above breathing line. Allowing 2 per cent per foot above 5 ft., or 2 × 15 = 30 per cent, makes the under roof temperature = 1.30 × 60 = 78 deg. fahr.

Floor: The 5 in. concrete floor is laid on the ground, and hence there is only one surface coefficient K_1 = 1.3 (Table 3).

$$U = \frac{1}{\frac{1}{1.30} + \frac{5}{8}} = 0.717$$

The air temperature at floor level = 60 − 5 = 55 deg. fahr.

Windows and Doors: Wood sash and doors with single thickness of glass. Take coefficient U for glass as 1.13 B.t.u. per sq. ft. per degree per hour for heat transmission (Table 6). Doors are solid wood 1¾ in. thick and coefficient U = 0.37 B.t.u. per sq. ft. per degree per hour (Table 6).

Infiltration: Window crack assumed $\frac{1}{16}$ in. and doors at $\frac{1}{16}$ in. By Table 14 (Part I) for a 10 mile wind velocity the leakage per foot of crack is 85 c.f. hr. for a plain window. The heat equivalent per hour, per degree is

$$85 \times .075 \times 0.24 = 1.53 \text{ B.t.u.}$$

and allowing for an 11 mile wind the factor becomes $1.53 \times \frac{11}{10} = 1.68$ (see preceding note). Allow twice this for door crack or 2 × 1.68 = 3.36.

CALCULATION SHEET
Entire Building
(See Fig. 7)

Building Material	Exposure	Width in Ft.	Height in Ft.	Area Sq. Ft. or Lin. Ft.	Coeffic. Trans. and Infilt.	Temp. Diff.	Net B.t.u.	Exposure Factor	Total B.t.u.
Concrete and Tile....	N	½ × 50	8½	213	0.29	74.0	4,570	1.15	5,250
	N	50	16	656	0.29	59.4	11,300	1.15	13,000
Doors 1¾"	N	12	12	144	0.37	56	2,980	1.15	3,430
Crack ⅛"	N	1 pair doors		60	3.56	56	11,900	½* × 1.15	6,850
									28,530
Concrete and Tile....	W	120	16	1380	0.29	59.4	22,900	1.15	26,300
Glass	W	15 × 4	9	540	1.13	59.4	36,200	1.15	41,600
Crack $\frac{1}{16}$"	W	Double Hung Windows (15)		450	1.78	59.4	47,500	½* × 1.15	27,300
									95,200
South Wall	Same as N	See above		......	......	......	30,750	½*	24,800
East Wall	Same as W	See above		......	......	......	106,600	½*	82,850
Roof 3" Concrete and Slag	No Ceiling	52.5	120	6300	0.60	74	280,000	None	280,000
Floor 5" Stone Concrete	On Dirt	50	120	6000	0.717	5	21,510	None	21,510
Grand total of heat required for building in B.t.u. per hour at + 4° with 11-mile Southwest wind..									532,890

*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 in paragraph 36.

(3) It is also possible to compute the heat required to take care of infiltration on the basis of ½ of an air change per hour as given in Table 13 for a factory with minimum conditions. Volume = 50 × 120 × 20 (mean height) = 120,000 cu. ft. and heat required per hour is

$$120{,}000 \times \tfrac{1}{2} \times 0.075 \times 0.24 \times 59.4 = 64{,}200 \text{ B.t.u.}$$

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

$$6{,}850 + 27{,}300 + 5{,}950 + 23{,}750 = 63{,}850 \text{ B.t.u.}$$

This 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.

CHAPTER II

HEATING BY RADIATION

By R. V. FROST, Member

CALCULATING RADIATION

RADIATION can be classified as direct, semi-direct, and indirect, and is usually made of pipe or cast iron; when it is made of pipe it is termed *pipe coil*, and when made of cast iron it is termed column, wall, semi-indirect, or indirect radiation.

The unit of measure in figuring radiation is the square foot of heating surface, which is the external surface.

The amount of heat a square foot of heating surface (radiation) will give off depends upon the temperature of the heating medium (steam, or hot water), the temperature of the surrounding air, and the velocity at which the air passes over same.

Tables 18 to 24 on succeeding pages indicate the number of B.t.u. a given size column or wall radiator will transmit in 1 hr. with steam as the heating medium and Tables 26 to 30 give similar data with hot water as the heating medium. The ordinary practice in calculating the amount of radiation of various kinds to meet a variety of conditions will be briefly stated.

To determine the amount of direct radiation to heat a room, figure all of the heat losses, adding the proper amount for exposure, and refer to Tables 18 to 30 to find the proper size radiator.

If a radiator of more than 20 sections is required, multiply the value, B.t.u. per intermediate section, for the particular radiator, Tables 18–24, by the number of additional sections above 20 and add this amount to the value, *Total B.t.u. per hour*, for the 20 section radiator. This will give the total B.t.u. per hour for the required radiator.

Example.—What is the total B.t.u. per hour for a 30-section 32 in., single column radiator?

Solution.—626 B.t.u. × 10 sections = 6260 B.t.u.
6260 B.t.u. + 12,875 B.t.u. = 19,135 B.t.u. Total per hour for 30-section radiator.

The values, B.t.u. per square feet of intermediate section and B.t.u. per square feet of end surface, are given on the tables to show the relationship between the two. The greater exposure of the end surface on the radiator, obviously will give a greater emission per square feet of surface.

To determine the amount of semi-indirect (sometimes termed direct-indirect), radiation to heat a room, figure all the heat losses, adding the