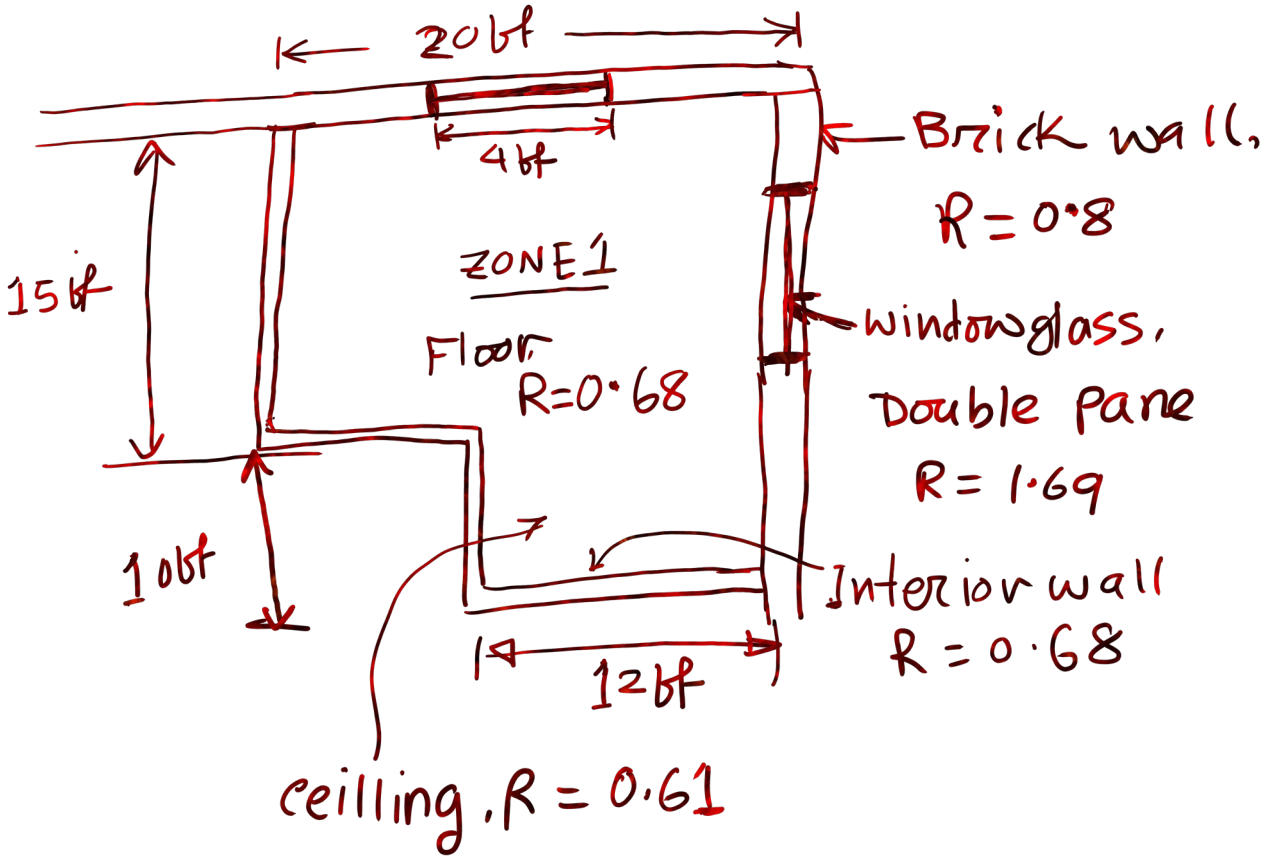
Simple cooling load calculation

This sample calculation will guide on calculating cooling load of a zone or a room and based on the load select a HVAC unit to serve the purpose of cooling.

The step-by-step process will guide you to create a spreadsheet to calculate cooling and heating loads for the whole apartment.

Simple cooling load calculation

R = Thermal Resistance = $\frac{°F * ft^2 * hr}{BTU}$



Using the information given on the Zone 1 drawing above, determine cooling Load

Step 1:- Determine overall heat transfer co-efficient U of wall and other enclosure material.

Types	R	U
wall	0·8	1·25
Floor	0·68	1·47
ceiling	0·69	1·45
window	1·69	0·59

Hint :- $U = \frac{1}{R}$, BTU/hr·Ft²·°F

Step 2:- Determine Exposed Surface area

Brick wall area = (20+25)*8 ← Height

A_{W_1} = 360 ft²

Interior wall area = (15+8+12)*8

A_{W_2} = 280 ft²

ceiling Area, A_C = (15X20 + 12X10)

= 420 ft²

Area of glass, $A_g = 2(4 \times 4) = 32\ ft^2$

Step 3:- Determination of Cooling Load Temperature Difference (CLTD).

Simply speaking $CLTD = T_o - T_i$

where, T_o = outdoor air temp.

T_i = Indoor Temp

As per ASHRAE Hand book CLTD for wall can be calculated using the following Equation

$$CLTD_{wall} = \left[CLTD + (78 - TR) + (TM - 85)\right]$$

$78 - TR$ = Indoor Design Temperature correction

$TM - 85$ = outdoor Design Temperature correction

Design conditions for New York city

out door Design Dry bulb = 96.6 F

" " " wet bulb = 76 F

TR = Indoor Design Dry bulb = 75 F

DR = Daily Range = 13.4 F

$$CLTD = 96.6 - 75 = 21.6\,F$$

$$78 - TR = 78 - 75 = 3$$

TM = Mean outdoor Temp

$$= \text{outdoor Design} - \frac{DR}{2}$$

$$= 96.6 - \frac{13.4}{2}$$

$$= 89.9$$

$$CLTD_{Wall} = CLTD + (78 - TR) + (TM - 85)$$

$$= 21.6 + 3 - (89.9 - 85)$$

$$= 19.7\,F$$

Step4. Use of Basic Equation

cooling Load through conduction, $Q = KA\frac{\Delta T}{\Delta x}$

$$= \frac{K}{\Delta x} * A * \Delta T$$

$$= U * A * CLTD$$

$$K = \frac{BTU}{hr.ft.^{\circ}F}$$

$$U = \frac{K}{\Delta x} = \frac{BTU}{hr.ft^2.^{\circ}F}$$

cooling load through outside wall

$$A_{W1} = 360\ ft^2$$

$$U = 1.2\ \frac{BTU}{hr.ft^2.^{\circ}F}$$

$$CLTD_{wall} = 19.7F$$

$$Q_{wall} = U * A_{W1} * CLTD_{Wall} = 1.2 \times 360 * 19.7$$

$$= 8510\ BTU/hr$$

Zone Analysis :- Use CLTD = 21.6 For all medium Except outside wall

Assume No heat Loss through partition wall and Floor. Assume ceiling is exposed.

medium	U	A	Q
outside wall	1.2	360	8510
~~Inside wall~~	~~1.47~~	~~280~~	~~8890~~
~~Floor~~	~~1.47~~	~~480~~	~~15240~~
ceiling	1.45	420	13154
window	0.59	40	590

Total = 22254 BTU/hr

∴ select a 25000 BTU unit For cooling the zone.

consider ventillation due to occupant only. Two components of ventillation

① sensible heat

Recommended 20 c.fm. per person

1b total occupant 5

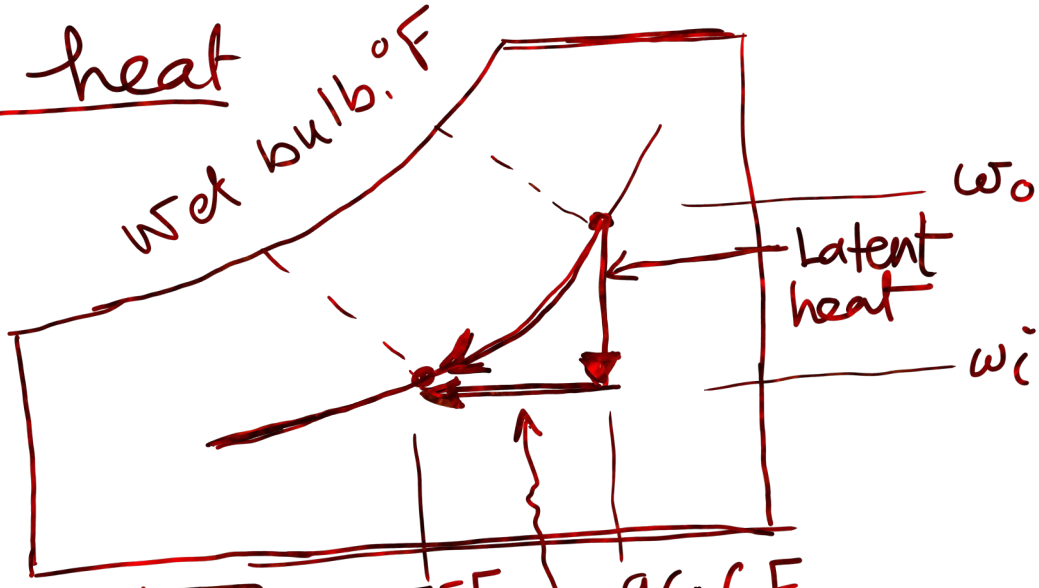
then total air = 100 cfm

$\therefore$ $Q_{sensible} = 1.08 * CFM * \Delta T$

$= 1.08 * 100 * 21.6$

$= 2332$ BTU/hr

② Latent heat



psychrometric chart

$$Q_{Latent} = 4840 * CFM * \Delta W$$

$$= 4840 * CFM * (w_o - w_i)$$

$$= 4840 * 100 * 0.005$$

$$= 2420 \text{ BTU/hr}$$

$w_o = 0.015$

$w_i = 0.01$

$\Delta W = 0.005$

∴ Total cooling Load for the zone

= conduction Loss + sensible + Latent

= 22254 + 2332 + 2420

= 27000 BTU/hr.

- Next step is to use this sample calculation to create Excel spreadsheet. Use similar Equations for all other zones. Then based on the cooling/Heating Load select a commercial HVAC unit. Highlight key specifications of those units.