Falsework for highway bridge arches across Grand Coulee Dam spillway. The eleven spans were formed at one time.

Falsework for Arches Set on Drum Gates

Contents in Brief—*Falsework used to support the concrete arches of the 135-ft. span—that will carry the crest roadway across the Grand Coulee Dam spillway—was framed as three-post bents with brackets to support overhanging cap ends. Falsework sections were assembled in a panel yard and delivered by railroad and crane.*

FALSEWORK more than twice as high as it is wide was perched on the narrow spillway crest of Grand Coulee Dam to support the forms for a reinforced concrete highway bridge. Only a narrow working space was available at the crest of the dam so that two legs of the three-post bents supporting the arch form were carried on the steel of the drum gates. At the top of the bents a 38-ft. timber cap had its ends supported on brackets to carry the overhang outside the 21-ft. wide bent.

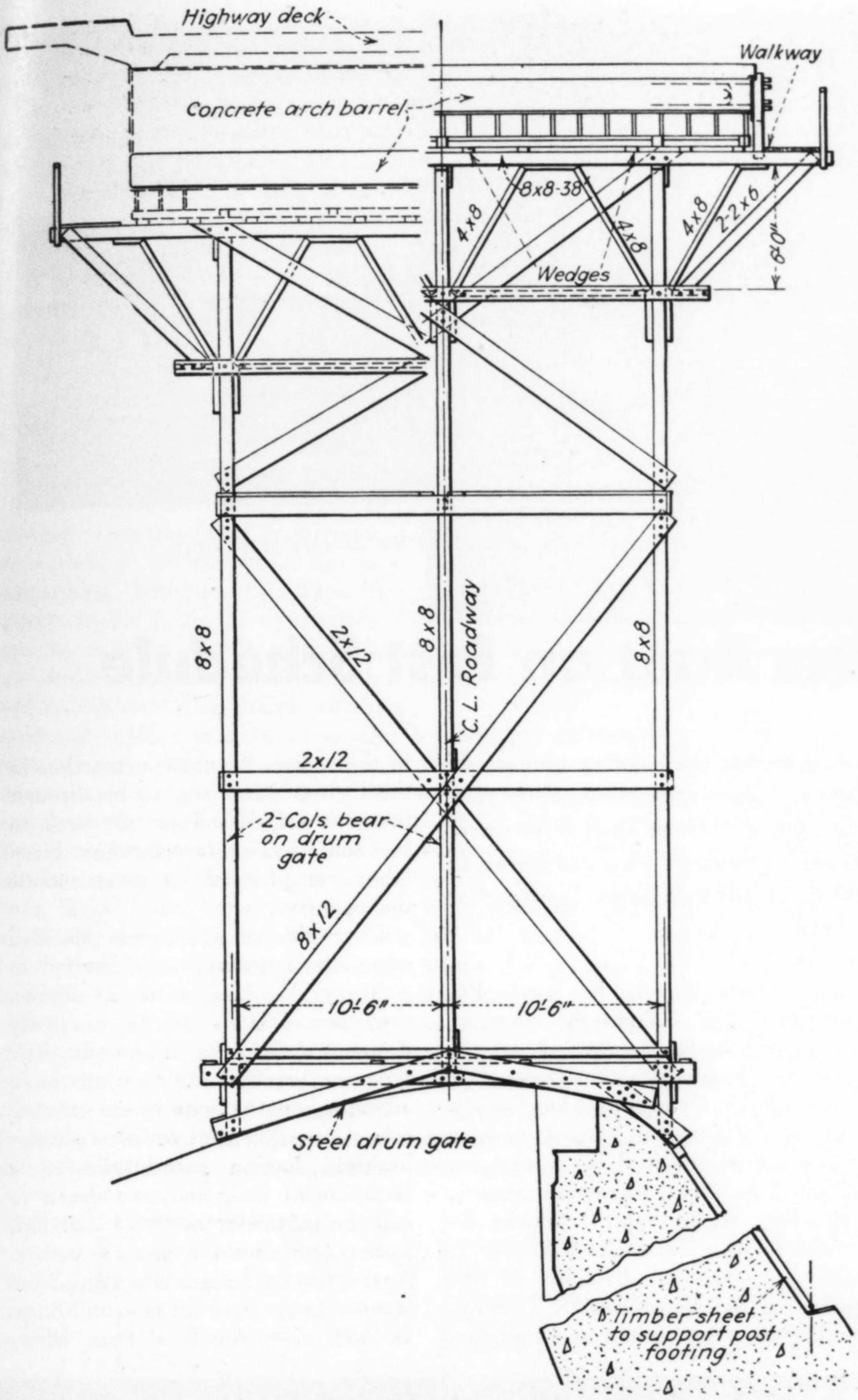
The bridge is a reinforced-concrete, open spandrel, multiple-arch structure supported by piers at 150-ft. centers. The eleven arches of the bridge, which are over the drum gates used for flood control, have clear spans of 135 ft. and a rise of 16.68 ft. in the variable thickness barrel. The roadway is carried on vertical concrete walls 12 in. thick, spaced at 10.75 ft. centers horizontally above the extrados of the arch.

In most cases it was possible to put the footings of the bent where they would bear on stiffener ribs in the steel drum gate structure. Where this could not be done, a 4-ft. length of 10x10-in. steel H-beam was used as a footing for the posts, thus making sure of transferring the load to the gate framework. The one-post bearing on the sloping surface of the concrete required a timber support to solid bearing as shown in the accompanying drawing. Horizontal bearing members in the falsework were avoided because of the relatively greater compression under load as well as objectionable swelling due to absorption of the curing water used on the freshly placed concrete.

Completely assembled falsework bents, sections of the decking and other parts of the temporary supporting structure were fabricated on the ground in an assembly yard and delivered ready for erection. A gantry-mounted crane and service railroad facilities previously required for other uses were available for handling the assembled falsework sections. Preassembly and erection in large units greatly decreased the amount of work that had to be done on the dam crest and speeded the construction of the falsework.

The desirability of salvage on almost 4,000 floor joists of 3x12-in. timbers (350 of these in each span) dictated a design which made it possible to fasten the joists securely without notching them. This saved time in assembly and greatly increased the salvage value of the lumber.

A definite pouring sequence was prescribed in the specifications to avoid the risk of unbalanced thrust on the piers during construction. The



Typical falsework features. Two of the posts in the three-post bent rest directly on the steel drum gates. Brackets at the top make it possible to support a 38-ft. cap on the relatively narrow dam crest.

seven pours prescribed for each arch, followed by the final 8-in. key pour, were required to begin with the crown, followed by filling alternate segments down to the haunch where simultaneous pours were required on both sides of the pier. Normal temperature of the concrete was taken as 40 deg. F. and adjustment of the falsework height, accomplished by the use of wedges, was made to assure that the finished barrel would be at the design elevation throughout. The walls and highway decks were placed in a separate operation at a later time.

The highway bridge is designed for H-20 loading; it has a sidewalk 6 ft. wide on the downstream side and 2 ft. 11 in. wide on the upstream side. Live load stresses, due to the H-20 truck-train loadings, were increased by an allowance of 30 percent for dynamic, vibratory and impact effects. As heavy power equipment may be hauled over the spillway bridge to the powerhouse, to be built later on the east bank, it was assumed that loads might cross the bridge on trailers with a loading of 85 tons.

The work was done for the U. S. Bureau of Reclamation; S. O. Harper, chief engineer, Denver; F. A. Banks, supervising engineer at Grand Coulee Dam. The contract for the work was held by Consolidated Builders, Inc., for which A. R. Nieman was general superintendent.

Military Engineering in East Africa

Difficulties of an engineering force following troops driving a retreating enemy are outlined in a description of such work in East Africa, as given in the *Railway Gazette* (London) of Nov. 28, 1941. In this case the engineering force was a battalion consisting of a harbor section, a survey section and a construction section, composed of men from the South African Railways and Harbors Department. Its first job was to build a railway line in Kenya colony to serve the military advance toward Mogadiscio, following this by reconstruction of the port facilities at that place. At Villagio, a large steel bridge destroyed by the retreating Italians was replaced by a pile trestle in eight days.

Progress was halted at the Awash River, where a three-span bridge, 260 ft. above the water, had been wrecked by blowing up the two steel piers or towers. The center span was 160 ft., flanked at each end by a 140-ft. span. A 3½-mile detour line was built, with grades of 33 percent, crossing the river at a lower elevation. A main span of 120 ft. was built of members cut from the wrecked bridge, and was flanked by spans of 60 and 30 ft. This detour, with its bridge, heavy rock cuts, high fills, concrete culverts and track work was completed in eight weeks, in spite of climatic difficulties due to intense heat and a malarial region.

At another place, a 120-ft. through bowstring truss bridge which had been blown up and dropped into the river, was replaced by three plate-girder spans of 40 ft. on new piers. Further on, a 500-ft. tunnel had been blocked by a blast at mid-length, causing a cavity that extended 40 ft. above the rails. This tunnel was cleared and re-lined in four weeks.