HEAT LOSS BY INFILTRATION

On an average, a reasonably tight house will have one air change per hour. A radiant floor heating system reduces drafts and the factor 0.7 air/hour may be used.

Heat loss by infiltration:

Imperial: ft^3 x 0.018 Btu/ft^3 x (t_{indoor} - $t_{outdoor}$) ^oF x air change / h = Btu/h
Metric: m^3 x 0.35 W/m^3 x (t_{indoor} - $t_{outdoor}$) ^oC x air change / h = Watts

HEAT LOSS BY TRANSMISSION

The R-value is the thermal resistance rating and it tells you how well a material insulates. The thermal resistance through a medium is obtained by adding all the layers of building materials:

$$R_{tot} = R_1 + R_2 + R_3 + ...$$

The coefficient of thermal transmission tells you how much heat passes through a medium.:

$$U = \frac{1}{R}$$

If a wall has an R-value of 20, it will have a U-value of 1/20 or 0.05. This means that 0.05 Btu of heat will pass through each square foot of the wall every hour for each degree of temperature difference. If it is 70^{o}F inside and 20^{o}F outside - that is a temperature difference of 50 degrees. Thus, our U-value of 0.05 x 50^o temperature difference gives us 2.5 -- the Btu that will pass through each square foot of wall. If the whole wall is 100 square feet, the heat loss through it would be 100 x 2.5, or 250 Btu/h. To maintain the inside temperature of 70^{o}F, you would need to replace these 250 Btu/h from your heating system, the sunlight and other marginal sources of heat, such as cooking and body heat.

Example: Floor area x U x ^{o}F diff. + Roof area x U x ^{o}F diff. + Walls x U x ^{o}F diff. + Windows x U x ^{o}F diff. + Doors x U x ^{o}F diff. = Total Btu/h per section

Heat loss by transmission

Imperial: ft^2 x (U) Btu/h ft^2 ^oF (t_{indoor} - $t_{outdoor}$) ^oF = Btu/h
Metric: m^2 x (U) W/m^2 ^oC (t_{indoor} - $t_{outdoor}$) ^oC = Watts

CONSUMPTION

The seasonal / annual heating load is:

$$\frac{\text{Heat loss x 24 h x Heating Degree Days}}{\eta\text{(efficiency of heating equipment, electric = 1)}} = \text{Btu or kWh (1kWh = 3412 Btu)}$$

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