

Heat transmission coefficients for wood doors, with and without glass storm doors are given in Table 20.

WIND VELOCITY EFFECT ON U VALUES

Tables 5 through 8, 13-A, 14-A, 15, parts of Table 19, and Table 20 show values of U for winter calculations, for an outdoor wind velocity of 15 mph. Tables 13-B and 14-B show values of U for summer calculations and an outdoor wind velocity of 7.5 mph. Tables 11, 12, and 15 show values of U for both winter and summer. Tables 9 through 12 are for indoor U values and are based upon still air. All roof coefficient tables also take into account the direction of heat flow. Care must be exercised in selecting the table which applies to the design conditions. Table 21 shows comparative values of U for other wind velocities. When this table is used for summer

Table 20 . . . Coefficients of Transmission (U) of Solid Wood Doors

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based upon an outside wind velocity of 15 mph.

Nominal Thickness Inches	Actual Thickness Inches	$U^{a,b}$ Exposed Door	$U^{a,b}$ With Glass Storm Door*
1	1 1/2	0.64	0.37
1 1/4	1 1/4	0.55	0.34
1 3/4	1 3/4	0.49	0.32
1 3/4	1 3/4	0.48	0.31
2	1 3/4	0.43	0.28
2 1/4	2 1/4	0.36	0.26
3	2 3/4	0.31	0.23

* Computed using $k = 1.10$ for wood, $f_s = 1.46$, $f_r = 8.0$, and 1.03 for air space.

^a U value of 0.85 may be used for single exposed doors containing thin wood panels or single panes of glass, and 0.89 for the same with glass storm doors.

^b 50 percent glass and thin wood panels.

U values, it is necessary to enter the table at 7.5 mph which can be interpolated between 5 and 10 mph. Any value taken from this table should be rounded to two significant figures.

Example 8: Find the coefficient of transmission U of a frame wall consisting of stucco, 2 1/2-in. insulation board sheathing, 2 x 4-in. studs, gypsum lath and plaster, and with 2-in. blanket insulation between studs, for 25 mph wind velocity.

Solution: From Table 5, this wall, F37, with no insulation between studs has a value of $U = 0.22$. From Table 16, Part A, Col. 4, this wall with 2-in. insulation added has a value of $U = 0.084$. Entering Table 21 in the 15 mph column, interpolate between 0.080 and 0.090 in 15 mph column and proceed horizontally to the 25 mph column where the U value is found by interpolation to be 0.085.

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:

$$\frac{R_1}{R_2} = \frac{(t_i - t_o)}{(t_i - t_o)} \quad (6)$$

Table 21 . . . Conversion Table for Wall Coefficient U for Various Wind Velocities

U for 15 mph*	U for 0 to 30 mph Wind Velocities					
	0	5	10	20	25	30
0.050	0.049	0.050	0.050	0.050	0.050	0.050
0.060	0.059	0.059	0.060	0.060	0.060	0.060
0.070	0.068	0.069	0.070	0.070	0.070	0.070
0.080	0.078	0.079	0.080	0.080	0.080	0.080
0.090	0.087	0.089	0.090	0.090	0.091	0.091
0.100	0.096	0.099	0.100	0.100	0.101	0.101
0.110	0.105	0.108	0.109	0.110	0.111	0.111
0.130	0.123	0.127	0.129	0.131	0.131	0.131
0.150	0.141	0.147	0.149	0.151	0.151	0.152
0.170	0.158	0.166	0.169	0.171	0.172	0.172
0.190	0.175	0.184	0.188	0.191	0.192	0.193
0.210	0.192	0.203	0.208	0.212	0.213	0.213
0.230	0.209	0.222	0.227	0.232	0.233	0.234
0.250	0.226	0.241	0.247	0.252	0.253	0.254
0.270	0.241	0.259	0.266	0.273	0.274	0.275
0.290	0.257	0.278	0.286	0.293	0.295	0.296
0.310	0.273	0.296	0.305	0.313	0.315	0.317
0.330	0.288	0.314	0.324	0.333	0.336	0.338
0.350	0.303	0.332	0.344	0.354	0.357	0.359
0.370	0.318	0.350	0.363	0.375	0.378	0.380
0.390	0.333	0.368	0.382	0.395	0.399	0.401
0.410	0.347	0.385	0.402	0.416	0.420	0.422
0.430	0.362	0.403	0.421	0.436	0.441	0.444
0.450	0.376	0.420	0.439	0.457	0.462	0.465
0.500	0.410	0.464	0.487	0.509	0.514	0.518
0.600	0.474	0.548	0.581	0.612	0.620	0.626
0.700	0.535	0.631	0.675	0.716	0.728	0.736
0.800	0.592	0.711	0.766	0.821	0.836	0.847
0.900	0.645	0.789	0.858	0.927	0.946	0.960
1.000	0.695	0.865	0.949	1.034	1.058	1.075
1.100	0.742	0.939	1.039	1.142	1.170	1.192
1.200	0.786	1.010	1.129	1.250	1.285	1.318
1.300	0.828	1.080	1.217	1.359	1.400	1.430

* U in first column is from previous tables or as calculated for 15 mph wind velocity.

where

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

R_2 = the overall resistance of the wall from indoor air to outdoor air.

t_i = indoor air temperature.

t_o = temperature to be determined.

t_o = outdoor air temperature.

Example 9: Determine the inside surface temperature for a wall having an overall coefficient of heat transmission $U =$

Heat Transmission Coefficients of Building Materials

0.25, indoor air temperature 70 F, and outdoor air temperature -20 F.

Solution:

$$R = 1/f_i = 1/1.46 = 0.684$$

$$R_2 = 1/U = 1/0.25 = 4.00$$

Then, by Equation 6

$$\frac{0.684}{4.00} = \frac{70 - t_o}{70 - (-20)}$$

$$t_o = 54.6 \text{ F}$$

Example 10: Determine the temperature of the bottom of a 4-in. insulated concrete roof slab to which has been glued 1/4-in. acoustical tile ($C = 0.84$) as the interior finish. The roof-ceiling overall coefficient of heat transmission U is 0.14 for heat flow up. The indoor air temperature is assumed to be 70 F and the outdoor air temperature -20 F.

Solution:

$$R_1 = \frac{1}{f_i} + \frac{1}{C} = \frac{1}{1.43} + \frac{1}{0.84} = 1.80$$

$$R_2 = \frac{1}{U} = \frac{1}{0.14} = 7.14$$

Then, by Equation 6

$$\frac{1.80}{7.14} = \frac{70 - t_o}{70 - (-20)}$$

$$t_o = 47.3 \text{ F}$$

The concrete surface temperature is of interest since reference to a psychrometric chart or table will show that moisture condensation could occur on this surface under the above conditions (47.3 F) if the relative humidity in the room exceeds 44 percent. Additional roof insulation should be considered above the slab to avoid condensation at this point if higher relative humidities in the room are anticipated.

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

A chart for determining inside wall surface temperature is given in Fig. 13 of Chapter 30, Panel Heating.

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