

Post-frame construction and the 2003 International Building Code

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The 2003 International Building Code is now being evaluated for use by states and local jurisdictions. How will it affect post-frame construction? How does it compare to the 2000 edition of the IBC? For the most part, the 2003 IBC is similar to the 2000 edition in regard to post-frame buildings. However, there are some differences.

Use and occupancy

The terms "occupancy" and "use group" are used interchangeably throughout the code to classify buildings according to their use. The degree of hazard in a building depends on the number of people using the building, how they are using it, and what kind of materials are stored or manufactured therein. Occupancy classifications have not changed much between the 2000 and 2003 IBC. The common designations of A (assembly), B (business), S (storage), and so forth are well known. The following are a few reminders about occupancy classifications in the IBC for post-frame buildings.

- Although the IBC contains requirements for agricultural buildings, in many states and jurisdictions they are exempt from code requirements by statute or local rule. Therefore it is important to first check with the local code official to find out what rules apply. If the project will be regulated by the IBC, agricultural buildings are typically Use Group U. IBC Section 312.1 lists barns, livestock shelters, sheds, and stables as typical Group U occupancies (see Section 312 for the entire list; Group U is not limited to only the structures listed). If the building is associated with a business or activity other than farming or is frequented by the public or employees, it may be classified in another use group such as S (storage), F (factory/

industrial), M (mercantile), or even A (assembly). Code requirements for one of these could differ significantly from a Use Group U building, but it should not be assumed that the requirements always would be more restrictive; in some cases it could result in greater flexibility of design. For instance, although classification as an S (storage) results in a sprinkler area threshold (the building is restricted to a certain allowable floor area unless an automatic sprinkler system is provided), the Group S classification permits larger allowable areas than Group U for even unsprinklered buildings (see Table 503).

- If it is motor vehicle related in use, it could be classified U, M, or S-1, depending on the exact activities. In addition, Section 406 of the IBC is dedicated to motor vehicle related uses and contains special requirements for repair garages, parking garages, and storage garages. Aircraft or boat storages where no repair work is done may be classified as S-2 (noncombustible storage), and are typically not subject to Section 406 requirements for parking or repair garages.

- Worship-related structures such as churches are classified A-3 and are subject to the same requirements as most other assembly occupancies.

- All food- and drink-related occupancies are classified A-2, and there is no distinction between restaurants, bars, or nightclubs as there were in previous model codes.

- IBC Section 302.2.1 contains exceptions for assembly areas associated with schools and religious education rooms, and for assembly areas under 750 square feet. These do not need to be classified as separate assembly occupancies.

When the International Residential Code applies

Unlike the previous model codes such as the BOCA National Building Code

and the ICBO Uniform Building Code, provisions for single, two-family, and townhouse construction and their accessory structures are addressed in the separate companion code for those structures, the International Residential Code, and using IBC provisions is not an option (see the scoping Section 101.2). Therefore if the building is accessory to a one- or two-family dwelling, on the same lot and incidental to its use, it is outside the scope of the IBC and is regulated by the IRC.

However, engineered design in accordance with the IBC is permitted for buildings regulated by the IRC (see 2003 IRC Section R301.1.3). For instance, engineered components such as trusses designed using IBC criteria are acceptable, but property line setbacks, fire resistance, and other non-structural design features must be in accordance with the IRC provisions. Load criteria are, for the most part, consistent between the two codes although there are specific design alternatives in the IRC for dwellings in high wind and seismic areas. Because the application of snow loads for purposes of design is not specific in the IRC, this will vary among jurisdictions. Design in accordance with the IBC criteria is acceptable per IRC Section R301.1.3.

Height and area

Chapter 5 of the code restricts the allowable height and area of all buildings according to use group classification and type of construction (degree of fire resistance). One notable change in the 2003 edition of the IBC is that assembly buildings intended for viewing of sporting events (A-4) are no longer permitted to be of unlimited area if they are of Type 5 construction (Section 507.2).

For most occupancies, however, the 2003 IBC retains the same opportunities for large single and two-story buildings found in the first edition (see Table 503).

In some cases, such as for storage buildings, the allowable areas are significantly increased, perhaps creating new opportunities for post-frame buildings. The following are examples, with a brief summary table at the end.

■ The allowable area for a single story Type 5B (unrated) agricultural building (Use Group U) is between 5,500 and 9,625 square feet, depending on how much of the perimeter faces open space of at least 30 feet (see Section 506 for area increases). Appendix C of the code, entitled Group U - Agricultural Buildings, contains greater height and area limits, which can be used as an alternative in jurisdictions, which have specifically adopted this appendix.

■ The allowable area for an un-sprinklered single story Type 5B (no fire resistance rating) storage building (Use Group S-1) is between 9,000 and 12,000 square feet, depending on how much of the perimeter faces open space of at

Occupancy classification	Description (see IBC chapter 3 for complete descriptions)	Range of single story area limits depending on the amount of open perimeter (Type VB unsprinklered buildings)
Group U	Barns, livestock shelters, sheds, and stables	5,500-9,625 square feet
Group S-1	Combustible storage	9,000-12,000 square feet
Group F-1	Manufacture of combustible goods	8,500-12,000 square feet
Group B	Business	9,000-19,125 square feet
Groups A-3 and A-4	Assembly	6,000-10,500 square feet (sprinklers required when occupant load is 300 or more)
Group A-2	Restaurant or night club	Sprinklers required at 5,000 square feet or an occupant load of 300

least 30 feet. (This is a significant increase over the former BOCA National Building Code area limits for storage buildings, which were fairly restrictive compared to the other model codes.) For a similar factory building

(Use Group F-1), the range is between 8,500 and 12,000 square feet; for a similar business building (Use Group B), the range is between 9,000 and 19,125 square feet; and for a similar assembly building (A-3 or A-4), the



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range is between 6,000 and 10,500 (sprinklers are required at 300 occupants for all Group A; A-2 must be sprinklered at 5,000 square feet or 300 occupants; see the subsequent section in this article dealing with sprinkler thresholds). These allowable areas can be increased dramatically with the installation of an automatic sprinkler system, compartmentalization with fire barriers or fire walls (which can be of rated wood frame construction in the IBC), by using one-hour rated walls and roofs, or any combination of these. In the case of one- or two-story Use Group B, F, S, or M buildings, sprinklers and 60 feet of open space on all sides will permit an unlimited area building.

- In most cases, mixed use groups buildings do not require a fire barrier separating the occupancies unless the building exceeds the allowable area for the more restrictive use group.

- In addition, floor areas that fit the definition of mezzanine need not be considered as contributing to the floor area of the building (see Section 505), except for purposes of sprinkler thresholds (area limits for buildings without sprinklers).

Fire resistance

Fire resistance rated walls and floors can be required by the IBC due to fire separation distance (proximity to a property line or another building), the need for a one-hour construction type due to building size, or for fire barriers separating incidental use areas or different use groups within the same building (although non-separated mixed use buildings are a commonly-used option, see Section 302.3.1).

Two significant changes occurred in the 2003 IBC: fire separation distance is now measured perpendicular to the building wall, not perpendicular to the lot line as was required in the 2000 edition (see the definition of fire separation distance in Section 702.1); second, incidental storage rooms are not required to be separated by a rated fire barrier if the space is protected by sprinklers (although a smoke resistant barrier is still required, see Section 302.1.1.1).

Fire resistance requirements due to

fire separation distance remain the same as in the 2000 IBC, and can be summarized as follows: for Type 5B (unrated) construction, exterior walls in Use Groups F-1, M, and S-1 buildings are required to be 2-hour rated if less than 5 feet, and 1-hour if less than 10 feet from a property line or an imaginary property line between buildings on the same lot. (Remember, if the buildings are small enough that the aggregate area does not exceed the allowable area for one building, opposing walls would not need to be rated.) For most other use groups, exterior walls are required to be 1-hour rated if the fire separation distance is less than 10 feet (see Table 602). The aggregate area of unprotected openings in rated exterior walls is limited by IBC Section 704.8.

Guidance on finding listings for tested 1-hour post-frame wall assemblies is available from NFBA, and listings for 1-hour truss roof/ceiling assemblies can be obtained from the Wood Truss Council of America (www.woodtruss.com). In addition, 1-hour floor and roof systems incorporating trusses can be found in Table 720.1(3) of the code. Listings for fire resistance rated conventional frame wall and floor assemblies can be found in IBC Tables 720.1(2) and (3), other commonly used fire resistance directories, and publications from AF&PA (www.awc.org). AF&PA also has resources for determining the fire resistance of exposed wood members.

By using rated assemblies for the building structure, the greater allowable areas and heights of Types 5A and 3A construction are permitted. Type 3 construction requires noncombustible exterior walls by definition, but fire retardant treated wood is permitted as an alternative (see Section 603.1). Therefore using fire retardant treated wood at the perimeter of a post-frame building would permit the greater areas and heights of Type 3 construction.

Sprinklers and exits

New in the 2003 IBC is Table 706.3.7, which indicates the rating required for walls defining fire areas in a single occupancy. The concept has not

changed since the 2000 IBC, but the table establishes more clearly the required rating of a fire barrier that creates two fire areas in a single use group. Automatic sprinklers are required in most use groups when the floor area or height exceeds a certain threshold. This threshold is based on fire area, a defined term which means an area of the building bounded by exterior walls, fire walls, or fire barriers (and rated floors in a multistory building, see the definition in Section 702.1). For instance, a single story Use Group S-1 (storage) occupancy is required to have sprinklers if the fire area exceeds 12,000 square feet, but can be 24,000 square feet if a fire barrier is provided to create two fire areas, each not exceeding 12,000 square feet. Table 706.3.7 indicates the required rating of that fire barrier: 3 hours.

The following are some sprinkler thresholds for common single-story buildings. In each case, there may be exceptions in the code that should be checked (see Section 903).

- Use Group A (assembly): 12,000 square feet and 300 occupants per fire area; the exception is A-2 (food and drink occupancies, such as restaurants and nightclubs) which is limited to 5,000 square feet and 300 occupants per fire area.

- Use Group E (educational): 20,000 square feet per fire area; however, if every classroom has at least one exterior door, the threshold does not apply.

- Use Groups F-1 (factory/industrial), M (mercantile), and S-1 (storage): 12,000 square feet per fire area, or 24,000 square feet total.

- Use Group H (hazardous): all are required to be sprinklered.

- Use Groups B (business), U (utility/agricultural), S-2 (noncombustible storage), and F-2 (noncombustible manufacture): no sprinkler threshold; however, sprinklers may be used to increase allowable areas. Unsprinklered S-2 and F-2 buildings may be unlimited in area if surrounded by open space of at least 60 feet on all sides.

Two exits are required in most single-story occupancies (including Use Group U) except when the occupant

load is less than 50 and travel distance to an exit is less than 75 feet (in Use Group S, it is less than 30 occupants and 100 feet, see Table 1018.2). The two exits must be remote from each other (see Section 1014.2.1). Post-frame structures are subject to all means of egress requirements such as egress illumination, exit signs, and openable doors, just as any other type of building. Assembly occupancies in particular require special attention and the code contains many special means of egress provisions for them. For agricultural buildings, there are certain exceptions for Use Group U throughout Chapter 10 (Means of Egress) of the code.

Wood-specific provisions

Requirements for lumber grading are for the most part unchanged in the 2003 IBC. Approved grade stamps are required on all load-bearing lumber, or a certificate of inspection issued by a certified

grading agency.

Locations requiring preservative-treated lumber are the same (see Section 2304.11). Quality marks or tags for all preservative-treated lumber are required, and requirements for fasteners used in conjunction with treated lumber have not changed. As in previous model codes and the 2000 IBC, fasteners for preservative-treated and fire-retardant treated wood must be hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze, or copper (see Section 2304.9.5). As the preservative CCA is being phased out for residential applications, there has been some indication that the newer preservative formulations may be more prone to cause corrosion of fasteners; using the correct fasteners may be more critical when using an alternative preservative. There are exceptions to the CCA phase-out, so it should not be assumed that CCA is prohibited for all post-frame applications.

Changes in design criteria

The code references specific editions of design standards, and therefore adopting the 2003 IBC will require using the updated design standards it references. Among the updated standards is the 2002 ASCE 7 Minimum Design Loads for Buildings and Other Structures (ASCE 7-02). The simplified wind design procedure in the 2003 IBC has undergone some revision in format to parallel the simplified design procedure that is new in the 2002 ASCE 7. Snow load criteria in the new 2002 ASCE 7 are similar to the previous 1998 edition referenced in the 2000 IBC, resulting in the same increased snow loads necessitated by the 1998 edition.

Another updated standard affecting post-frame design is the new 2001 AF&PA National Design Specification for Wood Construction. Summaries of some of the changes in the 2001 NDS



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which may affect post-frame design follow below. A more complete discussion of the changes can be found on the American Wood Council Web site.

Incising Factor: The incising factor applicable for incised dimension lumber has been revised to better reflect incisions patterns, and its applicability to dimension lumber has been clarified. The incising factor, C_i , for shear has been reduced to 0.80 from 1.0.

New Products: Three new product chapters have been added: Structural Composite Lumber, Wood Structural Panels, and Prefabricated Wood I-joists. These new chapters contain design value adjustments and special design considerations for these products, and parallel the format of chapters for sawn lumber and glued laminated timber.

Design information for construction poles has been added and combined with an existing chapter on piles. Like other product chapters, the new chapter titled Round Timber Poles and Piles contains

information such as applicable product standards and standard adjustments to design values.

Shear Design: In the 2001 NDS Supplement, shear design values for sawn lumber are generally 1.95 times higher than values printed in the previous edition, due to a revision of ASTM D245 to eliminate a redundant shear reduction factor. Related changes include:

- Removal of the shear strength increase factor, CH, which previously permitted shear design values to be increased based on limited occurrences of splits, checks and shakes.

- Revised provisions for ignoring beam shear loads applied near supports.

- Revised provisions for shear strength at notches and parallel revised provisions for shear strength at connections near member ends.

- Removal of 50 percent shear increases when connections are more than 5d from the member end.

- Removal of two-beam shear provisions that permitted load reductions for shear design of single span sawn lumber bending members.

Dowel-type Fasteners: Separate chapters for design of bolts, lag screws, wood screws, and nails have been consolidated into a single chapter. Significant changes include:

- One set of yield mode equations, describing behavior of dowels under lateral loads, is provided for all dowel-type fasteners.

- Capacity reduction terms are based on fastener diameter rather than fastener type.

- Differences in dowel bearing strength parallel and perpendicular to grain are recognized when the diameter of the fastener is at least 1/4-inch.

- Root diameter, D_r is used to calculate lag screw and wood screw lateral connection capacity, unless a more detailed analysis is performed.

- Tabulated design values for threaded hardened nails were removed, since this nail type is not standardized in ASTM F1667 (however, design values can still be calculated using the generalized yield mode equations).

- Dowel bearing strengths are added for wood structural panels.

Fire Design: A new chapter on fire design of exposed wood members has been added. It includes procedures that can be used to calculate fire endurance of tension, compression and bending members, and members subjected to combined loading. Special provisions for glued laminated timber beams are also incorporated.

For additional reading

NFBA and AF&PA recently collaborated on a publication now posted on the American Wood Council Web site (www.awc.org). Its title is AF&PA DCA-5, Post-Frame Buildings. Soon to be updated to the 2003 IBC, it contains references to IBC code sections and Web site links to other organizations that offer resources for post-frame design. This document provides additional information on code-compliant post-frame buildings and can be downloaded for free. ■

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