



WoodWorks

Building Height and Area Compliance with the 2012 IBC - Analysis Using Software Applications

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> Learning Objectives

- Participants will have a better understanding of the Code regulations on Building Area and Height limitations and will be better able to analyze mixed occupancy buildings for different construction types.
- Participants will be exposed to new techniques and methods that will help them to calculate front increases and grade plane for complex shapes of building and/or topography, to calculate front increases in a manner that will save time on building design and plan review
- Participants will learn how to determine the most effective way to design buildings with optimal floor area, number of stories, height and construction type
- Participants will learn to optimize design values for all occupancy groups and types of construction using a single application.

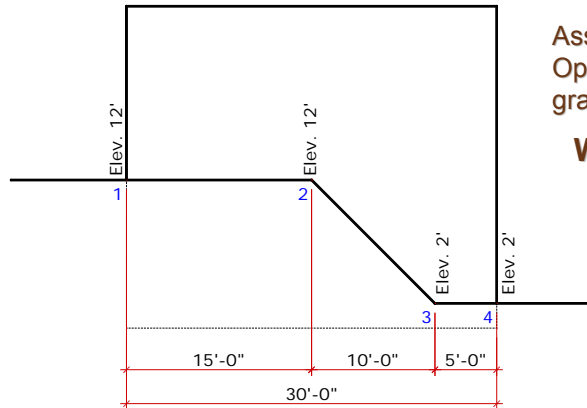


> Building Height and Area Limitations

- Definitions (502)
- General Height and Area Limitations (Table 503)
- Building Height (504)
- Mezzanines and Equipment Platforms (505)
- Building Area Modifications (506)
- Unlimited Area Buildings (507)
- Mixed Use and Occupancy (508)
- Incidental Uses (509)
- Special Provisions (510)



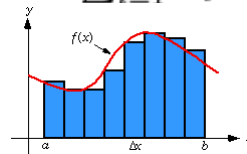
> Determination of the Grade Plane



Assuming 30' x 30' building,
Opposite side with the same
grade elevations

Weighted Average

$$\bar{x} = \frac{\sum_{i=1}^n w_i x_i}{\sum_{i=1}^n w_i}$$



$$\text{GPE} = \frac{2x[15' \times 12' + 10' \times (12' + 2')/2 + 5' \times 2'] + 30' \times (2' + 12')}{120'} = 7.83'$$

> Mezzanines and Equipment Platforms (505)

- Mezzanines ... shall be considered a portion of the story in which it is contained. Such mezzanines shall not contribute to either the building area or number of stories as regulated by Section 503.1 (Sec. 505.2)
- The aggregate area of mezzanines shall not be greater than one-third of the room in which they are located (505.2.1). Exceptions...
- The combined aggregate area of mezzanines and equipment platforms shall not be greater than two-thirds of the room in which they are located (505.3.1)

> Basements

- Basement definition- a story that is not a story above the Grade Plane
- Single basement need not be included in total allowable area (Sec. 506.4- Exception, 506.5)
 - basement does not exceed the permitted area for a building with no more than one story above grade plane
 - No more than one basement level may be considered as not contributing to the total building area. All area in the other basement levels must be included in total building area count



> Height (504)

Automatic sprinkler system Increase

- Installation of automatic sprinkler system in accordance with Section 903.3.1.1 (NFPA-13) allows a max. increase of:
 - 20' height increase to allowable height, and
 - 1 additional story to allowable story
- For Group R buildings with sprinkler system in accordance with Section 903.3.1.2 (NFPA-13R) max allowable increase:
 - 20' height increase (total building height no more than 60')
 - 1 additional story (building no more than 4 stories)
- Height increase is not allowed (504.2):
 - Buildings with an Occupancy Group I-2 of Type IIB, III, IV or V construction.
 - Buildings with an Occupancy Group H-1, H-2, H-3 or H-5.
 - Fire-resistance rating substitution in accordance with Table 601, Note d.



55' + 20' = 75'

2 + 1 = 3

TABLE 503
ALLOWABLE BUILDING HEIGHTS AND AREAS^{a, b}

Building heights shown in feet above grade plane. Story limitations shown as stories above grade plane.
Building area limitations shown in square feet, as determined by the definition of "Area, building," per story.

GROUP	TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION									
		TYPE I		TYPE II		TYPE III		TYPE IV		TYPE V	
		A	B	A	B	A	B	A	B	A	B
	HT (feet)	UL	160	65	55	65	55	55	50	40	
	STORIES(S)										
	AREA (A)										
A-1	S	UL	5	3	2	3	2	3	2	1	
	A	UL	UL	15,500	8,500	14,000	8,500	15,000	11,500	5,500	
A-2	S	UL	11	3	2	3	2	3	2	1	
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000	
A-3	S	III	11	3	2	3	2	3	2	1	
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000	
A-4	S	UL	11	3	2	3	2	3	2	1	
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000	
A-5	S	UL	11	3	2	3	2	3	2	1	
	A	UL	UL	15,500	9,500	14,000	9,500	15,000	11,500	6,000	
B	S	UL	11	5	3	5	3	5	3	2	
	A	UL	UL	37,500	23,000	28,500	19,000	36,000	18,000	9,000	
E	S	UL	5	3	2	3	2	3	1	1	
	A	UL	UL	26,500	14,500	23,500	14,500	25,500	18,500	9,500	
F-1	S	UL	11	4	2	3	2	4	2	1	
	A	UL	UL	25,000	15,500	19,000	12,000	33,500	14,000	8,500	
	c	III	11	5	3	4	2	5	2	2	

OK Area Increase for Fire Sprinklers

NFPA 13- Automatic Sprinkler System – Height Increase

> Unlimited Area Buildings (507)

Buildings surrounded and adjoined by public ways or yards not less than 60 feet:

- Nonsprinklered, 1 story, Group F-2 or S-2 buildings (507.2)
- Sprinklered, 1 story, Group B, F, M or S buildings; A-4 no Type V (507.3)
- Sprinklered, 2 story, Group B, F, M or S buildings (507.4)
- Mixed occupancy buildings with Groups A-1 and A-2. (507.3.1)
- Group A-3 buildings: Type II (507.6), Types III & IV (507.7)
- Group H-2, H-3 and H-4 occupancies within Groups F or S (507.8)
- H-2 Aircraft paint hangars (507.9)
- Group E buildings (507.10)
- Motion picture theaters (507.11)
- Covered mall buildings and anchor stores (507.12)

> Unlimited Area Buildings (507)

Reduced Open Space (507.5)

- The public ways or yards of 60 feet in width shall be permitted to be reduced to not less than 40 feet in width provided all of the following requirements are met:
 - The reduced width shall not be allowed for more than 75 percent of the perimeter of the building.
 - The exterior walls facing the reduced width shall have a minimum fire-resistance rating of 3 hours.
 - Openings in the exterior walls facing the reduced width shall have opening protectives with a minimum fire protection rating of 3 hours.

> Area Modification (506)

$$A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\}$$

(Equation 5-1)

- Allowable area per story A_a (sq. ft)
- Tabular area per story as per Table 503 (A_t)
- Area increase due to frontage (I_f)
- Area increase due to sprinkler system (I_s)

> Area Increase Due to Frontage (506.2)

- 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 506.2.1.



Area Increase Due to Frontage

(Building does not comply with 506.2.1 Exception)

$$W = \frac{20 \times (20+30)/2 + 80 \times 30 + 30 \times 20 + 60 \times 30 + 20 \times 30 + 20 \times (20+30)/2 + 5 \times (20+30)/2 + 10 \times 30 + 50 \times 30}{20+80+30+60+20+20+5+10+50}$$

$$W = \frac{8325}{295} = 28.22'$$

$$F = 295'$$

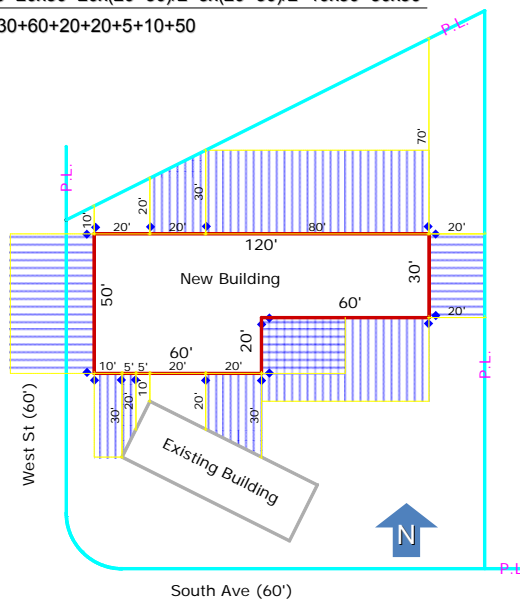
$$P = 340'$$

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

$$= [295/340 - 0.25] 28.22/30 =$$

$$I_f = 0.58$$

$$I_f \leq 0.75$$



Area Increase Due to Frontage (Building complies with 506.2.1 Exception)

$$W = \frac{80 \times (20+60)/2 + 20 \times 60 + 30 \times 20 + 40 \times 60 + 20 \times (60+50)/2 + 20 \times 60 + 20 \times (30+20)/2 + 5 \times (20+30)/2 + 10 \times 60 + 50 \times 60}{80+20+30+60+20+20+5+10+50}$$

$$W = \frac{13925}{295} = 47.20'$$

$$F = 295'$$

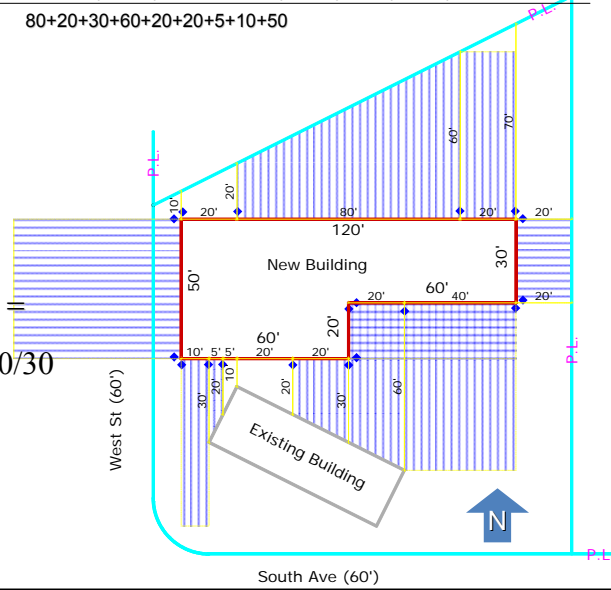
$$P = 340'$$

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

$$= [295/340 - 0.25] 47.20/30$$

$$I_f = 0.97$$

$$I_f < 1.5$$



Area Increase - Sprinklers (506.3)

- When a building is equipped with automatic sprinkler system as per Section 903.3.1.1 (NFPA-13), the area limitation per Table 503 is permitted to be increased as followed:
 - Increase by 200%, $I_s = 2$ for multi-story buildings
 - Increase by 300%, $I_s = 3$ for single-story buildings
- Area increase is not permitted:
 - Buildings with an occupancy in Use Group H-1.
 - The floor area of an occupancy in Use Group H-2 or H-3 (mixed use buildings).
 - Fire-resistance rating substitution as per Table 601, Note d.

> Area Determination (506.4)

Total Building Allowable Area (for single occupancy group)

- For building 2 stories above grade plane, multiply A_a by 2
- For building >2 stories above grade plane, multiply by A_a by 3.
- No story shall exceed A_a for the occupancies on that story.
- Exceptions for Unlimited Area Buildings and NFPA 13R sprinklered Buildings

Mixed Use and Occupancy (508)

> Accessory Occupancies (508.2)

- Aggregate accessory occupancies shall not occupy more than **10 %** of the building area of the story in which they are located and shall not exceed the tabular values in Table 503, without building area increases in accordance with Section 506 for such accessory occupancies.
- Accessory occupancies shall be individually classified in accordance with Section 302.1. The requirements of this code shall apply to each portion of the building based on the occupancy classification of that space.
- The allowable building area and height of the building shall be based on the allowable building area and height for the main occupancy in accordance with Section 503.1. The height of each accessory occupancy shall not exceed the tabular values in Table 503, without increases in accordance with Section 504 for such accessory occupancies.

Table 509- Incidental Uses

ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen cutoff rooms, not classified as Group H	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic sprinkler system
Laboratories and vocational shops, not classified as Group H, located in a Group E or I-2 occupancy	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
Group I-3 cells equipped with padded surfaces	1 hour
Waste and linen collection rooms located in either Group I-2 occupancies or ambulatory care facilities	1 hour
Waste and linen collection rooms over 100 square feet	1 hour or provide automatic sprinkler system
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium-ion and lithium metal polymer used for facility standby power, emergency power or uninterruptable power supplies	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.

> Nonseparated Occupancies (508.3)

- **Occupancy classification.** Nonseparated occupancies shall be individually classified in accordance with Section 302.1. The requirements of this code shall apply to each portion of the building based on the occupancy classification of that space except that the most restrictive applicable provisions of Section 403 and Chapter 9 shall apply to the building or portion thereof in which the nonseparated occupancies are located.
- **Allowable building area and height.** The allowable building area and height of the building or portion thereof shall be based on the **most restrictive** allowances for the occupancy groups under consideration for the type of construction of the building in accordance with Section 503.1.
- **Separation.** No separation is required between nonseparated occupancies.
 - Exceptions:
 - Group H-2, H-3, H-4, H-5, I-2, I-2.1, I-3 and L occupancies
 - Group R-1, R-2, R-2.1 and R-3 dwelling units and sleeping units

> Separated Occupancies (508.4)

- Each separated occupancy shall comply with the building height limitations based on the type of construction of the building in accordance with Section 503.1.
 - Exception: Special provisions permitted by Section 510.
- Individual occupancies shall be separated from adjacent occupancies as per Table 508.4
 - Required separations shall be fire barriers constructed as per Section 707 or horizontal assemblies constructed as per Section 712, or both, so as to completely separate adjacent occupancies.



Table 508.4

REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

OCCUPANCY	A, E		I-1, I-3, I-4		I-2		R ^a		F-2, S-2 ^b , U		B, F-1, M, S-1		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1, I-3, I-4	—	—	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	—	—	—	—	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R ^a	—	—	—	—	—	—	N	N	1 ^c	2 ^c	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2 ^b , U	—	—	—	—	—	—	—	—	N	N	1	2	NP	NP	3	4	2	3	2	NP
B, F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	N	N	NP	NP	2	3	1	2	1	NP
H-1	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1 ^d	NP	1	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

NS = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

N = No separation requirement.

NP = Not permitted.

^a See Section 420.

^b The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but to not less than 1 hour.

^c See Section 406.3.4.

^d Separation is not required between occupancies of the same classification.

> 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 building area of each occupancy divided by the allowable building area of each occupancy shall not exceed one. (508.3.3)

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

> Area Limitations- Mixed Occupancies Separated... Entire Building... (506.5)

The sum of the ratios of the actual building area of each occupancy divided by the allowable building area shall not exceed 2 for 2-stories building and 3 for buildings 3-stories or higher

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

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

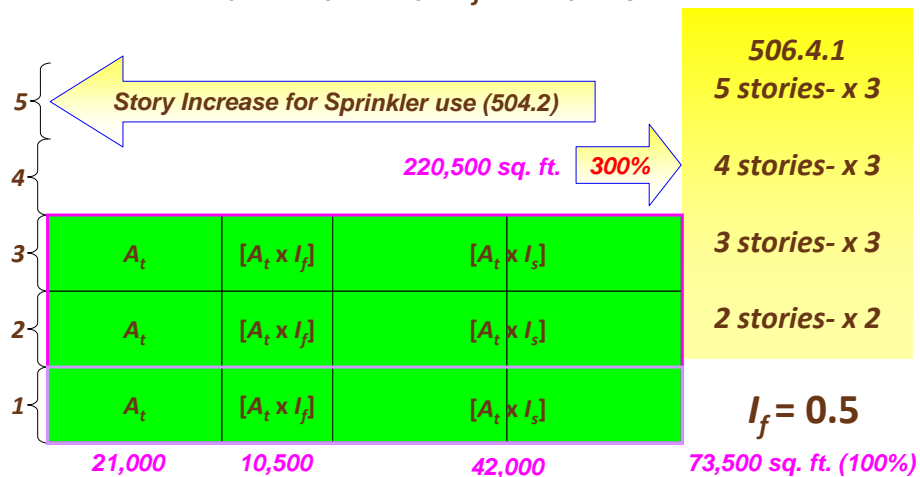
> Special Provisions (510)

- Horizontal building separation allowance (510.2)
- Group S-2 enclosed parking garage with Group S-2 open parking garage above (510.3)
- Group R-1 & R-2 buildings: Construction Type IIIA (510.5), Construction Type IIA (510.6)
- Open parking garage beneath Groups A, I, B, M and R (510.7)
- Group B or M with Group S-2 open parking garage (510.8)
- Multiple buildings above Horizontal assembly (510.9)



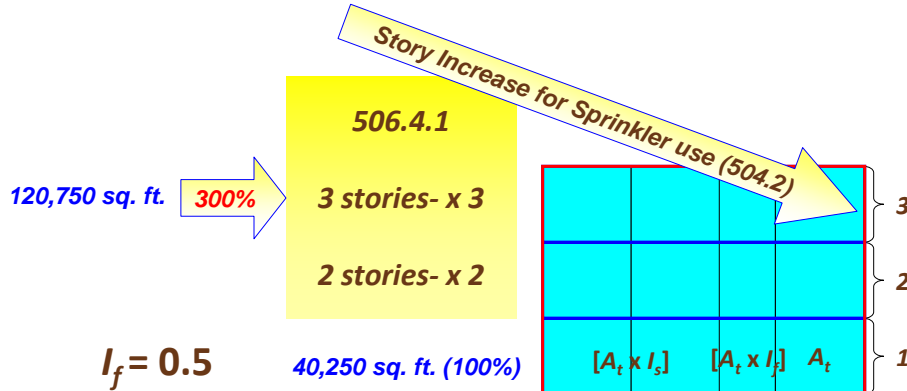
Area Modification Example S-2 Occupancy, Type VA Construction

$$A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\}$$



Area Modification Example A-3 Occupancy, Type VA Construction

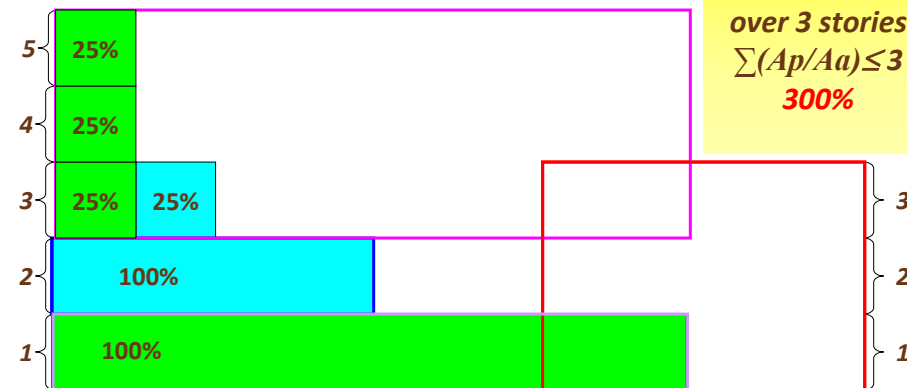
$$A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\}$$



Area Modification Example S-2/A-3 Mixed Occupancy, Type VA Construction

508.4.2 For mixed use, at each story
 $\sum(A_p/A_a) \leq 1$

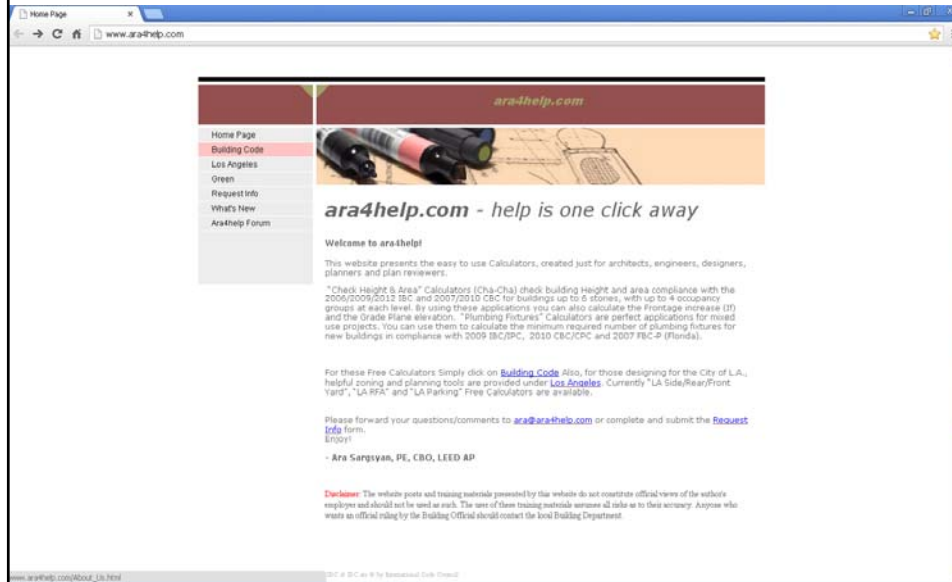
506.5.2
For building over 3 stories
 $\sum(A_p/A_a) \leq 3$
300%



S-2: 73,500 sq. ft. (100%) A-3: 40,250 sq. ft. (100%)

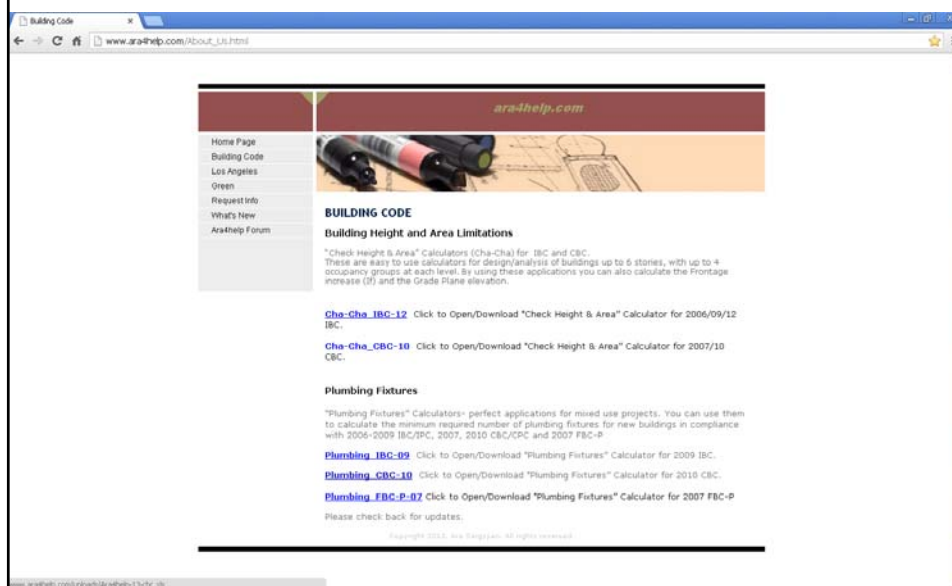
$I_f = 0.5$

2012 IBC Building Height & Area Calculator



The screenshot shows the homepage of ara4help.com. The browser address bar displays "www.ara4help.com". A navigation menu on the left includes links for Home Page, Building Code, Los Angeles, Green, Request Info, What's New, and Ara4help Forum. The main content area features a header with the site logo and a banner image of architectural blueprints and markers. Below the banner, the text reads "ara4help.com - help is one click away" and "Welcome to ara4help!". A paragraph describes the website's purpose: "This website presents the easy to use Calculators, created just for architects, engineers, designers, planners and plan reviewers." It then details the "Check Height & Area" (Cha-Cha) calculators for IBC and CBC, and "Plumbing Fixtures" calculators for mixed-use projects. A section for "Free Calculators" lists links for Building Code, Los Angeles, LA-IFA, and LA Parking. A "Request Info" form link is provided, along with contact information for Ara Saragyan, PE, CBO, LEED AP. A disclaimer at the bottom states that the website's content does not constitute an official view of the author's employer and should not be used as such.

2012 IBC Building Height & Area Calculator



The screenshot shows the "Building Code" page on ara4help.com. The browser address bar displays "www.ara4help.com/About_US.html". The navigation menu on the left is identical to the homepage. The main content area features a header with the site logo and a banner image of architectural blueprints and markers. Below the banner, the text reads "BUILDING CODE" and "Building Height and Area Limitations". A paragraph describes the "Check Height & Area" (Cha-Cha) calculators for IBC and CBC. Two links are provided: "Cha-Cha_IBC-12" for the 2006/09/12 IBC calculator and "Cha-Cha_CBC-10" for the 2007/10 CBC calculator. A section for "Plumbing Fixtures" describes the calculators for mixed-use projects. Three links are provided: "Plumbing_IBC-09" for the 2009 IBC calculator, "Plumbing_CBC-10" for the 2010 CBC calculator, and "Plumbing_FBC-P-07" for the 2007 FBC-P calculator. A note at the bottom asks users to check back for updates. The footer contains the copyright notice: "Copyright 2012, Ara Saragyan. All rights reserved."

2006/2009/2012 IBC Building Height and Area Calculator

WoodWorks Webinar- 3/27/13 www.ara4help.com
help is one click away Version: 12-IBC-01 Expires: 12/31/2013

Select the Code: 2012 IBC 2009 IBC 2006 IBC

Type of Construction: V-A Max Permitted Height (ft) Without Sprinklers: 903.3.1.1 Sprinklers: 50

Building Height (ft): 70 $I_f = 0.2400$

Number of stories: 5

Sprinklers Throughout per 903.3.1.1 (not substituted for the construction)

Floor #	Occup. Area (s.f.)	Occup. Area (s.f.)	Occup. Area (s.f.)	Occup. Area (s.f.)	Area per floor
1	A-3 6,400.00	A-2 6,000.00	B 18,000.00	M 18,200.00	48,600.00
2	A-3 5,800.00	B 13,600.00	S-2 12,000.00	M 16,000.00	47,400.00
3	R-2 16,000.00	B 12,000.00	A-3 2,000.00		30,000.00
4	R-2 16,000.00	B 12,000.00	A-3 760.00		28,760.00
5	S-2 27,600.00				27,600.00

CHA Overall Building:
Area: OL
Height: SPH
Stories: OL

CHA Per Each Occupancy Group @ Entire Building:
(Sec. 506.4)

Occup.	Result	Permitted	Proposed
A-2	OK	111,780.00	6,000.00
A-3	OK	111,780.00	14,960.00

Total Building Area (s.f.): 182,360.00

UL - Unlimited SPH - Sprinklers used for Height Increase
 NP - Not Permitted SPB - Sprinklers used for Story Increase
 OL - Over Permitted Limit SPA - Sprinklers used for Area Increase

Level	Result	Permitted	Proposed	Result	Permitted	Proposed	Result	Permitted	Proposed	Result	Permitted	Proposed
Level 1	OK	37,260.00	6,400.00	OK	37,260.00	6,000.00	OK	58,320.00	18,000.00	SPA	48,360.00	18,200.00
Area	OL			OK			OK			SPA		
Height	SPH	70	70	SPH	70	70	SPH	70	70	SPH	70	70
Stories	OK	3	1	OK	3	1	OK	4	1	OK	4	1
Level 2	OK	37,260.00	5,800.00	OK	58,320.00	13,600.00	OK	68,040.00	12,000.00	OK	48,360.00	16,000.00
Area	OK			OK			OK			OK		
Height	SPH	70	70	SPH	70	70	SPH	70	70	SPH	70	70
Stories	OK	3	2	OK	4	2	OK	5	2	OK	4	2
Level 3	OK	37,260.00	16,000.00	OK	58,320.00	12,000.00	OK	37,260.00	2,000.00			
Area	SPA	38,880.00	16,000.00	OK	58,320.00	12,000.00	OK	37,260.00	2,000.00			
Height	SPH	70	70	SPH	70	70	SPH	70	70			
Stories	SPS	4	3	OK	4	3	SPS	3	3			
Level 4	OK	37,260.00	16,000.00	OK	58,320.00	12,000.00	OK	37,260.00	760.00			
Area	SPA	38,880.00	16,000.00	OK	58,320.00	12,000.00	OK	37,260.00	760.00			
Height	SPH	70	70	SPH	70	70	SPH	70	70			
Stories	OL	4	4	SPS	4	4	OL	3	4			
Level 5	OK	27,600.00										
Area	SPA	68,040.00	27,600.00									
Height	SPH	70	70									
Stories	SPS	5	5									

What does Cha-Cha do?

- Checks and analyses Building Height and Area in compliance with the 2006, 2009 & 2012 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 Cha-Cha?

- Select proposed Type of construction
 - *Cha-Cha will show max. permitted height for the building without sprinklers per Table 503*
- 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 or 903.3.1.2
 - *No substitution for 1-hr construction*
- If applicable, input (I_f) value
- Select Occupancy Groups (4 per level)
- Input corresponding areas (sq. ft.)

Cha-Cha 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 Cha-Cha

- *CHA -Check Height and Area*
- *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 Cha-Cha

- 503.1.1 (Special industrial occupancies)
- Footnote b of Table 503
- 504.3 (Roof structures)
- 505 (Mezzanines)
- 507 (Unlimited Area Buildings)
 - *for Frontage increase (If), Cha-Cha considers the Exception under Sec. 506.2.1)*
- 510 (Special provisions)

Other Software Applications...

- Cha-Cha for 2007/2010 CBC
- Plumbing Fixtures Calculators for:
 - 2007 & 2010 CBC/CPC
 - 2006 & 2009 IBC/IPC
 - 2007 FBC- Plumbing (Florida)
- Sound Transmission Class (STC)
- etc...



Questions?

This concludes The American
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