

**Oregon
Interpretive Ruling No. 00-17**

**USE OF PERFORATED SHEAR WALL AS AN ALTERNATE METHOD
OF DESIGN FOR ONE & TWO FAMILY DWELLINGS**

REQUESTED BY: Oregon Building Industry Association.

REQUEST FOR RULING: The Oregon Building Industry Association (OBIA) requests approval of an alternate method for design of shear walls of one and two family dwellings, as provided in this ruling.

APPLICABLE CODE SECTIONS AND REPORTS: Section 2315.1, 1998 Oregon Structural Specialty Code (OSSC), Residential Structural Design Guide: 2000 Edition U.S. HUD publication, Perforated Shear Walls with Conventional and Innovative Base Restraint Connections U.S. HUD publication.

BACKGROUND: On August 1, 1999, OBIA submitted a code change to Section 2315 of the OSSC, which provided for the design of shear walls of one-and two-family dwellings by the use of Perforated Shear Wall (PSW) design methodology provided in this ruling. The proposed shear wall design methodology is based on recent studies (Sugiyama and Matsumoto, 1994; Dolan and Heine, 1997) and several full-scale tests conducted at Virginia Polytechnic Institute and State University and National Association of Home Builders (NAHB) Research Center. This methodology differs from the NEHRP 2000 proposal in the allowed aspect ratio and the hold-down requirements.

After extensive review by the Structural Engineering Committee (SEC) and the Oregon Structural Engineers Association (SEAO) code review committee, the SEC was reluctant to approve it as a code change. Instead they recommended the proposal be approved as an alternate method of designing shear walls, limited for use in one-and two-family dwellings.

ANALYSIS: The PSW alternative is a method, which varies from the traditional segmented, shear wall approach. Instead of relying on segmented panels (with or without bottom restraint devices), the PSW only requires that a fully-sheathed wall line with perforations for openings (windows) be restrained at each end with a hold-down device or adequate corner bracing in lower capacity shear walls. To determine the PSW capacity, all that is needed is the unit shear value for the shear wall construction, the area of wall openings, the length of the full-height wall segments, and the overall length of the wall using the equations included in this alternate method.

U.S. HUD reports documenting the testing of shear wall using narrow wall segments and corner restraint confirms the basis of the formula and the provisions included in this alternate method.

FINDINGS:

■ Section 104.2.8 of the OSSC, allows acceptance of an alternate which achieves the intent of PERFORATED SHEAR WALL INTERPRETIVE RULING Page 2

the code and provides equivalent suitability, strength, effectiveness, fire resistance, durability,

safety and sanitation for the occupants and property.

This interpretation is authorized by ORS 455.060, Rulings on Acceptability of Materials, Designs or Methods of Construction, and Attorney General's Opinion OP-5208, issued October 1, 1981, which advised the statute permits authoritative interpretations of code requirements.

This interpretive ruling provides equivalent suitability, strength, effectiveness, fire resistance, durability, safety and sanitation as required in the 1998 OSSC.

RULING: The Building Codes Structures Board accepts the recommendation of the Structural Engineering Committee for the approval of following as an alternate method of design of shear walls of one-and two-family dwellings.

A. DEFINITION

PERFORATED SHEAR WALL is a wood structural panel sheathed wall of conventional light-framing with openings or perforations for doors and windows and with hold-down restraint devices provided at the ends of the wall only. The shear capacity of the perforated shear wall is determined by an empirical relationship of opening amounts to the racking resistance of a wall of the same length, but without openings.

B. ALTERNATE SHEAR WALL DESIGN METHOD:

B.1 Perforated Shear Wall Design for One-and Two-Family Dwellings: The unadjusted shear capacity of a perforated shear wall shall be determined as though the entire wall length was solidly sheathed (i.e., no perforations using the unit resistance values of Table 23-II-I-1 of the OSSC. The design capacity for the perforated shear wall shall be determined by multiplying the unadjusted shear strength by the shear capacity ratio, F , given by the following equation:

$$F = \frac{r F}{2r} - 3$$

Where:

F = sheathing capacity ratio = sheathing area ratio determined as follows:

$$F = \frac{A_s}{1 + \frac{A_o}{\sum L_i}}$$

Where:

A_o = total area of all openings in the shear wall
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H = height of the shear wall
 L_i = length of the individual full-height sheathed wall segments

B.2 Hold -down restraint. Hold-down restraints shall be provided at the ends of the wall only and the required design uplift (i.e., tensile) capacity of the end restraints shall be determined by multiplying the adjusted unit shear value by the wall height. Design consideration of the offsetting effect of building dead load on hold-down forces shall be permitted. Hold-downs shall be permitted to be placed any distance from the end of the wall line provided the perforated shear wall is considered as that portion of the wall between the hold-downs.

EXCEPTION: Corner framing, including minimum length of braced wall panels on each side to the building corner and framing interconnections, shall be permitted to be considered as providing the required end restraint when installed in accordance with Figure 23-II-2 and B.3 Item 2, or rational analysis.

Shear transfer shall be provided between the wall and floor or foundation in accordance with the calculated shear capacity of the perforated shear wall where the shear transfer into or from the wall is through a continuous top or bottom plate. When the bottom plate is interrupted by wall openings (i.e., doors) the shear transfer through the bottom plate shall be designed using the unadjusted allowable shear capacity based on the length of full-height wall segments in the wall line.

B.3 Limitations. The use of this method is limited to the design of shear walls of one-and two-family dwellings otherwise constructed to the provisions of conventional light-frame construction of the OSSC or the One and Two Family Dwelling Specialty Code and is subject to the following additional limitations:

- 1 The structural wood panel fastening has a maximum capacity of 550 pounds per foot (3inch spacing of 8d nails at the panel perimeter with wood structural panel thickness of 15/32 inch per Table 23-II-I-1, OSSC).
- 2 For walls with unadjusted allowable unit shear capacity of not more than 255 plf in Table 23-II-I-1, OSSC and with bottom plates uninterrupted by door openings, the base attachment shall use anchor bolts not more than 6 feet on center for foundation sills or 16d common sinker or pneumatic nails spaced not greater than 24 inches on center for sole plates of walls located above the foundation sill plate. For walls with: (1)unadjusted unit shear capacity of more than 255 plf, and (2) at walls with bottom plates interrupted by door openings, the base attachment at each perforated shear wall shall be designed to transfer the unadjusted allowable shear capacity of the segment and shall provide an uplift resistance equivalent to the unadjusted unit shear capacity of the wall construction (Table 23-II-I-1, OSSC) per lineal foot of bottom plate. The uplift resistance may be provided by straps attached to wall studs and anchored to construction below.
- 3 Aspect ratio of full-height sheathed wall segments shall not be greater than 4:1.
- 4 Collectors for shear transfer shall be provided through the full length of the perforated shear wall. For perforated shear walls with openings not exceeding 12 feet in width, a minimum double 2x4 continuous top plate shall be an acceptable collector with a minimum splice connection of 8-16d nails per Table 23-II-I-1, OSSC.

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5. Wall studs shall be continuous for the full height of the wall and the wall height shall not exceed 20 feet and shall be uniform in height for the length of the perforated shear wall. Edges of sheathing shall be blocked.

Any vertical loads imposed on the wall by overturning forces originating from the action of lateral loads on the supported structure shall be adequately transferred through the wall.

C. EXCEPTION TO SECTION 2315.5.3, OSSC

The use of this alternate method is an exception to the limitations in Section 2315.5.3, OSSC.

D. FIGURE 23-II-2

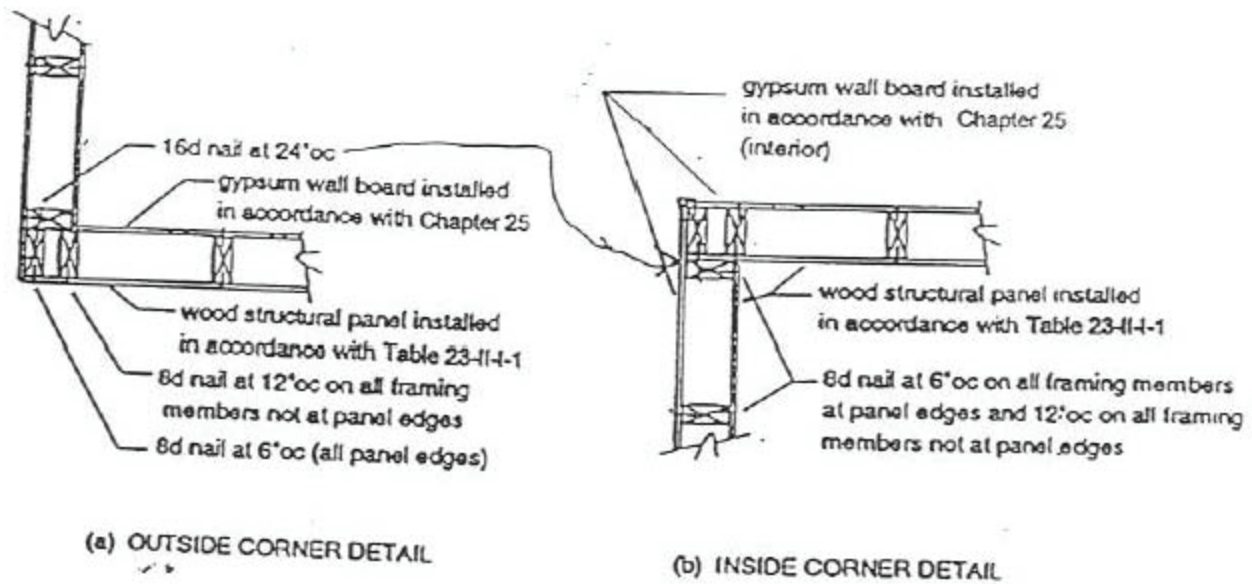


Figure 23-II-2 – EXTERIOR CORNER FRAMING

John A. Talbott, P.E. Chairman
Building Codes Structures Board

Date

The recommendation and findings of the Building Codes Structures Board are accepted and Interpretive Ruling 00-17 is adopted.

Joseph A. Brewer III, Administrator Date Building Codes Division