Puu-28.5000

Introduction to Wood Properties and Wood Products

Sawn wood and veneer-based products

25\textsuperscript{th} November 2015
Today

• Sawnwood
  • Principles of the production

• Veneer-based products
  • Principles of plywood
  • Principles of LVL
Wood products

There is a wide range of wood products!

Primary e.g.
- Round wood
- Sawnwood
- Plywood
- Laminated Veneer Lumber (LVL)
- Particleboard (chipboard)
- Medium density fibreboard (MDF)
- Oriented Strand Board (OSB)
- Softboard/hardboard

Secondary processed e.g.
- Laminated panel board
- Glue Laminated Timber (glulam)
- Composite “I” beams
- Coated wood and panels
- Pressure (preservative) treated
- Modified wood (chemical, physical modification)
Sawnwood
Sawnwood

- Harvesting
- Sawing
- Drying (mc 30-150%)
Sawnwood

(Classification of lumber by the manner of cutting)

(Source: Society of Wood Science & Technology)
Roundwood into rectangular boards

- Sawing method
- Sawing pattern
- “Loss” of wood
- All about optimization
The sawing method
The sawing pattern

Erilaisia asetteita
Anisotropy

Source: The wood Handbook 1999
Sawing patterns
1 m³ of round wood

- 45 % sawn goods
- 30 % chips
- 15 % sawdust
- 10 % bark
The sawing process

Edited: Ulla Rintala
Debarking of logs

• Logs are debarked so that byproducts (chips and saw dust) are not contaminated and can be used in other processes
Sawing - chipping
Sawing - profiling
Sorting, sticking and stacking

• After sawing, the wood is sorted into length and quality and then “stickered” (thin laths of wood inserted between planks to facilitate air flow and to restrain distortion) and stacked for drying
Drying – various methods

• Drying to reduce MC to near final EMC, reduce distortion etc.

• Various methods, including for example:
  – Air seasoning
  – Kiln drying, drying chambers or channels
  – High temperature drying
Air seasoning
Kiln drying

- Warm air blown through the stack
- Temperature and humidity set to a particular drying schedule
- Temperature always under 100°C, usually 60 - 80°C
- Two different kiln types:
  - Batch kiln drying (chamber)
  - Progressive kiln drying (channel)
Distortions of wood (warping)

twist

cup

bow

crook (also known as spring)
Sorting

- Different qualities required for different products
- Sorting either visually or automatically
- Sorting rules are defined in standards
Packing and shipping
Further processing

- Grading
- Planing
- Finger jointing
- Gluing (glue laminated timber – “glulam”)
- Others (CLT etc.)
Youtube clips:

Saw mill (short):
https://www.youtube.com/watch?v=5at4u6nDZJg

Saw mill (long):
https://www.youtube.com/watch?v=VxcOz6gLk_g
Veneer-based products
(veneers, plywood & LVL)
Plywood applications

• What applications do you know for plywood?

• Why is it used there?
Plywood has three main applications

- Transport technology
  - boats
  - trucks
  - aeroplanes
  - gas tankers (-160 °C)

- Building technology

- Concrete forming technology
Other plywood based products

• packing
• furniture
• interior decoration
• flooring products
• skate boards
• windmills
• ice-hockey rinks
• ice hockey sticks
• race cars floors
• bumerangs, etc...
Types of plywood

• There are several hundreds of different types of plywood available in the World

• Variations in
  ◦ species (in Finland mainly spruce & birch)
  ◦ thickness of veneers
  ◦ thickness of final plywood
  ◦ layout (cross-laminated, partly parallel, etc)
  ◦ glues
  ◦ surface coatings
Basic types of plywood (in Finland)

• Birch plywood
  • usually made out of 1,4 mm birch veneers
  • the toughest and most expensive
  • light coloured and durable surface
  • suitable for e.g. flooring

• Conifer plywood
  • usually made out of thicker 2-3,5 mm spruce veneers
  • lighter and slightly weaker than birch plywood
  • suitable for e.g. roofing, walls and fences

• Combi plywood
  • made out of birch and spruce veneers (every other veneer + surface is birch)
  • properties between both plywood types: durable, quite light, easy to cut

• Thin plywood (Aircraft plywood)
  • made out of special thin veneers 0,15-0,5 mm (for example birch)
  • very tough and high bending strength
  • suitable for e.g. miniature models, musical instruments, hockey sticks, business cards or designer wood products
Types of plywood

- The most common plywood sizes are:
  - 1200 x 1200/2400/2500/3000/3600 mm
  - 1220 x 1220/2440/2500/3050/3660 mm
  - 1250 x 1250/2500 mm
  - 1500 x 1500/2400/2500/3000/3600 mm
  - 1525 x 1525//2440/2500/3050/3660 mm

- First measure = width along the grain direction
Plywood properties

• Plywood in general has good properties when comparing to solid wood or some other materials (such as metals or concrete).
• Properties, however, depend on type of plywood
• The properties are such as:
  o durable
  o good resistance to wearing and loads
  o good resistance to changing RH (when compared to solid wood)
  o easy to clean, hygienic (with specific coating)
  o odourless
The exploited adhesive affects to the possible end uses

- **Phenol-Formaldehyde (PF)** adhesives, when weatherproof is required and price is crucial; concrete mould and truck floor board (most common)
- **Urea-formaldehyde (UF)** adhesives, when colourless glue line is required, the product is used indoors and price is crucial; toys
- **Melamine-formaldehyde (MF)** adhesives, when colourless and weatherproof glue line is required; usage was limited by relatively high price
- **Melamine-urea-formaldehyde (MUF)** adhesives, when colourless and weatherproof glue line is required; architectonic usage of veneer
Pohjoismaisen vanerin valmistus
Plywood Manufacturing Process in Nordic Countries

Raaka-aineen hankinta ja kuljetus tehtaille
Raw material supply and shipping

Katkaisu
Cutting

Haudonta
Soaking

Kuorinta
Debarking

Viilun sorvaus
Veneering

Kuivaus
Drying

Leikkaus
Cutting

Lajittelu
Sorting

Liimaus
Gluing

Puristus
Pressing
• Pre-pressing/cold
• Hot pressing (~150°C)

Sahaus
Sawing

Hionta
Sanding

Puristus
Pressing

Pinkkaus
Stacking

Pinnoitus
Coating

The biggest plywood producing countries 2004

Suurimmat vanerin tuottajamaat 2004

<table>
<thead>
<tr>
<th>Country</th>
<th>Plywood Production (milj. m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>21.8</td>
</tr>
<tr>
<td>USA</td>
<td>14.9</td>
</tr>
<tr>
<td>Malesia</td>
<td>5.0</td>
</tr>
<tr>
<td>Indonesia</td>
<td>4.5</td>
</tr>
<tr>
<td>Japan</td>
<td>3.1</td>
</tr>
<tr>
<td>Brazil</td>
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<td>Canada</td>
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<tr>
<td>Russia</td>
<td>2.2</td>
</tr>
<tr>
<td>India</td>
<td>1.9</td>
</tr>
<tr>
<td>Finland</td>
<td>1.4</td>
</tr>
</tbody>
</table>
The biggest plywood exporting countries 2004

Suurimmat vanerin viejämaat 2004

- China: 4.6 million m³
- Malesia: 4.3 million m³
- Indonesia: 4.0 million m³
- Chile: 3.1 million m³
- Brazil: 2.5 million m³
- Russia: 1.4 million m³
- Finland: 1.2 million m³
- Canada: 1.0 million m³
- USA: 0.6 million m³
- Belgium: 0.5 million m³

LÄHDE: FAO
Laminated Veneer Lumber - LVL

- LVL has been available commercially for over 30 years
- LVL is made from sheets of spruce veneers usually thicker than plywood (3-4 mm)
- The veneers are cut diagonal (~5 cm) from the edges and combined into a continuous mat. This way the length of the mat is not limited, unlike in plywood.

- Exact positioning of joints and their distribution throughout the LVL cross-section is crucial
- LVL is produced and used in a variety of different lengths, thicknesses and widths, but one of the main products are structural beams for constructions
LVL beam production

From the side

Hot press
Pre-press / cold press
Lay-up

12 m

From above

Cutting to beams
LVL Products (made in Finland)

Beams
• All veneers are glued in parallel direction. The billet is cut to beams after gluing
• Thickness 27 – 75 mm
• Width 200 – 600 mm
• Length standard max 12 m (customised up to 24 m)

Beams or boards
• Most veneers in parallel direction but a few middle layers perpendicular (but not every second like in plywood)
• Thickness 21 – 69 mm
• Width 600, 900, 1200, 1600, 2500 mm
• Length standard max 12 m (customised up to 24 m)
Veneer manufacture

Rotation peeling

Staylog (semi-peeling)

Slicing

3D veneer

• Cross-laminated veneer stripes allow 3D-forming of veneers without breaking the veneer
• Very expensive
• Used mainly in furniture and decorative elements

Through-coloured veneer

- The colour penetrates through the entire thickness of the material, and the surface can be renewed by sanding without loss of colour
- Very expensive
- Used mainly in furniture and decorative elements
Youtube clips:

**Plywood mill:**

https://www.youtube.com/watch?v=6uWPyn738zl