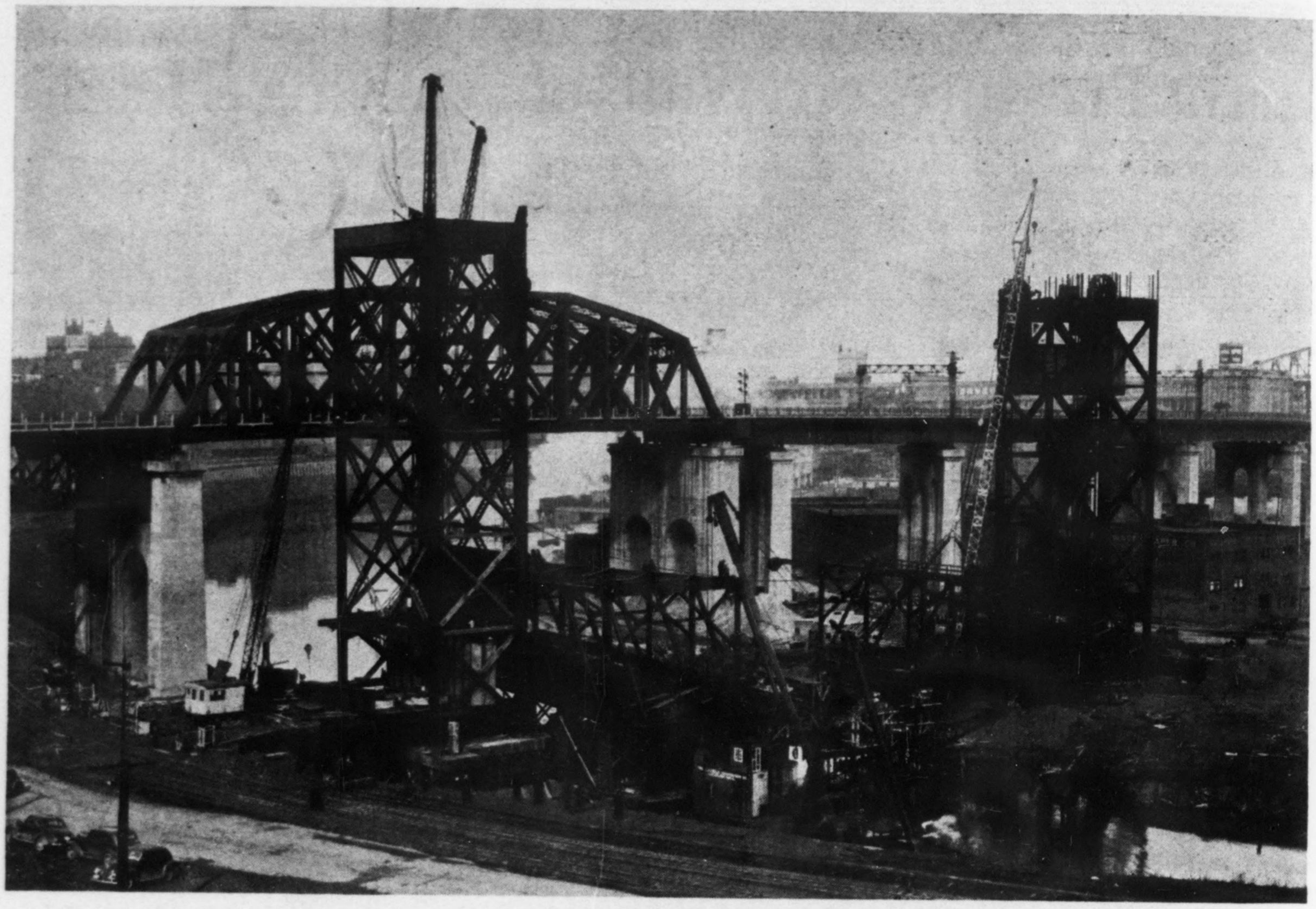
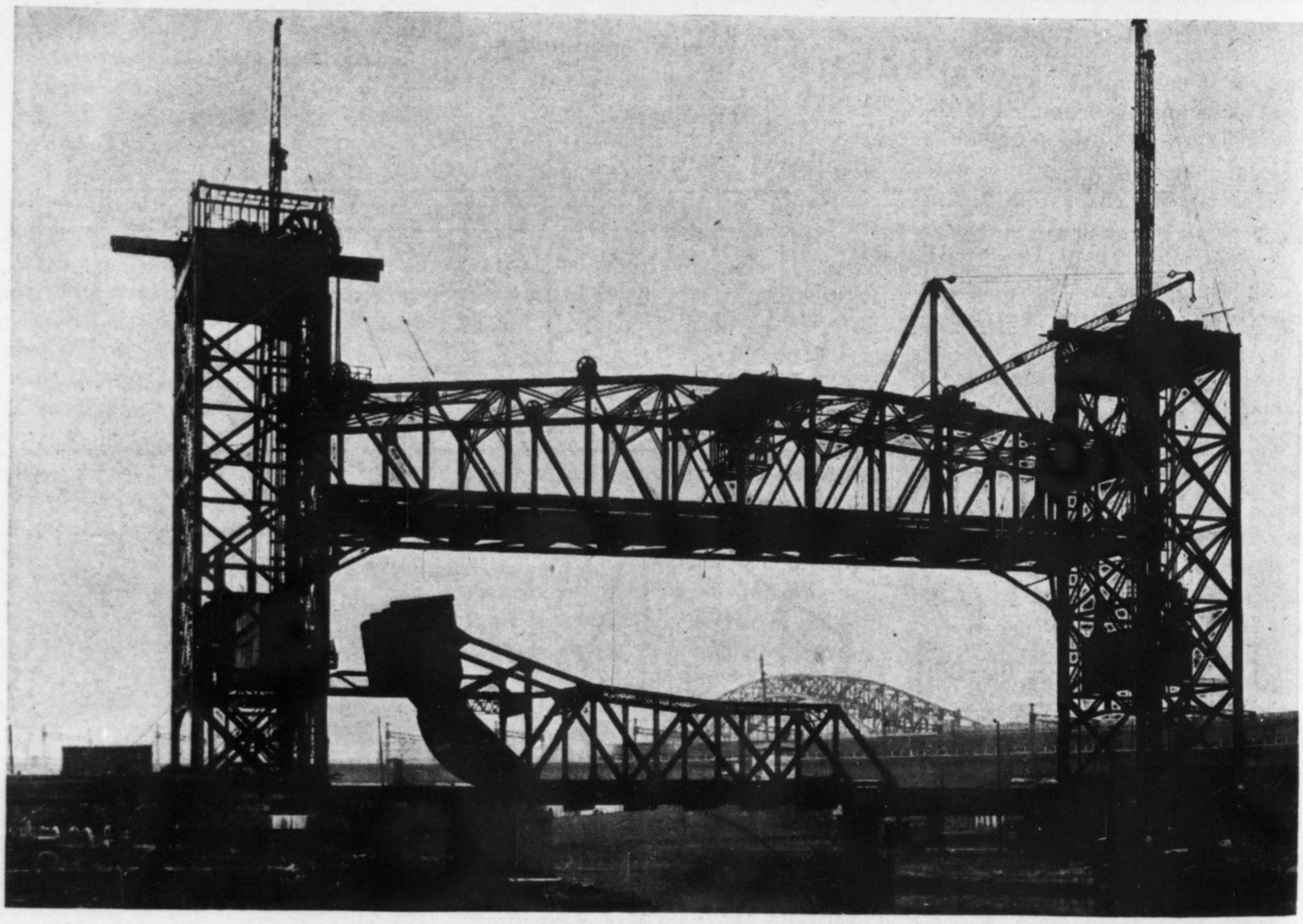
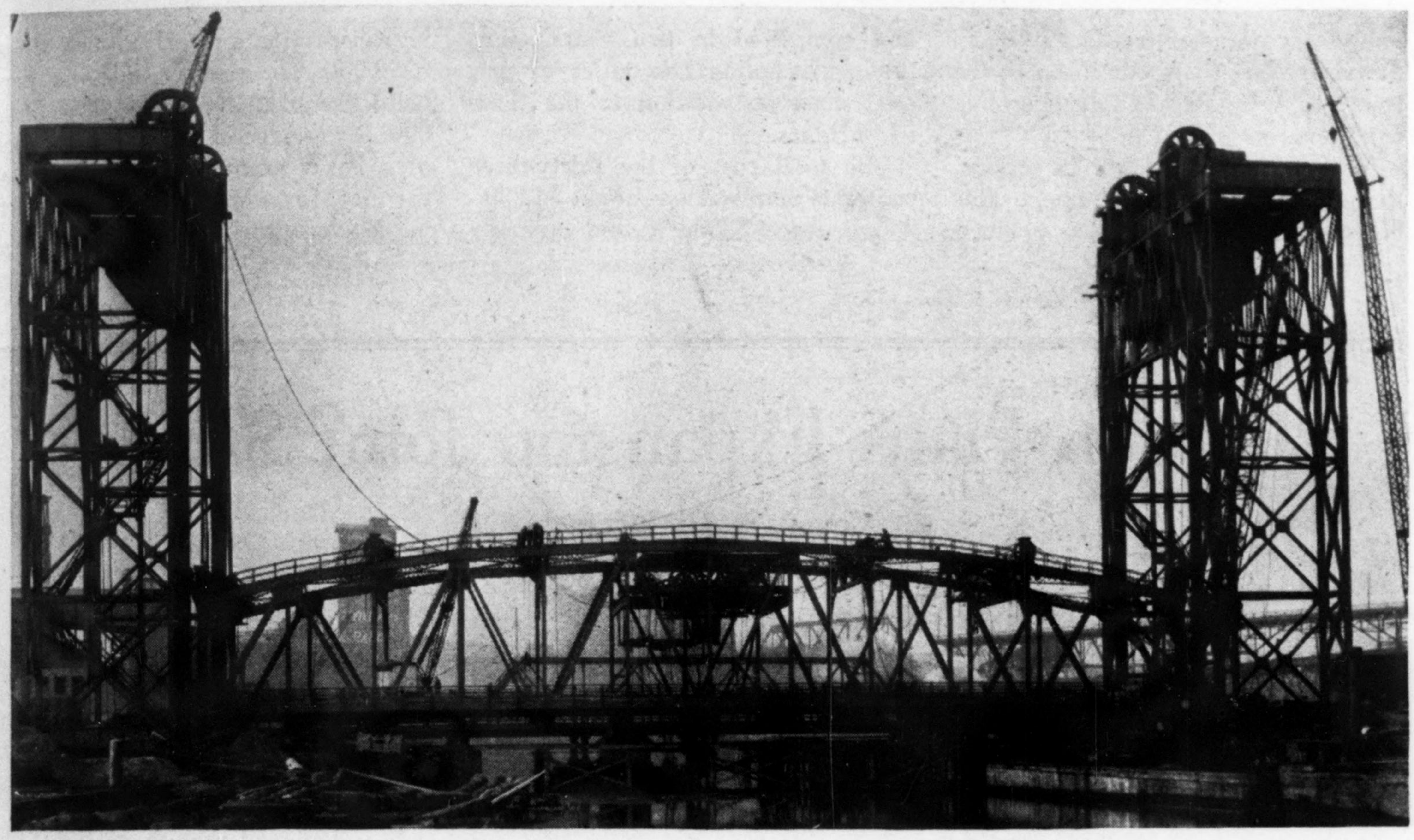




Columbus Road Bridge; four panels erected on timber bents, remainder of span erected on barges and floated to place. Below, Carter Road Bridge, cantilevered from towers in the raised position.



WEST THIRD ST. BRIDGE ERECTED BY FALSEWORK.

Three Methods for Erecting Lift Bridges

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LIFT-BRIDGE CONSTRUCTION on the Cuyahoga River improvement presented an interesting contrast of erection methods under almost identical conditions. Three new vertical-lift highway bridges of the same size and general design have been erected by three different contractors, each using a method of his own and each apparently well satisfied with the results achieved. As work began in November and December, most of the erection had to be carried out during unusually severe weather.

The bridges are part of the city's $5,500,000 program of widening and straightening the Cuyahoga River (*ENR*, Oct. 13, 1938, p. 448). This project involves the elimination of three sharp bends in the river, including the notorious Collision Band, which will permit the largest lake freighters, 625 ft. long by 70 ft. beam, drawing as much as 23 ft., to reach blast furnaces up the river as well as facilitate river shipping in general. For the foundation construction see *ENR*, Oct. 26, 1939, p. 541.

The Wisconsin Bridge & Iron Co., which fabricated and erected the Columbus Road bridge, adopted a combination of falsework erection and floating-in. Four panels of the river span, extending over the present land area where the channel is to be widened, were erected on falsework bents. Seven panels of the span were erected on two barges a few hundred feet downstream, and when completed were towed upstream and moved into place so that the section of span on the barges could be picked up and set on the river pier at one end and a pair of timber bents at the other. When the two parts of the bridge were thus in proper alignment, the barges were removed and the connecting members were entered and riveted up.

Carter Bridge was fabricated by Mount Vernon Bridge Co. and erected by cantilevering out from the towers, which had been designed strong enough for the purpose. Temporary kneebraces from the first panel point of the span down to the next panel point of the tower assisted in carrying the cantilever. The bridge was erected about 7 ft. below the maximum clearance position. Erection was somewhat slowed up by weather conditions, which affected operations high in the air. This bridge as well as that at Columbus Road was erected by the Bass Construction Co., by methods planned by the fabricating companies.

West Third St. Bridge, built by R. C. Mahon Co., was erected on a falsework trestle. The towers had been erected from the ground by a crawler crane with very long boom, and the 13-ton counterweight sheaves hoisted to the tower top by a boom set on top of the tower. The span was erected in low position on temporary wooden trestle driven in the river. The span was lifted to the tower tops by its auxiliary gasoline engine power plant.

With the three bridges in service, the entire river improvement was completed by July 1. It was planned and completed in two years' time, though including two miles of new steel dock in addition to the three lift bridges.

The total cost of the thirty-three contracts involved was about $4,250,000, land cost $805,000, and engineering, inspection and extra work about $250,000. The project thus was kept below the original estimate of $5,500,000. It was carried out with assistance of a PWA grant under direction of the city, for whom the writer is acting as consulting engineer.

Oregon Plans Expansion Joint Study

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Contents in Brief—Experiments on a section of concrete paving near the Oregon state capital involving five types of expansion joints have the twofold purpose of rating the relative effectiveness of load transference in such joints and comparing the effect of expansion joint spacings ranging from 30 to 495 ft.

IN A RESEARCH PROJECT now being carried on by the Oregon State Highway Commission, observations on expansion joint behavior are being made regularly on a 1.59-mile section of the Pacific highway south of Salem, Ore. The pavement, built by contract late in 1939, is portland cement concrete, 22 ft. wide with a 9-7-9-in. section, supported on a 6-in. compacted crushed-rock base. Five types of expansion joints are to be installed, designed to afford information, after prolonged observation, on two distinct but interrelated lines of inquiry: The first relates to the relative load transference efficiency of the several joint types and the second to the effect of expansion joint spacing upon joint movements and behavior in service.

Of the joints selected for test, type one (Fig. 2) is a standard doweled design which serves as a control. Type two employs a thickened edge with no dowelling. Types three and four have a continuous support beneath the joints proper, which functions to facilitate load transference and also to seal, more or less effectively, the joints against infiltration of surface water. Type five involves a system of creosoted timber sills. Of types two to five, two of each are put in, with reinforcing bars omitted from one of each type.

Normally the expansion joint spacing is 495 ft., with construction joints between and 15 ft. apart; all concrete is plain and joint types 2 to 5 are to be used as directed. The exceptions are: Between Sta. 65 + 03 and Sta. 85 + 00, plain concrete, joint type 1 is used for two 30-ft., two 60-ft., two 120-ft., two 240-ft. and two 495-ft. spacings with contraction joints 15 ft. apart, and between Sta. 27 + 25 and Sta. 37 + 15, mesh-reinforced concrete, joint type 1 is used for two 495-ft. spacings with no contraction joints.

In planning these tests, the program was based on the belief that the principal desiderata in expansion-joint design are (1) load transference efficiency, (2) watertightness and (3) reasonable freedom of movement. Absolute freedom is not required, as a certain amount of compression is desirable to check the "growth" or gradual enlargement of intermediate contraction joints and cracks. Watertightness is necessary to eliminate the possibility of subgrade volume change due to the infiltration of water at joints; finally, load transference efficiency is essential to prevent both elastic and permanent joint displacements under traffic.

It is believed that the joint types selected possess these desirable qualities in varying degrees. Hence the program of observation includes extensometer measurements of elastic displacement under varying test loads and also a program of continued observations under service to determine the amount of permanent joint deformation and the degree to which such deformation increases with age.

A second phase of the investigation contemplates a study of certain factors affecting expansion-joint movement. That these are somewhat interrelated and involved may be appreciated by the consideration of the following rather elementary theoretical deduction. Consider any pavement slab fitted with expansion joints, as indicated in Fig. 3 and let the line *a-a* represent the point of longitudinal fixity. This may or may not be at the center of the slab, depending upon conditions. Under the action of an "equivalent" maximum temperature rise of t_1 deg. F., the linear expansion of any infinitesimal element of length dx, whose abscissa measured from the joint is x (see Fig. 3) is given by the expression:

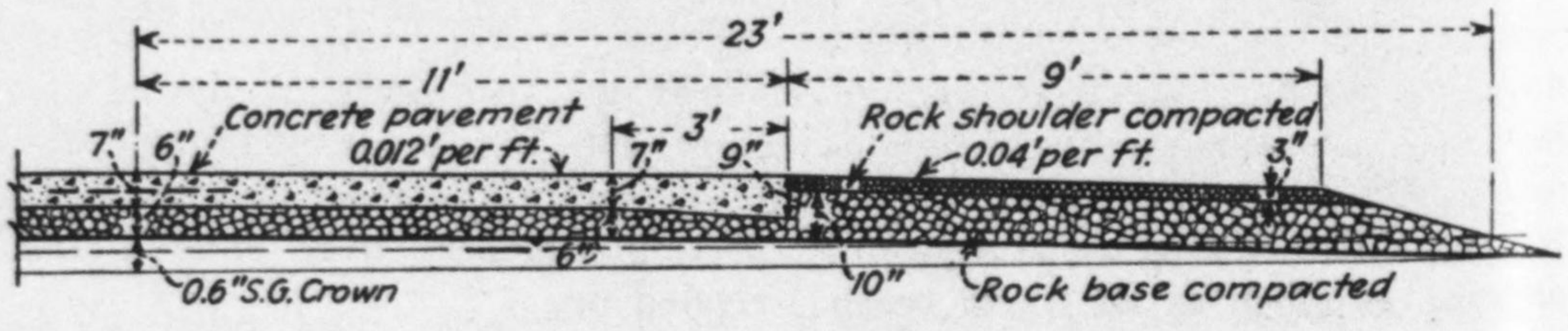

Fig. 1. Cross-section of concrete pavement used in expansion joint study.