INFORMATION SHEET
FIRE

BEHAVIOUR OF TIMBER IN FIRE

The information provided below has been taken from the New Zealand Timber Design Guide 2007, published by the Timber Industry Federation and edited by Professor A H Buchanan. To purchase a copy of the Timber Design Guide, visit www.nztif.co.nz

When a fire in a building develops, the structure of the building is often required to prevent the fire spreading, and to continue to carry the applied loads.

No building material is completely immune to fire damage. All materials suffer some damage when exposed to heat, even if they don't ignite and burn.

However, generally building materials perform better as their dimensional sizes increase and exposed surface areas proportionately decrease.

The insulating properties of timber can provide built-in fire resistance. Large timber members burn slowly, and form char on the surface.

The un-burnt timber retains some strength and stability during a fire. Because timber is dimensionally stable under fire conditions, failure will not occur until the cross section has been reduced considerably.

This allows fire fighters to operate safely for some time in or around a burning building of heavy timber construction.

Glued laminated structural timber elements have a fire performance comparable to solid wood members of equivalent size.

When a fire is brought under control before major damage occurs, heavy timber members will frequently still be useable, subject to cosmetic repairs and confirmation of their structural integrity.

Light timber frame construction can also be protected to provide a high degree of fire performance using fire resistant lining materials.

Because wood burns, many people assume that timber buildings have poor behaviour in fires.

However, timber buildings can be designed with excellent fire safety for the occupants, and sufficient fire resistance to prevent spread of fire or structural failure.

Large sized timber members, whether sawn timber or glulam, have the inherent ability to provide fire resistance because of the unique charring properties of wood.

In light timber framed structures, the design and use of appropriate lining materials can provide timber framing with excellent fire resistance by protecting the wood from the direct impact of the fire.

Wood is a complex mixture of natural polymers. The most important constituents being cellulose, hemicellulose and lignin which are present in the approximate proportions of 50, 25 and 25%.

The actual proportions may vary depending on the wood species. When wood is heated these constituents decompose at different temperatures to release combustible volatiles.

When wood burns, about 15-25% will remain in the form of a 'char' and most of this is from the lignin content.

When the fire exposure is intense the boundary transition from the charred area to the remaining heated wood is quite distinct.

A commonly accepted charring temperature of wood is about 300°C.

For a given fire severity, an average charring rate (mm/min) can be used to predict the amount of charred material as a function of time, and this is commonly the basis of calculating the fire resistance of heavy timber structural members.

Following a fire, an expert assessment of the structural integrity and the extent of repairs or replacement of members needed will be required.

Decomposition temperature of wood constituents	
	decomposition temperature
Hemicellulose	200–260°C
Cellulose	240–350°C
Lignin	280–500°C