



FIRE BARRIER RATINGS

in Separated Mixed Occupancies

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Fire barriers have a number of uses and applications in the 2006 *International Building Code* (IBC). Among other things, fire barriers are used to separate mixed occupancies and to compartmentalize a building in lieu of installing a fire sprinkler system.

As indicated in IBC Section 508.3, one option for properly designing a building with multiple occupancies is as a separated mixed occupancy building as specified in Section 508.3.3. Section 508.3.3.4 is specific to a mixed occupancy building design and refers to Table 508.3.3 for the minimum fire-resistance rating for fire barriers separating the different occupancies.

Assume that a mixed occupancy building is being designed. The building is of Type IIA construction and is being designed as a nonsprinklered, separated, mixed-use occupancy. Based on Table 508.3.3, the fire ratings of the separation walls required are as shown in Figure 1. As required in Section 706.3.8, the ratings of the fire barriers are based on Table 508.3.3.

Allowable area for the single story building is determined based on Section 508.3.3.2, which states that the total building area shall be designed so that the sum of the ratios of the actual floor area of each occupancy divided by the allowable floor area of each occupancy shall not exceed a value of 1.0. The allowable area calculation is shown in Table 1. Because the sum of the ratios of each occupancy does not exceed 1.0, the areas of the building satisfy the code's requirements with regard to allowable area.

In this particular facility, the owner prefers not to install an automatic fire sprinkler system, therefore the designer has chosen to compartmentalize the building to limit the size of the fire areas in accordance with Section 903.2 (IBC Section 901.7 permits the use of

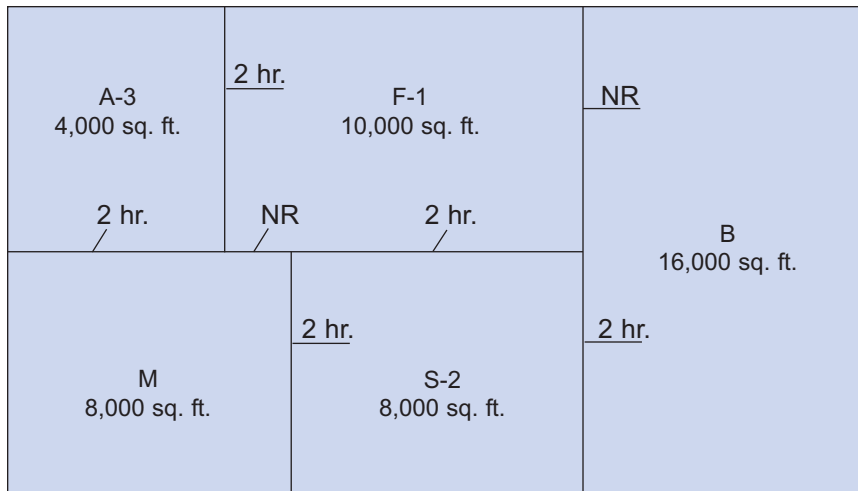


Figure 1. Type IIA, nonsprinklered, separated, mixed-use occupancy.

fire areas in lieu of fire sprinklers for certain occupancies of limited size). A fire area by definition is surrounded by exterior walls, fire barriers, fire walls or fire-resistance rated horizontal assemblies. The definition does not specify a fire-resistance rating. Although fire barriers separating occupancies could have a minimum fire-resistance-rating of 1 hour as shown in Table 508.3.3,

IBC Section 901.7 specifies that when fire areas are created to eliminate the requirement for fire sprinklers, the fire rating must be based on Section 706.3.9, which refers to Table 706.3.9. It is important to note that Section 901.7 is not located in the *International Fire Code*, it is only found in the IBC.

The required fire-resistance rating is based on the

IBC Table 508.3.3
Required separation of occupancies (hours).

OCCUPANCY	A ^e , E		I		R ^d		F-2, S-2 ^{c,d} , U ^d		B ^b , F-1, M ^b , S-1		H-1		H-2		H-3, H-4, H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A ^e , E	N	N	2	2	1	2	N	1	1	2	NP	NP	3	4	2	3 ^a
I			N	N	2	NP	2	2	2 ^f	2 ^f	N	N	4	N	4	NP
R ^d					N	N	1	2	1	2	NP	NP	3	NP	2	NP
F-2, S-2 ^{c,d} , U ^d							N	N	1	2	NP	NP	3	4	2	3 ^a
B ^b , F-1, M ^b , S-1									N	N	NP	NP	2	3	1	2 ^a
H-1											N	N	NP	N	NP	NP
H-2													N	NP	1	NP
H-3, H-4, H-5															N	NP

For SI: 1 square foot = 0.0929 m².

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

NS = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

N = No separation requirement.

NP = Not permitted.

a. For Group H-5 occupancies, see Section 903.2.4.2.

b. Occupancy separation need not be provided for storage areas within Groups B and M if the:

1. Area is less than 10 percent of the floor area;
2. Area is equipped with an automatic fire-extinguishing system and is less than 3,000 square feet; or
3. Area is less than 1,000 square feet.

c. Areas used only for private or pleasure vehicles shall be allowed to reduce separation by 1 hour.

d. See Section 406.1.4.

e. Commercial kitchens need not be separated from the restaurant seating areas that they serve.

Fire Barrier Ratings *(continued)*

**Table 1. Allowable area calculation for Type IIA construction
(fire separation distance = 30 feet on all four sides).**

OCCUPANCY	BASIC AREA	SPRINKLER INCREASE	FRONTAGE INCREASE	ALLOWABLE AREA (+ sprinklers + frontage)	ACTUAL AREA	RATIO
A-3	15,500	0	11,625	27,125	4,000	0.15
B	37,500	0	28,125	65,625	16,000	0.24
F-1	25,000	0	18,750	43,750	10,000	0.23
M	21,500	0	16,125	37,625	8,000	0.21
S-2	39,000	0	29,250	68,250	8,000	0.12
Total building area					46,000	
Sum of the ratios						0.95

most restrictive requirement found in Table 706.3.9. The separation requirement for an F-1 occupancy is 3 hours and the separation requirement for an M occupancy is 2 hours. The requirement for a separation between an F-1 occupancy and an M occupancy must be the most restrictive. Therefore, in order to use fire barriers to eliminate the requirement for fire sprinklers, the building will be compartmentalized as shown in Figure 2, which shows five separate fire areas. (Referring to Figure 1, there is only one fire area that encompasses the entire building because there is no complete separation between fire areas meeting the requirements of Table 706.3.9.)

The separation of the F-1 occupancy from the remainder of the building is required to be 3-hour fire-resistance rated. The fire-resistance rating between the M occupancy and the A-3 occupancy remains at 2 hours because that rating complies with both Table 706.3.9 and Table 508.3.3.

If the owner had decided to install an approved fire sprinkler system, several modifications could be made to the design. As illustrated in Figure 3, the fire barriers that were installed to create fire areas and the increased fire rating of others would not be required, the fire-resistance rating of each of the fire barriers separating the occupancies could be reduced by 1 hour as indicated in Table 508.3.3 and the type of construction could be changed to Type IIIB. An analysis of the allowable areas justifying a change in the type of construction is shown in Table 2.

Summary

There are several different criteria employed in determining the required fire-resistance rating of fire barriers. Each of the various requirements needs to be satisfied, which will result in using the most restrictive fire rating. Even though a fire area is defined as having barriers with a minimum 1-hour fire-resistance rating, IBC Table

**IBC Table 706.3.9
Fire-resistance rating requirements for fire barrier assemblies or horizontal assemblies between fire areas.**

OCCUPANCY GROUP	FIRE-RESISTANCE RATING (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

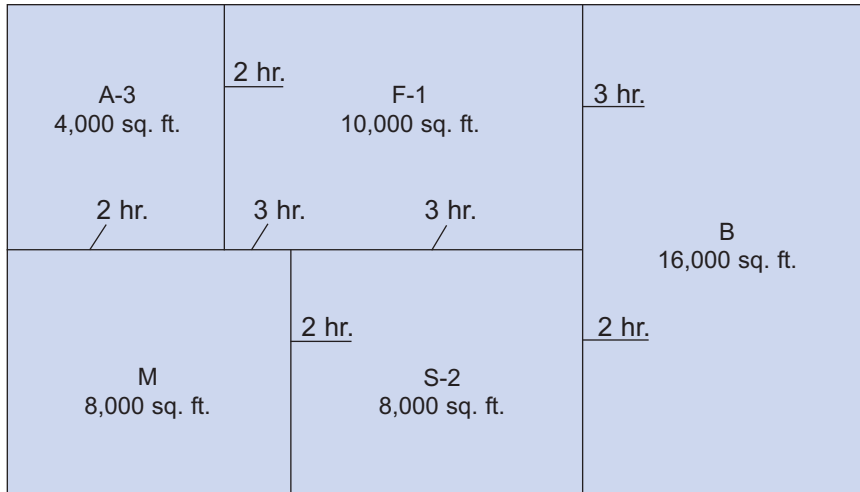


Figure 2. Without fire sprinklers.

706.3.9 governs when determining the required fire-resistance rating for fire barriers installed in lieu of sprinklers.

This discussion is based only on a separated mixed occupancy building. There are other options allowed by the IBC for the design of such a building. In this article, only the fire-resistance rating of the fire barrier is covered. ♦

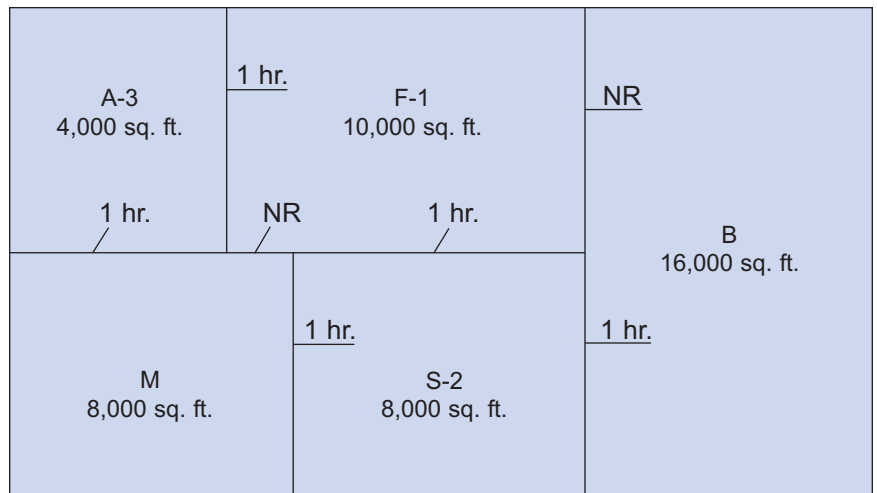


Figure 3. Type IIIB, sprinklered, separated, mixed-use occupancy.

Table 2. Allowable area calculation for Type IIIB construction (fire separation distance = 30 feet on all four sides).

OCCUPANCY	BASIC AREA	SPRINKLER INCREASE	FRONTAGE INCREASE	ALLOWABLE AREA (+ sprinklers + frontage)	ACTUAL AREA	RATIO
A-3	9,500	28,500	7,125	45,125	4,000	0.09
B	19,000	57,700	14,250	90,250	16,000	0.18
F-1	12,000	36,600	9,000	57,000	10,000	0.18
M	12,500	37,500	9,375	59,375	8,000	0.13
S-2	26,000	78,000	19,500	123,500	8,000	0.06
Total building area					46,000	
Sum of the ratios						0.64