

coefficient of a surface in still air is 1.65 Btu per hour per square foot per degree Fahrenheit, whereas the average coefficient of an air space in an outside wall is about 1.10 Btu per hour per square foot per degree Fahrenheit difference between the two surfaces, at a mean temperature of 40 F. An air space coefficient of 1.10 is equivalent to a surface coefficient of 2.20 for each of the two surfaces enclosing the air space, where the over-all transmission is computed by using the coefficients of the two surfaces enclosing the air space instead of the coefficient of the air space itself. Hence, in determining the values of U_r and U_{ce} to be used in the formula, the coefficients for the surfaces of the roof and ceiling enclosing the attic should be increased to allow for the additional amount of heat transferred by radiation, and a coefficient of 2.20 may be used with sufficient accuracy for each of these surfaces, although in very precise work a correction should be made to allow for the fact that the area of a pitched roof over an unheated attic is greater than the area of the ceiling, and hence, the amount of heat absorbed by radiation by each square foot of roof surface is less than is given off by radiation by each square foot of ceiling surface.

If the unheated attic space between the roof and ceiling has no dormers, windows or vertical wall surfaces, the combined coefficients may be used for determining the heat loss through the roof construction between the attic and top-floor ceiling, but it should be noted that these coefficients should be multiplied by the roof area and not by the ceiling area. If the unheated attic contains windows, ventilators or vertical wall surfaces, which would tend to reduce temperature in the attic to a temperature approaching or equaling the outside temperature, the roof should be neglected and only the top-floor ceiling construction and the corresponding ceiling area taken into consideration, using the coefficients given in Tables 8 or 9. Where there are no dormers, doors, or windows, and when the transmission coefficients of the roof and the ceiling are approximately the same, the value of the attic temperature may be taken as an average between the inside and the outside temperature.

Basements and Unheated Rooms

The heat loss through floors into basements and into unheated rooms kept closed may be computed by assuming a temperature for these rooms of 32 F.

Additional information on the inside and outside temperatures to be used in heat loss calculations is given in Chapter 7.

REFERENCES

- A.S.H.V.E. research paper entitled Wind Velocity Gradients Near a Surface and Their Effect on Film Conductance, by F. C. Houghten and Paul McDermott (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931).
 A.S.H.V.E. research paper entitled Surface Conductances as Affected by Air Velocity, Temperature and Character of Surface, by F. B. Rowley, A. B. Algren and J. L. Blackshaw (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930).
 A.S.H.V.E. research paper entitled Effects of Air Velocities on Surface Coefficients, by F. B. Rowley, A. B. Algren and J. L. Blackshaw (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930).
 A.S.H.V.E. research paper entitled Conductivity of Concrete, by F. C. Houghten and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931).
 A.S.H.V.E. research paper entitled Surface Coefficients as Affected by Direction of Wind, by F. B. Rowley and W. A. Eckley (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931).
 A.S.H.V.E. research paper entitled Thermal Resistance of Air Spaces, by F. B. Rowley and A. B. Algren (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929).

- A.S.H.V.E. research paper entitled The Heat Conductivity of Wood at Climatic Temperature Differences, by F. B. Rowley (A.S.H.V.E. Journal Section, *Heating, Piping and Air Conditioning*, June, 1933).
 A.S.H.V.E. research paper entitled Insulating Value of Bright Metallic Surfaces, by F. B. Rowley (A.S.H.V.E. Journal Section, *Heating, Piping and Air Conditioning*, June, 1934).
 Heat Transmission through Building Materials, by F. B. Rowley and A. B. Algren, *University of Minnesota Engineering Experiment Station Bulletin No. 8*.
 Insulating Effect of Successive Air Spaces Bounded by Bright Metallic Surfaces, by L. W. Schad (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931).
 Importance of Radiation in Heat Transfer through Air Spaces, by E. R. Queer (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932).
 Properties of Metal Foil as an Insulating Material, by J. L. Gregg (*Refrigerating Engineering*, May, 1932).
 Thermal Insulation with Aluminum Foil, by R. B. Mason (*Industrial and Engineering Chemistry*, March, 1933).
 Heating, Ventilating and Air Conditioning, by Harding and Willard, Revised Edition, 1932.
 Thermal Insulation of Buildings, Technical Paper No. 11 (*American Architect*, May, 1934).
 House Insulation, Its Economics and Application, by Russell E. Backstrom (Report of the National Committee on Wood Utilization, *United States Government Printing Office*, 1931).
 Heat Insulation as Applied to Buildings and Structures, by E. A. Allcut, University of Toronto, 1934.

PROBLEMS IN PRACTICE

1 • What is the coefficient U and how is it applied?

The coefficient U is the heat loss through walls, ceilings, and floors and the value depends upon the construction and material, expressed in Btu per hour per square foot per degree difference in temperature between the inside and outside. To determine the total heat loss, multiply U for each material by the square feet of surface and the temperature difference.

2 • What is the conductivity of face brick?

9.20 (Table 2).

3 • What is the conductance of wood shingles?

1.28 (Table 2).

4 • What is the over-all coefficient of transmission U for a solid brick wall 12-in. thick with plaster on wood lath, furred?

0.24 (Table 3, Wall 2C).

5 • Find the value of U for a 6-in. concrete wall with plaster on metal lath attached to 2-in. furring strips with flanged $\frac{1}{2}$ -in. blanket insulation.

0.23 (Table 3, Wall 12L).

6 • Find the value of U for a wood siding wall with an interior finish of $\frac{3}{4}$ -in. plaster on metal lath; sheathing thickness, $2\frac{5}{32}$ in.

0.26 (Table 5, Wall 41B).

7 • What value of U should be used for a brick veneer wall with $\frac{1}{2}$ -in. rigid insulation sheathing finished on the interior with plaster on $\frac{1}{2}$ -in. rigid insulation?

0.19 (Table 5, Wall 51D).

8 • What value of U should be used in computing the heat loss from an attic through a floor of yellow pine on joists with a ceiling of metal lath and plaster?

0.30 (Table 8, Floor 2B).

9 • What is the over-all heat transfer coefficient for a 6-in. concrete floor with no insulation and with yellow pine flooring on sleepers resting on concrete?

0.33 (Table 10, Floor 2B).