

**Oregon  
Interpretive Ruling No. 00-18**

**USE OF NEHRP 2000, PROPOSAL 7-17R  
(PERFORATED SHEAR WALL METHOD) AS AN  
ALTERNATE METHOD OF DESIGN OF SHEAR WALLS**

**REQUESTED BY:** Structural Engineering Committee

**REQUEST FOR RULING:** An interpretive ruling is requested to adopt the provisions of NEHRP (National Earthquake Hazard Reduction Program) 2000, Proposal 7-17R (Design of Shear Walls by Using Perforated Shear Wall Method) as an approved alternate method of design.

**APPLICABLE CODE SECTION:** Proposal 7-17R, NEHRP 2000 and Section 2315, 1998 Oregon Structural Specialty Code (OSSC). A copy of the Proposal 7-17R, NEHRP 2000 can be obtained from Building Seismic Safety Council, 120 L St., N.W., Suite 400, Washington, D.C. 20005.

**BACKGROUND:** The Structural Engineers Association of Oregon (SEAO) and Structural Engineering Committee (SEC) have reviewed extensively Proposal 7-17 of the proposed NEHRP 2000. Since their review, Proposal 7-17 has been approved for adoption in the final document of NEHRP 2000, with some amendments. After amendments the Proposal is renumbered as 7-17R. Both the SEAO and SEC have recommended the adoption and approval of the shear wall design methodology of this document as an acceptable alternate method of design.

**DISCUSSION:** Proposal 7-17R was chosen as the base document for this alternate design methodology because it is more thorough, contains commentary, and has design examples. Conventional accepted methods include providing hold-downs to resist overturning at each end of each pier, and strapping around openings to create spandrel beams. Under the alternate design method presented herein, resistance to overturning is only provided at the extreme ends of the entire perforated shear wall, and the shear wall capacity is reduced to account for the resulting increase in wall flexibility.

The NEHRP guidelines are in terms of ultimate loads, whereas the wood design in the OSSC is based on allowable stresses. Therefore, any reference to factored shear in Proposal 7-17R, must be adjusted to the allowable shear as appropriate, by the designer. The differences between the NEHRP document and the OSSC and the references mentioned in NEHRP and not included in the Proposal 7-17R are provided below.

EQUIVALENT CODE REFERENCES	
NEHRP proposal 7-17R reference	Equivalent UBC reference or explanation
Section 12.3.4.4	The 1997 edition of FEMA 302 reads as follows:

	<p><b>12.3.4.4 Shear Wall Anchorage:</b> Where net uplift is induced, tie-down (hold-down) devices shall be used. Tie-down (hold-down) devices attached to the end post with nails are permitted. All devices shall only be used where the uplift resistance values are based on cyclic testing of wall assemblies and the test results indicate that the tie-down devices do not reduce the stiffness, ductility, or capacity of the shear wall when compared to nailed-on devices. Foundation anchor bolts shall have a plate washer under each nut. The minimum plate washer sizes are as follows: <b>Bolt size Plate washer size for shear walls</b> ½ and 5/8 inch 1/4x3x3 inch ¾, 7/8, and 1 inch 3/8x3x3 inch Hole diameters in the plate washer 3/16 inch larger than the bolt diameter are permitted provided that a standard cut washer is placed between the plate washer and the nut. Foundation anchor bolt embedment shall conform to the requirements of Chapters 6 and 8 (OSSC equivalent is Chapter 19). Bolts shall be placed a maximum of 2 inches from the sheathed side of walls sheathed on one face. Walls sheathed on both faces shall have the bolts staggered with the bolt a maximum of 2 inches from either side of the wall. Alternatively, for walls sheathed on both faces, the bolt shall be placed at the center of the foundation sill with the edge of the plate washer within ½ inch of each face of the wall. The plate washer width shall be a minimum of 3 inches and the plate thickness shall be determined by analysis using the upward force on the plate equal to the tension capacity of the bolt. Anchor bolt and tie-down nuts shall be tightened without crushing the wood, and provision for preventing nuts from loosening shall be made just prior to covering the framing.</p>
Section 12.4.2.6	Section 2315, OSSC
Section 12.4.3.1	This section identifies an aspect ratio limitation of 2:1 for seismic loads. An exception is made to allow for aspect ratios of up to 3.5:1, which is acceptable for wind loads.
Tables 12.4.3-2a & b (Shear strength values for wood shear walls)	Table 23-II-I-1, OSSC (Allowable shear values for wood shear walls)
Section 12.4.1, Commentary	Section 2322.3, OSSC

Some clarifications about the provisions of the design methodology provided by this document:

1. The reduction specified in section 12.4.4.1 applies only for the seismic forces, and is not intended to apply for the wind loads.

2. The height limitation of 20 feet, in section 12.4.4.2.f, is intended as a plate-to-plate height limit, not as a total limit for the sum of all floor heights.

2 Section 12.4.4.4.1: the use of dead loads to resist overturning forces is permitted using a rational analysis in accordance with the OSSC provisions.

3 Section 12.4.4.4.3: design for uplift at intermediate piers. Example 2 in the commentary shows two possible details to account for these uplift forces.

4 Examples provided in the proposal 7-17 commentary are based on LRFD values, not ASD.

5 A perforated shear wall is inherently more flexible than a fully sheathed shear wall of equal length. Depending on the configuration of the walls used, story drift of a building utilizing this design method could be of greater concern than for a design using conventional fully sheathed shear walls. This is especially true of buildings of three or more stories, or with story heights greater than 10'-0". Designer must ensure that the story drifts are within acceptable limits as set forth in the OSSC.

**FINDINGS:**

Section 104.2.8 of the OSSC, allows acceptance of an alternate which achieves the intent of 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 and SEAO for the approval of Proposal 7-17R, NEHRP 2000, document as an alternate method of design of shear walls.

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

The recommendation and findings of the Building Codes Structures Board are accepted and Interpretive Ruling 00-18 is adopted.

Joseph A. Brewer III, Administrator Date Building Codes Division