PAPER No. 148.

UNDER-PINNING SATGHARA REST-HOUSE.

By. K. R. Sharma, Assistant Engineer, P. W. D. Irrigation.

The Satghara Rest-House is situated opposite R. D. 64,500, on the left side of the Northern Branch of Lower Jhelum Canal. The Mithalak Distributary takes off at R. D. 63,900 left Northern Branch and turns parallel to it just below its head. The Rest-House is enclosed on one side by the Northern Branch and is encircled on two sides by the Mithalak Distributary which carries a discharge of 136 cusecs. The Northern Branch is in heavy embankment up-stream R. D. 64,000 with full supply level 6·0 feet above natural surface and there is a fall of 3·5 feet at this place. There is a sudden drop in the percolation cone at the fall with the consequent collection of the upstream subsoil percolation water near about it. The Mithalak Distributary, encircling the Rest-House, is in heavy embankment with full supply level about 5 feet above natural surface. The water level in the Rest House well, just after the opening of the canal, in 1902, was about 75 feet below the natural surface, whereas at present, it is only 7 feet below. This speaks of the rapidity with which the spring level has been rising.

2. As water table rose, it carried up with it soluble salts from the soil in so large a quantity that the top layer is altogether saturated with salts. In dry weather the top layer of the soil looks like soft powdered earth. It becomes spongy in rains and is very hard after the rains though covered with white substances.

3. The Rest-House is an important one and is visited frequently by Inspecting Officers. It has got three rooms, two bath-rooms, and a pantry. The building faces north-east and has a 10 feet wide verandah in front and on the north-west. All arches of the verandah are semi-circular. Before under-pinning, the outer walls were built of pacca bricks outside lime pointed; and kacha bricks inside in mud mortar.

The inner walls were built of kacha bricks in mud mortar. The jambs and the chimneys were made of pacca bricks in lime. The verandah pillars and arches were built in lime with pacca bricks. As before, the roofing in the main rooms, bath-rooms, and verandahs consist of jack arches supported on the lower flanges of the R. S. girders.

Nature of damage.

4. On account of the rise of water table, the moisture of the soil was carried up the walls to a height of 6 or 7 feet by capillar attraction through the pores in the bricks. Mortar was attacked to begin with, which made the joints hollow. The damage then extended to the bricks which crumbled down in soft powder. Out of the buildings in the compound, the main building of the Rest-House was affected the most. If this slow process of disintegration had been allowed t continue for another few

years, the lower portions of the walls would have been completely eaten up, resulting in a collapse of the building.

The concrete floor became covered with white salts which caused swellings at many places. The cement plaster was merely covering the practically decomposed concrete, and the white salts.

The case of kacha plaster was hopeless ; it used to become all powder in three or four months. Surkhi and lime plaster met the same fate. Cement plaster or pudlo could not stick to the damp kacha-brick walls.

Plinth level of the Rest-House was just flush with the ground level. Rain water falling on the kallar-earth round the building recoiled up the walls carrying with it a certain amount of salts.

It appeared that the Rest-House had all the possible defects arising from the damage due to salts in the soil and was thus the worst in the Lower Jhelum Canal Circle. It was, therefore, selected by the Superintending Engineer, Lower Jhelum Circle, for under-pinning as an experiment.

Efflorescence.

5. The extensive damage done to walls, floor and plaster of the Rest-House (as detailed above in paragraph 4) was due to the rise of the soluble salts of the soil in solution carried up by the process known as capillary attraction through the pores of the bricks. In order to determine the exact nature of the changes taking place in the disintegration of brick-work by salts, the quantitative chemical analysis of the samples (given in Appendix No. 1) was worked out.

6. The analysis of soil in the compound of the Rest-House (sample No. 2) shows that it contains mostly the salts of sodium in the form of chloride and sulphate, though calcium oxide and potassium nitrate also occur in negligible quantities. Scrapings of white salts from the outer face of the brick-work of the building (sample No. 1) contain soluble salts of sodium as chloride and sulphate. It is also clear from analysis that the original brick (sample No. 8) was practically free from soluble salts. It is, therefore, evident that the white salts on the walls were mainly derived from the soil. Another noteworthy characteristic is that the scrapings of white salts contain only those salts which are present in the soil. Thus it follows that with the rise of water table, the soil grew saturated with salts which in solution were carried up the walls by capillary attraction. The simple process of evaporation left these salts on the outer face of the brick-work resulting in efflorescence on the building.

7. The inside and outside analysis of the bricks, the one covered with white salts and showing signs of disintegration (*i.e.*, sample "B"), and the other covered with white salts but without signs of disintegration (*i. e.*, sample "C") show that only those salts existed both inside and outside which were found in the soil and the brick scrapings. So, it is concluded that there is no chemical change taking place in the wall itself.

8. It is clear from analysis of brick (sample brick "B") that the crystallisation of the salts in the brick caused its disintegration. The sample brick "C" was better burnt than "B". It was found on breaking that sample brick "B" contained more voids inside than the sample brick "C", that is which led to the concentration of salts inside the former. The crystallization of salts on the outside by the process of efflorescence resulted in corrosion of the outer face of both the bricks "B" and "C". Similarly, the disintegration of mortar was also due to the crystallization of salts in it and the loss of water in the mortar through evaporation. It is, therefore, concluded that the damage to the brick-work was just a physical phenomenon, comprising disintegration due to crystallization inside the bricks and the corrosion through the deposition of the salts on the outside.

9. A brick fresh from the kiln near by (sample "A") was dipped in canal water, and on exposure to atmosphere it became covered with salts. Its analysis showed that it contained about 4 per cent. of soluble salts. Now if the brick itself and the mortar contain soluble salts, the efflorescence does take place even if there be no rise of moisture with salts in solution from the soil by capillary attraction. The rain water is absorbed by bricks which on evaporation leaves the salts on the outer face of bricks resulting in corrosion. So in order to guard against efflorescence it is essential that the bricks should be free from soluble salts.

10. One of the pillars in the verandah was under-pinned in February 1928. A Tarraki slab stone 3″ thick was put under it on the plinth level and the pillar rebuilt in lime mortar up to springing of the verandah arch without any accident. It was observed that up till the end of December 1928 no kallar rose through the slab stone and the wall, but rain water recoiling from the ground to the walls showed some signs of action on the mortar in the joints, on the outer side of the pillar only. It was, therefore, concluded that under-pinning if successfully carried out on the lines indicated above would not only be an effective cure but will also be a good preventive against the attack of salts on the building.

11. For all subsequent work Wah slate stone was considered to be the best material available, but this had to be given up on account of the inability of the firm to supply stone of the required thickness.

The choice therefore fell on cement concrete, and in order to make it perfectly damp-proof it was decided that it should be laid between two layers of bitumen (No. 6).

Damp-proof course.

12. The building had to be under-pinned by bits. If the concrete were laid at site it would not set in less than 3 weeks' time, so it was found impracticable to wait for every bit undertaken for such a long time.

The cement concrete laid *in situ* is an unseasoned porous material. The elastic deformation brought about by the first application of a load is removed, when the load is relieved, but in course of time the plastic yield in the material becomes a permanent set. Moreover, the unseasoned concrete laid *in situ* shrinks on drying on account of chemical action. A great amount of heat is produced in setting of cement concrete which leads to rise of temperature and, therefore, the concrete laid *in situ* is sure to cause serious cracks on cooling.

Cement concrete slabs, precast, behave like a seasoned porous material. The coefficient of shrinkage of cement concrete of the mixture 1 : 2 : 4 is taken to be ·00055. The use of cement concrete precast slabs after three weeks saves half the shrinkage which takes place in this period.

Even the slabs built outside will contract and expand with temperature and stress. In addition, humidity affects the porous materials considerably. There is great amount of shrinkage, when the concrete dries out completely. But these changes in the slabs precast outside in the seasoned condition are taken up by the joints between the slabs. These joints do not reduce the efficiency of the cement concrete as a damp-proof course if a double layer of precast slabs were used, breaking joints, and giving sufficient overlap. Moreover, the thin layer of bitumen, below and on the top of slabs, serves to flow into the joints in case of contraction, keeping the joints water-tight. The damp-proof course actually used, therefore, consisted of double layer of cement concrete slabs $1\frac{3}{8}''$ thick in 3 feet lengths precast in widths according to the thickness of the walls with a thin covering of the bitumen at the bottom of the lower slabs and on the top of the upper slabs. The thickness of the bitumen should not exceed one-sixteenth of an inch.

13. The whole success of concrete as a damp-proof course depends upon its compactness. Porous concrete will admit of the passage of the moisture and along with it the salts in solution. Special attention was, therefore, paid towards making the slabs of as compact a concrete as possible. Neat cement supplied by the Punjab Portland Company was used. Fine aggregate consisted of Haro sand well graded from fine to coarse. To ensure that it contained no earthy matter, it was thrice washed with water and dried before use. The coarse aggregate consisted of Pathankot bajri of $\frac{1}{4}''$ size. It was washed twice with water and dried to free it from earthy and organic matter. The water from the Satghara Rest-House well is saltish, and, therefore, it was not used. The canal water contained silt and earthy matter. It was, therefore, stored in a big galvanized iron tub whence clear water was decanted after 24 hours. The mixing of the concrete was done on iron sheets so that it could not touch the kallar soil and the slabs were laid on a specially prepared pacca and cement plastered platform. Six sample slabs were made to inspect the porosity of the concrete. On examination it was found that the use of too little water left voids, while use of too much water left air holes. It was eventually decided that the mixture of the concrete for the damp-proof course should be 100 lbs. cement : 2 c. ft. coarse Haro sand : 4 c. ft. shingle $\frac{1}{4}''$ size. It was found that an addition of water from 75 lbs. to 80 lbs. for 100 lbs. of cement used, produced the densest concrete. The variation in the quantity of water used was due to the moisture in the sand dried after washing.

Under-pinning.

14. The process of under-pinning is shown in sketches given in Diagram No. 1, and Photographs Nos. 1 to 5.

Sketch No. 1 shows the under-pinning of the doors and windows. Sketch No. 2 shows the under-pinning of the inside walls of the main rooms. These walls were high, and, therefore, could be opened out for sufficient length on account of the arching action. However, to be on the safe side, holes were made in the wall at intervals of 2·5 feet, opening out about 6 feet length in one operation. Care was taken to pierce the holes at about a foot above the moist bricks, where kallar had risen. Karries of 5″×5″ size were put through the holes. It was seen that the top of the holes was flat touching the karri at every point. The karries were supported on temporary pillars 0·8′ × 0·8′ in mud. The karries were wedged up securely on the pillars before dismantling the wall below. Each unit of 3 feet width was built up to the full height, before the karri in this section was removed. Holes made for karries were filled in as shown in Sketch No. 2.

Photograph No. 1 shows the raising of the plinth in the verandahs and the under-pinning of the arch pillars. Even the arches were renewed to the height up to which kalar had risen. Similarly, Photographs Nos. 2 and 3 show the under-pinning of the verandah pillars. Half of each verandah pillar was dismantled first, plinth was raised and damp-proof course put in and then the wall was completed up to the springing. The second half was similarly managed. An overlap of 9 inches of the top slabs over the bottom ones was arranged, and it was considered to be sufficient. Centering simply consisted of vertical supports near the walls under the girders coming over the arch, another vertical support under the crown of the arch and horizontal karries just at the springing or the point to which kallar had risen.

Photograph No. 4 shows similar temporary supports for the cross arch in the front verandah, after the outer wall had been under-pinned.

Photograph No. 5 shows the verandah arch which had to be rebuilt up to crown on one side. The complete centring was made for the right half and two holes were pierced above the second half to pass the horizontal karries. The left half was easily dismantled and built without any mishap.

Under-pinning of the whole house was finished in about a month's time, work being carried out steadily from the beginning to the end without any accident and without even the slightest crack occurring in the wall and the super-structure.

Laying of damp-proof course.

15. Damp-proof course consisted of slabs 3 feet long and $1\frac{3}{8}$ inches thick. The width of the precast slabs varied according to the requirements. The lower slabs projected 0·4 foot on either side of the inner walls as shown in Sketch No. 1 in Diagram No. 2. In case of the inner walls of the main room, the width of the lower slabs was 2·9 feet, and that of the upper ones was 2·1 feet. This ensured a cover of ·4 foot on either side of the

cement concrete floor to overlap the lower layer of the slabs, so that there may be no chance of kallar rising through the joint between the floor and the damp-proof course.

Sketch No. 2 shows the laying of the slabs for the outer walls of the main rooms. It was ensured that the joints were broken by overlap of at least one foot.

The arrangement of the slabs under the verandah pillar is shown in Sketch No. 3 in Diagram No. 2. This arrangement ensures complete overlap of the top slabs and of the verandah floors over the bottom slabs.

Utmost care should be taken in laying the slabs for ensuring complete success. It is very important that the slabs should not crack while handling or laying at site, nor should they crack when the load is first applied. Special care was taken that the slabs were made perfectly even so that they could be embedded firmly on mortar. The mixture of mortar used consisted of cement and sand in the ratio of 1 : 3. A uniform layer of ¼ inch thick mortar was laid. The lower slab was tried and pressed home so that the excess mortar oozed out of the joints. The slab was removed and the fluid bitumen uniformly spread over the partially dried mortar without disturbing its surface. The slab was then quickly laid and pressed, with the result that bitumen did not dry up and only the excess flowed out.

Then ¼ inch thick layer of the mortar was laid on the bottom slabs to receive the top slabs which were embedded well over it. It is very important that there should be no voids between the slabs which should cause cracks in the top slabs when load is applied. On the top of the second slab, fluid bitumen was applied in a uniform layer.

It is equally important to lay the top-most layer of brick-work properly. In case the joints are not properly filled in, it would cause uneven settlement of the top work and superstructure, when the supports are removed. It was, therefore, specified that the whole course should be filled in with mortar, and bricks wedged in when the mortar was yet plastic, as mortar could not be thrust into the top joint by means of a trowel. The superfluous mortar flowed out of the joints. This small wastage is amply repaid in complete security of the joints having been filled up with mortar. Temporary supports were removed after 24 hours.

16. The cost of under-pinning of the whole of the main building comprised the following expenditure actually incurred in execution of the work.

	Rs.	a.	p.
The cost of under-pinning, making temporary pillars, etc.	217	8	0
The cost of damp-proof course including laying and carriage to site	450	8	0
The cost of bitumen including laying	99	0	0
Total ..	767	0	0

Plinth area of building $=60\times44=2640$ sq. ft.

The cost of under-pinning and damp-proof course 767/2,640=0-4-6 per sq. ft. of plinth area.

17. When walls were under-pinned it was found that the kacha bricks, which were removed, were as wet and plastic as if they were freshly moulded. It was, therefore, decided to do away with them altogether and to replace them with pacca masonry in cement mortar up to the point where moisture had risen. Not only the damp-proof course has been added, but also all the walls have been replaced up to a height of about 4 feet above the raised plinth.

Clean sand from the bed of the Northern Branch was used in mortar. All the pacca bricks used for under-pinning and raising the plinth were spread on the bed of the canal and washed for two months to dissolve out all the soluble salts in them. During the closure of the canal the bricks were collected on the sides and conveyed from there to wooden boards placed near the masons. They were not allowed to touch the soil containing salts.

18. The cost of replacing the kallar eaten walls with pacca masonry up to 4·0 feet height is—

		Rs.	a.	p.
Cost of dismantling	..	69	12	0
Masonry up to 4·0 feet height	..	865	6	0
Total	..	935	2	0
or say	..	935	0	0

Cost of replacing the wall $= \frac{935}{60 \times 44 \times 4} = \overset{a-p}{1-5}$ per sq. ft. of plinth area per foot height of wall.

19. **Raising Plinth.**—It has already been pointed out that the plinth of the Rest-House was level with the ground. It was, therefore, decided to raise it by one foot. This necessitated the raising of all doors and windows by 1·0 foot. Sketch No. 1 in Diagram No. 1 shows the temporary supports erected to raise the doors. Three holes were made in the wall. The middle one was at a higher level than the other two, which were vertically above the springing of the relieving arch, leaving sufficient room so as to raise it up by one foot. Strong deodar ballies 5″×5″ were put through the holes supported on both sides on temporary pillars, 0·8′×0·8′ in mud. Ballies were pressed up tight by means of wedges on the pillars on both sides. Further precaution was taken to support the verandah girders coming over the doors by placing ballies under them wedged up tight. The inner doors were raised without any support under the girders in the main rooms. The door was removed altogether and the relieving arch was dismantled. The opening was just a rectangular hole enclosed on top by a segmental arch supported on three ballies (one at the crown and the other two at the same level about springing). The plinth was raised and damp-proof course put all over the plintharea even under the doors. The jambs were built and the doors put in at the raised level. The relieving arch was built in as ordinarily in a new building. The portion above the relieving arch was

filled in afterwards, taking special care that no joint was left empty. The supports were removed after 24 hours of the completion of the work. In this way all the doors and windows in the main rooms and the bath-rooms were raised without the slightest crack occurring in the building anywhere.

The chimneyswere also raised by putting three supports only, when the side walls were completely finished. They were dismantled completely and rebuilt. This work was easy as there was sufficent height of walls above the chimneys helping to support the roof by arching action.

The arches in the back verandah were segmental, and it was found that they looked very low. It was, therefore, decided to raise them by 1·5 feet. Temporary supports in this case consisted of three ballies as in the case of doors with additional vertical supports under the verandah girders. The arches were completed one after the other. The old arch served as centeringfor the new arch. Photograph No. 6 shows the completed work without the slightest crack appearing in the building.

Cost of Raising Plinth.

20. The work of raising plinth comprised of the raising of all doors, windows, chimneys, and both the arches of the back verandah. It also included the cost of raising the plinth by 1·0 foot in cement masonry with mortar containing cement and sand in ratio 1 : 5. The complete operation cost Rs. 613. The plinth area of the building is 2,640 sq. ft. The cost of raising plinth by one foot works out at Rs. 0-3-9 per sq. ft. of the plinth area of the building.

Floors.

21. The floors of the Rest-House were made of lime concrete of one foot depth covered with ½" of cement plaster. The concrete in the floors was badly affected with kallar. It was decided to remove it altogether. On dismantling it was found that the disintegration was due to the formation of crystals of salts in the concrete. On exposure to the atmosphere, the major portion of the concrete turned into powder. Even the soil below the concrete was dug out to the depth of one foot in all the rooms. The new floor now consists of 2·0 feet thick sand, ·25 foot lime concrete and 1½" thick conglomerate cement flooring. The sand used was taken from the bed of the canal. It was fairly coarse and contained very little clay and was also free from organic matter. Two feet thick layer of sand was considered quite ample to stop the rise of kallar from under the floors. A layer of cinderswould have served the same purpose; but it was cheaper to obtain this sand.

22. Sand was well rammed in, and was dressed afterwards. The foundation for the cement concrete floor was then laid which consisted of three inches of lime-sand concrete mixture 1 : 2 : 8. The ballast used consisted of half inch hard-broken bats which were especially selected from the recently dismantled notches of the fall at R. D. 64,000 Northern Branch. Slaked lime and sand were mixed dry, and concrete was laid and consolidated as per specification for lime concrete. This concrete

set very well, producing a very compact foundation for the cement floors. Twenty-five per cent. cement was added to lime for a foot width of concrete laid near the walls and a good joint was ensured with walls by raking out the joints and washing them.

The base of the cement floor, one inch thick, is made up of cement, sand, and brick ballast in ratio 1 : 3 : 6. Coarse canal sand, which was washed with water to remove all earthy and organic matter was used, and specially pacca bats were used for the ballast.

It was broken to $\frac{1}{4}''$ to $\frac{1}{2}''$ size and was well soaked in clean canal water before use.

The wearing coat $\frac{1}{2}''$ thick consisted of cement concrete prepared from one part of cement and two parts of Pathankot well-graded shingle (bujri) $\frac{1}{4}''$ size. The floors in the verandahs were made with this mixture in natural colour of cement.

The cost of the floors amounted to Rs. 899.

23. **Plaster.**—The kacha plaster on kacha walls was crumbling down. It served as harbour for white-ants which ate up the wood-work of the building and furniture. It was, therefore, decided to remove the kacha plaster altogether and put in cement plaster. For this the mixture consisted of cement, lime, and sand in ratio 1 : 7 :12.

Clean canal sand was mixed dry with cement ; and lime was added in the form of lime water sieved through a coarse cloth, till a pasty mass was obtained.

The following quantities were actually used per 100 sq. ft. of the surface :—

Cement	..	·28 c. ft.
Lime	..	1·76 c. ft.
Sand	..	3·36 c. ft.

The rate for cement plaster worked out to Rs. 5 per 100 sq. ft.

24. **Compound round the Rest-House.**—The earthen platform round the Rest-House is about 40 feet width. It consisted purely of kallar earth as already stated above. It was decided to dig it out all round to a depth of 1·5 feet and to fill it in as given in Sketch No. 4 Diagram No. II.

The platform now consists of 1·0 foot clean silt from the canal bed covered with good berm earth from the canal berms to a depth of half a foot. Up to 20 feet all round the building cinders 3 inches deep are laid. The plinth is now 1·3 feet higher that the surface of the earth. A good slope of 1 in 50 is provided all round to drain off rain water quickly into the drains.

Cost of improving the platform in the manner indicated above was Rs. 353.

25. The net cost of all the improvements made in the building of the Satghara Rest-House is summed up as below :—

			Rs.
(*a*) Renewing walls up to the height the kallar had risen			935
(*b*) Under-pinning and damp-proof course		..	767
(*c*) Raising plinth by 1·0 foot	..	..	613
(*d*) Cement floors ..	..	..	899
(*e*) Cement plastering walls	..	..	262
(*f*) Platform around the building	..	..	353
	Total	..	3,829

26. **Conclusion.**—The cost of dismantling the building and re-building it at the current rates affecting all of the above mentioned improvements was worked out to be Rs. 8,000. It was assumed in working out this estimate that pacca bricks above the points where kallar had risen and the wood and iron work could be re-used. This shows under-pinning effected a net saving of Rs. 4,171.

27. The author takes this opportunity of expressing his gratitude to Rai Sahib Lala Ram Das, Executive Engineer, and Mr. A. W. M. Jesson, Superintending Engineer, L. J. Canal, who took great interest in the work and guided him in overcoming the numerous difficulties encountered during the course of the execution of the work. The author is indebted also to Mr. Mukand Lal Mehta, Assistant Research Officer, Irrigation Research Laboratory, Lahore, for his assistance in the chemical analysis of the soil and the salts.

APPENDIX

Quantitive analysis of soluble salts expressed as percentage.

Serial No.	Description.	Soluble matter.	$Na_2\ CO_3$	$Na\ HCO_3$	$Na_2\ SO_4$	$Na\ Cl$	$Ca\ O$	KNO_3
1	Brick scrapings ..	89·18	Nil.	·756	13·32	73·56	..	Traces.
2	Soil ..	8·7250	..	·059	2·83	5·25	·6020	·35
3	Brick A ..	..	..	..	·7898	2·2643	..	..
4	Brick B inner ..	..	..	..	2·1534	·0234	..	..
5	Brick B outer ..	..	..	..	0·1804	5·1890	..	..
6	Brick C inner ..	..	..	..	Trace	1·7316	..	..
7	Brick C outer ..	..	..	..	Trace	5·3698	..	..
8	Brick D ..	..	..	..	Trace	0·0234	..	..

No. 1. This represented the white salts sticking to the walls.
No. 2. An average sample of soil of the compound of Satghara Rest-House.
No. 3. Newly manufactured brick at Bhalwal kiln.
Nos. 4. and 5. This was a brick covered with white salts showing signs of disintegration at a height of 4·0 feet from plinth.
Nos. 6. and 7. This was a brick about the same height as C covered with white salts but showing no signs of disintegration.
No. 8. This brick was taken from near the top cornice of the building. This represented the original brick used at the time of construction.

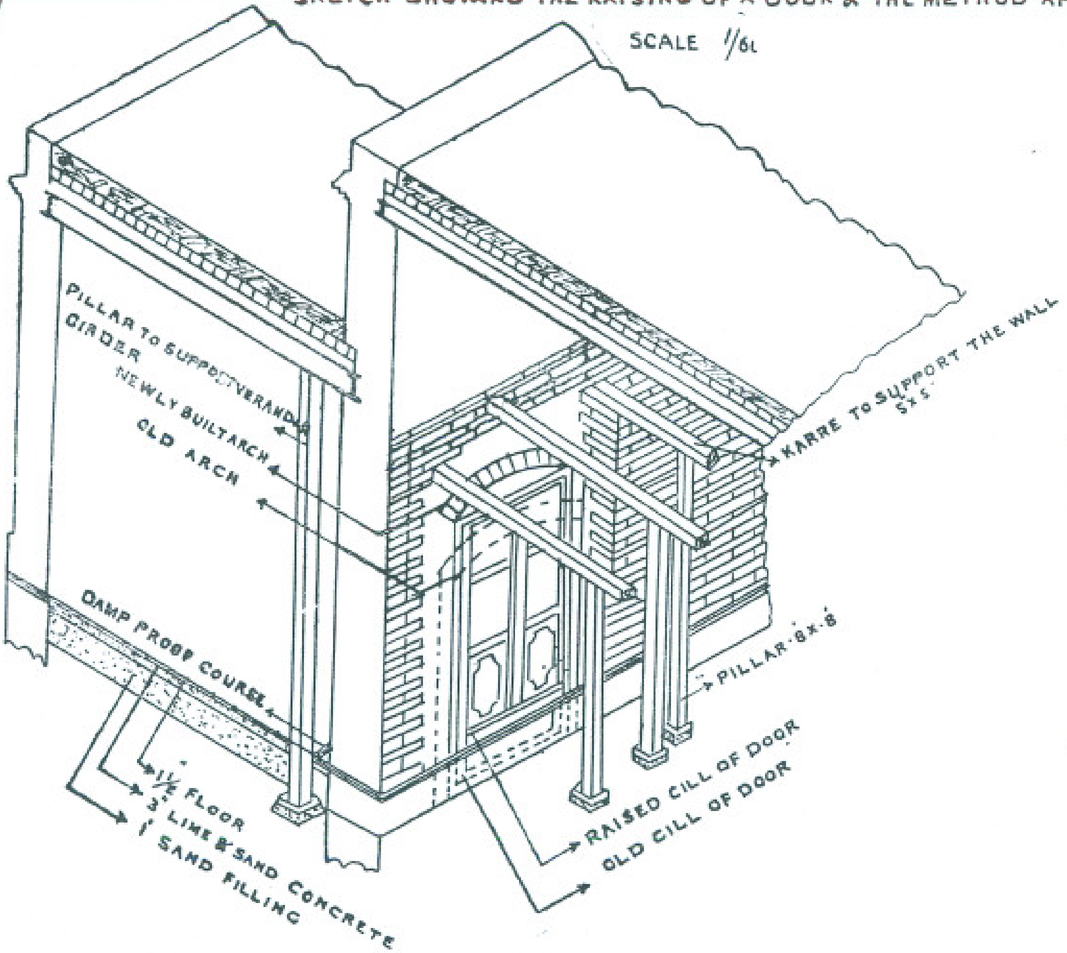
23rd October 1930.

K. R. SHARMA,
Assistant Engineer.

No. I

SKETCH SHOWING THE RAISING OF A DOOR & THE METHOD APPLIED

SCALE 1/6L



SKETCH SHOWING U

SC

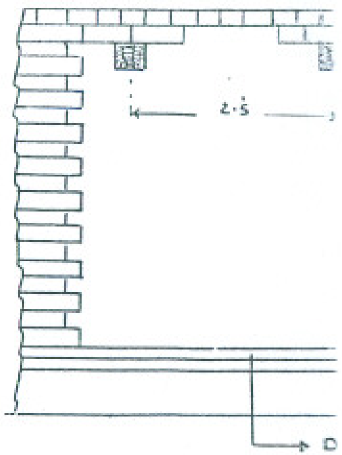


DIAGRAM Nº 1

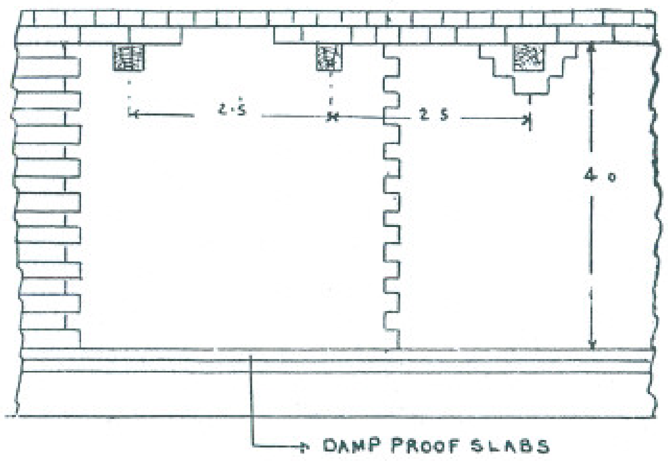
ETHOD APPLIED

T THE WALL

Nº 2

SKETCH SHOWING UNDER PINNING INTERIOR WALL

SCALE 1/24

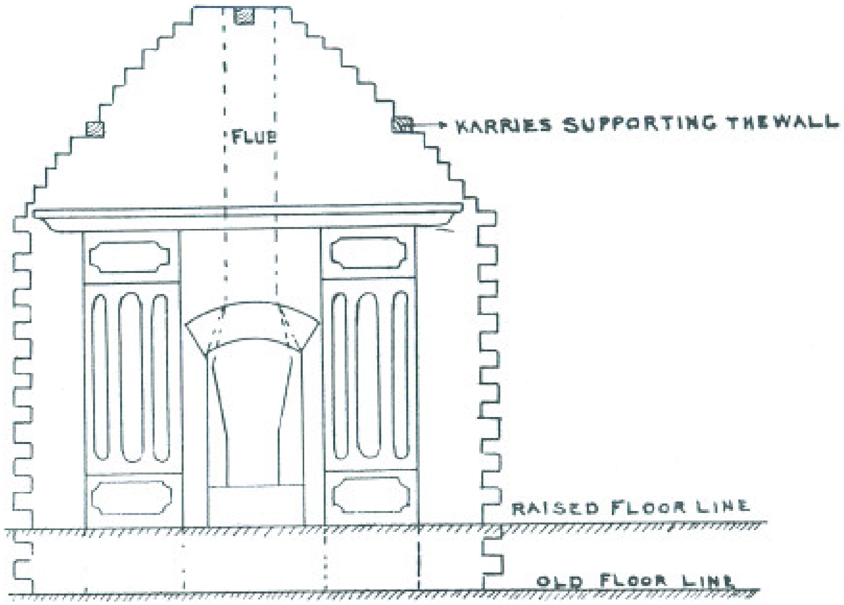


Nº 3

SKETCH SHOWING THE RAISING OF A FIRE PLACE

SCALE 1/30

ELEVATION



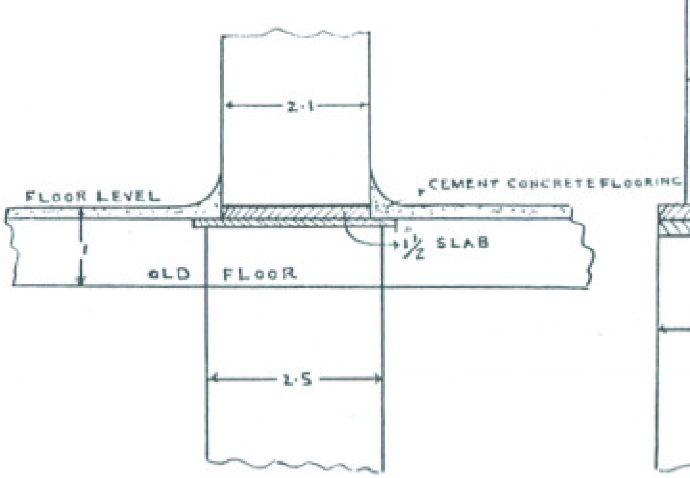
K R Sharma
24.10.30

SUB-DIVISIONAL OFFICER
MITHALAK SUB-DIVISION

No 1

SKETCH SHOWING THE UNDER PINNING OF INTERIOR WALLS

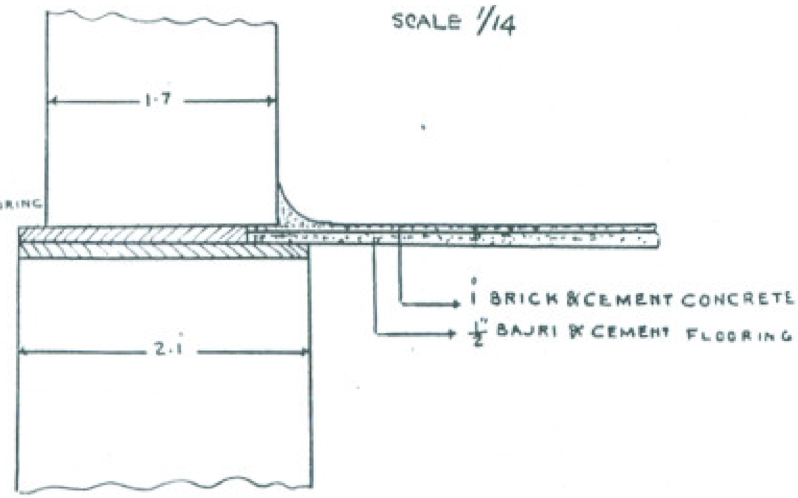
SCALE 1/28



No 2

UNDER PINNING OUTTER MAIN ROOM WALLS

SCALE 1/14



No 3

SKETCH SHOWING THE UNDER P

OF VERANDAH OUTTER WA

SCALE 1/28

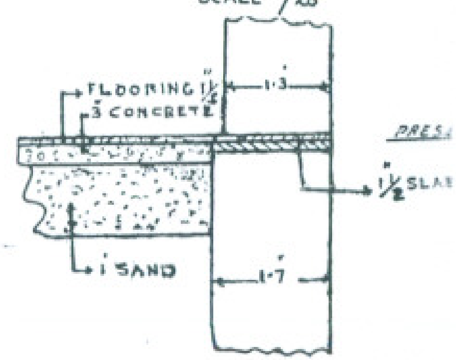


DIAGRAM ----Nº 2

Nº 2

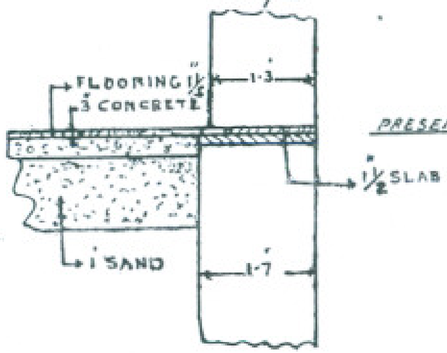
; OUTTER MAIN ROOM WALLS

SCALE 1/14

Nº 3

SKETCH SHOWING THE UNDER PINNING OF VERANDAH OUTTER WALL

SCALE 1/28

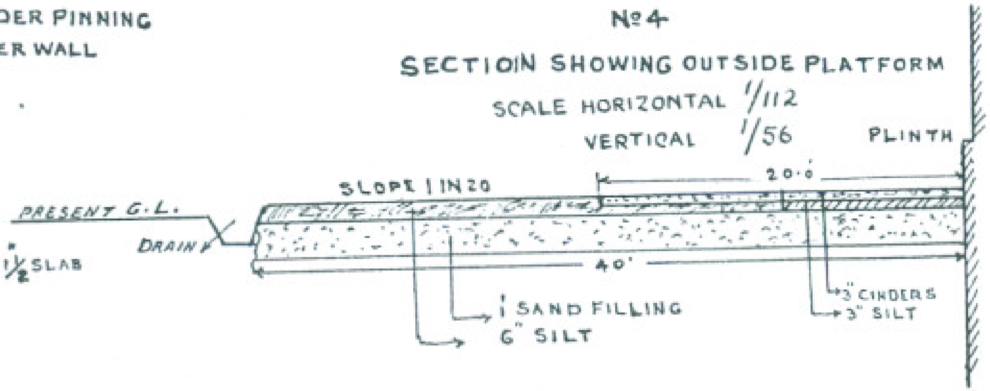


Nº 4

SECTION SHOWING OUTSIDE PLATFORM

SCALE HORIZONTAL 1/112

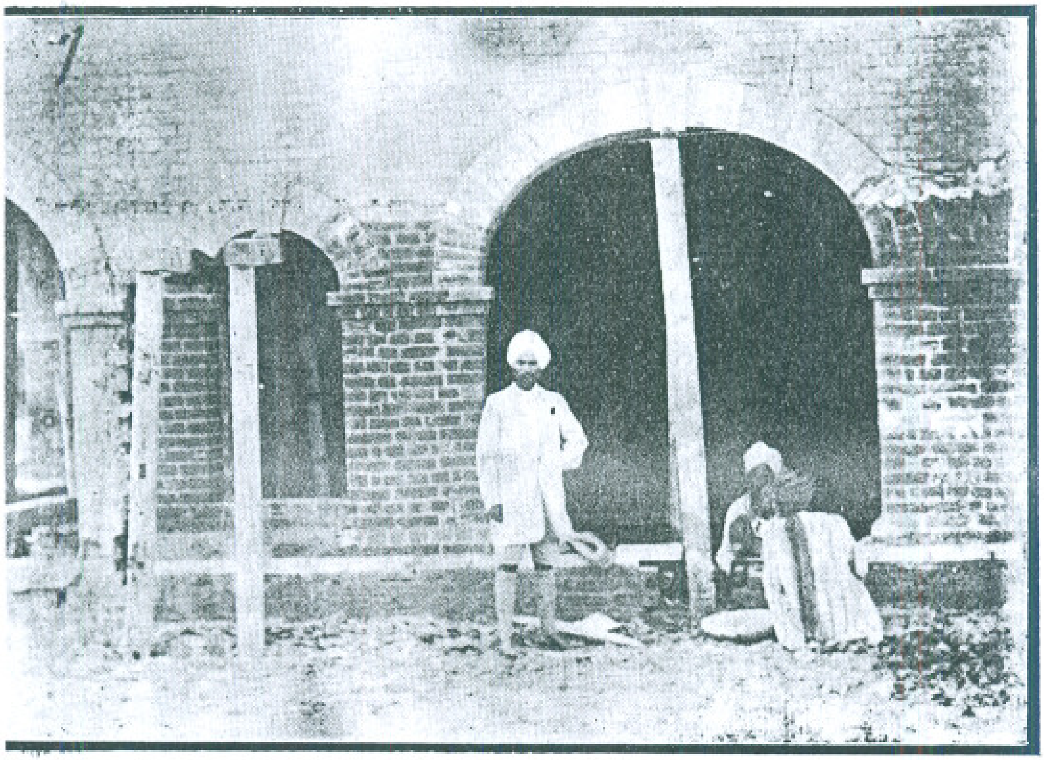
VERTICAL 1/56



KR Sharma
26.10.30

SUB DIVISIONAL OFFICER

MITHALAK SUB-DIVISION



Underpinning of Verandah Pillars.

Underpinning of Verandah Pillars.

Underpinning of Verandah Pillars.

PAPER No. 148. PHOTO No. 4.

Underpinning of the cross in the front Verandah.

PAPER No. 148. PHOTO No. 5.

Underpinning of the Verandah pillar and rebuilding the arch up to crown.

Completed work of the raised back Verandah Arches.

DISCUSSION.

In introducing the paper the **Author** said that an attempt had been made to describe in his small paper, the simple methods employed for successful underpinning of a complete building. There could not be any hard and fast rules but success depended upon the care and keen supervision by the engineer incharge of the work throughout the operations.

About two years had passed since this work had been executed. The kallar had risen up to the bottom of the lower layer of the slabs but it had no where passed through the damp proof course. There were no signs of any salts coming up through the floors. The cement, lime and sand plaster was successfully sticking to the mud brick walls and there were no signs of the whitewash scaling off the plaster anywhere. The compound round the Rest House also was free from kallar up to the limits where it had been renewed and the raising of the plinth had improved the appearance of the building very much. The experiment of underpinning had therefore proved to be a complete success.

He further remarked that the subject was of general interest as even a layman had to deal sometimes with cases of efflorescence, and he would be interested to hear the views of other members of the Congress.

Mr. Sardari Lal Malhotra said that he wished to point out one or two defects in the design as shown in the sketches. He instanced sketch No. 1 of diagram No. 2, where the damp proof course had been shown at the level of the floor which overlapped it, and remarked that if that was the way things had been done, kallar would appear again. The damp proof course ought to have been laid at least $\frac{1}{4}''$ above the floor level and clear of it.

Further, in sketch No. 2, of diagram No. 2, the lime concrete of the floor had been shown projecting into the wall and abutting against the top slab of the damp proof course. This arrangement was defective and did not afford any protection against Kallar.

The Author had not stated if the previous floor contained a layer of sand beneath it but it was very rare that a lime concrete floor was laid without a sand base. If the previous layer had failed, it was doubtful if the sand filling done by the author would be effective in preventing rise of kallar.

Mr. L. A. Freak congratulated the Author on his paper and his method of dealing with the practical problems, which some of the engineers present, might have to deal with in the future. He felt that many of the other members must have had other practical troubles such as those described by the Author in his paper, to face and he hoped they would come forward with papers. He remarked that the paper was one that was free of technicalities and was based on practical experience and suggested that such practical papers should take their place in the proceedings of the Congress, in addition to other highly technical papers some of which were beyond the power of comprehension of some of the members.

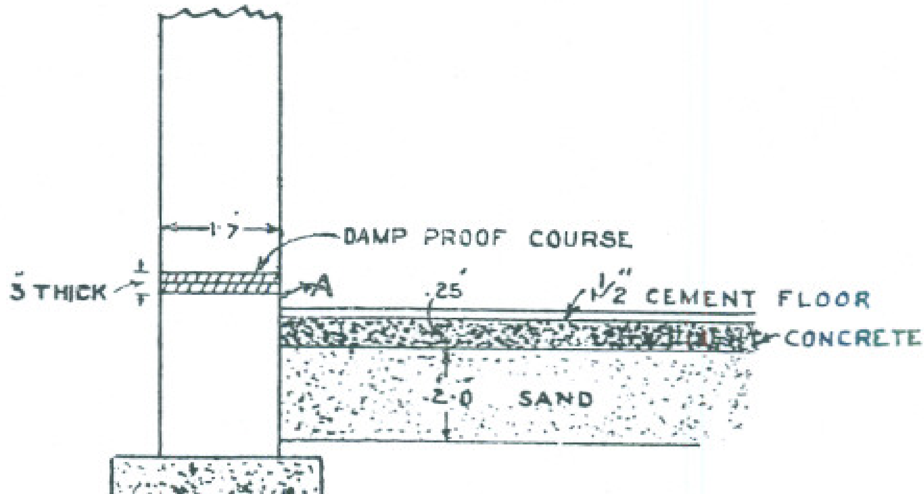
Rai Bahadur Pandit Chandar Bhan said that he wished to bring forward one or two points. There were lots of buildings which had been attacked by efflorescence. The usual remedy employed was to put sand under the floors and also around the buildings. That was the first precaution to be taken. The Author had shown how the walls were underpinned and explained the steps taken to stop kallar for the future, but there was one point that he would like to criticize and that was that the use of brick ballast was not advisable for floor slabs in cases where kallar was to be feared. He had seen slabs, made of 1 : 2 : 4 mixture in brick ballast, used on bridges, that had crumbled away after the first two or three years. He therefore advised that for a damp proof course, the specification should be 1 : 2 : 4 cement concrete with stone ballast. Either of the following methods would be found effective, for protection of the site :—

1. Pure sand to be put in round the work so that there should be no contact between the kallar soil and the work.
2. Lime refuse to be used in the same way.

It was essential that there should be no contact between the work and the kallar laden soil. It was also advisable to ensure that in the mortar used, there should be a minimum amount of surkhi or other material manufactured from "Pila" bricks.

Rai Bahadur Dewan Amar Nath Nanda, who was presiding at the afternoon session, remarked that there was nothing very substantial that he should say on the paper, but he drew the attention of the members to page 129, second paragraph from the top, where it was said that all the bricks used were immersed in water for a period of 60 days. Ordinarily the Public Works Department could not afford such a thing and probably extra care was taken in this case because perhaps it was of a special nature.

The Author replying to the discussion said with reference to the remarks of Mr. Sardari Lal Malhotra that the floor in all rooms and verandahs consisted of 2·0 feet depth of sand covered with ·25 feet foundation concrete and followed by 1½ inch thick conglomerate cement flooring. He did not agree with the suggestion of Mr. Sardari Lal Malhotra that the joint of the floor with the walls should be vertical and at a lower level than the damp proof course as sketched below.



The salts had actually risen up to the very bottom of the damp proof course and there was nothing below this level to check their rise. It would result in concentration of the salts at A by evaporation. The damage to the floor would start at the surface of the floor even if the proposed floor were effective. A vertical joint, as at A, between two different materials, the masonry of the wall and the concrete of the floor, was bound to crack, affording free passage of the salts to the surface of the floor. The joint proposed by the Author shown in the sketches in diagram No. II ensured complete overlap of the $1\frac{1}{2}''$ thick cement floor over the bottom layer of the damp proof course slabs and a good joint was ensured in rich cement. There was no chance of direct evaporation of the salts in the wall below the damp proof course. There had been no signs of the failure of the joints of the floor with the walls anywhere in Satghara Rest House during the past two years.

In reply to the remarks of Rai Bahadur Pandit Chandar Bhan, the Author said that no surkhi was used in the foundation concrete or the mortar for the masonry and plaster. Brick ballast was not used in the damp proof course or in the wearing coat of the floor. The foundation concrete and the base for the cement floor consisted of brick ballast. It would have been very expensive to use stone ballast or shingle instead, and he considered it unnecessary extravagance to use stone ballast or shingle in the foundation concrete because the damage due to the salts always began at the exposed surface, due to the crystallization of the salts on account of evaporation. The wearing coat, $\frac{1}{2}$-inch thick, consisted of cement and shingle in ratio 1 : 2. The surface of the floor was very strong and there was no likelihood of any damage.

No damage could, therefore, extend to the brick ballast in the foundation concrete when the surface was safe. There was even no likelihood of salts rising up through 2·0 feet depth of sand below the floors.

Replying to Rai Bahadur Dewan Amar Nath Nanda's remarks, the Author agreed that the immersion of bricks in canal water was a special thing but as the Canal was close by, they could afford to do this. In this connection, there were about 5 per cent. salts in the bricks used, as given in Appendix No. I. Sample D, which would have caused considerable efflorescence in the building if the precaution of washing the bricks had not been taken. This precaution, however, was not necessary where the bricks were free from salts.

The President in his closing remarks said that the Congress was very much indebted to the Author of this brief paper for the trouble that he had taken in acquainting the members with the measures that should be adopted if they were face to face with 'diseased' buildings similar to that described by the Author and to that extent the paper was of considerable usefulness. At the same time, there was an old adage which said that prevention was better than cure, and had a suitable damp proof course been provided in the first instance, such a state of affairs would not have arisen.