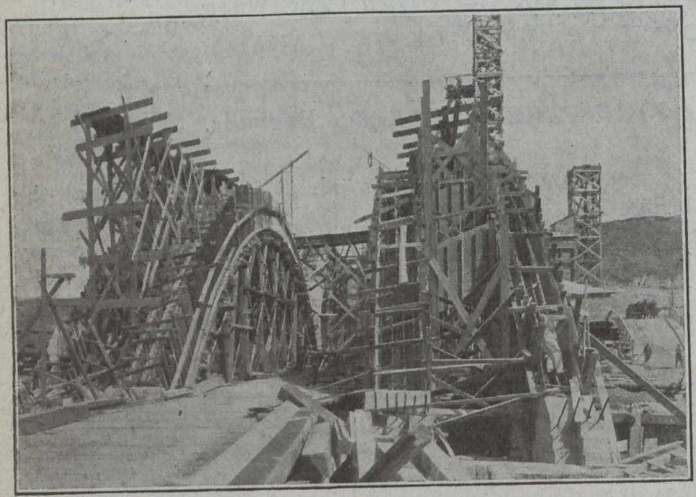
Uniform loads: Road, 100 lbs. per square foot; sidewalk, 100 lbs. per square foot on outside four feet, 40 lbs. per square foot on remainder.

Low level: Concentrated load, 20-ton motor truck; horizontal load, 300 lbs. per lineal foot of structure.

Arches: Concentrated loads, four 50-ton cars per 150 ft. span, with uniform loads on roadway and sidewalk, same as for the floor.

Temperature: Rise of 50° and fall of 70°.

Maximum stresses—Concrete: Floor, compression, 530 lbs. per square inch; arches, maximum compression



Falsework for one of the Arches. Looking North.

(live load and dead load) 540 lbs. per square inch; rib shortening, 677 lbs. per square inch; maximum tension, full load with 70° fall of temperature, 30 lbs. per square inch.

Steel: Maximum tension per square inch, 16,000 lbs.

Foundations: Maximum pressure upon rock, 12,300 lbs. per square foot.

Owing to the high cost of concrete materials, and to the depths of the piers and abutments, it was economical in obtaining the required carrying capacity in the arches to use deep, narrow ribs. Assuming a crown thickness of 5 ft., and placing the springing line of the flattest arch at low-water level, we found that there would be required two inner ribs, each 6 ft. wide, and two outer ribs, each 4 ft. wide.

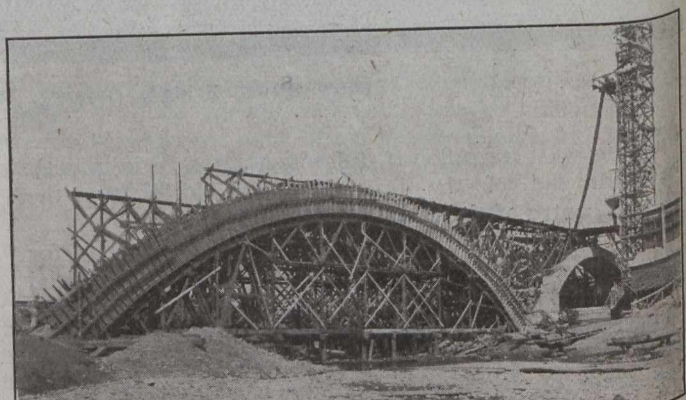
On the second arch retaining the same crown thickness and the same distance below the floor for the extrados at the crown, it was possible by taking advantage of the grade and increasing the rise of the arch, to reduce the width of the ribs, using two inner ribs at 5 ft. instead of 6 ft., and two outer ribs at 3 ft. 3 ins. instead of 4 ft. At the same time, by raising the springing line of the arch, we increased the moment arm of the thrust from the higher and narrower ribs, about the pier base, enough to offset the moment of the greater thrust from the lower and wider ribs. Again, on the third span, by increasing the rise we were enabled to use ribs 4 ft. wide and 2 ft. 6 ins. thick instead of 6 ft. and 4 ft. as on the shallowest span.

The piers are of the cellular type, the supports for the arch ribs resting on a concrete pedestal 5 ft. thick, extending over the entire area within the cofferdam. Those supports for the arches are connected by reinforced core walls 2 ft. thick, those between inner ribs constituting supports for the low-level deck, and those between inner and outer ribs rising to the upper deck, the whole pier presenting the appearance of two solid shafts. Manhole slabs have been provided in all piers and abutments for the convenience of the power, gas and telephone companies which have service mains on the bridge.

The retaining wall at the north end of the bridge is 48 ft. from base to top. The upper 12 ft. of the wall is of the cantilever slab type, the lower portion consisting of counterforts and slabs. The reaction from the cantilever slab portion is carried by the adjoining three feet of slab to adjacent counterforts, extra steel having been provided to carry this load.

The retaining wall at the south end has an umbrella-shaped top, the 4-inch sidewalk slab projecting several feet on both sides of the wall. Expansion joints have been provided at regular intervals in the wall, with lead strips 10 ins. wide to prevent seepage through the joints. The steel was of exceptional quality for re-rolled steel; the average ultimate tensile strength was 68,000 lbs. per square inch, and of 1,300 rods bent cold on tthe job, but four rods broke.

The problem of expansion joints for the floor was an unusual one, owing to the peculiar conditions. The spandrel ribs were designed as T-beams, with the floor slab for the flanges of the T. All floor beams are perpendicular to the centre line of the bridge, while the piers and abutments are skew. The accompanying plan of the floor system shows the method adopted. On each pier and abutment there was provided a heavy expansion beam upon which the system rested. Assuming the slabs over the box piers as fixed, the slabs on the arch spans moved to or from the expansion beam. Beams resting upon pier walls moved on steel plates in open pockets; slabs over piers rested only on the beams, a layer of clay 1 in. thick interposing between the wall and the bottom of the slab. Joints over the arch spans were made in the slab midway between beams, the slabs in these expansion panels having been designed as cantilevers. Troughs covered with lead were provided at all expansion joints, these troughs draining into pipes provided in the piers. Passing from the utilitarian to the aesthetic aspect of the design, one must bear in mind that the treatment of the parapet, piers and abutments should please and impress favorably both the distant observer, who will view the structure *in toto*, and



Another View Showing Falsework.

also the more frequent observer, who will view it from the sidewalk or from the passing automobile.

For the close-ranged observer we have provided four ornamental kiosks, and a massive concrete parapet of premoulded concrete balusters, base and rail. The kiosks span the sidewalk and open on observation balconies cantilevered from the side walls. The east and west faces expose shields containing the emblems of the various parts of the British Empire, the maple leaf