



Description

- This course provides an overview of the 2018 IBC Section 508 provisions for the application of code requirements addressing mixed occupancy buildings.
 - Other code provisions applicable to an understanding of mixed occupancies will also be addressed.



Goal

- This seminar is designed to familiarize and assist code officials in locating, describing and applying IBC requirements regarding mixed occupancies.



Objectives

After completing this seminar, you will be able to:

- Define the concept for addressing mixed-occupancy buildings.
- Identify and apply the three options that are available for regulating mixed-occupancy buildings.
- Describe the relationship of occupancy classification, allowable height, allowable area and occupancy separation to mixed-occupancy buildings.
- Identify incidental uses and understand how they differ from mixed-occupancy conditions.



Course Overview

- Module 1 – Concept of Mixed Occupancies
- Module 2 – Occupancy Classification
- Module 3 – Incidental Uses
- Module 4 – Foundations of the IBC for Mixed Occupancies
- Module 5 – Application of the Mixed Occupancy Methods
- Module 6 – Nonseparated Occupancies
- Module 7 – Separated Occupancies
- Module 8 – Accessory Occupancies
- Module 9 – Allowable Height and Area for Multistory Buildings
- Module 10 – Miscellaneous Applications



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Module 1

Concept of Mixed Occupancies

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Definition

- A mixed-occupancy condition occurs where two or more distinct occupancy classifications are determined to exist in the same building.
- Under such circumstances, the designer has available several different methodologies in Section 508 to address the mixed-occupancy building.
- Compliance with at least one of the methods is mandatory.



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Mixed Use and Occupancy Scope

- The provisions of Section 508 address specific mixed-occupancy requirements that are to be applied in addition to the applicable provisions established throughout the IBC.
- The provisions of Section 509 address incidental uses as identified in Table 509.
- There is no relationship between the mixed-occupancy provisions of Section 508 and those addressing incidental uses in Section 509.
 - It is important to identify the scope of each of the two concepts in order to recognize the differences in their applications.



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Use vs. Occupancy

- “Use” and “Occupancy” are terms that differ in meaning and application within the IBC.
- “Use” describes the activity that occurs within the space, room or building.
 - “Use” is seldom utilized in the IBC as the scoping mechanism.
 - Examples include occupant load calculation and incidental uses.
- “Occupancy” describes the specific classification a “use” is assigned when applying the code to a space, room or building.
 - Almost all code provisions with application only to a limited number of situations are regulated by “Occupancy”.
 - Primary examples include allowable height and area, fire protection features and means of egress requirements.



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General Provisions Section 508.1

- Three options established in Section 508 to address mixed-occupancy buildings include:
 - Accessory Occupancies.
 - Nonseparated Occupancies.
 - Separated Occupancies.
- Methods for determining maximum allowable size, height and area and separations are identified for each option.
- One of the three options must be applied to a mixed-occupancy condition.



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General Provisions Section 508.1

- Occupancy Classification
 - Proper occupancy classifications determined - Section 302.
 - Two or more different occupancies - Section 508.
- Allowable Building Height and Area
 - Final analysis for allowable building height and area cannot be done until one of the three mixed-occupancy options has been chosen.
- Separation
 - Separation is not required between occupancies; or
 - Some degree of fire-resistance-rated separation is mandated to isolate one occupancy from another.



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Module 2

Occupancy Classification

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Classification of Occupancies Section 302

- Classification is essential to the proper application of the IBC.
- Structure to be classified according to the function or functions for which it is intended.
- Buildings to be classified prior to the application of Section 508 regulating mixed-occupancy conditions.



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Classification of Occupancies Section 302

- Chapter 3 provides an extensive listing of various uses and their corresponding occupancy classifications.
- There are many special cases and exceptions.
- Unsure of classification? Ask for more information.
- If two or more distinct occupancy groups are present, the provisions of Section 508 will apply.



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General Provisions Section 302.1

- Structures are classified into one or more occupancies in accordance with their intended uses.
- If the use is not specifically identified in Chapter 3, it must be classified with the occupancy it most nearly resembles.



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Occupancy Groups Chapter 3

A	Assembly	Section 303
B	Business	Section 304
E	Educational	Section 305
F	Factory and Industrial	Section 306
H	High-hazard	Section 307
I	Institutional	Section 308
M	Mercantile	Section 309
R	Residential	Section 310
S	Storage	Section 311
U	Utility and Miscellaneous	Section 312



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Occupancy Classification Overview

- Multiple uses do not necessarily create multiple occupancies.
- General occupancy classification is intended to include related support areas such as corridors, stairways, restrooms, mechanical equipment rooms, small storage areas, etc.
- Support areas of higher hazard are often regulated as incidental uses.



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Module 3

Incidental Uses

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Incidental Uses Section 509

- Rooms or spaces that pose risks which aren't addressed by the provisions specific to a general occupancy group:
 - Presence of combustible or hazardous material.
 - Presence of a hazardous activity or equipment.
- Limited to those found in Table 509.
- Regulated according to their hazard level.
- Regulated as part of primary occupancy.
- Not regulated as accessory occupancy.
- Not regulated under mixed occupancy provisions.
- Limited to 10% of area of story in which located.



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Incidental Uses Identification

Uses are those listed in Table 509, including:

- Furnace rooms where any piece of equipment exceeds a 400,000-Btu per hour input rating.
- Paint shops (where located in other than a Group F occupancy, and not when Group H occupancy).
- Laboratories in Group E occupancies.
- Vocational shops located in Group E occupancies.
- Laundry rooms over 100 square feet.
- Physical plant maintenance shops in Group I-2 occupancies.



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FOR EXAMPLE

Incidental Uses Classification

- Occupancy classification is consistent with the general classification of the area of the building in which the incidental use is located.
 - A chemistry lab/classroom in a high school building. Classified as Group E occupancy.
 - A physical plant maintenance shop in a hospital. Classified as Group I-2 occupancy.

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FOR EXAMPLE

Incidental Uses Classification

Separated or Protected per Table 509

Group E Chemistry Classroom

Group E High School

Separated or Protected per Table 509

220 square feet Group R-1 Laundry Room

Group R-1 Hotel

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Incidental Uses Separation and Protection

- Intent is to isolate incidental use hazard from remainder of building, typically through use of:
 - Fire-resistance-rated separation; or
 - Smoke-resistant separation plus sprinkler system.
- Under certain conditions, sprinkler option cannot be substituted for fire-resistance-rated separation.
- Both fire-resistance-rated separation and automatic sprinkler system protection are mandated in limited cases.

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Incidental Uses: Separation and Protection

Incinerator Room

Protected by automatic sprinkler system

Minimum 2-hour fire barrier

Group F-1 Factory

Physical Plant Maintenance Shop

Minimum 1-hour fire barrier

Group I-2 Nursing Home

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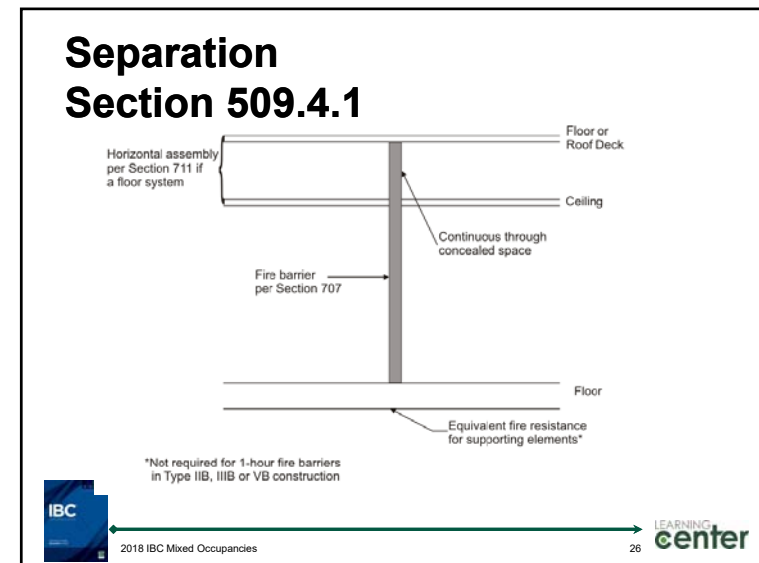
REFER TO
IBC
INTERNATIONAL
CODE COUNCIL
CODE BOOK

Incidental Uses Table 509

(F) TABLE 509
INCIDENTAL USES

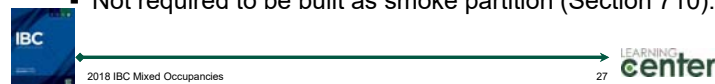
ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen fuel gas rooms, not classified as Group H	1 hour in Group R, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and provide automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours, or 1 hour and provide automatic sprinkler system
In Group E occupancies, laboratories and vocational shops not classified as Group H	1 hour or provide automatic sprinkler system
In Group I-2 occupancies, laboratories not classified as Group H	1 hour and provide automatic sprinkler system
In ambulatory care facilities, laboratories not classified as Group H	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
In Group I-2, laundry rooms over 100 square feet	1 hour
Group I-3 cells and Group I-2 patient rooms equipped with padded surfaces	1 hour
In Group I-2, physical plant maintenance shops	1 hour
In ambulatory care facilities or Group I-2 occupancies, waste and linen collection rooms with containers that have an aggregate volume of 10 cubic feet or greater	1 hour
In other than ambulatory care facilities and Group I-2 occupancies, waste and linen collection rooms over 100 square feet	1 hour or provide automatic sprinkler system
In ambulatory care facilities or Group I-2 occupancies, storage rooms greater than 100 square feet	1 hour
Stationary storage battery systems having an energy capacity greater than the threshold quantity specified in Table 1206.2 of the International Fire Code	1 hour in Group R, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Electrical installations and transformers	See Sections 110.26 through 110.34 and Sections 450.3 through 450.48 of NFPA 70 for protection and separation requirements.

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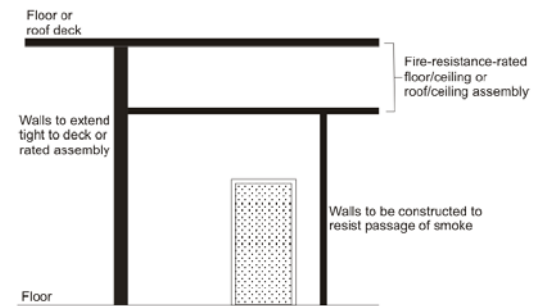


Protection Section 509.4.2

- Table 509 allows for the installation of an automatic sprinkler system provided the incidental use:
 - Is separated by construction capable of resisting passage of smoke.
 - Has doors that are automatic or self closing (no openings).
 - Has smoke dampers on air transfer openings in walls.
- Other:
 - Need not be fire-resistance rated.
 - Not required to be built as smoke partition (Section 710).

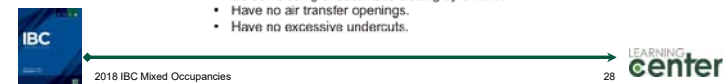


Protection Section 509.4.2



Note: Doors shall:

- Be self-closing or automatic closing by smoke.
- Have no air transfer openings.
- Have no excessive undercuts.





Application of Mixed-Occupancy Provisions

- Proper application of mixed-occupancy provisions rely on full understanding of:
 - Occupancy classification (Chapter 3).
 - Allowable building height (Chapter 5).
 - Allowable building area (Chapter 5).
 - Fire protection features (Chapter 9).
 - Construction of fire-resistant separations (Chapter 7).



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Occupancy Classification Chapter 3

- As previously addressed, occupancy classification is first required.
- Mixed-occupancy conditions occur where two or more distinct occupancy classifications occur in a building.
- Occupancy classification for all three mixed-occupancy methods is based on individual classification per Section 302.1.



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Building Heights and Areas Chapter 5

- Chapter 5 provides basic limits for each building:
 - Maximum height.
 - Maximum number of stories.
 - Allowable area.
- Limits are set according to type of construction and the occupancy.
 - Tables 504.3, 504.4 and 506.2.
 - Allowable increases.
- Allowable height and area cannot be determined until choice of mixed occupancy method is made.



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Fire Protection Features Chapter 9

- Chapter 9 identifies where automatic sprinkler systems, fire alarm systems and other fire protection features are required.
- Such systems are typically required based on occupancy classification, with thresholds selectively established based on:
 - Floor area
 - Occupant load
 - Location within building



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Fire-resistance-rated Separations Scope

- Section 508 specifies requirements.
- Not required for:
 - Accessory occupancies.
 - Nonseparated occupancies.
 - Certain combinations under separated occupancies.
- Required for:
 - Group H occupancies in mixed-occupancy buildings.
 - Certain combinations under separated occupancies as specified in Table 508.4.



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Fire Barriers/Horizontal Assemblies Sections 707 and 711

- Separations, where required, must be:
 - Fire barriers constructed in accordance with Section 707. Provisions of Section 707 address:
 - Continuity.
 - Openings.
 - Penetrations.
 - Joints.
 - Ducts and air transfer openings.
 - Supporting construction.
 - Horizontal assemblies constructed in accordance with Section 711.



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Module 5

Application of the Mixed Occupancy Methods

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Mixed Occupancies: Overview Section 508.1

- There are four key components that regulate mixed-occupancy buildings:
 - Occupancy classification (includes fire protection).
 - Allowable height.
 - Allowable area.
 - Separation.
- The three mixed-occupancy options differ from each other based on one or more of these four components.



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Application of Three Options Section 508.1

- Section 508.1 mandates that one of the three options must be applied where a mixed occupancy exists.
 - Determination of the option depends on the owner/designer.
 - Building function.
 - Construction costs.
 - Design flexibility.
 - Compliance with at least one of the three options to be verified by building official.



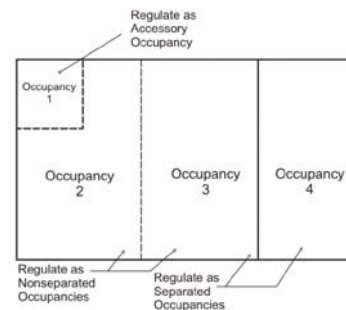
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Use of Multiple Options Section 508.1

- Owner/designer may choose to use more than one option within same building.
- Under separated occupancies option, relationship between multiple pairs of occupancies should be individually analyzed.



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Conditions Where Not Applicable Section 508.1, Exceptions

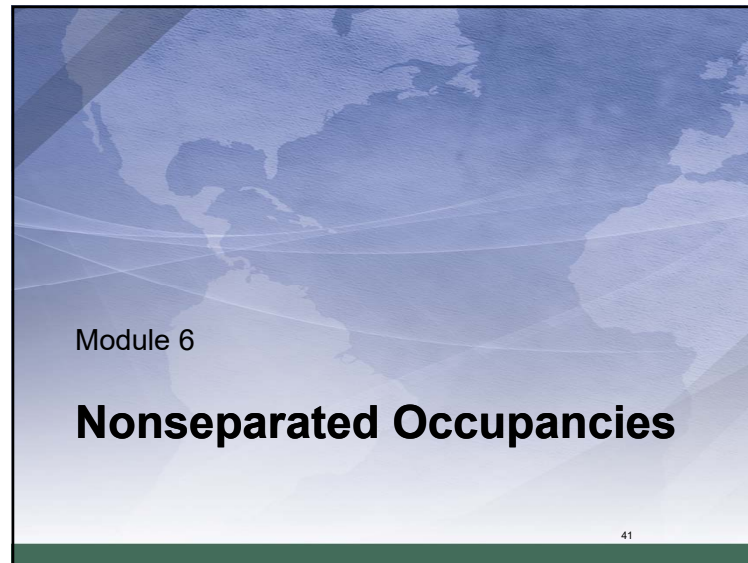
- There are three conditions under which the provisions of Section 508 do not apply:
 - Occupancies regulated under the special provisions height and area provisions of Section 510.
 - Group H-1, H-2 and H-3 occupancies where required to be in a detached building by Table 415.6.2.
 - Uses within live/work units in accordance with Section 419 (not considered as separate occupancies).



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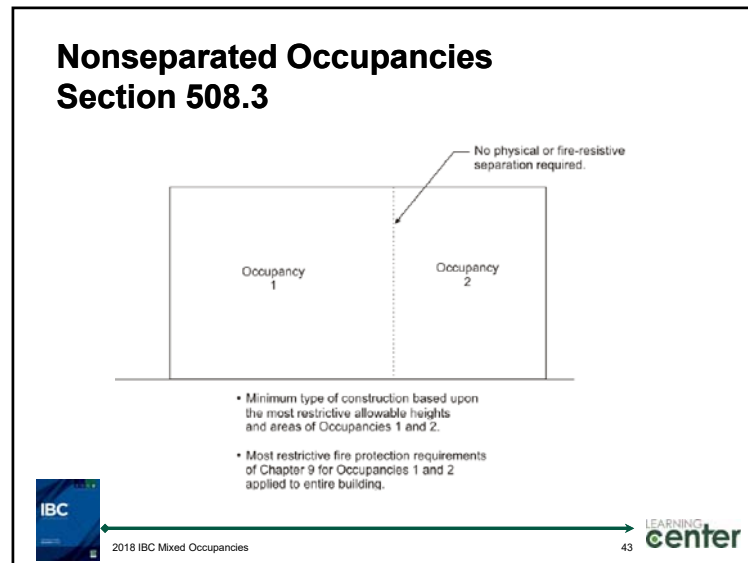
Nonseparated Occupancies Overview

- “Nonseparated occupancies” method considers most restrictive requirements for fire protection and allowable height/area for occupancies involved
- This method beneficial to designer due to:
 - No requirement to separate occupancies
 - Flexibility allowed by application of “worst-case” approach to fire protection and building size.
- No requirements for a fire-resistance-rated separation between adjacent occupancies.
- Nonseparated occupancies method is most common of methods utilized.



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Nonseparated Occupancies: Classifications – Section 508.3.1

- Occupancy classification based on the general provisions of Section 302.1.
- Individually classified based on the use of space.
- Most restrictive applicable provisions of Chapter 9 regulating fire-protection systems apply to the total nonseparated occupancy area, not just the specific individual occupancy, and typically address:
 - Automatic sprinkler systems.
 - Fire alarm systems.



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Nonseparated Occupancies: High-rise Buildings – Section 508.3.1

- Where nonseparated occupancies occur in a high-rise building, the most restrictive provisions of Section 403 that apply to the nonseparated occupancies to apply to the entire high-rise building.



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Nonseparated Occupancies: Group I-2, Condition 2 Occupancies – Section 508.3.2

- Where one of the nonseparated occupancies is Group I-2, Condition 2, the most restrictive provisions of the following sections shall apply throughout the fire area containing the Group I-2, Condition 2 occupancy:
 - Section 407 Group I-2
 - Section 509 Incidental uses
 - Section 712 Vertical openings
- Most restrictive egress provisions to apply to path from Group I-2, Condition 2 to the exit discharge

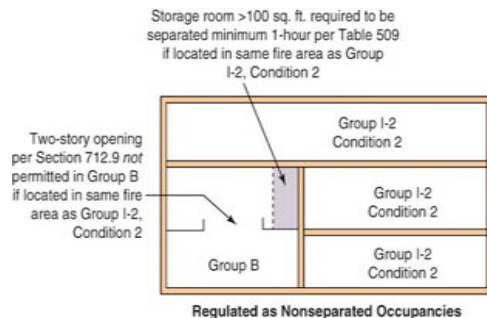


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Nonseparated Occupancies: Group I-2, Condition 2 Occupancies – Section 508.3.2

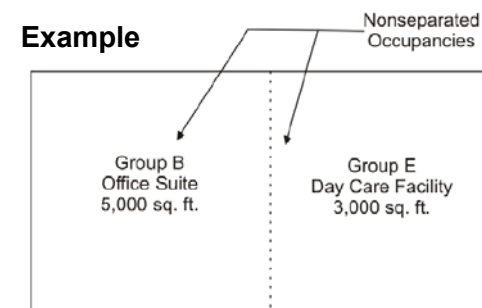


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Nonseparated Occupancies: Fire Protection – Section 508.3.1



- Manual fire alarm system required in Group E occupancy by Section 907.2.3 required throughout entire building.



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Nonseparated Occupancies: Allowable Area and Height – Section 508.3.2

- The maximum allowable height and area of building is based on the most restrictive allowances for the occupancy groups under consideration.
- The most restrictive allowable area is applied to the entire building.
- Same limitation is applied to the building's height.



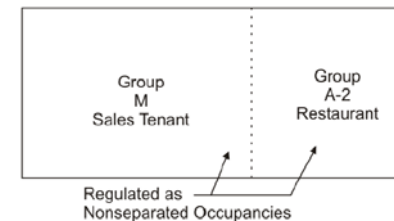
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Nonseparated Occupancies: Allowable Area and Height – Section 508.3.2

Example: Building is to be multistory, fully sprinklered and of Type VB construction. Frontage increase of 30 percent available. 1st story contains Group M and A-2 occupancies as shown with Group B occupancy above.



For SI: 1 square foot = 0.0929 m².



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Nonseparated Occupancies: Allowable Area and Height – Section 508.3.2

	Group M	Group A-2	Group B
Allowable Area (square feet)	29,700	19,800	29,700
Allowable Height (number of stories)	2	2	3

Result: Building is limited to 2 stories and 19,800 sf per story to comply with Nonseparated Occupancies method



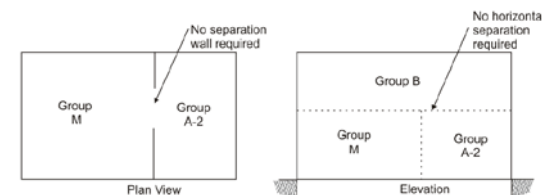
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Nonseparated Occupancies: Separations - Section 508.3.3

- Application of this option will result in no physical or fire-resistance-rated separation between the nonseparated occupancies.



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Nonseparated Occupancies Section 508.3.3, Exceptions

- Group H-2, H-3, H-4 and H-5 occupancies must be separated from all other occupancies per Section 508.4 (separated occupancies).
- Group I-1, R-1, R-2 and R-3 dwelling units and sleeping units must be separated from each other and from all other occupancies contiguous to them per Section 420.



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Nonseparated Occupancies: A Four-Step Process

1. Determine the occupancies present in the building.
2. Determine the maximum allowable height and area for each occupancy. Apply the most restrictive to the entire building.
3. Apply the most restrictive fire protection requirements of Chapter 9 to the entire building.
4. Apply all other code requirements to each portion of the building based on the occupancy classification of that portion.



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Nonseparated Occupancies: Applying the Process

- **Given:** A three-story, Type IIB building containing assembly, business and mercantile uses. The building is fully sprinklered and does not qualify for any frontage increase for allowable area purposes. Each story is 24,000 square feet in floor area.



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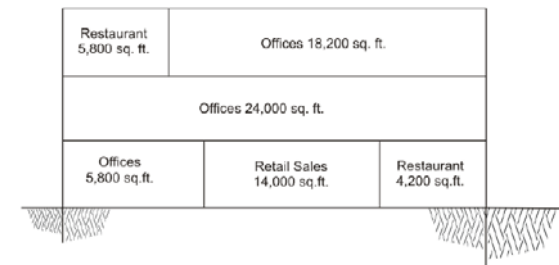
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Nonseparated Occupancies: Applying the Process

- **Determine:** Does the building comply with the nonseparated mixed occupancy option?



For SI: 1 square foot = 0.0929 m².

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FOR EXAMPLE

Nonseparated Occupancies: Applying the Process

- **Solution:**
 1. Determine the occupancies in the building.
Group A-2
Group B
Group M
 2. Determine the maximum allowable height and area for each occupancy. Apply the most restrictive to the entire building.
(see next slide)

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ACTIVITY

Nonseparated Occupancies: Applying the Process

	Group A-2	Group B	Group M
Allowable Height (number of stories)	3	4	3
Allowable Area per Story (square feet)	28,500	69,000	37,500
Allowable Building Area (square feet)	85,500	207,000	112,500

Building limited to:
3 stories
28,500 sf per story
85,500 sf per building

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ACTIVITY

Nonseparated Occupancies: Applying the Process

3. Apply the most restrictive fire protection requirements of Chapter 9 to the entire building.
 - **Building to be fully sprinklered due to Group A-2 occupancy located above the level of exit discharge.**
 - **Building to be provided throughout with manual fire alarm system due to more than 100 persons in Group B above the level of exit discharge.**
4. Apply all other code requirements to each portion of the building based on the occupancy classification of that portion.
Apply all other provisions based on the specific occupancy as applicable.

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ACTIVITY

Mixed Occupancies Practice 2

- **Given:** A two-story district fire station contains Group B, R-2 and S-1 occupancies as shown. The building is fully sprinklered, constructed of Type VB construction and has open frontage allowing for a 75-percent as redundant area increase.

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ACTIVITY

Mixed Occupancies Practice 2

- Determine:** Can the building be constructed under the nonseparated occupancies provisions for mixed-occupancy buildings?

Type VB Construction, Fire Station

For SI: 1 square foot = 0.0929 m².

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ACTIVITY

Solution

Classification of Occupancies	B – Offices R-2 – Dormitory S-1 – Vehicle Area
Identify maximum allowable height	Given: Type VB construction – fully sprinklered $R-2 - 2 + 1 = 3$ $S-1 - 1 + 1 = 2$ $B - 2 + 1 = 3$ Most restrictive is Group S-1 for 2 stories
Identify maximum allowable area	Given: Type VB; fully sprinklered; 75% increase for frontage From Table 503: $R-2 - 7,000$ square feet allowable $S-1 - 9,000$ square feet $B - 9,000$ square feet Group R-2 is the most restrictive tabular value Equation 5-1: $A_a = 21,000 + (0.75 \times 7,000)$ $A_a = 26,250$ sq. ft. per story allowed

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ACTIVITY

Solution

Verify most restrictive fire protection features	Given: Fully sprinklered. Fire Alarms: $R-2$ – Manual fire alarm – not required; smoke alarms required $S-1$ – No specific requirement B – Manual fire alarm where occupant load in excess of 500
Solution	Most restrictive provisions: $S-1$ – 2 stories maximum – complies $R-2$ – 26,250 sf maximum floor area – complies Fully sprinklered – complies Alarms – smoke alarms required Separation of $R-2$ from remainder of building by horizontal assembly required by Section 420

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Module 8

Separated Occupancies

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Separated Occupancies Overview

- “Separated occupancies” method uses a balanced approach to regulating mixed occupancy conditions.
- This method is typically applied where nonseparated occupancies method is impractical, undesirable or unavailable.
- Separated occupancies method to be applied where Group H-2, H-3, H-4 and H-5 occupancies are present.



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Separated Occupancies Section 508.4

- Separated occupancies is the only one of the three options where a fire-resistance-rated occupancy separation is required under mixed-occupancy conditions.
- Table 508.4 is referenced to determine the degree of fire resistance that is mandated for separations.
- Separations may not be required where occupancies are considered to be of same level of hazard.



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Separated Occupancies Section 508.4.1

- Where occupancy separations (fire barriers and/or horizontal assemblies) also define the limits of any fire areas as established in Chapter 9 for requiring an automatic sprinkler system, the provisions of Section 901.7 and Table 707.3.10 shall also comply.

TABLE 707.3.10
FIRE-RESISTANCE RATING REQUIREMENTS FOR
FIRE BARRIERS, FIRE WALLS 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



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Separated Occupancies Section 508.4.1

- This approach also differs from the other options regarding fire protection requirements:
 - The fire protection requirements of Chapter 9 are to be applied individually in each portion of the building based on the occupancies in each portion.
 - Where nonfire-barrier-separated occupancies are permitted by Table 508.4, the most restrictive provisions of Chapter 9 that apply to the separated occupancies shall apply to the total nonfire-barrier-separated occupancy areas.



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KEY LEARNING

Separated Occupancies Sections 508.4.2 and 508.4.3

- In addition, this approach differs from the other options regarding allowable height and area:
 - The allowable height for each occupancy within the building is based on Section 503.1.
 - The allowable area of the building is based on the sum of the ratios where the actual floor area of each occupancy divided by the allowable floor area of each occupancy is not to exceed 1.0 (unity formula).

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Separated Occupancies: Occupancy Classifications – Section 508.4.1

- This option requires that the occupancies be classified individually based on their specific functions.
- Requirements for means of egress, automatic sprinkler systems, fire alarm systems, plumbing facilities and all other provisions are to be applied individually to the various occupancies in the building.

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Separated Occupancies: Occupancy Classifications - Section 508.4.1

Fully Sprinklered Building

Group A-2 Restaurant

Group M Retail Sales

- Group A-2 portion to be regulated by Group A-2 requirements.
- Group M portion to be regulated by Group M requirements.

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Separated Occupancies: Allowable Area - Section 508.4.2

- When a mixed-occupancy building is regulated under the provisions of Section 508.4 for separated occupancies, the unity formula is used in the determination of allowable area.
- Compliance for allowable area can only be achieved where the sum of the ratios of actual floor area divided by allowable floor areas for each of the occupancies involved does not exceed 1.

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Separated Occupancies: Allowable Area - Section 508.4.2

- The formula can be expressed as:

$$a_1/A_1 + a_2/A_2 + a_3/A_3 + \dots \leq 1.0$$

- a_1 , a_2 and a_3 represent the actual floor areas for the individual occupancies.
- A_1 , A_2 and A_3 represent the maximum allowable areas for the same respective occupancies.
- Calculation applied regardless of any required separation.
- Applicable frontage increase for entire building applied to each of the occupancies.
- Sprinkler increase applied on a "per occupancy" basis.



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Separated Occupancies: Allowable Area - Section 508.4.2

- Given:** A one-story, 78,000-square-foot, fully sprinklered building with three occupancy groups as shown. The building is of Type IIB construction and adjoins two public ways that qualify for a 25-percent frontage increase.
- Determine:** Does the building comply with the allowable area limitations based on separated occupancies?

$$a_B/A_B + a_M/A_M + a_{A-2}/A_{A-2} \leq 1.0 ?$$



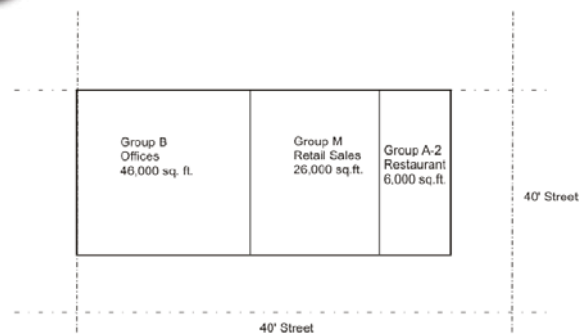
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Separated Occupancies: Allowable Area - Section 508.4.2

For SI: 1 square foot = 0.0929 m².

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Separated Occupancies: Allowable Area - Section 508.4.2

- Solution:**

$$a_B = 46,000 \quad A_B = 92,000 + 0.25(23,000) = 97,750$$

$$a_M = 26,000 \quad A_M = 50,000 + 0.25(12,500) = 53,125$$

$$a_{A-2} = 6,000 \quad A_{A-2} = 38,000 + 0.25(9,500) = 40,375$$

$$\frac{46,000}{97,750} + \frac{26,000}{53,125} + \frac{6,000}{40,375} \leq 1.0 ??$$

$$0.47 + 0.49 + 0.15 = 1.11 > 1.0$$

Conclusion: Building area exceeds allowable area as shown



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Separated Occupancies: Allowable Height - Section 508.4.3

- Each individual occupancy in a multiple-story, mixed-occupancy building is regulated for height independently based on Section 503.1.
- Maximum height for each occupancy is limited by the type of construction in Section 503.1.
 - Measured from the grade plane.
 - If a building has an automatic sprinkler system, an increase of one story and 20 feet is selectively available as reflected in Tables 504.3 and 504.4.
- Based on type of construction.

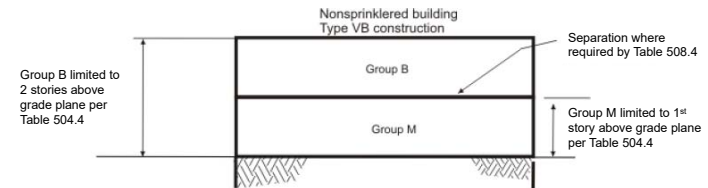


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Separated Occupancies: Allowable Height - Section 508.4.3

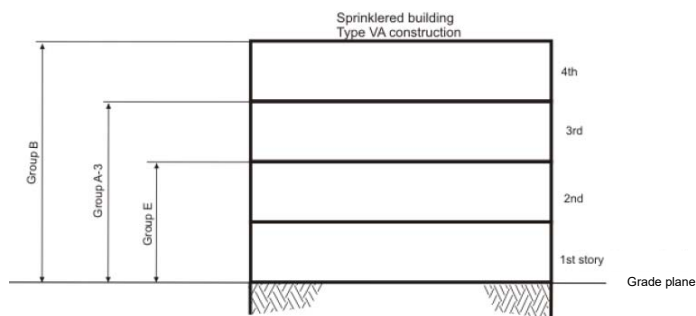


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Separated Occupancies: Allowable Height - Section 508.4.3



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Separated Occupancies: Separations – Section 508.4.4


- The requirements for a fire-resistance-rated separation between adjacent occupancies vary.
- The requirements are established in Table 508.4.
- Fire barriers and horizontal assemblies are to be utilized in the complete separation of adjacent occupancies with different levels of hazard.
- Table 508.4 allows for some occupancy pairs to be adjacent with no required fire-resistive or physical separation.



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REFER TO

CODE BOOK


Separated Occupancies: Separations – Section 508.4.4

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

OCCUPANCY	A, E	S-1, I-3, I-4	I-2	R*	F-2, S-2, U	B*, F-1, M, S-1	H-1	H-2	H-3, H-4	H-5
A, E	N	N	1	2	NP	1	2	N	1	2
I-1, I-3, I-4	—	N	N	2	NP	1	NP	1	2	1
I-2	—	—	N	N	2	NP	2	NP	2	NP
R*	—	—	—	—	N	N	1*	2*	1	2
F-2, S-2, U	—	—	—	—	N	N	1	2	NP	NP
B*, F-1, M, S-1	—	—	—	—	—	N	N	NP	NP	2
H-1	—	—	—	—	—	—	N	NP	NP	NP
H-2	—	—	—	—	—	—	—	N	NP	1
H-3, H-4	—	—	—	—	—	—	—	—	NP	1
H-5	—	—	—	—	—	—	—	—	—	N

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. See Section 420.
 b. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but not to less than 1 hour.
 c. See Section 406.3.2.
 d. Separation is not required between occupancies of the same classification.
 e. See Section 422.2 for ambulatory care facilities.
 f. Occupancy separations that serve to define fire area limits established in Chapter 9 for requiring fire protection systems shall also comply with Section 707.3.10 and Table 707.3.10 in accordance with Section 901.7.


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KEY LEARNING


Separated Occupancies: A Five-Step Process

1. Determine the various occupancies that occur within the building.
2. Determine the minimum required fire-resistance rating between adjacent occupancies.
3. Verify that the building does not exceed the maximum allowable area for the type of construction involved.
4. Verify that the locations of the occupancies do not exceed their maximum allowable height based on the building's type of construction.
5. Apply all other code requirements to each portion of the building based on the occupancy of that portion.


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FOR EXAMPLE


Separated Occupancies: Applying the Process

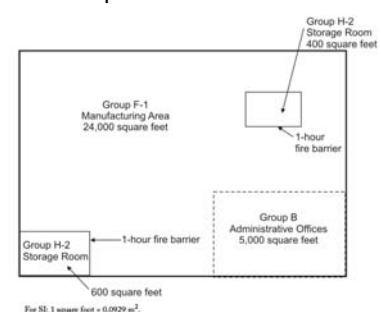
- **Given:** A 30,000-square-foot, one-story building of Type VB construction contains offices, manufacturing operations and flammable gas storage rooms (Group H-2) as shown on the following slide. The building is fully sprinklered and qualifies for a 50-percent allowable area increase for frontage. There is no fire-resistant separation between the office area and the manufacturing area. 1-hour fire barriers separate the hazardous storage rooms from other areas of the building.

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FOR EXAMPLE


Separated Occupancies: Applying the Process

- **Determine:** Does the building comply with the provisions for separated occupancies?



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FOR EXAMPLE

Separated Occupancies: Applying the Process

■ Solution:

- Determine the various occupancies that occur within the building.

Offices	Group B
Manufacturing Area	Group F-1
Flammable Gas Storage Rooms	Group H-2

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FOR EXAMPLE

Separated Occupancies: Applying the Process

- Determine the minimum required fire-resistance rating between adjacent occupancies.

F-1/H-2	2 hours (only 1-hour shown)
B/F-1	no separation required
B/H-2	not applicable

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FOR EXAMPLE

Separated Occupancies: Applying the Process

- Verify that the building does not exceed the maximum allowable area for the type of construction involved.

(see analysis on next slide)

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FOR EXAMPLE

Separated Occupancies: Applying the Process

$$\frac{a_{F-1}}{A_{F-1}} + \frac{a_B}{A_B} + \frac{a_{H-2}}{A_{H-2}} \leq 1.0?$$

$a_{F-1} = 24,000$	$A_{H-2} = 3,000$ T506.2
$a_B = 5,000$	$+ 1,500$ Frontage
$a_{H-2} = 1,000$	$= 4,500$ Total Allowable

$A_{F-1} = 34,000$ T506.2	$A_B = 36,000$ T506.2
$+ 4,250$ Frontage	$+ 4,500$ Frontage
$= 38,250$ Total Allowable	$= 40,500$ Total Allowable

$$\frac{24,000}{38,250} + \frac{5,000}{40,500} + \frac{1,000}{4,500} \leq 1.0?$$

$$0.63 + 0.12 + 0.22 = 0.97 < 1.0 \quad \text{OK}$$

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FOR EXAMPLE

Separated Occupancies: Applying the Process

- Verify that the location of the occupancies do not exceed their maximum allowable height based on the building's type of construction.
All one-story buildings comply.
- Apply all other code requirements to each portion of the building based on the occupancy of that portion.
Applicable provisions to be applied based on the specific occupancy involved.

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ACTIVITY

Mixed Occupancies Practice 3

- Given:** A one-story, multiple-tenant retail center containing Group A-2, A-3, B and M occupancies as shown. The 52,000-square-foot building is fully sprinklered, of Type IIB construction and has adequate frontage for a 60-percent allowable area increase.

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ACTIVITY

Mixed Occupancies Practice 3

- Determine:** Does this building comply with Section 508.4 for separated occupancies?

Type IIB construction
Fully sprinklered, Retail Center

Group A-2 6,000 square feet	Group M 10,000 square feet	Group M 10,000 square feet	Group B 10,000 square feet	Group A-3 10,000 square feet
Group A-2 6,000 square feet				

For SI: 1 square foot = 0.0929 m². One-hour fire barriers provide separation between all tenant spaces

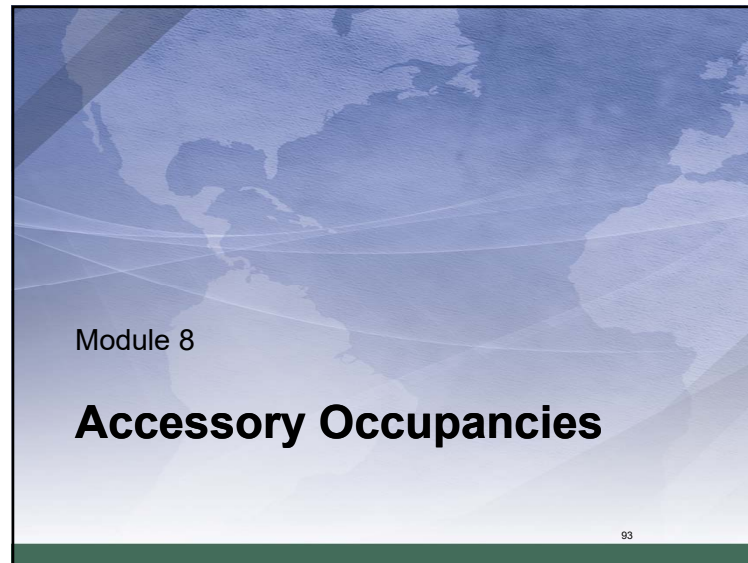
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ACTIVITY

Mixed Occupancies Practice 3 Solution

Minimum occupancy separation	Since building is fully sprinklered: A-2 /A-2 none required A-2 /M: 1-hour M/M: none required M/B: none required B/A-3 1-hour All OK
Allowable Height	Building is single story. OK
Allowable Area	A-2: 38,000 + 5,700 = 43,700 sf A-3: same as A-2 B: 92,000 + 13,800 = 105,800 sf M: 50,000 + 7,500 = 57,500 sf 12,000/43,700 + 10,000/43,700 + 10,000/105,800 + 20,000/57,500 ≤ 1 0.27 + 0.23 + 0.09 + 0.35 = 0.94 OK

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Accessory Occupancies Overview

- “Accessory occupancies” method is only applicable where support occupancies are relatively small compared to major occupancy.
- This method beneficial to designer due to:
 - No requirement to separate accessory occupancies from major occupancy.
 - In determination of allowable building area, allowable area based considering accessory occupancy as part of major occupancy.
- Accessory occupancies method has limited application.



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A circular icon with a padlock and the words "KEY LEARNING" around it.

Accessory Occupancies Section 508.2

- Must be subsidiary to the main occupancy of the building or to a portion of the building.
 - Examples of occupancies that may be considered as subsidiary to the main occupancy:
 - Group A-2 employee lunchroom within a Group S-1 warehouse.
 - Group A-3 training room in a Group B office building.
 - Group M showroom within a Group F-1 manufacturing building.
 - Group R-3 manager's dwelling unit within a Group S-1 self-storage facility.



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Accessory Occupancies: Occupancy Classification - Section 508.2.1

- Must be assigned to an occupancy group established in Chapter 3 based on unique characteristics.
- The spaces of the building considered as accessory occupancies must meet all code requirements applicable to the specific to the accessory occupancy classification, not that of the main occupancy, including:
 - Means of egress requirements.
 - Fire protection requirements.



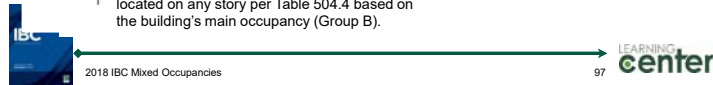
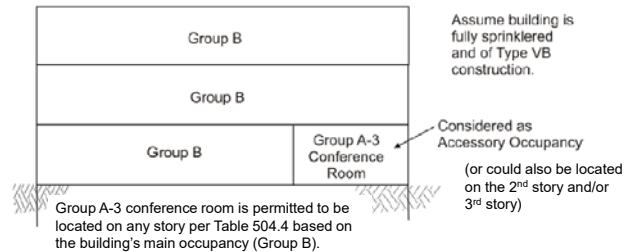
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Accessory Occupancies: Allowable Building Height - Section 508.2.2

- Allowable height and number of stories are limited to that set forth in Section 504 for the main occupancy.

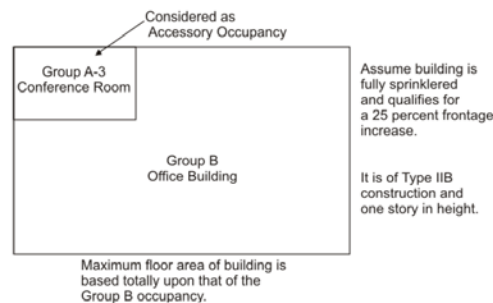


Accessory Occupancies: Allowable Building Area - Section 508.2.3

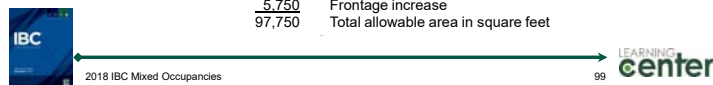
- Allowable area of building is based on the main occupancy.
- Combined area of the main occupancy and accessory occupancy cannot exceed that permitted by Section 503.1 for the main occupancy.



Accessory Occupancies: Allowable Building Area-Section 508.2.3



92,000	Table 506.2
5,750	Frontage increase
97,750	Total allowable area in square feet



Accessory Occupancies: Allowable Building Area - Section 508.2.3

- Limited to 10 percent of the floor area of the story located.
 - When more than one accessory occupancy is under consideration, the aggregate area of such occupancies are used to determine compliance.
- Floor area cannot exceed the tabular values for nonsprinklered buildings established by Table 506.2 for each accessory occupancy.



FOR EXAMPLE

Accessory Occupancy Example

- Showroom is considered subsidiary to manufacturing operation.
- Showroom occupies 6% of total story area.
- Showroom does not exceed tabular area for Group M, Type IIB construction (12,500 sq. ft.).

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Accessory Occupancies: Separation - Section 508.2.4

- Application of the accessory occupancy option will result in no physical or fire-resistance-rated separation being mandated.

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Accessory Occupancies: Section 508.2.4, Exceptions

- Group H-2, H-3, H-4 and H-5 occupancies to be separated from all other occupancies per Section 508.4 (separated occupancies).
- Group I-1, R-1, R-2 and R-3 dwelling units and sleeping units to be separated from each other and from accessory occupancies contiguous to them per Section 420.

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KEY LEARNING

Accessory Occupancies: A Seven-Step Process

- Determine the various occupancy classifications that are found within the building.
- Verify that any occupancy group under consideration as an accessory occupancy is subsidiary to the major occupancy of the building.
- Verify that the floor area of the accessory occupancy does not exceed 10 percent of the floor area of the story in which it is located.

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KEY LEARNING

Accessory Occupancies: A Seven-Step Process

- Verify that the floor area of the accessory occupancy does not exceed the tabular values for nonsprinklered buildings set forth in Table 506.2 for the building's type of construction.
- Limit the building's floor area to the allowable floor area based on the allowable area for the main occupancy.

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KEY LEARNING

Accessory Occupancies: A Seven-Step Process

- Limit the maximum allowable height of the occupancy based on Section 504.
- Apply all other code requirements to each portion of the building based on the individual occupancy classification of the space.

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FOR EXAMPLE

Accessory Occupancies: Applying the Process

- Given:** A four-story office building with a large meeting room (occupant load of 78) on the second floor. The building is fully sprinklered; is Type IIB construction and qualifies for a 75 percent frontage increase for allowable area. Each story of the building contains 45,000 square feet and the floor area of the meeting room is 1,170 square feet. It is intended that no fire-resistant occupancy separation be provided between the meeting room and the remainder of the building.

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FOR EXAMPLE

Accessory Occupancies: Applying the Process

- Determine:** Do the mixed-occupancy conditions comply with the requirements for accessory occupancies?

Elevation

2nd Floor Plan

For SI: 1 square foot = 0.0929 m²

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Accessory Occupancies: Applying the Process

■ Solution:

1. Determine the various occupancy classifications that are found within the building.

Offices: Group B
Meeting Room: Group A-3

2. Verify that any occupancy group under consideration as an accessory occupancy is subsidiary to the occupancy of the building.

The meeting room use is directly related to the function of the office environment.



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Accessory Occupancies: Applying the Process

3. Verify that the floor area of the accessory occupancy does not exceed 10 percent of the floor area of the story in which it is located.

Floor area of meeting room is 1,170 square feet, approximately 3 percent of the floor area of the 2nd story.



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Accessory Occupancies: Applying the Process

4. Verify that the floor area of the accessory occupancy does not exceed the tabular floor area (without area increases of Section 506) set forth in Table 503 for the building's type of construction.

Floor area of 1,170 square feet does not exceed tabular area of 9,500 square feet for Group A-3 in Type IIB construction



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Accessory Occupancies: Applying the Process

5. Limit the building's floor area to the allowable floor area based on the allowable area for the main occupancy.

Tabular area	69,000 sf	Based on all Group B
Frontage increase	<u>17,250 sf</u>	75% increase
Total per story	86,250 sf	
Total for building	258,000 sf	3x allowable/story



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Accessory Occupancies: Applying the Process

6. Limit the maximum allowable height of the accessory occupancy based on Section 504.
Group A-2 occupancy limited to 1st, 2nd and/or 3rd stories.
7. Apply all other code requirements to each portion of the building based on the individual occupancy classification of the space.
Means of egress, fire protection and other requirements based on individual occupancies.



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Practice Exercise 1

- **Given:** A 10,250-square-foot, single-story musical instrument manufacturing building with storage room and offices. The storage room is 700 square feet. The offices are 300 square feet. The building is not sprinklered, but has open frontage allowing 25-percent increase in allowable area. The building is of Type VB construction.



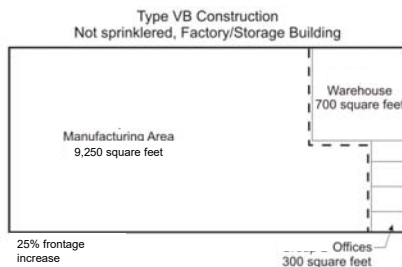
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Practice Exercise 1

- **Determine:** Do the mixed occupancy conditions comply with the requirements for accessory occupancies?



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Solution

Classification of occupancies	Groups: F-1 manufacturing S-2 storage B offices
Verify accessory occupancies are subsidiary to major occupancy.	Storage is used for holding materials used in the manufacturing process as well as the finished instruments. The offices are for managers, human resources staff, accounting and payroll staff.
Verify accessory occupancies do not exceed 10 percent of floor area.	Storage – 700 sq. ft. – Less than 10% Offices – 300 sq. ft. – Less than 10% Aggregate of accessory areas – 1,000 square feet Maximum allowed accessory area is 10% of 10,250 square feet = 1,025 square feet



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ACTIVITY

Solution

Verify accessory occupancies do not exceed tabular area per Table 503	Group B – 9,000 sq. ft. Group S-1 – 9,000 sq. ft.
Limit floor area to maximum allowable floor area of building based on main use	Principal use: Group F-1 Allowable area for Type VB building of Group F-1 8,500 sq. ft. (Table 503) 25% increase for frontage: 2,125 sq. ft. Maximum allowable building area: 8,500 + 2,125 = 10,625 sq. ft.
Limit allowable height of accessory occupancies to that of Section 503	Allowed height for Type VB buildings: Group B – 2 stories Group S-1 – 1 story
Apply all other code provisions	As applicable.

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Module 9

Allowable Height and Area for Multiple-story Buildings

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Mixed Occupancies: Allowable Height and Area for Multistory Buildings

- Application of Section 508 for mixed-occupancy is consistent for both single-story and multiple-story buildings.
- Multiple-story, mixed-occupancy building:
 - All three options available.
 - Evaluation of the mixed-occupancy conditions is expanded.
 - Each story evaluated individually for compliance.

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Nonseparated Occupancies

- The maximum allowable height and area of the building will be based on the most restrictive allowances for the occupancies under consideration.
- General height and area limitations of Chapter 5 will apply.



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Separated Occupancies

- An occupancy shall not be located higher than permitted by Tables 504.3 and 504.4.
- A variation of the unity formula of Section 508.4.2 that is applied on a per-story basis is applied to the total building.



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Separated Occupancies Section 506.2.4

- Where “separated occupancies” building is 3 stories or less in height, if each story complies, then the building complies.
- Where “separated occupancies” building is 4 or more stories in height, then each story must comply for allowable area and entire building must comply.
 - Sum of ratios for all stories above grade plane not to exceed 3.0.



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Separated Occupancies

- **Given:** A fully sprinklered, four-story, Type IIA hotel, containing a Group A-2 restaurant, Group A-3 meeting rooms and Group M retail stores. The floor areas of each occupancy are as shown in the following slide. Inadequate frontage provides for no area increase.
- **Determine:** Does the building comply with the allowable height and area provisions of Chapter 5 using the “separated occupancies” method?



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Separated Occupancies

A-2 8,000 square feet	R-1 38,000 square feet	
R-1 46,000 square feet		
R-1 46,000 square feet		
A-3 24,000 square feet	R-1 8,000 square feet	M 14,000 square feet

Occupancy to be located no higher than allowed by Tables 504.3 and 504.4

Occupancy to be located no higher than allowed by Tables 504.3 and 504.4

For SI: 1 square foot = 0.0929 m².



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FOR EXAMPLE

Separated Occupancies

Height Limitations:
 Groups A-2 and A-3 3+1 4 stories max.
 Groups R-1 and M 4+1 5 stories max.
 Height limits are not exceeded.

Solution for Total Building Area:

Allowable Area per Occupancy	Allowable Area per Occupancy Based on Table 506.2
A-2: 8,000 sf	A-2: 46,500 sf
A-3: 24,000 sf	A-3: 46,500 sf
M: 14,000 sf	M: 64,500 sf
R-1: 138,000 sf	R-1: 72,000 sf

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FOR EXAMPLE

Separated Occupancies

1st story $24,000/46,500 + 8,000/72,000 + 14,000/64,500 = 0.85$ OK
 2nd story $46,000/72,000 = 0.64$ OK
 3rd story $46,000/72,000 = 0.64$ OK
 4th story $8,000/46,500 + 38,000/72,000 = 0.70$ OK
 Aggregate for building $0.85 + 0.64 + 0.64 + 0.70 = 2.83 < 3$ OK

Note: Each floor is analyzed for compliance on a floor-by-floor basis, plus the building as a whole must also comply.

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Module 10

Miscellaneous Applications

IBC 127

Discussion Points and Review

- How are two or all of the mixed-occupancy methods applied within the same building?
- If one of two separated occupancies requires the installation of automatic sprinklers, does the other occupancy have to be provided with sprinklers?
- If an accessory occupancy requires sprinklers, can the system just cover the accessory occupancy?

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Discussion Points

- Can the means of egress pathway continue across a fire barrier separating different occupancies?
 - If it can, do the requirements for the means of egress pathway change?
- How do the provisions for accessory occupancies apply where there are multiple tenant spaces?
- Do mixed occupancy provisions of Section 508 apply to unlimited area buildings in Section 507?



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Multiple Options Used in a Single Building – Section 508.1

- Section 508.1 allows four combinations:
 1. Accessory and nonseparated occupancies.
 2. Accessory and separated occupancies.
 3. Nonseparated and separated occupancies.
 4. All three options in the same building.



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Section 901.7 – Fire Areas

- Based on time-tested approach to limiting the spread of fire in a building.
 - Created through use of fire walls, fire barriers and/or horizontal assemblies.
 - Limited to alternative approach to automatic sprinkler system requirements.
 - Where two occupancies are separated under the separated occupancies method of Section 508.4, fire areas may not necessarily be created in regard to the provisions of Chapter 9.



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Fire Areas: Section 901.7

- Fire-resistance rating of fire barriers creating fire areas based on Table 707.3.10.
- Fire-resistance rating of fire barriers used to separate occupancies based on Table 508.4.
- Where both conditions occur, the higher of the two required fire-resistance ratings to be applied.
- For example, where Table 707.3.10 requires greater fire-resistance than Table 508.4, complying with Table 508.4 will not establish separate fire areas.

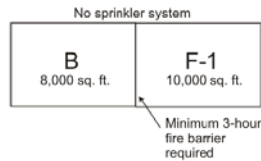


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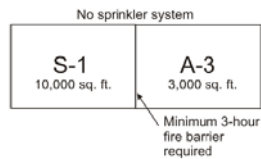


Fire Areas Section 901.7



- Occupancy separation not required per separated occupancies and Table 508.4.

- Fire area separation of 3 hours required by Section 903.2.4 and Table 707.3.10.



- Occupancy separation of 2 hours required per separated occupancies and Table 508.4.

- Fire area separation of 3 hours required by Sections 903.2.1.3 and 903.2.9 and Table 707.3.10.



For SI: 1 square foot = 0.0929 m².

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Means of Egress Chapter 10

- Can the means of egress (MOE) path for one occupancy travel through other occupancies in the building?
 - Yes, Section 1016.2 anticipates this to a great extent.
- Where the MOE path travels from one occupancy to another, which occupancy's egress requirements prevail?
 - The requirements for both occupancies should be applied, which typically results in the application of the most stringent provisions.



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Means of Egress Chapter 10

- Common occupancy-related MOE requirements:
 - Occupant load factor (function based) – Table 1004.5.
 - Common path of travel – Section 1006.2.1.
 - Threshold for two means of egress – Section 1006.2.1.
 - Single-exit stories – Section 1006.3.3.
 - Panic hardware – Section 1010.1.10.
 - Travel distance – Section 1017.2.
 - Corridor construction – Section 1020.1.



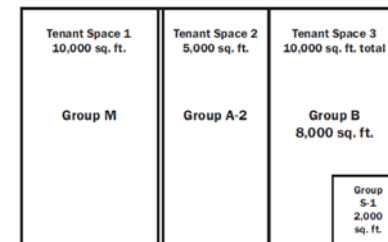
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Accessory Occupancies and Tenant Spaces

- Accessory occupancy provisions to be applied on a tenant-by-tenant basis.



For SI: 1 square foot = 0.0929 m².

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Unlimited Area Buildings (UAB) Section 507

- Unlimited area buildings permitted under the provisions of Section 507 may contain the occupancies and configurations specified in Sections 507.1 through 507.12.
 - Other occupancies are permitted in unlimited area buildings when in compliance with the provisions of Section 508.2 (Accessory Occupancies).
- Any or all of the mixed occupancy methods are permitted subject to the limitations of Section 508.



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Practice Exercise 4

- Given:** A fully-sprinklered, five-story hotel of Type IIA construction contains the following occupancies located as shown:
- First story:** Lobby (Group A-3), Restaurant (Group A-2), Administrative offices (Group B), Retail sales tenants (Group M) and Hotel guest rooms (Group R-1)
- Second story:** Meeting/Conference rooms (Group A-3) and Hotel guest rooms (Group R-1)
- Third and fifth stories:** Hotel guest rooms (Group R-1)
- Fourth story:** Restaurant (Group A-3) and Hotel guest rooms (Group R-1)



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Practice Exercise 4

- The floor areas of each occupancy are as indicated. Other than a 1-hour fire-resistant separation of the hotel guest room portion, no fire-resistant separations are provided between occupancies on the first floor. Streets on two sides provide for a 25-percent frontage increase for allowable area.
- Determine:** Does the building below comply with the provisions of Section 508.1 regulating mixed-occupancy buildings?



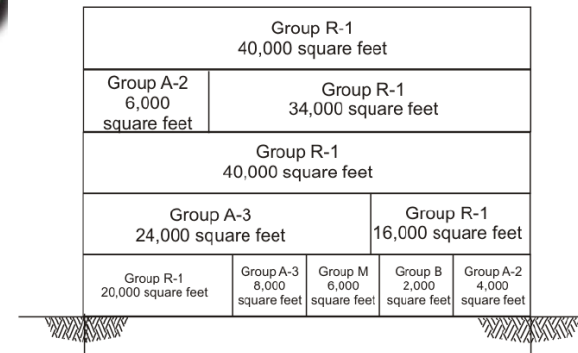
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Type IIA Construction Fully sprinklered NFPA 13

For SI: 1 square foot = 0.0929 m².

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ACTIVITY

Practice 4 Solution

Nonseparated Occupancies	This method may not be used for the entire building as Group A-2 limits building height to four stories. It may be utilized on the first story without applying to other stories.
Fire Protection	The building is fully sprinklered and has a fire alarm system in accordance with Section 907.2.8.
Allowable Height	Four-story limitation based on Group A-2 is not met for building.
Allowable Area	Groups A-2 and A-3 have the most restrictive allowance of 50,375 square feet (46,500 + 3,875). Since the aggregate building area of all stories is 200,000 square feet (40,000 times five stories) which exceeds the allowable building area of 151,125 square feet (three times 50,375), the building is not in compliance for allowable area.

Building does not comply. Both the allowable height and allowable area provisions must be in compliance, and neither complies.

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ACTIVITY

Practice 4 Solution

Separated Occupancies	This method is used throughout the building except for the non-Group-1 portion of the 1 st story. There is a minimum 1-hour fire-resistant separation required between the Group R-1 occupancy and all other occupancy groups. The required 1-hour separation is already provided horizontally due to the 1-hour floor construction required in a Type IIA building.
Separation per Table 508.4	
Allowable Height	Group R-1 occupancies are not permitted above the fifth story. Group A-2 and A-3 occupancies shall not be located above the fourth story.
Allowable Area	For allowable area purposes based on individual stories, the various occupancies on the first story, other than the Group R-1, will be evaluated under the nonseparated occupancies provisions of Section 508.3. Stories two through five, as well as the Group R-1 portions of the 1 st story, will be evaluated as separated occupancies in accordance with Section 508.4.

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ACTIVITY

Practice 4 Solution

Allowable Area per Occupancy:

- A-2 50,375 square feet
- A-3: 50,375 square feet
- B: 121,875 square feet
- M: 69,875 square feet
- R-1: 78,000 square feet

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ACTIVITY

Practice 4 Solution

Allowable Area per Occupancy:

- 1st story*
 $20,000/50,375 + 20,000/78,000 = 0.66$ **OK**

*All portions of first story other than Group R-1 regulated as nonseparated occupancies, limited by allowable areas of Group A-2/A-3 occupancies. As a whole including the Group R-2 portion, first story then regulated as separated occupancies.

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ACTIVITY

Practice 4 Solution

Allowable Area per Occupancy:

- 2nd story
 $24,000/50,375 + 16,000/78,000 = 0.69$ **OK**
- 3rd story
 $40,000/78,000 = 0.51$ **OK**
- 4th story
 $6,000/50,375 + 34,000/78,000 = 0.56$ **OK**

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ACTIVITY

Practice 4 Solution

Allowable Area per Occupancy:

- 5th story
 $40,000/78,000 = 0.51$ **OK**
- All stories
 $0.66 + 0.69 + 0.51 + 0.56 + 0.51 = 2.93$
 ≤ 3 **OK**

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FINAL REFLECTION

Final Reflection

- What?** What happened and what was observed in the training?
- So what?** What did you learn? What difference did this training make?
- Now what?** How will you do things differently back on the job as a result of this training?

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