occupancy, may be substituted for a portion of the heating installation. In no case should the actual heating installation (exclusive of heat sources) be reduced below that required to maintain at least 40 deg. fahr. in the building. The allowances indicated in Table 4 may be made when required. For more detailed information see Table 5.

Motors and the machinery which they drive, if both are located in the room, convert all of the electrical energy supplied into heat, which is retained in the room if the product being manufactured is not removed until its temperature is the same as the room temperature.

If power is transmitted to the machinery from the outside, then only the heat equivalent of the brake horsepower supplied is used. In the first case the B.t.u. supplied per hour $= \dfrac{\text{Motor horsepower}}{\text{Efficiency of motor}} \times 2{,}546$, and in the second case B.t.u. per hr. = b.hp. $\times$ 2,546, in which 2,546 is the B.t.u. equivalent of 1 hp. hour. In high-powered mills this is the chief source of heating and is frequently sufficient to overheat the building even in zero weather, thus requiring cooling by ventilation the year round.

For intermittent heating allow 10 per cent additional for rooms heated in the day time only, and for longer intervals of several days or more, add 25 per cent in determining minimum heating requirements, and size of plant.

EXAMPLES OF HEAT LOSS COMPUTATIONS

FACTORY BUILDING. (See Fig. 1).

1. LOCATION.................................Philadelphia, Pa.

2. LOWEST OUTSIDE TEMPERATURE. (Table 3).................– 6 deg. fahr.

3. BASE TEMPERATURE:

   In this example a design temperature 10 deg. fahr. above lowest on record instead of 15 deg. fahr. is used. Hence the base temperature $= (-6 + 10) = +4$ deg. fahr.

4. DIRECTION OF PREVAILING WIND (during Dec., Jan., Feb.)..............Northwest

5. BREATHING-LINE TEMPERATURE (5 ft. from floor)..................60 deg. fahr.

6. INSIDE AIR TEMPERATURE AT ROOF:

   The air temperature just below *roof* is higher than at the breathing line. Height of roof is 16 ft., or it is $16 - 5 = 11$ ft. above breathing line. Allowing 2 per cent per foot above 5 ft., or $2 \times 11 = 22$ per cent, makes the temperature of the air under the roof $= 1.22 \times 60 = 73.3$ deg. fahr.

7. INSIDE TEMPERATURE AT WALLS:

   The air temperature at the mean height of the *walls* is greater than at the breathing line. The mean height of the walls is 8 ft. and allowing 2 per cent per foot above 5 ft., the average mean temperature of the walls is $1.06 + 60 = 63.6$ deg. fahr. By similar assumptions and calculations, the mean temperature of the *glass* will be found to be 64.2 deg. fahr. and that of the *doors* 61.2 deg. fahr.

8. AVERAGE WIND VELOCITY (Table 3).........................11.0 miles per hour

9. OVERALL DIMENSIONS (See Fig. 1)..........................120 x 50 x 16 ft.

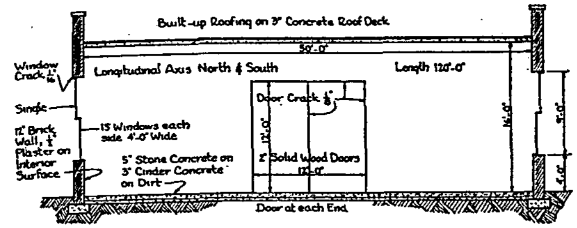

FIG. 1. ELEVATION OF FACTORY BUILDING

TABLE 6. CALCULATION SHEET SHOWING METHOD OF ESTIMATING HEAT LOSSES OF BUILDING SHOWN IN FIG. 1

PART OF BUILDING	EXPOSURE	WIDTH IN FEET	HEIGHT IN FEET	NET SURFACE AREA OR CRACK LENGTH	COEFFICIENT	TEMP. DIFF.	NET B.T.U.	EXPOSURE FACTOR	TOTAL B.T.U.
Brick, ½ in. plaster	N	50	16	656	0.277	59.6	10,820	1.15	12,460
Doors (2 in. Wood)	N	12	12	144	0.382	57.2	3,150	1.15	3,620
⅛ in. Crack	N	1 pair doors		60	3.34	57.2	11,440	½[a] x 1.15	6,580
Brick, ½ in. plaster	W	120	16	1380	0.277	59.6	22,800	1.15	26,200
Glass, (Single)	W	15 x 4	9	540	1.13	60.2	36,800	1.15	42,400
1/16 in. Crack	W	Double Hung Windows (15)		450	1.67	60.2	45,200	½[a] x 1.15	26,000
South Wall	Same as N	See Above						½[a]	19,690
East Wall	Same as W	See Above						½[a]	82,200
Roof, 3 in. Concrete and Slag-surfaced built-up roofing.	No Ceiling	50	120	6000	0.610	69.3	254,000	None	254,000
Floor, 5 in. Stone Concrete on 3 in. Cinder Concrete.	On Dirt	50	120	6000	0.521	5	15,630	None	15,630
GRAND TOTAL of heat required for building in B.t.u. per hour at +4 deg. with 11-mile northwest wind									488,780

[a]*Notes.*—(1) This building has no partitions and whatever air enters through the cracks on the windward side must leave through the cracks on the leeward side. Therefore, only one-half of the total crack will be used in computing infiltration for each side and each end of building.

(2) An exposure allowance of 15 per cent is also to be added to the wall and glass transmission losses and to the infiltration losses on the two adjacent sides of the building most nearly facing the prevailing wind as stated on page 88.

(3) It is also possible to compute the heat required to take care of infiltration on the basis of half of an air change per hour as given in Table 3, Chapter 4 for a factory with minimum conditions. Volume $= 50 \times 120 \times 16 = 96{,}000$ cu. ft. and heat required per hour is

$$96{,}000 \times \tfrac{1}{2} \times 0.075 \times 0.24 \times 59.6 = 51{,}500 \text{ B.t.u.}$$

Based on infiltration through one-half the total crackage in all walls, the heat to be supplied per hour is from Table 6,

$$6{,}580 + 26{,}000 + 5{,}720 + 22{,}600 = 60{,}900 \text{ B.t.u.}$$

The value based on crackage should be used, but if building is to be heated intermittently, not less than one air change per hour should be allowed.