KETTLE RAPIDS BRIDGE*

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THE Hudson Bay Railway extends from The Pas, the northern terminus of the Canadian Northern Railway in Manitoba, to Port Nelson, on Hudson's Bay, a distance of 424 miles. The grading has been completed throughout, and the rails have been laid to mile 332.

There are three important bridges on the line: The first crosses the Saskatchewan River at The Pas, and comprises four fixed spans of about 150 feet each, together with a swing-span of about 250 feet; the second crosses the Nelson River at Manitou Rapids (mile 242), and is a handsome structure of conventional deck cantilever type, with a channel-span of 304 feet 6 inches and anchor-spans of 108 feet 9 inches, supplemented by an 85-foot plate-girder span at the north end; the third, which is the subject of this paper, is at the second crossing of the Nelson River, or Kettle Rapids, (mile 332), the present end of steel.

The Nelson is one of the great rivers of Canada, its drainage including the prairies of Alberta, Saskatchewan and Manitoba on the west, the Red River Valley on the south and part of Ontario on the east; but, owing to the intervention of Lake Winnipeg, which serves as a huge reservoir, the flow of water in this river throughout the year is remarkably uniform.

The main channel at the bridge-site is only 350 feet wide, and estimated to be about 200 feet deep at the centre; the current is very swift, and there is always a certain amount of open water. Directly above and below the bridge-site, however, the river freezes all the way across, but only after the jamming of the ice and the consequent rising of the water. There can never be any danger from ice, either to the superstructure or to the piers, for the steelwork is 15 feet clear of the highest fixed ice-peaks, and there is running-ice only when the water-level is much below its maximum elevation.

In locating the line, advantage was taken of two very conveniently-placed islands, allowing a central span of 400 feet, with piers and abutments on the solid rock. This rock is of pre-cambrian origin, and is a tough granitoid gneiss.

The bridge is a continuous structure, 1,000 feet long, having a channel-span of 400 feet and two side-spans of 300 feet each. The trusses, or main girders, are of the sub-divided Warren type, 50 feet deep throughout, 24 feet apart, centre to centre, having 25-foot panels. There are two lines of stringers, 8 feet apart, centre to centre; and the base-of-rail is 17 feet 6 inches above the centre-line of the bottom-chords. The structure is riveted throughout, and all bracing is rigid; it is fixed at Pier 3, and provided with expansion-rollers at all other bearings. The ties are 8 x 12 inches, 14 feet long, spaced 12 inches, centre to centre; they are notched ½ inch on the stringers, and every fourth tile is fastened thereto by a ¾-inch hook-bolt. The outer guard-timbers are 8 x 9 inches, spaced 10 feet 10 inches in the clear; they are notched one inch and secured to every fourth tie by a ¾-inch bolt. Steel guard-rails, weighing 60 lbs. per yard, are provided inside of the running rails, with 8 inches clearance between heads. They are brought together in a frog beyond the ends of the bridge. The main (or running) rails are of the American Society of Civil Engineers' standard section, weighing 80 lbs. per yard.

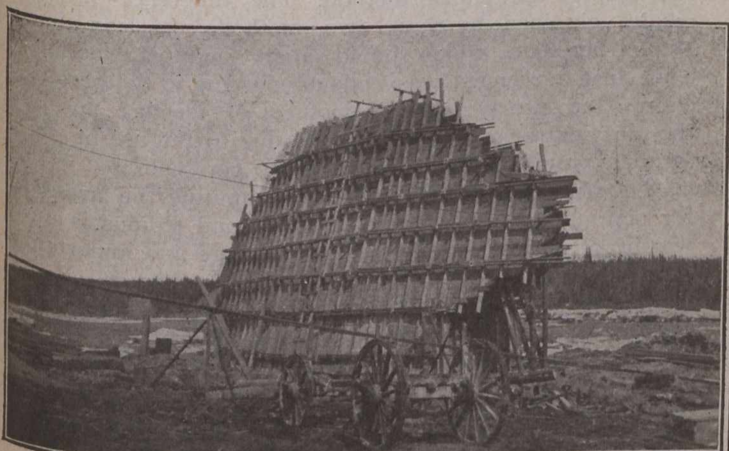

Fig. 1—Abutment 1 Under Construction

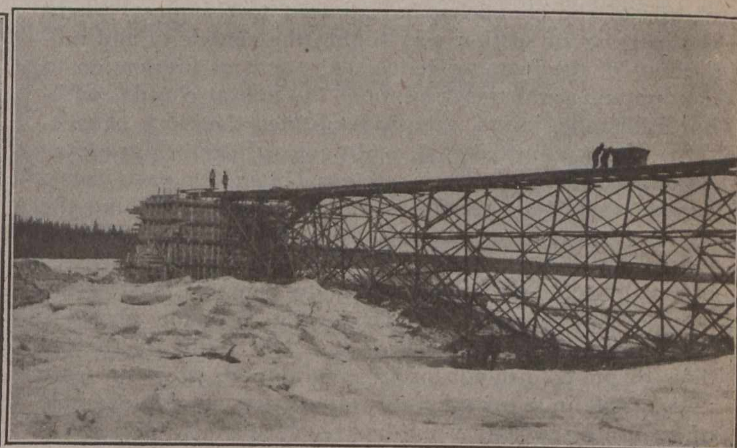

Fig. 2—Pier 2 Under Construction

At Abutment 1, where the total expansion and contraction of the bridge will be about 8 inches, they are provided with specially-designed expansion-joints of the split-switch form, with points of manganese steel. Refuge-bays, for pedestrians, are provided at intervals of 200 feet.

Three types of bridges were practicable for this location: First, simple spans, with temporary members over the piers for cantilever-erection of the channel-span; second, the conventional cantilever bridge, with a central freely-suspended span; third, a true continuous-girder bridge. The first would have been satisfactory, but uneconomical, owing to the great weight of extra metal required for erection stresses only. The second was rejected partly on account of the objectionable articulated joints at the end of the suspended span, but principally because of the expensive shop and erection work in connection therewith; for an economically-designed cantilever structure would have required a much greater depth over the piers, with considerably less depth at the abutments and for the suspended span, resulting in sloping chords and irregular webbing; besides, in order to obtain such economical proportions, it would have been necessary to locate the bottom-chords as close to the base-of-rail as possible, thus largely increasing the quantity of concrete in the structure.

The third type, as designed and built, is the most rigid of all, and the most economical; for it required no extra metal for erection-stresses, except in the bottom-

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