1x4 Wood Let-in Braces and Metal T-braces

Table 6.4 provides values for typical ultimate shear capacities of 1x4 wood let-in braces and metal T-braces. Though not found in current building codes, the values are based on available test data (Wolfe, 1983; NAHBRF, date unknown). Wood let-in braces and metal T-braces are common in conventional residential construction and add to the shear capacity of walls. They are always used in combination with other wall finish materials that also contribute to a wall's shear capacity. The braces are typically attached to the top and bottom plates of walls and at each intermediate stud intersection with two 8d common nails. They are not recommended for the primary lateral resistance of structures in high-hazard seismic or wind design areas. In particular, values of the seismic response modifier R for walls braced in this manner have not been clearly defined for the sake of standardized seismic design guidance.

TABLE 6.4 ***Unfactored (Ultimate) Shear Resistance (lbs) for 1x4 Wood Let-ins and Metal T-Braces[1,2]***

Type of Diagonal Brace	Ultimate Horizontal Shear Capacity (per brace)[3]
1x4 wood let-in brace (8-foot wall height)[4]	600 lbs (tension and compression)
Metal T-brace[5]	1,400 lbs (tension only)

Notes:
[1]Values are average ultimate unit shear capacity and should be multiplied by a safety factor (ASD) or resistance factor (LRFD) in accordance with Sections 6.5.2.2 and 6.5.2.3.
[2]Values are based on minimum Spruce-Pine-Fir lumber (specific gravity, G = 0.42).
[3]Capacities are based on tests of wall segments that are restrained against overturning.
[4]Installed with two 8d common nails at each stud and plate intersection. Angle of brace should be between 45 and 60 degrees to horizontal.
[5]Installed per manufacturer recommendations and the applicable code evaluation report. Design values may vary depending on manufacturer recommendations, installation requirements, and product attributes.

Other Shear-Resisting Wall Facings

Just about any wall facing, finish, or siding material contributes to a wall's shear resistance qualities. While the total contribution of nonstructural materials to a typical residential building's lateral resistance is often substantial (i.e., nearly 50 percent if interior partition walls are included), current design codes in the United States prohibit considerations of the role of facing, finish, or siding. Some suggestions call for a simple and conservative 10 percent increase (known as the "whole-building interaction factor") to the calculated shear resistance of the shear walls or a similar adjustment to account for the added resistance and whole-building effects not typically considered in design (Griffiths and Wickens, 1996).

Some other types of wall sheathing materials that provide shear resistance include particle board and fiber board. Ultimate unit shear values for fiber board range from 120 plf (6d nail at 6 inches on panel edges with 3/8-inch panel thickness) to 520 plf (10d nail at 2 inches on panel edges with 5/8-inch panel thickness). The designer should consult the relevant building code or manufacturer data for additional information on fiber board and other materials' shear resistance qualities. In one study that conducted tests on various wall assemblies for HUD, fiber board was not recommended for primary shear resistance in high-hazard seismic or wind design areas for the stated reasons of potential durability and cyclic loading concerns (NAHBRF, date unknown).

Combining Wall Bracing Materials

When wall bracing materials (i.e., sheathing) of the same type are used on opposite faces of a wall, the shear values may be considered additive. In high-hazard seismic design conditions, dissimilar materials are generally assumed to be nonadditive. In wind-loading conditions, dissimilar materials may be considered additive for wood structural panels (exterior) with gypsum wall board (interior). Even though let-in brace or metal T-brace (exterior) with gypsum wall board (interior) and fiber board (exterior) with gypsum wall board (interior) are also additive, they are not explicitly recognized as such in current building codes.

When the shear capacity for walls with different facings is determined in accordance with Sections 6.5.2.2 and 6.5.2.3, the designer must take care to apply the appropriate adjustment factors to determine the wall construction's total design racking strength. Most of the adjustment factors in the following sections apply only to wood structural panel sheathing. Therefore, the adjustments in the next section should be made as appropriate before determining combined shear resistance.

6.5.2.2 Shear Wall Design Capacity

The unfactored and unadjusted ultimate unit shear resistance values of wall assemblies should first be determined in accordance with the guidance provided in the previous section for rated facings or structural sheathing materials used on each side of the wall. This section provides methods for determining and adjusting the design unit shear resistance and the shear capacity of a shear wall by using either the perforated shear wall (PSW) approach or segmented shear wall (SSW) approach discussed in Section 6.4.2. The design approaches and other important considerations are illustrated in the design examples of Section 6.6.

Perforated Shear Wall Design Approach

The following equations provide the design shear capacity of a perforated shear wall:

$$F'_s = (F_s)C_{sp}C_{ns}x[\frac{1}{SF} or \phi] \quad \text{(units plf)} \qquad \text{Eq. 6.5-1a}$$

$$F_{psw} = (F'_s)C_{op}C_{dl}x[L] \quad \text{(units lb)} \qquad \text{Eq. 6.5-1b}$$

where,

F_{psw} = the design shear capacity (lb) of the perforated shear wall

F_s = the unfactored (ultimate) and unadjusted unit shear capacity (plf) for each facing of the wall construction; the C_{sp} and C_{ns} adjustment factors apply only to the wood structural panel sheathing F_s values in accordance with Section 6.5.2.1

F'_s = the factored and adjusted design unit shear capacity (plf) for the wall construction