ENGINEERING NEWS-RECORD

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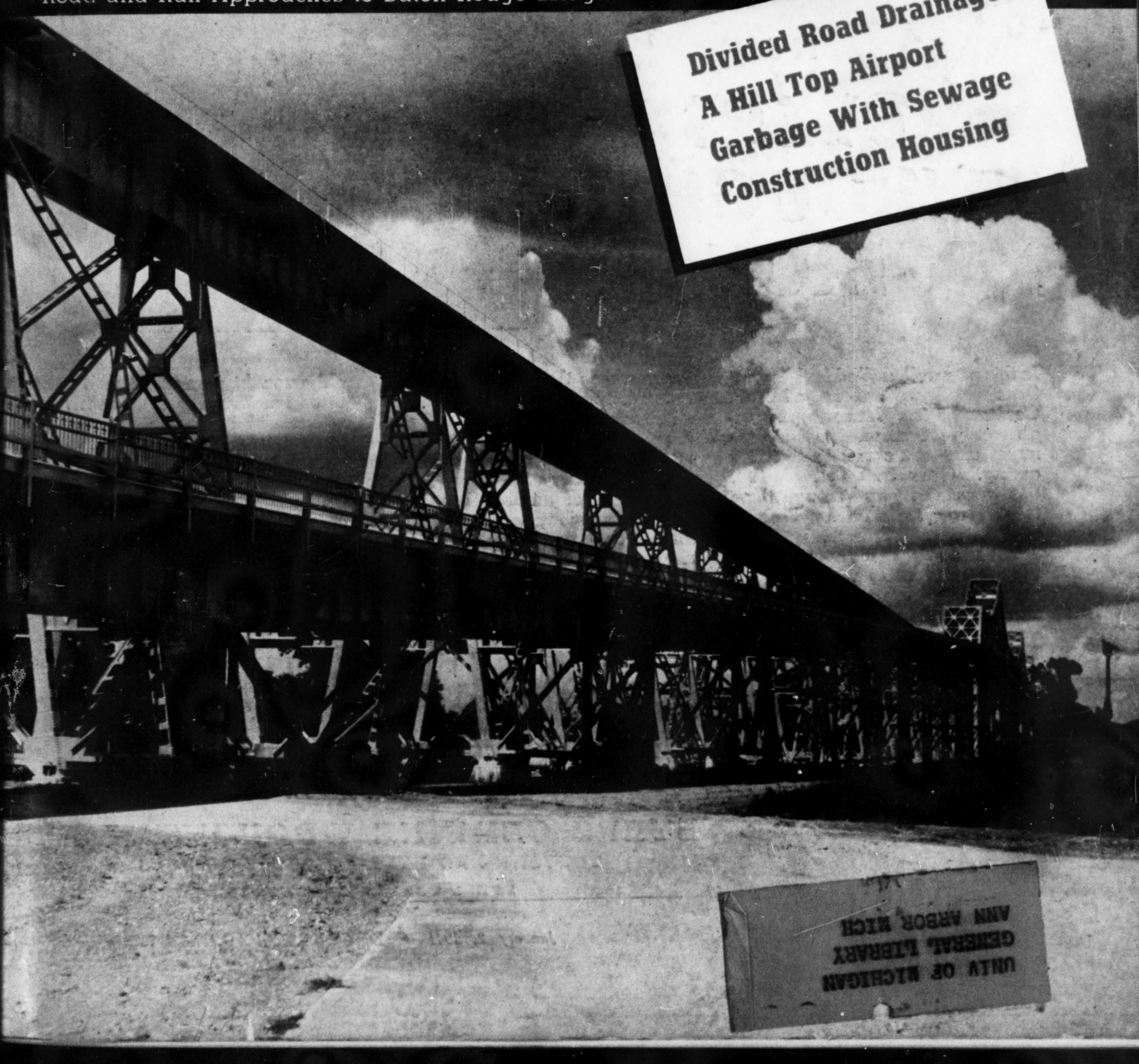
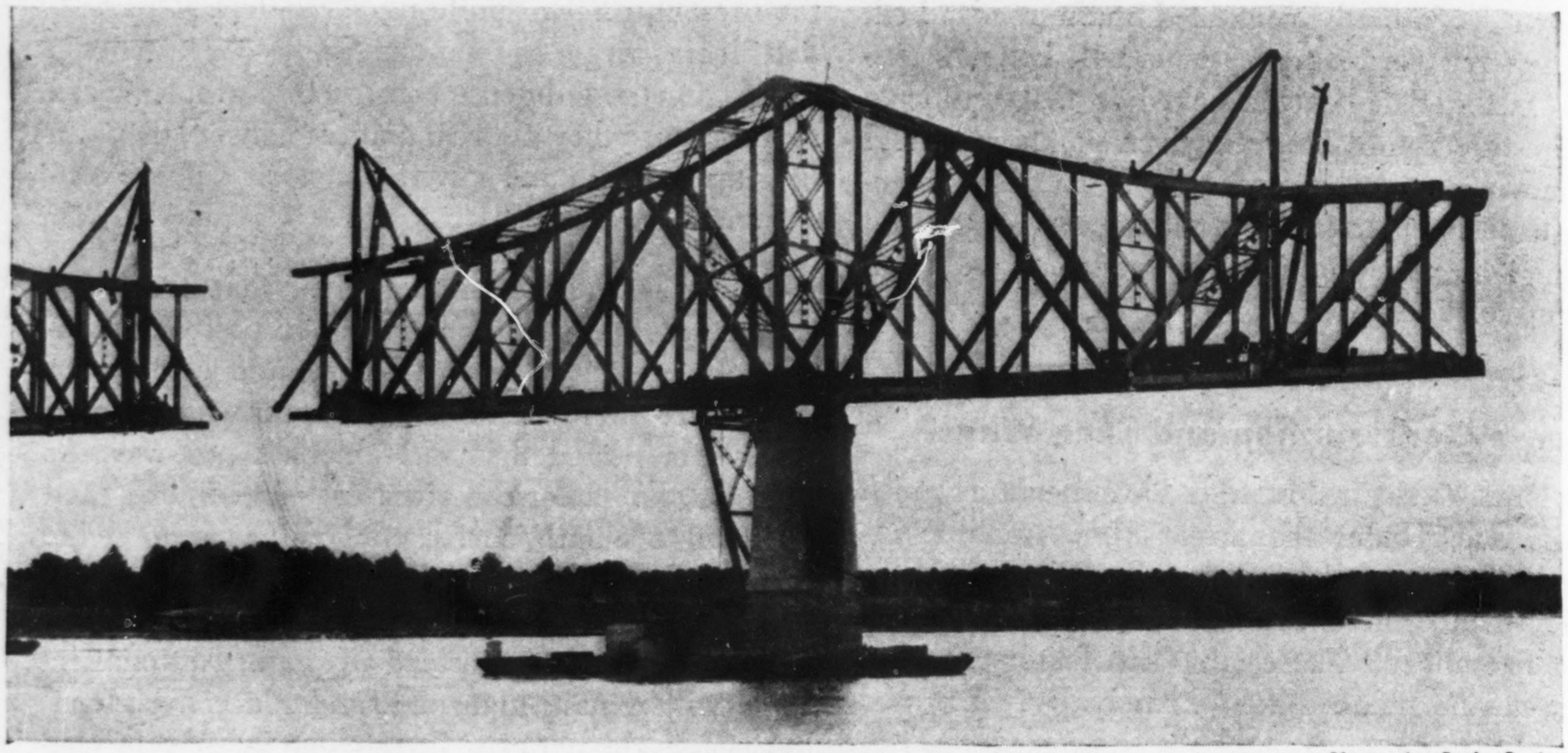
Road and Rail Approaches to Baton Rouge Bridge

Divided Road Drainage
A Hill Top Airport
Garbage With Sewage
Construction Housing





Photos by E. L. Durkee

Fig. 1. First stage of Baton Rouge Bridge erection nearing completion. Pier shown is No. 3.

Twin Cantilevers Erected by Balancing

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***Contents in Brief**—Deep water and deeper mud at site of new Baton Rouge Bridge over Mississippi River made falsework in stream out of question. Steel erected each way from piers, guy derricks starting work and assembling travelers which then carried on. Bridge is for both railway and highway use. Five spans of main river crossing vary from 490 to 848 ft. Only bridge crossing in the 180 miles between New Orleans and Natchez.*

Erection of the new railway and highway bridge over the Mississippi River 5 miles above Baton Rouge, La., was accomplished without the use of falsework bents in the river despite maximum span lengths of 848 ft. A single inclined bent at each pier supported the first panel of steel and thus provided a platform from which the derricks could start, but beyond this no falsework was used and erection proceeded by balancing steel each side of the piers. The method proved fast, economical and safe.

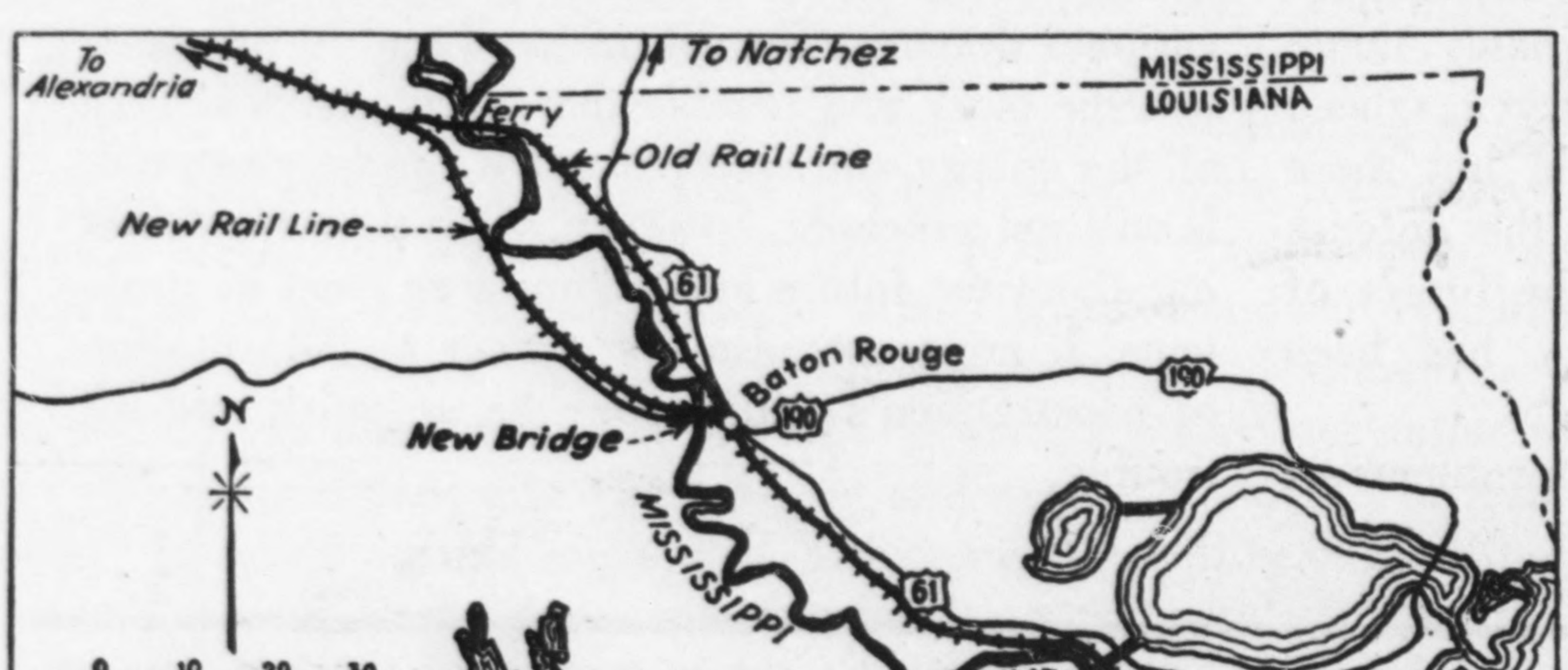

Fig. 2. Baton Rouge Bridge improves both highway and railway crossings of Mississippi, both previously effected by ferries.

The Baton Rouge Bridge is an important traffic link, replacing a highway ferry on U.S. 190 at Baton Rouge and permitting the Louisiana & Arkansas Railroad to abandon its old line on the east side of the river, which included a ferry crossing 40 miles upstream, and to use Missouri Pacific R.R. tracks on the west side of the river into Baton Rouge. Nearest adjacent crossings are the Huey Long Bridge 90 miles downstream at New Orleans and the new bridge at Natchez about an equal distance upstream. By its new routing the L&A saves an hour in time and eliminates long delays caused periodically by river conditions and fog on the ferry line. By locating the bridge 5 miles north of Baton Rouge, advantage was taken of a narrow width of the river, and in addition the site is beyond the limits of deep draft navigation which

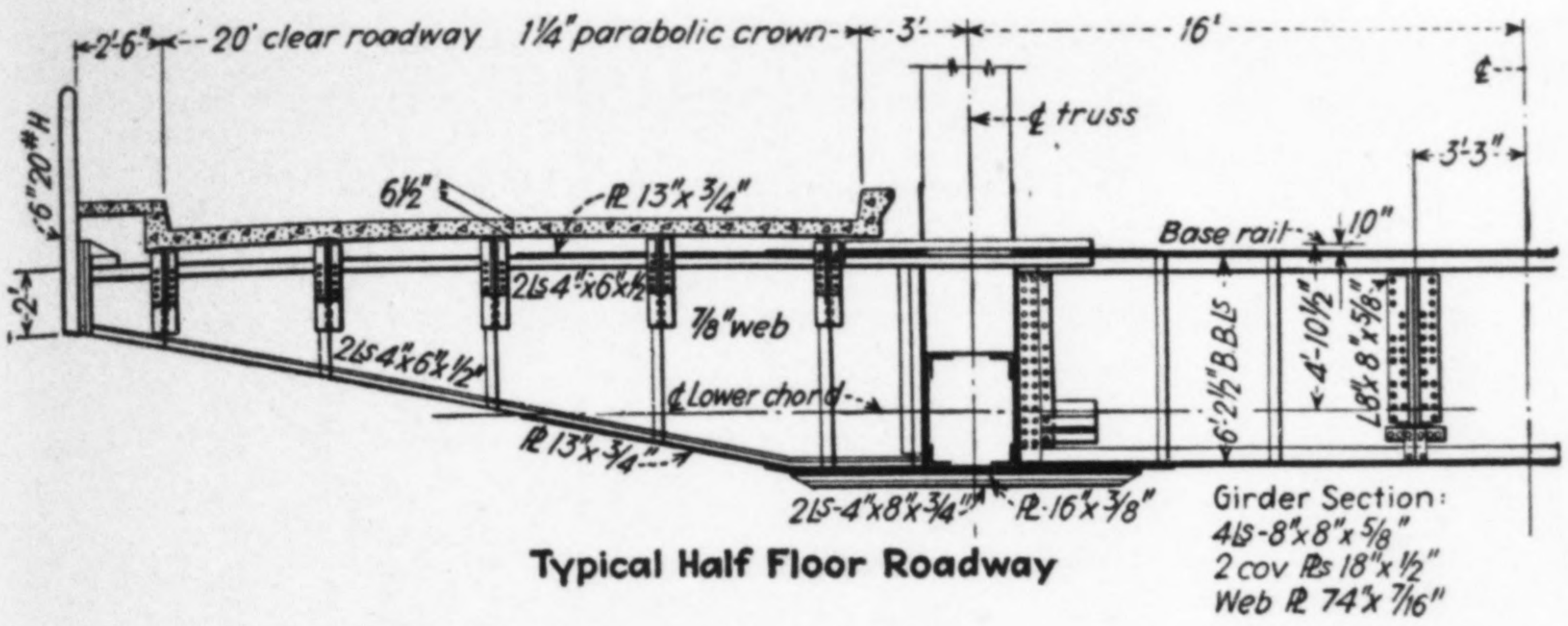

Fig. 3. Deck section of Baton Rouge Bridge, showing accommodations for both highway and railway.

permitted a 65-ft. instead of a 135-ft. underclearance for shipping.

Type and dimensions of structure

The main river bridge is a twin cantilever structure of 5 spans—490-ft. end anchor spans, a central anchor span of 650 ft. and two cantilever spans of 848 ft. which contain suspended sections of 396 ft. The trusses are 124 ft. deep at the piers and 62 ft. deep at the center. Approaches are a series of 83-ft.-span deck plate girders alternated with 43-ft.-spans on steel towers. The east railroad approach is 3,586 ft. long on a 1.13 per cent grade, the east highway approach 835 ft. long on a 5 per cent grade. The west railroad approach is 5,298 ft. on a 1.25 per cent grade and the west highway approach 1,719 ft. on a 5 per cent grade. On the main river bridge the railroad is carried between the trusses while the highways, designed for two lanes of H-20 loading, are outside on plate girder brackets. Dimensions are given in Fig. 3.

Of particular interest is the fact that all truss members are of built-up design; no eyebar tension members are used. Because of the heavy design loads and long spans some of the chord members weigh as much as 2,000 lb. per ft. Due to the heavy sections and joint details, a number of the top and bottom chord members were limited to one panel length and, including gusset plate connections at one end, weighed up to 42 tons each. Field rivets of 1-in. diameter with 8-in. grip were required for some of the joint connections. In general carbon steel rivets of 1-in. size were used for all principal truss, floorbeam, roadway bracket and bottom lateral connections; ⅞-in.-diameter rivets were used for portals, sway frames and top laterals. Main material in the primary truss members, floorbeams, roadway brackets and railway and highway stringers is silicon steel.

Construction of the piers and erection of the steelwork for the main river crossing was the most difficult and unusual part of the project, as is to be expected in any encounter with Old Man River in this locality. The two center river piers, Nos. 3 and 4, were built by the sand island method. Caissons for piers 1, 2 and 5 were sunk by open dredging. Construction of these piers was described in *ENR*, Jan. 20, 1938, p. 106. Caissons for piers Nos. 2 and 4 were sunk to the unusual depth of 180 ft. below low water.

Plan of erection

Erection was carried out in two distinct operations, Fig. 4. The first operation involved simultaneous balanced cantilevering over piers 3 and 4, then joining the center anchor span between these piers and leaving a cantilever arm and one half a suspended span cantilevered in the opposite direction from the piers. The second operation involved similar erection over piers 2 and 5, landing the shore anchor spans on piers 1 and 6, respectively, and then joining the suspended span halves to complete the structure.

No river falsework

The only falsework used was an inclined steel bent supported on the side of piers 2, 3, 4 and 5. Independent falsework was not considered because of river depths up to 80 ft. at low river stage between piers 2 and 4, unstable and unsatisfactory river bottoms for any temporary falsework supports, the excessive cost if it were possible to locate falsework, the hazards to navigation of placing any falsework bents in the river proper, and the dangers from flood and high water.

The inclined steel falsework was connected to the first bottom chord panel point, 40 ft. away from the main pier shoes, and to a temporary link and anchorages embedded in the pier caissons and shafts (Fig. 6). After closure of the center anchor span between piers 3 and 4 was made, the bents were removed from these piers, temporary connections burned off at El. +30 and under water, and the bents moved to piers 2 and 5 for similar use there.

Special precautions taken

This scheme of erection required special and accurate balance calculations. The falsework bents and bracing were designed to resist an unbalanced moment due to a load of 100 tons at the end of either erected arm at any stage of the work. This permitted some unequal progress in the balanced erection of steelwork and avoided delaying either of the two erection crews for minor out-of-balance conditions.

Provision was made in the design of the structure, in the falsework bents and in the piers themselves for wind loads in any direction, vertical as well as horizontal, and also for an unbalanced wind load on one arm of the structure. The resulting torsional stress was designed to be resisted en-

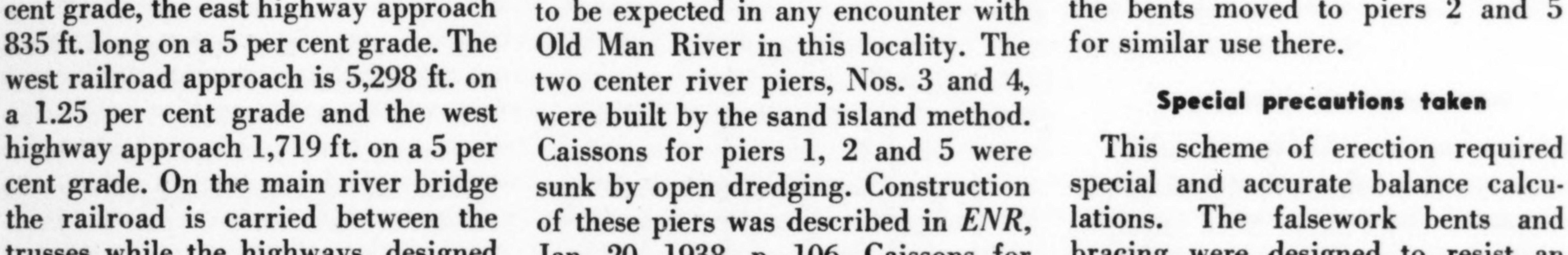

Fig. 4. Elevation of main river crossing of Baton Rouge Bridge, showing stages in the balanced-cantilever erection scheme, which required no falsework in the river.

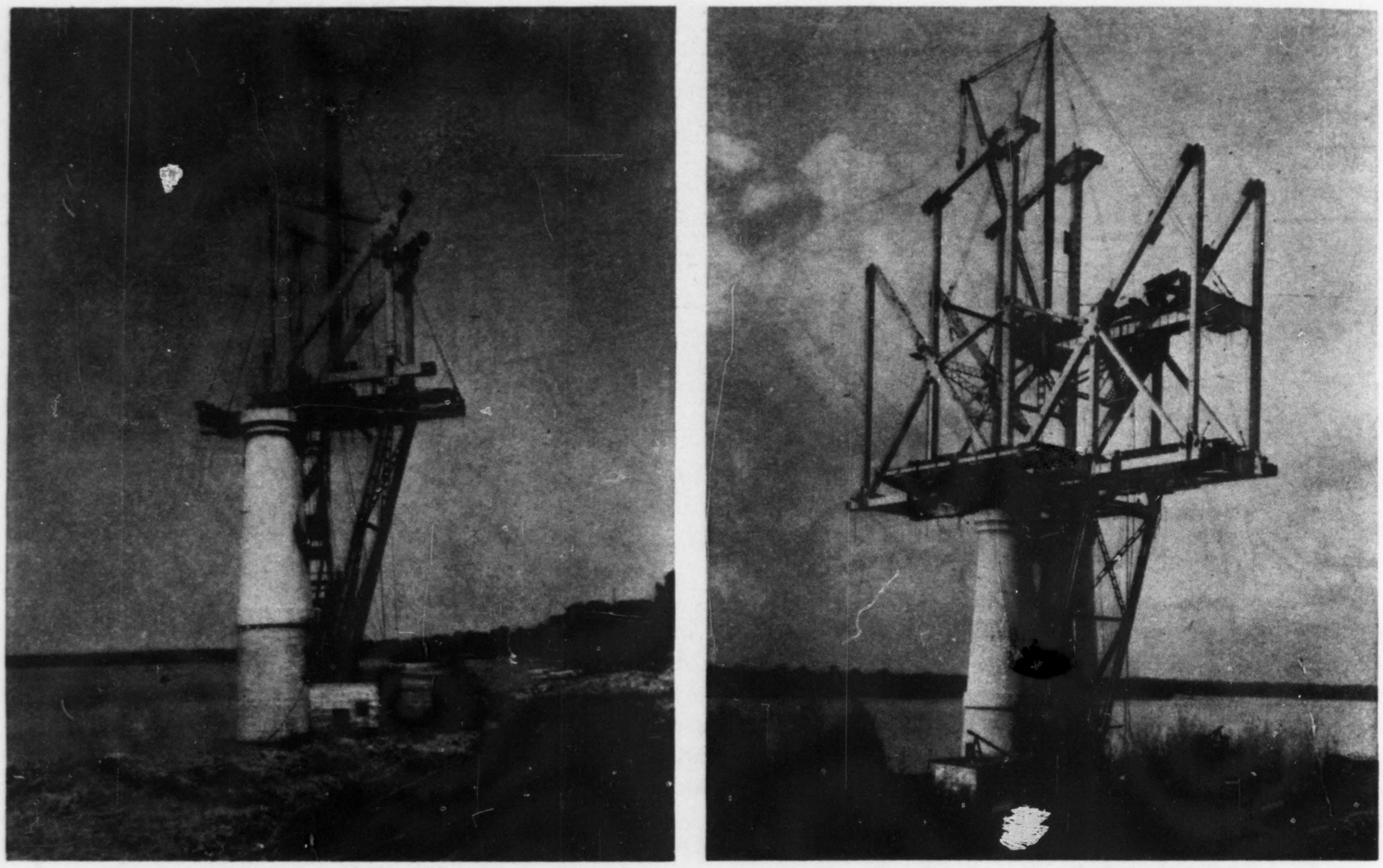

Fig. 5. Two stages in the start of balanced cantilever erection at Pier 2. Guy derrick in view at right subsequently assembled travelers which carried on the work as shown in Fig. 1.

tirely by the pier. No severe storms were encountered during the construction period.

A 95-ft. Chicago boom seated on the pier at about mid-height was first used to correct the inclined falsework bent and a temporary steel derrick platform at the top of a pier. The Chicago boom was then jumped to near the pier top where it was used to erect a 105-ft. guy derrick mast on the platform; finally it was stepped into the mast to make a 40-ton-capacity guy derrick.

With the guy derrick in this position (Fig. 5, left), the main pier shoes and a portion of the truss members in the two panels each side of the pier were erected. To reach the apex and top chords of the bridge truss over the piers, the guy derrick was jumped to a temporary platform of floorbeams and stringers 50 ft. above. From this point (Fig. 5, right), it completed the two panels of trusses each side of the pier and erected a second derrick ready to start the simultaneous balanced cantilevering. At this time the guy derrick was converted into a special type stiffleg traveler designed especially for this job. The base of the traveler rested on a platform which moved along on the

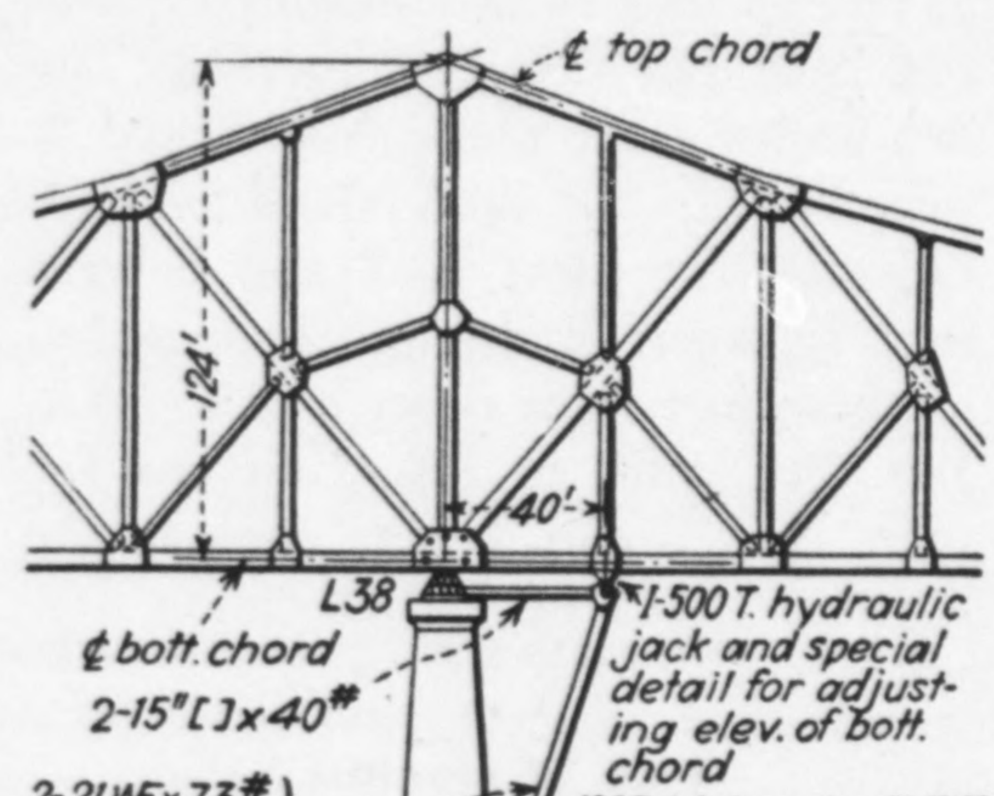

Fig. 6. Details of the inclined falsework bent which supported steelwork for entire balanced cantilever erection over main piers.

railroad rails while the stifflegs followed the inclinations of the top chords as shown in Fig. 1. Hoisting power for the two erecting derricks was supplied from engines on barges anchored at the base of the piers. By careful control during the progressive cantilevering, the unbalanced load was kept within allowable limits, and for the first operation steel was erected 325 ft. each way from piers 3 and 4 with no other falsework. After the center anchor span had been connected, cantilever erection proceeded to 425 ft. (taking in half of the suspended spans) before removal of travelers.

During the first operation (Fig. 4), expansion shoes and rollers over pier 4 were locked in a retracted position in order to increase the final opening at the center of the span between piers 3 and 4 by 5 in. The half span arms of this center anchor span were also kept in a slightly raised position from a true horizontal by adjustment of jacks on the inclined falsework bents one panel out from each pier. This permitted easy entering of the closing bottom and top chords. Closure was made by unlocking the expansion shoes on pier 4, lowering the four 500-ton hydraulic jacks at the inclined falsework bents (one jack under each truss) and by pulling the steel over pier 4 toward pier 3 by hydraulic jacking devices on the bottom chords at L46.

On the second operation, covering piers 2 and 5, balanced cantilevering was carried out to the shore piers 1 and 6 (490 ft.) before joining the two halves of the suspended spans between piers 2–3 and 4–5. A single steel falsework column, founded on timber grillages on shore and carried on two 200-ton wedge jacks and one 350-ton hydraulic jack for adjustment, was used under each truss to assist in landing on piers 1 and 6, respectively, and to relieve some of the temporary erection stresses that would have occurred had only the inclined falsework bents at piers 2 and 5 been used. Landing of the shore anchor arm spans was made by lowering the falsework bents on shore. The columns of these bents had been kept adjusted slightly above normal elevation for this purpose.

Closure of the suspended spans between piers 2 and 3 and piers 4 and 5 was effected by single 500-ton hydraulic jacks and special details temporarily built into the top and bottom chords at U20, U32 and L32, where permanent provision has been made for truss expansion and contraction. After closure, temporary details and jacking equipment were removed.

The entire superstructure of the bridge, including approaches, required about 35,000 tons of fabricated steel, of which 20,000 tons was used in the main spans between piers 1 and 6.

Engineers and contractors

Construction of the six main span piers was performed by the Kansas City Bridge Co., Kansas City, Mo., on a contract of $2,421,980. Fabrication and erection of the main span superstructure including railway track, roadway paving and painting, was completed by the fabricated steel construction division, Bethlehem Steel Co., at a contract price of $3,705,855. Approach foundation work was handled by the Uvalde Construction Co., Dallas, Tex., and approach superstructures by the Steel Construction Co., Birmingham, Ala.

The entire bridge project was designed and contracted for by the Louisiana Highway Commission, for which H. B. Henderlite is state highway engineer, N. E. Lant, bridge engineer, and E. L. Erickson, assistant bridge engineer in charge on the site. The total cost of the bridge including highway and railway approaches approximates $9,500,000. Harrington & Cortelyou, Kansas City, acted as consultants.

Wood Augers for Subsurface Test Borings

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LARGE WOOD AUGERS were used to supplement usual test boring equipment in exploring the site for a building at the foot of Grand St. on the East River in New York City. The contemplated building, to accommodate the crew of a fireboat, is only medium size, loads are light and previous work at the site indicated good bearing was available on original ground at moderate depth partly through fill material.

It was expected that two or three borings would be sufficient to give the necessary subsurface data. Soundings over most of the area of the site, however, were abruptly stopped at depths ranging from 12 to 21 ft. by wood too heavy to be pierced with the usual chopping bits and methods employed with a small casing.

Despite lack of precedent, it was decided to try wood augers. A 4-in. casing driven to the obstructing timber was planned to start the borings. A 3½-in. double-bit auger was welded to a standard rod coupling, it being planned to bore through the highest wood encountered, introduce 2½-in. casing, and then, if further wood were found, employ a 2-in. ship auger, which was also welded to a rod coupling. If this second hole did not weaken the timber so that the 2½-in. casing could be driven on down, further penetration could at least be secured by driving rods and a sample spoon.

The auger was assembled to turn clockwise, corresponding with the threading of the standard drill rods. The speed of the slowest rock drills is much too high for such augers, and sunken timber is apt to be full of nails and bolts, so pipe wrenches were used to turn the auger, grasping the drill rods just above the casing. It required less time to bore 8 or 10 in. of wood in this way than is necessary to chop through with the standard 2½-in. chopping bit operated in a 4-in. casing. As the auger could not be backed out without uncoupling the rods, and as it was desired to recover all of the chips possible to determine the condition of the wood, the bit was driven up and out by reversing the action of the drive hammer weight.

The wood encountered in at least three of the borings was evidently part of old ship's hulls. It was not necessary to use the smaller auger at all, as practically clear water was found between the deck and bottom of the hulls in all three borings. The large auger was worked down to the second layer of wood, unprotected by casing, and used to bore through it. Enough chips were recovered to show that the wood was pine, and in the same condition as that of the deck. The auger suffered remarkably little damage in the process, and it was not necessary to sharpen it during the entire job. The 2½-in. casing was inserted through the holes in the deck and bottom of the hulls and carried on down to good bearing on original material.

The New York City Department of Public Works, under Commissioner Irving V. A. Huie, carried on the boring work described with its own forces, organized under direction of J. Frank Johnson, chief engineer. Girard E. Wheeler, assistant geologist, is chief of the boring section, with the writer in charge of the field work.

Ship augers of 3½ and 2-in. size welded to drill rods are used to cut through subsurface timber. Note recovered samples of the wood encountered.

layout with a 224-ft. main span and 160-ft. anchor spans. Approaches consist of 160- and 128-ft. spans in continuous girder layouts. Total length, 1084 ft. (*ENR*, July 27, 1939, p. 114.)

NATCHEZ—Foundations are complete and steel erection is just getting started on the five-span continuous cantilever crossing of the Mississippi River at Natchez, Miss., a 2-lane toll bridge financed by an RFC loan and a PWA grant. Piers are founded from 80 to 150 ft. below mean low water. Anchor arm and cantilever span lengths vary from 559 to 875 ft. Total length of project, including approach roads and viaduct, is 8,135 ft.

GREENVILLE—Located 9 miles below the town of Greenville, Miss., so as to be at a stable point in the river below the famous Greenville Bends, this RFC and PWA financed project extends for nearly 12,000 ft. between the Mississippi River levees. Main river crossing is a cantilever bridge of 840-ft. main span with 640-ft. anchor arms resting on piers extending from 125 to 160 ft. below mean low water. Steel viaduct approaches of over a mile on the east side and of about 2000 ft. on the west side are nearly complete. Main river piers are finished.

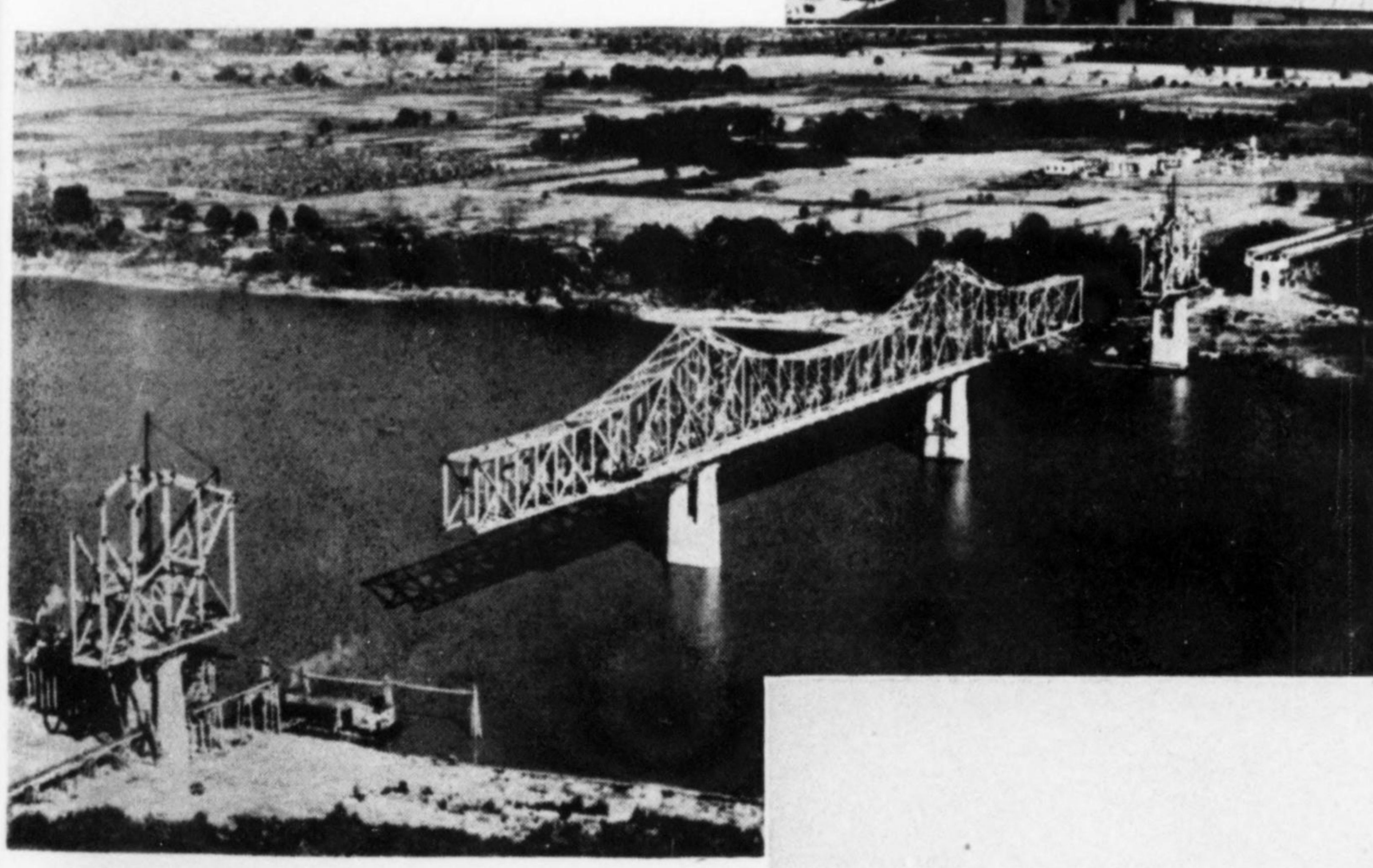
BATON ROUGE—Approach viaducts and roads are complete and steel erection on the main bridge is about 75 per cent finished on the $10,000,000 combined state highway and railway crossing of the Mississippi River at Baton Rouge, La. The main bridge consists of five spans—490-ft. anchor spans at either end, a 650-ft. center anchor span and two 848-ft. cantilever spans. Opening date is about June 1, 1940. (*ENR*, Jan. 20, 1938, p. 106).

ROCK ISLAND—Foundations are complete and steel erection about half finished on the new Mississippi River toll bridge between Rock Island, Ill. and Davenport, Iowa, being built to relieve traffic on the Arsenal Island bridge some distance upstream, which carries 9 million cars annually on a two-lane deck that also accommodates street cars. The new bridge, whose deck accommodates two 22-ft. divided roadways, is notable for its financing, which is one hundred per cent from private sources, and for its five steel tied-arch spans varying in length from 394 to 538 ft. It also includes some 1500 ft. of plate girder approaches.

LAKE WASHINGTON BRIDGE—The concrete pontoon bridge floating on Lake Washington at Seattle, took form rapidly during the year, and 12 pontoons, each 350-ft. long (about 2/3 the ultimate total length of 6,561 ft.) were anchored in place. Special pontoons for the floating drawspan are scheduled for placement early in 1940. Work is well along on tunnel and other approach structures and the entire project is now expected to be completed within the estimated cost.

RARITAN RIVER BRIDGE—All ten of the pneumatic caissons for foundations of the new high-level highway bridge across the Raritan River above Perth Amboy, N. J., have been completed, and the piers for the north and south approaches are about complete. Steel erection has started on the north approach. The bridge, carry-

Almost across. When this view of the Lake Washington bridge was taken, the pontoon section of the job had almost closed with the ramp from Seattle. In the distance can be seen Mercer Island.



Mississippi River Bridges. Above is shown end-of-year progress on the $10,000,000 rail and highway bridge at Baton Rouge, La. At the right, steel arches span the river between Davenport, Iowa and Rock Island, Ill.

Davenport Times Photo