Seattle Department of Construction and Inspections
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Tip 428
Seattle Permits
— part of a multi-departmental City of Seattle series on getting a permit

Fenestration in Seattle Energy Code

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This Tip helps permit applicants understand the Seattle Energy Code requirements regarding fenestration. The term "fenestration" includes not only windows, but also curtain wall, storefront glazing, glazed entrance doors, skylights, and other assemblies that allow daylight into our buildings. Plentiful daylight with a connection to nature and weather is important for our health and well-being, as well as reducing the electricity we need for artificial lighting.

Fenestration is also the weak point in the thermal envelope (the structure separating air inside from air outside) surrounding our buildings. It's the main source of heat loss in winter, and of unwanted solar heat gain in summer. This not only increases building energy use, but it can make the occupants sitting close to the windows uncomfortable.

A great deal of progress has been made over the past few decades to reduce those unwanted heat flows. Double-pane glass with selective coatings, with thermal breaks (or barriers) built into the frames, are now almost universal. Office towers with floor-to-ceiling glazing are becoming a thing of the past. To achieve Seattle's and Washington state's ambitious climate goal, we need to make more progress controlling our fenestration heat loss and solar gain.

The Seattle Energy Code has several means of controlling heat loss and solar gain in commercial buildings. The term "commercial buildings" includes all buildings except single-family, duplex, and townhouse construction. The principal fenestration requirements are found in Section C402.4, and they're focused on two principal issues: heat flow and fenestration area.

Heat Flow – Maximum Allowable U-Factors Section C402.4

Heat flow through fenestration is evaluated using a "U-factor," for which lower numbers indicate better performance. The allowable U-factor for each category of fenestration is shown in Table C402.4. These U-factors consider the entire glass plus frame assembly, so are not just the center-of-glass values.

There are two main categories of fenestration in the table: one category is mainly factory-built windows that are inserted into openings, while the second is mostly site-built fenestration such as curtain wall or storefront glazing. That second category also includes "Class AW windows," used in high-rises and other locations subject to severe wind loads. Both categories have separate values for "fixed" and "operable," recognizing that the extra hardware and framing for operable sections results in additional heat loss. There's also a third category for "entrance doors," which includes glazed swinging doors and automatic glass sliding doors.

Table C402.4
Maximum Fenestration U-Factors

Category	Fixed/Op	U-Factor
Curtain wall, storefront, other site-built fenestration, and Class AW windows	Fixed	U-0.34
	Operable	U-0.36
Entrance doors		U-0.60
All other vertical fenestration	Fixed	U-0.26
(Typically manufactured individual windows)	Operable	U-0.28

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Table C402.4.1
Maximum Solar Heat Gain Coefficient (SHGC)* for Vertical Fenestration

Projection Factor (PF)**	Fixed	Operable
PF < 0.2	0.38	0.33
0.2 ≤ PF < 0.5	0.46	0.40
PF ≥ 0.5	0.61	0.53

* SHGC = Solar Heat Gain Coefficient. Lower SHGC values are better, indicating less solar heat in the building. (Visible Transmittance (VT) is a separate metric indicating how much visible light passes through the glass. You generally want to choose glass with low SHGC and high VT.)

**The "projection factor" (PF) measures how much the glass is shaded by permanent overhead shading or other construction. You'll find the formula for determining PF in Section C402.4.3; it's the ratio of the horizontal distance from the glass to the outer edge of the projection above, and the vertical distance from the bottom of the projection to the bottom of the glass. You're permitted to use lower SHGC fenestration if your building has a higher projection factor.

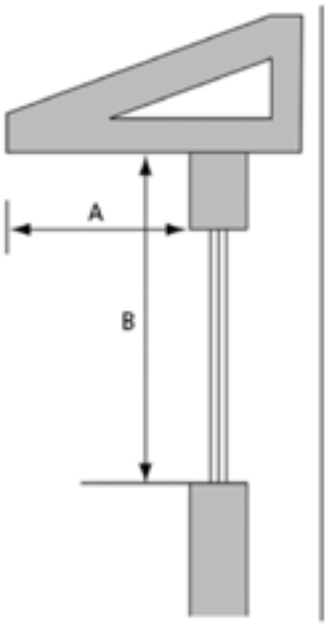

Diagram of Projection Factor

Area weighted U-factors. If your project has more than one kind of fenestration in any one of the fenestration categories in Table C402.4, you can comply with an area-weighted average U-factor for that category.

Sections C402.4.1.1 and C402.4.1.1.1 allow 40 percent fenestration area instead of 30 percent, if over half of the conditioned floor area is within "daylight zones" and the lighting is controlled by "daylight responsive controls." Daylight zones are areas close to windows or skylights, defined (with diagrams) in Chapter 2 of the Seattle Energy Code.

Sections C402.4.1.1 and C402.4.1.1.2 allow the maximum fenestration area shown in the table to be increased by 10 percent if the fenestration is "high-performance," meaning it complies with the more stringent U-factors listed.

Section C402.4.1.1.2
"High-Performance" Fenestration

Category	Fixed/Op	U-Factor
Curtain wall, storefront, other site-built fenestration, and Class AW windows	Fixed	U-0.31
	Operable	U-0.36
Entrance doors		U-0.60
All other vertical fenestration (Typically manufactured individual windows)	Fixed	U-0.23
	Operable	U-0.24

Skylights

Skylights must meet the U-factor requirements in Table C402.4.

Table C402.4.2
Skylights

Metric	Value
U-factor	Max U-0.45
SHGC	Max 0.32

Skylights are limited to a maximum 5 percent of the gross roof area. There's also a minimum area for certain buildings, with some exceptions. Section C402.4.2 requires skylights for any enclosed space that meets all of the following criteria:

- The space is greater than 2,500 square feet
- The space is directly under a roof
- The ceiling height is greater than 15 feet for at least 75 percent of the ceiling area
- The space is one of the following types:
  - Office
  - Lobby
  - Atrium
  - Concourse
  - Corridor
  - Gymnasium/exercise center
  - Convention center
  - Automotive service
  - Manufacturing
  - Nonrefrigerated warehouse
  - Retail store
  - Distribution/sorting area
  - Transportation
  - Workshop

The skylights in these spaces must provide daylight zones with top lighting for at least half of the floor area in the space, and the lighting in those zones must have daylight-responsive controls, to turn the lights down when the skylights provide enough light.

Doors

An opaque door is defined in Chapter 2 of the Seattle Energy Code as any door that is at least half opaque (or less than half glazed).

Opaque doors must meet the maximum U-factors in Table C402.1.4. U-factors are not typically provided by door manufacturers, so you must use the default U-factors in Appendix A, Section A107.

Doors that are more than half glazed are considered to be fenestration and must meet the maximum U-factors for fenestration in Table C402.4.

Additions

The rules for vertical fenestration in additions are shown in Section C502.3.1.

- If the total fenestration area of the addition plus the existing building is no more than the maximum allowed for new construction, comply with Section C402.4 as usual.
- If the total fenestration area of the addition plus the existing building is more than the maximum allowed for new construction, you can comply in any of these four ways:
  - C402.1.5 component performance alternative for the addition only, if approved by the code official.
  - C402.1.5 component performance alternative for the whole building (addition plus existing).
  - C407 total building performance energy modeling method for the addition only.
  - C407 total building performance energy modeling method for the whole building (addition plus existing).

The rules for skylights in addition are shown in Section C502.2.2.

- If the total skylight area of the addition plus the existing building is no more than the maximum allowed for new construction, comply with Section C402.4 as usual.
- If the total skylight area of the addition plus the existing building is more than the maximum allowed for new construction, you can comply in any of these four ways:
  - C402.1.5 component performance alternative for the addition only, if approved by the code official.
  - C402.1.5 component performance alternative for the whole building (addition plus existing).
  - C407 total building performance energy modeling method for the addition only.
  - C407 total building performance energy modeling method for the whole building (addition plus existing).

Alterations

The rules for vertical fenestration in alterations are shown in Section C503.3.2 and are similar to the rules for additions.

- If the total fenestration area of the addition plus the existing building is no more than the maximum allowed for new construction, comply with Section C402.4 as usual.
- If the total fenestration area of the addition plus the existing building is more than the maximum allowed for new construction, you can comply in any of these five ways:
  - C402.1.5 component performance alternative for the addition only, if approved by the code official.
  - C402.1.5 component performance alternative for the whole building (addition plus existing).
  - C407 total building performance energy modeling method for the addition only.
  - C407 total building performance energy modeling method for whole building (addition plus existing).
  - The alteration doesn't increase the existing fenestration area.
- If you are replacing existing fenestration, the new fenestration must meet the current code requirements in Table C402.4. If the existing fenestration is better than the current code requirement (has a lower U-factor), the replacement fenestration must perform at least as well as the existing. According to Section C503.3.2.1.

Skylights in alterations also follow a similar set of rules.

- If the total skylight area of the addition plus the existing building is no greater than the maximum allowed for new construction, comply with Section C402.4 as usual.
- If the total skylight area of the addition plus the existing building is more than the maximum allowed for new construction, you can comply in either of these ways:
  - C402.1.5 component performance alternative for the whole building (addition plus existing).
  - C407 total building performance energy modeling method for the whole building (addition plus existing).