Special Inspections for Wood Construction – BCD710
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The International Code Council’s (ICC) International Building Code (IBC) Chapter 17 is titled Structural Tests and Special Inspections. This presentation provides background on special inspections for wood construction in addition to discussion on related topics such as prefabricated wood components, special inspections for lateral resistance, and structural observation as it pertains to the 2012 and 2015 IBC.
Learning Objectives

1. Learn when a special inspection may be required on a structure.
2. Become familiar with IBC provisions referencing different types of special inspections.
3. Become familiar with specific items examined during a special inspection.
4. Be aware of professional qualifications required to conduct code compliant special inspections.

Polling Question

1. **What is your profession?**
   - a) Architect
   - b) Engineer
   - c) Code Official
   - d) Builder/Developer
   - e) Other
### History

- **1961 Uniform Building Code**
- **1988 National Building Code**
  - First Introduced Special Inspection
- **1991 Uniform Building Code**
  - Chapter 3 Permits and Inspections
    - No Special Inspection Requirements for Wood Seismic/Wind Systems
    - NEW Structural Observation Required Zone 3 & 4 Structural System
- **1997 Uniform Building Code**
  - (NEW) Chapter 17 Permits and Inspections

### History

- **2000 International Building Code**
  - Chapter 17 Structural Tests and Special Inspections
    - 1704.6 Wood Construction
    - 1705 Quality Assurance for Seismic Resistance
    - 1706 Quality Assurance for Wind Resistance
    - 1709 Structural Observations
- **2003 International Building Code**
  - Chapter 17 Structural Tests and Special Inspections
    - 1704.6.1 Construction – High Load Diaphragms (NEW)
Codes

- Intended quality control measure
- Beyond inspections normally performed by building department
- Building Official –
  - enforce special inspections
  - ensures competence of special inspectors
- **1704.2.1 Special Inspector Qualifications**
  - Approved agency - Special inspector, registered design professional in responsible charge and engineers of record
  - Experience or Training
IBC Special Inspection

- Chapter 1 - Section 110 Inspections – Building Official
  - 110.3.4 Frame Inspection
- Chapter 17 Inspections and Tests
- Section 1704 Special Inspections and Tests, Contractor Responsibility and Structural Observation
  - Owner or owner’s authorized agent employ approved agencies
  - Exception:
    1. Minor construction
    2. Group U accessory to residential
    3. Conventional light-frame construction 2308

IBC Special Inspection

- 1704.2.3 Statement of Special Inspections
  - Extent, duration and frequency
    - Complexity of construction details
    - General Contractor’s wood construction skill & experience
    - Building size
    - Staffing of the building department
  - Exception:
    - Cold-formed steel light frame construction
    - Conventional light-frame construction
**1704.2.5 Special inspection of fabricated items.**

- Structural, load-bearing or lateral load resisting members or assemblies
- Fabrication on premises of fabricator’s shop
- Exception:
  1. Fabricator maintains approved detailed fabrication and quality control procedures
  2. Fabricator is registered and approved per 1704.2.5.1

**1704.2.5.1 Fabricator approval –**

- Special inspections not required
  - work is done on the premises of a fabricator registered approved to perform such work without special inspection.
  - Approval – written procedural, quality control manuals & periodic auditing of fabrication practices

Examples: metal plate connected wood trusses, glued laminated timbers (glulam) and I-joists
IBC Ch. 17 Special Inspections and Tests

Section 1704 Special Inspections and Tests, Contractor Responsibility and Structural Observation

1704.5 Submittals to the building official. In addition to the submittal of reports of special inspections and tests in accordance with Section 1704.2.4, reports and certificates shall be submitted by the owner or the owner’s authorized agent to the building official for each of the following:

1. Certificates of compliance for the fabrication of structural, load-bearing or lateral load-resisting members or assemblies on the premises of a registered and approved fabricator in accordance with Section 1704.2.5.1.

2. Certificates of compliance for the seismic qualification of nonstructural components, supports and attachments in accordance with Section 1705.13.2.

3. Certificates of compliance for designated seismic systems in accordance with Section 1705.13.3.

4. Reports of preconstruction tests for shotcrete in accordance with Section 1908.5.

5. Certificates of compliance for open web steel joists and joist girders in accordance with Section 2207.5.

6. Reports of material properties verifying compliance with the requirements of AWS D1.4 for weldability as specified in Section 26.5.4 of ACI 318 for reinforcing bars in concrete complying with a standard other than ASTM A 706 that are to be welded; and

7. Reports of mill tests in accordance with Section 20.2.2.5 of ACI 318 for reinforcing bars complying with ASTM A 615 and used to resist earthquake-induced flexural or axial forces in the special moment frames, special structural walls or coupling beams connecting special structural walls of seismic force-resisting systems in structures assigned to Seismic Design Category B, C, D, E or F.
IBC Special Inspection

• 1705.5 Wood Construction

• IBC 1705.11 (IBC12 1705.10) Special Inspection for wind resistance
  • 1705.11.2 (1705.10.1) Structural wood.

• IBC 1705.12 (IBC12 1705.11) Special Inspection for seismic resistance
  • 1705.12.2 (1705.11.2) Structural wood.
**Section 1705 Required Special Inspections and Tests**

1705.5 Wood construction. Special inspections of prefabricated wood structural elements and assemblies shall be in accordance with Section 1704.2.5. Special inspections of site-built assemblies shall be in accordance with this section.

1705.5.1 High-load diaphragms. High-load diaphragms designed in accordance with Section 2306.2 shall be installed with special inspections as indicated in Section 1704.2. The special inspector shall inspect the wood structural panel sheathing to ascertain whether it is of the grade and thickness shown on the approved construction documents. Additionally, the special inspector must verify the nominal size of framing members at adjoining panel edges, the nail or staple diameter and length, the number of fastener lines and that the spacing between fasteners in each line and at edge margins agrees with the approved construction documents.

**1705.5 Wood Construction**

**1705.5.1 High-load Diaphragms**

- Wood structural panel
- Framing members at adjoining panel edges
- Nails
Panelized Roof Concept:
Pre-assemble large sections on the ground

2-3 people
4-5 minutes to assembly
Lift into position with high lift capacity forklifts
Fasten into place

1705.5 Wood Construction

Wood Structural Panels

• Grade and Thickness

Source: APA – The Engineered Wood Association
1705.5 Wood Construction

Wood Structural Panels

• Grade and Thickness

**TECO TESTED**

40/20
STRUCTURAL 1
EXPOSURE 1
19/32 CAT
PS 2-10
SHEATHING SPAN®
SIZED FOR SPACING
MILL 000
THICKNESS 0.563 IN

**TECO TESTED**

C-D 32/16
STRUCTURAL 1
EXTERIOR
15/32 CAT
PS 1-68
SHEATHING SPAN®
MILL 000
THICKNESS 0.438 IN

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1705.5 Wood Construction

Wood Structural Panels

**PREFramed Roof Panel**

(4' x 8'—APA Structural Panels Strength Axis Parallel to Supports)

Main supporting glulam member

Metal purlin hanger

Metal joint hangers

Stiffeners 16" o.c. or 24" o.c.

Stiffeners of adjacent preframed panel

APA structural panel

**APA – The Engineered Wood Association**

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**PREFramed Roof Panel**

(8' x 8' or larger—APA Structural Panels Strength Axix Perpendicular to Supports)

Main supporting glulam member

Metal purlin hanger

Glulam purlin

Stiffeners 16" or 24" o.c.

APA structural panel

**APA – The Engineered Wood Association**

Source: APA – The Engineered Wood Association
1705.5 Wood Construction

Nominal size of framing members at adjoining panel edges

Table 4.2B Nominal Unit Shear Capacities for Wood-Frame Diaphragms

Blocked Wood Structural Panel Diaphragms Utilizing Multiple Rows of Fasteners (High Load Diaphragms)\(^{3/3,4}\)

<table>
<thead>
<tr>
<th>Sheathing Grade</th>
<th>Cones</th>
<th>Minimum Fastener Penetration in Framing Members or Blocking (in)</th>
<th>Minimum Nominal Panel Thickness (in)</th>
<th>Minimum Unit Shear Capacity of Wood and connector (ksi)</th>
<th>Lines of Fastener</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural 1</td>
<td>1-1/2</td>
<td>1 1/2</td>
<td>3/8</td>
<td>2 1/8</td>
<td>2.0/2.0</td>
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<td>1-1/2</td>
<td>1 1/2</td>
<td>3/8</td>
<td>2 1/8</td>
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<td>Sheathing and Single-Floor</td>
<td>1-1/2</td>
<td>1 1/2</td>
<td>3/8</td>
<td>2 1/8</td>
<td>2.0/2.0</td>
</tr>
</tbody>
</table>

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Nails

A few 10d nails – There are even more!
1705.5 Wood Construction

1705.5.1 High-load Diaphragms

- Nail or staple
- Pennyweight
- Diameter (head & shank)
- Length
  - Ex: 10d common
    (0.312” head dia. 0.148” shank dia. X 3” shank length)
- Number of fastener lines
- Spacing between fasteners in each line and at edge margins

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Table A1: Standard Common, Box, and Sinker Nails

<table>
<thead>
<tr>
<th>Type</th>
<th>6d</th>
<th>7d</th>
<th>8d</th>
<th>10d</th>
<th>12d</th>
<th>16d</th>
<th>20d</th>
<th>30d</th>
<th>40d</th>
<th>50d</th>
<th>60d</th>
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<td>2-1/8&quot;</td>
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</table>

1. Tolerances specified in ASTM F 1067. Typical shape of common, box, and sinker nails shown. See ASTM F1067 for other and types.

Source: AWC – SDPWS & NDS (Table L4)
**Fastener Pattern for use with High-Load Diaphragm Table**

**Typical Boundary Fastening**

Note: Space panel end and edge joint 1/8". Reduce spacing between lines as necessary to maintain minimum 3/8" fastener edge margin. 3/8" is minimum distance between rows.  

Source: AWC – SDPWS Figure 4B

**Fastener Pattern for use with High-Load Diaphragm Table**

Source: AWC – SDPWS Figure 4B
Fastener Pattern for use with High-Load Diaphragm Table

Source: AWC – SDPWS Figure 4B

High Load Diaphragm

Source: California Nail & Supply Co., Inc.
High Load Diaphragm

Source: California Nail & Supply Co., Inc.

Typical panelized roof system
BN panelized roof system

BN panelized roof system
Polling Question

2. Inspections on high-load diaphragms include verifying:
   a) Nail diameter, length, and spacing
   b) Nominal size of framing members at panel edges
   c) Wood structural panel width and depth
   d) a and b

1705.5 Wood Construction

1705.5.2 Metal-plate-connected wood trusses spanning 60 feet or greater installation
   • Trusses clear span ≥ 60 feet
   • Temporary installation restraint/bracing
   • Permanent individual truss member

2303.4.1.3 Trusses spanning 60 feet or greater
IBC Special Inspection

- **1705.5 Wood Construction**
- **IBC 1705.11 (IBC 1705.10) Special Inspection for wind resistance**
  - 1705.11.2 (1705.10.1) Structural wood.
- **IBC 1705.12 (IBC 1705.11) Special Inspection for seismic resistance**
  - 1705.12.2 (1705.11.2) Structural wood.

Special Inspection - Wind

**IBC 1705.11 (IBC12 1705.10)** Special inspections for wind resistance

- Buildings and structures
- Wind Exposure Category B \( V_{asd} > 120 \text{ mph} \)
- Wind Exposure Category C or D \( V_{asd} > 110 \text{ mph} \)

**IBC 1705.11.1 (IBC12 1705.10.1)** Structural Wood

- Continuous special inspection – field gluing operations
Special Inspection - Wind

**IBC 1705.11.1 (IBC12 1705.10.1)**

*Structural Wood (cont.)*

- main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces and hold-downs
- nailing, bolting, anchoring and other fastening
- Exception: where fastener spacing of sheathing is more than 4”oc.

**IBC 1705.11.3 (IBC12 1705.10.3)**

*Wind-resisting components.*

1. Roof covering, roof deck and roof framing connections.
2. Exterior wall covering and wall connections to roof and floor diaphragms and framing.

---

Special Inspection - Seismic

**IBC 1705.12 (IBC12 1705.11)**

*Special inspections for seismic resistance*

- Systems SDC C, D, E or F
- **Exception:**
  - Light-frame construction
    - $S_{DS} < 0.5$
    - $H < 35$ feet
  - one- or two-family dwelling
    - $\leq$ two stories
    - No horizontal or vertical irregularities ASCE 7 12.3
Special Inspection - Seismic

**IBC 1705.12.2 (IBC12 1705.11)**

**Structural Wood**

- Continuous special inspection – field gluing operations
- Periodic special Inspection

  - Seismic force-resisting systems and elements including wood shear walls, wood diaphragms, drag struts, braces and hold-downs

Source: AWC – SDPWS

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Special Inspection - Seismic

**IBC 1705.12.2 (IBC12 1705.11.2)**

**Structural Wood (cont.)**

- Periodic special Inspection (cont.)

  - nailing, bolting, anchoring and other fastening
  - Exception: where fastener spacing of sheathing is more than 4"oc.
Drag Strap

Drag Strap
Wood Shear Wall

Specific nail size and spacing requirements

Wood structural panels of specific grade and thickness

Specific stud species

Hold-down anchors

Base shear anchor bolts

Material Properties of Wood - Problem Areas

• **Splitting** happens because wood is relatively weak perpendicular to grain
  
  • **Nails too close** (act like a wedge)
Staggered Nailing

Material Properties of Wood
Material Properties of Wood

- Staggered nailing in tightly nailed shear wall helps prevent splitting of framing

Shear Wall 3x Requirements

At adjoining panel edges
Ch. 4 - Shear Walls Sheathed on 2 Sides

• Adjoining Panel Edge Details

3x at Adjoining Panel Edge

• Section 4.3.7.1(4). 3x framing also required at adjoining panel edges where:
  • Nail spacing of 2 in. o.c.
  • 10d common nails having penetration of more than 1-1/2 in. at 3 in. o.c. or less
  • Nominal unit shear capacity on either side exceeds 700 plf in SDC D, E, or F

• Exception: (2) 2x framing permitted in lieu of (1) 3x where fastened in accordance with the NDS to transfer the induced shear between members.
Foundation Bottom Plate

- **Plate washer**
  - Must extend to within ½ in. of sheathed edge of bottom plate

- **Exceptions**
  - Lower capacity sheathing materials (nominal unit shear is 400 plf or less)
  - Hold-downs are sized for full overturning – neglecting dead load

Source: AWC – SDPWS

Foundation Bottom Plate – Testing

**Failure Mode?**

Small scale test specimen to induce cross grain bending
Foundation Bottom Plate – Testing

Mode I and Mode II observed in small specimen testing.

Failure Mode?

Small scale test specimen to induce cross grain bending.
Foundation Bottom Plate – Testing

Figure 2. Shearwall assembly in test fixture

View of bottom plate after test.

Foundation Bottom Plate – Testing

Shear wall assembly in test fixture

View of bottom plate after test.
Chapter 4 - Shear Wall Anchorage – 3” x 3” Default

Shear wall anchorage provisions at foundation – Section 4.3.6.4.3

• 3” x 3” x 0.229” steel
• slotted hole permitted
• placed within ½” of sheathing material
• automatically satisfied for 2x4 plate

Chapter 4 - Shear Wall Anchorage – 3” x 3” Default

Shear wall anchorage provisions at foundation – Section 4.3.6.4.3

• Exception: Standard cut washers permitted
  • Anchor bolts designed to resist shear only
  • Hold downs designed for uplift neglecting DL
  • Aspect ratio ≤ 2:1
  • Limited nominal shear wall capacities
    • ≤ 980 plf seismic
    • ≤ 1370 plf wind
Polling Question

3. Special inspections for seismic resistance are required in seismic design categories:
   a) A, B, C, and D
   b) C and D
   c) E and F
   d) C, D, E, and F

Structural Observation

IBC 1704.6.1 (IBC 1704.5) Structural observations

• Owner to employ registered design profession
• Prior to observations submit to B.O. frequency and extent
• Conclusion of work statement
  • Site visits made
  • Identify unresolved deficiencies
Structural Observation

**IBC 1704.6.1 (IBC 1704.5.1) Structural Observation for seismic**

Seismic Design Category D, E, or F with one or more of the following:

- Risk Category III or IV
- Height > 75 feet
- SDC E, Risk Category I or II Height > two stories
- Designated by the registered design professional responsible for the structural design
- Specifically required by the building official

Structural Observation

**IBC 1704.6.2 (IBC12 1704.5.2) Structural Observation for wind**

- $V_{asd} > 110$ mph one or more of the following:
  - Risk Category III or IV
  - Height > 75 feet
  - Designated by the registered design professional responsible for the structural design
  - Specifically required by the building official
Polling Question

4. The special inspection requirements for wind are dependent of the Exposure Category of the structure.
   True or False

Resource

Structure Magazine

Special Inspection for Wood Construction

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Resource

2015 SEAOC Proceedings

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Questions?

• This concludes The American Institute of Architects Continuing Education Systems Course

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