

## THE FOLLOWING FORMULAS MAY BE OF USE IN BUILDING SYSTEMS

### ELECTRICAL

$$\text{Footcandles} = \frac{\text{lumens}}{\text{area in ft}^2}$$

$$\text{Footcandles} = \frac{(\text{lamp lumens}) \times (\text{lamps per fixture}) \times (\text{number of fixtures}) \times (\text{CU}) \times (\text{LLF})}{\text{area in ft}^2}$$

$$\text{Number of luminaires} = \frac{(\text{footcandles}) \times (\text{floor area})}{(\text{lumens}) \times (\text{CU}) \times (\text{LLF})}, \quad \text{where } \text{CU} = \text{coefficient of utilization}$$

LLF = Light Loss Factor

$$\text{DF}_{\text{av}} = 0.2 \times (\text{window area/floor area}) \text{ for spaces with sidelighting or toplighting with vertical monitors}$$

$$\text{watts} = \text{volts} \times \text{amperes} \times \text{power factor (ac circuits only)}$$

$$\text{Demand charge} = \text{maximum power demand} \times \text{demand tariff}$$

### HVAC

$$\text{Btu/year} = (\text{peak heat loss}) \times (\text{full-load hours/year})$$

$$\$/\text{year} = (\text{Btu/year}) \times (\text{fuel cost/fuel heat value}) \times (\text{efficiency})$$

$$\text{Btu/h} = (\text{cfm}) \times (1.08) \times (\Delta T)$$

$$1 \text{ kWh} = 3,400 \text{ Btu/h}$$

$$1 \text{ ton of air conditioning} = 12,000 \text{ Btu/h}$$

$$\text{Btu/h} = (U) \times (A) \times (T_d), \text{ where } T_d \text{ is the difference between indoor and outdoor temperatures}$$

$$U = 1 / R_t$$

$$U_o = \frac{(U_w \times A_w) + (U_{op} \times A_{op})}{A_o}, \text{ where } o = \text{total wall, } w = \text{window, and } op = \text{opaque wall}$$

$$U_o = \frac{(U_R \times A_R) + (U_s \times A_s)}{A_o}, \text{ where } o = \text{total roof, } R = \text{roof, and } S = \text{skylight}$$

$$R = x / k, \text{ where } x = \text{thickness of material in inches}$$

$$\text{Heat required} = \frac{\text{Btu/h}}{\text{temperature differential}} \times (24 \text{ hours}) \times (\text{DD } ^\circ\text{F}), \text{ where DD} = \text{degree days}$$

### PLUMBING

$$1 \text{ psi} = 2.31 \text{ feet of water}$$

$$1 \text{ cubic foot} = 7.5 \text{ U.S. gallons}$$

### ACOUSTICS

$$\text{Sound} = \lambda = \frac{c}{f}, \text{ where } \lambda = \text{wavelength (ft), } c = \text{velocity of sound (fps), and } f = \text{frequency of sound (Hz)}$$

$$\text{NR} = \text{TL} - 10 \log [S / A_R], \quad \text{where } \begin{array}{l} \text{NR} = \text{Noise reduction (dB)} \\ \text{TL} = \text{Barrier transmission loss (dB)} \\ S = \text{Area of barrier wall (ft}^2\text{)} \\ A_R = \text{Total absorption of receiving room (sabins, ft}^2\text{)} \end{array}$$

$$\text{NRC} = a / s, \quad \text{where } \begin{array}{l} \text{NRC} = \text{Noise reduction coefficient} \\ a = \text{Total sabins (sound absorbing units)} \\ s = \text{Total surface area in the room} \end{array}$$

$$T_R = K \times \frac{V}{\Sigma A}, \quad \text{where } \begin{array}{l} T_R = \text{Reverberation time in seconds} \\ K = \text{a constant of 0.05 when measurements are in feet} \\ V = \text{Room volume (ft}^3\text{)} \\ \Sigma A = \text{Total room absorption, sabins (ft}^2\text{) at that frequency} \end{array}$$