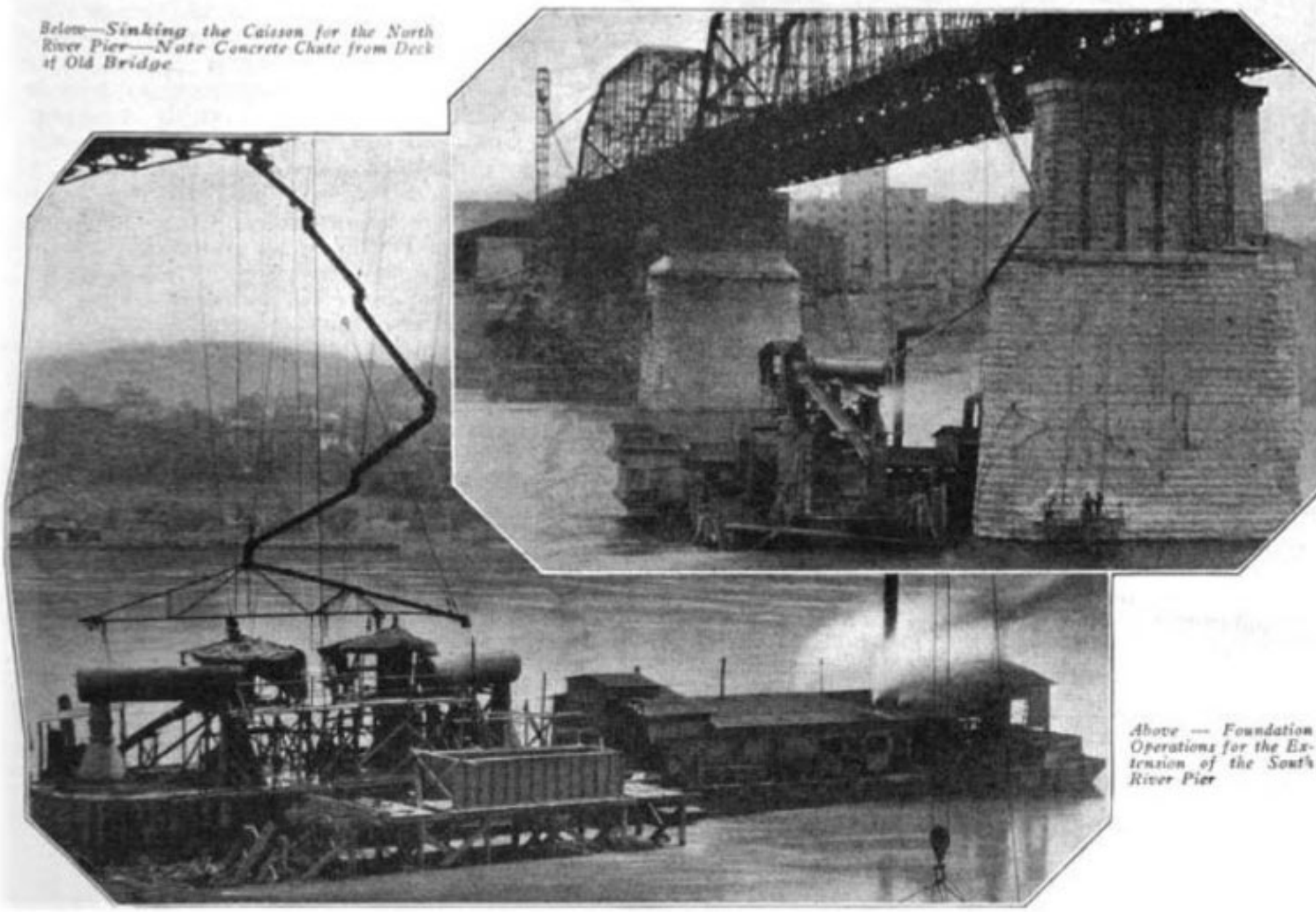
C. & O. To Renew Bridge Over Ohio River

Project at Cincinnati also includes separation of grades with streets through Covington, Ky.



Below—Sinking the Caisson for the North River Pier—Note Concrete Chute from Deck of Old Bridge

Above — Foundation Operations for the Extension of the South River Pier

WORK is now in progress on the substructure of a new railway bridge across the Ohio river at Cincinnati which is being built for the Chesapeake & Ohio to replace an old structure erected 40 years ago. As in the majority of such replacements, inadequate capacity of the old superstructure is responsible for the new project. The old river piers, which were carried to rock foundation by the pneumatic process, are of unquestioned stability and such deterioration of the shafts as has taken place can readily be corrected. As a consequence replacement has proceeded according to a rather unusual plan. The new bridge is being built immediately downstream from the old one (the new center line being 42.16 ft. south of the old center line) with one pier built as an extension of one of the old piers and the others independent only because of a difference in the span lengths. The old structure, which has served also as a highway toll bridge to carry highway traffic on cantilever roadways, is to be retained in service as a highway bridge.

The old bridge was built in 1886-8 by the Covington & Cincinnati Elevated Railroad & Transfer & Bridge Company. This is a subsidiary of The Chesapeake & Ohio and not only owns the bridge and its approaches and the approach tracks on the Kentucky side to Saratoga alley, in Covington, a distance of about 3,600 ft. south of the river bank, but serves also as a terminal operating company from Cincinnati to K C Junction where the Chesapeake & Ohio is joined by a line of the Louisville & Nashville. The bridge is used daily by 34 passenger and express trains of the Chesapeake & Ohio and the Louisville & Nashville, all of which move across the bridge twice because both railroads maintain engine terminals and coach yards on the Kentucky side. It is also used by four passenger trains of the Chesapeake & Ohio of Indiana, as well as the many transfer trains handling freight of the two railroads between the two sides of the river.

New Bridge to Have Longer Span

The present structure consists of one 550-ft. channel span and two 490-ft. flanking spans, measured center to

center of piers, but the new bridge, in conformity with requirements of the United States War department, will have a channel span of 675 ft. center to center of piers, with flanking spans of 450 ft. each. With the south channel pier of the new bridge built as an extension of the old south pier, the new north channel pier will be located 125 ft. north of the old pier.

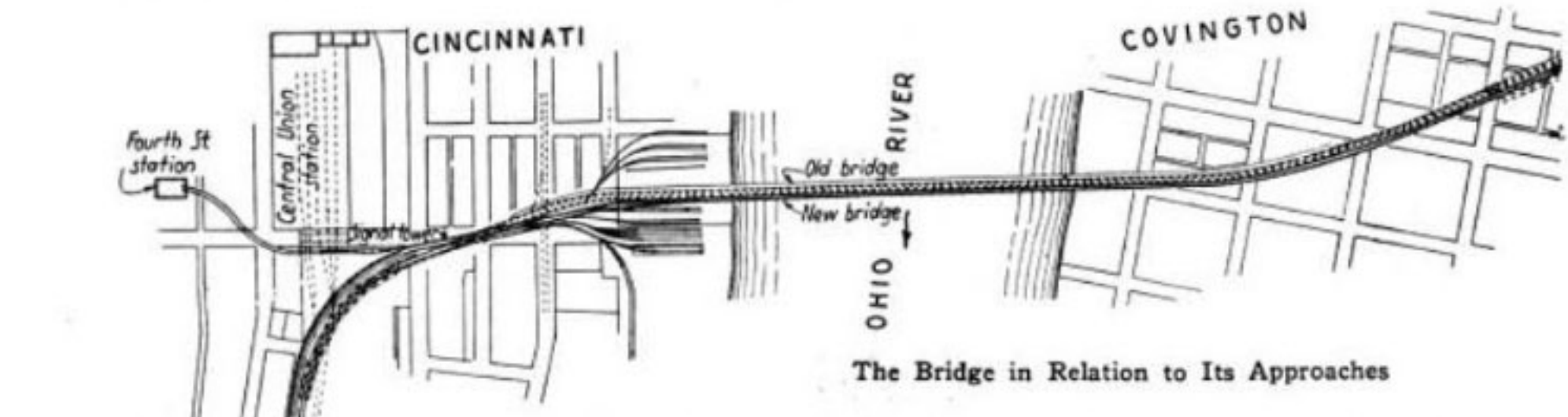
The Completed South Shore Pier for the River Bridge

The old bridge superstructure consists of through, pin-connected, Pennsylvania-type, simple truss spans carrying a double-track roadway between the trusses with a roadway for highway traffic cantilevered outside of each truss. The new superstructure will consist of through trusses continuous over the three spans, the two flanking spans to be erected on falsework and the channel span by the cantilever method. It will have a roadway for two tracks between the trusses which will be spaced 34 ft. center to center. Track level on the new bridge will be approximately three feet higher than on the old structure to avoid a reduction in the established waterway headroom as a consequence of the use of a thicker floor.

The Ohio River bridge is a high-level crossing, with the result that on the Ohio side, where the terminal tracks are at a level approximately 50 ft. below those on the bridge, a long approach is necessary. This approach has three arms and embraces a total of about 6,200 ft. of steel viaduct and a considerable length of wooden trestle. The main branch extends westward to a connection with the tracks of the Cleveland, Cincinnati, Chicago, & St. Louis, at Baymiller and Front streets and affords the means of access to the Central Union station. A second branch lies to the north of the main branch and extends to Fifth street where it connects with the Cincinnati, Hamilton & Dayton terminal and provides the physical connection with the Chesapeake & Ohio of Indiana. This branch is the property of the Cincinnati Interterminal Railroad, a subsidiary of the corporation which owns the bridge. A third branch extends directly north to a small passenger station owned by the Chesapeake & Ohio at Fourth street, known as the Fourth Street station.

In addition to the new viaduct approach which must be built by reason of the offset location of the new bridge, considerable viaduct construction will be entailed in replacing portions of the existing structure, double-tracking the lower end of the main branch and providing a second track on the Interterminal branch. On the Kentucky side of the river, 1,600 ft. of viaduct approach will be replaced by a new viaduct built alongside, but the construction of a south approach to the river bridge is closely inter-related with a project for the separation of grades with the streets in Covington, Ky.

The line of the Chesapeake and Ohio through Covington, embraces a stretch of about two miles over a rather winding alinement between the Licking river and the Ohio river. The natural ground level along the location of the railroad rises from the Licking river to a summit in the vicinity of Robbins street and then descends to the Ohio river. This situation was naturally adapted to a partial separation of grades at the time that the line was built in 1886. East of Madison avenue the roadbed was placed on an embankment with through truss spans over five streets, while at Fifteenth street, Eleventh street and Robbins street the elevation of the tracks relative to the streets was such as to favor the construction of three viaducts over the tracks. North of Robbins street to Sixth street, the streets and tracks are at substantially the same level and the crossings are at grade, and as this area is only a short distance from the business center of the city, grade separation has been highly desirable. North of Sixth street a natural separation of grades was effected by the elevation of the tracks on the trestle approach to the bridge.

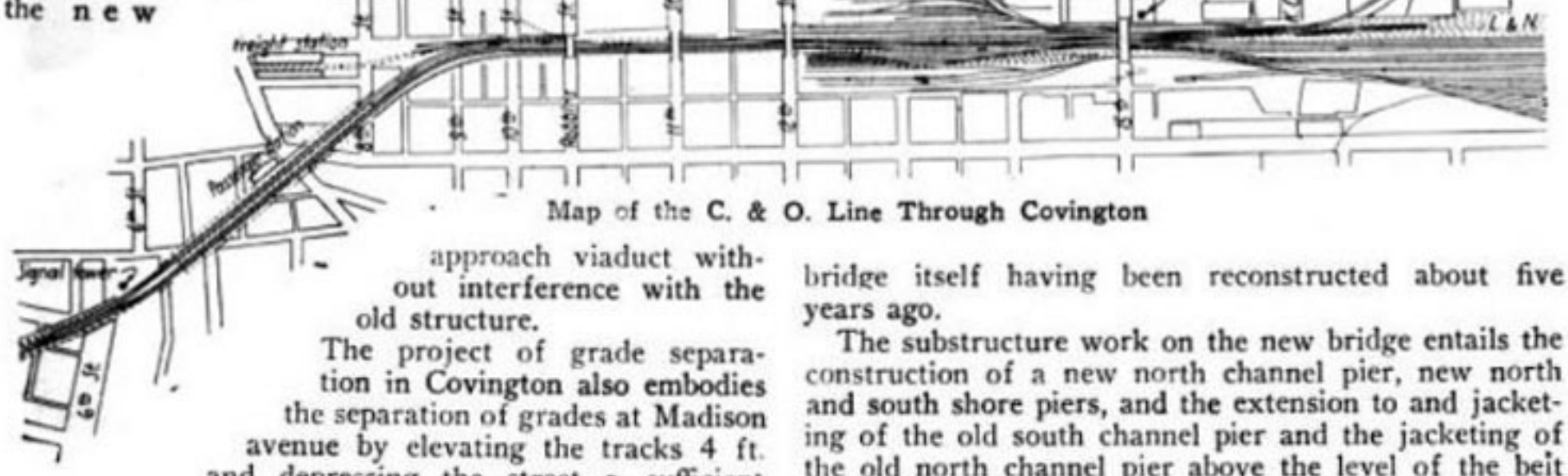


The Bridge in Relation to Its Approaches

Grade separation through the business part of Covington is being accomplished by placing the new south approach to the bridge on a 0.3 per cent grade, extending from the river to replace the 1 per cent grade of the old approach. This has the effect of extending the approach grade from Sixth street to Fifteenth street and introducing sufficient elevation of the tracks to permit the streets to cross under the tracks as far south as Eighth street. At Ninth and Tenth streets the grades of the street and tracks are so nearly the same that separation was found impossible and the streets are to be closed to traffic. However, at Robbins street, Eleventh street, and Twelfth street the separation of grades was possible by building a new viaduct at Twelfth street and by replacing the old viaducts at Robbins street and Eleventh street with new structures at higher elevations. The old viaduct at Fifteenth street will not be disturbed.

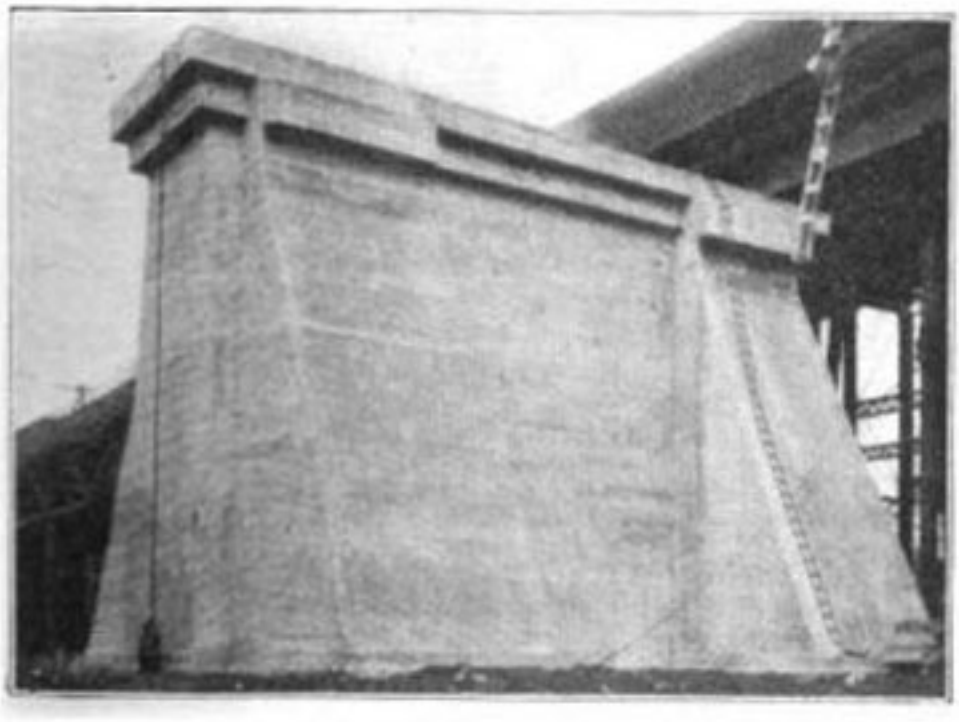
To Increase Number of Tracks

The plans for this grade separation project also embody an increase in the number of main tracks from two to four between K C Junction and Sixth street. The tracks on the new level will be substantially on the present location as far north as Fifth street where the new line will be diverted to the west a sufficient distance to permit the construction of the new approach viaduct without interference with the old structure.



Map of the C. & O. Line Through Covington

The project of grade separation in Covington also embodies the separation of grades at Madison avenue by elevating the tracks 4 ft. and depressing the street a sufficient amount to obtain a clear headroom of 13 ft. East of Madison avenue, the old through truss spans which carry the tracks across the streets are being replaced by deck girder spans, while the west approach to the Licking river bridge has been replaced with a modern steel viaduct, the river bridge itself having been reconstructed about five years ago.



The Pier on the Ohio Shore Was Designed for Stability Against Longitudinal Forces Imposed on the Superstructure

The substructure work on the new bridge entails the construction of a new north channel pier, new north and south shore piers, and the extension to and jacketing of the old south channel pier and the jacketing of the old north channel pier above the level of the beit course. The two shore piers are supported on concrete pile foundations while the river pier work involves the sinking of footings to bed rock at Elevation 375, or 64 ft. below normal pool level, which is at Elevation 439.3. The maximum recorded river stage, that of the flood of 1884, is at Elevation 498.2. Diamond drill borings carried into rock to a depth of 15 ft., disclosed alternate strata of shale and limestone of varying degrees of hardness. The rock is covered with an overburden of from 40 to 50 ft. of alluvial deposit.

Both Open Dredging and Pneumatic Work on River Piers

The sinking and excavating of the river piers is being conducted by open dredging, but the work will be completed by the pneumatic process in order to clean out the working chambers and fill them with concrete in the dry. The north river pier has a caisson 84 ft. by 34 ft. in plan, with an approximate height of 45 ft. The shaft will have round nosings for a height of 77 ft. 8 in. with a rectangular section above that level. In addition to reinforcing the faces of the pier, the bearings will be provided with a grillage of 24-in. 90-lb. I-beams placed longitudinally at a transverse spacing of 24 in.

Complication in the sinking of the caisson for the extension of the south river pier is being avoided by

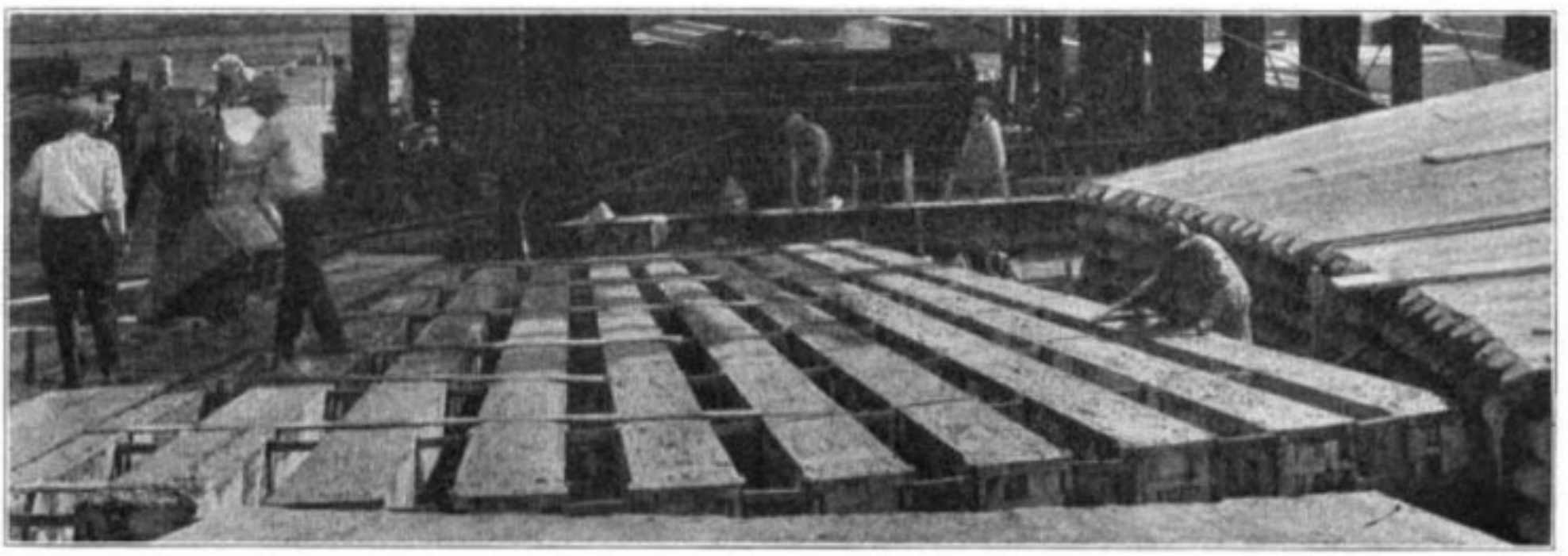
considering the caisson or footing of the extension as a separate unit that clears the west face of the old footing by approximately 10 ft. Above the top of the caisson, the extension will be joined to the old pier by bridging the shaft over the gap between the two caissons. The width of the new shaft, 30 ft. 9 in. at the bottom and tapering to 19 ft. 1 in. at the top is sufficient to permit this shaft to line up with a reinforced concrete jacket two feet thick over the sides of the old pier. In addition to a thorough doweling of the jacket into the old masonry, the shaft above the level of the belt course is to be strengthened effectively by encasing in the jacket, steel channels placed in a vertical position against both faces and holding them in place by means of tie bolts passed through holes drilled through the pier.

Weight Division, Supports and Load Distribution

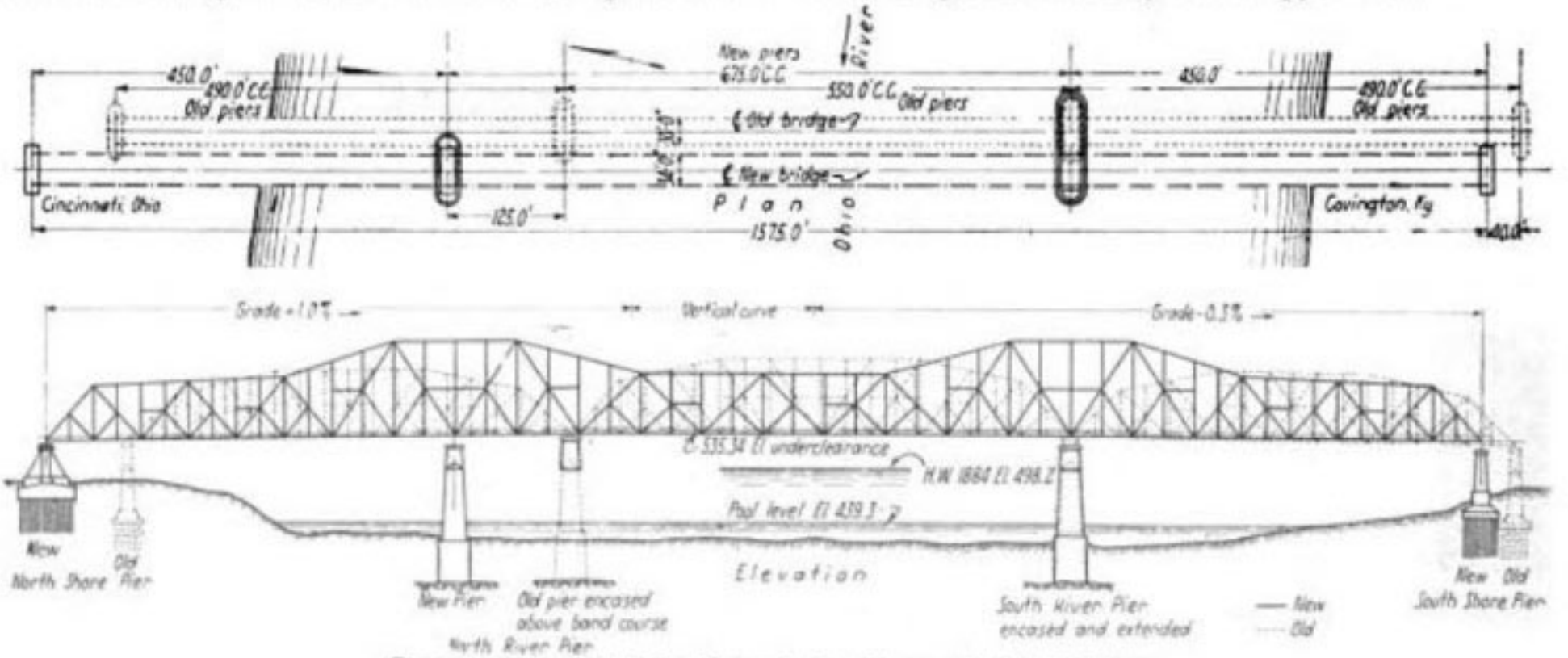
The weight of the new superstructure is to be divided equally between the old pier and its extension. The half-cone topping over the west nosing of the old pier will be removed to provide a seat for a steel tower enclosed in the pier shaft and placed concentrically under the bearing of the new east truss, so that the load from this truss will be transferred directly to the west end of the old pier. The top of this tower will not come directly in contact with the bearing shoes but will serve as the east support for a beam grillage embedded in the pier two feet below the bridge seat.

The two shore piers are to be supported on reinforced concrete piles, those under the Ohio pier having a penetration ranging from 10 to 25 ft, and those for the Kentucky pier being driven to depths up to 45 ft. As the superstructure of the bridge is continuous it can have fixed bearing on only one pier, and the Ohio shore pier has been selected for this purpose. Consequently it has been designed for stability against assumed longitudinal forces imposed on the superstructure. The pile base necessary to meet these requirements calls for 400 concrete piles, arranged in 20 rows, both longitudinally and transversely, at a spacing of 3 ft. center to center, thereby requiring a footing for this pier that is 61 ft. square.

The load of the superstructure is distributed over this large base area by means of a pier shaft having base dimensions of 52 ft. 10 in. by 13ft. 10 in. with heavy buttresses on each side in the planes of the trusses. Resistance to longitudinal thrust afforded by the foundation piles is supplemented by a row of reinforced concrete sheet piles 8 in. thick and 25 ft. long, driven along the north and south edges of the footing. The pier has been proportioned with exceptionally good taste and presents an impressive appearance.



Casting Concrete Piles for the Shore Piers and the Ohio Approach Structures



General Plan and Elevation of the New and Old Bridges