

LSAA Conference
14 November 2013 - Auckland

Opportunities for Re-Building Christchurch in Timber

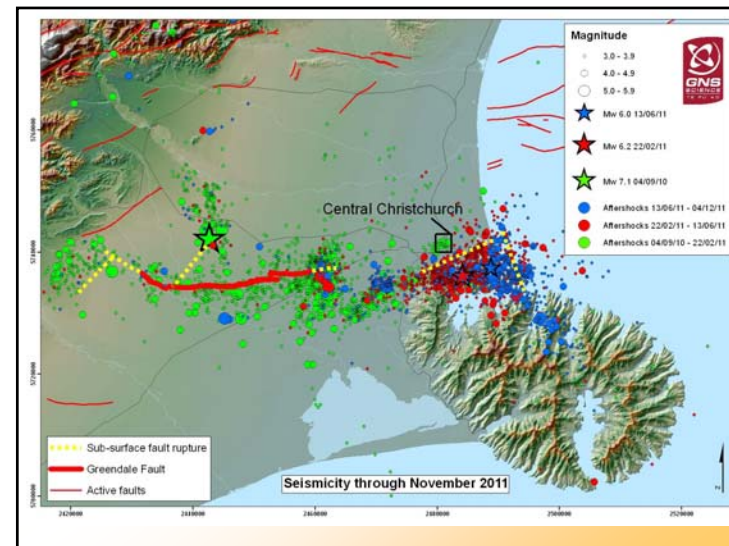
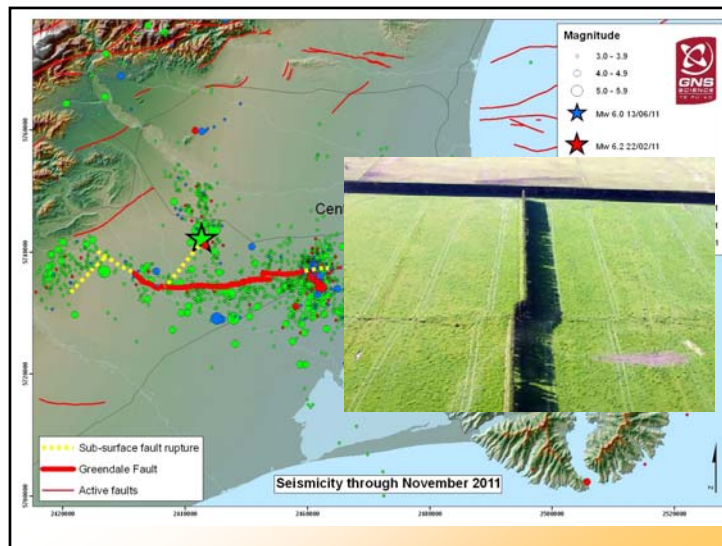
Professor Andy Buchanan
University of Canterbury, Christchurch

2010 & 2011 earthquakes

Seismicity of the Pacific Rim: 1990 - 2000

The diagram shows the Australian Plate, Pacific Plate, and New Zealand Plate. A red circle highlights the fault line between the Australian and Pacific plates. The seismicity map shows earthquake locations along the Pacific Rim from 120°W to 70°W and 60°N to 40°S. Labels include Japan, California, Taiwan, New Zealand, and Chile. A red circle highlights the New Zealand region. A red arrow points from the diagram to the New Zealand region on the map.

Movement of fault = 40mm per year



Christchurch earthquakes



Main quake:
4 September 2010,
4.30am. M 7.1
No deaths



Aftershock:
22 February 2011,
1 pm. M 6.3
182 deaths



Building collapses. Loss of life



115 deaths in CTV.



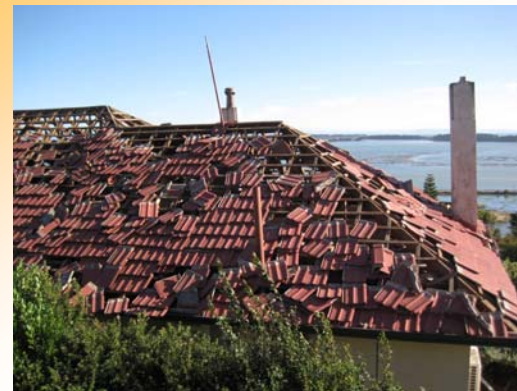
18 deaths in PGC

42 deaths in other buildings (masonry)
7 deaths in rockfall etc.
182 total deaths

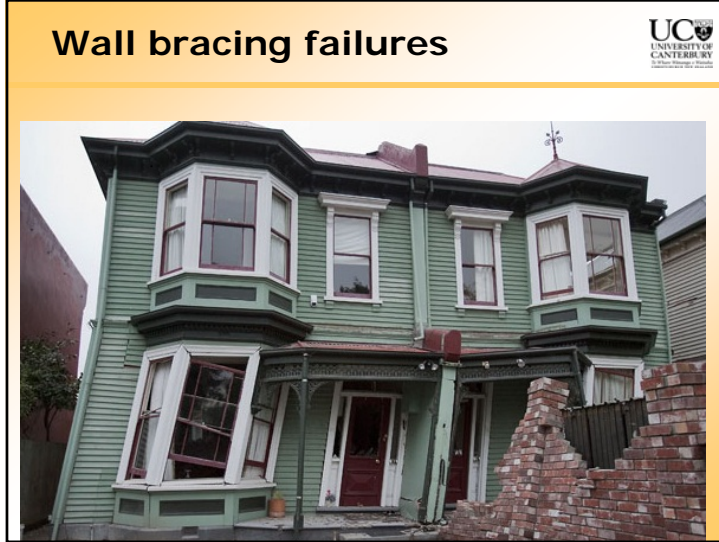
Liquefaction damage



Vertical accelerations




Roof shaken off
Timber house structurally safe



Re-building Christchurch

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What kind of city do we want?




Warren and Mahoney

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Wood is part of the solution



Old Government Buildings, Wellington, 1876

International

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7 storeys – Berlin (Glulam)

6 storeys – Switzerland (Light timber frame)

9 storeys – London (X-Lam panels)

New technology

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- New materials
 - LVL
 - CLT
- New fasteners
 - Screws
 - Rivets
- New structural concepts
 - Post-tensioning
- Hi-Tech manufacturing




New materials

- Glulam
- LVL
Laminated Veneer Lumber
- CLT
Cross Laminated Timber




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In Christ - Through Learning

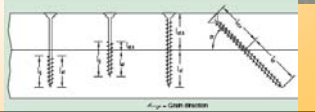
New fasteners



Rivets




Screws



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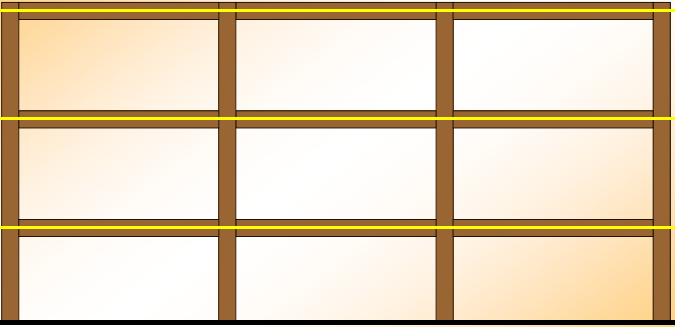
Rocking Concrete Systems

University of California, San Diego




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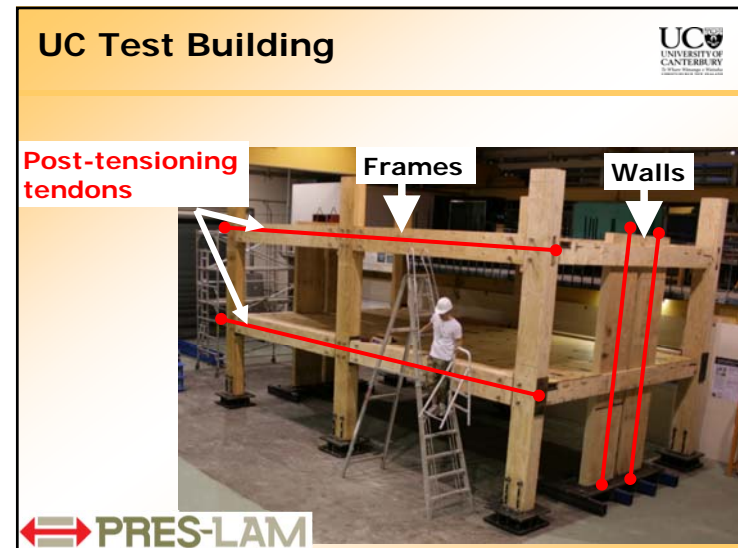
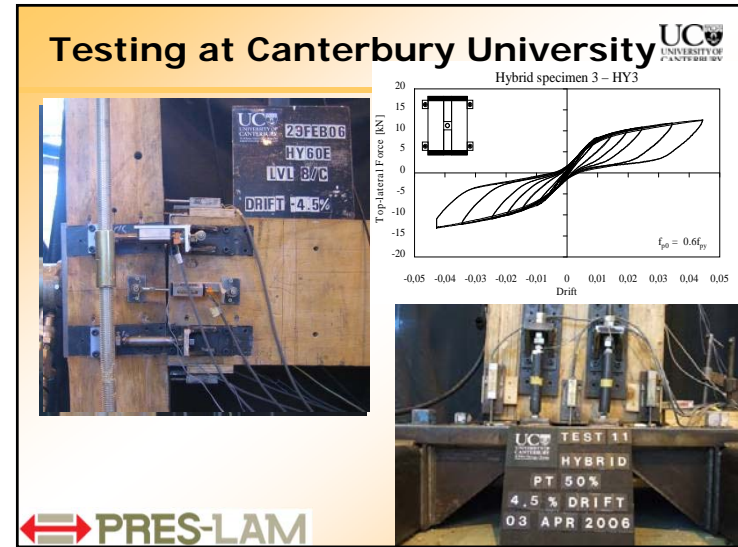
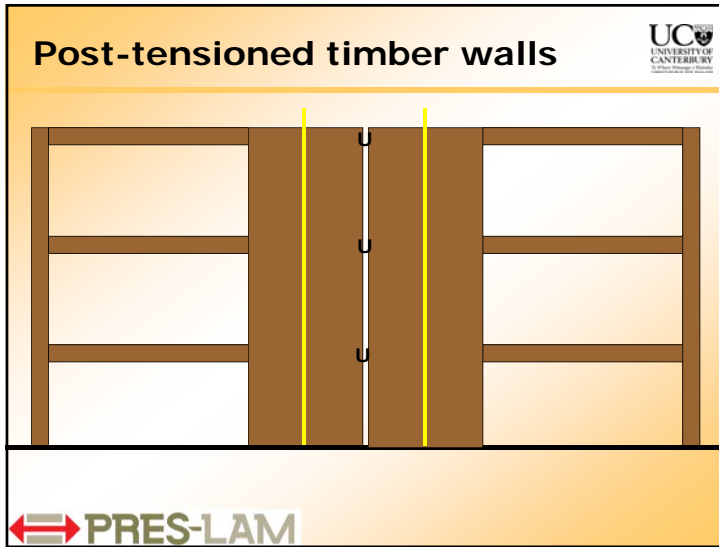
Post-tensioned timber frames



Post-tensioning solves problem of moment connections for heavy timber frames



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UC Test Building



Post-tensioning

University of Canterbury laboratories

Expan Head Office



PRES-LAM

Expan Head Office



No damage in Feb earthquake

PRES-LAM

NMIT Building, Nelson



NMIT Arts a
ISJ Architec

PRES-LAM

NMIT Building, Nelson

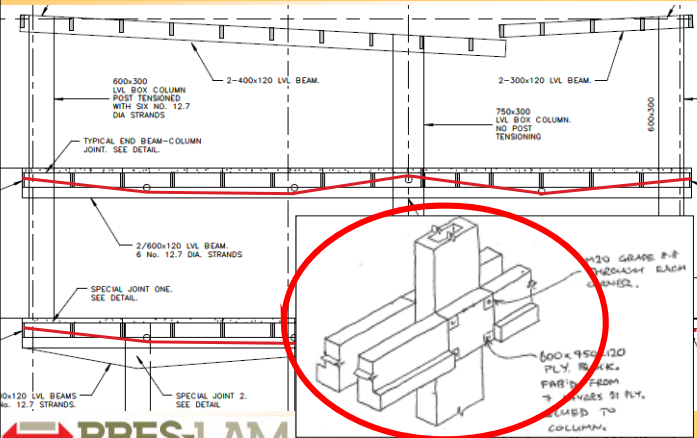


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PRE-SLAM

ISJ Architects, Aurecon

Massey University, Wellington



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Massey University Wellington

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Massey University Wellington
Athfield Architects, Dunning Thornton

Massey University, Wellington



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Massey University, Wellington.
Athfield Architects, Dunning Thornton

Carterton, Wellington

The top image is a perspective architectural rendering of a modern building with a prominent glass facade and a traditional gabled roof section. Below it are two photographs showing the construction progress: one shows the internal timber frame structure, and the other shows the exterior wall panels being installed.

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In Other Words, We're Here

←→ PRES-LAM

Opus architects and engineers

Kaikoura

A perspective architectural rendering of a modern building complex featuring a mix of traditional and contemporary architectural styles, including a large curved structure with horizontal slats.

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Museum, library, council offices, Kaikoura DC

All timber. No concrete. CLT + LVL walls.

←→ PRES-LAM

Re-building Christchurch

The left side shows a construction site with a large crane lifting a massive timber frame component. The right side is a technical architectural section drawing showing the vertical assembly of the timber structure.

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Sheppard and Rout Architects, Kirk Roberts Engineers

134 VICTORIA ST DEVELOPMENT VIEW 6

Re-building Christchurch

An interior photograph of a large, open-plan space under construction, showcasing the extensive use of light-colored timber for walls, ceiling, and structural elements.

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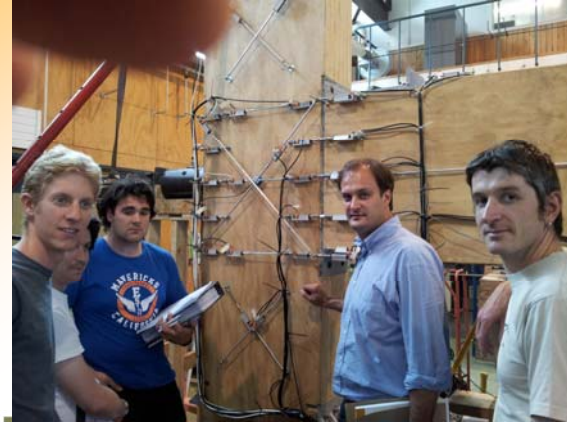
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Re-building Christchurch



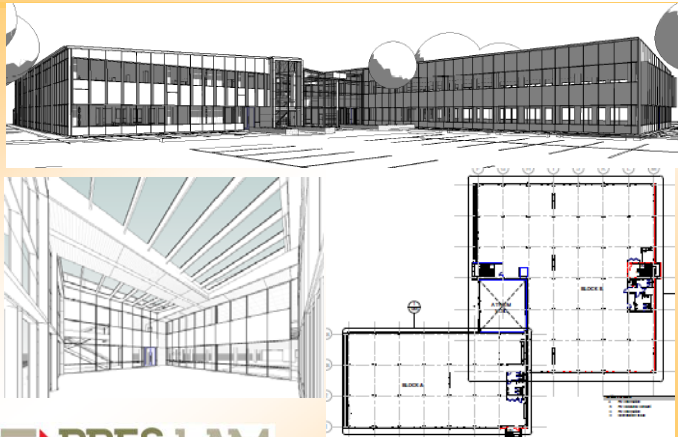
↔ PRES-LAM

Re-building Christchurch



↔ PRES-LAM

Re-building Christchurch



↔ PRES-LAM

Opus International Architects and Engineers

Re-building Christchurch



↔ PRES-LAM

Re-building Christchurch



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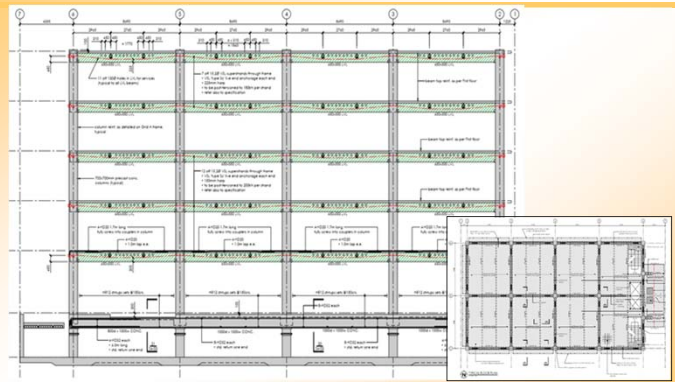


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Rick Proko Architects, Ruamoko Engineers

Re-building Christchurch



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Base-isolated building.
Frames both directions with concrete columns and post-tensioned LVL beams.

←→ PRES-LAM

Re-building Christchurch



← PRES-LAM

Re-building Christchurch




Epic Building, Manchester Street

Re-building Christchurch



Tait Building, Wairakei Road

Why use wood ?



- Constructability
- Sustainability
- Renewability
- Availability
- Weight
- Cost
- Fire safety, durability, acoustics, energy

Cost effective
High performance
Timber building systems

Light weight structures

- Density of dry wood 0.5 t/m³ (one quarter)
- Density of concrete 2.3 t/m³
- Beams and columns about the same size
- A timber building is less than half the weight of a similar concrete building
- Big savings in the foundations
- Density of steel 40 t/m³
- Very slender members (fire, instability problems)
- Timber has better strength/weight ratio

The Supply Chain

- Forest owner
- Logs
- Processor
- Wood products
- Fabricator
- Structural elements
- Erector
- Structural skeleton
- Contractor
- Whole building
- Building owner

Design Team


Research Team

They may have to take some risks

How to reduce the risk ?

PROVIDE CONFIDENCE

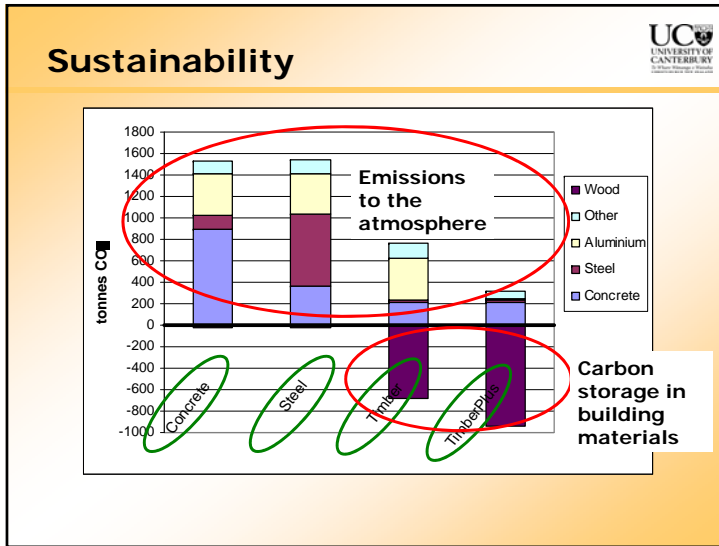
- Government support
- Research funding
- Support designers
- Educate new players
- Share knowledge
- Codes and Standards
- Design Guides



Fire safety



Heavy timber has excellent fire resistance



- ### Conclusions
- We have the technology, more coming
 - We have the materials, hybrids coming
 - We have the structural systems
 - Designers and builders are coming on board
- Light-weight low-damage timber buildings for a sustainable future**

