



Construction Benefits— Strength and Durability

The natural attributes of wood make timber building products very strong. In comparison to steel and concrete, plantation pine structural timber, for example, has a strength to weight ratio 20 percent higher than structural steel and four to five times higher than non-reinforced concrete in compression.

Durability

Timber has been used in construction for millennia and timber structures can survive for centuries. The oldest surviving wooden building, Horyuji temple in Japan was built in 670. Different timbers (species) have different durability, and the Australian Standard AS5604 (Timber - Natural durability ratings) defines the durability ratings for timbers in different environments. The selection of fit for purpose timber is important for the longevity of the structure. Timber that has been correctly chosen for its application and installed and maintained correctly can last well in excess of 50 years (see Table 1).

Quick Facts

1. Correctly chosen, treated and maintained timber buildings will last for many decades, even in adverse conditions they will exceed the Building Code of Australia design life of 50 years.
2. Timber is susceptible to decay when exposed to moisture. Good timber design and use of the right product for the right purpose can result in longevity of the timber structure.
3. Timber has a high strength for its weight. Cross Laminated Timber is easier to build with, and provides rugged and resilient built solutions.

Table 1 Durability of timber and associated life expectancies (From (Wood Solutions, 2015))

Natural durability class	Probable heartwood life expectancy (years) (1)		
	Fully protected from the weather and termites	Above ground exposed to the weather but protected from termites	In-ground contact and exposed to termites
Class 1 Highly Durable	50+	40+	25+
Class 2 Durable	50+	15 to 40	15 to 25
Class 3 Moderately Durable	50+	7 to 15	5 to 15
Class 4 Non-durable	50+	0 to 7	0 to 5

1. The rating system used in AS 5604 is based on the average life (range in years) of test specimens of sound, untreated heartwood (35 mm, 35 mm for the above-ground tests and 50 mm for the in-ground trials). In construction, commercial timber member dimensions would normally exceed the section sizes of specimens used in trials and the construction timber should provide life expectancy in excess of the above values.

Good building design increase the life of timber, as timber is susceptible to decay and attack from insects like termites. Decay occurs with fungal infection and requires four different factors to take hold; a timber moisture content of between 20 to 60 percent, exposure to oxygen, temperatures between five and 40 degrees Celcius and nutrients present within the wood. The best ways to prevent decay are to protect the timber from moisture or to treat the timber to remove the nutrients necessary for decay to establish.

It is necessary to manage for the impacts of moisture across the entire life of the building. Moisture can be introduced to timber by rain during the construction phase as well as during building use through condensation, humidity and ground moisture. This is the case for both structural timber and engineered timber products like cross laminated timber (Wood Solutions, 2013).

Strength

Timber has a high strength for its weight and strength generally increases with density. The strength of timber can be increased further with engineered products like Laminated Veneer Lumber (LVL), Glulam and Cross Laminated Timber (CLT), plywood and LVL. CLT is layers of timber glued with their grains opposing which increases the strength of the timber significantly;

a panel of CLT has a similar strength to a panel of concrete but with less weight (Wood Solutions, 2017). Timber is being successfully used to create mid-rise buildings, with the tallest timber office building in Australia to be completed in Brisbane in mid-2018, which is 45 metres tall.

Further Reading

Queensland Government. (2017). *Construction timbers in Queensland*. Available at: www.daf.qld.gov.au/business-priorities/forestry/using-wood-and-its-benefits

Wood Solutions. (2013). *Cross Laminated Timber (CLT)*. Available at: www.woodsolutions.com.au/Wood-Product-Categories/Cross-Laminated-Timber-CLT

Wood Solutions. (2015). *Timber service life design*. Available at: www.woodsolutions.com.au/system/files/WS_TDG_05_1_17.pdf

Wood Solutions. (2017a). *Strength performance*. Available at: www.woodsolutions.com.au/articles/strength-performance

Wood Solutions. (2017b). *Wood Product Categories*. Available at: www.woodsolutions.com.au/wood-product-search

Wood Solutions. (2017c). *2017 ATDA Winner: International House Sydney*. [Online] Available at: www.woodsolutions.com.au/inspiration-case-study/2017-atda-winner-international-house-sydney

Case Study – International House

International House at Barangaroo is a seven-storey office building and initially was Australia's first and largest commercial engineered timber building. CLT and glulam have been used for the floors, columns, walls, roof, lift shaft and stairs, supplemented with recycled Australian hardwood. The first floor has a traditional concrete structure to remove the timber from the hazards of moisture and termites from the ground. The strength of timber is uniquely displayed through the design of the building and the use of glulam and CLT for the structural loads and bracing.



Figure 1 International House, Barangaroo, Sydney. Image courtesy of Lendlease.