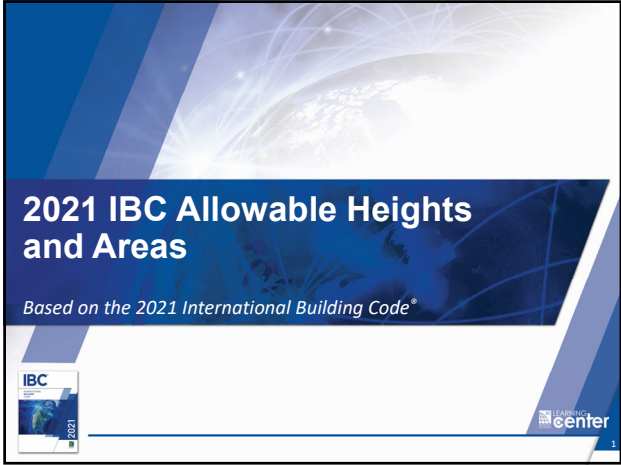
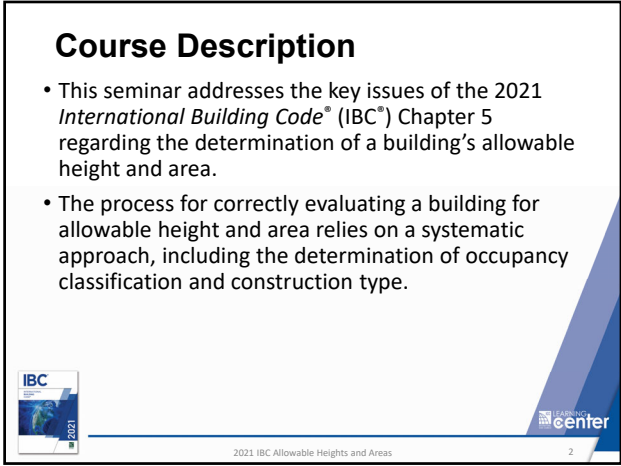


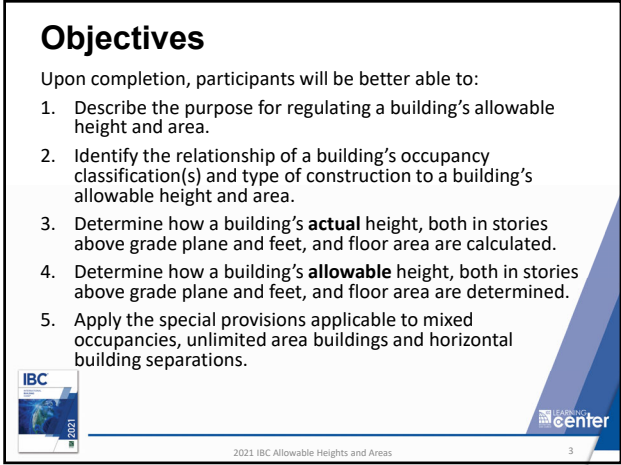
2021 IBC Allowable Heights & Areas



1





2



3

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





2021 IBC Allowable Heights and Areas 4

4

Concept of Allowable Heights and Areas

Module 1





2021 IBC Allowable Heights and Areas 5

5

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.



2021 IBC Allowable Heights and Areas 6

6

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.



7

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.



8



Allowable Height in Feet
Table 504.3

Partial
Table 504.3
Page 5-3

OCCUPANCY CLASSIFICATION	Size Footnotes	TABLE 504.3 ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE ^a											
		TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV		Type V		Type V	
		A	B	A	B	A	B	A	B	A	B	A	B
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS ^c	UL	160	65	55	65	55	120	90	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
H-4	NS ^d	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS ^e	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS ^f	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-4	NS ^g	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R ^h	NS ⁱ	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60

^a For SI: 1 foot = 304.8 mm.
^b UL = Unfired; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2, S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

(footnotes not shown)



9

REFER TO

CODE BOOK

Partial
Table 504.4
Page 5-4

Allowable Height in Stories Above Grade Plane Table 504.4

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE^a

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV		Type V		HT	
		A	B	A	B	A	B	A	B	A	B	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3

(other portions of table and footnotes not shown)

IBC

2021

LEARNING center

10

10

REFER TO

CODE BOOK

Partial
Table 506.2
Page 5-7

Allowable Area Factors Table 506.2

TABLE 506.2
ALLOWABLE AREA FACTOR (A = NS, S1, S1F, S1F or SM, as applicable) IN SQUARE FEET^a

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV		Type V		HT	
		A	B	A	B	A	B	A	B	A	B	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
A-2	SM	UL	UL	16,500	25,500	12,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
A-3	ST	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	ST	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	ST	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	ST	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
F	NS	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
	ST	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000

(other portions of table and footnotes not shown)

IBC

2021

LEARNING center

11

11

REFER TO

CODE BOOK

Partial
Table 504.3, 504.4 and 506.2

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.

IBC

2021

LEARNING center



12

12

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.





2021 IBC Allowable Heights and Areas 13

13

Allowable Area Modifications to Table 506.2

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 Sec. 509 horizontal separation
- Complies with Sec. 507 for unlimited area buildings
- Is located on a site with additional buildings





2021 IBC Allowable Heights and Areas 14

14

Relationship of Building Classification

Module 2





2021 IBC Allowable Heights and Areas 15

15

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.





2021 IBC Allowable Heights and Areas 16

16

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.





2021 IBC Allowable Heights and Areas 17

17

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.





2021 IBC Allowable Heights and Areas 18

18

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



2021 IBC Allowable Heights and Areas



19

19

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.



2021 IBC Allowable Heights and Areas



20

20

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.



2021 IBC Allowable Heights and Areas

21

21



Copyright 2023 International Code Council

EDUCODE 2024 – FOR CLASSROOM USE ONLY 7

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.





2021 IBC Allowable Heights and Areas 22

22

Type of Construction

Section 602.1

- The designer selects one of the 12 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.



2021 IBC Allowable Heights and Areas 23



23

Materials 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	
III IIIA IIIB	Exterior walls to be of noncombustible materials.
IV IV-A IV-B IV-C	Exterior and interior walls, floors, roof and structural elements to be of mass timber members or noncombustible materials.
IV-HT	Exterior walls to be of noncombustible materials. Interior element to be of heavy timber members.
V VA VB	Combustible materials permitted throughout.

See Sections 602 and 603 for allowances, modifications and exceptions.



2021 IBC Allowable Heights and Areas 24

24

Fire-Resistance of Construction

Table 601

- Types of building elements regulated for fire-resistance-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 fire-resistance requirements of the table.

IBC

2021

LEARNING center

25

25

REFER TO

IBC

INTERNATIONAL CODE COUNCIL

CODE BOOK

Table 601

Page 6-1

Type of Construction Minimum Fire-Resistance Ratings

Table 601

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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV		HT	TYPE V	
	A	B	A	B	A	B	C	D		A	B
Primary structural frame ^a (see Section 202)	3 ^h	2 ^h	1 ^h	0 ^h	0	0	2 ^h	2 ^h	1H	1 ^h	0
Bearing walls											
Exterior ^c	3	2	1	0	2	2	3	2	2	1	0
Interior	3 ^h	2 ^h	1	0	1	0	3	2	1H/1 ^h	1	0
Nonbearing walls and partitions											
Exterior											
Nonbearing walls and partitions											
Interior ^d	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	1H	1	0
Roof construction and associated secondary structural members (see Section 202)	1 ^{1/2}	1 ^h	1 ^h	0 ^h	1 ^h	0	1 ^{1/2}	1	1H	1 ^h	0

For SI: 1 foot = 304.8 mm.

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

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

d. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.

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

f. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).

g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

IBC

2021

LEARNING center

26

26

Calculation of Actual Building Height and Area

Module 3

IBC

2021



LEARNING center

27

27

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.





2021 IBC Allowable Heights and Areas 28

28

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.





2021 IBC Allowable Heights and Areas 29

29

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.



2021 IBC Allowable Heights and Areas 30

30

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:

Average of roof height

Flat roof

Average of highest gable

Pitched or hipped roof

2021 IBC Allowable Heights and Areas

center

31

31

Grade Plane Section 202

- Grade plane is relatively simple 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.

2021 IBC Allowable Heights and Areas

center

32

32

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.

2021 IBC Allowable Heights and Areas

center

33



33

Copyright 2023 International Code Council

EDUCODE 2024 – FOR CLASSROOM USE ONLY 11

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.





2021 IBC Allowable Heights and Areas 34

34

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:

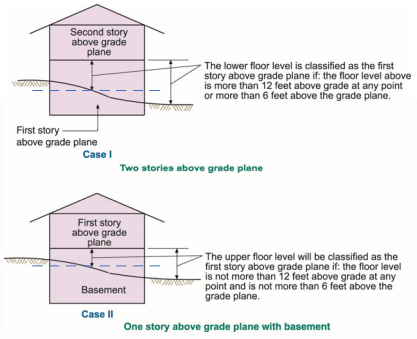
- More than 6 feet above grade plane, or
- More than 12 feet above the finished ground level at any point.



2021 IBC Allowable Heights and Areas 35



35

Story Above Grade Plane Section 202



The lower floor level is classified as the first story above grade plane if: the floor level above is more than 12 feet above grade at any point or more than 6 feet above the grade plane.

The upper floor level will be classified as the first story above grade plane if: the floor level is not more than 12 feet above grade at any point and is not more than 6 feet above the grade plane.





2021 IBC Allowable Heights and Areas 36

36

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.



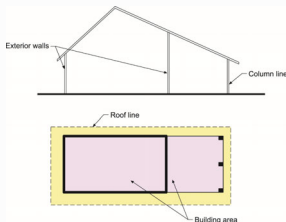


2021 IBC Allowable Heights and Areas 37

37

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.



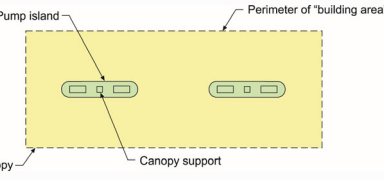


2021 IBC Allowable Heights and Areas 38

38

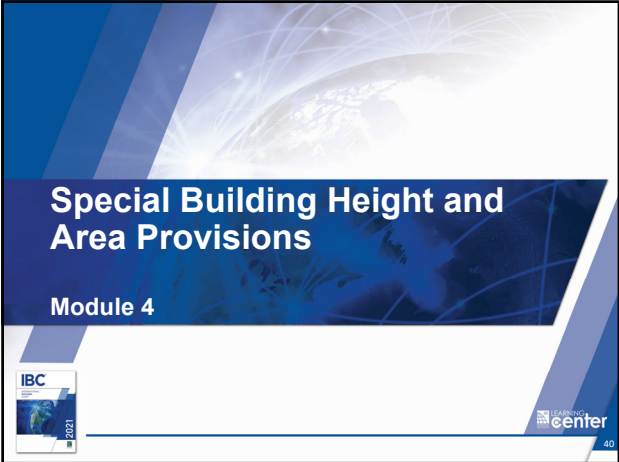
Building Area Section 202

- 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.

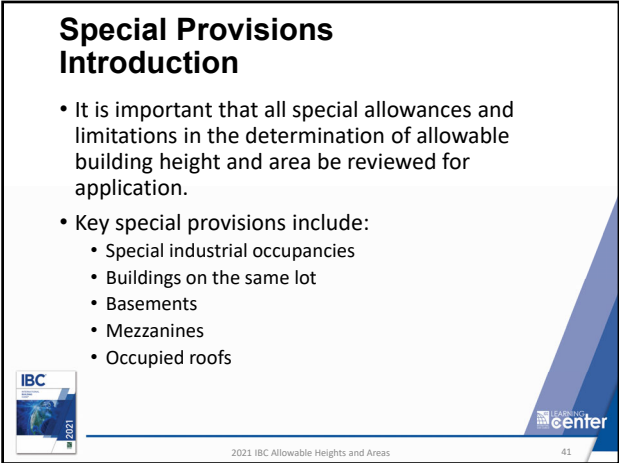


2021 IBC Allowable Heights and Areas 39

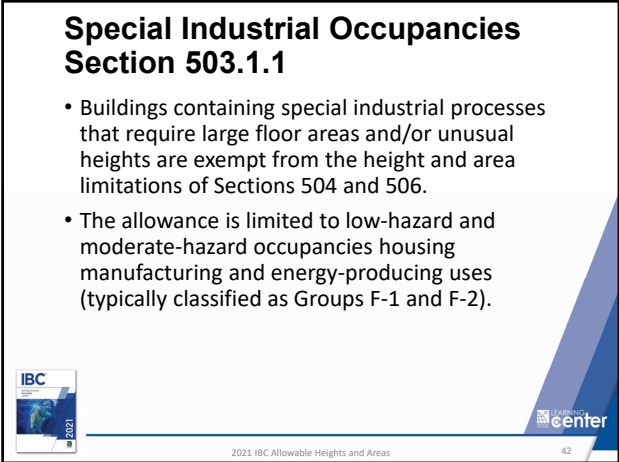
39



40



41



42

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





2021 IBC Allowable Heights and Areas



43

43

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.





2021 IBC Allowable Heights and Areas

44

44

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.



2021 IBC Allowable Heights and Areas

45

45

Buildings on Same Lot Section 705.3

Buildings 1 and 2 regulated as two separate and distinct buildings

2021 IBC Allowable Heights and Areas

46

46

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.

2021 IBC Allowable Heights and Areas

47

47

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

2021 IBC Allowable Heights and Areas

48

48

Buildings on Same Lot

Section 503.1.2

Building 1a

Building 1b

No assumed imaginary line

Buildings 1 and 2 regulated as portions of a single building

IBC 2021

2021 IBC Allowable Heights and Areas

49

49

Buildings on Same Lot

Example 2

A: separate buildings

Group B IIB construction
23,000 sq ft
3 stories
55 ft

Group B VB construction
9,000 sq ft
2 stories
40 ft

Buildings regulated independently for allowable height and area
For SI: 1 foot = 304.8 mm; 1 square foot = 0.093 m².

Assumed imaginary line

B: single building

Group B IIB construction
2 stories
40 ft

Group B VB construction
2 stories
40 ft

Aggregate allowable area limited to 9,000 sq ft as both buildings regulated as Type VB construction

Height limited in feet and stories above grade plane based upon Type VB construction of other building

Note: Assuming nonsprinklered buildings

IBC 2021

2021 IBC Allowable Heights and Areas

50

50

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 the actual height is measured from the grade plane.
 - Basements are not a factor in building height in stories because Table 504.4 regulates the 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.

IBC 2021

2021 IBC Allowable Heights and Areas



51

51

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.



2021 IBC Allowable Heights and Areas

52



52

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.



2021 IBC Allowable Heights and Areas

53



53

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.



2021 IBC Allowable Heights and Areas

54

54

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.

Total area of mezzanine(s) $\leq \frac{1}{3}$ room area

IBC 2021

2021 IBC Allowable Heights and Areas

55

55

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.

Floor area of mezzanine limited to 50% of room in which located

IBC 2021

2021 IBC Allowable Heights and Areas

56

Building to be

- Type I or II construction
- Fully sprinklered
- Provided with emergency voice/alarm communication system

56

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.

IBC 2021

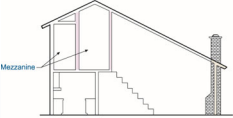
2021 IBC Allowable Heights and Areas

57

57

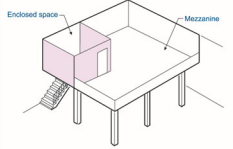
Mezzanine Openness Section 505, Exceptions 1 and 3

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



Mezzanine



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



Enclosed space

Mezzanine

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



2021 IBC Allowable Heights and Areas



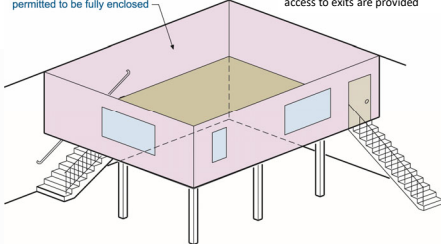
58

58

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



2021 IBC Allowable Heights and Areas

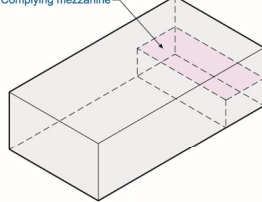
59

59

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

For SI: 1 square foot = 0.093 m².

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



2021 IBC Allowable Heights and Areas



60

60

Occupied Roofs

Section 503.1.4

- A roof level is permitted to be used as an occupied roof provided the rooftop occupancy is permitted by Table 504.4 to be located on the story immediately below the roof.
 - Exceptions permitted for sprinklered buildings with occupant notification extended to roof area, and for Type I or II open parking garages.
- Area of occupied roofs are not to be included in building area, building height or number of stories.



2021 IBC Allowable Heights and Areas 61

61

Occupied Roofs



Section 503.1.4

Example:
If building of Type VA construction,
Group B: 4 stories max. (S)
Group A-3: 3 stories max. (S)

Notification appliances shall be provided per Section 907.5

A-3 on roof	
B	Sprinkler system required throughout per Section 903.3.1.1
B	
B	
B	

Except for complying penthouses, enclosures of occupied roof areas limited to 48" above roof surface





2021 IBC Allowable Heights and Areas 62

62

Determining Maximum Allowable Building Height

Module 5





2021 IBC Allowable Heights and Areas 63

63

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.





2021 IBC Allowable Heights and Areas 64

64


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 sprinkler system
 - S13R = buildings equipped throughout with an NFPA 13R sprinkler system
 - S13D = buildings equipped throughout with an NFPA 13D sprinkler system



2021 IBC Allowable Heights and Areas 65

65





Partial Table 504.3 Page 5-3

Allowable Height in Feet Table 504.3

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE^a

OCCUPANCY CLASSIFICATION	Size Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV		Type V			
		A	B	A	B	A	B	A	B	C	H ^b	A	B
A, B, E, F, M, S, U	NS ^c	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS ^c	UL	160	65	55	65	55	120	90	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
H-4	NS ^c	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 1, I-3	NS ^c	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS ^c	UL	160	65									
	S	UL	180	85	55	65	55	65	65	65	65	50	40
I-4	NS ^c	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R ^a	NS ^c	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60


For SI: 1 foot = 304.8 mm.
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 903.3.1.3. S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3. S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.
(footnotes not shown)



2021 IBC Allowable Heights and Areas 66

66

REFER TO



CODE BOOK

Partial
Table 504.4
Page 5-4

Allowable Height in Stories Above Grade Plane Table 504.4

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE^{a,b}

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV		Type V		Type V	
		A	B	A	B	A	B	A	B	A	B	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3

(other portions of table and footnotes not shown)

IBC

2021

LEARNING center

67

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 above grade plane if:
 - the building is not sprinklered, and
 - if the building is sprinklered.

IBC

2021

LEARNING center

68

Allowable Height Increase Example #1

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

Group B
Type VB

2 stories
40
Max.

Not sprinklered

Group B
Type VB

3 stories
60
Max.

Sprinklered

Height Increases for Sprinklers

IBC

2021

LEARNING center

69



Copyright 2023 International Code Council

EDUCODE 2024 – FOR CLASSROOM USE ONLY

23

Group R Occupancies Tables 504.3 and 504.4

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





2021 IBC Allowable Heights and Areas 70

70

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.

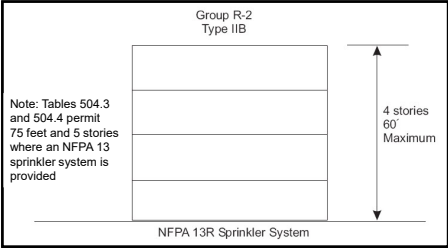


2021 IBC Allowable Heights and Areas 71

71

Group R Occupancies Example 2

- **Solution:**





Note: Tables 504.3 and 504.4 permit 75 feet and 5 stories where an NFPA 13 sprinkler system is provided

Group R-2 Type IIB

4 stories
60' Maximum

NFPA 13R Sprinkler System





2021 IBC Allowable Heights and Areas 72

72

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.





2021 IBC Allowable Heights and Areas 73

73

Roof Structures Section 504.3, Exception

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

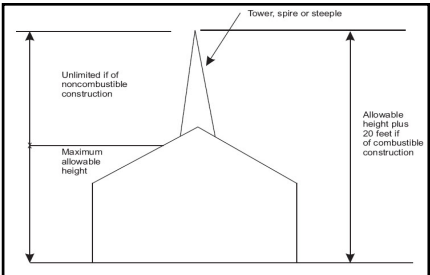
- Exception to Section 504.3, which regulates such roof structures in regard to the contribution to the overall height of the building.
- Section 1511 deals more with rooftop structures as independent elements.





2021 IBC Allowable Heights and Areas 74

74

Roof Structures Section 504.3, Exception



Height Limits of Roof Structures



2021 IBC Allowable Heights and Areas 75

75

Roof Structures Example

Maximum permitted height if nonsprinklered building
40 feet (Table 504.3)
+ 20 feet (Sec. 504.3, Exc.)
60 feet

Maximum permitted height if sprinklered building
60 feet (Table 504.3)
+ 20 feet (Sec. 504.3, Exc.)
80 feet

Maximum roof height limited by Table 504.3 and the Exception to Section 504.3, if applicable

Combustible Steeple*

Group A-3
Type VB

* No limit if of noncombustible construction

For SI: 1 foot = 304.8 mm.

IBC 2021

International Code Center

2021 IBC Allowable Heights and Areas 76

76

Determining Maximum Allowable Building Area

Module 6

IBC 2021

International Code Center

77

77

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.

IBC 2021



International Code Center

2021 IBC Allowable Heights and Areas 78

78


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 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



2021 IBC Allowable Heights and Areas 79

79

REFER TO

CODE BOOK



Partial
Table 506.2
Page 5-7

Allowable Area Factors Table 506.2

TABLE 506.2
ALLOWABLE AREA FACTOR (A = NS, S1, S1R, S150 or SM, as applicable) IN SQUARE FEET^a

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	G	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
A-2	SM	UL	UL	16,500	25,500	12,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
A-4	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000

(other portions of table and footnotes not shown)





2021 IBC Allowable Heights and Areas 80

80

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 also 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 at least 25% of the building's perimeter has complying frontage.





2021 IBC Allowable Heights and Areas 81

81

Frontage Increase

Section 506.3.2

- The minimum 20-foot public way or open space adjacent to the building perimeter is to be measured at right angles from the building space to the:
 - Closest interior lot line, or
 - Entire width of a street, alley or public way , or
 - Exterior face of an adjacent building on the same lot



2021 IBC Allowable Heights and Areas 82



82

Frontage Increase

Section 506.3.2

- The frontage increase (I_f) is to be based upon two factors as applied in Table 506.3.3:
 - The smallest public way or open space that is 20 feet or greater, and
 - The percentage of building perimeter having a minimum of 20 feet of open space and/or public ways.

PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)			
	0 to less than 20	20 to less than 25	25 to less than 30	30 or greater
0 to less than 25	0	0	0	0
25 to less than 50	0	0.17	0.21	0.25
50 to less than 75	0	0.33	0.42	0.50
75 to 100	0	0.50	0.63	0.75



2021 IBC Allowable Heights and Areas 83

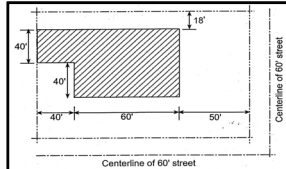
83



Frontage Increase

Example 1

- **Given:** Yards as shown, and two 60-foot streets.
- **Determine:** Percentage of frontage increase for allowable area.
- **Solution:** Smallest open space $\geq 20'$: 40 feet
Percentage of perimeter $\geq 20'$ open: 61%
(based on 220/360)

Frontage increase (I_f): 0.50 Based on Table 506.3.3





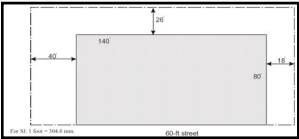
2021 IBC Allowable Heights and Areas 84



84

Frontage Increase Example 2

- Given: A building fronted by a 60-foot street and three yards, as shown.
- Determine: The factor, W , to be used in the calculation of I_f (area increase due to frontage).
- Solution: Smallest open space $\geq 20'$: 26 feet
Percentage of perimeter $\geq 20'$ open: 82%
(based on 360/440)

Frontage increase (I_f): 0.63 Based on Table 506.3.3





2021 IBC Allowable Heights and Areas 85



85

Frontage Increase for Section 507 Buildings Section 506.3.3.1

- Table 506.3.3.1 can be used to determine the frontage increase for unlimited area buildings that would be regulated by Section 507 except for compliance with the open space requirements.

PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)					
	30 to less than 35	35 to less than 40	40 to less than 45	45 to less than 50	50 to less than 55	55 to less than 60
0 to less than 25	0	0	0	0	0	0
25 to less than 50	0.29	0.33	0.38	0.42	0.46	0.50
50 to less than 75	0.58	0.67	0.75	0.83	0.92	1.00
75 to 100	0.88	1.00	1.13	1.25	1.38	1.50

*. Interpolation is permitted.





2021 IBC Allowable Heights and Areas 86

86

Frontage Increase Section 506.3.2

- There are situations where it will be advantageous for the designer to not consider all portions of the open space or public way that are 20 feet or more in width.
 - It is acceptable to ignore open space where its inclusion in the application of Table 506.3.3 will result in a smaller frontage increase.





2021 IBC Allowable Heights and Areas 87

87

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.




2021 IBC Allowable Heights and Areas 88

88

Open Space Limits Section 506.3.1



Entire perimeter considered for frontage increase



Min 20-ft-wide fire lane*

Street

For SI: 1 foot = 304.8 mm.





2021 IBC Allowable Heights and Areas 89

89

Open Space Availability Introduction

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





2021 IBC Allowable Heights and Areas 90

90

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.



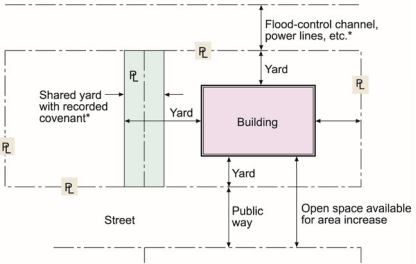
2021 IBC Allowable Heights and Areas 91

91



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





2021 IBC Allowable Heights and Areas 92

92

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.



2021 IBC Allowable Heights and Areas 93

93

Open Space Availability Example

- **Given:** Buildings 1 and 2, as shown.
- **Determine:** The percentage frontage increase for each building.

Area Increases for Open Spaces

30-ft yard

45-ft yard

30-ft yard

40-ft yard

10-ft yard

Street (40-ft wide)

Open Space Shared by Two Buildings

For SI: 1 foot = 304.8 mm.

2021 IBC Allowable Heights and Areas

94

94

Open Space Availability Example

- **Solution:** Because the 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 506.3.1.

Area Increases for Open Spaces

30-ft yard

45-ft yard

30-ft yard

40-ft yard

10-ft yard

Street (40-ft wide)

Open Space Shared by Two Buildings

For SI: 1 foot = 304.8 mm.

2021 IBC Allowable Heights and Areas

95

95

Open Space Availability Example

- 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.

Area Increases for Open Spaces

30-ft yard

45-ft yard

30-ft yard

40-ft yard

10-ft yard

Street (40-ft wide)

Open Space Shared by Two Buildings

For SI: 1 foot = 304.8 mm.

2021 IBC Allowable Heights and Areas



96

96

Allowable Area Determination

Section 506.2

- Determination of the allowable area of a building differs depending on the conditions presented:
 - Single-occupancy buildings Section 506.2.1
 - Mixed-occupancy buildings Section 506.2.2
- Under both conditions, the allowable area is determined for:
 - Each individual story, and
 - Entire building



2021 IBC Allowable Heights and Areas 97

97



Allowable Area Determination

Single-Occupancy, Each Story

Section 506.2.1

- The allowable area of each individual story in a **single-occupancy building** is determined by the following equation:
$$A_a = A_t + (NS \times I_f) \quad \text{(Equation 5-1)}$$

A_a = Allowable building area
 A_t = Tabular allowable area factor (NS, S1, SM, S13R or S13D 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



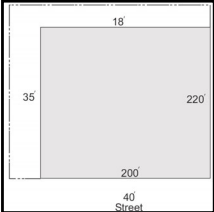
2021 IBC Allowable Heights and Areas 98

98

Allowable Area

Example 1

- **Given:** A 1-story, Type VA building housing a Group B occupancy.
- **Determine:** The maximum allowable area if the building is fully sprinklered (include frontage increase).





18'

220'

200'

40' Street

35'



2021 IBC Allowable Heights and Areas 99

99



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>9,000 sf</u>	18,000 x 0.50*
Total allowable area (A_a):	81,000 sf	Additive

*Based on Table 506.3.3, w/50% open $\geq 20'$, open space $\geq 30'$

The story/building is limited to 81,000 sf.

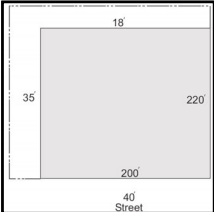




2021 IBC Allowable Heights and Areas 100

100

Allowable Area Example 2

- **Given:** A 2-story, Type VA building housing a Group B occupancy.
- **Determine:** The maximum allowable area if the building is fully sprinklered (include frontage increase).





2021 IBC Allowable Heights and Areas 101

101



Allowable Area for Building Example 2

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

Tabular area (A_t):	54,000 sf	SM, T506.2
Frontage increase ($NS \times I_f$):	<u>9,000 sf</u>	18,000 x 0.50*
Total allowable area per story (A_a):	63,000 sf	Additive

*Based on Table 506.3.3, w/50% open $\geq 20'$, open space $\geq 30'$

Each story is limited to 63,000 sf
Building is limited to 126,000 sf
Based on 63,000 x 2 (stories in building) = 126,000 sf



2021 IBC Allowable Heights and Areas 102

102

IBC

2021

2021 IBC Allowable Heights and Areas

103

Allowable Area Determination
Single-Occupancy, ≥ 4 Stories AGP
Section 506.2.1

• The allowable area of a single-occupancy building four or more stories above grade plane is determined by Equation 5-2:

• The actual area of any individual story shall not exceed the allowable area per Equation 5-1.

103

IBC

2021

2021 IBC Allowable Heights and Areas

104

Allowable Area Determination
Single-Occupancy, ≥ 4 Stories AGP
Section 506.2.1

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

(Equation 5-2)

A_a = Allowable building area

A_t = Tabular allowable area factor (NS, SM, S13R or S13D 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 = 3 where the actual number of stories above grade plane exceeds three, or

S_a = 4 where the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (13R)

104

IBC

2021

2021 IBC Allowable Heights and Areas

105

Allowable Area, ≥ 4 Stories AGP
Example 3

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

• **Determine:** The maximum allowable area if the building is fully sprinklered (include frontage increase).

18'

35'

220'

200'

40' Street

105

Copyright 2023 International Code Council

EDUCODE 2024 – FOR CLASSROOM USE ONLY 35



Allowable Area, ≥ 4 Stories AGP Example 3

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

Tabular area (A_t):	54,000 sf	SM, T506.2
Frontage increase ($NS \times I_f$):	<u>9,000 sf</u>	18,000 x 0.50*
Allowable area (A_a):	63,000 sf	Additive
Buildings ≥ 4 stories:	<u>x 3</u>	S_a
Building allowable area:	189,000 sf	Equation 5-2

*Based on Table 506.3.3, w/50% open $\geq 20'$, open space $\geq 30'$

Total building allowable area limited to 189,000 sf
No single story is permitted to exceed 63,000 sf
If all stories have same floor area, 47,250 sf per story

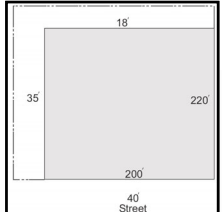




2021 IBC Allowable Heights and Areas 106

106

Allowable Area, 13R Building Example 4

- 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).





2021 IBC Allowable Heights and Areas 107

107



Allowable Area, 13R Building Example 4

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

Tabular area (A_t):	12,000 sf	S13R , T506.2
Frontage increase ($NS \times I_f$):	<u>6,000 sf</u>	12,000 x 0.50*
Allowable area (A_a):	18,000 sf	Additive
Buildings ≥ 4 stories:	<u>x 4</u>	S_a
Building allowable area:	72,000 sf	Equation 5-2

*Based on Table 506.3.3, w/50% open $\geq 20'$, open space $\geq 30'$

Total building allowable area limited to 72,000 sf
No single story is permitted to exceed 18,000 sf



2021 IBC Allowable Heights and Areas 108

108

IBC

2021

2021 IBC Allowable Heights and Areas

109

Allowable Area Determination
Mixed-Occupancy, Each Story
Section 506.2.2

- The allowable area of **each story** of a mixed-occupancy building is based on the applicable provisions of:
 - Section 508.3.2 Nonseparated occupancies
 - Section 508.4.2 Separated occupancies
- Where a mixed-occupancy condition is regulated by the accessory occupancy provisions, Section 508.2.3 permits the allowable area to be based on the main occupancy of the building.

109

IBC

2021

2021 IBC Allowable Heights and Areas

110

Allowable Area Determination
Four or More Stories
Section 506.2.2

- Total allowable area of a mixed-occupancy **building** with 4 or more stories above grade plane is determined by:
$$\frac{a_{Story\ 1}}{A_{Story\ 1}} + \frac{a_{Story\ 2}}{A_{Story\ 2}} + \frac{a_{Story\ 3}}{A_{Story\ 3}} + \frac{a_{Story\ 4}}{A_{Story\ 4}} + \dots \leq 3$$
Where $a_{Story\ 1}$, $a_{Story\ 2}$, $a_{Story\ 3}$ and $a_{Story\ 4}$ represent the actual floor areas of each individual story, and $A_{Story\ 1}$, $A_{Story\ 2}$, $A_{Story\ 3}$ and $A_{Story\ 4}$ represent the maximum allowable floor areas.
- For buildings designed as separated occupancies, sum of ratios not to exceed 4 for buildings equipped with NFPA 13R sprinkler system.

110

IBC

2021

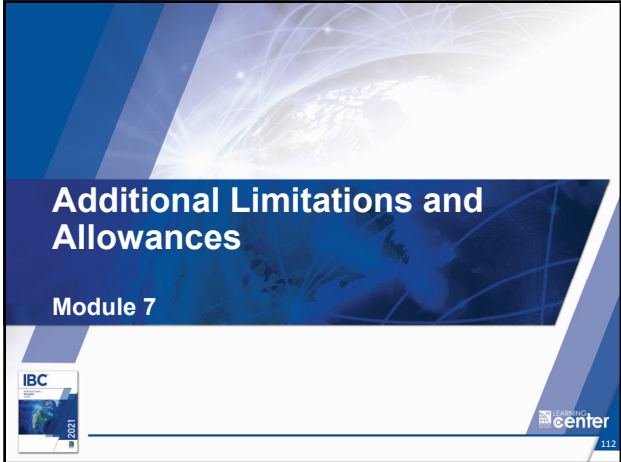
2021 IBC Allowable Heights and Areas

111

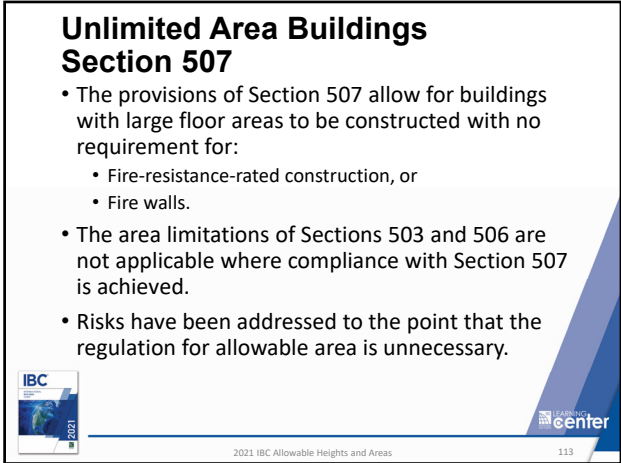
Group H-2 or H-3 Mixed Occupancies
Section 506.2.2.1

- For mixed-occupancy building containing Group H-2 or H-3 occupancies, allowable area increase for sprinkler protection applicable only to those portions of building not classified as Group H-2 or H-3.

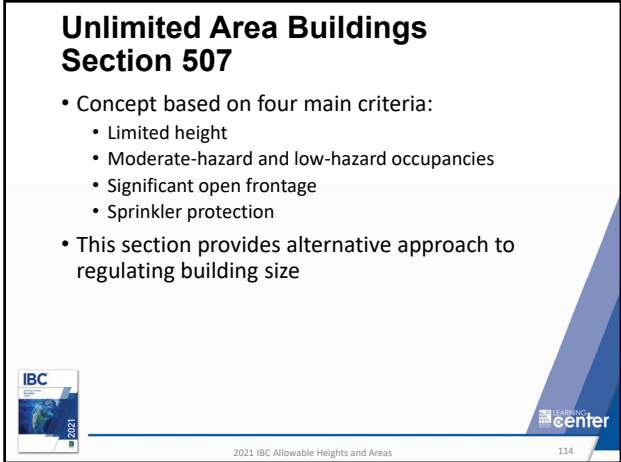
111



112





113



114

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



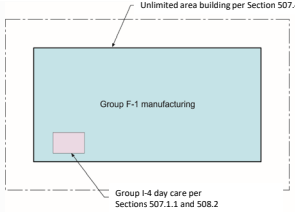
2021 IBC Allowable Heights and Areas 115

115



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:



*Only applicable where day-care facility is considered as subsidiary to manufacturing operation





2021 IBC Allowable Heights and Areas 116

116

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.





2021 IBC Allowable Heights and Areas 117

117

**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.





2021 IBC Allowable Heights and Areas 118

118

**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.





2021 IBC Allowable Heights and Areas 119

119

**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.



2021 IBC Allowable Heights and Areas 120

120

IBC

2021

2021 IBC Allowable Heights and Areas

121

Group A-1 and A-2 Occupancies Section 507.4.1 (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.

121

IBC

2021

2021 IBC Allowable Heights and Areas

122

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.

122

IBC

2021

2021 IBC Allowable Heights and Areas

123

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.

123

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).





2021 IBC Allowable Heights and Areas 124

124

Reduced Open Space Section 507.2.1

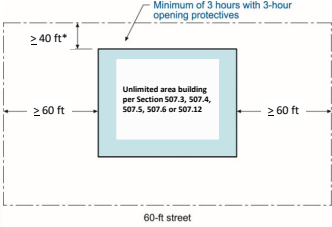
- Open space of at least 60 feet (18 288 mm) must be provided around complying unlimited area buildings. The minimum 60-foot width is permitted to be reduced to 40 feet provided:
 - The reduced open space applies to a maximum of 75 percent of the building’s perimeter, and
 - A minimum 3-hour fire-resistance 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.



2021 IBC Allowable Heights and Areas 125

125

Reduced Open Space Section 507.2.1



Minimum of 3 hours with 3-hour opening protectives

≥ 40 ft*

≥ 60 ft



Unlimited area building per Section 507.3, 507.4, 507.5, 507.6 or 507.12

60-ft street

*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.





2021 IBC Allowable Heights and Areas 126

126

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).





2021 IBC Allowable Heights and Areas 127

127

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





2021 IBC Allowable Heights and Areas 128

128

Group H Occupancies Section 507.8

- Aggregate floor area of Group H occupancies located at the building’s perimeter limited to 10% 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% of Group H area limits as specified in Section 506.





2021 IBC Allowable Heights and Areas 129

129

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)



2021 IBC Allowable Heights and Areas 130



130

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.**
- Fire protection systems.
- Separation.





2021 IBC Allowable Heights and Areas 131

131

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





2021 IBC Allowable Heights and Areas 132

132

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.





2021 IBC Allowable Heights and Areas 133

133

Accessory Occupancies Section 508.2

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



Allowable Area of Accessory Occupancy



2021 IBC Allowable Heights and Areas 134

134

Accessory Occupancies Section 508.2





2021 IBC Allowable Heights and Areas 135

135

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.





2021 IBC Allowable Heights and Areas 136

136

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.





2021 IBC Allowable Heights and Areas 137

137

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



2021 IBC Allowable Heights and Areas 138

138

Nonseparated Occupancies Section 508.3



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

Group M
Sales Tenant

Group A-2
Restaurant

Regulated as
Nonseparated Occupancies

Allowable Height and Area of Nonseparated Occupancies



2021 IBC Allowable Heights and Areas



139

139

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.





2021 IBC Allowable Heights and Areas

140

140

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.



2021 IBC Allowable Heights and Areas

141

141



Copyright 2023 International Code Council

EDUCODE 2024 – FOR CLASSROOM USE ONLY 47

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.



2021 IBC Allowable Heights and Areas 142

142



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.

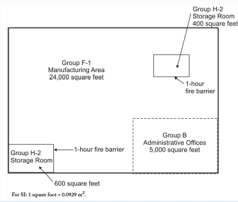


2021 IBC Allowable Heights and Areas 143

143

Separated Occupancies Example

- **Given:** A one-story, 30,000 square foot, fully-sprinklered building with three occupancy groups, as shown. The building is of Type VB construction and qualifies for a 50% frontage increase.
- **Determine:** If the building complies with the allowable area limitations based on separated occupancies.



Group F-1 Manufacturing Area 25,000 square feet



Group H-2 Storage Room 200 square feet

Group B Administrative Offices 5,000 square feet

1-hour fire barrier

600 square feet

For 1-hour fire barrier = 6000 sq ft



2021 IBC Allowable Heights and Areas 144

144

Separated Occupancies Example

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

$a_{F-1} = 24,000$	$A_{H-2} = 3,000$	T506.2 (no sprinkler increase per Sec. 506.2.2.1)
$a_B = 5,000$	$+ 1,500$	Frontage
$a_{H-2} = 1,000$	$= 4,500$	Total Allowable

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

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

$0.63 + 0.12 + 0.22 = 0.97 < 1.0$ **OK**

2021 IBC Mixed Occupancies

145

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.

2021 IBC Allowable Heights and Areas

146

Separated Occupancies Section 508.4

The diagram illustrates the allowable heights for separated occupancies in two types of buildings:

- Non-sprinklered building (Type VB construction):** Shows two levels, Group B and Group M. A note states "No separation required per Table 508.4".
- Sprinklered building (Type VA construction):** Shows four levels: 4th, 3rd, 2nd, and 1st story above grade plane. It also shows Group B, Group A-3, and Group E. A note states "Group M limited to 1st story above grade plane per Table 504.4".

Allowable Height for Separated Occupancies

2021 IBC Allowable Heights and Areas

147

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 height and area limitations, as well as type of construction.

Example of nonsprinklered structure



Building "A"
Group B
VB construction
9,000 sq ft
2 stories
40 ft

Building "B"
Group B
IB construction
23,000 sq ft
3 stories
55 ft

Both buildings "A" and "B" considered separate buildings for purposes of allowable height and area

Fire wall complying with Section 706

For SI: 1 foot = 304.8 mm, 1 square foot = 0.093 m².



2021 IBC Allowable Heights and Areas 148

148

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*.

IBC 2021

IBCCenter

2021 IBC Allowable Heights and Areas 149

149

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.

IBC 2021

IBCCenter

2021 IBC Allowable Heights and Areas 150

150

IBC

2021

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.

Page 85

2021 IBC Allowable Heights and Areas

151

center

151

IBC

2021

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.
- Type of construction.

2021 IBC Allowable Heights and Areas

152

center

152

IBC

2021

Horizontal Building Separation Allowance

Section 510.2

- 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.

2021 IBC Allowable Heights and Areas

153

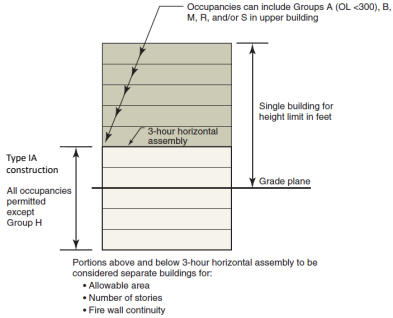
center



153

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 Type IA horizontal assembly having a minimum fire-resistance rating of 3 hours.

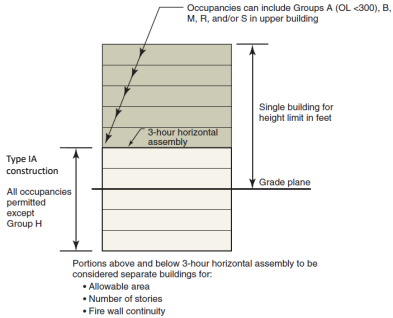






2021 IBC Allowable Heights and Areas154

154

Horizontal Building Separation Allowance Section 510.2



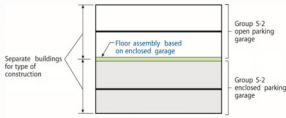




2021 IBC Allowable Heights and Areas155

155

Enclosed Parking Garage Above Open Parking Garage Section 510.3

If special provisions are met where a Group S-2 enclosed parking garage is located below a Group S-2 open parking garage, the open parking garage may be classified as a separate and distinct building for type of construction determination.







2021 IBC Allowable Heights and Areas156

156

Parking Beneath Group R Section 510.4

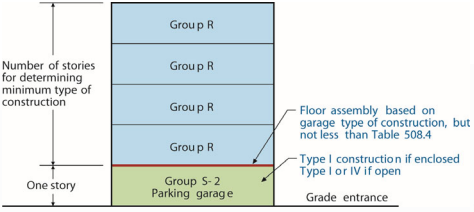
- Where parking is limited to the first story, the number of stories used in the determination of the minimum type of construction may be measured from the floor above the garage.
- The singular benefit provided by Section 510.4 is the allowance for an additional story above grade plane without requiring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



2021 IBC Allowable Heights and Areas 157

157

Parking Beneath Group R Section 510.4



Number of stories for determining minimum type of construction

One story

Group R

Group R

Group R



Group R

Group S-2 Parking garage

Floor assembly based on garage type of construction, but not less than Table 508.4

Type I construction if enclosed Type I or IV if open

Grade entrance





2021 IBC Allowable Heights and Areas 158

158

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.



2021 IBC Allowable Heights and Areas 159

159

IBC

2021

2021 IBC Allowable Heights and Areas

160

center

LEARNING CENTER

Buildings of Type IIIA Construction Section 510.5

For Type IIIA buildings the height limitation may be increased by one story and 10 feet (to 6 stories and 95 feet), where:

- The first floor construction above basement has a minimum fire-resistance rating of 3 hours.
- The floor area is subdivided by a minimum 2-hour fire-resistance-rated fire walls into areas not exceeding 3,000 sf.

160

IBC

2021

2021 IBC Allowable Heights and Areas

161

center

LEARNING CENTER

Buildings of Type IIA Construction Section 510.6

For Type IIA buildings the height limitation may be increased to 9 stories and 100 feet (typically 5 stories and 85 feet), where:

- 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.
- The first floor construction has a minimum fire-resistance rating of 1½ hours.

161

IBC

2021

2021 IBC Allowable Heights and Areas

162

center

LEARNING CENTER



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.

162

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.

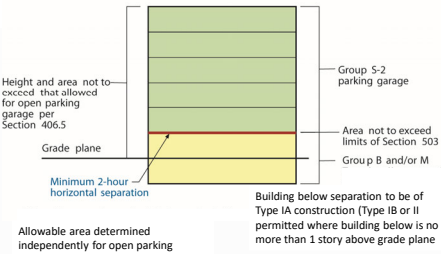


2021 IBC Allowable Heights and Areas 163

163

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

Exits from open parking garage to discharge directly to public way and separated from basement or first story by minimum 2-hour fire barriers and/or horizontal assemblies



IBC 2021



eCenter

2021 IBC Allowable Heights and Areas 164

164

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.



2021 IBC Allowable Heights and Areas 165

165

Multiple Buildings Above Group S-2 Parking Garages Section 510.9

Regulated as separate buildings from each other for application of:

- Section 510.2
- Section 510.3
- Section 510.8

Group S-2 parking garage

Horizontal separation

2021 IBC Allowable Heights and Areas

166

166

International Code Council is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request.

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

2021 IBC Allowable Heights and Areas

167

167

Copyright Materials

This presentation is protected by US and International Copyright laws. Reproduction, distribution, display and use of the presentation without written permission of the speaker is prohibited.

© International Code Council 2023

2021 IBC Allowable Heights and Areas

168

168

Thank you for participating!!

To schedule a seminar, contact:
ICC Training
1-888-ICC-SAFE (422-7233) Ext. 33821
or
E-mail: learn@iccsafe.org



2021 IBC Allowable Heights and Areas169

169
