PLANS AND SPECIFICATIONS FOR THE INSTALLATION

of a

300 KILO-WATT UNIT

in the

MANHATTAN POWER STATION.

* * * *

Geo. B. Eaton

G. Leon Hoffman.

Outline.

Plans and Specifications:

Building:

Engine Room.

Boiler Room.

Generator.

Engine.

Electrical Apparatus.

Boilers.

Heaters and Pumps.

Smoke Outlet.

Summary of Cost.

Engine Room Specifications.

Excavation. The excavation is to be 3 feet wide and 3 feet deep.

Foundation. The foundation is to built of good stone laid in Portland Cement Mortar.

Walls. The walls are to be of rough stone, the same as old walls. Thickness 30 inches. The east wall will be the new boiler room wall. The walls to be 11 feet in height above the floor, and the other dimensions can be found in the floor plan of the engine room.

Roof. The roof is to be a continuation of the old roof, the old roof being raised to a height so as to allow a continuous slope to the south wall. The ridge to remain the same as before. Hard pine lumber is to be used in the construction as shown on the cross section of the engine room. The rafters are braced with 6 inch fence boards, as shown, and the roof supported upon the walls and on two I beams supported on 12 inch by 12 inch posts. The roof is to be covered with gravel roofing. Rafters are to be placed 16 inches apart.

Floor. The floor is to be of concrete composed of one part cement, three parts sharp sand and five parts crushed lime stone. It is to cover the entire building and is to be 6 inches in thickness.

Windows and doors are to be placed as shown in the floor plan, and to be the same as old doors and windows. Those taken from old south wall are to be used in the new part.

Cost of Enginr Room Addition.

Stone work of addition.

Dimensions of walls:

Length on inside	58 feet 6 inches.
Width on inside	32 feet.
Stone in side wall	1632 cubic feet.
Stone in rear wall	512 cubic feet
Stone in foundation	1133 cubic feet.
Total	3277 cubic feet.

132.5 perch of stone at $3.20 per perch $424

(Note) The stone saved, by the openings for doors and windows, will pay for the door and window frames.

7 windows at $25 each	$75
3 doors at $25 each	$75

Concrete Floor.

1969 cubic feet of concrete at 15¢ per cubic foot $295.35

Roof.

Number of eet of dimension lumber, 4569.2

4569.2 feet at $30 per thousand	$137.00
2340 feet of sheeting at $25 per thousand	58.50
1720 feet of fencing at $25 per thousand	43.00
2340 square feet of gravel roofing at $4.03 per square foot	104.30
7 12 inch by 12 inch posts at $5.00	35.00
I beams	25.00
Excavation for foundation, 42 cubic yards at 50¢	21.00

Engine.

Capacity	500 Horse Power.
Speed	100 Revolutions per minute.
Type	Monarch, cross compound Corliss.

Specifications for Boiler Room.

The boiler room is to include the old coal room, and the west wall of the old coal room is to be used in the new boiler room. The line of the west wall is to be the line of the new west wall.

Excavation.

The excavation for the foundation is to be 3 feet deep and the floor is to be 5 feet below the engine room floor level.

Foundation.

The foundation is to be 3 feet deep and is to be of stone laid in Portland Cement mortar, consisting of one part American Portland cement to five parts sand.

Walls.

The walls are to be of rough stone, and they are to be 20 inches wide and 16 feet high. The floor plan and the cross section show all details of construction. There is to be a 20 inch cross wall between the coal room and the heater, to protect the heating apparatus. The front of the heating room is to be open.

Roof.

The roof is to be of iron and to be braced as shown in the cross section of the boiler room and the plan of the roof. All parts are to be riveted together with wrought iron rivets, and the cross timbers are to be braced with clips as shown, riveted to the iron rafters and screwed to the timbers. The height of the ridges of the new boiler room and of the old boiler room are to be the same.

Floor.

The floor in front of the boilers is to be of Portland Cement concrete, consisting of one part American Portland Cement, three parts

sharp sand and five parts crushed limestone.

Cost of Boiler Room.

Dimensions of Walls:

Length outside	51 feet 4 inches.
Breadth	43 feet 4 inches.
Length of cross wall	20 feet 6 inches.
Height of walls	16 feet.

Cubic feet of stone:

Side walls	1920 cubic feet.
End wall	1156 cubic feet.
Cross wall	547 cubic feet.
Foundation	1716 cubic feet.
Total	5339 cubic feet.

Price of stone laid in the wall per perch $3.20.

205.7 perch at $3.20 $690.25

(Note) The stone saved, by the openings for doors and windows, will pay for the door and window frames.

Cost of Concrete Floor.

Dimensions:

Length	40 feet.
Width	28 feet 6 inches.
Depth	6 inches.

570 cubic feet of concrete at 15¢ per cubic foot $85.50

Cost of three doors at $25 per door $75

Cost of Excavation for Boiler Room.

Foundation	104.4 cubic yards at 50¢	$52.20
Room	249 cubic yards at 50¢	$125

Cost of Boiler Room Roof.

Iron Work:

5	43 feet 4 inches	of 4 pound lattice	866.66	pounds
2	52 feet	of 1 pound angle	104	pounds
2	52 feet	of 2 pound angle	208	pounds
10	24 feet	of 2 pound angle	480	pounds
10	19 feet	of 2 pound angle	380	pounds
10	31 feet	of 1 pound angle	310	pounds
Total weight of iron (not including roof)			2290	pounds

2290 pounds at 6¢ per pound $137.40

Cost of Roofing.

2304 square feet at 30¢ per square foot $691.20

Cost of Hard Pine Lumber.

20	2 feet by 8 inches	51 feet 4 inches long	1380 feet.
	2 feet by 8 inches	146 feet long	195 feet.
	Total		1575 feet.

1575 feet at $30 per thousand $47.25

Dimensions and Data for Heine Boilers.

Number of boilers 3 Horse power each 200

Working pressure 150 pounds Total horse power 600

Setting:

Length over brick work battery of three	17 feet 8 inches
Width of brick work battery of three	26 feet 4 inches
Height of side walls battery of three	8 feet
Height to top of stream outlet battery of three	15 feet ¼ inch
Number of No.1 fire brick battery of three	4700
Number of common brick	26500

Drums: Number to each boiler 1
Diameter 44 inches. Length 17 feet 8 inches.

Specifications for Walling In Heine Boiler. Size 200 Horse Power.
Excavation. The excavation for the foundation is to be 3 feet deep.
Foundation. The foundation is to be built of good brick, laid in Portland Cement concrete, consisting of one part of American Portland Cement, three parts sharp sand and five parts crushed stone, or clean gravel. It consists of four walls of dimensions and arranged as shown on foundation drawing of boilers. The top of the foundation is to be smooth and level with the floor of the boiler room. The top 10 inches must be built to proper form and dimensions, to allow for the construe tion of the side walls of the sunken ash-pit.
Rear Wall. The wall at rear of boilers carries one-half the whole weight of the boilers, and must be built carefully. It is to be 22½ inches thick, of which 4½ inches are to be of fire brick. This wall carries the plates and rollers upon which the rear waterleg of the boiler rests, and must be of such height that the top of the roller, when in position, shall be 2¼ inches above floor level. A circle top ash door is to be placed in the rear wall, on the center line, with the sill one course above the boiler room floor. The five top courses of the wall are to be laid in Portland Cement, the remainder of the wall in Portland Cement mortar.
Front Wall. The front wall commences on top of the dead plate of fire front, and forms a 12 inch lining to the same. It is laid up around and over the fire brick jams and arches which form the openings at the fire doors, and is carried up to within 1 inch of the lower tubes, as shown in drawings. Both front and rear walls are 1 inch away from the rivet heads of the waterlegs, and from sheets of shells, and are not to touch either in any case. This 1 inch space is to be filled in with asbestos fiber. After passing the top tubes, the inside courses

of side walls are returned to the inside of and against the tube sheets of both waterlegs, thus becoming part of front and rear walls.

Side Walls. The side walls are to be run up at the same time as the rear wall and bonded thereto. They are to be 19 inches thick from floor level up to the height of the top tubes, of which thichness 4 inches are to be of fire brick lining and 2 inches air space. The air spaces are one brick in from outside faces and extend from floor level to two courses below the top of fire brick lining. Outside the air spaces the wall is built solid from floor level to two courses below top of fire brick lining. Outside the air space the wall is to be built solid from floor to top of setting with good red brick. Inside the air space, the wall is to be 9 inches, or one brick, thick, of which 4 inches are to be of red brick, and four inches of fire brick (headers every sixth course), and must be well braced across air space to outside wall. From height of top tubes, the wall continues solid up to a line level with the tile bars on side of shell. At this point, the side covering plates are put on as shown, entirely closing in the boiler from front end to a point 5 feet 6 inches forward from inside of 13 inch wall. Above the side covering plates the walls are to be continued up 13 inches thick to height shown on longitudinal section. A cast iron cleaning frame and plate is to be placed on each side of the shell, one side of the frame resting on the tile bars and one side built into the wall. The plate is to be paved with one course of red brick laid in sand. A cleaning door is to be placed in the rear wall between the two shells. The fire brick lining for the side and the partition walls at grates is to be 9 inches thick for nine courses above grates, the top two courses being headers. This 9 inch lining is to be the same length as the grate.

Partition Walls. The partition walls are to be run up at the same time as the rear wall and bonded thereto. They are to be 28 inches thick from floor level up to the height of the top tubes, of which thickness 4½ inches on each side are to be of fire brick lining (headers every sixth course) and 19 inches are to be of red brick with an air space in the center. The air space extends from the floor line up to two courses below the top of fire brick lining, the same as in the side walls. From height of top tubes the wall continues solid up to a line level with the bars on side of the shell. At this point, the side covering plates are put on as shown, entirely closing in the boiler from front end to a point 5 feet 6 inches forward from inside of 13 inch rear wall. The wall is not continued above side covering plates excepting in rear where the walls form part of the smoke flue and must be carried up to the full height of the setting.

Cross Wall. A 13 inch red brick cross wall resting upon the side covering plates and shell is to be built the entire width of setting, and is placed 3 feet 4 inches forward of inside face of 13 inch rear wall.

Bridge Wall. The bridge wall is to be located and built of the dimensions shown on drawing. Above the grates it is to be kept ¼ inch away from the side walls of the furnace. Below the grates it is to be tied into side walls.

Combustion Chamber. The sides and ends of the combustion cjamber are formed of fire brick furnace lining, and its floor by laying a course of red brick upon a smooth sand bed and a course of fire brick on this; the joints are to be well filled with fire clay. Floor of combustion chamber to be one course of brick above boiler room floor.

Covering Shell. The upper half of the shell is to be covered by one

rowlock course of brick. Forward of the cross wall, the shell covering will rest upon the side covering plates and is of red brick, well bedded in common clay or fire clay. Back of the cross wall the covering will rest upon tile bars at the sides of shell, and must be of fire brick laid in fire clay and smoothed over with salted fire clay.

Ash Pit. The sides and end of ash pit are to be of red brick, the fire brick forming the furnace lining not commencing until top of bearing bars are reached. The floor of the ash pit is to be sunken 6 inches below top of foundation, with an incline up to ash pit doors in fire front. This floor is to be made of one rowlock course of red brick, laid in cement and grouted.

The top five courses of rear, side and cross walls are to be laid in Portland Cement composed of one part of cement to three parts of clean, sharp sand. All other red brick to be laid in lime mortar, to which is added about of 12 percent Portland Cement, which is equivalent to about one 90 pound sack of cement to each thousand brick. All fire clay mortar to be salted, and all fire brick joints to be rubbed to close contact. All lime mortar to be mixed at least 24 hours before using.

Cost of Boiler Installation.

3 200 Horse Power Boilers f.o.b. Kansas City	$5500
Freight to Manhattan, Kansas	450
Erecting Boilers	200
Foundation	125
Brick Work	1200
Total	7475

Heater. The Cochran Heater to be installed is of the open type. It is to be so installed that the engine exhausts freely to the air, and all

the exhaust passes through the heater. The exhaust steam passes into the heater and the oil is separated from the condensed steam. The waste is carried off through a pipe. The foundation for the heater is to be of brick. The boiler room floor plan shows the detail connections for the steam and water to the heater. The floor plan of the boiler room shows the method of placing the heater. It is to have a capacity of 800 Horse Power.

Cost of Heater Installation.

Heater	$650
Piping	25
Foundation	12
Total	687

Chimney. The chimney is to be 90 feet high and 6 feet inside diameter at the base, and is to be able to handle 800 Horse Power boilers. It is to have an 8 foot square base at the bottom, this to run up to 20 feet. The foundation is to be of good stone laid in Portland Cement mortar, and the brick work is to be of red brick laid in Portland Cement mortar.

Cost of Chimney.

Number of brick in the chimney, 220,000

220,000 brick at $8.50 per thousand	$1717
Excavation for chimney, 30 cubic yards at 50¢	15
Cost of laying, including sand and mortar	565
Cost of foundation	400
Total cost of chimney	$2697

Generator.

Capacity	300 Kilo-watts.
Speed	100 revolutions per minute.
Frequency	60 cycles.
Voltage	2300
Kind	Direct connected.

The efficiency of the generator is to be at least 92 per cent at full load, and 91.5 percent at half load. The generator is to have an overload capacity of 25 percent for three hours, without exceeding a rise in temperature of over 50 degrees Centigrade.

Foundation for Engine. The foundation for the engine is to be built from the templet and the requirements on the same. It is to be of concrete the same as specified before.

Cost of engine and generator		$12900
Cost of foundation for engine:		
	1501 cubic feet of concrete at 15¢	$325.50
	Cost of excavation 96 cubic yards at 50¢ per cubic yard	48.00

Switchboard. The switchboard panels are to be of marble and the slabs are to be braced with angle iron and also with plugs fitting into the concrete floor. All parts are to be carefully built and insulated so as to insure entire safety and to be fire proof. In connection with the switchboard, as a protection inside of building, Horn lighting aresters are to be installed, and this should be done on the outside also with Wort aresters.

The switchboard to contain the following instruments:

Direct current:

One Ammeter	0 - 25
One Ammeter	0 - 50
Two Ammeters	0 - 125
One Voltmeter	0 - 150

Alternating current:

One Tirrell regulator.

One Syncronizer.

One ground detector.

Two Ammeters	0 - 50
Two Ammeters	9 - 100
Three Ammeters	0 - 150
One Ammeter	0 - 35
Two Voltmeters	0 - 120
Two Indicating Wattmeters	0 - 200 Kilo-watts.

The full connection and arrangement of panels are shown in the wiring diagram and front view of the switch board.

Cost of switch board complete $1200

Exciters. Two 15 Kilo-watt exciters are to be installed, having a voltage of 125. One is to be belted to the 300 Kilo-watt unit and the other to be driven by a 20 Horse Power induction motor. The motor to be connected to the buses.

The compensator of the 150 Kilo-watt machine is to be discarded and it is to be excited from the exciters. This allows the Tirrill regulator to control the voltage of either the 300 Kilo-watt unit or the 150 Kilo-watt unit and they can be run in parallel.

Providing continuous service is kept up, any one of the

machines can be thrown in, but in case of a shut down either the 300 Kilo-watt unit or the 75 Kilo-watt unit must be started and thrown on the buses until the induction motor starts, for the reason that the 150 Kilo-watt machine would have no field excitation.

Cost of induction motor	$344
Cost of tow exciters	$664

Wiring. The wiring from the machines is to be laid in the concrete floor in cast iron conduit.

Total Cost of Installation.

Boiler Room Wall:		$ 690.25
	Floor and Foundation	85.50
	Doors	75.00
	Roof Frame	137.40
	Roofing	691.30
	Lumber	47.25
	Excavation	77.20
	Boilers Complete	7475.00
	Heater Complete	687.00
Chimney		2697.00
Engine Room Walls and Foundation		424.00
	Excavation	21.00
	Windows and Doors	225.00
	Floor	295.35
	Lumber	238.50
	Roofing	104.30
	Posts	35.00
	I beams	25.00
	Carpenter work	100.00
Engine and Generator		12900.00
	Foundation	325.50
	Excavation	48.00
Switchboard		1200.00
Exciters		664.00
Motor		344.00
	Total Cost	$29711.45

CLO SOUTH WALL 11.TO OLD COAL ROOM

STEAM TO ENGINE

WATER INLET

HEATER

BY-PASS FOR WATER

PUMP

EXHAUST

NOT TO SCALE

FEED WATER TO BOILER

BOILER AND COAL ROOM.

20" WALL

SCALE 4' EQUALS 1"

BOILER FRONT

48'

26'-8"

40'

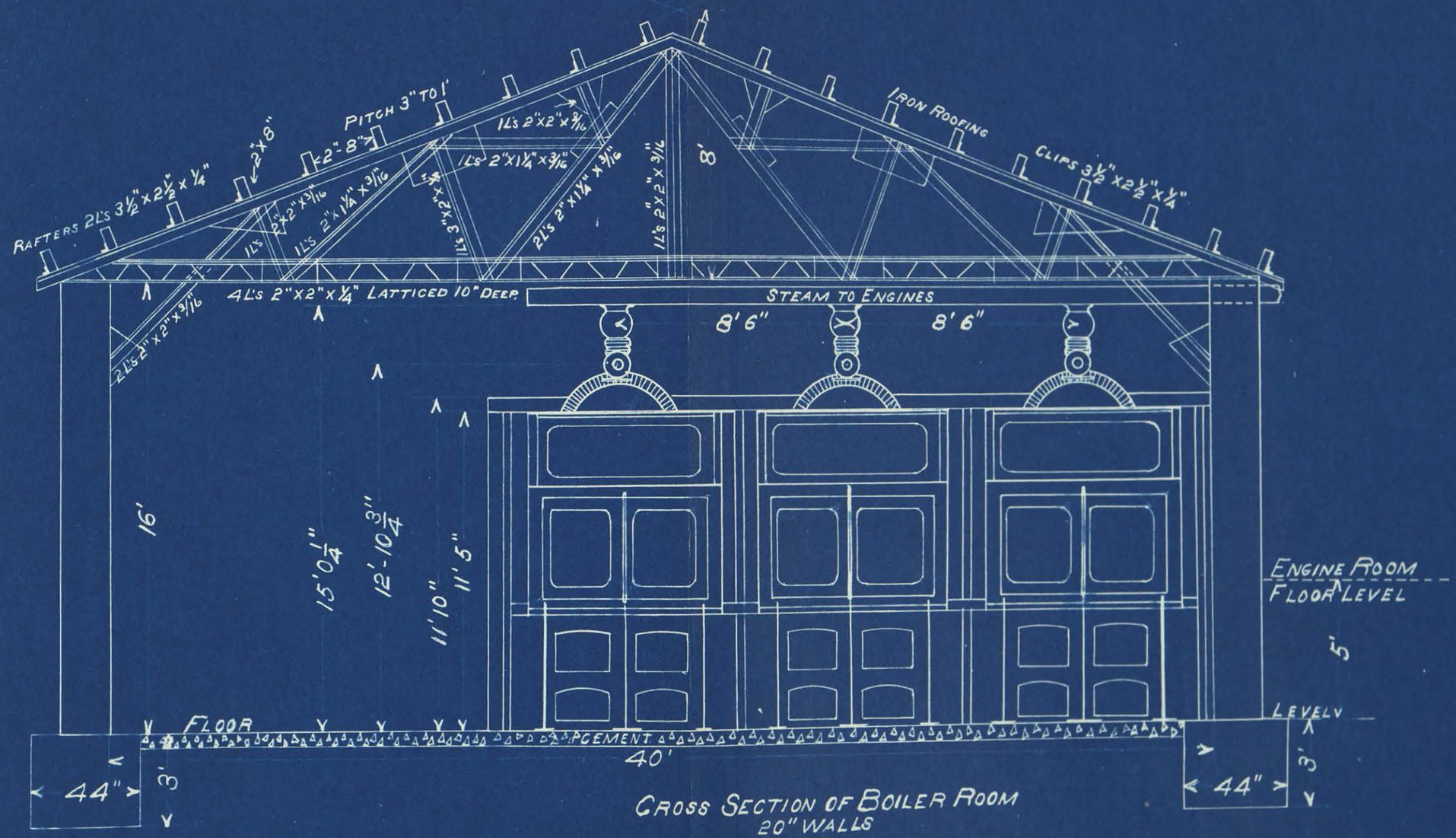
8'-11"

SPACE FOR EXTRA BOILER

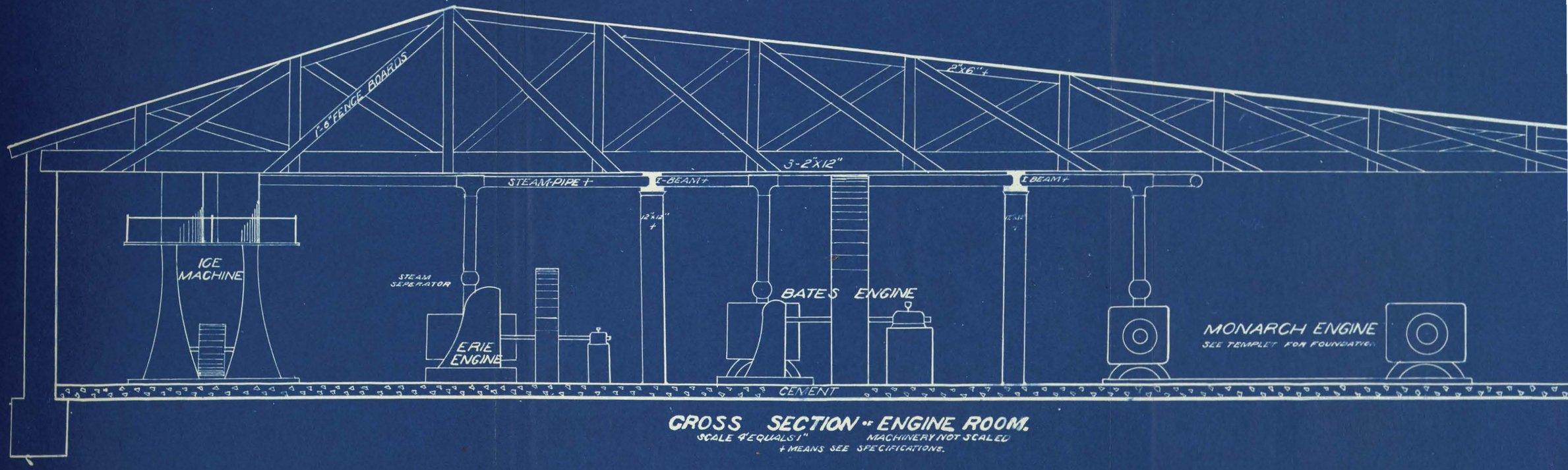
6'

6'

SMOKE OUTLET



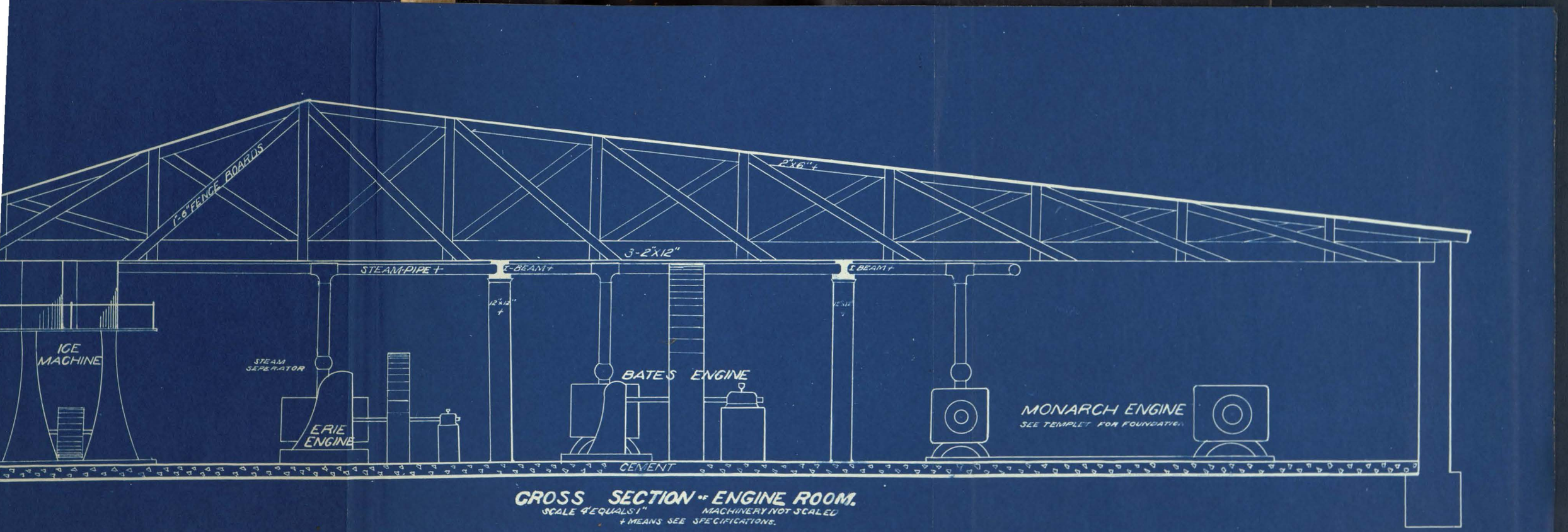
CROSS SECTION OF BOILER ROOM
20" WALLS



CROSS SECTION OF ENGINE ROOM.

SCALE 4' EQUALS 1" MACHINERY NOT SCALED

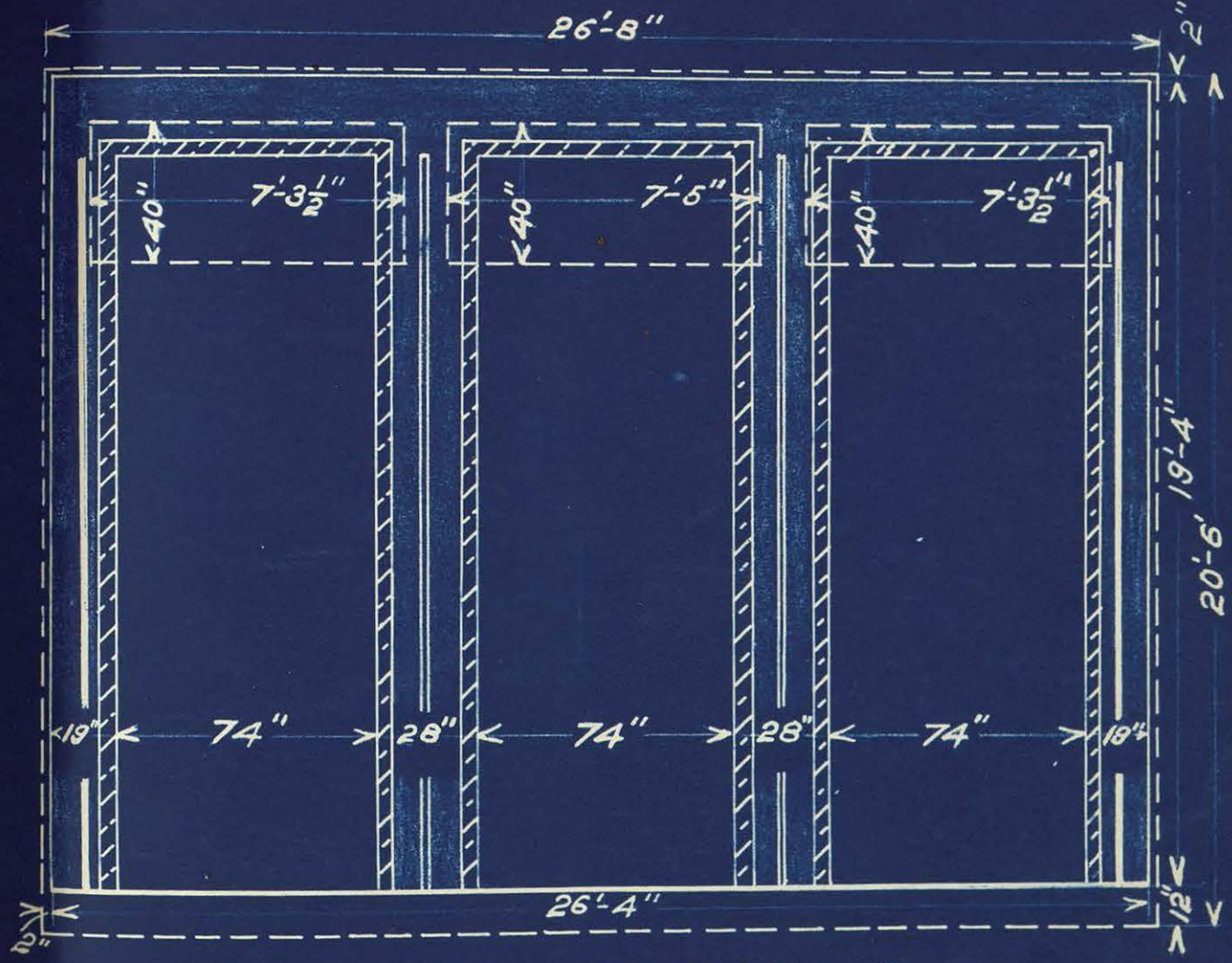
+ MEANS SEE SPECIFICATIONS.



GROSS SECTION OF ENGINE ROOM.

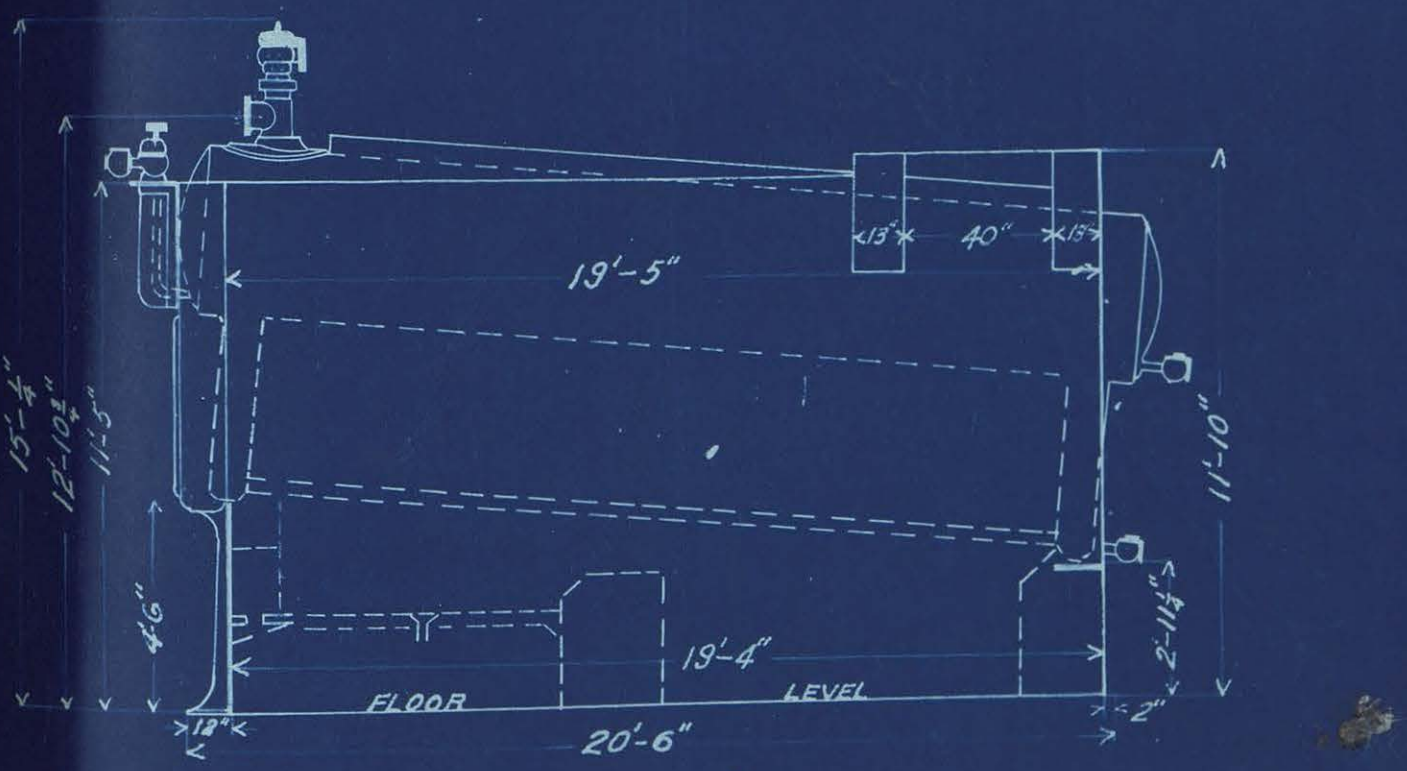
SCALE 8' EQUALS 1" MACHINERY NOT SCALED

+ MEANS SEE SPECIFICATIONS.

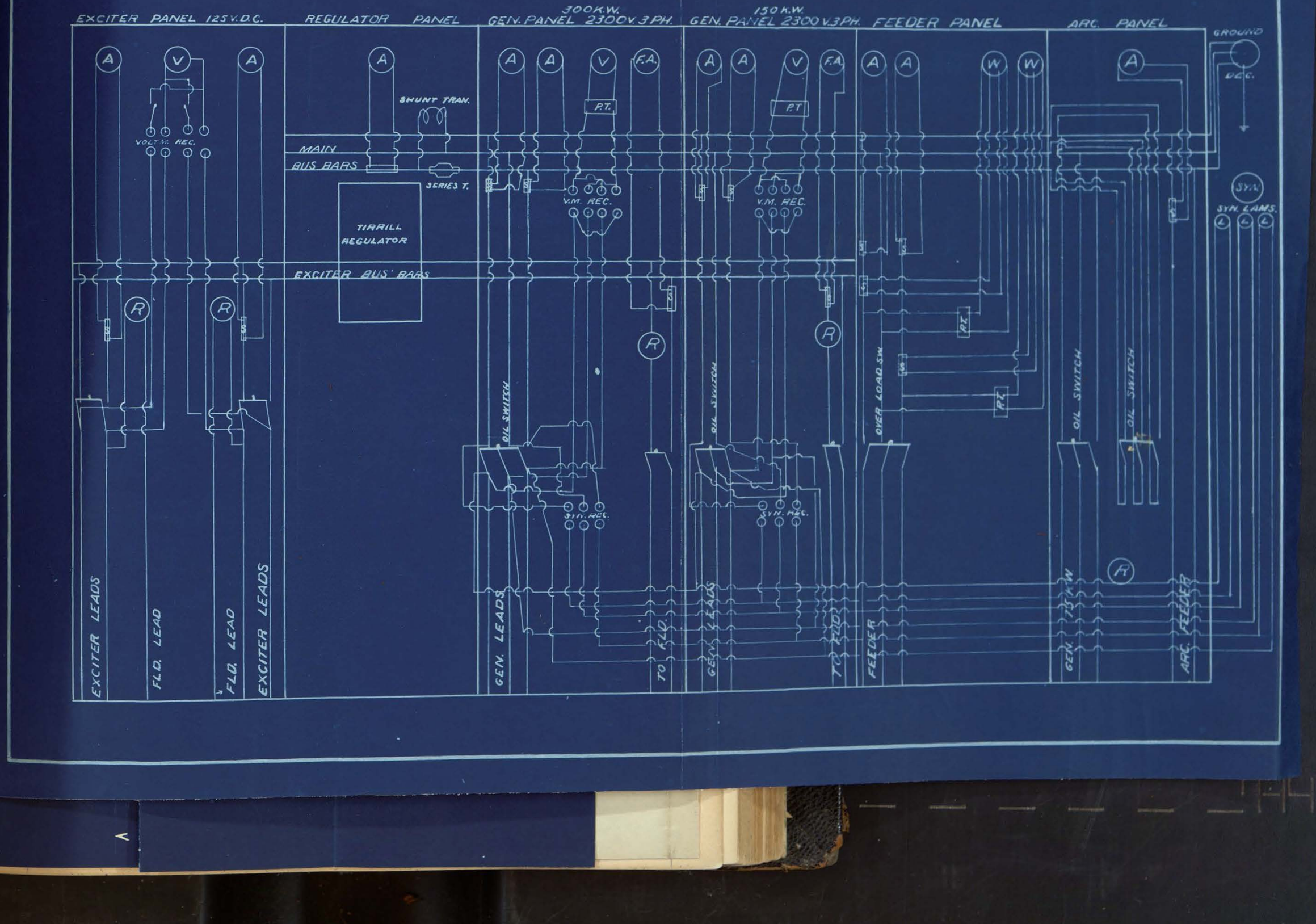


FOUNDATION PLAN 3-200 HP HEINE BOILERS

200 H.P. HEINE BOILER.

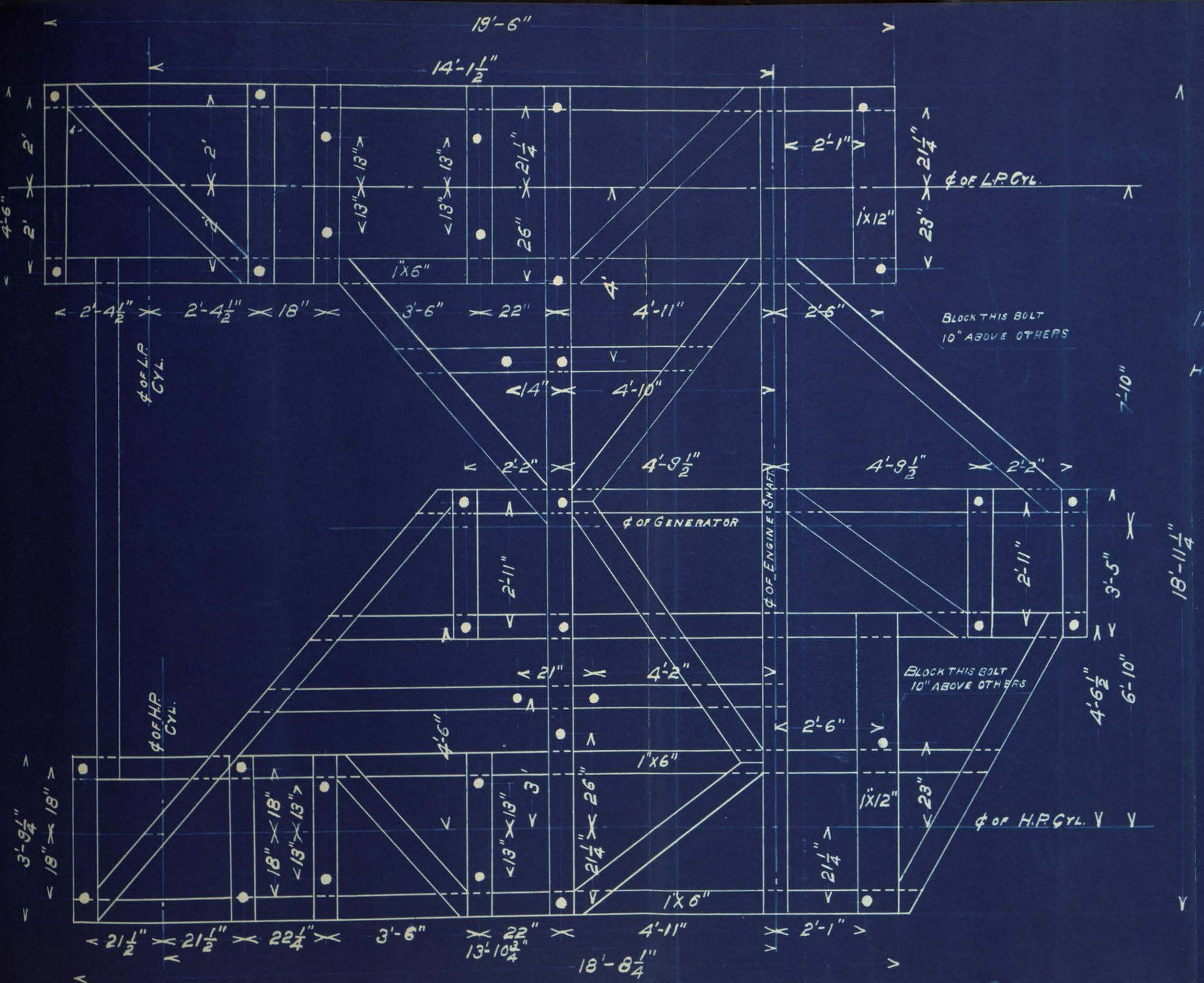


LONGITUDINAL SECTION.


EXCITER PANEL 125 V. D.C.
REGULATOR PANEL
300 K.W. GEN. PANEL 2300 V. 3 PH.
150 K.W. GEN. PANEL 2300 V. 3 PH.
FEEDER PANEL
ARC. PANEL
GROUND
D.C.
A
V
F.A.
W
R
P.T.
VOLT'M. REC.
SHUNT TRAN.
SERIES T.
MAIN BUS BARS
TIRRILL REGULATOR
EXCITER BUS BARS
V.M. REC.
OIL SWITCH
OVER LOAD SW.
SYN.
SYN. LAMPS
SYN. REC.
EXCITER LEADS
FLD. LEAD
FLD. LEAD
EXCITER LEADS
GEN. LEADS
TO FLD.
GEN. LEADS
TO FLD.
FEEDER
GEN 150 K.W.
ARC. FEEDER

ENGINE TEMPLATE FOR 17&34 X 36 MONARCH CORLISS FOR MANHATTAN KANSAS

HOLES FOR 1 1/2" BOLTS SCALE 1/2" = 1'



SWITCHBOARD FOR MANHATTAN STATION