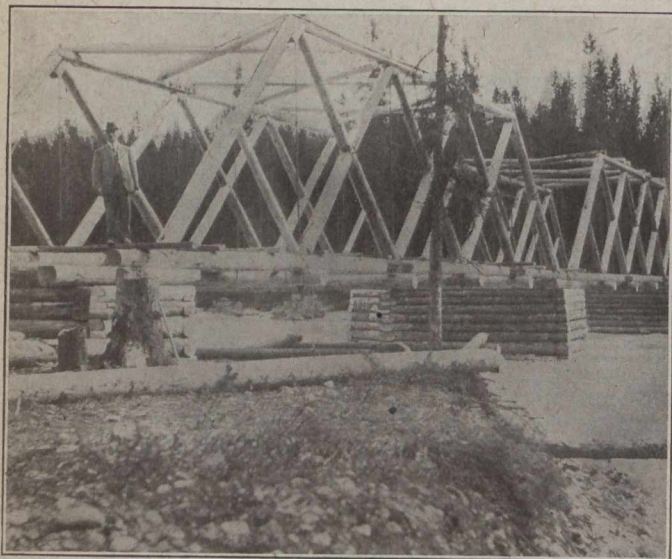


determining the proper capacity and best positions for drainage structures.

A large percentage of the park areas lies more than a mile above sea-level, and many of the roads are within one or two thousand feet of the timber-line. Combined with the steep mountain slopes, this results in the run-off from storms and melting snow reaching the roads very



Round Timber Truss Bridge Erected over the Kicking Horse River near Field, B.C.

quickly, and the maximum discharge of any channel may be reached in a few hours. These swift mountain streams have great powers of erosion and an entire change of channel may be effected in a few minutes' time.

Many streams carrying sediment, driftwood and boulders during freshet, deposit this material on reaching the gentler slopes of the valleys, and build up beds considerably higher than the general surface of the adjacent country. These conditions not only increase the difficulty of determining the proper locations and sizes of ordinary drainage structures, but in the case of the larger streams they introduce new problems in the selection of bridge sites.

Type of Drainage Structures.—At the present stage of development the general policy is to construct wooden cribs, culverts and bridges on all new roadwork. Since the park roads now in process of building traverse fairly well-wooded country, native timber suitable for construction purposes is available and is often obtained on the right-of-way.

The life of ordinary log drains or box culverts in the park areas is estimated at from nine to twelve years, and when they require re-placing, structures of a more permanent nature will be built. It is considered that by this time not only will increased traffic justify iron or concrete drainage structures, but that the roads themselves will require some type of surface paving.

Bridges are built of sufficient width to afford a minimum clear wheelway of 14 feet 6 inches,—15 feet being the usual wheelway adopted. The life of a wooden bridge is estimated at from 16 to 25 years, and it is considered that the width allowed will accommodate traffic during the life of the bridge.

For small spans of 25 feet and under, simple wooden bridges are erected, consisting of stringers and deck supported on wooden piers or bents. For spans between 25 and 40 feet a King type of truss is used, and for spans

over 40 feet and up to 80 feet, the Howe or Warren truss is employed.

With the exception of the decking, which is sawn planking, bridges are usually constructed of native timber cut near the bridge site.

A unique feature of wooden truss bridges is the use of round peeled logs for truss members. Timber for trusses is carefully chosen and matched. It should not taper too quickly and should be as straight and as free from defects as possible. When neatly framed this type of bridge is pleasing to the eye, has a better appearance than a hewn structure, and is comparatively inexpensive to erect.

These bridge trusses are designed to carry loads of from 16 to 18 tons,—thus having sufficient strength to support a steam roller or a light revolving steam shovel. In computing the unit stresses for truss members of round logs, the cross-section available is taken to be the strongest rectangular section that could be obtained from the member in question.

Grading.—Grading of the roads is accomplished by ordinary methods, scrapers or wheelers and the scraping grader being used for general work. Where interned alien labor is employed, picks and shovels with dump wagons are utilized to a greater extent than on work done by contract or day labor.

The scraping grader has been found invaluable for ordinary grading on level ground, and has been successfully used on side slopes up to 1 in 5. In order to handle more quickly and profitably the large amount of excavation necessary where side slopes are very steep, a light revolving steam shovel, mounted on traction wheels, was purchased by the Parks Branch. On sidehill construction this machine does all the rough grading, and the trimming and finishing is done by a small force of men. It is also used for ordinary grading,—in conjunction with dump wagons,—when the amount of excavation per lineal foot is sufficient for profitable operation.

The amount of excavation per mile on park roads varies from 2,000 cubic yards on level ground, to 10,000 cubic yards on steep sidehill. The cost of grading under normal conditions ranges from 20 to 35 cents for earth,



Section of Motor Road between Banff and Lake Louise, Alta.
This road when completed will be 38 miles long with a maximum grade of 6 per cent. Twenty-seven miles have already been constructed.

to \$1.40 and \$1.70 for solid rock. Intermediate material, usually classed as loose rock, costs from 50 to 70 cents per yard.

Surfacing Material.—One of the present problems in connection with the general roadwork of the National Parks is that of a satisfactory maintenance of the earth