

**Effective Insulation R-Values are affected by four main factors:**

1. Insulation type and density
2. Air leakage and associated convective heat transfer
3. Moisture
4. Mass of the insulation assembly

#### **h. Radiant Barriers**

Radiant barriers provide a mechanism for preventing the heat loss or gain associated with radiant energy. A typical location for radiant barriers is on the interior sheathing between roof rafters. This prevents solar heat gain into the attic space in warm months, and will actually prevent radiant heat loss in heating months.

#### **i. R-Value and U-Factor**

**R-Value** is a measure of the thermal resistance of a building material. A **large R-Value** indicates that a material has a high resistance to conduction of heat, therefore it is a **good insulator**. R-Values are used primarily to rate insulation products. Auditors estimate R-Values of composite wall, floor and ceiling systems.

R-Value has units of:

$$\frac{ft^2 \times ^\circ F \times hour}{BTU}$$

**R-Values are additive**, meaning that all of the R-Values of the components of a wall system can be added to calculate an aggregate wall R-Value.

**Example:**

**What is the R-Value of the following wall system?**

- Insulation: R-Value=38
- Exterior Siding : R-Value = 4
- Interior Sheeting: R-Value = 4

**Answer:**

Insulation R-Value + Exterior Siding R-Value + Interior Sheeting R-Value = \_\_\_\_\_.

**U-Factor** is a measure of the thermal conductance of a building material. A small U-Value indicates that the material is a poor thermal conductor and is therefore a good insulator. U-factors are used primarily to rate doors and windows.

U-Factors (conductance) have units of:

$$\frac{BTU}{ft^2 \times ^\circ F \times hour}$$

### **Relationship between R-Value and U-Factors**

R-Value and U-Value are inverses of each other... in other words:

$$\mathbf{R\text{-}Value = 1/U \text{ and } U\text{-}Factor = 1/R}$$

**Very important...** U-Factors are NOT additive like R-Values. In order to develop a composite U-Value for a wall system, first convert all U-Factors to R-Values, add them, and then convert to U-Factor.

### **Air Film**

The layer of air at the surface of walls provides a small amount of resistance to heat flow. This layer is referred to as the "air film". In order to make a more accurate estimate of heat loss, the R-Value of this film is often included. **The R-Value of the exterior Air Film is typically R-0.17, and the interior Air Film is R-0.68.**

### **Example:**

***What is the composite conductance (U-Factor) of a wall system with the following characteristics?***

Insulation: U-Factor= 0.02

Exterior Siding: U-Factor= 0.25

Interior Siding: U-Factor= 0.25

### **Answer:**

Insulation R-Value=

Exterior Siding R-Value =

Interior Siding R-Value=

Interior Wall Air Film=