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- (1) பக்கங்களின் எண்ணிக்கை 52
(2) புதுக்கித் திருப்பிய நாள் 3.8.88
(3) ஆதாரங்குறிப்பவர் சுருக்கொப்பம் 6/7

தமிழ்நாடு ஆவணக் காப்பகம்.

தமிழ்நாடு அரசு

பெறப்பட்டது 9 துறை

அரசாணை எண். 3131313223133 அச்சகம்
மு. கோப்புத் தாள் எண். பலவகை

நாள் : 6.10.1888

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மடிக்கவோ கண்டபடி கையாளவோ கூடாது

GOVERNMENT OF MADRAS.
PUBLIC WORKS DEPARTMENT.

General
Account.

READ—the following papers :—

From Colonel H. M. VIBART, R.E., Superintending Engineer, V Circle, to the Chief Engineer, Public Works Department, dated Chepâk, 17th August 1888, No. 2208.

I have the honor to forward the plans, &c., for the iron girders for the Gadilam bridge, South Arcot—

- 1 Tracing sheet, No. 2.
- 1 do. No. 3.
- 1 do. General elevation of two spans and section.
- 1 Sheet of calculation (19 pages).

2. I understand that you considered it would be desirable to have the piers 7 feet thick without batter, instead of 8' 6" at bottom and 6 feet at top. The span will then be 61 feet in the clear instead of 62.

3. Although these plans, &c., are to be forwarded to England, so that the iron work may be obtained from Home, Mr. Peters informs me that you considered girders of the same pattern as the "type designs" would be far preferable, as all the members being connected by pins there would be no riveting to be done in this country.

4. The width of roadway allowed in the type designs is only 14 feet, whereas it will be necessary to arrange for obtaining girders which will carry a roadway of 18 feet width.

5. It is more than probable that the design herewith forwarded will be revised in England, so it was not considered necessary to alter the original drawings which are intended for a clear span of 62 feet.

6. In ordering the girders, &c., the following points should be noted—

- (1) There are to be 13 spans of 61 feet clear.
- (2) The width of roadway is to be 18 feet.
- (3) All the members of the girders to be connected by pins to avoid riveting in this country.
- (4) Floor to be carried on buckle plates instead of planking.

7. Mr. Martin took the live-load on the bridge at 100 lb. per square foot. In the type design it is taken at 120 lb.

8. In the design sent up by Mr. Martin, buckle plates are allowed for an average thickness of gravel 63 feet. In the type designs planking is allowed with several inches thickness of gravel. It is thought that the buckle plates will be more lasting than the planking.

9. Mr. Martin's calculations of the girders accompany the plans which have not been altered except the small scale elevation and section of two bays which show the slight alteration proposed in the design.

10. It would be as well if the iron work was to reach this country in January. The cost of it could then readily be adjusted before the close of this official year.

ENCLOSURE.

From C. J. PETERS, Esq., Executive Engineer, in charge of Ponníár and Gadilam bridges, to the Superintending Engineer, V Circle, dated Cuddalore, 12th August 1888.

In accordance with the Chief Engineer's instructions, I have the honor to forward herewith the plans for the iron girders for the Gadilam bridge.

2. The Chief Engineer considered that the following alterations should be made in the design:—

The piers to be vertical and 7 feet thick from bottom to top instead of 8' 6" at bottom and 6 feet at top.

The span to be 61 feet clear instead of 62.

3. Although these plans are to be forwarded to England with the indent for the girders, it was considered that girders of the same pattern as the "type designs" would be far preferable, as all the members being connected by pins there would be no riveting to be done in this country.

4. As, however, none of the type designs have a greater width of roadway than 14 feet, it will be necessary to work out girders for a clear width of roadway of 18 feet.

5. As in any case it is probable that the design herewith forwarded will be revised in England, it was not considered necessary to alter the original drawings which are intended for a clear span of 62 feet.

6. Briefly the following are the main points to be noted in ordering the girders:—

(1) There are to be 13 spans of 61 feet clear.

(2) Width of roadway 18 feet clear.

(3) All the members of the girders to be connected by pins to avoid riveting at the site.

(4) Floor to be carried on buckle plates instead of planking.

7. I observe that Mr. Martin takes the live-load on the bridge to be 100 lb. per square foot. I think in the type designs it is taken as 120 lb.

8. As regards the dead-load, the buckle plates may make a slight difference and Mr. Martin allows for 63 thickness of gravel which amounts to about 80 lb. per square foot. I do not recollect what the weight allowed for gravel, &c., is in the type designs.

9. Mr. Martin's calculations of the girders accompany the plans which have not been altered except the small scale elevation and section of two bays which show the alterations in the design.

Office note from the Examiner, Public Works Accounts, dated Madras, 27th September 1888, No. 2325.

With reference to the accompanying letter No. 2433 A, dated 6th September 1888, from the Superintending Engineer, V Circle, forwarded to the Chief Engineer, Public Works Department, through me with an indent in triplicate for a wrought iron lattice girder bridge for the Gadilam river, I have to observe that the value of the bridge is not stated and I am unable to furnish the certificate prescribed by Code appendix G, para. 16.

2. In the note from the Chief Engineer, Public Works Department, No. 292 D, dated 8th June 1888, printed with Proceedings communicated with G.O., No. 2157 W., dated 16th July 1888, it is stated that exclusive of any payment to be made in England for iron works, a sum of Rs. 30,000 for each bridge will probably suffice, that is, Rs. 60,000 for the two bridges over the Gadilam and Ponníár rivers.

3. Arrangements are now being made to place a grant of Rs. 1,15,000 from Local Funds at the disposal of this department for the two bridges.

4. Please therefore inform me how much of the grant may be considered as set apart to meet the expenditure in England on account of this indent.

ENCLOSURE.

From Colonel H. M. VIBART, R.E., Superintending Engineer, V Circle, to the Chief Engineer, Public Works Department (through the Examiner of Public Works Accounts), dated Bangalore, 6th September 1888, No. 2433 A.

With reference to your memorandum No. 580 D., dated 27th August 1888, I have the honor to forward an indent (in triplicate) for a wrought iron lattice girder bridge for the Gadilam river in Cuddalore.

ORDER—dated 6th October 1888, No. 3131 W., Public Works.

Ordered that the indent be transmitted to the India office for compliance with request that the cost of the bridge work be intimated to this Government in view to the requisite funds being set apart for payment.

(Here enter No. 3132 W., dated 6th October 1888.)

(True Extract.)

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

To the Superintending Engineer, V Circle.
" Examiner, Public Works Accounts.
" Local and Municipal Department.

Exd. J. Henricus.
Spare Copies

GENERAL.
ACCOUNT.

Govt. of Madras.
PUBLIC WORKS.

Dated October, 6th.

Recd.

Encl.

G.O., 6th Oct. 1888, No. 3131 W.

OCTOBER.

Gadilam Bridge, South Arcot
District

Indent for iron work required for the —,
ordered to be forwarded to the India office
for compliance.

6TH OCTOBER 1888, No. 3132 W., PUBLIC WORKS.

PUBLIC WORKS DEPARTMENT.

General.
Account.

LETTER—from

COLONEL J. O. HASTED, R.E.,

Secretary to the Government of Madras,

Public Works Department,

To

THE DIRECTOR-GENERAL OF STORES,

INDIA OFFICE,

LONDON.

SIR,

I am directed to forward herewith an indent, in duplicate, for the iron work required for the Gadilam bridge in the South Arcot district.

2. The indent is accompanied by three tracings and a sheet of calculations. Tracing No. I shows the general elevation of two spans of the bridge, with cross section, and it is proposed to build the bridge in accordance with the modifications of the design here given. The other plans * are forwarded unaltered, as it is probable that they will be revised in the India

* Nos. II and III.

office; but I am to request that the iron work may be prepared so as to allow for thirteen spans of 61 feet clear, the piers being 7 feet thick as shown in plan No. I.

3. The girders should be of the same pattern as those shown in the "type designs," all the members being connected by pins, so that there would be no riveting to be done in this country.

4. The width of roadway allowed in the type design is 14 feet, but the girders now indented for are intended to carry a roadway of 18 feet width. The floor is to be carried on buckle plates instead of planking, and the live-load is to be taken at 120 lb. per square foot as in the type design.

5. It is desired that the iron work should, if possible, reach this country by January, and that meanwhile the probable cost of the bridge work be intimated to this Government in view to the requisite budget provision being made to meet it.

(Here enter No. 3133 W., dated 6th October 1888.)

I have the honor to be,

Sir,

Your most obedient servant,

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

OOTACAMUND,
6th October 1888.

ENDORSEMENT—dated 6th October 1888, No. 3133 W., Public Works.

Copy of the above, with copy of indent, forwarded to the Government of India for information.

(Signed) J. O. HASTED, Colonel, R.E.,
Secretary to Govt., P.W.D.

Exd. J. Henricus.
Spare Copies

GENERAL.
ACCOUNT.

Govt. of 1888 Madras.
PUBLIC WORKS.

Dated October, 6th.

Recd.

Encl.

6th Oct. 1888, Nos. 3132, 3123 W.

OCTOBER.

Gadilam Bridge, South Arcot
District

Forwarding copy of indent for iron work
required for the —

9784

C.A.W.

I forward for disbursement
at once. The indent for
iron work of the Gadilam
Bridge - all previous
papers appear & all these
with memo. No 590 D.

I have looked through
the file, & tell me that
the line plans are details
of the small one. The latter
came from Ooty with
your note overleaf,
in accordance with
instruction, & under
have been made &
retained here, in
to be done with the
indent.

With regard to the
Gadilam, it will be
sufficient to perhaps
in sending on the district
to the district office to
report the cost, & to
say that this Govt. are
prepared to provide
adequate funds on receipt
of a proper bill.

Gudilam River
South Arcot District

for iron girders for
of 62 feet span each
18 feet clear.

girder	2 feet
span	62 feet
girder	66.5 feet
span	66 feet
girder	$\frac{66}{10} = 6.6$

4 tons per square inch
5 — do — do
4 — do — do
5 — do — do

at 100 lbs per square
load per foot run on
at $\frac{18 \times 100}{2} = 900 = 402 \text{ tons}$

total weight
per column — $\frac{72805.36402}{2}$
 $8 \times 63 \times 120 = 64900$
 $\frac{64900}{2} = 32450$

36.29 tons
say
36.50 tons

SAW 5000

I have now
three copies of
this tracing made
to accompany the
triplicate copies
of Indent. The
original can then
be kept on record.
The Genl Supt has
the Indent under
preparation.

MS

28.04.88

The copies can be
kept at Madras.
The original being
returned to Govt.

MS

I have been told
that the original
is in the hands of
the Genl Supt.

30/8/88

Hamworth
The copies of this tracing
with original can be
sent to Govt.

(1)
Bridge over Gudilam River
at Cuddalore - South Arcot District

Calculations for iron girders for

Thirteen bays of 62 feet span each
and road way 18 feet clear.

Bearing of girder ——— 2 feet
Clear span ——— 62 feet
Length of girder ——— 66.5 feet
Effective span ——— 66 feet
Depth of girder ——— $\frac{66}{10} = 6.6$

Limit of strains.

Compression — 4 tons per square inch
Tension — 5 — Do — Do —
Shearing — 4 — Do — Do —
Bearing — 5 — Do — Do —

Line load equal 100 lbs per square
foot. Then line load per foot run on
one girder equal $\frac{18 \times 100}{2} = 900 = 402 \text{ tons}$

Fixed load

Half the total weight
of wrought iron for
one and span as per estimate — $\frac{72805.36402}{2}$
Gravel. $\frac{66 \times 18 \times 63 \times 120}{2} = 46908$
81308

36.29 tons
say
36.50 tons

Therefore weight per foot run $\frac{36.5}{66} = .55$ tons

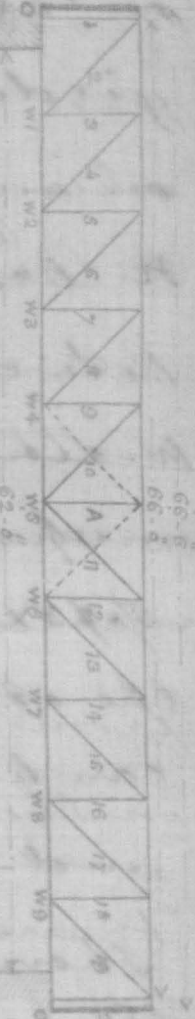
Weight for fixed load at intersection of diagonals with upright at the bottom boom equal $6.6 \times .55 = 3.63$ tons = W

Weight for lower load: $6.6 \times .602 = 3.97$ tons = W'

It will be convenient to consider first the strains caused in the diagonals and uprights by live load noting that the most severe shearing action takes place at any cross section of girder, where the larger segment of the span is loaded and the smaller unloaded.

Now if the weights at the meeting in the bottom boom of the uprights and diagonals are supposed to be applied as W, W', W'' , it will be seen from the diagram over leaf that, on the principle of lever, W' will be transmitted to the left abutment through diagonal No. 2 and upright No. 1 a force equal to $\frac{9}{10} W$ Sec 4.5 and to the right abutment $\frac{1}{10} W$ Sec 4.5. Similarly W'' will be transmitted to the left $\frac{8}{10} W$ Sec 4.5 and to the right $\frac{2}{10} W$ Sec 4.5, and so on for all the other weights.

Diagonal	Upright	Top Chord	Bottom Chord	Web	Flange	Stitch	Plate	Angle	Truss	Beam	Column	Foundation
1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20	20	20	20	20	20



By tabulating in the form given in diagram the strain produced by each weight on all the bars we obtain the maximum strain produced by live load on each bar shown in the column of total compression or tension.

Fixed load - It will be seen on examining the diagram of the girder, that the strain produced on any bar is equal $(W + W') \sin \theta$, n being the number of times the distance between bar and center of girder is $W \sec 45^\circ = 3.696 \times 1.414 = 5.23$. So strain on upright No. 1 and diagonal No. 2 = $5.23 \times 4.5 = 23.53$ tons. The strains on the other uprights and diagonals can be found in the same manner, and tabulated as shown in diagrams. Then by adding these strains to like strains produced by live load; we get the grand total strain on the bars as shown in diagrams.

We have a means for checking these results. The tension on diagonal No. 1

(2)

No. 2 must be equal to the shearing force at abutment resolved in its direction. Now shearing force at the abutment is half distributed load. Total load on girder equal $(W + W')g = (3.69 + 2.76)g = 58.05$ and half of this or 29 tons is the shearing force at each abutment. Now this force resolved in direction of bar No. 2

$$= \frac{29 \times 9.33}{6.6} = \frac{270.57}{6.6} = 41.00 \text{ tons}$$

length of bar and 6.6 feet depth of girder. The result 41.00 tons is the same as strain on bar No. 2 as shown in diagram. It is therefore correct.

Horizontal stresses in top and bottom beams of girder. - The supporting pressure F at each abutment is equal to half the load on girder = $\frac{g(W + W')}{2} = \frac{g(2.76 + 3.696)}{2} = 29$ tons. Then compute the first term, and by successive subtractions of the quantity $\frac{L}{N \cdot K} (W + W')$, all the other terms of the following series, which

which is that of the shearing action each multiplied by the ratio of the length of one horizontal division of the span to the depth of the girder n = number of bays = 10, b = span 66 feet and k = depth of girder 6.6 feet, F_1 = shearing action between abutment and W , F_2 between W and W_2 and so on.

$$H_1 = \frac{l}{N \cdot k} F_1 = 29.00$$

$$H_2 = \frac{l}{N \cdot k} F_2 + \frac{l}{N \cdot k} F_1 = \frac{l}{N \cdot k} (W + W') = 29 - 6.456 = 22.544$$

$$H_3 = \frac{l}{N \cdot k} F_3 + \frac{l}{N \cdot k} F_2 = \frac{l}{N \cdot k} (W + W') = 22.544 - 6.456 = 16.088$$

$$H_4 = \frac{l}{N \cdot k} F_4 + \frac{l}{N \cdot k} F_3 = \frac{l}{N \cdot k} (W + W') = 16.088 - 6.456 = 9.632$$

$$H_5 = \frac{l}{N \cdot k} F_5 + \frac{l}{N \cdot k} F_4 = \frac{l}{N \cdot k} (W + W') = 9.632 - 6.456 = 3.176$$

Let H_i be the horizontal stress in either boom between abutment W , bottom boom, H_2 between W and W_2 and so on. Then the series of the horizontal stresses in the several divisions of the booms can be completed by successive additions as follows.

$$H_1 = \frac{l}{N \cdot k} F_1 = 29.00$$

H_2

$$H_2 = H_1 + \frac{l}{N \cdot k} F_2 = 29.00 + 22.544 = 51.544$$

$$H_3 = H_2 + \frac{l}{N \cdot k} F_3 = 51.544 + 16.088 = 67.632$$

$$H_4 = H_3 + \frac{l}{N \cdot k} F_4 = 67.632 + 9.632 = 77.264$$

$$H_5 = H_4 + \frac{l}{N \cdot k} F_5 = 77.264 + 3.176 = 80.440$$

The test of the accuracy of this series of calculations is, that for the middle horizontal piece it should give a result agreeing with the formula $H = \frac{Nl}{8k} (W + W')$

$$= \frac{10 \times 66}{8 \times 6.6} (3.696 + 2.76) = \frac{10 \times 10}{8} \times 6.456 = 50 \times 1.614$$

= 80.70 tons which is practically the same as the last term of the series and therefore the calculations are correct.

Sizing of booms. Take top

boom first. The strain at centre is 80.70 tons. Then sectional area required = $\frac{80.70}{4} = 20.20$ Square Inches.

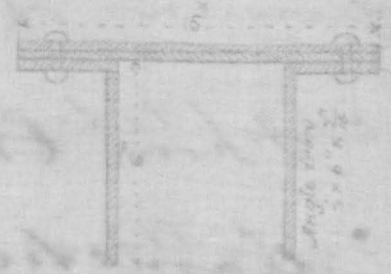
Now if the section is as sketch, the area will be as follows:-

$$\text{Plate } 15 \times \frac{1}{2} = 7.50$$

$$2 \text{ L } 10 \times \frac{1}{2} = 7.50$$

$$2 \text{ L } 10 \times \frac{1}{2} = 7.50$$

$$\text{Gross area } \underline{22.50} \text{ Square Inches}$$

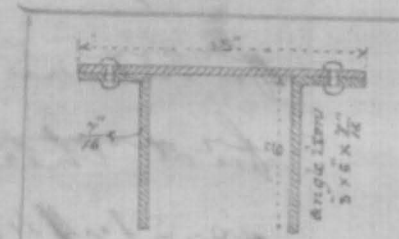


From this must be deducted area of two $\frac{3}{4}$ " diameter rivet holes or $\frac{3}{4} (\frac{1}{2} + \frac{1}{2} + \frac{7}{16}) 2 = \frac{3}{4} \times \frac{23}{16} \times \frac{2}{1} = \frac{69}{64} = 2.00$

Therefore net area equals $22.50 - 2.10 = 20.39$ square inches which is only slightly more than is required.

The sectional area proposed for centre of girder will be continued on each side of centre up to 13'-9" from each end of girder. Here the top plate will be omitted and the section

then will be as sketch.



The strain here is 51.44

tons, so sectional area required

$$= \frac{51.44}{4} = 12.90 \text{ square inches.}$$

Section proposed is as follows:-

$$\text{Plate} - 15 \times \frac{1}{2} = 7.50$$

$$2 \text{ L irons} = 7.50$$

$$\text{Gross sectional area} = 15.00 \text{ sq. inches}$$

From this deduct area of two $\frac{3}{4}$ " diameter rivet holes thus $2(\frac{1}{2} + \frac{7}{16})$

$$+ \frac{3}{4} = 1.40. \text{ Therefore net area} = 15.00 - 1.40$$

= 13.60 square inches, which is only

70

(3)
70 square inches too much.

Bottom boom. — The strain at centre is 80.70 tons, sectional area required = $\frac{80.70}{5} = 16.14$ square inches.

Section proposed is thus and area is as follows:-

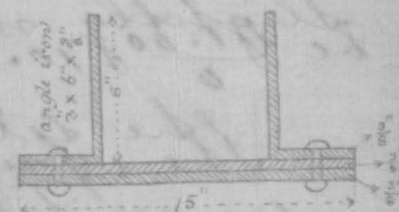
$$2 \text{ Plates } 15 \times \frac{3}{8} = 11.25$$

$$2 \text{ L irons} = 6.47$$

$$17.72$$

$$\text{Deduct 2 rivets } \frac{3}{4} = 1.70$$

$$\text{Net area} = 16.02 \text{ sq. inches which is practically sufficient.}$$

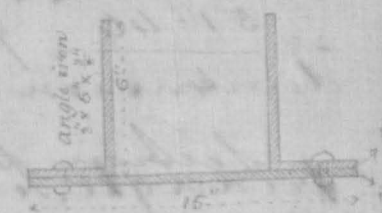


This section will be continued from each side of centre up to 13'-9" from end of girder. Here the strain

is 51.44 tons, so sectional area re-

quired equal $\frac{51.44}{5} = 10.30$ square

inches. Section is thus and area is as follows:-



$$\text{Bottom plate } 15 \times \frac{3}{8} = 5.60$$

$$2 \text{ L irons } 17.25 \times \frac{3}{8} = 6.47$$

$$12.07 \text{ sq. inches}$$

From this deduct two $\frac{3}{4}$ " rivet holes thus -

$2(\frac{3}{4} \times \frac{3}{4}) \times \frac{9}{8} = 1.25$. Then net area equal $12.07 - 1.25 = 10.82$ square inches, which

which is only a little more than the required area.

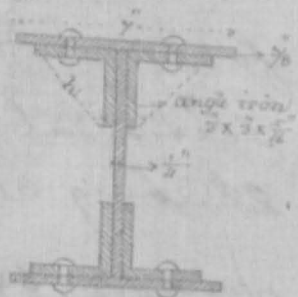
Uprights and Diagonal bars.

Take uprights first. The compression force on upright No. 1 is 41.00 tons. See diagram - area of section should be $\frac{41.00}{4} = 10.25$ square inches.

The upright however is more likely to give way by buckling than by weakness in any other way. So we must test the standing by the formula $\frac{P}{S} = \frac{P_c}{14 \frac{L^2}{5000 I^2}}$ P being com-

pression force, S sectional area in square inches, L length or height of upright, f limits of stress or 4 tons per square inch, and h least dimension of circumscribing triangle. Neglecting the support the upright receives from the angle iron and gusset plates of the top and bottom booms the height of each upright is 6.6 feet, or 79.2 inches. Therefore $b^2 = 4783.84$.

It will be safe to assume that each side of upright will act independently. So the



least dimensions of circumscribing triangle will be 3 inches.

$$\text{Then } \frac{P}{S} = \frac{P_c}{14 \frac{L^2}{5000 I^2}} = \frac{41.00}{14 \frac{79.2^2}{5000 I^2}} = \frac{103000}{34792 I^2}$$

= 3.4 tons. This then is the safe load the upright can bear per square inch of section.

Sectional area of upright is as follows:—

$$\text{Two flange plates } - 7 \times \frac{3}{8} \times 2 = 5.25$$

$$\text{Two pieces of web between angle irons } - 2 \times 3 \times \frac{1}{4} = 1.50$$

$$4 \text{ angle irons } 2.275 \times \frac{5}{16} = 7.10$$

$$\text{Deduct 4 rivets } \frac{3}{4} \text{ diameter or } \frac{4}{16} \times \frac{3}{4} \times \frac{4}{1} = \frac{33}{16} = 2.06$$

$$\text{net area} = 11.85$$

and this multiplied by 3.4 gives safe resistance to buckling $11.85 \times 3.4 = 40.29$ tons against 41.00 tons the maximum compression force on bar.

No. 3 Upright — The compressive force on this is 31.95 tons. Effective sectional area required to resist crushing $\frac{31.95}{4} = 8$ square inches.

now for buckling; section proposed is vide sketch as the circumscribing



triangle is the same as in the case of upright No. 1, the safe load per square of section will be the same in each case, that is, 3.46 tons. Now sectional areas as follows:-

4 angle irons $22.5 \times \frac{3}{8} = \frac{67.5}{8} = 8.44$

Web between angle irons $2 \times 3 \times \frac{1}{2} = \frac{1.50}{9.90}$

Deduct one rivet hole $\frac{3}{4}$ diameters $= 1.75$

Net area 9.15 sq. in.

* only one hole is taken into account because the rivets need not be opposite each other.

The upright can bear safely $9.15 \times 3.46 = 31.11$ tons against 31.95 the maximum compressive force

No. 5 Upright — Compressive force 22.82
Sectional area required to resist crushing $\frac{22.82}{3.46} = 6.59 \text{ sq. in.}$

Section proposed is as sketch area as follows:-

4 angle irons $18.75 \times \frac{5}{16} = \frac{58.75}{16} = 3.67$

Web between angle irons $5 \times \frac{1}{2} = \frac{1.25}{7.10}$

Deduct one rivet $\frac{3}{4}$ diameters $= 1.25$

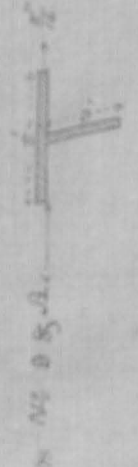
$\frac{7}{8} \times \frac{3}{4} = \frac{21}{32} = 0.66$
 6.59

Uprights, 7.

Diagonal Bars

No. 2 — Tension 41.00. Sec

required



required $= \frac{41.00}{5} = 8.20 \text{ square inches.}$

There will be two bars, so each must be 4.10 square inches effective in section. If each bar is $6 \times \frac{3}{4}$ the area will be 4.50. From this must be deducted one rivet $\frac{3}{4}$ diameter. So effective area $= 4.50 - .56 = 3.94$, which is very nearly correct.

No. 4 — Tension 31.95 Sec. required

$\frac{31.95}{5} = 6.40 \text{ square inches}$ or each bar must be 3.20 sq. inches. If each bar is $5 \times \frac{3}{4}$, area $= 3.75$. Deducting one rivet effective area $= 3.75 - .56 = 3.20$.

No. 6 — Tension 22.82 Sec. required $\frac{22.82}{5} = 4.56$ or each bar must be 2.28 square inches in section.

If bar is $5 \times \frac{1}{2}$, area $= 2.50$. Deduct one rivet or $\frac{1}{2} \times \frac{3}{4} = .37$. Then effective are $= 2.50 - .37 = 2.13 \text{ sq. in. enough.}$

No. 8 — Tension 13.69 tons. Sec. required $\frac{13.69}{5} = 2.74$ or each bar must be 1.37 square inches in section.

If bar is $4 \times \frac{7}{16}$, area $= \frac{28}{16} = 1.75$

Deduct

triangle is the same as in the case of upright No: 1, the safe load per square of section will be the same in each case, that is, 3.40 tons. Now sectional areas as follows:—

4 angle irons: $22.50 \times \frac{3}{8} = \frac{67.5}{8} = 8.44$

Web between angle irons: $2 \times 3 \times \frac{1}{4} = 1.50$

Deduct one rivet hole $\frac{3}{4}$ diameter $= 0.75$
 Net area 9.19 sq. in.

* only one hole is taken into account because the rivets need not be opposite each other.

The upright can bear safely $9.19 \times 34 = 31.11$ tons against 31.95 the maximum compressive force

No: 5 Upright — Compressive force 22.82
 Sectional area required to resist crushing $\frac{22.82}{3.40} = 6.71$ sq. inches.

Section proposed is as sketch area as follows:—

4 angle irons: $18.75 \times \frac{5}{16} = \frac{93.75}{16} = 5.85$

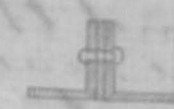
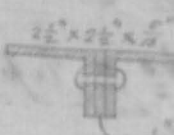
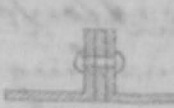
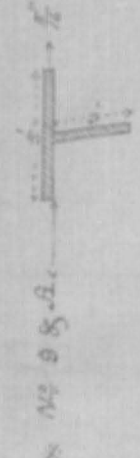
Web between angle irons $5 = \frac{1.25}{7.10}$

Deduct one rivet $\frac{3}{4}$ diameter $= 0.60$
 $\frac{7}{8} \times \frac{3}{4} = \frac{21}{32} = 0.66$
 6.59

Uprights, 7.

Diagonal Bars

No: 2 — Tension 41.00. See required.



required $= \frac{41.00}{5} = 8.20$ square inches.

There will be two bars, so each must be 4.10 square inches effective in section. If each bar is $6 \times \frac{3}{4}$ the area will be 4.50. From this must be deducted one rivet $\frac{3}{4}$ diameter. So effective area: $4.50 - .56 = 3.94$, which is very nearly correct.

No: 4 — Tension 31.95 lbs. required

$\frac{31.95}{5} = 6.40$ square inches or each bar must be 3.20 sq. inches. If each bar is $5 \times \frac{3}{4}$, area = 3.75. Deducting one rivet effective area = $3.75 - .56 = 3.20$.

No: 6 — Tension 22.82 lbs. required $\frac{22.82}{5} = 4.56$ or each bar must be 2.28 square inches in section.

If bar is $5 \times \frac{1}{2}$, area = 2.50 Deduct one rivet or $\frac{1}{2} \times \frac{3}{4} = .37$. Then effective are = $2.50 - .37 = 2.13$ sq. in. enough.

No: 8 — Tension 13.69 tons. See required $\frac{13.69}{5} = 2.74$ or each bar

must be 1.37 square inches in section. If bar is $4 \times \frac{7}{16}$, area = $\frac{28}{16} = 1.75$

Deduct

Deduct one rivet, or $\frac{3}{4} \times \frac{7}{16} = \frac{21}{40} = .525$

Then effective area is $1.75 - .525 = 1.225$ sq. in.

No. 10 — May be made $3 \times \frac{3}{8}$

Rivets in diagonal bars.

No. 2 Bar. Rivets take $\frac{3}{4}$ " diameter.

Sectional area = 4.4 square inches

Resistance to shearing $4.4 \times 4 = 17.6$ tons

Strain on each bar $\frac{61.00}{2} = 30.5$ tons

Number of rivets required to bear this

strain $\frac{30.5}{1.76} = 17.3$ say 13 rivets

No. 4 Bar — Strain on each bar
 $= \frac{31.95}{2} = 15.97$ tons. Number of rivets
equal $\frac{15.97}{1.76} = 9$, but say 11.

No. 6 Bar — Strain on each
bar $\frac{22.82}{2} = 11.41$ tons. Number of
rivets required $= \frac{11.41}{1.76} = 6.48$

No. 8 Bar. — Strain on each
bar $\frac{13.69}{2} = 6.85$. Number of rivets
required $\frac{6.85}{1.76} = 3.89$. This number

will also do for bar No. 10. In all
cases more rivets are provided
for than these calculations
show are required.

With regard to attaching the
uprights

uprights to ^{the} top and bottom booms
the same number of rivets can be
used for these as for the diagonal
bars, and it is evident the rivets
will be sufficient.

Cover Plates in top boom.

As plates are made 20 feet long
it will be convenient to have
joint in bottom plate on either
side of centre of girders 9'-10" from
the centre, and to limit the usual
lengths of plates and avoid having
too many joints it will be con-
venient to have one joint in
bottom plate, a short piece of top
plate 2'-4" long and then a cover
piece as shown:



The compression force in the
boom at joint is 77.264 tons and the
area of section of top plate after
deducting two rivets is 6.75 sq. in.

while

while the net area of section of
 the whole boom is 20.50 sq inches. Con-
 sequently the top plates resist a
 compression force equal to $\frac{77.264 \times 6.75}{20.50}$
 $= 25.44$ tons. If the rivets are $\frac{3}{4}$
 diameters. Two rivets in line will
 be parallel to joint, and, therefore,
 effective area of cover plate, which
 is $\frac{1}{2}$ inch thick: $(15 - 2 \times \frac{3}{4}) \frac{1}{2} = \frac{13.5}{2}$
 $= 6.75$ square inches. This can resist
 a compression force of $4 \times 6.75 = 27.00$
 tons. Therefore two rivets in line
 will not be too much. Now as to the
 number of rivets required to
 resist shearing force, this number
 is $\frac{25.44}{1.76} = 14$, supposing these are
 all in single shear. This however
 will not be the case for then
 will be an inside cover piece.
 The rivets in double shear can
 bear the double the force, the
 rivets in single shear can, and
 therefore it is not necessary to
 provide 14 rivets. At the same time
 this number is provided for on

(5)
 each side of joint, because it is not worth
 while to reduce it. It is not necessary to
 calculate here the number of rivets required
 for bottom plate because the joint in
 this plate is amply secured by cover
 plate on top plate as will be easily
 seen from the sketch.

Joint in angle iron. — The net
 area of each angle iron: $(8 \frac{3}{8} \times \frac{7}{8} - 2 \text{ rivets})$
 $= \frac{9.59 - .33}{2.56} = 3.74$ square inches. Therefore
 each angle iron will bear a compression
 force $\frac{77.264 \times 3.74}{20.50} = 14.09$ tons. So number
 of rivets required $= \frac{14.09}{1.76} = 9$, which is
 ample for the rivets will be in double
 shear. It is evident there will be ample
 material left after deducting the rivet
 holes to resist Compression, for resistance
 to Compression is $3.74 \times 4 = 14.96$ tons.

Bottom boom. — Net sectional area
 equal 15.47 square inches. Net sectional
 area of bottom plate $5.60 - .56 = 5.04$
 sq. inches.

Bottom plate will bear a tension
 equal $\frac{77.264 \times 5.04}{15.47} = 25.17$ tons. This
 divided

divided by 1.76 = 14 rivets. 16 is the number
allowed in place. ~~the number is 16~~

The cover plate will be strong enough to resist tearing, for it can bear safely a tension of 5.04×5.27522 tons.

Cover plate for angle iron

Net area of one angle iron equal
 $8\frac{5}{8} \times \frac{3}{8} = 3.23$ square inches.

Strain on angle iron = $\frac{77.264 \times 2.23}{15.47}$, lbs. tens.

No. of rivets required $\frac{16.13}{1.76} = 9$. But as

the rivets are in double shear & the

same as provided in top house will be

complete. The cover angle in α will be

the same size and thickness as the

angle irons. In net-section after reduction.

ing two rivets is 3.23, and this multi-

plied by 5 give resistance to tearing

16. 15 tons, which is enough.

Cross Girders

Span 19 feet. Depth 1.5 feet.

Heart is as follows.

Weight of gravel: $18 \times 6.6 \times 120 \times \frac{2}{4} = 10692$ lbs.
Live load 18×6.6

Line bond $18 \times 6.6 \times 102 = 11892 - \text{DL}$
 B $18 \times 6.6 \times 102 = 11892 - \text{DL}$

Buckle plates $\rightarrow 18 \times 6.6 \times 7.5 = 891.000$

Wright of guidon _____

24 323 lbs

02 - 574 tons per
foot run.

критерия

Benduz Haupt

at Centre $\left\{ \frac{2.574 \times (7.5)^2}{2} = \frac{5.120}{2} = 2.560 \right.$

Therefore stone at centre = $\frac{25.90}{1.5} = 17.27$ tons

area of section required for top flange

$$\frac{17.27}{4} = 4.304 \text{ in.}$$

and five bottom flanges $17 \frac{27}{5} = 3.5$ sq. inches

Section proposed is thus,

area is as follows: —

Top flange

2. angle iron = $11.25 \times \frac{3}{8} = 4.22$ sq. inches.

Web between angles = $5 \cdot \frac{5}{16} = \frac{.96}{5 \cdot 16}$

Deduct one $\frac{3}{4}$ diameter rivet — .80

Net area 4.36 sq. inches.

Bottom flange

2. angle irons = $11 \frac{3}{8} \times \frac{5}{16}$ = 3.55

Wtd between angles $3 \times \frac{5}{16} = \frac{15}{16}$ or inches.

Deduct $\frac{3}{4}$ kilometer rivet — .70

Caddisflies 1897
25 June 1897

(Signed) J. H. Martin
Can. Engineer.
(Signed) G. C. Stevenson Esq.
Oct. 87.

Col. R. E.

Super Engineers
V Circle.

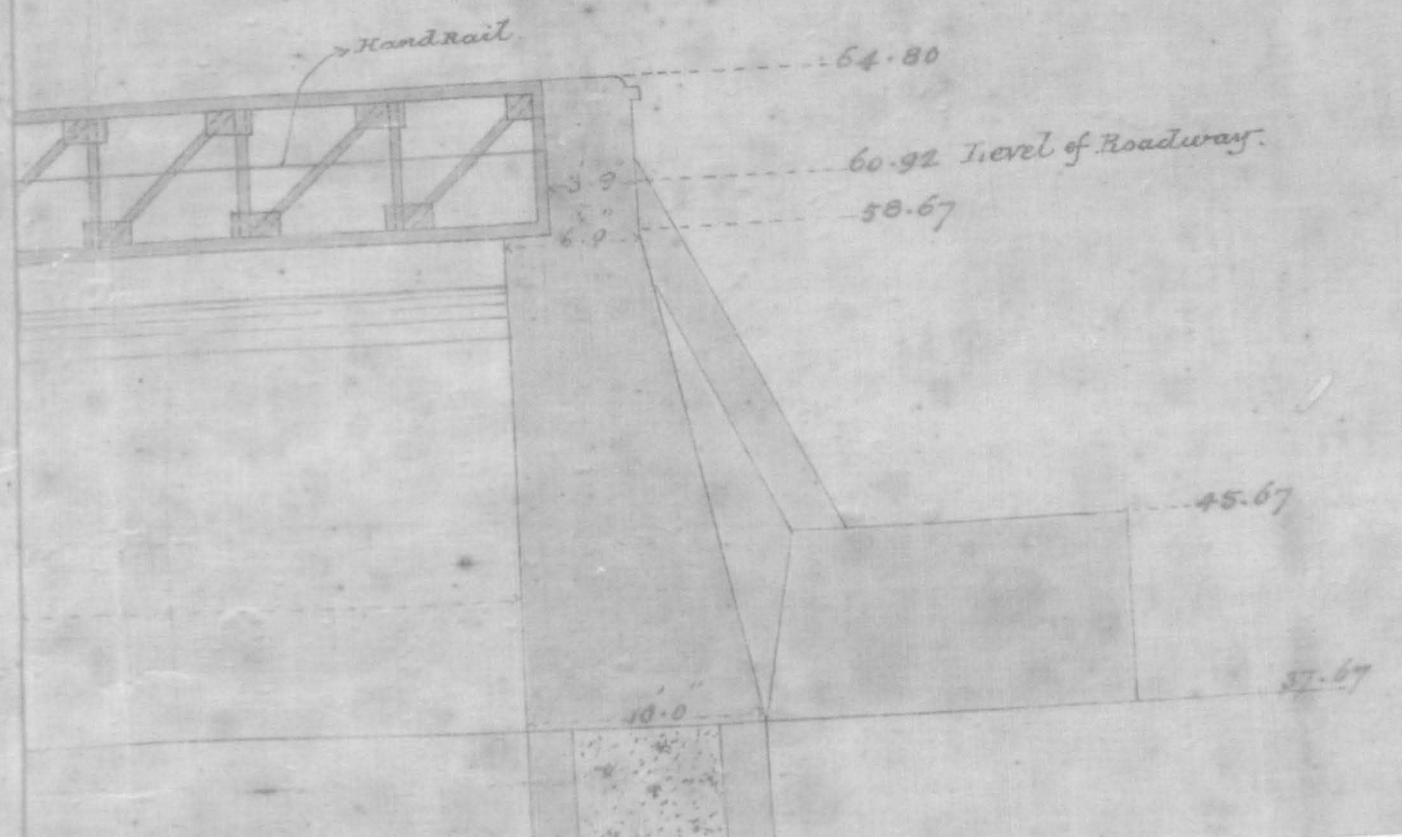


South Coast Division

Dated 22 June 1897

Calculations

Cuddalore Bridge
proposed over the
Guddalore River at



No. 2208.

SUPERINTENDING ENGINEER'S OFFICE,

V Circle, Madras,

Chennai, 17th August 1888.

From

Colonel H. M. Vilar R.E.

SUPERINTENDING ENGINEER, V CIRCLE,

To

THE Chief Engineer
P.W. Department

Sir,

Enclosures.

I have the honor to forward
the Plans &c for the Iron Girder
for the Gattilum Bridge, South
Arcot.

1 Tracing sheet No. 2.

1 Do No. 3

1 Do General elevation of
2 spans & section.

1 Sheet of calculation (19 pages)

2. I understand that you con-
sidered it would be desirable
to have the piers 7 feet thick
without batter, instead of 8'-6"
at bottom and 6 feet at top.

The span will then be 61 feet
in the clear instead of 62.

3. Although these plans &c are to
be

be forwarded to England so that the iron work may be obtained from Home. Mr Peters informs me that you considered Girders of the same pattern as the "Type Designs" would be far preferable as all the members being connected by pins, there would be no riveting to be done in this country.

4. The width of roadway allowed in the type designs is only 14 feet, whereas it will be necessary to arrange for obtaining girders which will carry a road way of 18 ft width.

5. It is more than probable that the Design herewith forwarded will be revised in England, so it was not considered necessary to alter the original Drawings which are intended for a clear span of 62 ft.

6. In ordering the girders the following points should be noted.

1. There are to be 13 spans of 61 feet clear.
2. The width of roadway is to be 18 ft.
3. All the members of the girders to be connected by pins to avoid riveting in this country.
4. Floor to be carried on buckle plates instead of planking.

7. Mr Martin took the live load in the Bridge, at 100 lbs per sq ft. In the type design it is taken at 120 lbs. 2/10

8. In the Design sent up by Mr. Martin buckle plates are allowed for and average thickness of gravel 6.3 ft. In the type designs, planking is allowed with several inches thickness of gravel. It is thought that the buckle plates will be more lasting than the planking.

9. Mr Martins calculations of the Girders, accompanying the plans which have not been altered except the small scale elevation and section of 2 bays which show the slight alteration proposed in the design.

10. It would be as well if the iron work was to reach this country in January. The cost of it could then readily be adjusted before the close of this official year.

I have the honor to be
Sir

Your most obedt servant
H. J. P. [Signature]
Col. R. E.

Superintending Engineer
5 Vicar

4. 6. 2386 W. 6. 8. 88
 527 W. 16. 2. 88
 2157 W. 16. 7. 88
 1984 W. 3. 7. 88
 1947 W. 28. 6. 88
 3372 W. 18. 6. 88
 2922 W. 8. 6. 88
 1815 W. 11. 5. 88
 1777 W. 15. 6. 88
 3074 W. 13. 9. 87
 2636 W. 9. 10. 86
 1751 W. 29. 7. 85
 237 W. 29. 1. 85
 399 W. 14. 2. 88
 3148 W. 21. 11. 87
 1387 W. 11. 5. 88
 1806 W. 7. 8. 10. 6. 88
 1147 W. 8. 9. 16. 4. 88
 237 W. 29. 1. 85

From
 THE SUPERINTENDING ENGINEER,
 (13)
 To
 THE Chief Engineer
 P.W. Department.

Dated 20th August 1888
 Recd.

ENCLOSURES 4.

No. 550 D. of 21st August 1888

No. 2248

Iron Girders for the
 Geddilam Bridge South
 Street.

Forwards Plan No.
 for the -

J. W. D.
 23/8/88

21/8/88
 21/8/88

Geddilam 18
 August 12th 1888

From
 380
 C. J. Peters Esquire
 Executive Engineer in
 Charge of Tennant &
 Geddilam Bridges
 To
 The Superintending Engineer
 5th Circle
 Sir,

In accordance with the Chief
 Engineer's instructions, I have the
 honor to forward herewith the plans
 for the iron girders for the Geddilam bridge.

1 Drawing sheet No 2
 1 3-0 No 3
 1 2-0 general
 elevation of 2 spans
 and section
 calculations

The Chief Engineer considered that
 the following alterations should be
 made in the design.

The piers to be vertical and 7 feet thick
 from bottom to top instead of 8' 6" at
 bottom and 6 feet at top.

The span to be 61 feet clear instead
 of 62.

Although these plans are to be forwarded
 to landward with the indent for the
 girders, it was considered that
 girders of the same pattern as the
 "type designs" would be for preferable,
 as all the members being connected
 by

by joining them would be no restriction
to be done in this country.

As however ^{none} of the type designs
have a greater width of roadway
than 14 feet it will be necessary to
work out girders for a least width
of roadway of 18 feet.

As in any case it is probable that
the design herewith forwarded will
be revised in England; it was not
considered necessary to alter the origi-
nal drawings which are intended for
a least span of 62 feet.

Briefly the following are the main
points to be noted in ordering the girders.

1. There are to be 13 spans of 61 feet each.
2. Width of roadway 18 feet clear.
3. All the members of the girders to be ^{supplied} as
needed by ^{the} ~~pieces~~ to avoid piling at
the site.
4. Floor to be carried on buckle plates
instead of ~~plating~~ ^{with} plating.

I observe that Mr. Martin takes
the live load on the bridge to be 100 lbs
per Sft. I think in the type designs
it is taken as 120 lbs.

As regards the dead load the buckle
plates may make a slight difference
and Mr. Martin allows for .63 thickness
of gravel which amounts to about 80 lbs
per Sft. I do not recollect what
the weight allowed for gravel ^{per} ~~per~~ ^{sq} ft.

is in the type designs: 4.51

Mr. Martin's calculations of the
girders accompanying the plans
which have not been altered except
the small scale elevation and section
of 2 bays which show the alterations
in the design.

I have the honor to be
Sir,
Yours most Obedient Servant

C. P. Allen
Executive Engineer

No. 2433-P.

From
THE SUPERINTENDING ENGINEER,
V CIRCLE,

To
THE



Dated } 188
Recd. }

ENCLOSURES.

GOVT.
OF MADRAS. }

1888

[C. No. 8.]
6P
P.W.
DEPT.

EXAMINER, P. W. ACCOUNTS.

Madras, 27 SEPTEMBER 1888

OFFICE NOTE No. 2325

To
W.

WITH REFERENCE TO THE AC-
COMPANYING LETTER NO. 2483 A. DATED
6TH. SEPTEMBER 1888 FROM THE SUPERIN-
TENDING ENGINEER 5TH. CIRCLE, FOR-
WARDED TO THE CHIEF ENGINEER P. W.
DEPARTMENT THROUGH ME WITH AN INCIDENT
IN TRIPLICATE FOR A WROUGHT IRON
LATTICE GIRDER BRIDGE FOR THE GUDLAM
RIVER, I HAVE TO OBSERVE THAT THE
VALUE OF THE BRIDGE IS NOT STATED
AND I AM UNABLE TO FURNISH THE
CERTIFICATE PRESCRIBED BY CODE AP-
PENDIX 3. PARA 10.

2. IN THE NOTE FROM THE
CHIEF ENGINEER P. W. DEPARTMENT NO.
292 D. DATED 2TH. JUNE 1888 PRINTED
WITH PROCEEDINGS COMMUNICATED WITH
G.O. NO. 3157 W. DATED 16TH. JULY
1888, IT IS STATED THAT EXCLUSIVE OF
ANY PAYMENT TO BE MADE IN ENGLAND
FOR

KEEP-WITH

Genl. No.

dated

188

1,000-7-2-88.

submitted with
582527-88

P.W.C no 9784

FOR IRON WORKS, A SUM OF RS. 30000-0-0
FOR EACH BRIDGE WILL PROBABLY SUFFICE,
THAT IS, RS. 60000-0-0 FOR THE TWO
BRIDGES OVER THE GUDLAM AND PONNAL
RIVERS.

3. ARRANGEMENTS ARE NOW BEING
MADE TO PLACE A GRANT OF RS. 125000-0-0
FROM LOCAL FUNDS AT THE DISPOSAL OF
THIS DEPARTMENT FOR THE TWO BRIDGES.

4. PLEASE THEREFORE INFORM ME
HOW MUCH OF THE GRANT MAY BE CON-
SIDERED AS SET APART TO MEET THE
EXPENDITURE IN ENGLAND ON ACCOUNT OF
THIS INCIDENT.

mb
C.

27/7
17/8

Enc.

was 20/10.

O. 1. X. 22-24. 6. 10. 08

En: 8
2/11/88

R/28.9.88

PROCEEDINGS OF THE MADRAS GOVERNMENT.

Under date the 6th October 1888

Read the following

Letter from the Executive Engineer
in charge of Sinner & Gadalam
bridges to the Supply Engineer (note)

H.E.

12th August 24, 1888

Letter from the Supply Engineer (note)

N^o 1108 of " 17. "

" " 2433 A of Sept 6, "

to from ————

" " 2325 of " 27. "

Office note from the Examiner S.W. de Silva

" " 2325 of " 27. "

Ordered that the
indent be transmitted to the
India Office for compliance
with request that the cost of
the bridge work be intimated
to the Government in view
to the requisite funds being
set apart for payment.

Ind
30/8

(H.E. N^o 2132 W of 6th October 1888)

To The Director General of Stores
India Office.

For

S.E. V (note)
F. W. de Silva
L. M. de Silva

Sir,

I am directed to forward herewith an indent, in duplicate, for the iron work required for the Gudulam bridge in the South West district.

2. The indent is accompanied by three tracings, and a sheet of calculations. Tracing

N^o I shows the general elevation of two spans of the bridge, with cross section, and it is proposed to build the bridge in accordance with the modifications of the design here given. The other plans are forwarded unaltered, as it is probable that they will be revised in the Survey Office, but

+ N^{os} II & III

27 81
I am to request that the iron work may be prepared so as to allow for thirteen spans of 61 feet clear, the piers being 7 feet thick as shown in plan N^o I.

3 The girders should be of the same pattern as those shown in the "type designs"; all the members being connected by pins, so that there would be no rivetting to be done in this country.

4 The width of roadway allowed in the type design is 14 feet, but the girders now indented for are intended to carry a roadway of 18 feet width. The floor is to be carried on buckle plates instead of plankings, and the live load is to be

taken at 120 lbs per
square foot as in the
type design.

5. It is desired that the
iron work should, if possible,
reach this country by
January, and that meanwhile
the probable cost of the
bridge work be intimated
to the Government in view to
the requisite budget provision
being made to meet it. 8/10

(H.E. Mervin Waple - Bombay)
1877

Copy of the above, with
copy of indent, forwarded to
the Govt of India for information

8/10

for
3/10/88

Urgent

9.78

R.P.
10/24/10 14/10 14/10 8/10

Govt. of (1882) Madras.
PUBLIC WORKS.

Dated

Recd.

By

O.O. 6 Oct 1882, No. 3/314

3/32
3/33 N

Indilam Bridge,
South Arcot St.

Indent for iron work
required for the — ordered
to be forwarded to the

Madras Office for con-
pliance —

Indilam Bridge,
S. Arcot St.

Forward indent for
iron work required for
the —

To L. J. L.

Indilam Bridge, S. Arcot St.

Forward copy of indent
for iron work required for
the —

3131 — 40 copies

3132 — 20 copies

3133 — 20 copies

Collection Copies 30

5
9
10