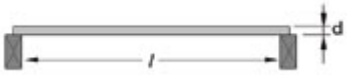
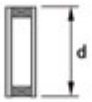
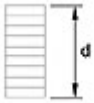
Wood Structural Systems

Wood can be used in many popular structural forms from the light duty repetitive small structures to the larger and heavier framing systems used in commercial projects such as arenas or storage facilities. Because wood has a high strength to weight ratio, dead load is a smaller component of the total load factor than for heavier materials. Usually the lightest or least involved construction type appropriate for a given span that is capable of carrying the design load is the most preferable. A table of typical spans is presented below to aid the designer in selecting an appropriate structural system.

Figure 4.3 Estimated span capabilities of wood members (for illustration purposes only)

Decking, joists and beams		Typical spans, m	Approximate span to depth ratio (l/d)
Wood decking		1 to 2.5	25-35
Panels		0.3 to 0.6	20 to 40
Dimension Lumber		3 to 7	15 to 25
Wood I-joists		6 to 10	20 to 25
Stressed-skin panels		3 to 7	24 to 30
Plywood box beams		4 to 9	18 to 20
Parallel strand lumber		4 to 18	18 to 20
Laminated veneer lumber		4 to 18	18 to 20
Glulam		4 to 25	18 to 20

Trusses and Arches		Typical spans, m	Approximate spa to depth ratio (l/d)
Pitched trusses		6 to 30	2 to 5
Parallel chord trusses		6 to 30	10 to 15

Bowstring trusses		20 to 50	5 to 10

Design Considerations

Wood is a naturally occurring renewable material affected by species, natural growth characteristics and moisture content all of which contribute to variability of its structural properties. Because of its cell structure, wood has different strength properties in different grain directions and is therefore categorized as an anisotropic material.

CSA O86 provides resistance equations and specified strength values for various wood products and connections. Links to these values can be found below under design values.

Like all building materials, wood has unique design properties. By understanding the nature of these properties, designers are able to maximize the positive attibutes of materials and account for other effects. Unique properties that affect wood design include:

- Hygroscopicity - The tendancy for wood to absorb moisture. This can affect both dimensional stability and strength. A calculator to account for this can be found **here.**
- Duration of Load effects - Wood has a greater capacity to carry short term loads compared to sustained loads enhancing its performance in seismic and high wind zones.
- System effects - Wood systems have the ability to distribute and mutually support loads increasing the efficiency of wood framing systems.
- Size effects - Research has shown that smaller wood members are stronger per unit area than larger members.

Detailed information on wood design and wood properties can be found in **Introduction to Wood Design**

Structural Design Standards

CSA Standard O86-01 Engineered Design in Wood is the referenced wood design standard in Canada. This consensus-based standard is referenced by Part 4 of the National and Provincial Building Codes and is written in the limit states design (LSD) format. It provides resistance equations and specified strength values for lumber, glulam, panels, composite components such as stressed skin panels, shearwalls and diaphragms, fastennings, poles and piles and proprietary structural wood products such as I-joists.

Major revisions in the 2001 edition of CSA O86 included: new design procedures for shearwalls and diaphragms,inclusion of design values for construction OSB, changes to connection design and modifications to sawn lumber and glulam design procedures. The Canadian Wood Council's comprehensive Wood Design Manual, has been updated to reflect the changes to the design standard including member and fastenings design examples, tables and reference material. The manual also includes a copy of CSA O86-01. For further details see the **Wood Design Manual**.

Wood designers in the US can use either an Allowable Stress Design (ASD) format or a Load and Resistance Factor Design (LRFD) approach. The referenced ASD design standard is the ANSI/AF&PA National Design Specification for Wood Construction. The ASD Manual, published by the American Forest and Paper Association, brings together all required elements for design of wood structures in one comprehensive package. It includes the NDS and Supplement, material design information and design examples. For further information, please visit, **http://www.awc.org/Standards/nds.html** .

The AF&PA/ASCE 16-95 Standard for Load and Resistance Factor Design (LRFD) for Engineered Wood Construction serves as the code recognized alternate basis for wood structures designed using the LRFD methodology. The LRFD Manual brings together all required elements for LRFD design of wood structures in one package that includes the design standard along with 5 supplements and 4 guidelines. For further information, please visit, **http://www.awc.org/Standards/lrfd.html.**

The American Wood Council publishes a series of accompanying supplements, commentaries and updates found **here**.

Design Values

Below are some useful links to commonly referenced structural wood product design values:
For use in Canada:
· Lumber design values
· MSR and MEL design values
· Timber design values
· Floor sheathing tables: OSB
For use in the U.S:
· Lumber design values
· MSR and MEL design values
· Timber design values
· AWC design info