Juvenile Wood

- Wood formed near the pith, characterized by progressive increases in dimensions and changes in the cell characteristics, and the pattern of cell arrangement; also called core wood.
- Secondary xylem at the center of a tree formed throughout the life of the tree.
- Pith plus the wood produced for the first 2 to 20 years.

Mature Wood

- Wood which is characterized by relatively constant cell size, well-developed structural patterns, and stable physical behavior, also called adult wood.
- Occurs as the cambium becomes farther from and less influenced by the apical meristems.

Juvenile wood is lower in quality than mature wood.

- Juvenile wood cells are shorter than those of mature wood.
- There are relatively few latewood cells in the juvenile zone and a high proportion of cells have thin wall layers. As a result, Juvenile Wood Has:
  - Up to 30% less density for DF, 76% less for SYP.
  - About 15-50% less strength.
  - Only 39% of the stiffness (MOE) in SYP
  - 54% of the bending strength in SYP
- Juvenile wood has a greater tendency for spiral grain.

Juvenile wood may have 3-10 times more shrinkage along the grain.
- Large microfibril angles are also associated with low tensile strength.
- Veneer produced from juvenile wood is rougher and contains more splits and deeper lathe checks.
For Southern Yellow Pine

• Logs of the same diameter, rapidly grown yielded 1/5th to 1/2 as much grade dimension lumber when compared to slowly.
• The value obtained from 20 year old 14.3” trees was only 66% of the value obtained from 50 year old 15.1” trees.
• 52-64% of 35 year old loblolly pine met stiffness requirements of existing lumber, versus 94% from 50 year old timber.

Chemical Pulping and Paper

• Juvenile Wood is generally regarded as inferior.
  – Lower density, yields less pulp per ton.
  – Higher chemical consumption means 10% higher manufacturing costs.
• The finer, thinner-walled fibers from juvenile wood may provide new opportunities to tailor make pulps with specific properties.
  – JW has a lower tear strength, but higher burst and folding strength and higher tensile strength.
  – JW has better interfiber bonding.

Chemical Pulping and Paper

• Juvenile wood is often processed under conditions designed for mature wood.
  – When JW is cooked under the sever conditions necessary for mature wood, pulp yield and strength suffer.
  – When cooked under more optimum conditions, properties improve.

Mechanical Pulp and Paper

• The situation is similar for mechanical pulping.
  – JW yields a higher portion of fines, shorter average fiber length, and a lower portion of lower fines.
  – Tensile and tear strength is lower.
  – More energy is required for processing.
• Juvenile wood mechanical pulps are ideally suited to the production of high quality publication grades.

Composite Products

• For particleboard, flakeboard, and fiberboard, juvenile wood is generally regarded as undesirable.
  – Strength may be 10% less.
  – Thickness swelling and linear expansion are greater in juvenile wood panels.
• Treating flakes with acetic anhydride (acetylation) increases dimensional stability under changing moisture conditions.

Identification of Juvenile Wood

• The transition from Juvenile Wood to Mature Wood is generally gradual.

Figure 6.2. Juvenile to mature wood transition in conifers. Many properties show gradual increase.
Identification of Juvenile Wood

Reaction Wood
- Wood with distinctive anatomical and physical characteristics formed in parts of leaning or crooked stems and in branches.
- **Tension Wood** – reaction wood formed typically on the upper sides of branches and the upper, usually concave side of leaning or crooked stems of hardwoods; characterized anatomically by lack of cell wall lignification and often by the presence of a gelatinous layer in the fibers.
- **Compression Wood** – abnormal wood formed on the lower side of branches and of curved stems of conifers; this tissue has unusually high longitudinal shrinkage and physical properties that differ from those of normal wood.

Compression Wood
- In Softwoods
- Universally in branches of softwoods, where it functions to maintain branch angle.
- Except for species with drooping branches, like spruce.

Compression Wood Properties
- Compression wood is less desirable than normal mature wood.
  - Tracheids are 30% shorter.
  - Contains 10% less cellulose and 8-9% more lignin and hemicellulose.
    - Less paper yield per ton, lower strength.

Compression Wood Properties
- Compression wood has more shrinkage.
- Compression wood has greater density, but strength is about equal to normal wood.

Identification of Compression Wood
- In Cross section:
  - Wide and dark reddish brown growth rings on the lower or compression side of the leaning stem
  - Narrower rings to the opposite side of the pith.
  - Pith is nearer to the upper side of the stem
Identification of Compression Wood

- Microscopic:
  - Spiral cavities in the wall of compression wood trachieds.

Tension Wood

- Hardwoods, on the upper or tension side of stems and branches.
- Properties – Higher cellulose content, 5-10% increase in density results in higher pulp yields.
  - Tension wood results in weaker paper, with less tensile and burst strength.
  - It can be refined to result in similar properties as normal wood.

Tension Wood Properties

- For Lumber, Tension wood is undesirable.
  - Tension wood shrinks excessively along the grain, warp and twist.
  - Tension wood is prone to collapse (cave in or flattening of wood cells, resulting in severely distorted wood surfaces.
  - Tension wood tends to be less strong.

Tension Wood Identification

- Tension wood often results in elliptical stems with wider rings in the reaction wood zone.

Tension Wood Properties

- Tension wood results in fuzzy surfaces when sawing or surfacing, making finishing very difficult.

Tension Wood Identification

- There are important differences:
  - more numerous fibers, fewer rays, vessels.
  - longer and thinner cell walls.
  - secondary cell wall is thicker and loosely attached.
Tension Wood Identification

- Gelatinous layer
  - fibers having more or less unlignified inner layers in the secondary wall.

Reaction Wood Formation

- Stem displacements as small as 2° can cause compression wood formation
- The amount formed is directly related to the angle of lean.
- Reaction wood helps the tree to remain upright with gravity.

Branchwood

- Branchwood utilization can substantially increase the quantity of wood fiber per unit area of forest harvested.
- Whole tree operations may use branchwood as fuel, particularly as oil prices climb.
- Branchwood has disadvantages:
  - Higher percentage of bark
  - Significantly lower wood-specific gravity and shorter fiber length.
  - Lower pulp strength.
  - Nonuniformity of chip sizes

Rootwood

- Roots are dirty and difficult to clean.
  - Excess soil can plug or cause excessive wear to expensive pulp mill equipment
  - Soil can dull knives and saws.
- Roots have lower density, and greater shrinkage.
- Rootwood may be valuable as a source of chemical extractives and fuel.

Questions?