The Evolution of Structural Composite Lumber

By Renee Strand, P.E.

Structural composite lumber shown as headers, beams, studs and I-joist flange material.

Structural composite lumber (SCL) is a broad term used to describe a variety of engineered wood products. Just like the old saying, "Necessity is the mother of invention," necessity brought about the development of SCL. In order to make the best use out of available lumber resources (younger and smaller trees), manufacturers focused on getting the maximum structural value from smaller, younger logs. The manufacturing of SCL allows the use of the strongest fibers (the outermost layers) of the log for structural applications because round logs are no longer constrained to being cut into rectangular sections. With SCL, the manufacturer can take a tree apart and put its fibers back together to distribute the natural log defects to minimize their effects, and to take full advantage of wood's natural strengths. Described below is the evolution of three types of SCL. *Table 1* summarizes the properties of each.

Laminated veneer lumber (LVL) was first developed in 1969 by Trus Joist Corporation to provide a strong, consistent, and stable chord component for their open web trusses. Today LVL is also used for flange material for I-joists and beam sections 1.75 to 3.5 inches thick up to 24 inches deep. LVL is manufactured by laminating thin sheets of veneer together in parallel alignment. The process of peeling the log allows for 30 percent more of each log to be used for high quality building material compared to solid lumber. Design properties of LVL vary from manufacturer to manufacture. Modulus of elasticity, or stiffness, typically ranges from 1.8×10^6 to 2.0×10^6 psi. Bending stress, F_b, typically ranges from 2500 to 2850 psi. Shear stress, F_v, ranges from 285 psi to 290 psi. Because a tree is not perfectly round, the first veneers peeled off the log are not suitable for LVL, yet they contain the strongest wood fiber. New technology was developed to use these veneers to manufacture parallel strand lumber (PSL). These odd shaped veneers are sliced into strands 2 to 8 feet long. These strands are then coated with adhesive, placed to form a billet, and cured under pressure in a patented microwave pressing process. Up to 65% of a whole log can be converted into high-grade structural lumber. Design stresses are generally 2.0×10^6 psi for stiffness, 2900 psi for F_b, and 290 psi for F_v. Standard stock sizes range from 3.5 x 3.5 inches to 7 x 18 inches. Custom depths, achieved through secondary lamination, are available up to a 54-inch depth.

In 1990, laminated strand lumber (LSL) was introduced as the most resource efficient engineered wood lumber, utilizing up to 75% of each log. LSL is manufactured by bonding up to 12-inch long strands of aspen or yellow poplar with resin in a steam injection pressing process. Common uses of LSL include rim board, wall studs, truss chords, flange material, and headers. Stiffness ranges from 1.3×10^6 to 1.7×10^6 psi. F_b ranges from 1700 to 2600 psi. F_v ranges from 310 to 400 psi. Common manufactured thicknesses range from 1.125 to 3.5 inches. Depths range from 3.5 to 16 inches.

Deciding which product to use depends on your application. All products are stable and resist twisting, warping, and shrinking when properly stored and used. The most economical choice is LSL, which is ideally suited for window and door headers as well as short-span interior beams and columns. LVL, most often produced in 1.75-inch thick members, can be installed in multiple pieces to reduce crane costs on a residential project. Because it is stiffer than LSL, it can span farther and support more load. PSL is the strongest of the three technologies. The ability to manufacture larger cross sections of PSL can reduce the labor cost of field built-up beams. PSL is ideal for heavily loaded columns or tall columns, as well as long span beams.

Three structural composite lumber technologies shown, from front to back, laminated Veneer Lumber, Laminated Strand Lumber, and Parallel Strand Lumber.

Most SCL products are intended to be used as an alternate to sawn lumber. Because SCL beams are manufactured with veneers or strands laid parallel, designing with SCL is similar to designing sawn lumber products. Evaluating field challenges, such as beveled end cuts, can be conservatively completed using standard equations found in references such as the *National Design Specification® for Wood Construction*. See each manufacturer's code evaluation report for their proprietary product information and design properties. For more information on manufacturers and distributors of SCL products, visit the Engineered Wood Products Association website at **www.ewpa.com**.▪

Table 1: Summary of Structural Composite Lumber Properties.

	E ($\times 10^6$ psi)	F_b (psi)	F_v (psi)	Dimensions (in.)
LVL	1.8 – 2.0	2500 – 2850	285 – 290	1.75 to 3.5 thick, up to 24 deep
PSL	1.8 – 2.0	2400 – 2900	290	3.5 to 7 thick, up to 18 deep (54 special order)
LSL	1.3 – 1.7	1700 – 2600	310 – 400	1.125 to 3.5 thick; 3.5 to 16 deep

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