

(1) Number of pages _____

(2) Date of repair _____

(3) Initials of the Referencer _____

MADRAS RECORD OFFICE.

Government of Madras.

Public Works DEPARTMENT.

G.O. No. 842	Press
399 400	~~Mis.~~
Dated 25. 3.	18 70.

Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

No. 399. Read the following Circular from the Deputy Secretary to the Government of India, Public Works Department, (Buildings and Roads—Communications,) to the Secretaries to the Governments of Madras, Bombay, Bengal, the North-Western Provinces and the Punjab, in the Public Works Department; the Chief Commissioners of the Central Provinces, British Burmah, Oudh, and Mysore and Coorg; and the Resident at Hyderabad, and the Agents to the Governor-General for Central India and Rajpootana, dated Fort William, 28th January 1870, No. 4:—

I AM directed to forward the accompanying selection of papers and plans illustrative of the engineering difficulties that have been met with by the Engineers of the Delhi Railway Company in bridging the River Sutlej.

From the Under Secretary to the Government of the Punjab, in the Public Works Department, Railway Branch, to the Secretary to the Government of India, Public Works Department, dated 30th December 1868, No. 312 D.

I AM directed to forward, for the information and early orders of the Government of India, Agent's No. 2,100 D, dated 11th December 1868, with copy of papers, as marginally noted, on the subject of increasing the water-way of the Sutlej; Chief Engineer's No. 204, and accompanying plan and estimate. Note by Consulting Engineer on above, dated 28th December 1868. Bridge.

2. The Lieutenant-Governor is of opinion that it will be the wisest course to sanction the recommendation of the Chief Engineer to lengthen the bridge 20 spans.

3. The return of the plan is requested with early reply.

Note by the Consulting Engineer to the Government of the Punjab, Railway Department, on Agent's No. 2,100 D. dated 11th December 1868, and annexures, on the subject of the Sutlej Bridge, dated 28th December 1868.

THE Chief Engineer recommends that the length of the water-way for the Sutlej be increased by 20 clear spans of 102 feet. He grounds his recommendation on the difficulty experienced in diverting the river, and forcing it into a channel between the present abutments. In fact, all the attempts hitherto made with this object, and at great expense, have not been successful.

It will be observed on Plan A. that the cold-weather channel of the present season is not more unfavourable than the cold-weather channel of 1865-66, although worse than that of 1867-68.

The operations of 1856 succeeded in diverting the river to a considerable extent in the direction towards which it was desired to make it flow.

In 1867 these operations were continued, but a gap of about 1,000 feet in length was left between the face of the abutment of the bridge and the Railway embankment. This opening was protected with a very strong tree-bund, behind which it was hoped that silt would be deposited, and thus assist towards the completion of the Railway embankment. The expectation was not unreasonable, but the set taken by the river in flood during last June overthrew all previous calculations, breached the tree-bund and Railway embankment back to a distance of about 2,100 feet from the face of the abutment, and in two or three weeks silted up its former main channel which, as will be seen by the section on Plan C. was in some parts nearly 30 feet deep.

It is this breach of about 2,000 feet which the Chief Engineer desires to bridge with 20 more spans of girders, 110 feet in length (precisely similar in design to those already erected) at an estimated cost of Rupees 7,21,756. I think, on the whole, it will be wise to accept and sanction this additional expense; for, although the river may still, perhaps, be turned so as to flow between the existing abutments, it is certain that to maintain it in that channel must be attended by a very heavy annual expenditure, and no inconsiderable risk. The first outlay by which the river will be given more room in which to shift its channel, without the necessity for large coercive operations which may fail, will probably be cheaper in the end.

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

From the Agent of the Delhi Railway, to the Consulting Engineer to the Government of the Punjab, Railway Department, dated 11th December 1868, No. 2,100 D.

In forwarding, in original, a letter, No. 204, dated 7th instant, from Chief Engineer (the accompanying plans having been sent to you direct), on the subject of the Sutlej Bridge, I have the honour to request that Government may be solicited to come to as early a decision as possible on this most important work.

2. On the engineering question I would not, of course, venture to give an opinion, but from the experience I have had in my endeavours to divert a torrent which threatened the Town of Hooshiarpour (a record of which will be found in the Government Offices), and the failure to effect which is almost stereotyped in the accounts here given of this much larger work, I feel so strongly on the inutility of throwing away money in attempts to divert these Indian rivers, that I venture strongly to urge the adoption of the plan of extension of the bridge without further experiment on deflecting the course of the river.

From the Chief Engineer, to the Agent of the Delhi Railway, dated 7th December 1868, No. 204.

In continuation of my No. 185 of the 7th ultimo, on the state and progress of the Railway Bridge over the Beas and Sutlej Rivers, with the probable date of their completion, I have now the honour to forward, for transmission to Government, the plans and sections referred to in the concluding paragraph of my letter, with a general explanation of the same, and a short account of the works executed, with my opinion as to what appears to me best to do under the circumstances.

In my letter of the 7th ultimo, I alluded to the yearly changes in the course of the cold-season channels—the large bays cut, and the silting up of others—the extent and nature of these changes will, however, be better understood by a reference to the plans A., B., and C.

On plan A. the cold-season channel of 1850 and 1861 is shown by dark brown lines running close to the high point at Phillour, and, so far as I have been able to ascertain, the water had washed against this high point for 60 or 70 years.

The cold-weather channel of 1865-66 is shown by strong yellow lines, which also indicate the bay cut behind the site of the abutment during the flood season of 1865.

The blue lines show the channels of 1867-68, when a considerable portion of the water flowed in front of the abutment, and the red lines that of 1868-69 (or the present season), by which the whole of the water passes behind the abutment.

The intermediate cold-weather channels have not been shown on plan, as I found the number of lines made it difficult to trace out the course of the channel of any one season. The extent of the bay cut near Kassabad during the flood season of 1866 is, however, shown by the portion coloured pink.

The edge of the high land above flood-level on the Loodianah side of the river up to 1861 is shown by a black line, shaded with brown, and the large strip of land coloured light sienna, in front of this line, was also above ordinary flood-level, and cultivated up to the spring of 1865.

The high land above flood-level at the present time, and the extent of abrasion, is shown by the black line shaded with green.

The centre line of the Railway and the face of the abutments is shown by a strong red line, the sand bund above by brown lines, the portion cut away during last floods being dotted.

Plan B. has been prepared by Mr. Tanner from the Revenue Survey of 1847-48, and the surveys by the Company's Officers since 1861-62.

A considerable abrasion appears to have taken place during the fourteen years previous to the surveys by the Company's Officers, as shown by a long strip coloured yellow on plan. Mr. Tanner, however, states that according to report, the most of this strip was cut away during the few years immediately preceding 1861-62.

On plan C. to a large scale are shown the cold-weather channels of 1867-68 and 1868-69; the face of the abutments and wells for retaining wall and piers; the sections of the channel in front of the Loodianah abutment on the 27th May and 10th June 1868; the section from Phillour abutment to the end of the embankment behind the Loodianah abutment in November 1868; the

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

longitudinal sections on the lines A., B., C., D., B., D., and E., C., D.; the embankment partly executed towards the abutment; the position of the tree-bund across the channel above the line of Railway washed away during last floods; the portion of the defence-wall founded on wells from the point where the Grand Trunk Road ended, and the sand-bunds partly destroyed last floods.

It was at first my intention to form a defence-wall founded on 8 feet wells sunk 30 feet below low-water level, commencing from the point where the Grand Trunk Road ended on the Loodianah side of the river; this work was put in hand during the cold-weather season of 1865-66. A number of wells were sunk across the channel cut during the previous floods; these caused a great scour, as the channel became narrower, and a portion were lost; these were re-placed, and the wall built for a length of 1,300 feet to a length of 2 feet above flood-level.

Simultaneous with this work, endeavours were made to turn the river away from the Loodianah shore by means of lines of boats moored at different angles with the current, and by forming spurs and bunds of jhow cylinders, brush-wood, etc., which appeared to produce a good effect so long as there was only the cold-weather stream, but immediately the floods came down, all these minor works were destroyed. During the floods of 1866, the current, from some change which must have taken place higher up the river, made a dead set against the high land immediately above Kassabad, scouring out the large bay coloured pink on plan A.; from this bay of an area of 250 acres, upwards of 100 million cubic feet of silt was removed in less than a month.

Simultaneously with the cutting of this bay, a small bank commenced forming at the lower extremity, and in a very short time the channels and bay cut behind and above the site of abutment during the previous floods (which we had been endeavouring to stop by wells and jhow cylinders, etc.,) became silted up.

It had occurred to Mr. Henfrey that an efficacious description of spur might probably be made by means of blocks of solid brick-works, 10 feet square at bottom, 10 feet by 3 feet at top, and 10 feet high, strongly linked together by suitable iron-work, the idea being that as the bank of the river scoured away, these blocks, each weighing about 30 tons, would fall one by one, and tend to make a slope instead of a perpendicular face for the water to flow fast.

Two spurs on this principle, composed of 15 blocks, were built on a point of land near Kurryana, which it was thought desirable to save from erosion, one in the centre of the bay near the village of Kassabad, and one of 10 blocks at the end of the defence-wall near the Grand Trunk Road.

Mr. Tanner reported the two at Kurryana were swept away in a week after the water washed against them, and that part of the former work was picked up close to the Railway Bridge 5 miles below, while the one at Kassabad has not yet been touched.

During 1867 the main body of the water was flowing a mile away from the spur at the end of the defence-wall, consequently it was only subjected to the shallow flood-water about 3 feet deep. Mr. Tanner reports he visited this spur on the 15th May, when the flood was at its highest: no damage had then apparently taken place, but on inspecting the works on the following evening after the floods had subsided, he found a scour had taken place, and that blocks Nos 9 and 10 were out of sight, and No. 8 considerably tilted.

It was evident the scour had been caused by the spur, as the hole around only extended for a width of 5 feet, and the chippings of the bricks from which the blocks had been made still remained, as also the mortar pit at a distance of only 15 feet from the face of No. 9 block.

In February 1868 a sand-bund, about 3,000 feet long, 10 feet high, 12 feet wide at top with a slope of 5 to 1 on the up-stream side, was thrown up from the Loodianah defence-wall from which, at right angle, six tree-spurs were constructed, the first three from the end being 250 feet, and the other three 500 feet apart; each spur was 210 feet long, composed of strong piles, 15 feet apart, driven down 16 to 20 feet, connected at the tops by a very thick mooj rope, to which trees and branches were fastened; and at the head of the sand-bund, a similar tree-spur, 100 feet long, slightly turned down-stream, was also constructed.

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

In May the stream came against the end spur, and washed out three piles in the centre where the longest timber had been used and driven as far as they would go; this breach (20 feet deep) was repaired by driving new piles, and putting in an immense quantity of brush-wood; the stream then attacked the first spur, carrying off 2 or 3 piles every day, which could not be re-placed, the water being there 32 feet deep, and before the floods showed any sign of subsiding, the whole of spurs Nos. 1, 2, and 3 were washed away, and 180 feet of spur No. 4.

The first breach was made on the 28th May, and by the 30th June 1,000 feet of the sand-bund and the spurs had disappeared; the stream after this having nothing firm to offer a resistance, left the bund, and sand-banks began to appear where recently there had been a scour of 32 feet.

Mr. Tanner remarks: "The result of this costly experiment goes to show how useless it is to construct against the rivers' encroachments by such a system as this, for, when the river came against the bund, it at once scoured to a depth of 30 feet, or 6 to 8 feet deeper than piles can be driven." He further adds: "It was only from this reason that the bund failed, for, until the end of the tree-spurs were carried away, the sand-bund was completely protected, nor was there anything to be desired in the workmanship, for all stood well until it had to yield to the deep scour."

The long tree-bund across the channel parallel to, and a short distance above, the line of Railway was scoured out about the same time, as the bund above suffered, and the deep channel in front of the abutment shown by the sections taken on the 27th of May and 10th of June were silted up in a few weeks, indeed, the greater portion in a few days forming the large sand-bank coloured yellow on plan C., containing from 70 to 80 millions cubic feet of silt.

As a general rule, the damage to the banks takes place after the high floods have subsided, when it inevitably follows a shoal is formed on one side causing a scour, when, if the material of which the bank is composed is soft, the stream undermines it, and the horizontal erosion is very rapid, forming a large bay similar to the one near Kassabad; the heavier portion of the material, such as coarse sand, dropping down the stream but a short distance, causes a shoal immediately below, and as this increases, the water may become diminished, and the stream is driven into the opposite bank.

If the stream, however, is running against a comparatively hard bank, a tree-spur, or a masonry wall, the result is a deep scour such as at Kurryana, the end of the sand-bund destroyed last floods, or the abutment wall at the Beas. On my return to India in February 1866, my attention was directed to the almost certainty of a deep scour against a long defence-wall founded on wells. This subject received my careful consideration, and I became convinced, if such a wall was constructed, it would be attended with great danger, as the permanent deep channel would establish itself on that side of the river, and have a tendency to draw the whole of the flood waters towards Loodianah, and cut in behind the wall. I therefore deemed it advisable to ensure the stability and permanence of one end of the bridge to place the north abutment under the protection of the strong high point at Phillour. I was then under the impression the channel could be turned and guided through the bridge opening by means of tree-spurs, which, instead of drawing the water to that side, would cause a silt, and divert the stream to the opposite side; but from recent experience of their failure at the Sutlej, and the difficulties we are encountering at the Beas, with a much less body of water, coupled with what took place during last floods, when a deep channel extending 1,300 feet in front of the abutment was silted up in less than a month, I have, after due consideration of all the circumstances, come to the conclusion there is great uncertainty of our being able to turn and guide the stream through the present opening between the abutments, and that the lengthening of the bridge has become a necessity.

I beg, therefore, to recommend that 20 spans be added to the length of the present bridge, which would place the face of the Loodianah abutment at the extreme edge of the present channel, as shown in red dotted lines on Plan C., at a cost to the Company, as per following estimate, of Rupees 7,21,786.

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

The wells, exclusive of brick-work in superstructure, sunk for the present Loodianah abutment, have cost, at the contract schedule of rates, Rupees 2,01,746, all of which, with the exception of three, would be abandoned on lengthening the bridge, and the Contractors could not be called upon to do this work a second time without payment; they are, however, prepared to bear a very large proportion of the cost of a new abutment.

I estimate for the new abutment—three 12½-feet wells, with iron curbs, sixty-seven 10-feet wells, and six 8-feet wells with wood curbs, will be required, which, at the contract schedule of rates, will cost Rupees 2,18,855. For this work, the Contractors will ask payment for only the three 12½-feet wells, four adjoining 10-feet wells on each side, and the internal 10-feet and 8-feet wells for the wing-walls, amounting to Rupees 60,036.

The cost of superstructure for one 102 feet span of 110 feet girders will be as follows:—

Tons.	cwt.	qr.	lbs.		RS.	A.	P.
47	13	2	0	Iron-works in girders, at Rs. 440	...	20,977	0 0
1	3	0	14	„ bolts and nuts, at Rs. 600	...	693	12 0
2	5	1	0	Cast-iron bed-plates and rollers, at Rs. 300	...	678	12 0
0	11	0	16	„ standards, at Rs. 350	...	195	0 0
				690 lineal feet piping for Railway, at Rs. 1-8-0	...	1,035	0 0
				482 cubic feet timber, at Rs. 2-8-0	...	1,205	0 0
						24,784	8 0

The cost to the Company for lengthening the bridge would, therefore, be—

	RS.
Abutment wells	60,036
19 piers, at Rs. 8,740	= 1,66,060
20 spans of superficial structure, at Rs. 24,784-8-0	= 4,95,690
	7,21,786

In conclusion, I beg to urge on you the necessity of obtaining the early sanction of Government to lengthen the bridge, for although it will be impossible for the Contractors to obtain the materials from England, so as to complete it by May 1870, it is of the greatest importance that no time should be lost in my giving them instructions to enable them to get out the iron well-curbs by August or September next, to ensure the wells being sunk next cold season.

From the Government of India, Public Works Department, to the Under Secretary to the Government of the Punjab, in the Public Works Department, Railway Branch, dated 15th January 1869, No. 46 R.

I AM directed to acknowledge the receipt of your letter, No. 312 D., dated 30th December 1868, with the enclosures, and in reply to communicate the sanction of the Governor-General in Council to the proposal to give increased water-way to the Delhi Railway Bridge over the Sutlej, by the addition to it of 20 spans, at an estimated cost of Rupees 7,21,786.

2. For the possible future tendency of the river to work south, the Government of India is of opinion that the Engineers should be prepared, and I am to request that the Punjab Government will obtain report on the subject, and submit a programme of operations to be carried out in case of the necessity arising.

3. The above sanction has been entered in the Register of this Office as No. 68 R of 1868-69, and the plans received with your letter are herewith returned.

Extract from Public Works Department letter No. 612 R., dated 27th May 1869, to the Government of the Punjab, in the Public Works Department, Railway Branch.

"3. It has been suggested by the Secretary in this Department that an earlier through opening, as well as a large saving of cost, might even now probably be effected by putting in the additional piers and abutments as proposed by Mr. Harrison, so as to embrace the present channel of the river, but instead of making these additional openings in excess of the water-way first

designed, and putting new girders over them, to shift the old girders already erected, from the 20 spans at the opposite extremity of the bridge, and to close finally that part of the water-way by an extension of the earthen embankment of approach. Even if this suggestion were not accepted as a final solution of the difficulty, the closing by an embankment of some of the spans that have been left dry, and the removal of their girders to the new spans might lead to an earlier through opening, in itself a recommendation of some importance. Further, an attempt might in this way be made to avoid the heavy additional cost of the new girders, and a trial given to what is proposed, leaving the re-erection of the new girders on the west flank of the bridge open for future consideration. The old piers and abutment would remain, and could be made use of at any time. I am accordingly to request that his suggestion may be placed before the Chief Engineer without delay, and an early report of that gentleman's conclusions submitted, accompanied by the plans of the river previously sent up, with the present position of the channel also marked. I am to add that the Government of India as at present informed is strongly disposed to consider that the suggestion thus made should be acted on, and will look for a reply on the subject at the earliest possible date, the final settlement of the question being plainly of much importance.

"4. Should Mr. Harrison adopt this suggestion, there may yet be time to counter-order some, if not all, of the additional girders. Under any circumstances the Government of India believes that there will be no difficulty in finding uses for them elsewhere."

From the Executive Engineer, 8th Division, Grand Trunk Road, to the Superintending Engineer,
2nd Circle, Punjab, dated 14th June 1869, No. 1,250.

SUBJECT.

Proposed extension of the Railway Bridge over the Sutlej River at Phillour.

REFERENCE TO PREVIOUS CORRESPONDENCE.

Letter No. 1,748, of the 23rd March 1869, from the Secretary to the Punjab Government.

THE estimate for the Sutlej Diversion Road submitted by me, and passed by the Secretary to the Punjab Government in his letter above quoted, provides for the construction of an embanked road 5,300 feet in length from the left bank of the river on the down-stream side of the Railway embankment and parallel to it. The end of the embankment, when finished, would have been on a line with the left abutment of the Railway Bridge as at present completed.

2. The Railway Bridge is at present 4,200 feet in length, and I am informed that the Railway Authorities intend to extend it by 2,000 feet towards the left bank, at an expenditure of between 8 or 9 lacs of rupees.

3. As the proposed extension of the bridge, if carried out, will in future be a source of very great inconvenience to the traffic across the river, both by boat-bridge and by ferry, and will also cause an extra expense in maintaining the crossing, I have the honour to address you on the subject.

4. It is not, I think, contended by any one that the original proposed length of the bridge, viz., 4,200 feet, is too small for the requirements of the river; but the reason assigned for extending the bridge is, that the river has receded towards the Loodianah side, and has left the Railway Bridge. I will consequently confine myself in this letter to giving my objections to the proposed extension, and to showing how I propose the river should be dealt with:—

1.—To drive it under the bridge as it is at present.

2.—To make protective works, to oblige the river in future to pass under the bridge, and not endanger the Railway embankment.

5. I beg to annex for references—

1.—A memorandum on the Sutlej embankment at Ferozepoor which was made about two-and-a-half miles in length from the left bank.

2.—Plan showing the different streams in the Sutlej River at Ferozepoor before the embankment was completed in 1862; also showing the effects of the floods of 1862.

3.—Plan showing the Sutlej River at Ferozepoor, with the embankment completed, and showing the river after the floods of 1863.

4.—Plan of the Sutlej River at Phillour with Railway bridge.

6. The objections to the extension are—*first*, after the heavy expenditure of eight or nine lakhs has been incurred, nothing will have been done to confine the river within reasonable limits, and to fix its wanderings within the 6,200 feet given to it under the bridge. Last year the river shifted 2,000 feet to the Loodianah side; this year it might go 2,000 or 4,000 feet further. If it does this, is the bridge to be extended another 4,000 feet? If the principle of following the river is adopted, we may have to bridge all the way into Loodianah. *Second*, by giving too large a water-way to the bridge, the river not being able to use the entire length, will throw up silt in the part it does not use, and the following year, if the river sets in the direction of this silt, it will cut it away, and in so doing will scour its bed. Whereas, on the other hand, if only the full requirements of the bridge are given, and the river compelled to keep within these limits, once having formed its bed, it will keep to it, without scouring to any great depth. *Third*, with the money sanctioned for the extension, the river could be forced under the bridge as it stands, and permanent and protective works could be made for a length of two miles along the embankment.

7. The following is the mode in which I propose the river should be turned:—Early in October the river should be surveyed, and the point at which the river can be turned fixed on. Such a point can always be found within a mile of the bridge; it should have a shelving bank on the Loodianah side, and the river would here have a set on to the Phillour side. At this point two channels, each 20 feet wide, 100 feet apart, and 1 foot below water surface, should be cut passing under the bridge, and falling into any convenient nullah, or into the river itself below the bridge. From the Loodianah side a spur should be run out above the mouths of the channels, formed of jhow fascines and sand or clay, but coated on the up-stream side with clay; when the water becomes too deep to continue such a spur, country-boats firmly anchored sides on to stream, and filled with sand, and jhow should be sunk, and a bank formed behind them; when the river gets too deep for this to answer, floating-boxes, each 50 feet long, 10 feet broad, with perpendicular sides 12 feet high of 2 inch planking, ribs and floor beams 2 feet apart, iron-knees and the interior strongly cross brand and filled with jhow and sand should be placed sides on to the stream, and firmly anchored in a line from the end of the spur and sunk. If these boxes are sunk in the current of the river, they will cause the river to take a turn, and set direct on to the channels, which will be cut away to suit the requirements of the river. The essential points to the success of these floating-boxes are—*first*, that they should be strongly built, so as not to be broken to pieces by the force of the current; *second*, that they should be firmly anchored, so as not to be washed away in sinking; and *third*, that they should be sunk in such an angle as will assist the river setting on to the mouths of the channels.

8. To keep the river permanently under the bridge, and to prevent its injuring the embankment, I propose that continuous masonry wells, 4 feet interior diameter with 1½ feet walling, should be sunk 50 feet deep at the foot of the slopes of the embankment on the up-stream side and parallel to the line of railway for a length of 200 feet from the abutments on either side. The wells to be concreted and masonry wing-walls raised on them. From the end of the wing-wall on the left bank a masonry spur to be run out on wells similar to the above, sunk as close as possible to each other, and in a continuous line of 1,000 feet at right angle to the line of railway. Three of the end wells to be larger than the others, 15 feet interior diameter, 3 feet walling, and carried 60 feet, or as deep as it is possible to sink them; two small wells to be sunk in the concavity between the large ones. The wells to be concreted, and masonry walls, 1½ brick thick, raised 3 feet above highest flood level; seven more spurs, 1,000 feet long, to be made at right angles to the line of railway, and with intervals of 1,500 feet, the first 500 feet of these spurs to be of clay or sand coated with clay, top 8 feet; slopes 1 in 15, and raised 6 feet above highest known flood. The remainder of the spur to be on masonry wells 4 feet interior diameter, 1½ feet walling, with three large walls at end as above, with masonry wall 6 feet above highest known floods.

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

9. This will give a wing-wall on the right or Phillour bank, and as the right abutment is close up to that bank, which is high and formed of hard kunkur soil, nothing further is required at present on that side. On the Loodianah side permanent protective works will be given for a length of 10,750 feet, or over 2 miles.

10. The cost of these wing-walls and spurs will be as per annexed detail :—

2 Wing-walls, each 200 feet in length, at Rupees 27,500 each	Rs.	55,000
1 Spur, 1,000 feet in length, all masonry, at, 1,40,000	..	1,40,000
7 Spurs, 1,000 feet in length, half-masonry, half-earth, at Rupees 80,000	..	5,60,000
Total ..		7,55,000

11. The extension of the bridge by 2,000 feet is to cost between 8 and 9 lakhs of rupees without any works to confine the channel of the river; whereas by the above plan for about the same sum permanent protective works for a length of 10,700 feet on the Loodianah side can be given.

12. From the plan of the river at Phillour, it will be seen that the Railway Contractors, made a half attempt to turn the river under the bridge, and as may be expected, when half measures are tried, they failed. A cut was made and a few boats anchored out in the stream, and this was the extent of the endeavours. Had a spur been run out in January above the mouth of the cut, as proposed by me in the 7th paragraph of this letter, there is not a shadow of a doubt but that the river would now have been flowing under the bridge, and the embankment right across to the left abutment.

13. Against my proposal for not extending the bridge, it might be urged that the contractors have ordered out the girders from England. The girders could be taken over for the Lahore and Peshawur Railway.

Detailed calculation of cost of wing-walls and spurs.

No.		Total cubic feet.	Total.	Amount.	Total.
2	Wing-walls, 200 feet in length—		Rs.	Rs.	Rs.
	Masonry, 54 wells $\times$ 1,295 60 ft. in each	69,962	80 per 100	20,989	
	Concrete, 54 " $\times$ 628 3 " "	33,923	25 " 100	8,482	
	Well-sinking, 54 " $\times$ 50 " "	2,700	8 " 100	21,600	
	Wall over well, 400 $\times$ 8 $\times$ 10 " "	12,000	30 " 100	8,600	
	Total cost of two wing-walls	..	..	..	54,671
1	Spur, 1,000 feet in length, all masonry—	Rs.	Rs.	Rs.	
	124 wells, cost of each as above	..	..	..	
	Masonry, 3 wells, $\times$ 10,179 c. ft. in each	30,537	946	1,17,304	
	Concrete, 3 " $\times$ 10,602 " "	31,806	30	9,161	
	Well-sinking, 3 " $\times$ 60 " "	180	25	7,951	
	Wall over wells, 1 $\times$ 1,000 $\times$ 15' $\times$ 6' " "	7,500	12	2,460	
	Total cost of one spur	..	..	..	1,38,826
1	Spur, 1,000 in length, half-e'ay, half-masonry—				
	58 wells, cost of each as above	..	..	..	
	3 large wells as above with wall	..	946	54,869	
	Earth 500 $\times$ 93 $\times$ 6 c. feet in each	294,000	Rs. 100 per 1,000	21,522	
	Total cost of one spur	..	..	..	79,330

(Signed) J. P. C. ANDERSON,
Exec. Engr., 8th Division, G. T. Road.

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

3. The point of low-land on the left bank opposite Kurryana has of late years been considerably cut away by the floods, and it seems likely to be still more cut away, and in the event of the removal of this point of land the river will not improbably return to the Phillour side.

The low-land here alluded to is that which is described in Mr. Harrison's letter (dated 27th September 1862), as that over which the water has never been known to overflow. This may no doubt be correct as regards the present generation, but the land is unquestionably a portion of the valley or bed of the Sutlej River, the permanent bank being as at Loodianah several miles to the southward.

4. The direction taken by the river immediately above Kurryana at the present time confirms, in the opinion of the Consulting Engineer, the correctness of the decision arrived at by Government in fixing the site of the bridge at Phillour, but it does not appear to the Lieutenant-Governor that any good can arise from re-opening the question as to which was, or was not the best site from a purely engineering point of view.

From J. HARRISON, Esq., Chief Engineer, to the Agent, Delhi Railway, dated 3rd June 1869,
No. 163.

The Consulting Engineer has forwarded to me a copy of a letter, No. 612-R., dated 27th of May 1869, from the Secretary to Government of India, Public Works Department, with copy of Despatch, No. 17, dated 8th April 1869, from the Secretary of State for India, on the subject of increased water-way for the Sutlej Bridge, with suggestions of the Secretary to Government of India, Public Works Department, to shift the girders already erected, and make an embankment in this place, on which I beg to offer the following remarks :—

In paragraph 3 it is suggested an earlier through opening might be effected by removing the present girders and making an embankment. Now a contract has been made in England for the last of the extra spans to be delivered on the 24th July, and one span was shipped early last month, they may therefore reasonably be expected to arrive in this country before we are prepared to erect them, consequently there would be no saving of time by removing the present girders, but even if there were, from my experience of the river, the risk and uncertainty of maintaining a communication with an embankment in such an unprotected position prevents my concurring in the views of the Secretary to Government of India, Public Works Department.

2. The mouth of the Phillour Nullah has recently been cleaned out, and a considerable volume of water is now flowing that way; there is a small quantity of water in this nullah nearly all the year round, and I expect a considerable increase will take place after this year's floods; in fact I shall not be surprised to see a large cold-weather channel on the Phillour side next season.

A channel was cut in front of the abandoned abutment wells on the Loodianah side a few months ago, and is now scoured to nearly twice the width, and there is every appearance of its increasing.

I took the opportunity, a few months ago, of laying the plans before Colonel A. Taylor, C. B., who has had great experience of the Punjab Rivers; we had a long discussion about the Sutlej; he fully agreed with me as to the advisability of placing the Phillour abutment under the protection of the high ground; our views on the whole were pretty much the same. I told Colonel Taylor I had thought of a line of wells with a chain and brush-wood for defence works; he had tried something similar on a small scale, and found it answer, but could not say what might be the result on such a river as the Sutlej. We found on laying a line on the plan nothing less than 3½ miles to commence with would be of use, and this might have to be considerably extended, and the cost must be large.

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

Memorandum by J. P. C. ANDERSON, Esq., Executive Engineer, 8th Division, Grand Trunk Road,
on the embanked road-way in the bed of the River Sutlej at Ferozepoor, dated
14th June 1869.

PREVIOUS to January 1862, the width of the River Sutlej at Ferozepoor, in a direct line from the metalled road on one bank to the metalled road on the other bank, was a little over 5 miles. During the rains there was not a piece of dry ground in the whole of these 5 miles. The main body of the water flowed sometimes through two, at other times through three or more channels, and between these channels there was marshy ground, through which the traffic of the country had to wade. Year by year the width of the river bed, and consequently the obstruction to traffic, increased, whilst, till 1862, no attempt had been made to keep the river within bounds. The river wandered uncontrolled over its bed of 5 miles, cutting away sometimes its right bank, other times its left bank, and frequently finding its way through channels in different parts of its bed, but never at any time did it occupy the entire extent of 5 miles. The difficulties and annoyance in crossing was a great hindrance to traffic.

2. In January 1862, an estimate was sent in to raise an embanked road-way across the bed of the river, leaving a gap one mile in extent about the centre of the bed for the river to discharge itself through. The estimate provided for a road 30 feet at top, slopes 5 to 1, and raise 4½ feet above highest flood-level, the embankment was to have earthen spurs raised on a level with the road, they were to be placed 1,000 feet apart at right angles to the embankment, and were to be 500 feet in length, the ends being protected with bullees and jhow.

3. For reference, two plans of the river are annexed: one shows the river as it was before the embankment from the Ferozepoor side was made; it shows also the two embankments made before the floods of 1862, and the effects of the river on the left bank; the second shows the embankment and river bed after the flood of 1863.

4. Before the floods of 1862, embankment No. 1 had been run out 7,730 feet in length to the edge of stream No. 2, and embankment No. 3 had been made 2,960 feet in length. A gap of 2,306 feet was left for stream No. 2, as will be seen from the plan. Both the embankments were completed with their spurs 500 feet in length and 1,000 feet apart, and intermediate spurs 250 feet in length which had subsequently been ordered.

5. In June 1862, the river commenced to rise, and took a set on to the left bank, of stream No. 2. After each flood it cut away a portion of the high land on its left bank and endangered the safety of the embankment which had been formed on this land. To check this, rafts of bullees and jhow were anchored in the current, which had not the least effect on the action of the current. A number of bullees, 10 feet long, were then tied together,

as per marginal sketch, and the interstices filled up with jhow and clay making a hurdle, 10 feet long, 10 feet broad, and 5 feet high. It was placed at the edge of the bank which was being cut away, and was firmly secured with strong ropes, when the river cut away the ground on which the hurdle had been placed, it fell into the river and sunk. A deep hole was made in the river bed where the hurdle sunk, and on this hole the current turned. The left bank was cut away for about 200 feet more, after which the river stopped doing

any further damage at this point, but went on cutting back towards Ferozepoor. The main current kept on the spot where the hurdle had been sunk. Up to this time the embankment for a length of about 930 feet had been carried away. Finding the sinking of the hurdle so successful, another and a larger one was made at the end of spur No. 11; it was 10 feet broad, 70 feet long, and 10 feet high, and was firmly secured with strong ropes. After one of the floods in July 1862, the river cut away its left bank, and carried away the ground on which the hurdle had been placed; the hurdle fell into the river head foremost, and caused a very deep hole to be formed, on which the river again turned. There was only a depth of 8 feet of water in the river all round the hole, but with two bamboos, each 20 feet long tied together, I could not touch its bottom. The river continu-

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

ing to cut back, a third hurdle was formed at spur No. 9, with similar success to the former two. Before anything could be done to protect spur No. 7, the river in September cut away its left bank still further, and carried away the ground on which the embankment was between spurs Nos. 7 and 8, and made a gap in the embankment of about 400 feet. Two boats were sunk at spur No. 5, after which no further damage was done to the embankment.

6. While the river was cutting away its left bank, it threw up silt toward its right bank. In October, channel No. 2, down which the main body of water had flowed in the rains, silted up when the damage done was repaired and the embankment completed right across.

7. The silting up of channel No. 2 was due to the river having reduced the fall of its bed by one-half, by its winding round by spur No. 4. The velocity having been decreased by the reduction of the fall, silt of a necessity was deposited. Before the floods, the distance from A to B (Plan No. 1) was under 5,000 feet, whereas, in September, the left bank from A to opposite B was about 10,000 feet.

8. I annex a register of the highest flood lines taken along the new embankment; it will be observed that in 1862, along embankment No. 1, which was 7,730 feet long, the river rose 1½ feet at the commencement, and half a foot at its end above the highest known floods. In 1863, when the continuous line of embankment was 12,996 feet long, the river rose 3½ feet at the commencement, and 1 foot at its end above the highest known floods, before the embankment was made.

9. As stated in the 2nd paragraph, the slopes of the embankment and spurs were made at 5 of base to 1 of height, this was found to be too steep for the up-stream slope and for the spurs, as the splashing of the water washed the clay down to an inclination of from 10 to 1 to 15 to 1; the latter should, I think, be the slope for all similar embankments on the up-stream side and for all spurs.

10. The body of the embankment and spurs was made of sand, which was coated over with clay 2 feet deep on the down-stream side, and on the road way, and 3 feet deep on the up-stream side.

11. In the floods of 1863, the embankment had a narrow escape from being carried away, the flood waters rose nearly to the top of the embankment, a ridge was made at the up-stream edge of the road to prevent the possibility of the flood-water over-topping the embankment. The danger was due in the first instance to the action of wind and traffic for one year on the surface of road, way bringing it below formation level, which would not have occurred had the road been metalled, and in the second to embankment No. 3 not having been completed to formation level.

12. It will, I think, be admitted that the sinking of the hurdles and the boats turned the current of the river, and prevented its cutting away the whole of the ground on which the embankment stood. At each spur, where a hurdle had been sunk, the river was turned, and the embankment saved. The only point where, owing to my absence from Ferozepoor, nothing had been done, the river cut into the embankment, but even then it went round by the points I had protected by the hurdles. From this it might, I think, be accepted, as a rule, that to turn the current of a river it is only necessary to throw into it a mass of either trees firmly tied together or bullees and jhow, and the mass so strongly secured that the current does not carry it away.

13. The original project, as far as I am aware, has not been completed, the embankment from the Lahore side not having been made. As the embankment on the Ferozepoor side has now stood for 6 years, and has greatly facilitated traffic across the river, it would be a blessing to the country if the embankment on the Lahore side were completed.

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

*Register of the highest flood lines in the Sutlej River at Ferozepoor measured along
the new embankment.*

	Present datum, level of embankment.	Original datum, level of embanked road-way.	Level of ground.	Highest flood level known before 1862.	Highest flood level of 1862.	Highest flood level of 1863.
At 570 feet from left bank of the river along embanked road-way						
" 1,070 "			40 82	41 50	46 02	47 55
" 1,570 "			43 05	44 50	45 96	47 04
" 2,070 "			42 05	41 50	45 96	47 03
" 2,650 "			42 31	41 50	45 46	47 03
" 3,050 "			43 14	41 50	45 93	47 96
" 4,050 "			41 88	41 50	45 80	...
" 5,050 "			42 00	...	...	...
" 5,550 "			42 91	41 50	45 16	...
" 7,050 "			43 60	41 50	44 29	47 25
" 9,050 "			41 86	...	...	...
" 10,050 "			36 93	...	...	...
" 12,150 "			38 56	...	...	...
			42 65	44 50	...	45 42

(Signed) J. P. C. ANDERSON,
Exec. Engr., 8th Divn., G. T. Road

From Lieut.-Col. H. DRUMMOND, R. E., Joint Secretary to the Govt. of the Punjab in the
Public Works Department, Railway Branch, to the Secretary to the Government of India,
Public Works Department, No. 157 D., dated 17th June 1869.

I am directed to acknowledge the receipt of Public Works Department No. 612-R., dated 27th
May 1869, and accompanying Despatch (No. 17) from Her Majesty's Secretary of State for India,
on the subject of increased water-way for the Railway Bridge over the Sutlej, and in reply to for-
ward, for the information of the Government of India, copy of a letter No. 1,304, dated 15th
June 1869, from the Agent, Delhi Railway, with enclosure from the Chief Engineer.

2. The Consulting Engineer to this Government agrees with the Chief Engineer that it
would be more advisable to extend the bridge by the addition of the new girders ordered, than to
maintain the existing water-way, but change its position towards Loodianah by moving forward the
abutment 20 spans from the Phillour side. The latter idea had suggested itself to the Consulting
Engineer, but was rejected by him for the reasons given by the Chief Engineer, and because there
is as yet no certainty that the river will, for any lengthened period, forsake altogether the right or
Phillour bank.

The danger to the embankment is not during the height of the flood, but after the water has
fallen, when bays commence cutting, this happening immediately above the bridge, there would
be great danger for the embankment being scoured away behind the abutment; as a safe-guard
against this, it has recently occurred to me it will be advisable to build a wall on the wells sunk

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

For the abandoned abutment taking the first advantage of a change in the present channel over
which the extra spans are to be erected of flinging up an embankment under the girders; thus
having an advanced abutment, if this can be accomplished, the fore-shore above the bridge will be
extended, and there would then be about half a mile of land and embankment to cut away behind
the advanced abutment before any permanent damage could be done by one of these bays.

At Kuryana, about eight miles above Phillour, the width of the river during floods is 4,200
feet, 300 feet of which is only a few inches deep, and the proposed addition of twenty spans was not
in any way influenced by a desire to obtain more water-way.

In the 2nd paragraph of the Secretary of State's Despatch, it is stated that the course of the
river "has latterly shown a tendency to move southward again, insomuch that the bridge 4,000
feet long, completed two or three years ago, etc.," there appears to me some misapprehension on this
point, for the bridge, as originally intended, is yet incomplete, and I reported, so far back as
September 1862, there was a deep channel running against the projecting point of land below the
line of bridge on the Loodianah side, 8,300 feet from the high land at Phillour, or about 1,200
feet behind the site of the proposed new abutment, while a little above the line opposite the end of
Grand Trunk Road the channel was 2,500 feet behind site of abutment.

In conclusion, I strongly recommend no action be taken to prevent the girders being sent out.

*Extract from Public Works Department letter No. 1,306-R., dated 4th September 1869,
to the Joint-Secretary to the Government of the Punjab, in the Public Works
Department, Railway Branch.*

I AM directed to acknowledge the receipt of your letter, No. 157-D., dated the
17th June 1869, submitting copy of a letter from the Agent of the Delhi Railway
Company, with enclosure from the Chief Engineer, and stating that the Consulting
Engineer agrees with the latter in considering it more advisable to extend the
bridge by the addition of the new girders ordered, than to maintain the existing
water-way, but change its position towards Loodianah by moving forward the abut-
ment twenty spans from the Phillour side.

2. Under the circumstances, the Government of India are not disposed to
interfere with the despatch of the girders; but desire that, as soon as the rains are
over, a report may be submitted as to the condition of the river and any further
proposals of the Railway Engineers, and then, if it seems necessary, further orders
in the matter will be issued.

*NOTE by Lieutenant-Colonel H. Drummond, R. E., Consulting Engineer to the Government
of the Punjab, Railway Department, on Report, dated 1st October 1869, on the
Sutlej Bridge by the Chief Engineer of the Delhi Railway, dated 7th October
1869.*

I DIRECTED the original of this report and the plans to be forwarded to the Government of India
from Lahore, in order to ensure their arrival at Simla during the first week of October, as desired
by the Supreme Government in letter, No. 1,306-R., dated 4th September 1869, the remarks, there-
fore, which I am now about to offer, must be made without the aid of the plans, but this is not of
much consequence, as I am intimately acquainted with the locality of the railway crossing over
the Sutlej between Phillour and Loodianah, having frequently inspected it during the last three
years. Moreover, in 1843, I was employed in closely watching this river at that point throughout
the whole of the rainy season, observed twice daily the rise and fall of the water, noted the changes
the course of the main stream, recorded formation of the sand-banks, etc., etc.

2. I need hardly observe that the length of a bridge over a river is not dependent entirely on
the maximum discharge of water, but a very great deal on the character and height of the banks

*Proceedings of the Madras Government, Public Works Department,
25th March 1870.*

between which the river flows. As an illustration I may mention that the length of a bridge required over the Sutlej at Phillour was estimated at 4,190 feet; that over the River Beas between Umritsur and Jullunder at 3,210, whereas that over the River Sutlej near Bhawulpore, which is below the junction of the two rivers, was estimated at 3,520 feet, which is 670 feet less than that estimated to be required over the Sutlej alone at Phillour.

3. Taking round numbers, 4,000 feet of water-way was considered to be sufficient for the bridge between Phillour and Loodianah, because it was found that the river at a point, Kuryana about five miles above Phillour, was discharged between banks about 4,000 feet apart. On the right the bank was high and of a comparatively permanent character, on the left, so far as was known, the bank had not been topped during recent years, but it was clearly part of the valley of the river, the permanent bank corresponding to that on the right, being some miles off in continuation of the high land at Loodianah.

4. The high bit of alluvial land on the left bank at Kuryana is year by year being eaten into by the river, and will, I have little doubt, ere long be entirely carried away, but it has unquestionably lasted long enough to have admitted of the construction of a bridge of the length originally proposed, viz, 4,190 feet. However, to have maintained the bridge at that point, extensive protective works would most certainly have been necessary.

5. I beg particular attention to the preceding observations, the crossing at Phillour has a high permanent bank on the right, but it has no high and tolerably permanent alluvial bank on the left side as at Kuryana, and the consequence is that the river has been able, in spite of the utmost endeavours of the Engineers, both of the Company and of the Contractors, to encroach more and more on the left bank, until it has cut for itself a main channel between the left abutment of the bridge as originally planned and the left bank. That it is possible even now to divert this channel and force the river to pass between the abutments I am not prepared to dispute; but I am confident that it can only be done at an enormous expense, exceeding probably the cost of lengthening the bridge by 2,000 feet; and the annual expense of maintaining the river when in flood within abutments about 4,000 feet apart, will assuredly be heavier than if these are 6,000 feet apart. Such considerations and the great importance of feeling assured that railway communication will not readily be liable to be broken, lead me to believe that the measure of lengthening the bridge in preference can be to trying further coercive experiments with the river is on the whole the most prudent that can be adopted.

No. 400.

ORDER THEREON, 25th March 1870, No. 842.

RAILWAY, No. 41.

COMMUNICATED to the Consulting
Engineer for Railways.

(True Extract.)

Colonel, R.E.,
Secretary to Government.

To the Consulting Engineer for Railways, with three plans.

Exd. E. C. Shunker.

**PUBLIC WORKS.
DEPARTMENT OF INDIA.
DEPARTMENT.**

AND ROADS.

Communications.

OFFICES OF MADRAS, BOMBAY, BENGAL, THE NORTH
WESTERN PROVINCES, PUNJAB, IN THE PUBLIC WORKS DEPARTMENT,
THE CENTRAL PROVINCES, BRITISH BURMAH,
AND THE RESIDENT AT HYDERABAD, AND THE
RESIDENT GENERAL FOR CENTRAL INDIA AND RAJPOOTANA.

PORT WILLIAM, JANUARY 28, 1870.

Forward the accompanying Selection of
Engineering difficulties that have been
experienced by the Railway Company in bridging the

I have the honour to be,

SIR,

Your most obedient Servant,

Frederick M. ... Colonel,
Deputy Secy. to the Govt. of India.

between which the river flows. As an illustration required over the Sutlej at Phillour was estimated at 3,210, whereas the Umritsur and Jullunder at 3,210, whereas the below the junction of the two rivers, was estimated to be required over the Sutlej alone.

3. Taking round numbers, 4,000 feet of bridge between Phillour and Loodianah, because about five miles above Phillour, was discharged the bank was high and of a comparatively permanent the bank had not been topped during recent years the permanent bank corresponding to that on the high land at Loodianah.

4. The high bit of alluvial land on the left by the river, and will, I have little doubt, eventually lasted long enough to have admitted of ally proposed, viz, 4,190 feet. However, to have protective works would most certainly have been

5. I beg particular attention to the permanent bank on the right, but it has the left side as at Kuryana, and the consequent utmost endeavours of the Engineers, both of more and more on the left bank, until it has culminated of the bridge as originally planned and the this channel and force the river to pass between but I am confident that it can only be done at a of lengthening the bridge by 2,000 feet; and the flood within abutments about 4,000 feet apart, feet apart. Such considerations and the great indication will not readily be liable to be broken, the bridge in preference can be to trying further of the most prudent that can be adopted.

No. 400.

ORDER THEREON, 2

RAILWAY, No. 41.

(True)

To the Consulting Engineer for Railways, with the

Exd. E. C. Shunker.

Govt. of {1870} Madras.

PUBLIC WORKS.

To

THE CONSULTING ENGINEER

RAILWAYS.

Dated March, 25th

Recd.

G. O., 25th March 1870, No. 842

MARCH

Nos. 399-400

Bridging the River Sutlej.—Circular from the Government of India forwarding a selection of papers and plans illustrative of the Engineering difficulties that have been met with by the Engineers of the Delhi Railway Company in bridging the River Sutlej, communicated to the officer concerned.

CIRCULAR No. 4 PUBLIC WORKS.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

BUILDINGS AND ROADS.

Communications.

To

THE SECRETARIES TO THE GOVERNMENTS OF MADRAS, BOMBAY, BENGAL, THE NORTH WESTERN PROVINCES AND THE PUNJAB, IN THE PUBLIC WORKS DEPARTMENT, THE CHIEF COMMISSIONERS OF THE CENTRAL PROVINCES, BRITISH BURMAH, OUDH, AND MYSORE AND COORG; AND THE RESIDENT AT HYDERABAD, AND THE AGENT TO THE GOVERNOR GENERAL FOR CENTRAL INDIA AND RAJPOOTANA.

FORT WILLIAM, JANUARY 28, 1870.

SIR,

I am directed to forward the accompanying Selection of papers and plans illustrative of the engineering difficulties that have been met with by the Engineers of the Delhi Railway Company in bridging the River Sutlej.

I have the honour to be,

SIR,

Your most obedient Servant,

W. Cunningham

Colonel,

Depy. Secy. to the Govt. of India.

*To The Secretary to the Govt. of Madras
in the Public Works Dept.*

53/3/77

1.1.1870
(9)

GOVERNMENT OF INDIA.
PUBLIC WORKS DEPARTMENT.
BUILDINGS AND ROADS.
Communications.

To
THE SECRETARIES TO THE GOVERNMENTS
OF MADRAS, BOMBAY, BENGAL, THE
NORTH WESTERN PROVINCES AND THE
PUNJAB, IN THE PUBLIC WORKS DEPART-
MENT, THE CHIEF COMMISSIONERS OF
THE CENTRAL PROVINCES, BRITISH
BURMAH, OUDH, AND MYSORE AND
COORG; AND THE RESIDENT AT
HYDERABAD, AND THE AGENT TO THE
GOVERNOR GENERAL FOR CENTRAL
INDIA AND RAJPOOTANA.

CIRCULAR NO. 4 PUBLIC WORKS.

Dated January 28, 1870.

Received *1.1.1870*

Encl.

No. 812-25: March 4/70.

Forwards Selection of papers and plans
illustrative of the engineering difficulties that
have been met with by the Engineers of the Delhi
Railway Company in bridging the River Sutlej.

P. W. D. Press—28-1-70—532.

With our Orders

*1.1.1870
2.5.1870
2.5.1870*

*The Secy to the Govt of India
for the Secy to the Govt of India
for the Secy to the Govt of India*

for the Secy to the Govt of India

Communications to the Secretary to the Government of India

Recd 29/3/70

4/4

4/4

1.1.1870 A. & March 1870

607
 Govt. of Madras.
 PUBLIC WORKS.

The Consulting Engrs.
 for Railways.

Dated
 Recd. 4

G.O. 75 June 1870 No 812

Nos. 399-400

Handwritten note in English:
 The following is a list of the
 papers and plans illustrating the
 various details that have been
 submitted in the progress of the
 work on the proposed line.
 The documents are as follows:

Handwritten notes:
 1. 1870
 2. 1871
 3. 1872

Handwritten notes:
 The last of the
 papers is the plan of the
 proposed line.

Handwritten note:
 for Railways -

Handwritten signature:
 The Consulting Engineer

Handwritten note:
 No. 29/3/70.

Handwritten initials:
 N
 R