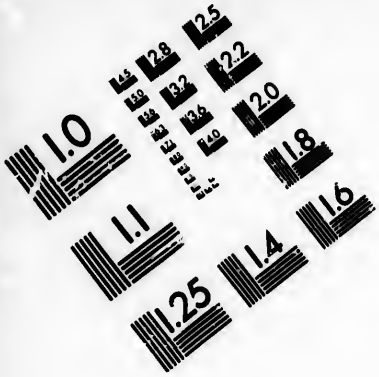

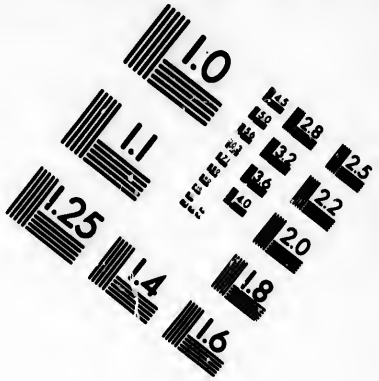

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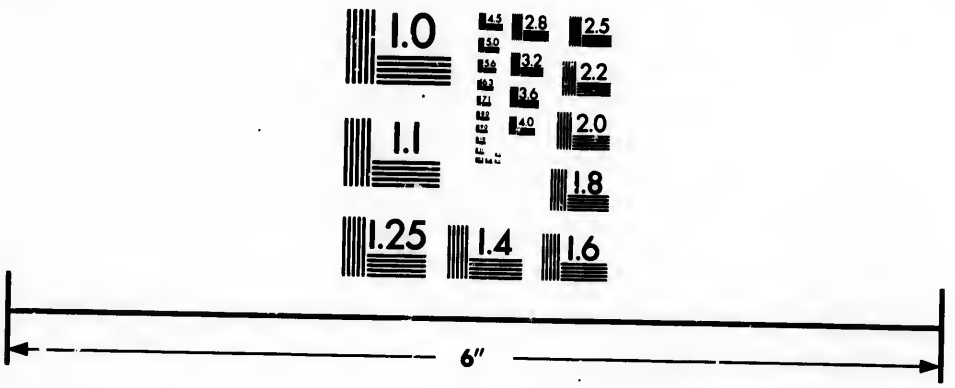

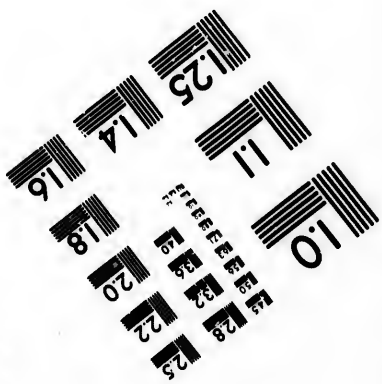

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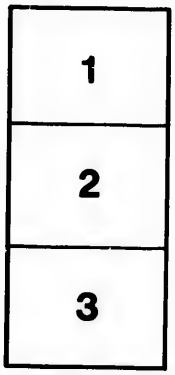

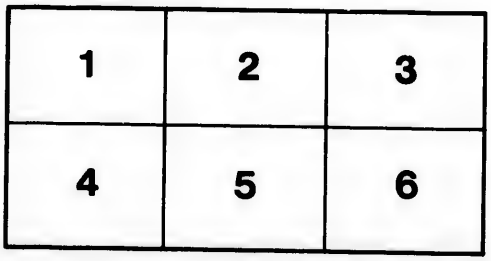

Canadian Society of Civil Engineers.

INCORPORATED 1887.

TRANSACTIONS.

FRASER RIVER BRIDGE.

CANADIAN PACIFIC RAILWAY, MISSION BRANCH.

By H. J. Cambie, M. Can. Soc. C. E.

To be read October 22nd, 1891.

To render the following description of the bridge over the Fraser River on the Mission Branch of the Canadian Pacific Railway intelligible, it is necessary to offer a few words of explanation as to the location, and the reasons therefor.

The Fraser River, after following a course nearly due south for 300 miles, breaks through the Cascade range of mountains by the Yale Cañon and continues on the same course to the Village of Hope about thirty miles from the boundary of the United States (49th parallel.) It then turns sharply to the west and flows in that direction for about 100 miles in a wide alluvial valley, till it empties into the Strait of Georgia. This is known as the lower Fraser and the lands on either bank are very fertile, forming the best agricultural district in British Columbia.

The main line of the Canadian Pacific Railway follows the right bank of the Fraser to Port Hammond, where it turns northward to Burrard Inlet and the City of Vancouver, while the Westminster Branch diverges to the city of that name situate on the Fraser River, about twenty miles from its mouth.

To connect the Canadian Pacific with the railway systems of the State of Washington, Mission Station, about forty miles from Vancouver, was selected as the most suitable point from which to branch off to the south, and the Fraser River had therefore to be crossed in that neighborhood.

The actual site of the bridge was selected in the longest straight reach in that part of the river, and which showed no signs of having changed its course in recent years. It is there a considerable depth all the way across—1,090 feet wide at high tide level, 42 feet deep near the north, and 25 feet deep near the south bank. A short distance above the bridge it is 200 feet narrower, and a similar distance below, 200 feet wider. In winter there is six feet of tide which decreases gradually for about twenty-five miles further up where it ends. Freshets usually occur in June or July and have risen as much as seventeen feet, continuing in flood for a couple of months.

With these characteristics it was hoped that there would not be much trouble with ice or driftwood, and that the bottom would be less likely to scour than elsewhere. Also that the water would not be dammed up to any appreciable extent by the piers, for on the south bank is a dyke six feet high, which reclaims from the overflow of the river about 10,000 acres of magnificent land. This dyke was completed in the winter of 1889-90 under the superintendence of Mr. G. A. Keefer, M. Can. Soc. C. E.

The bottom is of silt, which is probably of great depth, for the valley from Hope downwards has evidently at no very distant (geological) period been one of the great fiords or inlets which

reach from the Pacific Ocean, far into the Cascade range of mountains, and are found all the way from Puget Sound to Alaska.

These inlets are exceedingly deep, and this one which has been filled up during the lapse of ages by the silt brought down by the Fraser River, was no exception to the rule.

The work was started rather hurriedly, only four days being taken to prepare a plan and specification, and contractors having only three days in which to tender, nevertheless the work has not been materially altered since its commencement. The viaduct is of wood 3,000 feet long, and consists of pile trestle approach 150 feet, one span 100 feet, seven spans 150 feet, swing truss 239 feet over all, one span 150 feet, and 1,250 feet of pile trestle approach. Howe truss spans of 150 feet each were selected as being the largest which it is desirable to build in wood.

The chief difficulty lay in designing piers of moderate cost which should be safe in winter when there is thirty-five feet of water, a current of two and one half miles an hour, and at times ice which shoves with great force, and in summer when there is fifty-nine feet of water, a current of five miles an hour and drift-wood coming in tangled masses, sometimes nearly an acre in area, as well as trees of great size.

Piers were originally proposed with four rows of piles placed at two feet centres both ways, but the piles averaging fifty-five feet in length the butts were so large, that it was found impossible to drive them so close together, and consequently only three rows could be used, placed three feet centres across the current, that is in the line of the bridge, and two feet centres up and down stream.

Around these piles cribs were built of square timber, with ties nine feet apart for which spaces were left between the piles. The cribs are eleven feet wide outside measurement, and forty-one feet long, with noses at each end projecting five and a half feet farther and meeting in a right angle.

Ballast chambers were formed between the ties in two of the spaces—the centre row of piles being left out—and the cribs were sunk as built. When they reached bottom they were filled to the top with rock small enough to sink between the piles and form a solid mass. Rip-rap was then placed on the outside, eight feet deep next the cribs and extending fifty feet in all directions from them.

Some difficulty was experienced in sinking such a large mass of timber with small ballast chambers, and in some cribs ties near the bottom were allowed to extend six feet outwards, and two ballast platforms formed on each side, which arrangement was convenient for sinking the cribs during construction, but cannot be recommended where the bottom is soft, as in the present instance, as the surrounding riprap in settling into the mud, fell away from the platforms leaving a space through which the current scoured the material underneath to some extent before it was noticed and remedied.

The piles are driven about twenty feet into the bottom of the river, and are cut off at the level of high water neap tides, being thus wet to the top twice every day. The cribs are built to the same height and are expected to last for a very long time, as the water is fresh, very cold, and not known to be inhabited by any noxious insects. Resting on the piles are piers formed of framed bents twenty-five feet in height, which places the bridge seat just eight feet above the highest flood known, viz., that of 1882. These have cutwaters with a slope of 1 to 1.

Two of the framed piers were in position before the flood of this year (1890) and one of them was tested by a boom of logs descending the river, which a tug was unable to control. They were of long lengths, many of them four feet and upwards in diameter, and struck with such force as to slide up the cutwater several feet without jarring it in the least.

For reasons which it is unnecessary to discuss here the swing has been built with an opening of 100 feet on each side of the pivot pier, and far enough from the shore to give twenty-four feet of water in one channel and nineteen feet in the other. This pier is thirty feet in diameter, and being placed so far out in the current has caused a good deal of scour, so much so that the bottom of each channel has to be riprapped right across and for a considerable distance up and down the stream.

The substitution of mattrasses of brush for the riprap, or a portion of it, was fully considered, but owing to the depth of water and rapidity of the current it was feared that difficulty would be experienced in sinking them exactly where required. It was found, moreover, that the amount of rip-rap necessary to ensure their remaining permanently in position would bring the cost up to a higher figure than the rip-rap alone.

The swing truss and gear was designated by Mr. P. A. Peterson, the Chief Engineer of the Canadian Pacific Railway Company, and has an arched upper chord, fifty of the sticks in which are about 6" x 12" and range, from seventy-eight to ninety-seven feet in length. These are of Douglas fir, sound and almost clear, and were sawn by one of the mills at Vancouver.

As a further instance of the facilities afforded by the timber of British Columbia for special classes of bridge work, it is worth mentioning that all the piles used in the false works of this bridge, reached up to the lower chords, and ranged from seventy to eighty-five feet in length.

It is expected that the track will be laid over the bridge early next month. (January, 1891.)

The general character of the bridge will be best seen by reference to the accompanying plans.

VANCOUVER, B. C., December 27th, 1890.