Objectives

- Acquire working knowledge of Engineered Wood Beams
- Differentiate Engineered Wood Beams based on availability, cost, and strength
- Evaluate the use of Engineered Wood Beams for a variety of applications
- Identify how Engineered Wood Beams are commonly used based on project examples

What is an Engineered Wood Product?

Any wood-based building material that has been improved physically by a manufacturing process.
Engineered Wood Products

- Designed by optimally orienting wood strands, veneers or laminations
- Using structural durable adhesives
- Forming larger composite products
- With engineered properties manufactured to maximize wood’s natural and strength characteristics

Environmentally Friendly

Laminated Veneer Lumber (LVL)

Veneers bonded together
- Beams, headers, rafters & scaffold planking
- Common thicknesses: 3/4” to 3-1/2”

All grain parallel to length
Laminated Veneer Lumber = LVL

- Readily and widely available
- Variety of stress classes available to suit specific designs
- Competitively priced
- Strength achieved not by densification, but by grading and optimum layup of veneers
- To reduce handling of heavy beams, LVL can be site built into wider beams by nailing or bolting
- Dimensionally stable, water repellent sealers available to extend exposure performance
- Typical applications: beams, headers, columns, joists, studs, ridge beams, truss chords, scaffold planking, and I-joist flanges

LVL Beams in I-Joist Floor Systems

LVL Floor Beam Side Loaded

Side Loaded LVL

Timberstrand LSL
Solid Start LSL

Laminated Strand Lumber = LSL

• Permits use of smaller, variable quality logs
• Higher shear strength than LVL & PSL
• Allows holes 2x larger than LVL or PSL
• Typically less expensive than LVL & PSL
• Can be the best value, if structural demands are met
• Excellent fastener holding strength
• Species include aspen, yellow poplar
• Commonly used for headers, beams, columns, studs, stair stringers, door & window parts

Parallam® PSL introduced 1988

Parallam® PSL means:
Parallel Strand Lumber

Parallam® is a registered trademark brand name of iLevel.

Parallam® Exterior Solutions

Parallel Strand Lumber = PSL

• Stronger & stiffer than LSL
• Generally more $ than LVL, LSL, or Glulam
• Allows higher fiber utilization than LVL
• Readily treated with preservatives
• Easily bolted
• Used for columns, header, beams, trusses.
• For interior apps-can be finished & left exposed
Today’s Glulam – Important Considerations for Design and Construction Professionals

Tom Williamson, P.E.
Consulting Engineer
Retired Vice President, APA
Past Executive VP, AITC

Glulam

- Wood laminations bonded together
- Wood grain runs parallel to the length

Typical Widths:
- 2-1/2” to 10-3/4”
- 1-3/8” for Southern Pine
- 1-1/2” for Douglas Fir

What is Glulam?

Glulam = a structural composite of lumber and adhesives

Dispersal of Strength Reducing Characteristics

Single Lamination

Glued Laminated Timber

Glulam – One of the Original Glued Engineered Wood Composites

Introduced in the U.S. in 1933

Over 115 years of use worldwide

1933 – First Glulam in the U.S.A.
Madison, WI
SYP 2.1 E

LVL Hybrid Glulam with LVL Outer Laminations

- Full length with no finger joints required
- LVL has greater tensile strength compared to lumber
- 30F-2.1E stress level achieved
- Direct substitute for many SCL products

FRP Reinforced Glulam

Western Washington University

Cost savings for the FRP glulam beams was $22,000

Product Basics
Large Cross Sections Are Possible

21” x 27” x 110’
Unbalanced Layups
“Upside Down” Bending Stresses

Based on full-size beam tests conducted at APA, the “upside down” bending stress is 75% of the normal bending capacity.

Specifying Camber

- Glulam can be manufactured with camber to offset the anticipated dead load deflection
- Very important for long span members

Note the “TOP” Stamp for Unbalanced Layup
Stock Glulam Sizes

Beam Orientation and Sizes

- Horizontal or load perpendicular to face
- Typical beam depths
  - 9” – 30”
- Typical beam widths
  - 3-1/8” and 3-1/2”
  - 5-1/8” and 5-1/2”
  - 6-3/4”

Stock Glulam IJC Sizes

- Lengths are available as needed from distribution yards
- Typical IJC beam depths
  - 9-1/2”, 11-7/8”
  - 14” and 16”
- Widths for IJC beams match 2x4 and 2x6 framing

Naturally Durable Species

- Port Orford Cedar 22F-1.8E
- Alaska Yellow Cedar 20F-1.5E
- Western Red Cedar 16F-1.3E
- California Redwood 16F-1.1E
Alaska Yellow Cedar (AYC)
Santa Monica, CA Reservoir Cover

Preservative Treatment of Glulam
See APA Technical Note S580

Characteristics of Glulam in Fire
- Wood is an excellent heat insulator
- Develops a char layer after fire exposure
- Self-extinguishing after fire source removed
- Retains significant residual strength after being exposed to fire

Glulam: Char

Glulam: Fire Resistance

Tension Lam Provisions
Chemical Storage Facility
Portland, OR

Twin Rink Ice Arena
Anaheim, CA.

2010 Olympic Skating Oval
Richmond, B.C.

Cathedral of Light – Oakland, CA

Toronto Ontario Art Gallery
Glulam Truss Bridge in Hiroshima Japan

Total length = 650 ft.
Main central span = 275 ft.
Tower height = 155 ft.
Truss depth = 10 ft.

Selecting and Sizing

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Floor Beam Assumptions

- Dry Use
- Uniform Load Only — No Point Loads
- Beam Weight Included
- Most Restrictive of Simple or Multiple Span Conditions
- Live Load = 80% of Total Load
- Load Duration Factor = 1.00
- Live Load Deflection = L/360
- Total Load Deflection = L/240
- Adequate Bearing Area Provided
- Continuous Lateral Bracing Along Top and Bottom Chords and at Top and Bottom at Ends of Beam

Floor Beam 8-0-0

- Span in Feet: 8-0-0
- Total Load: 1200#
- Beam Width: 3.5"
- Beam Depth: 9.5"
- Beam Type: LSL 1.55E 2325fb
- Actual Capacity: 1292#
- Note: 310fv

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Floor Beam 8-0-0

- Span in Feet: 8-0-0
- Total Load: 1200#
- Beam Width: 3.5"
- Beam Depth: 9.5"
- Beam Type: PSL 2.0E 2900fb
- Actual Capacity: 1517#
- Note: 290fv

Floor Beam 8-0-0

- Span in Feet: 8-0-0
- Total Load: 1200#
- Beam Width: 3.5"
- Beam Depth: 9.5"
- Beam Type: SYP Glulam 2.1E 3000fb
- Actual Capacity: 1645#
- Note: 300fv

Floor Beam 20-0-0

- Span in Feet: 20-0-0
- Total Load: 300#
- Beam Width: 3.5"
- Beam Depth: 14"
- Beam Type: LSL 1.55E 2325fb
- Actual Capacity: 312#
- Note: 310fv

Floor Beam 20-0-0

- Span in Feet: 20-0-0
- Total Load: 300#
- Beam Width: 3.5"
- Beam Depth: 14"
- Beam Type: LSL 1.75E 2500fb
- Actual Capacity: 352#
- Note: 410fv

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<td><strong>Beam Width:</strong> 3.5”</td>
<td><strong>Beam Width:</strong> 3.5”</td>
</tr>
<tr>
<td><strong>Beam Depth:</strong> 14”</td>
<td><strong>Beam Depth:</strong> 14”</td>
</tr>
<tr>
<td><strong>Beam Type:</strong> DF Glulam 2.1E 3000fb</td>
<td><strong>Beam Type:</strong> DF Glulam 2.1E 3000fb</td>
</tr>
<tr>
<td><strong>Actual Capacity:</strong> 455#</td>
<td><strong>Actual Capacity:</strong> 455#</td>
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<tr>
<td><strong>Note:</strong> 300fv</td>
<td><strong>Note:</strong> 300fv</td>
</tr>
</tbody>
</table>
### LVL Conclusions
- Ability to Nail in Place
- Most Commonly Available Engineered Wood Beam
- Various Grades
- Available in Wide Widths (Verify)
- Competitive Pricing
- Available as Studs and Columns

### LSL Conclusions
- Best for Short Spans
- Large Holes Capability
- One Piece Solution
- Headers in Walls
- Available as Columns and Studs
- Tall Wall Applications

### PSL Conclusions
- High Strength
- Available in Wide Widths
- Can be Treated
- Can be Used in Timber Type Trusses
- Can be Exposed and Stained/Painted
- Available as Columns

### Glulam Conclusions
- Architectural Grades Available
- High Strength Hybrid Beams
- Widest Widths Available
- Can be Cambered and Curved
- Some Beams are Individually Wrapped
- Deepest Depths Available
- Cost Competitive with SCL
- Available in DF, SYP, Cedar and Others
- Can be Treated

### Glulam Design References
- AITC “Timber Construction Manual”
Questions?

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

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Thank You

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