Wood Education Presentation

Wood Construction, and Structural Wood Products and their various Applications
Wood as a Material

- preferred building material for residential construction in North America
- New engineered wood products (EWP) and Code changes have increased share of commercial market
Why Use Wood?

Wood is **Renewable**

- Over 600 million seedlings are planted in Canada each year
- The volume of trees in Canada’s productive forests increased by 3.8% in the last 15 years (1981-95)
Why Use Wood?

Wood is Sustainable

The rate of growth in Canada’s commercial forests is equivalent to:

• 50,354 houses a day
• 2,098 houses an hour
• 35 houses a minute
Why Use Wood?

Wood is Environmentally Friendly

**ENERGY USE**

<table>
<thead>
<tr>
<th>Material</th>
<th>Energy Use (GJ x 10^8)</th>
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<tbody>
<tr>
<td>Wood</td>
<td>4</td>
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<tr>
<td>Steel</td>
<td>7</td>
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<tr>
<td>Concrete</td>
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</table>

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Why Use Wood?

Wood is Environmentally Friendly

GREENHOUSE GAS

<table>
<thead>
<tr>
<th>Manufacturing</th>
<th>Equivalent CO₂ (Tonnes)</th>
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<tr>
<td>Wood</td>
<td>750</td>
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<tr>
<td>Steel</td>
<td>1050</td>
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<tr>
<td>Concrete</td>
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Why Use Wood?

Wood is Environmentally Friendly

**WATER POLLUTION**

<table>
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<th>Material</th>
<th>Index Value ($x 10^8$)</th>
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<tr>
<td>Steel</td>
<td>165</td>
</tr>
<tr>
<td>Concrete</td>
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</table>

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Why Use Wood?

Wood is Environmentally Friendly

**RESOURCE EXTRACTION**

<table>
<thead>
<tr>
<th></th>
<th>Index Value x 10^5</th>
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<tbody>
<tr>
<td>Wood</td>
<td>30</td>
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<tr>
<td>Steel</td>
<td>35</td>
</tr>
<tr>
<td>Concrete</td>
<td>60</td>
</tr>
</tbody>
</table>

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Why Use Wood?

Wood is Thermally Efficient

Wood keeps the heat in

Wood R-Value = 1.5/in

Steel R-Value = .0024/in
Why Use Wood?

Wood is Thermally Efficient

Effective R-Value

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Structural Lumber

Consists of:
- dimension lumber
- specialty lumber
- timber
Structural Lumber - Grading

Canadian Lumber is manufactured according to NLGA Standard Grading Rules:
  • approved by the Canadian Lumber Standards Accreditation Board
  • approved by the American Lumber Standard Board of Review
Structural Lumber - Grading

Example Dimension Lumber Grade Stamp

Grading Agency - Canadian Lumbermen’s Association

Assigned Grade

Mill designation

Species Group

Moisture Content
Specialty Lumber

Machine Stress Rated (MSR)

- lumber which is evaluated mechanically & visually

Features:
- more predictable properties
- higher strengths than visually graded lumber
Specialty Lumber

Fingerjoined Lumber

- dimension lumber into which fingerjoined profiles have been machined and end-glued together

Features:
- longer spans
Engineered Wood Products
Engineered Wood Products

An Engineered Wood Product (EWP) is a product that has gone through a process to provide better or more predictable properties.

• longer spans
• greater load carrying capacity
• more design flexibility
Engineered Wood Products

- Plywood
- Oriented Strandboard (OSB)
- Glulam
- Parallel Strand Lumber (PSL)
- Laminated Veneer Lumber (LVL)
- Laminated Strand Lumber (LSL)
- I-Joists / Open-Web Joists
- Trusses
Plywood

Thin veneers glued together oriented at cross grain.
- structural panels use waterproof phenol-formaldehyde resin glue certified for exterior use
Plywood - Features

- can be treated
- can be used in exposed exterior applications
**Plywood - Sizes**

- commonly available in sheets 1220mm (4’) by 2440mm (8’) long
- available in thicknesses of 7.5mm (9/32”) to 31.5mm (1-7/32”) unsanded
- available in thicknesses of 6mm (1/4”) to 30mm (1-3/16”) sanded
- other sizes custom manufactured
Plywood - Uses

Uses

• floor sheathing & underlayment
• wall sheathing
• roof sheathing
Plywood - Specialty Uses

Specialty Uses

• preserved wood foundations
• concrete formwork
• plywood Box Beams
• stress-skin panels
Plywood - Uses
Oriented Strandboard

• Successive layers of 80mm (3 1/8”) strands aligned at 90° to each other
• use waterproof phenol-formaldehyde resin adhesive or equivalent binder and wax for adhesion
Oriented Strandboard - Features

• high shear value (commonly used for webstock for I-joists)
• not recommended for exposed exterior applications
Oriented Strandboard - Sizes

• most common panel size is 1220mm x 2440mm (4’ x 8’)
• thicknesses are available from 6mm (1/4”) to 28.5mm(1-1/8”)
• custom sizes may be specially ordered
Oriented Strandboard - Uses

Uses

- wall sheathing
- floor sheathing
- roof sheathing
Oriented Strandboard - Specialty Uses

Specialty Uses
• concrete formwork
• siding
• structural insulated panels
• I-joist webs
Oriented Strandboard - Uses
Oriented Strandboard - Uses
Glulam

- dimension (lamstock) lumber glued together under controlled conditions
- pieces are end jointed or butted and arranged in horizontal layers
- uses special grade (lamstock) lumber with a maximum MC = 15%
Glulam - Features

- produces large members, many shapes & sizes
- can be curved and tapered
- suitable for exterior & interior applications
- industrial, commercial or quality finish
- uses waterproof adhesives for end jointing and face bonding
Glulam - Sizes

• available in lengths up to 40m (130’) however, limited by transportation restrictions

• standard finished widths range from 80mm (3”) to 365mm (14-1/4”)

• standard depths range from 114mm (4 1/2”) to 2128mm (7”) or more
Glulam - Uses

- Columns, beams, headers and girders
- Curved members loaded in combined bending and compression
- Used where structure of building is left exposed for architectural features
- Heavy trusses
Glulam - Uses
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Parallel Strand Lumber

High strength composite lumber product manufactured by gluing strands (~ 3mm x 13mm x 2.4m) of wood together under pressure.

• Manufactured from douglas fir or southern pine
Parallel Strand Lumber - Features

- consistent properties
- resistant to seasoning stresses
- high load carrying capabilities
- well suited to applications where appearance is important
Parallel Strand Lumber - Sizes

• length usually limited to 20m (66’) due to transportation constraints
• beams sold in thicknesses of 45mm - 178mm (1 3/4”-7”)
• can be sawn to any dimension
• multitude of cross-sections
Parallel Strand Lumber - Uses

- beams & columns (post & beam construction)
- beams, headers & lintels (light frame construction)
- heavy timber
- trusses
Parallel Strand Lumber - Uses
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Parallel Strand Lumber - Uses
Laminated Veneer Lumber

Type of structural composite lumber consisting of wood veneers coated with waterproof adhesives glued together and oriented in the same direction.
Laminated Veneer Lumber - Features

• strong when edge-loaded as a beam & when face loaded as a plank
• dimensionally stable
• high strength
• high reliability, lower variability
Laminated Veneer Lumber - Sizes

- available in lengths up to 24.4m (80’)
- manufactured in thicknesses from 19mm to 89mm (3/4”-3 1/2”)
- common LVL beam depths are 241mm to 476mm (9 1/2”-18 3/4”)
- easily cut to length at site
Laminated Veneer Lumber - Uses

• as flange member for prefab. wood I-joists
• well suited to applications where open web steel joists (OWSJ) & light steel beams may be considered
• beams & headers
• scaffold planking
Laminated Veneer Lumber - New Uses

New Applications

• columns
• wall studs
• trusses
Laminated Veneer Lumber - Uses
**Laminated Strand Lumber**

Consists of long strands (~300mm) oriented in a parallel direction laminated together with an isocyanurate-based adhesive.

- Manufactured from aspen
Laminated Strand Lumber - Features

- uniform and consistent properties
- dimensional stability
- manufactured to a consistent moisture content and uniform dimensions
Laminated Strand Lumber - Sizes

• studs available in lengths up to 22 feet
• studs generally available in 2” x 4” or 2” x 6”
• rim boards generally 1 1/4” wide
• rim boards usually available in depths of 9 1/2” to 16”
Laminated Strand Lumber - Uses

- tall wall studs
- rim boards
Laminated Strand Lumber - Uses
Laminated Strand Lumber - Uses
Wood I-Joists

Manufactured by gluing solid sawn lumber, LVL or MSR flanges to a plywood or OSB web.
Wood I-Joists - Features

- dimensionally stable, lightweight member
- uniform stiffness, strength
- known engineering properties
- use exterior rated waterproof adhesives
Wood I-Joists - Sizes

- length limited by transportation to 20m (66’)
- common depths range from 241mm to 508mm (9 1/2”-20”)
- common flange widths vary from 45mm to 89mm (1 3/4”-3 1/2”)
- web thickness usually varies from 9.5mm to 12.7mm (3/8”-1/2”)
- sizes can be specially ordered
Wood I-Joists - Uses

• floor and roof joists
• economical alternative to OWSJ
• well suited for longer span joist & rafter applications
Wood I-Joists - Uses
Wood I-Joists - Uses
Open Webbed Joists

Metal plate connected, glued or metal webbed trusses used for floor or roof joists.
Open Webbed Joists

Many manufacturers
Trusses

Structural frame relying on a triangular arrangement of webs and chords to transfer loads to reaction points.
Trusses

There are two categories of trusses:

1. Light Frame Trusses (metal plate connected)
2. Heavy Timber Trusses
Trusses - Light Frame

• made from dimension lumber of various sizes
• chords and webs connected by the use of toothed galvanized steel connector plates hydraulically pressed into precut lumber
**Trusses - Heavy Timber**

- made from timbers or from manufactured wood products (i.e. glulam, PSL)
- members connected using bolts & plates, split rings, and special brackets & hangars
Trusses - Features

- unlimited shape & size
- economy
- ease of fabrication
- fast delivery
- simplified erection procedures
- all trusses are custom designed
- flexibility in layout & longspans
Trusses - Sizes

• shapes and size restricted only by manufacturing capabilities, shipping limitations & handling considerations
Trusses - Uses

- floor systems
- roof systems
Trusses - Uses
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Trusses - Uses

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Trusses - Uses
Trusses - Uses
Engineered Wood Products

Summary
• engineered products with consistent properties
  - strength, MC, dimension
• proprietary products except panels and glulam
• long span capabilities
• economical alternative to steel and concrete systems
• engineering support from manufacturers
Wood Construction

Two basic types:

1. Light-frame
2. Post & Beam
Wood Construction - Light Frame

The use of closely spaced members of dimension lumber size combined with sheathing to form the structural elements of the building.

Two basic methods:

A.) Platform Construction
B.) Balloon Construction
Wood Construction - Light Frame

Platform Construction:

Consists of a floor platform upon which the walls are built. The second storey floor is then built on top of the first floor walls.
Wood Construction - Light Frame

Balloon Construction:

Wall members continue past the floors. The joists are then suspended from the completed wall frames.
Wood Construction - Light Frame

Single-family Residential
Wood Construction - Light Frame

Multi-family Residential
Wood Construction - Light Frame

Commercial
Wood Construction - Post & Beam

The use of large, widely spaced members to provide structural support.
Wood Construction - Post & Beam

Single-family Residential
Wood Construction - Post & Beam

Commercial
Architectural Considerations

Wood and moisture

• Use **DRY LUMBER** when possible
• facilitate shedding of water
• protect edge and end grain
• allow access for air drying
Architectural Considerations

Lateral Design - earthquakes & wind

Light-Frame
• sheathing and framing together resist lateral loads - shearwalls
Architectural Considerations

Lateral Design - earthquakes & wind

Post & Beam
• columns and beams support vertical loads and diagonal bracing or other support is required to resist lateral loads
Architectural Considerations

Fire Resistance

- Heavy Timber has inherent fire resistance
- Light frame uses GWB to achieve 45 min to 2 hour FRR