due to bending, which is in accordance with the Swiss regulations. The shearing stresses were very carefully analyzed, and wherever they exceeded 57 lb. per sq. in. stirrups were used to take up the entire stress. This condition necessitated the use of a great amount of steel in the form of stirrups.

Arch Ribs.—The two main arch ribs have a theoretical span of 328 ft. 1 in., a clear span of 314 ft. 11½ in., and a theoretical rise of 137 ft. 9½ in. The ribs are about 7 ft. deep and 3 ft. 3½ in. wide at the crown, the depth being increased toward the springing so as to keep the line of thrust well within the middle third. The width of ribs is increased from crown to spring in accordance with the batters previously given. The ribs are reinforced

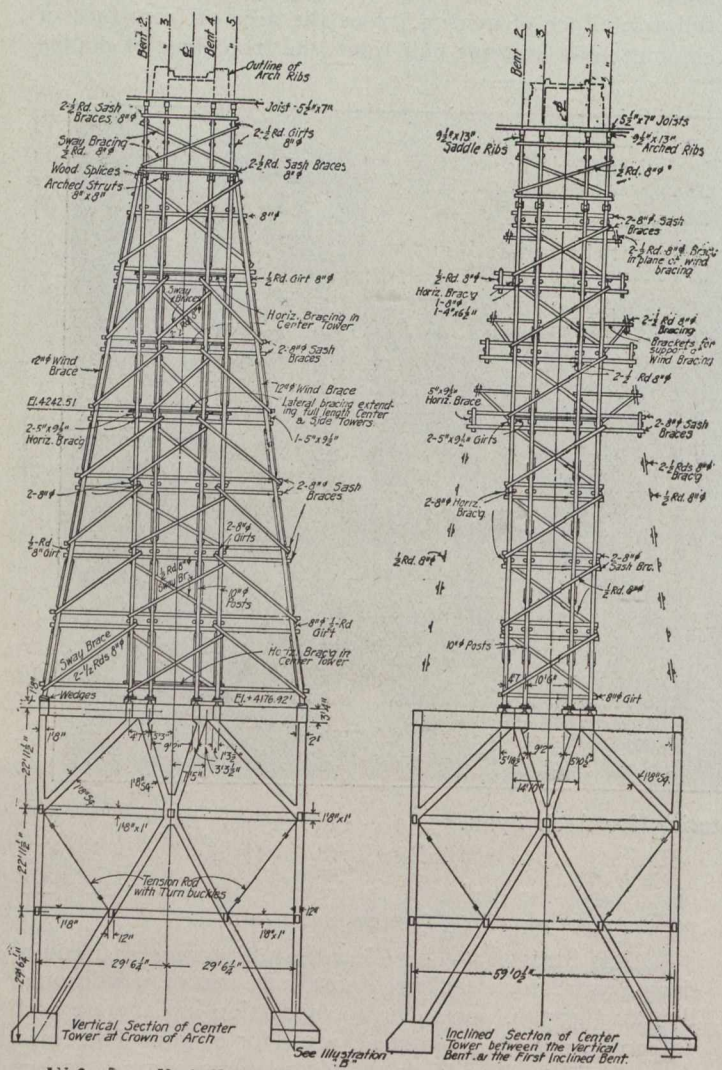

Fig. 5.—Details of Central Tower and Falsework.

with plain round bars of medium steel placed near the intrados and extrados to provide for temperature and rib shortening stresses. At intervals of about 15 ft. (measured horizontally and not following the line of ribs) the ribs are connected by reinforced concrete struts with heavy fillets at the rib connections, to give added stiffness. At the crown the ribs are spaced 9 ft. 11½ in. apart and they extend a little above the level of the deck, thus preserving the outline of the arch ribs very effectively. (See Fig. 1.)

Arch Abutments.—The arch abutments, consisting of two pyramoidal blocks of plain concrete one under each rib connected by reinforced slabs at bottom and front, are carried down to solid rock, with the bottoms stepped or serrated to give added stability, and to prevent sliding, and at the same time to follow closely the line of rock surface. The abutment faces are vertical while the backs are sloped in a line parallel to the thrust line in the arch ribs at the springing line. The left abutment (See Fig. 2) is 45 ft. 11 in. wide, while the right abutment is only 39 ft. 4½ in. wide, the difference in width being due to the difference in character of the foundations encountered on the two sides of the valley.

Arch Span Roadway Deck.—The roadway deck over the arch span (see Fig. 2) is carried by four pairs of posts, at each side of the crown, spaced 29 ft. 6 in. centres. These posts or columns are of reinforced concrete securely dowelled to the arch ribs and varying in width from 1 ft. 8 in. for the ones near the crown to 4 ft. 4 in. for those over the abutments. The two intermediate pairs are tied together by transverse struts (see Fig. 1) to make the posts act as two-post framed bents. The deck is carried over the abutments by twin piers, each consisting of two heavily reinforced posts connected for their entire height by a solid reinforced concrete wall, instead of struts. These piers, 4 ft. 4 in. apart, are connected at the bottom near where they intersect the arch ribs and are separated at the top by an expansion joint. One acts as the end pier for the roadway girders over the arch and the other as the end pier of the approach spans and, as previously noted, they take up all the expansion of the deck through their elastic deformation.

The deck construction consists of a thin reinforced concrete slab carried on cross-beams, spaced about 4 ft. 2 in. centres, supported by longitudinal spandrel girders continuous over the spandrel columns. The spandrel girders are anchored to the arch ribs near the crown and rigidly connected with the tall piers over the abutments, which provide for the expansion of the deck by their elasticity. The cross-beams at the spandrel columns are of greater depth than the others to provide extra lateral stiffness required by their action as part of the framed spandrel bents. Haunches and heavy fillets are provided where slabs and girders framed into their supports to care for the compression resulting from the continuous action developed.

The roadway is 13 ft. 1½ in. wide between railings, with a sidewalk space 2 ft. 4 in. wide on each side of curbs. The deck slab is waterproofed and covered with a layer of sand upon which is placed a layer of crushed stone 1 ft. deep, to serve as a track ballast.

Approach Spans.—The construction of superstructure of approaches is the same at that just described. The longitudinal girders were concreted first with reinforcement for cross-beams in place and anchored into the side girders. The floor reinforcement was then placed and the slab concreted. The cross-beams are reinforced with bent-up bars, stirrups and compression bars in top, the slab steel being bent up over these, to form negative reinforcement at right angles to the beams.

The main girders of the approach spans are of much longer span than those over the arch, *viz.*, 52 ft. 6 in. centre to centre or 48 ft. 2 in. clear. These girders are 5 ft. 3 in. deep and 1 ft. 7¾ in. wide. They are designed as continuous beams with a variable moment of inertia, with rigidly fixed ends at the cellular abutments and elastically framed connections at the intermediate piers and the double piers over abutments. The ends of girders are curved to a radius of 19 ft. 8 in. for a portion 16 ft. 5 in. out from the centre lines of columns or piers with a tangent portion 19 ft. 8 in. long, between. This gives them a very pleasing appearance and adds greatly to their