

Table 5.... Coefficients of Transmission (U) of Frame Walls*

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

Example—Wall D 4		Example of Substitution	
Resistances used are given below in this table or in Table 3 or 4 Construction 1. Outside surface (15 mph wind)..... 0.17 2. Siding, wood, 3/4 in. x 8 in. lapped (av. R)..... 0.85 3. Building paper..... 0.06 4. Wood sheathing (3/4 in.)..... 0.97 5. Air space..... 0.97 6. Gypsum lath (3/4 in.)..... 0.32 7. Plaster (sand agg.) (3/4 in.)..... 0.09 8. Inside surface (still air)..... 0.68 Total resistance..... 4.12 $U = 1/R = 1/4.12 = 0.24$ See value 0.24 in boldface type in table below.		Resistances used are given below in this table or in Table 3 or 4 Replace items 3 and 4 with insul. bd. sheathing (3/4 in.) and items 6 and 7 with gypsum wall board (3/4 in.) Total resistance..... 4.12 Deduct 3. Building Paper..... 0.06 4. Wood sheathing (3/4 in.)..... 0.97 6. Gypsum lath (3/4 in.)..... 0.32 7. Plaster (sand agg.) (3/4 in.)..... 0.09 Difference..... 2.67 Add 4. Insul. bd. sheathing (3/4 in.)..... 2.06 6. Gypsum bd. (3/4 in.)..... 0.46 Total resistance..... 6.18 $U = 1/R = 1/6.18 = 0.16$	

To Adjust U Values for Construction with Added Insulation between Framing Members, See Table 16.

Exterior*			Interior Finish			Type of Sheathing*							Number						
Material	R	Av. R	Material	R	A	None, Building Paper				Gypsum Board 3/4 in.		Plywood 3/4 in.		Wood, 3/4 in. and Building Paper		Insulation Board Sheathing			
						U	U	U	U	U	U	U		U	U	U	U	U	U
Resistance					↓	U	U	U	U	U	U	U	U	U	U	U	U		
						A	B	C	D	E	F								
Wood siding Drop—(1 in. x 8 in.) Bevel (3/4 in. x 8 in.) Wood shingles 7 1/2 in. exposure Wood panels (3/4 in.)	0.79 0.81 0.87 0.84 0.94	0.854	None.....	—	0.57	0.47	0.48	0.36	0.33	0.27	1								
			Gypsum bd. (3/4 in.).....	0.32	0.33	0.29	0.30	0.25	0.23	0.20	2								
			Gypsum lath (3/4 in.) and 1/2 in. plas. (lt. wt. agg.).....	0.64	0.30	0.27	0.27	0.23	0.22	0.19	3								
			Gypsum lath (3/4 in.) and 1/2 in. plas. (sand agg.).....	0.41	0.32	0.28	0.29	0.24	0.23	0.19	4								
			Metal lath and 3/4 in. plas. (lt. wt. agg.).....	0.47	0.31	0.28	0.28	0.24	0.22	0.19	5								
			Metal lath and 3/4 in. plas. (sand agg.).....	0.13	0.35	0.31	0.31	0.26	0.24	0.21	6								
			Insul. bd. (3/4 in.).....	1.43	0.24	0.22	0.22	0.19	0.18	0.16	7								
			Insul. bd. lath (3/4 in.) and 1/2 in. plas. (sand agg.).....	1.52	0.24	0.22	0.22	0.19	0.18	0.16	8								
			Plywood (3/4 in.).....	0.31	0.33	0.29	0.30	0.25	0.23	0.20	9								
			Wood panels (3/4 in.).....	0.94	0.27	0.25	0.25	0.22	0.20	0.18	10								
			Wood lath and 1/2 in. plas. (sand agg.).....	0.40	0.32	0.28	0.29	0.24	0.23	0.19	11								
Face-brick veneer ¹ Plywood (3/4 in.)	0.44 0.47	0.454	None.....	—	0.73	0.56	0.58	0.42	0.38	0.30	12								
			Gypsum bd. (3/4 in.).....	0.32	0.37	0.33	0.33	0.27	0.25	0.21	13								
			Gypsum lath (3/4 in.) and 1/2 in. plas. (lt. wt. agg.).....	0.64	0.33	0.30	0.30	0.25	0.24	0.20	14								
			Gypsum lath (3/4 in.) and 1/2 in. plas. (sand agg.).....	0.41	0.36	0.32	0.32	0.27	0.25	0.21	15								
			Metal lath and 3/4 in. plas. (lt. wt. agg.).....	0.47	0.35	0.31	0.32	0.26	0.25	0.21	16								
			Metal lath and 3/4 in. plas. (sand agg.).....	0.13	0.40	0.35	0.36	0.29	0.27	0.22	17								
			Insul. bd. (3/4 in.).....	1.43	0.26	0.24	0.24	0.21	0.20	0.17	18								
			Insul. bd. lath (3/4 in.) and 1/2 in. plas. (sand agg.).....	1.52	0.26	0.23	0.24	0.21	0.19	0.17	19								
			Plywood (3/4 in.).....	0.31	0.38	0.33	0.33	0.27	0.26	0.21	20								
			Wood panels (3/4 in.).....	0.94	0.30	0.27	0.28	0.23	0.22	0.19	21								
			Wood lath and 1/2 in. plas. (sand agg.).....	0.40	0.36	0.32	0.32	0.27	0.25	0.21	22								

Heat Transmission Coefficients of Building Materials

Table 5.... Coefficients of Transmission (U) of Frame Walls* (Concluded)

Exterior*			Interior Finish			Type of Sheathing*								Number
						None, Building Paper	Gypsum Board $\frac{1}{2}$ in.	Ply-wood $\frac{3}{8}$ in.	Wood, $\frac{3}{4}$ in. and Building Paper		Insulation Board Sheathing			
									$\frac{1}{2}$ in.	$\frac{3}{4}$ in.	1.32	2.06		
													Resistance	
Material	R	Av. R	Material	R	U	U	U	U	U	U				
					A	B	C	D	E	F				
Wood shingles over insul. backer bd. ($\frac{3}{8}$ in.) Asphalt insul. siding	1.40 1.46	1.484	None.....	—	0.43	0.37	0.38	0.30	0.28	0.23	23			
			Gypsum bd. ($\frac{3}{4}$ in.).....	0.35	0.28	0.25	0.25	0.22	0.20	0.18	24			
			Gypsum lath ($\frac{3}{8}$ in.) and $\frac{1}{2}$ in. plas. (lt. wt. agg.).....	0.64	0.25	0.23	0.23	0.20	0.19	0.17	25			
			Gypsum lath ($\frac{3}{8}$ in.) and $\frac{1}{2}$ in. plas. (sand agg.).....	0.41	0.27	0.24	0.25	0.21	0.20	0.18	26			
			Metal lath and $\frac{3}{4}$ in. plas. (lt. wt. agg.).....	0.47	0.27	0.24	0.24	0.21	0.20	0.17	27			
			Metal lath and $\frac{3}{4}$ in. plas. (sand agg.).....	0.13	0.29	0.26	0.27	0.23	0.21	0.18	28			
			Insul. bd. ($\frac{3}{4}$ in.).....	1.43	0.21	0.20	0.20	0.18	0.17	0.15	29			
			Insul. bd. lath ($\frac{3}{4}$ in.) and $\frac{1}{2}$ in. plas. (sand agg.).....	1.52	0.21	0.19	0.19	0.17	0.16	0.15	30			
			Plywood ($\frac{3}{4}$ in.).....	0.31	0.28	0.25	0.25	0.22	0.20	0.18	31			
			Wood panels ($\frac{3}{4}$ in.).....	0.94	0.24	0.22	0.22	0.19	0.18	0.16	32			
			Wood lath and $\frac{1}{2}$ in. plas. (sand agg.).....	0.40	0.27	0.24	0.25	0.21	0.20	0.18	33			
Asbestos-cement siding Stucco ² 1 in. Asphalt roll siding	0.21 0.20 0.15	0.194	None.....	—	0.91	0.67	0.70	0.48	0.42	0.32	34			
			Gypsum bd. ($\frac{3}{4}$ in.).....	0.32	0.42	0.36	0.37	0.30	0.27	0.23	35			
			Gypsum lath ($\frac{3}{8}$ in.) and $\frac{1}{2}$ in. plas. (lt. wt. agg.).....	0.64	0.37	0.32	0.33	0.27	0.25	0.21	36			
			Gypsum lath ($\frac{3}{8}$ in.) and $\frac{1}{2}$ in. plas. (sand agg.).....	0.41	0.40	0.35	0.36	0.29	0.27	0.22	37			
			Metal lath and $\frac{3}{4}$ in. plas. (lt. wt. agg.).....	0.47	0.39	0.34	0.35	0.28	0.26	0.22	38			
			Metal lath and $\frac{3}{4}$ in. plas. (sand agg.).....	0.13	0.45	0.39	0.40	0.31	0.29	0.24	39			
			Insul. bd. ($\frac{3}{4}$ in.).....	1.43	0.29	0.26	0.26	0.22	0.21	0.18	40			
			Insul. bd. lath ($\frac{3}{4}$ in.) and $\frac{1}{2}$ in. plas. (sand agg.).....	1.52	0.28	0.25	0.26	0.22	0.21	0.18	41			
			Plywood ($\frac{3}{4}$ in.).....	0.31	0.42	0.36	0.37	0.30	0.27	0.23	42			
			Wood panels ($\frac{3}{4}$ in.).....	0.94	0.33	0.29	0.30	0.25	0.23	0.20	43			
			Wood lath and $\frac{1}{2}$ in. plas. (sand agg.).....	0.40	0.40	0.35	0.36	0.29	0.27	0.22	44			

- * See text section Calculating Overall Coefficients for basis of calculations.
 * To adjust U values for the effect of added insulation between framing members, see Table 16.
 * Note that although several types of exterior finish may be grouped because they have approximately the same thermal resistance value, it is not implied that all types may be suitable for application over all types of sheathing listed.
 * Average resistance of items listed. This average was used in computation of U values shown.
 * Building paper is not included except where noted.
 * Small air space between building paper and brick veneer neglected.
 * Where stucco is applied over insulating board or gypsum sheathing, building paper is generally required, but the change in U value is negligible.

Solution: In Fig. 5 the following paths of heat flow from plane A to plane F will be noted:

- From A to B: One path through 3 in. of concrete.
 - From B to C: Two paths, (a) through 1 in. of tie rod, and (b) through 1 in. of concrete.
 - From C to D: Two paths, (a) through 2 1/2 in. of tie rod, and (b) through 2 1/2 in. of insulation.
 - From D to E: Two paths, (a) through 1 in. of tie rod, and (b) through 1 in. of concrete.
 - From E to F: One path through 3 in. of concrete.
- It will be noted that items 2 and 4 are paths of similar flow, and could be treated as one. If equilibrium or steady-state heat transfer is assumed, there will exist a temperature difference between the metal tie rod and the concrete, and also between the metal tie rod and the insulating material. The rate

of heat transfer between these materials is dependent upon their conductivity values and the temperature difference. As the conductivity of the metal tie rods is considerably higher than that of the concrete or insulating material, it cannot be assumed that the same rate of heat transfer takes place for all parallel paths. Likewise, an appreciable error would be made by assuming that no heat transfer takes place between the metal tie rod and the surrounding materials. Although the pattern of the isotherms is unknown, the following method of calculation does partially take into account the heat flow between the metal tie rods and its bounding materials.

Parallel Flow: The conductances through the areas of parallel heat flow may be determined as follows:

- The area of each 1/2-in. diameter tie rod is 0.00034 sq ft, and as the tie rods are spaced 9 in. vertically, and 12 in. hori-