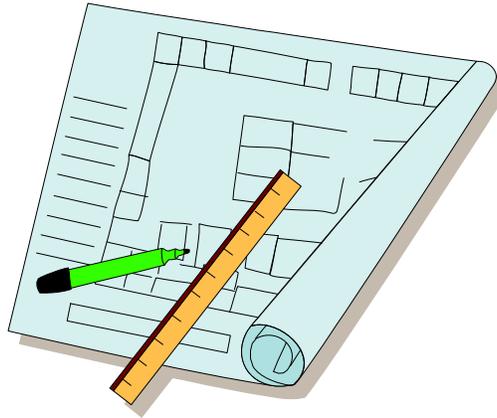




# DOES MY BUILDING DESIGN NEED ENGINEERING?

## Overview

Building construction has become increasingly complex during the last two decades. Buildings are larger and use new materials and construction methods. Updated structural stability and safety requirements address potential damage from fire, earthquakes, wind, snow, and other forces. Because of this, building design has become increasingly complex.



When a building of otherwise conventional construction contains structural elements outside the limits of Section R301 of the 2006 *International Residential Code* (IRC) or otherwise do not conform to the IRC, these elements shall be designed in accordance with accepted engineering practice. It may be possible to have only a portion of the structure designed and calculated, however the extent of such design must demonstrate compliance of the nonconventional elements with other applicable code requirements, and shall also be compatible with the performance of the conventional framed system. Engineered design in accordance with the 2006 *International Building Code* (IBC) is permitted for all buildings and structures, and parts thereof, included in the scope of the IRC. As a result, owners and builders have several design options: engineered design, prescriptive design, or a combination of the two. These options allow both trained professionals and ordinary citizens to design safe, economical, and durable structures.

## Engineered Design

With the engineered design method, a design professional (an architect or engineer) registered in Washington State analyzes the building's design and calculates the strength of the components to ensure that it will withstand the wind, earthquake, snow, and gravity loads required by the code. This method is used to design buildings that:

- Are complex or of irregular shape;
- Are not made from wood, or
- Do not otherwise meet the prescriptive requirements of the code.

Engineered designs submitted for building permits must have the designer's structural calculations attached to the plans. Both the plans and the calculations must have the designer's registration stamp and original signature on them; copies cannot be accepted.

The designer must transfer any hold-down and shear wall nailing schedules, beam, post, framing anchor, and other specifications included in the calculations to the

plan sheets. The applicant must provide two sets of all plans, calculations, and specifications when they apply for a building permit.

## Prescriptive Design

Prescriptive design is an alternative "cookbook" way to design a building to meet general code requirements. The prescriptive method can be used for buildings that:

- Use conventional wood-framed construction techniques;
- Have an ordinary shape (rectangle or connected rectangles);
- Have bearing walls no more than 10 feet high; and
- Have lateral wall bracing (braced wall lines) according to the code's prescriptive requirements.

Unlike engineered designs, prescriptive designs can be drawn by nearly anyone with a ruler, paper, pen, basic drawing skills and a general understanding of the prescriptive design requirements described in this brochure, "Braced Wall Panels" brochure and in "Conventional Light-Frame Construction" brochure.

## Irregular Structures

As mentioned above, irregular shaped buildings must be designed by a licensed design professional. According to the *International Residential Code*, and the *International Building Code* a building is considered to be of irregular shape when any one of the six conditions listed below are present.

If your building contains any one of these six conditions, it is considered an "irregular structure." In this case, an engineer or architect licensed by the state of Washington must prepare a lateral bracing design.

## Irregular Shape

### Condition 1

When exterior braced wall panels are not in one plane vertically from the foundation to the uppermost story in which they are required, the structure shall be considered to be irregular. [See Figure 2308.12.6(2)]

**Exception:** Floors with cantilevers or setbacks not exceeding four times the nominal depth of the floor joists [See Figure 2308.12.6(2)] may support braced wall panels, provided:

1. Floor joists are 2" x 10" or larger and spaced at not more than 16" on center.
2. The ratio of the backspan to the cantilever is at least 2 to 1.
3. Floor joists at the ends of braced panels are doubled.

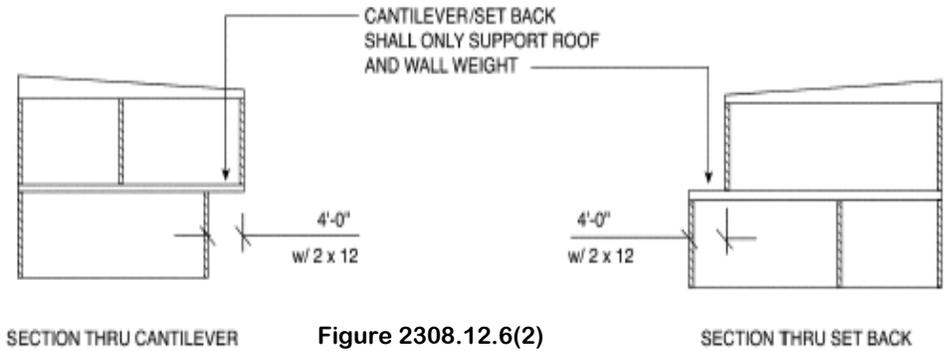


Figure 2308.12.6(2)

4. A continuous rim joist is connected to the ends of all cantilevered joists. The rim joist may be spliced using a metal tie not less than 0.058" (16 galvanized gauge) and 1.5" wide fastened with six, 16d nails. The metal tie shall have a minimum yield of 33,000 psi
5. Joists at setbacks or the end of cantilevered joists shall not carry gravity loads from more than a single story having uniform wall and roof loads, nor carry the reactions from headers having a span of 8 feet or more.

## Irregular Shape

### Condition 2

Where a section of floor or roof is not laterally supported by braced wall lines on all edges, the structure shall be considered to be irregular. [See Figure 2308.12.6(3)].

**Exception:** Portions of roofs or floors that do not support braced wall panels above may extend up to 6 feet beyond a braced wall line. [See Figure 2308.12.6(4)]. (Such as a covered porch)

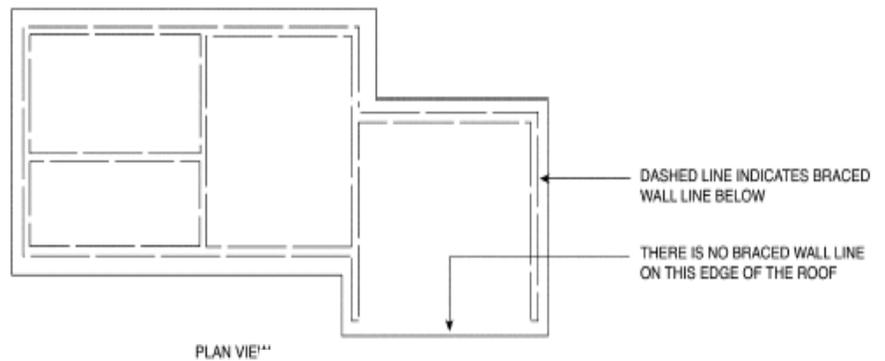


Figure 2308.12.6(3)

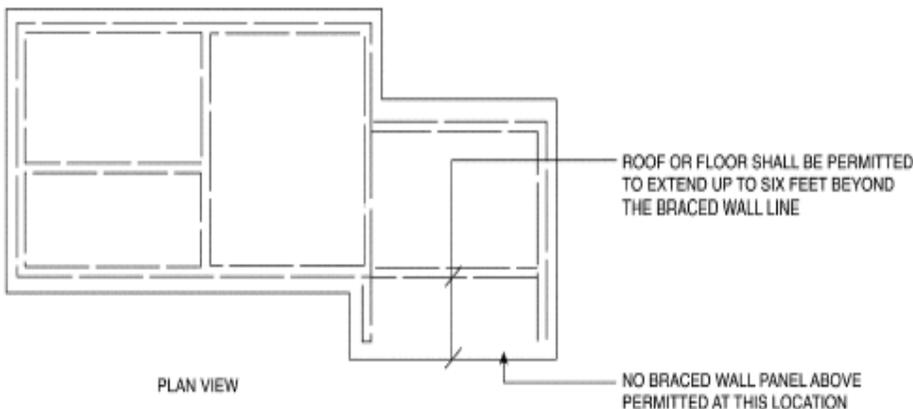


Figure 2308.12.6(4)

## Irregular Shape

### Condition 3

When the end of a required braced wall panel extends more than 1 foot over an opening in the wall below, the structure shall be considered to be irregular. This requirement is applicable to braced wall panels offset in plane and to braced wall panels offset out of plane as permitted by the exception in item 1 above. [See Figure 2308.12.6(5)].

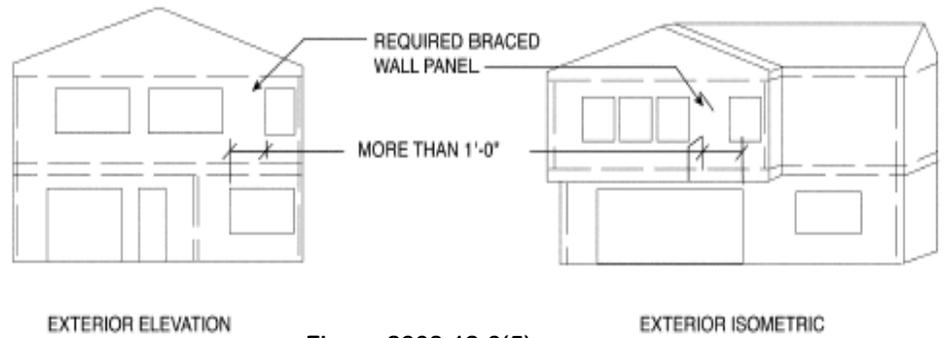
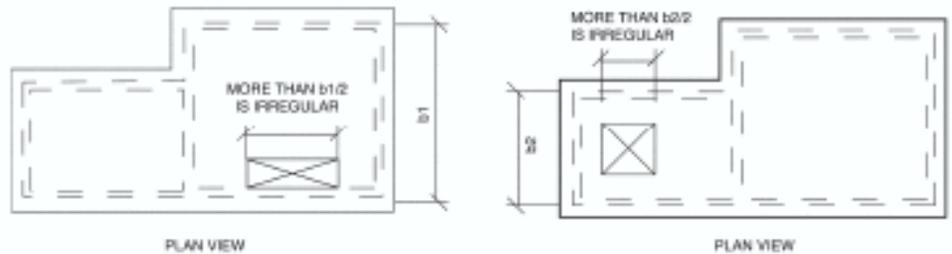


Figure 2308.12.6(5)

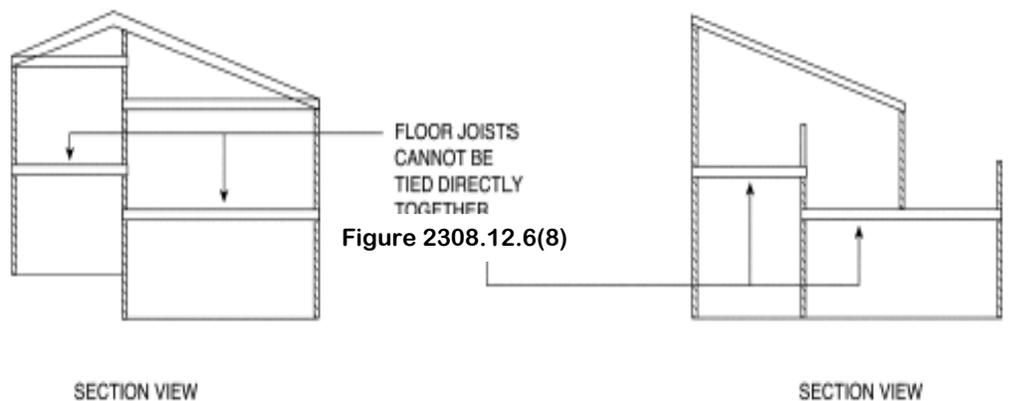
**Exception:** Braced wall panels are permitted to extend over an opening not more than 8 feet in width where the header is a 4-inch by 12-inch or larger member.



## Irregular Shape

### Condition 4

Where openings in floor and roof diaphragms having a maximum dimension greater than 50% of the distance between lines of bracing or an area greater than 25% of the area between orthogonal pairs of braced wall lines are present, the structure shall be considered to be irregular. [See Figure 2308.12.6(8)].



## Irregular Shape

### Condition 5

Where portions of a floor level are vertically offset such that the framing members on either side of the offset cannot be lapped or tied together in an approved manner, the structure shall be considered to be irregular. [See Figure 2308.12.6(6)].

**Exception:** Framing supported directly by foundations need not be lapped or tied directly together.

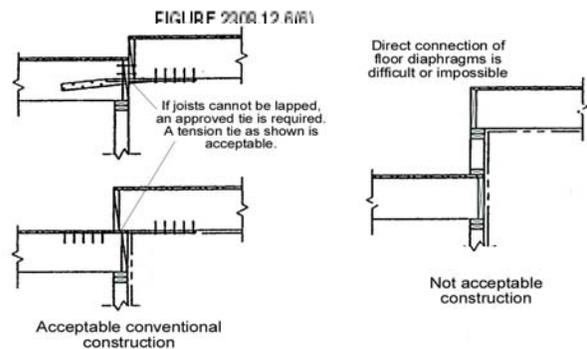


Figure 2308.12.6(6)



## Prescriptive Design

If your building design is not of "irregular shape," it can be designed in accordance with "prescriptive design." Prescriptive design is based on the concept of a structural box. One or more structural boxes may be combined to create the building. Boxes may be stacked or placed side by side in the design as long as each box has a floor, walls and roof or ceiling, that connect together in such a way that the walls run parallel or perpendicular (90° angles) to each other and do not exceed 10' in height. To give the boxes adequate strength to resist the forces of wind, earthquakes, snow and other loads, walls must have enough solid areas without openings (such as doors, windows, fireplaces, etc.) where braced wall panels can be built. The exterior walls, with their braced wall panels, make up the exterior braced wall lines. Interior partitions often make up the interior braced wall lines. These braced wall lines, together with the other load-bearing walls, the foundation, and the floor and roof diaphragms make up the essential elements of a prescriptive design.



In the City of Bremerton, a Seismic Design Category D<sub>2</sub> area, all buildings using prescriptive design must satisfy all of the prescriptive design requirements listed below. If any portion of the building does not satisfy all six of the following prescriptive design requirements, the building must have a lateral bracing design prepared by an engineer or architect licensed by the state of Washington.

1. The building must have braced wall lines (walls comprised of a series of braced wall panels) around the perimeter, and through the interior of the building at least every 25 feet, except that one room that does not exceed 900 square feet, may go up to 35 feet. In no instance may a building exceed 35 feet in length without interior braced wall lines.
2. Every braced wall line shall have a braced wall panel placed at the end of the braced wall line, or within 8 feet of the end if the appropriate corner panel and/or holddown is used. Every braced wall line must contain braced wall panels at least every 25' on center along the entire wall. (For example, a 50-foot-long braced wall line must contain a braced wall panel at each end and one in the middle.) See IRC Section R602.10.11 for more information.

3. Every braced wall panel shall be at least 4' wide (except the 2'8" alternate braced wall panel described in IRC 602.10.6) and shall be constructed by one of several methods as indicated in IRC Section R602.10.3 (for details, see brochure "Braced Wall Panels").

4. Bearing walls shall be constructed of 2 x 4 or 2 x 6 studs, not more than 10' in height.
5. A single story building, or the top story of a two-story building must have at least 25% of the braced wall's total length as braced wall panels. The first story of a two-story building must have at least 55% of the braced wall's total length as braced wall panels. See Table R602.10.1. for additional information.
6. The building must have a reinforced, continuous foundation system compliant with the 2006 IRC. Note: If the foundation does not meet the minimum prescriptive requirements, or if the foundation walls are more than 9' high, from the top of the footing, to the top of the wall, foundation engineering is required. See Tables R404.1.1(1) & R404.1.4 as adopted and amended by the state of Washington.

## Conclusion

If your building plans meet the prescriptive design criteria, **the plans must clearly indicate all the braced wall panel locations and types (no exceptions)**. The plans must also provide details describing how the panels will be constructed, and must show all hold-down locations (if any) on both the floor plans and the foundation plans.

If your building plans include a design prepared by a Washington State registered architect or professional engineer, **the plans must have the engineer's or architect's construction requirements clearly indicated on the plan sheets and must have the design calculations attached to the plan sets for review (no exceptions)**. All plans designed by an engineer or architect must bear the original stamp and signature of the registered professional who prepared them. No photocopies will be accepted unless specifically authorized by the design professional.