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1886.

PARLIAMENT OF TASMANIA.

ROYAL COMMISSION ON RAILWAYS AND PUBLIC WORKS:

REPLIES TO AND REMARKS UPON THE REPORT, BY THE ENGINEER-IN-CHIEF, THE GOVERNMENT STATISTICIAN, AND MR. C. K. SHEARD, C.E.

Presented to both Houses of Parliament by His Excellency's Command.

ROYAL COMMISSION ON RAILWAYS AND PUBLIC WORKS.

REPLIES TO AND REMARKS UPON

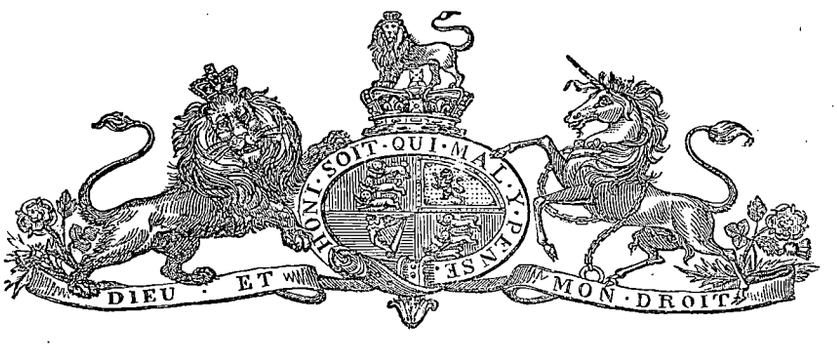
THE

REPORT OF THE ROYAL COMMISSION ON RAILWAYS AND PUBLIC WORKS,

RECEIVED FROM

THE ENGINEER-IN-CHIEF, THE RESIDENT ENGINEERS OF THE DERWENT VALLEY AND FINGAL RAILWAYS, AND MR. R. M. JOHNSTON, GOVERNMENT STATISTICIAN.

PRESENTED TO BOTH HOUSES OF PARLIAMENT BY COMMAND.



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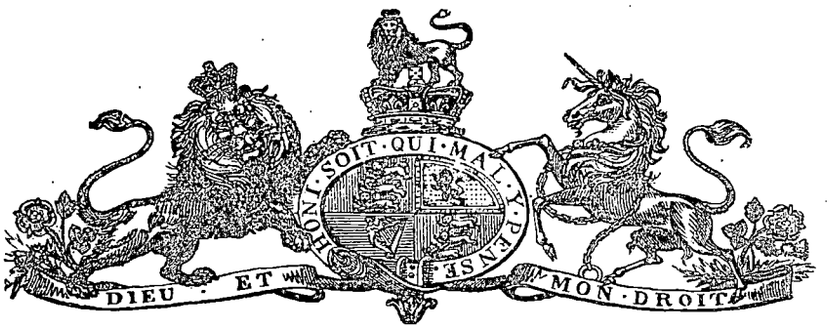
1886.



REPLIES to and Remarks upon the Report of the Royal Commission on Railways and Public Works received from the Engineer-in-Chief, Messrs. Sheard and Home, Resident Engineers, and of Mr. R. M. Johnston, Government Statistician, &c.

Lands and Works Department, Hobart, 29th April, 1886.

SIR,

I HEREWITH forward to you a copy of the Report of the Royal Commission on Railways and Public Works, and the Evidence on which that Report is based.

The Report and Evidence are not to be made public until you have had an opportunity of reviewing them and commenting thereon.

I shall be glad if you will kindly furnish me, at your earliest convenience, with such remarks or explanations as you may desire to offer for the consideration of the Government.

I have the honor to be,
Sir,
Your obedient Servant,
NICHOLAS J. BROWN,
Minister of Lands and Works.

JAMES FINCHAM, *Esq., C.E., Engineer-in-Chief.*

Public Works Office, Hobart, 6th May, 1886.

SIR,

HEREWITH I have the honor to submit, for the consideration of the Government, my remarks and explanations upon the Report of the Royal Commission on Railways and Public Works, and to express my thanks for the opportunity afforded me of so doing.

My reply, to be complete, should give information as to the cost involved in adopting the recommendations of the Commissioners; but this includes the preparation of plans for the several bridges, a survey for alteration of line at No. 1 bridge, and more time than the Government would possibly desire to elapse before my explanations were sent in. I will, therefore, only ask that when the above information is ready it may be accepted as if it had been sent in at the present time.

Having perused the voluminous papers forwarded, I will proceed to reply to the Report where I may consider it necessary, and in the order in which it is written.

DERWENT VALLEY RAILWAY.

New Bridgewater Bridge.—The Commissioners have overlooked the fact that this is an unavoidable and urgent necessity for the road traffic, that it is outside the contract, and beyond authorised terminus of line.

Surveys.—My own flying surveys, and knowledge of the country, added to such personal supervision as my duties would permit, enabled me to give a general check, but it was not in my power to provide an organised inspecting staff. The line at the Derbyshire Rocks is sound and solid; but without some indication of what else might have been done in a very difficult place, I cannot understand the criticism, unless indeed, it applies to the levels of the line, which the Chairman thought too low. In refutation of this the Department produced exact levels of floods that had been permanently registered by marks cut in several places, and I suggested that the evidence of long resident witnesses at this part would be advisable, instead of that of gentlemen residing some miles above New Norfolk. I regret that this suggestion was not carried out.

Back River.—Original Wall.—Although I neither saw nor knew anything of this before the greater portion was built and backed with the filling (when I was called to the failure of the culvert), yet Mr. Mault considers that I share his responsibility, and this is confirmed by Contractor (question 1998), but the reply I received to my letter following the question, and which was, with others, handed to the Commissioners, has been omitted. This reply is unqualified, and to the effect that my approval was limited to the better class of face work only at one portion of the wall. This old wall when taken down was found to rest partly on logs, and to have its foundation some 9in. deep in the light alluvial deposit of river bank.

New Wall.—On many extensive works with which I have been connected, and which I have observed, the plan of a counterforted wall, with less than the normal strength of more costly face material, and a cheaper backing (as lime concrete) is common enough on railway and dock works, &c.

One mile of wall of similar character, designed by Mr. Edwin Clark, the well-known engineer, was carried out by Mr. Sheard on the sea frontage of the Callao Harbour Works.

The lower cost of the backing allows a wall of greater weight for the price of a wall wholly of masonry or brickwork. The 5ft. 8in. of backing referred to, moreover, does not reach within 11ft. of the top of the wall. See detail 2A, sheet 3A, (attached to report), where it is stepped back.

Had the wall been built wholly of masonry, and with a batter, its great length would have required the construction of some counterforts, and this course would have been to the credit of the plan adopted.

I fail to see that the expressions "unusual," "extravagant," "rough," "unscientific," &c., &c., are applicable. The wall has to bear great stress, and is, I submit, far from being discreditable in appearance, as can be decided by any observer. I attach drawings of several examples of very important works where vertical walls, with concrete backing, are adopted.

Answers to questions 1135 to 1147 give reasons for adopting vertical face, and state positively that no excess was caused thereby.

This is entitled to more respect, at least, than the answer of contractor's engineer, who says, (question 1868), that he could have perhaps saved "thousands of pounds" on this wall.

Waterways.—Some of the damage caused by the storms of November last was certainly due to insufficient waterway—some owing to bad work and the non-completion of inlet and discharge drains. I was obliged to condemn the culvert at 0·15m. when I first inspected the works, just after their commencement; and the seemingly large increase in size of other waterways, as now being built, is more a matter of construction than of actual necessity for so much increase, *e.g.*, a small bridge with a narrow deck, on a few piles, is not more costly than an ordinary culvert affording the required extra waterway, and which would, in many cases, have to be supported on piles. Moreover, some amount of earthwork in filling up gaps is avoided.

Bridges 1, 2, *and* 3.—*Designs.*—Mr. Edwards's statement (question 618) is correct, and consistent as regards working drawings for erection, in place, of the girders and caissons manufactured from the drawings attached to contract. He only completed those for No. 2 bridge.

My answer (questions 95 and 97) refers to details, *i.e.*, of spans, waterway, skew, &c., not to construction details. Mr. Edwards inspected sites of all bridges at my request, and designed in their entirety all the piers and girders shown in what have been termed "the type drawings." I inspected same, sanctioned their embodiment in contract, and from them the ironwork has been constructed.

Stone Abutments and Piers.—The reason for adopting solid abutments in lieu of wings is given (question 113); the relative cost was estimated, and they have the advantage of giving a more solid foundation for permanent way, on curve entering the bridge, than an ordinary embankment would afford.

The piers while "green," and unassisted by weight of superstructure, stood the test of last flood without the slightest injury, and are safely and well built in cement throughout.

Superstructure.—This is practically identical with that in a large number of existing bridges in South Australia which have been in perfectly safe use for some years. I was fortunate in obtaining the loan of copies of the working drawings, which I handed over to the Commissioners, and give below comparative particulars.

As the girders are generally plate girders on the bridges referred to, I have only tabulated the particulars of same, but there are some lattice girders 6ft. high and 6ft. 2in. out to out, of same spans and arrangement of superstructure.

TASMANIAN BRIDGES.

Plate girders, continuous over two spans.
Width out to out of girders, 7ft. 6in.
Height, 6ft.
Span, clear, 60ft. and 59ft.
Girders connected every 12ft. with solid steel diaphragm plates as bracing, with L iron top and bottom, 4in. by 4in. by ⅜in.
Diagonal bracing of L iron, 3½in. by 3½in. by ½in. at bottom, between girders from end to end.
Mininum bearing on piers, 4ft. at centre of girder, and 2ft. at ends.
Minimum width of pier at top, to carry superstructure, 14ft.
No external stays.
Girders bolted down to bed stones by six "Lewis" bolts, 12in. long, at end of each girder.
Continuous timber deck, 8ft. 6in. wide, bolted through to girders.

SOUTH AUSTRALIAN BRIDGES.

Plate girders, non-continuous.
Width out to out of girders, 6ft. 2in.
Height, 4ft. 7in.
Span, clear, 58ft.
Girders connected every 12ft. with two horizontal T irons, and two diagonal L irons.
Diagonal bracing of 3½ by ½ bars between girders not carried throughout.
Mininum bearing on piers, 12in. on iron transom.
Minimum width to receive superstructure, 11ft.
External stays of T iron to ends of girders, where resting on iron transomes only, two to each pair of girders at end on square, and one to each pair at end on skew. No external stays where bearing is wide as on stone abutments.
Girders bolted down to bed stones by four "Lewis" bolts, 6in. long, at end of each girder.
Sleepers (open) 6ft. 6in. long, about 2ft. 9in. apart centres, and bolted through to girders.

With the above information you will understand that both the resident engineer and myself should feel bound to protest against the loss involved in suspending operations for the manufacture of the superstructure, and that I should look for some calculations to prove their non-stability. In the absence of such I wish to state that I am unable to accept Mr. Climie's figures. Take, for instance, the principal force of wind pressure; this is given on the assumption that a wind can blow with an extreme force in different directions at the same time, at the same spot, and bear equally on sheltered and on unsheltered portions. The Commissioners noted this. (Questions 1941-2).

The girders rest on cast iron bed and bearing plates as at Victoria Bridge, Pimlico, (Sir John Fowler); Thames Bridge, Staines; and others I can quote.

Long before the pressure of flanges of carriage wheels against rails from force of wind could materially affect the bridges, the carriages would be derailed or go over, and this might just as easily occur on bridges like those at Risdon, Crooked Billet, or Bridgewater.

The weight of carriages and weight of superstructure is known, the wind can be assumed to strike throughout in the most unfavourable position, the force can be taken at the extreme limit fixed by the wind committee on Tay Bridge, and the stability can be mathematically proved by the position of the resultant of the combined forces acting together.

The strength of the girders is admitted by all, and they are equal to carrying heavier engines than now provided.

It may be well to state that the technical term "a loose road," occurring in the evidence, does not mean a loose deck, but that the permanent way is laid in ballast, as is common in Victoria, instead of being fixed to bridge; it is also loose in the Nairne Viaducts in South Australia.

Only a madman would dream of laying the deck without attachment of any kind to the upper flange plates (not bed-plates) of bridge, as imputed to us by the contractor, who takes advantage of the omission to show two bolts in the type or contract drawings, although they were shown on working drawings which have been in his possession for over six months. The Commissioners knew the deck would be bolted (questions 952-3), and that provision could be made by driving out the small rivets where required to insert the bolts to suit planks, and must have overlooked these in working drawings referred to.

With regard to use of bridges, Nos. 1 and 3, for both road and rail traffic, I admit that this requirement, promised in Parliament during the progress of the Bill, was overlooked; the order having gone for the ironwork the bridges could not be altered, and a plan to utilise them was designed.

I do not think that the Commissioners were in a position to judge this matter, or that the strong language is justifiable, as they never saw the design, nor did they make enquiry as to details. For your information I would remark that the actual roadway is on a 7ft. 6in. floor (the width out to out of girders) between two kerbs, and so far it is identical with the roadway of the Cataract Bridge, Launceston; light footways with gas-pipe hand railing are carried upon U shaped T iron bearers and standards in one piece across the bridge. The description of height of pier should be corrected in report from "60ft." to "30ft."

Approaches.—No. 1 Bridge.—By some strange fatality the Commissioners have not based their remarks upon drawings to which the work is constructed. Actually the railway is on one dead level with the bridge for half a mile on the west side, and for five chains (the limit fixed by Commissioners) on east side, with a grade of only 1 in 200 for 12 chains beyond, and then level again.

I anticipate that the survey for altered alignment of railway approaching No. 1 bridge will prove the work to be a most extravagant and costly affair, and in reply to the objection can quote numerous examples of iron bridges on sharp curves that have been attacked in the same way as ours (which have only a curved approach), and yet have never fulfilled the gloomy predictions in reference to them.

Piers of Concrete in Iron Caissons.—The contractor's objections are comparatively of recent date. He took the contract on 22nd December, 1884, and soon afterwards ordered the ironwork for the caissons of all the bridges. He raised no objection whatever until a plan showing a wider base for two caissons was sent on the 9th October, and by letter dated 20th October, 1885, acknowledged plan for this wider base to No. 2 Bridge piers, and stated, "he did not wish to raise objections to alteration, and apprehended no difficulty in fixing caissons," but called attention to increased cost because of increased length; he also stated that, never having heard of bridge foundations being built with caissons (!) they did not convey to him the idea of security.

A letter containing general claims connected with bridges followed on 24th November, another on 26th December, with a list of claims to be settled before he would commence work, concluding with a protest against any responsibility whatever. On 11th January, 1886, he wrote, stating that he would proceed with the work and leave his claim open, and in a second letter protested, for the first time, against No. 1 Bridge. My repeated requests for calculations from his engineer, to satisfy me, were met with silence, and the correspondence closed.

After this, and upon the protest and evidence of the Contractor, whose pocket was affected, and without giving their own reasons or calculations, the Commissioners dismiss the subject by simply admitting the validity and force of his protest, *and on this most important point in the enquiry, narrowing the issue down to one of difference between the department and the contractor.* It is all the harder upon the department, because the desire of its officers to substantiate their complaints of bad work, which they considered affected the safety of the line, was actually met by the same objection.

In the cast-iron cylinder piers the whole weight of superstructure is taken up by the enclosed concrete, and had I seen fit to adopt the 5ft. cylinders shown in type drawings, no objection would have been raised as to their stability (question 1912). Much stress has been laid upon the fact that the wrought iron caissons are braced internally with 3in. by ½in. bars dividing the mass of concrete. I will allow it to be assumed that these light bars are solid plates, and then there is a supporting unbroken mass of 24 square feet of concrete under each girder, as against 20ft. in a cylinder 5ft. in diameter.

The vertical section of the pier, taken to foundation below river bed, contains an area of 208 square feet; the break of continuity by bracing is, in the aggregate, only 27 square feet; and surely the balance will leave an adhesion and connection between the assumed divided sections of considerable value.

As the piers are filled in, my intention is to remove the diagonal braces (then no longer required), and leave but the horizontal ties, making only a break of 13 square feet in a continuity of 208 square feet.

The wrought iron caissons were cheaper than the cast cylinders, and I doubt if the latter could have been manufactured locally.

The cast iron cylinders would have been easier for contractor, but would be damaged sooner under a blow, full on, from a floating log.

The wrought iron will last, if coated with tar or paint as provided. Within the last few months I have examined all the piles of Bridgewater Bridge at an unusually low tide, and found the sharp threads on the bolts and edges of the thin plate washers and straps (all tarred) as good as when fixed 13 years since. The thin plates of caissons, if assumed to decay, will still leave behind a strong L iron framing all round pier, and tied across same, after the concrete has permanently set.

Each of the four huge (70ft. diameter) permanent caissons forming the Inchgarvie pier of the great Forth bridge in Scotland, are of wrought iron, in a great depth of water, and on a foundation of sloping trap rock; they are formed with two skins 7ft. apart of $\frac{3}{8}$in. plates below low water, with internal framing and bracing very like ours. A foundation is cut in the rock and the caissons lowered into the same, as I propose for our small bridge—the space between the skins being filled with concrete lowered through the water in hopper-bottomed skips.

The piers are of safe proportions, according to recognised rules in America (where the most scientific and least costly bridges are constructed) if built, say only in brick in cement, without the iron surroundings; the small iron bars 3in. by $\frac{1}{2}$in. at intervals in the concrete, will not affect its setting or disturbing a mass of nearly 200 tons. If such a contingency did not seem to me absurd, the difficulty could be at once met by casting the cement with a small space round the bars to allow of movement. The piers are also perfectly safe under a tensile strain; and I will close my remarks hereon by a reference to a paper on the Forth Bridge, by Mr. Baker, one of the engineers of same (see *Engineering*, No. 974, 29th August, 1884, page 215), wherein he states that a rubble pier in cement stood a tensile strain of $8\frac{3}{4}$ tons per square foot, under a total thrust on the pier of 1400 tons. Mr. Baker, moreover, made various experiments in connection with the concrete, and found it developed a tensile strength of from 10 to 12 tons per square foot, and he states that it was from no inherent weakness in the concrete that masonry was substituted in the upper 36ft. length of the piers, which carry spans of 1700ft.

With the good concrete I mean to have, there will, therefore, be no fear of danger to our small piers. The vertical compressive strain, due to load of superstructure and train, is abnormally light, viz., 2 tons per foot at top, and $3\frac{1}{2}$ tons per foot at bottom.

The Ledbury Viaduct, upon which I was engaged, is on a curve, has vertical piers 45 and 50ft. high above ground, built in brick in lime mortar, and only $10\frac{1}{2}$in. thicker than cement concrete piers inside the caissons.

The Waimakiriri River Bridge, in New Zealand, has piers vertical on all sides, with rounded ends, exactly same shape as ours, and built of concrete without iron casing. These piers are about 90ft. above low water, and support iron plate girders of 100ft. spans; but I will obtain particulars.

I attach drawings illustrating comparative superstructure and piers of South Australian bridges, photograph of same, and photograph of the New Zealand bridge before referred to.

Information re *Estimates.*—I can say with confidence that all the information required has been given with alacrity as soon as it could be prepared. I know Mr. Sheard, the Resident Engineer, could not possibly have done more, for he worked far into the night for sixteen or seventeen nights to prepare accurate information, and the Commissioners told him he was doing more work than they wanted. I cannot understand the implied slur. I have always found the resident engineer disposed to full estimates, and have no reason to doubt his accuracy, especially as his estimate exceeded Mr. Falkingham's total; but any cost for works ordered by the Government, as the outcome of the enquiry, is excluded.

The contractor has made a bad bargain with regard to these bridges, and must fix the caissons, of No. 2 especially, at a considerable loss under his contract prices. This, together with the differences that have existed for months as to what was good work according to his specification, and the consequent irritation, has had much to do with the share, I have reason to believe, he has taken in the attacks upon the Department.

FINGAL RAILWAY.

I have dealt so often with question of estimates that I will confine my remarks to construction.

The instructions to resident engineers (questions 3346-7) were issued and acknowledged by the resident engineer in letter dated 14th January, 1885.

The culvert fronts referred to have been affected by the pressure of the banks, and I think only in one case will they require rebuilding—the other cases require tops resetting; the large culvert shows only a small crack at the joint on top of arch, without any in main body of wall, which is moved out of position, and would only be detected by experts.

Much has been made of the slopes through the stony "made" ground at Vinegar Hill being steep, and of the omission of a retaining wall. This, as I stated, was only a tentative measure on the part of Mr. Climie, and was concurred in by me; in any case we only proposed a foot wall. The estimate, as accepted from the contractor's assistant (£2572) is, in my opinion, most extravagant for the amount of walling actually necessary, if wall is adopted, and I should have been glad to supply drawings and figures, which could be checked in detail, had I been asked. I examined the place a week since, and found no cracks indicating the probability of anything like an important slip. The small stones and earth had been washed out of slopes from water behind in two or three places, but I do not think that this would amount, on the whole, to more than two or three barrow-loads. All that I propose now to do is to trim back the slopes from 3ft. to 4ft. where required, and leave the road its original width at this place. I anticipate that one-tenth part of the estimated cost of wall will cover this.

The fence has been adopted by many landowners here, and the contractors asked permission to erect it. As they find fault with it, their objections would, perhaps, have been less if they had been more liberal with the posts where ground was uneven.

I have adopted type plans for all our station buildings, of different classes; goods sheds are the same throughout all the new lines; passenger offices and residences will be identical for each class on all the lines now under construction. They were not adopted until plans had been considered and approved by the late manager, and, even to the minutest detail in office-fittings, I have consulted the wishes of the traffic branch. I trust to obtain your approval of their appearance when you see them built (as I have that of others), in addition to your approval of the plans given when I submitted them to you.

Signal, Stop, and Scotch-blocks.—A provision for same might not be seen in the yards, as the yards are incomplete, and under construction as yet. The signals are included in the estimate to complete the work handed in by me. With regard to Avoca station, I observed the other day that a train could be seen half-a-mile off on each side of same.

LAUNCESTON AND SCOTTSDALE RAILWAY.

I submit that I was perfectly justified in getting all the information I could from the engineers when running their trial lines in different directions for the best route for permanent survey; the information included proof of the practicability of the Lisle deviation, by which the line was shortened, and I took no further steps until the Minister and the whole Cabinet, before whom I was called, had discussed the question and authorised the permanent survey being commenced. The then Chief Secretary (the Hon. W. Moore) warmly commended the success of the engineers.

I also submit that the labours of the engineers, under the general supervision and check of Mr. M'Cormick, were as complete as they could be made. An aggregate length of about 140 miles was surveyed by trial lines cut through the forest, and accurately levelled before the permanent survey was commenced,—five engineers, with survey parties, being altogether at work for 11 months,—and the Commissioners, when inspecting the line, informed Mr. M'Cormick and myself that, in such a country, it was futile for them to attempt to judge of the survey by walking along the clearing. How it is that they have been able to judge in Hobart, I cannot understand.

The difference between haulage on a dead level and straight line and that on a mountain line is, of course, considerable.

Several kinds of fencing are provided for in contract, but only those will be adopted which are considered most suitable, and Bain's is excluded from this line, except where a landowner has asked for it.

The absence of roads and materials fixed the adoption of the massive log culverts: at some future date the permanent culverts can be built in solid without disturbance of log walls or top.

The superintending engineers, by my instruction, had a careful examination made in order to find suitable building material and ballast. Had they found limestone I would not have sanctioned lime concrete, and building stone is unobtainable locally. Really great trouble was taken to discover suitable ballast, and its importance was realised, but I can only deplore its non-existence, not the failure of the engineers to find it.

The labour of traversing for areas of watershed in this country, in many places, would have been excessive and costly, and when done the whole result would be affected by "absorption," which could only be guessed for such places.

MERSEY AND DELORAINE RAILWAY.

The site of Whitefoord Hills station is not a good one, but I did not feel justified in increasing the steepness of the heavy grade down the Coiler to secure a better; its arrangement is on the same plan recognised in New Zealand Government standard plans for similar exceptional cases.

The Chairman was good enough to inform me that the line was quite equal to any lines in Victoria of a similar class.

GENERAL.

The conclusions and recommendations of the Commissioners I must leave with the Government; but, if I may be permitted to make any remark, it is that I trust you will give effect to those relating to my being relieved of all work in connection with roads and buildings, if possible, at once: for the difficulties with the contractor for the Derwent Valley Railway, and work connected with the Royal Commission for the last three months, have, in the absence of any deputy, so disorganised and retarded all my other work, that this course is absolutely necessary.

The attacks upon the Department, which led to the enquiry, have, I believe, been, in the main, directed against myself personally; and it may, perhaps, not be considered egotistical if I inform you that I was an articled pupil with a firm of high standing, one member of which had been a pupil of George Stephenson, and the other of Sir Isambard Brunel, as well as Regius Professor of Civil Engineering at Glasgow, and that subsequently I have had more than 25 years' unbroken experience on railways and public works. I consider that the difficulties inseparably connected with the commencement of an extensive system of Public Works entitle the Department to more generous treatment than it appears to have received. The engineers now employed are gentlemen who are thoroughly capable, and who are giving faithful service to all the interests of the Government.

I do not ask that either myself or any officer should be shielded from blame that is justly due, but regret that the opportunity we were led to believe would be afforded us of fully refuting, if possible, any evidence to our injury, was not granted: and when I find contractors' estimates and statements accepted without check from the Department, I must, with all respect, be allowed to hesitate in accepting the conclusions as altogether impartial.

I feel sure that your sense of justice will secure the publication of these remarks at same time as the Report of the Commissioners.

I have the honor to be,
Sir,
Your obedient servant,
J. FINCHAM, *M. Inst. C.E.*,
Engineer-in-Chief.

The Hon. the Minister of Lands and Works.

P.S.—My remarks are subject to any additions that may be necessary after I have seen the Appendices to Report, which are not ready.

Lands and Works Office, Hobart, 19th May, 1886.

MEMORANDUM.

It is desirable that the Engineer-in-Chief should, for the information and consideration of the Cabinet, deal more specifically than the time at his disposal permitted him to do in his letter of the 6th instant, with some of the conclusions arrived at by the Royal Commission on Railways and Public Works. The attention of the Engineer-in-Chief is therefore directed to the conclusions numbered 1, 2, 3, 4, and 5, with the request that he will furnish such comments and explanations thereon as he may deem necessary, together with such further general reply to the Report of the Commission as he may desire to offer after perusal of the Appendices to the Report, as indicated in the postscript to his letter above referred to.

NICHOLAS J. BROWN, *Minister of Lands and Works.*

The Engineer-in-Chief.

Public Works Office, Hobart, 22nd May, 1886.

Sir,

I have the honour to acknowledge the receipt of your instructions of 19th instant, and will first supplement my remarks on letter of 6th May, as therein intimated, and then deal with the conclusions of the Commissioners as directed.

DERWENT VALLEY RAILWAY.

To avoid causing any misconception, it is very necessary to point out that my remarks as to the Main Line Railway bridge at Bridgewater, as quoted by Commissioners, apply solely to the condition of maintenance. I did not suppose they would be interpreted as meaning that a perishable material like timber would improve with age. The argument, however, one way or the other, is valueless, for the road-bridge must be built, and will absorb pretty well the total of estimate. I divided the cost merely as a matter of accounts if bridge is to be used for joint traffic.

I have deferred the preparation of new sets of drawings for bridges Nos. 2 and 3 until a final decision has been arrived at, and have meanwhile instructed Contractor to proceed immediately with the stone abutments and two stone piers of No. 2. I have also intimated to him the decision of the Government with regard to No. 1, accompanied by a request to settle up accounts for work already done, before it is disturbed, and to consider one of three modes of payment which I have suggested. When this is done the working drawings (which are limited to such alterations as would make the cartway two feet wider) will be complete.

The unwisdom of, firstly, suspending operations at these bridges, and, secondly, needlessly delaying the decision, is, I should think, patent to all, and is yet regretted by me: the girders and caissons would have been still useful for other works if they had gone on to completion, and the loss in pulling down and rebuilding the ready-dressed stone would have been small compared with any compensation claimed by the Contractor. The decision of sufficiency or otherwise of the bridges ought to have been given in as many hours as the Commissioners took weeks, especially as I am under the belief that the urgency of the case was repeatedly pressed upon them by the Government.

I informed you that I anticipated that the recommendation of the Commissioners with regard to approaches of No. 1 bridge would be costly and extravagant, and this statement is borne out by the accurate surveys that have been made by the Resident Engineer. These surveys, together with calculations, we have endeavoured to make in a scrupulously fair manner.

The present line is abandoned for about 18 chains on either side of the bridge; the massive abutments become useless. On the east side the line is buried in the rocky hill-side, with a cutting 31 ft. 6 in. deep, and on west with practically two cuttings of 43 ft. and 47 ft. deep respectively, the total excavation amounting to 81,709 cubic yards. To this must be added new bridge abutments, a new culvert at a cost of £260, work thrown away, £1151 4*s.*, amounting altogether to £14,388 13*s.* 5*d.*, without land and minor items. The excess of cost compared with the approaches as carried out would amount to £12,749 19*s.* 5*d.*, or more than the entire cost of the bridge.

The approach to No. 3 bridge on one side is being constructed in same manner as at No. 1, yet no alteration is suggested there. Its cost would have been £4339 1*s.* 11*d.* for 38,569 cubic yards of excavation, with allowance of only 1 to 1 slopes, which are of doubtful steepness in the clay hill-sides; if with 1½ to 1 slopes the cost would be £6193 9*s.* for 55,052 cubic yards, without accounting for work thrown away.

I attach plans and sections of these surveys.

Spans of 40 and 45 feet have existed in the bridges on this river for as many years without injury, while I have provided for 60 feet; and the intimation that 150 feet would have been better is only another illustration of the difficulty experienced by engineers of the old school getting "at touch" with the engineering of the less expensive narrow-gauge lines.

On the main range incline of the Southern and Western Railway of Queensland the railway traverses a series of short, abrupt, and often precipitous spurs and gullies, where embankments would be impossible, and these were crossed, in some cases, by *curved bridges* with *iron girders on timber piers.*

Further time has allowed me to find examples of the overhanging footways objected to for the joint traffic bridges. I will quote one,—viz., that of the great Kenzua Viaduct,—which is 300 feet high, with two girders 10 feet apart, and overhanging footways 5 feet wide on each side. The Commissioners' "Practical Builder" would doubtless have also gravely condemned the work of the engineers of this structure.

The Appendices being now to hand I can close my remarks on this Line. The important letter to which I referred as having been omitted, and which is a correction by Contractor of the extract from his letter given following question 1998, and of the whole letter given as "Appendix H," has since been inserted as an additional Appendix on my calling attention to the omission.

The Resident Engineer prepared, to written order of Commissioners, a tabulated schedule in detail of the whole of the work throughout the railway, showing—

Quantities scheduled in contract.
Quantities executed.
Quantities required to complete.
Totals on completion.
Increases and Decreases.

This is omitted; and a statement from Contractor's Assistant Engineer in same form, but without items of decrease in work, is given with his evidence (page 84).

A letter and statement in regard to the defective works was put in by me, but it is ignored, while a statement from the Contractor's Engineer is accepted (page 74, questions 1836–7), and included in the body of the evidence. I do now, as I have always done, regard these documents as important, and although the Commissioners seem to have regarded them as mere matters of dispute between the two parties, they are more than that. They show the decided stand taken by the Department for faithful work, and were the starting point of all the subsequent difficulties with the Contractor which indirectly led to the Commission. Containing as they do charges of bad work, I consider that they came within the scope of the Commission for special recognition, to say nothing of putting the Department on the same footing as the Contractor. I now submit them, therefore, to you (attached.)

The Resident Engineer also prepared and submitted the following further papers (exclusive of those in the Appendices):—

A statement, with detailed explanation, of every alteration in work, large or small, between 3rd June, 1885, and March, 1886.
A detailed estimate of cost of completing the line.
Reports and documents relating in detail to the condition of the works when he took charge in June, 1885.
A detailed statement of damage by floods due to non-compliance with orders, before floods occurred.
Estimates for substitution of masonry for iron caisson piers at No. 2 bridge.
A statement of all alterations from contract alignment, both during Mr. Mault's supervision and during his own.
Cost in detail of Back River work, showing portion wasted.

In addition to a large amount of general information prepared by myself personally.

Is it surprising that the Department should resent the words "this is all the information we have been able to elicit" when the Commissioners were dealing with cost of the works, and that the Department should have expected some acknowledgment of the assistance given?

At the commencement of the enquiry on the Derwent Valley Railway I was promised that each side would be represented while the other was being examined. This arrangement was altered, and a promise made that every opportunity for refuting damaging statements should be given. How this latter promise was kept you can judge from a perusal of the evidence.

FINGAL AND SCOTTSDALE LINES.

Permit me to call your attention to the remarks of the respective Resident Engineers upon the Report of the Commission, and to request that they may be attached to the other papers connected with reply (together with the letter from the Resident Engineer of the Derwent Valley Railway).

An analysis made of curves and grades, on the contract and Lower Piper routes respectively, of the Scottsdale Line, shows that 5-chain curves on contract route occur to only some three-fifths of the extent of same on Lower Piper line; that curves between 5½ and 6 chains, inclusive, occur also only to about three-fifths; that there is less of steep grade (1 in 40 to 1 in 45) outwards from Launceston by 60 chains, though more by 99 chains inwards from Scottsdale, at same time there is less than upper line by 6·4 per cent.; that the aggregate rise is 564 feet less outwards from Launceston on contract line, and 599 feet less inwards from Scottsdale on contract line. The statements in Report as to average grades on respective routes, without length of grades being taken into account, are of no real value.

ESTIMATES FOR RAILWAYS.

Regarding these, although the sums voted by Parliament have been exceeded to a greater or lesser extent, matters are not quite so black as painted, and I would ask your earnest attention to the following remarks in proof.

Take, first, the Mersey Line excess, say £70,000. I furnished a statement of appropriation of this in detail, but do not find it in Appendices, although a reference is made to the document on page 12 of the Report. It is allowed that Latrobe deviation, additional rolling stock, and land compensation (including accommodation works), are legitimate causes of increased cost—for which I am not at all responsible—and the total is thus reduced to some £38,000, without allowing me credit for rise in price of labour and materials, extra stations forced upon me, and increases under general construction that no Engineer could foresee. The present traffic has justified the additional stock, and I hope that its increase will necessitate a further excess upon this item. To sum up, the Colony has an admittedly good line for some £5000 per mile for every contingent expense of construction and equipment—just half the cost per mile of the Launceston and Deloraine Line; while the fact that the traffic department has been able to maintain the permanent way of a new line in really good running order, with only 27 men for the 37 miles, tells its own tale in our favour.

Take, next, the Derwent Valley Line. The Commissioners assume that the excess estimated by the Department, £24,000, "will be considerably exceeded." If it is exceeded it will be due to the Commissioners' own action, but otherwise I do not fear for the result, especially as Contractor's estimate for construction is £6000 below ours, (questions 1046–9). Now analyse the £24,000 of excess. Roughly some £3000 may be put down to work which it was impossible for any Engineer to calculate, at the Derbyshire Rocks; some £1500 to the unavoidable necessity of throwing the line up the hill at Glenora to avoid a tunnel whenever the extension to Hamilton &c. is carried out, and compelling its being lengthened some 50 chains. Allow for £1700 extra on rolling stock and other legitimate excesses, as cost of survey, supervision, and departmental charges not provided by Parliament, and the excess is reduced to some £12,000.

Now take the Fingal Line. The cost is stated as likely to be well within my first preliminary estimate, but estimated by me to exceed the vote by £23,000. This amount is based upon calculations of your responsible officers; yet the Commissioners give it at £30,000,—and what for? An allowance for uninvestigated statement of Contractors to extent of about £2000; rebuilding portion of culverts that have failed (viz. fronts of a few culverts, which, I again assert, can be put right for about £10)—question 3801—and the famous Vinegar Hill slopes, as to which, in my letter of 6th instant, I showed the absurdity of the estimate for securing same.

The admitted excess of £23,000 over the Parliamentary vote is made up of £3000 for Avoca deviation; all survey charges, preparation of plans for contract, departmental expenses, supervision of Engineers, &c. not provided for; a second junction with Main Line Railway at Corners, and minor matters,—such as signals at intermediate stations, separate telegraph line, &c. not contemplated,—and the excess becomes some £15,000.

Next take the Scottsdale Line; and, in this case, because of the rough country traversed, I cannot too strongly point out the unfairness of comparing an approximate estimate on a rough survey, with very limited time, with the close-detailed estimate upon a working survey over a different route that took nearly twelve months to complete.

The excess here is stated by me at £70,000; of this I have £23,000 yet to the good in the contract of Messrs. Boland & Scott, and £10,800 for a further margin, if the liberal allowance I have made in the estimate for land, stations, &c. is by any chance exceeded; and I am further entitled to a legitimate excess for surveys, departmental charges and supervision, not provided by Parliament (£19,000), as well as to a sum of £3000 on land,—making a total estimate for these two last items of £22,000.

The excess on this line, however, must be considered apart from that on other lines; being due partly to a radical alteration of route, and because it was approved before the liability was incurred, while the construction of the line could not be said to have been more than just started when Parliament was made acquainted with the facts.

To be just, one must compare the £370,000 as thus reduced with the £300,000 approximate as increased, if the Parliamentary line had been accurately located and estimated; while you have saved working the line, and taxing all passengers and goods to and from Scottsdale, for carriage over 12½ miles of unproductive country, for all time. The cost of this capitalised represents a very large sum,—far more than the difference between the two estimates.

ROADS AND BRIDGES.

As I have suggested a more complete severance of my duties from these, as well as buildings, it may be well in leaving them to note some of the remarks of the Commissioners.

They seem to have mixed up the Main Roads, as defined by Parliament and maintained by the Government, with the Local District Roads in rather a confusing manner.

In my annual Reports I have dealt with the same question of surveys and construction and maintenance of all important bridges.

I prefer steel or iron bridges and masonry walls if money is available.

The decks of bridges are not covered to protect them from warping influences, but from the rapid decay that ensues by timbers getting frayed under traffic and becoming spongy on the surface, and thus holding water, which perishes them. Timber is cheap here, and our generally massive work does not suffer with the weight.

The Commissioners are in error in their remarks about alternative plans (page 14), except, perhaps, in some trifling details. Otherwise it can be shown that *alternative prices* have to be given with alternative plans, and the evils they point out do not occur. This plan is occasionally adopted for various reasons, as when the Education Department requires a tender for both a timber or stone-built school or residence.

The Commissioners have touched upon one weak minor point in referring to the want of some arrangement for prompt payment of day laborers and petty contractors without the circumlocution that now exists. Our inspectors are hampered in doing their best for the Government in certain circumstances from this cause, and they have frequently brought it under notice.

PUBLIC BUILDINGS.

The only matter I need comment upon is the mode of construction of foundation of the new Custom House at Launceston. I must take the responsibility, as the plan was adopted by my direction, and is not only substantial and permanent, but considerably more economical than that suggested by the Commissioners. The Architect has got out comparative estimates of cost, and these are altogether in favour of the piling. The plan proposed means timbering a number of shafts sunk through the spongy ground, and keeping pumps at work in every case while the work is being done.

CONCLUSIONS OF COMMISSIONERS.

"1. That no proper system has been observed by the Engineer-in-Chief for providing uniformity of design and procedure in carrying on the works of his Department, each railway showing widely different types of work, both as to style, form, and general details, thereby materially increasing their cost, and rendering a larger staff of officers necessary than otherwise would be required."

This will not bear any close examination. Take the contract drawings for the Derwent Valley, Fingal, and Scottsdale lines, and you will find—

Fencing of different kinds,
Earthworks,
Level crossings,
Permanent way,
Masonry culverts,
Large culverts, with pier and timber decks,
Hardwood pile culverts,
Hardwood flood openings,
Sleeper culverts,
Hardwood bridges, 20-ft. spans,
Ditto, 30-ft. spans,
Masonry and concrete bridge piers,
Wrought-iron girders,
} Identical.

The only difference being in the concrete culverts and log culverts on Scottsdale line, which were necessitated by local circumstances.

The stations for different classes are identical, and the general plans and sections of the buildings are prepared in the same form.

The Mersey line, however, is a separate type, as a continuation of the Launceston and Deloraine line. Minor variations of these types are a necessity, here as elsewhere, to suit the different districts and local details.

The returns, measurements, and certificates are all made on identical forms,—the specifications and contracts are similar; and the statement of the Commissioners that cost has been materially increased, or that a larger staff of officers has been rendered necessary from want of uniformity, is grossly and gratuitously inaccurate.

> "2. That the Engineer-in-Chief has permitted the Resident Engineers to add to and alter drawings of important works without his being consulted, or, if consulted, not duly considering the effect such alterations would have on the Parliamentary estimates; and that it has been his practice to allow such alterations to be entered upon without his written consent being first obtained, as provided for in the respective contracts."

This is so much verbiage. No alteration of more than minor details (which are generally made by all Resident Engineers) has in any case been made without my sanction, if I have been aware of it, and the effect of these upon the Parliamentary estimates is inappreciable.

> "3. That the Engineer-in-Chief has verbally recommended important deviations on lines authorised by Parliament to the responsible Minister without obtaining the written approval of the Minister; and that such deviations have sometimes been made, although the Engineer-in-Chief has apparently been aware that they involved extra cost, and were not always desirable."

Certain deviations have been made after verbal consultation with yourself alone, or with yourself and other members of the Government. The criticism applies chiefly to the Scottsdale Line and the adoption of the direct route. The extra present cost is a decided eventual gain to the Colony, and I maintain now, as always, that it was a most desirable alteration.

With reference to Avoca deviation, I was led to recommend this in consequence of the Engineer's estimates showing that no extra cost would be involved.

At the same time, in future I think the recommendation of the Commissioners (No. 3) should be adopted.

> "4. That a large proportion of the increased expenditure on works, and the defective supervision of others, is mainly traceable to the want of an organised staff of responsible and qualified officers."

Some—not a large—proportion of the expenditure in the past is due to the cause stated; but, as regards the field staff, this is now overcome by the employment of Engineers and Inspectors who are thoroughly well qualified.

I commenced the Mersey Line with the assistance of the then District Inspector of Roads for the Northern Division (Mr. Cresswell, who was a Railway Engineer by profession), and, with his assistance and that of the Chief Draftsman and two or three juniors, prepared all the contract drawings, quantities, and specification, with the lithography and printing of same, without any outside help beyond that of one engineer on the contract survey. Mr. Cresswell had also to prepare all working drawings as the works progressed, in addition to his other duties, as I could not get them done in Hobart.

When the Derwent Valley, Fingal, and Scottsdale Lines were sanctioned, I made it my business to select Engineers for the survey who were also recommended as Construction Engineers; and thus, as surveys were finished, Messrs. M'Cormick, Sheard, Hales, Atkinson, Hargrave, Home, Climie, and Mault were available; all but Messrs. Atkinson, Climie, and Mault being now employed, in addition to Mr. Cresswell. In addition to above, there are five Construction Engineers now employed on surveys of new lines,—viz., Mr. Griffith, Inspecting Engineer of Surveys, and Mr. Bain, (both with certificates from the Engineer-in-Chief of South Australia); Mr. Cutten; Mr. Stewart, formerly of the London and North-Western Railway of England; and Mr. W. Reid Bell, in charge of Harbour Works.

I have also, as the works went on, been able to secure the services of well qualified Assistant Engineers, with a staff of Inspectors and Clerks of Works, who, in the majority of cases, had been tried, or whose qualifications had been known to myself personally.

By your directions a Railway branch of the Accountant's Department was started, and, with your permission, correspondence clerks and junior draftsmen were added, as well as the appointment of one of the correspondence clerks to act for me principally as Secretary in connection with railway matters. In fact, I have always received the support of yourself in all recommendations that I felt it necessary to make, whether verbal or otherwise, for the greater efficiency of the Railway Branch. What I am very deficient in is a qualified and experienced staff of draftsmen; and in connection with the Derwent Valley, Fingal, and Scottsdale Lines, this deficiency had to be met by the employment of Messrs. G. H. Edwards & Co.

"5. That the system which has hitherto obtained of letting works on partial or incomplete data is highly objectionable and misleading, and has led to greatly increased cost of some of the works."

I concur; but was not aware of it until tenders had been called. In the absence of assistance in the office, I requested the Engineers who were to have charge of the Derwent Valley and Fingal Lines to go through the quantities, for their protection as well as my own. Mr. Mault reported deficiencies; Mr. Climie reported them, as a whole, sufficient.

To shortly summarise the whole Report, I find that, generally, the works on the Fingal Railway "have been faithfully executed[a]," "reflect credit" on Contractors and Department[b]; bridges and culverts seemingly "unexceptionable[c];" that the work, so far as done on the Scottsdale Line, is very "substantial-looking[d]," and staff "well qualified[e]"; that the Mersey Line is, generally, "carefully and judiciously constructed[f]," Meander bridge is "sound and good[g]," girders of this and other bridges are very strong[h]," and of "superior quality[i]" of workmanship; minor works are built in a "careful manner[k]," all the works carried out in a "fairly efficient manner[l];" and the Commissioners might safely have included in this praise all the work accepted by Mr. Sheard on the Derwent Valley Railway.

As a set-off to the above, there are a number of complaints upon details of construction mixed up with many errors, but with no suggestion of blame to any contractor.

I will particularise some of these errors:—

1. Derwent Valley Railway.—The assumption that the new Bridgewater bridge *per se* should be included in cost as against Vote for Derwent Valley Railway.
2. The blunder in obtaining flood-levels at New Norfolk.
3. Statement as to unusual character of new Back River wall, and excessive cost of same.
4. Statement that the massive abutments at No. 1 bridge were a waste of material.
5. Assumption that fastenings of deck to iron girders were not provided in working drawings.
6. Statement as to height of pier carrying joint traffic, and assumption that bridge was insecure, in absence of any examination of drawings.
7. Statement as to any descending grades existing at No. 1 bridge.
8. Omission of any reference to same condition of things at No. 3 bridge.
9. Fingal Line.—Statement that the cost of repairs to a few culvert fronts, and making line secure at Vinegar Hill if required, will affect the estimates to the large extent suggested.
10. Statement that written instructions were not sent to Resident Engineer, (Mr. Climie).
11. Scottsdale Line.—Statement implying that the most strenuous efforts and ample time were not taken to secure more easy curves and gradients: and this is made when Commissioners were admittedly unable to judge, and after going over only one half the line.
12. That exhaustive search was not made for ballast and building material, and ample foresight displayed.
13. Statement that no uniform types of work were adopted.
14. The Main and Local Road systems were all mixed up in the Report.
15. The assumed waste in the foundation of Custom House, Launceston.

Finally, it seems to me that, as a whole, wherever the Commissioners inspected completed work they found it satisfactory and praised it; that wherever they dealt with estimates of cost they inclined to accept, in many instances, those of irresponsible men, to the rejection of those of your Officers; that wherever they dealt with the evidence generally it was without a calm judicial weighing of what was stated on both sides; while in the important question of the stability of the bridge piers they stood behind the Contractor, and gave no reasons of their own.

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[a] [b] *See* par. 1, page 7.
[c] Ditto 2, „ 7.
[d] Ditto 4, „ 9.
[e] Ditto 10, „ 9.
[f] Ditto 9, „ 10.
[g] *See* par. 10, page 10.
[h] Ditto 11, „ 10.
[h] Ditto 3, „ 11.
[i] Ditto 11, „ 10.
[k] Ditto 4, „ 11.
[l] Ditto 6, „ 11.

The one really important matter to be faced is the cost of the completed railways as against the amounts voted or yet to be voted for them.

The probable final cost of the Mersey, Fingal, and Derwent Valley Lines will be as follows:—

		£
Mersey Line	37¼ miles	190,000
Fingal Line	46¾ miles	173,000
Derwent Valley Line	24¼ miles....	164,000

108¼ miles, for a total cost of £527,000, equal to an average cost per mile of £4868 for all contingencies.

The original votes were as follows:—

	£	
Mersey Line.....	120,000	
Fingal Line	150,000	
Derwent Valley Line	140,000	
		£410,000

The excess is £117,000, out of which £65,000 has been provided by subsequent votes.

The explanations of excess can be summarised shortly, as follows; viz. —

	£	
MERSEY LINE.		
Items admitted as legitimate by Commission, viz.:—		
Latrobe Deviation, £13,000; Rolling stock, £11,511; Land (including accommodation works), £7464= £31,975, say	32,000	
Substitution of concrete and iron for timber in Meander and Kimberley Bridges	4000	
Additional Stations and Yard	5200	
Additions to old tramway, originally intended to be deferred	5800	
Difference due to rise in labour and material, provision for maintenance, for signals, furniture, telegraphs, increase in work that could not be foreseen, greater accuracy in quantities based on working survey....	23,000	
		70,000
FINGAL LINE.		
Surveys, supervision, and Departmental expenses not provided for	5200	
Avoca Deviation	3000	
Difference due to greater accuracy in quantities of working survey, signals, extra telegraph, furniture, a second junction at Corners Station, duplicates for rolling stock (£1000), &c.....	14,800	
		23,000
DERWENT VALLEY LINE.		
Surveys, supervision and departmental expenses not provided for	6900	
Rolling stock	1700	
Additional works for safety of Line at the "Rocks," New Norfolk	3000	
Lengthening Line.....	1500	
Difference due to greater accuracy in quantities of working survey, duplicates for rolling stock (£1000), signals, extra telegraph, furniture, and local manufacture of iron bridges	10,900	
		24,000
		£117,000

Some allowance should fairly be made when, as in above cases, both surveys and estimates were approximate, owing both to absolute want of the necessary time and the absence of any staff for the railway work, as well as for variation in tenders, amounting to between 50 and 60 per cent.

The preparation of working surveys and plans and quantities, in close detail, for all these lines, if made a condition precedent to their construction being sanctioned, would have thrown the works back for some two years at the least, and I do not think the Colony was prepared for that.

If the amounts voted will be exceeded there is value for it in works that will compare favourably with those of the same class elsewhere, both as regards cost and permanency.

I have the honor to be,
Sir,
Your obedient Servant,
J. FINCHAM, *M Inst. C.E.*,
Engineer-in-Chief.

The Hon. the Minister of Lands and Works.

APPENDIX A.

Public Works Office, Hobart, 23rd June, 1885.

DERWENT VALLEY RAILWAY.

SIR,

As you are aware, I examined the works on your contract on the 19th and 20th instant. You are also aware that the newly appointed Resident Engineer has made complaint of certain deficiencies therein, and I regret to find from my examination that he had real grounds for such complaint.

I will take the items *seriatim*.

Grubbing and Clearing.

Several roots and stumps are still left standing on the formation which has been prepared to receive the ballast.

Fencing.

A very large portion of this is far from being in accordance with specification, and must be renewed before being accepted.

Earthworks.

The formation has been left in a needlessly wet and sloppy state, and in this respect the terms of specification have not been carried out.

Pipe Culverts.

I fear that many of these have been put in regardless of specification. I found several—viz., at 7m. 39chns., 7m. 46chns., and 7m. 57chns.,—that were not properly bedded, and which were almost thrown together without any attempt at luted joints, or punning or ramming to same. These were pointed out to your officers, Mr. Parker and Mr. Joseph Falkingham, at the time. As far as I could examine the others already covered up, I have reason to fear that they are in the same condition, but in order to determine this, desire that all of them about which the Resident Engineer has any suspicion shall be opened out at our cost if found properly laid, and if otherwise, the same to be properly renewed by you. In one or two cases, as at 6m. 69chns., they are broken, and on sideling ground the provision for setting ends in cement concrete must be observed.

Timber Culverts.

I regret that many of these have not been coated with Stockholm tar as required by specification.

Masonry Culverts.

At 3m. 35chns.—Pointing must be re-done.

At 4m. 26chns.—Walls have cracked, and the mortar is worthless. These must be taken down and rebuilt.

At 4m. 63chns.—Pointing bad, arch stone crushed, mortar indifferent. This is to be further tested, and it may have to be pulled down.

Arched culvert at 7m. 20chns.—The arch is almost dry, coigns are undermined, and mortar is really only so much sand. The back work is not satisfactory, and the whole work must be taken down and rebuilt.

Culvert at 8m. 26chns.—The mortar is only so much sand as regards its setting powers, and the work is indifferent. This, too, must be rebuilt with proper mortar.

Culvert at 8m. 66 chains.—The cement concrete is bad, and must be replaced. The cause is not far to seek, viz., in the dirty stones used.

Pitching Slopes.

None of this work is in accordance with the specification, and I cannot accept it as such.

Permanent Way.

The one distinct condition upon which I allowed you the concession of laying the road upon formation was that the formation should be hard, dry, and smooth, by rolling or otherwise, to the satisfaction of the Resident Engineer, and that no traffic over the unballasted road would be allowed when rains made the foundation soft. This condition must be rigorously observed.

The proper allowance for expansion has not been made at some of the joints, and this must be altered.

The lead in the joints on curves in many cases amounts to more than half the distance between the bolt-holes. The inner rails must therefore be cut, as provided in specification.

Ballast.

A large proportion of that laid upon the road I cannot possibly accept, and must ask you to remove it forthwith; some of it is only clay-slate, and is decomposing under the action of the atmosphere. This will most certainly become mud with the traffic of heavy ballast trains over it, and will not stand the "beaters" without going to powder. The sand ballast put on is, to a large extent, a dirty loam, and, as I pointed out to your officers, holds the water, and is so spongy that it will not carry the weight of a man.

I observed gravel thrown out from the cuttings to be used as ballast. I will accept some of this if it is properly screened from the dirt, and the large stones broken down to the specified size.

I very much regret to have to complain of so many things, and hope that you will see your way to remedy what is deficient as soon as possible, so that the works may go on satisfactorily to all parties. I do not ask you to give me more than you agreed to do under your contract specification, but I can take no less.

I am sending a copy of this to the Resident Engineer for his guidance.

I am, Sir,
Yours faithfully,
JAMES FINCHAM, *Engineer-in-Chief.*

J. FALKINGHAM, *Esq., Railway Contractor, New Norfolk.*

DERWENT VALLEY RAILWAY.

COMPLAINTS BY ENGINEERS AS AGAINST CONTRACTOR.

Fencing.

For several months it was utterly impossible to get the several kinds of fencing erected to anything like the specification. About a mile was accepted as an inferior fence at reduced rate in order to meet contractor. Palings (for two measurements) were put on in defiance after fence was condemned. Even now, although a substantial fence is otherwise erected, the contractor has been allowed latitude both in the sizes of the fencing and material used in order to afford him all possible assistance.

Earthworks.

That, contrary to specification and without orders the contractor, to save his own pocket, has gone dangerously near to the toe of the slope with side-cuttings: this is especially the case in the sandy ground at the Plenty, where really serious danger is incurred by being below the high flood-level, and this the contractor has persistently refused to remedy without payment,—the side-ditches not being properly graded, although repeatedly ordered in writing, and, the table drains being left blocked contrary to specification, the water during recent storms broke over and caused damage to formation.

Inlets and outlets were left unfinshed, and for months were ordered to be pitched, but the contractor refused to do any pitching to these inlets under the specification, and this neglect caused much of the recent damage to line.

Coffer-dams.

That no attempt has been made to follow provisions of specification in this respect.—See Clause 17, page 30.

The dams at the most important bridge over the Derwent (No. 1), and the coffer-dams, with the exception of No. 6 pier, have, in all cases, been simply two rows of bags filled with sand, about 2 feet apart, and packed in between with sand. As, in places, from 5 to 6 feet of water had to be contended with, the sand and dirt was washed into the foundations, and in one case, viz., at No. 7 pier, sand was washed in to a depth varying from 5 to 15 inches over an area of not less than 20 square feet. That, after making arrangements with the Resident Engineer to take out this muck, the contractor employed men contrary to this arrangement on a Sunday morning, when neither the Resident Engineer nor Government Inspector was present, to cover up this foundation with cement concrete base of pier, thus leaving a hollow under the pier exposed to the rush and scour of the rapids at this the most dangerous pier of the whole bridge. This action is the more grave as it occurred after the contractor had officially protested against any responsibility for the stability of the work.

Masonry.

That, contrary to the strict provisions of contract, work has been sublet, and so continued, after request from Resident Engineer and Engineer-in-Chief for its discontinuance. That the original Back River wall was largely composed of rotten clay-slate, and perishable sandstone, partially built on logs in the most dangerous place, the foundations being trenches of about nine inches in alluvial deposit; that in numerous cases where really good stone has been obtainable and ordered by Resident Engineer, an inferior and

condemned stone, sometimes from the same quarry, has been used in a determinedly obstructive manner, or because the labour of working was slightly less—this being especially the case at the Plenty Bridge for the important bed-stones, and for the piers in the Derwent No. 1 Bridge; in the former case one stone being put on, although Mr. Climie at the finish condemned it himself.

The masonry culverts between North Bridgewater and New Norfolk were inferior to specification. The mortar was little better than sand, and in places absent altogether; the back work, instead of being fairly equal to face work, as provided, was in places made up of round boulders and gravel.

Rough Pitching.

This has been objected to almost throughout, and is not what was contracted for. Contractor does not deny this, but says it is good enough, and would not alter it to meet the case. He was induced to accept a reduced price for inferior work.

Concrete and Foundations.

There has been a marked want of ordinarily efficient appliances all through the works, by which the work paid for by the Department is jeopardised. For example, the foundation at the Plenty Bridge was about 17 feet deep in sandy loam, and several feet below the bed of the river. The planking and shoring was refused at the first request. Afterwards some ten or twelve old fence rails were used, with the result that the Government Inspector was instructed by the Resident Engineer not to risk possible injury to himself. The sides fell in, and mixed with the green concrete.

No. 1 *Bridge, No.* 7 *Pier*—already referred to under Coffer-dams.

Back River New Wall.—The same want of shoring occurred here within the past fortnight. A mass of rubbish fell in, covering an area of about 50 square feet of foundation 3 feet deep, and during the absence of Inspector this was being covered up with concrete to form part of the foundation.

Pipe Culverts.

These are generally objected to between Bridgewater and New Norfolk. They were laid in the most careless manner, without proper bed, and with open joints, and where the luting has been carried out it has been done with soil instead of well-tempered clay. In places, to save trouble, instead of grading and sinking the pipes properly, they built a loose bank and laid the pipes upon the same. Numbers have been broken already through the improper bedding, and damage to the railway banks caused thereby during recent sudden flood. Several requests were made that the pipes should be opened out and relaid at cost of Department if the Contractor's work was right, but these requests have been to this date evaded.

Ballast.

A large quantity of decaying clay-slate was laid on formation for bottom ballast. The Contractor positively refused to remove it on order of Resident Engineer, and it was only on final appeal to the Engineer-in-Chief, who made special inspection of the same, that Contractor removed it. This ballast can be seen along the line near Bridgewater.

Permanent Way.

Provisions of specification as to lead were ignored altogether, and the same may be said with regard to the use of hammer for bending rails. Remonstrances of Inspectors and Resident Engineer were defied. This occurred for about the first mile, when the Contractor got a rail-press for the rest of the work.

Maintenance.

No proper attempt has been made to keep the road and works in repair during the progress of construction, as required by the specification and repeated instructions. Rails, in consequence, are getting a permanent set.

Stability of Bridges.

That the protest with regard to this was only sent at the conclusion of discussions and correspondence wherein the contractor claimed extra prices and allowances, which, in the judgment of the Resident Engineer and Engineer-in-Chief, could not be allowed by the provisions of the specification and schedule of rates attached to the contract.—(*Vide* Correspondence.)

The designs are substantially those signed by the contractor upon entering into the contract. They called forth no remarks from him at the time, or from any of the many experienced men who examined them; and until the contractor endeavoured to get these extra prices and allowances he stated that he saw no objection other than on the ground of cost to himself.—(*Vide* Correspondence.)

Systematic defiance.

The engineers have been anxious to meet the contractor in every way consistent with their duty, and have actually done so in many ways; but they (the contractors) seem to resent being compelled to fulfil their obligations faithfully and honestly (sometimes at the cost of doing work two or three times over), and this resentment for a long time past has developed into constant and harassing neglect or open defiance of written and verbal orders both of Engineers and Inspectors.

J. FINCHAM, *Engineer-in-Chief.*
CHAS. K. SHEARD, *Resident Engineer, D.V.R.*

(Forwarded through the Engineer-in-Chief.)

Derwent Valley Railway, New Norfolk, May 12th, 1886.

SIR,

HEREWITH I beg leave to submit my remarks and comments, with complete references to authorities and precedents where required, on the report and recommendations of the Royal Commission on Railways and Public Works, especially on the Derwent Valley Railway and the Launceston and Scottsdale Railway; and at the same time to respectfully ask you, in the interests of the engineering portion of the department (and this is large), to make the same public, and record same along with the Engineer-in-Chief's reply, to place before Parliament.

I apologise for replying at such length, but the voluminous report prevents me from answering more shortly; and I will answer in the order in which it appears in the report.

DERWENT VALLEY RAILWAY.

The survey I had nothing to do with, and was only appointed resident engineer in June, 1885, after the construction had been going on for nearly six months. Having no knowledge of either survey or state of affairs, it was a very unpleasant and onerous duty to undertake; and my report of the 18th June, 1885, or a fortnight after my taking charge for the Government, will, having been handed to the Commission (and I expect printed in the evidence) show you what my opinion was at that time, and which has been further augmented by the occurrences of later date, full reports of which are before you.

Having explained this, I beg to refer you to the report.

Back River Wall.—The Commissioners state that "The new wall is now being built 4ft. thick, with a vertical face; it is stiffened by massive counterforts, and is backed up by lime concrete 5ft. 8in. in thickness. Comment on such an unusual and extravagant form of construction is unnecessary." Again, further, they state, "In the design of the present wall a want of constructive skill is apparent, an unnecessary mass of material (page 74, par. 10, given as authority) being used in what can only be regarded as a rough and unscientific design."

I reply to this uncalled for attack, by reference to any authority from the known engineering and recognised authorities on this branch of engineering,—viz., river retaining and frontage walls under heavy floods; and (remembering the state of affairs in June, 1885,) I can only say that it must be from ignorance on the part of the witness given as authority, and owing to the members of the Commission being led away by this evidence, they did not examine, look into, or acquaint themselves with the large number of similar designs under the same circumstances. I beg leave to quote the retaining and reclamation wall of the Callao Harbour works, designed by the well-known Edwin Clark and James Hodges, the consulting engineers for Brassey and Co., and the Societé Generale de Paris, the concessionaires for the work. Also the new Thames retaining wall for the extension of the dock works and river frontage now being constructed for the London, St. Katherine, and Royal Albert Dock Co., and designed by Robert Carr, Esq., M. Inst. C.E.; also to the retaining walls of the St. Gothard Railway, and to the River Mersey walls at Seacombe, and other places.

I am also quite certain that if the Commissioners had looked into the minutes of the proceedings of the Institution of Civil Engineers, London, or the same of the American Society of Civil Engineers, America, this condemnatory criticism would not have appeared in their report, to be circulated all over the engineering world, criticising a design adopted by all the leading engineers in similar circumstances. Precedents, and the authority of experts, consulting and leading engineers are disregarded entirely.

I may state that you have the cross sections and drawings before you of the walls and works I think necessary to refer to for the present, already constructed and being constructed at the present date, the cost amounting to hundreds of thousands of pounds, all similar designs and with vertical faces, but a little more extravagant in their thickness than even the alleged "extravagant," "rough," "unscientific," &c. wall at Back River. It seems strange that these works and the Thames wall are not denounced by the engineering world, but instead are spoken of with great praise; the reports on these works show this, and it is very much to be regretted that the Commissioners allowed any interested evidence to lead them into this error and neglect ordinary precautions in obtaining the above facts.

Nos. 1, 2, *and* 3 *Bridges.*—The Commissioners state "The abutments are built of solid masonry, in our opinion a waste of material." This surprises me, as no sketches or figures are produced to specify the waste implied, and I may inform you that this comment is incorrect, as the reports, estimates, and quantities have proved. Wing walls would have cost more than this class of work (more especially under the state of affairs in June), being 40ft. in height, and not have the same stability.

Position of Girders on Piers.—I regret very much to see this mistake, for hundreds of bridges are constructed, and others being constructed, with the centres of the webs the same horizontal distance as the vertical height; and as the Engineer-in-Chief has drawn attention to the fact, I need not go any further, excepting to state (on account of so many reports being afloat), that such a mode of construction is unknown only because raised platforms have not been seen by certain engineers. I am obliged to draw your attention to the fact that in America, where practicable, all bridges up to 80 (eighty) feet span are constructed, for stability, economy, and safety, with raised platforms. At the present time these bridges are being constructed and known as "boiler-plate girder bridges," unless a double road is required, and even then wherever it is practicable.

Timber Deck Fastenings.—Again, it is stated, "and the neglect to provide any means of fastening the timber floor to the upper bed plates (*sic*) constitutes grave defects in the design." This is rather ambiguous. My experience does not allow construction with "upper bed plates," and I fail to see where they are shown on the drawings. I expect it is implied, or meant to be, "upper flanges." Then, in that case, I must refer you to the working drawings (which must have been before the Commissioners, as they had the whole of the drawings and papers sent them), where the fastenings are shown, and, I must say, thoroughly and efficiently.

It is with deep regret that the action taken by the Commissioners has obliged me to make the following protests, but they are entirely the outcome of their own report, and the improper method of arriving at the result :—

1st. That the Royal Commissioners appointed by the Government have not furnished a single reason for or calculation based upon any acknowledged authority, have not verified, or gone into, or raised any objection, or found fault with, or proved the calculations furnished to be inaccurate, and this, I must say, I am more than astonished at. It is very easy to prove the correctness or incorrectness of the same, either graphically, statically, or to take the well-known American rules, or those adopted by the committee appointed for the Tay Bridge, or those of the committee of experts appointed for the enquiry into the construction of the huge undertaking for the bridge over the Forth, in the interests of the interested railway companies and the Board of Trade, since the failure of the Tay Bridge ; and I contend that in a case where the calculations for wind pressure are based on the assumption (and it is evident this has been the case) that wind can act with the same force in opposite directions, and with the same force on protected and unprotected surface areas, a commission composed of Engineers should have proved mathematically, and not reported haphazard or by rule of thumb, and contrary to all recognised practice.

2ndly. Refusing, as the Commissioners did, to accept American practice in evidence, and Question 1456 instructs me to keep to British practice—(what for I cannot surmise)—as six years of my practice, mostly under R. M. Brereton, Esq., M. Inst., C.E., was in America, where I must say railway and bridge construction is far in advance of any other country, and where more miles of railway and more bridges are constructed in any year than the remainder of the world ; and I must also say that it proves the Commissioners set authorities like Vose, Dubois, W. W. Evans, C. Shaler Smith, George Morrison, Wilson Bros., Benjamin La Trobe, and other well-known experts and authorities at nought. No notice to be taken of the American construction is more than I can comprehend, and is neither fair nor is it equitable to the Engineering department.

It seems that the engineers of South Australia and New South Wales do not share in this judgment, for the report of the Engineer-in-Chief of South Australia proves that they are adopting American practice, and in New South Wales an American Bridge Company has the contract for the Hawkesbury Bridge ; viz.—"The Union Bridge Company."

For further proof of American practice being accepted, far more influential and far wider known engineers, who are really experts, have been only too willing to follow (not accept in evidence) this practice,—viz., Sir John Fowler and B. Baker, Esq., joint engineers and designers of the Forth Bridge now being constructed by Tancred, Arrol and Co. Not only the above named, and other leading engineers, but the Board of Trade (more rigidly strict than ever since the failure of the Tay Bridge), through Captain Tyler and Major-General Hutchinson, approve of the American rules and designs. It is from American practice engineers obtain the latest improvements in bridge and railway construction. (*Vide* B. Baker's Address as President of the Mechanical Science Section of the British Association at Aberdeen.)

3rdly. That the Commissioners are not experts or specialists in bridge engineering, but engineers of general practice, and that they have not taken the evidence of a single expert or disinterested specialist ; the evidence is taken from engineers of general practice. This is corroborated in the evidence. Therefore I maintain and uphold that, there being confliction of opinion, and the only evidence disagreeing with the stability being that of the contractor and the contractor's engineer, who states in his evidence that he has never seen, read, or heard of this mode of construction (and therefore cannot be accepted as an authority), there was more than urgent necessity for referring to a well-known and disinterested specialist.

For these reasons I hope that the members of the Government will at least submit the reports, evidence, and all drawings to a well-known expert, who will, mathematically, scientifically, and thoroughly (not superficially) investigate the stability of the designs.

Contractor's Dispute.—The Commissioners state :—"We have not entered into the dispute between the Department and the Contractor, nor accepted his representations, unless they are confirmed by the evidence of the Government employés."

This I cannot agree with, because none but the Contractor's Engineer's evidence (p. 74, par. 10) is taken, and quoted for the attack on the design of the Back River wall ; their calculations accepted without any mathematical check provided by the Commissioners, so that this statement cannot be accepted. Again, I must say that I am decidedly of the opinion that the Department has been treated very unjustly, for it is not fair or just to the Department that the Contractor's objections and quarrels, with subjects of disputes, should appear in print in his evidence (and such is the case) ; at the same time no questions asked or evidence obtained from the Government officers to rebut the said evidence, and there is necessity for a great deal to be denied ; nor has any notice been taken of the statement sent to the Commissioners, signed by the Engineer-in-Chief or myself ; nor has the promise of the Commissioners to the Engineer-in-Chief, that "any interested party should have the opportunity of rebutting any damaging evidence," been kept.

I also wrote to the Commissioners on the 5th March ult., after my evidence had been taken, to ask if any inquiry was to be made into the bad work at No. 7 pier, No. 1 bridge, Back River, and other places, and I received the following reply :—

Royal Commission on Railways and Public Works,
Committee Room, Hobart, 6th March, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of your letter of yesterday's date, asking whether enquiry will be made into certain work in connection with the foundations of bridges, &c. In reply, I have to inform you that the Commissioners have no authority to interfere in matters governed by the terms of the contract between the Government and the Contractor. Their enquiry will be confined to ascertaining the mode of construction and the stability of the works.

I have the honor to be,
Sir,
Your obedient Servant,

Mr. CHARLES K. SHEARD, *C.E.*,
New Norfolk.

THOS. C. JUST, *Secretary.*

P.S.—Should you desire to submit any statement affecting yourself personally, the Commissioners will be happy to receive it.

And if the bad work in the foundations at these named places, constructed by the Contractor, and about which so much unpleasantness has occurred, is not the "mode of construction and the stability of the works," as provided for in the powers of the Commissioners, then "mode of construction" is a term not known on English and American works.

Information obtainable from the Department.—The Commissioners state "the foregoing is all the information we have been able to elicit from the Department."

I beg to enter the most emphatic protest against this extraordinary and incorrect statement, and to place before you the facts and quantity of work prepared for the Commissioners.

I received instructions from the Commissioners to provide certain information and reports, and herewith forward you the original memorandum taken in the Committee-room, and from which you will see that some of the instructions (of information required) are in the handwriting of one of the members of the Commission.

I worked for 18 days, Sundays included, averaging 17½ hours per day, making calculations, taking out quantities, costs, &c., in which I was assisted by my assistant and office staff, and in justice to the willingness and untiring energy of Mr. H. W. Calder, Mr. L. S. Forrest, and Mr. F. S. Knight, I cannot speak too highly or thank them sufficiently for their interest and valuable assistance.

The whole of the actual quantities for each culvert—whether masonry, timber, or pipes,—the bridges, cuttings, side-cuttings, and all other items contained and not contained in the schedule, were calculated.

The whole of the actual quantities had to be taken out to show the actual cost of each alteration, and this entailed double work in having to take out the quantities under each item as constructed, also the same, if the contract drawings had been carried out, and the total work taking out these quantities was actually equivalent to taking out contract quantities from plans and sections, and obtaining the necessary information of 36 miles of permanent line, and included 4 bridges. Also report and particulars of altered waterways; also tabulated statement showing each item of schedule under the following heads :—Item in schedule; original schedule, as executed to date; quantity to complete; total on completion; increase; decrease;—this entailing double work in taking out quantity executed, also quantity to complete.

The estimate of cost was not much extra work, except writing, as the quantities were taken out for the other reports.

The other items were not of much account, but took time to compile, and during this time the duties of the office I hold had to be attended to, entailing more work. Therefore, in face of all the information I furnished the Commissioners with (which was all they asked for), and having worked so hard and continuously that no time might be lost in having the progress report asked for by the Government, sent in—again, losing my health from such close application—it is no wonder that I feel more than aggrieved at such an unwarranted attack, for what reason I really cannot fathom, although I have tried my best to make excuses for it.

LAUNCESTON AND SCOTTSDALE LINE.

Survey.—The Commissioners state :—"This line runs through a rough and difficult country, and demanded both judgment and skill in its location. The officers employed seem to have performed their work well; but it is much to be regretted that in the survey of an important and difficult line like this that more time should not have been taken, and strenuous efforts made to secure more easy curves and gradients than now exist."

Having been Engineer in charge of the locations of Nos. 1 and 3 sections, I wish to protest, as strongly as it is possible for any Engineer to do, against the statement "but it is much to be regretted, &c." It is very evident that the members have not had the same experience or gained the same knowledge of the work and the engineering difficulty in surveying through such a broken and heavily-timbered country like

that the Scottsdale line traverses as our esteemed Superintending Engineer, J. M. M'Cormick, Esq. To have done this, the five survey parties would not have concluded their arduous duties even at the present date.

I know that more than 140 (one hundred and forty) miles of trial traverse work was completed, and not less than 300 (three hundred) miles of cross sections were run to give command of from 100 to 200 feet difference of levels for grade contours, on purpose to locate 47 miles of permanent line. I am convinced, from my knowledge of my own sections and the remainder of the broken country on the other sections, that the easier grades and curves would have simply been impracticable, as the increase in the cost would have been enormous. Several tunnels would have certainly been necessary; and I am surprised that the engineering principles of narrow gauge railways have been entirely overlooked by the Commissioners.

Under this item I beg to refer you to the Lima, Callao, and Oroya Railway in Peru, constructed across the Andes, rising to 15,560 (fifteen thousand five hundred and sixty) feet above sea level, at the summit grade near the Oima Tunnel at Mount Meiggs, where 31 (thirty-one) continuous miles of this line (which is 4ft. 8½in. gauge) is constructed, with the following gradients and curves:—

Straight line	1 in 25 or 4 per cent.
Curve about 1300ft. rad.	1 in 25 or 4 per cent.
Curves from 1300ft. rad. to	1 in 25 or 4 per cent.*
	to
350ft. rad.....	1 in 33⅓ or per cent.*
Curves limit 350ft. rad.....	1 in 33⅓ or 3 per cent.

* *Pro rata.*

This statement is actual practice; but W. W. Evans, who built the Verrugas Viaduct, in his report to H. C. Mais, Esq., M. Inst. C.E., on the Adelaide and Nairne Viaducts, will corroborate my statement.

I could quote hundreds of examples from narrow gauge practice as precedents, but the Tasmanian Main Line Railway is quite sufficient guide for the necessity for sharp curves and steep gradients; and if this can be worked satisfactorily, where there is a longer length of steep gradient than any on the L. and S. Railway, I can only arrive, after considering the matter carefully, at the conclusion that the Commissioners have entirely overlooked the very essence, principle, and engineering practice of narrow gauge railways, viz., sharp curves with steep gradients. The reports on the narrow gauge railways, and on the sharp curves and gradients on the Northern Pacific, California, and the Colorado and other lines, from 3ft. to 3ft. 6in. gauge, by eminent engineers (which can be easily obtained from the Amer. Soc. C.E.), will prove the truth of my statements, where they have as sharp curves as four chains radius constructed.

The plains of Victoria, Queensland, and India are not the same as the broken mountainous spurs of Tasmania, covered with dense forest, nearly, I may say, on this line, primeval; and I must record that it is against engineering principles to lay out narrow gauge railways on broad gauge principles, same as is feasible in most parts of Victoria, India, and, I dare say, in Queensland, but not in this country.

I am as much opposed to sharp curves and steep gradients as any engineer I have met, and in common with the other engineers on this line, under the supervision of the afore-mentioned Superintending engineer, viz., W. P. Hales, Esq., H. W. Hargrave, Esq., and T. M. Atkinson, Esq.,—all Assoc. M. Inst. C.E., London,—and W. F. De Mole, Esq., made every and strenuous effort to locate the line with easier curves and gradients. In one case I spent three weeks running contour lines and cross sections to throw out one of the five-chain curves, but it was impossible to do so, except at an extravagant cost.

Having been told by the Government Engineer personally that the Commissioners were quite satisfied on the works with the way in which the location survey was carried out, I am, therefore, like the Engineer-in-Chief, very anxious to be informed how the Commissioners could decide, only having examined to the tunnel, and then riding along the constructed portion, and walked over a portion of the Denison Gorge, how they could form any opinion on the subject, never having examined the remaining unconstructed portion, and more especially, when they have never seen the trial plans to locate the line from? I have come to the conclusion that this decision is past my comprehension, and, from my experience on this railway survey for twelve months, that this portion of the report is worthless; for how is it possible for any engineer, no matter how skilled he may be, or how competent, to judge in this superficial manner, especially never having seen the longest half of the route, and above all, to decide in Hobart without proper particulars beyond those contained in the contract plans?

Ballast.—The Commissioners state, "There does not appear to have been sufficient foresight displayed in the supply of ballast."

This is another very erroneous criticism on the part of the Commissioners, for the engineers made a very exhaustive examination to my own personal knowledge on each section,—"lack of ballast and building materials" being the daily observation and conversation when the engineers met. Again, Mr. Hargrave was engaged for three weeks examining the country outside the line specially for ballast and building material. During the whole of the location survey the superintending engineer's attention was devoted to looking out for same on the whole line. On my sections I can vouch for him spending weeks examining the country and making exhaustive inquiries, and I expect the remaining engineers will all protest against such uncalled for and undeserved attacks.

RECOMMENDATIONS.

Generally I do not coincide with the recommendations of the Commissioners with regard to the stability of the bridges on the Derwent Valley line. They have not pointed out where any error is, nor have proper engineering reasons been given or authorities or precedents quoted to give force to their conclusions.

Curves and Grades on Bridge Approaches.—That this is a most extravagant and uncalled-for recommendation no engineer who has ever been connected with narrow gauge railways will deny. Hundreds of bridges and bridge approaches are built on sharp curves and on steep gradients, and I quote the following in support of my condemnation :—

The Verrugas Viaduct, the second highest trestle bridge in the world, on the Lima, Callao, and Oroya Railway, Peru, 4ft. 8½in. gauge, where the ends of the bridge and approaches are 350ft. radius, with a gradient of 1 in 33⅓; and for 30 miles of approach, where the grade is not 1 in 33⅓, it is even steeper, viz., 1 in 25 ; the train comes down with either Eade's vacuum or Westinghouse's atmospheric brake.

The Nairne Viaducts.—Gauge 5ft. 3in. The two viaducts and approaches are on 10-chain curves, with a gradient on the same.

The Crooked Trestle, on the Cincinnati, New Orleans, and Texas Pacific Railway, between Somerset and Point Burnside, the curve on south end of bridge being a 3½-degree curve, reverses on the bridge with a 6-degree curve; approach on north end on same curve with gradient of 1 in 50 out of King's Mountain Tunnel.

South Forth Viaduct.—One mile in length, and on the south end has a curve, the tangent, 450ft. on viaduct, and the approach is the same.

Cumberland River Bridge.—On same line at Point Burnside, alignment straight out of tunnel to commencement of viaduct, 120 feet high, the whole viaduct to commencement of river main spans, on 8-degree curve.

New River Viaduct.—South approach 8deg. 30min. curve, north approach gradient 1 in 100.

Apple-tree Branch Bridge.—South approach on curve 6 chains radius, gradient 1 in 50. North approach same, but T.P. just on bridge. This is similar to No. 1 as regards curves, with gradients of 1 in 50 against our level.

New York Elevated Railway.—Here the curves on this bridge railway are very sharp indeed, trains running regularly the whole day through at the rate of 12 miles an hour. In some reports curves of 50 feet radius are mentioned, but there are plenty 100 feet radius.

I might quote numerous other examples on lines 4ft. 8½in. gauge, as I have visited and seen a great number of the bridges built by the Keystone Bridge Co., the Edgemore Bridge Co., Phœnixville Bridge Co., and other large companies, also a large number designed and erected by W. W. Evans, C. Shaler Smith, J. Morrison, W. Montagu, and other first-class engineers who are experts, making bridge engineering a speciality for years to my personal knowledge ; and the opinion of H. C. Mais, Esq., M. Inst. C.E., Engineer-in-Chief, South Australia, is shown in his Report of 1881 to the South Australian Government.

Look at the approach on the north side of the Derwent on the Tasmanian Main Line Railway, where there is the additional danger owing to the swing-bridge.

The Commissioners did not examine the approaches of all the bridges, or nature of the sites, but went straight from the west abutment of No. 1, without examining west approach, along the road to the Plenty, and from the Plenty to No. 2 bridge east side of Derwent, and never visited the site of No. 3 bridge, or I am quite certain they could never have made such an extravagant and unscientific recommendation against all recognised principles and practice (more especially American) of narrow gauge engineering, for this if carried out will entail the expenditure, not of a few pounds, but of not less than £10,000 for earthworks alone, and in my opinion a useless and most extravagant expenditure of public money. You will receive the exact amount, with all drawings, &c., from the Engineer-in-Chief.

(c) Caisson Piers.—This I cannot agree with. The Commissioners themselves, and Mr. Climie (Q. 1912) state that 5ft. cylinders would be stable ; these only contain 19,635 square feet cement concrete, and cast iron would not withstand the shock of floating logs, and as caissons obtain, even if admitted to be in sections—and which I do not, and would never do (see my evidence)—there would be a column of 24 square feet of solid cement concrete under each girder, or more than 5ft. in excess of the cylinders, and connected the whole width and height to each other with a mass of concrete all cast together, and weighing a great deal more than 200 tons. If these piers are not stable, then the cast iron cylinders approved of have no stability at all. Any constructed work shows that they have, and any expert taking out correct (not incorrect) calculations will prove that the caisson piers have more stability and will live longer than the approved cast iron cylinders. Both in America and England, and on the Continental works, wrought iron is taking the place of cast iron for foundations—see the accounts of the Thames Embankment, Blackfriar's Bridge, Charing Cross Bridge, Battersea Bridge, Forth Bridge now under construction, and other very large works on the Continent, especially the Italian works, Russian bridges on the Neva, Danube, and other rivers : full particulars of these are obtainable from the papers in the minutes of proceedings of the Institution Civil Engineers, London.

(d) Timber Decking.—This recommendation was uncalled for. The working drawings all show the construction—Nos. 1 and No. 3 with hook and through bolts, with fast road on longitudinal sleepers; No. 2 and River Plenty with hook bolts and through bolts through flanges; and, as the Engineer-in-Chief states, only a madman would dream a "loose road" meant a "loose deck."

Flood Levels.—As the Commissioners informed both myself and the Engineer-in-Chief that portions of the railway works were below the flood level of 1863, as obtained by them from reliable evidence and actual levels, and as was rather harshly found fault with, I will proceed to show from actual facts within my knowledge how they (the Commissioners) arrived at the reduced level height of the flood in connection with the railway datum.

On the 4th March ult. evidence was taken from Mr. Walter Matthews, of the Back River, who told them that the height of the flood of 1863 was about three feet below the underside of the girders of the old bridge. Mr. Matthews was pretty certain, as he had crossed the bridge when the flood was at its highest point. (I was present when this evidence was taken.)

In order to obtain the railway reduced level of this height as spoken of by Mr. Matthews, my assistant, Mr. H. W. Calder, in my absence in Hobart, was instructed by the chairman to run a line to ascertain the level of the aforementioned under side of the girder, not from the bridge of 1863, but I regret as an engineer to say, from the existing bridge, which was not then in existence, as it was constructed 13 or 14 years after this flood of which the height was required.

As there was several feet difference between the height of the old bridge of 1863 and the existing bridge constructed about 1876, and from which the reduced levels of the flood were calculated, any result arrived at in such a peculiar and unskilful manner must obviously be worthless.

Finally, I do not want to be shielded from any blame that you may consider my due, if proved on sound engineering principles, after you have the full particulars before you.

None of my work has failed in the slightest; and the only evidence quoted against the design of the Back River wall is that of the Contractor's Engineer (page 74, par. 10), and this I cannot accept, for the evidence on the Corners to St. Mary's Line discloses failures of face and wing walls of the culverts at 5m. 40c., 8m. 25c. (Stony Creek), and 11m. 44c., which, in the opinion of the members of the Commission, are due to "insufficient strength and faulty design."

If any expert impartially states that I have built my work too strong, then I have erred, I am very glad to say, on the right side, and in accordance with the tuition of my former chief and tutor in civil engineering, R. M. Brereton, Esq., M. Inst. C.E., and whose practice is, like American practice, not to be set aside, he having been a pupil and practitioner with Sir I. Brunel, and for years in practice as Consulting Engineer of well-known and world-wide reputation.

Hoping you will make this reply public, and recorded along with the Engineer-in-Chief's reply, or any other Engineer's reply that may be sent in, and thanking you for the courtesy in so doing,

I have the honor to be,
Sir,
Your obedient Servant,
CHAS. K. SHEARD. *Assoc. M. Inst. C.E.,*
Resident Engineer, D. V. Railway.

The Hon. the Minister of Lands and Works, Hobart.

Public Works Office, Hobart, 18th May, 1886.

FINGAL LINE, AND REPORT OF ROYAL COMMISSION.

SIR,

I HAVE the honor to forward, for your perusal, some remarks of the Resident Engineer, which he has volunteered for my acceptance or otherwise, as might be considered desirable.

I would particularly call your attention to his remarks in reference to the deviation to south of Fingal, by which it is shown that the suggestion of the Commissioners had actually been carried out.

During my examination I had completely forgotten that more than my own flying survey had been effected, and this slip of memory is not surprising under so long an examination, which comprised in the whole no less than about 1800 questions.

I have the honor to be,
Sir,
Your obedient Servant,
J. FINCHAM, *Engineer-in-Chief.*

The Hon. the Minister.

Fingal, 15*th May*, 1886.

SIR,

REFERRING to the report of the Royal Commission, published a few days ago, I consider their comments in connection with this line, though perhaps less severe generally than those on other work, contain several unmerited reflections and unwarranted conclusions; and as these all help to swell the sum total of condemnation which has been cast—I think to an unjust extent—upon the Department, I beg to submit the following remarks, which are at your disposal in any way you may think desirable.

The Commissioners have reported unfavourably on the following points:—

1. That "it is to be regretted steps were not taken to place the line on higher ground in the vicinity of Fingal," and that "as it appears probable from the evidence that an alternative line might have been obtained to the southward of the town, it would have been more satisfactory that the question should have been decided after actual comparative survey of the two lines."

2. That between 42 and 47 miles "it seemed to us that it would have been better if this low ground had been avoided, and the line kept on higher ground."

3. That the masonry culverts show signs of failure, which is considered to be the result of "insufficient strength and faulty design," and that the retaining walls at Vinegar Hill were unwisely omitted, and will have to be erected at a probable large cost.

4. That "sufficient attention has not been given to the question of waterways," and that "no definite instructions appear to have been issued to surveyors, especially in regard to any systematic method of determining the necessary waterways." (It will be seen by reference to other portions of the Report, that this alluded to the survey and calculation of catchment areas.)

To these I may reply seriatim:

1. It is equally to be regretted that the Commission should first jump to erroneous conclusions, and then proceed to pass a vote of censure thereon. The simple fact in this case is that the question *was* only decided after an actual comparative survey of the two lines, on which I spent several weeks. As you are aware, the sections and quantities of both routes were then carefully examined by yourself, and the balance proved to be altogether in favour of the existing line.

2. I stated in evidence to the Commissioners that this question received careful attention before the line was permanently laid out, and that the slight advantage which could have been gained did not compensate for the wide detour which would have been rendered necessary. Against this their opinion is based upon a glance *en passant* at the surrounding country. If this is to be taken as a sample of the whole, what possible value can be attached to any expression of opinion by the Royal Commission on the subject of survey throughout their Report?

3. This is the only instance in which I can complain of some slight want of fairness personally. The line has been constructed under the charge of two successive Resident Engineers, Mr. Climie and myself, the returns showing that almost exactly one-half has been carried out under each. In view of this the Chairman assured me that it would be made plain which engineer was responsible for whatever portions of the work were under criticism. As this does not come out in the Report, I may state that the condemned culvert fronts were built, and the retaining wall at Vinegar Hill dispensed with, before I took charge. I think it fair to Mr. Climie to add that I do not consider the amount of "failure" in the culvert fronts to be anything very serious (as may be seen from my evidence), and that, though disapproving of the slopes at Vinegar Hill, I do not anticipate that any such extravagant sum as £2572 will be required to keep them in a safe condition.

4. Want of sufficient attention to the question of waterways is one of the most serious indictments contained in the Report (for on scarcely any point does the safety of a line depend so greatly), and at the same time it appears to me to be the one based upon the least satisfactory grounds. The charge, practically, is that the dimensions of waterways are not determined by the actual survey and calculation of catchment areas, a system which one of the Commissioners mentioned to me he invariably insisted on. In Queensland, with a climate subject to occasional falls of rain of extraordinary amount in a given time, and natural features admitting for the most part of rapid traversing, no doubt this is found advantageous, but, with the greatest respect for Mr. Stanley, I consider such a system to be totally inapplicable to a country like Tasmania. Anyone who, like myself, has been engaged for several years exclusively on hydraulic work, knows the difficulty of fixing the discharge of catchment areas, under the most favourable conditions. Here a peculiarly partial rainfall and a heavily-timbered country, split up with a succession of small separate drainage areas, would have to be dealt with. Supposing a system of actual survey were adopted, after a huge expenditure of time and money in traversing water-sheds, the average and maximum discharge would practically have to be fixed by guesswork, varying with the ideas of every successive engineer employed. It is admitted that in certain special cases the water-shed must be traversed, but in ordinary ones better practical data can usually be obtained from a careful general observation of streams, natural features of existing waterways, assisted by the best local information obtainable. On this line, at all events, the alterations found necessary have been of a very trifling character.

On the general subject of estimates, I must enter a protest against the unusual course adopted by the Commission, of accepting evidence from contractors and their employees, without verification from the officers whose duty it is to control the expenditure on the works for which the estimate is given.

Many other statements in connection with this line might be referred to in similar detail, but several of them have been already answered in your Report, and, as I desire to be as brief as possible, I will content myself with dealing with the foregoing as samples of the whole.

While intending to confine my remarks to the subject of the line under my charge, I may be permitted to express my disappointment with the Report as a whole. The Commissioners seem to have adopted the functions, not of the judge, but of the counsel for the prosecution, devoting all their energies to making a strong case against the Department, which, under the circumstances, might have been more generously treated. It is admitted that an effort to carry out a large scheme of public works with (originally) a ridiculously small staff, has resulted in much that is open to objection, and in need of improvement. It may be doubted whether this is best effected by a wholesale system of condemnation, based, in many instances, upon interested evidence, erroneous data, hasty conclusions, and a strong suspicion of personal animus. Few persons, taking a temperate and unprejudiced view of matters, will, I think, be found to deny that such has been the case in dealing with the Derwent Valley Line, and it is a pity the Commissioners should thus have so seriously affected the whole value of their voluminous and costly Report.

I have the honor to be,
Sir,
Your obedient Servant,

J. H. HOME, *Assoc. M. Inst. C.E.*,
Resident Engineer, Fingal Line.

The Engineer-in-Chief.

[Forwarded through the Hon. the Chief Secretary.]

Lands and Works Department, Hobart, 15th May, 1886.

SIR,

I HAVE the permission of the Hon. the Chief Secretary, the head of your Department, to request your attention to an extraordinary statement with respect to the Launceston and Scottsdale Railway which appears in the Report of the Royal Commissioners on Railways and Public Works recently forwarded to the Government.

The statement I refer to is as follows:—

"As matters now stand it will be sufficient to say that this line is not likely to pay 4 per cent. upon the capital of £370,000 over and above the cost of working, until the gross earnings reach the sum of £75,000 per annum."

Your long experience of railway finance and your knowledge of railway statistics generally will doubtless enable you to offer some remarks upon this statement of the Commissioners which may be of much value to the Government in their consideration of the Report.

I have the honor to be,
Sir,
Your obedient Servant,

NICHOLAS J. BROWN,
Minister of Lands and Works.

R. M. JOHNSTON, *Esq.*, *Government Statistician.*

P.S.—I forward to you herewith a statement of the Engineer-in-Chief giving particulars of mileage and grades of the two routes for the railway that have been partially surveyed, and the same information as to the route that was finally adopted.

THE Chief Secretary will be glad if Mr. Johnston will give the subject-matter of this letter his earnest and early consideration.

B. TRAVERS SOLLY,
for the Chief Secretary.
15*th May*, 1886.

R. M. JOHNSTON, *Esq.*, *Government Statistician*,
Macquarie-street.

General Register Office, 27th May, 1886.

SIR,

I HAVE the honor to enclose my Report on the matter submitted to me by the Hon. the Minister of Lands and Works with reference to the financial prospects of the Scottsdale Railway; and beg that you will be good enough to transmit it to him as early as possible, as I understand that he is anxious that the Report should be in his possession early this day.

I have the honor to be,
Sir,
Your obedient Servant,
ROBT. M. JOHNSTON.

The Hon. the Chief Secretary, Hobart.

FORWARDED to the Hon. the Minister of Lands and Works.

J. W. AGNEW.
27th May, 1886.

REPORT of the Government Statistician on Statement made by the Railway Commissioners with respect to the Financial Prospects of the Launceston and Scottsdale Railway.

General Register Office, 26th May, 1886.

SIR,

IN accordance with your request, I have the honor to inform you that I have carefully examined the statement made by the Railway Commissioners with respect to the financial prospects of the Launceston and Scottsdale Railway, and beg to submit the following observations thereon.

The Commissioners assume that the effect of working the sharp curves and heavy gradients on the above railway will be that *working expenses* will be so increased in cost that the *net earnings* will not reach a sum equal to 4 *per cent. on cost of construction* until the *gross earnings* reach a sum of £75,000 *per annum*, or £1595·7 *per open mile worked.* This assumption, from a railway statistician's point of view, seemed so astounding and contrary to all railway experience, that I took every pains to analyse its value in a systematic manner. By tabulating the figures in the following way, the significance of the statement is more clearly appreciated:—

	£	*Per cent. to Capital.*	*Per cent. to Receipts.*
Gross Receipts	75,000	20·27	..
Equivalent of 4 per cent. on Cost of Construction ..	14,800	4·0	19·73
Working Expenses	60,200	16·27	80·27
	£75,000	20·27	100·00

What is most remarkable in the above figures is the proportion assumed for *working expenses*, viz. 80·27 per cent. of receipts, or £1280·8 per open mile of railway.

It is true that there are many railways in the colonies whose working expenses bear even a higher percentage to receipts; but in nearly every case of this kind,—as on the Launceston and Western and Tasmanian Main Line Railways,—such high *percentages* are due to the meagreness of traffic or unproductive train service, not to the costliness of working expenses. Whatever the present expectations may be, the assumption of £1595·7 per mile on the Scottsdale Railway forbids us from treating it at the stage contemplated as an unproductive line. Apart from a few miles of suburban lines, the most profitable railway in Australia does not yield anything approaching £1595·7 per mile; nor do I know of any railway in Australia yielding over £1000 per mile whose working expenses bears a higher relation to receipts than from 54 to 58 per cent.

The reason is obvious: the extent to which a railway is *utilised* is the real influence which determines the percentage relation of working expenses to receipts.

Indeed, it may be confidently affirmed, as shown in accompanying table, that in nearly every instance on record high relative working expense percentages are due to the absolute unproductiveness of the receipts in relation to the train service provided; and, further, that the lower relative working expense percentages are more frequently associated with high relative and absolute working expenses than with low.

The following illustration, typical of relatively high and low working expenses in various countries, demonstrates the truth of the foregoing observations in an unmistakable manner:—

TABLE showing the common experience in Railways of different Countries that the highest percentage of Working Expenses in comparison with Receipts is due to the extent to which the Train Service is utilised and made productive, and not *to the costliness of the Working Expenses.*

Railway.	*Miles worked per year—Average.*	*Train Miles per mile per year.*	*Receipts per Train Mile.*	*Working Expenses per Train Mile.*	*Percentage of Working Expenses to Receipts.*
India.					
Rajpootana	169	1302	5·61*s.*	4·52*s.*	80·55
Eastern Bengal	158	3535	11·70*s.*	6·10*s.*	52·18
Great Britain.			*s. d.*	*s. d.*	
London-Tilbury-Southland	...	5800	4 0¼	2 2¾	55·7
Furness	...	4100	7 5	3 4	44·8
Queensland.					
Central Railway, 1884	319	1547	6 8½	3 5½	52·03
Ditto, 1883	271	1207	9 2¼	4 1	44·50
Victoria.					
Eastern System	191¾	...	4 1·40	3 3·39	79·75
Northern System	545½	...	6 7·39	3 8·84	56·27
New Zealand.					
Picton Railway	18	...	5 6	5 2·30	94·47
Westport Railway	18	...	10 11½	5 9·15	52·52
Tasmania.					
L. and W. Railway—					
Month of August, 1884	45	...	3 6·2	3 9·6	108·0
Month of April, 1884	45	...	7 6·2	3 9	50·5

Nor is this curious effect of these relatively high percentages on cheaply worked lines to be wondered at when we come to consider the matter more closely.

The *absolute cost of working* is always co-ordinate with the maximum power of *railway equipment and train service.* It is not so with receipts, for it is possible for the latter to be anything between zero and that sum which the combination of actual traffic and current rates can make it, limited only by the available maximum power of the railway service.

Thus, for example, the gross receipts upon a new railway opened in a young colony, where the population in the railway district is under 300 per lineal mile, and where the country has not been fully developed, may fall short of £100 per mile per year. Notwithstanding the meagreness of receipts, however, a railway to be of service at all must run a morning and evening train both ways at regularly stated times. This regular service cut down to its lowest possible limits may still have capacity and power far in excess of the local traffic, and in such cases it inevitably follows that the relative percentage of working expenses is very high as compared with gross earnings.

Cost per Train Mile.

The cost per train mile being relative, not absolute, is always at its maximum when the absolute cost of working or cost per mile open is lowest: it decreases as the train miles and the absolute cost increase.

The reason of this effect is due to the fact that the cost of locomotive and carriage and wagon department is the only working expense which is fairly measurable by this factor. The absolute increase to the cost of working other departments by the increase of train mileage does not progress relatively so fast as the additions to train mileage, and hence it follows that a very high train mileage tends to reduce the *total relative cost* per mile even although the relative cost per train mile of the locomotive, carriage, and wagon department *per se* may have materially increased. This tendency is apt to be overlooked by those who are not intimately acquainted with these matters, and often leads many persons to make inaccurate estimates and false comparisons. A knowledge of the causes of its variations explains such anomalies as the Queensland 3ft. 6in. railways being 4*s.* 1*d.* a train mile, while the absolute cost was £555 per mile in 1883; while the Victorian Railways, in the same year, though absolutely costing £803 a mile, indicate only 3*s.* 10·14*d.* per train mile.

These considerations are absolutely necessary to arrive at a just appreciation of the value of estimates formed in connection with the working of railways.

When there are so many variables affecting the question—such as average rates and fares, the average proportion of distance travelled by ton and passenger in relation to average distance travelled per train, the number of train miles run per mile per year, average cost of labor and stores, &c., it becomes a very complicated problem to solve the lowest amount of earnings which will yield a profit of 4 per cent. on cost of construction on the Scottsdale Railway. As such problems lie outside the profession of engineering experts, it is natural that they should sometimes underrate its difficulties; and as by rigid computations, guided by long experience in such matters, I come to widely different results from them, I am satisfied that they have either adopted their figures in an arbitrary manner or have been misled by the adoption of a fallacious method.

That the Railway Commissioners have assumed either an excessive train service or an extravagant rate per mile for working expenses can easily be demonstrated. All railways paying over £1200 per mile in the Colonies earn at least 6*s.* 4*d.* to 7*s.* 11*d.* per train mile. Let us assume it to be 6*s.* 7*d.*

Then, as the Railway Commissioners assume £75,000 per year as receipts,

$$\frac{75{,}000}{\cdot 329} = 227{,}960 \text{ train miles per year, or 4850 train miles per mile per year,}$$

$$= 15\tfrac{1}{2} \text{ through trains per day.}$$

As the tonnage to carry could not exceed 15 tons per train per day, the assumed cost of working expenses, viz., £60,200, is proved to be far too high when we find it is equal, with the above train mileage, to 5*s.* 3·19*d.* per train mile, *i.e.*, 43·2 per cent., above the working cost of the heaviest traffic railways in Victoria or New South Wales.

There is always a temptation to over-estimate extra cost to rails and rolling stock caused by heavy gradients and sharp curves. It is well to have a definite standard present to the mind stated as a reasonable equivalent in *train miles*. For example, under the most favourable circumstances—slow speed and level—irrespective of difference in tonnage of train, practice has disclosed that the life of a rail is equivalent to about 203,112 trains, equal to 43·2 years of life, at 15½ trains a day.

But suppose we allow that the effect of heavy gradients and sharp curves reduced the life of a rail to one-fourth, this would only represent about 2*d.* per train mile per year (present value) with the mileage stated above.

In order that this important matter may be lifted out of the idle region of mere assertion, I have given a full explanation of my reasonings and calculations, as follows:—

Bases of Computations.

Let T = Train mileage per year.
R = Average receipts per train mile, say, 6*s.* 4·5*d.* = £·3188.
C = Average working expenses per train mile for lines running more than six trains per day, say, 4*s.* = £·2.
P = Profit of 4 per cent. on cost of construction per year, $\frac{370{,}000 \times 4}{100}$ = £14,800.
G = Gross earnings per year.
X = Working expenses.

I. To find train mileage required per year = $\frac{P}{R-C}$ = T.

Then $\frac{14{,}800}{\cdot 3188 - \cdot 2}$ = 124,579 train miles per year, or equal to 2650 train miles per mile, or 8·46 trains per day.

II. To find gross earnings which will yield 4 per cent. on cost of construction:—

Then TR = G.

124,579 + £·3188 = £39,715.

III. To find actual working expenses:—

Then TC = X

124,579 × £·2 = £24,915.

Having thus determined approximately the value of gross earnings per year, we are able to form an estimate of the probable traffic from the experience gained on similar lines. Thus, the gross earnings on the Launceston and Western Railway is made up of 51·2 per cent. passenger receipts; 34·7 per cent. goods, minerals, and live stock receipts; 14·1 per cent. all other receipts. The Tasmanian Main Line Railway proportions are very similar, being—passenger receipts, 54·8 per cent.; goods, minerals, and live stock receipts, 34·4 per cent.; other receipts, 11·8 per cent. The mean of these two railways, therefore, give—passenger receipts, 53 per cent.; goods, minerals, and live stock receipts, 34 per cent.; other receipts, 13 per cent.

If we now assume that each passenger will only pay on the average 2*s.* per journey, and each ton of goods, &c., 7*s.*,—as on the Launceston and Western Railway in 1884, which line was two miles less than the Scottsdale line,—we have the means of approximating the proportions of each kind of traffic, and the probable number of passengers and tonnage, as follows :—

Let P = Passenger receipts.
P^a = Proportion of passenger receipts to gross earnings = 53 per cent.
P^b = Average rate per passenger—say 2*s.* or £·1.
P^c = Number of passengers.
G = Goods, mineral, and live stock receipts.
G^a = Proportion of goods, mineral, and live stock receipts to gross earnings = 34 per cent.
G^b = Average rate per ton—say 7*s.*, or £·35.
G^c = Number of tons per year.
E = Gross earnings per year, as ascertained in former calculations, = £39,715.

Then $\frac{EP^a}{100} = P$, or—

$\frac{£39{,}715 \times 53}{100} = £21{,}049$, passenger receipts.

$\frac{EG^a}{100} = G$, or—

$\frac{£39{,}715 \times 34}{100} = £13{,}504$, goods, mineral, and live stock receipts.

Therefore $\frac{P}{P^b} = \frac{£21{,}049}{£·1} = P^c$, or 210,490 passengers.

$\frac{G}{G^b} = \frac{£13{,}504}{£·35} = G^c$, or 38,582·8 tons.

Having now approximately ascertained the tonnage and passengers to be carried in one year, we can judge of the sufficiency of the train service and of the loco. power necessary to work the traffic under the local conditions as affected by length, gradients, curves, and prevailing directions in which the traffic tends. Assuming that about two-thirds of the tonnage is carried in one direction (*i.e.*, Scottsdale to Launceston), then, as this is equal to 19·2 tons per train per day in one direction, it would seem that the train service—124,579 train miles per year, or 8½ trains per day nearly—is ample.

As the present goods engines ordered (*see* Appendix) can draw a load of 82¼ tons on a gradient of 1 in 40, with a curve of 5 chains radius, at a speed of 12 miles an hour, in addition to loaded engine and tender, there need be no apprehension that the tractive power will fail to supply the average demand made upon it throughout the year.

It must be borne in mind, however, that reference to the power of *existing locomotives* can only be relevant by the assumption that the development of the line will progress so rapidly that the traffic necessary to produce gross earnings of £39,715 will occur within the life of the existing rolling stock and engines, that is to say, within 10 years of the present time. As this desirable prospect is extremely doubtful, it would be absurd to order a heavier or more powerful class of engine than is required for the light traffic which it has to transport within the limited life of the engine. It will be time enough to burden the line with the heavier rails and engines when the conditions arise demanding them. These conditions, in my opinion, will not arise within the life of the present stock ordered, that is to say, within the next 10 years. It is almost a certainty that receipts equal to £75,000 will not be reached within the life of the locomotives and rolling stock now provided in contemplation of a smaller train service and a much lighter traffic.

Having thus carefully given the reasoning and the data for forming a correct estimate of the probable receipts which would yield 4 per cent. on cost of construction on the Scottsdale Line, I now give the results in a tabular form in order that they may be more clearly appreciated :—

ESTIMATE of the probable Traffic Earnings, Train Mileage, and Working Expenses which would be necessary to secure a net return of 4 per cent. on cost of Construction on the Launceston and Scottsdale Railway.

Miles open, 47. Train Mileage, 124,579 miles (equal to 8½ through trains) per day, or 2650 Train Miles per mile open.† Cost of Construction, £370,000.

	RECEIPTS.					WORKING EXPENSES.					
		Per Mile.	*Per Train Mile.*	*Per cent. to Total.*			*Per Mile open.*	*Per Train Mile.*	*Per cent. to Receipts.*	*Per cent. to Cost of Construction.*
	£	£	*s. d.*			£ ‡	£ ‡	*s. d.* ‡		
1. Passengers, 210,490 at 2*s.*[a]	21,049*	..	..	53*	Maintenance	7786[1]	165·6[1]	1 3		
2. Goods, Minerals, and Live Stock, 38,582·8 tons[c] at 7*s.*[b]	13,504*	..	..	34*	Locomotive, Carriage, and Wagon charges	9343	198·7	1 6[2]		
3. Other Receipts	5162*	..	..	13*	Traffic charges, &c.	7267	154·6[3]	1 2		
					Proportion of general charges	519[4]	11·1	0 1		
	£39,715	845	6*s.* 4·5*d.*	100		24,915	530·11	4 0	62·7	
					Profit on working	14,800	314·89	2 4·5	..	4 per cent.
						39,715				

* Proportions on Launceston and Western Railway, (1) 51·2; (2) 34·7; (3) 14·1. On Tasmanian Main Line Railway, (1) 54·8; (2) 33·4; (3) 11·8.

† The Train Mile factor is greatly reduced by every increase in Train Mileage: the average cost on Australian Railways for systems whose Train Mileage exceeds 2650 is on the average only 3*s.* 8·84*d.* per *Train Mile.*

‡ On the Launceston and Western Railway working expenses under each head averaged during last five years, (1) £120·3 per mile; (2) 1*s.* 2·5*d.* per Train Mile; (3) £92·7 per mile; (4) 31·9*s.* per mile.

[a] Average Receipts on Launceston and Western Railway for 45 miles in 1884, 2*s.* per Passenger.

[b] Average Receipts on Launceston and Western Railway for 45 miles in 1884, 6*s.* 11*d.* per Ton.

[c] Equal to an average of 14·5 Tons per Train per day.

In preparing the foregoing table, showing the lowest probable receipts necessary to pay 4 per cent. on cost of construction, I have been careful not to overrate receipts.

The working expenses are in my opinion unnecessarily high for such traffic, but I was anxious to show that I was making every allowance possible favourable to cover considerations which deeply impressed the Railway Commissioners. It will be observed that I have allowed 1*s.* 6*d.* per train mile for locomotive and carriage and wagon expenses, *i.e.*, 24·1 per cent. above the average of the Launceston and Western Railway during the last five years. When we consider that this difference alone would suffice to double the fuel consumed by the locomotives even at our present costly price of coal in Tasmania it will surely be allowed that ample provision has been made for the increased difficulty of working the grades and curves on the Scottsdale Line.

If, therefore, it be sustained, as I have shown, that the line under reasonable management should pay a profit of 4 per cent. on capital when receipts reach £39,715, it proves that the Railway Commissioners have made *an error of* £35,285, *or* 89 *per cent., a sum which of itself would suffice to pay the interest of two and one-third* (2·38) *similar lines across the same country independently of the one objected to by them.*

It is not a matter of surprise, therefore, that having adopted what appears to me to be a fallacious conclusion, they should have been led to object so strongly to the present Scottsdale route from a financial point of view.

Comparison of the rival Routes on Financial grounds.

The Railway Commissioners, in my opinion, for reasons already explained, have also failed to appreciate the advantages of the shorter line from a financial point of view in the consideration of the various contemplated routes. If we assume, which is reasonable, that the traffic would differ little on the three routes at the ultimate stage contemplated, *i.e.*, when the profit of working is equal to 4 per cent. on capital, then we must also assume that the same number of trains would be necessary on either route, viz., 2650 *train miles per mile.*

This would give a great advantage to the shorter route in the saving of cost of transit to the producer, or in saving the cost to the country in lessening the working cost. With the same train service exactly, the difference in open mileage would give the following *train miles for each :*—

				Train Miles.
Lower Piper route.....	67	miles, at	2650	= 177,550
Upper Piper route.....	59½	„ at	„	= 157,675
Present route.....	47	„ at	„	= 124,579

Even supposing that we saved 2*d.* per train mile on the longer routes, which is doubtful, the gain by the adoption of the shorter route would be considerable : thus :—

Lower Piper Route—177,550 train miles, at 3*s.* 10*d.* = £34,030·5, or £9115·5 above the present route, = to a capital sum at 4 per cent. of £227,887. This added to cost of construction would raise it to £527,887, or £157,887 above present route.

Upper Piper Route—157,675 train miles, at 3*s.* 10*d.* = £30,225, or £5306 above present route, = to a capital sum of £132,650. This added to estimated cost of construction would raise it to £432,650, or £62,650 above present route.

In reality, there is no justification for giving this advantage of 2*d.* per train mile in favour of the longer route, for by Appendix III. it is proved that the ascending grades of the longest routes in the direction of the heaviest traffic are, upon the whole, a much greater tax upon the locomotive power than the shorter route adopted. If the working expenses were calculated at 4*s.*, as on the shorter route, the difference in favour of the latter would be equivalent to £194,875 on cost of construction as compared with the 67-mile route, and £95,500 as compared with the 59½-mile route. (See Appendices III. and IV. supplied by Engineer-in-Chief.)

It is no valid argument to urge that a portion of the difference caused in working the longer routes would be recouped by addition to receipts from extra haulage, for, from a national point of view—the principal one to be regarded—the extra cost of transit would be an additional tax upon the producer, and a permanent hindrance to development at the extreme parts of the line.

In conclusion, I have to direct attention to Appendices, especially those referring to all railways in Australasia, Great Britain and Ireland, and to typical examples from India.

These statistics sustain all the arguments advanced by me in this Report. I would also beg to observe that these results are not mere opinions ; they have been arrived at by careful reasoning and by rigid computations based upon the most reliable data. I place no value myself upon any assertions made herein where they are not so supported.

I trust the observations made may be of service to the Government in coming to a proper conclusion with respect to the various matters touched upon.

I have the honor to be,
Sir,
Your obedient Servant,
ROBT. M. JOHNSTON, *Government Statistician.*

The Hon. N. J. BROWN,
Minister of Lands and Works, Hobart.

APPENDIX I.

A.—*Tractive Power of Goods Engines for Launceston and Scottsdale Line.*

GOODS ENGINE (*see* 5503 Batchelor's Evidence.)

D = Diameter of cylinder in inches = 14·25 inches.

P = Mean pressure of steam in cylinder in lbs. per square inch—say from 75 to 90 =
- P^a = 90 lbs.
- P^b = 80 lbs.
- P^c = 75 lbs.

L = Length of stroke in inches = 20 inches.
W = Diameter of driving-wheel in inches = 33 inches.
T = Tractive force *on rails* in lbs.

Then, according to formula, $T = \frac{D^2 PL}{W}$

(1) With effective pressure at P^a we have—
$\frac{14{\cdot}25^2 \times 90 \times 20}{33}$ = 9369 tractive force = T^a.

(2) With effective pressure at P^b we have—
$\frac{14{\cdot}25^2 \times 80 \times 20}{33}$ = 8328 tractive force = T^b.

(3) With effective pressure at P^c we have—
$\frac{14{\cdot}25^2 \times 75 \times 20}{33}$ = 8012 tractive force = T^c.

B.—*To find the load which the particular tractive force can draw (including weight of wagons, engine, and tender) on a gradient of* 1 *in* 40, *with a curve of five chains radius, and at a speed of* 12 *miles per hour.*

G = Resistance due to gravity in lbs. per ton - - = 56 lbs. per ton
R = Resistance due to velocity - - - - = 7·3 ditto
C = Resistance due to curve - - - = 10·7 ditto
W = Weight of engine and tender in tons (loaded) = 43 tons
T^a = Tractive force, as above - - - - = 9369 „
T^b = Tractive force, as above - - - - = 8328 „
T^c = Tractive force, as above - - - - = 8012 „
L = Load the engine can take in tons.

Then as $L = \frac{T}{G + R + C} - W$,

We have for effective pressure—

(1) at 90 lbs., (P^a) $\frac{9369}{56 + 73 + 10{\cdot}7} - 43 = \frac{9369}{74} - 43 = 82\frac{1}{4}$ tons*

(2) at 80 lbs., (P^b) $\frac{8328}{56 + 73 + 10{\cdot}7} - 43 = \frac{8328}{74} - 43 = 69\frac{1}{2}$ tons

(3) at 75 lbs., (P^c) $\frac{8012}{56 + 73 + 10{\cdot}7} - 43 = \frac{8012}{74} - 43 = 65\frac{1}{4}$ tons

If the resistance for five-chain curve were eliminated the load could be increased to :—

(1) P^a = 105 tons
(2) P^b = $88\frac{2}{3}$ tons
(3) P^c = $83\frac{1}{2}$ tons

Thus it is demonstrated that *the resistance caused by* a five-chain curve upon a gradient of 1 in 40 at a speed of 12 miles an hour would have the effect of reducing the load, without engine and tender, 21 to 22 per cent.; with engine and tender 14 to 15 per cent. The statement made by the Railway Commissioners that the five-chain curve would have the effect of reducing *the load "to a third"* (see question 5475) is, therefore, widely erroneous.

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* It is generally the case that the tonnage carried on a railway of the Scottsdale description flows more in one direction than the other, usually as 2 to 1. This in working a traffic of £39,715 per year would probably cause the maximum tonnage per year in one direction to amount to 26,000 tons, equal to 19·5 tons per train.

Appendix II.

Railway.	Gauge.	Average Miles open.	Cost per Mile.	Earnings.	Working Expenses.	Train Miles.		Earnings.		Working Expenses.		Working Expenses per cent. to Earnings.
						No.	No. per Mile.	Per Train Mile.	Per open Mile.	Per Train Mile.	Per open Mile.	
			£	£	£			s. d.	£	s. d.	£	
GREAT BRITAIN.*												
(Half-year ending June, 1885.)												
England.												
I. *Metropolitan & Provincial.*												
Lancashire and Yorkshire	4′ 8½″	..	79,400	..	..	..	13,600	5 3½	3610	3 0¼	..	56·9
Manchester, Sheffield, and Lincoln	..	..	53,800	..	..	..	10,800	5 1½	2767	2 7½	..	50·9
North-Eastern	..	..	38,900	..	..	..	7300	5 1½	1879	2 9½	..	54·5
Taff Vale	..	..	54,200	..	..	..	9900	7 7¾	3767	3 9½	..	51·0
North London	..	..	321,000	..	..	..	..	3 10¾	13,286	1 11¾	..	50·7
Metropolitan District	..	..	564,000	..	..	..	44,000	6 6	14,392	3 2	..	48·6
North Staffordshire	..	..	33,900	..	..	..	5100	5 10	1494	2 9¼ 3 0¼	..	46·8
Furness	..	..	32,800	..	..	..	4100	7 5	1524	3 4	..	44·8
Maryport and Carlisle	..	..	20,900	..	..	..	5300	5 0	1315	2 1¾	..	43·1
II. *Northern and Southern Lines.*												
Great Northern and Joint	..	..	45,100	..	..	..	10,300	4 4½	2250	2 7	..	59·2
London and South-Western	..	..	34,700	..	..	..	7500	4 9	1763	2 10½	..	60·3
Great Eastern and Joint	..	..	41,400	..	..	..	6700	4 6¾	1534	2 6	..	54·9
London, Chatham, and Dover	..	..	..	..	..	..	10,300	5 4½	2764	2 11¾	..	55·6
London, Tilbury, Southland	..	..	20,300	..	..	..	5800	4 0¼	1162	2 2¾ 2 6	..	55·7 60·1
Midland	..	..	55,400	..	..	..	12,800	4 5½	2865	2 4¾	..	53·7
South-Eastern	..	..	59,500	..	..	..	8400	5 8½	2408	3 0¾	..	53·6
London and North-Western	..	..	55,900	..	..	..	10,400	5 3	2707	2 8½	..	51·3
London B. S. Coast	..	..	54,300	..	..	..	9300	4 8¾	2194	2 5½	..	51·6
Great Western	..	..	39,500	..	..	..	6200	5 0	1559	2 6	..	50·0
Scotland.												
Glasgow and South-Western	..	..	38,800	..	..	..	6800	4 9	1618	2 5½	..	51·8
North British	..	..	35,100	..	..	..	6000	4 5	1311	2 2¾	..	50·7
Highland	..	..	10,800	..	..	..	2000	4 11	482	2 5¾	..	50·3
Great North of Scotland	..	..	13,200	..	..	..	2400	4 4¼	523	2 2	..	49·8
Caledonian	..	..	40,100	..	..	..	8200	4 8½	1969	2 3¾	..	49·2
Ireland.												
Great Southern and Western	5′ 3″	..	16,200	..	..	..	3000	4 6¾	689	2 8¼	..	58·8
Belfast and Northern Counties	..	..	11,900	..	..	..	2500	4 4½	539	2 6½	..	58·1
Great North of Ireland	..	..	14,600	..	..	..	2700	4 8¼	638	2 7½	..	55·9
Great Southern and Western	..	..	16,400	..	..	..	2100	4 10	498	2 7¼	..	53·9
Dublin, Wicklow, & Wexford	..	..	17,600	..	..	..	3800	4 3½	818	2 1¾	..	50·1
Cork and Bandon	..	..	6400	..	..	..	1600	4 11¾	395	2 5¼ 2 7	..	49·3 52·6
India.								s.		s.		
Rajpootana	..	169	6438	61,697	49,698	220,000	1302	5·61	365	4·52	294	80·55
Eastern Bengal	..	158	18,804	326,777	170,513	559,000	3535	11·70	2068	6·10	1079·2	52·18
Australasia.												
Victoria.								s. d.		s. d.		
(Year ending 30 June, 1885.)												
Northern System, 1885	5′ 3″	540½	..	625,466	351,958	1,883,791	3670	6 7·69	..	3 8·84	..	56·27
Western System, 1885	..	543	..	615,074	352,175	1,830,471	3555	6 8·65	..	3 10·12	..	57·26
Eastern System, 1885	..	191¾	..	197,822	157,759	961,111	5012	4 1·40	..	3 3·39	..	79·75
North-Eastern, 1885	..	363½	..	470,264	255,958	1,417,977	3699	6 7·60	..	3 7·32	..	54·43
South Suburban, 1885	..	162	..	273,306	159,575	756,468	45,486	7 2·71	..	4 2·62	..	58·89
All Systems, 1885	..	1655¼	13,672	2,181,932	1,277,425	6,849,818	4150	6 4·45	1318	3 8·75	771·7	58·54
New South Wales.												
All Sections—South West and Richmond	4′ 8½″	..	..	1,617,554	1,022,587	5,130,174	..	6 3·67	..	3 11·84	..	47·84
Sub-line—Sydney to Granville	..	..	..	259,483	125,954	653,672	..	7 11·27	..	3 10·24	..	48·54
Southern Line—Granville to Albury	..	..	..	606,822	377,082	1,926,243	..	6 3·61	..	3 10·99	..	62·14
South-Western Line—Junee to Hay and Jerilderie	..	186	..	63,236	64,291	249,480	1341	5 0·83	..	5 1·84	..	101·66
Western Line—Granville to Byerock in Richmond Branch	..	..	..	668,676	432,301	2,208,830	..	6 0·65	..	3 10·97	..	64·65
Mudgee Branch	..	..	..	15,169	19,660	73,311	..	4 1·66	..	5 4·36	..	129·61
Illawarra Line	..	3·75	..	4168	3299	18,638	..	4 5·67	..	3 6·48	..	79·15
North North-Western Line—All Sections	..	..	..	468,683	278,672	1,272,367	..	7 4·37	..	4 4·54	..	59·46
Newcastle to Glen Innes	..	97	..	43,024	42,188	165,599	..	5 2·35	..	5 1·14	..	98·06
South Australia	mixed	1056½	..	557,055	327,187	1,732,716	1640	6 5·16	526·2	4 3·35	316	66·81

* The Statements of Railways of Great Britain and Ireland are based upon Half-yearly Reports, and consequently Rates per *open* Mile and Train Mileage should be doubled as compared with Lines in other countries which are based on yearly Reports.

Appendix II.—*continued.*

Railway.	Gauge.	Average Miles open.	Cost per Mile.	Earnings.	Working Expenses.	Train Miles.		Earnings.		Working Expenses.		Working Expenses per cent. to Earnings.
						No.	No. per Mile.	Per Train Mile.	Per open Mile.	Per Train Mile.	Per open Mile.	
			£	£	£			s. d.	£	s. d.	£	
Queensland.												
Northern Railway, 1883	3′ 6″	..	..	132,495	57,085	26,125	..	8 7½	696	3 11¼	318	..
Ditto, 1884	..	129	..	69,128	35,926	169,129	1311	8 2	536	4 3	278	51·97
Central Railway, 1883	..	271	..	150,296	66.995	327,321	1207	9 2¼	555	4 1	247	44·5
Ditto, 1884	..	319	..	164,289	85,482	493,609	1547	6 8	515	3 5½	268	52·03
New Zealand.												
Westport	..	18	..	..	..	..	..	10 11½	717	5 9·15	377	52·52
Greymouth	..	8	..	..	..	..	..	17 8½	2381	9 9·7	1319	55·39
Napier	..	82	..	..	..	..	..	6 10	686	3 10·9	392	57·12
Hurunui Bluff	..	885	..	..	..	..	..	7 9	802	4 11·75	514	64·13
Auckland	..	168	..	..	..	..	..	6 3¼	695	4 3·01	471	67·78
Wellington	..	69	..	..	..	..	..	6 3¾	890	4 7·19	647	72·66
Nelson	..	23	..	..	..	..	..	5 1¾	421	4 0·03	327	77·59
Wanganui	..	191	..	..	..	..	..	5 2½	363	4 2·92	296	81·41
Whangarei	..	7	..	..	..	..	..	5 0	559	4 4·53	490	87·53
Kawakawa	..	8	..	..	..	..	..	9 0¾	711	8 0·13	627	88·25
Picton	..	18	..	..	..	..	..	5 6	367	5 2·30	347	94·47
All New Zealand Lines, 1884	..	1477	7522	..	..	..	1835·9	7 3·07	666	4 9·45	433·14	65·08

Appendix III.

LAUNCESTON AND SCOTTSDALE RAILWAY.

Approximate List of Grades.

Ascending Grades—Launceston to Scottsdale.

	Parliamentary Lines.		Contract Line.
	Lower Piper Route.	*Upper Piper Route.*	
Grades 1 in 39·6 to 1 in 45	956 lineal chains	1067 chains	896 chains
Ditto 1 in 45 to 1 in 50	276 ditto	238 ditto	349 ditto
Ditto 1 in 50 to 1 in 60	283 ditto	166 ditto	
Ditto 1 in 60 to 1 in 70	118 ditto	162 ditto	234 ditto
Ditto 1 in 70 to 1 in 100	328 ditto	232 ditto	87 ditto
Ditto 1 in 100 to 1 in 150	239 ditto	136 ditto	
Ditto flatter than 1 in 150	344 ditto	434 ditto	96 ditto
Total rise	2864 feet	2812 feet	2280 feet
Length of Level	852 chains	512 chains	790 chains
Total Length of Line	66 miles 65·86 chains	59 miles 33·86 chains	47 miles 4 chains

Ascending Grades—Scottsdale to Launceston.

	Parliamentary Lines.		Contract Line.
	Lower Piper Route.	*Upper Piper Route.*	
Grades 1 in 39·6 to 1 in 45	736 chains	892 chains	835 chains
Ditto 1 in 45 to 1 in 50	238 ditto	144 ditto	117 ditto
Ditto 1 in 50 to 1 in 60	211 chains	141 ditto	45 ditto
Ditto 1 in 60 to 1 in 70	164 ditto	113 ditto	97 ditto
Ditto 1 in 70 to 1 in 100	220 ditto	162 ditto	76 ditto
Ditto 1 in 100 to 1 in 150	157 ditto	127 ditto	55 ditto
Ditto flatter than 1 in 150	224 ditto	228 ditto	87 ditto
Total rise	2241 feet	2189 feet	1642 feet
Aggregate length of ascending grades	24·3 miles	22·5 miles	16·4 miles
Mean of ascending grades in relation to actual length of the same	of 1 in 57·49	of 1 in 54·5	of 1 in 52·7
Mean of ascending grades in relation to total length of Line, which includes levels, ascending and descending grades	1 in 157	1 in 143	1 in 151

Appendix IV.

LAUNCESTON AND SCOTTSDALE RAILWAY.

Average Gradients—Launceston to Scottsdale.

Parliamentary Line, Lower Piper route, is represented by column **A.**
Ditto, Upper Piper, ditto ..... **B.**
Contract Line ..... **C.**

	A.	B.	C.
Length of ascending gradient	2544chs.	2435chs.	1662chs.
Average of ditto, 1 in	58½	57	48¼
Length of level	852chs.	512chs.	790chs.
Length of descending gradient	1950chs.	1807chs.	1312chs.
Average of ditto, 1 in	57½	54½	52¾
Total length of Line	66m. 65·86chs.	59m. 33·86chs.	47m. 4chs.
Average of ascending gradients for whole Line	123	112	109
Ditto descending ditto	157	143	151
Ascending gradient of uniformly ascending Line between Launceston and Scottsdale, 1 in	566	504	389
Sum of ascents	2864ft.	2812ft.	2280ft.
Ditto descents	2241ft.	2189ft.	1642ft.
Difference of level of Launceston and Scottsdale	623ft.	623ft	638ft.

WILLIAM THOMAS STRUTT,
GOVERNMENT PRINTER, TASMANIA.

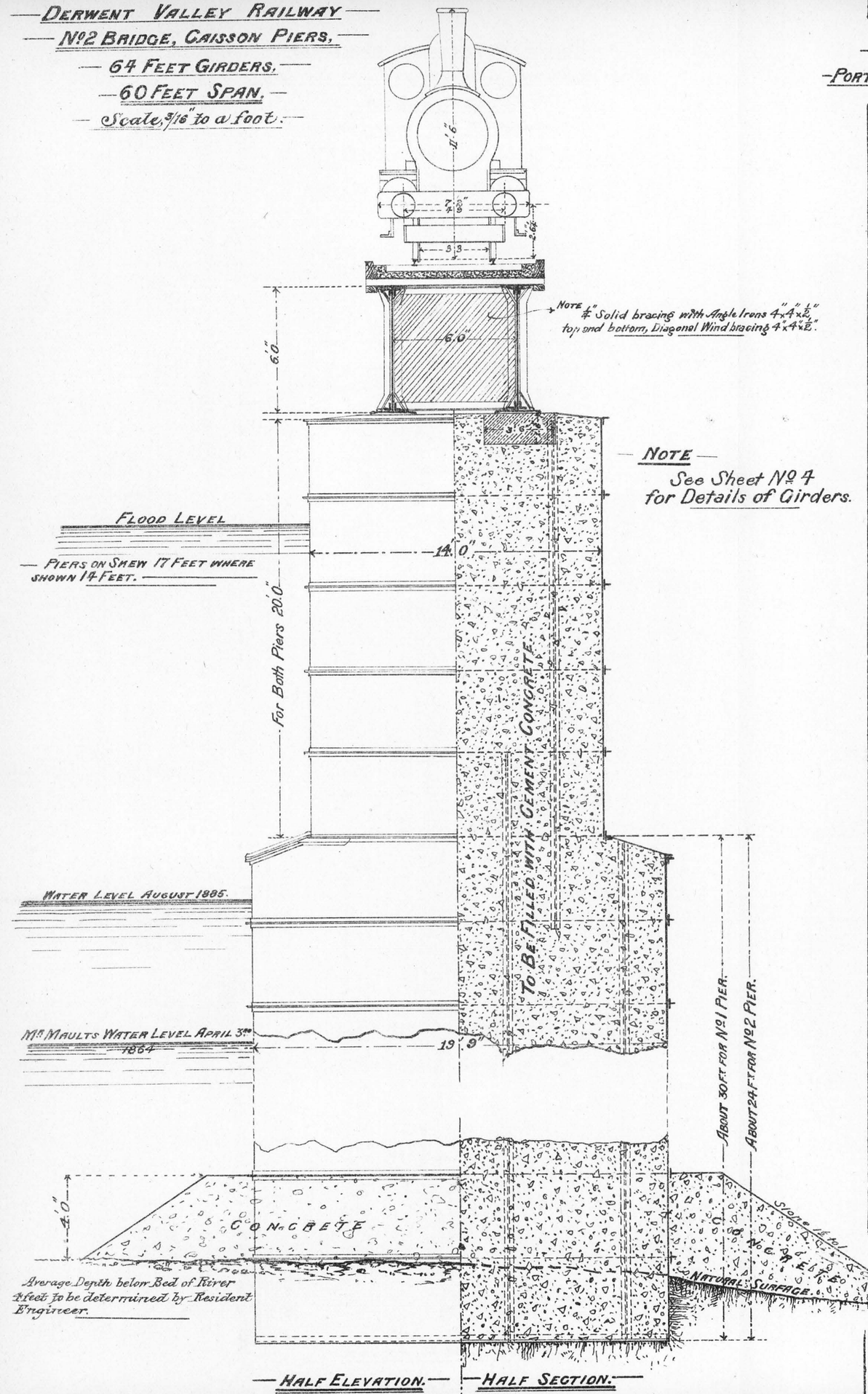
DERWENT VALLEY RAILWAY

No2 BRIDGE, CAISSON PIERS,

— 64 FEET GIRDERS. —

— 60 FEET SPAN. —

— Scale, 3/16" to a foot. —



NOTE

See Sheet No 4 for Details of Girders.

— HALF ELEVATION. — — HALF SECTION. —

SOUTH AUSTRALIAN RAILWAYS

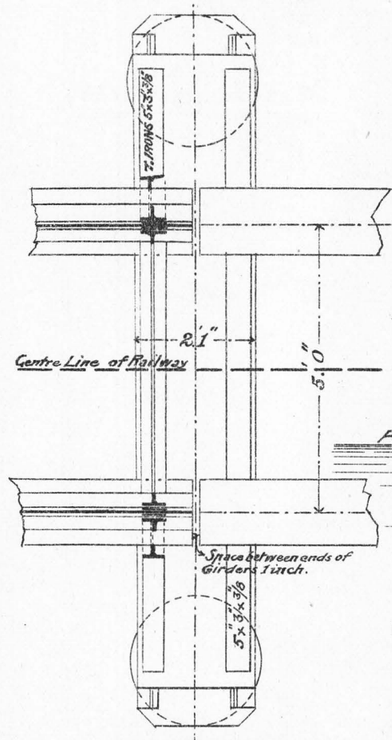
PORT AUGUSTA & GOVERNMENT GUMS RAILWAY

— 60 FEET GIRDERS —

— 58 F.T 4 INS SPAN —

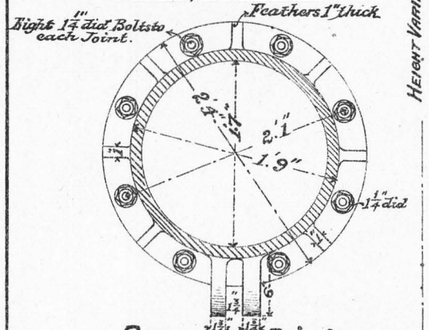
— Scale, 3/16" to a foot. —

— CONSTRUCTED. —

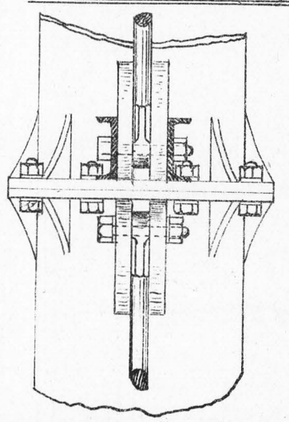


— ON STRAIGHT. —

— Scale, ⅜" to a foot. —

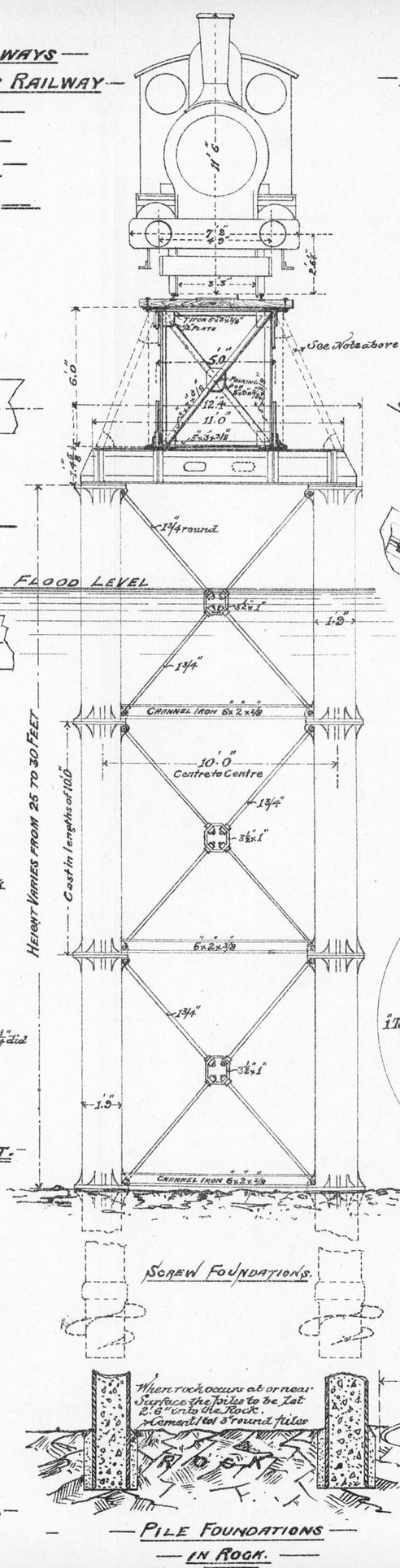


— PLAN OF PILE JOINT. —



— ELEVATION OF PILE JOINT. —

— ¾" to a foot. —



SCREW FOUNDATIONS.

— PILE FOUNDATIONS IN ROCK. —

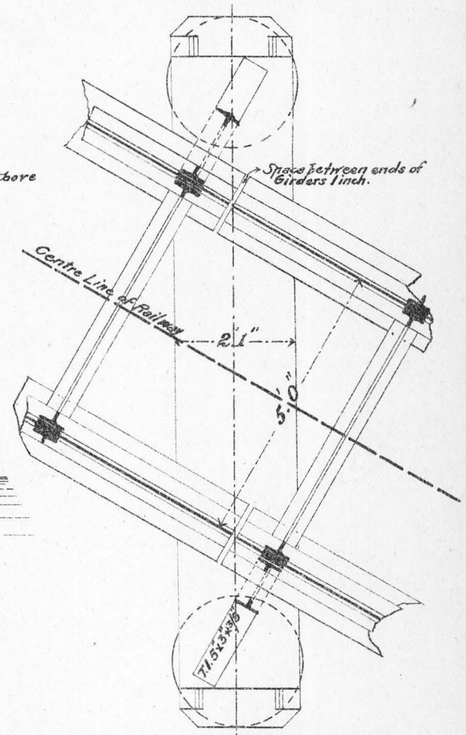
Sheet No 1

To accompany Report of Engineer in Chief Tasmania May 1886.

— NOTE —

On the Skew Piers of Lattice Girders these Struts are left out.

On the Skewed Piers Plate Girders the Struts are as shown on plan, one to each Girder, On the Square Piers Plate and Lattice Girders the Struts are at each end of Girders

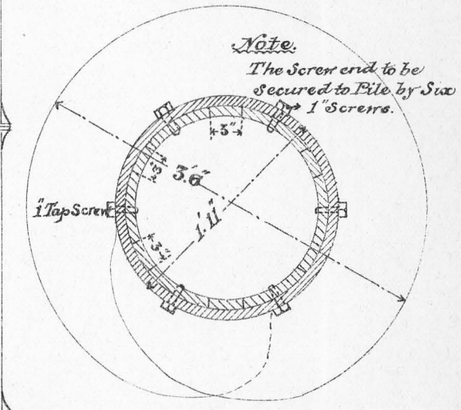


— ON SKEW —

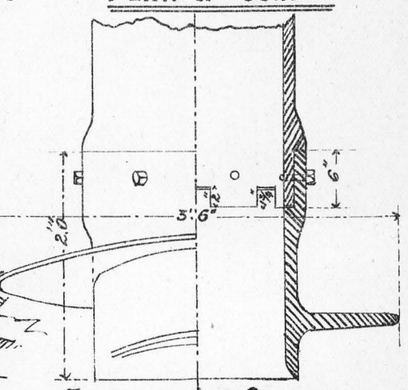
— Scale ⅜" to a foot. —

Note.

The Screw end to be Secured to Pile by Six 1" Screws.



— PLAN OF SCREW. —



— ELEVATION AND SECTION OF SCREW END. —

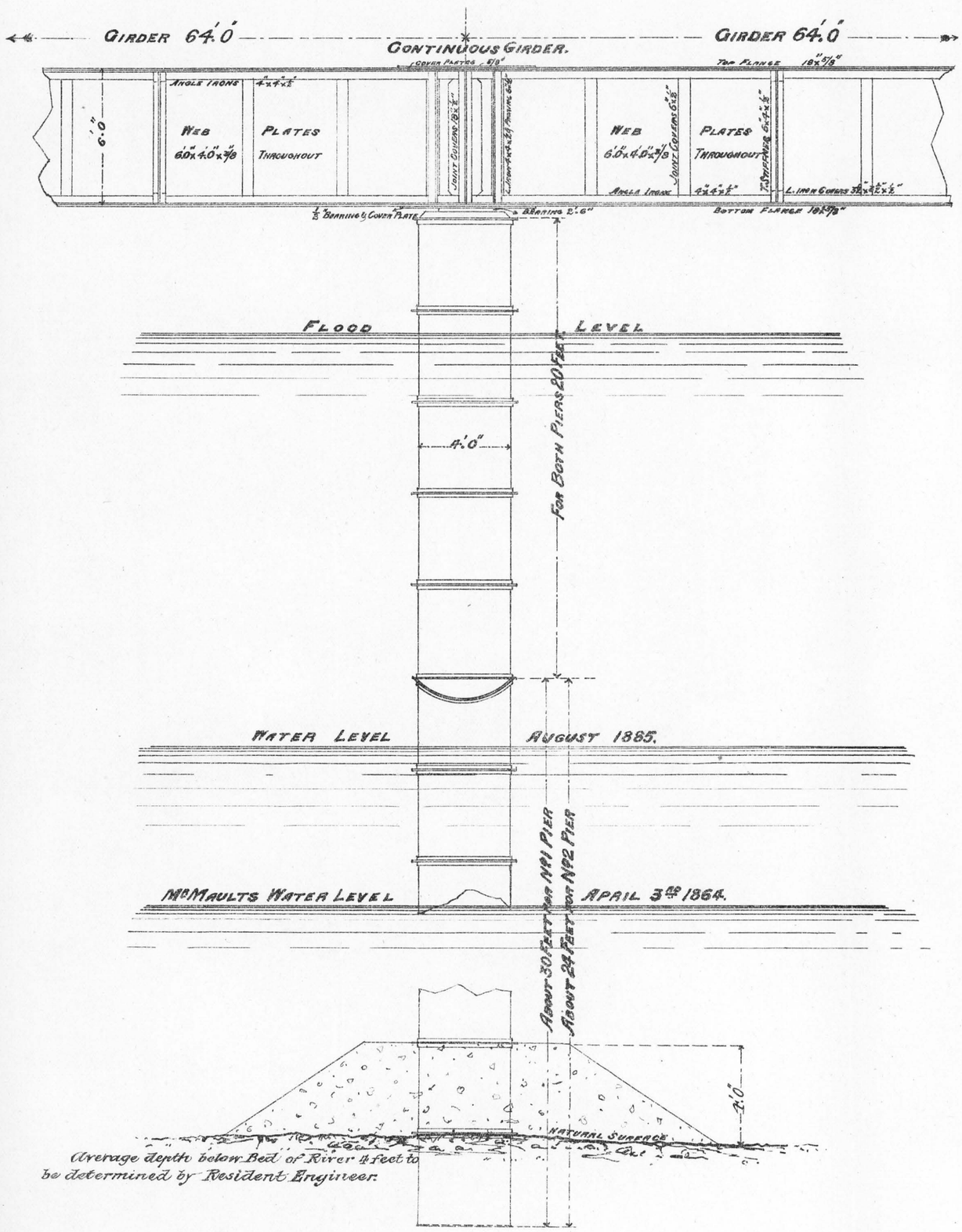
— ¾ to a foot. —

Sheet No 2
to accompany Report of
Engineer-in-Chief Tasmania
May 1886.

DERWENT VALLEY RAILWAY

No 2 BRIDGE SHOWING CONTINUOUS GIRDERS

60 Ft. SPAN.

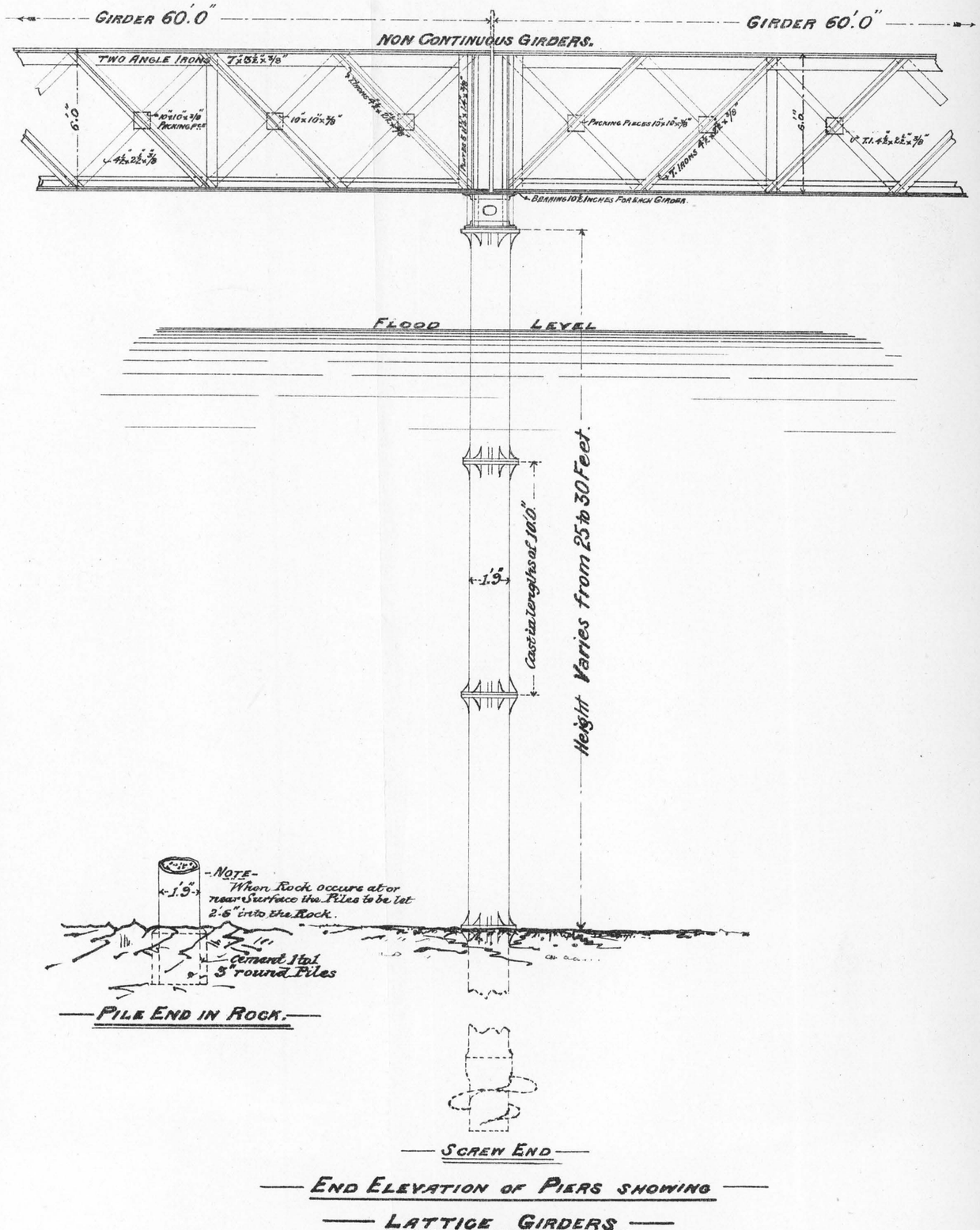


END ELEVATION OF PIERS SHOWING CONTINUOUS GIRDERS.

SOUTH AUSTRALIAN RAILWAYS

PORT AUGUSTA & GOVERNMET GUMS RAILWAY

58 FEET 4 INCHES SPAN.



PILE END IN ROCK.

END ELEVATION OF PIERS SHOWING LATTICE GIRDERS

Scale 3/16" to a foot.

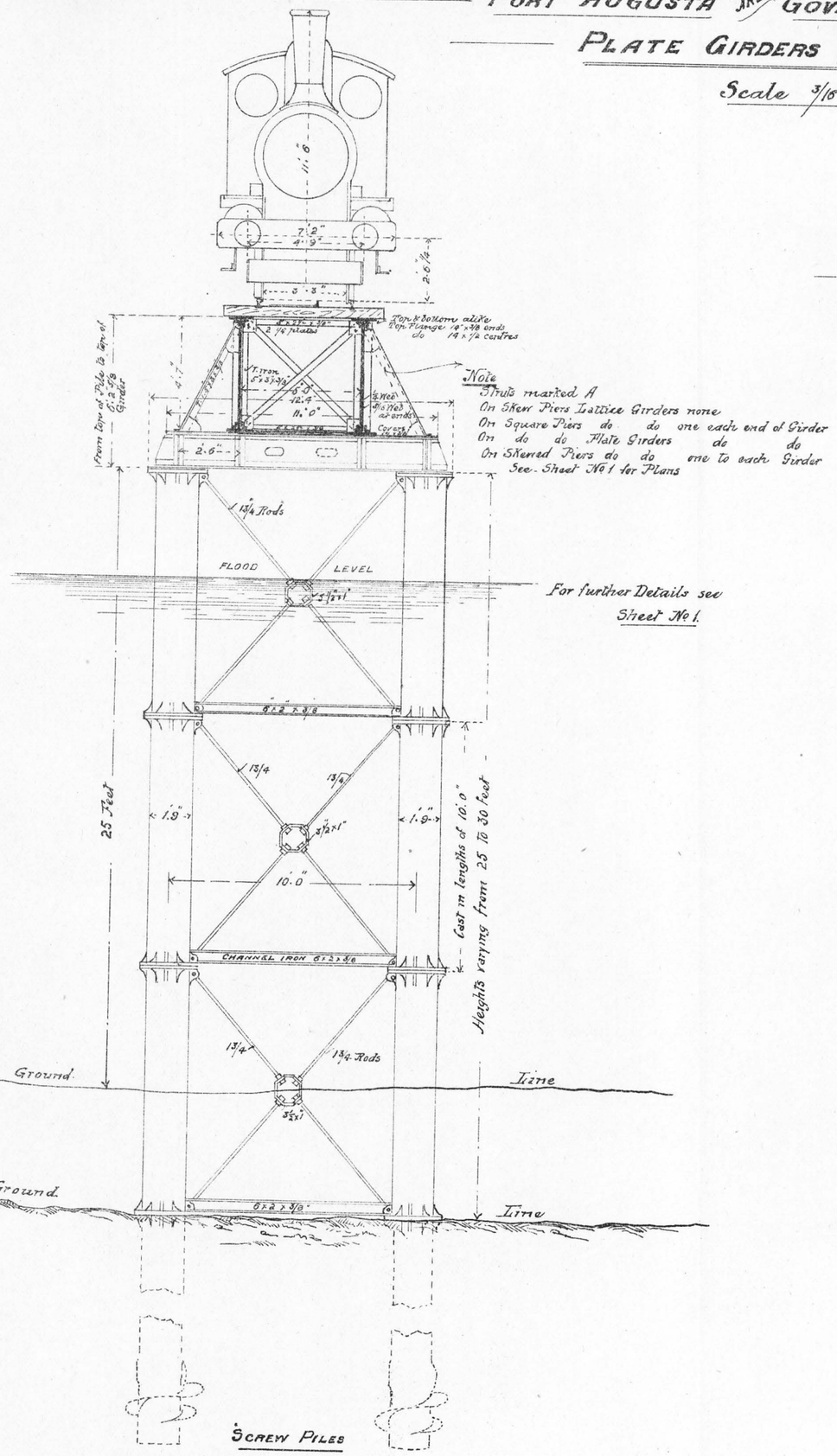
South Australian Railways

Port Augusta and Government Gums Railway

Plate Girders for 60Ft. Bridges

Scale 3/16" to a foot

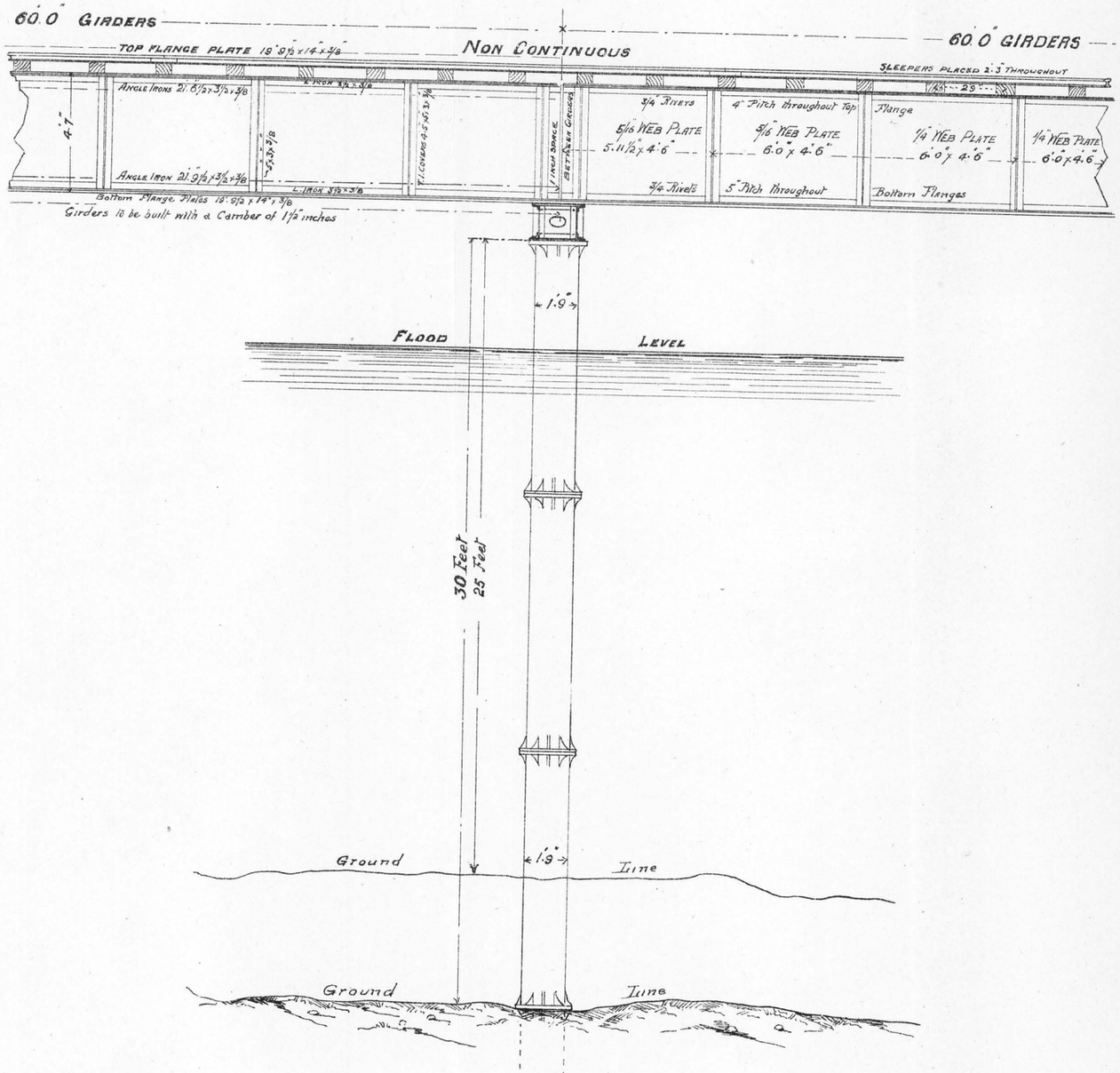
Sheet No 3
to accompany Report of
Engineer-in-Chief Tasmania.
May 1886



Note
Struts marked A
On Skew Piers Lattice Girders none
On Square Piers do do one each end of Girder
On do do Plate Girders do do
On Skewed Piers do do one to each Girder
See Sheet No 1 for Plans

For further Details see Sheet No 1.

Elevation of Piers and Cross Section of Girders



End Elevation of Piers

TM

Sheet № 4
to accompany Report of
Engineer-in-Chief, Tasmania
May 1886.

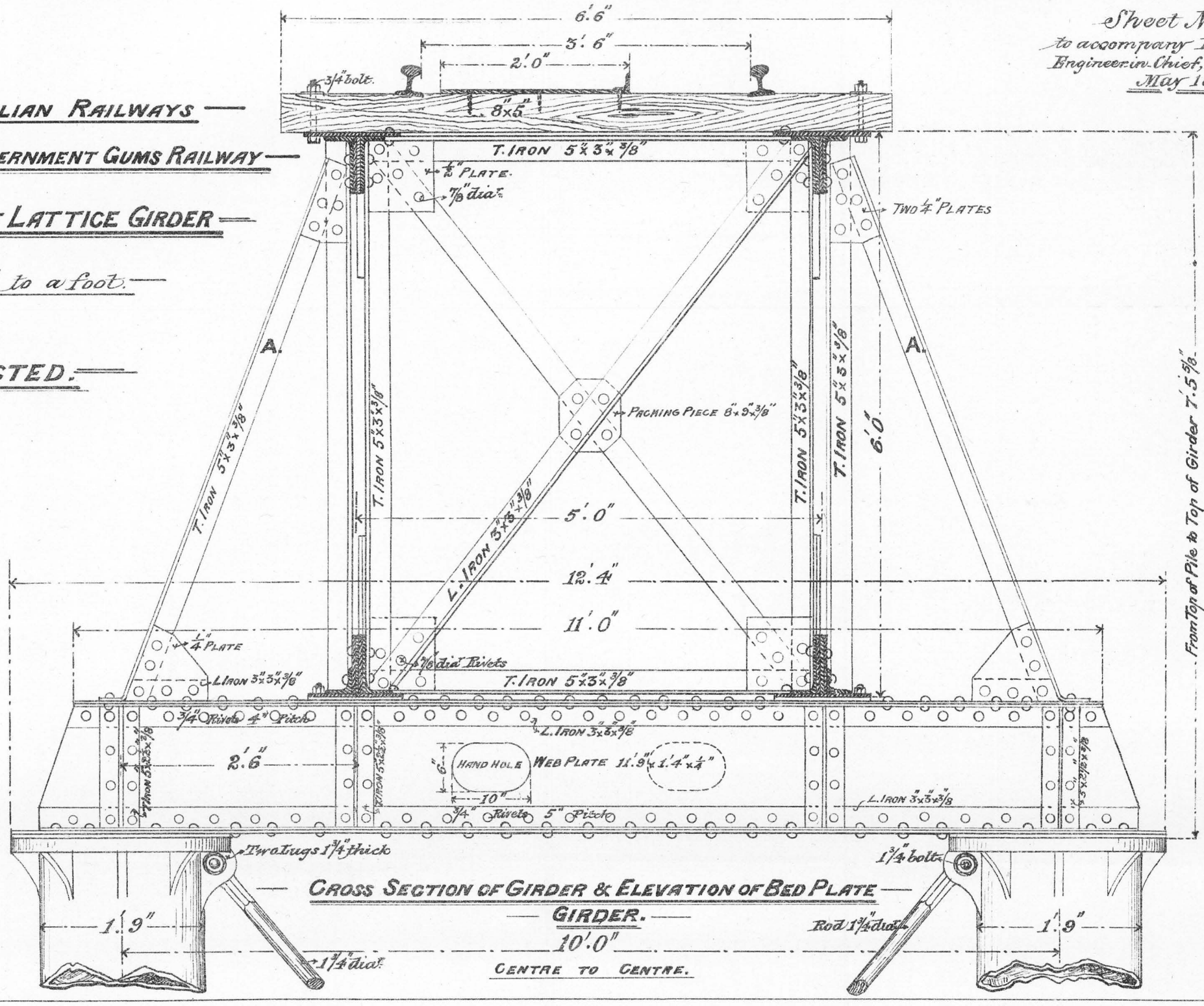
SOUTH AUSTRALIAN RAILWAYS

PORT AUGUSTA & GOVERNMENT GUMS RAILWAY

CROSS SECTION OF LATTICE GIRDER

Scale, 3/4" to a foot.

CONSTRUCTED.



NOTE.
Struts marked A.
On Skewed Piers Lattice Girders none.
On Skewed Piers Lattice Girders one each end of Girder.
On Square Piers do do do.
On do Plate Girders do do.
On Skewed Piers do do one to each Girder.
See Sheet № 1. for Plans.

CROSS SECTION OF GIRDER & ELEVATION OF BED PLATE

GIRDER.

10'.0"
CENTRE TO CENTRE.

DERWENT VALLEY RAILWAY

№ 2 BRIDGE GIRDERS.

Scale, 3/4" to a foot.

Gruerel Beams, Two Cut out of 10"x10" each 4" at Top, 6" at Bottom.

NOTE.
Every other plank fastened with hookbolt on alternate sides of Flange, and every fourth plank fastened with 3/4" bolt throughout Flange inside of Web at hole for Angle Rivet as shown on Working Drawing.

HOOK BOLT FOR PLANKING.

1/2 FULL SIZE.

PLAN.

ELEVATION.

NOTE
Each Girder Slotted for Four Holding down Bolts 1/8 Inches Diar on every Pier.

NOTE
Bed Plates Fastened Down by Six Lewis Bolts Twelve Inches Long.

CROSS SECTION OF GIRDERS

L.S.F.

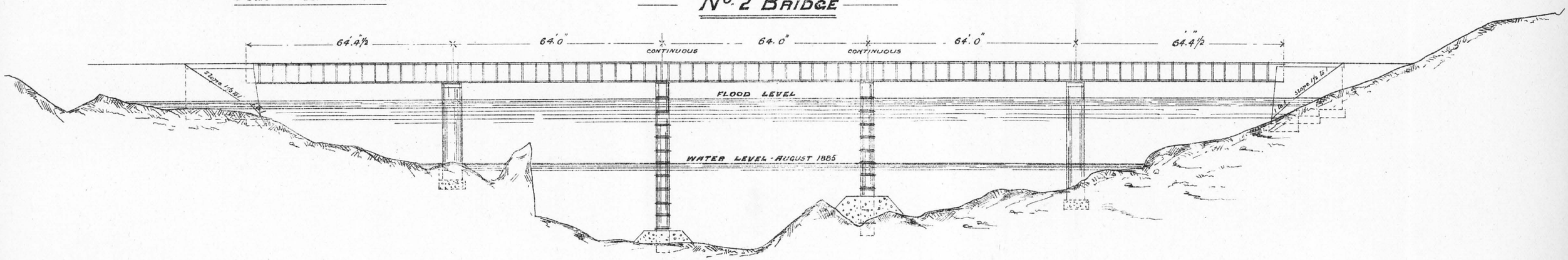
Sheet No. 5
To accompany Report of
Engineer in Chief Tasmania

DERWENT VALLEY RAILWAY

BRIDGE DIAGRAMS

Scale 30 feet to an Inch.

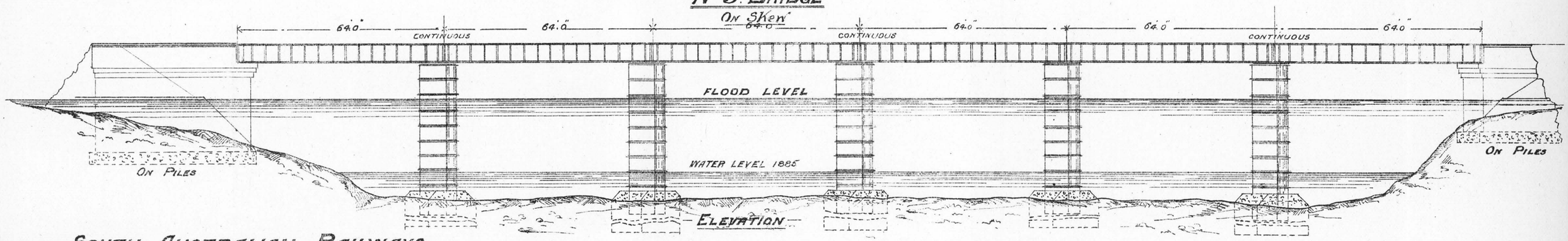
No. 2 BRIDGE



ELEVATION

No. 3. BRIDGE

On Skew



ELEVATION

SOUTH AUSTRALIAN RAILWAYS

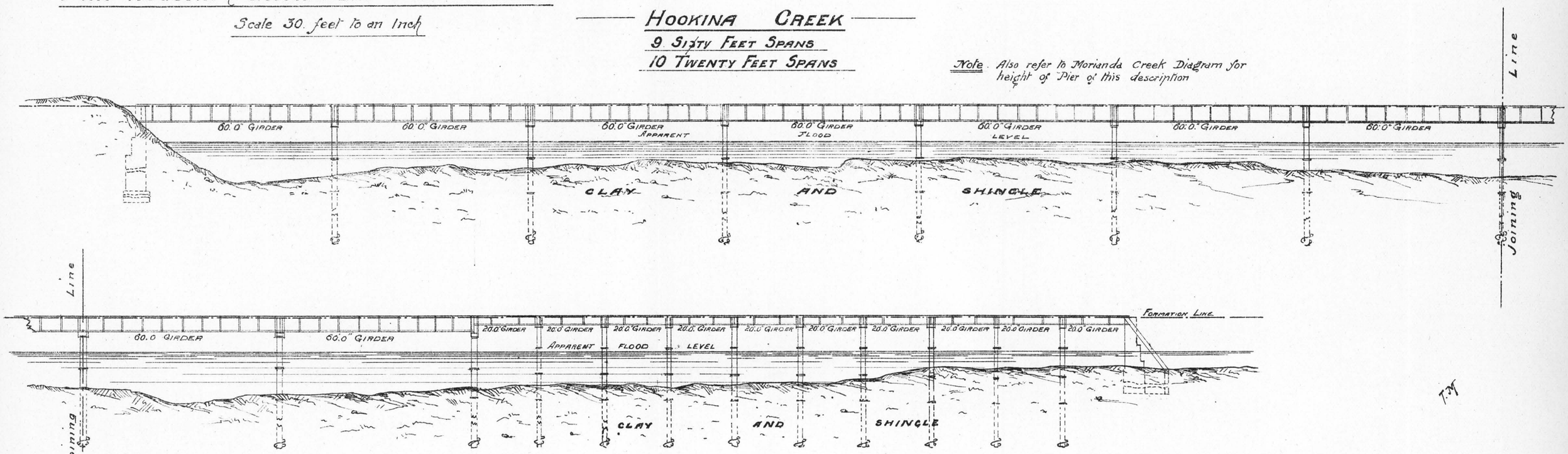
PORT AUGUSTA AND GOVERNMENT GUMS RAILWAY

Scale 30 feet to an Inch

HOOKINA CREEK

9 Sixty Feet Spans
10 Twenty Feet Spans

Note. Also refer to Morianda Creek Diagram for height of Pier of this description



ELEVATION

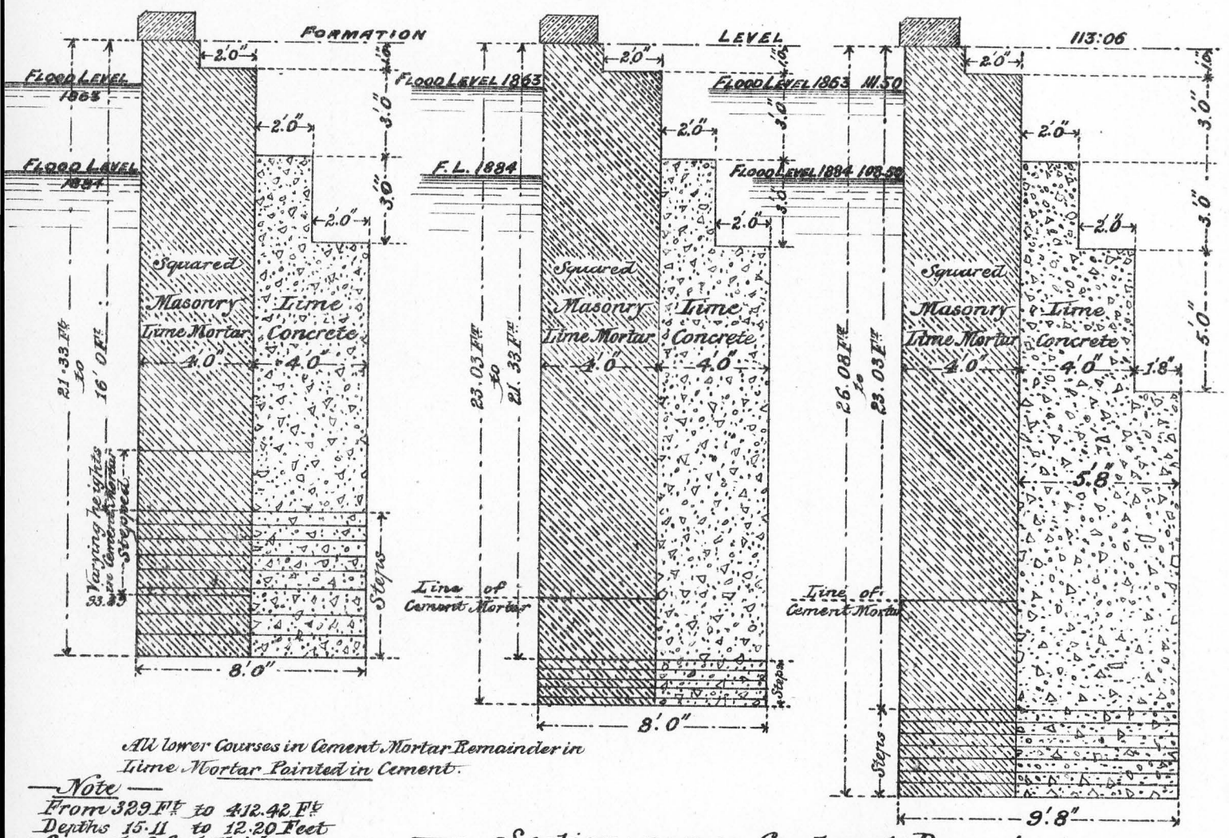
T.M.

Derwent Valley Railway

Sections Retaining Wall Back River as Constructed.

Scale, 3/16" to a foot.

From 250 Feet to 329 Feet. | From 140 Feet to 250 Feet | From Existing Work to 140 Feet.



All lower Courses in Cement Mortar Remainder in Lime Mortar Pointed in Cement.

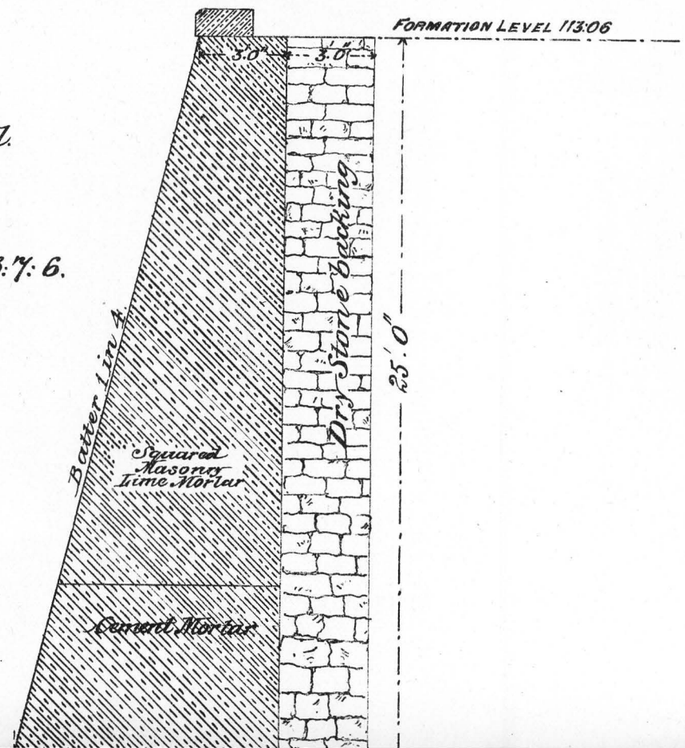
Note
From 329 Ft. to 412.42 Ft.
Depths 15.11 to 12.20 Feet
Concrete 2 feet thickness.
Wall 4 feet thickness.

Section as per Contract Drawings and Specification.

Note.

For 25 feet Wall Cost per lin: yd. as Constructed £41:17:1.

As per Contract Drawing £43:7:6.



Bhim Tal Kumaon N.W.P. India.

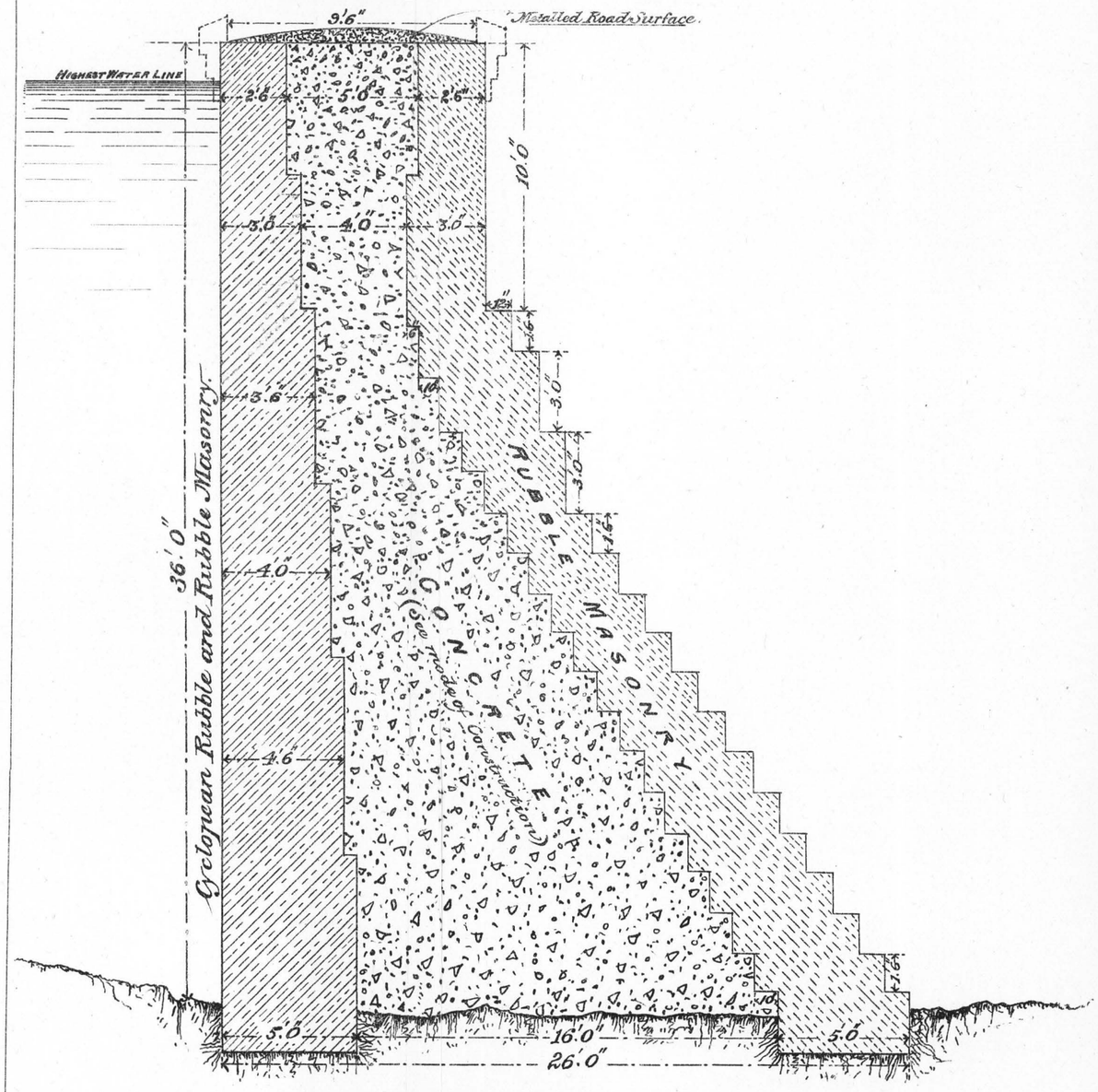
Masonry Wall Completed August 1883.

Sheet No 6
to accompany Report of Engineer-in-Chief Tasmania
May 1886.

Scale, 3/16" to a foot.

Taken from Minutes of Proceedings of the Institution of Civil Engineers London

Section



Mode of Construction

Mortar.

	In Wet Foundations.	Remainder of Work.
	8 Cub feet Portland Cement.	
No 1.	16 Cub feet Slaked Stone Lime.	
No 2.		20 Cub feet Slaked Stone Lime.
	8 Cub feet Ground Soorkhee.	10 Cub feet Ground Soorkhee.
	20 Cub feet Clean Coarse Sand.	20 Cub feet Clean Coarse Sand
	Mixture of Cement and Lime Mortar	1½ to 1.

Concrete

This was mixed in Situ, layers of broken quartzite stone were spread between the Masonry Face Walls about 4 to 6 inches thick on which the prepared Mortar (No 1 if in Wet Foundations No 2 elsewhere) was placed and the whole was then mixed with picks and Consolidated with 15 lb^s Cas Iron Rammers.

Proportions

50 Cub feet Mortar No 1 or No 2.
100 Cub feet Quartzite Stone 2" guage.
25 Cub feet Screenings.
but in the upper portions 6 to 9 inches Cubes of Rubble Stone were thrown into the middle of Concrete here and there to economise Mortar and hasten Work.

Quantities	D. V. Rates	Amount.
4800 Cub yards Rubble Masonry all taken in Lime Mortar	42/-	10560. 0. 0
5,200 Cub yards Concrete (all taken as Lime Concrete)	30/-	7800. 0. 0
333 Barrels Cement	20/-	333. 0. 0
16,300 Cub yards Excavations	2/-	1630. 0. 0
In these Quantities no account is taken of the Amount in Cement Mortar		£20438. 0. 0
Cost in India exclusive of Superrision		5790. 0. 0

NOTE — This Wall which was completed in August 1883, contains three times the Work of that at the Back River, and is vertical on face. Particulars are taken from the Minutes of Proceedings of the Institute of Civil Engineers London.

W.S.L.

Royal Albert Dock Works

as being constructed for the London St-Katherine and Royal Albert Dock Co 1886

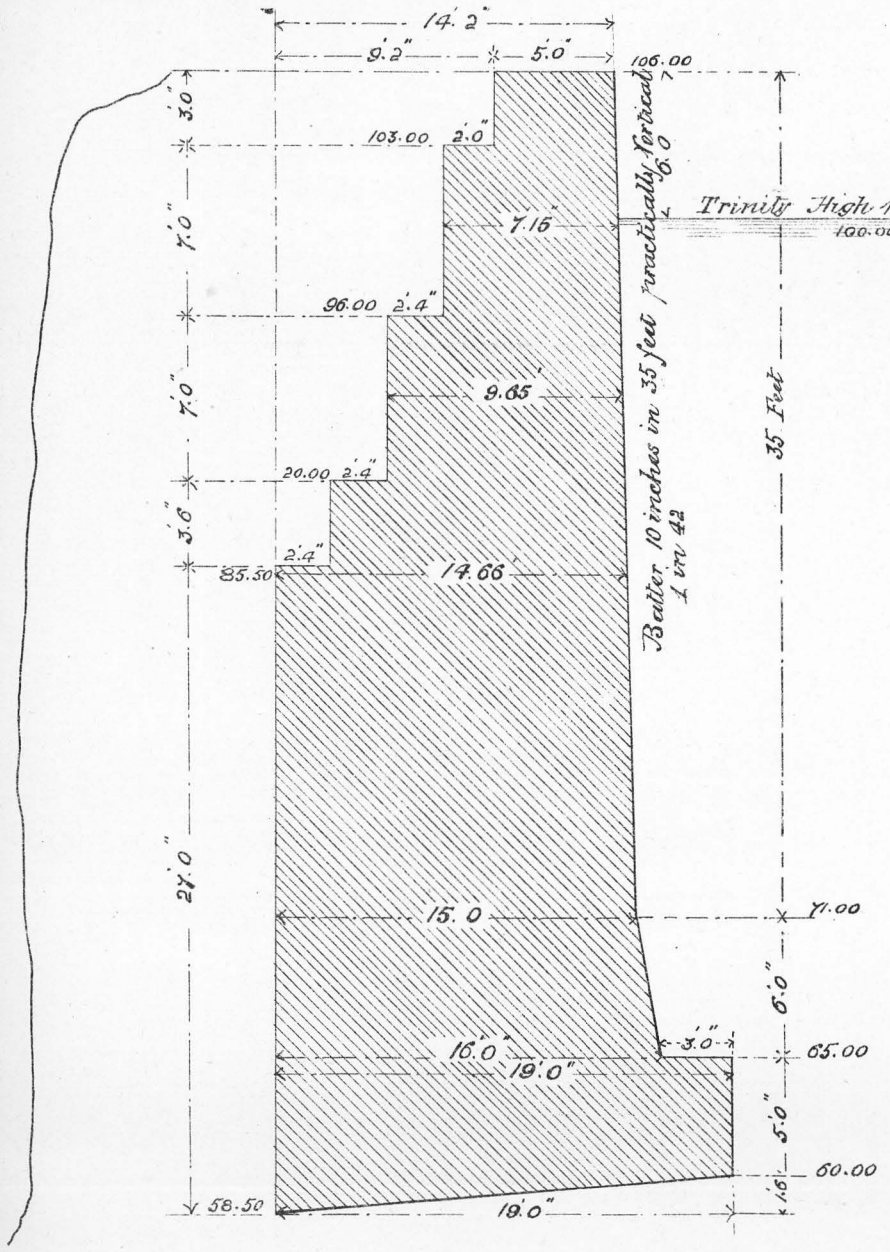
Robert Carr M Inst C.E Engineer

Sheet No 7

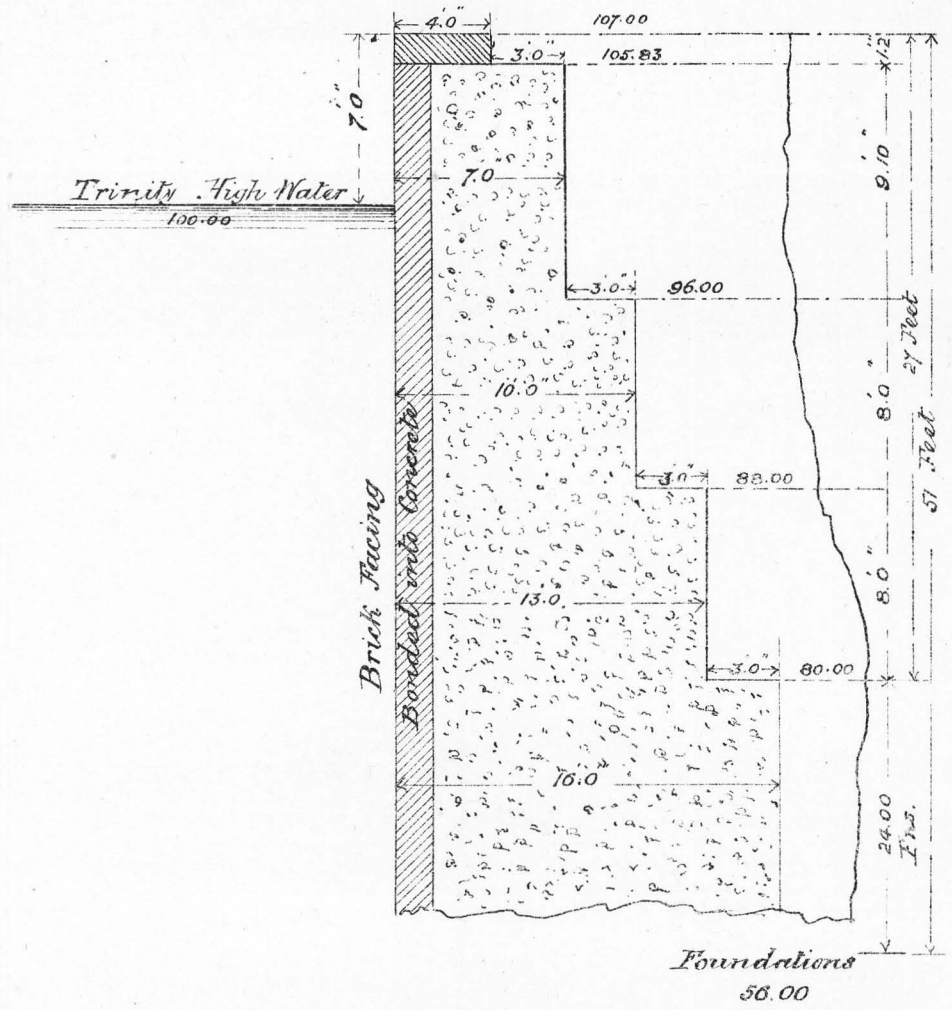
to accompany Report of Engineer-in-Chief Tasmania.

River Thames Retaining Wall

Scale 1/8 inch to a foot



New Lock Wall

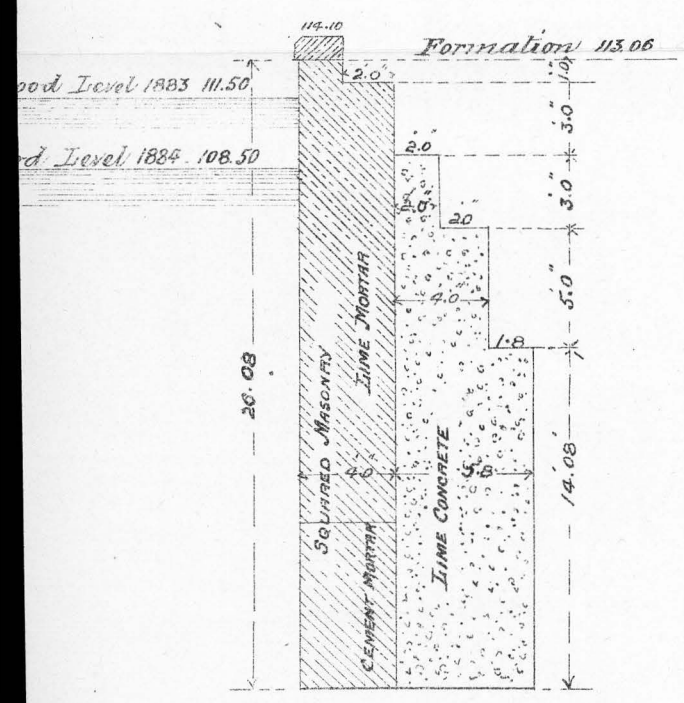


DERWENT VALLEY RAILWAY

BACK RIVER RETAINING WALL

WORST SECTION CONSTRUCTED

Scale 1/8 Inch to a Foot

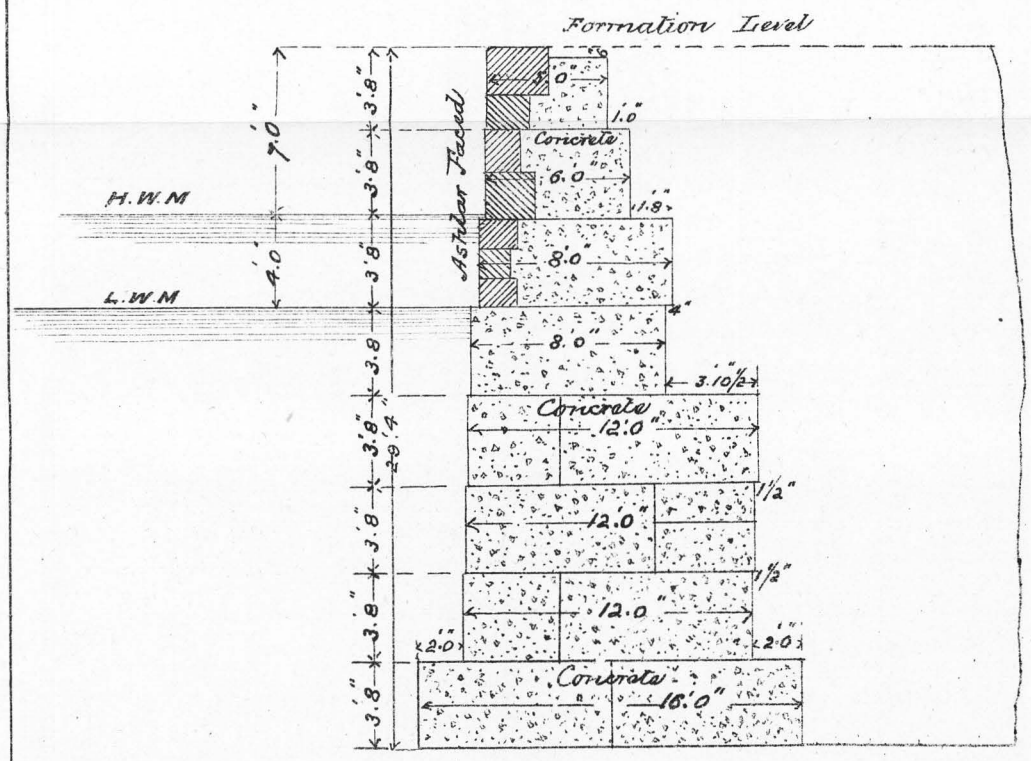


Callao Harbour Works

Section of Reclamation Wall Constructed by Brassey & Co - Nearly One Mile Constructed

Edwin Clark & James Hodges Consulting Engineers

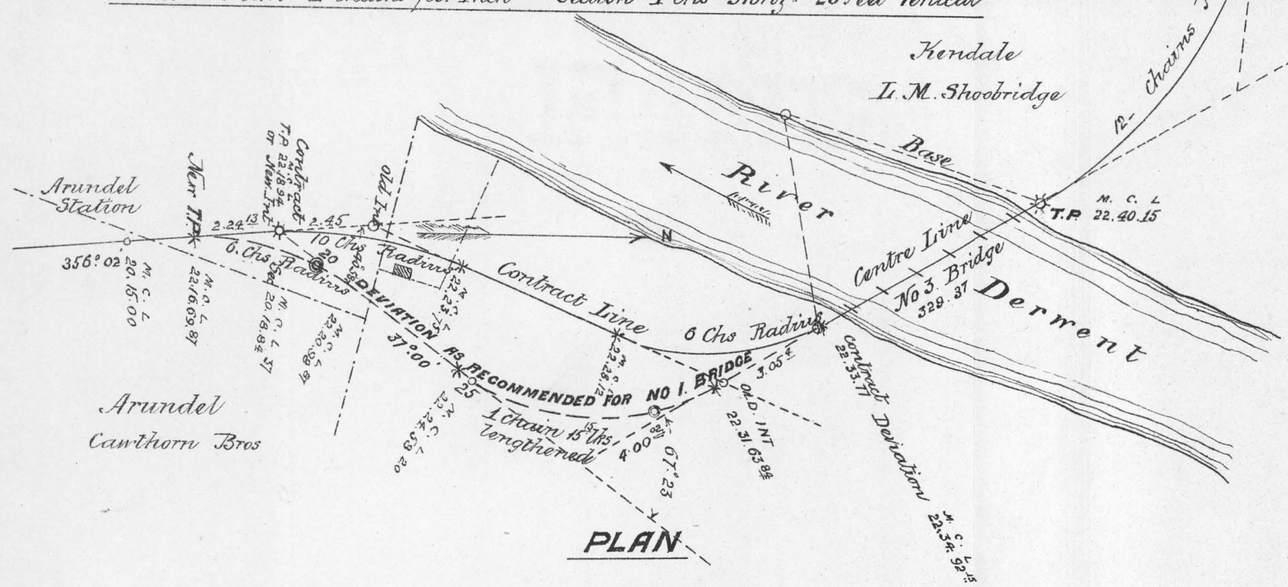
Scale 1/8 to a foot



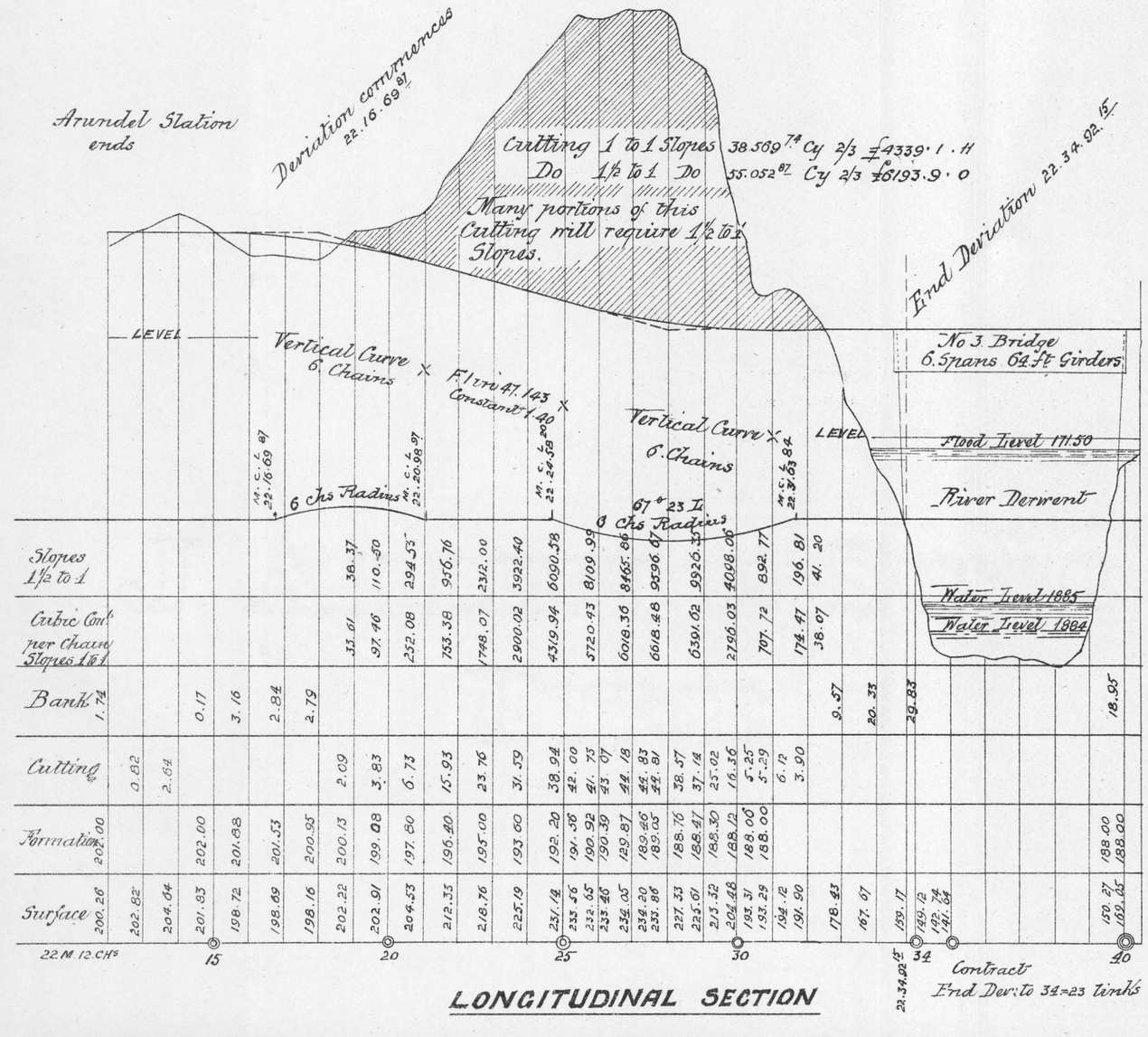
DERWENT VALLEY RAILWAY No 3 BRIDGE

APPROACHES AS RECOMMENDED BY ROYAL COMMISSION FOR No 1. BRIDGE

Scales Plan 4 Chains per Inch Section 4 Chs Horiz.l 20 Feet Vertical



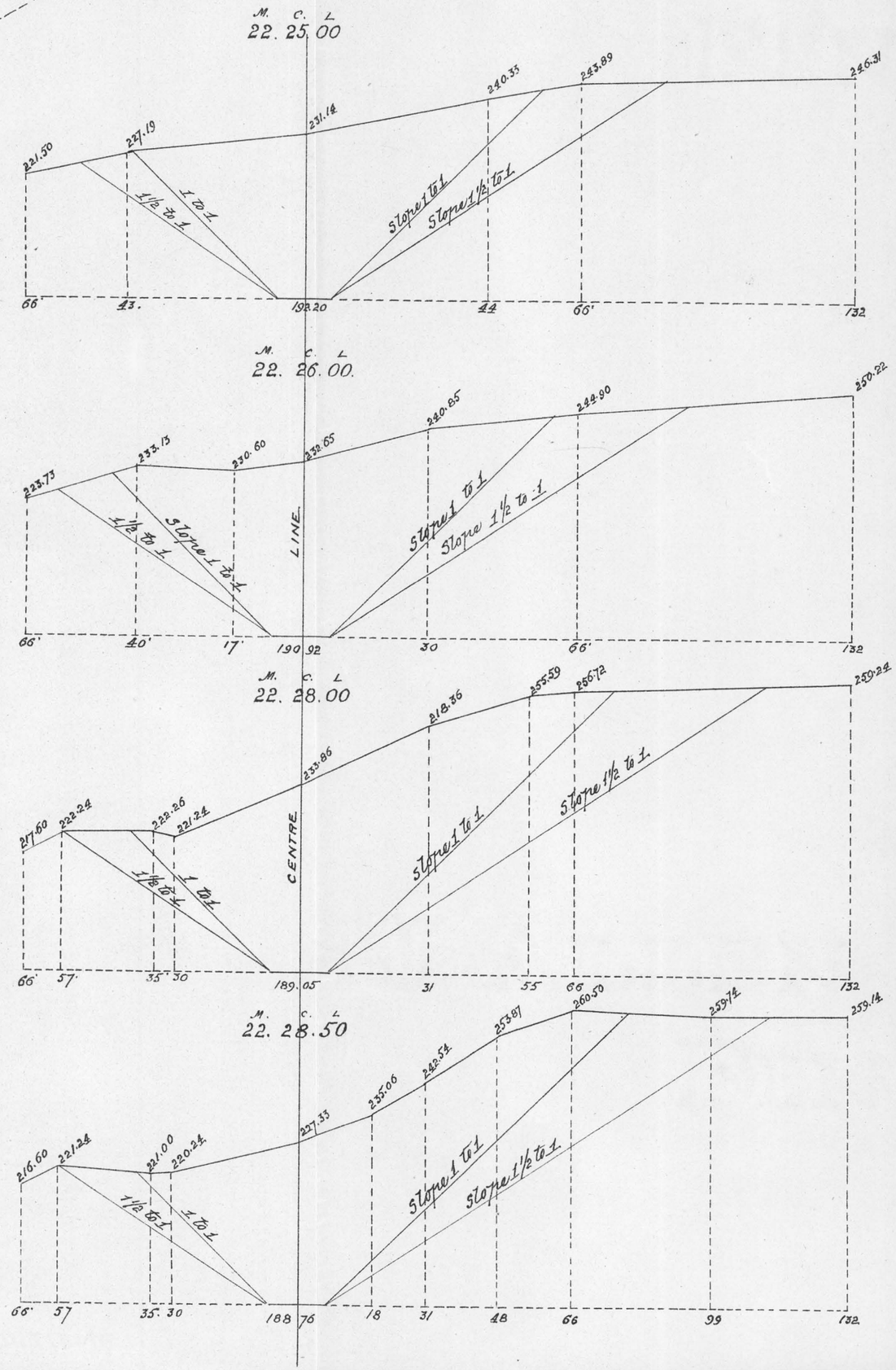
PLAN



Cross Sections -

Scale 30 Feet per Inch

Sheet No. 8
to accompany Report of
Engineer-in-Chief Tasmania
May. 1886.

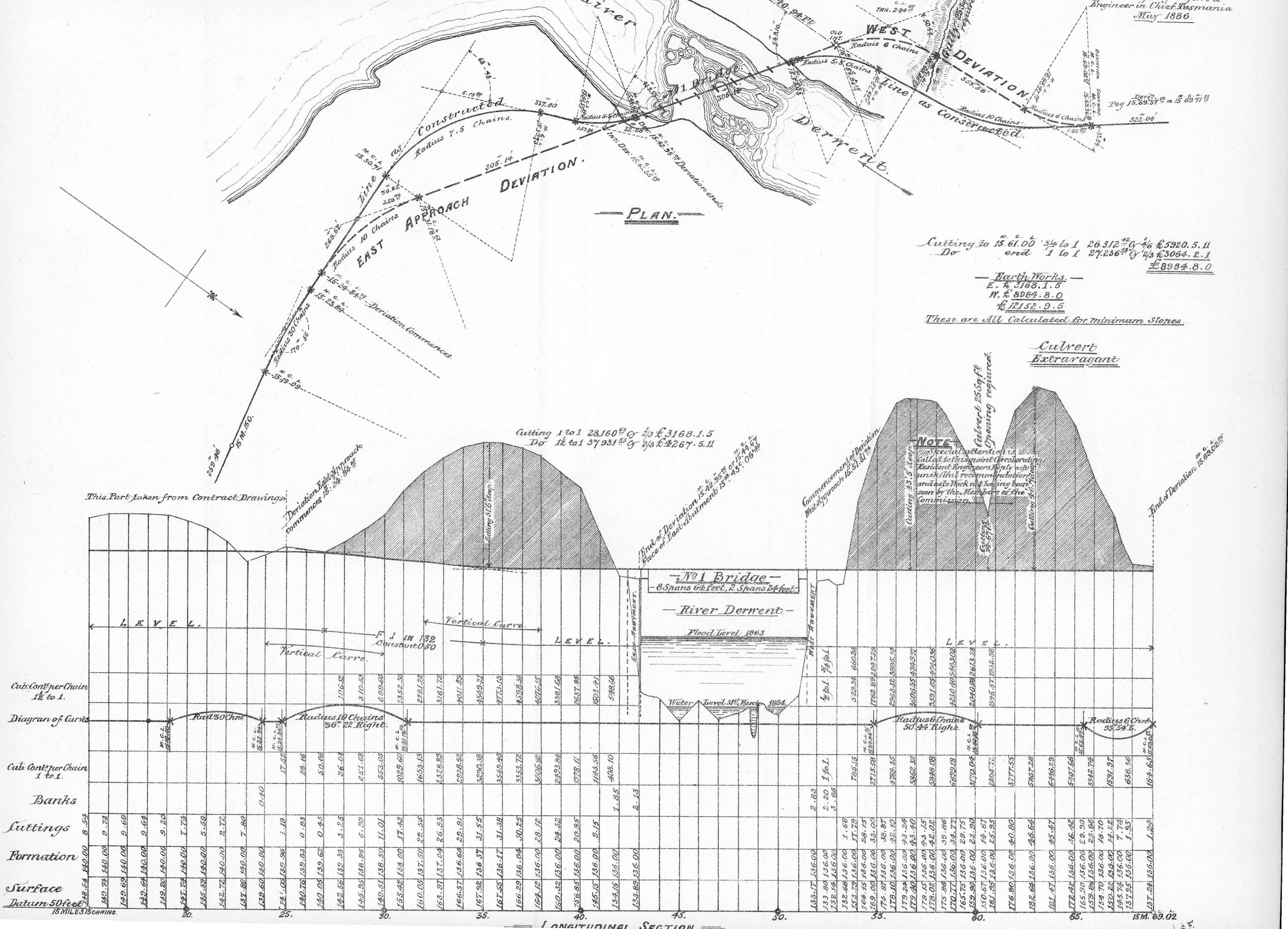


T.M

Derwent Valley Railway

Deviations to No 1 Bridge recommended by Royal Commission.

Scales, — Plan; 4 Chains per Inch. Section; 4 chs Horiz[l]. 20 ft Vertical.



Sheet No. 10
to accompany Report of
Engineer-in-Chief Tasmania
May 1886.

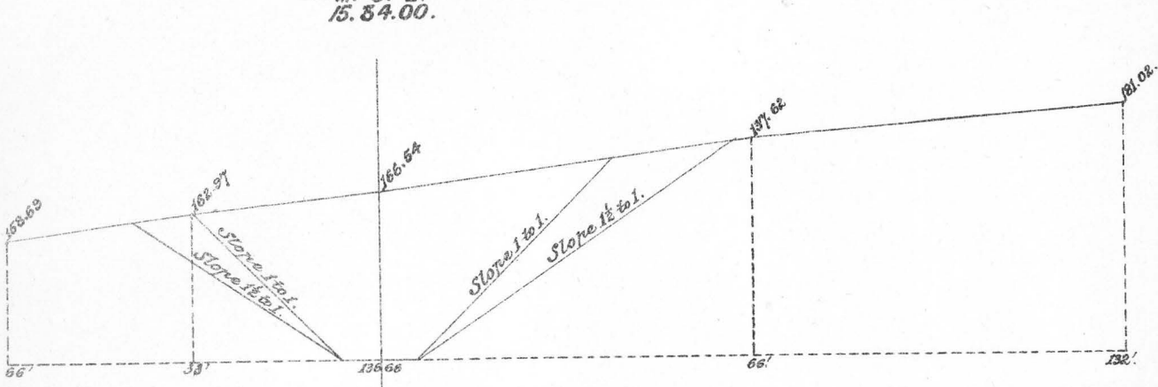
Derrent Valley Railway

Cross Sections

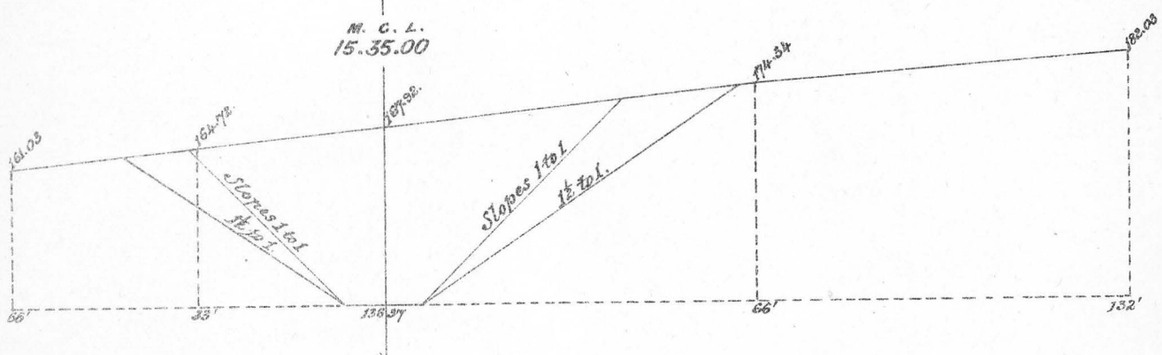
Scale, 33 feet per Inch.

East Approach.

M. C. L.
15.84.00.

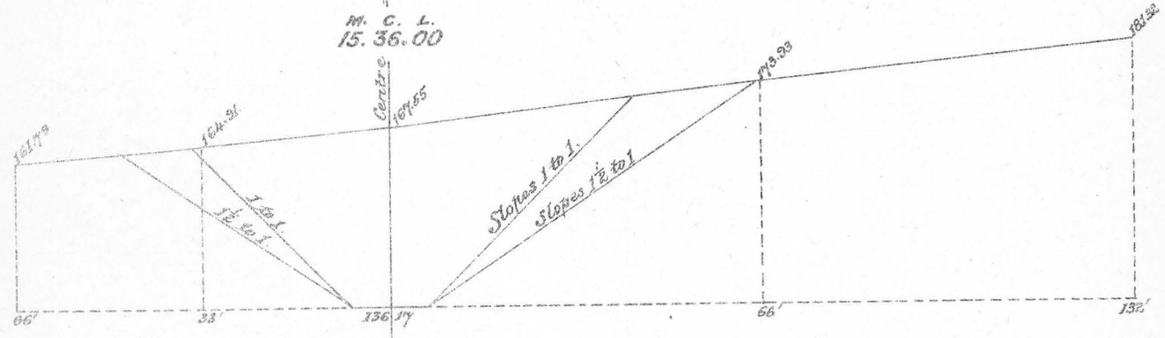


M. C. L.
15.35.00

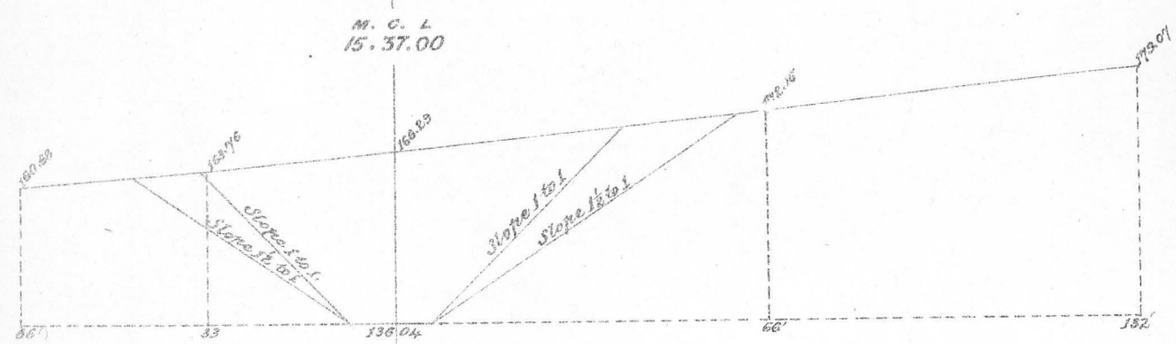


Line

M. C. L.
15.36.00

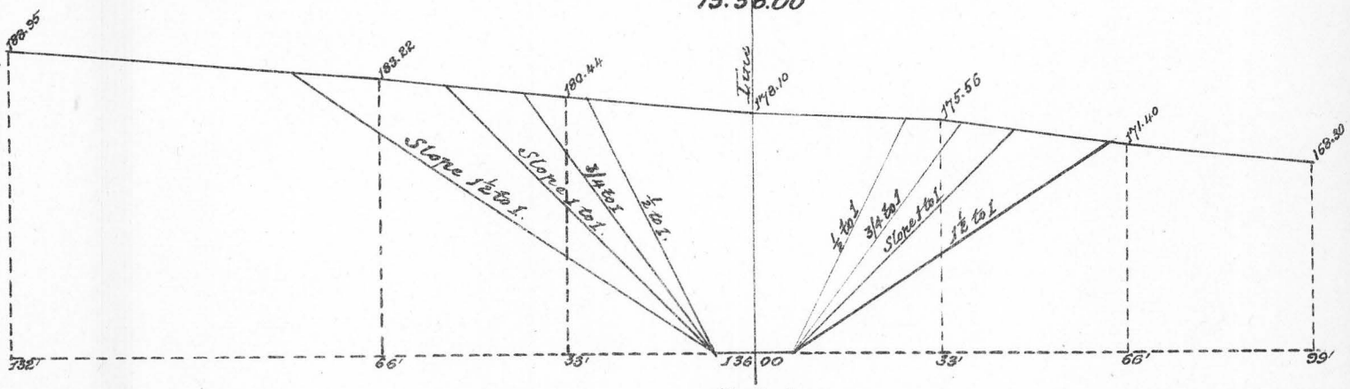


M. C. L.
15.37.00

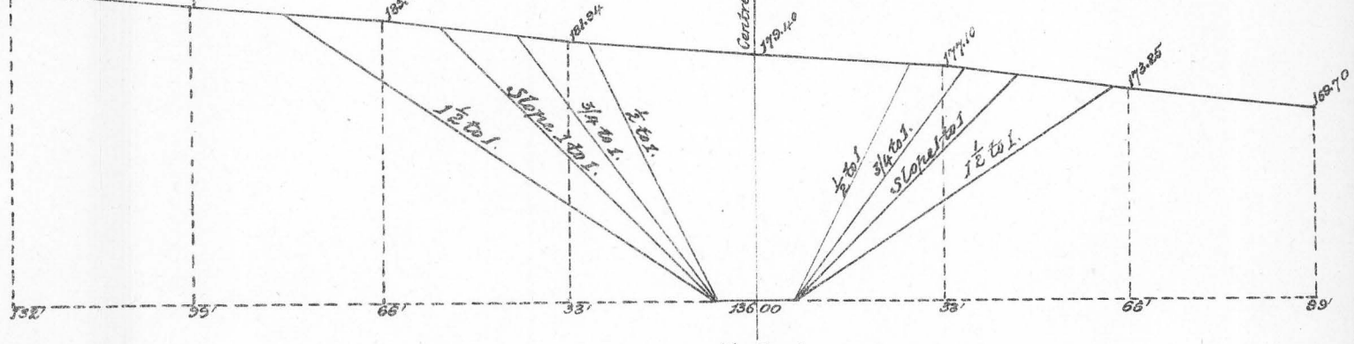


West Approach.

M. C. L.
15.56.00

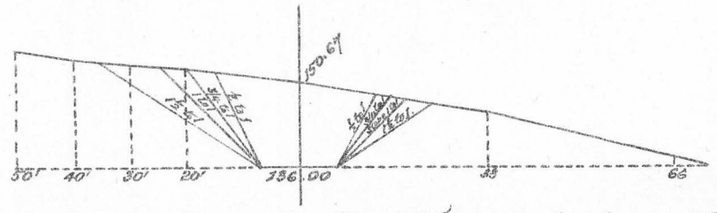


M. C. L.
15.57.00.



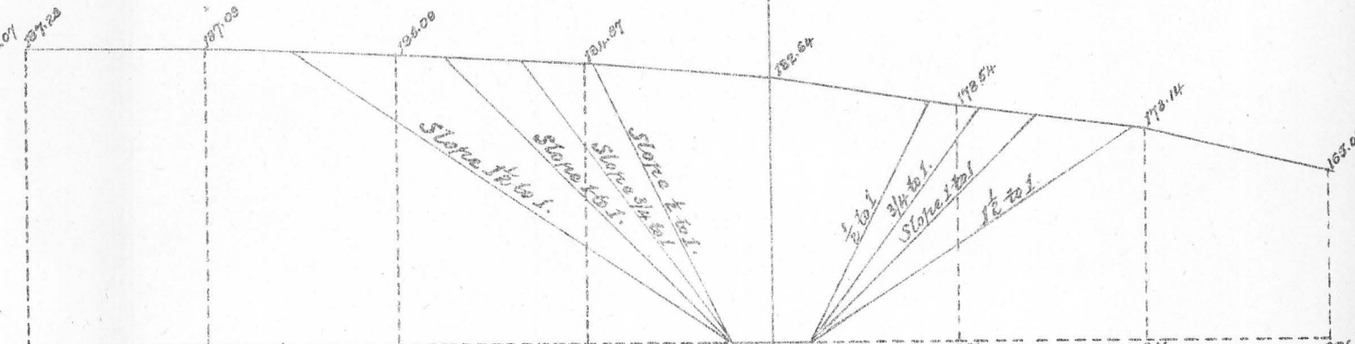
M. C. L.
15.60.48

Section along bottom of Creek.

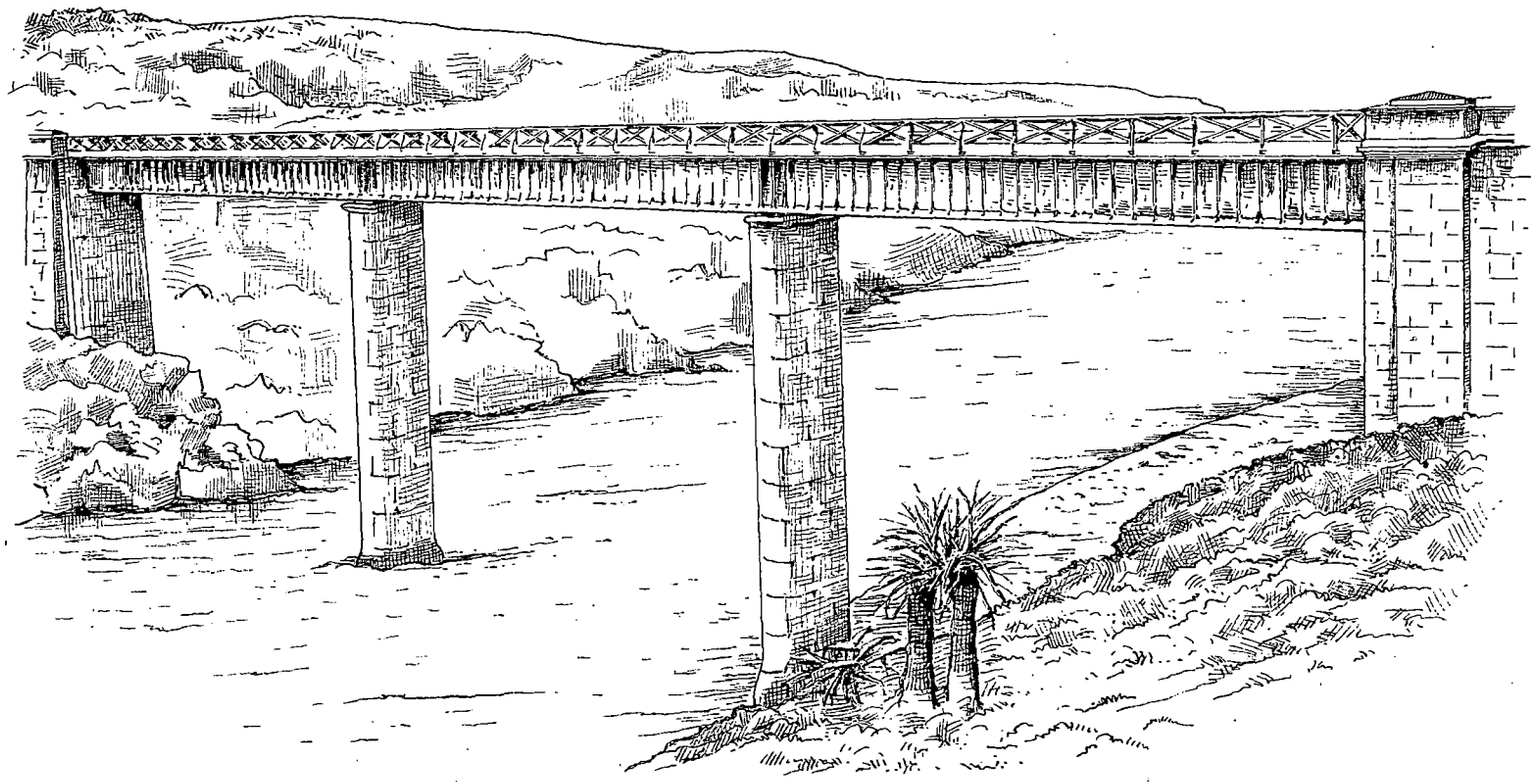


NOTE — Culvert for 25 Sq ft of Water to be provided for below Formation Level.

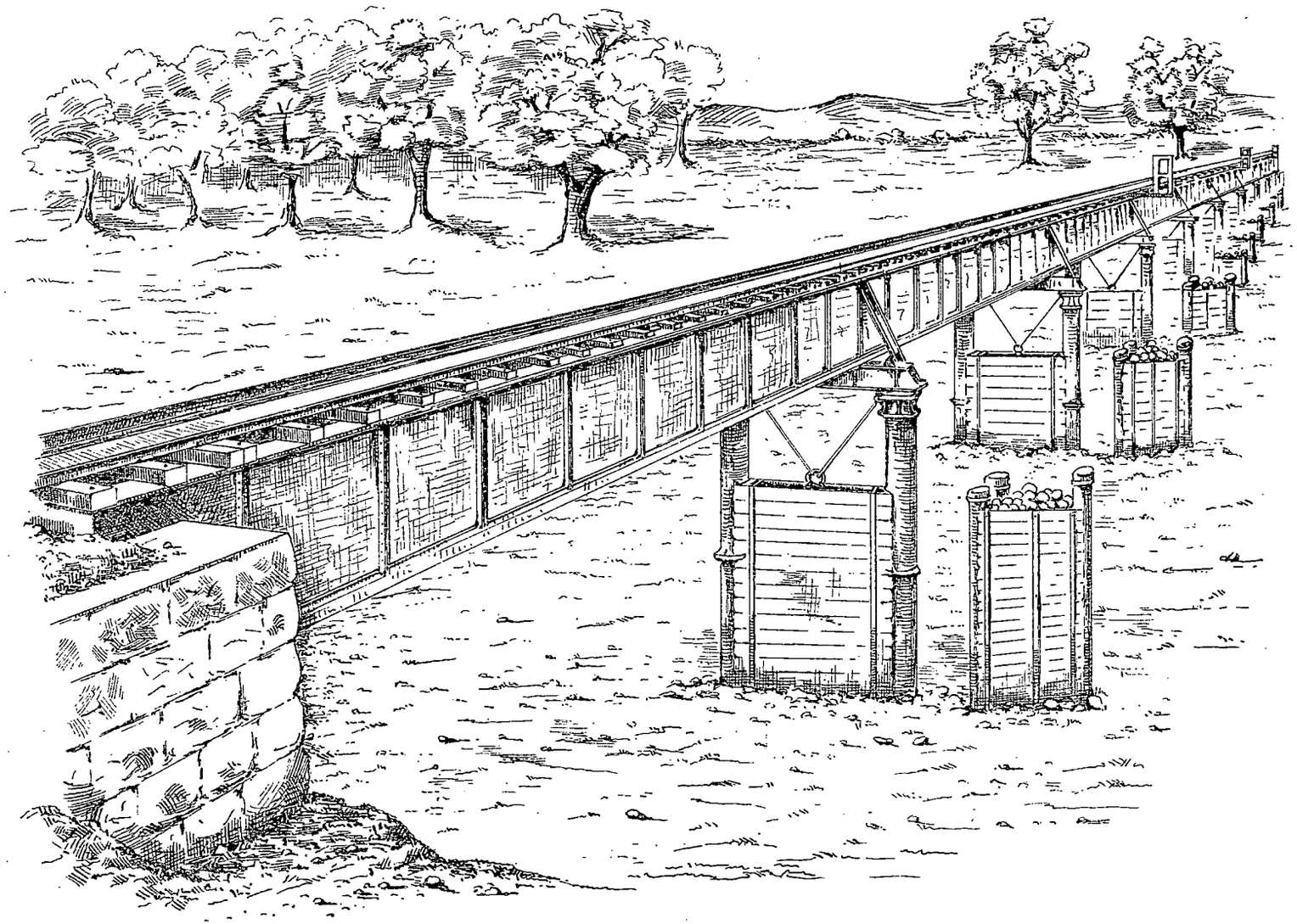
M. C. L.
15.63.00



L.S.F.



WAIMAKIRIRI BRIDGE – N.Z



GOVERNMENT GUMS RAILWAY — SOUTH AUSTRALIA

HOOKINA RAILWAY BRIDGE —

(In continuation of Paper No. 65.)

FURTHER Correspondence in connection with the Report of the Royal Commission on Railways and Public Works.

TELEGRAM.

The Premier to the Premier of South Australia.

Hobart, 14*th May*, 1886.

WILL you kindly permit Mr. Mais, your Engineer-in-Chief, to examine and report upon the plans of two important Railway Bridges, designed by our Engineer-in-Chief, the stability of which has been questioned by Royal Commission on Public Works recently sitting here? Plans forwarded by mail this evening in anticipation of your consent.

PREMIER.

TELEGRAM.

The Premier South Australia, to the Premier.

Adelaide, 14*th May*, 1886.

SHALL be happy permit Mr. Mais report upon plans as requested.

J. W. DOWNER, *Premier.*

The Premier to the Premier of South Australia.

Premier's Office, Hobart, 15*th May*, 1886.

SIR,

REFERRING to my telegram of yesterday's date and to your reply, I have the honor to convey to you the thanks of this Government for the permission, so promptly accorded, to allow Mr. Mais, the Engineer in Chief of South Australia, to report upon the plans of the two Bridges now in course of construction on the Derwent Valley Railway.

I enclose herewith a communication from the Minister of Lands and works to Mr. Mais relative to the points on which his opinion is sought.

I have, &c.

J. W. AGNEW.

Lands and Works Department, Hobart, 15*th May*, 1886.

SIR,

I HAVE the honor to ask if you would be good enough to examine the plans sent herewith for two bridges over the River Derwent on the Derwent Valley Railway, and report upon the stability and sufficiency of the proposed work if carried out according to the designs.

The contractor has lately challenged the stability of the work if carried out according to designs, and his objection has been upheld by the Commissioners lately appointed to enquire into the Railway

construction and Public Works of the Colony,—viz., W. A. Zeal, Esq., of Victoria; H. C. Stanley, Esq., Engineer-in-Chief of Queensland; and A. W. Lawder, Esq., late of the Public Works Department, India.

Our Engineer-in-Chief dissents strongly from this finding, and gives reasons that have decided the Government, in justice to him, to refer the matters to a third party for final decision.

If you can see your way to undertake this task I shall be much obliged, and, as the Government are now liable for claims for each day's delay, the receipt of an early reply and decision is of importance.

The construction of these bridges has not been commenced *in situ*, but all the girders and wrought-iron caissons are practically complete.

I forward with the drawings certain particulars and data for calculations from the Engineer-in-Chief.

Should you undertake this matter be good enough to forward account for your fees with the Report.

I have the honor to be,
Sir,
Your obedient Servant,

NICHOLAS J. BROWN,
Minister of Lands and Works.

H. C. Mais, *Esq., M. Inst. C.E.,*
Engineer-in-Chief, South Australia.

(*Particulars referred to in preceding letter.*)

DERWENT VALLEY RAILWAY.

Description of Bridge No. 2 (on square) for Railway only.

Superstructure.

Wrought-iron plate girders, 6 feet deep, 6 feet apart (centres).
Spans, continuous over the two iron caisson piers, braced vertically at every 12 feet with steel diaphragm plates and L iron, 4 × 4 × ½.
Wind bracing at bottom, between each of above plates.
Top secured by decking, bolted through at every 2 feet with ¾-inch bolts and intermediate hook bolts.

Wrought-iron Caisson Piers.

Sunk at least 4 feet in rock bottom.
Filled with cement concrete composed of 5 parts clean hand-broken stone, 2-inch gauge; 3 parts of clean sharp coarse sand; 2 parts best Portland cement (minimum tensile test 336 lbs. per square inch).
Concrete apron round base of pier (4 feet in height) after bottom is prepared for same. 2 feet in width on top; slope 1 or 1½ to 1.

Masonry Piers.

All in cement mortar, of best squared or block-in-course masonry, and ashlar ends. Footings on cement concrete foundation (of 5, 3, and 2) having projection of six inches all round.

Description of Bridge No. 3 (on skew).—To be used for Railway, with provision for a future very limited Road Traffic.

Superstructure.

Similar to No. 2, with girders continuous over one pier only.

Piers.

Wrought-iron caissons filled with concrete, as described for No. 2, and set in concrete foundation, but 17 feet in length where shown as 14 feet for No. 2.
The adaptation of the bridge for occasional road traffic was done subsequently to the ironwork being ordered from England.

Wrought-iron Caisson Piers generally.

Area of concrete to carry weight, 50 per cent more than in 2 5-feet cylinders.
Maximum gross distributed load at top, 2 tons per square foot.
Ditto at bottom, 3½ tons per square foot.
Vertical section of deepest pier, No. 2 Bridge, 208 square feet.
Break of continuity by ties and braces, 27 square feet.
All ironwork well coated with tar or paint.

Loads.

Superstructure.

Girders	20 tons
Hardwood, bolts, &c.	7¼ „
Ballast and rails	15¾ „
	43 tons

Combined dead and live load taken at 1½ tons per lineal foot of bridge.

Weight of pier, viz., highest at No. 2 Bridge:—

Concrete from underside of girders to base of foundation	204 tons
Wrought-iron caissons	16 „
	220 tons

Wind Pressure.

Taken at 30 lbs. per foot, square to bridge, with train on same, 13 tons.

General.

The wrought-iron casing was adopted—

(1.) As a precaution against timber coming down river in flood.

(2.) As cheapest construction under schedule prices in contract.

The 60 feet spans were adopted owing to limited means.

Road bridges, above and below proposed railway bridges, have existed for 40 years, with spans of 40 and 45 feet.

J. FINCHAM.
15. 5. 86.

Imperial Chambers, Bank Place, Melbourne
19*th May*, 1886.

SIR,

A REPORT appeared in the Hobart *Mercury* of the 14th instant, signed C. K. Sheard, reflecting in a violent manner on the Commissioners appointed by your predecessor to enquire into the construction of the Railways and Public Works of Tasmania.

I should not have noticed Mr. Sheard's letter had it been written in his individual capacity; but, as it has apparently been sent to the *Mercury* for publication, and has been accepted by that paper as an official and reliable document, I am constrained to believe it has received the approval of the Ministerial head of the Public Works Department.

I sincerely trust I am premature in having arrived at that conclusion.

As the letter abounds in mis-statements and inaccuracies, I take this opportunity of emphatically protesting against its publication, at all events until it had been referred either to me or to one of my late colleagues.

I protest against a subordinate officer of the Railway Department being permitted to misrepresent gentlemen whose services were sought for by the Government of Tasmania, and who were requested by His Excellency the Governor, by special Commission, to undertake certain onerous and highly responsible duties, amongst which was the particular function of inquiring into the manner in which public officers had performed their duties.

For a person in the above position (when reflected upon) to question the competency of his judges, to denounce their authority, and to cavil at their award, is a not unusual procedure; but such conduct would assume a grave aspect if it was approved by those who instigated the reference.

I hope a satisfactory explanation can be afforded to the late Commissioners, otherwise I fear it will be difficult in future to induce competent men to undertake similar enquiries.

The Hobart *Mercury* alleges that your Government contemplate referring some of the matters dealt with by the late Commission to Mr. H. C. Mais, of Adelaide. No objection can be taken to this course, provided the case submitted contains an accurate epitome of the facts disclosed. I think, however, the case should be sent first to the Commissioners for their perusal and concurrence before it is forwarded to Mr. Mais.

I venture to point out a significant instance of Mr. Sheard's inaccuracy, and with it conclude this letter. Mr. Sheard states he was "tutored by a pupil" of the late "Sir I. Brunel." Such an

intimate personal knowledge of either the pupil or the deceased gentleman which Mr. Sheard lays claim to would, I should have thought, compelled caution when referring to either of them; but Mr. Sheard appears even now not to be aware that the late Isambard Kingdom Brunel never was knighted, a fact which ought to be known by all engineers, and especially by Mr. Sheard.

Singularly enough, the Engineer-in-Chief has fallen into the same error.

In fairness to my late colleagues and myself, I ask you, Sir, to grant that publicity to this letter which was afforded to that of Mr. Sheard.

I am, &c.,

W. A. ZEAL,
Late Chairman of the Royal Commission on Railways and Public Works.

The Hon. J. W. AGNEW, *M.L.C., Premier, &c.,*
Hobart, Tasmania.

FORWARDED for the perusal of the Hon. the Minister of Lands and Works.

J. W. AGNEW.
22*nd May*, 1886.

PERUSED and returned to the Hon. the Premier.

NICHOLAS J. BROWN.
25. 5. 86.

Premier's Office, Hobart, 28*th May*, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of your letter of the 19th instant, in which you call my attention to a letter published in the Hobart *Mercury* of the 14th instant, signed by Mr. C. K. Sheard, C.E., which you complain of as reflecting on the Members of the late Royal Commission appointed to enquire into the construction of Railways and Public Works of Tasmania, of which Commission you were Chairman.

I regret extremely that you should in any degree feel aggrieved by the publication of Mr. Sheard's letter. It is still more a matter of regret that you should have arrived at the conclusion that the publication of the letter referred to implies that it had received the approval of the Ministerial head of the Public Works Department. You will observe that, with the exception of certain regretable expressions, which ought not to have been used, the letter deals with purely technical matters, as to which it could not fairly be expected that the non-professional head of the department was competent to express either approval or disapproval. Mr. Sheard's letter, in fact, was regarded merely as a defensive reply to authoritative statements impugning his professional knowledge and capacity. The writer also, not unfairly I think, wished to prove that the statement of the Commissioners, "the foregoing is all the information we have been able to elicit from the department," could not have a personal application, as he actually had furnished all the information required.

As to his publication of comments on the findings of the Royal Commission in reference to the works under his charge, I would submit for your consideration whether it could be fairly expected that an officer whose engagement with the Government is only temporary; whose professional reputation, in view of future employment, was of such importance to him, and whose capacity was so gravely reflected on, should be expected to remain silent, and allow himself to rest under public censure for an indefinite period.

I feel satisfied, after these observations, that you will not impute to this Government any intentional discourtesy either to yourself or to the other members of the late Commission, as I should be sorry indeed that the friendly relations which have hitherto existed should be affected, even temporarily, through inadvertence.

With regard to the reference made to Mr. Mais, of Adelaide, for his opinion as to the correctness of the designs, and the consequent stability of bridges No. 2 and 3 over the Derwent, I have the pleasure of enclosing for your information a copy of a letter [15th May, 1886] addressed by my colleague, the Minister of Lands and Works, to Mr. Mais, together with a list of documents and drawings forwarded at the same time.

I also beg to forward to you a copy of correspondence between the Minister of Lands and Works and Mr. R. M. Johnston, the Government Statistician of the Colony, in reference to the

Scottsdale Railway. Mr. Johnston writes from long and extensive experience on the subject referred to him, and as his calculations *re* the expensive working of the railway differ to a large extent from those of the Commissioners, I shall be very glad to be favoured with any further remarks you may be kind enough to offer on this important subject, and I shall have much pleasure in securing for them the same publicity as will be given to the correspondence now forwarded to you.

I have, &c.

J. W. AGNEW.

The Honorable W. A. ZEAL, *M.L.C., Melbourne.*

TELEGRAM.

To J. FINCHAM, *Esq., Engineer-in-Chief.* *Adelaide, 5th June.*

WHAT is nature foundations Nos. 2 and 3 bridges? What velocity current? Report next week.

MAIS, *Adelaide.*

TELEGRAM.

To H. C. MAIS, *Esq., Engineer-in-Chief, Adelaide.*

No. 2, solid blue and greenstone rock. Caisson sunk four feet into same. Current of highest registered flood, 6½ miles. No. 3, two feet of gravel, then solid bluestone rock, sunk same as No. 2. Current 6 miles.

FINCHAM, *Hobart.*
7. 6. 86.

Imperial Chambers, Bank Place, Melbourne, 5th June, 1886.

SIR,

I HAVE received your letter of the 28th ultimo, to which was attached a copy of the case submitted by your Government to the Engineer-in-Chief of South Australia, in reference to the proposed mode of constructing Nos. 2 and 3 bridges on the Derwent Valley Railway, and also a lengthy document which I understand you instructed the Government Statist to prepare in refutation of the late Commissioners' opinion as to the probable excessive cost of working the Launceston and Scottsdale Railway.

I desire at the commencement of my letter to assure you that any remarks I have made, or purpose now to make, are not prompted by any personal feeling, but are written with the view of pointing out that the very unusual and unceremonious treatment the late Commissioners have received at the hands of your Government is not only discourteous and unwarranted, but was wholly unprovoked, and in my opinion could not have happened to those gentlemen at the hands of any other Australian Government.

The letters published in your local papers, and the comments made by one of them, appear to have been inspired by a Member of your Government, and the extraordinary course has been taken of assuming *ex parte* statements as fact, while it is notorious that such assertions neither accord with the evidence taken by the Commissioners nor with the documents and plans submitted to them.

You do not deny that the publication of Mr. Sheard's letter was sanctioned by the Minister of his Department, if otherwise that officer would have acted in direct violation of the rules of the Civil Service, and rendered himself amenable to its discipline; but in explanation of that circumstance you merely say that Mr. Sheard's abusive epithets are "regretable expressions," while his virulence is accepted as fair criticism, and regarded by your Government as a "defensive reply."

I presume the late Government, composed as it was of three of your present colleagues, satisfied themselves, after due enquiry, that the members of the late Royal Commission were competent men, of considerable experience in railway matters, and that they were individually and collectively fitted to perform the onerous duties which it was proposed to entrust to their judgment and discretion. This must have been done before their names were submitted to His Excellency the Governor for his approval. To argue otherwise would be to admit a tacit insult to the Governor, and constitute an unpardonable breach of good faith on the part of his late advisers. I likewise assume that in the opinion of the members of the preceding Government some extraordinary circumstances connected with the construction of your railways rendered the constitution of an independent Board of Inquiry necessary, even if the creation of such a Board was personally distasteful to that Government. To assert the contrary will be to admit a loss of time and money, and a deception practised on the public by the late Government

If these premises are granted, and the conduct of the Government throughout the entire enquiry proves this, and warrants the inferences I have drawn, I search in vain for the motives which have moved your Government to allow the late Commissioners to be treated as they have been by the Minister of Public Works.

You have not supplied me with the calculations which your Engineer-in-Chief has made in proof of the stability of the piers of Nos. 2 and 3 bridges, and which you say you have forwarded to Mr. Mais. I likewise point out that the details submitted are in many essential particulars at variance with the plans and specifications and the evidence given by the Engineer-in-Chief; neither have you replied to my request to be permitted to furnish Mr. Mais with the Commissioners' reasons for their decisions respecting the above structures. I therefore regretfully arrive at the conclusion that the Minister of Public Works has no desire to obtain an impartial report, but seeks to secure from Mr. Mais an opinion based on the views of his interested officers.

This course, to be just to the Minister, is in conformity with the policy which has inspired the local newspaper to impugn the late Commissioners' integrity and judgment, to set aside the collated evidence, and to ignore the silent testimony of letters and plans, although these, taken altogether, barely corroborate the charges of incapacity and negligence stated by that paper to be exhibited in the construction of the Derwent Valley Railway.

In further proof of my allegation, I call your attention to the colored reports which have been circulated broadcast through the press over the Australian Colonies, a characteristic specimen of which appears in the Melbourne *Argus* of the 18th May. Another illustration is given in the annexed extract from the same paper on Saturday, 29th May. This reliable production is dated Hobart, 28th May, and purports to give the substance of a letter written by you to me on that day, but which only reached me through the post on Tuesday, 1st June.

THE COMMISSION ON RAILWAYS IN TASMANIA.

(By Telegraph from Our Correspondent.)

HOBART, FRIDAY.

A letter has been received by the Chief Secretary from the Chairman of the Commission on Railways, objecting to the replies of subordinates to the report being published, at least until referred to some member of the Commission. The Chief Secretary has answered that it is only fair to allow persons whose professional reputation is at stake to defend themselves. No discourtesy is intended to the Commissioners. He has forwarded with the reply an elaborate report by the Government Statistician, in which that officer shows from data that in regard to many of the lines the Commission made grave mistakes. They stated that the Scottsdale line must earn £75,000 a year before paying 4 per cent. on the cost of construction; whereas the Statistician maintains that the line will pay 4 per cent. when £39,715 is earned yearly.—[Extract from *Argus*, 29. 5. 86.]

If the Commissioners had published letters reflecting on your Government in newspapers outside your Colony, or if they had sent reports to your local papers, the action of your Government, though undignified, would have been to some extent justifiable.

I contend you have no right to allow highly-colored and sensational reports impugning the Commissioners' honour and professional ability to appear in newspapers circulating in Australia, where little, if any, interest is taken in your local quarrels, and which reports are grossly libellous.

I appeal, Sir, to your well known sense of justice, and, as Chief of the Government of Tasmania, is such conduct right and proper? Is this fair dealing towards gentlemen who did their utmost to serve your Colony and give effect to your instructions, and who, in the honest performance of a thankless and painful duty, have had contumely heaped on them, and the power of the press invoked to misrepresent them?

I now propose dealing briefly with the extremely voluminous report of the Government Statist.

This gentleman, I assume, from the position he holds, is an expert as far as facts and figures are concerned, and I take it for granted that he has had other railway experience than that obtained on the Launceston and Western Railway; but he either has never travelled over the route of the Scottsdale line, or does not sufficiently realise its physical peculiarities and difficulties.

To attempt any comparison between the *actual* cost of working railways in Great Britain and the *supposed* cost of working the Scottsdale line is, indeed, "an intricate problem,"—the former system being based on the experience of nearly half a century, while the other is entirely supposititious.

There is no railway in Great Britain like the Scottsdale line in any particular. British railways, as a rule, are comparatively straight and level; they are built for a tolerably wide gauge; they traverse densely populated districts; they are worked with cheap fuel and labour, and their goods and passenger traffic is enormous.

The Scottsdale line, on the other hand, is what may almost be termed a mountain railway, traversing an extremely broken and difficult country. It is built on the narrow gauge, and its curves and gradients are so exceptionally sharp and steep as to render it a unique type of its class.

It will probably have a very small traffic for some time to come, as for many miles along its route it has little *bonâ fide* settlement; the land is inferior for a similar length; and the aggregate population to be served by it (excluding Launceston) certainly cannot much exceed 1000 souls. The cost of fuel per ton and labour per man required to work the line also widely differs from that of any English railway.

Where, then, is the analogy? One system affords actual results; the other is an entirely unknown quantity. Moreover, the conditions affecting both are so dissimilar, that any comparison between them must be founded on the wildest conjecture.

The same remarks, to a great extent, apply to the comparison made by the Statist between those Australian railways quoted by him and the Scottsdale line.

As a contrast to the fanciful theories of the Government Statist, the Commissioners framed their estimate of the cost of working the latter line after they had personally inspected the country and carefully examined and considered the plans and sections. Then, fortified with these reliable preliminaries, they secured the evidence of experts to test the value of their deductions. If that combined procedure is unreliable, the Commissioners' opinions will, to some degree, be affected. Still, whatever may be the result, I think it will be conceded by all thinking men, that the Commissioners acted discreetly in basing their conclusions solely on fact and observation.

The Government Statist, on the other hand, solves his complicated problem by assuming something which exists only in his imagination, and on this nebulous data proves the Commissioners' opinions to be erroneous. Such finely-drawn theory is aptly illustrated by that well-known simile of a philosopher who, declaiming against waste and extravagance, attempted to prove that his horse could live and work on a straw per day, and he did so, until death overtook the victim. The Statist evidently has a poor opinion of "engineering experts," and I shall not attempt to remove the hallucination. He also considers himself a better authority on railway matters than the Commissioners are, and they accept his dictum in all humility. He is now quite satisfied that he has demolished the Report and its conclusions by the aid of his factors and equivalents, and the Commissioners are content it should remain so.

When the foregoing matters have been divested of their personal surroundings, the feeling, I believe, will be that of regret that your Government should have acted unfairly towards their own referees, and have considered it desirable on public grounds to place before the public conclusions which will not be borne out by the evidence contained in the Report. For none should know better than a Government that a decision may be right, even though the language in which it is conveyed may be either erroneous or misleading.

I have to request the favour of your supplying the newspapers who published a précis of the Government Statist's Report with a copy of this letter, and oblige

Your obedient Servant,
W. A. ZEAL.

The Hon. J. W. AGNEW, *M.L.C., Chief Secretary and Premier of the Government of Tasmania, Hobart.*

FORWARDED to the Hon. the Minister of Lands and Works, with the Premier's compliments, and the request that it may be laid before the Cabinet this evening.

J. W. AGNEW.
9th June, 1886.

PERUSED and returned to the Hon. the Premier, with a reply dealing with such portions of Mr. Zeal's communication as refer to me personally.

NICHOLAS J. BROWN.
10. 6. 86.

Lands and Works Department, Hobart, 10th June, 1886.

SIR,

THE letter of the Hon. W. A. Zeal, Chairman of the late Royal Commission on Railways and Public Works, dated the 5th inst., and forwarded to me by you this day, contains some statements and comments personal to myself which appear to require some notice from me. Mr. Zeal seems to be labouring under an entirely erroneous impression when he states that "the letters published in your local papers and the comments made by one of them appear to have been inspired by a member of your Government."

A subsequent paragraph, in which Mr. Zeal says "I search in vain for the motives which have moved your Government to allow the late Commissioners to be treated as they have been by the Minister of Public Works," unmistakably points to me as the member of your Government who is supposed to have inspired the letters referred to in the first instance, and subsequently the comments by the Press upon them.

This imputation is without the slightest foundation in fact. Every one of the published letters from the officers of the department has been entirely spontaneous and unsolicited either by myself or the Engineer-in-Chief; and the statement that I in any way inspired the comments of the Press thereon is as incorrect as it is ridiculous. Although it is quite unnecessary to offer any observations upon such a charge to you, or to my colleagues in the Ministry, or, I trust, to any one to whom I am personally known, it appears desirable to make this denial as public as the accusation.

It will be observed that Mr. Zeal's condemnation of your Government is for the most part based upon this most unworthy suspicion, which seems to have taken possession of his mind, that what he speaks of as "highly colored and sensational reports impugning the late Commissioners' integrity and judgment," were either written or directly or indirectly inspired by me. On being informed of the error into which he has fallen, I doubt not that Mr. Zeal's sense of justice will induce him to retract the angry reflections on the conduct of the Government which he has thought proper to embody in his letter.

With regard to Mr. Zeal's complaint that you have not supplied him with the calculations of the Engineer-in-Chief, etc., I desire to remark—

1. That the calculations of the Engineer-in-Chief were not asked for by Mr. Zeal in his previous communication, neither would it appear necessary that they should be furnished to him, inasmuch as they were given in the evidence taken before the Commission.

2. The details submitted to Mr. Mais exactly accord with the plans and specifications submitted to the Commissioners, and the evidence given by the Engineer-in-Chief and other officers of the department, except that in order not to prejudice the case in his own favour, the Engineer-in-Chief only submitted the data upon which his calculations were based.

3. A reference to Mr. Zeal's former letter shows that he did not request to be permitted to furnish Mr. Mais with the Commissioners' reasons for their decision with respect to the bridges referred to.

It may be permissible for me to remark, in connection with this portion of Mr. Zeal's letter, that the Government has not been favoured with the reasons which guided the Commissioners in their decision with respect to the piers of these bridges. All that appears in the report as to the piers of these bridges (apart from the recommendations of the Commissioners) is the following:—"Suffice it to say, we think Mr. Falkingham's objections as to the proposed mode of constructing the piers of Nos. 2 and 3 bridges to be valid, and we admit the force of his protest."

I most emphatically state that the conclusion regretfully arrived at by Mr. Zeal that "the Minister of Public Works has no desire to obtain an impartial report" is absolutely erroneous, and seems to have been based, like other conclusions of the Commissioners, upon insufficient or misunderstood data.

It was my purpose to have dealt solely with those portions of Mr. Zeal's letter which relate to me personally, but I may be permitted to call attention to the statement made by him as to the Scottsdale Railway only being likely to serve an aggregate population (exclusive of Launceston) of one thousand souls. If Mr. Zeal were possessed of more accurate information he would know that the present population of the district (exclusive of Launceston) that will be served by the railway is something over eight thousand.

I regret that Mr. Zeal has by his unwarrantable imputations compelled me to intervene in this correspondence.

I have, &c.,

NICHOLAS J. BROWN,
Minister of Lands and Works.

The Hon. the Premier

Premier's Office, Hobart, 12th June, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of your letter of the 5th instant.

In reply, I beg to say I frankly accept, in the same spirit in which it is offered, your assurance that your remarks are not prompted by any personal feeling, and in the same spirit I must add that

nothing could be more remote from the intention or desire of this Government than to act in any manner which could fairly be charged as discourteous either to yourself or your late colleagues on the Royal Commission. It is unnecessary for me to reply at any length to the chief points of your letter, as, with the exception of the dissent put forth to the calculations of the Government Statistician, they refer more particularly to the Hon. the Minister of Lands and Works, who has dealt with them in the communication which I now enclose.

At page three of your letter I read,—"Neither have you replied to my request to be permitted to furnish Mr. Mais with the Commissioners' reasons for their decisions," &c. To this I have to state in reply that the papers referred to had actually been forwarded to Mr. Mais two days before the receipt of your letter. Had it been otherwise, and had Ministers been aware that you intended to make a request, your letter would certainly have received that consideration to which it was justly entitled, though at the same time the words "I think, however, the case should be first sent to the Commissioners for their perusal," &c., seems to convey rather the expression of an opinion than a request. As to "the colored reports which have been scattered broadcast through the Press over the Australian Colonies," this is clearly a matter which is altogether outside the responsibility of the Ministry. And, although I should be extremely sorry to think it possible that "the power of the Press was invoked" to misrepresent the Commission at the head of which your well-known reputation placed you, I am sure you will acquit both myself and my colleagues of any action in such a matter.

I have, &c.

J. W. AGNEW.

The Hon. W. A. ZEAL, *M.L.C., Melbourne.*

Lands and Works Office, 11*th June*, 1886.

MEMORANDUM.

A communication having been received by the Premier from the Chairman of the late Royal Commission on Railways and other Public Works, in which exception is taken to the information furnished to the Chairman with respect to the case submitted to Mr. Mais, Engineer-in-Chief of South Australia, as to the sufficiency of the designs for Nos. 2 and 3 Bridges on the Derwent Valley Railway, and also to the case itself submitted to Mr. Mais, I propose to reply as follows:—

"With regard to Mr. Zeal's complaints that you have not supplied him with the calculations of the Engineer-in-Chief, &c., I desire to remark—

"(1.) That the calculations of the Engineer-in-Chief were not asked for by Mr. Zeal in his previous communication, *neither would it appear necessary that they should be furnished to him, inasmuch as they were given in the evidence taken before the Commission.*

"(2.) The details submitted to Mr. Mais exactly accord with the plans and specifications submitted to the Commissioners and the evidence given by the Engineer-in-Chief and other officers of the Department."

Will the Engineer-in-Chief be good enough to state whether he can confirm the statements herein made by me?

NICHOLAS J. BROWN, *Minister of Lands and Works.*

The Engineer-in-Chief.

Public Works Office, Hobart, 11*th June*, 1886.

SIR,

IN reply to your Memo. of above date, I have the honor to inform you that the information supplied to Mr. Mais, in connection with the reference to him regarding Bridges Nos. 2 and 3 on the Derwent Valley Railway, was, in all respects, identical with that submitted to the Commissioners, excepting that, with regard to calculations, I limited the information to the data for same, in order not to prejudice the case in the slightest degree.

I have, &c.

J. FINCHAM, *Engineer-in-Chief.*

The Hon. the Minister of Lands and Works.

Adelaide, 11*th June*, 1886.

DERWENT VALLEY RAILWAY, TASMANIA.—STABILITY AND SUFFICIENCY OF BRIDGES NOS. 2 AND 3.

SIR,

I HAVE the honor to forward herewith my report upon the strength and sufficiency of Bridges Nos. 2 and 3 on the Derwent Valley Railway of Tasmania, and by the same mail have returned the original plans of these bridges. I had intended to forward the explanatory diagrams which are referred to in the Report, but being unable to complete the tracings in time, have sent on the Report without them, as I understood that you were desirous of receiving it as early as possible. I trust that my Report may be sufficiently clear, but should you require any further information upon this subject I shall be quite willing to furnish it. I regret that I do not quite agree with the finding of the Royal Commission with reference to the necessity for widening the space between the girders; but, in my opinion, it is not required, especially when it is considered that a carriage with its narrow base must be blown over before any wind could disturb the girders, and in the absence of the carriages the girders are absolutely safe with the bolts indicated in my Report.

I have, &c.

H. C. MAIS, *M. Inst. C.E.*,
M. Inst. Mec. E., &c.

The Hon. NICHOLAS BROWN,
Minister of Lands and Works, Hobart.

Adelaide, 10*th June*, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of your letter of the 15th ultimo, also two sets of drawings of Bridges Nos. 2 and 3 on the Derwent Valley Railway, Tasmania, with a request that I should examine and report upon their stability and sufficiency. I also beg to acknowledge receipt of Report of Royal Commission appointed to enquire into and report upon the Railways and Public Works of Tasmania, dated 22nd April, 1886.

Strength of girders.

In reply, I beg to report that I have duly examined the drawings of the bridges referred to, and the specification for same, and have satisfied myself that the girders are sufficiently strong to carry any weight that is likely to be brought upon them in traffic; having assumed for this purpose a train of the heaviest narrow-gauge locomotives, each engine weighing 31 tons, and two such engines standing on each span, the dead load being ·67 of a foot run, and the live load one ton to the foot run, (See Diagram.)

For the purposes of calculation I have taken the following cases and have applied them to both bridges:—

Pressure of wind.

Case No. 1.—The pressure of wind required to overturn a narrow gauge carriage or train of carriages standing on a span of the bridge.

Stability of girders in piers and abutments.

Case No. 2.—The stability of the girders of both bridges upon their abutments and piers, with an assumed wind pressure of 30 lbs. to the square foot, when a train of empty carriages is standing upon a span.

Stability of concrete piers, No. 2 Bridge.

Case No. 3.—The stability of the concrete piers in No. 2 Bridge when a train of empty carriages is standing on the spans, and the wind pressure assumed at 30 lbs. per square foot upon the exposed surfaces of piers, girders, and carriages.

Stability of concrete piers, No. 2 Bridge.

Case No. 4.—The stability of the concrete piers in No. 2 Bridge when there is no train on the spans, but with a wind pressure assumed of 50 lbs. to the square foot upon the exposed surfaces of the piers and girders.

Stability of masonry piers, No. 2 Bridge.

Case No. 5.—The stability of the masonry piers of No. 2 Bridge when there is a train of empty carriages standing on the spans, and with an assumed wind pressure of 30 lbs. to the square foot upon the exposed surfaces of the piers, girders, and carriages.

Stability of concrete piers, No. 3 Bridge.

Case No. 6.—The stability of the skew concrete piers in No. 3 Bridge, with a train of empty carriages standing on the spans, and an assumed wind pressure of 30 lbs. to the square foot on the exposed surfaces of the piers, girders, and carriages. As it is proposed to utilise this bridge for road purposes also, the exposed surfaces of the additional width and height due to the planking, &c. have been taken into consideration.

Commencing with Case No. 1,—viz., "The wind pressure required to overturn an empty carriage,—I find that a pressure of 21·6 lbs. to the square foot of exposed surface is sufficient to do so, the carriage being 32 feet long by 9 feet high, standing 2 ft. 3 in. above the rails, and the gauge or base being 3 ft. 6 in., and that it requires a pressure of 28 lbs. to the square foot to overturn a similar carriage when loaded; but as the worst aspect of the case will be when the carriages are light, and therefore deficient in vertical pressure on the structure, I have chosen to adopt the empty carriages in the calculations.

Case No. 1. Overturning carriages by wind pressure.

I may observe that a fully loaded passenger train will leave the rails with a wind pressure of 31¼ lbs. and the heaviest freight train at 56½ lbs. to the square foot on a 4 ft. 8½ in. gauge; and if the wind attains much greater pressures than these it is unlikely that a train would venture to cross any bridge during such a storm, as it would be blown over by far less pressure before it reached the bridge. I append an explanatory diagram of Case No. 1.

I have calculated the stability of the girders on both bridges to sustain a wind pressure of 30 lbs. to the square foot (more than sufficient to overturn the loaded carriage,) and find that there is a downward pressure of 10 tons on the windward girder, leaving out of the calculation the additional security to be obtained by the holding-down bolts, with which I will deal further on. The above result is on the assumption that the carriage is in the act of turning over and thereby throwing its entire weight upon the leeward rail. (See explanatory diagram of Cases Nos. 1 and 2.)

Case No. 2. Stability of the girders upon the piers and abutments of Bridges Nos. 2 & 3.

"The stability of the concrete piers of No. 2 Bridge upon which the girders rest when the strain is on the span." I have assumed in this case a wind pressure of 30 lbs. to the square foot upon the exposed surface of the pier itself, upon the girders, upon the exposed surface of the planking, &c., and of the train of empty carriages standing on the bridge, and find that the stability of the pier has a factor of safety of 2½ nearly, the resultant of the wind and vertical pressures coming 5 ft. 6 in. within the leeward toe of the piers, and on the windward side a downward pressure of 69 tons, exclusive of any allowance to be made for the additional resistance against overturning due to letting the piers into the solid rock at least four feet, and for the adhesion attributed to the mound of cement concrete at least 4 ft. 6 ft. deep around their bases. These piers therefore appear to be sufficiently stable, presuming of course that the materials are good, the work well executed, and the holding-down bolts, to which I will presently refer, are used. (See diagram illustrating Case No. 3.)

Case No. 3. Stability of concrete piers of Bridge No. 2—loaded.

"The stability of the concrete piers only of No. 2 Bridge, there being no train on the bridge, and with an assumed wind pressure of 50 lbs. to the square foot upon the exposed surfaces of the pier and superstructure." I have omitted the carriages, because they would be blown over before the above pressure of wind was attained. In this case the resultant of the wind and vertical pressures come 6 ft. 5 in. within the leeward toe of the piers, and on the windward side there is a downward pressure of 74 tons, exclusive of any assistance derived from letting the foundations into the solid rock, from the concrete mound before referred to, or from the holding-down bolts of the girders. When the river is in flood and the piers nearly submerged, the resultant strikes the base within the leeward toe as before, so that the wind pressure upon the pier may be assumed to be balanced by its submersion. The piers, under these conditions, appear to be quite stable. (See diagram illustrating Case No. 4.)

Case No. 4. Stability of concrete piers in Bridges Nos. 2 and 3—unloaded.

"The stability of the masonry piers of No. 2 Bridge when there is a train of empty carriages standing on the spans, and with an assumed wind pressure of 30 lbs. to the square foot upon the exposed surfaces of the piers, girders, flooring, and carriages." In this case the resultant strikes the leeward toe 10 ft. 10 in. within it, and there can be no question that there will be an excess of stability. I have not therefore thought it worth while to test the stability of these piers with a wind pressure of 50 lbs. to the square foot, as there is evidently an ample margin of safety, provided the materials are good and the workmanship and foundations properly executed.

Case No. 5. Stability of masonry piers, Bridge No. 2.

Under the above conditions cited in Cases 1 to 5, I think the Bridge No. 2 will be safe and efficient if the work is well done and due care is exercised in putting in the foundations; but at the same time if I had to design this bridge with the same number of spans I should prefer to have the base of the concrete piers thicker, and should even now recommend that they be made 6 ft. thick at the base instead of 4 ft. as at present, and be carried up the same thickness to the level of the set-off shown. This would make a substantial piece of work, and would be beyond any chance whatever of failure. The cost of cutting the caissons, if they are already made, and inserting an additional width need not be great, and the weight of the additional concrete will materially add to the stability.

Additional thickness to concrete piers recommended.

I would also recommend at the same time that the cement concrete mound to be placed around the base of the concrete piers be made not less than 4 ft. 6 in. deep after the débris overhanging the rock foundations has been removed.

Concrete mounds.

I would further recommend that instead of the six Lewis-bolts securing the cast-iron bed-plates to the concrete and masonry upon which the girders rest, four bolts with washer-plates be used for this purpose in the concrete piers, each 6 ft. in length, and that oval holes should be made in the bottom bearing-plates and flanges of the girders through which bolts should pass to the

Long holding-down bolts required for piers and abutments.

underside of the cast-iron bed-plates, and that washer-plates sufficiently long to take these bolts should be placed on the flange and then bolted to the bed-plates; this will allow plenty of room for expansion, and the holding-down bolts for securing the bed-plates will materially add to the stability of the bridge.

Bolts for piers already built.

With regard to the masonry piers and abutments already built, the holding-down bolts of the above length can readily be made with split ends fitted with fox wedges, which can be inserted in the holes drilled for the purpose into the masonry, and subsequently filled up solid with neat cement; bolts properly made and fixed in this manner will never move. In my own practice I usually bolt the girders directly down to a cross box-girder supported on cylinders, or upon wrought iron framing thoroughly braced. I do not see any necessity whatever for placing these girders wider apart on a narrow-gauge railway than shown, and there are numerous bridges erected in India with spans of 40 feet, having only 4 ft. centres, and a large number spaced to the metre gauge with overhanging platforms of timber. Eight feet (8 ft.) centres is the usual spacing for broad-gauge girders when the trains run on the top of them.

Case No. 6.

I will now take Case 6, which deals with the stability of Bridge No. 3.

Stability of Bridge No. 3.

The girders being exactly of the same description as those in No. 2, are quite strong enough, and are continuous over two piers.—(See diagram.) With regard to this bridge I find that it is intended to use it for road as well as for railway purposes, and diagram, Case No. 6, herewith, shows the elevation of the skew piers as well as a plan of the same. I have assumed, in this case, an empty train of carriages standing on the bridge and a wind pressure of 30 lbs. to the square foot blowing on the exposed surface of the pier, as shown on the diagram in plan, upon the girders and flooring as well as upon the carriage sides; the resultant of the wind forces at right angles to the bridge and obliquely to the piers is 19·4 tons, striking 3ft. 3in. within the leeward toe as projected in diagram. The tendency of the pier is not to turn on its leeward toe, but in a direction normal to its face, with a force of 10·8 tons, acting with a leverage of 48ft. 8in. (*i.e.* the distance from the horizontal resultant of the three wind forces to the bottom of the pier), and the resultant cuts the bottom of the pier three inches outside the base, and therefore, taken as a simple column, the pier has not sufficient stability when standing unaided on its own base. I therefore recommend that these piers be made 6 ft. thick at the base and be carried up the same thickness to a height of 30 ft. from their bases—(See diagram.) In this case the resultant will cut the bottom of the pier 1 ft. 3 in. within its side at the base, and it would be then quite stable even without letting into the rock—although I recommend that this be done in *all* cases as originally proposed by the designer—and that the cement concrete mound be made as shown in the diagram herewith. These piers will then be amply sufficient for this bridge even with a wind pressure of 50 lbs. to the square foot blowing against the structure.

Cement-concrete makes a durable pier.

I am of opinion that the cement concrete proposed will make substantial and reliable work, and the masonry piers, as I have already pointed out, have a large margin of stability. I see very little more difficulty in putting down caissons than would obtain with cylinders if ordinary care is used, and as they only form the jacket or skin of the real pier, which is built within them, it is not expected that they will support the girders at all. A large number of bridges have been erected with foundations built within wrought iron caissons as well as with cast iron cylinder piers, but with the girders usually resting on the masonry, brickwork, or concrete only, built within them. The caissons when down, properly bedded, and filled with cement concrete, will make the pier more stable than two independent columns of the same height braced in the usual manner.

Cross bracing of girders ample. Wind bracing required to top flanges.

I observe that the girders are well braced together with solid diaphragms composed of plates and angles; this makes the girders very strong and unites them very firmly together; but I note the absence of wind-bracing to the top flanges, which, with such spans is, I think, necessary, although no doubt the designer considered the continuous planking sufficient; but notwithstanding this I would suggest that the requisite bracing for the top flanges be added.

Planking.

Although the mode of fixing the planking to the top of the girders is not shown in detail on drawings Nos. 23 and 25, yet provision has been made, and the details are shown on drawing No. 5 for securing it to the girders by $\frac{3}{4}$-inch bolts passing through a wrought iron longitudinal plate at intervals of every four feet. My practice has been to fasten every plank by through-bolts and washers where it is possible to do so, and by hook-bolts and washers where there is not sufficient flange available for through-bolts when close planking is employed; but upon narrow-gauge bridges with the line running on the top, I use sleepers eight inches wide and five inches thick, spaced 1 foot 3 inches centres and bolted to the girders. I also fix a steel angle guard-rail on all bridges to prevent derailment, carried back some distance from each abutment and carved inwards.

"Loose" or fixed road on bridges.

With regard to the rails being laid in the ballast upon the planking or secured to the planking direct, my experience has been that, although it is more economical to lay the rails on the planking direct, yet the plan of laying what is termed a "loose road" in the ballast in the same manner in which the rails are laid on the remainder of the line, tends materially to reduce vibration and makes

it easier to keep a good "top" on the road, and I should therefore give the preference to the loose road system.

A brief summary of my recommendations is as under :— Recommendations.

1st. That long holding-down bolts for the girders be substituted for Lewis bolts. Holding-down bolts.

2nd. That the wrought iron caissons for No. 2 bridge should be cut, and as much additional plate be inserted as will enable them to be made 6 ft. wide from their base to the present set-off, and that the internal stays be altered to suit the additional width. Caissons for No. 2 Bridge.

3rd. That the cement concrete mound round the base of all the piers should not be made less than 4 ft. 6 in. in thickness, and of the size shown on the diagram herewith. Concrete mounds round piers.

4th. That the wrought iron caissons of No. 3 bridge should be cut and as much additional plate inserted as will enable them to be made 6 ft. wide from their base to a height of 30 ft. therefrom, and that the internal stays be altered to suit the additional width. Caissons for No. 3 Bridge.

5th. That wind bracing be fixed to the top flanges of the girders. Wind bracing.

6th. That each plank of the deck be bolted to the top flange of the girders by through or hook bolts. Planking.

Before closing this report I wish to state for your information that the question of wind pressure on bridges is one that until the last few years has received very little attention at the hands of engineers, and at the present time a great difference of opinion exists among professional men upon the proper allowance to make in calculating bridge strains. I therefore subjoin the opinions of a few of the authorities on this subject both English, European, and American. Opinions of engineers on wind pressure.

English.

Board of Trade :—"In all large structures (such as high bridges and viaducts) the stability of the work must be such as will provide for a wind pressure of 56lbs. to the square foot."

B. Baker, C.E., (Forth Bridge), says :—"Both Mr. Fowler and I are of opinion, that as a result of our two years' further consideration, that the assumed pressure of 56lbs. per square foot over the whole of the bridge is considerably in excess of anything likely to be realised."

R. P. Brereton, C.E., thinks "that with his experience at Saltash Bridge, the pressure of 56lbs. prescribed by the Board of Trade was in excess of anything that had been proved to have happened to railway structures of large magnitude."

T. Hawkesly, C.E., thinks "that for structural calculations a maximum pressure for wind of 40lbs. to the square foot might be safely adopted."

W. H. Barlow, C.E., "had calculated the pressure required to blow down factory chimnies 100 to 150 feet high, and found that it ranged from 46 to 56lbs. per square foot. Railway carriages would be upset with a pressure of 30lbs. to the square foot as a maximum. Thousands of chimnies standing now would be blown down at a pressure of 56lbs. to the square foot. He thought the mean between these two pressures might be taken."

Sir Wm. Armstrong, C.E., was of opinion "that very high pressures did not operate on large surfaces, as witness the Crystal Palace, exposed as it was; and that it was absolutely impossible that the Observatory building at Bidston, where the anemometer recorded 90lbs. to the square foot, could stand against such a pressure."

Professor Unwin, C.E., takes 40lbs. to the square foot as the limit of probable intensity of wind pressure on bridge or roof structures."

Charles Douglas Tox, C.E., assumes for "roofs a wind pressure of 40lbs. to the square foot, of which 30lbs. is the resultant for the wind at right angles with the roof, and 10lbs. per square foot for snow."

Robert Johnson, C.E., (Bidston, near Liverpool) "takes 30lbs. per square foot acting in a longitudinal direction as wind pressure; every pier should be independent of holding-down bolts. During 25 years' residence near Bidston, where 90lbs. to the square foot of wind pressure has been recorded at the Observatory, no cases have occurred of carriages or goods wagons being blown over, although their stability is known to be from 30 to 40lbs. to the square foot (4ft. 8½in. gauge).

Europe.

France.—The practice has been with some engineers to assume 35½lbs. per square foot as wind pressure on the structure with a train upon it, and 64lbs. without a train.

M. Seyrig, C.E., relates cases of passengers and goods trains being derailed and blown over by wind. In one case at Salces a train composed of four carriages and two break-vans was entirely overturned. One van upset with a pressure of 33·8lbs. to the square foot; the other van did not turn over. On the same day at Rivesaltes a goods train of 14 wagons had 5 of them upset, 3 thrown off the line, and 6 left on the rails; the pressure causing them to upset was 26·6lbs. per square foot, and 56lbs. was sufficient to blow the

others from the rails. In another case at Fitton, a passenger train of 6 carriages and van were thrown over, the van alone standing; the pressure exerted was from 25·7 to 30·3lbs. per square foot to overturn the carriages, and 51·7lbs. per square foot to blow the van from the rails.

Professor Gaudaud adopts 55 lbs. per square foot as a sufficient co-efficient.

American.

Charles Shaler Smith, C.E.:—"30 lbs. per square foot on structure and train; or 50 lbs. to the square foot upon the structure alone. The minus strains on the windward columns of piers shall be computed with the lightest train upon the bridge which will not be blown off by a wind pressure of 30 lbs. to the square foot. The columns of piers are to be proportioned to resist the combined strains of wind, and have a factor of safety of 4. There shall be no tension on any column. If braces are designed to have a proportion of 7½ tons to the square inch, and a wind pressure of 30 lbs. to the square foot, they will be within the elastic limit at the moment a train is blown from the rails; destruction of the span would then result from derailment, to resist which a greater strength of bracing is of no value.

A. Gottleib, C.E., believes 30 lbs. to the square foot is sufficient pressure to estimate on the side of a train, and the whole surface of the windward, and such portion of the leeward trusses as are not covered by the train. "I do not think it necessary to provide against a greater wind pressure than 30 lbs. per square foot for spans over 200 feet."

James M. Wilson Bridge, C.E., Engineer to Pennsylvania Railway, uses 30 lbs. per square foot on vertical bridge surface with a train on it estimated at 300 lbs. per foot lineal, and thinks that it would be as well to increase the pressure to 40 lbs. in calculating bridge strains in exposed localities.

O. Chanute, C.E.:—"If wind ever attains a pressure of 90 lbs. to the square foot, why use 30 lbs. as a factor? I apprehend such pressures are only limited to very narrow belts,—less than the length of ordinary spans; not only would a train be blown over by far less wind pressures, but it is unlikely that a train would be allowed to cross a bridge in such a storm. All calculations for wind pressure are assumed to be taken at right angles to the axis of the bridge. It is not often that tornadoes strike such structures at right angles, and the probabilities are that these extreme pressures of 90 lbs. to the square foot are still further reduced."

I have the honor to be,
Sir,
Your most obedient Servant,
H. C. MAIS, *M. Inst. C.E., M. Inst. M.E., &c.*

The Hon. NICHOLAS J. BROWN, *Minister of Lands and Works,*
Hobart, Tasmania.

General Register Office, Hobart, 14th June, 1886.

SIR,

I HAVE the honor to submit to you the enclosed rejoinder to Mr. Zeal's remarks upon my Report with respect to the financial prospects of the Scottsdale line, which appeared in this day's *Mercury*. In the interests of truth it is desirable that my rejoinder should obtain the same publicity as that afforded to the Commissioners.

I have the honor to be,
Sir,
Your obedient Servant,
ROBT. M. JOHNSTON, *Government Statistician.*

The Hon. J. W. AGNEW, *Chief Secretary.*

General Register Office, Hobart, 14th June, 1886.

SIR,

WITH regard to Mr. Zeal's remarks published in to-day's *Mercury*, so far as they refer to my Report, I have the honor to address to you the following rejoinder.

In my original Report criticising the statements of the Railway Commissioners to the effect that the Scottsdale Railway would not pay 4 per cent. on cost of construction until the receipts reached £75,000 per annum, or £1595·7 per mile open, I showed by reasoning, figures, and a complete demonstration on scientific grounds, that the Commissioners had made an error of at least £35,285 per year, or 89 per cent., a sum which of itself would suffice to pay the interest of two and a third similar lines across the same country independently of the one objected to by them. I also showed by many illustrations how persons who were not experts on the financial side of the working of railways would be apt to be led astray in attempting to solve such problems. In doing so I was careful to point out that I did not pass any reflections upon the capacity of the Commissoners as *engineers*, for I stated that, as such problems lie outside the profession of engineering experts, it is natural that they should sometimes underrate their difficulties; and as by rigid computation, guided by long experience in such matters, I come to widely different results from them, I am satisfied that they have either adopted their figures in an arbitrary manner, or have been misled by the adoption of a fallacious method.

Mr. Zeal's recent rejoinder to this completely confirms me in the conclusion I then arrived at, for he has plainly indicated, not merely that he cannot explain by what reasoning or by what method the Commissioners arrived at their erroneous conclusion, but lack of experience in such matters makes it difficult for him to attempt to refute in detail any single point advanced by me in my reasonings and demonstrations. I shall not follow him in the undignified course he has pursued in his attempt to reduce the matter under discusssion to idle sneer, evasion, or a discourse on relative personal merits; it is sufficient for me to state that my experience as an expert in the financial and statistical matters connected with the working of railways throughtout the world has been gained from official connection with four English and three Colonial railways, covering a period of over a quarter of a century—too long a space of time to afford me altogether unmixed satisfaction when I regard the mere length of it.

The mere appointment of the Railway Engineers as a Commission of enquiry does not render them infallible, and only conscious weakness could force them to take refuge from reasonable criticism under such a plea. The writer has on several occasions acted on similar Commissions of enquiry,—indeed, few public officers in Australia have not been called upon at various times so to act,—but I have yet to learn that the decisions of such commissions are always regarded as final. I would myself scorn to take convenient refuge from inaccuracy or other defect upon such a plea. Where, as in the present case, there is positive evidence of inaccuracy, there is sufficient grounds for refusing to allow the Commissioners to rest their decisions on their own personal authority. In Mr. Zeal's rejoinder, we have a mere appeal from doubtful personal authority, in the face of opposing evidence and of rigid demonstration; and I am therefore obliged to resist his appeal to a self-constituted authority, especially as the reasons given by Mr. Zeal for such a course are themselves based upon assertions which I shall proceed to show are altogether inaccurate, and can easily be proved to be so.

Mr. Zeal assumes that the writer's estimates are defective because he infers they are based upon the experience of the working of English railways, without reference to peculiar local conditions.

This is not merely erroneous, but it betrays the fact that Mr. Zeal has not carefully studied my report. It further indicates that he seems to be imperfectly acquainted with the common facts of experience connected with the working of English or Colonial railways. Even the tables which I provided showing the working results of 63 English and Colonial railways (see Appendix II., page 35 of Replies to Report of Commission) should have enabled him to perceive that 4*s. per train mile for working expenses* for lines with 2650 train miles per mile and over is altogether above the range of English working expenses, while it greatly exceeds the relative working expenses of the heaviest traffic railways of Australia with a similar train mileage. The 4*s.** *per train mile* assumed by me actually exceeds the working expenses of similar train mileage lines in English railways by from 65·5 to 84·6 per cent., and even exceeds the heaviest traffic lines in Australasia by from 9 to 23 per cent. This in itself is sufficient to prove that Mr. Zeal at least is not altogether competent to deal with such matters.

The following comparative table of the average working expenses on English and typical Colonial railways puts mere opinion aside, and effectually disposes of Mr. Zeal's most erroneous assertion.

TABLE showing the average Working Expenses per Train Mile on English and Australasian Railways, as contrasted with Working Expenses estimated for the Scottsdale Line when the Train Service reaches 2650 *Train Miles per mile.*

	United Kingdom Average.			Australasia Average.			Estimate for Scottsdale Line, Present Route.
	England.	*Scotland.*	*Ireland.*	*Victorian Lines Average.*	*L. & W.R. Tasmania*[a].	*T.M.L.R. Tasmania*[a].	
Expenditure per Train mile—	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Maintenance	0 5·12	0 4·24	0 4·03	0 10·65	1 2		1 3
Locomotive, Carriage, Wagon Department	1 0·76	0 11·71	1 0·41	1 2·65	1 2·1	3 7·79[b]	1 6
Traffic charges	0 9·05	0 6·70	0 6·95	1 5·76	0 11·6		1 2
General charges	0 4·24	0 4·39	0 3·78	0 1·34	0 3·3		0 1[c]
Rates and Taxes	0 2·61	0 1·55	0 1·16	*Nil.*			
TOTAL	2 9·78	2 4·59	2 4·33	3 8·40	3 7·0	3 7·79	4 0

[a] Average of five years. [b] The total for running powers on the Launceston and Western Railway does not allow of detail comparison. [c] Only a proportion of General charges need be charged to this line—hence the smaller relative charge.

Mr. Zeal states as another reason why the writer's estimate should be ignored, that the writer was not acquainted with the nature of the country traversed by the Scottsdale Line, and therefore could not fairly judge of the effect to be produced in working its 1 in 40 grades and its 5-chain curves.

* Even if I assumed the extravagant rate of 4*s.* 6*d. per train mile* as the working cost for 2650 *train miles per day*, it would not materially alter the matter so far as the Commissioners are concerned, for it would still prove them to be £32,170 above the truth, a sum which would suffice to pay the interest on nearly 2¼ lines across the present Scottsdale route independently of the one objected to by them, or a sum which would suffice to lay the rails afresh every 11 months nearly.

This, again, is not merely a gratuitous assumption, but shows great lack of discretion on Mr. Zeal's part.

In the first place, Mr. Zeal had positive evidence to the contrary; for in my Appendix III. is to be found a more detailed account of the extent and character of the grades and curves upon the various Scottsdale lines than is to be found in the whole evidence and report of the Commissioners. In the second place, the reference to my supposed ignorance of the physical features of a country which I have carefully studied for sixteen years for scientific purposes, is contrasted with the flying visit of strangers which only covered a brief space of time, and in fact was confined to a flying traverse over a portion of one of the lines. When it is also taken into consideration that my knowledge of the physical character of the country enabled me to superintend the production of the first complete physical map of Tasmania for the Government, and when it is considered also that I am engaged by the Government at the present moment upon an extensive work descriptive of the physical and geological character of the Island, it is probable that the contrast may be disadvantageous to those who needlessly ventured upon the comparison.

Mr. Zeal assumes that the writer has not had practical experience of the working of 1 in 40 grades and 5-chain curves such as exist upon the Scottsdale line now being constructed.

This, again, is incorrect, for I was employed for a period of about five years as the Government Scrutineer and Auditor of the accounts and working expenses of the Tasmanian Main Line Railway, which is the only line in Australasia which is at all comparable with the Scottsdale line.

It shows how carelessly the Commissioners have studied this important matter of 1 in 40 grades and 5-chain curves in a 3 ft. 6 in. gauge, when they seem to be unaware of the fact that the Tasmanian Main Line Railway has, in 32 miles of its length, between North Bridgewater and the Flat Top, a greater extent of 1 in 40 and other steep grades, together with a much greater extent of 5-chain curves, than is to be found in the whole of the 47 miles of the present Scottsdale route. That there should be no question regarding this important matter, let the following comparative table decide. The table has been compiled for me from original sections, at my request, prior to the preparation of my first report.

COMPARISON showing approximately the extent of 1 *in* 40 *grades and 5-chain curves upon the various Scottsdale routes, and upon two sections of T.M.L. Railway between North Bridgewater and Oatlands:—*

A. Lower Piper Route.
B. Upper Piper Route.
C. Present Contract Route.
D. Tasmanian Main Line Railway (Section North Bridgewater to north side of Tunnack).
E. Ditto, 13m. 36c. to 60m. 40c.

	Scottsdale Route.			T.M.L. Railway.	
	A.	B.	C.	D.	E.
Length of line or sections ..... *Miles*	67	59½	47	32	47
Ascending grades of 1 in 40 to 1 in 45 * † ..... *Chains*	736	892	835	796	855
Ditto of 1 in 45 to 1 in 50 * † ..... „	238	144	117	151	151
Actual length of all ascending grades * † ..... *Miles*	24·3	22·5	16·4	19·8	26·9
Aggregate height of rise * † ..... *Feet*	2241	2189	1642	1943	2300
Mean of ascending grades in relation to actual length of the same * †	1 in 57·2	1 in 54·5	1 in 52·7	1 in 53·7	1 in 60
Ditto to total length of line or section.....	1 in 157	1 in 142	1 in 151	1 in 87	1 in 108
Total length of 5-chain curves on the whole length of line or sections..... *Miles*	3·85	...	2·33	4	4·15

* Direction of heaviest traffic, Scottsdale to Launceston.
† Direction, North Bridgewater to Oatlands.

It follows from reference to undeniable facts like the above, that Mr. Zeal's assumptions are altogether reckless and indefensible.

The effect of working 1 in 40 grades and 5-chain curves has not merely been considered by me, but I have actually made provision for the additional cost they would entail in working the line. On the other hand, the Commissioners have the most vague or extravagant notions as regards the effects of working a line of such a character. They seem to be unaware of the fact that to construct and work 4 miles of line in excess of the shortest route to save grade and curve on such a line and with such traffic would, as an extra working expense and yearly interest, more than suffice to renew the whole of the 50lb. steel rails, fastenings, &c., every tenth year upon the shorter route; and that to construct and work 20 miles extra for such a purpose (such as the Lower Piper route) would suffice to lay the rails and fastenings afresh every second year. Extra cost of fuel in some countries causes more expense on comparatively straight and level lines than heavy grades and sharp curves in other places. Thus, for example, the cost of fuel on Cape lines amounts to about £3 per

ton, that is, about £2 per ton above Tasmanian average prices. This would raise the cost of fuel in Tasmania above 8*d.* per train mile above the present cost, and would represent in a train mileage of 124,579 miles per year, £4153 per year, a sum which of itself would suffice to renew rails, fastenings, &c. every 7½ years. Again, as regards speed, the shorter route has a compensating advantage,—*e.g.*, 14 miles an hour upon the shorter route is equivalent to 20 miles an hour upon a 67 mile route where the termini of both lines are at the same fixed points. Questions of this kind have not been properly appreciated by Engineers, and without such study their comments upon comparative routes are valueless, if not harmful. See Appendix to this Report, giving further particulars concerning matters which were entirely overlooked by the Railway Commissioners.

In conclusion I would beg to observe, as stated in my first Report, that I value no assertion made by myself in a matter of this kind unless it is supported by reasoning, demonstration, and a reference to acknowledged facts. It is no injustice to the Commissioners, therefore, if I refuse to accept statements from them based upon a lower standard than that which I rigidly prescribe for myself. According to this standard, both the Commissioners in their Report, and Mr. Zeal in his rejoinder, signally fail.

I have, &c.

ROBT. M. JOHNSTON, *Government Statistician.*

The Hon. J. W. AGNEW, *Chief Secretary.*

APPENDIX.

SCOTTSDALE LINE.—CURVES OF GRADES *versus* LENGTH.

ILLUSTRATIONS showing relative importance of the consequences of Curves and Grades upon the financial prospects of a Line as contrasted with the effect of increased length.

Take a line of 47 miles with train service of 124,579 train miles per year as the relative standard.

	ITEM.	EQUIVALENTS IN	Working Expenses per Year.			COST OF CONSTRUCTION.*	
			Total.	Per Mile.	Per Train Mile.	Total Amount.	Per Mile.
			£	£	*s.* *d.*	£	£
	Value.						
1	Every 1*d.* per train mile	...	519·06	11·04	0 1	12,977	276
2	Every 1·483*d.* ditto	...	770	16·38	0 1·483	19,250	409·5
3*	Extra mile beyond 47 constructed and worked merely to save sharp curves and steep grades*.....	...	770	16·38	0 1·483	19,250	409·5
4	2·63 miles ditto*.....	Equals total cost of fuel consumed by locomotives per year.....	2029·53	43·18	0 3·91	50,738·9	1079·9
5	3·55 miles ditto*	Equivalent to a sum which would renew 50lb. steel rails, fastenings, &c. every 11 years.....	2746	58·4	0 5·28	68,650	1460·6
6	19·6 miles ditto*	Ditto, every 2 years.....	15,106·7	321·4	2 5·10	377,667	8035·2
7	12½ miles ditto * †	...	9625	204·7	1 6·52	240,625	5119·4
8	20 miles ditto* ‡	...	15,400	327·6	2 5·66	385,000	8191·5
9	The difference in the working cost per year upon the three routes upon Scottsdale line would, at most, not exceed 2*d.* per train mile per year.	...	1038·12	22·08	0 2	25,954	552
10	Every £70,000 added to cost of construction	Equals 3·63 extra miles constructed and worked	2800	59·5	0 5·39	70,000	1488·8
	Speed.						
11	14 miles per hour on 47 mile route.....	Equals 20 miles per hour on 67 mile route, and 17·07 miles per hour on 59½ mile route.					
12	11·2 miles ditto	Equals 16 miles per hour on 67 mile route, and 14·2 miles per hour on 59½ mile route.					

* The cost of construction for extra mileage in these columns is only reckoned as if limited to £6000 per mile.

† This represents the difference between the present route adopted and the 59½ mile route (Upper Piper route).

‡ This represents the difference between the present route adopted and the 67 mile route (Lower Piper route).

ROBT. M. JOHNSTON.

16th June, 1886.—Mr. Mais' report was submitted by the Hon. the Minister of Lands and Works to the Engineer-in-Chief for perusal.

17th June, 1886.—Telegram from Minister of Lands and Works to Engineer-in-Chief, (absent.)—"In returning Mr. Mais' report I suggest that it would be well if your letter acknowledging same took the form of a synopsis of the report which would be easily intelligible to unprofessional men."

June 19th, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of report by Mr. Mais, dated 11th June, 1886, upon the stability and efficiency of the bridges Nos. 2 and 3 over the River Derwent, on the Derwent Valley Railway.

No. 2 bridge is for railway traffic only. No. 3 bridge is for joint road and rail traffic.

I note that the report generally endorses the system of construction proposed to be adopted; that the superstructures are safe for heavier engines than any narrow gauge engines in use in the Colony, and that they are stable under wind acting upon them with hurricane force, both when unloaded and when carriages are on same, if long bolts are substituted for the short Lewis bolts, and if wind bracing is provided at top in addition to the bracing afforded by the continuous floor.

The stability of the piers under the traffic or for withstanding shocks is not questioned, and the wind pressure upon them is alone considered a subject for investigation.

Much uncertainty exists as to how far a maximum wind pressure acts over a large surface, and it is also pretty certain that, if only a moderate pressure acted uniformly over a large surface, many erections (and, to quote local examples, the extensive wind screens round the hop-gardens in the Derwent Valley) would have long since been demolished.

All the prevailing winds and gales in this Colony take one general direction, which is also that of the railway over all these bridges; but for purposes of calculation they are assumed to act in the most unfavorable manner upon the structures. Under these conditions, No. 2 bridge, which has the highest piers, is considered safe and efficient if properly built.

The piers of No. 3 bridge are oblique, and receive the assumed direction and force of wind on their side; accordingly a severer test of calculation is applied to them by supposing that they are standing unaided by the great strength of the concrete attaching them to foundations, and the assistance from adjoining piers by means of the superstructure; and on this supposition they are just over the limit of stability, although the weight of each pier is some 160 tons.

The chances, however, of a hurricane acting upon the piers with such force are very remote, both on account of the position of the bridge under the hill, and the general course of strong winds; and I consider the bridge practically as safe as No. 2, or scores of the earlier railway bridges, constructed when little attention was paid to wind bracing and wind pressure, which are deficient in stability according to calculations, but which have nevertheless withstood the storms of years.

The wrought-iron caissons are admitted to give a more stable pier than one made with cast-iron cylinders, which latter are now being superseded: one important example of this in Australia being the Hawkesbury Bridge, in New South Wales, with its spans of 400 feet.

The above remarks deal shortly with the conclusions in the report, the recommendations being as follows; viz.—

Superstructures.—Longer bolts to hold girders down, and wind bracing at top. This will take from 4 to 5 tons weight of iron, and cost some £150 for both bridges.

Piers.—The wrought-iron caissons to be made two feet wider in lower portions of piers, in order to give further stability to No. 2 bridge, and to take all strain off concrete at bottom of piers of No. 3 should wind ever act with the intensity assumed.

This involves new tie-bars inside the lower portion of piers, and extra plates at ends—altogether a weight of about 4¼ tons for No. 2 bridge, and 10½ tons for No. 3, with some more concrete (about 40 yards) in each pier. The increase of cost for the two bridges would be about £1500 at contract prices.

Put into a few words, the report is to the effect that the bridges are safe, but a recommendation is made that a larger margin be provided for contingencies of wind pressure.

I have, &c.

J. FINCHAM, *Engineer-in-Chief.*

The Hon. the Minister of Lands and Works.

Imperial Chambers, Bank Place, Melbourne, 28th June, 1886.

SIR,

I HAVE received your letter of the 12th instant, covering one from the Hon. the Minister of Lands of the 10th idem. I regret that a prolonged absence from Melbourne and pressure of business has prevented me forwarding to you an earlier acknowledgment.

I have also received your letter of the 16th instant, enclosing a copy of a second report of the Government Statist in reply to some previous remarks of mine with reference to his first report on the probable cost of working the Launceston and Scottsdale Railway.

I have read in the Melbourne *Argus* of the 18th instant that the Minister of Lands has received Mr. Mais' report on the proposed Nos. 2 and 3 bridges, Derwent Valley Railway. I again point out that if this report has been obtained on the data—copy of which you sent me on the 28th May—it is based on statements at variance in many essential particulars with the evidence obtained and the documents submitted to the late Commissioners.

I request the favor of your publishing this letter, and oblige

Your obedient Servant,

W. A. ZEAL.

The Hon. J. W. AGNEW, *M.L.C., Chief Secretary and Premier of the Colony of Tasmania, Hobart.*

FORWARDED to the Hon. the Minister of Lands and Works.

B. TRAVERS SOLLY.
3rd July, 1886.

REFERRED to the Engineer-in-Chief for his remarks as to statement that Mr. Mais's report is based on statements at variance in many essential particulars with the evidence obtained, and documents submitted to the late Commissioners.

NICHOLAS J. BROWN.
3. 7. 86.

HEREWITH letter dated 6th July, 1886.

J. FINCHAM, *Engineer-in-Chief.*
6. 7. 86.

Imperial Chambers, Bank Place, Melbourne, 2nd July, 1886.

SIR,

I HAVE received a printed Report, entitled "Replies to and Remarks upon the Report of the Royal Commission on Railways and Public Works," and I thank you for sending it.

I point out the unfairness of allowing officers of the Railway Department to publish documents which they inferentially allege were placed before the Commissioners, and to make statements thereon which neither accord with their evidence nor the plans and specifications they submitted and declared were authentic.

This manufactured evidence, if published by the authority of the Government for the purpose of misrepresenting the Commissioners, would be a most discreditable act, as would also be any attempt to purposely gloss over those blunders the Commissioners discovered in the construction of the railway works.

I can understand, and I trust rightly appreciate, the desire of the Government to shield their officers in every fair and honourable manner, but I cannot comprehend the policy of permitting the stamp of authority to be impressed on what is untrue.

I object in the strongest manner to the above document being accepted as reliable, and I protest against its publication.

I beg the favour of your sending this letter to the press, and oblige,

Your obedient Servant,

W. A. ZEAL.

The Hon. J. W. AGNEW, *M.L.C., Chief Secretary and Premier of the Colony of Tasmania, Hobart.*

FORWARDED to the Honorable the Minister of Lands and Works.

B. TRAVERS SOLLY, *for the Premier, absent.*
5th July, 1886.

REFERRED to the Engineer-in-Chief for his remarks.

NICHOLAS J. BROWN,
6. 7. 86.

HEREWITH (letter dated 6th July, 1886).

J. FINCHAM, *Engineer-in-Chief.*
6. 7. 86.

RETURNED to the Hon. the Premier with the remarks of the Engineer-in-Chief.

NICHOLAS J. BROWN,
7. 7. 86.

Public Works Office, Hobart, 6th July, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of letters from Mr. Zeal, referred to me by you, and dated 28th June and 2nd July, 1886.

I am totally at a loss to know upon what grounds Mr. Zeal can write that the data accompanying designs forwarded to Mr. Mais have caused the Report to be based on statements at variance in many essential particulars with the evidence obtained by, and the documents submitted to, the late Commissioners.

The data forwarded merely consisted of a short description of the designs and specifications, a statement of loads allowed for, with my reasons for adopting 60-ft. spans, and the particular construction of pier—just enough to make the drawings fully intelligible.

The data had nothing to do with anybody's evidence or statements; would be received by Mr. Mais for just what they were worth; and his Report shows that he adopted his own for calculating the stability and sufficiency of the bridges.

Mr. Mais had not to weigh evidence for and against, or to decide between opinions of Commissioners and Department, as Mr. Zeal's letter implies, but to give his own unfettered opinion; and that the papers prepared by me and forwarded by you could tend to unfairly influence that opinion in any way I most distinctly deny, and also assert that they essentially embodied only such information as had also been before the Commissioners.

It would have been a more straightforward course if Mr. Zeal had pointed out what he complained of, instead of making and repeating a serious charge in a vague general manner.

I can only account for the allegation by assuming that he refers to my not having included in the information sent to Mr. Mais some particulars of the evidence and statements of the Contractor for the Derwent Valley Railway and his engineer, upon which *alone* Mr. Zeal condemned the piers (*vide* Report), but, as I have pointed out, this was not necessary or within the scope of the instructions to Mr. Mais.

Mr. Zeal's letter of 2nd July, like so much that has gone before from his pen, will not bear the test of an impartial examination by any professional man.

He assumes that the officers of the Department were "allowed to publish" the defences which they were invited and permitted to make to a report containing inexcusable errors and misrepresentations. You are aware that the officers had nothing to do with publishing the replies about which Mr. Zeal is so sore. Next, he refers to the document as "*inferentially alleged* to have been placed before the Commissioners." I invite anyone to see Mr. Zeal's own initials on these documents, and then judge for themselves of the worth of this statement.

Mr. Zeal seems to give the Government officers credit for considerable rashness when he intimates that they have allowed the Government to put the stamp of authority (by the official publication of the replies) upon what is untrue; but he vastly exceeds this supposed rashness himself by deliberately charging all the engineers, and the Government Statistician too, by implication, with "manufacturing evidence"—a charge which carries quite sufficient answer in itself to the whole letter, and is evidence in its bitterness that the ex-Chairman now regrets the hurried conclusions of his Report.

For my part I protest in the strongest terms against the expressions used, and challenge Mr. Zeal to make them good; at the same time I respectfully request that a copy of the letter be sent to all the officers concerned, that we may consult together upon the matter.

When the Commission was mooted, you are aware that I gladly welcomed the idea of thus satisfying the public mind, knowing, as I did, that there was nothing but what would bear the light; but I did not anticipate having, in the Chairman, a gentleman who, because he has been convicted of errors, would descend to charging officials with "manufacturing evidence" and writing what was "untrue."

I regret that I feel compelled, in defence of myself and brother officers, to write in such strong and personal terms, but the bitterness of the letters, added to their transparent weakness, leaves me no alternative.

I have, &c.

J. FINCHAM, *Engineer-in-Chief.*

The Hon. the Minister of Lands and Works.

Premier's Office, Hobart, 7th July, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of your communication of the 2nd instant, in which you object to the replies of the Engineer-in-Chief and other officers of the Government to the Report of the late Royal Commission being accepted as reliable, and your protest against their publication.

I am sorry to note the grave charges which you have brought against the honesty and veracity of gentlemen whose characters in those respects have never hitherto been impeached.

I trust that the remarks of the Engineer-in-Chief upon your previous letter, and upon that of the 2nd instant, a copy of which I enclose (6th July, 1886), and which I propose to publish together with your letter, will convince you that you have been in error in attributing to that officer or other officers of the Government any unfairness or want of candour, or any untruthfulness, either in dealing with the Report or in submitting the matters in dispute to the judgment of Mr. Mais.

I desire to express my extreme regret that this correspondence has given rise to so much unpleasantness, and I hope that the publication of these documents may, as a matter of finality, meet the views of all interested.

I have, &c.

J. W. AGNEW.

The Honorable W. A. ZEAL, *M.L.C., Melbourne.*

Imperial Chambers, Bank Place, Melbourne, 21st July, 1886.

SIR,

I HAVE received your letter of the 7th July, in which was enclosed a copy of the Engineer-in-Chief's reply to the protest I forwarded to you relative to the erroneous statement made and submitted by that officer to Mr. H. C. Mais, as to the three large bridges on the Derwent Valley Railway. Apart from the most unfair and unusual course of permitting an interested person to present his naturally biassed opinions to a third party and seek a favourable verdict thereon, I complain that Mr. Mais's report—favourable though it must be to the Engineer-in-Chief—has not been published with the other correspondence connected with the late railway enquiry, although during one period of this controversy great reliance was affected to be placed on Mr. Mais's opinions. I think I have only to refer to this omission to ensure its being rectified.

I regret I cannot, even after reading the Engineer-in-Chief's courteous letter, withdraw or modify the views I have already expressed, but I frankly say I deplore equally with yourself that I have been compelled, in the interests of truth and justice to my late colleagues, to comment on the misrepresentations which have been systematically and persistently made respecting the decisions of the late Commissioners, based as they were solely on the evidence contained in their Report. When those incorrect versions of facts cease to be published I shall trouble you no further; but I must again ask you to give publicity to this letter, and oblige

Yours, &c.

W. A. ZEAL.

The Hon. J. W. AGNEW, *M.L.C., Chief Secretary and Premier of the Colony of Tasmania, Hobart.*

FORWARDED to the Hon. the Minister of Lands and Works.

J. W. AGNEW.
July 24th, 1886.

PERUSED and returned to the Hon. the Premier, with copy of Mr. Mais's Report for publication, as requested by Mr. Zeal.

NICHOLAS J. BROWN.
26. 7. 86.

Premier's Office, Hobart, 28th July, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of your letter of the 21st instant, in which you refer to the non-publication of the Report of Mr. Mais, the Engineer-in-Chief of South Australia, on the bridges on the Derwent Valley Railway at the same time as the other correspondence.

In reply, I have to inform you that your request with reference to the publication of your letter now under acknowledgment, and of the Report referred to, shall receive early attention.

I have, &c.

The Hon. W. A. ZEAL, *M.L.C., Melbourne,* J. W. AGNEW.

COPIES OF TELEGRAMS

To J. FINCHAM, *Esq., Engineer-in-Chief, Fingal.*

PREMIER in reply to Mr. Zeal has stated that you never offered any opinion whatever of your own to Mr. Mais on the subjects referred to him. Also that the whole of the drawings forwarded to Mr. Mais were the identical plans used by the Royal Commissioners. Premier is unwilling to allow letter to go without an assurance from you that he is strictly accurate in making both these statements. Please reply immediately.

NICHOLAS J. BROWN.
Hobart, 5. 8. 86.

To Hon. N. J. BROWN, *Hobart.*

I NEVER, directly or indirectly, offered any opinion whatever. I gave you, to forward, the identical working details of number two (2), as they came from the hands of the Commissioners. I also gave you a copy of the lithographed general drawings for both girders and piers of numbers two (2) and three (3), but sent details of number three (3), which were not completed when Commissioners sat, which I offered to supply as they were, but was informed they were not necessary.

J. FINCHAM.
Fingal, 5. 8. 86.

COPY of Telegram forwarded to Engineer-in-Chief, and copy of Engineer-in-Chief's reply herewith for the information of the Hon. the Premier.

NICHOLAS J. BROWN.
6. 8. 86.

Premier's Office, Hobart, 6th August, 1886.

SIR,

I HAVE, as promptly as possible, complied with your request that Mr. Mais's Report should be published. I regret extremely that this had not been done sooner, but the fact is, that until I received your letter I was under the impression the report had been printed, it having escaped my memory that I had read it, not in print, but in the original manuscript.

Although I have always been anxious that everything connected with the Royal Commission should be done in the most open manner, I am afraid from your allusion to "an interested person presenting his naturally biassed opinions to a third party," that you are under the impression Mr. Fincham has sought to influence Mr. Mais by some such action. I have consequently seen Mr. Fincham on the subject, and have received his explicit assurance that he has never offered any opinion whatever of his own to Mr. Mais on the subject referred to him.

If, however, an impression has been conveyed to your mind that something has been done which has not yet been fairly brought to light, I shall be only too glad to be informed of it. I hope, therefore, you will be kind enough to let me know, specifically, what you complain of in connection with thereference to Mr. Mais; this will only be a matter of justice to all concerned, as this Correspondence will no doubt be laid before Parliament, and I should of course be glad that the information it contains should be as full and complete as possible.

I may mention that the working drawings—which I believe are sufficient to enable an expert to decide as to the stability of the works—forwarded to Mr. Mais were the identical plans used by the Commissioners.

The Report of the Royal Commission accompanied the drawings, and the evidence would also have been sent had it been then published.

It may be difficult to see how this evidence could assist or influence Mr. Mais in forming an unbiassed judgment; but, in case it might do so, it has now been forwarded to him, with a request that he will state if its perusal affects in any way the opinion he has already given.

I have, &c.

J. W. AGNEW.

The Hon. W. A. ZEAL, *M.L.C., Melbourne.*

Imperial Chambers, Bank Place, Melbourne, 23rd August, 1886.

SIR,

Pressure of business has hitherto prevented my acknowledging and replying to your letter of the 6th instant.

I unreservedly accept as satisfactory your explanation of the cause which delayed the publication of Mr. Mais's report. I am sure I can but indifferently express the high opinion entertained by my late colleagues and myself of the courteous and fair treatment we invariably received from yourself, and I feel sure you will believe that the late Commissioners on their parts were actuated only by a sense of their duties and responsibilities when they reported to His Excellency the Governor at the conclusion of their long, tedious, and unthankful labours.

I have read Mr. Mais's report (on the case submitted to him by the Engineer-in-Chief) in the Hobart *Mercury* of the 2nd August, a copy of which you kindly sent me. I see nothing objectionable in that report, and think that had a similar case been presented to my late colleagues the conclusions they would have come to would have, in many respects, been the same as those of Mr. Mais. That gentleman, however, had not the opportunity of viewing the localities of the bridges; of considering the physical peculiarities and difficulties of their sites and foundations; of examining the ironwork and building materials; of inspecting all the plans and documents as they were presented to the late Commissioners, or of *hearing* the evidence, and particularly of *noting the demeanour* of the witnesses when under examination. All these advantages the Commissioners enjoyed, and as a natural consequence their decisions are more minute and precise than Mr. Mais's could be.

If under the foregoing circumstances the Minister of Public Works is prepared virtually to ignore the late Commissioners' Report, and recommend to your Government such proposals as appear to accord with his personal feelings and sympathies, on him alone must rest the responsibility.

Sufficient evidence has already been produced to prove to any unprejudiced mind that the Engineer-in-Chief submitted to Mr. Mais an incomplete, and, in some aspects, erroneous version of facts respecting the Derwent Valley bridges; and as my colleagues and myself have experienced at the hands of the Minister of Public Works such discourteous treatment, and have read his descriptive and valuable opinion of their professional skill, I feel—(if your request be complied with)—that I should particularise those variations from the plans and evidence in the case submitted to Mr. Mais by the Engineer-in-Chief—that the Public Works Department and its political Chief is not the channel through which that statement should be conveyed or considered.

I ask you to give publicity to this letter, and oblige

Your obedient Servant,

W. A. ZEAL.

The Hon. J. W. AGNEW, *M.L.C., Chief Secretary and Premier of the Government of Tasmania, Hobart.*

FORWARDED to the Hon. the Minister of Lands and Works for perusal.

J. W. AGNEW.
23rd August, 1886.

THIS letter has been perused by the Minister of Lands, and is now returned to the Hon. the Premier.

T. R. ATKINSON, *for Minister.*
26. 8. 86.

Minister of Lands and Works Department, Hobart, 26th August, 1886.

SIR,

I HAVE perused the letter of the Hon. W. A. Zeal, dated erroneously the 23rd instant, and in returning it I desire to express the hope that if you should think it necessary to communicate again with Mr. Zeal you will take the opportunity to deny the correctness of Mr. Zeal's reiterated statement that the Engineer-in-Chief submitted to Mr. Mais an incomplete or erroneous version of the facts respecting the Derwent Valley bridges. Mr. Zeal is evidently under a strange misapprehension as to the character of the Engineer-in-Chief.

In reference to a former complaint made by Mr. Zeal, that the decision of Mr. Mais on the designs of the Derwent Valley bridges had been given without perusal of the evidence taken before the Commission, I forward herewith copy of a letter (dated 16th August, 1886), received by me from Mr. Mais yesterday in reply to an enquiry from me, which I made under the erroneous impression that the copy of the evidence sent to Mr. Mais might not have reached that gentleman before he gave his decision. I desire to repel most emphatically Mr. Zeal's imputation that in submitting any recommendations to the Cabinet I have been actuated by my own personal feelings and sympathies.

The question I had to decide was one of the gravest public interest—namely, whether the recommendations of the Commissioners, involving an apparently unnecessary extra expenditure of many thousands of pounds, should be carried out, or cheaper and equally efficient plans, recommended by professional authority at least equal to that of the Commissioners, should be adopted in preference.

As to Mr. Zeal's charge of discourtesy on my part, I trust you will assure him that I regret exceedingly that he should have thought such a charge warranted, and I believe it is founded on an entire misunderstanding of the action I have thought it my duty to take in this matter. You are aware that I desire on all occasions to avoid showing discourtesy to anyone.

I have, &c.

NICHOLAS J. BROWN, *Minister of Lands and Works.*

The Honorable the Premier.

Engineer-in-Chief's Office, Adelaide, 16th August, 1886.

SIR,

I HAVE the honor to acknowledge receipt of your letter of the 4th instant, also a copy of the evidence taken before the late Royal Commission. In reply I beg to inform you that I read the evidence relating to the bridges on the Derwent Valley Railway as published in the Tasmanian newspapers. I was also supplied with a copy of the printed evidence (as laid on the Table of both Houses of Parliament) by the Engineer-in-Chief, Mr. Fincham, which I duly read before I sent forward my report; and although I have again looked through the evidence relating to the above bridges, I have no reason whatever to alter the opinions contained in the report forwarded to you.

I have, &c.

H. C. MAIS, *Engineer-in-Chief.*

The Hon. N. J. BROWN, *Minister of Lands and Works, Hobart.*

Premier's Office, Hobart, 27th August, 1886.

SIR,

I HAVE the honor to acknowledge the receipt of your letter dated the 23rd instant, but which was received in this office on that day, with reference to the case submitted to Mr. Mais, the Engineer-in-Chief of South Australia, by the Public Works Department of this Colony as to the bridges on the Derwent Valley Railway.

Your request that publicity might be given to this communication has received attention, and I forward herewith copy of a letter [26th August, 1886,] with enclosure, addressed to me by my colleague the Minister of Lands and Works, to whom your letter was referred for perusal.

I have, &c.

J. W. AGNEW.

The Honorable W. A. ZEAL, *M.L.C., Melbourne.*

Premier's Office, Hobart, 30th August, 1886.

SIR,

IN accordance with your request I have given publicity to your letter received on the 23rd instant, but bearing, no doubt by an oversight, the same date.

As Parliament is now in session, and as the Report of the late Royal Commission on Railways and Public Works will claim at a very early period the attention of Members, my colleague the Minister of Lands and Works is naturally most anxious that the request for specific charges contained in my letter of the 6th instant should have your earliest possible attention. I may add that, although I feel convinced you would not wittingly do anyone an injustice, I fear something of which I have no cognizance must unfortunately have influenced your mind in forming an estimate of the characters of the Minister of Lands and of the Engineer-in-Chief. From personal knowledge of the latter gentleman I am quite satisfied it is impossible he could have knowingly and deliberately "submitted to Mr. Mais an incomplete, and in some respects erroneous, version of facts respecting the Derwent Valley Railway" for the purpose of obtaining his professional opinion,—an opinion which, under such equivocal circumstances, would of course be worse than valueless. On the same grounds, I am equally certain my colleague could never have been a party to such a proceeding.

I state this in a spirit of fairness and justice to all on both sides of this vexed and disagreeable question.

I assure you, however, that the charges "specifically" referred to will have the most careful consideration.

I have, &c.

J. W. AGNEW.

The Hon. W. A. ZEAL, *M.L.C., Melbourne.*

Premier's Office, 11th September, 1886.

MEMO.

No communication from Mr. Zeal in reply to the Premier's letter of the 30th ultimo, having reference to the Case submitted to Mr. Mais, the Engineer-in-Chief of South Australia, as to the Bridges on the Derwent Valley Railway, has as yet been received.

JAS. ANDREW, *Secretary to the Premier.*

The Hon. the Minister of Lands and Works.

WILLIAM THOMAS STRUTT,
GOVERNMENT PRINTER, TASMANIA.

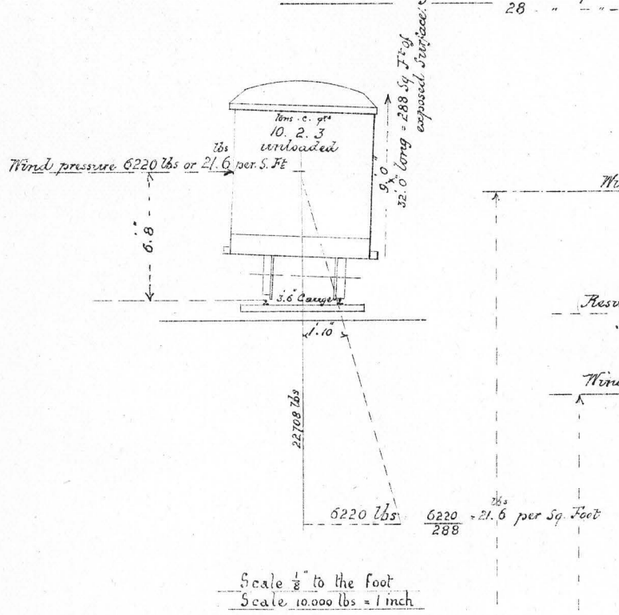
TASMANIAN GOVERNMENT RAILWAYS

DERWENT VALLEY LINE –

BRIDGE No 2.

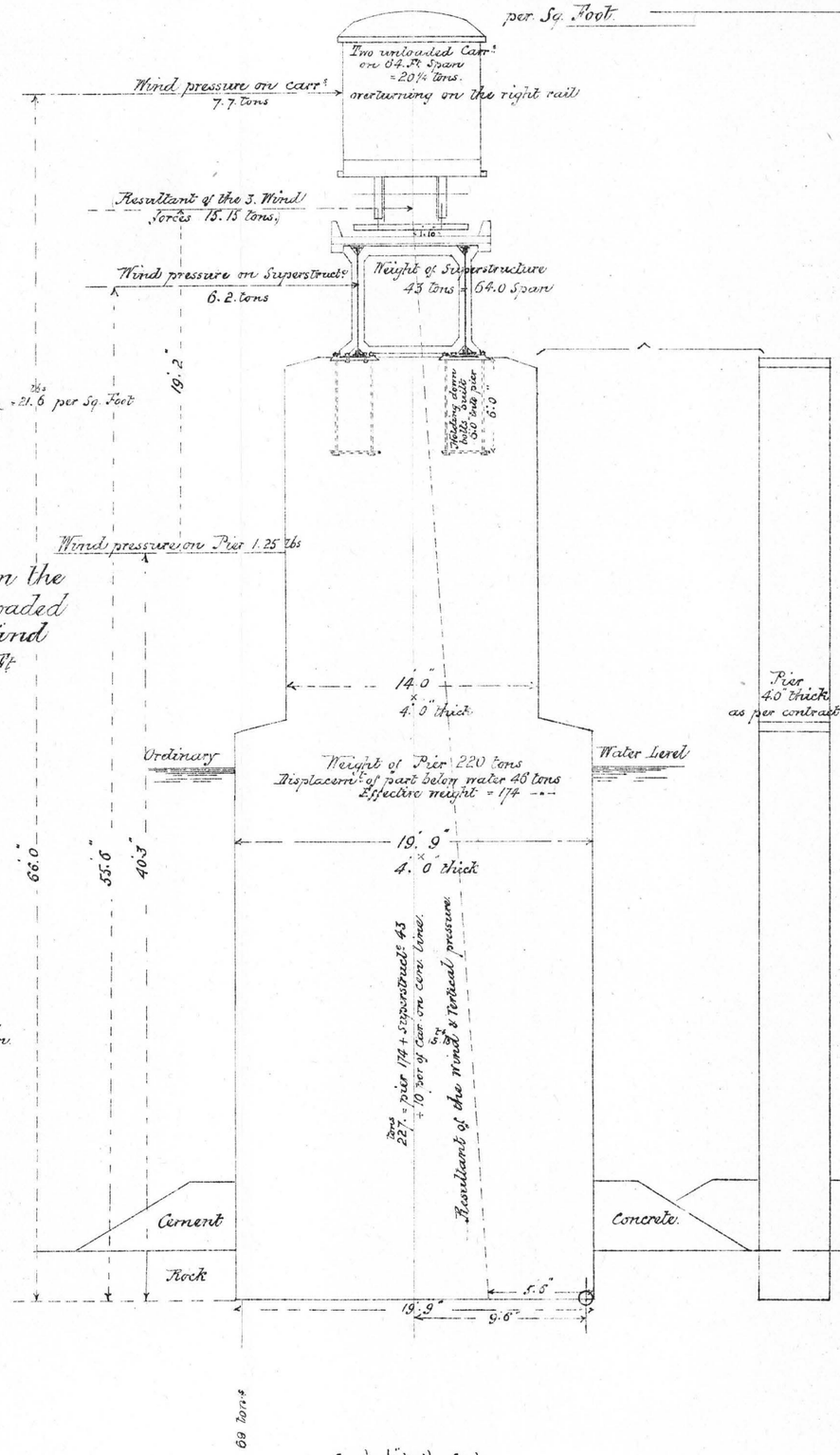
Sheet 1.
To accompany Report
dated 10th June 1886
(sd) H. S. Mais
M. Inst. C.E.

CASE 1 – Wind pressure required to overturn a Carriage — 21.6 lbs per Sq. Ft unloaded; 28 " " " " " loaded



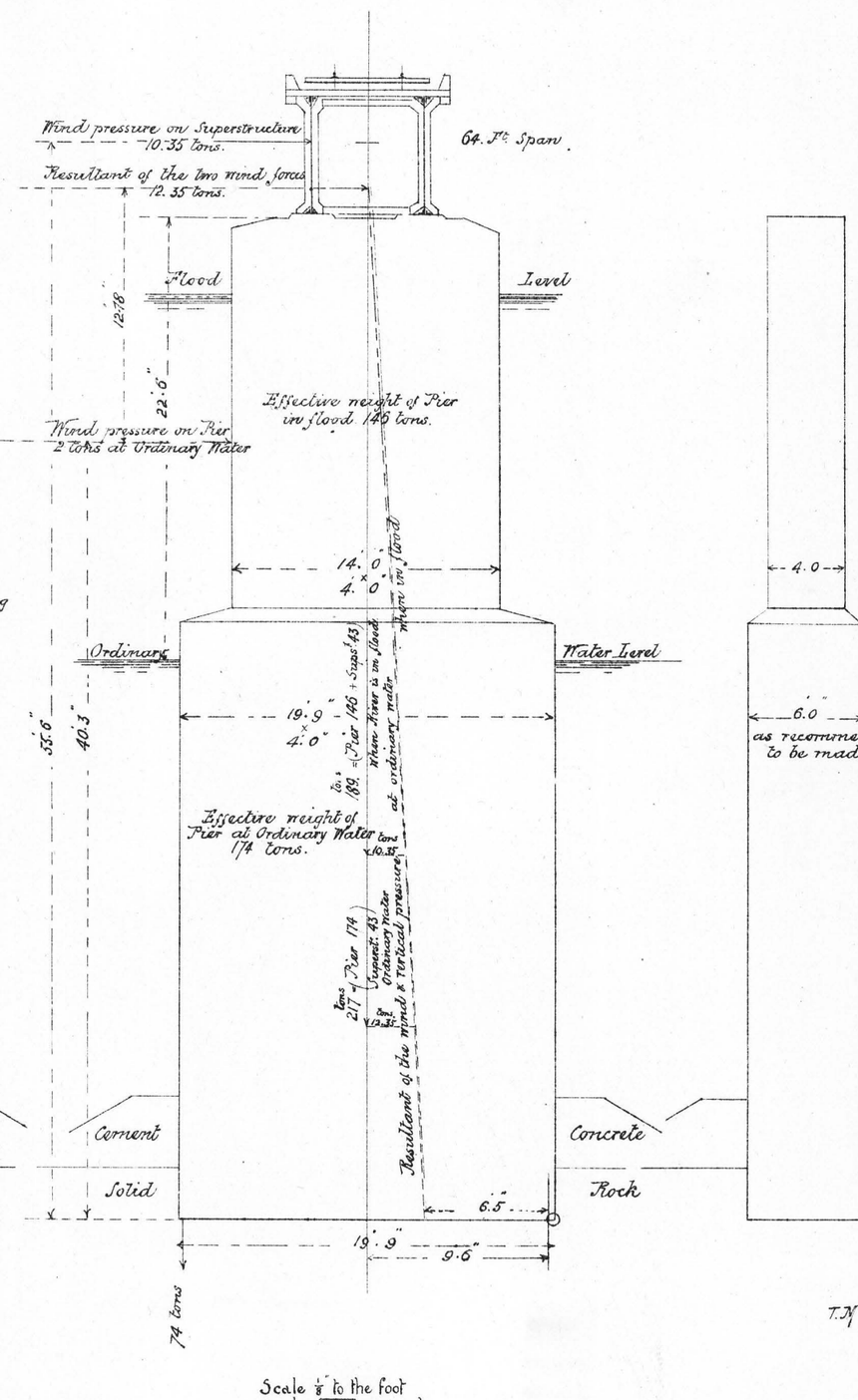
Scale 1/8" to the Foot
Scale 10.000 lbs = 1 inch

CASE 3. Stability of the Pier with a train of unloaded Carriages on the line, and with a Wind Pressure of 30 lbs per Sq. Foot.



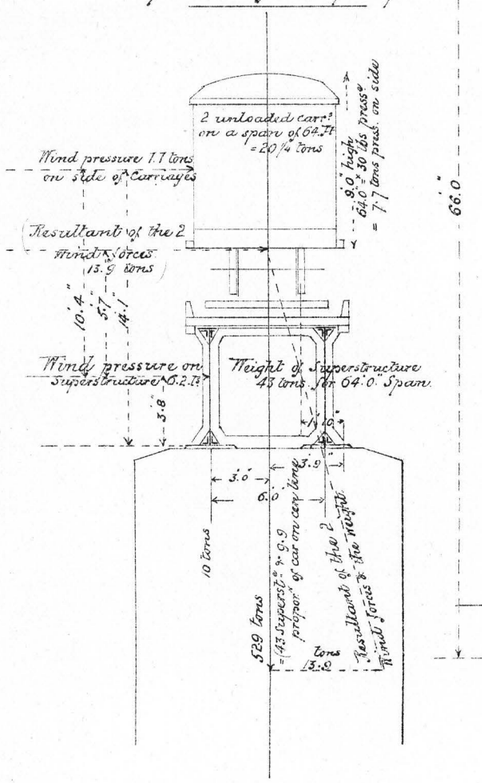
Scale 1/8" to the foot.
Scale 40. tons = 1 inch.

CASE 4 Stability of the Pier with no carriages on the Line and with a Wind pressure of 50 lbs per Sq. Foot.



Scale 1/8" to the foot
Scale 40 tons = 1 inch

CASE 2 Stability of the Girders on the Pier with a train of unloaded Carriages and with a Wind pressure of 30 lbs per Sq. Ft



Scale 1/8" to the foot
Scale 20 Tons = 1 inch

T.N

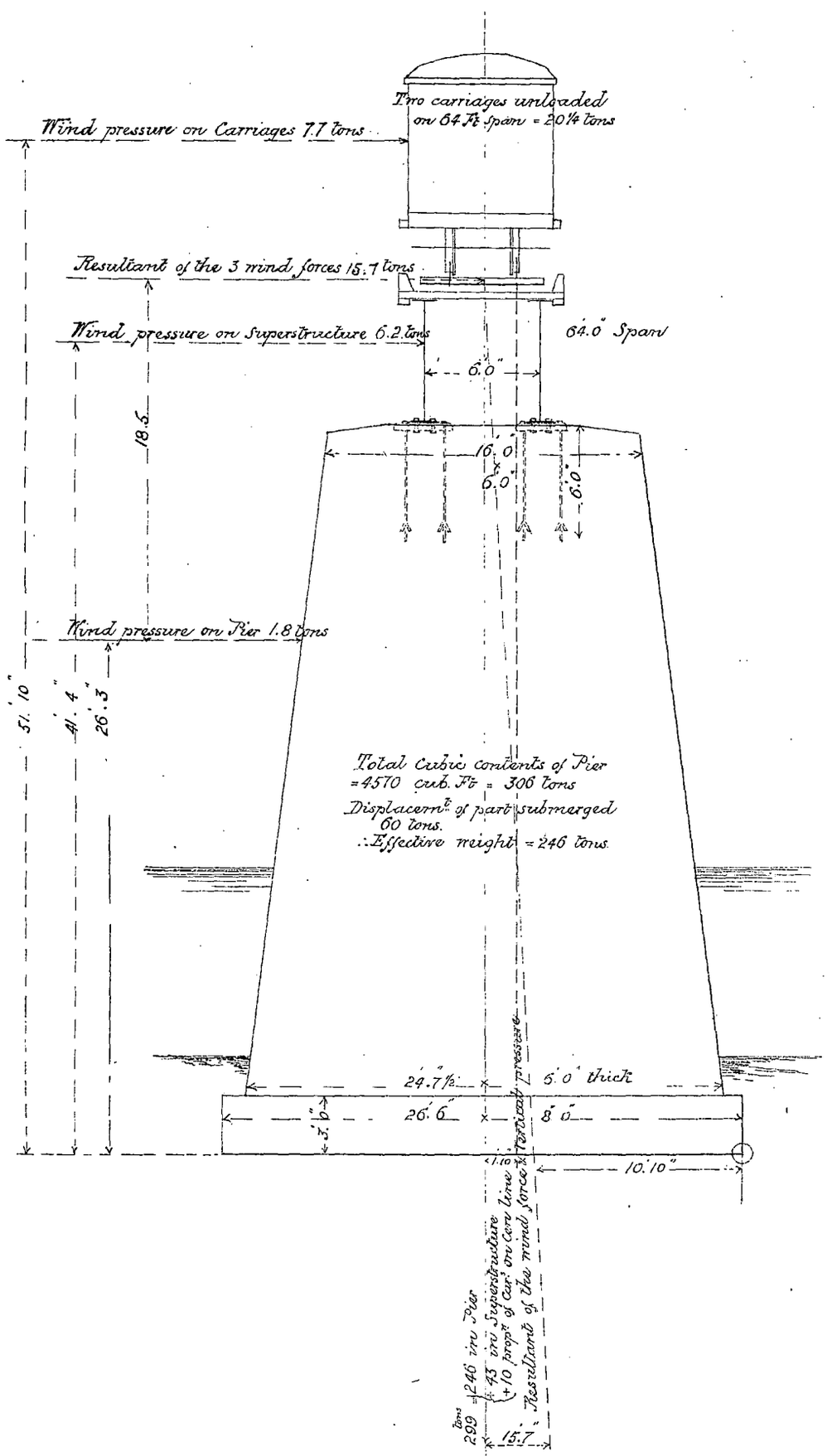
TASMANIAN GOVERNMENT RAILWAYS

DERWENT VALLEY LINE

Sheet 2.
To accompany Report
dated 10th June 1886.
(Sd) H.S. Mais
M. Inst. C.E.

BRIDGE No 2

CASE 5. Stability of the Masonry Pier with a train of unloaded Carriages on the Bridge, and with a Wind pressure of 30 lbs per Sq. Foot.



Scale ⅛" to the foot
Scale 40 tons = 1 inch

T.N

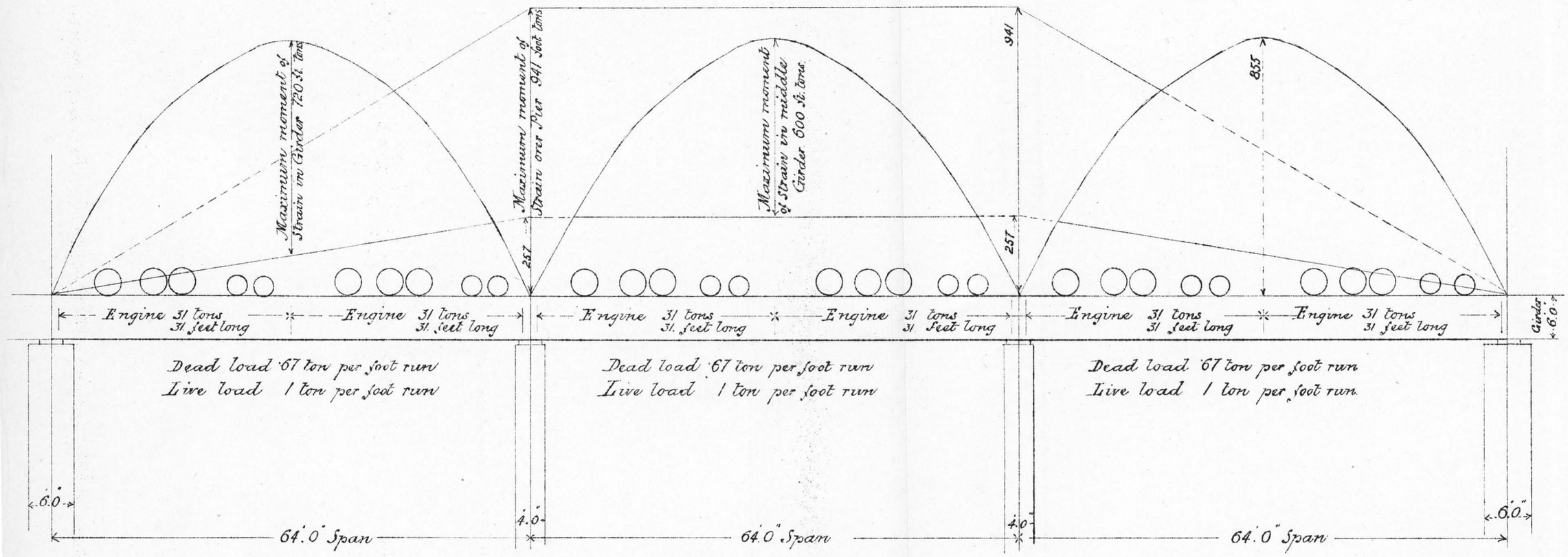
TASMANIAN GOVERNMENT RAILWAYS

DERWENT VALLEY LINE

BRIDGE No 2

Strength of Girders, Continuous over 3 Spans

Sheet 2A
To accompany Report
dated 10th June 1886.
(sd) H.S. Mais
M. Inst. C.E



Scale 1/16" to the foot
Scale for Strains 400 tons = 1 inch

941 ÷ 6.0 Girder = 157 tons strain in top and bottom flanges over the piers ------ 157 / 37.5 — 4.18 tons per sq inch compressive strain in bottom flange over the pier.

15.7 / 34.1 — 4.6 tons per sq inch tensible — top

720 ÷ 6.0" = 120 between the piers ---- 120 / 37.5 — 3.2 tons per sq inch compressive — in top flange in middle of outer girder

120 / 34.1 — 3.5 tons per sq inch tensible — bottom

Gross Sectional area of the flanges 37.5 sq. inches
Nett sectional area excluding rivets 34.1 sq. inches

Tasmanian Government Railways

Derwent Valley Line

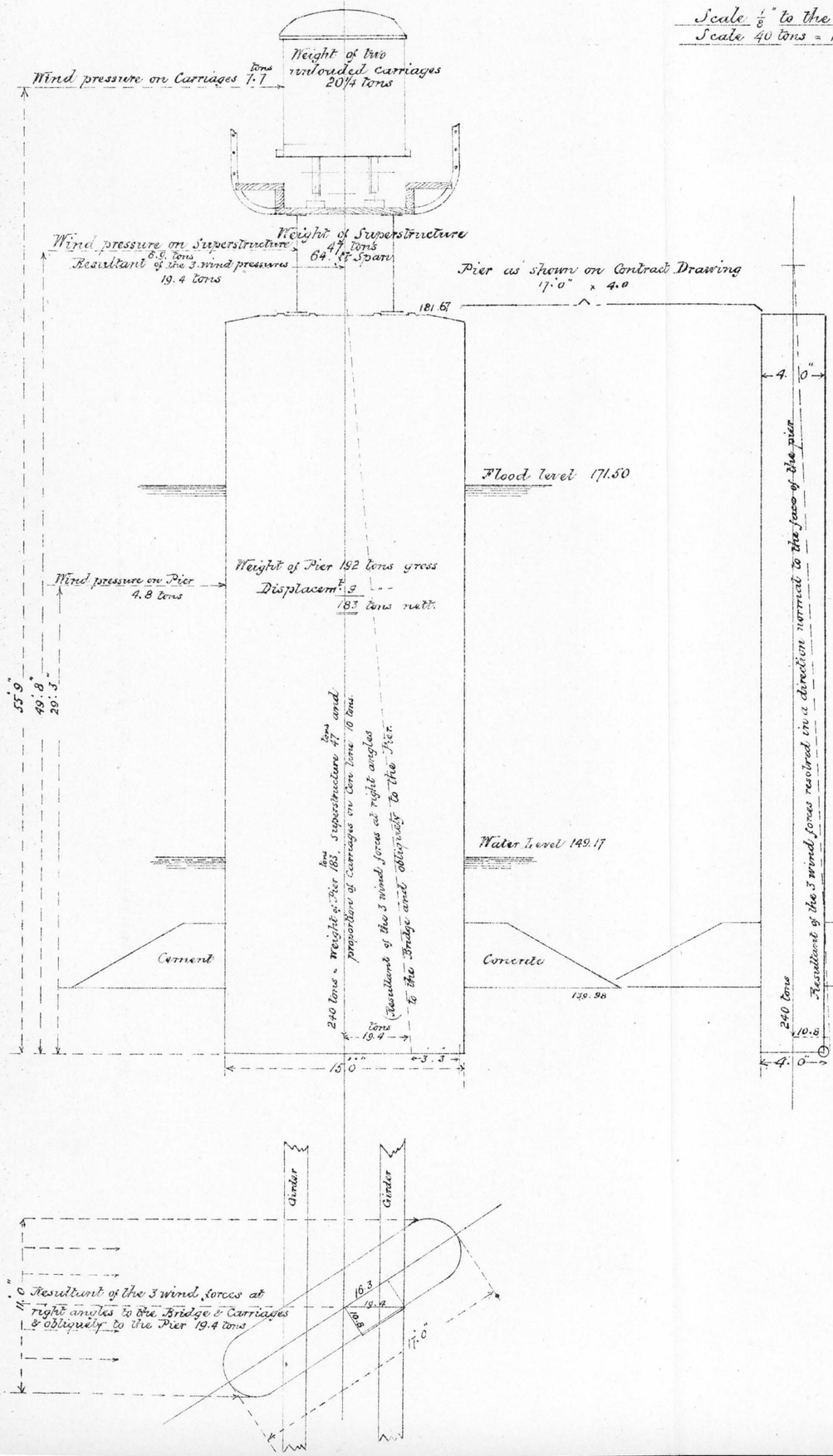
Bridge No 3 with Skew Pier

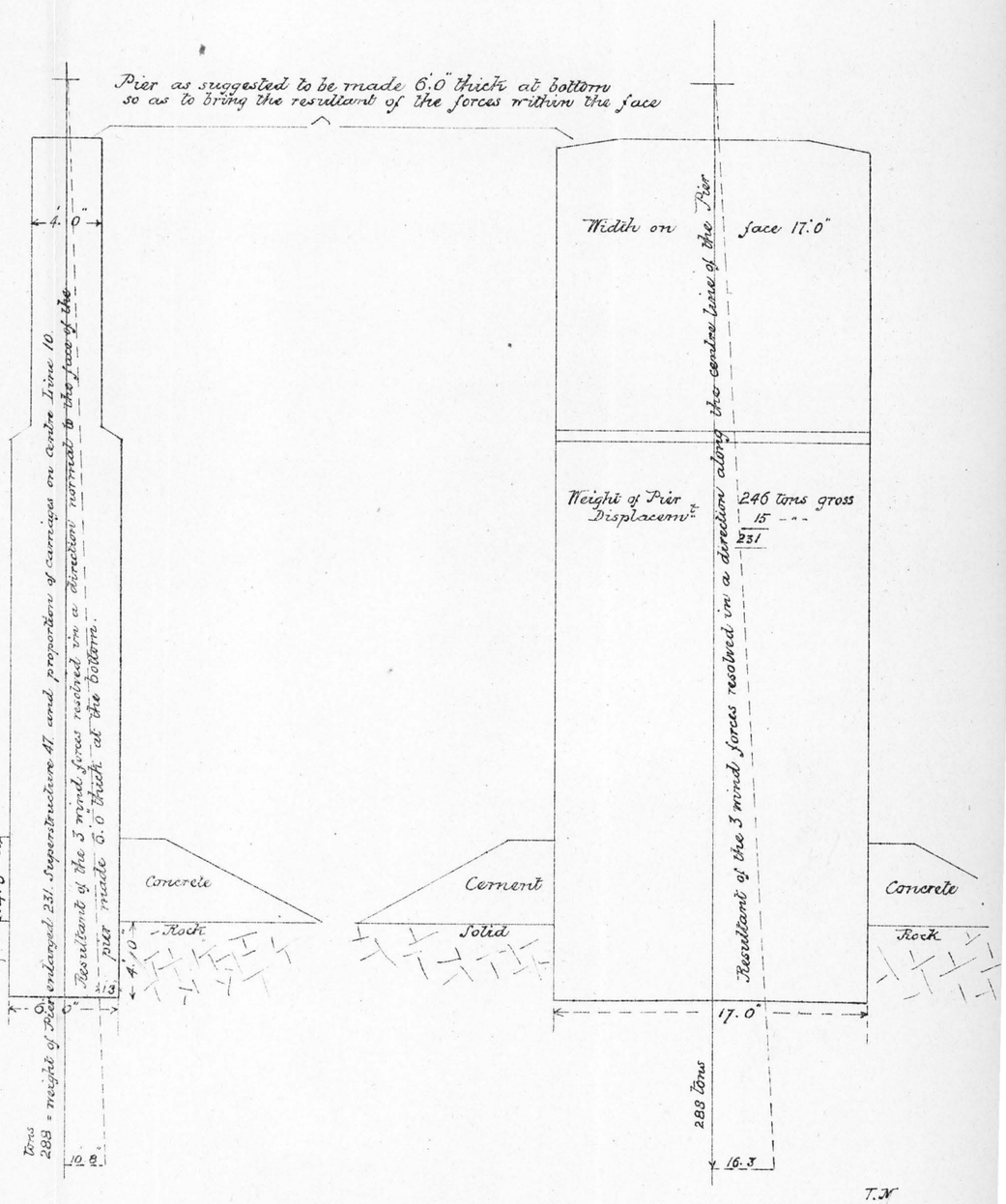
Case No 6

Sheet 3.
To accompany Report
dated 10th June 1886
(sd) H.S. Mais
M.Inst.C.E.

Stability of the Pier with unloaded Carriages on the Bridge, and with a wind pressure of 30 lbs per Sq. Foot.

Scale ⅛" to the Foot.
Scale 40 tons = 1 inch.





T.N