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Poultry Housing In Ohio

By
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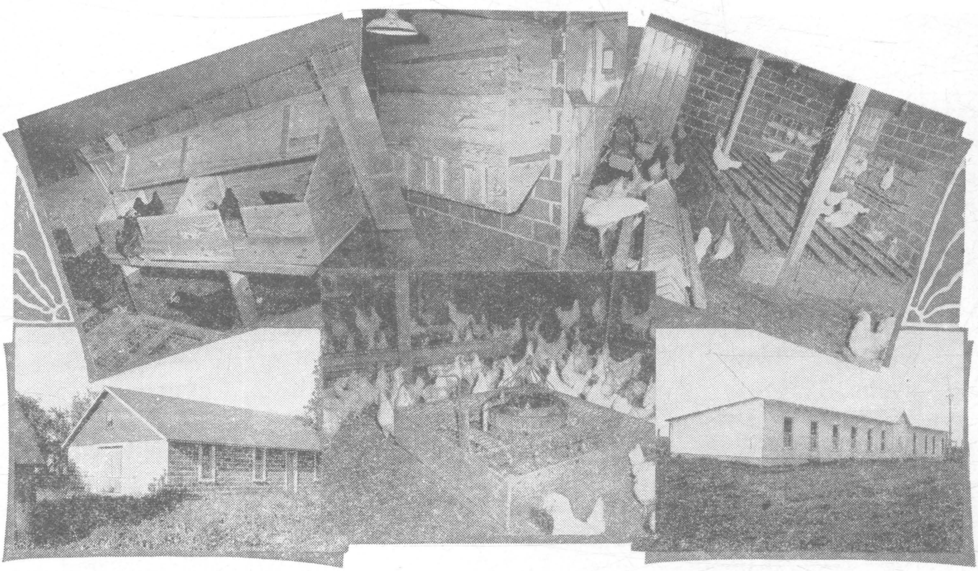

Proper housing and housing equipment make for a more economical poultry business.

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Poultry Housing In Ohio

There are many different kinds of structures used to house poultry in Ohio. Generally, these houses are of three types: the uninsulated house, the semi-insulated house, and the insulated house.

The uninsulated house is used extensively in Ohio. It is usually of more or less tight construction with large front wall openings. These openings are fitted with windows or cloth covered frames that can be closed during storms and cold weather. There is very little difference between the temperature inside the house and the outdoor temperaure, although drafts are eliminated to some extent.

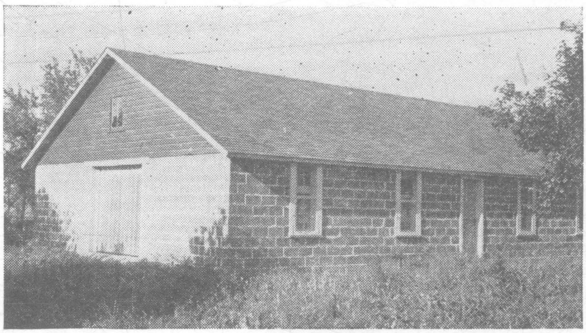

Fig. 1.—The 30x50 Ohio Poultry House with center driveway and equipped with wall type feed bins.

The semi-insulated house is also widely used in the State. It is usually a tightly constructed building with snug fitting doors and windows. Insulation is used in the ceilings and often in the side walls. There is some control of ventilation by the use of windows, air ducts and flues, or fans. Drafts are controlled fairly well and temperatures can usually be maintained above freezing inside the house without added heat, as long as the outside temperature remains above 15°F. Trouble with wet litter and frosting is common.

The number of **insulated poultry houses** in the State is increasing. A good insulated house is tightly built, and the side walls and the ceiling are heavily insulated. The ceiling is usually more heavily insulated than the side walls. In some instances, the doors and windows are weather-stripped and insulated doors and storm windows are used. The window area is reduced to prevent excessive heat loss. Controlled ventilation makes the house draft free and gives good protection against sudden temperature changes that affect egg production. The litter can be kept dry. Freezing can be prevented in the house in ordinary winter weather without the addition of heat other than that produced by the birds.

The Hen and the House

While the hen can be kept under a wide range of climatic conditions, she is affected by extremes in temperature, especially sudden and abrupt changes in temperature and cold drafts. One of the main functions of a poultry house is to provide a living and working area for the hens, protect them from extremes of heat and cold and from drafts. Tight construction to stop air leakage through the building walls and around the windows and doors, insulation in the walls and ceiling, and heat other than that produced by the birds may be used occasionally to meet these conditions.

The high production hen, when well cared for, will lay 200 or more eggs annually. The hen ordinarily lays best in the spring when temperatures range from 40 to 60°F. The type of construction that protects the birds from extremes of heat and cold, when combined with controlled ventilation and good lighting, produces living and working conditions in the poultry house conducive to high egg production.

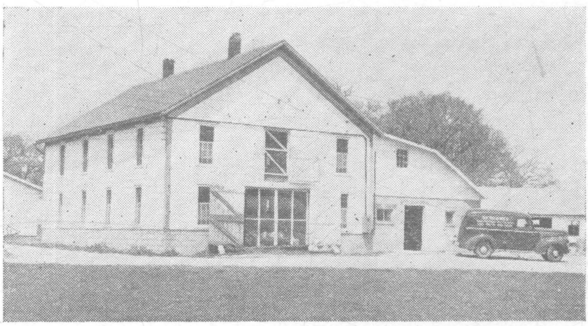

Fig. 2.—A multiple-story poultry house equipped with an elevator.

Twenty-five hens occupy approximately the same amount of floor space as one dairy cow and produce only one-third the amount of heat. The hen's body temperature of 106°F is the highest of domestic livestock. She has no sweat glands. Her temperature is regulated by the evaporation of moisture from the respiratory organs. She will exhale enough water vapor and void enough liquid in the droppings to amount to more than one-third pint of water per day. In cold weather, this moisture, along with the moisture from drinking fountains and other sources, accounts for wet litter and wet and frosted walls and ceilings. Unless additional heat is used, the heat produced by the birds must be relied on to evaporate this moisture before it can be removed by ventilation, and this heat must also be used to maintain the desired temperature in the house. Tight construction, heavy insulation, a small amount of added heat and controlled ventilation may be necessary to keep the poultry house dry, warm, and reduce odors.

The average hen will consume 22 to 25 gallons of water per year. In hot weather, she will consume approximately ½ pint of water per day. An adequate supply of fresh water should be available at all times. Water under pressure with well designed automatic waterers, equipped with screen platforms and good drains, will cut down chore time and tend to eliminate at the source one cause of damp litter and moisture in the poultry house. Protection to prevent the water and the water supply lines from freezing is necessary in cold houses.

A mature hen consumes about 15 to 20 times her own body weight in feed per year. Adequate feed storage space in overhead bins, wall feed bins, or feed rooms that are accessible from the outside for filling are desirable. These bins, located for ease of feeding in conveniently arranged feeding equipment, will reduce labor requirements.

One hundred hens produce about 2 to 2½ bushels of manure per week. Under some methods of housing, as much as 12 pounds of litter per month per bird may be required to keep the litter dry. Equipment, such as dropping pits, which require less frequent cleaning, building design that permits driving cleaning equipment into the house, smooth impervious floors that are easily cleaned, adequate and accessible storage for litter, either overhead or close by, all contribute to the saving of labor in caring for the flock.

Normally, the floor space allowed per bird is 3 square feet for light breeds and 4 square feet for heavy breeds. Some poultry raisers allow slightly more space per hen when less than 200 birds are confined in one pen, and a little less space when the pen confines more than 200 birds.

The Right House for the Poultry Enterprise

In many sections of the State, the size of farm flocks is increasing. Larger numbers of layers are housed together. Better management methods, better buildings, and labor-saving equipment have reduced the labor cost of producing a dozen eggs.

It is the general practice to house farm flocks of 500 birds or less in a single-story house. Where the poultry enterprise is large and the space requirements exceed 2,000 square feet, some poultrymen consider a two-story house more economical. The two-story house is more convenient to operate than houses with three or more floors, especially if the side or end of the house is banked, making both floors accessible from the ground level for handling feed and litter. If the multi-story house is built on a level site with no access to the upper floors other than stairs, it may be very inconvenient, unless a hoist is provided to transport feed, litter, and eggs. The hoist should have at least 1,000 pounds capacity.

For a large flock, a multi-story house will cost less to build than a one-story house of equal capacity. It will occupy less ground, require less foundation, save on ceiling insulation, and require less roofing. With this type of building, it is necessary to keep the birds confined the year around. See Fig. 2. An elevator or hoist, such as that shown in Fig. 3, is a necessity in such houses.

Single-pen houses are now built square, ranging from 12 by 12 feet for small flocks of 30 to 40 birds to 36 by 36 feet for flocks of 300 to 400 birds. Houses for larger flocks range from 30 to 40 feet in width and the amount of floor space is determined by their length. Wide buildings are recommended for both one-story and multi-story houses.

The trend is definitely away from the long, narrow type house that was popular a few years ago. The wide house has many advantages over a narrow house. The cost of construction is reduced, because there is less foundation and wall area required for the same amount of floor space. It is easier to keep warm, because there is less exposed wall area. Drafts are more easily controlled in a wide house than in a narrow one. Interiors can be more conveniently arranged to eliminate extra steps in caring for the flock. A driveway through the building may be used for pulled or power operated manure handling equipment. The wide building provides an opportunity for the use of a type of roof construction that will give ample overhead storage space for feed, litter, etc. The wide building is flexible. That is, it can be converted for other uses than housing poultry, if the occasion demands.

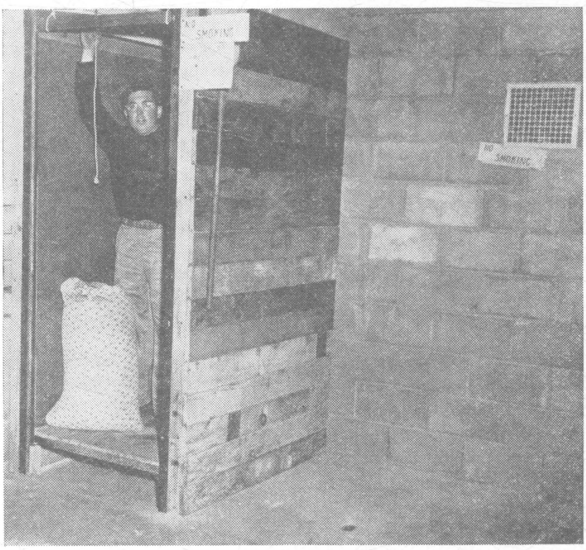

Fig. 3.—Close-up of elevator powered by an electric hoist.

A large number of barns have been converted into poultry houses on Ohio farms. The 36 by 40 foot width of most Ohio barns makes them easily converted into conveniently arranged poultry houses. However, special care is necessary to make them rat-proof. When they are converted, the suggestions made on the following pages in regard to construction, insulation, and ventilation should be followed. Figure 4 shows a three-deck, remodeled barn which is giving satisfactory results on a central Ohio farm.

Fig. 4.—This remodeled barn is housing a large flock of layers in central Ohio.

Location of the Poultry House

If poultry raising has a permanent place in the farm program, it is reasonable to assume that the poultry buildings should be as durable and have as pleasing an appearance as the other buildings on the farmstead. Careful planning is necessary to make certain the house is put in the right location in the farm layout. It should be convenient to the other buildings so that the poultry enterprise is on the chore route, and yet it should be located so that the birds will not be disturbed by other farm enterprises.

Exposure.—Poultry houses are usually built to face south, southeast, or east, to permit the greatest amount of winter sunshine to enter the house. However, on many farms where a large house is to be built, it can be run north and south so light will enter the house from both the east and west sides, in order to get better distribution of light in the house.

Drainage.—Good drainage, to carry the surface water away immediately, is important. If possible, the house should be located on a slope so that the water tends to run away from the house. However, if this is not practical, poor natural drainage can be greatly improved by grading and tiling.

Air Drainage.—If possible, poultry houses should be put on a south slope or on the level. If houses are put on a north slope, especially the lower part of the slope, cold damp air and fog are likely to settle around the poultry house and make it cold and drafty when windows are open.

Wind Protection.—Because winds play an important part in the heat loss from poultry houses, anything that tends to break the wind will make the house more comfortable in the winter. If there is no natural wind protection, a planting of a variety of evergreens recommended for windbreaks on the west side will be helpful in reducing heat loss during the winter.

Relation to Other Buildings.—In locating the poultry house, it is well to think of the possible future expansion of the poultry business. When the first unit of the poultry plant is planned, room should be provided for future expansion. In most areas, it is better to have the poultry house located east of the dwelling, because of the prevailing southwest winds in warm weather in most of Ohio. This will help to avoid odors, noise, dust, and flies in the dwelling area. The importance of locating the house to save as many steps as possible in caring for the flock cannot be over emphasized.

Construction

When building new or remodeling larger buildings for poultry, the future possibility of using the building for some purpose other than poultry should be considered. By careful site selection, a well designed building, set on a good foundation, and constructed with durable materials and good workmanship, may be converted economically for other uses. This adds considerably to its value.

Rat Proof Construction

Many poultry houses are heavily infested with rats. Rats consume and destroy considerable feed and they are disease carriers. Rat infestation has been especially serious in barns that have been converted into poultry houses.

A good foundation is important in keeping rats out of the poultry house. A foundation wall for a frame structure that extends 15 to 18 inches above the ground makes it more difficult for rats to gain entrance into the building.

When insulating the building, it is desirable to use metal, cement, asbestos board, or other rat resistant materials as lining in areas where rats are likely to enter the walls. The use of hardware cloth or metal on the sills and at ceiling level also aids in keeping rats from getting into the walls. When insulation board or sheathing is fastened on the inside of the studding, filling the space between the studding with insulation will discourage rats

All openings in the building should be covered with heavy, fine-meshed screen or ½-inch hardware cloth.

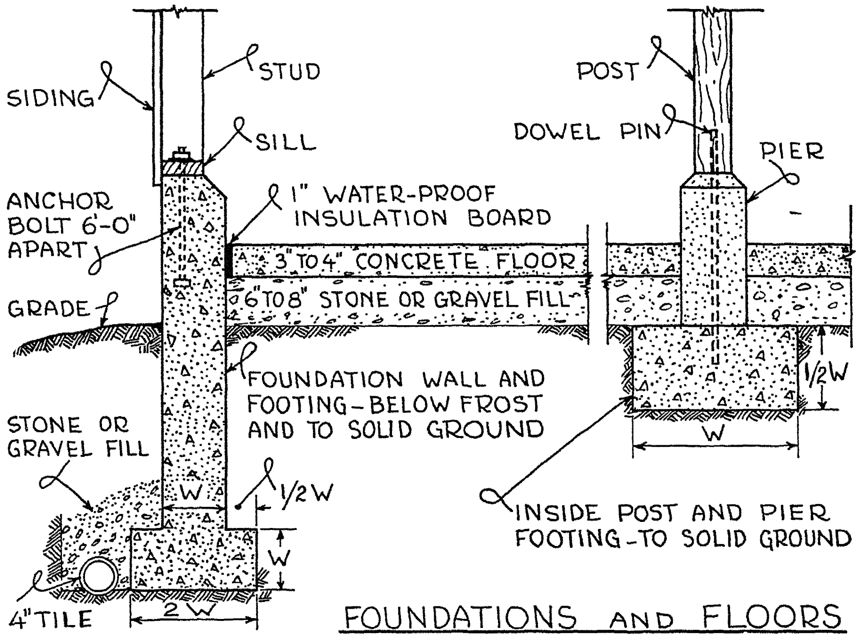

Fig. 5

Foundation

There is no surer way of wasting material, labor, and money than by constructing a building on a poor foundation. A poor foundation may cause walls to crack, sag, and spread, resulting in air leakage, broken and rotten sills and framing, doors and windows that will not shut, and roofs that sag and leak. A well designed and constructed foundation will prevent this. It will add years to the building's useful life and reduce maintenance and repair costs.

The foundation should rest on solid, undisturbed earth to prevent settling and extend 3½ to 4 feet into the ground to prevent frost heaving, which is caused by the earth under the foundation freezing and thawing. The bottom of the foundation should be level and flat. If it is necessary to change the depth of the foundation, because of the slope of the ground or for other reasons, the base should be stepped not sloped to the change in elevation.

The footing or slab at the bottom of the foundation transfers the weight of the building to the earth. It varies in size with the height of the building, the materials used in its construction, the loads carried by the wall supported floors and roof, and the kind of earth on which it rests. In some types of light, one-story buildings, the foundation wall itself acts as the footing. For buildings constructed of masonry, buildings that are heavily loaded, and multi-story buildings, the footings may have to be considerably wider than the foundation wall to carry the weight of the building.

Table 1.—Minimum Foundation Wall and Footing Requirements for Poultry Houses

Kind of House	Foundation Wall Thickness	Footing Size	
		Soil A*	Soil B**
One story frame	8″	none	none
One story masonry block	8″	8″ x 16″	8″ x 16″
Two story frame	8″	8″ x 16″	8″ x 16″
Two story masonry block	10″	9″ x 18″	12″ x 24″
Barn with mow	10″	9″ x 18″	12″ x 24″

* Soils that will carry a load of 30 pounds per square inch, such as dry clay, coarse sand, or gravel.
** Soils that will carry a load of 15 pounds per square inch, such as wet clay and fine sand.

Good drainage is essential around the foundation to prevent heaving and settling from frost action. This can be obtained by placing a 4-inch drain tile around the outside of the building at the footing level and back filling over the tile with 1 to 2 feet of crushed stone or gravel. The tile should have a uniform slope of at least 1 inch in 12 feet to a gravity outlet. The outlet should be constructed to prevent the entrance of rabbits or small animals and also to prevent damage from freezing at the outlet.

When the foundation is being constructed, provision should be made for the entrance of water lines into the building and the exit of drainage lines from the building. When the lines are to be installed at a later date, a passage provided through or under the footing with a 4- or 6-inch tile at the time of construction will eliminate cutting through the wall or tunneling under it after the foundation is in place.

Adequate footings under posts inside the building that carry the roof and the loads from overhead floors are of the greatest importance. The post footing may support more than double the weight supported by a 10- or 12-foot length of wall foundation, especially in multi-story houses or buildings with loft storage.

As there is little or no danger of the ground freezing or thawing under the poultry house floor, the post footing should be placed deep enough to rest on solid ground. The footing base should be level for maximum bearing and strength. Generally, the footings are one-half as thick as they are square on top.

Floors

Floors for One-Story Poultry Houses.—Concrete is the best material for the poultry house floor that is placed on the ground. The first cost and upkeep are low. It is rat, vermin, and decay-proof and is easy to clean and keep sanitary.

To obtain a dry, warm concrete floor, good drainage under the floor is essential. This can best be obtained by covering the area to be floored, after it has been graded and made firm, with 6 to 8 inches of coarse gravel or crushed stone, so that the finished floor will be at least 8 inches above the outside ground level. The stone or gravel prevents the capillary rise of water, and when used in conjunction with good drainage, eliminates the ground water as a source of wet floors. See Fig. 5, page 8.

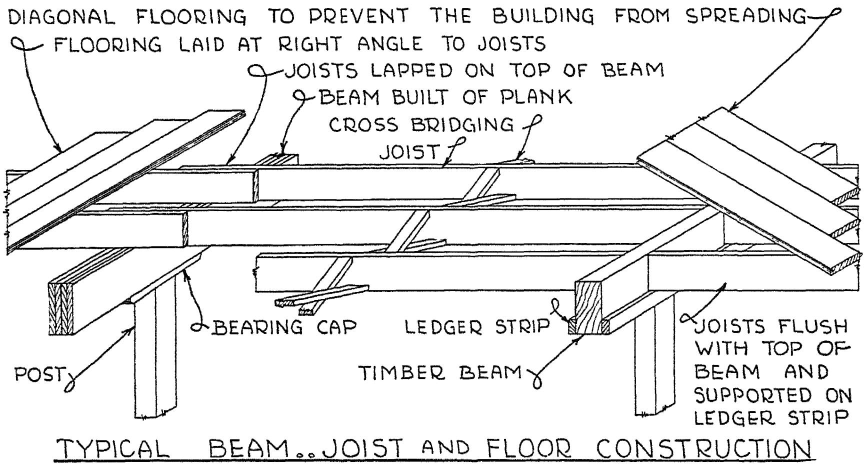

Fig 6

The floor is easier to clean, if it slopes toward the front of the house so that it can be flushed out with a hose at cleaning time. A slope of 1 inch in 10 feet is sufficient for this purpose.

The regular floor need be only 3 to 4 inches thick, while driveway sections should be 5 or 6 inches thick. A strip of 1 inch thick waterproofed insulation board, placed between the floor and the wall, will act as an expansion joint and help to keep the floor warm in the wall area. A good mix for the concrete floor is 1 part portland cement, 2¼ parts sand, and 3 parts gravel or crushed stone with a ¾-inch maximum size. With average damp sand, not more than 5 gallons of water per sack of cement is used. The floor is poured over the gravel or stone fill and levelled with a strike board. The surface is rough finished with a wood float and then given a final smooth finish with a steel trowel. The floor should be kept moist for at least 5 days after it is placed.

Floors for Multi-Story Houses.—The ground floor for multi-story houses is best made of concrete. For the upper floors, a single layer of matched lumber is usually satisfactory. If maximum fire safety is desired the floors may be made of reinforced concrete. If the rooms underneath are unheated, a double floor with water-proof paper between should be used. A wood that will not splinter when scraped is desirable for the floors.

The clearance or headroom between the floor and overhead joists and beams should be held to a minimum in order to conserve heat. A height of 7 to 8 feet will allow for built-up litter and head clearance for the operator. Several typical methods of supporting overhead floors are illustrated in Fig. 6.

The size of the beams to use for floors and ceilings depends on the distance between supports and the load carried by them. The size of floor and ceiling joists depends on the distance between supports, the distance they are spaced apart, and the load they have to carry. All woods do not have the same strength and this must be taken into consideration when calculating the size of beams and joists.

Table 2 gives the maximum loads allowable for uniformly distributed loads on wooden beams and joists for a number of common kinds of wood of No. 2 standard framing grade.

Table 2.—Maximum Carrying Capacity for Uniformly Distributed Loads of Wooden Beams and Joists of Oak, Rock Elm, Beech, Hickory, Hard Maple, Yellow Pine, and Douglas Fir

Poplar, soft maple, sycamore, chestnut, hemlock, and fir have 70 percent of the values.

Cottonwood, soft maple, basswood, and black ash have 50 percent of the values.

For load concentrated in center of span, safe load is one-half that given.

Nominal size	Actual size	Length of unsupported span in feet								
		2	4	6	8	10	12	14	16	18
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
2″ x 4″	1⅝″ x 3⅝″	2000	1050	700	550	425	350	275	250	225
2″ x 6″	1⅝″ x 5⅝″	4600	2350	1575	1180	950	800	675	600	525
2″ x 8″	1⅝″ x 7½″		4150	2800	2100	1700	1400	1200	1050	925
2″ x 10″	1⅝″ x 9½″			4400	3300	2650	2200	1900	1650	1475
2″ x 12″	1⅝″ x 11½″			7100	4700	3800	3200	2700	2350	2100

Data from U.S.D.A. Wood Handbook

Joists and Beams.—Joists containing bad knots near the edge should be rejected and no joist should be notched at the ends or any other place, as the strength of joists is reduced to the dimension of sound material left.

Table 3.—Weight of Materials per Cubic Foot and Live Load per Foot on Floors

Material	Lbs. per cu. ft.	Material	Lbs. per cu. ft.	Floors Live Load	Lbs. per sq. ft.
Ear corn	30	Soft woods	30	Dwellings	50
Oats	32	Hard woods	48	Poultry house	
Small grain	48	Concrete, solid	150	pens	30
Straw, loose	2	8″ concrete blk.	90		
Straw, loose baled	8	8″ cinder block	60	Values to use in absence of building regulations or speci'cations	
Straw, tight baled	12	Asphalt mix	150		

The beam can be made from a solid timber or built-up planks. In either case, the ends of the timber or spliced planks must be above the supporting posts to obtain full strength.

Bridging.—If joists have a span of more than 8 feet, a row of cross or solid bridging should be used halfway between the two supports. If the joists span 14 feet or more, two rows of bridging should be used. Bridging stiffens the floor and prevents the joists from buckling and it helps to distribute concentrated floor loads over a larger area.

Walls

The poultry house walls should be securely anchored to the foundation to avoid damage from heavy winds. This is accomplished in frame construction by bolting the sill to the foundation by means of ⅝-inch by 18-inch bolts or threaded rods spaced about 6 feet apart. These rods are embedded in the foundation so that the threaded end projects high enough above the foundation to pass through the sill and take a large flat washer and a nut. All corner posts should be well braced to keep the walls plumb and true. Dividing partitions in long houses should be securely fastened to the foundation, outside walls, and ceiling or roof.

Masonry walls depend largely on their weight to hold them in place. However, masonry walls more than 24 feet long should have pilasters spaced from 10 to 14 feet apart to increase their stability in heavy winds and where earth is banked against them. Anchor bolts similar to those used in the foundation are recommended in the top of masonry walls to firmly anchor the roof or other frame construction supported by the wall.

At the time the walls are being constructed, whether they be of frame or masonry, flashing or other means of protection from moisture should be provided above windows and doors that are unprotected from the weather by porches or overhanging roofs.

Frame Walls.—Frame walls usually are constructed of studs covered on the outside with diagonal or horizontal wood sheathing or large sheets of manufactured fiber board. Sheathing is desirable for added strength and to reduce the heat loss. In construction, where fill insulation is used between the studs and the inside of the wall is sealed and vapor-proofed, sheathing is often omitted. Between the sheathing and outside finish, a layer of building paper should be used to seal off air leaks. Paper that acts as a vapor barrier is not recommended for this location. The exterior finish may be wood siding, shingles (wood, asphalt or asbestos), masonry veneer, stucco, or metal.

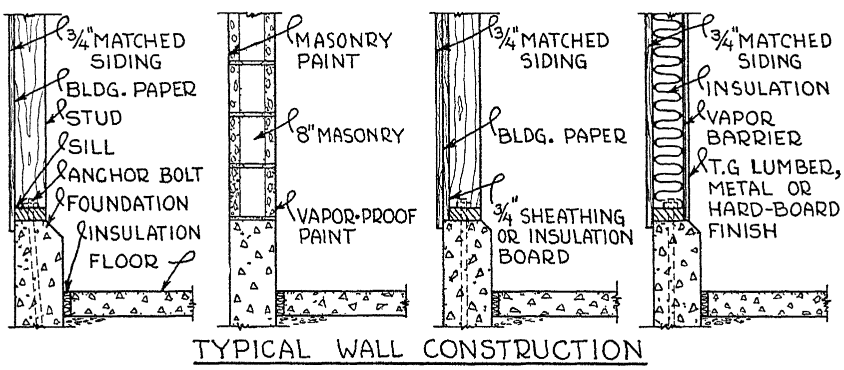

Fig. 7

The inside of the studs may be covered with wood, metal, manufactured fiber, or hard board. The space between the studs may be used as a container for various types of insulation, such as loose fill (mineral wool and granular), flexible (bat and blanket), rigid (fiber board), or reflective (bright metal).

Masonry Walls.—Masonry walls of concrete block, tile, brick, or stone make satisfactory walls for poultry houses when properly constructed. The quality of the masonry units should be excellent, free from cracks and softness. The mortar should be hard and well bonded to the masonry units. For a warm poultry house, the masonry wall should be built as a cavity or double wall which provides air space between the inside and outside wall that may be filled with insulation. Solid masonry walls should be furred and the inside finish fastened to the furring. Furring provides an air space between the inside finish and the masonry which may be filled with insulation. Furring is accomplished by fastening wood strips to the inside of the masonry wall and fastening the finish to them. If masonry walls are not furred or of cavity construction, they are usually damp or sweat unless they are extremely thick.

Roofs and Roofing

The roof is usually subject to the hardest wear of any part of the poultry house. If it fails, the house is practically useless. There is no substitute for good workmanship and good materials in roof construction. Provision for adequate ventilation directly under the roof is also essential to combat condensation in cold weather and to help keep the house cool in hot weather.

Many types of roofs are used on poultry houses; the shed, gable, and gambrel types being the most common. The roof rafters should be firmly anchored to the side walls and supporting beams so that lifting action caused by heavy winds will be transmitted to the foundation. Diagonal wind braces should be fastened securely to the underside of the rafters in gable and gambrel roof construction to hold the roofs in line. Heavy end bracing is also essential for walls enclosing the ends under these types of roofs.

Roof Deck.—Tight sheathing is preferred for all roofing except for wooden shingles. When using green or wet lumber for roof sheathing, narrow boards leave smaller shrinkage cracks than wide boards, resulting in a tighter roof deck with less strain on the nails that hold the roof boards and roofing. Tight roof decks of dry matched lumber are essential for roll roofing and built-up roofing.

Roof Pitch.—Shingles require a roof with a 1/4 pitch (6-inch rise in 12 inches) or steeper to prevent water from blowing under the shingles in high wind.

Metal sheets with unsoldered joints require a roof with a 1/8 pitch (3-inch rise in 12 inches) or steeper.

Roll roofing may be used on a roof with 1½-inch rise per foot or steeper.

Built-up roofing and metal roofing with soldered seams may be used on roofs that are dead level, although some slope may be desirable to get rid of the water quickly.

When installing a roof of any type, the manufacturer's instructions should be followed.

Shed Roof.—The shed roof requires less material than other roof types. It serves both as the roof and the ceiling. It can be sealed, vapor-proofed, insulated, and ventilated to provide a comfortable house in winter and summer. Because of the low pitch of shed roofs, built-up or rolled roofing is commonly used.

Gable and Gambrel Roofs.—Gable or gambrel roofs are becoming more popular for poultry houses as they are adaptable to greater widths than the shed roof. The space in the loft may be used to house additional birds or for feed and bedding storage. Because of the greater roof pitch, the owner has a greater variety of roofing materials from which to select. These roof types may be readily adapted for insulation and ventilation to give winter and summer comfort within the house.

Roof Leaks.—Roof leaks are bad any time but especially so when insulation is used on or between the rafters. Leaks in this type of construction are difficult to locate and may cause considerable damage before they are discovered and corrected. A good roof covering, suitable for the roof pitch and carefully laid on a good roof deck, is the best insurance against this trouble.

Gutters, Downspouts, and Drains.—The water from the roof should be conducted by a system of gutters and downspouts to a tile drain and carried away from the building area. In the absence of a tile drain, the downspout should dump the water on a splash block which conducts it away from the house. By draining the roof water away from around the building, one of the causes of wet floors in the poultry house may be eliminated.

Insulation

Insulation makes the poultry house warmer in winter and cooler in the summer. It tempers the sudden changes and extremes in temperature which are usually accompanied by lower egg production. Harmful drafts are also reduced, as the temperature in all parts of the pen is more uniform.

Insulation helps to prevent "sweating" or "frosting" on the walls and ceiling. Insulated doors and storm windows will help prevent "sweating" and "frosting" in these areas. Warm air will carry more moisture than cold air. Since an insulated building is warmer, the moisture carrying capacity of the air is increased. When the moisture laden air touches a cold surface the moisture condenses, or sweating occurs. The temperature at which the moisture condenses is called the dew point. The more moisture there is in the air, the higher the dew point temperature. Insulation helps to keep walls and ceilings warm or at a temperature above the dew point.

Insulated buildings are easier to ventilate. Because insulated buildings are warmer and the air has more moisture carrying capacity, it is possible to carry off the moisture with less air movement. This permits better temperature control inside the building and the reduction of vapor in the air helps to prevent condensation on the walls, ceiling, and in the litter.

Satisfactory results can be expected from insulation only if the following conditions are met:

1. The building must be tightly constructed to minimize air leaks around doors, windows, and through the walls and ceiling.
2. A sufficient amount of insulation must be used to maintain the desired temperatures inside the building.
3. The insulation must be adequately protected, by vapor barriers on the warm side of the wall and ceiling, to prevent the

moisture laden air inside the building from entering and ruining the effectiveness of the insulation, and eventually damaging the structure.

4. Ventilation must be provided to remove excessive moisture and odors from the building and to regulate the inside temperature.

Air leaks quite often account for as much as 20 percent of the heat loss in buildings. Tight construction reduces air leaks. Good building materials, suitable for the purpose for which they are used, and good workmanship are the best means of obtaining tight construction. Tight fitting weather stripped doors and windows eliminates two of the main sources of air leaks. Unless the building is tightly constructed, controlled ventilation is impossible to obtain.

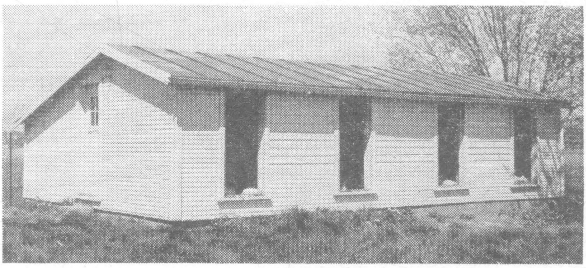

Fig. 8.—A 20x30 uninsulated house with large amount of window space.

The amount of insulation needed depends on the shape and size of the house and also on the temperature the poultryman wishes to maintain inside the house.

The square house has less exposed wall area per bird than the rectangular house. Consequently, both the cost and the heat loss per hen is less with the square or nearly square house. For example, a house 20 feet wide and 45 feet long has 130 linear feet of wall. A house 30 feet square, houses as many hens as a 20 by 45 foot house, yet has only 120 linear feet of wall area. With side walls 7 feet high, the house 30 feet square has 70 square feet less wall area to build, insulate, and contribute to the heat loss. The ceiling area is the same in both houses.

The small square house has more exposed wall area per hen than the large square house. This increases both the building cost and heat loss per hen for the small house. For example, a 100-bird capacity house 20 feet square with 7-foot side walls will have 5.6 square feet of wall area per hen, while a 400-bird capacity house 40 feet square with 7-foot side walls will have only 2.8 square feet of wall area per hen. Therefore, considerable insulation per bird can be saved with the larger house.

The amount of insulation necessary to maintain the desired temperature in the poultry house varies with the type of flock management practiced by the poultryman. With the cold or uninsulated house, tight construction to eliminate drafts is all that is necessary.

When the semi-insulated house is used, it is usually desirable to maintain the temperature inside the house above 15°F. or above the point at which the hen's comb will freeze. Walls with an insulating value* of 4 or more, ceilings with an insulating value of 6 or more, and controlled ventilation should give the desired results for outside temperatures down to 0°F.

When the insulated poultry house is used it is usually desirable to maintain the temperature inside the house above 32°F. Walls with an insulating value of 10 or more, ceilings with an insulating value of 12 or more, and controlled ventilation should prevent freezing inside the house for outside temperatures down to 0°F.

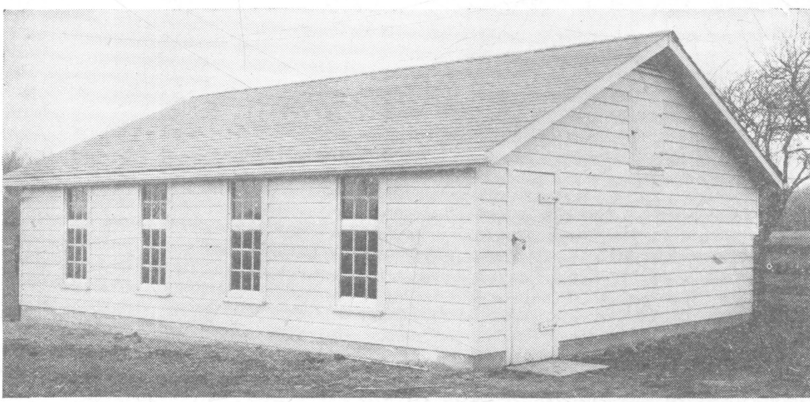

Fig. 9.—An insulated poultry house with filled insulation in side walls and ceiling.

In localities where temperatures below 0°F. are expected to prevail over a period of several days, the amount of insulation in the walls and ceiling should be increased over that suggested for 0°F. weather. Otherwise, a small amount of supplemental heat must be added inside the building to maintain the desired temperature. When insulation alone is used to maintain the desired temperature, the insulating value of the walls and ceilings should be increased one point for each 5°F. below zero in semi-insulated houses.

Restricting the ventilation in a house to raise the temperature, because it lacks sufficient insulation to keep it warm, will cause moisture to condense on the walls, ceiling, and in the litter unless supplemental heat is added.

Insulating Materials.—Any material that slows down the movement of heat is an insulator. Most common building materials have insulating value although some are better insulators than others.

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* The insulating value represents the number of degrees difference in temperature on opposite sides of a material or combination of materials of specific thickness that will cause one BTU (British thermal unit) of heat to flow through an area of 1 square foot of the material in one hour.

Heavy, dense materials, such as brick, masonry, and glass are usually poor insulators. Hollow tile and concrete block are somewhat better insulators because of the air space they contain. Concrete blocks made of cinders or other light weight materials have better insulating value than those made of heavier materials, such as crushed stone, sand, and gravel.

Light weight materials which contain numerous minute air spaces are generally good insulators. Wood is only a fair insulator because it is relatively dense. Wools made of rock, slag, and glass are excellent insulating materials. So are various plant materials, such as cane, sea weed, cornstalks, cork, redwood bark, shavings, sawdust, etc., when properly processed and treated.

Some bright metal surfaces make good insulators by reflecting the heat that radiates to their surfaces.

Types of Insulation.—Rigid board insulation is generally made of wood or plant fibers. The sheets are usually 4 feet wide and 6 or more feet long. They vary in thickness from ½ inch to 2 inches. These boards may be used for insulation, sheathing, or as finish for inside walls and ceiling. When used for inside walls, the area which can be reached by the hens should be covered with metal or hard board to prevent picking damage.

Fill insulation is made of many different materials. Mineral wools, expanded mica, redwood bark, etc., are some of the common commercial forms. Sawdust, planer shavings, ground corn cobs, chopped straw, etc., are common farm grown forms. This insulation is used to fill the spaces in walls between studs, joists, and rafters. Fill insulation can be used in both old and new construction. When farm grown insulation is used, it is the usual practice to mix about 1 pound of ordinary hydrated lime with each bushel basket of material to discourage rodents and insects.

Flexible insulation is usually in the form of "bats" or "blankets" which will fit between the studs, joists, or rafters. It is often made of loosely matted fibers of plant or mineral origin covered on one or both sides with an asphalt paper which may serve as a vapor barrier. It is available in thicknesses of ½ inch to 3⅝ inches. It may be used in new construction or in old construction when the studs, joists, and rafters are exposed.

Reflective insulation is usually a metal foil or a bright surfaced metal sheet. The foil may have a paper backing or be part of flexible or board type insulation. Its insulating value is determined by the number of reflecting surfaces and its reflective surface to be effective must installed so that it does not touch any other surface. In some forms it is used as a vapor barrier for other types of insulation.

Insulating Values of Building Materials.—All materials, air spaces, and surfaces that offer resistance to the passage of heat have an insulation value. The more slowly heat passes through a material, the better its insulation value. (Air spaces and wall surfaces, while not building material, are insulators.) For example, a material with an insulation value of 1 will lose heat 3 times as fast as a material with an insulation value of 3, or a wall with an insulation value of 2 will lose heat 6 times as fast as one with an insulation value of 12. The insulation value of a wall, ceiling or floor is the sum of the insulation values of all of the materials and insulators it contains.

Example No. 1: A wall framed with 2 by 4-inch studs and covered on the outside with matched siding has the space between the studs filled with 4 inches of rock wool. The inside finish is 1/4-inch cement asbestos board. A vapor barrier is placed on the inside of the studs between the cement asbestos board and the insulation. Referring to Table No. 4, page 20, the insulation value of the wall is calculated as follows:

Matched siding (fir)	1.2
4 inches rock wool	14.8
1/4 inch cement asbestos board	.1
Insulation value of wall	16.1

Example No. 2: A wall is constructed of 8-inch cinder block. The inside finish is a 1-inch vapor proofed fiber board set 3/4-inch away from the block wall on furring strips. Referring to Table No. 4, the insulating value is calculated as follows:

8-inch cinder block	1.7
3/4-inch air space	.9
1-inch fiber board	3.0
Insulation value of wall	5.6

Example No. 3: It is desirable to have a ceiling with an insulation value of 14 or more. The ceiling joists are 2 inches by 6 inches and sealed on the under side with a vapor barrier and 1-inch matched lumber. Referring to Table No. 4, we find:

1-inch lumber (fir)	1.2
6 inches ground corn cobs	14.4
Insulating value of ceiling	15.6

Vapor Barriers.—When a poultry house is insulated, a vapor barrier is essential to protect the insulation from dampness. During cold weather, when ventilation is restricted to keep the house warm, the amount of moisture in the air increases. In an uninsulated house, this moisture collects on the walls and ceiling in the form of water or frost. In an insulated house, the walls and ceiling are warm and condensation is eliminated. However, in the insulated house this warm moist air tends to seep through the walls until it comes in contact with a cold surface, at which point it often condenses as water or frost. Moisture in the wall reduces the efficiency of the insulation and in time may cause the wood to rot and paint to peel off the outside of the building. Moisture in the air travels from the warm side toward the cold side of the wall. Because of this, the vapor barrier is placed on the inside of insulated walls. Vapor barriers come in two forms, membrane barriers and paint barriers.

Table 4.—Average Insulation Values of Various Types of Building Materials and Insulators for Wall, Ceiling and Floor Construction*

Building Material and Insulators	Thickness in Inches	Insulation Value
Masonry:		
Solid Brick or Concrete	1	.1
Concrete Block (sand and gravel	8	.7
Hollow Clay Tile or Cinder Block	4	1.0
Hollow Clay Tile or Cinder Block	8	1.7
Cinder Block—Rock wool filled cores	8	3.7
Wood:		
Light weight woods (average)	1	1.2
Dense woods (average)	1	.9
Building Boards:		
Plywood	1	1.2
Cement Asbestos	¼	.1
Insulation:		
Commercial Flexible and Fill Types	1	3.7
Fiber Board	1	3.0
Farm Grown Fill Type	1	2.4
Insulators:		
Air spaces ¾-inch or more		.9
. Reflective Surface		1.2
Building Paper:		
Stops air leaks		.0

* The insulation values in the table are the average for a number of similar types of common building materials. While some materials may have a slightly higher or lower insulating value than those listed, the insulating values given can be safely used for estimating the insulating value of various types of wall, floor, and ceiling construction for poultry houses. For further information on insulating poultry houses, see Ohio Agricultural Extension bulletin, No. 208, Ventilation and Temperature Control for Dairy, Poultry, and Hog Houses.

Membrane Barriers are usually a shiny-surfaced, asphalt-treated felt or craft paper, metal sheets, or metal foils. Ordinary roofing felts and tar papers are not vapor barriers and should not be used as such. Some types of insulation are manufactured with asphalt or foil vapor barriers and need no other protection against moisture than ventilation on the outside.

The membrane vapor barrier is applied under the finish of the inside wall and ceiling. It should be fastened carefully around all openings and lapped and sealed at all joints and edges to keep the moisture trapped inside the pen where it can be handled with ventilation.

Paint Barriers are applied to the inside wall and ceiling surfaces. Aluminum paint with an asphalt or spar varnish base is an excellent vapor barrier when the walls are properly covered. Paint barriers are usually difficult to put on properly.

Ventilation above ceiling insulation is essential to keep the loft or space between the insulation and the roof cool in the summer and help remove moisture that may work its way into the insulation. This is usually accomplished by the use of vents in the cornice or under the eaves in conjunction with louvers or ventilators at the high point of the roof. See Fig. 10.

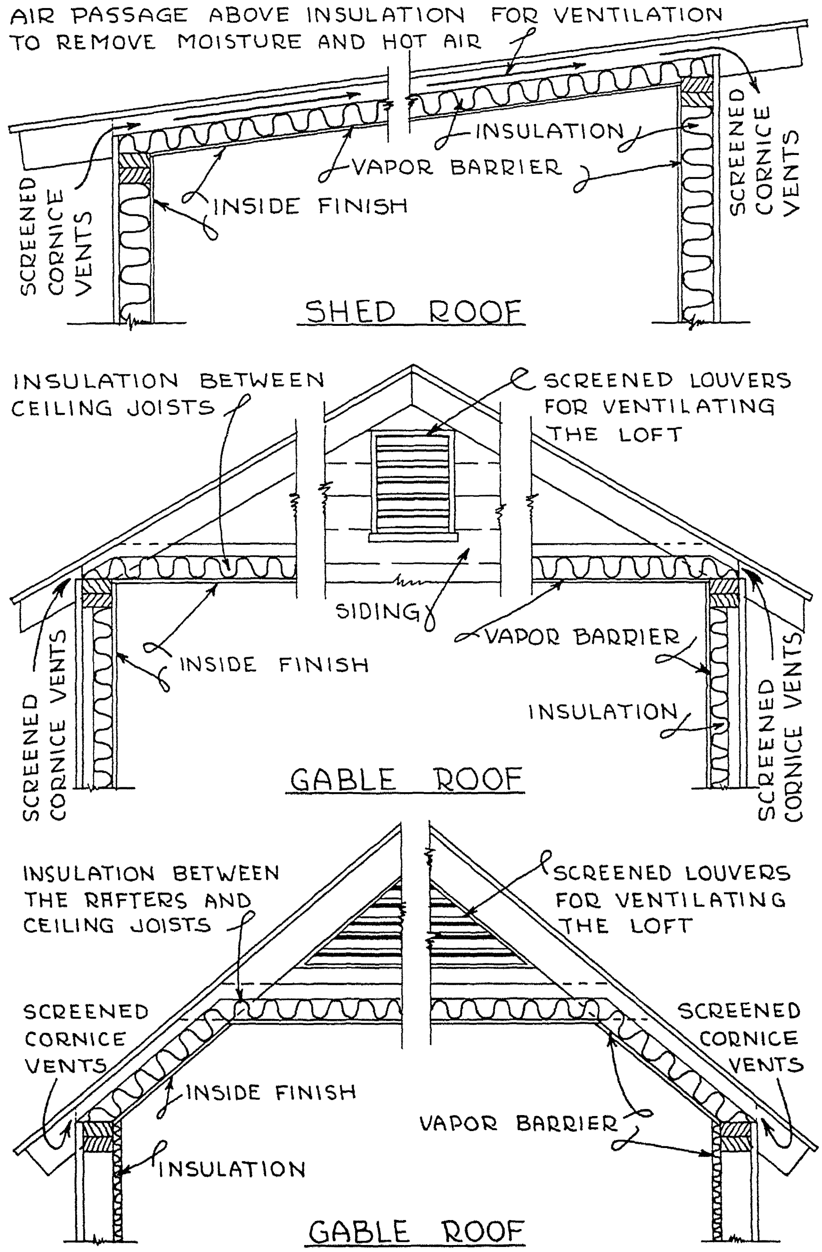

Fig. 10

Ventilation

The ventilating system in the poultry house has two jobs to do, one is to control inside temperatures and the other is to remove moisture and odors. These jobs may be done with adjustable windows, by means of flues, or by the use of fans. However, controlled ventilation can be accomplished only when the poultry house is tightly constructed and it is reasonably warm.

Restricting the ventilation in a poultry house to raise the temperature because it lacks sufficient insulation to keep it warm will cause moisture to condense on the walls, ceiling, and in the litter unless supplemental heat is added. For this reason, uninsulated houses must be kept open and operated as open front or cold houses in cold weather. Semi-insulated and insulated houses can be kept closed and temperatures controlled within the range permitted by the amount of insulation used in their construction.

Keeping the temperatures down during the summer can be accomplished best in insulated houses with windows or ventilating openings arranged to provide cross-ventilation.

Types of Air Intakes.—Special air intakes such as slot openings with a baffle to direct the flow of air, as shown in Fig. 11, can be used. Hinged windows that can be dropped back at the top may be used as air intakes. The lower sash of double hung windows can be raised to provide an air intake. However, a baffle board should be placed across the opening to prevent the air from sweeping across the floor. When windows are used as air intakes, care should be exercised to adjust the window openings so that the air is evenly distributed over the whole pen area. Window intakes require only half the opening of fixed intakes. The use of intake flues and windows as the only means of ventilation may not prove to be wholly adequate in cold weather without the addition of outlet flues or fans.

Flue Ventilation.—Chimney-like flues have been used for ventilation with varying degrees of success for years. The operation of the outtake flue is dependent on a number of variable factors of which the most important are:

1. The difference in temperature between the air inside and outside the building.
2. The height of the outtake flue.
3. The size and distribution of air intakes.
4. The velocity of the wind blowing across the top of the flue.
5. The proper insulation of the flue walls.

Flue ventilation has frequently been tried to improve poultry house ventilation. In most instances, flue ventilation has been of little value in one-story poultry houses. Flues to work at all should be at least 20 feet high to obtain the necessary draft action. If more than one flue is provided for each pen, the flues may act as air intakes rather than outlets. Flue ventilation has a better chance to operate satisfactorily in a multi-story house than in a one-story house. For further information on flue ventilation, see Ohio Agricultural Extension Bulletin No. 208, Control of Ventilation and Temperature.

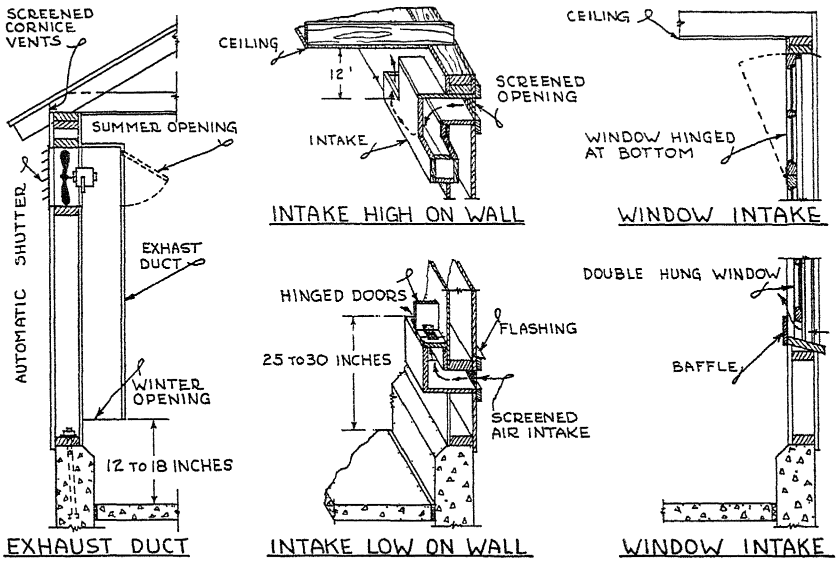

Fig. 11.—Types of intake openings for farm ventilation. Proper method of installing exhaust fan and exhaust duct.

Fan Ventilation.—During the past several years, forced ventilation with exhaust fans has been used in poultry houses. This type of ventilation is positive and will work satisfactorily, if the fan is of proper size and intakes are located to eliminate drafts and dead air pockets.

Experimental work on the amount of air required indicates that the movement of 1 to 2 cubic feet of air per minute for an average size mature bird is sufficient with forced ventilation. For example, a building, housing 500 birds, should be equipped with a fan that will move at least 1,000 cubic feet of air per minute to provide the minimum of 1 cubic foot of air per bird per minute and additional air for warm weather ventilation. An average 12-inch ventilating fan would have a capacity of approximately 1,000 cubic feet of air per minute.

Proper size and location of intakes is very important. If only two intakes are used, they should be located on the wall opposite the fan. If a larger number of intakes are used, they should be spaced evenly around the pen but none should be closer than 8 to 10 feet to the fan. When it is necessary to place the fans within 8 or 10 feet of a window or door, they should be of tight construction to prevent air leaks.

The total area of the intakes will depend on the capacity of the fan. Fan manufacturers recommend air intakes which have a cross-sectional area of 40 to 60 square inches each. A 1,000-cubic foot per minute fan would require between 300 to 350 square inches of air intakes for proper circulation.

Table 5.—Selection of Fan and Intake Openings

Floor area sq. ft.	Fan delivery* per min. cu. ft.	Approx. fan dia. inches	Size of exhaust duct inches	No. of 60 sq. in. intakes	Intake area sq. in.
400	260	9 or 10	12 x 12	2	120
800	530	9 or 10	12 x 12	3	180
1200	800	12	12 x 15	5	300
1800	1200	12	15 x 15	7	420
2700	1800	14	18 x 18	11	660

Larger floor areas normally would use two or more fan units.
* Figured on basis of ⅔ of a cubic foot of air per minute for each square foot of floor area. (Turner, Cornell Univ.)

The fan may be located in a vertical exhaust flue. The flue should extend to within 18 to 20 inches of the floor. Figure 11 shows a method of installing the fan. The door near the ceiling is opened for summer ventilation. During the winter, this upper opening is closed and the air taken from near the floor. If possible, the fan should be located on the side of the building away from the prevailing wind and should have a hood or shutter over the oulet to prevent back drafts.

Control of Dampness in Litter

Damp litter in the poultry house during the winter is a serious problem with many poultrymen. It is the main cause of dirty eggs, which must be cleaned, thus increasing the cost of production tremendously. It also necessitates frequent cleaning of the house, which increases the litter requirement.

Damp litter can be caused by several factors:

1. The location of the house. A location without adequate provision for carrying off surface and ground water may cause wet floors, resulting in wet litter.
2. Improperly designed water fountains. Water fountains that are not protected by wire platforms and drains permit birds to throw water on the litter while drinking.
3. The number of the birds in the house. Overcrowding causes excessive moisture in the house, creating a serious litter problem.
4. Egg production in the flock. Flocks in heavy production consume much more water and expel more moisture in the air. Unless this moisture is removed by ventilation, wet litter is apt to result.
5. The type of feed used. All mash rations increase the amount of water consumed, which tends to aggravate the dampness in the litter.

6. Condensation of moisture from the air. The moisture thrown off by birds through the lungs, unless removed by ventilation, is apt to condense on the walls, floor, and ceiling during cold weather.

Control of dampness in the poultry house can be achieved only when the temperature of the air is raised as it passes through the building. A well insulated building to permit restricted ventilation

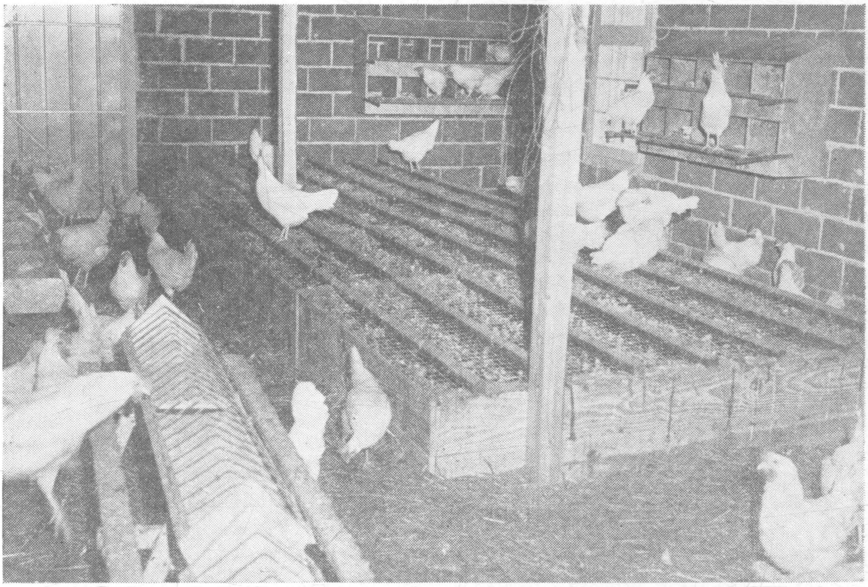

Fig. 12.—Low roosts in the Ohio Poultry House located near the center to provide wall space for nests.

can accomplish this goal. The water holding capacity of the air practically doubles with each 20 degree rise in temperature. Air taken into the house when the temperature outside is 10°F. and raised to a temperature of 40°F. before passing out of the building would have its moisture carrying capacity more than doubled.

Covering the floor with 6 to 8 inches of litter early in the fall and adding more litter regularly during the winter is widely practiced to combat wet litter. The use of hydrated lime at the rate of 1 pound for each 10 to 12 square feet of floor space at intervals of 10 to 12 days during the winter also aids in maintaining dry litter. When lime is used it is essential to keep the litter stirred to prevent packing or caking on the surface.

Equipment and Arrangement of Interior of Poultry Houses

The arrangement of the interior of the poultry house plays an important part in the amount of labor required to care for the flock. The interior of narrow poultry houses is difficult to arrange and more steps are necessary to take care of the flock. The house built nearly square can be most conveniently arranged.

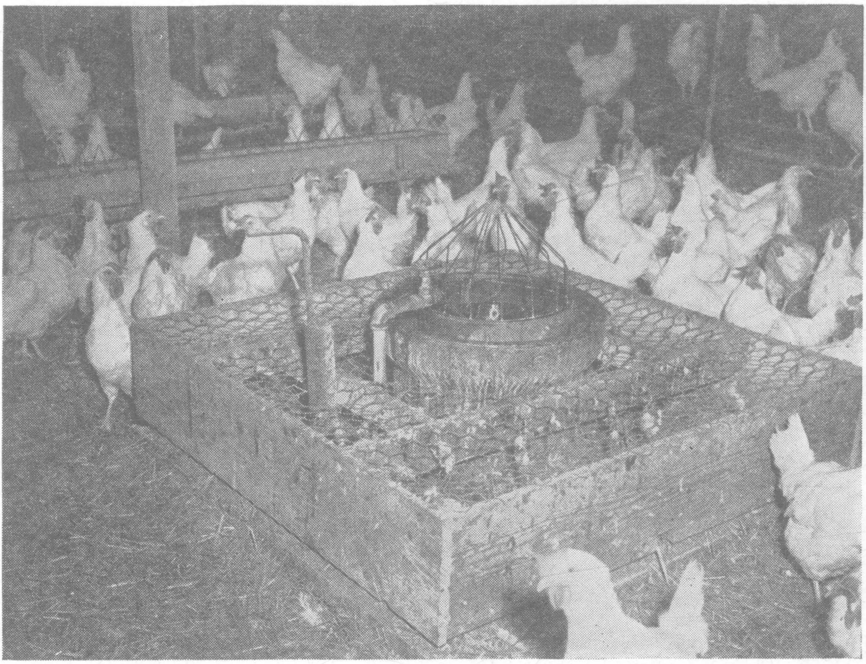

Fig. 13.—The automatic water fountain that insures constant supply of water.

Houses that are 30 or more feet wide may be constructed with a driveway, so that cleaning equipment can be pulled and worked in the building.

Roosts can be placed near the center driveway which releases wall space for nests. The space at the ends of the building can be used for built-in feed bins which can be filled from the outside.

Automatic Water Supply.—A laying flock of 300 birds will drink approximately 18 to 20 gallons of water per day, depending on production and the kind of ration fed. An automatic water fountain saves labor in caring for the flock. If the farm has a pressure water system, the amount of labor saved in a year will probably more than offset the cost of putting water into the poultry house. Figures 13 and 14 show satisfactory types of automatic drinking fountains.

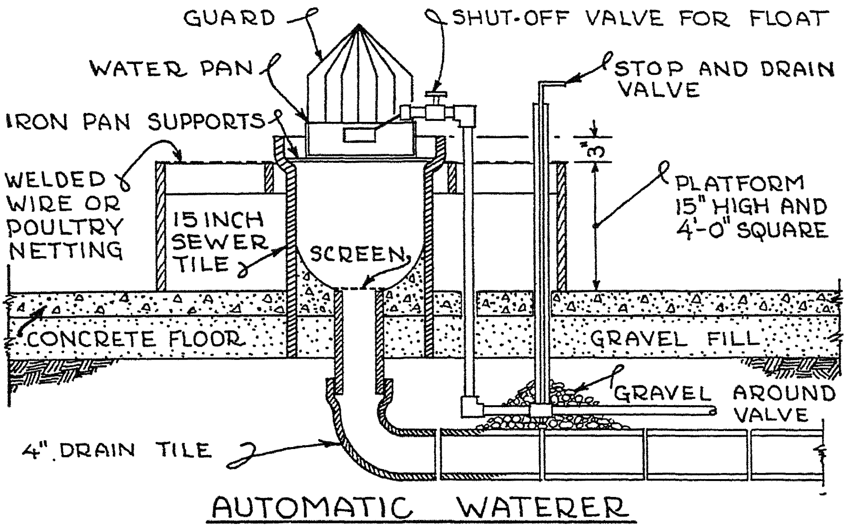

Fig. 14

Regardless of whether or not there is water pressure on the farm at the time the house is built, the drain, water line, and valve should be installed to prevent tearing out a section of the floor later.

Adequate Feeding Space.—Adequate feeding facilities are necessary for maximum egg production. There are always a few timid and backward birds that will not get enough feed around an overcrowded feeder. The amount of feeder space will depend on the method of feeding. Since it is preferable to feed both mash and grain in hoppers, regardless of the feeding system followed, the house should be well filled with feeders.

For example, if the high protein free choice system is used, one 8 to 10-foot feeder for mash and one for grain for each 100 birds should be provided. If the grain is to be fed once a day with a lower protein egg mash, extra feeders will be needed for grain.

Roosts.—Low protected roosts, frequently referred to as droppings pits, have given satisfactory results on Ohio farms. Figs. 12 and 15 show the arrangement of the roosts in an Ohio poultry house. By locating them near the driveway, cleaning is made easier.

Contrary to the opinion of some poultrymen, low roosts do not reduce housing capacity. The birds will actually spend more time on the low roosts when not eating.

The pit is best made up of 5 to 7-foot sections so they can be moved easily and will fit between posts. A pit depth of 16 to 18 inches will allow for the use of deep litter on the floor.

The pit should be large enough to provide 6 to 8 inches of perch space per bird. The roost poles or perches are spaced 14 inches apart, and may be placed either across or lengthwise of the pits.

The birds are kept out of the pits by tight sides and ends and with 1- by 2-inch welded wire or 1½-inch mesh fox wire fastened under the roost poles. See Fig. 15.

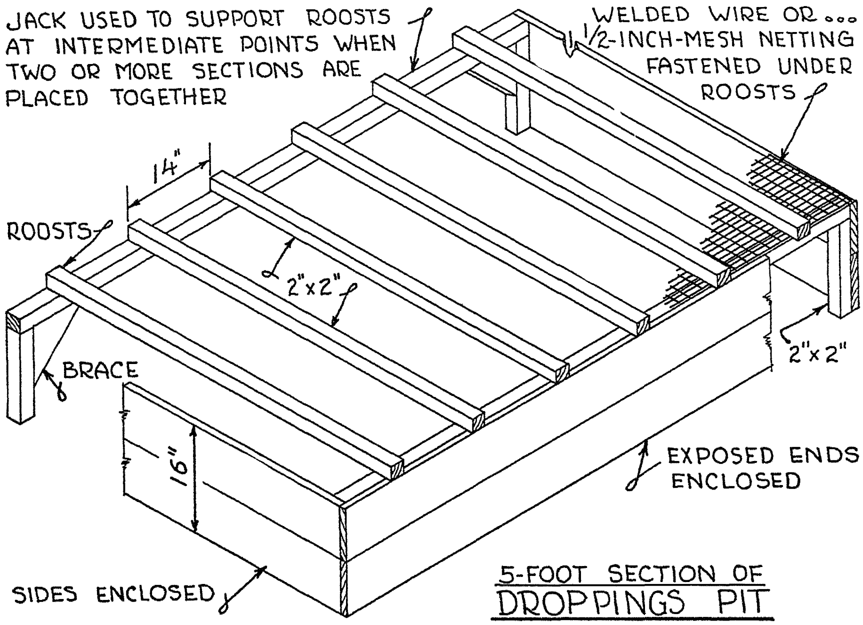

Fig. 15

Proper Distribution of Light.—Poultry houses are being built today with less than half the amount of window space that was used 15 to 20 years ago. By using the Ohio type window, Fig. 16, which is hinged to permit opening the entire window during warm weather, ample ventilation can be secured without a large amount of window space. One square foot of window space for each 20 to 30 square feet of floor space is ample. Poultry houses that are less than 30 feet wide may have windows placed on one side only, if ventilators are used in the opposite wall. For poultry houses that are 30 feet wide, or wider, the windows are placed on both sides and spaced so as to provide uniform distribution of light. Placing the windows as provided in the plans listed on page 31 provides good light distribution and ventilation for winter and summer.

Artificial Lights.—Lights, to be of real aid in increasing winter egg production, should be installed properly. They should be placed to give a maximum amount of light on the perches as well as to provide some light in the rest of the house. The efficiency of the lights will be increased considerably by the use of reflectors. Twelve-

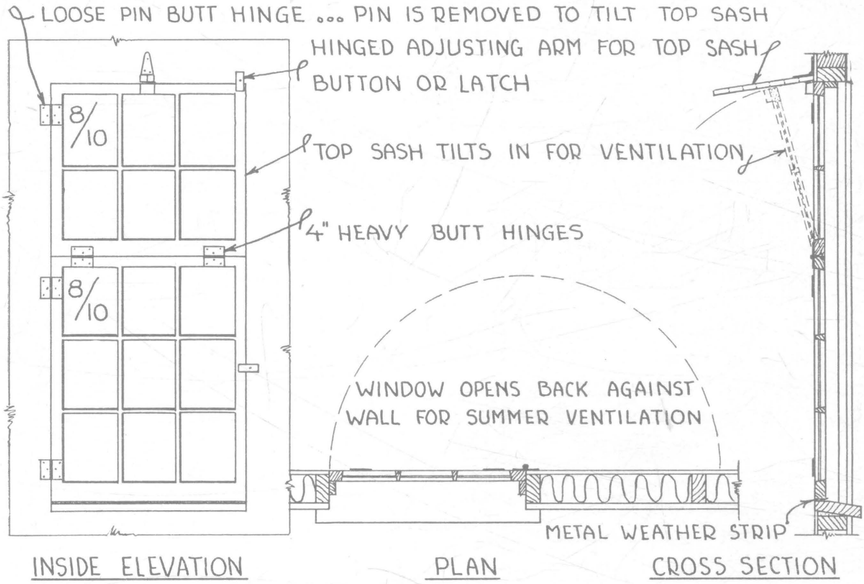

Fig. 16.—Detail of the Ohio type window.

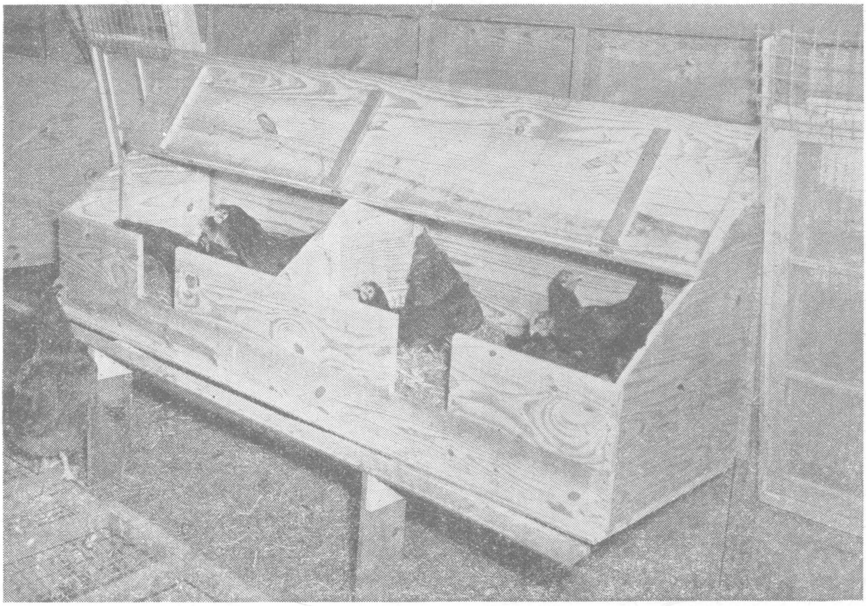

Fig. 17.—The clean egg nest. It reduces dirty and broken eggs.

or 16-inch, flat-type reflectors are best because they deflect the light over a wider angle. If morning and evening lights are used, a 40- or 60-watt bulb is sufficient for each 200 square feet of floor space. In most houses, the lights should be placed not more than 10 feet apart.

If this type of lighting system is used, it is important that a time switch be installed so that the lights will work automatically and will go on and off at a regular time without any attention from the poultryman. Time clocks are available at a nominal cost and are a good investment, if morning and evening lights are to be used. If a time clock is not used, all-night lights are satisfactory and only a 15-watt bulb is needed for each 200 square feet of floor space.

Nests.—Many types of nests have been designed in an attempt to find the most satisfactory one. The trend in recent years has been toward the large type nest. Figure 17 shows the community nest that is now extensively used. This nest is sometimes referred to as the "clean egg nest."

The two section nest is 8 feet long, 2 feet wide, 13½ inches high in front, and 30 inches high at the back. The top edge of the front is beveled to make the lid fit tight. The top is 30 inches wide and is composed of one 16-inch and one 14-inch section. The 16-inch section is hinged to open for gathering eggs. Only two entrance openings are provided, one for each section. These openings, 8 by 8 inches, are placed at the top of the front in the center of each section.

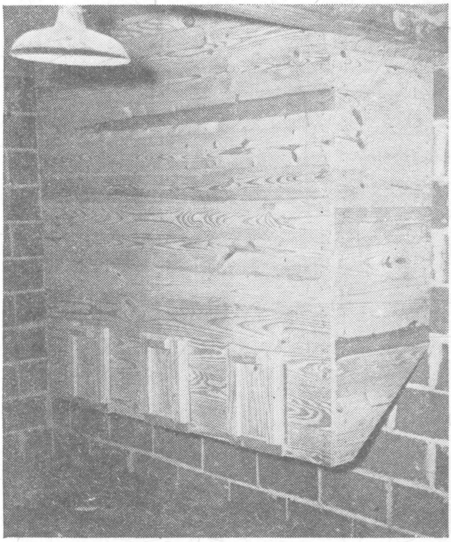

Fig. 18.—Wall feed bins save floor space and prevent feed waste. They can be filled from the outside.

Fig. 19.—An insulated egg room built adjacent to the laying house.

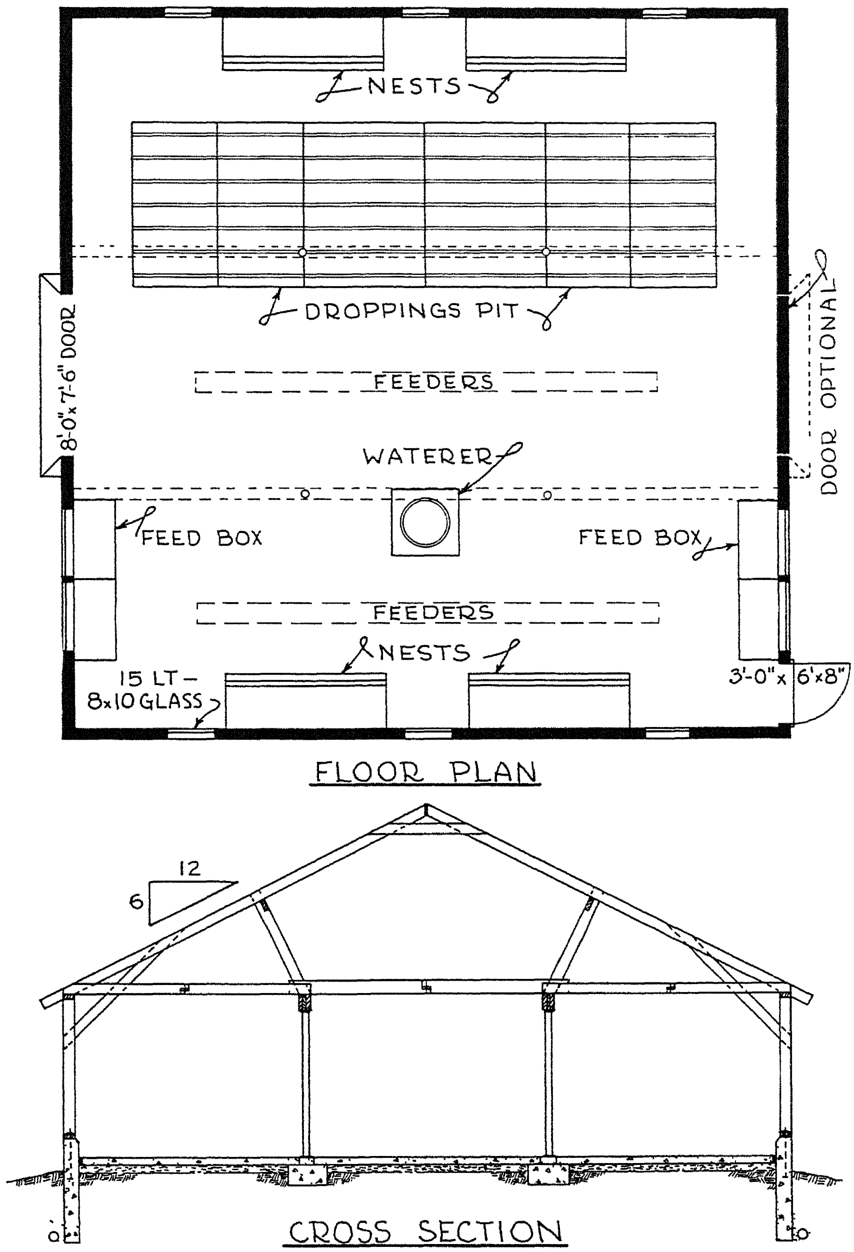

Fig. 20.—Plan for poultry house from 30 to 40 feet wide for large flocks. It may be built any length desired.

The floor may be hinged for easy cleaning, and the perch extends the full length of the nest directly in front of the entrances. The back need not be boarded up solid if placed along the wall. The nest is placed 18 to 20 inches above the floor. One two-section nest is sufficient for 80 to 100 hens.

Feed Bins.—Rat-proof feed bins, attached to the wall and elevated above the floor, conserve space and provide a worthwhile labor-saving feature. They should be constructed so they can be easily filled from an outside opening. A bin 18 to 24 inches wide and 6 to 8 feet long at each end of the house will provide ample feed storage.

Egg Room.—A well constructed, insulated egg room underneath or near the poultry house is desirable, especially if the house is of considerable size. The egg room is best built partially underground with the ceiling insulated so the room can be kept cool.

Plans for Laying House

Plans for the laying houses listed below may be obtained from your County Agricultural Agent or from the Department of Agricultural Engineering, The Ohio State University, Columbus, Ohio.

Plans should be ordered by name and number.

All plans show both frame and masonry construction unless otherwise listed.

Plan 02750. This is a small 12 by 14-foot one-story building that may be used either as a brooder house or a laying house. It has a capacity of from 40 to 50 hens.

Plan 02749. This is a 20 by 20-foot one-story laying house with a capacity of 100 to 125 hens. See Fig. 21.

Plan 02741. This is a 30 by 50-foot frame laying house with a capacity of from 400 to 500 hens. A driveway is provided for operating cleaning equipment in the building. The inside arrangement is similar to that shown in Fig. 22. The loft may be used for feed and bedding storage. This house may be built longer or shorter than 50 feet.

Plan 02741-C. This house is the same as Plan 02741 except that the walls are of concrete block construction.

Plan 02742. This one-story house may be constructed of wood or masonry in width of 32, 34, or 36 feet and to any desired length. The inside arrangement is shown in Fig. 22.

Plan 02743. This two-story house may be constructed of wood or masonry in widths of 30, 32, 34, or 36 feet and to any desired length. The inside arrangement is similar to that used in Plan 02742. The plans show the location of stairs, feed room, and hoist. The first floor is provided with a driveway for cleaning. Trap doors in the floor of the second story permit chuting the litter and manure into a spreader driven onto the first floor.