M.R.O. 1—77,006—8-6-37.

(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. 72, 72A, 78	2602	Press / Mis.
Dated	5 · 11	1872.

Not to be folded or roughly handled

No. 72. Read the following papers:—

From the Superintending Engineer, 5th Division, to the Secretary to Government, Public Works Department, dated Cuddalore, 5th July 1872, No. 78.

1 Copy of letter.
2 Plans.
1 Estimate.
1 Specification.

With reference to the Order of Government of the 26th March, No. 846, I have the honour to forward a copy of the report received from the Executive Engineer, Bangalore, on the cause of the failure of the cistern at the Cavalry Barracks. The report would have been forwarded at once; but I called for an estimate for restoring a portion of the cistern, to retain a few days' supply, to obviate the necessity for pumping daily.

2. There can be no doubt that the failure of the cistern is due to the original flooring having been laid on made earth, which was not properly consolidated. The cistern is divided into two portions by a cross wall. The floor of the entire cistern is above ground, which having a slope, there is a considerable portion of made earth under one-half of the cistern and much less under the other. A substantial water-tight flooring was formed over the original floor in 1869, and other repairs were made; but the half of the cistern, under which there is the greatest thickness of made earth, was found to leak as soon as water was admitted into it. The other half after repair answered perfectly for twenty-one months, and when it did fail, the leak was at the end where there was the greatest depth of earth.

3. I propose now to build a cross wall at 100 feet from the upper end so as to form a cistern that will hold eight days' supply. Under the floor of this portion there is so little made earth that there is a reasonable prospect of the leakage being stopped. There will then be no necessity for pumping daily until either the entire cistern is restored or a new one built on a different site.

From the Executive Engineer, Bangalore, to the Superintending Engineer, 5th Division, dated Bangalore, 27th April 1872, No. 93.

With reference to G. O., No. 846, dated 26th March 1872, I have the honour to forward a drawing showing the original section of the race-course cistern of the Ulsoor Water Works, and the same as repaired in 1870.

2. The repairs consisted in constructing a lining wall of brick in cement within the main walls of the cistern, one brick thick to a depth of one foot below the toe of the foundation of the walls. Two courses of brick on edge in cement were also laid diagonally on the old floors, and the whole interior surfaces plastered with cement.

3. The present failure has taken place, as far as I can judge, precisely in the same way as the previous one; that is the floor has sunk and so caused a crack along the interior edge of the cistern where the floor and walls join. The inference appears to me to be that the made earth with which the basement of the cistern was filled in has been the cause of the mischief.

4. The greatest depth of this made earth is 3 feet, and the fact that the cistern at Royal Horse Artillery Barracks after precisely similar repair has been perfectly successful affords, I think, sufficient evidence to show that there was a reasonable prospect of success attending the measures adopted at the race-course cistern. As a matter of fact, however, the repair of one half of this cistern was a complete failure, and the other half has again failed quite unexpectedly after having been in use for twenty-one months. It should be mentioned that the half of the cistern

having the greatest depth of made earth in the basement was the one which failed on repair, and that the leaks broke out in the second half at that end where the greatest depth of earth also was.

5. The work at both cisterns was executed by the same contractor and precisely in the same way, and I am unable to detect any difference in its quality. This being so, the only theory I can suggest is that the basement of, and adjacent grounds to, the race-course cistern, each half of which containing 475,000 gallons was entirely changed in its structure by the percolation of so large a body of water through it, and that holes and channels probably existed in it, which after having been thoroughly drained of the water they held, eventually gave way under the pressure of the superincumbent mass of water.

6. I consequently infer that the actual site of the cistern is an undesirable one to build on again, unless the earth to a depth of 5 or 6 feet is entirely removed and made good with a firm foundation consisting of a bed of concrete. As this will be a most expensive work, I beg to submit the question for your opinion. As regards the filter out of repair, the same reasoning applies. In this case, however, the made earth, on which the floor is laid, varies from 3 or 4 feet in depth on the north wall to 14 feet in depth along the south wall. The work which I consider necessary is, therefore, still larger in this case.

No. 72A. From the Superintending Engineer, 5th Division, to the Secretary to Government, Public Works Department, dated Camp at Ahtoor, 3rd October 1872, No. 138.

WITH reference to your memorandum No. 122 of the 23rd of September, I have the honour to inform you that the stone slabs that had been laid in the cisterns were not taken up, as the Executive Engineer considered they would serve to distribute the weight, and that by retaining them there would be less likelihood of the concrete and made earth giving way. The failure of the floor of the cistern was not due to leakage between the joints of the stones, but to the sinking of the made earth. I am unable to give any information as to how the floors were formed in the first instance, as the cisterns were built, or almost finished, before I was appointed to the division.

2. The work first undertaken in 1869 was the repair of the half of the Horse Artillery cistern, under the floor of which there was the greatest depth of made earth, as affording the best test of the efficiency of the proposed method. The repair having been found to be perfectly successful, the rest of the work was taken in hand; and it appears from Captain Wood's letter of the 5th April 1870, that the repair of one half of the Cavalry cistern and of one of the filters was next carried out and also successfully. The repair of the second half of each cistern and second filter was not commenced until the work already done had been found to answer.

3. No official report of the failure of half of the Cavalry cistern and second filter was received until after I had given over charge of the division in April 1870. The delay in the report was probably due to Captain Wood being on privilege leave, or to his wishing to ascertain exactly the nature and extent of the failure.

4. The contractor was paid the full amount of Rupees 34,000, the work done by him being considered very good, and the failure of a portion being due to the bad quality of the original flooring.

5. I take the opportunity to mention that while at Bangalore last month I carefully examined the Cavalry cistern, and came to the conclusion that before any large outlay is incurred in repairing it, it will be worthwhile trying whether simply repairing the cracks (which are very slight) with Portland cement will not render the cistern water-tight and allow of its again being used at least for some months.

Memorandum by Chief Engineer.

THE Royal Horse Artillery cisterns having been altered and made water-tight precisely in the same manner as the race-course cisterns; the greatest depth of made earth being the same at both sites; the masonry sections above and below not less in the latter than in the former; no difference discernible in quality of work of repair carried out, but both equally good; all these circumstances would appear to warrant the conclusion arrived at by the Superintending and Executive Engineers, namely, that failure of the latter work was caused by sinking of the floor.

2. But such sinking would not account for the "saturation of the walls on both sides;" nor for the "displacement of masonry causing a crack" visible for nearly 50 feet in length "through which the water spirted freely;" nor for the crack running perpendicularly upwards in an angle between a side and cross wall. Sinking of the floor would account only for cracks in the floor. The crack in the side wall can only be accounted for by its having given way to pressure of water. Saturation of the masonry under such pressure would then gradually ensue through the crack; and the crack would at last enlarge till it admitted of the escape of water through the wall.

3. Reasoning as above, I conclude that it would be unsafe to trust to the same masonry unless well buttressed, or the depth of water kept low, say, down to 5 feet at the utmost. I note that in a letter of 15th December 1868, the Superintending Engineer states that he considered the thickness of the walls, and the depth of the foundation insufficient. It was, therefore, an inconsistency raising the height of the walls, because the level of the floors was raised. And the latter step was an after-thought carried out without reference to G. O. No. 132 of 16th January 1869, which directed that the stone flooring should be removed, and the new floor substituted for it not laid upon it. And raising the wall was quite unnecessary, as cisterns to hold eight days' supply are amply large enough.

4. I should propose therefore again to utilize the upper cistern only, retaining the upper and two side walls as they are, but reducing height of the end wall to 4½ feet, which would permit of a sufficiency of water being stored. Whether the floor has really sunk must be accurately tested by levels being taken. If sunk, it must all be taken up and relaid at the original level, all made earth being previously removed and replaced with puddled clay. If not sunk, then provision of a cordon of masonry laid in hydraulic cement round the junction of the floor and walls ought to serve every purpose.

OOTACAMUND, *23rd October* 1872.

(Signed) G. W. WALKER, Colonel, R.E.,
Chief Engineer, D.P.W.

Proceedings of the Madras Government, Public Works Department, 5th November 1872.

No. 73. ORDER THEREON, 5th November 1872, No. 2,602.

MILITARY WORKS, No. 4.

THE Superintending Engineer of the 5th Division will ascertain, by accurate levels, whether the floor of the cistern has sunk or not; and will estimate for utilizing the upper half, according to the result of such inquiry, in the manner indicated by the Chief Engineer's remarks.

2. The failure of the repairs of the other half immediately after their execution in October 1869 should have been reported at the time; and stricter attention should have been paid to the wording of G. O. No. 132 of 16th January 1869.

(True Extract.)

Major, R.E.,

Acting Joint Secretary to Government.

To the Superintending Engineer, 5th Division.
" Military Department.

Exd. E. C. Shunker.

Specification to accompany plan and Estimate for repair of Cistern Race Course Barracks.

Amount of Estimate Rupees. 750/700

At one hundred feet from the East wall of the Eastern half of the 2d Coor water Cistern at the Race Course Barracks, a partition wall is will be built of the dimensions shewn in the plan.

The foundation of the cross wall to be of well burnt brick in Chunam, and the excavation necessary for its proper construction to be taken out on the west side, leaving that on the East side, quite perpendicular to the flooring.

Around the interior edges of the new partition of the Cistern, Masonry will be built of best bricks in Chunam to cut off any tendency the water held on the Cistern may have, to percolate between the floor and the walls.

The Masonry will be a triangle having 3 feet base & 2 feet height, and the plaster of the masonry in flows which and against which this triangular piece of masonry abuts, will be removed

removed to allow of proper adhesion between the old and new work. The masonry of the work, dividing the Cistern to be of well burnt bricks in Chunam, and where the new masonry joins the old, the old plaster should be removed and the new masonry grooved into the old. The new partition wall should be on completion plastered with two coats on the western side or exterior, and three coats on the Eastern or interior side.

The Chunam should be compposed as follows, 3 lime and 2 sand this also applies to first coat of plaster.

The second coat of plaster one lime and one sand.

The third coat of plaster two of lime to one of clean white sand.

The brickwork to be of English bond. The excavation whilst filling in to be rammed, round the masonry.

The site to be left clean on completion of the work.

All things not mentioned in the above specification, which shall be considered necessary, to be done on the order of the officer in charge of the works.

Captain R. E
Executive Engineer Bangalore

Chief Engrs office
Bangalore.
26th June 1872

Brevet Colonel R.E
Superintending Engineer 5th Dn

From The Exc. Engr
Bangalore
To Supdg Engr
5th Division
Nos 26th & 27th/72
Rd 2 June 1872
Forwarding & accompanying
the Estimate for repairs
of Cistern Race
Course Barracks
at Bangalore
Amounting to Rs 780

Bangalore

Abstract Estimate of 1872/73.

Work. Repairing the Cistern at the Race Course Barracks at Bangalore

Quantity	Description of Work	Rate	Per	Amount	Total
3.76	Squares of Picking up the old floor	2	" Sqr	8	
14.85	" Removing plaster	"	8 "	7	
1716	Cubic feet of Excavation	"	" 1 Cft	9	
462	" of filling in Superfluous Excavation	"	" 1 "	2	
37163	" of Brick in Chunam	"	29 "	647	
17.84	Squares of Plastering with 3 coats of Chunam	3	8 " Sqr	62	
3.34	" of Plastering with 2 coats of Chunam	2	8 "	8	
				743	
	Sundries			37	
	Total Estimate Rupees				780

Executive Engrs Office
Bangalore 26th June 1872

(Sigd) W. W. Wood Captain R.E.
Executive Engineer, Bangalore.

E A and Colonel R.E.
Supg. Engineer, 5th Division.

Executive Engineers Office
Bangalore 27th April 1872.

From

The Executive Engineer
Bangalore

To

The Assistant Secretary to Government
P.W. Division.

Sir

With reference to G.O. No 1886 dated 16th March 1872 I have the honor to forward an drawing showing the original elevation of the Tower Cistern of the Old Well at the Race Course Barrack together with the same as reduced and altered.

2. The plans contained in Contracting a lining of brick in Cement within the original walls of the Cistern, and also to the addition of one foot below the bed of the former, with the necessary alterations in the position of the steps &c.

3. The present position has taken place on the old floor and the whole is rendered unfit for use, and requires to be altered in the Cement.

4. The present position has taken place as per plans & estimate forwarded with the

5th Division P.W.

Bangalore

G.O. No: 2602 dated 25th
~~January 1872~~ 2/72
P.W. 3292/72.

Abstract Estimate for repairing the Cistern at the Race Course Barrack at Bangalore.

Amount of Estimate Rs 780-

same way as the previous one, that is the floor has sunk and so caused a crack along the interior edge of the cistern where the floor and walls join. The inference appears to me to be that the made earth with which the basement of the cistern was filled in, has been the cause of the mischief.

4 The greatest depth of this made earth is three feet, and the fact that the cistern at Royal Horse Artillery Barracks after precisely similar repair, has been perfectly successful, affords I think sufficient evidence to show that there was a reasonable prospect of success attending the measures adopted at the Race Course Cistern. As a matter of fact, however, the repair of one half of this Cistern was a Complete failure and the other half has again failed, quite unexpectedly after having been in use for 21 Months. It should be mentioned that the half of the Cistern having the greatest depths of made earth in the basement, was the one which failed on repair, and that

the leaks broke out in the second half at that end where the greatest depth of earth also was.

5 The work at both Cisterns was executed by the same Contractor and precisely in the same way, and I am unable to detect any difference in its quality. This being so, the only theory I can suggest is that, the basement of, and adjacent ground to, the Race Course Cistern each half of which contains 475,000 gallons was entirely changed in its structure, by the percolation of so large a body of water through it, and that holes (and channels probably existed in it, which after having been thoroughly drained of the water they held, eventually gave way under the pressure of the superincumbent mass of water.

6. I consequently infer that the actual site of the cistern, is an undesirable one to build on again, unless the earth to a depth of five or six feet is entirely removed and made good with a firm foundation consisting of a bed of Concrete. As this will be

a most expensive work, I beg to submit the question for your opinion. As regards the filter work of repair, the same reasoning applies. In this case however the made earth, on which the floor is laid, varies from three or four feet in depth on the north wall to fourteen feet in depth along the south wall. The work which I consider necessary is therefore still larger in this case.

Yours &c.

(Sd.) H. W. Wood Capt. R.E.

Executive Engineer Bangalore

(True copy)

E A Davis Colonel R.E.

Suptg. Engineer, 5th Div.

9-3292/72.

Annexure 5
Copy of letter
dated
Estimate
Certification

No. 78.

Suptg. Engr's Office, 5th Div.,
Cuddalore, 5th July 1872.

From

Colonel E. A. Davis R. E.,
Superintending Engr., 5th Div.

To

The Secretary to Government,
Public Works Department.

Sir,

With reference to the order of Government of the 26th March No. 846, I have the honor to forward a copy of the report received from the Executive Engineer Bangalore, on the cause of the failure of the Cistern at the Cavalry barracks. The report would have been forwarded at once, but I called for an Estimate for restoring a portion of the Cistern, to retain a few days supply, to obviate the necessity for pumping daily.

2. There can be no doubt that the failure of the cistern is due to the original flooring having been laid on made earth, which was not properly consolidated. The

cistern is divided into two portions by a cross wall. The floor of the entire cistern is above ground which having a slope, there is a considerable portion of made earth under one half of the cistern and much less under the other. A substantial water light flooring was formed over the original floor in 1869 and other repairs were made, but the half of the cistern, under which there is the greatest thickness of made earth, was found to leak as soon as water was admitted into it. The other half after repair answered perfectly for twenty one Months, and when it did fail, the leak was at the end where there was the greatest depth of earth.

3 I propose now to build a cross wall at one hundred feet from the upper end so as to form a cistern that will hold eight days supply. Under the floor of this portion there is so little made earth that there is a reasonable prospect of the leakage being stopped. There will then be no necessity for pumping

daily until either the entire Cistern is restored or a new one built on a different site.

I have the honor to be

Sir,

Your Most Obt. Servant

E A Ford Colonel R.E.

Superintending Engr, 5th Div.

No 138

Supy: Engineer's Office, 5th Div.
Camp Athlone, 3rd October 1872.

From

The Superintending Engineer,
5th Division.

To

The Secretary to Government,
Public Works Department.

Sir,

With reference to your Memo No 122 of the 23rd of September, I have the honor to inform you that the stone slabs that had been laid in the cisterns were not taken up, as the Executive Engineer considered they would serve to distribute the weight, and that by retaining them there would be less likelihood of the concrete and made earth giving way. The failure of the floor of the cistern was not due to leakage between the joints of the stones, but to the sinking of the made earth. I am unable to give any information as to how the floors were formed, in the first instance, as the cisterns were built, or almost finished before I was appointed to the Division.

2. The works first undertaken in 1869 was the repair of the half of the Horse Artillery cistern

Copy of Public Works Office Memo: No 3292 dated 8th October 1872.
Submitted to the Chief Engineer, 5th Division.
for information.
Fort St. George, 9th October 1872.
Secretary to Government,
Public Works Department.

Forwarding a sketch plan shewing the Executive Engineer's proposals for the repair of the Cisterns at the Fields of the Artillery Barracks with a plan and estimate for the restoring of the Cistern which fell in, a few days ago.

No 2603-5-Nov 72.
+2 Plans & 1 Estimate
Received 5th Nov 72.

No 92

Copy to Superintendent

Cistern under the floor of which there was the greatest depth of made earth, as affording the best test of the efficiency of the proposed method. The repair having been found to be perfectly successful, the rest of the work was taken in hand and it appears from Captain Wood's letter of the 5th April 1870 that the repair of one half of the Cavalry Cistern and of one of the filters was next carried out and also successfully. The repair of the second half of each cistern and second filter was not commenced until the works already done had been found to answer.

3. No official report of the failure of half of the Cavalry Cistern and second filter was received until after I had given over charge of the Division in April 1870. The delay in the report was probably due to Captain Wood being on privilege leave, or to his wishing to ascertain exactly the nature and extent of the failure.

4. The Contractor was paid the full amount of Rs: 34,000, the works done by him being considered very good, and the failure of a portion being due to the bad quality of the original flooring.

5. I take the opportunity to mention that while at Bangalore last month, I carefully examined the Cavalry Cistern and

and came to the conclusion that before any large outlay is incurred in repairing it, it will be worth while trying whether simply repairing the cracks (which are very slight) with Portland Cement will not render the Cistern water tight and allow of its again being used at least for some months.

I have the honor to be,
Sir,
Your most Obedient Servant.

E A Ward Lt Col, R.E.
Superintg: Engineer, 5th Division.

No 132

Memorandum

Written by Colonel Le Grand Jacob
Revising and confirming
Regarding the Distance at
Bangalore the Civil Station
Requests information on
the following points -

1st It having been alleged
that a road across an
Old Nullah 182 of 1858
January 1859 that the
Stone flooring should
be removed, which was done
accordingly of a tender
and specification prepared
= viding for laying a
brick flooring over the
stone floor cutting odd

C.W. 1872 Depart
Road Cash Account by
Rs. 48.00.
The Supdg Engineer
5th Div

To
The Secy to Govt:
P. W. Departt

Dated 3rd
Recd 7th } October 1852

No 138.

Furnishing informa-
= tion on certain points
regarding the Distems
connected with the
Ulsoor Water Works
at Bangalore. ——

No 2853 No 2602 - 5 Decr 52.

Letter to Colonel Le Grand

By the Superintending Engr.?

2nd Only one half of the Race Course Cistern completed in October 1869, having ban found to hold water when tested; why was not that fact reported till March 1872?

3rd Was the Superintending Engineer's suggestion in para 4 of the letter printed with the G.O above noted, that one half of the Cistern be repaired and tested before the other half was touched, acted on?

4th What saving on the sanction of Rs. 34,000 was effected by non

payment

25.

payment for the half Cistern which did not hold water—

Engr

23rd Sept 72.

A. 2602.

Memorandum by Chief Engineer

The Royal Horse Artillery Cisterns having been altered and made water tight precisely in the same manner as the Race Course Cisterns, the greatest depth of made earth being the same at both sites, the masonry sections above and below not less in the latter than in the former, no difference discernible in quality of work of repair carried out, but both equally good, all these circumstances would appear to warrant the conclusion arrived at by the Superintending and Executive Engineers, viz that failure of the latter work was caused by sinking of the floor.

But such sinking would not account for the "saturation of the walls on both sides", nor for the "displacement of masonry causing a crack" visible for nearly 30 feet in length

through which the water spirted freely; nor for the crack running perpendicularly upwards in an angle between a side and cross wall - Sinking of the floor would account only for cracks in the floor - The crack in the side wall can only be accounted for by its having given way to pressure of water - Saturation of the masonry under such pressure, would then gradually ensue, through the crack and the crack would at last enlarge till it admitted of the escape of water through the wall -

Reasoning as above I conclude that it would be unsafe to trust to the same masonry unless well buttressed or the depth of water kept low - say, down to 5 feet at the utmost - I note that in a letter of 15th Decr 1868, the Superintending Engineer states that he considered the thickness of the walls, and the depth of the foundation —

insufficient - It was therefore an inconsistency raising the height of the walls, because the level of the floors was raised - And the latter step was an afterthought carried out without reference to G.O. No. 132 of 16th January 1869, which directed that the stone flooring should be removed, and the new floor substituted for it not laid upon it. And — raising the walls was quite unnecessary, as cisterns to hold 8 days supply are amply large enough -

I should propose therefore again to utilize the upper cistern only, retaining the upper and two side walls as they are, but reducing height of the end wall to 4½ feet, which would permit of a sufficiency of water being stored - Whether the floor has really sunk must be accurately tested by levels being taken - If sunk, it must all be taken up and

relaid at the original level, all made earth being previously removed and replaced with puddled clay - If not sunk, then provision of a cordon of masonry laid in Hydraulic Cement round the junction of the floor and walls, ought to serve every purpose.

W. Mackellar Coll. R.E.

To Tacamund Chief Engineer D.P.W.
23rd Octr 1872

Proceedings of the Madras Government

Read the following:-

From The Supg. Engineer 5th Dn. } No. 1. dt 5th July 1872
Do. } No. 1. dt 3rd October 1872
~~From Chief Engr.~~ } ~~No. dt 23rd October 1872~~

The Superintending Engineer 5th Dn. will ascertain, by accurate levels, whether the floor of the Cistern has sunk or not, and will estimate for utilizing the upper half, according to the result of such inquiry, in the manner indicated by the Chief Engineer's remarks -

The failure of the repairs of the other half immediately after their execution in October 1869 should have been reported at the time, and stricter attention should have been paid to

to the wording of Q C
No 152 of 16th January
1869 GWW

C 5
5

S. R. 5th Dec
Instr Clerk of Deeds 7/11/72

Cr 24 Oct

Copies 3292 to 4860

Govt. of 1872 Madras.

PUBLIC WORKS.

To The Superintending Engineer
5th Division

Dated

Recd. Encl.

G. O 5th November, No. 2602.

Nos. 72-72A-73

Cistern at the Cavalry Barracks, Bangalore.

Papers orders on papers relating to the failures of the Cistern at the Cavalry Barracks at Bangalore.