4. The empirical values listed in the IBC and NEHRP do not list the common top plate height of 9 ft. The codes state that intermediate sheathing ratios may be interpolated but do not indicate if intermediate maximum opening height ratios are to be interpolated. For production design, engineers may utilize the underlying empirical formulas. In doing so, they should be aware that typographical errors exist with the empirical PSW formulas shown in the 2000 NEHRP commentary (BSSC 2001) (C12.4.3.3a1 and C12.4.3.3b). Readers are referred to 2003 NEHRP (BSSC 2004a, 2000b), APA 157 (Rose and Keith 1996), or the 2001 National Design Specification (AF & PA, 2001) that is adopted as ANSI standard NDS-2001, because they provide the correct formulas that are not shown in the IBC. Note that to develop the Co values shown in the tables of the IBC and NEHRP, all openings are conservatively assumed to share the same maximum clear height. Another difference to note with APA 157 is that it is a reduction applied to the entire wall rather than to the qualifying segments. Therefore the full-height sheathing ratio must be applied to APA 157 formulas to match the tabular values of the IBC and NEHRP.

5. When calculating overturning forces it is important to recognize that tension and compression are not equal as some could presume with 2000 NEHRP Sec. 12.4.3.4.4 and IBC Equation 23-3. Compression forces, especially on multi-story construction, are usually greater due to the presence of a resisting moment and differing basic load combinations. Note also that if a header or beam frames into the ends of the perforated shear wall, the greater load (including live load) must be considered in compression rather than the lighter dead load couple that is assumed for resisting tension. Further, when sizing the compression member note that the buckling capacity will usually be critical, rather than the capacity of the selected tie-down device.

6. Where stacked openings occur it is not clear how the Co values given in IBC Table 2305.3.7.2 are applied. Stacked openings are common on walls between 10-ft and 20-ft tall where the PSW method is permitted.

Future Research

Wood shear walls with openings are very complicated compared to the mathematical models used in most design offices. Some researchers have developed sophisticated modeling techniques. White and Dolan (1995), for example, refined a finite element program that calculated forces and stresses of shear wall elements. However, like many mathematical tools, typical field variations such as overnailing, issues with panel placement, and the presence of random splits or misalignments can challenge the uniform assumptions. Additionally there can be great significance to the effect of finish materials and walls that are not integrated into the model. On larger buildings with many interior walls there can be a significant capacity that is not considered as a part of the lateral force-resisting system, although it is also acknowledged these redundancies are typically brittle and may not be reliable lateral force-resisting elements. Future methods should improve the accuracy of our analytical tools. In addition, the industry can benefit from design methods that reinforce window openings rather than merely estimating the residual strength in the shear wall.

Keywords

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References

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