or the application of coatings, even though transparent to the eye, must be considered in selecting a material for use.[10] Surface emissivity values should be obtained by tests.

PRACTICAL COEFFICIENTS AND THEIR USE

For practical purposes it is necessary to compute average coefficients that may be applied to various materials and types of construction. Table 2, as revised in this issue, gives representative values for dry materials at 70 F mean temperature, as selected by the ASHAE Technical Advisory Committee on Insulation. Since there may be some variation in the materials and in test conditions, these selected values may not be in exact agreement with published data of all manufacturers. The exact value for the conductivity or conductance of a certain manufacturer's material can only be secured from unbiased tests or guaranteed by the manufacturer.

Caution

The conductivity or conductance values given in Tables 1 and 2 are taken from values obtained in most cases by the guarded hot plate method *ASTM* Standard C-177-45 which states,

"Because of the requirements prescribed in this method as to conditions under which conductivity tests shall be made, it should be recognized that the conductivity coefficients obtained will not necessarily be the values pertaining under all service conditions. As an example, the method provides that the conductivity coefficient shall be obtained by test on dry specimens, while in service such a condition will seldom be realized."

The user should realize that the average conductivity and conductance values given in Tables 2 or 5 do not necessarily apply to all products of the same general description. In using these values, judgment should be exercised with regard to the extent to which the product (either as received or as applied) will comply with the tabulated values. Exact conductivities or conductances for specific materials should be obtained from the manufacturer. Table 5 has been retained in this edition because it is the basis for computation of the U-values shown in Tables 7 to 18.

Because U values for heat flow upward, such as for ceilings in winter, may differ greatly from U values for heat flow downward, such as for ceilings in summer, a serious error may be made in calculating heat losses or gains if the appropriate U value is not used. (See Chapter 13 for recommended temperature gradients for cooling loads.)

Due to the inconsistency of actual building construction, because of the human element, many designers do not use overall coefficients of transmission lower than 0.10 for walls and particularly roofs, except where the construction is installed under continuous supervision. It should also be noted that these coefficients do not include any factor of safety and that when no supervision is used, some designers incorporate a 10 percent factor of safety.

Attention is called to the necessity of applying the insulating material in accordance with the manufacturer's specification. The engineer must evaluate carefully the economic considerations involved in the selection of an insulating material as adapted to various building constructions. Lack of proper evaluation, or improper installation may lead to unsatisfactory results. Special attention must be given to vapor barriers as outlined in Chapter 10. Moisture from condensation or other sources materially reduces the heat-flow resistance of insulation.

Insulating Materials

In order to determine the benefit derived from the addition of insulating materials to a given construction, the overall coefficient of heat transmission U_i of the insulated construction may be compared with the corresponding coefficient U without insulation. Table 6 (Part A to Part D) may be used for determining the coefficients of transmission of constructions with any combination of fibrous, bulk, or mass insulation and air spaces of various effective emissivities.

INSULATED CONSTRUCTIONS—HOW TO USE TABLE 6

In Tables 7 to 17, U values are given for many common types of building wall, floor, and ceiling constructions. For such of these constructions as contain an air space, the tabulated U value is based on the assumption that the air space is empty, and that its surfaces are of ordinary building materials of low thermal reflectivity, such as wood, masonry, plaster or paper. Considerable benefit in reducing the heat transmission coefficient of a construction can be effected by the application of thermal insulating materials in the air space.

Table 6 provides a means of determining, without calculations, the U value of the between-framing area of such constructions with the added insulation installed in the air space. Column 1 of Table 6 refers to the U values of uninsulated constructions as taken from Tables 7 to 17. Columns 2 to 14 of the table give corresponding coefficients U_i for the constructions with various insulating applications in the between-framing air space, as indicated by the column headings. Table 6 is in four parts, corresponding to the type of building element and the direction of heat flow. Each part is based on temperature conditions considered generally appropriate for the case.

Any and all U values are based on a series of assumptions as to nominal characteristics. Common variations in conditions, materials, workmanship, etc. can introduce much greater variations in U values than the variations resulting from the assumed mean temperatures and temperature differences described. From this it is also clear that the use of more than two sign ificant figures in stating a U value is assuming more precision than can possibly exist. Three significant figures are used in Table 6 merely as a means of reducing cumulative errors when the table is used several times to obtain a single result. It should not be assumed that the figures are accurate, over-all, to three significant figures. Also a result taken from Table 6 should always be rounded off to two significant figures.

To use Table 6:

1. Find in Column 1 of the appropriate table the value for U obtained from Tables 7 to 17.

2. If there is a column which exactly corresponds to the condition for which you desire the U value, read the answer in this column, opposite the Column 1 value. Interpolate if necessary.

3. If there is no column which fully corresponds to the condition for which you desire the U value, then obtain the answer by means of two or more steps—each time using the value obtained in one step to reenter the same table through Column 1. In this way U values may be obtained for combinations of insulation in the framing space.

Special Uses of Table 6

Values of U_i for insulating applications or combinations other than those indicated by the headings of Columns 2 to 14 of Table 6 can be ascertained