UNIT COSTS AND TIME LABOR UNITS IN REINFORCED CONCRETE MILL BUILDING CONSTRUCTION

Thesis for the Degree of C. E.

Frederick William Trezise

1928

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IN

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THESIS

Outline

Subject:

UNIT COSTS and TIME LABOR UNITS IN CONCRETE MILL BUILDING CONSTRUCTION.

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B. Unusual conditions

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2. Barge

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2. Excavating

3. Concreting

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b. Placing

c. Steel fabrications, etc.

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III.

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3. Time labor units

4. Cost per cu. yd.

III. (cont'd)

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B. Bibliography and acknowledgements.

A study of the Unit Costs and Time Labor Units in Reinforced Concrete Mill Building Construction.

The type of building discussed in this study is a reinforced concrete three and four story mill for the Riverside Fibre and Paper Company at Appleton, Wisconsin. This building as indicated in the accompanying plans and elevations is to be used in conjunction with the sulphite pulp mill of this company. The integral parts of the building as noted on the prints are: 1st. the four story stock building where the pulp stock is prepared for the two paper machines which are contained in (2nd) the basement and double story machine room; the paper is then carried by suspended trolley to the (3rd) finishing building. This latter section is two stories in height. The paper is received on the second floor where it is calendered, supercalendered, cut and prepared for packing. It is then transferred by elevator to the first floor where it is packed for shipment. A Jas. Lefell and Co. turbine utilizing a 13.7 foot head of water between the U.S. Government Canal and the S. channel of the Fox River, owned by the Riverside Fibre and Paper Co. was also installed on this floor. The forming, reinforcing and concreting of this waterwheel is also included in this study.

The building was constructed on the site of a furniture factory which was destroyed by fire some years previous. Reference to the various photographs will indicate more definitely the site conditions. It was necessary to drive 310 feet of sheet piling in a cofferdam in order to set the piers under the north side of the building in the South Channel of the Fox River. The south side of of the building borders the U.S. Government Canal which, with the series of locks in the city of Appleton furnishes water transportation around the various power dams of the city. This canal and the

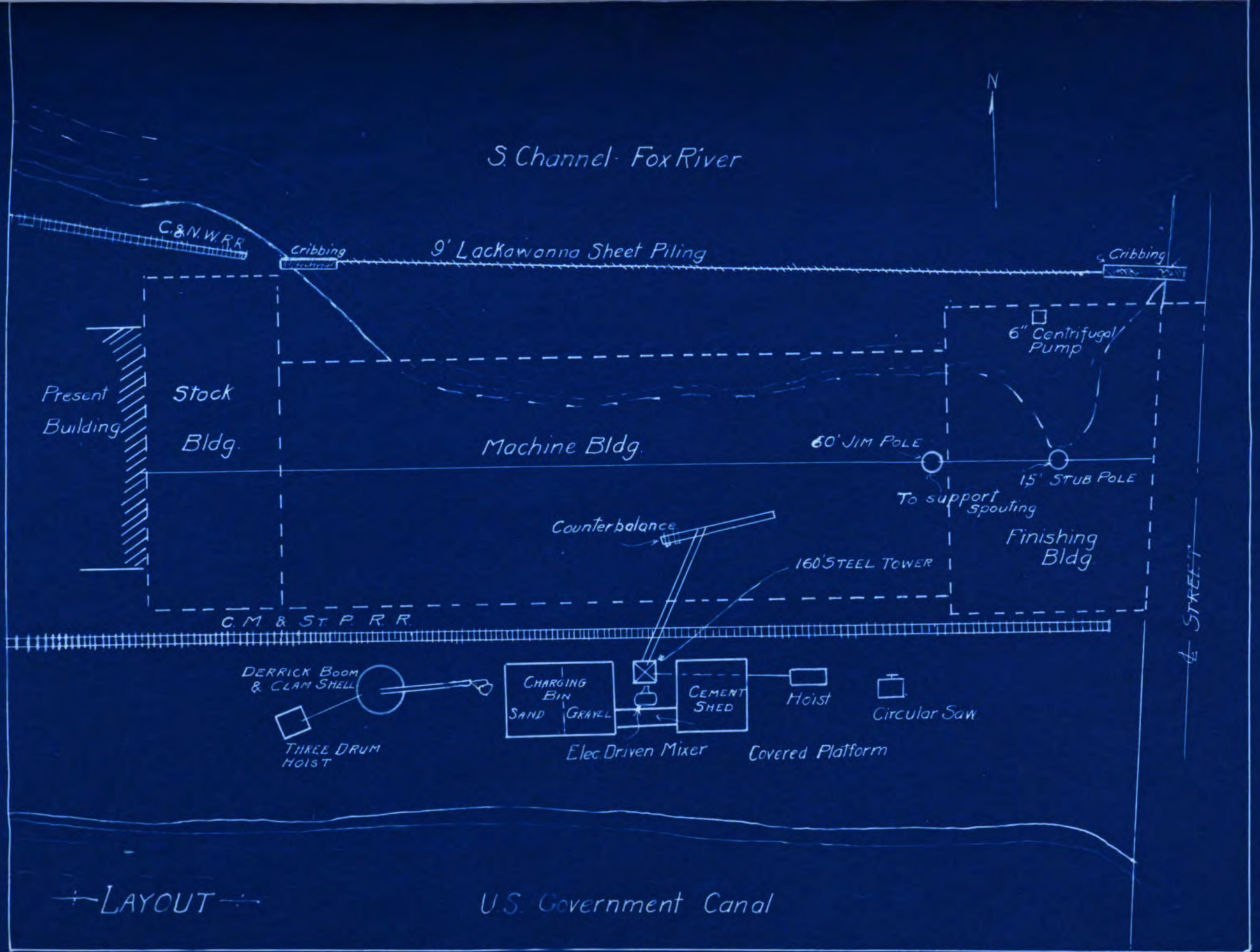
railroad spur between it and the building, which had been used by the Riverside Company for the transportation of pulp and manufacturing materials served admirably the needs of the contractor for the transportation of equipment and materials. The concrete materials were brought to the site by railroad entirely and unloaded directly. Barge service on the canal was used to a considerable extent for the transportation of equipment, form lumber and machinery.

Types of equipment

Lackawanna sheet piling was delivered to the site in 18 ft. lengths which were cut by oxy-hydrogen into 9 ft. lengths. Cribs were constructed at each end of the cofferdam because of the impracticability of driving the sheeting at these points. The piling was driven into hardpan 3 to 4 feet by a steam hammer suspended from a breast derrick. Five men worked five and a half days to complete the driving of this 310 feet of piling. A steam driven 6 inch centrifugal pump operated for about five minutes each hour was sufficient to maintain dry working conditions within the inclosure against a four foot water head.

The excavation for the entire substructure was by hand, using pick and shovel. Footings for the columns and piers were set on hard pan and bed rock. Most of the material removed was red clay although this was overlaid with the ruins of the former mill which occupied the site.

Reference to the various photographs of the operations will indicate the type of concreting material. Because of the nature of the clay it was deemed unnecessary to use forms in the wall footings. The areas being placed with concrete were kept reasonably dry by means of sump and trench pumps, operated by gas engines. The


N
S. Channel - Fox River
C. & N. W. R. R.
Cribbing
9' Lackawanna Sheet Piling
Cribbing
6" Centrifugal Pump
Present Building
Stock Bldg.
Machine Bldg.
60' Jim Pole
15' Stub Pole
To support Spouting
Finishing Bldg.
Counterbalance
160' Steel Tower
C. M. & St. P. R. R.
Derrick Boom & Clam Shell
Three Drum Hoist
Charging Bin
Sand
Gravel
Cement Shed
Hoist
Circular Saw
Elec. Driven Mixer
Covered Platform
U.S. Government Canal

LAYOUT

spread footings of all piers and columns were formed with two inch material. The foundation wall forms were of hemlock with 2 x 4 verticals or studding. These were reinforced with 4 x 4 horizontal headers. Wood spreaders and wire ties were used to maintain wall widths. The outside dimensions of the majority of the colums were the same, 2" planking could be re-used for the side panels to be fastened together with patent clamps. The forms for the exterior of the building were in the panel form, to be re-used as the work progressed by raising. The pilaster and curtain wall dimensions were uniform throughout the entire building. The photographs taken during the work show very well the method of forming and re-using the panel types which were constructed on the site.

Concreting. A 160 ft. Insley steel tower assembled on the site was the basis for the proper distribution and placing of the concrete. The plan of the entire construction layout indicates the relative positions of the various units. A half cubic yard Ransome mixer electric driven, was so set in the base of the tower to receive the concrete aggregates directly from the charging bin which contained approximately 200 cubic yards. This charging bin was filled directly from railroad gondolas, by a derrick and clam-shell bucket. Steam was furnished for this unloading and hoisting by the owner. Photographs accompanying this work show very well, I believe, the manner of distributing the concrete from the tower landing platform. The spouting was of necessity supported at various points and counterbalanced properly for even flow under a load.

Reinforcing. The reinforcing steel for the construction was fabricated by the manufacturer. However, because of the difficulty of properly setting numbered rods, the three way reinforcing for the flat slab

floors was cut and bent by the contractor on the job.

Progress of the Work

Daily Progress Record. A daily progress record of the entire construction was started July 16th 1923. This record incorporated various details and phases of the construction for each day, - the division of labor, amount of work accomplished and labor charges to each of the various construction accounts. These entires, together with the wages of the labor groups, served as a basis for the data from which the results of this study were derived. Current progress charts constructed and referred to during the work showing the percentage completed to date was very valuable in determining the estimates for the payments to the contractor.

Incidently, these entries and data proved very valuable in forecasting the needs of material and labor during the construction. Relative requirements could be anticipated much more readily after the labor and progress had been correlated. Material requirements could better be delivered to the site with minimum delay and expense. This can be noted particularly in the requirements for the various aggregates for concrete with the charging bin of 200 cubic yards, capacity and daily runs amounting to over 250 cubic yards of concrete.

Photographic Record. The photographs accompanying and referred to in this study are selected from those taken during the progress of the work. These were exhibited at frequent intervals during the construction period and resulted in a strong personal interest in the work.

Construction Unit Costs and Time Labor Units.

The study of the construction costs and time labor units for the work is considered in the chronological sequence as nearly as possible.

Excavating. The type of material excavated determines largely the cost and time required. As indicated above this material was for the most part stiff clay. The method used was 'pick and shovel'. It was necessary to use trench pumps in this work to control the water seepage and the labor charges for the care of these pumps is included in the cost items.

Cost was determined in dollars per cu. yd., both for excavation and backfill. This cost is graphically shown on Graph #1. Variations in cost show a minimum of $1.34 per cu. yd. to a maximum of $2.47 per cu. yd. The latter period, the week of August 20th, was during the excavation of the piers in the machine room where the work was confined to a single pit the size of the pier footings and where two handlings of the excavated material was necessary. The minimum charges for excavated material transferred is indicated at the time of backfilling where the cost is $1.40 and $1.34 per cu. yd.

Relative unit costs are of little value to other operations of this nature unless one can establish a ratio between the labor charges. Common labor was paid 40¢ per hour. Gang bosses received 55¢ and mechanics 80¢ per hour.

A study of the amount of work accomplished by each man per hour will furnish more valuable data upon which to base charges and estimates under similar circumstances. These units will vary inversely as the unit cost. A man according to the data compiled will excavate .258 to . 284 cu. yds. per hour.with one handling. Double handling reduces this yardage to .173. Backfilling is less expensive as indicated at .311 to .358 cu. yds. per hour. The average man transferred material on this job at the rate of .283 cu. yds. per hour and the cost per cu. yd. was $1.66.

As noted by Mr. Gillette, there is no phase in construction work which involves so many varying factors as excavation. The Handbook of Construction Cost by Mr. H. P. Gillette gives 3.8 cu. yards per ten hours per man in wet clay and 3.5 cu. yards in hard pan. These figures are based on an emperical formula.

Cu. Yds. per 10 hours equals

$$\frac{70}{.5 \text{ plus } .3(1.3) \text{ height in ft.}} \quad \text{in wet clay and}$$

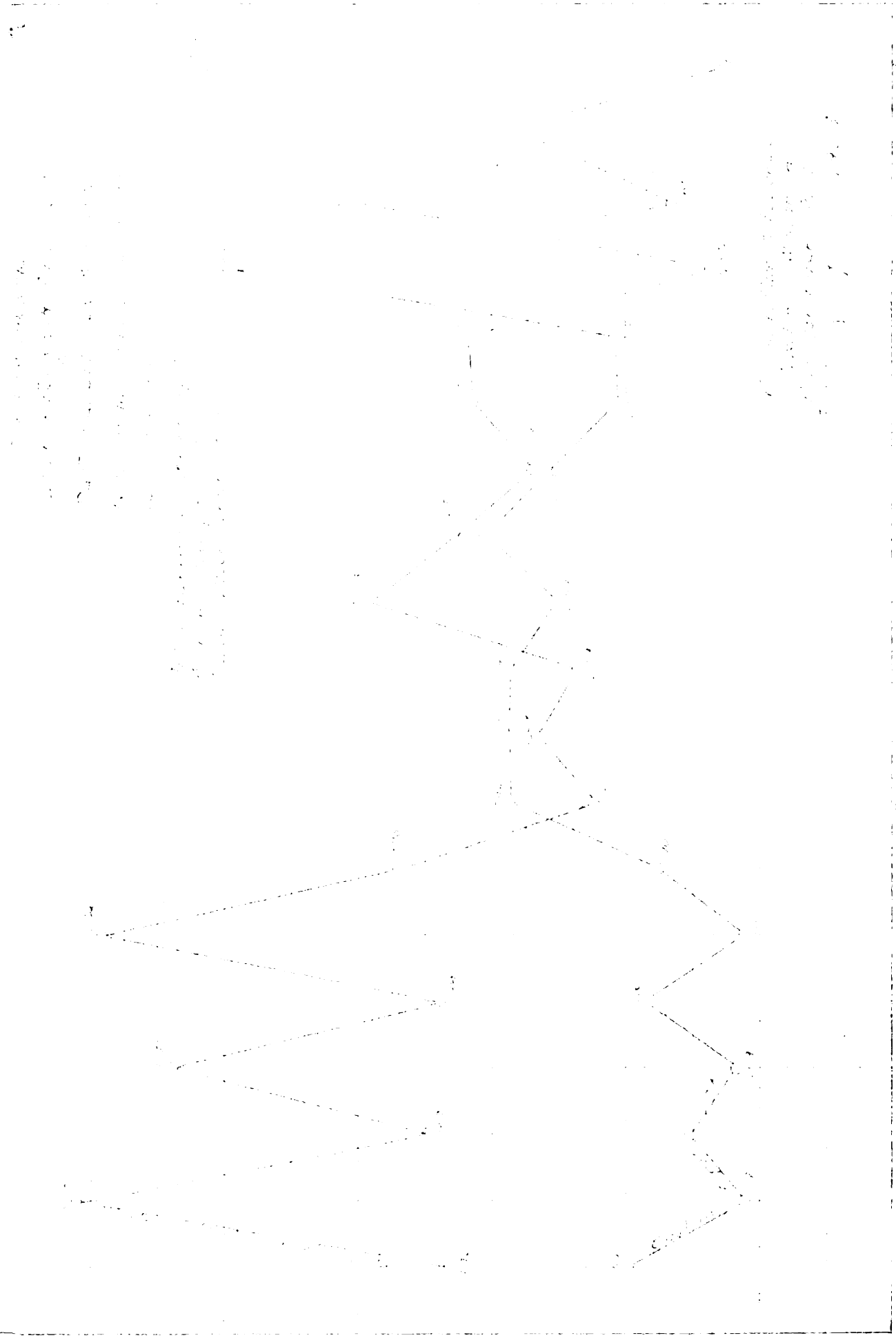
$$\frac{70}{4.5 \text{ plus } .3(1.1c) \text{ height in ft.}} \quad \text{in hard pan.}$$

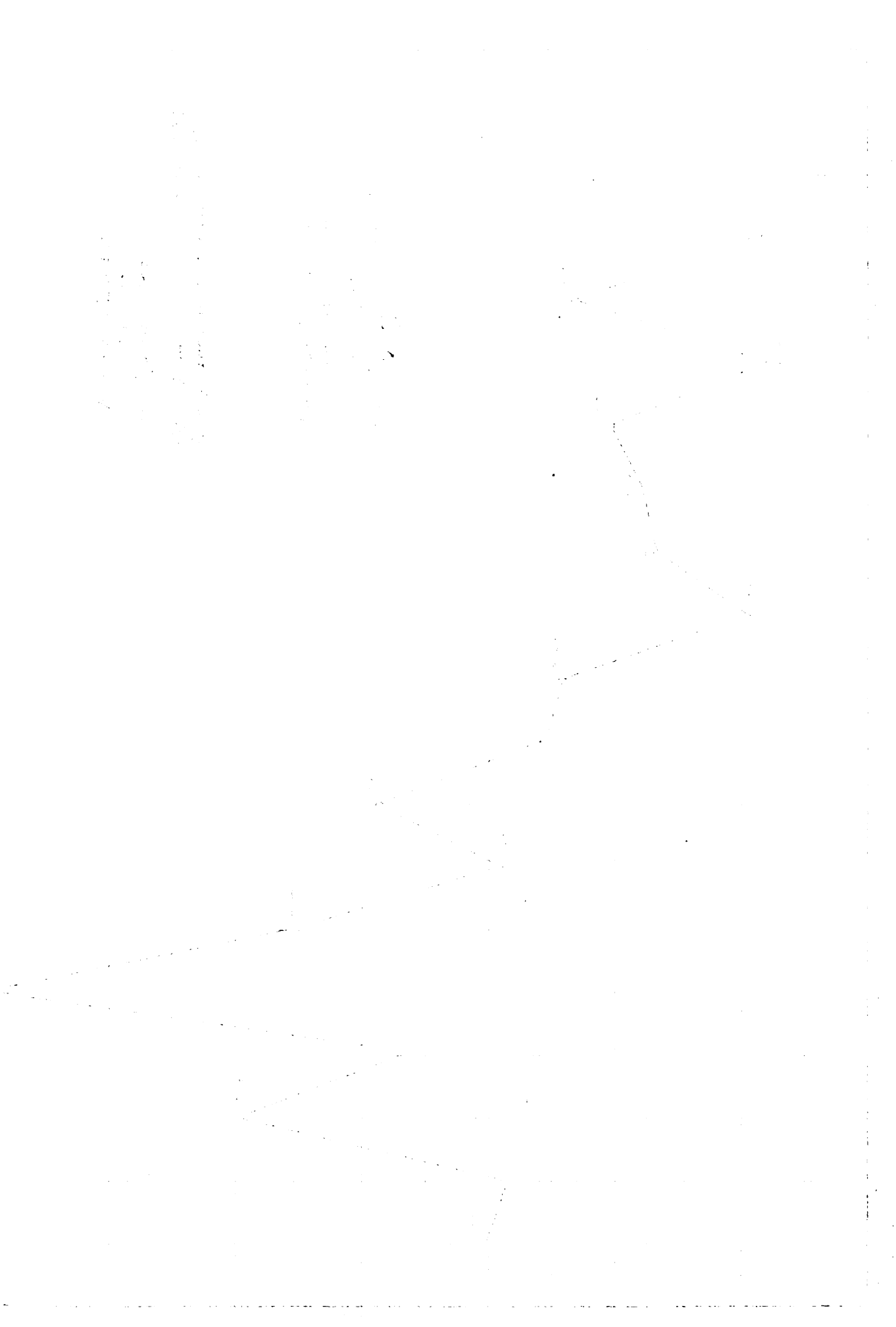
In spite of the varying factors in excavation work the actual results in this study of .28% cu. yds. and Mr. Gillette's emperical results of .38 and .35 cu. yds. indicate a worth while relationship.

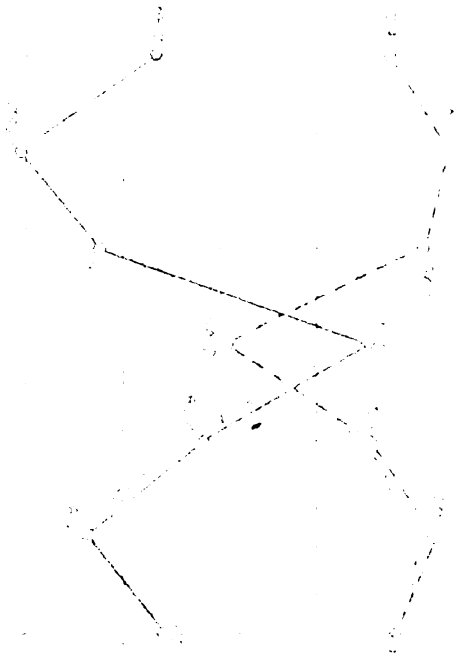
Form Building and Placing

Because of the nature of the construction of the forms and the necessity of properly placing reinforcing and shoring there is a considerable variation in the actual area erected per day and the cost per unit of area. Wall forms, represented by the foundation walls and the exterior surface walls, show in themselves a wide cost divergence, and may be studied as a definite type of form. The column forms, built of 2 x 6 and properly clamped and supported, may be regarded as another type. The type of floor used in this construction, the flat slab, with three way reinforcing demands in its formwork a large amount of centering, falsework or shoring, and it presents other problems for study. Special forming; - stairs, tanks, turbine casing and machine supports introduce factors of increased cost which determine the ultimate unit cost and time rates in the averages for the entire construction.

If it were at all possible to design the framework for the various types of concrete forms, the centering, supports, etc. at the





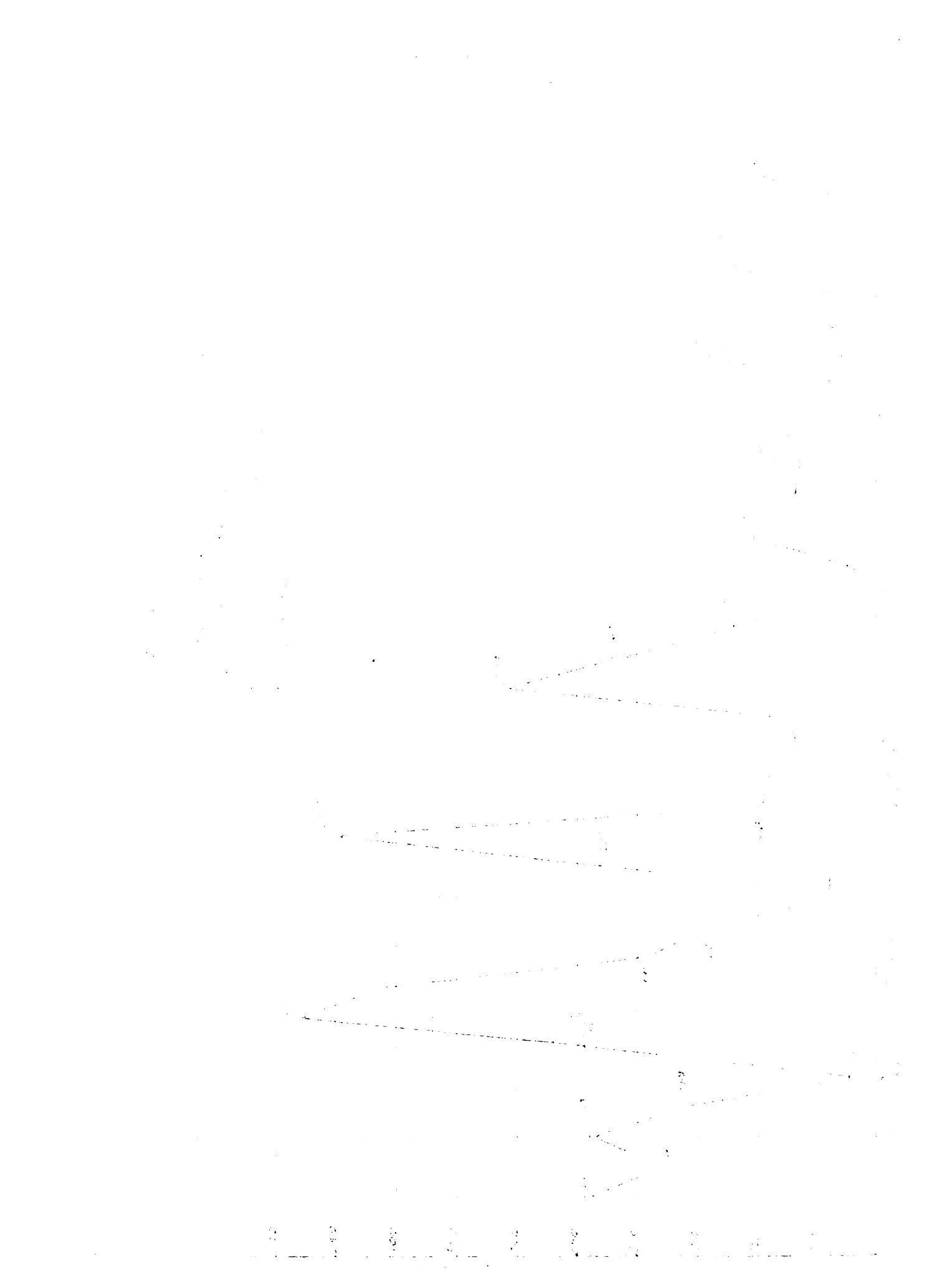


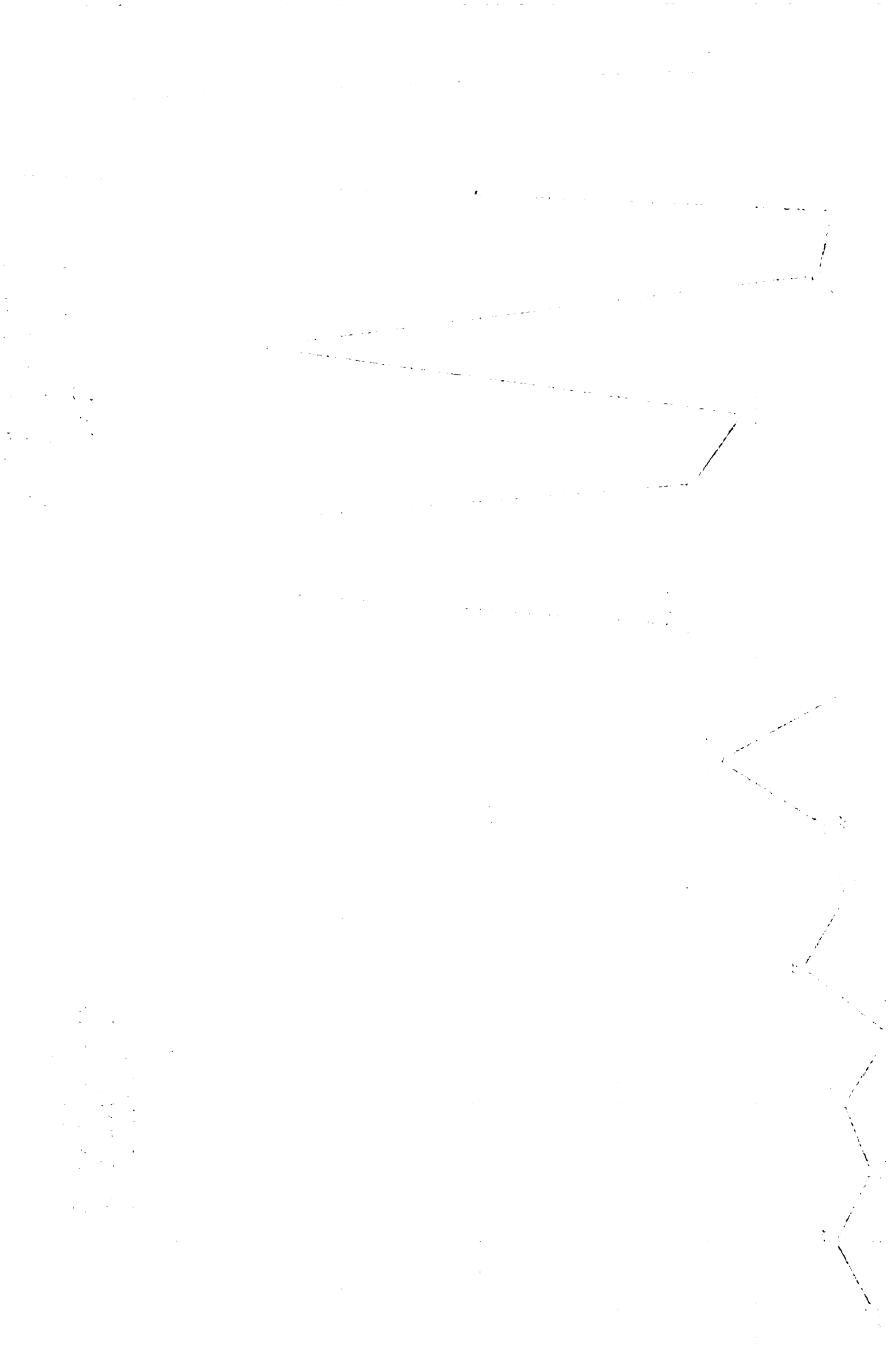
time of the design of the building in the architects or engineer's office it would be well worth-while as indicated by the large variations in unit cost and man hours necessary for form construction. However, at present, form cost estimate for concrete construction is based upon area of concrete to be formed, that is, contact area. Reference to Diagram #4 shows unit labor costs alone varying between 11.1¢ to 51.8¢ per square foot. Correlation of these figures with the type of form work under construction will justify to a large extent the large difference of cost units. Further discussion of the possibility of economies in form work will be made later.

Relation of the cost and time labor per unit area of various forms.

Week of	Cost per squ. ft.	Type of Construction	Squ. Ft. per man hour	
Aug. 6	19.9¢	foundation wall	3.32	1" board forms
Sept. 4	11.9	floor, flat slab	5.4	1" boards, 3 way reinforcing
Oct. 2	11.1	wall, first floor	5.92	panel forms
Oct. 30	28.8	spl. tanks, etc.	2.25	
Nov. 13	26.9	wall, second floor	2.69	. panel forms
Dec. 11	25.4	second floor slab	3.93	

Two references could be found relative to the cost per square foot of wall forms, Gillette in 'Handbook of Construction Data' gives one instance where the cost was 24.3¢ per square foot for labor alone, with common labor at 30¢ and carpenters at 55¢. A reference to Concrete Costs by Taylor and Thompson Page 6 gives an average labor cost of 8½¢ per sq. ft. of forms with carpenter wages at 50¢ per hour for the form work alone, whereas the above tabulation is based upon the 65¢ per hour rate. This book also lists other type costs such as column and foundation forms at 10¢ per sq. ft. compared with 19.9¢ in the foregoing table.





The cost and time labor units subsequent to the periods listed above varied considerably and the work became much more expensive which fact may be noted in Diagram #4. During the latter part of the concreting period stairways, steel tanks, machinery bases requiring skilled labor was a strong factor in increasing the unit labor costs. For these operations the unit labor costs averaged 32.3¢ per sq. ft. and progress was rated at 2.96 sq. ft. per man hour. Reference to the above diagram will show an average of 20¢ as the labor cost per sq. ft. with the average man completing 3.28 sq. ft. per hour. These computations are based on the entire forming operation including unloading and the placement of all reinforcing steel ready for concrete.

Concrete Mixing and Placing

No set values can be given for the concrete labor costs and time labor units in reinforced concrete construction. Various conditions and relationships must be considered in the effort to determine these units. However, if the type of construction and the site conditions are similated as far as possible, the results will be notably uniform.

The concreting equipment which was used has been noted. The location of the equipment relative to the building and site is shown in plan. The footings of the building, walls and columns are 1:2½:5 concrete but the entire construction above these footings is of 1:2:4 mix. Photographs of the progress of the work will also identify the type of work and use of the equipment.

Reference to Diagram #6 and 7 showing the cost per cu. yd. indicates the relative costs of the various phases and types of construction. The cost of concreting per cu. yd. increases quite uniformly during the construction period. The consideration of such peaks units as shown during Dec. 24th and March 17th and two weeks periods may be disregarded as the amount of concreting dur-

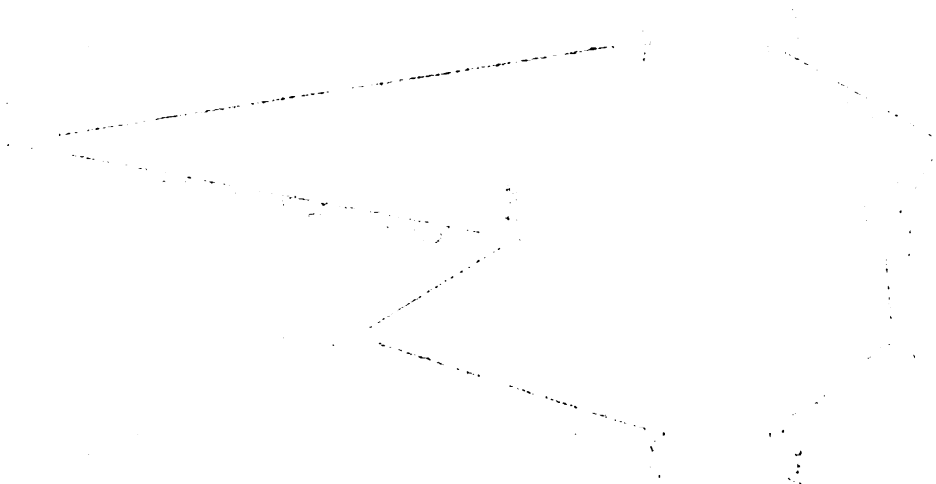
ing these times was unappreciable as noted on Diagram #5, showing the concrete placed per week.

This increase in cost is due in a large measure, first, to the necessity of using additional equipment and labor because of the increased height of the building. Second, the special methods of concreting necessary in finishing floors, stairs, tanks etc. A discussion of the general construction program will be more worthwhile however if the results are to be of value in comparative study.

Tabulation of costs and time rates classified according to the nature of construction.

Item	Type of Construction	Labor cost per cu. yd.	Cu. yds. per man hr.
1	footings and foundation walls	$1.37	.364
2	" " " "	1.80	.291
3	footings	1.32	.445
4	columns	1.78	.422
5	floor slab	1.04	.529
6	walls	2.38	.236
7	floor	1.75	.347
8	walls	2.76	.208
9	floor	1.73	.303

An increase in the cost per cu. yd. of concrete in walls and decrease in the labor output in cu. yds. per man hour is indicated in the above tabulation. The cost of the concrete in walls shown in items 1, 2, 6 and 8 is a gradual increase which is the result of the decreased returns in cu. yds. per man hour. Comparative results are shown in the floor construction in items 5, 7 and 9.



Labor costs in an example presented in Gillette's Handbook of Construction Costs, per cu. yd. labor costs averaged from $1.21 to $2.32 with the labor charges at 34¢ per hour, compared with 42¢ average on this job. Mr. Gillette also indicates a labot cost of $1.48 and $1.39 for a mill and warehouse with the concrete poured from a tower such as was used on this job. Messrs. Taylor and Thompson in Concrete Costs states that on a Paper Mill Construction at Milford, N. J. the labor cost on the concrete was $1.30 per cu. yd. After the week of Nov. 20th on this job a very appreciable increase in the unit cost of the concrete was evident. This is a fact which was due to conditions which must be reckoned with in all concrete construction, however, the data derived from these observations can not be chargeable to concrete cost per cu. yd. or the time rate. The increased cost and the decreased rate of production is significant only in that these items were derived during the period of grouting in the steel window frames, forming window sills, tank walls and when it was necessary to provide protection for the concrete to prevent freezing.

A compilation of the total unit costs and time rates is given graphically in Diagram $3. There is a pronounced variation in the cost per cu. yd. from $4.15 to $10.77. The latter cost is due to increased cost of forming with its accompanying skilled labor charges. The cu. yds. placed per man hour is a variation from .062 to .146. Narrow curtain walls, flat slabs and other sections of the construction where the ratio of the square ft. of form surface to the cu. yardage of the concrete inclosed is large is more expensive than the massive foundation walls of the monolithic type.

No discussion or reference to this fact has been found in the bibliography, Mr. Gillette however, points out a labor

cost of $1.20 in concreting alone with a total cost of $2.10 per cu. yd. which is the labor inclusive of forming, placing steel and concreting.

Recapitulation and conclusions.

Cost and labor data derived from actual records during the construction are of little value unless conditions are discussed in order that comparisions might be made readily and the data applied to other jobs. The only accurate method of making estimates is the consideration of unit costs and time labor units.

We referred to the Engineering News-Record Construction Costs from 1910 to 1926. In a compilation of labor cost variation during the period the index was set at 100 for 1913. In 1923-4, during the time of the construction of this mill the index of the labor cost was given as 222.1 and 217.3.

Relative progress. One can notice by merely a passing glance at Diagram #5 that certain factors were operating on the job to so strikingly effect such a drop in the number of cubic yards of concrete placed per week. During the first twenty weeks up to the 20th of December, 4063.3 cu. yds. of the total of 4917.7 or 83% approximately had been placed in 54% of the time. Probably the strongest reason for this decrease in actual construction was the cold weather when it was necessary to protect the work. This unbalanced proportion can be accounted for in some degree because of the limited area of operations which were confined to the stock building alone. A comparision of the relative progress before and after Dec. 20th will result in a ratio somewhat indicative of the amount of concrete placed under favorable weather conditions to the time when the temperature is sub-freezing.

Ratio of forms to Concrete. The total number of sq. ft. of forms placed is shown as 194,993. The total concrete volume amounted to

4917.3 cu. yds. This ratio of sq. ft. of forms to cu. yds. of concrete is 39.6. The total average cost of forms for the construction as computed on Diagram #4 is 20¢. The cost of forming one cu. yd. then of concrete will average 39.6 times 20¢ or $7.92. In a construction project, under similar conditions the area in sq. ft. of forms necessary will average 39.6 times the cu. yards of concrete and the cost of forming, placing the steel hauling form materials etc. complete for concrete will approximate $7.92 per cu. yd. Some estimate of the number of times that lumber for forming may be re-used can be made usually which will vary with the rate of construction. This is labor cost of $7.92 on forms for each cu. yd. of concrete.

If it is at all possible, great savings may be realized, as noted hereinbefore, if the office of the architect or designing engineer could so plan the structure in order that the forms might be re-used with minimum cost to the largest extent in view of the extreme high labor cost per cu. yd. of concrete. Proper design of shoring and falsework in the office will be well repaid in economies.

Comparison of labor and cost units. Mention might well be made of the relative value of the time labor units and unit costs. The Engineering News-Record Comparative Labor Costs and also those of the American Appraisal Co. assign 100 as the index of labor Cost in 1913. This index in June, 1920 reached 273.8 as the high wage period and remained 210 (plus or minus) during the last half of 1926. The extreme variation from 87.4 to the 273.8 shows the unsatisfactory method of using unit costs without very definite information regarding labor charges.

Labor in general is a constant factor under similar conditions and the amount of work performed by an average man is much the same. This unit time should be the better basis upon which to estimate costs. The unit is primal, it seems to me, and in the last analysis is the basis upon which the unit labor cost is derived and the wages fixed. There is a strong tendency in current construction practice to base estimates on this unit, but very little data has been accumulated from actual practice at the present time. The standardization of concrete construction to the extent which this has been accomplished in other construction work such as frame building and brickwork will eventually bring uniform results.

Acknowledgements and Bibliography.

I wish to express my gratitude to Mr. Eugene Orbison of Orbison and Orbison, Engineers, for the use of the plans from which the accompanying photostats were made, to C. R. Meyer and Sons Co. for use of pay-roll data.

Bibliography

Gillette: Handbook of Construction Cost.
" Handbook of Cost Data.
Taylor and Thompson: Concrete Costs.
Dinman: Estimating Building Costs.

#1 July 30.1923.

Construction tower up to 120'. Ultimate height 160'. Cement shed complete. Excavating for S. wall footings.

#2 View of the concrete distribution spouting. Counterbalance.

#3 July 30th, 1923.
Excavating for south wall footings. Removing old trestle

Driving Sheet Piling with steam hammer at extreme right.

#4 August 2, 1923.
Cofferdam completed and pumped out. Excavating for wall

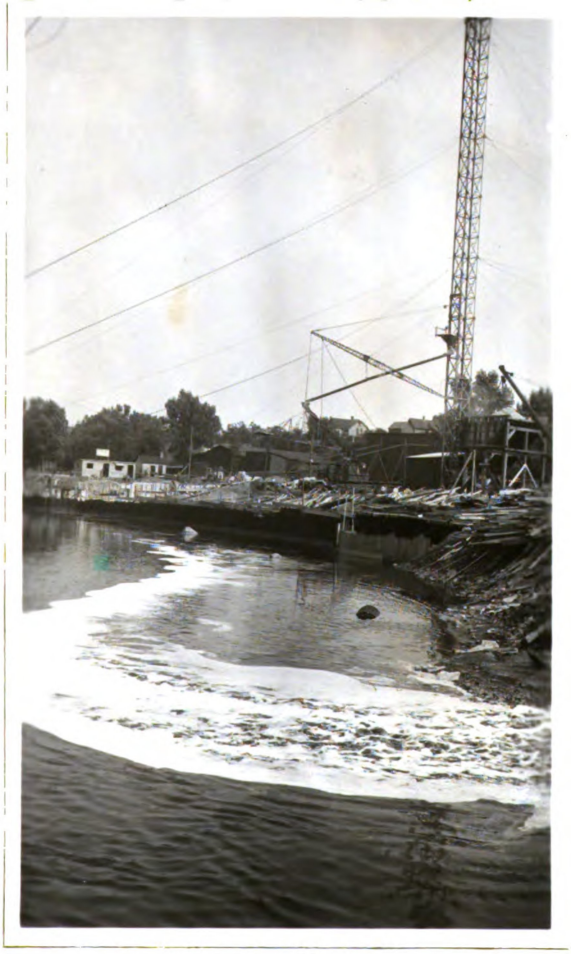
between machine and finishing bldgs.

#5 August 3,1923.
South wall excavation. Looking toward west.

#6 August 11,1923.
View of Riverside Fibre and Paper Co. looking west from 160'. Also note the government locks and canal.

#7 August 11,1923.

Looking east from pulp mill



#8 August 11,1923.

Tower at 160'. Charging bin and derrick to right. Coffer-dam.

#9 August 17,1923.
Forming for water wheel pit, Excavating for machine bldg. piers.

#10 August 17,1923.
Showing method of pouring the south wall of finishing building.

#11 August 23, 1923.
Forming basment floor of finishing building. Note pier heads.

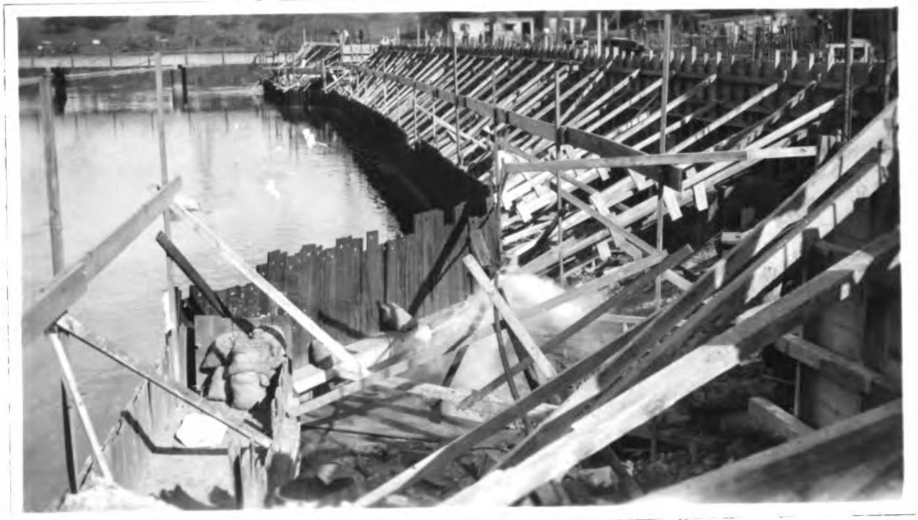
#12 August 23,1923.
View from tower of the footings of machine bldg. Reinforcing dowels set in footings.

#13 Sept.4,1923.

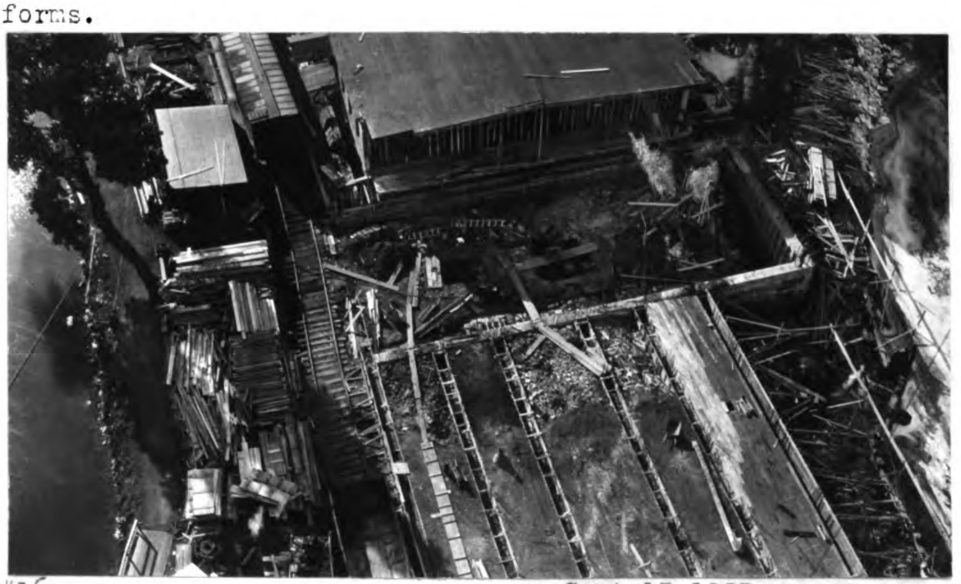
Unloading aggregates.

#14 Sept.12,1923.

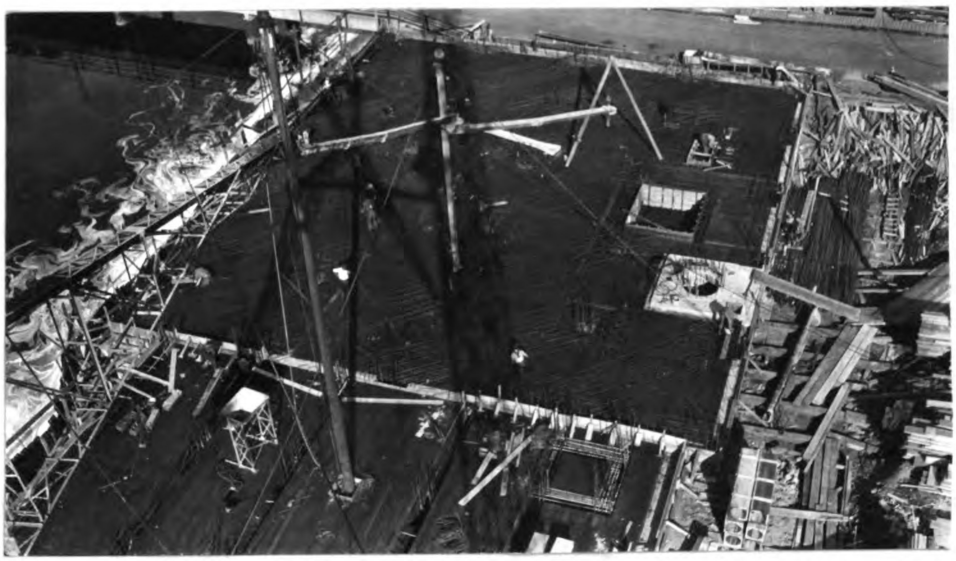
First floor of finishing bldg. ready for reinforcing steel.



#15 Sept.14,1923.
Cribbing and cofferdam. Method of bracing north wall forms.



#16 Sept.15,1923.
West end of building. View from 160'. Base of stock building.



#17 Sept.15,1923.

Ready to pour floor slab in finishing building. Note three way reinforcing, spouting from tower.

#18 Sept.29,1923.

Placing wall in machine building. Note construction of wall forms and pilasters.

#19 Sept.30,1923.
Piers under finishing building. Tailrace of water wheel

inforeground.

#20 October 8,1923.
Preparing to pour walls of finishing building in background.

Note platform for concrete'buggies'.

#21 Oct.23,1923.
Forming main or paper machine floor of machine building.

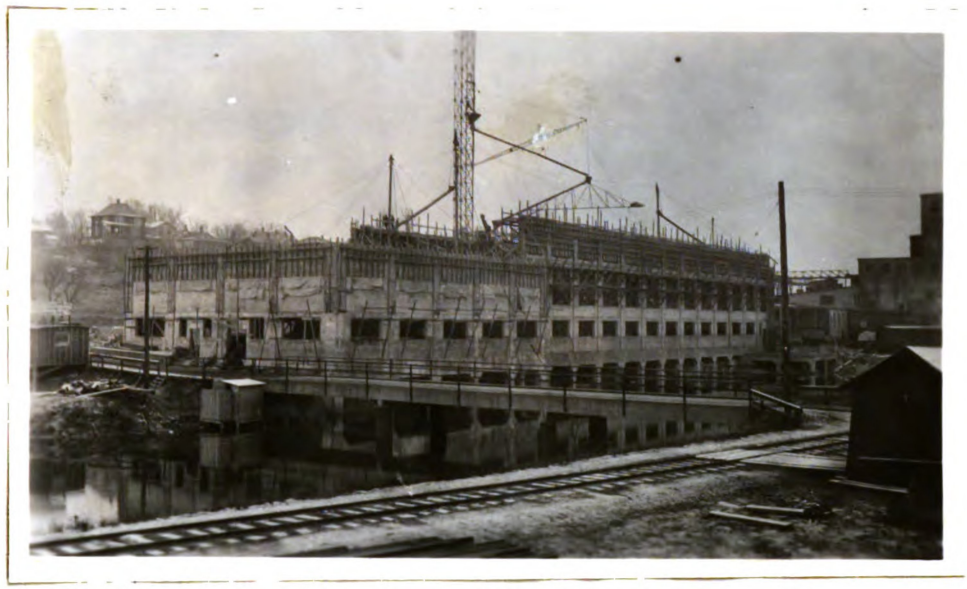
Machine pit partially formed at left.

#22 Nov.9,1923.
Pulling sheet piling. Block and tackle, breast derrick

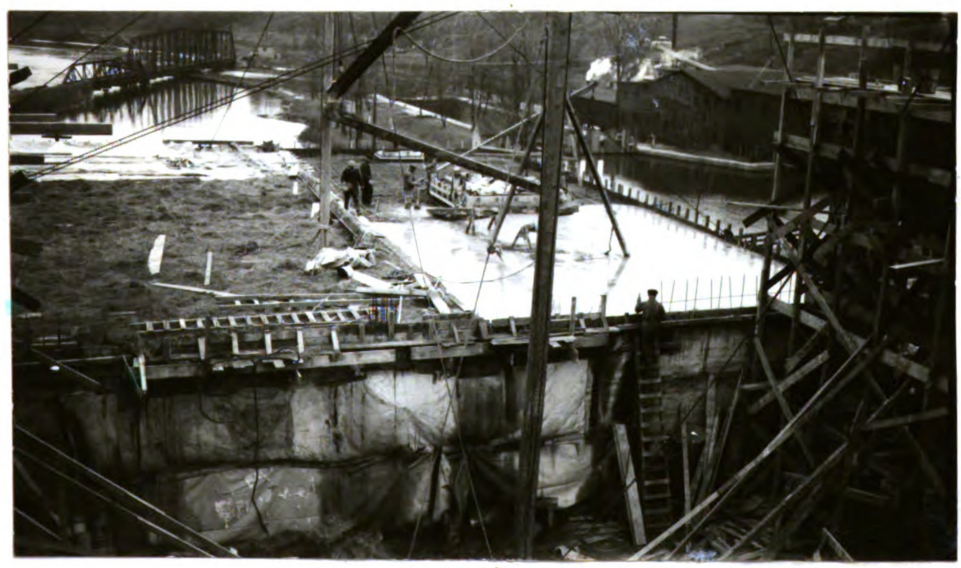
mounted on raft.

#23 Nov.7,1923.
Main floor of machine building protected with marsh hay. forming north wall.

#24
Forming south wall of machine building. Note type of walls forms which were raised as building progressed.



#25 Nov.21,1923.
View from the northeast.



#26 Dec.4,1923.

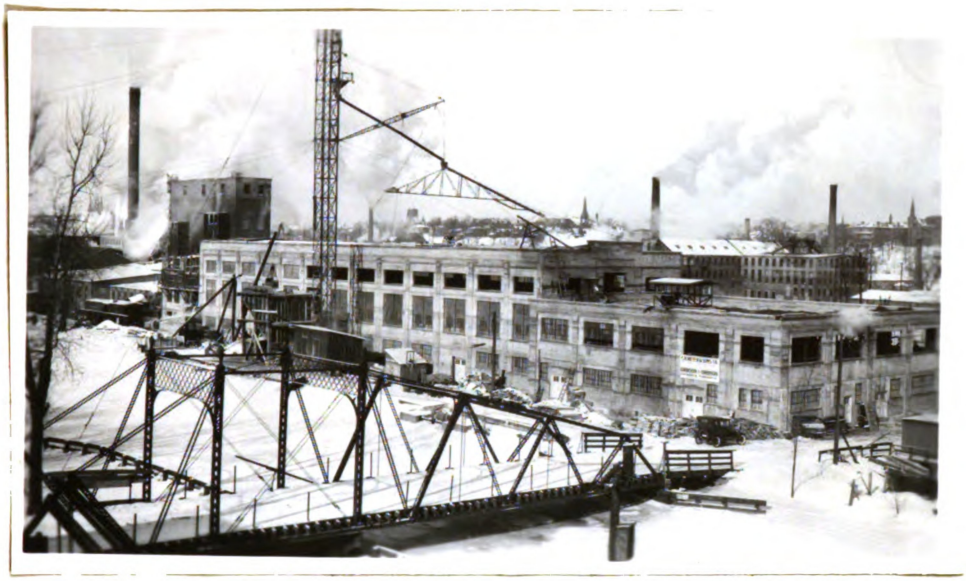
Pouring roof of finishing building. Note protecion to prevent freezing. Salamanders under slab. Marsh hay and felt used to cover concrete.

#27 Dec.15,1928.
Bolting, riveting setting roof steel in machine building.

#28 Dec.18,1923.
Forming stock building floor,(main) Setting roof steel in machine building.

#29 Dec. 19,1923.
View from the southeast.

#30 Dec.21,1928.
Stock building walls being formed. View from the northwest.
Setting steel sash.

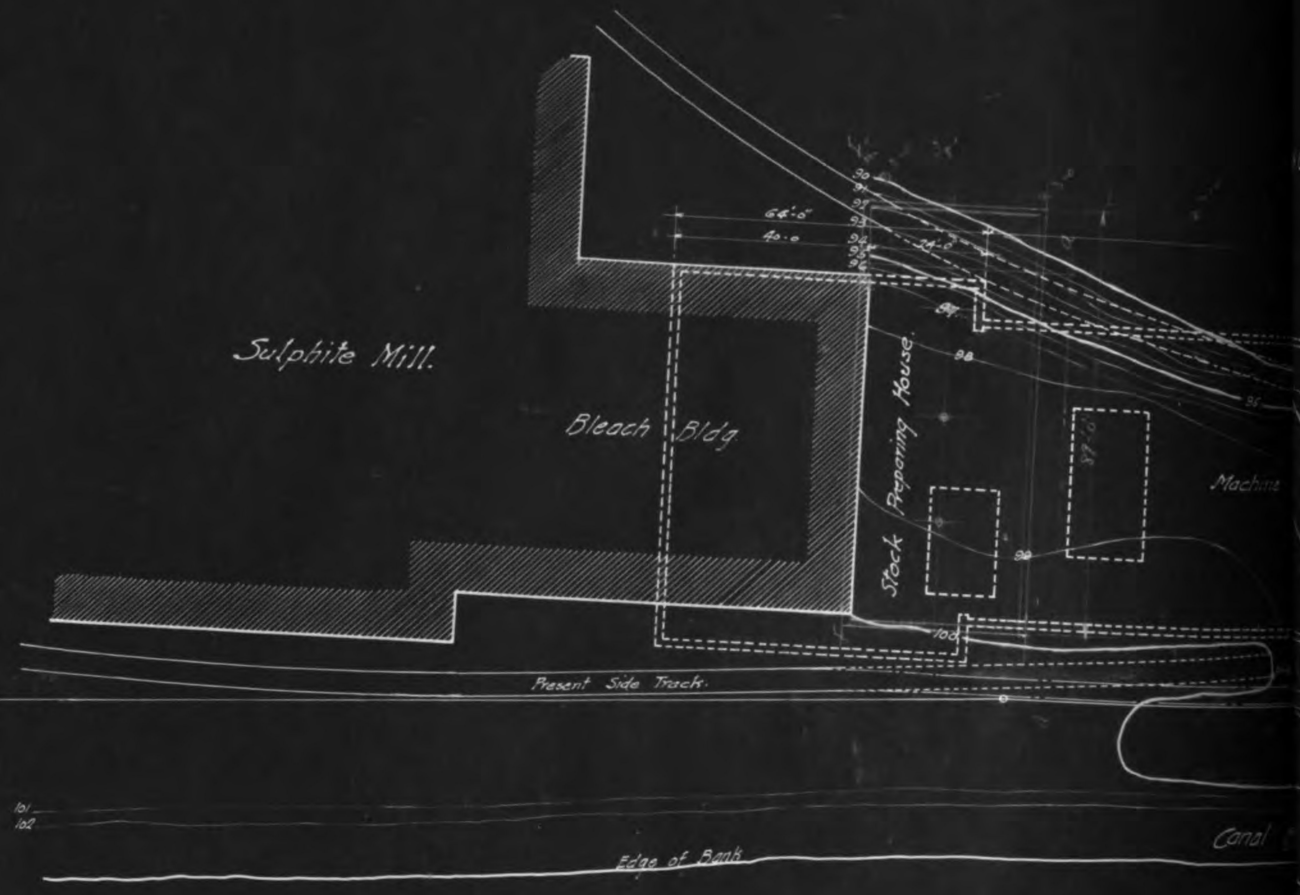


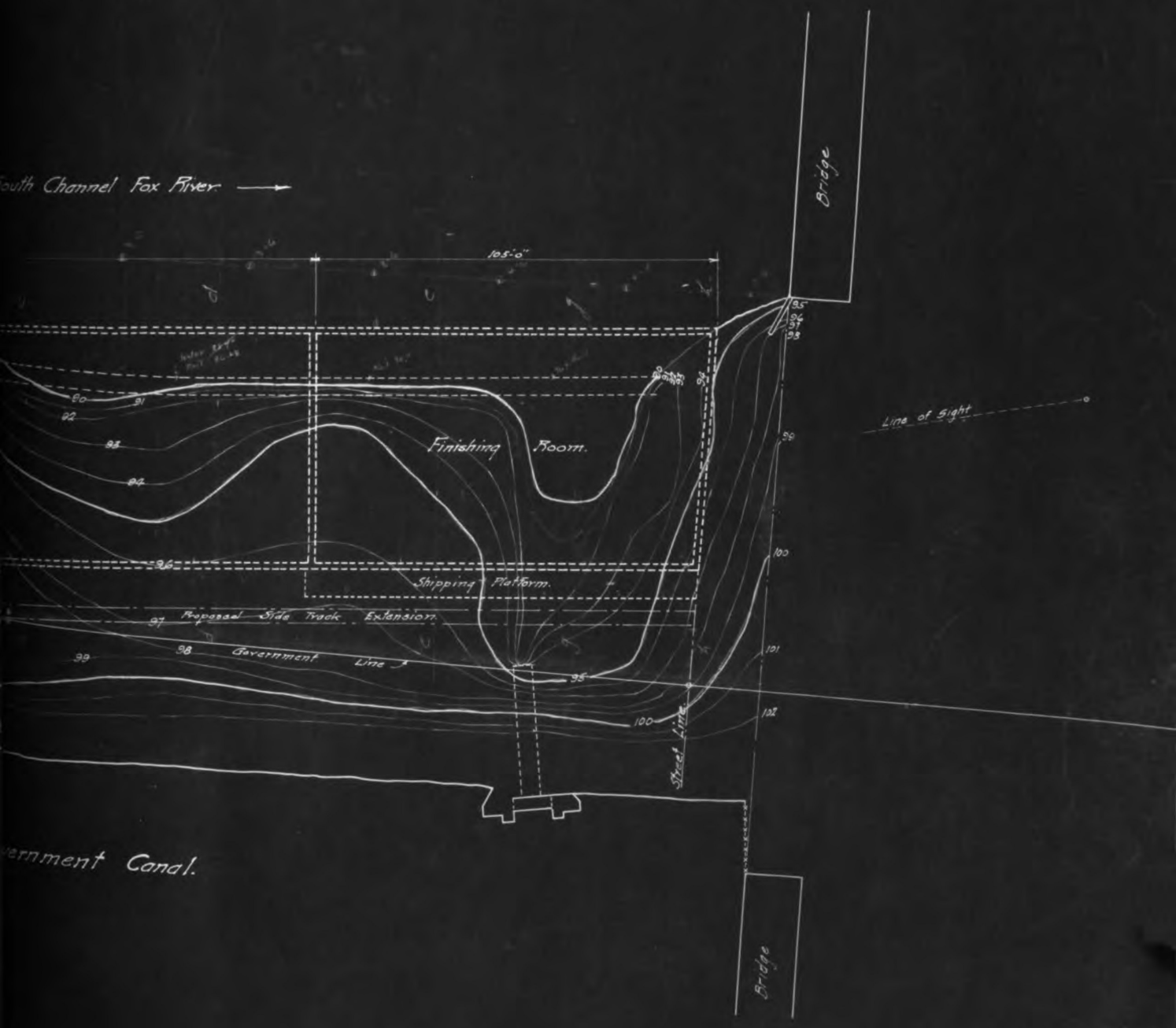
#31 Jan.10,1924.
Setting steel sash. Stock building walls going up.

View from the southeast.

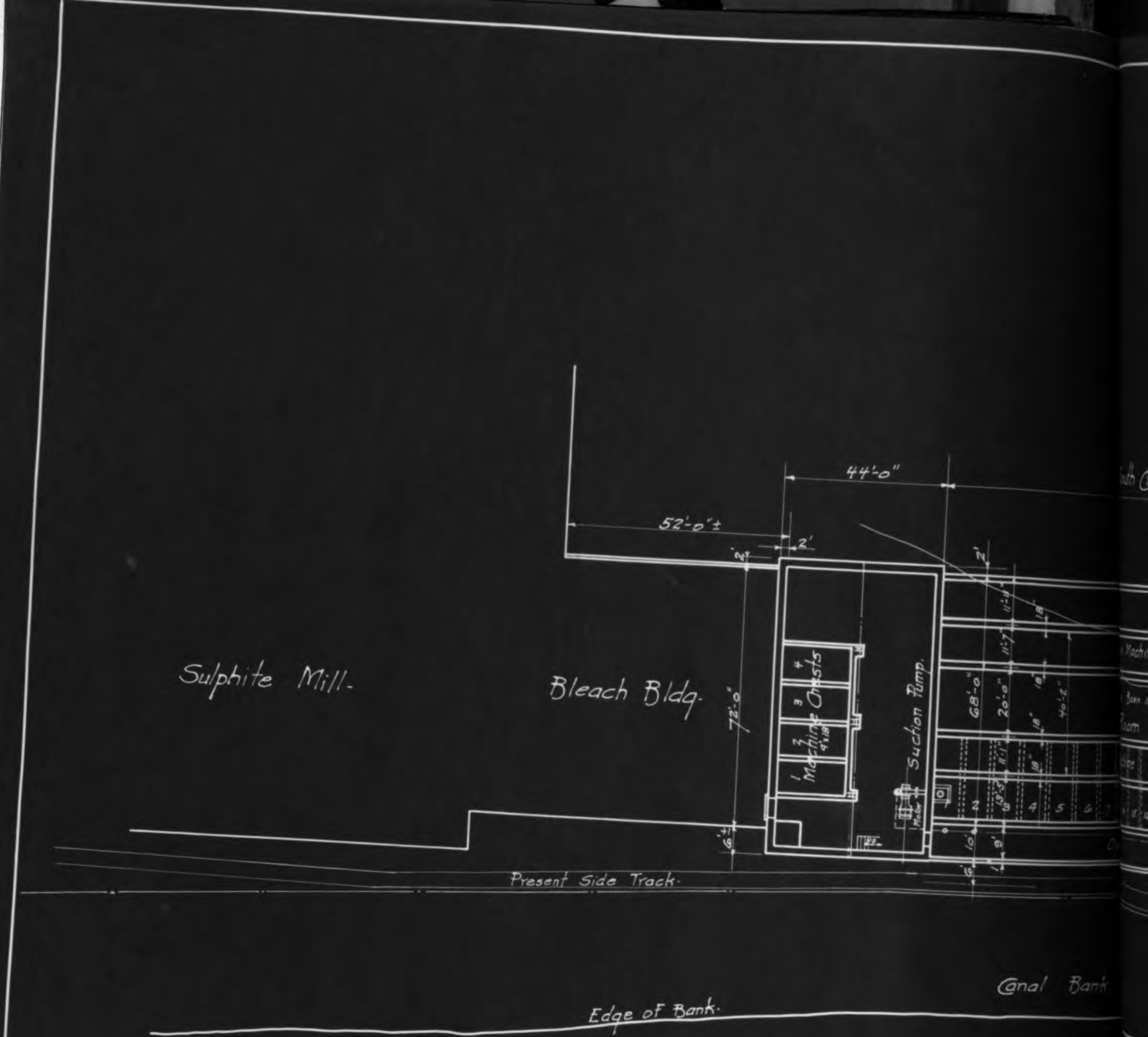
#32 April 3,1924.
Building practically complete. Pouring last concrete on

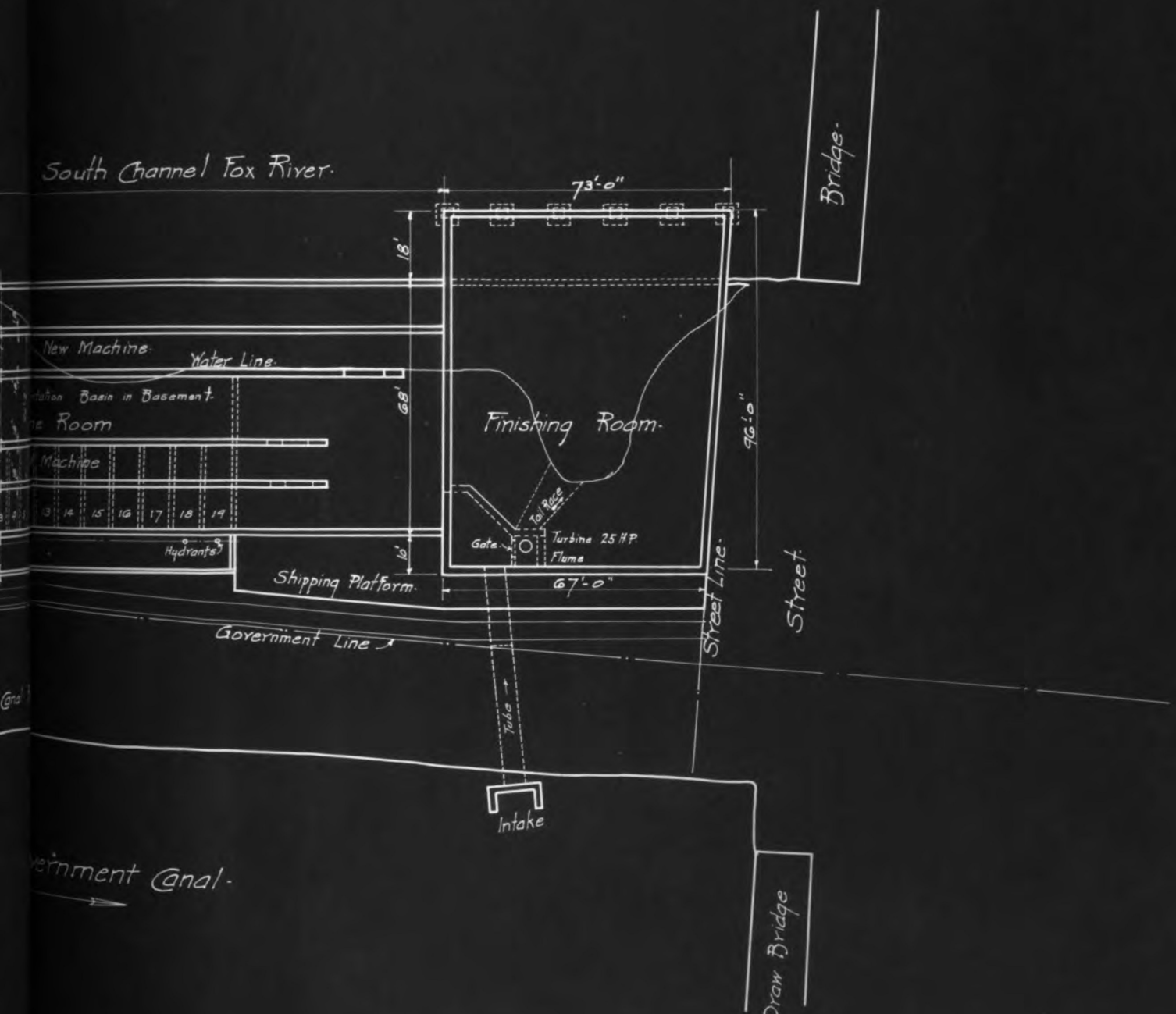
roof of stock building.


Sulphite Mill.
Bleach Bldg.
Stock Preparing House.
Machine
Present Side Track
Edge of Bank
Canal

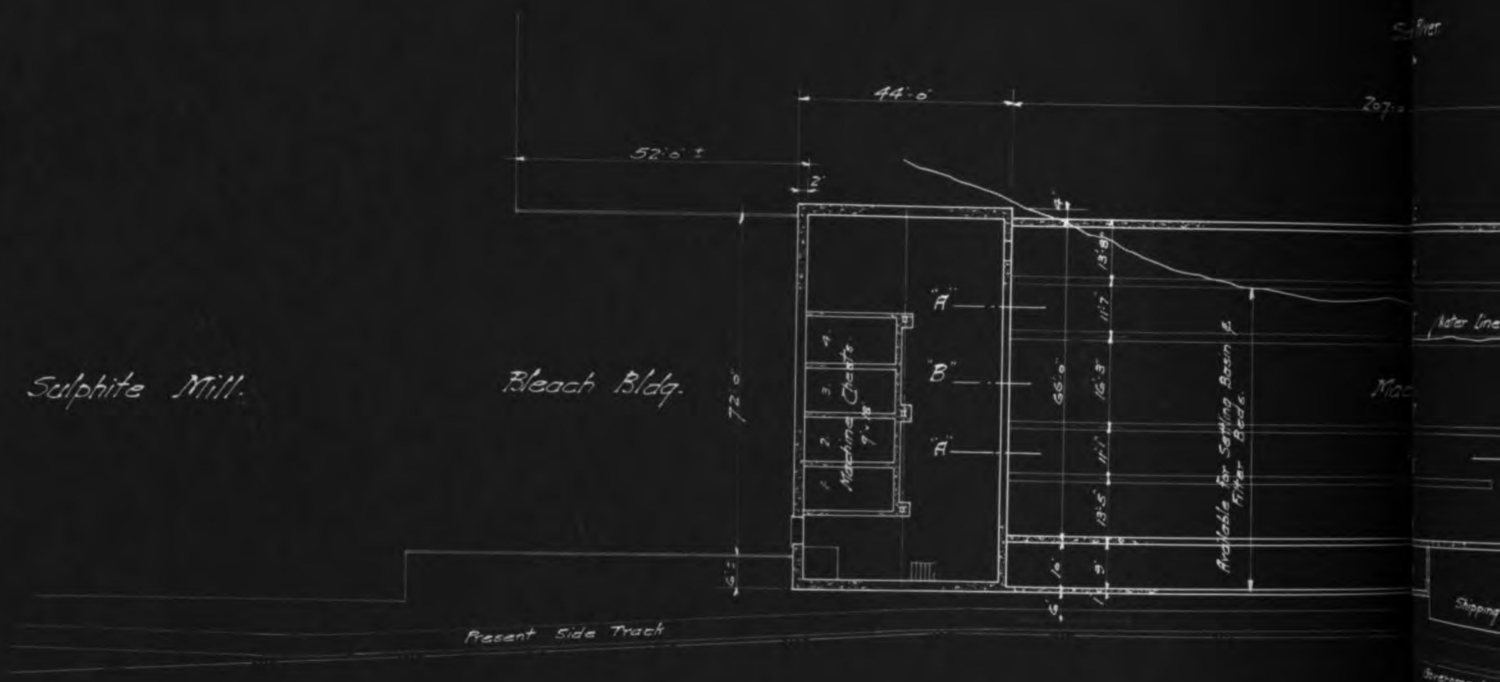


Riverside Fibre & Paper Co.
Appleton, Wisconsin.
Proposed Paper Mill.
Map of Location.
Scale:- 20' to 1."
Thomas W. Orbison, Consulting Engineer.
Appleton, Wis. May 7. 1917.
#5951.


44'-0"
52'-0"±
2'
2'
2'
Sulphite Mill.
Bleach Bldg.
72'-0"
Machine Chests
Suction Pump.
68'-0"
20'-0"
Present Side Track.
Canal Bank
Edge of Bank.

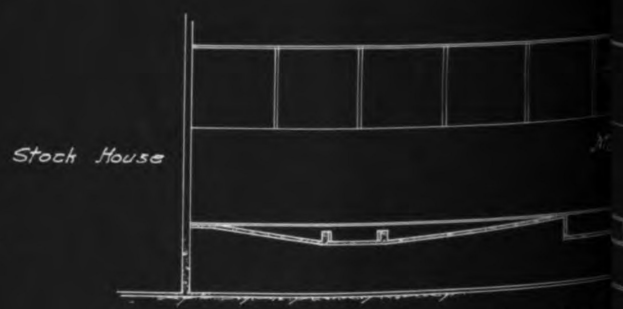


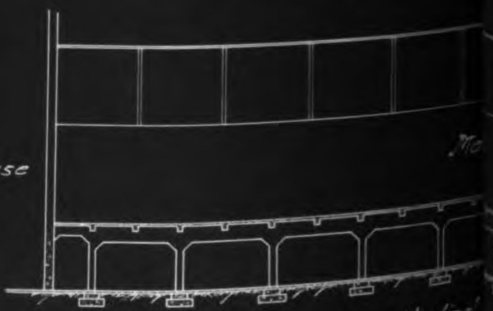
Riverside Fibre & Paper Co.
Appleton Wisconsin
Plans for New Paper Mill.
General Plan.
Scale: 20'=1"
Orbison & Orbison Consulting Engineers
Appleton, Wisc. June 22, 192
No 6763

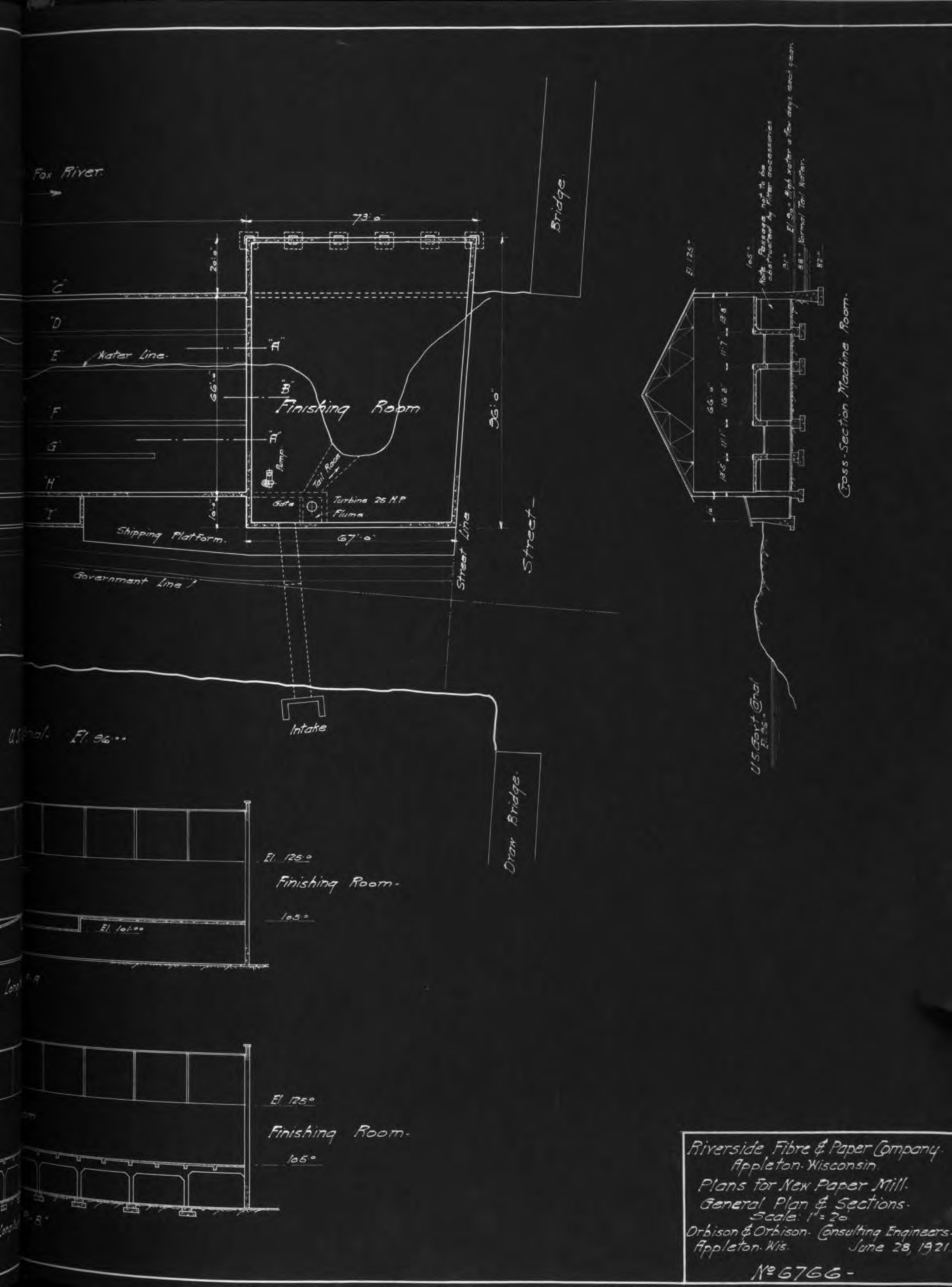


Canal Bank

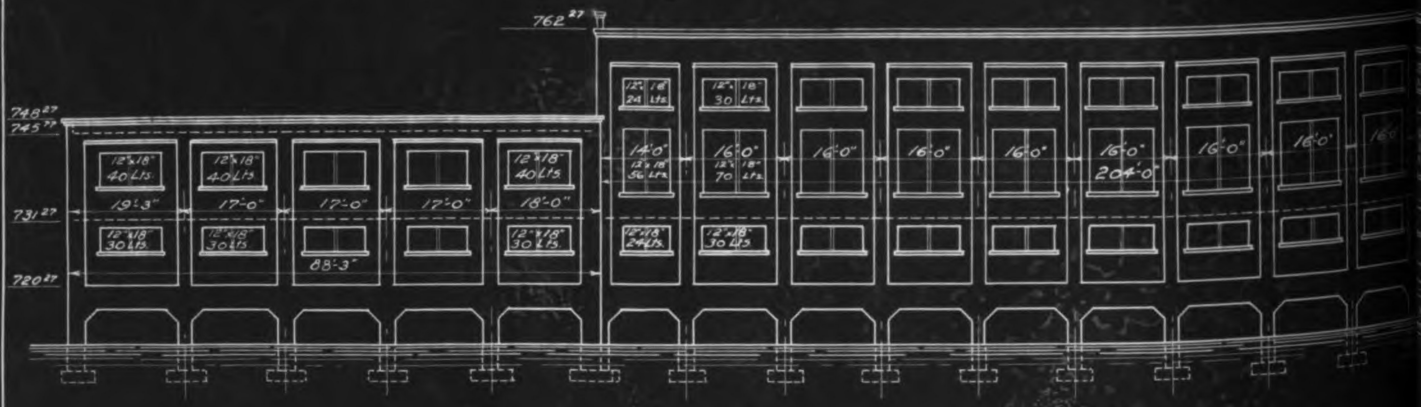
Edge of Bank



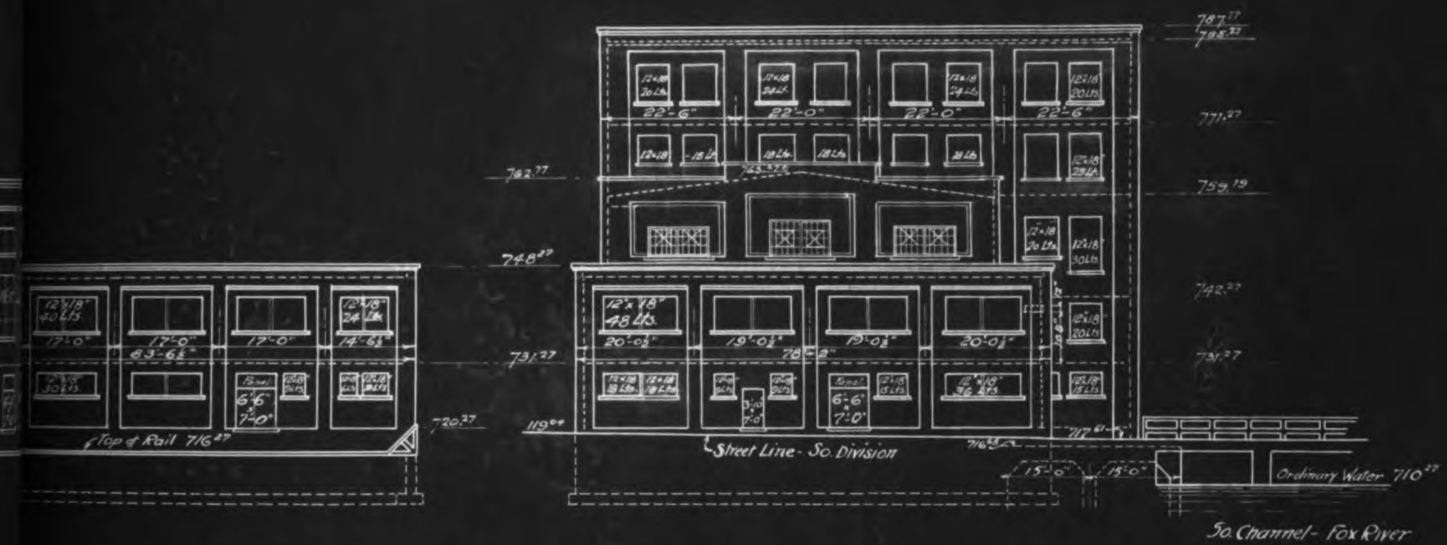



Fox River
Bridge
73'-0"
C
D
E
Water Line
F
G
H
I
A
B
A
Finishing Room
Pump
Roof
Gate
Turbine 26 H.P.
Flume
Shipping Platform
67'-0"
Street Line
Street
39'-0"
Government Line
Intake
U.S. Pierhead El. 96.00
Draw Bridge
El. 125.0
Finishing Room.
105.0
El. 101.00
El. 125.0
Finishing Room.
105.0
El. 125.0
Note Passage left for Addition by Riparian Proprietors
El. 96.0 High water a few days each year.
Normal Tail Water.
98'-
82'-
Cross-Section Machine Room.
66'-0"
16'-8"
11'-7"
13'-8"
13'-5"
10'
U.S. Govt. Grid
Riverside Fibre & Paper Company
Appleton. Wisconsin.
Plans for New Paper Mill.
General Plan & Sections.
Scale: 1" = 20'
Orbison & Orbison. Consulting Engineers.
Appleton. Wis. June 28, 1921
No 6766-

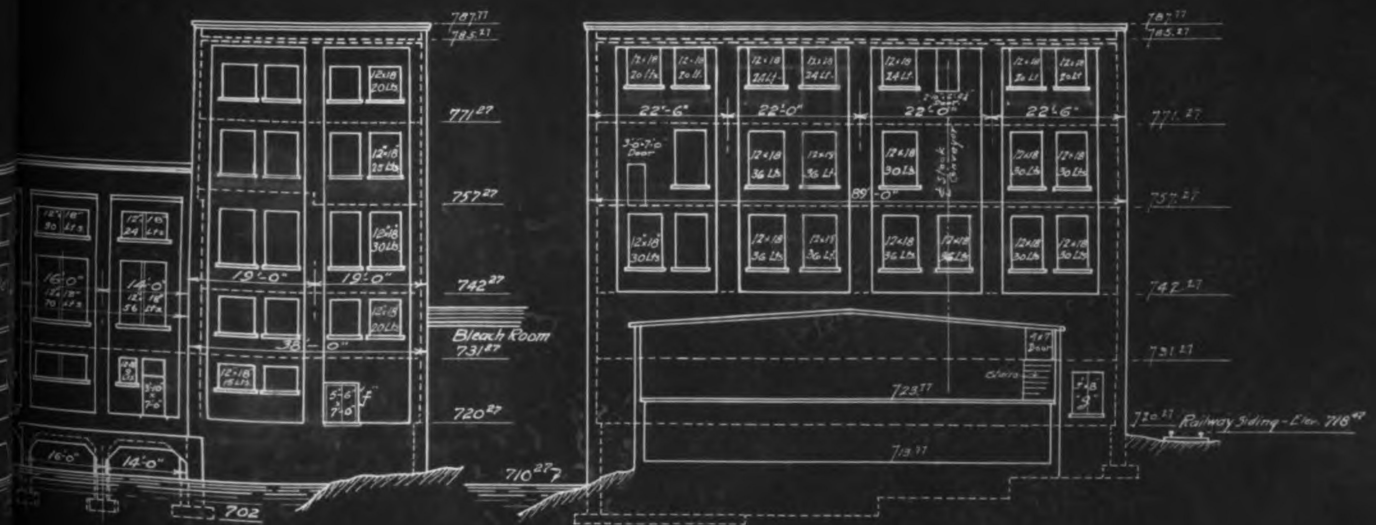
South Elevation



North Elevation

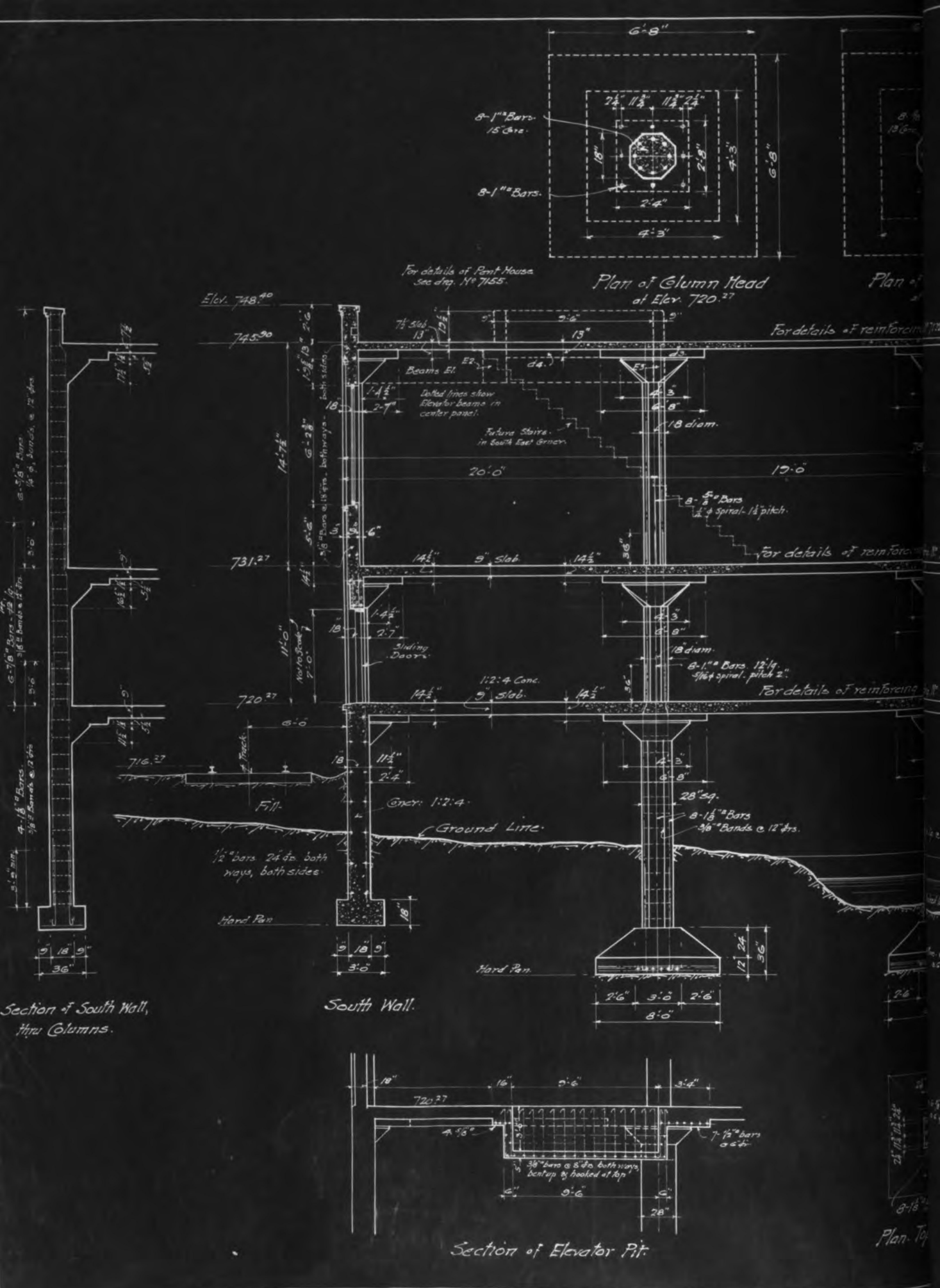


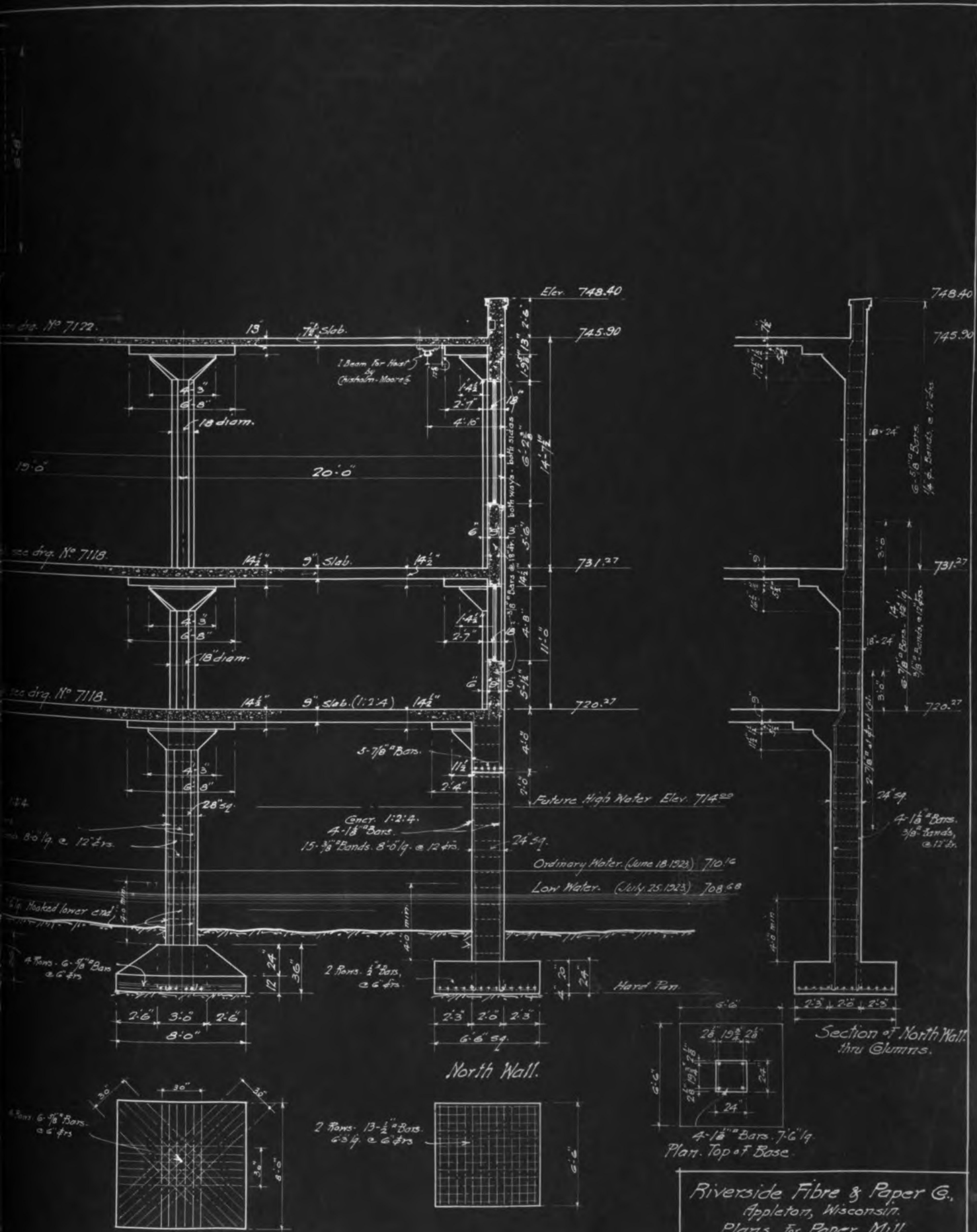
East Elevation

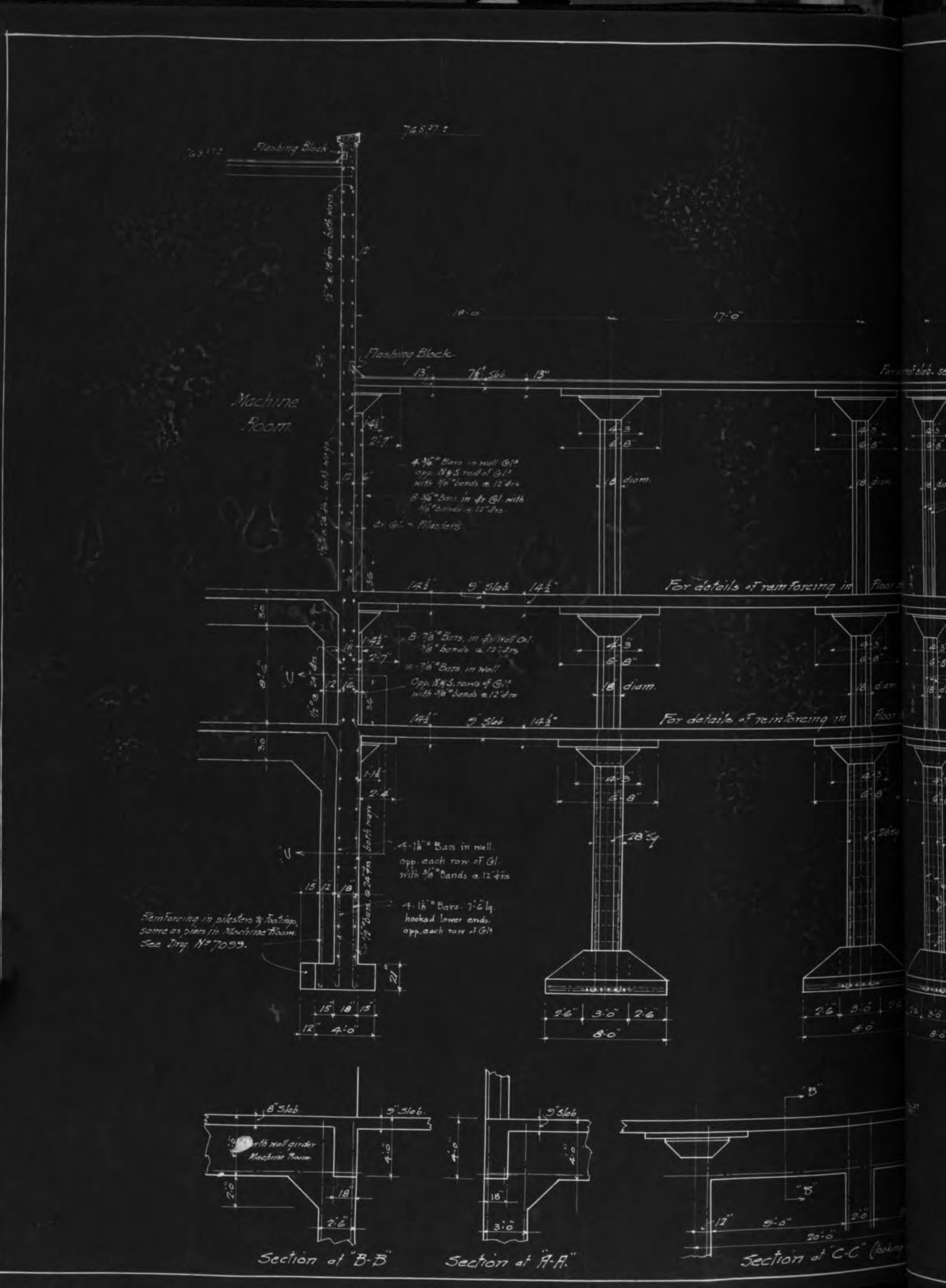


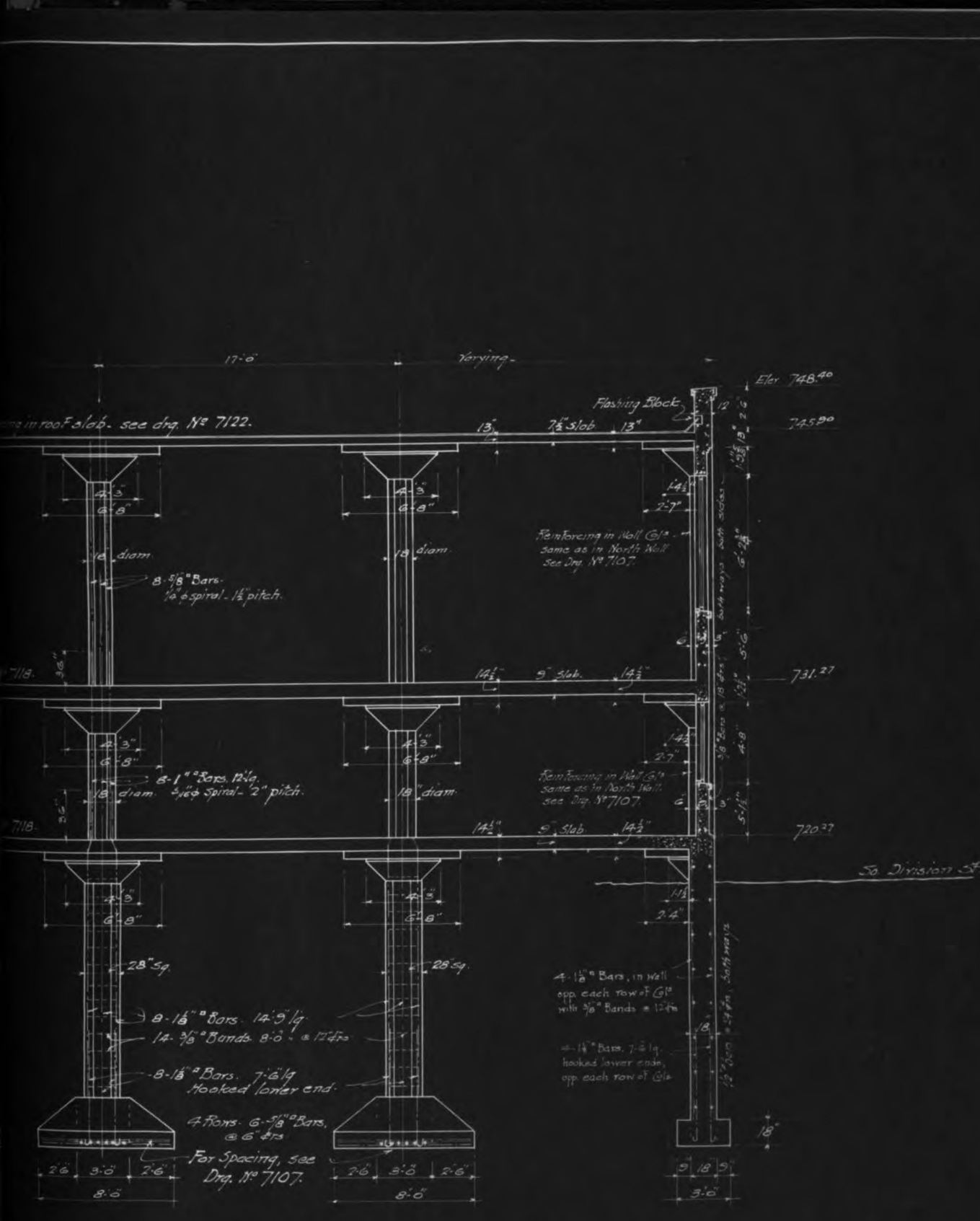
West Elevation

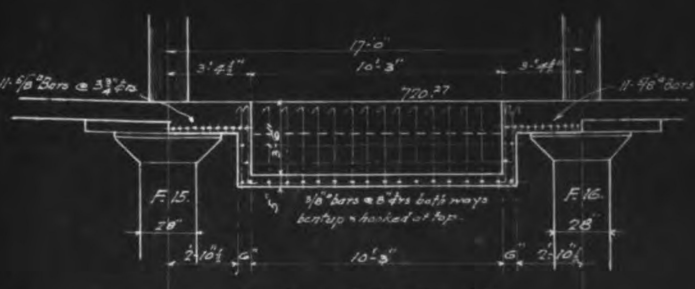
Riverside Fibre & Paper Co
Appleton, Wisconsin.
Plans for Paper Mill.
Elevations
Scale - 1/16" = 1'-0"
Orbison & Orbison Consulting Engineers
Appleton, Wis. Sept. 25-1923
No 7138 Revised - Nov. 7-1923


6'-8"
8-1"ø Bars. 15 Ctrs.
8-1"ø Bars.
2'-4"
4'-3"
6'-8"
For details of Pent House see drg. No 7155.
Plan of Column Head at Elev. 720.27
Elev. 748.40
745.90
731.27
720.37
716.37
7½" Slab
13"
Beams El.
Dotted lines show Elev. for beams in center panel.
Future Stairs in South East Corner.
20'-0"
19'-0"
8-⅝"ø Bars ¼"ø Spiral. 1½" pitch.
For details of reinforcement
9" Slab.
1:4½"
2'-7"
Sliding Doors.
18" diam.
8-1"ø Bars. 12"ø Spiral. pitch 2".
1:2:4 Conc.
Fill.
Ground Line.
Hard Pan.
Cinder 1:2:4.
28" sq.
8-1⅛"ø Bars
⅜"ø Bands @ 12" ctrs.
½"ø bars 24" ctrs. both ways, both sides.
Track.
Section of South Wall thru Columns.
South Wall.
Section of Elevator Pit.
Plan of


Elev. 748.40
745.90
731.27
720.27
714.22
710.16
708.68
19'-0"
20'-0"
18" diam.
9" Slab.
Future High Water Elev. 714.22
Ordinary Water. (June 18.1923) 710.16
Low Water. (July 25.1923) 708.68
Hooked lower end
4'-0" min.
2'-6"
3'-0"
8'-0"
6'-6"
2'-3"
2'-0"
Hard Pan
North Wall.
Section of North Wall thru Columns.
Plan of Column Bases.
Plan. Top of Base
4-1⅛" Bars. 7'-6" lg.
Riverside Fibre & Paper Co.
Appleton, Wisconsin.
Plans for Paper Mill.
Cross Section - Finishing Room.
Scale:- ¼" = 1'-0"
Orbison & Orbison, Consulting Engineers.
Appleton, Wis.
Aug. 4. 1923.
Revised Aug 28 "
" 31 "
No 7107.


Flashing Block
Machine Room
Flashing Block
13"
7½" Slab
13"
18'-0"
17'-0"
4-⅞" Bars in wall Gl.s opp. N & S. rows of Gl.s with ⅜" bands @ 12" ctrs
8-⅞" Bars in 4th Gl. with ⅜" bands @ 12" ctrs.
4th Gl. = Pilasters
18" diam.
14½"
9" Slab
14½"
For details of reinforcing in Floor
8-⅞" Bars in 4th row Gl.
⅜" bands @ 12" ctrs
6-⅞" Bars in wall
Opp. N & S. rows of Gl.s with ⅜" bands @ 12" ctrs
4-18" Bars in wall opp. each row of Gl. with ⅜" Bands @ 12" ctrs
4-18" Bars. 7'-6" lg. hooked lower ends opp. each row of Gl.s
28" Sq.
Reinforcing in pilasters & footings same as piers in Machine Room. See Drg. No. 7099.
8" Slab
9" Slab
North wall girder Machine Room
Section at "B-B"
Section at "A-A"
Section at "C-C"





Section of Elevator Pit.

Riverside Fibre & Paper Co.

Appleton, Wisconsin.

Plans for Paper Mill.

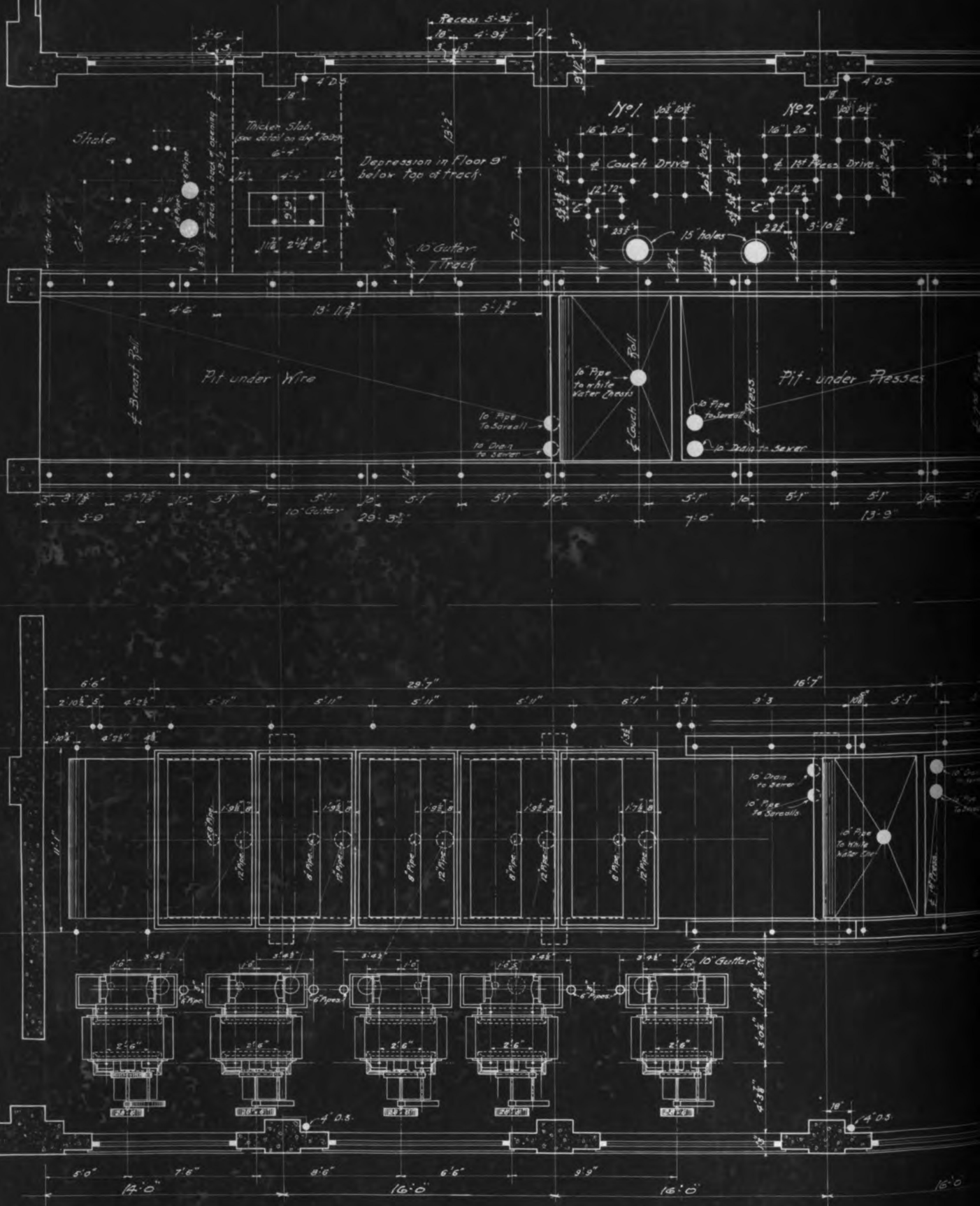
Longitudinal Section - Finishing Room.

Scale: ¼" = 1'-0".

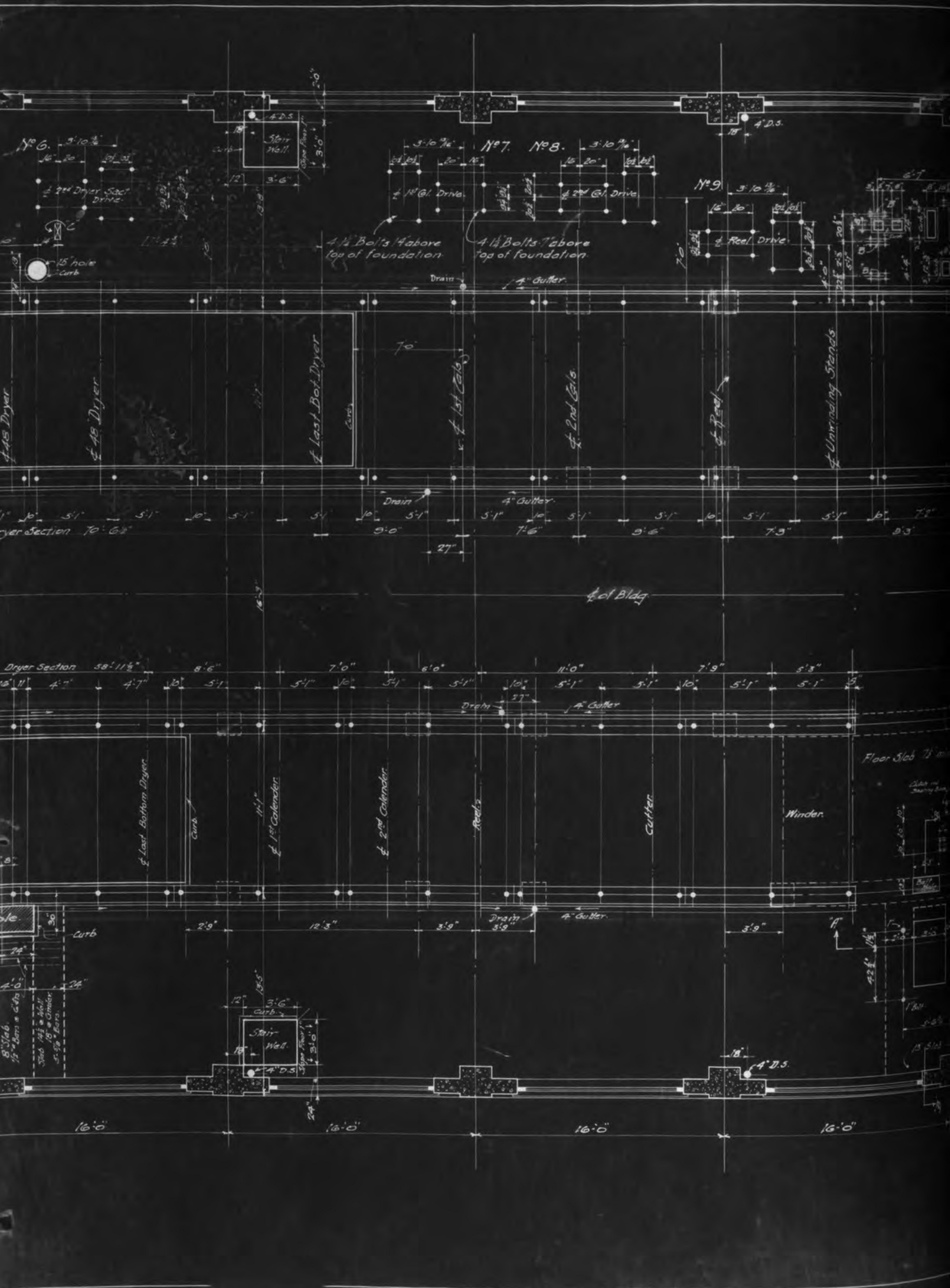
Orbison & Orbison, Consulting Engineers.
Appleton, Wis.

Aug. 3. 1923.
Revised. Aug. 11. 1923.
" " 18. "

No 7106.

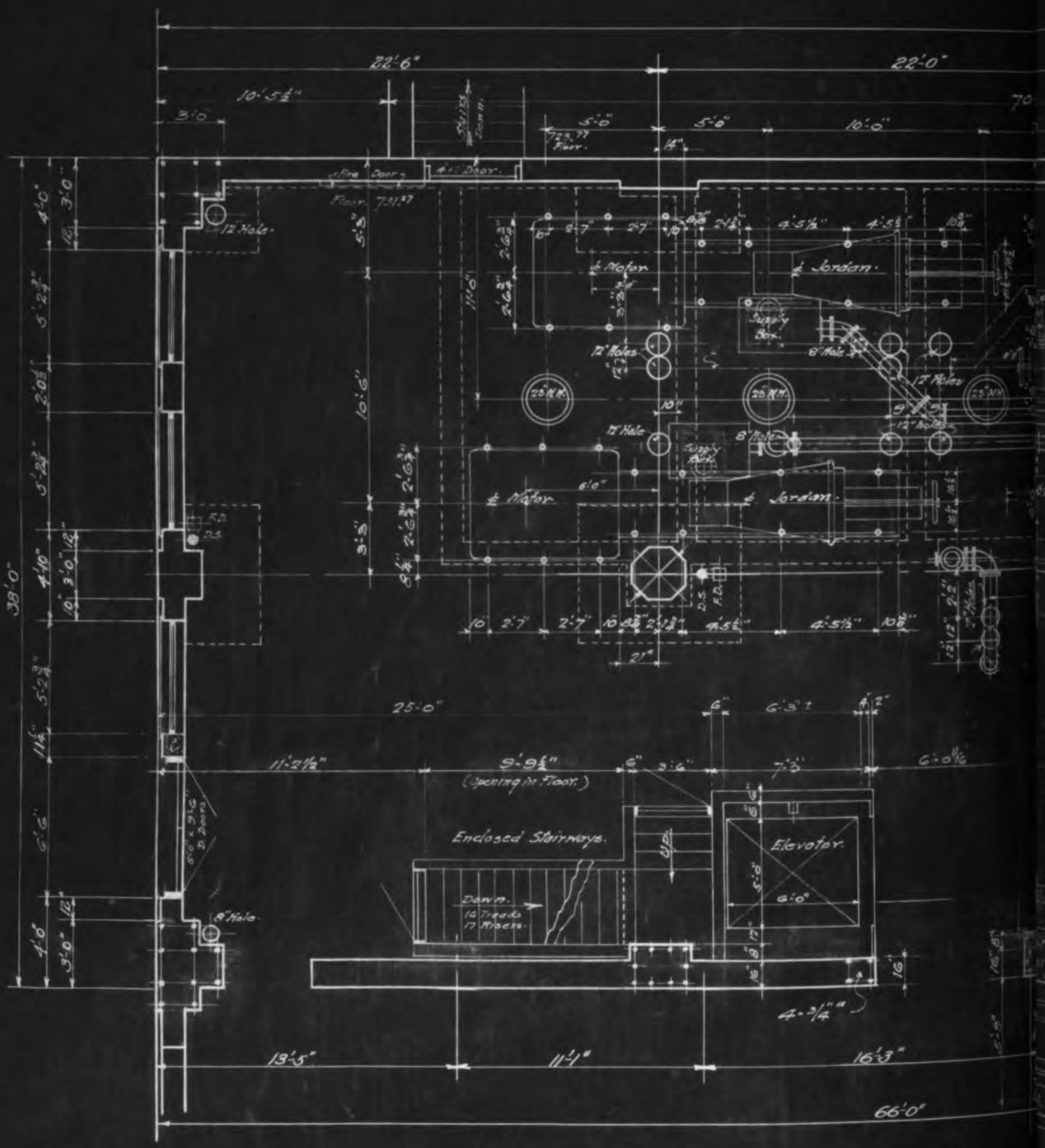

Recess 5'-3½"
Shale
Thicken Slab. see detail on dge Tools
Depression in Floor 9" below top of track.
10" Gutter
Track
No 1.
No 2.
℄ Couch Drive
℄ 1st Recess Drive
15" holes
℄ Breast Fall
Pit under Wire
10" Pipe to white water Davis
10" Pipe To Sprinkler
10" Drain to Sewer
℄ Couch
℄ Press
Pit - under Presses
10" Gutter
29'-3½"
7'-0"
13'-9"
10" Drain to Sewer
10" Pipe to Sprinkler
10" Pipe to white water Dav
℄ 1st Recess
8" Pipes
10" Gutter
14'-0"
16'-0"
16'-0"
16'-0

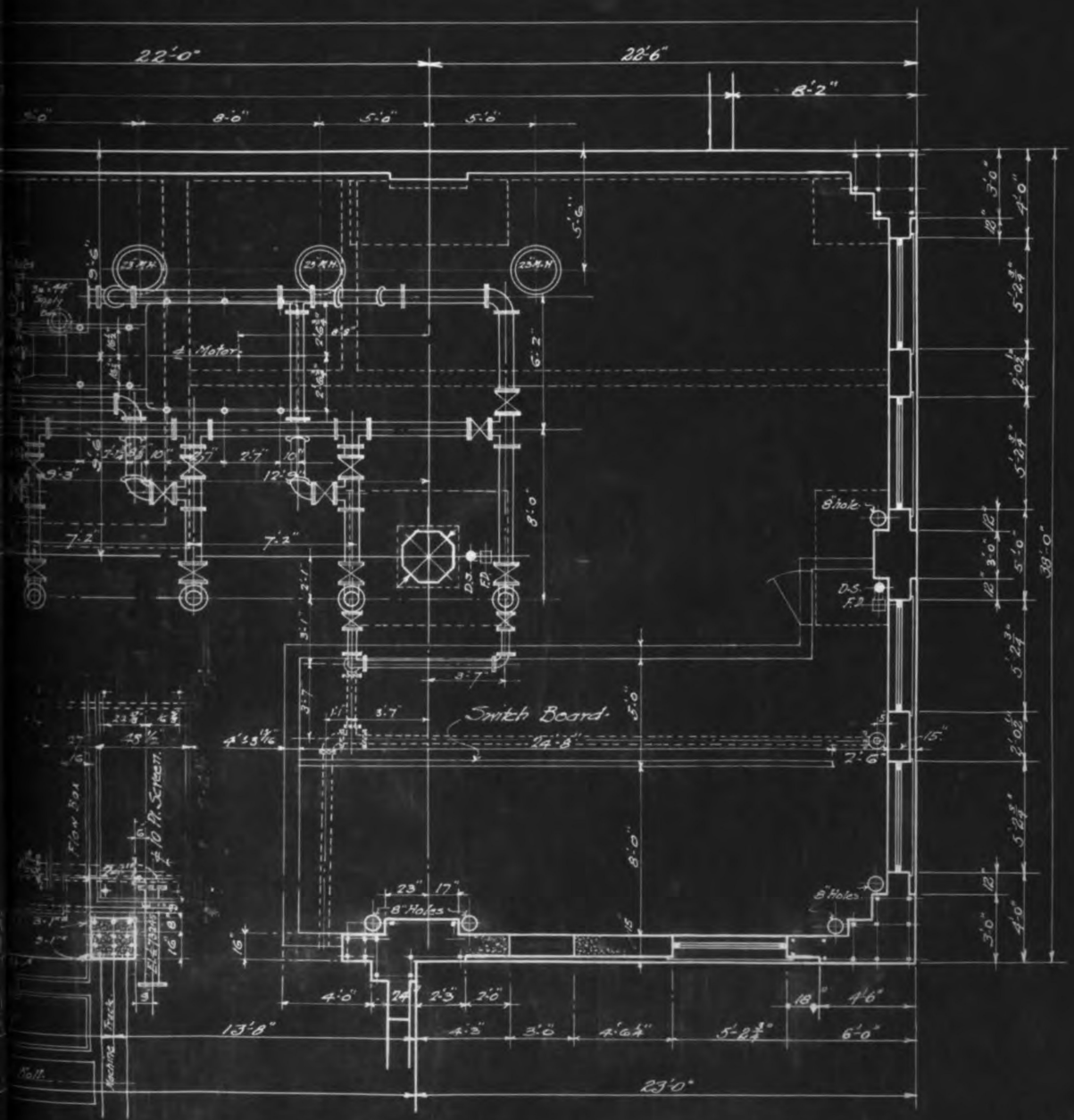
Riverside Fibre & Paper Co. No. 7144. Sheet


No 6.
No 7.
No 8.
No 9.
4" D.S.
Stair Well
Stair Floor
4 2nd Dryer Sect. Drive.
4 1st Cal. Drive.
4 2nd Cal. Drive.
4 Reel Drive.
4 1/2 Bolts 14" above top of foundation.
4 1/2 Bolts 7" above top of foundation.
15" hole
Curb
Drain
4" Gutter.
4 45 Dryer
4 48 Dryer
4 Last Bot. Dryer
Conv.
4 1st Cals.
4 2nd Cals.
4 Reel
4 Unwinding Stands
Dryer Section 70' 6"
9'-0"
7'-6"
9'-6"
7'-9"
27"
4 of Bldg.
Dryer Section 58' 11 1/2"
4 Last Bottom Dryer
Conv.
4 1st Calender
4 2nd Calender
Reels
Gutter
Winder
Floor Slab
Curb
2'-9"
12'-3"
3'-9"
Drain
3'-9"
4" Gutter.
"A"
Stair Well
16'-0"
16'-0"
16'-0"
16'-0"

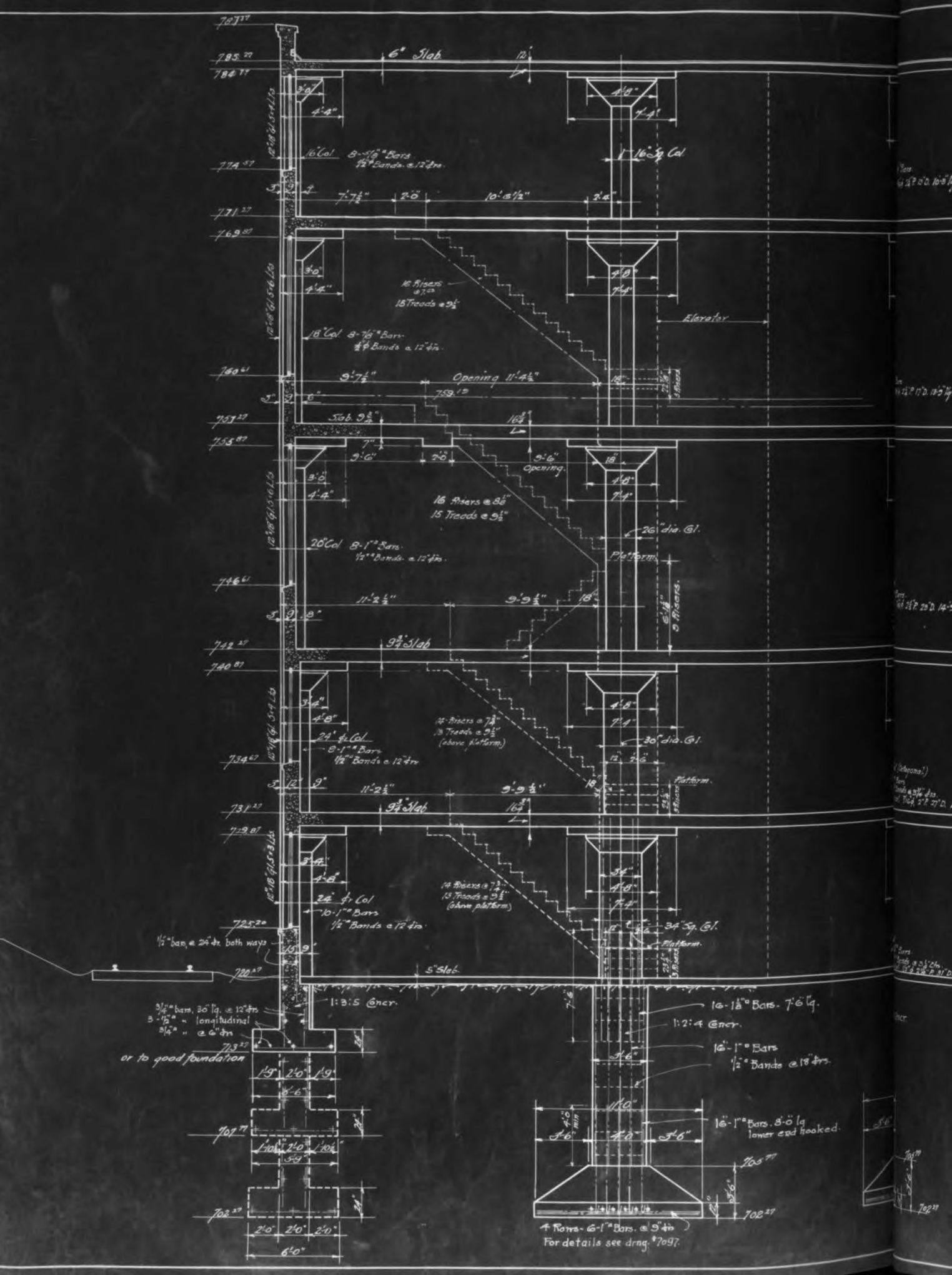
Sections.	"A"	"B"
No 1. Couch.	7⅞	2'-2¾
2. 1st Press.	2'-10	4'-5
3 & 4. 2nd & 3rd Press.	18⅛	3'-1½
5 & 6. 1st & 2nd Dryers.	6"	2'-1"
7 & 8. No 1 & 2nd Cal.s	8⅛	2'-3⅝
9. Reel.	7⅛	2'-2½

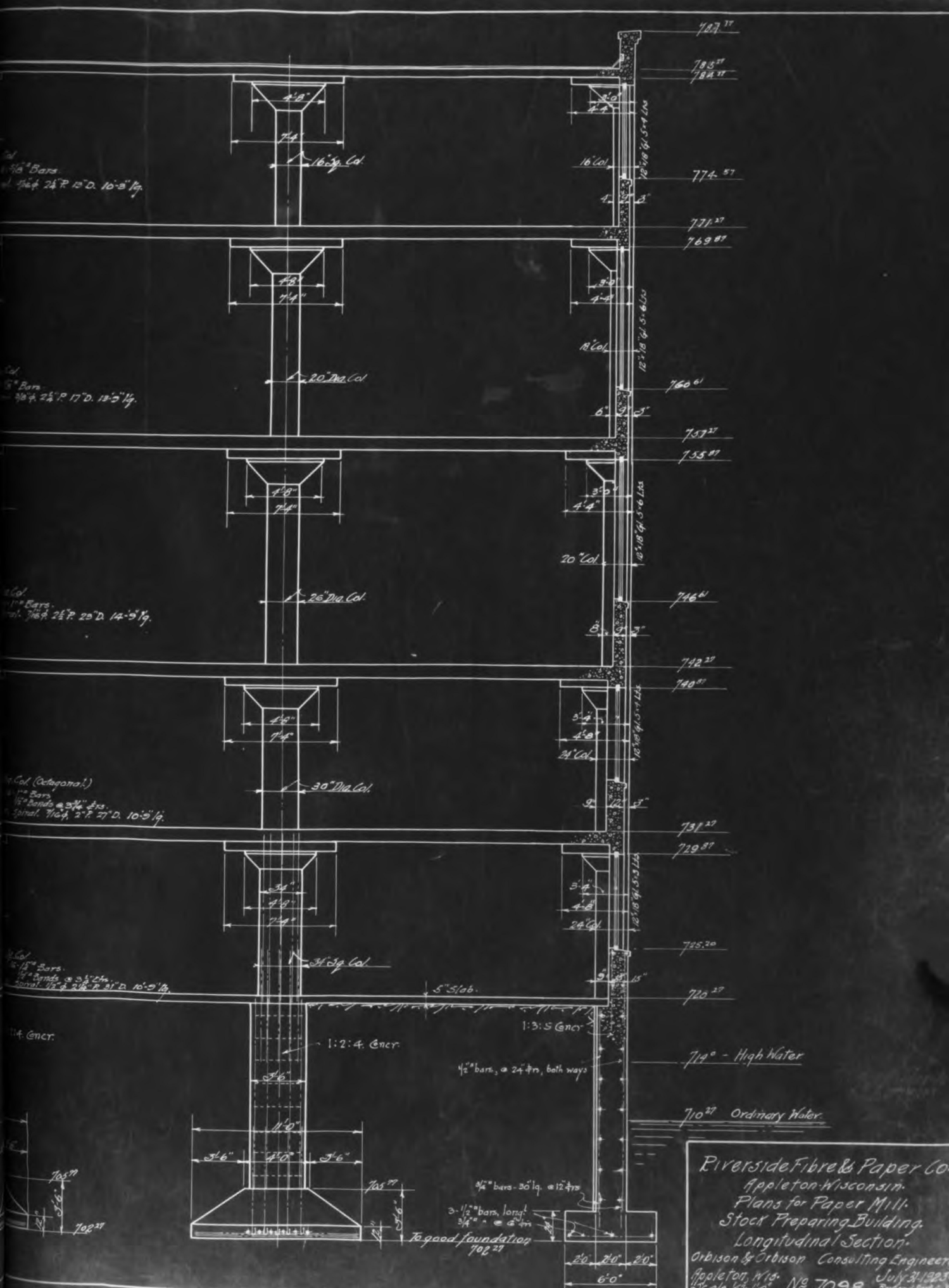
Riverside Fibre & Paper Co.
Appleton, Wisconsin
Plans For Paper Mill
Main Floor Plan - Machine Room.
Scale - ¼" = 1'-0"
Orbison & Orbison Consulting Engrs.
Appleton, Wis. No. 7144 Oct. 28 1923

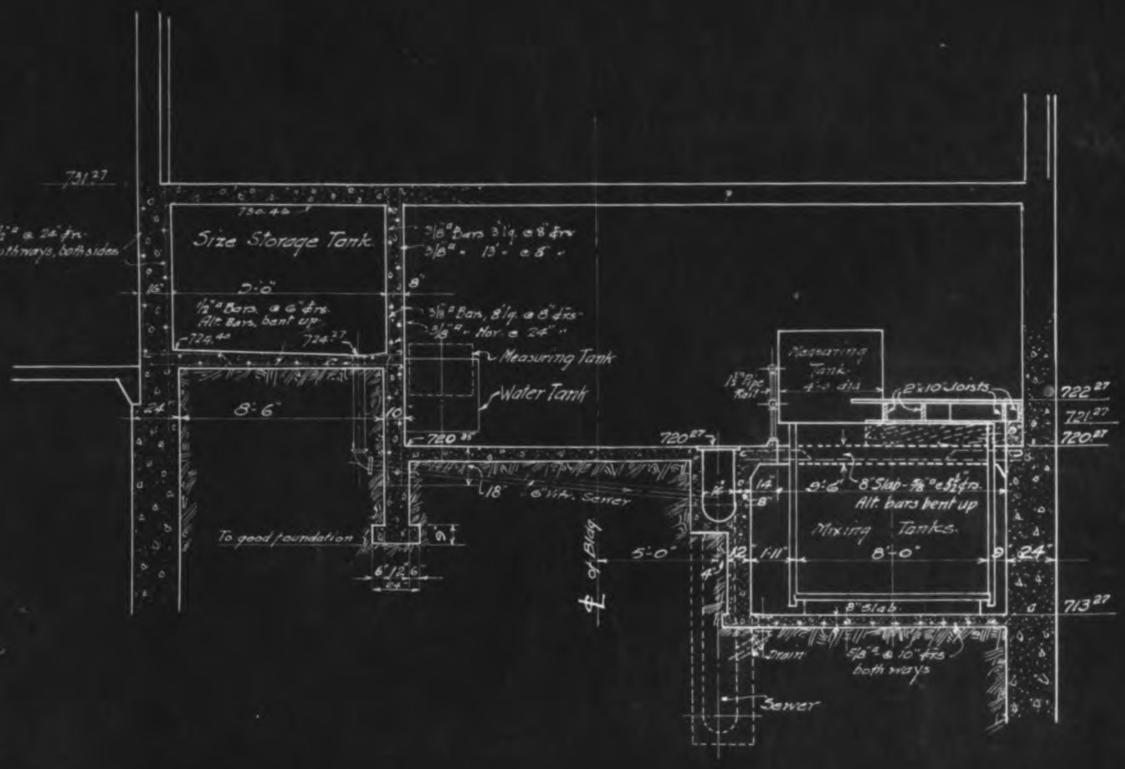

22'-6"
22'-0"
10'-5½"
3'-0"
5'-0"
5'-6"
10'-0"
14"
Fire Door
4'-1" Door
12" Hole
E. Motor.
E. Jordan.
Supply Box.
17" Holes
8" Hole
12" Holes
20" N.H.
10"
5'-3"
10'-6"
3'-3"
E. Motor.
6'-0"
E. Jordan.
F.D.
21"
38'-0"
25'-0"
11'-2½"
9'-9½"
(Opening to Floor.)
6"
3'-0"
7'-3"
6'-0½"
Enclosed Stairways.
Elevator.
Down.
16 Treads
17 Risers.
6'-0"
4'-3¼"
13'-5"
11'-1"
16'-3"
66'-0"

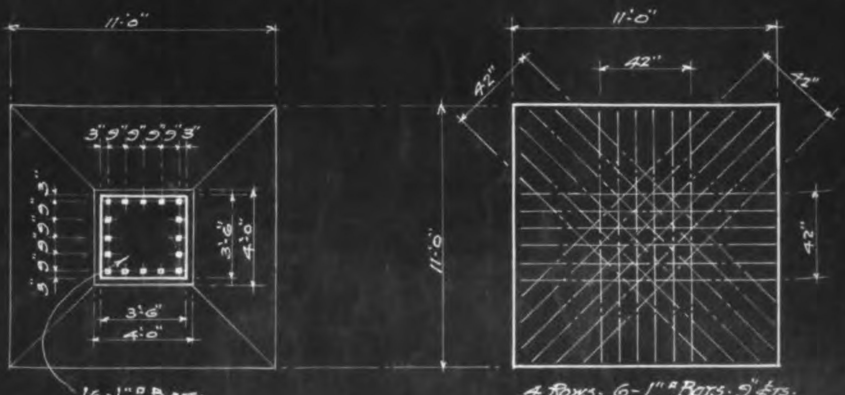


Riverside Fibre & Paper Co.
Appleton - Wisconsin.
Plans for Paper Mill.
Stock Preparing Building.
Main Floor Plan.
Scale; 1/4" = 1'0"
Orbison & Orbison, Consulting Engrs.
Appleton, Wisc. No. 7102 Aug. 1, 19


6" Slab
16" Col
8-⅞" Bars
½" Bands @ 12" ctrs.
16" Sq. Col
Elevator
Opening 11'-4½"
Slab 9¾"
16 Risers @ 7.63"
18 Treads @ 9½"
18" Col
8-⅞" Bars
½" Bands @ 12" ctrs.
Opening
16 Risers @ 8⅛"
15 Treads @ 9½"
20" Col
8-1" Bars
½" Bands @ 12" ctrs.
Platform
9 Risers
9¾" Slab
14 Risers @ 7⅞"
13 Treads @ 9½"
(above platform)
24" Col
8-1" Bars
½" Bands @ 12" ctrs.
30" dia. Gl.
Platform.
9¾" Slab
14 Risers @ 7⅞"
13 Treads @ 9½"
(above platform)
24" Sq. Col
10-1" Bars
½" Bands @ 12" ctrs.
34" Sq. Col.
Platform.
5" Slab
1½" bars @ 24" ctrs. both ways
1:3:5 Concr.
¾" bars, 30" lg. @ 12" ctrs
3-½" " longitudinal
¾" " @ 6" ctrs
or to good foundation
16-1⅛" Bars. 7'-6" lg.
1:2:4 Concr.
16-1" Bars
½" Bands @ 18" ctrs.
16-1" Bars. 8'-0" lg
lower end hooked.
4 Rows 6-1" Bars @ 9" ctrs
For details see drng. #7097.

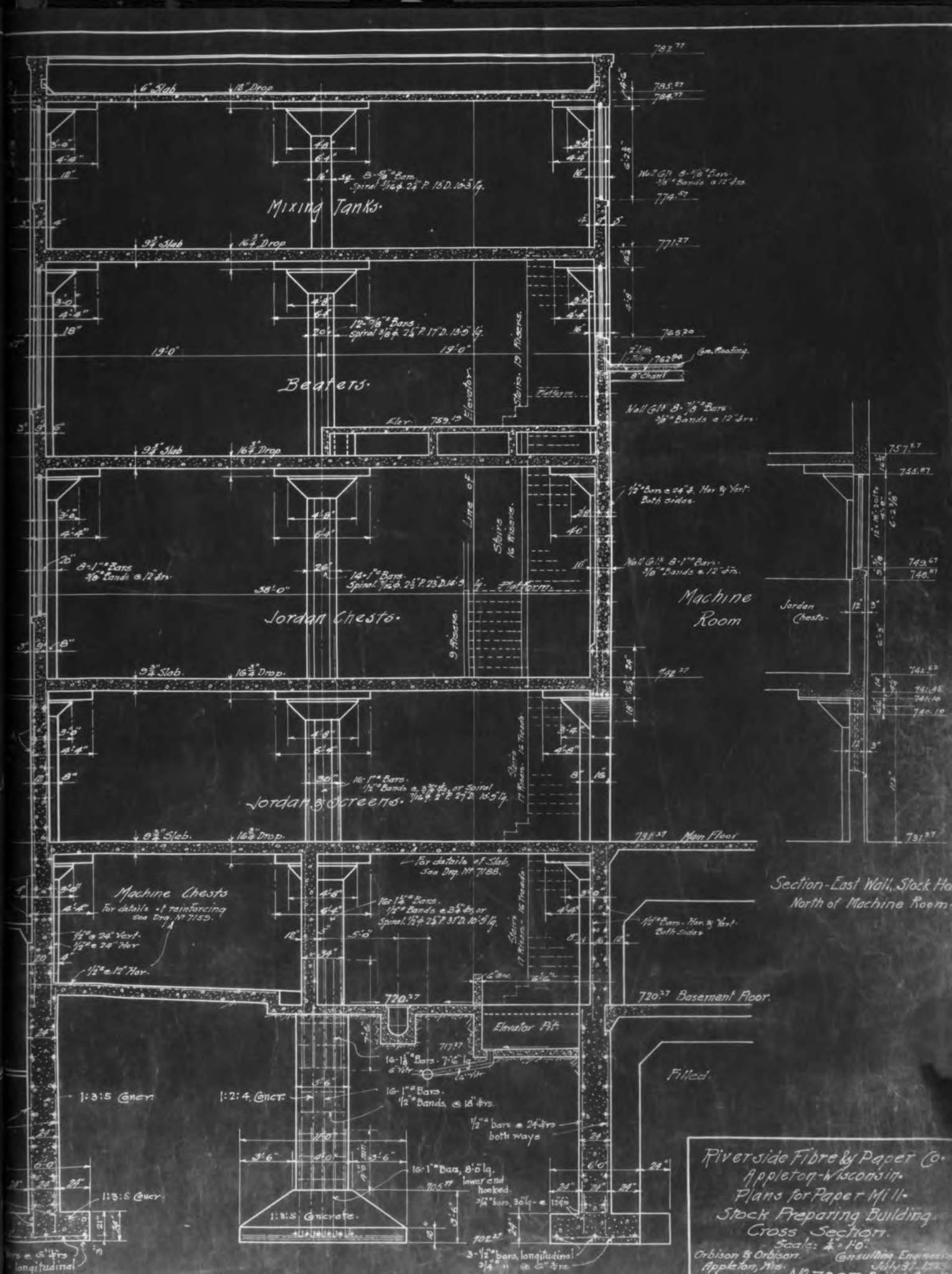

787.27
783.27
784.27
4'-0"
7'-4"
16"Sq. Col.
16" Col.
12"x18" @ 5'-9" Ctrs
774.57
771.27
769.87
4'-8"
7'-4"
20"Dia. Col.
18" Col.
12"x18" @ 5'-6" Ctrs
760.61
757.27
755.87
4'-8"
7'-4"
26"Dia. Col.
20" Col.
10"x18" @ 5'-6" Ctrs
746.61
742.27
740.87
4'-8"
7'-8"
30"Dia. Col.
24" Col.
12"x30" @ 5'-9" Ctrs
731.27
729.87
4'-8"
7'-4"
34"Sq. Col.
24" Col.
12"x18" @ 5'-3" Ctrs
725.20
720.27
5" Slab.
1:3:5 Concr.
1:2:4 Concr.
714.0 - High Water
4½"ø bars, @ 24" Ctrs, both ways
710.27 Ordinary Water
11'-0"
3'-6"
4'-0"
3'-6"
705.27
708.27
3¼" bars - 30" lg. @ 12" Ctrs
3-1½" bars, long.
3¼" " @ 6" Ctrs
To good foundation
708.27
2'-0"
2'-0"
2'-0"
6'-0"
River side Fibre & Paper Co
Appleton Wisconsin.
Plans for Paper Mill.
Stock Preparing Building.
Longitudinal Section.
Orbison & Orbison Consulting Engineers
Appleton, Wis. No. 7098 July 31 1923





Plan - Top of Base.

Plan of Column Bases.


Mixing Tanks.
Beaters.
Jordan Chests.
Jordan & Screens.
Machine Room
Jordan Chests
Machine Chests
Elevator Pit
Filled
Main Floor
Basement Floor
Section - East Wall, Stock Ho
North of Machine Room
Riverside Fibre & Paper Co.
Appleton - Wisconsin.
Plans for Paper Mill.
Stock Preparing Building.
Cross Section.
Scale: 1/4" = 1'-0"
Orbison & Orbison.
Consulting Engineers
Appleton, Wis.
July 31, 1923