

per 100. At mile 68, a uniform 2.2 per 100 upward grade, compensated for curvature, begins and continues, without interruption, to Eholt summit, mile 80.8. At Eholt the grade is level for 1200 ft. At mile 81 a uniform 1.8 per 100 downward grade begins and continues to mile 84.9. From mile 85.9 to mile 85 grades fall, varying from .07 to .55 per 100. From mile 85 to mile 85.7 grades fall, varying from 1.10 to 1.20 per 100. From mile 85.7 to mile 88.4 grades fall 1.8 per 100, compensated for curvature. From mile 85.7 to Greenwood, at mile 89.7, grades fall, varying from 1.70 to 1.43 per 100.

All grades exceeding 1.5 per 100 are compensated for curvature at the rate of $\frac{3}{100}$ of a foot in each 100 ft, for each degree of curvature, that is to say, that in the case of a 14° curve having a tangential grade of 1.8 per 100, the grade on the curve is reduced $\frac{42}{100}$ of a foot, which subtracted from the

structed, having full formation widths and height.

Excavations are 18 ft. wide at formation level, with side slopes of 1 to 1 in earth, sand & gravel, and $\frac{1}{4}$ to 1 in solid rock. In certain cases where the nature of the material admitted slopes have been vertical, or nearly so. As in the case of embankments all excavations have originally been thoroughly finished. In rock excavations all work, as a rule, has been well done, the faces of the excavations presenting uniform surfaces.

Rock slope walls occur at two points about midway between Grand Forks and Eholt, each wall being about 59 ft. long and 15 ft. high. They are merely dry stone walls, vertical on the inside face, and battering outwards 1 in 3 on the outside face. They are substantially built, the stones being rectangular blocks, breaking joint and in every way well laid. The top width is not less than 3 ft., and the inside filling is broken rock. In

surfaces approach very closely to the required symmetrical specifications, which are as follows: Width at formation level and at spring of roof, 16 ft.; clear centre height above formation level, 23 ft. $2\frac{1}{4}$ ins., and above rail level, 21 ft. 6 ins., ballast being 9 ins. deep. The rock through which the tunnels pass is solid, and no timbering has been required. The tunnel at mile 74.3 is 402 ft. long from portal to portal. The approaches are rock excavations; that on the north end being 120 ft. long, and that on the south end 100 ft. long. The grade through the tunnel is 1.80 per 100, rising northward, and the alignment is a 10° curve. The tunnel at mile 77.2 is 511 ft. long from portal to portal. The approaches are rock excavations, that on the north end being 110 ft. long, and that on the south end 150 ft. long. The grade through the tunnel is 1.80 per 100, rising north, and the alignment is a 10° curve. In both tunnels the centre lines have been



FIGURE 4.—A SNOW-CUT SHOWING DEPTH OF SNOW ON THE C. P. R., IN THE SELKIRK MOUNTAINS, B. C. (SEE PAGE 258.)

original grade of 1.8 per 100, leaves 1.38 per 100 as the compensated grade on the curve. This rule has been adhered to very closely, but in cases where changes of alignment during construction have altered distances, slight deviations have been rendered necessary.

The total ascent from Grand Forks to Eholt summit is 1,380 ft., and the total descent from Eholt summit to Greenwood is 630 ft. The average grade from the middle of Grand Forks siding upwards to Eholt summit is 1.9 per 100, and the average grade from Eholt summit downwards to the middle of Greenwood siding is 1.38 per 100.

Embankments are 14 ft. wide at formation level, having the usual slopes of $1\frac{1}{2}$ to 1 in earth, sand & gravel, and 2 to 1 in loose rock. With the exception of two cases, where dry stone retaining-walls are constructed, the toes of all slopes reach solid ground. No retaining timber crib-work has been used. All embankments have originally been well con-

structed, having full formation widths and height. The stability of the road-bed does not depend on these walls, there being a sufficient width of rock excavation to sustain the road-bed, even should the walls be removed.

Drainage under the road-bed has been excellently well provided for by means of culverts. Surface drainage, by means of ballast boxes, is still lacking. Side drainage, by means of catch-water drains, is unusually plentiful, and many of these appear to be unnecessary. All culverts are of the usual log pattern, having solid cedar or fir walls and covering, secured by tree-nails and drift bolts, the whole resting on round sills, in pairs, from 5 to 8 ft. apart, the spaces between the sills being filled flush with solid rock. The workmanship on these structures is excellent.

Two rock spurs have been pierced by tunnels, one at mile 74.3 and one at mile 77.2. Both tunnels are excellently well constructed, and present uniform clear-cut surfaces. The

placed 7 ins. off the centre line of the road-bed, in order to allow for the inclination of the cars, due to the elevation of the outer rail of the curve.

From Grand Forks to Greenwood there are, including bridge approaches, 6 framed timber trestles, which, combined, cover a distance of 1,610 ft. Following is a list of trestles:

| Location. | No. of bents. | Total length. | Centre height. |
|-----------|---------------|---------------|----------------|
| Mile 68.1 | 2 | 45 | 7 |
| " 70.2 | 16 | 250 | 30 |
| " 70.3 | 16 | 250 | 50 |
| " 73 | 27 | 421 | 102 |
| " 80.4 | 34 | 526 | 70 |
| " 89.4 | 6 | 106 | 65 |

Trestle at mile 58 is temporary, and, it is stated, will be filled at an early date. Trestle at mile 70.2 is on a tangent, with a grade rising north 2.2 per 100. It is built across a rock ravine, and has solid rock foundations. Trestle at mile 70.3 has two decks, and is on a 7 degree curve, with a grade rising north 1.92 per 100. It is also built across a rock