TABLE 18. COEFFICIENTS OF TRANSMISSION (U) OF DOORS, WINDOWS, SKYLIGHTS AND GLASS BLOCK WALLS

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in the temperature between the air inside and outside of the door, window, skylight or wall) and are based on an outside wind velocity of 15 mph.

Section A. Windows and Skylights		SINGLE	DOUBLE	TRIPLE
	U	1.13[ac]	0.45[ae]	0.281[ae]
Section B. Solid Wood Doors[bc]	NOMINAL THICKNESS INCHES	ACTUAL THICKNESS INCHES	U EXPOSED DOOR	U[d] WITH GLASS STORM DOOR
	1	25/32	0.69	0.42
	1¼	1 1/16	0.59	0.38
	1½	1 5/16	0.52	0.35
	1¾	1⅜	0.51	0.35
	2	1⅝	0.46	0.32
	2½	2⅛	0.38	0.28
	3	2⅝	0.33	0.25
Section C. Hollow Glass Block Walls	DESCRIPTION		U STILL AIR BOTH SIDES	U STILL AIR INSIDE 15 MPH OUTSIDE
	Smooth surface glass blocks 7¾ x 7¾ x 3⅞ in. thick		0.40	0.49
	Ribbed surface glass blocks 7¾ x 7¾ x 3⅞ in. thick		0.38	0.46

[a] See Heating, Ventilating and Air Conditioning, by Harding and Willard, revised edition, 1932.

[b] Computed using $C = 1.15$ for wood; $f_i = 1.65$ and $f_o = 6.0$.

[c] It is sufficiently accurate to use the same coefficient of transmission for doors containing thin wood panels as that of single panes of glass, namely, 1.13 Btu per (hour) (square foot) (degree difference between inside and outside air temperatures).

[d] These values may also be used with sufficient accuracy for wood storm doors. Neglect storm doors if loose and use values for exposed doors.

[e] Air spaces assumed to be ¾ in. or more in width.

indicate a unit area heat loss, at mid-height of the basement wall, approximately twice that of the same floor area.

For concrete slab floors laid in contact with the ground at grade level, recent tests[9] indicate that for small floor areas (equal to that of a house 25 ft square) the heat loss may be calculated as proportional to the length of exposed edge rather than total area. This amounts to 0.81 Btu per (hour) (lineal foot of exposed edge) (Fahrenheit degree difference between the inside air temperature and the average outside air temperature). It should be noted that this may be appreciably reduced by insulating the edges of the floor from the abutting wall.

CALCULATING SURFACE TEMPERATURES

In many heating and cooling load calculations it is necessary to determine the inside surface temperature or the temperature of the surfaces within the structure. As the resistance of any path of heat flow is expressed in Fahrenheit degrees per (Btu) (Hour) (Square Foot) the resistances through any two paths of heat flow would be proportional to the temperature drop through these paths and can be expressed as follows:

$$\frac{R_1}{R_t} = \frac{(t_i - t_x)}{(t_i - t_o)} \qquad (6)$$

where

R_1 = the resistance from the inside air to any point in the structure at which the temperature is to be determined.

R_t = the over-all resistance of the wall from inside air to outside air.
t_i = inside air temperature
t_x = temperature to be determined
t_o = outside air temperature

Example 2. Determine the inside surface temperature for a wall having an over-all coefficient of heat transmission U = 0.25, inside air temperature 70 F, outside air temperature −20 F. Solution:

$$R_1 = \frac{1}{f_i} = \frac{1}{1.65} = 0.606$$

$$R_t = \frac{1}{U} = \frac{1}{0.25} = 4.00$$

Then, by Equation 1

$$\frac{0.606}{4.00} = \frac{70 - t_x}{70 - (-20)}$$

$$t_x = 56.4 \text{ F.}$$

The same procedure can be used for determining the temperature at any point within the structure.

WATER VAPOR AND CONDENSATION

Water vapor is an important factor in the design and construction of many types of buildings and in processes where controlled air conditions are essential. It must often be considered in the construction of residences, or public buildings located in cold climates and, to a lesser extent, in those located in warm climates. It is extremely important to consider the moisture problem in the construction of cold storage and low temperature rooms. Manufacturing processes which require special humidity often require buildings designed with consideration for the effect of moisture on the building. There are, likewise, many processes which in themselves create moisture problems which become the major consideration in either the construction of the building or the method of plant operation.

These water vapor problems, being present to a greater or lesser extent in the majority of heating, cooling and air conditioning processes, make it necessary to understand the laws governing water vapor and its relation to air conditioning processes as well as its effect on different types of structures.

Water Vapor

The theory governing water vapor is well known and yet it is too often overlooked or given scant consideration in the construction of buildings and the layout of air conditioning processes. Water vapor is present in all air; it occupies the space; and has the same properties that it would have if the air were not present. It is steam at low pressure and temperature. Thus, in an air vapor mixture at 80 F, the density of the water vapor may be 0.00158 lb per cu ft providing that it is saturated and the vapor pressure would be 1.0323 inches of mercury. These are the same conditions that would be obtained in a cubic foot of saturated steam at 80 F, and it is spoken of as 100 per cent relative humidity air. If this same volume of air contained only one-half of the original moisture or 0.00079 lb per cu ft, it would be only 50 per cent saturated, or the relative humidity would be 50.1 per cent. In the first case, the vapor pressure would be 1.0323 inches of mercury and in the second case, it would be 50.1 per cent of this or 0.5172. In the first case, the vapor would be saturated and the dew point,