architectural projected, residential casement, and heavy casement section projected windows are given in Table 41.

The industrial pivoted window is generally employed in industrial buildings. The ventilators are pivoted, usually horizontally at the center or slightly above, the lower part of the ventilator swinging out and the upper part swinging in.

Architectural projected is a type of window usually manufactured of the same sections as the industrial pivoted window, except that the outside framing member is usually heavier, and there are refinements in the weathering and hardware, with the result that this window is usually used in the semi-monumental type of building such as schools. The ventilators swing in or out and are balanced on side arms.

The heavy section casement is a window manufactured of the so-called heavy casement sections. The leaves are hinged at the side and usually swing out.

Heavy casement section projected is a window manufactured of the same kind of sections as the heavy section casement window. The ventilators swing out or in, and are balanced on side arms that cause the ventilators to stay put at any degree of opening.

The residential casement window is of the same design, and is manufactured of the same shaped sections as those used in heavy section casement, but lighter in weight, and the swinging leaves cannot be built so large.

*Pivoted Steel Windows:* Table 42 presents some figures for infiltration through a steel window of the hollow-metal vertical-pivoted type tested in place in the Grand Central Palace Building, New York City.

The crack width was not given, but it was stated that the sash was not in good shape and fitted loosely in the frame.

*Frame Calking and Storm Windows:* Figs. 7 and 8 show the results of tests that were made at the University of Wisconsin to establish the value of storm sash for reducing infiltration, and reported in a paper entitled *Effect of Frame Calking and Storm Windows on Infiltration Around and Through Windows*, by Richtmann and Braatz. (JOURNAL, A. S. H. V. E., Vol. 34, No. 9, September, 1928). While the tests were made on storm sash only, the results and conclusions would no doubt also apply to storm doors.

The curves on Fig. 7 show the infiltration through the sash perimeter of a window with 5/64 in. crack and 1/32 in. clearance before and after storm sash have been applied. Curve *A* is for the window without storm sash, *B* for the window with storm sash suspended by the hook and eye arrangement, *C* for the window with storm sash fastened with four turn-buttons, and *D* is the same as *C* except a felt strip was placed between the storm sash and the window frame. This last condition could be used to advantage where the windows are fastened by means of the turn-buttons.

The curves on Fig. 8 correspond to curves *A*, *B* and *C* of Fig. 7 except that the window is fitted with a 1/8 in. crack and 1/8 in. clearance.

A study of these curves leads to the conclusion that a storm sash is of little value in reducing infiltration when applied to a well-fitted window, but that a reduction of about 50 per cent might be expected when storm





sash is securely applied to a poorly-fitted or loose window. Curves *B* and *C*, Fig. 8, show that much better results are obtained by means of turn-buttons on the outside than by securing the storm sash with toggle-links on the inside.

### *Calculations for Infiltration*

In order to arrive at the heat required for warming up the air entering by infiltration, the following procedure is necessary:

1. Determine the average wind movement in miles per hour for the locality in question (Table 3).

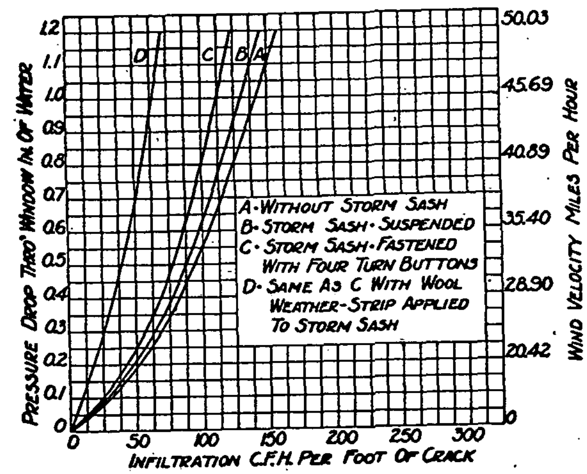


FIG. 7. INFILTRATION THROUGH SASH PERIMETER OF WINDOW WITH AND WITHOUT STORM SASH—5/64 IN. CRACK AND 1/32 IN. CLEARANCE

2. Determine the inleakage of outside air per lineal foot of the given window or door crack in cubic feet per minute at the given wind velocity, Tables 39 to 42, inclusive.

3. Express the heat equivalent in B.t.u. per hour per foot of crack to heat this air 1 deg. fahr.

Thus, for a plain wood window having 1/16 in. *crack* and 7/64 in. *clearance* (see Fig. 4), which means the air channel around the edge of the sash is approximately 1/16 in. wide, the heat equivalent of the air leaking in for a 0 to 70 deg. fahr. temperature difference is 157 B.t.u. per foot of crack per hour (Table 39, Part II). This value is found in the sixth column of the table. The computation for obtaining 157 is:

$$124 \times 0.075 \times 0.24 \times 70 = 157 \text{ B.t.u.}$$

*where*

124 = cubic feet of air per foot of crack per hour for a 15-mile wind for 7/64 in. clearance from the 5th column of Table 39.

0.075 = air density at 70 deg. fahr., pound per cubic foot.

0.24 = specific heat of air, and

70 = difference in temperature between inside and outside air.