

1899.

NEW ZEALAND.

MIDLAND RAILWAY.

REPORT OF COMMITTEE OF ENGINEERS APPOINTED TO CONSIDER THE FEASIBILITY OF WORKING THE PROPOSED LONG TUNNELS ON THE STEEP-GRADE INCLINE BETWEEN OTIRA AND ARTHUR'S PASS.

Laid on the Table by the Hon. Mr. Hall-Jones, with the Leave of the House.

Public Works Department, Engineer-in-Chief's Office,
Wellington, 11th October, 1898.

The Hon. the Minister for Public Works.

WE have the honour to report that we have very carefully considered the question, referred to us, of the possibility of working the tunnel 1,170 yards long proposed as an alternative to the switch-back. After full consideration we have unanimously agreed that we cannot recommend the construction of a tunnel of this length on a grade of 1 in 15. It is certain that locomotives generating their own power by the combustion of coal could not be successfully worked in such a tunnel under all conditions, in view of the difficulties experienced in the relatively short tunnels on the Rimutaka Incline, and also in view of the great difficulties experienced in working tunnels of half the length of the proposed tunnel on the Abt lines in Japan. We are aware that improvements in incline locomotives, by which all or a portion of the steam is condensed instead of being discharged into the tunnel, combined with improvements tending to insure better combustion, are likely to render the working of tunnels on very steep gradients somewhat easier than has been the case in the past. It is also probable that the combustion of liquid fuel would still further diminish the difficulties now experienced in such tunnels; but, as no very reliable and definite results are at present available, we are unable to recommend the adoption or trial of any of these means of rendering the tunnel more easily worked.

It can be contended that, if natural ventilation failed, recourse can be had to artificial ventilation, but we think the cost of installation and working, and the probability of the variable efficiency of the plant under differing atmospheric conditions, are so great that no proposal for working the line by means of artificial ventilation can be entertained.

A careful examination of the plans, &c., of the various surveyed lines shows that the following alternatives are feasible, in addition to that of simply reverting to the switchback line as originally proposed by the company:—

A. It is possible to locate the line on the left bank of the Rolleston, and get a line some 30 chains shorter than the alternative tunnel line proposed by the Midland Railway Company, with a tunnel about 850 yards long on a grade of 1 in 50, with no sharper curves than 10-chains radius. The same number of passing-places can be arranged for by keeping the 1 in 15 some 20 chains or more on the hillsides, instead of running along the Otira River bed as is now proposed. This alternative line will be about 24 chains shorter than the switchback line, exclusive of the length of the switchback itself. It will run on the hillsides for a length of 60 chains beyond the point where the company's line reached the bed of the Otira. Without a very careful examination of the ground it is impossible to say whether this would be a serious disadvantage or not. In the one case the line will perhaps be more liable to damage by slips; in the other it will be liable to damage by the Otira floods, and heavy protective works will be required to secure the railway bank.

The special works on this line would be a bridge over the Rolleston, and the tunnel, 850 yards long. There would also be bridges over several minor creeks, and heavy earthworks.

Including running in and out of the switchback, there would be nearly half a mile less of distance to be traversed between the Bealey and the Otira Stations by this line than by the switchback line for trains with engines at each end; while for trains with single engines there would be the additional saving of time required for the engine and van to change ends on the switchback.

The long tunnel being wholly on a flatter grade—say, 1 in 50—than the rack or Fell incline, and without the centre rails, trains would be hauled through it by the adhesion engines of the locomotives only, and the working of the tunnel would present no greater difficulties than is experienced in other long tunnels on New Zealand railways, as, for instance, the Deborah Bay Tunnel, 1,400 yards long, of which a length of 1,100 yards is on a grade of 1 in 60, or the Spooner's Range Tunnel, 1,474 yards long, of which a length of 979 yards is on a gradient of 1 in 44.

With a sharper curve than 10-chains radius—say, 8 or 9 chains—and a flatter grade to compensate for the sharper curves, the length of tunnel could be materially reduced, but to what extent it is not possible to say without a survey. The best curvature and grade to adopt could only be determined after a trial survey had been made, the essential point being that the gradient and curves adopted for the tunnel would be such that it could be easily worked by the Abt or Fell engines acting as adhesion locomotives only; so that the tunnel could be quickly traversed by any train which these engines could haul up the 1-in-15 grades above and below the tunnel.

We have no reliable information on which to base an estimate of the cost of this alternative proposal; it will probably cost several thousand pounds more than the switchback line, and the cost of maintenance would no doubt be greater, on account of the hillsides being apparently less stable along the left banks of the Rolleston and Otira than on the right banks, where it is proposed to locate the switchback line.

B. It is possible to amend the location of the switchback line so that the switchback can be eliminated, while the length of the line is only increased by about 12 chains. The line would turn by a loop near the proposed switchback. The loop would be partly in tunnel. Where the line is in tunnel the grade would be reduced, so that trains can be hauled through the tunnel by the locomotives acting only as adhesion engines, at such a speed as not to cause unendurable inconvenience to the train-men or passengers. As the length of tunnel required would not be more than 36 chains on a 1-in-60 grade, with $7\frac{1}{2}$ -chain curves, it should not be more difficult to work than the New Zealand tunnels already referred to under alternative *A*. After passing through the loop tunnel the line would be continued on the 1-in-15 grade to the summit. A passing-siding can be provided on a back-shunt at the loop, to take the place of the switchback siding, in the same manner as is proposed for several of the other stations, or by lengthening the loop, as found best when the line is relocated.

This alternative possesses all the advantages of working possessed by alternative *A*, and the line will be on more stable country, where the cost of ordinary maintenance may reasonably be expected to be less, and there should be less chance also of interruption of traffic by heavy slips. The bridges would be more expensive than on the line discussed under alternative *A*. The actual length to be run by a train on this line would be about 6 chains more than on the switchback, which is immaterial.

C. If the switchback line were constructed as proposed by the company, it would always be possible to eliminate the switchback at any time, if circumstances justified the expenditure, by constructing a tunnel on a flatter grade than the 1-in-15 incline, so that the trains would turn on a loop, as under alternative *B*. Instead of being reversed on the switchback, the trains would be run through the tunnel quickly, as above proposed, to avoid inconvenience or danger. This would cost £25,000 to £30,000. This is a modification of alternative *B*, but if the switchback line is constructed it should be so located that the tunnel of alternative *B* can be reverted to at any time if the switchback is found to be troublesome and a hindrance to traffic.

The principal objection to the switchback is the loss of time there would be with trains run with single engines only, the van and engine having to change ends. With trains run with two engines, one at each end, this objection would not hold, and for heavy traffic we think this would generally be the type of train run. For both types of train there would also always be the loss of time due to running in and out of the siding, which would not, however, be so great as the loss due to changing ends.

We therefore recommend that the switchback line generally be adhered to, with the addition of the curved loop mentioned above, which will then give the line all the advantages claimed for that on the left bank of the Rolleston. If in the first instance it is deemed advisable for the sake of economy to construct the switchback, the line should be constructed so that the loop of alternative *B* can be reverted to at any time.

The cost of alternative *A* may be taken at £65,000; of alternative *B* at £70,000; and of the switchback line at £60,000, for the sake of approximate comparison.

Some of the other tunnels on the 1-in-15 grades between the switchback and the summit are of considerable length. We are strongly of opinion that all these tunnels should be reduced to a maximum length of, say, 5 chains each. These long tunnels, we feel certain, would be found to be as unworkable as the long tunnel proposed as an alternative to the switchback. It seems quite feasible to break up the longer tunnels into shorter lengths by shifting the centre line of the railway towards the Otira. Some viaducts would likely be required between the short lengths of tunnels; but though the line might not be quite so safe on a viaduct as in a tunnel, yet, as it is necessary that it should be workable, we unhesitatingly recommend that this alteration be made. These tunnels must all necessarily be on the 1-in-15 grade.

WILLIAM H. HALES,

Engineer-in-Chief.

C. NAPIER BELL, M.I.C.E.

JOHN COOM, M.I.C.E.,

Inspecting Engineer, Working Railways.

P. S. HAY, M.A., M.I.C.E.,

Superintending Engineer, Public Works
Department.

NOTE.—Mr. J. H. Lowe, Chief Engineer, Working Railways, was invited to act on this Committee, and attended the first meeting, but was unable, through illness, to attend further. It was then arranged for Mr. Coom to take his place.

Approximate Cost of Paper.—Preparation, not given; printing (1,325 copies), £1 5s.

By Authority: JOHN MACKAY, Government Printer, Wellington.—1899.

Price 3d.]