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Air Conditioning Affects Structural Design

Improved Landfill Practice Saves Money

Long bascule bridge improves navigation at Lorain, Ohio and cuts delays to highway traffic.

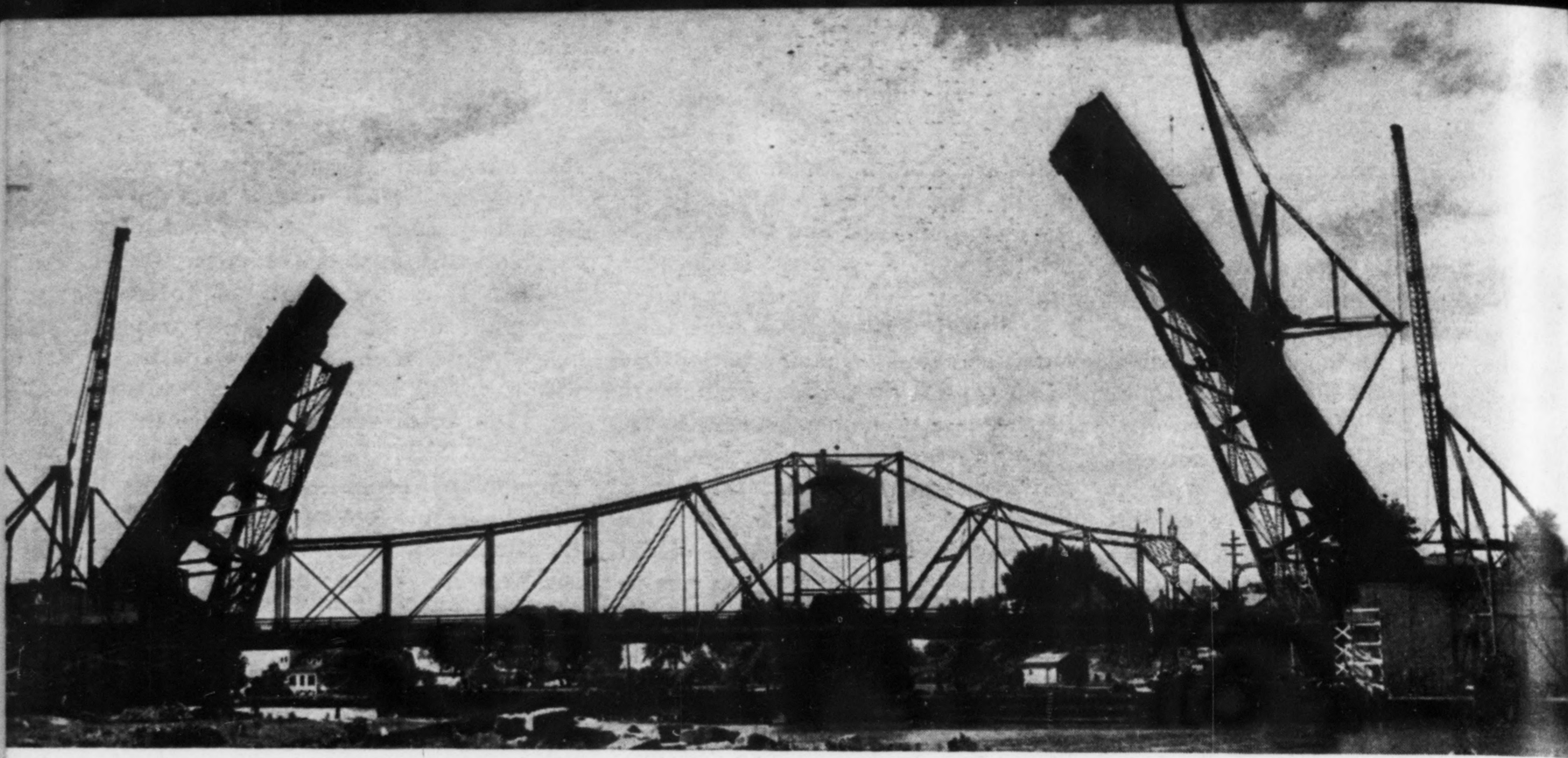

Fig. 1. At Lorain, Ohio, two derricks erect each bascule leaf to complete record 333-ft. highway span.

Lorain Bascule Sets New Span Record

Contents in Brief*—A 333-ft. four-lane double-leaf bascule bridge replaces a narrow highway swing span at Lorain, Ohio, improving navigation for long ore boats by elimination of the center pier. Close clearances required by alignment near the old bridge forced operating machinery into the center of each pier. Limited room for the counterweight was overcome by use of iron ore as aggregate for concrete. Unexpected foundation troubles were solved by driving steel H-piling to hard shale.*

LORAIN COUNTY, OHIO, has completed what is believed to be the longest trunnion bascule highway bridge in this country. It is 333 ft. center to center of trunnion pins and 295 ft. face to face of piers. Although the clear ship channel is only 180 ft. wide because of the skew of the roadway with the river, this represents a considerable improvement over the low swing bridge that it replaces, whose 100-ft. opening complicated the movement of ore boats to docks and smelters on the upper Black River. The new structure provides 33 ft. of vertical clearance near the centerline eliminating the necessity for opening the bridge for tugs and small boats. The entire project is 1,050 ft. long, half of which crosses a low plain westerly from the river with continuous plate girder spans varying from 56 ft. to 90 ft. in length to accommodate clearance requirements of existing railroad tracks. Easterly from the bascule a single 69-ft. span joins the natural ground. The deck carries two 22-ft. roadways separated by a 3-ft. center island and a 7-ft. cantilever-supported sidewalk on each side of the bridge. The approach span deck is a concrete-filled steel grid of about 6x6-in. pattern, the concrete being finished flush with the top of the steel. On the bascule span open-grid steel flooring is used.

Several features of the bridge are unique. Very scant working room, due to necessity for maintaining the old bridge until completion of the new, did not permit placing machinery outside the minimum lines required to house the structure, so all operating machinery is located within the piers immediately below the trunnion bearings. This position makes mechanical synchronization simple, both racks being driven from pinions on the same shaft. Driving power for each leaf is normally two 100-hp wound-rotor induction motors, operating at full normal load but either motor can open the bridge by operating at overload for a short period. Emergency power is provided by a 130-hp gasoline engine capable of mechanical connection to the gear train and equipped with an a.c. generator direct-connected to the driveshaft having sufficient capacity to motivate the auxiliary motors operating the gate locks and signals.

Placing the drive mechanism under the movable leaf reduced the available room for counterweight and made "heavy" concrete a necessity. Weight was added by the use of hematite iron ore for both fine and coarse aggregate, readily available at the local ore port, and by the addition of steel punchings to bring the concrete up to the required weight of about 184 lb. per cu. ft. The concrete contained 6.3 bags of cement per cubic yard.

Deck grades on the two leaves of the bascule are not the same and the elevation of the trunnion pins differ by about 3 ft. However, the steelwork for both is designed identically to cheapen fabrication and the variation is taken up by adjusting the travel limits of the respective leaves, though each leaf travels through the same arc. Some minor adjustment near the junction is taken care of by shims under the structural floorbeams. A positive lock is provided to keep the bridge in the down position as wind uplift, computed at 70 per cent of a solid surface for the open grid, indicated possible forces sufficient to raise the leaves.

The weight on the 29-in. trunnions is about 800 tons, of which 575 tons is counterweight. Trunnion pinions and shafts are SAE 2135 chrome nickel steel with a Brinnell hardness of about 300. Racks have chrome vanadium 6½-in. pitch circular gears.

Foundations

The bridge and its approaches span a clearly defined pre-glacial river-bed. Shale of bearing quality is about 70 ft. below normal water with the overlying material a mixture of soft black disintegrated shale, boulders, and debris (too unstable to permit securing a core) with the top few feet of sand, gray clay and fill. The hard shale bed rises quite sharply at the banks, the edges of the ancient river-bed, and the position of the new bridge is such that under the easterly river pier good bearing material is only 20 ft. below normal water, while under the westerly river pier it is about 90 ft. Thus the design and construction were substantially different on the two sides of the river.

The easterly pier was built inside a sheetpile cofferdam driven to an excellent seal in the higher shale available. On the river side of this pier the piling is driven several feet below the footing and will be left in place to prevent exposure and scour when the channel may be deepened to 5 ft. below the pier base, providing 25 ft. effective depth of waterway. Weight of the partially hollow pier is sufficient to counterbalance the full uplift pressure of the water so no provision is made to regulate the hydrostatic pressure under the slab.

The westerly pier was originally designed to be supported on concrete-filled 8-ft.-diameter caissons under the live load and anchorage columns, near the four corners of the pier, and 12-ft.-diameter caissons under the trunnion bearings. Sinking of the circular plate caissons was to be done inside a rectangular sheetpile cofferdam driven into the shale, then a tremie seal 9 ft. thick 20 ft. below lake level before attempting to dewater. Results of five test drillings to shale within the cofferdam area indicated conditions suitable for the use of sheetpiling instead of steel plate rings as caisson forms and the contractor elected to attempt this procedure. The cofferdam was easily dewatered and comparatively dry working conditions maintained. However, obstructions which were not indicated by the borings developed close to the shale surface and in the interest of time the whole substructure was redesigned for the use of steel 14-in. H-piles 102-lb. instead of concrete caissons. Tips were reinforced by two 11-in.-wide plates and four 6x4-in. angles welded on to reduce bearing on the shale to the assumed allowable of 2,300 lb. per sq. in. after driving to refusal.

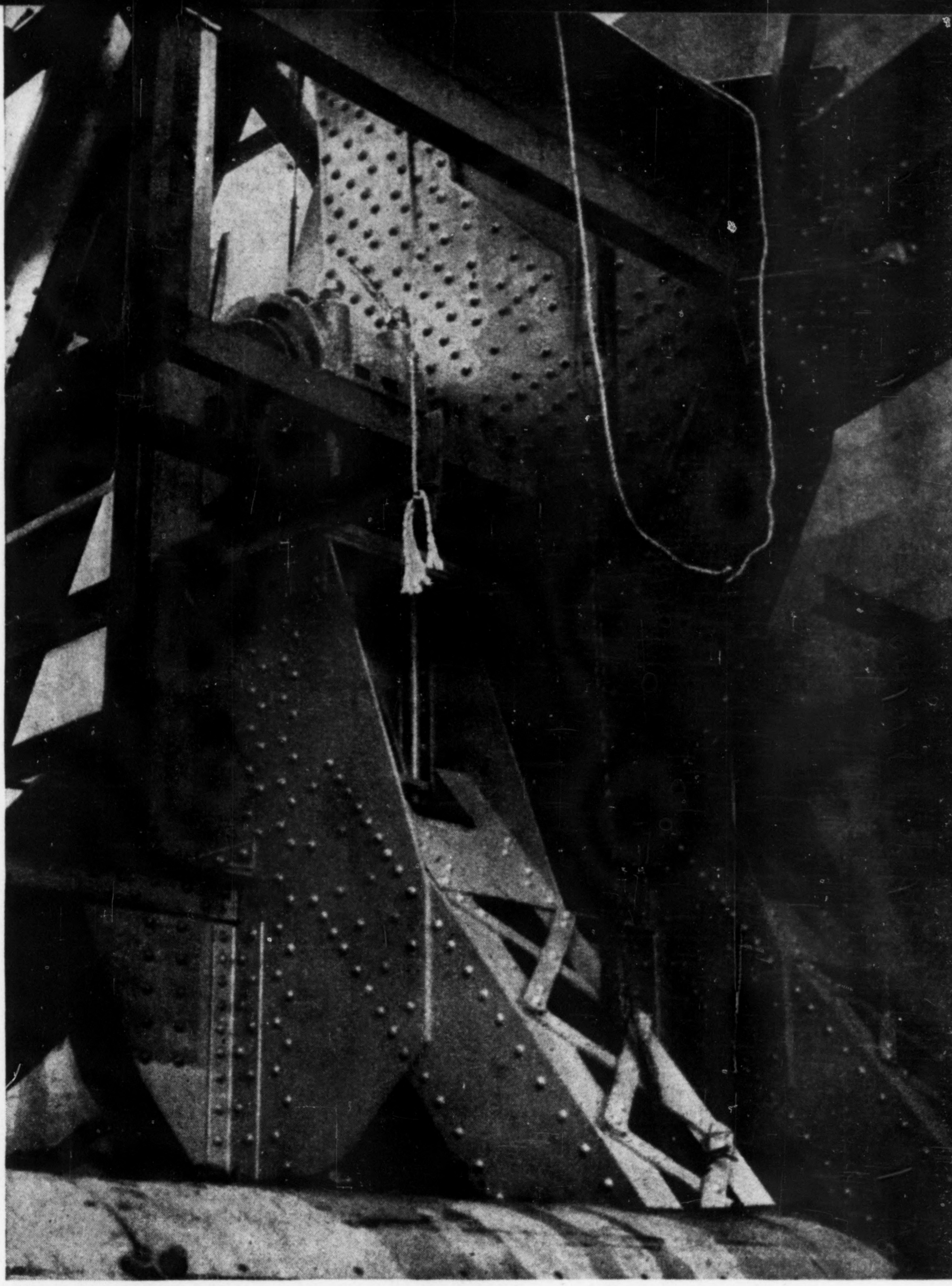

Fig. 2. Each 29-in. trunnion bearing carries 800-ton load of leaf and counterweight. Chrome nickel steel is used for trunnion pinions and shafts, chrome vanadium for rack gears.

Caps, designed to reduce concrete pressure to 830 lb. per sq. in., disregarding the bond on the pile, were welded on after driving was complete. Batter piles were evaluated at 45 tons each. No difficulty was experienced in driving the bearing piles to practical refusal, the reinforced points apparently resisting deformation in the material which turned the sheetpiling.

Construction procedure

Excavation and piledriving were done by floating derricks with the assistance of a land rig. Concrete was purchased delivered at the site by truck mixers, except the iron ore aggregate type which was mixed at the site in a 7S mixer, relatively small amounts being placed at a time to balance the erection of the bascule span.

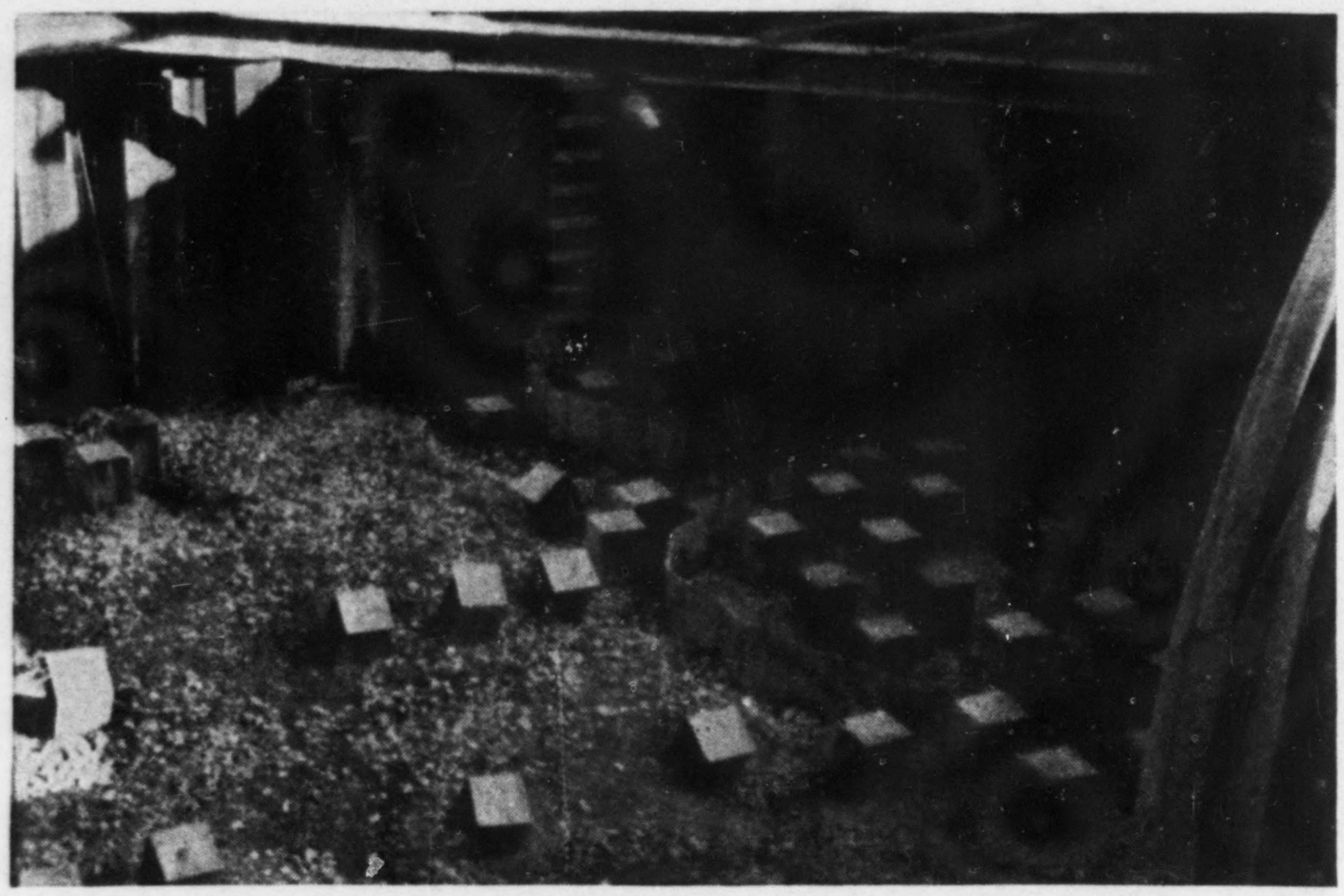

Fig. 3. H-beams driven to shale, and capped to distribute load on concrete support west pier after a circular sheetpile caisson scheme was abandoned.

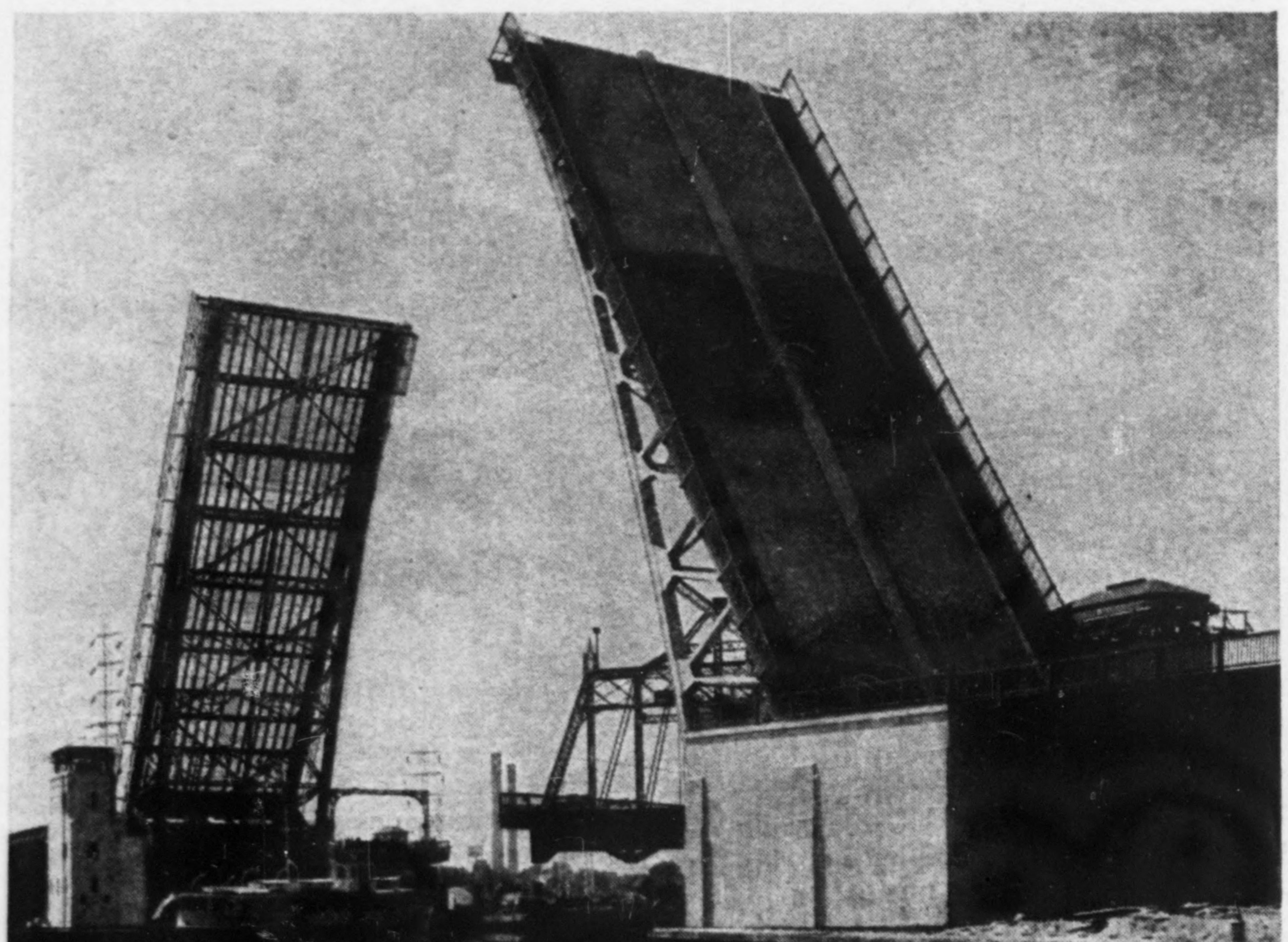

Fig. 4. How the long bascule with open-grid steel deck looked when completed. Old swing bridge adjacent is not being removed.

Superstructure erection, in open position to permit navigation, was done by long boom stiffleg erection derricks with one derrick set part way up on the open leaf to enable it to reach the 150-ft. height of the leaf. Fabricated steel members were delivered under the approach spans by rail, put on surface "dollys" and transported a few hundred feet to the westerly pier for erection or transfer to a barge which transported them across the channel to the easterly pier.

The bridge was financed by a Lorain County, Ohio, bond issue which included the construction of a 1,700-ft.-long high level bridge a short distance upstream. PWA assisted with a 45 per cent grant on both structures.

The bridge was designed and construction was supervised by Wilbur Watson and Associates, consulting engineers of Cleveland, for H. L. Dunham, county engineer of Lorain. Since the death of Mr. Watson in May, 1939, R. L. Harding has represented the Watson organization. For the county engineer, Walter W. Fleming, Harwood Lersch and Roger Hill were successive resident engineers, with G. D. McConnell, chief structural inspector.

The substructure was constructed by the Great Lakes Dredge and Dock Co. through their Cleveland Office. The Mt. Vernon Bridge and Iron Co. of Mt. Vernon, Ohio, fabricated and erected the steel and mechanical equipment. The Dingle Clark Co. furnished and erected the electrical equipment.

Garbage Handling Methods at Oak Park, Ill.

All combustible waste materials at Oak Park, Ill., are disposed of in the municipal garbage incinerator (including small dead animals such as cats and dogs), "without smoke, odor or nuisance of any kind," according to the annual report for 1939 of the Department of Public Works. The plant has a rated capacity of ten tons per hour. Garbage collection is handled by 18 men, with three 5-yd. motor trucks, five trailers, one tractor and three teams, working nine hours per day. Collections are made twice a week, except in bad weather. The incinerator is operated nine hours daily, except Sundays and holidays, and is open half a day on Saturday to receive commercial garbage. There are five men in all; two on the charging floor, one in the furnace room during the day and two at night to finish the burning and clean the furnaces and building. Men working on the collection and disposal forces work on a five-day week basis.

Collection of garbage and combustible waste by the Department aggregated 11,391.25 tons (including 644 small animals); in addition 2,164.75 tons were delivered at the incinerator by grocers, market men and others, making a total of 13,556 tons, with an average of 50.96 tons burned per day for 266 days. From the incinerator, 822.5 tons of ashes were taken to the dump. Cost of collection averaged $2.902 per ton, and disposal, 77.9c. per ton.

A combined collection of ashes, tin cans and other miscellaneous incombustible household waste was made about once a week. This material amounted to 70,320 cu. yd., or 10,177 loads, at a cost of 65.81c. per cu. yd. collected.