Gantry Used to Raise Bridge Approaches

ents in Brief*—*In changing the level of a long highway bridge that s the Tennessee River valley in the area to be flooded by Kentucky a high gantry crane was used to raise sections of the approach cts. The crane picked up 90-ft. sections of deck and held them while work was set. Later, after the viaduct supports had been rebuilt by g about 25 ft. to the height of the towers, the crane lowered the sec- of the deck into final position.

K RECENTLY CARRIED OUT to raise pproaches to the Tennessee River way bridge at Eggners Ferry, above pool level of TVA's Ken- Dam commands attention be- of the length of the deck raised unit, the method employed to ort the elevated deck sections un- ew tower bents could be con- cted, and the procedure followed uilding the new bents.

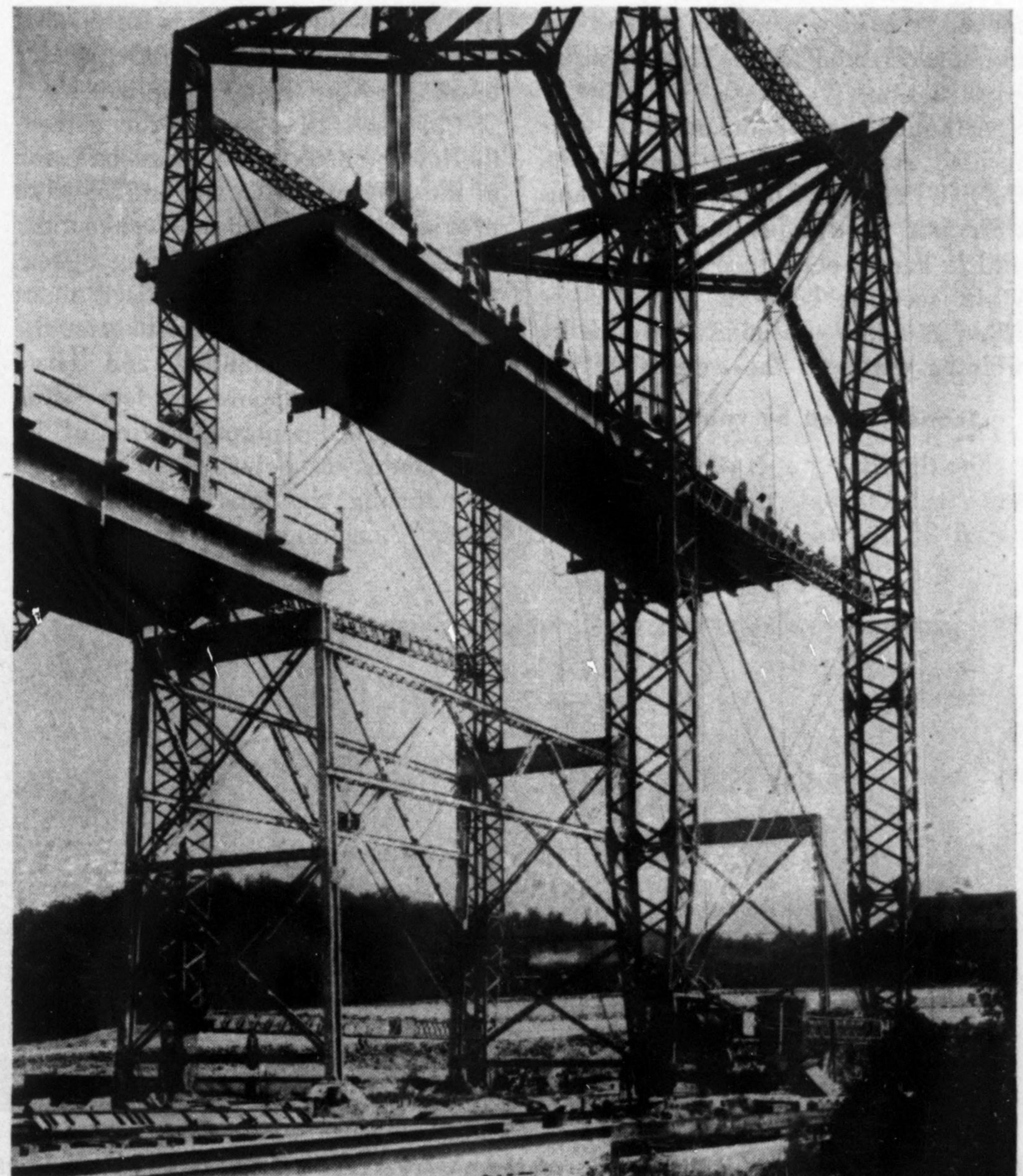
ocated some 20 miles upstream the dam on State Route 68, the inal crossing was about three- rters of a mile long. Its main struc- consisted of six through-truss s varying in length from 151 to ft., an east approach was made up eventeen 45-ft. steel-beam, con- e deck spans supported on steel ers, and a west approach consist- of 21 similar spans. These ap- aches were on a grade of 4 percent o the channel spans, which were el except for the transition in the spans.

o elevate the approaches above ximum pool level and to provide ficient clearance for river traffic in e main channel, most of the truss d I-beam spans had to be raised. me of the piers supporting the sses were strengthened and in- ased in height from 11 to 25 ft. he greater portion of the bents sup- rting the viaduct spans were in- eased about 25 ft.

Trusses raised with jacks

wo hydraulic jacks under each nd floorbeam were used to raise the sses, the piers being extended pe- iodically as jacking continued. This cedure resulted in no special prob- s, and is similar to the method ed in raising the vertical lift railroad bridge at Danville, Tenn., which was described in *Engineering News-Record* April 6, 1943, Vol. p. 486. An exception was the use of special auxiliary jacking girders located below the existing floorbeams for raising the 320-ft. and 366-ft. spans.

An electric-powered gantry crane of 200-tons lifting capacity was chosen to raise the approach spans. The gantry had a height of 80 ft. and a span of 48 ft. 9 in. It consisted of two portal frames, 50 ft. apart, joined by three lines of struts, one near the base, one at midheight and one at the top. An inverted kingpost truss at the top of each portal was pin-connected to the top of each leg and was knee-braced to one leg, an arrangement that avoided indeterminate stresses arising from any inequality in the elevation of the supports. The bottom of each leg was pin connected to a steel skid that was supported on two skid rails set 20 in. apart.



Sacta Studio photo

Fig. 1. By means of two 15-part fall lines, the gantry crane raised 90-ft. sections of deck (two spans) to permit supporting bents to be increased in height.

Engineers of the Tennessee Valley Authority had found the gantry economical in raising a highway bridge at Guntersville, Ala., (*ENR*, Dec. 7, 1939, p. 757). On the Guntersville project the deck was raised in one-span sections, swung through 90 deg., and lowered to the ground between the bents. The same procedure was considered for the job herein described, but was considered to be more expensive than raising two spans as a unit and supporting them on falsework while the new concrete bents were constructed.

Old bents utilized

Because of the scarcity of structural steel, maximum reuse of the old steel was necessary. The plan finally decided upon was to place the old tower bents on new reinforced concrete tower bents of sufficient height to bring the deck up to grade. Such a plan meant that the deck sections had to be supported on temporary falsework while the old bents were removed, the new bents built, and the old steel erected on the new concrete construction.

Although the expansion joints were located at every second panel point, the five lines of 27-in. steel floorbeams were not continuous for two spans, and so had to be spliced to permit the 90-ft. sections between joints to be lifted as a unit. Splicing was done by welding plates to the webs.

Section raised by two fall lines

For the lifting operation, two holes were cut through the concrete deck about 20 ft. from each end of each two-span section of the deck to permit the legs of the lifting sling to be attached to needle beams below the roadway (Fig. 1). The needle beams were spaced so that the moment in the splices in the floorbeams was practically zero. Actual lifting was done by two 15-part fall lines suspended from the trussed tops of the gantry towers, power being supplied by a 25-hp. electric motor suspended from the lower horizontal strut at one side of the gantry. Automatic brakes were provided in case the power supply failed while a span was being raised.

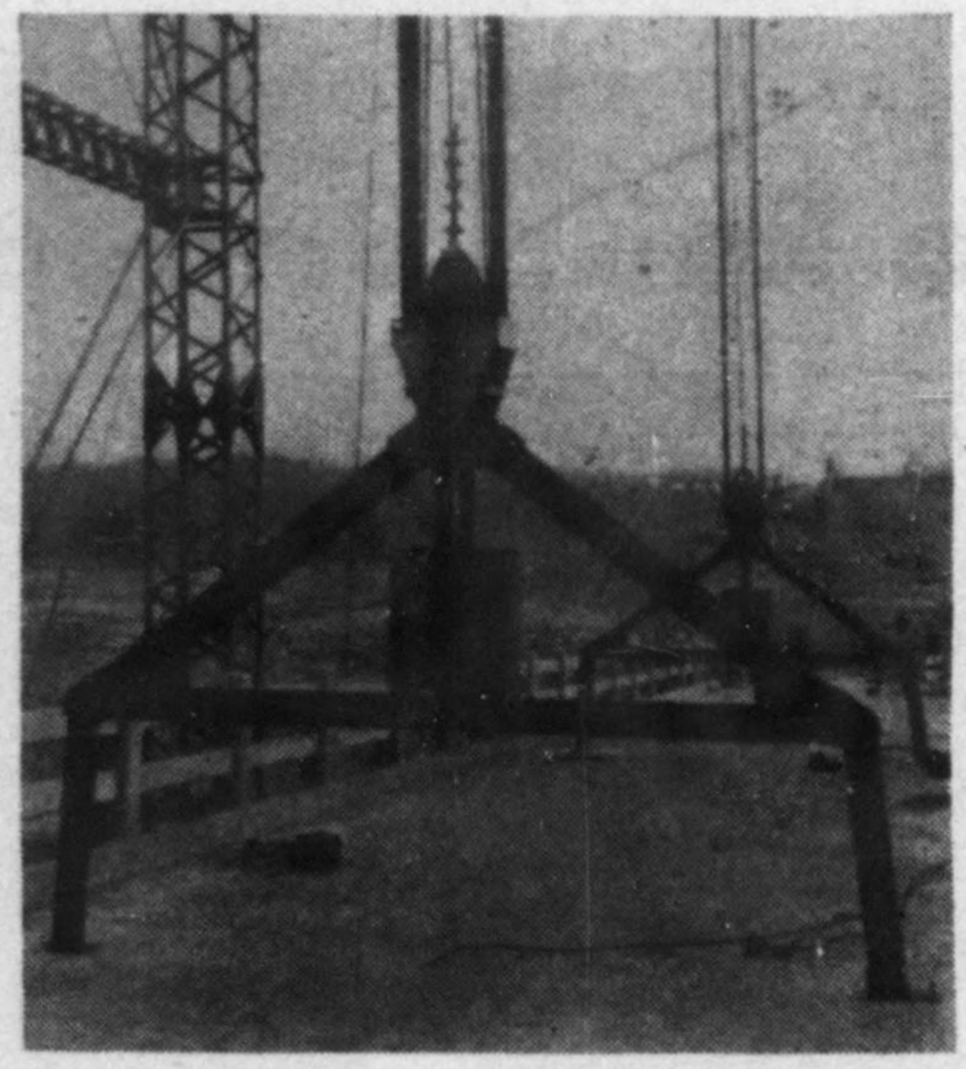


Fig. 2. The hitch to the needle beams below the deck was made through two holes cut in the floor at each beam.

After a span had been raised about 30 ft. above the old steel towers, the towers were dismantled and falsework built to support the deck while the reinforced concrete portion of the new bents was being constructed. In dismantling the old steel, only the rivets connecting the horizontal bracing to the columns were cut aw which permitted the two columns each bent to be removed as a u thus expediting removal and reasse bly of the old steel.

Two temporary falsework tow each consisting of two 2-column st bents was used under each 90 length of the deck (Fig. 4). The in. steel columns of these bents res on 5x5-ft. spread footings. The fo columns for a given tower were spaced as not to interfere with co struction of the lower reinforced-co crete section of the new bents.

About an 8-hr. day was requi to raise a section of the deck, remo the old steel, add the temporary fal work, and lower the section on to t falsework.

Bents built in three pours

The new reinforced-concrete tow bents rest on the footings of the o steel towers, the new concrete be tied to the old foundations as ill trated by Fig. 5. Their tops were ca ried to an elevation sufficiently abo pool level to protect the steel fro wave action. In constructing the r inforced-concrete base of a typic tower bent, three pours were us First, the four lower horizontal str were poured, next the four colum and finally the four top struts. Ge erally, three days were required to the reinforced concrete work at ea tower bent, four complete sets of st forms being available to expedite th part of the construction.

A concrete of 2,500-psi. strength 28 days was used. It was mixed b 1-yd. mixer at a central plant, del

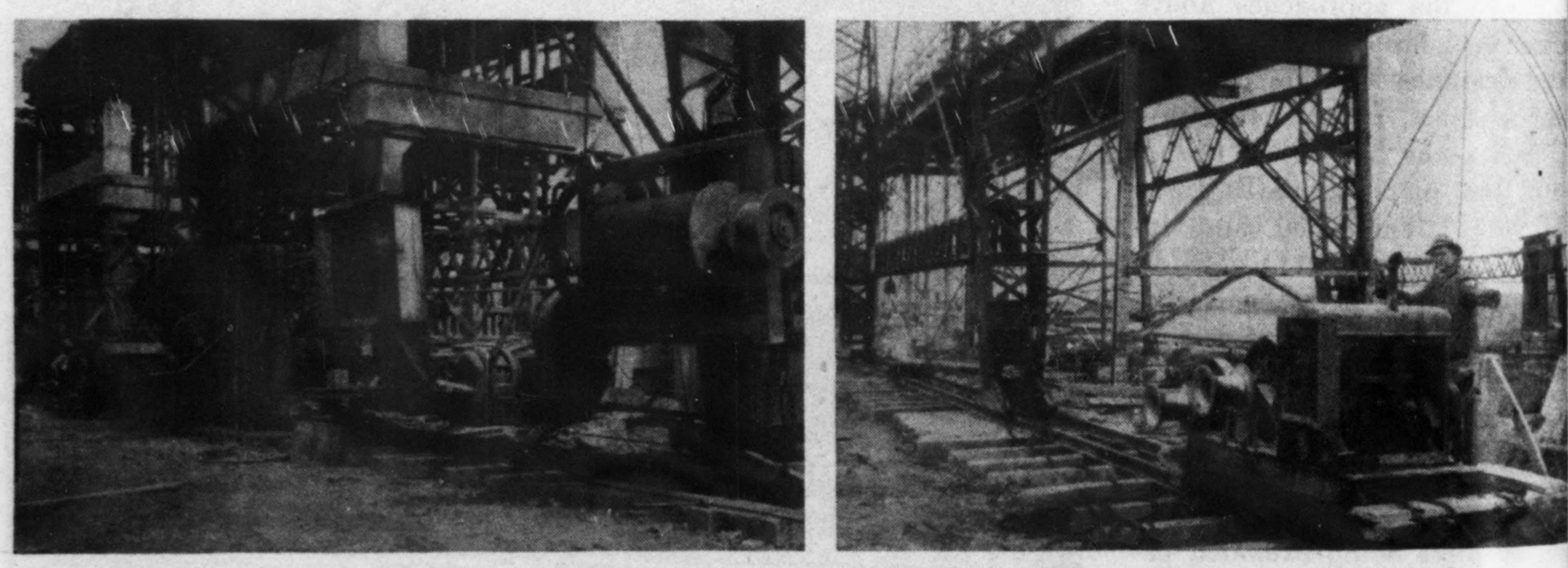
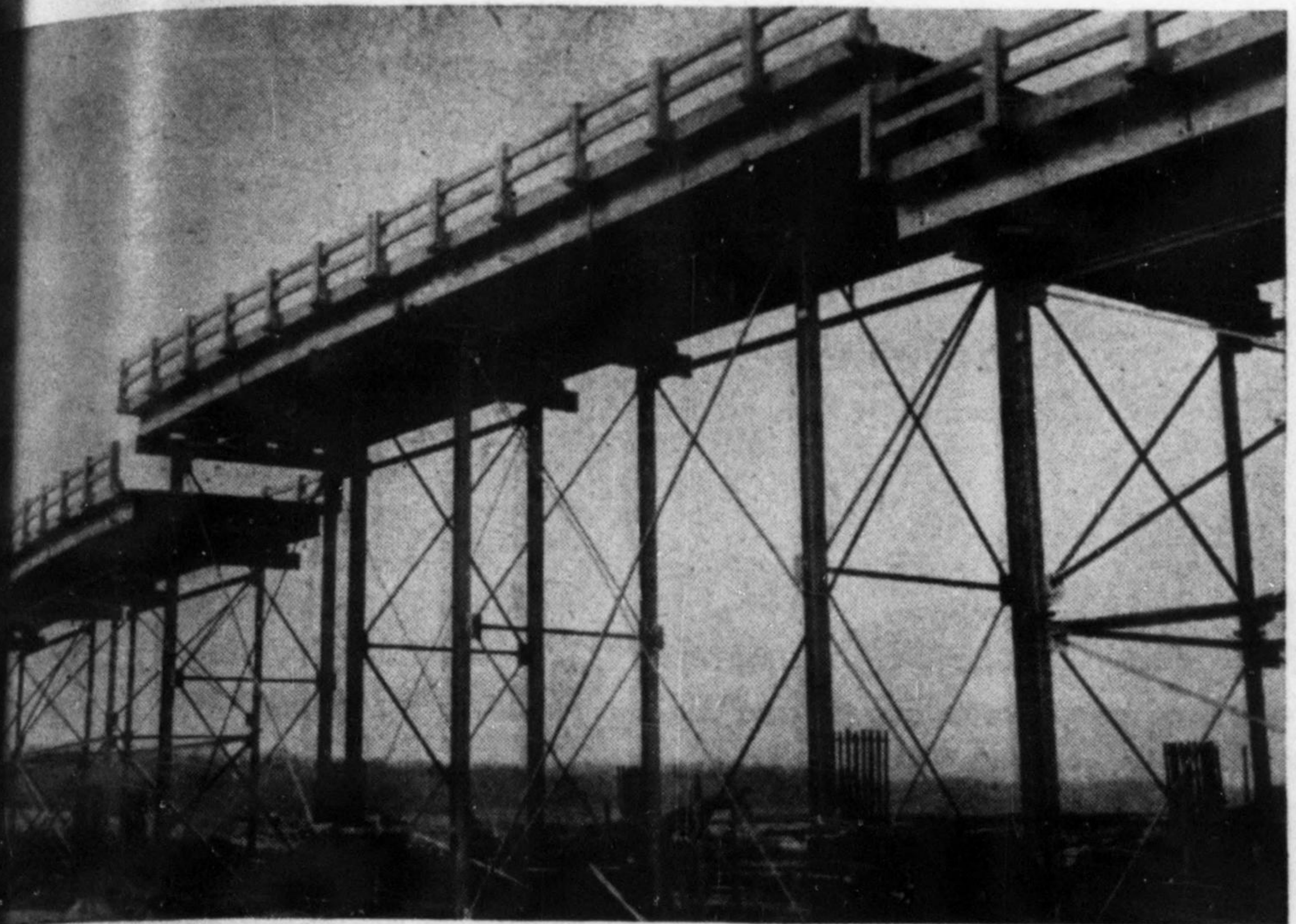
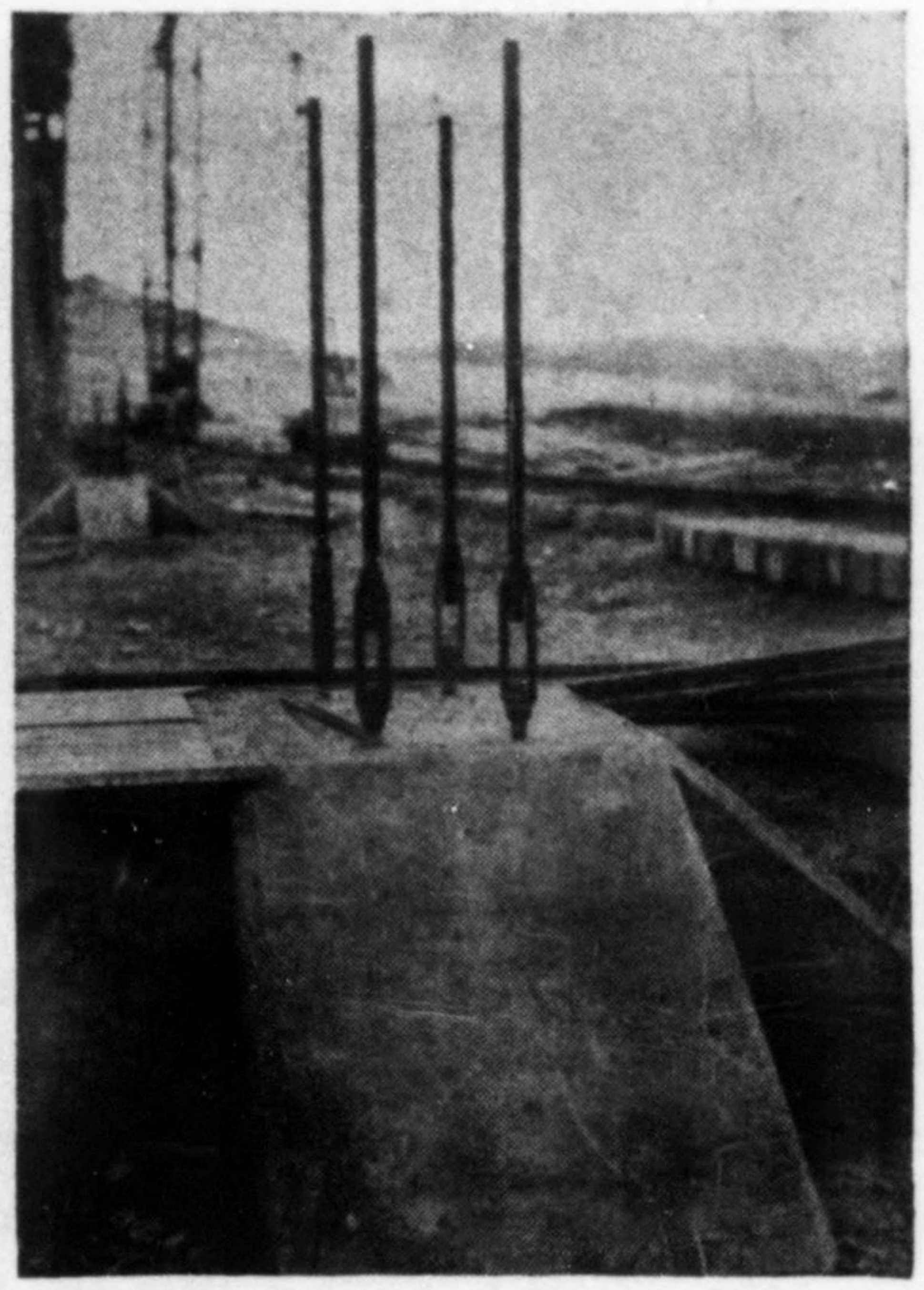


Fig. 3. Power for both lifting blocks of the gantry crane was provided by a 25-hp. electric motor (left) supported at o side between legs of the crane and a short distance above rail level. Power for moving crane forward (right) w supplied by a gasoline-powered, double-drum winch that slid along one pair of the crane rails. The winch also aid in erecting the needle beams below the bridge deck, removing and re-erecting the old steel.





4. Temporary support for the raised sections of deck (left) was provided by 4-column steel towers, two under each -ft. section of the deck. These towers were so arranged as not to interfere with construction of the new concrete pports. The new concrete towers were built on the old tower footings (right), the new construction being tied to old foundations by four steel dowels threaded onto the anchor bolts for the old steel.

d by dump truck, and placed with y-down bucket handled by a crane h a 75-ft. boom. All concrete was rated in place.

When the concrete bent for a two- n section had been completed, the try crane backed up to that point d supported the deck while the tem- ary falsework was removed and the steel tower was erected on the new struction. An exception to this thod was at those few spans where nges of grade required that the d steel bents either be shortened or t the lower end of the bents be em- dded in the new concrete. The latter thod was followed, as it required s work.

When the steel erection had been mpleted, the gantry lowered the k in place. In sections where the de was changed, steel plates were ed under the floorbeams at the pports to accommodate the minor anges of slope at the bearings. nge of grade also required replace- nt of some of the handrails to ke the handrail posts vertical, but erwise little work remained after deck sections were lowered in ce.

Power to move the gantry back and th along the bridge was provided a double-drum, gasoline-powered nch mounted on skids (Fig. 3). is winch also handled the needle ms used in lifting a section of the ck and set the falsework steel with the aid of a small crawler crane.

Because of the great length of the structure, the several phases of the work were carried out simultaneously, which permitted rapid progress. On the east approach, all work except reconstruction of the handrail was completed in 2½ months. During this time, operations continued 8 hr. per day six days of week. The contractor's crew number 140 men, a large proportion of these men working on the main crossing and the west approach.

All TVA bridge work is under the direction of C. E. Blee as chief engineer, George R. Rich, chief design engineer, K. C. Roberts, head structural engineer, and Everett Scroggie, senior structural engineer. Field engineering is supervised by E. M. Arnold, principal civil engineer, assisted by W. J. Starr and J. J. Helton.

The construction work involved in the raising of the Eggners Ferry bridge cost about $384,000. It was carried out under contract by the Rust Engineering Co., Pittsburgh, represented by E. P. Wilson, general superintendent.

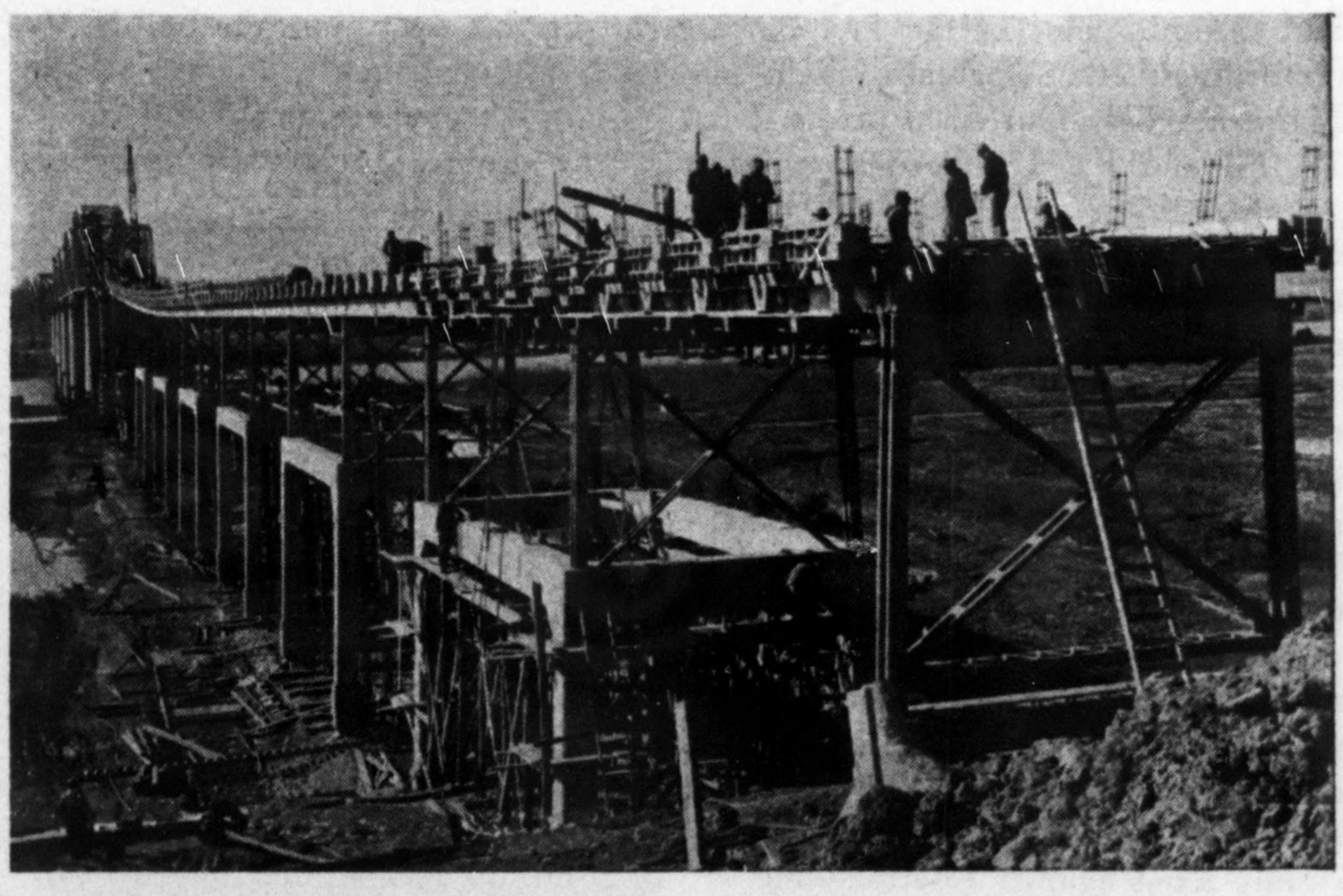


Fig. 5. Work of raising east approach nearing completion, erection of old steel on new concrete towers having been completed. Changes of grade of deck, which required addition of new handrails with vertical posts, were accommodated by embedding the lower portion of the old steel in the concrete.