

traffic, is not suitably equipped to carry satisfactorily the business offering at present, and is certainly not capable of dealing with the business of the near future economically and expeditiously. Over 400 miles of single track unrelieved by duplications would under favourable conditions be considered as inadequate media of conveyance for the bulk of the North Island business, but the conditions are not favourable. The terminal accommodation at Wellington and Auckland is inadequate, there being insufficient room to deal with either the passenger or goods traffic at busy times. The suburban traffic has to be worked over the same single track at the Wellington end and over portions of it at the Auckland end: congestion occurs in consequence. The grades prohibit good train-loads, and so tend to crowd the line with extra trains. The bridges in some cases will not carry the more powerful engines, and so have the same effect. The crossing-places are too few and far between.

Palmerston North, the principal intermediate station and the exchange-point for traffic between the Napier and New Plymouth lines and the Main Trunk, is inadequate for the business, and therefore adds to the difficulty of working.

I am including in this report proposals for new works at a number of points on the main line between Wellington and Auckland. The amount involved is heavy, but I am convinced that the expenditure is absolutely necessary, having in view the present needs and the rapid expansion of business in the North Island.

Grade-easements.

A scheme has been in hand since March, 1911, for an easement of the grades in the vicinity of Auckland. Several grade-improvements between Paerata and Pokeno have already been carried out under this scheme at a cost of £92,000, but the full benefits from this expenditure will not be obtained until the whole scheme of reducing the grades from Penrose to Mercer to 1 in 100 has been completed, for the reason that the loads of engines cannot be increased over this section until all the grades which limit the loads have been reduced to the new standard. The total estimated cost of reducing the maximum grade between Penrose and Mercer to 1 in 100 is £242,000; deducting the value of the works already carried out, leaves £150,000 as the amount required to complete the work. The diagram attached to this report (Appendix No. 1) indicates the existing grades over which the traffic has to be worked and the suggested improvements. When the whole scheme is completed the load between Penrose and Mercer will be increased from 162 tons to 494 tons with the same type of engine—an increase of 232 tons per train.

Between Frankton and Te Kuiti a grade of 1 in 43 at Lake Road restricts the tonnage to a maximum of 209 tons. The proposed reduction of the existing grade to 1 in 100 will enable the same engine to take 494 tons—an increase of 285 tons from Te Kuiti to Auckland.

The loading of engines working between Palmerston North and Taihape is governed by the Greatford and Kakariki banks (1 in 44). The maximum load for this section is 209 tons, but when the grades are eased to 1 in 70 the load will be increased to 355 tons—an increase of 146 tons over a section of 64 miles. (Appendix No. 2.)

The grade-easement scheme which I recommend for adoption provides for the attainment of a grade of 1 in 100 where this can be done at reasonable cost, and for a grade of 1 in 70 where the cost of the flatter grade would be excessive. It covers that portion of the line between Penrose and Te Kuiti (a distance of 126 miles) and Palmerston-Taihape (64 miles). Between Te Kuiti and Taihape (a distance of 100 miles) the ruling gradient is 1 in 50, and it is quite impracticable to improve this except by entire reconstruction at prohibitive cost.

Between Palmerston North and Paekakariki (61 miles) the existing gradients are easy, the ruling grade being 1 in 100. Between Paekakariki and Wellington (27 miles) the load of south-bound trains is governed by a grade of 1 in 53 and north-bound trains by a grade of 1 in 35 out of Wellington. The capacity of this portion of the line is already very heavily taxed, and a means must be found at an early date to relieve the position. No surveys have been made, but an examination of the country and information available indicate that it would be feasible to obtain an outlet for the Wellington traffic with a ruling gradient of 1 in 100 between Wellington and Paekakariki by partial deviation of the line, duplication also being necessary. To duplicate the existing line, retaining the heavy gradients, would be a mistake if a grade of 1 in 100 can be obtained by deviation at reasonable additional cost, in view of the large saving in operating-expenses which would be effected thereby. Although I have not included this work in the scheme of improvement to be undertaken immediately, because more urgent matters must have precedence, I bring it under notice in order that the project may receive consideration and the country may be surveyed and reliable estimates prepared in readiness for the time when the work must necessarily be put in hand. There is no gainsaying the fact that the existing means of getting traffic into and out of Wellington leaves much to be desired.

Effects of Gradients.

The effect of gradients on trains is strikingly shown by the following figures:—

The resistance on a grade of 1 in 100 is 7·5 lb. per ton greater than on a grade of 1 in 150. On a grade of 1 in 50 the resistance is 22·4 lb. per ton greater than on a grade of 1 in 100. An engine capable of hauling 249 tons up a grade of 1 in 50 will haul 494 tons over a grade of 1 in 100 and 686 tons over a grade of 1 in 150. The economies resulting from grade-reductions are therefore obvious. Speeds are affected in about the same ratio: e.g., a train weighing 220 tons and attaining a maximum speed of 15 miles per hour on a grade of 1 in 50 could attain a maximum of 30 miles an hour on a grade of 1 in 100 and 40 miles per hour on a grade of 1 in 150. (See Tables A, B, and C.)