EL PASO & SOUTHWESTERN BRIDGE AT EL PASO, TEXAS

The Rio Grande bridge just completed across the Rio Grande River, near the international boundary in New Mexico, is a substantial structure of more than ordinary magnitude for the Southwest. The bridge is 1,692 feet 6 inches long and its maximum height is 86 feet above the river, or 73 feet above high-water mark. The bridge is built on a tangent, but with a 2-degree curve leading off from the east end, and has an 0.8 per cent grade, increasing to the west. Its size was greater, not to avoid the natural disadvantages in crossing the Rio Grande River, but because of the difficult location of the railroad for the first few miles in New Mexico, and from the fact that both the Santa Fe and the Southern Pacific railroads have tracks crossing under the bridge.

The main structure consists of five spans, 181 feet each, with parallel chord truss deck spans. The chord centers are 30 feet apart in depth and between center and center of trusses 16 feet. Each span has seven panel lengths of 25 feet 10 3-16 inches, and is designed for a live load of two consolidation engines, with 40,000 pounds on each driver, followed by a trainload of 4,000 pounds per lineal foot, and for a dead load of 2,300 pounds per lineal foot and wind pressure of 600 pounds per lineal foot. The approaches are of eight 70-foot plate girder spans, supported by six structural towers carrying 35-foot plate girder spans.

The contract was let to the Phoenix Bridge Company, Phoenixville, Pa. Work was begun in April, 1902, and was completed in October, 1902. The Missouri Valley Bridge & Iron Works, Leavenworth, Kan., were given charge of the substructure, which they completed in August, 1902.

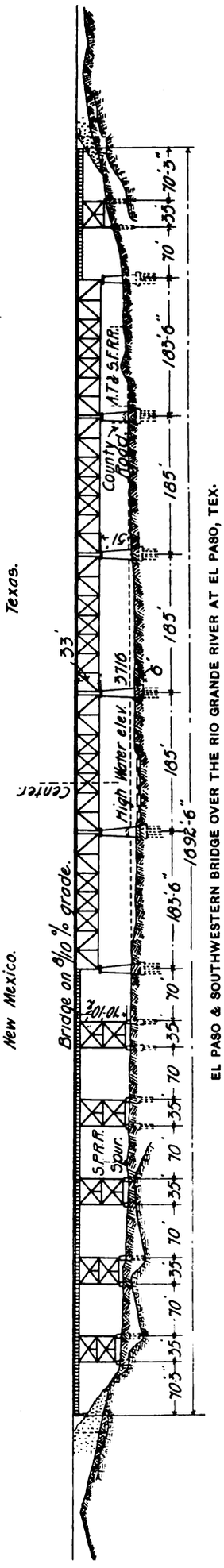
Probably the most interesting part of the work is the fact that the large piers were built entirely of concrete; these rest on piling at various depths below the natural surface, of from 9 to 23 feet. After the excavation to these depths piling was driven, spaced about 3½ feet centers. The average depth of piling driven was 26 feet, 18 inches of which at the top was surrounded by concrete; then a covering of expanded metal, size No. 4, 6-inch mesh, was laid on and the concrete pier base was completed to its full thickness of 6 feet. The pier bases have dimensions of 34 by 20 feet, with a 10-foot "V" projecting on the upstream side.

The river bed into which the piling penetrated is composed entirely of drift material and as no flood waters occurred during the principal period of construction little difficulty was experienced in handling water from the excavations. The average height of the body of the piers is 49 feet, dimensions under the coping being 22 feet 4 inches by 8 feet 4 inches. The coping is 18 inches deep and projects 6 inches all around. The batter of the piers is ¾ inch in 12 inches, and the average dimensions at the base are 28 feet 5½ inches by 14 feet 5½ inches. On the central piers the projecting "V" and "U," built on the upstream side, extend 4 feet above high-water mark. The average content of the six large piers is 702 cubic yards of concrete; this was made from one part American Portland cement, three parts sand and five parts broken stone. The total concrete structure was 5,707 cubic yards, for which 7,150 barrels of cement were used, making about 15 per cent cement for the finished concrete. The cement was tested during the progress of the work, the results by use of neat cement mixed with 20 per cent water were as follows:

During June, 1902, 10 sets tested, average eight days under water, tensile strength 595 pounds per square inch; during July, 1902, 12 sets tested, average seven days under water, tensile strength, 599 pounds per square inch; during August, 1902, 19 sets tested, average 6½ days under water, tensile strength, 695 pounds per square inch.

Lehigh Portland cement from Allentown, Pa., was used, except a small lot taken from local dealers. The shortest time in which the load was placed on the large piers was 30 days.

On July 28, 1902, pier No. 13 was completed and span No. 1 was lowered into place thereon August 27. Erecting steel was begun on the west side. In handling the plate girders it was found necessary to take precaution for the dry climate and use ropes of greater strength than would be used otherwise. The time in erecting main spans after the false work was in place was four to five days, and about an equal time was occupied in removing and erecting the false work for the next span. It was found necessary to change a bar of the lower chord on one span after it was erected. This was done by bracing with timbers and a 20-ton jack between the pier and first pin connection at one end of the span, and at the other end of the span a similar jack was inserted between the steel of the preceding span and against the shoe of the one. The pressure applied thus increased the camber enough to loosen the tension on the lower chord completely, so that one bar in the second panel and two bars in the fourth panel, with the one in the third panel to be exchanged, were taken off and replaced in a few hours by a small gang of men.



EL PASO & SOUTHWESTERN BRIDGE OVER THE RIO GRANDE RIVER AT EL PASO, TEX.

The fifth and last large span was completed on October 4, an average of about 20 tons of steel erected per day for the large spans. The average force employed was 46 men per day, half of which may be considered bridgemen and the balance principally Mexican labor and helpers. The same were employed in erecting the viaduct approaches. The average tonnage erected per day was a little over half of the main spans, but about in proportion to the length of the bridge and the weight of the steel in the two parts.

The structure was painted with two coats of metal paint, the first gray and the second a slate color; 500 gallons of paint and 115 gallons of boiled linseed oil were used. Eight men were employed 54 days painting, the cost of the labor and material amounting to $1.25 per lineal foot of bridge.

The floor or deck of the approaches are of 8 by 8 inches by 12 feet ties of Texas pine, spaced 6 inches; these are dapped over the girders from ¼ inch to ½ inch. A single line of guard rails is placed directly over the girders and these are dapped 1 inch on the ties. The flooring is anchored to the steel by the use of ¾-inch hook bolts through the guard rail at every third tie. The main spans have ties 8 by 8 inches by 18 feet, and a double line of guard rails anchored in the same manner as the approaches. The track is of 75-pound steel rails, with an inner guard rail spaced 8 inches from the track rail. The total steel structure was 1,311 tons. In considering the cost of the bridge the freight material, amounting to nearly 3,000 tons, added greatly to the outlay.

We are indebted to the courtesy of Mr. H. J. Simmons, chief engineer El Paso & Southwestern, El Paso, Tex., and to his assistant, Mr. F. B. Wilson, for the description of the work herein given.