

GREAT ENGINEERING WORKS ON THE CANADIAN PACIFIC RAILWAY.*

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The Huge Lethbridge Viaduct in Southern Alberta and the Grade Reduction in the Canadian Rockies.

Two great engineering triumphs have been achieved this year by the Canadian Pacific Railway Company, in the construction of a huge viaduct on its Crow's Nest branch, and the reduction of the steep grade in the Canadian Rockies. Both are works of considerable magnitude, and both have been successfully completed in a remarkably short time.

Although only separated by less than 200 miles as the crow flies, these engineering feats are essentially different in every aspect, even in their surroundings and conditions, the one being located in mountain recesses, and the other on the broad planes of a ranching and grain-growing region.

The Lethbridge Viaduct.

The Crow's Nest line of the Canadian Pacific Railway branches off the main transcontinental road at Medicine Hat, and parallels it through the mountains a hundred miles to the south, to give easy access from the east to the rich mining regions of southern British Columbia.

General.—The present line between Lethbridge Junction and MacLeod is 37 miles in length, the distance from Lethbridge, which is situated on a spur track, to Lethbridge Junction is 1.5 miles. The total distance from Lethbridge to MacLeod being 38.5 miles. The present line is constructed with curves as sharp as 7 deg. (819 feet radius) and with a grade of actual 1 per cent. (52.8 feet per mile), no compensation being allowed for curvature, so that in the estimates for new location the ruling gradient on this line was calculated to be equal to a virtual 1.2 per cent. grade (63.4 feet per mile).

On the above line, which was constructed in 1897 and 1898, are the following wooden deck bridges:—

Bridge	Length	Height from Ground to Base of Rail
108.7	406	110
112.2	476	105
112.4	420	94
112.8	463	87
113.1	674	67
113.5	503	102
113.8	405	77
114	569	84
114.3	569	74
114.8	473	62
115.2	317	41
115.6	419	39
116	2933	65
117.5	707	117
119.6	449	73
120	567	117
120.2	313	53
121.1	629	113
131.8	755	24
132.5	16	9

A total of twenty bridges, with a total length of 12,063 feet, or 2.8 miles, 1,450 feet of this length being Howe truss spans, varying in length from 100 feet to 150 feet. In the majority of cases these bridges cross streams and ravines with very steep-cut banks, which, on account of the nature of the soil, require constant watching, especially in the spring and during high water. The worst of these crossings are those at St. Mary's and Belly Rivers.

On account of the life of these bridges being very nearly expired, they would require, during the present year, heavy repairs, or practically rebuilding. The estimated cost of permanent bridges to replace these wooden bridges is \$1,065,000. Owing to the necessity of rebuilding these

bridges, and to the rapid increase of traffic, and the fact that the original charter for the Crow's Nest branch required the construction of a line to start from Lethbridge, it was therefore decided to have surveys made and ascertain if it were possible to secure a low grade line with better alignment. With this object in view extensive surveys were made in 1904 and 1905, the line which was finally adopted being as shown on small scale plan attached, marked "A." This line gives a maximum virtual grade of four-tenths of 1 per cent. (21.12 feet per mile) with a maximum curvature of 3 degrees (1,910 feet radius).

As already noted, the town of Lethbridge is on a spur track of the Crow's Nest Pass Railway, 1.5 miles long, which necessitates practically all trains running into Lethbridge and backing out, being a loss of three miles, which will be saved when the new line is placed in operation.

The saving effected by the new location as compared with the old is as follows:

5.26 miles of line, 1,735 degrees less curvature, thirty-seven fewer curves, and 401.5 feet less rise and fall, besides securing the 0.4 per cent. grade, as compared with a virtual 1.2 per cent. on the old line. These changes should so reduce operating expenses that the saving with an increase of 20 per cent. in traffic above what it was last year would pay an interest at the rate of 4 per cent. on an investment of \$3,625,000, besides which it would cost to replace the old bridges with permanent structures \$1,065,000. The total capital expenditure which would therefore be justified would be \$4,690,000, while the estimated cost of the change of the line is \$2,048,700. On this new line there are only two bridges, both large viaducts, one over the Belly River at Lethbridge, 5,327.6 feet in length, with a maximum height of 314 feet from the bed of the river. This viaduct is the subject of this article. The second bridge over the Old Man River, is 1,900 feet in length and 146 feet in height from the bed of the river.

Location.—The east end of the viaduct is 3,800 feet west of Lethbridge Station, being somewhat west of the centre of the town. Lethbridge is the centre of a large irrigation track and of an important coal-mining district, is a divisional point of the Crow's Nest branch of the Canadian Pacific Railway and the Alberta Railway and Irrigation Company, and has at the present time a population of about six thousand. It is located in the Province of Alberta, 759 miles west of Winnipeg, 2,174 miles west of Montreal, and is the centre of a rapidly developing territory.

Site.—The site of the bridge is the best for a high-level crossing in the immediate vicinity of the town. The slopes are fairly uniform for a distance of 1,000 feet from the prairie level, then drop more abruptly for 800 feet to the flat, which is flooded in extreme high water, then runs on an approximate level for a distance of 1,800 feet to the edge of the river, which is 300 feet wide. On the west side of the river it rises rapidly to prairie level in a distance of 1,300 feet.

On the east bank the soil is clay and gravel for about 6 feet from the surface, then 50 feet of hard clay, 12 feet to 20 feet of coarse gravel, and below this shale and coal.

In the bed of the river there is about 20 feet of gravel, then 20 feet of coal-shale, below that 2 feet of blue clay, then a hard shale for a distance of 16 feet to 18 feet, below which is hardpan and sandstone. The west side is of somewhat similar formation, but the bank has been eroded, causing it to cave in at several points, which makes it necessary to do extensive work in order to secure proper foundations for the bridge.

The alignment of the bridge is a tangent throughout, there being a 1 deg. curve at the east approach of the bridge, and a 3 deg. curve at the west approach; the grade is 0.4 per cent. rising to the west for the whole length of the bridge.

On the east side of the bridge there are some old mine workings which follow a vein of coal 7 feet thick which was worked out in 1888 to 1890. This vein of coal was practically horizontal and level with the flat at the river, varying

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