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MADRAS RECORD OFFICE

Government of Madras

Public Works

DEPARTMENT

G.O. No.	425	(Ry)	Press
B.P. No.			Mis.
Dated		16-2-	1876

Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
16th February 1876.*

No. 289. Read the following letter from Lieutenant-Colonel J. H. M. SHAW-STEWART, R.E., Consulting Engineer for Railways, to Major-General G. W. WALKER, R.E., Secretary to Government, Public Works Department, dated Madras, 20th December 1875, No. 662 :—

ADVERTING to the Proceedings of Government, under date the 4th August 1875, No. 2,250, and to previous papers upon the subject of the Accident to the Inspection Train at the Paupugnee bridge upon the 16th June 1874, I have the honor to lay before Government a letter* from the Agent of the Madras Railway giving cover to a

* No. 1,216, 4th December 1875. letter from the Board of Directors, in which they again request that the opinion expressed by His Excellency the Governor in Council, under date the 17th August 1874, may be reconsidered.

2. In laying these letters before Government it seems necessary to draw attention to that part of the Board's letter in which they apparently blame their Agent for having forwarded to this office Mr. Beresford Anderson's letter of the 14th July 1875, No. 505. If there is fault in this matter, it certainly does not lie with the Agent, for he lost no time in forwarding to this office paragraphs 11 to 13 of the Board's letter No. 548, with request that they should be submitted to Government; but before doing so, I asked the Agent to furnish me with a copy of any special report which might be sent to the Board upon the points raised in their letter, being of opinion that, without the information contained in such report, the question was not in a fit position to be laid before Government.

* No. 402, dated 16th April 1875.

* " 420, " 21st " " " 753, " 16th July " "

3. The papers* which accompanied my letter, No. 404, dated the 19th July 1875, are herewith resubmitted for the consideration of His Excellency the Governor in Council.

From R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, to Lieutenant Colonel J. H. M. SHAW-STEWART, R.E., Consulting Engineer for Railways, dated Madras, 4th December 1875, No. 1,216.

ADVERTING to your letter of the 19th of August last, No. 912, and to the Proceedings* of Government forwarded therewith, I have the honor to enclose, for submission to the

Noble the Governor in Council, copy of a letter from the Board of Directors of this Company upon the subject of the accident that occurred at the Paupugnee bridge on the 16th of June 1874.

2. In accordance with the instructions of the Board I request that the Government will be pleased to reconsider their Resolution* of the 17th of August 1874, with the view to relieve

Mr. Robinson from the very serious charge implied therein.

From J. BYRNE, Esq., Secretary, Madras Railway, to R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, dated London, 5th November 1875, No. 563.

REFERRING to paragraph 23 of your No. 1,171, on the subject of the accident at the Paupugnee bridge, I am instructed to inform you

Accident to Inspection Train at Paupugnee bridge.

that it was not the intention of the Board that this question, their decision upon which was communicated to you in paragraphs 11 to 13 of my

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No. 548, should be further discussed before being laid before Government, and they think that the opinion expressed by the Chief Engineer as to the exaggeration of Mr. Stoney's letter is to be especially regretted, as it appears to have had the effect of confirming the Government in a decision which the Board cannot but consider unjust to the Acting Deputy Chief Engineer.

2. That much blame is to be attributed somewhere is most probable, but the reasoning of the Consulting Engineer does not convince the Board that it ought to be laid on Mr. Robinson. The suggestion that he knew the speed to be dangerous is disclaimed; indeed, had he done so, it would have been sheer madness not to reduce it; but if it be now admitted that Mr. Robinson believed he was acting within the limits of safety, he cannot be justly held responsible for an accident consequent upon the mere performance of his duty.

3. No doubt, high speed is always a material element of danger, so is high pressure in boilers, but high speed is essential in testing the line, as high pressure is in testing boilers; and as no one would think of blaming an Engineer for the fatal consequences of an accident in testing a steam boiler, so neither ought Mr. Robinson to be blamed for the consequences of applying a test to the line, the highest estimate of which falls short of that which has, upon deliberation after the event, been declared to be proper and expedient.

G.O., No. 2,270, dated 17th August 1874.

4. The Consulting Engineer states his opinion that the Deputy Chief Engineer should have been thoroughly acquainted with the fact that a high rate of speed was unsafe, owing to structural defects of the bridge, which were well known, and it is upon this ground chiefly that he considers Mr. Robinson to blame; but from the information before the Board it would appear that this opinion requires some qualification, inasmuch as the unsafety of the bridge was far from being well known.

5. Mr. Robinson himself stated in his evidence that he had frequently travelled over the bridge at the speed of 35 miles per hour. Mr. W. Barton Wright, in reply to inquiries made by the Board, stated that, up to the time of the accident, he had never heard that the bridge in question was ever supposed to be unsafe, and that he had travelled over it both on engines and carriages, in some cases at high rates of speed considerably over 40 miles an hour, and never noticed any oscillation or symptom of weakness. Mr. Barnett stated, in answer to inquiries by the Board, that he was well acquainted with the bridge, and had frequently travelled over it by ordinary and special trains, more than once at a speed of upwards of 50 miles an hour. Mr. Webb, lately Bridge Inspector on the line, stated, in conversation with the Chairman, that he had always considered the bridge perfectly safe, and one of the best on the Company's lines.

6. These statements prove that although the opinion now expressed as to the influence of structural defects, in causing unsafety of the bridge for high velocities, may be correct, yet it was by no means generally held before the accident, nor was the unsafety of the bridge known. Had it been known, the Board would consider the neglect to affix the usual notices and give the proper cautions deserving of very severe censure (the nearness of the Camilapur station being no protection in some cases), not the conduct of the Engineer who, performing his duty in ignorance, very nearly forfeited his life.

7. The line was tested and found defective, and Colonel Shaw-Stewart's examination showed that it was not the gauge which was in fault, but the fact stated in evidence, as to the serious defect met with at the 170th mile, the evidence contained in Mr. Stoney's letter, and, lastly, the eminently significant fact referred to by the Chief Engineer, *viz.*, that the dog bolts were more "displaced on the portion of the bridge over which the Inspection Train had run at a high speed, than over the portion north of the breach over which the train had not run," convince the Board that the maintenance of the line was not up to the test. Whether this alone was the cause of the accident cannot now be ascertained.

8. The Board cannot but express their opinion that justice is not done in the expenditure of the Company's capital, nor are their bridges what the Company have a right to expect, if when sound and in good condition they are unsafe for a light train at a speed of 30 to 35 miles an hour;

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and I am to repeat their instructions that you will, in communication with the Chief Engineer and with the sanction of Government, spare no effort to improve them till they are quite equal in security to the best parts of their lines. They also wish the permanent-way to be periodically tested in the most efficient manner; and they cannot avoid the apprehension that, if their Engineers are blamed for applying the proper tests at their own personal risk, it will soon become the practice to perform the inspections in a superficial manner, and the accident at the Paupugnee bridge may thus become the parent of others of a more serious character.

9. You will be so good as to submit this letter for the orders of His Grace the Governor in Council, with the request that the Resolution of the 17th August 1874 may be again considered, with the view to relieve Mr. Robinson from the very serious charge implied thereon, a favor which the Board respectfully solicit, being strongly of opinion that the censure will be found to be undeserved on a fuller consideration of all the facts of the case.

From R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, to Lieutenant-Colonel J. H. M. SHAW-STEWART, R.E., Consulting Engineer for Railways, dated Madras, 16th April 1875, No. 402.

With reference to Order of Government, No. 2,270, dated the 17th August 1874, I have the

* Paragraphs 11, 12, and 13.

honor to forward herewith, for submission to Government, an extract* from a letter from the Board of Directors, No. 548, dated the 12th of March 1875, in which they express their views upon the subject of the accident that occurred to the Deputy Chief Engineer's Inspection Train at the Paupugnee bridge on the 16th of June last.

2. The Directors after having given their most careful consideration to the subject, and after consulting with Sir John Hawkshaw thereon have arrived at the conclusion that Mr. Robinson cannot be blamed for having allowed so light a train to cross the bridge at a speed of from 30 to 40 miles an hour, and they trust that, upon reconsideration of the subject, the Government will not object to relieve Mr. Robinson from the censure implied in the order above referred to.

2. I request that you will be so good as to communicate to me, for the information of the Board, any order that may be passed by the Government upon this subject.

Extract from a letter from the Secretary, Madras Railway Company, No. 548, dated London, the 12th March 1875.

Para. 11.—The Directors have given their most careful consideration to paragraphs 11 to 17 of your No. 1,122, on the subject of Accident to Inspection Train at the Paupugnee bridge. the accident to the Inspection Train crossing the Paupugnee bridge, and to the Order of Government, No. 2,270, dated 17th August 1874, which accompanied it. They have also had the advantage of referring to Driver Lem's evidence and Mr. Stoney's letter of the 25th June 1874, both of which are of material importance, but which had not been laid before the Government at the time when the order referred to was passed. The Driver's evidence is important, from its statement of the material fact that the speed of the train had been reduced to 45 miles an hour before the steam was shut off; and Mr. Stoney's letter, from the evidence it contains of the structural defects of the roadway, and the laxity of the superintendence. The Board have also had the advantage of the opinion of their Consulting Engineer, Sir John Hawkshaw, copy of whose letter, dated 10th instant, is herewith forwarded, and with the aid of the additional evidence and advice above referred to, they have been led to the conclusion that, even supposing the accident was not occasioned by the line being out of gauge, yet as nothing was previously known inconsistent with the perfect soundness and stability of the bridge, and, in the absence of any regulation to the contrary, Mr. Robinson cannot be blamed for allowing so light a train to cross it at the speed of from 30 to 40 miles an hour; should the Government, on reconsideration of the subject, having regard to the additional facts now brought

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under notice, be pleased to modify their former opinion, the Board trust that they will not object to relieve Mr. Robinson from the censure implied in their order above referred to.

12. The Board are surprised to find from Sir John Hawkshaw's report, that there must have been considerable negligence and carelessness in the construction and inspection of this bridge. They desire that you will ascertain who were engaged in the work, and who should be held responsible for its completion in a sound and secure condition.

13. It is also with much regret and disappointment that the Board observe that so many of the chief bridges on their lines have been considered by the Government insecure, and that the speed of trains is, on that account, ordered to be reduced in passing over them. This state of things cannot fail to be a great obstacle to the efficient and economical working of their lines, and they trust that, with the aid and sanction of Government, you will spare no effort to have it remedied as speedily as possible; if the bridges were properly constructed and kept in efficient condition, they ought to be, as a rule, quite as secure as any other part of their lines. Your attention was specially directed to this subject in paragraph 9 of the Board's letter, No. 484, dated 8th December 1871, when you were requested to obtain the sanction of Government for the execution of whatever repairs and improvements might be considered necessary for placing all the bridges, as far as possible, in a state of absolute security. You will observe that the Board expect an early communication from Sir John Hawkshaw on the subject of the best means of dealing with their bridges, which will be forwarded to you without delay.

(True Extract.)

(Signed) R. B. ELWIN,
Agent and Manager.

From Sir JOHN HAWKSHAW, to J. BYRNE, Esq., Secretary, Madras Railway Company,
dated Westminster, 10th March 1875.

I return you the papers sent with yours of the 22nd January, on the subject of the accident to the Deputy Chief Engineer's Special Inspection Train at the Paupugnee bridge on the 16th June last, and beg, as requested, to report thereon.

Firstly.—I am asked whether I am of opinion that Mr. Robinson's statement is correct when he says "that by shutting off the steam without the use of brakes, the speed of the train was reduced from 45 to 35 miles an hour on the bridge, it being explained that the steam is stated to have been shut off three-quarters of a mile before reaching the bridge, 28½ chains of this being a rising gradient of 1 in 1023, and 27 out of these 28½ chains curved to a radius of 64 chains."

Replying to this question I have gone into the calculation, and assuming the above data also that there was no head or side wind and that the road was in good order, I find that the speed would be reduced from 45 miles to between 34 and 35 miles an hour. If there were a head or side wind, the speed would be still further reduced; but as Mr. Robinson states there was no appreciable wind against him, and a Native Watchman says "there was not much wind," it must be assumed that the velocity of the train was not materially lessened by wind, although another Native Watchman states "the wind was blowing pretty strong from the west."

Secondly.—I am asked whether I consider "that a bridge like the Paupugnee, if properly constructed and in good order, ought to be held to be unsafe to run over with the Inspection Train at a speed of 55 miles per hour, or if that speed would be unsafe whether there would be danger in crossing it at the speed to which 45 miles per hour would be reduced by shutting off the steam as above without the use of brakes at three-quarters of a mile distance."

Thirdly.—I am asked whether I am of opinion "that such a bridge as the Paupugnee if properly constructed and in good order, may be considered equally safe with other parts of the line for the passage of trains at all speeds," and, if not, whether I can "suggest any addition or improvement which would have the effect of making it so."

Fourthly.—I am asked whether on perusing all the evidence now obtained, I am of opinion "that the accident ought to be attributed mainly, if not exclusively, to excess of speed in the train crossing the bridge," or if it was in my opinion or principally "due to some other cause."

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It will be convenient to answer these three questions together, but before doing so I must correct a statement which appears in the documents, that I designed the screw pile trestles. This is not the case, I have never been called upon to design the substructures of any of the bridges on the Madras Railway, excepting the Kuddelhoondy, and (quite recently) the piers of the new Cheyaur and Huggry bridges, neither, excepting in these cases, has my opinion ever been asked on the foundations or piers of the bridges on the line, or any correspondence that I remember sent to me respecting them.

The screw pile trestles were manufactured under my directions from a design sent from India by Mr. Heppel, and it would have been my duty if I had seen anything structurally defective in the design to point it out.

The design was one evidently suitable for India in many ways, and would be efficient, in a structural point of view, assuming the ground into which the piles were to be screwed was of a sufficiently tenacious or holding character, and assuming the piles were screwed down sufficiently deep which the design admitted of, as the piles from the lower bracing frame (which is usually put as low down as circumstances will admit) to the screw were sufficiently long. Notwithstanding I have from time to time strengthened the bracing frames, and I made an addition which added to the strength of the piers, by sending out a strong casting to unite together at the top the two sets of trestles comprising one pier.

To what depth the trestles have been actually screwed down I do not know, but I find that the bed of the Paupugnee river, instead of being of a good holding material, is of a sandy character.

I find also from Mr. Anderson (who had nothing to do with the design or erection of the bridge) that the piles in line in the trestle are not placed in the direction of the line of the bridge and at right angles to the bridge, respectively, as intended, or at least are much more out than they need be, thereby lessening the stability of the piers, and further in consequence of this defect in the erection the casting sent out to unite the trestles together at the top were not put in. I find, moreover, that Mr. Stoney, whose testimony is reliable, states in his letter of the 25th June 1874 that, owing to the neglect of the Maistry, a number of the dog bolts which fasten the Roadway joists to the girders were turned the wrong way, and had not been screwed up for a long period, and that, owing to long neglect, many of the nuts could not be turned one way or the other. If the roadway joists had been properly screwed down, they would have added to the stiffness of the bridge, and the security of the roadway would be increased if the joists were firmly united together by strong planking or longitudinal timbers, or kept securely true in place by distance pieces. No wonder, therefore, that the bridge is deficient in stiffness both laterally and longitudinally.

If the ground had been good and the piles screwed firmly into the ground, and the the piers and superstructure made as rigid as intended, or as they might have been, there would be no reason, as far as the design is concerned, why trains should slacken speed over the bridge, as it would practically have been as strong as other parts of the railway.

It appears to me probable, notwithstanding the bridge has not been erected so well as it might have been, that the accident might not have happened had the roadway joists been securely fastened to the top flange of the girder; for, owing to the loose condition of the dog bolts, the cross joists ceased to assist, at any rate to the extent they ought to do, in stiffening the structure, and their loose and insecure condition would besides tend to throw the line out of gauge. I notice a remark which to me renders the supposition not improbable that the line was out of gauge on the bridge, a circumstance which might in itself have caused the train to mount and leave the rails. The remark I refer to is in the 14th paragraph of Mr. Horsley's letter, No. 333, of the 25th June 1874, and is as follows:—"A rail was pointed out to me as a possible cause of the accident. This rail, down the greater part of its length, on the inside is flattened as if something had been pressed against it. This flattening is at first slight, but becomes more distinct as it goes along, until a piece of iron is split off the rails, and then there is a mark showing where a wheel crossed, or, as it is technically termed, mounted the rail." In

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the absence of any other explanation, I should infer that this flattening of the side of the rail came from the grinding action of the wheels against the rail, owing to the rails being out of gauge at the point in question.

But whether or not the state of the joists or roadway was the more immediate cause of the accident, it would in all probability not have happened if the structure, or the roadway, or both of them had been in a state as efficient as under the circumstances was possible. And considering this, it does appear to me that undue blame has been attached to Mr. Robinson. Of course, if the train were travelling at a less velocity, it might not have left the line, notwithstanding the defect in the structure, but before it can be asserted that Mr. Robinson was sanctioning a speed inconsistent in his opinion with safety, it must be proved that he was acquainted with the circumstance that the bridge was in such a state as to render it unsafe to travel at the speed at which the Inspection Train was going, and it must be remembered also that this train was very light, and it would be well known to Mr. Robinson that there would be less danger in running over a bridge subject to vibration at a high velocity with a light train than there would be with a heavy one.

As to the best way of dealing with the substructure and superstructure including the roadway of the Paupugnee as well as of other bridges, I will state my views fully when I report generally on the bridges on the Madras Railway to which my attention is now being directed and for which purpose Mr. Anderson is now at home.

From R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, to Lieutenant-Colonel J. H. M. SHAW-STEWART, R.E., Consulting Engineer for Railways, dated Madras, 21st April 1875, No. 420.

With reference to your letter of the 20th instant, No. 442, I have the honor to send you herewith a copy of the letter from Mr. Stoney, dated the 25th of June 1874, to which allusion is made by the Board in their remarks upon the Paupugnee bridge accident.

2. I have not yet replied to the Board upon this subject, but when I do so I will not fail to send you a copy of my report as requested.

From E. W. STONEY, Esq., Resident Engineer, Madras Railway, to the Acting Deputy Chief Engineer, Madras Railway, dated Cheyair, 25th June 1874, No. 626.

I beg to enclose a copy of a letter I have received from Mr. Kebby for your consideration: he is, I believe, very worthy of leave whenever it can be granted to him, as he is a most trustworthy and painstaking Inspector.

2. I think that the present Section Maistry is quite unfit for the position he holds, and should be dismissed immediately, as the state of the Paupugnee bridge shows that he greatly neglected his duty, numbers of dog bolts were turned the wrong way, and that they had not been screwed up for a long period is evident for two reasons—

First,—When I set men to put them right many of the nuts could not be turned one way or other;

Second,—The foot-board had in a great many places to be cut to allow the nuts to be turned, now had they been regularly attended to and screwed up, the necessary cuts would have existed in the footway, and the nuts would not have been so tight as to require their being cut off to get the bolts out.

3. I learn from Mr. Kebby that the Section Maistry was never either a Gang Cooly, or Gang Maistry, so that it is hardly likely he should know much of his work.

4. Mr. Kebby further informs me that the late Inspector allowed the Section Maistry to employ and dismiss Maistries and Gang Coolies as he liked, and the result of this is that men have been made maistries who are not at all qualified for their posts.

5. I had six gangs at work on the bridge laying on Tuesday, and was surprised at the ignorance of their work shown by a large number of the men and maistries, and had it not been

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for Inspector Saravanam's exertions aided by my own Platelaying Maistry, I should have got on but slowly.

7. I had a strong gang of men and carpenters under Mr. Kebby at work screwing up dog bolts and packing sleepers from Friday to Monday last, so as to render them secure for the present.

8. Before, however, fast traffic is again resumed over the bridge, it would be most desirable to have all packings taken from under the sleepers, and the chairs levelled by packings under them, some bent rails now in removed, and the present dog bolts replaced by the new muster square ones.

9. So far as I can form an opinion, the Section Maistry was grossly ignorant or negligent, if not both, and deserves to be at once dismissed and, if possible, prosecuted.

From R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, to Lieutenant-Colonel J. H. M. SHAW-STEWART, R.E., Consulting Engineer for Railways, dated Madras, 16th July 1875, No. 753.

With reference to paragraph 2 of my letter, No. 420, of the 21st April last, I have the honor to forward you herewith copy of a letter* from

* No. 505, dated 14th July 1875. the Chief Engineer, in which he furnishes the information called for by the Board in paragraphs 12 and 13 of their letter, No. 548, dated the 12th March 1875, with regard to the Paupugnee bridge.

From B. ANDERSON, Esq., Chief Engineer, to R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, dated Madras, 14th July 1875, No. 505.

Owing to pressure of very urgent work since my return from England, I have been unable sooner to deal with the important subjects referred to in the 12th and 13th paragraphs of the Secretary's letter, No. 548, dated London, 12th March 1875.

I have very carefully examined the records in my office bearing upon the question of the design and construction of the Paupugnee bridge, and am now in a position to furnish you with the required information.

The Paupugnee bridge was originally designed by Mr. J. M. Heppel, and was intended to consist of twenty openings, spanned by wrought iron girders 70 feet from centre to centre, supported on masonry piers and abutments. This design, however, was modified by Mr. W. G. Smart, and screw pile piers were substituted for masonry. It is important to note that the wrought iron girders were indented for by Mr. Heppel, and were designed and ordered by the Company's Consulting Engineer to suit the original proposal.

Mr. Heppel's design provided for a clear span between supports of 64 feet, while in the modified design the clear span of the girders was increased to 66 feet, and the piers were composed of each two screw pile trestles unconnected by either cross girders or bracings of any kind.

The bridge I find was constructed by Mr. T. M. H. Johnston and Mr. H. C. West, but the latter gentleman may, I think, be absolved from all responsibility incurred, as his share in the work consisted in finishing up what was left undone by Mr. Johnston, and this amounted only to screwing down two entire piers and one pile of a third.

The abutments were built and seventeen out of the nineteen piers (with the exception of one pile) were screwed into place by Mr. Johnston.

The accompanying tracing clearly illustrates the position in which Mr. Smart intended that the screw piles should be placed, and the position into which they were actually screwed by Mr. Johnston.

There can be no doubt that the deviation from the design contributed not a little towards the insecurity of the bridge.

I am unable to afford any explanation for this deviation, and can only assume that Mr. Johnston had in view the possibility of having to screw the piles down to much greater

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depths than shown on the original drawing, in which case the blades of the inner battering piles would foul the centre perpendicular piles.

There are, however, no records in my office referring to this subject, with the exception of the following remarks by Mr. Smart, in a letter to the Resident Engineer, dated 3rd August 1865:—

"You must observe the greatest possible accuracy in securing these piles and adhere strictly to the drawings, or you will get into difficulties."

As regards the condition of the bridge on the day of the accident to the Inspection Train, I cannot but think that the description given in Mr. Stoney's letter, No. 626, of 25th June 1874, is greatly exaggerated. All the evidence points to the fact that the bridge was in a sound state. The Gang Maistry deposed that he screwed up the dog bolts on the 15th June, the day before the accident.

The Section Maistry stated that he was ordered by Inspector Satur, who lost his life in the accident, to see that the bolts were properly screwed down, and produced Satur's written instructions regarding the bridge and the line generally.

Satur himself appears to have closely examined the bridge on the 13th, and finally and most important evidence of all, Colonel Shaw-Stewart and Mr. Going, who carefully examined the bridge immediately after the accident, testified to its good condition, but pointed out the eminently significant fact that the dog bolts were more displaced on the portion of the bridge over which the Inspection Train had run at a high speed, than over the portion north of the breach over which the train had not run.

Mr. Robinson, after the accident, "walked over the bridge, and could find nothing in the condition of the rails or in the situation of the bridge to account for the accident. He found some dog bolts loose, but not to an extent to account for the accident."

Mr. Horsley, the Magistrate, who inquired into the case, states in the 13th paragraph of his report to Government—

"Taking the last point first, the evidence is all in favor of the good condition of both permanent-way and bridge. Even Mr. Robinson is of this opinion."

My opinion is, and always has been, that the cause of the accident is to be found in the faulty design and construction of the bridge, which rendered it an unsuitable structure to be run over at so high a rate of speed as was attained by the Inspection Train, and I think that an examination of the cross section of the screw pile piers as constructed, a drawing of which is appended, will fully support my opinion.

As regards the 13th paragraph of the Secretary's letter, I should imagine that every one really interested in the success of the Madras Railway will share with the Board in their "regret and disappointment" concerning the condition of so many of the most important bridges on the line. The subject is one that has caused me the greatest anxiety for a long time past, an anxiety from which the head of the engineering staff cannot be relieved until the important protective works now proposed have been fully carried out.

The tone of the Board's remarks, it appears to me, would lead to the inference that some blame, for the existing unsatisfactory state of things, is attributable to the present engineering staff. In justice to myself and to the very efficient body of officers under my orders, I must endeavor to correct such a misapprehension, while it is quite true that in several cases the speed of trains over bridges has been reduced, there is no single instance in which such reduction of speed has been in any way called for in consequence of the bridges on the permanent-way not having been maintained in efficient condition. The special precautions in force on the Madras Railway are the direct result of want of confidence engendered by either faulty design or construction, and for neither of those defects can any of the Engineers now in the service be held responsible.

The Board have pointed out that your special attention was called in their letter, No. 484, dated 5th December, to the importance of having the bridges quite as secure as any other part of our line, but they are probably unaware how very much has been effected in this direction during the past few years.

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In the beginning of the year 1863 I received my appointment as Chief Engineer, and although at first my attention was principally directed towards the winding up of the important contracts for the completion of the North-west Line to Raichore and Bellary, I soon became aware of the necessity for very carefully considering the condition of the line already opened for public traffic. With this view I caused a systematic examination to be made of the foundations of all bridges of which I had the slightest suspicion, and I am able to point to the fact that since the middle of 1864 nine bridges have been either partially or wholly rebuilt, and no less than 697 bridges have been provided with efficient protective works.

When the difficulties and anxieties in connection with the opening up of foundations on a line open for traffic are taken into account, the above result cannot, I submit, be looked upon as otherwise than creditable to the Engineers engaged. I am quite ready to admit that it was not until after the catastrophe to the Cheyair bridge that attention was directed to the necessity for an examination of the large bridges on the line. Generally speaking so much thought is bestowed upon the design, and so much care on the construction of large and important bridges that, as a rule, they are looked upon as the safest and most secure parts of a line of railway. The very faulty nature of the foundations of the Cheyair bridge, however, naturally directed attention to all the other large bridges built over sandy rivers, and the result of an examination of the foundations of several was such as to cause no little alarm, and to justify fully the recommendation of elaborate and costly works of protection. That when these works are completed, and the new bridges now in progress and contemplated are built, the line will be in a thoroughly safe condition as regards floods in the large rivers, I have no doubt whatever, but the completion of these works will be a matter of time, and will call for the exercise of the greatest care and attention.

No. 289-A. Endorsement of the Consulting Engineer for Railways, dated Madras, 18th January 1876, No. 25.

From R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, to Lieutenant-Colonel J. H. M. SHAW-STEWART, R.E., Consulting Engineer for Railways, dated Madras, 15th January 1876, No. 45.

ADVERTING to your letter of the 8th instant, No. 22, I have the honor to enclose you a copy of Mr. Robinson's statement*

* Letter No. 47, 14th January 1876, with a diagram. with regard to the accident that occurred at the Paupugnee bridge on the 16th of June 1874.

2. In reply to the 2nd paragraph of your letter, I beg to quote as follows from the Acting Chief Engineer's letter, No. 46, dated yesterday:—

"The exact distance from the centre of Cuddapah Station-house to the south abutment of the Paupugnee bridge is 13 miles 56 chains, and from the staff bungalow (the point from which the train started) to the south abutment of the bridge is 13 miles 40 chains. I do not remember the mileage of the small bridge referred to, but Mr. Haworth informs me that it is at 170 miles 14th telegraph post."

From W. R. ROBINSON, Esq., Acting Chief Engineer, to R. B. ELWIN, Esq., Agent and Manager of the Madras Railway Company, dated Madras, 14th January 1876, No. 47.

I HAVE to acknowledge the receipt of your letter, No. 125, dated 10th January, enclosing me a copy of the Board's letter, No. 563, dated 5th November, and of Consulting Engineer's letter, No. 22, dated 8th instant.

*Proceedings of the Madras Government, Public Works Department,
16th February 1876.*

2. The Board in their letter have taken up the question of the Paupugnee accident so ably that little remains to be said on the subject. I shall, however, refer to some of the points already touched upon, giving additional information which may assist the Government in forming their decision.
3. First, with reference to the statements that the structural defects in the Paupugnee bridge were well known and rendered it unsafe at high rates of speed. On this point I believe Lieutenant-Colonel Shaw-Stewart to be misinformed. In paragraph 3 of his letter* of the 23rd of June 1874, he says, "in the case of the bridge over the Chittravutty, the speed was limited to 8 miles an hour, and it has always been understood that a similar limit would have been fixed in the case of the Paupugnee bridge had it not been that the Camalapur Station at which every train is timed to stop is only about half a mile distant."
4. Now it should be at once understood that although passenger trains stop at this station it was not on account of the bridge, but on account of the passengers, and because it is a convenient watering station. Special trains do not necessarily stop there, and many do not, as will be seen by a reference to the special train notices. Yet the train which would be most likely to cross this bridge at high speed would be a light special.
5. The speed over the Chittravutty was limited in 1871 owing to a defect being discovered in one of the trestles, and this limit was continued after the defect was remedied owing to others being discovered. Had there been any reason to doubt the stability of the Paupugnee bridge, similar precautions would have been taken.
6. I have learned within the last few days that in 1869 a proposal was made to the Acting Chief Engineer to limit the speed over both bridges, but that he declined to accede to it.
7. I confess that, even now, I do not think that a trestle bridge is necessarily unsuited to high rates of speed. With a little extra bracing to the girders a bridge similar to the Paupugnee might be made perfectly safe.
8. Mr. Anderson in his letter, No. 505, dated 14th July 1875, lays considerable stress on the position in which the screw piles were placed. I do not see how they could have been screwed in in any other way without fouling, and I believe the alteration referred to very slightly influenced the stability of the bridge. Mr. Stoney's report is also alluded to in this letter, and I can only say that Mr. Stoney has quite satisfied me that his statement was not exaggerated.
9. I have more than once crossed the old bridge with full steam on, and have no doubt that other trains have been driven at equal speed.
10. My only reason for saying in my evidence that I considered it unfair to run at high speed over these long bridges, was that it gives more work to the gangs to keep up the road.
11. Had the structural defects been well known, they would have been known to the Driver, who would have been careful to cross the bridge at a very moderate speed. The Inspection Train is very similar to any other special, and I do not think the Deputy Chief Engineer should be expected to take an active part in its control, even though there is a brake in the carriage.
12. I believe that the conclusion that speed was the cause of this accident was a good deal influenced by the fact that I was accustomed to test the road when on inspection by running at a high rate of speed. That this test is necessary I still believe. Our mail trains frequently run at 50 miles an hour over portions of the road when they have to make up time, and specials run at 60. Under these circumstances, I do not think the Chief Engineer should be debarred from applying an equally high test to the road which should be kept in such a state of efficiency as to carry a train safely at any speed an engine can be driven.
13. I enclose a diagram of this portion of the line for the information of Government.

SUBMITTED for the consideration of Government, with reference to their memorandum No. 22, dated the 7th instant.

*Proceedings of the Madras Government, Public Works Department,
16th February 1876.*

2. Mr. Robinson is of opinion that I was mistaken in stating that the structural defects of the Paupugnee bridge were well known, but I regret that I cannot withdraw that statement. In Mr. Robinson's letter allusion is made to the fact
- Paragraph 6.

that "in 1869 a proposal was made to the Acting Chief Engineer to limit the speed;" and upon two occasions, once before April 1870 and a second time in the early part of 1874, I suggested that speed should be limited; but was met upon both occasions with the reply that any such limit was unnecessary, as the bridge was within so short a distance of the Camalpure Station, at which every train was timed to stop. From Mr. Robinson's letter it appears that although this was true of all the trains entered in the time-table, special trains did not necessarily stop at Camalpure. If I had known that this was the case, I should have pressed more strongly for a limit of speed over the bridge; but I cannot withdraw the statement that its structural defects, due to the character of the piers, and the want of sufficient rigidity in the girders, were well known, and ought, in my opinion, to have been known to an officer holding the position of Chief Engineer.

3. The conclusion arrived at by the Magistrate who conducted the inquiry, and afterwards endorsed by the Government, was that the accident must be attributed to the excessive speed with which the inspection train was driven over the bridge. The Board of Directors question the correctness of that conclusion, and they are apparently of opinion that the accident was directly due to some defects in the permanent-way. With regard to this point, it must be observed that the bridge was examined by Mr. Robinson immediately after the accident, and that he could see nothing in its condition to account for it. A few hours after the accident the bridge was most carefully inspected by Mr. Going, the Acting Chief Engineer, and by myself, but nothing could be learnt by us regarding the cause of the accident. The gauge of the rails, from end to end of the bridge, was perfectly correct; and, without any apparent cause, the left wheels of the engine had clearly mounted the rail. It was remarked by Mr. Robinson, and also by Mr. Going and myself, that a few of the dog-bolts which fasten the sleepers to the girders were loose; but this was not considered to have any bearing upon the accident; and after comparing the condition of these bolts at the two ends of the bridge, Mr. Going and I arrived at the conclusion that they became loosened during the passage of the inspection train. Subsequently, Mr. Stoney, the Engineer employed in repairing the bridge, reported that a great number of these dog-bolts were loose and had apparently been neglected for long. The Directors attach much importance to this fact, and seem to be of opinion that it sufficiently accounts for the accident; but it appears to me that the only way in which the safety of a train passing over the bridge could be affected by the looseness of the dog-bolts would be by the gauge becoming thereby slack, in which case the engine might possibly have fallen between the rails. What actually happened was that the engine mounted the rail, and mounted it at a point where the gauge was perfect, as indeed it was all over the bridge. I cannot therefore see that the looseness of the dog-bolts, even admitting the accuracy of Mr. Stoney's report, in any way accounts for the accident.

4. There appears to me to be only one other possible explanation of the accident, viz., that it might have been caused by a defect in the engine; but the evidence

*Proceedings of the Madras Government, Public Works Department,
16th February 1876.*

taken at the Magisterial inquiry is altogether opposed to this supposition, which was also in my opinion excluded by the traces of the accident left upon the bridge, and by the position in which the engine was found.

5. The exact distance from Cuddapah to the Paupugnee bridge is stated in Mr. Robinson's letter. The exact distance to the small bridge where Mr. Robinson felt a shock is not stated, but its position is given at 170 miles 14 telegraph posts. As the position of Cuddapah is 161 miles 9 telegraph posts, the distance of the small bridge in question may be stated as 9 miles 5 telegraph posts, or about 9 miles 20 chains.

(Signed) J. H. M. SHAW-STEWART, Lt.-Col., R.E.,
Consulting Engineer for Railways.

No. 289-B.

MINUTE BY HIS GRACE THE PRESIDENT.

THE Government found on August 17th 1874 "that the accident on the Paupugnee bridge was attributable chiefly, if not solely, to the excessive speed with which the inspection train was driven over the bridge."

Against this decision and the blame thereby attributed to Mr. Robinson (the Acting Deputy Chief Engineer) the Directors appealed, and forwarding a letter of Sir John Hawkshaw's, in reply to certain questions addressed by them, the Government "after full consideration of the papers above recorded," saw "no reason to doubt the correctness of the views stated in their

G.O., No. 2,250, 4th August 1875.

order of the 17th August 1874, No. 2,270." A further application is now made by letter from the Agent and Manager of the Madras Railway, dated 4th of December 1875, requesting that "in accordance with the instructions of the Board" "the Government will be pleased to reconsider their Resolution of the 17th August 1874, with the view to relieve Mr. Robinson from the very serious charge implied therein," in accordance with a letter

of the Secretary of the Company, No. 563, dated London, 5th November 1875.

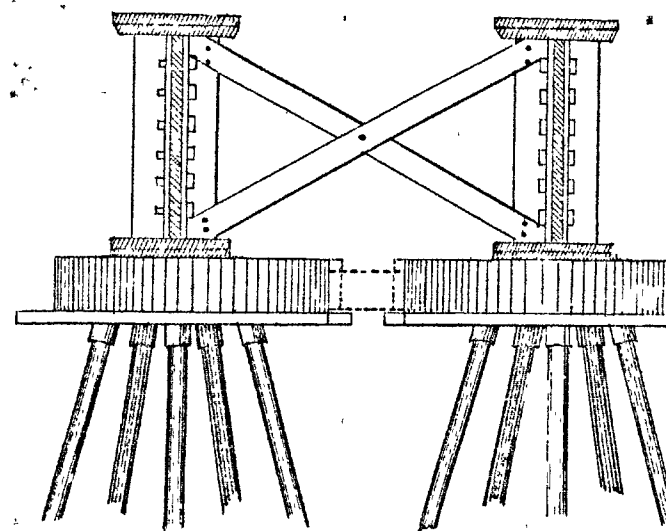
It is a serious matter to ask Government to reconsider a decision twice affirmed, and as I found from the Director's letter that they appeared to consider the structural defects in the bridge "far from being well known," and that the defective fastening of dog-bolts might have caused the accident, I thought I should better understand the case and evidence by visiting the spot. I did so on January 27th in company with Colonel Shaw-Stewart, Mr. Elwin, and Mr. Robinson.

Part of the bridge at the northern end remains as it was at the time of the accident, and I was therefore able to see its construction as it existed at the time of the accident.

*Proceedings of the Madras Government, Public Works Department,
16th February 1876.*

I can attribute the accident to no other cause than a high speed with an engine whose design rendered it "liable to oscillate more because it had outside cylinders" over a bridge liable to vibration from its design and unsafe from its construction.

The bridge consisted of a series of longitudinal girders about 140 feet in length, each girder spanning two openings.



The girders rest on circular cast iron caps, each supported by five screw piles. The girders were connected transversely by diagonal braces slightly rivetted to the vertical angles or T irons, by two rivets in each end.

The circular caps of the piers on which the girders rested were intended to have been connected by cast iron struts, bolted to each, but which were never inserted, as pointed out by Sir J. Hawkshaw, leaving the adjacent piers wholly unconnected with each other. These are indicated by the dotted lines on sketch.

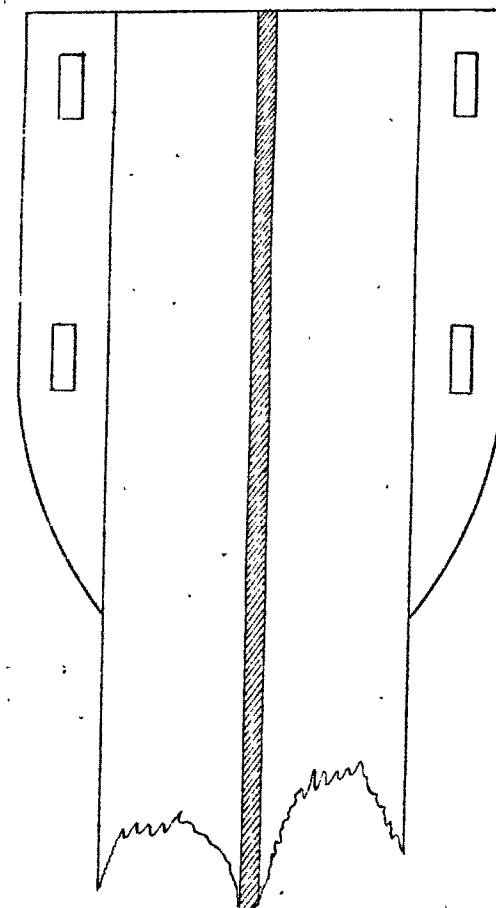
The girders were specified to have, and were duly constructed with, sole-plates fitted for holding-down bolts worked into the lower flange of the girder. Six for the centre of each girder and four at each end of each, i.e., fourteen for each girder.

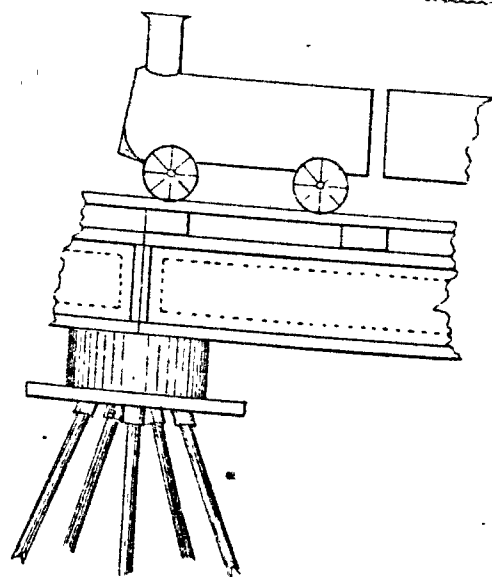
The bolts at the ends by securing adjoining ends of consecutive girders to one and the same casting forming the cap of the pier would have kept the girders in line and enabled them to resist lateral shocks.

The holding-down bolts, the size and number of which with arrangements to meet expansion were duly shown in the original drawings to which I referred, were altogether omitted in construction.

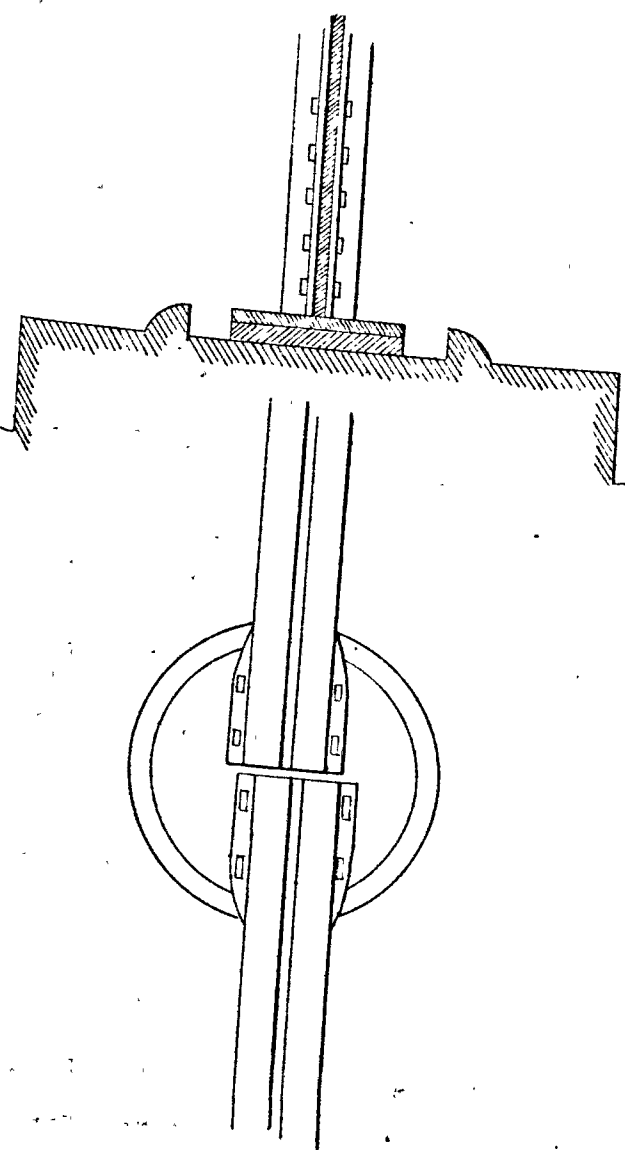
The result was that the bridge instead of being formed of one continuous framing, became a mere series of disjointed and unsecured girder frames held in place solely by their own weight, each except for its own weight free to be moved laterally or moved out of line on its own centre by any casual shock.

Their own weight was not very con-





siderable to resist the shock of any oscillation of a rolling weight of 36 tons with the momentum due to a velocity of, say, 35 miles per hour, acting at the height of the rails.



I should state that the cast iron caps on which the girders rested had small ledges cast on, which were intended to confine the flanges of the girders, in fact to act as distance pieces, but as the girders did not fill the space between the ribs they were of no use to prevent slight movements.

With girders thus unsecured it is obvious that any subsidence whatever of a pier supporting an end of a girder would slacken the support, and would in effect leave the girders resting upon it balanced on their centres ready to yield to any lateral thrust they might receive at either end.

+ Any lateral movement of the end of a girder must necessarily throw the girders, and consequently the rails, out of line.
See sketch on previous page.

A bridge so constructed and so fastened could not be said to be safe for anything more than a slow speed. Mr. Robinson's train ran towards the bridge at an high speed, which he considers by the time the train reached it to have been reduced to 35 miles per hour.

He in the evidence admits he "regulated the speed of the train," that is to say, the general rate of running. The speed is variously described, but if the distance, 14 miles, and the time, 18 minutes, be compared, it is obvious that the speed was high, and if the driver, as subsequently stated, shut off steam and reduced speed on feeling a shock, at 9 miles from Cuddapah to 45 miles per hour, travelling the remaining 5 at that speed, then the first 9 must have been travelled at a much higher speed.

The omission of fastenings I have alluded to was in no way concealed, and was immediately apparent to me when I looked at the girders *in situ*.

Mr. Robinson appears to be in no way responsible for the faults or any omissions or deviations from design in the construction of the bridge, but I cannot advise any modification of the opinion formerly expressed by the Government of Madras, "that the accident on the Paupugnee bridge was attributable chiefly, if not solely, to the excessive speed with which the inspection train was driven over the bridge; for which the Acting Deputy Chief Engineer, Mr. Robinson, who has gone home for his health, is responsible, as he has admitted that he regulated the speed," as I am clearly of opinion that the accident was due to the speed at which the train was driven on to a bridge of a construction rendering it unsafe for any but a very slow speed.

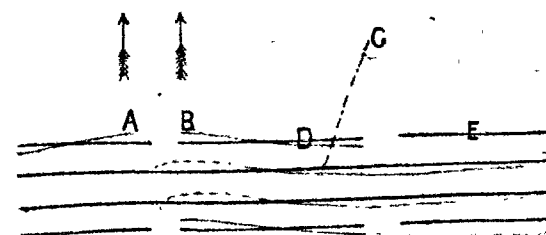
The circumstances attending the accident are thus described. Mr. Robinson says, "I observed a few oscillations before the accident occurred. They were so marked that I jumped up."

G.O., No. 2,270, 17th August 1874. Evidence of Mr. W. R. Robinson. "I think I noticed the swaying some 12 or 15 yards from the place where she left the rails."

The engine when she did leave the rails struck the end of the next girder.

This all appears to indicate that the whole cause arose within the length of 140 feet, *i.e.*, on one girder.

Now these girders being unsecured as I have described, if anything caused either the end of the last previous one, or the end of the one on which the accident occurred to be displaced laterally a very small amount, as at A B in the direction of the arrows, the rails would be pressed out of line, as shown in an exaggerated form by the red line in this figure, and thus cause the engine to oscillate and the engine wheels, with the momentum due to a velocity of 35 miles, to grind the rails.



*Proceedings of the Madras Government, Public Works Department,
16th February 1876.*

with a severe pressure and alternately to mount and cross the rail probably at the moment when the oscillation of the engine and the action of the crank combined to momentarily relieve the wheel from part of its proper weight on the springs.

Marks would be thus produced, as actually described in evidence; the diagonal bracings would be torn from their slight fastenings; the girder D would fall outwards, letting down the road, and the ends of girder E would be struck by the engine.

It is not improbable that this was the actual mode in which the accident occurred.

The lateral oscillation of an engine of the description of the engine which was running the train is considerable, and, on a girder balanced as these were, and at an high speed, might easily give a lateral shock to the end of a girder.

The dog-bolts referred to could not affect the gauge of the line however loose, as the rails were secured to the sleepers irrespective of these bolts, which were only intended to hold the sleepers down to the girders; the construction of the dog-bolts, however tightly screwed up, could not have given any material stiffness or rigidity to the girders

It is right I should add the probable cause of the non-application of the intended holding-down bolts. The girders were intended to have been erected on masonry piers, and the bolts are shown on the drawings as suited to stone blocks.

The design of the bridge was subsequently changed here to one on screw pile piers, and in the change of design the alteration of the specification for bolts (which themselves required an altered form to suit iron castings instead of stone) was probably overlooked.

31st January 1876.

BUCKINGHAM AND CHANDOS.

No. 290.

ORDER THEREON, 16th February 1876, No. 425.

RAILWAY, No. 37.

ORDERED that the Minute of His Grace the President, confirming the opinion already expressed in G.O., No. 2,270, of

17th August 1874, and re-affirmed in G.O., No. 2,250, of 4th August 1875, be communicated to the Directors of the Madras Railway Company through the Secretary of State for India.

2. The attention of the Consulting Engineer for Railways will be called to the defects of construction of the Paupugnee bridge disclosed by His Grace's Minute. It is probably not possible, so many years after its construction, to account for the defects, or to ascertain how the Consulting Engineer's Department omitted to notice these defects when passing the bridge for traffic. But their attention will be specially called to the subject; and they may well be called upon to scrutinize with the greatest care the details of all reconstructions now in progress on the North-west Line of the Madras Railway; as well as the new bridges in the course of construction on the South Indian Lines. Those lately opened on the sections south of Trichinopoly, under pressure to meet the exigencies of the visit of His Royal Highness the

*Proceedings of the Madras Government, Public Works Department,
16th February 1876.*

Prince of Wales, will be re-inspected, and finally reported on for the satisfaction of Government.

(True Extract.)

Major-General, R.E.,
Secretary to Government.

To the Consulting Engineer for Railways.

Exd. S. T. Austin.
Spare Copies

712
RAILWAY DEPARTMENT

CONSULTING ENGINEER'S OFFICE

Madras 20 December 1875.

No. 662

From

LIEUT.-COLONEL J. H. M. SHAW-STEWART, R.E.,

Consulting Engineer for Railways,

To

MAJOR-GENERAL G. W. WALKER, R.E.,

Secretary to Government,

Public Works Department,

Fort Saint George.

SIR,

Adverting to the Proceedings of Government under date the 4th August 1875, No 2250, and to previous papers upon the subject of the accident to the Inspection train at the Pampunice bridge upon the 16th June 1874, I have the honour to lay before Government a letter from the Agent of the Madras Railway giving cover to a letter from the Board of Directors

1216

Decr: 75

Directors, in which they again request that the opinion expressed by His Excellency the Governor in Council under date the 14th August 1874, may be reconsidered.

2. In laying these letters before Government it seems necessary to draw attention to that part of the Board's letter in which they apparently blame their Agent for having forwarded to this office Mr. Percord

Anderson's letter of the 14th July 1875.

No 505. If there is fault in this matter, it certainly does not lie with the Agent, for he lost no time in forwarding to this office paragraphs

paragraphs 11 to 13 of the Board's letter No 548, with request that they should be submitted to Government; but before doing so, I asked the Agent to furnish me with a copy of any special report which might be sent to the Board upon the points raised in their letter; being of opinion that, without the information contained in such report, the question was not in a fit position to be laid before Government.

3.

The papers which accompanied my letter No 404, dated the 19th July 1875, are herewith resubmitted for the consideration of His Excellency the Governor in

Council

No 402 of
16 April 75.
No 420 of
21 April 75
No 453 of
16 July 75.

Council.

I have the honour to be

Sir

Your most obedt Servt.

Mantleworth Esq. & Co.

Cons. Engineer for
Railways

40-58-59-4 Aug 1875-
15-16-20-21 Dec 74
238-239-13-24 July 74-
236-237-13-21
Original 684-333-334-17 Aug 74

Dated 20th Dec 1875.
Recd 21/12
No. 662

To
The Secretary to Government,
P. W. Department,
Fort Saint George.

From
The Consulting Engineer
for Railways.

P. W. 1875 Dec 21st
RAILWAY DEPARTMENT.
No 8088.

with reference to the
proposed Bill
regarding the late
Pauwpuce accident
and the clause at
checked to Mr. Robinson
in connection with

No. 1216

MADRAS RAILWAY.

AGENT AND MANAGER'S OFFICE,

Madras, 4th December 1875.

From

R. D. Clavin Esq.

Agent and Manager of the M. R. Co.

To

Mr. J. H. H. Shaw Stewart, R.E.

Consulting Engineer for Railways.

Sir,

Adverting to your letter of the 19th of August last, at 9/12, and to the Proceedings of Government forwarded therewith, I have the honour to enclose for submission to the most Noble the Governor in Council copy of a letter from the Board of Directors of this Company upon the subject of the accident that occurred at the Pauwpuce bridge on the 16th of June 1874.

In accordance with the instructions of the Board I request that the Government will be pleased to reconsider their Resolution of the 17th of August 1874 with the view to relieve Mr. Robinson from the very serious charge implied therein.

I have the honour to be,
Sir,

Your most obedient servant,

R. D. Clavin

Greenland & Co. Managers.

1863.

Madras Railway Company
33 New Broad Street
London 5th November 1875.

Sir,

Referring to para 23 of your 1171 on the subject of the accident at the Pampunee Bridge, I am instructed to inform you that it was not the intention of the Board that this question, their decision upon which was communicated to you in para 11 to 13 of my 548, should be further discussed before being laid before Government, and they think that the opinion expressed by the Chief Engineer as to the exaggeration of Mr. Stoney's letter is to be especially regretted, as it appears to have had the effect of confirming the Government in a decision which the Board cannot but consider unjust to the Acting Deputy Chief Engineer.

2. That much blame is to be attributed somewhere is most probable, but the reasoning of the Consulting Engineer does not convince the Board that it ought to be laid on Mr. Robinson. The suggestion that he knew the speed to be dangerous is disclaimed; indeed, had he done so, it would have been sheer madness not to reduce it; but if he now admitted that Mr. Robinson believed he was acting within the limits of safety, he cannot

Accident to
Suspension
Train at
Pampunee
Bridge.

MADRAS RAILWAY.

From

The Agent and Manager.

To

The Consulting Engineer

for Railways.

Dated 4th December 1875
Recd. 5th 1875

No. 1216.

Regarding accident
that occurred at the
Pampunee Bridge on
the 16th of June 1874.

M. 8088
9/75

Per 16th Feb 16 B. 1879

be justly held responsible for an accident consequent upon the mere performance of his duty.

3. No doubt, high speed is always a material element of danger, so is high pressure in boilers; but high speed is essential in testing the line, as high pressure is in testing boilers; and as no one would think of blaming an Engineer for the fatal consequences of an accident in testing a steam boiler, so neither ought Mr. Robinson to be blamed for the consequences of applying a test to the line, the highest estimate of which falls short of that which has, upon deliberation after the event, been declared to be proper and expedient.

G.O. 17th August
1874, p. 2270.

4. The Consulting Engineer states his opinion that the Deputy Chief Engineer should have been thoroughly acquainted with the fact that a high rate of speed was unsafe, owing to structural defects of the bridge, which were well known, and it is upon this ground, chiefly, that he considers Mr. Robinson to blame, but from the information before the Board it would appear that this opinion requires some qualification, inasmuch as the unsafety of the bridge was far from being well known.

Proceedings
of the Board
of the
Government
14th August 1875
p. 2250.

5. Mr. Robinson himself stated

in his evidence that he had frequently travelled over the bridge at the speed of 35 miles per hour. Mr. R. Barton Knight, in reply to enquiries made by the Board, stated that up to the time of the accident he had never heard that the bridge in question was ever supposed to be unsafe, and that he had travelled over it both on engines and carriages, in some cases at high rates of speed, considerably over 40 miles an hour, and never noticed any oscillation or symptom of uneasiness. Mr. Barnett stated, in answer to enquiries by the Board, that he was well acquainted with the bridge, and had frequently travelled over it by ordinary, and special trains, more than once at a speed of upwards of 50 miles an hour. Mr. Webb, lately bridge inspector on the line, stated, in conversation with the Chairman, that he had always considered the bridge perfectly safe, and one of the best on the Company's lines.

6. These statements prove that, although the opinion now expressed as to the influence of structural defects in causing unsafety of the bridge for high velocities, may be correct, yet it was by no means generally held before the accident nor was the unsafety of the bridge known. Had it been known, the Board would consider the neglect to affix the usual notices and give the proper cautions

deserving of very severe censure (the nearness of the Shamalapur station being no protection in some cases) not the conduct of the Engineer, who, performing his duty in ignorance, very nearly forfeited his life.

7. The line was tested and found defective, and Colonel Shaw Stewart's examination showed that it was not the gauge which was in fault; but the facts stated in evidence, as to the serious defect met with at the 17th mile, the evidence contained in Mr. Stoney's letter, and, lastly, the eminently significant fact referred to by the Chief Engineer, viz: that the dog bolts were more "displaced on the portion of the bridge over which the inspection train had run at a high speed, than over the portion north of the breach over which the train had not run", convince the Board that the maintenance of the line was not up to the test. Whether this alone was the cause of the accident cannot now be ascertained.

8. The Board cannot but express their opinion that justice cannot be done in the expenditure of the Company's Capital, nor are their bridges what the Company have a right to expect, if when sound and in good condition they are unsafe.

for a light train at a speed of 30 to 35 miles an hour; and I am to repeat their instructions that you will in communication with the Chief Engineer, and with the sanction of Government, spare no effort to improve them till they are quite equal in security to the best parts of their lines. They also wish the permanent way to be periodically tested in the most efficient manner; and they cannot avoid the apprehension that if their Engineers are blamed for applying the proper tests, at their own personal risk, it will soon become the practice to perform the inspections in a superficial manner; and the accident at the Paupugue Bridge may thus become the parent of others of a more serious character.

9. You will be so good as to submit this letter for the orders of His Grace the Governor in Council, with the request that the Resolution of the 17th August 1874, may be again considered, with the view to relieve Mr. Robinson from the very serious charge implied therein; a favor which the Board respectfully solicit, being strongly of opinion that the censure will be found to be undeserved, on a fuller consideration of all the facts of the case.

To the Agent & Manager
Madras Railway
Madras

I am, Sir,
Yours faithfully,
Julian Pym,
Secretary.

No. 402

MADRAS RAILWAY.

AGENT AND MANAGER'S OFFICE.

Madras, 16 April 1875.

From

Robert B. Shwin Esqr

Agent and Manager. M. R. Compang

To

Lieut Colonel J. W. M. Shaw Stewart
Consulting Engineer for Railways.

Sir,

With reference to Order of Government No 2270 dated the 17th of August 1874 I have the honour to forward herewith for submission to Government an extract from a letter from the Board of Directors No 548, dated the 12th of March 1875, in which they express their views upon the subject of the Accident that occurred to the Deputy Chief Engineer's Inspection train at the Pampunee Bridge on the 16th of June last.

Paragraphs
11, 12, and 13.

M. 8088
8/75

The Directors after having given their most careful consideration to the subject, and after consulting with Sir John Hawkshaw thereon, have arrived at the conclusion that Mr. Robinson cannot be blamed for having allowed so light a train to cross the bridge at a speed of from 30 to 40 miles an hour, and they trust that upon reconsideration of the subject the Government will not object to

Pro. 16th Feb 76 B. 1289

8
39
to relieve Mr. Robinson from the censure
implied in the Order above referred to.

I request that you will be so good
as to communicate to me for the information
of the Board any order that may be
passed by the Government upon this
subject.

I have the honour to be,

Sir

Your most obedient Servant

W. H. L. W.

Agent and Manager

509
Extract from a letter from the Secretary,
M. R. Co. No 548 dated Pondicherry the 12th /
March 1875.

Accident to
inspection train
at the Pampunee
bridge.

Para. 11. The Directors have
given their most careful consideration
to para. 11 to 17 of your No. 1122 on the
subject of the accident to the inspection
train crossing the Pampunee bridge,
and to the Order of Government No. 227,
dated 17th August 1874, which accom-
panied it. They have also had the
advantage of referring to Driver Linn's
evidence; and Mr. Stoney's letter of the
25th June 1874, both of which are of
material importance, but which had
not been laid before the Government
at the time when the Order referred to was
passed. The Driver's evidence is important
from its statement of the material fact
that the speed of the train had been re-
duced to 45 miles an hour before the
steam was shut off; and Mr. Stoney's
letter, from the evidence it contains of
the structural defects of the roadway,
and the laxity of the superintendence.
The Board have also had the advantage
of the opinion of their Consulting Engineer,
Mr. John Hawkshaw, copy of whose
letter, dated 10th instant, is herewith forwarded,
and with the aid of the additional evidence

MADRAS RAILWAY.

211

From
The Agent and Manager.

To
The Consulting Engineer
for Railways.

M. 8088/75

Dated 16th April 1875
Recd. 17th April
No. 402

According to report
from the Pleasants
letter No. 548, in which
are given the views
of the Board upon the
subject of the accident
to the inspection train
crossing the bridge at the
Pampunee bridge on the
16th of June last.

No. 16th Feb 76 B/1289

and advice above referred to, they have
been led to the conclusion that, even
supposing the accident was not occasioned
by the line being out of gauge, yet as
nothing was previously known in-
consistent with the perfect soundness
and stability of the bridge, and in the
absence of any reputation to the contrary,
Mr Robinson cannot be blamed for
allowing so light a train to cross it at
the speed of from 30 to 40 miles an hour.
Should the Government, on reconsideration
of the subject, having regard to the
additional facts now brought under
notice, be pleased to modify their
former opinion, the Board trust that
they will not object to relieve Mr Robinson
from the censure implied in their Order
above referred to.

12. The Board are surprised
to find from Sir John Hawkshaw's
report, that there must have been
considerable negligence and carelessness
in the construction and inspection of these
bridges. They desire that you will dis-
certain who were engaged in the work,
and who should be held responsible
for its completion in a sound and
secure condition.

13. It is also with much regret
and disappointment that the Board
observe that so many of the chief bridges
on their lines have been considered by

the Government insecure, and that the
speed of trains is, on that account, ordered
to be reduced in passing over them. This
state of things cannot fail to be a great
obstacle to the efficient and economical
working of their lines, and they trust
that with the aid and sanction of Govern-
ment, you will spare no effort to have it
remedied as speedily as possible, if the
bridges were properly constructed, and
kept in efficient condition, they ought
to be, as a rule, quite as secure as any
other part of their lines. Your attention
was specially directed to this subject
in para. 9 of the Board's letter No. 484
dated 8th December 1871, when you were
requested to obtain the sanction of
Government for the execution of what-
ever repairs and improvements might
be considered necessary for placing
all the bridges, as far as possible, in a
state of absolute security. You will
observe that the Board expect a nearly
communication from Sir John
Hawkshaw on the subject of the best
means of dealing with their bridges,
which will be forwarded to you without
delay.

True Extract

W. F. Shaw
Agent & Manager.

Wm

50
Mudras Railway
Engineers Office
33 Great George Street
Westminster

10th March 1875.

Dear Sir,

I return you the papers sent with yours of the 22nd January on the subject of the accident to the Deputy Chief Engineer's special inspection train at the Paupugnee Bridge on the 16th June last and beg as requested to report thereon.

Firstly. I am asked whether I am of opinion that Mr. Robinson's statement is correct when he says "that by shutting off the steam, without the use of brakes the speed of the train was reduced from 45 to 35 miles an hour on the bridge, it being explained that the steam is stated to have been shut off three quarters of a mile before reaching the bridge, 28½ chains of this being a rising gradient of 1 in 1023 and 27 out of these 28½ chains curved to a radius of 64 chains."

Replying to this question I have gone into the calculation and assuming the above data, also that there was no head or side wind and that the road was in good order, I find that the speed would be reduced from 45 miles to between 34 and 35 miles an hour. If there were a head or side wind the speed would be still further reduced, but as Mr. Robinson states there was no appreciable wind against him, and a Native Watchman says "there was not

M. 21/1/75

M. 8088/75

Pro: 16th Feb 76 B.N. 189

not much wind it must be assumed that the velocity of the train was not materially lessened by wind, although another Native Watchman states the wind was blowing pretty strong from "the west."

Secondly. I am asked whether I consider "that a Bridge like the Paupugnee, if properly constructed and in good order, ought to be held to be unsafe to run over with the inspection train at a speed of 55 miles per hour, or if that speed would be unsafe, whether there would be danger in crossing it at the speed to which 45 miles per hour would be reduced by shutting off the steam as above without the use of breaks at $\frac{3}{4}$ mile distance."

Thirdly. I am asked whether I am of opinion "that such a Bridge as the Paupugnee, if properly constructed and in good order, may be considered equally safe with other parts of the line for the passage of trains at all speeds and if not whether I can suggest any addition or improvement which would have the effect of making it so."

Fourthly. I am asked whether on perusing all the evidence now obtained I am of opinion "that the accident ought to be attributed mainly if not exclusively to excess of speed in the train crossing the Bridge" or if it was in my opinion or principally "due to some other cause."

It will be convenient to answer these three questions together, but before doing so I must correct a statement which appears

in

in the documents, that I designed the screw pile Tressels. This is not the case, I have never been called upon to design the substructures of any of the Bridges on the Madras Railway excepting the Ruddlehoondy, and (quite recently) the piers of the new Cheyair and Huggry Bridges, neither excepting in these cases has my opinion ever been asked on the foundations or piers of the Bridges on the Line or any correspondence that I remember sent to me respecting them.

The screw pile Tressels were manufactured under my directions from a design sent from India by Mr. Heffel, and it would have been my duty if I had seen anything structurally defective in the design to point it out.

The design was one evidently suitable for India in many ways and would be efficient, in a structural point of view, assuming the ground into which the piles were to be screwed was of a sufficiently tenacious or holding character, and assuming the piles were screwed down sufficiently deep which the design admitted of, as the piles from the lower bracing frame (which is usually put as low down as circumstances will admit) to the screw were sufficiently long. Notwithstanding I have from time to time strengthened the bracing frames and I made an addition which added to the strength of the piers, by sending out a strong casting to unite together at the top the two sets of tressels comprising one pier.

To what depth the tressels have been actually screwed down I do not know but I

find

find that the bed of the Pamunnee River instead of being of a good holding material is of a sandy character.

I find also from Mr. Anderson (who had nothing to do with the design or erection of the Bridge) that the piles in line in the tressel are not placed in the direction of the line of the Bridge and at right angles to the bridge, respectively, as intended, or at least are much more out than they need be, thereby lessening the stability of the piers, and further in consequence of this defect in the erection the castings sent out to unite the tressels together at the top were not put in. I find moreover that Mr. Stoney whose testimony is reliable states in his letter of the 25th June 1874 that owing to the neglect of the masonry a number of the dog bolts which fasten the roadway joists to the girders were turned the wrong way, and had not been screwed up for a long period, and that owing to long neglect many of the nuts could not be turned one way or the other. If the Roadway joists had been properly screwed down they would have added to the stiffness of the bridge and the security of the roadway would be increased if the joists were firmly united together by strong planing or longitudinal timbers or kept securely true in place by distance pieces. No wonder therefore that the Bridge is deficient in stiffness both laterally and longitudinally.

If the ground had been good and the piles screwed firmly into the ground, and the

13
the piers and superstructure made as rigid as intended, or as they might have been, there would be no reason as far as the design is concerned why trains should slacken speed over the bridge, as it would practically have been as strong as other parts of the Railway.

It appears to me probable notwithstanding the bridge has not been erected so well as it might have been, that the accident might not have happened had the roadway joists been securely fastened to the top flange of the girder, for owing to the loose condition of the dog bolts the cross joists ceased to assist, at any rate to the extent they ought to do, in stiffening the structure, and their loose and insecure condition would besides tend to throw the line out of gauge. I notice a remark which to me renders the supposition not improbable that the line was out of gauge on the bridge, a circumstance which might in itself have caused the train to mount, and leave the rails. The remark I refer to is in the 14th paragraph of Mr. Horsley's letter N^o. 333 of the 25th June 1874, and is as follows:— "A rail was pointed out to me as a possible cause of the accident. This rail, down the greater part of its length, on the inside is flattened as if something had been pressed against it. This flattening is at first slight, but becomes more distinct as it goes along, until a piece of iron is split off the rails, and then there is a mark showing where a wheel crossed, or as it is —

Technically

technically termed mounted the rail." In the absence of any other explanation, I should infer that this flattening of the side of the rail came from the grinding action of the wheels against the rail, owing to the rails being out of gauge at the point in question.

But whether or not the state of the joints or roadway was the more immediate cause of the accident, it would in all probability not have happened if the structure, or the roadway, or both of them had been in a state as efficient as under the circumstances was possible. And considering this, it does appear to me that undue blame has been attached to Mr. Robinson. Of course if the train were travelling at a less velocity it might not have left the line, notwithstanding the defect in the structure; but before it can be asserted that Mr. Robinson was sanctioning a speed inconsistent in his opinion with safety, it must be proved that he was acquainted with the circumstance that the Bridge was in such a state as to render it unsafe to travel at the speed at which the inspection train was going, and it must be remembered also that this train was very light, and it would be well known to Mr. Robinson that there would be less danger in running over a Bridge subject to vibration at a high velocity with a light train than there would be with a heavy one.

As to the best way of dealing

with the substructure and superstructure including the roadway of the Paupugnee, as well as of other Bridges I will state my views fully when I report generally on the Bridges on the Madras Railway to which my attention is now being directed and for which purpose Mr. Anderson is now at home.

Yours Truly
Edw. John Hawkshaw

Julian Byrne Esq.

(True copy)

Edw. John Hawkshaw
Agent and Manager

Edw. John Hawkshaw

No. 420

MADRAS RAILWAY.

AGENT AND MANAGERS OFFICE.

Madras, 21st April 1875.

From

A. B. Clavin Esq.
Agent and Manager of the M. R. Co.

To

Mr. C. H. M. & Co. Stewart, & Co.
Consulting Engineer for Railways.

SIR,

With reference to your letter of the 20th instant No 442, I have the honour to send you herewith a copy of the letter from Mr. Stoney dated the 25th of June 1874, to which allusion is made by the Board in their remarks upon the Pampore Bridge accident.

I have not yet replied to the Board upon this subject, but when I do so I will not fail to send you a copy of my report as requested.

I have the honour to be
Sir

Your most obedient Servant

A. B. Clavin
Agent & Manager.

~~RECEIVED~~

M. 8088/75
6

No. 626.

Madras Railway Company
1st Division at P. O. Post Office
Chennai 25th June 1874.

The ^{1st} Deputy Chief Engineer
Madras Railway.

My dear Sir,

I hereby enclose a copy of a letter
I have received from Mr. Hebbly for your
consideration, he is, I believe, very worthy
of leave whenever it can be granted to him, as
he is a most trustworthy and painstaking
Inspector.

I think that the present section
-master is quite unfit for the position he
holds, and should be dismissed immediately,
as the state of the Pampuneri Bridge shows
that he greatly neglected his duty, numbers
of dog bolts were turned the wrong way,
and that they had not been screwed up for
a long period is evident for 2 reasons.
1st When I set men to put them right
many of the nuts could not be turned
one way or other.

2^d The foot boards had in a great
many places tabs cut to allow the nuts to
be turned, now had they been regularly
attended to and screwed up, the necessary
cuts would have existed in the footway
and the nuts would not have been so tight
as to require their being cut off, to get the
bolts out.

I have told Mr. Hebbly that the

MADRAS RAILWAY.

From

The Agent and Manager.

To

The Consulting Engineer

for Railways.

Date 21st April 1875
No. 420.

Resolving a copy
of Mr. Hebbly's letter
asked for on the
subject of the
Pampuneri Bridge
Accident.

Section hairing was never either as I aug.
Cooley, or Lang hairing, & that it is hardly
likely he should know much of his work.

Mr. Kebby further informs me that
the late Inspector all owed the section hairing
to employ and dismiss hairiers and Lang
coolies as he liked, and the result of this is
that men have been made hairiers who are
not at all qualified for their posts.

I had six Langs at work on the
Bridge laying on Tuesday, and was sur-
prised at the ignorance of their work
shown by a large number of the men,
and hairiers, and had it not been for
Inspector Tavenham's exertions aided
by my own Plate laying hairier I should
have got on but slowly.

I had a strong gang of men and
carpenters under Mr. Kebby at work
screwing up dog bolts and packing sleepers
from Friday to Monday last, so as to
render them secure for the present.

Before however that Traffic is
again resumed over the Bridge, it would
be most desirable to have all packings
taken from under the sleepers, and the chairs
loosened by packings under them, some
bent rails now in removed, and the present
dog bolts replaced by the new must
& given over.

So far as I can form an opinion
the section hairing was grossly ignorant,
or negligent, if not both, and deserves

to be at once dismissed and if possible
prosecuted.

Yours very truly
for C. W. Stovel
Resident Engineer.

True Copy
for Riverford & Anderson
Chief Engineer.

True Copy

J. W. Nelson

for the Agent & Engineer

57 17

Done

No. 753

MADRAS RAILWAY.

AGENT AND MANAGERS OFFICE.

Madras; 16th July 1875.

From

Robert B. Clinis Esq.
Agent and Manager of the M.R.

To

Lieut Colonel J. W. Shaw Stewart R.E.
Consulting Engineer for Railways.

Sir,

With reference to paragraph
2 of my letter No 420 of the 21st April
last, I have the honour to forward
you herewith copy of a letter from the
Chief Engineer, in which he furnishes
the information called for by the Board
in paragraph 12 and 13 of their letter
No 5218, dated the 12th March 1875, with
regard to the Paupers Bridge.

No 505-
dated 14th
July 1875.

Enclosed
to you

I have the honour to be
Sir
Yours most obedt Servt
R. B. Clinis
Agent and Manager.

7 Enclosed
connected with
No 2250/75

~~No 4912/75~~

No 8288/75

151

843

508.19
 American Railway Company,
 Chief Engineer's Office
 Madison 14th July 1875.

The Hippo's design provided for
 a clear span between supports of 64'-
 while in the modified design the clear

span of the girder was increased to 66' and the piers were composed of each two screw pile bents, unconnected by either cross girders or bracing of any kind.

The bridge, I find, was constructed by Mr. J. M. H. Johnston, and Mr. H. L. Keat. But the latter gentleman may, I think, be absolved from all responsibility incurred, as his share in the work consisted in finishing up what was left undone by Mr. Johnston, and this amounted only to securing down two entire piers, and a couple of a third.

The abutments were built and secured out of the nineteen piers (with the exception of one pile) were secured into place by Mr. Johnston.

The accompanying tracing clearly illustrates the position in which Mr. Sumner intended that the screw piles should be placed, and the position into which they were actually secured by Mr. Johnston.

There can be no doubt that the deviation from the design contributed not a little towards the insecurity of the bridge.

I am unable to afford any explanation for this deviation, and can only assume that Mr. Johnston had in view the possibility of having to secure the piles down to much greater depths than shown on the original drawing, in which case the blades of the inner battering piles would foul the outer perpendicular piles.

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There are however no records in my office referring to this subject, with the exception of the following memorandum by Mr. Sumner, made to the Resident Engineer dated 3rd August 1865.

"You must observe the greatest possible care in securing the screw piles and adhere strictly to the drawings, or you will get into difficulties."

It is regarding the condition of the bridge on the day of the accident to the Inspection train - I cannot but think that the description given in Mr. Sumner's letter to Mr. B. of 25th June 1874 is greatly exaggerated. All the evidence points to the fact that the bridge was in a sound state. The Surveyor having deposed that he saw the day before on the 15th June, the day before the accident.

The section master stated that he was ordered by Inspector Latimer, who lost his life in the accident, to see that the bolts were properly secured down, and produced Latimer's written instructions regarding the bridge, and the bridge generally.

Latimer himself appears to have closely examined the bridge on the 13th and finally, and most important evidence of all, Colonel Shaw Stewart and Mr. Goring, who carefully examined the bridge immediately after the accident, testified to its good condition, but pointed out the eminently significant fact that

the clay bolts were were displaced on the
position of the bridge over which the inspection
train had run at a high speed, than over
the position north of the bridge, over which
the train had not run.

Mr. Robinson after the accident
went back over the bridge, and could find
nothing in the condition of the rails, or in
the situation of the bridge to account
for the accident. He found some clay
bolts loose but not so as to account for
the accident.

Mr. Hawley, the magistrate who
inquired into the case states in the 13th page
of his report to government.

"In being the last point of view, the
evidence is all in favour of the good condition
of both the permanent way and bridge. Even
Mr. Robinson is of this opinion."

My opinion is, and always has
been, that the cause of the accident is to
be found in the faulty design and construction
of the bridge, which rendered it an un-
satisfactory structure to be run over at so high
a rate of speed as was attained by the
Inspection train - and I think that
an examination of the cross section of
the various pile pieces is warranted. A
drawing of which is appended, will fully
support my opinion.

As regards the 13th page of the
magistrate's letter, I should imagine
that every one really interested in the

24
success of the Macbray Railway will share
with the Board in their regret and disappoint-
ment concerning the condition of so many
of the most important bridges on the line.
The subject is one that has caused me the
greatest anxiety for a long time past,
and anxiety from which the head of the
Engineering Staff cannot be relieved
until the important protective works now
proposed have been fully carried out.

The tone of the Board's remarks,
it appears to me, would lead to the in-
ference that some blame, for the existing
unsatisfactory state of things, is attributable
to the present Engineering Staff. In
justified to myself, and to the very efficient
body of Officers under my orders, I must
endeavour to correct such a misapprehension.
While it is quite true that in several
cases the speed of trains over bridges has been
reduced, there is no single instance in which
such reduction of speed has been in any
way called for in consequence of the bridges
on the permanent way not having been
maintained in efficient condition. The
special precautions imposed on the Macbray
Railway are the direct result of want of
confidence engendered by either faulty
design, or construction, and for neither
of these defects can any of the Engineers
now in the service be held responsible.

The Board have pointed out that
your special attention was called in their

letter 10-404, dated 5th December, to the importance of having the bridges quickly secured as any other part of our line, but they are probably unaware how much has been effected in this direction during the past few years.

In the beginning of the year 1888 I received my appointment as Chief Engineer, and although at first my attention was principally directed towards the winding up of their important contracts for the completion of the North West Private Railway, I soon became aware of the necessity for very carefully considering the condition of the line already open for public traffic. With this view I caused a systematic examination to be made of the foundations of all bridges of which I had the slightest suspicion, and I was able to point to the fact that since the middle of 1886, 9 bridges have been either partially, or wholly rebuilt, and no less than 67 bridges have been provided with efficient protection works.

When the difficulties and anxieties in connection with the opening up of foundations on a line open for traffic are taken into account, the above result cannot, I submit, be looked upon as other than a most creditable one. I am quite ready to admit that it was not until after the Calcutta and the Chingai Bridges

that attention was directed to the necessity for an examination of the large bridges on the line. Generally speaking so much thought is bestowed upon the design, and somewhat care on the construction of large and important bridges, that as a rule, they are looked upon as the safest, and most secure parts of a line of Railway. The very faulty nature of the foundations of the Chingai bridge however naturally directed attention to all the other large bridges built over sandy rivers, and the result of an examination of the foundations of several was such as to cause no little alarm, and to justify fully the recommendation of elaborate, and costly works of protection. That, when these works are completed, and the new bridges now in progress and contemplated are built, the line will be in a thoroughly safe condition as regards floods in the large rivers, I have no doubt whatever, but the completion of these works will be a matter of time, and will call for the exercise of the greatest care, and attention.

Yours faithfully
Benford Anderson
Chief Engineer

/ True Copy /
W. J. Brown
Chief Engineer

Wm

Encl. *W. H. W. H. W. H.*
No. 45

MADRAS RAILWAY.

AGENT AND MANAGER'S OFFICE.

Madras, 15th January 1876.

From

R. B. Elwin Esq.
Agent and Manager. M. R. Co.

To

Mr. Col. J. Hall Esq. & Mr. Stewart, R.E.
Consulting Engineer for Railways.

Sir,

Adverting to your letter of the 8th instant p. 22, I have the honour to enclose you a copy of Mr. Robinson's statement with regard to the accident that occurred at the Paupugan bridge on the 16th of June 1874.

In reply to the second paragraph of your letter I beg to quote as follows from the Acting Chief Engineer's letter p. 46 dated yesterday:-

The exact distance from the centre of Gundalah station house to the south abutment of the Paupugan bridge is 13 miles 56 chains and from the staff bungalow (the point from which the train started) to the south abutment of the bridge is 13 miles 40 chains. I do not remember the mileage of the small bridge referred to but Mr.

Letter to Mr. 47
14 Jan 1876
with Diagram

M. 8088/
4/75

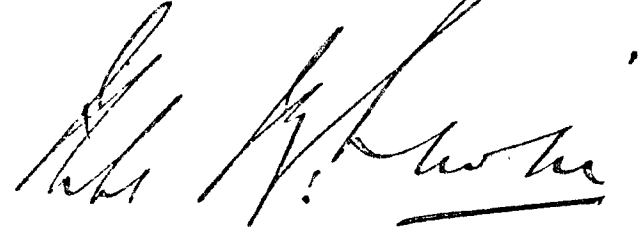
M. 4712/
2/75

H. M. W.

15 24
Haworth informs me that it is at 170
"Miles 14 Telegraph Post."

I have the honor to be,
Sir,

Your most obedient servant

H. M. Howe

Agent and attorney.

S.P.A. 25
67

C 47.

Madras Railway Company
Chief Engineer's Office
Madras 14th January 1876.

The Agent and Manager,

Dear Sir,

I have to acknowledge the receipt of your letter C 125 dated 10th January enclosing me a copy of the Board's letter C 563 dated 5th November and of Consulting Engineer's letter C 22 dated 8th instant.

The Board in their letter have taken up the question of the Pauperguee accident so ably that little remains to be said on the subject. I shall however refer to some of the points already touched upon, giving additional information which may assist the Government in forming their decision.

First with reference to the statements that the structural defects in the Pauperguee bridge were well known and rendered it unsafe at high rates of speed. On this point I believe Lieutenant Colonel Shaw Stewart to be misinformed. In paragraph 3 of his letter of the 23rd of June 1874 he says, "in the case of the bridge over the Chittavally the speed was limited to 8 miles an hour, and it has always been understood that a similar limit would have been fixed in the case of the Pauperguee Bridge had it not been that the Coimbatore station at which every train is timed to

C 564 - vide
G.O. of 1879 of
13 July 1874.

MADRAS RAILWAY.

From

The Agent and Manager.

To

The Consulting Engineer

for Railways.

Dated

15th January 1876

No. 46.

Forwarding a copy
of Mr. Robinson's
Statement with
regard to the accident
at the Pauperguee
Bridge.

M. 431/3/76

No. 16 "Feb 76 B/1289

stop is only about half a mile distant.
Now it should be at an under-
stand that although passenger trains
stop at this station it was not an account
of the bridge but an account of the passenger,
and because it is a convenient stopping
station. Special trains do not necessarily
stop there, and many doubt, as well as
seen by a reference to the special train
notices. Yet the train which would be most
likely to cross this bridge at high speed
would be a light special.
The speed over the Chittenden was
limited in 1871 owing to defects being
discovered in one of the trusses, and this
limit was continued after the defects were
remedied owing to others being discovered.
Had there been any reason to doubt the safety
of the Paupiquet Bridge, similar or
precautions would have been taken.
I have learned within the last
few days that in 1869 a proposal was
made to the Acting Chief Engineer to limit
the speed over both bridges but that he
declined to proceed to it.
I confess that even now I don't
think that a truss bridge is necessarily
unsuited to high rates of speed. With a
little extra bracing to the girders as bridges
similar to the Paupiquet might be made
perfectly safe.
Mr. Stevenson in his letter of 10th
dated 14th July 1875 says considerably at times

on the position in which the screw piles
were placed I do not see how they could
have been screwed in in any other way
without fouling, and I believe the alter-
ation referred to very slightly influenced
the stability of the bridge. Mr. Stoney's report
is also alluded to in this letter and I
can only say that Mr. Stoney has quite
satisfied me that his statement was not
exaggerated.
I have more than once crossed
the old bridge with full steam on and
have no doubt that other trains have been
driven at equal speed.
The only reason for saying in
my evidence that I considered it unfair
to run at high speed over the long bridge
was that it gives more work to the gangers
to keep up the road.
Had the structural defects been
well known, they would have been known
to the Driver, who would have been care-
ful to cross the bridge at a very moder-
ate speed. The inspection train is very
similar to any other special and I don't
think the Deputy Chief Engineer should
be expected to take an active part in
its control even though there is a brake
in the carriage.
I believe that the conclusion
that speed was the cause of this accident
was a good deal influenced by the fact
that I was accustomed to test the road

when an inspection by running at a high rate of speed. That this test is necessary I still believe. Our mail trains frequently run at 50 miles an hour over portions of the road when they have to make up time, and specials run at 60. Under these circumstances I do not think the Chief Engineer should be deterred from applying an equally high test to the road which should be kept in such a state of efficiency as to carry a train safely at any speed an engine can be driven.

I enclose a copy of this portion of the line for the information of Government.

Yours faithfully,
W. R. Robinson
Chief Engineer

True Copy
W. R. Robinson
Agent & Engineer

No. 16 Feb 16 B 189

M 431 / 2 / 16

Railway Department
Chicago, January 1890
No 25

Submitted for the consideration of Government, with reference to their memorandum No 22 dated the 7th instant

Mr. Robinson is of opinion that I was mistaken in stating that the structural defects of the Paupaugue bridge were well known, but I regret that I cannot withdraw that statement. In Mr. Robinson's letter, allusion is made to the fact that in 1869 a proposal was made to the Acting Chief Engineer to limit the speed; and upon two occasions, once before April 1870, and

paragraph 6.

and a second time in the early part
of 1874, I suggested that speed should
be limited, but was met upon both
occasions with the reply that any
such limit was unnecessary, as the
bridge was within so short a distance
of the Cannalpoie station, at which
every train was timed to stop.
Now from Mr. Robinson's letter it appears
that, although this was true of all
the trains entered in the time table,
special trains did not necessarily
stop at Cannalpoie. If I had known
that this was the case, I should
have pressed more strongly for a limit
of speed over the bridge; but I cannot

withdraw

withdraw the statement that its
structural defects, due to the character of
the piers, and the want of sufficient
rigidity in the girders, were well
known, and ought in my opinion to
have been known to an Officer holding
the position of Chief Engineer.
The conclusion arrived
at by the Magistrate who conducted
the inquiry, and afterwards endorsed
by the Government, was that the ac-
cident must be attributed to the ex-
cessive speed with which the in-
spection train was driven over the
bridge. The Board of Directors
question the correctness of that
conclusion

conclusion, and they are apparently of opinion that the accident was directly due to some defects in the permanent way. With regard to this point, it must be observed that the bridge was examined by Mr. Robinson immediately after the accident, and that he could see nothing in its condition to account for it. A few hours after the accident the bridge was most carefully inspected by Mr. Goring, the Acting Chief Engineer, and by myself, but nothing could be learnt by us regarding the cause of the accident. The gauge of the rails, from end to end of the bridge, was

29
was perfectly correct; and, without any apparent cause, the left wheels of the engine had clearly mounted the rail. It was remarked by Mr. Robinson, and also by Mr. Goring and myself, that a few of the dog-bolts which fasten the sleepers to the girders were loose, but this was not considered to have any bearing upon the accident; and after comparing the condition of these bolts at the two ends of the bridge, Mr. Goring and I arrived at the conclusion that they became loosened during the passage of the inspection train. Subsequently, Mr. Storey, the Engineer employed

employed in repairing the bridge, re-
ported that a great number of these
dog bolts were loose and had apparently
been neglected for long. The Directors
attach much importance to this fact,
and seem to be of opinion that it
is insufficiently accounts for the accident,
but it appears to me that the only
way in which the safety of a train
passing over the bridge could be
affected by the looseness of the
dog bolts would be by the gauge
becoming thereby slack, in which
case the engine might possibly
have fallen between the rails. —
What actually happened was that
the

30
the engine mounted the rail, and
mounted it at a point where the
gauge was perfect, as indeed it was
all over the bridge. I cannot
therefore see that the looseness of the
dog bolts, even admitting the accuracy
of Mr. Morey's report, in any way
accounts for the accident.
There appears to me
to be only one other possible explana-
tion of the accident, namely, that
it might have been caused by a
defect in the engine; but the
evidence taken at the Magisterial
inquiry is altogether opposed to
this supposition, which was also in
my

my opinion included by the traces of
the accident left upon the bridge, -
and by the position in which the
engine was found.

The exact distance
from Cuddapah to the Pausugue
bridge is stated in Mr. Robinson's
letter. The exact distance to the
small bridge where Mr. Robinson
felt a shock is not stated, but
its position is given at 140 miles
14 telegraph posts. As the
position of Cuddapah is 161 miles
9 telegraph posts, the distance of
the small bridge in question
may be stated as 9 miles 5

telegraph

telegraph posts, or about 9 miles 20 -
chains.

Maintenant
L. Hol. A. E.

Geno. Engineer for Railways

The Secretary to Government
Public Works Department
Fort Saint George.

Feb 16 B.N. 289
+ Plan with subscription
submitted

Gift accounts for
Refugees letter
opening the
refugee
account

Feb 16 B.N. 289
+ Plan with subscription
submitted

Gift accounts for
Refugees letter
opening the
refugee
account

Mr. 18 y 68 Sept
 1891 No 431
 Low Supply
 12 y 68
 12 y 68
 12 y 68

Proceeding of the Madras
Government. Public Works
Department. 4th August 1875
No. 59. Order Thereon, 1st August
1875, No. 2250.

against this decision
and the blame thereby
attributed to Mr. Robinson
(the Acting Deputy Chief
Engineer) the Directors
appealed - and forwarding
a letter of Sir John Hawkshaw
in reply to certain questions
addressed by them - The
Government "after full
consideration of the papers
above recorded" saw "no
reason to doubt the
correctness of the views stated
in their Order of the 14th
August, 1874, No., 2,270"

A further application is now made by letter from the Agent and Manager of the Madras Railway dated 4th of December 1875 requesting that "in accordance with the instructions of the Board" the Government will be pleased to reconsider their Resolution of the 17th August 1874 with the view to relieve Mr Robinson from the very serious charge implied therein.

in accordance with a letter of the Secretary of the Company. No. 563. Dated London 5th November 1875.

It is a serious matter to ask Government to reconsider a decision twice affirmed - and as I found from the Director's letter that they appeared to consider the structural defects in the Bridge "far from being well known" and that the defective fastening of dog bolts might have caused the accident

Letter No. 1216. 4th Dec 1875.
From R. B. Elvin Esq. Agent & Manager of the M. R. Co.
to Lt Colonel J. H. M. Shaw Stewart R.E.
Consulting Engineer for Railways

paragraph 4. Letter No. 563
London November 5th 1875.

para. No 4. Letter No 563. dated
London November 5th 1875

I thought I should better understand the case and evidence by visiting the spot. I did so on January 24th in company with Colonel Shaw Stewart Mr Elvin and Mr Robinson.

Part of the Bridge at the Northern end remains as it was at the time of the accident and I was therefore able to see its construction as it existed at the time of the accident.

I can attribute the accident to no other cause than an ^{high} speed with an engine whose design rendered it liable to oscillate more because it had outside cylinders over a Bridge liable to vibration from its design and unsafe from its construction.

The Bridge consisted of a series of longitudinal girders about 140 feet in length each girder spanning 2 openings.

vide evidence of Mr E. C. Boodler, Acting Locomotive Superintendent. Mr Boodler's Report No. 333. 14th August 1874.

The girders rest on circular cast iron caps each supported by 5 screw piles.

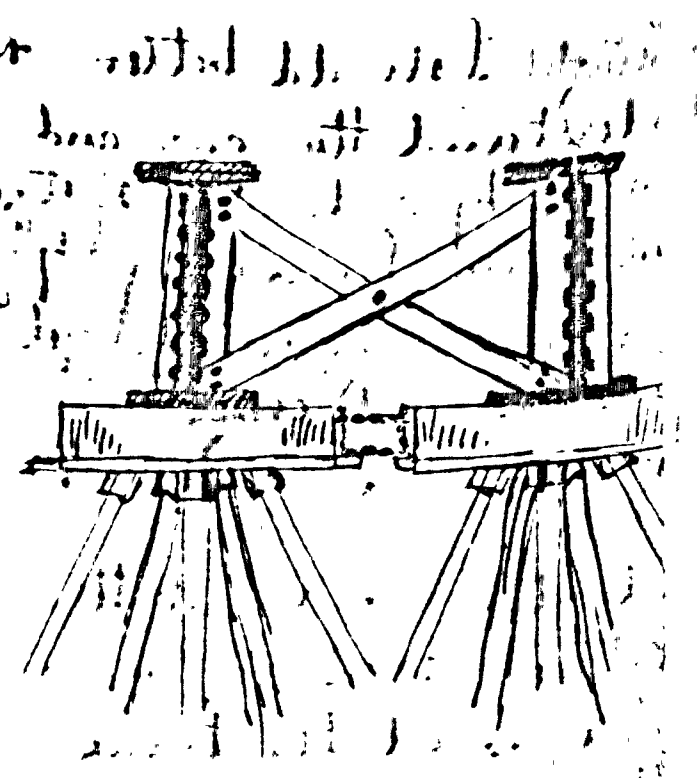
The girders were connected transversely by diagonal braces slightly riveted to the vertical angles or T irons, by 2 rivets in each end.

The circular caps of the piers on which the girders rested were intended to have been connected by cast iron struts - bolted to each -

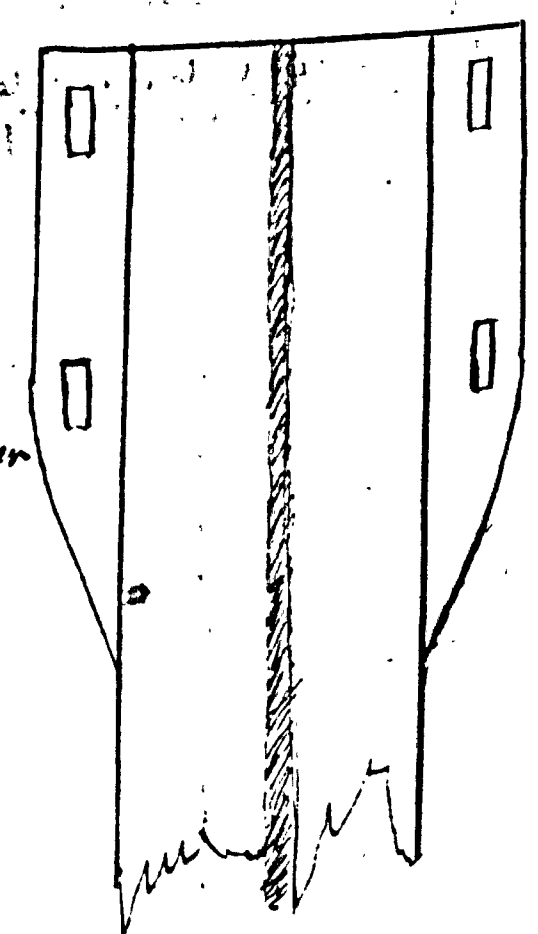
but which were never inserted. These are indicated by the dotted lines on sketch.

The girders were specified to have, and were duly constructed with, plates fitted for holding down bolts worked in to the lower flange of the girder. 6 for the centre of each girder and 4 at each end of each - i.e. 14 for each girder.

The bolts at the ends by securing adjoining ends of consecutive girders to one and the same casting would have kept the girders in line and



as pointed out by Mr. Handley leaving the adjacent piers wholly unconnected with each other -



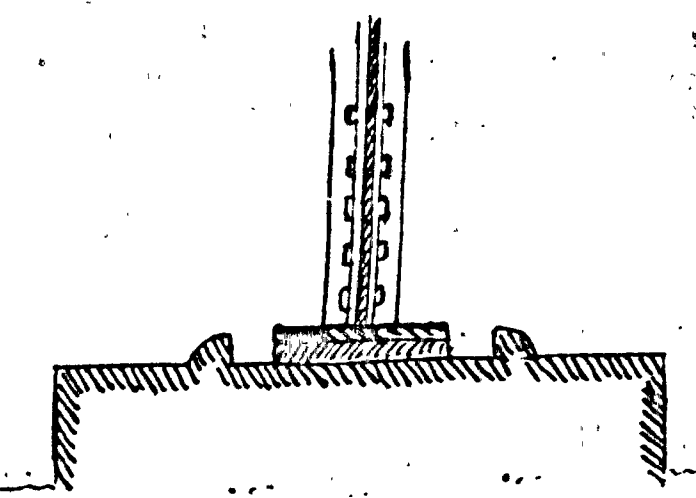
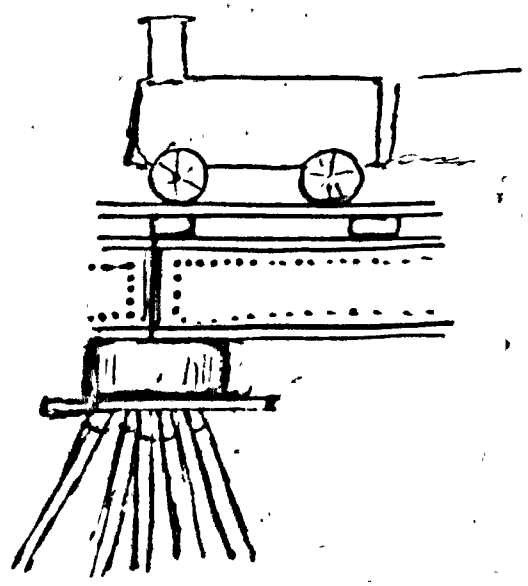
enabled them to resist lateral shocks.

The holding down bolts, the size and number of which with arrangements to meet expansion were duly shown in the original drawings to which I referred, were altogether omitted in construction.

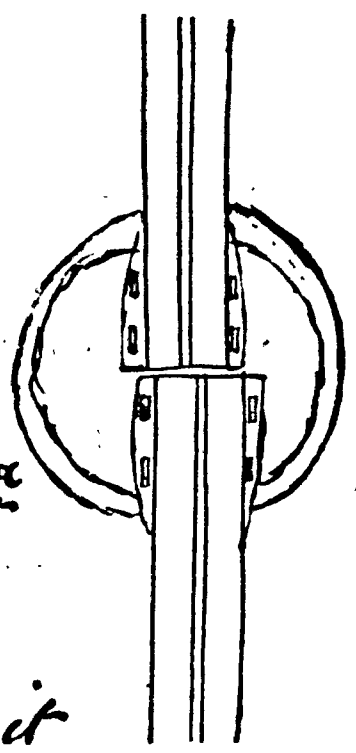
The result was that the Bridge instead of being formed of one continuous girder, became a mere series of disjointed and unsecured girder frames held in place solely by their own weight each except for its own weight free to be moved laterally or thrown out of line at its own centre by any casual shock.

Their own weight was not very considerable.

to resist the shock of any oscillation of a rolling weight of 36 ^{with} tons, the momentum due to a velocity of say 35 miles per hour, acting at the height of the rails, ~~leaving the point of contact~~ ^{leaving the point of contact} I should state that the cast iron caps on which the girders rested had small ledges - cast on which were intended ~~to confine~~ ^{to confine} the flanges of the girders - in fact to act as distance pieces - but as the girders did not fill the space between the rails they were of no use, to prevent slight movements.



With girders thus unsecured - it is obvious that any subsidence of a pier supporting an end of a girder ^{would slacken the support} ~~and~~ ^{and} would in effect leave the 2 girders resting on it balanced on the centres



ready to yield to any lateral thrust they might receive at either end.

And any lateral movement of the end of a girder must necessarily throw the girders and consequently the rails out of line -

See sketch on previous page.

A Bridge so constructed and so fastened could not be said to be safe for anything more than a slow speed.

Mr. Robinson's train ran ~~on the bridge~~ ^{towards the bridge} at a high speed which he ~~estimated~~ ^{estimated} to have been reduced to 35 miles per hour.

Was the state of the bridge such that it was left to the chance of the train?

He in the evidence admits he ~~was~~ ^{was} regulated the speed of the train that is to say the general rate of running. The speed is variously described - but if the distance 14 miles and

vide Proc^s of the Madras Govt. Public Works Department. No 333. 17th August 1874. Evidence of Mr. W. R. Robinson

with some other sketch

to the time 18 minutes be
an compared it is obvious
rol that the speed was high
and if the driver as stated,
shut off steam
on feeling a shock, and
at reduced speed at 9 miles
from Cuddapah to
45 miles per hour, travelling
the remaining 5 at that
speed, then the first 9 must
have been done at a
considerably much higher
speed.

The omission
of fastenings
was in
no way concealed
and was immediately
apparent to me when
I looked at the girder
in situ.

It is obvious that
Mr. Robinson is
in no way responsible
for the faults or any omissions or deviations from
the design in the construction
of the bridge, ~~as far as the~~
~~construction of the~~

~~I cannot advise that~~
~~anyone holding the position~~
~~of Acting Inspector of~~
~~Engines and in respect~~
~~of capacity during the~~
~~time inspected the line~~
~~or of those who were if~~
~~did not know the defect~~
~~continued and operating~~
~~the bridge one of the~~
~~important causes of the~~
~~accident was the~~
~~excessive speed of~~
~~the train and the~~
~~failure of~~
~~the girder~~
~~and the~~
~~bridge of similar~~
~~construction~~
~~to be made~~
~~of wood~~
~~and~~
~~of steel~~

I cannot advise any
modification of the opinion
formerly expressed by the
Government of Madras
that the accident on
"the Pampunne Bridge"
"was attributable chiefly,
"if not solely, to the excessive
"speed with which the
"inspection train was
"driven over the bridge;
"for which the Acting

to "Deputy Chief Engineer,
a "Mr. Robinson, who has
to "gone home for his health,
to "is responsible, as he has
to "admitted that he
a "regulated the speed"

as I am clearly of opinion
that the accident was
due to the speed at which
the train was driven on
to a Bridge of a
construction rendering
it unsafe for any but
a very slow speed.

The circumstances attending
the accident are thus
described.

Mr. Robinson says "I
observed a few oscillations
before the accident occurred.
They were so marked
that I jumped up."

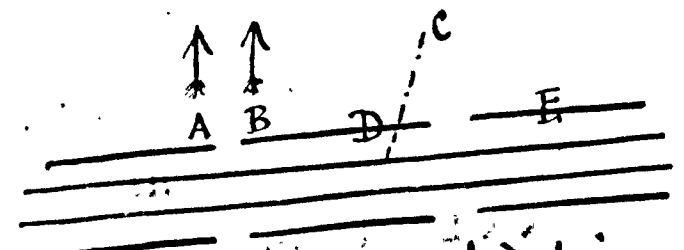
"I think I noticed the
swaying some 12 or
15 yds from the place
where she left the rails"

Vide Pavinging. Minutes. York
Public Works Depart. No. 333
17th August 1874. Evidence
W. W. R. Robinson

The engine when she did
leave the rails struck the
end of the next girder.

This all appears to
indicate that the whole
cause arose within the
length of 140 feet, i.e.
on one girder.

Now these girders being
unsecured as I have described
if anything ~~was~~ caused
either the end of the last
previous one or the end of
the one on which the
accident occurred to be
displaced laterally a very
small amount.



rails would be pressed out
of line - as shown in an
exaggerated form in this
figure - and thus cause
the engine wheels, with the
high momentum, to grind
the rail at C - with
severe pressure and

* as at A B in the direction
of the arrows.
the engine to oscillate and
due to a velocity of 35 miles
per hour - probably at the moment
when the oscillation of the engine
combined to momentarily elevate the wheel from its proper
contact with the rails -

the engine would be thus
produced as actually
described in evidence - the
diagonal bracing would

to be torn from their slight
a fastenings the girder D
would fall outwards
letting down the road -
to and the ends of girder
to E would be struck by
the engine.
It is not improbable that
this was the actual
mode in which the accident
occurred -

The lateral oscillation of
an engine of the description
of the engine which was
running the train is
considerable, and on a
girder balanced as there
were and at an high
speed might easily give
a lateral shock to the end
of a girder.

The dogbolts referred to
could not affect the gauge
of the line. However loose,
as the rails were secured
to the sleepers irrespective of the
bolts which were only
intended to hold the sleepers
down to the girders - the
construction of the dogbolts
however tightly ~~drawn~~
screwed up could not
have given any material

13
38 93
stiffness or rigidity to the
girders.

It is right I should add
the probable cause of the
non application of the
intended holding down bolts

The girders were intended
to have been erected
on masonry piers - and
the bolts are shown ^{on the drawings} as seated
to stone blocks -

The design of the bridge
was subsequently changed
from one on screw pile
piers - and in the change
of design the provision of
the bolts (which themselves
required an altered form
to suit the ^{in castings just as if stone} ~~was~~ ^{was} probably ~~omitted~~ ^{omitted} over the

~~Leitch & Co.~~

B.C. Jan 31/76

Notes on Pampore
Bridge accidents

P. H. Sept. 1875
Proceedings of Madras Govt.
under date 31st December, 1875.

From Consulting Engineer
for Ryots.

Read the following
(H.L. No. 662 d/20 Dec/75)

The most noble the
Governor in Council
is unable to modify
the opinion expressed
in G.O. No. 2270 of
17th August, 1874, formed
after deliberate con-
sideration of all the
evidence therein recorded,
and which is opposed
to the

That this report is
in accordance with
the instructions in regard to
the subject. The question of
the proposed work is
assisted by the fact that
the proposed work is
a correct one and that
the fact have not been

to the assumption that
 the inspection train
 was not going at
 a greater speed
 than 35 miles an
 hour, in which the
 Directors of the
 Madras Railway
 apparently base
 their justification
 of Mr Robinson

Wm

Is it like to be
 the great decision for
 Cuddalore with the
 same of accident -
 from Cuddalore to
 the small bridge
 between the full
 stock - apparently from
 there straight - & the
 bridge is full of the 17th

Ci. 3-1-76-

I have had my attention
 drawn to this case of
 Is it like to be
 and refused to the
 that such an application
 made to the
 Submit any statement
 to the

Public Works Dept.

Letter from the Consulting Engineer
 for Railways No 25 dated 18th January 1876.

For Orders

Circulated for orders

Mr. Fraser who places the
 cause of the accident in the
 cleared light - and seems to
 be only to appraise Mr. R.
 responsibility. He wonders
 what these defects were
 Mr. Fraser brought & light - December 1875.
 Previous orders must
 be affirmed - and Mr. R.
 - on left - in the hands of his
 Director

Wm. Fraser M.A. M.P.

But I certainly
 think that Col. Chaw
 of the asked how
 obvious these parts of the
 structure which were essential
 to its holding together were
 allowed of his Dept. to be
 omitted

Secretary to Government

Note
 The records of the
 the Government, which I hope
 he will allow to take the
 form of a Minute, hoping
 one in thinking that the
 Resolution of this Govt
 as to the cause of the accident
 was substantiated, correct
 & it should again be affirmed
 10/2/76 MR

10/2
 I am sure that
 the records of the
 Government will
 be found to be

Proceedings of
Madras Govt
under date

(H.L. no. 425)

To the Right Hon the Secretary
of State

My Lord Marquis

We have
the honour herewith
to forward a copy
of proceedings of
the Madras Government
no 425, dated 16 February 1876
in which is recorded
a Minute by his
Grace the President
in Council upon
the Panpugnee accident,
10 June, 1874, and to
request

W

Copy of the
proceedings of the
Madras Government
no 425, dated 16 Feb 1876
in which is recorded
a Minute by his
Grace the President
in Council upon
the Panpugnee accident,
10 June, 1874, and to
request

C No 8088
431

Madras Govt

See within
W

No. 16 Feb 76 B.N. 189

that your Lordship
will transmit the papers
to the Directors of
the Madras Railway
Company.

G.M.W.

His Grace the Governor.
You: R. & Ellis C. H.

Forwarding copy of Pro.
in which is recorded the
Minute by H. Grace the
President in Council on
the Pampunee bridge accident
of 16th June /74, and requesting
that the papers on the subject
may be transmitted to the
Directors Madras Ry. Com.

289-290

No 425 of 16th July 1876. P.
Letters from the Consulting
Engineer for Railways
No. 662 of 20th Dec 1875
— 25 — 18th Jan 1876
Minute by H. Grace the
President of the Council.

Ref.

The question was
of the [unclear] [unclear]

M.W.

M.P.

Ordered that the
Minute of the
Board the Presi-
dent [unclear]
ing the Council
in the [unclear]
ready prepared
in G.O. No. 2270 of
17th Aug 1874, &
reaffirmed in G.O.
No. 2250 of 1st Aug
1875, be com-
mended to the
Directors of the
Madras Railway
Company through
the Secretary of
State for India -
The attention.

1876
 GOVT. of 1876 Madras.
 PUBLIC WORKS.

To
 The Comy Engineer
 for Railways

Dated

Issued

Recd

Encl.

G. O., 1st July 1876, No.

Nos. 289 290

Incident at the Puzos
 Bridge, Madras Railway
 Ordered that the
 J. L. the Governor in the
 the Communication
 the Director of the
 the Railway Company, the
 the City of Madras.

Section called to the
 effects in the structure
 the bridge.