International Building Code Essentials for Wood Construction

Paul Coats, PE, CBO
Southeast Regional Manager, Codes and Standards
American Wood Council

Copyright Materials

This presentation is protected by US and International Copyright laws. Reproduction, distribution, display and use of the presentation without written permission of AWC is prohibited.

© American Wood Council 2014
CCWD Document

- This program is based on the Code Conforming Wood Design (CCWD) document
- The CCWD is intended as a brief yet comprehensive resource for wood design in accordance with the IBC
- Download at [www.awc.org](http://www.awc.org) (go to “Codes and Standards” and then “Codes”; or just type “CCWD” in the search box)

Classifications

- Group A, Assembly occupancies
- Group B, Business occupancies
- Group E, Educational occupancies
- Group F, Factory/Industrial occupancies
- Group I, Institutional occupancies
- Group M, Mercantile occupancies
- Group R, Residential occupancies
- Group S, Storage occupancies
Participant Poll Question

Sample poll question:

Please choose the answer that best describes yourself:

A. Architect or Designer
B. Engineer
C. Code Official, Plan Reviewer or Inspector
D. Builder/Developer
E. Other
### Table 503 Excerpt, Allowable Building Heights and Areas

<table>
<thead>
<tr>
<th>Group</th>
<th>Height (ft)</th>
<th>Type of Construction</th>
<th>Type III</th>
<th>Type IV</th>
<th>Type V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A 65</td>
<td>B 55</td>
<td>HT 65</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>50</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>20</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td>16</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td></td>
<td></td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

### CCWD Table 12: Group M NFPA 13–Compliant Sprinklered Buildings – Maximum floor area per story a, b, c

<table>
<thead>
<tr>
<th># of stories</th>
<th>% frontage</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25</td>
<td>1</td>
<td>74,000</td>
<td>50,000</td>
<td>82,000</td>
<td>56,000</td>
<td>36,000</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
<td>75,500</td>
<td>53,500</td>
<td>87,500</td>
<td>59,500</td>
<td>38,500</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>87,500</td>
<td>67,500</td>
<td>97,500</td>
<td>66,500</td>
<td>42,500</td>
</tr>
<tr>
<td>100 (60')d</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td></td>
</tr>
<tr>
<td>0-25</td>
<td>1</td>
<td>55,500</td>
<td>37,500</td>
<td>61,500</td>
<td>42,000</td>
<td>27,000</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
<td>60,000</td>
<td>40,000</td>
<td>66,000</td>
<td>45,500</td>
<td>29,500</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>69,500</td>
<td>46,500</td>
<td>76,500</td>
<td>52,500</td>
<td>33,500</td>
</tr>
<tr>
<td>100 (60')d</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td></td>
</tr>
<tr>
<td>0-25</td>
<td>1</td>
<td>55,500</td>
<td>37,500</td>
<td>61,500</td>
<td>42,000</td>
<td>NP</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
<td>60,000</td>
<td>40,000</td>
<td>66,000</td>
<td>45,500</td>
<td>NP</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>69,500</td>
<td>46,500</td>
<td>76,500</td>
<td>52,500</td>
<td>NP</td>
</tr>
</tbody>
</table>

(table continued on next slide)
CCWD Table 12: Group M NFPA 13–Compliant Sprinklered Buildings – Maximum floor area per story a, b, c (cont.)

<table>
<thead>
<tr>
<th># of stories</th>
<th>% frontage</th>
<th>Maximum floor area per floor (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>IIIA</td>
</tr>
<tr>
<td>4</td>
<td>0-25</td>
<td>41,620</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>45,090</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>52,030</td>
</tr>
<tr>
<td>5</td>
<td>0-25</td>
<td>33,300</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>36,070</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>41,620</td>
</tr>
</tbody>
</table>

a. The maximum floor area for four or more stories above grade plane was determined by dividing the maximum total allowable building area by the number of stories in accordance with Section 506.4. The floor area of the stories is assumed to be equal.
b. Frontage based on open space widths of 30 feet or more.
c. Interpolation permitted.
d. Sprinklered Group M buildings of one or two stories may be unlimited in area if the frontage width is at least 60 feet in accordance with Sections 507.3 and 507.4.

506 Building Area Modifications

\[ A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\} \]  
(Equation 5-1)

where:

- \( A_a \) = Allowable building area per story (square feet).
- \( A_t \) = Tabular building area per story in accordance with Table 503 (square feet).
- \( I_f \) = Area increase factor due to frontage as calculated in accordance with Section 506.2.
- \( I_s \) = Area increase factor due to sprinkler protection as calculated in accordance with Section 506.3.
506 Building Area Modifications

\[ A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\} \]  \hspace{1cm} (Equation 5-1)

\[ I_f = \left( \frac{F}{P} - 0.25 \right) \times \frac{W}{30} \] \hspace{1cm} (Equation 5-2)

where:

- \( I_f \) = 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. (A weighted average may be used when \( W \) varies along the perimeter.) \( W \) is the open space width plus the width of the public way.
506 Building Area Modifications

\[ A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\} \]  
(Equation 5-1)

\[ I_f = \left(\frac{F}{P} - 0.25\right) \times \frac{W}{30} \]  
(Equation 5-2)

\[ I_s = 2 \text{ for multistory; } \]
\[ 3 \text{ for single story} \]  
(Section 506.3)
506 Building Area Modifications

\[ A_a = \{ A_t + [A_t \times I_f] + [A_t \times I_s]\} \]  
(Equation 5-1)

\[ I_f = \frac{(F / P - 0.25) \times W}{30} \]  
(Equation 5-2)

\[ I_s = \begin{cases} 2 & \text{for multistory;} \\ 3 & \text{for single story} \end{cases} \]  
(Section 506.3)

\[ W = \frac{(L_1 \times W_1 + L_2 \times W_2 + L_3 \times W_3\ldots)}{F} \]  
(Equation 5-3)

where:
- \(L_n\) = Length of a portion of the exterior perimeter wall
- \(W_n\) = Width of open space associated with that portion of the exterior perimeter wall
- \(F\) = Building perimeter that fronts on a public way or open space having a width of 20 feet or more

Weighted Average

\[ W = \frac{(L_1 \times W_1 + L_2 \times W_2 + L_3 \times W_3\ldots)}{F} \]  
(Equation 5-3)

If each exterior wall \(= 200\) ft.; and
\(W_1 = 22\) ft., \(W_2 = 35\) ft., \(W_3 = 33\) ft., and \(W_4 = 30\) ft.

Then:
\[ W = \frac{[(200)(22)+(200)(30)+(200)(30)+(200)(30)]}{800} \]
\[ W = 28\] ft.

*Note we have to take \(W_2\) and \(W_3\) at 30 per Section 506.2.1.*
Allowable Building Area Calculation

Given: Single-story Type VB grade school
Provided with an NFPA 13-compliant automatic sprinkler system throughout and located on lot as shown.

Determine: Maximum allowable building area

Maximum Allowable Area

$$A_g = \{A_t + [A_t \times I_I] + [A_t \times I_s]\}$$  (Equation 5-1)
Maximum Allowable Area

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

\[ A_a = \{9500 + [9500 \times I_f] + [9500 \times I_s]\} \quad \text{(Table 503)} \]
Maximum Allowable Area

\[ A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\} \quad \text{(Equation 5-1)} \]
\[ A_a = \{9500 + [9500 \times I_f] + [9500 \times I_s]\} \quad \text{(Table 503)} \]

\[ I_f = \left(\frac{F}{P - 0.25}\right) \times \frac{W}{30} \quad \text{(Equation 5-2)} \]
\[ I_f = \left(\frac{350}{700 - 0.25}\right) \times \frac{30}{30} = \frac{25}{30} \quad \text{(where } W < 30, \text{ use } 30, 506.2.1) \]
Maximum Allowable Area

\[ A_a = \{A_t + [A_t \times I_f] + [A_t \times I_s]\} \]  \hspace{1cm} (Equation 5-1)

\[ A_a = \{9500 + [9500 \times I_f] + [9500 \times I_s]\} \]  \hspace{1cm} (Table 503)

\[ I_f = \left(\frac{F}{P - 0.25}\right) \times \frac{W}{30} \]  \hspace{1cm} (Equation 5-2)

\[ I_f = \left(\frac{350}{700 - 0.25}\right) \times \frac{30}{30} = 0.25 \]  \hspace{1cm} (where \( W > 30 \), use 30)

\[ I_s = 3 \]  \hspace{1cm} (Section 506.3)

\[ A_a = \{9500 + [9500 \times 0.25] + [9500 \times 3]\} \]

\[ A_a = 40,375 \]
Maximum Allowable Area

\[ A_a = \{ A_t + [A_t \times I_f] + [A_t \times I_s] \} \]  (Equation 5-1)
\[ A_a = \{ 9500 + [9500 \times I_f] + [9500 \times I_s] \} \]  (Table 503)

\[ I_f = \frac{F}{P - 0.25} \times \frac{W}{30} \]  (Equation 5-2)
\[ I_f = \frac{350/700 - 0.25}{30/30} = 0.25 \]  (where \( W > 30 \), use 30)

\[ I_s = 3 \] for single story  (Section 506.3)

\[ A_a = \{ 9500 + [9500 \times 0.25] + [9500 \times 3] \} \]

\[ A_a = 40,375 \]

Actual area = \( 250 \times 100 = 25,000 \)
\( \checkmark \) OK

W vs. Fire Separation Distance
W vs. Fire Separation Distance

Example – Group E

Given: Single-story Type VB grade school
Provided with an NFPA 13-compliant automatic sprinkler system throughout and located on lot as shown; determine maximum allowable area using the CCWD tables
Example – Group E

Frontage Increase (Section 506.2)
50% of the open space qualifies for the frontage increase

![Diagram showing frontage increase](image)

Example – Group E

Table 6 (p. 32) – Group E NFPA 13-Compliant Sprinklered Buildings – Maximum floor area per story a, b, c

<table>
<thead>
<tr>
<th># of stories</th>
<th>% frontage</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-25</td>
<td>94,000</td>
<td>58,000</td>
<td>102,000</td>
<td>74,000</td>
<td>38,000</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>99,870</td>
<td>61,620</td>
<td>108,370</td>
<td>78,620</td>
<td>40,370</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>111,620</td>
<td>68,870</td>
<td>121,120</td>
<td>87,870</td>
<td>45,120</td>
</tr>
<tr>
<td>2, 3</td>
<td>0-25</td>
<td>70,500</td>
<td>43,500</td>
<td>76,500</td>
<td>55,500</td>
<td>28,500</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>76,370</td>
<td>47,120</td>
<td>82,870</td>
<td>60,120</td>
<td>30,870</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>88,120</td>
<td>54,370</td>
<td>95,620</td>
<td>69,370</td>
<td>35,620</td>
</tr>
<tr>
<td>4</td>
<td>0-25</td>
<td>52,870</td>
<td>NP</td>
<td>57,370</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>57,280</td>
<td>NP</td>
<td>62,150</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>66,090</td>
<td>NP</td>
<td>71,710</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>
Table 10 (p. 36) – Group I-1, NFPA 13R or 13D-Compliant Sprinklered Buildings – Maximum floor area per story

<table>
<thead>
<tr>
<th># of stories</th>
<th>% frontage</th>
<th>Maximum floor area per story (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>IIIA</td>
</tr>
<tr>
<td>1, 2 &amp; 3&lt;sup&gt;e&lt;/sup&gt;</td>
<td>0-25</td>
<td>16,500</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>20,620</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>28,870</td>
</tr>
<tr>
<td>4</td>
<td>0-25</td>
<td>12,370</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>15,460</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>21,650</td>
</tr>
</tbody>
</table>

(Table 10) Footnotes – Group I-1 (p. 36), NFPA 13R or 13D-compliant buildings

- NP = Not Permitted
  - The maximum floor area for four stories above grade plane was determined by dividing the maximum total allowable building area by the number of stories in accordance with Section 506.4. The floor area of the stories is assumed to be equal.
  - Frontage based on open space widths of 30 feet or more.
  - Interpolation permitted.
  - Section 903.2.6 permits Group I-1 occupancies to be sprinklered with NFPA 13R and NFPA 13D-compliant systems. The occupancy does not qualify for area increases due to sprinklers.
  - Type VB construction does not permit three stories above grade plane.
  - Use of NFPA 13D is allowed when specific conditions in Section 903.2.6 are met.
Example – Group I-1

• Given: Two-story Type IIIB NFPA 13-R compliant sprinklered nursing home
  Determine: Maximum allowable building area
  Frontage Increase: 50% of the open space qualifies for the frontage increase

Participant Poll Question

• Given: Two-story Type IIIB NFPA 13-R compliant sprinklered nursing home
  Determine: Maximum allowable building area
  Frontage Increase: 50% of the open space qualifies for the frontage increase
  What is the maximum area per floor for this example, using the tables at the end of the CCWD document?

A. 16,250 sq. ft.
B. 12,500 sq ft.
C. 32,500 sq. ft.
D. Two stories are not permitted
### Example - Group I-1

Table 10 (p. 36) – Group I-1, NFPA 13R or 13D-Compliant Sprinklered Buildings – Maximum floor area per story

<table>
<thead>
<tr>
<th>Group I-1 Sprinklered Buildings - NFPA 13R or 13D Complianta, b, c, d, f</th>
<th># of stories</th>
<th>% frontage</th>
<th>Maximum floor area per story (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1, 2 &amp;3(^5)</td>
<td>0-25</td>
<td>IIIA 16,500, IIIB 10,000, IV 18,000, VA 10,500, VB 4,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>IIIA 20,620, IIIB 12,500, IV 22,500, VA 13,120, VB 5,620</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td>IIIA 28,870, IIIB 17,500, IV 31,500, VA 18,370, VB 7,870</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0-25</td>
<td>IIIA 12,370, IIIB NP, IV 13,500, VA NP, VB NP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>IIIA 15,460, IIIB NP, IV 16,870, VA NP, VB NP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td>IIIA 21,650, IIIB NP, IV 23,620, VA NP, VB NP</td>
</tr>
</tbody>
</table>

---

Table 503 Excerpt, Allowable Building Heights and Areas

<table>
<thead>
<tr>
<th>Group</th>
<th>Type of Construction</th>
<th>Height (ft)</th>
<th>Type III</th>
<th>Type IV</th>
<th>Type V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A 65</td>
<td>B 55</td>
<td>HT 65</td>
<td>A 50</td>
<td>B 40</td>
</tr>
<tr>
<td>A-1</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>8,500</td>
<td>15,000</td>
<td>11,500</td>
</tr>
<tr>
<td>A-2</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>9,500</td>
<td>15,000</td>
<td>11,500</td>
</tr>
<tr>
<td>A-3</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>9,500</td>
<td>15,000</td>
<td>11,500</td>
</tr>
<tr>
<td>A-4</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>9,500</td>
<td>15,000</td>
<td>11,500</td>
</tr>
<tr>
<td>A-5</td>
<td>S</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
</tr>
<tr>
<td>B</td>
<td>S</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>28,500</td>
<td>19,000</td>
<td>36,000</td>
<td>18,000</td>
</tr>
<tr>
<td>E</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>23,500</td>
<td>14,500</td>
<td>25,500</td>
<td>18,500</td>
</tr>
</tbody>
</table>
Table 503 Excerpt, Allowable Building Heights and Areas

<table>
<thead>
<tr>
<th>Group</th>
<th>Height (ft)</th>
<th>Type III</th>
<th>Type IV</th>
<th>Type V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>HT</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>65</td>
<td>55</td>
<td>65</td>
<td>50</td>
</tr>
<tr>
<td>A-1</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>8,500</td>
<td>15,000</td>
</tr>
<tr>
<td>A-2</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>9,500</td>
<td>15,000</td>
</tr>
<tr>
<td>A-3</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>9,500</td>
<td>15,000</td>
</tr>
<tr>
<td>A-4</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>14,000</td>
<td>9,500</td>
<td>15,000</td>
</tr>
<tr>
<td>A-5</td>
<td>S</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
</tr>
<tr>
<td>B</td>
<td>S</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>28,500</td>
<td>19,000</td>
<td>36,000</td>
</tr>
<tr>
<td>E</td>
<td>S</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>23,500</td>
<td>14,500</td>
<td>25,500</td>
</tr>
</tbody>
</table>

Height Increases for Sprinklers (504)
Height Increases for Sprinklers (504)

- This increase is permitted in addition to the building area increases

+ 1 story and 20 ft.
Table 503 limit
Height Increases for Sprinklers (504)

- This increase is permitted in addition to the building area increases; for buildings using NFPA 13R systems, the limit is 4 stories and 60 feet

CHAPTER 9 AREA LIMITS FOR NONSPRINIKLERED BUILDINGS
Area Limits for Nonsprinklered Buildings (Chapter 9)

- Many occupancies have floor area limits allowed by Chapter 5 that are greater than those permitted in Chapter 9 for nonsprinklered buildings.

Participant Exercise—Allowable Area

- Given:
  - Three-story retail store
  - Type IIIA construction
  - (no sprinklers)
  - Street width of 22 feet
- Determine:
  - Area limitation
### Maximum Allowable Area

\[ A_s = \{A_t + [A_t \times I_f] + [A_t \times I_s]\} \]

\[ A_s = \{18,500 + [18,500 \times I_f] + [18,500 \times I_s]\} \]

\[ W = \frac{(L_1 \times w_1 + L_2 \times w_2 + L_3 \times w_3...)}{F} \]

\[ W = 28 \text{ ft.} \]

\[ I_f = \left(\frac{F}{P} - 0.25\right) \times \frac{W}{30} \]

\[ I_f = \left(\frac{580}{700} - 0.25\right) \times \frac{28}{30} \]

\[ I_f = 0.54 \]

\[ I_s = 0 \]

\[ A_s = \{18500 + [18500 \times 0.54] + [18500 \times 0]\} \]

\[ A_s = 28,490 \text{ sq. ft. (per floor)} \]

Actual area = (120)(230) = 27,600 \text{ OK}

### Participant Exercise—Allowable Area

- **Given:**
  - Three-story retail store
  - Type IIIA construction
  - (no sprinklers) ? ?
  - Street width of 22 feet

- **Determine:**
  - Area limitation
Area Limits for Nonsprinklered Buildings (Chapter 9)

[F] 903.2.7 Group M. An automatic sprinkler system shall be provided throughout buildings containing a Group M occupancy where one of the following conditions exists:

1. A Group M fire area exceeds 12,000 square feet (1115 m²).
2. A Group M fire area is located more than three stories above grade plane.
3. The combined area of all Group M fire areas on all floors, including any mezzanines, exceeds 24,000 square feet (2230 m²).
4. A Group M occupancy used for the display and sale of upholstered furniture or mattresses exceeds 5,000 square feet (464 m²).

[F] 903.2.7.1 High-piled storage. An automatic sprinkler system shall be provided in accordance with the

Maximum Allowable Area

\[ A_a = \{A_t + [A_t \times If] + [A_t \times Is]\} \]

\[ A_t = \{18,500 + [18,500 \times If] + [18,500 \times Is]\} \]

\[ W = \left( L_1 \times w_1 + L_2 \times w_2 + L_3 \times w_3 \ldots \right) / F \]

\[ W = 28 \text{ ft.} \]

\[ If = \left( \frac{F}{P} - 0.25 \right) \times \frac{W}{30} \]

\[ If = \left( \frac{580}{700} - 0.25 \right) \times \frac{28}{30} \]

\[ If = 0.54 \]

\[ Is = 0.2 \]

\[ A_a = \{18500 + [18500 \times .54] + [18500 \times 2]\} \]

\[ A_a = 65,490 \text{ sq. ft. (per floor)} \]

Actual area = (120)(230) = 27,600 \(\checkmark\) OK
<table>
<thead>
<tr>
<th># of stories</th>
<th>% frontage</th>
<th>Maximum floor area per story (sq. ft.)</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-25</td>
<td>74,000</td>
<td>50,000</td>
<td>82,000</td>
<td>56,000</td>
<td>36,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>78,620</td>
<td>53,120</td>
<td>87,120</td>
<td>59,500</td>
<td>38,250</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>87,870</td>
<td>59,370</td>
<td>97,370</td>
<td>66,500</td>
<td>42,750</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 (60')d</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0-25</td>
<td>55,500</td>
<td>37,500</td>
<td>61,500</td>
<td>42,000</td>
<td>27,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>60,120</td>
<td>40,620</td>
<td>66,620</td>
<td>45,500</td>
<td>29,250</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>69,370</td>
<td>46,870</td>
<td>76,870</td>
<td>52,500</td>
<td>33,750</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 (60')d</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td>UL</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0-25</td>
<td>55,500</td>
<td>37,500</td>
<td>61,500</td>
<td>42,000</td>
<td>NP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>60,120</td>
<td>40,620</td>
<td>66,620</td>
<td>45,500</td>
<td>NP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>69,370</td>
<td>46,870</td>
<td>76,870</td>
<td>52,500</td>
<td>NP</td>
<td></td>
</tr>
</tbody>
</table>

(table continued on next slide)

(difference: in this table W assumed 30 ft. and only 50% open frontage estimated here)
### CCWD Table 12: Group M NFPA 13–Compliant Sprinklered Buildings – Maximum floor area per story a, b, c (cont.)

<table>
<thead>
<tr>
<th># of stories</th>
<th>% frontage</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0-25</td>
<td>41,620</td>
<td>NP</td>
<td>46,120</td>
<td>31,500</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>45,090</td>
<td>NP</td>
<td>49,960</td>
<td>34,120</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>52,030</td>
<td>NP</td>
<td>57,650</td>
<td>39,370</td>
<td>NP</td>
</tr>
<tr>
<td>5</td>
<td>0-25</td>
<td>33,300</td>
<td>NP</td>
<td>36,900</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>36,070</td>
<td>NP</td>
<td>39,970</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>41,620</td>
<td>NP</td>
<td>46,120</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

a. The maximum floor area for four or more stories above grade plane was determined by dividing the maximum total allowable building area by the number of stories in accordance with Section 506.4. The floor area of the stories is assumed to be equal.
b. Frontage based on open space widths of 30 feet or more.
c. Interpolation permitted.
d. Sprinklered Group M buildings of one or two stories may be unlimited in area if the frontage width is at least 60 feet in accordance with Sections 507.3 and 507.4.

---

### CCWD Table 12: Group M NFPA 13–Compliant Sprinklered Buildings – Maximum floor area per story a, b, c (cont.)

<table>
<thead>
<tr>
<th># of stories</th>
<th>% frontage</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0-25</td>
<td>41,620</td>
<td>NP</td>
<td>46,120</td>
<td>31,500</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>45,090</td>
<td>NP</td>
<td>49,960</td>
<td>34,120</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>52,030</td>
<td>NP</td>
<td>57,650</td>
<td>39,370</td>
<td>NP</td>
</tr>
<tr>
<td>5</td>
<td>0-25</td>
<td>33,300</td>
<td>NP</td>
<td>36,900</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>36,070</td>
<td>NP</td>
<td>39,970</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>41,620</td>
<td>NP</td>
<td>46,120</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

a. The maximum floor area for four or more stories above grade plane was determined by dividing the maximum total allowable building area by the number of stories in accordance with Section 506.4. The floor area of the stories is assumed to be equal.
b. Frontage based on open space widths of 30 feet or more.
c. Interpolation permitted.
d. Sprinklered Group M buildings of one or two stories may be unlimited in area if the frontage width is at least 60 feet in accordance with Sections 507.3 and 507.4.
<table>
<thead>
<tr>
<th>Sprinkler Trade-offs</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Reductions in corridor ratings and corridor opening protection</td>
</tr>
<tr>
<td>- Flexibility in means of egress (travel distance to exits, number and separation of exits, common path of travel)</td>
</tr>
<tr>
<td>- Reductions in dwelling unit separations</td>
</tr>
<tr>
<td>- Alternate to emergency escape openings</td>
</tr>
<tr>
<td>- Alternate to certain fire and smoke damper requirements</td>
</tr>
<tr>
<td>- Interior finish flexibility</td>
</tr>
<tr>
<td>- Other trade-offs</td>
</tr>
</tbody>
</table>
Single Occupancy

- Buildings three or more stories above grade have a total building area of the allowable building area per story (Aa) multiplied by three (Section 506.4)

Building Area (506.4)

- Based on Single Story Maximum Area
  - Assume a maximum area (Aa) of 37,500 ft per story
Building Area (506.4)

- Two story building:
  - Total allowable building area $A_{total} = 2(Aa)$

\[
\begin{array}{c}
37,500 \\
37,500 \\
\end{array}
\]

Building Area (506.4)

- Three story building
  - Total allowable building area $A_{total} = 3(Aa)$

\[
\begin{array}{c}
37,500 \\
37,500 \\
37,500 \\
\end{array}
\]
Building Area (506.4)

- Four story building
- Total allowable building area $A_{total}$ remains 3(Aa)
Building Area (506.4)

- Four story building
  - Total allowable building area $A_{total}$ remains 3(Aa)

(total building area = $(3)(37,500) = 112,500$; $112,500/4 = 28,125$ per story)
Building Area (506.4)

- Four story building of unequal stories:
  - $A_{\text{total}} = 3(Aa)$, and no single story > (Aa)

| 28,125 | 28,125 | 28,125 | 37,500 |
Building Area (506.4)

- Four story building of unequal stories:
  - $A_{total} = 3(Aa)$, and no single story > $(Aa)$

Mixed Occupancy

- 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 (506.4)
Mixed Occupancy

- 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 (506.4)

Mixed Occupancy

- Mixed occupancy buildings are permitted a total allowable building area calculated in accordance with Section 506.5
Mixed Occupancy

- Mixed occupancy buildings are permitted a total allowable building area calculated in accordance with Section 506.5
  - Section 508.3 Nonseparated

- Section 508.4 Separated
Mixed Occupancy

- Mixed occupancy buildings are permitted a total allowable building area calculated in accordance with Section 506.5
  - Section 508.3 Nonseparated
  - Section 508.4 Separated
  - Section 506.5 Single and multistory mixed occupancy buildings

STACKED BUILDINGS

p. 16-17 of the CCWD
Stacked Buildings (510)

- Buildings of different types of construction and occupancy are allowed to be built on top of each other--they are commonly referred to as pedestal buildings.

510.2 Horizontal Building Separation Allowance

- 3-hr rated Horizontal Assembly required between the lower and upper buildings
  - Limits in Section 510.2
  - Group B, M and R occupancies and Group S-2 open and enclosed parking garages are permitted in either building
  - Multiple Group A occupancies, each with an occupant load of less than 300, are also permitted in either building
  - Group S occupancies other than parking garages are permitted only in the upper building
Building Height – Stacked Buildings (510.2)

- Building Height – in feet
  - Upper building height (feet) is measured from grade plane
- Building Height – stories
  - Upper building height (stories) – measured from top of lower building

Stacked Buildings

- See other alternatives for stacked buildings in subsections 510.3 through 510.9
UNLIMITED AREA BUILDINGS

One or Two-story - Sprinklered (507)

- Unlimited area Group B, F, M and S
- Limits in Section 507.3 and 507.4
- Building must be equipped throughout with an NFPA 13-compliant automatic sprinkler system
- Must be surrounded on all sides by public ways or yards not less than 60 feet wide
One-story - Sprinklered

- Group A-1 and A-2 occupancies are allowed in unlimited area mixed occupancy buildings containing Group B, F, M or S occupancies
  - Limits in Section 507.3.1
  - Type III or IV construction
  - Occupancies are separated as required in Section 508.4.4
  - All exit doors from Group A-1 and A-2 occupancies must discharge directly to the exterior of the building

One-story - Sprinklered

- Unlimited area Group A-3 buildings
  - Limits in Section 507.7
  - Type III or IV construction
  - Building used for religious worship, community hall, dance hall, exhibition hall, gymnasium, lecture hall, indoor swimming pool or tennis court

- Unlimited area Group A-4 buildings
  - Limits in Section 507.3
  - Type IIIA, IIIB and IV construction
One-story - Sprinklered

- Unlimited area Group E buildings
- Limits in Section 507.10
  - Type IIIA or IV construction
  - Each classroom must have two means of egress, with one means of egress a direct exit to the outside of the building
  - Must be surrounded on all sides by public ways or yards not less than 60 feet wide

One-story - Nonsprinklered

- Unlimited area Group F-2 or S-2 buildings
  - Limits in Section 507.2
  - Must be surrounded on all sides by public ways or yards not less than 60 feet wide
Reduced Open Space

- Section 507.5 allows up to 75 percent of the perimeter open space to be less than 60 feet in width.
- In the plan below, 50% of the perimeter has less than 60 feet of open space

507.5 Reduced Open Space

- There must be at least 40 feet open width provided and the exterior wall and all openings on those portions will require 3-hour minimum fire-resistance and fire protection ratings.

3-hr fire rating required on walls and all openings
FIRE WALLS

Fire Walls

- Fire walls define separate buildings for allowable building size (706)
  - Not fire barriers (707)
  - Not fire partitions (708)
  - Not smoke barriers, smoke partitions, or horizontal assemblies
  - Table 706.4 gives required ratings based on occupancies separated
Fire Walls

- Type V construction:
  - Fire walls may be wood frame
- Types III and IV construction:
  - Fire walls must be of noncombustible materials in accordance with Section 706.3

Questions . . .
Table 601

Table 601 Fire-resistance Rating Requirements For Building Elements (hr)

<table>
<thead>
<tr>
<th>BUILDING ELEMENT</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A&lt;sup&gt;d&lt;/sup&gt;</td>
<td>B&lt;sup&gt;d&lt;/sup&gt;</td>
<td>B&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Primary structural frame&lt;sup&gt;e&lt;/sup&gt; (see Section 202)</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bearing walls, Exterior&lt;sup&gt;e&lt;/sup&gt;</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Bearing walls, Interior&lt;sup&gt;e&lt;/sup&gt;</td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Nonbearing walls and partitions, Exterior</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nonbearing walls and partitions, Interior&lt;sup&gt;e&lt;/sup&gt;</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>See Table 602</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor construction and associated secondary members (see Section 202)</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Roof construction and associated secondary members (see Section 202)</td>
<td>1-1/2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>1&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1&lt;sup&gt;b,c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Methods for Determining Fire Resistance (703)

- Five methods to determine fire resistance:
  - Tested fire assembly (per ASTM E119 or UL 263)
  - Prescriptive designs in Section 721 or approved sources
  - Calculation of fire resistance per Section 722
  - Engineering analysis based on a comparison of building element, component or assembly designs
  - Alternative protection methods per 104.11 as approved by the code official

703.2 Tested Assembly

- Tested to the ASTM E 119 or UL 263 standard
- Choose listed assemblies from fire-resistance publications or directories
Prescriptive Assembly

• Fire-resistance of certain wood assemblies is prescribed in Section 721 based on testing using ASTM E 119 or UL 263
• Fire-resistance designs documented in approved sources

722 Calculated Resistance

• Fire resistance of exposed wood members may be calculated using the provisions of Chapter 16 of the National Design Specification® (NDS®)
722 Calculated Resistance

- AWC’s Technical Report No. 10 (TR10), Calculating the Fire Resistance of Exposed Wood Members contains explanations and examples of the method

- Development of Design Procedures for Exposed Wood Members
722 Calculated Resistance

- AWC's Technical Report No. 10 (TR10), Calculating the Fire Resistance of Exposed Wood Members contains explanations and examples of the method
  - Development of Design Procedures for Exposed Wood Members
  - Comparison of Calculation Methods and Experiments
722 Calculated Resistance

- Fire resistance of wood frame assemblies also may be calculated based on the known fire resistance of the components, using the provisions of Section 722.6 (Component Additive Method)

<table>
<thead>
<tr>
<th>DESCRIPTION OF PANEL</th>
<th>TIME (IN MINUTES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 inch nominal panel bonded with concrete mix</td>
<td>3</td>
</tr>
<tr>
<td>1/2 inch nominal panel bonded with cement mix</td>
<td>10</td>
</tr>
<tr>
<td>1 inch nominal panel bonded with cement mix</td>
<td>15</td>
</tr>
<tr>
<td>1 inch gypsum wallboard</td>
<td>10</td>
</tr>
<tr>
<td>1 inch gypsite wallboard</td>
<td>15</td>
</tr>
<tr>
<td>1 inch gypsite wallboard</td>
<td>15</td>
</tr>
<tr>
<td>1 inch Type X gypsite wallboard</td>
<td>40</td>
</tr>
<tr>
<td>1 inch Type X gypsite wallboard</td>
<td>40</td>
</tr>
<tr>
<td>1 inch Type X gypsite wallboard</td>
<td>40</td>
</tr>
<tr>
<td>Double 1/2 inch gypsite wallboard</td>
<td>40</td>
</tr>
</tbody>
</table>

**Ten Rules of Fire Resistance Rating (Harmathy’s Rules)**

- Document of origin in AWC’s DCA-4, containing all the same provisions, with background
Engineering Analysis Based on Comparisons of Tested Elements (703.3)

- Engineering analysis—one of the original five alternatives for establishing ratings
- Based on comparison of tested elements
- DCA-3 embodies this for wood frame assemblies, and to some extent DCA-4 also
- It can be applied to other elements and other ratings with appropriate and qualified fire protection engineering judgment

Participant Poll Question

Which of the following methods are permitted by the code to establish a fire resistance rating? Select all correct answers.

A. Using a fire protection engineering analysis  
B. Choosing a prescriptive assembly from the code  
C. Using noncombustible materials for a 30-minute baseline  
D. Calculating fire resistance per Chapter 16 of the NDS  
E. Field testing during construction
TYPES OF CONSTRUCTION
(CHAPTER 6)

Type V Construction (chptr 6)

- Permits the use of wood or other approved materials for structural elements
Type IV Construction (chptr 6)

• Heavy Timber (HT) has ...
  • Exterior walls made of noncombustible materials or fire-retardant-treated wood (FRTW)
  • Interior building elements of heavy timber or laminated wood meeting minimum dimensions and without concealed spaces

Type III Construction (chptr 6)

• Requires exterior walls to be noncombustible material or FRTW and have a minimum 2-hour fire-resistance rating (bearing walls)
Type I and II Construction (chptr 6)

- Type I and II construction require building elements constructed of noncombustible materials

WOOD USE IN NONCOMBUSTIBLE CONSTRUCTION (SECTION 603)

p. 18-19 of the CCWD
Type I and II Applications

- Require the use of noncombustible materials
- Section 603 specifies 25 applications where combustible materials are permitted

Fire-Retardant-Treated Wood (FRTW)

- There are many additional applications for fire-retardant-treated wood (FRTW) in Type I and II construction (603)
  - Permitted in nonbearing partitions where the fire-resistance rating does not exceed 2 hours
  - Nonbearing exterior walls (unrated)
  - Roof construction, including structural framework, permits FRTW, except for Type IA construction of three stories or more where the lowest roof member is less than 20 feet measured vertically from the upper floor
  - (can be used in exterior walls of Types III and IV)
Heavy Timber (HT)

- Permitted in roof construction as an alternative to 1-hour or less fire-resistance rated (FRR) noncombustible construction (Table 601 footnote c, except Type IA buildings)

Type I and II Applications (603)

- Some other examples:
  - Interior finishes, millwork, trim, flooring, windows, and doors
  - Partitions of limited height, platforms, blocking for fixtures
  - Exterior wall coverings, balconies and projections
Participant Poll Question

Which of the following best describes the permitted use of wood in buildings of noncombustible construction types?

A. Wood is not permitted
B. Wood is permitted for all non-structural applications
C. Wood is permitted for finish materials and trim only
D. Wood is permitted in the applications listed in Section 603

WOOD FEATURES IN BUILDINGS

p. 19-25 of the CCWD
Wood Interior Finish (chptr 8)

- Wood materials may be used as interior finish in almost all occupancies

Wood Interior Finish – Nonsprinklered Buildings (p. 20, CCWD; T803.9 IBC)

<table>
<thead>
<tr>
<th>Location</th>
<th>Minimum Interior Finish Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exit enclosures and exit passageways</strong></td>
<td>A, B, E, I, M, R-1, R-4</td>
</tr>
<tr>
<td><strong>Corridors</strong></td>
<td>B, E, M, S, I-1, R-1, R-2, R-4</td>
</tr>
<tr>
<td><strong>Enclosed spaces and rooms</strong></td>
<td>I, A-1, A-2, R-4</td>
</tr>
</tbody>
</table>

\[\text{Minimum Interior Finish Classification by Occupancy} \]
# Wood Interior Finish – Sprinklered Buildings (p. 21, CCWD; T803.9, IBC)

## Sprinklered Buildings: Minimum Interior Finish Classification by Occupancy

<table>
<thead>
<tr>
<th>Location</th>
<th>Minimum Interior Finish Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exit enclosures and exit passageways</td>
<td>A, B, E, M, R-1, R-4, I-1, I-2, I-4</td>
</tr>
<tr>
<td></td>
<td>F, R-2, R-3, S</td>
</tr>
<tr>
<td>Corridors</td>
<td>A, I-2, I-4</td>
</tr>
<tr>
<td>Enclosed spaces and rooms</td>
<td>I-2, I-4</td>
</tr>
<tr>
<td></td>
<td>A, B, E, F, M, R, S, I-1, I-3</td>
</tr>
</tbody>
</table>

---

## Wood Interior Finish (803)

- Most wood species qualify as Class B or C
- Wood boards and panels may meet Class A criteria when pressure treated with a fire-retardant chemical
- AWC’s DCA-1 documents the performance

---

© American Wood Council 2014
Wood Interior Finish

• Exceptions (803.3):
  • Traditional wood floor covering (804.1)
  • Exposed portions of Type IV structural members (803.3)

Wood Interior Trim

• Trim is required to meet a Class C classification
• Combustible trim, excluding handrails and guards, cannot exceed 10 percent of the wall or ceiling area to which it is attached (806.5)
Exterior Windows and Doors (705.8)

- Exterior openings are required to be protected with fire protection rated window or door assemblies when the exterior wall is within given distances of a lot line.

- Unlimited amounts of unprotected openings are permitted by Table 705.8.
  - When exterior walls are 30 feet or more from the lot line.
  - 10 feet or more from the lot line (Type IIB or VB construction).
  - No unprotected openings are permitted in the exterior wall.
  - Within 5 feet of the lot line (nonsprinklered buildings).
  - No openings.
  - When wall is closer than 3 feet from the lot line.
Interior Windows and Doors

- Interior wood door assemblies are required to be fire-protection rated when the wall assembly they are in requires a FRR and opening protection (Table 716.5)

Wood Siding

- Wood siding is regulated in 1406 (see height limits as combustible exterior wall covering)
- Minimum thicknesses for wood siding in 1405.2 and and restrictions for exterior wood veneers in 1405.5
- See Chapter 23 for wood siding as a structural building material
Wood Balconies (1406.3)

- Exterior balconies may be of Type IV construction or construction that provides a fire-resistance rating equal to the floor rating required by Table 601
  - Length is limited to 50% of perimeter, each floor
  - See exceptions for sprinkler-protected balconies

Open Exterior Stairs and Ramps

- Open exterior exit stairs and ramps may be constructed of wood when the building is of Type IV and V construction (1009.9 and 1010.8)
  - Buildings up to six stories and no high-rise
Wood Roof Covering (Table 1505.1)

- Roof assemblies and coverings are divided into classifications by testing to the ASTM E 108 or UL 790 standard

<table>
<thead>
<tr>
<th>IA</th>
<th>IB</th>
<th>IIA</th>
<th>IIB</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

Table 1505.1 requires a minimum Class B roof covering for all types of construction except Types IIB, IIIB and VB
Wood Projections – Limits (705.2)

• No projections permitted with less than 2 feet FSD

Wood Projections – Limits (705.2)

• 2 feet to less than 5 feet fire separation distance
Wood Projections – Limits (705.2)

• 5 feet FSD to a FSD where Table 705.8 allows the area of unprotected openings to be unlimited

Wood Rooftop Structures (1509)

• Wood penthouses of FRTW may be placed:
  • On Type I construction two stories or less above grade plane
  • On Type II construction with the penthouse at least 5 feet from the lot line
Wood Rooftop Structures (1509)

- Type III, IV and VA construction permits the penthouse to be Type IV construction or FRTW when 20 feet or more from the lot line

- Wood towers, spires, domes and cupolas are permitted on buildings of Type III, IV and V

Wood in Locations Subject to Decay or Termites

- Wood must be naturally durable wood species or preservative-treated wood using water-borne preservatives, in accordance with AWPA U1

- Location are listed in Section 2304.11
PRECAUTIONS DURING CONSTRUCTION (CHAPTER 33)

Precautions During Construction (chptr 33)
### Fire Extinguishers - 3309

- During construction, one portable fire extinguisher must be placed:
  - At each stairway on all floor levels with combustible materials,
  - At each storage or construction shed and where special hazards exist

### Maintaining Means of Egress - 3310

- During construction, when a building height reaches 50 feet or four stories, a minimum of one temporary lighted stairway must be provided unless a permanent stairway is available for use at all times
Standpipes - 3311

- A minimum of one standpipe must be available during construction for fire department use
  - The standpipe must be installed before the construction is 40 feet above fire department access; see other conditions

Sprinkler System Commissioning - 3312

- Sprinkler system must be tested and approved before the certificate of occupancy is granted.
Requirements of the IFC

- Additional requirements for fire safety during construction are contained in the IFC (now directly referenced in Section 3302.3 of the IBC)

Requirements of the IFC – Chapter 33

- Additional requirements for fire safety during construction are contained in the IFC.
  - Temporary heating equipment must be listed and labeled.
  - Smoking is prohibited except in approved areas with posted signage.
  - A fire watch must be maintained with qualified personnel if required by the fire code official.
Requirements of the IFC – Chapter 33

- Welding operations must follow the provisions of IFC Chapter 35. Electrical wiring must follow the provisions of NFPA 70 (IFC 3304).
- The owner must designate a fire prevention superintendent responsible for implementing a fire prevention program during construction.
- An accessible emergency phone must be provided in an approved location at the construction site.

Requirements of the IFC – Chapter 33

- Fire-fighting vehicle access must be provided within 100 feet of temporary or permanent fire department connections.
- An approved water supply for fire protection must be available when combustible material is at the construction site.
- Requirements for safeguards during roofing operations.
Participant Poll Question

Which of the following is NOT required as a precaution against fire during construction, for wood construction?

A. A fire protection program must be implemented
B. Exits must be completed before the height reaches 40 ft.
C. A fire watch must be kept if required by the fire official
D. Fire extinguishers at each stairway on every floor level

AWC Standards Referenced in the IBC

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1004.9-2006</td>
<td>2006 Special Design Provisions for Wind and Seismic</td>
</tr>
<tr>
<td>2012 WFCM</td>
<td>2012 Wood Frame Construction Manual for One- and Two-family Dwellings</td>
</tr>
<tr>
<td>2012 ANSI/AF&amp;PA</td>
<td>Span Tables for Joists and Rafters</td>
</tr>
<tr>
<td>WCD No. 4-2003</td>
<td>2003 ANSI/AF&amp;PA Wood Construction Data—Plank and Beam Framing for Residential Buildings</td>
</tr>
</tbody>
</table>

These standards and related code publications, design aids, technical reports and guides for wood design and construction can be purchased or downloaded for free at [www.awc.org](http://www.awc.org).
Chapter 23 - Wood

SECTION 2301
GENERAL

2301.1 Scope. The provisions of this chapter shall govern the materials, design, construction and quality of wood members and their fasteners.

2301.2 General design requirements. The design of structural elements or systems, constructed partially or wholly of wood or wood-based products, shall be in accordance with one of the following methods:

1. Allowable stress design in accordance with Sections 2304, 2305 and 2306.

2. Load and resistance factor design in accordance with Sections 2304, 2305 and 2307.

3. Conventional light-frame construction in accordance with Sections 2304 and 2308.

Exception: Buildings designed in accordance with the provisions of the A1&PA WFCM shall be deemed to meet the requirements of the provisions of Section 2308.

4. The design and construction of log structures shall be in accordance with the provisions of ICC-400.
Section 2301 General

2301.1 Scope. The provisions of this chapter shall govern the materials, design, construction and quality of wood members and their fasteners.

2301.2 General design requirements. The design of structural elements or systems, constructed partially or wholly of wood or wood-based products, shall be in accordance with one of the following methods:

1. Allowable stress design in accordance with Sections 2304, 2305 and 2306.
2. Load and resistance factor design in accordance with Sections 2304, 2305 and 2306.
3. Conventional light-frame construction in accordance with Sections 2304 and 2308.

Exception: Buildings designed in accordance with the provisions of the AF&PA WFCM shall be deemed to meet the requirements of the provisions of Section 2308.

4. The design and construction of log structures shall be in accordance with the provisions of ICC-400.

Section 2304 General Construction Requirements contains:

- General rules for framing, sheathing, decking and fastening
- Rules for protection against decay and termites
Chapter 23 - Wood

• Section 2305 General Design Requirements for Lateral Force-Resisting Systems contains:
  • Direct reference to AF&PA (AWC) Special Design Provisions for Wind and Seismic (SDPWS) for designing diaphragms and shear walls: “Structures using wood-frame shear walls or wood-frame diaphragms to resist wind, seismic or other lateral loads shall be designed and constructed in accordance with AF&PA SDPWS . . .” (2305.1)
  • Deflection criteria for diaphragms and shear walls

Chapter 23 - Wood

• Section 2306 Allowable Stress Design contains:
  • Direct reference to AF&PA (AWC) National Design Specification for Wood Construction (NDS), the SDPWS, and other industry standards
National Design Specification (NDS)

- The NDS contains:
  - General requirements for design
  - Adjustments for referenced design values
  - Design criteria for sawn lumber, glued laminated timber, poles and piles, I-joists, SCL, WSPs, mechanical connections, dowel-type fasteners, split ring and shear plate connectors, timber rivets, shear walls and diaphragms, special loading conditions, and fire design

Chapter 23 - Wood

- Section 2307 Load and Resistance Factor Design contains:
  - Direct reference to AF&PA (AWC) National Design Specification for Wood Construction (NDS), and the SDPWS: “The design and construction of wood elements and structures using load and resistance factor design shall be in accordance with AF&PA NDS and AF&PA SDPWS.” (2307.1)
SECTION 2301
GENERAL

2301.1 Scope. The provisions of this chapter shall govern the materials, design, construction and quality of wood members and their fasteners.

2301.2 General design requirements. The design of structural elements or systems, constructed partially or wholly of wood or wood-based products, shall be in accordance with one of the following methods:

1. Allowable stress design in accordance with Sections 2304, 2305 and 2306.
2. Load and resistance factor design in accordance with Sections 2304, 2305 and 2307.
3. Conventional light-frame construction in accordance with Sections 2304 and 2308.

Exception: Buildings designed in accordance with the provisions of the AI&PA WFCM shall be deemed to meet the requirements of the provisions of Section 2308.

4. The design and construction of log structures shall be in accordance with the provisions of ICC 400.
Chapter 23 - Wood

SECTION 2301
GENERAL

2301.1 Scope. The provisions of this chapter shall govern the materials, design, construction and quality of wood members and their fasteners.

2301.2 General design requirements. The design of structural elements or systems, constructed partially or wholly of wood or wood-based products, shall be in accordance with one of the following methods:

1. Allowable stress design in accordance with Sections 2304, 2305 and 2306.

2. Load and resistance factor design in accordance with Sections 2304, 2305 and 2307.

3. Conventional light-frame construction in accordance with Sections 2304 and 2308.

Exception: Buildings designed in accordance with the provisions of the APA-PA WPCM shall be deemed to meet the requirements of the provisions of Section 2308.

4. The design and construction of log structures shall be in accordance with the provisions of ICC 490.

Chapter 23 - Wood

- Section 2308 Conventional Light-Frame Construction contains:
  - Prescriptive framing requirements and limits, span tables, stud tables, and prescriptive requirements for braced wall lines
Chapter 23 - Wood

- Section 2308 Conventional Light-Frame Constr
  - Maximum 3 stories
  - Maximum floor-to-floor of 11’ 7”
  - Maximum 10’ bearing walls
  - Roof spans of 40 feet or less
  - Low-wind only
  - SDC A (additional requirements for high SDCs)
  - Loads are limited (40 psf for floors)
Chapter 23 - Wood

SECTION 2301  GENERAL

2301.1 Scope. The provisions of this chapter shall govern the materials, design, construction and quality of wood members and their fasteners.

2301.2 General design requirements. The design of structural elements or systems, constructed partially or wholly of wood or wood-based products, shall be in accordance with one of the following methods:

1. Allowable stress design in accordance with Sections 2304, 2305 and 2306.

2. Load and resistance factor design in accordance with Sections 2304, 2305 and 2307.

3. Conventional light-frame construction in accordance with Sections 2304 and 2308.

Exception: Buildings designed in accordance with the provisions of the AE&P C WFCM shall be deemed to meet the requirements of the provisions of Section 2308.

4. The design and construction of log structures shall be in accordance with the provisions of ICC 400.

Wood Frame Construction Manual (WFCM)

- The WFCM contains:
  - Engineered criteria for one and two-family dwellings
  - Prescriptive (but engineered) criteria for one- and two-family dwellings
  - Can be used as a design tool for small commercial buildings within its applicability limits
Coming in the 2015 IBC

• Reformatted height and area provisions
Coming in 2015 IBC

- Inclusion of Cross Laminated Timber in Type IV construction type (and reference of ANSI/APA PRG 320-2012)

- CLT Handbook now available
- www.masstimer.com
- Free download
Coming in 2015 IBC

• Slightly broader application of WFCM
• Re-organization of Conventional Wood Frame Construction Provisions (2308)
• Revised span tables based on new Southern Pine design values

Questions?

www.awc.org
info@awc.org
American Wood Council

The American Wood Council (AWC) provides wood design and construction information to assist building industry professionals, develops structural and fire performance data on a wide range of traditional and engineered wood products, and engages in long-term research.

AWC provides technical expertise, education, and support on building codes, standards, and wood engineering design issues. www.awc.org info@awc.org

© American Wood Council 2014
Remember...

Follow up email TODAY

- Survey Link
- Information on Certificates of Completion (2 weeks)
- Links to Multiple Attendee Form and pdf of presentation and other resources

More AWC educational events

- education@awc.org
- www.awc.org
- Sept. 24-26, 2014 - Prescriptive and Engineering Design per the 2012 WFCM @ Virginia Tech
- October 30, 2014 - WUI Webinar — Chapter 7A Compliance Options for Buildings in Wildfire Prone Areas in California