The North or Entrance Elevation of the Station Head House

St. Paul Union Depot Completed

Limitations of site and demands of traffic imposed a nine-year construction program

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THE new passenger terminal improvements of the St. Paul Union Depot Company, which have been under construction since 1917, are now completed, with the exception of five platforms on newly made fill, which will not be built until the fill has settled. Although construction work started in 1917, the work of planning had commenced in 1911, over one hundred schemes being prepared and discarded before the one finally decided upon was selected.

The plan which was finally adopted in the spring of 1917, and to which the construction work has conformed, with minor changes, is described herewith. The headhouse is located in the block bounded by Sibley, Fourth, Wacouta and Third streets. There are 8 stub and 13 through passenger tracks, as well as four freight tracks, two of which belong to the Chicago, Milwaukee & St. Paul, elevated about 19 ft. above those in the old station. The waiting room is over the tracks, leading to platforms by stairways, and connected to the headhouse by a concourse on a grade of about two per cent, the headhouse floor being about 2½ ft. lower than the waiting room floor.

Limited Working Space Imposed Complex Construction Plan

The old station building, destroyed by fire in October, 1913, and the station yard occupied the space south of Track 8 in the new layout. The ground between the old yard and Third street, and between Sibley and Wacouta streets, was occupied by warehouses, used as a temporary depot. The old yard was inadequate, which precluded the abandonment of any tracks before new facilities for traffic were provided. This made it necessary to divide the work into periods or stages, each of which had to be completed and turned over to operation before work could commence on another. These periods were as follows:

1. Build the headhouse thus releasing the old warehouse used as a depot.
2. Build the structure to support the first six tracks with platforms and train sheds, and lay tracks, thus releasing six tracks in the old yard. Build the concourse and a portion of new waiting room.
3. Build an addition to the waiting room on the structure for supporting the second six tracks, with platforms and train sheds and lay tracks. Four of these were through tracks, so four through tracks in the old yard were thus released.
4. Build the next four tracks complete, releasing all of the old yard except the freight transfer, and complete the waiting room.
5. Build the next three tracks complete releasing the remainder of the old yard.
6. Complete the work.

It will be seen that there were six complete construction jobs, explaining why it has taken seven years to build the station. It may be added that delays due to the world war account for two years' lost time.

The work of the first period was described in the *Railway Age* of May 21, 1920, page 1442; that of the second period in the issue of December 17, 1921, page 1200; and that of the third period in the issue of March 20, 1924, page 827. This article deals more particularly with the work of the fourth, fifth and sixth periods.

The remaining 90 ft. of the waiting room was completed in December, 1924, extending to the platform between Tracks 17 and 18. A passageway from the south end to an elevator and stairway between Tracks 19 and 20 was completed in December, 1925.

The train sheds are of the butterfly type, built of steel framing, and with a wooden deck extending to within 18 in. of the center line of track. The sheds for the fourth, fifth and sixth sections were erected in 1925, on newly made fill. Separate spread footings were built for each column, with the top four feet below the platform.

The shed columns were erected on wooden wedges and anchored, but were not concreted, as it may be expected that considerable settlement will take place. When permanent platforms are built, the columns will be concreted below the platform line. Two six-inch H-section columns were used for wide sheds instead of a single column; but both columns were supported on a single spread footing to prevent racking due to uneven settlement.

The St. Paul Union Depot is the transfer point for mail and express for the northwest. An average of 1,300 tons

The West Approach

of mail is handled daily through the station, the greater part of which is transfer business which has to pass through the terminal railway post office for sorting and distribution. It was, therefore, necessary to provide commodious quarters for this business and make allowances for future growth. In fact, before the work was completed, it was thought necessary to increase the mail quarters beyond those originally planned and 50,000 sq. ft. of space was added. For the purpose of handling mail, express, baggage and milk, 300,000 sq. ft. of floor space has been provided, entirely under the tracks.

All of the track structure, except the additional 50,000 sq. ft. in the southeast corner along Sibley street, was completed in the third period, and has been previously described. It is a reinforced concrete flat-slab structure on pile foundations.

Connection between the under-track rooms and track level is made by elevators, ramps and chutes. The elevators and chutes have been described in previous articles. The original intention was to provide only elevators, but, after three years of service, it was found that elevators were too slow for the volume of business to be handled, and two ramps, one at each end, were added, at the sacrifice of a station yard track.

Subways for Street Traffic

Subways carrying Sibley, Jackson and Second streets under the tracks were built during 1924 and 1925. The subways at Sibley and Jackson streets have columns in the center of the streets and at curb lines. Sibley street has two 22-ft. roadways and two 16-ft. sidewalks. Jackson street has two 18-ft. roadways and two 10-ft. sidewalks. The column spacing in Sibley street is 14—26—26—14; in Jackson street 8—22—22—8. The vertical clearance for Sibley street is 13 ft. 6 in.; for Jackson street, 12 ft. 6 in.

The structures for these two subways are similar, consisting of reinforced concrete slabs and girders on spirally reinforced concrete columns. The sidewalls of the Jackson street subway consist of self-supporting mass retaining walls. The west sidewall of the Sibley street subway is a mass wall, while the other is a two-foot reinforced wall, acting as a pier and partition between the street and the under-track rooms. The structures are designed for Cooper's class E 60 loading, with 25 per cent impact with tracks at an assumed spacing of 14 ft. The Sibley street subway is 202 ft. long with skewed portals at each end. The Jackson street subway is 93 ft. long with a skewed portal at the south end.

The Sibley street subway was built in four sections during the third, fourth, fifth and sixth periods of work to comply with the construction program. The Jackson street subway was built in three sections during the third, fourth and sixth periods of work.

Connecting the subways at Sibley and Jackson streets, a distance of 254 ft., and extending 162 ft. beyond Jackson street a subway has been built for Second street to give access to the Omaha freight depot. This has two 20-ft. roadways, with a line of columns between them.

The Waiting Room as Seen from the Concourse

The sidewalls, slab and columns of the Second street subway are built of monolithic reinforced concrete, designed transversely by the slope-deflection method, with unit stresses and loadings the same as in the Sibley street subway. Longitudinally the steel was proportioned according to the rules of the Chicago building code for flat slabs with two-way reinforcing. Piles in the footings were offset from the center of columns and wall so as to produce bending moments equal to and opposite from those in the columns and walls. The structure was built during the third and fourth construction periods.

Another subway under the tracks, leading from Broadway easterly to a teamyard, was constructed during the second period of work. The north side is open through-

out the whole length; the south side consists of a mass wall, supporting the elevated structure. The roadway narrows from 35 ft. wide at the Broadway end to 20 ft. at the east end, where a 3½ per cent ramp leads to the team yard. It is paved with an eight-inch reinforced slab.

All subway structures are waterproofed with four plies of asbestos and one of cotton fabric, protected with 1¼ in. of asphalt sand mastic. The roadways in the street subways are paved with second-hand granite blocks on a six-inch concrete base. They are lighted by 200-watt lights spaced about 40 ft. center to center.

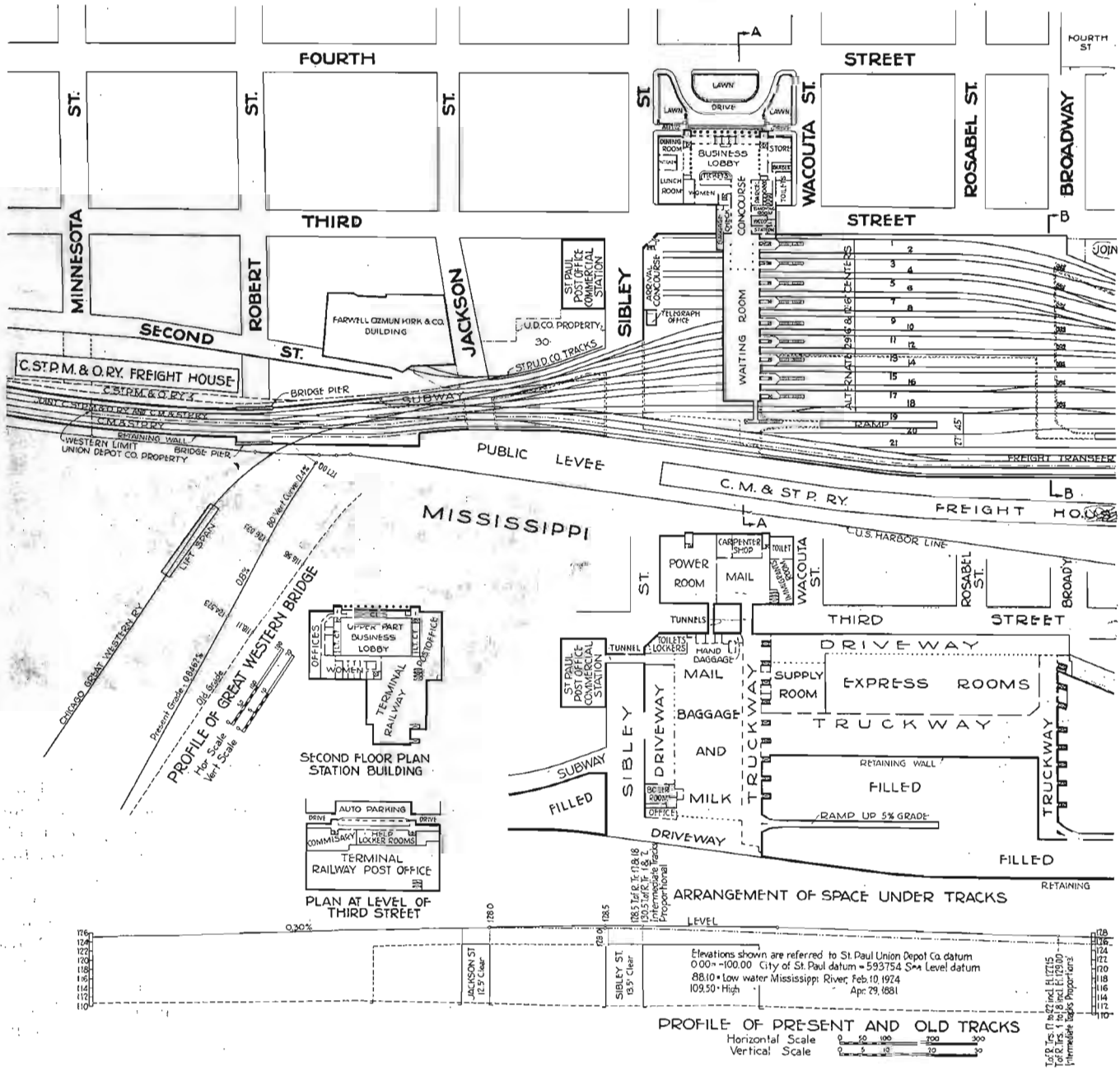
The larger part of the retaining walls in the project are of the mass type, 18 in. wide at the top and with a batter of 4 in. to the foot on the rear side. Footings are five feet six inches thick, with the bottom six feet below the surface. The footings were built of 1:3:6 concrete and the neatwork of 1:2½:5 concrete. The walls were poured in alternate sections, 30 ft. long, and to date no cracks have developed due to settlement or temperature, although considerable settlement has developed along the north side of the team yard, due to subsidence.

Use Cellular Retaining Wall

The retaining wall from the return near Jackson street to Minnesota street is built of reinforced concrete cells, in 30-ft. sections, with two back stays in each section. The height varies from 16 to 27 ft. above the ground. This wall is along the river bank, on fill and rip-rap placed many years ago. The type was selected because it introduces the least toe pressure on the footings of all types of retaining walls.

The Track Layout

The track layout is shown in the drawing. There are 21 station-yard passenger tracks and five freight tracks. All tracks connect through the east throat, with the two main connections at this end forming a wye. The through tracks all connect through the west throat to the two main connections, the Chicago Great Western crossing the yard diagonally from one side to the other, to effect a connection with a bridge across the Mississippi river. To provide against possible interference to traffic due to derailments, crossovers, pocket tracks and auxiliary leads are



Track Layout and Floor Plans of the Station

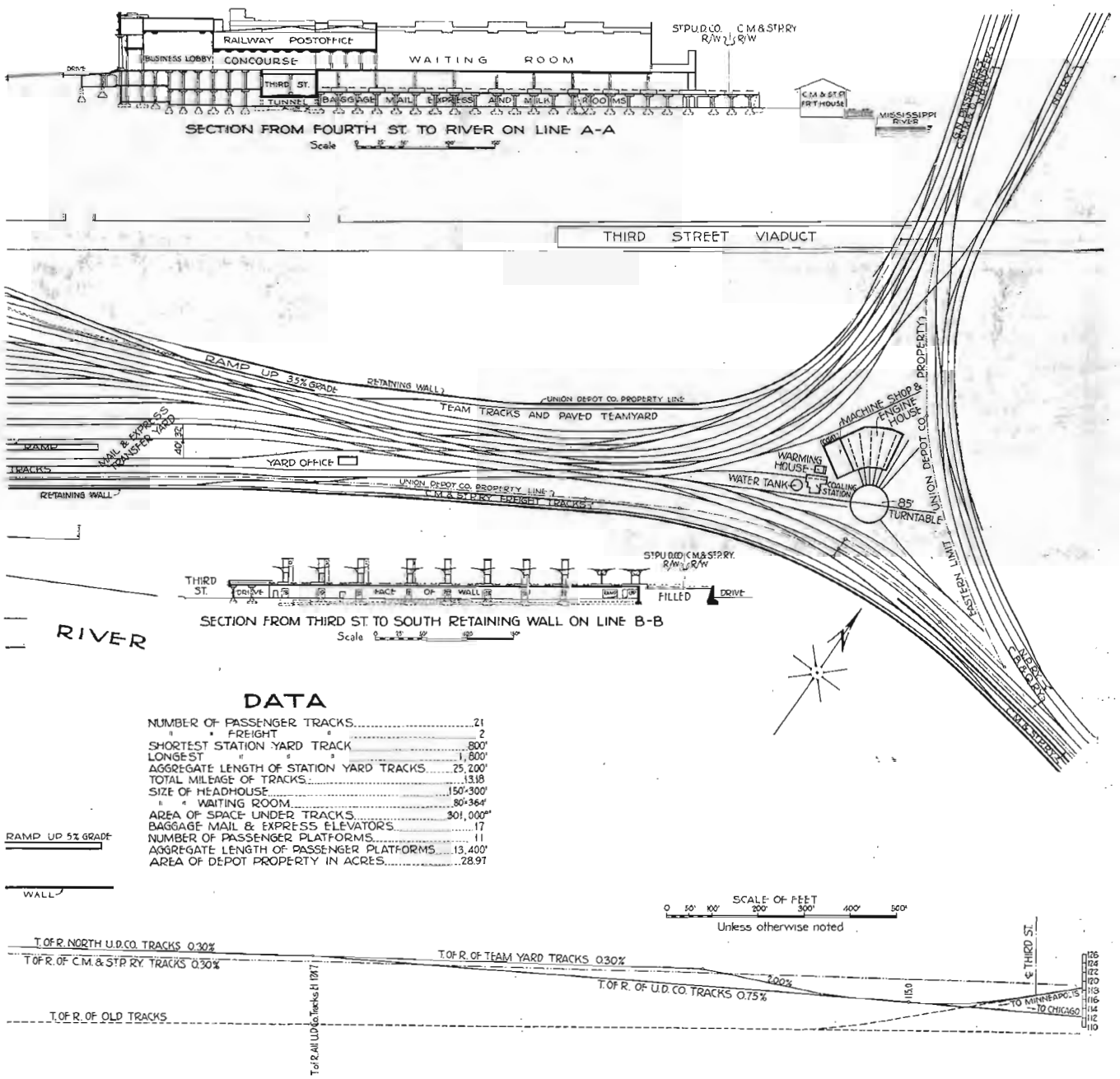
so arranged so as to give several routes from any lead to any track in the yard.

Along the north side of the property, east of Broadway, a paved team yard was provided for delivering direct from baggage and express cars to motor trucks, and for icing fruit and fish express cars. The yard has a capacity of 16, 80-ft. coaches. Tracks 17 to 21, inclusive, are used mainly for the transfer of express and mail and for the advance loading of cars. Track 20 has a platform on each side. These tracks have a capacity of 90, 80-ft. coaches.

All rail used through the new layout is 90-lb. A. R. A. type A open-hearth rail. White oak cross and switch ties were used without treatment. Ballast consists of bank run gravel and cinders, except on the track structure and subways, as considerable settlement will occur and the tracks will have to be re-ballasted several times before becoming stable. On the track structure and subways, washed gravel and crushed limestone ballast was used.

With the exception of a few turnouts on curved tracks at the east end, where No. 14 frogs were used, all frogs are No. 8 in turnouts and slip switches. There are 83 turnouts, 42 double slip switches and 11 crossings, one with movable frog points. Switches were built according to A. R. E. A. Plans 101, 201 and 203, specification F, except that rail braces were provided with three spike holes. Frogs were built according to A. R. E. A. Plans 303 and 305, with a four-foot center plate. Slip switches were built according to A. R. E. A. Plan 801, with rail-bound manganese frogs, A. R. E. A. Plan 603. Crossing frogs were built of rail-bound manganese, according to A. R. E. A. Plan 765. Switches are non-insulated, as no interlocking plant is to be installed.

During the progress of the work it was necessary to make many temporary track connections and shift the old tracks to permit new construction. During the work of the third, fourth and fifth periods, trains were operated on two levels, connected together at the throats at each end. This made it necessary to raise these throats under traffic, many slip switches being raised 10 ft. or more. During the winter of 1924-25 the Chicago Great Western, having no connection to the high level at the west end and the



East Approach to the Station and Typical Sections

low level station yard tracks being abandoned, with the exception of a single freight transfer, found it necessary to make a switch back movement in order to get to the depot. The last low level track was removed in February, 1925, the Great Western detouring over the South St. Paul bridge for 4½ days.

The fourth period fill was practically all made with Western standard gage 20-yd. air dump cars. The contractor furnished 20 of these cars for the work, divided into two trains. Material was obtained from property of the Great Northern Terminal Railway Company, near Mississippi street, about one and one-half miles from the depot. The average carload was 21.4 cu. yd., the best day's work being 140 carloads in 10 hours, in spite of having to haul over very busy tracks and dump in the yard when opportunity offered. During the month of July, 1924, 80,000 cu. yd. of fill was made. A Jordon spreader was used for trimming the dump. A total of 190,300 cu. yd. of fill was placed by this method in 1924.

The same method was used for filling in the sixth period, 65,800 cu. yd. of fill being made in 1925. Additional filling was furnished in gondola cars to enable switches to be laid in the east throat during the summer, while the old work, which had been partially raised under traffic the previous year, was replaced by new work. Considerable filling material was obtained from the excavation for the south retaining wall. The total volume of fill made for the entire job was about 480,000 cu. yd.

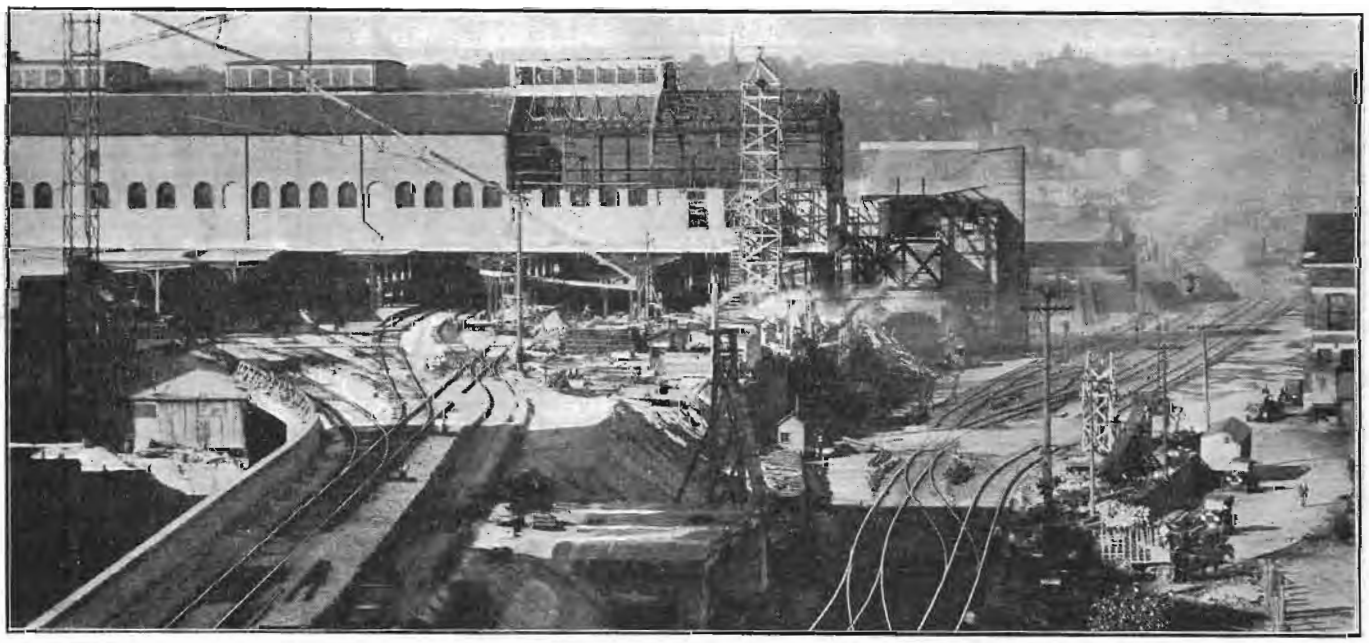
In order that filling operations could be carried out in the various periods without interfering with traffic on the low level, about 4,000 ft. of timber cribs and 1,000 ft. of dry stone wall were built. Cribs were built out of second-hand ties from the old yard, old timber from wrecked buildings, and new undersized tamarack ties, purchased for 50 cents each. The cribs were from 3 to 18 ft. high.

The Chicago Great Western bridge is a single-track structure with a vertical lift span, 189 ft. long, over the navigable channel of the river which is near the north or station bank. To provide for the change from the old to the new level of the tracks in the station it was necessary to raise the north end of this bridge about 16 ft., a project which was attended with considerable difficulty on account of the lift span.

Between each pair of tracks in the station yard, water connections have been located about 120 ft. apart. Steam connections for heating cars are located at the west end of the stub tracks, between each pair of tracks at Broadway, and at about 250-ft. intervals east of Broadway between Tracks 16 and 21. Train lighting outlets, with alternating current at 32 and 64 volts, have been located at the west ends of stub tracks, between Tracks 16 and 19 near Sibley street, and between Tracks 16 and 21, 180 and 430 ft. east of Broadway.

A yard office has been built south of the east throat, but north of the freight transfer tracks. It is a wooden-frame structure, sheathed with Celotex, finished with cement stucco and roofed with red Hawthorne cement tile. As it was erected on newly made fill, the ground floor and foundation walls were built in the form of a reinforced concrete raft.

The general plans and most of the details of the project were developed under the direction of W. C. Armstrong, who was chief engineer of the Depot company from January, 1915, until his death in June, 1923, when construction had been carried through the first and second stages. He was succeeded by Col. Frederick Mears, who was chief engineer until May, 1925, and directed the work through the third, fourth and fifth stages. The writer, who had been structural engineer and later principal assistant engineer, has been chief engineer since Col. Mears' resignation. O. L. Hoebel was assistant engineer in direct charge of construction from May, 1917, to June, 1922. W. B. May was assistant engineer in immediate charge of construction from April, 1923, to June, 1925, since when he has been principal assistant engineer. C. P. Bohland was chief inspector from June, 1923, until the completion of the work.



A Construction View Showing the New High Level Tracks on the Left and the Last Low Level Tracks on the Right

Charles S. Frost of Chicago was the architect for the headhouse and the waiting room, for whom the Toltz Engineering Company of St. Paul (now Toltz, King & Day, Inc.) were consulting engineers, and Neiler, Rich & Co. of Chicago were mechanical and electrical engineers. Neiler, Rich & Co. were also retained with respect to other parts of the project.

Foley Brothers, Inc., was the general contractor for the third and subsequent periods of the work, with D. A. Daly as general superintendent and J. R. Holmes as superintendent on the job.