Chapter 2: Foundation

Crawlspace

[V502.1.2]	Vents. Vents in the crawlspace help keep floor insulation and floor framing dry. Crawlspace vents also reduce the potential for radon buildup under the floor.
	Ventilation required is equivalent to IRC requirement (1 ft. ² of net free vent area for each 150 ft. ² of crawlspace area, or 1/150 ft. ²).
[V502.1.2]	If venting area is less than 1/300 ft. ² or the vents can be closed, a radon vent must be installed (see Radon, p. 2-18).
	Vents must be placed below floor insulation (see Figure 2-1) or they must be properly baffled (see Figure 2-2).
[V502.1.3]	HVAC Plenum. If the crawlspace is used as a supply plenum as part of the HVAC system, a functioning radon mitigation system must be installed (see Radon, p. 2-18). This includes:
	 a radon vent. 4-inch layer of aggregate
	 Sealed soil gas retarder membrane.
	 100 CFM in-line fan.
[V502.1.3]	Crawlspaces may not be used as a return plenum.

Insulation. If you choose a prescriptive compliance path, the WSEC requires that the floor over the crawlspace be insulated to the required value determined by using WSEC Tables 6-1 or 6-2.

Foundation Vent



Figure 2-1

Baffled Foundation Vent



Figure 2-2

[502.1.4.8]	Thermal Break. Where a crawlspace stem wall abuts a slab- on-grade within a conditioned space, insulation must be used to create a thermal break (see Figure 2-3 for possible detail.)
[502.1.6.7]	Ground Cover. Six-mil black polyethylene (or approved equal) must be laid over the ground within all crawlspaces.
	The ground cover:
	 Must extend to the foundation wall. Seams must be lapped 12 inches (see Figures 2-1 and 4-6).

• May be omitted if a minimum 3¹/₂-inch concrete slab is poured in the crawlspace.

Thermal Breaks





WSEC Builder's Field Guide, 7th Edition, 2006 • Washington State University Extension Energy Program

Slab-On-Grade

[201.1]	Defined by Code as any slab with its top surface less than 24 inches below the final exterior grade (see Figures 2-4, 2-5, and 2-7). In such cases, you must:
	• Maintain a thermal break at the edge of a slab. Slabs must not run continuously from heated to unheated areas. (See Figures 2-8 and 2-9.)
[502.1.4.8]	• Extend R-10 (Zone 1) or R-12 (Zone 2) insulation for a total of 24 inches either vertically or a combination of vertically and horizontally around the entire on-grade perimeter.
	 Install water-resistant insulation material manufactured for this purpose.
	• Install a cover flashing or parging to protect the insulation from moisture and physical damage above grade.
[502.1.4.9]	Radiant Slabs. If a radiant heating system is to be installed in a slab, a minimum of R-10 insulation (all zones) is required under the slab. The entire area of radiant slab in contact with the ground must be thermally isolated (see Figure 2-6).
[V503] [IRC Appendix F]	Higher Risk Radon Areas. Builders in the higher risk radon counties (see p. 1-3) must place 4 inches of aggregate and a soil gas retarder membrane under all slabs within conditioned space in residential construction. Penetrations of the slab must be sealed and a radon vent stack installed (see Radon, p. 2-18 and Figure 2-15).
	Notes: Ducts. Any heating system ductwork in or under a slab must be insulated to R-5 with insulation manufactured for this use.
	Pipes. Any hot water pipes buried under a slab must be insulated to as noted in Table 5-12. (R-3.6 for $\leq 2''$ pipe, R-5.4 for $\geq 2''$)
	Combustion Air. Installation of a wood stove or other solid fuel combustion appliance in a basement must provide combustion air to the appliance.



Slab Construction Perimeter Insulation

Figure 2-4

Slab-On-Grade



Figure 2-5

Meeting Below Grade Wall Requirements Monolithic Slab-On-Grade



Radiant Slab with Radon Source Control



Figure 2-6

Note: See IRC Appendix F and VIAQ 503.2.4 for requirements in radon counties.



Note: See VIAQ 503.2.4 for membrane requirements in radon counties.

WSEC Builder's Field Guide, 7th Edition, 2006 • Washington State University Extension Energy Program

Figure 2-7



Possible Slab Insulation Details

Figure 2-8

Non-Bearing Slab Thermal Break





Figure 2.9

WSEC Builder's Field Guide, 7th Edition, 2006 • Washington State University Extension Energy Program

2-11

Basements

Any basement with a heat source must have insulated walls. For a basement to be considered unheated and not require wall insulation, there must be no heat supplied. An unheated basement must be thermally isolated from adjoining conditioned spaces. This would include:

- Ceiling insulation (i.e. the floor above).
- Insulated stairwell walls.
- A weatherstripped access door.
- Insulated and sealed ducts and pipes.
- [502.1.4.10] **Below-Grade Walls.** For the purposes of the Energy Code, wall sections that extend 24 inches or less above grade may be considered below-grade walls.

Insulation:

- May be placed on either the interior or the exterior of the wall.
- The minimum required R-value is determined by the compliance path chosen.

Exterior insulation must:

- Be approved for below-grade installation.
- Extend from the top of the below-grade wall to the top of the footing.
- Be protected where it extends above grade (see Figure 2-10).

Interior insulation must:

• Extend from the top of the below-grade wall to the top of the below-grade floor (see Figure 2-11).

Daylight Basement. Pay attention to corner details when insulating a daylight basement (see Figures 2-12 and 2-13 for examples). Anywhere the slab in a daylight basement is within 24 inches of the finish grade, perimeter slab insulation is required.

[V501]

Higher Risk Radon Areas. Basement slabs in higher risk radon counties (see list, p.1-20) must be poured over 4 inches of aggregate and a soil gas retarder membrane. Slab penetrations must be sealed, and a radon vent installed (see Radon, p. 2-18, and Figure 2-14).

See IRC Appendix F and VIAQ 503.2.4 for requirements in radon counties.

Note:

Ducts and pipes in the slab and combustion air requirements are the same for heated basements as they are for slab-on-grades. Unheated basements require R-8 duct insulation. Any hot water pipes buried under a slab must be insulated to as noted in Table 5-12. (R-3.6 for > 2" pipe, R-5.4 for >/= 2", see Note, p. 2-5).



* Good practice: required only in higher risk radon counties.

Figure 2-10

WSEC Builder's Field Guide, 7th Edition, 2006 • Washington State University Extension Energy Program

2-14



Heated Basement: Interior Insulation

Figure 2-11

WSEC Builder's Field Guide, 7th Edition, 2006 • Washington State University Extension Energy Program

Heated Daylight Basement: Exterior Insulation





Heated Daylight Basement: Interior Insulation



Figure 2-13

Radon

Radon is a colorless, odorless, naturally occurring, radioactive soil gas. The U.S. Environmental Protection Agency (EPA) estimates that radon causes over 20,000 lung cancer deaths each year. To reduce this risk, the IRC Appendix F and VIAQ Code require additional measures in some counties for types of construction that may increase occupant exposure.

[V503.2.6] **Radon Vent.** Radon vents are required by the VIAQ Code in some crawlspaces and for all concrete slabs within living spaces in higher risk radon areas (see Crawlspaces, p. 2-1 and list of radon counties, p. 1-13).

A radon vent is a pipe that keeps unwanted gases out of the home by evacuating them to the outdoors, much as a plumbing vent removes sewer gas.

When a radon vent must be installed, the Code requires a continuous sealed pipe that runs from beneath the ground cover in the crawlspace or the soil gas retarder membrane under a slab to a point outside the building (see Figure 2-14). The radon vent must:

- Have a minimum 3-inch diameter.
- Be constructed of PVC schedule 40, ABS, or approved equivalent smooth walled pipe.
- Terminate no less than 12 inches above the eaves.
- Terminate more than 10 feet horizontally from chimneys or operable windows.
- Be sloped to drain.
- Be visibly labeled "Radon Vent."
- Be located within the thermal envelope to the extent practicable (see Figures 2-16 and 2-17 for additional details).

The radon vent may be eliminated if an approved alternative active depressurization system is installed. **Radon Fan.** Vent installation must provide a location for the possible future installation of an in-line fan. This includes:

- Isolation of the fan and any downstream piping from indoor air.
- Electrical outlet.
- Access to the location.
- [V502.1.3] The Code requires installation of the fan only when the crawlspace is used as a supply air plenum.

[V503] High Risk Area Prescriptive Requirements. The provisions of this section *apply only to the designated higher risk counties*: Clark, Ferry, Okanogan, Pend Oreille, Skamania, Spokane, and Stevens (see Figure 1-5, p. 1-13).

Concrete Slabs. Concrete slabs in contact with the ground and within residential living space including unheated basements must be:

- Placed over a minimum 4-inch thick layer of graded aggregate.
- Placed directly on top of a soil gas retarder membrane or placed over the gravel bed with at least 2 inches of fine sand or pea gravel installed between the concrete and membrane.
- The soil gas retarder membrane shall be overlapped by 12 inches or more at all seams and sealed at all penetrations to limit the entry of soil-gas into indoor air.
- Connected directly to a radon vent. The vent must meet the same specifications listed on p. 2-18; installation of a fan is not required.

Note: These requirements don't apply to garages.

- [V503.2.2] **Aggregate.** The aggregate used under the slab must meet one of the following gradation specifications:
 - ASTM standard C-33 and be No. 67 size aggregate or larger as listed in Table 2 "Grading Requirements for Concrete Aggregates."
 - Washington State Department of Transportation specification 9-03.1(3) "Course Aggregate for Portland Cement Concrete." Aggregate size shall be Grade 8 or larger.
 - Screened and washed consistent with ASTM Standard C-33 with 100% of the gravel passing a ¹/₂-inch sieve and less than 5% passing a No. 16 sieve.
- [V503.2.8] **Separate Aggregate Areas.** Aggregate areas should be as continuous as possible. Where areas are separated by footings or other barriers, two options are available:
 - A separate radon vent must be installed for each distinct area.
 - Separate areas may be considered a single area if a minimum 3-inch diameter connection joining the areas is provided for every 30 feet of barrier (see Figure 2-14).

[V503.2.5]	Below-Grade Sealing. All penetrations in the slab and joints in the slab or other floor systems and below-grade walls must be sealed.
	Concrete block walls in below-grade areas are considered unsealed surfaces. Block walls and any penetrations must be sealed to create a continuous air barrier to limit the transport of soil-gas into the indoor air.
[V102.1]	Alternative Methods. The VIAQ Code allows alternative methods of construction. The alternative must:
	 Meet the intent of the Code. Be at least equivalent to the prescribed practice in suitability, effectiveness, safety, and indoor air quality.
	• Be approved by the Building Official.

This provision has been used by a number of jurisdictions to approve alternative methods for radon control. Check with your local jurisdiction.

Radon Requirements



Figure 2-14

Note: See IRC Appendix F and VIAQ 503.2.4 for requirements in radon counties.

WSEC Builder's Field Guide, 7th Edition, 2006 • Washington State University Extension Energy Program



Figure 2-15









Note: See IRC Appendix F and VIAQ 503.2.4 for requirements in radon counties.

WSEC Builder's Field Guide, 7th Edition, 2006 • Washington State University Extension Energy Program