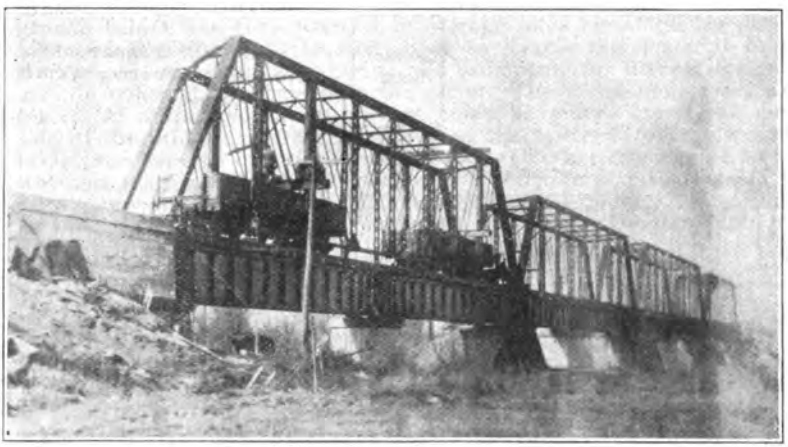
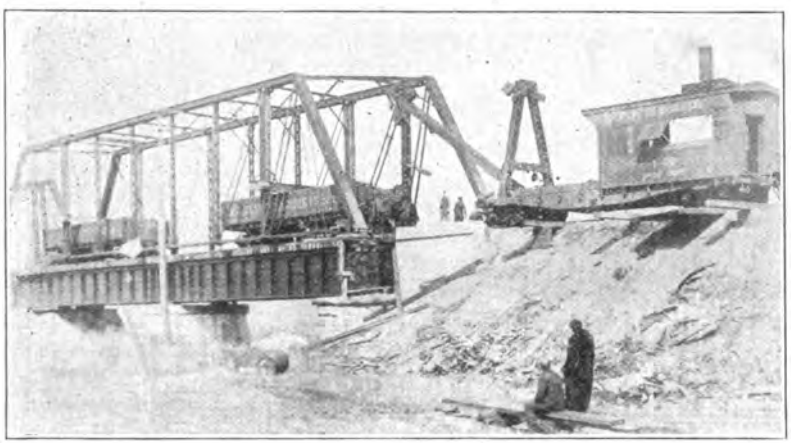
shell bucket to lift the gravel to the mixer. By handling the work in the manner described above, it was unnecessary to build falsework and the results indicate that the work was done economically and that the saving amounted to practically the cost of falsework.





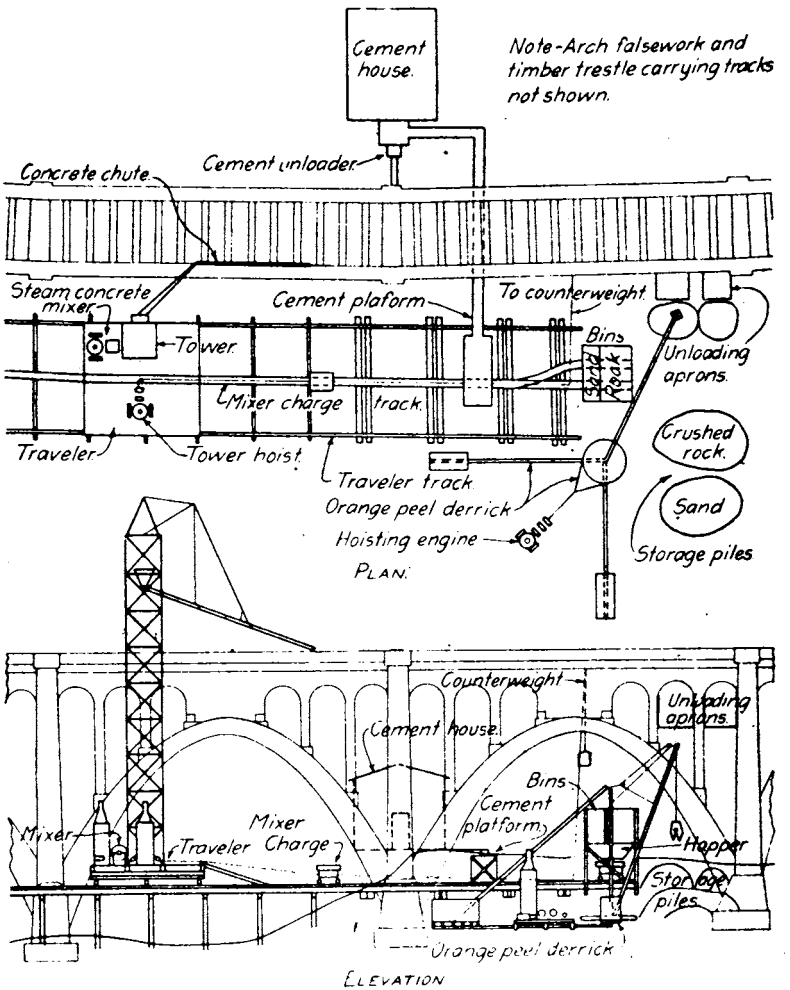
Replacing Trusses with Girders, Pere Marquette R. R.

Construction of Two Concrete Bridges at Rosalia, Washington.

By J. F. Pinson, Chicago, Milwaukee & St. Paul Ry.

In 1915 the Chicago, Milwaukee & St. Paul completed two single-track reinforced concrete arch viaducts on its Puget Sound line near Rosalia, Washington. These bridges replaced a frame trestle 60 ft. high and about 2,100 ft. long which was built in 1907. The line is on a 3 deg. curve to the left, and crosses successively the Palouse line of the Northern Pacific, a private road, Pine creek, a state highway, the

tracks of the Spokane and Inland Empire electric railway, and another private road. The distance between the two railway crossings is about 850 ft. At the time the construction of the concrete structures was begun there were two timber trestles with an embankment 334 ft. long between, the filling having been completed in 1911 before any definite



The Concreting Plant

Fig. 1.—Concrete Bridges, Rosalia, Wash. Chicago, Milwaukee & St. Paul Ry.

design had been decided upon for the permanent structure. The easterly structure consists of a 107 ft. 6 in. reinforced concrete trestle abutment, an 100 ft. spandrel arch span and a 79 ft. 6 in. reinforced concrete trestle abutment. The westerly structure consists of a 77 ft. reinforced concrete abutment, three 77 ft. 6 in. and one 68 ft. 4 in. rein-

forced spandrel arches, one 58 ft. 6 in. encased steel girder and a combination trestle and U abutment. The high fill east of and between the two bridges, and a side hill cut at the west end made it impracticable to place the plant on the track grade. After considerable study it was decided to locate the plant under the westerly bridge and this was done as shown in the diagram, Fig. 1. The crushed rock and sand were delivered in hopper bottom cars and unloaded through chutes to the ground below, and then handled to storage piles by a stiff-leg derrick with orange-peel bucket located so as to handle this material to the storage piles and from the storage pile to hoppers for loading the small cars, in which it was hauled to the mixer. The mixer and tower were placed on a traveling platform that could be moved along the north side of the bridge. In this way most of the concrete for the westerly bridge was spouted directly into the forms. One hoisting engine on this traveling platform did the hoisting of the concrete and also hauled the cars containing the dry material from the loading hoppers. The empty cars were hauled back to the loading hoppers by a counterweight fas-

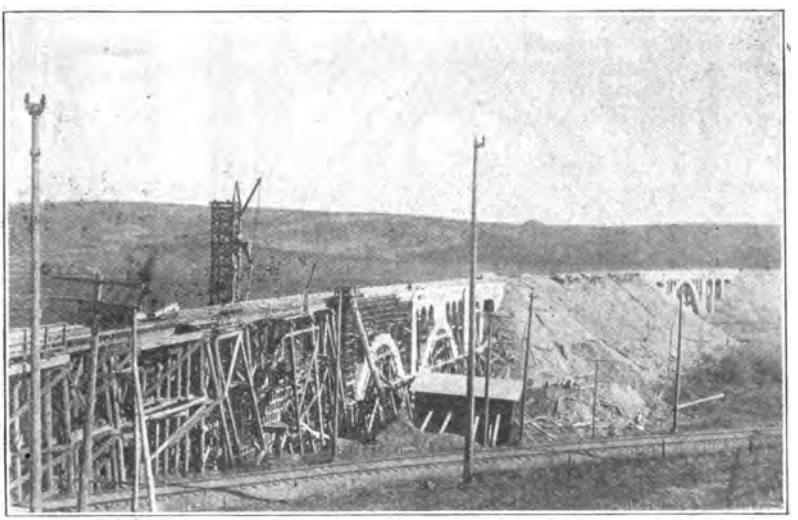


Fig. 2.

tened to the bridge as shown in Fig. 1. The cement was unloaded into a storage house immediately underneath and south of the bridge by means of an endless belt with a friction brake which enabled the lowering of the cement at slow speed to prevent damage to sacks by tearing or burning. The cement was then wheeled directly to the cars as they left the loading hoppers.

The concrete for the easterly bridge was mixed by this same plant and hoisted into small cars on a narrow gage track on the north side of the main line and hauled by a gasoline locomotive. Concrete was mixed and placed in the easterly bridge for as low as 34 cts. per cu. yd. in this way, although the average was considerably above this on account of the inability to make continuous runs while concreting.

The steel reinforcement was all cut and bent on the platform at the west end of the westerly bridge and lowered into place from the track level. Portable forms were also built at the same point and handled in necessity of installing a pump was avoided.

The excavation for foundations for the piers caused very little difficulty, rock being encountered at from 4 to 10 ft. below the creek bed. The excavations for columns in the abutments, however, were more difficult, particularly for those coming high up in the fill, six of which required excavations to be made through the fill to a depth of approximately 60 ft. These were made by sinking a shaft and timbering with second hand 8 x 8 bridge ties. The material was hoisted by means of buckets. Water was encountered in the bottom of these foundations and was taken care of by driving a 2 in. pipe through the fill into a shaft near the bottom and installing 2 in. Pemberthy ejectors. No attempt was made to remove the cribbing or forms from the columns in these shafts below the top of the fill.

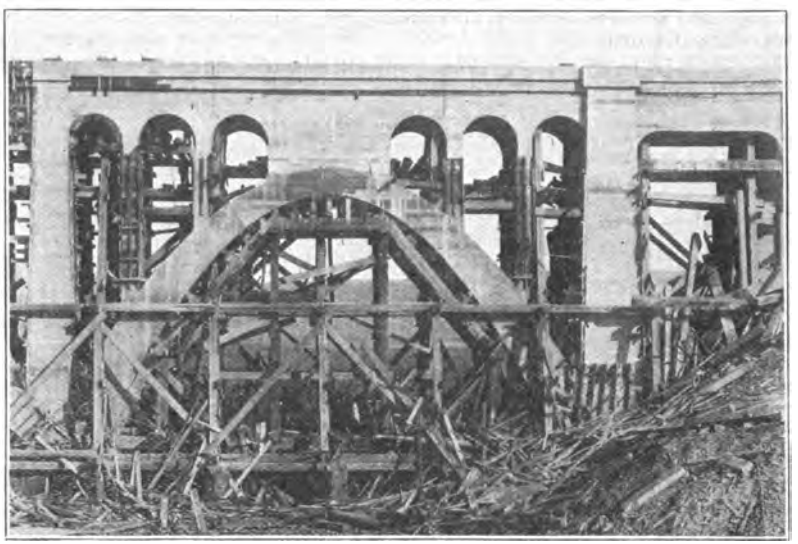


Fig. 3.—Concrete Bridges, Rosalia, Wash. C. M. & St. P. Ry.

The organization of the forces was as follows:

One general foreman	$150.00	per	mo.
One timekeeper	75.00	"	"
One carpenter foreman	3.50	per	10 hrs.
One blacksmith	3.25	"	10 "
One labor foreman	3.00	"	10 "
Two sub-foremen	3.25	"	10 "
Twenty-six carpenters	3.00	"	10 "
Two engineers	3.00	"	10 "
One engineer (gasoline)	2.50	"	10 "
One fireman	2.50	"	10 "
Ten carpenter helpers	2.25	"	10 "
Twenty-four laborers	2.00	"	10 "

The size of the crew varied considerably on account of the difficulty in obtaining men and on account of some delay in obtaining material and plans at various times.

During the progress of the work the average traffic was eight passenger and about twelve freight trains per 24 hrs. There was

an average of four passenger and four freight trains on the Northern Pacific track under the easterly bridge; eight passenger and four freight trains on the Spokane & Inland Empire tracks under the westerly bridge and heavy team and automobile travel on the state highway, so that it was necessary to provide special falsework in each case to avoid blocking traffic.

At the time of filling the easterly and center portions of the bridge in 1911 the bents in the trestle were crowded badly out of position; some of the bents being as much as 24 in. out of plumb. This made necessary the placing of heavy struts and shores, and in order to avoid disturbing the old bents as much as possible a special plan of supports for arch forms was devised as shown in Fig. 2. This was constructed so as to be entirely free and independent of the old bents and proved very economical as second hand timber was largely used.

The derrick used for handling the crushed rock and sand was of the ordinary stiff-leg type fitted with a 60 ft. boom and orange peel bucket. The engine used to operate the derrick was a double drum engine fitted with a Dake swinging gear connected to a bullwheel on the base of the mast for swinging the derrick. Attention is called to the construction of the tower on the traveler, enabling the moving of the tower along the bridge and the use of the counterweight for hauling back the empty material cars; also the method employed to avoid damage to cement sacks while unloading.

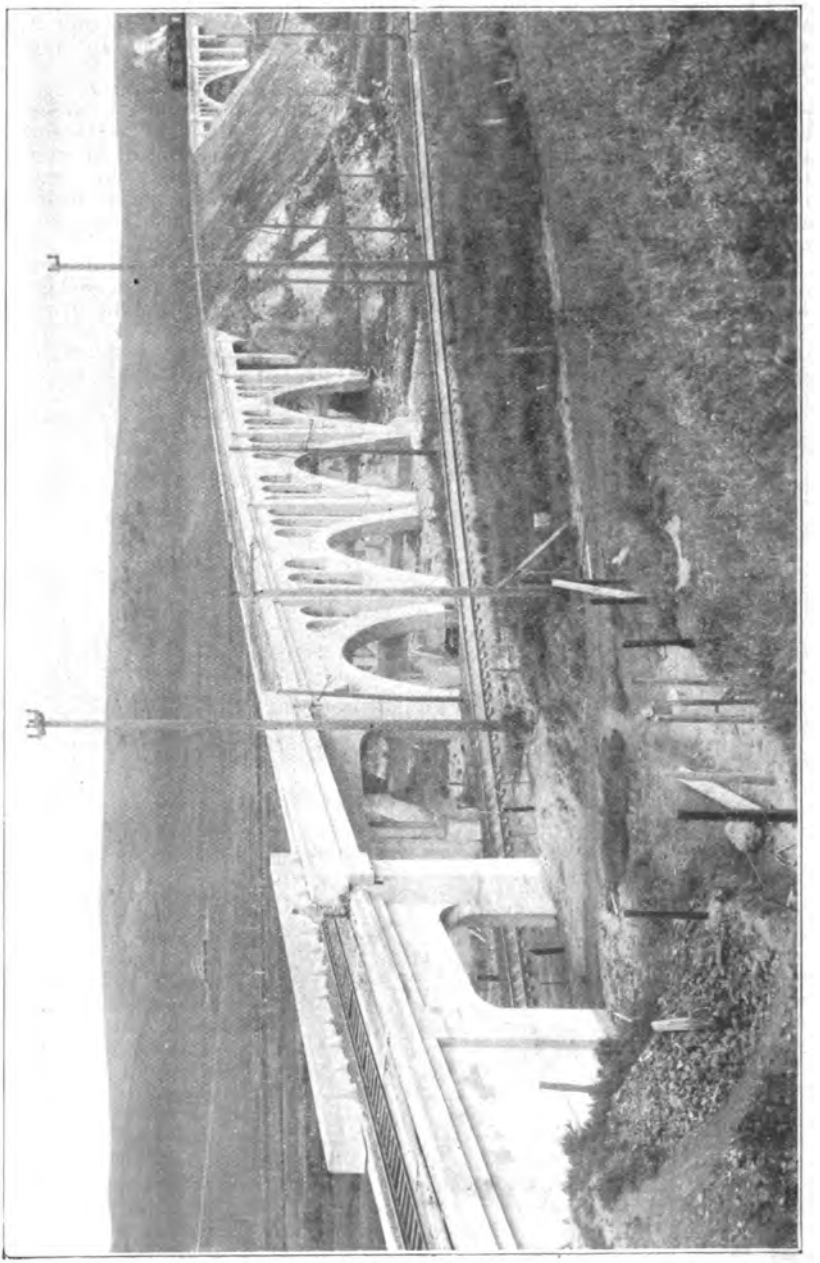


Fig. 4.—General View of Two Concrete Bridges, Rosalia, Wash., C. M. & St. P. Ry.