Non-structural plan review of post-frame buildings

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Although many jurisdictions do not perform structural plan reviews—often relying upon certification by the Design Professional of Record—it is appropriate for nonstructural plan reviewers to examine structural plans of post-frame buildings for compliance with applicable code requirements.

This article offers information on important elements of post-frame building plans that should be considered by nonstructural plan reviewers.

Elements of Post-Frame Construction

The post-frame method provides for an extremely efficient structural system, typically utilizing a roof diaphragm, shear walls and post-frame interaction with the roof diaphragm. Unfortunately, unlike conventional wood-frame construction, prescriptive details are not currently provided in the model building codes for numerous important elements of the construction. As a minimum, post-frame plans should convey the following.

Table of Design Loads

The structural designer should provide a table giving the design dead loads, roof snow loads, wind loads and seismic loads, as well as the "importance factors" for the structure (see 2003 International Building Code [IBC] Table 1604.5) and wind exposure category (see 2003 or 2006 IBC Section 1609.4) and allowable soil bearing pressure for the proposed site.

Truss Design Drawing

Every post-frame plan should include a truss design drawing. A thorough overview of truss design review would require an article in itself, but basically the plan reviewer should make sure that the design parameters of the truss match the rest of the plans.

The reviewer should also be sure that the plans specify the permanent bracing for chords and webs to meet the bracing assumptions shown on the truss design drawings. Part of the permanent bracing specification must include details or specifications that address the overall stability of the bracing system (typically accomplished by specifying diagonal bracing at specified intervals).

Size, Grade and Species of Wooden Members

Every piece of lumber shown on the drawings should be identified by size, grade, and species or species group. Any engineered wood products, such as laminated veneer lumber (LVL), should be identified by the product name, size and stress grade.

Preservative Treatment

All wood in contact with the ground must be pressure-preservative treated in order to prevent decay. In particular, structural posts embedded in the ground should be treated to the retention levels for American Wood-Preservers' Association Use Group UC4B (refer to "Posts, Building Construction, Sawn" in Table 5 of the Southern Pine Council Pressure Treated Southern Pine manual, which is available online at http://newstore.southernpine.com/images/Pressure_Treated300.pdf, for chemicals and retentions.) Plans should specify the type of preservative treatment and the quality mark the treated member should bear.

Although it is not yet a matter of code compliance, it is also necessary to isolate steel siding from contact with many of the newer pressure treated woods, and the methods and materials used to do so should be specified and detailed on the plans.

Foundations

The plans should show the depth that posts are to be embedded in the earth and the diameter, thickness and concrete strength of the pad below them. Some provision for increasing resistance to uplift, such as a lumber cleat or equivalent, should also be specified and detailed.

Additional Post Parameters

Most post-frame buildings today use posts fabricated from multiple plies of lumber. If the posts are to be shop manufactured, the plans should refer to the manufacturer and completely describe the post with regard to lumber grades and the connection system between plies. If the posts are to be field fabricated, the plans should completely describe the component plies, the fasteners and the fastener pattern.

Note that American Society of Agricultural Engineers EP 559, Design Requirements and Bending Properties for Mechanically Laminated Columns, is adopted by reference in the 2003 and 2006 editions of the IBC.

Connection of Truss to Bearing Post

Almost all failures of post-frame buildings observed by the authors were caused by the lack of an engineered connection between the truss and bearing posts—a failure mode that was reported as early as 1970 by researchers at Cornell University. As such, the structural designer should specify a notch bearing, properly designed bearing block or other means for positive load transfer.

Fastener Schedule

Many elements in a post-frame structure are under a relatively high stress at design loads, and the importance of the connections among elements cannot be overstated. As such, the plans should include a fastener schedule completely describing the fasteners and quantities required at each connection.

Note that it is not sufficient to specify nails by penny weight, such as 16d. To the engineer, "16d" may mean a 16d Common nail—which has a diameter of 0.162 inch—but to the erector it may mean a 16d gun nail—which might have a diameter of 0.131 inch or even 0.120 inch. If the engineer designs for a 16d Common, the plans should clearly communicate that information, and power-driven gun nails should be specified by type, diameter and length.

In addition, nails in treated wood must be protected against corrosion and the structural designer should completely describe the manner of protection (see www.southernpine.com/ptfasteners.shtml for protection of fasteners and connectors).

Roofing and Siding Diaphragms

The largest and most important elements of a building's lateral force resisting system are the roof and side diaphragms (or shear walls), and research has shown that light-gauge metal roofing and siding provide for very stiff and strong structural diaphragms. Therefore, the structural plans should completely describe the metal roof panels in terms of product profile and thickness, the siding panels, and the fasteners, and clearly show the fastener pattern for both roof and siding.

If "stitch screws" are required to attach metal sheet-to-sheet, the plans should clearly show the locations. It is also quite common for post-frame buildings to have shingle and wood panel roof sheathing, in which case the panel thickness, span rating and its fastening should be specified.

Truss Erection Standards

The plans should reference truss erection standards such as Wood Truss Council of America/Truss Plate Institute BCSI-10, Post Frame Truss Installation and Bracing (a useful summary of which is available at www.sbcindustry.com/images/publication_images/b10.pdf).

Post-Frame Structural Design

Finally, it is recommended that design professionals familiarize themselves with the National Frame Builders Association Post-Frame Building Design Manual, which is available for purchase at www.nfba.org.

Conclusion

Because post-frame buildings are primarily wood structures and the current model building codes only contain prescriptive provisions for conventional wood or "stud" buildings, the necessary structural design may not be properly completed or simply taken for granted. This is important considering that whereas stud buildings are composed of highly repetitive structural elements and often are exposed to a relatively low level of stress at design loads; post-frame buildings are composed of non-repetitive major elements (framing more than 2-feet on center) that are typically near the allowable stress for the materials at design loads.

As a result, every post-frame structure must be carefully engineered by the design professional. He or she should never rely on the experience of the carpenter to create a safe, code-conforming post-frame structure. The level of stress in each structural element of a post-frame structure is beyond the experience of many carpenters, and the same is true of the truss-erection process. Erecting 30-foot house trusses does not prepare one for erecting 60-foot clear-span post-frame trusses at 8-feet on center and may, in fact, lead to a dangerous sense of false confidence and possibly an injury accident.

By the same token, this article is in no way to be construed as an all-inclusive guide for the plan reviewer: all applicable provisions of the locally enforced building code should be considered in conducting the nonstructural review of specific post-frame applications. ■

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