Formulas

Construction Math	
Area A = L x W	Volume V = L x W x H
Perimeter P = a + b + c + d …etc.	Area of a triangle A = ½ x (B x H)
Hypotenuse (long side) of a right triangle $a^2 + b^2 = c^2$	Area of a circle $A = \pi \times Radius^2$
Circumference of a circle $C = \pi \times Diameter$	

Energy/Baseload	
Heating Energy Intensity EI = Btu/sq. ft./HDD	Showerhead flow: Gal/Hr = 60 ÷ seconds for 1 gal.
Heating Degree Day HDD = 65 – Avg. temp for day	Cooling Degree Day CDD = Avg. temp for day – 65
Calculate lighting savings: saved (old wattage – new wattage) kWh/yr x utility cost kWh/yr = kW x hours x 365	Base refrigerator consumption: kWh/yr = (metered usage in kWh ÷ metering time in minutes) x 60 x 8760

ASHRAE 62.2 2016/Building Air Flow	
Total required ventilation rate in CFM: (ASHRAE) $Q_{tot} = 0.03 A_{floor} + 7.5(N_{br} + 1)$ **Where**: ***Qtot*** *= total required ventilation rate in CFM* ***0.03Afloor*** *= dwelling unit floor area in square feet x 0.03* ***7.5(Nbr +1)*** *= number of bedrooms plus 1 x 7.5 cfm per bedroom*	Estimated annual infiltration rate - CFM: (ASHRAE) $Q_{inf} = 0.052 \times Q_{50} \times wsf \times (H/Hr)^z$ **Where:** ***Qinf*** = CFM of estimated natural infiltration **Q_{50}** = CFM50 from blower door test ***wsf*** = weather and shielding factor – Appendix B **$(H/H_r)^z$** = height correction factor H = height of above grade pressure boundary Hr = reference height – 8.2 feet z = 0.4 constant used in calculations
CFH (ft^3/hour) = CFM x 60 minutes/hr	ACH (air changes per hour) = CFH ÷ Volume ft^3
$ACH_{nat} = Q_{inf}$ x 60 minutes ÷ ft^3 Volume (estimate)	ELA (estimated leakage area) = CFM_{50} ÷ 10
$ACH_{50} = CFM_{50}$ x 60 ÷ ft^3 Volume	

Heat Load and Insulation	
R-value from U-factor R = 1/U	U-factor from R-value U = 1/R
Air transported heat loss: Btuh = V x ACH x 0.0182 x ΔT (hour) Btu/yr. = V x ACH x 0.0182 x HDD x 24 (heating yr.)	Air transported heat loss: Btuh = CFM x 1.08 x ΔT (hour) Btu/yr. = CFM x 1.08 x HDD x 24 (heating year)
Surface heat loss: Btu = area x ΔT x time ÷ R-value (typically 1 hour) Btu/yr. = area x HDD x 24 ÷ R-value (heating year)	Surface heat loss: Btu = area x ΔT x time x U-factor (typically 1 hour) Btu/yr. = area x HDD x 24 x U-factor (heating year)

Reasonable assumptions: A properly insulated standard wall assembly will approximate the insulation R-value less 10%	Reasonable assumptions: Un-insulated wall assembly: R-3 Ceiling with no attic floor: R-1 Ceiling with an attic floor: R-2
Mechanical	
Combustion appliance output Btuh = 1.08 x CFM x ΔT	Combustion appliance CFM CFM = Btuh output (Input x efficiency) / 1.08 x ΔT
Clocking a gas meter (1 revolution) Btuh = (3600/1 rev secs) x dial size x Btu per cu. Ft.	Clocking a gas meter (2 cubic feet) Btuh = (7200/seconds) x Btu per cu. Ft.
Combustion air (standard method - .4 ach) Required volume = total Btuh / 20	
Combustion air (KAIR method) (Draft hood) Required volume = (21/ach) x (Input/1000)	Combustion air (KAIR method) (Fan-assisted) Required volume = (15/ach) x (Input/1000)
Minimum duct size requirements: Low efficiency (draft hood): $2^{sq.in.}$ / 1000 Btuh input Mid efficiency (80%): $2.5^{sq.in.}$ / 1000 Btuh input High efficiency (90%): $3^{sq.in.}$ / 1000 Btuh input	SSE (NEAT) /AFUE (MHEA) calculations NEAT: measured SSE or nameplate eff x .8 / .95 MHEA: measured SSE or nameplate eff x.8 (draft hood only – low eff MH units)
CFM flow (exhaust fans) CFM = sq. root of the ΔP x Area (In Pa and sq. in.)	Velocity to CFM CFM = A (sq. ft.) x V (fpm)
Electricity	
Ohm’s law for resistive circuits E (volts) = I (amps) x R (resistance) I = E/R R = E/I	To calculate Watts for resistive circuits W = I x E I = P/E E = P/I
Electric Heat CFM CFM = Btuh output (E x I x 3.414) / 1.08 x ΔT	

Conversions/Definitions

BTU – amount of heat required to raise 1 lb. of water 1 degree F	Watt = 3.414 Btu’s Kilowatt (KW) = 1,000 watts = 3,414 Btu’s
Btu content of natural gas – 1000 to 1025 average (per cu. ft. at sea level) Therm: 100,000 Btu’s (approx. 100 cu. ft.)	
Btu content of propane – approximately 96,000 per gallon	Btu content of # 2 heating oil – approximately 140,000 per gallon
Fahrenheit to Celsius: C = (F – 32) / 1.8	Celsius to Fahrenheit: F = (1.8 x C) + 32
Pascals to Inches of water column: Pa/250	Inches of water column to Pascals: Inches x 250
1 square foot = 144 square inches	Value of Pi: π = 3.14
1 gallon of water weighs about 8.34 lbs.	1 cubic foot of water weighs about 62.4 lbs.
A/C – 1 “ton” = 12,000 Btu/hr.	Air flow – Heat pump or A/C = 400 cfm/ton min