

Oregon Non-Residential Building Energy Code



Walls

The construction of exterior walls affects comfort, operating costs, acoustic separation, and the size of heating and cooling systems. Oregon Department of Energy Code includes a variety of requirements to ensure that walls are an efficient part of the building envelope.

Prescriptive Approach

The easiest way to comply is to use insulation that meets the minimum R-value requirements for walls in Table 13-E (if you are in Zone 1) or Table 13-F (if you are in Zone 2). Wall requirements from these tables are shown below.

There are different requirements depending on the class of wall (frame, masonry with interior, exterior, or integral insulation) and the glazing fraction of the building.

No averaging or tradeoffs are allowed. For example, if one portion of the wall is masonry and another framed, each portion must comply on its own.

Zone 1 Prescriptive Requirements for Walls (From Table 13-E of the Oregon Energy Code)

Wall Construction	Maximum Glazing Fraction	Maximum Component U-Factor		Minimum R-Value
Masonry, with integral insulation*	15%	0.300		
Masonry, with integral insulation**	40%	0.210		
Masonry or concrete, with interior insulation	40%	0.130	or	11
Masonry or concrete, with continuous exterior insulation	15%	0.300	or	1.4
Masonry or concrete, with continuous exterior insulation	40%	0.210	or	2.8
Frame	40%	0.130	or	13
Other	40%	0.130	or	13
Below-grade walls		0.110	or	7.5

* All cores to be filled. At least 50% of cores must be filled with vermiculite or equivalent fill insulation.

** All cores except bond beams must contain rigid insulation inserts approved for use in reinforced masonry walls.

Code Language

1312.1.1 Air Leakage. Penetrations or through openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, or weathertipped, or otherwise sealed to limit infiltration and exfiltration.

Exception: Openings required to be fire resistant.

Building assemblies used as ducts or plenums shall be sealed, caulked, and gasketed to limit air leakage.

Exterior joints around windows and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations or utility services through walls, floors, and roofs, and all other openings in the exterior envelope shall be sealed in a manner approved by the building official.

1312.1.2 Insulation materials and installation. All insulation materials shall be installed according to the manufacturer's instructions to achieve proper densities, maintain clearances and maintain uniform R-values. Access to equipment shall be provided which prevents damaging or compressing the insulation. Refer to Section 1312.2 for performance requirements.

To the maximum extent possible, insulation of the required R-value shall extend over the full component area.

1312.1.2.3 Batt insulation. Wall batt insulation shall be installed flush with the heated side of the cavity.

1312.1.4 Moisture control. A 1-perm vapor retarder shall be installed on the warm side (in winter) in all exterior floors, walls and ceilings of heated buildings.

Documentation:

To document compliance with this section of code, fill out Compliance Form 3a.

In addition:

- **Prescriptive Approach:** Form 3b with the appropriate associated worksheets.
- **Simplified Trade-Off Approach:** Submit a disk with the Code-Comp file on it. This file can be found in the GDT\CodeComp\Project directory with an .occ file extension.
- **Whole Building Design Approach:** Call Oregon Dept. of Energy or information on complying via the Whole Building Design Approach.

Exceptions:

1. Masonry walls with exposed interior surfaces.
2. The building official may require designed moisture control systems for refrigerated buildings, buildings covering swimming pools or similar buildings with unusual potential for moisture damage.
3. The building official may accept designed moisture control systems which may include vapor barriers, ventilation, dehumidification or combinations thereof.

1312.2 Thermal performance. All heated or mechanically cooled buildings and structures, or portions thereof, shall be constructed so as to provide the required thermal performance of the various components as set forth in this subsection.

Exception: Glazing up to 1 percent of the exterior wall area is exempt from the U-factor and shading coefficient requirements of this code.

Buildings shall comply by using either Section 1312.2.1 or 1312.2.2.

1312.3 Additions and alterations.

1312.3.1 Additions. Additions shall meet all requirements that apply to new buildings.

Exceptions:

1. Addition of the same use and occupancy classification as the existing building which increase floor area up to 10 percent of the existing building area, not to exceed 1,000 square feet (93 m²), if the component U-factors, including glazing, are equal to or less than corresponding U-factors in the existing building.
2. Additions which have glazing areas and/or skylight areas exceeding the maximum allowed under the prescriptive path and meet all of the following requirements:
 - 2.1 The maximum height of the addition shall not exceed 20 feet (6.1 m) measured from the ground floor area.
 - 2.2 The maximum floor area of the addition shall not exceed 3,000 square feet (279 m²) or 15 percent of the existing building ground floor area, whichever is less.
 - 2.3 The center-of-glass U-factor shall not exceed 0.30, tested or calculated on the vertical plane,
 - 2.4 The shading coefficient for overhead glazing shall not exceed 0.40, the shading coefficient for vertical glazing shall not exceed 0.57,
 - 2.5 At least 25 percent of the gross area of the exterior wall of the addition shall have a U-factor not to exceed 0.13 in Zone 1 and 0.09 in Zone 2, and

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Zone 2 Prescriptive Requirements for Walls
(From Table 13-F of the Oregon Energy Code)

Wall Construction	Maximum Glazing Fraction	Maximum Component U-Factor		Minimum R-Value
Masonry, with integral insulation*	15%	0.300		
Masonry, with integral insulation**	33%	0.160		
Masonry or concrete, with interior insulation	33%	0.090	or	13
Masonry or concrete, with continuous exterior insulation	15%	0.270	or	1.8
Masonry or concrete, with continuous exterior insulation	33%	0.160	or	4.3
Frame	33%	0.090	or	19
Other	33%	0.090	or	19
Below-grade walls		0.110	or	7.5

* All cores to be filled. At least 50% of cores must be filled with vermiculite or equivalent fill insulation.

** All cores except bond beams must contain rigid insulation inserts approved for use in reinforced masonry walls.

U-factor Calculation

If the wall insulation R-value doesn't meet the requirements in the tables above, then calculate the U-factor of the assembly on Worksheet 3b of the compliance documentation (this worksheet is not required to be completed if insulation R-value is used to demonstrate compliance).

The first step is to determine the effective R-value of the various components of the wall. Table 3a provides effective R-values for a variety of wall framing and insulation assemblies, including wood framing and metal framing. Table 3b gives insulation R-values of other common components of the wall assembly (such as gypsum wall board.) Table 3d gives the R-values of air layers next to the interior and exterior surfaces of the wall. The inverse of the total R-value is the U-factor for the assembly. If the calculated U-factor of the wall does not meet the requirements in the tables above, you will need additional insulation to meet the prescriptive requirement. The figure below is an example of a typical U-factor calculation for a wall taken from Worksheet 3b of the energy code compliance forms.

(a) Layer	(b) Description	(c) Detail	(d) R-value
Exterior	Moving Air		0.17
A	Exterior Finish	Siding, aluminum, steel or vinyl, over sheathing/insulating board (not tested) 0.5%	2.96
B	Rigid Insulation		
C	Concrete		
D	Framing & Insulation	Wall Wood Framing (2x4 @ 16" o.c.) R-19	13.64
E	Gypsum Wallboard	1/2", hardwood finish	0.08
Interior	Still Air		0.68
1. Total column (d)			18.13
2. Assembly U-factor (invert the amount in line 1)			0.06

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Providing continuous insulation is an effective way to improve thermal performance. It also can serve as an air barrier and vapor barrier. Common types of continuous insulation include expanded polystyrene foam (bead board) or polyisocyanurate foam. “Polyiso” foam has a higher R-value per inch of thickness than polystyrene foam, but its performance deteriorates over time more rapidly.

Other Compliance Options

If you can not meet prescriptive requirements for walls as shown above, the Simplified Trade-Off may be used to demonstrate compliance (see the Envelope Compliance Methods fact sheet for more information).

Moisture Control

As with exterior floors and ceilings, exterior walls of heated buildings must have a 1-perm vapor retarder installed on the warm side (in winter) (Section 1312.1.4). For all Oregon climates this is the interior of the assembly. Vapor retarders can either be film materials such as asphalt coated kraft paper, aluminum foil or polyethylene sheet, or closed-cell insulation materials such as extruded polystyrene. Asphalt coated kraft paper, asphalt-impregnated felt, are both wood-based materials and perform very differently than foil and polyethylene. While the performance of polyethylene and foil in resisting vapor diffusion is independent of the relative humidity of the surrounding air, wood-based materials such as kraft paper, asphalt-impregnated felt, and oriented strand board increase their perm rating with an increase in the humidity of the adjacent air. This allows more water vapor to pass through the material, allowing increased drying when needed. New synthetic materials, resistant to mold and rot, have been formulated to perform in a similar way and are called “smart” vapor retarders. These new materials are specially formulated to act as vapor retarders when the RH drops indoors in the winter, yet allow drying through them during warm, humid outdoor conditions.

Demising Surfaces

In Oregon code, demising surfaces are defined as, “A building element consisting of walls, windows, doors, floors, or ceilings that separates conditioned space from either unconditioned or semi-conditioned space(s).”

Oregon code requires that demising walls must meet building envelope requirements:

General Exceptions to Insulation Requirements

1. Exterior wall insulation is not required in semi-conditioned spaces, which are defined as spaces that have a limited heating system output capacity that:
 - Does not exceed 15 Btu/hr ft² (47 W/m²) or 4 W/ft² (47 W/m²) of heated floor area (Climate Zone 1) or

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- 2.6 Any opaque roof/ceiling portions shall have a U-factor not to exceed 0.05 or an insulation value not less than R-9.

1312.3.2 Alterations. Alterations to the building envelope shall meet the prescriptive requirements of the code. Exterior wall, roof and floor cavities opened or created during alteration shall be ventilated as required by Section 1505.3 and insulated as required by Table 13-E and 13-F or to the full depth of the cavity, whichever is less.

Exceptions:

1. When up to 25 percent of the glazing in any one wall is being replaced, it may be replaced with glazing with a U-factor and shading coefficient equal or better than the existing glazing.
2. Walls and floors without framing cavities need not be insulated.

The addition of heating to an unconditioned space shall require that the entire roof and one-half the opaque wall area meet or exceed the prescriptive path standards described in Section 1312.2.1. The addition of cooling to a heated space does not initiate any requirements to improve the envelope.

Examples

Q My space is only freeze-protected. Am I exempted from envelope requirements?

A No, but it may be exempt from exterior wall insulation if your space, meets **requirements** for a semi-conditioned space as defined by Oregon Code: “Spaces that have a limited heating system output capacity that does not exceed the values listed below, and where each heating system is controlled by a thermostat with a maximum setpoint capacity of 45°F (7°C), mounted no lower than heating unit for convection systems or below the heating unit for radiation systems.

Climate Zone 1: 15 Btu/hr ft² (47 W/m²) or 4 W/ft² (47 W/m²) of heated floor area.

Climate Zone 2: 20 Btu/hr ft² (47 W/m²) or 5.86 W/ft² (47 W/m²) of heated floor area.”

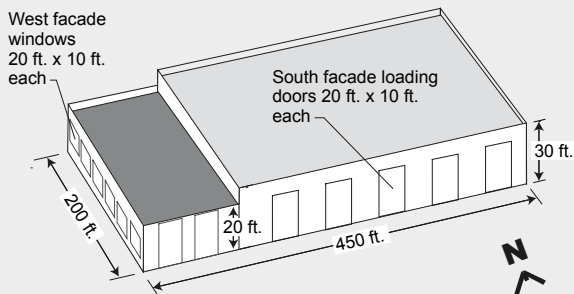
Q I have a wall that is partially below grade. What’s the insulation requirement?

A You are allowed to install less insulation on a below-grade wall. The above grade wall requirements are more stringent. However, most people meet above grade requirements for ease of design and construction.

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Examples

Q We have an office next to a n unconditioned warehouse.



Do we need to comply?

A Since the office is considered a conditioned space and the warehouse an unconditioned space, the wall separating the two is defined as a demising wall. Therefore, the office must comply with the code requirements.

Q Can I construct a CMU wall without insulation?

A No, but it will comply if at least 50% of the cells are un-grouted and filled with insulation. If the glazing fraction is 15% or less, the fill insulation may be loose-fill vermiculite. If the glazing fraction is greater than 15% (up to the maximum glazing fraction allowed), the fill insulation must be rigid insulation inserts approved for use in masonry walls.

Find Out More

Copies of Code:

Oregon Building Officials Association
phone: 503-873-1157 fax: 503-373-9389

Technical Support:

Oregon Department of Energy
625 Marion Street NE phone: 503-378-4040
Salem, OR 97301-3737 toll free: 800-221-8035
www.oregon.gov/energy fax: 503-373-7806

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Photo on page 1 c/o Warren Gretz, DOE/NREL

12/05 ODOE CF-125/Fact Sheet 7

Non-residential code ENVELOPE fact sheets include:

- Envelope Compliance Approaches
- Fenestration Performance
- Walls
- Roofs

20 Btu/hr ft² (63 W/m²) or 5.86 W/ft² (63 W/m²) of heated floor area (Climate Zone 2).

- Has each heating system controlled by a thermostat with a maximum setpoint capacity of 45°F (7°C)
- Is mounted no lower than heating unit for convection systems or below the heating unit for radiation systems.

2. Exterior wall insulation and doors in spaces enclosed in Group S, Division 3 Occupancies or Group H, Division 4 Occupancies, motor vehicle service station occupancies where each heating system is controlled by a thermostat with a maximum set point of 55°.
3. Windows installed in demising walls need not meet the shading coefficient requirements of this section.
4. Buildings whose sole source of space conditioning energy is from on-site solar or wind resources.
5. Greenhouses intended primarily for plant propagation.

Additions

Additions must meet the same requirements as a new building with a few exceptions. Small additions are one exception to this rule. Specifically, your addition must be:

- 10% or less the size of the existing building (no more than 1,000 ft²),
- of the same use/occupancy, and
- with U-factors equal to or less than the existing building.

Another exception is if you exceed the amount of glazing area allowed under the prescriptive requirements (more than 40% in Zone 1, and more than 33% in Zone 2). If the addition exceeds the maximum glazing area and a host of other criteria listed in the code language above are met, it is excepted.

Alterations

Alterations must comply with the requirements of the code.

Opening up a cavity or adding a new wall cavity to an existing un-insulated wall requires insulation as required by Tables 13-E and 13-F or to the full depth of the cavity, whichever is less.

Walls and floors without framing cavities are exempted from this requirement.

Examples

Q I am converting an old, heated warehouse to office space. I will be furring out the CMU exterior walls and adding interior finished wall board. Do I need to insulate the walls?

A Yes, since you are creating a wall cavity it must be filled with insulation to the prescriptive requirements of Table 13 E or F, or to the full depth of the cavity, whichever is greater.