JOINTING PROPERTIES OF NEW ZEALAND RADIATA PINE

Wood properties in relation to jointing

New Zealand radiata pine has relatively uniform density within the growth rings, medium over-all density, and good resistance to splitting. These qualities result in excellent jointing properties, both with mechanical fasteners and with glues.

Density: Over-all density trends are discussed in the section on "THE TREE AND ITS LUMBER". Higher grades, particularly in machine-graded lumber, will have higher than average densities.

The density variation, latewood : earlywood, within the ring is less than 2:1 whereas for woods like Douglas fir it can be up to 5:1. This uniform structure assists shear strength and resistance to splitting in mechanically fastened joints, and improves the strength of glued joints.

Shrinkage and stability: New Zealand radiata pine is typical of a medium-density softwood, having shrinkage and stability similar to Douglas fir and considerably better than hardwoods in general. This stability reduces splitting forces in glued joints and joints with multiple connectors across the grain.

Strength properties: From the summary of mechanical properties in Table 4 it can be seen that New Zealand radiata pine has moderate hardness, good shear strength, and moderate compression strength parallel and perpendicular to the grain. These properties allow close nailing without splitting whilst retaining an adequate joint strength.

General properties: New Zealand radiata pine is non-corrosive to metal fasteners and, because it has a low extractives content, it glues well. Its good machining properties allow accurate joints, including finger-joints, to be made with smooth surfaces so that good bearing can be obtained in bolted joints and close mating surfaces in glued joints.

Nails

Withdrawal loading is important for roofing fasteners and for many of the connections in light frame construction, pallets, and packaging. Basic working loads for several nail types in withdrawal are given in Table 15.

Laterally loaded nails are the most common structural connector, and in New Zealand radiata pine form very cost-efficient jointing in small and large structures. New Zealand radiata pine may be nailed green or dry at the relatively close spacing of 10 times the nail diameter along the grain and 5 times the nail spacing across the grain without splitting.

TABLE 15–*Basic working loads* for nails in withdrawal — one nail in side grain of New Zealand radiata pine*

Nail type	Shank diam. (mm)	Moisture condition of lumber for lowest allowable loads in withdrawal		Load (N/mm)
		At assembly	In service	
Plain steel	2.5	>25%	16%	3.5
	3.4	>25%	16%	4.2
	4.0	>25%	16%	5.7
	6.0	>25%	16%	8.6
Galvanised	3.4	>25%	16%	12.1
Galv. annular groove	3.4	16%	16%	19.1
Galv. helical groove	3.4	16%	16%	14.5

* These loads are based on a permanent load duration

At these close spacings, connections may be made with steel or plywood plates to develop the full strength of glue-laminated lumber beams. Portal frames in glue-laminated radiata pine with this type of nailed connection are popular for their competitive cost, ease of on-site assembly, and fire resistance. Basic working loads for nails in lateral loading are given in Table 16.

Bolts

Bolted joints, with or without reinforcing metal connectors such as shear plates and split rings, are still used in many structures where nailed joints are not suitable. Basic working loads for bolted joints are given in Table 17.

Truss plates

New Zealand radiata pine has proved suitable for trusses connected with proprietary toothed metal-plate connectors or truss plates. House roof construction, is of course, the major market for roof trusses but in the industrial market New Zealand leads the world through the innovative use of truss plates. Trusses with spans of 30 m are now common and straight beams assembled with truss plates have been made up to 600 x 200 mm by 15 m long.

More recently, curved truss-plated beams have been developed to the stage where a 27-m span arch building has been completed, and even larger spans are being planned. These buildings are costing less than equivalent buildings in other materials.

Glued joints

Medium-density softwoods generally glue well and New Zealand radiata pine confirms this rule. Its good permeability allows moisture and solvents to move out of the glueline and so speeds curing. No difficulties have been experienced with any of the common wood glues in combination with untreated wood or wood treated with preservatives at normal retentions.

These gluing characteristics are reflected in the popularity of finger-jointed and glue-laminated products. The plywood and panel products industries also depend on the good gluing characteristics of New Zealand radiata pine.

TABLE 16–*Basic working loads for nails in lateral loading — one plain steel nail in single shear in the side grain of dry New Zealand radiata pine, embedded to a depth of at least 10 times the nail diameter in each wooden member*

Nail diameter (mm)	2.00	2.50	3.15	3.55	4.0	4.50	5.00	6.00
Lateral load (N)	91	138	214	269	336	419	571	721
With metal side-plate load (N)	114	173	268	336	420	524	639	901

These loads are based on a permanent load duration

TABLE 17–*Basic working loads for bolted joints — one bolt in a two-member joint of dry New Zealand radiata pine in lateral loading, embedded 10 diameters in each member*

Member thickness (mm)	Bolt diameter (mm)	Parallel to grain — basic working load (kN)	Perpendicular to grain — basic working load (kN)
22	12	2.9	1.0
	20	4.8	1.7
	30	7.2	2.6
45	12	3.1	2.1
	20	8.6	3.4
	30	14.5	5.2
65	12	3.1	2.4
	20	8.6	5.1
	30	19.3	7.5

These loads are based on a permanent load duration