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Modern Poultry Housing

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Louis Lubinus

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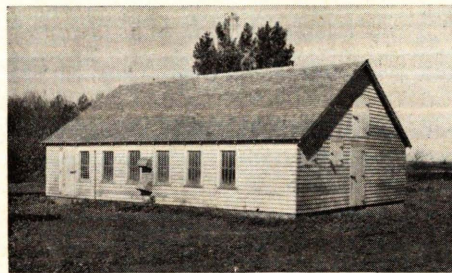
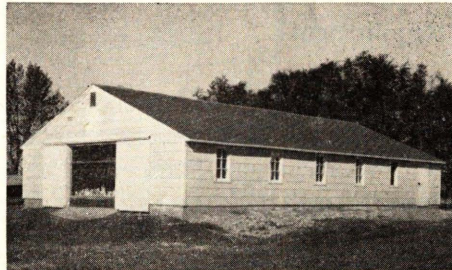
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MODERN

poultry housing



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MODERN

poultry housing

Proper housing is essential for a profitable business in poultry. The building needn't be new; a remodeled structure can do the job well.

A MODERN POULTRY HOUSE is an asset to a farm. It need not be expensive to give good results. Often some building already on the farm can be remodeled inexpensively to serve the needs of hens. Where old buildings are not available, new housing should be considered.

Remodeling or building new poultry housing is a very important job. In order to invest money wisely, careful attention should be given to planning, choice of materials, arrangement of floor plan and use of labor saving devices. A modern, well organized house can do a lot of the chores for the poultry operator.

Too often a poultry house is thought of only as a roosting place for the hens. In addition to this it must protect the birds from the hot

sun in summer, the cold temperatures in winter and temperature extremes in spring and fall. If properly insulated and ventilated, it will provide a warm, dry place for the hens that will mean good egg production at all times of the year.

The purpose of this circular is to discuss the principles of poultry housing and the use of some labor saving devices. Many of these devices can be installed when a house

is being built with little additional expense.

Plans are available for two types of poultry houses from the Extension Agricultural Engineer, College Station, South Dakota—Extension Circular 504, Modern Poultry Housing Plans for the New South Dakota Laying House (24 x 34) for 300 hens and Circular 515 Modern Poultry Housing Plans for the 30 x 50 South Dakota Laying House for 500 hens.

INSULATION of the house

One of the first things to consider in remodeling or building is insulation of the walls and ceiling. Insulation aids the effective use of ventilation and deep litter.

An insulation job need not be expensive. A vaporproof paper should be placed on the *in* side of the studding. The vapor barrier should be covered with lumber or other



Fig. 1. Insulating material is filled between studs.

sheathing material. The space between the studs may be filled with commercial insulation or home processed insulation material such as ground corn cobs (pea size), wood shavings, or sawdust. Mix about one pound of hydrated lime with each 10 pounds of home processed fill to discourage rats and mice if they should get in. Tamp the

fill lightly as the wall is filled.

A rigid insulation board in sheets can be used for sheathing on the inside wall. Where insulation board is used for sheathing, it should be protected by boards where the birds might pick at it.

Two or three coats of aluminum paint on the inside surface will add to the appearance of the house and

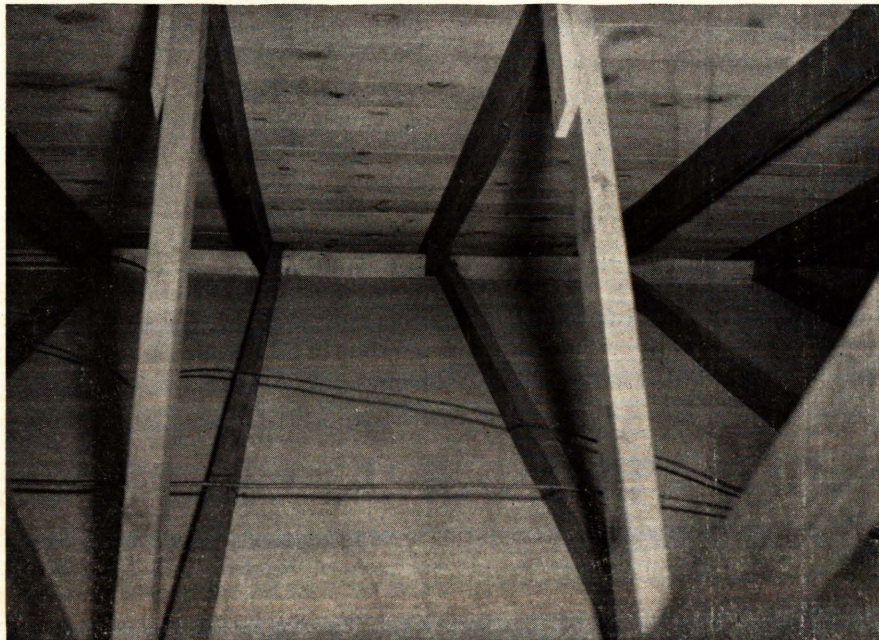


Fig. 2. The ceiling before insulation is installed.

preserve the material by providing an additional vapor barrier.

A blanket type insulation also can be used in place of the loose fill in the wall. Vapor proof paper and sheathing are still required.

Fan ventilation requires a solid ceiling which can be insulated much the same as the wall. Put a vaporproof paper on the underside of the joists and sheath with lumber, asbestos cement board or other rigid material. Heat has a tendency to rise, so at least four inches of commercial fill or eight inches of farm processed fill insulation are needed above the ceiling. A four-inch fill or two inch blanket is sufficient in the walls.

An outside door into the loft is handy for installing the ceiling insulation. The loft area also may be used for storage.

The insulation value of a wall or ceiling can be figured by adding the resistance ratings of all the different parts together as shown in Fig. 4.

To figure the resistance rating of a wall or ceiling you merely add the ratings for each individual part, for example: a wall constructed of drop siding, building paper, sheathing, a one-inch blanket placed midway on the studs, vapor proof paper and sheathed with shiplap, would be figured as shown in Fig. 5.

This wall would have a resistance rating of 9.08 and would sufficient cient for a poultry house in South Dakota. A two-inch blanket would have a resistance rating of 12.78 which would be more desirable. Insulation of the ceiling can be figured in the same manner, figuring only the materials between the chickens and the open space in the attic. Where the insulation and sheathing are applied to the rafters the material should be figured the same as the side walls.

To be effective, any insulation must remain dry. This is accom-

plished by placing a vapor barrier on the warm side of the insulation. See Fig. 5.

Fig. 3. Resistance Ratings Recommended for South Dakota
Walls Ceiling
10 15

*These figures are insulation resistance ratings. Large numbers indicate good insulation values.

WINDOWS need consideration

An insulation job is not complete unless some provision is made for doubling the windows or putting on storm sash in the winter.

Too much window space allows excessive heat loss and adds to the cost of construction. Window area equal to five percent of the floor area is considered ample in South Dakota. Many houses are constructed with less than five per cent and are doing a good job. Houses 24 feet wide and less generally have most of the window space in the south. Wider houses may have windows on both sides when placed east and west with the heavier concentration of windows on the south. Wide houses running north and south will use an equal amount of window space in the east and west sides.

When wood window frames are used they can be installed as shown in Sheet 3 of Extension Circular 515. Steel window frames will usually provide for a storm sash.

Vapor Barrier Important

To be effective, insulation must stay dry. This is the job of the vapor barrier on the warm side of the insulation. Suitable materials are: two layers of kraft paper with asphalt between, asphalt roll roofing, aluminum coated paper or foil, or two or three coats of aluminum paint. Building papers such as tar felts and red resin paper are *not* vapor barriers.

Fig. 5 shows the proper installation of a vapor barrier in a wall or ceiling.

Fig. 4. Insulation or Resistance Values of Materials

Material	Thickness in Inches	Resistance Rating
Air space	¾" or wider	.91
Aluminum Foil		
Accordion type—varies as to use and number of air spaces		5.15 to 13.69
Sheet type, one side (with ¾" or more air space)		2.44
Asbestos Board	¼	.13
Asbestos Board	⅜	.20
Blanket Insulation	1	3.70
Blanket Insulation	2	7.40
Blanket Insulation	3	11.10
Beaded ceiling	9/16	.45
Brick, common	4	.80
Cinder Block	8	1.73
Cinder Concrete	10	2.00
Concrete	10	1.00
Concrete Block	8	1.00
Door, wood	1	1.43
Fill Insulation		
Ground Corn Cobs, fine	3⅞	8.85
Ground Corn Cobs, fine	5⅞	13.70
Chopped Straw	3⅞	5.18
Chopped Straw	5⅞	8.05
Shavings	3⅞	8.85
Shavings	5⅞	13.70
Sawdust	3⅞	8.85
Sawdust	5⅞	13.70
Fluffy Rock or Mineral Fiber	3⅞	13.40
Gypsum Board	⅝	.27
Gypsum Board	½	.35
Hollow tile, two cell	8	1.67
Insulation Board, typical fiber	½	1.52
Insulation Board, typical fiber	25/32	2.37
Insulation Board, typical fiber	1	3.03
Insulation Board, cork board	½	1.67
Insulation Board, cork board	25/32	2.60
Insulation Board, cork board	1	3.33
Paper—building		
Red Resin		
Tar Paper		
Paper—Vapor Barrier		
Two Layers of Kraft Paper with Asphalt Between		
Plywood	⅜	.47
Pressed Board	¼	.31
Pressed Board	⅜	.45 (estimated)
Roofing, roll, 55 (vapor barrier)	⅛ to ¼	.15
Sheathing and Flooring	¾	.92
Sheet Rock	⅝	.27
Sheet Rock	½	.35
Sheet Rock	⅜	.44
Shingles—asbestos		.17
Slate		.10
Wood		.78
Stone	16	1.28
Siding, drop	¾	.94
Lap		.78
Surface, inside		.61
Surface, outside		.17
Window, single glass		.10
Window, double glass (in single frame)		1.44
Window (as commonly used—considering air films)		.88

VENTILATION of the house

Adequate summer ventilation can usually be accomplished by removing the poultry house windows and opening doors. Screens over the

openings exclude flies and wild birds. During the colder seasons additional ventilation equipment is required.

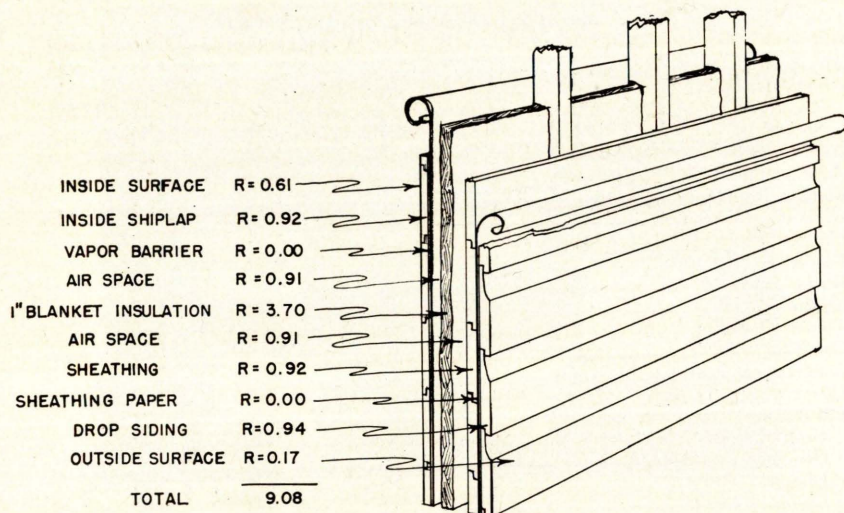


Fig. 5. Adding insulation values of the component parts of a wall.

Electric fan ventilation offers several advantages over gravity ventilation systems. First of all, it assures more positive air displacement from the poultry house if proper equipment is installed. Air removal will take place as long as the fan is operating. Another advantage is that an electrically operated fan lends itself to automatic controls to compensate for temperature and humidity changes in the poultry house.

The first cost of a fan ventilation system generally is no greater than a well designed gravity system. Although there is a slight operating cost, this disadvantage is more than offset by the advantages fan ventilation afford to the poultry house.

In a fan ventilation system there should be continuous air movement—that is, there should be some air movement 24 hours a day. A single fan system that shuts off completely when the temperature drops is not desirable, as this will cause the relative humidity to increase and stops the inflow of fresh air.

The fan is only the activating force which draws the fresh, dry air into the building. Although ventilation should be continuous, there should be some modulation in air volume being removed. Cold fresh

air coming into the building and becoming warmer can pick up much more moisture than can mild, moist, fresh air. Therefore on extremely cold days only a fraction as much air needs to be moved through the poultry house as on a mild day. The ratio that seems to work best in this climate is about 1 to 4. That is, four times as much air movement is required in mild weather as is required in extremely cold weather.

Single Fan System

The fan in a single fan system should run continuously. Throttling down the volume of air moved by the fan can be accomplished by the use of a cabinet with a damper, providing the fan is so designed as to not overload the motor. The amount of exhaust opening can this way be manually controlled.

One manufacturer builds a cabinet with motor-operated shutters in the upper part of the cabinet. A damper motor operating the shutter is controlled by a thermostat. When the temperature gets up to a predetermined setting, the motor opens the shutters removing a high volume of air. When the temperature in the poultry house is lowered, the motor

will close the shutters. The system then removes only about one-fourth its total capacity of air through the bottom of the cabinet. This type of system meets the requirements of continuous, but modulating, ventilation and does it automatically.

Two Fan System

Continuous ventilation with modulation for various conditions can also be obtained with the use of two fans. In this case, one fan should have about one-fourth and the other about three-fourths of the total capacity needed. The smaller fan should run continuously, and the larger one should kick in and out as needed. A thermostat should be used to control the larger fan. The fans should be side by side in the wall about 8 to 12 inches from the ceiling. Then a cabinet should be

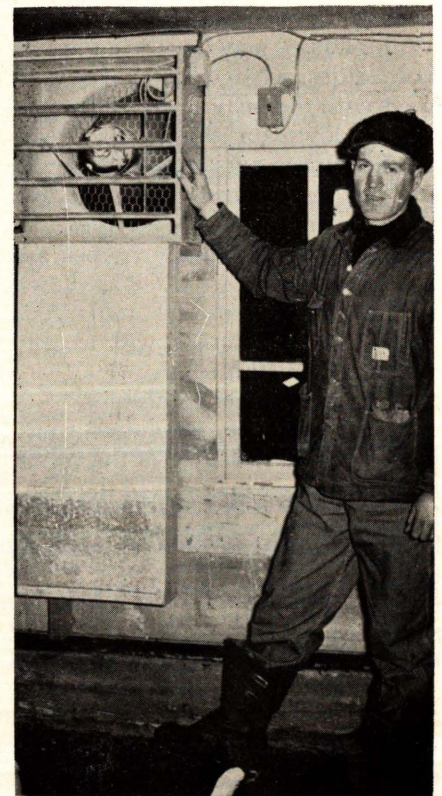


Fig. 6. The single fan system.

used on the smaller fan to remove the cooler, more humid air from near the floor. A damper in the cabinet should be used to further restrict the air removal when desired. The larger fan does not require a cabinet. All openings should be covered with hardware cloth or netting to keep trash, poultry and people from getting in the fan. For details see drawing at bottom of the page.

Fan Capacity

The fan capacity for ventilating a poultry house is related to the weight of the birds and the insulation value of the structure. *Average recommendations call for three cubic feet per minute per hen for the lighter breeds, four cubic feet per minute per hen for the crossbreeds and hybrids and up to five cubic feet per minute per hen for the heavier breeds. It is important that these ratings be at one-eighth inch static pressure.* The fan system will always

be working and drawing in fresh air through designed inlets. On some days it may be exhausting air against a strong wind. If the ratings, as given above, are specified to be at one-eighth inch static pressure, reasonable assurance can be had that the fan is moving the necessary amount of air.

Let's take an example: Let's say we have a 30' x 50' poultry house housing 500 cross-bred pullets. Since they fall in the medium weight classification, we need to provide four cubic feet per minute per bird or $500 \times 4 = 2000$ cubic feet per minute total capacity.

If one or two fans are selected for this house, they should have a total rating of 2000 cubic feet per minute at one-eighth inch static pressure (never at free delivery) or as close to this figure as possible. If the two fan system is used, the small fan which operates continuously, should have about one-fourth the total or 500 cubic feet per minute capacity and the larger one about 1500 cubic feet per minute.

Fan Location

The location of the fan as to north, south, east or west side is not of great importance. However, it is usually a little more desirable to get them away from prevailing winter winds. This would mean that a south or east location would be most desirable.

Thermostat Location

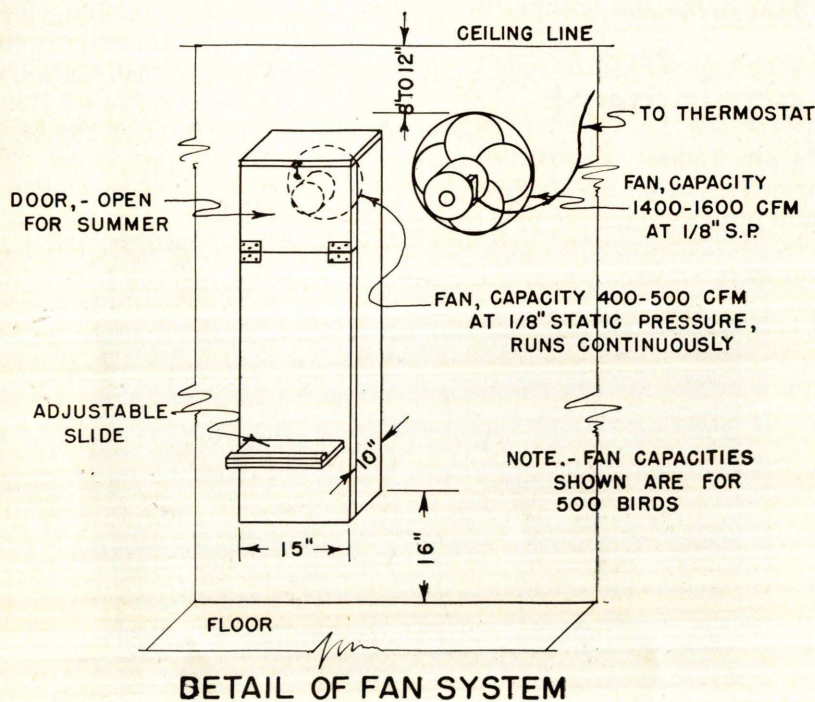
The thermostat should be placed in a location representative of temperature and humidity conditions within the poultry house. Usually a location on a central post or inside partition about five feet from the floor is satisfactory. It should not be located over the dropping pit roosting area or some place where the sun can shine on it directly.

Fresh Air Inlets

It is important that fresh air inlets be carefully planned for size and location. It is ideal to have openings for fresh air intakes small enough

Table 8. Total Feet of Slot

Fan Capacity at 1/8" S.P.	1/2" Wide	3/4" Wide	1" Wide
1000	40	26'-8"	20
1200	48	32'	24
1400	56	37'-4"	28
1600	64	42'-8"	32
1800	72	48'	36
2000	80	53'-4"	40
2200	88	58'-8"	44
2400	96	64'	48
2600	104	69'-4"	52
2800	112	74'-8"	56
3000	120	80'	60



and well distributed throughout the house to prevent drafts. The correct amount of opening is very important to allow the fan to maintain a low pressure in the house so that the amount of fresh air can be controlled without causing back-drafting. *Twenty-four square inches of inlet opening for every 100 cubic feet per minute fan capacity at one-eighth inch static pressure is recommended.* See Fig. 8.

The continuous slot inlet which takes fresh air from the loft has been working very well for the fan systems where some fan capacity is available continuously. A long narrow slot or intermittent slots in the ceiling at the junction with the walls allows fresh air to be drawn into the house from the loft in a finely metered stream with no drafts. See Fig. 9. Air from the loft is somewhat tempered. This results in some heat savings which would otherwise be lost through the ventilation system. This slot also brings the fresh air in directly over the outside wall surfaces helping to prevent condensation.

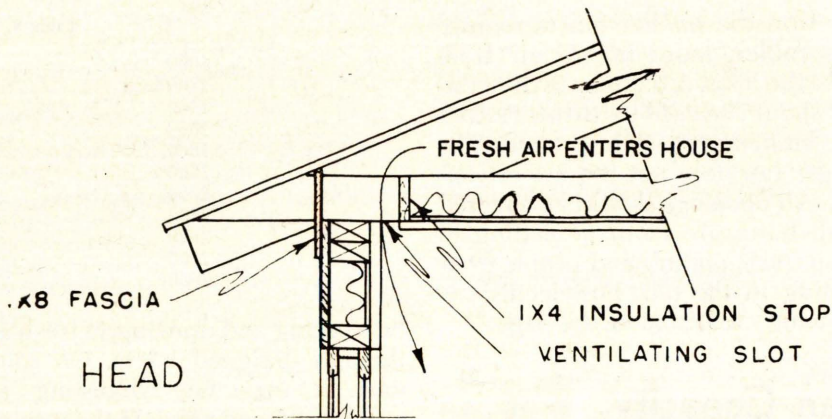


Fig. 9. Construction details of the slot inlet.

The inlet slot should be distributed around the perimeter of the house as evenly as possible, the one exception being that the slot should be discontinued for eight or 10 feet on either side of the fan or fans. It is not recommended that slots wider than one inch or narrower than one-half inch be used. A header can be placed between the ceiling joists to hold the insulation back and allow the free flow of air down from the loft through the slots. See Fig. 9.

helps keep the house warm in winter and is beneficial for ventilation.

Pit odors will not be a problem in houses that are properly insulated and ventilated. Odors can be reduced by sprinkling hydrated lime or super phosphate fertilizer over the droppings in the pit.

Roosts should be placed 13 to 15 inches apart on the pit. Each bird should be allowed at least eight inches of linear roost area. For detailed instructions on building a pit see Circular 504 "Modern Poultry Housing Plans" for small houses, or Circular 515 Modern Poultry Housing Plans for the 500 Hen House.

LABOR SAVING equipment

Dropping pits, feed bins, nesting rooms, automatic water fountains, and deep litter will save a lot of steps for the person doing the poultry chores. Some of these labor savers will also help produce clean eggs which is a big advantage in itself.

Dropping Pits

When dropping pits are used properly they can be expected to accumulate a good share of the droppings from the flock. This relieves the moisture load on the litter area in the house and helps along a successful deep litter program.

Size and location of pits plus the use of feed and watering equipment

on the pit all add to its efficiency as a labor saver. The pit has another important purpose in the house in that it releases heat from the bacterial action in the droppings. This heat

Feed Bins

Many steps will be saved by having a supply of feed in bins in the



Fig. 10. The dropping pit along a wall of a narrow house.

house. Plans should call for three bins. One for each corn, oats, and protein feed. Feed bins are also handy for keeping track of how much feed goes into the flock.

Circular 504 and Circular 515 both show plans for the construction of feed bins in the house.

Automatic Fountains

A flock of 500 hens will use around 10,000 gallons of water in a year. This is over 40 tons of water to carry to the hen house if automatic fountains are not installed. An automatic water supply has another advantage in that water is in front of the birds at all times.

There are several different types of automatic water fountains on the market. Manufacturers directions should be followed as to number of birds each fountain will handle. Generally one fountain is recommended for 100 to 125 birds.

The fountains should be located near the feed supply. Placing the fountains over the dropping pit will eliminate the necessity for a special drain to take away the spillage. It will also relieve the floor litter of some moisture load by keeping the birds up on the pit more of the time. See Fig. 14 and Fig. 15 for suggested arrangement of fountains in a house.

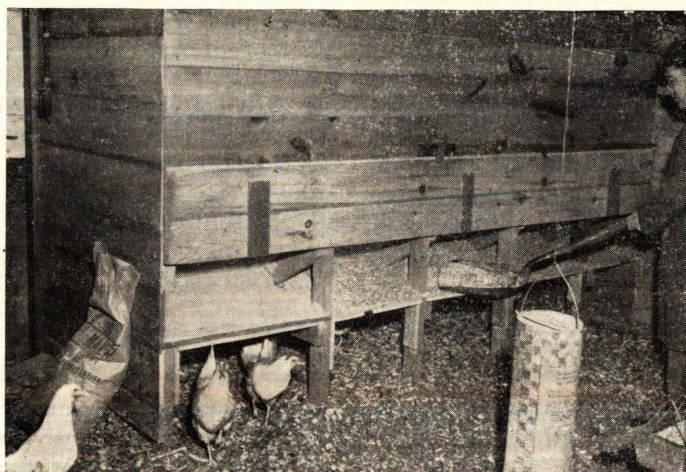


Fig. 11. Feed bins can be built on or above the floor.

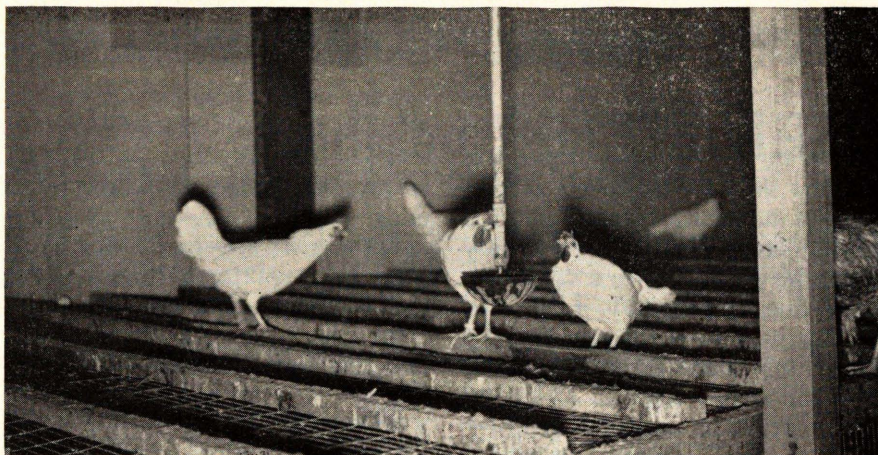


Fig. 12. Fountains over the dropping pit limit dampness.

Nesting Room

A nesting room is a labor saver for the person gathering eggs and has many advantages. All the nests may be located in one place near the door and away from heavy traffic around the feeders and water fountains. The litter can be kept cleaner in the nesting room area resulting in cleaner eggs. The room can be darkened if the birds start cannibalism or egg eating.

Commercial 10 or 15 hole nests or home constructed shelf nests can be used in the nesting room. Allow one individual nest to each four or five hens and one square foot of shelf

space for five hens. See Circular 504 or Circular 515 for detail construction of shelf nests and a nesting room.

Poultry House Floors

A cement floor in a poultry house is optional when insulation and ventilation are installed and deep litter is used. Most folks feel a coarse

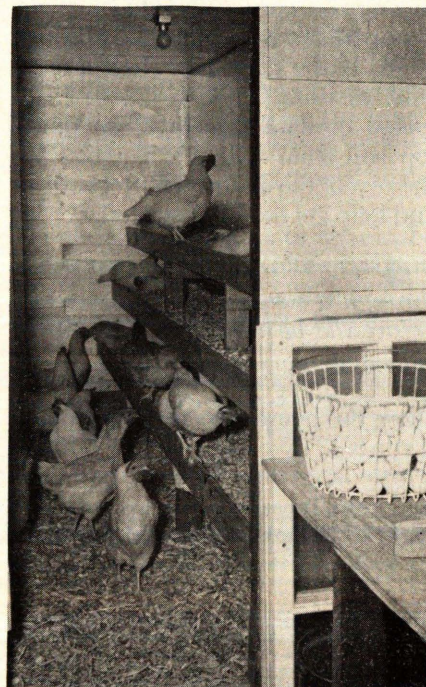


Fig. 13. The nesting room.

gravel fill floor that is well-tamped is sufficient. Any saving in construc-

tion costs can probably be best met by eliminating the concrete floor.

DEEP LITTER helpful

Deep litter offers many advantages in the poultry house. First it is a labor saver when the house only has to be cleaned once a year (between flocks). Secondly, it provides needed heat in the house to help ventilation. Deep litter in a house with the proper balance of insulation, ventilation, and bird numbers will stay relatively dry resulting in a comfortable place for the birds as well as the production of clean eggs.

Deep litter depends on bacterial action rather than absorption so some definite things have to be done to make it work properly.

- Start the litter in the early fall. Bacteria need warm temperatures to multiply.

- Start with three to four inches of a relatively porous material such as cracked corn cobs, shavings, or chopped straw. Long straw is not good. If the litter is started late in cold weather, an inch layer of old rotted cow manure or clean black top soil from a field will inoculate the rest of the material with bacteria and help get the litter started.

- *The litter will probably go through a sweating or messy stage before the bacteria gets built up to sufficient numbers to dry it.* Don't get discouraged at this point and clean the house. Stir the litter when it starts to cake over on top. Adding a little more litter from time to time will help. It can be built up until it is eight to 10 inches deep. Adding a little hydrated lime or superphosphate to wet litter will also help dry it.

- It may be necessary to clean small areas in the house where there is a high concentration of birds such

as around feeders or water fountains. If this is necessary clean out only the small area that is wet. Then spread some of the old litter over the area and mix new litter with all the litter in the area. The old litter will inoculate the new with bacteria.

- Once the litter gets started and dries itself it should go on through the laying season with very little care. An occasional stirring with a fork and addition of litter should be sufficient.

- Here is a check list to study if deep litter is not working properly:

1. The house must be insulated to conserve heat. Storm windows are also important. See the insulation section of this circular.

2. The ventilation system must be adequate, able to exhaust 3 to 5 cubic feet of air per minute per hen at one-eighth inch static pressure at maximum capacity. Inlets must be distributed so fresh air comes into all areas of the house. See the ventilation section of this circular.

3. Birds should be allowed 2¼ to 3½ square feet of floor space in the house. Crowding puts more moisture load on the litter. Too few birds are also undesirable because there is not enough heat produced to keep the house temperature up.

4. House temperature should stay above freezing. Preferably 35 to 45 degrees. Poor insulation may restrict the use of ventilation because of heat loss through the walls and ceiling, driving the relative humidity above what it should be.

5. Poor drainage around the house or a high water table may allow ground water to wet the litter from underneath.

6. Leaky water fountains or lack of provision for drainage around fountains on the floor may wet litter area.

7. Unwise use of material for deep litter. Long straw or other material of that nature will not make good deep litter because the particles do not lie close enough together.

8. Too little dropping pit space or lack of full use of the dropping pit space will overload the floor litter. Put water and feed on the dropping pits to encourage birds to spend more time on them. See Figs. 14 and 15 for arrangement of equipment in house.

9. Excessive salt or milk in the ration will tend to make the droppings wet and put more load on the litter.

FLOOR SPACE requirements

One of the most serious mistakes a lot of poultrymen make is to put too many birds in a house, crowding them to the point that profits suffer. Very seldom has a flockowner proven he can overcrowd and not have a lot of trouble in the flock. Usually the story is low production, disease losses, cannibalism, or some other profit robbing factor.

Circular 504, "Modern Poultry Housing," is a house plan for a 24 x 34 foot house for 300 pullets. This has 816 square feet or about 2¾ square feet of floor space per bird.

Circular 515 "Modern Poultry Housing," is a house plan for a 30 x 50 foot poultry house for 500 to 600 birds. This house has 1500 square feet of floor space.

LIGHTS in the house

Light stimulant is an important factor in egg production. Before the use of electric lights in the laying house the heavy production came in

the spring after the days started to get long. Now with the use of electricity we can provide the birds with spring-like light conditions and get heavy production at any time of the year.

Two things to consider in lighting a poultry house are length of light period and intensity of light. Birds should have a 13 to 14 hour day. When the daylight period is shorter than that, it should be supplemented with lights. Morning lights, evening lights, or both morning and evening lights can be used. The important thing is to be regular with the lighting period.

One 40 to 60 watt bulb is sufficient for each 200 square feet of floor space in the house. The lights should be so located that they light the feeding and water area.

Reflectors over the bulbs aid in directing the light rays down on the birds. Keeping the bulbs clean also helps get full use from the lights. Some folks have been successful in helping their birds out of a slump in production by increasing the wattage of the bulbs.

A time switch should be installed in the circuit to regulate the lighting period. The switch should be adjusted each week or 10 days to fit the changing lengths of day.

Where poultry houses have an entry room there should be a light that can be turned on separate from the house lights. There should also be a separate bulb and switch for the nesting room for night egg gathering.

FEEDER SPACE requirements

Experiment stations have proven that each hundred hens in the house need the equivalent of two to three 8-foot feeders for maximum production. Round tubular type feeders are quite popular in some areas and are good if enough of them are used (four to five per hundred birds). A good plan is to use a combination of both five or eight foot feeders and tubular type. Place the conventional type feeders on the floor and hang the tubular feeders over the dropping pit.

When sufficient feeder space is used in a house it will not be in use

all the time. The important thing is to have enough space for all birds to get to a feeder when they feel like eating. They don't like to stand and wait in line to eat any better than we do and will probably scratch in the droppings to fill up if crowded away from the feeders. Also when there is a shortage of feeder space the stronger birds will bully the weaker birds and not let them near the feed supply.

Maximum production can only be obtained when all the birds in a flock get all of a balanced ration they want without competing for it.

WORK SAVING arrangement

The poultry house equipment should be arranged for the convenience of the flockowner while working in the house as well as convenient for the birds to use so they can do their best in the nest.

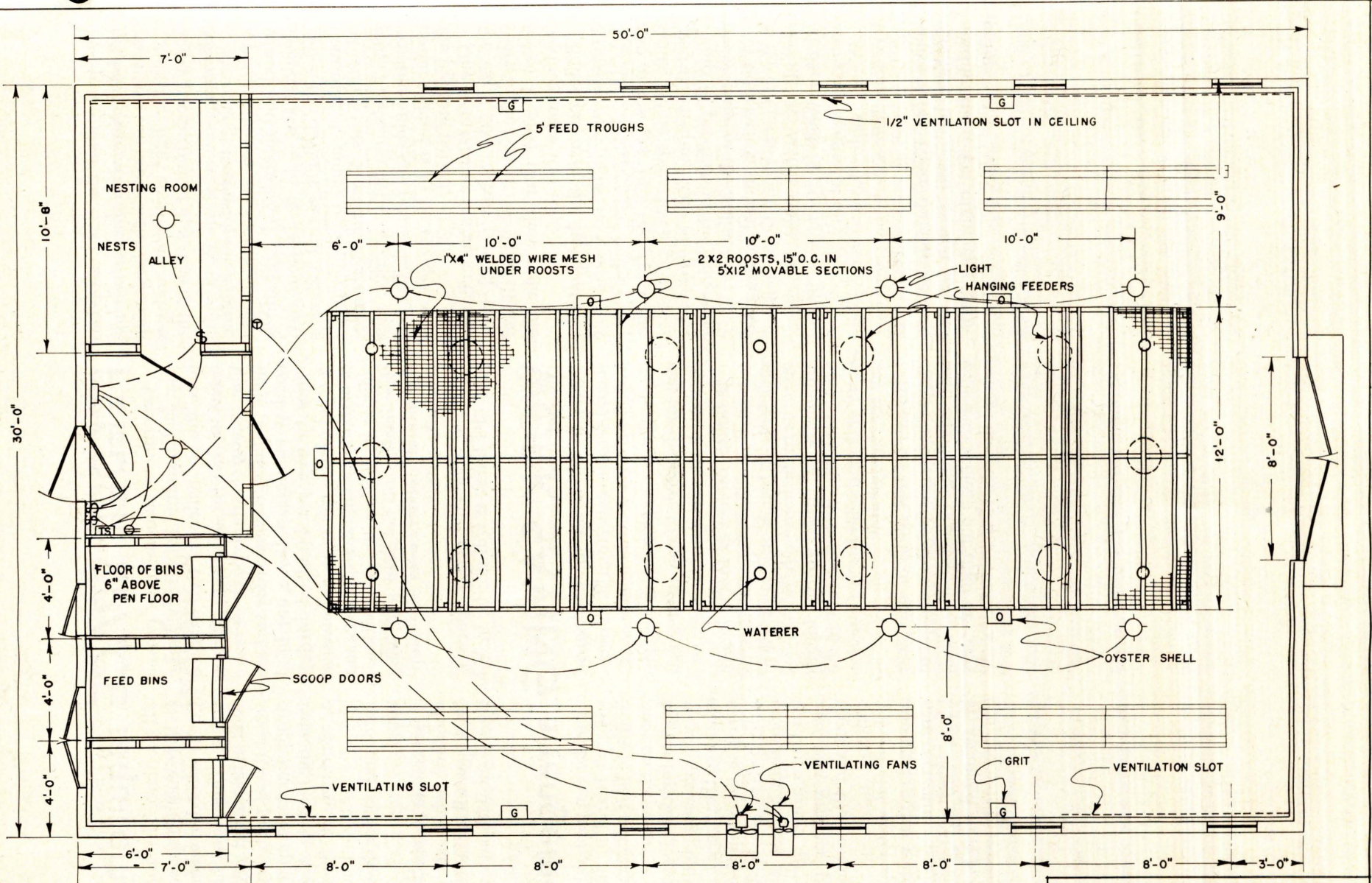
In houses 50 feet or less in length one nesting room near the door is sufficient. It brings the nests all to one area in the house where the eggs are handy to gather. In this length house feed bins near the door in the same end of the house are convenient for the operator.

Houses 24 feet wide or narrower can probably use the dropping pit to best advantage against the back wall with a clean out door or doors behind the pits. Houses 30 feet wide

or wider can probably use the dropping pit island in the center of the house to best advantage with a large door on the south or east to admit a tractor for cleaning. One should always leave enough space around the island so they aren't crowded when carrying things in the house.

If houses are to be built much more than 50 feet long, it might be wise to consider dividing the house into two sections putting a feed room and the nesting rooms in the center.

Feed and water space should be arranged so that water and feed are near each other in all sections of the house. This equipment should also be arranged so it is convenient for the operator to service.



NOTE.- ORIENT BUILDING SO THAT IT RUNS NORTH AND SOUTH.

FLOOR PLAN
SCALE 3/8"=1'

500 HEN LAYING HOUSE
EXTENSION SERVICE
 SOUTH DAKOTA STATE COLLEGE
 U.S. DEPARTMENT OF AGRICULTURE
 CO-OPERATING

DESIGNED BY *[Signature]*
 DRAWN BY *[Signature]*
 CHECKED BY *[Signature]*
 APPROVED BY *[Signature]*
 DIRECTOR OF EXTENSION

SHEET 1 OF 5
NO. 314
 DATE JUNE 1954
 SCALE AS SHOWN

Fig. 14. Plan of arrangement in the South Dakota 500 hen poultry house.

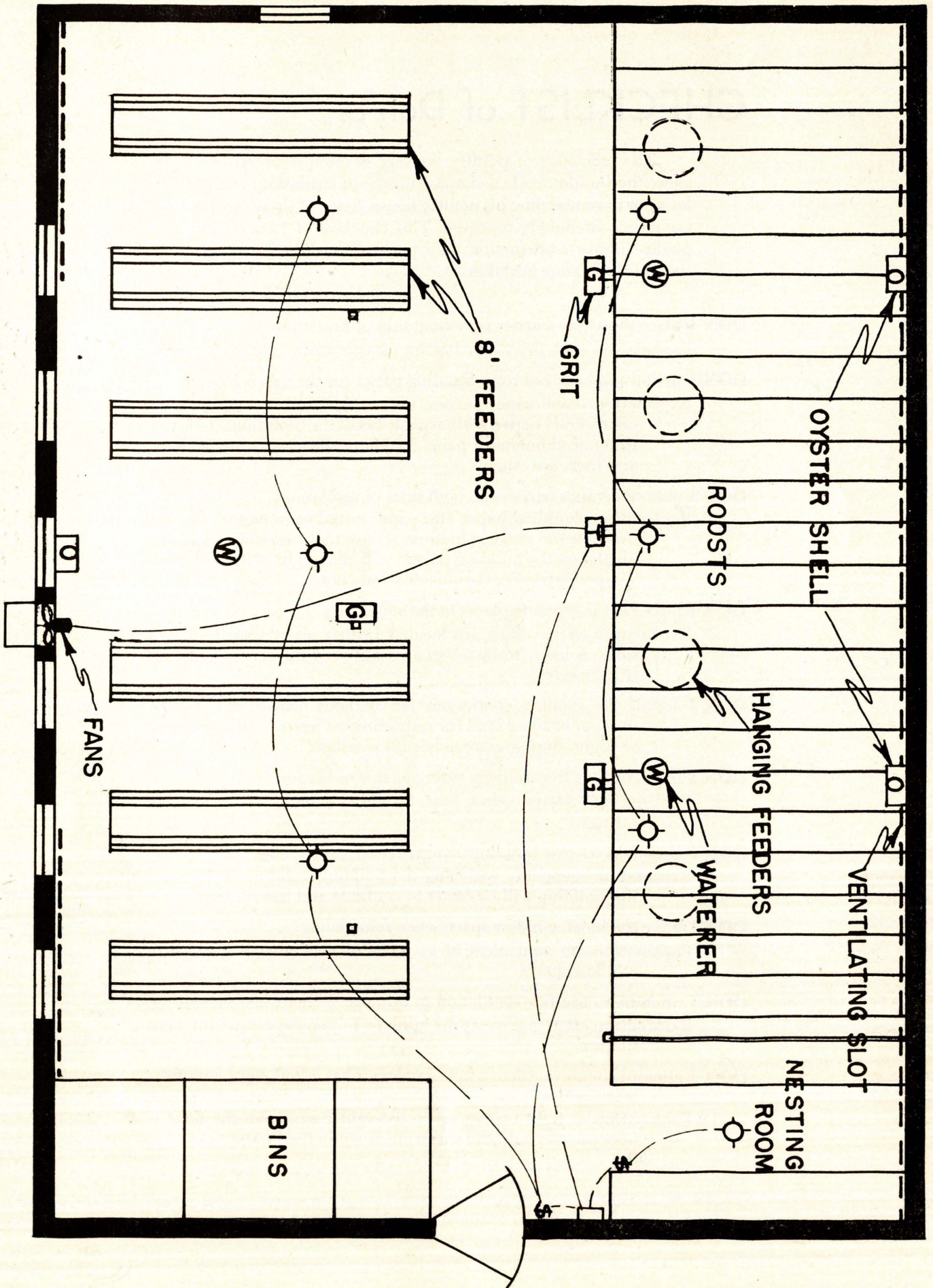


Fig. 15. Plan of arrangement in the South Dakota 300 hen poultry house.

CHECKLIST of Don'ts

The efficiency of poultry housing is often lessened because the builder made a simple mistake in insulating, ventilating or in remodeling his poultry house. Some of these errors are rather commonly repeated. This checklist of "don'ts" in poultry house construction may prevent you from making some of these same mistakes.

DON'T place the vapor barrier on wrong side of insulation.

Explanation—put the vapor barrier on the warm side or "in" side.

DON'T use tar paper or red resin building paper for the vapor barrier.

Explanation—good vapor barriers are: asphalt roll roofing, two layers of kraft paper with asphalt between, aluminum foil, two coats of aluminum paint (if joints and cracks are sealed), and there are others.

DON'T place the vapor barriers on both sides of insulation.

Explanation—building paper (tar paper or red resin paper) may be used on the outside because if any moisture collects in the insulation the building papers will allow it to escape whereas a vapor barrier on the outside would not.

DON'T place fans in separate places in the house.

Explanation—if two fans are located farther apart than four feet there is likely to be a wet area between the fans. Place fans side by side.

DON'T install the smaller, continuous fan without providing a sliding damper of some kind for restricting air movement, especially at night, during extremely cold weather.

DON'T buy fans by a free delivery rating or size of blades.

Explanation—always select fans by their $\frac{1}{8}$ inch static pressure ratings.

DON'T build old narrow buildings longer when remodeling.

Explanation—generally widening the building will be cheaper and the building will be easier to ventilate and less drafty.

DON'T leave too much window space when remodeling.

Explanation—an equivalent of 3% to 5% of floor area is enough in window space.

DON'T attempt to use fan ventilation in a house without first insulating.

Explanation—It is necessary to insulate to conserve heat for ventilation.

DON'T attempt to fan ventilate a house unless it has a low, tight and insulated ceiling.

Explanation—a tight ceiling seven to eight feet above the floor is necessary to hold the warm air down in the house.

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