SOME MATERIAL HANDLING PROBLEMS
IN A LEATHER TANNERY,
WITH PRACTICAL SOLUTIONS
THESIS FOR THE DEGREE OF M. E.
W. P. Robinson
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Conveying machinery

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# SOME MATERIAL HANDLING PROBLEMS IN A LEATHER TANNERY, WITH PRACTICAL SOLUTIONS

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THESIS

# - I N D E X -

## a - GENERAL STATUS OF THE INDUSTRY TO BE CONSIDERED.

The forward march of the world makes inexorable demands on our industrial life which more often than not take the form of problems for the proper solution of which engineering assistance in some form is necessary. A few outstanding branches of our great industrial body set this forward pace. Perhaps one is pushing forward some new discovery or invention; another may be interested in the intensive developments in some such field as the generation of power. In such cases an appeal is made to the imagination and love of accomplishment of the modern business man and it appears that all the incentives are present for rapid development. It is quite evident that with some stepping out in front the others soon catch the spirit, and the race is on. Soon we see the demand for greater and still greater efficiency taking form in one way or another; greater production is wanted, or better material. We see a brand new industry arise over night with material requirements that were not dreamed of before; immediately certain suppliers of the required materials begin to perform the impossible and the demands are met satisfactorily. Besides this form of stimulus to our technical advance, and of an equally insistent nature, there is the ever present force of competition at work operating to make the progressive manufacturer more progressive and to eliminate the too conservative manufacturer. This is probably the most generally felt and most

easily recognized cause of technical advance and the terms in which it is expressed are familiar to all - how can the cost of manufacturing be still further reduced? How can the cost of power be reduced, etc.? Still another incentive to the development of new ideas, new methods, etc., is the possibility existing in so many industries of suddenly having to change from an old well-known product to another entirely new one. Witness the number of automobile manufacturers that were originally carriage builders. And so we see going on around us continually the building of new plant, installing of new machinery, the trying of new methods, and it is safe to say that there is not a major industry unaffected. Let us now recognize that the driving force behind all this industrial life is the making of a satisfactory living or profit.

Assume, however, that a major industry, such as will be discussed in this paper, has found it difficult, if not impossible, to secure a satisfactory profit from operations. It is not the purpose of this paper to show why there should be, or should not be such, but to merely state that there were three in 1920 - leather, sugar and wool - in a total of 57 industries, and of these three the leather industry has shown a deficit consistently for several years. This is the industry that this paper is concerned with and it is our purpose to show how this condition may give rise to problems which can be solved only by the application of exactly the same devoted and concentrated engineering attention that is causing the world to march at its present pace, - with, however, this difference:- that the cost of improvements must be the absolute minimum, and these costs will be incurred only when the results are certain beyond question to produce lower process costs. Let it be stated here that the unfavorable situation in which the tanning industry has found itself for several years past is in no measure due to lack of ability on the part of the tanners. On the contrary quality has been improved and manufacturing costs cut without the encouragement of visible profits, which is a condition requiring both ability and courage of high order.

The condition we have to bear in mind than is that there is a great basic industry like the sole leather tanning business, with an intense desire to surmount the economic handicaps that exist internally, and little money with which to do it.

b - SPECIAL LABOR REQUIREMENTS.

The tanning industry is an old one, in many cases having descended from generation to generation in the same family, each generation having been born in and bred to the business. A natural result has been self-reliance and great conservatism on the part of executives who have been entirely self-sufficient, and, urged by necessity have developed considerable strength in handling the heavy wet hides, with the result that a heavy labor turnover has been undesirable. Another consequence has been that labor-saving machinery or methods were bound to receive more than ordinary attention. The tanning process is continuous and considerable ingenuity must be exercised in order to have most of the handling in and out of vats, as well as the processes in which direct labor is involved such as de-hairing, done in the daylight hours. The labor situation will continue to be a difficult one in so far as such phases continue as the difficulty of breaking in new men and the need of great physical exertion. Relief can be had only by making free use of machinery for doing the hard jobs, and since labor is one of the large items in the cost of the product, as much labor should be saved as possible.

## c - THE ECONOMIC SITUATION AS IT AFFECTS BUILDINGS AND EQUIPMENT

The need of more and more labor saving methods being granted, it is interesting to note the conditions which keep the problem from being so simple as one would wish. The plants are usually old and low-roofed and are spread over considerable ground area, due to the necessity for using vats filled with various solutions in which the hides are treated;- further, the buildings often were constructed piecemeal and without too much recourse to surveying instruments or stress figures. If labor saving methods proven in other industries can be made use of without too great alteration to existing plant, well and good; if not what shall be done? There probably is no surplus in the treasury available for new plant, and the financial reports of the leather industry for years past would not tend to induce new capital to supply the need.

d - NECESSITY FOR IMPROVED MATERIAL HANDLING METHODS

It has long been recognized that material handling is a field which offers very great possibilities to those who would lower production costs, and the leather tannery looks like one place where the material handling expert can effect worth-while savings. The hides must pass through vat after vat, each time being lifted with the absorbed load of liquor through a height of from three to six feet, and each time being transported some distance by some means. The primitive method of lifting, transporting and putting in the vat has been to handle each hide individually in and out and transport in piles on cars travelling along narrow gauge tracks over the vats. It is evident that some floor space must be devoted to these tracts which would better be used for vat space. These old methods are still practiced to a very large extent because of the great difficulty experienced when one tries to make use of any equipment obtainable on the market. There is no question about the need for some system able to relieve the labor requirements as they have existed and having the possibility of either expediting or improving the processing of the hides.

e - CHOICE OF EQUIPMENT TO BEST SUIT THE CONDITIONS:

The situation confronting us then when called upon to recommend proper handling methods was, first, to search for suitable and standard equipment even tho it might be something of a compromise; and second, to design if necessary machinery for doing the work. With this in mind, it is well to consider the design of vats and buildings in plants of more recent origin in which standard handling equipment has been installed. The vats have been enlarged in area and the buildings designed without posts for the use of travelling cranes. Racks can then be used for holding a certain number of hides, the best method being to fold each hide across a stick which has its ends carried by the top frame work of the rack. This rack fits into the vat and the hides hand freely in the liquor. The total weight may be from one to six tons and even more. In the case we have to consider however, there are posts throughtout the tannery spaced from 16' to 20' and in some cases the posts are not even in line. The ceilings are low, averaging from 9' to 10'.

Two general handling schemes were worked out to suit two different sets of conditions. The scheme which will be designated as the Monorail Scheme is suitable where the progress of the material is in general along one row of vats and not across vats,- another requirement of this

system being that the load should not be more than 2000 lbs. It will immediately be seen that the monorail system is a compromise. The only reason for its adoption is its cheapness. It is essentially a manually travelled system because there is not sufficient head room for motor travelled telfers or monorail trolleys. Due to the same restriction it is impossible to use heavy and rugged equipment which will give minimum maintenance cost. Its limitations are then: Small capacity; hand travel by pushing; slow hoisting speed; difficulty of feeding current to the hoist; line coverage instead of area coverage; necessity for carefully balancing the loaded rack; the necessity for foot paths along each row of vats; the interference of the hanging racks with each other on the monorail tracks unless the routing can be worked out to avoid this.

The scheme designated as the Crane System has no such limitations as the Monorail System, but in a building having a great many rows of posts the cost of installing runways and cranes over each row would be prohibitive and even if standard cranes could be found which would go into the low headroom there would still be the impossibility of easily carrying the racks from one row of vats across to another parallel row. Nevertheless means were found to adapt the travelling crane to the peculiar needs of the situation and several years of successful service have proven the adaptability of the Crane System and its efficiency and low maintenance.

<u>f - DESCRIPTION OF MONORAIL SYSTEM AND ITS APPLICATION:</u>

Sketches 2-4-29A and 2-4-29B show the monorail system adapted for one particular department where the hides can be loaded on the racks directly from the de-hairing stands and processed in a fairly straight line. The arrangement of tracks and junctions is such that the racks progress in an orderly manner without interference, being loaded on track BH2-BH3-BH4 and unloaded many hours later on track C30, the empties being returned on the outside track G7E to C3. The tracks are continuous, with no gaps, and hang from the steel ceiling I-beams by means of ordinary bolts with spacer washers to permit of leveling the complete system. Due to the possibility of slippage and consequent misalignment of junctions clamps are not used but bolt holes are drilled in the lower flanges of ceiling beams and the upper flanges of the monorail beam. The bolt heads are placed under the monorail beam flange with wedge shaped washers and as little room as possible taken up in order not to interfere with the trolley wheels. The junctions are a standard design having a continuous upper member bolted securely to the top flanges of the abutting monorail beams but with openings in the lower flanges and webs through which the trolleys may pass. On the bottom flange at the entering end is a shallow lug which engages a movable pin on the trolley at the will of the operator. When the trolley approaches the junction without engagement of the pin and lug the trolley keeps on straight through the junction, but when the operator pulls a handle engaging the pin with the lug the trolley is deflected to the right or left as the case may be on to the curved track. These junctions are made of malleable iron reinforced with steel plate top and when once adjusted properly will remain so permanently. The track supports are spaced so that very little bending is resisted by the junctions. The trolleys are of standard four wheel articulated design with large, ball bearing wheels, altered as to length so that the center distance of two trolleys when as close together as possible will not exceed 14". A small number of trolleys carry small electric hoists which were found after much search. These hoists have a capacity of 2000 lbs., weigh only 125 lbs., and take up very little head room. The balance of the trolleys used carry only a special double hook as shown on Sketch 1-10-29B. The hide rack has at its center a special double eye steel bail which is also shown on Sketch 1-10-29B, and when being lifted by the electric hoist the upper loop of the bail is used; when the rack has reached the upper limit of its travel one hook of the double hook is engaged in the lower loop and the electric hoist lowered away until the rack is swung over the distance of 14" until it centers under the adjacent trolley. The trolley and electric hoist are then free to handle another rack and the rack just lifted is pushed away to its destination. Each hoist carries a length of rubber covered triple conductor cable with a plug on its end for plugging into sockets located on each post. One man can handle the racks, and the operation of loading and unloading the racks is much easier than the old method of throwing the hides on cars. Two manual handlings now instead of at least six before effects considerable labor saving and the mechanical handlings almost entirely remove the disagreeable phase of this work. One expert is sufficient and the rest may be common laborers of usual strength and ability. The cost of maintenance is confined to an occasional overhaul for the hoists and the regular lubrication of the trolleys. Speed is not a requisite in this department and the number of vats is sufficient to keep busy the minimum number of men which would in any case be required to man the system, thus giving a very efficient installation.

The monorail system has the inherent advantage of easy expansion as evidenced by the fact that the tracks shown on Sketch 2-4-29B had not been in use more than a few months when it appeared that a small extension enabled another operation to be greatly simplified.

## 8 - DESCRIPTION ON SPECIAL ELECTRIC OVERHEAD TRAVELING CRANE AND TRANSFER SYSTEM AND ITSAPPLICATION:

Many departments could not be equipped with the Monorail System for several reasons, some of which have been mentioned. For instance, in most cases the ceiling beams were already loaded to their limit as floor beams of the second floor. In most cases the capacity of a Monorail System would not be large enough. To meet the situation in a complete manner required the use of electric traveling cranes and the idea was conceived of equipping every longitudinal bay with crane runway rails; installing a transfer bridge on runway rails in a transverse bay, and use only one crane. A complete installation of this nature was made in the one and only department where the headroom was sufficient to permit the use of standard crane equipment obtainable on the market. It was necessary, however, to alter the crane trolley design somewhat to obtain a four suspension head beam lifting rig for carrying the large six ton rack by its four corners. It was also necessary to carefully design the crane bridge for an absolutely minimum headroom dimension. This installation is shown on Ph A where the crane is in the background and the transfer is in the foreground. The transferring of the crane from one bay to another was new because so far as is know this is the first installation of its kind. The transferring of monorail cranes on which the trolley travels on an underslung beam is very common practice and it seemed entirely feasible to adapt the same principles to the design of a transfer which would carry a standard double girder crane having its trolley traveling on the top of the bridge girders.

It will be evident that the transfer must have tracks of some sort to run on and that as the electric traveling crane passes on or off the transfer beams it must clear these tracks. It is equally obvious that the transfer tracks must be as close to the ceiling as possible with the electric traveling crane passing under them in order to minimize the head room required. Two heavy I-bems were used fastened directly to the ceiling and on the lower flanges 20 lb. tee rails were bolted, on which the transfer bridge wheels travelled. This would be designated therefore as an underslung birdge. Half of the wheels are driven by a 7½ HP motor. The structure is designed with two longitudinal beams carrying rails and matching exactly with the runway bemas in the several bays. Clearance is provided for the electric traveling crane to travel clear across the transfer. In other words when the transfer is locked in place opposite any crane runway it forms an integral part of the runway. Two sets of current collectors are provided on the electric traveling crane bridge to avoid interruption of the travel motor circuit when crossing the gaps. The safety features consist of two things; the transfer travel controller is so placed that it can be reached by the operator, who rides in a cab on the electric traveling crane, only when the electric traveling crane is in proper position on the transfer; an interlocked locking arrangement on the transfer locks the crane to the transfer and unlocks the transfer from the building, or vice versa. Only one lever performs these operations and it can be reached only when the electric traveling crane is in proper position. It is therefore impossible for the crane to run off an open runway or for the transfer to be moved without carrying the crane. Actual operation has checked the original design of these features thoroughly.

A second installation of the crane system was then made in a department with somewhat less head-room and several changes were necessary or advisable on account of the different conditions. In this case there was a transverse ridge in the roof providing ample clearance in one transverse bay for the transfer, but at other places the clearances were very restricted. It was decided therefore that the transfer should run on two ordinary runway beams instead of being underslung, and that the hoist would be built into the bridge of the electric traveling crane between the girders, thus saving about a foot of room and permitting the crane to run under the low eaves of the building. This installation likewise proved exceptionally satisfactory in service.

In both Case 1 and Case 2, described above, of the Crane System, it was necessary to rebuild the vats to suit the cranes and when it came to studying the other departments of the plant it was found that such rebuilding would be prohibitive. Furthermore in both of these cases the available head room was greater than elsewhere in the plant where cranes might be installed, and a decision was made to try and design a crane transfer system which would go into about 3 feet head room and which would not require any vat changes except as certain ones might have to be altered to suit a standard size of rack. It must not require too much special construction for the installing of crane and transfer runways. Absolutely nothing in the way of complete standard equipment could be found, so design drawings were made which will now be explained. One very important consideration which had to be faced was the difficulty that might be encountered in having very special crane equipment built by the usual makers, especially in busy times. It is generally found that the work is either refused entirely or else a very fancy price charged. To overcome this the design must be such that parts could be obtained from standard sources and the equipment assembled in a jobbing shop or in the tannery's own shop, if necessary.

h - SOLUTION OF PROBLEMS MET WITH IN DESIGN OF CRANE TRANSFER SYSTEM:

Referring to SK-6-8-29A, showing the design of Crane adopted, the following assumptions were made, based on previous experience with Case 1 and Case 2 installations:

Capacity on four ropes - 6 tons

Span - Variable but usually about 20'

Hoisting Speed ± 23½ FPM

Crane Travel Speed ± 250 FPM

Lift - max. 20'

Rack size - Variable but approximately 7' x 10'

Current - 110 volts, direct.

The frame of the crane consists of simple shapes riveted or welded together and great rigidity laterally is provided by the $\frac{1}{4}$" plating on underside of main channels. The standard mechanical parts are simple and may be assembled to suit the crane dimensions required. Considering the hoist mechanism first, the component parts consist of the motor with motor-mounted solenoid brake, direct connected to a speed reducer; two rope drums on the slow speed shaft of the reducer; idler sheaves for two of the suspension ropes; and the controller having dynamic braking lowering connections. After considerable search for a speed reducer that would have a maximum reduction of 80 to 1; that is completely ball or roller bearing; and that would not be more than 18" in height; with input and output shafts in the same horizontal plane; it was found that the specifications could not be met by any of the hundred or more reducers on the market. That the specifications are not too difficult to accomplish is indicated by the very simple design that was developed and which is shown on SK-5-11-29A. Its depth overall is 16-1/8" and the maximum gear ration is 80 - 1. It will transmit 10 HP with a Factor of Safety of at least five and its efficiency may be assumed to be over 95%. It may be described as a straight spur gear reducer with four pairs of heat treated steel gears mounted on three shafts, two of which carry quills; each gear with its neighboring pinion is carried between two roller or ball bearings; the two halves of the cast iron case are exactly duplicate; all joints are protected by gaskets against oil leakage, so that lubrication is by oil bath and need be attended to only once or twice a year. One respect in which this hoist mechanism differs from the usual designs is that the drum shafts and gears are proportioned to carry full load directly from the drum instead of reducing the load by multiplying the number of strands of rope supporting the load. This saves head room but requires that all the speed ratio be secured in the gearing, and it increases all stresses in the parts.

The load of 6 tons is to be carried on 4 strands of rope but more than half load may be carried on 2 strands so the size selected is 9/16" diameter, 6 x 9 best plow steel, which is good for $2\frac{1}{2}$ tons at a Factor of Safety of $\frac{12\frac{1}{2}}{2\frac{1}{2}} = 5$. The drum diameter should be about 24 times the rope diameter or $13\frac{1}{2}$", but 12" was chosen as the pitch diameter because of the restricted room. The gear ratio is therefore

$$\frac{600 \text{ (F.L. Motor.Speed)} \times 3.1416' \text{ (drum circum)}}{23\frac{1}{2} \text{ (F.L. Hoisting Speed)}} = \pm 80$$

The gears in the speed reducer will be

$$\frac{12\text{-}2/3}{5\text{-}1/3} \times \frac{13\frac{3}{4}}{4\frac{1}{4}} \times \frac{13\frac{3}{4}}{4\frac{1}{4}} \times \frac{13\frac{3}{4}}{4\frac{1}{4}} = 80 \text{ reduction}$$

Although it is specified that two strands of rope shall be able to carry full load, the usual method of suspension will be one rope to each corner or near the corner, of the hide rack. If there are two rows of vats in a bay a head beam may be used with the 4 hoisting ropes attached to it at convenient points, and with the rack carried from the headbeam by means of hooks as shown on SK 5-9-29A and SK 6-8-29A. The hooks are adjustable on the beams and will hook into the bails on racks by moving the crane bridge forward. When headbeams are not used simple angle spacers are used between the four hooks to hold them in alignment because in no case is it necessary to use a ground man for hooking the load. In some cases automatic self-locking hooks are used which enter the bail and lock securely by simply moving the bridge forward, and vice versa. Racks of any size within the span and capacity of the crane may be handled by this arrangement and racks may be moved transversely within the crane bays by making use of the transfer to be described later. The hoist motor horsepower equals

$$\frac{12000 \times 23.5}{33000 \times .875} = 10$$

For the sake of standardization of parts all bearings on the crane outside of the speed reducers are exactly the same; the bridge axles and the drum shaft are the same diameter; and the speed reducers are the same except that the bridge reducer has only two pairs of gears with a reduction of $7\frac{3}{4}$, arrived at by the use of gears as follows: $\frac{12\text{-}2/3}{5\text{-}1/3} \times \frac{13\frac{3}{4}}{4\frac{1}{4}} = 7\frac{3}{4}$. By using a 230 volt motor on the 110 volt crane circuit the gear ratio can be obtained more easily; and with 12" diameter wheels this ratio will be:

$$\frac{638\ (\text{F.L. motor speed}) \times 3.1416\ (\text{circum. of wheels})}{250\ (\text{F.L. travel speed})} = 8$$

A full torque solenoid brake is mounted on the hoist motor to hold the load when stationary and suspended, and a half torque brake is mounted on the bridge travel motor to decelerate the crane and hold it when stationary.

The simple design of a standardized bearing is shown on SK 5-13-29A. The very much greater cost of roller bearings on the 2-15/16" shafts resulted in a decision to use babbitted bearings outside of the speed reducers with low bearing pressure and Alemite pressure lubrication. It is to be noted that the weight of crane and load is hung on the bearings, calling for extra large bearing bolts.

The idler sheave pins and the idler wheel pins are of the same size and the method of mounting both is very flexible as to location. The wheel assembly construction used is such that the driving wheels are overhung while the idler wheels are of standard pin type, and the greatest dimension from center of runway rails to face of posts is $2\frac{1}{4}$, which with $\frac{3}{4}$" minimum clearance gives 3" from centre of rails to face of posts. The total height of the crane above the runway rails is 15". Both of these dimensions are exceptionally small for a 6 ton crane, especially so in view of the very rugged and rigid design. A narrow stand-up type of suspended operator's cab close to the floor permits the operator to step in and out easily. The two controllers for hoist and bridge travel are mounted in the cab over the operator's head with handles hanging downward.

The assembling of the various units in this design in the tannery's own shop is a comparatively easy matter, assisted by the use of flexible couplings between the motors and the speed reducers. All material outside of the speed reducers, drums and bearings, which are special, is easily procured from known sources and a few of the special parts are carried in stock, which means that cranes can be built at any time without special drawings and in record time.

Referring to SK 6-13-29A this design drawing shows the type of transfer adopted for installations where the dimension from floor to ceiling is only 9 feet, embodying the same principal of carrying the crane bodily as described for Cases 1 and 2, but differing in design and clearances.

The clearance over the crane just described when traveling along the longitudinal crane bays is 3", i.e., there is a distance of 3" from the highest point of crane to the lowest point of the ceiling. The transfer operates in a transverse bay where the ceiling is 4" higher than in the longitudinal bays, and the problem was to put the rails for carrying the transfer into this dimension of 4" plus 3", or 7". With any standard construction at least a 15" beam would be required and some clearance in addition, probably 18" in all. This problem was solved by doing two things: making an open ended transfer, and using a swinging transfer runway beam adjacent to the crane tracks. For such a scheme the transfer must be installed in an end bay because the crane cannot run onto both sides of it. The transfer runway track next to the end of the building is of usual I-beam construction surmounted by Tee rail, while the track at the entrance side of the transfer consists of lengths of 18" heavy ship channels with a Tee rail fastened to the inside of the lower flange. Opposite each crane bay is a swinging section of this track suspended by means of specially designed strap hinges from the wood ceiling beams; between the swinging sections are short fixed sections. The transfer end truck on the wall side is of usual construction and the same as the crane end trucks, but at the entrance or open gap side there are two trucks, each with a double flanged wheel running on the channel track Tee rail and with a plain tread wheel running on the under side of the ship channel; the section of beam corresponding to the crane runway tracks, which is carried by the transfer, is thus cantilevered on these two trucks, permitting the crane to pass on to the transfer by swinging the section of transfer track out of its way. This is done by two deflector bars on the crane, one on each end. Only the one section opposite the crane bay in which the crane is traveling swings and the transfer cantilever trucks are carried by the adjoining sections. Horizontal alignment is preserved by the fixed transfer track on the wall side and the transfer is locked on this side. The transfer travel controller and the locking mechanism are both located exactly as described for Cases 1 and 2 transfers. The travel motor, speed reducer, axles and wheels are the same as on the crane. The idler wheels, however, are overhung and carried on long squaring axles the same as the driving wheels in order to assist in keeping the transfer structure from getting out of line.

The crane operators become very expert in spotting the transfer, and the transferring of racks of hide from bay to bay is done very quickly and smoothly. There are no complications in the machinery; the maintenance required is confined to daily greasing of a few bearings and an occasional inspection; and one crane with its transfer will cover every square foot of vat space in the building. Furthermore, the initial cost is less than that of standard crane equipment, instead of greater as would usually be the case with specially built equipment.

CONCLUSION:

It has been the intention in this paper, not to set forth the comparatively simple calculations necessary for the design or proper proportioning of parts of the equipment, but to indicate by examples of what has actually been done, how important it is for an engineer when faced with problems, whether usual or unusual, to approach his problem with an open mind and with the exercise of as much imagination and ingenuity as he is capable of. It is wise to assume that it is usually quite possible to perform the impossible when the impossible is simply something that has not been done before. Use has been made of the design drawings and not working drawings for illustration.

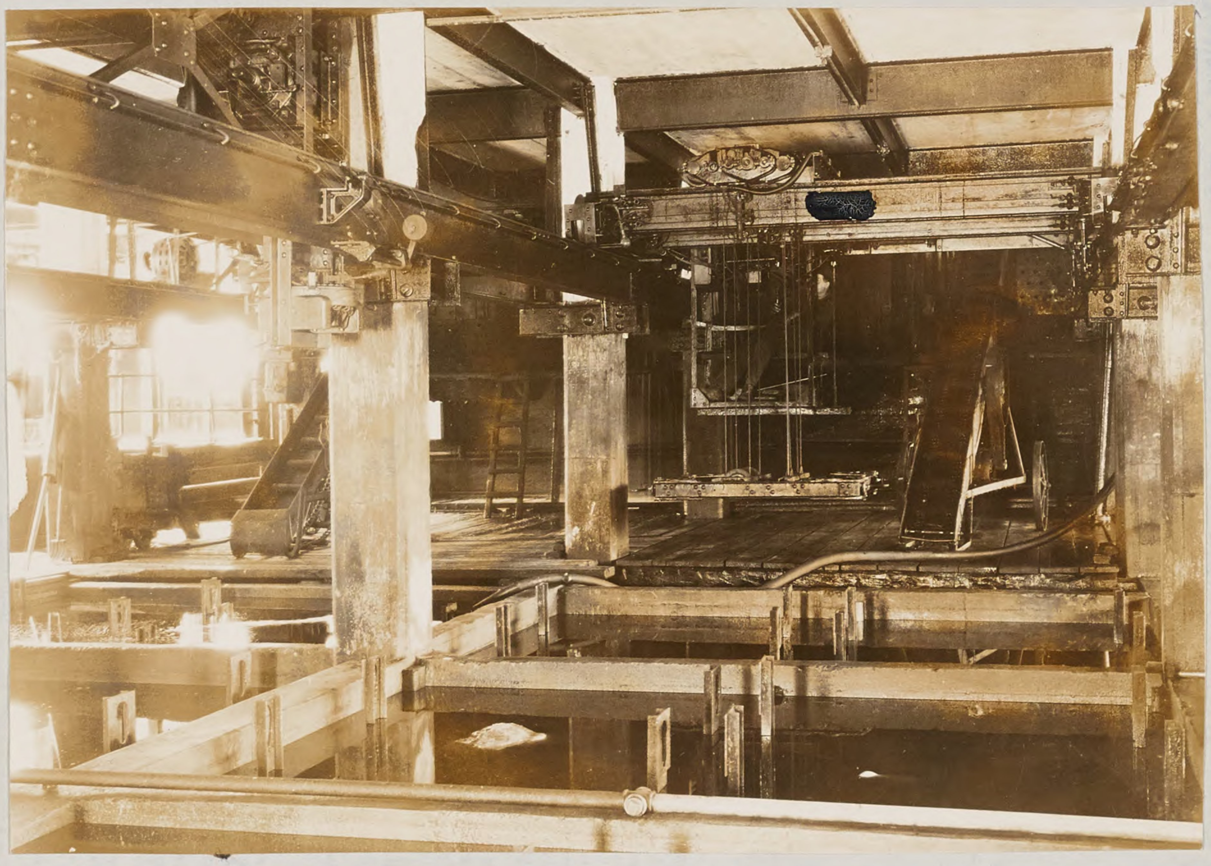
Pocket has: 9 objects

CSK = 8

Photo = 1

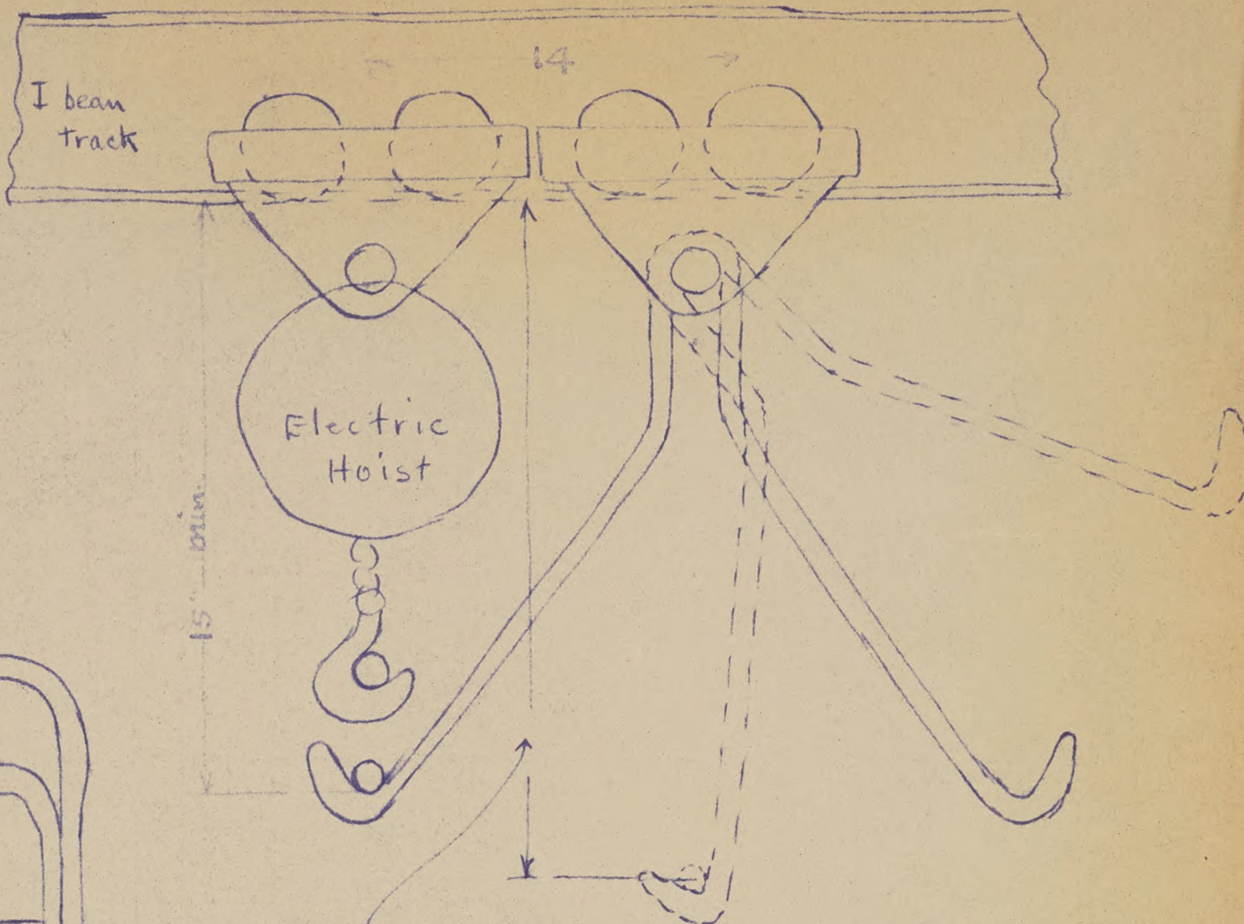
9

[redacted]

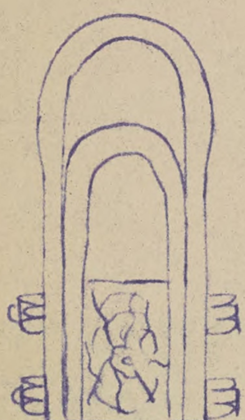


TRANSFER CRANE - CASE 1.

PH. A.




This dimension will be about 5" more than the minimum beam to hook dimension of hoist.



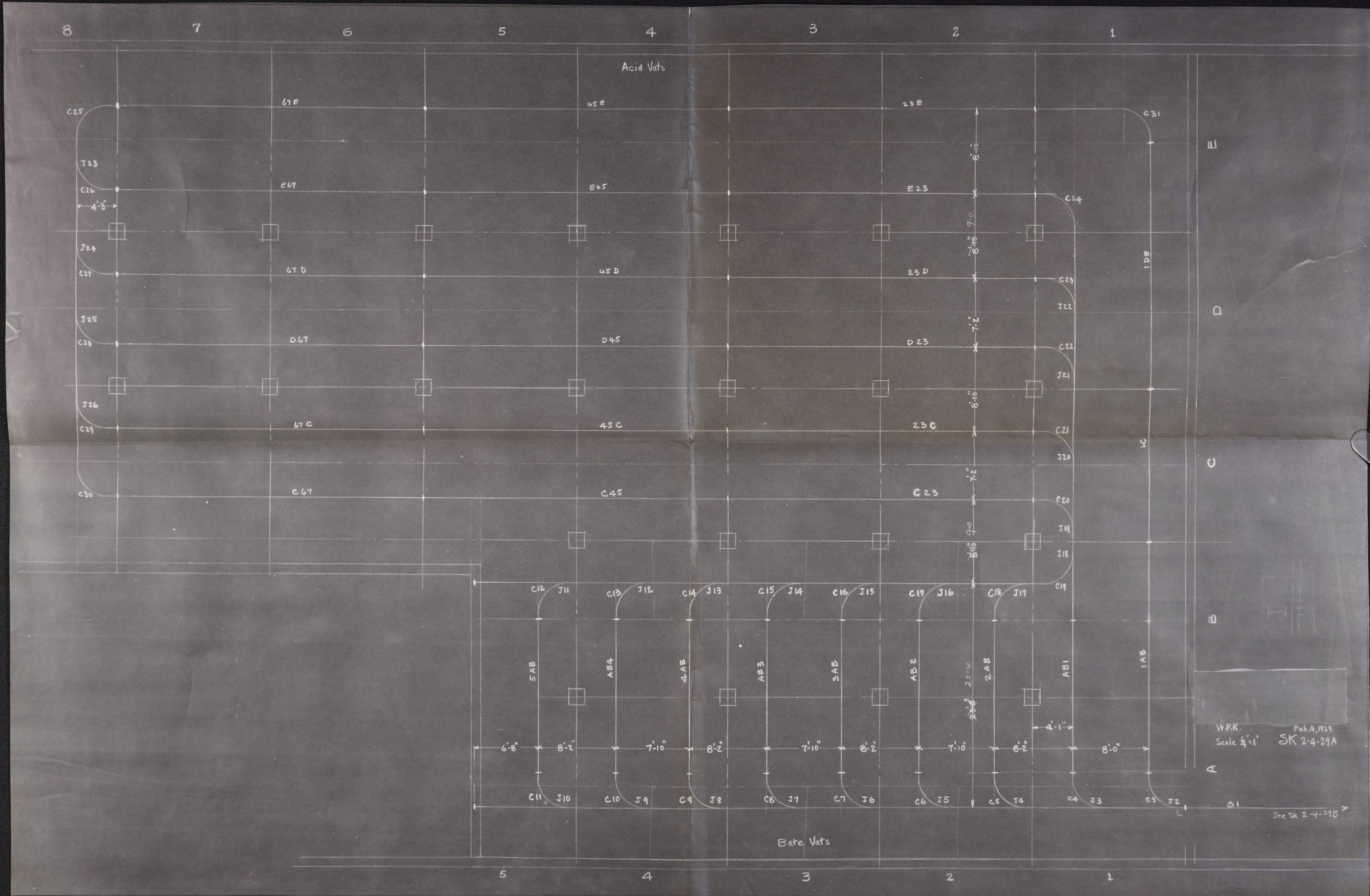
Double hook eyes on hide racks.

Note! If hook eyes are made large enough the hangers will engage automatically. Electric hoist hook is disengaged by lowering. Load must be transferred from hanger to hoist by hooking hoist hook in hook upper eye by hand.

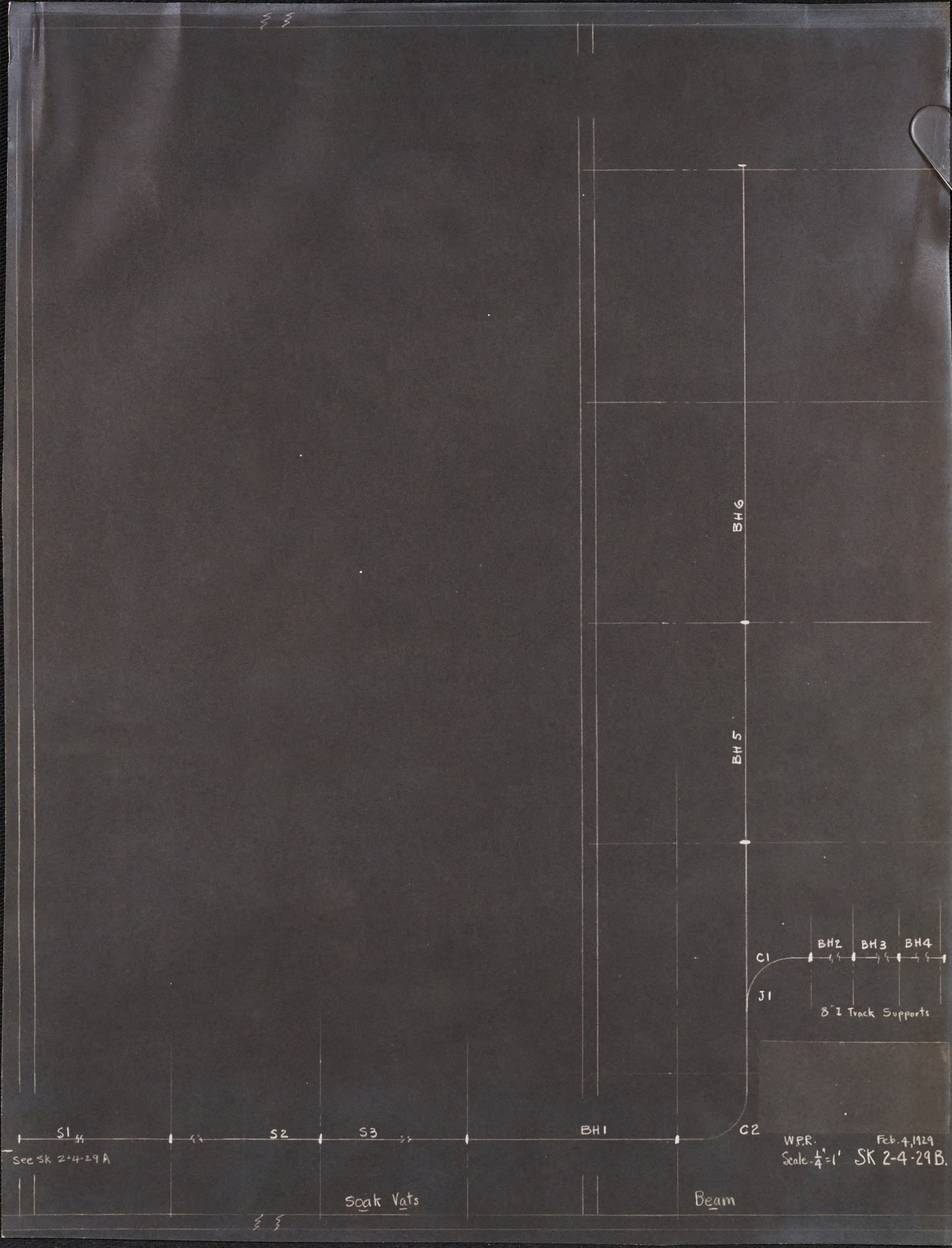
[redacted]

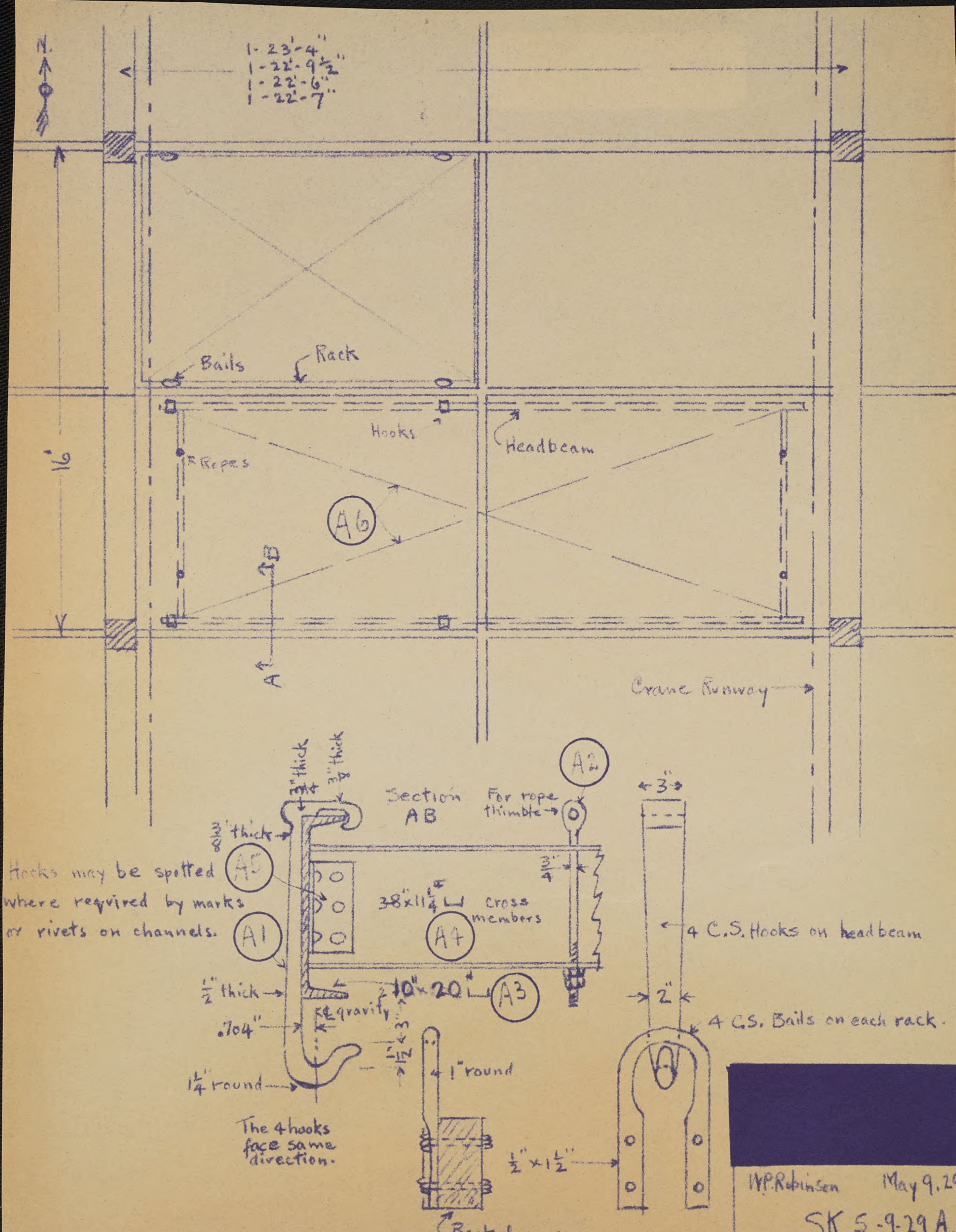
W.P. Robinson    Jan. 10, 1929

SK. 1-10-29 B.



Acid Vats
Bate Vats
8 7 6 5 4 3 2 1
E D C B A
67E 45E 23E
E67 E45 E23
67D 45D 23D
D67 D45 D23
67C 45C 23C
C67 C45 C23
1DE
1AB
AB1 2AB AB2 3AB AB3 4AB AB4 5AB
4'-3"
4'-1"
6'-8" 8'-2" 7'-10" 8'-2" 7'-10" 8'-2" 7'-10" 8'-2" 8'-0"
W.P.R.
Scale 1/4"=1'
Feb 4, 1929
SK 2-4-29A
See Sk 2-4-29B

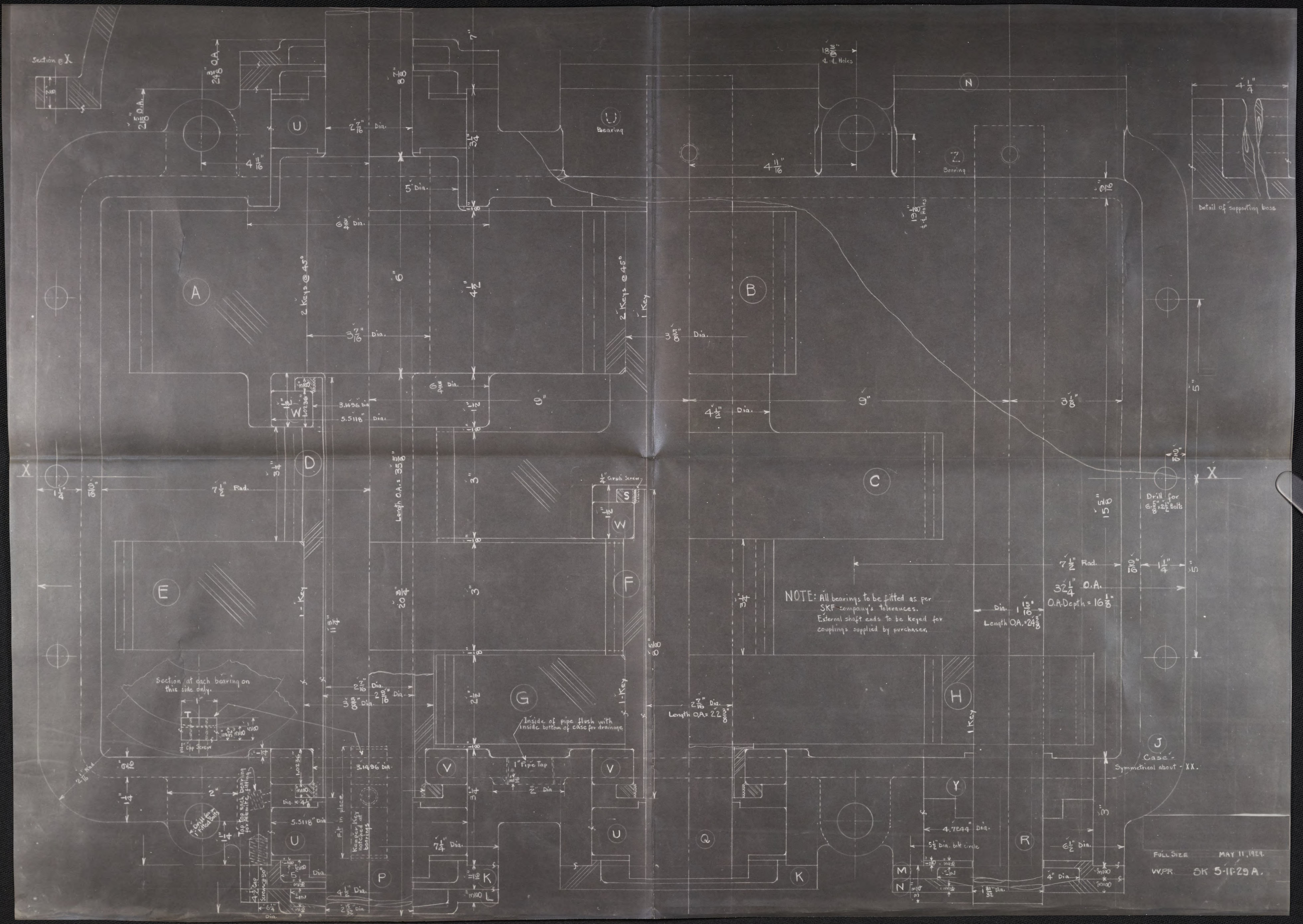

BH6
BH5
BH2
BH3
BH4
C1
J1
8" I Track Supports
S1
S2
S3
BH1
C2
See SK 2-4-29 A
W.P.R.
Feb. 4, 1929
Scale-1/4"=1'
SK 2-4-29B.
Soak Vats
Beam



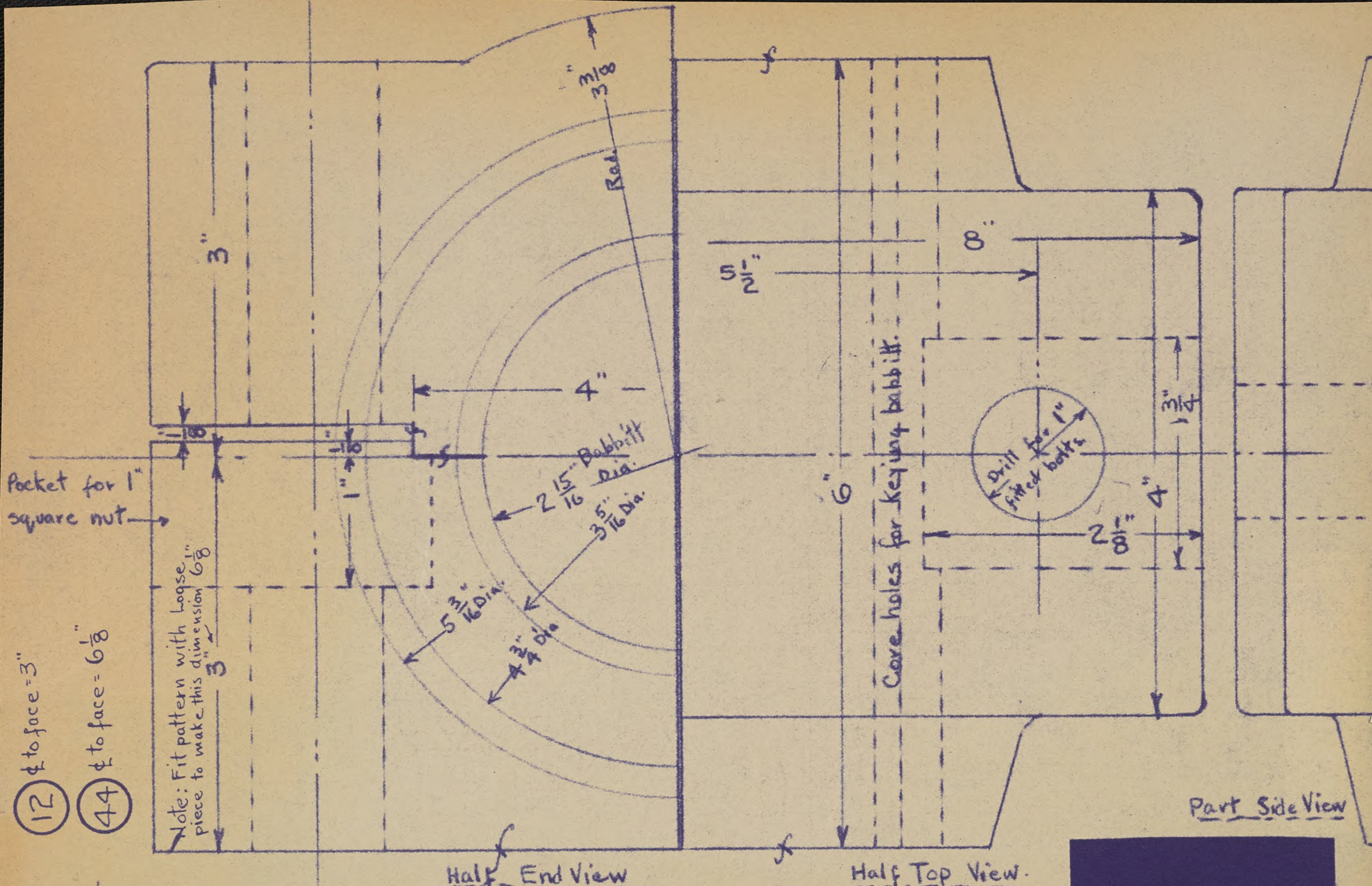

[redacted]

W.P. Robinson May 9.29

SK 5-9-29 A.



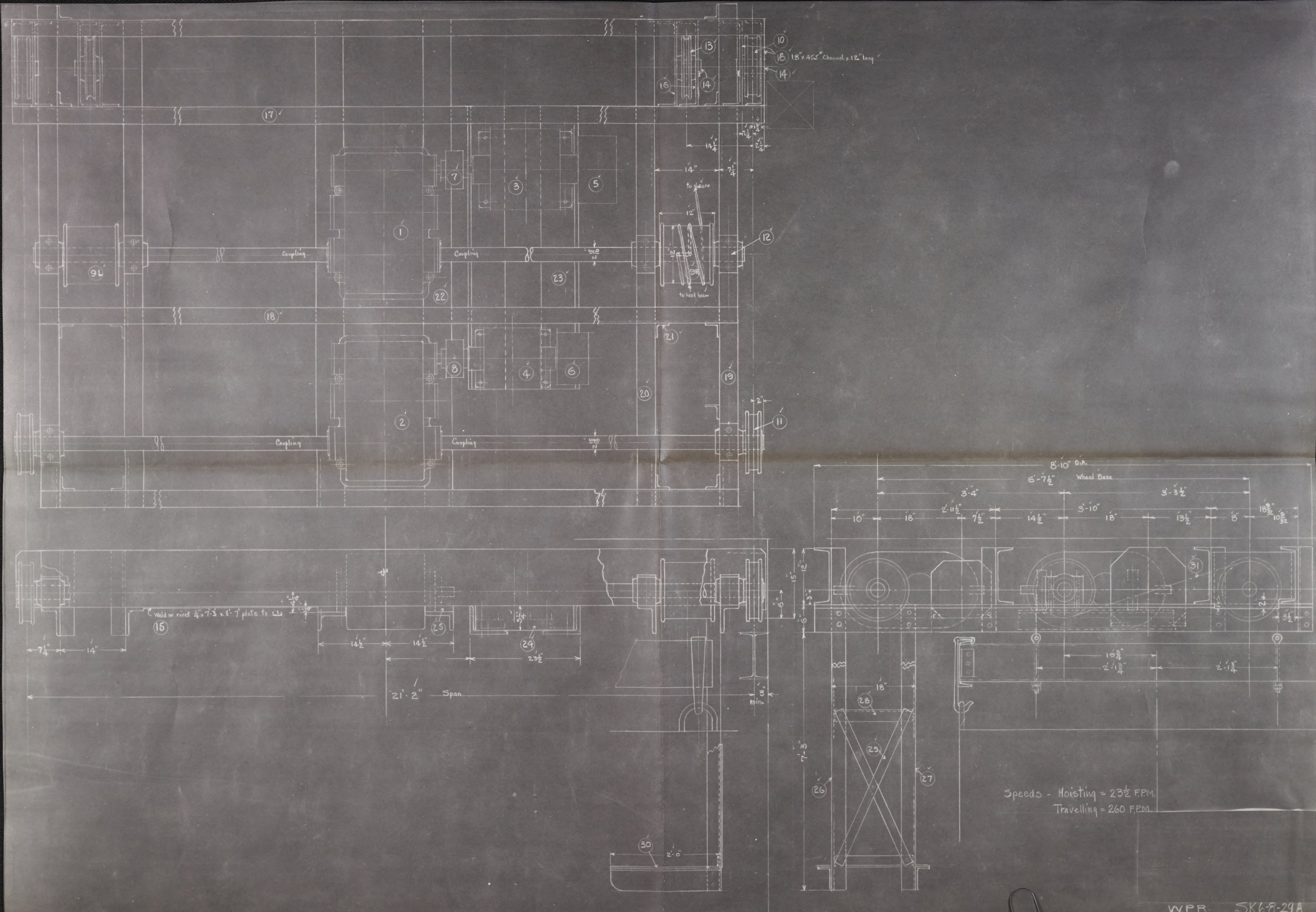
Section @ X
Bearing
Detail of supporting boss
Drill for 5/8" x 2 1/2" Bolts
Section at each bearing on this side only.
Cap Screw
Inside of pipe flush with inside bottom of case for drainage
1" Pipe Tap
Fit in place
Keeper Key outside of bearings
Tap top each bearing for Alemite fitting
Drill for Fitted Bolts
NOTE: All bearings to be fitted as per SKF company's tolerances.
External shaft ends to be keyed for couplings supplied by purchaser.
7 1/2" Rad.
32 1/4" O.A.
O.A. Depth = 16 1/8"
Length O.A. = 24 3/8"
Length O.A. = 35 5/16
Length O.A. = 22 3/8"
Case - Symmetrical about - XX.
Full Size
May 11, 1929.
W.P.R.
SK 5-11-29 A.



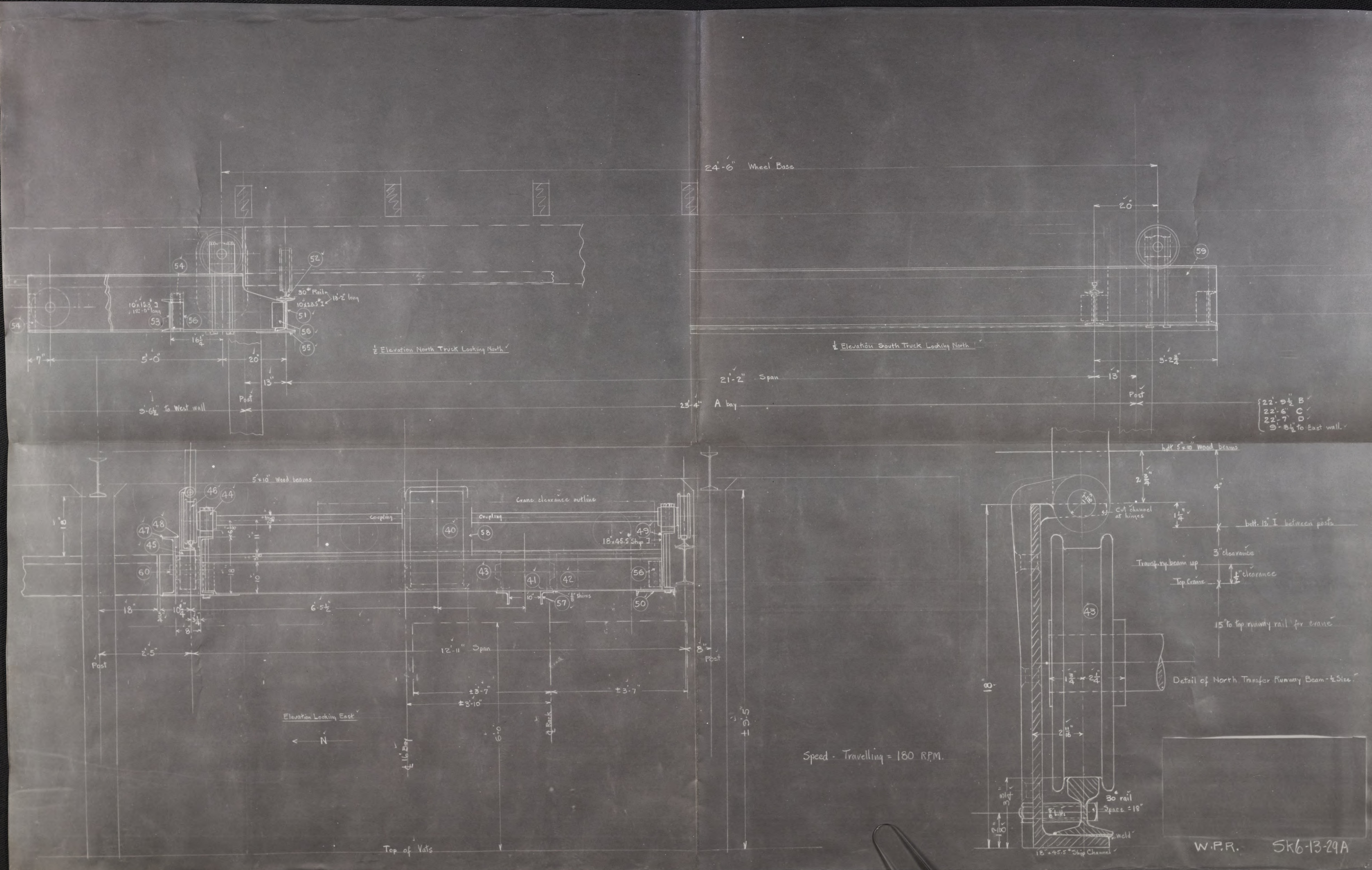

Note! Drill & tap for Alemite bayonet fitting, and groove bearing on side opposite pressure. Use only best grade babbitt.

[redacted]

SK 5-13-29A.



18" x 45.5" Channel x 12" long
to sheave
to head beam
Coupling
Coupling
Coupling
Coupling
Weld or rivet 3/4" x 7'-3" x 8'-7" plate to
21'-2" Span
8'-10" O.A.
6'-7 1/2" Wheel Base
Speeds - Hoisting = 23 1/2 F.P.M.
Travelling = 260 F.P.M.
W.P.R.
SK6-8-29A


24'-6" Wheel Base
½ Elevation North Truck Looking North
½ Elevation South Truck Looking North
30# Rail
10" x 28.5# I 13'-2" long
10 x 15¼ I 12'-0" long
21'-2" Span
23'-4" A bay
9'-6½" To West wall
Post
22'-9½" B
22'-6" C
22'-7" D
9'-8½" To East wall
5" x 10" Wood beams
Crane clearance outline
Coupling
18 x 45.5 Ship I
Shims
12'-11" Span
Elevation Looking East
N
Top of Vats
℄ 16 Bay
℄ Rack
Speed - Travelling = 180 RPM.
bott. 5 x 10 Wood beams
Cut channel at hinges
bott. 15" I between posts
3" clearance
Transfer beam up
Top Crane
½" clearance
15 to top runway rail for crane
Detail of North Transfer Runway Beam - ½ Size.
30# rail
Space = 18"
weld
18" x 45.5# Ship Channel
W.P.R.
SK6-13-29A