though the wind velocity be imperceptible, gravity will effect a change in the air in a room, if the difference between the temperature of the air indoors and that out-of-doors is great enough that the warmer, lighter air indoors rises and escapes and is replaced by cooler, heavier air from outdoors.

In poorly constructed buildings, without means for agitating the air, warm air accumulates in spaces near the ceiling, from which point heat

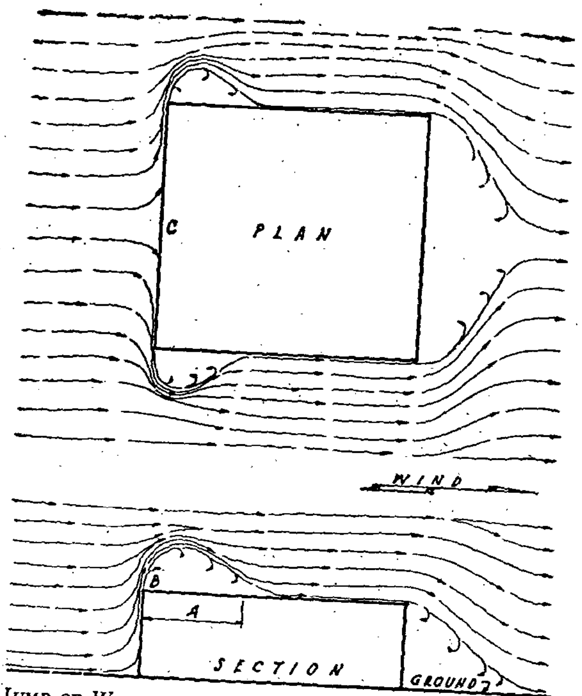

FIG. 1. THE JUMP OF WIND FROM WINDWARD FACE OF BUILDING. (*A*—LENGTH OF SUCTION AREA; *B*—POINT OF MAXIMUM INTENSITY OF SUCTION; *C*—POINT OF MAXIMUM PRESSURE)

escapes either with the air that filters out through the walls and ceiling and through cracks around the tops of windows and doors, or by direct transmission through the walls and roof resulting from difference between the indoor and outdoor temperatures.

The volume of air actually lost by exfiltration is normally replaced by cooler, heavier air which tends to stratify in the room at its temperature level, usually near the floor. In this way, regardless of wind velocity or direction, air is constantly being changed whenever indoor and outdoor temperatures are different. The rate of change is dependent upon the tightness of construction and the temperature difference. This manner of air change, however, could hardly be dignified as a *system* of ventilation, which term *system* implies something more than a haphazard result.

Wind Action[1]

The wind operates to produce regions of pressure or suction about the exterior of a building as compared with the conditions that would exist in these regions if the air were still. The principal effects of the wind when blowing directly against one face of a building are illustrated in Fig. 1. The maximum intensity of pressure at point C is approximately given by the equation.

$$P_{\mathrm{w}} = 0.00048M^2 \tag{1}$$

where P_{w} is pressure in inches of water, and M is velocity of wind in miles per hour. The mean pressure over the windward face is somewhat less, being, perhaps, 75 per cent of the maximum.

The maximum suction occurs at point B at roof and sides, and in magnitude is about three-quarters of the maximum pressure as given by equation (1). The distance A, measuring the extent of the suction regions on sidewalls and roof, caused by the leap, or splash, of the wind from the windward face, seems to be determined by the height and width of the windward face, and is independent of the wind velocity. The intensity of the suction diminishes from the maximum at B to zero at the point where the stream lines again flow parallel to the surfaces of the building.

Maximum effect of the wind in producing ventilation can be obtained by providing openings in the windward face for ingress of air and in the leeward face, or in sidewalls and roof near the leeward face, for egress of air, in which case the air moves through the building in the same general direction as the wind; or, with no openings in the windward face, but with openings provided in the suction regions in sidewalls and roof near the windward face for egress of air, and openings in the leeward end, or in sidewalls near the leeward end for ingress of air, in which case the air movement within the building is in a direction opposite to that of the wind. A knowledge of these facts and their application will often result in a better layout of operations and processes, and even in a more favorable orientation of a building with respect to the prevailing direction of the wind, so that heat and objectionable fumes may be removed more advantageously from an industrial building.

Where the wind comes at an angle to the building, the same general rules apply. The mean pressure of the wind on the oblique faces may be considered as being approximately equivalent to the normal component of the wind, except that when the wind's direction is within 15 or 20 deg. of parallelism, the splash from the corner begins to appear, and there will then be suction near the windward corner.

Temperature Difference

Excess temperature inside a building over that outside tends to produce flow as in a chimney. The total head or force arising from this cause is given approximately by equation (2).

$$p_{\mathrm{t}} = 0.000028mD \tag{2}$$

where p_{t} is the total force or head in inches of water; m is the vertical

[1]See *Airation of Industrial Buildings*, by W. C. Randall (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928).