Type I and II Construction

Type I and II construction requires structural building elements to be of noncombustible materials. Sections 5 and 6 of this book outline circumstances where wood is permitted in Type I and II buildings.

Figure 15—Type I and II Construction

3. Allowable Heights and Areas for Type III, IV and V Construction

General building height and area allowances are given in Chapter 5 of the IBC. Allowances are shown in IBC Tables 504.3, 504.4 and 506.2 for height, number of stories and area factor, (A_t), respectively. Excerpts of the tables are shown in Figure 16.

Type IV-B height and story limits were established based on equivalent performance to Type I-B. The number of stories permitted for Type IV-A is generally 50 percent more than Type IV-B with exceptions. Area factors were established by applying a multiplier to Type IV-HT tabular areas.

The maximum height, number of stories permitted and area of a building is dependent on the occupancy classification and the presence and type of an automatic sprinkler system, as designated in Tables 504.3, 504.4 and 506.2. The increases allowed due to the installation of an automatic sprinkler system are included in the respective tables. Table 504.3, Allowable Building Height in Feet Above Grade Plane, allows for a 20-foot increase in height when the building is equipped with an automatic sprinkler system installed in accordance with NFPA 13, except for Type IV-A and IV-B construction, which can have much greater increases for certain occupancy classifications. Buildings of Residential Group R occupancies equipped with an automatic sprinkler system installed in accordance with NFPA 13R or NFPA 13D are limited in height. These limitations in allowable heights reflect differences in the requirements of NFPA 13R and NFPA 13D versus NFPA 13.

Similarly, Table 504.4, Allowable Number of Stories Above Grade Plane, allows for a one-story increase when the building is equipped with an automatic sprinkler system installed in accordance with NFPA 13, except for Type IV-A, IV-B and IV-C construction, which can have greater increases for certain occupancy classifications. Residential Group R occupancies equipped with automatic sprinkler systems installed in accordance with NFPA 13R or NFPA 13D are limited by the scope of the standards, which is reflected in the story increase or decrease in Table 504.4.

Additional increases are possible depending on the building's location on the lot and by using some of the design options in Chapter 5. Additional limits for the allowable area of certain occupancies or situations without sprinklers can be found in Chapter 10.

Increases and limits are discussed in detail in this section, as shown in Tables 504.3 and 504.4, respectively. This applies to all occupancies addressed in this book, except Group I-2 and certain Group I-1 Condition 2 occupancies, which do not always allow the number of stories to be increased when an automatic sprinkler system is installed.

For Group R buildings in Type V construction, a similar height increase (but no area increase) is given for the use of NFPA 13R-compliant systems: up to 60 feet and four stories in accordance with Section 504.3.

	OCCUPANCY CLASSIFICATION		TYPE OF CONSTRUCTION							
			Type III		Type IV				Type V	
			A	B	A	B	C	HT	A	B
Table 504.3: Allowable Building Height (feet above Grade)	A, B, E, F, M, S, U	NS	65	55	65	65	65	65	50	40
		S	85	75	270	180	85	85	70	60
	I-1 Condition 1, I-3	NS	65	55	65	65	65	65	50	40
		S	85	75	180	120	85	85	70	60
	I-1 Condition 2, I-2	NS	65	55	65	65	65	65	50	40
		S								
	I-4	NS	65	55	65	65	65	65	50	40
		S	85	75	180	120	85	85	70	60
	R	NS	65	55	65	65	65	65	50	40
		S13R	60	60	60	60	60	60	60	60
		S	85	75	270	180	85	85	70	60
Table 504.4: Allowable Number of Stories above Grade	A-1	NS	3	2	3	3	3	3	2	1
		S	4	3	9	6	4	4	3	2
	A-2, A-3, A-4	NS	3	2	3	3	3	3	2	1
		S	4	3	18	12	6	4	3	2
	B	NS	5	3	5	5	5	5	3	2
		S	6	4	18	12	9	6	4	3
	E	NS	3	2	3	3	3	3	1	1
		S	4	3	9	6	4	4	2	2
	M	NS	4	2	4	4	4	4	3	1
		S	5	3	12	8	6	5	4	2
	S-2	NS	4	3	4	4	4	5	4	2
		S	5	4	12	8	5	6	5	3
	R-1[1], R-2[1]	S13R	4	4	4	4	4	4	4	3
		S	5	5	18	12	8	5	4	3

Figure 16–Table 504.3, 504.4 and 506.2 Excerpts (continued next page)

Table 506.2: Allowable Area Factor	OCCUPANCY CLASSIFICATION		TYPE OF CONSTRUCTION							
			Type III		Type IV				Type V	
			A	B	A	B	C	HT	A	B
	A-1[2], A-2, A-3	NS	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
		S1	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
		SM	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
	B	NS	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
		S1	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
		SM	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
	E	NS	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
		S1	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
		SM	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
	M	NS	18,500	12,500	61,500	41,000	26,625	20,500	14,000	9,000
		S1	74,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
		SM	55,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
	S-2	NS	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
		S1	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
		SM	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500
	R-1[1], R-2[1]	S13R	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
		S1	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
		SM	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000

1. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.
2. Allowable Area Factor for Type III-B and Type V-B construction are smaller than shown. Type IV allowable area factors are permitted.

NS—nonsprinklered; S—sprinklered (NFPA 13 System); S13R—sprinklered NFPA 13R requirements (NFPA 13R System); S1—single-story sprinklered building (NFPA 13 System); SM—multistory sprinklered building (NFPA 13 System).

Figure 16–Tables 504.3, 504.4 and 506.2 Excerpts (continued from previous page)

Allowable Building Area Increases

Sections 506.2 and 506.3 provide criteria whereby the allowable area for single and mixed-occupancy buildings can be determined based on whether an automatic sprinkler system is installed or frontage factors apply. Equation 5-1 establishes the allowable area for each story of a single-occupancy building with a maximum of three stories above grade plane. A single-story basement does not need to be included in the total allowable building area when the basement does not exceed the area permitted for a single story (see Section 506.1.3). IBC Equation 5-1 establishes the maximum allowable area per story for a single-occupancy building.

The allowable area per story of a single-occupancy building shall be determined by the following equation:

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

where:

A_a = Allowable building area (square feet).

A_t = Tabular allowable area factor (NS, S1, S13R or SM value, as applicable) in accordance with Table 506.2 (square feet).

NS = Tabular allowable area factor in accordance with Table 506.2 for a nonsprinklered building (regardless of whether the building is sprinklered).

I_f = Area factor increase due to frontage (percent) as calculated in accordance with Section 506.3. See Figures 17 and 19 of this book.

IBC Equation 5-2 establishes the maximum allowable aggregate area of a single-occupancy building more than three stories above grade plane, and simply includes the additional factor, S_a, as defined below. Keep in mind that while IBC Equation 5-2 produces the allowable area per building, IBC Equation 5-1 above still provides the limitation on the allowable area for any one floor within that building.

The allowable area for a single-occupancy building more than 3 stories above grade plane shall be determined by the following equation:

$$A_a = [A_t + (NS \times I_f)] \times S_a \qquad \textbf{(Equation 5-2)}$$

where:

A_a = Allowable building area (square feet).

A_t = Tabular allowable area factor (NS, S1, S13R or SM value, as applicable) in accordance with Table 506.2 (square feet).

NS = Tabular allowable area factor in accordance with Table 506.2 for a nonsprinklered building (regardless of whether the building is sprinklered).

I_f = Area factor increase due to frontage (percent) as calculated in accordance with Section 506.3.

S_a = 3 where the actual number of building 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 NFPA 13R (Group R occupancies, see Section 903.3.1.2).

Mixed-occupancy Buildings

Provisions to increase the area of mixed-occupancy buildings that contain nonseparated or separated occupancies are provided in Section 506.2.2. For buildings not exceeding three stories, the allowable area for each story is determined using Equation 5-3, which is identical to Equation 5-1. For buildings with more than three stories, the aggregate sum of the ratios of the actual area of each story divided by the allowable area of such stories shall not exceed 3. Where $S_a = 4$, as permitted above and buildings are designed as separated occupancies, the ratio shall not exceed 4.

Allowable Increases for Frontage

Buildings adjacent to open space adjoining a public way having any portion of exterior walls a minimum of 20 feet to the closest interior lot line, the exterior face of an adjacent building on the same property, or the entire width of the public way for more than 25 percent of the building perimeter, may have the allowable floor area from Table 506.2 increased using Equations 5-1 or 5-2. The area

factor increase based on frontage, I_f, used in Equations 5-1 and 5-2 is provided in Table 506.3.3. Factors are provided for building perimeters with 25 percent or more of qualifying frontage based on the smallest public way or open space that is 20 feet or greater. I_f has a value of 0 when less than 25 percent of the building perimeter qualifies as open space and a maximum value of 0.75 when 75 percent or more of the building perimeter has open space of 30 feet or more.

The frontage increase shall be based on the smallest public way or open space that is 20 feet or greater, and the percentage of building perimeter having a minimum 20 feet public way or open space.

IBC Table 506.3.3 Frontage Increase Factor[a] (I_f)

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

a. Interpolation is permitted

Figure 17—IBC Frontage Increase Factor

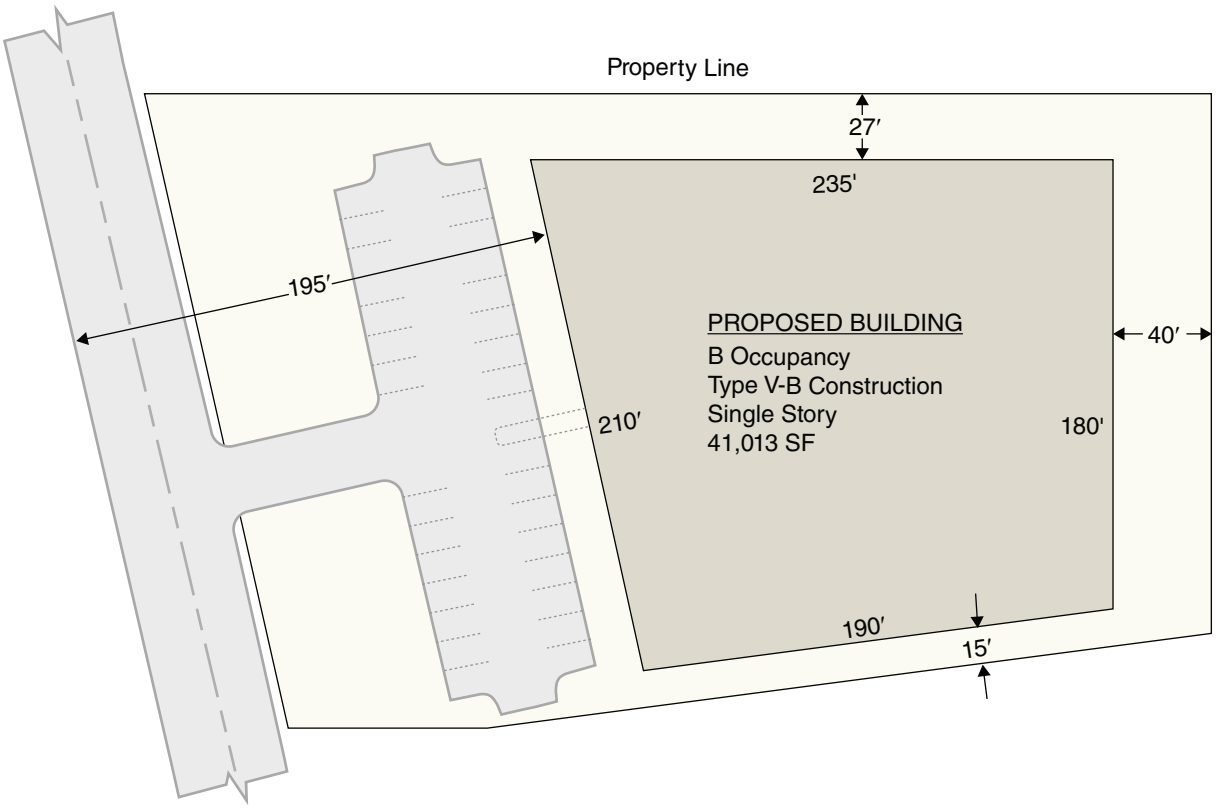

Figure 18—Allow Building Area Example (calculations follow)

Allowable Building Area Example

Given: One-story, Type V-B Business Occupancy, 41,013 square feet (sf)—see Figure 18

Determine: Can this building be constructed without a sprinkler system?

Solution 1: Using 2021 IBC

Per Table 506.2: $A_t(NS) = 9{,}000$ sf
$A_t(S1) = 36{,}000$ sf
$A_t(SM) = 27{,}000$ sf

Per Section 506.3.1, a building is required to have at least 25 percent of its perimeter on a public way or open space that is accessed from a street or approved fire lane. Verify this requirement.

Determine total perimeter: 210 ft + 235 ft + 180 ft + 190 ft = 815 ft

Check for minimum qualifying perimeter with 20 ft of open space: 210 ft

210 ft/815 ft = 0.257 = 25.7%, therefore a frontage increase may be applied

Calculate frontage increase.

Determine the minimum open space (feet) required by Table 506.3.3:

27 ft (note the 190 ft side has a 15 ft open space which does not qualify)

Calculate perimeter with qualifying sides: 210 ft + 235 ft + 180 ft = 625 ft

Calculate percentage of building perimeter required by Table 506.3.3:

625 ft/815 ft = 0.767 = 76.7%

Per Table 506.3.3:

- Open Space of 27 feet is in the **25 to less than 30** column.
- Percentage of building perimeter is in the **75% to 100%** row.

Find the corresponding frontage factor: $I_f = 0.63$

Calculate allowable floor area using Equation 5-1. $A_t = NS$ when not sprinklered.

$A_a = A_t + (NS \times I_f) = 9{,}000 \text{ sf} + (9{,}000 \text{ sf} \times 0.63) = 14{,}670$ sf

41,013 sf proposed area > 14,670 sf allowable area; therefore no good (NG)

Because interpolation is permitted in Table 506.3.3, I_f is determined to be 0.678.

$A_a = A_t + (NS \times I_f) = 9{,}000 \text{ sf} + (9{,}000 \text{ sf} \times 0.678) = 15{,}102$ sf

41,013 sf proposed area > 15,102 sf allowable area; therefore NG

Calculate allowable floor area as a sprinklered building, complying with NFPA 13. $A_t = S1$.

$A_a = A_t + (NS \times I_f) = 36{,}000 \text{ sf} + (9{,}000 \text{ sf} \times 0.63) = 41{,}670$ sf

41,013 sf proposed area < 41,670 sf allowable area; therefore OK

Because interpolation is permitted in Table 506.3.3, I_f can also be 0.678.

$A_a = A_t + (NS \times I_f) = 36{,}000 \text{ sf} + (9{,}000 \text{ sf} \times 0.678) = 42{,}102$ sf

41,013 sf proposed area < 42,102 sf allowable area; therefore OK

Conclusion: Type V-B is permitted when the building is equipped with an NFPA 13 system