C H A P T E R 3

Completing the Residential Analysis Worksheet

The Residential Analysis Worksheet is designed to help the reader in making the preliminary calculations necessary to complete Forms 600A-04, 600B-04 and 600C-04, although a full plans take off is not necessary for Forms 600B-04 and 600C-04. Like Form 600A-04, the Residential Analysis Worksheet take-off is performed on single units of multifamily buildings. This section will give you important information on the proper methods of computing the necessary measurements. A completed example Worksheet can be found in the Appendix to this manual.

The worksheet and Form 600A-04 calculations evaluate the basic energy-using elements of the house. These elements include the building envelope (exterior glass, walls, doors, ceilings, floors and air infiltration), the heating and cooling system(s), and the water heating system. The time-consuming part of these calculations deals with the analysis of the exterior portion of the house. Since different types of building materials (glass, concrete, wood, insulation, etc.) have varying degrees of thermal resistance, each material must be considered separately. In the Form 600A-04 calculation, multipliers specific to the type of material are used with the net areas of the component to evaluate its energy impact. For this reason, most of the worksheet is used to calculate the areas of different building components.

A blank Residential Analysis Worksheet can be found on pages 28-35. If you are preparing a house for Energy Code compliance, copy the worksheet or tear it out of the manual and complete it for your house as you go over these instructions. Do not submit this worksheet to the local building department. If you wish to make the preliminary calculations using some other format, you may do so.

STEP 1: WINDOWS AND OTHER GLASS AREAS

Use the glass plans takeoff to organize the information you will need about the glass portions of the building envelope. Take into account all non-opaque (clear) areas including:

+ Windows;
+ Glass brick walls;
+ Skylights, whether glass or plastic;
+ French doors;
+ Sliding glass doors; and,
+ Glass area in doors (if glass area is one-third or more of the total area of the door.)

RESIDENTIAL ANALYSIS WORKSHEET

STEP 1: WINDOWS AND OTHER GLASS AREAS

(includes skylights, sliding glass doors and all windows in doors which exceed 1/3 of the door area)

ORIENTATION	WALL TYPE	GLASS TYPE[1] U-factor	GLASS TYPE[1] SHGC	OH LENGTH ÷	OH HEIGHT =	OH RATIO	WIDTH X HEIGHT (Rough Opening)	= GLASS AREA	ADDITIONS[2]	AREA SUBTOTALS

Glass Areas by Wall Types

	Description	R-Value	Glass Area	SHGC
Type A		R=	sq.ft.	
Type B		R=	sq.ft.	
Type C		R=	sq.ft.	
Type D		R=	sq.ft.	

TOTAL GLASS AREA

DECIMAL EQUIVALENTS: INCHES (“) FEET(‘)

1”	**=**	**.1’**	**7”**	**=**	**.6’**
2”	**=**	**.2’**	**8”**	**=**	**.7’**
3”	**=**	**.3’**	**9”**	**=**	**.8’**
4”	**=**	**.3’**	**10”**	**=**	**.8’**
5”	**=**	**.4’**	**11’’**	**=**	**.9’**
6”	**=**	**.5’**	**12”**	**=**	**1.0’**

Numbers encircled with this style of shading will be used to determine multipliers on Form 600A.

Numbers encircled with style of shading will be transferred directly to Form 600A.

[1] or DEFAULT: Single pane clear, Single pane tint, Double pane clear, Double pane tint if window not labeled.

[2] Existing glass area removed or enclosed by an addition may be subtracted from addition total

STEP 2: CONDITIONED FLOOR AREAS

TABLE 1. RAISED FLOOR OVER UNCONDITIONED SPACE			
TYPE: _____ INSULATION R-VALUE = _____			
FLOOR SUBUNIT	LENGTH X	WIDTH =	AREA
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			
Subtotal			
FLOOR AREA SUBTOTAL			

TABLE 2. ADJACENT FLOORS			
INSULATION R-VALUE = _____			
FLOOR SUBUNIT	LENGTH X	WIDTH =	AREA
F1			
F2			
F3			
F4			
F5			
F6			
Subtotal			
FLOOR AREA SUBTOTAL			

TABLE 3. SLAB-ON-GRADE CONDITIONED FLOOR			
INSULATION R-VALUE = _____			
FLOOR SUBUNIT	LENGTH X	WIDTH =	AREA
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			
Subtotal			
FLOOR AREA SUBTOTAL			

TABLE 4. CONDITIONED FLOORS OVER CONDITIONED SPACE (2nd or 3rd stories)			
FLOOR SUBUNIT	LENGTH X	WIDTH =	AREA
F1			
F2			
F3			
F4			
Subtotal			
FLOOR AREA SUBTOTAL			

TABLE 5. TOTAL CONDITIONED FLOOR AREA	
FLOOR TYPE	SUBTOTAL
RAISED FLOOR OVER UNCONDITIONED SPACE (TABLE 1)	
ADJACENT FLOOR AREA (TABLE 2)	
SLAB-ON-GRADE CONDITIONED FLOOR AREA (TABLE 3)	
CONDITIONED FLOOR AREA OVER CONDITIONED SPACE (TABLE 4)	
FLOOR AREA SUBTOTAL	

STEP 3: NET WALL AND DOOR AREAS

TABLE 1. EXTERIOR WALLS			
WALL TYPE: _____ INSULATION R-VALUE = _____			
WALL	LENGTH X	WIDTH =	AREA
W1			
W2			
W3			
W4			
W5			
W6			
W7			
W8			
W9			
W10			
W11			
SUBTOTAL			
GROSS WALL AREA SUBTOTAL			

DOORS ON EXTERIOR WALL A					
TYPE	AREA X	NO. =	AREA –	GLASS =	NET AREA
NET DOOR AREA SUBTOTAL					

GLASS AREA FROM STEP 1 FOR WALL TYPE A	

GROSS WALL AREA SUBTOTAL	–	NET DOOR AREA SUBTOTAL	–	GLASS AREA	=	NET WALL AREA

STANDARD DOOR SIZES	
DIMENSIONS	ROUGH OPENING AREA
2’ 6” x 6’ 8” 2’ 8” x 6’ 8” 3” 0” x 6’ 8”	18.2 square feet 19.0 square feet 21.6 square feet

TABLE 2. EXTERIOR WALLS					
WALL TYPE: _____ INSULATION R-VALUE = _____					
WALL	LENGTH	X	WIDTH	=	AREA
W1					
W2					
W3					
SUBTOTAL					
GROSS WALL AREA SUBTOTAL					
DOORS ON EXTERIOR WALL					
TYPE	AREA	X NO.	= AREA	– GLASS	= NET AREA
NET DOOR AREA SUBTOTAL					
GLASS AREA FROM STEP 1					
GROSS WALL AREA SUBTOTAL	–	NET DOOR AREA SUBTOTAL	–	GLASS AREA	= NET WALL AREA

TABLE 3. ADJACENT WALLS					
WALL TYPE: _____ INSULATION R-VALUE = _____					
WALL	LENGTH	X	WIDTH	=	AREA
W1					
W2					
W3					
W4					
SUBTOTAL					
GROSS WALL AREA SUBTOTAL					
DOORS ON ADJACENT WALL					
TYPE	AREA	X NO.	= AREA	– GLASS	= NET AREA
NET DOOR AREA SUBTOTAL					
GLASS AREA FROM STEP 1					
GROSS WALL AREA SUBTOTAL	–	NET DOOR AREA SUBTOTAL	–	GLASS AREA	= NET WALL AREA

STEP 4. CEILING AREA

TABLE 1. CEILING UNDER ATTIC (R-19 Minimum)				
INSULATION R-VALUE = _____				
CEILING	LENGTH	X	WIDTH	= AREA
C1				
C2				
C3				
C4				
C5				
Subtotal				
□Radiant Barrier Installed				
□IRCC Installed				
UNDER ATTIC TOTAL				

TABLE 2. SINGLE ASSEMBLY CEILING (WITHOUT ATTIC)			
INSULATION R-VALUE = _____			
CEILING	LENGTH	X WIDTH	= AREA
C1			
C2			
C3			
C4			
C5			
Subtotal			
SINGLE ASSEMBLY TOTAL			

TABLE 3. OTHER CEILINGS			
TYPE: _____ INSULATION R-VALUE = _____			
CEILING	LENGTH	X WIDTH	= AREA
C1			
C2			
C3			
Subtotal			
OTHER CEILINGS TOTAL			

STEP 5: SLAB PERIMETER

SLAB-ON-GRADE	INSULATION R-VALUE = _____
WALL LENGTH SUBTOTALS FROM STEP 3	
EXTERIOR WALL TYPE “A”	
EXTERIOR WALL TYPE “B”	
ADJACENT WALL TYPE “C”	
TOTAL WALL LENGTH (SLAB PERIMETER)	

STEP 6: DUCTS, COOLING, SPACE HEATING, AND WATER HEATING

DUCTS: SUPPLY RETURN	
□ □	DUCTS IN CONDITIONED SPACE
□ □	DUCTS IN UNCONDITIONED SPACE
□ □	DUCTS IN ATTIC W/RBS
□ □	DUCTS IN ATTIC W/IRCC
□ □	DUCTS IN ATTIC W/WHITE ROOF
□ □	NONE
□ □	EXISTING
AHU LOCATION: □ GARAGE □ CONDITIONED SPACE □ BUILDING EXTERIOR □ ATTIC	
COOLING SYSTEM:	□ CENTRAL, SEER/EER = ____ □ PTAC OR ROOM UNIT, EER = ____ □ HEAT PUMP, gas, COP = ____ □ NONE □ EXISTING SIZING CALCULATION: CALCULATED SENSIBLE COOLING CAPACITY X 1.20 = BUT/H ALLOWED = TONS 12000
COOLING CREDIT:	□ CEILING FANS □ MULTIZONE □ CROSS VENTILATION □ WHOLE HOUSE FAN □ PROGRAMMABLE THERMOSTAT □ NONE
HEATING SYSTEM:	□ ELECTRIC STRIP □ HEAT PUMP, ELECTRIC, HSPF = _____ □ NONE □ EXISTING □ PTHP OR ROOM UNIT, COP = _____ □ COMBINATION GAS/WATER HEATING □ COMBUSTION FURNACE, HSPF = _____ □ OTHER _____
HEATING CREDIT:	□ PROGRAMMABLE THERM. □ MULTIZONE □ NATURAL GAS, AFUE = ____ □ LP GAS, AFUE = _____ □ NONE
WATER HEATING:	□ NUMBER OF BEDROOMS: _____ □ EXISTING □ SOLAR WITH TANK, EF= _____ □ DED. HEAT PUMP WITH THANK, EF- _____ □ ELECTRIC, EF= _____ □ NATURAL GAS, EF = _____ □ LP GAS, EF = _____ □ GAS TANKLESS WATER HEATER, EF= _____
WATER HEATING CREDIT:	□ HEAT RECOVERY UNIT, W/AC □ SOLAR, no tank, EF= ____ □ HEAT RECOVERY UNIT, W/HEAT PUMP □ DED. HP, no tank, EF= ____ □ NONE

The Code classifies glass areas by four factors:

1. Orientation - which compass point the window faces;
2. Wall type - the material of the wall in which the window is installed (example, frame, concrete block, etc.)
3. Type of glazing – U-factor and SHGC or default (worst case) single-pane clear, single-pane tint, double-pane clear, or double-pane tint; and,
4. Either the overhang ratio or overhang length - indicators of the amount of shading from a permanent overhang.

Add the areas of windows with identical features together and treat them as a group. For instance, treat all north-facing, single-pane, clear windows with a 0.18 overhang ratio (overhang length divided by overhang height) as a group. However, do not group windows with different orientations, glass type, or overhang ratio with these windows. Since this will require you to make several concurrent decisions about the glass, read through all of Step 1 before attempting the grouping.

If the glass area in a door is less than one-third of that specific door area, calculate the entire door as opaque (wood or metal) under Step 3. If the glass area is one-third or more of the total door area, either calculate the entire door as glass, or calculate the glass area separately from the door area. In the latter case, include the glass square footage with the glass calculation, and the opaque square footage with the door calculation (see Step 3).

Orientation

Using the house plans, begin with one orientation, for example, north-facing windows (N). List the information for each window on the Step 1 table of the worksheet. Choose the window orientation from one of the eight compass direction options: N, NE, E, SE, etc. For skylights and other non-vertical roof glass use the orientation designation "H" (horizontal). Group together all the windows with the same orientation, glass type and overhang height and overhang length.

Wall Type

At the bottom of the table is a box for identifying the wall types, GLASS AREAS BY WALL TYPES. Write in the DESCRIPTION column the wall construction type (wood frame, CBS, etc.) and insulation level (R-VALUE) for each type. Use the letters "A", "B", etc. to identify like walls in the WALL TYPE column on the Step 1 table.

GLASS AREAS BY WALL TYPES		
DESCRIPTION	R-VALUE	GLASS AREA
TYPE A: *Masonry - Block*	R= *3*	*248.9* sq. ft.
TYPE B: *Frame - Ext.*	R= *11*	*0* sq. ft.
TYPE C: *Frame - Adj.*	R= *11*	*0* sq. ft.
TYPE D:	R=	sq. ft.

Glass Type

In most houses the glass type is the same throughout the house, with the possible exceptions of sliding glass doors and skylights. Glass is rated by an U-factor, and a Solar Heat Gain Coefficient. The U-factor and the SHGC may be found on windows that have been tested and labeled according to National Fenestration Rating Council (NFRC) procedures. However, if labeled windows will not be installed, you may use DEFAULT glass types: single- or double-pane, and clear or tinted. DEFAULT glazing values are for a worst case window and will not accurately reflect the energy use of the windows installed.

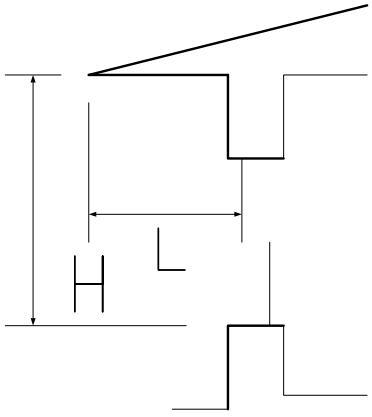
Any window tint, or film, either manufactured or applied, qualifies as "TINT." Only the exterior glazing needs to be tinted in double-paned glass. Solar screens qualify as "TINT" for purposes of code calculation.

ORIENTATION	WALL TYPE	GLASS TYPE	OVERHANG LENGTH
North	A	Single Tint	2.0
↓	↓	↓	2.0
↓	↓	↓	2.0
↓	↓	↓	10.0
↓	↓	↓	10.0
East	↓	↓	2.0

Enter in the GLASS TYPE column the U-factor and SHGC for each glass area. If not using labeled windows, enter whether the glazing will be single or double pane and clear or tinted glass.

Overhang

The Code gives you the option of evaluating the effects of window overhangs either by the OVERHANG LENGTH alone or by the OVERHANG RATIO.



The OVERHANG LENGTH (L) of a window is the horizontal measure of how far the overhang projects out from the glass surface.

The OVERHANG HEIGHT (H) is the vertical measure of the distance from the bottom of the glass to the bottom of the overhang.

Figure 2. *Overhang Lengths and Heights*

Overhang Length Method. This method is easier to calculate than the Overhang Ratio Method, but is less accurate. You may use this method only for windows with an overhang height no greater than 8 feet. You must use the Overhang Ratio Method for all windows which extend below 8 feet. To calculate by overhang length, complete the OVERHANG LENGTH column only. You do not need to complete the columns labeled OVERHANG HEIGHT or OVERHANG RATIO. This short cut will save you time. If you use this method and later find your calculation does not meet the Code requirements, you may recalculate using the Overhang Ratio Method.

Overhang Ratio Method. The Overhang Ratio is calculated by dividing the OVERHANG LENGTH by the OVERHANG HEIGHT (Fig. 3). Windows with the same overhang length and height will have the same OVERHANG RATIO.

$$\text{OVERHANG RATIO} = \frac{\text{OVERHANG LENGTH}}{\text{OVERHANG HEIGHT}} = \frac{3.0 \text{ feet}}{5.0 \text{ feet}} = .6$$

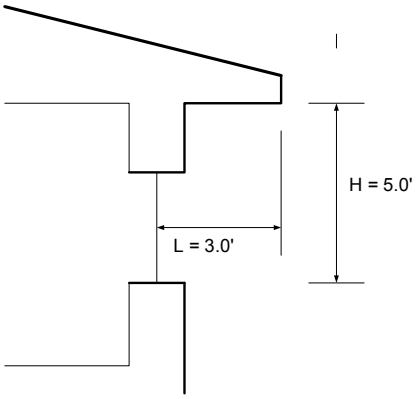
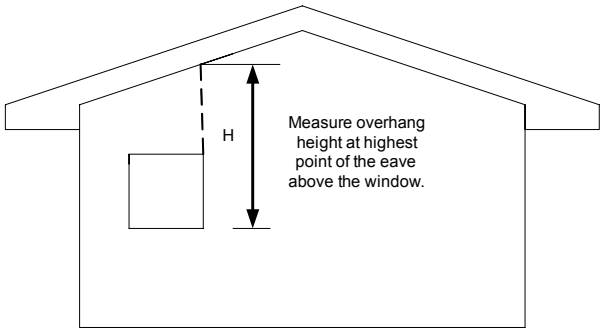


Figure 3. *Calculating Overhang Ratios*

Enter on the worksheet the Overhang Length and Overhang Height for each window. Divide the Overhang Length by Overhang Height. Enter the Overhang Ratio on the worksheet.



A window on a gable end wall is a special case. Measure the overhang length as usual. However, measure the overhang height from the bottom of the window to the bottom of the overhang at its highest point directly above the window. See Figure 4.

Figure 4. *Overhang Measurements for Uneven Overhangs*

The Code does not consider non-permanent shading devices such as canvas awnings as overhangs. For other qualifying shading devices such as slotted overhangs, louvered

shading devices, or Bahama shutters see Chapter 5, "Special Cases: Overhangs". If the overhangs do not meet the above conditions, the overhang length and ratio is 0.

Glass Area

Record the WIDTH and HEIGHT of the rough opening for each window and multiply to obtain the GLASS AREA.

SAMPLE WORKSHEET (See pages 90-97 for an example of a completed worksheet.)

ORIENTATION	WALL TYPE	GLASS TYPE[1] U-factor	GLASS TYPE[1] SHGC	OH LENGTH	OH HEIGHT	OH RATIO	WIDTH (Rough Opening)	HEIGHT (Rough Opening)	GLASS AREA	ADDITIONS[2]	AREA SUBTOTALS
North	A	Dbl	Clr	2.0	3.5	0.57	4.0	3.0	12.0		↓
↓	↓	↓	↓	2.0	3.5	0.57	4.0	3.0	12.0		↓
↓	↓	↓	↓	2.0	3.5	0.57	4.0	3.0	12.0		36.0 sq f
↓	↓	↓	↓	10.0	7.2	1.39	8.0	6.7	53.6		53.6 sq f
↓	↓	↓	↓	10.0	3.5	2.86	3.7	3.0	11.1		11.1 sq f
East	↓	↓	↓	2.0	3.5	0.57	4.0	3.0	12.0		↓
↓	↓	↓	↓	2.0	3.5	0.57	4.0	3.0	12.0		24.0 sq f
↓	↓	↓	↓	2.0	4.5	0.44	6.0	4.0	24.0		24.0 sq f
South	↓	↓	↓	2.0	4.5	0.44	6.0	4.0	24.0		24.0 sq f
West	↓	↓	↓	2.0	3.5	0.57	2.0	3.0	6.0		

As you work, circle any areas which are glass panels located in doors. You will use this information later when calculating net door areas.

Glass Area Subtotals

When you have listed all the windows and glass areas, check to be sure you have grouped together the windows with the same orientation, glass type, and overhang ratio or overhang length. Sum the areas for each group and enter the area under the column marked AREA SUBTOTALS. Glass in an existing building that is enclosed by an addition may be subtracted from the total glass for that orientation of the addition. Sum all the subtotals and enter the total in the box labeled TOTAL GLASS AREA.

Glass Areas by Wall Types

In the lower left corner of the Step 1 worksheet is the GLASS AREAS BY WALL TYPE box. Using the information in the WALL TYPE and GLASS AREA columns in the above table, total the amount of glass in each type of wall. You will use this information later to calculate net wall areas.

STEP 2: CONDITIONED FLOOR AREAS

Step 2 helps you organize the information you will need to calculate the conditioned floor area of the house. You will need to group conditioned floor areas into the following types:

1. Raised floors over unconditioned space;
2. Adjacent floors;
3. Slab-on-grade floor; and,
4. Floor areas over conditioned space (upper floors).

Calculate each group separately. To find the conditioned area for each floor type, divide the floor plan into rectangles. Make sure each rectangle includes only one type of floor and insulation level. Using the exterior dimensions from the house plans, find the length and width of each rectangle.

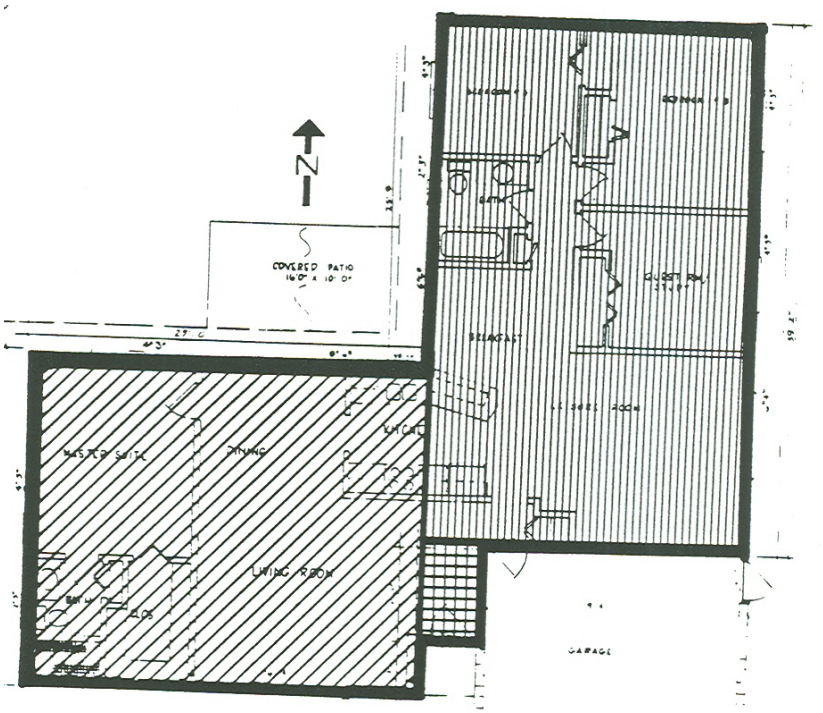


Figure 5. *Calculating Conditioned Floor Area*

Enter the dimensions on the table for the specific floor type. Multiply the length times the width of each rectangle to find the area of each rectangle. Add the areas of the rectangles together to find the FLOOR AREA SUBTOTAL for each type of floor.

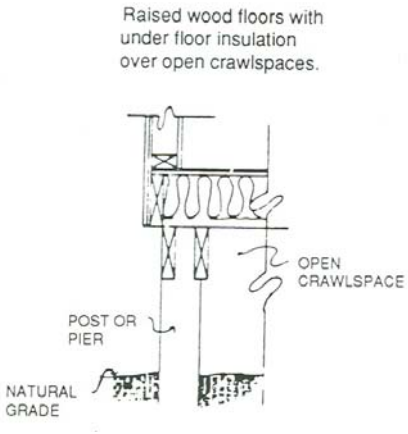
If part of the house has a sloped ceiling, calculate the floor area for that part of the house separately from the non-sloped ceiling part of the house. You will find this information helpful later when calculating the ceiling areas.

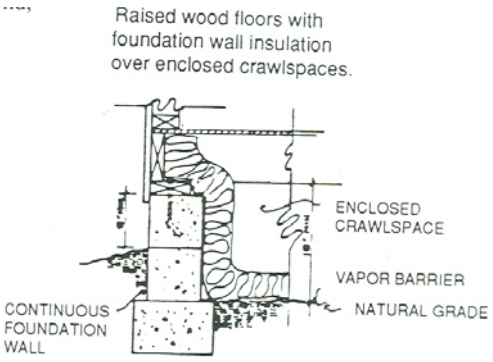
Table 1: Raised Floors over Unconditioned Space

Calculate the area of RAISED FLOORS on Table 1 of Step 2. A raised floor over unconditioned space is one which separates conditioned space from unconditioned space. Floors over a crawl space or raised on piers are examples of this type of floor (Fig. 6.) You will need to separate this category by type (wood or concrete) and by insulation level. The Code distinguishes between wood floors of the following types of construction:

+ Post or pier with under floor insulation;
+ Stem walls with under floor insulation; and,
+ Stem walls with stem wall insulation.

Treat each group separately.





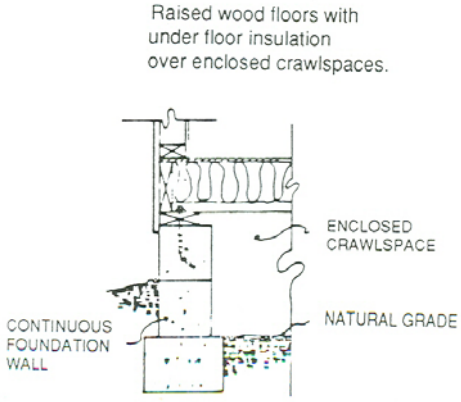


Figure 6. *Raised Wood Floor Types*

To qualify as "stem wall" construction, there must be a continuous stem wall around the perimeter of the enclosed crawl space. See Section 605.1.A.1 for crawl space ventilation requirements.

Table 2: Adjacent Floors

Calculate the areas of ADJACENT FLOORS in Table 2. Adjacent floors separate conditioned space from unconditioned but enclosed space. A second story floor separating conditioned space from a garage is an example of this type of construction. See Figure 7.

Table 3: Slab-on-Grade Conditioned Floor

Calculate the SLAB-ON-GRADE CONDITIONED FLOOR areas on Table 3 of Step 2. A slab-on-grade floor separates conditioned space from the ground. See Figure 7.

Table 4: Conditioned Floors over Conditioned Space

Calculate CONDITIONED FLOORS OVER CONDITIONED SPACE on the fourth table. These areas include second story floors and any other floors over conditioned spaces. See Figure 7.

Table 5: Total Conditioned Floor Area

On Table 5, enter all the area SUBTOTALS from Tables 1 through 4. Add the SUBTOTALS to obtain the TOTAL CONDITIONED FLOOR AREA.

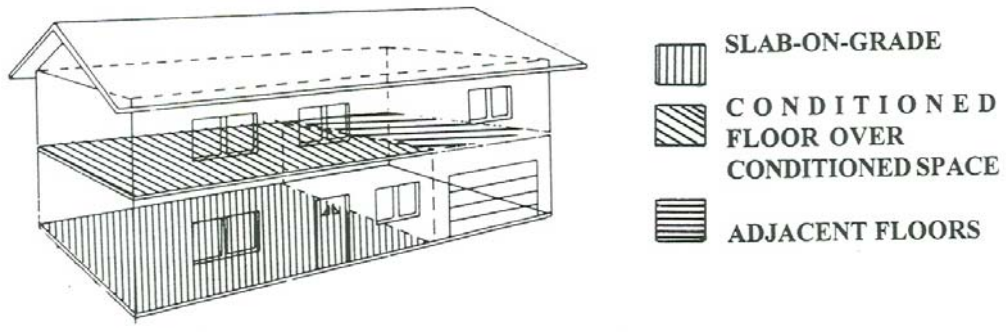


Figure 7. *Conditioned Floor Types*