River near Macleod. The first-mentioned crossing required a structure 5,327 ft. long and 300 ft. high, and it was decided to erect a steel viaduct with 67-ft. deck girder spans on towers and 100-ft. similar girders spanning the openings between the towers. The second of these two crossings was over the Old Man River near Macleod. This required a structure 1,890 ft. long and 150 ft. high, and it was decided to erect a steel viaduct with 45-ft. deck girder spans on towers and 60-ft. deck girders between the towers. Plate 7 shows a profile of the Lethbridge viaduct.

On the centre line, which was tangent throughout, permanent hubs were established at *W* and *F* (Plate 7), which were points near enough to the ends of the viaduct to be of value throughout the building of the bridge, but far enough from the structure that they would not be disturbed during construction. Holes, similar to post holes, were dug to a depth of between four and five feet, and pieces of 8 x 8-in. timber were inserted in these, so that about two inches projected above the surface of the ground, which had been carefully levelled off. These were firmly tamped around with concrete, and after being centered, constituted the hubs from which the true centre line was established.

These were securely fenced, leaving a sufficient space within the enclosure to permit the setting up of a transit, and by a special arrangement, shown in Plate 8, a sighting rod was always left standing over the centre on these hubs, which was established on a small brass brad. These sighting arrangements saved considerable time, as otherwise it would have been necessary to have sent a picket man to the hubs every time they were used. As it was, the sighting rods were inspected from time to time to see that they were in true position, and were always carefully replaced after having been removed for a transit set-up.

After having carefully adjusted the transit, it was set up on *F*. Hubs *E*, *C* and *X* were established by using *W* as a foresight, then *T*, *S* and *R* were established from the west end of the line, using *F* as the foresight. Needless to say, all hubs were established in a manner similar to that of *W* and *F*, just described.

It will be noticed from the profile that in centering these points there would often be a great difference between elevations; and, in addition to having the lining hair of the transit truly vertical, and the standards carefully adjusted so that a vertical plane would be followed in depressing or elevating the telescope, double centering was used to further eliminate errors.

After having these main hubs or stations set up at the most commanding or useful points, Station *X* was chosen as the starting point for all measurements. There were several reasons for this. From *X* there was an excellent opportunity to get a sufficiently long base line for triangulation. More of the centre line could be seen from this than from any other point. At it, also, the triangulation base could be laid out at right angles to the centre line of the bridge, making it equally valuable for work in the direction of *W* as in the direction of *F*. The ground was fairly level, affording a good opportunity of measuring and checking the base line, and as it was of most importance to have the river work started first, Hub *X* would be close at hand and no delay would be had in laying out excavations for the river piers, the contractors for the substructure being already on the ground.

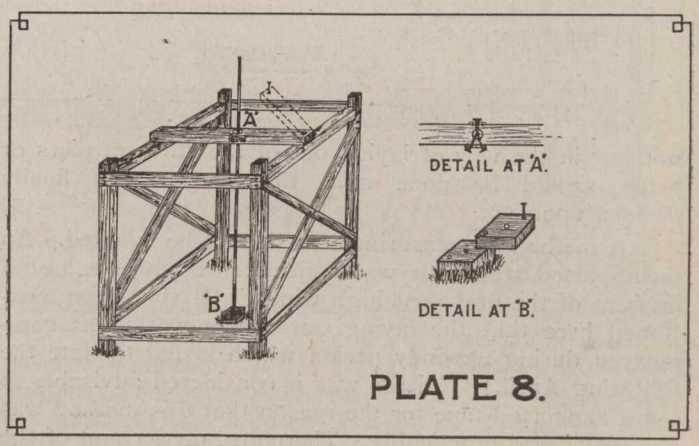
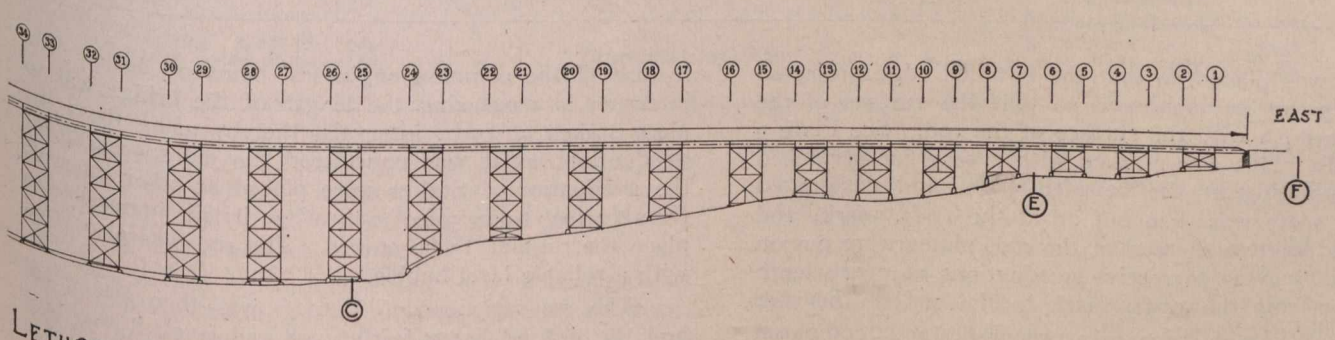


PLATE 8.

Although the centre line of the bridge had been measured both by the location engineer and the engineer making the preliminary survey from which the bridge was designed, no measurement across the gorge was made with sufficient accuracy for the construction of the foundations. It might be noted here that during the winter of 1906 and 1907, a special party was put into the field to make a preliminary survey of the site just referred to, and although extreme care was used, the final measurement, made with a steel tape, was slightly over three feet in error, as was found when the ultimate measurement was decided upon.

The banks of the gorge were very steep and irregular in places, and it was decided to start measurements in both directions from *X*, so that any error in the



LETHBRIDGE VIADUCT

PLATE 7.