ratings. Generally, they must be selected from manufacturers' tables. It is, therefore, very important to consider the reliability of the ratings used.

Controls

Gravity ventilators may have dampers controlled by hand, thermostat, or wind velocity, in combination with a fan. The thermostat station may be located anywhere in the building, or it may be located within the ventilator itself. The purpose of wind velocity control is to obtain a definite volume of exhaust regardless of the natural forces, the fan motor being energized when the natural exhaust capacity falls below a certain minimum, and again shut off when the wind velocity rises to the point where this minimum volume can be supplied by natural forces.

Stacks

Stacks or vertical flues are really chimneys which function through the effects of the wind and temperature difference. Like the roof ventilator, the stack outlet should be located so that the wind may act upon it from any direction. With little or no wind, the chimney effect depends entirely on temperature difference to produce a removal of air from the rooms where the inlet openings are located.

GENERAL VENTILATION RULES

A few of the important considerations, in addition to those already outlined, are:

1. Inlet openings in the building should be well distributed, and should be located on the windward side near the bottom, while outlet openings are located on the leeward side near the top. Outside air will then be supplied to the zone to be ventilated.
2. Inlet openings should not be obstructed by buildings, trees, sign boards, etc., outside, nor by partitions inside.
3. Greatest flow per square foot of total opening is obtained by using inlet and outlet openings of nearly equal areas.
4. In the design of window ventilated buildings, where the direction of the wind is quite constant and dependable, the orientation of the building, together with amount and grouping of ventilation openings, can be readily arranged to take full advantage of the force of the wind. Where the wind's direction is quite variable, the openings should be arranged in sidewalls and monitors so that, as far as possible, there will be approximately equal areas on all sides. Thus, no matter what the wind's direcition, there will always be some openings directly exposed to the pressure force, and others to a suction force, and effective movement through the building will be assured.
5. Direct short circuits between openings on two sides at a high level may clear the air at that level without producing any appreciable ventilation at the level of occupancy.
6. In order that temperature difference may produce a motive force, there must be vertical distance between openings. That is, if there are a number of openings available in a building, but all are at the same level, there will be no motive head produced by temperature difference, no matter how great that difference might be.
7. In order that the force of temperature difference may operate to maximum advantage, the vertical distance between inlet and outlet openings should be as great as possible. Openings in the vicinity of the neutral zone are less effective for ventilation.
8. In the use of monitors, windows on the windward side should usually be kept closed, since, if they are open, the inflow tendency of the wind counteracts the outflow tendency of temperature difference. Openings on the leeward side of the monitor result in cooperation of wind and temperature difference.
9. In an industrial building where furnaces that give off heat and fumes are to be installed, it is better to locate them in the end of the building exposed to the prevailing wind. The strong suction effect of the wind at the roof near the windward end will then cooperate with temperature difference, to provide for the most active and satisfactory removal of the heat and gas-laden air.

10. In case it is impossible to locate furnaces in the windward end, that part of the building in which they are to be located should be built higher than the rest, so that the wind, in splashing therefrom, will create a suction. The additional height also increases the effect of temperature difference to cooperate with the wind.
11. The intensity of suction, or the vacuum produced by the jump of the wind, is greatest just back of the building face. The area of suction does not vary with the wind velocity, but the flow due to suction is directly proportional to wind velocity.
12. Openings much larger than the calculated areas are sometimes desirable, especially when an increase in occupancy may occur, or when extremely hot days may be anticipated. In the former case, free openings should be located at the level of occupancy for psychological reasons.
13. In single story industrial buildings, particularly those covering large areas, natural ventilation must be accomplished by taking air in and out of the roof openings. Openings in the pressure zones can be used for inflow, and openings in the suction zone, or openings in zones of less pressure, can be used for outflow. The ventilation is accomplished by the manipulation of openings to get air flow through the zones to be ventilated.

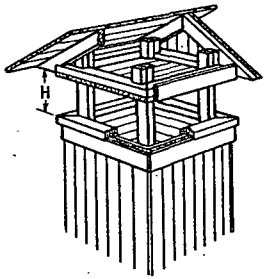


FIG. 5. RECOMMENDED TYPE OF COVER FOR WOODEN OUTLET FLUE

The opening *H* should equal one-half the least dimension of the flue. Heavy insulation of the level deck is essential.

VENTILATION OF ANIMAL SHELTERS[9]

Animal shelters require ventilation to remove moisture, odors and, in the case of dairy stables, excess heat.

Outlets. Outlet flues for natural draft systems should be round or approximately square. A thermal resistance ($1/U$) of not less than two is required in their side walls. They should extend at least two feet above the highest part of the roof. Only one outlet is recommended for each room or pen. The use of several outlet flues may result in excessive up-drafts in some flues, and down-drafts in others.

If flues have roofs or covers, these should be high enough to provide unobstructed openings on all sides, equal in height to one-half the least dimension of the flue, Fig. 5. A level, heavily insulated ceiling under the flue roof, and over the entire area of the flue, is important.

Inlets. Inlets should direct the incoming air vertically upward so as to avoid drafts on the animals, and to insure immediate mixing of incoming air with the room air. A reasonably uniform distribution around the stable or pen is desirable. Inlet flues, that deliver air close to the side walls, stimulate convection currents, which is desirable. When so placed, they also