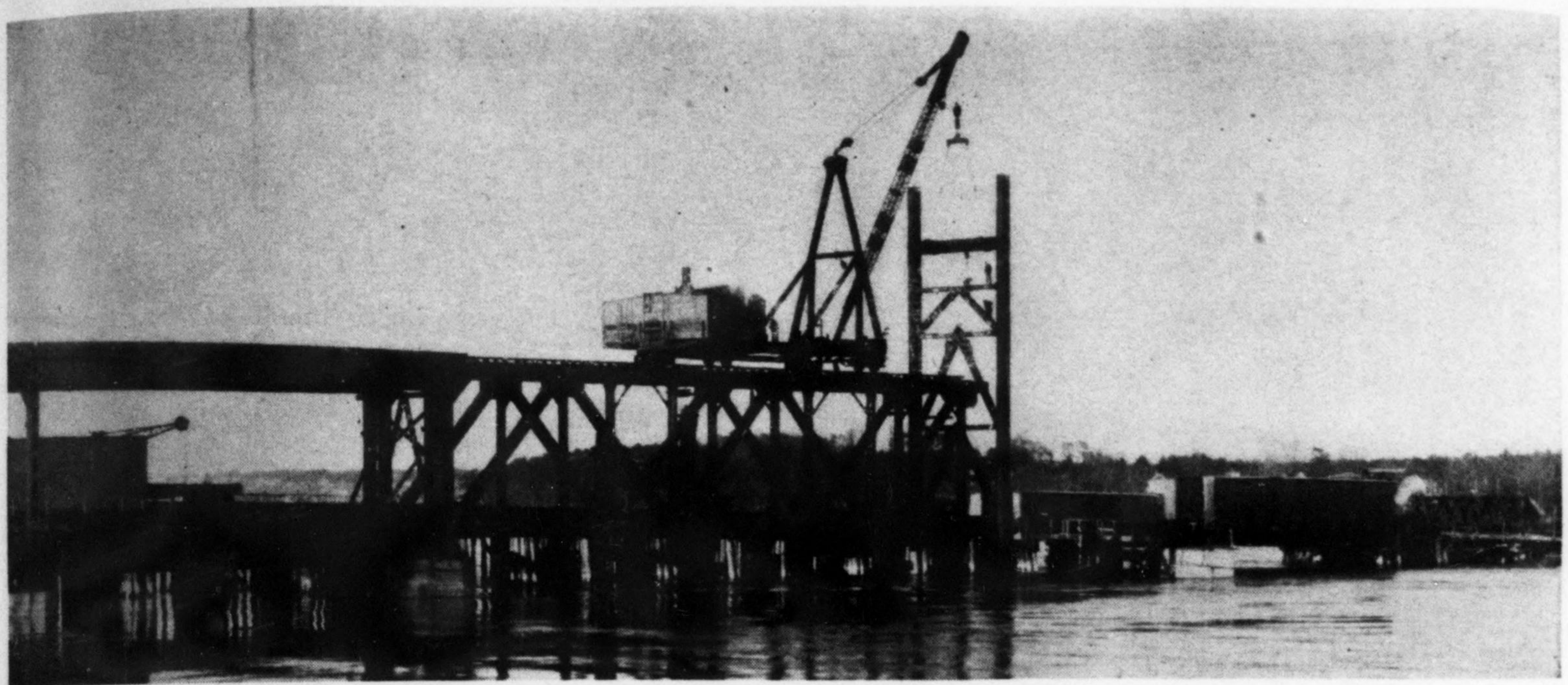

Lowering falsework bracing bent through whose hollow legs H-piles were driven to rock.

H-Piles in Hollow-Leg Bents For Bridge Falsework

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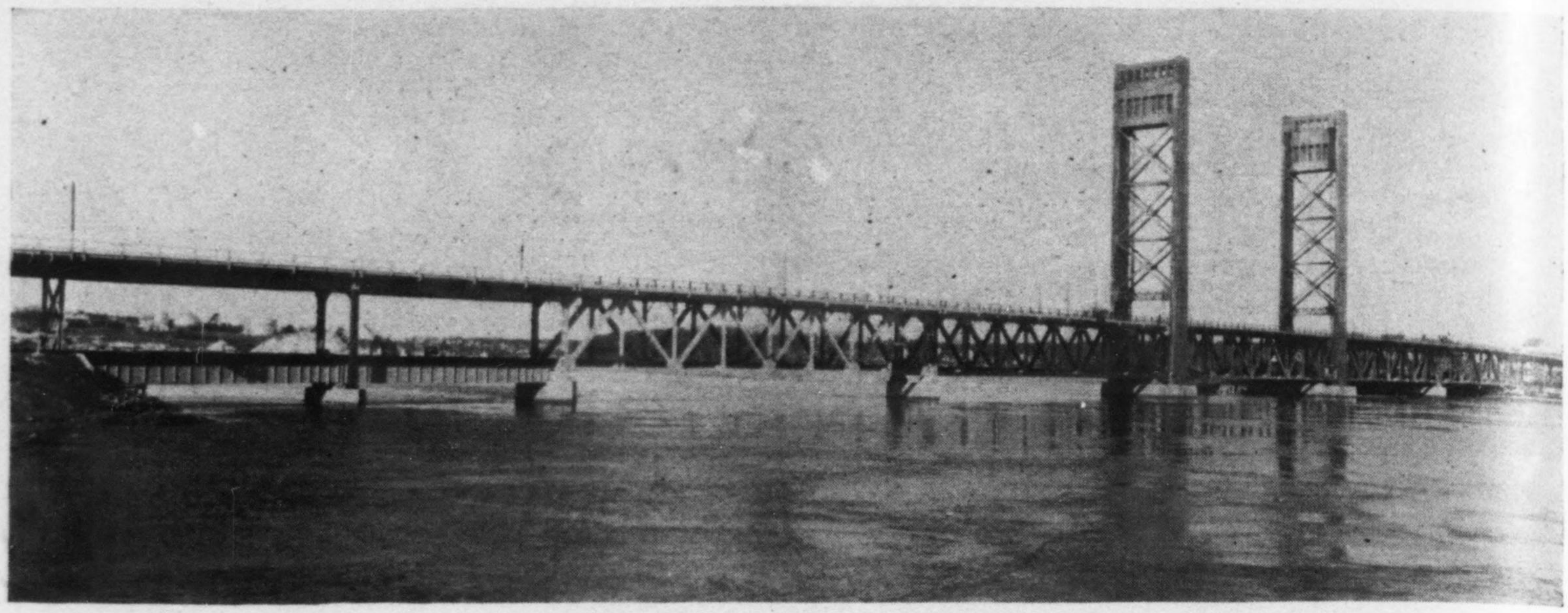
Contents in Brief*—Double-deck highway and railway bridge over Piscataqua River at Portsmouth, N. H., is at a location where swift tides and deep water made falsework erection difficult. Solution was to set braced bents of hollow legs on the bottom and drive steel H-piles through these legs to rock. The piles averaged 100 ft. in length. Bridge loads were carried on the bents and transferred to the piles through a bolted connection.*

FOR MANY YEARS the historic city of Portsmouth, N. H., has formed a bottleneck for interstate highway traffic on U. S. Route No. 1, while the 100-year-old pile trestle and timber drawbridge there, carrying the eastern branch of the Boston & Maine Railroad over the Piscataqua River, was inadequate to serve rail traffic efficiently. Both of these unsatisfactory conditions were recently remedied when the Maine-New Hampshire Interstate Bridge Authority with the aid of PWA opened its new double-deck bridge between Portsmouth and Kittery, Me. In addition to being an important traffic artery the bridge is also of interest because of the erection scheme that was used, particularly a special falsework design to cope with swift, deep water.

The new bridge has a total length on the upper, or highway deck, of 2,798 ft.; a 30-ft. concrete roadway and two 3-ft. sidewalks are accommodated. The lower deck carries 1,606 ft. of single-track railroad. The main river crossing consists of a 224-ft. vertical lift span flanked on either end by two 225-ft. truss spans; towers for the lift span are 207½ ft. high. On the south bank of the river there are two 88-ft. deck girder approach spans, which carry the railroad, and fifteen deck plate girder spans, varying from 68 to 88 ft. in length, which carry the highway. On the north bank of the river six deck girder spans carry the highway, and three deck girder spans carry the railroad.

One of the architectural features of the bridge is the use of steel sheathing plates welded on the faces of the lift span towers. The lift span is operated by 100-hp. electric motors in machinery houses on each tower top, power being applied to the counterweight ropes and sheaves through a train of gears. Counterweights are of concrete incased in steel boxes. The two ends of the span are kept level by 50-hp. synchro-tie motors installed on the same shaft as the driving motor; a selsyn skew limit device prevents the lift span from getting more than 4 in. out of level. The bridge is controlled from an operator's house located on the fixed span adjacent to the south tower.

Superstructure erection was not unusual, a 25-ton traveler with 75-ft. boom, operating on the roadway deck, being used for the truss spans; a guy derrick mounted on skids, operating on the roadway deck, being used for the south approach girders; and a locomotive crane, operating on the ground, being utilized to lift the north approach girders into place. The truss span traveler also erected



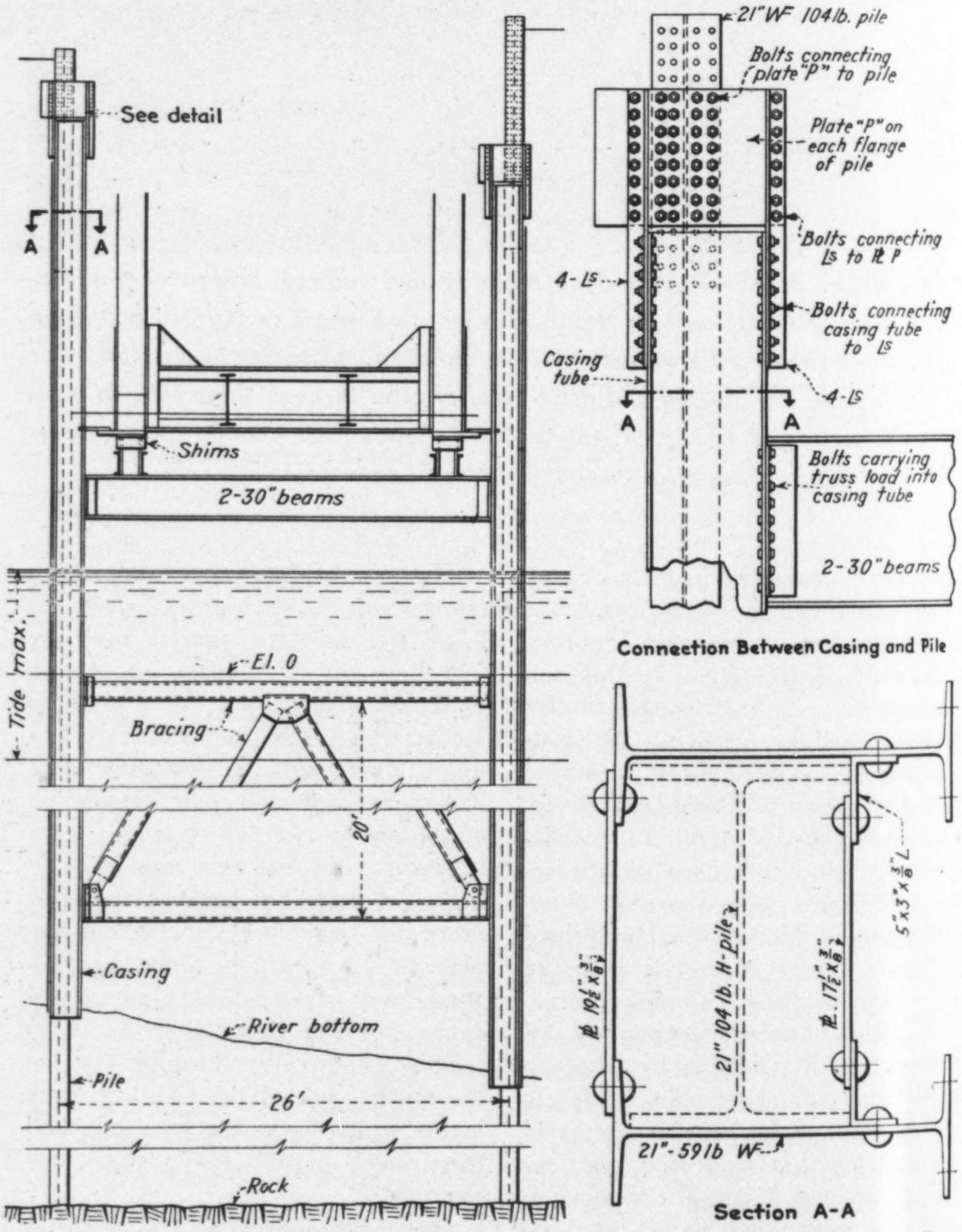
Portsmouth-Kittery Bridge completed. Highway is on upper deck, railway beneath. Lift span towers reflect care taken to achieve good appearance.

the lower half of the lift span towers, while the top halves were placed by guy derricks, supported at two successive levels on the tower itself.

The principal interest in the job rests in the falsework developed for the truss spans. Conventional bents could not be used because the Piscataqua River at the bridge site has an 8 to 10-ft. tide, a current of high velocity, a 60 to 70-ft. depth of water and a considerable layer of bottom mud overlying solid foundation. To meet these conditions, braced bents with hollow legs were prefabricated and set on the river bottom, after which H-piles were driven through the hollow legs to rock.

Since the five trusses including the lift span were of similar design and of eight panels each, one set of falsework was sufficient. This consisted of three bents, one at every second panel point for a span. The prefabricated bracing consisted of hollow legs or steel casings made of 21-in. 59-lb. H-sections and plates in 20 to 60-ft. lengths, making a total casing length of 80 ft. when required. These hollow legs were braced at 20-ft. heights in the transverse direction of the bridge but no bracing was used longitudinally. The piles driven inside the legs were 21-in. 104-lb. H-sections averaging 100 ft. in length and weighing 5 tons. Each pile driven was required to carry a dead load of 152,660 lb.; a traveler live load of 88,000 lb.; a tide overturning load of 48,000 lb.; and wind load of 105,000 lb.

In placing the falsework, the two hollow casings for a bent were assembled with the accompanying bracing on the upper deck of the bridge, the casing legs being adjusted to sounded depths by means of holes for the bracing in the casing legs. At a slack tide period the traveler picked up the assembled bent, moved forward and lowered it to rest on the bottom as shown in the accompanying illustration. Timber shores and crossed lashings from the bent top to a pier



Connection Between Casing and Pile

Section A-A

Falsework details showing how bridge load was transferred from bent to H-piles.

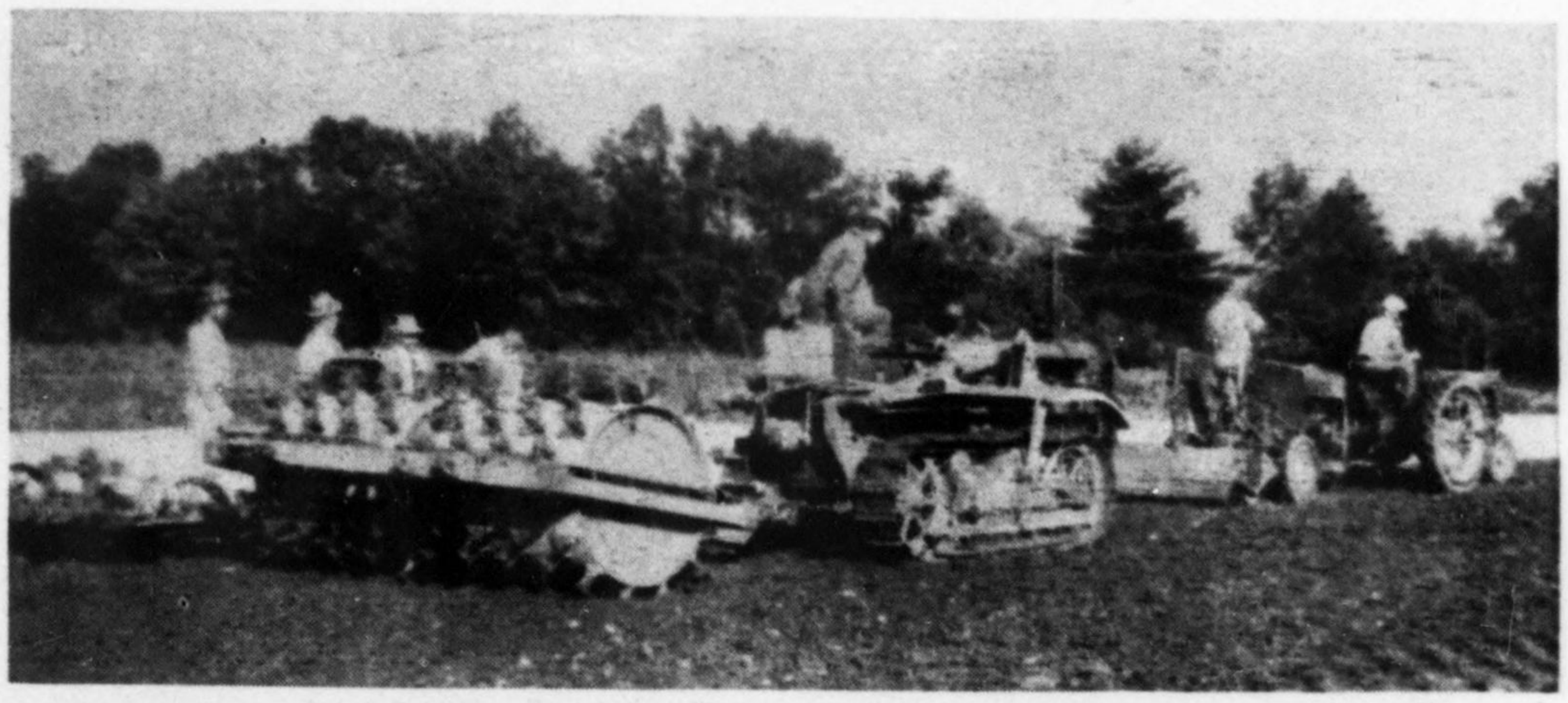
or to bents already placed were used to hold the new bent in correct position. The traveler then inserted the 21-in. H-pile in each casing leg and drove it to rock. After the bottom chords and the bottom laterals of a span were erected on a bent, the temporary wooden shores and lashings were removed.

Inasmuch as the bridge load was carried by a pair of 30-in. 108-lb. H-beams bolted between the casing tops, it was necessary to connect the casing with the piling in order to transfer the load to the foundation. This transfer of load was made at the top of the casing by means of adjustable plates and a series of holes drilled in the pile top as shown in the drawing. The bridge camber was obtained by shims between pedestals on the 30-in. beams and steel slabs bolted to the under side of the bottom chords.

After a truss span was erected and the bottom chord splices riveted, the falsework bents were freed by lifting an end of the span with hydraulic jacks on the pier. The traveler then removed the 30-in. transverse beams and the bracing between the hollow casings. After being disconnected from the piles, the casings were pulled up to provide access to the lower pieces of bracing. The pile sections were removed by the traveler at slack tide.

The total cost of the project was $2,477,369. The Phoenix Bridge Co., Phoenixville, Pa., held the superstructure work on a bid of $994,351. The substructure contract was held by the Frederick Snare Corp., New York, the north approach roadway by the Littleton Construction Co., Littleton, N. H., and the south approach roadway by John Iafolla Construction Co., Dedham, Mass.

Harrington & Cortelyou, Kansas City, Mo., were consulting engineers for the project with H. D. Peoples as resident engineer at the bridge site for the consulting engineers and the Maine-New Hampshire Interstate Bridge Authority. James R. Gardner was the chief resident engineer inspector for the PWA. The Phoenix Bridge Co. was represented in the field by J. F. Kinter, general superintendent of erection, Harry A. Archinal, field superintendent, and the writer as resident engineer. The falsework erection scheme was devised by William H. Ellis, assistant erection engineer of the company.



Rotary tiller, sheepsfoot roller, and spring-tooth harrow mix and compact soil cement runway at Westover Field, Northeast Army Air Base.

Soil Cement Runway for Army Airbase Placed With Enrichment in Top Inch

Contents in Brief*—Low-cost runway construction at the Northeast Army Air Base used ten percent by volume of portland cement well mixed for a six-inch depth and the surface enriched by additional cement in the top inch. Heavy duty field cultivators and harrows, rotary tillers, sheepsfoot and tandem rollers and a bituminous distributor for application of water constituted the principal equipment required to give a density and weight equal to concrete.*

CONSTRUCTION of a soil cement runway at Westover Field, Northeast Army Air Base, Chicopee Falls, Mass., was completed last fall using only medium size machines yet securing efficient mixing to the 6-in. design depth. Removal of larger stones from the top and enrichment of the upper 1-in. of the runway with added cement gives the surface a smooth, weather-resistant texture. The runway on which the soil cement surfacing was applied is 150 ft. wide and 2,500 ft. long, and is an auxiliary landing strip for use pending completion of the permanent runways and for minor and storage use thereafter.

Soil cement is not recommended by the Portland Cement Association for heavy-duty runways and aprons but does offer a satisfactory surface for auxiliary and secondary runways and airports where first cost must be low. At Westover Field about 90 percent of unprocessed local material and the inexpensive procedure of in-place mixing were used to secure a runway surface at a contract cost of 54c. per sq.yd.

Base preparation

Prior to contract construction on the soil cement runway area, the WPA removed 6 to 18 in. of loam to expose a fine sand which extends to considerable depth. Soil for major portion of the mixture used was obtained from a nearby pit selected to avoid tannic acid and to provide a pit run material of sandy gravel with about 35 percent passing the ¼-in. screen and nothing larger than 3-in. This material was hauled to the runway in medium-size dump trucks and spread to a 7-in. uncompacted depth with not more than 0.1 ft. variation of surface above or below plan grade.

Contractor takes over

From this point the work was done under a competitive bid contract which required furnishing cement and all equipment for properly applying and mixing the soil cement of the runway. Lines, grades and inspection were handled by the Constructing Quartermaster.

The 150-ft.-wide runway was divided into 50-ft. strips for processing and the center section worked first for its entire length. An area about 600 ft. long constituted a usual day's work and this was definitely laid off by placing 8x8-in. timber headers across the end of the work with 2x8-