actual time of covering the distance on the "Loop", the time being taken when the center of the train in motion was approximately at the junction both entering and leaving. The *average* excess of time for the rush-hour trip over the non-rush-hour is about 3 minutes and 8 seconds. This extra time is made up of:

a. Junction waits and delays.

b. Longer station stops to discharge and take on passengers.

c. Handling longer and heavier trains.

d. Trains of the same road when entering in groups have to wait at the first station *after passing the entrance* junction for the train ahead to make its station stop and get out of the way. Trains using the front platform have to wait for those using the rear to get out of the way.

e. Delay to trains using the rear portion of the platform, at the first station after passing the entrance junction waiting for the train ahead to make its station stop and clear.

f. Delays at intermediate stations to the following trains waiting for the train ahead to clear and get out of the way.

The last two items of delay ("*e*" and "*f*") are the only ones that would have any relation to the length of station platforms as a factor.

On account of the inter-relation of these different delays, it is impossible to determine the exact amount of any one or more of them. It can be conceded, however, that the largest single item of delay is that relating to delays in getting past junction points. The average extra time consumed on account of junction delays will probably amount to two minutes, or more, per rush-hour trip. In some instances the entire delay appears to be chargeable to junction limitations.

Out of a record of over fifty train trips around the "Loop," in both the rush and non-rush hours, in no case is there a trip shown where an extra stop or even delay was required for *any train in reaching all stations.* The record does, however, show a wait of as high as two minutes and a half actual stop, with slow downs in addition, in getting past a junction point on the "Loop." Some cases show over eight minutes actual standing wait outside of the "Loop."

Another factor in causing delay is cumulative delays occasioned by heavy loading and unloading at certain stations. If at any one station the time for loading or unloading passengers on the cars is longer on the average than for the stations preceding, this delay becomes cumulative, and the trains approaching the heavy loading station may be delayed and become bunched. However, when the "Loop" is being worked to its maximum capacity, when a train making a trip is slower in movement and makes longer station stops than the average, that will also tend to produce cumulative delays. As above stated, in no case does the record show any train making two stops for *every* station. During rush hours, there was almost without exception, either an actual stop or slow running in getting past junctions.

Taking into account all of these different factors, it is not reasonable to suppose that a *following train having extended platform facilities, could save as much as one minute* out of the three or more extra required on the average in making a "Loop" trip during the rush-hours.

On the assumption that trains having extended platform facilities could save an average of one minute in the rush-hour trip, it would mean a saving per train of about 6.5 per cent. in time in making the trip. On an average, only about *30.7 per cent.* of the trains entering the "Loop" come in the required *order* to make extended platform loading facilities available. That would be only 30.7 per cent. of 6.5 per cent., or 2 per cent. saving in time; in other words *increase* the *capacity* of the "Loop" by *2 per cent.* When the still further condition of *time interval* in connection with the *order movement* of trains is taken into account, as previously outlined, showing an average of only about *11 per cent.* of the total number of trains possible to be loaded as double-units the saving of time is reduced to 11 per cent. of 6.5 per cent., or *0.7 per cent.* as the possible saving of time or per cent. increase in the capacity of the "Loop" by platform extension to load two trains at once.

If three minutes per trip, making an average of 16.4 seconds per station, which amounts to more than the length of the average station stop for rush-hour loading by about four seconds, were allowed instead of one as the basis of time saved and consequent increase in the capacity of the "Loop," about 20 per cent. increase would be credited if the *number, order* and *time* of trains were ideal. The *possibility* under the present *order* grouping of trains, would reduce that to 30.7 per cent.

of 20 per cent., or to about *6 per cent.* The *time-order* grouping would reduce still further to 11 per cent. of 20 per cent., or to about *2 per cent.* increase under liberal and favorable assumptions. As a matter of fact, out of a record of 60 train trips the longest total aggregate time consumed in station stops for any one trip was 2 minutes and 57 seconds. The total aggregate time for the average evening rush hour stops is only about 2 minutes and 17 seconds.

By reference to Table No. 7 (see page 79) some of the following facts are shown: In the record for Clark street station under the column headed "Outer Track," "Number," "Order-Time Grouping," only three of the C. & O. P. trains in the morning rush-hour and five in the evening rush-hour arrived within the time interval of 20 seconds to establish as double units. The per cents. of double-units to total trains on the outer track amount to 3 for the morning rush-hour and 5.7 for the evening rush-hour at Clark street. These are both less than the *average total per cent.* for the outer track. For the record at Adams and Wabash the number of South Side trains (those shown under "Inner Track," "Number," "Order-Time-Grouping") is shown to be 20 during the evening rush-hour and 9 during the morning rush-hour, arriving within the time interval of 20 seconds to establish as double units. The average per cent. of whole is 15.7 and 5, respectively. That gives an average per cent. of double-units at Adams under order-time-grouping to the whole number of trains on the inner track of 10.9 per cent. That is 3.8 per cent. less than the average for all of the stations at which records were taken on the inner track, which is 14.7 per cent. As these two stations are the first stations reached on the "Loop" after passing the entrance junction by the

respective lines using the rear platforms of the stations for loading and unloading, they may be considered more nearly representative of possibilities which might be expected from double-unit platforms than the other stations on the "Loop." If it were not for the "sifting" of the trains through the junction points many more trains would arrive at the first station on the "Loop" within the time to establish as double-units than actually do.

In making the assumption of allowing a double-unit to be credited where the time interval is twenty seconds or less, trains which have merely caught up and have not stopped and actually waited for the train ahead to clear and get out of the road, have been counted as full factors. Under the law of averages it would be more nearly correct to consider them as saving only one-half of the time credited, as being actually saved by establishing double-units. That, of course, would reduce the per cents to one-half that already credited.

To load two trains at one platform, and pass them around the "Loop" as a double-unit, making the various station stops, without coupling them together, and do it in the same time that you can move a single train, is an operating impossibility. Safety demands and requires a certain amount of time and space interval between trains.

Even after double-units were "established," there is always the even chance of their being separated and the theoretical advantages of the double-unit destroyed in passing junction points. This is more particularly the case with trains operating on the outside "Loop" track on account of having to pass two double crossing junctions. For this reason the efficiency or advantage of the double-unit would be very materially reduced over what has been credited to double-unit loading.

. 7.

DURING THE MORNING AND EVENING RUSH-HOUR PERIODS
MINUTES

	Possible Double-Unit Grouping for Station Stops.											
	Order.						Order—Time (20 Sec. Interval)					
	Number.			Per Cent. of Whole.			Number.			Per Cent. of Whole.		
Total	Outer track	Inner track	Total	Outer track	Inner track	Total	Outer track	Inner track	Total	Outer track	Inner track	Total
235	31	40	71	32.2	28.7	30.2	3	19	22	3.	13.6	9.3
216	27	38	65	31.	29.4	30.	5	17	22	5.7	13.1	10.1
177	28	33	61	37.8	32.	34.4	1	24	25	1.3	23.2	14.1
232	31	38	69	32.2	27.9	29.7	2	15	17	2.1	11.	7.3
187	25	29	54	33.3	25.8	28.8	5	26	31	6.	23.2	16.5
215	31	37	68	35.2	29.1	31.6	7	20	27	7.9	15.7	12.5
237	34	38	72	34.3	27.5	30.3	5	9	14	5.0	5.	5.9
216	30	40	70	32.6	32.2	32.4	8	15	23	8.7	12.1	10.6
233	30	37	67	29.7	28.	28.7	7	22	29	6.9	16.6	12.4
218	31	42	73	33.6	33.3	33.4	12	23	35	13.	18.2	16.0
244	30	42	72	29.4	29.4	29.5	4	17	21	3.9	12.	8.6
410	328	414	742	.....	.....	.....	59	207	266	.....	.....	.....
.....				32.7	29.4	30.7	.....			5.9	14.7	11.0
.....				.....	.....	.....	.....			.....	.....	.....
.....				.....	.....	.....	.....			.....	.....	.....

ber of trains that arrive at the stations in the required order to allow two trains to number arriving within an interval of 20 seconds from the time the preceding train g is greater than 20 seconds, observation shows that the following train had not

As stated elsewhere, the record showed only 5 per cent. of the junctions passed by trains on the outer track *without delay*. As at present operated, the trains seem to be passed in and out of the "Loop" more with the idea of facilitating junction movement than station loading. To get results in double-unit loading, or two trains at the same station at the same time, would require that the trains should be passed into the "Loop" in *alternate order,* and *the proper train ahead.* It is the practice at present to send trains in the "Loop" largely *in groups of twos and threes of the same road together.*

To load two trains on the same track, at the same station platform, at the same time, on the "open road," is a "facility" I do not think is or ever has been in operation on any line to increase its capacity.

2nd. Outside "Stub" Terminals.

As previously mentioned, anything in the nature of a "terminal" in a congested district as a part of urban transportation should as far as possible be avoided. The most notorious case as an example of the evils attending a terminal is that of the old Brooklyn Bridge in New York.

Instead of building outside terminals to take care of the growing traffic, it is believed the same purpose could be accomplished to much better advantage by building an extension of the elevated lines to reach the different steam railroad depots, with the proper connections to the various elevated lines to provide for additional through routing and such "loops" as may be required. This in addition to giving the much needed steam road service, would also enlarge the delivery in the business district. It would make the system

much more flexible for handling traffic in case of fire or accident on the "Loop" route.

As a last expedient (if the extensions for the steam railroad depot service and enlarging the business district delivery cannot be had) and when all other facilities have been outgrown, or if required, to furnish additional facilities over those which may be necessary to balance the service on the line with which any road may be through routing, outside "Loop" terminals should be installed.

One disadvantage of outside "Loop" terminals, is that for the considerable expenditure necessary for the installation, they are only in use for handling the rush-hour traffic for a short time in the morning and evening. On the other hand, they are a decided advantage to the patron of the road doing business in that portion of the district in which the terminal is located. For illustration: a passenger doing business near the corner of the "Loop" where the road he uses enters and leaves, is compelled almost invariably to take a train that already has a standing load. As a result he is compelled to stand up for most of his journey. While with the outside "Loop" terminal available, he has an even chance of getting a seat.

The Northwestern now back a number of trains in to Randolph street station to load during the evening. To back into the "Loop" stations against traffic, as is done, causes rather serious delay, is hardly in accord with good operating principle, and should be done only as a last resort.

NOISE FROM OPERATION ON THE "LOOP."

Noise results principally from the following causes:

1st. Noise from the Movement of Trains.

Most of the noise resulting from the movement of trains over the track is caused by the passage of the wheels over the rail joints. The rail joint has inherent weak features which no amount of ingenuity or skill has so far effectually remedied. On account of expansion and contraction, a certain amount of space must be left at the end of the rails, and a joint employed that will admit of movement to accommodate the varying length of rails under high and low temperature.

Under commercial conditions it is not possible to produce rails and splice bars all of which are absolutely uniform in section. On that account the best track will have projections in the alignment of the rail, or what is termed "lips." Poor fitting splices, on account of the inherent weakness and flexibility of the joint, allow rapid wear of the surfaces in contact, and is one of the predisposing causes of rough and noisy track.

It is not deemed necessary to give a detail discussion of the joint reaction, but suffice it to say that even when the bolts of the splice bars are kept reasonably well tightened up, there is more or less violent reaction and movement when the loaded wheel passes from one rail to the other, causing a reversal of the intense shear.

2nd. The Noise Produced by Motor Gears.

The noise produced by motor gears is in many cases quite pronounced and seems to be an inherent factor in

gear operation. When the trains are operating on the "surface" the gear noise is the most noticeable of any resulting from the operation of trains. The noise is accentuated and made worse on account of the vibration being carried into the car body and there acting on the resonant and loose parts of the car, as well as being carried into the structure with the present roadbed used and set up in the plates and parts under tension.

3rd. Train Air-Brake Exhausts.

The noise resulting from the exhaust of the air brakes on some of the trains operating on the structure is one which is very noticeable. It is perhaps more noticeable for the reason that it is a noise one has not grown accustomed to, like that of the general rumble attending traffic movements.

4th. Rattling of Loose Parts.

The rattling of loose parts on the structure or equipment which is subject to vibration, may become, and in some cases are, very noticeable factors in producing noise.

5th. Grinding of Wheels on Rails Around Curves.

The passage of trains around the sharp curves produces a screeching and grinding noise of the wheels as a result of the slipping of one of the pair of wheels rigidly fastened to the same axle.

6th. Exhaust from the Pneumatic Interlocking.

Exhaust air from the cylinders used for the movement of the interlocking and switches at junction points, results in considerable annoying noise. Switches of this type are located at the junction points at Lake and Fifth Avenue, Fifth Avenue and Van Buren and Van Buren

and Wabash. There is also considerable noise at these junction points caused by the more or less violent contact of the mechanism when the switches are thrown.

7th. Noise at Junction Points from Crossing and Switch Frogs.

With the present style of roadbed for carrying the track, the noise from the above cause is almost deafening. It is the worst and most unbearable noise resulting from the operation on the structure. This is most marked at Wabash and Van Buren and Van Buren and Fifth Avenue. When the trains of the outer "Loop" track pass the junction point, the wheels are passing over eight crossings and one switch frog. The noise is equally as bad or worse when two trains operating on the inner "Loop" track, one in-bound and the other out-bound, are passing the junction at the same time. In this case the same number of crossing and two switch frogs are being passed over.

8th. Screeching and Chattering Produced by the Brake Shoes.

At the stations, or wherever stops are made, the noise from the above cause is quite noticeable and annoying on account of being unusual.

SUGGESTED REMEDIES TO REDUCE NOISE.

1st. Roadbed, Track and Structure.

Roadbed, Etc.

There are a number of constructions which can be employed for the roadbed carrying the rails and ties, so as to dissipate and absorb most of the noise producing vibration originating from the rolling of wheels on the rails and over rail joints, etc.

The main factors instrumental in attaining this end are:

(*a*) Some inelastic medium, such as broken stone, placed under the ties and rail supports to break up the rigid continuity, and dissipate to a large extent the vibration which originates in the passage of wheels over the rails, from the motor gears, etc.

(*b*) Increased mass of the supporting medium below and in addition to the ballast, to absorb, in part at least, the vibration before it is carried into and set up in the broad, thin plates of the girders and parts of the structure under tension.

The most successful construction in this connection, to the knowledge of the writer, is that employed by the Philadelphia Rapid Transit Company in the construction of their elevated line, which has recently been put in operation. The general type of the construction is shown in Figure 2. In this construction cross girders are placed at intervals of about 10 feet, and on top of these are carried shallow steel troughs, in and over which is placed a solid bed of concrete about four inches

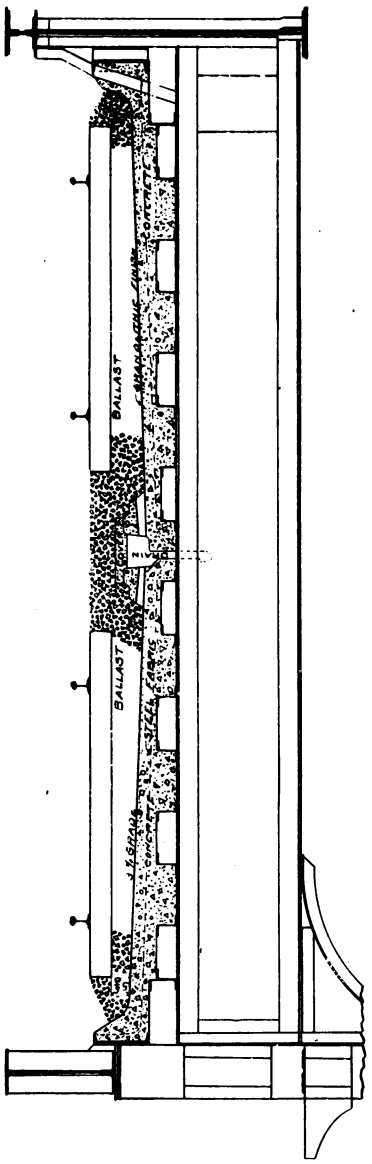


Fig. 2. Type of Elevated Roadbed Construction used by the Philadelphia Rapid Transit Co. on its Elevated Line. Longitudinal steel troughs covered with concrete. Stone ballast under ties. It is believed this type of construction is the most effective in the reduction of noise of any that has ever been employed on an elevated road.

in depth over the highest or inverted portion of the trough. On this is placed a bed of broken stone ballast to a depth of over six inches between the bottom of the

tie and the top of the concrete bed, and the ties embedded in the stone even with their top surface. This, while rather an expensive construction, and forming a solid covering over the roadway, is very effective in the elimination of the noise which would otherwise result from the operation of trains.

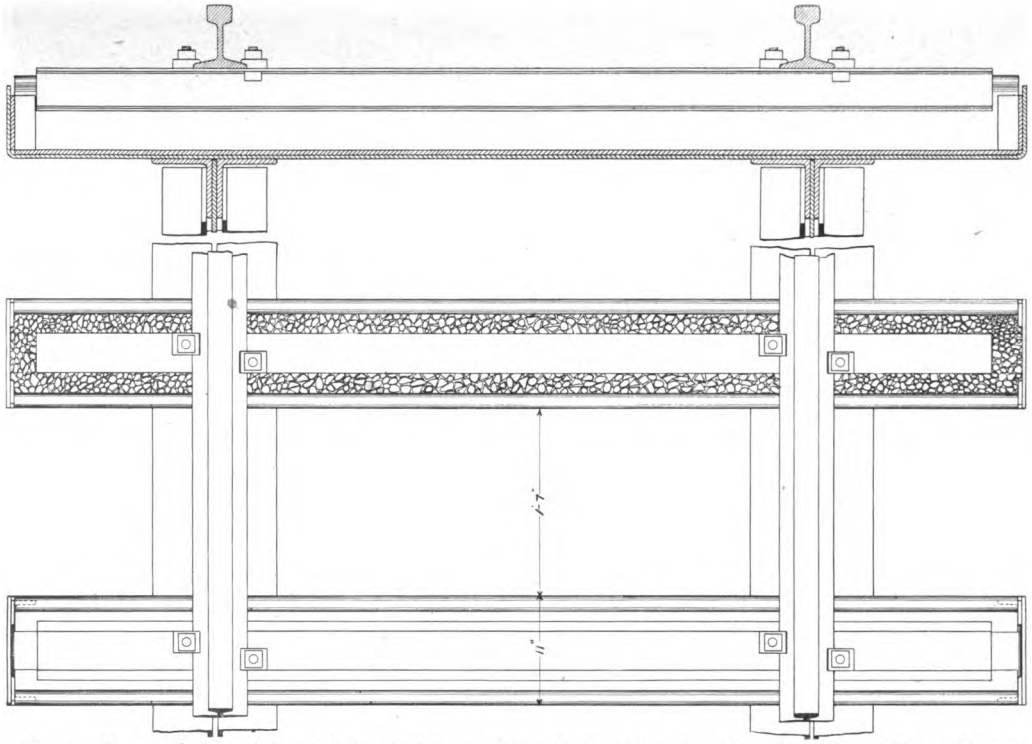
The noise from the operation over this structure seems to be as nearly eliminated as is possible on elevated construction. When standing on the street a short distance away the noise made by the passage of a train over the structure is not as noticeable as that from a car moving over the surface track beneath. As a matter of fact, only two damage suits have ever been started against the Company on account of noise. One of these suits was discontinued for lack of evidence.

The road-bed as built is practically water-tight.

In Fig. 3 is shown a design for road-bed consisting of steel troughs built up of plates and bulb angles, and filled with stone ballast. Steel ties are embedded in the ballast for carrying the rails. In the sketch the spacing is such as to leave 1 foot and 7 inches clear space between the troughs.

In some cases a combination of the Philadelphia type of construction with either of the trough designs shown in Figures 3 or 4 might be made; for instance, where it is undesirable to have all the vertical light cut off from the street below. By using 60-foot rails with the Philadelphia type of construction at the joints for 6 or 8 feet and the open steel trough construction for the balance, very satisfactory results probably could be obtained.

It is believed that some such construction, as shown in Figure 4, might be employed, in which the rails are



STEEL TROUGH AND TIE
FOR STONE BALLAST
ELEVATED ROADBED.

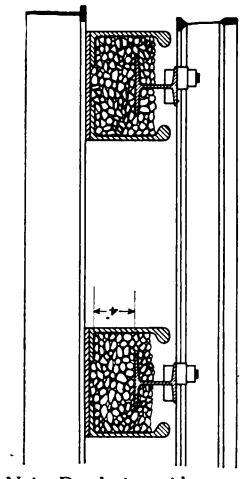


Fig. 3. Suggested Type of Elevated Roadbed Construction with Steel Cross Troughs. Steel Ties on Broken-Stone Ballast. For Noise Deadening without cutting off all overhead Light from the Street. Plan, Longitudinal Section through trough, and cross-section. Ballast not shown in longitudinal section.

bolted to steel plates. The rail and plate are carried on stone ballast filling placed in the built up steel trough running parallel to and carried on top of the longitudinal girders. It would not be open to the objection of cutting off all the light, as would be the case with solid floor construction and would probably add the least weight and cost the least of any sound deadening device that could be employed on the old structure. If the trough were filled with broken stone, over the base of the rails, it would act as an absorbent of the vibration set up in the rail itself. No construction of this character has ever been employed, to my knowledge, but I know of no reason why it could not be used to advantage.

A type of construction in some respects similar to that shown in Fig. 4 was used on the elevated railroad in Kansas City constructed in 1886 under the direction of George H. Pegram, now chief engineer of the Interborough Rapid Transit Company of New York. This is shown in Fig. No. 5 and is a reproduction of a cut published in the Journal of the American Society of Civil Engineers. In this no ballast was used, and the channel bars forming the trough extended high enough above the head of the rails to serve the purpose of guard rails. The following extract is taken from Mr. Pegram's discussion in the publication above referred to:

"The writer has always believed that cross-ties are out of place on an elevated structure. On the ground, where they are necessary to distribute the weight over the surface, they have proved the best construction, but they are not neeeded for this purpose on an elevated road, and their effect there is to darken the street below, to intensify the noise, increase the labor of cleaning the structure, and lead to unpleasant drippings after a fall of snow or rain."

While the use of guard rails in connection with the type of construction for the elevated roads is an essential of the greatest importance for safety, none were shown on any of the above drawings for the reason that it is a detail apart from sound deadening. It is believed that in some cases an inside guard projecting well above and bolted to the running rail could be employed to ad-

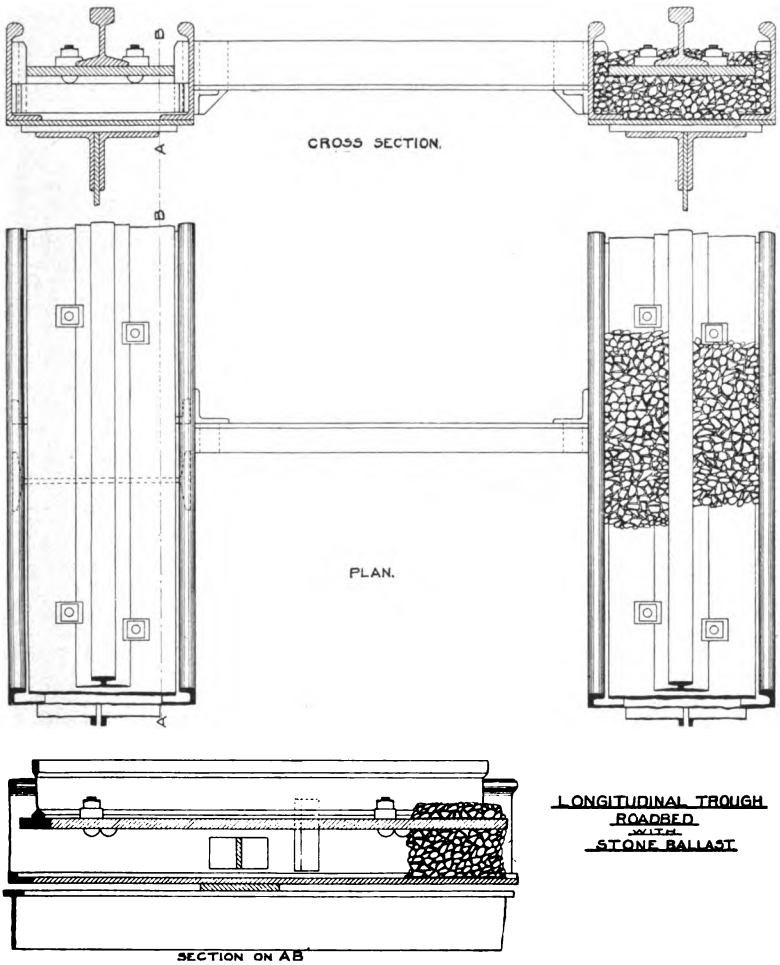


Fig. 4. Suggested Type of Longitudinal Steel Trough Roadbed with Stone Ballast. Steel Bearing Plate bolted to Base of Rail.

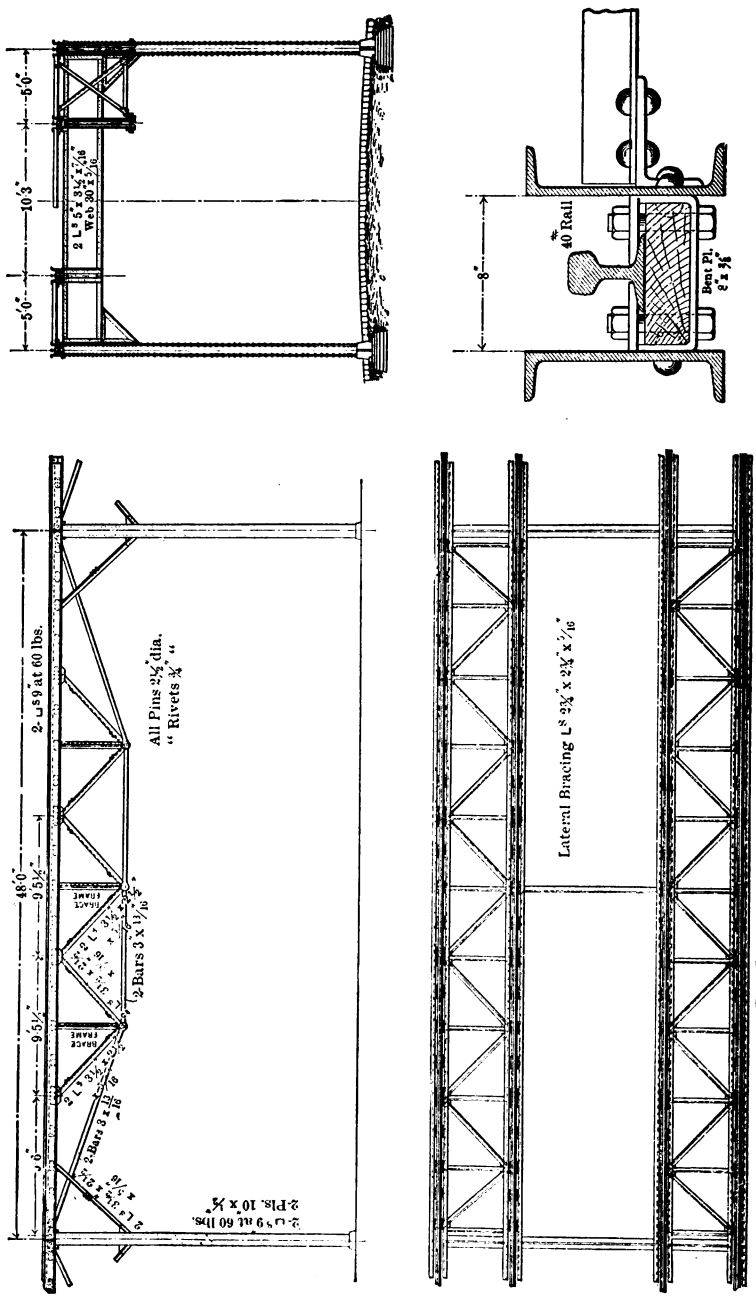


Fig. 5. Trough Roadbed construction of the Kansas City Elevated. Built in 1886.

vantage. A guard rail of that type would cut off much less light than the wooden inside guard now used, and should be quite as effective.

For Wabash avenue it is believed the Philadelphia type of construction shown in Fig. 2 could be very advantageously employed as the exclusion of light by the solid floor would not be so objectionable there on account of the great width of the street, *while the reduction of noise is one of the most important objects to accomplish.* For Fifth avenue and Lake street the same type of construction might be employed. For Van Buren street a more open type of construction either of the cross trough shown in Fig. 3 or the longitudinal trough shown in Fig. 4 should be used. Or possibly for Lake street and Fifth avenue and Van Buren street a combination of the Philadelphia type of Fig. 2 under the joints for 60-foot rails and the open type of Fig. 3 or 4 used for the balance of the rail lengths could be employed .

Track—Rails and Joints.

As previously stated, most of the noise vibration originates at the rail joints from the pounding by the wheels. I know of no reason why one-half of this could not be eliminated at once by the adoption of 60 ft. instead of the 30 ft. rails now used. It is not reasonable to suppose that the joints for 60 ft. rails would be noisier to any marked degree than those for the 30 ft. rails. The expansion difficulty would hardly cause any serious trouble. As a matter of fact 60 ft. rails have been in use on several of the roads for some time.

The pounding and resulting noise at the joints could probably be very materially reduced by the adoption of a set of splice bars such as shown in Fig. 6. In this the outside splice bar is made of greater depth than

those ordinarily in use. They are so designed that the outside splice bar comes up with a gradual slope to a fraction of an inch higher than the head of the rail at the joint. By that arrangement the outside splice bar will receive the wheel tread and carry the wheel and

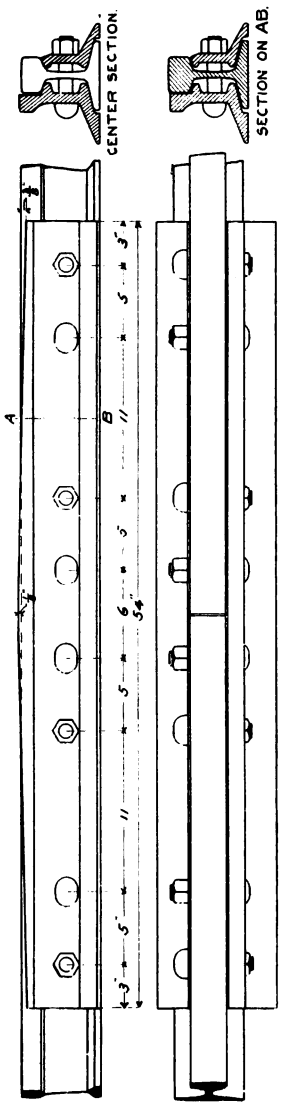


Fig. 6. Suggested Type of Rail Joint, with High Outside Bar to carry the Wheel Tread over the break at the ends of the rails. 4′—6″ Long, with 8 Bolts. No bearing contact at the "Quarters" (Section AB). A Rail joint of this type should produce less noise in operation than those in common use.

load over the gap between the rail ends at the joint, without allowing the consequent pounding on the rail joints and almost instant reversal of the shear, as is the case with the ordinary splice bar. The outside splice bar would serve the function of a girder in carrying the wheel over the weak spot in the joint. In the design shown the splice bars are 4½ feet long and are supplied with eight bolts and grouped in such a way as to give bearing only at the ends and middle of the bars. It is intended, as shown in cross section "A-B," to have the splice bars so constructed that there will be no bearing between the splice and the rail, whatever, for part of the distance between the wide spaced bolts or at the quarters. That with the extra length will prevent very largely the hinge motion which takes place with the short splice bar. The bar made in this way should be of extra quality steel to resist the unusual wear that would be brought upon it.

Almost every conceivable device has been tried for strengthening the rail joints of track. Some give better results than the angle bars in use on the loop; others have been rejected for various reasons, such as high cost, complication in their use, etc. The splice bars for the joint as above described would cost more than the ordinary angle bars, but would be no more complicated in their application. On account of the urgent need for reducing the noise, some such form of joint should be given a thorough trial. Splice bars similar to those above described have been tried at different times on steam railroad track. On account of the great variation of rolling stock, badly worn wheel treads, heavy loads and high speeds, they have not proven very successful. For the elevated service, however, where the wheels can

be well maintained and the loads are not excessively heavy, very good results should be expected.

A splice bar construction similar in type to that shown above has recently been employed on the Chicago & Oak Park line at different points. This, while quite an improvement over the old joint, is apparently not giving as satisfactory results as might be hoped for, as it is not employed under favorable conditions, neither do the details of the design appear to be the best that could be used. The splice bars, as applied to the old worn rails, are too short, of insufficient depth, and too thin to give the necessary stiffness and resistance to wear and crushing.

Structure.

Even with the changes in road-bed and track above suggested, it may be necessary to employ still other expedients to prevent vibration which may be carried into the structure from producing noise by its action on the broad thin plates and members under tension. It is believed that in many cases creosoted boards or planks could be bolted to the vibrating and noise producing parts of the structure in such a way as to very materially reduce, if not prevent, the noise entirely. In some cases felt placed between the plank and the members to which they were applied might prove more effective. In still other cases incasing with concrete may be the better expedient to adopt.

2nd. Motor Gears.

There does not seem to be much promise for noiseless motor gears. About the most that can be hoped for is to have them reasonably well maintained, and have the vibration absorbed in the road-bed construction before it is carried into the structure itself and accentuated

and widely distributed. Some of the noise might be eliminated by housing or casing the motor and gears so as to confine the vibration as much as possible. Some such device should at least be given a trial to learn if any relief can be had by that means.

3rd. Air Brake Exhausts.

There is no reason why the orifice of the air brake exhausts should not be changed and mufflers employed, dispensing with that noise feature entirely at a trifling cost. It has already been largely taken care of by some of the roads.

4th. Rattling of Loose Parts.

The noise resulting from the rattling of loose parts can be almost, if not wholly, remedied by proper construction and maintenance.

5th. Curves.

On account of the short radius of the curves, and both wheels being rigidly fastened to the axle, the slipping of one of the wheels on the rail is inevitable. This results in grinding and screeching noise. I know of no way to prevent this aside from the employment of some lubricant, on at least one of the rails.

6th. Exhausts from Pneumatic Interlocking.

The noise from the exhaust of the pneumatic interlocking can be entirely prevented by changing the exhaust port and putting on exhaust mufflers.

As the movement of the interlocking must be quick and positive the "throw" will be attended with more or less noise. In some cases it is believed the resulting noise could be prevented in part.

7th. Crossing Frogs.

The excessive noise at junction points resulting from wheels passing over frogs can be reduced in part by the use of a solid floor and stone ballast to carry the track at these points.

8th. Brake Shoes.

The screeching and chattering produced by the rubbing of the wheels on the brake shoes can be largely reduced, if not prevented entirely, by the use of a brake shoe of the proper combination of metals and properly hung.

METHODS TRIED FOR DEADENING NOISE.

The only effort made or experiment tried for deadening noise on the structure to my knowledge is that installed several years ago. Two different methods were employed on the structure on Wabash avenue between Monroe street and Jackson boulevard. On the west track the space between the bottom of the ties and the outside edge of the outer and inner guard rails was boxed in. This space was filled in with gravel up to a height covering the base and about half the depth of the rail. The method employed on the east track was to box in the space from the bottom of the ties extending across the entire width over the outside guards. This was also filled in with gravel covering the ties and base of the rails and extending up about half the depth of the rail. The method employed on the east track was more effective than that on the west. As might have been expected, however, neither method proved to be of any great efficiency as the contact between the rigid parts of the structure consisting of rails, ties, etc., remained unbroken.

Two factors of the method employed would serve to reduce noise to a limited extent:

1st. The loose gravel in which the rail is embedded causes a part of the noise producing vibration set up in the rail to be absorbed before being carried to a great distance and widely distributed. The same feature of sound deadening is noticeable on steam roads after a fresh fall of snow when the rail is largely covered with loose snow, the noise being very materially reduced.

2nd. The increase of mass by the addition of the loose and inelastic gravel absorbs a part of the vibration before it is carried into the structure itself. On account of the greater mass of gravel used on the east track, that method was more effective.

As previously stated to secure sound deadening in the elevated road-bed, the continuity between the rails and ties, and the structure itself should be broken by interposing some inelastic medium to break up and dissipate the vibration, as well as increase the mass to act as an absorbent.

OBSTRUCTION TO LIGHT, AND UNSIGHTLY APPEARANCE.

1st. Stations.

Anyone passing along any of the thoroughfares occupied by an elevated structure becomes conscious of a certain sensation of gloom and oppression. This is especially the case on the route of the Union Elevated Railroad on account of the large and unsightly stations and exits occupying street intersections, darkening the roadway and sidewalks and cutting off the view of the sky along the sidewalk.

Plate 3 is a half-tone reproduction of a photograph of the present station on Randolph and Wabash avenue looking West. This view is taken some distance East of the station and shows the Masonic Temple in the background on the right and above the station, and the Marshall Field and Trude Buildings on the left.

Plate 4 is a reproduction of a photograph of the Madison and Wabash station looking East, with the tower of the Montgomery Ward Building in the background above and on the left, and the Chicago Athletic Association Building on the right.

These two views looking along the intersecting streets show relatively the size and great amount of obstruction to view and light when seen at some distance from the elevated structure.

Plate 5 is a reproduction of a view of Adams and Wabash station looking North. This shows the great amount of obstruction to light and view, when looking along the sidewalk of Wabash, caused by the exit stairs as well as the station structure which is built out over

PLATE 3. RANDOLPH AND WABASH STATION LOOKING WEST. SHOWING OBSTRUCTION TO VIEW AND LIGHT, AND SHADOW CAST.

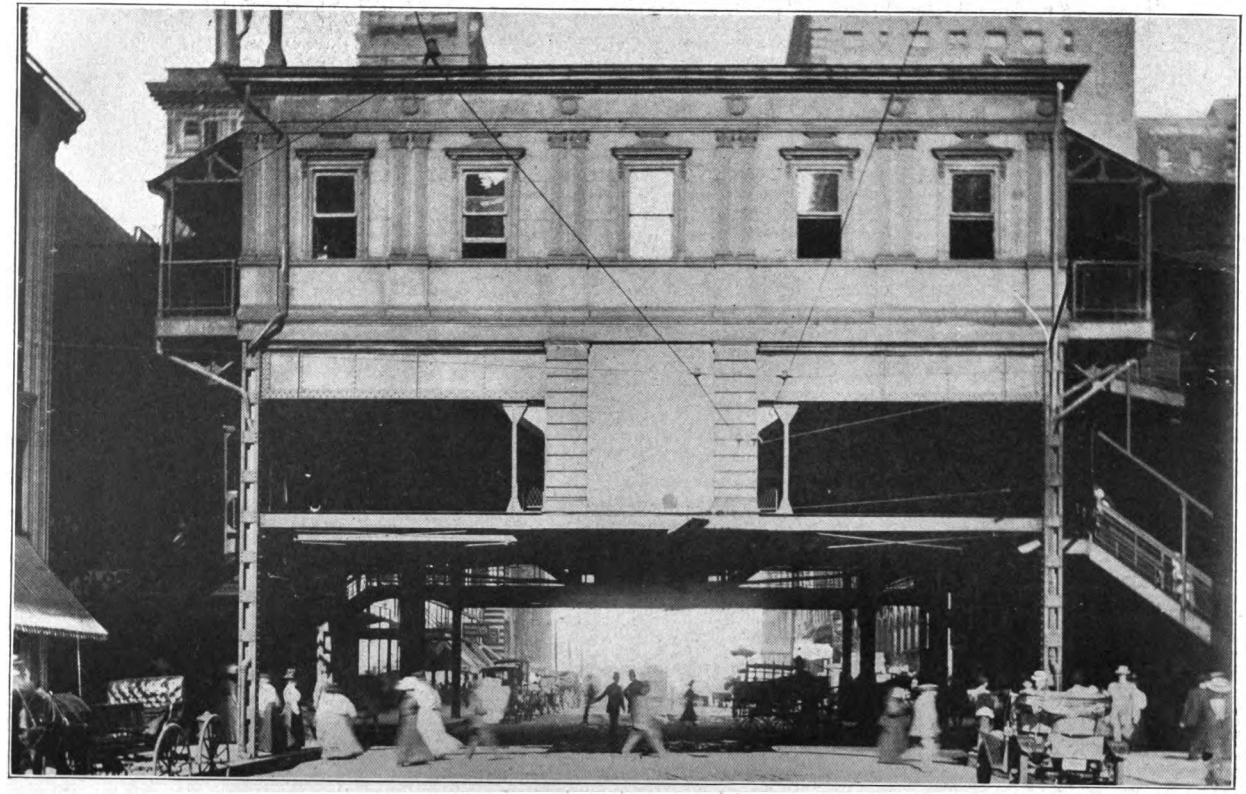


PLATE 4. MADISON AND WABASH STATION LOOKING EAST. SHOWING OBSTRUCTION TO VIEW AND LIGHT, AND SHADOW CAST.

PLATE 5. ADAMS AND WABASH STATION LOOKING NORTH. SHOWING OBSTRUCTION TO VIEW ALONG SIDEWALK, AND SHADOW CAST BY STATION AND PLATFORMS. "EXIT ONLY" STAIRS BUT LITTLE USED.

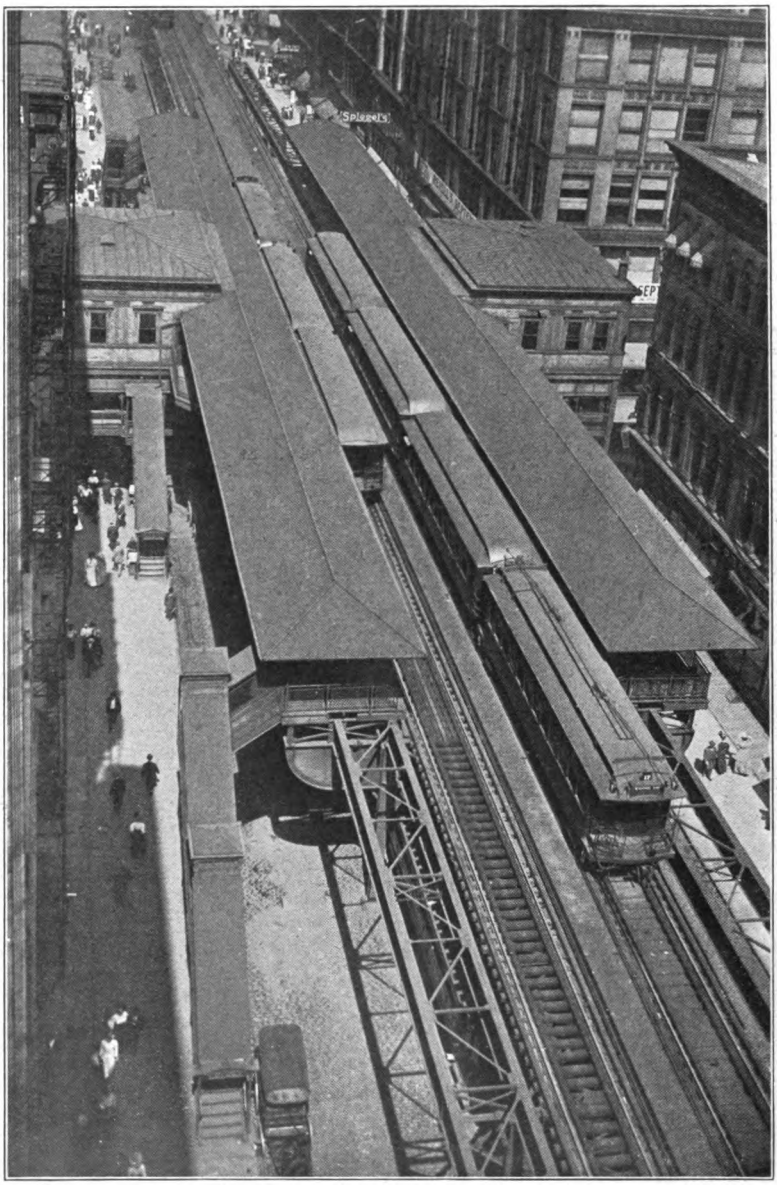


PLATE 11. VIEW LOOKING DOWN ON ADAMS AND WABASH STATION, SHOWING THE SIZE OF THE STATION BUILDING OVER THE ROADWAY OF THE INTERSECTING STREET, THE WIDTH OF THE PLATFORM CANOPIES, AND THE RELATIVE PROPORTION OF THE ENTIRE STREET OCCUPIED BY THE PRESENT STATION STRUCTURE.

the roadway of the intersecting street, past the building lines of Wabash.

Plate 11 is a view looking down on the Adams and Wabash Avenue station. This plate shows very clearly the great width of the stations over the street intersection as built on Wabash and Fifth Avenues. While they are not as wide on Van Buren, they extend out beyond the building lines of the street a greater distance.

These cuts speak for themselves in expressing the great obstruction to view and light, and the overshadowing size of the structures occupying the street intersections.

The removal of these unsightly stations would go a long way toward *civic improvement* and beauty in Chicago, which is being earnestly sought after by many individuals and organizations.

2nd. "Exit Only" Stairs.

The little used and almost useless "exit only" stairs are large factors in causing unsightly appearance and obstruction to view and light along the sidewalks and in front of buildings.

3rd. Maintenance and Painting of Structure.

On account of the lack of proper care in keeping the structure reasonably clean and well painted, it is much more unsightly and objectionable than it would be if a greater amount of care and attention were given.

4th. Attachments to the Structure.

Where the structure has been used for purposes other than conveying traffic the features have not been made ornamental. The brackets for the electric arc lamps attached to the structure are of poor design and unpleasing appearance.

SUGGESTED CHANGES TO REMEDY OBSTRUCTION TO LIGHT AND UNSIGHTLY APPEARANCE.

1st. Stations.

In order to remedy the unsightly appearance, and remove obstruction to light, it is recommended that the present stations on Wabash avenue, Van Buren and Fifth avenue, be reconstructed, and the ticket offices and waiting rooms removed from the platform elevation to the space beneath the tracks and platforms on the level now occupied by the cross-over foot-ways, and the old station buildings over the roadway and above the platform level torn down. By this arrangement the width and height of the station would be limited to that covered by the outside of the present platforms.

For the convenience and comfort of the travelling public it would also be desirable to have the stations on Lake at State and Clark streets reconstructed on the same plan. At present they have no waiting rooms or cross-over foot-ways.

By the proposed arrangement, having all of the waiting rooms and ticket offices grouped under the tracks and platforms, in case universal transfers were adopted, it would offer a possible convenient means in the transfer service of keeping a record of the transfers from one line to another. Passengers having to transfer could go down the platform entrance stair to the waiting rooms and receive a transfer slip from the agent of the road on which the fare was paid. Then to continue the journey on another road, the transfer slip would be immediately presented at the ticket window of the other road

which the passenger wished to take. With this means of transferring, the roads would be able to keep a record of transfers made one to the other. It would also render unnecessary the construction of the proposed over-head transfer bridges over the tracks from one platform to another.

To further reduce obstructions to light, the present canopies over the platforms should be removed and replaced with canopies, preferably of saw-tooth roof design, so constructed that the highest point of the roof would be on a level with what is now the lowest point, or of a height just sufficient to clear the roofs of the cars. The covering of the canopies could be advantageously made of wire glass, so as to have practically all the light falling on the roof available for distribution to the sidewalks and fronts of adjacent buildings. For the platforms over the station waiting rooms, sidewalk prism glass could be installed for lighting the interior of the station.

Plates 6, 7, 8 and 9 are photographs of a small size model of a station which the Association recently had constructed. This, while a design for a steel frame construction, is actually built of wood and one-twenty-fourth actual size. On that account the details of many of the parts are out of proportion. Only a short section of platform and canopy, representing about 75 feet in length, was built; 25 feet of which is over half the street intersection where the station and waiting rooms are located.

Plate 6 is an end view of the model showing the proposed design of the canopy for reducing the height, in which wire glass could be used to advantage. The black girder and post on the right hand side of the picture represents the girder and post as it stands in the street

at the present time to support the waiting rooms and ticket offices. They would be unnecessary with the proposed station and could be removed. The portion in black on the extreme right and left, shows the position occupied by the buildings on the near side of the street.

Plate 7 is the same view of the station with the reproduced model of the present waiting room and ticket offices in the relative position occupied on the present structure. The present type of canopy is also shown in place. The opaque canopy over the stair is shown in place on the right of the cut. The relative amount of obstruction to view and light as presented in the new design and that of the old station can be readily seen at a glance.

Plate 8 is a side view of the model looking along the line of the curb. In this the relative position of the stair is readily seen. The exit stairs from the platform are at the extreme right, and the entrance stair to the platform is shown ascending from the waiting rooms beneath the tracks and platform. The stairs leading to the street are clearly shown. Under the stairs leading to the street is shown the effect of the proposed filling in beneath the foot of the stairs, doing away with the practically inaccessible dark space which now only serves for the collection of dirt and rubbish.

The relative position of the building lines are shown by the broad, black band on the extreme left, and the narrow band just to the right of the center of the cut.

The position of the waiting rooms and ticket booths are clearly shown just a little to the left of the center line of posts. Just adjoining the center line of posts to the left is the passageway from one side of the structure to

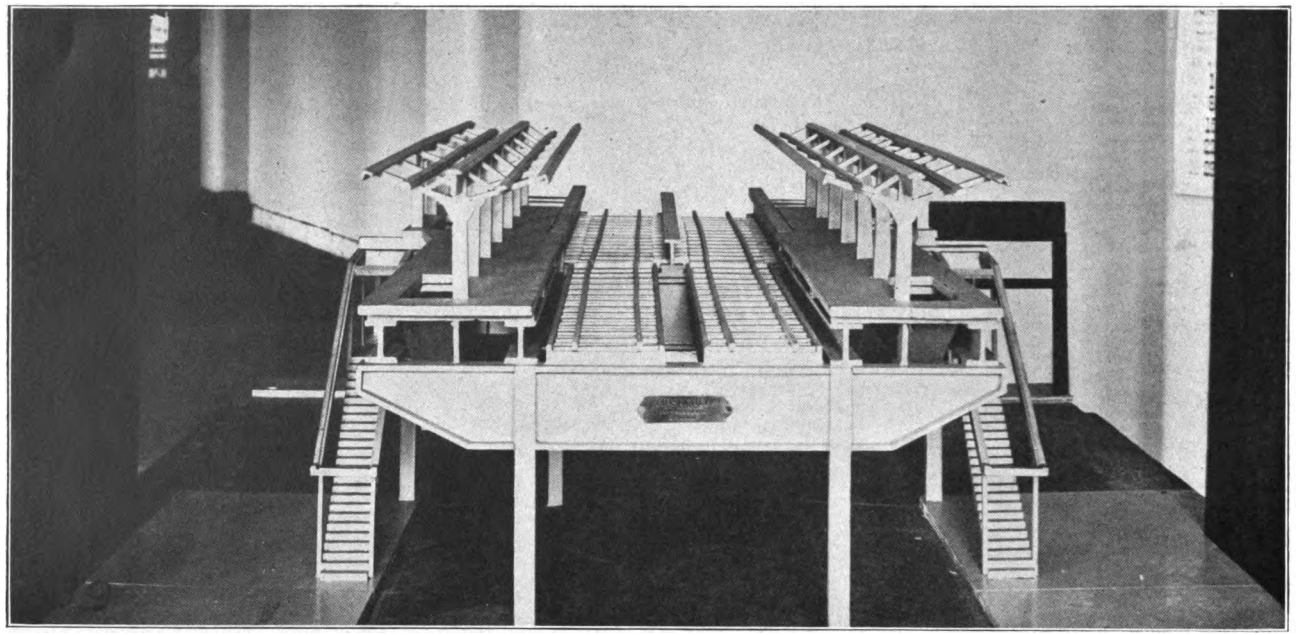


PLATE 6. Model of Proposed "Subtrack Station" for reducing obstruction to light and view. End View Showing Canopies of "Saw Tooth" design and wire glass, covering the platforms. Ticket Offices and Waiting Rooms below the Tracks and Platforms, on the level of the Present Crossover Foot-ways. (Black Girder and Post to Right are Part of Old Structure to be Removed.)

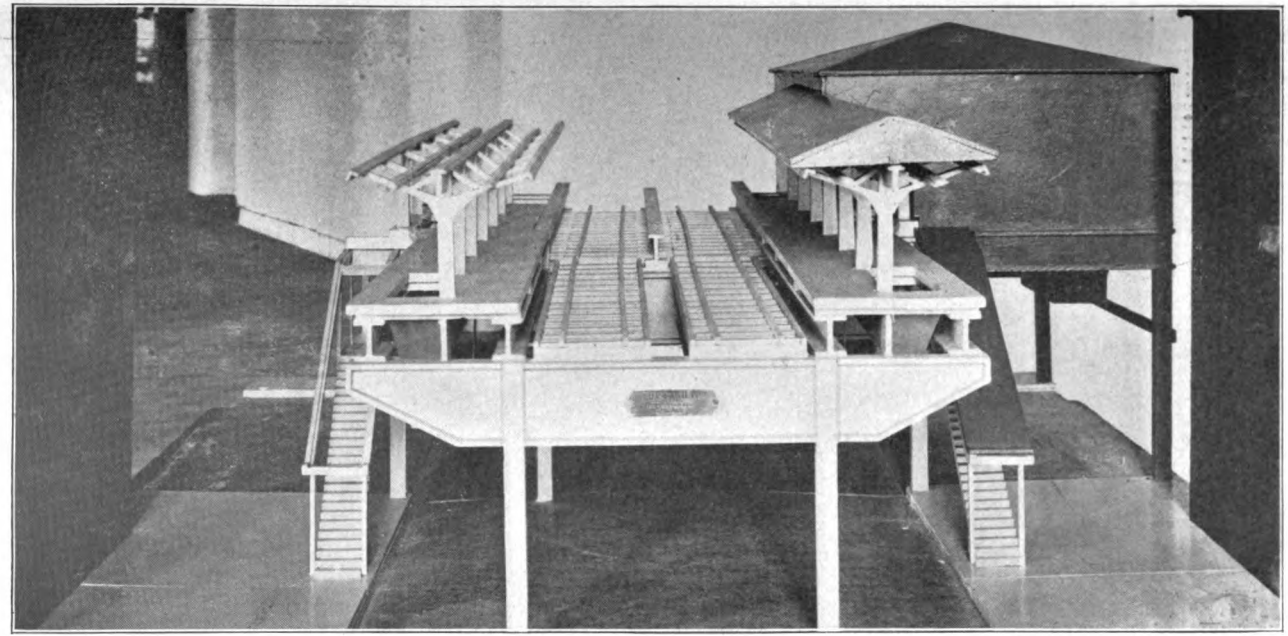


PLATE 7. Model of Proposed "Subtrack Station." Same View of Model as Plate 6 with Reproduced Model of one of the Present Ticket Offices and Waiting Rooms in Place. The Reproduced Model shows the Bulk of the Structure which extends over the roadway on each side and which can be dispensed with by the use of the Proposed "Subtrack Station" Design.

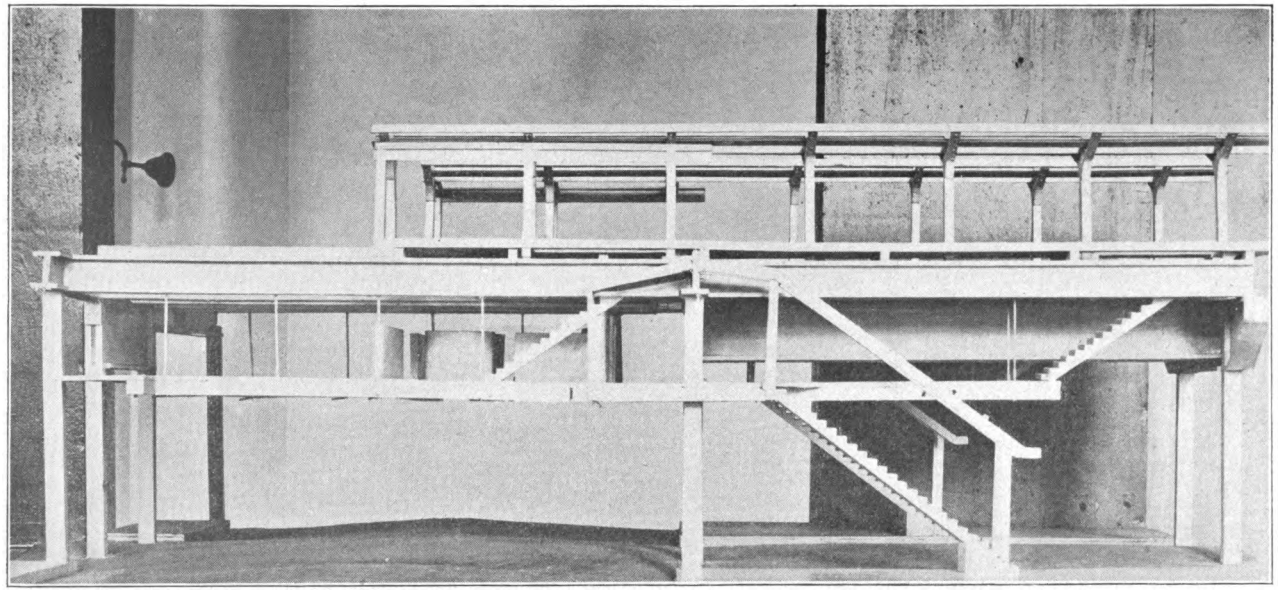


PLATE 8. MODEL OF PROPOSED "SUBTRACK STATION." SIDE VIEW SHOWING SPACE BENEATH TRACKS AND PLATFORMS, ON THE LEVEL OF THE PRESENT CROSS-OVER FOOTWAYS, TO BE USED FOR TICKET OFFICES, WAITING ROOMS, AND PASSAGEWAYS. THE SPACE IS THAT SHOWN IN THE LEFT SIDE OF THE PLATE BETWEEN THE POST AT THE HEAD OF THE STAIRS, WHICH LEADS TO THE SIDEWALK, AND THE LINE OF POSTS ON THE EXTREME LEFT. THE POST SHOWN IN BLACK ON THE LEFT TO BE REMOVED.

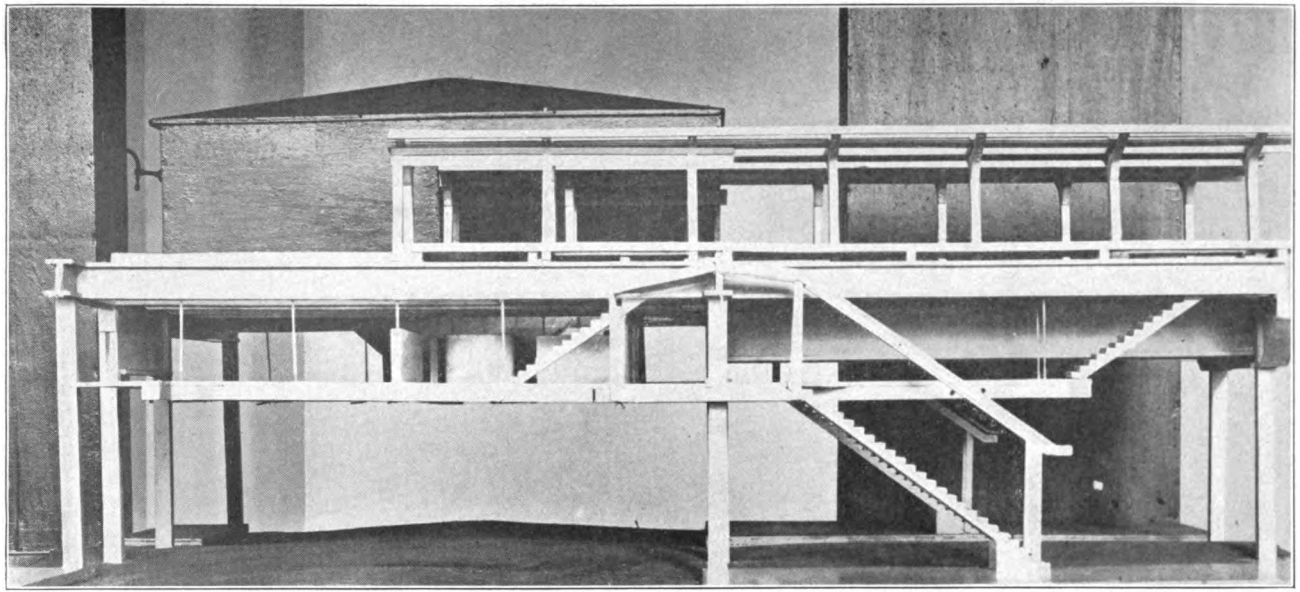


PLATE 9. Model of Proposed "Subtrack Station." Side View of Model same as Plate 8, with Reproduced Model of Present Ticket Offices and Waiting Rooms in Place on Opposite Side, Showing in Contrast the Amount of Space Occupied, and Obstruction to Light and View.

the other and leads to the main entrance of the ticket offices and waiting rooms.

In Plate 9 the same view as Plate 8 is shown. In this the reproduction of the outline in model of the old station, waiting room and ticket offices is shown in place.

As a matter of detail, in some cases the stairs which are now used as exit stairs at street intersections could be used as entrance stairs with the proposed arrangement, and the stairs leading to the sidewalks would remain in their present location.

The contrast of the old to the suggested new stations in the matter of obstruction to light and view is well seen by comparing Plates 8 and 9 of the model with 3 and 4 of the old stations. Plate 3 is on nearly the same scale as 8 and 9 of the model.

Figure 7 is a plan of the suggested new type of station showing the location of the passage ways, ticket offices, waiting rooms, stairs, etc. For the four different roads as at present operated there would be a separate waiting room and fare booth for each road. One main passageway running lengthwise of the structure and connecting with two cross-passageways from the heads of the stairs leading to and from the street. (The direction of traffic movement is indicated by arrows.) In the arrangement shown each fare booth could be supplied with two windows for collecting fares. The lower ends of the exit stairs from the platforms end in landings leading to the cross-passageways and stairs reaching the street level.

The amount of space provided for each separate waiting room is about 160 square feet and is ample to meet any requirements under normal operation. As a matter of fact it is much more than is now provided at stations for passengers after having paid their fare. The

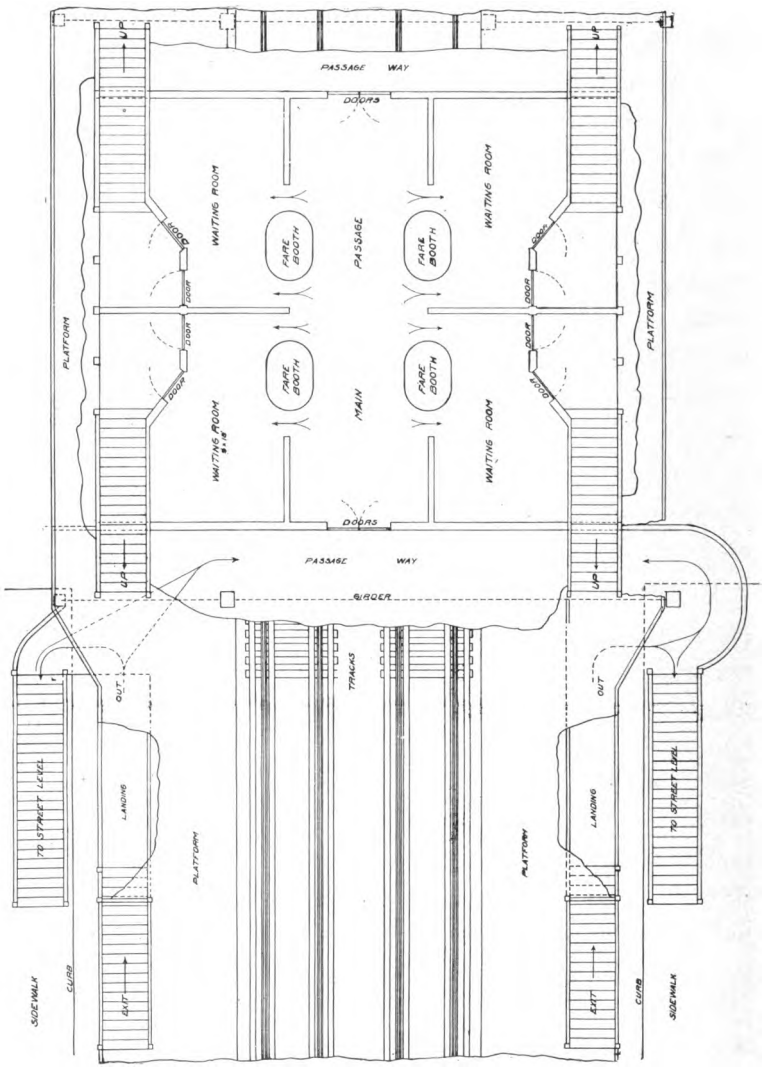


Fig. 7. Plan of Recommended New "Loop" Station. Each Waiting Room is about 9′x18′. Dimensions in the Plan shown would be suitable for the stations on Wabash, 5th Ave. and Lake St. Those on Van Buren would be somewhat less in width. The upper portion of the cut, inside the irregular lines, shows the plan on the level of the Fare Booths, Waiting Rooms, Passageways, etc. The lower portion of the cut shows the tracks, platforms, stairs, etc., in plan.

waiting rooms are very little used during the rush-hour period at any season of the year.

While the width of the old stations on Wabash avenue is over 102 feet, that of the recommended new station would only be the width covered by the outside width of the platform, or less than 54 feet.

The great improvement in appearance and reduction in light obstruction by the removal of the old station buildings can hardly be overestimated.

2nd. Exit Stairs.

In the matter of station stairs, the present width and arrangement of stairs at some stations is not satisfactory for handling the crowds to the best advantage. The "extra exit" stairs at the far ends of the platforms, are almost wholly unused for the reason that passengers getting off at a station are naturally destined for points leading the four directions away from the station. The use of the "extra exit" stairs, as located, would take three-fourths of the passengers away from their desired destination, and as a result are practically useless factors in accommodating traffic. The uselessness of the "exit" stairs is especially evident for the stations on Fifth avenue. For the Northwestern and Chicago & Oak Park there are few or no passengers getting off from the trains at Randolph and Madison streets; while the same is true for the Metropolitan at Madison and Quincy; and as a matter of fact, very little unloading is done by any of the roads at Fifth avenue stations, during the rush-hours. As at present located there seems to have been no warrant for the original construction of the stairs, and certainly is none for their continued existence under the present method of operation.

The almost exclusive use of these Fifth avenue stations is for passengers taking trains.

In the matter of exit stairs, it may be pertinent to ask what purpose the exit stairs at the Congress and Wabash avenue station for the *south bound* trains on the South Side line are intended to serve.

As a factor in the moving of large crowds, stairs are conducive of congestion, for the reason that a crowd moves slower on a stair than on the level. This is especially aggravated when feeble or disabled persons have to make their way on a crowded stair. On that account extra provision should be made for facilitating the movement. Stairs at congested points should be arranged to give greater convenience and facilities to passengers than at present exist. For example, at Madison and Wabash avenue, the point of congestion for passengers taking trains for a short time in the evening rush-hours is on the stairs leading up from the West side of Wabash avenue. As the present stairs are only four feet in the clear it is not only annoying and difficult for a person to go against the rush-hour crowd, but causes a great deal of delay and inconvenience to the predominating movement. As a remedy, one of three expedients should be employed at points where congestion of traffic would demand.

(*a*) The simplest arrangement is that of providing a wider stair of, say, 5½ or 6 feet in the clear, when the concentration of traffic at such point seems to demand additional relief. With a stair about 5½ feet in the clear, opposing movements of passengers can be handled with a fair amount of facility.

(*b*) As a second expedient it is believed that in some cases the exit stairs could be made through business houses and office buildings to advantage.

(*c*) At points of extreme congestion the incoming and outgoing traffic should be entirely separated, if possible. This could be done in some cases by placing exit stairs just above the entrance stairs, in such a position as to serve for the roof covering over the latter. Then by using glass canopies over the upper stairs the obstruction to light on the sidewalk and adjoining buildings would be but little more than with the present arrangement, and the facilities doubled.

As a feature of stair construction, a design could be employed whereby much less obstruction to light would result than is the case with the present form of construction. As uprights and framework are required to carry the canopy these members by the addition of a few diagonals, and made of proper proportions, could be formed into members of a truss, and the stair and load could be carried on this construction. In the present construction the entire stair and load are carried by beams on which the stair is made, varying in depth from 15 to 20 inches. By employing the trussing, as above described, the depth of the stair beam could be reduced to about 6 or 8 inches, and would give much less obstruction to light.

Instead of having the risers of the stairs solid, as at present, a large proportion of the number could be left nearly, if not entirely, open to advantage.

The open space under the foot of the stairs should be filled in solidly with some such material as concrete or brick, between the sidewalk and stair, for a height of at least three feet. (See Plates 8 and 9.) This space as it exists at present serves only as a place for the collection of dirt and rubbish.

Another feature to be taken into consideration, is that

of utilizing the waste space under the sidewalk stairs for the entrance to public comfort stations, which has been taken up and agitated by different civic organizations of the city, if the installation in the vicinity of any of the "Loop" stations is decided upon.

3rd. Maintenance and Painting of Structure.

The proper maintenance of the structure to insure its preservation would demand more care and frequent painting than seems to have been given the structure in the past. By painting the structure some light sightly color it could be made much less objectionable in appearance than it is at present, or has been for some time. The prevention of deterioration by rust and corrosion by frequent painting would perhaps more than justify the expense, even if the appearance of the structure were not a consideration.

4th. Added Utility, Improved Appearance, Etc.

In some cases the structure has been used for purposes other than merely handling traffic. Electric lights, and the wires for distributing the current, are attached to the structure at different points. The lamps are suspended from very light inartistic brackets attached to the posts. The wires are strung about promiscuously without any regard to appearance.

It is believed that the unsightly appearance of the structure could be modified and relieved to a certain extent and at the same time made to serve a useful purpose by employing the following method: For the purpose of illumination, brackets of somewhat massive appearance to harmonize with the structure and of curved outlines could be attached to the outside of the posts. From the ends of the brackets electric lamps of a general design

to harmonize with the outlines of the structure could be suspended. By suspending feed wires, which should be as large as can be consistently allowed, from the ends of the curved brackets, over the lamps, and leaving them loose enough for considerable sagging to produce curves of pleasing outline, the present straight and angular lines of the structure would be somewhat modified and relieved.

The distance between posts is a little over 50 feet. By placing lamps on every post, but lighting only every other one, the lights would be a little over 100 feet apart. By using, say, a 200 candle power Tungsten lamp, a high degree of illumination should be secured. By suspending the lights at the proper height and using reflectors so that the upper part of the structure is left in shadow, the streets would be well illuminated, at the same time serving to obscure the structure itself from notice or view.

By the adoption of some such expedient as the above, it is believed that the structure would be rendered much less objectionable in appearance during daylight, while the illumination at night would lend itself to making the street, if anything, more attractive on that account.

In the design of the model for the suggested rearrangement of stations, no attempt was made at ornamentation or design on pleasing outlines. That, however, is an important factor and should receive considerable attention, as there would seem to be possibilities of producing a structure of much more pleasing outlines than those shown in the model which was constructed. It is not believed that ornamentation which is to be had only through masking of the present structure or any part which may be reconstructed is advisable or desirable as the undesirable features which could not be

masked would be rendered more unsightly and unpleasing by contrast.

While the work of producing a structure of somewhat pleasing outline should have been undertaken in the original design, still it is believed that it is susceptible of material improvement even as it stands to-day.

The whole question of improving the appearance of the elevated structure and securing effects which would in any way add to civic beauty, is of such a public nature and importance as to deserve attention and study by artists and architects best qualified to judge and work out details relating to that feature. It is to a certain extent outside the province of engineering, but could very properly be made a subject of competition for suggestions and design covering the points mentioned and such others as might be brought up for consideration. The competition could be carried on under the auspices of some such organizations as the Municipal Art League or the Chicago Architectural Club and a suitable prize offered either by the association or some of its members.

CONCLUSION.

In preparing this report I have kept in mind the statement of the President of the Loop Protective Association in his letter expressing the hope that an adjustment of the loop problem can be made which will be for "the mutual benefit of the City, the property owners, and the Elevated Railroad Companies."

It is believed that the suggestions and recommendations of the report as related to the structure and the operation of trains over it, are well within conservative bounds. The net revenue earning capacity of the Union Elevated Railroad is evidently such that its owners could well afford to make the necessary changes to eliminate the nuisance features of the structure and its operation. Even if it were assumed that the rush-hour traffic which could be handled by the "Loop" had reached its maximum, there is no reason apparent why the non-rush hour traffic should not increase with the growth of the City up to a point where it would nearly equal the present rush-hour business.

The revenues from the "Loop" will increase greatly during the franchise period claimed and the cost of the changes suggested by this report are of relatively small significance when compared with the "Loop's" net earning capacity. The advantages to the property owners and to the public from the changes suggested in this report, and the advantages to the Companies in a definite validation of the "Loop's" franchises and a final settlement of the problem are all so obvious that it would seem that an agreement for the mutual benefit of all parties concerned, should be reached without great difficulty.

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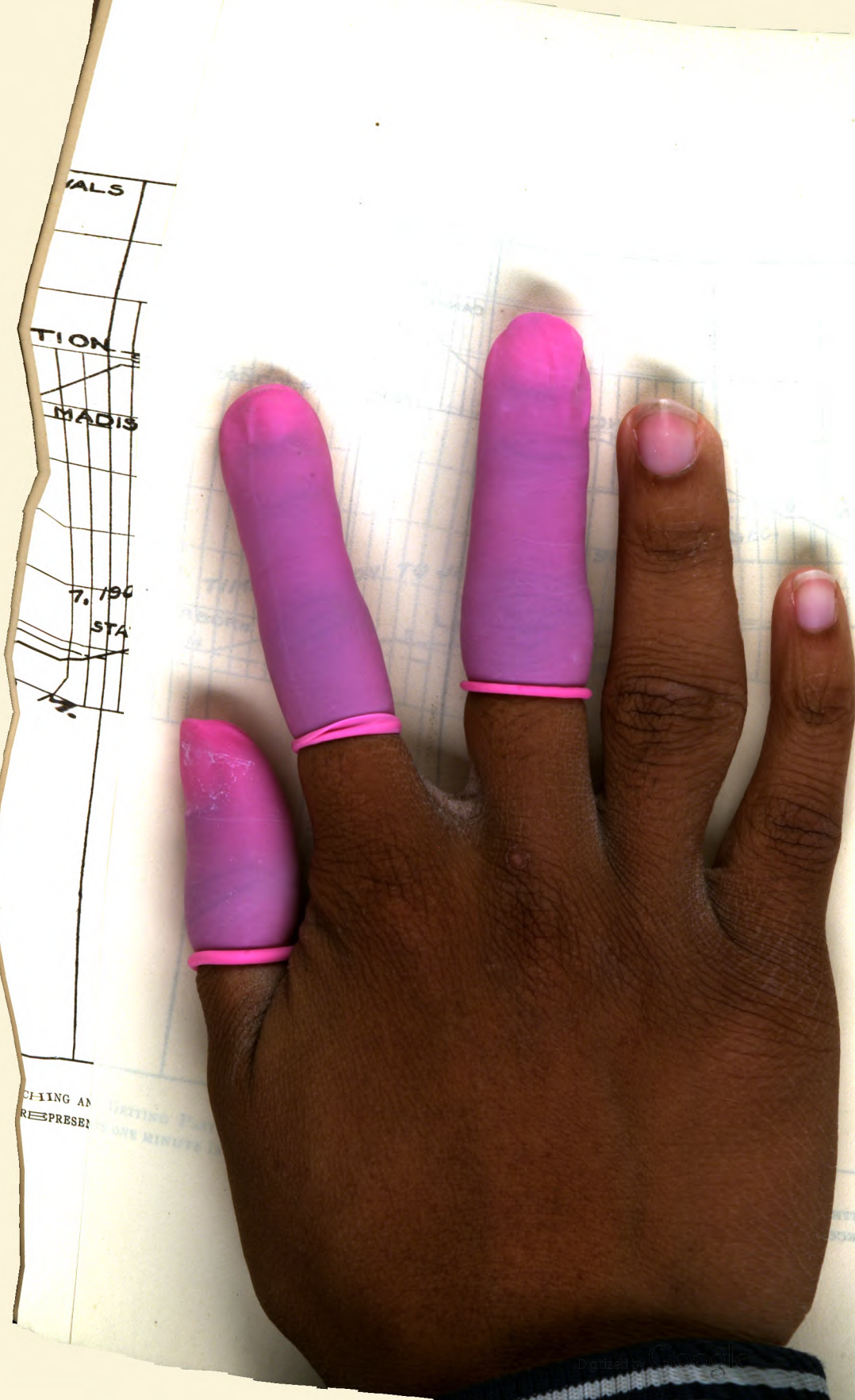
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