DESIGN OF A ROUND HOUSE

BY

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

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ENTITLED Design of a Round House

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

of Bachelor of Science in Civil Engineering

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Design of a Round-House.

A study of the most approved methods of round-house construction is to be pursued rather than the design of some one particular round-house. If the latter were the problem, it would be necessary to take into account all the local conditions such as, climate, soil, etc. which in this case would have to be assumed in designing the building. A twenty-stall round-house will be considered which would be adequate for a division point say in Central Illinois.

Owing to a large increase of traffic over railroads there has been a great improvement in the design and construction of locomotives. Accordingly, machine shops in which to repair these larger engines have been improved but round-house construction has not advanced proportionally. The old buildings are poorly lighted and ill ventilated, thus rendering it more difficult.
to make repairs; and in many instances the stalls are too short to receive the engines in which case a vestibule is sometimes built at one end. Since a greater amount of work is required of the improved engines and the time between trips is therefore shorter, it is quite necessary that the facilities for housing and cleaning the engines during the few hours when they are not on the road, should be the best. When an engine comes in from a trip, it must at least be cleaned and oiled, and in many cases the boiler must be washed out and possibly some slight repairs are made. All this must be done in the round-house so that in order to keep the engine in service as much as possible and in good condition, it is necessary to have it well taken care of when not in service.

General Dimensions

Engines should always head into the round-house. This places the working parts near the outer wall which is quite necessary as more room is afforded for
cleaning and repairing than would be if the engine backed in. Near the outer wall is the best lighted part of the building and the work benches are placed there. Sixty-five feet will be used as the maximum length of engine and tender. As the work benches are placed around the outer wall a space of ten feet will be needed between the engine and this wall. Five feet will be needed between the rear of tender and the door of the stall. These dimensions added together fix the inside length of the stall at 80 feet. The distance center to center of columns of inner wall is 14 feet which allows 13 feet clear space for the engine to enter. There should be ample room for an engine to stand between the door of the stall and the turntable. The table will be 70 feet in diameter since a long one permits the same load to be handled much more easily than a shorter one, because the engine can be balanced better on account of the longer leverage. The above conditions fix the radius of the inner wall at 100 feet and that of the outer wall
at 180 feet. The doors will have a clear height of 17 feet and a width of 13 feet.

Walls

The walls are to be of brick. There will be a 13-inch wall around the outer circle and at the ends. Between stalls 7 and 8 and between stalls 14 and 15 there will be 9-inch walls. At the points between the stalls where the roof trusses are supported there will be brick pilasters. These will be 4 feet long corbeled to 4 feet 6 inches at the top and the bottom, and will be 17 inches wide corbeled to 25 inches at the top and the bottom. The wall will extend 18 inches above the end of the roof truss and will be surmounted by a stone coping 4 inches thick and 18 inches wide. Above the roof trusses the wall will be 13 inches thick.

Another way of supporting the roof trusses would be by steel columns placed in the wall, but where a great deal of brick work is to be done and the load to be supported is comparatively light, the cost of steel columns would not be offset by
the decreased cost of brick work. Then again the appearance of the wall is much better when the pilasters are used. The partition walls between the stalls are needed to brace the building; they also divide it into rooms so that if for any reason large quantities of smoke or steam escape into one room it can be shut off from the rest of the building. The walls will be supported on a concrete foundation. The depth of this foundation will be determined by the depth it is necessary to excavate in order to obtain a firm subsoil.

Roof Trusses.

These will be placed between the stalls. The span will be 20 feet and the rise 20 feet. It has been found that for spans less than 100 feet, the Fink truss is better adapted and more economical than any other style of truss, hence the Fink truss will be used. There is some objection to the use of steel in the roof because the action of gases is apt to
eat away the metal. This can be prevented by attaching some form of ceiling to the lower chords of the trusses, but this is objectionable and unless the action of the gages is very serious it is best to leave the trusses exposed. Around the outside circle the trusses will rest on brick pilasters and around the inner circle on steel columns. The sketch below shows the style of the truss as well as the stresses and sections of the members.
The meanings of the signs used on the sketch are as follows:

- # --- pounds
- " --- inches
- + --- compression stress
- - --- tension stress
- L --- steel angle shape

Roof

The partitions will be of yellow pine, 8x10 inches and will be placed 10.605 feet center. The rafters will be 2x6 inches and will be placed 2 feet centers. The rafters will support the sheathing which will be 6x1 inches white pine. The outside covering will be of the best Bangor slate 6x12 x 3/6 inches.

There is quite a difference of opinion as to whether a round-house should be covered with a low flat roof or with a high, curved roof. If the low flat roof is used it will be necessary to support it by columns between the stalls, which of course is an objection. The room will fill with smoke or steam more quickly than if a
high roof is used, because of the decreased space. With a flat roof the danger of leakage is very great. If snow and ice stand on it for some time and then slowly melts, it is almost certain to leak through and rust the jackets of the engine. Even if it does not leak, in cold weather the steam will rapidly condense and drip on the engines. The most serious objection to the high roof is that it is apt to allow the cold air to come in at the ventilators and thus prevent the smoke and gases from passing out. This can be remedied by means of a fan blown or some other device for producing an upward current of air in the building.

Wall of the Inside Circle

The doors and steel columns will make up the lower part; above the doors will come the windows and above the windows will be a 9-inch brick wall, cored out to 13 inches at the top and surmounted by a stone coping 4 inches thick and 15 inches
Columns.

Hooke's formula for allowable stress
is used in the design of the columns;
viz: \( P = 15,000 - 55 \text{ lb.} \) Taking into account
the maximum of time reaction, the weight
of the wall and the weight of the door, it is
found that a column whose area of cross
section is 8.12 square inches is required.
The door are to be hung directly on the
column, and hence it is necessary to choose
a style of column permitting this. A Z bar
column will be used and will be placed
so that the doors can be hung on the out-
standing flanges of the Z bar. The sketch
shows a sectional view of the
column which will be made
of one plate 6\( \frac{1}{2} \times \frac{3}{4} \) inches and
4 Z bars 3\( \frac{1}{6} \times \frac{1}{4} \) inches. Area
of section is 11.54 square inches.
Seventeen columns will be
required. At the ends and at the par-
tition walls the doors will be hung
on brick piers.
The column bases will be composed of a plate 14 x 14 \times \frac{3}{4} inches and two connection angles 6 x 3\frac{1}{2} x \frac{1}{2} inches 14 inches long. These bases will be anchored to the concrete foundation by four 1-inch bolts. The columns will be placed on concrete piers having tops 18 inches square sides with a batter of 1 inch in 12 inches and shall extend down to a firm foundation. The brick wall above the windows will be supported by two 1-inch 9\frac{3}{4} pound channels placed 5 inches back to back with their flanges turned toward each other.

Doors.

Each stall entrance shall have two doors swinging outward. As was mentioned before when the doors are open there will be a clear height of 17 feet and a width of 13 feet. For a height of 8 feet the doors will be made of 7/8 inch lumber, braced by 2 x 12 inch pieces and 2\frac{1}{2} x \frac{1}{2} inch wrought iron straps. The material must be a comparatively strong wood. Yellow fir will be used.
In the large door of each entrance will be placed a small door 6 x 2 1/2 feet made of 3/8 inch lumber and braced by 2 x 6 inch pieces. The small door will be placed in the right hand door going in. The upper 9 feet of the door will be composed of window lights with a 2 x 12 inch cash braced by 2 1/2 x 1/2 inch wrought iron straps.

Light.

To get daylight to the center of an 80-foot round house is quite an important matter. Either a great deal of light must be admitted through the windows of the inner and outer walls, or a skylight must be built in the roof. A skylight is objectionable because of the danger from leaking. Then again, the glass soon becomes dirty and being so far away, it is seldom cleaned. It has been proposed to build an oculus in the roof and put a window there; but this has the same objections as a skylight, as well as making it necessary to put a column
In the center of the building at each stall.

In each stall there will be two windows in the outer wall and in the inner wall there will be windows in the doors and in the wall above the doors. The windows in the outer wall will be 12 x 4 feet, those in the doors 8 x 4 1/2 feet, and those above the doors 10 x 4 feet. This will give 208 square feet of windows for each stall. In addition, there will be six 12 x 4 foot windows in the end walls.

The artificial light will be furnished by electricity. The old-fashioned torches furnish very poor light and make a great deal of smoke and dirt. Gas might be used but it has the disadvantage that it can not be moved to suit the workman. There will be three 16-candle power lamps between the stalls, one opposite the cylinders, one opposite the cab and one opposite the center of the tender. There will also be in every stall a connection for a portable lamp to be used in the pit.
White-Washed Walls.

Much can be added to the light of a round house by the condition of the walls. A first class method would be to line the inside with white glazed brick, but this would be rather expensive. White-washing the walls will serve this purpose very well, and it can be made inexpensive by the use of a spraying machine. The walls should be white-washed twice a year.

Smoke Jacks.

Wood and metal jacks are in use although some round houses are without either, depending on openings and ventilators to carry away the smoke. Wood jacks are cheaper both as regards first cost and maintenance. The great danger is that they are apt to catch fire from the engine, but this can be partially remedied by the use of a fire-proof paint. The cast iron jack is probably the best and will be used. It will be made to telescope down over the stack of the engine and
will have a motion parallel to the lines of the track. The last requirement is quite necessary because many times it is desirable to move the engine slightly in order to change the relative positions of some of the working parts for cleaning. The jacks will be placed 16 feet from the outer wall which will give ample clearance for the longest engine.

Ventilation and Heating.

A round-house is apt to contain a great deal of smoke and gas from the engines, hence adequate ventilation is quite necessary. This can best be accomplished by a forced hot-air blast for heating in connection with ventilators in the roof. Two ways of admitting the hot-air might be used; by an overhead duct or by an underground duct. The underground duct will be used and there will be openings in the floor and one in each pit. This is better than the overhead duct because if an engine should come in covered with ice and snow a large part of the air blast
can be turned under it, which affords a
quick and effective means of cleaning it.
If convenient the air from the boiler room,
which is quite hot should be used for
heating the round-house.

Engine-Pits

The pits should be from 50 to 60 feet
long and of a depth governed by the
style of engine to be accommodated. If
the wheels are 60 inches or larger the
depth should be between 2½ and 3 feet: but if
the wheels are small and the fire boxes
depth the pits should be from 3 to 3½ feet
deep. The depth should be such that a
man can stand in the pit and be within
reach of the link motion of the engine. If
such is not the case much time is lost
in arranging trestles. The pit will be 4 feet
wide, 3 feet deep, and 55 feet long. The
walls of the pit should be made of good
masonry and should be strong enough to
support the jacking timbers in case the
engine needed to be raised. The walls
and floor of the pit will be made of
Portland cement concrete. The walls will
be 18 inches thick at the top, will have a batter on the outside of 1 inch in 12, and will extend down to a firm foundation. The end walls will be 18 inches thick at the top, and will have a batter on the outside of 1/2 inch in 12. The pit floor will have a crown at the center of 3 inches and will also slope toward the turntable. At the lower end of the pit will be placed a catch-basin, which will connect with a vitrified pipe drain extending around the house and finally connecting with the sewer.

There are three methods by which the rails may be supported on the pit walls: viz.: by longitudinal timbers placed on the walls, by short ties placed on the wall, or by fastening the rails directly to the masonry. The first two methods are objectionable because the timber is apt to deteriorate and hence require frequent renewals. The last method will be used. The rails will be fastened to the concrete by means of wrought iron bolts and straps as shown on the sheet of details.
Floor.
The floor of the round-house will be of vitrified brick laid on edge, and will be supported by a natural concrete foundation.

Turntable Pit and Turntable.
The dimensions will be sufficient to install a 70-foot deck turntable. The walls and floor will be made of concrete. The wall will be 12 inches wide at the top and will have a batter on the outside of 1 inch in 12, extending down to a firm foundation. There will be a ledge 20 inches wide to support the circular rail, which will be fastened to the concrete in the same manner as the rail on the engine pits. The floor will drain to a catch-basin near the fire in the center, and the catch-basin will connect with the sewer.

The turntable will be of structural steel, supported at the center on conical steel bearings. On each side of the rail there will be a deck, forming a foot bridge. The total width on top should not...
be less than 15 feet. The turntable should be painted frequently to prevent rust. Electric power for operating the turntable is much to be preferred, especially to hand power. In the latter case four men would be needed to operate the table, while in the former, one man could attend to it.

Drop Pit.

In and between stalls 2 and 3 there will be a drop pit for removing the driving wheels of the engine. The rails are carried across this by means of stringers and the whole thing is lowered by means of hydraulic jacks.

Blow Off Pipe.

Over each stall will be a 4-inch pipe through the roof for blowing out the boilers. This is quite necessary, for if the steam is allowed to escape into the building it will condense on the metal parts and cause rust to form. This blow off pipe will be joined to the dome of the engine by means of a flexible metallic joint.
Compressed Air.
Compressed air will be supplied at 100 pounds pressure to be used for operating pneumatic hammers, sprayers, air jacks, etc.

Work Benches
There will be a bench for every stall which will be fastened to the outer wall by brackets. There will also be several portable benches.

Drawings
Plate 1 following shows the general plan of a twenty-stall round-house designed in accordance with the preceding general principles; and Plate 2 shows some of the details of construction.

Conclusion
In the above discussion, the attempt has been to get a round-house which would require as few repairs as possible, and one in which the work could be done with the greatest possible speed. This is quite necessary
because often engines are allowed only a few hours in the house and the making of repairs on the building or fire equipment would cause troublesome delay. The lack of time in which to get engines ready for the next trip is caused by the demands of the transportation department, which does not seem to realize the amount of attention that an engine requires.
PLATE 2
DETAILS FOR A
ROUND HOUSE
PLATE I
GENERAL PLAN
FOR A
ROUND HOUSE
SCALE 1/4"=1'-0"