1155-3.

Govt. of 18 Madras.

PUBLIC WORKS.

Dated 5/12/90

Recd. Encl.

G.O. 5th Dec. 1890, No. 1947 R.

Municipal Engrs

Decision of the Govt regarding the assessment of Charges for — levied on H.H. the Impins Guaranteed State Railway: building at Bezwada, Cammd by the Chyor Rys.—

80
2

Exc 8/12 Ry 10

B

No 1495 R Dg 9th October 1890

PUBLIC WORKS DEPARTMENT,

RAILWAY BRANCH.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

~~UNDER date the~~

~~READ the following~~

The Consulting Engineer for Railways is requested to submit a note embodying such information as may be available with regard to the comparative advantages & cost of a bridge over the Godavari at Rajahmundry on the East Coast Railway.—

By order
W. R.

To the Consg Engr for Rys

11.3.4-3

B

No 1495 R d 9th October '90

Read the enclosed papers:—
G.O. 839 dated 20th Oct. 1892
Endorse the Reply

Note on Bridging the Godavery at Rajamundry.

From the information available in the office of the Chief Engineer for Irrigation it appears that the Godavery at Rajamundry is about 8,800 feet wide and that the water rises about 17 feet above the dry season level in high floods. The highest known flood over the Anicut gave a discharge of about 10,00,000 cubic feet per second and the average velocity did not exceed 5 miles per hour or 7.3 feet per second in the current. The discharge of 10,00,000 c ft per second from the drainage area of 115,000 Square miles appears correct as it nearly corresponds to the highest

highest flood discharge of
820,000 c.ft per second in
the Kistna with a drainage
area of 97,000 Square miles
and the catchment abutment basins
of both rivers appear to
be subject to similar rainfall.
It will be seen from the
plans that the river is
narrower at Rajamundry
than at any place within
reasonable distance up or
down stream. This narrowing
is probably caused by the
presence of soft Sand stone
rock cropping out in the
bed of the river at the
Rajamundry Side against
which the water washes in
high flood and where there
is always deep water at all
Seasons. On the Arungabad
Side on the contrary the
water in flood is Slack
the bed of the river

Sandy, and the dry Season
Channel of the river is
Constantly varying as will
be Seen from the plans
of the Sand banks in the
river for two Seasons about
10 years apart. With the
exception of the right bank
where soft Sand stone rock
Crops out the bed is Said
to be of coarse Sand which
is Supposed to extend to
a great depth but no
borings have been taken

2. Owing to the position of
the Anicut about 4 miles
below the bridge Site, if
the river is bridged at
Rajamundry Sufficient
waterway Should I think
be given to pass the highest
flood without greatly
increasing the average
velocity.

It would I think be profer to provide for passing the high floods at a mean velocity not exceeding the mean existing velocity of the river in the current. This velocity as before stated is reported not to exceed 7·3 feet per second. The greatest recorded rise of the rivers above the ordinary dry season level is 14 feet and it may be safely assumed that in high flood the average scour will increase this depth to at least 23 feet. Assuming therefore that at high flood the average depth of the water will be 23 feet and the average mean of 7·3 feet per second the waterway required to the river

discharge the 10,00,000 c. ft. per second will be $\frac{10,00,000}{23 \times 7.3}$ = 5956 lineal ft — I do not suppose that the rivers can be made to run with anything like equal velocity and equal scour through all the spans of which the bridge will be composed, on the contrary with a mean depth of 23 feet and a mean velocity of 7·3 feet per second it is probable that through some of the spans the water may be 50 feet deep and the velocity 10 to 12 feet per second whilst other spans may be silting up the depth being only 8 or 10 feet and the velocity of the current hardly appreciable

3. The clear spans of bridge over the godawery should in my opinion not be less than 200 feet and need not be greater than 242 feet the former gives a distance of 213 feet from centre to centre of piers the latter of 259 feet Anything less than 200 feet would I think obstruct the waterway too much and anything more than 242 would increase the cost of the bridge inordinately.

4. I understand that bricks of good quality can be made cheaply and easily at several places along the Canals near the head works and that the stone at hand is very inferior I therefore assume that the bridge if built will be of brickwork.

5. A design for the bridge similar to that which has been lately sanctioned for the Vistula should be suitable and altering the rates to suit brickwork & masonry the cost for piers for 200 and 242 ft clear spans should be as under

200 ft clear Span cost of 1 piers

11 tons iron in well curbs + bund rings	at 350 per ton	Rs	3850
45,000 c ft well sinking	at 25	per 100 c ft	11,250
4,200 " concrete cement	at 80	" " "	3360
9,500 " Mortar cement	at 25	" " "	2,375
26,400 " " Brickwork in mortar	at 50	" "	13,200
4,900 " " " " Cement	" 90	" "	4,410
17,400 " " Brickwork in mortar in piers	at 50	per 100 c ft	8,700
2,000 " " Ashlar masonry	1/8 c ft		3000
50,000 " " stone pitching	at 10	per 100 c ft	5,000
Total Rs			55,145
Contingencies 10 per cent			5,515
Total cost 1 piers for 200 ft Span			60,660

or Say Rs 61,000.

242 ft clear Span cost of 1 pier

	Rs
16 tons iron in well curbs & bracing at 350 f/ton	5,600
62,000 c.ft Sinking at 25 f. per 100 cub: ft	15,500
6,700 c.ft cement concrete at 80 f" "	5,360
12,900 " " Rubble masonry concrete at 25 f " "	3,225
35,100 " " Brickwork in mortar at 50 f " "	14,550
7,600 " " " " cement at 100 f " "	7,600
21,800 " " Brickwork in piers at 50 f	10,900
2,500 " " Ashlar masonry at 1/8 " "	3,750
50,000 " " stone pitching at 10 f.	5000
Total Rs	74,485
add 10 per cent for contingencies	7,445

Total cost 1 pier 250 feet span Rs 81,920
or Say Rs 82,000.

b. The cost of the girders I estimate as below

200 ft clear span erected

210 tons at 300 f per ton Rs 63,000

242 ft clear span erected.

320 tons at 300 f per ton Rs 96,000

7. For 5,950 lineal feet
30 spans of 200 feet or
25 spans of 242 feet would be

be required giving 6,000 and 6,050 lineal feet of waterway and 6,390 and 6,475 lineal feet of bridging respectively

7 Assuming that the cost of an abutment is equal to that of 1 1/2 piers. The cost of bridging the Godavery with 200 and 242 ft spans would work out as follows

Estimated cost of a bridge of 30 spans of 200 ft clear

	Rs
29 piers at 61,000 f each	17,69,000
2 abutments at 91,500 f each	1,83,000
30 Spans 200 ft girders at 63,000 f each	18,90,000
Total Rs	38,42,000

add

Earthwork approaches on both banks	1,00,000
Training works on Right bank	8,00,000
Plant &c	3,50,000
Establishment	2,08,000
Grand Total Rs	53,00,000

Estimated cost of a bridge of 25 spans of 242 ft clear

	Rs
24 piers at 82,000 for each	19,68,000
2 abutments 123,000 for each	246,000
25 Spans 200 ft girders at 96,000 each	24,00,000
Total Rs	46,14,000

add

Earthwork approaches on both banks	100,000
Training works on Right bank	890,000
Plant &c	350,000
Establishment	236,000
Grand Total Rs	61,00,000

From which it appears that a bridge of 30 spans of 200 feet giving 6,000 lineal feet of waterway might be expected to cost Rs 53,00,000 and a similar bridge of 25 spans of 242 ft giving 6050 lineal ft: of waterway Rs 61,00,000.

I am of opinion that at the 25 Spans of 242 feet waterway the 200 feet spans will not obstruct the waterway injurious-ly and I therefore think the 200 spans should be adopted.

8. The ferry across the Godavery at Rajamundry is estimated to cost Rs 11,00,000 and it will be seen from the plan of the river Sand banks that its maintenance will be costly and that it will be difficult to keep up owing to the constant Shifting of the Sand banks on the right bank of the river. It will in fact be constantly necessary to shift the river bank Sidings between the middle of June and the middle of December (as the Godavery river is affected by both monsoons and is constantly rising & falling between

between these periods)
to a dread of wagons being
run on board the ferry boats.
It appears doubtful indeed
if the ferry could be kept
up efficiently during these
6 months if any abnormal
pressure of traffic took place.

9. I have no reliable data
upon which I can base
an estimate of the cost
of maintaining the ferry
but if paying down and
taking up Sidings and
building temporary bridges
to reach the channels of
the rivers; losses of permanent
way in Sudden floods;
Maintenance of Ferry boats
and staff and fuel to work them;
Stations and staff to work
them on both banks of the
rivers; quarters for the
ferry and Station staff and
and delays in crossing
Vehicles and wagons especially
in times of heavy traffic
be taken in account; the
annual cost will I feel certain
not amount to less than Rs
150,000 per year which capi-
talized at 4 per cent would
represent Rs 37,50,000. If to
this sum of Rs 37,50,000 be
added the original cost
of the ferry Rs 11,00,000, the
total capitalized cost of
the ferry would be Rs 48,50,000
against Rs 53,00,000 for a bridge.

10. If the figures I have
given above are even approxi-
mately accurate the case in
favor of building the bridge
is overwhelming and at all
events a case has been made
out which I think shews
that the cost of building
a bridge should be
fully

fully investigated and
compared with the
capitalized cost of maintaining
and equipping a ferry
before the latter is
decided upon. With
the help of an Assistant
Engineer to make Surveys
and take borings at
Rajamundry Mr Spring
should be able to make
out an estimate for
bridging the Godavery
in a few months and
orders might be issued
to Mr Walker to this
effect and the Govern-
ment of India informed
of the action taken.

Yours Obdt Servt
Yr Consulting Engineer

P.S. Since writing the above Mr Walker
has ascertained that the annual cost
of maintaining the ferry over
the Indus at Sukkur was
1 3/4 Lacs.

P.W. Rec'd 9838/90.

Form No. 1.

PUBLIC WORKS DEPARTMENT.

OFFICE OF CONSULTING ENGINEER FOR RAILWAYS,
Madras, 16th October 1890.

Note by the Consulting Engineer for Railways dated 16th October 1890 on bridging the Godaveri at Rajamundry

No. 686

SUBMITTED _____ to _____ Government.

Sidney Smith
Major R.E.
for Offg Consg Engr for Rys

Subject.

Form No. 3.

B. No. 1585 R. 23rd Oct/90.

H.S. 17/10/90

Ordered that the Govt: of India be addressed.-

H.E. No 1586 R. 23rd Oct/90.

H.S.
Ps. R

From

THE CONSULTING ENGINEER
FOR RAILWAYS,
MADRAS.

No. 686

Dated 16th
Received 17 } October 1890.

No. of Enclosures.

Subject.

Submitting note by the Consulting Engineer for Railways on bridging the Godaveri at Rajamundry

B.
No. 1585-86 R. 23rd Oct/90

P.W. Cir. 9838.

DE

1¾ lacs

B.
No. 1586 R. 23rd October 1890.

H.S.
17/10/90

For approval

Rs 48,50,000 in Cash

To
The Govt of India

Sir

I am directed to forward
Copy of a note by the ~~Chief~~ Officiating
Consulting Engineer for Railways on the Combatoor Cut
& a bridge and ferry over the
Godavery river at Rajmundry
from which it appears that a
bridge ~~in Eight~~ of 30 spans of 200
feet in clear waterway & Cut Rs 53
lacs is omitting the Rs 3,50,000
the Estimated value of the tools &
plant which will be available for
the Kistna bridge works ~~is~~ and
that the Estimated ~~cost of~~
Calculated Cost of ~~the ferry~~ &
Resuscitating the ferry is Rs 48,50,000

2. His Excellency in Council is ~~of~~ opinion
that if ~~the projected~~ these ferries
are even approximately accurate
a complete case has been made
out for the immediate Construction ~~of the~~
bridge of ~~more~~ of the bridge ~~will~~
~~the~~ ~~Kistna~~ ~~Resuscitation~~ ~~charges~~
~~is~~ ~~more~~ ~~than~~ ~~the~~ ~~estimate~~ ~~of~~ ~~the~~
~~bridge~~ ~~proper~~.

but as the figures are admitted
put forward as incomplete doctor
he Considers there ~~would~~ insufficient
has been shewn to call for a
Complete investigation into the
relative Cost of building a bridge
and Establishing & maintaining a
ferry over the Godavery at Rajmundry
3. His Excellency ~~The Govt of Madras~~ is of opinion
Communicated, the Govt of
that the investigations ~~with which~~
should be placed in the hands of
Officers specially selected for the purpose
submitted ~~with~~ ~~a~~ satisfactory proposals
~~for~~ for bridging the River at
Rajmundry. He ~~is of opinion~~ ~~that~~
proposes ~~that~~ Could perform ~~the~~ his
duties under the Council as Secretary
of Mr. Walker the Engineer in Chief
of the East Coast Railway and would
not need the assistance ~~of~~ an Executive
Asst Engineer with ~~a~~ two subordinates
to take borings and make out the
requisite plans & Estimates. ~~that~~
a Complete project could be ready
to be put out in 6 months at a Cost
not exceeding Rs 10,000 or Rs 12,000
~~4. His Excellency in Council thinks~~
~~that the Govt of India will sanction~~
~~the proposed investigations and~~
~~Operations~~
4. His Excellency in Council does
not Consider it necessary to enter

at large into ~~the~~ discussion of
detail, the advantages ~~of~~ ~~the~~ ~~bridge~~ ~~over~~ ~~the~~ ~~Godavery~~ at Rajmundry
bridge over the Godavery at Rajmundry
would have over a ferry. ~~under~~
being sufficiently obvious.
these advantages ~~are not to be doubted~~
He therefore thinks that the Govt of India
will sanction the proposal under
Rule 15 fully recognizing the Question
and ~~what point of principle is involved~~
~~the Govt of India must therefore~~
~~point out what the Govt~~
will point the result seen of necessary
Expenditure to meet the ~~Expenditure~~
that must be incurred.

14/10/90

Drgs accepts to Govt of India
with 2 tracings
23-10-90.

Dft. Hon. Mr Governor
Hon. Mr J.H. Garstin C.I.E.

Special

Issued 2nd
Dr
23/10

B
No 1586 R dy 23rd Oct 90.

No. 1012R. 6

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

RAILWAY Construction

All communications should be addressed to the Secretary.

SS/
23/11/90

To

The Joint Secretary to the Government of Madras
(Railway Branch) Public Works Department

Calcutta, the 17th November 1890

Sir,

I am directed to acknowledge the receipt of your letter No 1586 R dated 23 October 1890, forwarding a Note by the Officiating Consulting Engineer for Railways, Madras, on the comparative cost of a bridge and of a ferry, respectively, over the Godavari river at Rajahmundry, East Coast Railway, and proposing that the question should be fully investigated.

2. In reply I am to say that the Government of India has no objection to

the

H.W. 17.x.90
R18/-
Hdlt Dr 18.x.90
R13/-

31/10

Dr 30/10.

P.W. Cdc. 11224.

8

the proposed investigation by such of the East Coast Railway staff as the Govern-ment of Madras may consider best; and that the cost of these investigations should be charged against the Construction grant for the East Coast Line and debited against the head "Preliminary Expenses"

Rd 24-11-90

I have the honour to be,

Sir,

Your most Obedient Servant,

F. S. Hebbert

Offg Under Secretary

No 1586 Rd/23.10.90
" 1585-86 Rd/23-10-90
" 1495 Rd/9-10-90.

Documents accompanying Nil

Nil

P.W. Department

List of papers detained in Circulation

Current number	Date	Subject	taken circulation	Returned taken.
11280	18th Novr.	Mr. F. J. C. Spring, Ex. Engr. Kistna bridge works. Approving the proposal to place — directly under the Consulting Engr. for Railways, with powers of an Engineer-in-Chief	26th Novr.	
11224	17th Novr.	Bridge and ferry over the Godavari river. Letter from the Govt of India stating that there is no objection to the investigation of the comparative cost of the —	26th Novr.	

The undersigned will feel much obliged if His Excellency the Governor could kindly return the papers noted above, which were sent for approval, as it is necessary to communicate them to the officers concerned as early as possible.

Dispatched 2-30 pm 27/11

Lt Colonel RE

Offg Jt Secy to Govt P.W.D. Ry Branch

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Railway.

Read again the following papers :—

G.O., dated 9th October 1890, No. 1495 R., Public Works.

Order—dated 9th October 1890, No. 1495 R., Public Works.

The Consulting Engineer for Railways is requested to submit a note embodying such information as may be available with regard to the comparative advantages and cost of a ferry and bridge over the Godávari at Rajahmundry on the East Coast Railway.

(True Extract.)

(Signed) T. GRACEY, Lieut.-Colonel, R.E.,
Offg. Joint Secy. to Govt., P.W.D.,
Railway Branch.

G.O., dated 23rd October 1890, No. 1585 R., Public Works.

From the Consulting Engineer for Railways, dated Madras, 16th October 1890, No. 686.

NOTE by the Consulting Engineer for Railways, dated 16th October 1890, on bridging the Godávari at Rajahmundry.

From the information available in the office of the Chief Engineer for Irrigation it appears that the Godávari at Rajahmundry is about 8,500 feet wide and that the water rises about 17 feet above the dry season level in high floods. The highest known flood over the anicut gave a discharge of about 10,00,000 cubic feet per second, and the average velocity did not exceed 5 miles per hour or 7·3 feet per second in the current. The discharge of 10,00,000 cubic feet per second from the drainage area of 115,000 square miles appears correct, as it nearly corresponds to the highest flood discharge of 820,000 cubic feet per second in the Kistna with a drainage area of 97,000 square miles, and the catchment basins of both rivers appear to be subject to similar rainfall. It will be seen from the plans that the river is narrower at Rajahmundry than at any place within reasonable distance up or down stream. This narrowing is probably caused by the presence of soft sand-stone rock cropping out in the bed of the river at the Rajahmundry side against which the water washes in high flood and where there is always deep water at all seasons. On the Arungabad side on the contrary the water in flood is slack, the bed of the river sandy, and the dry season channel of the river is constantly varying as will be seen from the plan of the sand banks in the river for two seasons about 10 years apart With the exception of the right bank where soft sand-stone rock crops out the bed is said to be of coarse sand which is supposed to extend to a great depth, but no borings have been taken.

2. Owing to the position of the anicut about 4 miles below the bridge site, if the river is bridged at Rajahmundry sufficient water-way should I think be given to pass the highest flood without greatly increasing the average velocity.

It would I think be proper to provide for passing the high floods at a mean velocity not exceeding the mean existing velocity of the river in the current. This

per year, which capitalized at 4 per cent. would represent Rs. 37,50,000. If to this sum of Rs. 37,50,000 be added the original cost of the ferry Rs. 11,00,000, the total capitalized cost of the ferry would be Rs. 48,50,000 against Rs. 53,00,000 for a bridge.

10. If the figures I have given above are even approximately accurate, the case in favor of building the bridge is overwhelming, and at all events a case has been made out which I think shows that the cost of building a bridge should be fully investigated and compared with the capitalized cost of maintaining and equipping a ferry before the latter is decided upon. With the help of an Assistant Engineer to make surveys and take borings at Rajahmundry Mr. Spring should be able to make out an estimate for bridging the Godávari in a few months and orders might be issued to Mr. Walker to this effect and the Government of India informed of the action taken.

P.S.—Since writing the above I have ascertained that the annual cost of maintaining the ferry over the Indus at Sukkur was $1\frac{3}{4}$ lakhs.

Submitted to Government.

Order—dated 23rd October 1890, No. 1585 R., Public Works.

Ordered that the Government of India be addressed.

(Here enter No. 1586 R., dated 23rd October 1890.)

(True Extract.)

(Signed) T. GRACEY, Lieut.-Colonel, R.E.,
Offg. Joint Secy. to Govt., P.W.D.,
Railway Branch.

Letter from the Officiating Joint Secretary to the Government of Madras, Public Works Department, Railway Branch, to the Secretary to the Government of India, Public Works Department, dated 23rd October 1890, No. 1586 R.

I am directed to forward copy of a note by the Officiating Consulting Engineer, Madras, on the comparative cost of a bridge and ferry over the Godávari river at Rajahmundry, from which it appears that a bridge of 30 spans of 200 feet is estimated to cost Rs. 53 lakhs or Rs. 49,50,000 in cash, omitting Rs. 3,50,000 the estimated value of the tools and plant which will be available for the Kistna bridge works, and that the estimated capitalized cost of maintaining the ferry is Rs. 48,50,000.

2. His Excellency in Council is of opinion that if these figures are even approximately accurate a complete case has been made out for the immediate construction of the bridge, but as the figures are admittedly put forward on incomplete data he considers that sufficient has been shown to call for a complete investigation into the relative cost of building a bridge and establishing and maintaining a ferry over the Godávari at Rajahmundry.

3. His Excellency is of opinion that the investigations connected with the projects should be placed in the hands of Mr. Spring, the Executive Engineer, who has just submitted satisfactory proposals for bridging the Kistna at Bezváda. Mr. Spring could prepare his proposals under the general supervision of Mr. Walker, the Engineer-in-Chief of the East Coast Railway, and would only need the assistance of an experienced Assistant Engineer with one or two subordinates to take borings and make out the requisite plans and estimates. A complete project could probably he got out in six months at a cost not exceeding Rs. 10,000 to Rs. 12,000.

4. His Excellency in Council does not consider it necessary to enter at length into a detailed description of the advantages that a bridge over the Godávari at Rajahmundry would have over a ferry, those advantages being sufficiently obvious. He

therefore trusts that the Government of India will sanction the proposal now made to fully investigate the question and will grant the small sum of money required to meet the expenditure that must be incurred.

Read also the following paper :—

From the Officiating Under-Secretary to the Government of India, Public Works Department (Railway Construction), to the Joint Secretary to the Government of Madras, Public Works Department, Railway Branch, dated Calcutta, 17th November 1890, No. 1012 R.C.

I am directed to acknowledge the receipt of your letter No. 1586 R., dated 23rd October 1890, forwarding a note by the Officiating Consulting Engineer for Railways, Madras, on the comparative cost of a bridge and of a ferry, respectively, over the Godávari river at Rajahmundry, East Coast Railway, and proposing that the question should be fully investigated.

2. In reply, I am to say that the Government of India has no objection to the proposed investigation by such of the East Coast Railway staff as the Government of Madras may consider best, and that the cost of these investigations should be charged against the construction grant for the East Coast line and debited against the head "Preliminary expenses."

ORDER—dated 5th December 1890, No. 1948 R., Public Works.

Communicated, with reference to endorsement No. 686, dated 16th October 1890, to the Consulting Engineer for Railways, who is directed to call upon Mr. Spring to report what staff he will require to fully investigate the question of bridging the Godávari at Rajahmundry and to furnish an estimate of the cost thereof, as also an estimate of the cost of carrying out the investigation.

2. The Consulting Engineer will forward a copy of these Proceedings to the Engineer-in-Chief, East Coast Railway, for information.

(True Extract.)

Major, R.E.,
Under-Secy. to Govt., P.W.D.,
Railway Branch.

To the Consulting Engineer for Railways.
" Examiner, East Coast Railway Accounts.

Exd. J Moses.
Spare Copies

velocity, as before stated, is reported not to exceed 7·3 feet per second. The greatest recorded rise of the river above the ordinary dry season level is 17 feet, and it may be safely assumed that in high flood the average scour will increase this depth to at least 23 feet. Assuming therefore that in high flood the average depth of the water will be 23 feet and the average mean velocity 7·3 feet per second the water-way required to discharge the 10,00,000 cubic feet per second will be $\frac{10,00,000}{23 \times 7·3} = 5,956$ lineal feet. I do not suppose that the river can be made to run with anything like equal velocity and equal scour through all the spans of which the bridge will be composed; on the contrary with a mean depth of 23 feet and a mean velocity of 7·3 feet per second it is probable that through some of the spans the water may be 50 feet deep and the velocity 10 to 12 feet per second, whilst other spans may be silting up, the depth being only 8 or 10 feet and the velocity of the current hardly appreciable.

3. The clear spans of bridge over the Godávari should in my opinion not be less than 200 feet and need not be greater than 242 feet—the former gives a distance of 213 feet from centre to centre of pier, the latter of 259 feet. Anything less than 200 feet would I think obstruct the water-way too much, and anything more than 242 would increase the cost of the bridge inordinately.

4. I understand that bricks of good quality can be made cheaply and easily at several places along the canals near the head works and that the stone at hand is very inferior. I therefore assume that the bridge if built will be of brickwork.

5. A design for the bridge similar to that which has been lately sanctioned for the Kistna should be suitable, and altering the rates to suit brickwork masonry the cost for piers for 200 and 242 feet clear spans should be as under :—

200 feet clear spans cost of 1 pier—			RS.
11 tons iron in well curbs and bund rings at 350 per ton		...	3,850
45,000 cubic feet well sinking at 25 per 100 cubic feet		...	11,250
4,200	„	concrete cement at 80 per 100 cubic feet	... 3,360
9,500	„	mortar cement at 25 per 100 cubic feet	... 2,375
26,400	„	brickwork in mortar at 50 per 100 cubic feet.	13,200
4,900	„	brickwork in cement at 90 per 100 cubic feet.	4,410
17,400	„	brickwork in mortar in piers at 50 per 100 cubic feet	8,700
2,000	„	Ashlar masonry 1/8 cubic feet	... 3,000
50,000	„	stone pitching at 10 per 100 cubic feet	... 5,000
		Total	... 55,145
Contingencies 10 per cent.			... 5,515
		Total cost 1 pier for 200 feet span	... 60,660
		or say	... 61,000

242 feet clear spans cost of 1 pier—			
16 tons iron in well curbs and bund iron at 350 per ton		...	5,600
62,000 cubic feet sinking at 25 per 100 cubic feet ...		...	15,500
6,700	„	cement concrete at 80 per 100 cubic feet	... 5,360
12,900	„	mortar concrete at 25 per 100 cubic feet	... 3,225
35,100	„	brickwork in mortar at 50 per 100 cubic feet.	17,550
7,600	„	brickwork in cement at 100 per 100 cubic feet.	7,600
21,800	„	brickwork in piers at 50 per 100 cubic feet ..	10,900
2,500	„	Ashlar masonry at 1/8 per 100 cubic feet	... 3,750
50,000	„	stone pitching at 10 per 100 cubic feet	.. 5,000
		Total	... 74,485
Add 10 per cent. for contingencies			... 7,445
		Total cost 1 pier 250 feet spans	... 81,930
		or say	... 82,000

6. The cost of the girders I estimate as below :—

	RS.
200 feet clear spans erected—	
210 tons at 300 per ton	63,000
242 feet clear spans erected—	
320 tons at 300 per ton	96,000

7. For 5,950 lineal feet 30 spans of 200 feet or 25 spans of 242 feet would be required giving 6,000 and 6,050 lineal feet of water-way and 6,390 and 6,475 lineal feet of bridging respectively.

Assuming that the cost of an abutment is equal to that of 1½ piers, the cost of bridging the Godávari with 200 and 242 feet spans would work out as follows :—

	RS.
Estimated cost of a bridge of 30 spans of 200 feet clear—	
29 piers at 61,000 each	17,69,000
2 abutments at 91,500 each	1,83,000
30 spans 200 feet girders at 63,000 each	18,90,000
Total ...	38,42,000
Add—	
Earthwork approaches on both banks	1,00,000
Training works on right bank	8,00,000
Plant, &c.	3,50,000
Establishment	2,08,000
Grand Total ...	53,00,000
Estimated cost of a bridge of 25 spans of 242 feet clear—	
24 piers at 82,000 each	19,68,000
2 abutments 1,23,000 each	2,46,000
25 spans 200 feet girders at 96,000 each	24,00,000
Total ..	46,14,000
Add—	
Earthwork approaches on both banks	1,00,000
Training works on right bank	8,00,000
Plant, &c.	3,50,000
Establishment	2,36,000
Grand Total ...	61,00,000

From which it appears that a bridge of 30 spans of 200 feet giving 6,000 lineal feet of water-way might be expected to cost Rs. 53,00,000, and a similar bridge of 25 spans of 242 feet giving 6,050 lineal feet of water-way Rs. 61,00,000. I am of opinion that the 200 feet spans will not obstruct the water-way injuriously, and I therefore think the 200 spans should be adopted.

8. The ferry across the Godávari at Rajahmundry is estimated to cost Rs. 11,00,000, and it will be seen from the plan of the river sand-banks that its maintenance will be costly and that it will be difficult to keep up owing to the constant shifting of the sand-banks on the right bank of the river. It will in fact be constantly necessary to shift the river bank sidings between the middle of June and the middle of December (as the Godávari river is affected by both monsoons and is constantly rising and falling between those periods) to admit of wagons being run on board the ferry boats. It appears doubtful indeed if the ferry could be kept up efficiently during these six months if any abnormal pressure of traffic took place.

9. I have no reliable data upon which I can base an estimate of the cost of maintaining the ferry, but if laying down and taking up sidings and building temporary bridges to reach the channels of the river, losses of permanent-way in sudden floods, maintenance of ferry boats and staff and fare to work them, stations and staff to work them on both banks of the river, quarters for the ferry and station staff and delays in crossing vehicles and wagons especially in times of heavy traffic be taken in account, the annual cost will I feel certain not amount to less than Rs. 1,50,000

RAILWAY.

Govt. of {1890} Madras.

PUBLIC WORKS.

Dated December, 5th.

Read. *Encl.*

G.O., 5th Dec. 1890, No. 1948 R.

DECEMBER.

Bridge or a Ferry over the Godavari River at Rajahmundry

Investigation of the proposal to construct a —, sanctioned by the Government of India with remarks.

A

No. 1948 R

PUBLIC WORKS DEPARTMENT,

RAILWAY BRANCH.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

UNDER date the 5th Dec 1890.

Read again the following

Progs: of the Madras Govt. P. W. Dept: } Dt. No. 1495 R dy 9th Oct 90

Do. Do. " 1585-86 R dy 23rd Oct 90

Read also the following.

Letter from the Govt. of India P. W. Dept: } Dt. No. 1012 R.C dy 17th Nov 90

148 R

Communicated, with reference to Endorsement No. 686 dy 16th October 90, to the Consulting Engineer for Railways, who is directed to call upon Mr Spring to report what staff he will require to fully investigate the question of bridging the Godavari at Rajahmundry and to furnish an estimate of the cost thereof, as also an

an estimate of the cost
of carrying out the investi-
gation.
2. The Consulting Engineer will forward
a Copy of these proceedings to the
Engineer in Chief East Coast
Railway for information Bg: R.

A

No. 1948 R&S 5th Dec 1890.

To
The Consulting Engr for Rys
— Engr E. C. Ry. Accts.