

Welcome to the

2018 Annual Conference Educational Sessions

**Session: Heights and Areas Using Software to
Ease Building Code Analysis**

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Heights and Areas Using Software to Ease Building Code Analysis

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This Session Presents:

- 2018 IBC review for determining height and area allowances
- Introduce “Check Height and Area” Calculator as a tool for designers and plan reviewers
- Review purpose and configuration of input and output of the Calculator
- Demonstrate with calculation examples

Learning Objectives

- Learn how to save time in calculating grade plane for any topography.
- Understand how to optimize design values for all occupancy groups and types of construction using a single application.
- Evaluate methods for calculating front increases in a manner that will save time on building design and plan review.
- Explain how to calculate allowable floor area, number of stories and height for a mid-rise building.

Disclaimer

The training materials and opinions presented at this webinar do not constitute official views of the author's employer and should not be used as such. Anyone who wants an official ruling by the Building Official should contact the local Building Department.

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Building Height and Area Limitations

- Definitions (202)
- General Building Height and Area Limitations (503)
- Building Height and Number of Stories (504)
- Mezzanines and Equipment Platforms (505)
- Building Area (506)
- Unlimited Area Buildings (507)
- Mixed Use and Occupancy (508)
- Incidental Uses (509)
- Special Provisions (510)

Definitions

Grade Plane

Basement

Story Above Grade Plane

Building Height

Mezzanine

Equipment Platform

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

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
H-1, H-2, H-3, H-5	NS ^{c, d}	UL	160	65	55	65	55	65	50	40
	S									
H-4	NS ^{c, d}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
I-1 Condition 1, I-3	NS ^{d, e}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
I-1 Condition 2, I-2	NS ^{d, e, f}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85						
I-4	NS ^{d, g}	UL	160	65	55	65	55	65	50	40
	S	UL	180	85	75	85	75	85	70	60
R ^h	NS ^d	UL	160	65	55	65	55	65	50	40
	S13D	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	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 903.3.1.1; S13R = 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.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the *International Existing Building Code*.



e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

TABLE 504.4—continued
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	
		A	B	A	B	A	B	HT	A	B
R-1 ^h	NS ^d	UL	11	4	4	4	4	4	3	2
	S13R	4	4						4	3
	S	UL	12	5	5	5	5	5	4	3
R-2 ^h	NS ^d	UL	11	4	4	4	4	4	3	2
	S13R	4	4	4					4	3
	S	UL	12	5	5	5	5	5	4	3
R-3 ^h 	NS ^d	UL	11	4	4	4	4	4	3	3
	S13D	4	4						3	3
	S13R	4	4						4	4
	S	UL	12	5	5	5	5	5	4	4
R-4 ^h 	NS ^d	UL	11	4	4	4	4	4	3	2
	S13D	4	4						3	2
	S13R	4	4						4	3
	S	UL	12	5	5	5	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	3	1
	S	UL	12	5	3	4	3	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	2
	S	UL	12	6	4	5	4	5	5	3
U	NS	UL	5	4	2	3	2	4	2	1
	S	UL	6	5	3	4	3	5	3	2

UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the *International Existing Building Code*.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and 1103.5 of the *International Fire Code*.

g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET^{a, b}

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1									
	SM									
B	NS	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	76,500	55,500	28,500
F-1	NS	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500
	S1	UL	UL	100,000	62,000	76,000	48,000	134,000	56,000	34,000
	SM	UL	UL	75,000	46,500	57,000	36,000	100,500	42,000	25,500
F-2	NS	UL	UL	37,500	23,000	28,500	18,000	50,500	21,000	13,000
	S1	UL	UL	150,000	92,000	114,000	72,000	202,000	84,000	52,000
	SM	UL	UL	112,500	69,000	85,500	54,000	151,500	63,000	39,000



■	R-1 ^h	NS ^d	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
		S13R									
		S1	UL	UL	96,000	64,000	96,000	64,000	82,000	48,000	28,000
		SM	UL	UL	72,000	48,000	72,000	48,000	61,500	36,000	21,000
■	R-2 ^h	NS ^d	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
		S13R									
		S1	UL	UL	96,000	64,000	96,000	64,000	82,000	48,000	28,000
		SM	UL	UL	72,000	48,000	72,000	48,000	61,500	36,000	21,000
■	R-3 ^h 	NS ^d	UL	UL	UL	UL	UL	UL	UL	UL	UL
		S13D									
		S13R									
		S1									
		SM									
■	R-4 ^h 	NS ^d	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
		S13D									
		S13R									

TABLE 506.2—continued
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET^{a, b}

For SI: 1 square foot = 0.0929 m².

UL = Unlimited; NP = Not Permitted; NS = Buildings not equipped throughout with an automatic sprinkler system; S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

- See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.
- See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.
- New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.
- The NS value is only for use in evaluation of existing building area in accordance with the *International Existing Building Code*.
- New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies, Condition 1, see Exception 1 of Section 903.2.6.
- New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.
- New Group I-4 occupancies see Exceptions 2 and 3 of Section 903.2.6.
- New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.
- The maximum allowable area for a single-story nonsprinklered Group U greenhouse is permitted to be 9,000 square feet, or the allowable area shall be permitted to comply with Table C102.1 of Appendix C.

Allowable Area Determination (506.2)

Single-Occupancy, One-Story Building

$$A_a = A_t + (NS \times I_f) \quad \text{(Equation 5-1)}$$

- Allowable area - A_a (sq. ft)
- Tabular area - A_t (sq. ft)
- Tabular allowable area factor for nonsprinklered building - NS
- Area increase due to frontage - I_f (%)

Area Limitations- Mixed Occupancies Separated... Each story... (508.4.2)

In each story, the building area shall be such that the sum of the ratios of the actual floor area of each separated occupancy divided by the allowable area of each separated occupancy shall not exceed one.

$$\frac{\text{Actual area}}{\text{Allowable area (A}_a\text{)}} + \frac{\text{Actual area}}{\text{Allowable area (A}_a\text{)}} + \dots \leq 1 \text{ for each floor}$$

Allowable Area Determination (506.2)

Single-Occupancy, Multi-Story Building

$$A_a = [A_t + (NS \times I_f)] \times S_a \quad \text{(Equation 5-1)}$$

- Allowable area - A_a (sq. ft)
- Tabular area - A_t (sq. ft)
- Tabular allowable area factor for nonsprinklered building - NS
- Area increase due to frontage - I_f (%)
- Number of Stories above the Grade Plane - S_a

Area Limitations- Mixed Occupancies Separated... Multi-Story Building... (506.2.4)

The sum of the ratios of the actual area of each story divided by allowable area of such stories shall not exceed:

2 for 2-stories building

3 for buildings 3-stories or higher

$$\frac{\text{Actual area}}{\text{Allowable area (A}_a\text{)}} + \frac{\text{Actual area}}{\text{Allowable area (A}_a\text{)}} + \dots \leq 2 \text{ for 2-stories building}$$

$$\frac{\text{Actual area}}{\text{Allowable area (A}_a\text{)}} + \frac{\text{Actual area}}{\text{Allowable area (A}_a\text{)}} + \dots \leq 3 \text{ for 3-stories building or higher}$$

Area Increase Due to Frontage (506.3.3)

- Applicable to buildings with more than 25% of perimeter fronting on a public way or open space with minimum 20' in width.

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

- I_f = Area increase due to frontage.
- F = Building perimeter that fronts on a public way or open space having 20 feet open minimum width (feet).
- P = Perimeter of entire building (feet).
- W = Width of public way or open space (feet) in accordance with Section 506.3.2.

What does

“Heights and Areas Calculator” do?

- Checks and analyses Building Height and Area in compliance with the 2018 IBC for buildings up to 6 stories, with up to 4 occupancy groups at each level.
- Optimizes design values for all occupancy groups and types of construction using single application
- Calculates Frontage increase (I_f)
- Calculates Grade plane elevation for any topography

How to use the Calculator?

- Select proposed Type of construction
 - *The Calculator will show max. permitted height for the building without sprinklers per Table 504.3*
- Input proposed Building Height (ft)
- Input proposed number of stories (6 max)
- If applicable, check the box for sprinklers throughout per 903.3.1.1, 903.3.1.2 or 903.3.1.3
- If applicable, input (I_f) value
- Select Occupancy Groups (4 per level)
- Input corresponding areas (sq. ft.)

The Calculator will check:

Allowable height, number of stories and the area for:

- *Each Occupancy group at each floor*
- *Each floor*
- *Each Occupancy group throughout Entire building*
- *Overall building*

Abbreviations used in the Calculator

- *NP -Not Permitted*
- *OL -Over Permitted Limit*
- *SPA -Sprinklers used for Area increase*
- *SPH -Sprinklers used for Height increase*
- *SPS -Sprinklers used for Story increase*
- *UL -Unlimited*


Code Sections not covered by the Calculator

- 503.1.1 (Special industrial occupancies)
- Footnote a of Table 504.3
- 503.1.4 (Occupied Roofs)
- 505 (Mezzanines and Equipment Platforms)
- 507 (Unlimited Area Buildings)
 - *for Frontage increase (If), the Calculator considers the Exception under Sec. 506.3.2)*
- 510 (Special provisions)

2018 IBC Building Height & Area Calculator

EXAMPLE

ICC 2018 - Education Program

Type of Construction: V A 

Building Height (ft):	70
Number of stories:	4

☒ Sprinklers Throughout per 903.3.1.1

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Max Permitted Height (ft) Without
903.3.1.1 Sprinklers

$$I_f = 0.3640$$

Version: 18-IBC-1

Expires: 12/12/2018

Special notes:

*Level 1 Area is Overlimit per Sec.508.4.2

[illegible]

CHA Overall Building:

Area: OL
Height: SPH
Stories: SPS

CHA Per Each Occupancy Group @ Entire Building:

(Sec. 506.4)

Total Building Area (s.f.): 127,000.00

CHA Per Occupancy Group @ Each Level:

UL - Unlimited

NP - Not Permitted

OL - Over Permitted Limit

SPH - Sprinklers used for Height increase

SPS - Sprinklers used for Story increase

SPA - Sprinklers used for Area increase

	Result	Result	Permitted	Proposed	Result	Permitted	Proposed	Result	Permitted	Proposed	Result	Permitted	Proposed
	Level 1	A- 2 Occ.			M Occ.			B Occ.			S-2 Occ.		
Area	OL	OK	38,686.00	12,000.00	SPA	47,096.00	26,000.00	OK	60,552.00	8,000.00	OK	70,644.00	1,000.00
Height	SPH	SPH	70	70	SPH	70	70	SPH	70	70	SPH	70	70
Stories	OK	OK	3	1	OK	4	1	OK	4	1	OK	5	1
	Level 2	B Occ.			A- 3 Occ.			M Occ.					
Area	OK	OK	60,552.00	20,000.00	OK	38,686.00	4,000.00	OK	47,096.00	4,000.00			
Height	SPH	SPH	70	70	SPH	70	70	SPH	70	70			

Σ	Occup.	Result	Permitted	Proposed
of ratios				
for building	A- 2	OK	116,058.00	12,000.00
2.8196	A- 3	OK	116,058.00	8,000.00
Σ				
per Level	B	OK	181,656.00	28,000.00
1.0085				
0.5186				

Thank You For Attending

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