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MADRAS RECORD OFFICE.

Government of Madras.

Public works. **DEPARTMENT.**

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Dated 5 12 1871.

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Proceedings of the Madras Government, Public Works Department, 5th December 1871.

No. 72. Read the following letter from the Acting Consulting Engineer for Railways, to the Secretary to Government, Public Works Department, dated Madras, 11th October 1871, No. 439 :—

I HAVE the honour to forward the surveys, plans, and estimates for the Great Southern of India Railway Extension, from Trichinopoly to Tuticorin, framed for a line of 3 feet 3 inches gauge, and in accordance with the location approved of in G. O., No. 939, dated 30th March 1871.

2. The working plans for a line on the Indian gauge were completed and sent in to this office on the 1st March 1871; but were returned to the Chief Engineer that they might be recast on the narrow gauge.

The opportunity was then taken to point out in what respects the changes in the principles applicable to the construction of Railways in India would demand different treatment from that adopted in the designs as prepared for the Indian gauge. It was explained that a much more searching examination into the drainage areas to be provided for, if not actual surveys of the smaller catchment basins, would be required; that economy in construction would be looked for, and specially in those points in which the experience gained on the open lines in this Presidency had shown European practice to be unsuited to the requirements of this country; and above all it was requested that all plans and estimates might be drawn up in such full detail that the Government Officers should be enabled to judge both of the sufficiency and suitability of all designs.

An examination of the designs and estimates as now submitted, however, necessitated still further reference on several points, and the Chief Engineer in concluding his letter of 16th September, detailing the reasons which induce him to adhere to his original designs, writes as follows: "No doubt all the suggestions made by you could be carried out, but as all the designs were matured after full and careful consideration in the light of our past experience in working this Railway, I should be acting contrary to the dictates of my own judgment were I to acquiesce in the changes."

3. The Government of India, however, have in the last two years enunciated the following principles:—

That a line should be commenced on the most economical scale possible, improvements being carried out by degrees in the future, as the traffic is developed, and an amelioration of gradients and additions to the conveniences first provided, are justified by increased returns. The buildings provided should, at the outset, be strictly limited to what is essential for the protection of the engines and vehicles; goods requiring cover, and the persons employed for the working of the line, and everything should be built in the most economical manner possible, and the accommodation allowed be on the most frugal scale. Raised platforms should be given up.

No. 544-R, 12th May 1869, paragraph 5.

No. 544-R, 12th May 1869, paragraph 7.

The Secretary of State also wrote on the 13th April 1870, (paragraph 3,)—

I am glad to observe the stress laid by you on the necessity for the strictest economy of first outlay on all the adjuncts of a State Railway, the road and

machinery for working it, alone, being first class at the beginning, and all expensive accessories being postponed until called for and warranted by increased traffic.

And again on the 26th October 1870, paragraph 11—

I entertain no doubt of the soundness of the general principles on which your recommendation is founded; that principle is the pre-eminent value, and indeed the absolute necessity of the utmost possible economy in the execution of all our great public works.

These latter remarks refer especially to State Railways, but their tenor is entirely in accordance with the orders for the construction of Guaranteed Railways; it remains, therefore, only for me to submit the estimates and designs as received, with my recommendation that they be sanctioned subject to such of the modifications hereinafter detailed, as for the reasons given may be approved by the Government.

4. *Water-way.*—As regards the water-way provided, the Chief Engineer has drawn up a tabulated statement showing the approximate areas of the catchment basins, as taken from the Ordnance Map, (some few of the smaller ones having been corrected by actual survey,) and the rainfall provided for in each case by the water-way allowed, with an assumed maximum velocity at the bridge.

A list of the water-ways along the existing road, which for a great portion of the distance runs parallel to the proposed line of railway, accompanies the above statement, but the arrangement of the information is such as not to admit of a comparison being made between existing and proposed water-ways.

The tabulated statement indicates that the water-ways are in some cases very limited, but the Chief Engineer gives explanation in his letter of the 13th September, and states that the water-ways have been arrived at from a careful study of each individual case, having regard to such existing works as are to be found on the adjacent public roads, and to the known height and action of floods.

5. *Gradients.*—As regards the "ruling gradient" of the line between Madura and Trichinopoly, the longitudinal section shows that, as the line is located, no easier gradient than 1 in 100 is attainable.

South of Madura a ruling gradient of 1 in 200 has been attained at the cost of some earthwork. This gradient was recommended, in the former report on the sections of this line, on the Indian gauge, and though the gradient might be altered to 1 in 150, the difference in outlay would not be great, while the current expenses would necessarily be raised in the working of the line.

6. *Bridges.*—In the designs for large bridges the Chief Engineer allows for no iron girders of larger span than 50 feet in the clear, and in reply to a suggestion as to the advisability of wider openings, he assigns his reasons to be (1) that 50 feet girders are more easily handled; (2) that should any of the girders be lost at sea they can, if not exceeding 50 feet, be replaced by beams of wood; (3) that there is no trained staff of men available; (4) that with the rivers in question it is not dangerous to narrow the water-way to the extent required for 50 feet spans.

As to the 1st and 3rd objections, all the bridges of any importance on the Madras Railway are of 70 feet spans: no difficulty has been complained of there in getting the girder set up; and the workmen employed on those bridges might

be obtained for bridges in the Southern Districts. The risk of casualties at sea must always be incurred, and does not appear to me of any weight in this case. But, with regard to the 4th objection, I believe the rivers to be dealt with are such that any contraction of water-way is particularly to be avoided. The section of the Vygay at the point selected for the crossing, on traffic and other considerations, is of considerably less area than that of the river both above and below; and the water-way thus already restricted should, in my opinion, not be contracted more than is absolutely necessary.

The Vypar or Satoor river is one of those rivers subject to most unmanageable floods owing to climatic conditions.

I therefore think the Chief Engineer should be asked to reconsider the subject as to the substitution of 70 feet for 50 feet spans in the bridging of both the Vypar and Vygay rivers.

7. *Floorings to Bridges.*—No floorings or retaining walls are provided for any of the bridges, the Chief Engineer, in reply to a reference on this point, stated that there are no bridges to which, under his present knowledge of requirements, he has decided to put aprons or cross walls; but that provision has been made under contingencies and extra masonry for such work if needed. In the estimate there is an allowance for each district, varying from 400 to 200 cubic yards of extra masonry, but it is not shown on what data this allowance is based, though it would appear from the Chief Engineer's letter that it was intended to meet unforeseen additions, such as retaining walls, extra foundation to wings, abutments, etc., etc.

Looking to the accidents that have happened on the Madras Railway attributable to absence of flooring, and in the light of general experience on all sides in this country, it is hardly to be taken for granted that no bridge along a continuous line of over 200 miles will require flooring, and I would recommend that, when the staff has taken the field, the Chief Engineer should be called upon to furnish a detailed report showing every case in which he may consider a flooring unnecessary, with explanation of the grounds on which he has formed that opinion.

8. *Formation Width.*—The Chief Engineer strongly recommends that the width of formation be increased from 12 to 16 feet, on the ground that the cost would not exceed Rupees 500 per mile, while the additional up-keep would exceed yearly the interest on this sum.

So long as the stability of the line is not endangered in a narrow road being exposed to heavy storms of rain and the scour of unusual floods, the question of the width of the foundation level can be treated from a financial as well as from an engineering point of view. If Rupees 500 per mile additional be expended on construction, there is thenceforward an additional fixed charge of Rupees 25 per annum in interest. But the Government of India have assigned a standard width of 12 feet, and it is yet to be proved that the further repairs necessitated by that limited width will exceed the sum of Rupees 25 per annum. In the meantime a saving will be effected in the first construction of the line if the width of 12 feet is adopted; while in case hereafter any portion of the line is found to require a greater width, such addition to the earthwork as is necessary may be made without an increase of width to the entire length of the line.

9. *Weight of Rail.*—The Chief Engineer also strongly recommends a heavier weight of rail than the standard weight, 36 lbs., fixed by the Government of India, and suggests that a weight of 45 lbs. to the yard should be employed where the gradients are steeper than 1 in 200, if the alteration is not approved of for the whole line. No standard design has been given for the rail on the narrow gauge; and if the Government of India have not decided on any particular section, I think it advisable that the Chief Engineer should take the opinion of the Consulting Engineer to the Railway Company in England.

No. 3,624, dated 7th August 1871.

10. *Sleepers.*—The Chief Engineer estimates for creosoted wooden sleepers, on the ground that the renewals on the open line have not been excessive, and were principally due to imperfect impregnation of the sleepers, which will be less likely to occur with the smaller sleepers on the narrow gauge. In support of these views it is stated that the life of a wooden sleeper on the Great Southern Railway may be estimated at about 12 or 13 years, and that on that line which has been open for 10 years, the renewals have amounted to only about one-sixth of the number originally laid down..

With these data there should, in my opinion, be no other than wooden sleepers used on the extension, as their employment will certainly effect a considerable saving in first cost as compared with iron, and will probably be cheaper also in a course of years.

11. *Fencing.*—The Chief Engineer proposes to indent for wire fencing for about one-half of the length of the line, to put up along such portions where it is certain that vegetable fence will not grow, assuming that permission will be given to work the line with trial and imperfect live fencing.

Assuming that the running speed on the narrow gauge lines will be restricted, I am of opinion that many parts of the line may remain without further side protection than a ditch and mound; but that at stations, villages, crossings and other places where people or cattle are in the habit of congregating, wire fencing should be used. I would therefore recommend that wire fencing for one quarter of the length of line should be admitted, and that the item in the estimate should be reduced from Rupees 5,61,297 to 1,40,324.

12. *Alternative Lines.*—Two modifications in the location of the line, as laid before the Government of India, were adverted to in my former report of the 21st January 1871, No. 33, and these have received further consideration. The first is that affected by the site of the Tinnevelly station. The second affects the line between Virduputty and Covilputty.

Vide G. O., No. 456, dated 11th Feb. 1871.

As originally located the line crossed the Vypar river at Satoor, and the affluents of the same river at three different points, but 4 miles to the east of Satoor these branches unite, and as the crossing at Satoor presents the objectionable feature of two bridges over the same stream with a shifting sandy bed, it was thought advisable to examine the country to the east, with a view to an alternative line crossing the river below the confluence of the branches.

The results of this examination are that the more easterly line would cost less in construction by about 50,000 Rupees, that the river may be bridged with 1,830 feet of water-way instead of 2,090 lineal feet; but that, on the other hand, the length of line would be increased by 2 miles, and that the aggregate of rise and fall in gradients is the greater by 58·16 feet. As regards the accommodation which is to be given to Shivacausy, which is considered the great collecting centre for the produce of the neighbourhood, goods going northward would in no way be affected by the diversion eastwards, while goods going south would, if a road were made connecting Satoor with the nearest point of the line, have to travel 14 instead of 10 miles, a difference in distance of no great practical importance.

Satoor is an unhealthy place, and not inhabited by wealthy people; still it is the head-quarters of the Taluq, with a Tahsildar's Cutcherry, Subsidiary Jail, and Post Office; and it is called by the Collector of the District one of the centres of traffic. On engineering grounds alone I think the diversion to the east would be preferable; but considering that it would add 2 miles to the length of the line, and take it away from the present set of traffic, I am of opinion that the line as located should be adhered to.

The approach to the town of Tinnevelly was laid out by the Chief Engineer as the best in an engineering point of view; but I think, on other considerations, that the site for the terminal station has its disadvantages, and that the approach should be considerably to the east of the town. The Collector in his memorandum* of the 19th December 1870, to the Chief Engineer, recommended the line to be brought along the bank of the Ninarcolum tank, to the toll gate immediately to the east of the town; the principal merchants being also of opinion that the station should be on that side. The Chief Engineer shows a valid objection to the line following the Ninarcolum tank bund, inasmuch as the station yard would have to be raised several feet, and the great depth of foundations would make the station buildings exceedingly expensive.

* Enclosed.

The traffic into Tinnevelly will be principally from the south, and pass over the Tambrapoorney bridge (when restored), within half a mile of the station site on alternative line No. 1. The traffic from the north and east will be already served by the Railway, and there remains only the comparatively small traffic from the west that might be benefited by the site to the west of the town. This site is upwards of 2 miles from the Tambrapoorney bridge, and 4 miles from the town and cantonment of Palamcottah. On the other hand, near the river bridge there are the villages of Koharacolum and Vannarpettah on the right bank, and the villages of Sindamenthoray and Veerapuram on the left bank of the river, all to the east of No. 1 alternative station site.

No. 2 alternative route would bring the line to terminate a few chains from the Ninarcolum tank, and about a mile to the west of No. 1, the advantage of this line would be its close proximity to the town of Tinnevelly and the merchants' godowns there.

But all produce brought direct to the station, (excepting only the small share from the western country,) and all consignments from Palamcottah and the cluster

of villages about the river bridge, would have the extra mile to reach the station: the station site will be much nearer to the tank bund, and also the land near the bund is of higher value than that to be taken up by No. 1 route. The balance of advantages appears to me, on the whole, to be in favour of this latter, which is also the shorter line, and the cheaper by Rupees 43,697. Mr. Puckle, the Collector, went over both of the station sites with me, and expressed himself satisfied with either of the alternative routes to the east of the town.

The station proposed for Tetchanellur on the located line is also avoided by the shorter route.

13. *Platform Roofs.*—In the estimates for 3rd class stations no cover has been provided over the platforms. I think the saving of expense is judicious; a light zinc awning may be hereafter provided at any station where, from development of traffic, it may be found necessary. At the terminal stations iron roofs of 42 feet span are allowed. I recommend instead a corrugated zinc roof over the passenger platform and a carriage shed of small span, which will furnish the required accommodation at a less cost.

14. In the engine sheds the walls are estimated for at 18½ feet in height, and venetianed windows are allowed. On the open lines brick or tile open work is found effective, and is less costly, the walls may be reduced by 4 feet so as to be 14½ feet high.

15. *Porticoes.*—At some stations I think the porticoes may be reduced outside the booking office, as only a width sufficient to allow of one line of vehicles appear to be necessary.

16. *Station Masters' Bungalows.*—In the station arrangements the Chief Engineer provides for each 3rd class station a Station Master's bungalow and out-offices. This plan was followed on the open line between Erode and Tanjore, and the Chief Engineer states that it was found difficult to persuade respectable natives to occupy the houses, but it is believed that this was partly on account of the designs being on an European model and the site being exposed to the public. The buildings are quite unsuited to Native habits. No difficulty is found in inducing respectable Natives along the line of the Madras Railway to occupy a room and verandah (opening to the rear of the building) in the same block as the ticket office, telegraph office, etc.; but the Agent of the Great Southern of India Railway, I think with good reason, objects to that arrangement, if avoidable, on the score of its affording cover to suspicious characters and facilities for all sorts of irregularities. I would recommend the provision of merely a tiled building surrounded by a compound wall, built of the materials commonly used in the neighbourhood, and designed on the model of native buildings, such a building would not cost more than Rupees 1000, whereas those designed at first to serve as Engineer's quarters are estimated to cost Rupees 3,505.

17. *Platforms.*—The length of platform allowed in the present estimates appears to me to be unnecessary; the experience gained on the open line goes to prove that except at the terminal, junction, or large stations, a length of eight carriages is sufficient with a length of curb equal to about thirty carriages where feasts are

Proceedings of the Madras Government, Public Works Department, 5th December 1871.

held or exceptionable traffic is lookedfor; I would therefore suggest that no further accommodation in the way of platforms be sanctioned.

18. *Latrines.*—The estimates for urinals for natives provide for the space within the walls be roofed in. The arrangements now carried out on the Madras Railway are generally admitted to be scarcely susceptible of improvement, and I recommend that the walls of the enclosure be reduced to 7 feet in height, and that the roof be dispensed with.

19. *Water Columns.*—For all stations the estimates provide two water cranes, with a corresponding length of cast-iron piping; this appears to me unnecessary, and I am of opinion that only one need be provided at each 3rd class station.

20. *Approaches.*—At all level crossings provision has been made for fencing in the approaches; except where these are embanked, fencing appears unnecessary.

21. *Engineers' Bungalows.*—The Chief Engineer, with a view to economy, proposes to build the Station Masters' bungalows at first, and to make them available for his Engineers during construction, by giving some additional accommodation; there are however so great disadvantages in this plan that, in my opinion, it should not be adopted. I have stated above the objections of native Station Masters to a dwelling built to suit Europeans. The house would be placed on a spot convenient for the Station Master to carry on his duties, but the Engineers should reside at a place selected from sanitary considerations and with reference to their own convenience for inspecting the works under their charge. It would be impossible to design a bungalow with any degree of comfort to the Engineer that would not be quite disproportionate, both in arrangement and cost, to the wants of the low-salaried Station Master at a 3rd class station. The design furnished, allowing three rooms only 12 feet square, appears to me to give insufficient accommodation, and I think it would be a far better plan to allow Rupees 1,500 for a temporary bungalow which might be made commodious and comfortable, though intended to last only for a few years. One such bungalow is already entered in the estimates on plan No. 180.

22. *Rates.*—Sufficient information is not given to admit of the accuracy of the rates being determined. The tabular statement furnished shows that the material for the larger bridges does not vary in character, being described throughout as gneiss: and except in three instances it is stated to be procurable within 4 miles of the work. Yet the rates entered for the bridge work in the six districts southwards from Trichinopoly are from 12½ to 14 Rupees, and to the south of Madura from 15 to 18 Rupees per cubic yard. For the masonry in station buildings, engine sheds, etc., a rate of Rupees 10 is given for the whole line, except at Tuticorin, for which the rate is Rupees 18.

Embodied in G. O., No. 456, dated 14th February 1871.

Now, on the North-West Line of the Madras Railway the masonry of the Cheyair bridge, to be built of lime-stone, is estimated to cost Rupees 8 per cubic yard. On the Neilgherry Branch Line, where the stone used is gneiss, work is readily taken on contract at 9 Rupees, some of the stone is of a very hard description and is brought from a distance of 6 to 8 miles. Much of the station building work on the North-West Line, also of gneiss, was carried out by the Engineer Department at rates not exceeding 9 Rupees.

The minor buildings at the stations are not required to be of masonry of the same quality as the large buildings: but a uniform rate of Rupees 10 is entered in the estimates for the masonry everywhere. Likewise for bridge work, taking all together, whether for high piers or small culverts, the rate is nowhere less than 12 Rupees.

I am of opinion, on the above considerations, that the rates given by the Chief Engineer are unnecessarily high: and that general sanction should not be given to a higher rate than Rupees 12 per cubic yard, without explanation of the necessity being furnished.

23. Excepting in the details as commented upon above the plans are, in my opinion, drawn up with judgment and attention to economy. To illustrate the reductions which I have proposed should be effected I have made the following statement, exhibiting approximately the amounts which I would deduct from various items of the estimates, together with some additional items caused by the proposed alterations.

The reductions amount to Rupees 7,82,933, but a further deduction has to be made of Rupees 1,44,960, the provision made for putting up a line of telegraph, with establishment (on construction) for ten months. The total cost of the extension will then be brought down from Rupees 108,80,091 to Rupees 99,52,198, or Rupees 46,055 per mile over the length of the line, 215 miles.

Statement showing Savings and Additional Expenditure proposed in the Estimates for Station Offices and other works on the Great Southern of India Railway Extension.

Description.	Nature of Work.	Nature of proposed Alterations.	Saving. Rs. A. P.	Additional Cost. Rs. A. P.
Special Stations... ...	Engine Sheds	By lowering the walls 4 feet (at window level), ...	at Trichinopoly and Madura.... ...	1,910 0 0	.....
			at Tinnevelly.	640 0 0	.....
			at Tuticorin	1,476 0 0	.....
		By omitting concrete under walls of engine pits, ...	at Madura.	870 0 0	.....
			at Tinnevelly	534 0 0	.....
			at Tuticorin	642 0 0	.....
		By assimilating pattern of engine pits to the pattern proposed for Trichinopoly, and so reducing masonry, ...	at Madura.	536 0 0	.....
			at Tinnevelly.....	100 0 0	.....
			at Tuticorin	1,620 0 0	.....
		By substituting honey-comb brick-work for teak wood windows, ...	at Trichinopoly...	1,218 0 0	.....
			at Madura.	426 0 0	.....
			at Tinnevelly	696 0 0	.....
			at Tuticorin.	1,044 0 0	.....
	Platforms	By omitting roof over platform and line, ...	at Trichinopoly..	14,010 0 0	.....
			at Madura.	28,253 0 0	.....
			at Tinnevelly.	10,549 0 0	.....
			at Tuticorin.	10,331 0 0	.....
		By cost of providing awning over platforms (of similar design to that over main platform at Trichinopoly), ...	at Trichinopoly local traffic platform...	.....	2,200 0 0
			at Madura.	.....	4,200 0 0
			at Tinnevelly and Tuticorin	.....	5,200 0 0
		By provision of cover for carriages,	at Trichinopoly...	.....	4,600 0 0
			at Madura..	.....	6,760 0 0
			at Tinnevelly.	.....	3,000 0 0
			at Tuticorin.	.....	3,600 0 0
	Urinals.	By omitting roof and reducing walls to 7 feet high, ...	at Trichinopoly, Madura, and Tinnevelly.	2,668 0 0	.....
			at Tuticorin.	1,374 0 0	.....

Statement showing Savings and Additional Expenditure proposed in the Estimates for Station Offices, &c.—(Concluded.)

Description.	Nature of Work.	Nature of proposed Alterations.	Saving. Rs.	A.	P.	Additional Cost. Rs.	A.	P.
Special Stations... ...	Coal Stores..	By reducing thickness of panels of walls from 2 feet 3 inches to 1 foot 6 inches. ... at Trichinopoly, Madura, and Tinnevelly. at Tuticorin.	2,100	0	0	.....		
			1,200	0	0	.....		
2nd Class Stations ...	Platforms	By reducing platforms from 300 feet × 20 feet. to 200 feet × 25 feet.	375	0	0	.....		
	Urinals.	By omitting roof and reducing the walls to 7 feet high.	7.7	0	0	.....		
	Station Machinery....	By do. one water column and the piping leading to it ...	3,700	0	0	.....		
Municheo Junction....	Urinals.	By do. roof and reducing walls to 7 feet high. ...	253	0	0	.....		
	Station Machinery..	By do. one water column and piping from 1 foot to 41 inches....	1,500	0	0	.....		
	Approaches..	By reducing thickness of metalling to 41 inches....	1,701	0	0	.....		
3rd Class Stations ...	Staff Quarters... ...	By omitting station at Thatchaulkere..	14,017	0	0	.....		
		By erecting on Station Master's Bungalows	31,970	0	0	.....		
		By providing temporary accommodation for Engineers.	.....			13,180	0	0
	Platforms....	By reducing the length from 300 feet to 250 feet and the width from 25 feet to 20 feet. ...	.....			.....		
	Urinals.	By omitting roof and reducing walls to 7 feet high. ...	1,850	0	0	.....		
	Station Machinery ...	By do. one water column and the piping leading to it. ..	4,500	0	0	.....		
	Approaches..	By reducing thickness of metalling to 41 inches	21,500	0	0	.....		
Level Crossings... ...	Approaches to	By omitting wooden railings at level crossings,	23,985	0	0	.....		
Rates for Masonry ...	.....	By reducing rates for masonry to a general average of Rupees 11 per cubic yard.	7,500	0	0	.....		
Line Fencing	.....	By omitting fencing to line except for about one quarter of the length.	2,00,000	0	0	.....		
		By adopting alternative like No. 1 at Tinnevelly.	1,20,000	0	0	.....		
			6,182	0	0	.....		
		Total Savings .	2,23,913	0	0	47,980	0	0
		Total additional expenditure...	47,980	0	0	.....		
		Balance being net saving ..	1,82,933	0	0	.....		

* Taking the ... and ... together, except for the section where ... and ... are ... and ... and ... is repeated.

(Signed) H. L. PRENDERGAST, Major, R. E.,
Acting Consulting Engineer for Railways.

From the Chief Engineer, to the Agent of the Great Southern of India Railway Company, dated Trichinopoly, 7th August 1871, No. 3,624.

I HAVE now the pleasure to forward to you the detailed working plans and estimates for a narrow gauge (3 feet 3 inch) Southern Extension of our line.

2. In making out these documents I have adhered to the instructions laid down in Madras Government Order, No. 872, of 22rd March 1871, under the heading "Dimensions to be followed in the construction of Indian narrow gauge Railways and rolling stock."

3. The remarks in my letter of 27th February last, in forwarding the plans and estimate for the broad gauge, apply in the main to those now sent in to you.

4. My experience on our open line however goes to confirm me in the belief that a width of only 12 feet for formation in embankments is too little. The formation width of the existing line is 20 feet, leaving about 7 feet outside the rails on each side, and we find that in the rainy season such a width is not a bit too much. The width of formation laid down by Government in the instructions referred to is 12 feet, which width a 3 feet 3 inch gauge leaves only about 4 feet 3 inches outside the rail on each side; this especially in embankments of black cotton soil is insufficient. The difference in cost between adopting a 16 feet bank, which would give a minimum width outside the rails of about 6 feet 3 inches, and a 12 feet bank, would average Rupees 500 per mile, and I am quite sure that the additional cost of maintenance due to a 12 feet formation would far exceed the saving in interest on Rupees 500 (or Rupees 25 per annum), to say nothing of the additional safety and stability to the line.

5. As cheap first cost seems to be one of the aims of Government, I have estimated for wooden sleepers. The creosote for sleepers used in the construction of the Negapatam-Trichinopoly section of the open line have proved satisfactory as wooden sleepers, having been laid for upwards of ten years without any excessive cost in renewals. The sleepers which have gone have been chiefly those which exhibited imperfect impregnation with the creosote. The sleepers for the narrow gauge being smaller will be more readily saturated with this, and will thus be likely to last even longer than those now in use.

6. With reference to the weight of rails I would strongly recommend a section of not less than 45 lbs. to the yard, as being more conducive to real economy than one so light as 36 lbs. per yard. If Government will not sanction this alteration for the whole line, I would suggest for their consideration whether it would not be advisable to lay the heavier section (45 lbs. to the yard) on such parts of the line as have gradients steeper than 1 in 200.

7. The station accommodation has been cut down to a minimum. Giving the narrow gauge estimate every advantage I have kept the lengths of sidings the same as in my broad gauge estimates, while the width of the goods shed has been reduced from 42 feet to 30 feet.

8. On the bridge plans I have given all the information I possess regarding flood levels, and it must remain for more minute and intimate acquaintance with the ground at different seasons to verify or correct the data upon which the water-ways are fixed.

9. In fencing I have estimated for a wire fence for the whole line. This is an item which lies in the hands of Government greatly to modify. If we are to be permitted to open and work any portion of the line with imperfect, because in a great measure trial, vegetable fences, some portion of the wire fencing may be dispensed with; assuming that my estimates were sanctioned, my intention was to indent for about one-half of the wire fence to put up along such portions of the line as it is quite certain that no vegetable fence will grow on; leaving the balance to be sent out as telegraphed for according to the success or non-success of the vegetable fence. I am not sanguine as to great success in raising a vegetable fence along the extension, so much of it runs through dry cultivation, without facilities for being well and regularly watered, that much money may be thrown away in experiment if planting is gone into wholesale; and if it is not so gone into there arises the question of delay to the opening of the line from want of efficient fencing, which brings me back to the fact that this question can only be decided when it is known what conditions are to be laid upon us by Government. It is not possible at present to approximate to the length

of line upon which vegetable fences can with any chance of success be tried. I do not think it amounts to nearly one-half the length of the extension, so that if fencing is a *sine qua non* it will be quite necessary to have out at least one-half of my estimated quantity of wire.

10. With reference to the planting trees at stations, I do not think that if early undertaken this need be a costly work. I should propose to plant the greater part of the unoccupied portions of the different station grounds with trees indigenous to the soil. The greater portion probably of the Accacia Arabica (Curroovalay marum, Tamil) with a few Banian trees close to the offices for shelter to the native passengers.

11. On this line, as we did on our open section, I propose to push the sowing broad-cast of the seed of the Accacia Arabica. It grows without much care, and forms capital firewood in from six to eight years. I have not entered any special charge in the estimates for this planting, because I think that it can be carried out under the item "Fencing contingencies."

12. In the staff quarters I have revised and altered the designs to secure greater economy. I do not think any more can now be done in this way without rendering the accommodation so small as to be unfit for a climate like India.

13. With reference to the station ground at Tinnevelly, I forward plans and estimates of two alternative lines leading to the east side of the town of Tinnevelly. I have no doubt whatever that the site selected by me is the best obtainable in an engineering point of view, but the Collector of Tinnevelly objects that all the traffic from the south and east would have to traverse the narrow streets of Tinnevelly to get at this station. Two alternatives have been staked, marked No. 1 and 2 respectively, on the plans sent herewith. No. 1 leads to the school-house near the river Tambraparny, which flows between Palamcottah and Tinnevelly. This line runs too far from the town of Tinnevelly without at the same time going so near Palamcottah as to prove of much advantage to that town. I think therefore that it would be advisable to adopt a site nearer to Tinnevelly without going so near to the large tank as alternative No. 2, which is, I understand, the site recommended by the Collector of Tinnevelly. His object is to keep as far as possible on the land of the tank to avoid cutting up valuable paddy land. This will, however, necessitate a very undesirable site for our station buildings, not only as regards expensively deep foundations, but, in a sanitary point of view, being so close to the bed of the tank. I consider that a line about 5 or 10 chains to the east of No. 2 will enable us to meet all the requirements of traffic if it is decided to go to the east side of the town, and at the same time enable us to secure less costly foundations. Being at some little distance from the tank our embankments need not be kept so high, as, in the event of the tank breaching, the water would have time to spread and lose height before reaching the line.

The following is the comparative cost of—

	Rs.
Alternative No. 1	2,31,951
Do. „ 2	2,75,645
Located line west of Tinnevelly	2,28,453

taking the length of each from the common point 13 miles 40 chains on District 14. In round figures the located line and No. 1 are equal in cost, while alternative No. 2 is Rupees 45,000 higher.

14. I am sorry that the estimates of the alternative line between Virduputty and Covilputty, asked for by the Consulting Engineer, are not ready to accompany the plans now sent. The Assistant Engineer engaged in the field work necessary to carry out these alternative estimates was laid up for some time by sickness, and the work delayed in consequence. I hope, however, to send forward the required information in the course of a week or ten days.

Proceedings of the Madras Government, Public Works Department, 5th December 1871.

From the Chief Engineer, to the Agent of the Great Southern of India Railway Company, dated Trichinopoly, 23rd August 1871, No. 3,673.

I SEND herewith plans and comparative estimate of that part of the Southern Extension lying between Virduputty and Covilputty called for in Consulting Engineer's letter, No. 122 of 20th April last.

2. The alternative line follows the route recommended by Mr. Carr, on the 2nd September in 1862, with slight alterations to come nearer to Virduputty and to avoid a considerable detour to the east a few miles south of Virduputty, which adds to the length of the line without any great improvement in gradients over the line now estimated for. The estimated cost of the alternative line is less than that of the located line by Rupees 49,963, or, say, £5,000.

3. From the comparative statement accompanying the estimates it will be seen that the excess in cost of the located line is due to a larger amount of earthwork and masonry. The alternative line runs south from Virduputty along a ridge where it meets with few water-ways until at the River Vypar it has to pass by one bridge the aggregate of the watershed met with between Virduputty and the same river (Vypar) on the located line.

4. In locating the line as now staked out I was perfectly aware that it would be more costly than the line recommended by Mr. Carr, but I chose it for the following reasons :—

1*st*. It was ordered to be adopted by the Government of Madras.—*Vide* G. O. No. 2,510, of 5th August 1868.

2*nd*. I concurred in the view taken by the Collector of Tinnevelly and Captain Lindsay (see Proceedings of Government, G. O., No. 2,510), that it was advisable to carry the line near to the public road between Madura and Tinnevelly so as to keep as close to the western portion of the district as possible, looking to the accommodation of such large and important localities as Shevacausy and Streeviliputur. By a reference to the Ordnance Map of the district it will be seen that the distance from Shevacausy, taking that as about the centre of the Western District to be served, to the nearest point of the located line is due east about 9 miles; and from Shevacausy to Virduputty on the north and Satur on the south the distances are 14 miles and 11 miles respectively. Taking the stations as arranged in the estimates lately forwarded, goods and passengers for the north would take the rail at Virduputty and for the south at Satur, having travelled by road 14 and 11 miles respectively.

5. Assuming the alternative line adopted, the point of taking the rail for the north would remain the same (Virduputty) 14 miles, the nearest point of the rail due east being about the same distance; but for traffic to the south the nearest available station to which there is a road would be Covilputty a distance of about 24 miles, and I feel convinced from past experience that if the merchants and others find that they have to cart goods that distance they will not use the railway at all but rather than break bulk send their goods right on to Tuticorin or Tinnevelly as the case may be.

6. The alternative line is 1¾ miles longer than the located line, and while risking the loss of Western District traffic it will not, in my opinion, gain any by keeping to the eastward, at the same time that by its extra length it adds at least 2 Annas to the cost of every ton of produce carried by that route.

7. From the accompanying table of gradients with rises and falls, etc., it will be seen that the alternative line is not only about 2 miles longer than the located one, but it involves a greater expenditure of haulage in rise and fall; the total rise and fall on the alternative line being 340·91 feet against 282·75 on the located line, equivalent to raising every ton carried over the former length a height of 29·08 feet more than by the located line. The item "stations" has been left out of these comparative estimates, as I estimate that the same accommodation will be required on both lines, namely, a station at Virduputty and Covilputty and one midway,

GRADIENTS OF LOCATED LINE.

Between 6 Miles 28 Chains, District 9, and 1 Miles 2 Chains 27·20 District 11.

Total length 25 Miles 55 Chains.

Gradient	Length in Chains.	Rise.	Fall.	Gradient.	Length in Chains.	Rise.	Fall.
1 in 200	90	.....	29·70	Level	84·10	.....	.....
Level	75·43	.....	.....	1 in 200	33·25	.....	19·93
1 in 1000	62·37	4·13	.....	Level	44·65	.....	.....
1 in 510	21	.....	2·93	1 in 200	10·60	3·30	.....
Level	44	.....	.....	Level	17	.....	.....
1 in 210	65	.....	17·87	1 in 200	10·60	.....	3·30
Level	28	.....	.....	Level	82·60	.....	.....
1 in 250	72	.....	19·01	1 in 200	48	15·46	.....
Level	45	.....	.....	1 in 320	50	.....	4·38
1 in 600	73	.....	8·03	1 in 2577	107·70	1·90	.....
Level	87·60	.....	.....	Level	50	.....	.....
1 in 500	48	9·61	.....	1 in 300	60	13·20	.....
Level	22·84	.....	.....	Level	40	.....	.....
1 in 200	91·37	.....	39·35	1 in 300	165·64	.....	23·23
Level	111·15	.....	.....	Level	23·60	.....	.....
1 in 400	60	11·15	.....	1 in 200	102·06	33·88	.....
1 in 320	70	.....	18·60	1 in 330	14·20	2·67	.....
1 in 200	50	.....	16·00				
				Total...	254·78	58·30	184·16

(Signed) D. LOGAN,
Chief Engineer.

(Signed) WILLIAM S. BETTS,
Agent.

GRADIENTS OF ALTERNATIVE LINE.

Total length 27 Miles 44 Chains

Gradient	Length in Chains	Rise	Fall	Gradient	Length in Chains	Rise	Fall
1 in 200	110·10	.....	55·30				
1 in 200	39·10	.....	19·70				
1 in 200	65·10	.....	43·00				
1 in 200	22·50	.....	11·25				
Level	17·00	.....	.....				
1 in 200	4·15	1·17	.....				
Level	15·12	2·43	.....				
1 in 425	55·00	.....	12·96				
Level	61·00	.....	.....				
1 in 200	5·00	1·25	.....				
Level	41·00	.....	.....				
1 in 200	31·00	15·50	.....				
1 in 200	1·22	0·61	.....				
1 in 200	8·28	4·14	.....				
Total	472·77	125·67	342·21				

(Signed) D. LOGAN,
Chief Engineer.

(Signed) WILLIAM S. BETTS,
Agent.

From the Chief Engineer, to W. S. BETTS, Esq., dated Trichinopoly, 13th September 1871, No. 3,765.

IN answer to the letter of the Acting Consulting Engineer for Railways of the 29th ultimo (to which your No. $\frac{6772}{1750}$ of 2nd instant gave cover), I have the honour to submit the following remarks upon the waterways provided for in the estimate of the Southern Extension now under consideration of the Acting Consulting Engineer :—

1. "*In No.* 12 *the rainfall carried off by the waterway allowed is considered small when compared with Nos.* 10 *and* 32."—The area of No. 12 basin was originally estimated from the Ordnance Map to be 148 square miles, but a subsequent detailed survey shows the area to be only 104 square miles. If this amended area be substituted the rainfall becomes ·13 inches per hour as against ·09 inches.

2. "*The provision in No* 42 *is considered small when compared with No.* 33."—The apparent deficiency of No. 42 may be easily accounted for—

(1.) In the first place, the two drainage basins are entirely dissimilar in character. No. 33 is intersected by the Vencuttachellapoorum Nullah, which concentrates the flood into, and facilitates its passage from, the basin. No. 42 is a flat district of country intersected by no defined watercourse of any size. It is thickly covered with tanks and wet cultivation, both of which will act as distributors of the flood-waters and cause a diminished quantity to reach the railway.

(2.) In the second place, the statement of waterways proposed to be given does not include openings of a less span than 6 feet. Now, in No. 42 the openings due to culverts of 4 feet and under amount to 91 lineal feet, and in No. 33 to only 3 feet. The culverts were excluded from the calculation because the water which will flow through some of them being under the control of adjacent sluices the culverts were not considered available for the passage of flood-water. This, however, is applicable to only a few, and it is considered that a great part of the flood-water in No. 42 will pass under the line by these culverts.

3. "*No.* 22 *is considered out of proportion to areas of somewhat similar character, such as* 40 *and* 29."—The colouring of No. 22 represents the area from which the flood-water would naturally find its way across the railway to the river Vygay ; but the area is intersected by a system of artificial drainage which interferes with the natural flow of the water and carries a large portion of it eastwards in a direction parallel with the railway, disposing of it in the river Vygay to the east of Madura. This accounts for the smallness of the proposed provision of waterway on No. 22 and renders the comparison between it and 40, 29 an unfair one.

4. "*No.* 28 *has nearly double the waterway of No.* 29."—This discrepancy arises from two causes—first, in No. 28 the available flood area of the Oduputty Bridge has been underestimated, and second, in 29 *all* the bridges occurring on the railway opposite the basin have been calculated as available for the passage of flood-water from west to east, whereas some of them are for the return of the water from east to west. These must be deducted from the provision originally stated. The amended table of waterways shows the rainfall provided for in No. 28 to be 20 inches and in No. 29 ·24 inches.

5. "*Nos.* 6, 10, *and* 11 *are considered out of proportion.*"—The area of No. 11 as originally estimated from the Ordnance Map was 42 square miles, but a subsequent survey of the basin proves the area to be only 30 square miles ; substituting this area the amended table gives the areas of 6, 10, 11, to be ·20, 32, and ·17 inches, respectively. The excessive provision of No. 10 when compared with Nos. 6 and 11 may be accounted for by its superior elevation and the probably greater rainfall.

6. "*No.* 5 *is considered out of proportion to Nos.* 1, 2, 3, *and* 4."—That No. 5 should exceed Nos. 1, 2, 3, and 4 is due to the fact of its catchment basin being small when compared with the others.

7. "*Nos. 24 and 25 are considered deficient in provision.*"—Through both of these areas the line has for the great part been located in tanks and wet cultivation, and the provision of culverts, which has not (for the reason already stated) been included in the calculation, is large. In No. 24, while 77 lineal feet of bridging is provided, the culverts amount to 49 feet, and in No. 25, with 30 feet of bridging, the culverts amount to 40 lineal feet. To the omission of these culverts is due the apparently meagre provision of waterway.

8. "*Nos. 13 to 18 inclusive require explanation.*"—Since the submission of the estimate a detailed survey of these drainage areas has been completed, which proves their form and extent to have been incorrectly ascertained from the Ordnance Map. In the amended table it will be seen that the rainfall provided for is much more uniform. Nos. 16 and 17 are still considerably in excess of the others; but this is probably accounted for by the fact that 16 and 17 are intersected by streams running from the adjacent range of hills direct across the railway in deep and well-defined channels, whereas in 13, 14, 15, and 18 the streams are of the most part caught up and distributed by tanks before reaching the railway.

9. "*No. 37 has less provision than No. 35.*"—The deficiency in No. 37 is due to an opening of 36 feet at its southern extremity having been erroneously entered as belonging to No. 39. Making the correction, the provision in No. 37 becomes ·35 inches as against ·40 in No. 35. The consequent reduction in No. 39 is from ·76 to ·68 inches.

10. "*There appears to be a mistake in the colouring of No. 9.*"—No. 9 is a basin through the hollow of which the railway will run. The flood-water on the southern portion will run across the line from east to west, and re-cross from west to east near the northern extremity of the basin.

11. "*Nos. 19 and 20 require explanation.*"—Although these are adjoining basins and equal in area they differ materially; for while No. 19 has two deep nullahs intersecting it and carrying the flood-water directly to the railway, No. 20 has a large tank stretched across it midway between the hills and the railway, which tank impounds and distributes the flood-water over the intervening track of wet cultivation as in the other similar cases, the culvert provision which is in No. 20 extensive has not been included in the calculation.

12. "*No. 30 has a very small allowance.*"—The deficiency in No. 30 is caused by the available area of flood-waterway having been underestimated. The amended table shows the result to be ·78 inches.

2. In addition to the above remarks it may be stated that many of the catchment basins, even adjoining ones, differ so materially in various ways that no satisfactory result can be derived from a comparison unless all these varied circumstances be taken into account. The rainfall is believed to be much greater at some parts of the line than at others, while the physical features of the catchment basins and the varied soils with which they are covered renders the amounts of absorption and evaporation ever varying quantities. In compiling the table of waterways a velocity of 8 feet per second has been assumed, whereas this condition will vary in almost every basin; in the hilly parts of the line it will probably be exceeded, and for the flat parts of the line the velocity is probably excessive.

3. The various waterways provided for in the estimate have been arrived at from a careful study of each individual case, having regard to such existing works as are to be found on the adjacent public roads and to the known height and action of floods.

From the Chief Engineer, Great Southern of India Railway, to the Acting Consulting Engineer for Railways, Madras, dated Trichinopoly, 16th September 1871.

I HAVE the honour to acknowledge receipt of your letter, No. 720, of the 8th instant, and would have answered it earlier had I not been absent from head-quarters for some days after its arrival.

2. The masonry rates are those at which I estimate we shall be able to execute the work according to our usual departmental system.

Proceedings of the Madras Government, Public Works Department, 5th December 1871.

3. The rates are based on the average cost of the quantities of masonry of different description in each work.

4. In designing the platforms I adhered to the lengths and widths which we found convenient, during a long course of working, for the traffic of the present or broad gauge line. It is admitted that with an equal amount of traffic longer sidings and platforms are requisite for a narrow than for a broad gauge line. I considered therefore that I was keeping well within the requirements of the extension when I kept to the same lengths of platform for the narrow as for the broad gauge. Of course, the lengths mentioned in your letter can be made at first and added to afterwards; but, as we have had ten years' experience to guide us in the matter, I feel sure that, especially at the larger stations, the lengths I have provided are wanted at once.

5. At Trichinopoly, a junction station, the east and west trains will stand on the same line at the same time, and, instead of 600 feet being too great a length of platform, it will be found, I fear, too short.

6. I consider the roof over the local platform a very great convenience for passengers, while at the same time it will be used to shelter spare carriages; and as for substituting a short siding for the 16-feet turn-table, apart from the fact of a siding not being so convenient to work and necessitating the watching of an additional set of points, it must be remembered that certain vehicles require to be turned at times (*e. g.*, horse boxes, goods brake vans), and this cannot be accomplished without a turn-table.

7. I do not think, looking to the importance of Madura and the large passenger traffic certain to be interchanging there, that the platform ought to be less than 600 feet long, and for the same reason, for the protection of the people as well as for the shelter of spare stock, the shed over the platform and two lines of rails should be provided. At Trichinopoly the shed is provided over the local platform, because at a junction station it would be inconvenient to stand carriages on the main line for shelter.

8. At Maniachee again, which is a junction station, I now think that it was an oversight not to make the platform 600 feet long, because both local and main line trains will frequently require to stand alongside it at the same time.

9. So with regard to all platforms I do not think that they are at all too long for convenience and economy in working. *Some* perhaps of the third class stations might be reduced to 150 or 200 feet to start with; but looking to the small cost of such platforms, there being merely a low curb of stone or brick, I do not think that this item need be altered in the estimate.

10. With regard to providing a room at third class stations under the Ticket Office roof, in the first place I think it is objectionable to have Station Masters living in the station house; in the second place, what accommodation would one room offer for a man with wife and family? and, in the third place, assuming these objections removed, no respectable native would consent to live in such a place. On the eastern section we began without houses for Station Masters. This after fair trial was found detrimental to working, and we built the small bungalows which now exist, both to keep the men on the spot and because in some places no accommodation was to be got for them. It has been found extremely difficult, on the score of caste and other prejudices, to get men to occupy these houses; they are built European fashion, and are said not to provide sufficient privacy for native families. So much was this felt that certain Station Masters I believe resigned or were dismissed because they could not, or would not, live in the houses. Now there is less difficulty as one after another of the houses have come into use, I doubt if it would be possible, if it were desirable, to get respectable natives to live next to the Ticket Office.

11. It is quite possible to work the line to start with, with the number of water-cranes suggested in your letter; but it should, I think, be recollected that with a narrow gauge line and reduced speed every facility should be offered at the stations, both in platforms, water-cranes, and other arrangements, to prevent delay to trains.

12. *Trichinopoly Station Office, Plan No.* 164.—The verandah facing the approaches at Trichinopoly could not be dispensed with without rendering the offices almost unendurable in such an exposed situation. The circumstances at Madura and at Trichinopoly are quite different.

13. I do not think it would be advisable to reduce the porticoes at any of the stations; as Trichinopoly especially a good many vehicles are certain to be in use, and a great outcry would at once be made against a small and insufficient portico.

14. Masonry pillars would be objectionable on the platform as obstructing the way much more than the wooden ones. The pillars are high, and would require to be of considerable thickness in masonry.

15. *Madura Station Offices, Plan No.* 165.—The offices were designed to be built in stone. If it turns out that brick can be procured for any part, of course the walls in that part would be reduced in thickness.

16. *Plan No.* 166, *Station Offices at Tuticorin and Tinnevelly.*—The foundation at both these sites will be on uncertain ground, and I do not consider the walls too thick.

17. *Plan No.* 167, *Station Offices for second class stations.*—Doing away with the end verandahs would save little on the estimate, while it would add to discomfort from heat and glare.

18. *Plan No.* 168.—There is not, in my judgment, any practical objection whatever to the arrangement of the roof couples in this design. The venetianed windows are necessary to shelter the men when working in the shed. Fitters' benches are placed in these sheds, and if on account of the heat, glare, rain, or wind the shutters have to be closed, the men, without venetains, would be comparatively in the dark.

19. *Plan No.* 169, *Engine Stable, at Madura.*—Trichinopoly engine-shed is on hard laterite gravel immoveable; the substratum at Madura is on alluvial soil and requires the concrete provided.

20. To Plans Nos. 170 and 171 the same remarks apply.

21. *Plan No.* 174, *Coal Store.*—Great loss of space would be entailed by raising the floor, as I presume is intended, to the coal platform level. The extra expense, too, would not be neutralized by the saving in labour. The same force of coal coolies would be employed in the one case as in the other. The end walls of the tank-house are only two feet thick, the same as the sides, and I consider this thickness necessary for safety.

22. *Native Latrines.*—We first built latrines as suggested without roofs, but were ordered by Government, under the recommendation of the Consulting Physician, to cover them, in order that the *dry* conservancy system might be carried out. Of course, if Government does not desire this to continue to be acted upon the latrines may be left open, although my own opinion is that even if no dry conservancy is attempted the shelter of a roof to such buildings is, out of consideration to passengers, advisable.

23. Iron wire fencing is not so well adapted for road approaches as palings. When all the requisite straining posts and struts are provided I do not think the saving in expense will be much. Injury from carts and idlers would be more readily done to the wire fence and be less easily repaired, while at road crossings a close fence is more advisable than an open one.

24. There are none of the bridges on the extension to which I have yet, under my present knowledge of requirements, decided to put aprons or cross walls; but provision has been made in the estimates for such work under "Contingencies" and "Extra Masonry."

25. I hope that I have now noticed the items in your letter satisfactorily. No doubt all the suggestions made by you *could* be carried out; but as all the designs were matured after full and careful consideration in the light of our past experience in working this railway, I should be acting contrary to the dictates of my own judgment were I to acquiesce in the changes.

26. As a good many of the alterations would affect the working of the Traffic Department, I have forwarded a copy of your letter with my answer to the Agent, in consultation with whom the designs were fixed, in order that should he desire it his opinion may also be recorded in the matter.

Proceedings of the Madras Government, Public Works Department, 5th December 1871.

GREAT SOUTHERN OF INDIA RAILWAY.

SOUTHERN EXTENSION.

Masonry provision under or across roads for Nullahs, &c., crossed by the Railway.

District.	Mileage opposite which Masonry provision occurs.		Masonry provision at Road.				Distance from Line.	
			No. of openings.	Span.		Height.	Right.	Left.
	MILES.	CHS.		FT.	IN.	FT. IN.	CHAINS.	CHAINS.
No. 1	0	55	6	12	0	5 6	.....	
	2	28	2	5	0	5 0	.....	11
							.....	13½
	3	43	River Coryaur. 5	26	0			50
,, 3	14	60	3	17	0	9 6	9	
,, 4	7	20	...	Invert.		... ...	.....	.....
,, 5	2	20	1	7	0	3 3	13	.....
	2	48	2	4	6	6 6	6	.....
	2	54	1	3	0	3 0	6½	.....
	2	63	2	4	6	3 6	7	.....
	3	6	...	Invert.		... ...	6½	.....
	3	40	1	7	0	... ...	14	.....
	3	67	...	Invert.		... ...	13½	.....
	4	10	...	do.		... ...	16	.....
	4	19	...	do.		... ...	18	.....
	4	25	...	do.		... ...	19	.....
	7	67	6	5	0	... ...	5	.....
	8	22	3	3	6	4 0	1	.....
	8	35	2	4	6	3 0	.....	6
	8	65	3	4	6	4 0	.....	9
	9	25	2	4	6	3 6	.....	8
	12	40	6	5	0	9 0	.....	17½
	12	70	4	4	6	4 6	.....	12½
	13	20	4	5	0	3 0	.....	7
	13	60	1	2	6	2 3	.....	5
	14	5	4	4	6	6 0	.....	10½
	14	8	4	4	0	7 0	.....	10½
	14	40	3	4	6	4 4	.....	2
	14	71	3	2	6	4 0	8	.....
	15	1	1	3	0	3 0	10	.....
	15	12	1	6	0	5 0	15	.....
,, 6	0	27	1	3	0	3 0	1	.....
	0	41	1	7	6	4 3	3½	.....
	0	53	1	6	0	2 9	4½	.....
	0	54	5	5	0	3 6	4½	.....
	1	37	3	4	6	4 9	.....	1½
	4	65	2	9	6	6 0	9½	.....
	5	29	1	3	0	2 6	1	.....
	5	37	1	4	0	2 9	1½	.....
	5	39	1	3	0	2 0	1½	.....
,, 7	5	15	Causeway.	River Vygah.				50
	5	30	2	9	0	3 0	5½	
	7	5	2	5	6	7 6	3½	.....
,, 8	2	57	...	Invert.		... ...	2	.....
	2	69	1	6	0	... ...	2½	... ..
	3	10	...	Invert.		... ...		.....
	4	31	1	2	3	... ...	2½	.....
							8	.....

Masonry provision under or across roads for Nullahs, &c.—(Continued.)

District.	Mileage opposite which Masonry provision occurs.	Masonry provision at Road.			Distance from Line.	
		No. of openings.	Span.	Height.	Right.	Left.
	MILES. CHS.		FT. IN.	FT. IN.	CHAINS.	CHAINS.
No. 8	4 37	1	6 0	... ...	6½	.....
	4 42	1	6 0	... ...	6½	.....
	4 55	1	3 3	... ...	6½	.....
	5 36	1	3 4	... ...	7	.....
		1	12 6	4 3	8	.....
	5 52	River Goondar 6	30 0		9	.....
	6 46	1	6 3	3 2	5½	.....
	6 50	1	8 0	7 0	4½	.....
	7 3	1	11 9	4 6	6	.....
	8 10	1	6 9	4 0	24	.....
	8 75	1	8 0	5 0	33½	.....
	9 38	1	24 0	8 0	48½	.....
	10 47	River Shurscotay. 4	36-8, 40-8, 30-8, 32-8		50	.....
	... ...	1	13 0	6 0	38	.....
	13 17	2	15 0	4 6	16	.....
	14 15	1	24 6	9 0	9½	.....
	14 20	...	Invert.		10	.....
„ 9	14 45	1	5 0	3 0	15½	.....
	1 36	1	12 0	6 0	5½	.....
	2 21	1	2 0	... ...	12½	.....
	2 61	1	3 0	... ...	14½	.....
	3 13	...	Invert.	... ...	14½	.....
	3 35	...	do.	... ...	15½	.....
	3 42	1	4 0	4 6	15½	.....
	3 53	1	4 0	4 6	16½	.....
	3 15	...	Invert.	... ...	17½	.....
	7 30	River Virudhutty. 30	9 0	9 0	20	.....
	7 70	...	Invert.	... ...	13	.....
	8 5	...	do.	... ...	16	.....
	8 14	...	do.	... ...	15	.....
	8 30	...	do.	... ...	13	.....
	8 36	...	do.	... ...	12	.....
	10 22	5	5 0	4 9	12	.....
	10 54	...	Invert.	... ...	22	.....
	11 3	...	do.	... ...	26½	.....
	11 60	...	do.	... ...	23½	.....
	11 66	6	6 0	5 0	23½	.....
	11 72	1	5 0	5 0	24	.....
	12 1	...	Invert.	... ...	24	.....
	12 17	1	4 0	4 0	19½	.....
	12 39	...	Invert.	... ...	17	.....
	12 56	...	do.	... ...	16	.....
	13 22	...	do.	... ...	13	.....
	13 23	...	do.	... ...	7½	.....
	13 49	1	3 6	3 6	4½	.....
	13 57	1	3 6	3 6	4	.....

Masonry provision under or across roads for Nullahs, &c.—(Continued.)

District.	Mileage opposite which Masonry provision occurs.	Masonry provision at Road.			Distance from Line.	
		No. of openings.	Span.	Height.	Right.	Left.
	MILES. CHS.		FT. IN.	FT. IN.	CHAINS.	CHAINS.
No. 9	13 73	15	6 0	6 0	4	.....
	13 78	7	6 0	4 6	4½	.....
	14 10	...	Invert.	... ...	6½	.....
	14 27	...	do.	... ...	9½	.....
	14 40	2	4 0	4 0	11	.....
	14 56	...	Invert.	... ...	11	.....
„ 10	0 19	...	do.	... ...	10½	.....
	0 31	...	do.	... ...	10½	.....
	1 19	...	do.	... ...	5½	.....
	1 59	...	do.	... ...	2	.....
	1 61	1	3 0	2 0	2	.....
	1 68	1	3 0	2 3	2	.....
	2 5	1	4 9	3 0	1½	.....
	2 20	River Cunnucherry. 9	30 0		4½	.....
	2 25	1	20 0	13 3	7½	.....
	2 35	6	4 3	5 0	10	.....
	2 60	6	4 3	5 0	8½	.....
	2 64	...	Invert.	... ...	8	.....
	2 76	...	do.	... ...	10½	.....
	3 12	...	do.	... ...	14½	.....
	3 22	...	do.	... ...	16½	.....
	3 37	...	do.	... ...	19	.....
	3 60	...	do.	... ...	24	.....
	4 0	...	do.	... ...	24	.....
	5 30	...	do.	... ...	26	.....
	6 7	5	4 3	4 9	34	.....
	6 33	7	32 0		44	.....
	7 70	1	4 6	5 0	17	.....
	8 9	1	3 0	4 0	16	.....
	8 30	River Vypar. 17	40 0		26	.....
	8 46	1	20 0	7 6	31	.....
	8 73	2	12 0	5 0	36	.....
	11 0	...	Invert.	... ...	50	.....
	11 25	1	5 0	3 6	52	.....
	11 38	...	Invert.	... ...	56	.....
	11 52	...	do.	... ...	60	.....
	11 65	1	11 9	6 0	62	.....
	12 7	...	Invert.	... ...	67	.....
	12 32	...	do.	... ...	72	.....
	12 45	6	8 0	9 6	73½	.....
	12 50	...	Invert.	... ...	74	.....
	13 45	...	do.	... ...	85	.....
„ 11	0 0 to 0 73	...	Seven Inverts.	... ...	.....	.....

Masonry provision under or across roads for Nullahs, &c.—(Concluded.)

District.	Mileage of position which Masonry provision occurs.		Masonry provision at Road.				Distance from Line.	
			No. of openings.	Span.	Height.		Right.	Left.
	Miles.	Chs.		Ft. In.	Ft. In.		Chains.	Chains.
No. 11	0	73	3	30 0				.....
	3	0	2	12 0	6	0		
	4	0	1	24 0	9	0	.....	.....
			2	20 0			.....	.....
	5	8	1	12 0	4	8	4	.....
	5	18	...	Invert.	...	...	5½	.....
	6	13	...	do.	...	...	3	.....
	6	45	1	3 . 0	4	6	.....	26
	7	20	...	Invert.	...	...	.....	25
	7	30	...	do.	...	...	.....	16½
	7	56	1	3 0	2	6	.....	13½
	7	77	...	Invert.	...	...	.....	6½
	8	0	1	3 0	2	6	.....	5½
	8	1	1	3 0	2	6	.....	5
	8	16	1	3 0	2	6	.....	1½
	8	29	1	3 0	2	6	2	.....
	8	50	...	Invert.	...	...	7	.....
	8	61	...	do.	...	...	9	.....
	10	30	...	do.	...	...	.....	.....
			River Chittaur.					
„ 14	5	10	7	44 0				
			River Hoopaur.					
	...	...	5	45 0				
	9	66	1	20 0	7	0	.....	.....
	...	...	1	6 0	3	9	.....	.....
	...	...	1	11 0	8	0	.....	.....
	10	30	4	3 0	2	0	.....	.....
					3	6		
					2 4	6		
	10	58	6	6 6	6	6	.....	.....
	11	65	1	2 0	2	0	.....	.....
	12	45	2	2 0	2	6	7½	.....
	13	6	6	3 9	6	3	2	.....
	13	27	1	1 6	1	6	7½	.....
	13	35	1	2 0	1	0	7	.....
	13	61	5	6 0	8	0	3	.....
	...	...	1	4 7	8	0	3	.....
	...	...	1	4 4	8	0	3	.....
	...	...	1	4 0	8	0	3	.....
	14	11	1	2 0	2	0	2	.....
	14	23	1	5 7	6	0	.....	7
	...	...	1	5 3	6	0	.....	7
	15	35	2	2 6	2	6	.....	3
	15	52	1	1 9	1	0	.....	3½
	15	60	1	2 6	2	6	.....	4½
	15	71	1	3 0	1	0	.....	8½

(Signed) DAVID LOGAN,
Chief Engineer.

Memorandum from the Collector of Tinnevelly, to D. LOGAN, Esq., Trichinopoly, dated Tinnevelly, 19th December 1870, No. 346.

The site selected for the terminus at Tinnevelly seems to be objectionable in many ways. It is to the west of the town, while the great trading marts of Petei, Melapalayum, and Palamcottah are all to the south or east of the town. The traffic to and from the railway would thus pass through the narrow streets, and the distance from Palamcottah and the villages along the river, where the principal natives reside, would be one mile more than it need be if the line be brought from Tachanallur along the bank of the Nainakolum Tank to the toll-gate immediately to the east of the town. Again, should it ever be contemplated to carry the line further south, the western site would involve encircling the town on two sides entirely through valuable rice-fields, while the site I propose would advance the line a mile nearer Palamcottah and would avoid all needless detour on extension. The termination of the dotted line in the map is precisely the point I select; but the dotted line should take off from Tachanallur, which place should certainly not be avoided.

2. I have consulted the principal merchants and traders of Tinnevelly, Petei, Melapalayum, and Palamcottah, who are all of opinion that the station should be to the east of the town.

(True Copy.)

(Signed) R. K. PUCKLE,
Collector.

No. 73. Order thereon, 5th December 1871, No. 3,068.

RAILWAY, No. 13.

Ordered that these papers be forwarded to the Government of India:—

(Here enter No. 3,069, dated 5th December 1871.)

(True Extract.)

Colonel, R. E.,
Secretary to Government.

To the Consulting Engineer for Railways.

Exd. A. S. Rodgers.

PUBLIC WORKS DEPARTMENT,
FORT ST. GEORGE, *5th December* 1871.

No. 74.

No. 3,069.

To

THE SECRETARY TO THE GOVERNMENT OF INDIA,
PUBLIC WORKS DEPARTMENT.

RAILWAY, No. 14.

SIR,—With reference to paragraph 10 of the letter from the Government of India, dated 17th March 1871, No. 469-R., approving of the location for the Great Southern of India Railway, recommended in the letter from this Government dated 14th February 1871, No. 457, I am directed to forward the accompanying letter from the Consulting Engineer for Railways giving cover to the surveys, plans, and estimates for constructing the extension on the 3 feet 3 inches gauge.

2. As the Government of India have already been apprised, the working plans and estimates for the construction of the line on the broad gauge were nearly ready for submission when it was determined to adopt the narrow gauge, and the Consulting Engineer did not fail to avail himself of the opportunity to impress upon the Railway authorities the necessity for keeping in view the principles enunciated by both the Home and Indian Governments to ensure the utmost economy in construction. The plans and estimates as now submitted have been prepared to accord with those principles so far as, in the opinion of the Railway authorities, it would be expedient to adopt them in the light of past experience; but the Consulting Engineer makes certain suggestions which this Government consider might with advantage be adopted. Major Prendergast's proposals are—

(1.) To substitute 70 for 50-feet spans in the bridging of the Vypar and Vigay rivers.

(2.) To provide floorings with retaining walls for such bridges as may nced them, which this Government would define to be all bridges in which the foundations of the piers and abutments are not laid on rock.

(3.) To adhere to the standard formation width of 12 feet instead of increasing it to 16 feet.

(4.) The adoption of a weight of 45 lbs. of rail to the yard instead of the standard weight of 36 lbs., to be made dependent on the opinion of the Consulting Engineer to the Railway Company in England.

(5.) To reduce the total length of wire fencing from one-half to one-fourth of the length of the line.

(6.) To substitute a corrugated zinc roof for an iron roof over the passenger platforms at the terminal stations, and to provide a carriage-shed of small span.

(7.) To reduce the height of the walls of the engine-sheds, of the width of the porticoes outside the Booking Office, and of the length of platform at all but the terminal, junction, and large stations.

(8.) To adopt a simpler and cheaper style of accommodation for Station Masters in third class stations.

(9.) To reduce the height of the walls of the enclosures of latrines for natives, and to dispense with the roof for the space within the walls.

(10.) To provide one instead of two water-cranes at each third class station, and to dispense with fencing in the approaches at level crossings except where they are embanked.

(11.) To construct temporary bungalows for the accommodation of Engineers during construction, in preference to locating them in the Station Masters' bungalows which it is proposed to build at first.

3. The saving which these proposals will effect is estimated at Rupees 5,82,933. To this must be added Rupees 1,44,900, the provision made for putting up a line of telegraph, and, considering that the rate for masonry should not exceed Rupees 12 per cubic yard, the Consulting Engineer makes a further deduction of Rupees 2,00,000 on this account. The estimates for the extension aggregate Rupees 108,80,091; but if the Consulting Engineer's recommendations be adopted, the amount will be reduced to Rupees 99,52,258, or Rupees 46,289 per mile over the whole length of 215 miles of railway.

4. The expediency of adopting the approach to the town of Tinnevelly originally selected is now questioned, and two alternative routes, marked as Nos. 1 and 2 on Plan No. 187, have been proposed. The relative merits of these two lines are discussed in paragraph 12 of the Consulting Engineer's report, and I am to state that this Government, while concurring in the opinion that the terminal station should be more to the east of the town than the approach as approved would place it, consider that the alternative line No. 1 is to be preferred as being shorter and cheaper and better calculated to serve the traffic than No. 2 route.

5. I am to request the sanction of the Government of India to the plans and estimates subject to such modifications as have been recommended by the Consulting Engineer.

I have the honour to be,
Sir,
Your most obedient servant,

Colonel, R. E.,
Secretary to Government.

Ed. A. S. Rodgers.

Great Southern of India Railway
Southern Extension
Alternative Line between Virdupatchy & Coilpatchy
Estimate of located Line
from 6.28 District 9 to 2.27.20 District 11
Total length M. Chs 25.55

Description	Unit	Quantity	Rate	Amount		Total.	
IIII Construction of line							
1 Earthwork							
Embankment	Cyds	429.675	3/-	80545	5	-	
Cutting	"	30588	3/-	5735	14	-	
Channel Diversions &c	"	11320	2/3	2685			88965 9 -
2. Brickwork							
1 Junior Bridges & Culverts							
2.20 ft arches at	M. Chs 8.31					5.166	- -
2.20 ft. Girders at	12.22					3,882	8 -
2.20 ft " at	12.50					4895	12 -
1.15 ft Arch at	13.50					1468	- -
1.15 ft " at	14.26					2167	4 -
1.12 ft Girder at	7.77					2201	6 -
1.6 ft Arch at	12.65					2798	- -
2 - 6 ft Rail girders at	9.40 & 10.50					2887	3 2
Junior Bridges District 10						20821	12 4
1.30 ft Girder at	0.62					4928	11 10
1 - 6 ft Rail girder at	2.13					1443	9 7
Carried forward						52660	2 11 88965 9

District 9

District 11

Great Southern & Western Railway Co.

Estimate for Extra Works

Estimate of Cost

from 6.28 Bishop to

Total Expenditure

Construction of Line

Embankment

Cutting

Channel Diversions &c.

2. Brickwork

Piers Bridges & Culverts

2.20 ft arches at 8.81

2.20 ft Gables at 12.22

2.20 ft " at 12.50

1.15 ft Abut at 13.50

1.15 ft " at 14.26

1.12 ft Gables at 7.77

1.6 ft Retaining Abut at 12.65

2 - 6 ft Retaining Abutments

Piers Bridge District 10

1.30 ft Gables at 0.62

1 - 6 ft Retaining Abut at 2.13

District 9

District 11

Carried

Cost

Expenditure

Statement showing savings and additional expenditure proposed on the estimates for Station Offices and other Works on the Great Southern & Western Railway Co. Ireland

Explanation

Reasons for proposed alterations	Saving	Additional cost
Signal Station Engine Sheds By lowering walls 11 feet at Inniskeen Siding		
at Drumcondra	1310	
" Finnamally	600	
" Culmore	1076	
By omitting internal cross walls of Engine Sheds		
at Meadura	870	
" Finnamally	534	
" Culmore	402	
By assimilating platforms of carriage sheds to the platforms proposed for Drumcondra and so reducing masonry		
at Meadura	3536	
" Finnamally	100	
" Culmore	1,620	
By substituting honey comb brick work for Oak wood windows		
at Drumcondra	276	
" Meadura	426	
" Finnamally	691	
" Culmore	1,044	
Platforms By omitting roof over platform and line		
" Drumcondra	14,010	
" Meadura	28,776	
" Finnamally	10,547	
" Culmore	11,231	
By cost of providing awning and platforms (of similar design to that over main platform at Drumcondra)		
at Drumcondra local traffic platform		2,200
" Meadura		4,200
" Finnamally and Culmore		5,200
By provision of cover for carriages		
at Drumcondra		4,600
" Meadura		6,700
" Finnamally		2,110
" Culmore		3,600
Arcades By omitting roof and reducing walls 6 feet high at Drumcondra, Meadura and Finnamally	2,668	
" Culmore	1,379	
carried forward	77,897	29,500

Culverts

Single 4 ft Square

Fronts

Double 3 ft. Square

Fronts

Single 3 ft Square

Fronts

Single 2 ft Square

Fronts

Masonry in Retaining Walls &c

2. Large Bridges

9-30 ft Girders at £7.30

4-20 ft " at 13-72

4-20 ft " at 14-2

Large Bridges District 10

3-30 ft Girders at 0-73 District 11

4. Level Crossings

9 ft Gates for 3rd Class Roads

Check Rails

Footpath Crossings when required

Earthwork in Road approaches

Culverts	Brought forward			52.660	2	11	88.965	9 ~
Single 4 ft Square	Lyds	12⅓	50/-	616	10	8		
Fronts	Pairs	2	266/-	532	~	~		
Double 3 ft. Square	Lyds	4	52/-	208	~	~		
Fronts	Pairs	1	205/-	205	~	~		
Single 3 ft Square	Lyds	38⅓	32/-	1.226	10	8		
Fronts	Pairs	6	181/-	1.086	~	~		
Single 2 ft Square	Lyds	4	21/-	84	~	~		
Fronts	Pairs	1	139/-	139	~	~		
Masonry in Retaining Walls &c	Cyds	575	15/-	8625			65382	8 3
2. Large Bridges								
9-30 ft Girders at 7.30				31.666	7	2		
4-20 ft ~ at 13-72				6.751	12	~		
4-20 ft ~ at 14-2				5.398	8	~		
Large Bridge District 10				190.908	4	4		
3-36 ft Girders at 0-73 Brist: 11				11.099	8	8	245826	8 2
4. Level Crossings								
9 ft Gates for 3d Class Roads	Pairs	32	100/-	3,200	~	~		
Check Rails	Sets	32	28/-	896	~	~		
Footpath Crossings when required	No	25	75/-	1,875	~	~		
Earthwork in Road approaches	Cyds	3,610	3/-	676	14	~		
Carried forward				6647	14	~	400172	9 5

				Brought forward			400.172	9 5
	Installing of Roads	Cy[d]	1.455	1/4/-	1.818	12 -		
	Fencing for raised Roads	Cy[d]	665	3/4/-	1.995	- -		
	Platelayers huts	No	12	248/-	2976	- -		
	Gate Lodges	No	5	310/-	1.550	- -		
	Mile Stones	No	27	5/-/-	135	- -		
	Grade posts	No	30	7/-/-	210	- -	15.332	10 -
	5. Fencing							
	Galvanized Iron wire	Cy[d]	90.424	2/9/-	50863	8 -		
	Erecting	-	90.424	2/2/6	11.128	12 -		
	Carriage of materials	T. M.	22723	1/5/2	1656	11 2	66.649	2 2
				III Construction of Line			482154	5 7
IV	Ballast & Permanent Way							
	1 Ballasting							
	In Main Line	C. Cy[d]	63814	7/8/-	26907	- -	26.907	- -
	2 Permanent way							
	Materials	Cy[d]	45212	5/8/-	248666	- -		
	Laying Do:	-	45212	7/6/-	16.954	8 -		
	Carriage of materials	T. M.	157387	4/4/-	39816	12 -	305467	4 -
				IV Ballast & Permanent way			332374	4 -

VII	Electric Telegraph						
	Cost and erection of a double line of Telegraph	Miles	$25\frac{55}{80}$	@ £/p/k	16586	-	6
IX	Maintenance						
	Maintaining the line for 24 Months		$25\frac{55}{80}$	per Annum £/p/k	16237	8	-
	Contingencies						
III	Construction of Line						24108 - -
	1 Earthwork				4449	-	-
	2 Bridgework						
	1 Minor Bridges Culverts &c:				3269	-	-
	2 Large Bridges				12291	-	-
	4 Level Crossings				767	-	-
	5 Fencing				3332	-	-
IV	Ballast & Permanent Way						16.619 - -
	1 Ballasting				1345	-	-
	2 Permanent Way				15274	-	-
VII	Electric Telegraph						828 - -
				Contingencies			41555 - -

D. L.

Summary

III	Construction of Line		506.262
	1 Earthwork	88.966	
	2 Bridgework		
	(1) Minor Bridges Culverts &c	65.382	
	(2) Large Bridges	245.824	
	4 Level Crossings	15.333	
	5 Fencing	66.649	
	Contingencies	24.108	
IV	Ballast & Permanentway		348,993
	1 Ballasting	26.907	
	2 Permanentway	305467	
	Contingencies	16.619	
VI	Electric Telegraph		17,394
		16.566	
	Contingencies	828	
IX	Maintenance		46,238
	Total -		9,18,887

Chief Engineers Office
Secunderabad 23rd August 1871

Chief Engineer

Secretary & Board
Agents

P.W. 4852/31

Great Southern of India Railway

Southern Extension

Estimate of

Alternative line between Viriyputty & Covilputty leaves located line at 6-28 m ch. District 9 & rejoins do. at 12 ch. 2.27.20. District 11

Total length 2m 27-44.

Description	Unit	Quantity	Rate	Amount			Total		Total.	
III Construction of Line										
1. Earthwork										
Embankment	Cy.d	319.167	3/-	59.843	13	-				
Cutting	"	5.318	3/-	997	2	-				
Channel Diversions	"	20.000	3/-	3750	-	-			64.590	15 -
2. Brickwork										
1 Minor Bridges Culverts &c										
Bridge of 1-30 ft Girder at 6-35 in 9 ft Embt as per Drawing No. 127										
Excavations of foundations	C.yd	155	4/-	38	12	-				
Masonry	-	122	15/-	1830	-	-				
Superstructure				1527	12	-				
Carriage of materials by Train 67×7	T.m.	469	1/2	34	3	2	3430	11	2	
Bridge of 1-15 ft Girder at 7-57 in 6 ft Embt as per Drawing No. 136										
Excavations of foundations	C.yd.	86	4/-	21	8	-				
Masonry	"	59	15/-	885	-	-				
Superstructure				537	-	-				
Carriage of materials by Cart 66×2½	T.m.	165	4/-	41	4	-	1484	12	-	
Bridge of 1-12 ft Girder at 3-13 in 9 ft Embt (Same as at 7.77 District 9) as per Drawing No. 141							2201	6	-	
		Carried	forward				7.116	13	2	64.590 15 -

		Brought forward				7.116	13	2	64590	15 -
Bridge of 1.12 ft Girder at 24.76 in 7 ft Embt as per Drawing No 141										
Excavation of foundations	Cyds	109	7/4	27	4 -					
Masonry	"	78	15/-	1170	- -					
Superstructure				425	14 -					
Carriage of Materials by Cart 49×2	Tons	98	7/4	24	8 -	1647	10 -			
Bridge of 1.12 ft Girder at 20-66 in 6 ft Embt as per Drawing No 141.										
Excavation of foundations	Cyds	86	7/4	21	8 -					
Masonry	"	58	15/-	870	- -					
Superstructure				425	14 -					
Carriage of Materials by Cart 53×2	Tons	106	7/4	26	8 -	1343	14 -			
Bridge of 1.8 ft Arch at 17-22 in 9 ft Embt as per Drawing No 148										
Excavation of foundations	Cyds	197	7/4	49	4 -					
Masonry	"	125	15/-	1875		1924	4 -			
Bridge of 1.6 ft Rail girder at 8-32 in 4 ft Embt as per Drawing No 150										
Excavation of foundations	Cyds	94	7/4	23	8 -					
Masonry	"	63	15/-	945	- -					
Superstructure				216	9 7	1185	1 7			
Bridges at 1.6 ft Rail girder as above at 8-45. 8-74 13.82. 20.7 - 21.26 - 27.31.	No	6	183/4			7110	9 6			
Bridge of 1.6 ft Arch at 18-12 in 11 ft Embt as per Drawing No 149.										
Excavation of foundations	Cyds	152	7/4	38	- -					
Masonry	"	184	15/-	2760		2798	- -			
		Carried forward				23.126	4	3	64590	15

				Brought forward			23126	4	3	64590	15 -
Culverts											
Single 4 ft Square	Lgth	30⅔	50/-	1533	5	4					
Spirits	Pairs	7	266/-	1862	-	-					
Single 3 ft Square	Lgth	22⅔	32/-	725	5	4					
Spirits	Pairs	5	181/-	906	-	-					
Single 2. ft. Square	Lgth	48	21/-	1008	-	-					
Spirits	Pairs	6	139/-	834	-	-					
Masonry in Retaining Walls	Cyds	600	15/-	9000	-	-	15867	10	8	38993	14 11
2. Large Bridges											
Bridge of 30-50 ft Girders over the Vyrar River at 1865 as per Drawing No 123											
Excavation of foundations	Cyds	7228	1/6	3614	-	-					
Baling	Hmn	—	—	6300	-	-					
Masonry	Cyds	3757	18/-	67.626	-	-					
Teak Timbers	Cft	2000	3/6	7000	-	-					
Wrought Iron Girders	Tons	408.6	200/-	81720	-	-					
Fixing do	Days	32.	200/-	6000	-	-					
Carriage of do by Train 450×55	Tons	24758	1/6	1804	11	-					
Tarring	Sqds	11613	2/-	1139	2	-	175503	13	-		
Bridge of 6-30 ft Girders at 25-31 in. 10 ft. Embk as per drawing No. 124											
Excavation of foundations	Cyds	880	1/6	440	-	-					
Baling	Hmn	—	-	1400	-	-					
Masonry	Cyds	578	18/-	10404	-	-					
Teak Timber	Cft	260	3/6	910	-	-					
Wrought Iron Girders	Tons	34.39	200/-	6878	-	-					
Fixing do	Days	6	180/-	1080	-	-					
Carriage of do by Train 48×46	Tons	2208	1/6	161	-	-					
Tarring	Sqds	1.284	2/-	160	8	-	21433	8	-		
				Carried forward			196937	5	-	103584	13 11

	Brought forward						19693	5	-	103584	13 11
Bridge of 2-30ft Girders at 21-73 in 12ft: Embk as per Drawing No 128.											
Excavation of foundations	Cyds	300	7/4	75	-	-					
Masonry	"	220	15/-	3300	-	-					
Superstructure				3027	8	-					
Carriage of Materials by Train 52×13½	T.M.	702	7/2	57	3	-	6463	11	-		
Bridge of 2-30ft Girders at 2-7 in 10ft: Embk as per Drawing No 128.											
Excavation of foundations	Cyds	260	7/4	65	-	-					
Masonry	"	175	15/-	2625	-	-					
Superstructure				3027	8	-					
Carriage of Materials by Train 71×13½	T.M.	958	7/2	69	13	8	5787	5	8		
Bridge of 2-30 ft. Girders at 4-41 in 8 ft Embk. as per Drawing No 128.											
Excavation of foundations	Cyds	237	7/4	59	4	-					
Masonry	"	133	15/-	1995	-	-					
Superstructure				3027	8	-					
Carriage of Materials by Train 69×13½	T.M.	932	7/2	67	15	4	5149	11	4	214328	1 -
4 Level Crossings											
9ft Gates for 3d class Roads	Pr.	34	100/-	3400	-	-					
Check rails	Set	34	28/-	952	-	-					
Footpath crossings where required	Nr	27	75/-	2025	-	-					
Earthwork in Road approaches	Cyds	3900	3/3	731	4	-					
Metalling of Roads	"	1550	25/-	1937	8	-					
Fencing for Railroads	Lyds	720	3/-	2160	-	-					
Platelayers Huts	Nr	14	248/-	3472	-	-					
Gatekeepers Lodges	-	5	310/-	1550	-	-					
	Carried forward			16227	12	-				317912	14 11

	Brot Forward			16227	12	-			317912	14	11
Mile stones	No	28	5/-	140	-	-					
Grade posts	"	30	7/-	210	-	-			16577	12	-
5 Fencing.											
Galvanized Iron wire	Lyds	96970	1/-	64525	10	-					
Erecting	"	96970	3/16	15151	9	-					
Carriage of Materials by Train 60×413	Tons	24780	1/2	1806	14	-			71504	1	-
			III	Construction of Line					405994	11	11
IV Ballast & Permanent Way.											
1 Ballasting	Cyds	57235	8/-	28617	8	-	28617	8	-		
2. Permanent Way											
Materials	Lyds	48504	6/-	26677	-	-					
Laying Do	"	48504	2/-	18189	-	-					
Carriage of Materials by Rail 2862×60	Tons	171912	2/-	42978	-	-	327939				
			IV	Ballast & Permanent Way					356556	8	-
VI Electric Telegraph											
Cost & erection of a double line of Telegraph	Miles	27 44/80	644/-						17767	2	8
IX Maintenance											
Maintaining the line for 24 months	"	27 44/80	Rates 7/-						49590	-	-

Contingencies

III	Construction of Line			20300 — —
	1 Earthwork	3230		
	2 Bridgework			
	1 Minor Bridges Culverts &c.	1950		
	2 Large Bridges	10.716		
	4 Level Crossings	829		
	5 Fencing	3575		
IV	Ballast & Permanent Way		17828	
	1 Ballasting	1431		
	2 Permanent Way	16397		
VI	Electric Telegraph			888 — —
			Total	39,016 — —

Summary

III	Construction of Line		4,26,295
	1 Earthwork	64.591	
	2 Brickwork		
	(1) Minor Bridges, Culverts &c	38.994	
	(2) Large Bridges	214.328	
	4 Level Crossings	16.578	
	5 Fencing	71.504	
	Contingencies	20.300	
IV	Ballast & Permanent Way		3.74.384
	1 Ballasting	28.617	
	2 Permanent Way	3.27.939	
	Contingencies	17.828	
VI	Electric Telegraph		18.655
		17.767	
	Contingencies	888	
IX	Instruments		49.590
		Total Rs	8.68.924

Chief Engineer's Office
Kedlimpsby 23/8/71

Chief Engineer

P.M. 4852/71

Great Southern of India Railway
Southern Extension
Alternative Line between Virdupatty & Coviljutty
Comparison of Estimates of Located & alternative lines.

Heading	Located Line	alternative Line	Difference in favor of Located Line	Difference against Located Line
III Construction of Line				
1 Earthwork	88.966	64.591	———	24.375
2 Bridgework				
(1) Minor Bridges &c	65.382	38.994	———	26.388
(2) Large Bridges	2.45.824	2.14.328	———	31.496
4 Level Crossings	15,333	16.578	1.245	———
5 Fencing	66.649	71.504	4.855	———
Contingencies	24.108	20.300	———	3.808
IV Ballast & Permanent Way				
1 Ballasting	26.907	28.617	1.710	———
2 Permanent Way	3,05.467	3.27.939	22 472	———
Contingencies	16.619	17.828	1.209	———
VI Electric Telegraph	16.566	17.767	1.201	———
Contingencies	828	888	60	———
IX Maintenance	46.238	49.590	3.352	———
Total	9.18.887	8.68.924	36.104	86.067
				36.104
		Total difference against Located Line		49.963

Chief Engineers Office
Trichinopoly 23rd Augt 1871

A Brodie
Chief Engineer

Williams & Betts
Agents

Great Southern of India Railway
Chief Engineer's Office
Nº 3624. Pitchinopoly August 7th 1871.

W. S. Betts Esquire
My dear Sir

I have now the pleasure to forward to you the detailed Working plans and Estimates for a narrow guage (3ft 3in) Southern Extension of our Line.

In making out these documents I have adhered to the instructions laid down in Madras Government Order Nº 872 of 23d March 1871 under the Heading "Dimensions to be followed in the construction of Indian Narrow Guage Railways and Rolling Stock".

The remarks in my letter of 27th February last in forwarding the plans and Estimate for the Broad Guage apply in the main to those now sent in to you.

My experience on our open line however goes to confirm me in the belief that a width of only 12 feet for formation in Embankments is too little. The formation width of the existing line is 30 feet leaving about 7 feet outside the rails on each side and we find that in the rainy season such a width is not a bit too much. The width of formation laid down by Government in the instructions referred to is 12 feet which with a 3 feet 3 inch guage leaves only about 4 feet 3 inches outside the rail on each side; this especially in

in embankments of black cotton soil is insuff-
-icient- The difference in cost between adopting
a 16 feet bank which would give a minimum
width outside the rails of about 6 feet 3
inches and a 12 feet bank would average
~~Rs~~ 500/ per mile and I am quite sure that
the additional cost of maintenance due to
a 12 feet formation would far exceed the
saving in interest on Rs 500/ or Rs 25 per
annum/ to say nothing of the additional
safety and stability to the line.

As cheap first cost seems to be
one of the aims of Government I have estimated
for wooden sleepers- The creosoted fir sleepers
used in the construction of the Negapatam
Pichimpoly Section of the open line have proved
satisfactory as wooden sleepers, having been laid
for upwards of ten years without any excessive
cost in renewals. The sleepers which have
gone have been chiefly those which exhibited
imperfect impregnation with the Creosote-
The sleepers for the narrow gauge being smaller
will be more readily saturated with this
and will thus be likely to last even longer
than those now in use.

6 With reference to the weight of Rails
I would strongly recommend a section of not
less than 45 lbs to the yard as being more
conducive to real economy than one so
light as 36 lbs per yard- If Government
will not sanction this alteration for the whole
line I would suggest for their consideration
whether it would not be advisable to lay the
heavier section /45 lbs to the yard/ on such part
of

of the line as have gradients steeper than 1 in 30.

The Station accommodation has been cut down to a minimum. Giving the narrow Guage Estimate every advantage I have kept the lengths of sidings the same as in my broad Guage estimates while the width of the Goods Shed has been reduced from 42 feet to 30 feet.

On the Bridge plans I have given all the information I possess regarding flood levels and it must remain for more minute and intimate acquaintance with the ground at different seasons to verify or correct the data upon which the waterways are fixed.

In fencing I have estimated for a wire fence for the whole line. This is an item which lies in the hands of Government greatly to modify. If we are to be permitted to open and work any portion of the line with imperfect because in a great measure trial, vegetable fences some portion of the wire fencing may be dispensed with assuming that my estimates were sanctioned my intention was to indent for about one half of the wire fence to put up along such portions of the line as it is quite certain that no vegetable fence will grow on; leaving the balance to be sent out as telegraphed for according to the success or non success of the vegetable fence. I am not sanguine as to great success in raising a vegetable fence along the extension, so much of it runs through dry cultivation without facilities for being well and regularly watered that much money may be thrown away in experiment if planting is gone into wholesale; and if it is not so gone into then arises the question of delay to the opening of

cordly

of the line from want of efficient fencing, which brings one back to the fact that this question can only be decided when it is known what conditions are to be laid upon us by Government. It is not possible at present to approximate to the length of line upon which vegetable fences can with any chance of success be tried - I do not think it amounts to nearly one half the length of the extension, so that if fencing is a sine-qua-non it will be quite necessary to have out at least one half of my estimated quantity of wire.

With reference to the planting trees at Stations I do not think that if duly undertaken this need be a costly work - I should propose to plant the greater part of the unoccupied portions of the different Station grounds with trees indigenous to the soil. The greater portion probably of the accacia arabica / Curroo-valay marum Tamil. / with a few Bainan trees close to the offices for shelter to the native passengers.

On this line - as we did on our open section I propose to push the sowing broad cast of the seed of the accacia arabica - It grows without much care and forms Capital firewood in from 6 to 8 years - I have not entered any Special Charge in the estimates for this planting because I think that it can be carried out under the item "Fencing Contingencies".

In the Staff quarters I have revised and altered the designs to secure greater economy - I do not think any more can now be done in this way without rendering the accomodation

So
costly

so small as to be unfit for a climate like Ceylon

With reference to the Station ground at Jaffna I forward plans and estimates of two alternative lines leading to the East side of the Town of Jaffna - I have no doubt whatever that the Site selected by me is the best attainable in an Engineering point of view but the Collector of Jaffna objects that all the traffic from the South and East would have to traverse the narrow Streets of Jaffna to get at this Station - Two alternatives have been suggested marked No 1 and 2 respectively on the plans sent herewith - No 1 leads to the School house near the river Jambopany which flows between Palamcottah and Jaffna - This line runs too far from the Town of Jaffna without at the same time going so near Palamcottah as to prove of much advantage to that Town I think therefore that it would be advisable to adopt a site nearer to Jaffna without going so near to the large Tank as alternative No 2. which is I understand the site recommended by the Collector of Jaffna - His object is to keep as far as possible on the bund of the Tank to avoid cutting up valuable paddy land - This will however necessitate a very undesirable site for our Station buildings, not only as regards expensively deep foundations but in a Sanitary point of view being so close to the bed of the Tank - I consider that a line about 5 or 10 chains to the East of No 2 will enable us to meet all the requirements of traffic if it is decided to go to the East side of the Town, and at the same time enable us to secure less costly

costly foundations - Being at some little distance from the Tank our embankments need not be kept so high, as in the event of the Tank breaching the water would have time to spread and lose height before reaching the line.

The following is the comparative cost of

Alternative No 1 Rs 231,951

" " 2 " 275,648

Located line west of Sinnerelly " 238,433

taking the length of each from the common point 13 miles 40 chains on District 14 - Ten pound figures the located line and No 1 are equal in cost, while alternative No 2 is Rs 40,000 higher.

I am sorry that the Estimates of the alternative line between Virapetty and Covilpetty asked for by the Consulting Engineer are not ready to accompany the plans now sent. The Assistant Engineer engaged in the field work necessary to carry out these alternative Estimates was laid up for some time by sickness and the work delayed in consequence I hope however to send forward the required information in the course of a week or ten days.

Yours faithfully

(Sgd) David Logan

Chief Engineer

/ True Copy /

William A Bell

2nd Bb

costly than the line recommended by Mr Carr but

P. W. 4852/71

S 34

Chief Engineers Office
Trichinopoly August 23d 1871.

No 3673.

36

D. S. Betts Esquire
My dear Sir

I send herewith plans and comparative estimate of that part of the Southern Extension lying between Virdupetty and Coilputty called for in Consulting Engineers letter No 132 of 20th April last.

The alternative line follows the route recommended by Mr Carr on the 2d September in 1862 with slight alterations to come nearer to Virdupetty and to avoid a considerable detour to the East a few miles South of Virdupetty. which added to the length of the line without any great improvement in gradients over the line now estimated for— The estimated cost of the alternative line is less than that of the located line by Rupees 49,963 or say £5000.

From the comparative Statement accompanying the estimates it will be seen that the excess in cost of the located line is due to a larger amount of Earthwork and Masonry— The alternative line runs South from Virdupetty along a ridge where it meets with few waterways until at the River Vygor it has to pass by one bridge the aggregate of the waterway met with between Virdupetty and the same River /Vygar/ on the located line.

In locating the line as now staked out I was perfectly aware that it would be more costly than the line recommended by Mr Carr but

but I chose it for the following reasons:
1st It was ordered to be adopted by the Govern-
-ment of Madras vide G. O. No. 2150 of 5th Sept/68
2nd I concurred in the view taken by the Collector
of Tinnevelly and Captain Lindsay (See Proceedings
of Government G. O. No. 2150) that it was advisable
to carry the line near to the public road between
Madura and Tinnevelly so as to keep as close to
the Western portion of the district as possible
looking to the accommodation of such large and
important localities as Sheracanai and Srivilliputtur
By a reference to the ordnance map of the
District it will be seen that the distance from
Sheracanai taking that as about the centre of the
Western District to be served to the nearest point
of the located line is due East about 9 Miles;
and from Sheracanai to Virdupetty on the North
and Satur on the South the distances are 14
Miles and 11 Miles respectively - Taking the
Stations as arranged in the estimates lately
forwarded goods and passengers for the North
would take the rail at Virdupetty and for
the South at Satoor having travelled by road 14
and 11 Miles respectively.

Assuming the alternative line adop-
-ted, the point of taking the rail for the North
would remain the same (Virdupetty) 14 Miles,
the nearest point of the rail due east being about
the same distance, but for traffic to the South
the nearest available Station to which there is a
road would be Covilpetty a distance of about
24 Miles, and I feel convinced from past
experience that if the Merchants and others find
that they have to cart goods that distance they

will

will not use the railway at all but rather than break bulk send their goods right on to Jaleswar or Sinnerelly as the case may be.

38

The alternative line is 1/8 miles longer than the located line and while picking the bye of Western District traffic it will not in my opinion gain any by keeping to the Eastward at the same time that by its extra length it adds at least 2 annas to the cost of every ton of produce carried by that route.

From the accompanying table of gradients with rises and falls we it will be seen that the alternative line is not only about 2 miles longer than the located one, but it involves a greater expenditure of haulage in rise and fall; the total rise and fall on the alternative line being 340-91 feet against 202.75 on the located line, equivalent to raising every ton carried over the former length a height of 29.08 feet more than by the located line. The item "Stations" has been left out of these comparative estimates as I estimate that the same accommodation will be required on both lines viz a Station at Virdupatty and Coilpatty and one midway.

Yours faithfully

(Sgd) David Logan
Chief Engineer

True Copy

Asst. Chief Agents Office

P.W. 4852/71

39

Gradients of Located line
between 17 m. 6 ch. 28 District 9 and 2. 27. 20 District 11.
Total length 25. 55

Gradient	Length in chains	Rise	Fall	Gradient	Length in chains	Rise	Fall
				Brot Forwd	1550.89	46.85	160.93
1 in 200	90	—	29.70	1 in 3577	107.70	1.99	—
Level	75.43	—	—	Level	50	—	—
1 in 1001	62.57	4.13	—	1 in 300	60	13.20	—
1 in 540	24	—	2.93	Level	40	—	—
Level	44	—	—	1 in 300	105.64	—	23.23
1 in 240	65	—	17.87	Level	23.69	—	—
Level	28	—	—	1 in 200	102.66	33.88	—
1 in 250	72	—	19.01	1 in 350	14.20	2.67	—
Level	45	—	—				
1 in 600	73	—	8.03	Total	2.54.78	98.57	184.16
Level	87.69	—	—				
1 in 330	48.	9.61	—				
Level	22.88	—	—				
1 in 200	91.97	—	30.35				
Level	111.15	—	—				
1 in 420	90.	14.15	—				
1 in 256	70	—	18.00				
1 in 288	70	—	16.00				
Level	84.10	—	—				
1 in 200	33.25	—	10.96				
Level	44.05	—	—				
1 in 200	10.60	3.50	—				
Level	17.	—	—				
1 in 200	10.60	—	3.50				
Level	82.60	—	—				
1 in 200	48	15.46	—				
1 in 720	50	—	4.58				
Forwd	1550.89	46.85	160.93				

Danl Roberts
Chief Engineer

Lachlan Shaw
agent.

Chief Engineers office
Inverness July 23rd Augt 1871

P. Nr. 485 e/71

Gradients of alternative Line
Total length 27. 44 —

Gradient	Length in chains	Rise	Fall	Gradient	Length in chains	Rise	Fall
				Brot. forw.	1996.92	76.37	213.24
Level	13.35	—	—	Level	37.06	—	—
1 in 330	81.65	—	16.33	1 in 250	55.00	14.52	—
1 in 200	65.00	—	19.50	1 in 200	106.72	35.22	—
1 in 330	60.00	—	12.00	1 in 350	8.28	1.56	—
1 in 750	110.00	—	9.68				
Level	75.00	—	—	Total	27 33.98	127.67	213.24
1 in 800	60.00	4.95	—				
1 in 330	45.00	—	9.00				
Level	10.00	—	—				
1 in 500	35.00	4.62	—				
Level	17.00	—	—				
1 in 300	38.00	—	8.36				
Level	10.00	—	—				
1 in 600	80.00	8.80	—				
1 in 220	80.00	24.00	—				
Level	40.00	—	—				
1 in 200	110.00	—	36.30				
1 in 800	30.00	—	2.48				
1 in 220	65.00	—	19.50				
1 in 330	225.00	—	45.00				
Level	97.00	—	—				
1 in 200	68.88	—	22.73				
Level	204.12	—	—				
1 in 325	152.12	12.17	—				
1 in 264	87.32	21.83	—				
Level	75.68	—	—				
1 in 330	61.80	—	12.36				
Forward	1996.92	76.37	213,24				

Mandsley
Chief Engineer

Cecil Raikes
Agent

Chief Engineers office
Spechnes July 23rd aug 1871

P. M. 4852/71

S 30 39

№ 3765

Spithiopoly
September 13th 1871

M. S. Betts Esquire
My dear Sir

In answer to the letter
of the Acting Consulting Engineer for Railways
of the 29th Ultimo / to which your № 6772/2290 of
2d Instant gave cover / I have the honor to
submit the following remarks upon the waterways
provided for in the estimate of the Southern
Extension now under consideration of the Acting
Consulting Engineer.

1 "In № 12 the rainfall carried off by the
waterway allowed is considered small when
compared with №s 10 and 32"

The area of № 12 basin was originally
estimated from the ordnance map to be
148 Sq: Miles but a subsequent detailed survey
shews the area to be only 104 Sq. Miles. If this
amended area be substituted the rainfall
becomes .13 inches per hour as against .09 inches

2 "The provision in № 42 is considered small
when compared with № 33" The apparent
deficiency of № 42 may be easily accounted
for (1) In the first place the two drainage
basins are entirely dissimilar in character
№ 33 is intersected by the Vencettachellyporum
Mullah which concentrates the flood waters and
facilitates its passage from the basin: № 42
is

is a flat district of country intersected by no defined water course of any size - it is thickly covered with tanks and wet cultivation both of which will act as distributors of the flood waters and cause a diminished quantity to reach the Railway

(2) In the second place - the Statement of waterways proposed to be given does not include openings of a less span than 6 feet. Now in Nº 42 the openings due to culverts of 4 ft. and under amount to 91 lineal feet and in Nº 33 to only 3 feet - The culverts were excluded from the Calculation because the water which will flow thro' some of them being under the control of adjacent sluices the culverts were not considered available for the passage of flood water This however is applicable to only a few, and it is considered that a great part of the flood water in Nº 42 will pass under the line by these culverts

3 "Nº 22 is considered out of proportion to area of somewhat similar character such as 40 and 29"

The colouring of Nº 22 represents the area from which the flood water would naturally find its way across the Railway to the River Vygay. but the area is intersected by a System of artificial drainage which interferes with the natural flow of the water. and carries a large portion of it eastwards in a direction parallel with the Railway disposing of it in the River Vygay to the east of Madura —

This accounts for the Smallness of the proposed provision of waterway on Nº 22 and renders the comparison between it and 40 29 an unfair one

4

continued

4. "№ 28 has nearly double the waterway of 29"

This discrepancy arises from two causes pt In № 28 the available flood area of the Adupatty bridge has been underestimated and 2nd in 29 all the bridges occurring on the Railway opposite the basin have been calculated as available for the passage of flood water from West to East, whereas some of them are for the return of the water from East to West These must be deducted from the provision originally stated- The amended table of waterway shews the rainfall provided for in № 28 to be 20 inches and in № 29 .24 inches.

5. "№ 6. 10 and 11 are considered out of proportion"

The area of № 11 as originally estimated from the ordnance map was 42 Square miles but a subsequent survey of the basin proves the area to be only 30 Square miles, substituting this area the amended table gives the areas of 6. 10. 11 to be 20, 32 and 27 inches respectively. The excessive provision of № 10 when compared with №s 6 and 11 may be accounted for by its superior elevation and the probably greater rainfall

6 "№ 5 is considered out of proportion to №s 1. 2. 3. and 4"

That № 5 should exceed №s 1. 2. 3. and 4 is due to the fact of its catchment basin being small when compared with the others

7 "№ 24 and 25 are considered deficient in provision"

This both of these areas the line has for the great part been located in tanks and wet cultivation and the provision of Culverts which has not /for the reason already stated/ been included in the calculation is large. In № 24

while Southern

while 77 lineal feet of bridging is provided the culverts amount to 49 ft. and in №25- with 30 ft. of bridging the culverts amount to 40 lineal ft. To the omission of these culverts is due the apparently meagre provision of waterway.

8 "№ 13 to 18 inclusive require explanation"

Since the submission of the estimate a detailed survey of these drainage areas has been completed which proves their form and extent to have been incorrectly ascertained from the ordnance map. In the amended table it will be seen that the rainfall provided for is much more uniform - №16 and 17 are still considerably in excess of the others, but this is probably accounted for by the fact that 16 and 17 are intersected by streams running from the adjacent range of hills direct across the Railway in deep and well defined channels, whereas in 13. 14. 15 and 18, the streams are of the most part caught up and distributed by tanks, before reaching the Railway

9 "№ 37 has less provision than №35"

The deficiency in №37 is due to an opening of 36 feet at its Southern extremity having been erroneously entered as belonging to №39. making the correction the provision in №37 becomes .35 inches - as against .40 in №35- The consequent reduction in №39 is from .76 to .68 inches

10 "There appears to be a mistake in the colouring of №9"

№9 is a basin thro' the hollow of which the Railway will run. The flood water on the Southern

Southern portion will pass across the line from East to West, and passes from West to East near the northern extremety of the basin.

11 "Nos 19 and 20 require explanation."

Altho' these are adjoining basins and equal in area they differ materially; for while No 19 has two deep nullahs intersecting it and carrying the flood water directly to the Railway, No 20 has a large tank stretched across it midway between the hills and the Railway which tank impounds and distributes the flood water over the intervening track of wet cultivation as in the other similar cases - the culvert provision which is in No 20 extensive, has not been included in the Calculation.

12 "No 30 has a very small allowance"

The deficiency in No 30 is caused by the available area of flood waterway having been underestimated: the amended table shews the result to be .78 inches

In addition to the above remarks, it may be stated that many of the Catchment basins, even adjoining ones, differ so materially in various ways that no satisfactory result can be derived from a Comparison unless all these varied circumstances be taken into account. The rainfall is believed to be much greater at some parts of the line than at others while the physical features of the Catchment basins and the varied soils with which they are covered, renders the Amounts of absorbtion and evaporation ever varying quantities.

In compiling the table of waterways a velocity of 8 feet

feet per second has been assumed, whereas this condition will vary in almost every passing, in the hilly parts of the line it will probably be exceeded, and for the flat parts of the line the velocity is probably excessive.

The various waterways provided for in the estimate have been arrived at from a careful study of each individual case having regard to such existing works as are to be found on the adjacent public roads and to the known height and action of floods

Yours faithfully
David Logan
Chief Engineer

/ Spare Copy /

Pa

P. W. 4852/71

S 845

Great Southern of India Railway
Chief Engineers Office
Trichinopoly 16 Sept 1871

From. David Logan Esquire
Chief Engineer
To.
Major H.L. Prendergast R.E.
Consulting Engineer for Railways
Madras

Sir,

I have the honor to acknowledge receipt of your letter No. 720 of the 8th instant, and would have answered it earlier had I not been absent from Head Quarters for some days after its arrival.

The Masonry rates are those at which I estimate we shall be able to execute the work according to our usual Departmental Systems.

The rates are based on the average cost of the quantities of masonry of different description in each work.

In designing the Platforms I adhered to the lengths and widths which are found convenient, during a long course of working, for the traffic of the present N broad guage line. It is admitted that when an equal amount of traffic keeps sidings and platforms are requisite for a narrow, than for a broad guage line

line. I considered therefore that I was keeping well within the requirements of the extension when I kept to the same length of platforms for the narrow as for the broad guage. Of course the lengths mentioned in your letter can be made at first and added to afterwards but as we have had ten years experience to guide us in the matter I feel sure that especially at the larger stations the lengths I have provided are wanted at once.

At Trichinopoly, a junction station the East and West trains will stand on the same line at the same time and instead of 850 feet being too great a length of platform it will be found all too short.

I consider the roof over the local platform a very great convenience for passengers, while at the same time it will be used to shelter spare carriages and as for substituting a short siding for the 45 feet turntable, apart from the fact of a siding not being so convenient to work and necessitating the watching of an additional set of points it must be remembered that certain vehicles require to be turned at times (e.g. Horse boxes, Goods Brake Vans) and this cannot be accomplished without a turntable.

I do not think, looking to the importance of Madura and the larger passenger traffic certain to be interchanging there that the platform ought to be less than 850 feet long, and for the same reason for the protection of the people as well as for the shelter of spare stock the shed over the platform and two lines of rails should be provided. At Trichinopoly the shed is provided over the local platform because at a junction station it would be inconvenient to stand carriages on the main line for shelter.

At Ellaneiacken again which is a junction station I am think that it was an oversight not to make the platform 850 feet long because both local and main line trains will frequently require to stand along side of at the same time.

So with regard to all platforms I do not think that they are at all too long for convenience and economy in working. Some few of the third Class stations might be reduced to 450 or 280 feet to start with, but looking to the small cost of such platforms, there being usually a short curve of platform on which I do not think that the item need be altered in the estimate.

With regard to providing a room at third class stations under the ticket office roof, as the first plan, I think it is objectionable to have station masters living in the station house; in the second

required place - what accomodation would
one room offer for a man with wife
and family? and in the third place
assuming these objections removed, no
respectable natives would consent to
live in such a place. At the Eastern
Section we began without houses for Station
Masters. This after fair trial was
found detrimental to working, and we
built the small Bungalows which now
exist both to keep the men on the spot
and because in some places no accomo-
dation was to be got for them. It has
been found extremely difficult on the
score of caste and other prejudices to
get men to occupy these houses; they
do not like European fashion and do not
not to provide sufficient privacy for nat-
tive families - so much was this felt
that certain Station Masters Shelters
designed or were designed because they
could not or would not live in the houses.
Now there is less difficulty as one after
another of the Stations have come into use.
I doubt if it would be possible if it
were desirable to get respectable natives
to live next to the ticket office.

It is quite possible to work
the line with the number of water cranes
suggested in your letter, but it should
I think be recollected that with a mixed
goods line and reduced speed every
facility should be offered at the Stations
both

both in platforms, water cranes and other
arrangements to prevent delay to trains.

Tuticorin Station Office plan No 166

The Verandah facing the offices
at Tuticorin could not be dispensed
with without rendering the offices almost
uninhabitable in such an exposed situation.
The Circumstances at Madura and at
Tuticorin are quite different.

Did not think it would be
advisable to reduce the portices at any
of the stations, at Tuticorin especially
a good many vehicles are certain to be
in use and a great outcry would at
once be made against a small one
insufficient portico.

Masonry pillars would be
objectionable in the platform as ob-
structing the way much more than the
wooden ones. The pillars are high and
would require to be of considerable thick
ness in masonry.

Madura Station Offices plan No 165

The offices were designed to
be built in stone. If it turns out that
Brick can be procured for any part of
course the walls in that part would be
reduced in thickness.

Plan No 166. Station Offices at Tuticorin
and Tinnevelly.

The foundations at both these
sites will be on uncertain ground and I
do not consider the walls too thick.

Plan

Plan No 167 Station Offices for 2nd Class Stations.

Doing away with the end Verandahs would save little on the Estimate while it would add to discomfort from heat and glare.

Plan No. 168. There is not in my judgement any practical objection whatever to the arrangement of the roof couples in this design. The Venetioned windows are necessary, to shelter the men when working in the Shed. Fitters benches are placed in these sheds and if on account of the heat, glare, rain or wind the shutters have to be closed the men, without Venetians would be comparatively in the dark.

Plan No. 169 Engine Stable Madura.

Trichinopoly Engine Sheds on hard laterite gravel immovable, the substratum at Madura is on alluvial soil and requires the concrete provided.

In Plans Nos 170 & 171 the same remarks apply.

Plan No 174 Coal Store.

Great loss of space would be entailed by raising the floor as the ramp is intended to the Coal platform level. The extra expense would not be neutralized by the saving in labor. The same force of coal coolies would be employed in the one case as in the other.

The end walls of the South bays are only two feet thick the same as the piers and I consider this thickness necessary for safety.

Native Latrines

We first built Latrines as suggested without roofs, but were ordered by Government under the recommendation of the Consulting Physician to cover them in order that the dry Conservancy system might be carried out. If ever Government does not desire this to continue to be acted upon the latrines may be left open although my own opinion is that even if no dry conservancy is attempted the shelter of roof to such buildings is out of consideration to passengers advisable.

Iron wire fencing is not so well adapted for road approaches as paling. When all the requisite straining posts and struts are provided I do not think the saving in expense will be much. Injury from carts and riders would be more easily done to the wire fence, and be less easily repaired, while at Road Crossings a close fence is more advisable than an open one.

There are some of the Bridges on the Extension to which I have yet under my present knowledge of requirements decided to put aprons or Cross walls,

but

but provision has been made in the Estimate for such work under "Contingencies" and Extra Masonry.

I hope that I have now noticed the items in your letter satisfactorily. No doubt all the suggestions made by you could be carried out, but as all the designs were matured after full and careful consideration in the light of our past experience in working this Railway, I should be acting contrary to the dictates of my own judgement were I to acquiesce in the changes.

As a good many of the alterations would affect the working of the Traffic Department, I have forwarded a copy of your letter with my answer to the Agent, in consultation with whom the designs were fixed, in order that should he desire it his opinion may also be heard in the matter.

P. W. 4852/7.

I have the honor to be
Sir
Your Most Obed't Servt
Robert Logan
Chief Engineer

Great Southern of India Railway
Southern Extension

Masonry provision under or across roads for Nallahs &c crossed by the Railway.

District	Mileage opposite which Masonry provision occurs	No of openings	Masonry provision at Road	Span	height	Distance from line Right chains	Left chains
	M. chs						
	0. 55	6		12	5. 6	—	11
1	2. 28	2		5	5. 0	—	13 1/2
"	3. 43	Rivers Cottaur		26	26 feet		50
"	14. 60	3		17	9. 6	9	—
4	7. 20			Invert		—	—
5	2. 20	1		7	3. 3	13	—
"	2. 48	2		4. 6	6. 6	6	—
"	2. 54	1		3	3. 0	6 1/2	—
"	2. 63	2		4. 6	3. 6	7	—
"	3. 6	1		Invert		6 1/2	
"	3. 40	3		7		14	—
"	3. 67	2		Invert		13 1/2	
"	4. 10			Do		16	
"	4. 19			Do		18	
"	4. 25	6		Do		19	
"	7. 67	6		5	—	5	—
"	8. 22	3		3. 6	4. 0	1	—
"	8. 35	2		4. 6	3. 0	—	6
"	8. 65	3		4. 6	4. 0	—	9
"	9. 25	2		4. 6	3. 6	—	8
"	12. 40	6		5	9. 0	—	17 1/2
"	12. 70	4		4. 6	4. 6	—	12 1/2
"	13. 20	4		5	3. 0	—	7
"	13. 60	1		2. 6	2. 3	—	5
"	14. 5	4		4. 6	6. 0	—	10 1/2

		No. of openings	Span	height	Right chains	Left chains
No. 5	14. 81	4	4	7. 0		10
	14. 49	3	4. 6	4. 4		2
	14. 71	3	2. 6	4. 0	8	
	15. 1	1	3.	3. 0	10	
	15. 12	1	6	5. 0	15	
6	0. 27	1	3.	3. 0	1	
	0. 41	1	7. 6	4. 3	3½	
	0. 53	1	6	2. 9	4½	
	0. 54	5	5	3. 6	4½	
	1. 37	3	4. 6	4. 9		1½
	4. 65	2	4. 6	6. 0	9½	
	5. 29	1	3.	2. 6	1	
	5. 37	1	4	2. 9	1½	
	5. 39	1	3.	2. 0	1½	
7	5. 13	Causeway	River Veygals (1800')			5
	5. 30	2	9	3. 0	5½	59
	7. 5	2	5. 6	7. 6	3½	
8	2. 57		Invert		2	
	2. 69	1	6	—	2½	
	3. 10		Invert		2½	
	4. 31	1	2. 3	—	8	
	4. 37	1	6	—	6½	
	4. 42	1	6	—	6½	
	4. 55	1	3. 3	—	6½	
	4. 58	1	3. 4	—	7	
	5. 36	1	12. 6	4. 3	8	
	5. 52	River Goondar	30	30' 0"	9	
	6. 46	1	6. 3	3. 2	5½	
	6. 50	1	8	7. 0	4½	
	7. 3	1	11. 9	4. 6	6	
	8. 10	1	6. 9	4. 0	24	
	8. 75	1	8	5. 0	35½	
	9. 38	1	24	8. 0	48½	

		No. of openings	Span	height	Right chains	Left chains
8	10. 47	River Shuracotay 4	36.8–40.8–36.8–32.8	36' 8"	50	
	[illegible]	1	13	6. 0	38	
	13. 17	2	15	4. 6	16	
	14. 15	1	24. 6	9. 0	9½	
	14. 20		Invert	215	10	
	14. 45	1	5	3. 0	15½	
9	1. 36	1	12	6. 0	5½	
	2. 21	1	2	—	12½	
	2. 61	1	3	—	14½	
	3. 13		Invert		14½	
	3. 35		Do.		15½	
	3. 42	1	4	4. 6	15½	
	3. 53	1	4	4. 6	16½	
	5. 16	River Vaddeputty	Invert		17½	
	7. 30	30	9	9. 0	20	
	7. 70		Invert		13	
	8. 5		Do.		16	
	8. 14		Do.		15	
	8. 30		Do.		13	
	8. 36	5	5	4. 9	12	
	10. 22		Invert		22	
	10. 54		Do.		22	
	11. 9		Do.		26½	
	11. 60	6	6	5. 0	23½	
	11. 66	1	5	5. 0	23½	
	11. 72		Invert		24	
	12. 1	1	4	4. 0	24	
	12. 17		Invert		19½	
	12. 30		Do.		17	
	12. 36		Do.		16	
	12. 62		Do.		13	
	13. 23	1	3.6	3. 6	7½	
	13. 49	3	5.6	3. 6	24½	

		No of openings	Span	height	Right chains	Left chains
9	13. 57	1	3. 6	3. 6		
	13. 73	15	6			
	13. 78	7	6	6. 0	4.	
	14. 10		6	4. 6	4 1/2	
	14. 27		Invert		6 1/2	
	14. 49	2	Do		9 1/2	
	14. 56		4	4. 0	11	
10	0. 19		Invert		11	
	0. 31		Do		10 1/2	
	1. 19		Do		10 1/2	
	1. 59		Do		5. 1/2	
	1. 61	1	Do			
	1. 68	1	3	2. 0	2.	
	2. 5	1	3	2. 3.	2.	
	2. 20	9	4. 9	3. 0	1 7/2	
	2. 25	1	30	30 Long 0	4 1/2	
	2. 35	6	30	13. 3	7 1/2	
	2. 60	6	4. 3	5. 0	10	
	2. 64		4. 3	5. 0	8. 1/2	
	2. 76		Invert		8.	
	3. 12		Do		10 1/2	
	3. 22		Do		12 1/2	
	3. 37		Do		16 1/2	
	3. 60		Do		19	
	4. 0		Do		24	
	5. 30		Do		24	
	6. 7	5	Do		26	
	6. 33	7	4. 3		34	
	7. 70	1	32.	32 Long 0	44	
	8. 9	1	4. 6	5. 0	17	
	8. 30	1	3	4. 0	16	
	8. 46	1	40	40 Long 0	26	
			20	7. 6	81	

River Cunnucherry

River Uffan

		No of openings	Span	height	Right chains	Left chains
10	8. 73	2	12	5. 0	36	
	11. 0		Invert		50	
	11. 25		5	3. 6	52	52
	11. 38		Invert		56	
	11. 52		Do		60	
	11. 65		11. 9	6. 0	62	
	12. 7		Invert		67	
	12. 32		Do		72	
	12. 45	6	8	9. 6	73 1/2	
	12. 50		Invert		74	
	13. 45	1	Do		85	
11	0. 0	1	Seven Inverts			
	0. 13	2	30	30 Long 0		
	0. 73	3	12	6. 0		
	3. 0	2	24 20	9. 0		
	4. 0	1/2	12	4. 8	4	
	5. 8	1	Invert		5 1/2	
	5. 18		Do		3	
	6. 13		3	4. 6		26
	6. 45	1	Invert		25	
	7. 20		Do		16 1/2	
	7. 50		3	2. 6		13 1/2
	7. 56	1	Invert		6 1/2	
	7. 77		3	2. 6		5 1/2
	8. 0	1	3	2. 6		5
	8. 1	1	3	2. 6		1 1/2
	8. 16	1	3	2. 6	2	
	8. 29	1	Invert		7	
	8. 50		Do		9	
	8. 61		Do		—	—
	10. 30					

No	No. of openings Rivers	Chittoors	Rivers	Hoogpaurs	Span	Height	Right Chains	Left Chains
No 14	5.	10			44			
					45	44 Circles 0		45 Circles 0
	9.	66 ✓		1	20	7. 0	—	— ✓
				1	6	8. 9	—	— ✓
		✓		1	11	8. 0	—	— ✓
	10.	30 ✓		4	3	3. 9 / 4. 6	—	— ✓
	10.	58 ✓		6	6.6	6. 6	—	— ✓
	11.	65 ✓		1	2	2. 0	—	— ✓
	12.	45 ✓		2	2	2. 6	7 1/2	— ✓
	13.	6 ✓		6	3. 9	6. 3	2 —	— ✓
	13.	25 ✓		1	1. 6	1. 6	7 1/2	— ✓
	13.	35 ✓		1	2	1. 0	7	— ✓
	13.	61 ✓		5	6	8. 0	3	— ✓
	—	— ✓		1	4.7	8. 0	3	— ✓
	—	— ✓		1	4.4	8. 0	3	— ✓
	—	— ✓		1	4.0	8. 0	3	— ✓
	14.	11 ✓		1	2	2. 0	2	— ✓
	14.	25 ✓		1	5.7	6. 0	1	7 ✓
	—	— ✓		1	5.3	6. 0	1	7 ✓
	15.	35 ✓		2	2.6	2. 6	0	3 ✓
	15.	52 ✓		1	1.9	1. 0	1	8 1/2 ✓
	15.	60 ✓		1	2.6	2. 6	1	4 1/2 ✓
	15.	71 ✓		1	3	1. 0	1	8 1/2 ✓

✓ Signed ✓ David Logan.

No 346.

Memo

The site selected for the terminous at Tinnevelly seems to me to be objectionable in many ways. It is to the west of the town while the great trading marts of Petri Palayum & Palamcottah are all to the south or east of the town the traffic to & from the railway would thus pass through the narrow streets & the distance from Palamcottah & the villages along the river where the principal natives reside would be one mile more than it need be if the line be brought from Sacka-mallur along the bank of the Naina kolum tank to the toll gate immediately to the east of the town. again should it ever be contemplated to carry the line further south the western site would involve encircling the town on two sides entirely through valuable rice fields while the site I propose would

advance the line a mile nearer Palamcottah & would avoid all needless detour on extension. The termination of the dotted line in the map is precisely the point I select but the dotted line should take off from Pachanellar which place should certainly not be avoided.

I have consulted the principal merchants & traders of Tinnevelly, Pettai, Melapalayam & Palamcottah who are all of opinion that the station should be to the east of the town.

Tinnevelly
19 December 1870

(Signed) R. K. Sickle
Collector

To
D. Logan Esqre
Trichinopoly

True Copy.

R K Sickle
Collector

1

CONSULTING ENGINEER'S OFFICE.

57

Railway Department.

No. 439.

From Major H. Le. Prendergast R.E.
Actg Consulting Engineer for Railways,

To Colonel J. Carpendale R.E.
Secretary to Government,
Public Works Department,
Fort Saint George.

Sir,

I have the honour to forward the surveys, plans, and estimates for the Great Southern of India Railway extension from Trichinopoly to Tuticorin, framed for a line of 3'-3" gauge, and in accordance with the location approved of in G. O. No 939, dated 30th March 1871.

2. The working plans for a line on the Indian gauge were

completed and sent in to this office on the 1st March 1871; but were returned to the Chief Engineer that they might be recast on the narrow gauge.

The opportunity was then taken to point out in what respects the changes in the principles applicable to the construction of railways in India would demand different treatment from that adopted in the designs as prepared for the Indian gauges. It was explained that a much more searching examination into the drainage areas to be provided for, if not actual surveys of the smaller catchment

catchment basins, would be required; that economy in construction would be looked for, especially in those points in which the experience gained on the open lines in this Presidency had shewn European practice to be unsuited to the requirements of this country; and above all, it was requested, that all plans and estimates might be drawn up in such full detail that the Government Officers should be enabled to judge both of the sufficiency and suitability of all designs.

An examination of the designs and estimates as now submitted, however, necessitated

still further references on record,
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points, and the Chief Engineer in concluding his letter of 16th September detailing the reasons which induces him to adhere to his original designs, writes as follows; "No doubt all "the suggestions made by you could "be carried out, but in all the "designs were matured after full "and careful consideration in the "light of our past experiences in "working this railway, I should be "acting contrary to the dictates of "my own judgement were I to acquiesce "in the changes."

3.

The Government of India

Establishment

59

India, however, have in the last two years enunciated the following principles:—

D

No 544 R
12th May 1869
Para: 5

That a line should be commenced on the most economical scale possible, improvements being carried out by degrees, in the future as the traffic is developed, and an amelioration of gradients and additions to the conveniences first provided, are justified by increased returns. The buildings provided should at the outset be strictly limited to what is essential for the protection of the Engines and Vehicles, goods

Do
para 7

requiring cover, and the persons employed for the working of the line, and every thing should be built in the most economical manner possible, and the accommodation allowed be on the most frugal scale. Raised platforms should be given up.

The Secretary of State also wrote on the 13th April 1870 (para 3).

I am glad to observe the steps laid by you, on the necessity for the strictest economy the first outlay on all the adjuncts of State Railway; the road and for working it, alone,

being first clapt at the beginning, and all expensive accessories being post poned, until called for, and warranted by increased traffics.

And again on the 26th October 1870. para 11.

I entertain no doubt of the soundness of the general principles on which your recommendation is founded; that principle is the pre-eminent value, and indeed the absolute necessity, of the utmost possible economy in the execution of all our great public works.

These latter remarks refer especially to State Railways; but their tenor is entirely in accordance with the orders for the construction of Guaranteed Railways; it remains therefore only for me to submit the Estimates and designs as received, with my recommendation that they be sanctioned subject to such of the modifications herein-after detailed, as for the reasons given, may be approved by the Government.

4. As regards the waterway provided, the Chief Engineer has drawn up a tabulated statement, shewing, Waterway

shewing the approximate areas of the catchment basins, as taken from the Ordnance Map (some few of the smaller ones having been corrected by actual survey) and the rainfall provided for in each case, by the waterways allowed, with an assumed maximum velocity at the bridge.

A list of the waterways along the existing road, which for a great portion of the distance runs parallel to the proposed line of railway accompanies the above statement; but the arrangement

of the information is such as not to admit of a comparison being made between existing and proposed waterways.

The tabulated statement indicates that the waterways are in some cases very limited, but the Chief Engineer gives explanation in his letter of the 12th September, and states that the waterways have been arrived at from a careful study of each individual case, having regard to such existing works, as are to be found on the adjacent public roads, and to the known height and action of floods.

Gradients

5. As regards the "ruling gradient" of the line between Madura and Trichinopoly, the longitudenal section shews that, as the line is located, no easier gradient than 1 in 100 is attainable.

South of Madura a ruling gradient of 1 in 200 has been attained, at the cost of some earthwork. This gradient was recommended in the former report on the sections of this line, on the Indian gauge and though the gradient might be altered to 1 in 150, the difference in outlay would not be great, while the current expenses would necessarily be raised in

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in the working of the lines.

6. In the designs for large bridges, the Chief Engineer allows for no iron girders of larger span than 50 feet in the clear, and in reply to suggestions as to the advisability of wider openings, he assigns his reasons to be (1) that 50 feet girders are more easily handled, (2) that should any of the girders be lost at sea, they can, if not exceeding 50 feet, be replaced by beams of wood, (3) that there is no trained staff of men available, (4) that with the rivers in question it is not dangerous to narrow the waterway to the extent required for 50 feet spans.

Bridges.

As to the 1st and 3rd objections, all the bridges of any importance on the Madras Railway are of 70 feet spans: no difficulty has been complained of, there, in getting the girders set up; and the workmen employed on those bridges might be obtained for bridges in the Southern Districts. The risk of casualties at sea must always be incurred, and does not appear to me, of any weight in this case; but with regard to the 4th objection, I believe the rivers to be dealt with, are such that any contraction

of waterway is particularly to be avoided. The section of the Vyjay at the point selected for the crossing on traffic and other considerations, is of considerably less area than that of the river both above and below; and the waterway thus already restricted, should in my opinion not be contracted more than is absolutely necessary.

The Vyjpar or Patoor river, is one of those rivers subject to most unmanageable floods owing to climatic conditions.

I therefore think the Chief Engineer should be asked, to

Floorings to Bridges.

to reconsider the subject, as to the substitution of 70 feet for 50 feet spans in the bridging of both the Vyjpar and Vyjay rivers.

7. No floorings or retaining walls are provided for any of the bridges; the Chief Engineer in reply to a reference on this point, stated, that there are no bridges to which under his present knowledge of requirements, he has decided to put aprons or cross walls; but that provision has been made under contingencies and extra masonry for such work if needed. In the Estimate there is an allowance

for

for each district, varying from 400 to 200 cubic yards, of extra masonry, but it is not shown on what data this allowance is based, though it would appear from the Chief Engineer's letter that it was intended to meet unforeseen additions such as retaining walls, extra foundation to wings abutments

Looking to the accidents that have happened on the Madras Railway attributable to absence of flooring, and in the light of general experience on all sides in this country, it is hardly to be taken for granted

Formation width.

that no bridge along a continuous line of over 200 miles, will require flooring, and I would recommend that, when the staff has taken the field, the Chief Engineer should be called upon to furnish a detailed report shewing every case in which he may consider a flooring unnecessary, with explanation of the grounds on which he has formed that opinion.

8. The Chief Engineer strongly recommends that the width of formation be increased from 12 to 16 feet, on the ground that the

cost would not exceed Rs. 500 per mile, while the additional up keep would exceed yearly the interest on this sum.

So long as the stability of the line is not endangered, in a narrow road being exposed to heavy storms of rain and the scour of unusual floods, the question of the width of the foundation level can be treated from a financial, as well as from an engineering point of view. If Rupees 500 per mile additional be expended on construction, there is thereforward an

an additional fixed charge of Rupees 25 per annum, in interest. But the Government of India have assigned a standard width of 12 feet, and it is yet to be proved that the further repairs necessitated by that limited width will exceed the sum of Rupees 25 per annum. In the meantime, a saving will be effected in the first construction of the line, if the width of 12 feet is adopted; while in case hereafter any portion of the line is found to require a greater width, such addetion to the earthwork as is necessary may be made without an increase of width to the entire length of the line.

9.. The Chief Engineer also strongly recommends a heavier weight of rail than the standard weight 36 lbs, fixed by the Government of India, and suggests that a weight of 45 lbs to the yard should be employed, where the gradients are steeper than 1 in 200; if the alteration is not approved of for the whole line. No standard design has been given for the rail on the narrow gauge; and if the Government of India have not decided on any particular section, I think it advisable that the Chief Engineer should take the opinion of the Consulting Engineer to the Railway Company in England.

Weight of rail.

No 3624 J
7 Augt 1871.

Sleepers.

10.. The Chief Engineer estimates for creosoted wooden sleepers on the ground that the renewals on the open line have not been excessive and were principally due to imperfect impregnation of the sleepers, which will be less likely to occur with the smaller sleepers on the narrow gauge. In support of these views, it is stated that the life of a wooden sleeper on the Great Southern Railway may be estimated at about 12 or 13 years, and that on that line which has been open for 10 years, the renewals have

amounted to only about $\frac{1}{6}^{th}$ of the number originally laid down.

With these data, there should in my opinion, be no other than wooden sleepers used on the Extension, as their employment will certainly effect a considerable saving in first cost as compared with iron and will probably be cheaper also in a course of years.

II. The Chief Engineer proposes to indent for wire fencing for about one half of the length of the line, to put up along such portions where it is certain that vegetable fence will not grow;

Fencing!

assuming

assuming that permission will be given to work the line with trial and imperfect line fencing.

Assuming that the running speed on the narrow gauge lines will be restricted, I am of opinion that many parts of the line may remain without further side protection than a ditch and mound; but that at stations, villages, crossings and other places where people or cattle are in the habit of congregating, wire fencing should be used. I would therefore recommend that wire fencing for one quarter of the length of line should be admitted; and

that the item in the estimate should be reduced from Rupees 5,61,297 to 1,40,324.

12. Two modifications in the location of the line, as laid before the Government of India, were adverted to, in my former report of the 21st January 1871, No 33, and these have received further consideration. The first is that affected by the site of the Tunnel by station. The second affects the line between Virdupatty and Coilpatty.

Alternative Lines.

Vide G. O. No 456 dated 14th February 1871.

As originally located the line crossed the Vyper river at Patoor, and the affluents of the same river at three different points.

but 4 miles to the East of Patoor, these branches unite, and so the crossing at Patoor presents the objectionable feature of two bridges over the same stream with a shifting sandy bed, it was thought advisable to examine the country to the East, with a view to an alternative line crossing the river below the confluence of the branches.

The results of this examination are, that the more easterly line would cost less in construction by about 50,000 Rupees, that the river may be bridged with 1,830 feet of waterway instead of 2,090 lineal feet; but that on the

the other hand, the length of line would be increased by two miles and that the aggregate of rise and fall in gradients is the greater by 58.16 feet. As regards the accommodation which is to be given to Shivacaushy which is considered the great collecting centre for the produce of the neighbourhood, goods going northward would in no way be affected by the diversion eastwards, while goods going south, would, if a road were made, connecting Satoor with the nearest point of the line, have to travel 14 instead of 10 miles, a difference in distance, of no great practical importance.

Satoor

Satoor is an unhealthy place, and not inhabited by wealthy people; still it is the Head Quarters of the Taluq with a Tahsildar's Cutchery, Subsidiary Jail, and Post office; and it is called by the Collector of the District, one of the centres of traffic. On Engineering grounds alone, I think the diversion to the East would be preferable; but considering that it would add 2 miles to the length of the line, and take it away from the present set of traffic, I am of opinion that the line as located should be adhered to.

The approach to the town of Tinnevelly was laid

out by the Chief Engineer, as the best in an Engineering point of view; but I think on other considerations, that the site for the terminal station has its disadvantages, and that the approach should be considerably to the East of the town. The Collector, in his memo: of the 19th December 1870, to the Chief Engineer, recommended the line to be brought along the bank of the Nimarcolum tank, to the toll gate immediately to the East of the town; the principal merchants being also of opinion that the station should be on that side. The Chief Engineer shews a

× Enclosed

a valid objection to the line following the Nimarcolum tank bund, inasmuch as the Station yard would have to be raised several feet, and the great depth of foundations would make the station buildings exceedingly expensive.

The traffic into Tinnevelly will be principally from the South, and pass over the Tambraparney bridge (when restored) within half a mile of the Station site on alternative line No. 1. The traffic from the North and East will be already served by the railway, and there remains only the comparatively small traffic from the

West, that might be benefitted by the site to the West of the town. This site is upwards of 2 miles, from the Tamberaparney bridge, and 4 miles from the town and Cantonment of Palamcottah. On the other hand, near the river bridge, there are the villages of Kokkarakolum and Vannarpettah on the right bank, and the villages of Pindamanthoray and Veerapuram on the left bank of the river, all to the east of No 1 alternative station site!

No 2 alternative route would bring the line to terminate a few chains from the Nimarekolum tank

tank, and about a mile to the West of No 1: the advantage of this line would be its close proximity to the town of Tinnevelly, and the merchants godowns there.

But, all produce brought direct to the station (excepting only the small share from the Western country) and all consignments from Palamcottah and the cluster of villages about the river bridge, would have the extra mile to reach the station: the station site will be much nearer to the Tank bund, and also the land near the bund is of higher value than that to be taken up by No 1

West route. The balance of advantages appears to me, on the whole, to be in favor of this latter, which is also the shorter line, and the cheaper by Rupees 43,697. Mr. Puckle the Collector went over both of the station sites with me, and expressed himself satisfied with either of the alternative routes to the East of the town.

The station proposed for Tetchanellur on the located line is also avoided by the shorter route.

13.

In the Estimates for 3rd class stations, no cover has

Platform roofs.

been provided over the platforms. I think the saving of expense is judicious; a light zinc awning may be hereafter provided, at any station where from development of traffic, it may be found necessary. At the terminal stations, iron roofs of 42 feet span are allowed. I recommend instead, a corrugated zinc roof over the passenger platform, and a carriage shed of small span, which will furnish the required accommodation at a less cost.

14.

In the engine sheds the walls are estimated for, at 18¾ feet in height, and ventilated

windows are allowed. On the open lines brick or tile open work is found effective, and is less costly, the walls may be reduced by 4 feet, so as to be 14 3/4 feet high.

15. At some stations I think the porticoes may be reduced outside the booking office, as only a width sufficient to allow of one line of vehicles, appears to be necessary.

Porticoes.

16. In the station arrangements, the Chief Engineer provides for each 3d class station, a station master's bungalow, and out offices. This plan was followed on the open line between Erode and Tanjore and the Chief Engineer states

Station Master's bungalow.

states that it was found difficult to persuade respectable natives to occupy the houses, but it is believed that this was partly on account of the designs being on an European model, and the site being exposed to the public. The buildings are quite unsuited to native habits. No difficulty is found in inducing respectable natives along the line of the Madras Railway, to occupy a room and verandah (opening to the rear of the building) in the same block as the ticket office, telegraph office &c.; but the Agent of the Great Southern of India Railway, I think

with good reason, objects to that arrangement, if avoidable, on the score of its affording cover to suspicious characters and facilities for all sorts of irregularities. I would recommend the provision of merely a tiled building surrounded by a compound wall, built of the materials commonly used in the neighbourhood, and designed on the model of native buildings; such a building would not cost more than Rupees 1000; whereas those designed at present, to serve as Engineers' quarters are estimated to cost Rupees 3,805.

17. Platforms. The length of platform allowed in the present estimates appears to me to be unnecessary; the experience gained on the open line goes to prove that except at the terminal, junction, or large stations, a length of eight carriages is sufficient with a length of curb equal to about 30 carriages, where feasts are held or exceptional traffic is looked for. I would therefore suggest that no further accommodation in the way of platforms be sanctioned.

18. Latrines. The estimates for urinals for natives, provide for the space within the walls being roofed

in. The arrangements now carried out on the Madras Railway, are generally admitted to be scarcely susceptible of improvement, and I recommend that the walls of the enclosure be reduced to 7 feet in height, and that the roof be dispensed with.

19. For all stations the estimates provides two water cranes, with a corresponding length of cast-iron piping; this appears to me unnecessary, and I am of opinion that only one need be provided at each 3d class station.

Water Columns.

20. At all level crossings provision has been made for fencing in the approaches; except where these are embanked, fencing appears unnecessary.

Approaches.

21 The Chief Engineer, with a view to economy, proposes to build the station masters bungalows, at first; and to make them available for his Engineers during construction, by giving some additional accommodation: there are however so great disadvantages in this plan, that in my opinion it should not be adopted. I have stated above, the objections to station masters to a dwelling built to suit Europeans. The house would be placed on a spot convenient for the station master to carry on his duties, but the Engineers should

Engineers Bungalows.

reside at a place selected from sanitary considerations, and with reference to their own convenience for inspecting the works under their charge. It would be impossible to design a bungalow with any degree of comfort to the Engineer, that would not be quite disproportionate both in arrangement and cost to the wants of the low-salaried station-master 3rd class at a station. The design furnished, allowing three rooms only 12 feet square, appears to me to give insufficient accommodation, and I think it would be a far better plan to allow Rupees 1,500 for a temporary bungalow which might be made commodious and comfortable, though intended to last only for a few years. One such bungalow is already entered in the Estimates on Plan No 180.

Rates.

22. Sufficient information is not given to admit of the accuracy of the rates being determined. The tabular statement furnished, shews that the material for the larger bridges does not vary in character, being described throughout, as gneiss: and except in three instances, it is stated to be procurable within 4 miles of the work. Yet the rates entered for the bridge work in the six districts Southwards from Trichinopoly, are

* Embodied in G. O. No 456 dated 14th February 1871.

from 12½ to 14 Rupees: and to the south of Madura from 15 to 18 Rupees per cubic yard. For the masonry in station buildings, Engine sheds, &c., a rate of Rupees 10 is given for the whole line, except at Tuticorin, for which the rate is Rupees 18.

Now on the North-West Line of the Madras Railway, the masonry of the Cheyair bridge to be built of lime-stone, is estimated to cost Rupees 8 per cubic yard.

On the Neilgherry branch line, where the stone used is gneiss, work is readily taken on Contract at 9 Rupees

some of the stone is of a very hard description, and is brought from a distance of 6 to 8 miles. Much of the Station building work on the North-West Line, also of gneiss, was carried out by the Engineer Department at rates not exceeding 9 Rupees.

The minor buildings at the Stations are not required to be of masonry of the same quality as the large buildings: but a uniform rate of Rupees 10 is entered in the estimates for the masonry every where. Likewise for bridge work, taking all together: whether for high piers or small

culverts; the rate is no where less than 12 Rupees.

I am of opinion on the above considerations, that the rates given by the Chief Engineer are unnecessarily high: and that general sanction should not be given to a higher rate than Rupees 12 per cubic yard, without explanation of the benefits being furnished.

23.

Excepting in the details as commented upon above, the plans are in my opinion drawn up with judgment, and attention to economy. To illustrate the reductions which I have proposed should be effected, I have made the following statement exhibiting approximately the amounts which I would deduct from various items of the estimates, together with some additional items caused by the proposed alterations.

The reductions amount to Rupees 7,82,933, but a further deduction has to be made of Rupees 1,44,900, the provision made for putting up a line of telegraph, with establishment (on construction) for 10 months. The total cost of the extension will then be brought down from Rupees 108,80,091 to Rupees 99,52,258, or Rupees 46,055 per mile over the length of

the line, 215 miles.

I have the honour to be,
Sir,
Your most obedient Servant
Lieut Prendergast Major R.E.
Dy Cons: Eng.r for Railways

Madras
11th October
1871

Public Works Department

No. 3968.

Proceedings of the Madras Government.

Read the following

25

81

From—

The Agt. Chief Engineer for Railways

H.C. No. 439 of 11th October 1871

Ordered that the following letter be sent:—

To

The C. Engr. for Rys.

No. 3069.

Rec'd 6/12/71.

The Secretary to the Govt. of India.

Sir,

With reference to para 10 of the letter from the Govt. of India dated 17th March 1871. No. 469 R, approving of the location for the Great Southern of India Railway recommended in the letter from this Government dated 14th Feb/71, No. 457, I am directed to forward the accompanying letter from the Consulting Engineer for Railways

His letter does not allude to the question of Sleepers reported in the Betts & Major Brandyards letters. The question is one worthy of full consideration & if the wooden sleeper is to be got in this way, it will be a considerable additional saving.

Agt.

10-1.

The Members are to
for 1 week.

Dated 11th Oct 1871.

Received 12th Oct 1871.

To C.E. Rys.

Que: H. to Genl. No. [illegible]

[illegible]

the enquiry, & I am
and acknowledge Port
G. P. & R. enclosure
from Executive
Engineer
No. 3068-3069-S. dated 11th

To

The Secretary to Government
P. W. Department,
Fort St. George.

Public Works Dept.

Despatched 12th Oct 1871.

From

The Consulting Engineer for Railways

for Secy. to Govt.

giving Copies of the Surveys, plans and estimates for constructing the extension on the 5'3" Gauge.

2 As the Govt. of India have already been apprised, the working plans and estimates for the construction of the line on the broad Gauge were nearly ready for submission when it was determined to adopt the narrow Gauge, and the Consulting Engineer did not fail to avail himself of the opportunity to impress upon the Railway authorities the necessity for keeping in view the principles enunciated by both the Home Govt and Govt of India and Supreme Governments to ensure the utmost economy in construction. The plans and estimates as now submitted have been prepared to accord with those principles so far as, in the opinion of the Railway Authorities, it would be expedient to adopt them in the light of past experience; but the Consulting Engineer makes certain suggestions which this Govt. consider might with advantage be adopted. Major Prendergast's proposals are:-

1. To substitute 70 for 50 feet spans in the bridging of the Vyhar and Vijay rivers.

2. To provide floorings with retaining walls for

such bridges as may need them while the foundations of the piers & abutments are laid on rock.

3. To adhere to the standard formation width of 12 feet instead of increasing it to 16 feet.

4. The adoption of a weight of 45 lbs of rail to the yard instead of the standard weight of 56 lbs to be made dependant on the opinion of the Consg. Engineer to the Railway Company in England.

5. To reduce the total length of wire fencing from one half to one fourth of the length of the line.

6. To substitute a corrugated zinc roof

6. All bridges in which the foundations of the piers & abutments are laid on rock."

but this amendment being one touching a technical point should be left to the Chief Commissioner of Public Works.

for an iron roof over the passenger platforms at the terminal stations and to provide a carriage shed of small span

7. To reduce the height of the walls of the Engine sheds of the width of the particoes outside the hooking office and of the length of platform at all but the terminal, junction and large stations.

8. To adopt a simpler and cheaper style of accommodation for station masters in 3rd class stations.

9. To reduce the height of the walls of the enclosures of latrines for natives and to dispense

with the roof for the space within the walls.

10. To provide one in-
Head of two water cranes
at each third class station
and to dispense with
4. fencing in the approaches
at level crossings except
where they are embanked.

11. To construct tempo-
rary bungalows for the
accommodation of En-
gineers during construction
in preference to locating
5. them in the Station Mas-
ters Bungalows which
it is proposed to build
at first.

3 The saving which these proposals will effect is estimated at Rs: 5,82,933.

Does this mean that there is to be no roof shall - If so I object. N

I think that the cranes

84

To this must be added Rs: 1.44.900; the provision made for putting up a line of telegraph, and, considering that the rate for masonry should not exceed Rs: 12 per cubic Yard; the Cons: Engineer makes a further deduction of Rs: 200,000 on this account. The estimates for the extension aggregate Rs: 108.80.091 but if the Cons: Engineer's recommendations be adopted, the amount will be reduced to Rs: 99.52.258, or Rs: 46,289 per mile over the whole length of 215 miles of Railway.

The expediency of

adopting the approach to the Town of Trincomalee originally selected is now questioned, and two alternative routes marked as Nos 1 and 2 on Plan No 187 have been proposed. The relative merits of these two lines are discussed in Para 12 of the Conf: Engineer's report, and I am to state that this Govt; while concurring in the opinion that the terminal Station should be more to the East of the town than the approach as approved would place it, considers that the alternative line No 1 is to be preferred

as being shorter & cheaper and better calculated to serve the traffic than No 2 route.

– I am to request the sanction of the Govt. of India to the plans and estimates subject to such modifications as have been recommended by the Conf: Engineer.

I have &c

No 61

Conf: 6/12/71.

75 loose plans, 30 bdles of plans & 11 estimates forwarded 12/12/71 per steamer

of [1871] Madras.

PUBLIC WORKS.

Chief Consulting Engr.
for Railways
and
Secretary to the
Govt of India

Encl. 8

5th Dec. 1871. No. 3068-3069.

Nos. 72-73 & 74

Tanjore Extension - Passengers
Letter from the Engineer
in charge regarding the construction
of Southern Extension
S. S. of I. Ry on 3'3" Gauge.

Letter, with remarks,
the Engineer in Ry
the construction of the
Extension of the G. S. of I.
3'3" Gauge.