Exterior of Passenger Station

Eliminate 29 Busy Grade Crossings

New York Central and Grand Trunk Western complete extensive track elevation and construct joint facilities at South Bend, Ind.

THE New York Central and the Grand Trunk Western have completed track elevation projects of magnitude through the city of South Bend, Ind., which involved the elimination of 29 important street crossings at grade and of an interlocked railway grade crossing. In carrying out this work it was necessary for the Grand Trunk Western to build 1.3 miles of double-track main line, including three street subways and a six-span steel bridge over the St. Joseph river, the latter structure also separating the grades at two streets. When this was done, approximately one mile of main line which traversed Division street through the heart of the city was abandoned.

The New York Central elevated its tracks for 2.5 miles and extended its four-track system through the city. This involved the construction of 6 miles of temporary main tracks and 12 miles of permanent main tracks, 10 miles of which are laid with new 127-lb. rail and 2 miles with 105-lb. rail; the placing of more than 440,000 cu. yd. of filling; the construction of 8,200 lin. ft. of heavy retaining wall, which, together with bridge masonry and the walls and foundations for the passenger station, required the placing of more than 50,000 cu. yd. of concrete; the erection of 11 steel bridges, each carrying from four to eight tracks; the construction of enlarged passenger facilities, including a union station; and the installation of an extensive interlocking and signal system. As a necessary part of this work and preceding the elevation of the tracks, a new modern freighthouse and team tracks with paved driveways were built on a new site which provided room for present enlargement and later expansion. The cost of the project carried out by the New York Central was approximately $8,000,000 and of the Grand Trunk Western project $1,800,000.

For a number of years the continued industrial development of South Bend had created increasingly serious hazards at the numerous grade crossings over these two railways. The New York Central passes through the city from northwest to southeast, immediately south of the business district. Prior to the completion of the track elevation, the four-track system of this road ended near the westerly city limits, from which point two tracks continued east to Elkhart, Ind., 15 miles, where the line again expanded into four tracks. The double-track line of the Grand Trunk Western entered South Bend from the east, merging into a single track through the city, and extended due west through the business district, occupying Division street which carries a heavy vehicular traffic, and from which it turned southwest to cross the New York Central at grade, where double track was resumed.

Extended negotiations resulted, in 1924, in separate agreements between the railways and the city for the separation of grades and the removal of the track in Division street. A track-elevation contract ordinance was passed on January 9, 1925, under which the New York Central was to elevate its tracks and replace its passenger station with new facilities. The Grand Trunk agreed to relocate and elevate its tracks west of the St. Joseph river, so that they would lie north of and immediately adjacent to the New York Central, and build a separate passenger station. The latter road began the preparation of plans at once and started actual construction on May 10, 1927. It was necessary for the Grand Trunk to acquire considerable property, however, this being a slow process owing to the congested district through which its line was to pass, so that the starting of its work was delayed.

Agree to Joint Facilities

In the meantime a supplementary agreement was consummated between the city and the two railways, whereby

the relocation of the Grand Trunk was altered to enable it to operate over the New York Central tracks west of the river and use the station facilities which the latter was constructing. A supplementary contract ordinance was passed and after several minor amendments was accepted by both roads. This final agreement made no fundamental change in the New York Central plans. It was necessary, however, to make minor revisions in the track arrangement at each end of the section over which the Grand Trunk was to have trackage rights to provide for the Grand Trunk connections, to alter the details of two steel bridges and to extend the signal system to provide for interlocking the junction switches. This agreement also made possible the elimination of the crossing and interlocking plant at the point where the tracks of the two roads formerly crossed.

The final contract gives the Grand Trunk Western trackage rights over the New York Central for 1.54 miles and the joint use of the union station and passenger facilities. The old line of the Grand Trunk west of Michigan street has been removed from Division street, but that part east of Michigan street remains to serve the freighthouse, the team tracks and a number of industries which are located on this part of the line.

New York Central Track Elevation

The primary purpose of the New York Central in elevating its tracks was to eliminate the growing hazards which were presented by the street crossings at grade. A secondary but important reason was that by doing this it became practicable to extend its four-track system through the city and thus afford an opportunity later to fill out the gap which now extends to Osceolo, the first station west of Elkhart. Furthermore, there was a pressing need for expansion of its passenger facilities, which could best be accomplished by removal of its tracks from street level.

The track elevation proper begins about 0.5 miles west of the former crossing with the Grand Trunk Western and extends easterly for 2.5 miles on earth fill. The section between High street on the east and Chapin street on the west is confined between heavy retaining walls, with discontinuous retaining walls at several other points. The tracks are carried over the streets on steel bridges which are independent structures for individual tracks, except at High and Main streets where Bethlehem beams encased in concrete are used in order to accommodate turnouts and crossovers. The extension of the third and fourth tracks began a short distance west of the limits of the track elevation and ends at the eastern limits of the work, approximately 1.5 miles east of the new passenger station which occupies the site of the former station. In addition to the four main tracks, a switching lead and running track was constructed from a point just west of the former Grand Trunk Western crossing to Miami street, approximately two miles, and three station tracks were provided to serve the passenger platforms and the baggage, mail and express facilities.

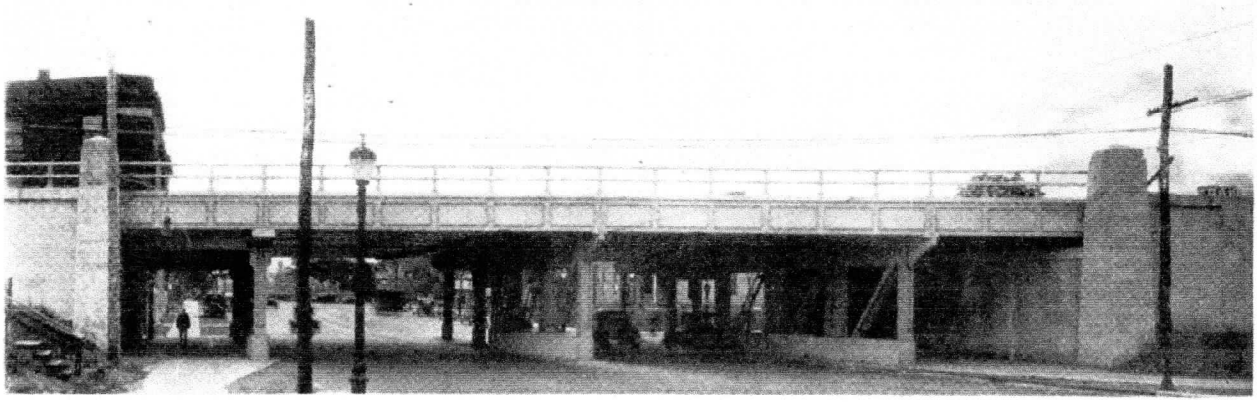
Prior to the track elevation, the New York Central freighthouse and team tracks were located immediately north of the main tracks and west of Scott street. This location not only interfered with the development of the passenger facilities, but, after the extension of the four-track system it would have been necessary to switch all cars to and from the freighthouse and team tracks across the main line passenger tracks almost at the throat of the station layout. Furthermore, the existing facilities had been outgrown, so that considerable expansion of these facilities was desirable, but was impracticable at this location. Accordingly, a new site was selected on Prairie avenue, some distance south of the original location, where adequate facilities have been constructed with ample room for future expansion.

Programming the Work

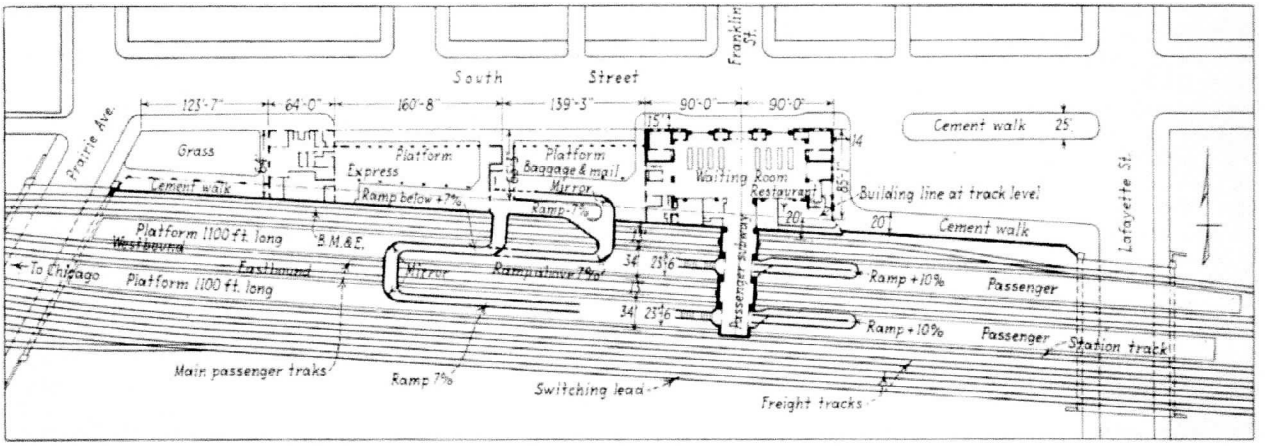
Between High street and the former Grand Trunk Western crossing the entire right of way is occupied by the new layout, so that within these limits the work was carried out under somewhat cramped conditions. Both the freight and passenger traffic passing over this line is heavy, with many important high-speed trains. It became necessary, therefore, to plan the work very carefully in order to minimize the interference with train movements and at the same time allow for as rapid progress as practicable on the construction of the various parts of the project. The removal of the freighthouse and its attendant switching greatly simplified the arrangement of temporary tracks and facilitated the placing of the filling material.

As soon as the freighthouse connections were removed, two temporary main tracks were constructed adjacent to the south right of way line from the G.T.W. crossing to the eastern limits of the work. This provided room for the construction of the north retaining wall, the abutments and piers for the bridges which carry the northerly two tracks, the subway and the ramps to reach the passenger platforms. As soon as the retaining wall and bridge masonry were completed, the grading and the erection of the bridge steel was started.

Owing to the heavy vehicular and foot traffic using the streets involved in the grade separation, it was planned to erect the steel bridges without recourse to falsework, in order to minimize the interference with this traffic. This was done at all of the streets except Michigan and Miami streets, where late delivery of the bridge steel made it necessary to employ falsework in order to avoid



Michigan Street Bridge, Looking South



Station Layout, Showing Ramps and Floor Plan of Station Building

delaying the construction program. By utilizing this method it did not become necessary to close any one of the streets for more than a few hours, besides which considerable saving was made in the cost of the work. As soon as the riveting was completed, the reinforced concrete floor slabs were placed so as to be ready for use as soon as the grading was completed. The erection equipment consisted of two locomotive cranes, one bridge derrick and one caterpillar tractor, the erection being carried out from the original track level.

Method of Grading

Likewise, the plan, as outlined at the beginning of the construction program, provided that the grading should be done without the use of a temporary filling trestle to avoid subsequent settlement of the tracks as the timber decayed. The contractor provided equipment, therefore, which enabled him to cast up the embankment for the first two tracks with material which was unloaded at the original track level from the side dump cars in which the filling material was delivered to the site of the work. This was done by means of three dragline graders and one caterpillar tractor, the latter being used for leveling off and compacting the material placed by the dragline equipment. The fill for the first two permanent tracks was completed in this manner and the tracks were laid. Before they were placed in service, however, the embankment for the third track was completed by dumping from the most southerly of these two tracks.

As soon as the first two permanent tracks were placed in service the temporary tracks were removed and the construction of the south retaining wall and the remainder of the bridge masonry was begun. The third track was laid, and as rapidly as the bridges were erected the placing of the remainder of the fill was carried on progressively from the permanent track level. The tracks at the west end of the work were raised under traffic, the raise at the G.T.W. crossing being six feet.

The material for making the fill was obtained from a pit at Ginger Hill on the Illinois division about nine miles from the site of the work. The contractor used a 5-cu. yd. dragline excavator for loading the 18-yd. cars in which the material was transported. The average rate of delivery was 96 cars a day, so that approximately 255 working days were required to place the 440,000 cu yd. of material which were used in making the fill.

When the temporary tracks were placed in service, temporary passenger and baggage facilities were constructed to serve them, and the existing station and platforms were razed. When traffic was turned onto the first two permanent tracks, the old freighthouse was utilized as a passenger station until the new union station was completed.

The retaining walls, exclusive of the bridge abutments, aggregated 8,200 lin. ft., and together with the bridge masonry required the placing of 45,000 cu. yd. of concrete. They range in height from about 6 ft. to more than 20 ft. above the footings. All walls and abutments are designed as gravity sections and, in general, are not supported on piles, the footings being spread to provide a safe unit-bearing load.

Street Bridges Designed for Heavy Loading

As has been mentioned, except at Main and High streets, independent bridges are provided for each track, so that the structures carrying any track can be removed or repaired without interfering with the use of the adjacent tracks. Each structure consists of half-through plate-girders, with sidewalk and roadway spans, and the tracks are carried on reinforced concrete floor slabs which are supported on I-beam floors. The concrete extends up to and over the top flange of the girders to protect them completely from brine drippings or other corrosive agents. Still further protection is afforded by the application of membrane waterproofing to the floor slab and the concrete which encases the inside face of the girders.

Because of the divergent tracks at the junction with the Grand Trunk Western at High street and the closing in of the station tracks at Main street, it was not practicable to use the through-girder construction at these streets, for which reason the tracks are carried on Bethlehem beams encased in concrete, which rest on transverse girders which, in turn, are supported on steel columns placed on the curb line at High street and at the center of the roadway and the curbs at Main street.

Prior to the track elevation, 14 streets crossed the tracks at grade, the crossing of Bronson and Michigan streets being at the intersection of these streets. Similarly, at Marietta and Ohio streets, the intersection was just outside the right of way, while there was a jog in Rush street where it crossed the tracks approximately at the crossing with Sample street. With the approval of the city, Rush and Ohio streets were closed across the tracks, but Ohio street was diverted south of the tracks so that a single subway serves to carry the traffic on Marietta and Ohio streets under the railway. A single bridge spans the intersection of Bronson and Michigan streets without disturbing the alinement of either. As a result of these changes, only 11 bridges are necessary to provide for the street traffic which formerly required 14 grade crossings.

Some of the streets involved in the grade crossing elimination are too narrow to serve efficiently the traffic they now carry. For this reason, the city plans to widen them as opportunity affords, and, in order that the subways at these streets might conform to this plan, the railway agreed to construct them to the proposed width and widen the streets for some distance on either side, the city paying for all work outside of the right of way lines. Accordingly, Fellows street was widened from 40 ft. to 60 ft.; Sample street from 40 ft. to 80 ft.; and Miami street from 50 ft. to 60 ft.; while the diversion of Ohio street was made 66 ft. wide, although the remainder of the street has a width of only 50 ft.

The Union Station

While the work on the track elevation was progressing, the construction of the passenger station and allied facilities was also under way, the walls for the passenger subway and ramps having been built at the time the north retaining wall was constructed. The station fronts on South street at the corner of La Fayette street and is located one block west of Main street, one of the principal north and south streets of the city. The passenger facilities include the station proper, with separate space masked from the main part of the building, for the handling of baggage and mail, and express.

The main part of the building, which is 180 ft. by 85 ft. in plan, is two stories high, the waiting room extending the full height of the building. Surrounding three sides of this room at the first floor or street level are the usual facilities for purchasing tickets and checking baggage, and the rest rooms and toilets. The concessions include a news stand, a restaurant, a barber shop and a taxicab stand. On the second floor the space surrounding the waiting room is given over to office purposes.

The main entrance to the waiting room is from South street, but passengers arriving or leaving in taxicabs use the entrance at the east end of the building. A wide passage leads from the main entrance to the subway, from which the platforms at the track level are reached by means of ramps and stairways. Separate ticket offices are maintained by the two roads, and these are located on the track side of the waiting room to the right of the passenger subway. At the west end of the waiting room, immediately to the right of the ticket offices, is the baggage counter for checking baggage and parcels and the delivery of hand baggage.

The exterior of the building, which is faced with a light gray brick, is severely plain but very attractive, the flat surfaces being broken by wide pilasters and panels. The arched roof which spans the waiting room, in combination with the vertical lines of the wall surfaces, gives an effect of height and great size and adds materially to the pleasing appearance which the building presents. On the South street front and the east end there is a 15-ft. concrete walk protected by long, deep canopies. Between the east end of the building and La Fayette street a large paved area provides parking space for automobiles and taxicabs.

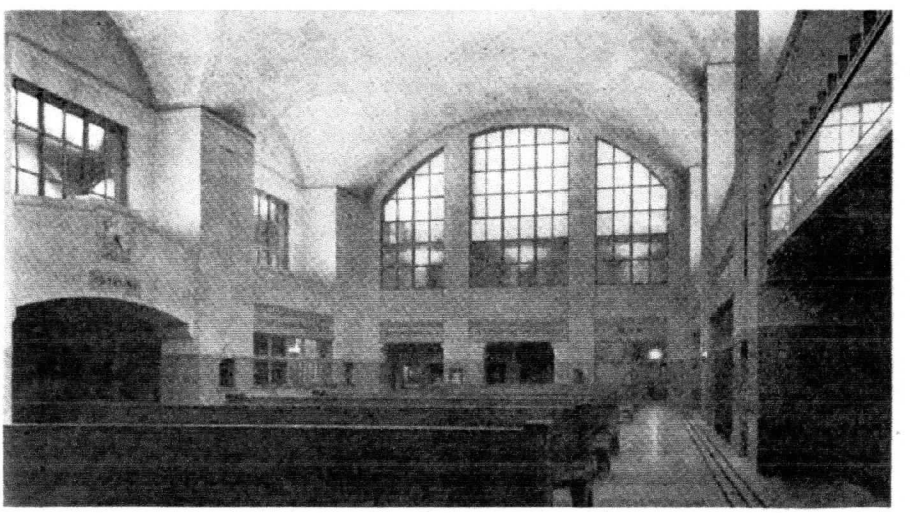
Features of the Waiting Room

The entire area at street level, except the ticket offices where wood floors are installed, is laid with terrazzo floors in alternate light and dark squares with three black bands for the border. The walls are finished in marble, the dado course being a dark-toned Botticino marble above which unpolished Tennessee marble extends to the ceiling. The Tennessee marble is omitted in the passenger tunnel, so that here the Botticino wall finish extends to the ceiling. The ceilings in both the waiting room and tunnel are of the barrel-vault type, the arches being constructed of light buff Gustavino tile. The groins at the intersecting arches which span the window openings are edged with darker tile, and small inserts and panels of darker tile in patterns have been introduced to break the monotony of the large vaulted surface. At lintel height, legible signs with recessed lettering indicate the location of the various facilities and concessions.

The large window areas provide ample daylighting, but without glare. The night lighting is of the indirect type and is accomplished by means of floodlighting units concealed in the parapet of the balconies on either side of the room. Fourteen units are employed in each of the center panels and 18 in the end panels to give a soft well diffused light. Half-hidden lights, not of the floodlight type diffuse a soft radiance through the passenger tunnel. Direct lighting is employed in the ticket offices and other rooms exterior to the waiting room.

Twelve radio clocks, which are controlled by a master clock that is regulated hourly by radio, are distributed throughout the public rooms and the various facilities, thus making it possible for both patrons and employees to ascertain the time from almost any position in the entire station. One of these clocks can be seen in the view of the waiting room.

The public rooms are heated by the indirect system of heating from a self contained heating plant in the basement. The Sturtevant system of heating and ventilation is used, there being no direct heating units in the building, except in the office on the second floor.



Waiting Room, Looking Toward Baggage Room

Separate facilities at street level have been provided for handling baggage and mail, and express, the quarters for these operations being in that part of the station building located immediately west of the main part of the structure. The baggage and mail room is 139 ft. by 65 ft., while the express room occupies an area 160 ft. by 65 ft., with additional office space 64 ft. by 64 ft. The main feature of both facilities is the high receiving and delivery platforms which are at wagonbed level. The floor upon which the trucks and trailers run, upon which shipments are taken to the platform at track level, are at street level. The station platforms are reached by an intricate system of ramps, one of which has two stages, as shown in the drawing.

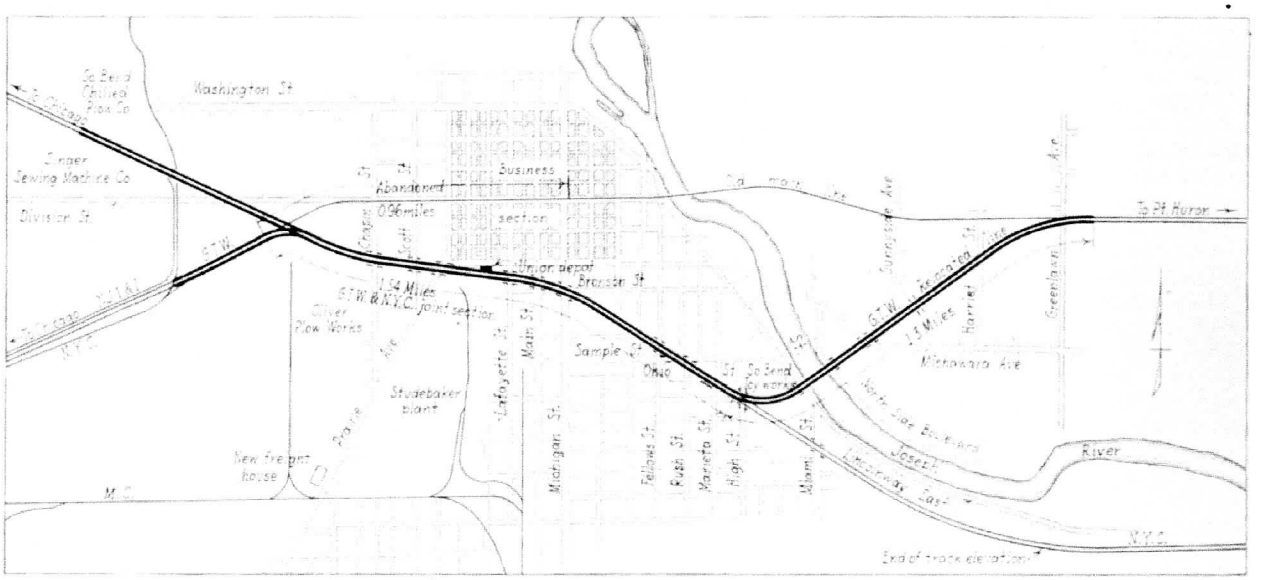
Two station platforms, each 1,100 ft. long have been provided, the main passenger tracks being between them, with supplementary station tracks on either side. The third station track which was mentioned earlier, lies adjacent to the platform along the building and is used exclusively for unloading and loading baggage, mail and express cars which are received at or dispatched from South Bend.

A single interlocking plant controls all of the switches from the end of the four-track system on the east to the crossing with the Illinois division on the west, a distance of 3.68 miles. The interlocking machine, which is of the all-electric type furnished by the General Railway Signal Company, has 259 working levers and is housed in a three-story brick tower, 17 ft. by 70 ft. which conforms in appearance to the station to which it is adjacent. All signals are of the color-light type, with approach lighting. They are mounted on ground masts, bracket masts or signal bridges as required to bring them to the right of the tracks they govern. Track 5, the switching track, is signalled in both directions, all other tracks being signalled for the normal direction only. A complete description of this plant and its operation appeared in the July issue of Railway Signaling.

Grand Trunk Western Diversion

Immediately east of South Bend, the Grand Trunk Western and the New York Central are about a mile apart and from this point the lines formerly converged to the point of crossing, about one mile west of Michigan avenue. To obtain a connection with the New York Central, it was necessary for the Grand Trunk Western to begin its diversion approximately 1.5 miles east of Michigan avenue. The relocated line turns sharply to the southwest on a long easy curve as it leaves the old line and crosses the St. Joseph river nearly at right angles and then curves again to the west to join the New York Central at High street. This double-track diversion is carried on a high embankment for 1.3 miles, crossing Harriet street, Sunnyside street, Mishawaka avenue and the two streets which parallel the St. Joseph river on either bank of this stream. East of the river the fill was made by means of trucks with basement and other excavation from building projects in the city. Since the line passes through a recently-developed high-class residential and park district the slopes have been carefully dressed and sodded.

The height of the embankment facilitated the separation of grades at all of the five streets which are crossed. The principal structures on the new line are at Mishawaka avenue and the St. Joseph river. The tracks are carried over Harriet and Sunnyside streets on I-beam spans encased in concrete, which are supported on concrete abutments and reinforced concrete piers. The pleasing design of these structures is accentuated by the paneled parapets which mask the tracks. Mishawaka avenue is crossed by means of a skew barrel arch having a clear span of 70 ft., the springing line of which is about 6 ft. above the sidewalk.



Grand Trunk Diversion and Trackage Rights Over New York Central, South Bend, Ind.

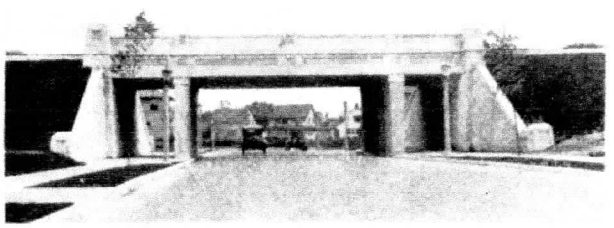
The arch has a rise of 15 ft. 9 in., giving a clearance of 20 ft. at the center of the street and 13 ft. at the curb. The cellular-type abutments are supported on creosoted piles to decrease the dead load and are filled with granulated slag to the elevation of the subgrade. Asphalt membrane waterproofing was applied to the barrel of the arch and this is protected with a layer of asphalt mastic blocks, over which a 6-in. layer of crushed stone was placed, with a system of cast-iron drain pipes embedded in the stone. The large surface of the spandrel walls and parapets is relieved by recessed panels. The entire exposed surface was waterproofed with an iron waterproofing applied with a cement gun, after which a cement finish was applied in the same manner. The construction of this arch required the placing of 2,000 cu. yd. of concrete, which was mixed at the site of the work. The concrete for the abutments was spouted from a bucket in the hoisting tower which was high enough to reach all parts of the work. The concrete in the arch and spandrel

walls was placed by means of bottom-dump concrete cars which operated on a narrow-gage track and which were filled from the hoisting bucket. Street-car traffic was maintained at all times during construction, but vehicular traffic was detoured during the depositing and curing of the concrete in the arch ring.

St. Joseph River Bridge

The bridge over the St. Joseph river consists of four 107-ft. deck plate-girder spans over the channel and two 90-ft. half-through spans, one over the North Side boulevard along the east bank of the stream and the other over the Lincoln highway on the west bank. The outer girders of the boulevard spans are masked by concrete fascia and the piers and abutments which support them are extended upward as pylons to add to the decorative effect. On the channel spans the tracks are carried on reinforced concrete floors which rest on the top chords of the girders and are cantilevered out 4 ft. 9 in. to form a walk. The shorter spans are designed with I-beam floors which are encased in concrete which extends to the top of the girders and is also cantilevered out to form a walk. The concrete is also carried down on the outside faces of the outside girders of these spans to form the fasciae, the reinforcement of this concrete being wire mesh supported by longitudinal bars which are carried through holes in the legs of the stiffening angles.

The east pier and the cellular concrete approach which

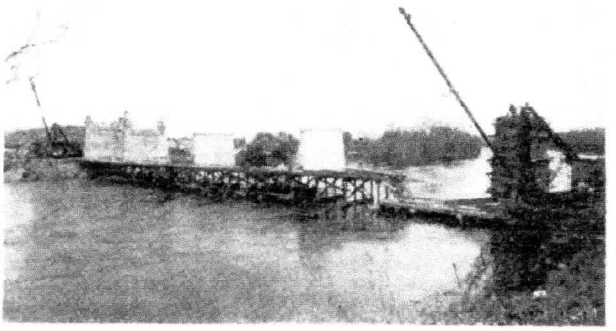


Grand Trunk Bridge Over Sunny Side Avenue

acts as an abutment are supported on concrete piles. The west abutment, which is similar in design to the one at the east end, rests on a stratum of gravel as do the channel piers which reach a depth of 16 ft. below low water. The foundations are protected by steel sheet piling which were used in the coffer-dams. They were anchored to the footings and left in place for this purpose.

In preparing for the construction of the piers, a wide low-level pile trestle with a wood plank floor was driven on the down-stream side of the structure. The coffer-dams were driven with a steam hammer working from a portable stiff-leg derrick from the deck of the trestle. After the driving was completed, the derrick was equipped with a clam-shell bucket for excavating the foundations. Later the same derrick handled the concrete from the mixer to the forms. The excavation was cast outside the coffer-dams and used for backfill.

When the footings were completed, the trestle was raised about 10 ft. on frame bents to facilitate the handling of the forms and concrete for the neat work. It was found convenient to utilize the aggregate storage and proportioning equipment which were being used for the arch at Mishawaka avenue, as it was only a short distance from the river. The aggregates were proportioned at this point and handled to the mixer in trucks. A mobile mixing plant was employed, which could be moved readily to the most convenient point on the trestle for work at any of the piers, the concrete being handled from the mixer to the forms by the portable derrick.



Construction Trestle, Bridge Over St. Joseph River

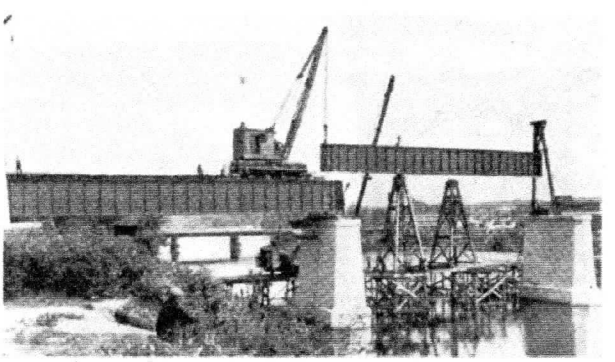
A total of 12,000 cu. yd. of concrete was placed in the substructure in this manner. The water-cement ratio was used for the concrete in this bridge as well as in the remaining structures on this line; the concrete for the arch ring at Mishawaka avenue was Class B concrete which has a required strength of 3,000 lb. per sq. in.

Erection Methods

Erection of the bridge over the St. Joseph river began at the west end, the girders being brought in over the connection with the New York Central at High street. The girders for the westbound track were placed first on each span, after which the girders for the eastbound track were erected, thus completing the double-track structure before proceeding to the next span. The girders for the span over the Lincoln highway were placed directly by a bridge derrick having a 60-ft. boom, thus avoiding the necessity for the use of falsework which would have obstructed the heavy traffic on this street. As a precaution, however, traffic was halted while each of these girders were being lowered onto its bearings.

The longer river spans were erected by an ingenious method of launching to a position where they could be lowered into place, thus avoiding the construction of expensive falsework. As each girder was to be erected, it was unloaded from flat cars at the west end of the bridge and placed on two 40-ton car trucks, then pushed slowly forward by a locomotive crane until its end rested on a timber tower equipped with dollies and vertical guide rollers, which was located about one-third of the way across the opening. The forward truck was then removed and a line from a hoisting engine was attached to the girder to pull it forward. This line passed through pulleys in an A-frame located on the pier next in advance. The launching continued until the girder rested on a second tower where a set of lifting blocks and line from the A-frame were attached. Thus, as the forward end reached the pier it was held suspended in the A-frame

(Continued on page 1234)



Erection of a River Span, St. Joseph River Bridge

Eliminate 29 Busy Grade Crossings

(Continued from page 1219)

at one end and by the derrick at the other. It was then raised to release the towers, which were picked up by the stiff-leg derrick, thus permitting the girder to be lowered onto its bearings. These temporary towers rested on piles and were moved to the next span where this method of erection was repeated.

The construction of the fill was started in May, 1926. The bridges crossing Harriet street and Sunnyside avenue were started in June, 1928, and completed during November of that year. Work on the river bridge began November 1, 1928, and the structure was completed August 14, 1929. The heavy fill west of the river was started on September 5, 1928, and completed during September, 1929. The Grand Trunk Western began operation over this line and the joint tracks with the New York Central at midnight on September 28, 1929.

The work on the New York Central was carried out under the general direction of R. O. Rote, chief engineer, H. B. Reinsagen, assistant chief engineer, and A. P. Button, engineer of grade separation. I. G. Webster, resident engineer, had charge of all field work. The bridge structures, including the retaining walls, passenger subway and ramps at the station were designed by B. R. Leffler, engineer of bridges. The union station was designed by Fellheimer-Wagner, architects, New York City.

The Walsh Construction Company, Davenport, Iowa, had the contract for all of the work connected with the project, except the fabrication of the structural steel in the bridges. This company did all of the work with its own forces except the erection of the steel bridges, which it sublet to the F. K. Ketter Company, Chicago.

The work on the Grand Trunk Western was planned and carried out under the direction of J. A. Heaman, chief engineer, and F. P. Sisson, principal assistant engineer. The structures were designed by A. N. Laird, bridge engineer and the construction was in charge of W. Glen Heggie, field engineer. Whitcomb & Keller, South Bend, Ind., did the grading east of the river, while the embankment west of the river was constructed by the Walsh Construction Company as an extension of the grading on the New York Central. The Meade-Balch Construction Company, Indianapolis, Ind., erected the bridges at Harriet and Sunnyside streets. Foley Brothers, Inc., and Peppard & Fulton Co. constructed the arch at Mishawaka avenue, and the bridge over the St. Joseph river, including the erection.