Track Depression at Mattoon; Illinois Central R. R.

SYNOPSIS—Details of a grade-crossing elimination, involving cuts and special reinforced-concrete bridge crossings.

The elimination of grade crossings at Mattoon, Ill., has been complicated by the fact that two railways intersected near the center of the city. With a train standing at the station or a long freight train passing over one line and trains held on the other line, the street traffic was blocked to a serious extent. The plan adopted was to lower the Illiniois Central R.R. (as having the heavier traffic) and to leave the Cleveland, Cincinnati, Chicago & St. Louis Ry. unaltered. At the intersection a two-story union station will be built, with station facilities on the first floor and railway offices above, stairs leading to the platforms of the depressed tracks.

The grade is lowered through the city for about 7000 ft., and continues for some distance beyond, to the freight yards. This eliminates a former summit with 0.6% grades and gives a slight sag, with descending grades of 0.3% from the south and 0.05% from the north. This effects a material improvement in the operation of the division. The maximum depth of cut is about 28 ft. The C., C., C. & St. L. Ry. will be raised about 2 ft. at its bridge over the cut, and five street bridges will be built. An inclined transfer track north of the station will provide for interchange between the two lines.

The Illinois Central R.R. has a 200-ft. right-of-way, and the cut is taken out to a bottom width of 100 ft., with nominal slopes of 1 on 1. This provides for five main tracks, with three through tracks and platforms at the station, and leaves room for a future additional track. At the south end of the station will be two stub tracks for the lines east to Evansville and west to Peoria. Originally, the Peoria & Evansville division had crossed the main line at grade, but this crossing has been replaced by double Y connections on each side, so that trains will not run through between Peoria and Evansville. For this division a new freighthouse and team yard have been built, as shown.

It was expected that the clay in which the cut is made would slip after the steam-shovel work and stand finally at about 1 on 1, so that retaining walls would not be neces-

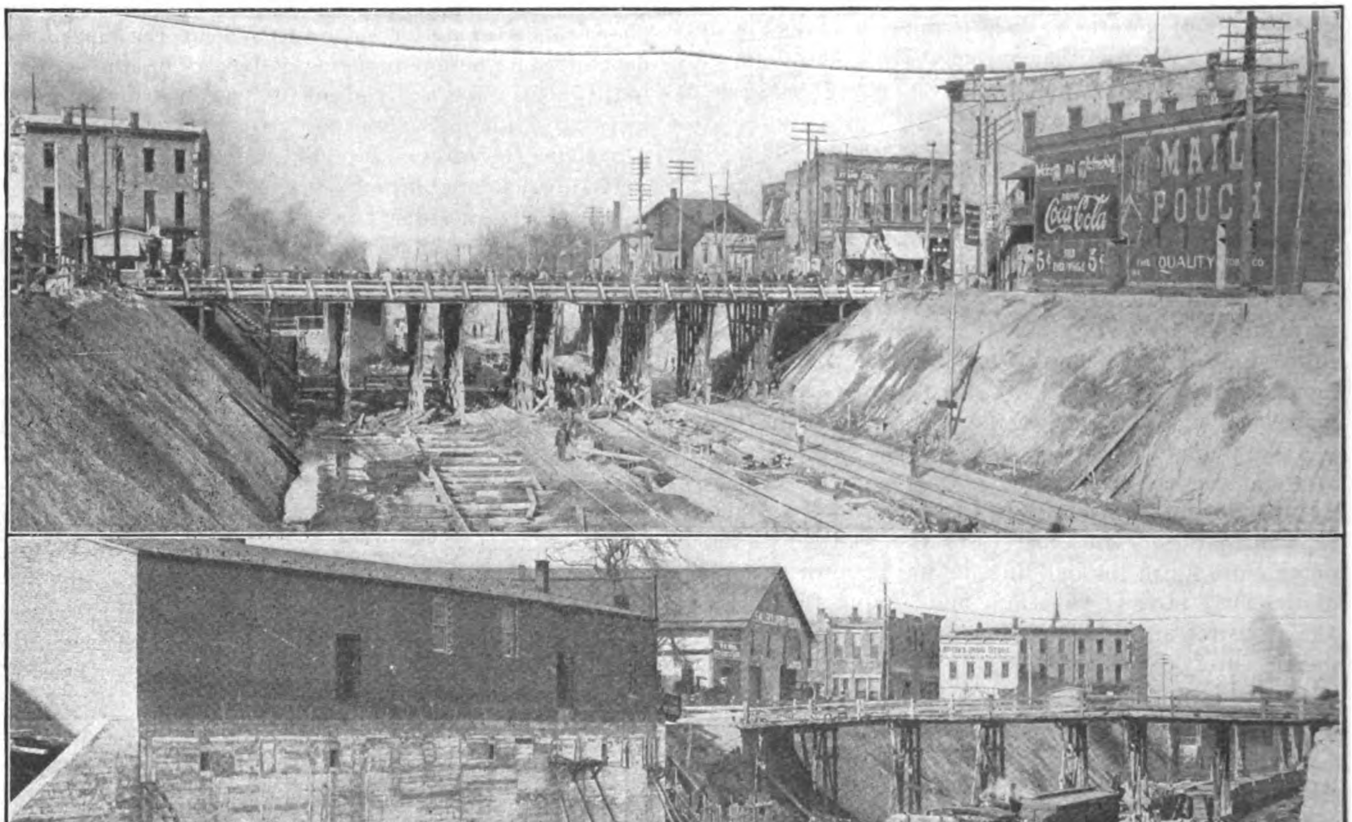

FIG. 1. TRACK DEPRESSION AT MATTOON, ILL.; ILLINOIS CENTRAL R.R.

The upper view shows the work at Broadway, with the temporary bridge. The new station will be at the left. The three-story building at the left is the old union station and hotel, a part of which has been pulled down to make room for the slope of the cut. The lower view shows a broom-corn warehouse, with concrete underpinning. Beyond it is the temporary bridge at Charleston St.

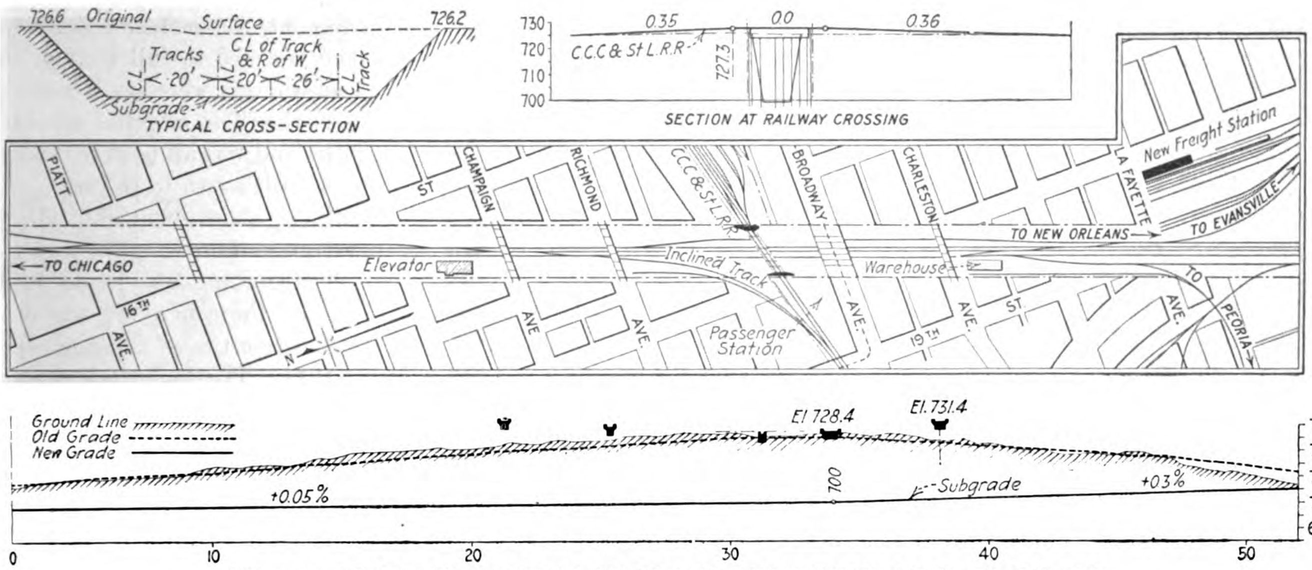

FIG. 2. PLAN AND PROFILE OF TRACK DEPRESSION AT MATTOON, ILL.

sary. But the material continues to slide and cave, and it is probable that retaining walls will have to be built in the deeper section, where the slips may affect private property. To keep the right-of-way clear, a toe wall of piles backed with heavy planks has been built, but this does not check the slipping.

There are several industries adjacent to the right-of-way line. In some cases the buildings occupied by these have been supported on timber trestling, allowing the slope to extend beneath them; in others a heavy retaining wall has been built. For this latter work piles were first driven and I-beam needle-beams placed with the inner ends resting on solid ground and the outer ends on the piles. A trench was then made to the required depth, and the retaining wall was built before making the cut for the track depression.

The typical design of the street bridges is shown in Fig. 3. There are five spans of 30-ft. clear width measured on the square, providing for four main tracks and for inclines to the industry connections. Most of them are 30 ft. wide between parapets, with 20-ft. roadways. But the bridge at Broadway, the principal street, will be 100 ft. wide, with 25-ft. sidewalks. The bridges are of reinforced concrete, with slab and beam deck supported on bents and abutments. No piling is required, the footings being carried down in the clay to about 5 ft. below subgrade. In the bents the columns are connected at the bottom by a guard wall 3½ ft. high above rail level, as a protection against derailed wheels. The beams of the floor slab rest on brackets upon the faces of the bents and abutments, and the sidewalks are cantilever slabs carried by brackets on the ends of the bents.

Gas and water mains are carried through the bents, being supported by U-hangers embedded in the deck slab. The sewerage system being separated by the deep cut an intercepting sewer had to be built along the east side of the right-of-way.

In concreting, the bents are poured to the level of the tops of the column shafts, and the concrete for the cap girder, extending to the top of the bent, is poured sepa-

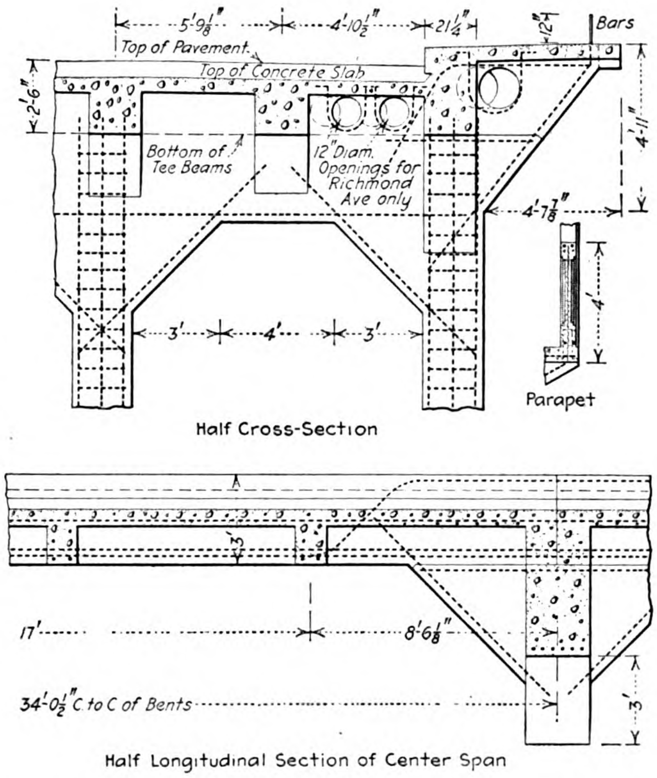

FIG. 4. DETAILS OF BRIDGE OVER TRACK

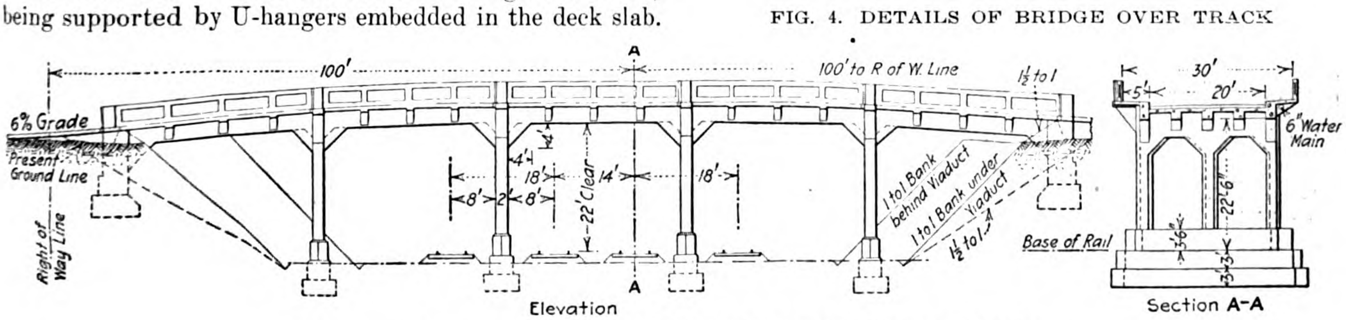

FIG. 3. TYPICAL DESIGN OF REINFORCED-CONCRETE BRIDGES

rately. The floor slab, with its longitudinal and transverse beams, is poured next, the parapets being poured last as a separate operation. The forms are of wood. The concrete in the footings is 1 : 3 : 6, and that in the upper work 1 : 2 : 4, using both gravel and broken stone. A concreting plant is installed adjacent to the bridge, with an elevator tower for spouting the concrete into place.

The C., C., C. & St. L. Ry. will be carried by a double-track through-girder bridge, the steel being incased in concrete to harmonize in appearance with the adjacent street bridges. This railway and the several streets are carried across the cut by timber bridges during the progress of the work.

In making the excavation a cut wide enough for two tracks was made first, while trains were operated on surface tracks at one side of the right-of-way. When running tracks were laid in the cut, the surface tracks were abandoned and the cut then widened to full section. In both cases two 75-ton steam-shovels were used, working from opposite ends of the work. The material was handled in 12-yd. side-dump cars and was all used for widening the roadbed and freight yards south to the city.

The cost of the work will be about $600,000. All of this will be paid by the Illinois Central R.R. and the C., C., C. & St. L. Ry. The grading was let to J. D. Lynch, of Monmouth, Ill., and the concreting was done by the Bates & Rogers Construction Co., of Chicago. The work was begun in April, 1914. The four-track cut was completed in December, 1914, and the bridges are rapidly nearing completion. The work is under the direction of A. S. Baldwin, Chief Engineer of the Illinois Central R.R., and F. L. Thompson, Assistant Chief Engineer.

Framing of the Dome of the Palace of Horticulture

By A. W. Earl* and Thos. F. Chace*

SYNOPSIS—Details of intricate steel work of a special dome. Method of erection also given.

The dome of the Palace of Horticulture at the Panama-Pacific Exposition, already referred to in *Engineering News* of Oct. 15, 1914, p. 759, is quite fully shown as to framing by the group of drawings in Fig. 1 of the present article, and is briefly described in the following.

Dome Framing

The dome framing is similar to that first used by the noted German engineer, Schwedler, being of the rib type. The dome has 24 latticed ribs, 36 in. in depth, which frame into a ring at the top and are connected by 11 horizontal latticed rings. These horizontal rings are 18 in. deep, except a 36-in. ring at the springing line of the dome, which absorbs all residual dome thrust. The ribs, however, continue 25 ft. below the springing line as vertical members framing the cylindrical base of the dome, down to a level 65 ft. above ground, where they foot upon a system of girders forming the top of the supporting tower.

Between the main ribs, 4-in. I-beam jackrafters frame into the horizontal rings. These carry wooden purlins to which skylight bars are attached, all of the dome surface except the basket being glass. All bays of the dome frame are braced by crossed adjustable rod diagonals, ranging in size from $\frac{9}{16}$ in. square at the top to $1\frac{3}{8}$ in. square at the bottom.

In all the latticed members of the dome framing, angle lacing bars were used instead of flat bars. These give greater shear resistance and can transmit compression, for which flat bars are poorly adapted.

The spider or ring at the apex of the dome is a circular girder 6 ft. in diameter and 36 in. deep; it has $\frac{5}{16}$-in. web-plate and four flange angles $4\times4\times\frac{5}{16}$ in. Two diametral diaphragms at right angles to each other stiffen the ring. These have $3\times3\times\frac{5}{16}$-in. flange angles, and $\frac{5}{16}$-in. web-plates.

Supporting Tower

The system of tower framing supporting the dome itself is also shown in the drawings, Fig. 1. It comprises eight piers capped by girders and trusses. Each pier is composed of four columns placed at the corners of a trapezoid. The trapezoid has two sides normal to a radius of the dome passing through its center, the shorter side being $4\frac{1}{2}$ ft. long; the diverging sides, which inclose an angle of 45 deg., are 15 ft. 10 in. in length. The outer and inner sides of the piers are braced from bottom to top, but the diverging sides have portal-framed openings for a height of 14 ft. 7 in. from the bottom, to provide a passageway.

Between the tops of the interior columns of adjacent piers are plate-girders 6 ft. $4\frac{1}{2}$ in. in depth, 57 ft. $5\frac{7}{8}$ in. long. These, together with trusses which frame from girder to girder across the interior face of the piers, support the 24 ribs of the dome.

Between the exterior columns of adjacent piers, steel trusses (also 6 ft. $4\frac{1}{2}$ in. deep) support a portion of the flat roof and the staff ornaments forming the decoration of the wall surrounding the lower part of the dome. These trusses, as well as the plate-girders on the inner face of the tower, are kneebraced to the columns of the piers. The trusses and plate-girders are braced together in both upper- and lower-chord planes. This not only serves the purpose of bracing the compression chords of the girders and trusses, but constitutes a stiff ring around the entire base of the dome which effectually distributes the horizontal wind load to all of the eight piers.

Each of the inner columns is a 20-in. 59-lb. I-beam; the two adjacent columns are laced together front and back with $5\times3\times\frac{5}{16}$-in. angles. The lacing is doubled above the knee-braces, to provide for portal action. These col-

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