Conclusion

This seemingly simple design example has demonstrated the many decisions, variables, and assumptions to consider in designing the lateral resistance of a light-frame home. For an experienced designer, certain options or standardized solutions may become favored and developed for repeated use in similar conditions. Also, an experienced designer may be able to effectively design using simplified analytical methods (i.e. the total shear approach shown in Step 1) supplemented with judgment and detailed evaluations of certain portions or unique details as appropriate.

In this example, it appears that a 7/16-inch-thick Structural I wood structural panel sheathing can be used for all shear wall construction to resist the required wind shear loading. A constant sheathing panel edge nail spacing is also possible by using 3 inches on center if the perforated shear wall method is used and 4 inches on center if the segmented shear wall method is used (based on the worst-case condition of Wall Line B). The wall sheathing nails specified were 8d pneumatic nails with a 0.113 inch diameter. In general, this wall construction will be conservative for most wall lines on the first story of the example house. If the seismic shear load were the only factor (i.e., the wind load condition was substantially less than assumed), the wall construction could be simplified even more such that a perforated shear wall design approach with a single sheathing fastening requirement may be suitable for all shear wall lines. The garage opening wall would be the only exception.

Finally, numerous variations in construction detailing in a single project should be avoided as it may lead to confusion and error in the field. Fewer changes in assembly requirements, fewer parts, and fewer special details should all be as important to the design objectives as meeting the required design loads. When the final calculation is done (regardless of the complexity or simplicity of the analytic approach chosen and the associated uncertainties or assumptions), the designer should exercise judgment in making reasonable final adjustments to the design to achieve a practical, well-balanced design. As a critical final consideration, the designer should be confident that the various parts of the structural system are adequately “tied together” to act as a structural unit in resisting the lateral loads. This consideration is as much a matter of judgement as it is a matter of analysis.

6.7 References

AF&PA, *National Design Specification for Wood Construction*, ANSI/AF&PA NDS-1997, American Forest & Paper Association, American Wood Council, Washington, DC, 1997.

AISI, *Shear Wall Values for Light Weight Steel Framing*, Publication RG-9601, American Iron and Steel Institute, Washington, DC, January 1996.

Ambrose, J. and Vergun, D., *Design for Lateral Forces*, John Wiley & Sons, New York, NY, 1987.

APA, *Diaphragms and Shear Walls*, APA–The Engineered Wood Association, Tacoma, WA, December 1997.

APA, *Nail Penetration and Framing Specific Gravity Factors for Shear Walls and Diaphragms*, APA Report T98-22, APA–The Engineered Wood Association, Tacoma, WA, 1998.

APA, *Wood Structural Panel Sheathing for Narrow-Width Wall Bracing*, Report 156, APA–The Engineered Wood Association, Tacoma, WA, 1994.

ASTM, ASTM E-564, American Society of Testing and Materials, West Conshohocken, PA, 1998a.

ASTM, *Standard Methods of Conducting Strength Tests of Panels for Building Construction* (ASTM E72-86), American Society of Testing and Materials, West Conshohocken, PA, 1998b.

ATC, *A Critical Review of Current Approaches to Earthquake–Resistant Design*, ATC-34, Applied Technology Council, Redwood City, CA, 1995.

Boughton, G.N. and Reardon, G.F., "Simulated Cyclone Wind Tests on a Timber Framed House," *Proceedings of the Pacific Timber Engineering Conference*, Vol. 2, Auckland, New Zealand, 1984, 527-534.

Diekmann, Edward R., *Design of Wood Diaphragms*, Vol. IV, Clark C. Heritage Memorial Series on Wood, Pennsylvania State University, University Park, PA, 1986, 479-547.

Dolan, J.D. and Heine, C.P., *Monotonic Tests of Wood-Frame Shear Walls with Various Openings and Base Restraint Configurations*, Report No. TE-1997-001, Virginia Polytechnic Institute and State University, Blacksburg, VA, 1997a.

Dolan, J.D. and Heine, C.P., *Sequential Phased Displacement Cyclic Tests of Wood-Frame Shear Walls with Various Openings and Base Restrain*