BARNDOMINIUM DESIGN - BUILDING CODE COMPLIANCE

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Anyone who's been paying attention to the building industry over the past few years is sure to recognize the term "barndominium" (barn+condominium) or "shouse" (shop+house). With the amount of exposure these structures have been given across social media and television, it's hard to ignore their continued growth in popularity and evolving design features. While it may be the high aesthetic appeal that initially draws people in, there are quite a few other aspects of these buildings that make them worthy of being labeled as more than just the next big industry trend.

A barndominium is a post-frame structure with a barn-like exterior that contains a residential living space combined with a personal garage or workshop area. Often times the exterior finish consists of metal siding and metal roofing, although there is no shortage of other siding and roofing options available. High ceilings, large window/door openings and the ability to have open floor plans are some other typical barndominium characteristics.

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Like any building, barndominiums must be compliant with all applicable building codes. The adopted codes will vary locally. Currently in the United States, most states have adopted some form of the International Building Code and the International Residential Code. It is important to understand how both of these codes can apply to barndominiums. The International Residential Code, or IRC, applies to single-family houses or two-family houses and buildings consisting of three or more townhouse units. These buildings are limited to a height of three stories above grade plane. The IRC is a prescriptive code, meaning that all design specifications can be found in the tables, charts and other content within the code. It encompasses common and conventional residential construction practices. The IRC does reference other building codes as alternative means of compliance for systems or methods that it lacks coverage for. The International Building Code, or IBC, is the building code standard that applies to commercial buildings and buildings that do not fall under the scope of the IRC. Since the main structure of a post-frame barndominium is not constructed with conventional residential framing methods, the structural design requirements of the IBC would apply. With any building project, it is always recommended to check with the local building department to ensure that the permitting process is understood and the correct codes and requirements are being used. Doing this can avoid costly delays. It is also important to know what inspections will be required prior to and during construction.

Site-specific designs are essential for structurally sound, code compliant buildings. There is not a one-size-fits-all design. The geographic location of the building will change the requirements for snow loads, wind loads and even soil bearing capacity. The design professional uses the site-specific criteria to ensure an efficient design, while still meeting the minimum code requirements.

Foundation design of barndominiums should be reflective of the site conditions and building

needs. The National Frame Building Association's Post-Frame Building Design Manual 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.

Embedded posts with a concrete footing, typical to most post frame buildings can be utilized in barndominiums. A poured concrete foundation wall with the posts fastened to the top of the wall with a bracket is another option for those wanting a continuous foundation wall. In regions where frost depth isn't a concern, a concrete slab on grade with posts attached by brackets to a thickened slab edge is a common design choice. A shallow foundation is still acceptable in frost-prone areas, as long as it includes correctly placed insulation for frost protection. The foundation insulation shall conform to ASCE-32 and consists of rigid insulation under the slab and along the perimeter, extending away from the building for a specific distance. The perimeter of concrete slabs on grade may also require insulation to satisfy energy code requirements and to protect against heat transfer. Whatever type of foundation is selected, it should be designed and installed properly in order to act effectively as part of the post-frame system.

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Post and truss spacing will vary, with larger truss spacings more common in the mid-western parts of the country. 8' o/c posts is a pretty typical post frame design standard. For some, the preference is to have the truss spacing match the post spacing, so that no additional headers are needed to carry intermediate trusses, however there are multiple factors to consider when deciding this. With larger truss spacings, some interior finishes will require additional framing. Bracing and roof purlin configurations are different with larger truss spacings as well. The trusses themselves may need to be multi-ply or consist of higher grade or larger members. The truss manufacturer will provide the engineered truss design, which the design professional will incorporate into the building design. 4' o/c roof trusses with headers to carry the intermediate trusses may end up being just as efficient as the larger truss spacings. Roof pitch and span of the trusses are both factors that will impact the truss design as well.

The post frame shell of a barndominium allows for a second floor to be easily incorporated into the building. The outside perimeter of the second floor framing can be supported by the side and end wall columns. The most common detail for this type of support includes a single or doubled ledger board fastened to the wood columns with nails or structural screws. A support below the ledger may be required if the ledger cannot fit the required quantity of fasteners. The floor joists are attached to the ledger board with joist hangers.

The second floor system will need to be designed to satisfy the strength and deflection requirements of the IBC. The span of the floor system will determine if any of the interior walls will need to be used as bearing walls. In post-frame buildings, the second floor framing consists generally of dimensional lumber or manufactured joists (i-joists, floor trusses), dimensional lumber, glulam or laminated veneer lumber (LVL) beams, and dimensional lumber or LVL ledgers. The beams are supported by posts or interior walls on a thickened concrete slab, spread footings below the slab, or a round shallow post foundation. The design of wood framing and connections is governed by the National Design Specification for Wood Construction (NDS).

The loading on the floor framing is determined by the intended use of the space. Residential live load requirements can be separated into habitable sleeping areas and all other areas.

The climate zone will determine the insulation requirements for the building. Post frame walls provide deep wall cavities with fewer breaks in the thermal insulation barrier because of the greater post spacing. Because of this, post frame buildings can actually exceed the minimum insulation requirements. ResCheck software can be used to determine the building envelope compliance, or the prescriptive method can be used by meeting the values for each building component listed in the tables in the energy code.

There are fire protection and life safety requirements that apply to barndominiums, similar to other buildings. Proximity to the lot line will determine if the exterior wall of the barndominium will need to be fire-resistance rated. If the distance between the building and the lot line is less than five feet, a 1-hour fire resistant rating with exposure from both sides is required. There are UL-approved fire-resistance rated post frame wall assemblies to meet 1,2, and 3-hour rating requirements. Separation of the dwelling area from the garage per Table R302.6 is required. This table does not provide an hourly rating requirement like the

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table for exterior wall ratings, nor does it specify that the separation must be a UL tested assembly. The separation can be as simple as installing ½" drywall on the garage side of the wall between the living area and the garage. However, it is worth noting that there can be different interpretations of the code-required separation methods. The authority having jurisdiction's interpretation will determine final requirements.

Emergency escape and rescue openings from sleeping rooms are necessary, so be sure to select windows that comply with both the size requirements and the operational requirements for egress. An egress window is required to have a minimum net clear opening width of 20 inches and net clear opening height of 24 inches. The bottom of the opening shall not be located more than 44 inches above the floor. The window needs to be operational from inside the room.

TABLE R302.6DWELLING-GARAGE SEPARATION

SEPARATION	MATERIAL
From the residence and attics	Not less than $^{1}/_{2}$-inch gypsum board or equivalent applied to the garage side
From habitable rooms above the garage	Not less than $^{5}/_{8}$-inch Type X gypsum board or equivalent
Structure(s) supporting floor/ceiling assemblies used for separation required by this section	Not less than $^{1}/_{2}$-inch gypsum board or equivalent
Garages located less than 3 feet from a dwelling unit on the same lot	Not less than $^{1}/_{2}$-inch gypsum board or equivalent applied to the interior side of exterior walls that are within this area

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm

A well-designed and properly constructed barndominium will provide an efficient, versatile building that will meet its owner's needs as a cost-effective alternative to a conventionally framed building. Post-frame construction continues to demonstrate how it grows and evolves to keep up with rapidly changing building trends, all while helping to advance building design standards.

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This article was subjected to a peer review process conducted by the NFBA Editorial Committee, which consists of at least 10 members from engineering and academic organizations throughout the United States who are each knowledgeable about Post-Frame construction.