

Time and time tables.—Twenty-four hour system, vs. a.m. and p.m. Information to the public re late trains. Permanent time at Fort William for transcontinental trains. Furnishing proofs of working time tables sufficiently ahead to admit of proper advertising.

Relations between railway lines and steamship lines.

Fuel. Handling and consumption at stations, at stationary boilers, on locomotives, and on steamships. Utilizing old ties for fuel. Fuel tickets furnished fuel department, not giving correct informa-

tion.

Types of snow fighting equipment.

Necessity alterations in certain series of 40 ton steel frame box cars.

Discussion of sleeping and dining car service in relation to public and operation of road.

Freight claims.

Stations and staff.—General appearance, station gardens, etc. Providing fences and gates to control public. Inspection of tickets prior to passengers entraining. Prizes to stations for increased receipts.

Relations between traffic department and operating officers.

Economy in use Pintsch gas and electric light on cars.

Telegraph service.—Shortening of telegrams. Handling of important business in telegraph offices.

Economical handling of passenger cars.—Discussion as to allotment of this work to one department.

Handling of insurance survey reports. Handling cinders and ice in terminals.

Uniform system of reporting accidents, slides and washouts. Industrial sites.

Unique Engineering Features of C.P.R. Bridge in British Columbia.

By E. B. Skeels, Resident Engineer, C.P.R., Lethbridge, Alta.

The C.P.R.'s Granby Subdivision is a spur from the Boundary Subdivision to Granby smelter, over which ore and coke are hauled to the smelter. The old crossing of the Kettle River at Bude, mileage 1.3, consisted of a 160 ft. dock Howe truss, with a 20 degree curve approaching one end and a 22 degree curve on the other end. The new structure (bridge 1.3) consists of one 30 ft. deck plate girder, one 120 deck lattice span, 2 skew deck plate girds spans of a total length of 150 ft., on a change of line eliminating the heavy curves and permitting erection without interruption to traffic.

was done, two base lines were laid out, one on each bank, so that one would be used as a check on the other in assuring accuracy. The result of the first triangulation gave a check of half a tenth of a foot. This was not considered accurate enough, but as there was other urgent work to be done, the rechecking was postponed. It was a month before the opportunity was presented to recheck the work, and again a check of half a tenth was made on the day's work, but the result was practically one tenth longer than the previous month's results. The angles were added four times in reading them,

tween hubs on this date was found to be one tenth longer than the previous month and two tenths longer than two months previous. The work was gone over carefully the following day, but the distance was practically the same. It was then arranged to have another instrument man check the work with other chain men, although chain men had been changed around on the work previously, and various methods of chaining the base lines were carried out, distance and elevation between points being taken and true distance computed. Chains were also checked and different chains used in measurements of base lines. When piers 2 and 3 were built two base lines were checked separately.

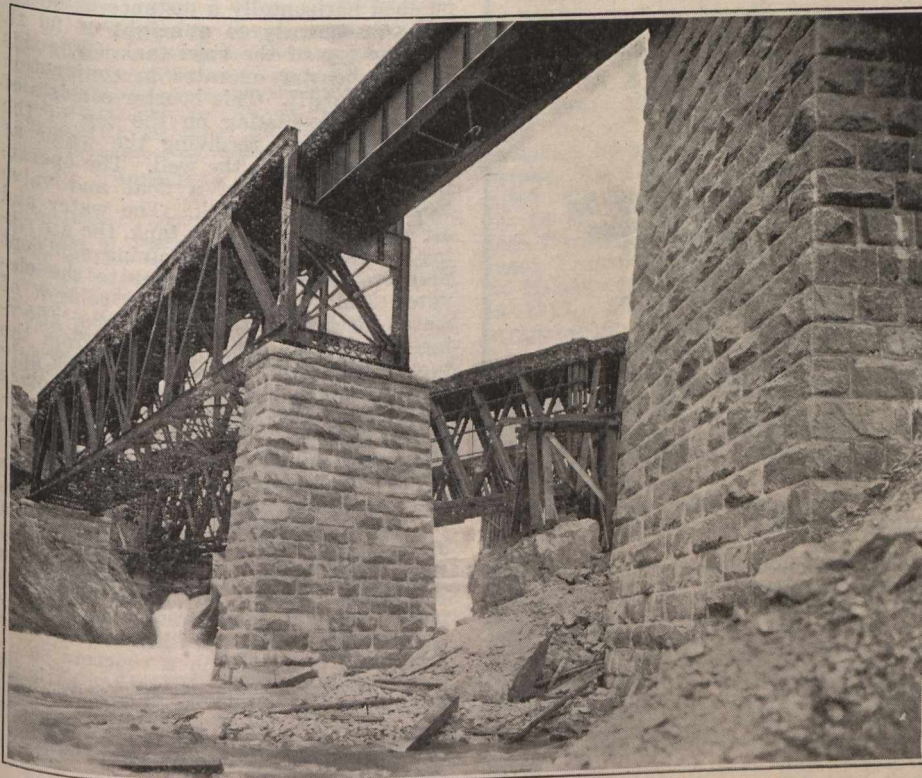
It was again a month after that when the work was all gone over by the second instrument man, angles being added six times to give accuracy. The results showed the nearest checks to be one half thousandths and the greatest difference to be twenty-eight thousandths.

It was after this last check had been made that it was decided that the contraction of the rock of the canyon walls was responsible for the differences, due to cold weather, there having been a period when the thermometer registered from 20 to 35 degrees below zero daily. The matter was then referred to the Division Engineer and to the Chief Engineer, J. G. Sullivan, who arranged to have larger rollers placed under one end of the 120 ft. deck lattice span, which rested on a pier built on the south side of the river.

Checks were made of the distances monthly, covering a period of 15 months, which showed an expansion and contraction difference of approximately six tenths of a foot, or about $7\frac{1}{4}$ in. in the year. The temperature varies from 35 degrees below zero to 102 above in the shade. The figures given are approximate, and are as close as can be remembered.

The old Howe truss span had always given considerable trouble, it being necessary to line it, as it shifted on its end bearings. No reason could be given, as there were wooden trestle approaches to the span which received the thrust of trains on the curves, until the facts above recorded were found. The rock is of a very hard formation, being of a flinty granite, the hardest encountered in the Boundary district.

The writer is indebted to John R. Grant, M. Can. Soc. C.E., of Cartwright, Matheson & Co., Vancouver, for the suggestion as to the solution of the cause of the canyon apparently widening, and for searching for information showing that a similar case had been found in Mexico, where



Bridge 1.3, Granby Division, C.P.R., over Kettle River.

When laying out the work for building the granite masonry piers and abutments it was necessary to triangulate to determine the distance across the canyon, the walls being too precipitous to permit of chaining. Triangulation hubs consisted of 1 in. holes drilled in the solid rock and plugged with wooden plugs, finishing nails of 1 in. length being used as points, and small, round hardwood toothpicks being held on these points for back and foresights.

The distance between hubs on the centre line of bridge was approximately 341 ft. When the first triangulation work

so that the average angles were reduced to seconds. When the result was found to be one tenth longer than the previous work the work was rechecked, but the result was the same.

Again, a month elapsed before a check was made, and this time two more base lines were laid out, one on each bank, thus having four triangulations for checking purposes. The excavation for the piers was proceeding during this past month. When the results of the four triangulations were compared the check showed the greatest difference to be twenty-five thousandths, but the length be-