building be used for this computation. To determine the infiltration caused by the temperature difference, one-half the crack length of the building is multiplied by the infiltration coefficient from Table 2 corresponding to the equivalent wind velocity computed from the following equation developed from basic relationships between velocity, pressure, density and temperature.

$$V_e = B\sqrt{h(t_i - t_o)} \quad (1)$$

where

V_e = equivalent wind velocity corresponding to the temperature difference $(t_i - t_o)$, miles per hour.
h = height of rooms, feet.
t_i = inside temperature, Fahrenheit.
t_o = outside temperature, Fahrenheit.
B = a constant to account for leakage through floor and ceiling and for the number of stories in the building.

The constant B would be 0.12 for a single-story building or for any story of a multi-story building whose floor and ceiling were impervious to air, whereas the value of B was found to be approximately unity for a single-story frame building with basement and attic having double wood flooring, plastered ceiling, and the walls finished with plasterboard on the inside. The value of this constant would increase as the the number of stories increased and for stories farther removed from the neutral zone in either direction in buildings that lacked perfect sealing between stories.

Sealing of Vertical Openings

In tall, multi-story buildings, every effort should be made to seal off vertical openings, such as stair-wells and elevator shafts, from the remainder of the building. Stair-wells should be equipped with self-closing doors, and, in exceptionally high buildings, should be closed off into sections of not over 10 floors each. Plaster cracks should be filled. Elevator enclosures should be tight, and solid doors should be used.

If the sealing of the vertical openings is made effective, no allowance need be made for the chimney effect. Instead, the greater wind movement at the greater heights makes it advisable to install additional heating surface on the upper floors above the level of neighboring buildings, this additional surface being increased as the height is increased. One arbitrary rule is to increase the heating surface on floors above neighboring buildings by an amount ranging from 5 percent to 20 percent. This extra heating surface is required only on the windward side and on windy days, and hence, automatic temperature control is especially desirable with such installations.

In stair-wells that are open through many floor levels, although closed off from the remainder of each floor by doors and partitions, the stratification of air makes it advisable to increase the amount of heating surface at the lower levels, and to decrease the amount at higher levels. One rule is to calculate the heating surface of the entire stair-well in the usual way, and to place 50 per cent of this in the bottom third, the normal amount in the middle third, and the balance in the top third.

Infiltration and Air for Combustion

Infiltration in buildings normally supplies the air required for combustion by fuel-burning appliances, but in some cases weatherstripping, sealing and calking may reduce infiltration to the point that special openings must be provided to supply adequate air to the heating appliances. This need for combustion air is recognized in various building codes. For instance, the State Building Construction Code of New York State for One- and Two-Family Dwellings[8] requires that an air inlet area not less than the area of the smoke pipe connection be provided if adequate air supply at all times is not assured. Similarly the same code for multiple dwellings requires a permanent opening to the outdoor air for rooms containing fuel-burning appliances having a gross capacity in excess of 250,000 Btu per hour.

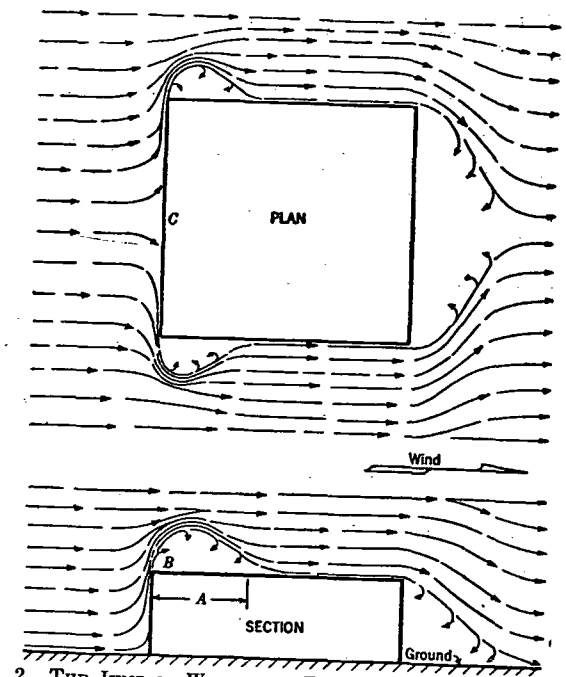

FIG. 2. THE JUMP OF WIND FROM WINDWARD FACE OF BUILDING. (*A*—LENGTH OF SUCTION AREA; *B*—POINT OF MAXIMUM INTENSITY OF SUCTION; *C*—POINT OF MAXIMUM PRESSURE)

NATURAL VENTILATION

Ventilation by natural forces finds application in industrial plants, public buildings, schools, dwellings, garages, and in farm buildings.

The natural forces available for moving air into, through, and out of buildings are: (*a*) wind forces, and (*b*) the difference in temperature between the air inside and outside a building. The air movement may be caused by either of these forces acting alone, or by a combination of the two, depending upon atmospheric conditions, building design, and location.