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TRACK ELEVATION

IN

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BY

NOAH HENNING JACOBSEN

THESIS

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

NOAH HENNING JACOBSEN

ENTITLED TRACK ELEVATION IN CHICAGO

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

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Introduction.

My object in writing this thesis on "Track Elevation in Chicago" is to bring together in one volume as many valuable facts as possible regarding the historical and constructional features of this great undertaking and to show the great influence which this immense expenditure of means and energy has had in promoting the interests of the commercial affairs of the city, in safeguarding the lives of its people, and in bettering in many ways the conditions of the railway companies themselves, to whose tireless energy and financial backing the credit is due for the successful solution of the problem of eliminating the grade-crossing evil.

This is not intended to be an exhaustive treatise on the subject, only the chief facts regarding the various phases of the undertaking being mentioned. Numerous articles have been written regarding particular features of the work, but it is believed that this information has never been brought together in one paper. It is hoped that this thesis will be of interest to those who are unfamiliar with the subject.

History of Track Elevation in Chicago.

In writing this history of Track Elevation in Chicago, it shall be my aim to deal only with the general movement without attempting to record the events and influences which lead up to the present condition of affairs on each individual road. Almost innumerable ordinances have been passed by the city council providing for track elevation, and it would be decidedly impracticable to attempt to give an account of each of these. Reference will be made to only those which indicate the general progress of the movement. A fairly complete table of ordinances is given on page 34.

As in all large cities, the enormity of the grade-crossing evil was continually being brought to the attention of the public. Hundreds of people were killed each year on the surface tracks of the steam railways, and the commerce of the city was subjected to great inconvenience and expense. With the rapid growth of the city, the need of some remedy was appreciated more and more, but the extreme difficulty of the task of supplying this remedy made the city and also the railways reluctant to attempt it.

Over twenty companies own lines running into the city, and the trains of other companies run over some of these under lease or contract. Those roads which gained admission early in the history of the city have more or less direct lines, while the location of

Table of Track Elevation Ordinances 1892-1905

TABLE OF TRACK ELEVATION,

SHOWING A STATEMENT IN DETAIL OF ORDINANCES PASSED FOR THE ELEVATION OF RAILWAY TRACKS, WORK PERFORMED AND UNDER WHAT ADMINISTRATION.

Ordinance Passed.	Railroad.	During Term of Mayor.	Width of Right of Way. Number of Feet.	Number of Track Head.	Miles of First Main Track.	Miles of Track Elevated.	Actual Subways Constructed.	Joint Subways Constructed.	Street Grade Crossings Diverted into Subways.	Street Not Opened.	Estimated Approximate Cost.
May 25, 1892	I. C. R. R. Co.	Washburne	200	8	3.0	28.70	13		1	2	$ 2,000,000
July 9, 1894	L. S. & M. S. R'y	Hopkins	100	3	4.0	28.70	32			4	1,700,000
July 9, 1894	C., R. I. & P. R'y	Hopkins	100	3	4.5	31.57	7		1	1	1,300,000
July 9, 1894	L. S. & M. S. R'y. C., R. I. & P. R'y.	Hopkins									
Feb. 18, 1895	C. & N.-W. R'y. Galena Division	Hopkins	100	6	2.5	18.29	7			2	400,000
Mar. 30, 1896	C. & N.-W. R'y. Wisconsin Div'n.	Swift	100	4	4.5	15.78	27		5	3	1,000,000
Mar. 30, 1896	C. & N.-W. R'y. Milwaukee Div'n.	Swift	66	3	4.5	11.85	21			7	900,000
July 27, 1896	P., Ft. W. & C. R'y	Swift	66	4	3.0	15.16	20		2		750,000
Jan. 18, 1897	P., Ft. W. & C. R'y	Swift	100	5	1.0	4.79	2				250,000
Jan. 18, 1897	L. S. & M. S. R'y	Swift	Yards	8	2.0	20.61	2				1,000,000
Jan. 18, 1897	P., Ft. W. & C. R'y	Swift	66	4	1.8	5.37					400,000
Jan. 18, 1897	C. & N.-W. R'y	Swift	125	4	1.8	6.84					600,000
Jan. 18, 1897	C. T. T. R. R.	Swift	66	2	0.4	1.98	1				130,000
May 17, 1897	St. Charles Air Line	Harrison			3.0	10.77	10	1		4	2,000,000
Dec. 29, 1897	C. & N.-W. R'y	Harrison	100	7	3.0	29.80	25			2	1,200,000
Dec. 29, 1897	Bloomingdale Rd. C., M. & St. P. R'y	Harrison	80	2	0.5	2.14	8				100,000
Feb. 21, 1898	C., M. & St. P. R'y	Harrison	100	4	6.0	10.72	31			9	2,040,000
Feb. 21, 1898	C. & N.-W. R'y	Harrison	90	2	0.5	1.0	3				130,000
Feb. 21, 1898	C., M. & St. P. R'y	Harrison	100	2	0.7	2.0	2				230,000
Jan. 24, 1898	C., B. & Q. R'y	Harrison	80	4	2.3	9.46	18		11	11	500,000
Jan. 17, 1898	C., R. I. & P. R'y	Harrison	100	3	1.5	4.43	7		6		300,000
April 6, 1898	Belt R'y of Chicago	Harrison	66	2	1.35	2.5	10				250,000
May 1, 1898	A., T. & S. F. R'y. C., M. & N. R. R.	Harrison	66 66	2 2	2.0 2.0	4.65 4.65	2 1	1			225,000
May 22, 1899	A., T. & S. Fe R'y	Harrison			3.41	6.78	1	19			650,000
May 22, 1899	C., M. & N. R. R.	Harrison	100	8	3.61	5.42	1	19			650,000
May 22, 1899	C. & A. R. R.	Harrison			4.92	21.18	32		6	14	1,250,000
May 22, 1899	U. S. Y. & T. Co.	Harrison			1.25	2.32		6			220,000
May 22, 1899	C. T. T. R. R.	Harrison	100	6	1.25	1.79		6			220,000
May 22, 1899	P., C., C. & St. L. R'y	Harrison			1.35	2.94	7				680,250
Oct. 23, 1899	P., Ft. W. & C. R'y	Harrison	66	4	4.3	38.71	2	28			2,000,000
Oct. 23, 1899	C. & W. I. R. R.	Harrison	125	6	6.41	62.18	48				6,000,000
Oct. 23, 1899	P., C., C. & St. L. R'y Eng. Conn. Branch	Harrison	50	1	0.7	1.18	6				200,000
Oct. 23, 1899	C. & G. T. R'y	Harrison	50	2	0.5	0.68	3				175,000
Oct. 23, 1899	U. S. Y. & T. Co.	Harrison	50	2	0.5	0.68					175,000
Feb. 19, 1900	C. T. T. R. R.	Harrison	125	3	2.0	5.85	15			2	750,000
July 16, 1900	C. T. T. R. R.	Harrison	30	2	0.75	2.0	5				150,000
Feb. 11, 1901	P., C., C. & St. L. R'y	Harrison	100	7	2.0	12.25	9				600,000
Feb. 11, 1901	C. & N.-W. R'y	Harrison	50	3	2.25	21.70		9			700,000
Feb. 11, 1901	C., M. & St. P. R'y	Harrison	100	4	3.5	37.88	6				500,000
Feb. 11, 1901	L. S. & M. S. R'y	Harrison	200	12	0.5	2.75	2	2		1	400,000
Feb. 11, 1901	C., R. I. & P. R'y	Harrison			0.5	2.0		2			400,000
Feb. 11, 1901	L. S. & M. S. R'y	Harrison	100	4	0.7	3.8	5				175,000
Feb. 11, 1901	P., Ft. W. & C. R'y	Harrison	100	4	0.7	2.8		5			175,000
Jan. 13, 1902	C. & N.-W. R'y	Harrison	100	4	4.25	13.63	10				1,125,000
Jan. 13, 1902	Belt R'y of Chicago	Harrison	100	Yards	2.0	7.68	8	5			1,000,000
Jan. 13, 1902	C., M. & St. P. R'y	Harrison	100	4	1.5	4.0	10				800,000
Feb. 3, 1902	G. T. W. R. R. Co.	Harrison	66	2	2.25	7.11	21	21		2	600,000
Feb. 3, 1902	M. C. R. R., as lessee Terminal R. R.	Harrison	28	2	1.73	4.07					400,000
Feb. 3, 1902	C. J. & U. S. Y. & T. Co.	Harrison	200	8	0.25	4.20	1				200,000
June 18, 1902	P., C., C. & St. L. R'y	Harrison	66	2	1.5	0.12	6				150,000
June 18, 1902	C. T. T. R. R.	Harrison	66	2	1.5	5.54		6			150,000
July 7, 1902	C., B. & Q. R'y	Harrison	Yards	Yards	3.0	37.5	1	14			800,000
July 7, 1902	C. & N.-W. R'y	Harrison	Yards	Yards	3.5	37.7	14		1		800,000
July 7, 1902	C. T. T. R. R.	Harrison	66	2	3.5	14.5	2	14			900,000
Sept. 29, 1902	I. C. R. R. Co.	Harrison	200	8	1.5	11.5	9				700,000
Sept. 29, 1902	I. C. R. R. Co., South Chicago.	Harrison	66	2	0.3	0.4					10,000
Sept. 29, 1902	B. & O. R. R.	Harrison	100	2	0.2	0.4					1,000
Sept. 29, 1902	N. Y., C. & St. L. R'y	Harrison	66	2	0.75	1.25	1				150,000
Sept. 29, 1902	L. S. & M. S. R'y	Harrison	100	4	1.5	4.5	7				319,500
Sept. 29, 1902	P., Ft. W. & C. R'y	Harrison	100	4	1.5	4.4		7			319,500
Mar. 16, 1903	U. S. Y. of Chicago Chicago Junct. R'y	Harrison	66	3	3.5	19.0	29		1		1,900,000
Mar. 23, 1903	C. & N.-W. R'y	Harrison	66	3	2.5	7.5	15				1,300,000
April 6, 1905	P., Ft. W. & C. R'y	Harrison	100	3	4.5	14.3	19				1,340,000
April 6, 1905	L. S. & M. S. R'y	Harrison	100	3	4.5	11.25	1	10			1,200,000
April 6, 1905	B. & O. R. R.	Harrison	100	2	2.33	8.33	4	7			500,000
April 6, 1905	So. Chicago R. R.	Harrison	50	3	0.6	1.2		4			150,000
April 6, 1905	C. & W. I. R. R.	Harrison	100	3	1.8	3.8	2	4			250,000
April 6, 1905	C., R. I. & P. R'y	Harrison	100	3	1.4	2.5	4				250,000
April 6, 1905	C., L. S. & E. R'y	Harrison	50	2							20,000
					153.23	746.33	567	251	34	64	$48,910,250

Railroad.	Date of Completion of Work.	During Term of Mayor.	Width of Right of Way.	Number of Track Head.	Miles of First Main Track.	Miles of Track Elevated.	Actual Subways Constructed.	Joint Subways Constructed.	Street Grade Crossings Diverted into Subways.	Street Not Opened.	Estimated Approximate Cost.
I. C. R. R. Co.	1892-3	Washburne	200	8	3.0	28.70	13		1	2	$ 2,000,000
L. S. & M. S. R'y	1894	Hopkins	100	3	1.5	9.0	7	7			375,000
C., R. I. & P. R'y	1895-6	Swift	100	3	3.5	16.5	17	17		1	1,125,000
L. S. & M. S. R'y. C., R. I. & P. R'y.	1897-9	Harrison	100	6	9.5	34.77	15	6	1	4	1,500,000
C. & N.-W. R'y. Galena Division.	1895	Swift	100	6	2.5	18.29	7			2	400,000
C. & N.-W. R'y. Wisconsin Div'n.		Harrison	100	4	4.5	15.78	27		5	3	1,000,000
C. & N.-W. R'y. Milwaukee Div'n.	1896	Swift	66	3	2.5	7.0	13			4	500,000
C. & N.-W. R'y. Milwaukee Div'n.	1897	Harrison	66	3	2.0	4.85	8			3	400,000
P., Ft. W. & C. R'y	1897-8	Harrison	66	4	3.0	15.16	20		2		750,000
P., Ft. W. & C. R'y	1898-9	Harrison	100	5	1.0	4.79	2				250,000
L. S. & M. S. R'y	1898-9	Harrison	Yards	3	2.0	20.61	2				1,000,000
P., Ft. W. & C. R'y	1897	Harrison	66	4	1.8	5.37					400,000
C. & N.-W. R'y	1897	Harrison	125	4	1.9	6.84					600,000
C. T. T. R. R.	1897	Harrison	66	2	0.4	1.98	1				130,000
St. Charles Air Line	1898	Harrison			3.0	10.77	10	1		4	2,000,000
C. & N. W. R'y	1898-9	Harrison	100	7	3.0	29.80	25			2	1,200,000
Bloomingdale Rd. C., M. & St. P. R'y	1898	Harrison	30	2	0.5	2.14	8				100,000
C., M. & St. P. R'y	1898-9	Harrison	100	4	6.0	10.72	31			9	2,040,000
C. & N. W. R'y	1898-9	Harrison	90	2	0.5	1.0	3				130,000
C., M. & St. P. R'y	1898-9	Harrison	100	2	0.7	2.0	2				230,000
C., B. & Q. R'y	1898-9	Harrison	80	4	2.3	9.46	18		11	11	500,000
C., R. I. & P. R'y	1898	Harrison	100	9	1.5	4.49	7		6		300,000
Belt R'y of Chicago	1898-9	Harrison	66	2	1.35	2.5	10				250,000
A., T. & S. F. R'y. C., M. & N. R. R.	1899	Harrison	66 66	2 2	2.0 2.0	4.65 4.65	2 1	1			225,000
A., T. & S. F. R'y	1901-2	Harrison			3.81	6.78	1	19			650,000
C., M. & N. R. R.	1901-2	Harrison	100	8	3.61	5.18	1	19			650,000
C. & A. R. R.	1901-2	Harrison			4.92	21.18	32		6	14	1,250,000
U. S. Y. & T. Co.	1903-4	Harrison			1.25	2.32		6			220,000
C. T. T. R. R.	1903-4	Harrison		9	1.25	1.79		6			220,000
P., C., C. & St. L. R'y	1903-4	Harrison			1.35	2.94	7				680,250
P., Ft. W. & C. R'y	1903-4 1903-4	Harrison Harrison			1.50	25.00	4				600,000
C. & W. I. R. R.	1904 1901 1903	Harrison Harrison Harrison	 125 400	 7 20	 2.0	 17.0	 17			 1	1,675,000 500,000 325,000
P., C., C. & St. L. R'y	1903	Harrison		1	0.5	1.5	6				200,000
C. & G. T. R'y											
U. S. Y. & T. Co.											
C. T. T. R. R.											
C. T. T. R. R.											
P., C., C. & St. L. R'y											
C. & N.-W. R'y		Harrison					Retaining wall, etc.				200,000
C., M. & St. P. R'y											
L. S. & M. S. R'y	1902-3	Harrison	200	12	0.5	2.75	3	2		1	400,000
C., R. I. & P. R'y	1902-3	Harrison			0.5	2.0		2			400,000
L. S. & M. S. R'y											
P., Ft. W. & C. R'y											
C. & N.-W. R'y	1902-3	Harrison	100	4	4.25	13.63	10				1,125,000
Belt R'y of Chicago	1903-4	Harrison		Yards	2.00	7.88	8	5			1,000,000
C., M. & St. P. R'y	1902-3	Harrison	100	4	1.5	4.0	10				800,000
G. T. W. R. R. Co.											
M. C. R. R., as lessee Terminal R. R.											
C. J. & U. S. Y. & T. Co.	1903	Harrison	200	10	0.25	2.50	1	Forty-seventh st. subway.			200,000
P., C., C. & St. L. R'y											
C. T. T. R. R.											
C., B. & Q. Ry.	1904	Harrison						Retaining wall.			225,000
C. & N.-W. R'y											
C. T. T. R. R.											
I. C. R. R. Co.											
I. C. R. R. Co., South Chicago.											
B. & O. R. R.											
N. Y., C. & St. L. R'y											
L. S. & M. S. R'y											
P., Ft. W. & C. R'y											
U. S. Y. of Chicago Chicago Junct. R'y											
C. & N.-W. R'y											
P., Ft. W. & C. R'y											
L. S. & M. S. R'y											
B. & O. R. R.											
So. Chicago R. R.											
C. & W. I. R. R.											
C., R. I. & P. R'y											
C., L. S. & E. R'y											
					82.09	390.54	300	111	22	42	$28,725,250

those which entered later was governed to a great extent by the price of real estate. The growth of the city made belt lines necessary, and the situation in 1892 was about as complicated as can be imagined. In most cities the railway terminals are grouped in certain localities; but in Chicago, on account of the location of the city on a flat prairie, there was no natural reason for such a grouping.

The question of doing away with grade-crossings had been agitated for a long time - principally by the press. A few viaducts were built at a great expense by the city for carrying streets over railway tracks.

On account of its very favorable location and because of the necessity of providing for the safest, speediest and best means of supplying transportation to the World's Columbian Exposition, the Illinois Central Railway Company saw that it would be conducive to its best interests to elevate a portion of its tracks. The exposition management contributed $250,000 for this purpose, as the elevation would render access to the grounds safer and more convenient. An ordinance was passed by the city council, accepted by the railroad and the work was completed in 1892. At the time of the exposition, there was not a grade-crossing from the old Randolph Street Station to Twenty-second Street. For about 5 1/2 miles the road is built on the shore of Lake Michigan and, as there were no streets to cross, it was unnecessary to elevate this portion. The tracks of no other railway company cross those of the Illinois Cen-north of Grand Crossing - about 9 miles from the city terminus. This condition did away with many of the greatest difficulties usually encountered in track elevation. The total cost of this elevation of eight tracks for a distance of 2 3/4 miles was approximately $I,360,000. The method employed was one of partial elevation of tracks and corresponding depression of streets. This action of the Illinois Central Railway Company doubtless exerted a great influence in favor of a movement for general elevation.

In February I892 a resolution was passed by the city council authorizing the mayor to appoint a committee of three to make investigations and report upon a means of abolishing about fifteen hundred grade crossings, which then existed in the city. This committee was appointed and consisted of an ex-mechanic, a real estate agent, and an insurance agent. The committee employed a bridge engineer, and visited several eastern cities where experiments in this direction had been made. The final report dated July, I892, made the following recommendations: I, That all tracks within the city be required to be elevated I6 feet; and 2, that in order to reduce the amount of elevating, all tracks be removed from the district bounded on the north by Kinzie, on the west by Canal, and on the south by Twenty-second Street, and that union stations be established on the outskirts of this district.

On account of its radical nature, this report naturally caused a great deal of agitation. Without doubt the elevation of tracks was the only solution of the problem; but the plan of securing this elevation was open to serious criticism. Two of the chief objections raised against it were: I, It advocated an immediate and radical change of existing conditions; and 2, it proposed to treat all railways alike without regard to locations or conditions.

Notwithstanding these objections, an ordinance was passed by the city council, February 23, 1893, requiring all steam railway tracks to be elevated sufficiently to secure a minimun clearance of 16 feet. This work was to be begun by June, 1893; one part of the work was required to be completed by January, 1895, another by January, 1897, and the entire work was to be finished by January, 1899. This ordinance required a uniform elevation and system of construction, and made the railway companies responsible for all land damages. The work did not begin as required by the ordinance. The railways merely ignored the ordinance, and the city being uncertain of its legal rights in the matter, did not attempt to force the railways to compliance.

Very little was done concerning the matter during the remainder of the year 1893; and many people both inside and outside the city council were of the opinion that the project was impracticable. Some of the arguments advanced to show its impracticability were: I. Any system would be detrimental to industries whose establishments were located along the tracks to be elevated. It would seriously cripple all manufacturing interests thus situated, and it would drive the lumber and possibly the coal business out of the city. Grain elevators would have to be reconstructed at an expense which would be prohibitive; 2. The expense of elevating would be beyond the means of the richest railway company entering the city; and rather than elevate the companies would take their depots entirely out of the city.

Now that we have seen the success of track elevation demonstrated, such arguments seem ridiculous and absurd. Such opinions were however held by many at that time. To what extent the railways were responsible for such opinions, I can not say. To illustrate the idea which seemed to be prevalent to some extent, at least regarding constructional method which would have to be employed in case all tracks were elevated as required by the ordinance, the following is quoted from the city commissioner's report for 1892.

"One objection raised by railroad men to elevating terminals to the full height on iron or steel structures is the large cost of maintenance to which they claim they would be subjected". This seems to indicate that metal structures instead of sand or gravel filling were considered as a necessary means for obtaining the required elevation. One advantage of such a method would be that the space beneath the tracks could be utilized for various purposes and this is by no means an insignificant consideration in a large city like Chicago.

The framing and passing of the ordinance was an easy task compared with that of in some way inducing the railways to comply with it. There was considerable friction in the city council during the year 1893 regarding the matter. The committee on track elevation urged the mayor, Mr. Harrison, to take steps to force the railways to elevate at once. The mayor replied (and he was sustained by the corporation council) that, since the ordinance did not provide for any method of forcing the railways to elevate, he was powerless to act. Some of the members of the council were in favor of tearing up the railway companys' tracks in case they would not elevate them. This the corporation council said would render the mayor and city liable to suit for damages.

At the close of the Columbian Exposition, John P. Hopkins was elected on a pledge to abolish grade-crossings. He sought to carry out his promise, but was confronted with very serious difficulties. The people were clamoring for immediate elevation and the railways were united in opposition to the ordinance of February 23, 1893. If force was resorted to, the railways would appeal to the courts thereby causing perhaps years of delay.

Although the railways were very reluctant to comply with the ordinance as passed, they realized the many advantages which would result to them from track elevation. Among these advantages were:

I, Saving in salaries of gatemen; 2, saving in damage suits; and 3, greater speed and facility in train movement. The chief obstacle was the enormous expenditure of money which would be necessary.

However the pressure of public opinion and various other influences began to have their effect; and some of the railways, although they would not submit to the ordinance, became conciliatory and were willing to meet the city half way.

The first company to take steps which could possibly lead to an agreement was the Pittsburg, Ft. Wayne, and Chicago R. R. A plan was submitted to the city council for elevating its tracks 9 feet and depressing the crossing streets 5 feet. Various other modifications of the plan required by the ordinance were also suggested. The plan was submitted to Mr. G. H. Ellers, then consulting engineer for the city, and he drew up a plan which was a compromise between that submitted by the railway and the one required by the ordinance. The company took no action on this revised plan.

The Lake Shore and Michigan Southern, and the Chicago, Rock Island and Pacific, which own and operate jointly about 6 I/3 miles of track from Van Buren Street to Englewood, were the first to act. They submitted a plan for the elevation of their tracks south of Sixteenth Street. This plan was very different from that required by the ordinance, and it also was modified by Mr. Ellers. The new plan was agreed to by the council, but the railway companies would not accept it. They suggested other modifications, and finally an ordinance providing for the elevation of these tracks was passed by the council and agreed to by the railways. Thus an agreement had at last been reached.

It may be well to pause at this stage and note the changes which had taken place in the ideas of promoters of track elevation. The most noticeable of these changes was in the method of dealing with the railways. The first ordinance provided for a general plan of elevation for all roads. The ordinance just mentioned provided for a special plan of elevation for one certain portion of track. The only argument in favor of a general plan was the uniform level of land in the city. In favor of special plans were the following: I. The conditions in various localities and on different roads were so different and interests so diverse; 2. Certain groups of roads had common interests and conditions; and 3. This was the easiest and in fact the only way to secure the immediate cooperation of the railways. The legal fights which would be sure to come up under the other system would cause almost endless delay.

Another change of ideas which had taken place was in regard to the maximum elevation necessary. Excepting in the older parts of the city, where real estate is very valuable and changes could not be made except at an enormous expense, a depression of the streets from one to seven feet is not especially objectionable, since by virtue of the impetus gained in the decent teams can haul the heaviest ordinary loads through a sag of four to six feet.

To return to the progress of the movement, we find that soon after the passage of the ordinance providing for the Lake Shore and Michigan Southern, and the Chicago, Rock Island and Pacific elevation, an agreement was reached with the Chicago and Northwestern for the elevation of I.7 miles on its Galena Division. Some other negotiations were begun, but nothing more was accomplished until the spring of I895 when Geo. B. Swift became mayor.

The track elevation situation with which the new mayor had to deal presented some very serious difficulties. A study of the table on page 11 will show to some extent the nature of these difficulties. It will be seen that the elevation of eleven rights-of-way would give elevated entrances to twenty-three roads.

The situation in the southern part of the city was especially complicated. The Pittsburg, Ft. Wayne and Chicago Railway was so located that it could not elevate its track except in conjunction with the Chicago and Western Indiana. The latter company however refused to elevate. Its peculiar relations with other roads made the elevation of its tracks a very difficult proposition. It receives its revenue from the rental of trackage rights to five other roads. It would not be practicable here to explain in detail the relations between this company and its tenants; but it is sufficient to say that the task of adjusting the interests of all con-

Table showing most important railways entering Chicago and manner in which entrance is made:

Railway.	Enters city via-
Atch., Top. & Santa Fe	Its own line.
Baltimore & Ohio	Chic. & Northern Pacific.
Chic., Bur. & Quincy	Its own line.
Chic. & Great Western	Chic. & Northern Pacific.
Chic., Mil. & St. P.	Its own line.
Chic., Rock Isl. & Pac.	Its own line.
Chicago & Alton	Its own line.
Chic. & Eastern Ill.	Chic., Rock Isl. & Pac.
Chicago & Erie	Chicago & Western Indiana.
Chic. & Grand Trunk	Chicago & Western Indiana.
Chic. & Northern Pacific	Its own line.
Chicago & Northwestern	Its own line.
Chicago & Western Indiana	Its own line.
Chich. & W. Mich.	Illinois Central.
Illinois Central	Its own line.
L'k Sh. & Mich. Sou.	Its own line.
Monon	Chicago & Western Indiana.
Mich. Central	Illinois Central.
N. Y., Chic. & St. L.	L'k Sh. & Mich. Sou.
Pitts., Cin., Chic. & St. L.	Its own line.
Pitts., Ft. W. & Chic.	Its own line.
Wabash	Chicago & Western Indiana.
Wisconsin Central	Chic. & Northern Pacific.

cerned, which would be necessary to secure the means with which to elevate its tracks, was a difficult one indeed. Hence, the Chicago and Western Indiana resorted to delay.

The St. Charles Air Line proved to be another obstacle to elevation in the southern part of the city. This road branches off from the Illinois Central and runs due west just north of Sixteenth Street, thus intersecting almost every road entering from the south This line is owned by several separate companies which could not come to an agreement regarding elevation. The city, however, finally brought about an agreement between these companies, which, at the close of 1894, left the Chicago and Western Indiana as the only obstacle to the elevation of most of the lines on the south side.

Some means of inducing this road to elevate must be found. The mayor decided to use drastic measures. In the fall of 1895 an ordinance was passed by the city council requiring all trains to stop, on reaching the crossing at Sixteenth and Clark Streets, and not to proceed unless signaled to do so by the flagman. This brought the Chicago and Western Indiana to terms.

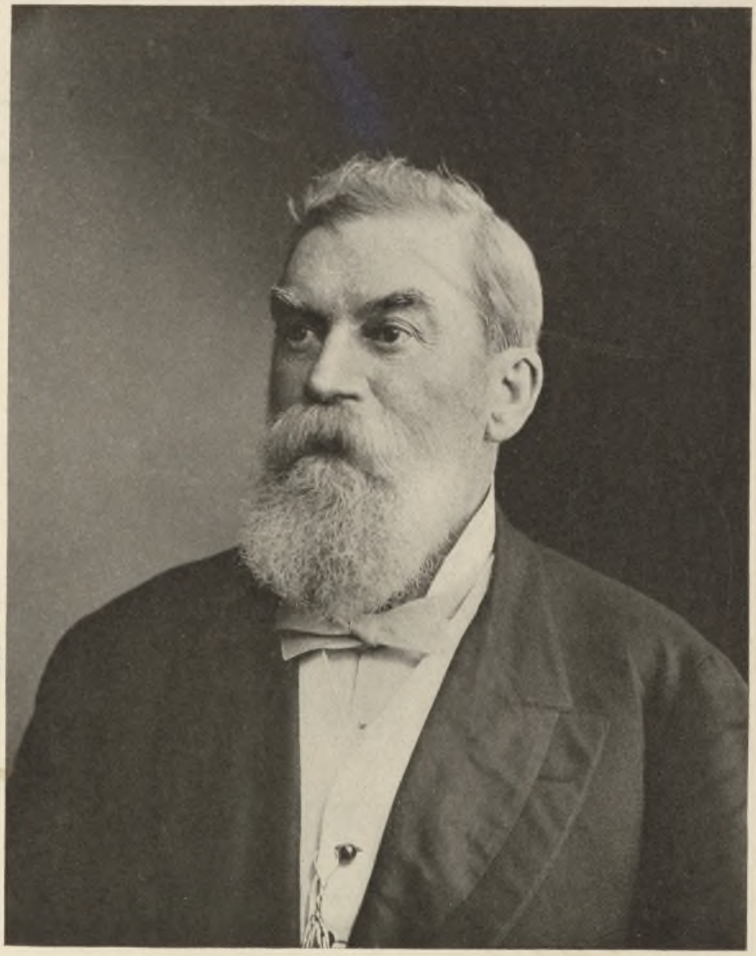
A history of track elevation during the period from 1896 to the present time would be chiefly a record of agreements reached between the various railway companies and the city, and of ordinances passed providing for the elevation of certain tracks. Of course difficulties were continually being met, but the most serious of these had been overcome.

Suffice it to say that nearly all of the tracks in the city have been elevated or their elevation has been provided for by city ordinances.

Thus in the short space of I5 years we have seen the practical completion of one of the greatest tasks ever attempted by a municipality. The expense has been enormous, but the advantages accrueing to all concerned have proven to be manifold, and these benefits will materially increase with the growth of the city. The accomplishment of this great achievement is a tribute to the energy of the Twentieth Century.

A large measure of the success of this movement is due to the tireless efforts of Mr. John O'Neill, Superintendent of Track Elevation for the city, who is commonly known as the "Father of Track Elevation".* Neither should the fair minded policy of the railway companies (which are usually accused of everything that is bad) be forgotten.

*A photograph of Mr. O'Neill is shown on page 13b.



John O'Neill

EXPERT ON TRACK ELEVATION.

Filling Material

Sand is more extensively used than any other material for the filling necessary to raise the tracks to the required height between streets. Enormous quantities of this material have been used, and we can get an idea of its magnitude by imagining a prism of sand IO to 20 feet high, 60 to 200 (and in many cases more) feet wide and miles in length.

Most of the roads obtain sand from the Indiana sand hills, near the southern end of Lake Michigan. This material, which is furnished by contractors, is almost absolutely ideal for the purpose. It is very fine, free from loam or clay, and flows into place, quickly reaching a settlement. Experiments show this settlement to be not more than one or two per cent. Its only disadvantage is that it blows about considerably and requires a covering of heavier material; but, since the settlement is slight and takes place rapidly, it is possible to ballast the tracks very soon after they have been elevated.

The Chicago and Northwestern uses a mixture of clean sand and gravel. This material is obtained from their own gravel pit at Carey, 38 miles from Chicago, It gives a solid and substantial bank at once settling only slightly and serving also as ballast.

Methods of Unloading Filling Material.

The usual and until recently the only method of unloading filling material was by hand. The sand or gravel is loaded on gondola cars by means of a steam shovel at the pit, and thirty to sixty of these loaded cars are coupled together to form a train, which is transported to the elevation site. Provision is usually made for storing several hundred car loads near at hand. As the work proceeds a number of these cars, depending upom the space to be filled, are taken and unloaded wherever desired. When the unloading is done by hand, six or eight men with shovels are placed in each car. Eight men usually unload a car containing 35 to 40 cubic yards in twenty minutes. In this way the sand is merely deposited in piles alongside the track and must be handled again.

For fairly long and straight stretches of track, the plow is a more efficient means of unloading. This method has been employed extensively by several roads including the Lake Shore and Michigan Southern, the Chicago Rock Island and Pacific, and the Chicago and Western Indiana; and is briefly as follows: Gondola cars with side doors opening outward at the bottom are used. By turning a rod which runs the length of the car on each side, the doors may be opened or closed. The ends of the cars are provided with iron aprons which may be placed in an upright position to retain the sand during transit, or, when the plow is to be used, they may be turned to the horizontal position resting upon the coupling and sliding upon each other, thus forming a floorway from one car to another. The plow is a heavy iron structure, resting on the car floor, of a width sufficient to allow it to move freely in a direction parallel to the length of the car. The face of the plow is curved in such a manner that it will force the sand out through the doors on one side. Following the plow is a small V-shaped contrivance which is heavily loaded with scrap iron and which pushes out any sand not unloaded by the plow. The frame work of the plow is provided with a strong hook to which the cable may be attached. The "rapid unloader" consists of a stationary engine operating a horizontal drum upon the surface of which is wound a wire cable. The whole is mounted on a car, coupled to the front end of a locomotive. The latter supplies steam to the unloader engine. The spreader, as its name implies, is used to spread out the sand deposited by the plow alongside the track. This machine is mounted upon a flat car and is provided with two large wings, one on each side, either of which may be lowered for use or folded back to approximately a vertical position. These wings are operated by compressed air.

The following operations are involved in this method of unloading by machinery: First, a number of loaded cars, usually from ten to twenty, are taken from the storage tracks and attached to the front end of the unloader. Second, the cable is drawn over the tops of the cars. This is accomplished by hooking the end of the cable to a rope which spans the track at a height sufficient to allow the sand cars to pass. The ends of this rope are attached to heavy upright timbers 10 or 15 feet high placed one on each side of the track. These posts are set at the most convenient place. If a large yard is being elevated, as is often the case when this method is employed, they will be set on either side of the main lead. The train is pulled along under the transverse rope, and the cable unwinds from the drum until it rests on the tops of the cars for the entire length of the train. Third, the car carrying the plow is coupled to the front sand-car and the cable is hooked to the plow. Fourth, this train, preceded by the spreader and its engine, is pushed on to the sand track, from which the material is to be unloaded. Fifth, the sand is plowed off. The entire train and the plow move in the same direction at the same time, the speed of the train being two or three times that of the plow. This is necessary to prevent the sand from accumulating in sufficient quantities to foul the track.

In order that this method may be efficient the sand track must be long enough to permit the train to be unloaded in one operation. This is the condition which limits the usefulness of this method. Only ten or fifteen mem are needed when this method is employed.

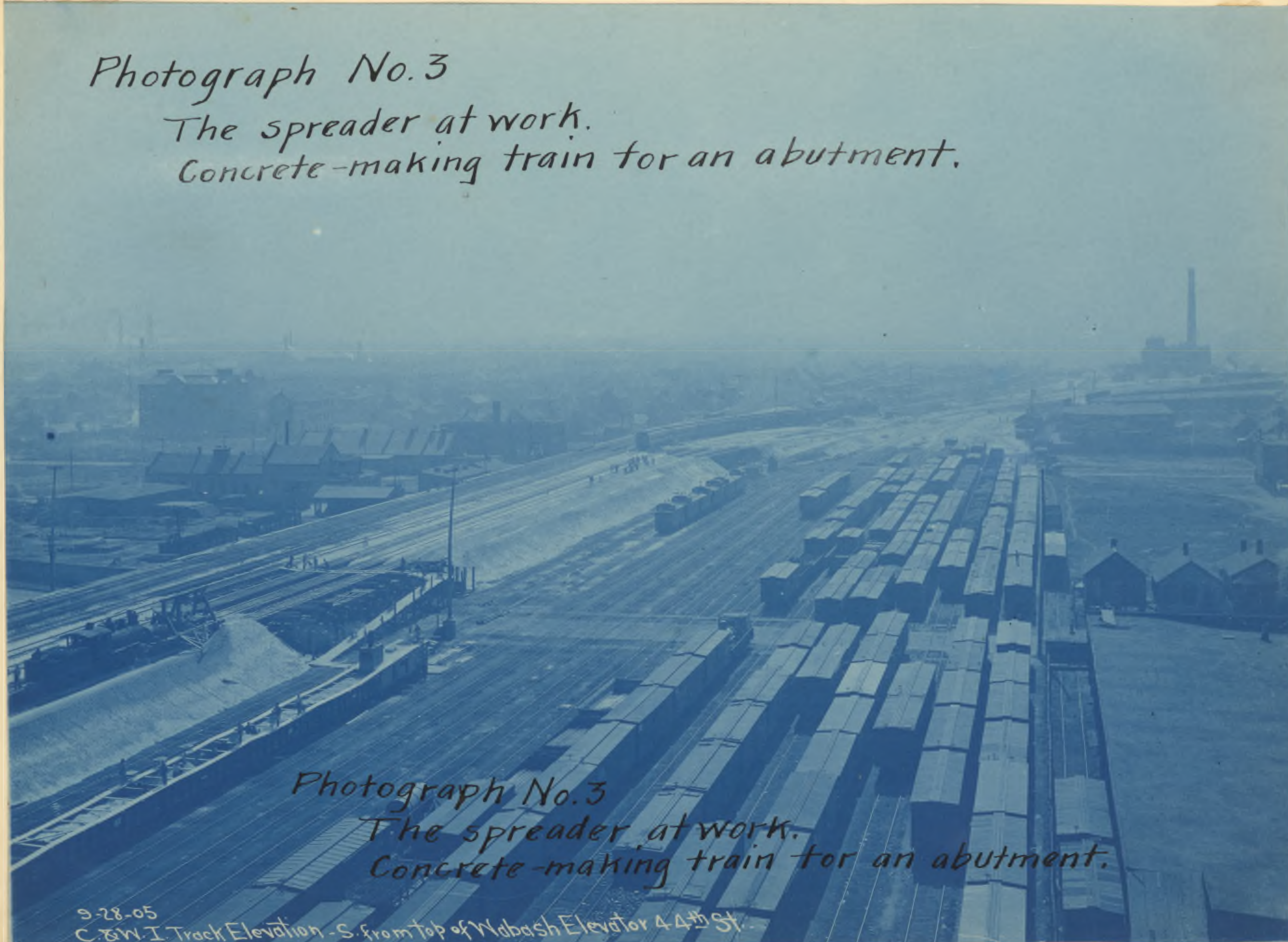
Probably two hundred men would be necessary to do the same amount of work in the same length of time by hand. Delays, owing to derailment of cars, accidents to the unloader, etc., frequently occur; but, nevertheless, for long straight stretches of track, the plow is the most efficient means of unloading sand.

Photograph No. 1, page 19 illustrates the operation of the plow, Photograph No. 2, page 20 shows the unloader at work, while on the extreme left of Photograph No. 3, page 21. may be seen the spreader with one wing down and leveling off the sand pile just unloaded by the plow.

These views of the Chicago and Western Indiana elevation were obtained through the kindness of Mr. M. K. Trumbull, Principal Assistant Engineer.

Photograph No. 1
The sand plow at work.
C. & W. I. Track Elevation.

Photograph No. 2
The unloader at work.
C. & W. I. Track Elevation.



Photograph No. 3
The spreader at work.
Concrete-making train for an abutment.

General Method of Procedure.

The necessity for the continual uninterrupted maintenance of traffic complicates greatly the task of elevating tracks, and requires great ingenuity and foresight on the part of those in charge of the work. The plans adopted differ, in details at least, on every road, due to the variation in conditions and also to the personal preference of the engineer in charge. The same general plan has, however, been followed in almost every case and this is briefly as follows.

The first step usually is the construction of retaining walls when needed. This work is sometimes completed months before the real work of elevation begins; or it may be carried on simultaneously with, but in advance of, the dumping of material. The object of these walls is to keep the filling material within the company's right of way. If the right of way extends some distance beyond the space occupied by the tracks, or if the outer tracks are not elevated, one or both of these walls will not be necessary. The masonry abutments for supporting the girders at street crossings are usually not built until after the tracks have been elevated, but the foundations for these are often completed before the dumping of material begins. Many other preliminary operations, such as a change in the arrangement of tracks to facilitate the work of elevating, may be necessary.

The actual work of elevating now begins. The filling material, usually sand or gravel, is hauled in cars to the site, where it is unloaded either by hand or machinery. The tracks are raised in various ways. They may be gradually elevated upon the filling material by means of jacks; they may be drawn up the bank in sections by a derrick; or the tracks may be torn up and relaid upon the completed bank. Usually only one or two tracks are disturbed at the same time, the others being left for traffic. While the tracks are being raised on either side of a street, men must be employed in providing some sort of an arrangement, usually of a temporary nature, for carrying the tracks across the street. This work may consist of the construction of pile bents surmounted by caps and stringers, or temporary, usually pile, abutments may be constructed to support the permanent steel girders.

As soon as a track is elevated, it is usually used first as a work track but in some cases it is immediately turned over to traffic.

Care must be taken to avoid excessive grades and the continual shifting of traffic requires continual track changes, both in advance of, and in the rear of the elevation.

Methods of Advancing Elevation.

It will not be possible to describe all the methods employed in elevating tracks. Only general descriptions of a few of these will be given.

Illinois Central R. R.

The elevation of the main line of the Illinois Central was, as previously noted, completed in 1893. The ordinance provided for the construction of a roadbed of sufficient width to carry ten tracks. The method adopted was as follows.

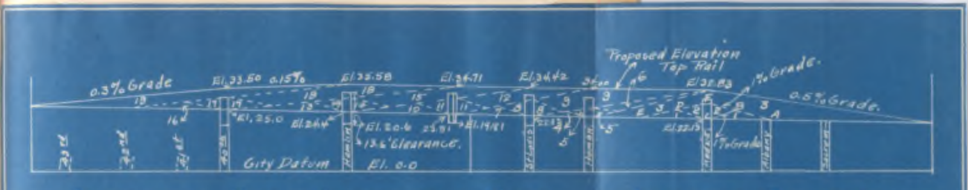
An embankment of sand was first built on the extreme east side of the company's property. This embankment was raised as high as possible and a track was laid upon it. It was necessary to keep the streets open to traffic and , hence, these were left at grade for some time - the tracks reaching the street level by steep gradients. Finally pile and timber trestle work was constructed at these street crossings and the track was connected on the same. The filling was widened to the west; and, as fast as required, additional lines of trestle work were built across the streets.

Chicago and Northwestern R. R.

Galena Division. The first elevating done by the Chicago and Northwestern R. R. consisted of 1.85 miles of five-track railway on its Galena Division.

The method of filling adopted on this work was quite unique and is illustrated by Fig. 1, page 26. The solid lines represent respectively beginning at the bottom the city datum, the original grade of the tracks, and the grade after elevation. The broken lines are boundaries of various sections of the filling, the numbers thereon indicating the order in which these sections were built. Thus triangles 1 were first built, trains of sand hauled to these positions and the tracks being raised gradually until the grade ABCDE had been secured. This grade offered no serious obstacle to traffic. Through plate girders for the two outside and center tracks, complete with floors, tracks etc., were brought, loaded on jacks on flat cars, and hoisted to the partial elevation F, where they rested on piles, driven at each end. During this operation, the tracks on either side of the center were left unobstructed. The triangles 2 were now filled in (on account of the small quantity only one day being required for this filling) and the grade ABFDE obtained. Bridges for the remaining two tracks were placed upon their supporting piles. Prism 3 was next filled in, the girders at Kedzie Avenue raised to their full grade, girders erected at Holman Avenue, triangles 4 and 5 filled in and so on, as shown by Fig. 1, page 26, until the work was completed.

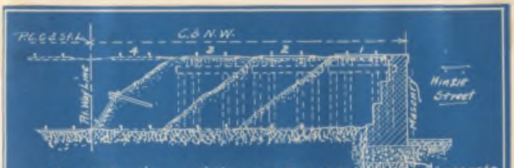
Galena Division - Kinzie Street. The elevation of the tracks of the Chicago and Northwestern R.R. from Kedzie Avenue to Ada Street, a distance of 2.4 miles, was completed in 1905.



— CONSTRUCTION PROFILE ILLUSTRATING METBOD OF ADVANCNG ELEVATION —

—C&N. W. RY. — GALENA DIVISION —

Fig. 1.



CROSS-SECTION OF FILLING AND FALSE WORK

C.& N.W. RY. — KINZIE ST. — 1905

Fig. 2.

The work on the retaining walls having advanced sufficiently, the elevation of the main tracks, eastward from Oakley Avenue, began. Beginning at the north side, one track was elevated at a time. The method employed is illustrated in Fig. 2, page 26 The north track originally occupied the position shown by the broken line, immediately under track No. 2.

While a track pile-driver was engaged in driving piles for the temporary trestles for tracks No. 1 and 2 at Leavitt Street, sand trains were run upon original track No. I, on the west side of Leavitt Street. The material was unloaded and the track was raised and thrown over, as the raising progressed, to the present position of track No. I.

Meantime, the pile driver had completed its duties and as soon as it had moved out of the way, original track No. 1 was "cut" east of the bridge and raised and lined over to the present position of track No. 1.

The approaches to the Leavitt Street bridge were now rapidly filled in, the piles were cut off, surmounted by caps and stringers, and track No. 1 was connected up and carried across the bridge. Sand trains were run over track No. 1, unloading material for the space between Leavitt Street and Hoyne Avenue; also other sand trains backed in upon No. 1 east of Hoyne Avenue, the material was unloaded and the track raised and lined over as before. Thus track No. 1 was elevated, working east from street to street.

As soon as track No. 1 was elevated, piles for the third track were driven, the second was abandoned and tilted upon edge against the fill. Sand trains were run upon the now elevated No.1 and material for raising No. 2 was unloaded. As soon as the bank had been sufficiently widened, 30 foot sections of track No. 2 were lifted to the top of this bank by means of a derrick mounted on a car on track No. 1. These sections were then connected up, the track surfaced and carried across the various streets on temporary trestles which had previously been constructed. Thus track No. 2 was elevated for the entire distance. It was now used as a work track for elevating No. 3, and No. 1 was turned over to the transportation department.

The process of elevating No. 3 was the same as that employed for No. 2. Owing to the proximity of the Pennsylvania tracks, No. 4 could not be elevated at that time. Therefore the track was turned up on edge to keep the sand from running onto the Pennsylvania's right of way - see Fig. 2, page 26.

In the elevation work, grades as high as 5% were used. Passenger trains were, however, not allowed to use a track having a greater grade than 2%.

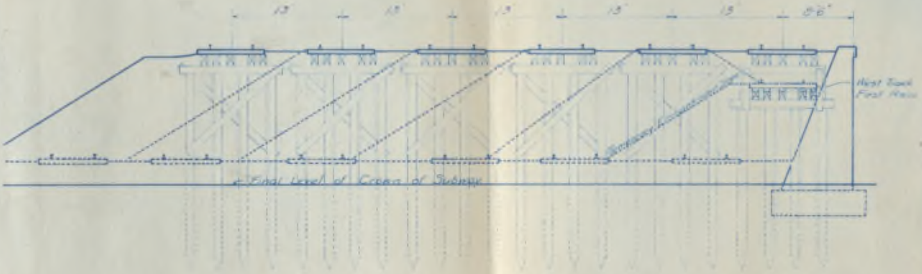
Chicago and Western Indiana R.R.

The method just described is essentially the same as that employed in all cases where the work was prosecuted vigorously, within the last few years


Photograph No. 4.
A section of track
ready to be hauled
up the bank.
CHICAGO
Photograph No. 4
A section of track ready to be
hauled up the bank.
Inbound freight thrown on elevation 6-29-03-
Out " passenger " " " 7-1-03-
In " " " " " 7-6-03-
Old Englewood Yard lead taken up across street 7-6-03-
6G 7-7-03 C. & W. I. Track Elevation-looking south at 67th St.-

Fig. 3, page 30b, shows how the work progressed on the Chicago and Western Indiana R.R. It will be noticed that the first track was not elevated immediately to its full height. This plan was not adopted in all cases, owing to the large number of subways; but where practicable it was found to be advantageous, as providing a basis for dumping the material on the side for the next track. Later the sand was unloaded from the elevated second track and the first was brought up to the proposed height, 12 by 12 inch timbers, placed one above the other upon the caps of the trestles, being used for obtaining the elevation at street crossings. The remaining tracks to the east were elevated in much the same manner as was done on the Kinzie Street elevation of the Chicago and Northwestern R.R.

Instead of elevating each track for the entire length, the territory to be elevated in any one season was divided into several so called "reaches". As soon as one reach (a length of two or three blocks) had been completed as far as the dumping of material was concerned, the work upon the next reach was begun, the tracks being raised successively from the west to the east side of the right of way. On a portion of the work north of Fifty-ninth Street, the elevation was made in two lifts, all tracks being first elevated to half the required height and later to the full height. Additional caps were used on the trestling for obtaining the second lift. This complicated matters greatly, but it de-



TRACK ELEVATION

C. & W. I. R. R.

Typical Cross-Section of Subway Showing Method of Elevating Tracks.

Scale 1" = 10'

Engineers Office, Jan 28 1904.

Fig. 3.

creased the cost of the work about 28%.*

St. Charles Air Line R.R.

The St. Charles Air Line R.R., as was mentioned in the historical sketch, is a two track road extending west from the Illinois Central tracks to the South Branch of the Chicago River, and is located just north of Sixteenth Street. The following somewhat novel method of elevating was employed.

†The original tracks of the St. Charles Air Line were located generally on the south side of the right of way. The retaining walls were constructed on the extreme borders of the property. Because of the location of the tracks, the north retaining walls were built without interferring in any way with traffic. As fast as sections of the wall were completed together with the adjacent ends of abutments at the several streets and alleys which were crossed by the Air Line, a trestle work was constructed to carry an elevated track on the extreme north line of the Air Line property. This was completed to a connection with an elevated track over Clark Street, without stopping traffic on the southerly of the two original tracks on the surface of the ground. At the same time certain sections of the south retaining wall had been con-

* The author obtained the above information from an article in the Railway Age. The reasons for this decreased cost were not given.

† Taken from an article by Mr. H. W. Parkhurst in the Journal of the Western Society of Engineers, Dec. 1898.

structured and the foundations for the greater portion of the southerly wall had been put in. The traffic was then changed to the elevated track, while the remaining sections of the south retaining wall and the unfinished portions of the street and alley abutments were being completed. As soon as the trestle work was constructed along the north side of the Air Line, the work of filling was begun. Slag was used for this purpose. It was received in the ordinary gondola cars and also in side dumping cars; and very shortly after the elevated track was put in operation for the business of the Air Line, the space beneath this track was entirely filled with slag, and, from time to time, the stringers and caps were removed from the trestle work and the filling was widened out to receive the remaining tracks.

Chicago, Milwaukee and St. Paul R.R.

The general method employed by the Chicago, Milwaukee and St. Paul R.R. was as follows.

* The sand for forming the embankment was received in gondola cars and unloaded by hand. The track to be elevated was "jacked up" three or four feet, and supported on piles of sand or on stakes, and the sand was then thrown on it from a train on an adjoining track. The timber trestles at the subways were built to the temporary height of the track, and the track connected across them,

* Taken from an article by Mr. W. L. Webb in the Journal of the Western Society of Engineers, Oct. 1898.

and the sand trains were run on it. The adjoining track was then raised as high as possible without interfering with the other tracks and the process continued until all the tracks had been raised to the desired height.

Retaining Walls.

Several types of retaining walls were built by the various roads. A few of these will be considered and the method employed in their construction will in some cases be described.

Fig. 7, page 38, shows the form and dimensions of a stone wall constructed on the Kinzie Street elevation of the Chicago and Northwestern R.R. A steam shovel was used in excavating the trench; and concrete making trains, each consisting of a concrete mixing machine followed by cars of cement and crushed stone, were used in putting in the foundation course. Later a track was constructed on top of the concrete; and derrick cars mounted on this track, lifted the stones from gondola and flat cars and set them in place in the wall. The stones were obtained from the company's own quarry.

The concrete wall used by the Pennsylvania R.R. on its work done in conjunction with the Chicago and Northwestern is shown in Fig. 8, page 38. Concrete making trains were used, the concrete being hauled in wheel barrows from the mixer up an incline and dumped into the forms.

Photograph No. 5, page 35, shows the footing course of a wall on the Pittsburg Ft. Wayne and Chicago R.R. with the sheet piling still in place, while Photograph No. 6, page 35, gives a good idea of


Photograph No.5-
P.F.W.&C.Ry.
Foundation - Retaining Wall.
P.F.W.&C.RY.
CHICAGO TRACK ELEVATION
39TH. STREET LOOKING NORTH.
SEPT. 30TH 1904.


Photograph No.6-
P.F.W.&C.Ry.
Retaining Wall.
CHICAGO ORNAMENTAL IRON CO
P.F.W.&C.RY.
CHICAGO TRACK ELEVATION
37TH ST. LOOKING NORTH
SEPT. 30, 1904

the appearance of the completed work. Concrete was used throughout. The front of the wall is vertical while the back is stepped.

The typical Chicago and Western Indiana retaining wall is shown in Photograph No. 7, page 37. On the right may be seen the concrete-making train used in the construction of this wall. The front was made vertical the back being given a batter. A mortar face for all exposed surfaced was applied to the form immediately before the concrete was deposited.

Fig. 6, page 36b, shows the cross section of a retaining wall built by the Lake Shore and Michigan Southern, and the Chicago Rock Island and Pacific on their joint work. The foundation is of concrete, while the wall itself is first class rubble masonry.

The form and dimensions of retaining walls built by the Chicago Milwaukee and St. Paul are shown in Fig. 4, page 36c. Reinforcing bars were used as shown. A 4-inch pipe through the wall provided drainage.

Fig. 9, page 38, is a cross section of the typical wall built by the Chicago Junction Railway. The concrete consists of screened and washed gravel and sand - two parts of the former and one of the latter. This comes artificially mixed on the cars in this proportion. The method of handling is thus simplified for the reason that the entire contents of each car can be used up independently of the others. On other work the stone and screenings are

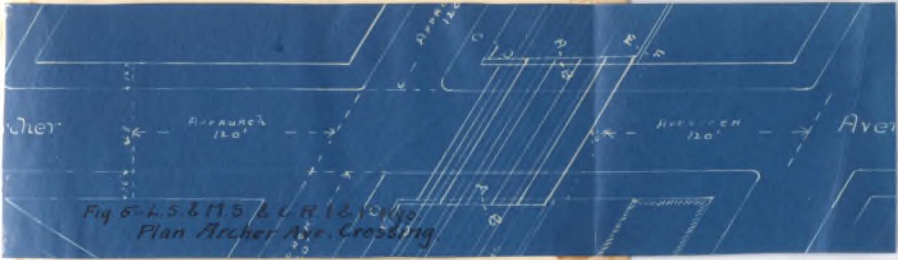


Fig. 6 - L.S. & M.S. & C.R.I. & P. Rys.
Plan Archer Ave. Crossing

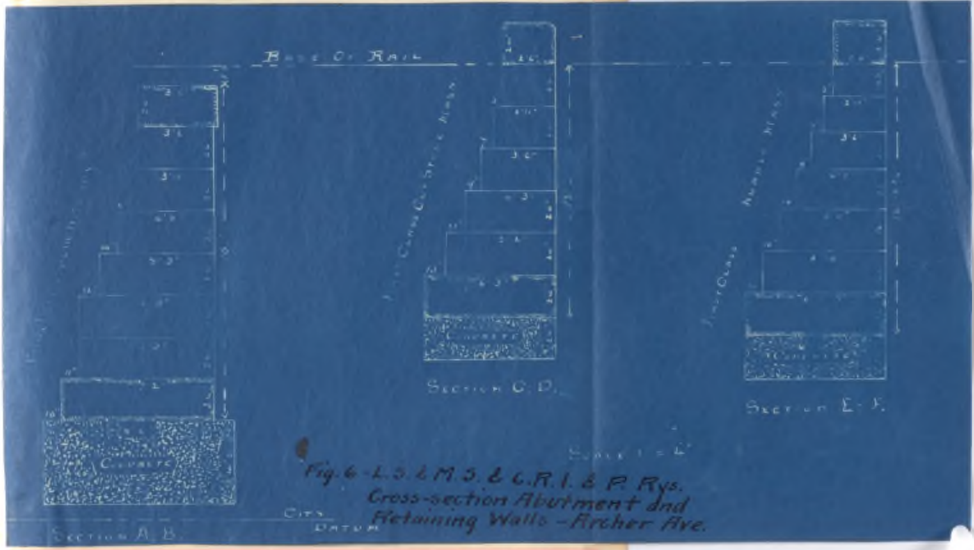


Fig. 6 - L.S. & M.S. & C.R.I. & P. Rys.
Cross-section Abutment and
Retaining Walls - Archer Ave.

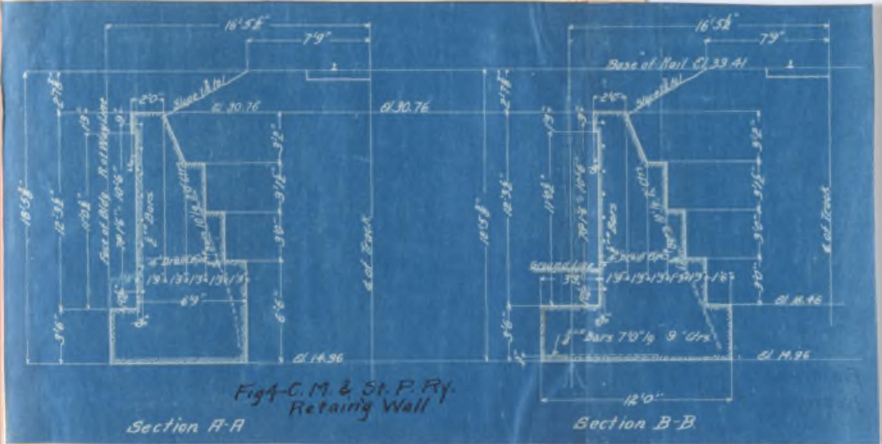
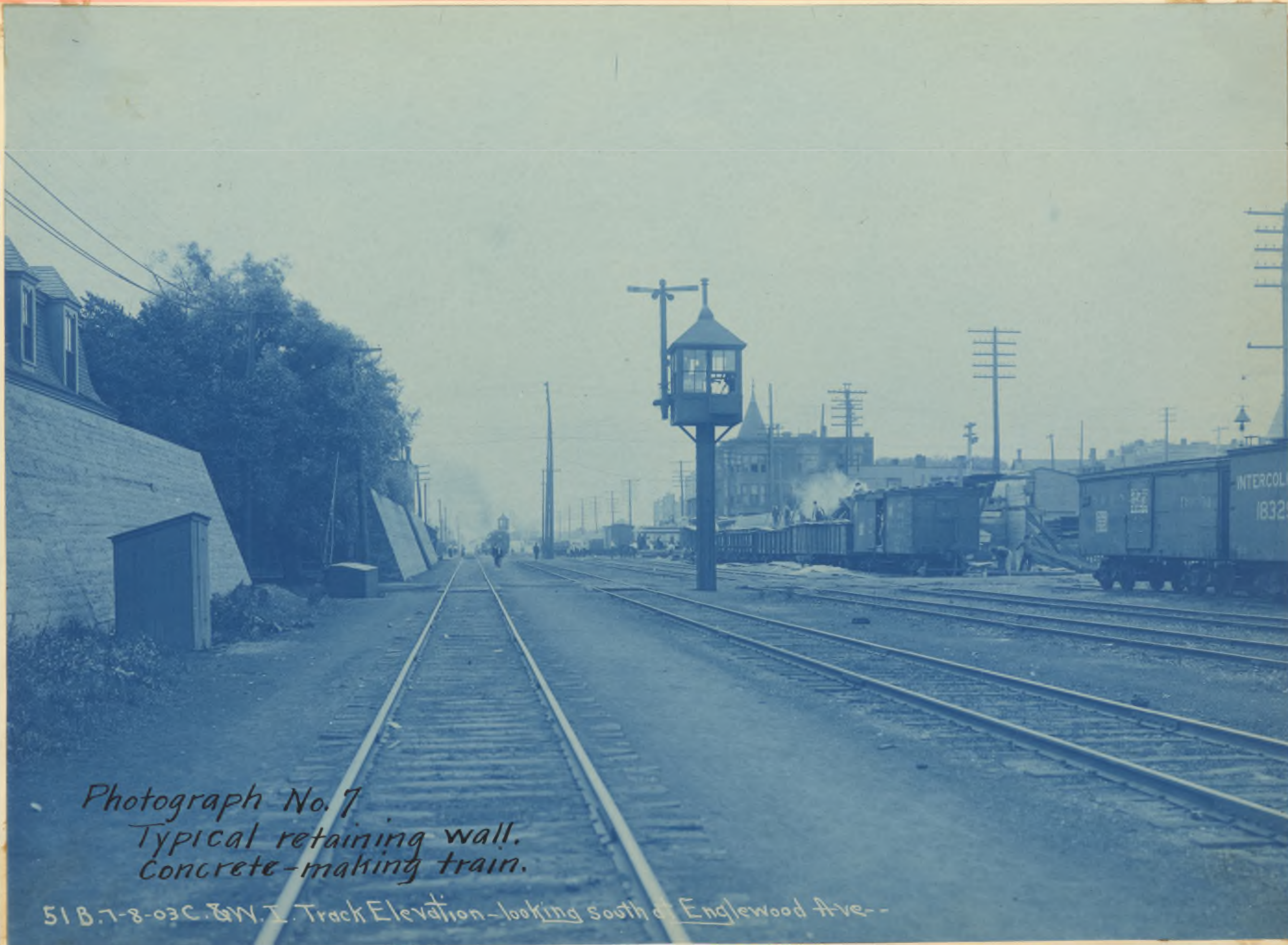


Fig 4 - C. M. & St. P. Ry. Retaining Wall


Photograph No. 7
Typical retaining wall.
Concrete-making train.
51 B. 7-8-03 C. & W. I. Track Elevation - looking south of Englewood Ave--
INTERCOL

kept in separate cars, necessitating a great deal of train service to keep the concrete-making train supplied with the materials in the right proportion.

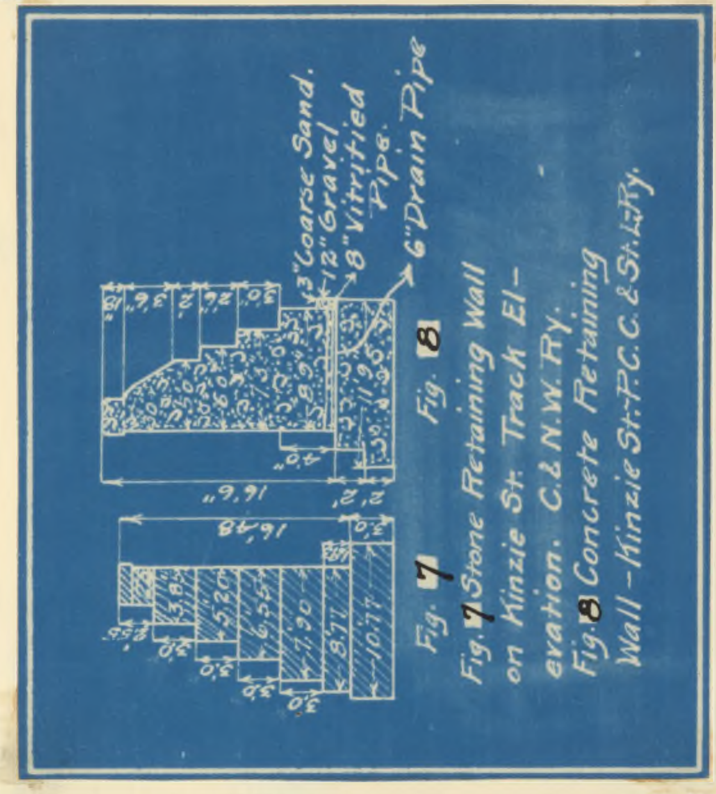


Fig. 7 Fig. 8

Fig. 7 Stone Retaining Wall on Kinzie St. Track Elevation. C.& N.W. Ry.

Fig. 8 Concrete Retaining Wall - Kinzie St.-P.C.C.& St.L.Ry.

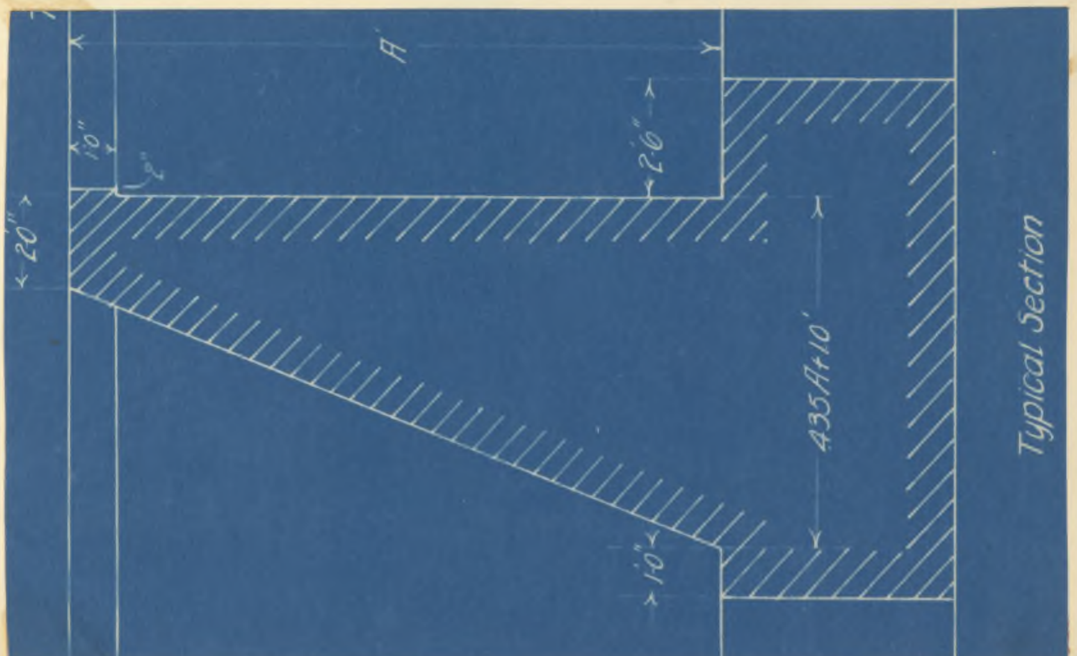


Fig. 9. Chicago Junction Ry. Retaining Wall.

Bridges.

When temporary bridges are first put in, the type shown in Photograph No. 8, page 41, is usually employed. This structure consists of pile bents surmounted by caps and stringers.

Plate girders have been used in all cases for spanning streets. A variety of types have been used and some interesting designs, intended to meet the requirements of a structure of this nature, have been made. Both through and deck girders have been used, the former being prefered in most cases. The ordinary deck girder decreases considerably the overhead clearance at subways; and is for that reason objectionable. On the other hand, it is undesirable that the girder should reach high above the tracks because of accidents which are liable to occur on account of the small clearance between the girder and passing cars. A combination of these two general types has been resorted to in some cases.

Particular attention has been paid to the girder floor. It is desirable that the bridge shall be economical, tight and free from noise. The way these elements were obtained will be seen from the following description of a few of the bridges used on this work.

On the accompanying drawings*, page 40, is shown the standard bridge used in some of the early work. This is an ordinary through

* From Report of the Department of Track Elevation, 1900.

DEPARTMENT OF

TRACK ELEVATION.

REPORT FOR THE YEAR 1900.

To the Honorable the Mayor and Common Council
of the City of Chicago.

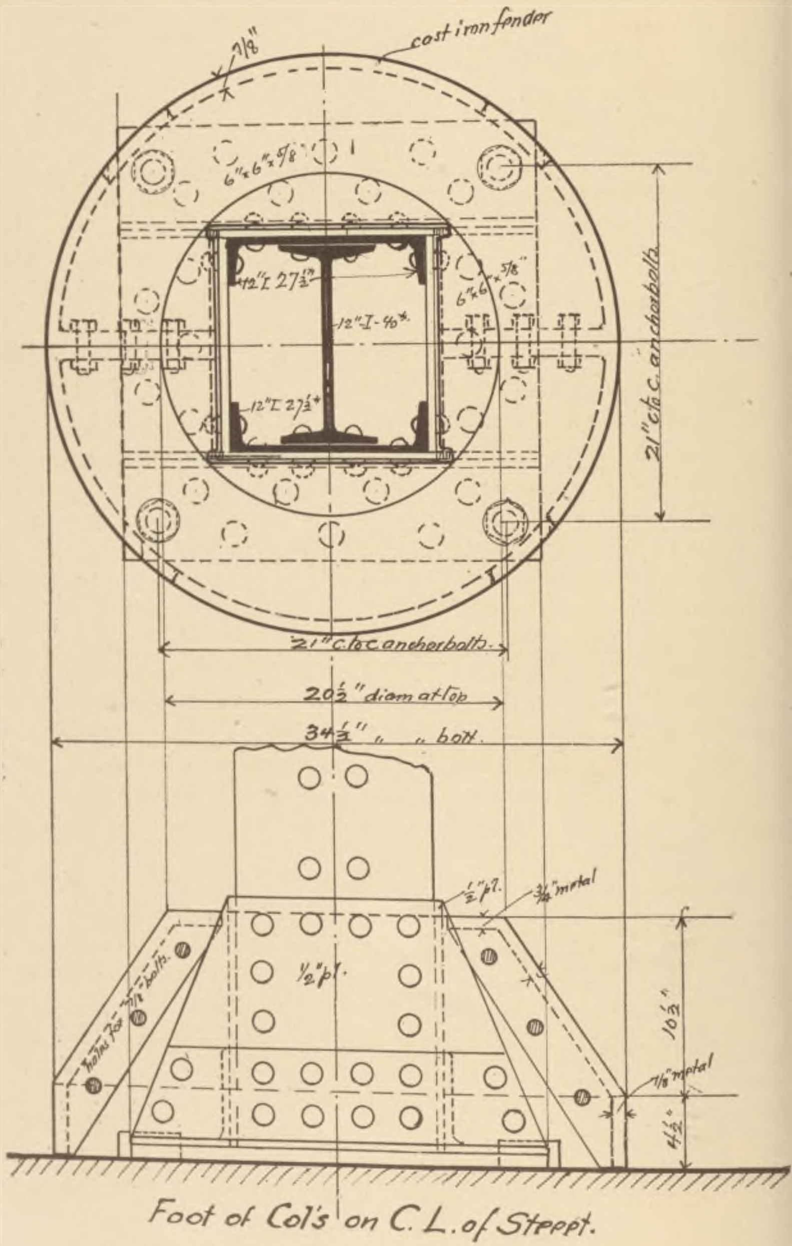
GENTLEMEN :

We are highly gratified at the wonderful progress that has been made in the elevation of the roadbed and tracks of the several railway and railroad companies having their terminals within the corporate limits of the City of Chicago, since the first agitation of the question in the year 1890, and the commencement of the first work in the year 1892.

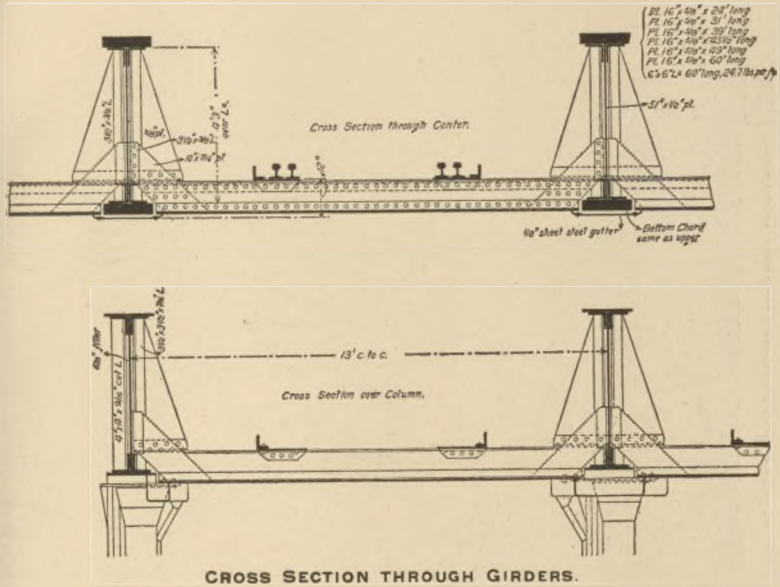
We think it highly proper that a statement of the character of the work done and material used in the elevation of the tracks should be made at the present time.

The right of ways of the several railroads are of different widths, from 66 to 200 feet, and in some cases even more. The minimum clearance, or head-room, required in subways is 12 feet, and the maximum 13.5 feet. The length of subways between portals is the right-of-way lines. The structural material used for bridges or viaducts is steel throughout; character of bridges or viaducts, through plate girders; character of floor system, solid; bridges proportioned for a dynamic load, assumed to be a train, weighing 3,600 lbs. per lineal foot, hauled by two standard eight-wheel engines, each engine, with its tender, weighing 220,000 lbs., concentrating a weight or load of 96,000 lbs. on a fixed or driving wheel base of 8 feet 6 inches. Height of abutments from bottom of footing course to bridge seats is 18 feet; depth or thickness at footing course, 8 feet; depth or thickness at ground line seats, 6 feet 3 inches; depth or thickness at line of bridge seats, 3 feet 6 inches; depth of bridge seats, 2 feet each. Distance from surface of bridge seat to grade or base of rail is 1 foot 6 inches; total height of abutment from bottom of footing to grade or base of rail, is 19 feet 6 inches.

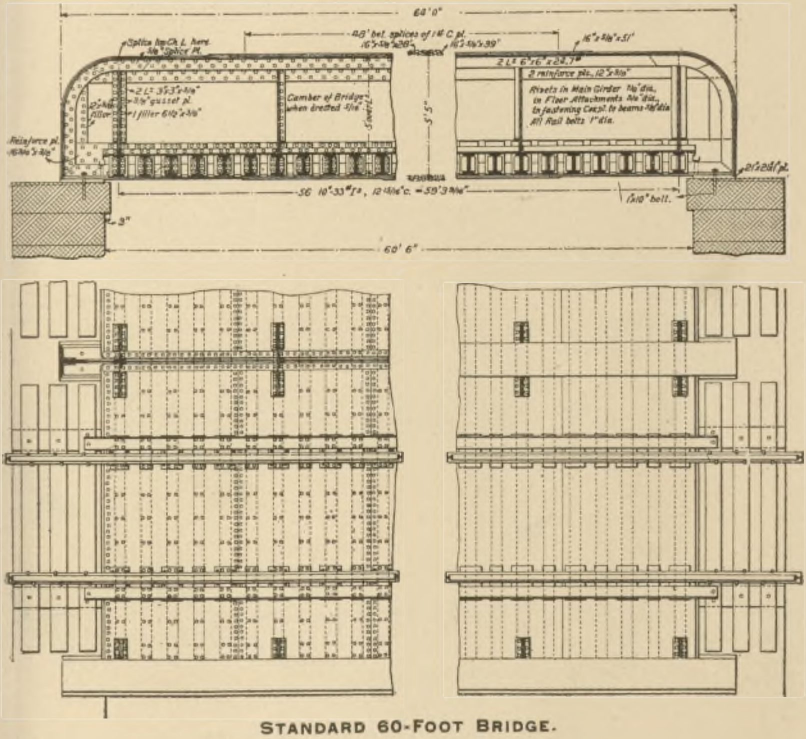
Structural material in abutment, footing course, is concrete; body of abutment above footing course, sound hard limestone, Berea stone or concrete. All of said materials have been used in Chicago elevation. (See pages 6 to 12 and 16 for drawings, and close of Report for photo views of construction.)



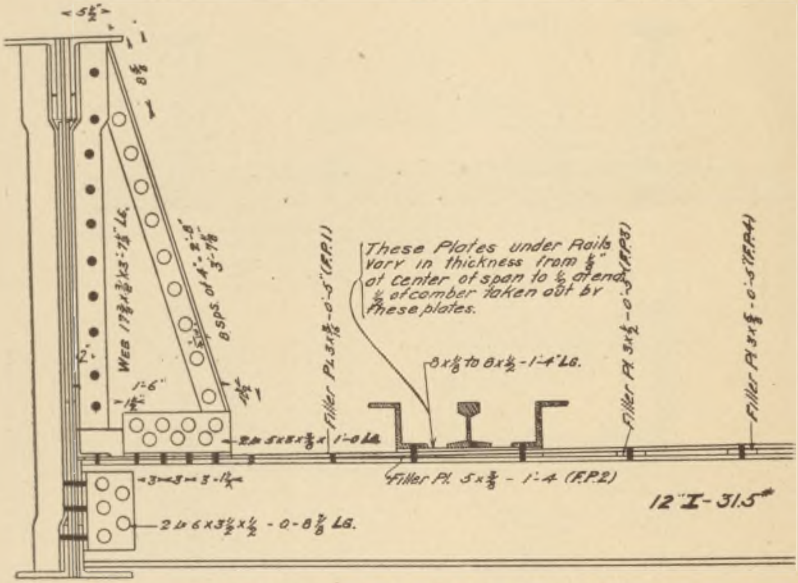
DETAILS OF FOOT OF CENTER COLUMN OF DECK BRIDGES.



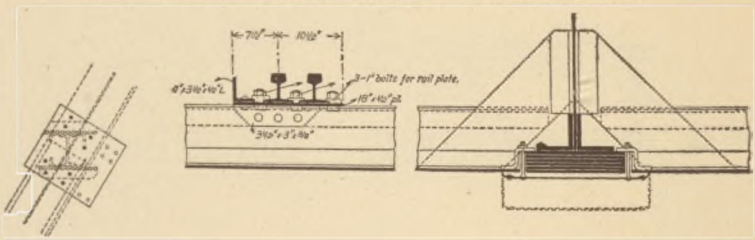
CROSS SECTION THROUGH GIRDERS.

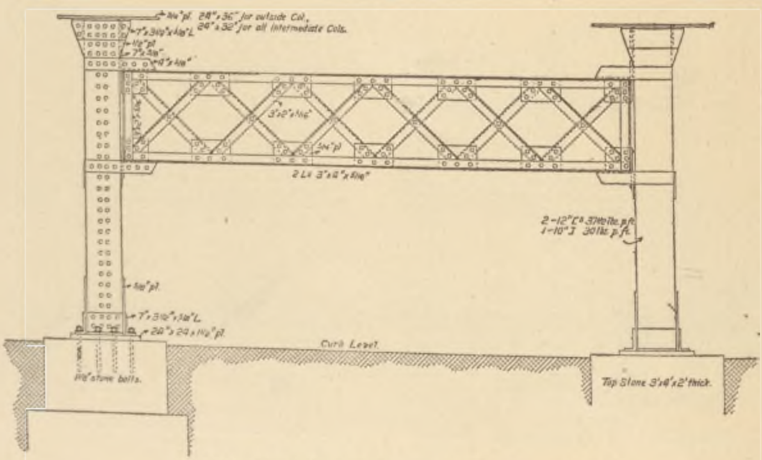


STANDARD 60-FOOT BRIDGE.

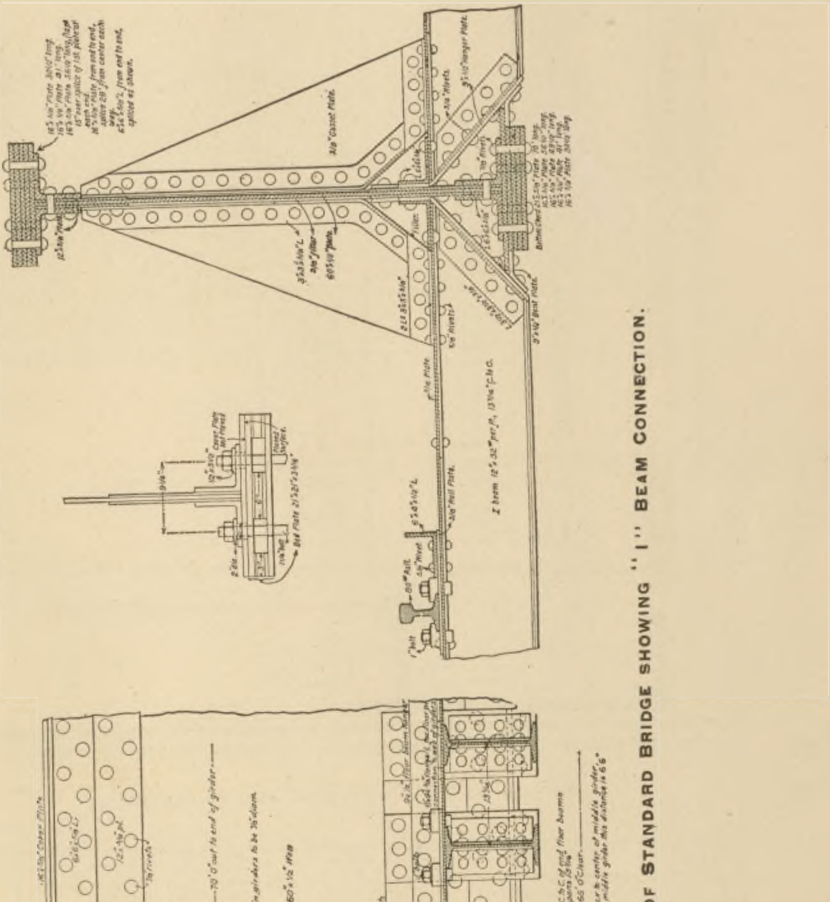


HALF CROSS-SECTION OF GIRDER OF BRIDGE FLOOR.

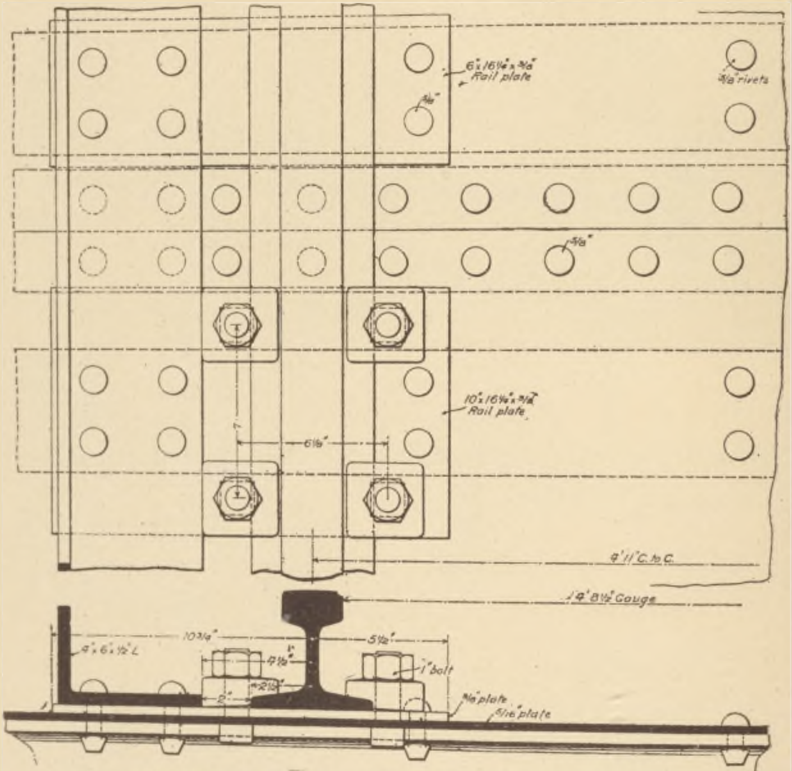




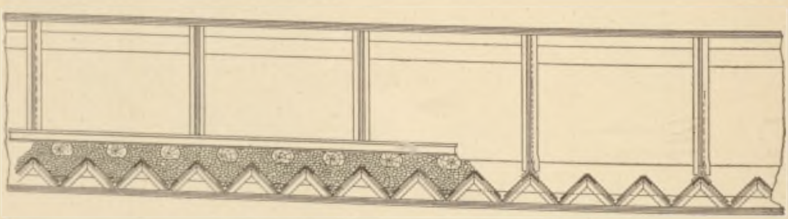
DETAIL OF GIRDER WEBB CONSTRUCTION.



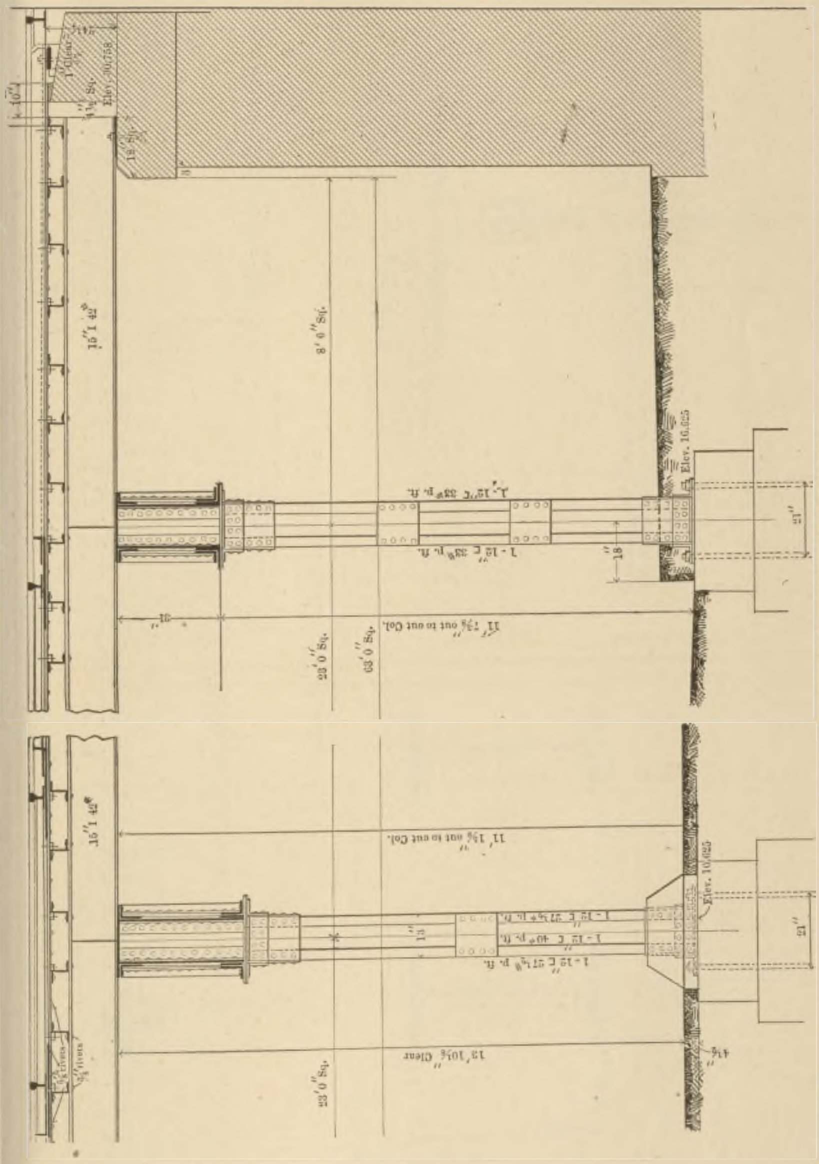
DETAILS OF STANDARD BRIDGE SHOWING "I" BEAM CONNECTION.



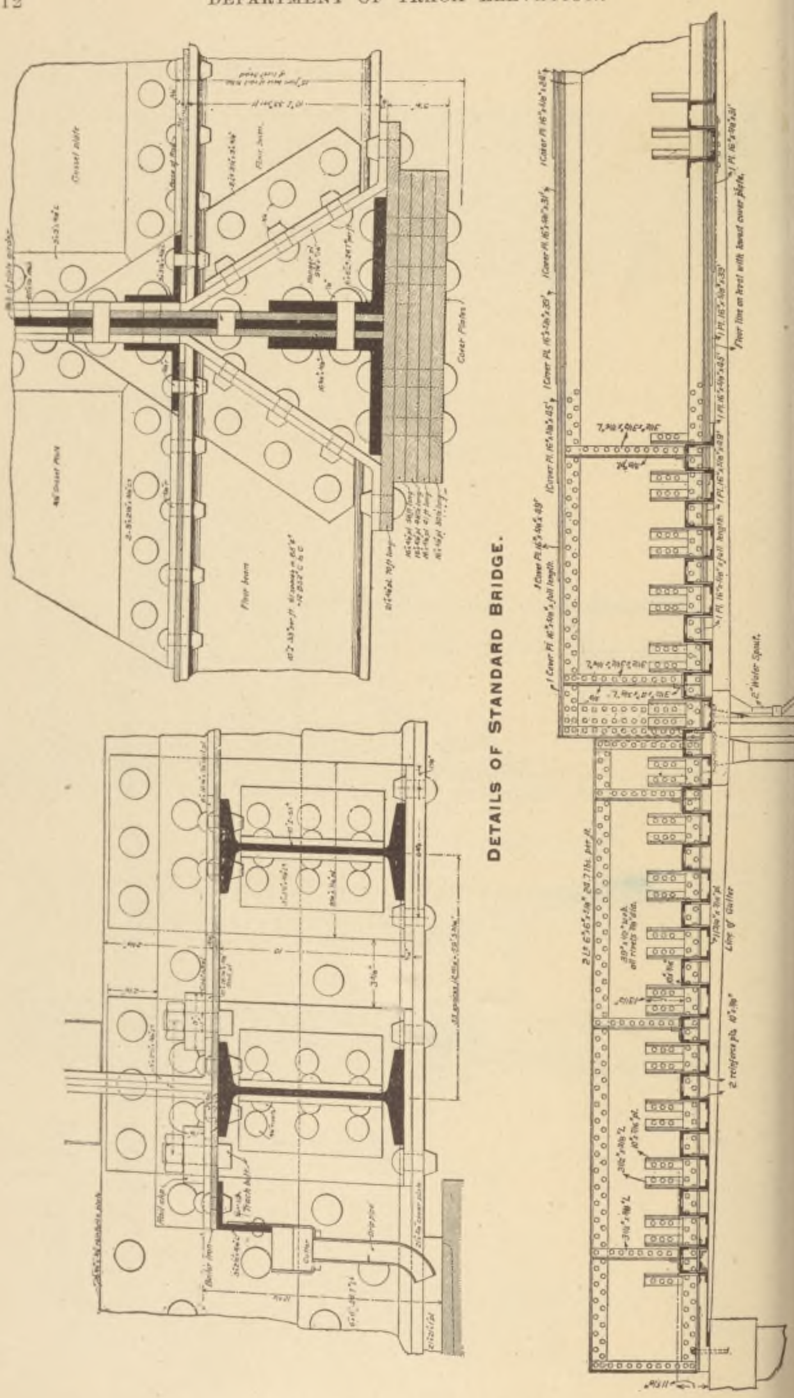
DETAILS OF RAIL FASTENING AND GUARD ANGLE.



LONGITUDINAL SECTION OF CROSS SECTION OF BRIDGE FLOOR.



DETAIL OF DECK BRIDGE.



DETAILS OF STANDARD BRIDGE.

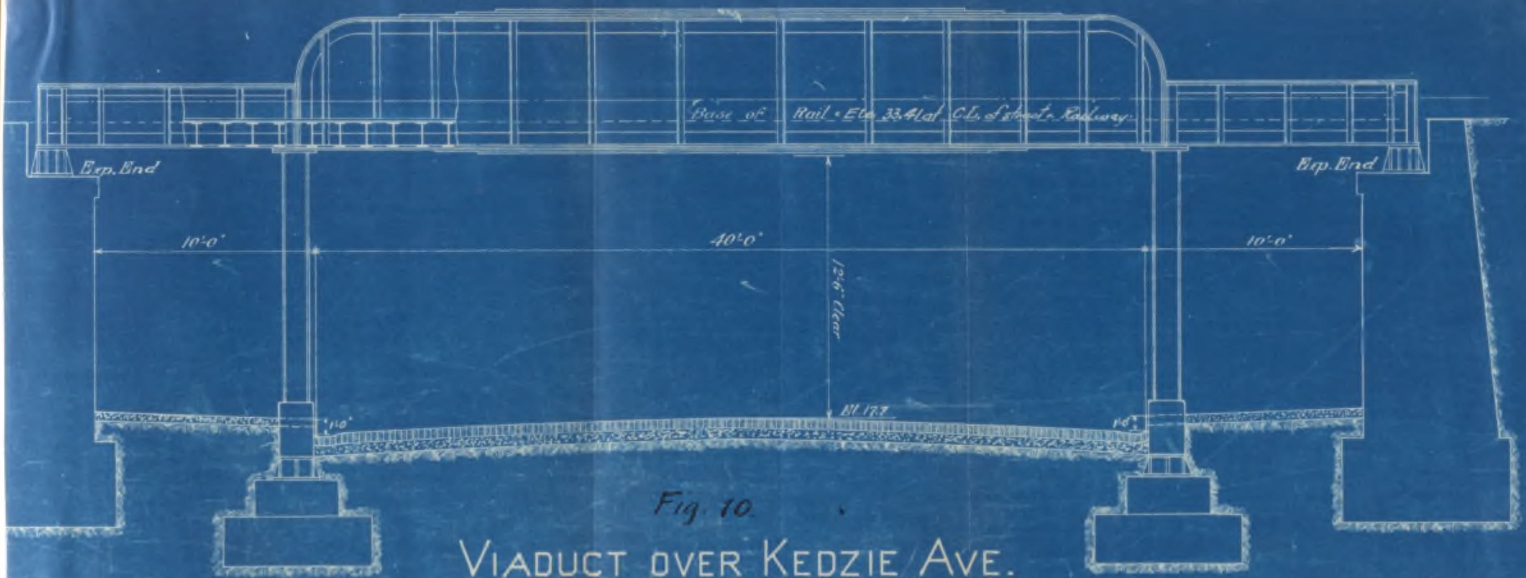


Fig. 10.

VIADUCT OVER KEDZIE AVE.

AT 90° WITH THE STREET LINE.

Scale: 1/4" = 1'-0"

Photograph No. 8
Temporary Trestle.

In Frgt thrown on Elev. 8-18-03.
Out Pass " " " 8-21-03 } Gauntlet.
In " " " " 8-21-03 }

32D.8-22-03. C. & W.I. Track Elevation - looking west on 63rd St.

plate girder with floor constructed of I-Beams, and presents no especially new features. This type was used extensively by the Lake Shore and Michigan Southern, the Chicago Rock Island and Pacific, and several other roads. The details of a deck bridge used to some extent, are also shown. A glance at several of the other figures and photographs will give an idea of the bridges used by a number of the roads.

It is presumed that the reader is familiar with these usual types of girders, and attention will now be turned to some of the more recent designs.

The Chicago and Western Indiana has devoted considerable attention to procuring a floor which should possess the above mentioned characteristics, i. e. - economy, tightness, and freedom from noise; and, as a result, they have finally obtained a floor which is giving exceedingly satisfactory results. A ballasted floor, though necessitating greater height of embankment than a decked plate floor, was thought to be more economical and hence was adopted. The bridges are of the through plate-girder type, the girders being connected by I-Beams in the ordinary manner. The first type of floor used is shown in Fig. 11 page 43b,. Fig. 12 page 43c, shows a longitudinal section. On top of the I-Beams were placed creosoted planks, joined together as shown in Fig. 11 page 43b,. The planks were finished with Hydrex felt, mopped with hot asphaltum cement. A half inch of asphalt mastic was placed above this. This floor did not prove to be waterproof, and a concrete fillet was built against the side of each girder. This fillet was covered with felt and sealed with asphalt; and better results were thus obtained. Later the floor shown in Fig. 14, page 45, was designed. A reinforced concrete floor, extending 4 inches above and 1 inch below the I-Beams was substituted for the creosoted plank. This floor has proven to be absolutely waterproof, durable, noiseless and satisfactory in every way.

A floor similiar in some respects to the one first tried by the Chicago and Western Indiana has been used by the Atchison, Yopeka and Santa Fe. A floor of this kind has a great advantage over the usual steel plates because of the fact that in the latter the stone ballast must be dug out periodically and the metal be painted in order to prevent corrosion.

Fig. 13, page 44, shows a novel type of bridge floor recently adopted by the Chicago and Northwestern on its Kinzie Street work. The bridge is of steel. No longitudinal girders are used; and the floor, which consists of longitudinal troughs made up of plates and angles, rests on the abutments and on transverse girders riveted to the columns. The columns, which are 13 feet center to center, are of the H section composed of four Z bars and a central web plate with batten plates riveted across the flanges. The transverse plate girders, which are 3 feet 8 inches deep, fit between the columns, resting on knee braces. The troughs forming the floor are

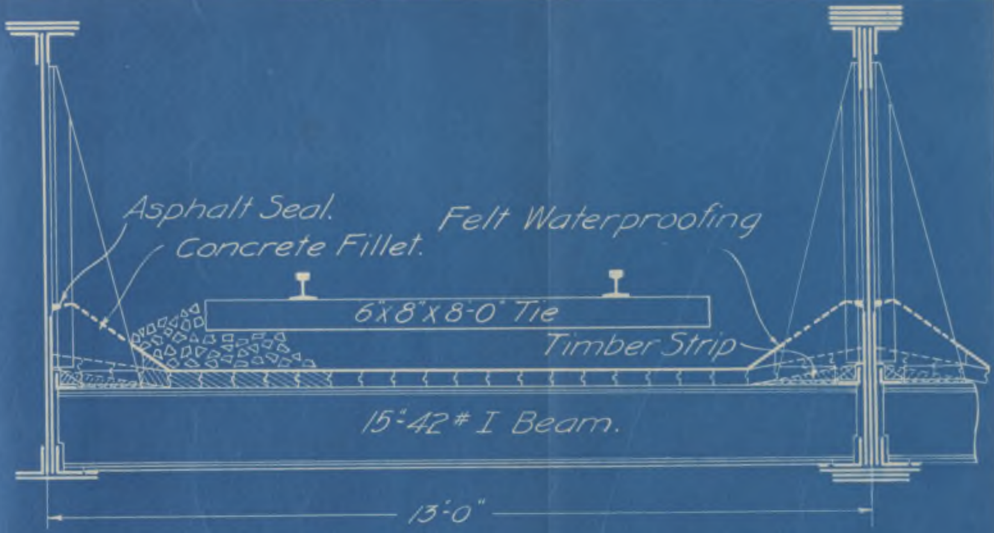


Fig. 11 - C. & W. I. R.R.

CROSS-SECTION OF
CREOSOTED TIMBER BRIDGE FLOOR.

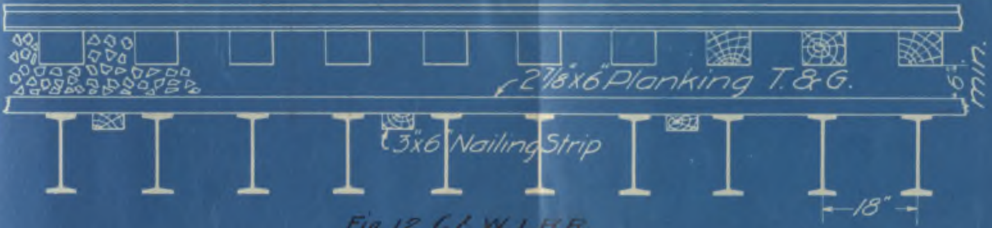


Fig. 12 C.L.W.I. R.R.

LONGITUDINAL SECTION.

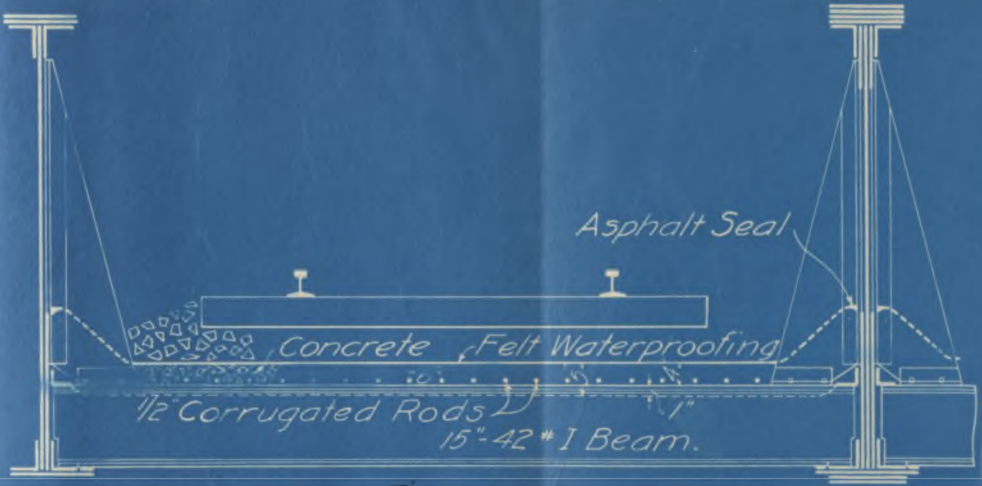


Fig. 14.

C. & W. I. R. R.

CROSS-SECTION OF

REINFORCED CONCRETE BRIDGE FLOOR.

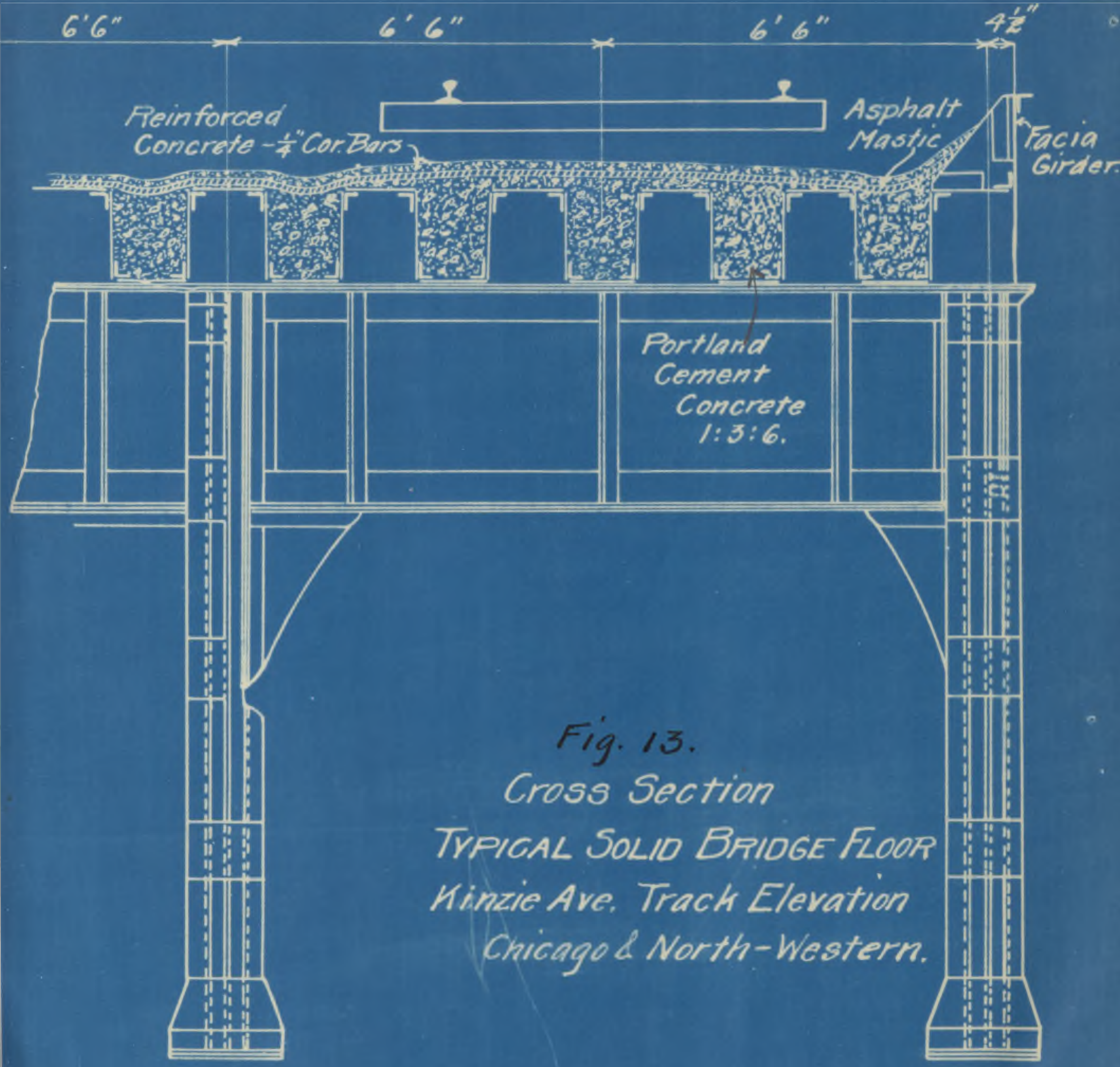
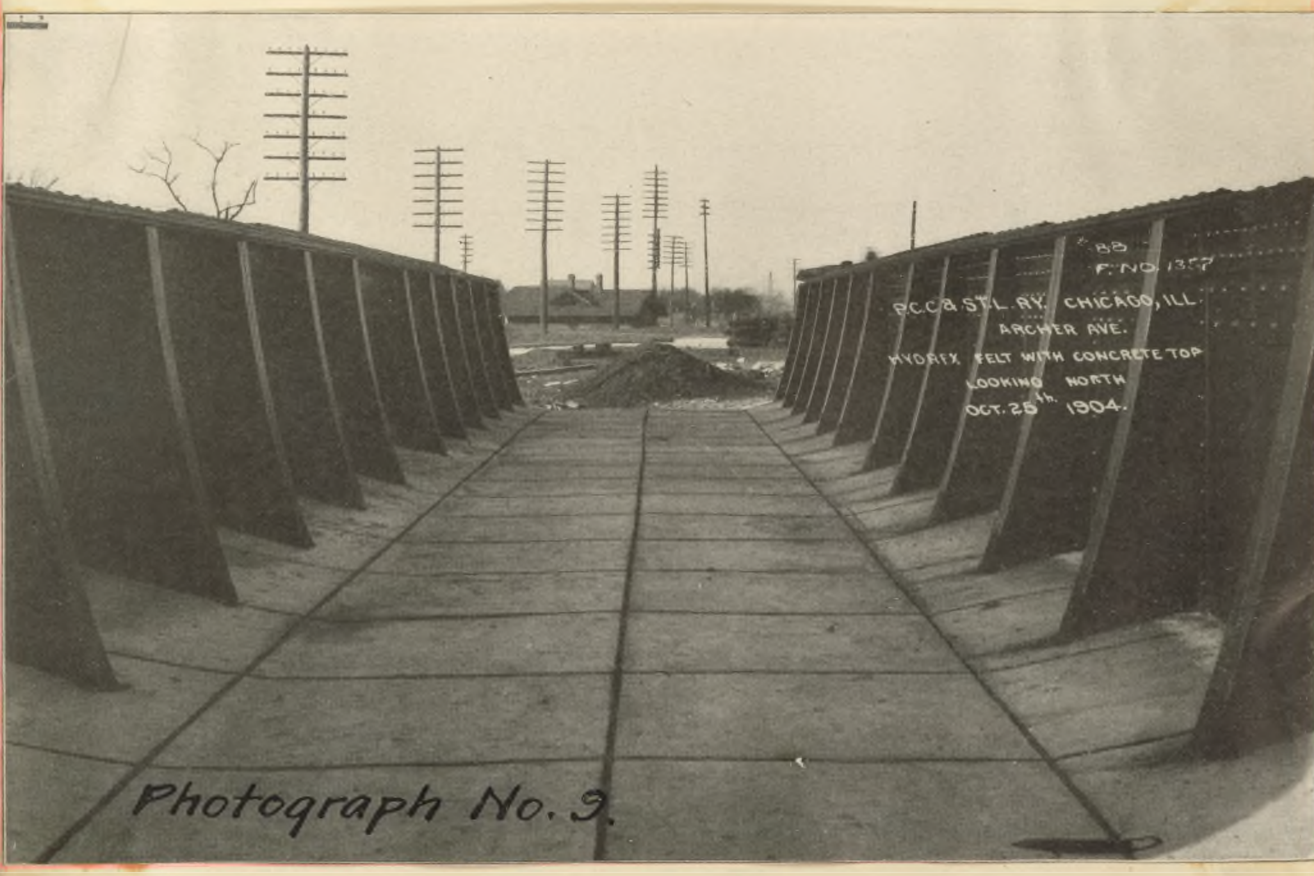


Fig. 13.
Cross Section
TYPICAL SOLID BRIDGE FLOOR
Kinzie Ave. Track Elevation
Chicago & North-Western.

15 5/8 inches wide center to center of web plates; and for sidewalk spans (11 feet 3 inches), they are 12 1/4 inches deep over angles while for the roadway spans (24 feet 6 inches), the depth is 18 1/4 inches. After these troughs have been constructed and placed in position, they are swabbed on the inside with hot asphalt and then filled with 1-3-6 concrete; and over this is placed a covering of 1 1/8 inches of asphaly mastic. Next comes a 2 inch layer of 1-2-4 reinforced concrete, 1/4 inch corrugated bars 6 inches center to center being used. The ballast is laid on the concrete. The floor is drained by side gutters having a fall of 6 inches from the center of the floor to the ends. The water is carried off by drain tiles back of the abutments and under the ballast. A facia girder to retain the ballast is provided along the outer row of troughs. These bridges were designed for a live load of two 177 1/2-ton locomotives followed by a uniform load of 5000 pounds per foot. Because of the ballasted floor, no allowance was made for impact. Although the author has no definite information on the matter, he is of the opinion that so far these bridges have given entire satisfaction.

Photograph No. 8 and Photograph No. 9 ,page 46, show two stages in the construction of a girder floor on the P. C. C. & St. L. work

Photograph No. 8



Photograph No. 9.

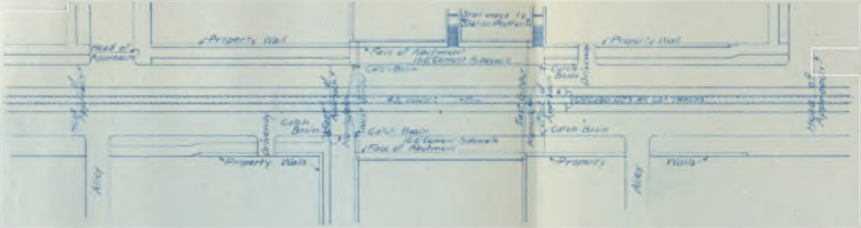
Subways.

The construction of subways is an important phase of the prolem of elevating tracks. Considerable excavating is usually done, and this is accomplished by means of wheel scrapers. Wherever water pipes or sewers are encountered and changes in these are necessary, this work is done by the railroad company. The length of the subway is the distance between the right of way lines, and its width is the distance between abutments. Each subway is provided with a drainage system, and the street on either side must be given a small gradient. The railroad does all the paving.

It will not be necessary to enter into a detailed description of the various subways which have been constructed, since this information can be easily obtained by a study of Figs. 10, 15, 16, 20 and Photographs No. 8, 10, 12, 13 & 16 which illustrate the types adopted by a few of the roads.

Fig. 15

CROSS SECTION OF 43rd ST SUBWAY



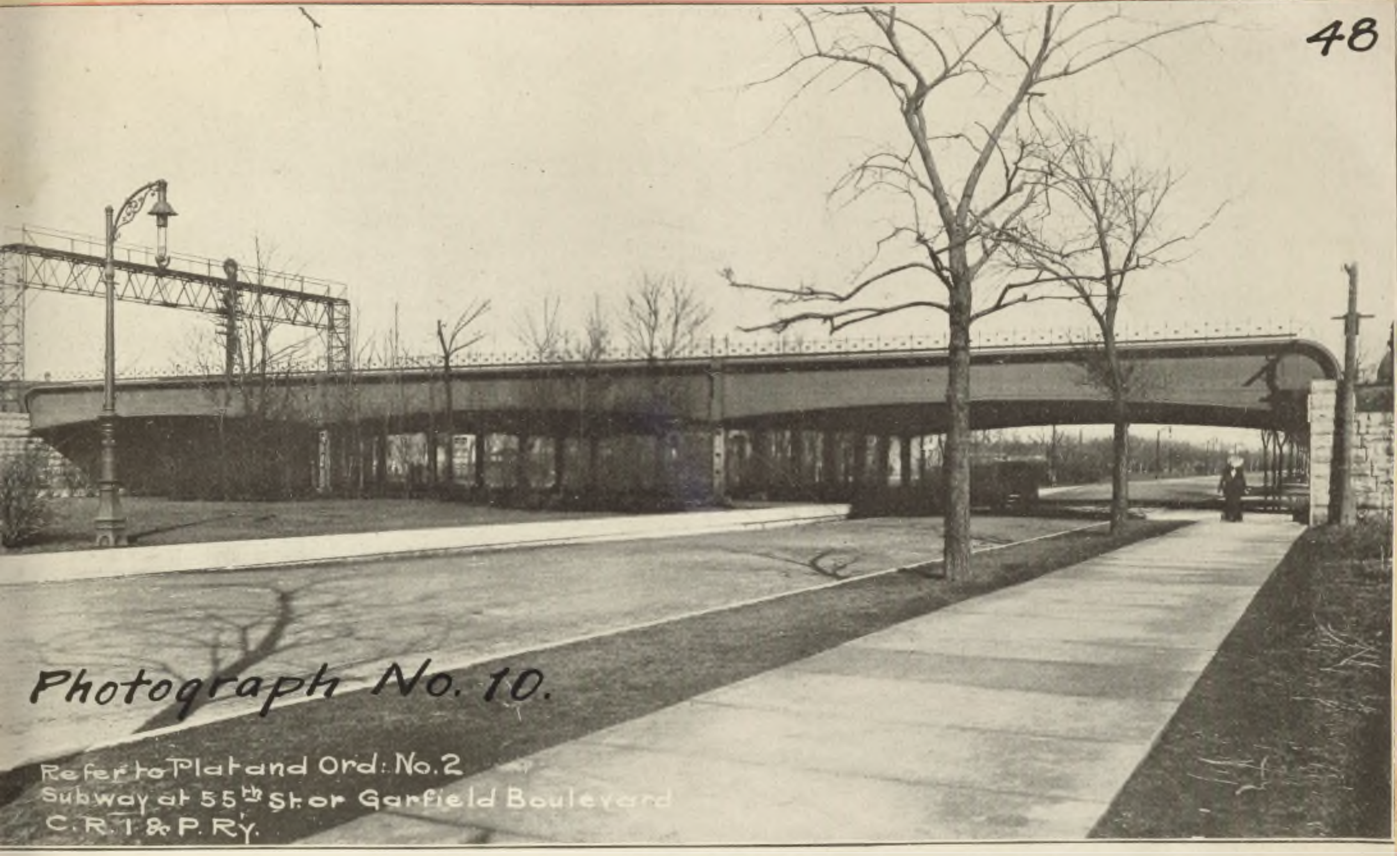
PLAN
Scale 1" = 50'

CROSS-SECTION
Scale 1"= 20'

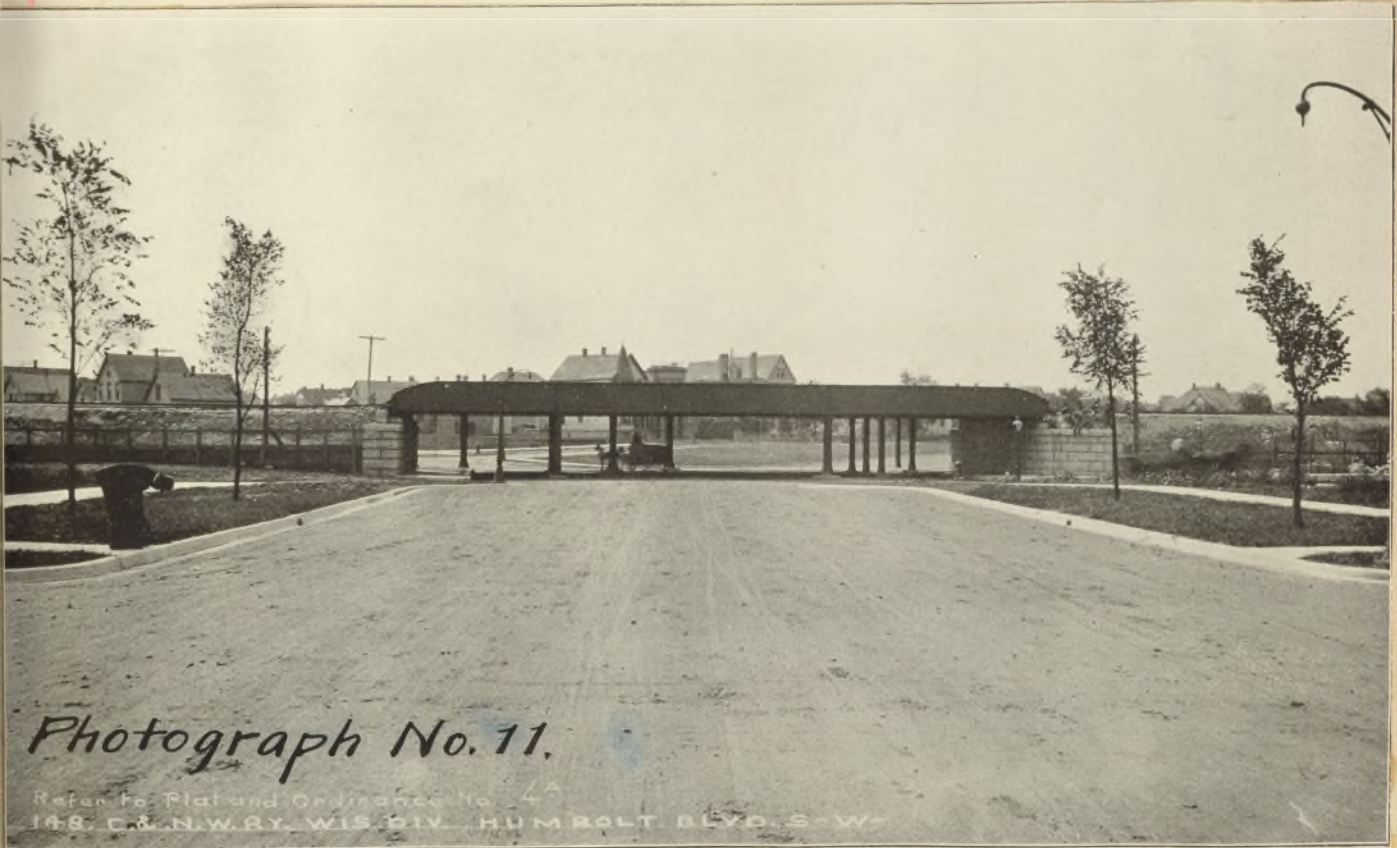
Fig. 16.

TRACK ELEVATION.
C. & W. I. R. R.
Plan and Cross-Section of
Typical Subway.
Scales—As Noted.
Engineer's Office, Jan 28, 1904

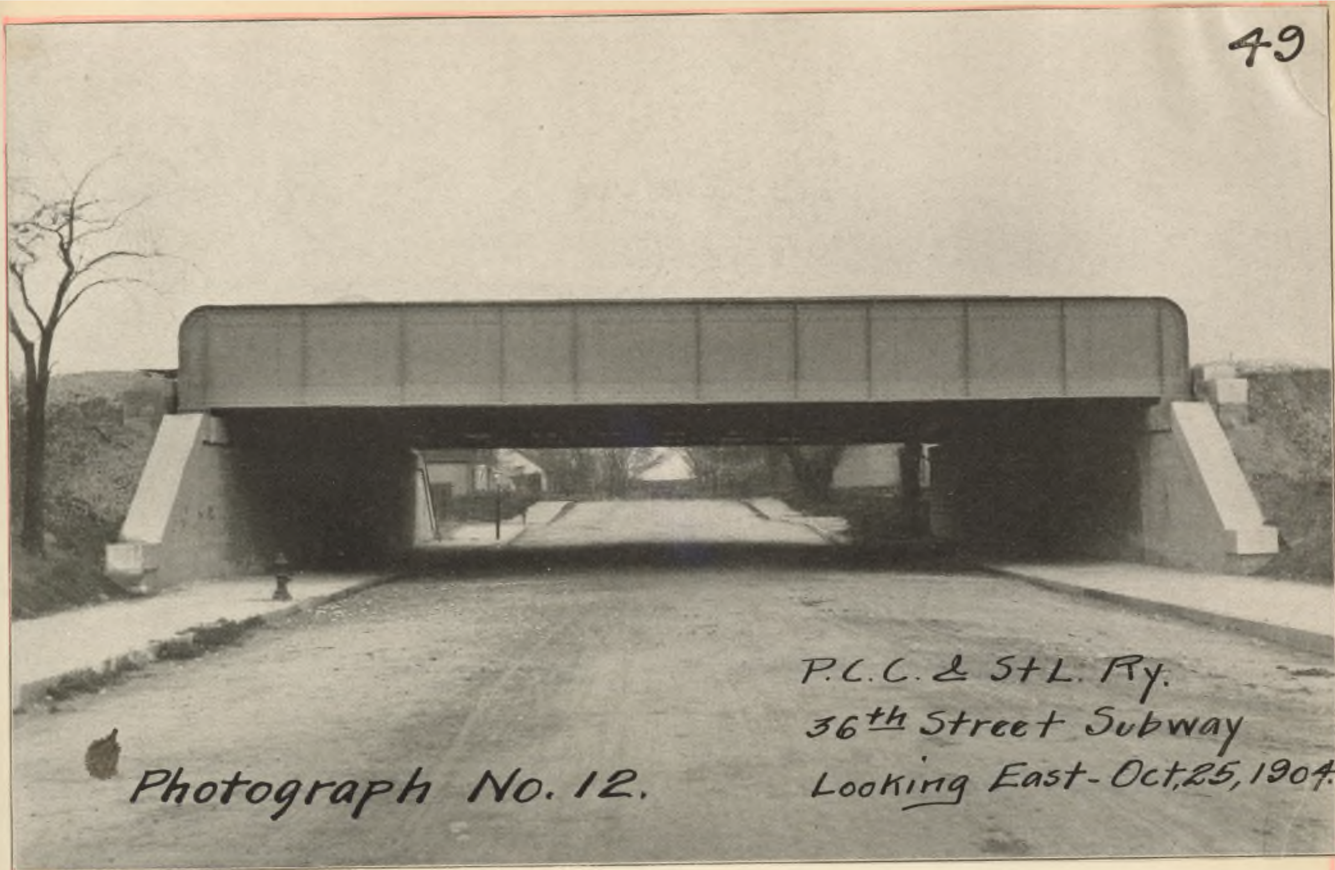
TPS



GARFIELD BOULEVARD SUBWAY UNDER C. R. I. & P. RY. AND L. S. & M. S. RY.



SUBWAY OF HUMBOLDT BOULEVARD UNDER C. & N. W. RY., WISCONSIN DIVISION, LOOKING SOUTHWEST.



Photograph No. 12.

P.C.C. & StL. Ry.
36th Street Subway
Looking East - Oct. 25, 1904.

Photograph No. 13

Abutments.

Abutments which are constructed to support girders at crossing streets are built either of natural stone or concrete. In some cases the wing type is employed; but in most cases the face is straight and vertical, and the back is given a batter.

Photograph No. 3 , page 20, shows the work of constructing a concrete abutment in progress on the Chicago and Western Indiana elevation. The form is built under the temporary trestle, the concrete being hauled from the concrete-making train in wheel barrows up the plank incline to the top of the bridge, from which it is dumped into the form. The form for an abutment may be seen in Photograph No. 14, page 52. Fig. 15, page 47b, shows cross sections of the abutments at Forty-third Street.

Fig. 20, page 50c, shows cross sections of the two concrete abutments on the Chicago Milwaukee and St. Paul at Kedzie Avenue; and those at Franklin Boulevard are shown in Fig. 17, page50b.

Fig. 18, page 51, is the cross section of an abutment on the Lake Shore and Michigan Southern and the Chicago Rock Island and Pacific elevation. Section A-B, Fig. 6, page 36, is a stone abutment at Archer Avenue on the same work.

Fig 21, page 53, shows the section of a stone abutment with concrete foundation on the Chicago Burlington and Quincy elevation.

A typical concrete abutment built by the Chicago Junction

Fig. 17.

Note:- Cross Sections for East & West Abutments are identical

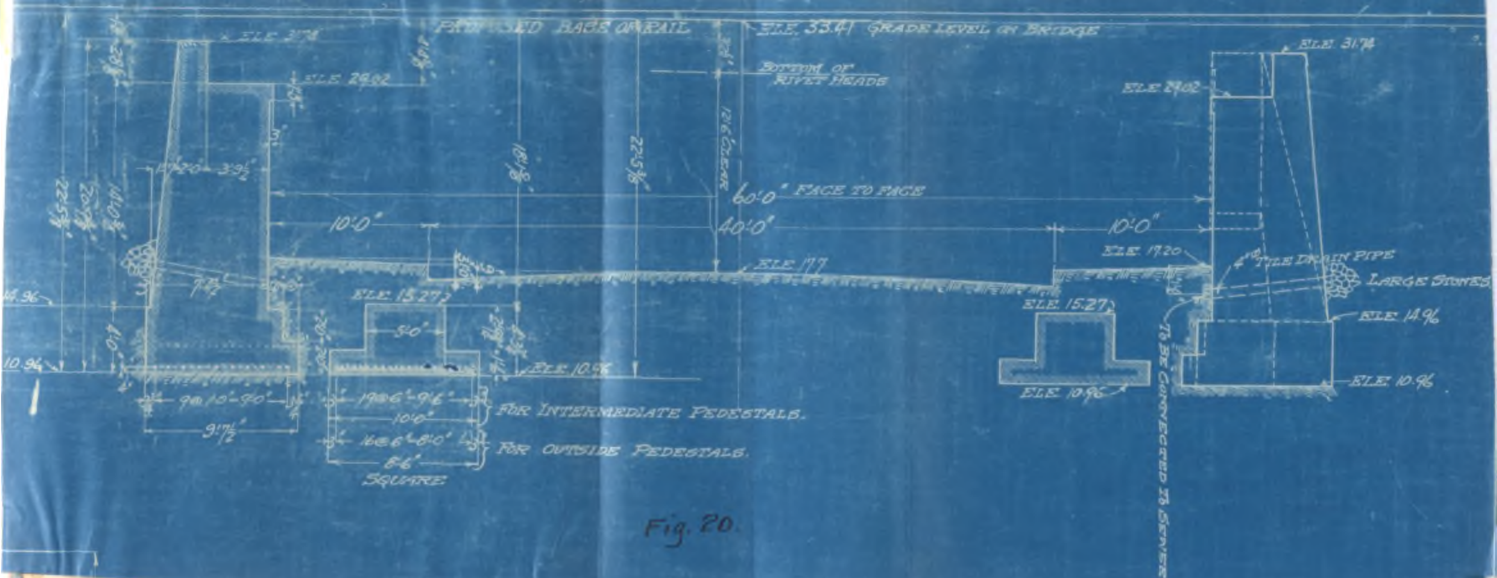

PROPOSED BASE OF RAIL
ELE. 33.41 GRADE LEVEL ON BRIDGE
ELE. 31.74
ELE. 29.02
BOTTOM OF RIVET HEADS
12'6" CLEAR
60'0" FACE TO FACE
10'0"
40'0"
10'0"
ELE. 17.7
ELE. 17.20
4" TILE DRAIN PIPE
LARGE STONES
ELE. 15.27
ELE. 14.96
ELE. 10.96
9'7½"
10'0"
8'6"
SQUARE
FOR INTERMEDIATE PEDESTALS.
FOR OUTSIDE PEDESTALS.
TO BE CONNECTED TO SEWER

Fig. 20.

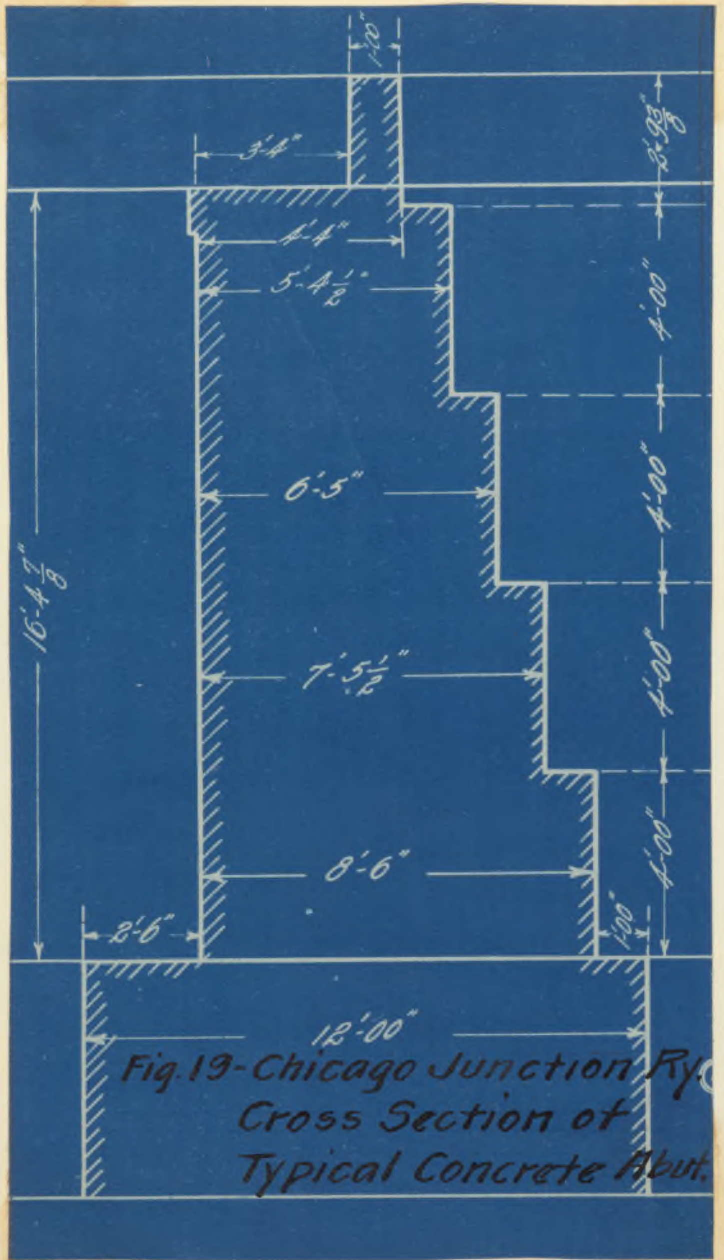


Fig. 19 - Chicago Junction Ry.
Cross Section of
Typical Concrete Abut.

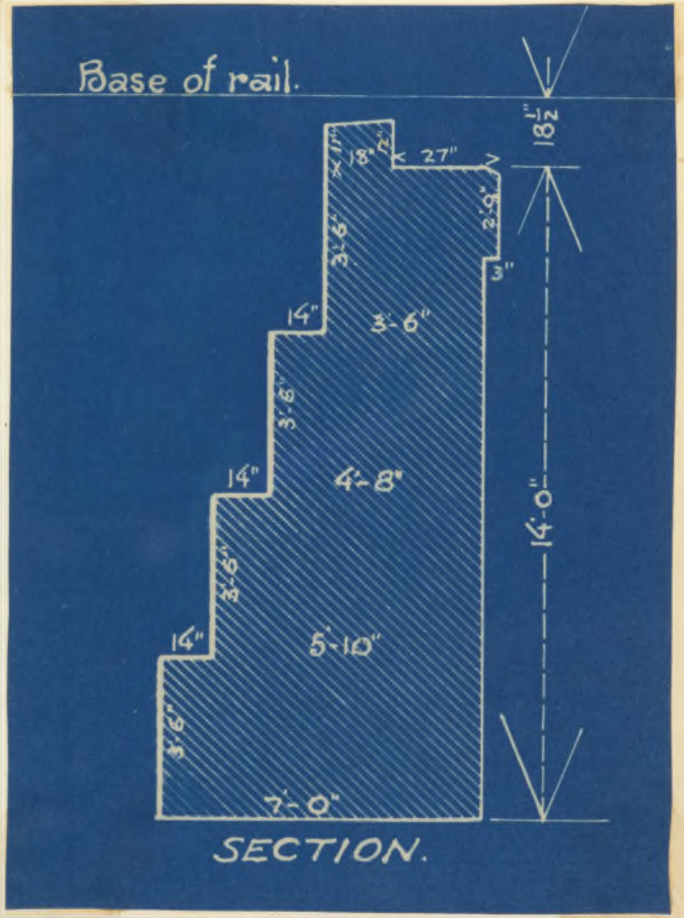


Fig. 18 - L. S. & M. S. & C. R. I. & P. Rys.
Cross Section of a
Concrete Abutment.


Photograph No. 14
Abutment Form,
Retaining Wall,
Temporary Trestle, etc.
9-27-05
C.&W.I. Track Elevation - n.e. from roof of Commonwealth Electric Power House

Railway is seen in Fig. 19, page 51.

Photographs No. 10, 11, 12, + 13, pages 48 + 49 show abutments used by several other roads.

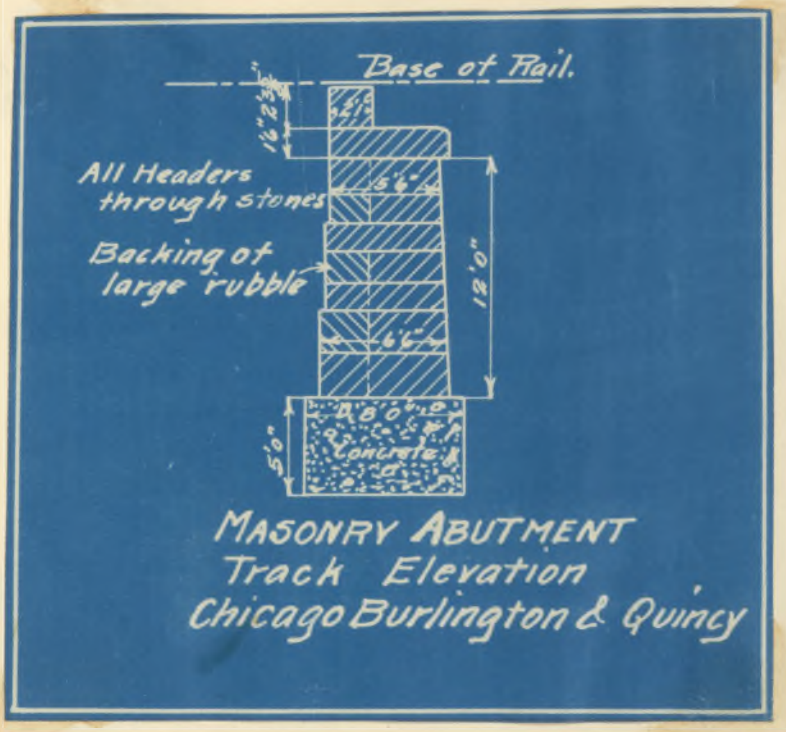
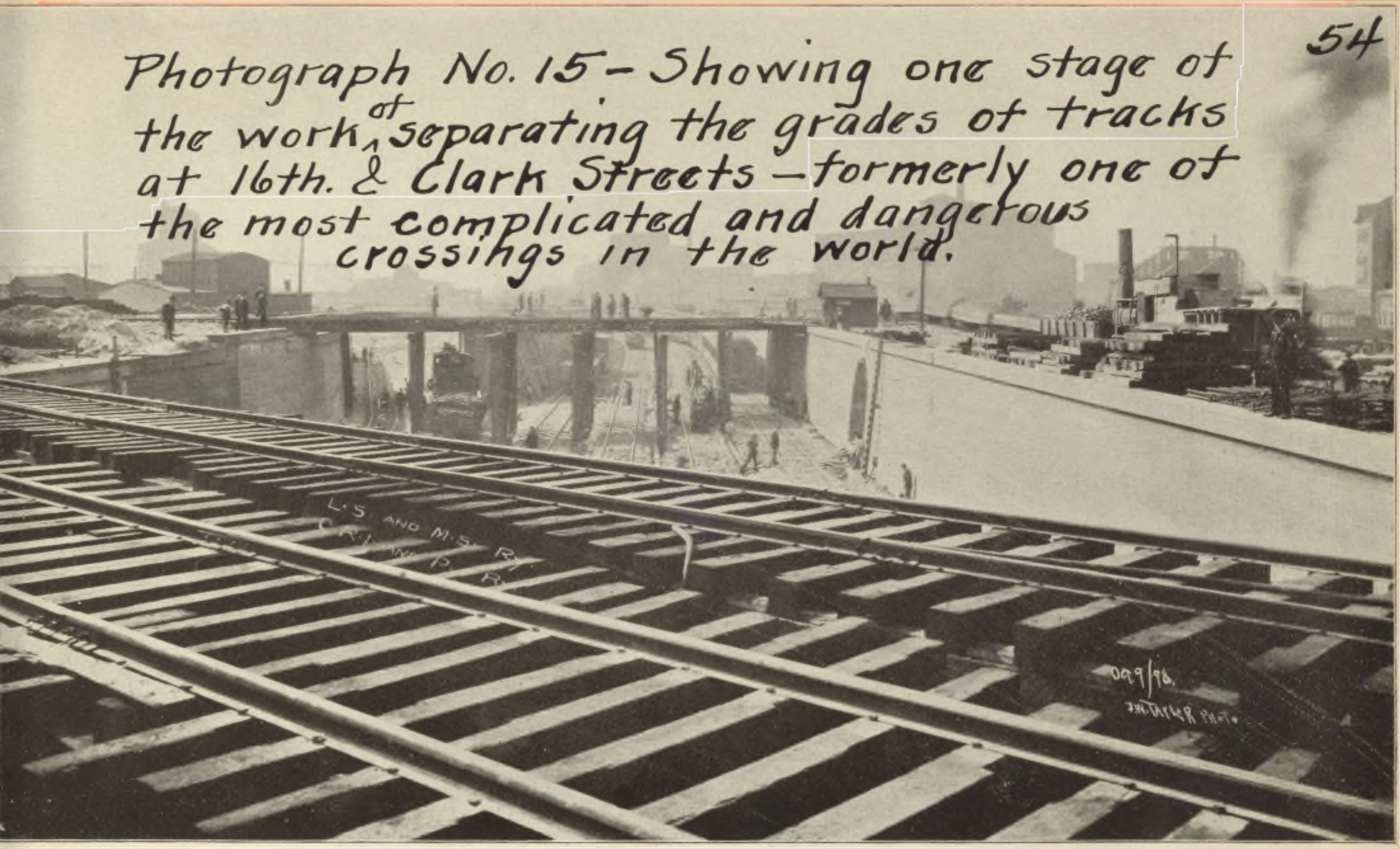


Fig. 21.



Photograph No. 15 – Showing one stage of the work of separating the grades of tracks at 16th. & Clark Streets – formerly one of the most complicated and dangerous crossings in the world.

16TH AND CLARK STREETS, VIEW OF THE C. & W. I. AND SANTA FE TRACKS IN THE DEPRESSION. L. S. & M. S., C. R. I. & P. AND ST. CHARLES AIR LINE ON TEMPORARY BRIDGES.

Photograph No. 16 – A "3 grades" crossing – 63rd St.

Photograph No. 17 -
Method of providing for yard teaming.

1035 B 12-31-03 C. & W. I. Track Elevation - Approach to south end of Englewood Yard -

Photograph No. 18 - C. & W. I. R.R.
General view of elevation work in progress.

Photograph No. 19 - C.&W.I. R.R.
Panorama view of elevated tracks.
9-27-05
C.&W.I. Track Elevation - Panorama View North from Erie Elevator 49th St.

Photograph No. 20 – C. & W. I. R.R.
Panoramic view of work in progress.

Organization and Equipment.

The organization necessay for elevating tracks depends upon the extent to which the work is let to contractors. A Track Elevation Engineer usually has general supervision over the work which naturally divides itself into two departments i. e., the Engineering and the Constructional. The engineering department usually attends to laying out and inspecting the work, preparing plans and receipting and accounting for material. Several surveying parties are necessary for laying out tracks, establishing lines for retaining walls and abutments, and for doing numerous other things which will readily suggest themselves to the reader. The constructional department has charge of the actual work of raising the tracks, building the various structures etc. Each part of the work is under the charge of a foreman. The unloading of filling material and track work is invariably done by foreigners from Italy and various other countries in Southern Europe. Track Elevation is affording employment to hundreds of these people in Chicago at a salary ranging from $1.65 to $1.75 per day. This is a rather inferior class of labor but it is the best available, since Americans will not do this kind of work. The mixer gangs are composed either of Italians or Negroes. The building of forms, temporary trestles etc. is usually done by Americans at a salary ranging from $2.00 to $3.00 per day. A large number of trainmen are necessary to attend to the movement of sand and other materials from one place to another. Fig. 22, page 60b, shows the organization of engineering and superintendence on the Chicago and Western Indiana Railroad.

The equipment varies greatly on different roads, depending upon the extent to which machinery is used in doing the work; but it usually consists of locomotive engines, gondola and flat cars, a pile driver, a derrick and, sometimes, an unloader, plows and a spreader.

ORGANIZATION
— OF —
ENGINEERING AND SUPERINTENDENCE.

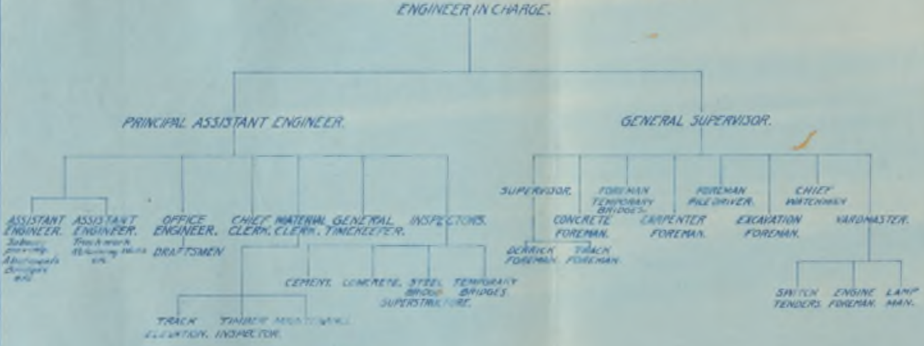


Fig. 22.

The Letting of Work to Contractors.

On nearly all roads the actual work of constructing the embankment has been done by the railway companies themselves. Some companies build their own retaining walls, abutments , subways, temporary bridges etc.; while others let this work to contractors. There is a great diversity of opinion as to which is the better practice. The entire work will probably progress more harmoniously if it is all done by the railroad; but from the standpoint of economy the other course is in most cases the better. This is due to the fact that the contractor knows from experience how best to do the work, and he has at hand the requisite equipment and an organized force of men. The quality of the work will probably be better if done by the railroad company. The peculiar conditions encountered on each road will usually decide which course is better to pursue. Almost without exception the permanent steel girders have been built and erected by bridge companies.

Decrease in Accidents due to Track Elevation.

Table showing the total deaths by railroad accidents, with the percent of deaths by railroad accidents to all deaths by violence from January 1, 1891, to January 1, 1902.-

Years.	Total deaths from all causes.	Total deaths from violence.	Per cent of deaths from violence to deaths from all causes.	Total deaths by railroad accidents.	Per cent of deaths by R. R. acc. to all deaths by acc.
1891	27,754	1,457	5	301	21
1892	26,219	1,573	6	355	23
*1893	27,083	1,879	7	387	21
1894	23,892	1,537	6	256	17
1895	24,219	1,458	6	222	15
1896	23,257	1,363	6	198	14
1897	21,809	1,415	6	186	13
1898	22,793	1,536	7	221	14
1899	25,503	1,554	6	228	15
1900	24,941	1,577	6	258	16
1901	24,406	1,674	6	241	14
1902	26,455	1,830	7	287	15

* This was the year of the Worlds Fair and there was no track elevation before this year.

With the continual increase in population and traffic, the per cent of deaths by railroad accidents to all deaths by accidents would naturally be expected to increase. The influence of track elevation in keeping this per cent low is clearly shown.

Influence of Track Elevation.

The elevation of tracks has in every case proved to be a benefit to all concerned.

The railways are justified in the enormous expense because of the permanent nature of the work. It finally and forever does away with the many inconveniences which attended the operation of trains on surface lines.

Industries, along the lines elevated, which have also necessarily been at considerable expense in reconstructing their establishments, reap the benefits of better service. Aside from this, the handling of material is much simplified, since in many cases a gravity method of unloading coal and similiar materials may be employed.

Above all the city has been benefited. Traffic of all kinds has been rendered safer and subject to less interruption. The elevation of tracks has exerted an influence for good upon every avenue of life in Chicago.