Design for Code Acceptance 5

Post-Frame Buildings

INTRODUCTION

Post-frame buildings are efficient structures whose primary framing system is comprised of wood roof trusses or rafters connected to vertical timber columns or sidewall posts. Secondary members such as roof purlins and wall girts support the exterior cladding and transfer vertical and horizontal forces to and from the post-frame. Figure 1 illustrates the components of a post-frame building.

The purpose of this document is to provide guidance to post-frame building designers for meeting the requirements of the International Building Code (IBC) and to confirm that a properly designed post-frame building is in fact code compliant.

The following chapters and headings correspond to those of the *2000 IBC*:

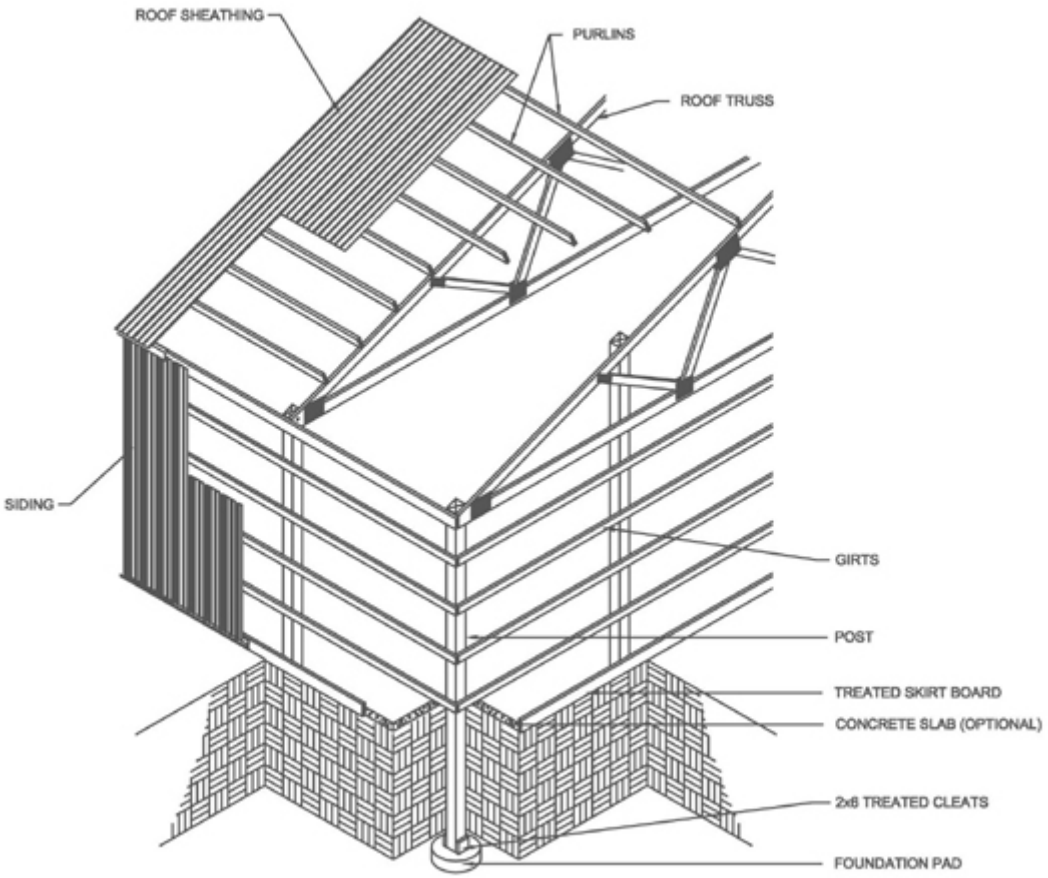

Figure 1 Components of a Post-Frame Building

CHAPTER 5 GENERAL BUILDING HEIGHTS AND AREAS

Table 503 Allowable Height and Building Areas

Post-frame buildings are wood structures and as such are classified as Type V A or V B. The basic allowable height and area for each occupancy group is presented in the last two rows of Table 503. The allowable height may be modified in accordance with Section 504 and the allowable area may be modified in accordance with Section 506.

CHAPTER 6 TYPES OF CONSTRUCTION

Table 601 Fire Resistance Rating Requirements for Building Elements

Per this table, there is no minimum required fire resistance rating of the elements of Type V B construction. With some exceptions (Notes 3 and 4), the minimum required fire resistance rating of the elements of Type V A construction is one hour. There is a report of a tested one-hour post-frame wall assembly available from the National Frame Builders Association (NFBA). A one hour roof ceiling assembly may be constructed with wood roof trusses in accordance with item 21-1.1 of Table 719.1c. Other systems are available from the Truss Plate Institute (TPI) and the Wood Truss Council of America (WTCA) as well as proprietary systems from the manufacturers of truss metal connector plates. A compendium of all known fire-rated truss assemblies is available from WTCA. There are many one hour assemblies for roofs built from dimensional lumber or engineered wood. Many of these can be found in DCA No. 3 - Fire Rated Wood Wall Assemblies.

Table 602 Fire Resistance Rating Requirements for Exterior Walls Base on Fire Separation Distance

This table presents the minimum fire resistance rating for exterior walls based on occupancy group and fire separation distance. As previously mentioned, a report of a tested one-hour post-frame wall assembly is available from the NFBA. To date there is no tested assembly of a two hour or higher fire resistive post-frame wall. Where such requirements cannot be avoided, the designer may consider using a two hour rated stud wall assembly. DCA No. 3 - Fire Rated Wood Wall Assemblies describes how interior and exterior wood-frame walls can be used to meet building code requirements for fire resistive assemblies.

CHAPTER 7 FIRE RESISTIVE MATERIALS AND CONSTRUCTION

Table 704.8 Maximum Area of Exterior Wall Openings

This table presents the maximum allowable percentage of wall openings based on fire separation distance and fire classification of the opening.

Section 704.11 Parapets

A parapet is an extension of the wall above the roof line. In general, it is wise to avoid placing parapets along the eave line of post-frame buildings. Parapets at the eave increase the likelihood of roof leaks, and in cold climates will catch ice and snow. There are six exceptions provided in this Section.

Section 705.3 Exception

This Section allows fire walls in Type V Construction to be of combustible materials.

CHAPTER 12 INTERIOR ENVIRONMENT

Section 1202.2 Attic Spaces

It is important that attics are ventilated in accordance with this section.

CHAPTER 13 ENERGY EFFICIENCY

One of the benefits of post-frame construction is that it allows for economical super-insulated buildings. Attic spaces may be easily insulated with R-40 or higher materials. Because of their unique construction, post-frame walls may be easily insulated with R-30 batts. See Figure 2.

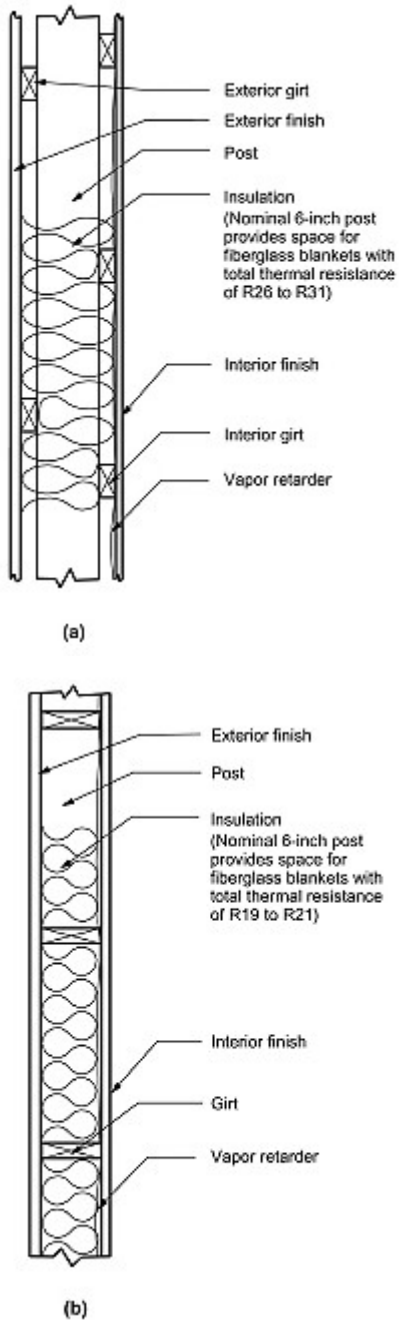

Figure 2 Typical post frame wall sections with (a) girts on exterior and interior of posts, and (b) girts between posts.

CHAPTER 14 EXTERIOR WALLS

Table 1405.2 Minimum Thickness of Weather Coverings

The most common exterior wall covering for post-frame buildings is pre-painted corrugated steel siding. But other materials such as exterior plywood, wood sidings, brick veneers, etc. are also common. This table provides the code prescribed minimum thickness for weather coverings.

Section 1405.10 Metal Siding

This section provides the requirements for metal sidings.

Section 1406 Combustible Materials on the Exterior Side of Exterior Walls

This section provides requirements for combustible sidings and Section 1406.2.4 provides fire blocking requirements.

CHAPTER 15 ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

Section 1507.2 Asphalt shingles

Shingle and wood sheathed roofs are also common on post-frame buildings. Section 1507.2 provides the minimum code requirements for asphalt shingle roofs.

Section 1507.4 Metal roof panels

As with siding, the most common roof cladding for post-frame buildings is pre-painted corrugated steel. Section 1507.4 provides the minimum code requirements for metal roof panels. These steel roof systems are commonly used as horizontal diaphragms to transfer lateral loads from the post-frame to end and interior shear walls. When using a "floating" metal roof such as standing seam, it is essential to recognize that the "floating" roof does not provide a diaphragm, and to accommodate this during structural design.

CHAPTER 16 STRUCTURAL DESIGN REQUIREMENTS

Post-frame buildings must be designed for structural requirements of this chapter, just as any other building.

Table 1604.3 Deflection Limits

One notable exception is to Table 1604.3 Deflection Limits. Experience has shown that purlins or girts supporting only corrugated metal cladding may be designed for stress only. Because of its inherent flexibility, corrugated metal will sustain no damage from extreme deflections parallel to its supports. If purlins or girts are used to support interior finishes in addition to metal siding, then they must meet the deflection limits of Table 1604.3.

Section 1604.8 Anchorage

Embedded posts must maintain a load path for uplift loads per the provisions of Section 1604.8.1. Note that dead load can be used to offset uplift as permitted in Section 1605.3.

CHAPTER 18 SOILS AND FOUNDATIONS

The foundation system of a post-frame building is unique. The posts can be buried in the ground, embedded in concrete, or anchored to a concrete foundation.

In all cases the vertical loads from the roof are transferred to the column, and from the column to a concrete footing or foundation, and to the soil. Buried or embedded posts also can resist lateral loads by developing partial fixity. See Figures 3 and 4.

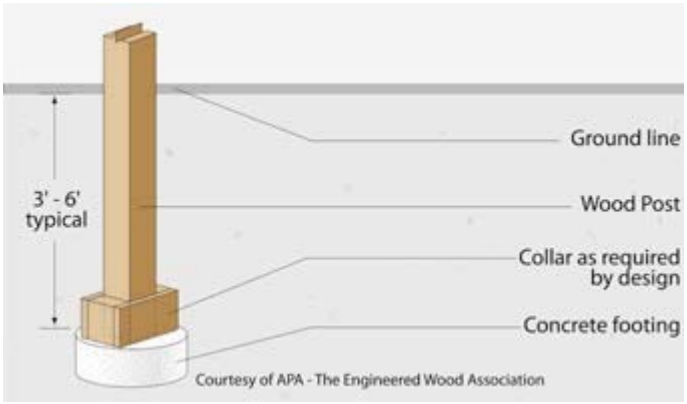

Figure 3 Post anchorage (post embedded) typical for solid-sawn columns

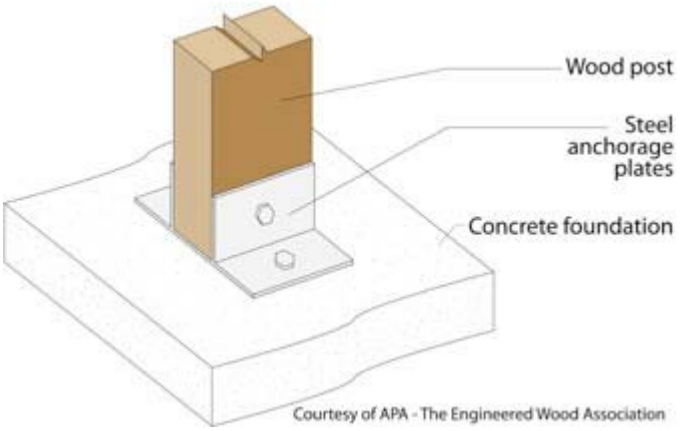

Figure 4 Post anchorage (post pinned) typical for glued-laminated columns

Section 1804 Allowable Load Bearing Values of Soils

The foundation system must be evaluated with respect to load bearing values of the soil. Section 1804 outlines those requirements.

Section 1805 Footings and Foundations

Standard practice for embedded posts is that a round hole is drilled for each post approximately four feet in the ground (or greater if required for frost protection per 1805.2.1). Either a pre-cast or cast in place round concrete pad is placed in the bottom of this hole. Pads are usually unreinforced. The diameter of this pad is determined so that the calculated vertical load in the post divided by the area of the pad is less than the allowable soil bearing pressure (per Sections 1804 and 1805). The foundation under an anchored post is designed conventionally. The minimum 28 day concrete strength is 2,500 psi per Section 1805.4.2.1.

Section 1805.7 Designs employing lateral bearing

Embedded posts can resist lateral loads through the development of partial fixity of the base. Research has shown that where the roof and side walls can act as diaphragms or shear walls, that the majority of the lateral loads will be resisted by them. The *Post-Frame Design Manual*, published by the National Frame Builders Association, as well as ANSI/ASAE EP 484, referenced in Section 2306.1, provide techniques for dividing the lateral loads among frames and diaphragms. After the design moments at the base of the posts have been determined, the embedment depth can be checked in accordance with Section 1805.7. A more extensive post embedment is treated more extensively in ANSI/ASAE EP 486.

CHAPTER 23 WOOD

Section 2308.1 Preservative-treated wood

Preservative treated wood has been used successfully in contact with the ground for many years. The use of properly treated wood will provide assurance that a post-frame building will last for 50 years or more. This section and Section 1805.7 specify that wood posts shall be treated in accordance with American Wood Preservers' Association (AWPA) standard C2 or C4. Waterborne preservatives are the preferred method of treatment for wood in contact with the ground. The minimum waterborne treatment retention for posts in post-frame buildings is 0.6 pounds per cubic foot (pcf). Southern Pine has long been a preferred species for treatment because its cellular structure permits deep uniform penetration of the preservative.

Section 2303.4 Trusses

Metal plate connected wood trusses shall be designed and manufactured in accordance with ANSI/TPI 1. Appendix A to ANSI/TPI 1 is entitled *Standard Design Responsibilities in the Design Process involving Metal Plate Connected Wood Trusses* (also known as WTCA 1-95). Every post-frame building designer should be familiar with this document, since trusses are normally purchased items based on the building designer's specifications. It is important that building designers understand their role in the design process relating to wood trusses. Additional information pertaining to design and installation of metal plate connected wood trusses is available from WTCA.

Section 2304.9 Connections and Fasteners

Structural lumber in a post-frame building is usually in a highly stressed state at design loads. Therefore, it is important that all connections between structural members be carefully designed by the post-frame building designer, not left to the discretion of the erector.

Section 2304.11 Protection against decay and termites

This section specifies the locations where wood is required to be preservative treated.

Section 2306.1 Allowable stress design

Post-frame design is normally based on allowable stress. The ANSI/ASAE standards cited in this section as well as the *Post-Frame Design Manual* published by the National Frame Builders Association, give guidance to the post-frame building designer.

For additional information or assistance contact:

American Forest & Paper Association
American Wood Council
1111 19th Street, NW, Suite 800
Washington, DC 20036
http://www.awc.org/
202-463-4713