(1) பக்கங்களின் எண்ணிக்கை 62
(2) புதுக்கித் திருப்பிய நாள் 3/90
(3) ஆதாரங்குறிப்பவர் சுருக்கொப்பம்

தமிழ்நாடு ஆவணக் காப்பகம்.

தமிழ்நாடு அரசு

P.W.D துறை

அரசாணை எண்.
மு. கோப்புத் தாள் எண். 3442

அச்சகம்
பலவகை

நாள் : 4-12-1889 198

கண்டபடி கையாளவோ கூடாது

31 Sheets

(13, 14 Maps)
20 sheet
k sandcastle

—1—18,006—15-6-87.

3442

4th December 1889, No. 3442 W., Public Works.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Military Works.

Read—the following papers :—

Memorandum.

Bellary Arsenal New Workshops.

Work ordered in G.O., M.D. No. 3095, dated 9th May 1887. Materials ordered to be collected in anticipation of sanction to estimate by the Superintending Engineer, Mr. Peters, in his No. 1116, dated 14th September 1887, giving at the same time height of walls and basement, but saying nothing about foundations. Materials and work to the value of Rs. 15,558-4-7 were collected and done to end of March 1888 though only Rs. 6,837-9-4 actually paid. G.O., P.W.D. No. 1199 W., dated 23rd April 1888, sanctioned them.

2. The estimate was approved by Inspector-General of Ordnance and Director-General of Ordnance and forwarded to Government by the Inspector-General with his No. 64 G., dated 18th July 1888, and it was finally sanctioned on 17th August 1888, No. 2527 W., Public Works, for Rs. 45,500, the only remark of the Chief Engineer being that ramps should be provided instead of steps.

3. The estimate was prepared by the Executive Engineer, Mr. Garrett, in consultation with the Ordnance officer and submitted by him to the Superintending Engineer (Colonel Smalley) on the 29th November 1887, by whom it was countersigned on the 21st January 1888 and forwarded to the Inspector-General of Ordnance. It must be here remarked that the report attached to the estimate was very meagre.

4. The site was selected by a committee on the 7th October 1889, of which the Executive Engineer was a member. Their opinion was that "the only ground within the arsenal suitable for the erection of a workshop is a site in line with the present harness store-room," and this is the site on which the workshop has been built, except that, at the instance of Ordnance officer approved by the President of the Committee, the site was moved nearer the harness room than originally intended.

5. Work was begun in February 1888. Three trial pits were sunk 12 feet deep in the centre and at each end of the site selected. Nothing but made-earth was found to that depth except stones apparently from some old foundations. The earth stood perpendicularly in the pits and appeared to be thoroughly consolidated though not the natural soil. There were existing buildings on either side of the site selected and close to it. There was the rampart wall of the fort running nearly parallel to the face of the site selected which was looked upon as sufficient to retain the soil behind it in position. Moreover, the Engineer's offices had been constructed lately under similar conditions not far off.

6. The plan and estimate allowed 6 feet depth of foundation, viz., 4 feet masonry in steps and 2 feet of concrete below 6 feet wide at bottom, and the work was carried out accordingly except in the case of the chimney where Mr. Clift put in 4 feet of gravel well rammed below the concrete and which has stood perfectly well though 40 feet high.

7. Before the end of the rains of 1888 the superstructure had been raised about 6 feet high all round and no signs of settlement were apparent. The work has been

built slowly and deliberately throughout. Nothing was noticed in the shape of cracks or settlement till the 9th October 1889, after which they increased to the present state by the 22nd idem; they have not increased since that date.

8. The rainfall at Bellary in 1889 has been quite abnormal and concentrated in the months of September and October, most heavy and continuous from 1st to 21st October. The north-east monsoon succeeding the south-west without a break.

9. The harness store-room in line with the new workshop, a building 50 years old or more, has been badly cracked; a bastion of the fort wall in the arsenal enclosure immediately below the workshop has collapsed (which no doubt has added to the disintegration of the soil above); and in five other places has the fort wall fallen down in consequence of the rain.

10. The execution of the work has been thoroughly good throughout; the initial mistake is alone to blame, insufficient foundations, and I can only bitterly regret that I was induced to pass them against my better judgment. Great trouble has been taken with the roof, with the chimney, and with fixing the boiler and pipes in position especially. The expenditure up to date including liabilities not settled is Rs. 35,642-6-0 against the estimate Rs. 45,500. The work is therefore not only good, but has been carried out economically. It is very nearly completed; all that remains to do is to roof in with Mangalore tiles, and finish up generally before fixing machinery. It seems a great pity to condemn the building altogether if it can possibly be avoided.

11. I suppose that underpinning on a large scale all round on both sides of the walls inside and outside is all that can be attempted to make the building secure. The machinery must have independent supports and not be in contact with the present walls. Plinth protection with drains all round must be given. The drainage under the foundations must be cut off above the site. The fort rampart should be rebuilt *pukka* to serve as a real retaining wall to the soil behind it. The cross walls inside the building might be removed perhaps either partially or wholly. Iron pillars might be introduced under the trusses. Bonding stones and iron or copper joggles would I suppose be necessary to bind the cracks in the walls. I think now that what ought to have been done at first (supposing there was no appeal against the site) was to have insisted upon an underground basement forming cellars for stores, &c., connected with the surface by stairs and ramps and lighted and ventilated by openings into an area all round the building. I am not prepared to say whether it would be practicable now to effect this by tunnelling underneath the present workshop walls. If it were considered practicable, a fine large space could be made available for stores and thereby probably avoid requisitions for such space in future and the building above would be made secure.

12. The floor of the present building would have to be supported on girders and presumably boarded throughout.

(Signed) H. SMALLEY, Colonel, R.E.,
Superintending Engineer, III Circle.

Enclosures.

From A. S. RUSSELL, Esq., Executive Engineer, Bellary Division, to the Superintending Engineer, III Circle, dated Bellary, 21st October 1889, No. 2600.

I have the honor to report that the walls of the new Workshop, Bellary Arsenal, have lately cracked to such a degree that it becomes a question for consideration whether the work now going on of roofing in the building shall be allowed to continue until the steps necessary to prevent further cracking of the walls have been taken.

2. The original estimate for the building amounted to Rs. 45,500 and was sanctioned in G.O., No. 2527 W., dated 17th August 1888. The accompanying tracing shows the section of the walls and foundations. The building is founded on made-earth. Neither the report nor the plans contain information regarding the nature of the soil and sub-soil, but the original site plan, which is forwarded herewith, shows that three trial pits were sunk to a depth of 12 feet in made-earth, and the maistry in charge of the work reports that, when the estimate was under preparation, borings to a depth of 15 feet were taken without anything but silt being passed

3442

through. The site is in fact nothing but a mound of made-earth, bordering the wall and bastions of the fort, while immediately below the fort wall runs the deep moat (*vide* accompanying sketch).

3. I only took charge of the Bellary division on 15th instant. When going over this building with Mr. Clift, the former Executive Engineer, slight cracks in both the cross walls and main walls were pointed out to me. These cracks had only appeared about 6th instant, and both Mr. Clift and I agreed that these were undoubtedly due to inadequate foundations, and that the only remedy was underpinning the cracked portions of the walls with concrete. Copy of my inspection notes made at the time are sent up for information. I observe from the office records that Mr. Clift reported the occurrence of these cracks in this office letter No. 2533, dated 15th instant.

4. From 15th to 19th instant I was away from head-quarters on tour. To-day I again inspected the building, and found that, while the old cracks had opened out to a great extent, numerous new cracks had appeared both in the main and cross walls. These cracks are of the most serious character, some of them gaping to over one inch in width. I also noticed that outside the building a large crack in the ground was visible, and that the continuation of this crack ran right down the centre line of the new workshop, while radiating from this crack in the ground short transverse tracks were here and there to be seen. Close to the new workshop is the saddlery and harness room—a building said to have been constructed about the year 1815. I traced the cracks in the ground right along one side of this building, the verandah pillars of which had cracked and had evidently settled some two or three inches. Cracks in the wall of this building were also visible. Following up the cracks in the ground I traced them to the fort wall which had, in some portions, fallen down, while one of the bastions had also fallen and another appeared to be in a very shaky condition. These damages are all reported to have occurred about the same time, viz., after the very heavy and continuous rains of last week. On the whole, it is plain to me that the mound of the made-earth on which all these structures stand has parted in the middle, one portion of it slipping down towards the deep depression of the moat.

5. As regards the causes of the damages, it is to be noticed that, in addition to the inadequate foundations given to the new workshops, it is probable that the made-earth on which the building stands is composed of various soils, and that, so far as can at present be seen, the earth near the surface is a loose porus kind of silt, which is liable to crack after heavy rain, and through which rain-water would percolate, and would ultimately drain into the moat below. The slight cracks first seen in the workshop walls were doubtless due to weak foundations and inequality of settlement, while the damages afterwards done simultaneously both to the new workshop and to structures which had stood unharmed for many years, were certainly due to the cracking of the made-earth on which the buildings are founded.

6. The workshop is now in an advanced stage of completion. The iron trusses of the roof have been put into position, and over them a portion of the building has been roofed in with Mangalore tiles. The work of tiling the remaining portion of the roof is now in progress, and I request orders whether I am to go on with this work or wait until it has been decided what is to be done as regards the foundations of the building. I may here notice that the expenditure up to date is very inadequate, the grant for the year being Rs. 15,992 and the expenditure to date being only Rs. 4,166.

7. Until I have exact information regarding the nature of the made-earth on which the building is erected, and regarding the depth* at which natural ground is found, I can make no specific proposals regarding what should be done. I have not, however, delayed my report on this account, as, should the cracks in the walls go on, the safety of the building may be endangered. The subject is, I think, of sufficient importance to make personal inspection by the Chief Engineer advisable. My own opinion is that, that unless the foundations are carried down to hard ground, the walls will never be safe when it is considered that they will ultimately be subjected to the continual jarring of machinery, and that the cracking of the made-earth may again occur at any time after heavy rain. The expense of carrying down foundations to hard ground will doubtless be very great, as they will certainly have to be sunk a great depth, and the work will be of so tedious and difficult a character that it may be a matter for consideration whether, in the end, it will not be advisable to abandon the present building and erect a new one on a better site. In another week the result of the borings will be known, and some definite decision can then be arrived at.

* Borings to a depth of 23 feet have now been taken and show nothing but silt, dust and ashes.

EXTRACT from Inspection Notes of A. S. RUSSELL, Esq., Executive Engineer, Bellary Division, for the month of October 1889.

New Workshop, Bellary Arsenal.

This massive building is everywhere founded on made-earth, and the maistry in charge reports that trial pits at each corner of it were carried down 15 feet without solid ground being reached. Building on such ground is a risky experiment, and has resulted in some serious cracks appearing in the walls. These cracks are undoubtedly due to defective foundations. They will probably open out still more as the rains go on. Nothing can now be done till the rains are over, but the cracks should be carefully watched, and, to enable it to be ascertained whether they are extending, a piece of paper about 6 inch square should be tightly stretched, and pasted over each of the more important cracks, with the date it is pasted on written on it. As the nature of the sub-soil has never yet been properly ascertained and recorded, borings should now be taken until solid ground is reached and the result of the borings carefully noted and reported.

2. The only remedy that will be effective will be underpinning with concrete, and thereby giving to the walls a deeper and wider base than they now have. The work will have to be carefully done by small portions at a time. The design will be made by the Executive Engineer, when the result of the borings now ordered has been ascertained. Arrangements should at once be made by Sergeant Temple to do this, and the result should be reported in due course.

(Signed) A. S. RUSSELL,
Executive Engineer.

9th October 1889.

Note by the Acting Chief Engineer, Public Works Department, General Buildings and Roads Branch.

Arsenal Workshops, Bellary.

The building was inspected by me in company with the Superintending Engineer and the Sub-Engineer, Sergeant Temple, who was in immediate charge of the work. Upon a critical examination of the building itself and its surroundings, I came to the conclusion that the cracks were due to an actual creeping of the made-soil in which the foundations were laid towards the hollow ground that intervened between it and the ramparts of the fort. The quality of the masonry itself was good, although the side joints of the stones composing it were not as fine as they should have been, but the failure could not be attributed to this defect. I noted that the foundation trench had not been filled in carefully round the work when it was completed, and the heavy rain had caused serious depressions along the line of the walls. If the plinth protection in the shape of a gravelled platform had, as provided for in the estimate, been laid down as soon as the trench had been filled in, and care taken to carry away the water draining off the ground above the work instead of allowing it to flow down to and into the foundations, it is probable that no damage to the building would have accrued. The structure is at present so shaken that it cannot possibly be used as workshops, and the only thing that can be done is to brace the walls together by iron tie rods and use the building as a store. It would be necessary that a committee should be convened to decide upon the ultimate use the building is to be put to, as well as for the selection of a site for a new building which is urgently required.

Madras, (Signed) R. R. E. DRAKE-BROCKMAN, Lt.-Col., R.E.,
15th November 1889. Ag. Chief Engineer, P.W.D., General
Buildings and Roads Branch.

Order—dated 4th December 1889, No. 3442 W., Public Works.

His Excellency the Governor in Council considers that the failure of the building constructed for the Workshops of the Bellary Arsenal is most regrettable and unsatisfactory. The Chief Engineer being of opinion that the failure was caused by the omission to lay down the gravel protection provided for in the estimate, the Executive Engineer in charge of the work, Mr. H. W. Clift, will be called on, through the Railway Branch, to explain why he did not execute this item.

2. In accordance with the recommendation of the Chief Engineer, the Government resolves to appoint a committee, composed as under, to consider and report how the building can be utilised, and to select a site for a new building for the workshops:—

- The Superintending Engineer, III Circle.
- The Executive Engineer, Bellary Division.
- An officer of the Ordnance Department to be nominated in the Military Department.

3442

3. It will be considered in the Military Department whether the Officer Commanding Bellary should be added to the committee, as it is possible that the building may be found of use for other military purposes than those of the Ordnance Department.

4. Meanwhile the Superintending Engineer will take steps to make the building secure, as suggested by the Chief Eng[illegible]eer.

([illegible]rue Extract.)

Captain, R.E.,
Under-Secy. to Govt., P.W.D.

To the Superintending Engineer, III Circle.
" Military Department.
" Public Works Department (Railway Branch).

Exd. J. Moses.
Spare Copies

3

BUILDINGS AND ROADS.
MILITARY WORKS.

Govt. of {1889} Madras.

PUBLIC WORKS.

Dated December, 4th.

Recd. *Encl.*

G.O., 4th Dec. 1889, No. 3442 W.

DECEMBER.

Building constructed for the Arsenal Workshops, Bellary

Passing orders on reports regarding the failure of the —.

Exec Engineer's Office
No. 2533 Bellary 14th Octr/89
Desp. 15th Octr/89

From

The Executive Engineer
Bellary Division

To

The Deputy Engineer
3 Circle

Subject- Arsenal Workshop

Sir,

I have the honor to inform you that several cracks have made their appearance in the walls of the above building.

Two of the crosswalls shew cracks very markedly - and the more westerly one has settled towards the north, and the other cross wall has settled towards the south.

On the outside main wall not far from the former there is a very slight crack and there is also a slight hair crack on the eastern outside gable wall. All these cracks have made their appearance during the last week.

4

lley himself [illegible] 6 ... of a [illegible] platform paid, as
[illegible] the damaged 12

These cracks are evidently due to settlement, the made earth on which the whole building has been erected having settled unequally.

Precautions I understand were taken. The foundations were generally 5½ ft below surface of ground and the main walls had a layer of concrete 6 ft wide.

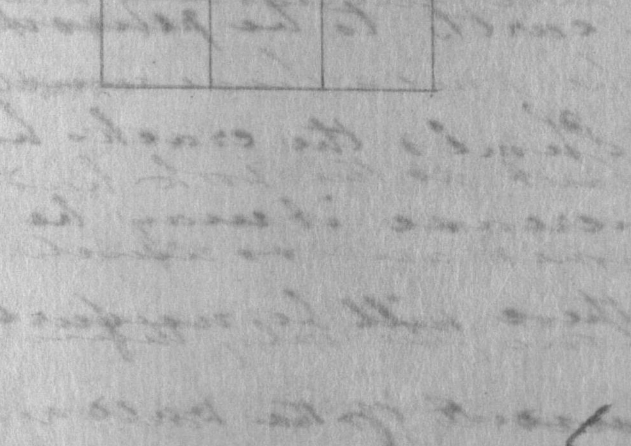
In taking over charge from Mr Garrett, he remarked that the soil was made earth and that pits had been dug showing no thing better for the depth of 14 ft. I remarked that the stability of the building would be at the best doubtful; that in Bengal not more than 1 ton was allowed on a square foot of the soft alluvial natural earth, and here including weight of roof he would have much more.

But as the work had been sanctioned and so much had been done, the only thing left, appeared to go on, and make

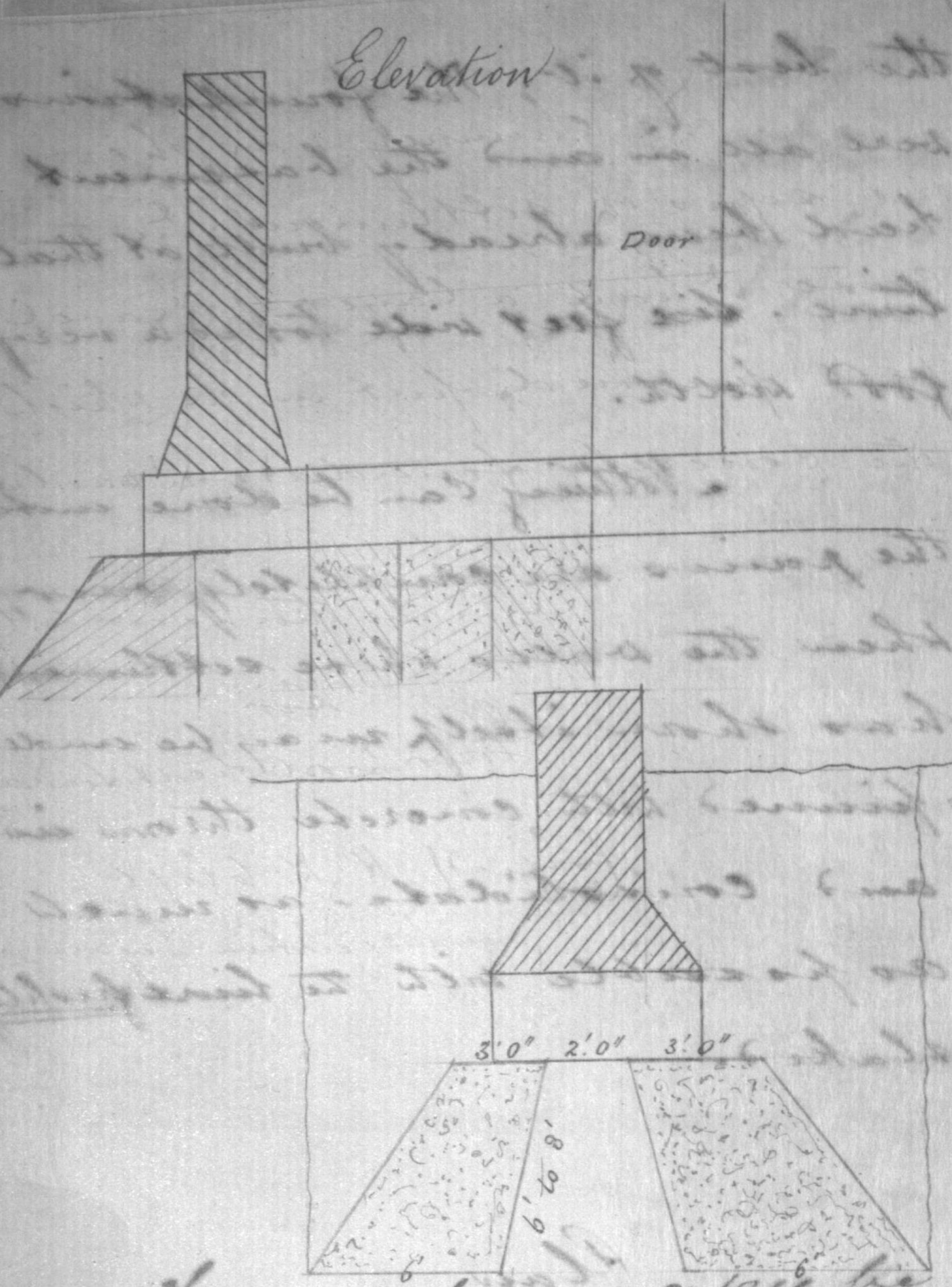
the best of it. The foundations were all in and the basement had been already built at that time. Six feet wide too is a very good width.

Nothing can be done until the rains are completely over, when the walls where settlement has shown itself may be underpinned with concrete thrown in and consolidated as much as possible with the lime freshly slaked.

Plan



lley himself aware & [illegible] the danger of [illegible] of a parallel platform had, as



The underpinning will be laid in 3 feet lengths and I should suggest its being done on both sides of the cross wall as shown – only one side at a time and only 3 ft in length too of the earth to be removed;

Should the cracks however not increase it may be hoped that there will be no further movement of the walls.

The

3442

The chimney has shewn no signs of settlement. In this case I had a layer of gravel well rammed put in on which the concrete foundation was laid.

I have the honor to be
Sir
Your most obedt Servant
(Signed) H. H. Clift
Executive Engineer

Encl 2
No 10975
89

Ex Engineer Mr Clift's
report about cracks
in the Arsenal Work
Shop walls—

3442

Tanjore
2nd November/89

× × × × ×

You ask how the depth of foundations was settled. After ascertaining the nature of the soil, this point was often discussed by us. As a guide we had the Supdg & Exec Engr's office built on precisely similar soil.

The offices are upstairs building had shown signs of settlement, and it was therefore determined that the Arsenal although only a single storied building should have deeper foundations as well as a larger bearing area.

These precautions would it was thought, ensure the safety of the building provided that arrangements were made to prevent water entering the foundations. To exclude water the estimate allowed for laying down gravel, which was to be well rammed all round the building and sloping the gravel so that

the

of a gravelled platform pad, as

the rain should be rapidly
carried away from the building
to drains. Was the roof on and
had this gravel been put down
before the accident occurred.

Very heavy and continuous
rain must always be the source
of danger to buildings founded
on made soil, but the rainfall
in Bellary is very small and a
number of public buildings have
been built in the fort and have
stood very well, the foundations
of which are on made earth. In
making the foundations of the
arsenal as deep and as wide as
we did it was reasonable to
suppose it could have a better
chance than other buildings with
shallower foundations. The plinth
protection also afforded an
additional safeguard.

Your rainfall of this year
however must have been quite
abnormal, as you say the walls

---

have cracked of buildings which have
been in existence for 30 or 40 years
without showing any signs of failure.

You mention the collapse
of one of the bastions of the Fort
near the workshops.

Was there a flow of water
through the breach in the Fort
wall at this place and if there
was at what level did it take
place. You say the rain from
the rock passed right underneath
the foundations. It must then
have sunk through all the made
earth till it came to the gravel
below. It follows that to make
buildings in the Fort perfectly
safe the foundations should
be carried right down to the
underlying gravel.

But Government have in the
case of I suppose nearly all the
public buildings in the Fort,
sanctioned their being founded
on made earth. In the case of
the arsenal special precautions

were

Findlay himself seems to
have noticed the dangers

as of a gravel(?) platform [illegible] as
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were taken to ensure the safety of the building and it is to be presumed the Chief Engineer thought they were sufficient as he passed the plans and estimates.

~~Yours sincerely~~

~~(Sd) A. H. Garrett~~

(Extract)

H Smalley Col R.E.
Supg Engineer

Extract from Ex Engineer Mr Garretts' Demi-Official, about Arsenal Workshops.

Gen 3
Pr 10905
89

P. W. D.

3442

The item being provided in the estimate, & the Chief Engineer declaring that the omission to carry it out is the cause of the failure of the building, Mr. Cliff must explain why he did not execute it.

The amount is Rs 64 only. For such a sum we lose Rs 40000 or more.

W.S.
29 Nov

G

why

proba. bly caused by

To W.O.

Abstract estimate obtained from C.E. Office & submitted

C.E.
28.11.89

F. H.ns. For information - The item under reference is marked ~~items~~ —×— in abstract estt.

[illegible] 28.11.89

3442

Bring to Council. & be prepared to say whether as a fact the gravel protection omitted by Mr. Clift was provided in the estimate or not.

Also whether it is unavoidable to entirely condemn the building as a workshop, and whether this is to be considered a settled question.

I want to know whether in 1880 the gravel protection was in the estimate or not. If it was & now. Mr. Clift will have to explain why he did not carry it out. [illegible]

J.H.L.
27 Nov.

[illegible] CO 28/11

prob.ly caused

3442

What is the fact with reference
to the Co's remarks.
Who was the S.E. who framed
the plans.

NCS
29/11

I do not consider the failure due to insufficient foundations. Their depth was $\frac{1}{3}$ that of the height of wall above, which is more than sufficient in ordinary soil — The ground here is made soil for a depth of 25 feet — and the cracks ~~may have~~ ~~been~~ were most prob. ly caused by

The cracking of this soil is constitutional as shown by the cracks in the ground now apparent — this cracking I attribute to the saturation of the soil by the rain water draining into it under the foundation, & percolating through it, which the gravel path 10' wide round the building would have greatly prevented — It was an error of judgment on Mr Clift's part not to have put this down — Perhaps he thought it was only provided to make the surroundings of the building neat in appearance — Russell. 25.11.89

P.W.D.

34

Note by the Chief Engr on the failure of the Arsenal Workshops at Bellary — with enclosures.

I fear there is nothing to be done now — I think that in works of this magnitude the Chief Engineer ought to be held responsible.

For orders.

Russell

16.11.89

W

Most regrettable and unsatisfactory result, but I don't see whom to hang. If it be the case that the building cannot be used for workshops, better have a committee as suggested, & take steps to make it as secure as is possible.

J.H. [illegible]

Circ. 17 Nov.

It appears that Mr. Clift on taking charge was alive to the dangerous nature of the building. Why then did he not put in the plinth protection of gravel which would apparently have saved the building? But he is in no way responsible for the faulty design.

Mr. Clift seems to have put a plinth of gravel under the chimney which has stood well though 40 ft high. Col. Smalley himself seems to have noticed the danger of building on such soil without proper foundations. He says he regrets taking so many days instead of [illegible] [illegible] been proved insufficient — so that he is clearly more to blame than any one else seems not to acknowledge having himself to some degree.

20/11

The Chief Engineer in his note of 15th Nov states "If the "plinth protection in the shape "of a gravelled platform had, as

12

"provided for in the estimate, "been laid down as soon as the "trench had been filled in, "and care taken to carry away "the water draining off the "ground above the work instead "of allowing it to flow down to and "into the foundations, it is "probable that no damage to the "building would have accrued" but according to the memo of the Supdg Engineer (without date) the mistake was in the estimate and the accident was due to the failure in that estimate to provide sufficient foundation and not to any departure from the estimate — If the statement of the Chief Engineer is correct the Officer who takes upon himself to depart from the estimate is most seriously to blame, but if Col. Smalley's statement is correct and no plinth was included in the estimate, then it appears to me that ~~the~~ blame must be attached to both the then Chief Engineer and the Supdg Engineer —

L. G. G.
20.11.89

H.W. 16.XI.89.

Con: 18.XI.89

The Hon'ble Sir J. H. Gorst
His Exc. the Com. in Chief
His Exc. the Governor

2/490b

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ilding can
be utilised, and
to

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Chief Engineer and the Supdg
Engineer —

C.G.G.
20.11.89

H.W. 16.XI.89

M.G. 18.XI.89

Gov. 18.XI.89

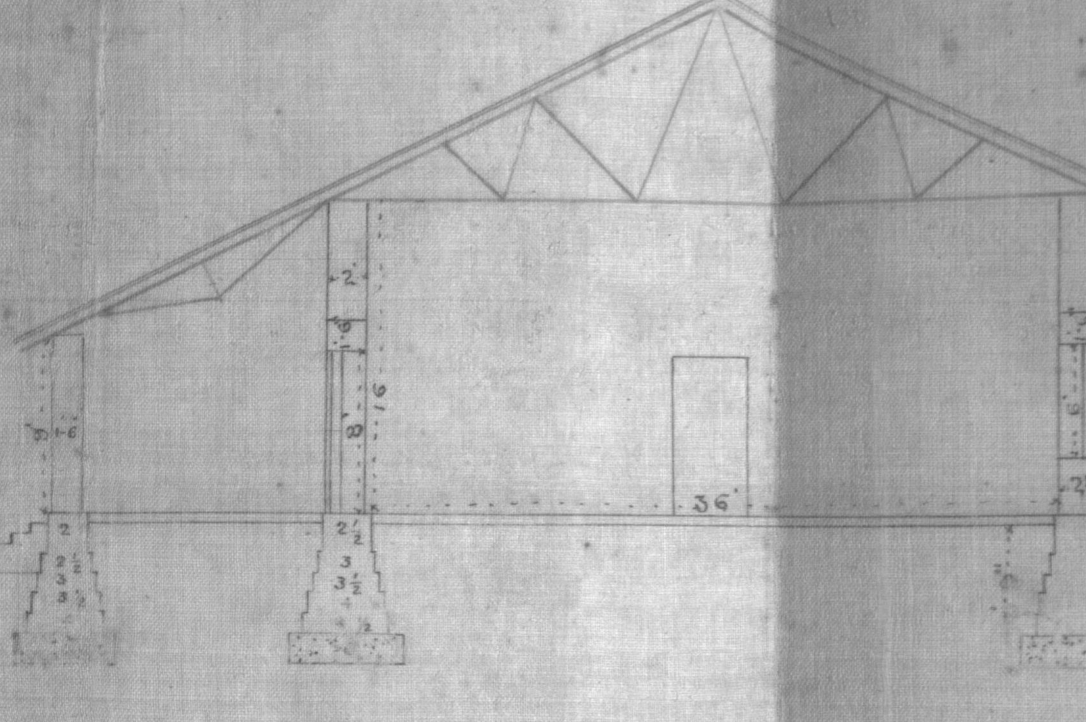
H.W.

~~The Hon. Mr J. H. Garstin C.S.I.~~

~~His Exc. the Commander in Chief~~

~~His Exc. the Governor~~

SECTION
OF
ARSENAL WORK SHOP BEL
SCALE 10 FEET = 1 INCH



Executive Engineer's Office
Bellary Division 21 October 1883

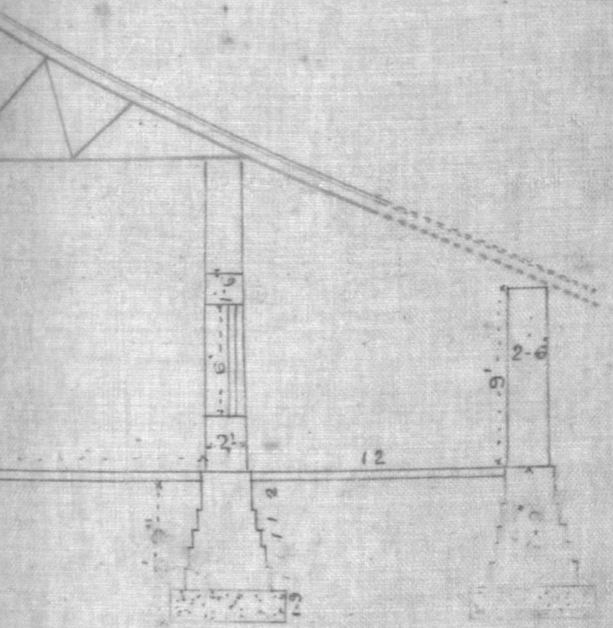
TRUE COPY
(Signed) A. H. [illegible]
Executive Engineer

under,
and report-
how the [illegible] building can
be utilised, and
to

8.9.12

SHOP BELLARY

CH



True copy

A. S.

EXECUTIVE ENGINEER

13

Encls 5

P.W. 1890

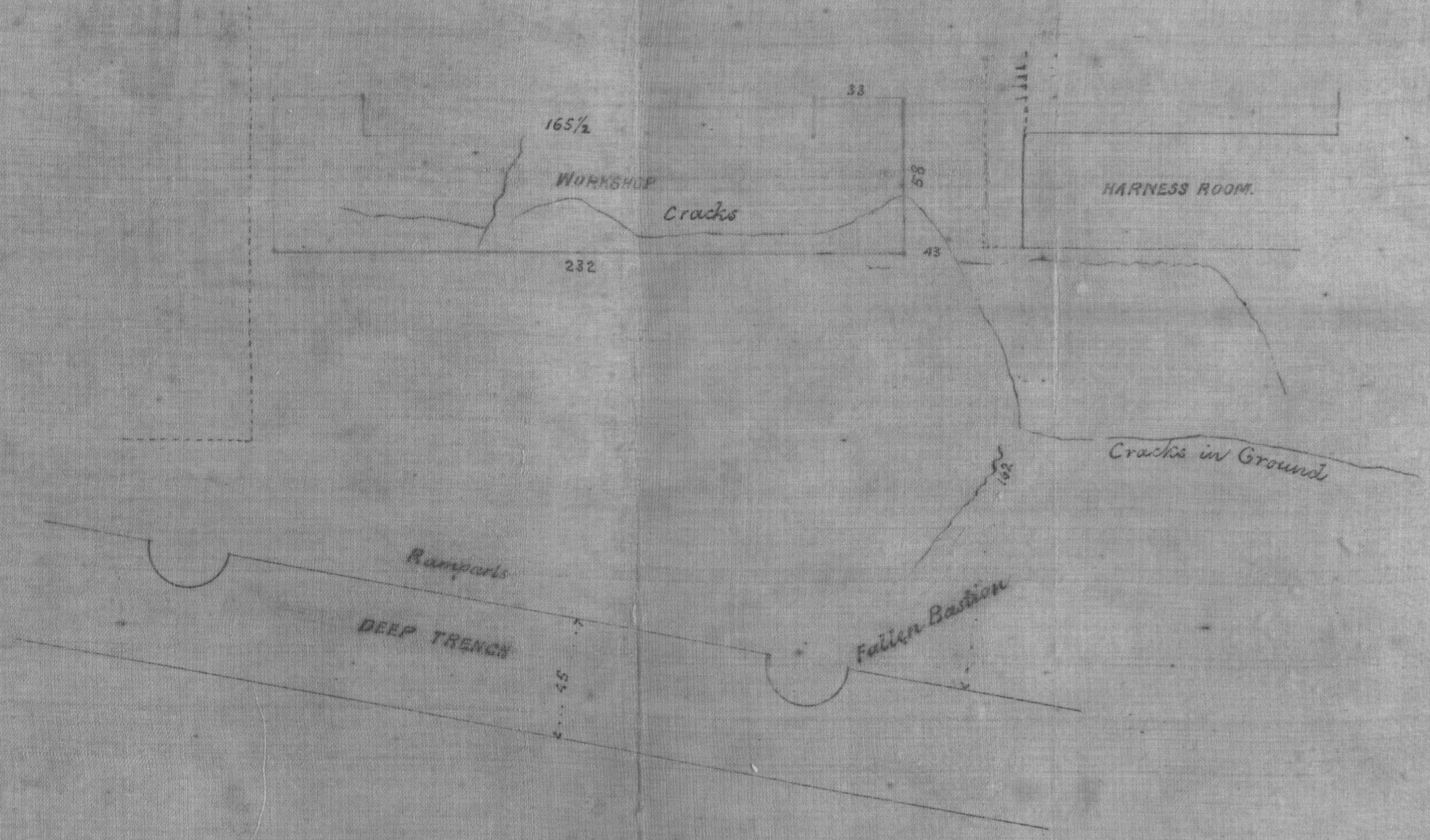
87

ROUGH SKETCH to SCALE

shewing Cracks in Ground at Site of

NEW WORKSHOP BELLARY ARSENAL.

Scale 50 Feet = 1 Inch



Executive Engineer's Office
Bellary

(Signed) A. S. Russell
Executive Engineer

how the
be utilised, and
to

to select a site for a new building for the workshops:—

The Supdg. Engr. III Circle
The Ex. Engr. Bellary Div.
An officer of the Ordnance Dept. to be nominated in the Military Dept.

3. It will be considered in the Military Dept. whether the Officer Commanding Bellary should be added to the Committee, as it is possible that the building may be found of use for other military purposes than those of the Ordnance Dept.

4. Meanwhile the Supdg. Engr. will take steps to make the building secure, as suggested by the Chief Engr.

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Again 26.11.89
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M. 28.11.89
29.11.89

Superseded draft

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To The Secy to Govt. M.D.
for information [illegible]

To the S.E. III Circle
„ Mil. Dept.
„ P.W. Dept (Ry. Branch)

Enclosures

3442

No. 2600

Executive Engr's office
Bellary 21st October 1889

[illegible]

From
A. S. Russell Esqr.
Executive Engineer
Bellary division

To
The Supdg. Engineer
3 Circle
Bellary

Sir,

I have the honor to report that the walls of the new workshop of Bellary Arsenal have lately cracked to such a degree that it becomes a question for consideration whether the work now going on of roofing in the building shall be allowed to continue until the steps necessary to prevent further cracking of the walls have been taken.

2. The original estimate for the building amounted to Rs 45,500 and was sanctioned in G.O. No. 2527 W of 17th August 1888. The accompanying

tracing shews the section of the walls and foundations. The building is founded on made earth. Neither the report nor the plans contain information regarding the nature of the soil and sub soil, but the original site plan, which is forwarded herewith, shews that three trial pits were sunk to a depth of 12 ft. in made earth, and the mistry in charge of the work reports that, when the estimate was under preparation, borings to a depth of 15 ft. were taken with out anything but silt being passed through. The site is in fact nothing but a mound of made earth, bordering the wall and bastions of the Fort, while immediately below the Fort wall runs the deep moat, vide accompanying sketch.

3. I only took charge of the Beawar Division on 15th instant. When going over this building

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with Mr. Clift, the former Executive Engineer, slight cracks in both the cross walls and main walls were pointed out to me. These cracks had only appeared about 6th instant and both Mr. Clift & I agreed that these were undoubtedly due to inadequate foundations, and that the only remedy was under-pinning the cracked portions of the walls with concrete. Copy of my inspection notes made at the time are sent up for information. I observe from the office records that Mr. Clift reported the occurrence of these cracks in this office letter No. 2533 dated 16th instant.

4. From 15th to 19th instant, I was away from head quarters on tour. To-day I again inspected the building, and found that, while the old cracks had opened out to a great extent, numerous new cracks had appeared both in the main and cross walls. These cracks

are of the most serious character, some of them gaping to over one inch in width. I also noticed that outside the building a large crack in the ground was visible, and that the continuation of this crack ran right down the centre line of the new workshop, while radiating from this crack in the ground short transverse cracks were here and there to be seen. Close to the new workshop is the Saddlery and Harness room – a building said to have been constructed about the year 1815. I traced the cracks in the ground right along one side of this building, the verandah pillars of which had cracked and had evidently settled some two or three inches. Cracks in the walls of this building were also visible. Following up the cracks in the ground I traced them to the fort wall

M.S. 22.11.87 / H.W. 25.11.87 / Again 26.11 / R 28.11.87 / M. 28.11.88 / 2.11.87

which had, in some portions, fallen down, while one of the bastions had also fallen and another appeared to be in a very shaky condition. These damages are all reported to have occurred about the same time, viz after the very heavy and continuous rains of last week. On the whole, it is plain to me that the mound of the made earth on which all these structures stand, has parted in the middle, one portion of it slipping down towards the deep depression of the moat.

5. As regards the causes of the damages, it is to be noticed that, in addition to the inadequate foundations given to the new workshops, it is probable that the made earth on which the building stands is composed of various soils, and that, so far as can at present be seen, the earth

near the surface is a loose porous kind of silt, which is liable to crack after heavy rain, and through which rain water would percolate, and would ultimately drain into the moat below. The slight cracks first seen in the workshop walls were doubtless due to weak foundations and inequality of settlement, while the damages afterwards done simultaneously both to the new workshop and to structures which had stood unharmed for many years, were certainly due to the cracking of the made earth on which the buildings are founded

6. The workshop is now in an advanced stage of completion. The iron trusses of the roof have been put into position, and over them a portion of the building has been roofed in with Mangalore tiles. The work of tiling the remaining portion of the roof is now in progress, and I request orders whether I am to go on with this work or wait until it has been decided what is to be done as regards the foundations of the building. I may here notice that the expenditure up to date is very inadequate, the grant for the year being Rs 15,992 and the expenditure to date being only Rs 4,166.

7. Until I have exact information regarding the nature of the made earth on which the building is erected, and regarding the depth× at which natural ground is found, I can make no specific proposals regarding what should be done. I have not, however, delayed my report on this account, as should the cracks in the walls go on the safety of the building may be endangered. The subject is, I think, of sufficient importance to make personal inspection by the Chief Engineer advisable. My own opinion is that, that unless the foundations are carried down to hard ground, the walls will never be safe when it is considered that they will ultimately be subjected to the continual jarring of machinery, and that the cracking of the made earth may again occur at any time after heavy rain. The expense of carrying down foundations

× Borings to a depth of 23 ft have now been taken & show nothing but silt, dust, and ashes.

foundations to hard ground will doubtless be very great, as they will certainly have to be sunk a great depth, and the work will be of so tedious and difficult a character that it may be a matter for consideration whether, in the end, it will not be advisable to abandon the present building and erect a new one on a better site. In another week the result of the borings will be known, and some definite decision can then be arrived at.

I have the honor to be
Sir
Your most obedt servant
(Signed) A. S. Russell
Executive Engineer

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Encl 4
No. 1893
89

Report from
Mr. Russell on cracks
in the walls of the new
workshops in the Bellary
Arsenal.

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Print as
Encl. 2

Extract from Inspection Notes
of A. S. Russell Esqr. Exec. Engineer
Bellary Division for the month of
October 1889.

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New Workshop Bellary Arsenal.

This massive building is everywhere founded on made earth, and the maistry in charge reports that trial pits at each corner of it were carried down 15 feet without solid ground being reached. Building on such ground is a risky experiment, and has resulted in some serious cracks appearing in the walls. These cracks are undoubtedly due to defective foundations. They will probably open out still more as the rains go on. Nothing can now be done till the rains are over, but the cracks should be carefully watched, and, to enable it to be ascertained whether they are extending, a piece of paper about 6" square should be tightly stretched, and pasted over each of the more important cracks, with the date it is

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pasted or written on it. As the nature of the sub soil has never yet been properly ascertained and recorded, borings should now be taken until solid ground is reached and the result of the borings carefully noted and reported.

The only remedy that will be effective will be under-pinning with concrete, and thereby giving to the walls a deeper and wider base than they now have. The work will have to be carefully done by small portions at a time. The design will be made by the Executive Engineer, when the result of the borings now ordered has been ascertained. Arrangements should at once be made by Sergeant Temple to do this, and the result should be reported in due course.

(Signed) A. S. Russell
Exec. Engineer

d/ 9th October/89

Extract from R
[illegible] Ex Eng
Mr A. S. Rus

Encl 1
No 10905
89

Extract from Inspection Notes of Ex Engineer Mr A. S. Russell

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(1) Print 3442 1 p

Memo-

Bellary Arsenal new workshops

+ Ext Cont

Work ordered in G. O. M. D. No 3095 dated 9th May/87. Materials ordered to be collected in anticipation of sanction to estimate by the Supt Engr. Mr Peters in his No 1116 of 14th Septr/87 giving at the same time height of walls & basement but saying nothing about foundations. Materials and work to the value of Rs 15,558-4-7 were collected and done to end of March 1888 though only Rs 6887-9-4 actually paid. G. O. P. W. D No 1199 W of 23/4/88 sanctioned them.

The estimate was approved by Inspector General of Ordnance and Director General of Ordnance and forwarded to Govt by the Inspector General with his No 64 G of 18th July/88 and it was finally sanctioned 17th August/88 2527 W P. W for Rs 45500, the only remark of the Chief Engineer being that ramps should be provided instead of steps.

The estimate was prepared by the Executive Engineer Mr Garrett in

Consultation with the Ordnance Officer and submitted by him to the Supdg. Engineer (Col Smalley) on the 29th Novr/87, by whom it was countersigned on the 21st January/88 and forwarded to the Inspector General of Ordnance. It must be here remarked that the report attached to the estimate was very meagre.

The site was selected by a Committee on the 7th October/87 of which the Exec Engineer was a member. Their opinion was that "the only ground within the arsenal suitable for the erection of a workshop is a site in line with the present Harness Store Room" and this is the site on which the workshop has been built except that at the instance of Ordnance Officer approved by the President of the Committee the site was moved nearer the Harness Room than originally intended.

Work was begun in Feby/88. 3 trial pits were sunk 12' deep in the centre and at each end of the site selected. Nothing but made earth was found to that depth except

stones apparently from some old foundations. The earth stood perpendicularly in the pits and appeared to be thoroughly consolidated though not the natural soil. There were existing buildings on either side of the site selected and close to it. There was the rampart wall of the fort running nearly parallel to the face of the site selected which was looked upon as sufficient to retain the soil behind it in position. Moreover the Engineers offices had been constructed lately under similar conditions not far off.

The plan and estimate allowed 6' depth of foundation viz 4' masonry in steps and 2' of concrete below 6' wide at bottom and the work was carried out accordingly except in the case of the chimney where Mr. Clift put in 4' of gravel well rammed below the concrete and which has stood perfectly well though 40' high.

Before the end of the rains of/88 the superstructure had been raised about 6' high all round and

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no signs of settlement were apparent. The work has been built slowly and deliberately throughout. Nothing was noticed in the shape of cracks or settlement till the 9th October/89 after which they increased to the present state by the 22nd idem: they have not increased since that date.

The rainfall at Bellary in 1889 has been quite abnormal and concentrated in the months of Septr & October, most heavy and continuous from 1st to 21st October. The N. E. Monsoon succeeding the S. W. without a break.

The Harness store room in line with the new workshop, a building 50 years old or more, has been badly cracked; a bastion of the fort wall in the arsenal enclosure immediately below the workshop has collapsed (which no doubt has added to the disintegration of the soil above); and in ~~three~~ five other places has the fort wall fallen down in consequence of the rain.

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The ~~excavations~~ execution of the work has been thoroughly good throughout: the initial mistake is alone to blame, insufficient foundations, and I can only bitterly regret that I was induced to pass these against my better judgement. Great trouble has been taken with the roof, with the chimney, and with fixing the boiler and pipes in position especially. The expenditure up to date including liabilities not settled is Rs 34,501-5-8 against the estimate Rs 45,600. The work is therefore not only good, but has been carried out economically. It is very nearly completed: all that remains to do is to roof in with Mangalore tiles, and finish up generally before fixing machinery. It seems a great pity to condemn the building altogether if it can possibly be avoided.

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I suppose that underpinning on a large scale all round on both sides

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sides of the walls inside & outside is all that can be attempted to make the building secure. The machinery must have independent supports and not be in contact with the present walls. Plinth protection with drains all round must be given. The drainage under the foundations must be cut off above the site. The Fort Rampart should be rebuilt *pukka* to serve as a real retaining wall to the soil behind it. The cross walls inside the building might be removed perhaps either partially or wholly. Iron pillars might be introduced under the trusses. Bonding stones and iron or copper joggles would I suppose be necessary to bind the cracks in the walls. I think now that what ought to have been done at first (supposing there was no appeal against the site) was to have insisted upon an underground basement forming

cellars for stores & connected with the surface by stairs and ramps and lighted & ventilated by openings into an area all round the building. I am not prepared to say whether it would be practicable now to effect this by tunnelling underneath the present workshop walls. If it were considered practicable, a fine large space could be made available for stores & thereby probably avoid requisitions for such space in future and the building above would be made secure.

The floor of the present building would have to be supported on girders and presumably boarded throughout.

H Smalley Col R.E.
Supt g Engineer
3 Circle

E.O. 2497-8 W. & 25-9-86
" 1199 W & 23-4-88
" 2527 W & 17-8-88
" 1081 W & 10-4-88
1187 C & 16-3-88
620 C & 13-2-88
G.O. 3496 W & 20-12-87
" 190 W & 17-1-88
" 3491 W & 20-12-87
" 2879 W & 25-10-87

P.W. Cnd. 4/2905

Enclos. 6.
(& 2 plans)

SECRETARY TO GOVERNMENT
15 NOV. 89
P.W. DEPARTMENT, MADRAS.

Recd 15.11.89

Memo by the Supdg. Engr. Col. H. Smalley R.E. regarding cracks in the walls of new workshops in the Bellary Arsenal.

3442

Note by the Dy Chief Engineer P.W. Department

Letter from Mr. C.H. Clift No. 2533 d/ 12th October 1889.
Letter from Mr. A.S. Russell. No. 2600 d/ 21st October 1889 with Inspection Notes.
Extract from Demi official from Mr. A.A. Jarrett d/ 2nd November 1889.
Memo by the Supdg. Engineer III Circle

Arsenal Workshops, Bellary.

The building was inspected by me in company with the Supdg. Engineer and the ~~Overseer~~ Sub Engineer, Sergeant Temple, who was in immediate charge of the work. Upon a critical examination of the building itself and its surroundings, I came to the conclusion that the cracks were due to an actual creeping of the made soil in which the foundations were laid towards the hollow ground that intervened between it and the ramparts of the fort. The quality of the masonry itself was good, although the side joints of the stones composing

27

composing it has fine as they should have been, but the failure could not be attributed to this defect. I noted that the foundations trench had not been filled in carefully round the work when it was completed, and the heavy rain had caused serious depressions along the line of the walls. If the plinth protection in the shape of a gravelled platform had, as provided for in the estimate, been laid down as soon as the trench had been filled in, and care taken to carry away the water draining off the ground above the work instead of allowing it to flow down to and into the foundations, it is probable that no damage to the building would have accrued. The structure is at present so shaken that it cannot possibly be used as workshops, and the only thing that can be done is to brace the walls together by iron tie rods and use the building as a Store. It would be necessary that a Committee should be convened to decide upon the ultimate use the building is to be put to as well as for the selection of a site for a new building which is urgently required

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R. E. Drake - Brockman

Lt. Col. R.E.

Ag. Chief Engr. P.W.D.

Madras
5th Novr 1889 } Genl. Buildings & Roads Branch

16.11.89

Procs with 2 enclos

Procs

28/11/89

3442

PUBLIC WORKS DEPARTMENT.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

4th December 1889

READ the following

Memo by the Supdg Engineer III Circle (without number or date)

Note by the Chief Engineer P. W. Dept d/ 16 - 11 - 1889

13 P

His Excellency the Governor in Council considers that the failure of the building constructed for the workshops of the Bellary arsenal is most regrettable and un=satisfactory. The Chief Engineer being of opinion that the failure was caused by the omission to lay down the gravel protection provided for in the estimate the Executive Engineer in charge of the work, Mr. H. W. Clift, will be called on, through the Railway Branch, to explain why he

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he did in

item.

2. In accordance with the recommendation of the Chief Engineer, the Government resolves to appoint a Committee, composed as under, to consider and report how the building can be utilised, and to select a site for a new building for the workshops:—

The Supty: Engineer III Circle
The Ex: Engineer Bellary Division
An officer of the Ordnance Dept to be nominated in the Military Dept.

3. It will be considered in the Military Department whether the Officer Commanding Bellary should be added to the Committee, as it is possible that the building may be found of use for other Military purposes than those of the Ordnance Department.

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4. Meanwhile the Supty: Engineer will take steps to make the building secure, as suggested by the Chief Engineer.

Rueds
3.12.89

Dc 14/12

To
The Supty: Engineer III Circle
Military Department
P. W. Dept (Railway Branch)

Ce

Ex. DHw

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Bellairs, Arsenal Woolwich

Revised draft order for approval

Print [illegible]

5 May

3.XII.89

4.XII.89

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Govt. of 18 Madras.

PUBLIC WORKS.

Print 4oows

ated 5/11/89

ecd. Encl.

G.O. 4th Decr. 1889 No. 3462 W

Building cements for the Arsenal Workshops Bellary.

Passing orders on reports regarding the failure of the —.

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5/12. 3/5/12