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### Course Description

- This seminar addresses the key issues of the 2015 *International Building Code*® (IBC®) Chapter 5 regarding the determination of a building’s allowable height and area.
- The process for correctly evaluating a building for allowable height and area relies on a systematic approach, including the determination of occupancy classification and construction type.



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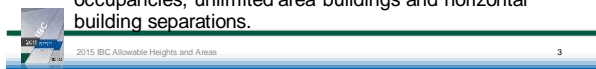
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### Objectives

- Upon completion, participants will be better able to:
1. Describe the purpose for regulating a building’s allowable height and area.
  2. Identify the relationship of a building’s occupancy classification(s) and type of construction to a building’s allowable height and area.
  3. Determine how a building’s **actual** height, both in stories above grade plane and feet, and floor area are calculated.
  4. Determine how a building’s **allowable** height, both in stories above grade plane and feet, and floor area are determined.
  5. Apply the special provisions applicable to mixed occupancies, unlimited area buildings and horizontal building separations.



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## Course Overview

- Module 1 – Concept of Allowable Heights and Areas
- Module 2 – Relationship of Building Classification
- Module 3 – Calculation of Actual Building Height and Area
- Module 4 – Special Building Height and Area Provisions
- Module 5 – Determining Maximum Allowable Building Height
- Module 6 – Determining Maximum Allowable Building Area
- Module 7 – Additional Limitations and Allowances



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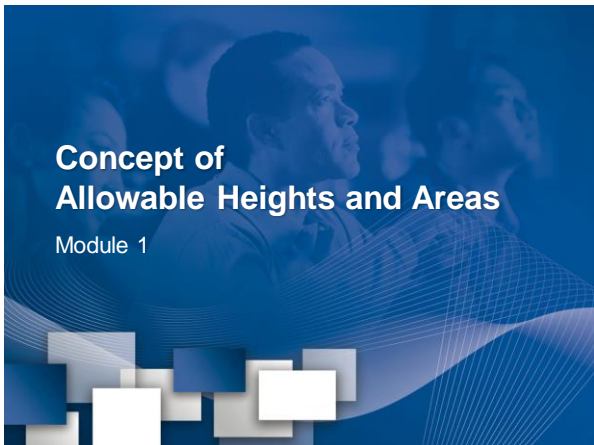
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## Allowable Height and Area Introduction

- After determining a building's occupancy and identifying the proposed type of construction, the next step in the classification process is to verify compliance with the height and area limitations.
- Building occupancy, building type of construction and allowable building height and area must simultaneously be considered in order to achieve code compliance.



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## Allowable Height and Area Introduction

- As the size of the building increases, either in height or area, the number of acceptable construction types is reduced.
- Conversely, where a higher type of construction is provided, the building size may be increased.



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## Tabular Height and Area Values Tables 504.3, 504.4 and 506.2

- Tables 504.3, 504.4 and 506.2 are the foremost code provisions used in establishing “equivalent risk”—offsetting a building’s inherent fire hazard—represented by group—with materials and construction features.



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### Allowable Height in Feet Table 504.3

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION									
		TYPE I		TYPE II		TYPE III		TYPE IV		TYPE V	
		A	B	A	B	A	B	A	B	A	B
A, B, E, F, M, S, U	NS <sup>a</sup>	UL	160	65	55	65	55	65	65	50	40
	S	UL	180	85	75	85	75	85	70	60	
H-1, H-2, H-3, H-5	NS <sup>a</sup>	UL	160	65	55	65	55	65	65	50	40
	S	UL	180	85	75	85	75	85	70	60	
H-4	NS <sup>a</sup>	UL	160	65	55	65	55	65	65	50	40
	S	UL	180	85	75	85	75	85	70	60	
I-1 Condition 1, I-3	NS <sup>a</sup>	UL	160	65	55	65	55	65	65	50	40
	S	UL	180	85	75	85	75	85	70	60	
I-1 Condition 2, I-2	NS <sup>b,c</sup>	UL	160	65	55	65	55	65	65	50	40
	S	UL	180	85							
I-4	NS <sup>a</sup>	UL	160	65	55	65	55	65	65	50	40
	S	UL	180	85	75	85	75	85	70	60	
R	NS <sup>b</sup>	UL	160	65	55	65	55	65	65	50	40
	S13R	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	85	70	60	

Foot 3: 1 foot = 304.8 mm.  
 Note: UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2.

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### Allowable Height and Area Modifications to Tables 504.3, 504.4 and 506.2

The tables regulating allowable height and area generally provide for sizeable increases where the building is sprinklered throughout.

- The sprinkler increase to allowable area is one of the most generous benefits for fully sprinklered buildings.
- Sprinkler increases for height in feet and number of stories also provide a significant benefit in the determination allowable construction types.



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### Allowable Height and Area Modifications to Table 503

A more comprehensive review is necessary when the building:

- Has sizable frontage
- Is multistory
- Contains multiple occupancies
- Has one or more fire walls
- Contains one or more mezzanines
- Has an occupied roof
- Is separated by a Section 509 horizontal separation
- Complies with Section 507 for unlimited area buildings
- Is located on a site with additional buildings



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## Relationship of Building Classification

Module 2



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### Building Classification

It is critical that a building be classified according to the *occupancy group* and the anticipated *type of construction* prior to determining the building's allowable height and area.

The maximum building size is based on the specific occupancy groups within the building, as well as the materials of construction and the building's degree of fire resistance.



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### Occupancy Classification Section 302.1

#### Occupancy Groups

- Structures are to be classified into one or more of the occupancy classifications established in the code.
- The 10 general types are subdivided into 26 specific occupancies.



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### Occupancy Classification Section 302.1

- Where a room or space is to be occupied for different types of uses at different times, all of the requirements applicable to each of the uses must be considered.
- Those buildings that contain two or more distinct occupancy classifications must comply with the provisions of Section 508 for mixed-occupancy buildings.



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### Type of Construction Section 602.1

- A building must be classified as a single type of construction only.
- Unlike mixed-occupancy conditions where multiple uses occur, the type of construction must be established based on full compliance with the minimum requirements for the intended construction type.



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### Type of Construction Section 602.1

- The designer selects one of the 9 construction types that will be in conformance with the requirements of the code, based primarily on the building's anticipated height and area.
  - The design decision is based on a variety of factors, but ultimately the construction type chosen must comply with the code.
- The plan reviewer then verifies that the type of construction chosen by the designer is permitted.



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### Type of Construction Section 602

Type of Construction		Materials of Construction
I	IA IB	Exterior and interior walls, floors, roof and structural elements to be of noncombustible materials.
II	IIA IIB	Exterior walls to be of noncombustible materials.
III	IIIA IIIB	
IV	H,T	Interior elements permitted to be of combustible materials.
V	VA VB	Combustible materials permitted throughout.

NOTE: The classification of the building for construction type is based on the elements of the building itself and not on what minimum type of construction is permitted due to its height and area.



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### Actual Building Height and Area Introduction

- The IBC establishes a specific approach to establishing a building's actual:
  - Height in feet
  - Height in stories above grade plane
  - Floor area
- This determination may not necessarily be consistent with the height and area established by zoning regulations, real estate terminology, and other uses.



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### General Building Height Limitations Section 503

- The height of a building is limited to that established by Tables 504.3 and 504.4.
- Before calculating the maximum allowable height (in both feet and stories above grade plane), it is necessary to determine the actual height of the building.



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### Building Height (in feet) Section 202

- **Building height (in feet):** Defined as the vertical distance from grade plane to the average height of the highest roof surface.
- Average height for a sloping roof is the midway point between the extremes of the sloping roof.
- Grade plane is established by definition as the average of finished ground level adjoining the building.



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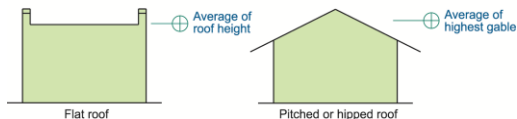
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## Building Height Section 202

- Building height is not measured to the top of a parapet wall.

Height of building is the vertical distance above grade plane measured to:



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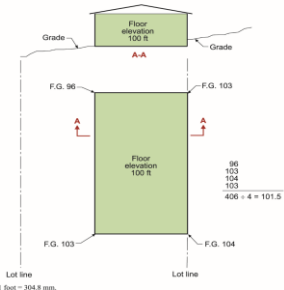
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## Grade Plane Section 202

- Grade plane is easy to calculate if the land adjoining a building is relatively flat.

Grade plane is reference plane representing average of finished ground level adjoining building. In this example, the grade plane is approximately 101.5.



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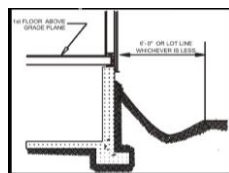
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## Grade Plane Section 202

- In the case of sloping ground, grade is the lowest ground elevation within 6 feet of an exterior wall or, if the lot line is within that 6 feet, the lowest ground elevation between the wall and the lot line.



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### Building Height (in stories) Table 504.4

- The allowable height limitations on stories based on Table 504.4 are only applicable to stories considered as “stories above grade plane.”
- Unlike the limitation on height in feet, the limits on allowable stories above grade plane vary significantly based on the occupancy classification of the building.



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### Story Above Grade Plane Section 202

**Story Above Grade Plane:** Any story having its finished floor surface entirely above grade plane, or in which the finished surface of the floor next above is:

1. More than 6 feet above grade plane, or
2. More than 12 feet above the finished ground level at any point.



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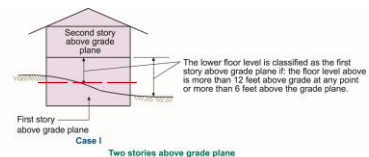
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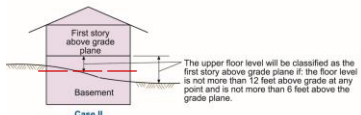
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### Story Above Grade Plane Section 202



Two stories above grade plane



One story above grade plane with basement



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### General Building Area Limitations Section 503

- The area of a building is limited to that established by Table 506.2, along with any permitted increase due to the presence of significant exterior open space at the building's perimeter.
- Before calculating the maximum allowable area, it is necessary to determine the actual floor area of the building on a story-by-story basis.



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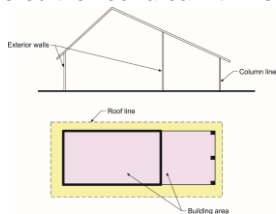
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### Building Area Section 202

- For that portion of the building surrounded by exterior walls and/or fire walls, the building area is considered the floor area within such walls.



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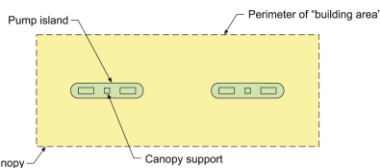
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### Building Area Section 202

- For that portion of the building not surrounded by exterior walls, the building area is considered the floor area within the horizontal projection of the roof or floor above.



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## Special Provisions

### Introduction

- It is important that all special allowances and limitations in the determination of allowable building height and area be reviewed for application.
- Key special provisions include:
  - Special industrial occupancies
  - Buildings on the same lot
  - Basements
  - Mezzanines



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## Special Industrial Occupancies

### Section 503.1.1

- Buildings containing special industrial processes that require large floor areas and/or unusual heights are exempt from the height and area limitations of Sections 504 and 506.
- The allowance is limited to low-hazard and moderate-hazard occupancies housing manufacturing and energy-producing uses (typically classified as Groups F-1 and F-2).



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### Special Industrial Occupancies Section 503.1.1

Some of the uses that qualify for these special allowances include:

- Rolling mills
- Structural metal fabrication shops
- Foundries
- Production and distribution of electric, gas or steam power



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### Buildings on the Same Lot Section 503.1.2

If two or more buildings are located on the same lot, they must be:

- Regulated as separate buildings in accordance with Section 705.3, or
- Considered as portions of one building.



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### Buildings on the Same Lot Section 705.3

- If viewed as separate buildings, an imaginary line (location determined by the designer) must be assumed between the buildings to determine exterior wall and opening protection.
- This approach is consistent with the regulation of buildings on adjacent lots insofar as fire separation distance is concerned.



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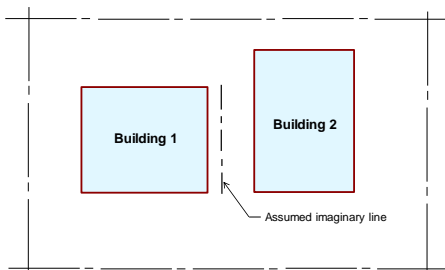
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### Buildings on Same Lot Section 705.3



Buildings 1 and 2 regulated as two separate and distinct buildings

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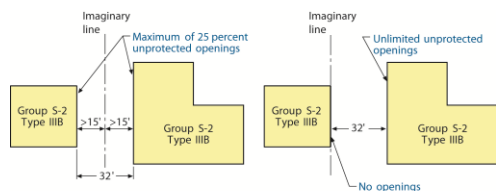
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### Buildings on Same Lot Example 1



Note: Imaginary line may be located to take best advantage of provisions.

For SI: 1 foot = 304.8 mm.

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### Buildings on Same Lot Section 503.1.2

- As an alternative, multiple buildings on the same lot are permitted to be considered as portions of single building if the building height in feet, number of stories of each building, and aggregate building area of such buildings is within limits specified in Sections 504 and 506 for a single building.
- Provisions of IBC applicable to aggregate building area and applicable to each building

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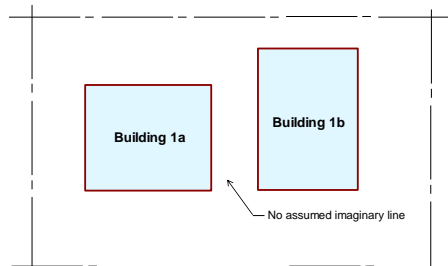
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### Buildings on Same Lot Section 503.1.2



Buildings 1 and 2 regulated as portions of a single building



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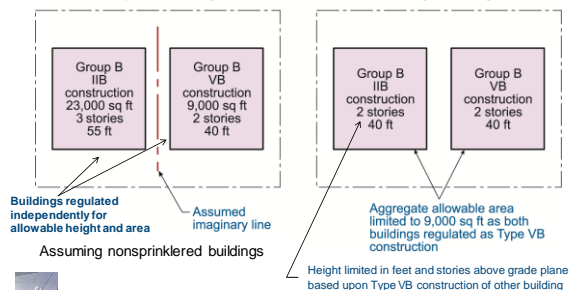
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### Buildings on Same Lot Example 2

A: separate buildings

B: single building



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### Basements Sections 202, 504.3, 504.4, 506.1.3

- In the determination of compliance for allowable building size, basements are not typically included in a building's actual height and area.
  - Basements are not a factor in building height in feet because actual height is measured from the grade plane.
  - Basements are not a factor in building height in stories because Table 504.4 regulates allowable number of stories to only those stories above grade plane.
  - Basements are not a factor in building area provided the total area of such basements does not exceed the area permitted for a one-story above grade plane building.



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### Mezzanines Section 505

- A mezzanine is a complying intermediate floor level placed between the floor and ceiling of a story.
- The use of the mezzanine provisions is a design option, because an intermediate floor level can also be considered an additional story.



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### Mezzanines Section 505

The use of mezzanine provisions focuses on the fact that:

- Mezzanines do not contribute to the number of stories in the building.
- Mezzanines do not contribute to the building area.



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### Mezzanines Section 505

Conditions to qualify as a mezzanine include:

- Aggregate area of mezzanines limited to one-third of floor area of room where located (2 exceptions allow for greater percentages).
- Mezzanines to be open and unobstructed to room where located (5 exceptions allow for partial or full enclosure of mezzanine area).
- Mezzanines contribute to floor area for fire area size determination.



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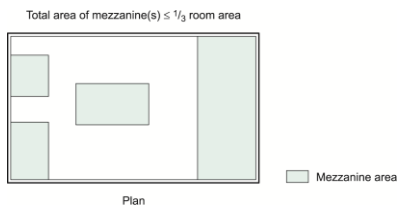
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### Mezzanine Floor Area Section 505.2.1

The aggregate floor area of all mezzanines cannot exceed 1/3 of the floor area of that room or space in which they are located.



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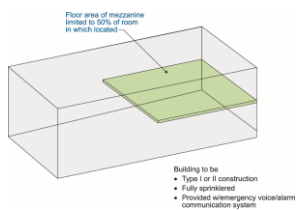
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### Mezzanine Floor Area Section 505.2.1, Exception 2

The aggregate floor area of all mezzanines cannot exceed 1/2 of the floor area of that room or space in which they are located under very specific conditions.



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### Mezzanine Openness Section 505.2.3

- A mezzanine is intended to be open and unobstructed to the room in which the mezzanine is located.
- A variety of exceptions allow for the mezzanine to be enclosed.



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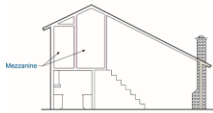
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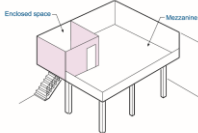
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### Mezzanine Openness Section 505, Exceptions 1 and 3

Partitioning may be installed if either of the following conditions exists:



• Occupant load of the enclosed area does not exceed 10 or



• Aggregate floor area of the enclosed space does not exceed 10 percent of the mezzanine area



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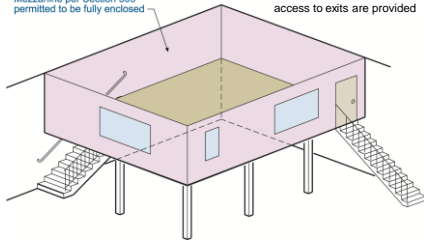
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### Mezzanines Section 505.2.3, Exception 2

Mezzanine per Section 505 permitted to be fully enclosed

Two or more exits or access to exits are provided



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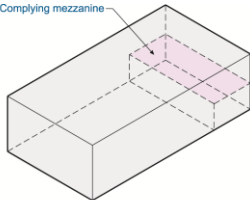
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### Mezzanines Example 1

Complying mezzanine

Enclosed portion of room not to be included in determination of floor area of room in which mezzanine is located



**Example:**  
For 8,000 sq ft building as shown with 2,000 sq ft mezzanine, building area is 8,000 sq ft, building is one story in height, and fire area is 10,000 sq ft

- Mezzanine:**
- Does not contribute to floor area for maximum allowable area
  - Does not contribute as an additional story
  - Does contribute to floor area for fire area size determination

For SI: 1 square foot = 0.093 m<sup>2</sup>.



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## Allowable Building Height Introduction

- Once the actual building height is determined, in both feet and stories above grade plane, it cannot exceed the allowable height as determined by Section 504 based on:
  - Occupancy classification
  - Type of construction
- Where towers, steeples, spires and other rooftop structures are provided, specific provisions are to be applied.



62

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## Height Increase for Sprinklers Section 504.1

- The tabular limits on height in both feet and stories are typically greater where the building is protected by an automatic sprinkler system.
- Tables 504.3 and 504.4 identify the type of sprinkler system required to receive any sprinkler increase.
  - S = buildings equipped throughout with an NFPA 13 system
  - S13R = buildings equipped throughout with an NFPA 13R system



63

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### Allowable Height Increase Example 1

- **Given:** A Type VB building classified as a Group B occupancy.
- **Determine:** The maximum allowable height in feet and stories if:
  - the building is not sprinklered, and
  - if the building is sprinklered.



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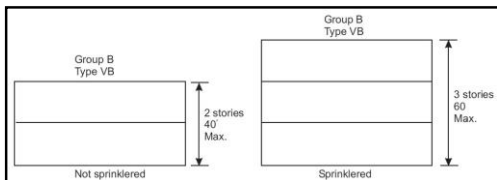
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### Allowable Height Increase Example #1

- **Solution:** Taken directly from Tables 504.3 and 504.4



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### Group R Occupancies Tables 504.3 and 504.4

- If the building is a Group R occupancy sprinklered with an NFPA 13R system, the 1-story and 20-foot increases are also applied; however, the building cannot exceed a total of 4 stories or 60 feet in height as reflected in the tables.



69

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### Group R Occupancies Example 2

- **Given:** A Type IIB building classified as a Group R-2 occupancy. The building is sprinklered with an NFPA 13R system.
- **Determine:** The maximum allowable building height in feet and stories.

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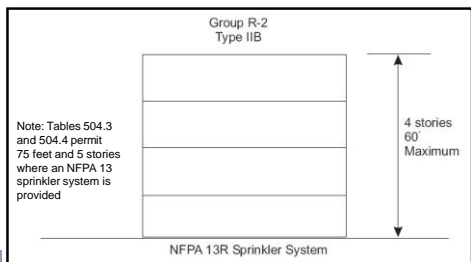
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### Group R Occupancies Example 2

▪ **Solution:**



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### Allowable Height Increase Tables 504.3 and 504.4

- Occupancies where the installation of an automatic sprinkler system does not provide for an increase in allowable height include:
  - Group I-2 occupancies in Type IIB, III, IV and V buildings.
  - Group H-1, H-2, H-3 and H-5 occupancies.
- In these high-hazard occupancies, sprinkler protection is such an integral part of the building's overall protection package that no additional benefit is granted.



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## Roof Structures Section 504.3, Exception

The height limitations for towers, spires, steeples and other roof structures are found in:

- Exception to Section 504.3, which regulates such roof structures in regard to the contribution to the overall height of the building.
- Section 1510 deals more with rooftop structures as independent elements.



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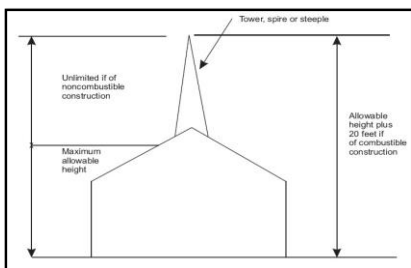
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## Roof Structures Section 504.3



Height Limits of Roof Structures



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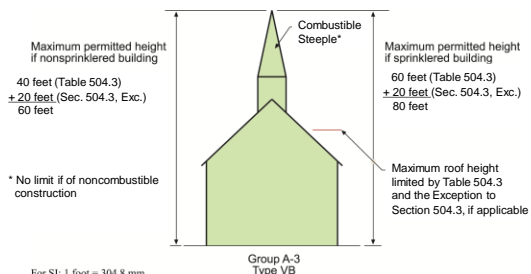
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## Roof Structures Example



For SI: 1 foot = 304.8 mm.

Group A-3  
Type VB



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### Allowable Building Area Section 506

- Building area is limited to that established by Table 506.2, along with any permitted increase due to the presence of significant frontage on open space.
- The table addresses the presence of an automatic sprinkler system, as well as multistory conditions, where applicable.
- The entire building must be analyzed for allowable area compliance, along with the area of each individual story.



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77

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### Automatic Sprinkler System Increase Table 506.2

- The presence of a sprinkler system can provide a significant increase in allowable area in most buildings.
- The allowable area increase in Table 506.2 for sprinkler protection only applies where an NFPA 13 system is provided throughout the building.
- Table 506.2 does not provide for a sprinkler increase for:
  - Group H-1 occupancies
  - Portions of buildings classified as Group H-2 or H-3



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78

78

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### Width Limits

#### Section 506.3.2, Exception

- An exception to Section 506.3.2 provides credit in special cases for those open spaces that are greater than 30 feet (9144 mm) in width.
- The quantity of  $W$  divided by 30 is permitted to be a maximum of 2 if the building meets all the criteria for unlimited area buildings in Section 507 except for compliance with the open space requirements.



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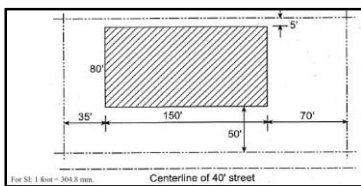
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### Extended Frontage Example

- **Given:** A one-story, fully-sprinklered retail sales building with yards and street, as shown.
- **Determine:** The percentage frontage increase,  $I_f$ , for allowable area purposes.



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### Extended Frontage Example

- **Solution:**

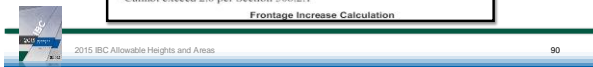
$$I_f = \left[ \frac{F}{P} - 0.25 \right] \frac{W}{30} \quad W = \frac{150(60') - 80(35') - 80(60')}{310}$$

$F = 310$  ft  
 $P = 460$  ft  
 $W = 35$  ft  
 $W = 53.22$

$$I_f = \left[ \frac{310}{460} - 0.25 \right] \frac{35}{30} \quad I_f = \frac{[0.42] \cdot 77^*}{0.74}$$

$= [0.67 - 0.25] \cdot 1.17^*$   
 $= [0.42] \cdot 1.17$   
 $I_f = 0.49$   
 $^* \text{Cannot exceed 2.0 per Section 506.2.1}$

Frontage Increase Calculation



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### Open Space Limits Section 506.3.1

- Section 506.3.1 mandates that the open space used for a frontage increase must be on the same lot as the building or dedicated for public use.
- This ensures that the space will remain open and available. Fire personnel must also be able to access the open space from a street or fire lane.



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### Open Space Limits Section 506.3.1

Entire perimeter considered for frontage increase



Open space to be on same lot or dedicated for public use and accessed from a street or approved fire lane

\*Fire lane need only be provided to within 150 feet of exterior wall per Section 503.1.1 of the IFC

For SI: 1 foot = 304.8 mm.



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### Open Space Availability Introduction

- Three issues to consider when evaluating potential yards for use as open space in the determination of a frontage increase:
  1. What type of public and common spaces are permitted to be utilized for frontage increases?
  2. How is the frontage increase calculated for a common yard shared by two buildings on the same lot?
  3. Does the presence of a fire wall affect the allowable area calculation for a frontage increase?



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### Open Space Availability Introduction

- Yards, public ways and other types of open spaces are expected to be open and relatively unobstructed from the ground to the sky.
- The decision as to what types of uses are permitted within the designated open space is left to the building official.
- Parking lots, low level landscaping, light standards and similar features are often permitted to occupy open space.
- Conversely, the storage and/or display of goods and similar uses would typically be prohibited.
- The intent is provide effective fire department access and maintaining building separation from site hazards.



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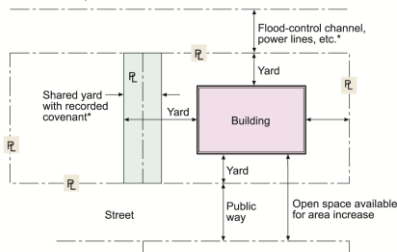
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### Open Space Availability Section 506.3.1

Yards to be accessed by street or fire lane



\*May be used when approved by the building official



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### Open Space Availability Section 506.3.2

- The entire open space between two buildings on the same lot is available for a potential frontage increase for both buildings.
- For the purpose of determining the width of the yard, no imaginary line between the buildings is assumed.
- The entire width of the yard can be used by both buildings.



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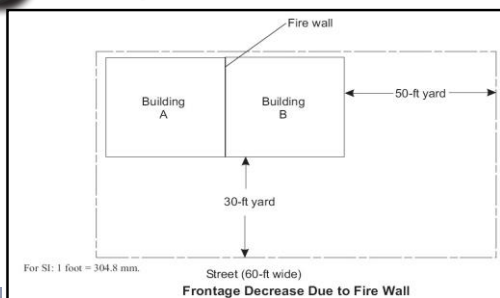
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### Open Space Availability Example



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### Allowable Area Determination Section 506.2

- Determination of the allowable area of a building differs depending on the conditions presented:
  - Single-occupancy, one-story building 506.2.1
  - Mixed-occupancy, one-story building 506.2.2
  - Single-occupancy, multistory building 506.2.3
  - Mixed-occupancy, multistory building 506.2.4



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101

101

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### Allowable Area Determination Single-Occupancy, One-Story Section 506.2.1

- The allowable area of a single-occupancy building with no more than one story above grade plane shall be determined by the following equation:

$$A_a = A_t + (NS \times I_f)$$

- $A_a$  = Allowable building area
- $A_t$  = Tabular allowable area factor (NS, S1, or S13R value, as applicable) in accordance with Table 506.2
- NS = Tabular allowable area factor in accordance with Table 506.2 for nonsprinklered building (regardless of whether building is sprinklered)
- $I_f$  = Area factor increase due to frontage in accordance with Section 506.3



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102

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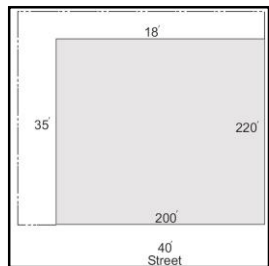
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FOR EXAMPLE



### Total Allowable Area Example 1

- **Given:** A one-story, Type VA building housing a Group B occupancy.
- **Determine:** The maximum allowable area if the building is fully sprinklered (include frontage increase).



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103

103

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FOR EXAMPLE



### Total Allowable Area Example 1

- **Solution:**  $A_a = A_t + (NS \times I_f)$

Tabular area ( $A_t$ ):	72,000 sf	S1, T506.2
Frontage increase ( $NS \times I_f$ ):	<u>4,500 sf</u>	18,000 x 0.25
Total allowable area ( $A_a$ ):	76,500 sf	Additive

The building is limited to 76,500 sf.



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104

104

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### Allowable Area Determination Mixed-Occupancy, One-Story Section 506.2.2

- The allowable area of a mixed-occupancy building with no more than one story above grade plane shall be determined by the following equation:

$$A_a = A_t + (NS \times I_f)$$

- The determination shall comply with the applicable provisions of Section 508.1 for each applicable occupancy. Refer to discussion of Section 508.



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105

105

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### Allowable Area Determination Single-Occupancy, Multistory Section 506.2.3

- The allowable area of a single-occupancy building with more than one story above grade plane shall be determined by the following equation:

$$A_a = [A_t + (NS \times I_f)] \times S_a$$

- $A_a$  = Allowable building area
- $A_t$  = Tabular allowable area factor (NS, SM, or S13R value, as applicable) in accordance with Table 506.2
- NS = Tabular allowable area factor in accordance with Table 506.2 for nonsprinklered building (regardless of whether building is sprinklered)
- $I_f$  = Area factor increase due to frontage in accordance with Section 506.3
- $S_a$  = Actual number of building stories above grade plane, **not to exceed three.** (not to exceed four for 13R sprinklered buildings)



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### Allowable Area Determination Single-Occupancy, Multistory Section 506.2.3

- No individual story shall exceed the allowable area ( $A_a$ ) as determined by the equation:

$$A_a = [A_t + (NS \times I_f)] \times S_a$$

- Using the value of  $S_a = 1$



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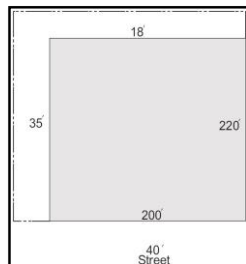
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### Total Allowable Area Example 2

- Given:** A two-story, Type VA building housing a Group B occupancy.
- Determine:** The maximum allowable area if the building is fully sprinklered (include frontage increase).



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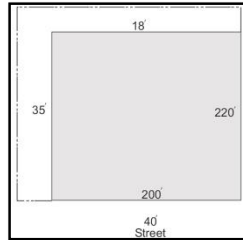
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### Allowable Area, 13R Building Example 3

**Given:** A 4-story, Type VA building housing a Group R-2 occupancy.

**Determine:** The maximum allowable area if the building is fully sprinklered with an NFPA 13R system (include frontage increase).



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### Allowable Area, 13R Building Example 3

▪ **Solution:**  $A_a = A_t + (NS \times I_f) \times S_a$

Tabular area ( $A_t$ ):	12,000 sf	<b>S13R, T506.2</b>
Frontage increase ( $NS \times I_f$ ):	<u>3,000</u> sf	12,000 x 0.25
Allowable area ( $A_a$ ):	15,000 sf	Additive
Buildings $\geq$ 4 stories:	<u>x 4</u>	$S_a$
Building allowable area:	60,000 sf	Equation 5-2

**Total building allowable area limited to 60,000 sf**  
**No single story is permitted to exceed 15,000 sf**



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### Allowable Area Determination Mixed-Occupancy, Multistory Section 506.2.4

- Each story of a mixed-occupancy building with more than one story above grade plane shall individually comply with the applicable requirements of Section 508.1.
- In addition, for those buildings four or more stories above grade plane, the total building area shall be such that the aggregate sum of the ratios of the actual area of each story divided by the allowable area of such stories does not exceed three.



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**Allowable Area Determination  
Mixed-Occupancy, Multistory  
Section 506.2.4**

- Determining compliance with allowable area is more complicated in multistory mixed-occupancy buildings.
- Where the building is no more than 3 stories above grade plane, each floor must be evaluated independently and comply with the applicable provisions of Section 508.1. No additional determination of building floor area is necessary.



118

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**Allowable Area Determination  
Mixed-Occupancy, Multistory  
Section 506.2.4**

- However, where there are 4 or more stories above grade plane, each individual story must comply, as well as the aggregate floor area of all stories.
  - In such situations, the total building area is limited such that the sum of the ratios of the actual area of each story divided by the allowable area of each story, based on the applicable mixed occupancy provisions of Section 508.1, is not to exceed 3.



119

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**Allowable Area Determination  
Mixed-Occupancy, Multistory  
Example**

- **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?



120

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### Mixed Occupancy Area Determination Section 506.5

- Further information required to evaluate allowable building area, as well as height, is provided in Section 508.
- The evaluation of height and area varies depending on which of the following options is chosen by the designer:
  - Accessory occupancies
  - Nonseparated occupancies
  - Separated occupancies



124

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### Additional Limitations and Allowances

Module 7



125

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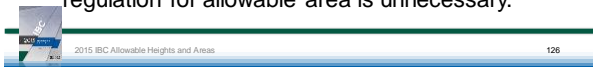
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### Unlimited Area Buildings Section 507

- The provisions of Section 507 allow for buildings with large floor areas to be constructed with no requirement for:
  - Fire-resistance-rated construction, or
  - Fire walls.
- The area limitations of Sections 503 and 506 are not applicable where compliance with Section 507 is achieved.
- Risks have been addressed to the point that the regulation for allowable area is unnecessary.



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### Unlimited Area Buildings Section 507

- Concept based on four main criteria:
  - Limited height
  - Moderate-hazard and low-hazard occupancies
  - Significant open frontage
  - Sprinkler protection
- This section provides alternative approach to regulating building size



127

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### Unlimited Area Buildings Section 507

- Although the allowance for unlimited floor area typically permits the building to be of any construction type, the actual type of construction will be important in the application of other code provisions, such as:
  - Accessory occupancies
  - Group H occupancies in unlimited area Group F and S occupancies



128

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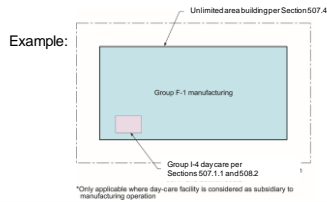
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### Unlimited Area Buildings Section 507.1.1

- The use of the unlimited area provisions is limited to those occupancies specifically addressed in Section 507, but other occupancies are permitted where in compliance with Section 508.2 (Accessory Occupancies).



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### One-story Nonsprinklered Buildings Section 507.3

- A one-story building housing a Group F-2 and/or S-2 occupancy is permitted to be unlimited in area if it is completely surrounded by minimum 60-foot public ways and/or yards.
- An automatic sprinkler system is not required in order to obtain unlimited area status because the occupancies involved are not expected to have any significant fire loading.



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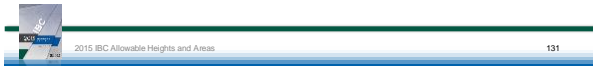
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### One- and Two-story Sprinklered Buildings Sections 507.4 and 507.5

- A building of no more than two stories is permitted to be unlimited in area where:
  - The building houses only Group B, F, M, and/or S occupancies.
  - The building is protected with a sprinkler system throughout.
  - Open space and/or public ways at least 60 feet in width adjoin and surround the building.



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### One-story Group A-4 Occupancies Section 507.4

- Group A-4 occupancies are granted unlimited area in a manner consistent with that for B, F, M and S occupancies with two exceptions:
  - The Group A-4 building can be only one story in height.
  - The building's construction must be of Type I, II, III or IV.



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**Group A-1 and A-2 Occupancies  
Section 507.4.1**

- In complying unlimited area buildings housing Group A-4, B, F, M and/or S occupancies, it is permissible to include a limited amount of Group A-1 and A-2 occupancies within the building.
- The type of construction of the building must be Type I, II, III or IV.



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133

133

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**Group A-1 and A-2 Occupancies  
Section 507.3.1 (continued)**

- The Group A-1 and A-2 occupancies shall be separated from other spaces as required by Section 508.4.4 for separated occupancies with no reduced rating allowed for sprinkler protection. This will result in a minimum 2-hour fire-resistance-rated separation.



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134

134

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**Group A-1 and A-2 Occupancies  
Section 507.4.1 (continued)**

- The floor area of each Group A-1 and A-2 occupancy cannot exceed the maximum allowable area established in Section 503.1, which includes any applicable frontage increase.
- All required exits from Group A-1 and A-2 occupancies must discharge directly to the exterior of the building.



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135

135

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### Group A-3 Buildings Sections 507.6 and 507.7

The area of a Group A-3 occupancy is permitted to be unlimited under the following conditions:

- Maximum of one story in height.
- Used as a place of religious worship, community hall, dance hall, exhibition hall, gymnasium, lecture hall, indoor swimming pool or tennis court.
- Type II, III or IV construction.



136

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### Group A-3 Buildings Sections 507.6 and 507.7 (continued)

- No stage, but may contain a platform.
- Fully sprinklered.
- Surrounded and adjoined by minimum 60-foot yards and/or public ways.
- Assembly floor located within 21 inches of street or grade level with egress provided by ramps rather than stairs, where applicable (only required where building is Type III or IV construction).



137

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### Reduced Open Space Section 507.2.1

- Open space of at least 60 feet must be provided around complying unlimited area buildings. The minimum 60-foot width is permitted to be reduced to 40 feet provided:
  - The reduced open space applies to a maximum of 75 percent of the building's perimeter, and
  - A minimum 3-hour fire-resistance rating is required for any exterior wall facing the reduced open space, and
  - Openings in the exterior wall facing the reduced open space have a minimum fire protection rating of 3 hours.



138

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### Reduced Open Space Section 507.2.1

- The allowance for reducing the required open space from 60 feet to 40 feet is only permitted for the following unlimited area buildings:
  - One-story nonsprinklered Groups F-2 and S-2 (507.3).
  - One-story sprinklered Groups B, F, M, S and A-4 (507.4).
  - Two-story sprinklered Groups B, F, M and S (507.5).
  - One-story sprinklered Group A-3 (507.6 and 507.7).
  - One-story sprinklered motion picture theaters (507.12).



139

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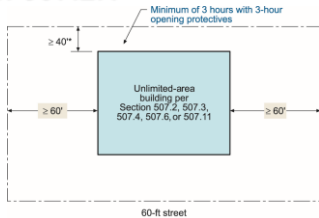
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### Reduced Open Space Section 507.2.1



- \*Reduced open space permitted:
- Up to 75 percent of building perimeter
  - Where exterior wall facing reduced open space has minimum 3-hour fire-resistance rating
  - Openings in such walls are protected for minimum 3 hours
- For SI: 1 foot = 304.8 mm.



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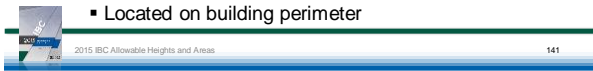
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### Group H Occupancies Section 507.8

- Group H-2, H-3 and H-4 occupancies are permitted to be located in unlimited area buildings containing Group F and S occupancies with the following limitations:
  - Compliance with the unlimited area provisions of Sections 507.4 and 507.5 for Group F and S occupancies.
  - Limits on permitted floor area of Group H occupancies based on whether:
    - Located within the building, or
    - Located on building perimeter



141

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### Group H Occupancies Section 507.8

- Aggregate floor area of Group H occupancies located at the building's perimeter limited to 10 percent of the actual building area or Group H allowable area per Section 506 with any applicable frontage increase.
- Aggregate floor area of Group H occupancies not located on perimeter of building are limited to 25 percent of Group H area limits as specified in Section 506.



142

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### Other Unlimited Area Buildings Sections 507.9 through 507.13

The following occupancies are also permitted to be unlimited in floor area subject to the specific requirements:

- Mixed-occupancy buildings with Group H-5 (507.9)
- Group H-2 aircraft paint hangars (507.10)
- Group E educational buildings (507.11)
- Group A-1 motion picture theaters (507.12)
- Covered mall buildings and anchor stores (507.13)



143

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### Mixed Occupancies Section 508

Where two or more distinct occupancies are located within a building, the provisions of Section 508 must be applied.

The scope of Section 508 is limited to:

- Occupancy classification.
- **Allowable building height.**
- **Allowable building area.**
- Separation.



144

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### Mixed Occupancies Section 508

- Three design options for compliance in mixed-occupancy buildings are established:
  - Accessory occupancies
  - Nonseparated occupancies
  - Separated occupancies
- Each design option varies in its approach to allowable building height and area



145

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### Accessory Occupancies Section 508.2

#### Allowable Area and Allowable Height

- The allowable area of any accessory occupancy is to be based on that of the main occupancy.
- The allowable height and number of stories of the building shall comply with Section 504 for the main occupancy of the building.



146

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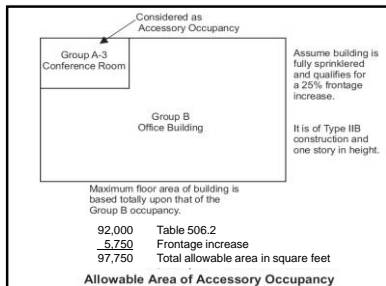
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### Accessory Occupancies Section 508.2



147

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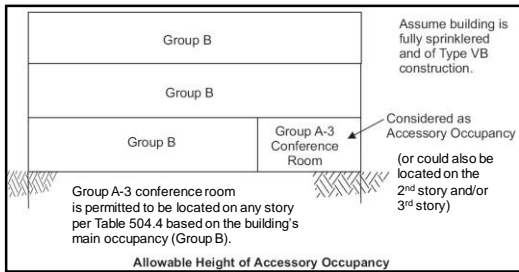
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### Accessory Occupancies Section 508.2



148

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### Nonseparated Occupancies Section 508.3

- Occupancies are not required to be separated if they are in compliance with the provisions of Section 508.3. If the building is designed in part to address the most restrictive and most hazardous conditions that are expected to occur, a fire-resistance-rated separation is not necessary.
- The worst-case application of the type of construction (allowable height and area) and fire protection provisions forms the basis for this option.



149

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### Nonseparated Occupancies Section 508.3

**Allowable Area and Allowable Height is:**

- Based on the most restrictive allowances for the occupancies involved.
- Based on the building's type of construction, each occupancy is individually evaluated for height and area in accordance with Section 503.1.



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### Nonseparated Occupancies Section 508.3

- Frontage increases to Table 506.2 are permitted for open space and sprinkler protection, where applicable.
- The most restrictive height and area allowance of the occupancies under consideration is then applied to the entire building.
  - Most restrictive type of construction is applied



151

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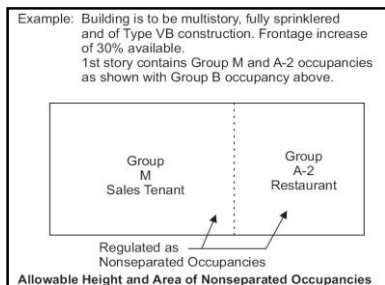
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### Nonseparated Occupancies Section 508.3



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### Nonseparated Occupancies 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

Using the nonseparated occupancies method, the maximum allowable area is 19,800 square feet per story with a maximum of two stories in the building.



153

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## Separated Occupancies Section 508.4

- This is the only method that potentially requires a fire-resistance-rated separation between adjacent occupancies.
- Table 508.4 establishes the degree of fire resistance that is mandated.
- Provides a balanced approach in the evaluation of a building's allowable height and area.



154

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## Separated Occupancies Section 508.4

### Allowable area

- The unity formula is used to determine allowable area per story. This provides a weighted average of the allowable areas for the different occupancies located on each story.
- Compliance is achieved where the sum of the ratios of the actual floor area divided by the allowable floor area for each of the occupancies involved does not exceed 1.



155

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## Separated Occupancies Section 508.4

### Allowable area

- The formula is:

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

Where  $a_1$ ,  $a_2$  and  $a_3$  represent the actual floor areas of the individual occupancies, and  $A_1$ ,  $A_2$  and  $A_3$  represent the maximum allowable floor areas.



156

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FOR EXAMPLE



### Mixed Use and Occupancy Example

- **Given:** A one-story, 66,000 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:** If the building complies with the allowable area limitations based on separated occupancies.



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157

157

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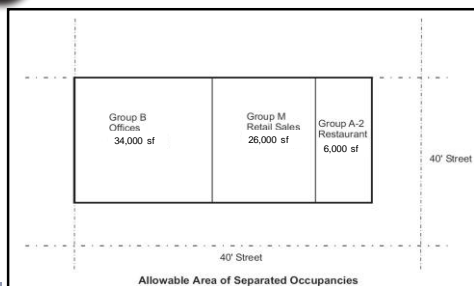
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FOR EXAMPLE



### Mixed Use and Occupancy Example



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158

158

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### Mixed Use and Occupancy Example

▪ **Solution:**

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

$a_B = 34,000$        $A_B = 92,000 + 0.25(23,000) = 97,750$   
 $a_M = 26,000$        $A_M = 50,000 + 0.25(12,500) = 53,125$   
 $a_{A-2} = 6,000$        $A_{A-2} = 38,000 + 0.25(9,500) = 40,375$

$$\frac{34,000}{97,750} + \frac{26,000}{53,125} + \frac{6,000}{40,375} \leq 1.0$$

$$0.35 + 0.49 + 0.15 = 0.99 > 1.0$$

∴ Building complies for allowable area as shown.



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159

159

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## Separated Occupancies Section 508.4

### Allowable height

- The maximum allowable height of each occupancy is regulated independently based on the building's type of construction.
- An occupancy cannot be located higher than that permitted by Section 503.1.



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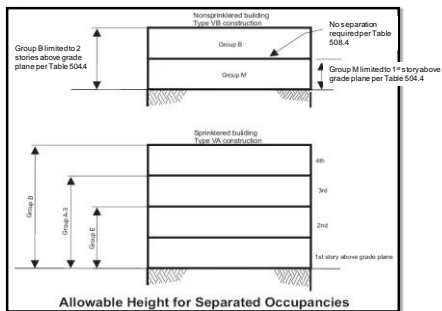
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## Separated Occupancies Section 508.4



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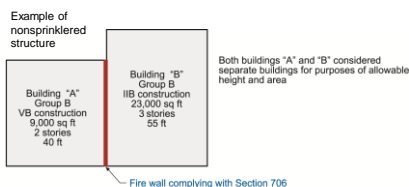
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## Allowable Height and Area Use of Fire Walls

- One or more fire walls complying with Section 706 may be also utilized to gain compliance with allowable height and area.



162

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### Special Provisions Section 510

- Allows for modifications or exceptions to the general requirements for building areas and heights, taking precedence over any general provisions that may apply.
- Because Section 510 permits, rather than requires, the use of its special conditions, the provisions are *optional*.



163

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### Special Provisions Section 510

- Conformance with Section 510 is only required where the designer intends to take advantage of the special allowances that are available.



164

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### Horizontal Building Separation Allowance Section 510.2

- The benefit of Section 510.2 is the ability to create two separate buildings, one above the other, for the purpose of applying several specific code provisions independently to each building.



165

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### Horizontal Building Separation Allowance Section 510.2

Referred to as “podium” or “pedestal” buildings, they may be viewed as separate buildings above and below the required fire separation for these purposes:

- Determination of **allowable area** limits.
- Continuity of fire walls.
- Limitation on **number of stories** (not height in feet).
- Type of construction.



166

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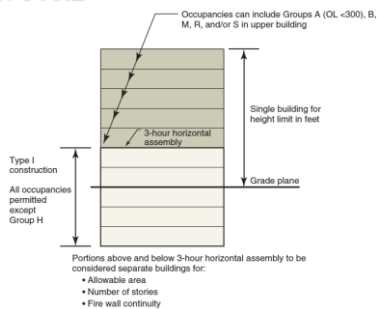
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### Horizontal Building Separation Allowance Section 510.2



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### Other Horizontal Building Separations Section 510

- Additional special provisions are available that modify the general height and area requirements, including:
  - Sec. 510.3 Group S-2 enclosed parking garage with Group S-2 open parking garage above
  - Sec. 510.4 Parking beneath Group R
  - Sec. 510.7 Open parking garage beneath Groups A, I, B, M and R
  - Sec. 510.8 Group B or M buildings with Group S-2 open parking garage above



168

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169

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170

170

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171

171

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