

common error in installing such a material is to nail the blanket on the outside of the studs underneath the sheathing, in which case one air space is lost and also the thickness of the insulating material is materially reduced at the studs. There are certain other types of insulation which are very porous, allowing air circulation within the material if not properly installed. The architect or engineer must carefully evaluate the economic considerations involved in the selection of an insulating material as adapted to various building constructions. Lack of good judgment in the intelligent choice of an insulating material, or its improper installation, frequently represents the difference between good or unsatisfactory results.

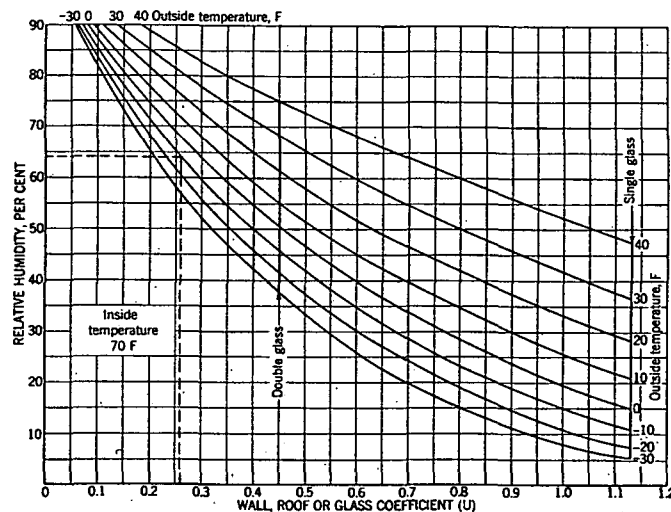


FIG. 2. PERMISSIBLE RELATIVE HUMIDITIES FOR VARIOUS TRANSMISSION COEFFICIENTS

CONDENSATION IN BUILDINGS

The water vapor or moisture mixed with the air in buildings will be transmitted through many types of building construction if there is a difference in the vapor pressures on the two sides of the structure. Such water vapor will also condense whenever it comes in contact with surfaces or objects at or below the dew-point temperature. Thus two types of condensation problems are encountered in building practice, namely: (1) *Surface condensation* or condensation on the interior building surfaces including the walls, ceiling (or roof) and glass, and (2) *Interstitial condensation* or the transmittance of the vapor through the building materials and condensation of the moisture on surfaces or voids within the materials of construction.

Condensation within the construction as well as condensation on the interior surfaces does not necessarily occur in all buildings but only in isolated cases when conditions conducive to such condensation exist. The

probability of condensation increases with the relative humidity or vapor pressure and with the temperature difference and, in the case of interstitial condensation, decreases with the vapor resistance on the warm side of the wall.

Condensation on interior building surfaces³ (surface condensation) may be eliminated by either reducing the relative humidity or by maintaining the interior surfaces at or above the dew-point temperature. Permissible relative humidities for various wall, roof or glass coefficients and temperature differences may be determined from Fig. 2. The permissible relative humidity for any specific type of construction may be determined by first ascertaining the coefficient of transmission (U) of the construction and then locating this coefficient on the horizontal scale of Fig. 2. A vertical line drawn to the proper outside temperature curve and then to the left hand scale will indicate the permissible relative humidity for the conditions involved. The dotted line shown in Fig. 2 indicates the permissible relative humidity (64 per cent) if surface condensation is to be avoided, for a frame wall having a coefficient of 0.26 and for an outside temperature of -10°F .

Condensation within the construction may likewise be prevented by eliminating the moisture at the source or by providing a barrier on the warm side of the insulation construction. A good vapor barrier construction may be obtained with a vapor-proof paper properly applied under the plaster or a vapor-proof finish on the interior surface of the wall⁴. In the case of attics, the greater the heat resistance in the top floor ceiling, the lower the attic temperature and consequently the greater the tendency for condensation to take place on the under side of the roof boards which moisture will drop on to the ceiling. Thus where thick insulations are installed between ceiling joists, it is desirable to allow openings for outside air circulation through attic space as a precaution against condensation on the underside of the roof even though barriers are used in the ceiling below.

Computed Transmission Coefficients

Computed heat transmission coefficients of many common types of building construction are given in Tables 3 to 13, inclusive, each construction being identified by a serial number. For example, the coefficient of transmission (U) of an 8-in. brick wall and $\frac{1}{2}$ in. of plaster is 0.46, and the number assigned to a wall of this construction is 1-B, Table 3.

Example 1. Calculate the coefficient of transmission (U) of an 8-in. brick wall with $\frac{1}{2}$ in. of plaster applied directly to the interior surface, based on an outside wind exposure of 15 mph. It is assumed that the outside course is of hard (high density) brick having a conductivity of 9.20, and that the inside course is of common (low density) brick having a conductivity of 5.0, the thicknesses each being 4 in. The conductivity of the plaster is assumed to be 3.3, and the inside and outside surface coefficients are assumed to average 1.65 and 6.00, respectively, for still air and a 15 mph wind velocity.

Solution. k (hard high density brick) = 9.20; x = 4.0 in.; k (common low density brick) = 5.0; x = 4.0 in.; k (plaster) = 3.3; x = $\frac{1}{2}$ in.; f_i = 1.65; f_o = 6.0. Therefore,

³Permissible Relative Humidities in Humidified Buildings, by Paul D. Close (A.S.H.V.E. JOURNAL SECTION, Heating, Piping and Air Conditioning, December, 1939).

⁴Condensation within Walls, by F. B. Rowley, A. B. Algren and C. E. Lund (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 95).