PAPER No. 99.

A DESCRIPTIVE NOTE ON THE NORTH-WESTERN RAILWAY CREOSOTING PLANT AT DHILWAN.

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1. Preliminary remarks.

The wide distribution of the two species of conifers—the spruce and the silver fir—on the Himalayan slopes, coupled with a keen and ever-increasing demand for wooden sleepers for the Indian railways, created a lively interest in the utilisation of these timbers. Unfortunately neither of them are durable sleeper woods and a longer life than two to three years cannot be expected anywhere in the Indian climate, if they are used without some kind of treatment. The cost of their extraction even cannot be repaid, if their economic values as compared to deodar and sal sleepers, which last 15 to 20 years, were to be considered.

This problem is not peculiar to India alone as many attempts in other parts of the world, notably Canada and United States of America, have been made to realise the wealth contained in spruce and fir forests, by their use for similar purposes. Until recently not much success had been attained, however, the problem is now under careful investigation.

Another interesting question in this connection had to be answered. Do Indian spruce and fir behave in the same way as similar species of other countries? Experiments to elicit this information were undertaken at Forest Research Institute, Deradun, under the supervision of Mr. J. H. Warr, Officer-in-Charge, Wood Preservation. As a result of his experiments, he was of opinion that from a purely techniological point of view, there did not appear to be much difference between the structures of the two varieties of fir as found in this country and those of similar species found in the Western Hemisphere except that the former appeared to be harder. For this reason, it was anticipated that greater success would be attained with Indian varieties when treated with an antiseptic than had been the case in other countries.

As an experimental measure and with a view to minimise the stringency of the market for hard wood sleepers, the North-Western Railway have erected a plant for creosoting the soft wood varieties of sleepers. The varieties treated consist of—

(*a*) Spruce fir.

(*b*) Chir.

2. Site.

The plant has been erected on the left bank of the River Beas, between Beas and Dhilwan stations on the main line from Lahore to Saharanpur and the siding takes off from Dhilwan station.

The attached plan (No. 1) shows the lay out. This site was selected on the understanding that the major portion of the sleepers to be treated, would be floated down the Beas river, which so far has not been the case. It may be pointed out that the site is rather lowlying and although protected by bunds against river floods, yet some parts of the depot turn into swamps in the flood season by a rise in the subsoil water. The machinery not being centrally situated, necessitates haulage of sleepers about the depot on the narrow gauge trollies and causes considerable waste of energy in pumping creosoting mixture from storage tanks to cylinders.

3. Plant and its description in brief.

The plant consists of—

(1) B. G. track .. .. .. = 2·82 miles.
(2) N. G. track .. .. .. = 2·40 miles.
(3) B. G. trollies .. .. .. = 11 number.
(4) N. G. tramway trucks .. .. = 18 number.
(5) N. G. creosote trucks .. .. = 39 number.

Plan No. 2 shows the present trucks in use. It is intended to alter these truck wheels to ball or roller bearings to minimise friction and excessive wear and tear.

(6) N. G. Engines (working pressure, 130 lbs. per square inch) .. .. = 2 No.
(7) Petrol tractor, 5′ 6″ gauge for shunting work in the depot .. .. = 1 No.
(8) Boring and adzing machine (M. J. Type Robinson & Co.) .. .. = 1 No.

This machine is capable of cutting and adzing 1,300 9-feet sleepers per day, but when boring has also to be done, its progress drops to 800 a day. This machine has recently been fitted with a sawdust-conveyor to prevent its stoppage of every hour or so for cleaning wood chippings.

(9) Portable boiler (No. 27, 133, Marshall Sons & Co., Gainsborough, England), working pressure, 100 lbs. per square inch for working No. (8).

(10) Storage tanks (Plan No. 3) = 10 No.

Their total capacity is 840 tons for storing creosote and earth oil. They are below ground level and are made of brick masonry, lined with lime concrete. They leak badly in spite of various expedients, such as lining with lead, iron sheets, pitch and canvas. Steel tanks placed above ground would perhaps have answered better. The pipe connections also are defective, as they pierce through the masonry of the tanks at the bottom and cause leakage.

(11) Vertical boiler (74,672-A 597, Marshall and Co.)
Hydraulic pressure .. =250 lbs. per square inch.
Working pressure .. =125 ,, ,, ,, ,,

(For heating oil in storage tanks in extreme cold weather).

(12) Lower service tank.

This lies under the cylinder and is of the same type as the storage tanks and gives the same kind of trouble. This stores the mixture of creosote and earth oil for the cylinder and can hold 92 tons of the mixture.

(13) High service tank.

This is a small iron tank on iron staging for storing mixture of creosote and earth oil. This tank measures 21′ 5″ ×7′ 6″ × 5′ 6″ ; can hold 5,500 gallons of the mixture.

(14) Treating cylinder (J. & J. Hornsfield Dewsbury, England, Plan Nos. 5 and 5*a*).
Hydraulic pressure .. =300 lbs. per square inch.
Working pressure .. =200 ,, ,, ,, ,,
Pressure at safety valve .. =175 ,, ,, ,, ,,

This is a long barrel of steel 75′×6½′ diameter with swinging doors at either end, which can be closed air tight. A. N. G. track runs through it, which is connected with the one outside at both ends by means of removeable bridges. It can take 8 loaded trollies containing from 300 to 360 sleepers in one charge and that gives about 1,350 sleepers per working day in four charges.

(15) Two vacuum pumps, 7¼″×4½″×6″, Dupleix steam pumps (Jessop Evan's Wolverhampton, England).

(16) Two pressure pumps, 9″×16″×12″, Evan's Cornish air compressures (Jessop Evan's Wolverhampton, England).

(17) One vertical boiler feed Dupleix pump.

Nos. 15, 16 *and* 17—These are located in the operating room for working the creosoting plant, *vide* Plan No. 4.

(18) Lancanshire boiler (2,259-A 600, J. & J. Hornsfield).
Hydraulic pressure .. =200 lbs. per square inch.
Working pressure .. =120 ,, ,, ,, ,,
for working the pressure plant.

(19) A 15′ diameter well to supply water to the depot.

(20) High service water tank on masonry tower, measuring 15′×15′×8′ and capable of holding 11,250 gallons.

(21) One 8 horse power Petter pump (Lee Howl & Co., Tipton), for lifting water into the high service tank.

(22) Vertical boiler (74,671/598, Marshall Sons & Co.)
Hydraulic pressure .. =250 lbs. per square inch.
Working pressure .. =125 ,, ,, ,, ,,

(23) Duplex Worthington steam pump (Hayward Tyler & Co., London).

Nos. 22 and 23.—Stand bye plant for lifting water.

(24) One 3 horse-power Petter pump, is being installed also as a stand bye, in case of failure of 8 horse-power Petter pump No. 21.

(25) One shed for storing 10,000 dry sleepers to be used on damp and rainy days.

4. Material.

(*a*) *Sleepers*—The present sleeper supply consists of half fir and half chir. The former includes a large quantity of spruce sleepers. They are being supplied by Messrs. Spedding & Co. against their contract at the rate of 3 lacs annually, at different depots, and have therefore to be carried to Dhilwan by rail therefrom.

The chir sleepers supplied at Havelian, Sihala and Jhelum come from Hazara Government Forest. These sleepers are hill cut and are usually brought down by camels and occasionally by river. Good many of these sleepers warp before they are treated.

The chir sleepers supplied at Dhilwan are from Government Forest Department and are river borne, their quality is fairly good.

The chir sleepers supplied at Hardwar come from Tehri State Forest ; these are floated down the Ganges and are comparatively speaking the best of the whole lot.

The majority of the fir sleepers are supplied at Marala ; these come from Kishtwar and Bhalarwa forests through the Chenab river.

The sleepers in the depot are stocked in a 1 in 10 piling method, so as to give as much air as possible. Plan No. (6) illustrates this method of piling—

(*i*) Fir is rather a doubtful timber, dry rot is apt to set in rather rapidly, cracks develop equally fast, and rise in temperature hastens both. The minimum period of six months hitherto adopted for seasoning them, has played havoc with our stock at Dhilwan and a large percentage of it had to be rejected due to sleepers having split badly, dry rot having set in and fungus developed therein. Water-borne sleepers behave better than those borne only by camels or rail. Further this wood is notorious for bad penetration even if otherwise sound. Captain J. H. Warr in his report of experiments on these sleepers, also arrived at the same results and hence it has now been decided to treat fir sleepers as fast as they come in the depot.

(*ii*) Chir sleepers are better in certain respects in as much as they absorb the mixture more rapidly and evenly but about 25 per cent. of them warp badly after seasoning in the plains.

(*iii*) Cost price of sleepers—Chir and fir Rs. 4 each, if supplied in equal quantities. Chirs Rs. 4-6-0 each individually.

Fir Rs. 3-12-0 each individually.

(*b*) *Creosote*—The term creosote oil, frequently abbreviated to "creosote," has come to be applied to the heavy distillate from coal tar and the use of the term has become more and more extended until at the present time, it is commonly used in referring to the distillates heavier than water from any tar or tar like substance.

Our supply of creosote at Dhilwan is obtained from "Messrs. The Shalimar Tar Distillery and Waterproof Manufacturing Co., Ltd., 4, Council Street, Calcutta," at Rs. 9-3-0 per cwt.; last year the price was Rs. 9-13-0 a cwt. and freight charges at Re. 1 a cwt. A copy of specifications as approved by the Government of India (Stores Department) is appended as appendix (A).

(*c*) *Naptheline.* Up to 4 per cent. of the creosote supply naptheline is to be supplied by the same firm at Rs. 8 per cwt. plus Re. 1-2-6 freight charges.

(*d*) *Fuel oil.*—Furnace oil is obtained from Shaw Wallace & Co., Karachi, at Rs. 55 per ton plus Rs. 10 per ton for freight. A copy of specification is attached as Appendix (B).

(*e*) For importing creosote and fuel oil a number of tanks are placed at the disposal of the Factory Superintendent at Dhilwan, who directs the tanks to Karachi or Calcutta according to his immediate requirements of one or the other.

(*f*) A mixture of 50 per cent. of creosote and 50 per cent. of furnace oil is used but in extremely cold weather, when naptheline separates and settles down in the storage tanks, extra naptheline up to 4 per cent. is added. Each fir sleeper is on the average allowed 28 lbs. of the mixture and each chir 24 lbs., but as stated by Captain Warr in his report of the experiments, the distribution is far from uniform, the fungus attacked sleepers taking a lion's share of the mixture without in any way improving their usefulness.

(*g*) Distilled wood tar from Mysore Distillery has also been tried but the result has been unsatisfactory. Firstly, crude settled hard wood tar has an acid liquor content of 5 to 10 per cent., which is of no value as a preservative, but very injurious to metals, with which it comes into contact, as well as the treating equipment. Secondly, it contains 7 to 14 per cent. of light oils distilling below 195 C of little or no preservative value; these oils are very volatile and when injected into timbers, would soon be lost by evaporation besides being a serious fire hazard.

(*h*) *Durol Process.*—In March 1923, 10,000 sleepers were treated by this process. This is a salt process with sundry refinements, which, it is hoped, will overcome the leaking out of the salt, under Indian climate. It is, however, worthy of note that in America the salt process is losing ground rapidly as compared to the creosote process.

5. Method of treatment.

A narrow gauge tramway brings the sleepers to the adzing and boring machine, where they are adzed, heart side upwards, and cut to 9 feet

length. As in the present adzing and boring machine, the boring spindles cannot be brought nearer than 3″ centre to centre, no boring to suit 4″ flange rails over 6 holed bearing plates can be done. It is therefore intended to instal a second machine with moveable spindle, $2\frac{1}{2}$″ to 4″, centre to centre.

From the adzing and boring machine, the sleepers are led out for being bored by manual labour. It may also be pointed out, that due to warping of sleepers, about 20 per cent. are not properly adzed by the machine even and these have further to be dressed outside by carpenters.

The adzed, cut and bored sleepers are loaded on eight low trollies and run into the cylinder. The doors are closed and a vacuum of about 20 inches created, a connection to the low service tank is then opened and mixture is sucked up into the cylinder. When no more will enter, the valve is closed and more mixture pumped in from high service tank. The pumps raise the pressure to a certain point usually 140 lbs. for fir and 120 lbs. for chir and then maintain it for about half an hour. The pressure is then released and the non-absorbed mixture runs into the low service tank. A vacuum is again created to withdraw mixture from the sleepers till they contain the correct quantity, *viz.*, 28 lbs. for fir and 24 lbs. for chir with normal side penetration of $\frac{1}{4}$″. The vacuum is then broken, the doors are opened and the treated sleepers run out of the cylinder and taken to a loading platform, whence they are shipped away. This completes one charge.

It must be admitted that the treatment is erratic, some sleepers are treated well and the others badly, and on the whole, the absorption is not quite satisfactory. A normal side penetration of $\frac{1}{4}$″ only is to be expected in healthy wood. If additional oil is forced in, it goes along the ends and penetrates for a considerable distance. To prove the uneven distribution of the mixture in the treated sleepers, I reproduce copy of a page from the Record Register at Dhilwan, *vide* Appendix (C). While the theoretical absorption aimed at is 24 lbs. per sleeper, the net absorption as determined by actual weighment varies from 12 lbs. to 44 lbs. from sleeper to sleeper, a fact which is corroborated by Deradun experiments.

6. The output of the Plant.

With fir sleepers, the time between two charges is two hours and with half an hour's rest in a working day of $8\frac{1}{2}$ hours, four charges can be turned out with a daily turn out of $4\ (44\times8)=1{,}408$ sleepers, and with an average of 25 working days, Sunday being a holiday, in a month, the monthly turn out$=25\times1{,}408=35{,}200$ sleepers. Similarly the monthly turn out in the case of chir sleepers comes to $25\times4\times(8\times41)=32{,}800$ sleepers. However, as the time between two charges in the case of chir sleepers is $1\frac{3}{4}$ hours only it is quite possible to turn out 5 charges a day and to increase the output by 25 per cent.

It may be pointed out that by working a few extra hours during October 1924 to January 1925, we managed to get 8 charges a day and were in a position to turn out 65,000 to 70,000 sleepers a month.

7. The Staff employed at the work, both Temporary and Permanent.

(*a*) *Permanent Staff.*—One Superintendent, a Senior P. W. I. in rank, and one junior P. W. I.

The labour gangs employed on the works are as follows :—

Gang No. 1	.. One mate and	10 coolies	.. Employed on loading sleepers on trollies for adzing machine.
,, No. 2	.. One ,,	11 ,,	.. Employed on adzing machine.
,, No. 3	.. One ,,	14 ,,	.. Employed on loading adzed and bored sleepers on trollies for the creosoting cylinders.
,, No. 4	.. One ,,	10 ,,	.. Employed on working valves of the creosoting cylinder and breaking naptheline.
,, No. 5	.. One ,,	12 ,,	.. Employed on unloading and stacking creosoted sleepers.
,, No. 6	.. One ,,	13 ,,	.. To replace absentees and work odd jobs, such as emptying creosote and furnace oil, wagons etc.
,, No. 7	.. One mate, one keyman and 6 coolies.		To maintain permanent way track.

7 Drivers.
7 Firemen.
6 Khalasis.
1 Hammerman.
1 Bellowman.
3 Carpenters.
2 Carpenter coolies.
1 Challandar.
1 Gatekeeper.
3 Fitters.
3 Fitter coolies.
1 Blacksmith.
1 Bhishti.
1 Sealman.
2 Sweepers.
6 Chawkidars.
4 Trollymen.

(b) Temporary.

10 Carpenters—for rectifying any defects and properly readzing sleepers turned out defective from adzing machine.

Gang No. 1—One mate and 20 coolies—for boring including four men for making out template for boring and 4 men for spreading sleepers.

Gang No. 2—One mate and 20 coolies—for boring including four men for making out template for boring and 4 men for spreading sleepers.

Besides this, the permanent gang Nos. I and II are given ¼ day as overtime allowance for working 2 hours extra on A. and B. machines.

And another gang is allowed Rs. 2-extra, as this gang is expected to be present in the depot for 24 hours to cope with any emergent work, such as fire, etc.

8. Cost of treatment.

(*a*) On the assumption that the output will be about 1,350 B. G. sleepers per working day and 400,000 per year (300 working days in the year excluding all Sundays and three days every quarter for boiler inspection), the estimated cost would work out as below :—

(*i*) Interest on capital cost of plant (*vide* Appendix D) Rs. 10,23,837 at 6 %		=Rs. 61,430
(*ii*) Depreciation on building Rs. 3,22,961 at 2 % ..	=Rs. 6,459	
(*iii*) Depreciation on machinery Rs. 5,08,882 at 10 % ..	=Rs. 50,888	= 59,662
(*iv*) Depreciation on rails, Rs. 46,307 at 2 % ..	=Rs. 926	
(*v*) Depreciation on sleepers Rs. 23,153 at 6 % ..	=Rs. 1,389	
(*vi*) Labour and supervision charges, average figure ..		= 72,500
(*vii*) Carriage charges 4 lacs, sleepers, from different stations to Dhilwan at = Re. 0-3-0 (average figure), per sleeper ..	=Rs. 75,000	=129,500
(*viii*) Loading and unloading charges ..	,, 17,000	
(*ix*) Store charges	,, 37,500	
(*x*) Creosote and naptheline 46,450 cwt. at Rs. 10-3-0 a cwt. including freight charges ..		=,, 4,73,210
(*xi*) Liquid fuel 46,450 cwt. at Rs. 65 per ton, including freight charges		=,, 1,51,000
(Creosote and furnace oil 1 : 1.)		
Total cost of treating 4 lacs sleepers ..		=,, 9,47,302
Cost per sleeper (including adzing and boring)		=,, 2-5-10
(*b*) Average actual cost as worked in several months [*vide* Appendix (E.)]		=,, 2-1-6

This difference is due to the less creosote allowed so far, *viz.*, one-third of the mixture instead of half as allowed now.

By deducting 3 annas per sleeper for cutting ends, adzing and boring, the total cost of a creosote sleeper with 1 : 1 of creosote and liquid fuel comes to Rs. 6-2-0 each with an estimated life of 12 years.

The capital cost of the installation is rather high, because prices were near the top when the plant was purchased. For the present, we might allow two-thirds the actual figure for a similar plant and taking interest at 5 per cent., the items for interest on capital and depreciation will come down by about 2 annas per sleeper.

The price of creosote during the period has also been high and it is presumed that a reduction of 25 per cent. will take place in the near future and this will reduce the working cost of a sleeper by another 2 annas.

The working cost per sleeper can be reduced further by 3 annas a sleeper by working the plant to its full extent, *viz.*, day and night, as will appear from figures for October 1924 to January 1925, *vide* Appendix (E).

9. General remarks.

Originally we started with dipping fir and chir sleepers in creosote and fuel oil mixture in open masonry tanks, but the penetration was not quite satisfactory. We have now got at Dhilwan, an installation capable of treating 4 lacs of sleepers annually by impregnation under pressure, and so it is worth mentioning here that our yearly contract with Messrs. Spedding & Co., which has been for 3 lacs of sleepers only, would not suffice to find sufficient work for this plant. Heretofore we have been falling back on the previous year's balance, to utilise the plant fully but as there is no balance left now, it is necessary that the authorities should make arrangements for the supply of another one lac sleepers annually, otherwise the plant will either be under-worked or lie idle for 3 months even with the present four charges a day.

The installation of the plant has proved very useful by indirectly lowering the price of deodar sleepers as the latter have recently been tendered at Rs. 6-15-0 and Rs. 7-0-0 each against Rs. 7-15-0 each in 1923.

As desired by the Chief Engineer with the Railway Board, attempts are being made to instal an incising machine to ensure more or less uniform penetration of the mixture and enquiries are being made from some well known Firms in Canada and United States of America.

As both the sleepers and the process of creosoting are on trial, it is absolutely necessary that an accurate history of every lot from the time of its supply to the time of its renewal should be available. For this purpose, a diagram has been devised by the Chief Engineer, Railway Board, wherein proper accounts are to be maintained. A sample form showing the history of a particular lot of sleepers as offered for passing to the railway on 6th March 1925 and the date of its despatch from the depot after creosoting on 4th July 1925 is given as Appendix (F).

Columns 15 to 30 are to be filled in from the information to be supplied annually by Executive Engineers in whose Divisions the sleepers are laid. To enable the Executive Engineers to keep a proper look out

for a particular lot, the sleepers before despatch from the depot are branded as—

(*i*) Class of sleeper, " C H " for chir and " F " for fir.

(*ii*) Date of creosoting.

(*iii*) Nature and quality of mixture.

" $\frac{1}{2}$ P. I." for $\frac{1}{2}$ of creosote and $\frac{1}{2}$ of furnace oil.

" $\frac{1}{3}$ P. I." for $\frac{1}{3}$ of creosote and $\frac{2}{3}$ of furnace oil.

" D. L." for Durol process.

" P. T." for treated with settled tar.

" D. D." for tipped in open tank.

10. Fire protection.

Fairly good arrangements have been made at the depot for protection against fire, in the form of fire alarms, buckets and tins filled with sand. Water pipes with hydrants and canvas hose pipes are provided at suitable places, but to supplement it still further, it is intended to provide one more N. G. Tractor for shunting purposes, thus eliminating all chances or mischief from the flying sparks emitted by the engines.

APPENDIX A.

GOVERNMENT OF INDIA.

INDIAN STORES DEPARTMENT.

Specification No. G./O. P.-33 for creosote for the treatment of Railway sleepers, Telegraph and Telephone poles and timber generally.

Description.

1. The creosote shall be of the best quality and shall be a pure distillate of coal tar and shall be free from any admixture of petroleum or similar oils. It shall be clear and free from all feculent matter.

General Characteristics.

2. The creosote shall have the following characteristics :—

(1) *Fluidity.*—It shall become completely liquid on being slowly warmed to 38° C. with stirring and on cooling down shall remain completely liquid after standing for two hours at 32° C.

(2) *Specific Gravity.*—The creosote shall have a specific gravity of not less than 1·0 at 15° C.

(3) *Water content.*—The amount of water in the material shall not be more than 2 per cent. when determined in accordance with the British Engineering Standards Association Specification No. 144-1921 (Appendix II).

(4) *Insoluble matter.*—The amount of matter insoluble in benzine shall not exceed 1 per cent. by weight.

(5) *Free tar acids.*—The amount of tar acids shall not be more than 8 per cent. It will be determined by the method described in Appendix IV of British Engineering Standards Association Specification No. 144-1921.

(6) *Distillation.*—The loss by distillation shall be limited to the following values :—

Upto 200	C.	not to exceed 5.		
,, 240°	C.	between 10%	and	40%
,, 260°	C.	,, 20%	,,	50%
,, 280°	C.	,, 30%	,,	60%
,, 300°	C.	,, 35%	,,	70%
,, 320°	C.	,, 45%	,,	80%
,, 340°	C.	,, 60%	,,	95%
,, 360°	C.	,, 75%	,,	100%

The distillation to be conducted at the rate of one drop per second on 250 grammes of oil in a 500 C. C. Hampel flask with the bulb of the thermometer opposite the slide tube.

Inspection and Tests—

3. Before taking over the creosote from the contractor the Inspecting Officer, nominated by the Chief Controller of Stores, Indian Stores Department, will take such samples from the storage tanks as may be necessary or may request such samples as he may require to be sent to him for test, the tests being carried out at the Government Test House or elsewhere as may be most convenient to the Inspecting Officer. If the creosote is found, after tests, to be in accordance with the requirements of this specification, the contents of such of the tanks as may be specified by the Inspecting Officer will be loaded into tank wagons for weighment in the presence of the Inspecting Officer whose certificate will certify the accuracy of weighments before despatch. The net weight of the consignment shall be determined as follows :—

The empty tank will be weighed on a weigh bridge and the tare recorded in the presence of the Inspector. The tank will then be filled and again weighed. The difference in weight will be the net weight of the consignment and for this quantity, the Inspector will grant a "Despatch Memo."

The Inspecting Officer may further cause samples to be drawn off from the tank wagons for tests and such tank wagons will not be despatched without his approval. Should the samples taken from tank wagons not pass the tests, the contents of such wagons will be liable to rejection.

Delivery—

4. The creosote shall be delivered as provided in the enquiry letter, order or contract.

APPENDIX B.

Liquid Fuel.

Diesel oil at Rs. 57-8-0 per ton.

Furnace oil at Rs. 52-8-0 per ton.

The rates include free delivery into tank wagons on rails at Karachi and all charges such as wharfage, terminal tax, weighing and filling charges, import duty, etc.

Contractor—Messrs. Shaw Wallace & Co., KC.

Specification.

1. Diesel oil—

(*a*) Specific gravity at 60° F.	..	= ·895
(*b*) Calorific value of B. T. U.'s per lb.	..	= 19,000 = 19,500
(*c*) Flash point not less than	..	= 150° F.
(*d*) Sulphur content not more than	..	= 1·3%
(*e*) Water and other impurities	..	= Nil to 5% max.
(*f*) Viscosity	..	= Fluid at 40° F.
(*g*) Asphalt content	..	= 1·8%
(*h*) Ash	..	= trace only.

2. *Furnace oil.*—In no way inferior to—

(*a*) Specific gravity at 60 F.	..	= ·950
(*b*) Calorific value of B. T. U's per lb.	..	= 18,750
(*c*) Flash point not below	..	= 150° F.

Inspection and tests.

10. The oil fuel is to be the best of the descriptions specified, and is to be supplied to the entire satisfaction of the Inspector who shall have full power to inspect the oil fuel and to reject the whole or any portion thereof of which he may disapprove and his decision thereon shall be final and conclusive. Inspection will be made, when required from samples drawn from storage tanks at Kiamari as required by the Inspector. The contractor shall give the Inspector due warning before pumping oil into tank wagons.

11. The contractor shall provide without any extra charge for materials, tools, labour and assistance of every kind which the Inspector may consider necessary for any test or examination which he may require to be made on the contractor's premises and shall pay all costs attendant thereon. The contractor shall also provide and deliver free of charge at such place as the Inspector may direct such samples of the oil fuel as he may require for test by chemical analysis or independent testing machine. The cost of any such tests will be defrayed by the buyer.

Charge for work necessary for completion of contract.

12. The contractor shall pay all charges for handling the oil fuel into the tank wagons on rails at Karachi and other work necessary for carrying out this contract.

APPENDIX C.—3rd July 1925.

Block No.	Charge No.	Description Treated on Date. B. G. Fir.	B. G. Chir.	B. G. Asna.	M. G. Koil.	M. G. Chir.	Beams. Fir.	Bridge. Asna.	Treated up to date.	Oil used.	Vacuum applied.	Pressure applied.	Temp. range.	Before treatment. L. S.	Before treatment. H. S.	Before treatment. Total.	Vacuum applied.	After treatment. L. S.	After treatment. H. S.	After treatment. Total.	Quantity used in charge.	Net absorption per sleeper.
Brought over.		386,659	357,023	200	6,500	9,679	638	..	960,699													
7	3,993	..	336	..	..	..	..	..	961,035	50 %C. 50 %E.	20″ for 20 minutes.	100 lbs.	150′	3′-4¼″ / 12,330	5′-1″ / 5,105	17,435	20″ for 20 minutes.	3′-1⅝″ / 11,497	5′-1″ / 5,105	16,602	833	24
7	3,994	..	336	..	..	..	..	..	961,371	,,			,,	3′-1⅝″ / 11,497	5′-1″ / 5,105	16,602		2′-11¼″ / 10,662	5′-1″ / 5,105	15,767	835	24
7	3,995	..	336	..	..	..	..	..	961,707	,,			,,	2′-11¼″ / 10,662	5′-1″ / 5,105	15,767		2′-8¾″ / 9,829	5′-1″ / 5,105	14,934	833	24
7	3,996	..	336	..	..	..	..	..	962,043	,,			,,	2′-8¾″ / 9,829	5′-1″ / 5,105	14,934		2′-6½″ / 8,994	5′-1″ / 5,105	14,099	835	24

Oil in High Service Tank	22	2	0	14
Oil in Low Service Tank	38	18	3	21
Oil in Storage Tanks	317	6	3	8
Total	378	7	3	15

APPENDIX C—*concluded.*

Description No.	Weight before treatment.	Weight after treatment.	Net absorption per sleeper.	Charge No.
301	130	168	38	3,993
302	157	190	33	..
303	160	182	22	..
304	118	132	14	..
305	144	180	36	2,994
306	120	151	31	..
307	120	150	30	..
308	151	188	37	..
309	133	160	27	3,995
310	112	133	21	..
311	138	166	28	..
312	147	170	23	..
313	112	156	44	3,996
314	129	170	41	..
315	144	156	12	..
316	136	161	25	..

APPENDIX D.

COST OF TIMBER CREOSOTING DEPOT AT DHILWAN, LAHORE DISTRICT.

Sub-estimate.	Description.	Cost.			Allocation.	
		Cash.	Stores.	Total.	Capital.	Revenue.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	Land ..	23,593	..	23,593	23,593	..
2	Formation ..	88,242	..	88,242	88,242	..
3	Fencing ..	3,418	10,118	13,536	13,536	..
4	Ballast and Permanent-way tracts ..	5,813	61,147	66,960	66,960	..
5	Staff quarters ..	50,682	4,969	55,651	55,651	..
6	Station building ..	1,02,634	86,508	1,89,142	1,89,142	..
6 A.	Narrow gauge sidings	12,460	17,465	29,925	29,925	..
6 B.	Station machinery ..	3,084	3,119	6,203	6,203	..
6 C.	Machinery for depot	8,300	2,31,575	2,39,875	2,39,332	543
6 D.	Fire protection and watering arrangements ..	16,587	40,933	57,520	57,520	..
7	Rolling stock ..	1,710	1,86,674	1,88,384	1,88,384	..
8	General charges ..	15,580	..	15,580	15,580	..
		3,22,103	6,42,508	9,74,611	9,74,068	543
	Contingencies on Rs. 9,84,519 @ 5 % ..	16,605	32,621	49,226	49,143	83
	Grand Total ..	3,48,708	6,75,129	10,23,837	10,23,211	626

SUB-ESTIMATE No. 6-C. MACHINERY FOR DEPOT.

Item No.	Description.	Cost.
		Rs.
1	Adzing boring machine, 2 No.	56,000
2	Cylinder, 1 No., Oil Tank H. S., 1 No., pump vacuum, 2 No., pressure pump oil, 5,000 gallons per hour, 2 No., with erection, 1 No.	94,735
3	Boiler Horizontal, 60 B.H.P., Lancashire workshop, working pressure 120 lbs., 1 No.	10,200
4	Feed Pump for filling water in Lancashire Boiler, 1 No. ..	1,100
5	Portable Engine, 12 Horse Power, 2 No.	8,000
6	Portable Engine, 10 Horse Power, 1 No.	2,200
7	Vertical Boiler, 12 Horse Power, for heating oil storage tank, 1 No.	4,435
8	Iron staging to oil High Service Tank, 1 No.	1,486
9	Tractor, 1 No.	10,000
10	Creosote Pipe from storage tank to cylinder and feed pipes, 1 No.	13,863
11	Steam Pipe for heating purposes with fixing two sides of trough (Figures given by X. P. W.)	2,250
12	Weigh Bridge 3 tons for narrow gauge tracks (complete), 2 No.	5,700
13	Oil Engine, 20 Horse Power, complete, 1 No.	1,700
14	Creosote temporary pipe line to soaking pits as per detail attached, 1 No.	701
15	Sea freight on items 1 and 2, Rs. 1,49,195 @ 10 % ..	14,920
16	Freight charges on stores, Rs. 2,04,070 @ 7 % ..	14,285
	Total	2,41,575
	CREDIT.	
	Oil Engine, 20 Horse Power, complete, 1 No.	minus 1,700
	Net Total	2,39,875

APPENDIX E.

Name of month.	Labour charges.	Handling carriage, fuel and stores charges.	Interest on capital outlay.	Depreciation charges.	Cost of creosote liquid, fuel and Naphthaline.	Total cost.	Number of sleepers outturned.		Cost per sleeper B.G. creosoted.			Remarks.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Cres.	Dip.	Rs.	a.	p.	
Augt. '23 ..	3,220	9,689	5,120	5,000	28,704	51,733	19,209	6,119	2	3	5	Cost of dipping Re. 1-8-0 per sleeper.
Sept. '23 ..	2,927	11,430	5,120	5,000	25,489	49,966	21,077	4,459	2	0	10	
Octr. '23 ..	3,590	8,659	5,120	5,000	33,621	55,990	24,966	..	2	3	11	
Novr. '23 ..	3,617	6,559	5,120	5,000	24,313	44,609	21,036	..	2	2	7	
Decr. '23 ..	3,366	14,493	5,120	5,000	40,470	68,449	32,626	..	2	1	7	
Jany. '24 ..	3,624	11,848	5,120	5,000	21,747	47,339	B. G.	M.G.				
							13,618	15,000	2	4	0	Re. 1-2-0 per M. G.
							28,618					
Feby. '24 ..	3,486	8,322	5,120	5,000	27,305	49,233	14,456	(Durol)	3	6	5	
March '24 ..	3,468	4,259	5,120	5,000	16,689	34,536						
							9,222	10,200	2	9	1	Re. 1.-1-0 per Durol.
April '24 ..	3,282	8,744	5,120	5,000	47,200	69,346	26,974	..	2	9	1	
May '24 ..	3,559	5,960	5,120	5,000	17,445	37,084	12,187	..	3	0	8	
June '24 ..	3,401	12,472	5,120	5,000	40,256	66,249	28,515	..	2	5	2	
July '24 ..	5,191	14,261	5,120	5,000	44,023	73,595	33,587	..	2	3	0	
August '24 ..	5,574	16,733	5,120	5,000	42,619	75,046	37,168	..	2	0	3	
Sept. '24 ..	6,018	15,728	5,120	5,000	35,907	67,773	33,635	..	2	0	2½	
Octr. '24 ..	9,453	31,573	5,120	5,000	77,298	1,28,444	72,656	..	1	12	3½	
Novr. '24 ..	9,719	28,145	5,120	5,000	68,871	1,16,855	65,080	..	1	12	8	Reduced figures are due to working day and night, utilising the plant to full extent.
Decr. '24 ..	8,554	27,153	5,120	5,000	68,875	1,14,702	64,900	..	1	12	11¾	
Jany. '25 ..	7,097	25,329	5,120	5,000	64,618	1,07,364	61,380	..	1	11	11	
Feby. '25 ..	4,593	13,824	5,120	5,000	27,099	55,636	29,402	..	1	14	3	
March '25 ..	4,270	18,084	5,120	5,000	29,372	61,846	34,144	..	1	12	9	
April '25 ..	3,844	9,307	5,120	5,000	25,889	49,160	20,448	..	2	6	5	
May '25 ..	4,249	14,900	5,120	5,000	44,893	74,162	30,976	..	2	6	4	

APPENDIX F.

DETAIL SUPPLIED BY SLEEPER MUNSHI.

Messrs. Spedding & Co. and B. Dinga singh Sahib.	1	Name of supplier.
Dhilwan	2	Place of supply at Railway Depot.
Kulu Forest.	3	Source of timber.
Water-borne.	4	Whether water-borne or rail-borne.
B. G. Chir.	5	Kind of timber.
6th March 1925.	6	Date of passing sleepers by S. D. Officer.
8,490	7	Number of sleepers passed.
Supplied from Forest Depot at Dhilwan.	8	Date of loading in wagons.
290.	9	Number of sleepers rejected at time of loading.
..	10	Number of sleepers loaded in wagons.
..	11	Number of wagons.
Condition good.	12	General remarks as regarding quality and condition of sleepers.

8,200.	No. of sleepers received at Dhilwan.	*1
21st March 1925 and 22nd March 1925.	Date between which arrived at Dhilwan	2
6 and 7.	Block in which unloaded.	3
8.	Detail No	4

*NOTE.—The last 4 columns (1 to 4) are kept by us but are not shown in the regular forms issued by Chief Engineer In the case of sleepers, which are not despatched immediately after being treated, the detail number is marked on each stack after they have been treated and stacked and the detail numbers correspond with those issued by Sleeper Munshis, which are marked serially as they are received.

TO BE FILLED IN BY SUPERINTENDENT, DHILWAN.

Messrs. Spedding & Co. and B. Dinga Singh Sahib.	1	Name of supplier.
Dhilwan.	2	Place of supply at the Railway Depot.
Kulu Forest.	3	Source of timber.
Water-borne.	4	Whether water-borne or rail-borne.
B. G. Chir.	5	Kind of timber.
6th March 1925.	6	Date of passing sleepers by S. D. Officer.
8,490.	7	Number of sleepers passed.
Supplied from Forest Depot at Dh lwan	8	Date of loading in wagons at Supply Depot.
290	9	Number of sleepers rejected at the time of loading.
21st March 1925 and 22nd March 1925	10	Date of receipt of sleepers at Dhilwan.
2nd July 1925, 3rd July 1925	11	Date of creosoting.
334 1,100 Total 1,434	12	Number of sleepers creosoted.
4	13	Number of sleepers rejected on the day of creosoting.
4th July 1925.	14	Date of despatch to Executive Engineers.
	15	Date of receipt by Executive Engineers.
	16	Name of district.
	17	Where laid giving mileage.
	18	When laid.
	19	Number of sleepers rejected by Executive Engineers before laying.
	20	Number of sleepers rejected during 1st year.
	21	Number of sleepers jected during 2nd year.
	2	Number of sleepers rejected during 3rd year.
	23	Number of sleepers rejected during 4th year.
	24	Number of sleepers rejected during 5th year.
	25	Number of sleepers rejected during 6th year.
	26	Number of sleepers rejected during 7th year.
	27	Number of sleepers rejected during 8th year.
	28	Number of sleepers rejected during 9th year.
	29	Number of sleepers rejected during 10th year.
	30	Remarks.

N.B.—All this information is given on the back of the Issue Note, when d . .tching from Dhilwan.

Sleepers of each date should be kept separately and paid in continuous length according to the date marked on one end of a sleeper.

22nd March 1925.

Received the following from Messrs. Spedding & Co. and B. Dinga Singh, Contractor of Lahore :—

Sleepers B. G. Chir new .. 8,200 No.

Block No.	Description.	Quantity or number.	Date arrived Dhilwan.	Grand total.	Depot came from.
	B. G. Chir ..	3,136	21st March 1925	3,136	Dhilwan Forest Depot.
	B. G. Chir ..	5,064	22nd March 1925	5,064	Dhilwan Forest Depot.

Despatched the following :—

4th July 1925.

Wagon No.	Description.	R. M. C. Note.	I. Note.	Whom to.	Contents.	Date of creosoting.	Authority.	Untreated sleepers came from.
24276/23 ..	B. G. chir creosoted new 1st class bored for 60 F. F. steel rails for 7″..7½″, B. Plate.	No. 83, dated 4th July 1925.	No. 74, dated 4th July 1925.	P. W. Inspector, Lilla, at Haranpur.	200	2nd July 1925.	D. E. N., R. W. P., No. 835 W/6, dated 19th July 1925.	Dhilwan Forest Depot.
18696/22¼ ..					134			
17708/20¾ ..					230	3rd July 1925.		
17235/18½ ..					210			
17264/22¼ ..					230			
3672/22 ..					210			
30989/23¼ ..					220			
				Total ..	1,434			

4th July 1925.	Month and date,
Haranpur.	Destination.
1,434.	Number of Sleepers.
No. 83, dated 4th July 1925.	R. M. C. No.
No. 74, dated 4th July 1925.	Issue Note No. and date.
½ C. ½ E.	Proportion of oil used.
2nd July 1925 and 3rd July 1925.	Date of treatment.
B. G. Chir.	Description.
D. E. N., R. W. P. No 835 W/6, dated 19th June 1925.	Authority.

P. W. Inspector, Lilla.

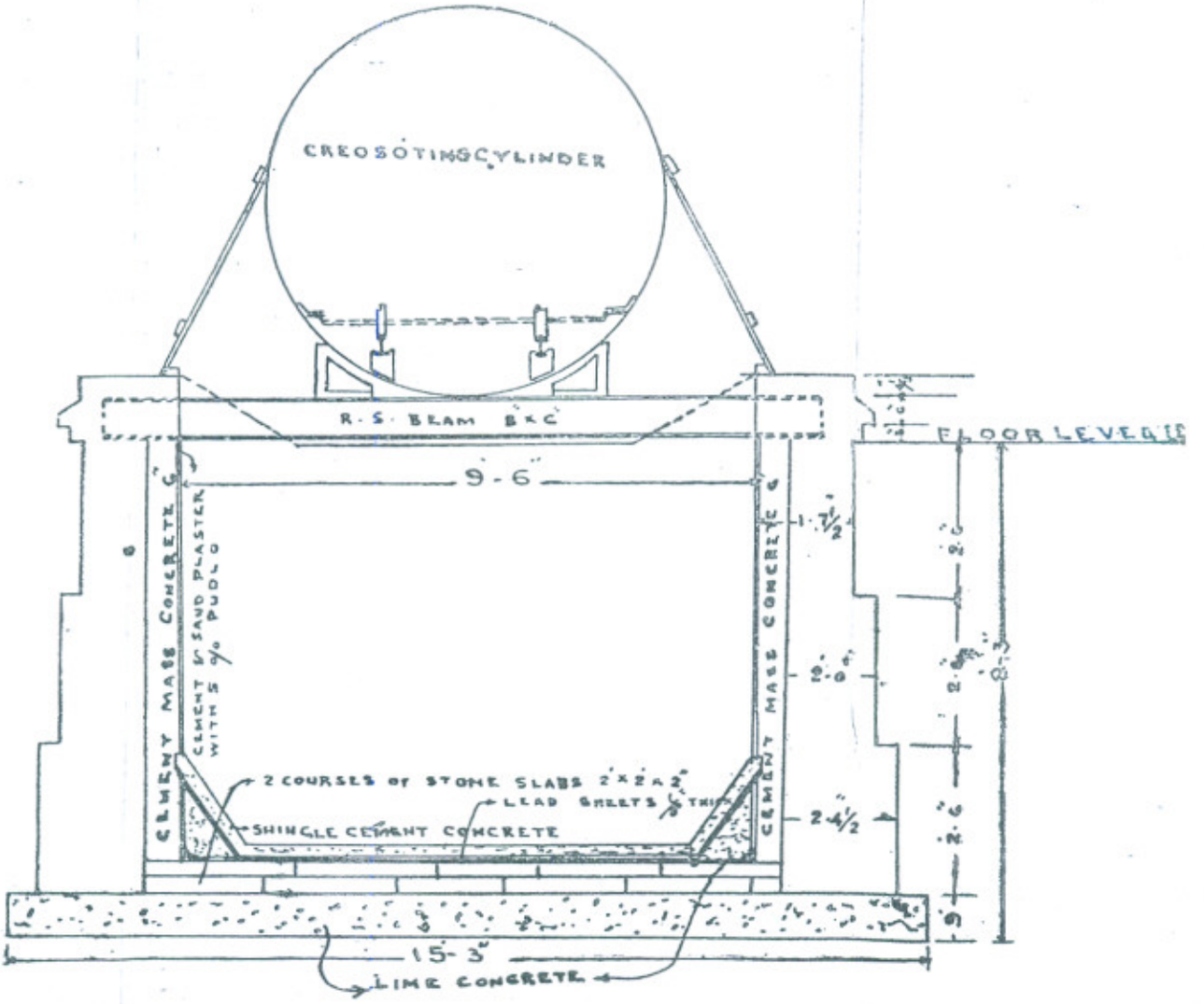
NOTE.—Two complete pages are kept for each P. W. Inspector to whom sleepers are supplied from this depot for ready reference hereafter.

"SH

- CREOSOTING CYLINDER AND -
- LOW SERVICE TANK -

- Scale

0 5 10 Ft

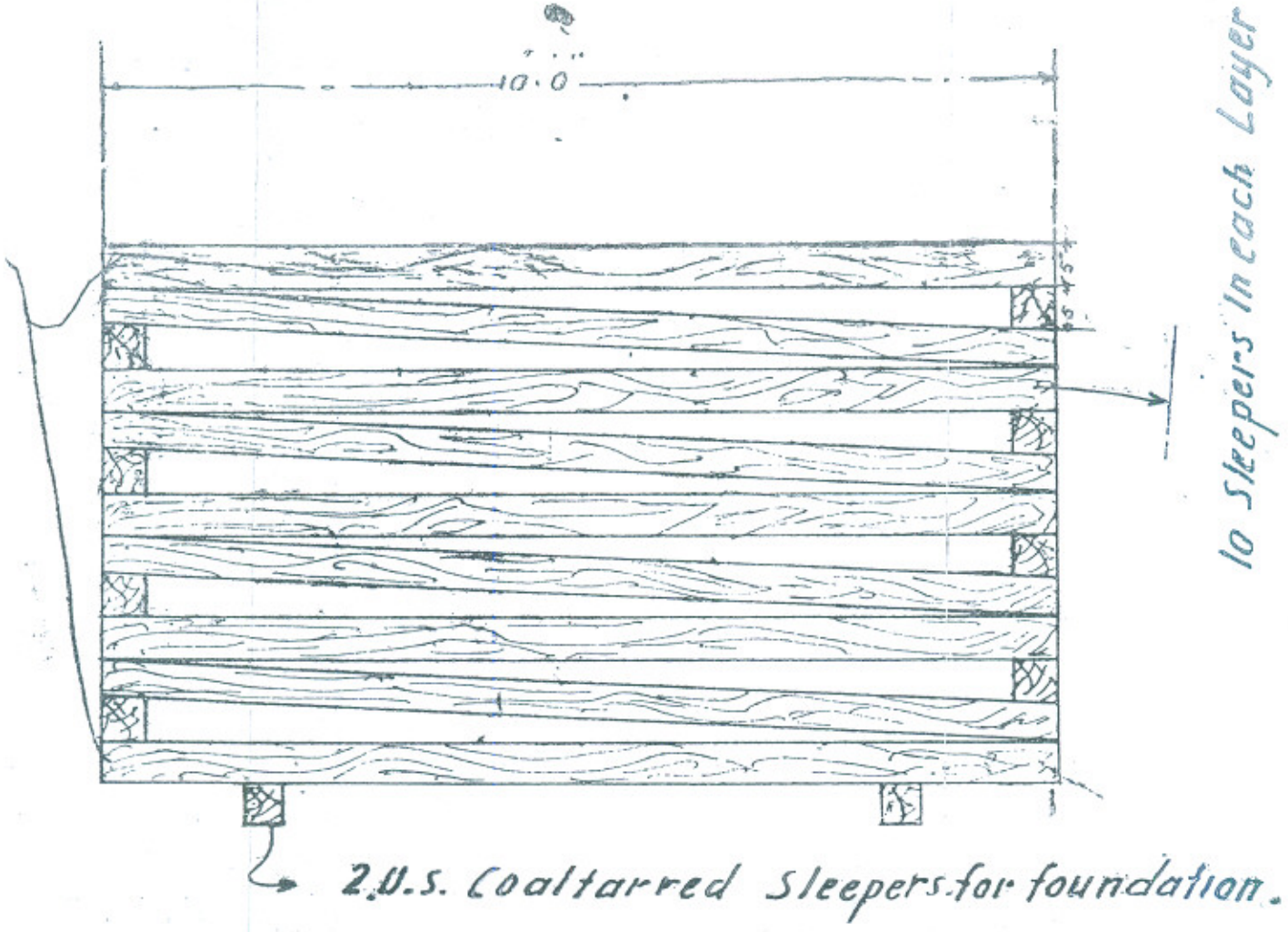


SHEET NO 6

SLEEPERS PILING 1 IN 10 METHOD -

SCALE

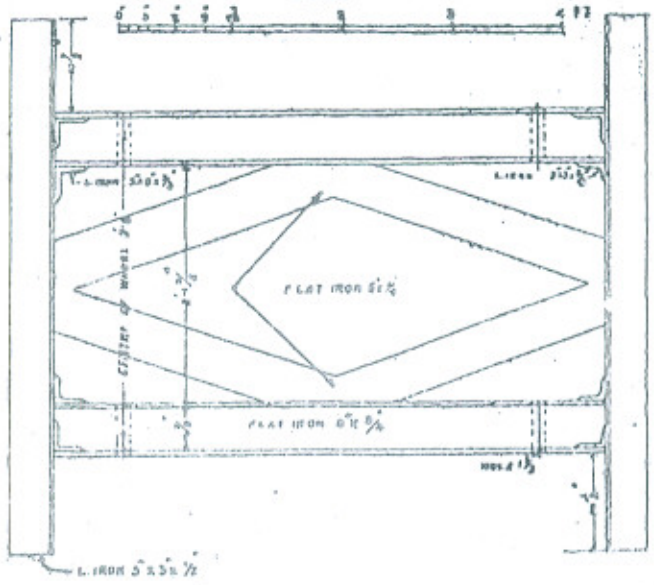


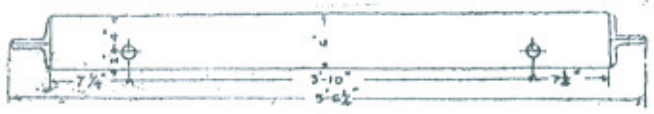


sheet no 2

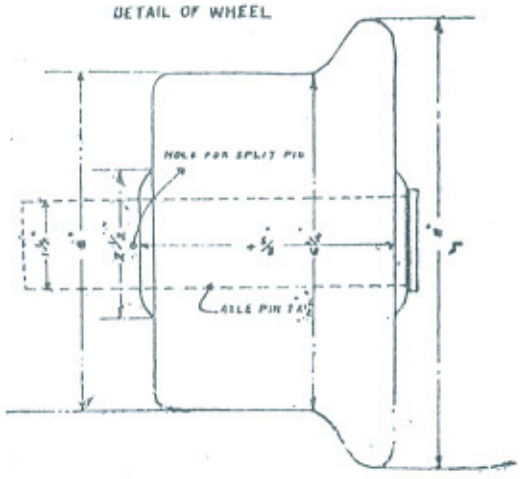
PLAN AND SIDE ELEVATION OF CREOSOTING TRUCK

SCALE





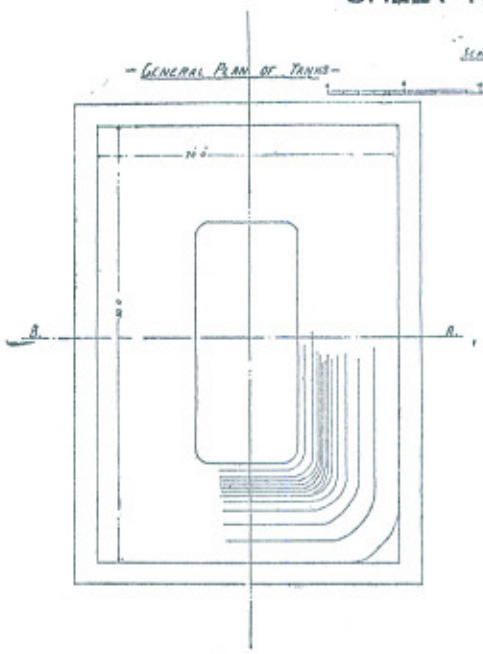
DETAIL OF WHEEL



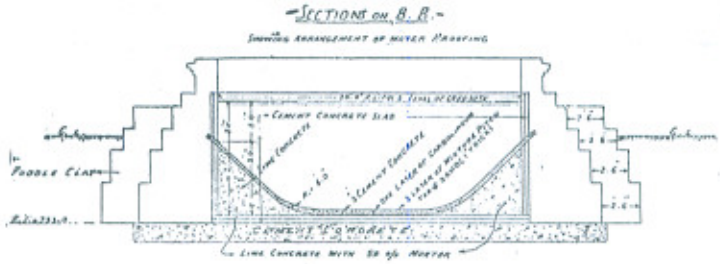
LOAD ON SINGLE AXLE — ¾ TON

SHEET NO 3

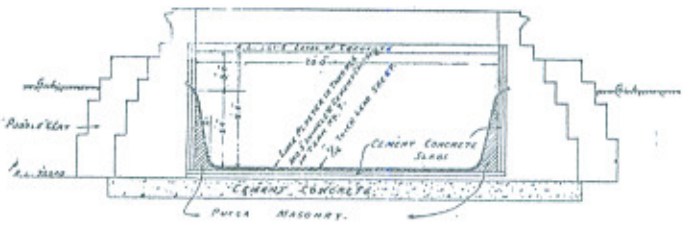
- GENERAL PLAN OF TANKS -



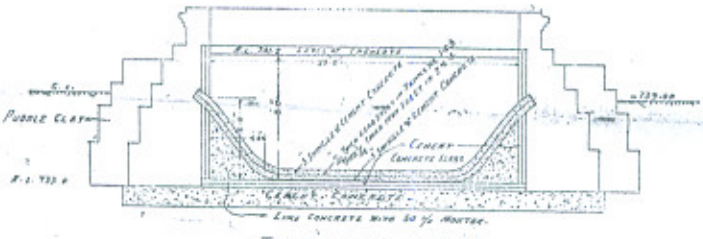
- SECTIONS ON B.B. -



- TANKS Nos. 5, 8, 9 & 10 -



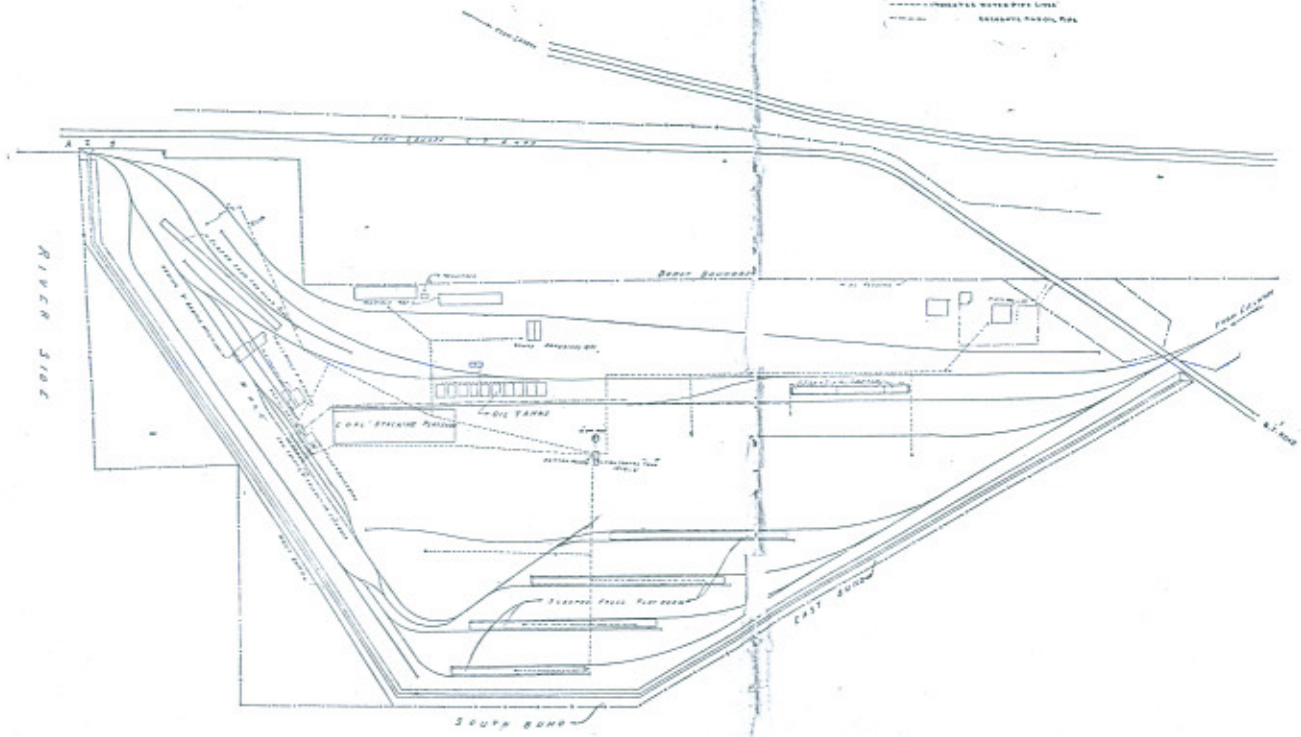
- TANKS Nos. 6 & 7 -



- TANKS Nos. 1, 2, 3 & 4 -

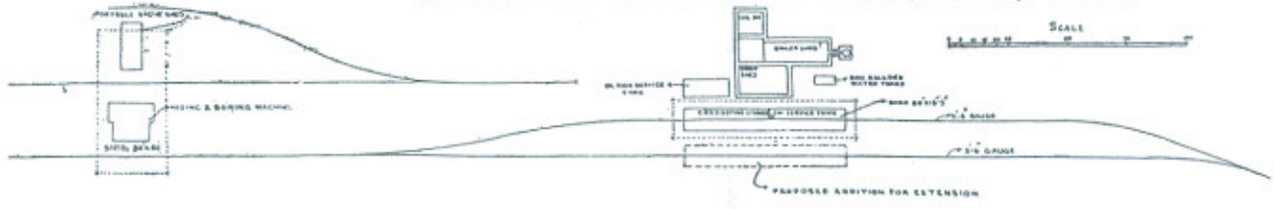
GENERAL LAY OUT

SHEET NO 1



LOCATION CREOSOTING CYLINDER & PUMPS'

SHEET' NO 4



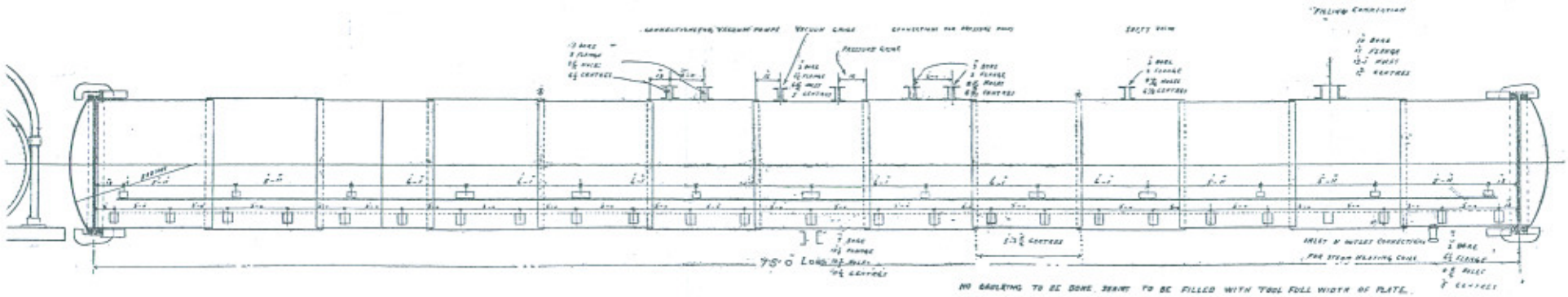
SHEET No. 5

ARRANGEMENT OF CYLINDER

SCALE

NOTE

AFTER TESTING THE CYLINDER TO BE CUT INTO 3 SECTIONS AT THE SEAMS MARKED X



NO CAULKING TO BE DONE. SEAMS TO BE FILLED WITH TOOL FULL WIDTH OF PLATE.

DISCUSSION.

MR. WAZIR SINGH in introducing his paper said that a brief note, which formed the nucleus of this paper, had been written some time back in reply to enquiries from different Railways and firms in India as to the design and method of working of the creosoting plant at Dhilwan and the same had now been amplified.

This paper was neither a note on the preservation of wood, nor discussed the different methods of creosoting employed by several Railways and firms in America and Europe. He had simply tried, as the heading of the paper indicated, to describe in brief the method of creosoting soft wood sleepers for Railway requirements as adopted at Dhilwan and the economic value thereof as compared to that of deodar.

To his knowledge, the plant at Dhilwan was the only creosoting plant in India except the experimental one at Dehra Dun and this paper might be useful to those who were interested in the study of the subject, at least the practical part thereof, and to those who might have to instal similar plant in future. With this idea in view he had pointed out a few main defects in the design, construction of works and the method of working; and as the work was still new to India there might be other defects, which could be improved upon, and avoided in future installations.

MR. LINES remarked that the Railway were thinking of using this system for deodar sleepers.

He found that the amount of penetration varied enormously.

One of the disadvantages of the system was that when once dry-rot had begun, the sleeper took up so much of the mixture.

In Bengal they found that deodar sleepers did not stand so well as those of sal.