SIP Wall Aspect Ratios

A wall aspect ratio is the ratio of the height of a wall segment to its length measured parallel to the wall line. For instance, a wall segment with a height of 8 feet and a length of 4 feet has an aspect ratio of 2:1. Similarly, a wall measuring 8 feet in height and 32 inches in length has an aspect ratio of 3:1. The length of the wall is often referred to as its width. The aspect ratios applicable to SIP wall segments depend on whether the wall is analyzed as a prescriptive braced wall according to the 2012 International Residential Code (IRC) or as an engineered shear wall per the 2012 International Building Code (IBC). It's important to note that IRC and IBC provisions for SIPs only pertain to SIPs with wood structural panel facings and a foam core.

Prescriptive Braced Wall Segments

In the 2012 IRC, Section R602.10.4 outlines 16 wall bracing methods, with minimum braced lengths of 48 inches for some panel-type methods or a 2:1 aspect ratio. Section R602.10.4.2 allows for the continuous sheathing bracing method (CS-WSP), permitting a braced length of 24 inches or a 4:1 aspect ratio for an 8-foot wall. However, limitations apply, such as adjacency to a garage door in Seismic Design Categories (SDCs) A-C. The CS-WSP method also allows a 24-inch braced wall length next to openings up to 64 inches high, like windows, and a 32-inch minimum length or a 3:1 aspect ratio next to full-height door openings up to 80 inches.

Wall Aspect Ratios for SIPs

Section R613.5.3 of the 2012 IRC considers SIP walls as "continuous wood structural panel sheathing" (CS-WSP) for calculating required wall bracing. Thus, a SIP wall under IRC prescriptive requirements may have a braced length as narrow as 24 inches or a 4:1 aspect ratio under specific conditions, such as garage doors in low SDCs or adjacent to windows up to 64 inches high. Additionally, a 3:1 aspect ratio is permitted next to full-height door openings up to 80 inches without restrictions.

Engineered Shear Walls

The 2012 IBC directs designers to the 2008 ANSI/AF&PA Special Design Provisions for Wind and Seismic (SDPWS) for lateral force resisting systems design, including wood frame shear walls. Table 4.3.4 of the 2008 SDPWS provides maximum shear wall aspect ratios for various wall sheathing types. For blocked wood structural panels, the aspect ratio can reach up to 3.5:1. However, designs resisting seismic forces must not exceed a 2:1 aspect ratio unless certain criteria are met. Notably, there is no explicit mention of SIPs in Table 4.3.4, requiring an interpretation regarding their classification as a blocked wood structural panel system.

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Recent Shear Wall Research

To assess SIP shear wall performance with openings, a study was conducted at the Home Innovation Research Labs. This study aimed to address aspect ratio limitations set by product evaluation agencies, such as NTA and ICC-ES, which restrict SIP shear wall aspect ratios to 2:1 for low seismic risk areas and 1:1 for high seismic risk areas. These limitations pose challenges for engineered shear walls in both residential and nonresidential construction, particularly where narrow aspect ratio segments are common due to closely spaced doors and windows or placement near building corners.

The 2013 study examined various wall configurations with openings and aspect ratios, and results were detailed in the HIRL Report "SIP Shear Walls: Cyclic Performance of High Aspect Ratio Segments and Perforated Walls." Testing adhered to ASTM E 2126-11 standards for cyclic load testing of shear resistance.

An important objective of the study was to assess the applicability of the perforated shear wall (PSW) method to SIP shear walls. The PSW method, outlined in the 2008 ANSI/AF&PA Special Design Provisions for Wind and Seismic (SDPWS), is a commonly used design approach. Results from the study indicated that perforated SIP shear walls closely aligned with the overall PSW method trend for strength and stiffness.

Summary

- In residential construction complying with the 2012 IRC, SIPs can be deemed equivalent to continuously sheathed wood frame walls with aspect ratios up to 4:1 under specific circumstances and 2:1 without limitation.
- For nonresidential construction governed by the 2012 IBC, interpretation is needed regarding whether maximum shear wall aspect ratios from the 2008 ANSI/AF&PA SDPWS apply to SIPs. Nevertheless, findings from the HIRL study strongly advocate for utilizing the PSW method in SIP shear wall design.