CHAPTER 5
GENERAL BUILDING HEIGHTS AND AREAS

IBC Interpretation No. 03-03
Section 503.3, 2000 Edition
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503.3 Area determination. The maximum area of a building shall be determined by multiplying the allowable area per floor (A_a), as determined in Section 506.1 by the number of stories up to a maximum of three stories.

>**Exception:** Unlimited area buildings in accordance with Section 507.

Q: Assume a multi-story building that has a different allowable area per floor (A_a) because the occupancy classification of each floor is different. The different occupancy classifications are separated with fire-resistive barriers/assemblies.

Is the maximum area of the building limited by adding the per story building ratios together, dividing by the number of stories (up to a maximum of 3 stories) and the resulting ratio cannot exceed a value of 1?

A: Yes; however, the area ratio for each floor, as stipulated in Section 302.3.3, shall not exceed a value of 1. The area ratio for each floor is determined by applying the unity formula where the Actual Area is divided by the Allowable Area (Table 503). The resulting value is the area ratio for that floor, which shall not exceed 1.
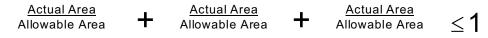
Section 503.3 limits the maximum area of a building to the allowable area per floor multiplied by a maximum of three floors. For a multi-story, single occupancy building, the area ratio is not applied. The area ratio is applied to multi-story, mixed occupancy buildings and the sum of the area ratios of all floors divided by 3 shall not exceed 1, or more simply stated, the sum of the area ratios of all floors shall not exceed 3.

The area ratio (unity formula) does not apply to buildings designed using the nonseparated provisions of Section 302.3.2.

Understanding the Unity Formula (Mixed-Area Ratio)
Section 302.3.3, *International Building Code*

In applying the provisions of the 2000 *International Building Code*[a] (IBC), one must understand that many of the separate provisions must be used together. One example is the "unity formula," so termed because it deals with the allowable area ratio of mixed occupancy buildings in which one or more fire barriers separate the individual occupancies. Under the IBC, an architect may choose whether to or not to separate areas of a building that house different uses or occupancies. The exception is that Group H occupancies must be in mixed-use buildings, must be separated by appropriate fire barriers and may not be in unseparated buildings. (Note that Group H-1 occupancies must be in single-use buildings and may not be in mixed-use buildings.)

Section 302.3 of the 2000 IBC states in part that " In each story, the building area shall be such that the sum of the ratios of the floor area of each use divided by the allowable area for each use shall not exceed 1." Thus, the unity formula impacts the allowable area of any given floor or story of a building. The unity formula may be expressed as follows:

$$\frac{\text{Actual Area}}{\text{Allowable Area}} + \frac{\text{Actual Area}}{\text{Allowable Area}} + \frac{\text{Actual Area}}{\text{Allowable Area}} \leq 1$$
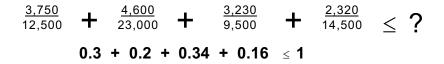
The diagram below depicts a small strip center of Type IIB construction with use groups as indicated. Assuming that there are no increases in the allowable area, we can use the unity formula to check for compliance.

Group M	Group B	Group A-3	Group E
Retail	Office	Library	Day Care
3,750 ft.^{2}	4,600 ft.^{2}	3,230 ft.^{2}	2,320 ft.^{2}

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Using IBC Table 503, we find the allowable area of each use-group is as follows:

Group M: 12,500 ft.^{2} Group B: 23,000 ft.^{2} Group A-3: 9,500 ft.^{2} Group E: 14,500 ft.^{2}

Now we need to apply the unity formula:

$$\frac{3,750}{12,500} + \frac{4,600}{23,000} + \frac{3,230}{9,500} + \frac{2,320}{14,500} \leq \,?$$

$$\mathbf{0.3 + 0.2 + 0.34 + 0.16} \leq \mathbf{1}$$

The resulting value is 1, so the building under consideration complies with the code with regard to allowable area. Provided that there were abilities to increase the area based on open yards or sprinklers, the maximum allowable area for each separate occupancy must be determined first using IBC Section 506.

With multistory occupancies, the unity formula must be applied to each separate story, with the result being a value less than or equal to 1. Buildings that exceed three stories, however, require additional consideration. IBC Section 503.3 limits the maximum allowable area of a building to three times that determined for a single-story building. Thus, the area ratio calculation for each floor must be less than or equal to 1, and the ratio area calculation for the total area of all floors may not exceed 3. In the example below, we will assume that the building and each occupancy receive the maximum increase permitted for frontage increase, 75% (per Section 506.2), and a fire sprinkler increase of 200% (per Section 506.3). The building is of Type IIA construction.

| A-3 19,181 ft^2 | R-2 21,357 ft.^{2} | A-2 19,762 ft.^{2} |

0.33 + 0.24 + 0.34 = **0.91**

| R-1 30,150 ft.^{2} | R-2 30,150 ft.^{2} |

0.335 + 0.335 = **0.67**

| B 20,150 ft.^{2} | M 20,200 ft.^{2} | R-1 20,000 ft.^{2} |

0.14 + 0.25 + 0.22 = **0.61**

| B 20,300 ft^2 | M 40,000 ft.^{2} |

0.14 + 0.5 = **0.64**   **0.91 + 0.67 + 0.61 + 0.64 = 2.83**
OK $\leq$ 3

The allowable area per floor per occupancy based on Equation 5-1, Section 506.1, is as follows:

Group A-3 - 58,125 ft.^{2}; Group R-2 - 90,000 ft.^{2}; Group A-2 - 58,125 ft.^{2};

Group R-1 - 90,000 ft.^{2}; Group R-2 - 90,000 ft.^{2};

Group B - 140,625 ft.^{2}; Group M - 80,625 ft.^{2}; Group R-1 - 90,000 ft.^{2};

Group B - 140,625 ft.^{2}; Group M - 80,625 ft.^{2}

For this four-story building, the value of the mixed-area ratio for each floor does not exceed 1 and the total value for all the floors in the building does not exceed 3. Therefore, the building is within allowable area.

Finally, the unity formula does not apply to buildings designed using the nonseparated provisions of IBC Section 302.3.2.

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