Chapter 1: Compliance

[101]

Who Must Comply?

All new residential construction must comply with the *Washington State Energy Code* (WSEC).

Exceptions. Exempt from envelope requirements but needing to comply with other Code provisions are:

[101.3.1.1]

- Buildings with peak design energy usage for space conditioning less than 1 watt (3.4 Btu/hour) per square foot of floor area. May apply to garage, shop or similar part of building.

[101.3.1.2]

- Buildings neither heated nor cooled by a non-renewable energy source (for the purposes of the Code, wood heat is not considered renewable, and must comply).

[101.3.1.3]

- Greenhouses isolated from any conditioned space and not intended for occupancy.

[101.3.2.1 - 101.3.2.8]

Additions and remodeling to existing buildings must comply. See pages 1-15 through 1-18 for specific conditions.

Three Compliance Approaches

The Code allows three possible approaches to demonstrate compliance:

[101.2]

Prescriptive Approach. Follows prescribed building component efficiency levels. [WSEC Chapter 6]

Component Performance Approach. Compares building envelope heat loss rates of the proposed house design to a Code-defined reference house. [WSEC Chapter 5]

System Analysis Approach. Compares an estimate of annual building energy use of the proposed house design to that of a Code-defined reference house. [WSEC Chapter 4]

You must meet the requirements of only *one* approach to comply.

All three compliance options require that the project meet requirements concerning heating systems, water heating and ventilation systems. These requirements are detailed in other chapters of this Guide.

[502.2.1] Buildings constructed using log walls must use "other" fuels to apply the exception noted in Section 502.2.1 UA Calculations.

In addition to meeting the Prescriptive or Component Performance requirements of the Code, a single family or duplex dwelling must develop one credit from Chapter 9. Chapter 9 lists 14 measures that can be used to obtain one credit. The designer, builder or homeowner can choose which measure best applies to their house. If a Systems Analysis Approach is used, compliance with Chapter 9 is met by demonstrating that the proposed building energy use is 8 percent less than the target building energy use.

[502.2.2] **The WSEC defines two fuel types:**

Electric Resistance. Includes baseboard units, radiant units, boilers, and forced air units using more than 1kW per dwelling unit or 1 watt/ft.^{2}, whichever is greater. This applies whether units are primary or secondary sources of heat.

Other. Includes all gas, wood, oil, and propane heating systems, unless electric resistance is used as a secondary heating system (see above), and **all heat pump** heating systems.

The prescriptive approach does not distinguish between fuel types. All fuels have the same requirements for building envelope.

Climate Zones

[302.3] The WSEC divides the state into two Climate Zones, shown in Figure 1-1.

Figure 1-1
Washington State Energy Code Climate Zones I & II

Prescriptive Approach

The Easiest Way

The prescriptive approach dictates the minimum insulation level required for each building component. Each component must meet or exceed the listed performance value to qualify.

[601.1] The two prescriptive tables reproduced on pages 1-5 and 1-6 are taken from Chapter 6 of the WSEC. To select the correct table, simply determine your Climate Zone.

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How To Use The Prescriptive Tables

Example House:
- Location: ....Olympia
- Occupancy: ....R-3, Single Family
- Conditioned floor area (measured
  to outside of exterior walls): ....1000 sq.ft.
- Glazing area (measured window
  rough openings): ....260 sq.ft.
- Glazing to floor area ratio: ....260/1000 = 26%

Process:
- Zone Map (Figure 1-1) identifies Olympia as Zone 1.
- Single Family (R-3) may use the prescriptive approach.
- 26 percent glazing area limits us to Option III, unlimited glazing.

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[602.6]   Glazing in doors and skylights are treated like any other window. When a door contains over 50 percent glass, the entire rough opening is included in the glazing area.

If a portion of the glazing area is over the allowable U-factor, and a portion is under, you may use an area weighted average U-factor to show compliance with your prescriptive option. To determine the average U-factor, find the corresponding glazing area for each distinct U-factor. Multiply the U-factor by the corresponding glazing area (U x A). Add together the U x A for each distinct U-factor, and divide by the total glazing area. Glazing in the reference calculation is limited to 15 percent of the conditioned floor area.

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Example of Area Weighted U-Factor Calculation

Window #1 area 10 sq.ft. U = .32   U x A = 3.2
Window #2 area 15 sq.ft. U = .28   U x A = 4.2
_____

Total area 25 sq.ft.   Total U x A = 7.4

Area weighted average 7.4/25 = 0.29

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WSEC Table 6-1
Prescriptive Requirements[0,1] for Group R Occupancy
Climate Zone 1

Op-tion	Glazing Area[10]: % of Floor	Glazing U-Factor		Door [9] U-Factor	Ceiling[2]	Vaulted Ceiling[3]	Wall[12] Above Grade	Wall• int[4] Below Grade	Wall• ext[4] Below Grade	Floor[5]	Slab[6] on Grade
		Verti-cal	Over-head[11]								
I.	13%	0.34	0.50	0.20	R-49 or R-38 adv	R-38	R-21 int[7]	R-21 TB	R-10	R-30	R-10 2'
II.*	25%	0.32	0.50	0.20	R-49 or R-38 adv	R-38	R-21 int[7]	R-21 TB	R-10	R-30	R-10 2'
III.	Unlim-ited	0.30	0.50	0.20	R-49 or R-38 adv	R-38	R-21 int[7]	R-21 TB	R-10	R-30 U=0.029	R-10 2'

* Reference Case

0. Nominal R-values are for wood frame assemblies only or assemblies built in accordance with Section 601.1.

1. Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 13%, it shall comply with all of the requirements of the 13% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above may calculate compliance by Chapters 4 or 5 of this Code.

2. Requirement applies to all ceilings except single rafter or joist vaulted ceilings complying with note 3. 'Adv' denotes Advanced Framed Ceiling.

3. Requirement applicable only to single rafter or joist vaulted ceilings.

4. Below grade walls shall be insulated either on the exterior to a minimum level of R-10 continuous, or on the interior as a framed wall. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See Section 602.2.

5. Floors over crawl spaces or exposed to ambient air conditions.

6. Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See Section 602.4. For slabs inside a foundation wall, the insulation shall be installed to provide a thermal break (TB) between the slab edge and the foundation. Monolithic slabs shall include insulation, installed outside the foundation wall, and shall extend downward from the top of the slab for a minimum distance of 24 inches or downward and then horizontally for a minimum combined distance of 24 inches. Monolithic slabs shall also include R-10 insulation under the non-load-bearing portions of the slab.

7. Int. denotes standard framing 16 inches on center with headers insulated with a minimum of R-10 insulation.

8. Reserved.

9. Doors, including all fire doors, shall be assigned default U-factors from Table 10-6C.

10. Where a maximum glazing area is listed, the total glazing area (combined vertical plus overhead) as a percent of gross conditioned floor area shall be less than or equal to that value. Overhead glazing with U-factor of U=0.35 or less is not included in glazing area limitations.

11. Overhead glazing shall have U-factors determined in accordance with NFRC 100 or as specified in Section 502.1.5.

12. Log and solid timber walls with a minimum average thickness of 3.5" are exempt from this insulation requirement.

Prescriptive Requirements[0,1] for Group R Occupancy
Climate Zone 2

Op-tion	Glazing Area[10]: % of Floor	Glazing U-Factor		Door[9] U-Factor	Ceiling[2]	Vaulted Ceiling[3]	Wall[12] Above Grade	Wall• int[4] Below Grade	Wall• ext[4] Below Grade	Floor[5]	Slab[6] on Grade
		Verti-cal	Over-head[11]								
I.	12%	0.32	0.50	0.20	R-49 or R-38 adv	R-38	R-21 int[7]	R-21 TB	R-12	R-30	R-10 2'
II.*	15%	0.32	0.50	0.20	R-49 or R-38 adv	R-38	R-19 + R-5	R-21 TB	R-12	R-30	R-10 2'
III.	Unlim-ited	0.30	0.50	0.20	R-49 or R-38 adv	R-38	R-19 + R-5	R-21 TB	R-12	R-30	R-10 2'

* Reference Case

0. Nominal R-values are for wood frame assemblies only or assemblies built in accordance with Section 601.1.

1. Minimum requirements for each option listed. For example, if a proposed design has a glazing ratio to the conditioned floor area of 13%, it shall comply with all of the requirements of the 15% glazing option (or higher). Proposed designs which cannot meet the specific requirements of a listed option above may calculate compliance by Chapters 4 or 5 of this Code.

2. Requirement applies to all ceilings except single rafter or joist vaulted ceilings complying with note 3. 'Adv' denotes Advanced Framed Ceiling.

3. Requirement applicable only to single rafter or joist vaulted ceilings.

4. Below grade walls shall be insulated either on the exterior to a minimum level of R-12 continuous, or on the interior as a framed wall. Exterior insulation installed on below grade walls shall be a water resistant material, manufactured for its intended use, and installed according to the manufacturer's specifications. See Section 602.2.

5. Floors over crawl spaces or exposed to ambient air conditions.

6. Required slab perimeter insulation shall be a water resistant material, manufactured for its intended use, and installed according to manufacturer's specifications. See Section 602.4. For slabs inside a foundation wall, the insulation shall be installed to provide a thermal break (TB) between the slab edge and the foundation. Monolithic slabs shall include insulation, installed outside the foundation wall, and shall extend downward from the top of the slab for a minimum distance of 24 inches or downward and then horizontally for a minimum combined distance of 24 inches. Monolithic slabs shall also include R-10 insulation under the non-load-bearing portions of the slab.

7. Int. denotes standard framing 16 inches on center with headers insulated with a minimum of R-10 insulation.

8. Reserved.

9. Doors, including all fire doors, shall be assigned default U-factors from Table 10-6C.

10. Where a maximum glazing area is listed, the total glazing area (combined vertical plus overhead) as a percent of gross conditioned floor area shall be less than or equal to that value. Overhead glazing with U-factor of U=0.35 or less is not included in glazing area limitations.

11. Overhead glazing shall have U-factors determined in accordance with NFRC 100 or as specified in Section 502.1.5.

12. Log and solid timber walls with a minimum average thickness of 3.5" are exempt from this insulation requirement.

Single Rafter Joist

Single Rafter Joist or "vaulted" ceilings are required to be insulated to R-38. If standard R-38 batts are used, a 14-inch I-joist is necessary to allow for the full depth of the insulation and a 1-inch airspace between the top of the insulation and the underside of the roof sheathing. If "high density" R-38 batts are used, a 2 x 12 or 11-7/8-inch I-joist may be used. Check the insulation manufacturer's specifications regarding insulation depth to insure full depth insulation can be installed while still allowing for a 1-inch (min.) ventilated space.

Remember that this requirement applies to single rafter joist type roof assemblies only. Scissor trusses and sloped ceilings are not considered vaulted ceilings.

Component Performance Approach

[502.1]

Calculations Required

If none of the prescriptive options are suitable for your house design, you may be able to show compliance using the component performance approach. This process allows trading off the thermal efficiency of one component for another; for example, more attic insulation may allow less wall insulation.

To calculate energy performance, you must determine each building component's area and U-factor (default U-factors for common building practices are listed in Chapter 10 of the WSEC and summarized in Chapter 10 of this Guide). Multiply the U-factor for each component by the component area. That gives a component UA. Add component UAs to find overall UA for the proposed building.

The overall UA must be compared to a target value based on WSEC specifications, found in WSEC Table 5-1. The overall target UA is calculated by multiplying the component areas from the proposed design by prescribed U-factors from the Code. Glazing in the reference calculation is limited to 15 percent of the conditioned floor area. The proposed overall UA must be less than or equal to the target UA to show compliance. In addition, a house using the Component Performance Approach must develop one credit from the list of options in Chapter 9 of the WSEC.

To choose the correct target from WSEC Table 5-1, identify the Climate Zone for the home.

The WSU Extension Energy Program developed spread sheets that simplify the component performance calculations. They are discussed in more detail at the end of this chapter.

Target Component Values for Group R Occupancy

Component	Climate Zone	
	1	2
Glazing % Floor Area	15%	15%
Vertical Glazing U-Factor	U = 0.30	U = 0.30
Overhead Glazing U-Factor	U = 0.50	U = 0.50
Doors	U = 0.200	U = 0.200
Ceilings	U = 0.027	U = 0.027
Walls	U = 0.056	U = 0.056
Floors	U = 0.029	U = 0.029
Slab on Grade	F = 0.36	F = 0.36
Below Grade		
Wall R-Value	R-21	R-21
2' Depth: Walls	U = 0.042	U = 0.042
Slab	F = 0.59	F = 0.59
3.5' Depth: Walls	U = 0.041	U = 0.041
Slab	F = 0.64	F = 0.64
7' Depth: Walls	U = 0.037	U = 0.037
Slab	F = 0.57	F = 0.57

Log and solid timber walls that have a minimum average thickness of 3.5" in spaces with space heating by "other fuels" are exempt from wall target UA and proposed UA calculations.
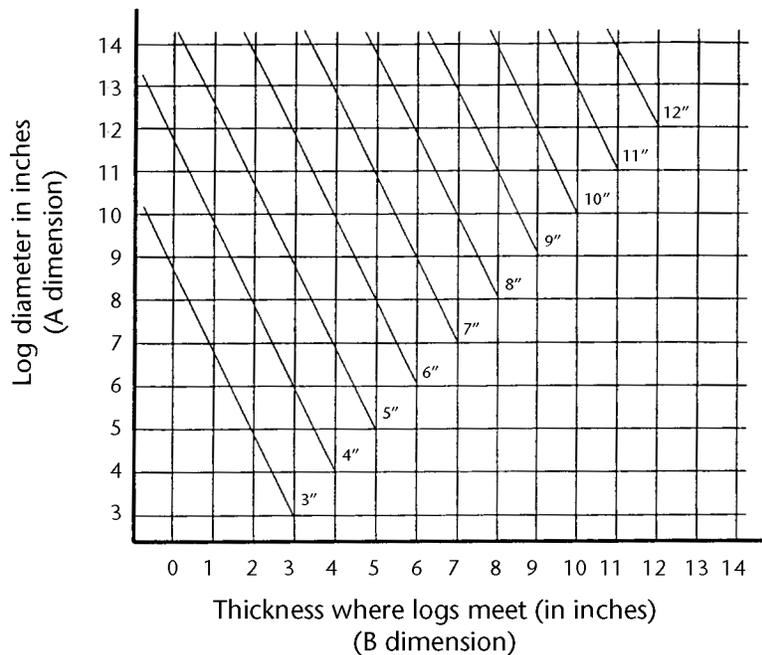
Log Walls

Footnote 12 of Tables 6-1 and 6-2 and Footnote 1 of Table 5-1 provide an exemption for log walls with a minimum average thickness of 3.5". The home must be heated with "other fuels" to qualify for this exception.

Figure 1-3 provides a method for determining average thickness, based on the log diameter, and the thickness of where two logs meet.

Figure 1-3
Average Thickness For Round Log Walls

Log diameter in inches (A dimension)

Thickness where logs meet (in inches)
(B dimension)

Example:
A = 11"
B = 5"

From chart:
Average thickness = 7"

Systems Analysis

Computer Simulation Recommended

[402.1.2]   The Systems Analysis Approach requires a calculation of the annual energy use of the proposed design. If the calculation demonstrates that the proposed design uses 8 percent less energy than the Code defined target home, it meets the envelope requirements of the Code. No additional credits from Chapter 9 are required when using systems analysis. The proposed house using 8 percent less energy than the target house accounts for the additional measures required under the Prescriptive and Component Performance Paths.
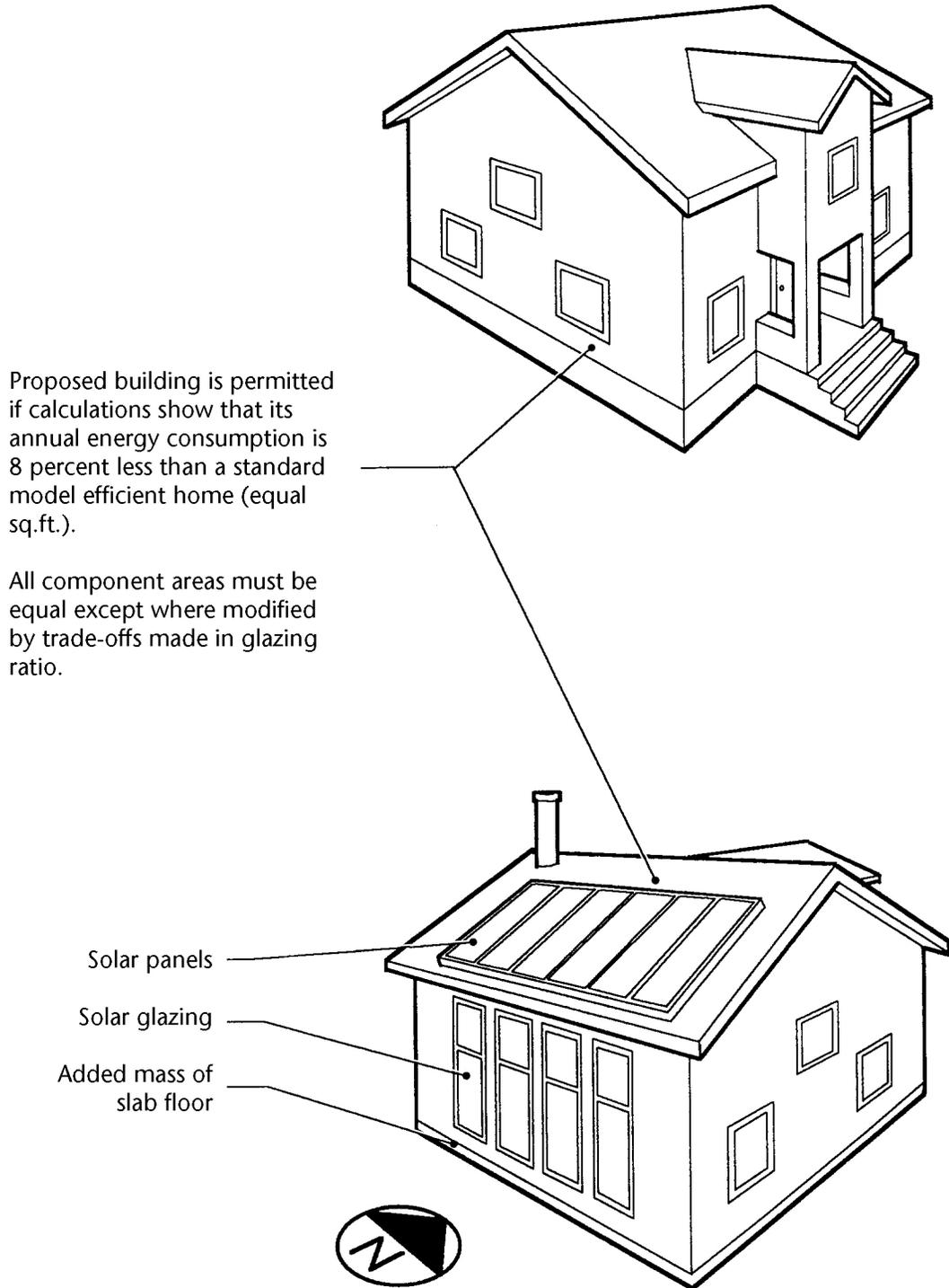
The calculation must be done as described in Chapter 4 of the Code. It must account for local weather data, air infiltration, heating system efficiencies, solar gains, and internal gains including occupancy loads, as well as the building shell insulation. The envelope requirements for the home are based on the component performance target UA. For other systems, refer to WSEC Chapter 4.

When your design includes high efficiency heating equipment, or solar gain and thermal mass, systems analysis may allow trades between other components. The calculation is complex, however, and should be done using a computer program that is capable of documenting all of the building system interactions. This may require the help of a design professional.

WSEC Chapter 8 suggests software that may be used for systems analysis. The WSU Extension Energy Program suggests that users interested in demonstrating compliance using the systems analysis approach use one of the many variations of DOE-2 software. Additional information on documenting code compliance is included at the end of this chapter.

Figure 1-4

Systems Analysis

Proposed building is permitted if calculations show that its annual energy consumption is 8 percent less than a standard model efficient home (equal sq.ft.).

All component areas must be equal except where modified by trade-offs made in glazing ratio.

Solar panels

Solar glazing

Added mass of slab floor

Additions and Remodeling

[101.3.2.1-8]   Additions and remodeling to a home must meet requirements of the WSEC.

Table 1-1

Remodeling Requirements

Replacement of:	Requirement
Combustion Furnace	Minimum AFUE 78 percent.
Heat Pump	Minimum HSPF 7.7
Water Heater	Meet 1987 National Appliance Energy Conservation Act (NAECA). Set to 120° F.
Electric Water Heaters	R-10 insulated pad in unconditioned space or on uninsulated slabs.
Window Replacement	Required U-factor – *Varies*
Insulation Walls & Ceilings	Exposed cavities must be filled to the requirements of Table 6-1 or 6-2, or have an average UA that complies with the requirements of Table 5-1. Where structural elements limit the level of insulation that can be applied to less than the code requirements, the cavities must be filled to code requirements in 101.3.2.5. Roof decks must be insulated to the requirement of the code if a complete roof tear-off is part of the work.

[101.3.2.2]   There are a few exceptions (historical buildings and other special cases) when the WSEC may not be fully enforced. Check with your local jurisdiction.

Table 1-2

Additions Requirements

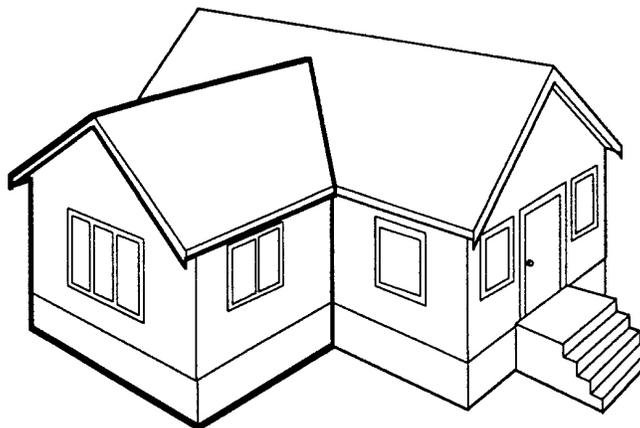| Size	Code Compliance for Additions
Under 750 sq.ft.	Addition can comply with the WSEC either by prescriptive approach, or by using tradeoffs with existing building for WSEC compliance.*
Over 750 sq.ft.	Addition must show full WSEC compliance as a stand alone project.

*See component performance approach.

The need to perform complicated tradeoffs for additions was reduced considerably with the introduction of unlimited glazing options in the prescriptive approach. Consider the prescriptive approach first.
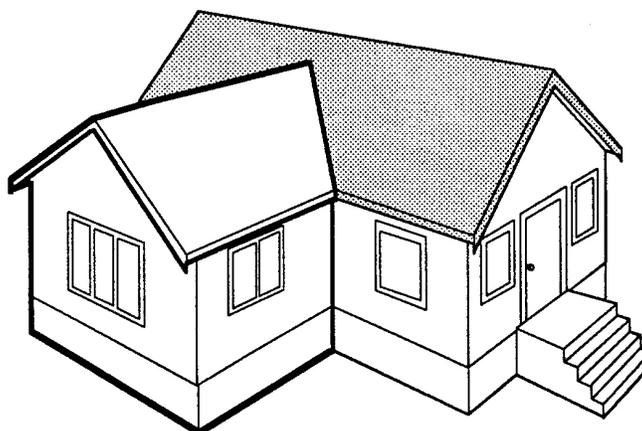
Figure 1-5

Energy Code Requirements for Additions

If an addition complies with the Code, no change is required in the existing buuilding.

A non-complying addition < 750 sq. ft. is permitted if improvements made to existing building (increase ceiling insulation) to compensate for a non-complying addition.

Documenting Code Compliance

To obtain a building permit you will be required to provide the local building department with a description of the Code compliance approach that will be used. This will include details on the plans and documentation required to demonstrate compliance with the code requirements. This will typically include energy code compliance forms, and a description of the chosen ventilation systems.

Plans and Specifications

The Code requires that sufficient detail be included on the plan set to assure that the energy code requirements are implemented during construction. This *Builder's Field Guide* book includes many examples of insulation and air sealing details. A similar level of detail should be included as part of the plan set. A few examples of areas needing good details follow.

Framing:
- Show framing with sufficient depth to accommodate the required insulation.
- Detail header insulation when insulated headers are required.

Roof Ventilation:
- Show minimum 1-inch air space in single rafter joist systems. Provide details for ventilation openings on the top and bottom on all roof sections.

  If an unvented attic is being proposed, the plans need to show how the requirements allowing unvented attic spaces are being met. When constructing an unvented attic space, careful attention to the details of the WSEC is necessary to minimize any potential moisture problems.

Slab Insulation:

- Detail insulation integration with the foundation and floor system. Show insulation protection when installed on the exterior. Show the thermal break on the vertical edge of below grade heated slabs.

Vapor Retarder:

- Indicate the type and location of vapor retarders.

Air Sealing:

- Detail difficult areas, including attic knee walls, cantilevered floor systems, mechanical and plumbing chases, etc.

Ducts:

- Provide framing details with specific space for major duct runs.

The Prescriptive Approach

The prescriptive approach for the *Washington State Energy Code* is the simplest method of code compliance. The WSU Extension Energy Program has created an Excel® spreadsheet to help provide documentation of the prescriptive building envelope requirement sections of the code. This worksheet also helps provide documentation required to meet the heating system sizing requirements of IRC section M1401.3. To select the correct worksheet, you will need know the climate zone. The worksheet is available from the WSUEEP website at ***www.energy.wsu.edu/code***

Component Performance Approach

The WSU Extension Energy Program developed a package of Excel® worksheets designed to document the qualification of building designs by the Component Performance (CP) approach described in Chapter 5 of the WSEC.

There is one Excel® workbook for both climate zones. The workbook contains both the CP worksheet and the *CP Library* which contains all of the component descriptions in Chapter 10 of the WSEC. This workbook can be downloaded from the WSU Extension Energy Program website at ***www.energy.wsu.edu/code***

Systems Analysis Approach

The WSU Extension Energy Program no longer provides software that supports a systems analysis approach. Select a DOE-2 based software package for this type of analysis. Use the WSU Extension Energy Program Component Performance worksheet to develop a target and proposed building envelope as required by the Code, then load this information into a DOE-2 product and perform the systems analysis.