Right Sizing AC Systems for Profit and Energy Star Certification

Part I

RESNET 2007

Dennis J Stroer

CALCS-PLUS

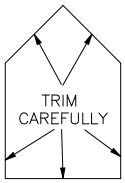
Venice Florida

BUBBA'S PERFESSIONAL HVAC LOAD CALCULATION

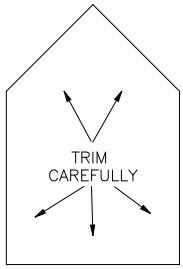
SIZING CHART

AIR CONDITIONING OR HEAT PUMP

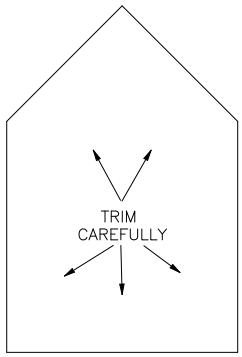
TRIM OUT VERY CAREFULLY ON BLACK LINES, THEN FOLLOW INSTRUCTIONS BELOW



1.5 TO
2–TON



2.5 TO
3.5–TON

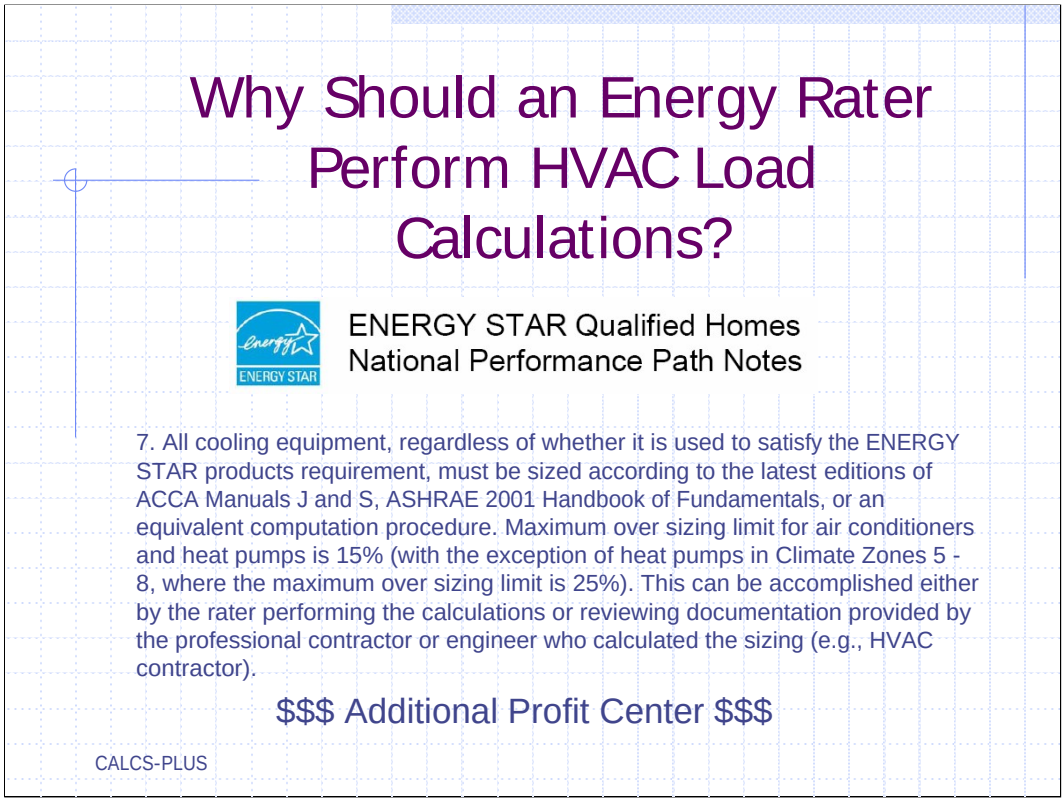


4 TO
5–TON

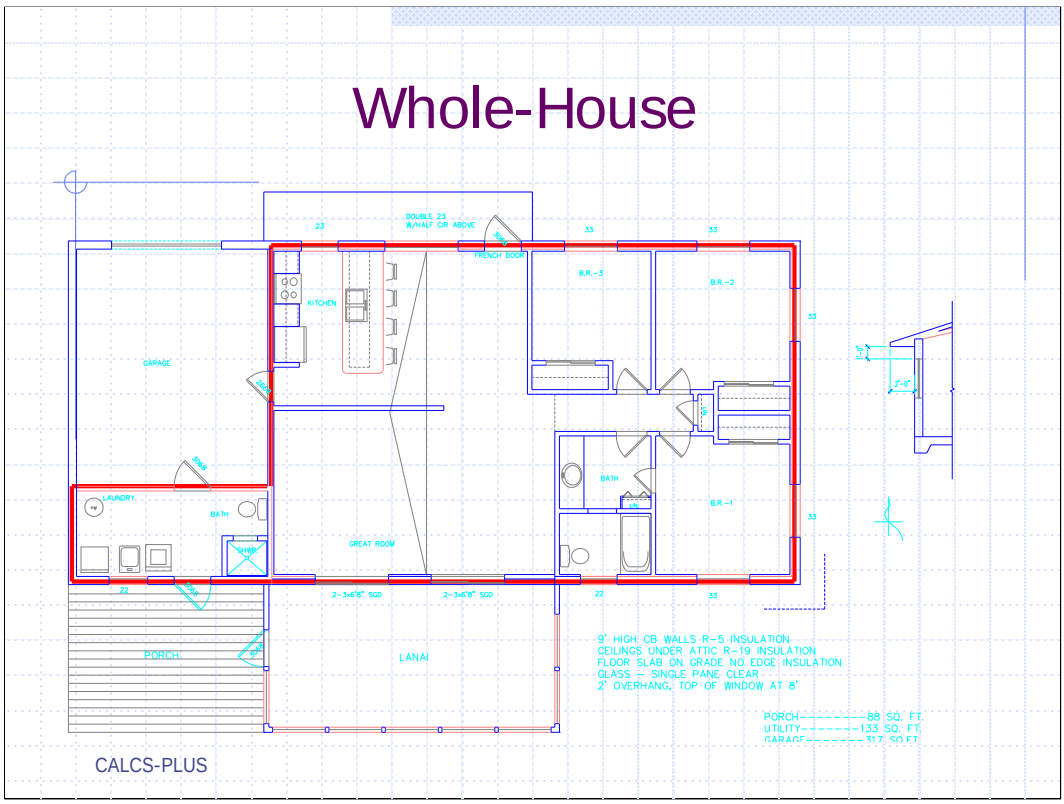
INSTRUCTIONS:
Stand on the curb and look through Sizing Holes,
what ever Hole the house fits into that's the size unit to use.
(For larger homes and or zoning use multiple Sizing Holes.)

HVAC Load Calculations.

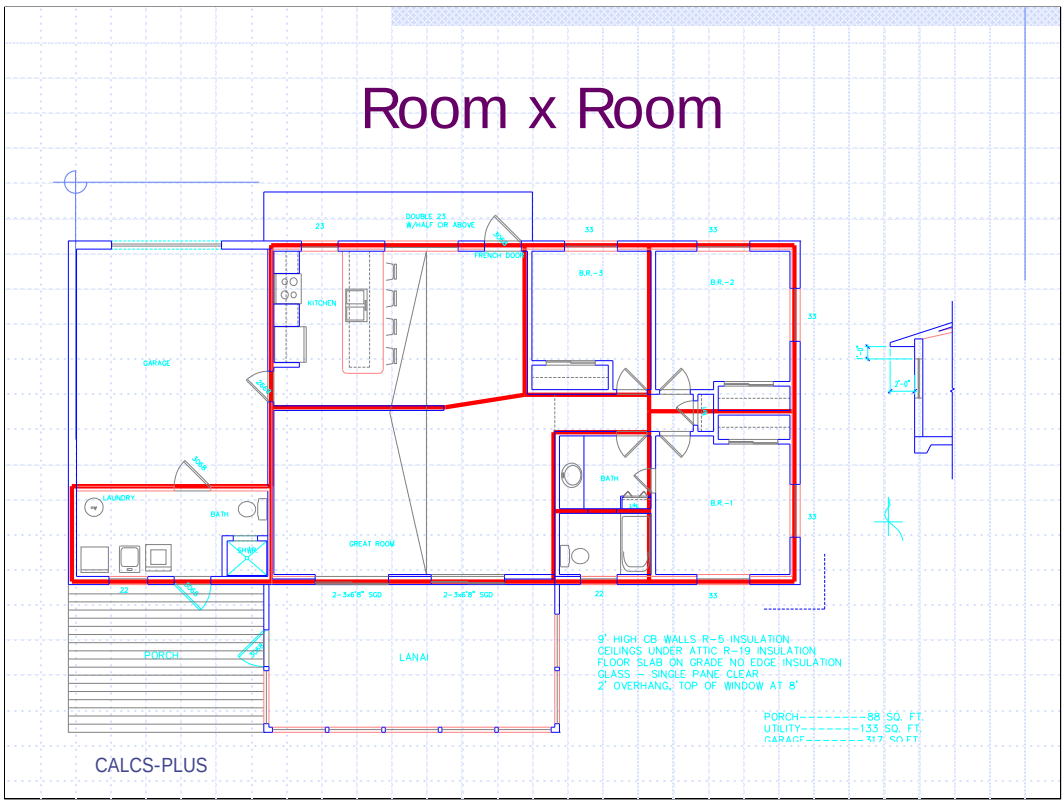
- HVAC Load Calculations
  - Why should an Energy Rater perform these calculations?
  - Whole-House or room x room?
    - What are the benefits
  - Why use ACCA MJ8
  - MJ8 Sensitivities
- MJ8 take off
  - Design Conditions
  - What constitutes the envelope (air barriers and the thermal barriers)



From Number 7 of the National Performance Path Notes.



The Whole-House approach calculates the heat gain and loss for the envelope. It is a quicker way to accurately calculate the building's heating and cooling loads to verify overall equipment sizing. But this method is no help when trying to satisfy an individual room's requirement.



By breaking the house up into rooms we can get a better idea of each rooms unique requirements.

Room x Room Loads

If the HVAC system is the backbone of the house as a system. The HVAC load calculation is the backbone of the HVAC system

- Required to determine supply CFM for each room
- Required to select Supply Outlets
- Required to select Return Inlets
- Required to design a Duct System
- Required to diagnose comfort problems

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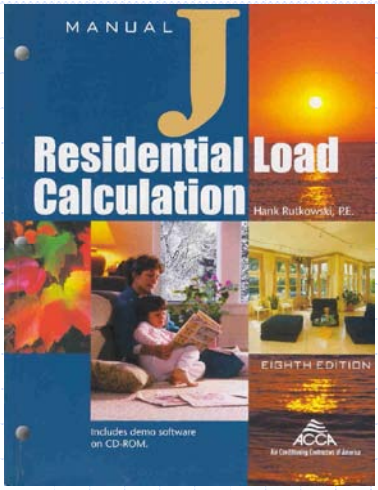
ACCA Manual J V8



Why use it?

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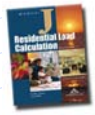
Value of Manual J



- Eliminate Under-sizing of Heating & Cooling Equipment
- Eliminate Over-sizing of Heating & Cooling Equipment
- Humidity Control During the Cooling Season
- Eliminate Comfort Problems

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Under Sizing Equipment

The obvious problem with undersized equipment is that it will not maintain the desired temperature. However, slightly undersized cooling equipment (by a margin of 10% or less) may actually provide more comfort at a lower cost.

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Oversized Equipment Causes

- short-cycling, minimal runtime
- marginalized temperature control
- pockets of stagnate air
- degrades humidity control during the cooling season
- requires larger duct runs

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Oversized Equipment Causes

- increased installed cost
- increased operating cost
- increased demand on our utilities
- adds unnecessary stress to equipment

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Why Use MJ8

The heating and cooling load estimates affect every aspect of the system design procedure

- From system selection
- To equipment selection procedures
- To placement and selection of air distribution hardware
- To duct routing and airway sizing or pipe layout and sizing

Because of this the load calculation must be as accurate as possible

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MJ8 Sensitivities

- Design conditions
- Building tightness
- Fenestration
- Air duct system design & installation

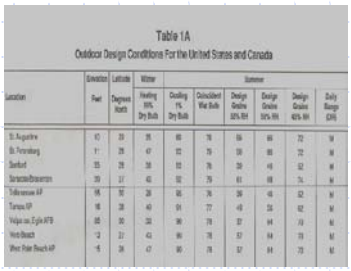
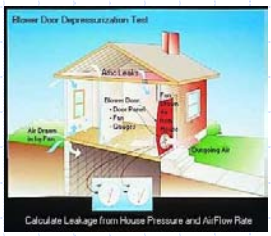


Table 1A
Outdoor Design Conditions For the United States and Canada



MJ8 Guidelines

- Use outdoor design conditions recommended by Table 1 Manual J.
- Use the default indoor design conditions recommended by Manual J.
- Take full credit for all internal shading devices and external overhangs.
- Use internal shading devices that are compatible with the type of room.

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MJ8 Guidelines

- Do not use internal shade if the room is specifically used for day lighting.
- Use the tested performance coefficients when known.
- Take full credit for all insulation & sealing efforts.
- Take full credit for insulated & sealed duct runs located in unconditioned space.

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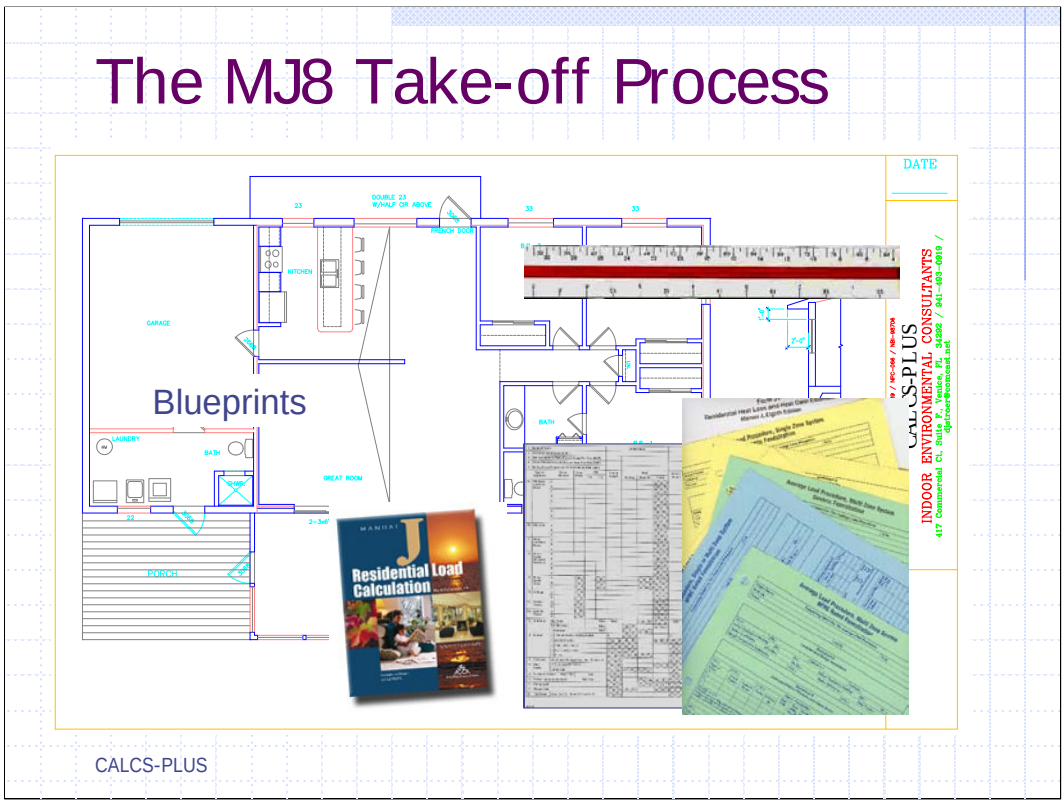
MJ8 Guidelines

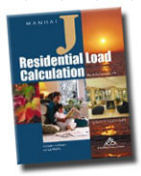
- Take full credit for load factors and diversity when estimating internal loads.
- Take full credit for diversity when estimating the cooling load on central equipment.



In order to perform an accurate HVAC load calculation you will need scalable blueprints, a scale, MJ8 forms, and of coarse Manual Jv8 to obtain all the heat transfer factors.

From Part of Section 1-16 ACCA Manual J 8th Edition

- Computerized method calculates load by month of year and time of day associated with each room load and with the equipment sizing load.
- Computer can generate solutions for 288 scenarios (12 month year and 24 hour day)



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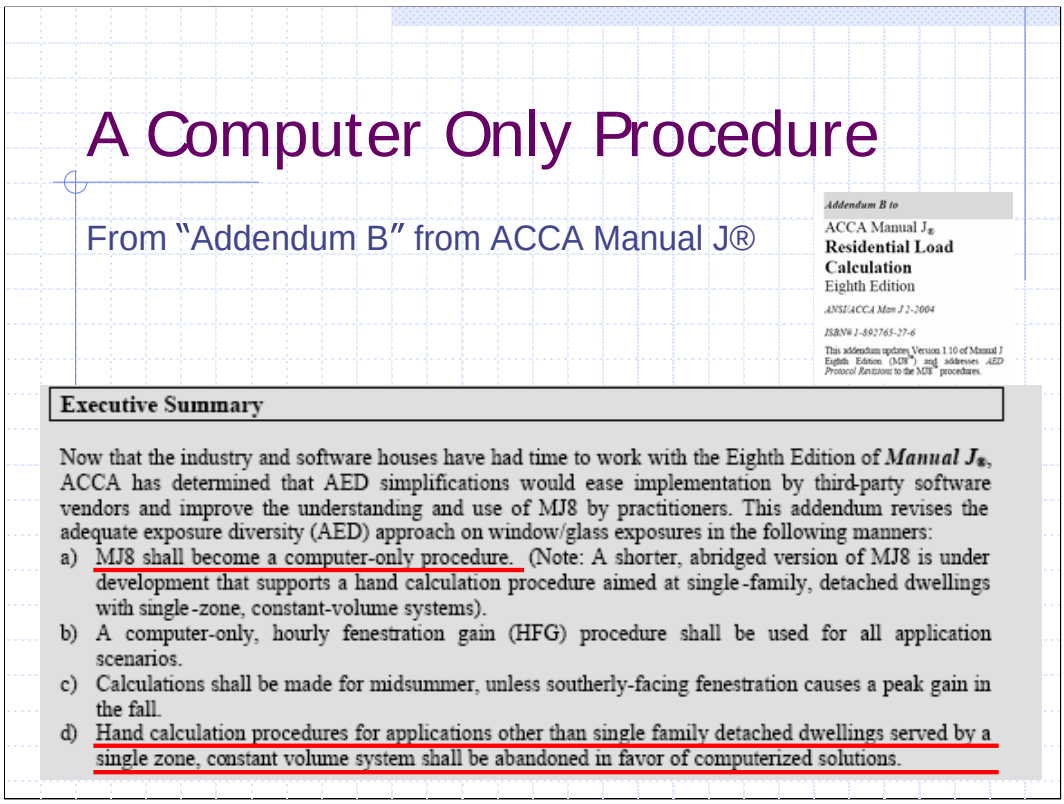
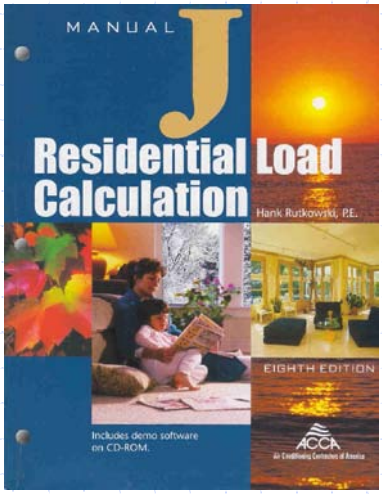


The is from the Executive Summery in Addendum B to ACCA Manual J. Version 8 is a very complex calculation which was designed to be performed by a computer.



Only three software programs are recognized by ACCA as meeting the standards of Manual J residential load calculations.

Powered by ACCA Air Conditioning Contractors of America MANUAL J

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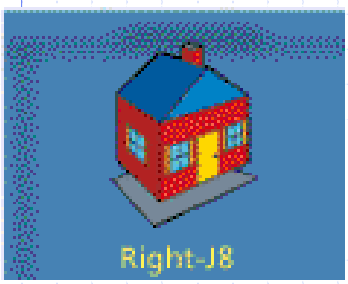
Elite Software	RHVAC
WrightSoft	Right-J
Nitek	HVAC Wizard

From the ACCA website which is www.ACCA.org.

ACCA Approved MJ8 Programs



Elite Software

RHVAC RESIDENTIAL HVAC LOADS

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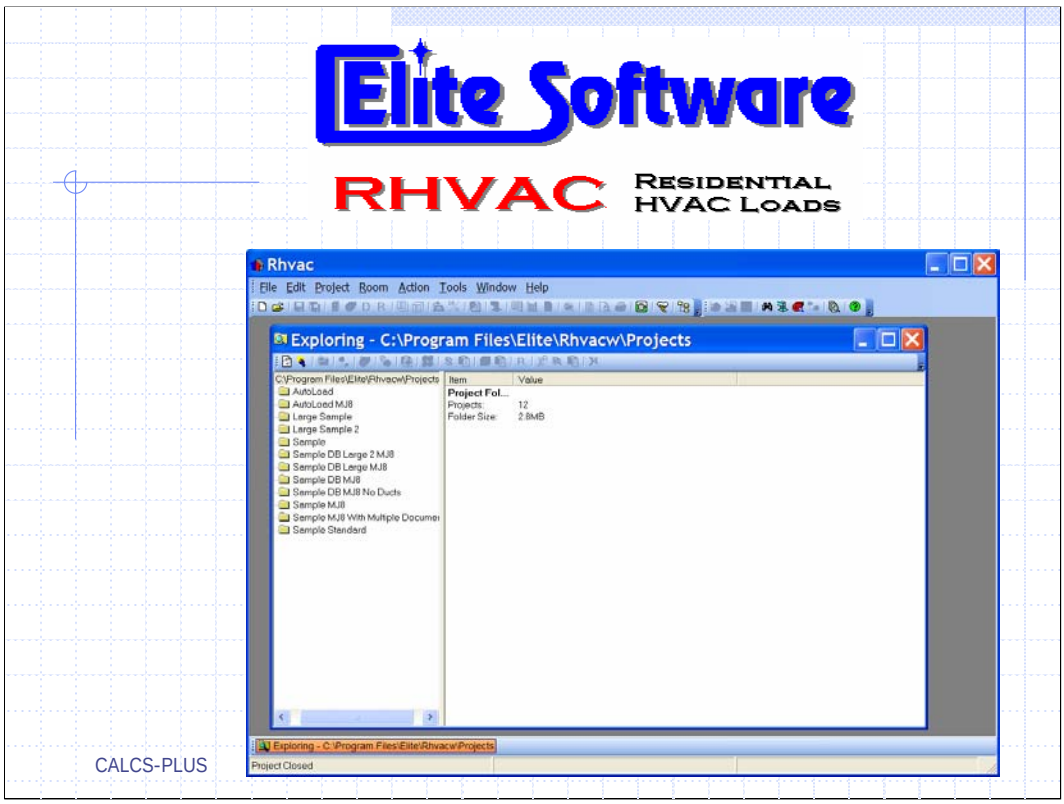
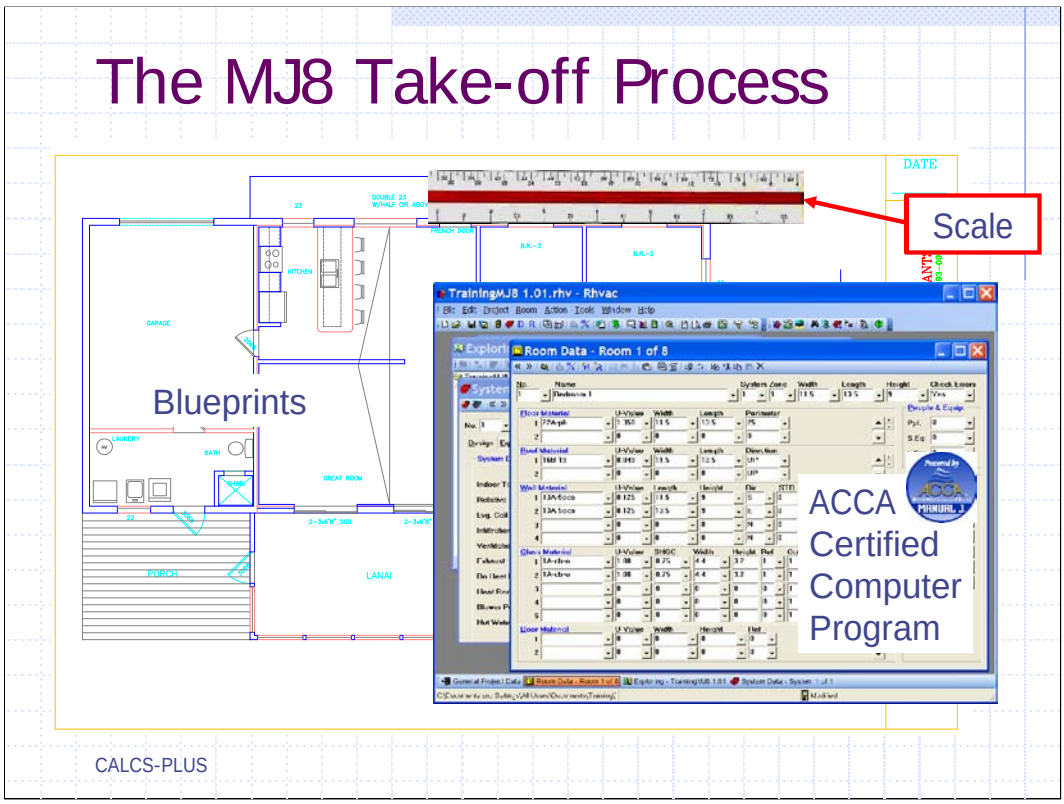


The software we will be using for this program will be Elite Software. Not to say that Elite Software is better than Wright Soft or HVAC Wizard, we started using Elite back in 1987. At that time, and even now the basis of our business is HVAC load calculations. After researching both Elite and Write Soft we chose Elite because we thought it appeared more user friendly. We have learned it well and are very satisfied with our selection and have found the Elite Software company to be sensitive to our needs.

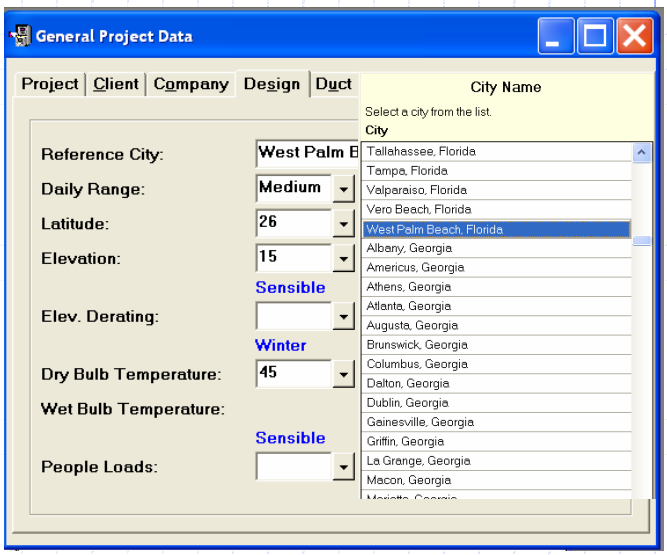


In order to perform an accurate HVAC load calculation only three things are required: a blue print, a scale, and a certified ACCA MJ8 computer program. Most of the certified programs have a computer aided drawing program that, if set up correctly will do the loads in the background while you draw the floor plan. For the purposes of satisfying the intent of this session we will do the take-off the old fashioned way; understanding the construction documents which includes scaling the plans.

Design Conditions

The Data that is automatically filled in comes from Table 1A in ACCA Manual J 8th edition.

Outdoor Design Conditions For the United States and Canada.



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The certified programs have “Table 1-A” database from Manual J already built into them. This table shows outdoor design conditions for the United States and Canada. Selection of the climate area for the location of the building is very important. For this example we will be using West Palm Beach, Florida.

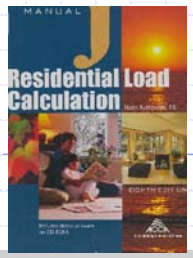

Table 1A

RHVAC weather data base comes directly from ACCA Manual J version 8 Table 1A & 1B(micro climates).

Table 1A

Outdoor Design Conditions For the United States and Canada

Location	Elevation	Latitude	Winter	Summer					
	Feet	Degrees North	Heating 99% Dry Bulb	Cooling 1% Dry Bulb	Coincident Wet Bulb	Design Grains 55% RH	Design Grains 50% RH	Design Grains 45% RH	Daily Range (DR)
St. Augustine	10	29	35	89	78	59	66	72	M
St. Petersburg	11	28	47	93	79	59	66	72	M
Sanford	55	28	38	93	76	39	46	52	M
Sarasota/Bradenton	30	27	43	92	79	61	68	74	M
Tallahassee AP	55	30	28	93	76	39	46	52	M
Tampa AP	19	28	40	91	77	49	56	62	M
Valpariso, Eglin AFB	85	30	33	90	78	57	64	70	M
Vero Beach	13	27	43	90	78	57	64	70	M
West Palm Beach AP	15	26	47	90	78	57	64	70	M

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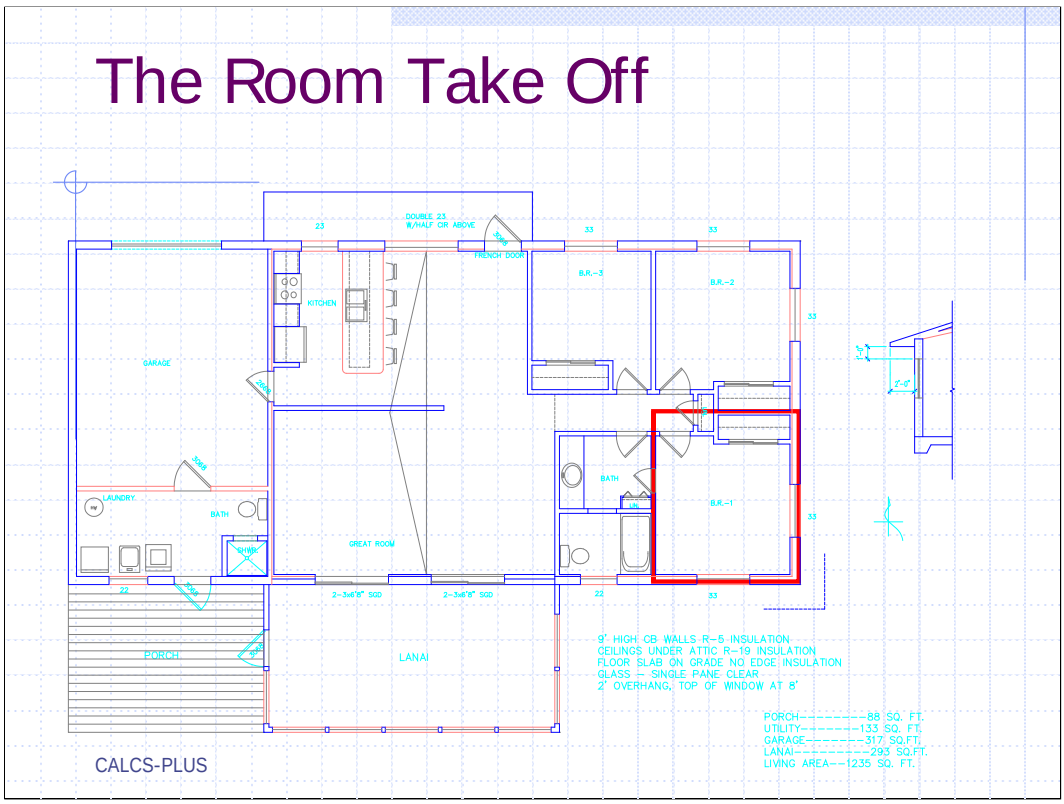
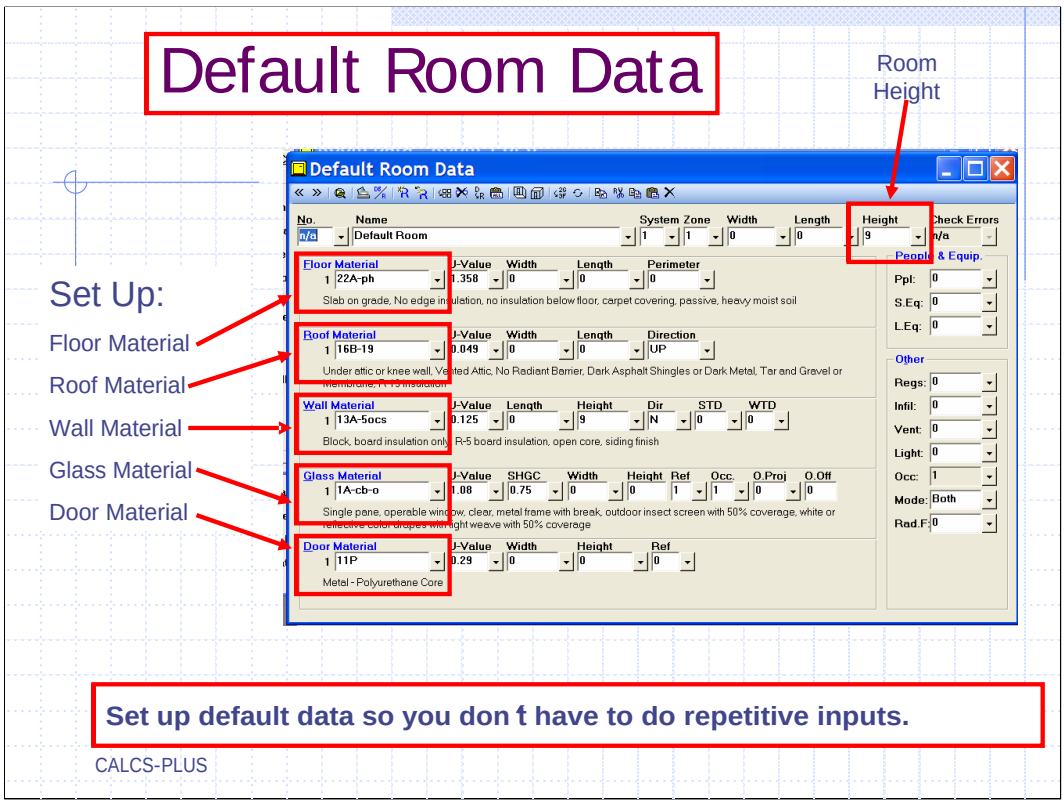
Setting up the correct design conditions for the area the building is very important when it comes to satisfying one of MJ8's sensitivities.

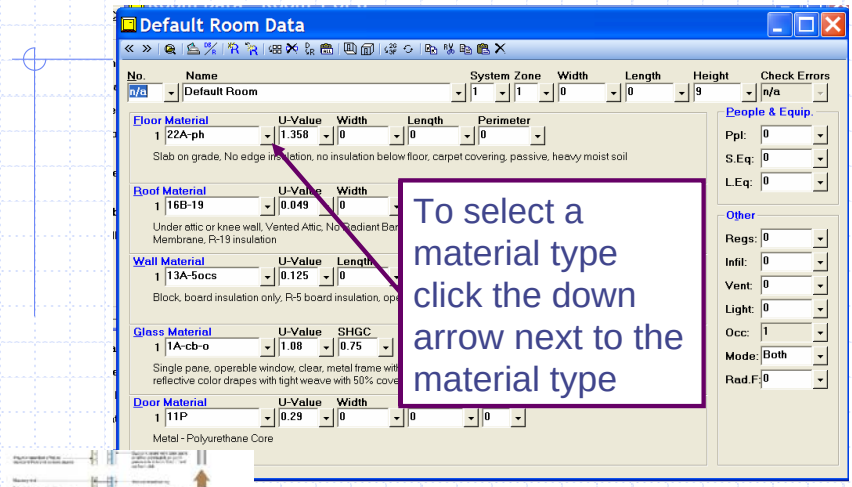


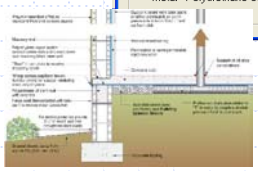
We are going to be using a simple 3 bedroom 2 bath floor plan. The home has 9’ CB (cement block) walls with R-5 board insulation on the inside of the wall; 100% coverage, furred and dry walled. The ceiling has a vented attic above with R-19 insulation, floor is slab on grade, all of the glass is single pane clear, and the top of the window as at 8’ with an average overhang of 2’.



Set up a default room. The materials in the Default Room Data are those materials that make up the air and thermal barrier of the building. This room will be used as a template and it will include the most common building materials used in the home we will be sizing, All of the ACCA MJ8 materials are stored in the program's database. Some boxes will be left at 0 or unfilled but at minimum the floor to ceiling height should be entered, the floor material, roof material, wall material, glass material, and door material. This will save a lot of time later.

Floor Materials





We will be using the wall section at the right (ripped off from Joe Lstiburek, Ph.D.,P.Eng, Builders Guide, Hot Humid Climate, Figure 7.15).

The floor will be slab on grade with no edge insulation.

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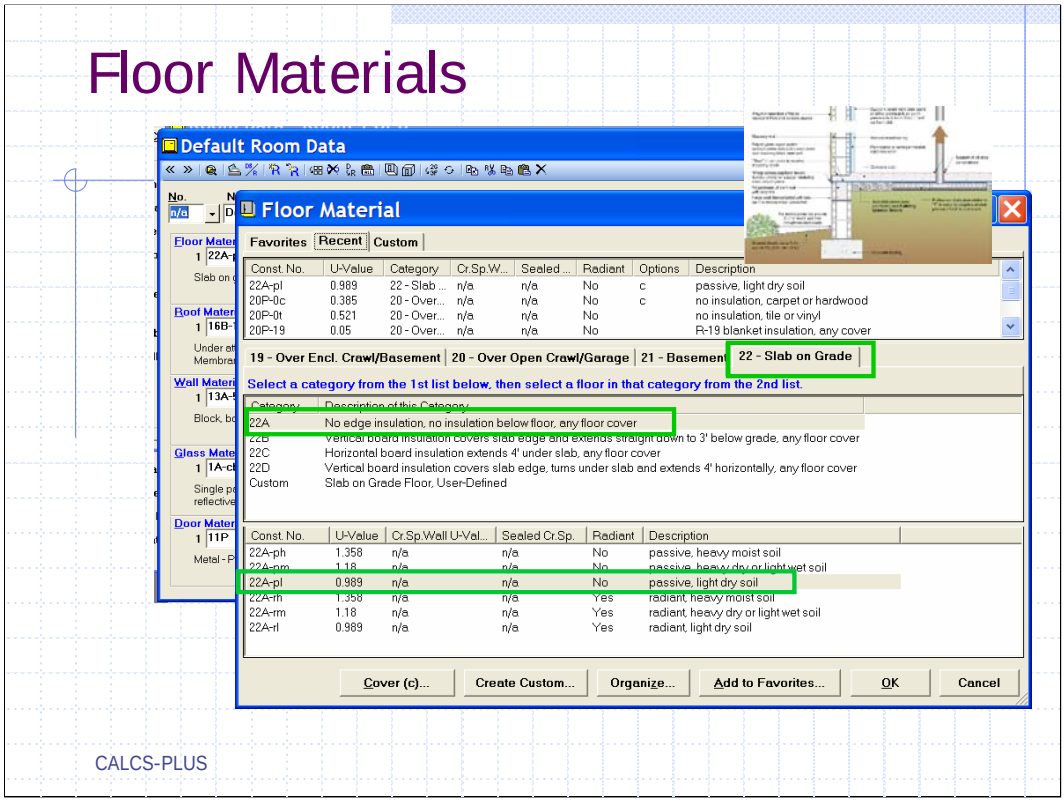
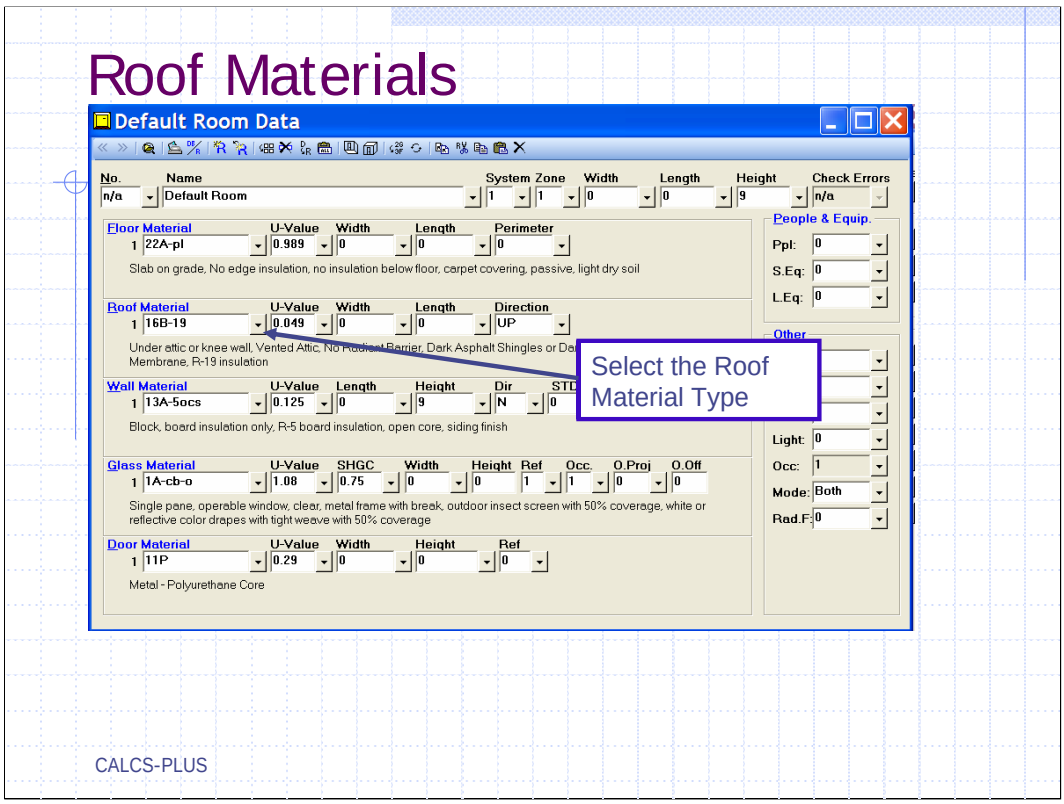
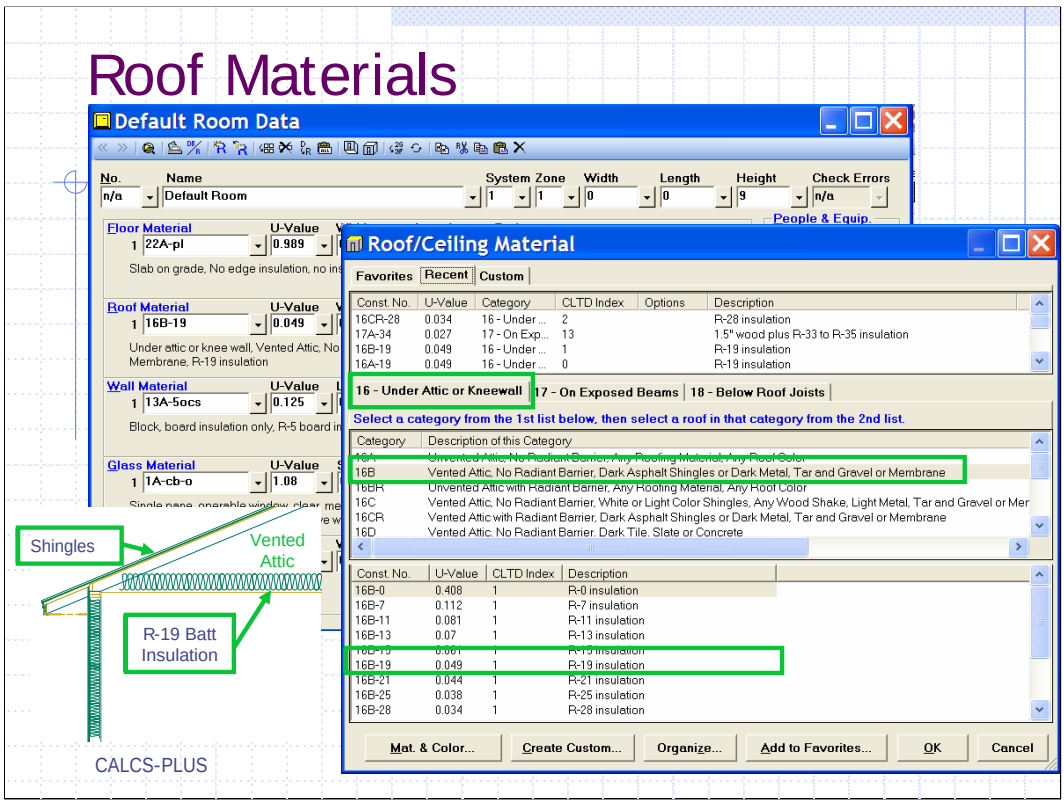
To set the floor “material type” click the down arrow



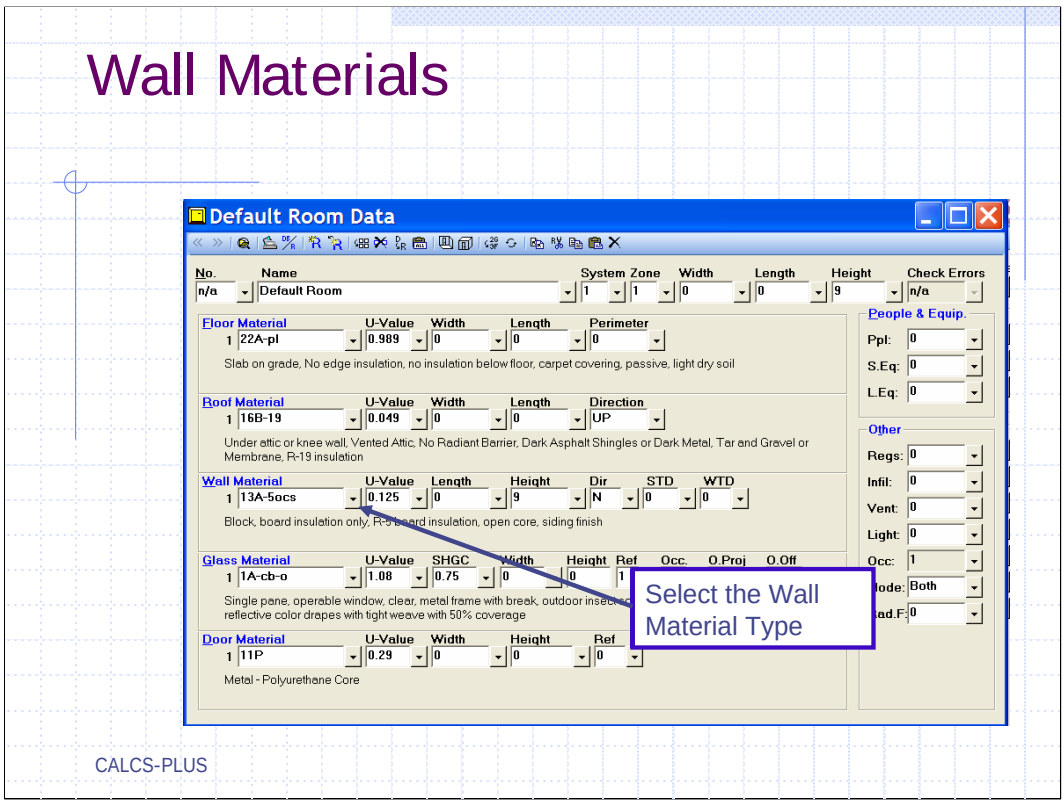
Here we click on the Floor Material and the Floor Material database window pops up. For this home we will choose “Slab on Grade”, “No edge insulation, no insulation below floor, any floor cover”, “passive, light dry soil”.



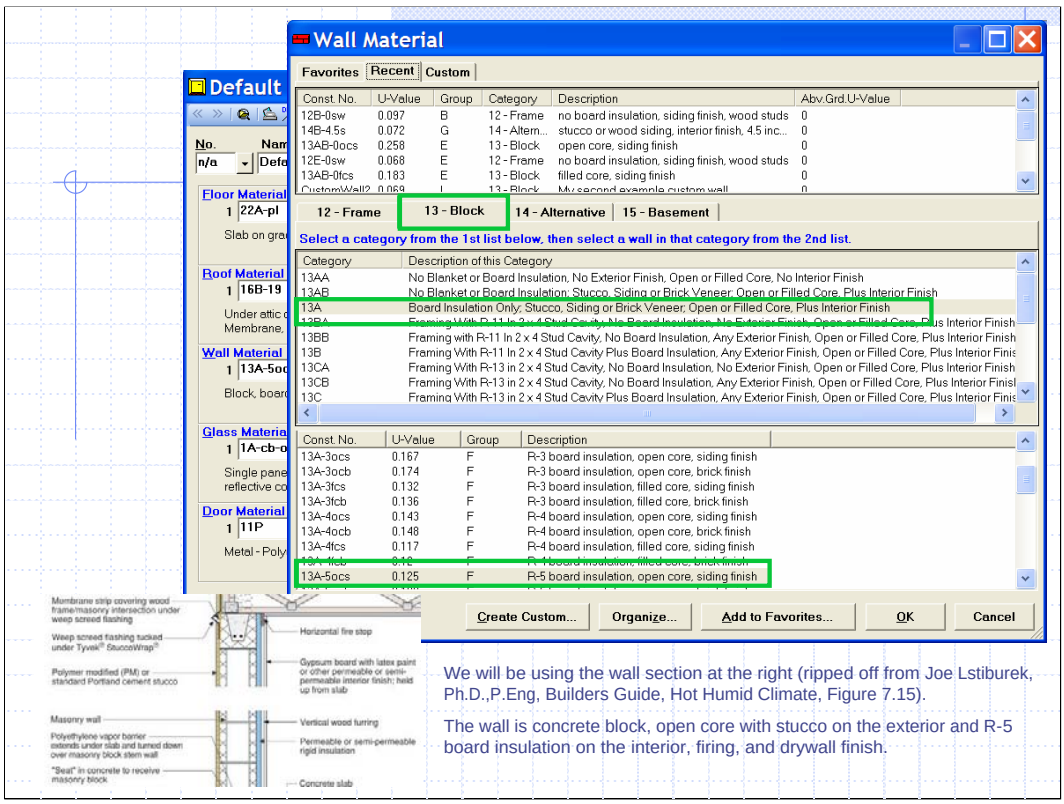
To set the roof “material type” click the down arrow.



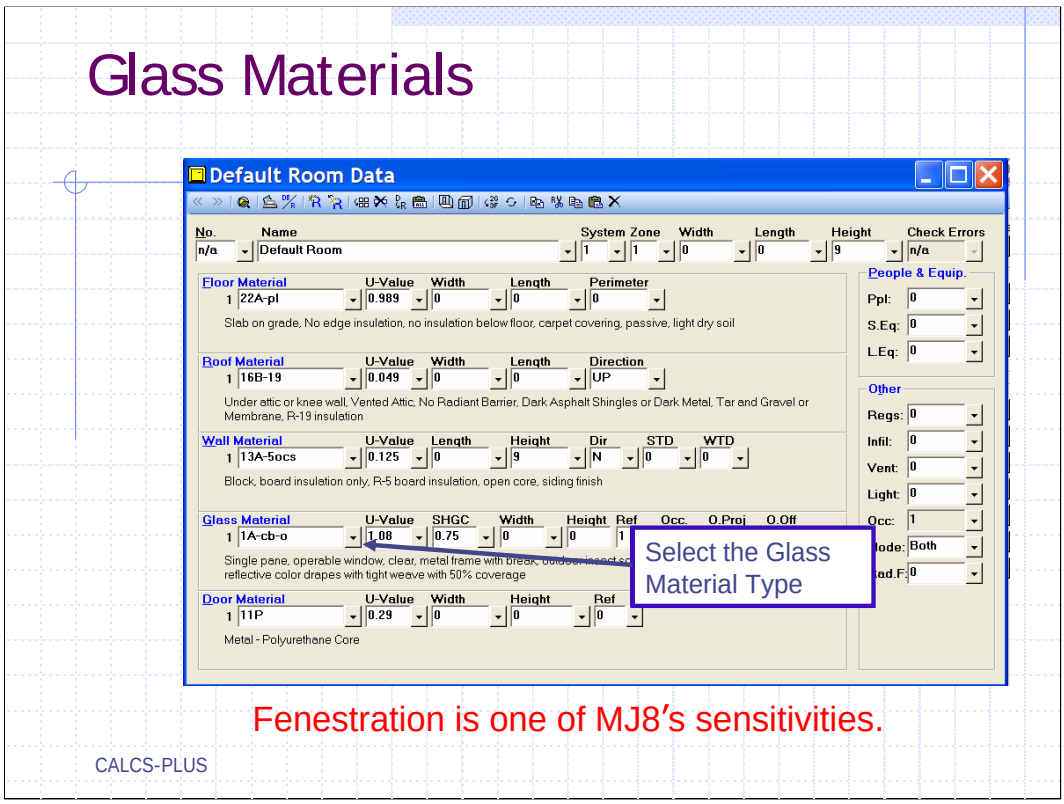
For this home we will be using a vented attic; choose “16-Under attic or Kneewall”, under category choose “16B Vented attic, No Radiant Barrier, Dark asphalt Shingles or Dark Metal, Tar and Gravel or Membrane”, and under construction number choose “16B-19” for R-19 insulation. If you know the roof will be tile, or white metal select the proper vented attic description.



To set the wall “material type” click the down arrow.



The Wall Material dialog box is the ACCA Manual J wall type database found in the tables of the manual. The construction numbers and properties come directly out of Manual-J. The wall type we will be using is “13-Block”, “13A Board Insulation Only, Stucco, Siding or Brick Veneer, Open or Filled Core, Plus Interior Finish”, and “13A-5ocs, R-5 board insulation, open core, siding finish.



Fenestration Notes

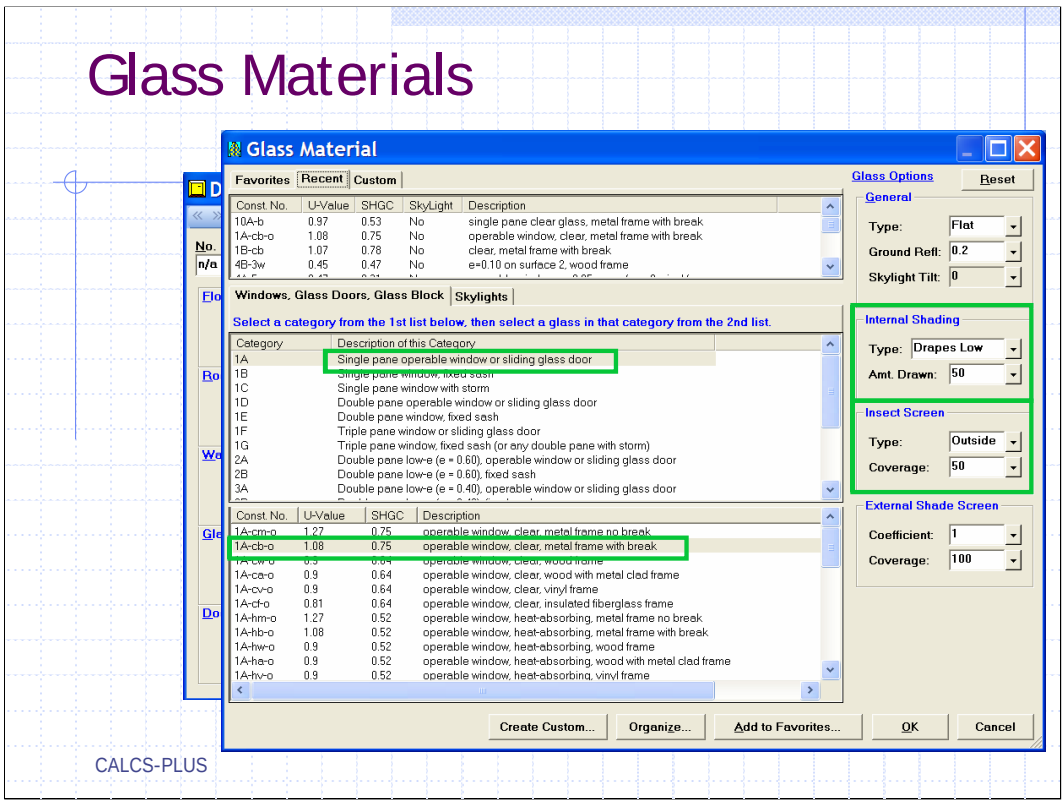
In general, take full credit for the rated (or tested) performance of glazing assemblies, construction materials and construction features.

Take full credit for documented window, glass door and skylight U-values and SHGC values. For generic fenestration, use the Appendix 10 data provided by MJ8. For NFRC fenestration, use the Table 3D-1 procedures provided by MJ8.

Take credit for bug screens when such devices are installed or specified.

Take credit for internal shade (per MJ8 defaults and protocols, and Table 3D-4). Windows and glass doors shall be shaded by a medium blind. However, internal shades are not applicable for purpose-built day-lighting windows.

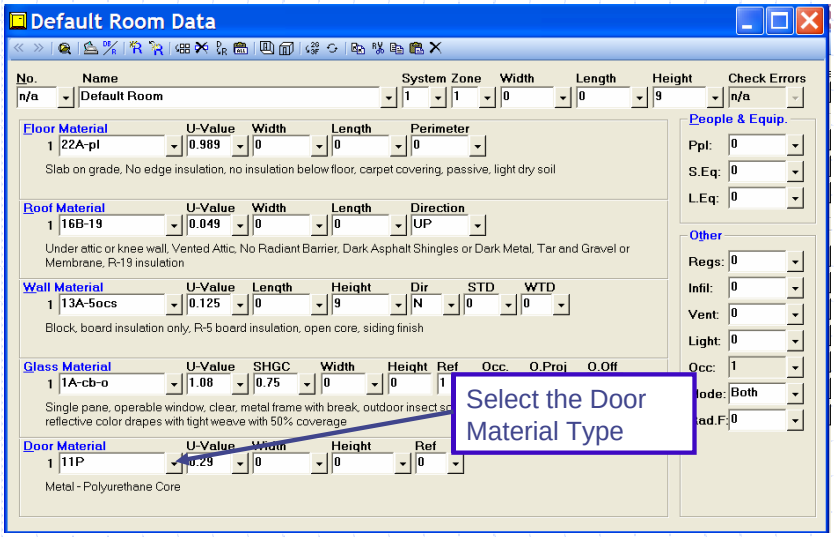
Take credit for overhangs (per MJ8 defaults and protocols, and Table 3E-1). The overhang adjustment shall be applied to all windows and glass doors, including purpose-built day-lighting windows.



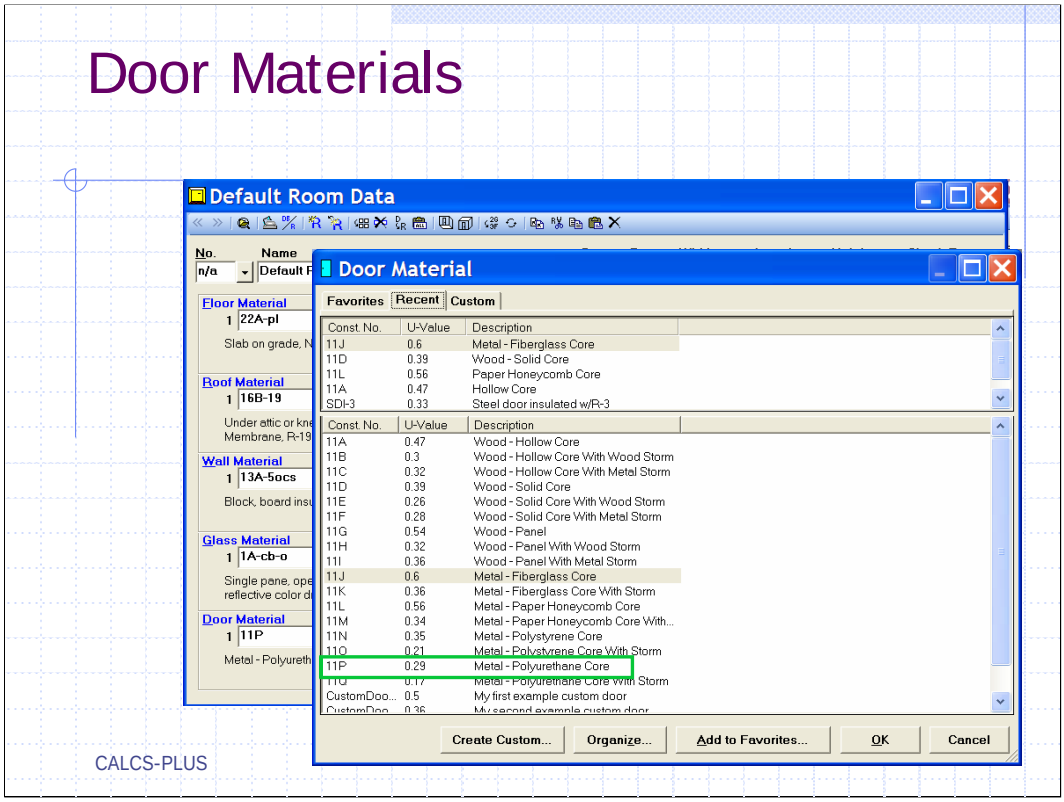
The Glass Material dialog box contains the complete Manual-J fenestration database. Glass is one of the building's major contributors to heat loss and heat gain. So it is very important to include only the most accurate glass data in the calculation. Things like internal shading, insect screens, and external shading screens must be considered. For unoccupied (or "spec") homes, system designers almost always assume the worst case for window shading (none) and site shading (none) during sizing. This assumption can unnecessarily add one-half ton of installed cooling capacity to a 2,500 sq ft home. MJ8 stipulates that drapes and blinds be assumed unless there is specific information to the contrary.

For this home we will be using "1A, Single pane operable window or sliding glass door", "1A-cb-o, operable window, clear metal frame with break".

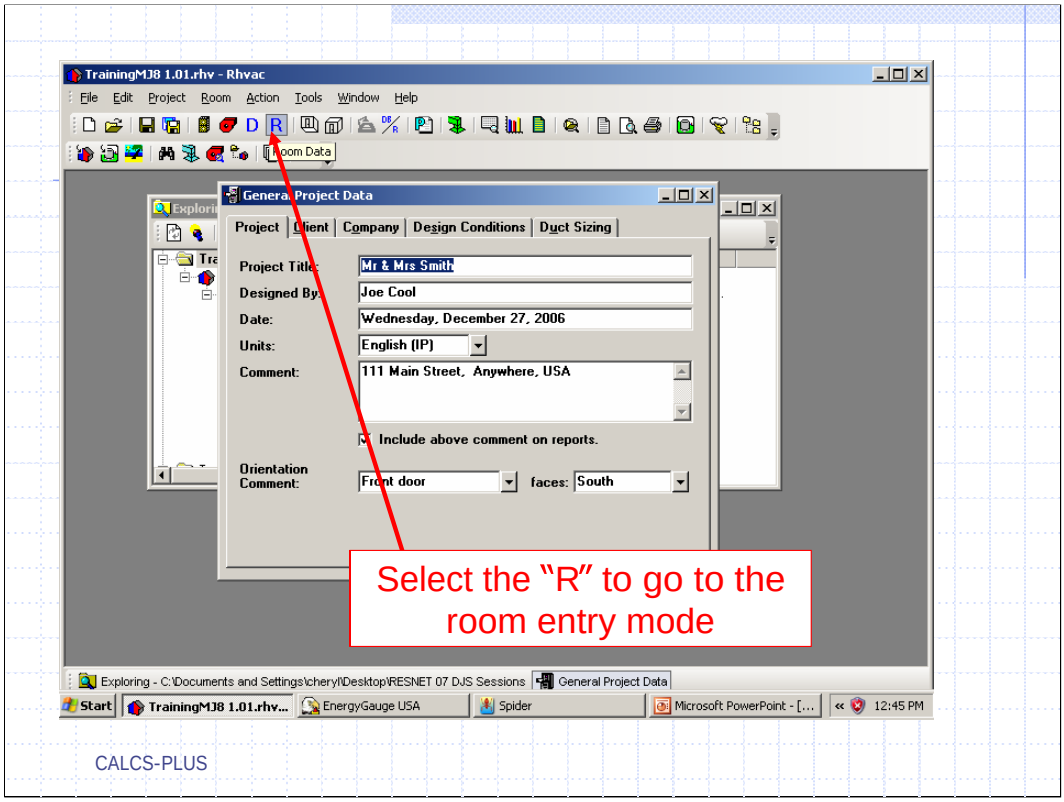
Door Materials



Select a door material.



Select a door material.


TrainingMJ8 1.01.rhv - Rhvac
File Edit Project Room Action Tools Window Help
Room Data
General Project Data
Project Client Company Design Conditions Duct Sizing
Project Title: Mr & Mrs Smith
Designed By: Joe Cool
Date: Wednesday, December 27, 2006
Units: English (IP)
Comment: 111 Main Street, Anywhere, USA
Include above comment on reports.
Orientation Comment: Front door
faces: South
Select the "R" to go to the room entry mode
Exploring - C:\Documents and Settings\cheryl\Desktop\RESNET 07 DJS Sessions
General Project Data
Start
TrainingMJ8 1.01.rhv...
EnergyGauge USA
Spider
Microsoft PowerPoint - [...
12:45 PM

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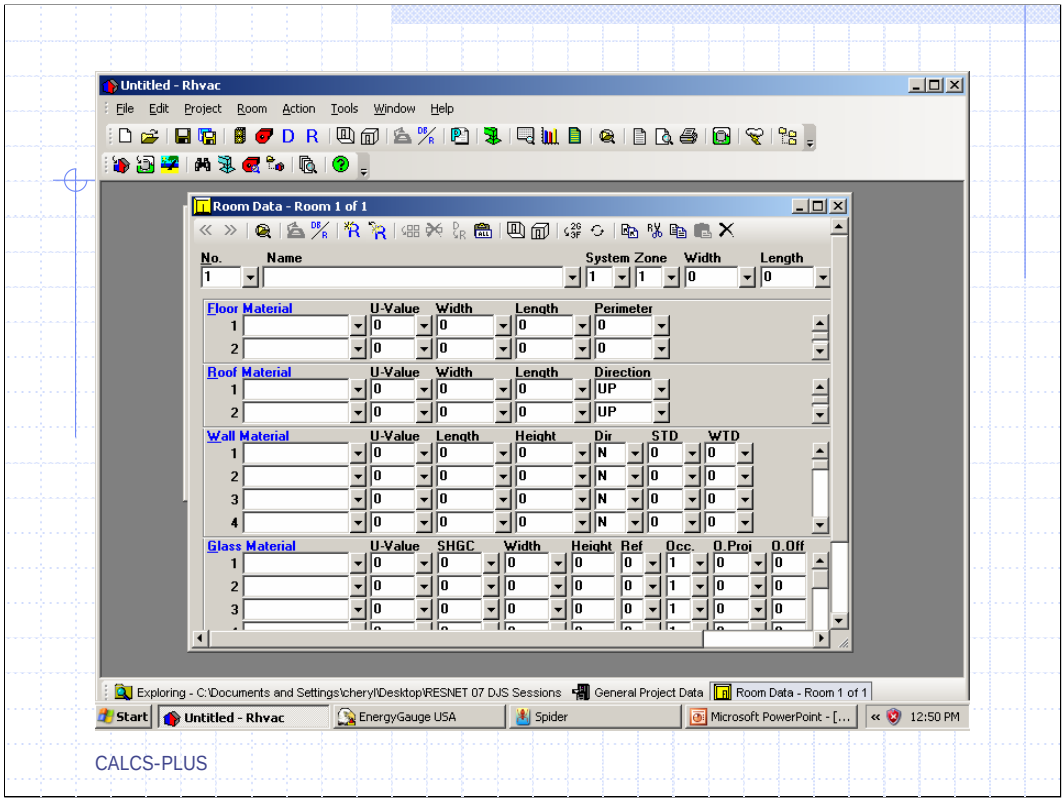
Untitled - Rhvac
File Edit Project Room Action Tools Window Help
Room Data - Room 1 of 1
No. Name System Zone Width Length
Floor Material U-Value Width Length Perimeter
Roof Material U-Value Width Length Direction
Wall Material U-Value Length Height Dir STD WTD
Glass Material U-Value SHGC Width Height Ref Occ. O.Proj O.Off
Exploring - C:\Documents and Settings\cheryl\Desktop\RESNET 07 DJS Sessions
General Project Data
Room Data - Room 1 of 1
Start
Untitled - Rhvac
EnergyGauge USA
Spider
Microsoft PowerPoint - [...
12:50 PM

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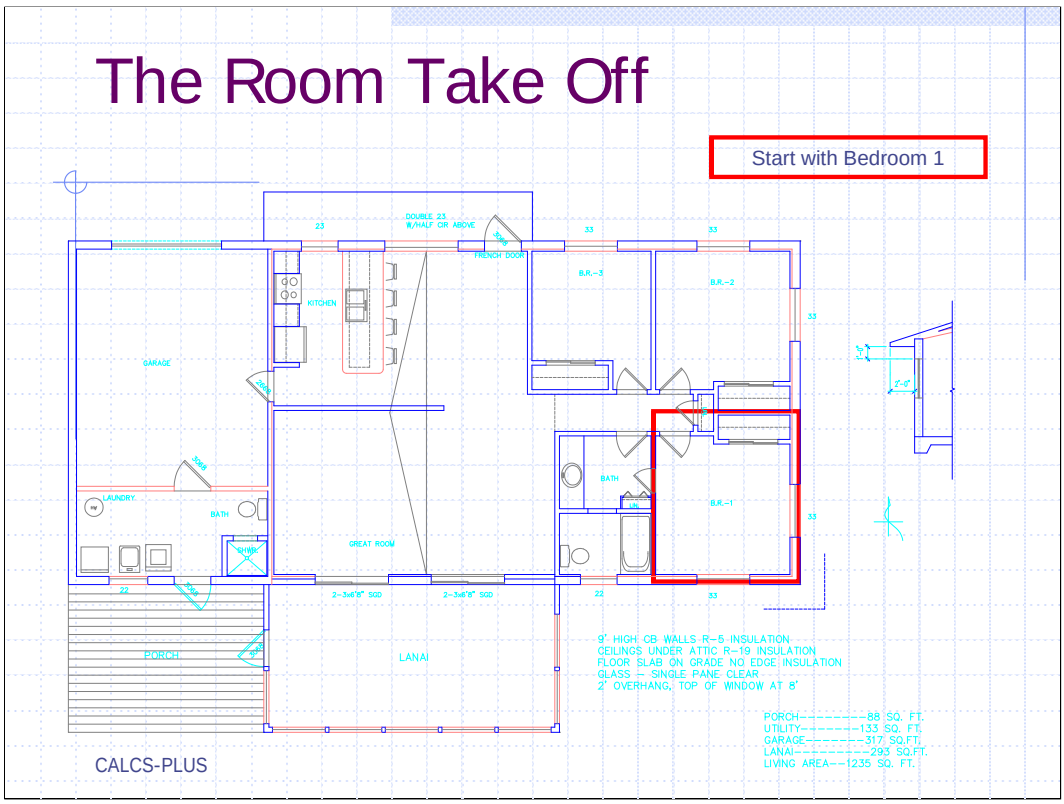
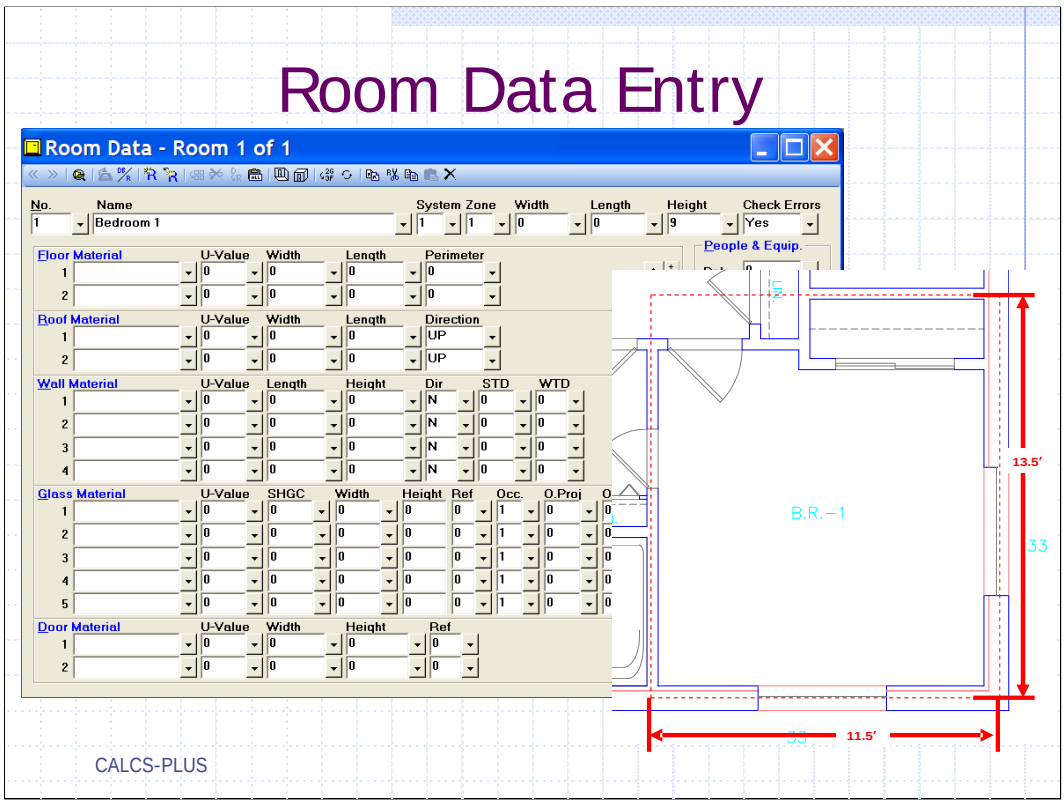
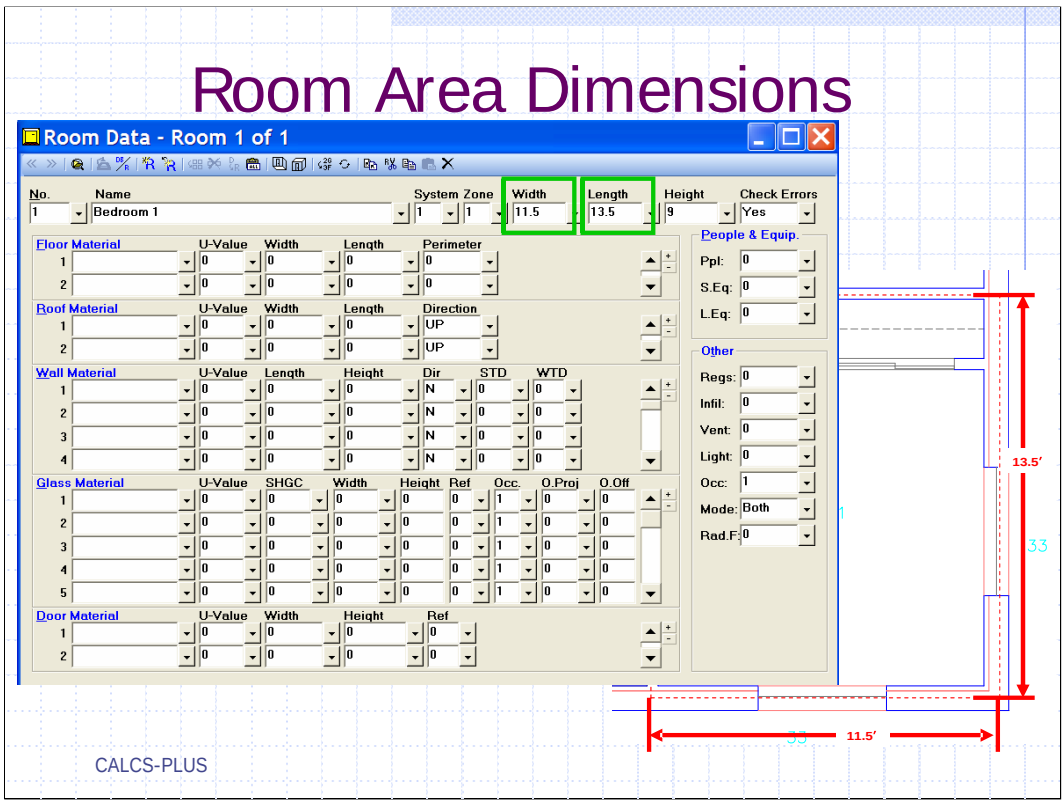


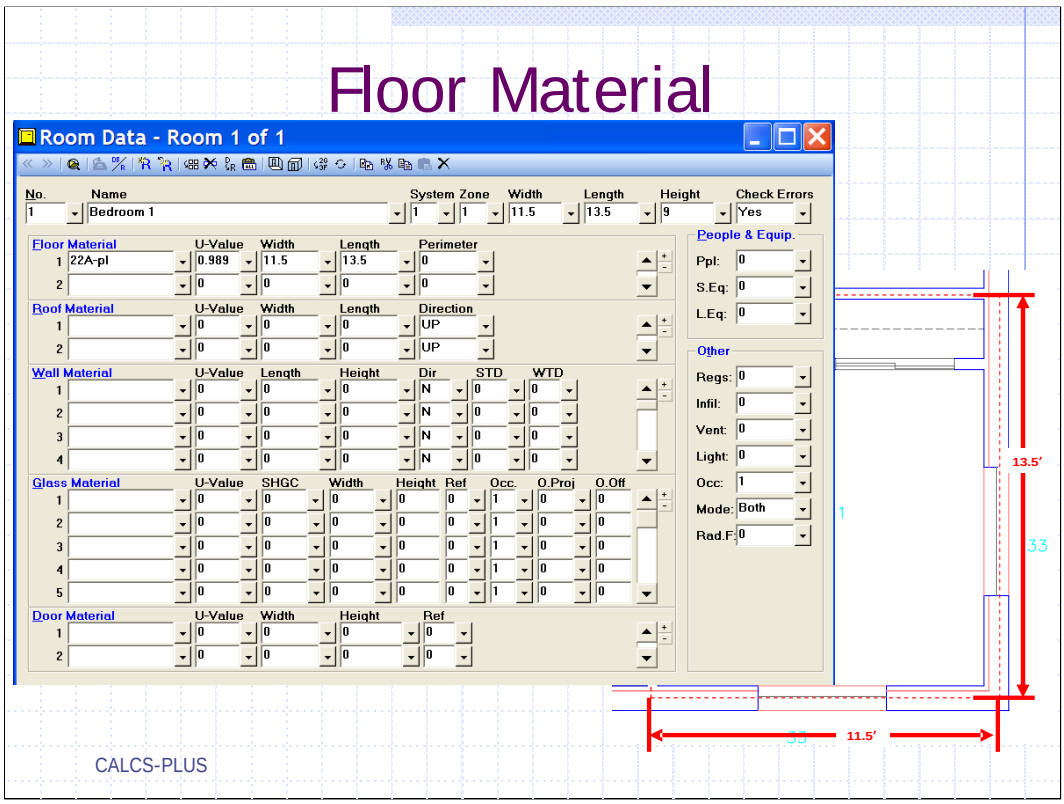
Starting with Bedroom 1



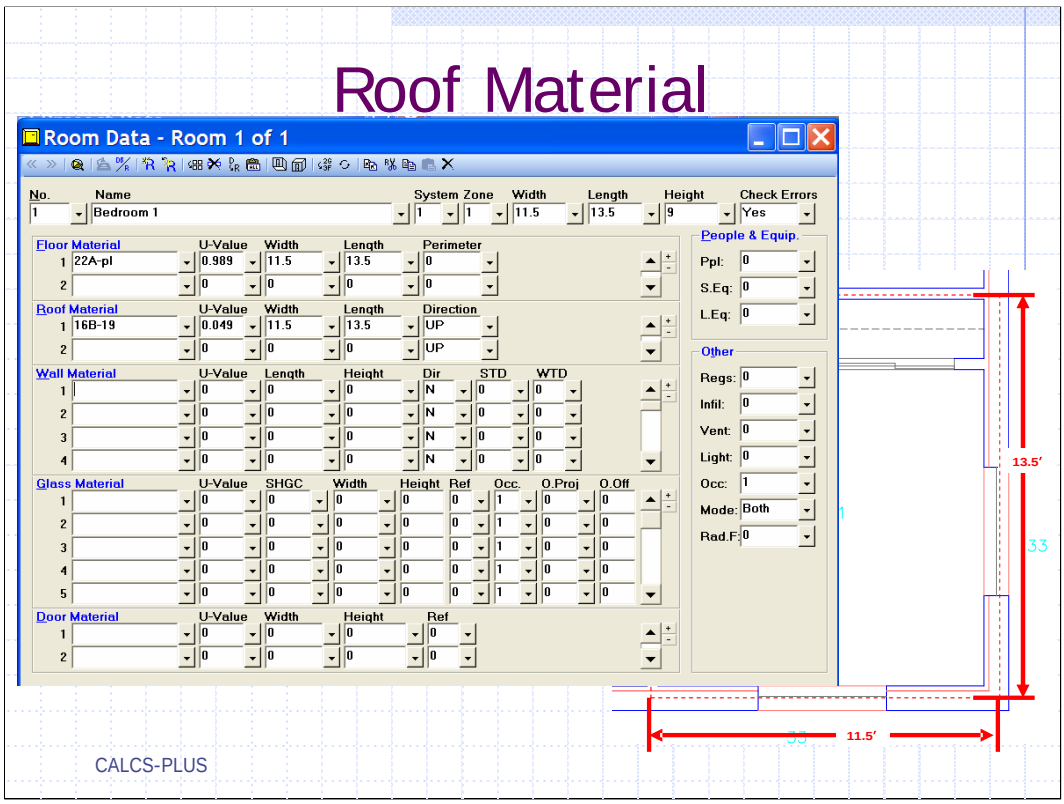
Any good room x room ACCA approved program will allow the designer to look at the individual room in it's entirety. When filling out the "Room Data" window it forces the designer to look at every heat transferable building material in that room; you begin to understand how the building will be put together.



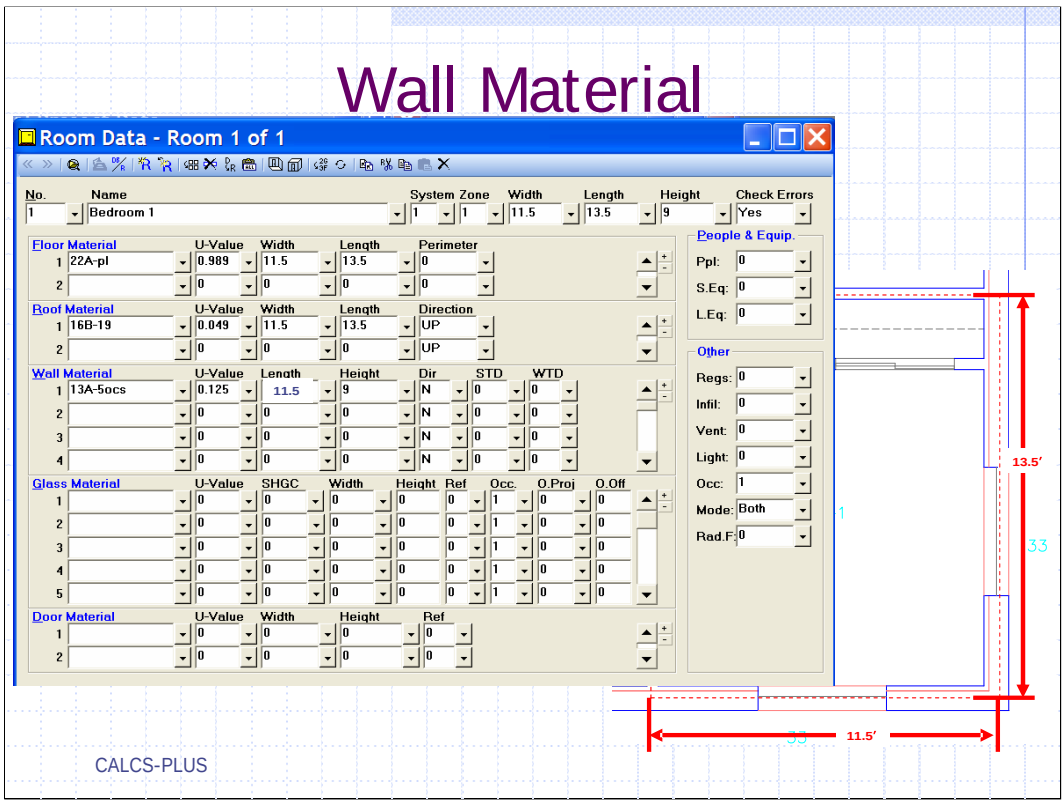
Enter the width and length of the room. The height was set up in the default screen so it appears on this screen. Move to the “Floor Material” box



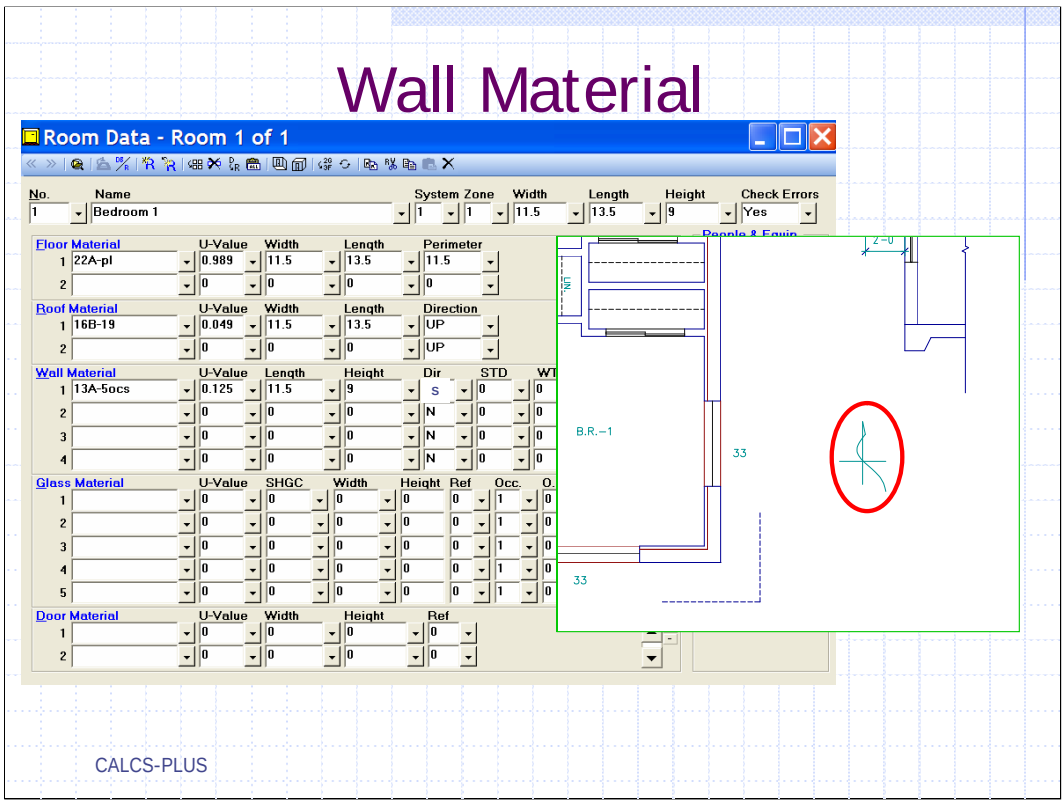
In this software program hitting the F5 key with the curser in the “Floor Material” box will enter the floor material that was set up in the default screen. The floor area dimensions are also copied to the width and length screen. But since our floor is slab on grade with no edge insulation no load will be calculated until the length is entered into the “Perimeter” box. This program tracks the perimeter as you enter walls. We will now move to the “Roof Material” box.



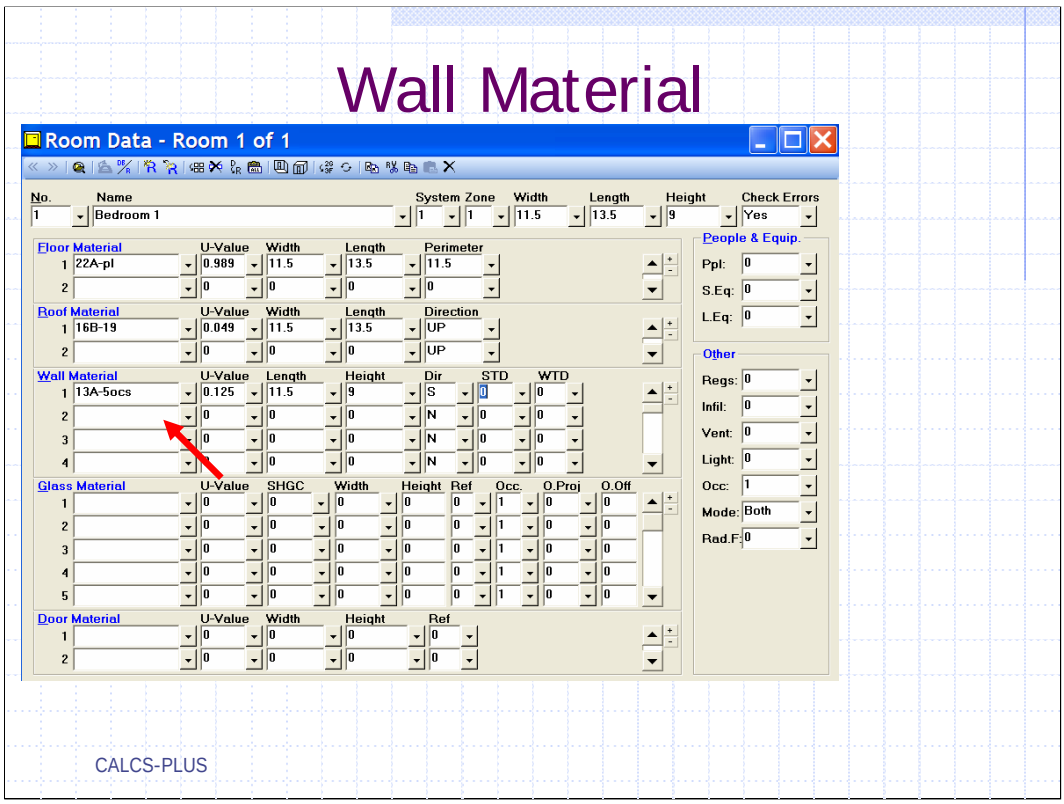
In the “Roof Material” box again hit the F5 key and the roof materiel we set up in the default room will appear, so will the width and length which is copied from the room width and length. If the room has a flat ceiling and no kneewalls the “Roof Material” section is completed and we can move on to the “Wall Material” section.



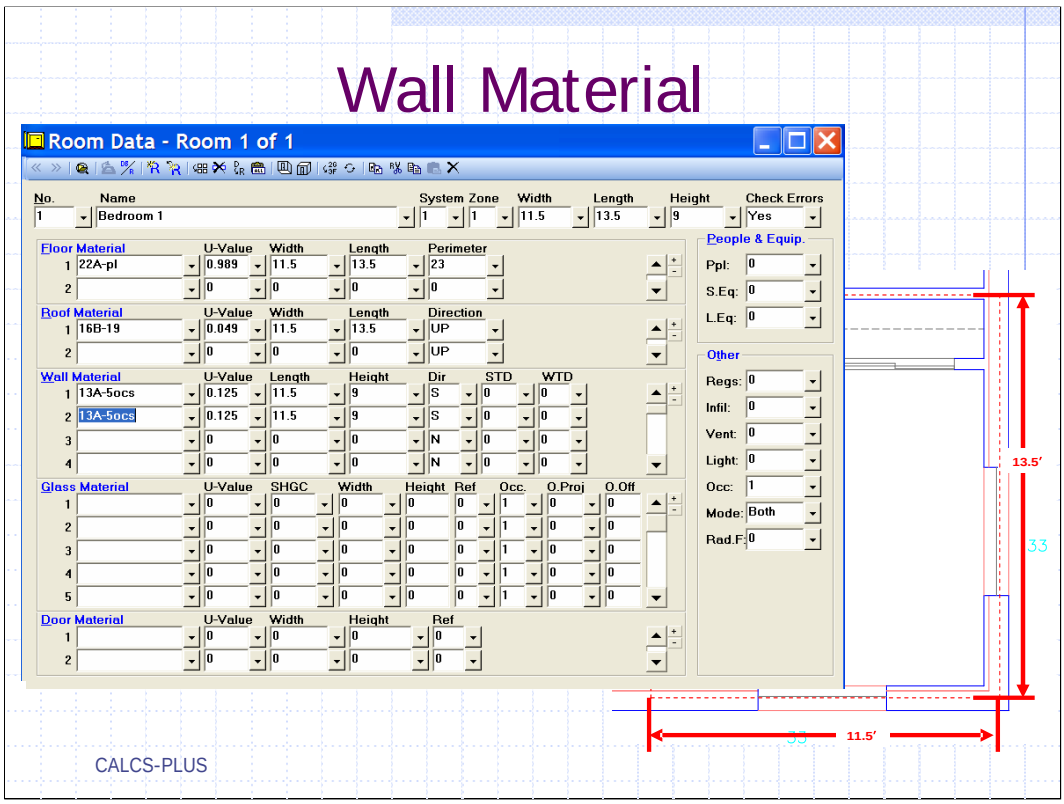
In the “Wall Material” box hit the F5 key and the wall material previously set up in the default room appears. The room height is copied but the length is set to zero, direction is North and there is something called STD and WTD. Enter the length of the front facing wall for Bedroom 1 and move to the “Dir” box.



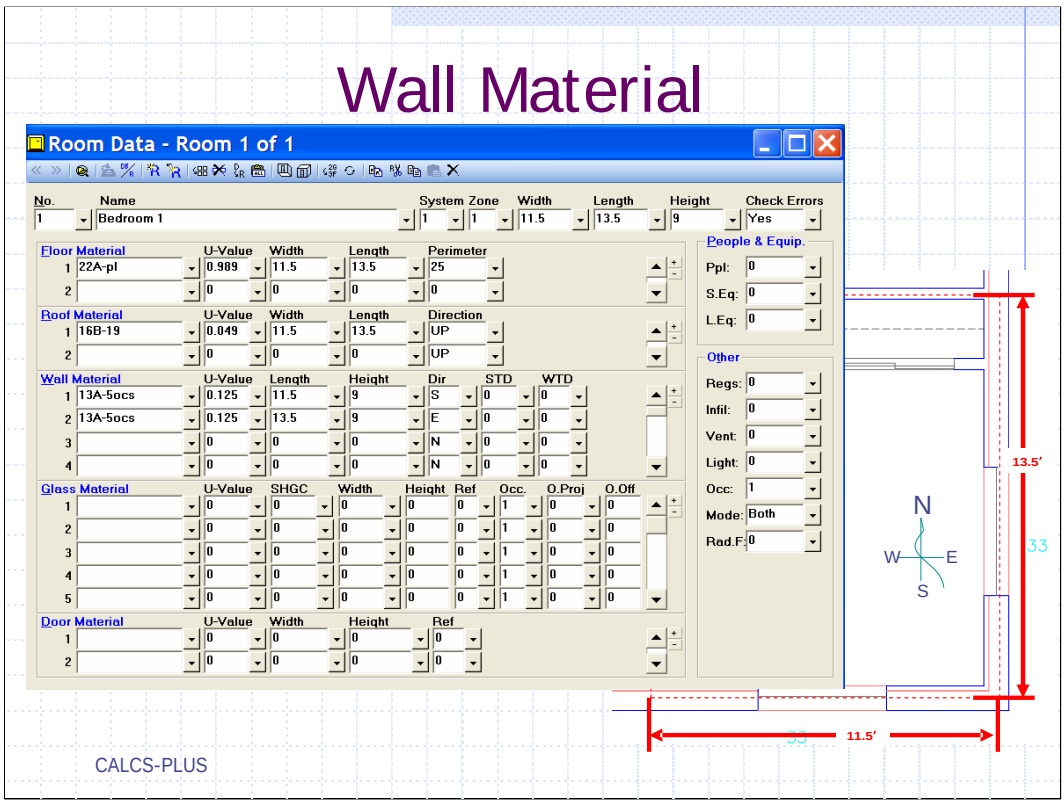
The orientation arrow on the plan shows that the back of the home is to the North, so the front is south, enter a S in this box for “South”.



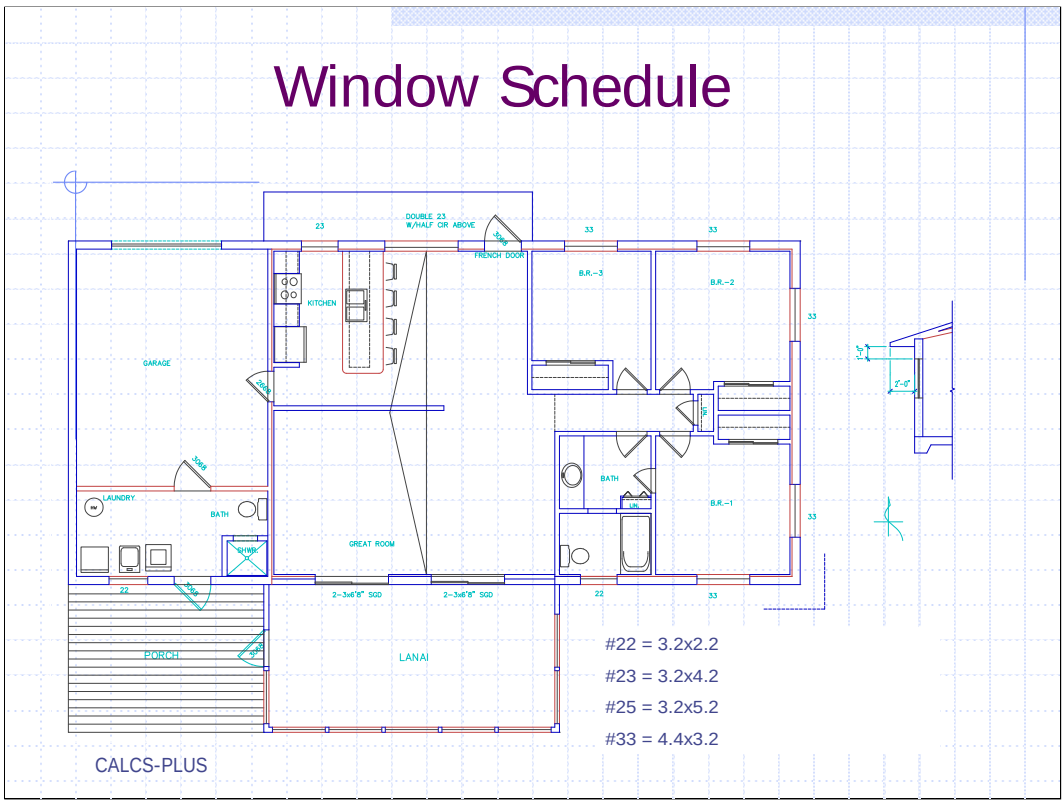
STD (summer temperature difference) and WTD (winter temperature difference) are used when the wall is adjacent to an un-conditioned space such as a garage. Move to the first empty box under “Wall Material” to enter in the East wall for Bedroom 1.



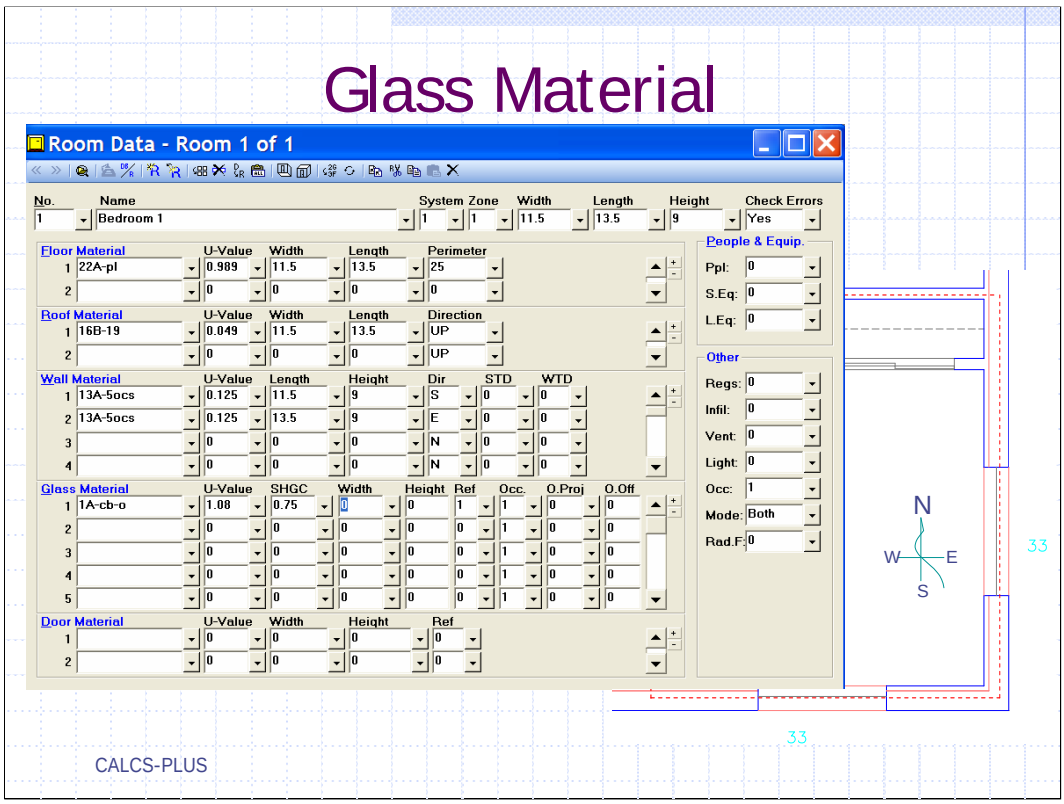
In this software program hitting the F5 key will copy Wall 1 into Wall 2 which is OK, all we will need to do is edit the Length and Direction



Once this has been done and we have accounted for all of the exterior walls we can move to the box under Glass Material.

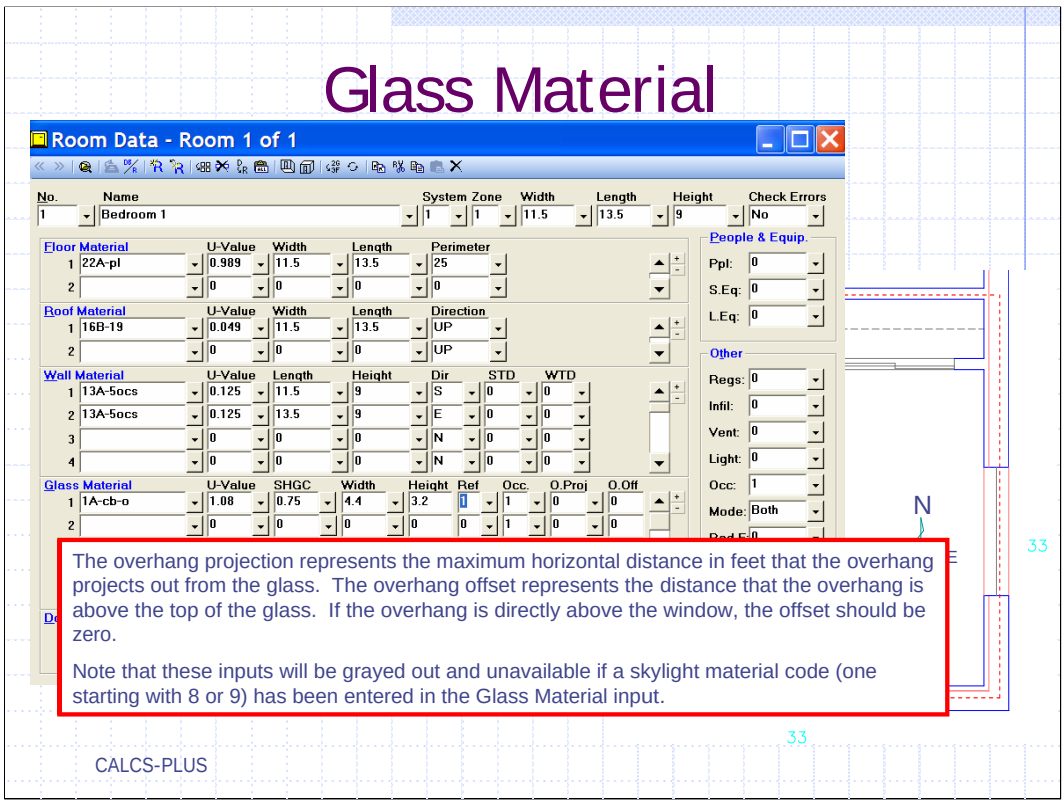


Hopefully some place on the plans there will be a window schedule. It is always important to use the correct window size and just as important to know the U-values and SHGC (solar heat gain coefficient). If this information is not on the plans it may take a few telephone calls to get it but as glass is one of the major transmittance factors of heat gain and loss it is worth the effort.



Again hitting the F5 key will enter the glass material that was set up in the default room data we originally set up. This is a bedroom so we can safely assume that there will be some kind of window covering. Enter in the width and the height of the glass. Opening the glass material window will allow you to ad drapes to this window.

Glass Material



After we enter the width and height the next box is the “Ref “ (reference) box. This is where you tell this software what wall the window is attached to. “Occ” is the number of (occurrences) windows of this same size and type are in this wall; in this case 1. “O.Proj” and “O.Off” is the overhang projection and overhang offset.

Overhang Projection and Offset

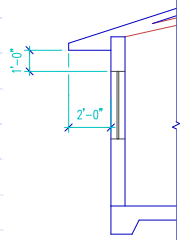
Table 3E-1 from ACCA MJ8 (to the right) is a calculation for HTM adjustment factor.

All of the ACCA approved MJ8 software will do these calculations in the background

The sample house has a 2′ overhang and the top of the window is 1′ from the bottom of the overhang.

O.Prog = 2′

O.Off = 1′



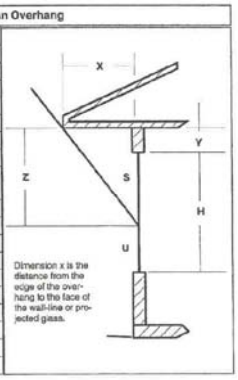
CALCS-PLUS

Heat Gain Adjustment For Generic and NFRC Rated Fenestration
HTM Adjustments for Overhang, Foreground Reflectance, Latitude and Internal Shade Color
Average Load and Peak Load Procedure

Table 3E applies to the average and the peak load procedures. The adjustment procedures for shade by an overhang and foreground reflectance apply to generic and rated fenestration. The HTM adjustment procedures for latitude and internal shade color only apply to generic fenestration (the rated fenestration HTM equations are sensitive to latitude and shade color). Table 3E-5 is used to estimate the shading coefficient for an unrated or undocumented sun screen. Table note 2 (page T3I-4) specifies the order of application of the HTM adjustment procedures.

HTM Adjustment For Shade By An Overhang

Shaded Glass Area Calculation	Operation	Window #1	Window #2	Window #3
A) Direction glass faces				
B) Overhang distance	X (Ft)			
C) SLM value at latitude =				
D) S-line to overhang (Z Ft)	Z = X ± SLM			
E) Top of opening to overhang	Y (Ft)			
F) Shaded glass height (S Ft)	S = Z - Y			
G) Height of opening	H (Ft)			
H) Unshaded glass height (U Ft)	U = H - S			
I) Width of opening	W (Ft)			
J) Shaded area (SqFt)	S x W			
K) Unshaded area (SqFt)	U x W			
L) Adjusted HTMN (From Worksheet J, JJ, B or BB)				
M) Adjusted HTMD (From Worksheet J, JJ, B or BB)				
N) Btuh gain for shaded area	Lines: J x L			
O) Btuh gain for area in sun	Lines: K x M			
P) Btuh gain for entire assembly	Lines: N + O			
Q) Total assembly area (SqFt)	H x W			
R) HTM_{OH} for entire assembly	Lines: P / Q			



Dimension x is the distance from the edge of the overhang to the face of the wall-line or projected glass.

Midsummer Shade Line Multiplier Values (SLM)

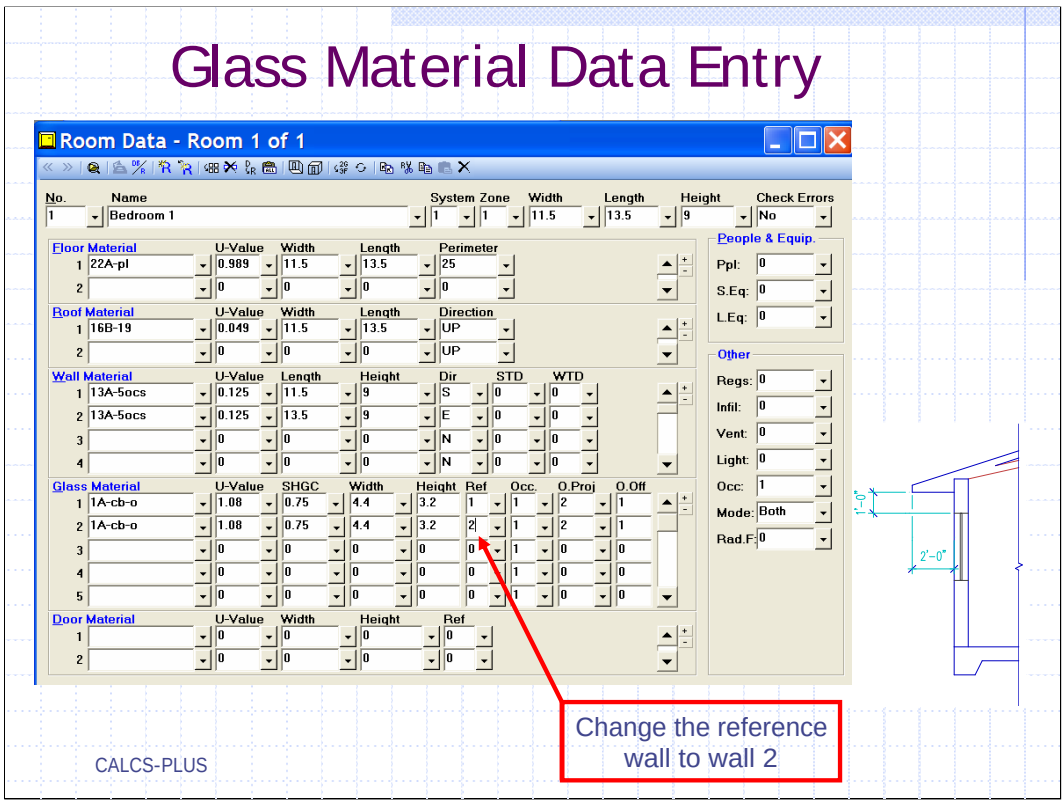
Direction of Exposure	Degrees North Latitude 25	30	35	40	45	50
East and West	0.83	0.83	0.82	0.81	0.80	0.79
South-East and South-West	1.89	1.63	1.41	1.25	1.13	1.01
South	10.1	5.40	3.53	2.80	2.05	1.70

1) Use this table to determine the shaded and sunlit areas of a generic or NFRC rated window or glass door shaded by an overhang. Refer to Section 6-14 for discussion and examples pertaining to its use.
2) Shade line multiplier values are for August — East at 8 to 9 am; West at 3 to 4 pm; South-East at 9 to 10 am; South-West at 2 to 3 pm and South at 3 to 4 pm.

Table 3E-1

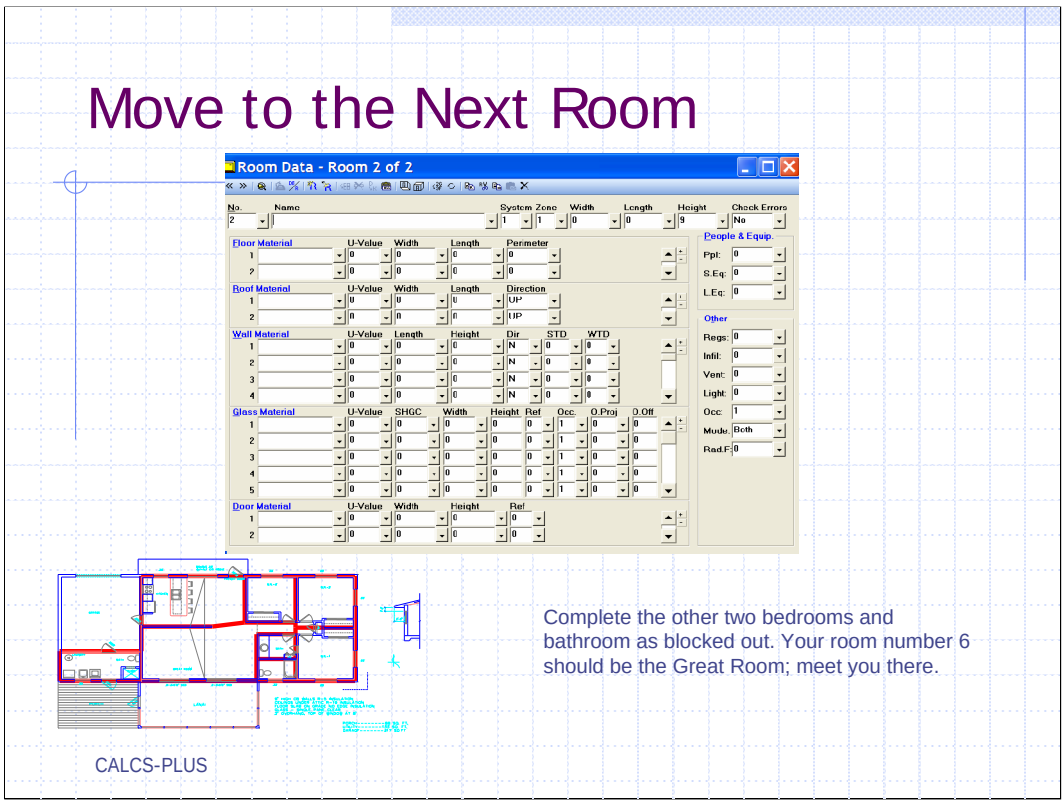
T3E-1

Table 3E-1 from ACCA MJ8 (to the right) is a calculation for the HTM adjustment factor. The adjustment procedures for shade by an overhang and foreground reflectance apply to generic and rated fenestration. All of the ACCA approved MJ8 software will do these calculations in the background.

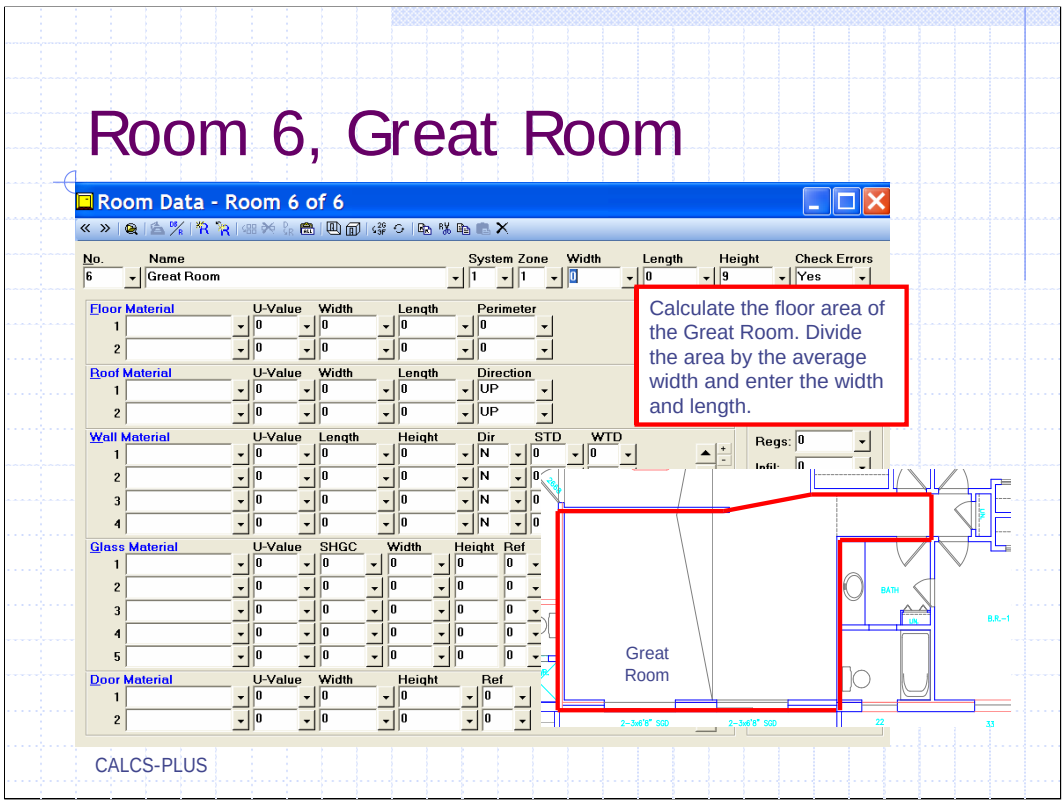


Enter 2 in O.Proj and 1 in O.Off. Hitting the enter key will bring us to the Glass Material 2 box. Hitting the F5 key will copy the glass from 1 to 2.

Change the reference wall (Ref) to wall 2 which is the East wall.

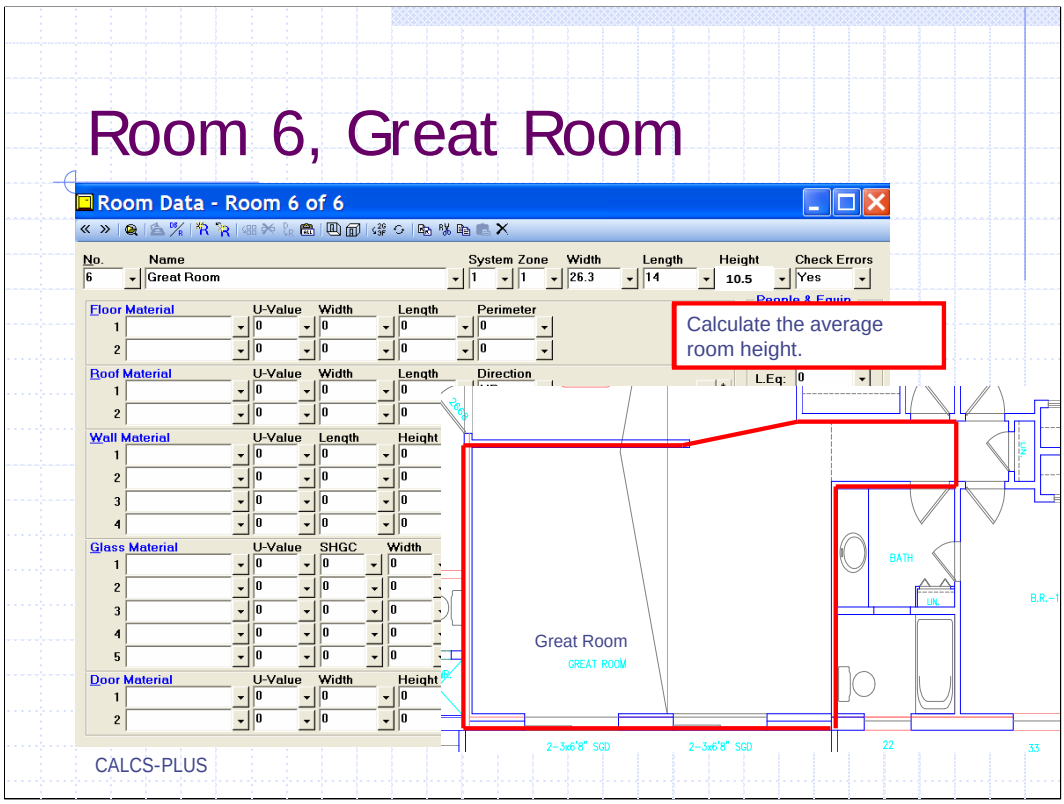


We have entered all the information relating to this bedroom and now we can move on to the next room. In this software package you can hit the F2 key which will bring up the second room. Move to Bedroom 2 and repeat the same procedures as in Bedroom 1. Following the schematic, also complete Bedroom 3, Bathroom Powder Area, Bathroom Tub Area, and I will meet you in the great room.

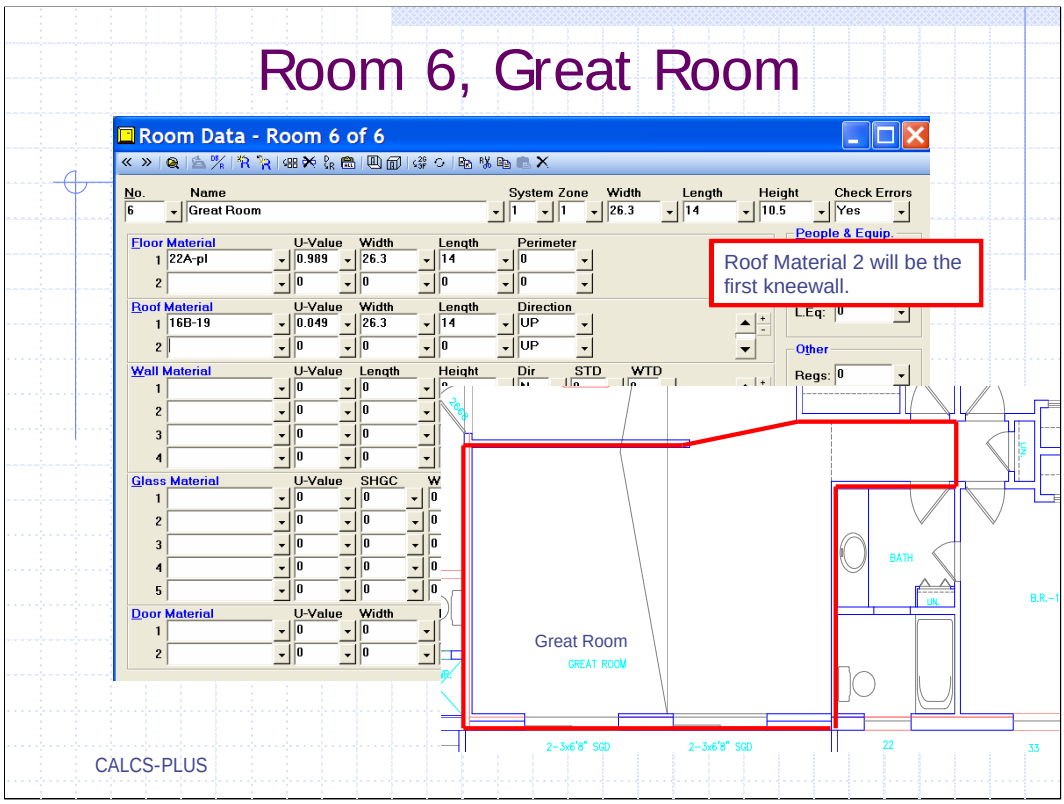


The Great Room has several different features to it that make it unique to other rooms such as bedrooms and bathrooms. Not only is the occupant type different but this room also has a cathedral ceiling that incorporates pre-manufactured trusses which makes the space above the cathedral a vented space. The room also has two kneewall areas that we must include in the calculation. We also have a different glass type instead of windows they are sliding glass doors.

Room 6, Great Room



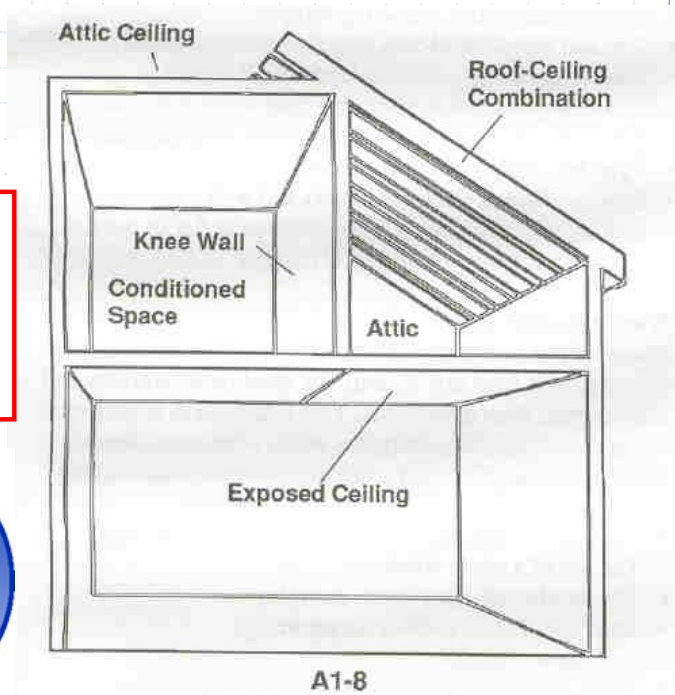
The Great Room has a cathedral ceiling so the average room height is higher than 9’ as set up in the default room. The draftsman has drawn a section of the cathedral on the floor plan which makes it easer to figure the average room height.



Enter the floor material and the roof material. This room has two kneewalls, one to the east and the other to the west. MJ8 considers any wall that is adjacent to a vented attic as a kneewall

Knee Wall

Figure A1-8 in the Appendix of ACCA MJ8 pretty well defines a knee wall as any wall that is adjacent to the attic.



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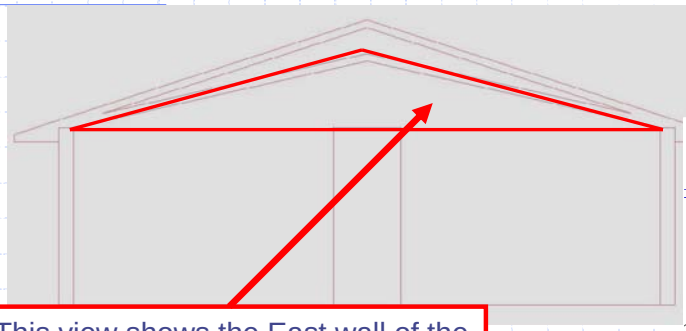
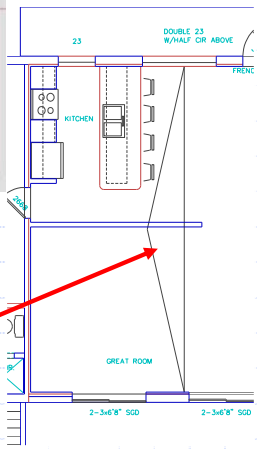
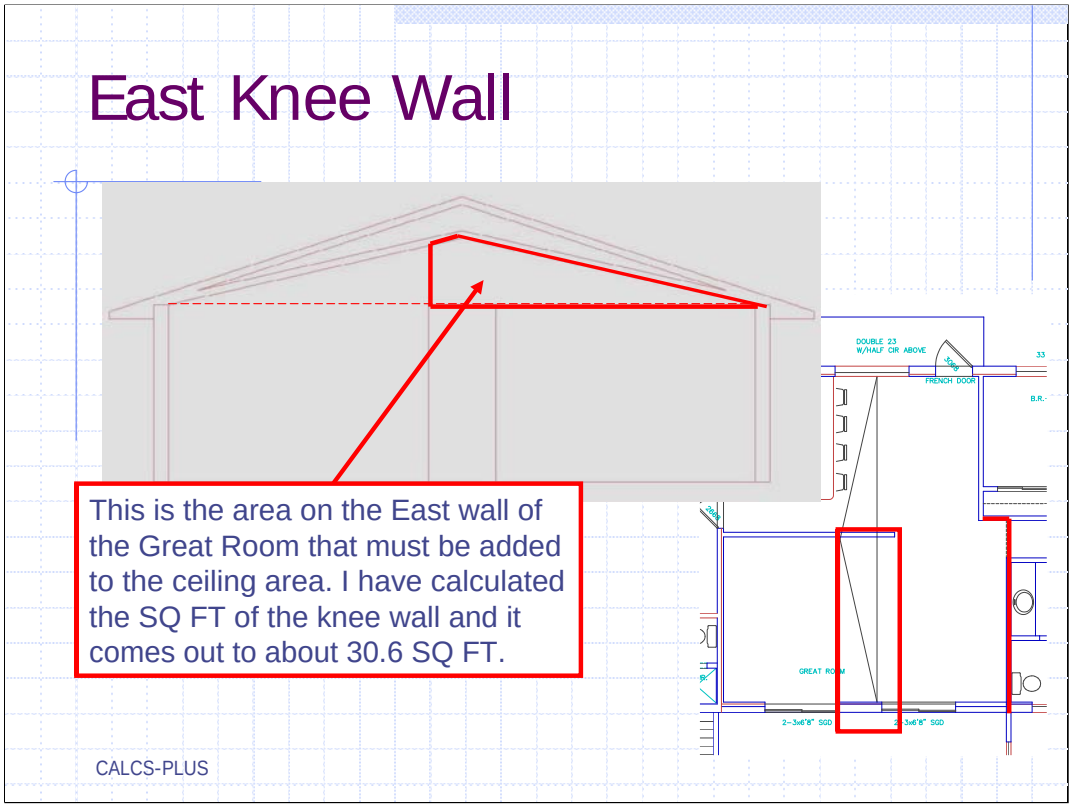
When it comes to HVAC load calculations the building envelope is the air barrier (in contact with the thermal barrier) that separates the conditioned space from the unconditioned space. Basically all we are doing is calculating the heat transfer across the building materials that make up the building envelope. But sometimes it's hard to decide if a certain part of the envelope is a wall or part of the ceiling.

Knee Walls

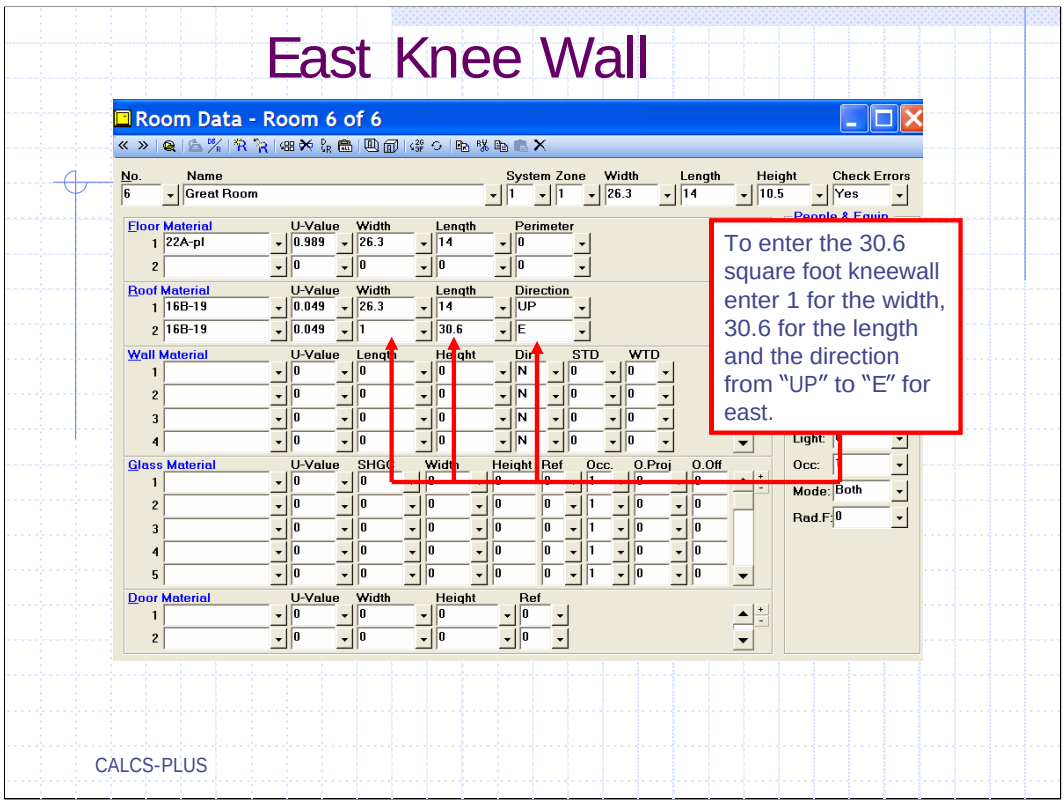




This view shows the East wall of the Great Room; the west wall will look much the same. Any area of the wall above the normal 9′ ceiling height will face the vented unconditioned attic. The area is easer to calculate by drawing it to scale on the floor plan.

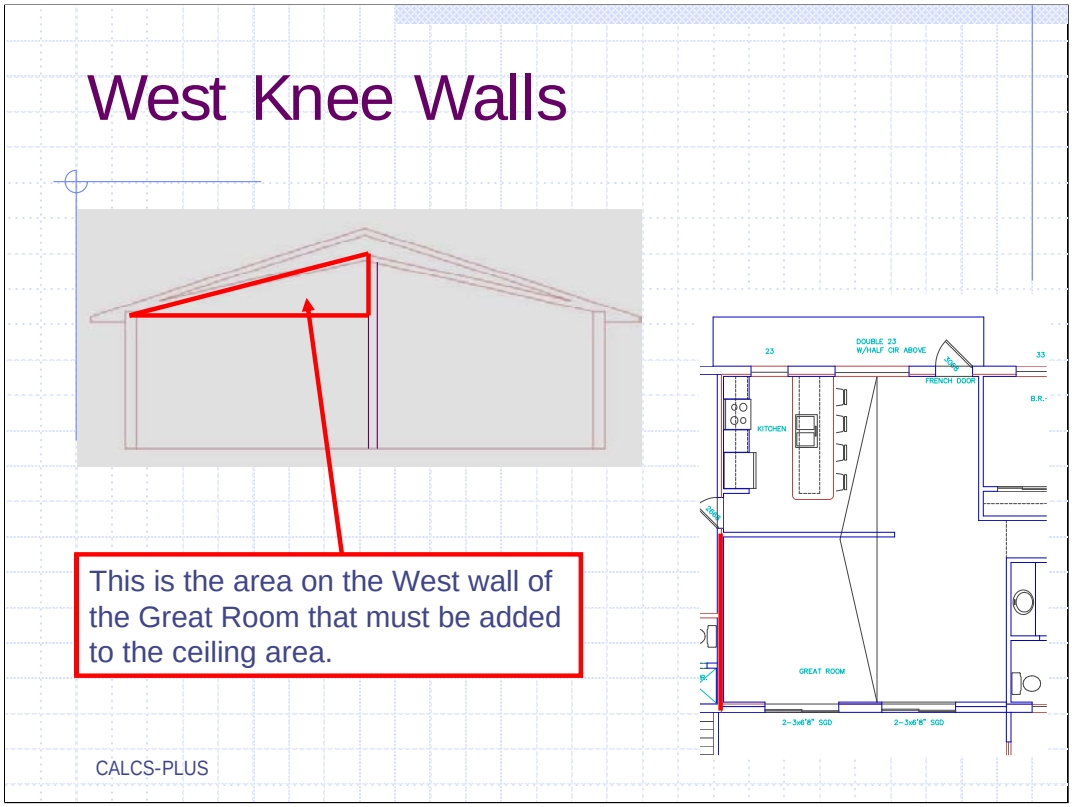


Calculate the area of the east kneewall and enter it as Roof Material #2.



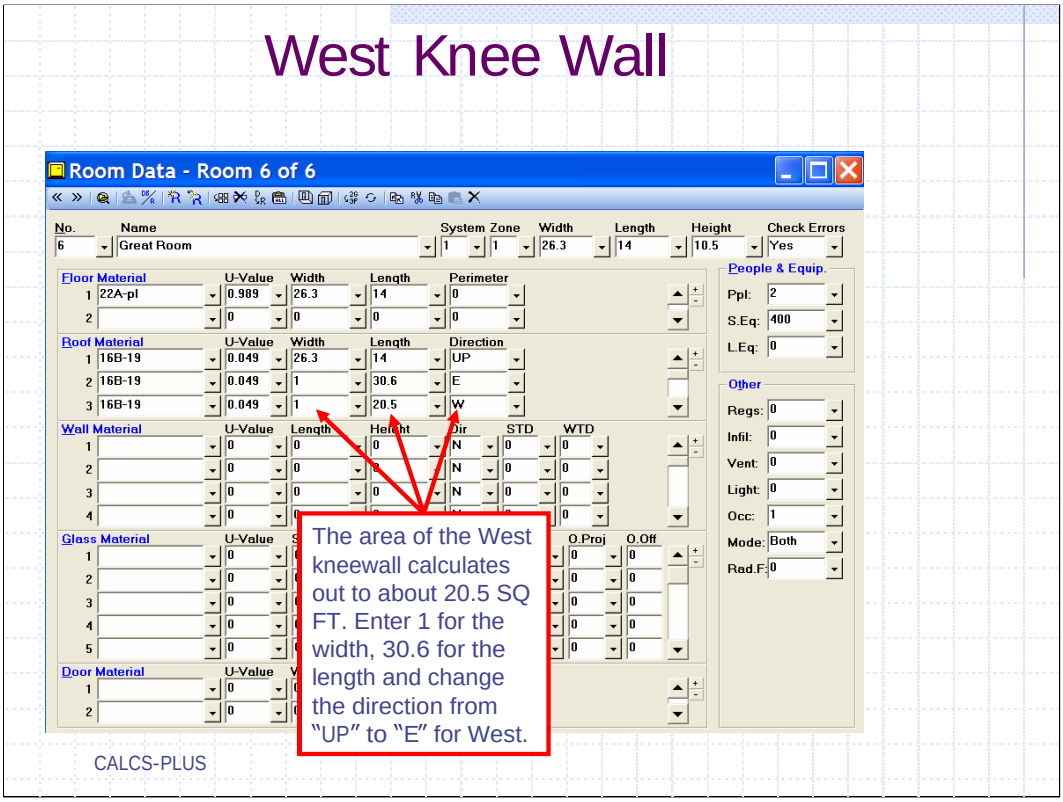
In this program hitting the F5 key will return a copy of Roof Material 1. You would normally have to just edit the width and length. The area of the east kneewall is 30.6 SQ FT. This can be entered as a Width of 1 and a length of 30.6. Change the direction from UP to E for east. Typically we assume that kneewalls are insulated with the same R value but that's not always true, Some times kneewalls will be insulated with a slightly lower R values. So the "Roof Material may have to be edited.

If your software is capable of exporting data as an ENB file into EnergyGauge USA® it helps to give all kneewalls a "Roof Material" number slightly different than the one we used in the default setup. This will help to identify the kneewalls after file transfer to insure that the kneewalls were labeled properly in EnergyGauge USA® (more on this later).

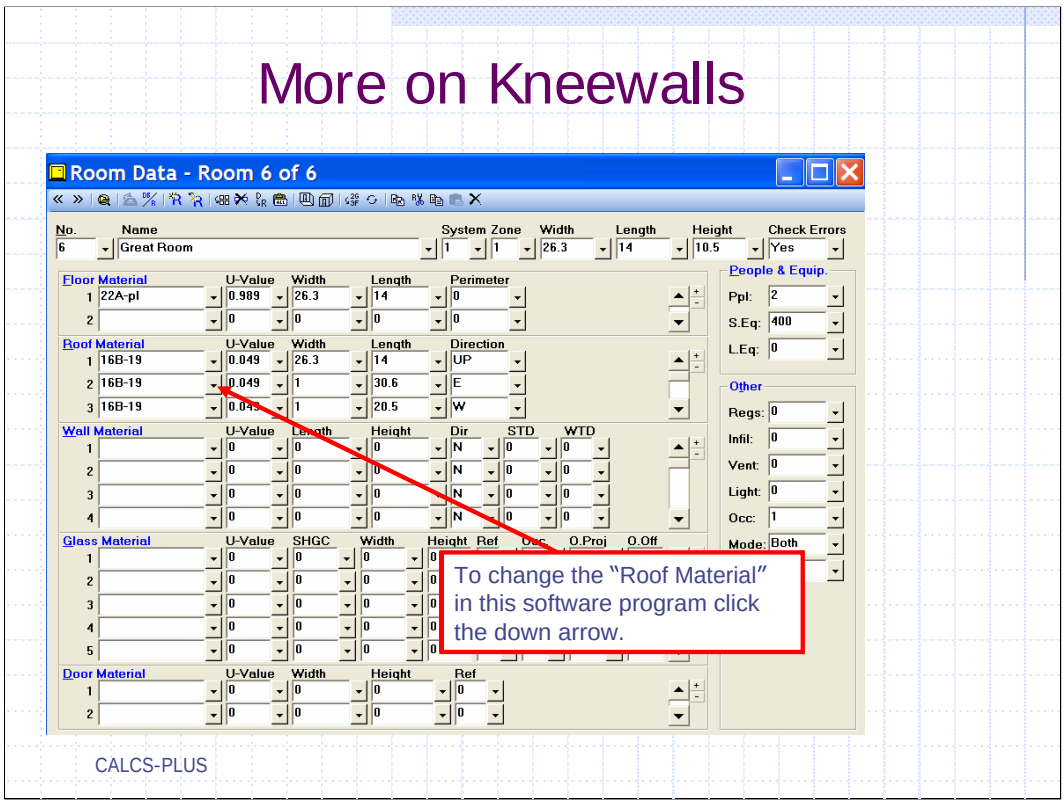


The area of this kneewall is about 20.5 SQ FT.

West Knee Wall

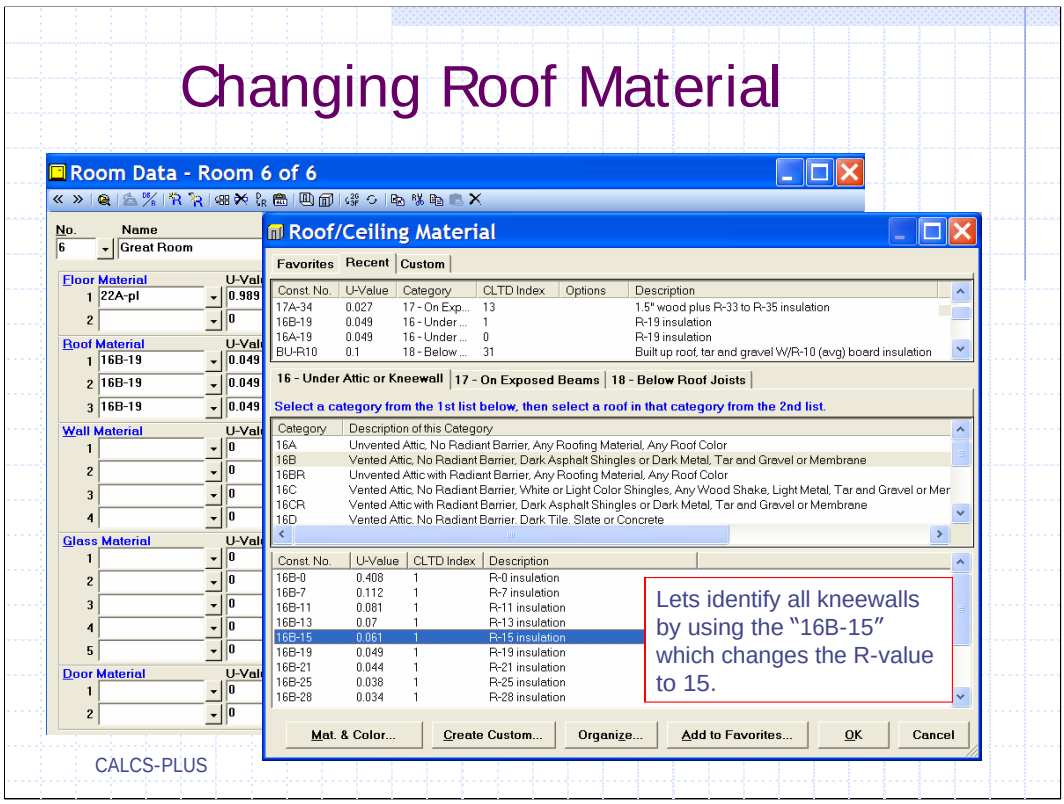


The West kneewall can be entered and edited the same way.



As I mentioned above, if you are using EnergyGauge USA® for your rating software, slightly lowering your R-value for the kneewalls will help you to identify them after exporting from your MJ8 software into USA. In most software programs its easy to change from one material type to another by doing a "Global Material" change. To change the "Roof Material" in this software program click the down arrow.

As raters we know what happens to kneewalls, the insulation doesn't always stay in place.

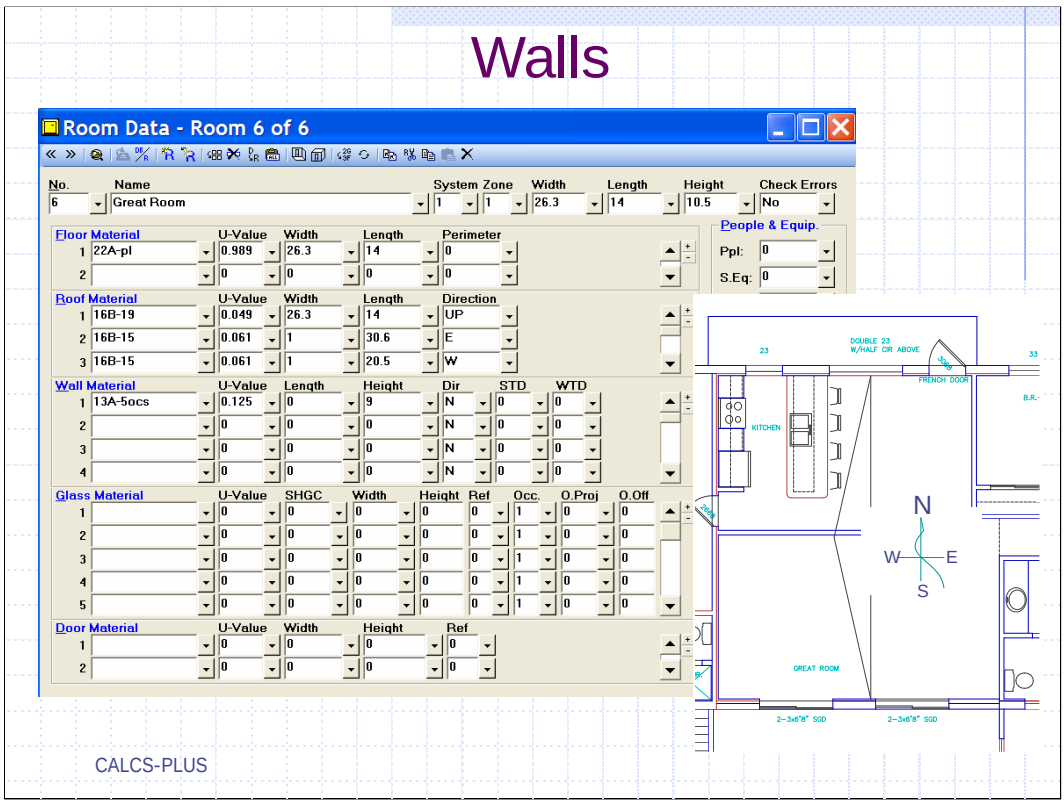


Lets identify all kneewalls by using the "16B-15" which changes the R-value to 15.

Real World Kneewalls

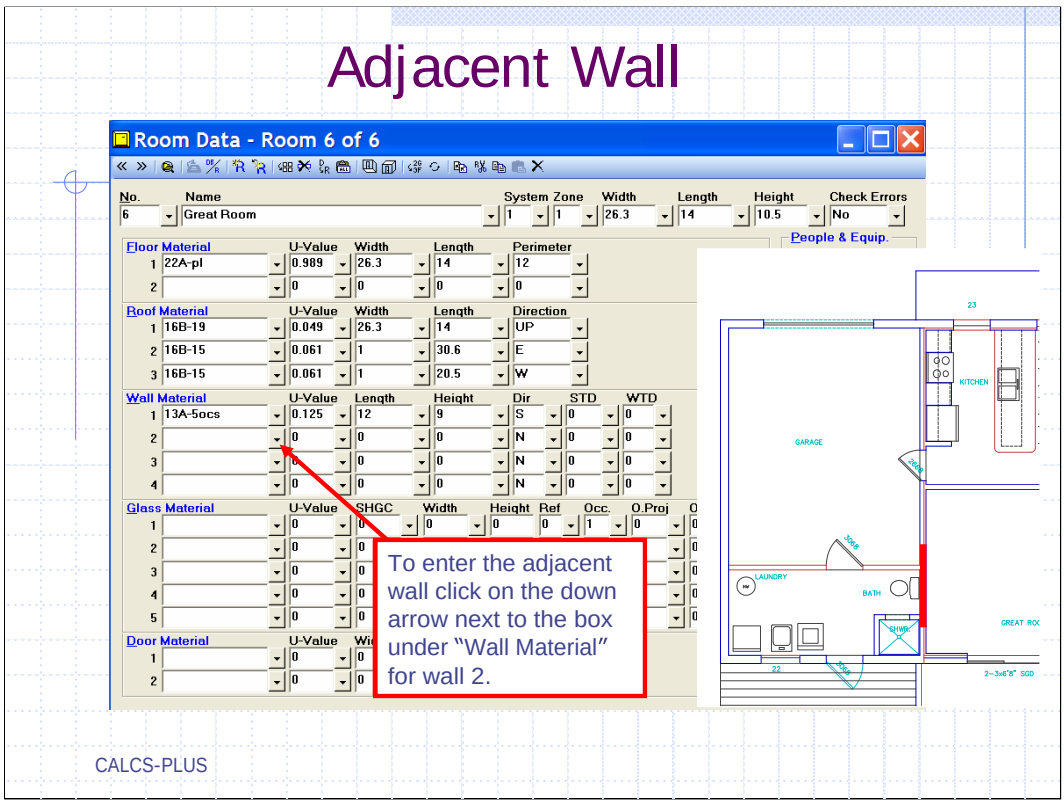
CALCS-PLUS

This is typically what we find in the field a few years after the home is built. So what do you think the average R-value of the insulation on this knee wall is?

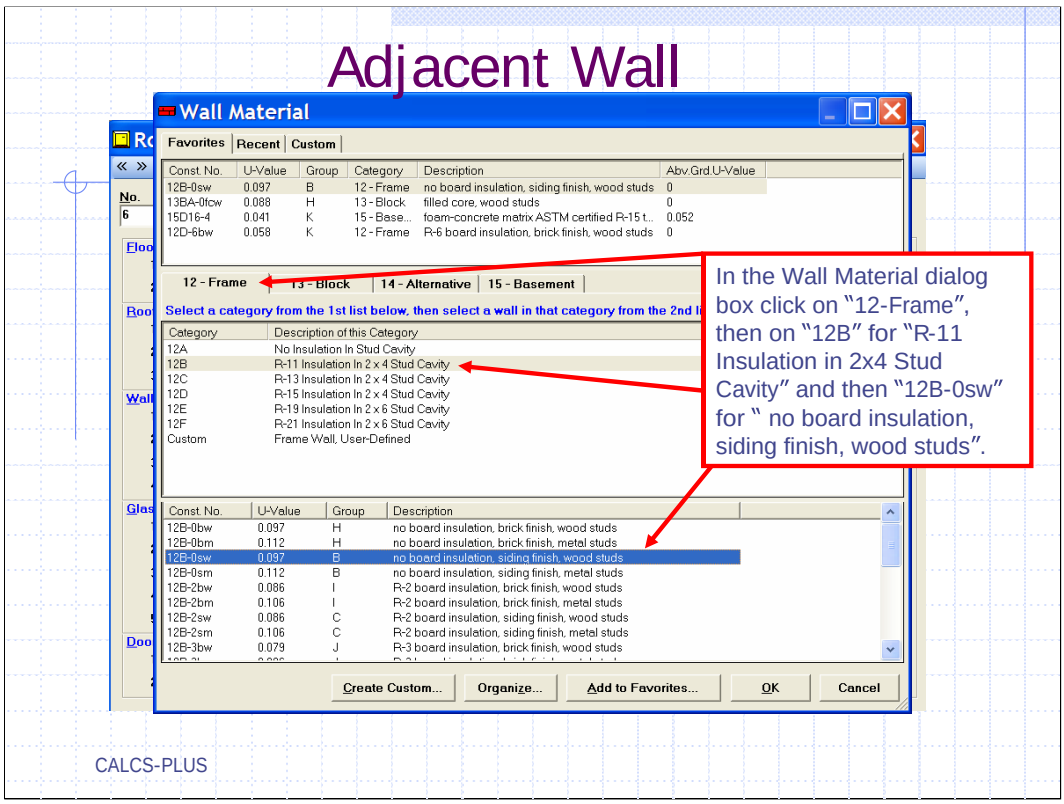


Now that the roof & knee walls for this room are completed we can move on to walls. In this program hitting the F5 key while in the “Wall Material” box will enter the default wall. All we have to do is enter the length of the wall and the direction (Dir). Enter in the length of the South wall.

Adjacent Wall

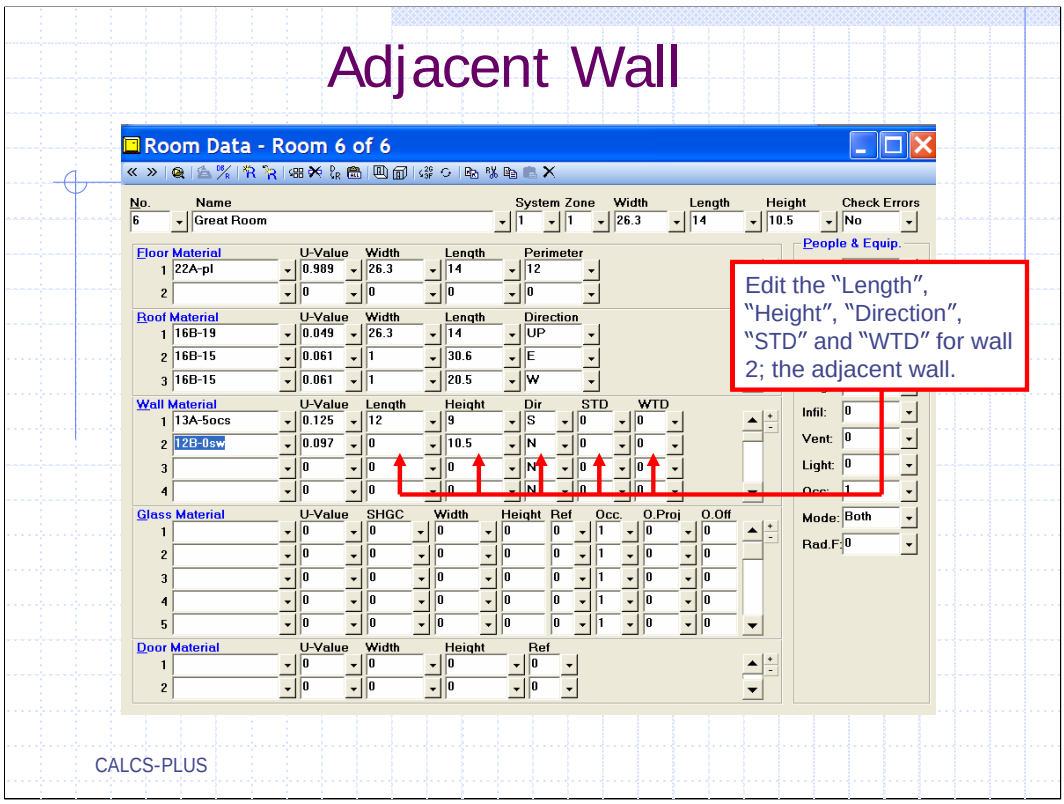


Adjacent walls are those walls that are adjacent to unconditioned spaces. Those unconditioned spaces could very well be at a different temperature than outdoor conditions. In this case the Great Room has an adjacent wall that separates it from the garage. The adjacent wall is a wood frame wall with R-11 batt insulation.

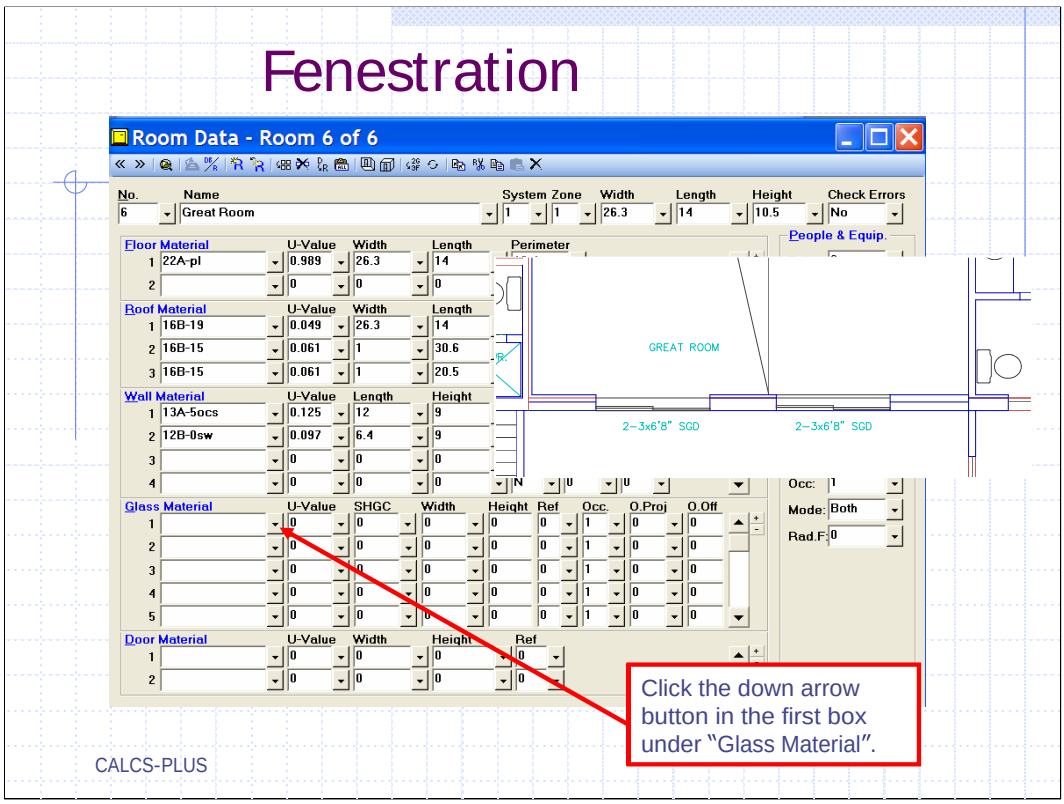


Click the down arrow to enter the wall material box and select the wall that will match the great room's adjacent wall.

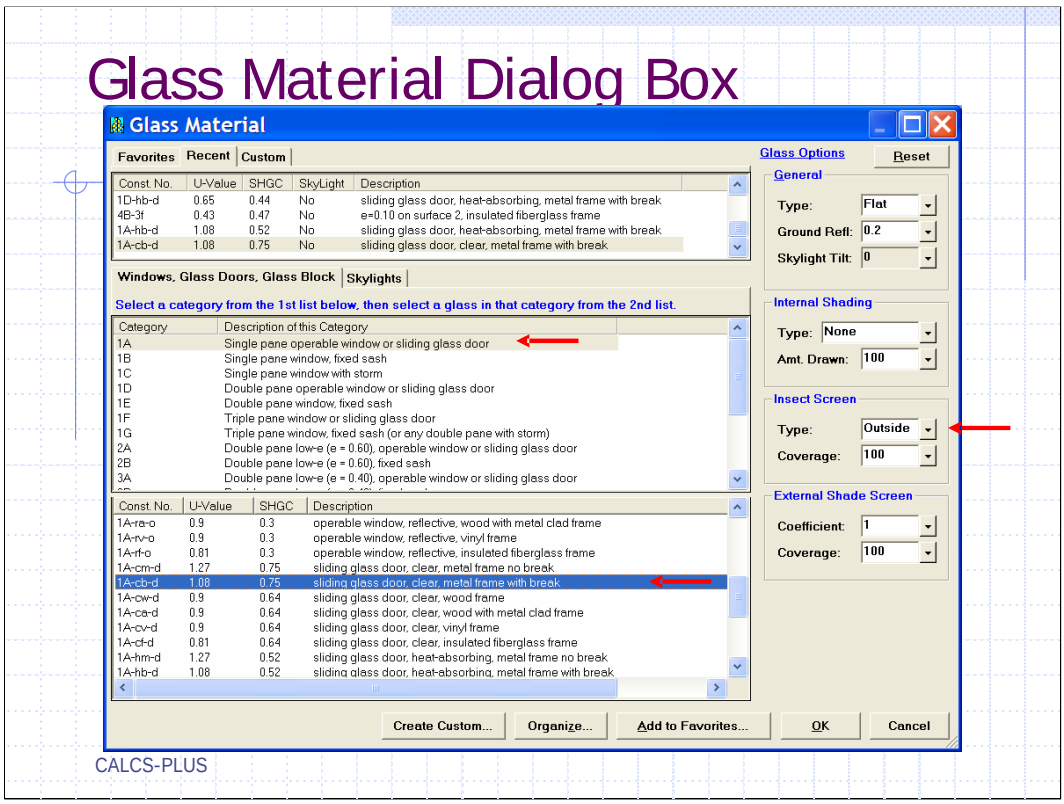
Adjacent Wall



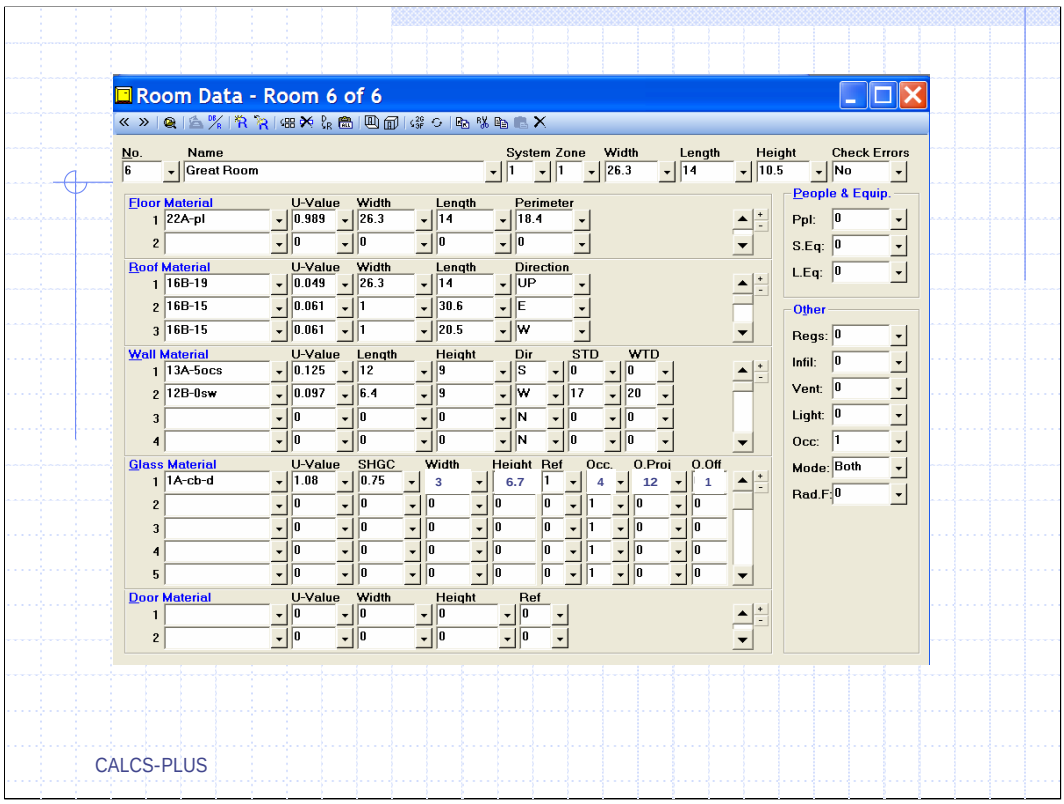
After the wall material type has been selected we will need to enter the length of the wall, the wall height (the software program automatically copied the average room height as the wall height), the direction, the "STD" and the "WTD". It is the "STD" and the "WTD" that makes this an adjacent wall. The "STD" is the summer temperature difference and the "WTD" is the winter temperature difference.



Enter the fenestration for the Great Room. Notice that the glass area consists of sliding glass doors which is a little different than operable windows.

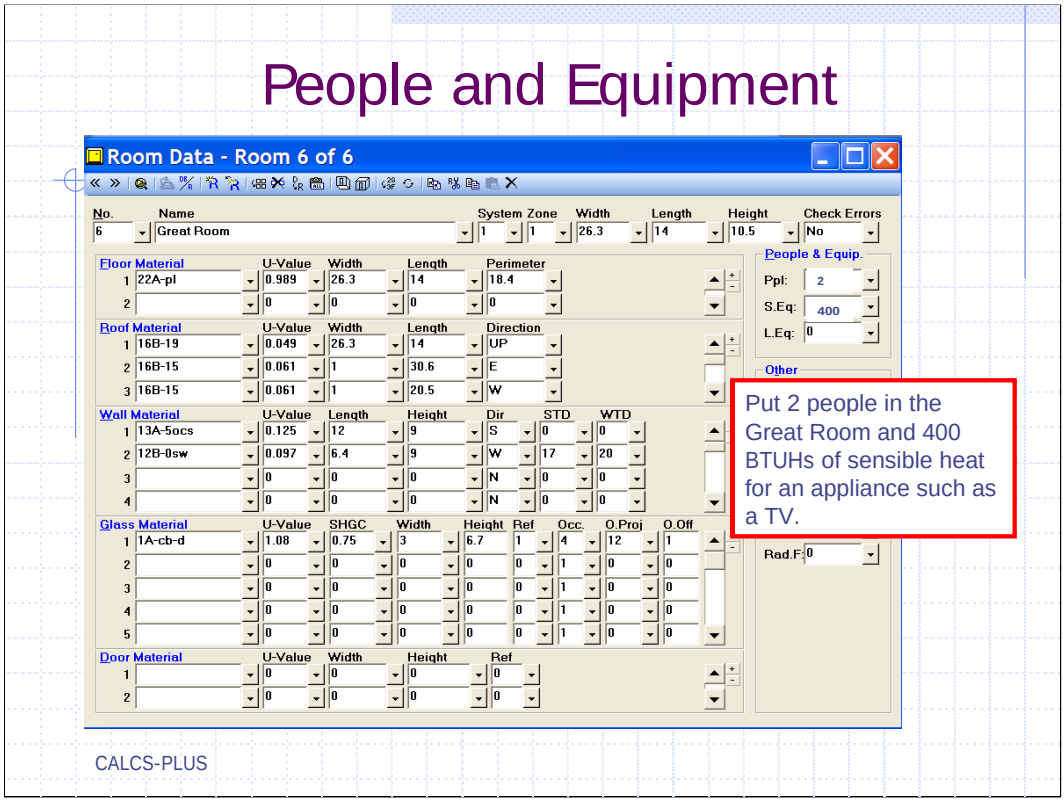


In the glass material dialog box we will choose “1A” for “Single pane operable window or sliding glass door” then “1A-cd-d” for “sliding glass door, clear, metal frame with break”. Since this glass is in the great room we will assume no internal shading, because the glass is surrounded by a lanai with an insect screen we can take 100% “Insect Screen” shading.

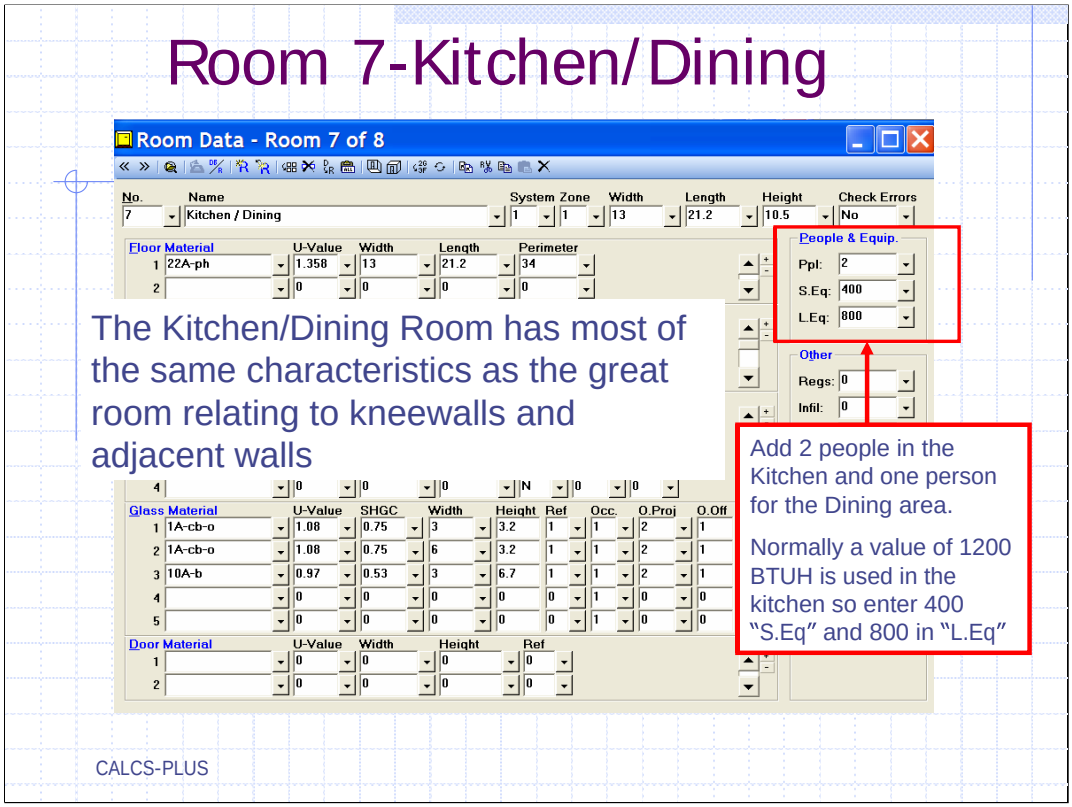


There are two sets of sliding glass doors or four doors total; each is 3’ wide by 6’8” high. Enter 3 for the “Width”, 6.7 for the “Height”, leave the “Ref” (reference wall) to 1, enter 4 in “Occ” (occurances, the number of times this piece of glass is in the wall). The lanai goes out 12’ so the “O.Proj” is 12 and the top of the glass is 1’ under the lanai ceiling so use 1 for the “O.Off”

People and Equipment

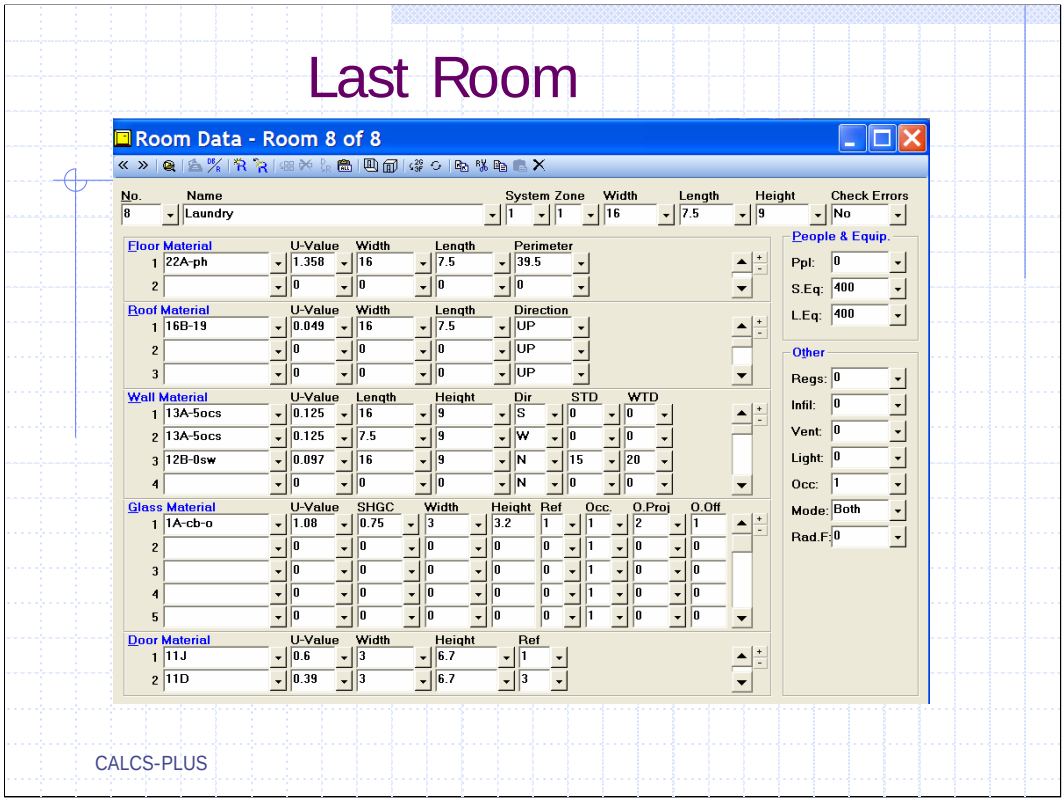


Before we move on to the next room we should add some internal heat gain to this room. Internal heat gain loads consist of people and appliances. The number of people is based on the number of bedrooms in the home plus 1. People are never put in bedrooms, they are put in the rooms that will be occupied around 5 PM. We will put 2 people in the “Ppl:” box. We will also enter 400 BTUH in “S.Eq:” (sensible heat of equipment) to cover an appliance such as a television.

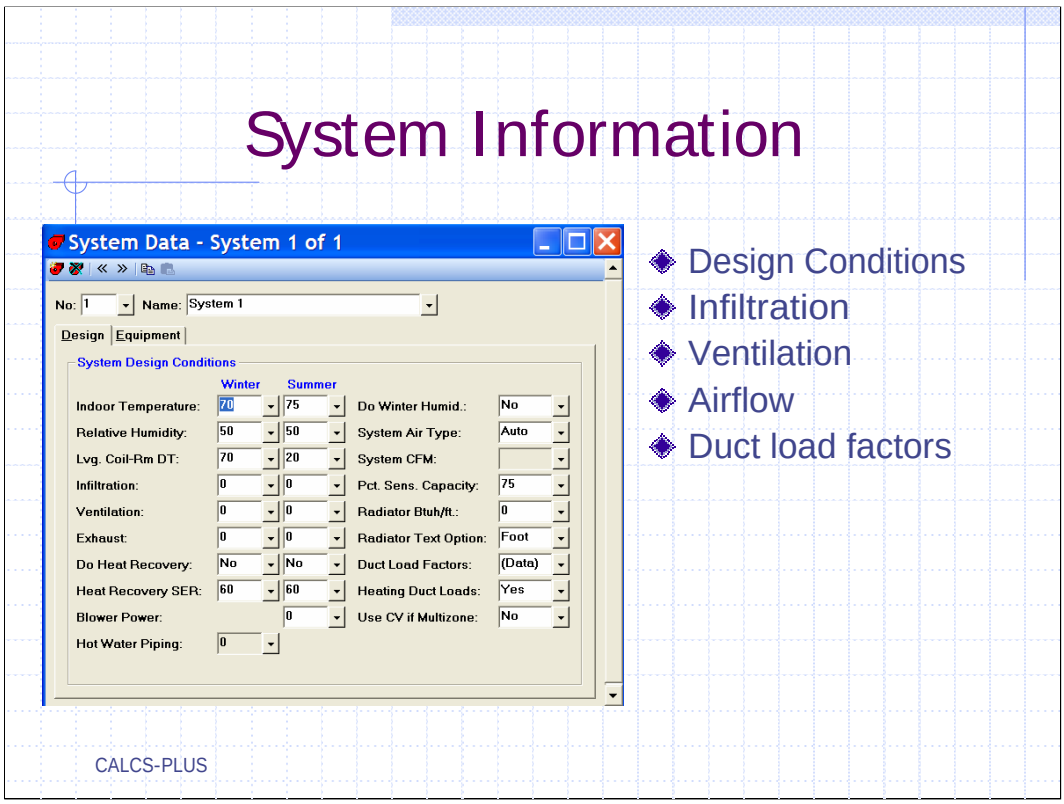


The Kitchen/Dining Room has most of the same characteristics as the great room relating to kneewalls and adjacent walls. It will also have 2 people and both sensible and latent heat added for appliances and cooking.

Last Room



The laundry is the last room, enter in all the pertinent data including some sensible and latent for cloths washing equipment.

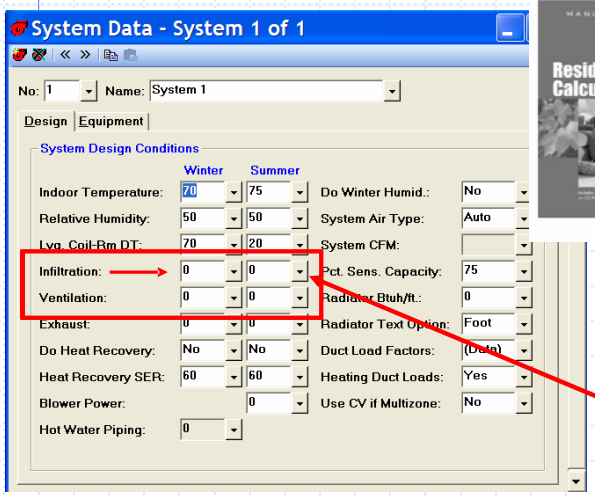


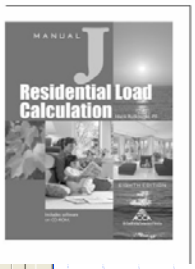
System information can be inputted before you start the take-off or after. In this software package “Duct Load Factors” is part of the system information along with indoor conditions, infiltration/ventilation, system airflow, etc. “Duct load Factors” cannot be completed until all of the room data has been completed because duct loads are a calculation in itself and is based on duct surface area.

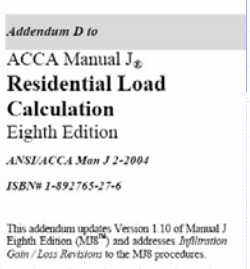
Design conditions are easy, just use MJ8 suggested conditions, 70º for indoor winter temperature, 75º for indoor summer temperature. Use 50% for the design relative humidity.

The “Lvg. Coil-Rm DT” stands for the temperature difference between the conditioned room ambient temperature and the leaving coil temperature. This value represents the difference in degrees Fahrenheit between the air entering the rooms which are in the system and the inside design temperature of the system. For example, if 140 degree air (winter heating) enters the room which is in a system with a 70º indoor temperature, the leaving coil-room ΔT would be 70º. For summer a typical ΔT would be 20º; 75º room temperature and 55º leaving coil temperature.

Infiltration or Ventilation







Infiltration rates can be guessed at by using the information in Addendum D to ACCA Manual J.

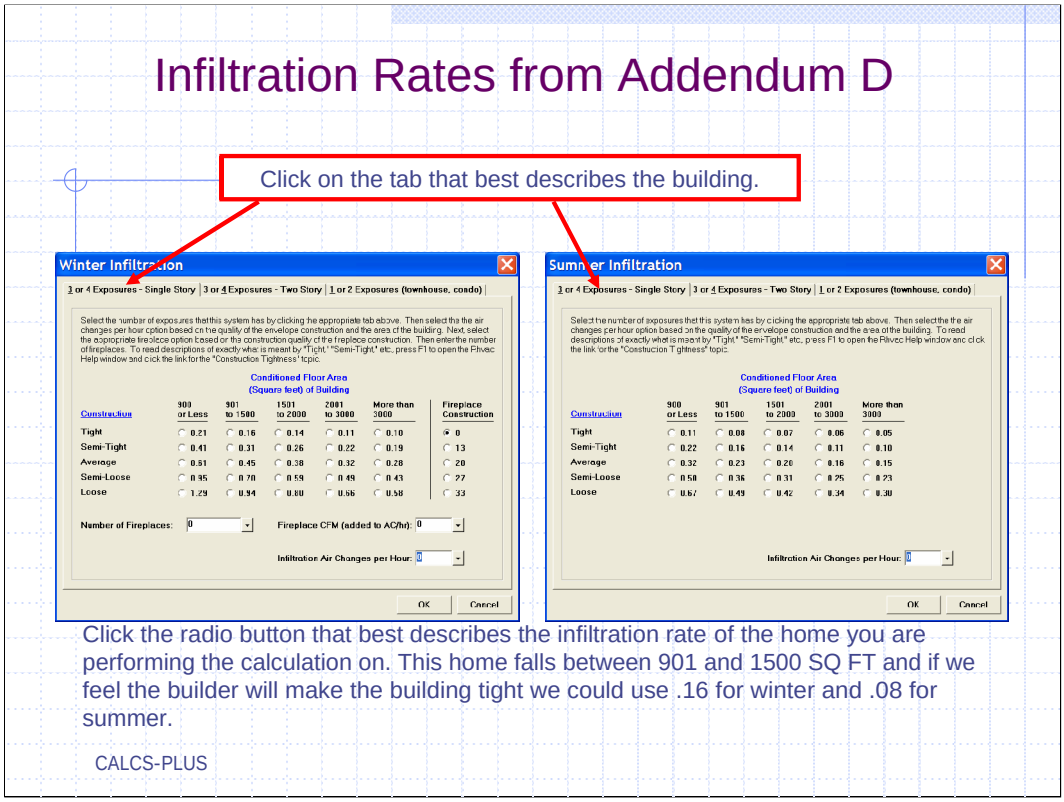
To do so, click the down arrow button.

CALCS-PLUS

There has been a lot of talk on which to use, we don't want to use both. As energy raters we can test the building and enter the actual tested natural infiltration rate for winter and summer. The results of a Blower Door Test can be entered into the boxes to the right of "Infiltration". But typically in new construction HVAC load calculations are performed from plans before the home is built.

If we want to use the suggested infiltration rates in Addendum D then click the down arrows in the two infiltration boxes.

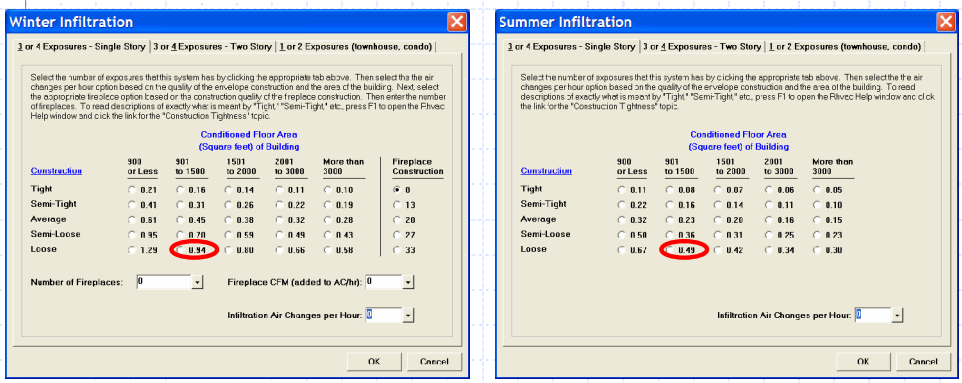
Instead of using infiltration we can input ventilation, if doing so we should use the criteria in ASHRAE Standard 62-2; 7.5 CFM per person + .01 CFM/SQ FT.



Addendum D gives suggested infiltration rates. But remember this is a leap of faith; if you know the builders construction practices then you can make an educated guess.

The effects of Infiltration

"What if" the home was very loose? Use .94 for winter and .49 for summer.



Infiltration: Winter CFM: 190, Summer CFM: 99	5,222	3,998	1,741	5,739
Ventilation: Winter CFM: 0, Summer CFM: 0	0	0	0	0

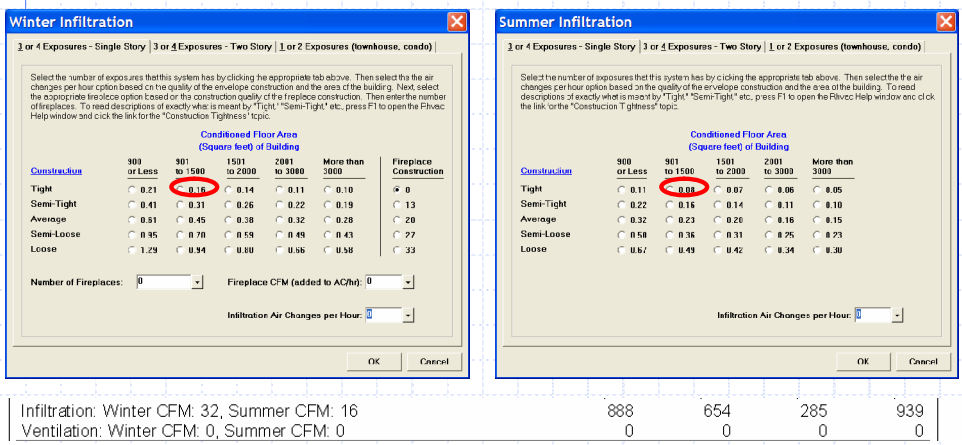
The winter heat loss is 5,222 BTUH and the summer heat gain is 5,739 BTUH

CALCS-PLUS

One of the nice things about computer programs is the ability to do "what if" calculations. If we used the "Loose" construction, .94 ACH for winter and .49 for summer we can see the results. The winter heat loss from 190 CFM of natural infiltration will be 5,222 BTUH; the summer heat gain will be 3,998 BTUH sensible and 1,741 BTUH latent, totaling out to 5,739 BTUH heat gain.

The effects of Infiltration

But if we consider the same home very tight and use .16 for winter and .08 for summer.



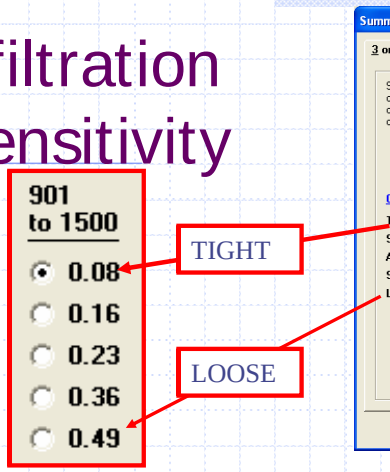
Infiltration: Winter CFM: 32, Summer CFM: 16	888	654	285	939
Ventilation: Winter CFM: 0, Summer CFM: 0	0	0	0	0

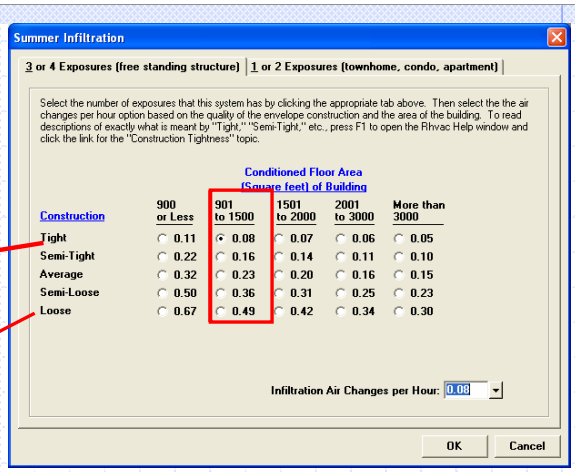
The winter heat loss is 888 BTUH and the summer heat gain is 939 BTUH

CALCS-PLUS

If we use a “Tight” construction scenario the winter heat loss reduces to only 888 BTUH and the summer heat gain reduces to 939 BTUH

Infiltration Sensitivity





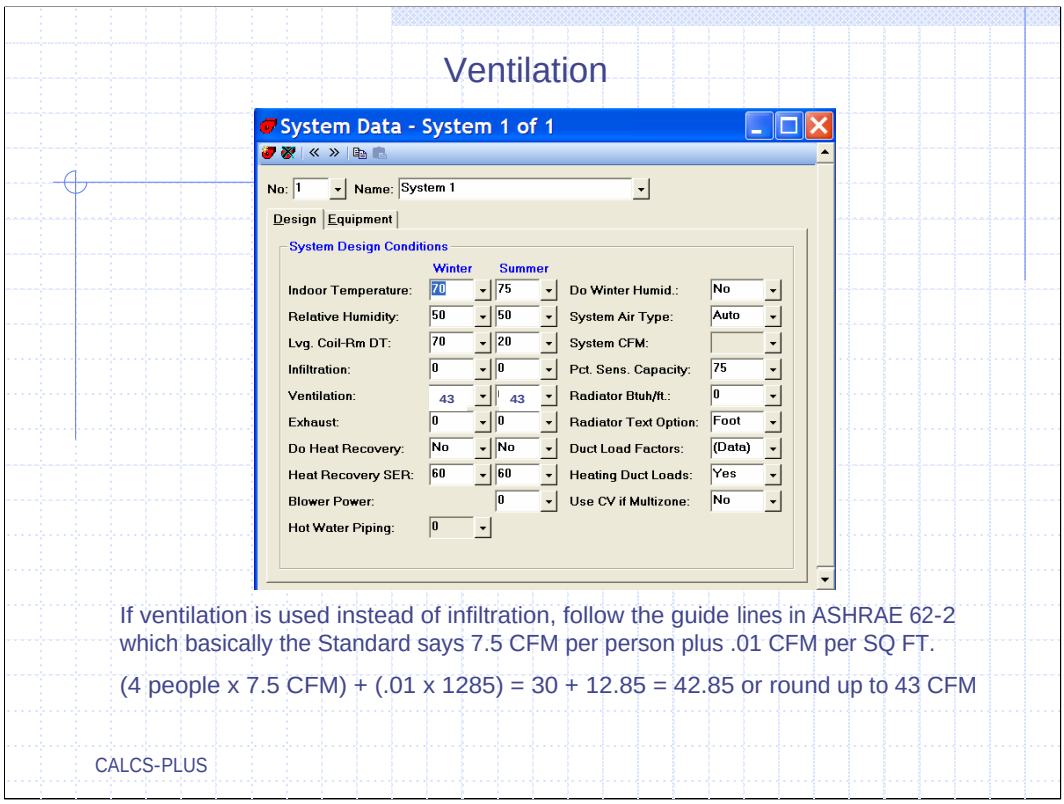
Loose Construction

Infiltration: Winter CFM: 190, Summer CFM: 99	5,222	3,998	1,741	5,739

Tight Construction

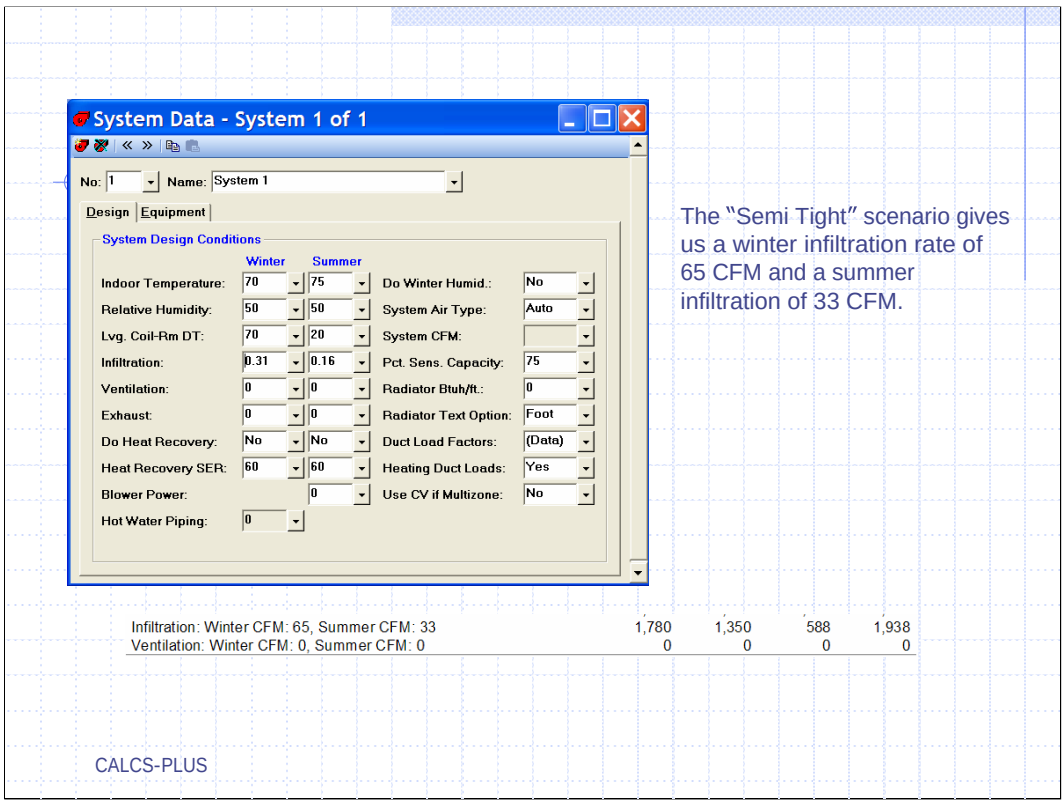
Infiltration: Winter CFM: 32, Summer CFM: 16	888	654	285	939

CALCS-PLUS



Typically we never use both infiltration and ventilation together. If you decide to use ventilation then follow the guide lines in ASHRAE Standard 62-2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. Basically the Standard says 7.5 CFM per person plus .01 CFM per SQ FT.

If you are going to export data into EnergyGauge USA® then you will want to use only infiltration otherwise USA will get confused and not run properly. For this calculation we will use infiltration and select the “Semi Tight” construction Scenario.



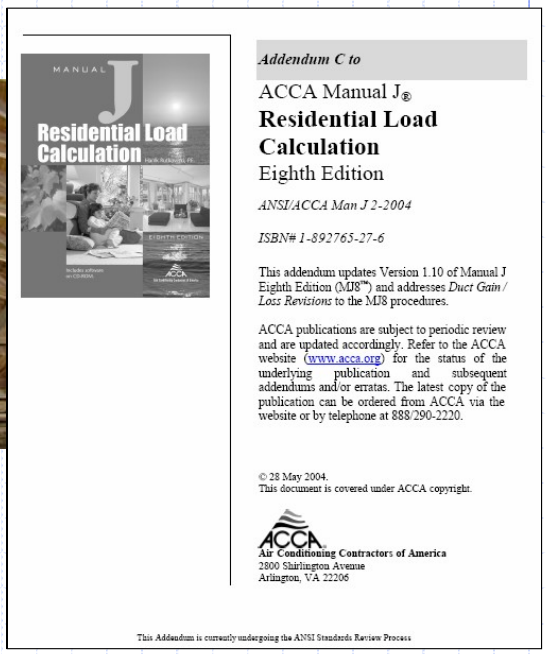
The "Semi Tight" scenario gives us a winter infiltration rate of 65 CFM and a summer infiltration of 33 CFM.

MJ8 & Duct Leakage

Now that all of the rooms have been entered and the system design conditions are completed we can calculate the duct loads associated with duct systems located in unconditioned spaces.

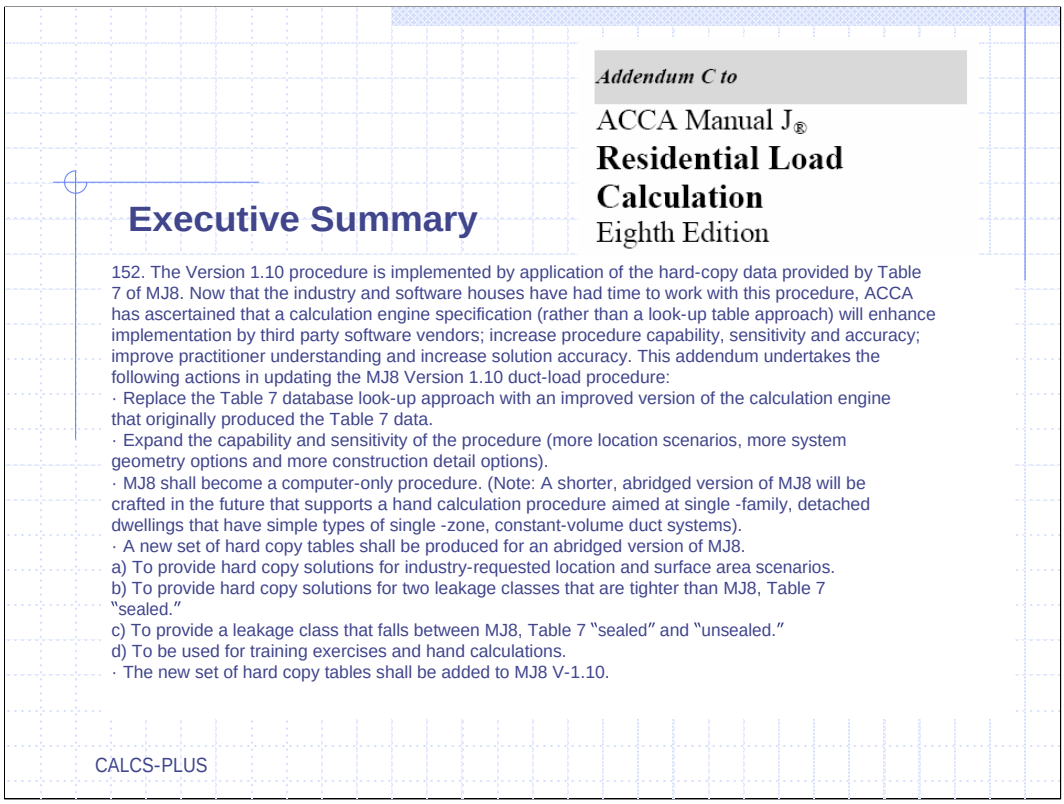
Duct Loads

Ducts located in the unconditioned space also have a heat gain that adds to the cooling load of the building.

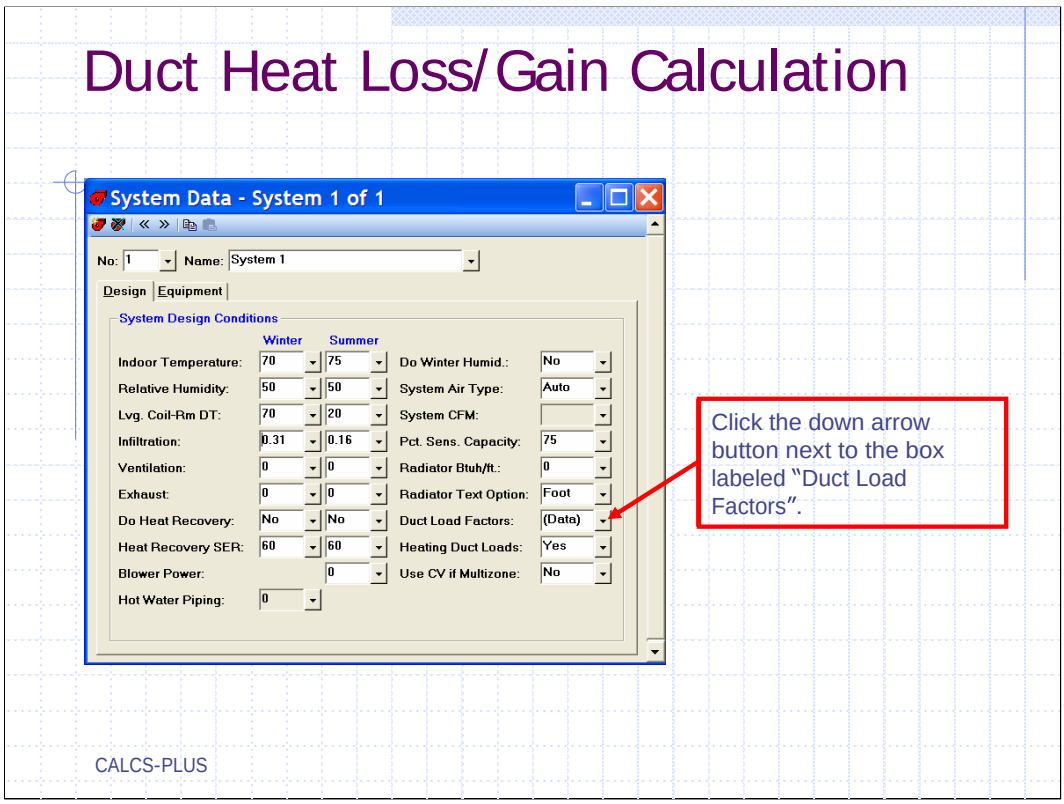


CALCS-PLUS

The author and his committees recognized the need to more accurately calculate the gain and loss due to duct leakage.



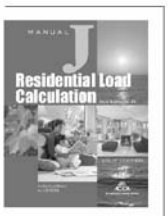
The engine the author developed to do the calculation is very comprehensive and it must be used by all ACCA certified software.



To start the duct heat gain/loss calculation in this software program click the down arrow button next to the box labeled “Duct Load Factors”.

Duct Loads

Ducts located in the unconditioned space also have a heat loss/gain that adds to the heating/cooling loads of the building.



Addendum C to

ACCA Manual J$_8$

Residential Load Calculation

Eighth Edition

ANSI/ACCA Man J 7-2004

ISBN# 1-892763-27-6

This addendum updates Version 1.10 of Manual J Eighth Edition (MJ8™) and addresses *Duct Gain/Loss Revisions* to the MJ8 procedures.

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Air Conditioning Contractors of America
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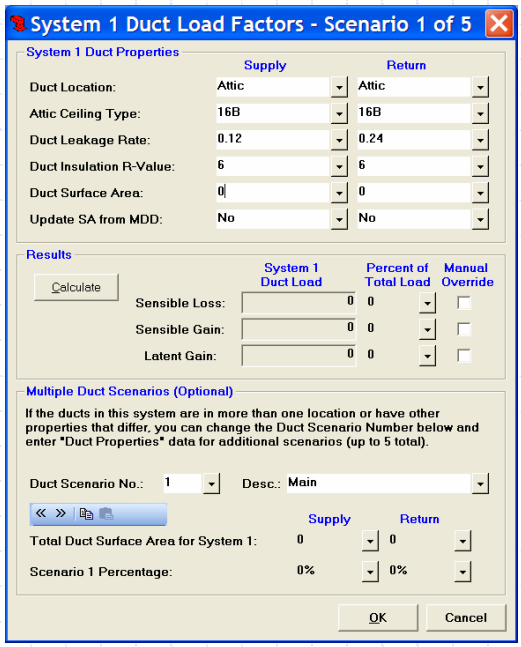
Arlington, VA 22206

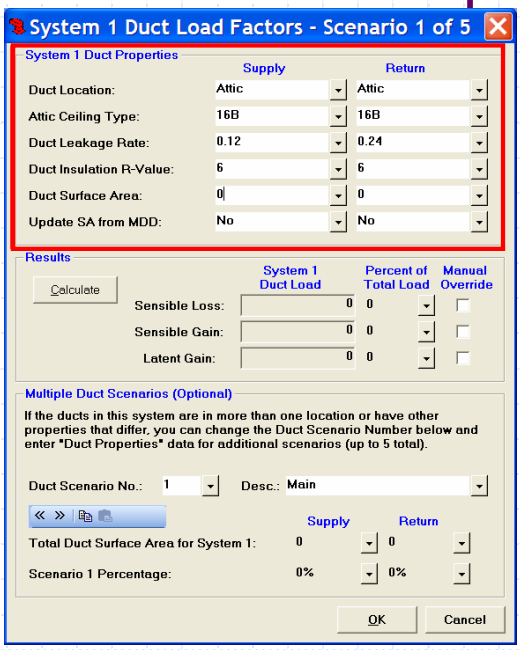
This Addendum is currently undergoing the ANSI Standards Review Process



CALCS-PLUS

In the “Duct Load Factors" dialog box, the “Duct Location”, “Attic Ceiling Type”, “Duct Leakage Rate”, “Duct System R-Value”, and “Duct Surface Area” must be filled in for Supply and Return to calculate duct loads for ducts in un-conditioned spaces. Duct load calculations are based on Addendum C to ACCA Manual J version 8, the procedure is compatible with ASHRAE Standard 152.

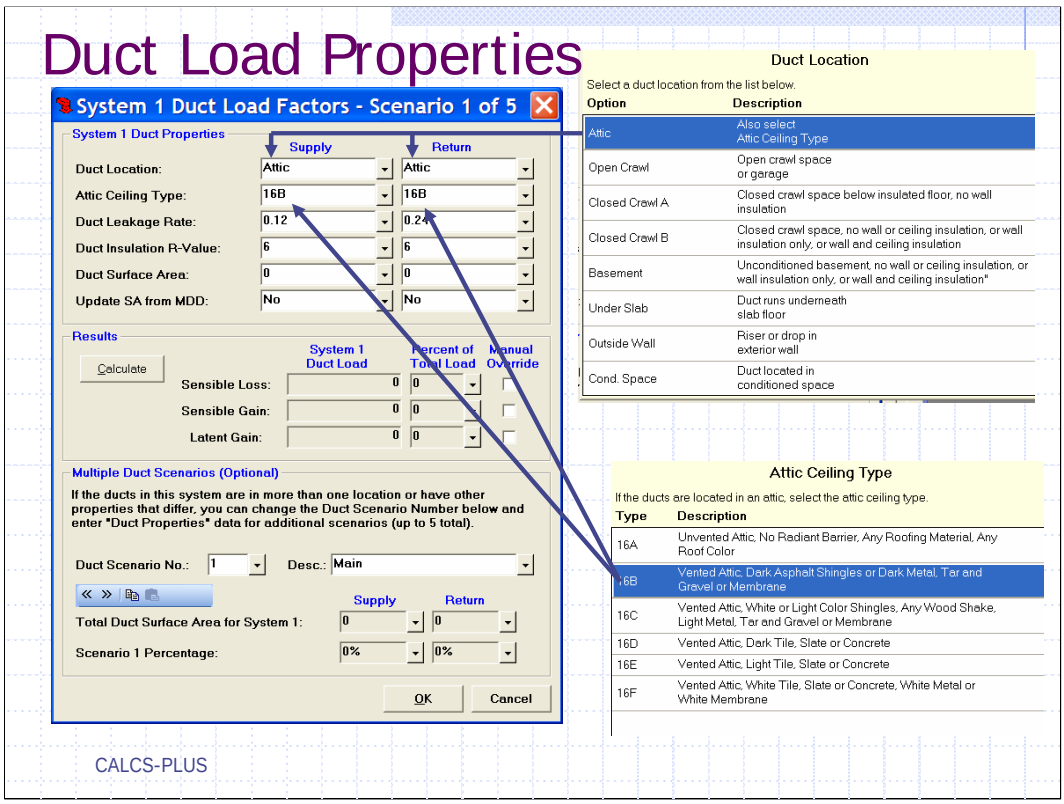
Duct Load Properties



To calculate the sensible loss/gain and latent gain you must first enter in the "Duct Load Properties.

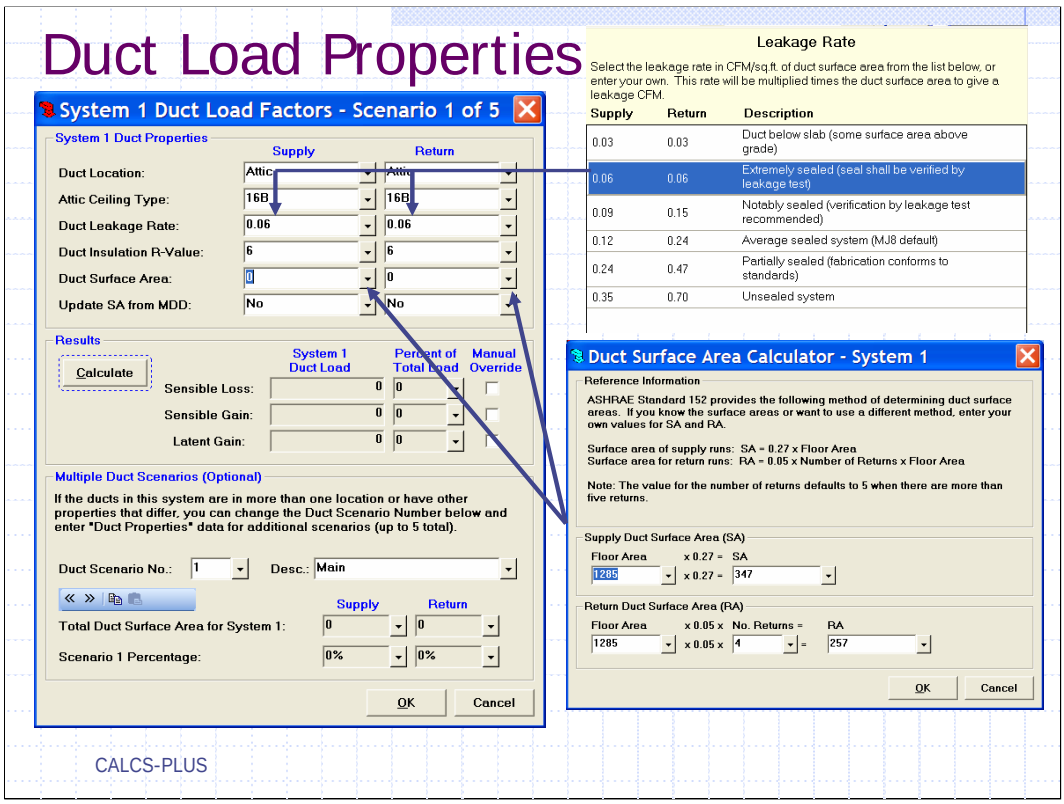
Note: before doing this calculation all of the room data must be entered. The SQ FT of duct surface area is based on the SQ FT of conditioned space.

In this particular software the down arrow key for each item will give us the information we need to complete the input; this would be typical of most ACCA approved programs. But the duct load calculation cannot be completed until all the rooms of the building have been entered into the program



Pick out the location of the duct system; “Attic”, “Open Crawl A”, “Open Crawl B Basement”, “Under Slab”, “Outside Wall”, “Cond Space”.

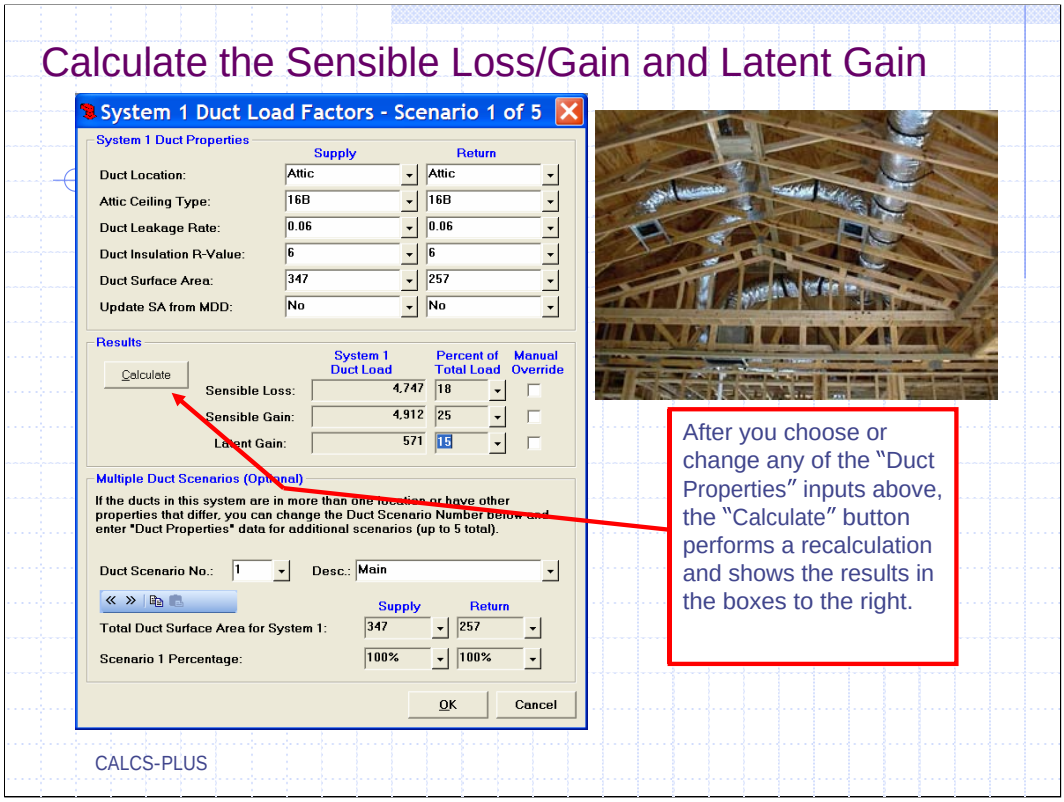
If the duct system is located in the attic pick out the type of attic; vented, un-vented roof color type, roof cover and material, etc. Remember in this case that whether the attic is vented or unvented the thermal barrier is located on the ceiling.



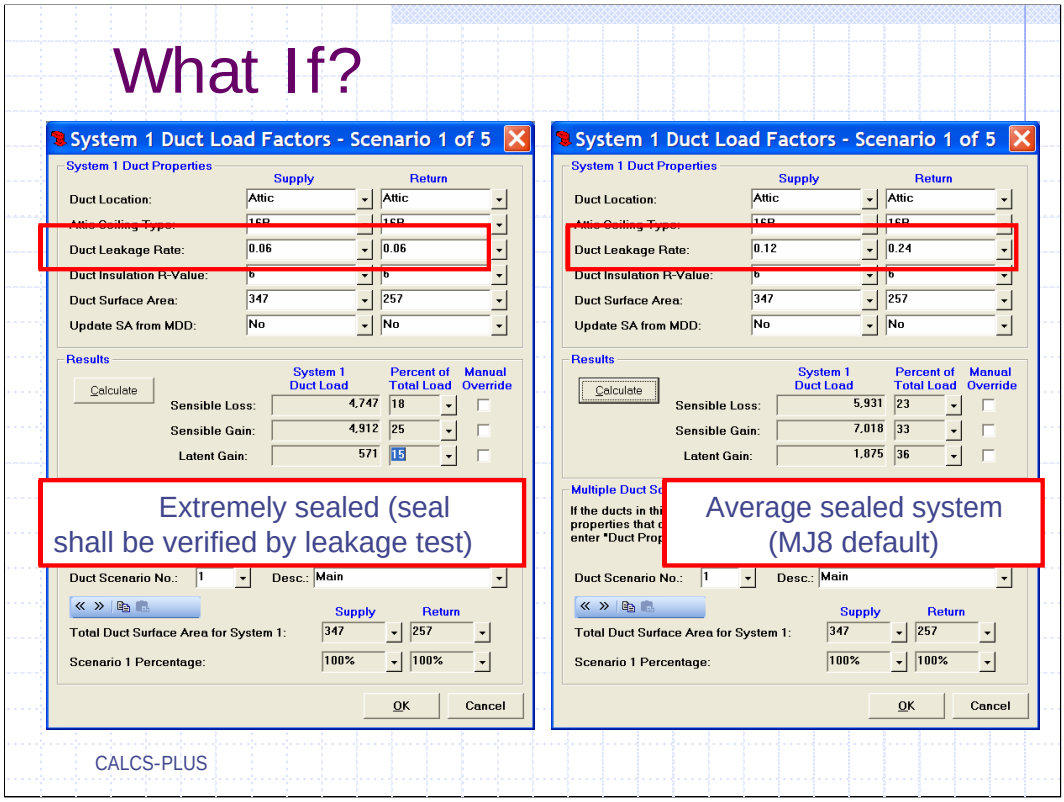
Choose the duct sealing category. If the calculation is done from plans before construction has been started assume that the duct system is going to be tight to prevent over sizing. If the building has been completed duct test results can be entered here.

Calculate the duct surface area, this program calculates a duct surface area based on the SQ FT of the building which may or may not be correct. Typically I find that the actual duct area calculates out to less than ASHRAE 152

Calculate the Sensible Loss/Gain and Latent Gain



When all of the proper information has been filled in for the “Duct location”, “Attic Ceiling Type” (if applicable), “Duct Leakage Rate”, “Duct Insulation R-Value”, “Duct Surface Area”, clicking the “Calculate” button in this program will calculate the sensible loss, sensible gain, and latent gain that is associated with the environment where the duct system is located and the anticipated or measured duct leakage.



One of the benefits of computer based HVAC load calculation programs is the ability to play “what if” scenarios with quick results.

The duct leakage rate has a huge impact on the calculation. As can be seen by this slide