Chapter 6:
Types of Construction

General Comments

Chapter 6 contains the requirements to classify buildings into one of five types of construction. Tables 601 and 602 provide the minimum hourly fire-resistance ratings for the structural elements based on the type of construction of the building and fire separation distance. Section 602 describes each construction type in detail. Section 603 describes the permitted use of combustible materials in buildings of noncombustible construction.

Correct classification of a building by its type of construction is essential. Many code requirements applicable to a building, such as allowable height and area (see Chapter 5), are dependent on its type of construction. If a building is placed in an incorrect construction classification (for example, one that is overly restrictive), its owner may be penalized by increased construction costs. On the other hand, when a building is incorrectly classified in an overly lenient type of construction, it will not be constructed in a manner that takes into account the relative risks associated with its size or function. The provisions of this chapter, coupled with Chapters 3 and 5 and Tables 601 and 602, establish the basis for the "equivalent risk theory" on which the entire code is based.

Purpose

The purpose of classifying buildings or structures by their type of construction is to account for the response or participation that a building's structure will have in a fire condition originating within the building as a result of its occupancy or fuel load.

The code requires every building to be classified as one of five possible types of construction: Type I, II, III, IV or V. Each type of construction denotes the kinds of materials that are permitted to be used [i.e., noncombustible steel, concrete, masonry, combustible (wood, plastic) or heavy timber (HT)], and the minimum fire-resistance ratings that are associated with the structural elements in a building having that classification (i.e., 0, 1, $1^1/_2$, 2 or 3 hours). Type I and II construction consists of building elements that are noncombustible. Buildings of Type III construction have noncombustible exterior walls and combustible or noncombustible interior elements. Type IV construction identifies those structures with noncombustible exterior walls and heavy-timber interior elements. Type V buildings are permitted to have building elements that are either combustible or noncombustible, or a combination of both. Types I, II, III and V construction are further subdivided into two categories (IA and IB, IIA and IIB, IIIA and IIIB, VA and VB) that identify differences in the degree of fire resistance required.

SECTION 601
GENERAL

601.1 Scope. The provisions of this chapter shall control the classification of buildings as to type of construction.

❖ This section requires that all buildings be assigned a type of construction classification as indicated in the "General Comments" above.

TABLE 601. See page 6-2.

❖ Table 601 has three components: the top rows list the five general types of construction and their subclassifications; the left column lists the various building elements that are regulated by the table; and each cell in the table contains the minimum required fire-resistance rating, in hours, for the various elements based on the required type of construction of the building. "Building element" is defined in Section 202 as a fundamental component of building construction which needs to be constructed of the materials and have the fire-resistance rating specified in this chapter in order for a building to be classified in a type of construction. Notes a through f apply as specifically referenced in the table.

Types I, II, III and V construction are further subdivided into two categories (A and B). Type A and B construction are not defined in the code. The designations simply refer to the hourly fire-resistance rating required for the structural elements. A Type A designation will have a higher fire-resistance rating for the structural element than a Type B designation. In other than Type I construction, Types A and B are often referred to as protected and unprotected construction, respectively. Please note this terminology does not refer to whether the building is protected by an installed automatic sprinkler system.

The following describes the items in the left column of the table, titled "Building Element."

Row 1: *Primary structural frame.* This category includes the structural (load-bearing) components of the building frame. Definitions of "Primary structural frame" and "Secondary members" are

found in Section 202. Any structural item that provides direct connections to columns and bracing members that are designed to carry a gravity load is considered part of the structural frame. To delay vertical (i.e., gravity) load-carrying collapse of a building due to fire exposure for a theoretical amount of time, the components that make up the primary structural frame are required to maintain a minimum degree of fire resistance. The components defined as part of the primary structural frame, with the exception of Type IV construction, must also comply with Section 704 [see the commentary to Section 602.4 for more information about Type IV (Heavy timber) construction]. Secondary members (e.g., floor or roof panels without a connection to the column) are not considered part of the structural frame (see Rows 5 and 6 of the table).

Row 2: *Bearing walls—exterior and interior.* Exterior bearing walls are the outermost walls that enclose the structure and support any structural load other than their own weight. Their required fire-resistance rating is established by the higher of two fire-resistance ratings. The first component of determining the fire-resistance rating is based on the type of construction of the building (Table 601). The second component of determining the fire-resistance rating is based on the exterior walls' fire separation distance (Table 602). Whichever of the two tables requires the higher fire-resistance rating will dictate the minimum required fire-resistance rating of the exterior wall.

In addition to Tables 601 and 602, exterior walls must comply with Section 705 and Chapter 14. In addition, Section 706.5.1 has fire-resistance-rating requirements for exterior walls on each side of the intersection of fire wall.

There are also several requirements related to exterior walls mentioned in Chapter 10. Section 1009.7 has fire-resistance-rating requirements for exterior walls adjacent to exterior areas for assisted rescue. Section 1023.7 has specific fire-resistance-rating requirements for exterior walls adjacent to an interior exit stairway. Section 1027.6 has fire-resistance-rating requirements for exterior walls adjacent to exterior exit stairways. Section 1028.4.2 has fire-resistance-rating requirements for exterior walls adjacent to an egress court.

Additionally, this category includes the structural (load-bearing) interior walls of a building. To delay vertical load-carrying collapse of a building due to fire exposure for a predetermined amount of time, the structural partitions are required to maintain a minimum degree of fire resistance. Primary structural frame elements supporting such walls must comply with Table 601, as well as have at least the same degree of fire resistance as the supported wall. See the commentary to Section 602.1 regarding opening and penetration protection of bearing walls.

Row 3: *Nonbearing walls and partitions—exterior.* This category includes all exterior walls that only support their own weight. The minimum required fire-resistance rating, unlike for load-bearing walls, is based solely on the exterior wall's fire separation distance (Table 602). Where nonbearing exterior walls occur in buildings of

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a]	2[a]	1	0	1	0	HT	1	0
Bearing walls Exterior[e, f] Interior	 3 3[a]	 2 2[a]	 1 1	 0 0	 2 1	 2 0	 2 1/HT	 1 1	 0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1^{1}/_{2}$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

Type I or II construction, the walls can be constructed of fire-retardant-treated wood (FRTW) if no rating is required (see Section 603.1).

Row 4: *Nonbearing walls and partitions—interior.* This category includes all interior nonload-bearing walls and partitions (for example, the common wall separating two offices in the same suite). These walls need only comply with all of the material requirements associated with their type of construction classification and are not required to have a fire-resistance rating. Where they occur in buildings of Type I or II construction and are to be constructed of wood, the wood must be fire-retardant treated as indicated in Section 603.1. Nonload-bearing interior walls may be required to be fire-resistance rated when they also serve another purpose. Examples include interior walls also serving to separate mixed occupancies, dwelling units, sleeping units and incidental uses, as well as corridor walls required to have a fire-resistance rating.

Row 5: *Floor construction and associated secondary members.* Floor construction provides a natural fire compartment in a building by means of a horizontal barrier that retards the vertical passage of fire from floor to floor. In order to accomplish this, floor assemblies, including the beams and secondary structural members supporting the floor, must comply with Table 601 and Section 711. Ceilings are included if they are part of the tested assembly. A definition of "Secondary member" is provided in Section 202. Secondary members are not considered part of the primary structural frame.

Row 6: *Roof construction and associated secondary members.* Proper roof construction is necessary to prevent collapse from fire as well as potential impingement on adjacent buildings. Roof construction must comply with Table 601 and Section 711 (see the definition of "Secondary member" in Section 202). Additionally, when a portion of the roof construction is less than 20 feet (6096 mm) above the floor immediately below, the entire structural member must be protected to meet the minimum fire-resistance-rating requirements. In Commentary Figure 601(2), the roof construction is assumed to be one structural member. While a majority of the roof construction is greater than 20 feet (6096 mm) above the floor below, a portion of the roof construction is only 15 feet (4572 mm) above the mezzanine. As such, the entire length of the structural member, or in this case, the entire roof, must be rated for not less than 1 hour. The fire-resistance rating is not permitted to terminate at the portion where the roof is 20 feet (6096 mm) above the floor below unless the structural member ends at that point. The fire-resistance rating of a column must also be continuous for the full height of the column and not reduced or eliminated at a height of 20 feet (6096 mm) and above (see Note b). It should be noted that those members of the roof construction that are considered as primary structural frame members are not regulated by Row 5, but rather by Row 1.

Note a permits the fire-resistance ratings of primary structural frame and interior load-bearing walls in buildings of Type IA and IB construction to be reduced by 1 hour if the members are supporting only the roof.

Note b applies to the construction of the roof and related secondary members in all types of construction. It allows these elements to be of unprotected construction when all parts of the roof construction are more than 20 feet (6096 mm)

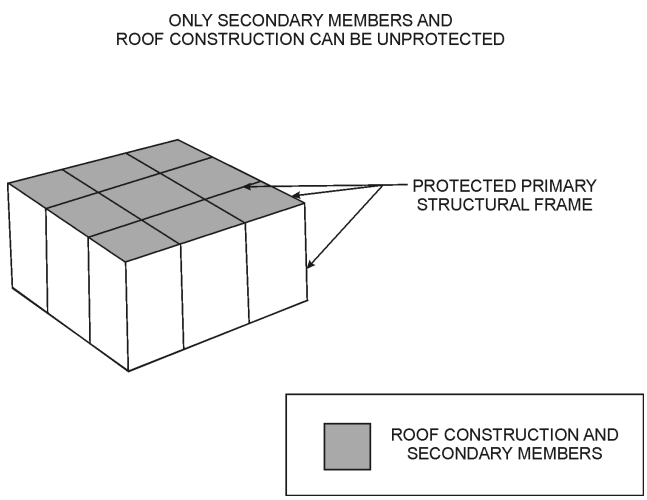


Figure 601(1)
PROTECTION OF SECONDARY MEMBERS

above any floor below. This allowance only applies to the secondary members of the roof structure and not to primary structural frame located within the roof or at the roof level [see Commentary Figure 601(1)]. This alternative is applicable for all occupancy classifications except Groups F-1, H, M and S-1. Commentary Figure 601(2) shows an example where a mezzanine reduces the clearance to the roof to less than 20 feet (6096 mm) for a portion of the total roof. Designs similar to Commentary Figure 601(2) do not comply with Note b, and elimination of fire resistance is not allowed for any portion of the roof.

In buildings of Type I and II construction, fire-retardant-treated wood (FRTW) may be utilized for unprotected roof members. Please note that FRTW is not required in the roof of buildings of Type IIIA or VA construction since combustible materials are already permitted by Sections 602.3 and 602.5, respectively.

Note c permits heavy timber (HT) construction to be utilized in the roof construction as an alternative to having a fire-resistance rating of 1 hour or less. Note that HT cannot be used in Type IA construction since the roof is required to have a rating greater than 1 hour. The intent of the note is to allow the substitution of HT for 1-hour construction in roof construction; it is not intended to say that HT is 1-hour-rated construction.

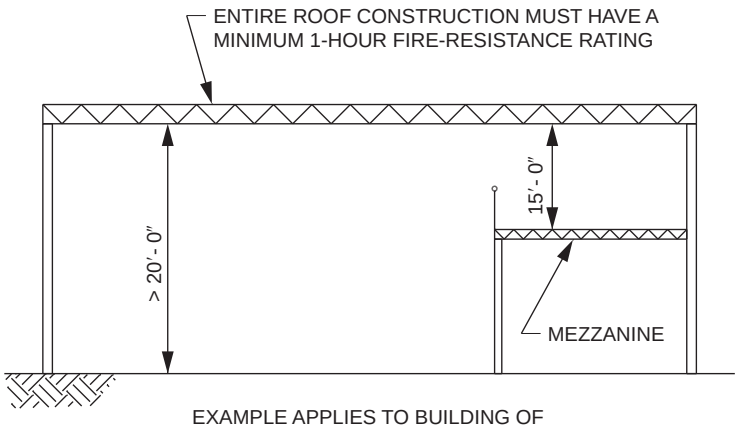
Note d is applicable only to interior nonload-bearing walls. While nonbearing interior walls are not required to have a rating in accordance with Table 601, other sections of the code may require a rating (e.g., corridor walls, dwelling unit separation, sleeping unit separation). If other sections of the code require a rating, this would override the requirements of Table 601 stating no rating is required. In addition, interior nonbearing walls in buildings of Type IV (Heavy Timber, HT) construction shall be of solid wood construction formed by not less than two layers of 1-inch (25 mm) matched boards or laminated construction 4 inches (102 mm) thick, or of 1-hour-rated construction (see Section 602.4.6).

Note e is a reminder that exterior load-bearing walls must also comply with the fire-resistance rating listed in Table 602 based on the fire separation distance. Exterior load-bearing walls must satisfy the higher of the fire-resistance ratings required by these two tables.

Note f is a reminder of the provisions of Section 704.10 that load-bearing structural members located within the exterior walls or “outside” of the structure need to comply with the highest of three fire-resistance ratings: the requirement for the primary structural frame; the requirement for exterior bearing walls; or the requirement from Table 602 based on the fire separation distance of the exterior wall. In Type III and IV construction, the rating for an exterior load-bearing wall is higher than that required for a primary structural frame alone.

TABLE 602. See page 6-5.

❖ Table 602 establishes the minimum fire-resistance ratings for both load-bearing and nonload-bearing exterior walls based on fire separation distance as defined in Section 202. The required ratings are based on the fuel load, probable fire intensity of the various occupancy classifications and the physical separation between the exterior wall and the line used to determine fire separation distance as established in Section 202 [see Commentary Figure 602(1)]. In using the table, the occupancy classifica-



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

Figure 601(2)
PROTECTION OF ROOF CONSTRUCTION

tion of the building and the fire separation distance of the walls must be determined. Once determined, the required fire-resistance rating is obtained by referring to the appropriate row and column corresponding to these parameters.

Please note that where there is more than one building on a lot, an imaginary lot line must be assumed between the buildings in accordance with Section 705.3. Commentary Figure 602(1) shows an assumed line halfway between the two buildings. The imaginary lot line can be at any location between the structures. Wherever the line is established, fire separation distance for each wall must be measured from the line, and wall and opening protection based on the distance to the assumed location.

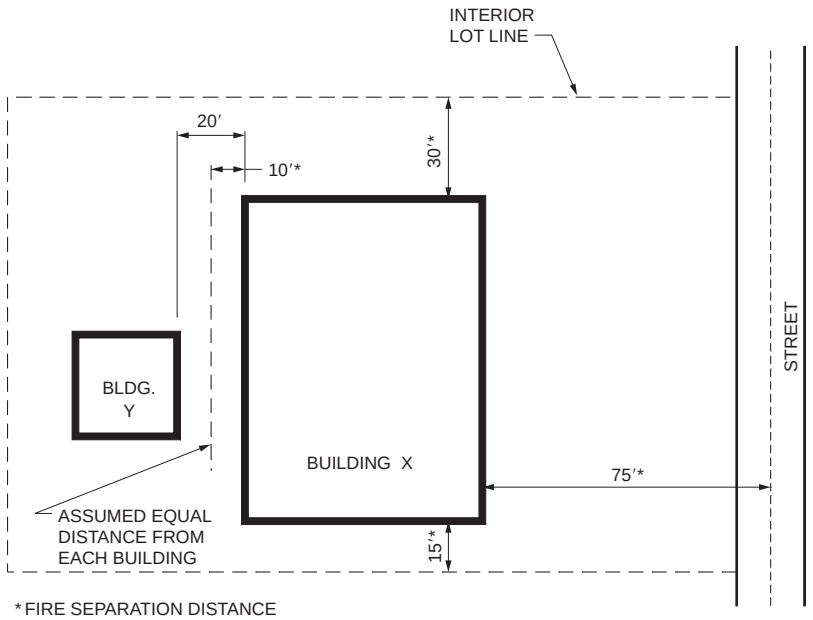
Note a indicates that the fire-resistance-rating

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA Others	3 2	2 1	1 1
10 ≤ X < 30	IA, IB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.4.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet or more.



For SI: 1 foot = 304.8 mm.

Figure 602(1)
DETERMINING FIRE SEPARATION DISTANCE

requirements of Table 601, which are based on construction type, also apply. Exterior load-bearing walls must conform to the higher of the fire-resistance ratings specified in Tables 601 and 602. Exterior nonload-bearing walls need only comply with Table 602.

Note b requires walls that are located on lot lines between adjacent buildings (i.e., zero fire separation distance) to be constructed as fire walls and be rated in accordance with Table 706.4.

Note c permits the exterior walls of an open parking garage to have no fire-resistance rating where the fire separation distance is at least 10 feet (3048 mm). Table 705.8 allows the openings to be unlimited for open parking garages at 10 feet (3048 mm) of fire separation distance. If the amount of openings is no longer limited, then the entire wall could be removed.

Note d clarifies that the required minimum fire-resistance rating of each exterior wall in each story of a building must be determined separately. Should a multistory building be configured such that the fire separation distance of each story is different, the required fire-resistance ratings associated with each of the exterior walls in each of those stories is established separately [see Commentary Figure 602(2)].

Note e provides a reference for Group H occupancies to Section 415.6 where there are specific standards for fire separation distances and wall and opening protection that supersede those of Table 602.

Note f provides a reference to Section 412.4.1 regulating aircraft hangars where there are specific standards for fire separation distances that supersede Table 602.

Note g allows for an elimination of the required wall protection for those exterior walls permitted to have unlimited openings in accordance with Table 705.8. For buildings protected by an automatic sprinkler system, Table 705.8 allows unlimited openings in walls with a fire separation distance of 20 feet (6096 mm) or more. This note is limited to the fire-resistance rating requirements of Table 602, and does not eliminate requirements established in Table 601 for load-bearing walls. Wall and opening protection for Group H-1, H-2 and H-3 occupancies is established by Section 415.6.

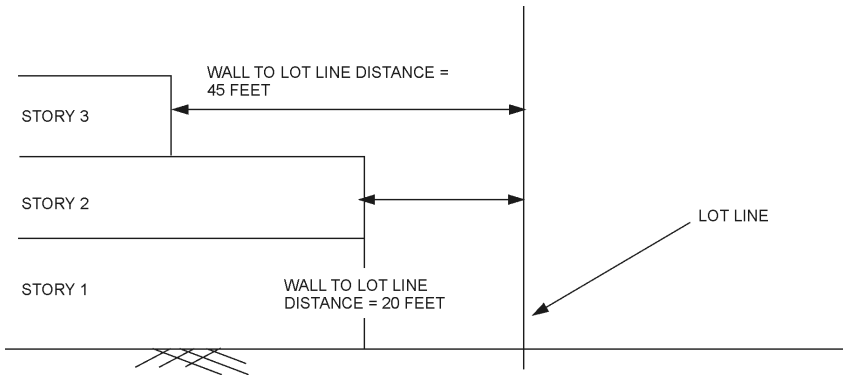
Note h addresses Group U occupancy garages and carports. Such structures are usually small and are either stand-alone or are attached to smaller apartment buildings or commercial buildings. This note would not apply to a Group U structure not used for the parking and storage of motor vehicles. Other Group U occupancies would have a minimum 1-hour fire-resistance rating for a fire separation distance of less than 10 feet (3048 mm).

SECTION 602
CONSTRUCTION CLASSIFICATION

602.1 General. Buildings and structures erected or to be erected, altered or extended in height or area shall be classified in one of the five construction types defined in Sections 602.2 through 602.5. The building elements shall have a *fire-resistance rating* not less than that specified in Table 601 and exterior walls shall have a *fire-resistance rating* not less than that specified in Table 602. Where required to have a *fire-resistance rating* by Table 601, building elements shall comply with the applicable provisions of Section 703.2. The protection of openings, ducts and air transfer openings in building elements shall not be required unless required by other provisions of this code.

❖ This section requires that each building or structure be put into one of five possible construction classifications: Type I, II, III, IV or V. Structural members are required to have a fire-resistance rating in accordance with Table 601. Additionally, the exterior walls of the structure must satisfy the requirements in Table 602, which bases the fire-resistance rating on the fire separation distance.

The use of multiple construction classifications in a single building is very limited and can only be done when specifically called out in the code. An example



For SI: 1 foot = 304.8 mm.

Figure 602(2)
DETERMINING FIRE SEPARATION DISTANCE FOR MULTISTORY BUILDINGS

of combining types of construction is an office building of Type IIA construction located above an open parking structure of Type IIB construction, as described in Sections 510.7 and 510.7.1. Several other special provisions found in Section 510 also permit a building of multiple construction classifications.

A more common example is where a single structure is divided into two parts by using a fire wall, resulting in two separate buildings or structures—each of which may be of a different type of construction. Where a structure contains more than one building (for example, separation by a fire wall), each building is to be individually assigned a type of construction.

Also, a building may have elements that comply with the requirements of more than one type of construction, in which case the building as a whole must be assigned the less restrictive type of construction. The designer may have intended, however, to comply with a higher type of construction, in which case those elements not in compliance with the intended type of construction are to be brought into compliance. The selection of a construction type is the prerogative of the permit applicant. The applicant should have the designer indicate on the submitted construction documents which construction type has been selected. This will expedite the compliance review by the plans examiner.

Section 602.1 applies to both new construction and additions. The provisions in Section 503 on general height and area limitations, Chapter 7 on fire and smoke protection features and construction, and other applicable portions of the code depend on the requirements of this section. Where Table 601 requires a building element to meet a fire-resistance rating, that rating is determined based on the criteria in Section 703. Building elements required to have a fire-resistance rating by Table 601 do not necessarily need opening protectives or dampers for penetrations through these elements. Opening protectives or dampers are only required for building elements listed in Table 601 that are also a specific type of wall or horizontal assembly that is required by other criteria in the code to have protected openings.

Where Table 601 requires a building element to meet a fire-resistance rating, that rating is determined based on the criteria in Section 703. Although a building element is required to have fire resistance by Table 601 this does not mean that the required openings in these building elements or duct penetrations through these elements have to be protected. However, a building element listed in Table 601 may also be a specific type of wall or horizontal assembly that is required by other criteria in the code to have protected openings. For example, an interior bearing wall inside a Type IIA building is required to have a fire-resistance rating of not less than 1 hour. However, the openings in that wall need not be protected unless that bearing wall is also serving another purpose. This wall could also be part of the walls establishing a control area on the second story. In accordance with Section 414.2.2, such a wall would also have to be a 1-hour-rated fire barrier, and in accordance with Table 716.5, openings in this 1-hour-rated fire barrier would need to have 45-minute-rated opening protection. It is essential to check the provisions of Chapter 7 to determine where building elements are required, or not required, to have protected openings, transfer openings, ducts, joints and other penetrations.

602.1.1 Minimum requirements. A building or portion thereof shall not be required to conform to the details of a type of construction higher than that type which meets the minimum requirements based on occupancy even though certain features of such a building actually conform to a higher type of construction.

❖ These requirements permit design flexibility by allowing various building materials and components to be used. A building must, as a minimum, meet all of the requirements of a given type of construction to be classified as such, even though portions of that building meet the criteria of a higher construction type (e.g., greater fire-resistance ratings). This is consistent with the concept that the code is a minimum requirement. For example, a building classified as Type III construction is not prohibited from having construction that is superior, but it could not be reclassified into a higher type of construction unless it met all of the requirements for that construction type. In a normal situation, the design professional has identified the construction classification on the drawings. When this assignment has not been made, the building official is placed in a position of verifying the designer's intent and selecting the least-restrictive type that will meet all of the code requirements.

602.2 Types I and II. Types I and II construction are those types of construction in which the building elements listed in Table 601 are of noncombustible materials, except as permitted in Section 603 and elsewhere in this code.

❖ Buildings of Types I and II construction are required to be constructed of noncombustible materials (see Section 703.5) and, therefore, are frequently referred to as "noncombustible construction." All Type I and II structural members have a fire-resistance rating as required by Table 601 and 602. A typical example of a building of Type IA, IB or IIA construction would be a high-rise structure or a very large low-rise structure. These buildings are permitted to be relatively large in height and area due to the fire resistance afforded the structure's components. The structural members of a building of Type IIB construction do not have the same fire resistance as structural members in a building of Type IA, IB or IIA construction. As such, the height and area requirements are not as large for Type IIB construction (see Commentary Figure 602.2 for an example of Type I or II construction).

Types I and II construction are divided into four subclassifications: Types IA, IB, IIA and IIB. The only

difference among the four subclassifications is the degree of fire-resistance rating required for similar elements and assemblies. For example, the required rating for structural frame members in Type IA construction is 3 hours, for Type IB it is 2 hours, for Type IIA it is 1 hour, and for Type IIB no rating is required (0 hours). Often, the fire-resistance ratings required by Tables 601 and 602 for structural elements are achieved by "fireproofing" structural members. Fireproofing is typically the process of creating a fire-resistance-rated assembly that incorporates the structural member by encapsulating it, either by boxing it in or by spraying on a coating to achieve the required fire-resistance rating. It should be noted that when a protective covering is used to provide the fire-resistance rating, it must be of noncombustible material, except as indicated in Section 603.1, Item 21.

Fire-retardant-treated wood (FRTW), although combustible, is permitted in limited uses in buildings of Type I and II construction (see Section 603 and Table 601, Note b). While FRTW is permitted in certain applications in buildings of Type I and II construction, it is not assumed to be fire-resistance rated, and generally does not afford any higher fire-resistance rating than untreated wood material.

Other combustible items (as specified in Section 603.1) are also permitted in buildings of Type I or II construction.

602.3 Type III. Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. *Fire-retardant-treated wood* framing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies of a 2-hour rating or less.

❖ Buildings of Type III construction are typically constructed with both combustible and noncombustible materials. The exterior walls are required to be noncombustible with load-bearing exterior walls required to have a minimum 2-hour fire-resistance rating. Exterior nonloadbearing walls are not required by Table 601 to have a fire-resistance rating, but must comply with the provisions of Table 602. The elements within the perimeter established by the exterior walls (i.e., floors, roofs and walls) are permitted to be of combustible materials. An example of a typical building of Type III construction is a structure having its exterior walls constructed of concrete, masonry or other approved noncombustible materials, but with a wood frame floor, interior wall and roof construction (see Commentary Figure 602.3). The structural members of a building of Type IIIB construction are not

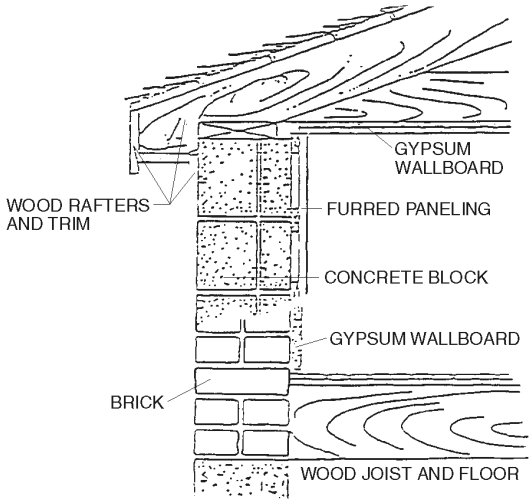


Figure 602.3
EXAMPLE OF TYPE III CONSTRUCTION

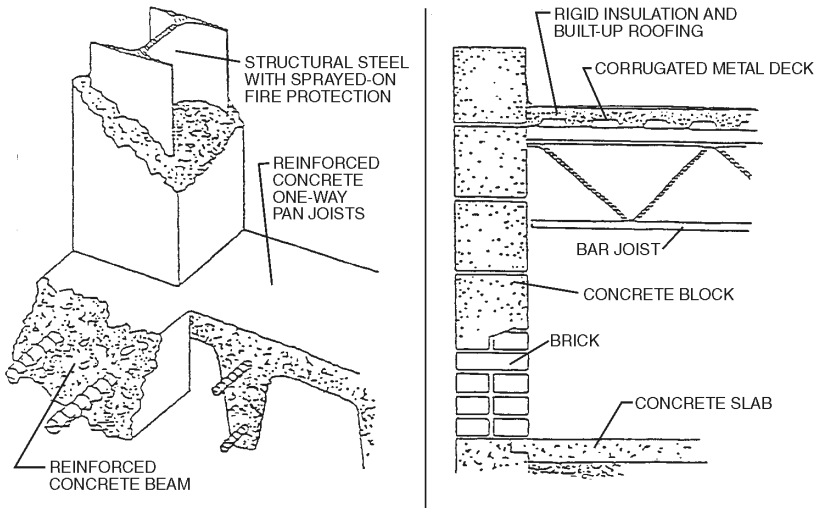


Figure 602.2
EXAMPLES OF TYPE I AND II CONSTRUCTION

required to have a fire-resistance rating, with the exception of the exterior load-bearing walls.

Although fire-retardant-treated wood (FRTW) does not meet the specifications of the code as a noncombustible material, it is permitted as a substitute for noncombustible materials for framing within exterior wall assemblies of Type III construction. The exterior surfaces of the walls must be of noncombustible materials. While the exterior walls are permitted to be either nonload-bearing or load-bearing, to apply the allowance for FRTW the required fire-resistance rating of the exterior wall must be no greater than 2 hours. FRTW is required to comply with the provisions in Section 2303.2.

602.4 Type IV. Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. The details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.1 or 602.4.2 shall be permitted. Minimum solid sawn nominal dimensions are required for structures built using Type IV construction (HT). For glued-laminated members and structural composite lumber (SCL) members, the equivalent net finished width and depths corresponding to the minimum nominal width and depths of solid sawn lumber are required as specified in Table 602.4. *Cross-laminated timber* (CLT) dimensions used in this section are actual dimensions.

❖ This section provides the general regulations for Type IV (Heavy Timber, HT) construction. HT construction requires the exterior walls to be constructed of noncombustible materials. The interior elements are required to be constructed of solid or laminated wood without any concealed spaces. All of the combustible structural elements are permitted to be unprotected because of the massive element sizes and the requirement that there not be any concealed spaces, such as soffits, plenums or suspended ceilings. Because HT elements are unprotected, they do not have a fire-resistance rating. Therefore, compliance with Sections 703 and 704 is irrelevant and not required.

Sections 602.4.1 through 602.4.9 provide specific requirements for the connection of structural members and minimum dimensions. An examination of Tables 504.3. 504.4 and 506.2 indicates that the allowable height and area for Type IV construction is greater than that permitted for buildings of Type IIB construction. This distinction is based on testing that demonstrated that HT structural members perform better structurally under fire conditions than comparable unprotected steel structural members because of charring, which insulates the wood mass.

Historically, heavy timber was simply large pieces of sawn lumber from the large trees of North American forests. Over time, as such trees became less common, the industry has created three types of engineered wood products that can be used as "heavy timber": glued-laminated; structural composite lumber (SCL); and cross-laminated timber (CLT).

TABLE 602.4. See below.

❖ Solid sawn wood members, glued-laminated timbers, structural composite lumber and cross-laminated timber are manufactured using different methods and procedures and, therefore, do not have the same dimensions. However, they all have the same inherent fire-resistance capability. The dimensions noted in Sections 602.4.1 through 602.4.9 refer to the nominal dimensions of solid sawn lumber. These dimensions do not directly correlate to the dimensions of glued-laminated timbers, structural composite lumber or cross-laminated timber. Table 602.4 provides a simple procedure to determine the dimensions that are required for glued-laminated timbers and structural composite lumber when designing to meet the requirements of Type IV construction. Cross-laminated timber is not included in the table because the actual dimensions of CLT are to be used. The table provides minimum dimensions for glued-laminated wood members and for structural composite lumber for each set of dimensions specified in the specific provisions of Section 602.4. To use the table, compare the required minimum dimensions for sawn timber found in the two left-hand columns with the dimensions found in the two middle columns for glued-laminated wood members or the two right-hand columns for structural composite lumber. For example, where the code requires a minimum sawn timber of 8 inches by 8 inches (203 mm by 203 mm): for a glued-laminated wood member to be used, it would need to be a minimum of $6^3/_4$ inches wide by $8^1/_4$

TABLE 602.4
WOOD MEMBER SIZE EQUIVALENCIES

MINIMUM NOMINAL SOLID SAWN SIZE		MINIMUM GLUED-LAMINATED NET SIZE		MINIMUM STRUCTURAL COMPOSITE LUMBER NET SIZE	
Width, inch	Depth, inch	Width, inch	Depth, inch	Width, inch	Depth, inch
8	8	$6^3/_4$	$8^1/_4$	7	$7^1/_2$
6	10	5	$10^1/_2$	$5^1/_4$	$9^1/_2$
6	8	5	$8^1/_4$	$5^1/_4$	$7^1/_2$
6	6	5	6	$5^1/_4$	$5^1/_2$
4	6	3	$6^7/_8$	$3^1/_2$	$5^1/_2$

For SI: 1 inch = 25.4 mm.

inches deep (171 mm by 210 mm); and for structural composite lumber to be used, it would need to be a minimum of 7 inches wide by $7^1/_2$ inches deep (178 mm by 190 mm).

602.4.1 Fire-retardant-treated wood in exterior walls. *Fire-retardant-treated wood* framing complying with Section 2303.2 shall be permitted within exterior wall assemblies with a 2-hour rating or less.

❖ As with Type III construction, fire-retardant-treated wood (FRTW) is permitted as a substitute for noncombustible materials within exterior wall assemblies of Type IV construction. Except as noted in Section 602.4.9, exterior structural members used externally must be noncombustible. While the exterior walls are permitted to be either nonload-bearing or load-bearing, to apply the allowance for FRTW the required fire-resistance rating of the exterior wall must be no greater than 2 hours. FRTW is required to comply with the provisions of Section 2303.2.

602.4.2 Cross-laminated timber in exterior walls. *Cross-laminated timber* complying with Section 2303.1.4 shall be permitted within exterior wall assemblies with a 2-hour rating or less, provided the exterior surface of the cross-laminated timber is protected by one the following:

1. *Fire-retardant-treated wood* sheathing complying with Section 2303.2 and not less than $^{15}/_{32}$ inch (12 mm) thick;
2. *Gypsum board* not less than $^1/_2$ inch (12.7 mm) thick; or
3. A noncombustible material.

❖ Similar to FRTW, cross-laminated timber can be used within the exterior walls of a Type IV building provided the CLT is protected by one of the three methods listed. In other words, the CLT can be part of the exterior wall provided it is not exposed but is covered.

602.4.3 Columns. Wood columns shall be sawn or glued laminated and shall be not less than 8 inches (203 mm), nominal, in any dimension where supporting floor loads and not less than 6 inches (152 mm) nominal in width and not less than 8 inches (203 mm) nominal in depth where supporting roof and ceiling loads only. Columns shall be continuous or superimposed and connected in an *approved* manner.

❖ Minimum construction requirements and dimensions for timber columns are provided in this section. Columns are required to be a minimum of 8 inches (203 mm) nominal in any dimension if they support floor loads, or a minimum of 6 by 8 inches (152 by 203 mm) nominal if they support no more than a roof and ceiling. Timber columns are required to be continuous or superimposed, positioned on or over each other, through floors for the entire height of the building. The design engineer or architect must provide details of all column connections. As with all structural members, each column must also be adequately

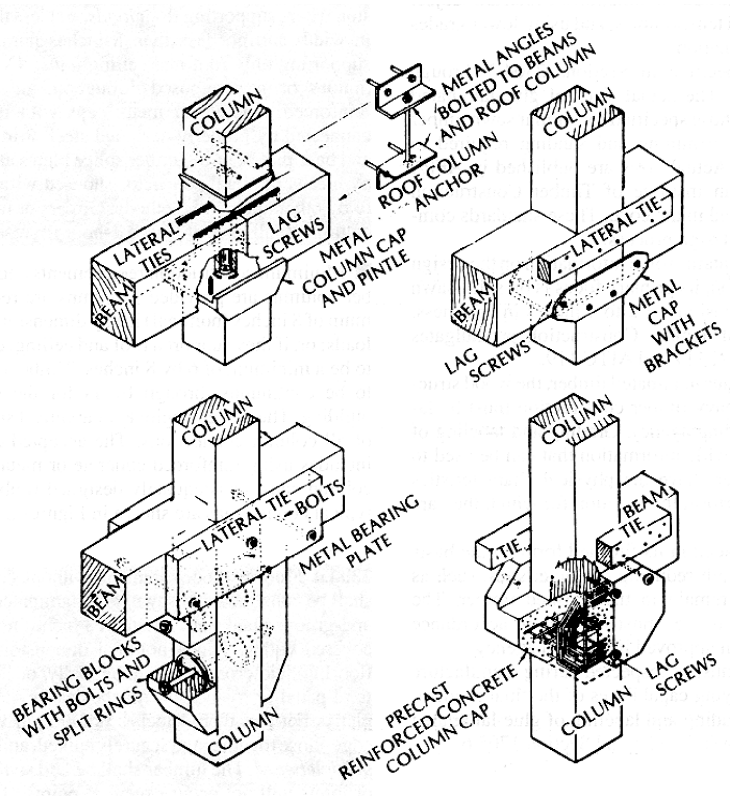


Figure 602.4.1(1)
HEAVY TIMBER—FLOOR BEAM AND COLUMN FRAMING

fastened to other structural members in order to withstand the loads that will be placed upon the column. Some typical examples include reinforced concrete or metal caps, steel or iron column caps and timber splice plates [see Commentary Figures 602.4.1(1) and 602.4.1(2)]. CLT is not included in this section because CLT is not used as a column or framing material.

602.4.4 Floor framing. Wood beams and girders shall be of sawn or glued-laminated timber and shall be not less than 6 inches (152 mm) nominal in width and not less than 10 inches (254 mm) nominal in depth. Framed sawn or glued-laminated timber arches, which spring from the floor line and support floor loads, shall be not less than 8 inches (203 mm) nominal in any dimension. Framed timber trusses supporting floor loads shall have members of not less than 8 inches (203 mm) nominal in any dimension.

❖ Minimum construction requirements and dimensions for floor framing are provided in this section. Girders are the principal horizontal structural members that support columns or beams. Beams are the structural members that support a floor or roof. Both girders and beams are required to be a minimum 6 inches (152 mm) wide and 10 inches (254 mm) deep. Both framed timber trusses supporting floor loads and framed sawn or glued-laminated timber arches that spring from the floor line and support floor loads are required to be at least 8 inches (203 mm) in any dimension. CLT is not included in this section because CLT is not used as a framing material.

602.4.5 Roof framing. Wood-frame or glued-laminated arches for roof construction, which spring from the floor line or from grade and do not support floor loads, shall have members not less than 6 inches (152 mm) nominal in width and have not less than 8 inches (203 mm) nominal in depth for the lower half of the height and not less than 6 inches (152 mm) nominal in depth for the upper half. Framed or glued-laminated arches for roof construction that spring from the top of walls or wall abutments, framed timber trusses and other roof framing, which do not support floor loads, shall have members not less than 4 inches (102 mm) nominal in width and not less than 6 inches (152 mm) nominal in depth. Spaced members shall be permitted to be composed of two or more pieces not less than 3 inches (76 mm) nominal in thickness where blocked solidly throughout their intervening spaces or where spaces are tightly closed by a continuous wood cover plate of not less than 2 inches (51 mm) nominal in thickness secured to the underside of the members. Splice plates shall be not less than 3 inches (76 mm) nominal in thickness. Where protected by *approved* automatic sprinklers under the roof deck, framing members shall be not less than 3 inches (76 mm) nominal in width.

❖ Minimum construction requirements and dimensions for arches and other types of roof framing are pro-

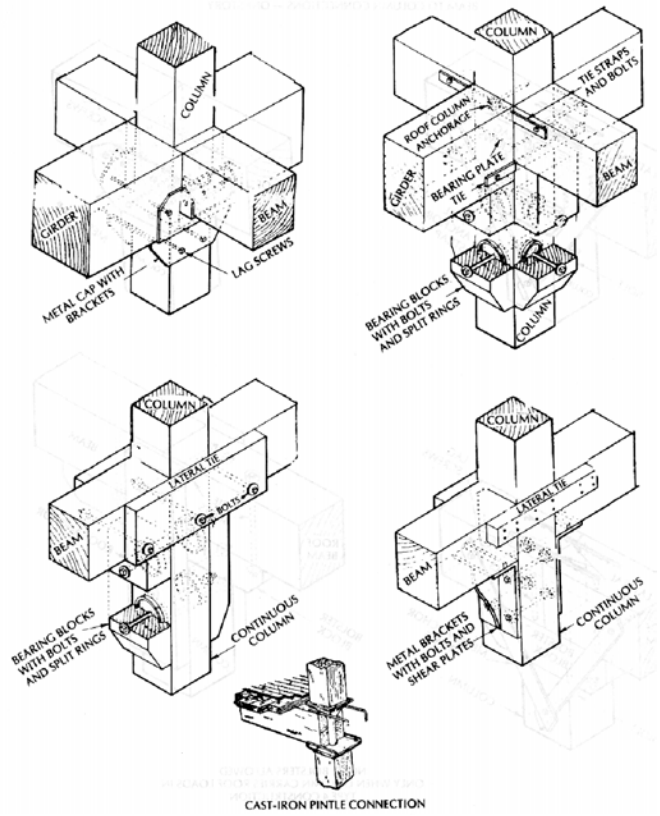


Figure 602.4.1(2)
COLUMN/FLOOR BEAM CONNECTIONS
American Institute for Timber Construction

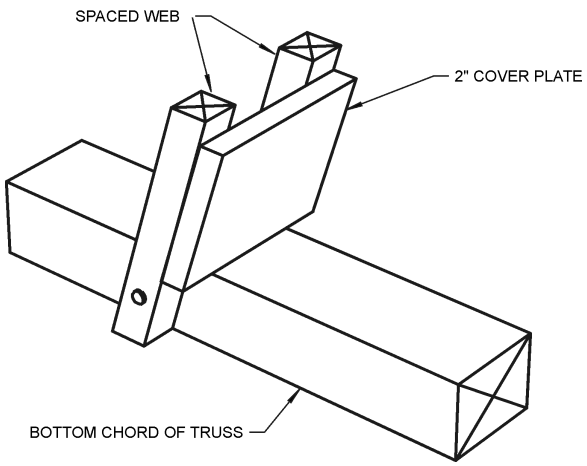
vided in this section. Other types of roof framing included in this section are heavy timber trusses with spaced members. When the members of a heavy timber truss are split and placed on either side of a main member, such as a web connecting a chord, each component of the web must be 3 inches (76 mm) or more in nominal thickness. The space between the two web members must be protected with a 2-inch-thick (51 mm) cover plate [see Commentary Figure 602.4.3(1)], or solidly filled with blocking [see Commentary Figure 602.4.3(2)]. The size of the roof framing members is dependent on the configuration used and is regulated by this section. CLT is not included in this section because CLT is not used as a framing material.

If a building of Type IV construction is equipped with approved automatic sprinklers under the roof deck, the minimum required size of the roof framing members is reduced to 3 inches (76 mm). Roof framing members of a smaller size will have a lower resistance to fire than the 6-inch by 8-inch (152 mm by 203 mm) or 4-inch by 6-inch (102 mm by 152 mm) members required by this section where a sprinkler system is not present. However, the trade-off allowing smaller roof framing members when the building is equipped with an automatic sprinkler system is consistent with the concept of maintaining "equivalent risk" for the building.

602.4.6 Floors. Floors shall be without concealed spaces. Wood floors shall be constructed in accordance with Section 602.4.6.1 or 602.4.6.2.

602.4.6.1 Sawn or glued-laminated plank floors. Sawn or glued-laminated plank floors shall be one of the following:

1. Sawn or glued-laminated planks, splined or tongue-and-groove, of not less than 3 inches (76 mm) nominal in thickness covered with 1-inch (25 mm) nominal dimension tongue-and-groove flooring, laid crosswise



For SI: 1 inch = 25.4 mm

Figure 602.4.3(1)
SPACED MEMBERS WITH COVER PLATE

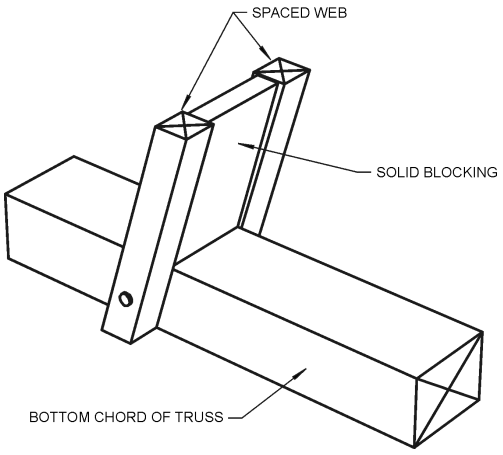


Figure 602.4.3(2)
SOLID BLOCKING OF SPACED MEMBERS

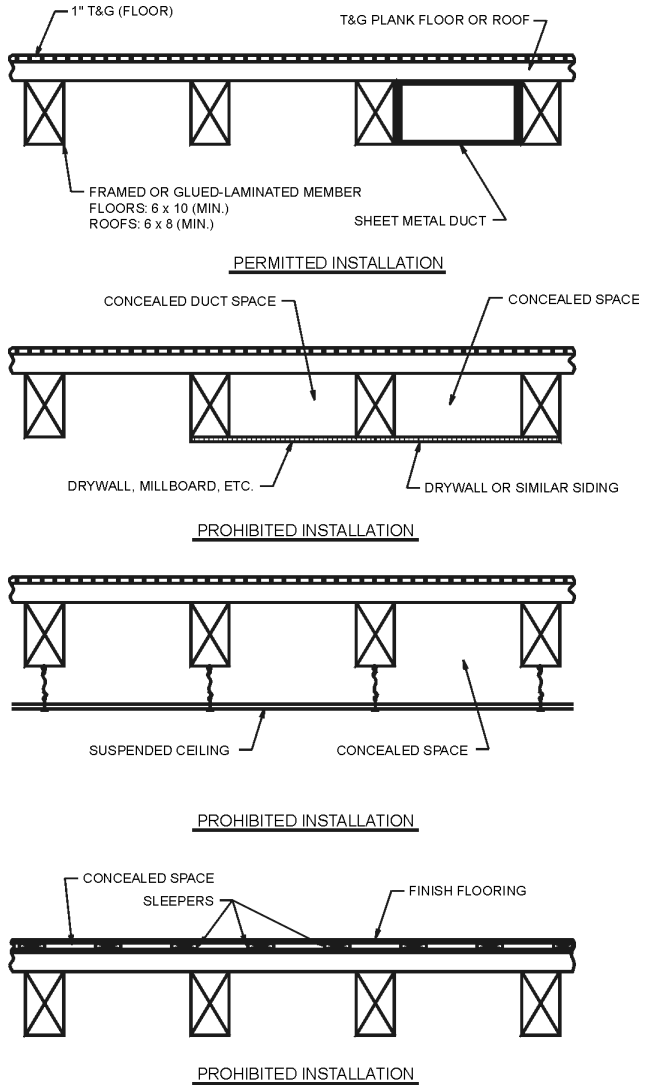
or diagonally, $^{15}/_{32}$-inch (12 mm) wood structural panel or $^{1}/_{2}$-inch (12.7 mm) particleboard.

2. Planks not less than 4 inches (102 mm) nominal in width set on edge close together and well spiked and covered with 1-inch (25 mm) nominal dimension flooring or $^{15}/_{32}$-inch (12 mm) wood structural panel or $^{1}/_{2}$-inch (12.7 mm) particleboard.

The lumber shall be laid so that no continuous line of joints will occur except at points of support. Floors shall not extend closer than $^{1}/_{2}$ inch (12.7 mm) to walls. Such $^{1}/_{2}$-inch (12.7 mm) space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinkage movements of the floor. Corbelling of masonry walls under the floor shall be permitted to be used in place of molding.

❖ Heavy timber (HT) flooring is required to consist of minimum 3-inch-thick (76 mm) sawn or glued-laminated planks, splined floors or tongue-and-groove floors with an overlayment of 1-inch (25 mm) tongue-and-groove flooring, laid crosswise or diagonally. HT flooring may also consist of $^{1}/_{2}$-inch (12.7 mm) particleboard or planks at least 4 inches (102 mm) in width set on edge and secured together, with an appropriate overlayment, such as 1-inch (25 mm) hardwood flooring or a $^{15}/_{32}$-inch (12.7 mm) wood structural panel. Flooring in Type IV construction is not permitted to have concealed spaces because an undetected fire can spread quickly in combustible concealed floor spaces [see Commentary Figure 602.4.4(1)]. Because of the support afforded by adjacent members, continuous joints must only occur over supports.

Wood flooring must be fastened to supports that are perpendicular to the planking. Fastening must not be made to beams or girders that are parallel to the



For SI: 1 inch = 25.4 mm.

Figure 602.4.4(1)
CONCEALED SPACES

planks [see Commentary Figure 602.4.4(2)]. This precaution is intended to prevent separation of the planks because of differential movement of the beam relative to the girders and possible expansion/contraction due to differing moisture or humidity levels. This section requires a minimum $^1/_2$-inch (12.7 mm) clearance between the wood flooring and exterior walls. This will prevent damage to the walls if the flooring expands or moves due to factors such as use and natural forces. It should be emphasized that the integrity of the floor assembly must be maintained to provide the equivalent of a 1-hour fire-resistance rating. In addition, the $^1/_2$-inch (12.7 mm) gap must be protected by a molding connected to the wall so that any possible contracting or expanding of the floor is not impeded. If masonry walls are utilized, corbeling of the masonry may be used as an alternate to the molding requirements.

602.4.6.2 Cross-laminated timber floors. *Cross-laminated timber* shall be not less than 4 inches (102 mm) in thickness. *Cross-laminated timber* shall be continuous from support to support and mechanically fastened to one another. *Cross-laminated timber* shall be permitted to be connected to walls without a shrinkage gap providing swelling or shrinking is considered in the design. Corbelling of masonry walls under the floor shall be permitted to be used.

❖ Cross-laminated timber is a large, thick panel composed of crosswise layers of dimension lumber bound with a structural adhesive. When used in floors, CLT is unlike traditional plank decking because the CLT panel doesn't have joints to protect. Therefore, there is no requirement for sheathing. Sheathing can be used on CLT, but is not necessary for compliance with this section.

602.4.7 Roofs. Roofs shall be without concealed spaces and wood roof decks shall be sawn or glued laminated, splined or tongue-and-groove plank, not less than 2 inches (51 mm) nominal in thickness; $1^1/_8$-inch-thick (32 mm) wood structural panel (exterior glue); planks not less than 3 inches (76 mm) nominal in width, set on edge close together and laid as required for floors; or of cross-laminated timber. Other types of decking shall be permitted to be used if providing equivalent fire resistance and structural properties.

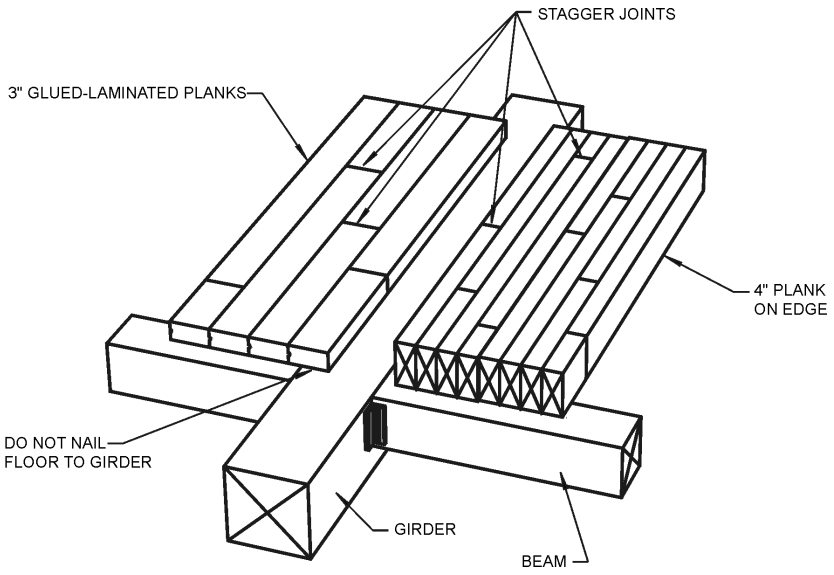
Cross-laminated timber roofs shall be not less than 3 inches (76 mm) nominal in thickness and shall be continuous from support to support and mechanically fastened to one another.

❖ Minimum construction requirements and dimensions for roof decks are provided in this section. As required for floors, roofs are not permitted to have concealed spaces [see Commentary Figure 602.4.4(1)]. If the materials used in roof construction are different from those described in this section, the roof must have a minimum 1-hour fire-resistance rating and be of the same structural properties.

602.4.8 Partitions and walls. Partitions and walls shall comply with Section 602.4.8.1 or 602.4.8.2.

602.4.8.1 Interior walls and partitions. Interior walls and partitions shall be of solid wood construction formed by not less than two layers of 1-inch (25 mm) matched boards or laminated construction 4 inches (102 mm) thick, or of 1-hour fire-resistance-rated construction.

❖ Minimum construction requirements and dimensions for partitions in Type IV construction are provided in this section. Partitions must either be formed by not less than two layers of 1-inch (25 mm) matched boards or laminated construction 4 inches (102 mm)



For SI: 1 inch = 25.4 mm.

Figure 602.4.4(2)
HEAVY TIMBER FLOORING

thick if they are constructed of solid wood. Partitions are permitted to be constructed of materials other than solid wood if they have at least a 1-hour fire-resistance rating. An example of the use of alternative materials is when a fire-resistance rating for a corridor wall is required. It is common practice to utilize a 1-hour fire-resistance-rated stud and gypsum wallboard assembly between the exposed columns to form the walls of the corridor.

602.4.8.2 Exterior walls. Exterior walls shall be of one of the following:

1. Noncombustible materials.
2. Not less than 6 inches (152 mm) in thickness and constructed of one of the following:
   2.1. *Fire-retardant-treated wood* in accordance with Section 2303.2 and complying with Section 602.4.1.
   2.2. *Cross-laminated timber* complying with Section 602.4.2.

❖ Exterior walls of Type IV buildings must be of noncombustible materials, or can include either fire-retardant-treated wood in accordance with Section 602.4.1 or cross-laminated timber complying with Section 602.4.2. In addition, wood columns and arches that are of heavy timber sizes can be exposed in the exterior wall in accordance with Section 602.4.9.

602.4.9 Exterior structural members. Where a horizontal separation of 20 feet (6096 mm) or more is provided, wood columns and arches conforming to heavy timber sizes shall be permitted to be used externally.

❖ Heavy timber columns and arches that conform to minimum dimensional requirements may be used on the exterior if a fire separation distance of at least 20 feet (6096 mm) is maintained, although the exterior wall itself must be of noncombustible construction. If a fire separation distance of at least 20 feet (6096 mm) is maintained, the risk of exposure of the wood members to fire from an adjacent building is reduced, and the HT columns and arches are permitted to be exposed to the exterior.

If a building of Type IV construction has a fire separation distance of less than 20 feet (6096 mm), the wood columns and arches are to be located on the interior side of the exterior wall. The noncombustible construction of the exterior wall will provide some degree of protection to the interior timber members. Therefore, placing the wood structural members inside an exterior wall is preferable to placing them within 20 feet (6096 mm) of a lot line or adjacent building with no exposure protection.

602.5 Type V. Type V construction is that type of construction in which the structural elements, *exterior walls* and interior walls are of any materials permitted by this code.

❖ Type V construction allows the use of all types of materials, both noncombustible and combustible, but Type V buildings are most commonly constructed of dimensional lumber (see Commentary Figure 602.5 for an example of Type V construction). It is divided into two subclassifications: Types VA and VB. An example of a typical building of Type VA construction is a wood frame building in which the interior and exterior load-bearing walls, floors, roofs and all structural members are protected to provide a minimum 1-hour fire-resistance rating. Type V construction is required to comply with Table 601 and Chapter 23.

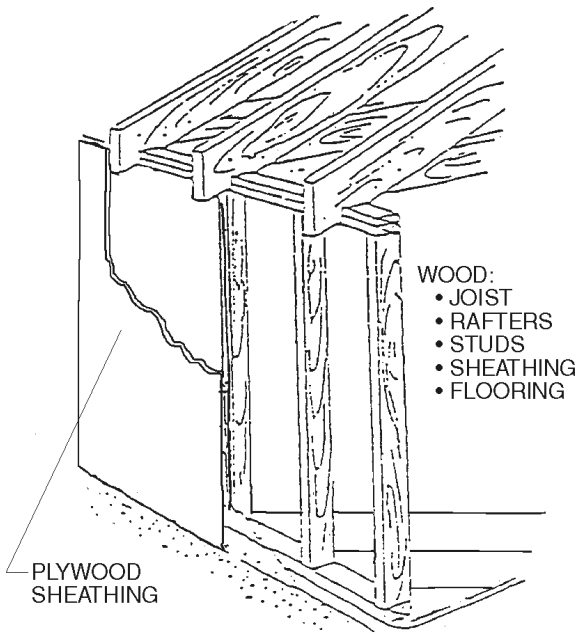


Figure 602.5
EXAMPLE OF TYPE V CONSTRUCTION

SECTION 603
COMBUSTIBLE MATERIAL IN TYPES I AND II CONSTRUCTION

603.1 Allowable materials. Combustible materials shall be permitted in buildings of Type I or II construction in the following applications and in accordance with Sections 603.1.1 through 603.1.3:

1. *Fire-retardant-treated wood* shall be permitted in:
   1.1. Nonbearing partitions where the required *fire-resistance rating* is 2 hours or less.
   1.2. Nonbearing *exterior walls* where fire-resistance-rated construction is not required.
   1.3. Roof construction, including girders, trusses, framing and decking.

Exception: In buildings of Type IA construction exceeding two *stories above grade plane*, *fire-retardant-treated wood* is not permitted in roof construction where the vertical distance from the upper floor to the roof is less than 20 feet (6096 mm).

2. Thermal and acoustical insulation, other than foam plastics, having a *flame spread index* of not more than 25.

   Exceptions:

   1. Insulation placed between two layers of noncombustible materials without an intervening airspace shall be allowed to have a *flame spread index* of not more than 100.
   2. Insulation installed between a finished floor and solid decking without intervening airspace shall be allowed to have a *flame spread index* of not more than 200.

3. Foam plastics in accordance with Chapter 26.
4. Roof coverings that have an A, B or C classification.
5. *Interior floor finish* and floor covering materials installed in accordance with Section 804.
6. Millwork such as doors, door frames, window sashes and frames.
7. *Interior wall and ceiling finishes* installed in accordance with Sections 801 and 803.
8. *Trim* installed in accordance with Section 806.
9. Where not installed greater than 15 feet (4572 mm) above grade, show windows, nailing or furring strips and wooden bulkheads below show windows, including their frames, aprons and show cases.
10. Finish flooring installed in accordance with Section 805.
11. Partitions dividing portions of stores, offices or similar places occupied by one tenant only and that do not establish a *corridor* serving an *occupant load* of 30 or more shall be permitted to be constructed of *fire-retardant-treated wood*, 1-hour fire-resistance-rated construction or of wood panels or similar light construction up to 6 feet (1829 mm) in height.
12. Stages and platforms constructed in accordance with Sections 410.3 and 410.4, respectively.
13. Combustible *exterior wall coverings*, balconies and similar projections and bay or oriel windows in accordance with Chapter 14.
14. Blocking such as for handrails, millwork, cabinets and window and door frames.
15. Light-transmitting plastics as permitted by Chapter 26.
16. Mastics and caulking materials applied to provide flexible seals between components of *exterior wall* construction.
17. Exterior plastic veneer installed in accordance with Section 2605.2.
18. Nailing or furring strips as permitted by Section 803.11.
19. Heavy timber as permitted by Note c to Table 601 and Sections 602.4.7 and 1406.3.
20. Aggregates, component materials and admixtures as permitted by Section 703.2.2.
21. Sprayed fire-resistant materials and intumescent and mastic fire-resistant coatings, determined on the basis of *fire resistance* tests in accordance with Section 703.2 and installed in accordance with Sections 1705.14 and 1705.15, respectively.
22. Materials used to protect penetrations in fire-resistance-rated assemblies in accordance with Section 714.
23. Materials used to protect joints in fire-resistance-rated assemblies in accordance with Section 715.
24. Materials allowed in the concealed spaces of buildings of Types I and II construction in accordance with Section 718.5.
25. Materials exposed within plenums complying with Section 602 of the *International Mechanical Code*.
26. Wall construction of freezers and coolers of less than 1,000 square feet (92.9 m^2), in size, lined on both sides with noncombustible materials and the building is protected throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

❖ Section 603.1 provides a listing of circumstances where combustible materials can be used in buildings of Type I and II construction, which are otherwise required to be constructed of noncombustible materials. The list of 26 items frequently references the code user to other sections of the code where specific allowances are found. Most of these listed items, while of combustible materials, are either of minor quantities in the overall building or are of materials with fire-resistive properties.

Treated wood: Fire-retardant-treated wood (FRTW) does not meet the criteria in the code for a noncombustible material. It is, however, permitted as an alternative to noncombustible materials in specific locations in Type I and II construction (see Items 1, 11 and 13). For example, the use of FRTW in walls of Type I and II construction has been limited to nonload-bearing partitions with a fire-resistance rating of no greater than 2 hours and nonload-bearing exterior walls without a fire-resistance rating. Additionally, roofs in buildings of Type I and II construction are permitted to be constructed of FRTW. The exception to Item 1.3 does not permit FRTW in the roofs of buildings of Type IA construction over two stories in height if the distance from the uppermost floor to the roof is less than 20 feet (6096 mm). If the distance is 20 feet (6096 mm) or greater, then FRTW is acceptable in the roof. FRTW is permitted in the roof of any Type IA building two stories or less in height regardless of the distance from the floor to the roof. Similarly, FRTW is permitted in the roof of any Type IB or Type II building (no height restrictions) regardless of the distance from the floor to the roof.