4.0 Glued-laminated Timber Overview

Glued wood structural members are manufactured in a variety of configurations. Structural composite lumber, or SCL, consist of small pieces of wood glued together to form sizes that are common to that of solid sawn lumber. SCL was developed in response to the increasing demand for high quality and unrestrained sized lumber at a time when it became difficult to obtain this type of lumber naturally from a forest. There are several types of SCL products manufactured. The first product is laminated veneer lumber or LVL and is manufactured by laminating veneer with all the plies parallel to the length. The second product, depending on the component material, is laminated strand lumber (LSL), parallel strand lumber (PSL), and oriented strand lumber (OSL). This product consists of strands of wood or strips, such as aspen or other underutilized or juvenile species, of veneer glued under high pressure and temperatures. The third product is glued-laminated timber (glulam for short) which consists of two or more layers of lumber in which the grain of all the layers is oriented parallel to the length of the member. And finally SCL can also include lumber that is glued to panel products, such as box beams and I-beams, and structural sandwich construction.

Structural composite lumber is a growing segment of the engineered wood products industry. It is used as a replacement for lumber in various applications and in the manufacture of other engineered wood products, such as prefabricated wood I-joists, which take advantage of engineering design values that can be greater than those commonly assigned to sawn lumber.

Glued-laminated timbers was first used in Europe in the construction of an auditorium in Basel, Switzerland in 1893 A.D.. It was patented as the "Hertzer System" and used non-waterproof adhesives which limited it self to dry use conditions. Improvements in adhesives during the Great World War stimulated the use of glued-laminated timbers in aircraft and building frames. During the second Great World War, the development of synthetic resin adhesive that were waterproof made it possible for glued-laminated timbers to be used extensively for every practical application. Structures that would not have been feasible using only sawn-timber members have proved practical and successful using glued-laminates. Glued-laminates were originally developed to produce curved members such as large arches. Later they were used to solve the problems faced in obtaining sawn timbers of both large size and good quality. Glued-laminates have the following advantages over sawn timbers:

a. Greater strength

b. Larger cross section

c. Longer spans

d. Freedom from warping and checking

e. Diversity of shapes

f. Varying section properties

g. Camber

h. Fire resistance

i. Economy

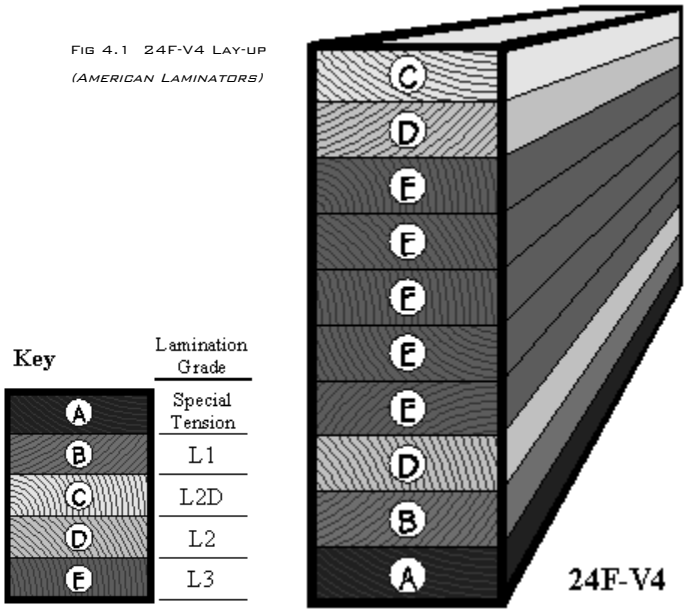

Fig 4.1 24F-V4 Lay-up (American Laminators)

4.1 Grades and Combinations

Wood for glued-laminated laminations are graded under special rules. Grading may be either visual or by machine. Visual grading is based on the occurrence and spacing of defects such as knots and cross grains. Groupings of laminations by strength are specified by the AITC specifications. These groupings are called combinations and are designated by terms such as combination 24F-V4. The numerals preceding the first letter indicate the allowable flexural stress – the 24, for example, meaning 2,400 psi. The letter "V" indicates visual grading of the individual lamination; a letter "E" is used to show machine grading. The "4" of the combination number indicates the fourth combination in the series that has the 2,200 psi bending strength (Fig 4.1).

Douglas Fir-Larch, Southern Pine, Hem-Fir, and Spruce-Pine-Fir (SPF) are commonly used for glued-laminate in the United States. Nearly any species can be used for glued-laminated timber, provided its mechanical and physical properties are suitable and it can be properly glued. Industry standards cover many softwoods and hardwoods, and procedures are in place for including other species

4.2 Adhesives

Two types of glue are permitted in the fabrication of glued-laminated members: (1) dry-use adhesive (casein glue) and (2) wet-use adhesives (usually phenol-resorcinol-base, resorcinol-base, or melamine-base adhesives). Both types of glue are capable of producing joints which have horizontal shear capabilities in excess of the capacity of the wood itself.