

It is proper to say that estimates of cost not based on instrumental surveys are liable to be more or less erroneous, but for purposes of comparing the merits of alternative lines the figures given can, in my judgment, be accepted as reliable, it being assumed, of course, that progress of the work would be regular from year to year until its completion. If the work should be pushed with vigour, the time required to build line A would be seven years; line B, four years and a half; line C or C1, three years; line D, D1, or D2, three years and a half to four years; and line E or line F, say, two years and a half.

TRAFFIC.

It has been established in previous reports that the maximum east-bound revenue traffic would be 150,000 tons, and the west-bound 50,000 tons. The maximum grade of the line from Greymouth to Otira, opposed to the eastward traffic, is 1 in 57½, while that of the line between Bealey Station and Springfield, opposed to the westward traffic, is 1 in 50. Trains ought, therefore, to be well loaded for eastward movement, while many cars and wagons going westward would be empty and the trains light. This will suit very well the arrangement of grades mentioned.

A locomotive of class B is the heaviest now in service on the New Zealand lines. Its total weight is 65 tons, and weight on the drivers 70,112 lb. On grades of 1 in 37 and 1 in 32, the maximum grades of lines A and B, an assistant locomotive in addition to a class B would be required to haul the full load, which one of class B could haul up the 1-in-57½ maximum grade to Otira, but such assistant locomotive could also be one of class B. On steeper grades a heavier assistant locomotive would be required, and for the object we have in view we may assume that a locomotive weighing 85 tons, and having a weight of 100,000 lb. on four pairs of drivers, would be used. In the table below are given the gross and revenue loads which each locomotive mentioned would haul up the several maximum grades of the lines under consideration, it being assumed that one-third the gross load would, on an average, consist of cars and wagons. As many of the wagons would be loaded with lumber or coal, this is probably a fair assumption.

Locomotives : Capacity of Haul.

Name of Line.	Maximum Grade.	Class B Locomotive. (Total draught, 65 tons; weight on driving-wheels, 70,112 lb.)		Assisting Locomotive. (Total weight, 85 tons; weight on drivers, 100,000 lb.)	
		Approximate Gross Load behind Tender.	Approximate Load, exclusive of Weight of Vehicles.	Approximate Gross Load behind Tender.	Approximate Load, exclusive of Weight of Vehicles.
		Tons.	Tons.	Tons.	Tons.
...	1 in 50	238*	159	...	...
...	1 in 57½	278	186	...	...
A ...	1 in 37	187	112	...	...
B ...	1 in 32	140	94	...	...
C and C1 ...	1 in 25	98	66	150	100
D, D1, D2 ...	1 in 28	118	79	177	118
E ...	1 in 22	80	53	122	81
F ...	1 in 20	67	45	104	70

* At the Dunedin test, 24th September, 1899, on 1-in-50 grade, the gross load was 239 tons.

Up the 1-in-25 grade the class B locomotive and the assistant locomotive suggested could haul 248 tons of gross load, which is 30 tons short of what the former could bring up to Otira. The fact is, however, that a full train-load would not often present itself, cars quite generally not being laden to their full capacity. When a full load did appear one or more cars would be dropped at Otira, to be taken up with the first light train. But this point is not important, because, if necessary, an assistant locomotive, having 4,000 lb. or 5,000 lb. more on the drivers, could be used, her total weight perhaps being 90 tons.

On the grade of 1 in 28 the two locomotives could haul 295 tons, rather more than the class B locomotive would bring up to Otira.

On the 1-in-22 and 1-in-20 grades it would probably be best to detach the class B locomotive and let her take the return train to Greymouth, while two special locomotives of heavy type, each having, say, 105,000 lb. on the drivers, would haul the train through to Bealey Station; or it might be thought best to retain the road-locomotive (class B), and use two lighter assistant locomotives. However, it is needless, in view of all that is being done in New Zealand and all other parts of the world in the matter of assistant locomotives, both on steep and easy grades, to pursue this branch of the subject further. The traction-locomotive, used as an assistant engine, has become one of the most important elements of modern transportation, and has made it possible for the railway to penetrate mountain districts which otherwise would have been partially inaccessible, and to cross difficult ranges, carrying civilisation to desert regions and building up a vast commerce.

It has been seen above that the gross load brought to Otira by the road-locomotive would be 278 tons, of which 186 tons would be revenue load. Attention has also been directed to the fact that the wagons of trains are generally not loaded to their full capacity. Much has been and is being done in America and elsewhere to compel the full loading of cars, and with a large amount of success; but, with the exception of coal, ores, and like heavy commodities, it is of note that,