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MADRAS RECORD OFFICE.

Government of Madras.

Public works DEPARTMENT.

G.O. No. 2710

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*Proceedings of the Madras Government, Public Works Department,
12th November 1870.*

No. 217. Read the following letter from the Acting Consulting Engineer for Railways, to the Secretary to Government, Public Works Department, Fort Saint George; dated Madras, 2nd November 1870, No. 429:—

I HAVE the honour to submit reports from the Agent and Manager and Chief Engineer of the Madras Railway, relating to the fatal disaster on the North-West line at the Cheyair river on the morning of the 21st ultimo.

(Enclosures 2.)

From Agent, No. 597, dated 26th October 1870.
From Chief Engineer, No. 561, dated 28th October 1870.

2. The 7-15 p.m. train from Madras consisted of engine and tender, two high-sided goods wagons, guard's brake van, composite carriage, second class mail carriage, and passenger luggage brake van, coupled in that order.

The driver having been warned that the river was in high flood, proceeded over the bridge at the rate of only about three miles an hour, exchanging signals by lantern with the guard in the rear brake van. After this, what occurred is left to conjecture, as no coherent story has been obtained from the survivors; but the engine was found to be lying at the foot of the 18th pier, with the goods brake van and two passengers' carriages close by; so that the whole train passed 17 piers, and fell into the river at the 17th opening from the south bank.

The Reverend Mr. and Mrs. Seymour were in the front compartment of the composite carriage, a coupé; and a native gentleman, Streenivasa Charriar, was in the centre first-class compartment; these three were the only passengers lost; but the driver, three firemen, and the under-guard who was in the goods brake van, have also been killed, so that altogether eight lives have been lost.

3. The Cheyair bridge is divided into two parts: from the abutment on the right bank, there are twenty-two openings of 70 feet each from centre to centre, then an embankment 464 feet in length over the high bed of the river or island; and again sixteen more openings to reach the left bank. The abutments and piers are all of masonry, and continuous wrought-iron girders of 140 feet are each laid over two openings.

I proceeded to the spot by the next morning's train, after the accident happened. The flood had then fallen about 4 to 5 feet; the three piers nearest to the island abutment, Nos. 19 to 21, were not visible at all; the 18th and 17th presented a broken appearance, sunk and thrown over on one side, the girders still rested on the 15th and 16th piers; but these piers are both cut in half transversely from the sills of the girders. The 16th pier has plainly sunk at the down stream end, and the 15th seems to have been crushed down, from the shock of the bridge giving way. The body of the rear brake van was swept away by the flood and found two miles down the river; the composite carriage was lying on its right side, on the top of the goods brake van and close to the engine; the second-class mail carriage was standing upright, with its front to the stream; while the two goods wagons had disappeared altogether.

The front of the first-class coupé was all open, as if stove in by a headlong fall; and the appearance of Mr. Seymour's body when found gives the idea, that he was killed at once, not drowned, after being carried away in the water. The survivors had a marvellous escape, for after the engine went down off the bridge, there was a considerable interval, during which they were able to crawl along the

rails, and over the sleepers, which are laid 2 feet or so apart, at any rate as far back as the 16th pier; for beyond that the girders are twisted over into the bed of the river, and those who escaped say they were never off the ordinary level of the rails. I believe this to be the case; and that judging from the position the carriages were in, they must have passed over the 17th pier before that subsided so far as to cause the overthrow of the girders.

4. There is no evidence at all whether the three last piers gave way before the arrival of the train, or at the moment when the engine came upon the last girder. But it seems to me most probable, that the immediate cause of the fall of the train was the displacement of the 18th pier, and the loosening of the girder, the end of which rested on that pier.

It is thus not known whether loss of life might have been saved if the bridge had been inspected during the night; or if a watchman going across, even half an hour before the fatal event, would have detected any signs of danger; but it was not the duty of any one to go over the bridge in the night time; the previous train had gone on in safety, and the flood is supposed to have reached its height just about the time the ill-fated train was due, between 4 and 5 in the morning.

5. The flood, though higher than has been known for some years, does not exceed that which was reckoned on when the bridge was designed. I measured the high-water mark, 8 feet 7 inches below the top of the piers; and this level is about 2 feet below the flood level on the plan. There has, however, been one great fault in the construction of the bridge, in dividing the water-way into two parts, by a long embankment: the effect of this obstruction has been, that for the greater part of its length the water that would have flowed on through the openings of a bridge was diverted into the already deep channel of the river, and a strong current thrown obliquely against the piers. The bed of the river consists of coarse loose sand, and the force of the current made a deep scour through the five or six openings next to the island embankment. The foundations consequently were undermined, and the piers thrown over.

6. The Acting Chief Engineer, in attributing prime cause of the mischief to the scour, considers that if the pier foundations and character of the masonry were such as they ought to have been, the work would not have failed. The fracture of the piers, as hitherto seen, does not exhibit by any means good work; but a close examination of the foundations is to be made when the water goes down, and a further report will then be sent in.

The bridge, according to the original design, was to have had forty openings in one stretch; but this plan was altered, and the sanction of Government accorded to the revised estimate in G. O. No. 751, dated the 6th November 1861.

The Chief Engineer explains the nature of the foundations of the piers, in quoting from a letter of Mr. Johnston, the Engineer, who had charge of the work; and I find the following passage in Mr. Heppel's letter to the Board of Directors for the half year ending 31st December 1860:—"2,515 cubic yards of masonry have now been completed, comprising the south abutment and seven following piers, and the 38th and 39th piers. The two last are built on a timber platform, constructed at a depth of 11 feet 6 inches below the river bed on the sand. I have no doubt that in the situation of these piers this depth will be found sufficient to place the foundations beyond the reach of scour; but for

situations nearer the main channel of the river, 14 feet should be given to make them safe, and I have requested Mr. Johnston to carry all sand foundations to this depth in future, being assured by him that there will be no difficulty in doing so." Now from piers sixteen to nineteen the level of the deep river bed, as per plan, is about 11 feet from the girder, and if finally a depth of 14 feet was determined on, as the minimum, safe depth below the river bed, the bottom of the foundations would be 25 feet below the girder. Mr. Going says, in paragraph 11, that the work of sinking foundations on blocks proposed by the Chief Engineer, and sanctioned by the Government Consulting Engineer, was not carried out; but that a different method, that is, building on a framework of timber, was substituted. The plan, according to the latest sanction of Government, shows the foundations to be 30 feet below the girder, and it would be inferred from the above that the foundations were really 5 feet less in depth than those shown on the sanctioned plan.

If this were really the case, the scour in the channel on the 21st October would have reached very near the bottom of the foundations. The water is said to have been 14 or 15 feet deep, and adding $8\frac{1}{2}$ feet between the surface of the water and the girder, the deep bed of the channel would have been $23\frac{1}{2}$ feet from the girder, and the platform level only $1\frac{1}{2}$ feet further down in the sand.

On the other hand, however, Mr. Going says, in paragraph 13, that the foundations marked on the revised plan in 1865, or some time after the completion of the bridge, averaged a little over 20 feet, so that by this account the full depth of 30 feet from the girder was attained.

7. The Acting Chief Engineer proposes to repair the gap in the bridge, so as to render it available for temporary use, and to investigate carefully how far the remaining piers are to be trusted; but is apprehensive that a totally new bridge will be necessary. Meanwhile, a temporary way is in rapid construction down each bank, so that the engine will probably run across the bed of the river before the end of this month, without any use being made of either portion of the bridge.

8. The Mails were delayed for two days from the 21st; there was no boat to be found in the river, and no means of establishing communication till the morning of the 23rd, when a masula boat having been brought up from Madras, a hawser was made fast cross the current, and since then the post bags have been regularly conveyed across each day.

From the Agent and Manager of the Madras Railway Company, to the Acting Consulting Engineer for Railways, dated Madras, 26th October 1870, No. 597.

ADVERTING to my letter, No. 591, dated the 21st instant, I have the honour to report for the information of Government such further particulars as I have been able to ascertain respecting the deplorable accident which occurred at the Cheyair bridge on Friday morning last.

2. The Chief Engineer and the Traffic Manager are still at Rajampett, and I have not received from them any official Report upon the subject but I have personally been able to glean the following information.

3. The train to which the accident occurred left Madras at 7-15 P.M., on Thursday evening last, the 20th instant. It arrived safely at the Rajampett station, consisting of an engine and tender, two goods waggons, an under-guard's brake van, a composite passenger carriage, a Post Office carriage with second-class compartment, and the head guard's brake van, six vehicles in

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all. Travelling in the train were three first-class and ten second-class passengers, with the usual complement of Railway servants, viz., an engine driver (East Indian), three firemen (Natives), and two guards (one a European, the other an East Indian).

4. I am informed by Guard McCoy, who was saved, that at Rajampett station the driver was warned that the river was in flood, and that he accordingly proceeded most cautiously, the pace on approaching the bridge and while on it not exceeding from two to four miles per hour.

5. It will be as well here to inform the Government that the bridge over the Cheyair river is between the Rajampett and Nundalore stations, and is composed of two parts, divided by an embankment of 464 feet. The first or East part consists of twenty-two openings, and the second or West part of sixteen openings. The piers are of masonry, and the span of the openings from centre to centre is 70 feet. The superstructure is of wrought-iron girders four feet deep, similar to those used on other portions of the line.

6. The train safely passed over fourteen of the piers, and the head guard from his brake van saw the driver on the side of his engine waving his lantern as if to ascertain the state of the road and the height of the water in the river. Suddenly the light disappeared, and McCoy states that a great crash was heard, when he immediately put on his brake, and remembers nothing more beyond that he and some of the others who had got out of the train crept along the rails to the Rajampett side of the bridge.

7. The number of persons who escaped is eleven, and they in all probability owe their safety to the caution of the engine driver, for it appears most improbable that if the speed had been greater any one could have been saved.

8. The number unfortunately lost is eight, viz., three passengers, the Rev. Mr. and Mrs. Seymour and Mr. Streenevassa Charry, and five servants of the Company, viz., Engine Driver Erskin, three Native firemen, and under-guard Breden. The Rev. A. H. Seymour's name appears in the Gazette of the 11th instant as having been appointed Chaplain of Bolaram and Chudderghaut, and Mr. Streenevassa Charry was a Pleader of the High Court.

9. Yesterday I unfortunately received erroneous information that the bodies of Mr. and Mrs. Seymour had been found, but by a telegram received this morning, I learn that the two bodies which have been recovered are those of the Rev. Mr. Seymour and Mr. Streenevassa Charry, and that Mrs. Seymour's has not yet been found.

10. The Chief Engineer and the Traffic Manager are at the scene of the accident making arrangements for the transfer of passengers, parcels, and mails from one side of the break to the other, and with the apparatus lately used at the Pier, which has been obligingly lent to us by Mr. Crowther, the Acting Master Attendant, they have, I am happy to say, effected such communication as enabled us to convey across the river the Overland mail which left Madras at 6 A.M. yesterday and reached Ghooty at 10 P.M. last night.

11. In consequence of this accident and the uncertain state of the weather at this season of the year, I have deemed it prudent to discontinue for the present the running of night trains on the North West Line, a course which I feel satisfied the Government will approve.

12. As I imagine that the Government will consider it advisable to nominate a Commission to inquire into the cause of the accident, I will refrain from offering any opinion on the subject.

13. The Locomotive Superintendent and the Traffic Manager have been requested to submit Accident Reports in the usual form relating to the engine driver, three firemen, and guard.

14. I have arranged to leave Madras for Rajampett by the 6 A.M. train on Friday, and I shall be glad if you can make it convenient to accompany me.

15. I need hardly say that I am most desirous that the fullest investigation shall be made into the cause of this calamity, and that it has occasioned all the Officers of the Company the deepest distress and anxiety.

From the Acting Chief Engineer, Madras Railway Company, to the Agent and Manager, Madras Railway Company, dated Madras, 28th October 1870, No. 561.

As you were present at the scene of the late deplorable accident to the North West night train of the 20th instant from Madras, it will be unnecessary for me to recapitulate its sad details.

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2. You are aware that the train had passed in safety over fourteen of the southern openings of the Cheyair bridge, and was precipitated into the river in consequence of the failure of the seven succeeding piers. To what extent the destruction of these piers had advanced by the time the train had arrived at the 15th opening is not known, but when morning appeared they were found to be all washed away, with the exception of portions of the 15th, 16th, and 17th piers, and the iron girders which had been supported by them were precipitated into the river, and together with the engine and entire train of six vehicles imbedded deep in the sand and almost wholly covered by water.

3. The train must have arrived on the bridge between 3 and 4 o'clock A.M. of the 21st. It was an intensely dark night and raining heavily.

4. The engine was evidently proceeding at the slowest possible speed, to judge from the position in which it and the vehicles which composed the train are lying, as well as from the fact of the escape of eleven out of the nineteen persons who travelled with it.

5. From the evidence I can collect it would appear that the river was not in very heavy flood at nightfall of the 20th, but that it began to rise rapidly after sunset. The maximum rise was to within about eight feet six inches below the level of the bottom of the girders. No suspicion appears to have ever been entertained as to the safety of the bridge.

6. In considering the causes of its failure it will be necessary to give a history of the progress of its construction from the commencement.

7. The original design for Cheyair bridge contemplated a structure of forty wrought-iron girder openings of each 64 feet clear span, supported on masonry piers founded on brick wells, except in the case of a few of the most southerly ones, where a rock foundation was available. The wells were designed to be carried down to a minimum depth of 24 feet below the bed of the river. This design was sanctioned by Government on the 5th August 1859, and its construction under the immediate superintendence of Mr. Edward Johnston was commenced in February 1860.

8. The Chief Engineer's (Mr. Heppel's) report for half-year ending 31st December 1859 brings forward a proposition for abandoning the brick wells and sinking the bridge foundations on "blocks," a system which proved successful in the case of two of the Naggery bridge piers. Captain C. C. Johnston, Consulting Engineer in his letter No. 315 of 19th May 1860, communicated his approval of this proposition.

9. Mr. E. Johnston in his report, dated 4th January 1861, when alluding to the 38th and 39th piers of the Cheyair, writes as follows, viz.:—

"Owing to the depth of sand at these last points being 26 feet from the bed of the river to a sound bottom, I found it necessary to construct the masonry on timber frames or platforms, and by which means I was enabled to get in these foundations in the most easy, economical, and satisfactory manner possible to a depth of 11 feet 6 inches below the bed of the river by the following method: "In the first place, the dam is constructed and pumped out, in exactly the same manner that we did at the Palar, and when arriving at the proper depth, the bottom is carefully levelled throughout.

"The main beams having been previously bolted, are then lowered singly into the dam, and placed on wedges; the cross pieces are then bolted to them, and finally, the planking composed of selected sleepers are spiked down, the wedges are then removed and the platform takes its place in the sand; this operation only occupies about three hours; the masons commence at once, and in about thirty-six hours afterwards, the masonry having been raised above the level to which the water at this season reaches, the pumps are removed."

10. Commenting on the foregoing description of the mode of laying the foundations, Mr. Heppel writes as follows in his letter of January 15th, 1861:—

"I have been reading your report on the Cheyair bridge. I fear that 11 feet 6 inches below the bed is not deep enough to be safe from scour, or at least the chance of it. You will find that on the drawing the bottoms of the wells are shown 25 feet below the bed. This is probably more than is necessary, but I have always considered about 14 feet the minimum safe limit, and I think every effort ought to be made to get down to that depth. We know that this may be done by building on a curb, leaving 4 feet square vertical wells or openings through the body of the masonry, and sinking the whole together by excavating the sand at the bottom of the wells.

Some of the pier foundations of the Naggery bridge were got in in this way, and I was under the impression that it was the way you were working.

"There can of course be no possible objection to your plan so long as we get out of the possible reach of scour, but unless you can ensure 14 feet for the future, I shall at least feel it necessary to go in for sanction to alter the plan. This, however, I of course could not do unless I were in possession of what should appear to me satisfactory grounds for supporting the proposal."

11. It would appear from this correspondence that the mode of sinking the foundations on "blocks" which had been proposed by the Chief Engineer and sanctioned by the Government Consulting Engineer was not carried out in the actual execution of the work, but that a different method was substituted, by which a framework of timber was placed at the bottom of an excavation made at the site of each pier, and that the masonry was built upon this. This method appears to have received the sanction of the Chief Engineer on the condition that a minimum depth of 14 feet was ensured.

12. Mr. Johnston's letter of 20th January 1861 states that piers Nos. 1 to 11 inclusive are constructed on solid rock, varying in depth from nine to 14 feet. He again states in his Report of 4th January 1861 that piers Nos. 38 and 39 are founded on timber platforms at a depth of 11 feet 6 inches below bed of river.

13. With regard to the remaining twenty-seven piers, viz., from No. 11 to No. 38, from the revised plan of the bridge which received Government sanction on the 8th November 1861, and which was sent to Mr. Johnston on 18th February 1865 at the request of the then Consulting Engineer (Lieutenant-Colonel P. P. L. O'Connell), in order that the foundations should be marked on it, it appears that the depths at which these twenty-seven piers were founded varied from 18 to 26 feet, and averaged a little over 20 feet. Mr. Johnston's letter returning the plan is dated 8th March 1865, and runs thus:—

"I return you by this day's Tappal the drawing of the Cheyair bridge, having shown on it the foundations adopted, as accurately as the scale will admit of, as requested in your note of the 18th ultimo, No. 69." The only other evidence I can find bearing on the nature of the foundations is embodied in a letter from Mr. Johnston to the Chief Engineer (Mr. Ross), in reply to an inquiry from the latter as to the character of these foundations. Mr. Johnston's reply is dated 6th May 1861, and runs thus:—"I am perfectly satisfied that all the foundations of the Cheyair bridge are built in the most satisfactory manner possible, and of course with mortar, a specimen of which I beg leave to send for your inspection."

14. The first mention I find in the correspondence in reference to the altered design whereby some of the central openings in the bridge as originally sanctioned were superseded by an embankment is contained in Mr. Johnston's letter of 20th January 1861, in which he states as follows, viz.:—"A bank of sand rises about 5 feet above the natural bed of the river, and continues nearly level to within 300 feet of the north abutment, when it begins to fall, until it arrives nearly on the same level with the south channel. Floods very rarely cover this bank, and never beyond a depth of two feet, and from the flat nature of its surface, would, in my opinion, have a tendency to deposit sand, rather than create a scour; nearly all its surface is jotted over here and there with small tufts of rank grass, and a small strong shrub, which, I think, argues in favour of floods having no effect upon it."

15. It would appear that subsequent to this the Chief Engineer and Consulting Engineer to Government visited the bridge, and agreed to substitute an embankment for eight of the openings on the so-called Island, and to lengthen the bridge at its northern end by an equal number of openings. For I find Mr. Johnston writing on 8th March 1861 as follows, viz.:—"I beg to report having forwarded to you, by this day's Tappal, a plan showing the proposed alterations of the Cheyair bridge for sanction. In drawing the plan I considered that it would be a more desirable arrangement to do away with ten openings on the sandbank between piers 24 to 34 instead of eight, and replace them in the low part of the section on the north end by eight openings instead of six, as proposed by you and Captain Johnston when last on the spot."

16. The revised plan and estimate introducing a central bank of 464 feet in length were sanctioned by Government on the 6th November 1861.

17. The section of the river at the crossing of the Railway is peculiar. Its banks are not above 6 feet 6 inches higher than the lowest part of its bed, and they fall away to the level of the bed at a distance of a quarter of a mile inland on each side. High floods must, therefore, inundate the country on both sides. This is, however, prevented on the south side by a dam, which has been constructed by the villagers. The sandbank in the river which divides the bridge into two portions is within a foot of the level of the river banks.

18. There can be no question but that in times when the water of the river would rise to a sufficient height to overflow this sandbank and to impinge against the pitched slopes of the embankment which is placed on it (as happened in the late flood), a current would be induced to set across the stream and to cause a scour. This scour did actually take place, as I myself can testify, and I regard this as the prime cause of the mischief which was done, although I do not think that, if the pier foundations and the character of the masonry were such as they ought to have been, they would have failed. However this is a matter for more careful investigation, and it is premature to comment on it at present.

19. Immediately on a telegram of the accident having reached Madras, Mr. Hardinge (in the absence of Mr. Carter, who was inspecting on the West coast) proceeded to the spot, and I have pleasure in bringing to your notice the promptness and decision with which he acted in taking such measures as appeared best for restoring temporary communication. A road is being now laid from each side to connect across the bed of the river, so as to be available for the through passage of trains by such time as the subsidence of the water will permit.

20. I have taken steps for the removal of the wreck of the train and that portion of the bridge which has fallen. After this has been done, I propose making arrangements to repair the gap in the bridge so as to render it at least available for temporary use. How far the remaining piers can be trusted for the future is still a question to be carefully investigated. I am myself apprehensive that a totally new structure will be necessary, and for the following reasons:—

1st.—The principle on which the foundations of the present bridge are laid is in my opinion most objectionable.

2nd.—There appears reason to believe that the character of the masonry is not sufficiently good for the piers of such a bridge.

3rd.—The central embankment ought not to be allowed to enter into the scheme of reconstruction.

21. Meantime, however, a close examination of foundations will be made, and I am preparing to have careful borings taken across the bed of the river.

21. One thing, at all events, is quite certain, that it will be necessary to replace the four sets of wrought-iron girders (for the eight openings which have been destroyed), and I beg you will request the Board of Directors to supply them with the least possible delay. An indent will be immediately sent forward.

23. I trust to be able to report within a few days that through communication by engine has been restored by means of the temporary road across bed of river. Meanwhile, as you are aware, Mr. Church is on the ground, and has, by skilful management, with only two days' interruption, succeeded in passing mails and passengers over the break.

No. 218. ORDER THEREON, 12th November 1870, No. 2,710.

RAILWAY, No. 29.

From the papers which the Consulting Engineer for Railways now submits in continuation of his previous report on

the accident that occurred to the night train from Arconum to Cuddapah on the morning of Friday the 21st ultimo, from the failure of the bridge across the Cheyaur river on the North-West line, and by which the lamentable loss of the lives of three first-class passengers and of five Railway servants was caused, it does not appear that any reliable information is likely to be obtained of the exact time at which the

first portion of the bridge fell, or in what precise manner the train was precipitated into the stream. The magisterial inquiry, of which the report will be separately recorded, has not thrown any light upon the matter, nor has it shown whether the watchmen in the neighbourhood of the bridge were sufficiently alert, or whether, by any extraordinary precautions that it is within the power of the Railway Company to enforce, the accident might have been prevented. This point will no doubt receive the careful attention of the Agent and Manager, but, meanwhile, the Government remark that the cause of the failure of the bridge seems clearly to be due directly to the action of a powerful current on the loose sandy bed of the river causing an excessive scour at one particular point, and thereby undermining the foundations of the piers which have given way.

2. The Government have little doubt that this action was intensified, as described by the Consulting Engineer and Mr. Going, from the arrangement by which the bridge, instead of being constructed in one continuous length, was divided into two by an embankment 464 feet long; but His Excellency in Council is led to fear that although the force of the stream, increased by an oblique set from the embankment, was the primary cause of the mischief, no such serious damage as has occurred would have been possible had the foundations of the piers been laid as the original specification provided for, or as subsequently they were supposed to have been built.

3. According to the design which originally received the sanction of Government the piers of the bridge were to have been raised on well foundations sunk to a depth of 20 feet below the level of the bed of the river. The proposal by which the general plan of the bridge was altered so as to divide it into two parts, separated by an embankment and consisting together of 38 instead of 40 openings, met with the sanction of the Government on the 6th November 1861, but there is nothing on record to show that any change in the character of the foundations, or in the depth to which it was considered necessary to carry them, was ever brought under the consideration of Government, or was ever authorized by competent authority. It is only now, from the correspondence quoted by Mr. Going, the Government learn that long previously, after the Chief and Consulting Engineers had agreed to substitute for wells the system of sinking the foundations in blocks built on strong timber curbs, according to a method successfully employed at the Nuggery river bridge, Mr. Edward Johnston, who had been entrusted with the special charge of the erection of the Cheyaur bridge, acting on his own responsibility, had rejected this modification, and had adopted a method by which he had been able without any extraordinary difficulty to get the foundations of the two northernmost piers down to a depth of 11½ feet. This comparatively shallow depth seems to have been considered by Mr. Johnston amply sufficient to secure all necessary stability, but it is difficult to reconcile his confidence in this with the terms in which he describes the river bed to consist of loose sand to a depth of 26 feet before sound ground can be touched; and the Government cannot suppress their surprise that such an important change in the character of the foundations of a sanctioned work should have been adopted without their permission, or that the Chief Engineer of the Company, well acquainted as he seems to have been with the treacherous nature of the river sands, and with the probable effect of scour upon them, should have

acquiesced in the arrangement, with the simple stipulation that the minimum depth to be reached should be 14 feet.

4. No measures appear to have been adopted for ascertaining whether, by the method followed by Mr. Johnston, the platform on which his foundations rested could be got down even to the depth Mr. Heppel prescribed, and the result is that all confidence in the sufficiency of the foundations of the bridge, as built in the manner advocated by Mr. Johnston, is destroyed, and that, in the opinion of His Excellency the Governor in Council, the Government would not be justified in consenting to the restoration of the broken part of the bridge with a view to its retention for the use of the Railway, even after the extension of the openings across the sand bank on which the embankment now stands, until, by a careful scrutiny of the whole structure, and especially of the foundations, the Government can be satisfied that, as respects the system on which these have been laid, the depth to which they have been put down, and the character of the masonry, the work possesses the stability which, with such additions as may be recommended, will ensure to the public the perfect security that they have a right to demand.

5. The scrutiny will require to be made by competent professional officers, and His Excellency the Governor in Council accordingly resolves to select for the duty Captain (Lieutenant-Colonel) R. Roberts, R.E., and Major H. L. Prendergast, R.E., the Acting Consulting Engineer for Railways, and to request Mr. Elwin to associate with these gentlemen the present Acting Chief Engineer of the Railway.

6. As the bridge across the Palar on the South-West line was also erected under Mr. Edward Johnston's supervision on foundations which are understood to be similar to those employed by that gentleman at the Cheyaur, and as the recent accident appears to be calculated to raise doubts as to the stability of such of the other bridges over wide and shifting river beds intersected by the Madras Railway as are supported on masonry piers founded on the sand of which these beds are as a rule formed, His Excellency the Governor in Council considers it essential that the investigation now ordered should be extended to all the bridges on the line, beginning with that over the Palar.

7. The attention of the Commission will also be directed to the contrivance of some arrangement by which the watchmen on the line may be enabled to traverse these open girder bridges at all times with safety and convenience, so as to inspect the condition of the bridge previous to the passage of the trains.

(True Extract.)

(Signed) CHARLES A. ORR, Colonel, R.E.,
Secretary to Government.

To the Consulting Engineer for Railways.
To Captain R. Roberts, R.E.

Railway Department.

No. 429

From

Captain M. L. Pendergast R.E.
Consulting Engineer for Railways,

To

Colonel G. A. Orr R.E.
Secretary to Government,
Public Works Department,
Fort Saint George.

SIR,

From Agent
no 59787 26 Oct/70
From Chief Engineer
no 56187 28 Oct/70

I have the honour to
submit reports from the Agent
and Manager and Chief
Engineers of the Madras
Railway, relating to the fatal
disaster on the North-West
line at the Changanur line on
the morning of the 21st ultimo.
The 7-15 p.m. train
from Madras, consisted of
Engine

Engine and Tender, two High
sided goods wagons, Guards
Brake Van, Composite carriage,
2^d class mail carriage, and —
Passenger Luggage Brake van,
coupled in that order.

The Drivers having been
warned that the river was in
high flood, proceeded over
the bridge at the rate of
only about 3 miles an hour;
exchanging signals by lantern
with the guard in the rear
brake van. After this, what
occurred is left to conjecture,
as no coherent story has been
obtained from the survivors;
but

but the engine was found to
be lying at the foot of the 18th
pier, with the goods brake van,
and two passenger carriages
close by: so that the whole
train passed 17 piers, and fell
into the river at the 17th opening
from the south bank.

The Reverend Mr. and Mrs.
Leymon, were in the front
compartment of the composite
carriage, a couple; and a Native
gentleman, Keemivasa Charria,
was in the centre 1st class
compartment; these three were
the only passengers lost:
but the Driver, 3 Firemen, and
the

the tender-guard who was in
the Goods Brake Van have also
been killed; so that altogether
8 lives have been lost.

9 The Chicago bridge
is divided into two parts: from
the abutment on the right
bank, there are 22 openings of
70 feet each from centre to
centre: then an embankment
464 feet in length, over the
high bed of the river or island;
and again 16 more openings, to
reach the left bank. The
abutments and piers are all
of masonry, and continuous
wrought iron girders of 140 feet
are

215
are each laid over two openings.
I proceeded to the spot,
by the next morning's train,
after the accident happened.
The flood had then fallen
about 4 to 5 feet; the three
piers nearest to the island
abutment, Nos 19 to 21 were not
visible at all; the 18th and 17th
presented a broken appearance,
sunk and thrown over on one
side: the girders still rested
on the 15th and 16th piers; but these
piers are both cut in half
transversely from the sills of
the girders. The 16th pier was
plainly

plainly sunk at the down-
stream end, and the 15th seems
to have been crushed down,
from the shock of the bridge
giving way. The body of the
Great Brake Van, was swept
away by the flood and found
two miles down the river;
the composite carriage was lying
on its right side, on the top
of the Good Brake Van and
close to the Engine; the 2^d
class Mail Carriage was standing
upright, with its front to the
stream; while the two goods
wagons had disappeared al-
together.

The

The front of the 1st class
couple was all open, as if stove
in, by a head long fall; and
the appearance of Mr. Seymour's
body when found, gave the
idea, that he was killed at
once, not drowned, after being
carried away in the water.
The survivors had a marvellous
escape, for after the Engine
went down off the bridge,
there was a considerable interval,
during which they were able
to crawl along the rails, and
over the sleepers, which are laid
two feet or so apart, at any
rate as far back as the 16th pier.
for

for beyond that the girders are
twisted over into the bed of
the river, and those who escaped
say they were never off the
ordinary level of the rails.
I believe this to be the case,
and that judging from the
position the carriages were in,
they must have passed over
the 17th feet, before that sub-
sided or far as to cause the
overthrow of the girders.

4 There is no evidence
at all whether the three last
feet gave way before the ar-
rival of the train, or at the
moment when the engine came
upon

19
upon the last girder.
But it seems to me that
most probable that the im-
mediate cause of the fall of the
train was the displacement
of the 18th feet, and the loosen-
ing of the girder, the end of
which rested on that feet.

It is then not known
whether loss of life might
have been saved, if the bridge
had been inspected during the
night; or if a watchman going
across even half an hour before
the fatal event, would have
detected any signs of danger;
but

but it was not the duty of
any one to go over the bridge
in the night time; the pre-
vious train had gone on in
safety; and the flood is sup-
posed to have reached its
height just about the time
the ill-fated train was due,
between 4 and 5 in the morning.

5 The flood though
higher than has been known
for some years, does not ex-
ceed that which was reckoned
on when the bridge was
designed. I measured the
high water mark, 8 feet 7
inches

inches below the top of the
piers, and this level is about
2 feet below the flood level
on the plan. There has how-
ever been one great fault in
the construction of the bridge,
in dividing the waterway into
two parts, by a long embank-
ment. The effect of this
obstruction has been, that for
the greater part of its length
the water that would have
flowed on through the opening
of a bridge, — was diverted
into the already deep channel
of the river; and a strong
current

current thrown obliquely against
the pier. The bed of the
river consists of coarse, loose
sand, and the force of the
current made a deep scour
through the fine or screenings
next to the island embank-
ment. The foundations con-
sequently were undermined,
and the pier thrown over-
board. The Acting Chief
Engineer in attributing the
prime cause of the mischief
to the scour, considers that
if the pier foundations, and
character of the masonry were
such

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such as they ought to have
been, the work would not
have failed. The fracture
of the pier as hitherto seen
does not exhibit by any
means good work, but a
close examination of the
foundations is to be made,
when the water goes down,
and a further report will
then be sent in.

The bridge according to
the original design was to
have had no openings in one
sketch; but this plan was
altered, and the sanction of
Government

Government accorded to the
revised estimate in L. P. No. 751,
dated the 6th November 1861.

The Chief Engineer explains
the nature of the foundations
of the piers, in quoting from
a letter of Mr. Johnston, the
Engineer who had charge of
the work; and I find the
following passage in Mr.
Mappin's letter to the Board
of Directors for the half-year
ending 31st December 1860;
"2515 cub. yards of masonry have
now been completed, comprising
the south abutment and 7
following

25
following piers, and the 38th and
39th piers. The two last are
built on a timber platform,
constructed at a depth of 11
feet 6 inches below the river
bed on the sand. I have no
doubt that in the situation of
these piers, this depth will
be found sufficient to place
the foundations beyond the
reach of scour; but for situation
nearest the main channel of the
river, 14 feet should be given to
make them safe and I have
requested Mr. Johnston to carry
all sand foundations to this
depth in future, being assured
by him, that there will be no
difficulty

difficulty in doing so.
Now from para 16 to 19 the level
of the deep river bed, as per
plan is about 11 feet from
the girder, and if finally
a depth of 14 feet was
determined on, as the minimum
safe depth below the river
bed: the bottom of the
foundations would be 25 feet
below the girder. Mr. Goering
says in para 11 that the work
of sinking foundations on
blocks proposed by the Chief
Engineer and sanctioned by
the Government Consulting Engineer,
was not carried out; but that

a different method, that is.
building on a frame work of
timber, was substituted. The
plan according to the latest
sanction of Government, shows
the foundations to be 30 feet
below the girder, and it
would be inferred from the
above that the foundations
were really 5 feet less in
depth, than those shown on
the sanctioned plan.

If this were really the
case, the silt in the channel
on the 21st October would
have reached very near the
bottom of the foundations.
The water is said to have
been

been 14 or 15 feet deep, and adding $8\frac{1}{2}$ feet between the surface of the water and the girdes, the deep bed of the channel would have been $23\frac{1}{2}$ feet from the girdes, and the platform level only $1\frac{1}{2}$ feet further down in the sand.

On the other hand, however, Mr. Loring says in para 13, that the foundations marked on the revised plan in 1865, or some time after the completion of the bridge, averaged a little over 20 feet, so that by this account the full

29
full depth of 30 feet from the girder was attained.

7 The Acting Chief Engineer proposed to repair the gap in the bridge, so as to render it available for temporary use, and to investigate carefully how far the remaining piers are to be trusted, but is apprehensive that a totally new bridge will be necessary. Meanwhile, a temporary way is in rapid construction, down each bank, so that the Engine will probably run across the bed.

bed of the river, before the
end of the month, without
any use having made of
either portion of the bridge.
The mails were delayed
for two days, from the 21st,
there was no boat to be
found in the river, and no
means of establishing communi-
cation till the morning of
the 23rd, when a madula boat
having been brought up
from Madras, a hawser
was made fast across the
current, and since then the
Post bags have been reg-
ularly conveyed across, each

day.

Madras
2^d November
1870

I have the honour to be,
Sir,
Yours most Obedt Servt
Chas Henry Esq Captl
of the 1st Bn: 60th Regt

Received

Received

No. 597

MADRAS RAILWAY.

33

AGENT AND MANAGERS' OFFICE.

Madras, 26 October 1870.

From

A. B. Quinn Esq.
Agent and Manager. of the M.R.

To

Captain W. L. O'Spender Esq. R.E.
Acting Consulting Engineer for Railways.

SIR,

Addressing to my letter No 591 dated the 21st instant, I made the honor to report for the information of Government such further particulars as I have been able to ascertain respecting the deplorable accident which occurred at the Cheyair Bridge on Friday morning last.

The Chief Engineer and the Traffic Manager are both at Rajampett and I have not received from them any official Report upon the subject but I have personally been able to glean the following information:

The train to which the accident occurred left Madras at 7.15 p.m. on Thursday evening last the 20th instant. It arrived safely at the Rajampett

G.O. No. 2710 of 12-11-70

To

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

From

W. L. O'Spender Esq.
Acting Consulting Engineer
for Railways

RAILWAY DEPARTMENT

26/10/70 W.L.O.

Dated 2nd

Received

No. 429
2nd November 1870

Submitting the rough

has report of the fatal
accident at the Cheyair
Bridge, Mr. Quinn on the
21st October 1870.

27 October 1870

Station consisting of an Engine and Tender, two
Goods Waggon, an Underguards Brake Van,
a Composite Passenger Carriage, a Post-
Office Carriage with Second Class Compartment
and the Head Guards Brake Van, six
Vehicles in all. Travelling in the train
were 3 first Class and 10 Second Class
Passengers, with the usual complement of
Railway servants; viz an Engine Driver
(East Indian) three Firemen (Natives)
and two Guards (one a European the other
an East Indian)

4. I am informed by Guard
McLoy who was posted, that at Rajampett
Station the Driver was warned that the
River was in flood, and that he accordingly
proceeded most cautiously, the pace on
approaching the bridge and while on it,
not exceeding from two to four miles per
hour.

5. It will be as well here to
inform the Government that the bridge
over the Okeyair River is between the
Rajampett and Kundaloh Stations and
is composed of two parts. Divided by an
embankment of 464 feet. The first
or East part consists of twenty two openings
and the second or West part of 16 openings

The Piers are of Masonry and the span of the opening from Centre to Centre is 70 feet. The superstructure is of Wrought Iron I-beams 40 feet deep, similar to those used on other portions of the line.

6. The train safely passed over 14 of the Piers and the Head Guard from his Brake Van saw the Driver on the side of his Engine moving his lantern as if to ascertain the state of the road and the height of the water in the river. Suddenly the light disappeared and Mr. Jones states that a great crash was heard when he immediately put on his Brake and remembered nothing more beyond that he and some of the officers who had got out of the train crept along the rails to the Chajampett side of the Bridge.

7. The number of persons who escaped is eleven, and they in all probability owe their safety to the caution of the Engine Driver, for it appears most improbable that if the speed had been greater any one could have been saved.

8. The number unfortunately lost is eight viz. three passengers - The Reverend Mr. and Mrs. Seymour and

MADRAS RAILWAY.

From

The Agent and Manager

To

The Consulting Engineer

for Railways.

Dated

186

Recd.

No.

Mr. Sreenivasa Chetty and 5 servants
of the company, viz. Engine Driver Eekino,
3 Native Gunmen and Under Guard Bredon.
The Reverend A. W. Seymour's name
appears in the Gazette of the 11th instant
as having been appointed Chaplain of
Palasam and Chuddergaunt, and Mr.
Sreenivasa Chetty was a Pleader of the
High Court.

9. Yesterday I unfortunately
received erroneous information that the
bodies of Mr. and Mrs. Seymour had been
found, but by a Telegram received this
morning I learn that the two bodies
which have been recovered are those of
the Rev. Mr. Seymour and Mr. Sreenivasa
Chetty, and that Mrs. Seymour has not
yet been found.

10. The Chief Engineer and the
Traffic Manager are at the scene of the
accident making arrangements for the transfer
of Passengers, Parcels and Mails from
one side of the break to the other, and
with the apparatus lately used at the
Pier which has been obligingly lent to us
by Mr. Howther the Acting Master Attendant
they have I am happy to say effected
such communication as enabled us to
commence.

MADRAS RAILWAY.

From

The Agent and Manager.

To

The Consulting Engineer

for Railways.

Date

186

Per

No

MADRAS RAILWAY.

From

The Agent and Manager.

The Consulting Engineer

for Railways.

To

Dulal

Rao

No.

180

Cauvery across the river the Oveland Mail which left Madras at 6 A.M. yesterday and reached Yhoaty at 10 P.M. last night.

11. In consequence of the accident and the uncertain state of the weather at this season of the year I have deemed it prudent to discontinue for the present the running of Night Trains on the North West Line, a course which I feel satisfied the Government will approve.

12. As I imagine that the Government will consider it advisable to nominate a Commission to enquire into the cause of the accident I will refrain from offering any opinion on the subject.

13. The Locomotive Superintendent and the Traffic Manager have been requested to submit Accident Reports in the usual form relating to the Engine Driver, Fireman and Guard.

14. I have arranged to leave Madras for Rajampett by the 6 A.M. train on Friday and I shall be glad if you can make it convenient to accompany me.

15. I need hardly say that

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I am most desirous that the fullest
investigation shall be made into the
Cause of this Calamity and that it
has occasioned all the Officers of the
Company the deepest distress and
anxiety.

I have the honor to be,
Sir,
Your most obedient servant,
W. J. W. W.
Agent and Manager

MADRAS RAILWAY.

From

The Agent and Manager.

To

The Consulting Engineer

for Railways.

Date

186

Recd.

No.

Madras Railway Company
 Chief Engineer's Office
 28th October 1870.
 The Agent and Manager,
 Dear Sir,
 As you were present at the scene of
 the late deplorable accident to the North West Light
 Train of the 20 instant from which it will be
 unnecessary for me to recapitulate the sad
 details.
 You will remember that the train
 passed in safety over 14 of the southern openings
 of the bridge and was precipitated into
 the River in consequence of the failure of the
 7th succeeding pier. For a short extent the destruction
 of these piers had occurred by the time the train
 had arrived at the 15th opening and remained
 when morning appeared they were found to be all
 washed away with the exception of portions of the
 15th, 16th and 17th piers, and the 18th pier, which
 had been supported by the pier precipitated
 into the River, and together with the engine and
 entire train of 12 vehicles which had been in the
 sand and almost wholly covered by water.
 The train must have arrived on the
 Bridge between 3 and 4 o'clock A.M. of the 21st.
 It was an intensely dark night and having been
 4th 11th 12th 13th 14th 15th 16th 17th 18th 19th 20th 21st
 The engine was evidently proceeding
 at the slowest possible speed to judge from the
 position in which it and the vehicles which
 preceded the train were found as well as from the
 fact of the escape of 11 out of the 19 persons who

MADRAS RAILWAY.
 From
 The Agent and Manager.
 To
 The Consulting Engineer
 for Railways.

4491/70

Dated 26 October 1870.
 Recd. 27th "

No. 594.

Turning further
 into recent accident
 to the 7-15 PM train
 at the Mysore Bridge

travelled with it.

5. From the evidence I can collect it would appear that the River was not in very heavy flood at night-fall of the 20th, but that it began to rise rapidly after sunset. The maximum rise was to within about 8 feet 6 inches below the level of the bottom of the piers. No suspicion appears to have ever been entertained as to the safety of the Bridge.

6. In considering the causes of its failure it will be necessary to give a history of the progress of its construction from the commencement.

7. The original Design for the new Bridge contemplated a structure of 40 wrought-iron girder openings of each 64 feet clear span, supported on masonry piers founded on brick wells, except in the case of a few of the most southerly ones where a rock foundation was available. The wells were designed to be carried down to a minimum depth of 24 feet below the bed of the river. This design was sanctioned by Government on the 5th August 1859 and its construction under the immediate superintendence of Mr. General Johnston was commenced in February 1860.

8. The Chief Engineer (Mr. Heffels) report for half year ending 31st December 1859 brings forward a proposition for abandoning the Brick wells and sinking the Bridge foundations on Blocks, a system which proved successful in the case of two of the Liverpool Bridge Piers. Captain C. A. Johnston.

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Consulting Engineer in his letter No. 315 of 19th May 1860 communicated his approval of this proposition. Mr. C. Johnston in his report dated 2nd January 1861, when alluding to the 38th and 39th Piers of the Liverpool Bridge, writes as follows. "Very Owing to the depth of sand at these last points being 26 feet from the bed of the River, I found it necessary to construct the masonry on Timber Frames or Platforms, by which means I was enabled to get in these foundations in the most easy, economical, and expeditious manner possible, to a depth of 11 feet 6 inches below the bed of the River by the following method. In the first place, the square constructed, and pumped out, in exactly the same manner that we did at the Palace, and when arriving at the proper depth, the bottom is carefully levelled, though not having been previously levelled. The main beams having been previously halved, are then lowered singly into the Darn, and placed on wedges, the cross pieces are then halved to them, and finally the planking cam-piled of selected sheers, and the Platform taken up, the piers are spiked down, the piers are then removed and the Platform only occupies its place in the sand. This operation only occupies about three hours. The masonry commences at once, and in about 36 hours afterwards, the masonry having been raised above the level to which the water at this season reaches, the pumps are removed. Commenting on the foregoing description of the mode of laying the foundations, Mr. Johnston in his letter of July 15, 1861.

I have been reading your report on the
Cheyenne bridge. I fear that 11 feet 6 inches
below the bed is not deep enough to be safe
from some more than the chance of it. You will
find that on the drawing the bottoms of the wells
are shown 25 feet below the bed. This is probably
more than is necessary but I have always
considered about 14 feet the minimum safe
limit and I think every effort ought to be
made to get down to that depth. We know that
this may be done by building on a cubic leaving
4 feet square vertical wells or openings through
the body of the masonry and sinking the whole
together by excavating the sand at the bottom
of the wells. Some of the pier foundations of the
Hagerman bridge were got in in this way and
I was under the impression that it was the way
you were working.

There can of course be no possible objection
to your plan so long as we get out of the possible
reach of scour, but unless you can ensure
14 feet for the future I shall at least feel
it necessary to go in for sanction to alter the
plan. This however of course could not
do unless I were in possession of what should
appear to me satisfactory grounds for supporting
the proposal.

It would appear from the
correspondence that the mode of sinking the
foundations on blocks which had been pro-
posed by the Chief Engineer and sanctioned
by the Government Consulting Engineer was
not carried out in the actual execution of the

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work, but that a different method was sub-
stituted by which a framework of timber
was placed at the bottom of an excavation made
at the site of each pier and that the masonry
was built upon this. This method appears to
have received the sanction of the Chief Engineer
on the condition that a minimum depth of
14 feet was ensured.

Mr. Johnston's letter of 20th January
1865 states that Piers 27 & 28 were
constructed on solid rock, excepting in depth
from 9 to 14 feet. He explains in his Report
of 4th January 1865 that Piers 27 & 28 and 29 were
founded on timber platforms at a depth of 11
feet 6 inches below bed of River.

With regard to the remaining 27 piers
which received foundation from the
8th November 1865 and which were sent to
Mr. Johnston on 18th February 1865 at the request
of the then Consulting Engineer (Lieut. Col.
Rd. L. O'Connell) in order that the foundations
should be increased so it appears that the
depth at which these 27 Piers were founded
varied from 18 to 26 feet and averaged a little
over 20 feet.

Mr. Johnston's letter referring
the Plan is dated 8th March 1865 and runs thus
"I return you by this day's post the
drawing of the Cheyenne Bridge showing
on it the foundations adopted, as necessarily
as the scale will admit of, as requested in your
note of the 18th ultimo; &c &c &c. The only other
evidence I can find bearing on the matter

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The other part of the same document is a letter from
the Chief Engineer to the Chief Engineer (Mr. Paine)
in reply to an enquiry from the latter as to the
character of the foundation, etc. Johnstone
reply in dated 16th May 1865 and says that
"I am, specifically satisfied, that all the founda-
tions of the Cheyenne Bridge are built in the
most satisfactory manner possible and
of course with attention, a specimen of which
I have been a subject of my own inspection."
The first attention I paid to the
dampers provided in reference to the altered design
when I saw some of the central openings in the
Bridge. My original objections were superseded
by an Embankment constructed in the Johnstone
letter of 20th January 1865 in which he states
all of all and says "I have of said river about
5 feet above the natural bed of the River, and
continues nearly level to within 30 feet of the
mouth of the river, where it begins to fall in its
it is made rising on the required level with the
mouth of the river - the bed is very heavily covered with
hard sand, mixed with gravel, and depth of 2 feet
and from the flat surface of its surface, which
is very opinionable, has a tendency to deposit sand,
rather than create a cause, merely all the
surface is pitted over there and there with small
tufts of reeds, grass, or small shrubs, which
which I think, are good in favor of the bridge,
having no effect upon it."
It would appear that the frequent
to the Chief Engineer and Council of the
Engineer to Government visited the Bridge

and agreed to substitute an embankment for
eight of the openings in the so-called Island and
to lengthen the Bridge at its northern end by
an equal number of openings. For I find the
Johnstone writing is 18th March 1865 as follows:
viz. "I beg to report having forwarded to you
this day's 'Appendix' a Plan showing the pro-
posed alterations of the Cheyenne Bridge for
sanction. In showing the Plan I considered
that it would be a more desirable arrangement
to do away with the openings on the south
bank between Piers 22 to 34 instead of eight
and replaced them in the low part of the section
on the south end by eight openings instead
of six as proposed by you and Captain Johnston
when last on the spot. The proposed Plan and estimate
of the work is 464 feet in length
interposing a central Bank of 46 feet on the
embankment by Government on the 18th
November 1865. The direction of the River at the crossing
of the Railway is peculiar. Its banks are not
above 6 feet higher than the lowest
part of its bed and they fall away to the level
of the bed at a distance of a quarter of a mile
inland on each side. High floods, therefore
inundate the country on both sides. This is however
prevented on the south side by a dike, which
has been constructed by the Villagers. The sand
Bank in the River which divides the Bridge into
two portions is within 100 feet of the level of the
River. Banks... There can be no question but that

in times when the water of the River would rise to a sufficient height to overflow this sand Bank and to run up against the pitched slopes of the embankment which is placed on it (as happened in the late floods) a current would be induced to set across the stream and to cause a scour. This scour did actually take place as I myself can testify and I regarded this as the prime cause of the mischief which was done, although I do not think that if the pier foundations and the character of the masonry were such as they ought to have been, they would have failed. However, this is a matter for more careful investigation and it is premature to comment on it at present.

19. Immediately on a telegraph of the accident having reached Messrs. Mr. Herdridge (in the absence of Mr. Carter who was inspecting on the West Coast) proceeded to the spot and I have pleasure in bringing to your notice the promptness and decision with which he acted in taking such measures as appeared best for restoring temporary communication. A road is being made from each side to connect across the bed of the River so as to be available for the through passage of trains by such time as the subsidence of the water will permit.

20. I have taken steps for the removal of the wreck of the train and that operation has been done. I propose making arrangements to repair the gap in the bridge so as to

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render it at least available for temporary use. How far the remaining piers can be trusted for the future is still a question to be carefully investigated. I am myself apprehensive that a totally new structure will be necessary and for the following reasons.

1. The principle on which the foundations of the present Bridge are laid is in my opinion most objectionable.
2. There appears reason to believe that the character of the masonry is not sufficiently good for the piers of such a Bridge.
3. The central embankment ought not to be allowed to enter into the scheme of the construction.

21. Meantime however a close examination of foundations will be made and I am preparing to have careful borings taken across the bed of the River.

22. One thing at all events is quite certain, that it will be necessary to replace the four sets of wrought iron girders (for the eight openings which have been destroyed) and I beg you will request the Board of Directors to supply them with the least possible delay. Mr. Indent will be immediately sent forward.

23. I trust to be able to report within a few days that through communication by Engine has been restored by means of the temporary Road across bed of River. Meanwhile, as you are aware, Mr. Church is on hand, by skilful management,

with only 2 days interruption, succeeded in
 passing rails and passengers over the break.
 The work was done by James faithfully,
 Chief Engineer.
 J. H. Cope
 Agent and Engineer
 P.W. 4491/70

G. No 2710 of 12th Nov 1870 PND

(Proceedings
 From the Cong. Eng for
 Railways

of the Madras Government
 Under date the Nov 1870
 Read the following
 H. E No 409 of 2nd Nov 1870

From the papers which
 the Consulting Engineer for Rail-
 ways most minutely in continua-
 tion of his previous report on
 the accident that occurred to
 the night train from Tir-
 conn to Cuddapah on the
 morning of Friday the 21st
 ultimo, by the failure of the
 bridge across the Cheyner
 river on the North West line,
 and by which the lamentable
 loss of the lives of three first
 class passengers and of five
 Railway Servants was caused,
 it does not appear that any

A. J. J.

reliable information is likely
to be obtained of the exact time
at which the first portion of
the Bridge fell or in what
precise manner the train
was precipitated into the
stream. The Material
inquiry, of which the report
will be separately recorded,
has not thrown any light upon
the matter, nor has it shown
whether the watchmen in the
neighborhood of the bridge
were sufficiently alert, or
whether by any extraordinary
precautions, that it is within
the power of the Railway
Company to enforce the
accident might have been
prevented. This point

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will no doubt receive the careful
attention of the Agent and
Manager; but, meanwhile,
the Government remark
that the cause of the failure
of the Bridge seems clearly to
be due directly to the action
of a powerful current on the
loose sandy bed of the river
causing an excessive scour
at one particular point, and
thereby undermining the
foundations of the piers which
have given way.

The Government have
little doubt that this action
was anticipated, as described
by the Consulting Engineer and
Mr. Goring, from the arrang-
ment by which the Bridge,
instead of being constructed

in one continuous length, was
divided into two, by an em-
bankment 464 feet long, but
His Excellency in Council is
led to fear that although the
force of the stream, increased
by an oblique let from the
embankment, was the primary
cause of the mischief, no such
serious damage as has occurred
would have been possible
had the foundations of the piers
been laid to the original
specification provided for,
or as subsequently they were
supposed to have been built.

According to the design
which originally received the
sanction of Govt. the piers of
the bridge were to have been
raised on well foundations
sunk to a depth of 20 feet

below the level of the bed of the
river. The proposal by which
the general plan of the Bridge
was altered so as to divide it
into two parts, separated by
an embankment, and consist-
ing together of 32 instead of
40 openings met with the sanc-
tion of the Government on
the 6th November 1861, but
there is nothing on record to
show that any change in the
character of the foundations,
or in the depth to which it
was considered necessary to
carry them was ever brought
under the consideration of
Government or was ever
authorized by competent
authority. It is only now
from the correspondence

quoted by Mr. Joring, the
Government learn that
long previously, after the
Chief and Consulting Engineers
had agreed to substitute for
wells the system of sinking
the foundations in blocks
built on strong timber
curbs, according to a method
successfully employed at
the Sagoy River Bridge.
Mr. Edward Johnston, who
had been entrusted with
the special charge of the
erection of the Cheyenne
Bridge, acting on his own
responsibility, had rejected
this modification and had
adopted a method by
which he had been able
without any extraordinary

Such an important change in the character
of the foundations of a sanctioned work
should have been adopted without
their permission or that

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difficulty to get the foundations
of the two northernmost piers
down to a depth of $11\frac{1}{2}$ feet.
This comparatively shallow depth
seems to have been considered
by Mr. Johnston amply suf-
ficient to secure all necessary
stability, but it is difficult
to reconcile his confidence
in this with the terms in
which he describes the river
bed to consist of loose sand
to a depth of 26 feet before
solid ground can be touched,
and the Govt. cannot suppress
their surprise that the Chief
Engineer of the Company, well
acquainted as he seems to
have been with the treacherous
nature of the river sand

and with the probable effect
of scour upon them, should
have acquiesced in the
arrangement, with the simple
stipulation that the minimum
depth to be reached should
be 14 feet.

No measures appear
to have been adopted for as-
certaining whether, by the
method followed by Mr.
Johnston, the platform on
which his foundations rested
could be got down even to
the depth Mr. Heppel prescribed,
and the result is that all
confidence in the sufficiency
of the foundations of the Bridge,
as built in the manner
advocated by Mr. Johnston,
is destroyed, and that, in

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the opinion of His Excellency the
Governor in Council, the Govt.
would not be justified in
consenting to the restoration
of the broken part of the Bridge
with a view to its retention, for
the use of the Railway, even
after the extension of the opening
across the sand bank on which
the embankment now stands,
until, by a careful scrutiny
of the whole structure, and
especially of the foundations,
the Govt. can be satisfied
that, as respects the system
on which these have been
laid, the depth to which they
have been put down, and
the character of the masonry,
the work proper to the
stability, which, with such

additions as may be recommended,
will ensure to the public the
perfect security ^{that} ~~which~~ they
have a right to demand.

This scrutiny will re-
quire to be made by com-
petent professional Officers
and His Excellency the Governor
in Council accordingly resolves
to select for the duty Capt.
(Lieut. Col.) R. Roberts R.E.
and Major W. L. Pendergast R.E.
the Acting Consulting Engineer
for Railways and to request
Mr. Elvin to associate
with these gentlemen the
present Acting Chief Engineer
for the Railway.

As the Bridge across
the Palar on the South West

and as the recent accident
appears to be calculated
to raise doubts as to
the stability of the
the Bridges over
wide & shifting river
beds intersected by
the Madras Railway
as are supported
on temporary piers
founded on the
banks of which these beds are
as a rule formed.

I would add -

35 67-11
Line was also erected under
Mr. Edward Johnston's super-
vision on foundations which
are understood to be simi-
lar to those employed by
that gentleman at the Cheygar.
His Excellency the Governor
in Council considers it
essential that the inves-
tigation now ordered should
be extended to the Palar
Bridges all the bridges
on the line beginning with
that near the Palar.

The attention of the
Commission will also
be directed to the
arrangement by which
the line is to be
operated.

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line may be called
to have these per-
guder bridges at all
times with safety and
commerce. So as to
inspect the condition
of the bridge previous
to the passage of the
trains.

To the Chief Engineer for Railways.
Capt. R. R. Roberts R.R.

line marshalled

Cp 6491

Govt. of 1870 Madras

PUBLIC WORKS.

To

Dated

Recd.

No.

G. O. 12th Nov 1870. No. 2710

No. 217-18

Madras Bridge - Passing orders
in the letter from the Agent
of the Madras Railway submitting a
report on the recent disaster
at the Thengur on the S. R.
line of the Madras Railway

12th Nov 1870

No. 217-18