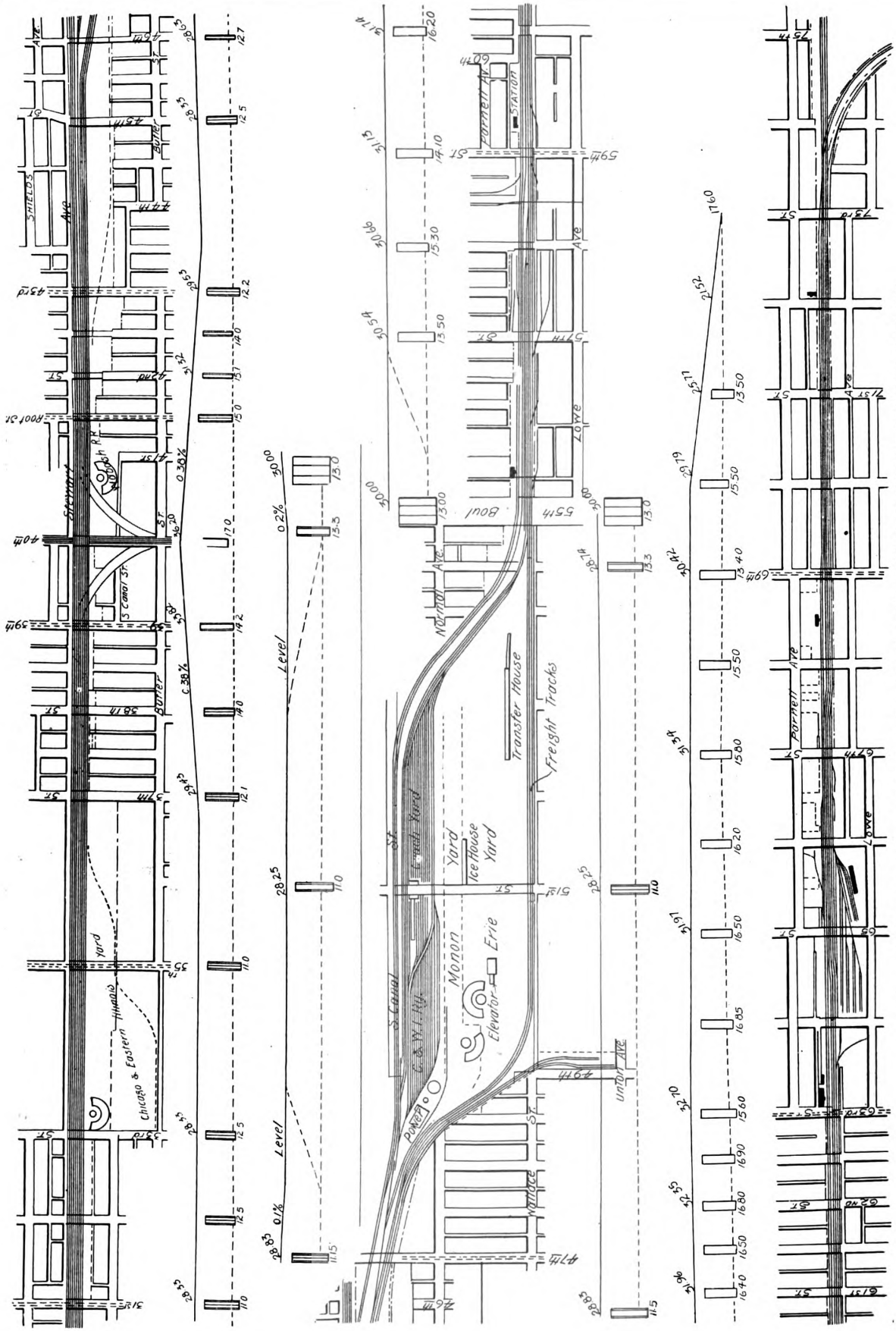


CHICAGO & WESTERN INDIANA TRACK ELEVATION—PLAN AND PROFILE, THIRTY-FIRST TO SEVENTY-FIFTH STREETS, SOUTH SIDE.

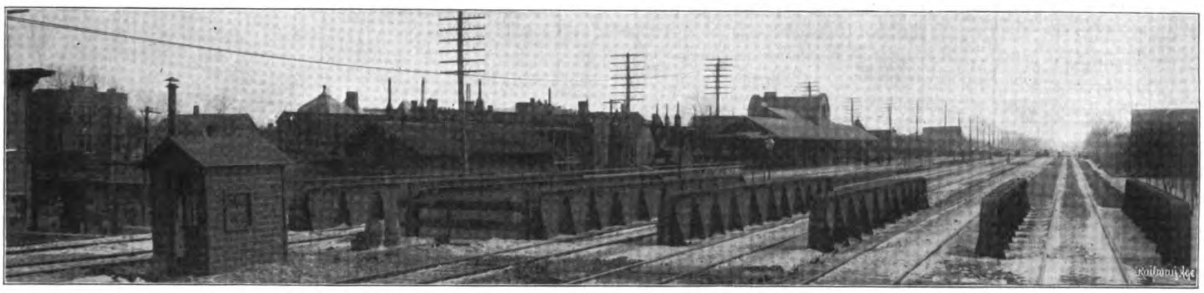
TRACK ELEVATION OF THE CHICAGO & WESTERN INDIANA THROUGH THE CITY OF CHICAGO.

It must be understood that the Chicago & Western Indiana Railroad is merely an operating company for five proprietary companies, namely: The Erie, Wabash, Monon, Chicago & Eastern Illinois and the Grand Trunk. These have accepted the Atchison Topeka & Santa Fe as a tenant of their terminal at Polk street, and excepting the passenger service of the Chicago & Eastern Illinois all of them occupy this terminal.

The change of grade on the Chicago & Western Indiana began in 1898 between Fifteenth and Eighteenth streets at that great network of tracks where the St. Charles Air Line, the Lake Shore & Michigan Southern and the Chicago Rock Island & Pacific intersect. This was really depression work and it was not until 1899 that the real work of separation was started by a city ordinance which was accepted by the Chicago & Western Indiana, and which required the elevation of all of its tracks between Eighteenth and Seventy-third streets. This portion of the work forms the major part of the present description and involves about 100 miles of single track.

As a subordinate property, the Belt Railway is operated independently, but is owned by the proprietary companies of the Chicago & Western Indiana. In connection with this line, an ordinance was passed by the city council of Chicago in 1902, requiring the elevation of the tracks from a point near Kinzie street to the northern terminus of the Belt Railway at its junction with the Chicago Milwaukee & St. Paul on the west side of the city. This elevation amounts approximately to 20 miles of single track.

Although the actual authority for the track elevation dates from 1899, there was much preliminary work to be done in settling with the private owners of property and no actual elevation took place until the season of 1903, when that portion of the tracks between Seventy-third and Fifty-fifth streets was raised to the new grade. This was continued during the season of 1904, when three main passenger tracks between Fifty-fifth and Forty-seventh streets, together with a new coach yard (described in The Railway Age of February 17, 1905), were elevated.

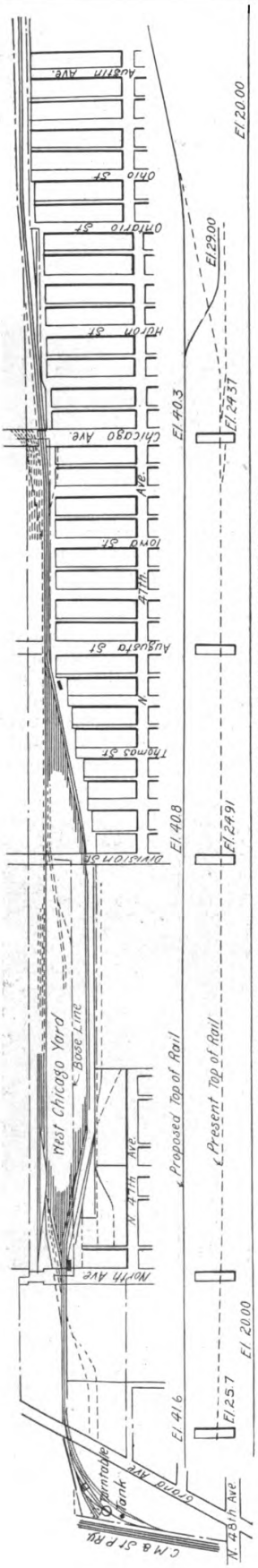


CHICAGO & WESTERN INDIANA TRACK ELEVATION—GIRDERS AT SIXTY-THIRD STREET WITH ENGLEWOOD STATION IN THE BACKGROUND.

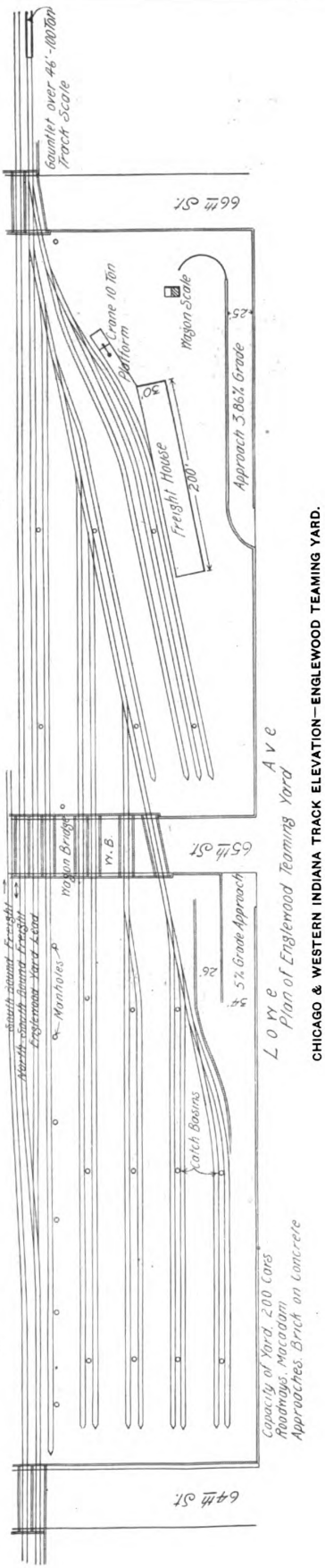
Equipment.

It is unnecessary to prove the great advantage in the use of machinery for construction work, and in work of the character now to be described it is essential to success that many different kinds of operations be carried on with about equal progress, in order that one portion shall not be delayed by another. For instance, it is necessary that the retaining walls be kept well ahead of the filling, and in like manner temporary track changes, pile driving, etc., be carried forward so as not to block the dumping of material. Temporary trestles must be erected immediately after the embankment has been placed and there can be no delay in decking these for the passage of trains, while the construction of abutments must follow very quickly in order that the street shall not be closed for a greater length of time than is absolutely necessary. In planning this work due regard was paid to all these considerations, and wherever economy would be subserved a machine was supplied to do the work of men. But

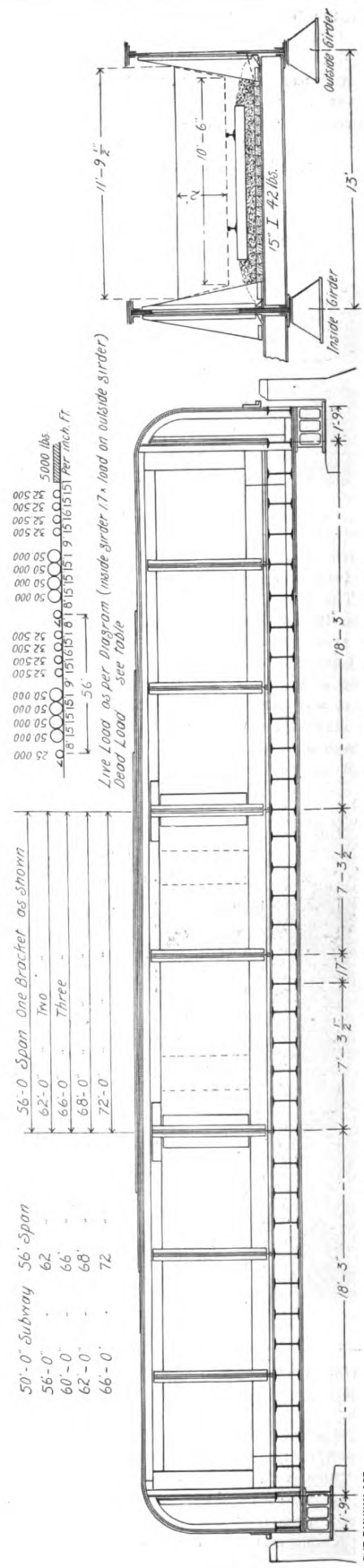
CHICAGO & WESTERN INDIANA TRACK ELEVATION—TEMPORARY STRUCTURE AT SIXTY-THIRD STREET.



CHICAGO & WESTERN INDIANA TRACK ELEVATION—PLAN AND PROFILE WEST SIDE LINE.



CHICAGO & WESTERN INDIANA TRACK ELEVATION—ENGLEWOOD TEAMING YARD.



CHICAGO & WESTERN INDIANA TRACK ELEVATION—TYPICAL GIRDER.

apart from questions of economy, machinery has the advantage that it may be worked overtime, during the night or during stormy weather, when laborers refuse to come out, and consequently it permits a better control and regulation of the progress than is possible where the effort is dependent upon large gangs of laborers.

There were used upon this work:

3 machine concrete mixers (two steam and one gasoline power).
1 steam pile driver.
1 rapid unloader and two plows (one right-hand and one left-hand).
1 spreader operated by air.
50 flat cars.
50 Rodger ballast cars, convertible side-door type.
550 Haskell & Barker side-door gondola cars, capacity 80,000 pounds and 100,000 pounds, of which 300 were purchased and delivered in 1904.
1 wrecking derrick, used very generally to pull tracks up the slope (instead of jacking), where the height of the fill did not exceed from 10 to 12 feet.

As a first consideration a material yard of suitable size and conveniently located was found to be a necessity, which in addition should be confined inviolably to construction uses and not available for even occasional use by the traffic department. The spot selected for this yard was at a point near Eighty-seventh street, where sufficient right of way was held and where plenty of room existed for storing lumber, ties, piles, structural steel, etc. Storehouses covered with tar paper for the protection of cement, small track material and tools were constructed in this yard, and the contractors for the erection of the girders were required to provide a small traveling crane for handling structural steel. This was done and was found to be of great use in facilitating future operations.

Besides the evident advantage of a steam pile driver for track elevation work in driving piles it can be used for many other purposes. A boom rigged in front of the guides is found very convenient for loading all sorts of materials upon cars when the driver is not occupied in its conventional duties.

Method of Operation.

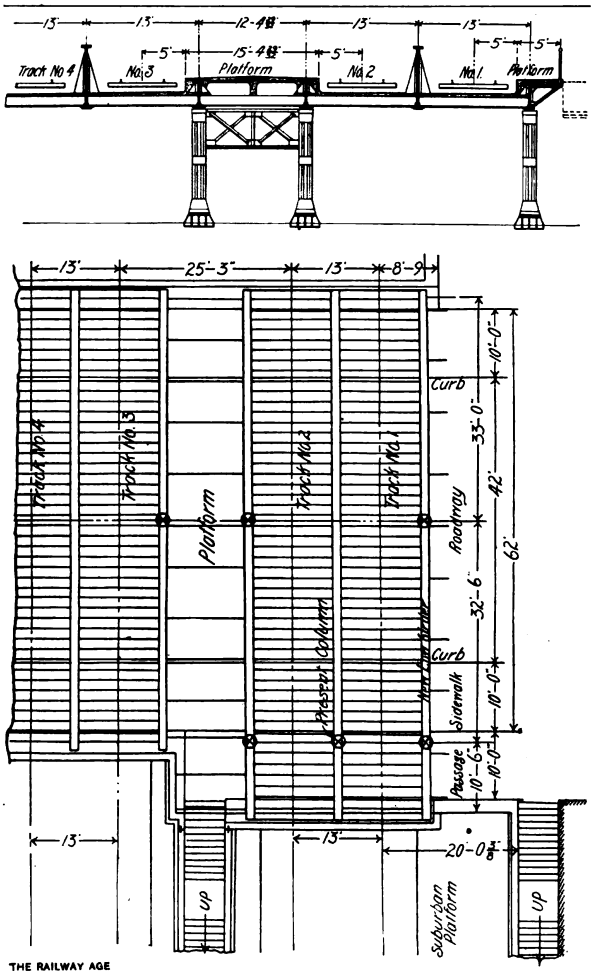
According to the preliminary plans, all engine houses and their appurtenances in the various tenant yards were to be maintained at their present elevation, with approaches to the new line on a gradient of 3 per cent. This decision was based upon an estimate that the cost of elevating would equal the cost of rebuilding these structures; hence a large saving was made and the work of raising the engine houses put off to a more favorable time. Between Fifty-fourth and Seventy-third streets two new temporary tracks were constructed and the present west track was entirely removed. Owing to the large number of subways it was necessary that the elevation of the first two tracks should be carried to their full height immediately, and from that as a basis the material was dumped from the side and the succeeding tracks gradually were hauled up the bank as the lateral progress of the filling took place. This required but a very short closing of each street, and the decision to perform the work in this way was fully justified by the event. Sand for filling was bought in great quantities and delivered to some point on the company's line, whence all of the switching and handling were performed by company forces.

CHICAGO & WESTERN INDIANA TRACK ELEVATION—SHALLOW FLOOR CONSTRUCTION, SIXTY-THIRD STREET.

In using side door cars, a rapid unloader and a plough with a spreader for levelling the unloaded material, it is of the first importance that a sufficient face shall be developed to prevent the fouling of the construction track and the consequent possible derailment of cars. In these operations generally it has been found best to start the train in the same direction as the plow, at a speed two or three times the speed of the plow. In effect, this deposits the material in a car over a distance two or three times the length of the car, and it reduces the height of the sand pile along the track in the same proportion. Such an operation as we are considering, therefore, must complete its performance, since any dumping arrangement which does not leave the track clear can have little advantage over unloading the material by hand, if it becomes necessary to release the train by digging it out.

So complex were the problems presented by the necessity for maintaining a heavy traffic that none of the work was

let by contract, except the erection of the plate girders. This added to the care and responsibility of the engineering forces, but permitted the work to be arranged in the way best suited to the conditions without regard to penalty clauses in contracts. The work further was complicated by the immediate neighborhood of the Pennsylvania Lines, which also were in the throes of track elevation and whose right of way is in contact with that of the Chicago & Western Indiana for a long distance. Because of these considerations the work was divided into two parts and with measurable exactness



THE RAILWAY AGE
CHICAGO & WESTERN INDIANA TRACK ELEVATION—PLAN AND SECTION OF ENGLEWOOD SUBWAY AND PLATFORMS.

the operations have been performed in the following way:

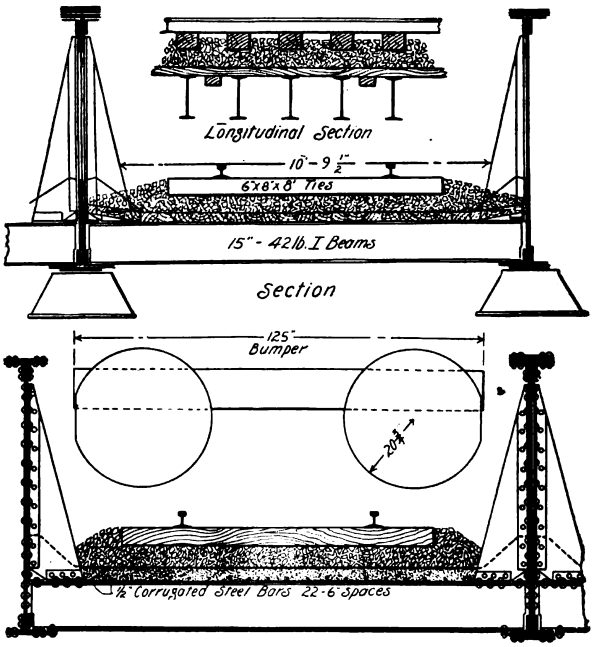
First, from Seventy-third to Fifty-fifth streets.

Second, from Fifty-fifth to Forty-seventh streets.

At the beginning of 1903 two additional temporary tracks were constructed between Seventy-third and Sixtieth streets, while retaining walls were built in various places between Seventy-third and Forty-ninth streets. This prepared the way for active operations, and besides the purchase of the necessary machinery, a force was organized with two subdivisions, the first of which was under the principal assistant engineer, Mr. M. K. Trumbull, who took charge of laying out and inspecting the work, preparing the plans and the receipt and accounting for material. The other subdivision, under a general supervisor, Mr. F. S. Wilhelm, dealt with all construction work of whatever character.

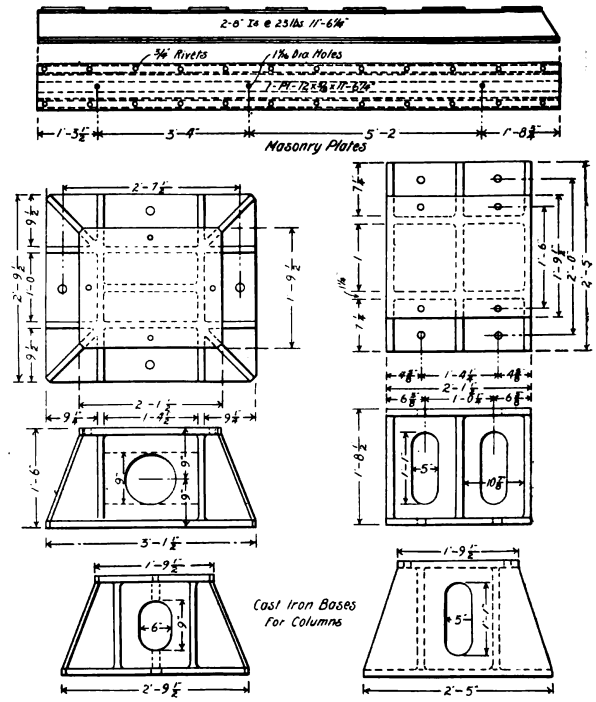
These gentlemen both reported directly to Mr. E. H. Lee, chief engineer, who exercised a general supervision over the whole work.

During the season of 1903 about 560,000 yards of filling material were placed in the work of elevation, and 57,000 yards were excavated for subways and foundations; about 50,000 yards of concrete were built. In one of the illustrations the typical wall is shown and also the train of concrete machinery with which these walls were built. Very



CHICAGO & WESTERN INDIANA TRACK ELEVATION—CREOSOTED TIMBER AND REINFORCED CONCRETE FLOORS.

remarkable results were secured by this method, which progressed with an evenness, cheapness and certainty scarcely to be exceeded. In other illustrations the method adopted in



CHICAGO & WESTERN INDIANA TRACK ELEVATION—MASONRY PLATES AND CASTINGS.

raising the track at difficult places is shown, with the Ford street crossing as a particular instance. Here several hundred men were congregated and as many cars as could be delivered in a short time were unloaded. The men then,

with jacks and other hand tools, raised the tracks as high as the material delivered would permit, and the whole was then surfaced for the passage of trains. On the occasion when the photographs were taken the time occupied in a 2-foot raise was but 16 minutes, and this period was about the delay caused at any one time in making such changes.

About 2 miles of temporary track were located and the permanent tracks relaid with new steel equaled about 4 miles. Piles to the number of more than 4,300 were driven, which included 114 trestle bents, with an average of seven per street, while nearly 2,000,000 feet B. M. of timber was consumed in decking. Bridges were completed across 17 streets, with a total length of more than 13,000 lineal feet. In this work an awkward complication existed, since from Fifty-ninth street northward the elevation was made in two lifts, and here it was necessary to finish all the trestling first at half its ultimate height, and then, by using additional caps, to make the final raise. A comparison of the cost of this work with that where the raise was made in one move shows that the latter method cost something like 28 per cent less than the former. About 4,600 tons of structural steel were received during the year, manufactured by the American Bridge Company, and erected by the Kelly-Atkinson Construction Company. Some of the periods during which streets were closed to traffic are interesting as showing the speed with which the work was carried on. Between Sixty-fourth street

CHICAGO & WESTERN INDIANA TRACK ELEVATION—BEGINNING A "RAISE" AT FORD STREET CROSSING.

CHICAGO & WESTERN INDIANA TRACK ELEVATION—THE END OF A "RAISE" AT FORD STREET CROSSING.

and Cleveland avenue, in the case of seven subways, the average time was ten days and the minimum time seven days.

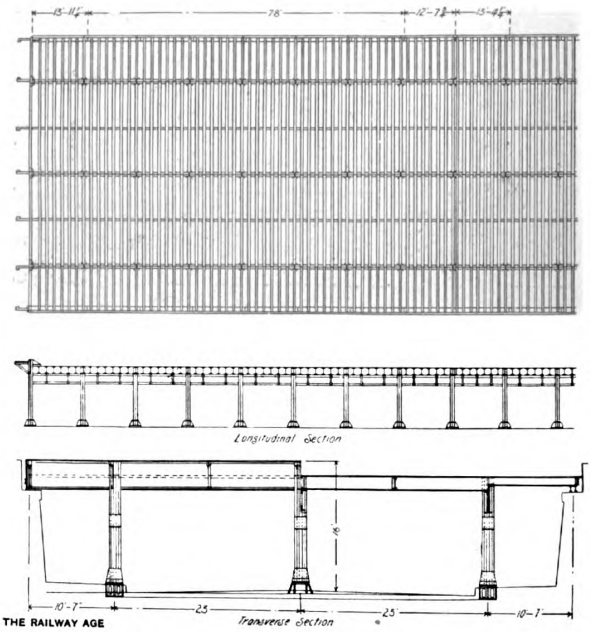
In carrying on this work it was divided into five so-called "reaches," which means that a certain territory was substantially completed before the one following it was begun. This was done by a run-off at the end of each reach, and as soon as the material had been dumped in the work back of the run-off was finished to all intents and purposes. After this, the force was moved forward to the next reach.

Materials.

Contractors furnished the sand for filling loaded on the company's cars at the Indiana sand hills, near the southern end of Lake Michigan. It is fine, quite free from clay or loam, and reached a settlement very quickly, which, according to observations, amounted to not more than one or two per cent. It has the disadvantage of blowing about very badly, and therefore it was found necessary to cover all slopes with a more stable material; owing, however, to the slight settlement of the sand, it was found possible to ballast the tracks very soon after their elevation. Of this material, the Knickerbocker Ice Company furnished about 390,000 cubic yards and the Brownell Improvement Company about 167,000 cubic yards.

Concrete has been used so generally throughout this work that, except in the upper walls of the stations at Englewood and Sixty-eighth street, no other form of masonry has been used. Also it has been applied to the flooring of bridges. During the first operations, the wall footings were made with Louisville natural cement, but a subsequent fall in the price of Portland cement made it possible to use the latter material exclusively. Crushed limestone was bought at the various quarries in and near the city, and the specifications required that the stone should pass through a 2-inch ring with all of the dust removed. No particular objection was felt toward the dust, except that the crusher plants are very generally arranged to screen out the dust, and the amount of sand necessary to complete the mixture, using crusher run stone, was uncertain. The decision to follow this practice was reached in the face of some unusual facts.

Extended laboratory experiments were made during a period of two years into the use of limestone screenings in concrete as compared with sand, and different kinds of sand also were mutually compared. These experiments indicate that when properly proportioned limestone screenings produce a concrete which is considerably stronger than that made with any other form of sand. Roughly, the value of the materials is in the order following: Limestone screenings; moderately fine gravel with not more than four per cent of clay or loam; torpedo sand and Indiana bank sand, which latter, although very fine and clean, is composed of rounded grains of nearly equal size. In the physical laboratory all cement was thoroughly tested by samples taken from one bag out of every ten.



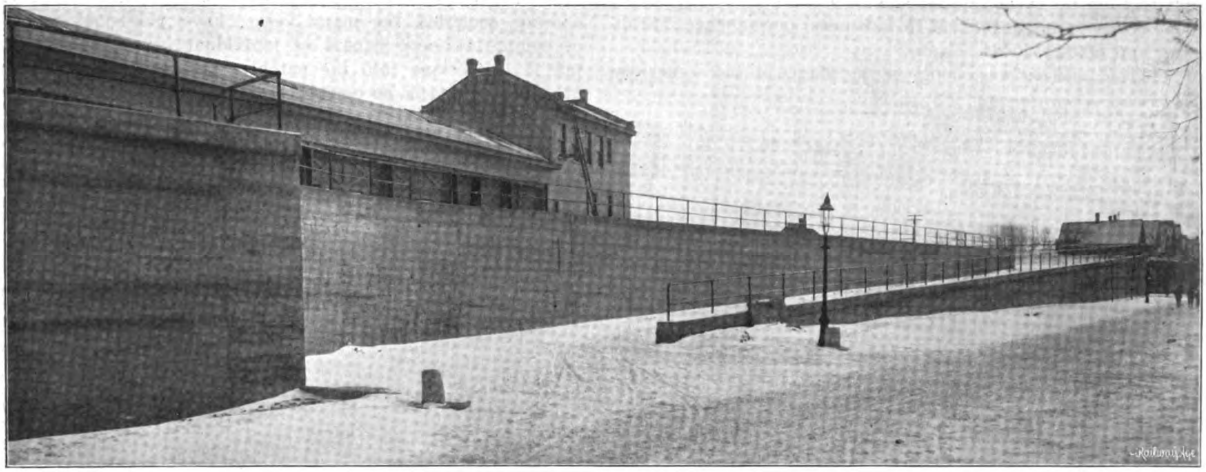
CHICAGO & WESTERN INDIANA TRACK ELEVATION—PLAN AND SECTIONS OF DIVISION STREET SUBWAY.

A wet mixture is greatly preferred on the Chicago & Western Indiana, and the concrete uniformly is put through the mixers as wet as it can be handled on conveyor belts or in wheelbarrows. With derricks and skips it is believed that a still wetter mixture can be used to advantage, but the conditions of the work prevented this method of operation. In building the walls a mortar face for all exposed surfaces was applied to the form immediately before the concrete was deposited, and here again the inability to use a wetter mixture was somewhat regretted, since it is believed that spading would secure a face equally good in appearance and perhaps with a better union between the surface and the main body of the concrete. It must be said here, however, that no scaling has taken place.

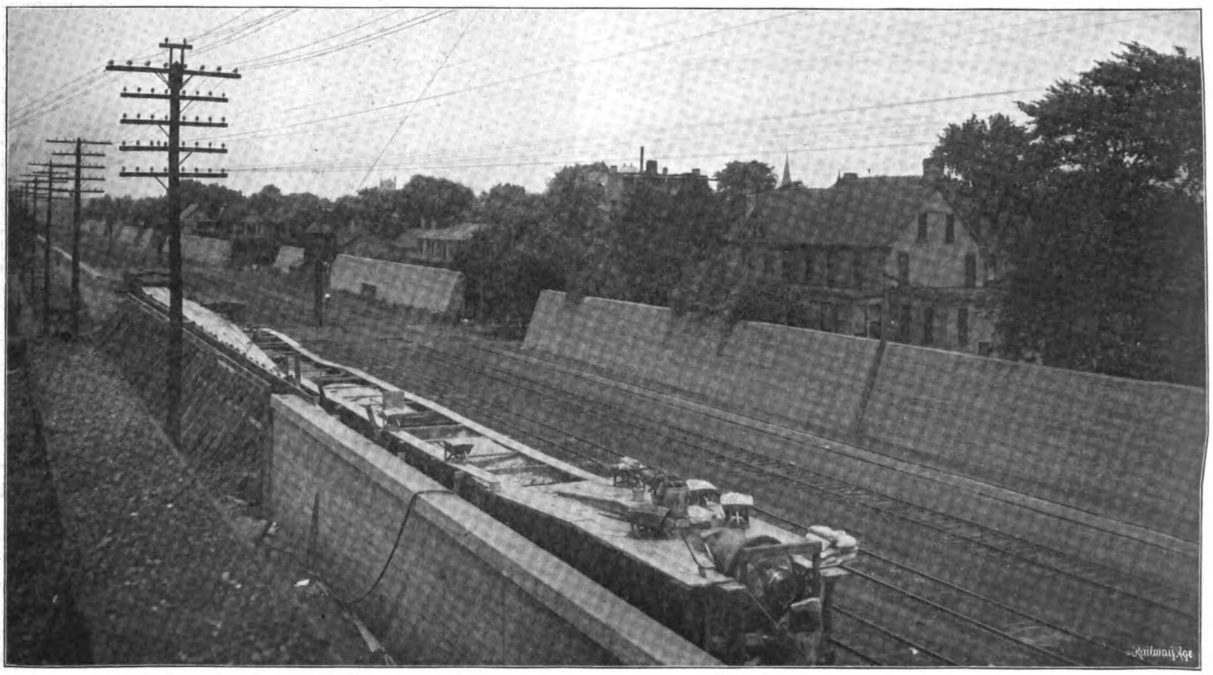
CHICAGO & WESTERN INDIANA TRACK ELEVATION—FILLING PARTLY DONE AND TRACK READY FOR SLIDING UP THE BANK.

West Side Elevation.

During the season of 1904 the West Chicago yard of the Belt Railway was elevated. This lies parallel with and adjacent to the Mayfair cut-off of the Chicago & Northwestern, extends from Kinzie street to the Council Bluffs division of the Chicago Milwaukee & St. Paul and, as already stated, involved about 20 miles of track. Although some preliminary work had been done here, the elevation of these tracks was begun actively on July 1, and the embankment, temporary trestles, rearranging and relaying of tracks were completed on the first of September. This was somewhat remarkable, since there was left to be done only the placing of the permanent bridges and the ballasting of the tracks when the embankment should have settled. During the progress of this work it was necessary to care for the traffic, amounting to between 800 and 1,000 cars per day, although the classification of this work was performed elsewhere during the two months in which active elevation was going on; the yard was restored to its normal duties immediately after September 1.



CHICAGO & WESTERN INDIANA TRACK ELEVATION—CONCRETE WALLS AND INCLINE AT SIXTY-THIRD STREET TEAMING YARD.



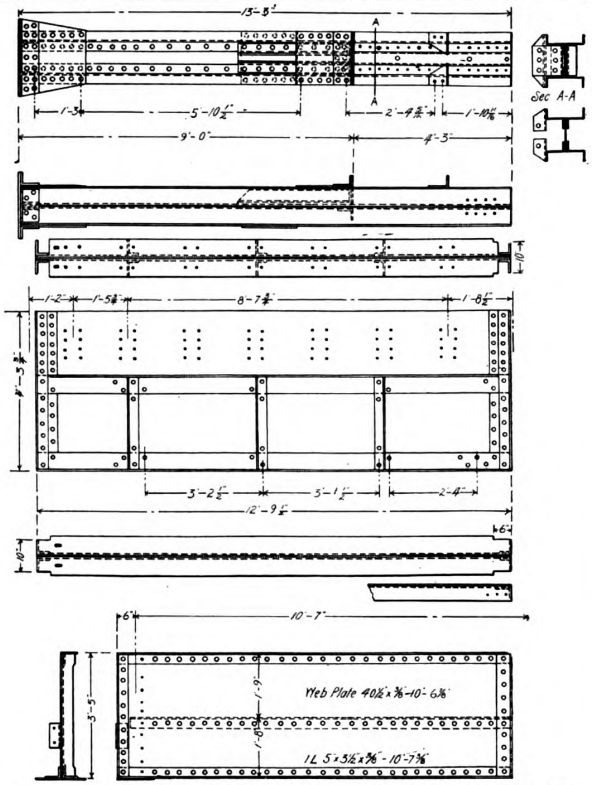
CHICAGO & WESTERN INDIANA TRACK ELEVATION—TYPICAL RETAINING WALLS AND CONCRETING TRAIN.

Girders.

Three principal elements were considered in the design of the girders used in all of this work—economy, tightness and freedom from noise. The advantage of a ballasted floor as compared with a decked plate floor was considered sufficient to warrant the adoption of the former, and the additional height of embankment required by this was found to be more than offset by the money saved in the use of the ballasted floor. In 1903, the girders bore a 15-inch I-beam floor, covered with creosoted plank, and finished with three-ply Hydrex felt, mopped with hot asphaltum cement. Above this was placed a half inch of asphalt mastic, but more or less leakage developed around the sides of the girders and gusset plates, and for this reason a concrete fillet was built against the side of each girder, covered with felt and then sealed with

asphalt. This arrangement has proved reasonably but not perfectly tight; consequently, in 1904, a change was made and a reinforced concrete floor, 4 inches thick, on top of the I-beams, and extending 1 inch below, as a weather protection, was adopted as a standard. This floor was waterproofed much as the former one, and is thought perfectly satisfactory, since many of them have passed through a hard winter without any indication of failure, and they are believed to be the best floors so far developed in tightness, permanence, cheapness and noiselessness.

These girders were built in the shops of the American



CHICAGO & WESTERN INDIANA TRACK ELEVATION—OUTSIDE WEB AND COLUMNS, DIVISION STREET SUBWAY.

Bridge Company and the Kelly-Atkinson Construction Company of Chicago performed the work of erection.

Work To Be Done.

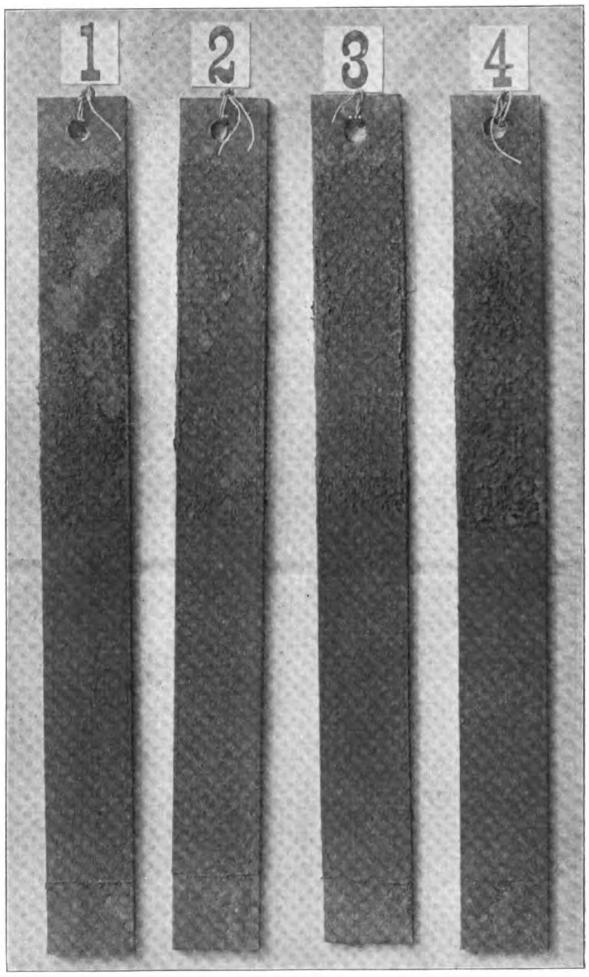
Although the ordinance under which this work is done covers from Seventy-third to Eighteenth streets, there are certain spots in that distance where special permission is required, and these necessarily are in an unfinished state. Among them is the Fifty-fifth street boulevard, which, however, it is hoped soon will be in a position to allow the completion of that part of the line.

In general, it is expected that the work of elevation will be completed as far as Thirty-fifth street during the coming season, leaving only that portion between Thirty-fifth and Eighteenth streets for subsequent operations. At the same time it is expected that the Fifty-first street yard of the Chicago & Western Indiana may be elevated; and, including all of the work yet to be done between Fifty-fifth and Thirty-fifth streets, it is believed that about twice as much is involved as was done during the year 1904.

Turney Drier Company, Louisville, Ky., announce that they have become associated with the Henry Vogt Machine Company, and have moved their office and works to the plant of that company, where new machinery is being installed for the manufacture of their direct heat and steam driers, roller and filter presses. President, Adam Vogt; vice-president, Henry Vogt; secretary and treasurer, Albert H. Vogt.

PROTECTING STEEL STRUCTURES.

Probably there is no detail of engineering work concerning which there is less knowledge or more failures recorded than in the apparently simple matter of protecting structural steel from the attacks of moisture and gases. Engineers have experimented with materials and studied this subject in a just proportion to its importance; engineering societies, for many years, have published reports of committees and papers of individual members, recounting investigations into the subject; and yet the chemistry of paints is nearly as elusive to-day as it was 20 years ago,



PROTECTING STEEL STRUCTURES—EXPERIMENTAL BARS.

and there are numerous places where the best paints fail within a few months.

The interesting studies here described are attributable to Mr. Louis H. Barker, C. E., now assistant chief engineer but until recently principal assistant engineer of the Pennsylvania Railroad in charge of maintenance of the United Railroads of New Jersey division. Mr. Barker began them upon assuming his late jurisdiction and has prosecuted them constantly ever since. This responsibility included the care of all structures, and of these structures the one most exposed to damage is the terminal station in Jersey City. For many years this structure has cost an average of $5,000 annually for painting alone, and even at this great expense the results have been far from satisfactory. The conditions, of course, are as bad as they can be. Locomotives on departing trains, with fresh fires throwing off the unconsumed gases of combustion combined with steam, deluge the truss