Design for Heating &
Ventilating system for
new Engineering Building
at M. A. C.

E. C. Pokorny

(Orig.)

This thesis was contributed by

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A design for a Heating and Ventilating system for the new Engineering Building at the Michigan Agricultural College.

E. C. Pokorny.

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THESIS

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A design for a Heating and Ventilating system for the new Engineering Building at the Michigan Agricultural College.

In designing a heating system, there are several things which must be taken into consideration, such as the size of the building, its location and its distance from the power plant.

= BUILDING =

The building in which the sustem is to be installed is rectangular in shape, 184 feet long and 84 feet wide. It is five stories high, the first story of stone and the other stories of brick. (These measurements do not include the laboratory in the rear of the building.) The building is partly protected on the east side by the old Mechanical Building and on the west side by Wells hall. The building has a north and south exposure.

= KIND of SYSTEM =

As there are several different systems of heating buildings on the campus, it was possible to determine the efficiency of each system and make a comparison of same. From these results as a basis to work from, it was decided to use the direct, indirect system of heating. In the direct system, the radiators are placed in the rooms and heated directly. In the indirect system, the air is taken from an outside source and drawn in between steam coils, by means of a blower. From the blower, the air is forced through a tunnel to the different openings in the walls and then into the rooms.

The direct system is to furnish forty per cent of the required heat and the indirect system sixty per cent.

By using these two systems together, a good system of ventilation to the different rooms is provided for.

The system is to be arranged so as to heat the rooms at a temperature of seventy degrees Fahrenheit, when it is zero degrees outdoors.

As most of the buildings on the campus are heated by steam from the boiler house, it was decided to get the steam in the same manner.

= DIRECT RADIATING SURFACE =

The amount of heat required for each room, depends upon its size, the amount of air supplied and the glass and exposed wall surfaces. Since there are some losses caused by leakage around the sash and window frames, it was necessary to allow about ten per cent in figuring the amount of radiating surface required. The amount of radiating surface put in depended also on the exposure of the rooms. Where the exposure was from the north, ten to fifteen per cent was allowed. On a west exposure ten per cent was allowed. This rule was not strictly adhered to because it depended largely on the size of the rooms and the size of the radiators which did not always contain the number of square feet required.

To find the amount of radiating surface required, the following formula from Carpenter's Heating and Ventilating was used.

$$R = \left(\frac{N\,C + G + \frac{1}{4}W}{55}\right)\left(\frac{t - t}{T - t}\right)\frac{}{a}$$

N = Number of times air is changed in rooms per hour.
C = number of cubic feet in each room.
G = number of square feet of glass surface.
W = area of exposed walls.

t = temperature of room taken as seventy degrees.
t = temperature outdoors " " zero "
T = temperature of radiating surface.
a = heat given off per square foot of radiating surface per hour per degree difference in temperature.

This rule is not as simple as the following rules and a comparison of same shows that Willets rule is equally as good.

= MILL'S RULE FOR DIRECT RADIATION =

(Monroe's Book)

R = .5G + .05W + .005C.

R = number of square feet of radiating surface.
G = " " " " " glass" "
W = " " " " " wall surface not including windows.
C = number of cubic feet in room.

This rule holds good when temperature of room is 70 degrees and outside temperature from 10 to 15 degrees below zero.

= WILLET'S RULE FOR DIRECT RADIATION =

(Monroe's Book)

R = .9(t-t)(.6G + .1W + .0025C)FJ ÷ t

F = Factor depending on method of heating.
F = .8 for low pressure systems.
J = factor depending on exposure of building.
J = 1 for south and east exposure and 1.4 for north and west

When t is taken at 8 degrees below zero, t at 70 degrees, F at .8 and J at 1, the formula redues to the following.

R = .48G + .08W + .002C

= MONROE'S RULE FOR DIRECT RADIATION =

R = (1.3G + .25W + .008C) J (t-t) ÷ (T-t)a

J = depends on exposure and taken as 1.
T = temperature of steam in radiator.
t = " " room.
t = " " outside air.
a = coefficient of heat transmission from a radiator which varies from 1.7 for low pressure steam to 1.9 for 40# steam pressure.

This reduces the formula to the following.

R = .42G + .08W + .0026C.

= STEAM MAINS =

(Mills System)

To get the best results and on account of the location of the rooms, it was thought best to have the mains run from the tunnel west to the main entrance. From each corner of the entrance the mains extend up to the attic floor and then in an easterly and westerly direction. These mains continue around the building to the south side where they decrease in size.

The return mains are to be placed in the basement and run in the same direction as the steam mains. Between the steam mains and the returns are the risers and from the risers, extend the branches to the different radiators. The return main is to be some what larger so as to equalize the pressure, in case there should be an excess of steam in the returns. The highest point of the return is to be near the main entrance. The lowest point of the returns will lead into two steam taps which are to be fitted with by-pass valves. From here the two pipes lead into one and continue on to the tunnel.

The total amount of radiating surface is 11677 square feet, but as 40% of this is to be direct, we have 40% of 11677 or 4671 sq. ft. of radiating surface for direct heating. To figure the size of main required Carpenter's table on page 223 was used.

Assuming a velocity of 50 feet per second for steam and a pressure of about 3 lbs, we use the tables as follows:

Column 1 gives the velocity.
" 3 " " factor for diameter of pipe.
" 5 " " steam pressure in lbs.

Then the square root of the number of sq. feet. of radiation x .092 gives the diameter of the steam main.

4671 x .092 = 6.25 inches diameter.

The area of a pipe 6.25 in. in diameter = 30.6 square in.
" " " two pipes 4 " " " = 25.0 " "

It was decided to use the two four inch mains and put on a little more steam pressure if necessary. The returns were figured wome what larger to allow for any excess of steam that may pass through the risers and into the returns. This would give the surplus steam a chance to flow up some other riser and thus equalize the pressure.

= SIZE OF RETURN MAINS =

Prof. Carpenter says that the size of a return pipe should be about one size less than one half the size of the steam main. Since the diameter of the steam main is 6.25 inches, the diameter of the return main would be about 3 inches.

= SIZE OF BRANCHES LEADING TO RADIATORS. =

The pipes running between the risers and radiators are called branches. As there is no fixed rule for determining the sizes of them, we have figured the sizes on the following basis.

For	20 ft. or less	of	radiating	surface	in	each	radiator	use	1" pipe
"	20 to 60 ft.	"	"	"	"	"	"	"	$1\frac{1}{4}$" "
"	60 to 80 "	"	"	"	"	"	"	"	$1\frac{1}{2}$" "
"	80 to 100 "	"	"	"	"	"	"	"	2" "

The above sizes will evidently give good results, since they are generally used in the ordinary practice of steam heating.

Carpenter's, Mills and Monroe's Books on Heating and Ventilating were used as reference books for this thesis.

- SIZE OF RISERS -

To determine the size of a riser, it is necessary to know the amount of radiating surface to be heated by the riser. This amount should not exceed 400 sq. feet. In our case, we intend to use a 2" riser throughout the building, although in some places the 2 in. riser is a little larger than necessary and in other places, it is a little smaller. By using the 2 in. risers, it simplifies the piping and equalizes the steam pressure in the risers.

- RADIATORS -

Having determined the amount of radiating surface required in each room, the number of radiators required was figured as follows: Each room is to have a certain number of radiators, depending on the number of sq. feet of radiating surface. Divide this amount into certain parts, each part corresponding to the size of the radiator wanted. The size of radiator depends on its location, for if the radiator is to be near the north or west wall, it should be larger than if placed near an inner wall. Where the radiator has a west or north exposure, we have allowed from 10 to 15% more, to allow for losses due to such exposures. (See data sheet for number of radiators and amount of radiating surface). Also see specifications.

- THE INDIRECT SYSTEM -

The indirect system is to be installed with the direct system for the purpose of furnishing 60% of the heat when it is required and also to give good ventilation. To get the best results, it was thought best to place a thermostatic valve on each radiator, so that in case it got to warm, the thermo-stat would close the valve.

It is intended to operate this system without opening any of the windows.

Of course there is a limit to the amount of hot air entering the room. That is, on cold days, it will probably be necessary to use all the four section of steam coils, which are to heat the air, but on warmer days, it will not. There are to be four sections, connected so that any one section or all of the sections can be shut off. The hot and cold air registers will also furnish a method of shutting off excess of heat, although this method is to be avoided if possible.

= AMOUNT OF INDIRECT HEATING SURFACE REQUIRED =

First Method.

See Carpenter's book on Heating and Ventilating, page 292.

No. of square feet of radiation = $\frac{nc(t-t)}{56a(T-t.)}$ = R

T = temperature of heated surface 220°
t = " " air in the room 70°
t' = " " outside air 0°
t" = temperature of air leaving heated surface 120°
t. = mean temperature of air surrond heating surface 60°
t = ½ (t"-t')
n = number of times air is changed in room per hour
C = number of cubic feet in rooms.
a = coefficient giving number of heat units per degree difference of tempprature per square foot per hour from heating surface.

nc = 3 x 800000 = 2400000 cubic feet.

T = 220° t = 70° t. = 60° t. = ½(120°-0) = 60 t' = 0

$R = \frac{3 \times 800000(70^\circ)}{56\ (10)\ 180}$ = 2850 square feet radiating surface.

The number of heat units given off per degree difference of temperature per square foot of surface per hour is equal to twice the square root of the velocity of the air in feet per second. Assuming a velocity of 25 feet per secon, we have $2\sqrt{25} = 10$. $A = 10$.

= SECOND METHOD =

Carpenter's, Page 293.

Amount of air delivered per hour = 40000 x 60 = 2400000 cu. ft.

Temperature of air to be delivered into room = 130°

Steam pressure in coils = 3#

Temperature of condensed water = 213°

At 3# pressure above atmosphere = 17.7 = 1181 BTU.

1181 BTU in 1# steam
213 " " 1# water
968 " given off by heating surface.

See Carpenter's table 8, page 382. At 70° one heat unit will warm 56 cu. ft. ofair one degree and to heat one cubic foot 130° will require 2.32 heat units. Each pound of steam gives off 968 heat units and will heat 450 cu. feet of air from zero to 130°. To heat 2400000 cu. feet of air to 130° will require 5334# of steam.

The indirect heater with blower attachment will condense about 2# of water per square foot ofsurface per hour. Hence the total amount of square feet of surface is equal to 5334 lbs. divided by 2 = 2660 square feet of radiating surface.

= AIR SUPPLIED PER HOUR =

The amount of air supplied per hour to each room was figured as follows.

Allowing 40000 cubic feet per minute as the capacity of the blower, the total number of square feet in the warm air registers was found. Then dividing the number of cubic feet by the area gives the number of cubic feet per one square foot of register area. Multiplying this by the area of each register gives the amount of air flowing through register per one minute.

$$\frac{40000}{\text{Area of registers in sq. feet}} \times \text{size of register in sq. feet} \times 60$$
= amt of air per hour.

= SIZE OF HOT AIR REGISTER =

See Carpenter's, page 53.

Velocity of air taken at 3 ft. per second and air is to be changed 3 times per hour. Then from the tables we have 40 square inches in area per 1000 cu. ft. of air. Divide the total volume of each room by 1000 and multiply by 40, and the result will be the area of the register. The net area of the register should be from .5 to .7 of the nominal area.

To get the best results with the circulation of air in the rooms, it is necessary to have the hot air register about 7 feet above the floor and the cold air register on the same side of room and near the floor. (See data sheet for size of registers.)

= THE MAIN DUCT AND BRANCHES =

To get the best results and to save as much space as possible, it was decided to have the hot air duct run under the ground floor in an easterly and westerly direction. At the east end the duct branches north and south, being some what smaller in size than the main duct.

The blower is to be located in the fan room, which is the first room east of the main entrance. The duct is to come to a place directly under the blower, and from here, the duct runs due west and then makes a large turn to the south and into the main duct.

= SIZE OF TUNNEL =

To determine the size of duct required.(See Carpenter's page 53). The number of cubic feet of air per hour is 2400000. Assuming the velocity to be 15 feet per second, we find in the tables the factor 26.6, which is to be multiplied by(2400000 ÷ 10000) which is equal to 6384. This amount 6384 ÷ 144 gives 45 square feet, which would be equal to the cross sectional area of the tunnel. This would enable us to use a tunnel about 6½ x 7 feet in size.

= SIZE OF BLOWER =

There is one thing that must not be overlooked, figuring out the size of the blower and that is that it should run without making too much noise. To be able to do this and get the best results, the blower should run from 180 to 200 revolutions per minute.

To figure out the size of the blower, we know that it must be able to deliver about 40000 cubic feet of air per one minute. Since the blower is to stand in an open room and have a free outlet, it will be able to discharge air at a velocity nearly 10% greater than the peripheral velocity of the fan blades. When the blower is arranged so it will draw its supply of air through banks of heated coils and discharge through the tunnel, the resistance due to friction is so great that it reduces the velocity about 50%.

To allow for this loss and to retain a factor of safety, it is necessary to have the peripheral velocity of the fan blades equal to the linear velocity of the air and the efficiency of delivery is to be 50% of the latter amount. Assuming the diameter of the fan as 8 feet, we will see if it will fufull our conditions.

8 ft. x 3.1416 x 180 = 4536 ft. using 180 RPM.

But since we must allow 50% for friction, we have 4536 ÷ 2 = 2268 ft. per minute.

The size of opening for an eight foot fan is about 19 square feet. Multiplying 2268 feet per minute by 19 sq. ft. gives 43092 cubic feet. This will be the amount of air delivered per minute, which is somewhat larger than we used.

= POWER REQUIRED =

According to Carpenter's tables of capacity and power of blowers, a 7 H. P. engine would run the blower. But the blower is to be run by an electric motor instead of an engine. To be on the safe side in case a greater speed is desired, a 12 to 16 H.P. motor was thought sufficiently large enough to run the blower.

Specification for a Heating and Ventilating system to be installed in the New Engineering Building at the Michigan Agricultural College.

= CONSTRUCTION =

The heating system proposed is to be a direct, indirect system and to include the furnishing, delivery and complete erection, in said building and at the above place, all material and labor which shall enter into the construction of the above system.

All work is to be first class and done in a workmanlike manner and according to the following specifications.

The words "Owner" and "Contractor" refer respectively to owning the building and the party doing the work.

The system is to be erected in two parts,(See drawings of elevations) the east and west half. It is to be a low pressure, gravity system and so arranged that the radiators can be shut off without interfering with the circulation system.

All main risers leading from the basement to the top floor are to be properly supported and fastened by wrought iron straps. All mains running in the direction, as the flow of the steam are to have a fall of one inch in every twelve feet.

= PIPES AND FITTINGS =

All necessary pipes and fittings are to be of such sizes and connected as shown on drawings, so as to give a free and noiseless circulation. The system is to be free from all water pockets.

Wrought iron shall be of standard quality and as follows:

All pipes 1½" in diameter and above are to be lap welded and tested to 300# per square inch.

All piping and fittings are to be exposed. All mains and returns passing through walls are to have wrought iron thimbles with cast iron flanges on each side of the wall.

A two pipe coil is to be placed along the east wall of the dark and wash rooms located on the top floor. This coil is to be about 30 ft. long and made up of 1½" pipe. It is to have a Fairbanks Radiator valve and Allen's automatic air valve.

All mains to be 3" - $3\frac{1}{2}$" and 4" as shown on elevation drawings.

" returns " " 3" " " " " "

" risers " " 2" " " " " "

= HEATING COILS =

The heating coils which are to be used for the indirect system are to be erected in the basement and placed in their proper place. The pipes are to be 1" in diameter and $2\frac{1}{8}$" from center to center. These coils are to be made into 20 sections, each section being made up of a cast iron header with holes tapped for pipes and an opening for the feed pipe on the front end and an air pipe on the rear end.(See drawings for same.) All air pipes to extend above the sheet iron covering and connected with automatic vacum valves.

Each section is to be tested long enough to see if coils are free from leaks. Each section is to be connected to the feed pipe which is connected to the main header above. This header connects to the main leading to the tunnel.

= HOUSING THE COILS =

The contractor is to house in the coils with No. 18 gauge sheet steel, all properly riveted and supported. The east end of housing to be left open for the supply of cold air. The front portion of the housing is to be so arranged that the sheets can be taken off and any desired section removed without disturbing the other part of the housing. The housing to be made tight around the blower. The housing is to be painted with one coat of asphaltum varnish on the inside and two coats on the outside. For the sizes of angle and tee irons to be used in the construction of the housing. (See drawings and details of same.)

= RADIATORS =

The radiators are to be of Perfection pattern and of such size as specified.

All radiators carrying 20 ft. or less of radiation tohave 1" radiator valves.
All radiators carrying 20 to 60 ft of radiation to have $1\frac{1}{4}$" radiator valves.
All radiators carrying 60 to 80 ft. of radiation to have $1\frac{1}{2}$" radiator valves.
All radiators carrying 80 to 100 ft. of radiation to have 2" radiator valves.
All radiators to be fitted with Allen automatic air valve.

= FLOOR AND CEILING PLATES =

All pipes passing through walls, partitions and floors must be provided with galvanized iron sleeves and all necessary floor and ceiling plates. The Crane cast iron floor and ceiling plates to be used.

= VALVES =

The Fairbanks Radiator Valve with thermostatic connections is to be used throughout the building on all direct radiation. All radiator valves to have ground joints and union couplings.

= PIPE COVERING =

All mains to be covered with pipe covering composed of 85 % magnesia and 15% asbestos and to be 1" thick. After the mains are covered, they are to be painted with one coat of fire proof mineral paint.

= CARPENTER AND MASON WORK =

All necessary mason and carpenter work to be done by the mason and carpenter contractors on the building. The steam fitter must give the contractor sufficient time to do any cutting or changing that he orders, providing that the changes ordered are approved by the superintendent of the building.

= DECORATING =

All painting and decorating(not includingthe mains) is to be done by the owner.

- TEMPORARY HEAT -

Temporary heat is to be furnished when the owner thinks it is necessary and he is to take the responsibility for any damage to the work that may be caused from same.

- CHANGES IN THE WORK -

Any changes made in the plans or specifications are to be submitted to the owner or his superintendent who is to have charge of the work. Upon his consent for any change, a written request for this change must be handed to the superintendent and he is to keep a record of same. If any of these changes are extra, or the change in the work is a saving for the owner, then they are to be allowed for at the same rate as the contract price.

- COMPLETION OF THE CONTRACT -

When the heating system is completed and ready for testing, the contractor is to notify the owner, who is to make the final inspection of the work. If for any reason that the owner should overlook some detail of the work and said work not being according to plans or specifications, the contractor is to be held responsible for same.

The contractor is not to be held responsible for any delay in his work it is caused by other contractors or by changes in the work which are suggested and ordered done by the owner.

- PAYMENTS -

No work is to be paid for unless same is inspected by the owner or his superintendent. The payments are to be made as the work proceeds and on a basis of 70% of the value of the work at the time of payment.

- FINAL -

These specifications cover everything necessary to make a first class direct, indirect steam heating system. If at any

time that the contractor does not clearly understand the full meaning of the plans or specifications, he is expected to see the superintendent and get his interpretation of same. The plans of the heating system and of the building are to be used to the best of advantage. All final measurements are to be taken from the building and not from the drawings.

= BILL OF MATERIAL.=

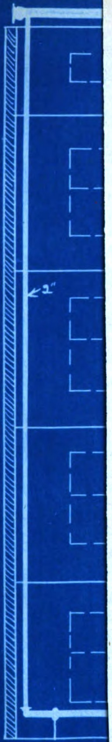
561	ft.	of 4"	wrought	iron	pipe	
75	"	" 3½"	"	"	"	
565	"	" 3"	"	"	"	
1868	"	" 2"	"	"	"	
360	"	" 1½"	"	"	"	
305	"	" 1¼"	"	"	"	
50	"	" 1"	"	"	"	

2	1"	Fairbanks	Thermostatic	Radiator	Valves.			
45	1¼"	"	"	"	"			
65	1½"	"	"	"	"			
6	2"	"	"	"	"			
118	Allen's automatic air valves.							
2	4" Gate valves.							
17	4½"	Cast	iron	pipe	flanges	for	brick	wall.
29	3½"	"	"	"	"	"	"	"
7	3"	"	"	"	"	"	"	"
6	4"	Pipe	supports	in	basement.			
54	3"	"	"	"	"			

= RADIATORS =

No.	Radiating Surface(Sq. Ft.)	Sections	Height	Length.
30	76	19	38"	47½"
2	92	23	38"	57½"
4	52	13	38"	32½"
3	56	14	38"	25"
9	48	12	38"	30"
5	36	9	38"	22½"
2	24	9	26"	22½"
3	157	28	38"	70"
6	72	18	38"	45"
1	80	15	38"	37½"
1	16	4	26"	10"
1	20	5	26"	12½"
1	40	10	38"	25"
8	60	15	38"	37½"
11	64	16	38"	40"

No	Radiating Surface(Sq.Ft.)	Sections	Height	Length.
10	68	17	38"	42½"
4	32	8	38"	20
13	44	11	38"	27½"
4	28	7	38"	17½"



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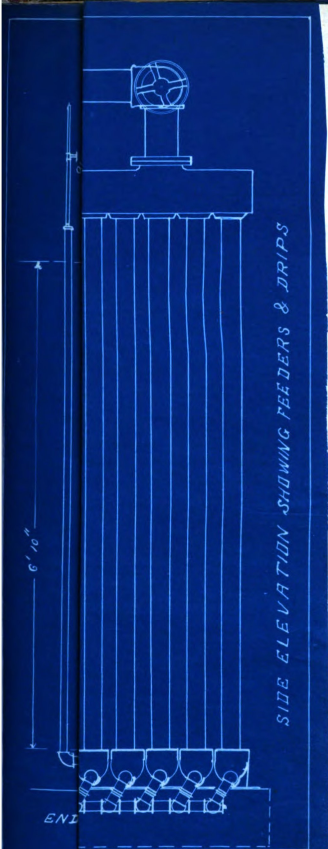

HEATING PLAN
BLD'G M.A.C.
OILS FOR
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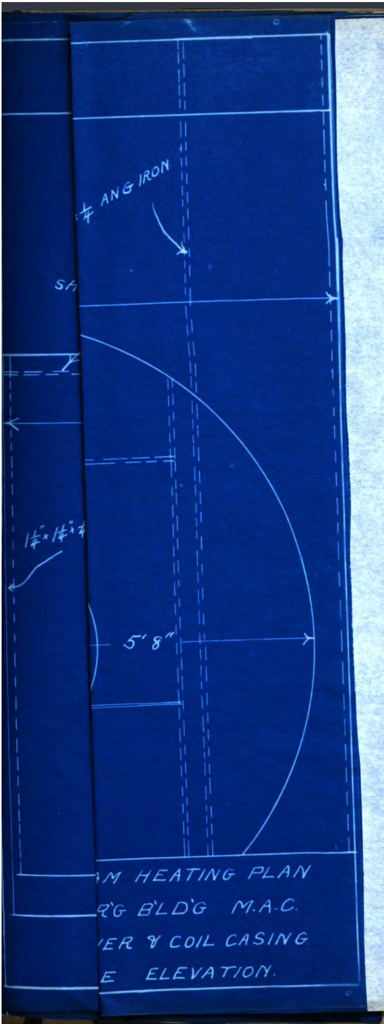
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5' 8"
AM HEATING PLAN
R'G B'LD'G M.A.C.
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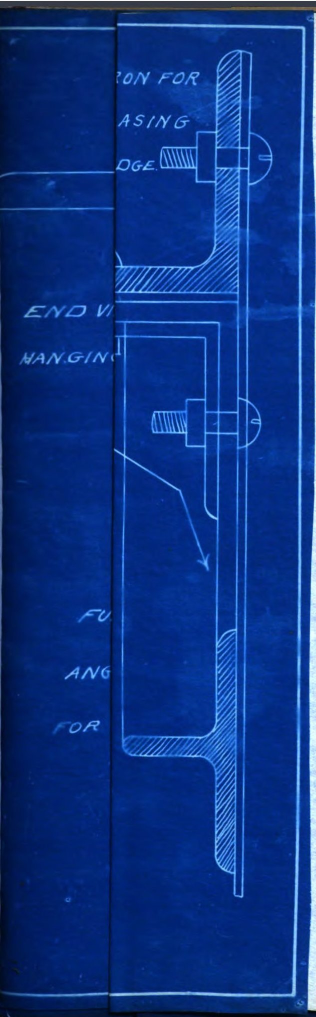
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ROOM	R	COLD AIR FLUE	SIZE OF REGISTER	HEIGHT OF RAD.	No. OF RAD.	KIND.
DYNAMO				38"	3	PERFECTION
HEAT & ELEC.				"	3	"
ELEC. TEST				"	2	"
BATTERY				"	0	"
OFFICE				"	1	"
PRIVATE				"	1	"
PHOTOMETRY				"	1	"
MEN'S TOILET				"	1	"
MAIN ENTRANCE				"	1	"
FAN ROOM				"	0	"
LOCKER ROOM	8			"	2	"
HYDRAULIC	4			"	3	"
EAST ENTRANCE				"	1	"
TESTING MAT.	24			"	2	"
REPAIR ROOM				"	1	"
MECH. LAB.	22			"	2	"
WEST ENTRANCE				"	1	"

ROOMS.	ISTER / E OF COLD AIR FLUE / SIZE OF REGISTER	HEIGHT OF RADIATOR	No OF RAD.	KIND.
LECTURE	2x24	38"	3	PERFECTION
APPARATUS	8x12	"	1	"
OFFICE	8x8	"	1	"
COAT ROOM.	8x8	"	1	"
OFFICE	8x8	"	1	"
LECTURE ROOM.	0x24	"	2	"
OFFICE	8x9	"	1	"
MECH LIGHT	16x24	"	2	"
BISSELL'S OFFICE	8x9 8x9	"	3	"
VEDDER'S OFFICE	8x9 8x9	"	2	"
RECITATION	16x21	"	1	"
INSTRUMENT	8x12	"	1	"
REPAIR ROOM		"	1	"
RECITATION.	16x20	"	2	"
MODELS		"	1	"
RECITATION.	20x29	"	2	"

ROOMS	E. REGISTER	SIZE OF COLD AIR FLUE	SIZE OF REGISTER	HEIGHT OF RADIATOR	No. OF RAD. KIND
PREP LAB	40×	22×30	38"	3	PERFECTION
RECITATION	29×	16×25	"	2	"
REPAIR ROOM	18×	8×9	"	1	"
RECITATION	31×	24×24	"	3	"
PRIVATE LAB	14×	8×9	"	1	"
RECITATION	31×2	16×24	"	2	"
STUDY	31×	8×9 8×9	"	2	"
CLASS ROOM.	26×	24×24	"	1	"
LIBRARY	25×	16×24	"	3	"
SENIOR DRAW	33×	17×20	"	2	"
MODELS	25×		"	1	"
CLASS ROOM	28×	16×24	"	2	"
STUDY	9½×2	8×9	"	1	"

ROOMS	E.	ZE OF COLD AIR FLUE.	SIZE OF REGISTER	HEIGHT OF RADIATOR	NO OF RAD. KIND.
FREE HAND.	40×40	30×32	38"	3	PERFECTION
FREE HAND	29×28	16×24	"	2	"
WOMEN'S CLOAK	10×18	8×12	"	1	"
STUDY	10×24	8×24	"	1	"
WOMEN'S STUD	51×33	16×21 16×21	"	3	"
OFFICE	13×24	8×9	"	1	"
STUDY	18×24	8×12	"	1	"
RECITATION	31×24	16×24	"	2	"
RECITATION	31×24	16×24	"	1	"
RECITATION	42×25	16×36	"	2	"
MECH DRAW	41×28×	20×26	"	3	"
MODELS	25×11×		"	1	"
SOPH & JUNIOR	41×28	24×22	"	3	"

E. REGISTER.

ROOMS	SIZE OF COLD AIR FLUE.	SIZE OF REGISTER.	HEIGHT OF RADIATOR	NO OF RAD.	KIND
DRAWING.	40x2	20x22	38"	3	PERFECTION
DRAWING	40x4	20x22	"	2	"
TOILET	10x18		"	1	"
STUDY	23x10	8x12	"	1	"
DRAWING.	51x33	16x21 16x21	"	3	"
DRAWING	31x24	14x20	"	1	"
CLASS ROOM.	31x24	12x24	"	1	"
DRAWING	31x24	16x18	"	1	"
DRAWING	31x24	16x18	"	2	"
TANK ROOM	24x11		"		"
DRAWING	41x28	24x24	"	2	"
DRYING ROOM	16x11x		"	1	"
DARK ROOM	16x11x		"	1	"
DRAWING	28x40	16x24	"	1	"
CORRIDOR					