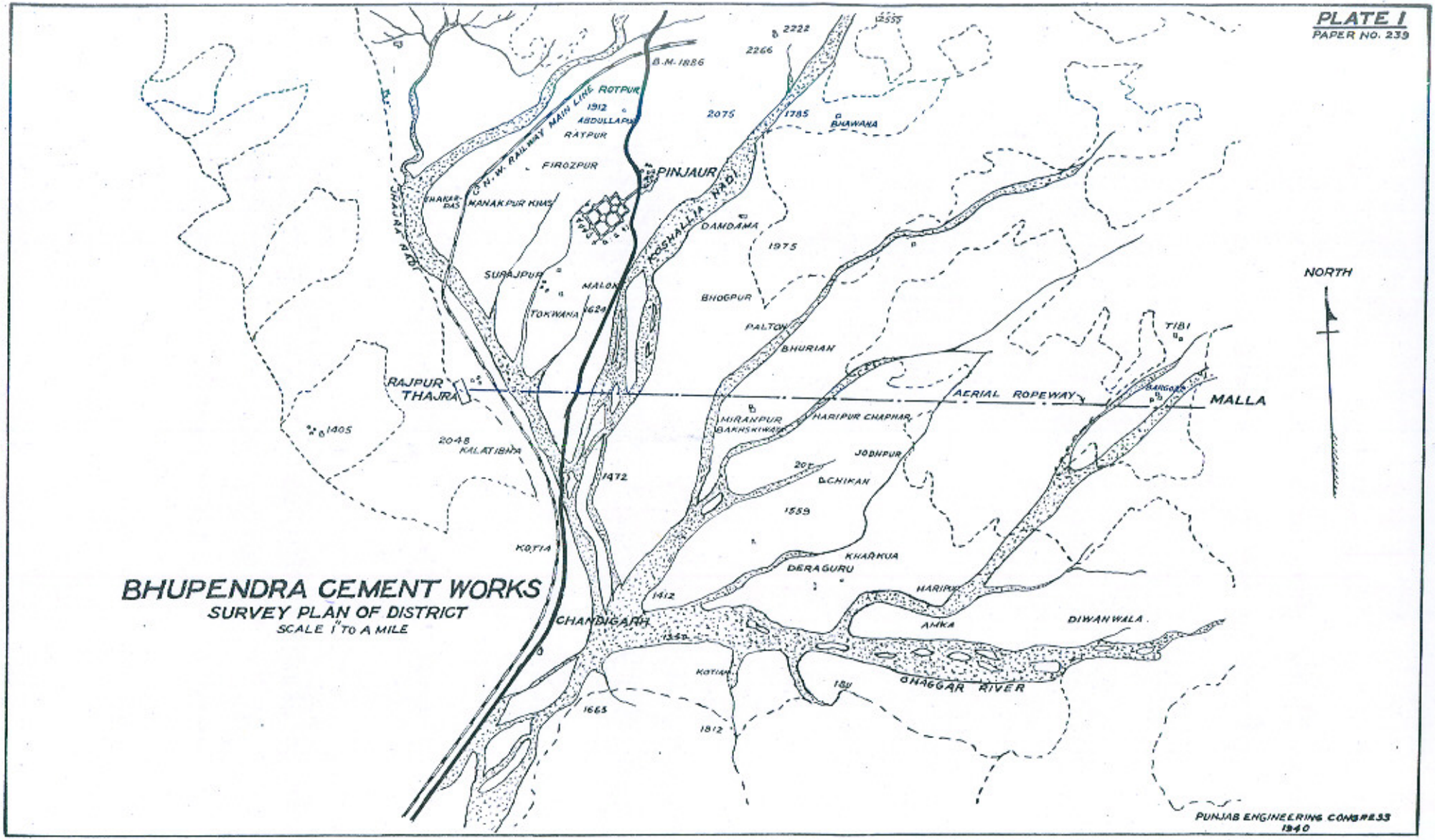
PLATE I
PAPER NO. 239



BHUPENDRA CEMENT WORKS

SURVEY PLAN OF DISTRICT

SCALE 1" TO A MILE

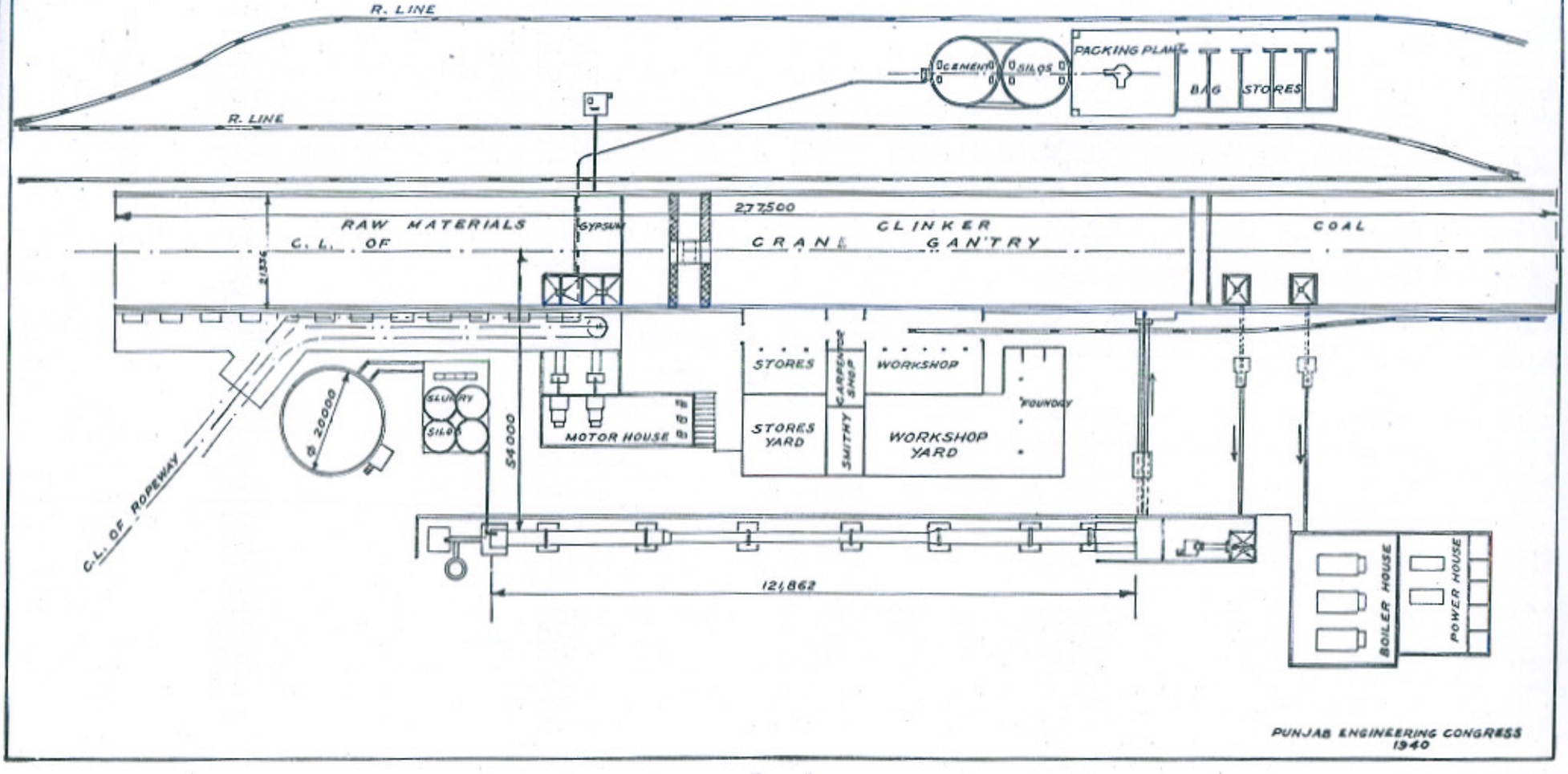
PUNJAB ENGINEERING CONGRESS
1940

PLATE 2
PAPER NO. 239

BHUPENDRA CEMENT WORKS

WORK'S GENERAL LAYOUT

SCALE 1:1000



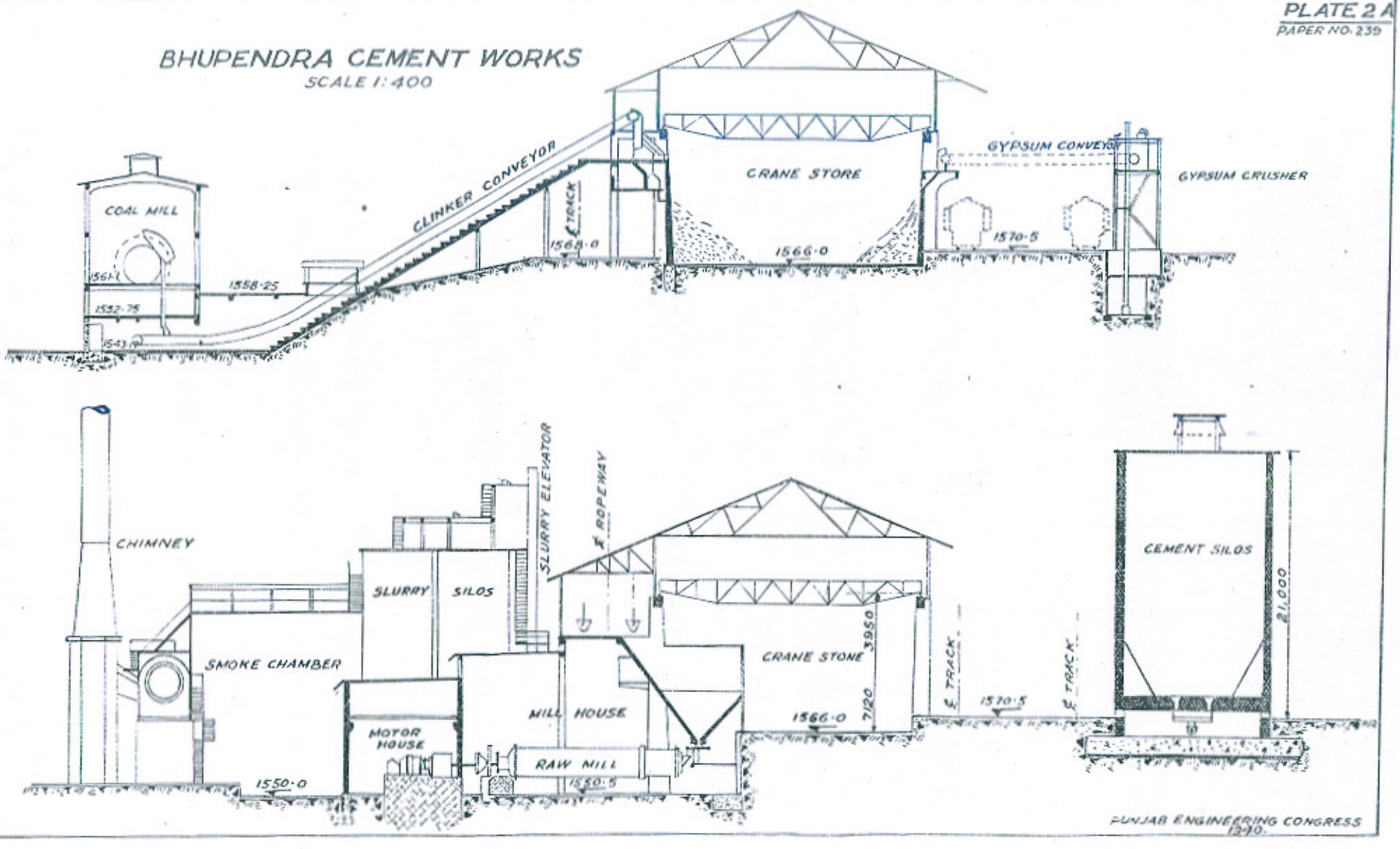
PUNJAB ENGINEERING CONGRESS
1940

PLATE 2 A

PAPER NO. 239

BHUPENDRA CEMENT WORKS

SCALE 1:400

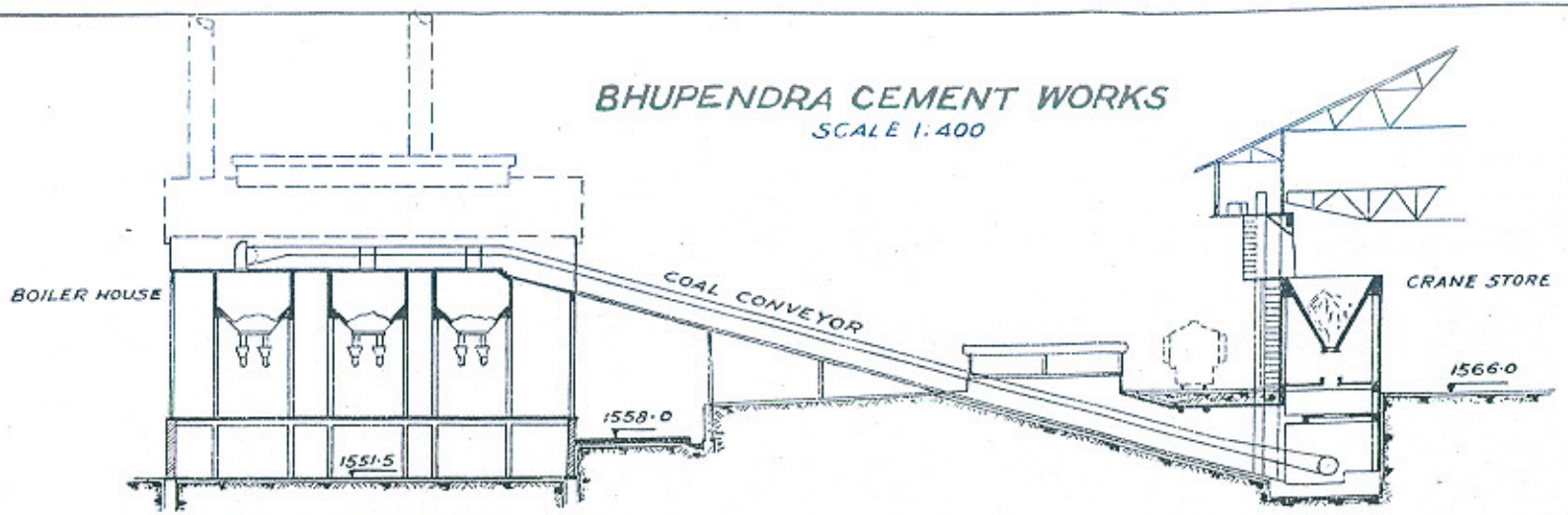


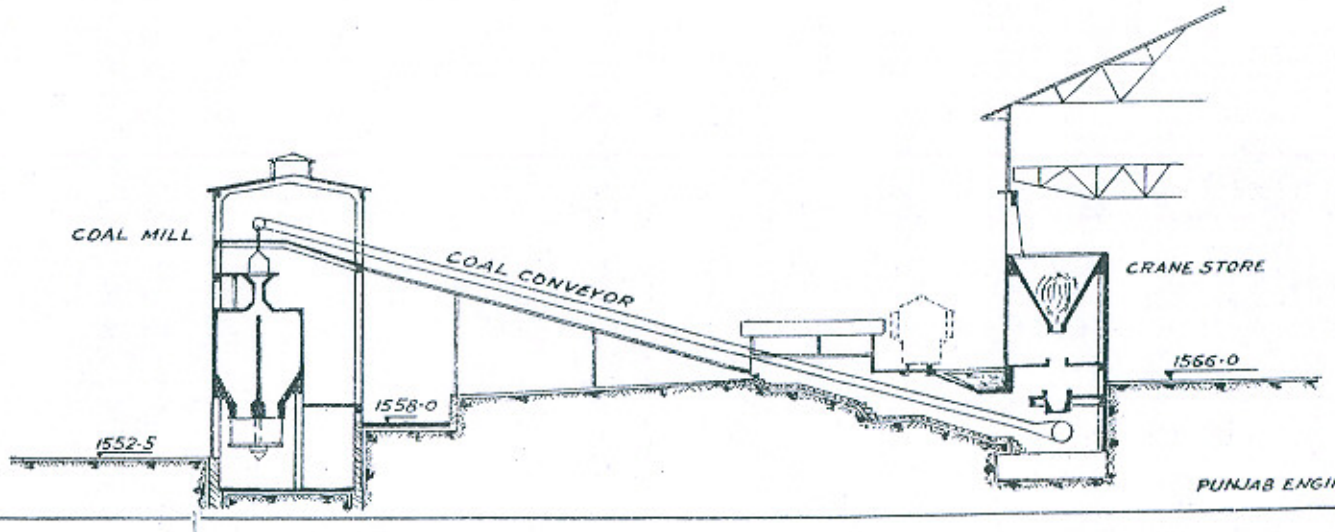
PUNJAB ENGINEERING CONGRESS
1940

PLATE 2B
PAPER NO. 239

BHUPENDRA CEMENT WORKS

SCALE 1:400





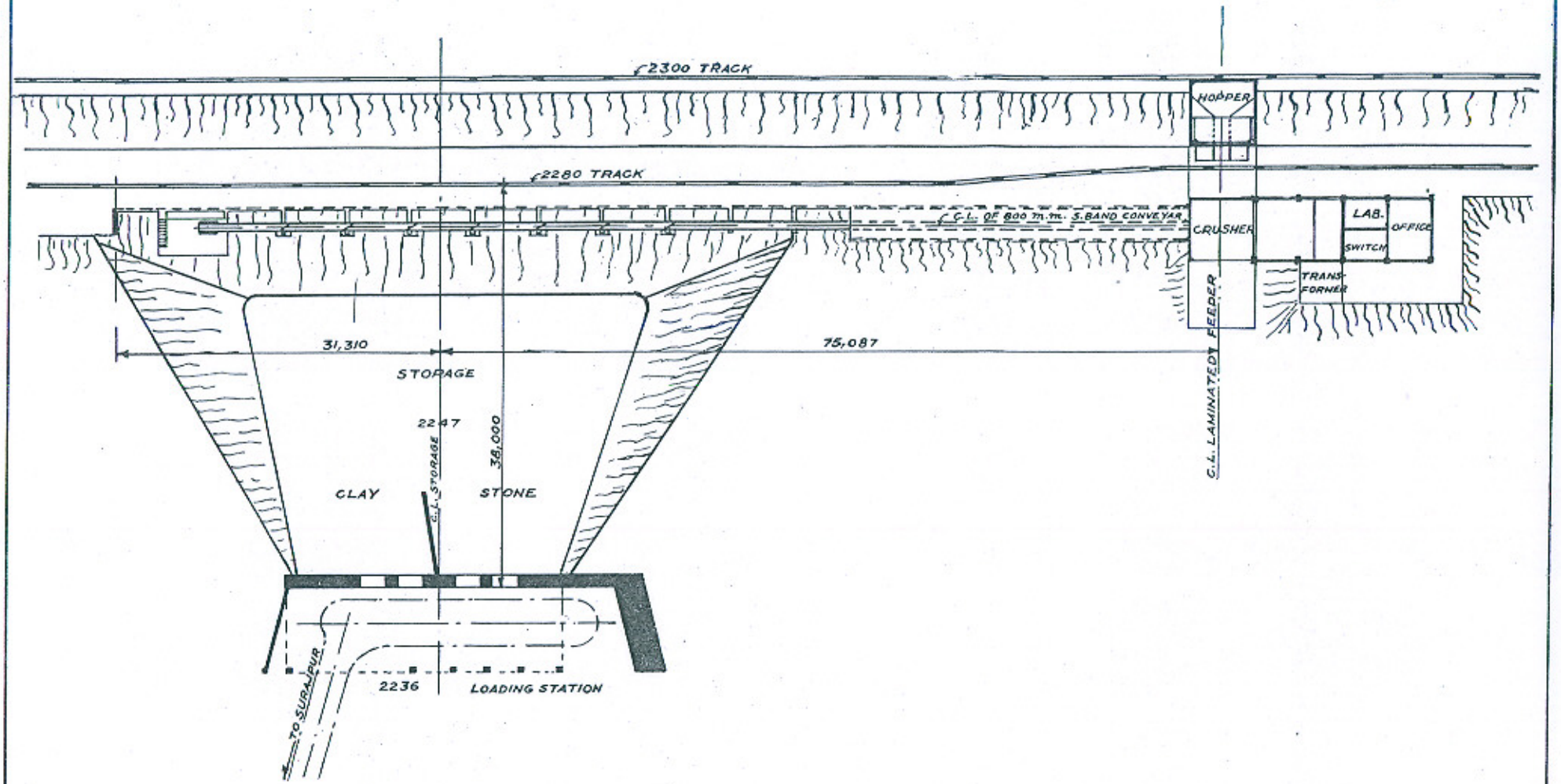
PUNJAB ENGINEERING CONGRESS
1940.

PLATE 3
PAPER NO. 239

BHUPENDRA CEMENT WORKS

CRUSHING PLANT AND LOADING STATION

SCALE 1: 500



PUNJAB ENGINEERING CONGRESS.
1940.

BHUPENDRA CEMENT WORKS

9" HOLLOW BRICK WALL

SCALE 1½" = 1'

PLATE 5

PAPER NO. 239

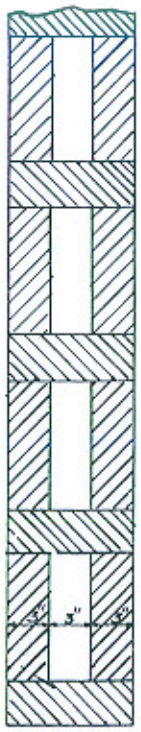


FIG. 1

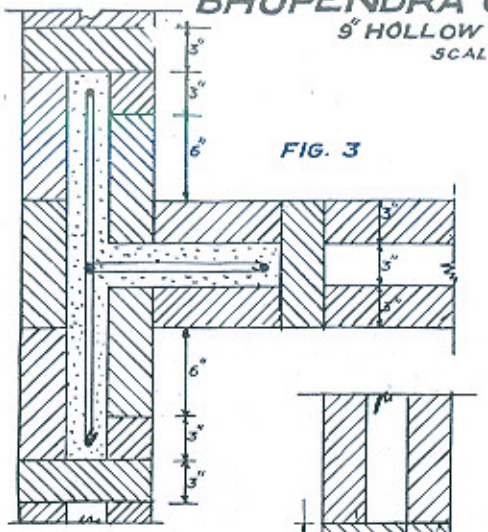


FIG. 3

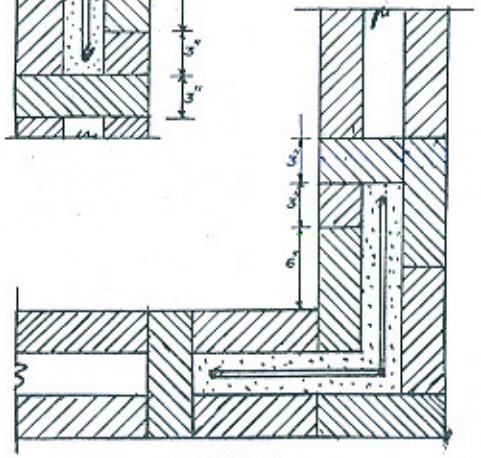


FIG. 2

FIG. 4

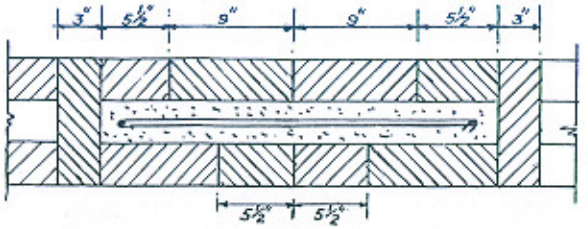
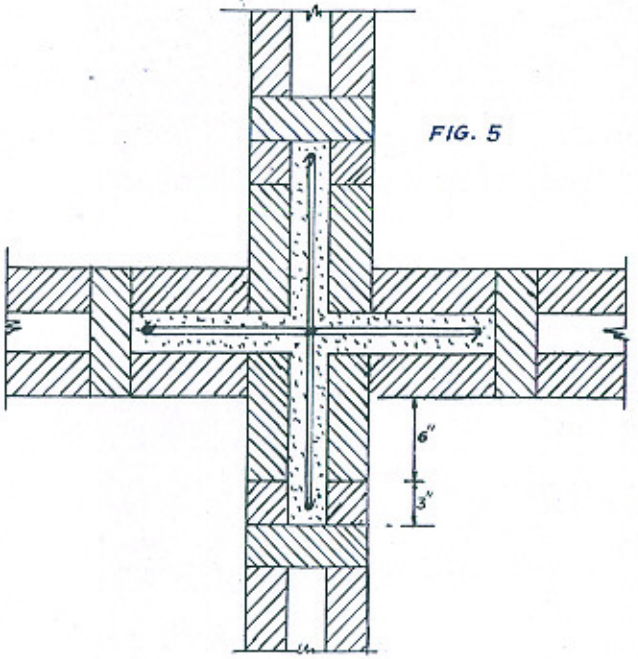


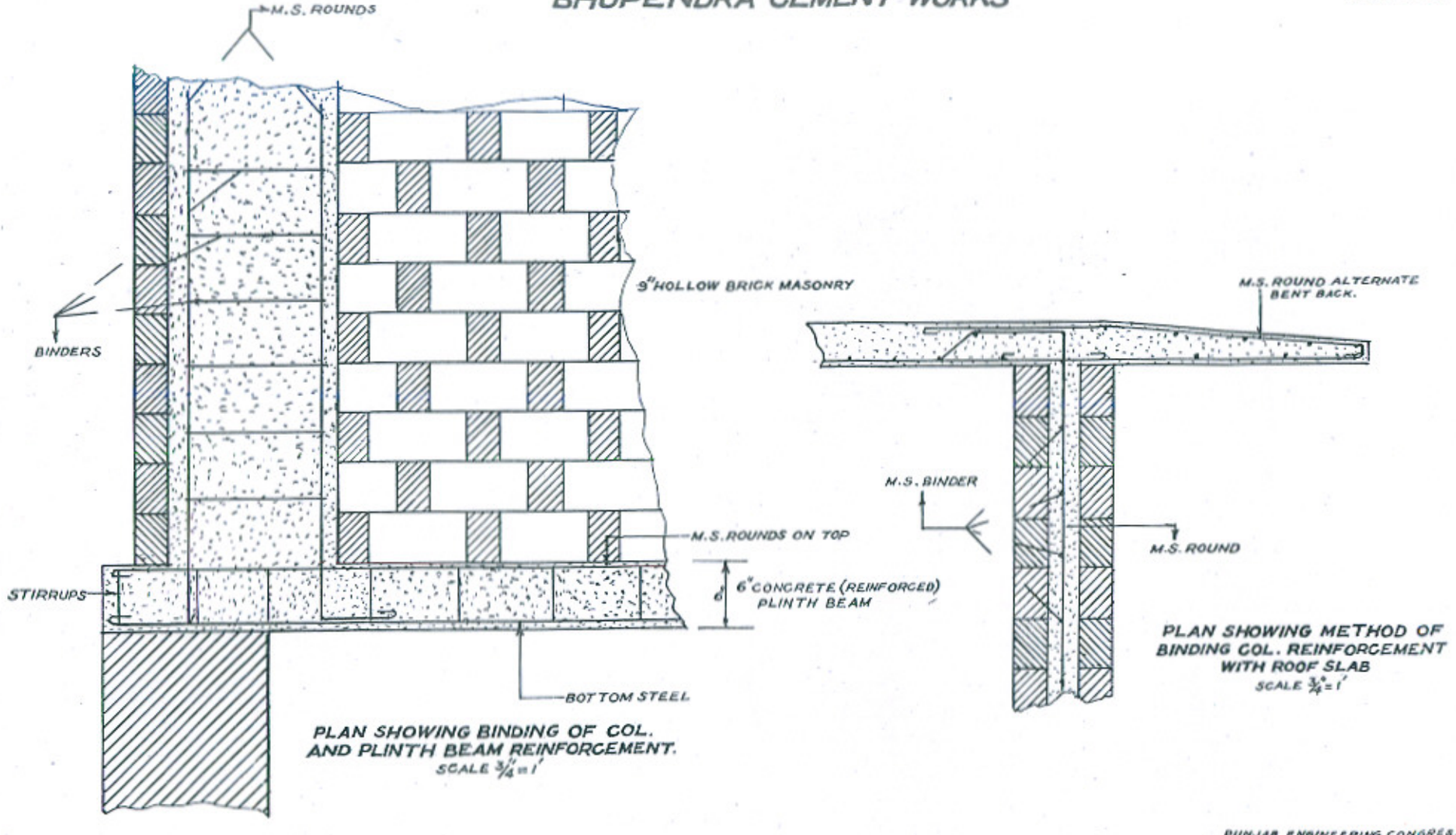
FIG. 5



PUNJAB ENGINEERING CONGRESS
1940.

PLATE 6
PAPER NO. 239

BHUPENDRA CEMENT WORKS



PLAN SHOWING BINDING OF COL. AND PLINTH BEAM REINFORCEMENT.
SCALE 3/4" = 1'

PLAN SHOWING METHOD OF BINDING COL. REINFORCEMENT WITH ROOF SLAB
SCALE 3/4" = 1'

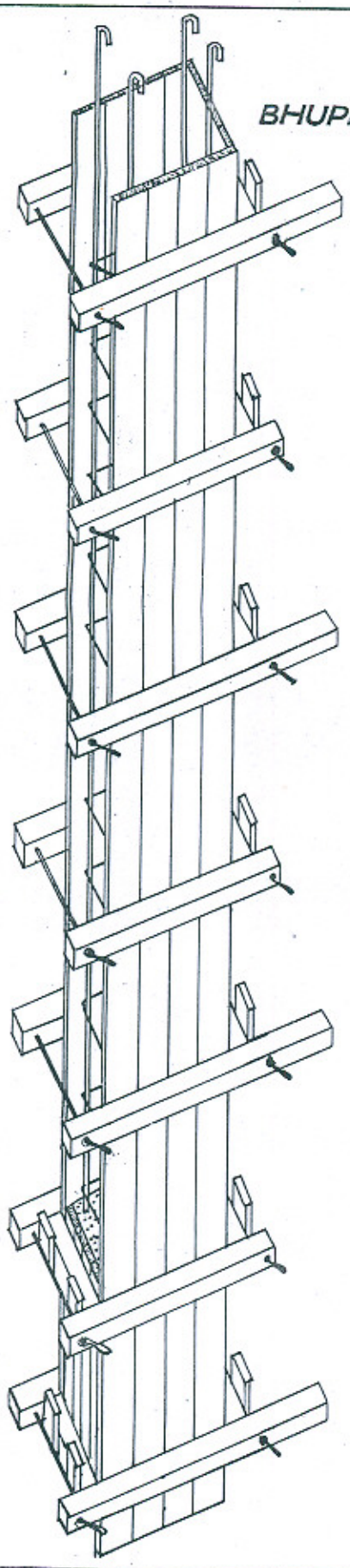
PUNJAB ENGINEERING CONGRESS 1940

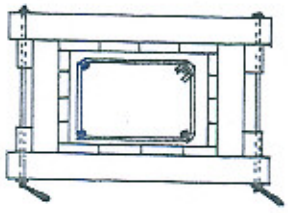
PLATE 7
PAPER NO. 239

BHUPENDRA CEMENT WORKS

COLUMN FORM

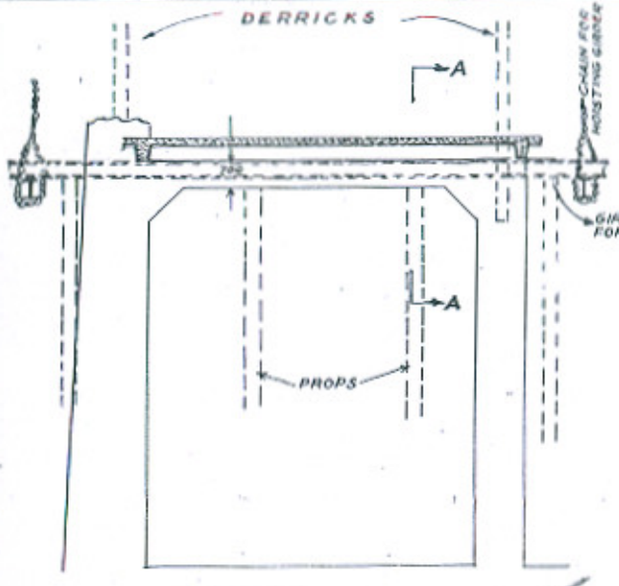
SCALE ½" = 1'



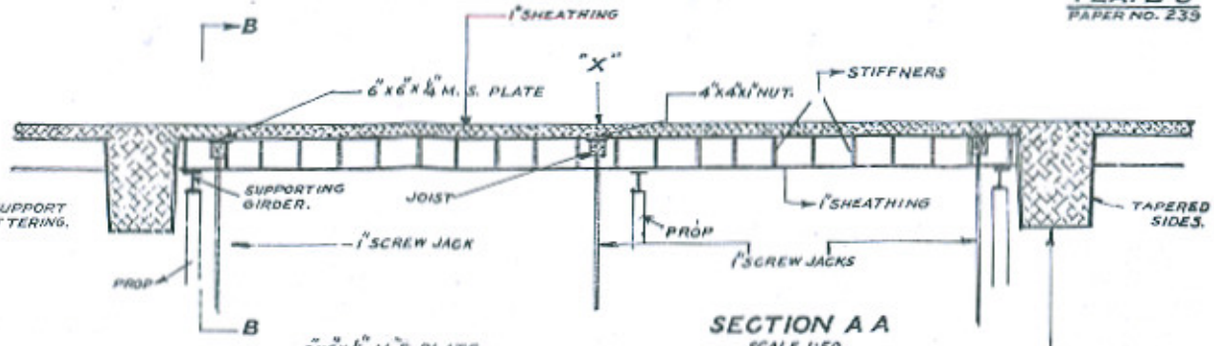


PUNJAB ENGINEERING CONGRESS
1940

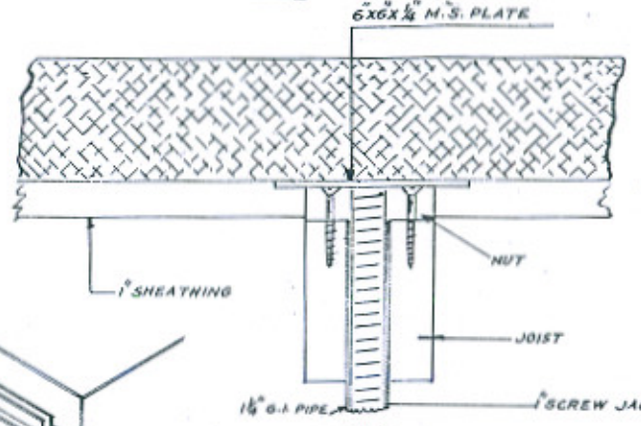
PLATE 8
PAPER NO. 239



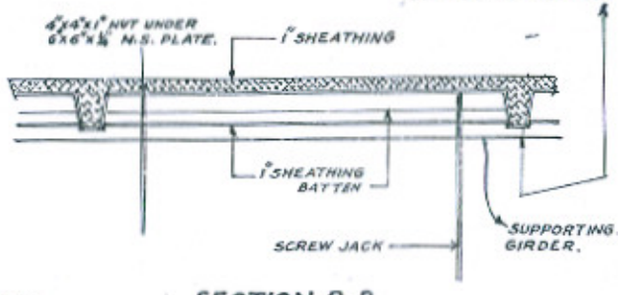
ELEVATION
SCALE 1:100



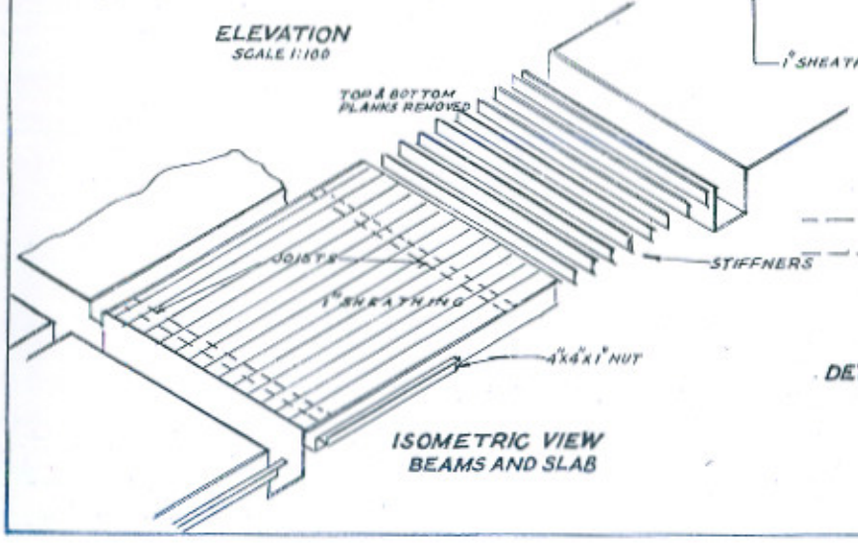
SECTION A A
SCALE 1:50



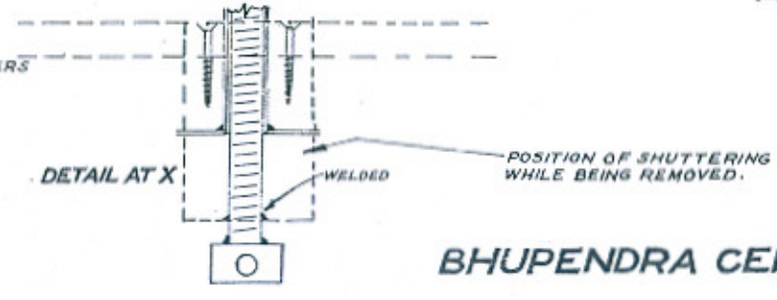
BOTTOM PLANK OF BEAM SHUTTERING TO BE FIXED AFTER THE BOXES HAVE BEEN HOISTED AND PUT IN POSITION.



SECTION B.B
SCALE 1:50



ISOMETRIC VIEW
BEAMS AND SLAB



DETAIL AT X

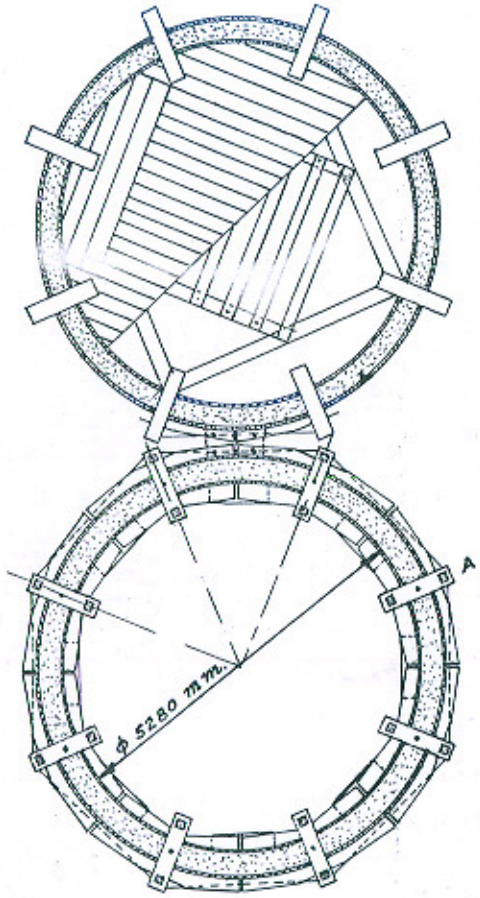
BHUPENDRA CEMENT WORKS

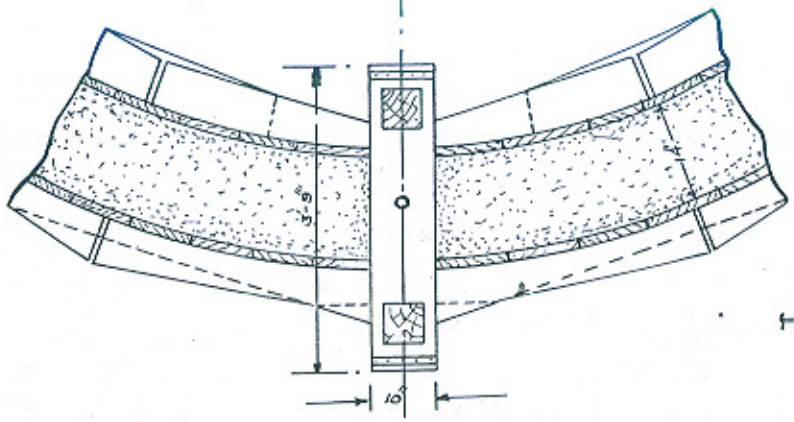
PUNJAB ENGINEERING CONGRESS
1940

BHUPENDRA CEMENT WORKS

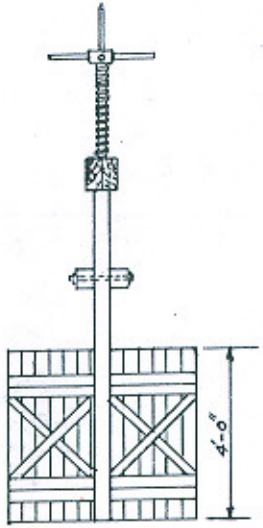
SLIDING SHUTTERING DETAILS

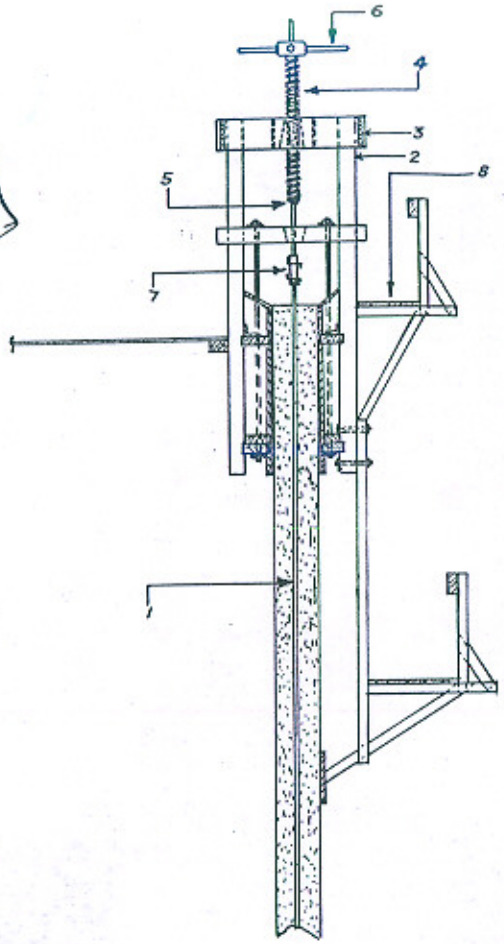
PLATE 9
PAPER NO. 239





DETAIL AT A



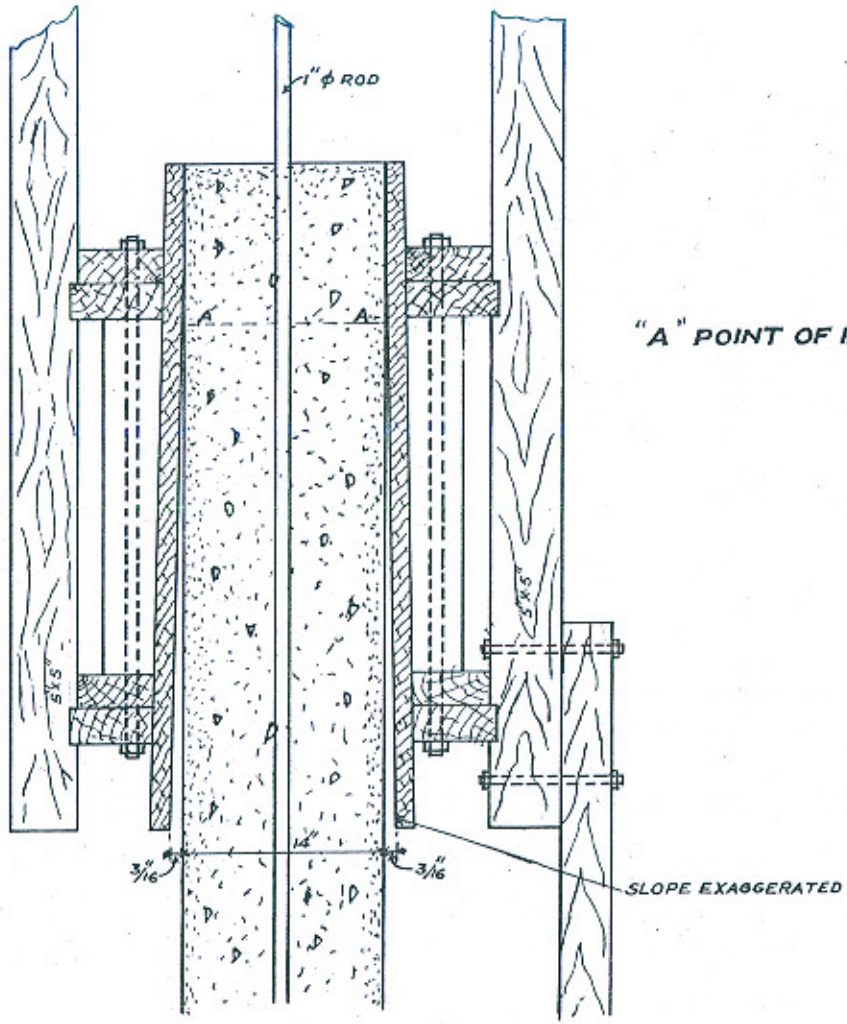


PUNJAB ENGINEERING CONGRESS
1940

PLATE 10
PAPER NO. 239

BHUPENDRA CEMENT WORKS

SECTION OF SLIDING FORM



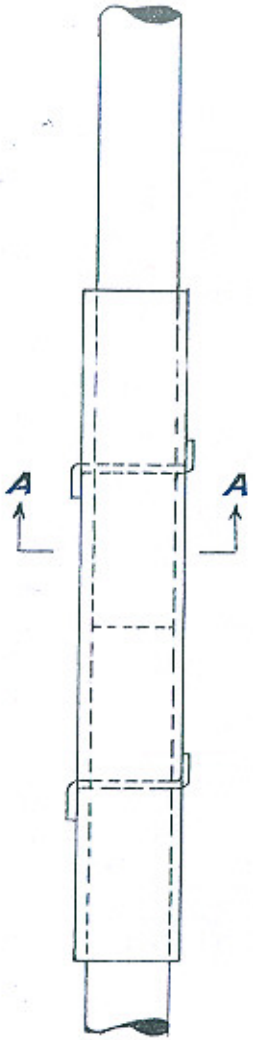
"A" POINT OF INITIAL SET

PUNJAB ENGINEERING CONGRESS
1940

PLATE 10A
PAPER NO. 239

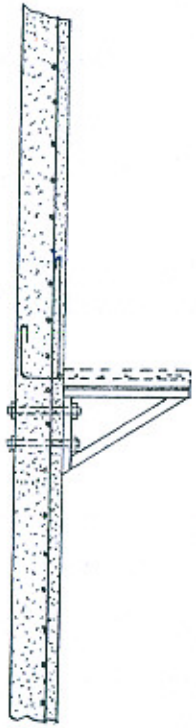
BHUPENDRA CEMENT WORKS

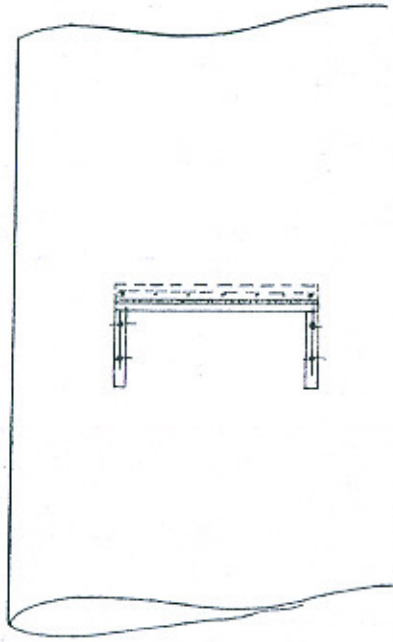
METHOD OF EXTENDING BAR





SECTION AT "A.A"





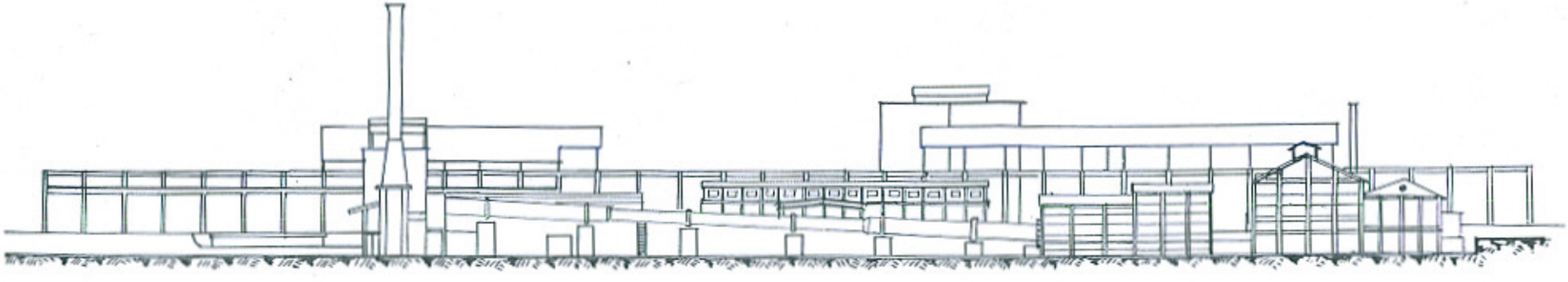
LEAVING STEEL FOR A LANDING

PUNJAB ENGINEERING CONGRESS
1940.

PLATE II
PAPER NO. 139

BHUPENDRA CEMENT WORKS

SCALE 1:1000

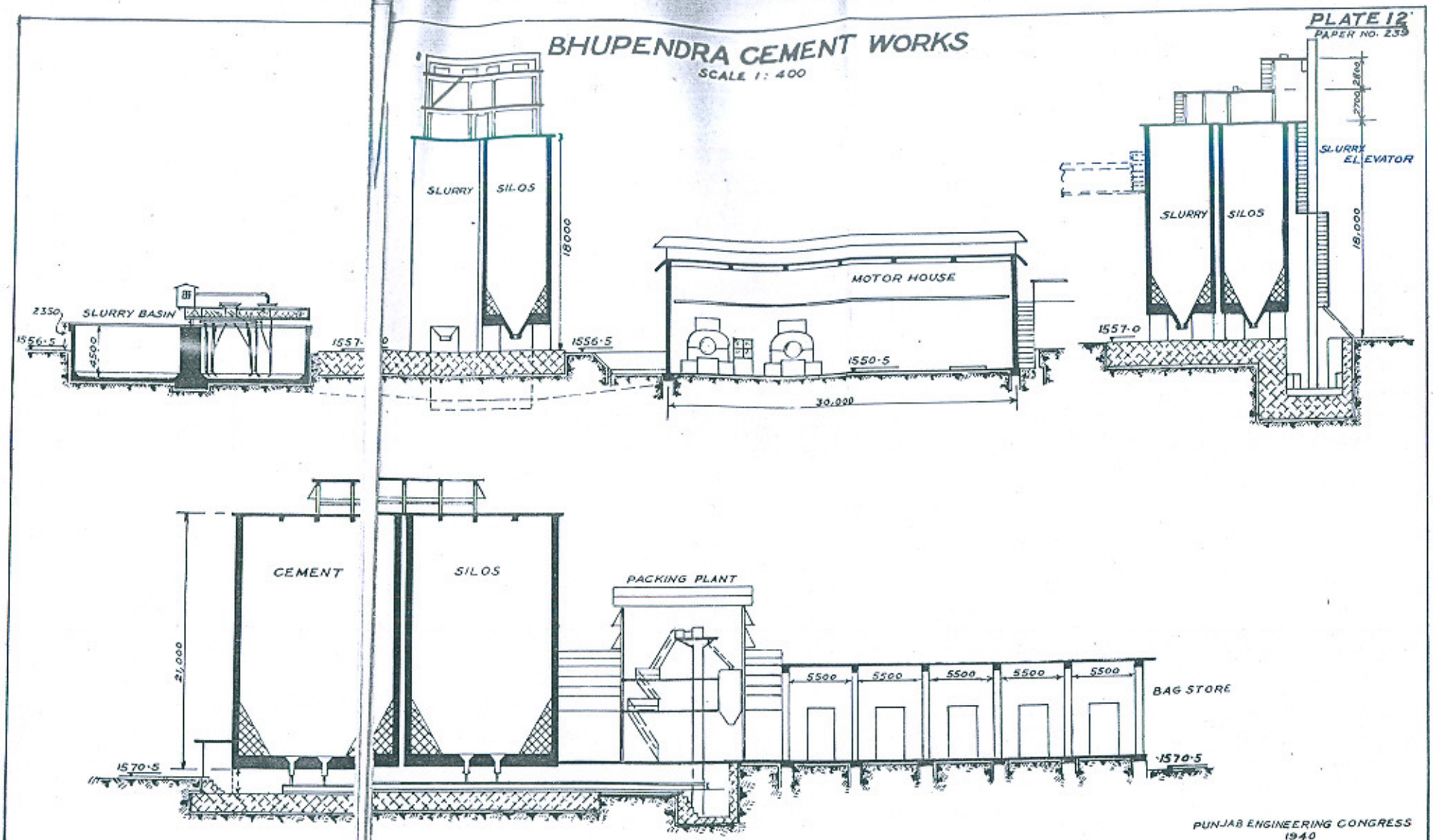


PUNJAB ENGINEERING CONGRESS
1940

PLATE 12
PAPER NO. 239

BHUPENDRA CEMENT WORKS

SCALE 1 : 400



PUNJAB ENGINEERING CONGRESS
1940

DISCUSSION.

The Author in introducing his Paper stated that he felt honoured to have the opportunity of presenting to the Congress a Paper which deals briefly with some of the more salient features of the recent construction work on a new cement factory at Surajpur and he trusted that some of the information contained therein would be found to be informative and of general interest

The Author continued that the supervision of such a work called less for specialisation than some other branches of engineering so that it could be said that the necessary qualifications for the supervisor were such that he must, in some measure, be "a jack of all trades" as the work embraced not only the construction of buildings, but both mechanical and electrical engineering in the lay-out and erection of the machinery proper.

As this Paper, therefore, merely touched very briefly on a few items which were thought would be of general interest dealing mostly with construction work as applied to the use of cement concrete and as this kind of work as opposed to the manufacture of cement was more or less, a side line to the normal duties of a Cement Works Engineer, the Author hoped that he would be forgiven for the inclusion of any items in the Paper which may, to many of you, be more or less every day jobs.

Had space permitted the Author would have liked to have included more details regarding the various types of houses built for the accommodation of the Works staff and to have touched upon some of the experiences in the grading and economy of the concrete mixes employed, especially as they were confronted by what appeared to be the fairly general problem throughout the Punjab, of utilising extremely fine local sand.

The Author continued that tests on this subject were now being carried out in the Works Laboratory and it might be possible to submit the results of these tests at a later date.

To those members of the Congress who had not seen a cement factory, the Author felt that the description in the Paper was inadequate. The factory was situated within easy reach of Kalka and a short visit to the actual Works would convey more than can be conveyed in many pages of reading matter.

The Author took this opportunity, therefore, of extending a cordial invitation to any interested members to visit the factory when they were on their way to Simla when he would do his best to make their visit of interest.

Mr. L. A. Freak remarked that reference had been made on page 255 of the Paper and in the introductory remarks of the Author to the extremely fine sand available for the construction work at Surajpur. He said that he had not seen the particular kind of sand used, but he imagined that it was from a local *nullah* (stream) and would be one which in the Punjab would be considered relatively course. Standard sand as laid down in the British Standard Specifications was much coarser than nearly all the sands available in India, and for tests of cement to British Standard Specifications, this standard sand had to be imported from England at great cost. It was suggested that a new standard sand be adopted for India nearer to the best kinds of coarse sand actually available in India, and for this purpose some Engineering Institution or Body should propose the new standard. Alternatively the Associated Cement Companies, Ltd., could put forward a new standard for general acceptance in India.

Mr. Freak stated that tests had been made with both Wah and Surajpur cement using standard sand and local sands from Ambala and Jullundur. The reduction in strength by the use of fine local sand, particularly the very fine Ambala sand, had been found considerable. These tests had brought out an interesting comparison showing that Wah cement was slightly weaker than Surajpur cement with standard sand, but the reverse with local sand. In other words, Surajpur cement had been found not to cope with local sand so well as Wah cement. The speaker understood that Mr. Holman was carrying out further tests with fine sand and the result of these further tests will be awaited with interest.

Mr. Brij Mohan Lal remarked that on page 253, the Author had mentioned that cement mortar consisting of a mixture of 1 : 13 was used in the construction of a temporary workshop which hardened so much in about ten months, that it was not found possible to break the wall down and keep the bricks intact. He requested the Author to kindly state whether any tensile tests were carried out for this mortar, and if so, with what result. In Lahore, cement mortar 1:6 was generally used and gave tests upto about 200 lbs. after being kept in water for 28 days.

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The speaker further said that on page 255, the Author had mentioned that distribution steel upto 0·4% had to be used in reinforced concrete slabs exposed to the rays of the sun instead of the usual 20% of main reinforcement, *viz.*, 0·135%. This, in the opinion of the speaker, appeared excessive and unnecessary. In Lahore a great number of reinforced concrete slabs had been laid using only 0·135% steel as distribution reinforcement without developing any appreciable shrinkage and temperature cracks.

Rai Bahadur W. C. Chopra enquired of the Author the approximate cost per sq. ft. of plinth area of the earthquake proof bungalows of the type described on page 257 of the Paper, and further requested that the height of plinth above natural surface and the height of the roof above plinth level may also be stated.

Replying to Mr. Freak's assumption that the fine sand used on the factory construction would, in the Punjab, be considered relatively coarse the Author pointed out that this could hardly be the case as the Surajpur nallah sand had a fineness modulus of only 1·11 unscreened and of 1·479 when screened to a 75% recovery so that it was necessary to add coarse grit screenings to increase the modulus to that required by the specification for 1st class concrete of 2·2.

With regard to the use of Leighton Buzzard, *i. e.*, standard sand, by the Associated Cement Cos. Ltd., for tensile strength tests, the Author pointed out that so long as this requirement existed in the British Standard specification for British Standard Portland Cement, it was incumbent upon the manufacturer to comply with this proviso, but that for many of the purely routine factory tests carried out in the Works Laboratories local sands were used upon which the difference in strengths obtained from that of standard sand had been pre-determined.

The Author agreed that for Indian made cements, it should be possible to standardise for use in standard tests, a specific sand procurable in India at a fraction of the cost of the imported sand and stated that the use of Malarna sand for this purpose had already been mooted sometime ago. Such a proviso to the specification would, however, have to be proposed by a representative engineering body in India.

Referring to Mr. Freak's statement that cement from Surajpur, although comparing favourably with Wah cement when tested with standards and, gave poorer comparative re-

sults when tested with fine local sand the Author stated that he had seen no evidence supporting this statement and further contended that a cement which gave higher strength figures than another cement with standard sand, would automatically maintain this superiority when using other sands. The author stated that tests to prove this were being carried out and duly communicated the following laboratory results :—

Tensile and compressive strengths on random samples of Wah and Surajpur cement

Proportions—Cement : Ambala fine sand 1 : 3

Test No.	Cement Brand.	Fineness 170² 72²	Tensile strength 3 days 7 days	Compressive strength 3 days 7 days.	Per cent. water used.
1	Wah cement	4·1 0·1	422 584	3653 4331	9
2	Surajpur ..	4·7 0·08	518 620	3835 5421	9·5
3	Wah cement	4·1 0·1	348 488	2942 3041	8
4	Surajpur ,,	4·7 0·08	355 582	3405 3438	8·5
	Proportions — Cement : Standard sand 1 : 3				
	Wah cement	4·1 0·1	522 592	4926 6479	8·3
	Surajpur ,,	4·7 0·08	593 660	6215 7041	8

Tamping and mixing of mortar carried out by machine according to Continental standards.

The tests uphold the Author's contention and are interesting inasmuch as it will be seen that the standard water percentage (approximately 8% under relevant conditions with B. S. S. sand) does not hold good for the fine sand which has a greater specific surface area and consequently requires more water to wet that surface.

The water % used in tests No. 1 and 2 gave a mortar consistency approximating to normal consistency with standard sand whereas the water % used in tests 3 and 4 was obviously too low for complete hydration

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Replying to Mr. Brij Mohan Lal, the Author stated that as the building was of a temporary nature only, the 1 : 13 cement sand mortar had not been tested but promised to send figures. The Author later reported that tests made on a similar 1 : 13 sand and cement mortar on an average of four test pieces yielded 86 lbs. per sq. inch in tension and 364 lbs. per sq. inch in compression at 7 days, respectively. The Author expressed surprise at the low tensile strength of up to 200 lbs. sq. inch only on Lahore 1 : 6 cement sand mortar after 28 days immersion in water and stated that strengths of greater magnitude would normally be expected. Actual results using 1 cement 6 local sand with 10% water gave 203 lbs. and 299 lbs. at 4 and 7 days, respectively.

As regards Mr. Brij Mohan Lal's contention that distribution steel of 0·4% used in reinforced cement concrete slabs appeared to be excessive and unnecessary, the Author stated that the figure was put forward as one which had been found by long practical experience to be necessary with good aggregates to ensure a water tight slab when that slab was exposed to the sun's rays and had to resist the extremes of temperature met with in the Punjab. The Author is of the opinion that under these extreme conditions where the summer winter temperature variation may amount to as much as 150 F. it is dangerous to design distribution steel in roof slabs to the arbitrary figure of 20% of the main reinforcement as the latter varies largely according to load condition, slab thickness, etc.

Further, the general stipulation in the Code to provide 20% of the main steel as transverse reinforcement is merely intended to cover distribution of normal load conditions in slabs not subject to special temperature stresses so that if a water-tight slab is desired, it is essential to provide adequate temperature reinforcement in order to reduce the size of the cracks.

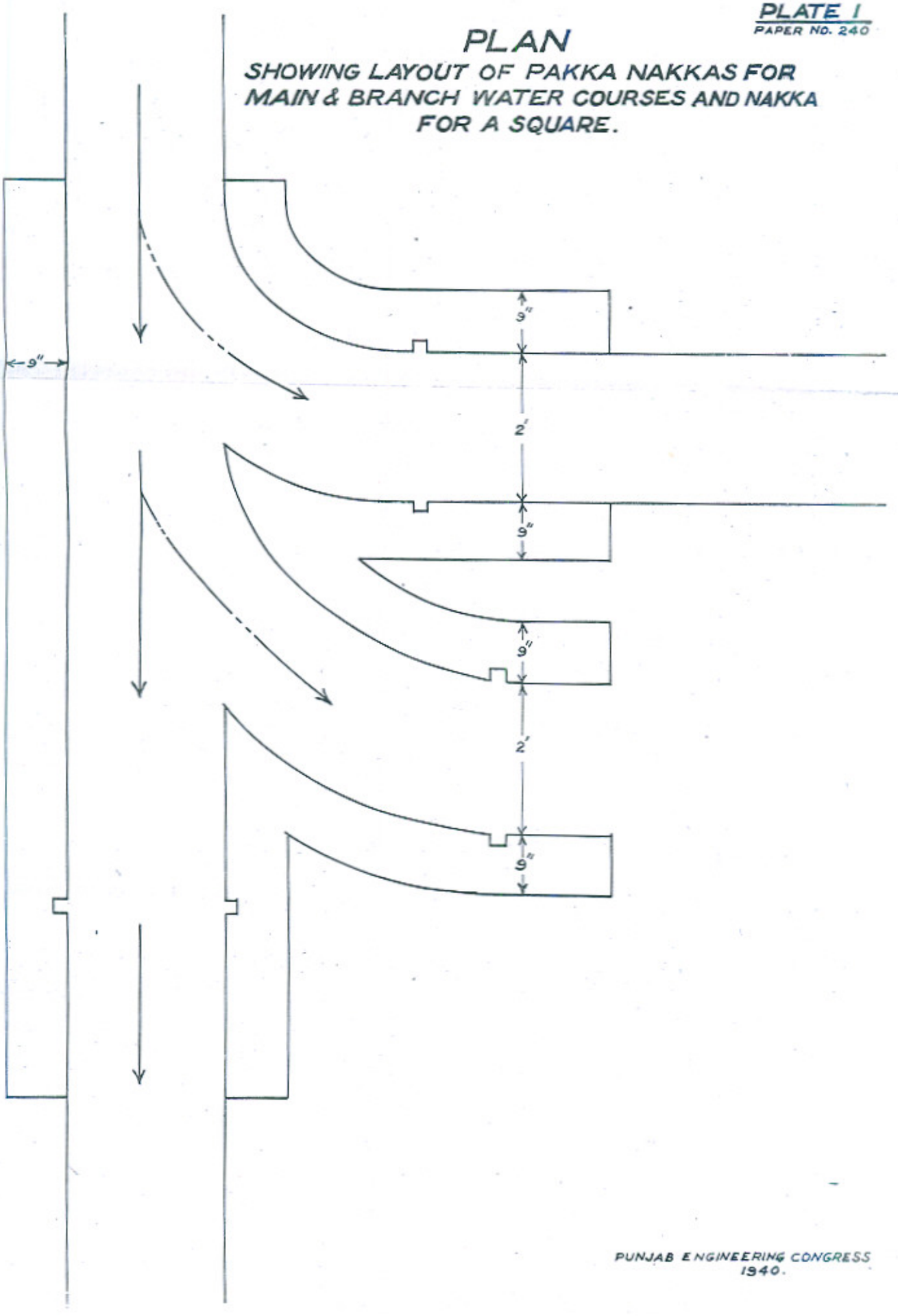
A percentage of 0·4% should theoretically cater for shrinkage stresses due to a change in temperature of 150° F. when the steel is worked to the elastic limit of 50,000 lbs. per sq. inch.

Replying to *Rai Bahadur* W. C. Chopra as to the cost per sq. ft. of plinth area of the earthquake proof bungalows described in the Paper, the Author quotes a figure of Rs. 4/2/ per sq. ft. for single storey houses with a plinth of 2'-0" and a height to top storey of 26' and Rs. 2/8/ per sq ft. for bungalows with a similar height of plinth and a roof level of 12' above plinth level.

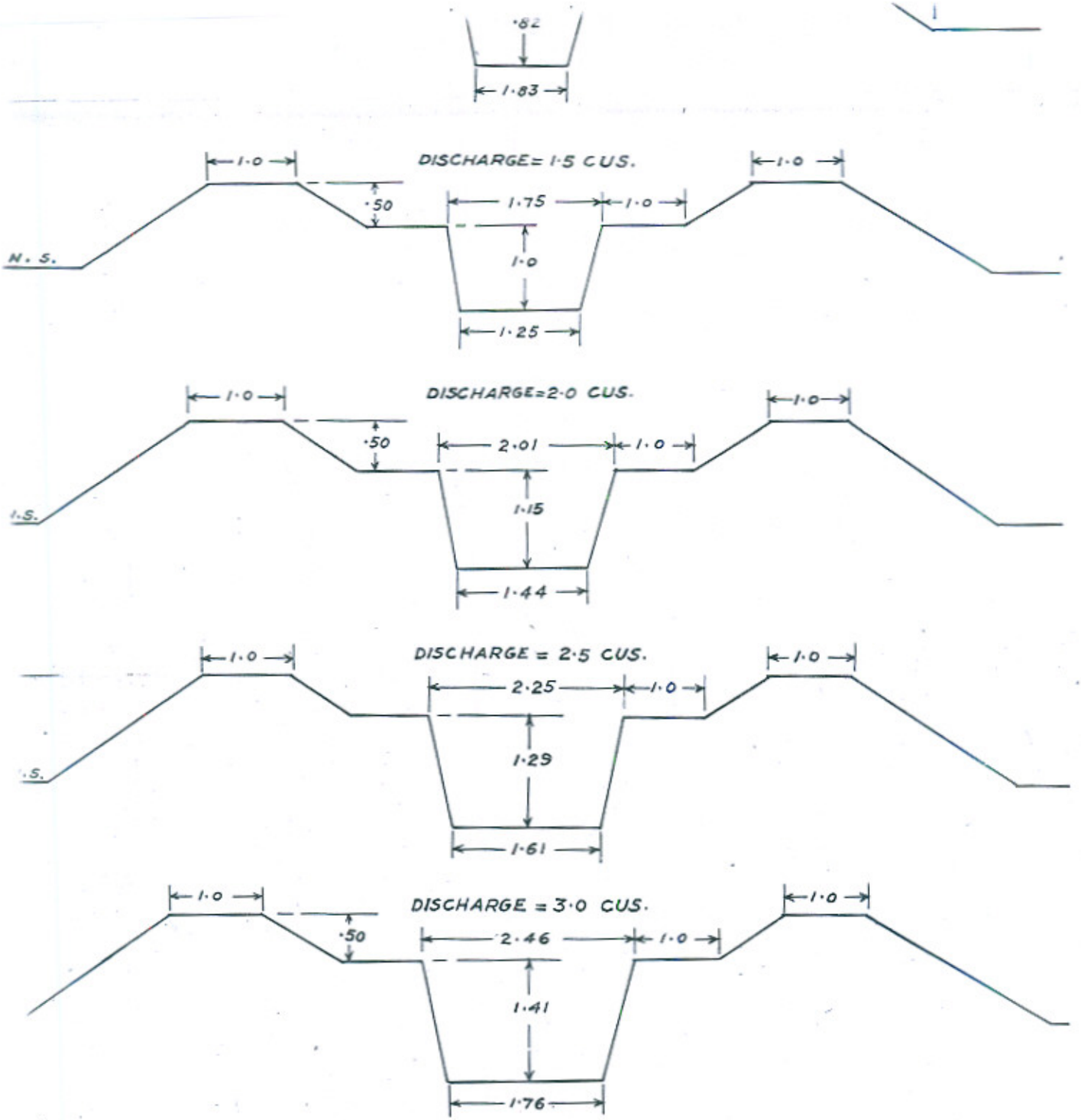
PLATE I
PAPER NO. 240

PLAN

SHOWING LAYOUT OF PAKKA NAKKAS FOR MAIN & BRANCH WATER COURSES AND NAKKA FOR A SQUARE.



PUNJAB ENGINEERING CONGRESS
1940.



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PLATE 2
PAPER NO. 240

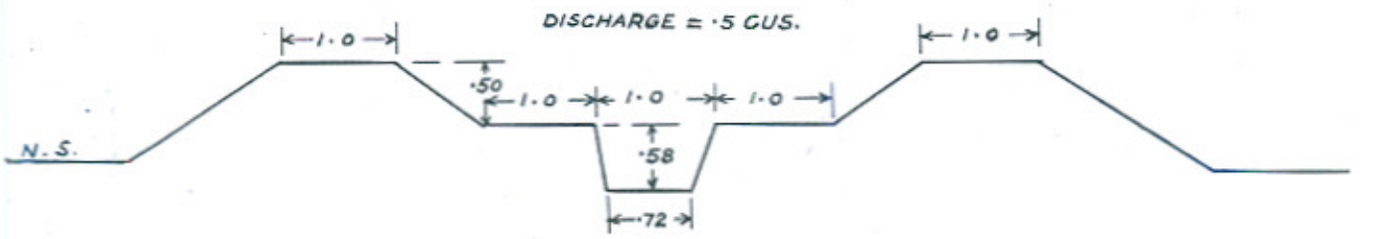
MONTGOMERY DIVISION L.B.D. CANAL

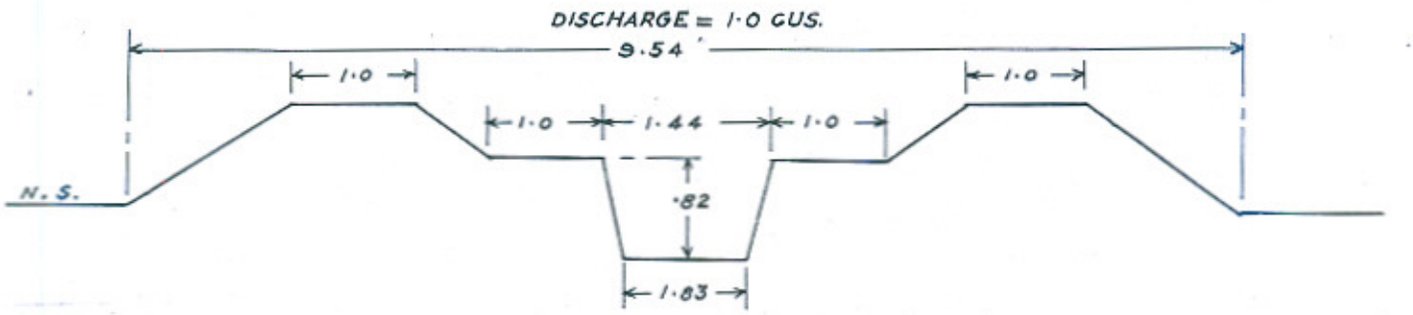
SECTIONS OF WATER COURSES WITH AVERAGE FLAT SLOPE

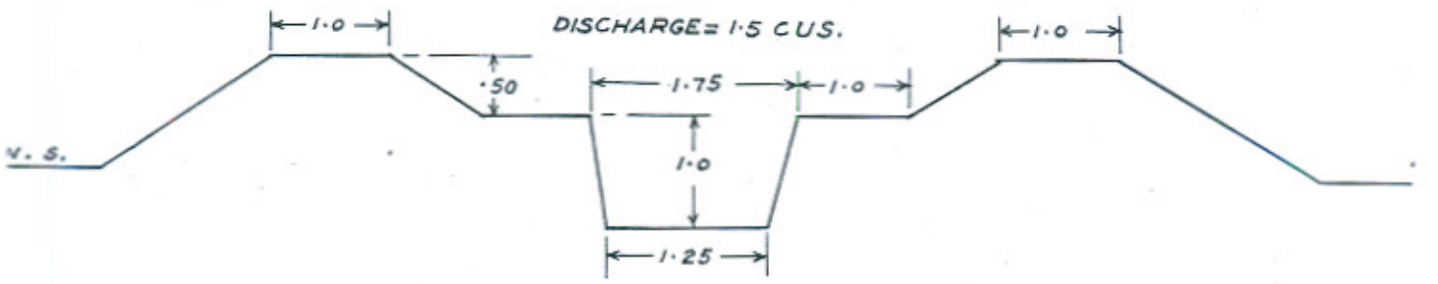
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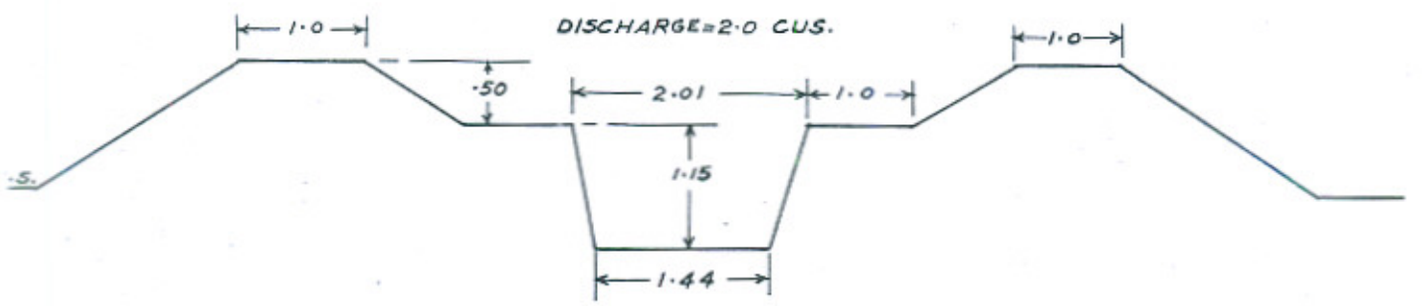
VELOCITY 1·0 PER SECOND

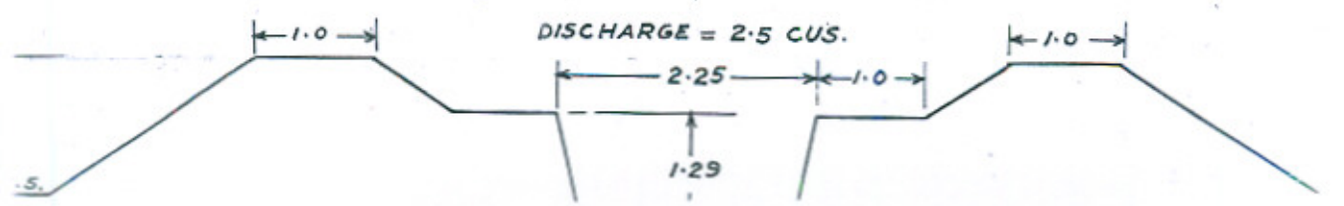
B:D = 1·25 : 1 SIDE SLOPES 1/4 : 1











DISCUSSION

Mr. G. R. Sawhny in introducing his Paper remarked that the question of saying water which is being wasted in absorption in our channels is at present uppermost in our thoughts.

This plaster having definitely proved to have caused a considerable amount of saving in water which was otherwise being wasted every day in the watercourses. The writer has taken the earliest opportunity to present you with this rather brief Paper for the mere reason that he thought it was best that the beneficial result of these few experiments should be made known to you immediately, rather than his waiting for another year or two to collect more facts and figures, so that with your cooperation and help this method may also be tried elsewhere earlier than would otherwise be possible.

For the proper working of our scientifically designed Government channels we have to be constantly maintaining them at a considerable cost. Hence it stands to reason that the case of watercourses which are the actual distributors of water on the land and which have to be tapped at short intervals all along their course in a most unorthodox manner, should be seriously considered. Now that this inexpensive method of plastering has actually resulted in so much saving in water we should whole heartedly try and find ways and means of getting the watercourses plastered. In practice as the only means at our disposal to introduce this method is to persuade the zamindars to do the needful and the zamindar by nature not being easily persuaded, there will be a considerable amount of difficulty to get this plastering done in the beginning, but, once the benefits are brought home to them in a proper manner in most cases they will not be long in following the advice. To gain this end a good deal of propaganda is very necessary. As a first step the writer would suggest that we should plaster all our rest-house watercourses straight away, collect the zamindars of the adjoining *chaks* and explain to them the advantages of such plastering. A demonstration in this manner—is sure to have immediate

effect on some of them. Then we should try and persuade one or two bigger zamindars to do this plastering. Once one or two watercourses are done in each *ilaqa* the news about their beneficial working will spread like fire and then most of them will try to follow the good example. The plastering of the experimental watercourses must be carefully done as this will serve as a demonstration to the zamindar as well as to teach the method to our staff because it is very necessary that our staff should be fully conversant with the details to be in a position to answer the zamindar's various questions and give them necessary advice whenever asked to do so, and also help them in actual operations.

Besides the plastering of the watercourse systems on the Military Farms, Okara, (an area of nearly 21,000 acres), plastering has now been done on one complete watercourse in each *chak* on Coleyana Estate, Okara, two watercourses in Renala Estate, one watercourse in Dairy Farm, Montgomery, part of a watercourse each in Rai Bahadur S. Biasakha Singh and in Convillpur Farms and a complete watercourse on the Agricultural Farms, Montgomery.

A large number of other zamindari watercourses have already been straightened, cleaned of all jungle, brought to proper section and *pacca nakas* wherever very necessary made on various channels and actual plastering is now being done. It is expected that after these watercourses have been done, even the backward zamindars who are watching at present are very likely to follow this good example.

I have had surface velocities observed of various watercourses on different channels—those badly maintained, some which have been lately cleaned and straightened and the few that have been plastered. The results are very encouraging—the plastered watercourse with 0·8′ working head gave better results than an ordinary clean watercourse with 2·0′ working head.

To make this beneficial method known to the zamindars of Montgomery Division, the writer published it in the Local "*Weekly Islah*" and then on request from the

zamindars got a copy of the article printed in the form of a poster and sent it to all the villages, estates and various societies and other departments for the informations of all concerned. Later on the writer started holding zamindars meetings at different rest-houses after giving a sufficient notice to the *ilaqa* zamindars and also requested the local Agricultural Department Officers to join him in giving the necessary advice to the zamindars on the various important points concerning their welfare. At these meetings the advantages of this plastering of watercourses were fully explained and in some cases an actual demonstration was also given. These meetings have been all along very well attended ; nearly 3000 zamindars attended the meeting held at Yusafwala rest-house on the 10th of February.

The increase in *peech* (field irrigation) noticed in these plastered watercourses varies from 12 to 30%. If by your endeavours even a saving of 12% which is the lowest recorded can be accomplished everywhere at such a small cost, it is worth while to push this plastering whole heartedly all over the irrigated areas and to help zamindars as well as the Government.

Mr. Brayne said that the lining of channels with a Soda-Ash plaster had been established as the best method of making the same amount of canal water mature considerably more crops. He, therefore, wanted arrangements made for broadcasting it to all users of irrigation water, so that it could be taken up on as wide a scale as possible. For this purpose, a simple and effective technique was wanted which could be described in simple language and supported by pictures published in every language and dialect. If teaching and demonstration was also necessary, then that must also be provided on a sufficiently large scale to ensure that its use can be made as quickly and as widely as possible. He offered every assistance from the Rural Reconstruction Branch in obtaining the maximum publicity and the maximum use of the new method.

Another point is, who is going to get the benefit of the water which will be saved? For existing irrigators, some sort of assurance requires to be given that the lining of channels will not led to the cutting down of

outlets or the reduction of minors, etc. If the economisers are going to receive the benefit of their economies, it will not be difficult to persuade them to do this work. If, however, they suspect that economy of water will lead to reduction of water, then naturally they will do nothing about it.

As for extensions of irrigation and new projects, as soon as this method has been applied in sufficiently large areas to ensure that every one knows about it, it might be possible to design new channels and outlets on the assumption that Soda-Ash lining will be applied by all new irrigators.

Dr McKenzie Taylor remarked that for some years attempts had been made to use the base exchange method of deflocculating clay to provide an impermeable material for the lining of small channels and watercourses. Originally the methods investigated were the base exchange using salts such as sodium chloride and sodium sulphate. Later in these investigations Dr. Puri suggested using sodium carbonate, which salt has a number of advantages over sodium chloride and sodium sulphate and the lining produced has proved satisfactory as regards its impermeability. The best results were obtained when the soil to be used for the lining material had about 15% of clay.

The material has been tried by Major Prideaux at the Military Farm, Okara, and, while other alterations had been made in the watercourses, he has estimated an increase in the area irrigated with the same water-supply to be of the order of 15 to 20 per cent. as a result of the saving of water. He had found no difficulty in getting the tenants to line the watercourses appeared to be sound after a period of two years and there seemed to be no reason to anticipate any rapid deterioration of the lining material.

Dr. McKenzie Taylor pointed out that if animals entered the watercourses then they were likely to be injured as they sank through the clay lining and it was difficult for them to extricate themselves. On account of this he suggested that no large channel should be lined

by this method as it might lead to considerable difficulties and possibly loss of life.

Dr. McKenzie Taylor stated that he was glad that Mr. Sawhny has taken the process up as it was only the Engineer who could get the results of research into the field.

Sir W. Roberts said that he was glad to find Mr. Sawhny breaking into a new ground with this Paper on the lining of channels. Since Kennedy's work, the speaker observed very little investigation of economy of water in the fields had been undertaken, he hoped that this paper would be a forerunner of several others. It must be remembered that water after it reaches the irrigation field is much more valuable than water at the head of the canal. In fact, it is generally admitted that 100 cusecs at the head of the canal becomes at least 65 per cent. or thereabouts by the time it reaches the field—so each unit is about 30 per cent. more valuable than it is near the head works. Too much should not however be claimed for lining with sodium carbonate. We are told, for example, that fine clay is deposited on the lining, and that lined channels have no silt trouble. In other words they carry heavy silt right down to the field. These two statements are contradictory.

Mr. Ishar Das remarked that where head was available masonry flumes should be constructed on watercourses to be lined and discharges observed to find out saving in absorption effected by lining. These savings should be made known to cultivators so as to make lining of water-courses popular.

Mr. S. H. Bigsby said that the paper dealt with a most important subject which was emerging from the experimental stage. While he was not in a position to bind the Government, he agreed with previous speakers that the benefit of their enterprise should go to the cultivators.

While he was of opinion that the technique of lining of watercourses was emerging from the experimental stage, he would emphasise that they had as yet no reliable