Introduction to the Use of Wood as a Building Material

Presented by

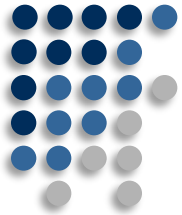
MAPLE LEAF HOUSING CENTRE

Sustainable Solutions for Global Housing

Use of Wood as a Building Material

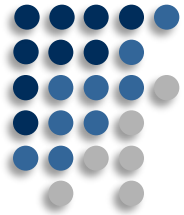
- Today, approximately 80% of all structures in North America are constructed using wood as the primary building material
- More wood by both weight and volume is used than all other construction materials combined

Sustainability of Wood-Frame Construction



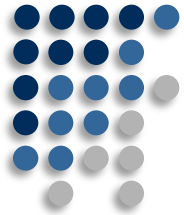
- Natural, organic carbon based material
- Renewable resource
- More environmentally friendly and energy efficient than concrete or steel
- Wood-frame construction minimizes the pollution caused by the manufacture of the materials used in the building

Sustainability of Wood-Frame Construction



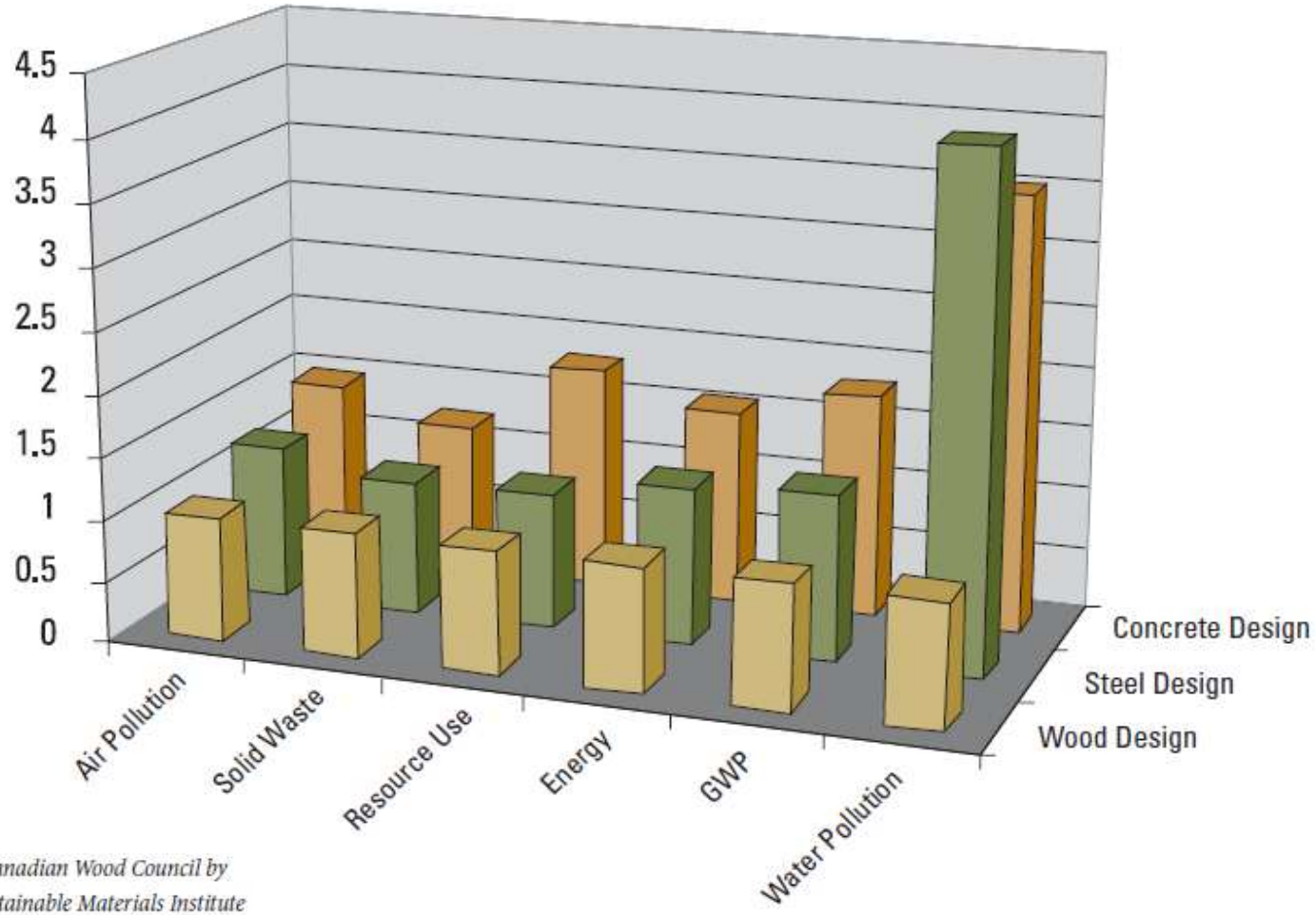
- lower greenhouse gas emissions than steel or concrete
- lower air pollution than steel or concrete
- lower water pollution than steel or concrete
- lower solid waste by-products than steel or concrete

Sustainability of Wood-Frame Construction



- Embodied energy includes all energy, direct and indirect, used to extract, manufacture, transport and install materials
- The manufacture of wood uses very little energy so, even though it may be brought to the building site from outside the area, the embodied energy will normally be less than locally manufactured concrete

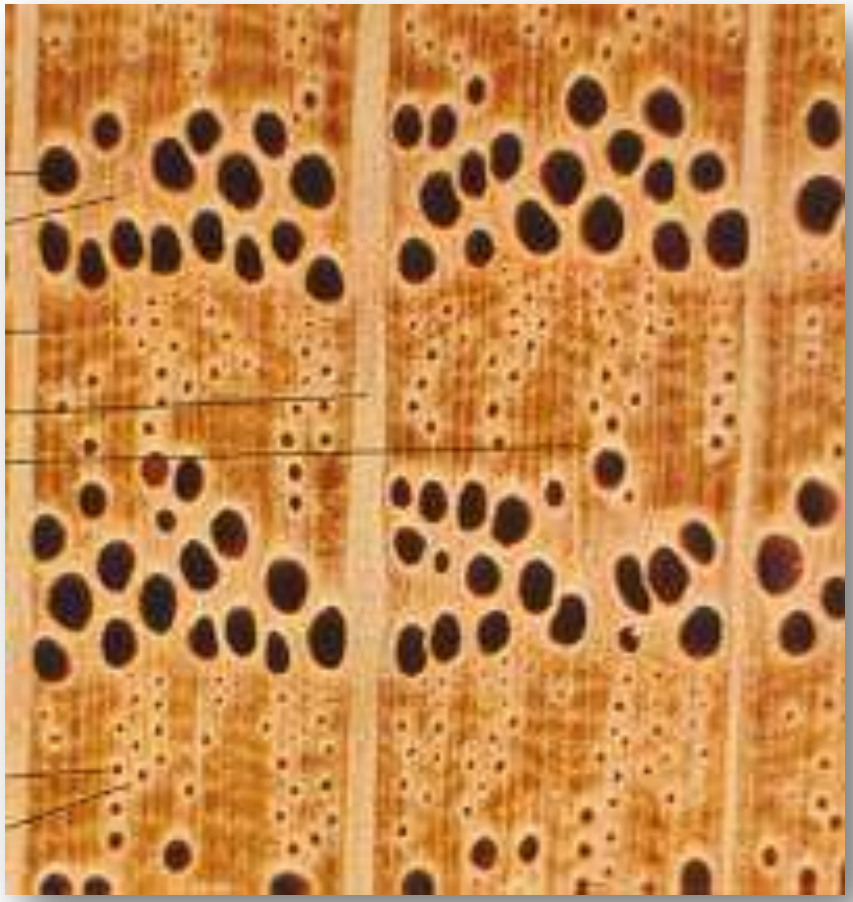
Sustainability of Wood-Frame Construction



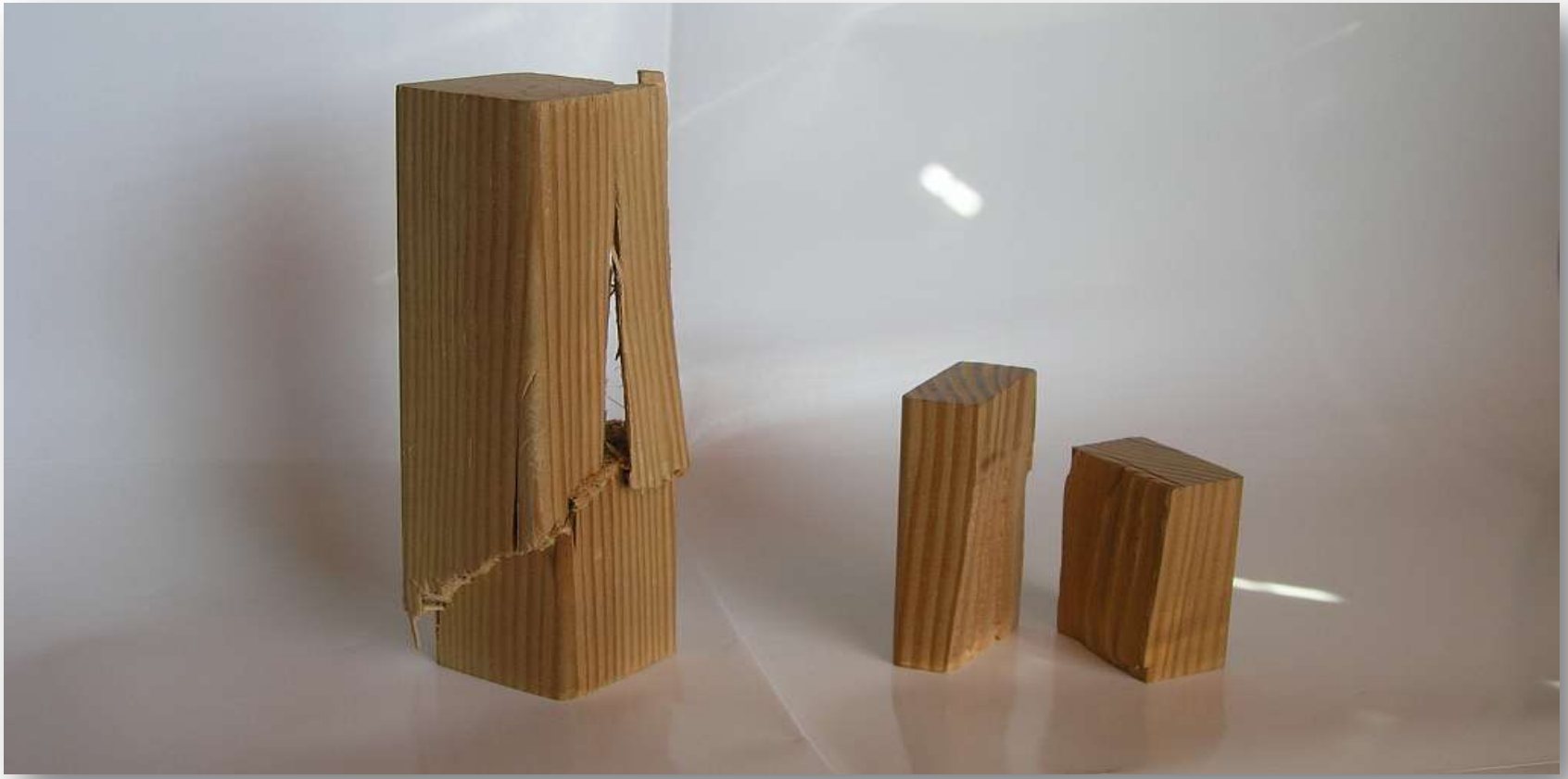
Prepared for the Canadian Wood Council by the ATHENA™ Sustainable Materials Institute

Wood Characteristics

- Wood cells are like a bundle of drinking straws
- Straws have different properties in different directions

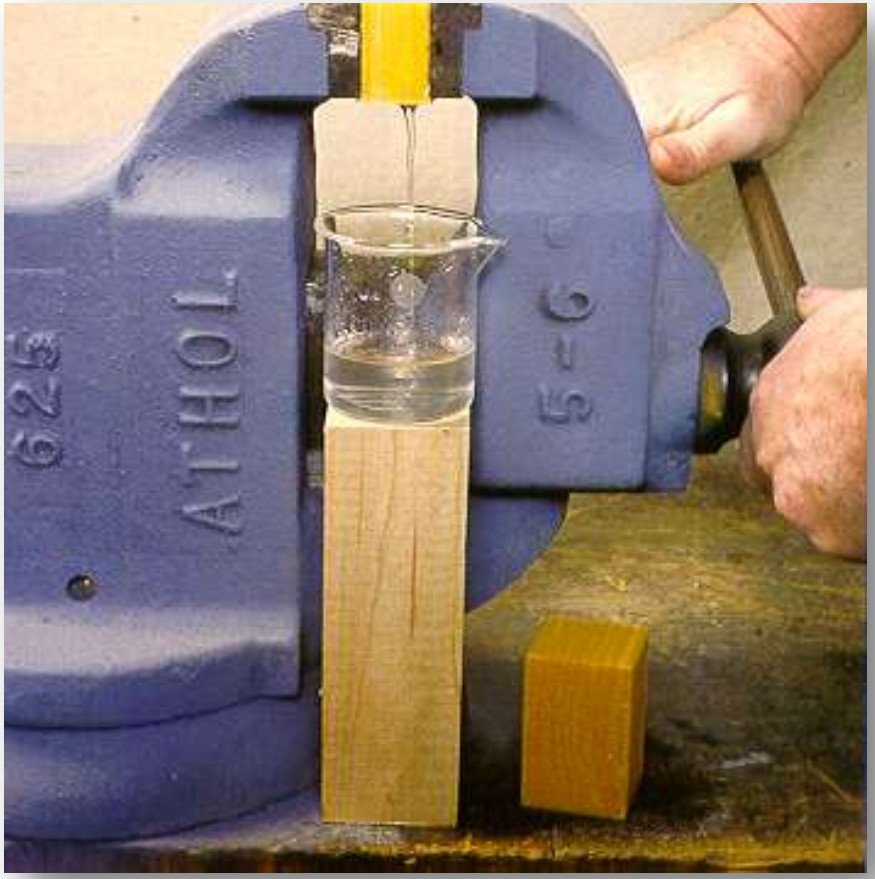


Wood Characteristics



Wood Characteristics

- Wood is affected by moisture
- Wood cells can hold a great deal of water



Wood Characteristics

- It shrinks or swells depending on its moisture content
- Unless shrinkage is accounted for, some of the building elements may crack or settle in an undesirable manner

Wood Characteristics

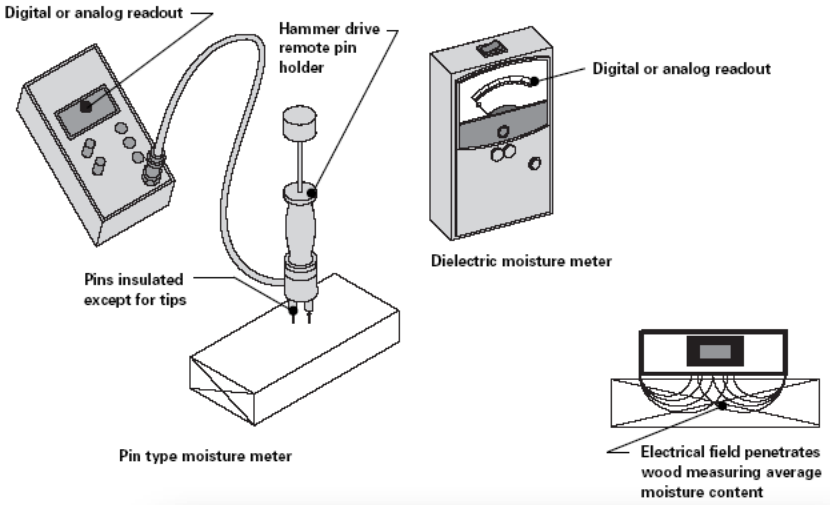
- As wood dries, its shrinkage characteristics depend on where it was cut from the tree

Wood Characteristics

- Wood manufactured for use as structural building components is usually kiln dried

Wood Characteristics

- It is recommended that all structural framing lumber have a moisture content of approximately 19–25%, depending upon local conditions



Wood Characteristics

- To provide continued protection from moisture, wood-frame buildings should be constructed to provide the following:
  - Deflection; keep water away
  - Drainage; allow water to leave structure
  - Drying; provide opportunity for wet wood to dry, ventilation
  - Durability; choose or make materials suitable for exposure to moisture


Deflection
PRIVATE
DRIVEWAY
PLEASE
DO NOT BLOCK


Drainage


Drying


Durability

Light Wood-Frame Construction

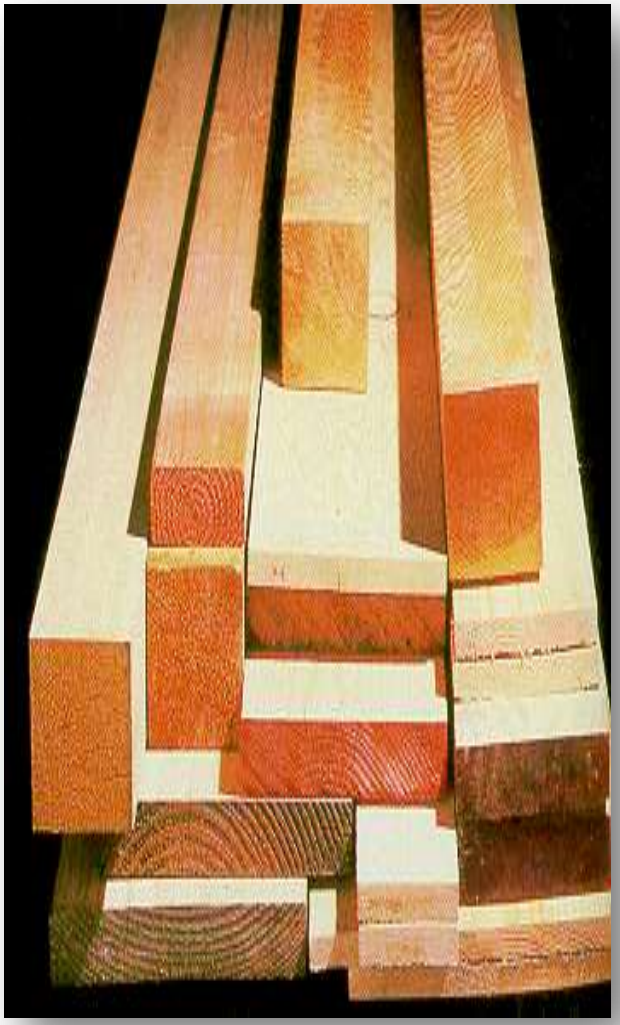
- Light wood-framing is the use of closely spaced members of dimension lumber combined with sheathing to form structural elements of a building.

Light Wood-Frame Construction

- The structural elements provide rigidity, support for interior finish and exterior cladding, and a cavity for the installation of insulation & mechanical/electrical systems.
- Wood-frame construction commonly combines dimension lumber, engineered wood products and structural wood panel sheathing to make wall, floor and roof assemblies.

Dimension lumber

- common sizes of framing lumber
  - 38x89 mm
  - 38x140 mm
  - 38x184 mm
  - 38x235 mm
  - 38x286 mm



Dimension lumber

- common lengths of framing lumber
- 2400mm to 7200mm, in 600mm increments

Dimension lumber

- lumber structural characteristics

  grading

  strength

  species

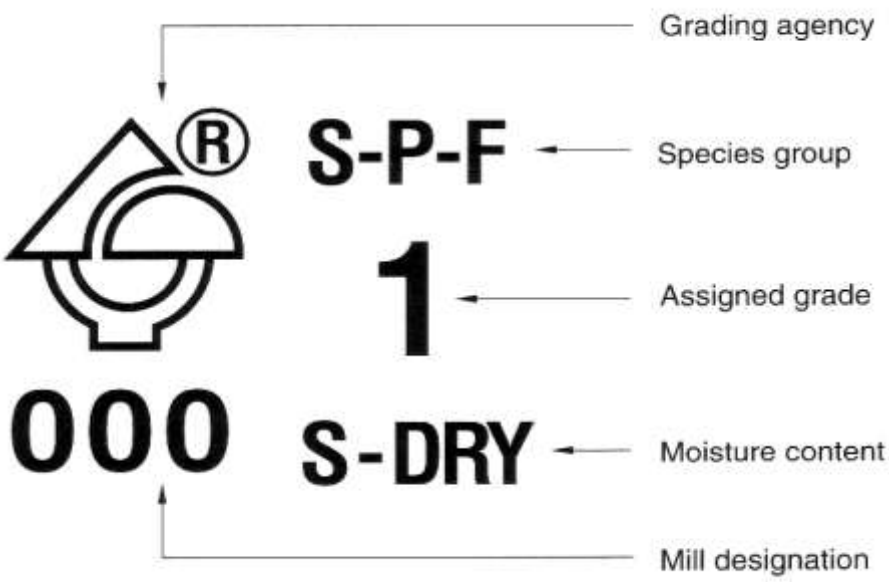
  moisture content

Dimension lumber

- National Lumber Grades Authority
- Standard Grading Rules for Canadian Lumber

Dimension Lumber Grading Stamps (North America)

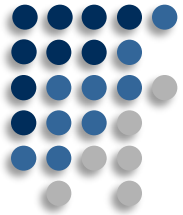
- grading agency
- species
- grade
- moisture content
- saw mill



Dimension lumber Species Grading (Canada)

- lumber species with similar characteristics are grouped together
- Douglas Fir – Larch (D.Fir-L)
- Hemlock – Fir (Hem-fir)
- Spruce – Pine – Fir (SPF)
- Northern Species (Northern)

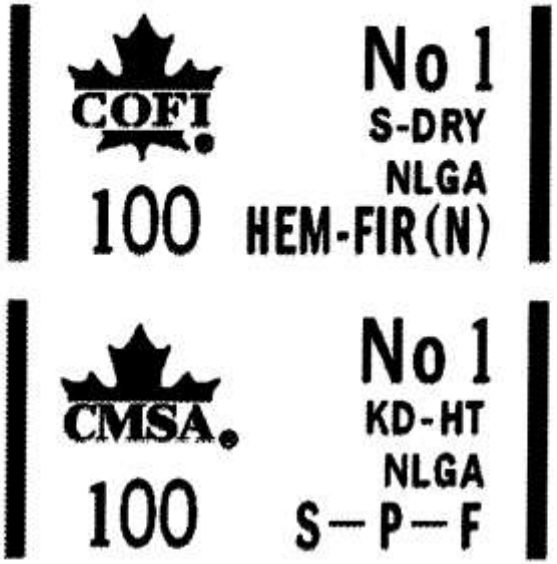
Dimension Lumber Strength Grading



- size and location of knots
- slope of grain
- amount of wane
- size of shakes, splits and checks

Dimension Lumber Strength – Visual Grading

- select structural (SS)
- No.1 & No.2
- No.3

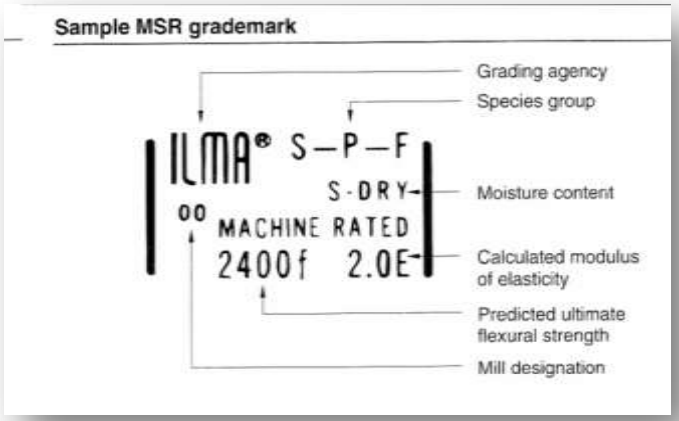


Dimension Lumber Moisture Content

- S – Dry (surfaced dry)
- S – Grn (surfaced green or wet)
- measured at time of milling

Machine Stress Rated Lumber (MSR)

- each piece of lumber is load tested
- determines bending strength and stiffness
- used in highly stressed components, such as trusses and I-joists

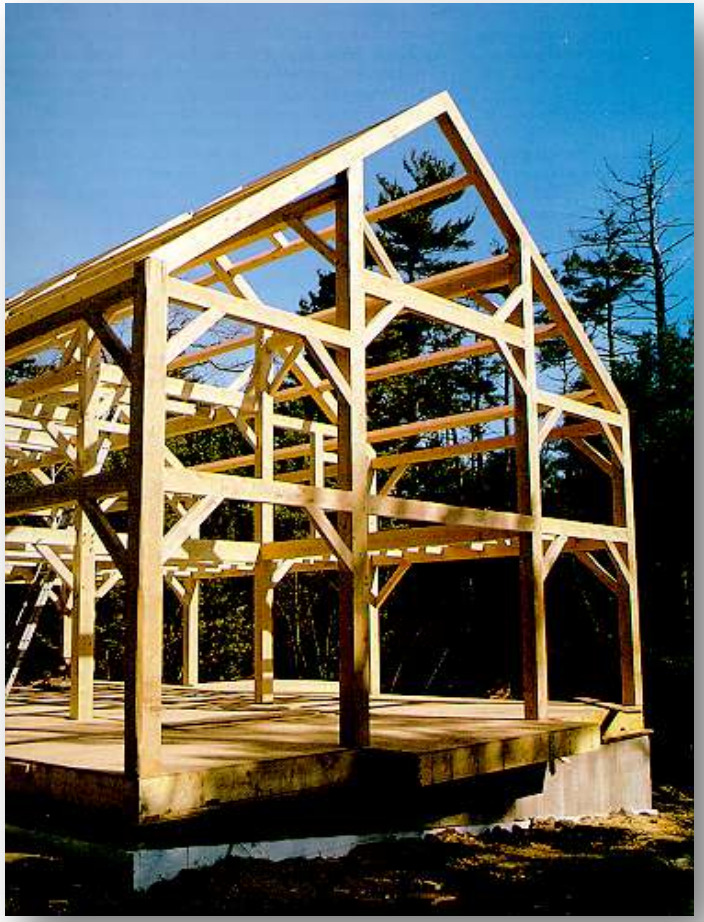


Finger Jointed Lumber

- short pieces glued together, end to end
- visual and machine tested
- primarily compression members (studs)
- kiln dried (SPF)

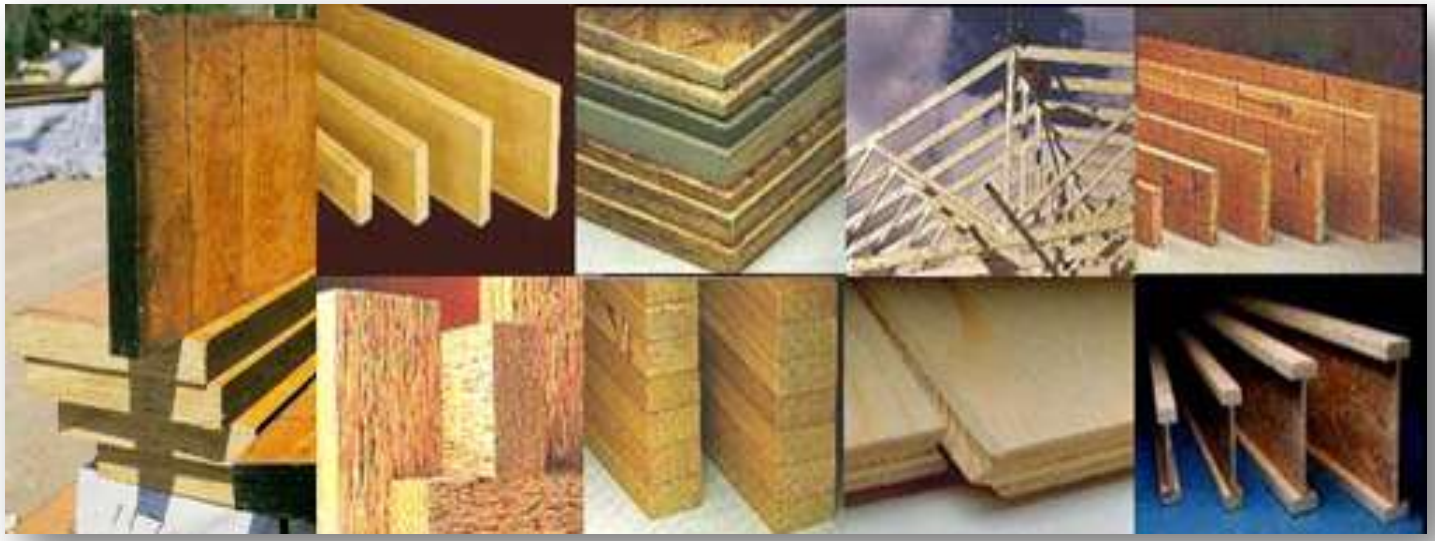
Timber Frame Lumber

- Minimum dimension of 140 x 140mm, maximum 394 x 394mm
- Usually used for columns and beams
- Visually graded – Select Structural, No.1, No.2
- Surfaced green

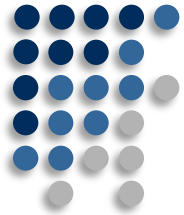


Engineered Wood Products

- Engineered wood products are produced to enhance qualities of wood



Engineered Wood Products



- large sections of wood becoming difficult to find
- engineered wood can utilize waste material
- product more uniform, weak sections of wood removed

Engineered Wood Products

- dimensionally stable
- can span large distances
- provide high strength components

Engineered Wood Products

- Plywood is the original engineered wood-based panel.
- Plywood is a highly stable panel. When exposed to moisture or high humidity, plywood is up to seven times more resistant to thickness swell than other wood-based panels.

Engineered Wood Products

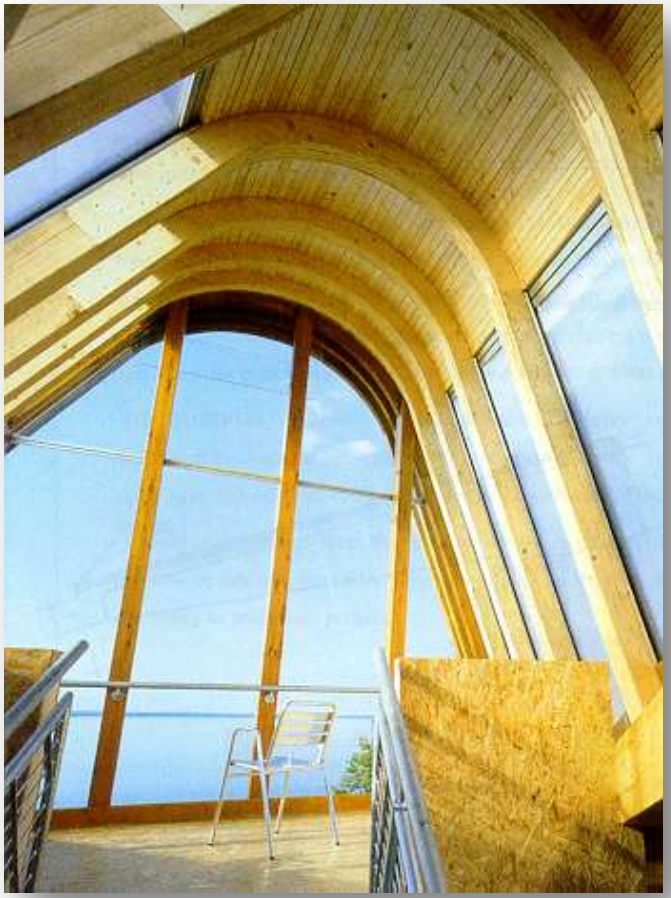
- Plywood is stronger than other wood-based panels in the four important engineering strength properties of bending, tension, compression and planar shear and plywood weighs up to 40% less than substitute wood-based panels of equivalent thickness.
- Plywood is a highly impact-resistant panel and continues to perform even when wet.

Engineered Wood Products

- Plywood has over 50 years of proven service as a structural panel for homes and other wood-frame structures.

Engineered Wood Products

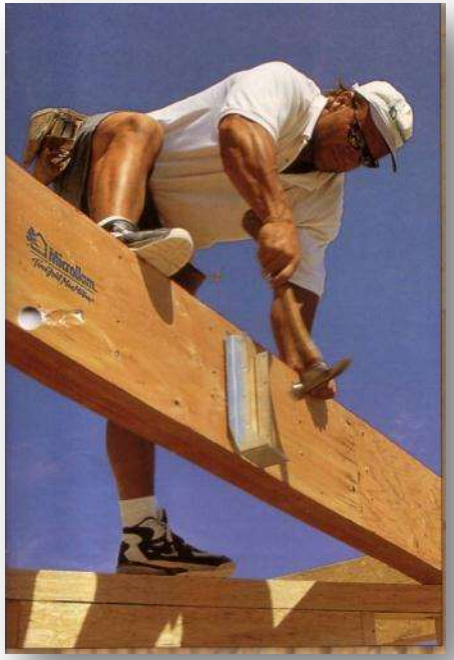
- Glulam (glue laminated)
- 38mm or 19mm laminations
- available in various shapes



Engineered Wood Products

- structural composite lumber
- lumber made from small pieces of wood glued together
- poor parts of wood removed
- 3 times bending strength and stiffness of standard dimension lumber

Engineered Wood Products

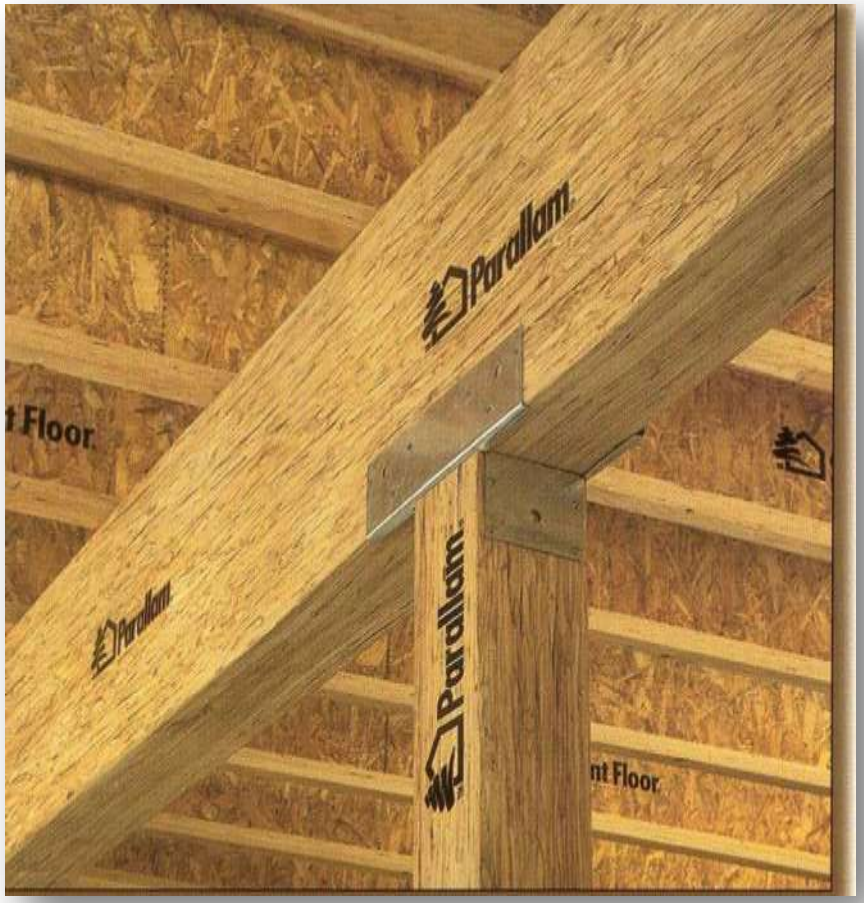


- laminated veneer lumber (LVL)
- veneers glued together, grain in same direction

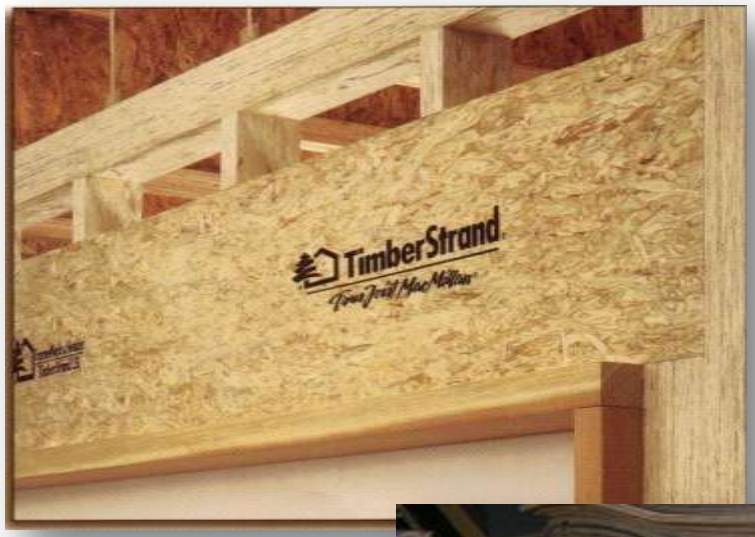
Engineered Wood Products

Engineered Wood Products

- parallel strand lumber (PSL)
- strands of lumber glued together



Engineered Wood Products



- timber strand lumber
- wafers of lumber glued together, same direction – similar to OSB

Engineered Wood Products

- wood I-joist

Wood Trusses

Advantages of Wood Trusses

- high quality engineered components
- unlimited profiles
- long spans
- light weight
- fast close-in
- economical

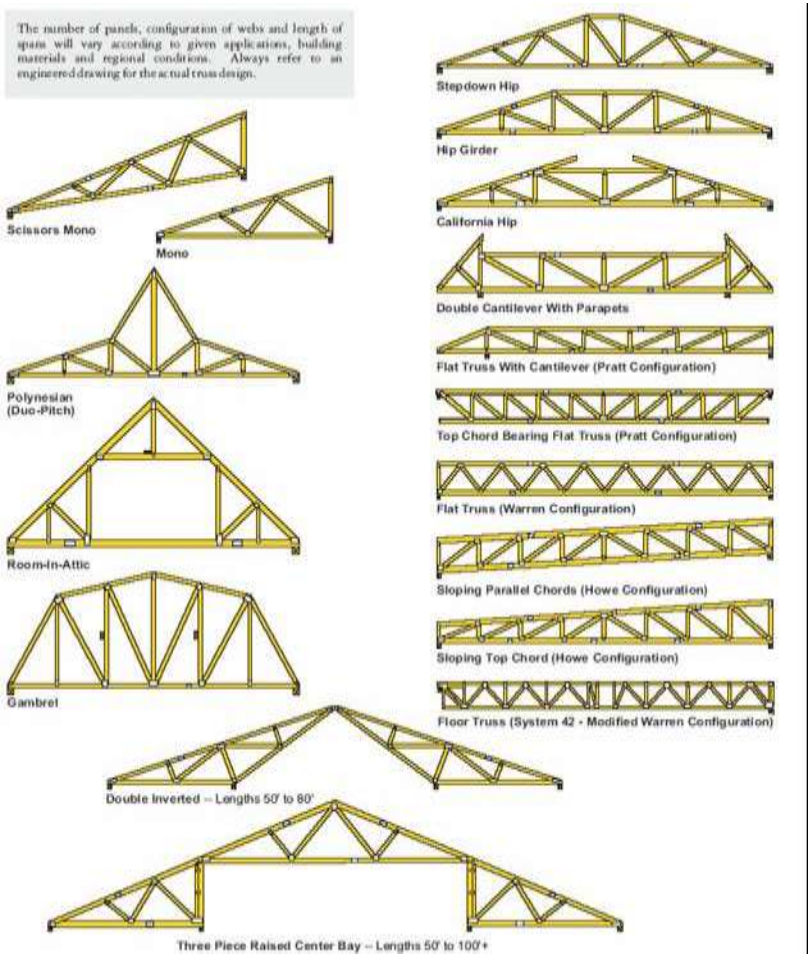
Proven Performance

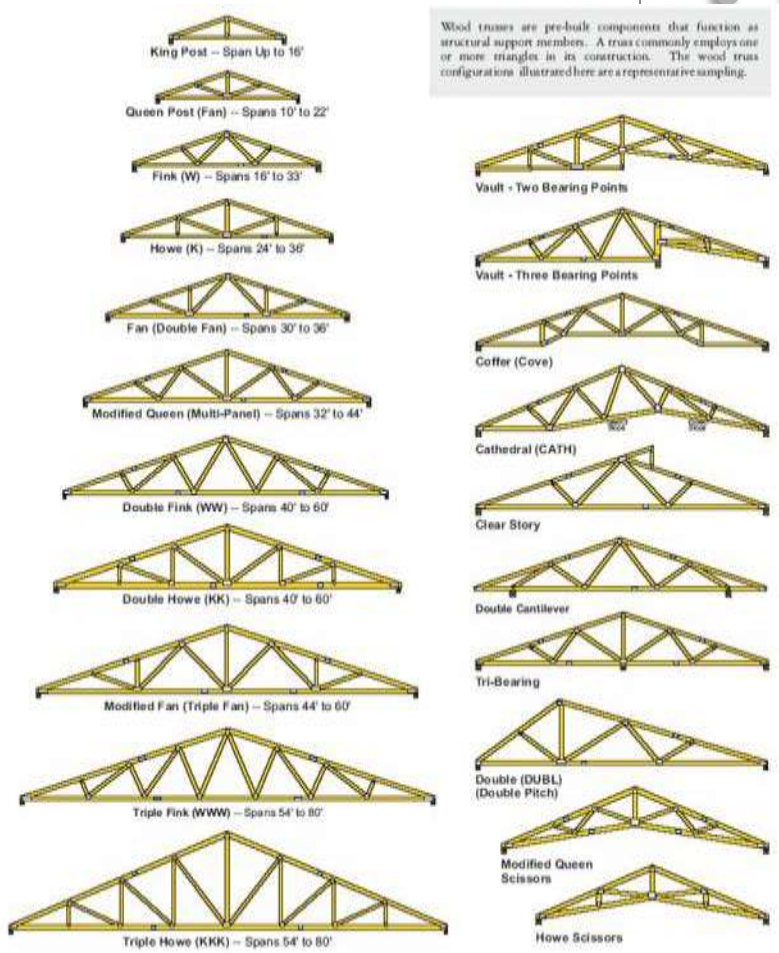
- used in residential, commercial and farm buildings in North America since the 1950's
- used in over 90% of the homes built in Canada and the USA today

Architectural Versatility

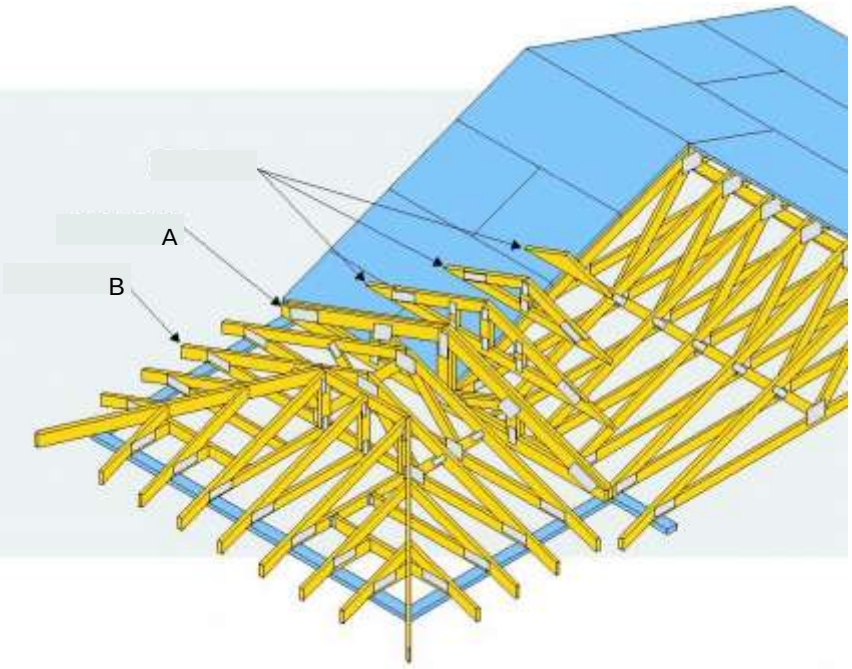
- wood trusses are compatible with other structural systems
- allow flexible interior partitioning and room arrangements

Common Truss Shapes





Easy to erect

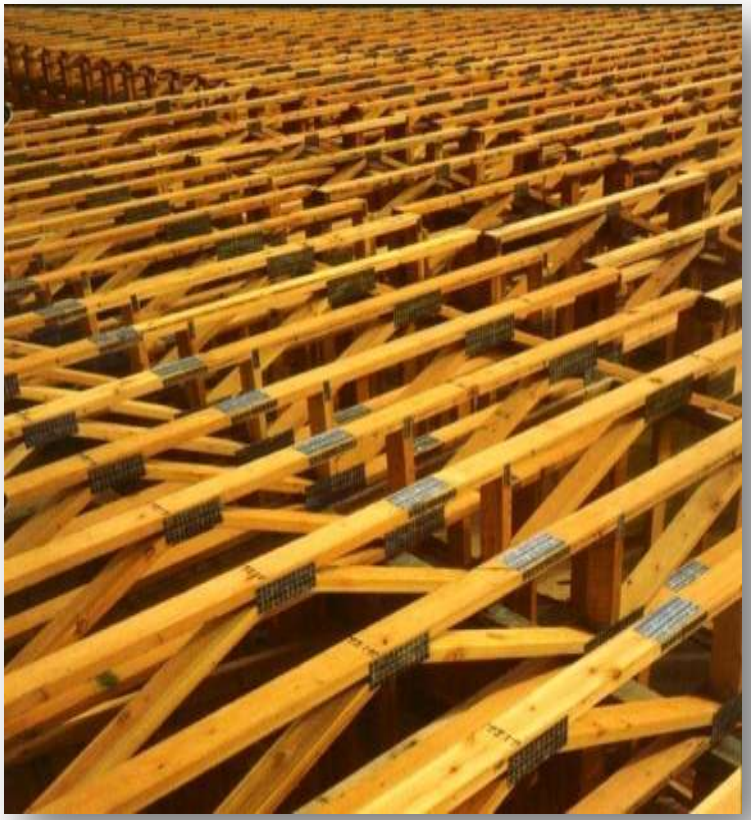


Can be used on wood structures

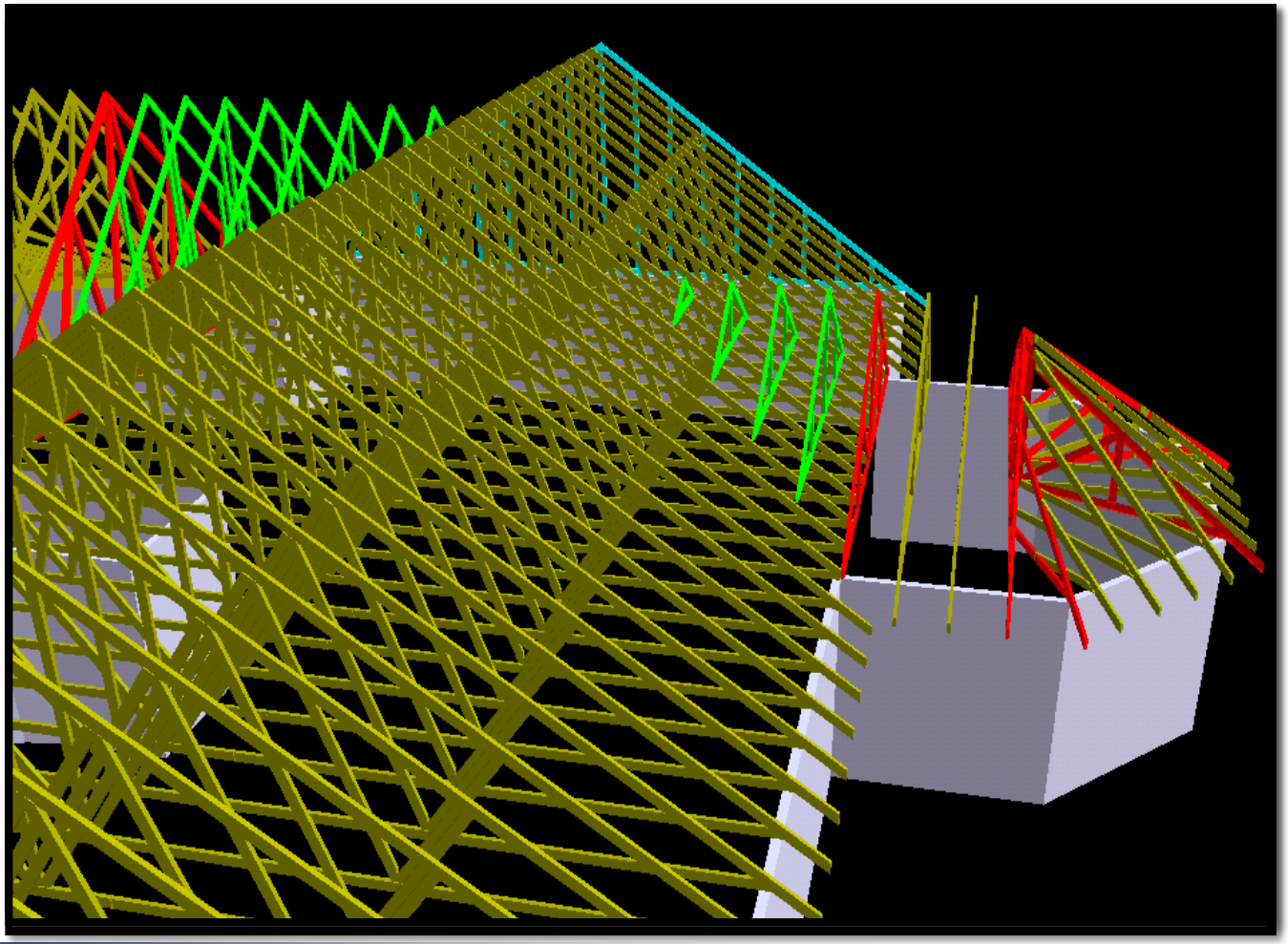
Can be used on masonry or steel

Can be assembled on the ground or on the structure

Floor Trusses



Computerized truss design



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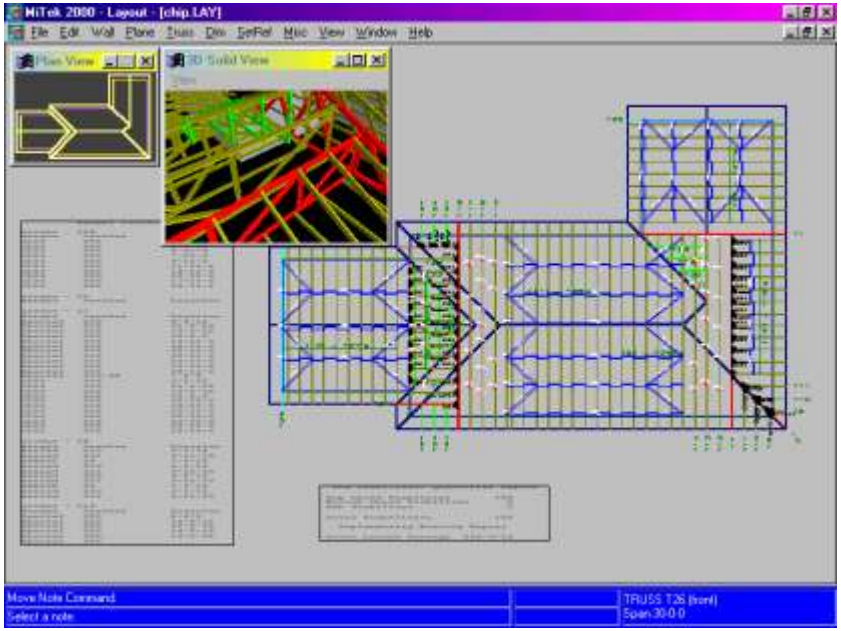
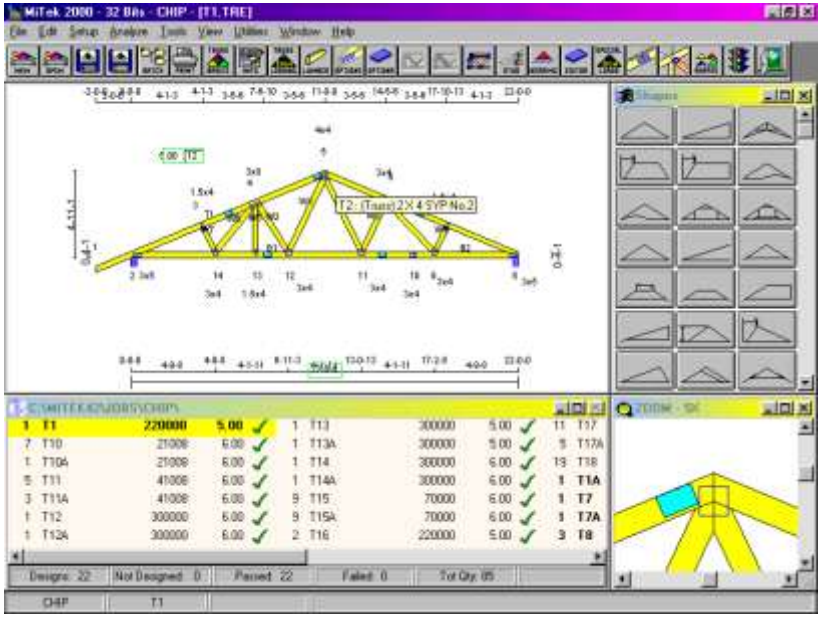
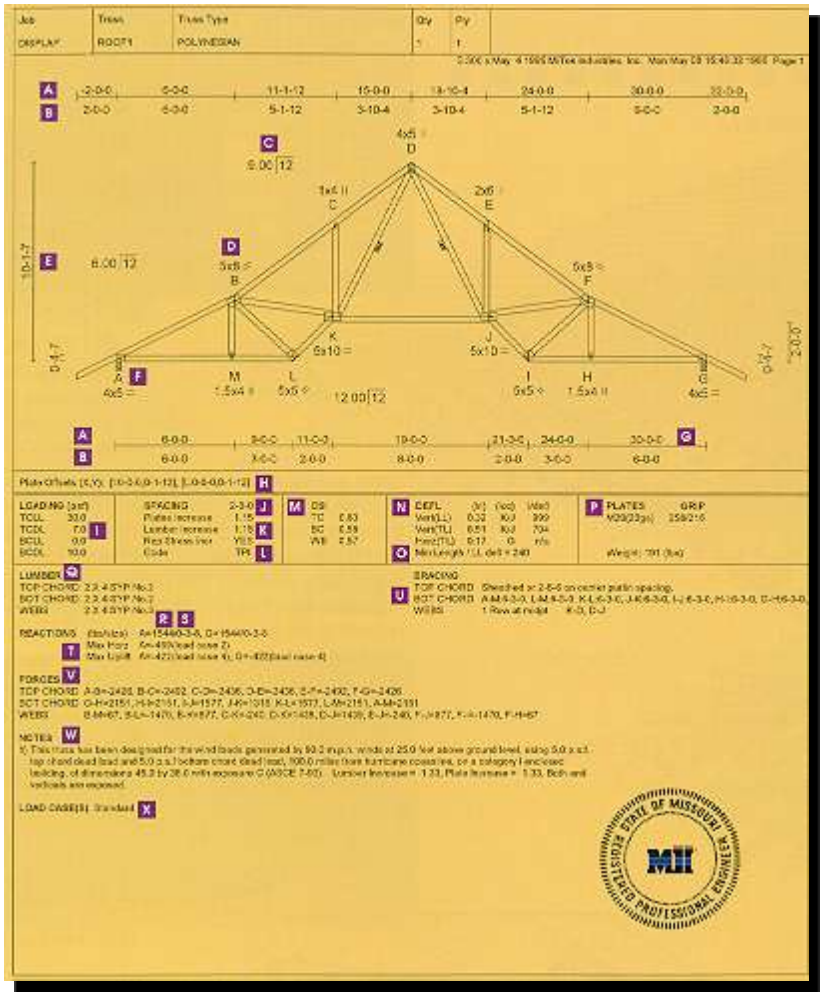
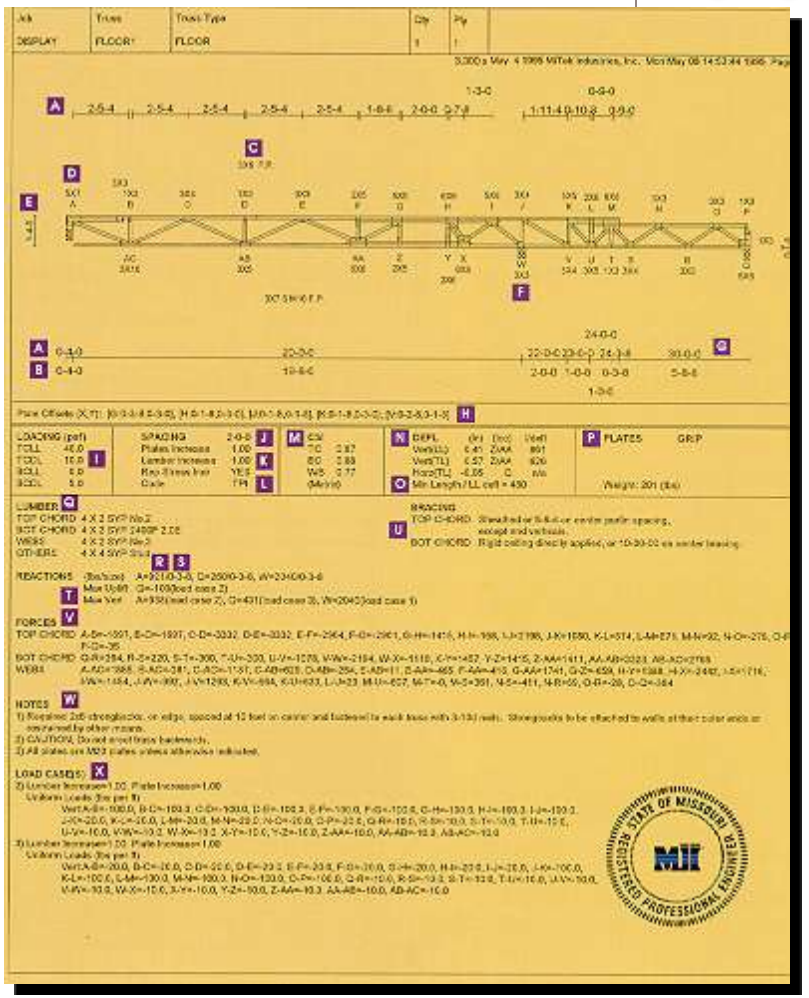




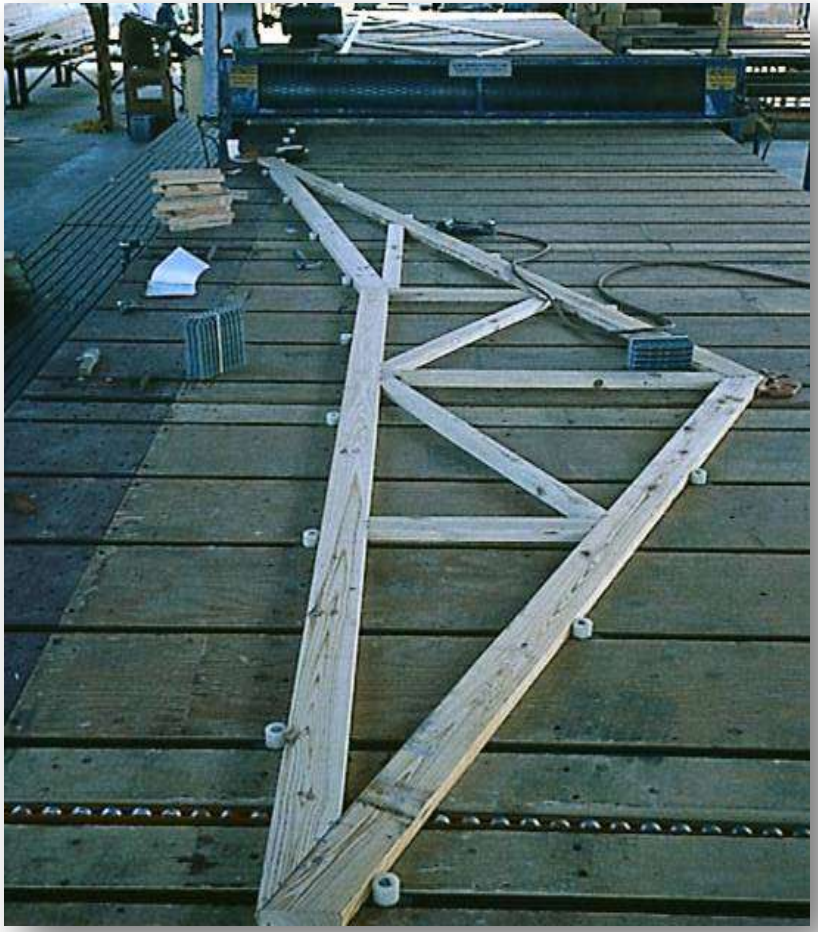
Engineering Drawings





Truss manufacturing

Truss manufacturing



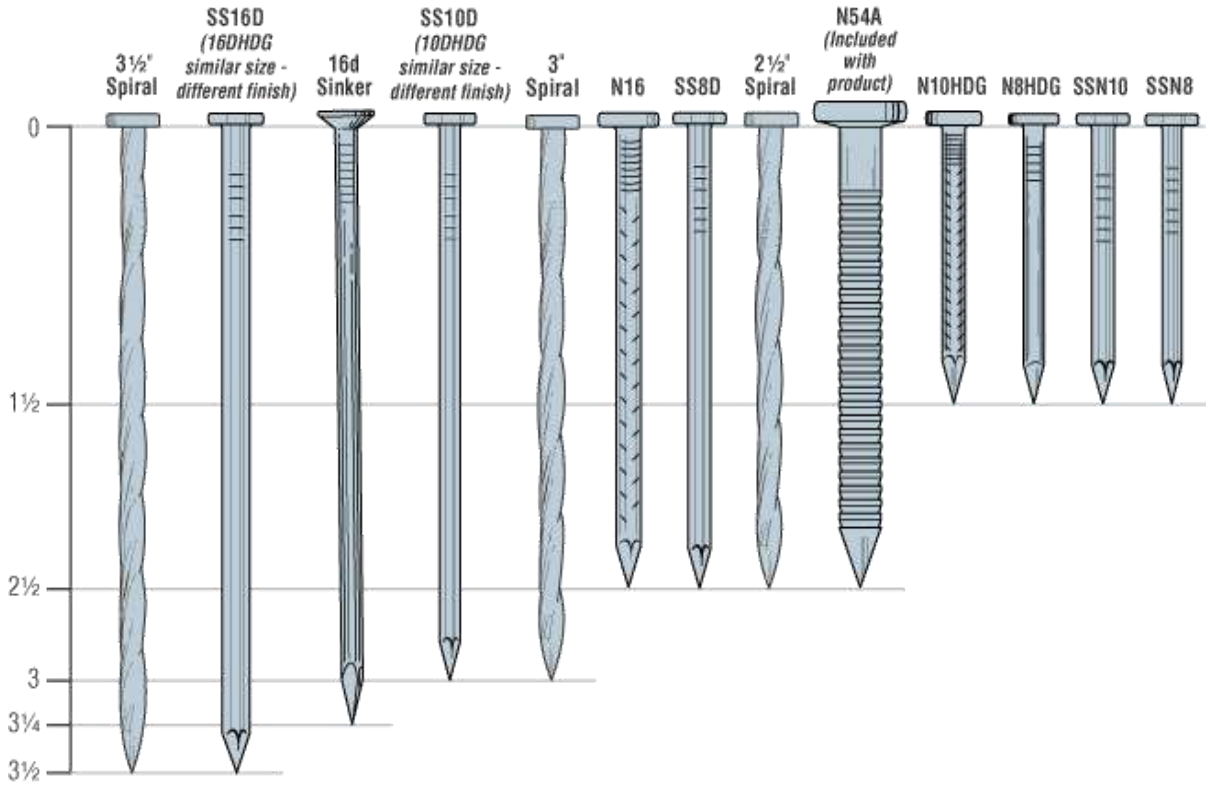
Truss manufacturing

Fasteners used in wood-frame construction

- Light framing makes use of many small fasteners in the form of nails, spikes, or staples to attach framing members to each other and to attach the sheathing to the framing members.
- Nailing requirements for light framing are established by the building codes.

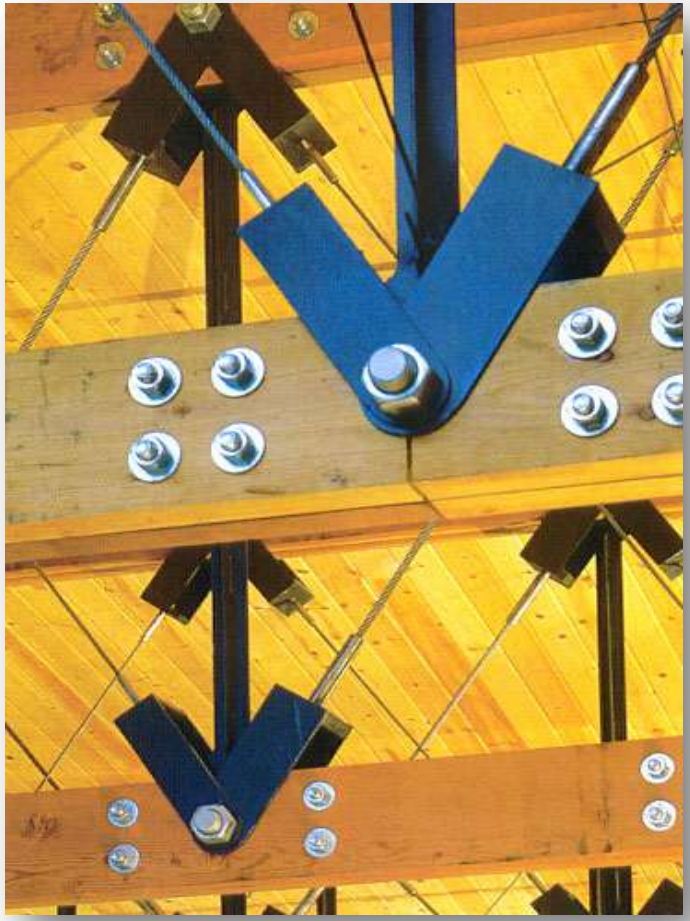
Fasteners used in wood-frame construction

- There are a variety of nails used in wood-frame construction.



Fasteners used in wood-frame construction

- Bolts are also used in wood-frame construction – quite often to make the connections between wood and steel or wood and concrete.



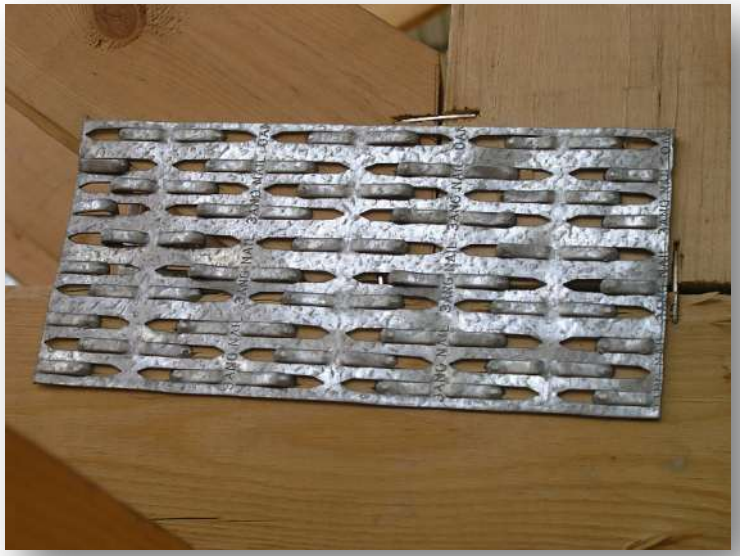

STAEDTLER-MARS 561 70-2 JAPAN

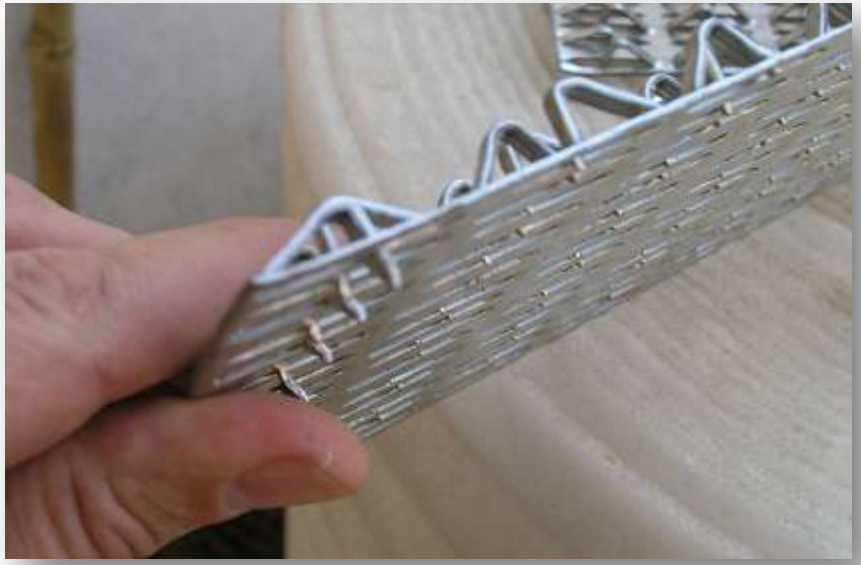
Fasteners used in wood-frame construction

- Timber rivets are special nails made of hardened steel and are used for the to fasten glulam or parallam component connections using metal connectors.

Fasteners used in wood-frame construction

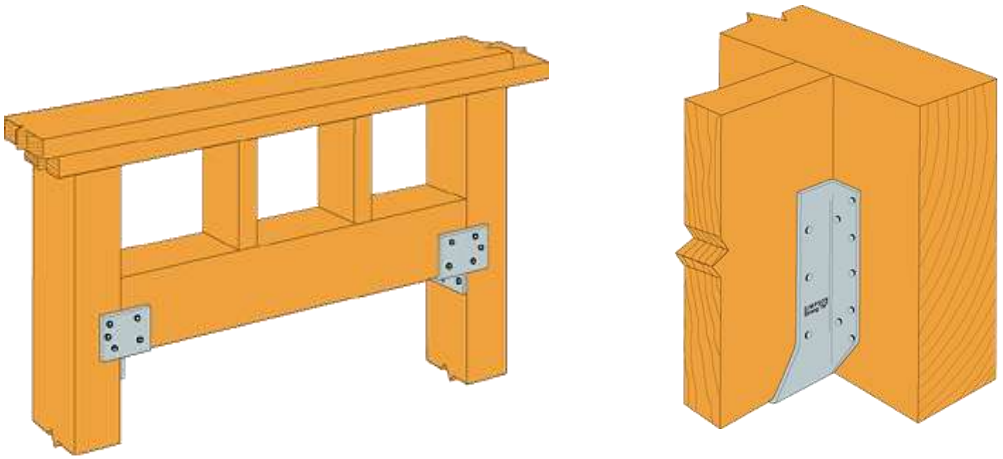
- Truss plates connectors are made from light gauge metal toothed plates which are forced by pressure into the wood surfaces to be joined.





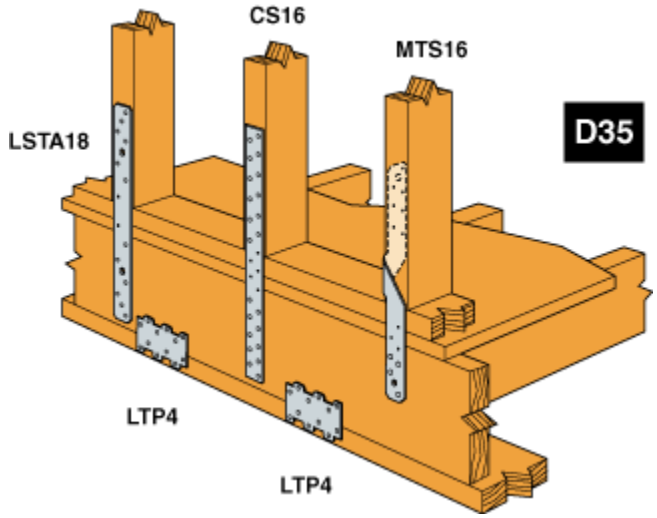
Fasteners used in wood-frame construction

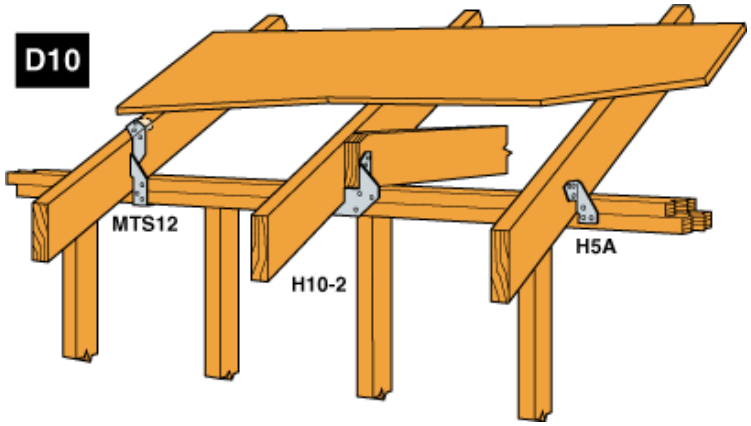
- A variety of metal fasteners, such as joist hangers, are available which can reduce installation time and improve connection strength. Most light framing connectors rely on nails for attachment.

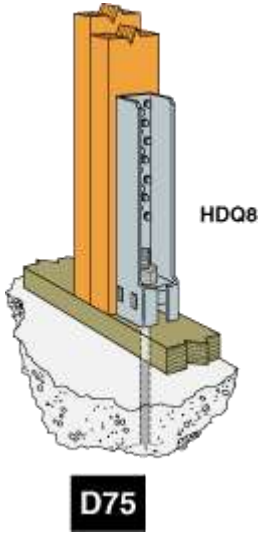


Fasteners used in wood-frame construction

- In addition, special fastens are used to achieve greater structural strength in areas prone to earthquakes or high wind loads.





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