Modern Construction Practices on Latest Hudson River Bridge

Rip Van Winkle Bridge contractors used a barge mixing plant for both water and land piers, a modified sand-island method for sinking a deep river pier, erected 12,000 tons of steel by deck travelers and distributed pavement concrete through a 1,200-ft. pipe line

FIG. 1—CONNECTING the Rip Van Winkle country of the Catskills with eastern New York and New England, this new bridge, near Hudson, N. Y., provides the only highway crossing of the Hudson River for 25 miles up and downstream.

PROVIDING the only highway bridge crossing of the Hudson River between Poughkeepsie and Albany, a distance of 50 miles, the new Rip Van Winkle Bridge near the towns of Catskill and Hudson, N. Y., is one of the notable large structures completed this year. In design it is not extraordinary in spite of its size, but during its construction several noteworthy practices were followed. For example, in concreting the eight land piers of the east approach an efficient combination of boat mixing plant, industrial railway and pump distribution was worked out; the deep river pier caisson was sunk by a modified sand-island method; 12,000 tons of steel were erected rapidly with two deck travelers; and the deck was poured from a mobile concrete plant consisting of a paver, a belt conveyor and a duplex concrete pump located 1,200 ft. behind the point of pour. The contract cost of the bridge was $2,166,101. Work began in June, 1933, and the bridge was opened July 2, 1935, after a construction period that included two of the worst winters in recent years.

At the bridge site the valley is about 5,000 ft. wide between high bluffs. In this valley the navigable river channel follows the west bank and is separated from a narrower back channel along the east bank, adjacent to the tracks of the New York Central Railroad, by a marshy island some 1,600 ft. wide. The type of structure selected for these conditions consisted of ten 330-ft.-span deck trusses from the east bank across the island and a through cantilever bridge with an 800-ft. main span and 400-ft. anchor spans over the navigable channel. The cantilever bridge provides a 142-ft. clearance for navigation over a width of 765 ft.

Tall steel towers on low piers (El. +16 to +25) support the spans. Of the fourteen piers, seven are on piles; five of these are on the island, while the other two are immediately east of the main cantilever span. The bridge provides a 30-ft. roadway consisting of an 8½-in. concrete slab with a ½-in. monolithic wearing surface. The approaches aggregate 3,700 lin.ft. and include some rather heavy cuts and fills. Spurs connect with state highways, which parallel the river on either side.

Difficult foundation problems on the Rip Van Winkle Bridge were confined to the east pier of the main cantilever span. This pier was located practically at the center of the river in 20 ft. of water and was to be founded on rock at a depth of about 70 ft. A compressed-air caisson was therefore required (at least to permit an inspection of the rock bottom). However, soundings revealed that the river bottom presented a sloping profile, which would complicate landing the caisson in a truly vertical position at the start of the work. To overcome this difficulty, it was decided to level the river bottom by dumping fill material to about El. —10, and then to drive a steel sheetpile enclosure within which the caisson could be started. The sandfill not only permitted the caisson to be started on a level support, but it also served to resist the exterior hydrostatic head on the cofferdam when the enclosure was unwatered. This plan differs from the artificial sand-island method only in that the "island" is not built up above the water surface.

A sketch of this pier construction is shown in Fig. 4. The detailed procedure was as follows: after placing of the fill, temporary timber piles and bracings were installed around which the sheetpile enclosure was driven. This cofferdam was then pumped out in so far as was possible, and the steel cutting edges were set. Working-chamber forms were then added, and at the same time the working chamber was filled with well-tamped soil. Installation of reinforcing steel was followed by the placing of concrete up to 6 ft. above the cutting edge. Tweve hours later a second pour brought the concrete to about 10 ft. above the cutting edge. The outside forms were then removed and the cofferdam was flooded. The bracing was removed, and the wales were lowered about 18 in. and rebraced against the concrete caisson. The cofferdam was then pumped to about El. —2, after which the first 16-ft. lift of the caisson was poured. Following the second 16-ft. lift, the caisson was dredged until it sunk to a point where its top was at El. + 5, and a new 16-ft. lift was added. This operation was repeated until the cutting edge reached solid hardpan at about El. —90. The working chamber was then filled with tremie concrete, after which the dredging wells were pumped out and filled with concrete placed in the dry.

The method proved unusually satisfactory. At no time was it necessary to do any unbalanced dredging to bring the caisson back to plumb.

None of the other piers presented any unusual points of interest. Those on the island consisted merely of concrete pedestals on piles, while the other river piers were built in timber-braced steel sheetpile cofferdams, which had to be excavated only to about elevation —20.

In considering the foundation concreting problem as a whole, it was evident that a floating plant would be necessary to take care of the four piers in the river. Some means, therefore, was sought to utilize this floating plant for the piers on the island. The scheme finally worked out was to build a pile-supported dock on the west side of the island to which the concrete boats could be moored. From this dock industrial tracks were laid along the center line of the bridge (Fig. 2). Concrete was chuted from the concrete boat to a hopper on the dock from which it was loaded into bottom-dump buckets on flat cars. These cars, traveling the length of the track along the bridge center line, delivered the concrete to the piers, where crawler cranes lifted the buckets into the forms.

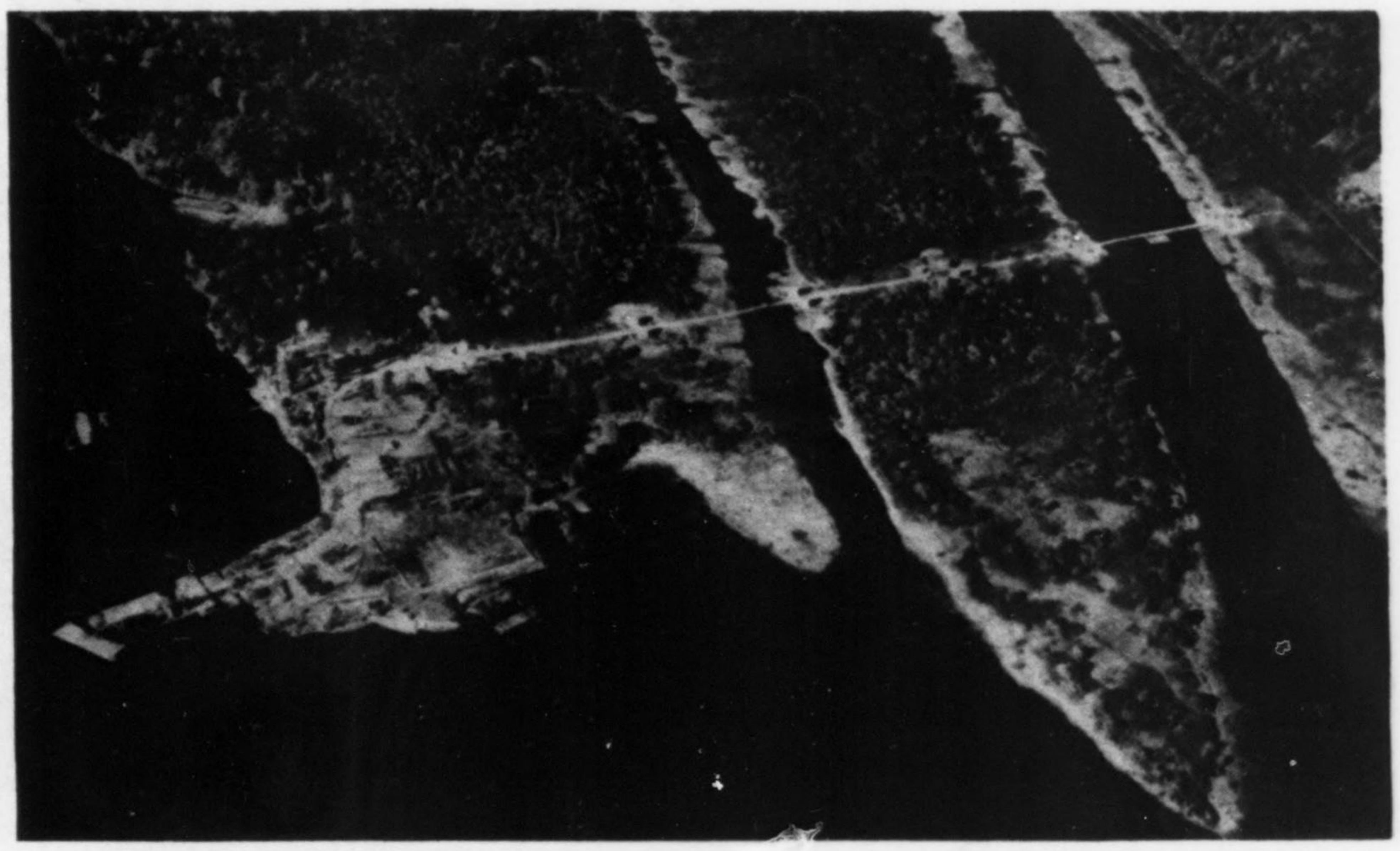
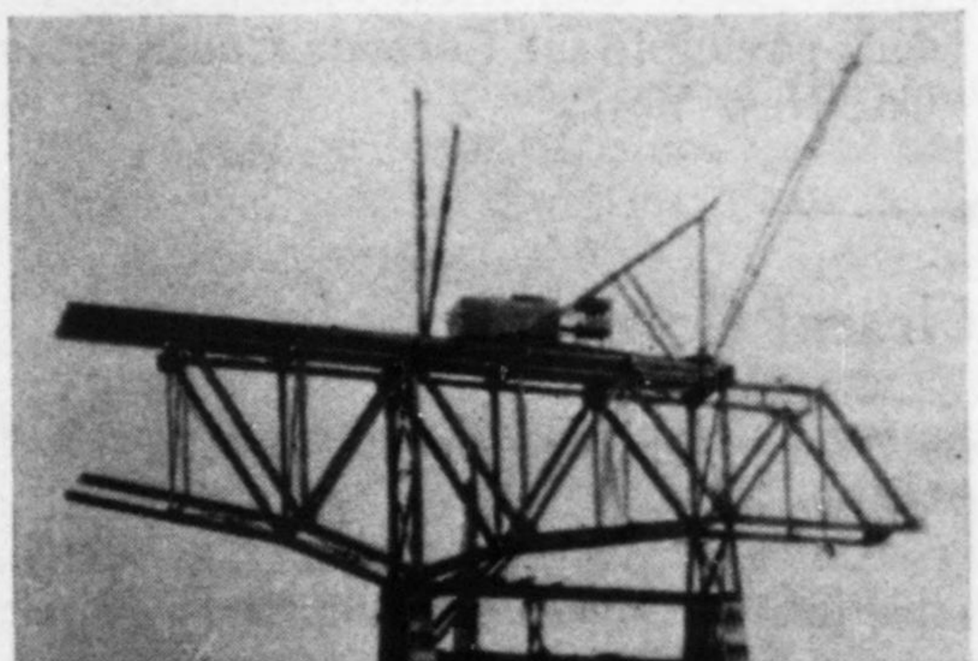


FIG. 2—CONSTRUCTION OPERATIONS centered at a dock and storage yard on an island that divides the river into a main and a back channel. Note industrial railway connecting concreting plant at the dock with all land piers, and also the start of steel-erection operations on the left side of the island.

Steel erection

Use was also made of the dock by the steel erector, who centered his operations at this point since materials were brought in by boat. Erection was begun at the pier at the west side of the island. The steel tower was set up on this pier, and one of the other towers was temporarily used as falsework (Fig. 3), to permit erecting enough of the first island deck span to support the traveler. This initial erection was done by a 90-ft. boom guy derrick on the ground. This derrick also erected another guy derrick on top of the steel work with which the traveler was assembled. The traveler moved east, erecting the deck spans by the cantilever method, light steel falsework bents being placed at panel point 4 (about 25 ft. beyond center) in each span. When this traveler had erected the deck spans to the east abutment, it was dismantled and trucked around to the west end, where it started on the erection of the anchor arm of the main cantilever bridge.

In the meantime another traveler had been set up on the west island pier and worked west, erecting the two deck trusses, the east anchor arm and half of the main cantilever span. Closure was made in the center and was aided by eight 300-ton hydraulic jacks on each of the main piers. Steel falsework bents were used under each panel point of the anchor arms. No falsework was used under the main span.



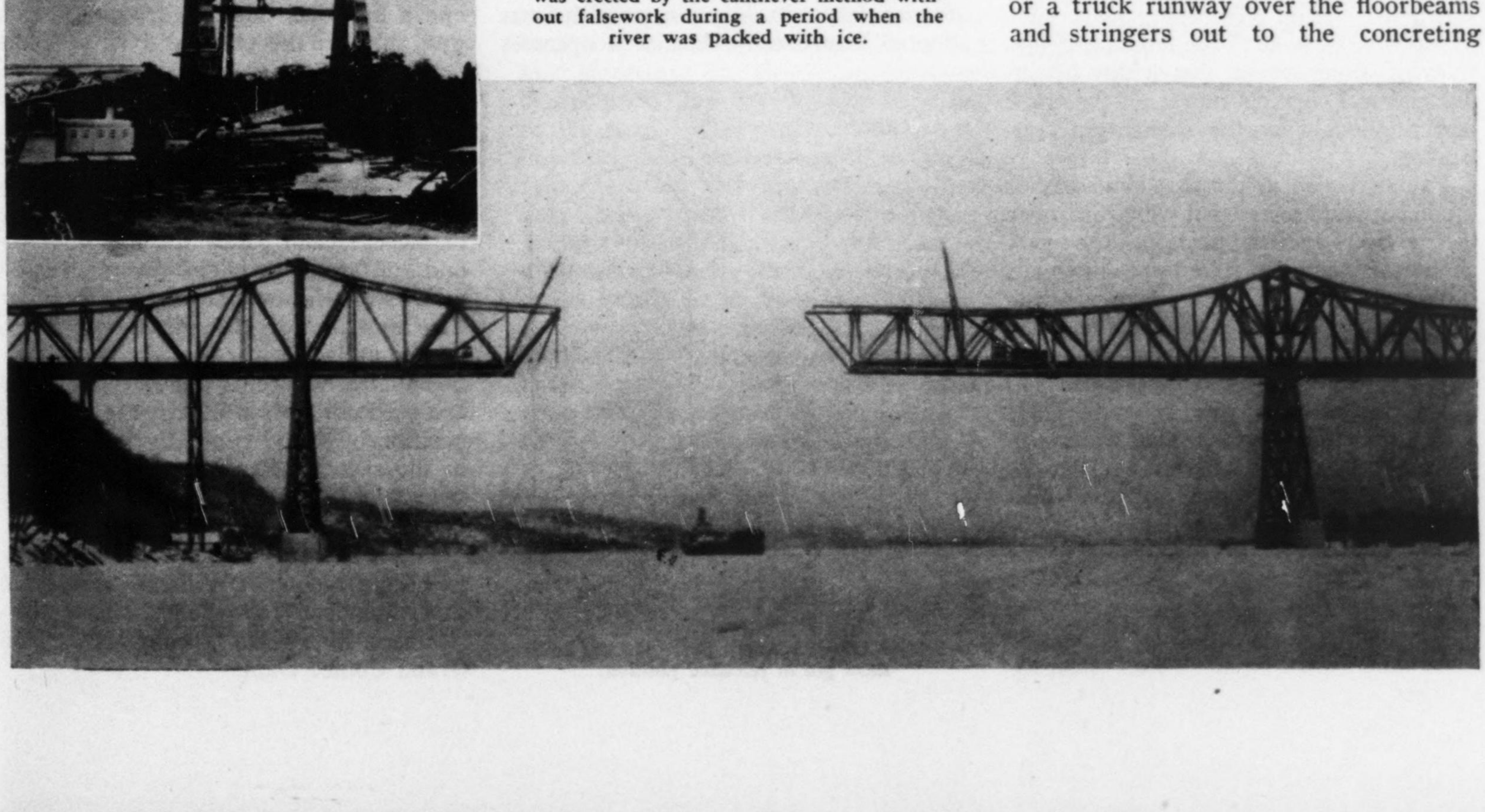


FIG. 3—STEEL ERECTION by traveler derrick was begun in about the center of the 5,000-ft.-long bridge (left) and proceeded both ways. The main 800-ft. span was erected by the cantilever method without falsework during a period when the river was packed with ice.

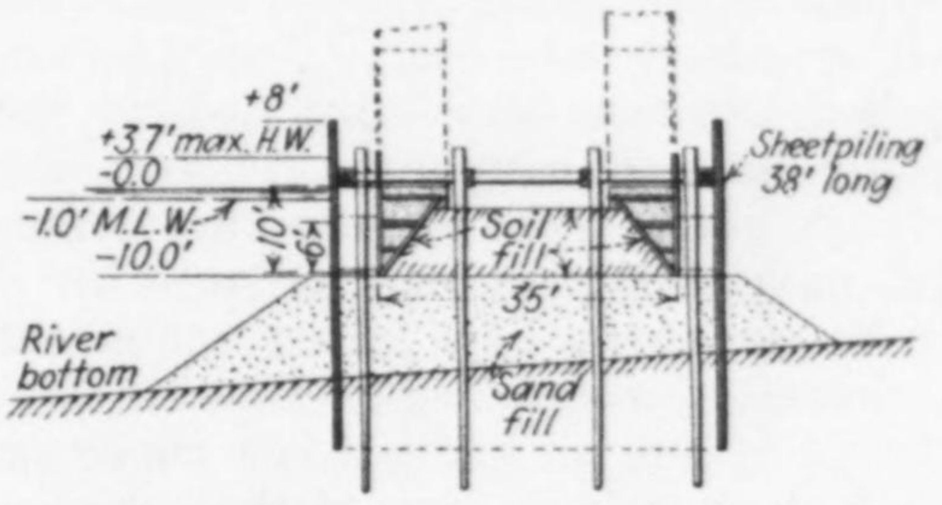


FIG. 4—MODIFIED artificial sand-island method used in sinking the caisson for the main river pier.

Deck concreting

As much interest attaches to the concreting of the deck of the Rip Van Winkle Bridge as to any other element of the construction program. The reason lies basically in the adaptation of the concrete pump to such operations. Instead of laying an industrial rail track or a truck runway over the floorbeams and stringers out to the concreting

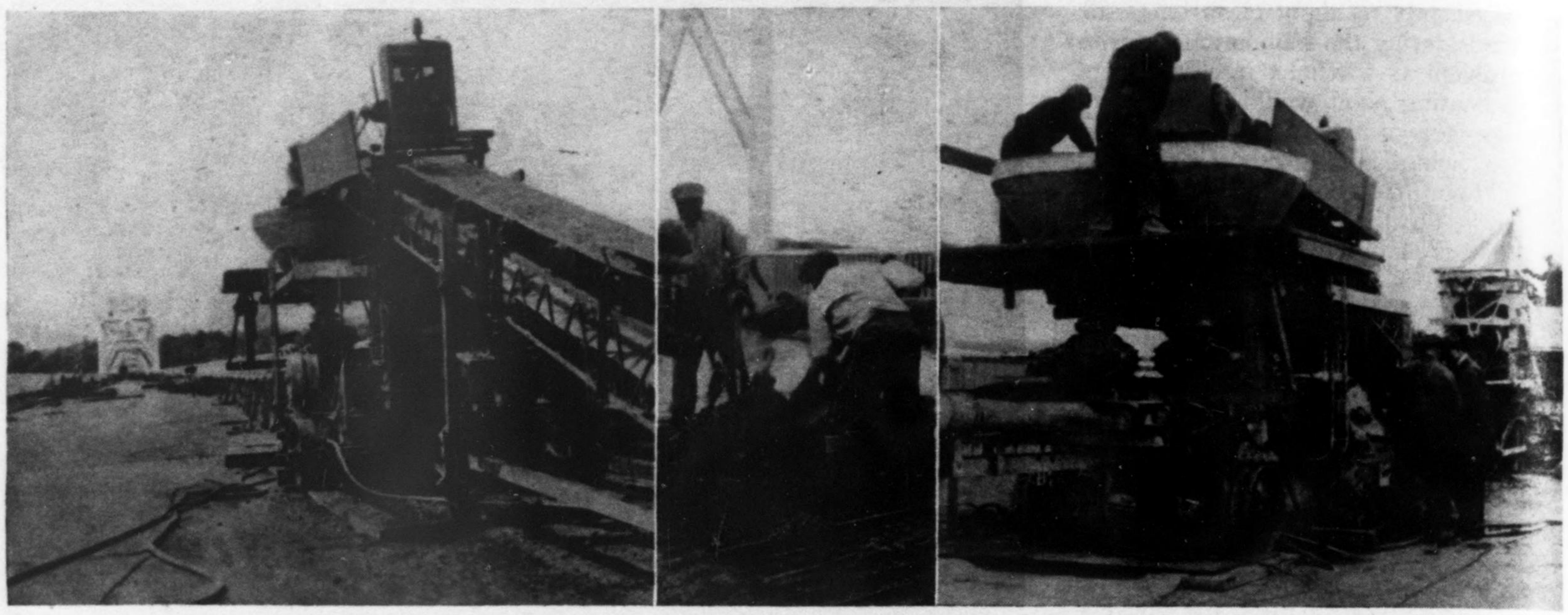


FIG. 5—DECK CONCRETING was carried out by an equipment combination consisting of paver, belt conveyor and 7-in. duplex concrete pump, located some 1,200 ft. behind the point of pour on slab that had cured seven days. Concrete of a slump of 1 to 2 in., as delivered to the pipe line, was spread on the deck with the aid of an electric tamping screed.

point, the procedure developed permitted all equipment to be operated on the compelted concrete slab. By making the pipe line long enough, the concrete was always given seven days to cure before the mixer and pump moved up to it.

As shown in Fig. 5, the equipment consisted of a standard 27 E paver, discharging onto an inclined belt conveyor 25 ft. long, which dumped the concrete into the twin hoppers of a 7-in. duplex concrete pump. These three items of equipment were coupled together and moved forward as a unit. Aggregate and cement were batched at a railroad siding at Hudson, N. Y., three miles away, and trucked to the paver as on any road job.

The equipment was set up about 1,200 ft. behind actual pouring operations. At the start of work in the morning the discharge end of the 7-in. pipe line was placed at the far end of the day's pour. Each day's pour was 246 ft., or three expansion-joint units. As pouring proceeded, the pipe line was successively shortened. Steel reinforcing mats were brought in by boat to the island and distributed along under the bridge by industrial rail cars operating on the track laid previously by the foundation contractor.

Paving began at the east abutment of the bridge and proceeded westward over the entire viaduct section, the east anchor arm and 200 ft. out onto the main cantilever span. The equipment was then moved to the west bank of the river, and the pavement was poured from the west abutment eastward to closure.

The concrete mix specified was 1:2:3½, with a maximum of 5½ gal. of water per sack. This gave a concrete of 1- to 2-in. slump, and this was vibrated into place with an electric screed. Control cylinders averaged 3,000 lb. after seven days.

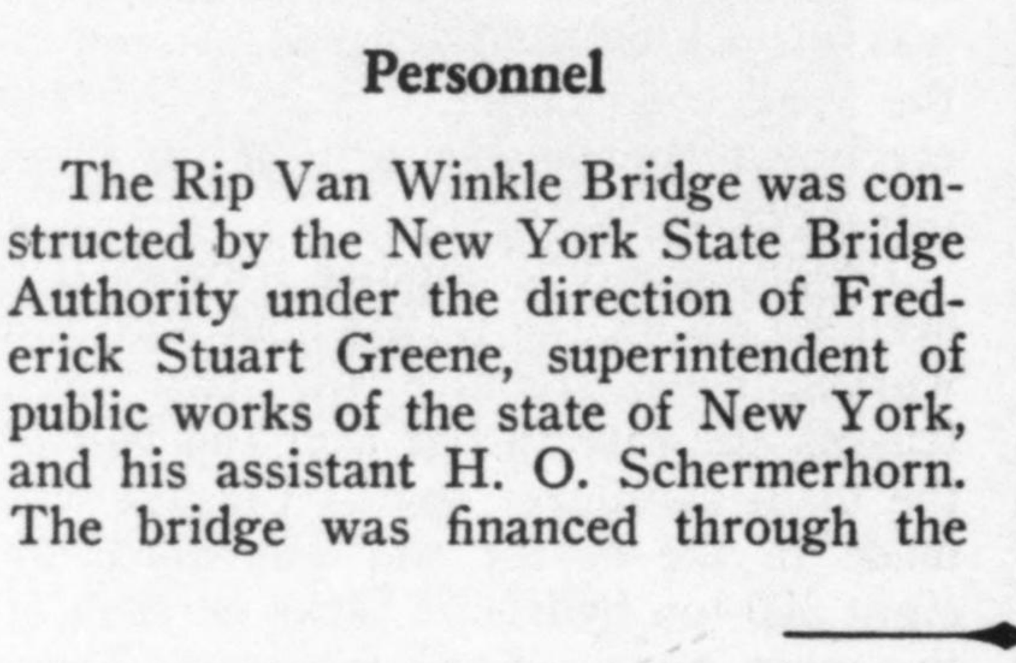
The contractor was unusually well pleased with the operation of the equipment, and work went ahead steadily from beginning to end. At the completion of each pour the concrete pipe line was cleaned out by inserting a charge of sawdust. When this had pushed the mass of the concrete out, the pipe line was directed over the edge of the bridge and flushed clean with water.

Personnel

The Rip Van Winkle Bridge was constructed by the New York State Bridge Authority under the direction of Frederick Stuart Greene, superintendent of public works of the state of New York, and his assistant H. O. Schermerhorn. The bridge was financed through the sale of Bridge Authority bonds to the Reconstruction Finance Corp. Tolls will be charged commensurate with those on the Mid-Hudson Bridge at Poughkeepsie, which is also under the supervision of the Bridge Authority. The bridge was designed by Glenn B. Woodruff in 1930, before Mr. Woodruff became engineer of design for the San Francisco-Oakland Bridge. The general contractor was the Frederick Snare Corp., New York, which built the foundations with its own forces. The steel erection was sublet to the Harris Structural Steel Co., New York, and the deck paving to the Corbetta Construction Co., New York.

Safety Shackle Pin Adopted at Grand Coulee Dam

A NEAR ACCIDENT on the Grand Coulee Dam project, when a bolt fell from one of the shackles used in placing sheetpiling, has led to invention of a safety shackle pin, which was adopted immediately because it operates more quickly than the ordinary pin and cannot fall out.



SHACKLE with safety pin. Dotted lines show pin in retracted position.

As shown in the acompanying sketch, the pin of improved design has on one end a lug much like the front side of a gun, and on the other end is a handle formed by bending the pin itself into a right angle. The pin is retracted by grasping the handle and turning it into the raised position, shown dotted in the accompanying sketch, in which the lug can be drawn back entirely through one of the eyes and partly through the second. A stop provided by a washer welded on the outside of the eye after the insertion of the pin serves as a keeper and prevents the pin from coming all the way out. As these shackles are used chiefly for lifting, the working position of the U generally is as shown in the sketch. Thus gravity ordinarily keeps the handle in the lowered safety position.

Credit for application of this idea goes to (Pete) G. C. Willson, cofferdam superintendent for the Mason-Walsh-Atkinson-Kier Co., contractors on Grand Coulee Dam.