BUILDINGENERGY BOSTON

Learn to Create Your Own Manual J Energy Model

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Curated by Joytika Bhargo (CMTA) and
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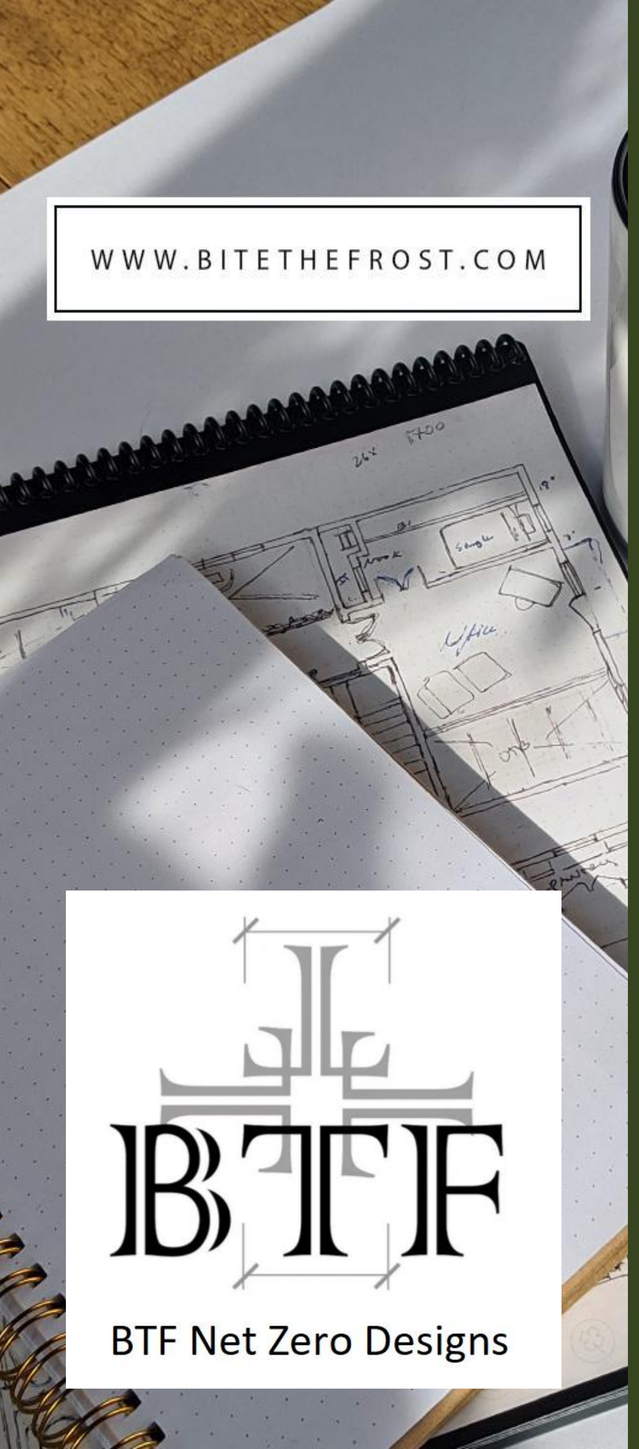
Northeast Sustainable Energy Association (NESEA) | March 19, 2024



Intro Definitions + Thermodynamics

Part 01 Geometry Visualizing the Envelope

Part 02 GATHER Data

Part 03 INPUT Data into Model

+Reading Reports

- Already an essential design tool, energy models are used for:
    - Code compliance,
    - Utility incentives
    - Green building certifications
    - Tax rebates
    - Accurately sizing HVAC equipment

- This technical presentation will provide the tools and training participants need in order to create energy models “in-house.”

- This presentation is applicable for all types of construction: New, Retrofit, Commercial & residential

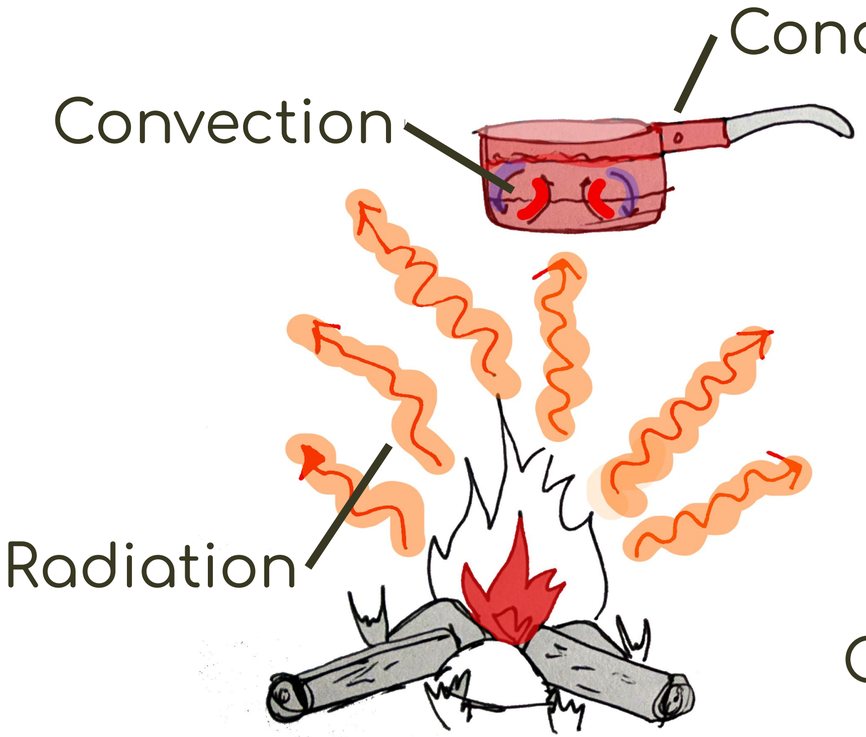
- This presentation is applicable to many modeling softwares

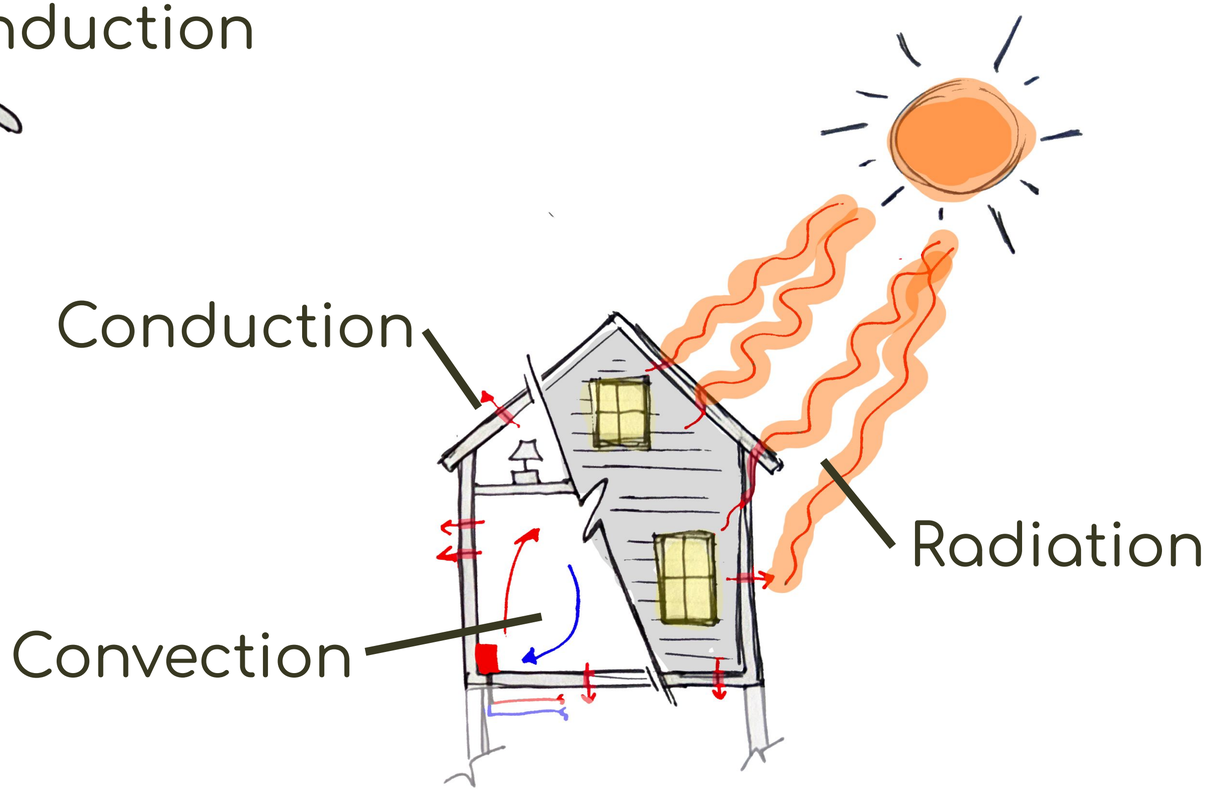
Definitions

Intro

Definitions +
Thermodynamics

Heat Transfer

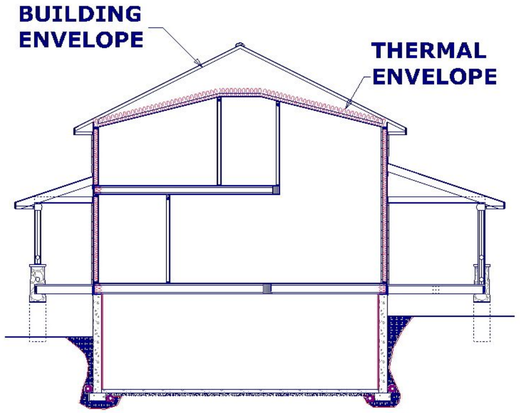


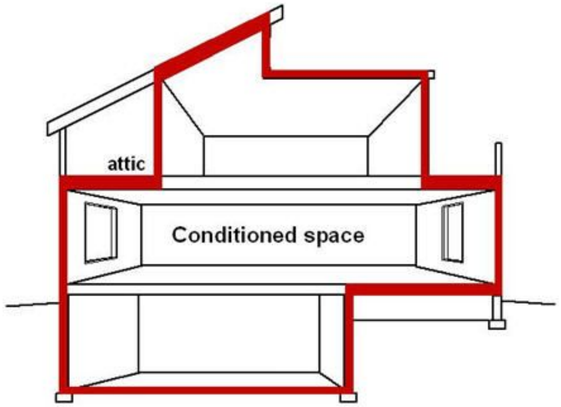


Intro

Basics + Definitions

- Thermal Boundary / Envelope
- Conditioned space
- Ambient = Outdoor Air
- Square Footage SF / Floor Area
- Cubic Volume
- ACH - Air Changes Per Hour





Perimeter, Area & Volume

(L+L+W+W)

(LxW)

(LxWxH)

L = Length

W = Width

H = Height

Intro

Definitions + Thermodynamics

- BTU/ BTUh
- Ton(s) Cooling

  note: 1 Ton cooling = 12,000btuh

- R-Value / U-value
- SHGC=Solar heat gain coefficient

  note: SHGC 0.39 = 39% of the solar energy is transferred via radiation

- Heat Flow / Heat loss

Second Law of Thermodynamics:

Simplified -

Heat flows from hot to cold,

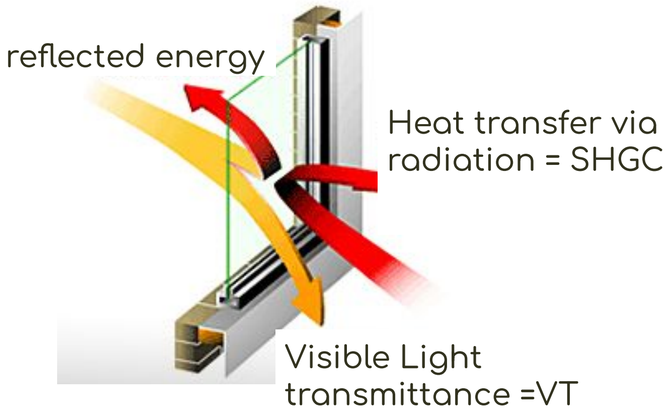
Moisture flows from Humid to Dry

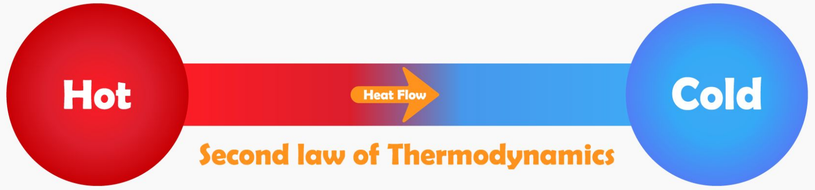
Pressure flows High to Low

$$U = \frac{1}{\text{R-value}}$$

Heat loss through a material

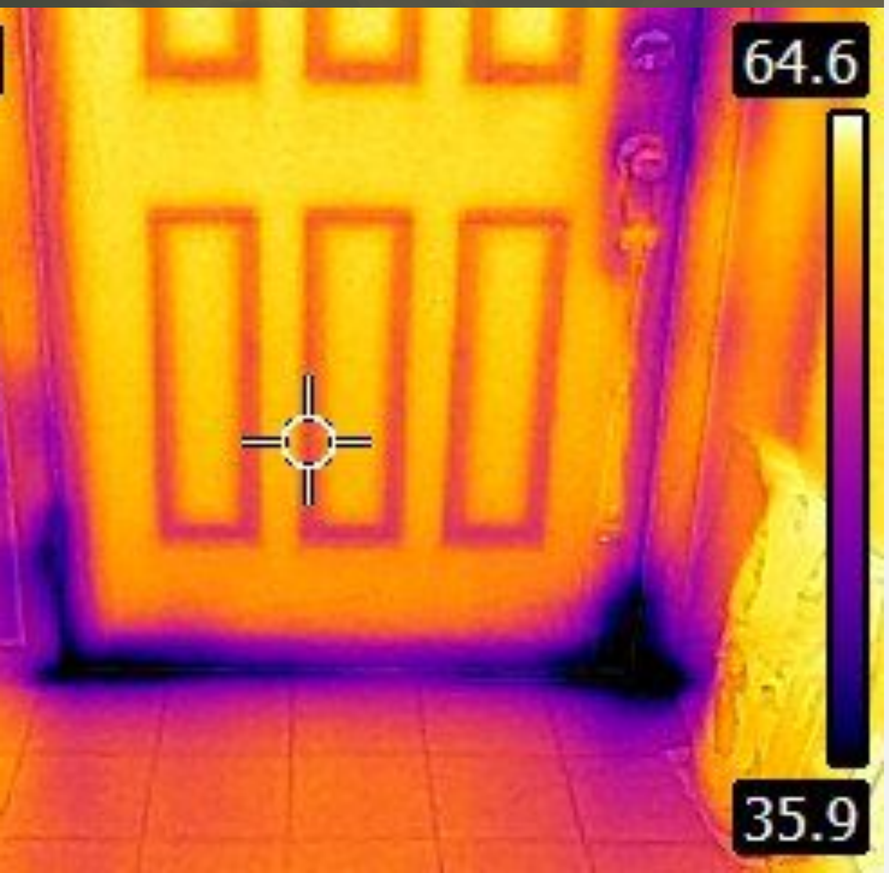
Resistance to heat flow





Intro

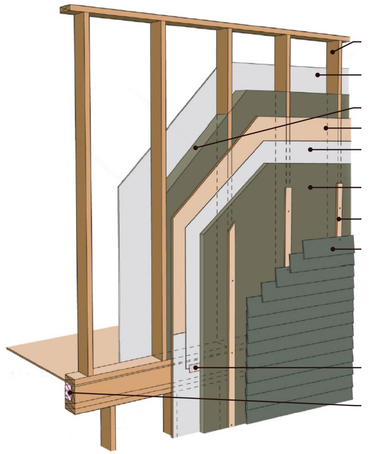
Definitions + Thermodynamics

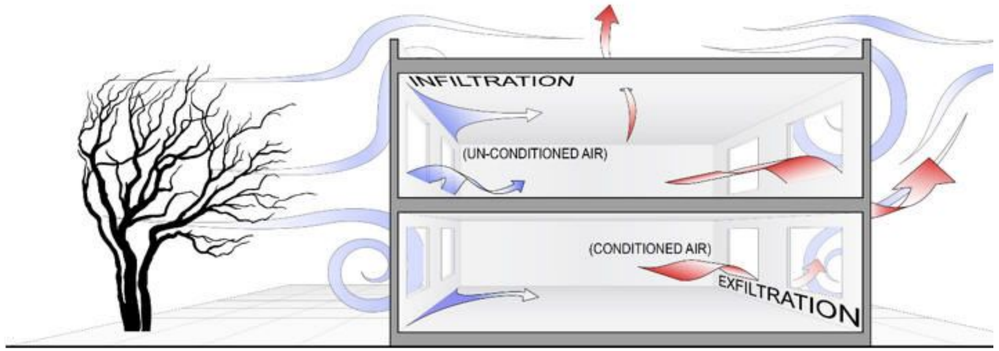


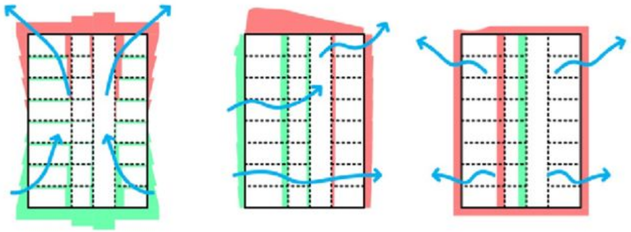
- **Building Assembly**
- **Infiltration**

  Air that enters the building through the assembly
- **Exfiltration**

  Air that leaves the building through the assembly
- **Leakage**
- **Air Sealing**





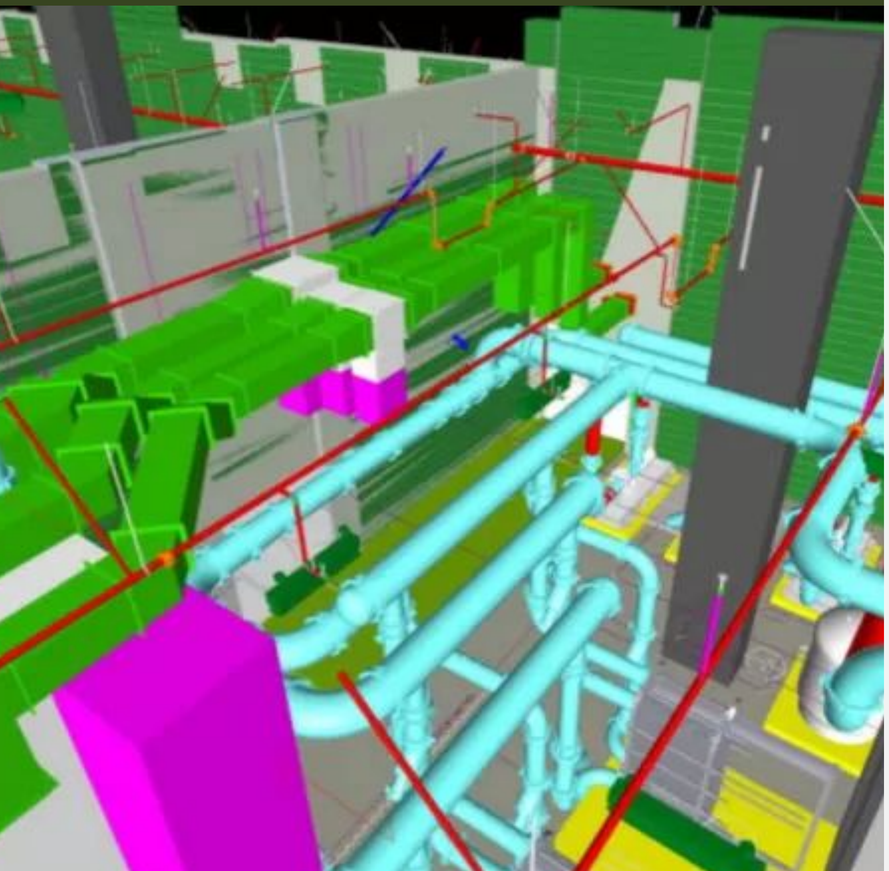


Stack Effect | Wind Effect | Mechanical Ventilation

Heat flows from hot to cold,
Moisture flows from Humid to Dry
Pressure flows High to Low

What types of Energy Modeling are there?

Types of Energy Modeling



BIM vs BEM

Building Information Modeling
Building Energy Modeling

Hydrothermal

Modeling the movement of heat & moisture through an assembly

Energy Use

Modeling $$$ - projected operation costs & consumption w/ local utility rates or even full life cycle analysis

Energy Loads

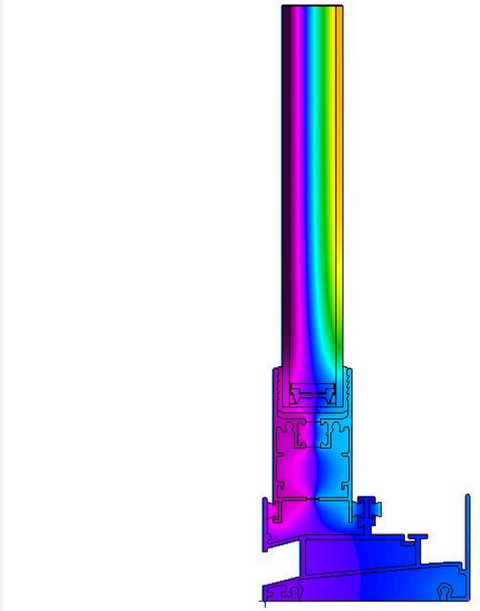
Modeling the projected heating & cooling loads of a building

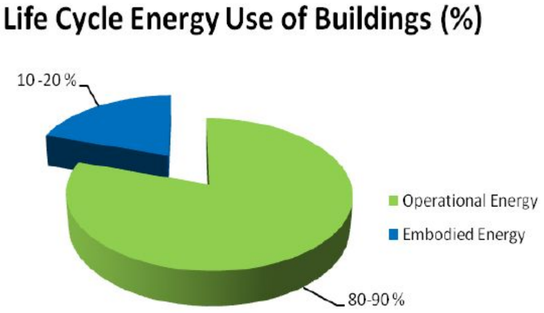
ie. Block Loads:
Modeling the whole building as one zone/area

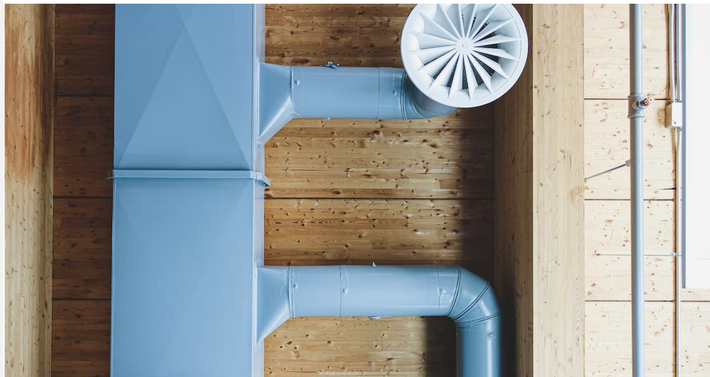
ie. 8760 Loads:
Modeling each room within a building, with results projecting the loads 24hrs a day, times 365 days a year. *Note: 24 x 365 = 8760 hours*

Electrical Modeling

Power-system modeling
Lighting modeling







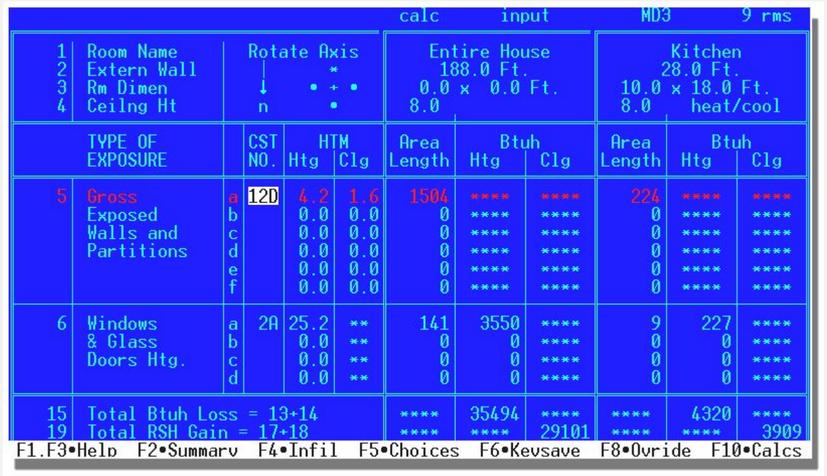
A Little History

What is Manual J?

Developed by ACCA - Air Conditioning Contractors of America

100s of pages of tables, calculations, building sections, weather data, multipliers, building materials etc.

Back in 1985 Wrightsoft was developed, by Bill Wright - the first software that created energy models following the Manual J load calculations.



Luckily - today there are dozens of softwares available that make Manual J energy models quick and easy!

ACCA made other manuals too, such as Manual S: Equipment Selection, Manual T: Air Distribution Basics, Manual D: Residential Duct Systems etc.

~~*Intro* Definitions + Thermodynamics~~

Part 01 Geometry Visualizing the Envelope

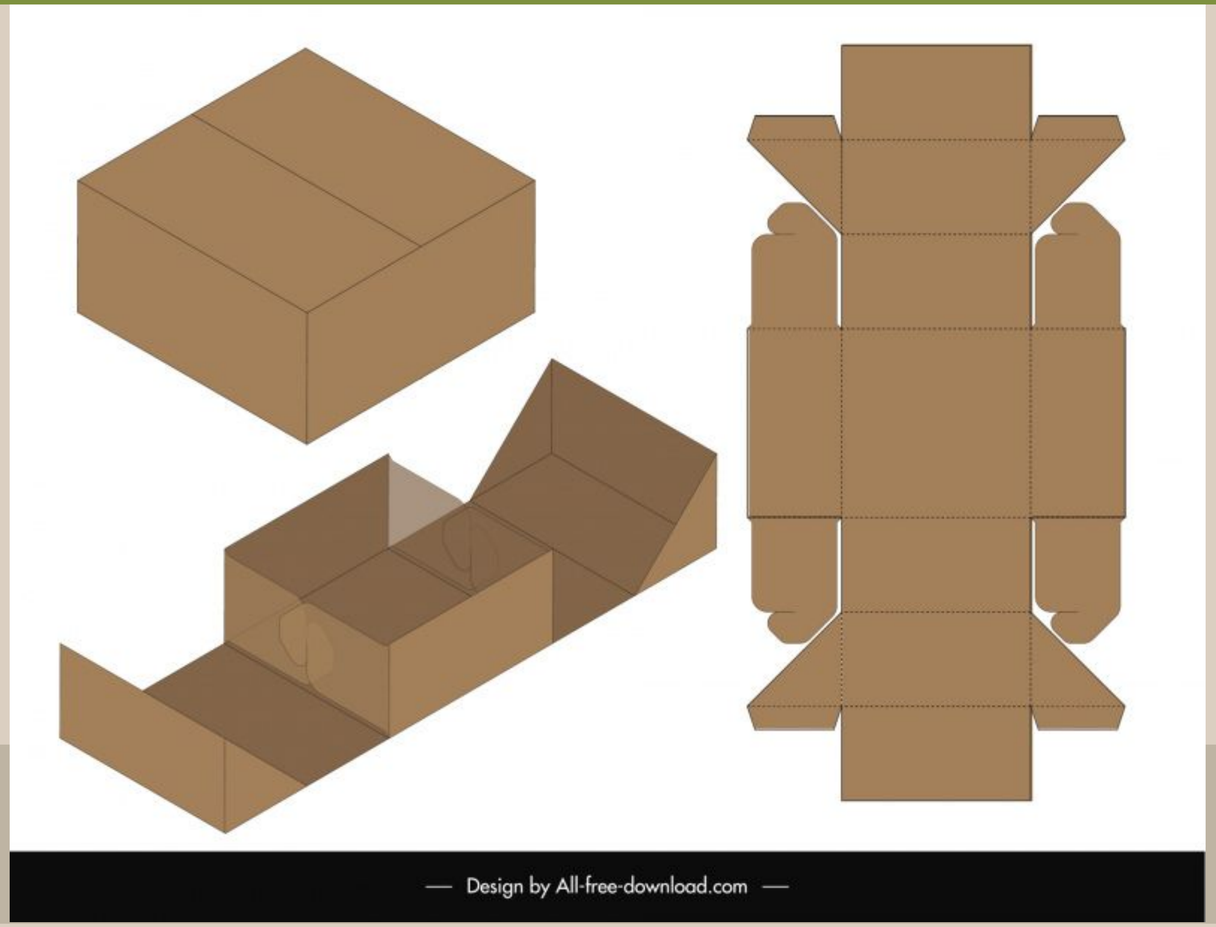
Part 02 GATHER Data

Part 03 INPUT Data into Model

Part 01

THERMODYNAMICS + Geometry

GEOMETRY



3000 SF HOME COMPARISON OF OPTIONS A,B &C

OPTION A

MODERN CRAFTSMAN
STYLE HOME

OPTION B

HISTORICAL CAPE
STYLE HOME

OPTION C

CLASSIC COLONIAL
STYLE HOME

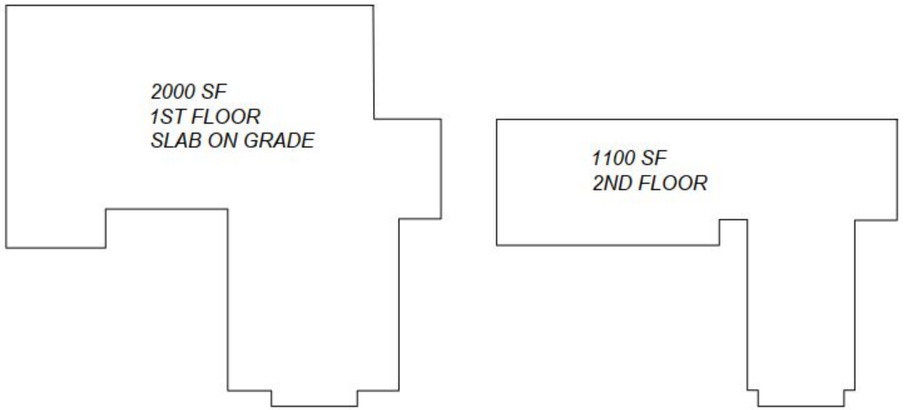
3000 SF HOME COMPARISON - HOME STYLE A

FOUNDATION: ***2000 SF***

WALLS: ***2800 SF***

ROOF: ***3200 SF***

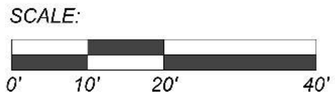
SEAMS: ***1080 LF***

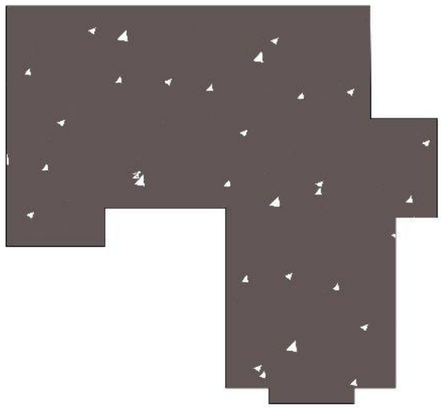


SCALE:

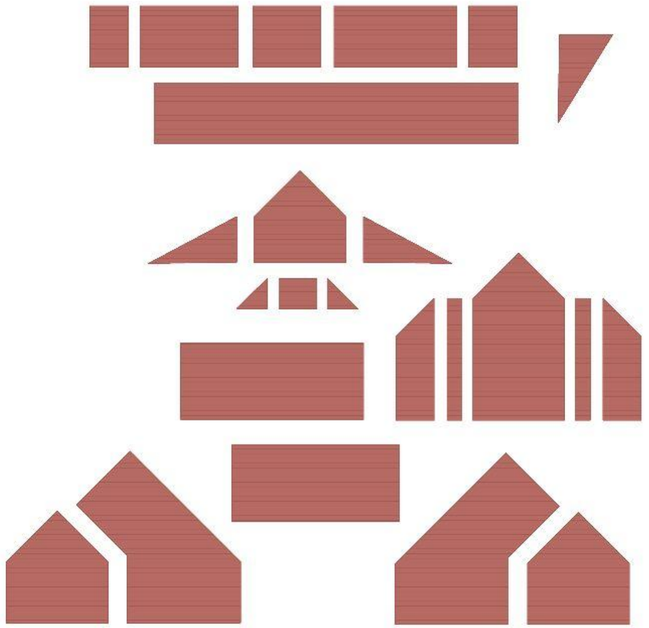
0' 10' 20' 40'

SURFACE AREA: HOME STYLE A

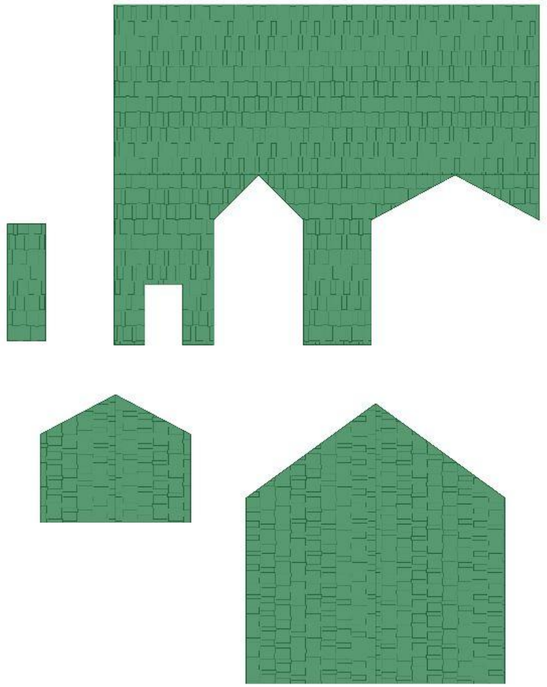




FOUNDATION: 2000 SF



WALLS: 2790 SF



ROOF: 3190 SF

SEAMS: 1080 LF

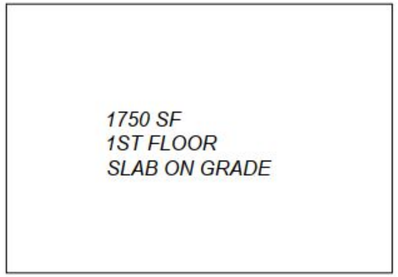
3000 SF HOME COMPARISON - HOME STYLE B

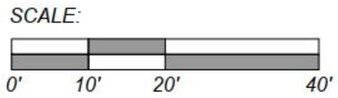
FOUNDATION: ***1750 SF***

WALLS: ***1600 SF***

ROOF: ***2500 SF***

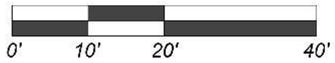
SEAMS: ***410 LF***

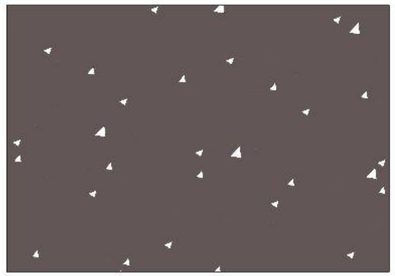




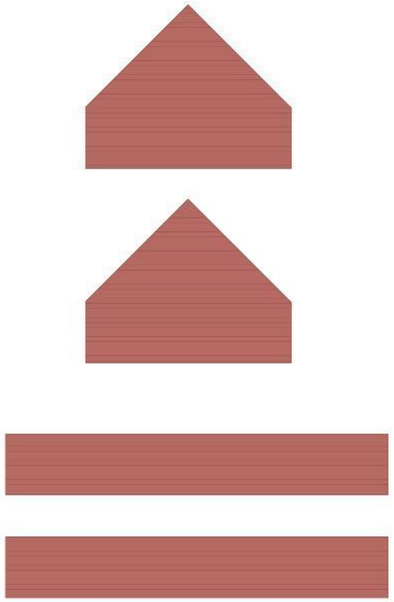
SURFACE AREA: HOME STYLE B

SCALE:

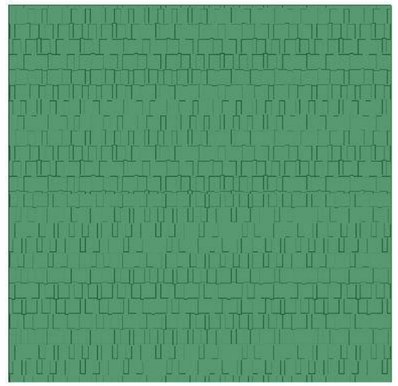




FOUNDATION: 1750 SF



WALLS: 1600 SF



ROOF: 2480 SF

SEAMS: 410 LF

3000 SF HOME COMPARISON - HOME STYLE C

FOUNDATION: ***1150 SF***

WALLS: ***2700 SF***

ROOF. ***1600 SF***

SEAMS: ***400 LF***

SCALE:

0' 10' 20' 40'

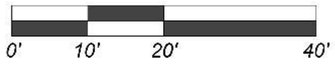
1150 SF
1ST FLOOR
SLAB ON GRADE

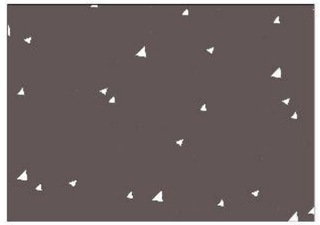
1150 SF
2ND FLOOR

850 SF
3RD FLOOR

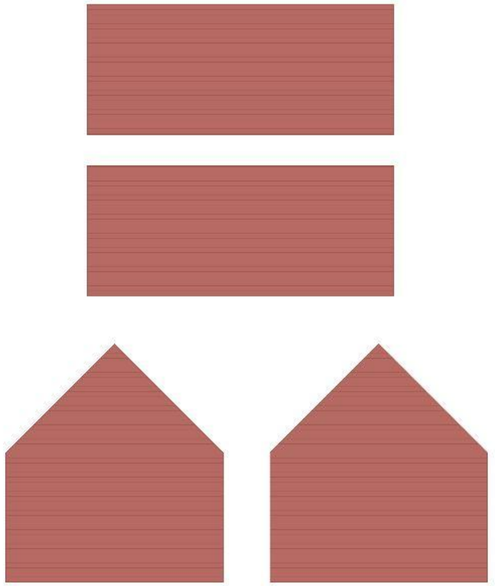
SURFACE AREA: HOME STYLE C

SCALE:

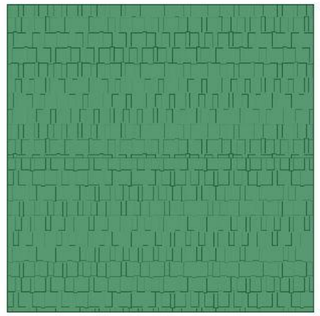




FOUNDATION: 1150 SF



WALLS: 2720 SF



ROOF: 1620 SF

SEAMS: 400 LF

3000 SF HOME COMPARISON OF OPTIONS A,B &C

TOTAL SURFACE AREA:

8,000 SF

Seams: 1080 LF

TOTAL SURFACE AREA:

5,800 SF

28% LESS

Seams: 410 LF

TOTAL SURFACE AREA:

5,500 SF

32% LESS

Seams: 400 LF

Outdated Methods

Rules of thumb = An inaccurate & outdated

~~Old rules of thumb:~~
~~25 BTU / SF heating~~
~~400 SF / Ton cooing~~

Two home Example: 1440 SF vs 1475 SF

Exact same:

- Climate
- Window types
- Internal gains
- Thermostats
- Envelope materials
- Foundation type
- etc.

Heating Demand:

<u>12 btu/sf</u>

Cooling Demand:

<u>1 Ton</u>

What's the difference between these two homes?

Only the exterior surface area & window/door locations differs

Heating Demand:

<u>20 btu/sf</u>

Cooling Demand:

<u>2 Tons</u>

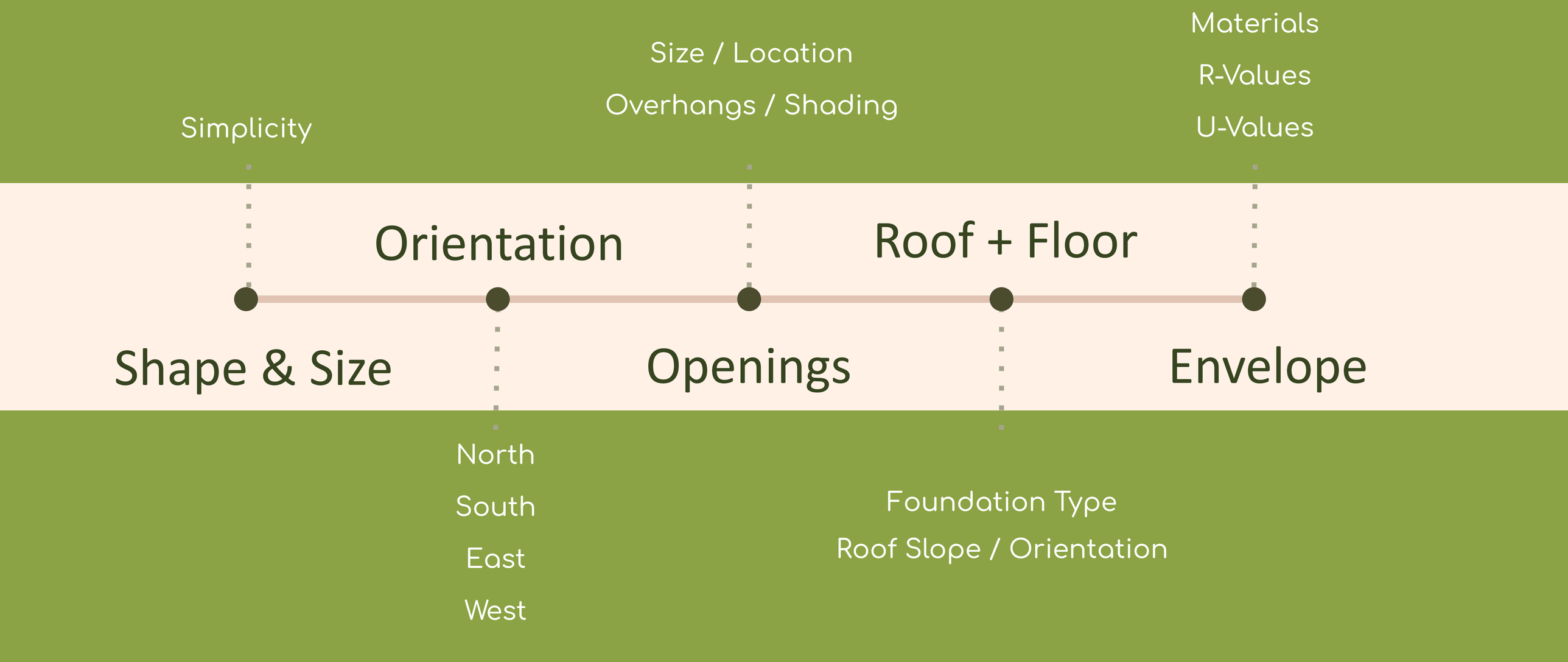
~~*Intro* Definitions + Thermodynamics~~

~~*Part 01* Geometry Visualizing the Envelope~~

Part 02 GATHER Data

Part 03 INPUT Data into Model

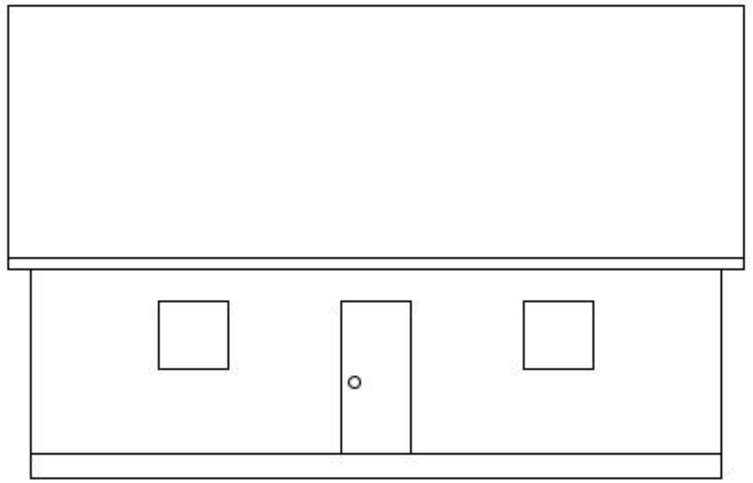
Part 02 GATHER Data

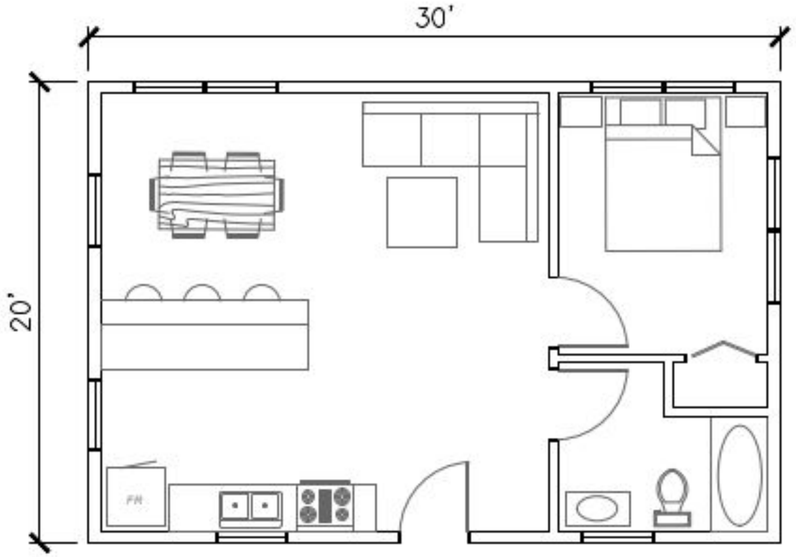


Part 02 GATHER

Example

1 bedroom
600 sf cottage
slab on grade





NORTH

Modeling Steps Outlined

Gather Data

1. *Separating Building Areas*
2. *Create Room Table*
3. *Orientation*
4. *Wall Geometry*
5. *Window & Door Openings*
6. *Roof Geometry*
7. *Floors/ Foundation Geometry*
8. *Foundation Assembly/Assemblies*
9. *Wall Assembly/Assemblies*
10. *Roof Assembly/Assemblies*
11. *Window U-value(s) & SHGC(s)*

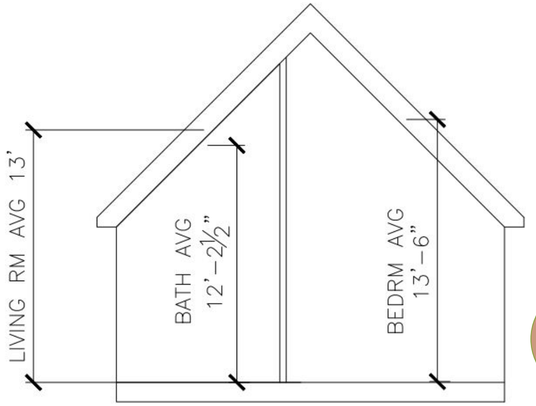
INPUT Data into Model

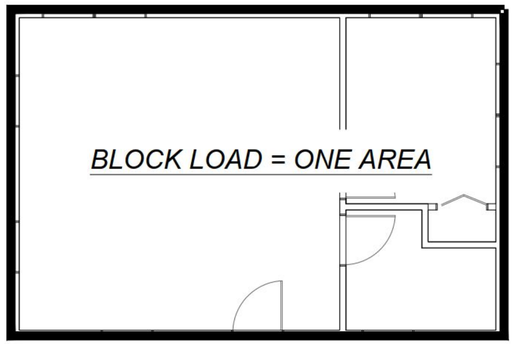
12. *Select Climate*
13. *Assemblies / Templates*
14. *Build Areas*
15. *Infiltration*
16. *Internal Gains*

Generate Reports

✓ *Generate Systems/ Reports*

Shape





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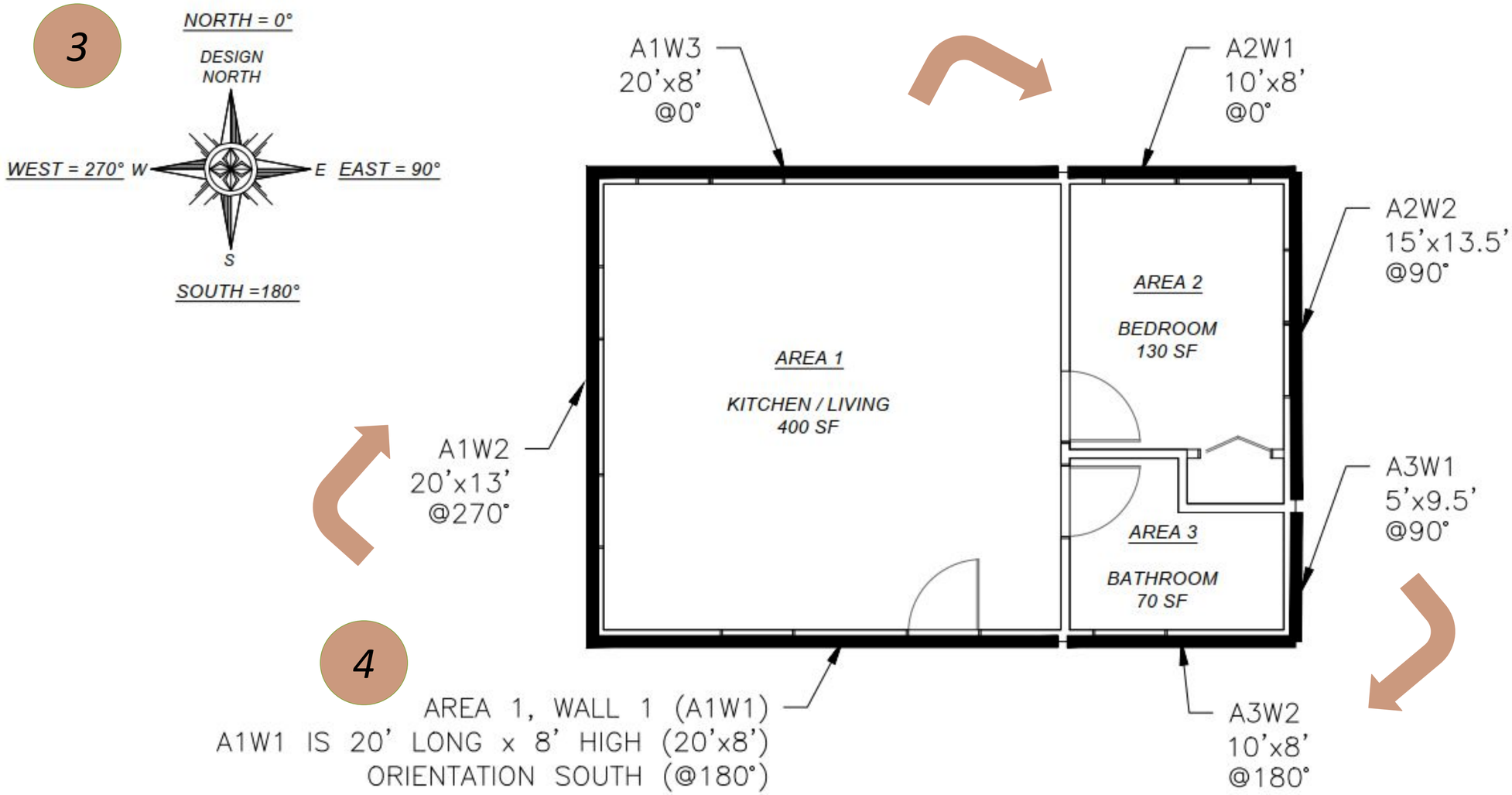
ROOM TABLE:

AREA	DESCRIPTION	SF	AVG. CEILING HEIGHT	MISC. NOTES + INTERNAL GAINS
1	KITCHEN/LIVING	400	13'	TYPICAL KITCHEN GAINS
2	BEDROOM	130	13.5'	TYPICAL HOME GAINS
3	BATHROOM	70	12'	TYPICAL BATHROOM GAINS
	SF CHECK	600 SF		

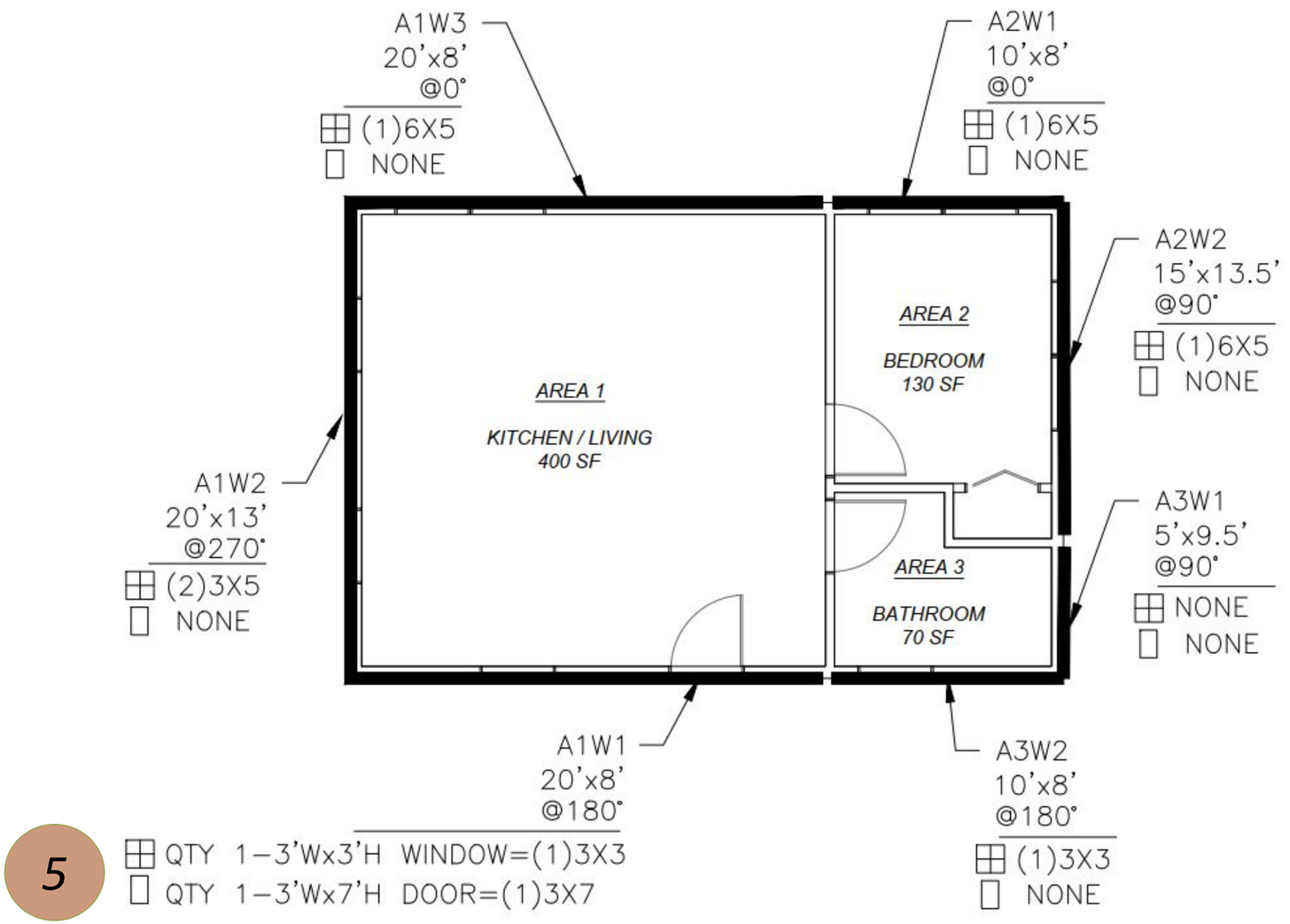
~~Shape~~
Size & Orientation
Openings
Roof + Floor
Envelope

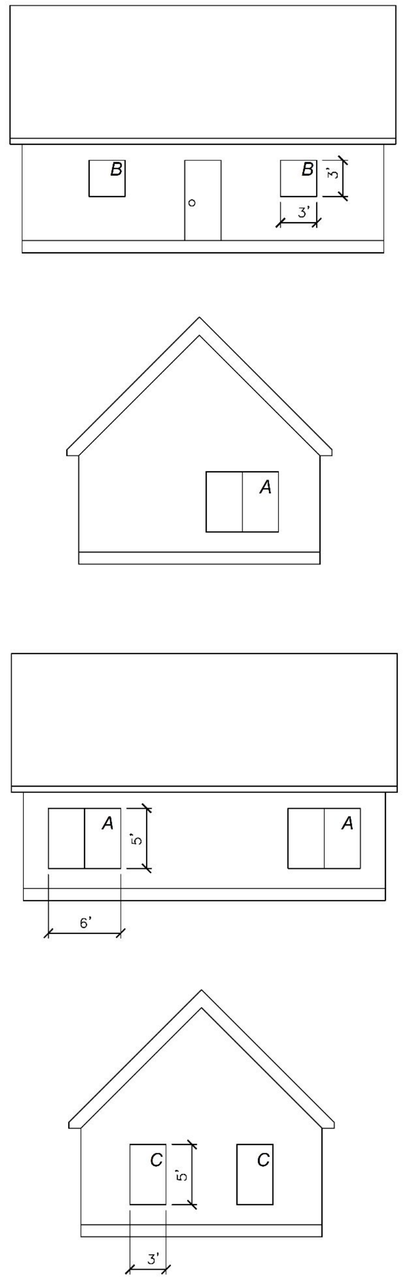
Part 02 GATHER

Size & Orientation



Openings


A1W3
20'x8'
@0°
(1)6X5
NONE
A2W1
10'x8'
@0°
(1)6X5
NONE
A2W2
15'x13.5'
@90°
(1)6X5
NONE
AREA 1
KITCHEN / LIVING
400 SF
AREA 2
BEDROOM
130 SF
AREA 3
BATHROOM
70 SF
A1W2
20'x13'
@270°
(2)3X5
NONE
A3W1
5'x9.5'
@90°
NONE
NONE
A1W1
20'x8'
@180°
QTY 1-3'Wx3'H WINDOW=(1)3X3
QTY 1-3'Wx7'H DOOR=(1)3X7
A3W2
10'x8'
@180°
(1)3X3
NONE

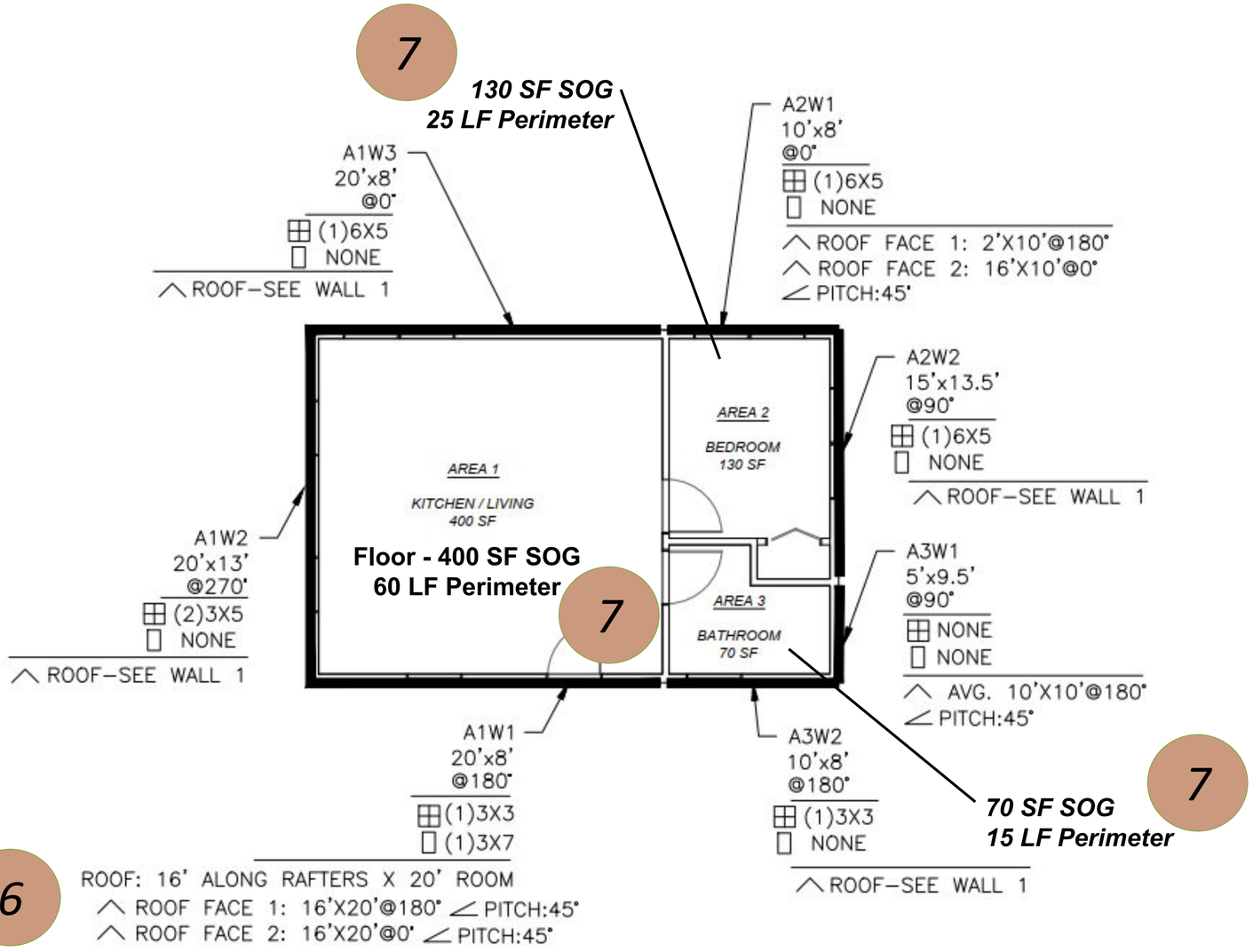

B
B
3'
3'
A
A
A
5'
6'
C
C
5'
3'

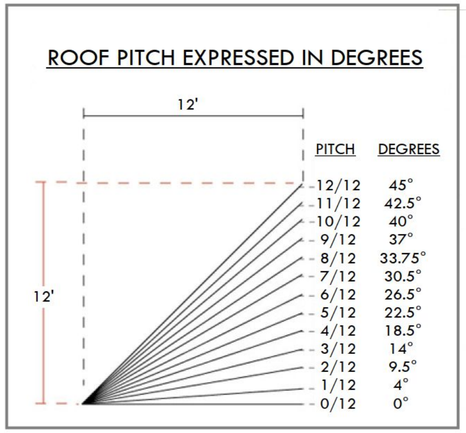
5

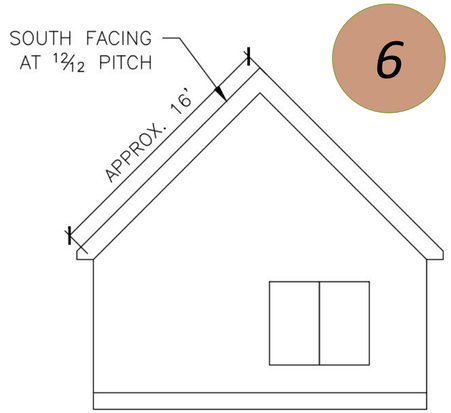
~~Shape~~
~~Size & Orientation~~
~~Openings~~
Roof + Floor
Envelope

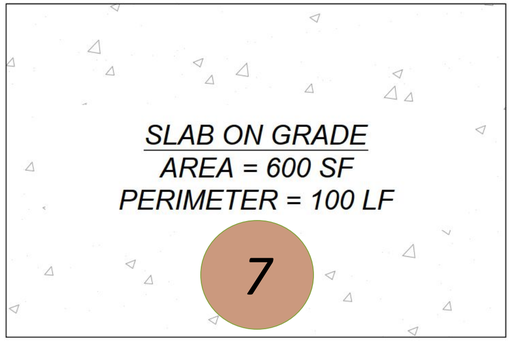
Part 02 GATHER

Roof +Floor







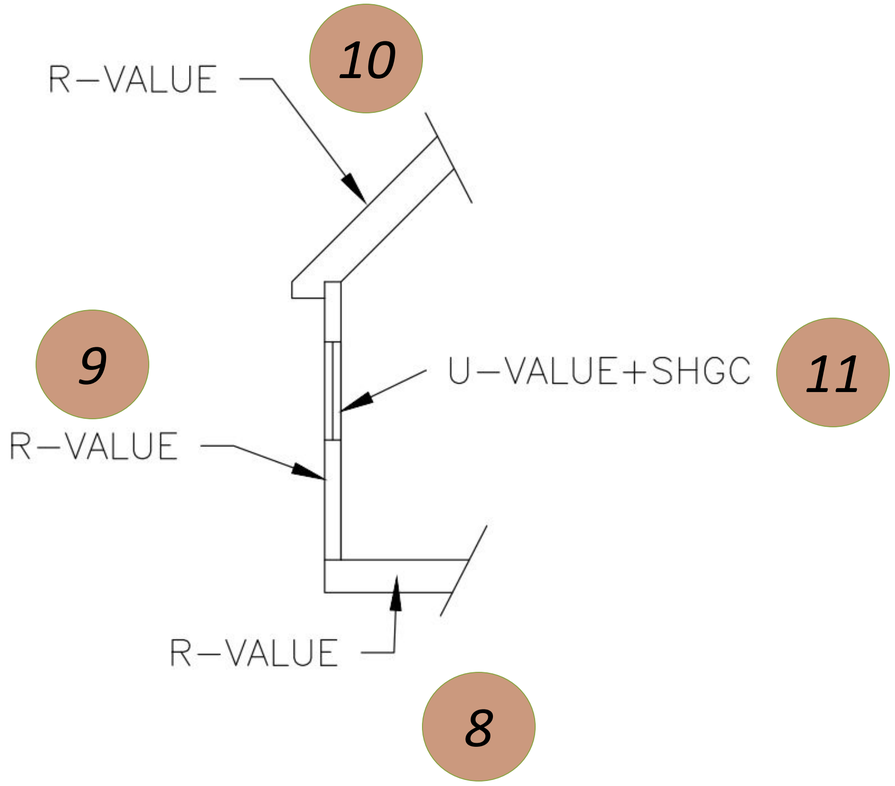


F-FACTOR

~~Shape~~
~~Size & Orientation~~
~~Openings~~
~~Roof + Floor~~
Envelope

Part 02 GATHER

Envelope



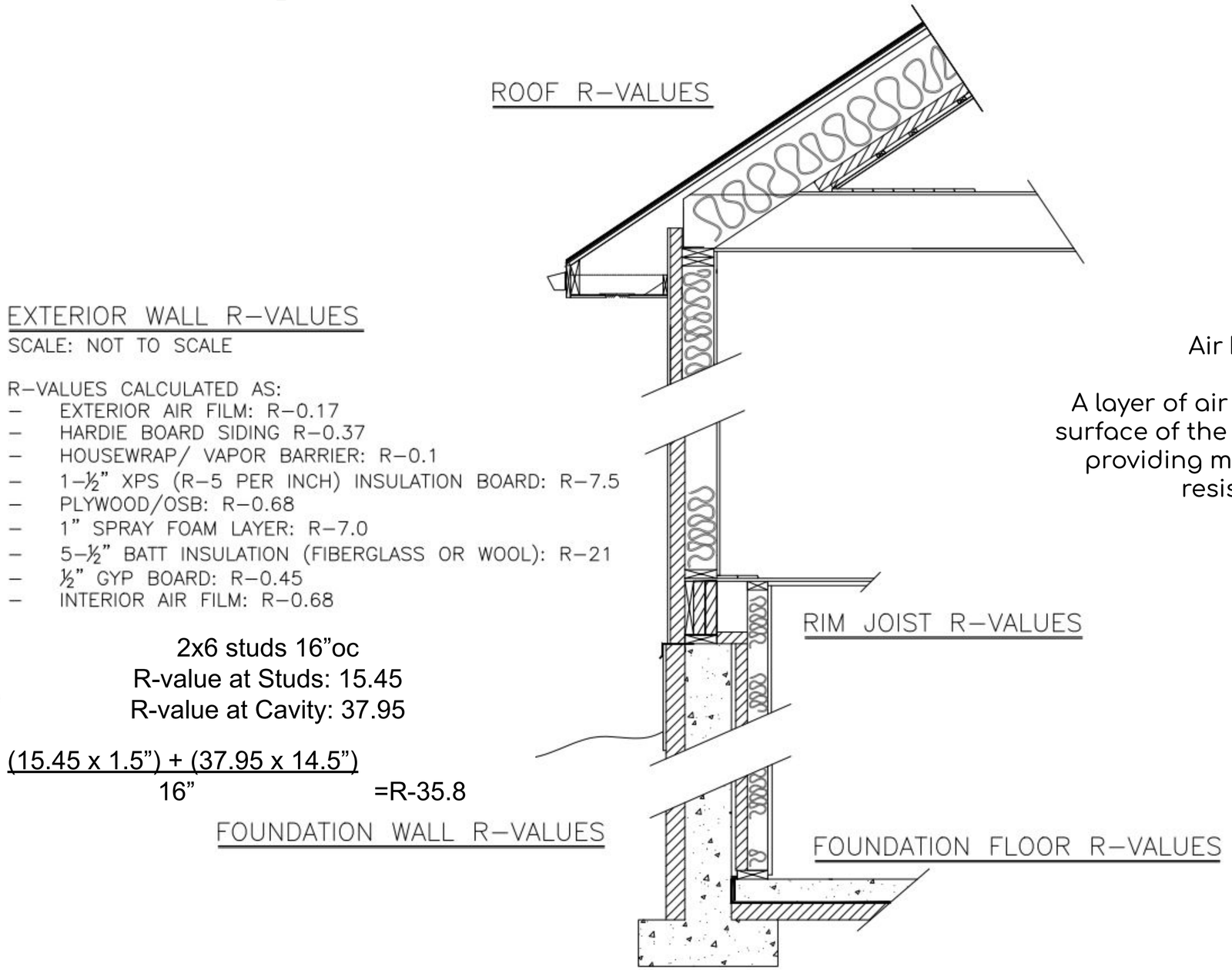
$$Q = UA\,\Delta T$$

where
Q is the heat flow rate [W]
A is the heat flow area [m^2]
U is the overall heat transfer coefficient [$W.m^{-2}.K$]
ΔT is the temperature difference [K]

~~Shape~~
~~Size & Orientation~~
~~Openings~~
~~Roof + Floor~~
Envelope

Part 02 GATHER

Envelope Cont.



2x6 studs 16"oc
R-value at Studs: 15.45
R-value at Cavity: 37.95

$$\frac{(15.45 \times 1.5") + (37.95 \times 14.5")}{16"} = R\text{-}35.8$$

Air Films?

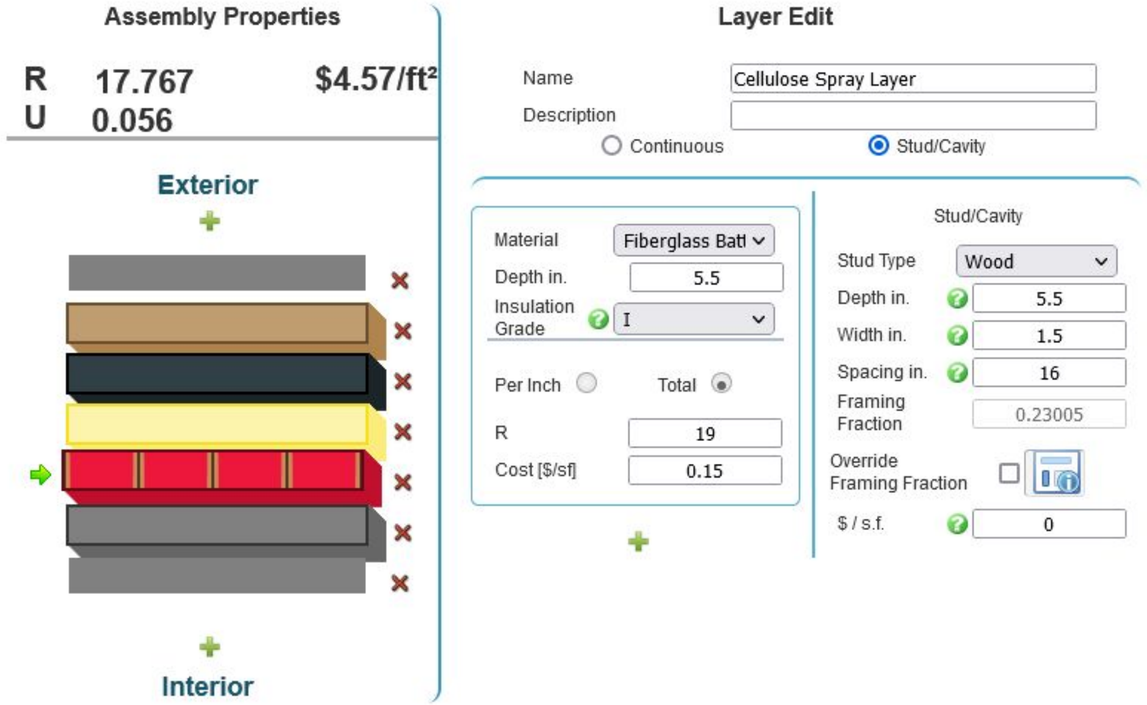
A layer of air adjacent to the surface of the building element providing minimal thermal resistance.

~~Shape~~
~~Size & Orientation~~
~~Openings~~
~~Roof + Floor~~
~~Envelope~~

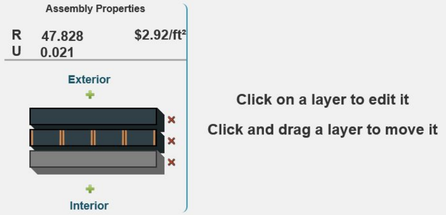
Part 02 GATHER

Envelope Cont.

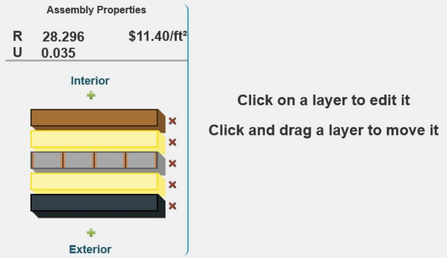
Wall Calculator



Roof Calculator



Floor Calculator



~~*Intro* Definitions + Thermodynamics~~

~~*Part 01* Geometry Visualizing the Envelope~~

~~*Part 02* GATHER Data~~

Part 03 INPUT Data into Model

Part 03

INPUT Data into Model

Part 03 Modeling

DONE!

Location

Input the envelope

Infiltration

Utility Data

Mechanical Systems (not covered today)

Walls/ Roofs /Windows

Templates

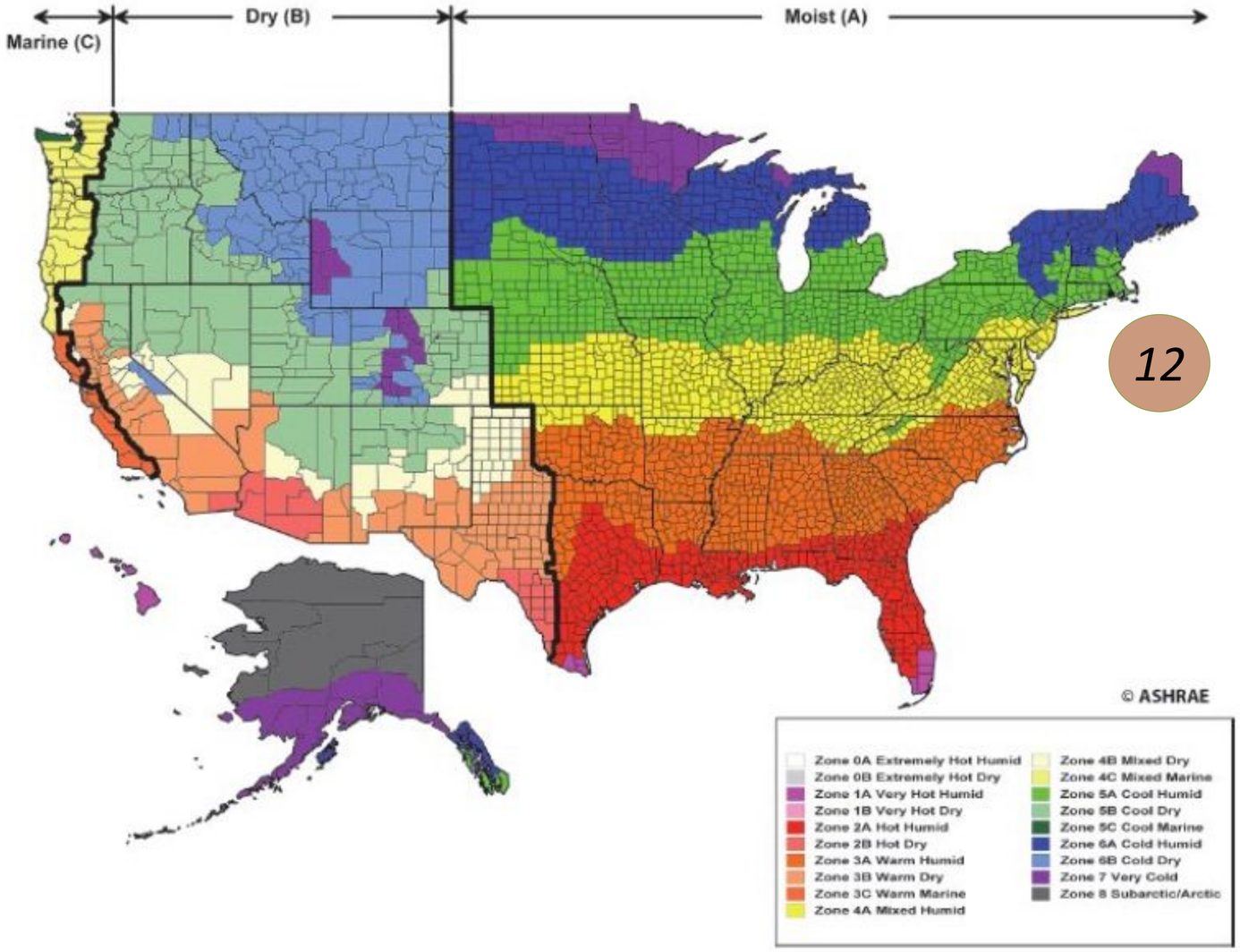
Thermostat set points

People

Lighting

Equipment

Part 03 Climate Zones + Location



12

IECC Climate Zone map is based on Heating Degree Days - Not your garden!

Weather data files used in Manual J softwares are often TMY data sets.

TMY = Typical Meteorological Year

TMY data sets represent medium weather conditions over a multi year period. These sets include and calculate median solar resource potential, wind speed, ambient temperature & more.

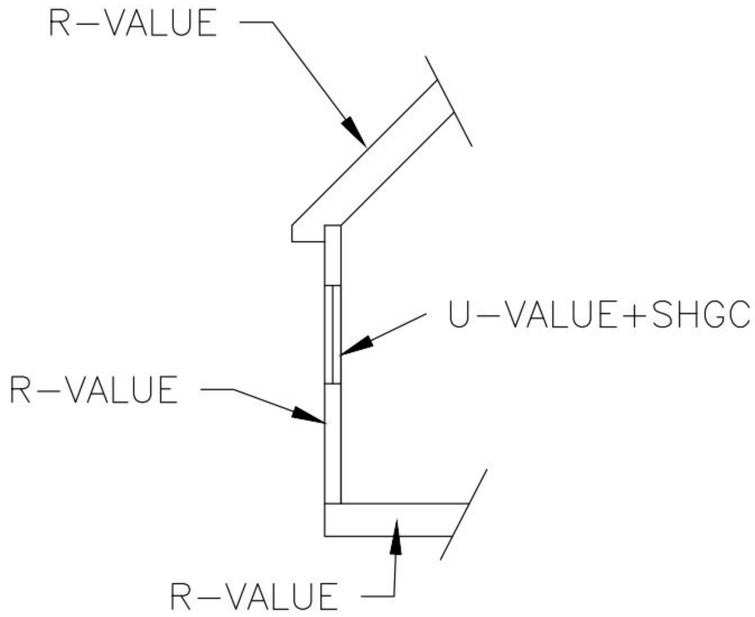
Most softwares have several data sets loaded for each State.

Part 03

Areas & Assemblies

13 *Assemblies / Templates & Thermostat Setpoints*

ie. Cathedral Ceiling Assembly
Garage Ceiling Assembly
Finished basement Assembly
Unfinished basement Assembly etc.



14

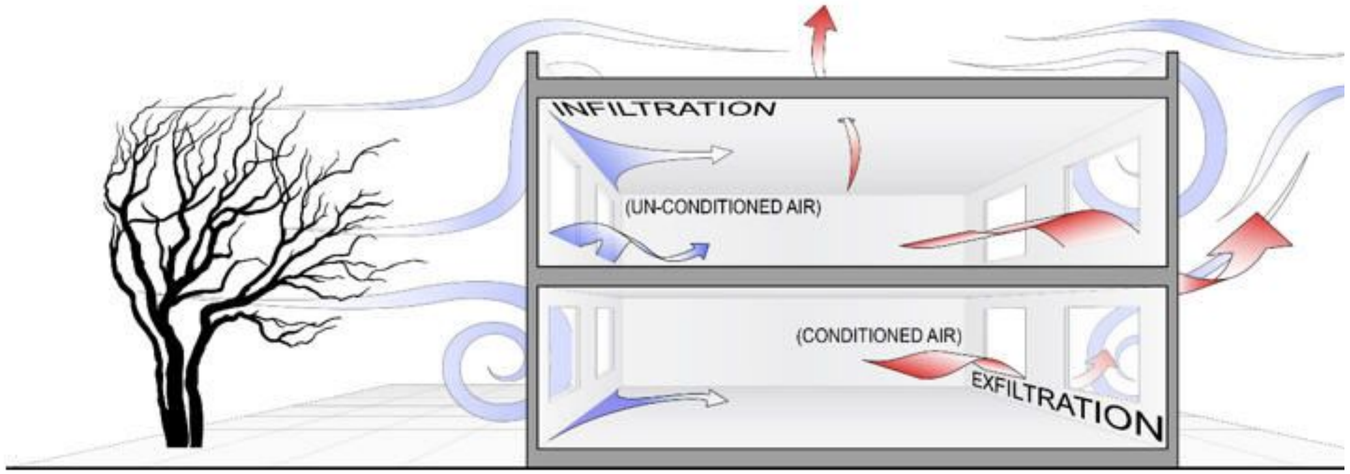
ROOM TABLE:

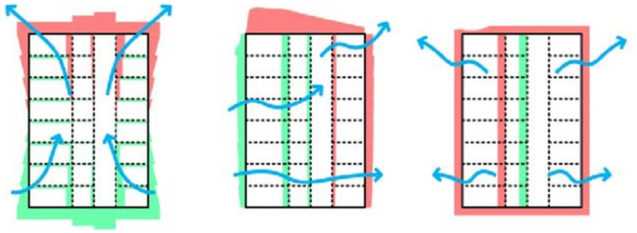
AREA	DESCRIPTION	SF	AVG. CEILING HEIGHT	MISC. NOTES + INTERNAL GAINS	INFILTRATION MODELED ?
1	KITCHEN/LIVING	400	13'	TYPICAL KITCHEN GAINS	☑
2	BEDROOM	130	13.5'	TYPICAL HOME GAINS	☑
3	BATHROOM	70	12'	TYPICAL BATHROOM GAINS	☑
	SF CHECK	600 SF			

Part 03

Infiltration

15





Stack Effect | Wind Effect | Mechanical Ventilation

Heat flows from hot to cold,
Moisture flows from Humid to Dry
Pressure flows High to Low

Part 03

Infiltration Cont.

15

Infiltration:

Air that enters the building through the assembly

- Blowerdoor / tests for leakage at ACH50
- Converting ACH50 TO ACHnat

  (ACHnat = natural flow without pressurization)
- Many modeling softwares use ACHnat
- ACH vs CFM/sf exterior surface area

Low ACH = tight construction

High ACH = loose construction

Example

Given:

Home Volume = 20'x20'x8' = 3,200 Cubic Feet

Home Surface (walls) = 640 SF

Blower Door CFM50 = 1,000 CFM

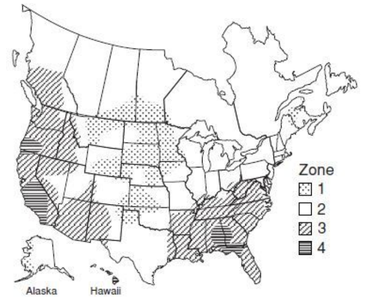
Convert: ACH50 = $\frac{\text{(CFM50 x 60 Min/hour)}}{\text{Cubic Feet Volume}}$

ACH50 = 18.75

Convert: ACHNat = $\frac{\text{ACH50}}{\text{N-Factor}}$

N-Factor Table: 18.5

ACHNat = 1.01

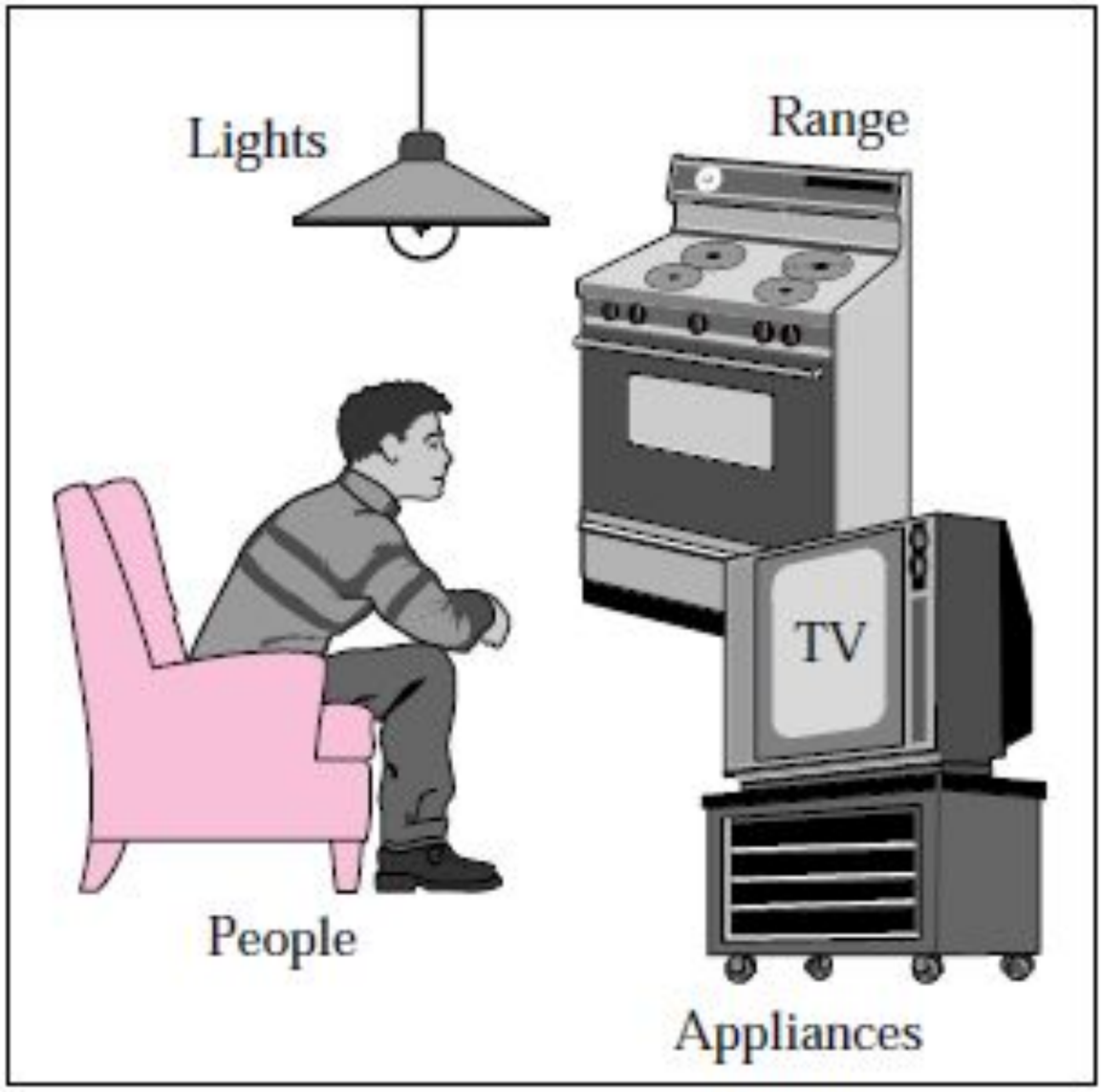


n-Factor Table

Zone	# of stories →	1	1.5	2	3
1	Well-shielded	18.6	16.7	14.9	13.0
	Normal	15.5	14.0	12.4	10.9
	Exposed	14.0	12.6	11.2	9.8
2	Well-shielded	22.2	20.0	17.8	15.5
	Normal	18.5	16.7	14.8	13.0
	Exposed	16.7	15.0	13.3	11.7
3	Well-shielded	25.8	23.2	20.6	18.1
	Normal	21.5	19.4	17.2	15.1
	Exposed	19.4	17.4	15.5	13.5
4	Well-shielded	29.4	26.5	23.5	20.6
	Normal	24.5	22.1	19.6	17.2
	Exposed	22.1	19.8	17.6	15.4

Part 03

Internal Gains



Sensible Heat Gain

How much heat does a <u>15W LED Bulb</u> give off?

10.5W of light energy
4.5W of heat energy

Note: 1 Watt = 3.41 BTU/h
ie. 4.5x3.41 = 15.3 BTU/h

Latent Heat Gain

Is the energy added to a space due to added moisture. ie

- Brewing Coffee
- Running the Shower
- Working out in the basement
- Boiling water
- etc.

<u>How much heat is released by A Human?</u>

Average human sitting releases:
215 BTU/h sensible heat
185 BTU/hr of latent heat

Average human jogging releases:
270 BTU/hr of sensible heat
580 BTU/hr of latent heat

Steps Outlined

Gather Data

1. *Separating Building Areas*
2. *Create Room Table*
3. *Orientation*
4. *Wall Geometry*
5. *Window & Door Openings*
6. *Roof Geometry*
7. *Floors/ Foundation Geometry*
8. *Foundation Assembly/Assemblies*
9. *Wall Assembly/Assemblies*
10. *Roof Assembly/Assemblies*
11. *Window U-value(s) & SHGC(s)*

INPUT Data into Model

12. *Select Climate*
13. *Assemblies / Templates*
14. *Build Areas*
15. *Infiltration*
16. *Internal Gains*

Generate Reports

✓ *Generate Systems/ Reports*

Reading Reports - What to Look For

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 23
Outside Air: OADB/WB/HR: 83 / 65 / 69

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	0	0	0	0
Glass/Door Cond	0	0	0	0
Wall Cond	3,540	0	3,540	36
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	3,540	0	3,540	36
Internal Loads				
Lights	928	232	1,160	12
People	0	0	0	0
Misc	0	0	0	0
Sub Total ==>	928	232	1,160	12
Ceiling Load	0	0	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	5,241		5,241	53
Exhaust Heat		0	0	0
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	9,709	232	9,941	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 23
OADB: 83

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	0	0
Glass/Door Cond	0	0
Wall Cond	3,540	36
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	3,540	36
Internal Loads		
Lights	928	10
People	0	0
Misc	0	0
Sub Total ==>	928	10
Ceiling Load	0	0
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	5,241	54
Grand Total ==>	9,709	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 0

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	-8,302	-8,302	85.51
Partition/Door	0	0	0.00
Floor	-1,407	-1,407	14.49
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-9,709	-9,709	100.00
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-9,709	-9,709	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.0	90.0
Ra Plenum	75.0	70.0
Return	75.5	70.0
Ret/OA	75.5	70.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	458	458
Terminal	458	458
Main Fan	458	458
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
Min Stop/Rh	0	0
Return	458	458
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.48	1.48
cfm/ton	552.93	
ft²/ton	374.21	
Btu/hr·ft²	32.07	-31.32
No. People	0	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.8	9.9	9.9	458	75.5	62.5	68.5	55.0	55.0	67.9
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.8	9.9								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	310		
Part	0		
Int Door	0		
ExFlr	40		
Roof	0	0	0
Wall	450	0	0
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-9.7	458	70.0	90.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-9.7			

Trace 700 Example

What are the common mistakes to look for in your reports and in the modeling reports of others?

Not all mistakes are going to be noticeable only significant errors are easy to spot

1. Look at the envelope loads
   If you have a roof, windows, walls are their btuh loads associated with each?
2. Are the areas reasonable?
   Is the floor area, wall area, roof etc. reasonable?
3. Are there loads associated with infiltration?
   This is an IMPORTANT & easy thing to miss & can easily double the loads
4. Are your temperatures accurate?
   Are the Peak outside air temperatures reasonable for your climate zone?

Reading Reports - What to Look For

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 85.0 °F / 69.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -14.0 °F / -14.8 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	404 ft²	9201	-	404 ft²	-	-
Wall Transmission	1073 ft²	886	-	1073 ft²	2764	-
Roof Transmission	903 ft²	1682	-	903 ft²	2439	-
Window Transmission	267 ft²	448	-	267 ft²	5602	-
Skylight Transmission	138 ft²	277	-	138 ft²	3465	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	720 ft²	150	-	720 ft²	1875	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	0 W	0	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	**12643**	**0**	-	**16144**	**0**
Zone Conditioning	-	11781	0	-	15711	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	0 CFM	0	0	0 CFM	0	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	
Duct Heat Gain / Loss	0%	0	-	0%	0	
>> Total System Loads	-	**11781**	**0**	-	**15711**	**0**
Terminal Unit Cooling	-	11781	0	-	0	0
Terminal Unit Heating	-	0	-	-	15711	-
>> Total Conditioning	-	**11781**	**0**	-	**15711**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Carrier HAP 5.11 Example - A

(Infiltration load is missing)

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400 COOLING OA DB / WB 84.4 °F / 68.8 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -14.0 °F / -14.8 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	404 ft²	9325	-	404 ft²	-	-
Wall Transmission	1073 ft²	805	-	1073 ft²	2764	-
Roof Transmission	903 ft²	1730	-	903 ft²	2439	-
Window Transmission	267 ft²	401	-	267 ft²	5602	-
Skylight Transmission	138 ft²	248	-	138 ft²	3465	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	720 ft²	134	-	720 ft²	1875	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	0 W	0	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	1332	10	-	11885	
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	**13975**	**10**	-	**28030**	**0**
Zone Conditioning	-	13159	10	-	27870	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	0 CFM	0	0	0 CFM	0	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	
>> Total System Loads	-	**13159**	**10**	-	**27870**	
Terminal Unit Cooling	-	13159	0	-	0	0
Terminal Unit Heating	-	0	-	-	27870	-
>> Total Conditioning	-	**13159**	**0**	-	**27870**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

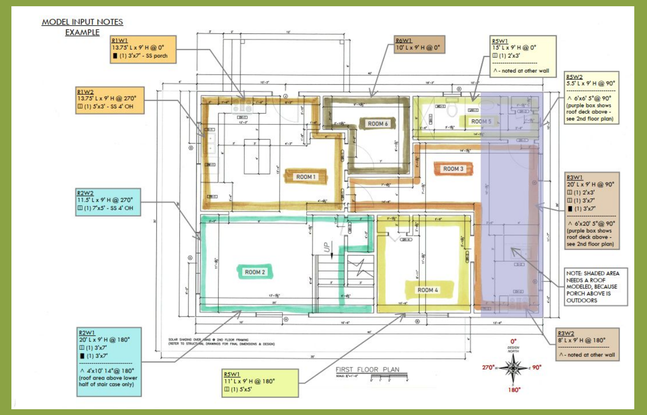
Carrier HAP 5.11 Example - B

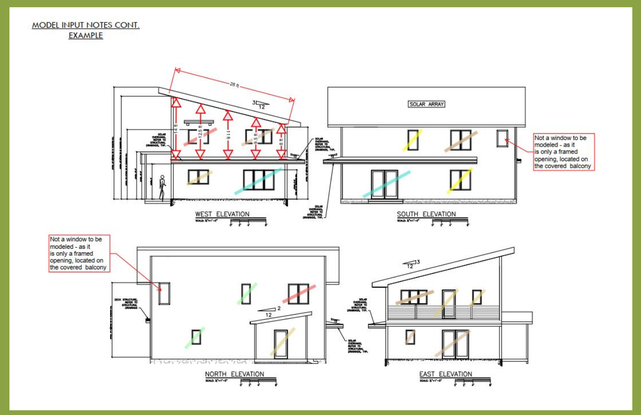
Recap & Resources

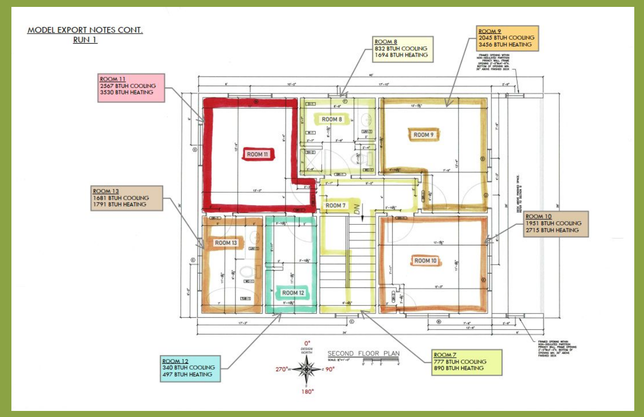
Recap

- Energy modeling = a tool for decision making.
- Not only for sizing equipment but also for shaping buildings & selecting materials.
- We must not rely on expensive high end / high R-value materials to achieve energy efficiency. They should be used to supplement architecturally efficient designs.

Resources - PDF - Email Gwen for Example PDF





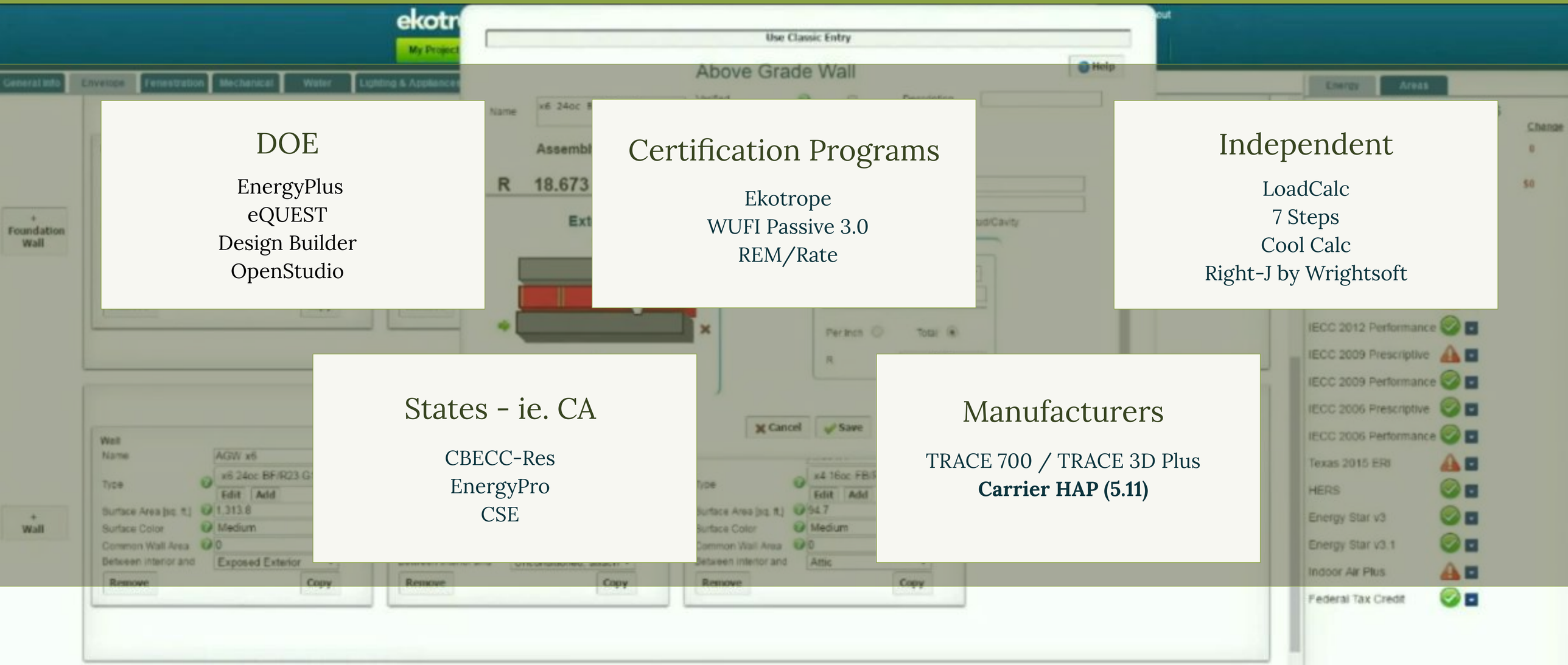


Please note:

Your first several models will likely be wildly inaccurate

In time & with practice you can use energy modeling to assist your design decisions

A Few Energy Modeling Softwares



DOE

EnergyPlus
eQUEST
Design Builder
OpenStudio

Certification Programs

Ekotrope
WUFI Passive 3.0
REM/Rate

Independent

LoadCalc
7 Steps
Cool Calc
Right-J by Wrightsoft

States - ie. CA

CBECC-Res
EnergyPro
CSE

Manufacturers

TRACE 700 / TRACE 3D Plus
Carrier HAP (5.11)

A Few Energy Modeling Softwares

Federal Tax Deduction

Qualified Softwares:

DesignBuilder

DeST

DOE-2.2

EnergyGauge

- **EnergyPlus®**
- **eQUEST**
- **Hourly Analysis Program (HAP)**

IES Virtual Environment

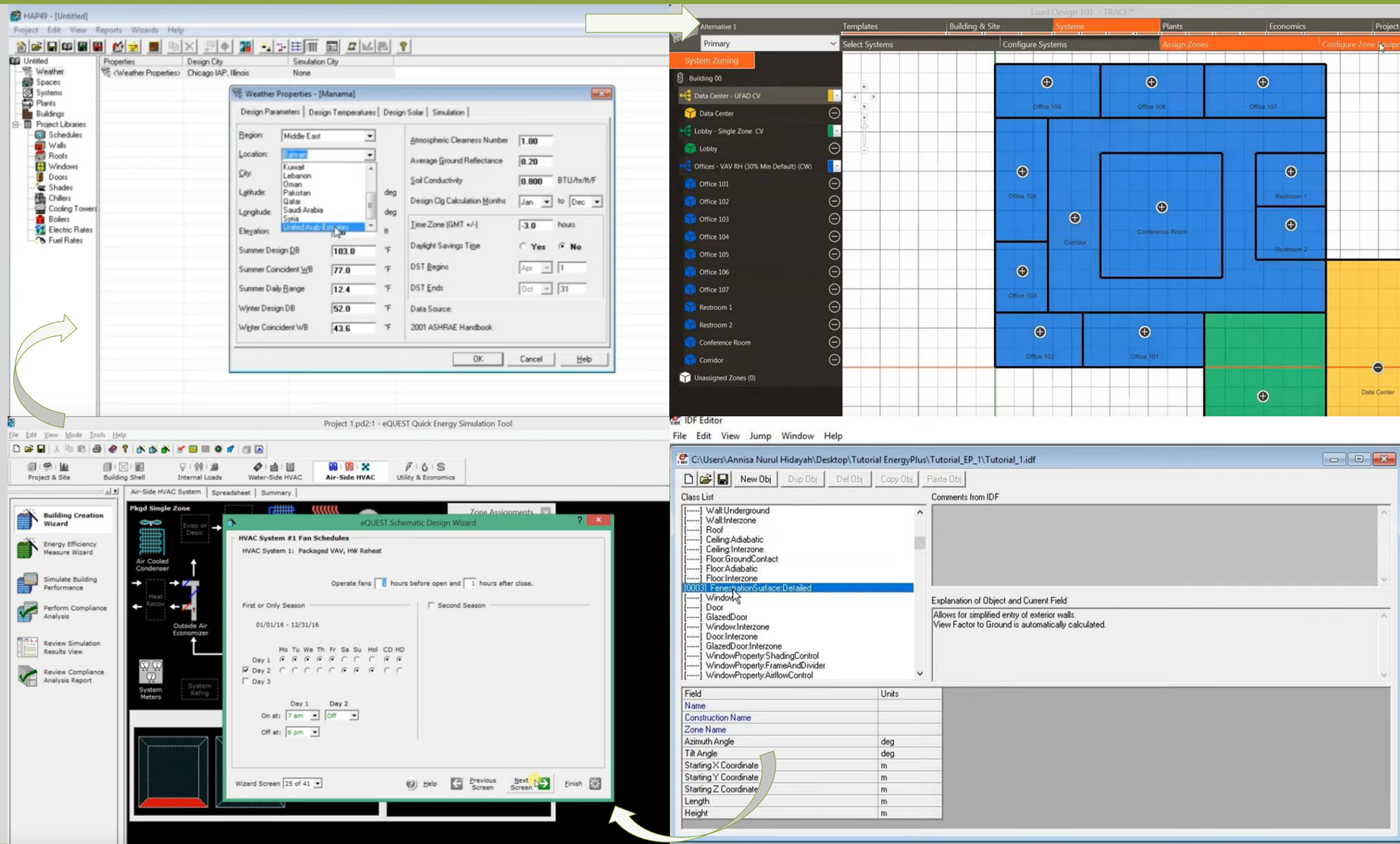
OpenStudio® with EnergyPlus

TAS

- **TRACE 3D Plus**

TRACE 700

TRNSYS



Are you ready to use energy modeling as a design & decision making tool?

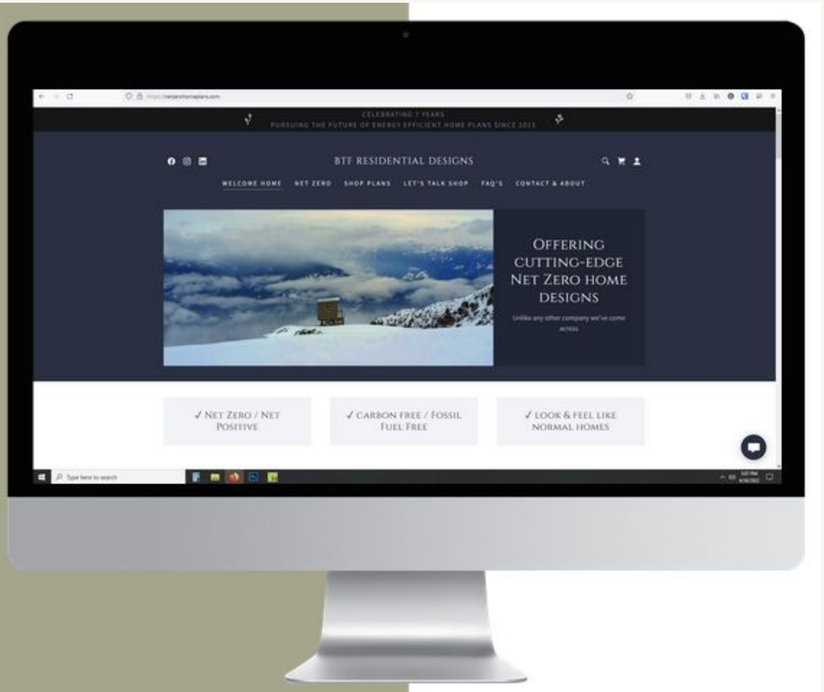
Thank you for joining in!

Ideas

Energy Modeling for All

Construction

Results



STAY IN TOUCH!

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