VENTILATING THE FARM POULTRY HOUSE

By
A. F. Gamble, Inspector, Colorado Poultry Improvement Board
H. S. Wilgus, Jr., Colorado Agricultural Experiment Station

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The poultry house is simultaneously a home and a factory for the working hen. It should therefore be comfortable and efficiently equipped. It is estimated that fully 80 percent of the poultry houses in Colorado are inadequate in these respects. In most cases, existing houses can be readily remodeled at a low or even negligible cost into comfortable and efficient houses. Remodeling should be so done as to assure adequate ventilation, to reduce the labor in cleaning out litter and droppings, and to furnish adequate and sanitary equipment.

Part of the tremendous increases in egg and poultry production requested during the war and for the first few years of peace may be obtained by improving housing as well as feeding conditions in present flocks. Many requests have been received for information on remodeling, especially for adequate ventilation. The suggestions presented here are based on observations on a large number of poultry farms in all parts of the State and on research at other experiment stations. This circular is therefore issued to meet the emergency, pending research on this subject at the Colorado Agricultural Experiment Station.

Ventilation

Ventilation is necessary to supply fresh air and to remove exhaust air carrying waste gases and moisture from the birds' breath and droppings. Good ventilation therefore assists in keeping the air fresh and the walls, ceilings, and litter dry.

Principles of Ventilation in Cold Weather

All practical ventilation systems are based on two principles, namely, that warm air will hold more moisture than cold air, and that warm air has a tendency to rise to the highest point in a building. When cold air comes into the poultry house it passes over the birds and, as it is warmed by their body heat, takes up moisture from their breath, from the litter, and from the droppings. This warmed air will have a tendency to flow to the highest part of the house (fig. 1), and if there is an opening there it will pass out of the house. If no outlet is provided, the air will be cooled in cold weather by contact with the cold ceiling and walls and will lose its ability to carry moisture; the moisture will be deposited back on the litter and on the ceiling in the form of frost.

Figure 1.—Air movement in shed-roof house with rafter outlet. (Adapted from Cornell Extension Bulletin 315)
The rate at which the warmed air rises and flows out of the house depends on the difference in temperature inside and outside of the house. The greater this difference is, the more rapid the rate of flow tends to be.

A successful ventilation system must therefore provide a definite way for the air to come into the room and a definite way for it to go out. Also the inlets and outlets must be placed to give the maximum of air flow without drafts. The house must be filled to near capacity to provide enough animal heat to keep up the desired exchange of air. The animal heat must be maintained by keeping window exposure to the minimum essential for good lighting and, in the colder areas of the State, by insulating the ceiling and sidewalls.

The following rules, if applied in houses constructed according to the accompanying diagrams, will provide a practical and simple ventilation system for most Colorado conditions.

1. Provide 1 square inch of outlet area for each 2 square feet of floor space. This must always be open.

2. Provide 1 square inch of inlet area for each 2 square feet of floor space. This must always be open.

3. Put enough birds in the house to fill it to capacity but do not overcrowd. Allow 3 square feet of floor area for each Leghorn hen and 3 1/2 to 4 square feet per hen of heavier breed.

4. Conserve heat by using only enough window space to light the house efficiently. One square foot of window glass should be allowed for every 16 to 22 square feet of floor area. Frames covered with light-weight (porous) muslin may be used. A ratio of 1 square foot of muslin area to 10 square feet of floor area is generally used.

5. Conserve heat by insulating the ceiling and possibly the sidewalls.

Rafter Outlet for Shed-Roof House

In the rafter ventilation system, the rafter overhang in front of the house is boxed in on the under side (fig. 2). The rest of the under side is closed by a hinged board except for a 1-inch opening extending the length of the house (for houses 20 feet deep; for a 24-foot house allow 1 1/4 inches). The hinged board may be dropped down in warm weather to allow added air movement.

Figure 2.—Details of the front rafter ventilator.  
(From Cornell Extension Bulletin 315)
A variation of this outlet is to open the space over the top plate between every third rafter, boxing in the front edge of the rafters and leaving the underside open.

**Outlets for Double-Pitched or Gable-Roof Houses**

Since the high point in the double-pitched or gable-roof house is at the ridge, it is essential to allow the exhaust air to escape at that point. This may be accomplished either by louvered (slatted) openings under the peak at each end of the house or by a flue located in the center of the building.

The choice of outlets to be used will depend largely on the pitch of the roof. If there is a rise of 4 feet or more from the plate level to the peak of the roof, the louvered openings in each end of the house close to the eaves as in figure 6 will give satisfactory results. These should be 1 foot square for houses up to 20 by 20 feet, increasing the combined area at the rate of 1 square inch for each 2 square feet of additional floor space.

In houses with less than 4 feet of rise from plate level to peak, the ceiling flue outlet must be used to get proper air exchange in the house. The ceiling flue is placed at the peak of the roof midway between the two ends, with only one flue for each house or each completely walled section. The area should be half as many square inches as there are square feet of floor space, no flue being less than 16 inches square. It must extend at least 2 feet above the building with an insulated cap on top (fig. 7). The flue must be extended farther if there are high buildings or trees close to the poultry house. It must be of insulated construction with an insulated cap. The clearance in inches between the top of the flue and the base of the cap should be one-half the square root of the flue area (8 inches for a 16 by 16 flue, 10 inches for a 20 by 20 flue, and so forth).

A house need be only high enough to give the caretaker room to work comfortably. A high ceiling means more air space to be kept warm in cold weather, and therefore a colder house. The straw loft provides the ideal solution for converting a cold, drafty house into comfortable, well-ventilated quarters. The straw loft should be 6 1/2 to 7 feet above the floor level and should consist of a layer of straw 10 to 12 inches deep. It may be supported by poultry fencing laid across stringers about 4 feet apart, or by boards spaced 4 to 5 inches apart. The straw acts as insulation, making the house cooler in summer and warmer in winter. The air moves slowly and evenly through the straw and out of the house, carrying off moisture and undesirable odors. There appears to be little if any danger of the straw loft being a hiding place for...
place for mites and bedbugs; these parasites seem to prefer to stay in cracks or between boards nearer the birds.

Inlets for All Types of Houses

The cheapest and most easily constructed air inlet is the front window type (fig. 4). Each lower sash is blocked open so that the total area of all intakes will supply 1 square inch of inlet space for each 2 square feet of floor space. The sill is made wider and a baffle installed to prevent the wind blowing directly on the floor. The window sill should not be more than 30 inches from the floor. Windows should not tip in, either at the top or the bottom, because this sets up drafts which destroy the efficiency of the ventilation system.

If the window sash cannot be raised conveniently, or if the windows are too high, built-in inlets similar to the one shown in figure 5 will give good results. Note that the inlet extends inside the frame. Each inlet should have an area of at least 60 square inches, one being placed near each front corner and the others distributed evenly in between as needed.

**Figure 4.---Inlet under window.**
(From Cornell Extension Bulletin 315)

**Figure 5.---Built-in inlet.**
(From Cornell Extension Bulletin 315)
Insulation

After installing an adequate ventilation system it may be found necessary in colder areas of the State to insulate the house in order to conserve the heat from the birds. In houses with low ceilings the ceiling may be insulated by boarding in the lower side of the rafters with tongue-and-groove lumber and packing dry sawdust, shavings, or cinders as insulation material. The University of Wyoming recommends straw packed between the exposed rafters. In houses already having a straw loft, the ceiling is adequately insulated. In both types of houses the side walls may be insulated in the same manner as prescribed for the ceiling.

In a fully insulated house with a flue ventilator, the flue should be extended to 18 inches above the floor in order to conserve heat in the house.

Window Area

Since the windows should supply the maximum light with the least necessary area in the winter time, window glass is the most efficient means of lighting a house and still conserving all the heat possible. Muslin and glass substitutes transmit less light. A greater window area must be allowed for these materials; hence there is more heat loss. Single windows should be placed well up on the wall to get maximum light on the floor, while double-sash windows are best placed about 2 feet off the floor.

Floors

A comfortable poultry house should have a floor that is sanitary, dry, permanent, rat-proof, and easy to clean. Experience has shown that concrete is the only one that fills specifications.

In general the foundation should be at least 6 inches thick. It should extend a minimum of 18 inches below the surface and about 12 inches above the surface of the ground. It should be made of a mixture of 1 part cement, 2 1/2 parts sand, and 3 1/2 parts gravel.

The floor should be underlaid with about 8 inches of gravel covered with cinders or fine gravel firmly tamped down. Where the location is damp, there should be a slight drainage toward the front center of the house. A layer of tar paper may be laid over the cinders to break capillary flow of soil moisture. The layer of concrete should be from 2 to 3 inches thick, consisting of a mixture of 1 part cement, 2 parts sand, and 3 parts gravel. This should be troweled to a smooth surface. The floor should be kept moist for several days to permit proper setting without cracks.

The University of Nebraska has found an oil mat floor to be satisfactory. About 4 inches of cinders or fine gravel are spread evenly and tamped down firmly. The cinders are then covered with about 1 1/2 inches of a mixture of 1,800 pounds of road gravel, 1,000 pounds of plaster sand, 200 pounds of cement, and 35 pounds of asphalt emulsion (a liquid). Sufficient water is added to make the mixture plastic so that it can be spread and troweled out. Asphalt emulsion can be obtained through firms dealing in road building material.

Dirt floors are dusty and insanitary. It is necessary to dig out at least 6 inches in depth each year, refilling with clean soil.

Operation of the House

The inlets and outlets previously described are the minimum size for the coldest of weather and must never be closed. As the weather becomes warmer, ventilation openings should be increased. Windows are intended to provide not only light but also a means of increasing ventilation by opening them. A suggested seasonal schedule of operation is as follows:
1. Winter—close any rear ventilators and windows.
   a. On severe nights, close all front windows, leaving inlets open.
   b. On moderate nights, open one or more front windows all the way.
   c. Day time, open one or more front windows all the way. During sunshiny periods, most or all front windows should be open unless too windy or severely cold.

2. Spring and fall—keep all front windows entirely open in the day time unless too windy or unseasonally cold or stormy. Close part of the windows at night if necessary.

3. Summer—front and rear windows should be entirely open or closed except for the air inlets. If windows are opened only part way at the top there may be interference between incoming and outgoing air, and stagnation may result.

Remodeling Typical Houses

Experience has indicated that poultry houses should be at least 20 feet in depth. Narrower houses are colder because they have greater wall surface exposed per unit of floor area. It is also difficult to obtain proper exchange of air without drafts, especially over the roosts.

The following figures illustrate how some common types of farm poultry houses may be remodeled.

Figure 6.—Gable roof house.
A.—Louvered outlet.
B.—12 inches of loose straw.

Figure 7.—Narrow shed-roof house. This house has been widened by an addition in front to give a double-pitched roof. The rise is low, hence a flue ventilator is provided.
A.—12 inches of loose straw. B.—Straw packed between rafters.
C.—Original front wall removed.
Figure 8.—Semi-monitor house.
A.—Rafters outlet.
B.—Windows removed and openings boarded.
C.—12 inches of loose straw.
D.—Straw packed between rafters.
E.—Windows placed in ends of house.

Figure 9.—High shed-roof house.
A.—Rafters outlet.
B.—12 inches of loose straw.
C.—Straw packed between rafters.

Droppings Pits

Droppings pits are strongly advised in new houses, in houses with only perch poles, and in some cases to replace droppings boards. Experience shows that droppings pits do not reduce the capacity of the house. The house is cleaner because more droppings are deposited in the pits. Less litter is required. Keeping the birds from their droppings aids greatly in preventing and controlling disease and also helps keep eggs cleaner. Droppings pits in a well-ventilated house need be cleaned only 4 to 6 times a year.

Note in figure 10 that two 6-inch boards at the front of the pits keep the birds from beneath the perches and also prevent litter being scratched beneath them. The 4-inch open space at the top-front of the pits permits air circulation to aid in drying out the droppings. The perches and supporting 2 by 2's are built in sections 8 or 10 feet long and are raised to the ceiling to permit cleaning the pits. They can be hinged in the back, or they can rest on a 2 by 4 nailed to the back wall. One and one-half inch mesh heavy-gauge wire netting is preferred, because droppings and feathers will collect and mat on smaller mesh. Perches can be raised to collect small eggs that drop through. Perch poles should be spaced 14
inches apart, allowing 8 inches of perch space for light breeds and 10 inches for heavy breeds. When droppings are cleaned out, 2 or 3 inches of straw or other coarse litter should be spread on the floor to aid in drying the droppings and to make the next cleaning easier.

Figure 10.—Droppings pits.

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