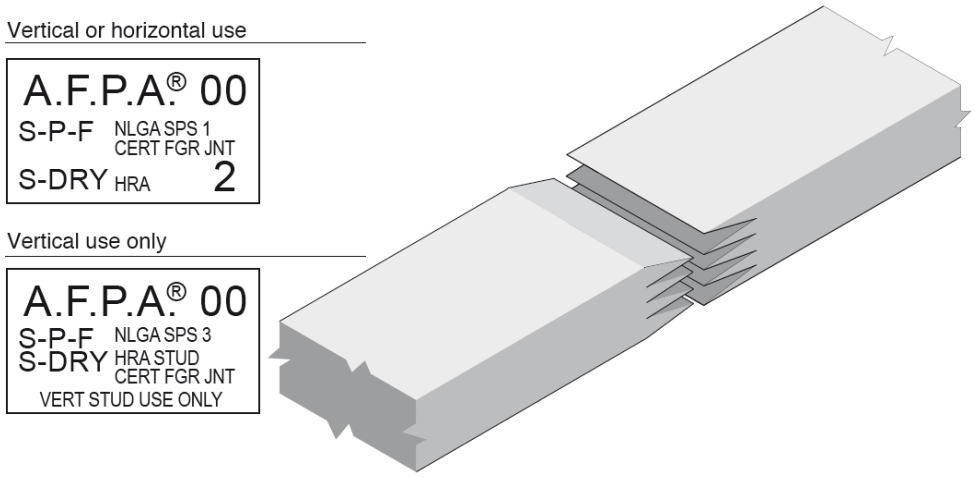
Fingerjoined lumber

Fingerjoined products are manufactured by taking shorter pieces of kiln-dried lumber, machining a ‘finger’ profile in each end of the short-length pieces, adding an appropriate structural adhesive, and end-gluing the pieces together to make a longer length piece of lumber. The length of a fingerjoined lumber is not limited by the length of the log. In fact, the manufacturing process can result in the production of joists and rafters in lengths of 12 m (40 ft) or more. The process of fingerjoining is also used within the manufacturing process for several other engineered wood products, including glued-laminated timber and wood I-joists. The specific term “fingerjoined lumber” applies to dimension lumber that contains finger joints.

FIGURE 6.4
Fingerjoined lumber



Fingerjoining derives greater value from the forest resource by using short length pieces of lower grade lumber as input for the manufacture of a value-added engineered wood product. The fingerjoining process utilizes short off cut pieces of lumber and results in more efficient use of the harvested wood fibre. Fingerjoined lumber can be manufactured from any commercial species or species group. The most commonly used species group from which fingerjoined lumber is produced is Spruce-Pine-Fir (S-P-F).

Design advantages of fingerjoined lumber

Fingerjoined lumber is an engineered wood product that is desirable for several reasons:

- straightness
- dimensional stability
- interchangeability with non-fingerjointed lumber
- highly efficient use of wood fibre

The design and performance advantages of this engineered wood product are its straightness and dimensional stability. The straightness and dimensional stability of fingerjoined lumber is a

result of short length pieces of lumber, consisting of relatively straight grain and fewer natural defects, being combined with one another to form a longer length piece of lumber. The grain pattern along fingerjoined lumber becomes non-uniform and random by attaching many short pieces together. This results in fingerjoined lumber being less prone to warping than solid sawn lumber. The fingerjoining process also results in the reduction or removal of strength reducing defects, producing a structural wood product with less variable engineering properties than solid sawn dimensional lumber.

The most common use of finger-joined lumber is as studs in shearwalls and vertical load bearing walls. The most important factor for studs is straightness. Fingerjoined studs will stay straighter than solid sawn dimensional lumber studs when subjected to changes in temperature and humidity. This feature results in significant benefits to the builder and homeowner including a superior building, the elimination of nail pops in drywall and other problems related to dimensional changes. This also makes fingerjoined lumber an ideal candidate for non-load-bearing partitions used in dry-service conditions.

Finger-joined lumber is also commonly used for flange material in wood I-joists. This application of the product requires the wood fibres and the glued joint to resist long term tension loads when in use. For this reason, fingerjoined lumber used for the manufacture of I-Joists must comply with the requirements of NLGA SPS 1. Wood I-joist manufacturers undertake additional quality assessment procedures during production.

Types of fingerjoined lumber

Canadian fingerjoined lumber is manufactured in conformance with either NLGA Special Products Standards SPS 1, *Fingerjoined Structural Lumber,* SPS 3, *Fingerjoined "Vertical Stud Use Only" Lumber,* or SPS 4*, Fingerjoined Machine Graded Lumber.*

In almost all cases, fingerjoined lumber manufactured to the requirements of SPS 1 is interchangeable with solid sawn lumber of the same species, grade and length, and can be used for either horizontal or vertical load bearing applications, such as joists, rafters, columns and wall studs.

Fingerjoined lumber manufactured according to SPS 3 can only be used as vertical end-loaded members in compression, e.g., wall studs, where bending and tension loading components do not exceed short term duration and where the moisture content of the wood will not exceed 19% and the temperature will not exceed 50 °C for an extended period of time. SPS 3 lumber is manufactured in section sizes up to 38 x 140 mm (2 x 6), in lengths up to 3.66 m (12 ft).

Fingerjoined machine graded lumber manufactured in accordance with SPS 4 can be used for wood I-joist flanges and metal plate connected truss applications. SPS 4 graded fingerjoined lumber designated as "Dry Use Only" shall only be used in applications where the equilibrium moisture content of the lumber is not expected to exceed 19%.

Fingerjoined lumber is typically produced from lumber that has no more than 19% moisture content for ease of manufacturing the joint to meet the strict quality control standards. For this reason, fingerjoined lumber is almost always sold as ‘S-Dry’.

Adhesives in fingerjoined lumber

There are several different types of adhesives used in the manufacture of fingerjoined lumber. The National Lumber Grades Authority (NLGA) Special Product Standards (SPS) outline what types of adhesives can be used in SPS 1, SPS 3 and SPS 4 fingerjoined lumber as well as the test standards that those adhesives must meet. SPS 1, sometimes referred to as a structural fingerjoint, uses a phenol-resorcinol formaldehyde (PRF) adhesive, similar to what is used in structural panel products or in glued-laminated timber. SPS 3 typically uses a polyvinyl acetate adhesive. Adhesives used in the manufacture of SPS 3 fingerjoined lumber are not suitable for joining wet lumber and therefore only ‘S-Dry’ lumber is utilized in order to ensure a quality joint.

Adhesives used in fingerjoined lumber are designated as either a Heat Resistant Adhesive (HRA) or Non-Heat Resistant Adhesive (Non-HRA). Qualification as an HRA adhesive requires an adhesive to be exposed to elevated temperatures during a standard fire resistance test of a loadbearing fingerjoined stud wall assembly loaded to 100 percent of the wall’s allowable design load. All SPS 1 products must be manufactured using HRA adhesives. SPS 3 products may be manufactured with either HRA or non-HRA adhesives. All SPS 4 products must be manufactured using HRA adhesives.

For further information on the performance of adhesives in fingerjoined lumber in fire-resistance-rated wall assemblies, refer to the following document (http://cwc.ca/wp-content/uploads/2019/03/FJL-FR.pdf).

Structural testing protocols for fingerjoined lumber

The strength of the finger joints is controlled by stipulating the quality of wood which must be present in the area of the joint. For the majority of fingerjoined lumber, the segments between the fingerjoints are visually graded in accordance with the NLGA rules for the lumber grade indicated on the grade stamp. Near the fingerjoints, more restrictive visual limits are generally imposed.

The structural properties are confirmed through a comprehensive quality assurance program with independent third party verification. Daily structural tests are certified to verify that the product meets the requirements as set out by the North American lumber grading system. Each piece must be comprised of species from the same species group, and strict tolerances are established for the machining of the fingers; the quality, the mixing, and the curing of the adhesive. Depending on the type of fingerjoined lumber being manufactured, edge and flat bending tests and tension tests are performed on each piece to ensure the joint can meet the engineering design values for the lumber.

Fingerjoint lumber test requirements are selected to enable the same specified strength and stiffness as non-finger-joined lumber of the same grade and size to be assigned to the finger-joined lumber. Test methods (e.g. bending or tension tests) and target test load (e.g. minimum and 5th percentile finger joint strengths) for samples of single fingerjoints are not only linked to the size, grade and species to be joined, but also take into account the average fingerjoint spacing. Fingerjoints used at lower average fingerjoint spacing need to achieve a higher 5th percentile strength level than the same fingerjoints used at higher average fingerjoint spacing. In selecting the tests, only some properties, such as bending strength, are directly tested. Others characteristics are established by correlation to the property monitored, or implied by the specification imposed on the adhesive (e.g. adhesive bondline performance).

For further information on the performance of adhesives in fingerjoined lumber in fire-resistance-rated wall assemblies, refer to the following document (http://cwc.ca/wp-content/uploads/2019/03/FJL-FR.pdf).

Fingerjoined lumber grading and grade stamps

Fingerjoined lumber must meet the identical requirements found in the grading rules for regular sawn lumber. Grading rules do not consider the presence of finger joints to reduce strength properties. Fingerjoined lumber must also meet special product standards on quality control requirements for strength and durability of the joints. The National Lumber Grades Authority (NLGA) Special Product Standards SPS 1, SPS 3 and SPS 4 in Canada or Western Wood Products Association (WWPA) Glued Products Procedures & Quality Control, C/QC 101.97 are examples of these product standards.

All fingerjoined lumber manufactured to the Canadian NLGA Standards carries a grade stamp indicating:

• the species or species combination identification

• the seasoning designation (S-Dry or S-Green)

• the registered symbol of the grading agency

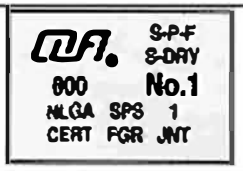
• the grade

• the mill identification

• the type of adhesive used (HRA or Non-HRA)

• the NLGA standard number and the designation SPS 1 CERT FGR JNT (certified finger joint), or SPS 3 CERT FGR JNT-VERT STUD USE ONLY (certified finger joint for vertical use only), or SPS 4 CERT FGR JNT (certified finger joint)

Additional information on SPS 1 and SPS 3 fingerjoined lumber is provided in Table 1 below.

Table 1: Recognizing and understanding finger-joined lumber.			
	VERTICAL STUD USE ONLY		Structural Fingerjoint
Grade Stamp Designation (Example)	Both must appear	SPS 3 CERT FGR JNT or CERT GLUED JNTS VERTICAL STUD USE ONLY	SPS1 CERT FGR JNT or CERT EXT JNTS[1]
Grade Stamp Facsimile			
Product Standards	SPS 3 and C/QC 101.97		SPS 1 and C/QC 101.97
Comparison to Non-Finger-joined Lumber	Intended for use as wall studs, limited to normal short term bending and tension loads		Fully interchangeable with lumber of the same grade and species
Permissible Uses	Load bearing studs[2], non-load bearing studs, locations where any bending or tension stresses are of short duration (e.g., wind or earthquakes), dry-service conditions only		Load bearing studs, Non-load bearing studs, Headers, lintels, built-up beams, Floor and roof joists, etc., dry or wet-service conditions
Adhesives	Typically polyvinyl acetate and white-colored, but can be any glue which meets the applicable standards		Phenol-resorcinol or equivalent performance that meets or exceeds ASTM D2559 or CSA O112.7, dark-colored
Grades Allowed[3]	**Stud**, Construction, Standard, recently added: No.1, No.2, No.3		Select Structural (SS), No.1, No.2
Dimensions[3] and Lengths	**2x2", 2x3", 2x4", 2x6" 8' to 12'**		2x2", 2x3", 2x4", 2x6", 2x8", 2x10", 2x12" 8' to 40'

Notes:

1. This designation can also be used under Vertical Stud Use Only finger-joined lumber, but is not common.
2. Except in the case where longer term bending or tension loads are applied, such as with soil loads acting on a permanent wood foundation.
3. Highlighted items are those most commonly produced.