POLLING QUESTION

1. **What is your profession?**
   a) Architect
   b) Engineer
   c) Code Official
   d) Fire Service
   e) Builder/Manufacturer/Other
WHAT IS DCA3?

- An AWC publication containing the following information for wood-framed assemblies:
  - Fire-resistance data for tested wood-frame wall and floor/ceiling assemblies
  - Sound insulation data for tested wood-frame floor/ceiling assemblies
  - Example details for exterior wall – floor intersections in platform construction

- Part of a series of AWC documents: Design for Code Acceptance (DCA)

- Available for free download on the AWC website at:
  [https://awc.org/codes-standards/publications/dca3](https://awc.org/codes-standards/publications/dca3)

DEFINITIONS

Fire resistance:

The ability of a material, product, or assembly to withstand fire or give protection from it for a period of time (Source: ASTM E176)

> Building codes stipulate minimum fire-resistance ratings for specific building elements or assemblies to slow the spread of a fire from one part of the building to another

FIRE RESISTANCE. That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.

FIRE RESISTANCE RATING. The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.

> Minimum code-required fire-resistance ratings are typically in one-hour increments (1-hour, 2-hour or 3-hour)
DEFINITIONS

Sound insulation:

The capacity of a structure to prevent sound from reaching a receiving location (Source: ASTM C634)

- Building codes stipulate minimum values for two laboratory test-based parameters of sound insulation:
  - Sound transmission class (STC) – provides a measure of airborne sound insulation
  - Impact insulation class (IIC) – provides a measure of impact sound insulation (floors only)
- Minimum STC and IIC values are required for assemblies separating dwellings

DEFINITIONS

Wood-frame construction:

Construction in which the primary structural system consists of wood members and assemblies

- All of the assemblies described in DCA3 are light-frame wood assemblies
TYPES OF ASSEMBLIES

The following wood-frame assemblies are addressed in DCA3:

- Floor/ceiling assemblies
  - Fire resistance test results and sound insulation data (one- and two-hour)

- Wall assemblies
  - Fire resistance test results (one- and two-hour)

- Exterior wall-floor intersections
  - Example details provided

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Methods for Establishing Fire Resistance Ratings (IBC 702 and 703):

- Tested in accordance with ASTM E119 or UL 263
- Fire-resistance rated designs described in approved sources
- Assemblies prescribed in IBC Section 721
- Calculations per IBC Section 722
- Engineering analysis based on comparisons of data from other ASTM E119 tests
- Alternative methods allowed under IBC Section 104.11
POLLING QUESTION

2. DCA-3 addresses which wood frame assemblies?
   a) Floor-ceiling assemblies
   b) Wall assemblies
   c) Exterior wall-floor intersections
   d) a) and b)
   e) All the above

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Assemblies that may need to be fire-resistance rated:
- Walls, floors & roofs on the basis of building construction type (IBC Table 601)
- Exterior walls (Table 602 and Section 705)
- Fire Walls (Section 706)
- Fire Barriers (Section 707)
- Fire Partitions (Section 708)
- Smoke Barriers (Section 709)
- Horizontal Assemblies (Section 711)
- Shaft Enclosures (Section 713)
Walls, floors & roofs rated on the basis of construction type:

- Have general protection requirements in IBC Section 704
- Do not require opening/penetration protection
- Have ratings based on IBC Table 601

### TABLE 601

<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>Primary structural frame</td>
<td>3a</td>
<td>2a</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bearing walls Exterior</td>
<td>3a</td>
<td>2a</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Interior</td>
<td>3a</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nonbearing walls and partitions Exterior</td>
<td>See Table 602</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonbearing walls and partitions Interior</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</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 1/2b</td>
<td>1be</td>
<td>1be</td>
<td>0</td>
<td>1be</td>
</tr>
</tbody>
</table>
Exterior Walls (IBC Section 705):

- Have unique structural and penetration protection requirements
- Have material requirements based on construction type
- The most restrictive rating from Table 601 or Table 602 must be used
- Required to be rated for exposure to both sides of the wall only when FSD ≤10’ (otherwise rating is required only from the interior side)
“ORDINARY” CONSTRUCTION

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Exterior Walls - rating requirements based on fire separation distance (IBC Table 602)

<table>
<thead>
<tr>
<th>FIRE SEPARATION DISTANCE (X feet)</th>
<th>TYPE OF CONSTRUCTION</th>
<th>OCCUPANCY GROUP H</th>
<th>OCCUPANCY GROUP F-1, M, S-1</th>
<th>OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U</th>
</tr>
</thead>
<tbody>
<tr>
<td>X &lt; 5</td>
<td>All</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5 ≤ X &lt; 10</td>
<td>IA, IB Others</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>10 ≤ X &lt; 30</td>
<td>IA, IB IIB, VB Others</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>X ≥ 30</td>
<td>All</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Separation Distance:

- if ≤ 10 feet, wall must be rated for exposure from both sides

POLLING QUESTION

3. Load-bearing wood-framed exterior walls in Type III construction:
   a) Must have a 1-hour fire-resistance rating
   b) Must have a 2-hour fire-resistance rating
   c) Must be framed with FRTW
   d) a) and c) only
   e) b) and c) only
BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Walls (IBC Section 706):

➤ Act as a divide between separate buildings

➤ Have unique structural, continuity and penetration protection requirements

➤ Material requirements based on type of construction (wood allowed in Type V)

➤ Rating requirements based on occupancy

BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Barriers (IBC Section 707):

➤ Create fire resistant separations

➤ Have unique continuity and opening/penetration protection requirements

➤ May have any materials permitted by the construction type

➤ Rating requirements based on function:

  ○ shaft enclosures, exit enclosures, occupancy separations, hazardous material control areas, fire areas, atrium protection, and others
BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Fire Partitions (IBC Section 708):

- Create fire resistant separations
- Have unique continuity and opening/penetration protection requirements
- May have any materials permitted by the construction type
- Rating requirements based on function and sprinkler protection:
  - dwelling unit separation, tenant space separation, corridor walls, elevator lobby separation

Horizontal Assemblies (IBC Section 711):

- Have unique continuity and opening/penetration protection requirements
- Have requirements for supporting construction
- Rating requirements based on function
Integrity and Continuity of Fire Resistance Rated Assemblies:

- Penetration protection (IBC Section 714)
- Opening protection (IBC Section 716)
- Fire resistant joint systems (IBC Section 715)
  
  Joint: The opening in or between adjacent assemblies that is created due to building tolerances, or is designed to allow independent movement of the building... (Source: IBC)
BUILDING CODE REQUIREMENTS – EXTERIOR WALL/FLOOR INTERSECTIONS

Exterior bearing walls in Type III construction must be fire-resistance rated

- In *platform* construction, the floor assembly bears on the wall below; and the wall above bears on the floor
  - This intersecting part of the floor assembly is *not* considered part of the exterior *wall* assembly...
  - However, the portion of the floor that transfers load from the wall above to the wall below must be designed to provide continuity of FRR from the wall above to the wall below

Exterior bearing walls in Type III construction:

- Must have a 2-hour fire-resistance rating  
  (IBC Table 601)
- If wood is used, the framing members within the exterior wall must be FRT (IBC Section 602.3)
In platform construction, the floor assembly bears on the wall below; and the wall above bears on the floor.

- This intersecting part of the floor assembly is *not* considered part of the exterior wall assembly (and therefore not required to be FRT).

- However, the portion of the floor that transfers load from the wall above to the wall below must be designed to provide continuity of FRR from the wall above to the wall below.

---

Example Details of Exterior Wall/Floor Intersections

- Applicable to Type III platform construction

- Provide continuity of FRR through the floor, from the wall above to the wall below

- Identify which framing members are required to be FRT
DCA3 – EXTERIOR WALL/FLOOR INTERSECTIONS

Example Details of Exterior Wall/Floor Intersections

➢ Example details achieve FRR by:

✓ Calculations per IBC Section 722 (NDS Ch 16)

✓ Engineering analysis based on comparisons of tested building elements

BUILDING CODE REQUIREMENTS – SOUND RATINGS

Assemblies required to be sound rated (IBC Section 1206.1):

➢ Assemblies that are between adjacent dwelling/sleeping units, and

➢ Assemblies that are between dwelling/sleeping units and adjacent public areas
BUILDING CODE REQUIREMENTS – SOUND RATINGS

Summary of Sound Rating Requirements

<table>
<thead>
<tr>
<th></th>
<th>Airborne Sound Transmission</th>
<th>Structure-borne Sound Transmission</th>
</tr>
</thead>
</table>
| **Floor/ceiling**    | **STC ≥ 50 (or 45 if field-tested)**  
                        | IBC Section 1206.2 | **IIC ≥ 50 (or 45 if field-tested)**  
                        |                             | IBC Section 1206.3 |
| **Walls**            | **STC ≥ 50 (or 45 if field-tested)**  
                        | IBC Section 1206.2 | (no requirement) |

Methods for Establishing Sound Ratings (IBC Section 1206):

- **Tested** in accordance with ASTM E90 and ASTM E492
- **Engineering analysis** based on comparisons to empirical data from ASTM E90 and ASTM E492 tests performed on similar assemblies
- **Alternative methods** allowed under IBC Section 104.11
BUILDING CODE REQUIREMENTS – FIRE RESISTANCE

Methods for Establishing Fire Resistance Ratings (IBC Section 703):

- **Tested** in accordance with ASTM E119 or UL 263
- Fire-resistance rated designs described in approved sources
- Assemblies prescribed in IBC Section 721
- Calculations per IBC Section 722
- Engineering analysis based on comparisons of data from other ASTM E119 tests
- Alternative methods allowed under IBC Section 104.11

DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Fire resistance ratings in DCA3 are established by:

- All assemblies were tested per ASTM E119
- DCA3 is typically considered an approved source
- Duplicate assemblies are prescribed in IBC Section 721

- Thus, the FRR of the assemblies are established through multiple methods allowed by IBC 703
Wall Assemblies:

- Table 1 provides descriptions of one-hour assemblies
  - Symmetrical assemblies rated from both sides
  - Asymmetrical assemblies rated from interior side
- Table 2 describes a two-hour wall assembly
  - Rated from both sides
- Embedded links take reader to detailed descriptions

Symmetrical One-hour Wall Assemblies:

- Rated from both sides
  - 5/8" Type X gypsum wallboard on each side
- Four symmetrical one-hour wall assemblies in all
  - One with 2x4 studs 16”o.c., three with 2x6 studs 16”o.c.
  - One with fiberglass, two with mineral wool, one without insulation
- All four rated under 100% design load
**DCA3 – FIRE RESISTANCE RATED ASSEMBLIES**

Asymmetrical One-hour Wall Assemblies:
- Rated from gypsum wallboard side (interior side)
- Five asymmetrical one-hour wall assemblies in all
  - Two with 2x4 studs 16”o.c., two with 2x6 studs 16”o.c., one with 2x6 studs 24”o.c.
  - Two with fiberglass, three with mineral wool insulation
- Four rated under 100% design load; one rated under 78% design load

Symmetrical Two-hour Wall Assembly:
- Rated from **both sides**
  - Two layers of 5/8” Type X gypsum wallboard on each side
- One symmetrical two-hour wall assembly
  - 2x6 studs at 24”o.c.
  - Mineral wool insulation
- Rated under 100% design load
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Optional Variations to Wall Assemblies:

- Stud framing options
  - Any species and grade of lumber meeting IBC Section 2303.1.1

- Exterior wall covering options
  - Any code-permitted exterior wall covering

Floor/Ceiling Assemblies:

- Table 3 provides descriptions of one-hour assemblies

- Seven one-hour floor/ceiling assemblies in all
  - Variety of single-layer and double-layer assemblies
  - One direct-attached assembly, the rest with steel furring

- Embedded links take reader to detailed descriptions
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Single-Layer One-Hour Floor/Ceiling Assemblies:

- Four single-layer assemblies in all
  - Three have 5/8” Type C GWB, one with 1/2” Type C GWB
  - I-joist framing at 24”o.c. or less
  - Utilize steel furring (resilient channels or hat channels)
  - Include mineral wool insulation
- All four assemblies rated under 100% design load

DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Double-Layer One-Hour Floor/Ceiling Assemblies:

- Three double-layer assemblies in all
  - All three have two layers of 1/2” GWB (Type X or C)
  - I-joist framing at 24”o.c. or less
  - Two utilize steel furring, the other has direct-attached GWB
  - One assembly has fiberglass, the others have no insulation
- All three assemblies rated under 100% design load
**DCA3 – FIRE RESISTANCE RATED ASSEMBLIES**

Two-Hour Floor/Ceiling Assembly:

- Table 4 describes the assembly;
  - Three layers of \( \frac{5}{8}'' \) Type C GWB
  - Steel hat channels between base and middle layer of GWB
  - I-joist framing at 24”o.c. or less
  - Minimum 3\( \frac{1}{2} \)”-thick fiberglass insulation
- Assembly rated under 100% design load

Optional Variations to Floor/Ceiling Assemblies:

- Floor topping options
  - Concrete (normal or light weight), any thickness
  - Gypsum concrete, any thickness
- I-joist framing options
  - Any spacing less than or equal to 24”o.c.
  - Any joist depth, flange size and web thickness greater than or equal to the minimums specified in DCA3
DCA3 – FIRE RESISTANCE RATED ASSEMBLIES

Optional Variations (continued):

- Any code-permitted floor covering
- Any insulation thickness greater than or equal to the specified minimums

These options apply to all DCA3 floor/ceiling assemblies

- Fire-resistance ratings still apply with these variations

DCA3 – EXTERIOR WALL/FLOOR INTERSECTIONS

Example Details of Exterior Wall/Floor Intersections

- Applicable to Type III platform construction
- Provide continuity of FRR through the floor, from the wall above to the wall below
- Identify which framing members are required to be FRT
Example Details of Exterior Wall/Floor Intersections

- Example details achieve FRR by:
  - Calculations per IBC Section 722 (NDS Ch 16)
  - Engineering analysis based on comparisons of tested building elements

POLLING QUESTION

4. In Type III construction, IBC 602.3 requires which of the following wood members to be FRTW?
   a) Framing and sheathing in the interior walls
   b) Framing and sheathing in the exterior walls
   c) Framing and sheathing in the floor assembly
   d) Framing and sheathing in portions of the floor assembly
   e) b) and d) only
DCA3 – EXTERIOR WALL/FLOOR INTERSECTIONS

Two-hour fire-resistance-rated exterior wall assembly, rated for exposure from interior side (and from exterior side as required by IBC 705.5)

FRTW wall framing (studs, plates, blocking, etc.)

Unvented rim board with minimum additional sacrificial thickness of 1 1/2" (Case A), 1 3/4" (Case B) or 1 3/4" (Case C). Material options include sawn lumber, SCL, and glulam. Must be designed to support full wall load based on actual thickness minus sacrificial thickness.

FRTW wall framing (studs, plates, blocking, etc.)

Exterior fire protection (as required to achieve fire-resistance rating per IBC 705.5)

Two-hour fire-resistance-rated exterior wall assembly, rated for exposure from interior side (and from exterior side as required by IBC 705.5)

One-hour fire-resistance-rated floor/ceiling assembly made with unvented framing members and floor sheathing

Ceiling membrane (as required for one-hour floor assembly):
- Case A: Two layers of min 1/2" Type X GSW or equivalent (used in conjunction with min 1/4" rim board)
- Case B: Two layers of min 1/2" Type X GSW or equivalent (used in conjunction with min 1/4" rim board)
- Case C: One layer of min 1/2" Type X or Type C GSW (used in conjunction with min 1/4" rim board)

DCA3 – EXTERIOR WALL/FLOOR INTERSECTIONS

Two-hour fire-resistance-rated exterior wall assembly, rated for exposure from interior side (and from exterior side as required by IBC 705.5)

FRTW wall framing (studs, plates, blocking, etc.)

Unvented rim board, designed to support full wall load, with a minimum thickness of 1 1/2" if wall is required to be rated from exterior per IBC 705.5

Unvented wood blocking (single or multiple layers) with minimum combined thickness of 2 1/4". Material options include sawn lumber, SCL, and glulam. Blocking must be designed to support full wall load if wall is required to be rated from exterior per IBC 705.5.

FRTW wall framing (studs, plates, blocking, etc.)

FRTW sheathing (as required)

Exterior fire protection (as required to achieve fire-resistance rating per IBC 705.5)

Two-hour fire-resistance-rated exterior wall assembly, rated for exposure from interior side (and from exterior side as required by IBC 705.5)

Wood or other approved material to fill gap between blocking and stud (if studding is used)

Unvented floor/ceiling assembly made with unvented framing members and floor sheathing (rated floor/ceiling assemblies are also acceptable)
BUILDING CODE REQUIREMENTS – SOUND RATINGS

Assemblies required to be sound rated (IBC Section 1206.1):

- Assemblies that are between adjacent dwelling/sleeping units, and
- Assemblies that are between dwelling/sleeping units and adjacent public areas

SECTION 1206
SOUND TRANSMISSION

1206.1 Scope. This section shall apply to common interior walls, partitions and floor/ceiling assemblies between adjacent dwelling units and sleeping units or between dwelling units and sleeping units and adjacent public areas such as halls, corridors, stairways or service areas.

BUILDING CODE REQUIREMENTS – SOUND RATINGS

Airborne sound transmission (IBC Section 1206.2)

- Example sources include:
  - Amplified electronic devices
  - Human voices or pets
  - Musical instruments
- Code-specified minimum Sound Transmission Class (STC) of 50
- Applies to Walls and floor/ceiling assemblies
BUILDING CODE REQUIREMENTS – SOUND RATINGS

Structure-borne sound transmission (IBC Section 1206.2)

- Example sources include:
  - Footfall (stomping) noise
  - Objects dropped on floor
- Code-specified minimum Impact Insulation Class (IIC) of 50
- Applies to Floor/ceiling assemblies (not walls)

POLLING QUESTION

5. What way(s) can the code-required minimum STC and IIC ratings be demonstrated for an assembly?
   a) Ongoing full-scale structural monitoring
   b) Direct laboratory testing per ASTM E90 and E492
   c) Engineering analysis from comparisons to other lab tests
   d) Either b) or c)
BUILDING CODE REQUIREMENTS – SOUND RATINGS

Methods for Establishing Sound Ratings (IBC Section 1206):

- Tested in accordance with ASTM E90 and ASTM E492
- Engineering analysis based on comparisons to empirical data from ASTM E90 and ASTM E492 tests performed on similar assemblies
- Alternative methods allowed under IBC Section 104.11

DCA3 – SOUND RATED ASSEMBLIES

- Sound ratings in DCA3 were established by a combination of the following:
  - Testing per ASTM E90 and ASTM E492
  - Engineering analysis based on comparisons to empirical data tests performed on similar assemblies
- The DCA3 sound ratings are established per IBC Section 1206
DCA3 – SOUND RATED ASSEMBLIES

Sound ratings are given for the floor/ceiling assemblies described in DCA3.

- Both STC and IIC values are given.
- Sound ratings are given for various configurations of each assembly, corresponding to optional variations.
- Most of the estimated values were determined using the AWC TR15 model.
- Test-based values are derived from testing per ASTM E90 and ASTM E492.

DCA3 – SOUND RATED ASSEMBLIES

- STC and IIC values are provided for:
  - Assemblies with and without gypsum concrete topping
  - Two different floor covering types (vinyl & carpet/pad)
  - Two different joist spacings (16”o.c. & 24”o.c.)

<table>
<thead>
<tr>
<th>Joist/RC Spacing</th>
<th>Without Gypsum Concrete</th>
<th>With 1” Gypsum Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cushioned Vinyl</td>
<td>Carpet &amp; Pad</td>
</tr>
<tr>
<td>STC</td>
<td>IIC</td>
<td>STC</td>
</tr>
<tr>
<td>24”o.c./16”o.c.</td>
<td>56 b</td>
<td>51 b</td>
</tr>
<tr>
<td>16”o.c./24”o.c.</td>
<td>55 b</td>
<td>48 b</td>
</tr>
</tbody>
</table>

*This assembly may also be used in a fire-rated roof/ceiling application, but only when constructed exactly as described.

STC and IIC values established by engineering analyses using the AWC Technical Report 15 (TR15) model, assuming minimum 3.5”-thick fiberglass insulation is used.