

Post-Frame Construction and the International Building Code

By Amanda Stauffer

When most people think of post-frame construction, they do not think of houses. However, post-frame construction has many benefits that make it a great choice for residential applications. With the wide variety of materials that builders have available, the result is often indistinguishable from conventional framing. Post-frame construction makes it possible to incorporate many architectural design elements such as high ceilings, exposed timber, and large window and door openings that would be more difficult to incorporate with conventional framing. Methods to achieve a rustic timber look with post frame can be used at a fraction of the cost of typical heavy timber or post-and-beam construction. The speed of construction of post frame compared to conventional framing also makes post frame a great choice for residential applications.

The International Residential Code (International Code Council, 2018) is a prescriptive code that applies to detached one- and two-family dwellings and townhouses. It also applies to accessory structures such as detached garages. Because the IRC is a prescriptive code, it provides tables and charts with the acceptable design parameters for typical residential structures. No specific section in the IRC applies to post-frame systems; however, if the residential post-frame system is an engineered design, it is deemed acceptable under the IRC. Section R301.1.3 states: “When a building of otherwise conventional construction contains structural elements exceeding the limits of Section R301 or otherwise not conforming to this code, these elements shall be designed in accordance with accepted engineering practice.” If the structure complies with the International Building Code (International Code Council, 2018), it is also acceptable under

the IRC. Alternative provisions under the IRC (R301.1) allow the use of reference standards such as those in the American Wood Council’s *Wood Frame Construction Manual for One- and Two-Family Dwellings* (2018).

The design criteria for wind loading, seismic categories, roof loads, deflection limits and protection against decay can be found in chapter 3 of the IRC. These requirements are usually determined by the geographic location of the project, the site exposure, soil conditions and the location of adjacent structures.

Chapter 3 of the IRC also contains the requirements for when and where fire-resistant construction is needed. One-hour-rated exterior walls can be required, depending on the proximity to lot lines (see Table R302.1 in the IRC). Post-frame walls have the ability to be fire rated in accordance with UL design V304 (see **Figure 1**). A 1-hour post-frame wall has been tested and approved and is acceptable for use in residential construction. Because drywall can be installed over the wall girts, post-frame walls can meet the requirements of Table R302.6 of the IRC, which requires a layer of a specific type of drywall to separate the garage from the dwelling unit. Fire blocking that is required in wood-frame walls can be achieved in post-frame construction by adding wood blocking between the posts at the ceiling line or at the header-to-truss connection for the vertical requirement. For the horizontal fire-blocking requirement, wood blocking is placed between the wall girts at each post location or at the maximum spacing determined by the code.

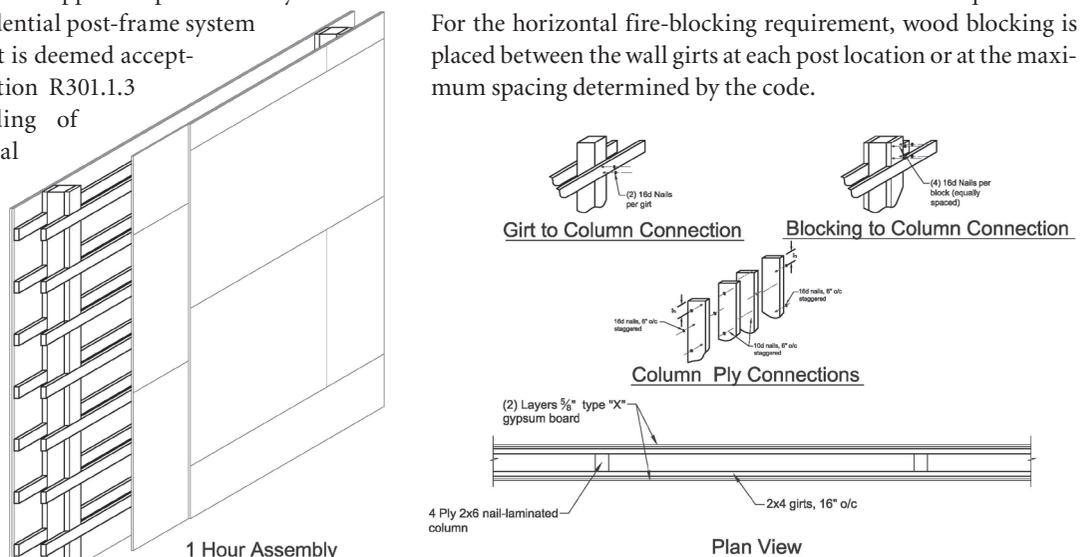


Figure 1. Post-frame fire-rated wall assembly details (from UL design V304)

The National Frame Building Association's Post-Frame Building Design Manual (2015) and other industry-approved references found on the NFBA website are important resources for foundation designs specific to post-frame systems. The IRC specifies foundation systems only for typical wood-frame houses. Post foundations need to be designed and installed properly if they are to act effectively as part of the post-frame system. These guidelines should be considered:

- Place the footing below the frost line or install a frost-protected foundation to eliminate frost heaving.
- Install a concrete collar or concrete backfill on top of the footing for frost protection. When a concrete collar is used correctly, the collar is placed on top of the footing and extends up the post by the distance specified by the engineer. Incorrect placement of the concrete collar or backfill will not protect against frost heave.
- Provide good drainage away from post foundation systems.
- Use only preservative-treated wood for all elements in contact with the ground.
- Use hot-dipped galvanized or stainless steel hardware when it will be in contact with preservative-treated wood and for all below-ground applications.

Figures 2 and 3 show examples of proper foundation footings. For additional information on foundation design, refer to *Design and Construction of Frost-Protected Shallow Foundations*, ASCE 32-10 (American Society of Civil Engineers, 2001), which is an approved IRC-referenced standard.

The parameters for wall construction contained in chapter 6 of the IRC will apply to stud-frame walls, but post-frame construction does not use stud-frame walls. The wall system consists of posts, wall girts and headers. Additional bracing may be required by the design engineer for large openings in the wall system. The wall sheathing is crucial for post-frame construction. Post-frame systems rely on the wall sheathing for support of the lateral loads (shear strength). Exterior wall covering is usually 29-gauge steel siding but can also be ply-

wood covered with various types of siding or thin-set masonry. Walls can be insulated and finished with most types of interior finishes found in traditional wood-frame houses. The deep wall cavity of a post-frame home allows the IRC's minimum insulation requirements to be easily met and often exceeded. With the wall-framing members spaced farther apart than conventional wood studs, the insulation barrier has fewer thermal breaks. Studies are currently being done to determine exactly how much more efficient post-frame homes are than traditional wood-frame homes.

Chapters 8 and 9 of the IRC discuss roof and ceiling construction and roof assemblies. The roof system is just as important to the design of post-frame systems as the wall system. Roof trusses are designed by the truss manufacturer and serve as one part of the roof system. The truss designer, along with the building engineer or architect, will specify the required bracing. The wider and longer the building, the more bracing required. Typically, a bracing system is required at each end wall and with braces evenly spaced along the length of the building. Uplift resistance is required to provide a continuous load path from the truss to the foundation. The uplift requirement for the truss-to-wall connection is specified in chapter 8 of the IRC. A common material used for post-frame systems is 29-gauge steel roof sheathing. Standing-seam and plywood systems or plywood and shingles are also acceptable for use with post frame. The roof sheathing is part of the lateral load-resisting system.

Although proper roof ventilation is not necessarily a structural design element, it is essential; it prevents condensation on the wood trusses, which over time could create structural problems. Section R806 specifies the minimum ventilation requirements. Intake ventilation is required near the eave, and exhaust ventilation is required at the ridge to provide adequate airflow of attic spaces.

The following three residential projects are examples of code-compliant post-frame design. For additional examples, check out the winners in the residential categories of the NFBA Building of the Year Awards (see the article beginning on p. 38 in this issue).

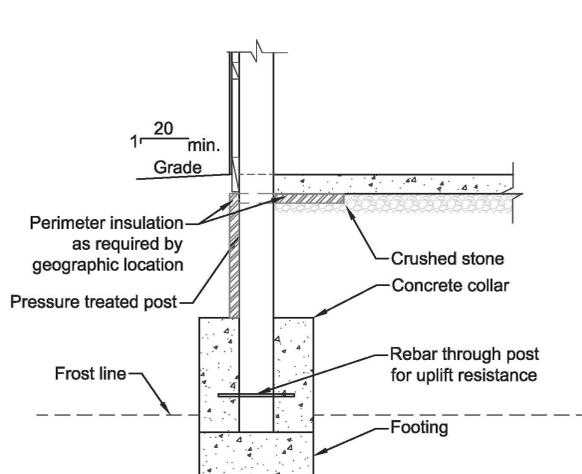


Figure 2. A constrained shallow-post foundation with a concrete collar and a concrete floor

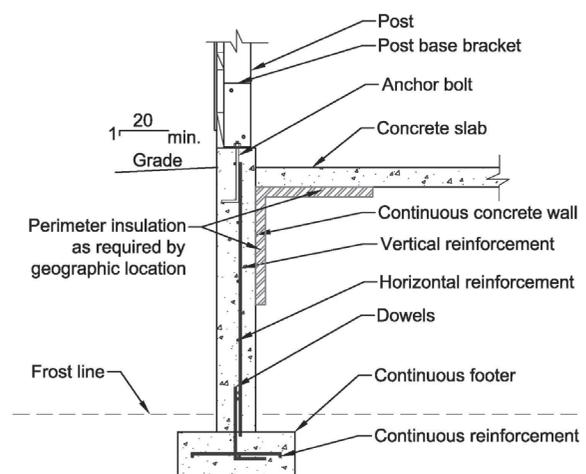


Figure 3. A continuous concrete wall foundation with a concrete floor. Posts are attached to the foundation with post base brackets.

PROJECT 1

The two-story house with attached garage (Figures 4–9) was built in 2010 by Wood Originals. By using post-frame construction, the owner was able to create a home with unique features such as a large great room with exposed scissor trusses, a loft area with exposed framing, a large cupola, and post-and-beam porches. The exterior was finished with board-and-batten siding and a standing-seam metal roof.



Figure 5. Project 1: Wall framing during construction



Figure 6. Project 1: Completed side elevation



Figure 7. Project 1: Completed front elevation

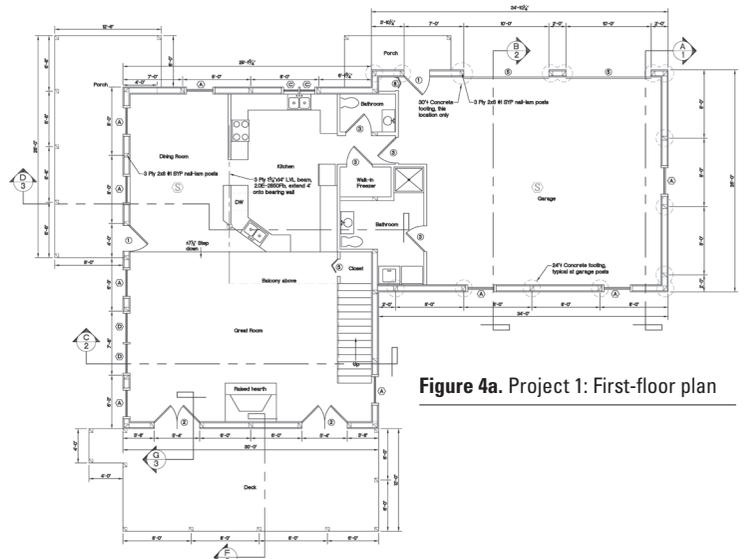


Figure 4a. Project 1: First-floor plan

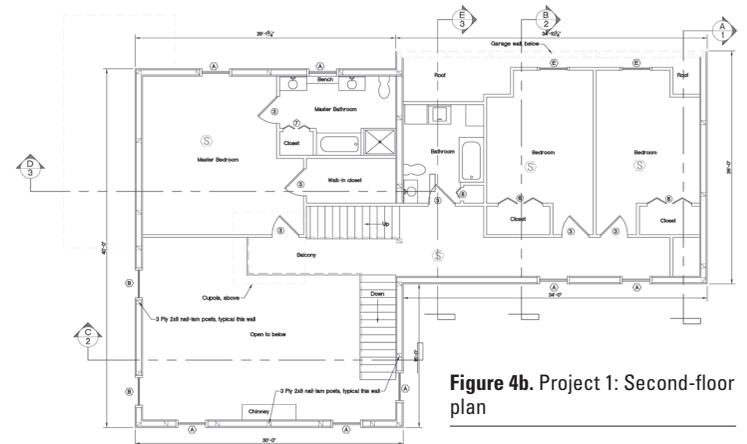


Figure 4b. Project 1: Second-floor plan



Figure 8. Project 1: Roof framing during construction



Figure 9. Project 1: Interior view of stair framing to second floor and loft

PROJECT 2

The gambrel-style residence shown in **Figures 10–13**, designed by Lee Calisti Architecture and Design and built by Graber Post Buildings Inc., is located in Rockwood, Pennsylvania. It features large window openings, a loft located in the trusses, and a thermal envelope that exceeds the energy code requirements

by 20 percent. The exterior was finished with board-and-batten siding and a metal roof. A lean-to along the rear sidewall was constructed with parallel chord trusses. Post frame was a great option for this project because of the clear-span capabilities and side-wall post spacings.

Figure 10. Project 2: Wall framing during construction



Figure 11. Project 2: Side and gable elevation during construction



Figure 12. Project 2: Side elevation during construction



Figure 13. Project 2: View of interior finish



Figure 14. Project 3: Wall and roof framing during construction. Photos by Ben Freed.



Figure 15. Project 3: Wall cavity and insulation system



Figure 16. Project 3: Exterior view of wall framing and insulation system

PROJECT 3

The New York residence shown in **Figures 14–16** was designed as a net-zero home (i.e., the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on the site), with a unique insulation envelope. Perma-Column bases were used as the foundation system. The deep wall cavity of post-frame construction made achieving the high insulation values easy.

With the growing emphasis on energy efficiency and cost of construction, post frame is a great choice for residential applications. Building trends are constantly evolving. As people look for new or alternative ways to construct their homes, post-frame construction provides a versatile option that can keep up with the changing industry and still comply with the relevant building codes. **FBN**

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REFERENCES

- American Society of Civil Engineers. 2001. *Design and Construction of Frost-Protected Shallow Foundations*. Standards ASCE/SEI 32-01. Reston, VA: ASCE.
- American Wood Council. 2018. *Wood Frame Construction Manual for One- and Two-Family Dwellings*. Leesburg, VA: AWC.
- International Code Council. 2009. *International Residential Code for One- and Two-Family Dwellings*. Washington, DC: ICC.
- International Code Council. 2009. *International Building Code Council*. Washington, DC: ICC.
- National Frame Building Association. 2015. *Post-Frame Building Design Manual*. Chicago, IL: NFBA.

TECHNICAL RESOURCE LIBRARY

For technical articles exclusively written about post-frame construction, visit the following sources online:

- **The NFBA website**
More than two dozen articles released by NFBA and others are available for download. Visit <http://www.nfba.org/resources/technical>
- **The Construction Magazine Network** (home to *Frame Building News*)
Technical articles from NFBA and various other sources dating back to 1995 are available for download. Visit <http://www.constructionmagnet.com/technical-resources>