

The piers were designed by Mr. Blackett, and I fully approve of the designs, which are cheap, effective, and ingenious. The estimated cost of the bridge is £34,183.

In all the above plans it is proposed to let the highway traffic pass on the same platform as the railway traffic. The bridge will therefore be closed to the public except at stated hours of the day. The roadway will be 19 feet wide, giving room for two drays to pass.

I consider plan No. 1 certainly the best of the three designs, except that it is too expensive; comparing it with plan No. 2, there is a difference in first cost of £19,000, which, put at compound interest at 5 per cent., would replace the destructible part of No. 2 plan every nine years. I have no doubt that the wooden bridge would last twenty years instead of nine, so it would be sound policy to adopt the wooden bridge as against plan No. 1.

Plan No. 3 has much to be said both for and against it. The spans are too small to allow drift timber to pass, and I do not, therefore, consider it a perfectly durable bridge. It is apt, also, on account of the smallness of the spans, to cause excessive scouring during the usual floods. Its advantages are its cheapness, and the fact that it comes within the amount appropriated by Parliament. It could also be erected in six months from the time the piles arrive from England, while the other plans would take fully a year. The girders are already ordered, and will soon be on their way out.

On the whole, I consider the advantages, especially the cheapness of this plan, sufficient to give it the preference over the others, and therefore recommend its adoption.

I think the iron work ought to be ordered at once by the Government from England, and the erection submitted to public tender here.

JOHN CARRUTHERS,  
Engineer-in-Chief.

The Hon. the Minister for Public Works.

NOTE.—No. 3 design was the one approved of.

### Nos. 3 and 4.

#### REPORTS ON AUCKLAND AND MERCER RAILWAY.

Mr. CARRUTHERS to the Hon. J. D. ORMOND.

SIR,—

Auckland, 6th January, 1872.

I have the honor to report that I have examined the line from Auckland to Onehunga, and recommend the adoption of the line known as the Tunnel line.

There have been three lines surveyed from Fort Britomart to Newmarket—the Coast line, the Domain line, and the Tunnel line—the last being the one formerly adopted by the Province of Auckland, and on which a great deal of work has been done, and the land bought throughout. Mr. Wrigg, to whom the surveys were intrusted, has prepared comparative estimates of the three lines, showing the cost of the Coast and Tunnel lines to be the same, and that of the Domain line to be less by £7,000. There must be added, however, to the Coast line the cost of pitching the slopes of the sea embankment with stone, £3,600, and a further sum of £6,100 for additional earthwork not provided for in the estimate, so that the Coast line is the most expensive of the three; it is also the worst, as it is one and a quarter miles longer than the Tunnel line, very curved, and with a ruling gradient of 1 in 40 against 1 in 47 on the Tunnel line. The Domain line is estimated, as above stated, at £7,000 less than the Tunnel line, and corrections since made in the quantities of earthwork increase this to £7,500. Against this saving, there must be placed—firstly, the cost of land for one mile and sixty-seven chains, most of which is through the Domain; secondly, the maintenance and working expenses for 32 chains of line, by which the Domain exceeds the Tunnel line in length. This is a more serious item than is generally supposed by the public, for assuming twelve trains a day (six each way)—which is a low estimate, seeing that the Mercer and Onehunga branches both pass over this part of the line—the extra cost, at 7s. 6d. per train mile, would be £1 16s. a day, or £657 a year, equal, if capitalised at 5 per cent., to £13,140.

By far the greatest objection to the Domain line is the excessive curving and steep gradients. There is a gradient of 1 in 40 for one mile twenty-three chains, and nearly the whole of this is on reversing curves of 5 chains radius.

On the Tunnel line, the steepest gradient is 1 in 47 for one mile and eight chains, all of which is either straight or on easy curves. On the Domain line, special engines would be required, entailing extra first cost and increased expense in repairs; while on the Tunnel line, ordinary engines can be employed, and in any case, the resistance due to the curves and steeper gradients combined would make three engines necessary for the same load that one engine could take up the Tunnel line.

The only objections to the Tunnel line are, the Tunnel itself and the open cutting at the mouth of it. The former is 320 yards in length, probably through soft sandstone, but full information has not yet been obtained as to the material. The open cutting at the end is very bad indeed; it consists of slippery clay, which has already slipped into the cutting formerly made, the ground for a distance back of 200 feet having given way, so that two houses are in danger of coming down. It will require great care to make this part of the line, but I feel no hesitation in saying that the difficulty may be successfully met without excessive cost.

It has been assumed that similar material would not be met with on the Domain and Coast lines, and no provision for such contingency is made in the estimates. I am convinced, however, that two or three cuttings on the Domain line, and one at least on the Coast line, would turn out just as bad, and would require still more expensive works than are required on the tunnel line.

#### SUMMARY.

##### *Coast Line.*

This line is the longest, the most expensive, and the worst for working; its length is three miles 31 chains; the total rise and fall is 168 feet; steepest gradient, 1 in 40; sharpest curve, 6 chains radius.