Allowable Building Area - Part 1

By Ronald L. Geren, AIA, CSI, CCS, CCCA, SCIP

Imagine taking a project into the building department for plan review, and when you get the comments back (there are always comments), the first comment you read hits you like a ton of code books: "Building exceeds allowable area for occupancy and construction type." Nothing says "design changes" more that exceeding the allowable floor area. Even a missing fire partition or having to add some fire-resistive-rated windows and doors (although annoying and costly) won't equal the modifications necessary to make a project compliant with the allowable area of the building code.

Determining the allowable area is critical when making initial plans for a project. Although basic in building design, calculating allowable area is one of the most misunderstood applications of the building code. Under the previously published *Uniform Building Code* (UBC), calculating allowable area was confusing at best, and usually led to mistakes; fortunately, these were typically in favor of the architect (the permitted allowable floor area was actually greater). However, no matter whose favor a mistake was made, the mistake may have forced the project design in a direction contrary to the architect's or owner's desires.

Since the UBC is "old news," I won't dwell on its methods. But, it is important to highlight the significant differences, which I'll do throughout this article.

Before proceeding with the actual calculations, there are three key items of information you should have, all of which was discussed in previous articles:

1. The classification of the building by occupancies (See my article titled "Building Classification – Part 1: Occupancies").
2. Determine if you'll use separated or nonseparated occupancies (See same article mentioned above).
3. The classification of the building by construction type (See my article titled "Building Classification – Part 2: Construction Types").

To illustrate the methods of calculating allowable area, we'll use the fire station example in my previous article on occupancies. In that article, we determined that the Type IIIA construction would be required, but that was based solely on the tabulated areas of Table 503. After talking with the owner, he wants to double the size of the fire station, but not increase the cost per square foot significantly. In other words, the construction type should remain the same. The increased actual areas and occupancy classifications for our fire station include the following:

Space	Actual Area
First Floor	
Office Area (B)	7,200 sf
Apparatus Bays (S-2)	16,800 sf
Total	24,000 sf

Second Floor

Sleeping Area (R-2)	3,600 sf
Day Room (A-3)	2,000 sf
Training Room (A-3)	1,600 sf
Total	7,200 sf

We know from the previous article on occupancies, that the tabular allowable area for nonseparated uses for the building above is 14,000 square feet since the A-3 occupancy is the most restrictive for height, area, and construction type. We've, therefore, exceeded that limitation, so we must now take into consideration other factors permitted that can increase that allowable area.

Section 506 of the IBC addresses area modifications. It establishes a formula for calculating the allowable floor area based on the tabular areas of Table 503 plus increases due to open building frontage and for installation of an automatic fire sprinkler system. The formula for calculating area increases is very basic and easy to understand:

$$A_a = A_t + \left[\frac{A_t I_f}{100}\right] + \left[\frac{A_t I_s}{100}\right]$$

Whereas:
A_a = Allowable area per floor
A_t = Tabular floor area per Table 503
I_f = Increase due to frontage
I_s = Increase due sprinkler installation

The increase for sprinkler protection is not difficult to determine. If your building is protected throughout with an approved automatic sprinkler system per NFPA 13, then you may increase the allowable area by 200% ($I_s = 200$) for multistory buildings, or 300% ($I_s = 300$) for single story buildings.

The increase for frontage is a little trickier. To take advantage of this increase, at least 25% of the building perimeter must be on a public way or open space with at least a 20-foot width. To determine the increase, the IBC introduces another formula:

$$I_f = 100\left[\frac{F}{P} - 0.25\right]\frac{W}{30}$$

Whereas:
I_f = Increase due to frontage
F = Building perimeter that fronts on a public way or open space > 20 feet (feet)
P = Entire building perimeter (feet)
W = Width of public way (feet)

Additionally, the value of *W/30* cannot exceed 1.0. So, if the actual width is greater than 30 feet, then only 30 feet can be used in the formula. This *W/30* may be increased 2.0, but only if the building could qualify as an unlimited area building (which I'll review next month), but cannot because the only item restricting it from becoming unlimited area is the 60-foot minimum yard or open space. However, the largest increase that can be achieved is 75%. This is noticeably different that the UBC, which allowed an increase up to 100% depending on the number of sides that were considered open.

Now, let's take a look at our example fire station. The building will have a sprinkler system installed, and have the following perimeter and open frontage lengths:

Building Perimeter: 760 feet

Frontage with Open Space ≥30 feet: 680 feet

Frontage with 25-foot Open Space: 80 feet

Per Section 506.2.1, if the width varies, then a weighted average of the widths is to be used. Since the code doesn't define how the weighted average is calculated, the IBC Commentary does provide a method. To calculate the weighted average, use the following formula (W_1 is the width of open space and L_1 is the length of that width, and so on):

$$W = \left[\frac{W_1 L_1 + W_2 L_2 + W_n L_n \ldots}{F}\right]$$

For our example, we would use the formula as follows:

$$W = \left[\frac{(30' \times 680') + (25' \times 80')}{760'}\right] = 29.5'$$

Since this is less than 30 feet, then we won't be able to get the full increase allowed. With this information calculated, we can calculate the increase for frontage as follows:

$$I_f = 100\left[\frac{760'}{760'} - 0.25\right]\frac{29.5'}{30} = 73.75\%$$

And, finally, the calculation for total allowable floor area per floor:

$$A_a = 14{,}000sf + \left[\frac{14{,}000sf \times 73.75}{100}\right] + \left[\frac{14{,}000sf \times 200}{100}\right] = 52{,}325sf$$

This allowable area is greater than the actual area of 24,000 square feet, so the building can be constructed as a nonseparated use building, with a total building area not exceeding 104,650 square feet (52,325 sf × 2 stories). Remember, the area we calculated is the allowable per floor. So, for a 2-story building, the allowable building area is 2 times the allowable area per floor, and a 3-story building will have an allowable building area that is not greater than 3 times the allowable area per floor. Buildings 4 stories and higher are limited to 3 times the allowable area per floor, with two exceptions: 1) Buildings permitted to have unlimited floor area, and 2) R occupancies, with an NFPA 13R system installed, can have an allowable building area equal to the allowable floor area per floor times the number of stories (which is limited to 4 stories). This is because a building with an NFPA 13R system installed is not permitted to have the fire sprinkler increase.

In the next article, I'll discuss calculating allowable areas for separated occupancies and the provisions for unlimited area buildings.

To comment on this article, suggest other topics, or submit a question regarding codes, contact the author at ron@specsandcodes.com.

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