Introduction

APA represents approximately 175 member mills in 23 states and seven provinces. The leading resource for information about engineered wood products.

Who is APA – The Engineered Wood Association?

Voice of industry
Mark of quality
Technical support
Free education
Research
Non-profit Trade Assoc.
HQ in Tacoma, WA
www.apawood.org

Agenda

Why is training needed?
Building from the ground up
- Woods Strength
- Walls
- Floors
- Roofs
- Special topics
Q&A

Presented by Larry Oenning, PE
October 7, 2022

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Engineered Wood Products (EWP)

- Plywood
- OSB – Oriented Strand Board
- I-joists
- Glulams – Glued Laminated Lumber
- LVL – Laminated Veneer Lumber
- LSL – Laminated Strand Lumber
- OSL – Oriented Strand Lumber
- CLT – Cross Laminated Timber

Wood has a strong and weak direction.

Wood's Strength Direction

OSB flakes are engineered for strength.

OSB Mat
Panel Strength

Panels are not to be used in simple span applications.

Continuous Span (2 spans or 3 supports min.)
No simple spans

Strength axis perpendicular to supports

Reasons for no simple spans:

- Strength axis perpendicular to supports
- Continuous span (2 spans or 3 supports min.)

Panel Certification Marks

APA panel grade
Span Rating (Bond Classification)
Exposure 1
Applications where construction delays expected prior to providing protection, not intended for permanent exposure to the weather

SIZED FOR SPACING
Notation indicating panels may be manufactured to length & width less than standard size. Tolerance is +/- 1/16" of "manufactured size"

Mill number
Performance-rated panel standard
Performance Category

Bond Classification

- Exposure 1
- Exterior

Exposure due to construction delays
Long term weather exposure

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APA Stamp in the Field

Walls

Wall Sheathing
- Racking/shear resistance
- Square
- Wind pressure resistance
- Nonstructural benefits
- Installation:
  - Per engineer’s design
  - Min. fastening: 8d nails @ 6” o.c. perimeter and 12” o.c. in the field min.

Walls

- Wall sheathing
  - Plywood or OSB
  - Orientation
  - 8’ to 10’ panels

Lateral Forces

Modes of Failure
- Racking
  - Resisted by Wall Bracing
- Base Shear
  - Resisted by Anchors
- Overturning
  - Resisted by Hold-Downs & Dead Load

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Anchor Bolts

- Size and spacing per engineer
- Large plate washers (3"x3"x0.229") prevent cross grain bending-splitting of sill plate (Required in Seismic Zones D and E, IBC 2308.3.1) APA recommends for High Wind Applications

Walls

Hold-down hardware

Shear Wall Design

Special Design Provisions for Wind & Seismic (SDPWS), provides designers three acceptable methods for designing wood shear walls to resist lateral forces.

Segmented Shear Walls
Perforated Shear Walls

Continuously sheathed walls

Force Transfer Around Openings (FTAO) Shear Walls

Straps above and below opening

FTAO

Force Transfer Around Openings
- Window Flange
- Length of strap
- Blocking in interior - flatwise
- Strap interior/exterior
- APA FTAO Calculator
- APA T555 - FTAO Publication

Structural I Panels
- Increased shear capacity
- Increased stiffness, especially across the panel
- Plywood & available in OSB (performance tested)
- Before specifying, check local availability

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Staggered Fastening

Splitting will not occur perpendicular to grain, no matter how close nails are. Staggering a line of nails parallel to wood grain minimizes splitting.

Floors

- **IBC Minimum Nailing**
  - Panel ends - 6" on center
  - Intermediate - 12" on center
  - Fastener edge distance - 3/8 inch

Panel ends 6" o.c. min.

Intermediate Supports 12" o.c. min.

“Composite action”

Q300 - Builder Tips:
*Construct a Solid, Squeak-Free Floor System*
Fully Fasten with Clamping Force

Floors
- Sturd-I-Floor
- Combined subfloor & underlayment
- Resistant to concentrated & impact loads
- Plywood or OSB

Overdriven Fasteners

Nail installation
- Overdriving reduces performance
- APA recommends – add one for every two overdriven

Overdriven Nails

Refer to APA publication TT-012
To Maintain Shear Capacity:

<table>
<thead>
<tr>
<th>Overdriven Fasteners</th>
<th>Overdriven Distance</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20% Perimeter</td>
<td>&lt; 1/8&quot;</td>
<td>None</td>
</tr>
<tr>
<td>&gt; 20% Perimeter</td>
<td>&gt; 1/16&quot;</td>
<td>Add 1 nail for every 2 overdriven</td>
</tr>
<tr>
<td>Any</td>
<td>&gt; 1/8&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Resource: Effect of Overdriven Fasteners on Shear Capacity publication TT-012

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Floor Joist Layout - Consistency Counts

Inconsistent spacing & span

Use Wood's Strength Direction

- I-joist
  - Used for floor & roof framing
  - Long lengths available

Flange (LVL or lumber)

Web (OSB)

I-Joist vs. Lumber
- Both at 16” o.c.
  - 36% less wood fiber
  - I-Joist at 19.2” o.c & Lumber at 16” o.c.
  - 46% less wood fiber

Sustainability

Cutting Holes in I-Joists

Before cutting any holes, refer to the I-joist manufacturer's guidelines.

Hole Size in Proportion to Shear Force
Laminated Veneer Lumber (LVL)
- Veneers bonded together
- Common uses
  - Beams
  - Headers
  - Rafters
  - Scaffold planking

All grain parallel to length

Structural Composite Lumber

Floors
Field notching and drilling LVL (Form G535)
Minimum amount of spacing = 2 x diameter of the largest hole

Floors
Laminated Strand Lumber (LSL)
Floors

Glued Laminated Timber Beams (Glulam)

Balanced and Unbalanced Glulam

Unbalanced Beam

Balanced Beam

24F-V4 Layup

24F-V8 Layup

Caution when using Unbalanced Glulams

Glulam Product Basics

Stock Beams – Camber is not an issue

Camber in stock beams is usually zero or based on a 3500’ or 5000’ radius where a 20’ beam has a curvature of 1/8” or less

3500’ radius

Zero camber
**Floors**

Field notching and drilling glulam (Form S560)

**Large Holes**

Large Diameter Holes in LVL and Glulam Beams (Forms V900, V700)

**Season Checks in Glulams**

Seasoning Checks
Uneven surfaces with torn wood fiber

**Wood Properties**

Checking Evaluation
- Guidelines established for what size checks are okay without an engineering analysis
- Published in Owner’s Guide to Understanding Checks in Glued Laminated Timber, APA Form F450

See APA Technical Note: Evaluation of Check Size in Glued Laminated Timber Beams, Form R475
Roof Covering

Rated Sheathing
• Plywood or OSB

Special Topics
Allow for panel expansion
Space panels 1/8" min. (ends & edges)

Top plates

Toe-nail installation

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Top Plate Connection

3-dimensional metal connectors

Top plate connection

Roof trusses 16" to 24" on center (typ.)

Typical wall stud nailed to top plates; wall sheathing nailed to studs and top plates provides strength to wall stud top plate connection

McClure Tornadoes 2003
APA Report SPE-1118

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Narrow Width Roof Sheathing
Form R275

Narrow Roof Sheathing
- If WSP* is 16” to 24”
  - 2 clips at lower edge acceptable
  - Lumber block lower edge
- If WSP is 12” to 16”
  - Lumber block lower edge
- If WSP is less than 12”
  - Lumber block upper and lower edges
    (Regardless of adjacent ridge or valley)

*WSP = wood structural panel (plywood or OSB)

Special Topics

Special topics
- On-site moisture management
- Shrinkage

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Special Topics

Prevent Moisture Intrusion
Drying of Subfloor

Installation Recommendations*
- Space all panels 1/8”
- 1/8” min.

Recommended spacing of floor underlayment panel = 1/32”

Proper spacing
- 1/8”
- 10d box nail
- 3/8”

M300 – Builder Tip
FT-058 – Slant Nailing

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Special Topics

What can happen if panels aren’t allowed to acclimate?

- Nailing approx. 3" o.c.

Special Topics

Buckling - High Risk Applications:
- Panels installed parallel to supports (e.g., walls)
- Edge nailing 4" o.c. or closer
- Long lasting rainy weather or high humidity
- Panels installed within a few days of their manufacture
- Others...

High risk because the conditions may reduce edge gap’s effectiveness in absorbing panel expansion.
Special Topics

Attic Spaces require adequate ventilation

- Provide adequate moisture control both during and after construction
- Ventilate attics and roof structural spaces per requirements of International Building Code (IBC) Section 1203.2

Mold from Improper Ventilation

FAQ:

Questions About Structural Plywood and OSB Performance

Questions include:

- Delamination
- Buckling
- Checking
- Warping
- Grade
- Swelling
- Flaking
- Applications
- Siding substrate

Panel Expansion of large structures

- Panel expansion may accumulate through the framing of large, continuous floor or roof decks
- Provide temporary expansion joints to minimize displacement when building plan dimension exceeds 80'

Temporary Expansion Joints for Large Buildings

Provisions for large structures

12" gap in wall bottom plate at expansion joint

APA Technical note U425

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Provisions for large structures

Roofs:
- Sheath 80-foot sections, omitting a roof sheathing panel between sections
- Complete installation with fill-in panels immediately before sheathing is covered with roof underlayment

Shrinkage occurs primarily in horizontal wood dimensional lumber members such as wall plates and floor joists.

Tangential shrinkage averages about twice that of radial shrinkage in most species.

Longitudinal shrinkage or expansion is negligible.

Zone of movement
- Shrinkage occurs primarily in horizontal members such as wall plates and floor joists.
- WoodWorks paper, Accommodating Shrinkage in Multi-Story Wood-Frame Structures

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Quick Summary

- Simple steps make a big difference:
  - Follow the prints and specifications
  - Space panels
  - Follow fastening guidelines
  - Check load paths/stacking
  - Control moisture

Assistance is available from APA

APA Resources

APA Engineered Wood Construction Guide (E30)

- The “go to” APA publication
- Free download
- $12 to buy hard copy
- www.apawood.org/publication

Thank You!

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