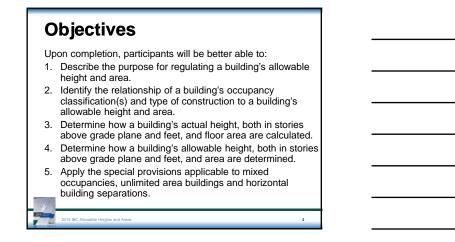


Course Description

- 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.

Goal

- Participants will be able to use:
 - Table 504.3 to determine the allowable height in feet of a building.
 - Table 504.4 to determine the allowable height in stories above grade plane of a building.
 - Table 506.2, along with permitted frontage increases of Section 506.3, to determine the allowable floor area of a building.

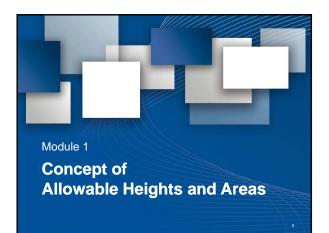


Course Overview

2015 IBC Allo

able Heights and Areas

- Module I 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



Allowable Height and Area Introduction

- After determining a building's occupancy and 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.

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.

Tabular Height and Area Values Tables 504.3, 504.4 and 506.2

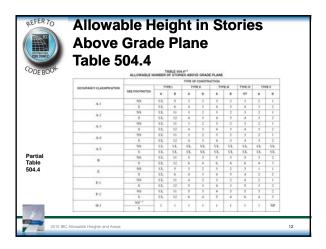
 Tables 504.3, 504.4 and 506.2 are the foremost code provisions used in establishing "equivalent risk"—offsetting a building's inherent fire hazard—represented by group—with materials and construction features.

Tabular Height and Area Values Tables 504.3, 504.4 and 506.2

- The application of Tables 504.3, 504.4 and 506.2 is accomplished by:
- 1. Identifying the group classification of the building in question along the left column.
- 2. Identifying the building's type of construction across the top of the table.
- The cell at the intersection of the occupancy classification and type of construction establishes the tabular values for allowable height in feet, allowable number of stories above grade plane, and allowable building floor area per story.

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	H-4		UL	180	85	25	85	75	85	30	60
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		554	UL	UL.	45,500	25,500	42,000	25,500	-45,000	34,500	14,500
	100	NS	UL.	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
	.4.2		UL.	UL.	62,000	38,000	56,000	38,000	60,000	46,000	24,000
	1.	555	11L	43.	45,500	28,500	42,000	28,500	45,000	34,500	13,000
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	1000	N5	UL.	12.	36,500	14,500	23,500	14,500	25,500	18,500	9,500
-	E		11.	UL.	106,000	58,000	94,000	51,000	102,000	74,000	38,000
		SM	UL.	11.	29,500	43,500	30,500	41,500	76,500	55,500	28,500



Tabular Height and Area Tables 504.3, 504.4 and 506.2

- The height and area tables provide insight to the hierarchy of occupancies and construction types.
- Tabular allowable heights and areas vary based on the degree of hazard anticipated.
 - Examples for nonsprinklered buildings include:



Allowable Height and Area Modifications to Table 503

A more comprehensive review is necessary when the building:

 Has sizable frontage on open yards or streets, or both,

- Is multistory,
- Contains multiple occupancies.

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.

	Example of nonsprinklered structure		Both buildings "A" and "B" considered	
	Building "A" Group B VB construction 9,000 sq ft 2 stories 40 ft	Building "B" Group B IIB construction 23,000 sq ft 3 stories 55 ft	Both buildings A and B Considential sequents buildings for purposes of allowable height and area	
The sector	For SI: 1 foot = 304.8 mm,	and the second	ng with Section 706	
2015	BC Allowable Heights and Are	eas		16



Building Classification

It is critical that a building be classified according to the *occupancy group* and the *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.

Occupancy Classification Chapter 3

Evaluate the building for use and occupancy:

- How the space will be used.
- The abilities of the occupants to respond in an emergency.
- Specific requirements (levels of safety) related to the various occupancy groups.

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.

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.

Occupancy Classification Section 302.1

 When in doubt, it is important that an occupancy classification be assigned that most nearly resembles those occupancies with similar fire safety and life safety risks.

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Occupancy Classification Section 302.1

Types of Use	General Occupancy Group	Occupancy Sub- Groups
Assembly	Group A	A-1, A-2, A-3, A-4, A-5
Business	Group B	None
Educational	Group E	None
Factory and Industrial	Group F	F-1, F-2
High Hazard	Group H	H-1, H-2, H-3, H-4, H-5
Institutional	Group I	I-1, I-2, I-3, I-4
Mercantile	Group M	None
Residential	Group R	R-1, R-2, R-3. R-4
Storage	Group S	S-1, S-2
Utility	Group U	None
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2015 IBC Allowable Heights and A	Ireas	2

Type of Construction Chapter 6

- Equally as important as occupancy designation, the determination of a building's type of construction describes its resistance to fire by addressing whether:
 - The materials of construction that make up the building's key elements are combustible or noncombustible, and
 - These same key elements are protected from fire by a recognized level of fire resistance.

2015 IBC Allowable Heights and Areas

Type of Construction Chapter 6

- The relationship of a building's construction type and its allowable height and area is the most important reason for correctly evaluating the type of construction.
- The permitted building size is directly related to the construction type.

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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.

	Type of Construction	Materials of Construction	
1	IA IB	Exterior and interior walls, floors, roof and structural elements to be of noncombustible	
П	IIA IIB	- materials.	
Ш	IIIA IIIB	Exterior walls to be of noncombustible materials.	
IV	H.T	Interior elements permitted to be of combustible materials.	
v	VA VB	Combustible materials permitted throughout.	
	itself and not on what m	g for construction type is based on t inimum type of construction is perm	



Type of Construction Table 601

- Types of building elements regulated for fireresistance-rated construction, based on Table 601:
 - Structural frame
 - Interior and exterior bearing walls
 - Floor construction
 - Roof construction
- All building elements must meet or exceed the fireresistance requirements of the table.

28

	TY	I I	TY	PEB	TY	11.26	TYPE IV	TYP	£٧
BUILDING ELEMENT	A		A	8	A		HT	A	
Primary structural frame? (see Section 202)	32	2	1	0	1	.0	HT	1	
Bearing walls Exterior** Interior	3 39	2	ł	0	2	20	2 L/HT	ł	-
Nonbearing walls and partitions Exterior				Se	e Table I	402			
Nonbearing walls and partitions Interior ⁴	0	0	0	0	0	0	See Section 602.4.6	0	1
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	
Roof construction and associated secondary members (see Section 202)	$\pm^i T_2^{2i}$	$T_{-}^{\rm bi}$	185) - 1850	0'	$I_{\mu \tau}$	0	нт	\mathbf{f}_{PC}	1
	and bearing s f structural an e any floor im or less fine-re of this code, statuce (see Ta	alls air p robers sh nodiately intance 1	termitted tall not be t before. F uting is re	to be redu required. Tro retard	cod by 11	cur who	re supporting	g a roof-	i

Module 3 Calculation of Actual Building Height and Area

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.

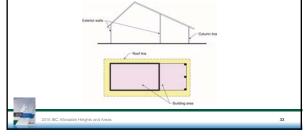
General Building Area Limitations Section 503

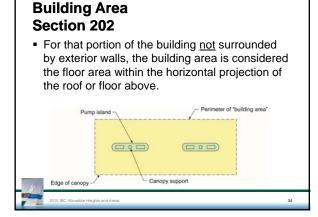
- The area of a building is limited to that established by Table 506.2, along with any permitted increase due to the presence of significant exterior open space at the building's perimeter.
- Before calculating the maximum allowable area, it is necessary to determine the actual floor area of the building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

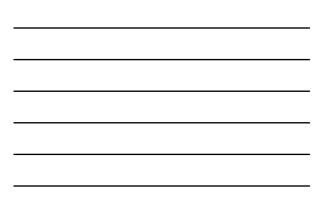
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Building Area Section 202

• 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.





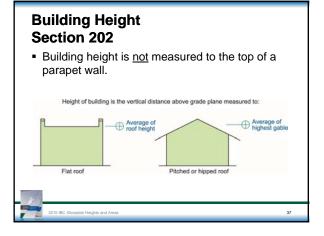


General Building Height Limitations Section 503

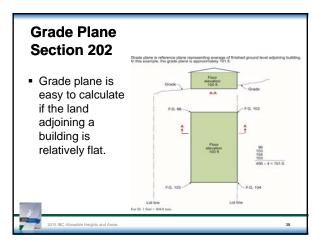
- The height of a building is limited to that established by Tables 504.3 and 504.4.
- Before calculating the maximum allowable height (in both feet and stories above grade plane), it is necessary to determine the actual height of the building.

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.









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.

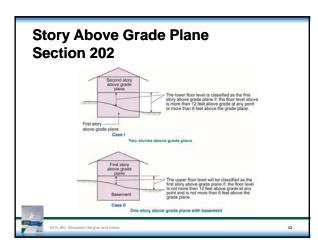


Building Height (in stories) Table 504.4

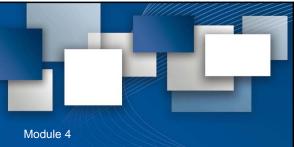
- The allowable height limitations on stories based on Table 504.4 are only applicable to stories considered as "stories above grade plane."
- Unlike the limitation on height in feet, the limits on allowable stories above grade plane vary significantly based on the occupancy classification of the building.

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.







Special Building Height and Area Provisions

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
 - Mezzanines

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.

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 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).



these special allowances include:

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



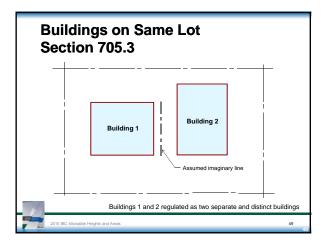
Buildings on the Same Lot Section 503.1.2

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

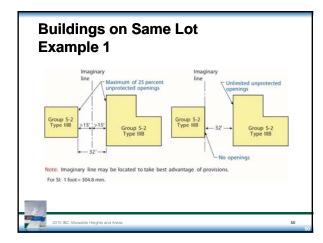
- Regulated as separate buildings in accordance with Section 705.3, or
- · Considered as portions of one building.

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.



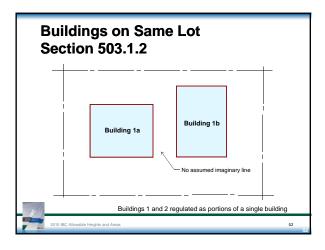




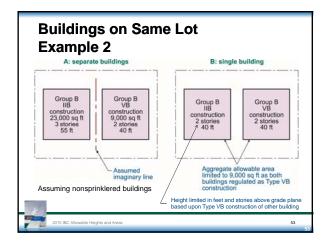


Buildings on Same Lot Section 503.1.2

- 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







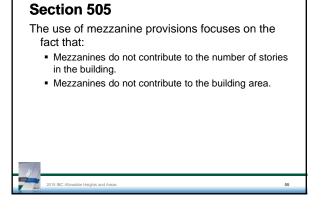


Mezzanines Section 505

- 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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Heights and Area

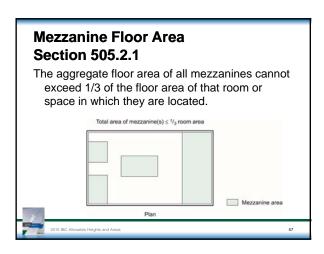


Mezzanines Section 505

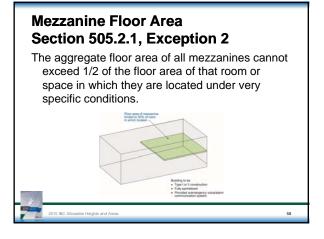
Mezzanines

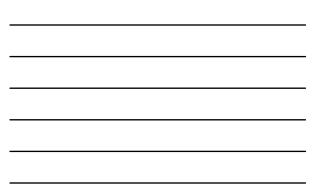
Conditions to qualify as a mezzanine include:

- 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.



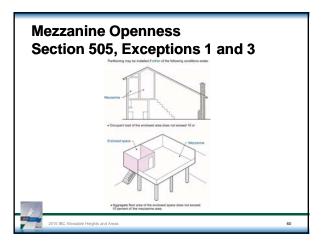




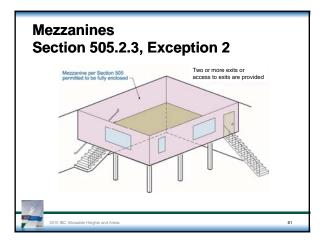


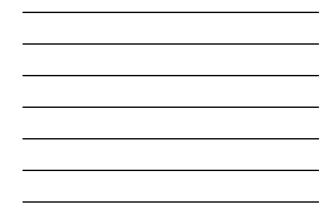
Mezzanine Openness Section 505.2.3

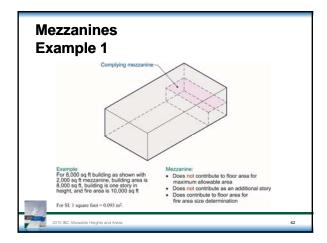
- A mezzanine is intended to be open and unobstructed to the room in which the mezzanine is located.
- A variety of exceptions allow for the mezzanine to be enclosed.

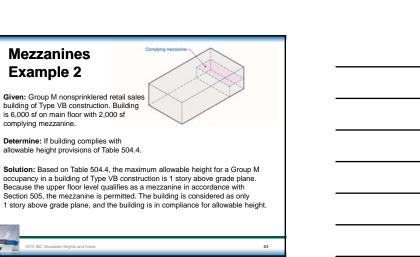




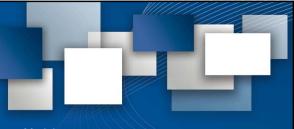












Module 5

Determining Maximum Allowable Building Height

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.

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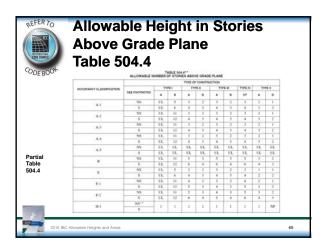
Height Increase for Sprinklers Section 504.1

- 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

Allowable Height Increase Section 504.2

- A building with an NFPA 13 sprinkler system throughout is typically permitted to be 20 feet and 1 story higher than allowed for a similar nonsprinklered building.
- This increased height is permitted in addition to that for allowable area as indicated in Table 506.2.

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		NS ^{c.}	UL	160	6.5	. 55	65	35	- 65	.50	-80
	E-I Condition 1, 1-3	5	UL	180	83	75	85	75	85	20	60
	E1 Condition 2.1-2	NSELL	UL	160	65	55	65	55	65	50	40
Partial	FTCondition 2, 1-2	5	UL.	380	85	- 39	-63	- 30	10	- 50	- 40
Table	14	NS ^{1,3}	UL.	160	65	.55	65	55	65	50	-40
504.3		. 5	UL.	180	85	75	85	75	85	-70	60
	1 100	NSL	UL.	160	65	. 35	65	55	65	- 50	-41)
	R	\$13R	60	60	60	60	60	60	60	60	60
	10.75.0	5	UL.	180	85	75	85	75	85	20	60







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.

<section-header>

Group R Occupancies Tables 504.3 and 504.4

 If the building is a Group R occupancy sprinklered with an NFPA 13R system, the 1story 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.



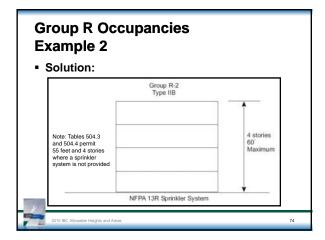
Group R Occupancies Example 2

• Given: A Type IIB building classified as a Group R-2 occupancy. The building is sprinklered with an NFPA 13R system.

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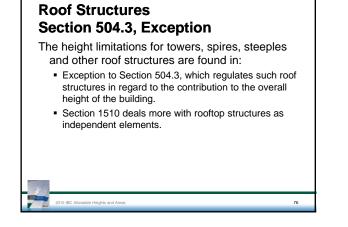
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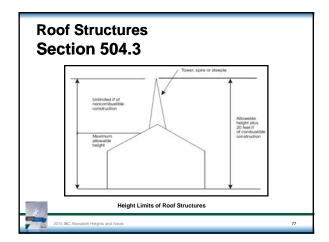
• Determine: The maximum allowable building height in feet and stories.



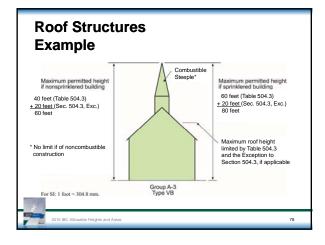
Allowable Height Increase Tables 504.3 and 504.4

- 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.

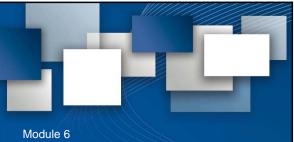












Determining Maximum Allowable Building Area

Allowable Building Area Section 506

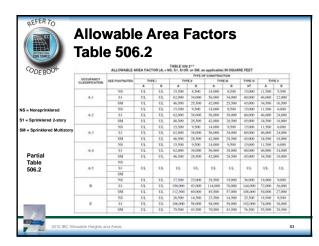
- Building area is limited to that established by Table 506.2, along with any permitted increase due to the presence of significant frontage on open space.
- The table addresses the presence of an automatic sprinkler system, as well as multistory conditions, where applicable.
- The allowable area of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

Automatic Sprinkler System Increase Table 506.2

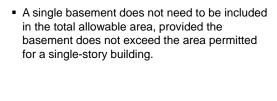
- The presence of a sprinkler system can provide for a significant increase in allowable area in most buildings.
- The area limitations of Table 506.2 represent the following increases where a sprinkler system is installed in the building:
 - an increase of 300 percent for one-story buildings
 - an increase of 200 percent for multistory buildings

Automatic Sprinkler System Increase Table 506.2

- The allowable area increase reflected in Table 506.2 for the installation of an automatic sprinkler system is only applicable where an NFPA 13 system is provided throughout the building.
- In addition, 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



Basements Section 506.1.3



Frontage Increase Section 506.3

- An increase in allowable area is permitted for buildings that have substantial open space adjacent to the exterior walls (to facilitate fire department access). Open space greatly limits the potential for exterior materials to contribute to a fire within the building.
- To qualify, the yard or public way must have a minimum width of 20 feet. No allowable area increase is given unless more than 25% of the building's perimeter has complying frontage.

Frontage Increase Section 506.3.3

 Formula to calculate the frontage increase (*I_f*) for allowable area purposes:

 $I_f = [F/P - 0.25] W/30$

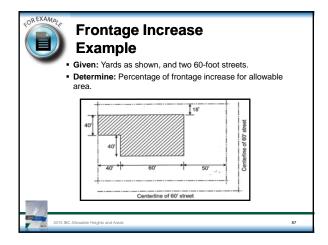
```
   It
   =
   Area factor increase due to frontage

   F
   =
   Building perimeter that fronts on a public way or open space having 20 feet open minimum distance

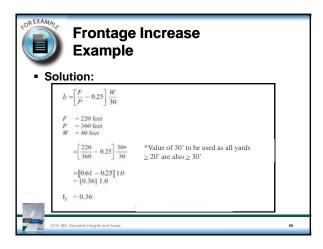
   P
   =
   Perimeter of entire building

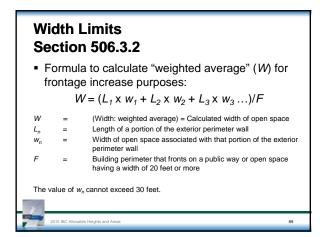
   W
   =
   Width of public way or open space per Section 506.3.2

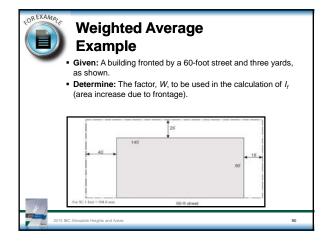
   The value of W must be a minimum of 20 feet. Where W exceeds 30 feet, a value of 30 feet is to be used. (Section 506.3.2)
```



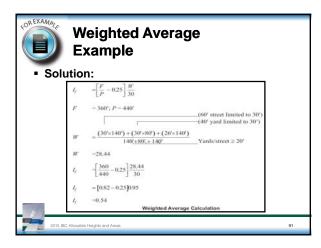


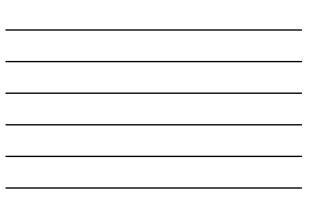






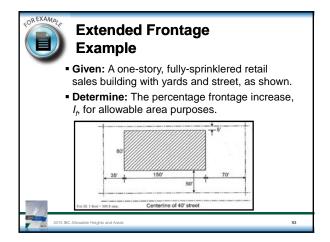




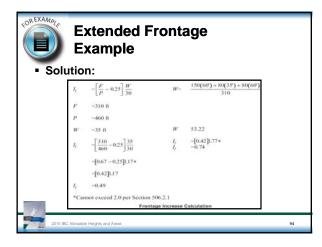


Width Limits Section 506.3.2, Exception

- 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.



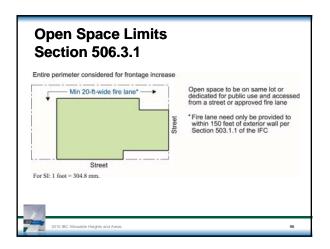






Open Space Limits Section 506.3.1

- 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.



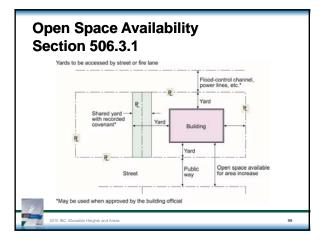


Open Space Availability Introduction

- 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?

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.



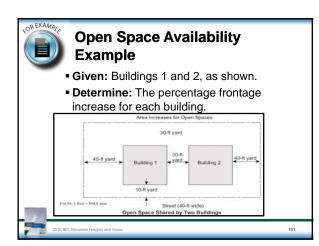


Open Space Availability Section 506.3.2

- 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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Open Space Availability Example

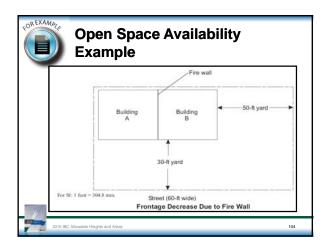
• Solution: Because both buildings are located on the same lot, both buildings may use the 30-foot yard that separates them for area increase. Each building may use the total perimeter for area increase, provided access is available in accordance with Section 506.3.2, 2.

Open Space Availability Section 506.3.2, Item 3

• A fire wall separates a single structure into two buildings. In this case, the use of the fire wall prohibits the use of the 50-foot yard for a frontage increase for Building A.

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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

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

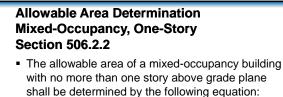
• The allowable area of a single-occupancy building with no more than one story above grade plane shall be determined by the following equation:

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

- = Allowable building area $A_a \\ A_t$
- 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) = Area factor increase due to frontage in accordance with Section 506.3
- **Total Allowable Area** Example 1 • Given: A one-story, Type VA building 18 housing a Group B occupancy. • Determine: The maximum allowable 35 220 area if the building is fully sprinklered (include frontage increase). 200 40 ohts and Are 107

Total Allow Example 1		
• Solution: $A_a = A_t +$ Tabular area (A_i) : Frontage increase $(NS \ge I_i)$: Total allowable area (A_a) : The building is limited to 76	72,000 sf <u>4,500 sf</u> 76,500 sf	S1, T506.2 18,000 x 0.25 Additive
2015 IBC Allowable Heights and Areas		108





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

• 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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Allowable Area Determination Mixed-Occupancy, One-Story Example

- 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?

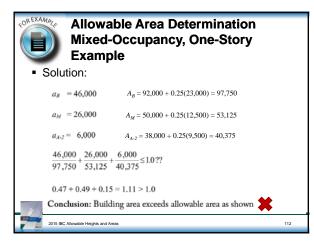
2015 IBC Allowable Heights and Areas

 $a_{B} / A_{B} + a_{M} / A_{M} + a_{A-2} / A_{A-2} \le 1.0?$

 OF EXAMPLY
 Allowable Area Determination dised-Occupancy, One-Story bample

 Image: Im







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.

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

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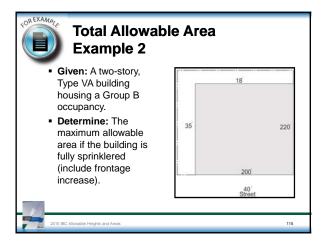
 Actual number of building stories above grade plane, not to exceed three. (not to exceed four for 13R sprinklered buildings) Ś,

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:

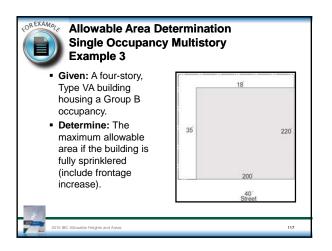
$$A_a = [A_t + (NS \times I_f)] \times S_a$$

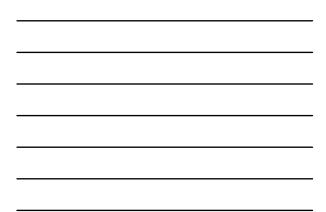
Using the value of S_a = 1





Total Allowa Example 2	ble Area	
• Solution: $A_a = [A_t + (A_t)]$	VS x I _f)] x S _a	
Frontage increase (NS x I_f): 7 Multistory increase (S_a)	2,000 sf <u>4,500 sf</u> <u>6,500 sf</u> <u>x 2</u> 53,000 sf	S1, T506.2 18,000 x 0.25 Additive 2 stories AGP
The building is limited to 153, permitted to exceed 76,500 sf.	000 sf, and no single	story is
2015 IBC Allowable Heights and Areas		116





Allowable Area Dete		
Single-Occupancy, M Example 3	nuitistory	
Solution: $A_a = [A_t + A_t]$	(<i>NS x I_f</i>)] x	S _a
Tabular area (A,):	72,000 sf	S1, T506.2
Frontage increase (NS x I_f):	<u>4,500 sf</u> 76,500 sf	18,000 x 0.25
Multistory increase (S_a) Total allowable area (A_a) :	<u>x 3*</u> 229,500 sf	Limit on stories
The building is limited to 22 to exceed 76,500 sf. If all stresult in a maximum of 57,3	ories have the	same floor area, it would
2015 IBC Allowable Heights and Areas		118

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

Heights and Area

- 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.

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.

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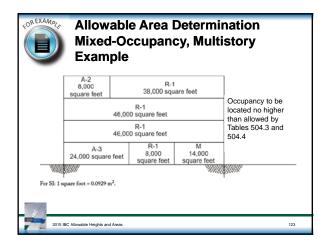
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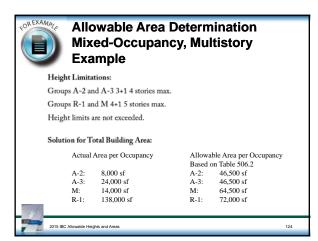
2015 IBC Allowable Heights and Areas

Allowable Area Determination Mixed-Occupancy, Multistory Example

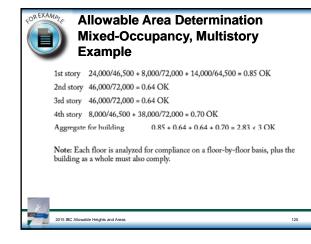
- **Given:** A fully sprinklered, four-story, Type IIA hotel, containing a Group A-2 restaurant, Group A-3 meeting rooms and Group M retail stores. The floor areas of each occupancy are as shown in the following slide. Inadequate frontage provides for no area increase.
- **Determine:** Does the building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









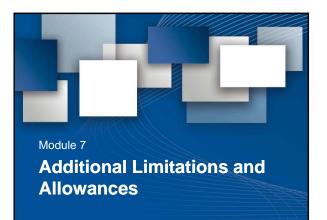


Mixed Occupancy Area Determination Section 506.5

- 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:

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- Accessory occupancies
- Nonseparated occupancies
- Separated occupancies



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

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

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Unlimited Area Buildings Section 507.1.1

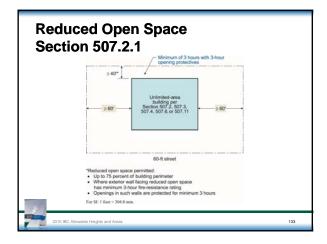
The use of the unlimited area provisions is limited to those occupancies specifically addressed in Section 507, but other occupancies are permitted where in compliance with Section 508.2 (Accessory Occupancies).

 Example:



Reduced Open Space Section 507.2.1

- Open space of at least 60 feet (18 288 mm) 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.





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).

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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.

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.

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.

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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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.

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.

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 (18 288 mm) yards and/or public ways.
- Assembly floor located within 21 inches (533 mm) 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).

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Group H Occupancies Section 507.8

- Although very limited in unlimited area buildings, hazardous materials may be found in greater quantities in manufacturing and storage facilities. Allowance is made for these materials. 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.

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.

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)

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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.

Mixed Occupancies Section 508

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

Accessory Occupancies Section 508.2

- Must be subsidiary to the main occupancy of the building or portion of a building.
- Aggregate accessory occupancies are limited to 10 percent of the floor area on the story on which they are located.
- The floor area of accessory occupancies cannot exceed the tabular values established by Table 506.2 for nonsprinklered buildings for each such accessory occupancy.

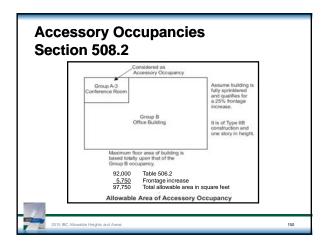
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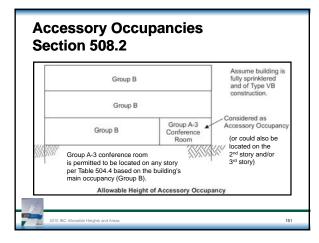
Accessory Occupancies Section 508.2

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.









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 fireresistance-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.

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Nonseparated Occupancies Section 508.3

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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.

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.

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Most restrictive type of construction is applied

of 30% available. 1st story contains G	tistory, fully sprinklere struction. Frontage inc roup M and A-2 occup o B occupancy above
Group	Group
M	A-2
Sales Tenant	Restaurar



19,800	29,700
2	3
es method, the maxir	num allowable
with a maximum of	two stories in the



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.
- It is also possible that no separation is required.

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Separated Occupancies Section 508.4

Allowable area

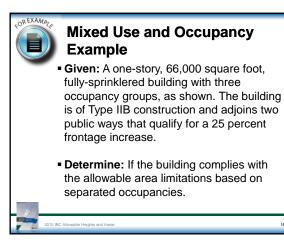
- The unity formula is used to determine allowable area per story. This provides a weighted average of the allowable areas for the different occupancies located on each story.
- Compliance is achieved where the sum of the ratios of the actual floor area divided by the allowable floor area for each of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

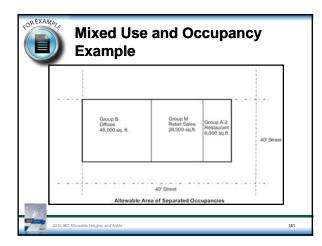
Separated Occupancies Section 508.4 Allowable area

The formula is:

$$a_1/A_1 + a_2/A_2 + a_3/A_3 + \ldots \le 1.0$$

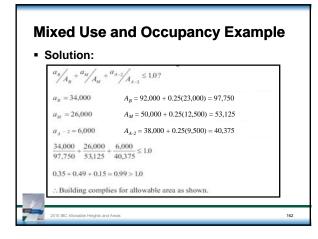
Where a_1 , a_2 and a_3 represent the actual floor areas of the individual occupancies, and A_1 , A_2 and A_3 represent the maximum allowable floor areas.





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Separated Occupancies Section 508.4

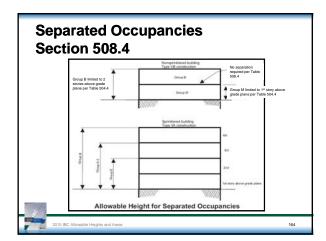
Allowable height

• The maximum allowable height of each occupancy is regulated independently based on the building's type of construction.

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• An occupancy cannot be located higher than that permitted by Section 503.1.



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*.

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.

Horizontal Building Separation Allowance Section 510.2

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 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.

Horizontal Building Separation Allowance Section 510.2

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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.
- Type of construction.



- Vertical enclosures through horizontal assembly to have a minimum fire-resistance rating of 2 hours (see exception for 3-hour/1-hour allowance).
- Building above horizontal assembly limited to Group A with individual occupant loads less than 300, B, M, R and/or S.
- Building below horizontal assembly to be any occupancy other than Group H.
- Maximum building height in feet based on most restrictive height of the upper and lower buildings.

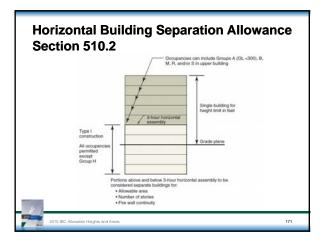
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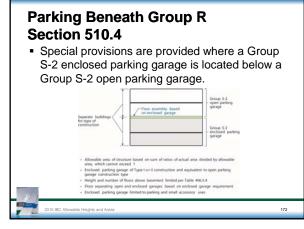
Horizontal Building Separation Allowance Section 510.2

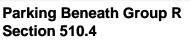
Requirements to be considered as separate and distinct buildings:

- Lower building of Type IA construction.
- Lower building separated from building above with horizontal assembly having a minimum fire-resistance rating of 3 hours.



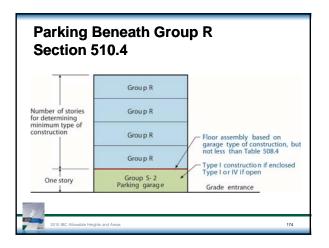






- Where parking is limited to the first story, the number of stories used in the determination of the minimum type of construction may be measured from the floor above the garage.
- The singular benefit provided by Section 510.4 is the allowance for an additional story above grade plane without requiring a higher type of construction.

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Group R-1 and R-2 Buildings of Type IIA and IIIA Construction Sections 510.5 and 510.6

 The height limitations for Group R-1 and R-2 buildings of Type IIA and IIIA construction are permitted to be increased if special conditions are met.

Buildings of Type IIA and IIIA Construction Sections 510.5, 510.6

For example, in Type IIA buildings the height limitation may be increased to 9 stories and 100 feet, where:

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- The building is separated by at least 50 feet from any other building on the lot and from lot lines.
- The exits are segregated in an area enclosed by a minimum 2-hour fire-resistance-rated fire wall.

Open Parking Garage Beneath Groups A, I, B, M and R Section 510.7

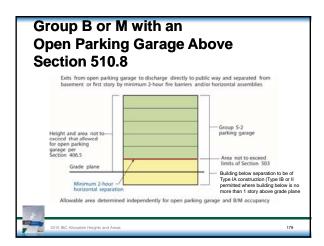
- Applies to open parking garages only.
- If in compliance, the areas above and below the horizontal separation are permitted to be regulated for allowable height and area as separate buildings.
- Specific fire separation and means of egress requirements have been established to address any reduction in construction type.

Group B or M with an Open Parking Garage Above Section 510.8

- Special provisions address a condition where an open parking garage is located above Group B or M occupancies—representing a desire to have offices and/or retail stores on the lower level(s) of open parking garages.
- The benefit provides for a potential reduction in the building's type of construction by permitting the evaluation of allowable floor areas independently for the open parking garage and the occupancy.

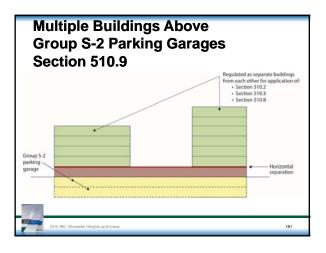
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Multiple Buildings Above Group S-2 Parking Garages Section 510.9

- Where the varying provisions of Section 509 are used to create separate buildings above and below a complying horizontal separation, it is permissible to have multiple buildings above the separation.
- This allowance is limited to those cases where there is a single open or enclosed parking garage below the horizontal separation.





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2015 IBC Allowable Heights and Areas

