



Nuove opportunita' per edifici multipiano in legno

Sicurezza e Sostenibilita'
Nuove opportunita' per edifici multipiano in legno
la tecnologia Pres-Lam

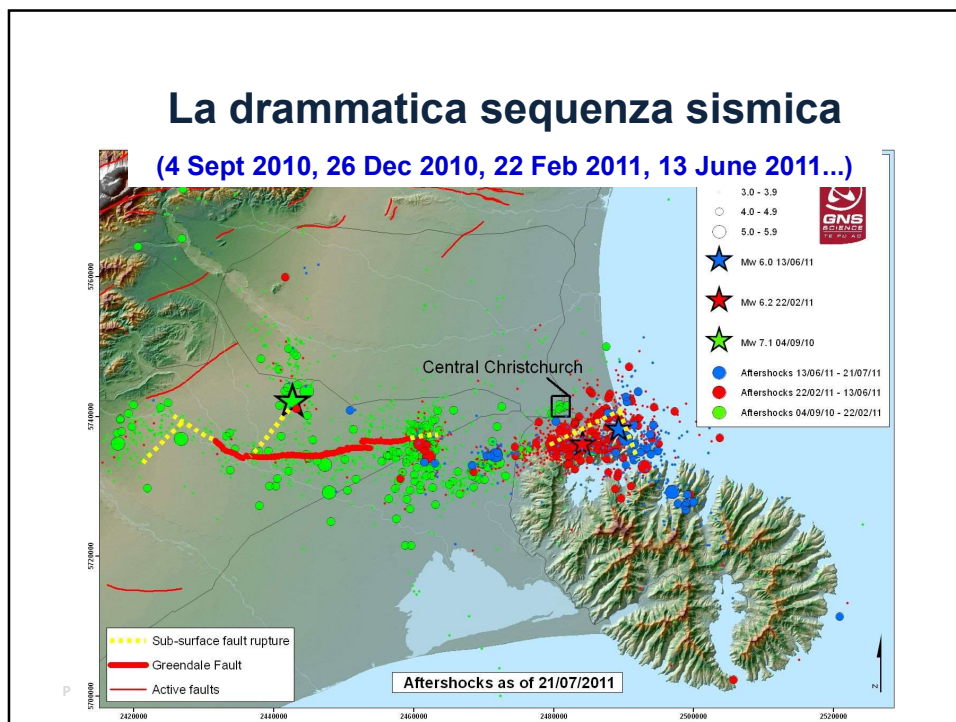
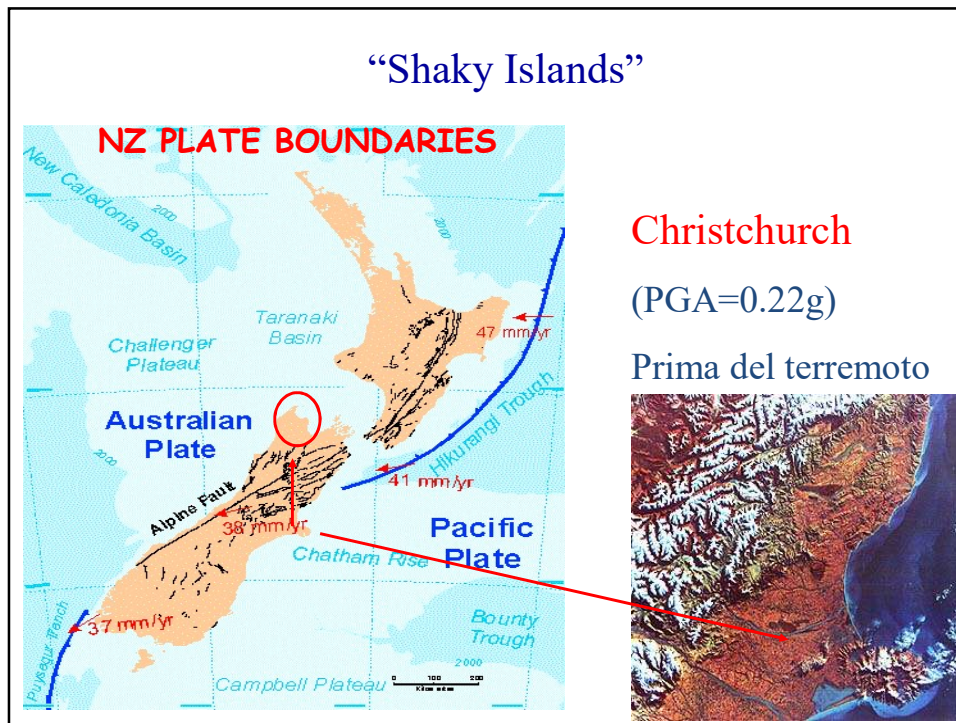
Christchurch CBD

Prof. Ing. Stefano Pampanin
La Sapienza Universita' di Roma
University of Canterbury, Christchurch, New Zealand





Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno

The Christchurch Earthquake
scossa principale 4 September 2010 (4:35 am NZST)
A success story or a wake-up call?
"Successo" o campanello di allarme per scampato pericolo?

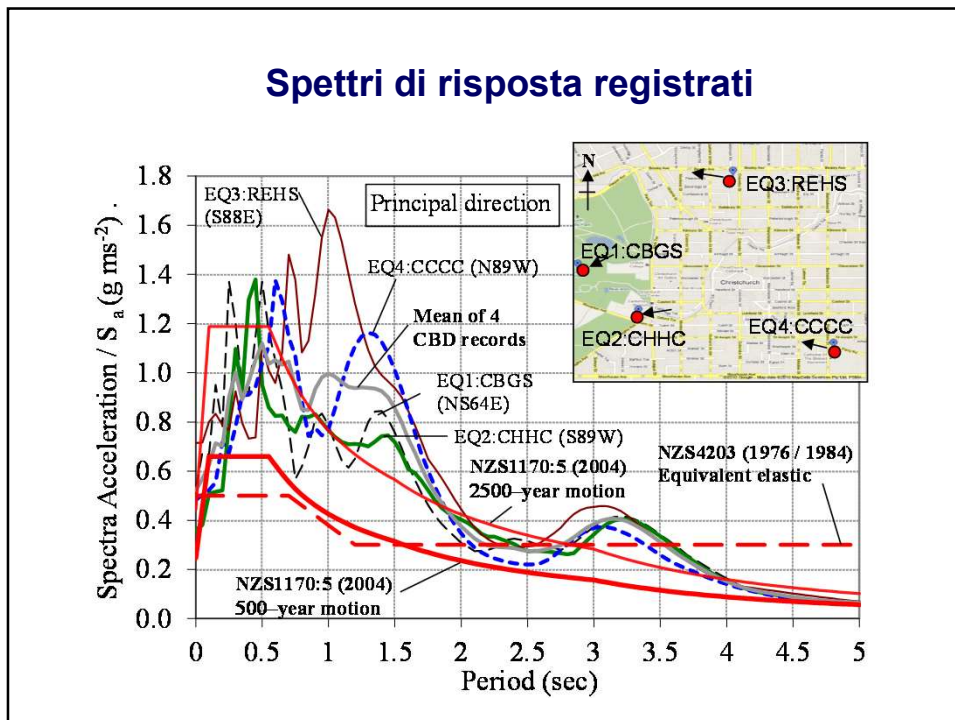
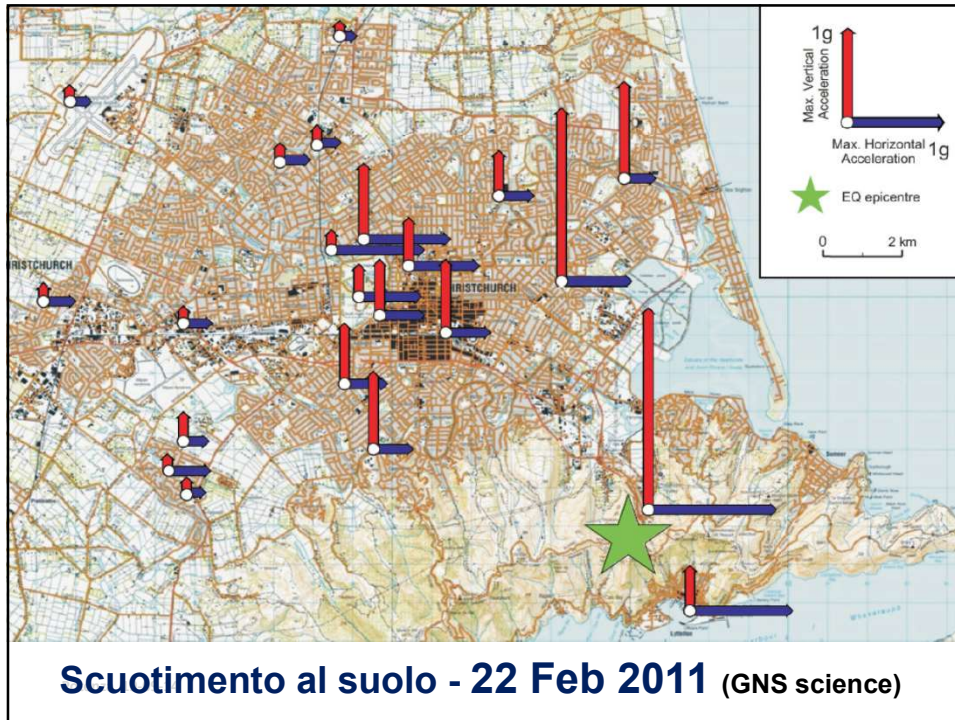


12.51pm 22nd Feb 2011...





Nuove opportunita' per edifici multipiano in legno





Fallacy

"The earthquake does not read the seismic codes."

*- late Prof Tom Paulay
(University of Canterbury)*





Nuove opportunita' per edifici multipiano in legno

CTV Building (mid 1980s)



Edifici Moderni Post-1980s



Nuove opportunita' per edifici multipiano in legno

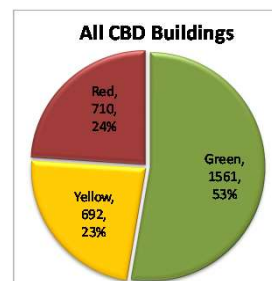
Danno severo e non riparabile



Cerniere plastiche in travi
(fusibili sacrificali)



Risultato: demolizione



1600-1800 Buildings demolished



Nuove opportunita' per edifici multipiano in legno

Quale capacita' residua?
Riparabili? Come?



Potenza 19-09-14

Cuevas and Pampanin





Nuove opportunita' per edifici multipiano in legno



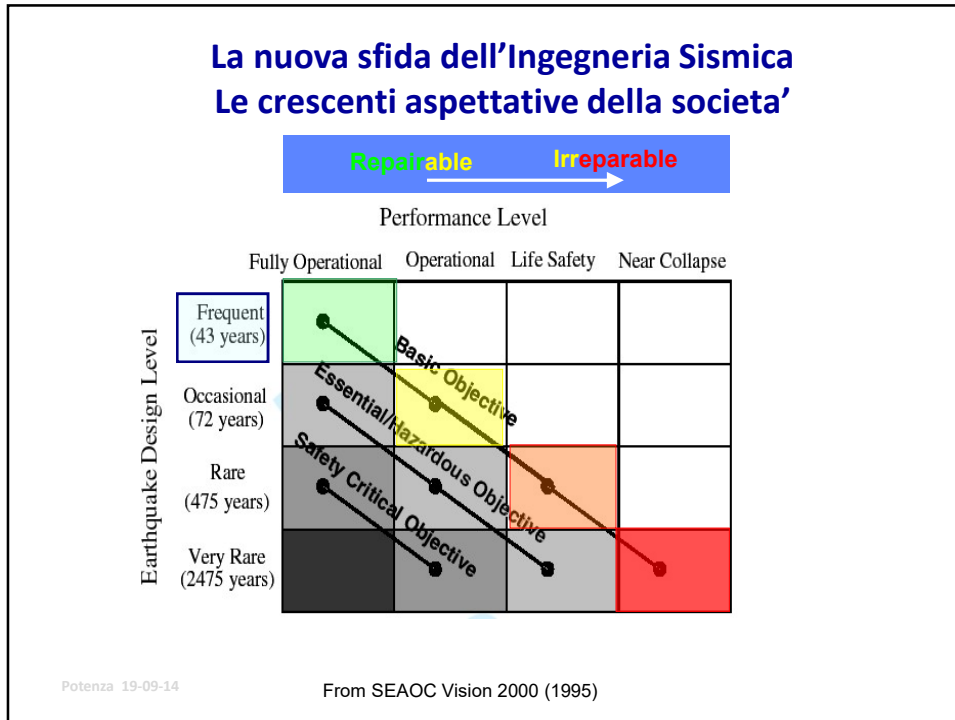


Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno



La sfida/opportunita' per il futuro: Tecnologie a basso-danneggiamento

Isolamento alla base
(Christchurch Women Hospital)

Tecnologie Rocking/Dissipative
(Southern Cross Hospital Endoscopy Building)

Potenza 19-09-14

Nuove opportunita' per edifici multipiano in legno

“Base Isolation” in the ancient past



Temple of
Diana
(Artemis) in
Ephesus

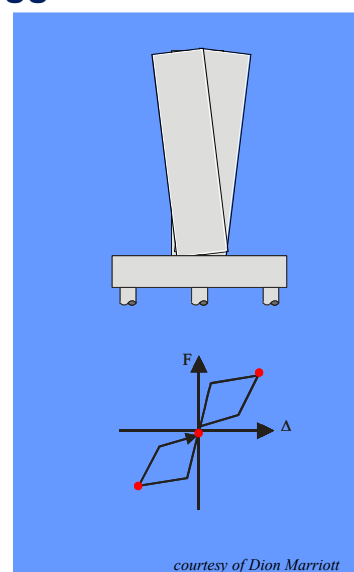
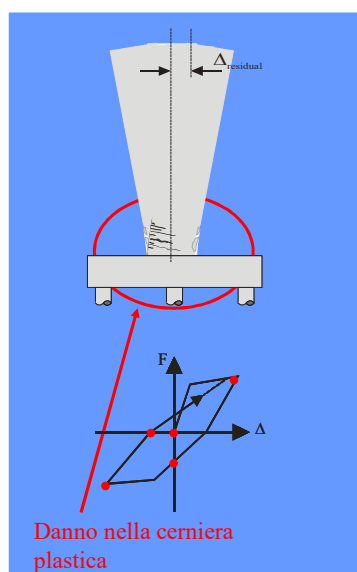
“ It was built on marshy soil, locating charcoal and wool furs under its foundations, to reduce its sensitivity to earthquakes and to avoid locating such a big mass on unsable soil”

by Pliny (in Naturalis Historia)

Potenza 19-09-14

Nuova Generazione di sistemi a basso danneggiamento

A2



Nuove opportunita' per edifici multipiano in legno

Tecnologia PRESSS : Sett con ricentrimento e dissipazione

Unbonded post-tensioned tendons

Energy Dissipation Devices

Potenza 19-09-14

A paradigm shift Una rivoluzione concettuale

a) Column sidesway mechanism (soft storey)

b) Beam sidesway mechanism

□ Estendendo il concetto di gerarchia di resistenze

Brittle Links Ductile Link Brittle Links

□ Duttilita' **NON** necessariamente = danno

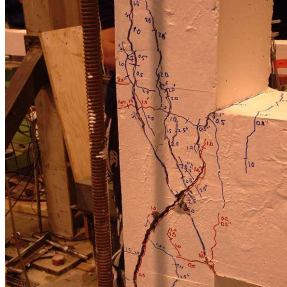
Potenza 19-09-14



Nuove opportunita' per edifici multipiano in legno

Historical Developments in Seismic Design

PAST (pre-1970s codes)



PRESENT (post-1970s codes)



FUTURE (Next Generation of codes: NZ 3101:2006 (Appendix B))

Potenza 19-09-14



One Further Step Ahead

REPAIRABILITY

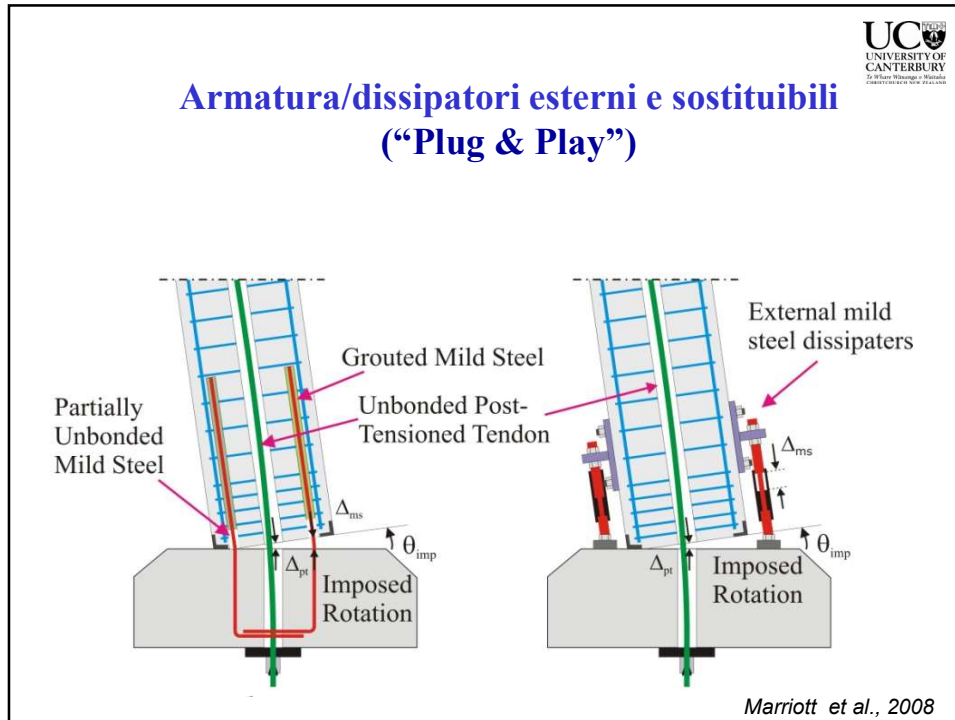
OF THE

***WEAKEST LINK* OF THE CHAIN**

Potenza 19-09-14

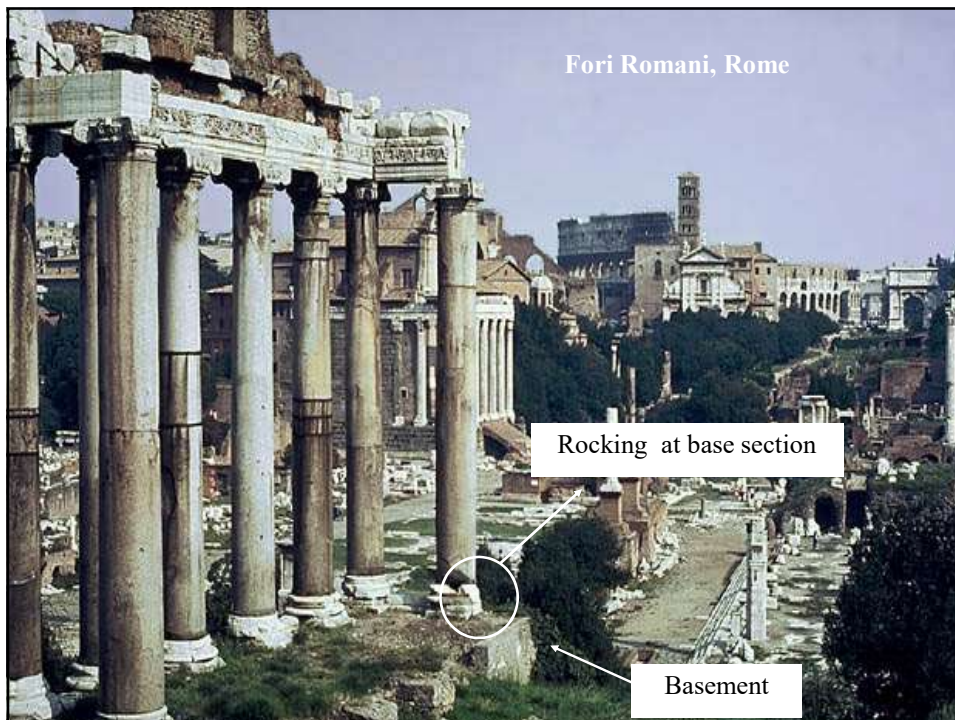
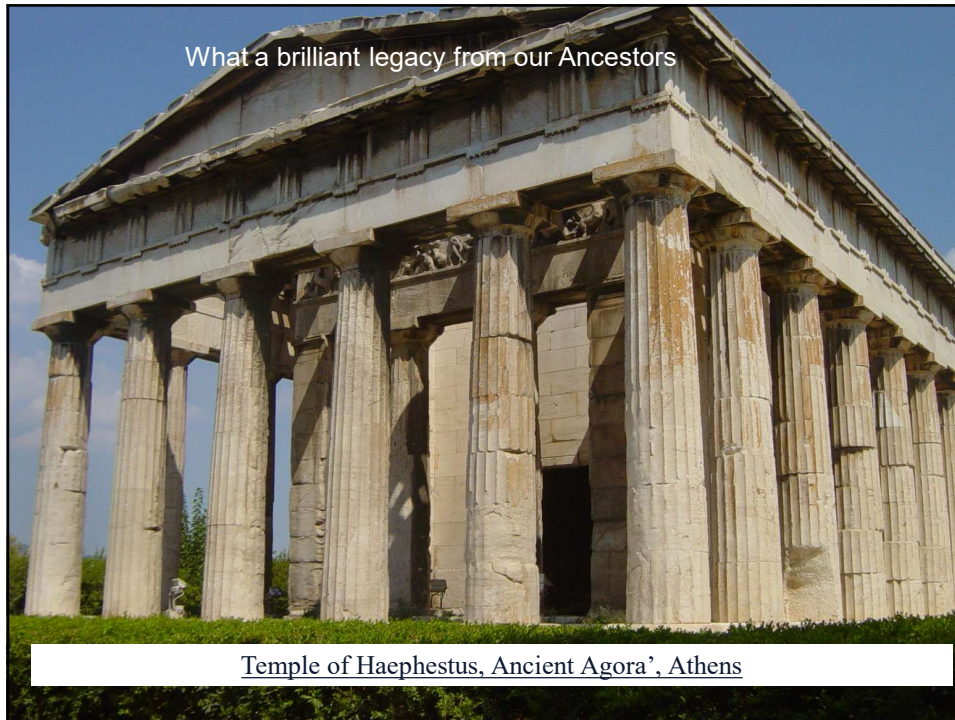


Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno





“Base Isolation” in the ancient past



Temple of
Diana
(Artemis) in
Ephesus

“ It was built on marshy soil, locating charcoal and wool furs under its foundations, to reduce its sensitivity to earthquakes and to avoid locating such a big mass on unsable soil”

by Pliny (in Naturalis Historia)

Potenza 19-09-14

2000+ years later: why not also in Timber?



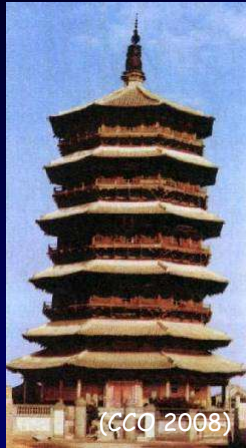
Brooklyn System (BS Italia)

Pampanin, Pagani, Zambelli (NZCS 2004)



Nuove opportunita' per edifici multipiano in legno

Timber in tall buildings... Not a new idea



(CCO 2008)

Sakyamuni pagoda, China
constructed in 1056 and
stands at 67.3m (12 stories)

12th century
Knochenhaueramtshaus, Germany 8
storeys standing 25.7m tall



(Knochenhaueramtshaus.com 2007)

Light timber frame





Plywood Shear walls



Edifici multipiano in legno



Germania
(Legno lamellare)



Svizzera
(Telaio in legno)



Inghilterra
(Xlam)

Potenza 19-09-14



Nuove opportunita' per edifici multipiano in legno

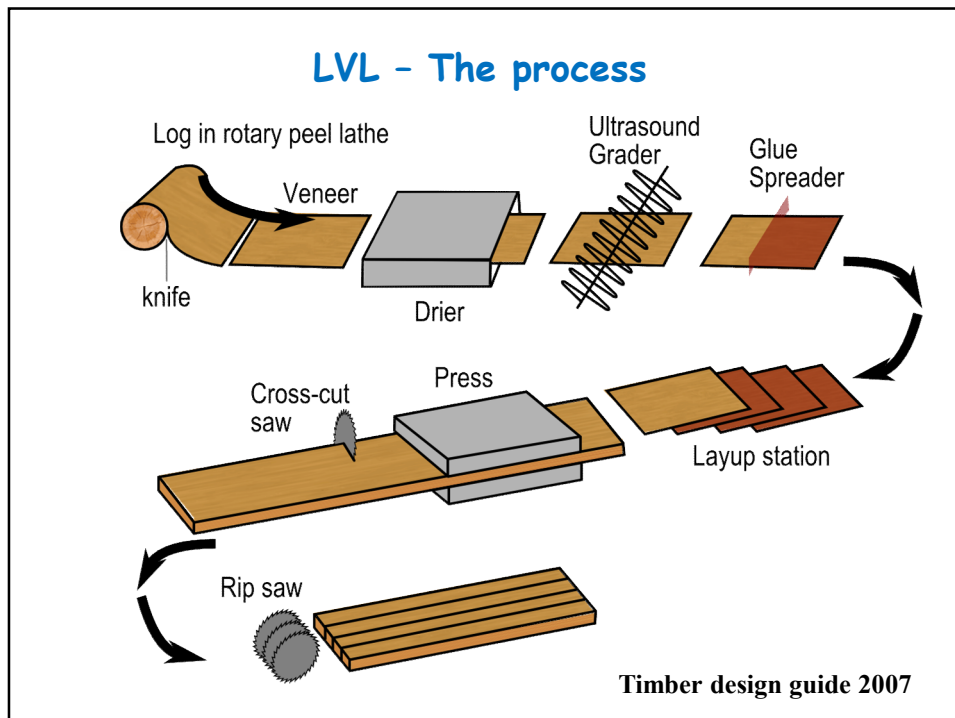
LVL - Laminated Veneer Lumber

LVL changes Radiata Pine from a commodity to a top class engineering material

May use glulam in other countries

Veneers 3mm thick

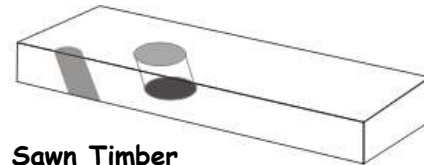
The photograph shows a large industrial facility with high ceilings and bright lighting. In the foreground, there are several tall stacks of light-colored wood panels, likely LVL, arranged on a blue floor with yellow safety markings. In the background, a worker is visible near a forklift, and the structure of the building's roof is visible.



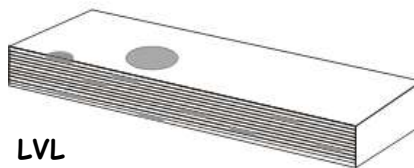


Nuove opportunita' per edifici multipiano in legno

LVL - The result



Sawn Timber

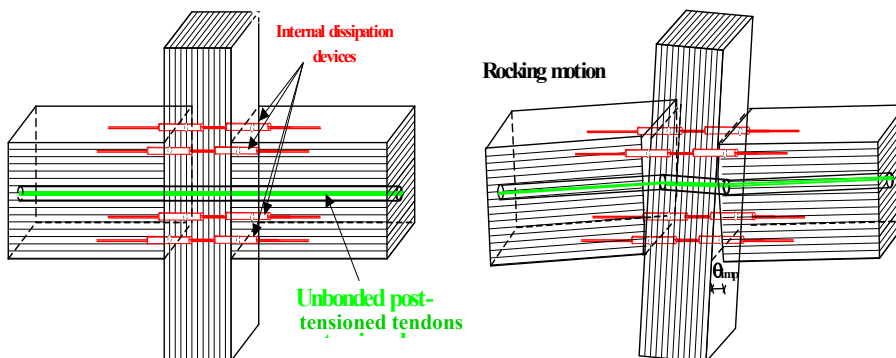


LVL

Any defects in the timber a spread through the member increase reliable strength and stiffness

This gives a strength comparative to that of concrete in compression

La "Rivoluzione"
del/nel Legno Lamellare



from Palermo, Pampanin,
Buchanan, Newcombe, 2005



Engineered Wood Products



Laminated Veneer Lumber LVL



Glued Laminated - GluLam



Cross Laminated - X-Lam

Prestressed Laminated

 PRES-LAM

Nodi trave-colonna in legno post-teso



Riparabile





Demolito

 PRES-LAM

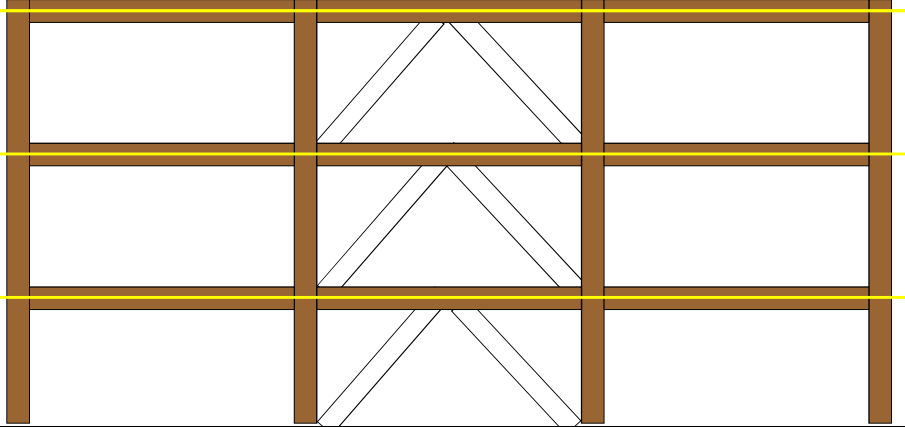


Nuove opportunita' per edifici multipiano in legno

 **P.T.L.**
PRESTRESSED TIMBER LIMITED

 **UC**
UNIVERSITY OF
CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND


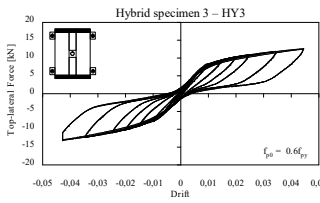
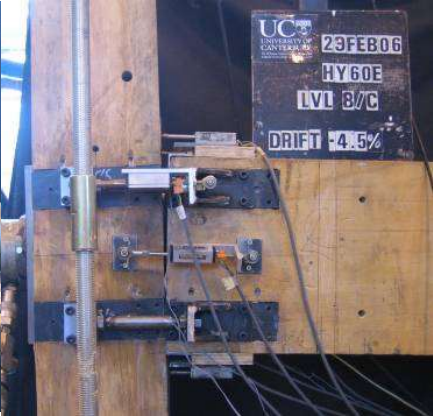
Strutture "low-damage" (legno post-teso)




La post-tensione crea connessioni a momento

Potenza 19-09-14

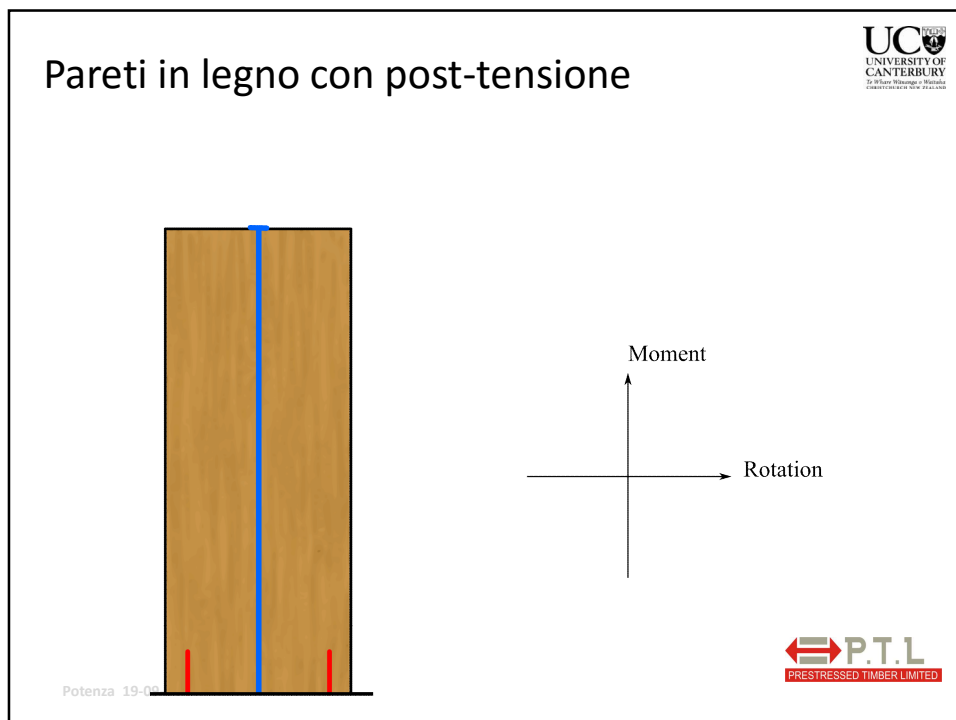
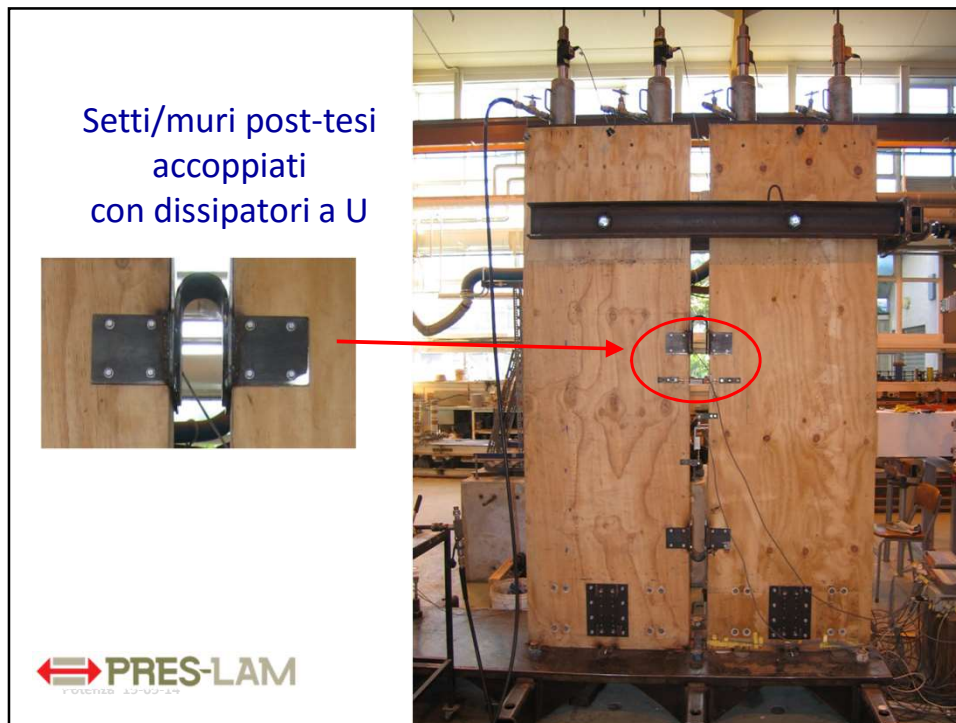
Meccanismo di rocking controllato



 **PRES-LAM**
Potenza 19-09-14

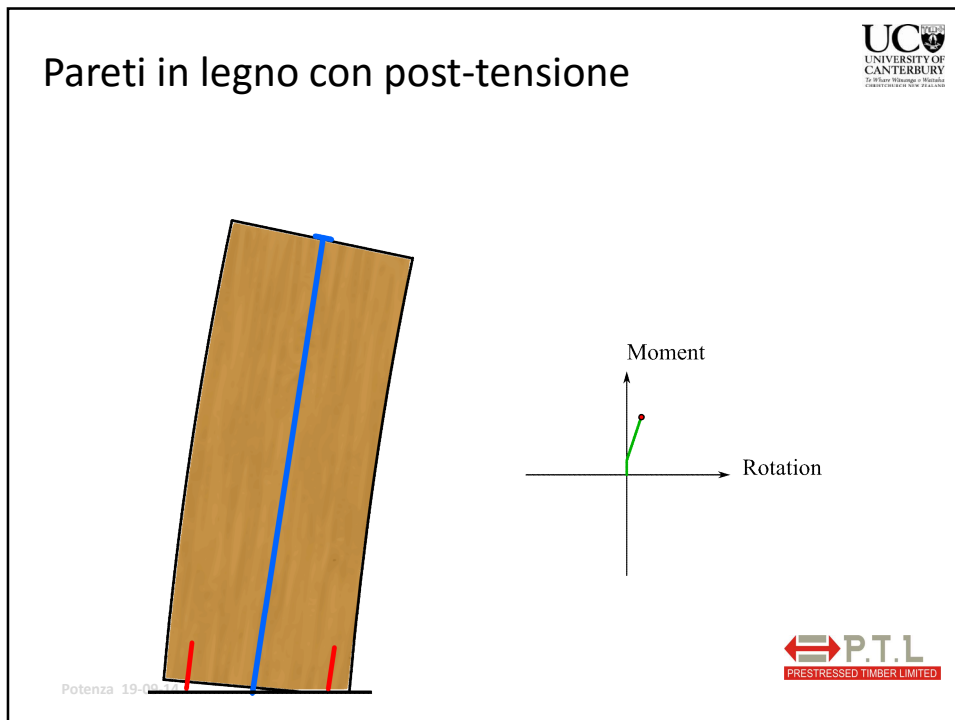
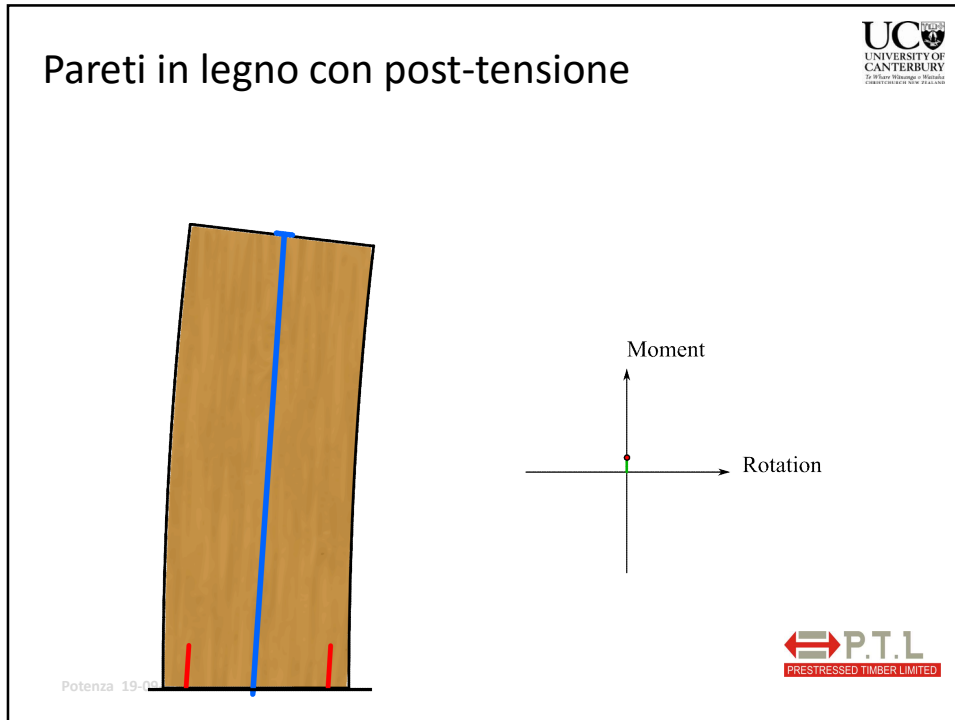


Nuove opportunita' per edifici multipiano in legno



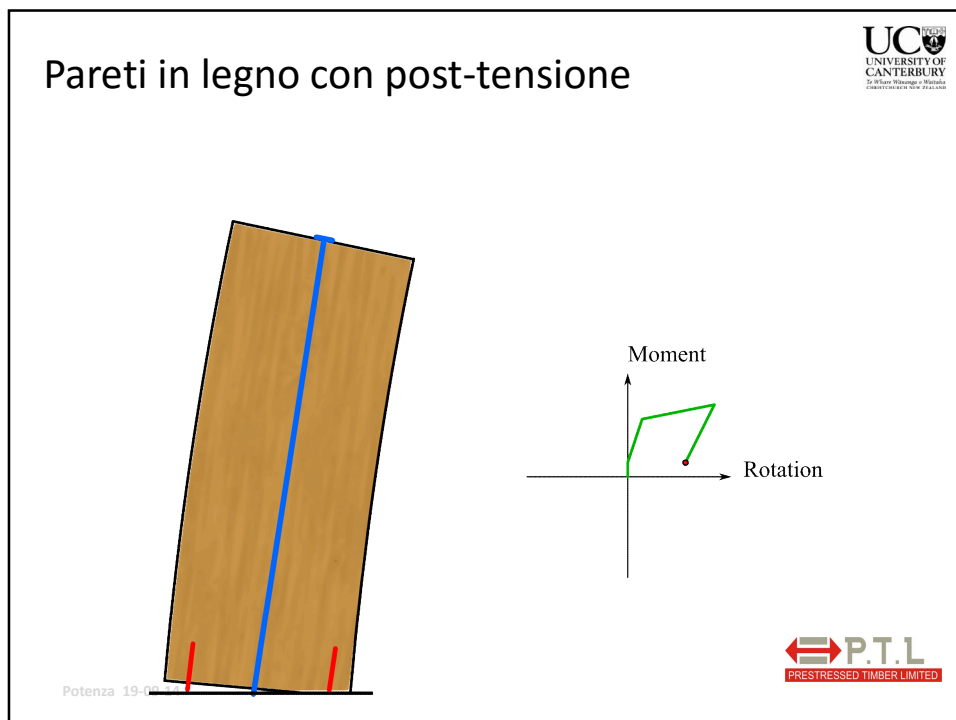
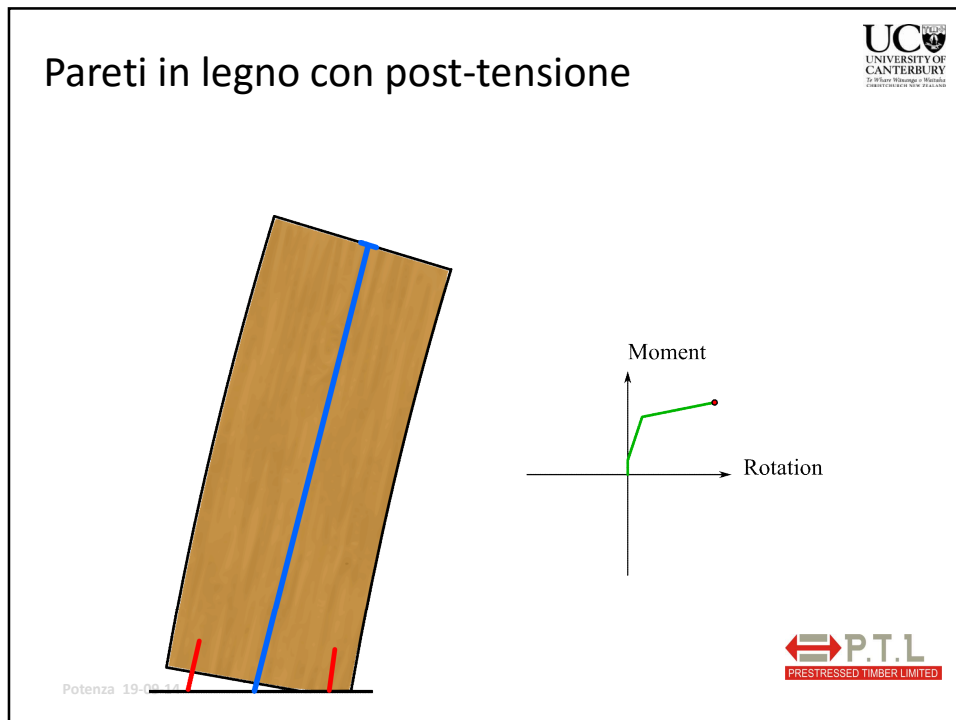


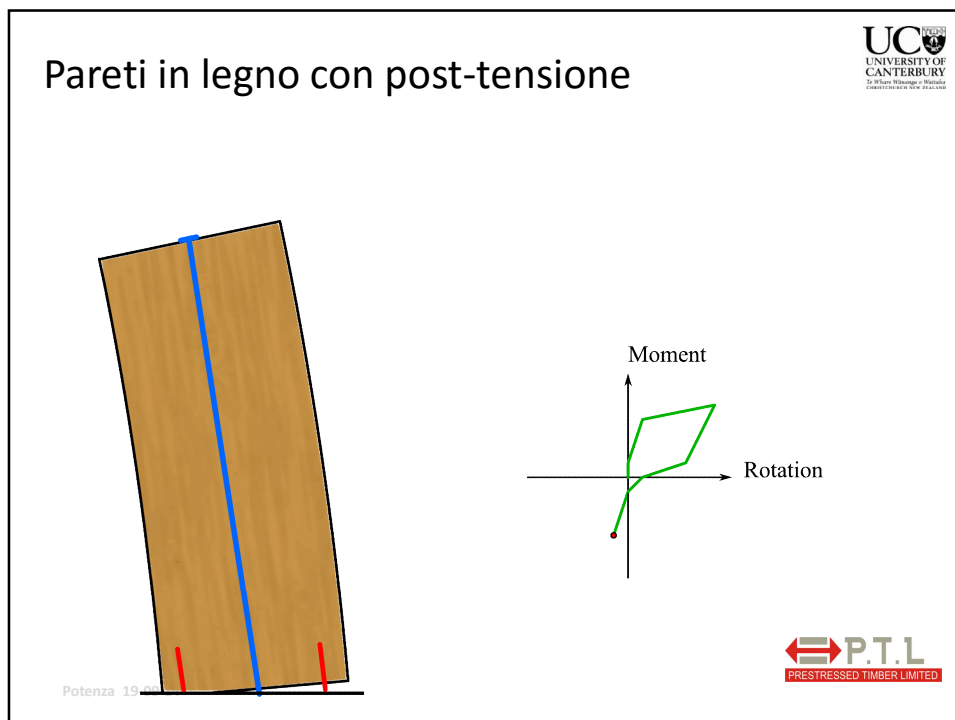
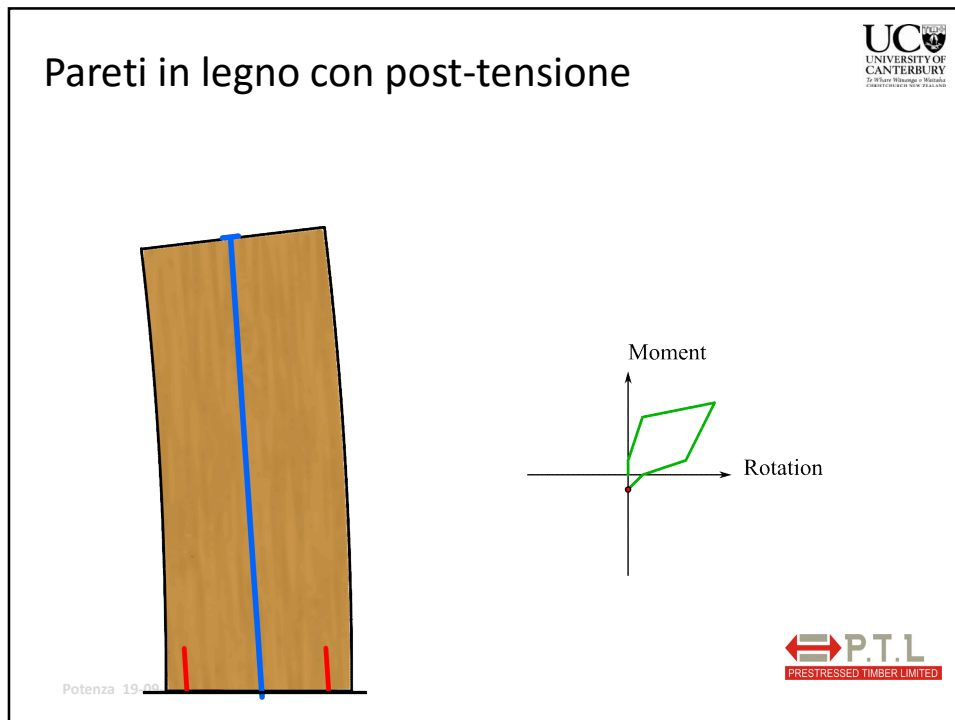
Nuove opportunita' per edifici multipiano in legno

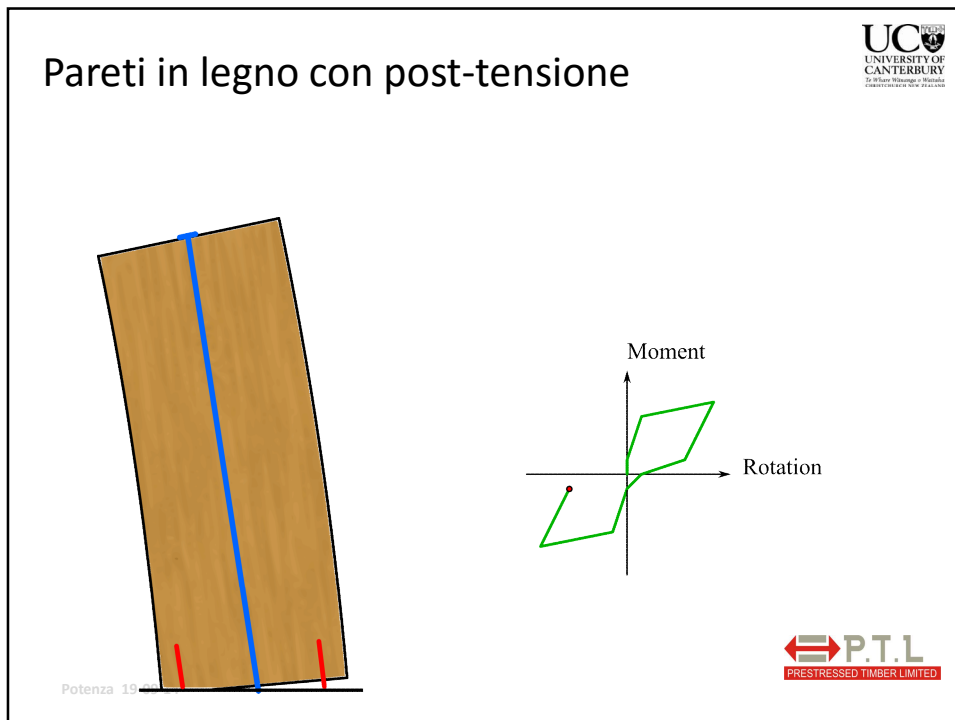
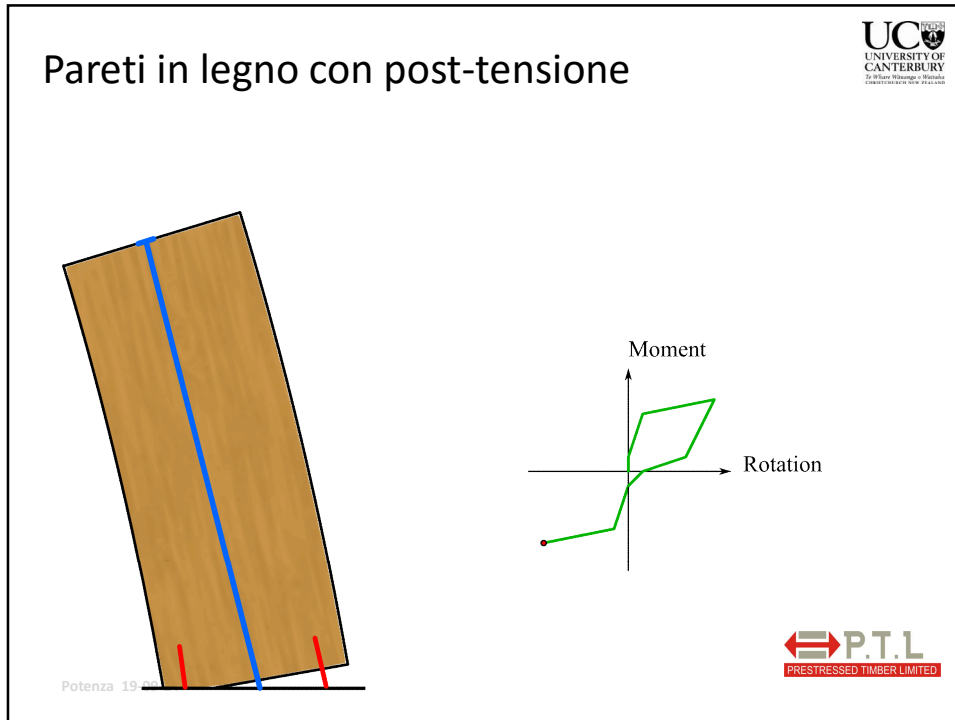




Nuove opportunita' per edifici multipiano in legno









Pareti in legno con post-tensione

The diagram shows a vertical timber wall with a blue line representing a post-tensioning cable running through its center. To the right, a graph plots Moment on the vertical axis and Rotation on the horizontal axis. The graph shows a hysteresis loop, indicating the wall's behavior under cyclic loading. The P.T.L. logo (PRESTRESSED TIMBER LIMITED) is located in the bottom right corner.

University of Canterbury Test-Building
(Pres-Lam technology)

Cavi di post-tensione

A photograph of a large timber test building under construction. Red lines are drawn over the image to show the location of post-tensioning cables: one horizontal line across a beam and two vertical lines in a column. A white arrow points to the cables. The PRES-LAM logo is in the bottom left corner.



Nuove opportunita' per edifici multipiano in legno



Demounted and remounted into a real building

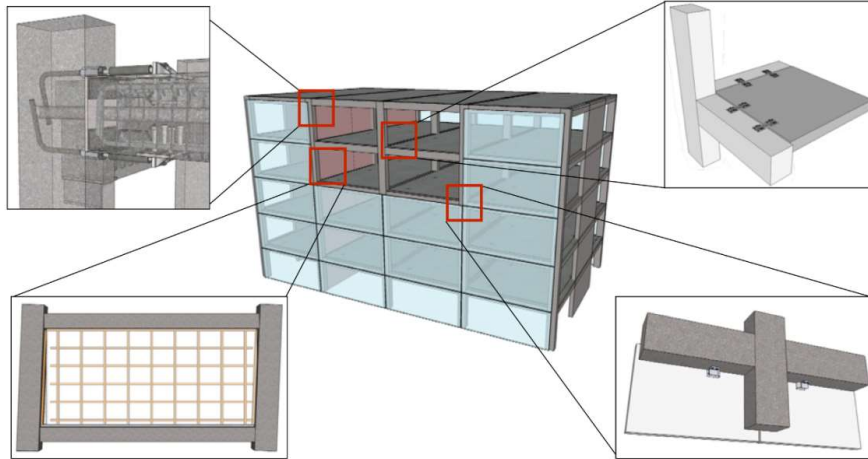


Potenza 19 EXPAN/STIC Office building with Pres-Lam technology



Nuove opportunita' per edifici multipiano in legno

Towards the "Ultimate Earthquake Proof-building"



Next Generation of Integrated Low-Damage Building
Precast (concrete, steel, timber) with dry jointed ductile connections

**Low-damage solutions
for
Non-Structural Elements**

Potenza 19-09-14

Nuove opportunita' per edifici multipiano in legno

Low-damage façades (Baird, Palermo, Pampanin, 2010-2014)

UFP Connections

Potenza 19

Low-damage infills (Tasligedik, Pampanin, Palermo, 2010-2014)

LOW DAMAGE DRYWALL DESIGN RECOMMENDATIONS

Detail A

- Friction Fitted Studs with gap on top: **Studs are free to slide**
- Gypsum Linings are attached only to the vertical studs, but not attached to the (1) outermost stud that is anchored to concrete column
- Side, upper and lower gaps around the edges of the linings
- Gap between the outermost stud and the first internal stud to allow for free sliding (A mid-height pivot can be introduced for centring the drywall after seismic movements)

LOW DAMAGE UNREINFORCED CLAY BRICK INFILL WALL DESIGN RECOMMENDATIONS (Shown on a single skin)

- Infill panel zone to be constructed by **multiple infill panels** with the required design side gap (Δ_{cs}) equally distributed among the clay brick infill panels to achieve rocking cantilever walls: A minimum height to length aspect ratio of 1.5-2.0 is desirable for each sub-panel
- The gaps to be filled with Polyurethane Joint Sealant (Construction AP); Can either be fire rated or non-fire rated. To ease the application polyethylene foam can be used to prevent overflow
- The unreinforced clay bricks to be **infilled inside the area bounded by the light gauge steel sub-framing** (Light gauge steel tracks and studs)

Note:
All weight of the infill panel zone will be carried by the steel framing system. Therefore, the steel framing system should be attached to the surrounding structural system with adequate out-of-plane capacity (Area based unit weight=1.36 kN/m²)

Nuove opportunita' per edifici multipiano in legno

**Low Damage Unreinforced Clay Brick Infill Walls
(Tasligedik and Pampanin 2014)**

Subdivision of Infill Panel Zone to Modify Geometry

Rocking Elements

Rocking Cantilever Infill Panel Walls

- Gulkan and Langenbach 2004
- Langenbach 2008
- Priestley et al. 1990s
- Pampanin et al. 2000s,

Rocking Infill Wall (Low Damage)

- Ductile cantilever wall mechanism
- Moderate-high deformation capacity (Controlled by the amount of gaps)
- Delayed strut action by vertical gaps (low damage)

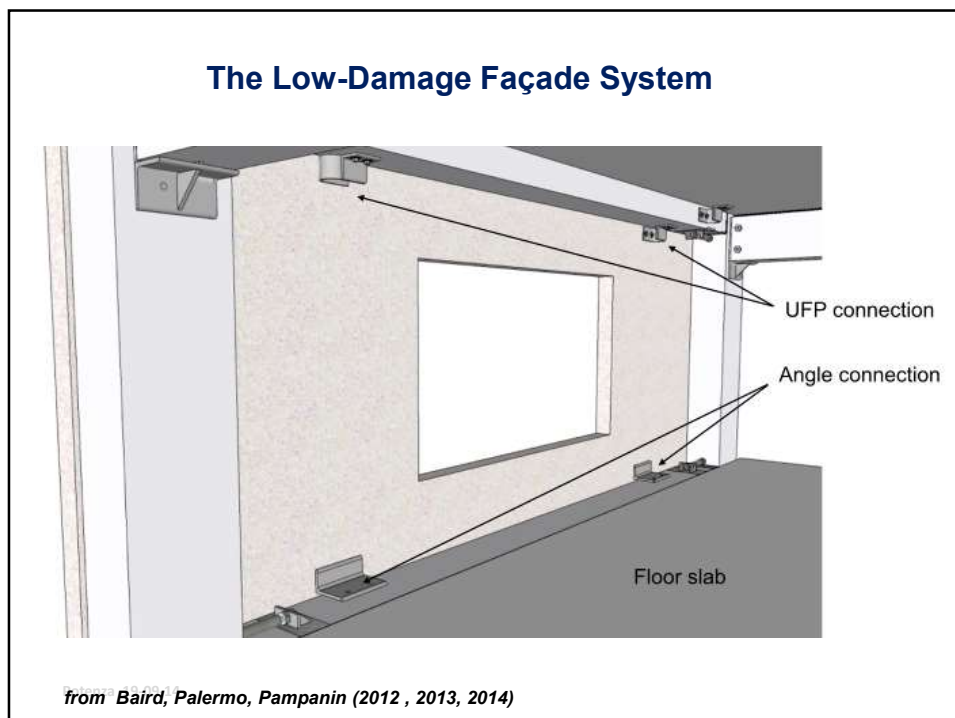
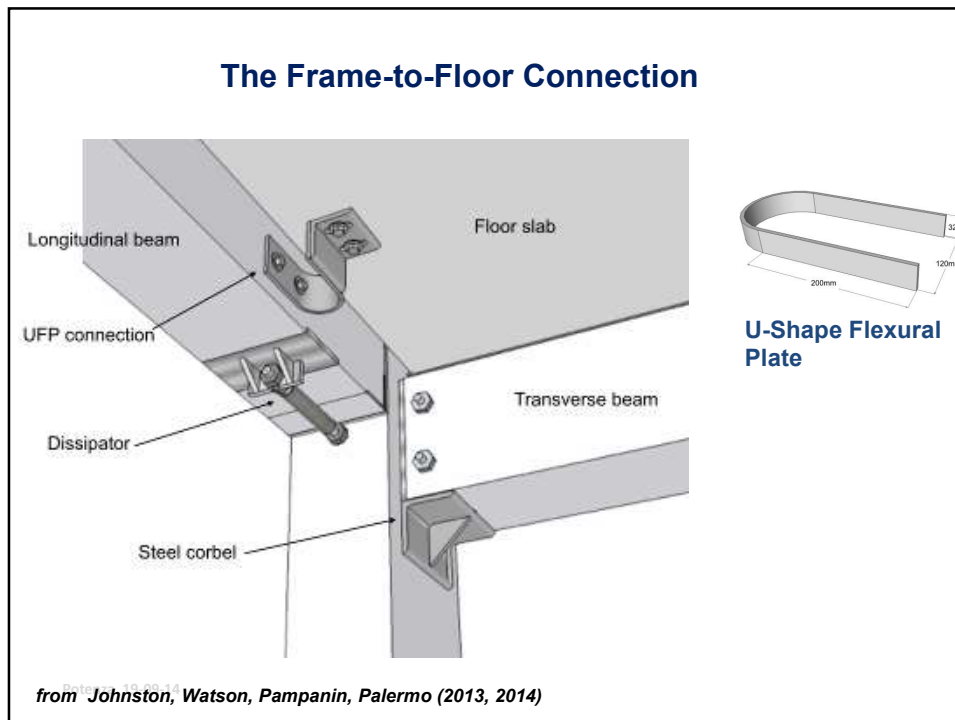
1) Steel channels
2) Steel studs
3) Clay bricks infilled within sub-frame
4) Polyethylene construction sealant

Potenza 19-09-14

**Shake-table testing of an integrated low-damage system
Johnston, Watson, Pampanin, Palermo (2013, 2014)**

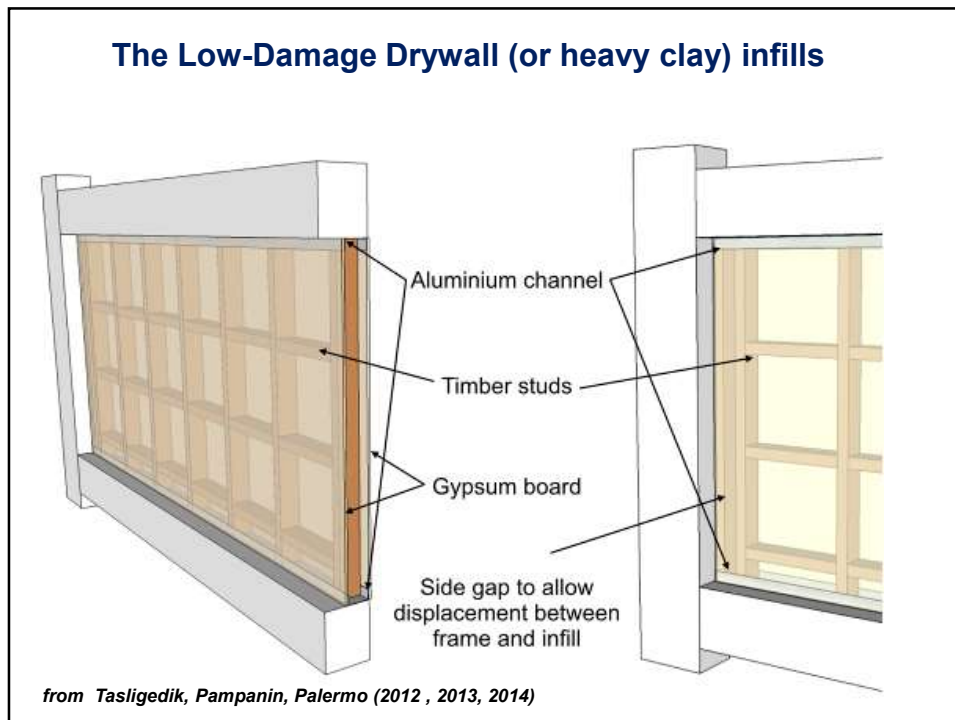


Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno



Applicazioni Pres-Lam

UC
UNIVERSITY OF
CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

c.o. Irving-Smith-Jack

*Parma Project
c.o. Archest*

irving smith jack

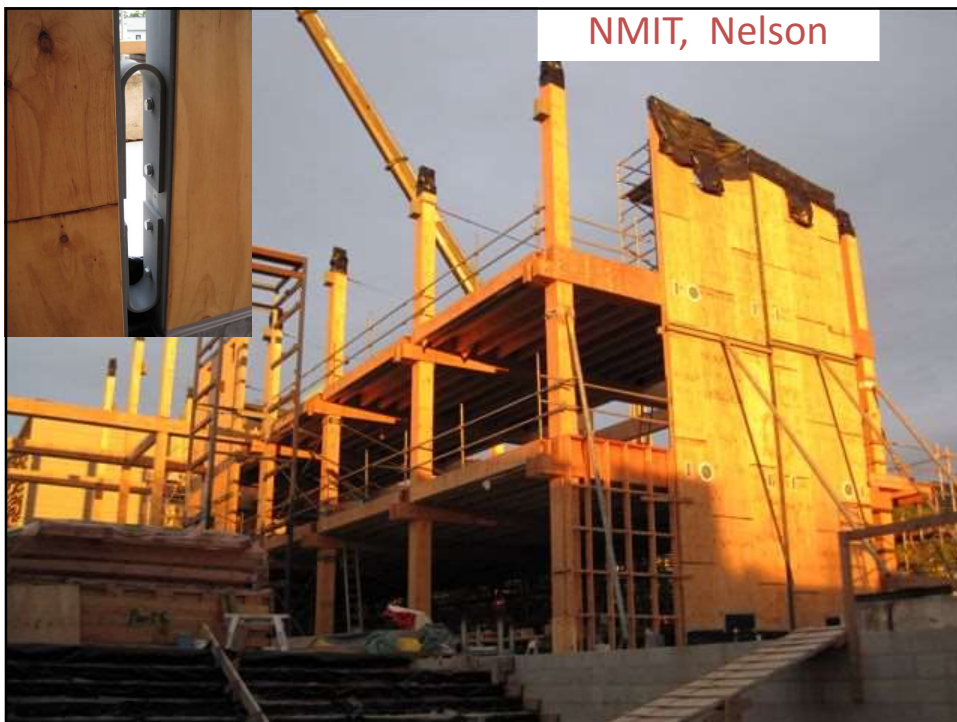
PreStressed Timber Limited – info@prestressedtimberltd.co.nz



Nuove opportunita' per edifici multipiano in legno

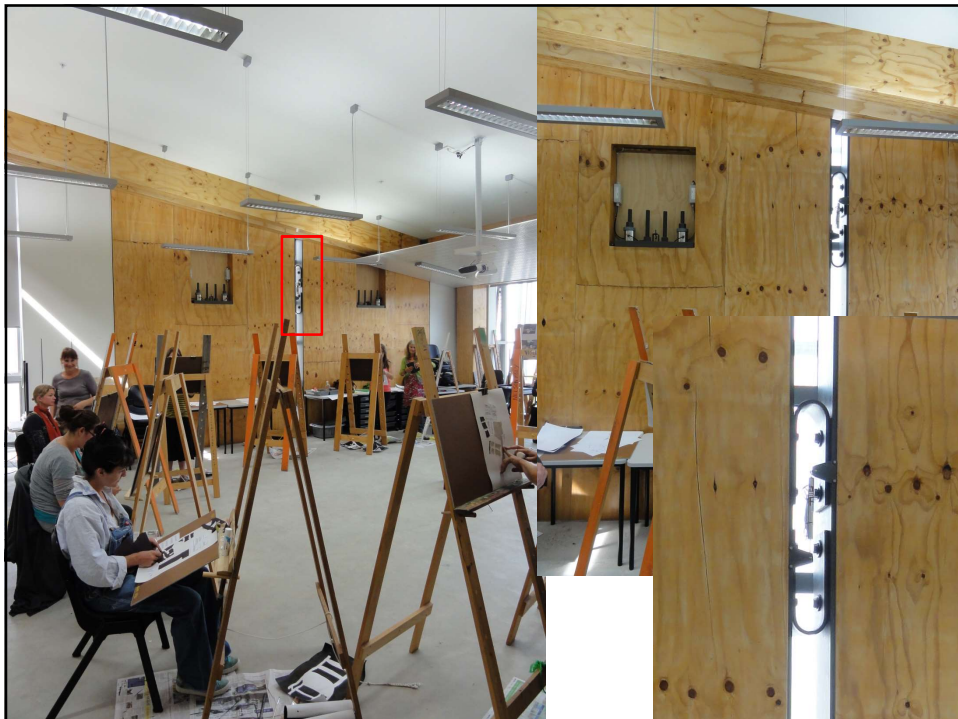
World's First Pres-Lam Building:

Nelson Marborough Institute of Technology (NMIT), Nelson (2008)





Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno





Sicurezza e Sostenibilita'

Nuove opportunita' per edifici multipiano in legno



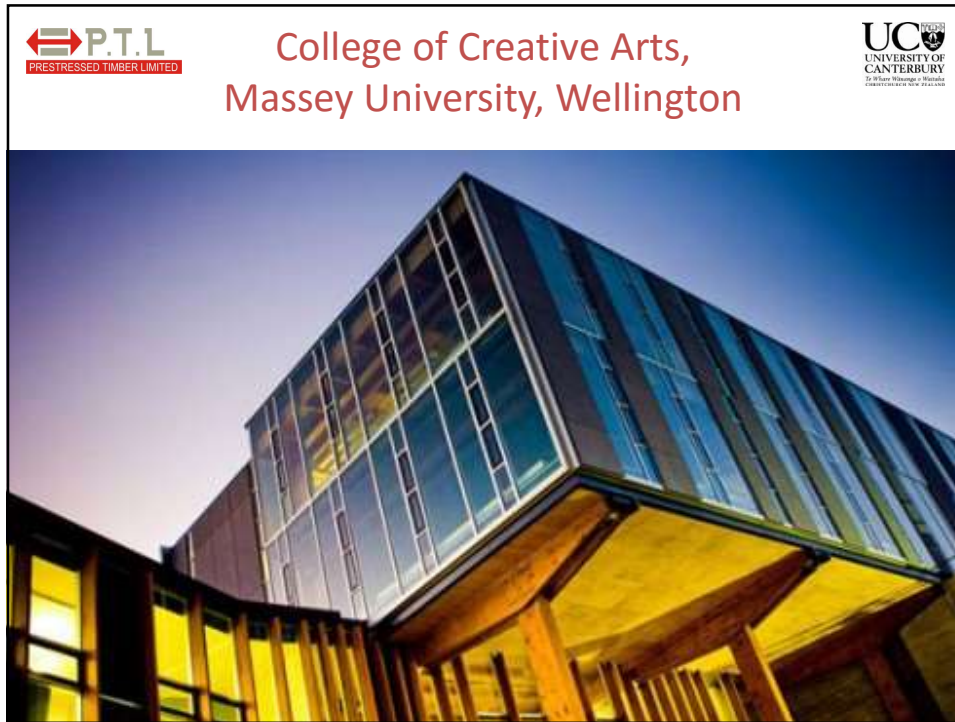
Carterton Event Centre





Sicurezza e Sostenibilita'

Nuove opportunita' per edifici multipiano in legno



Prof. Ing. Stefano Pampanin
La Tecnologia Pres-Lam



Nuove opportunita' per edifici multipiano in legno

Massey University, Wellington



Architect: Athfield Architects
Engineer: Dunning Thornton
QS: Rider Levett Bucknall

Progetti 6
11 - 24
TEA BRNO
2019

Concorsi

MANAGER LAVORO 11

SPAZIO

CONTI

Il sistema Pres-Lam debutta in Europa con il Palazzo dell'Ambiente vinto da Archaz

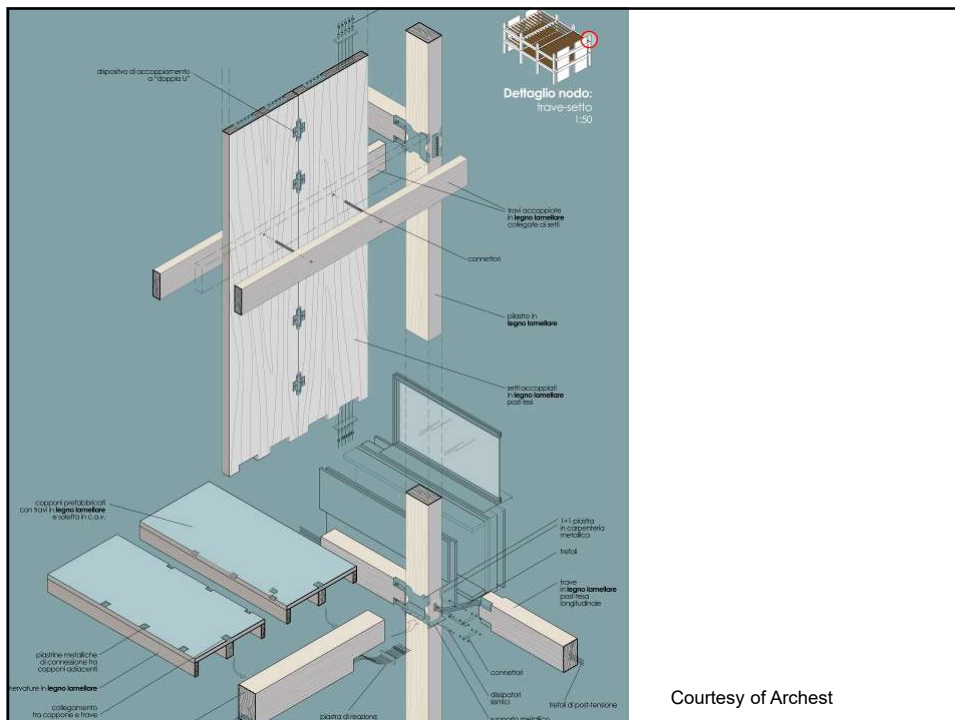
Provincia di Parma, uffici in legno hi-tech

Sarà il centro di Parma quello che per primo adotterà il sistema Pres-Lam per la costruzione di un edificio di uffici hi-tech. Il progetto è stato vinto da Archaz, un consorzio di architetti e ingegneri italiani, che ha presentato un'idea di un edificio a 10 piani, con una struttura in legno lamellare e un design moderno e sostenibile. L'edificio sarà il primo in Europa a utilizzare il sistema Pres-Lam per la costruzione di un edificio di uffici hi-tech. Il progetto è stato vinto da Archaz, un consorzio di architetti e ingegneri italiani, che ha presentato un'idea di un edificio a 10 piani, con una struttura in legno lamellare e un design moderno e sostenibile. L'edificio sarà il primo in Europa a utilizzare il sistema Pres-Lam per la costruzione di un edificio di uffici hi-tech.

First Pres-Lam Building that could have appeared in Europe



Nuove opportunita' per edifici multipiano in legno

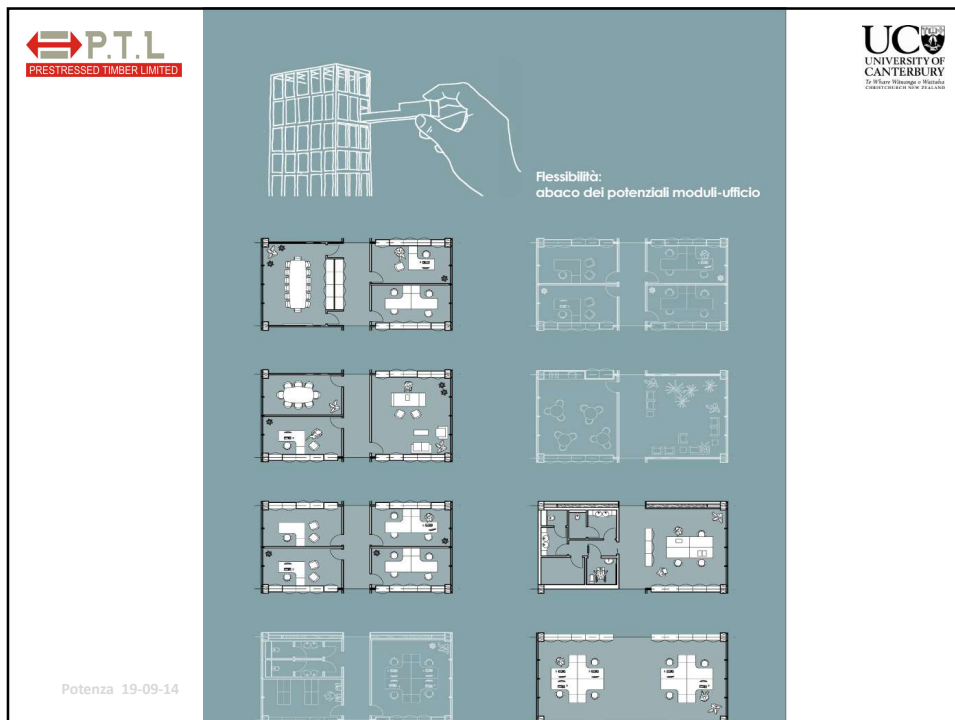
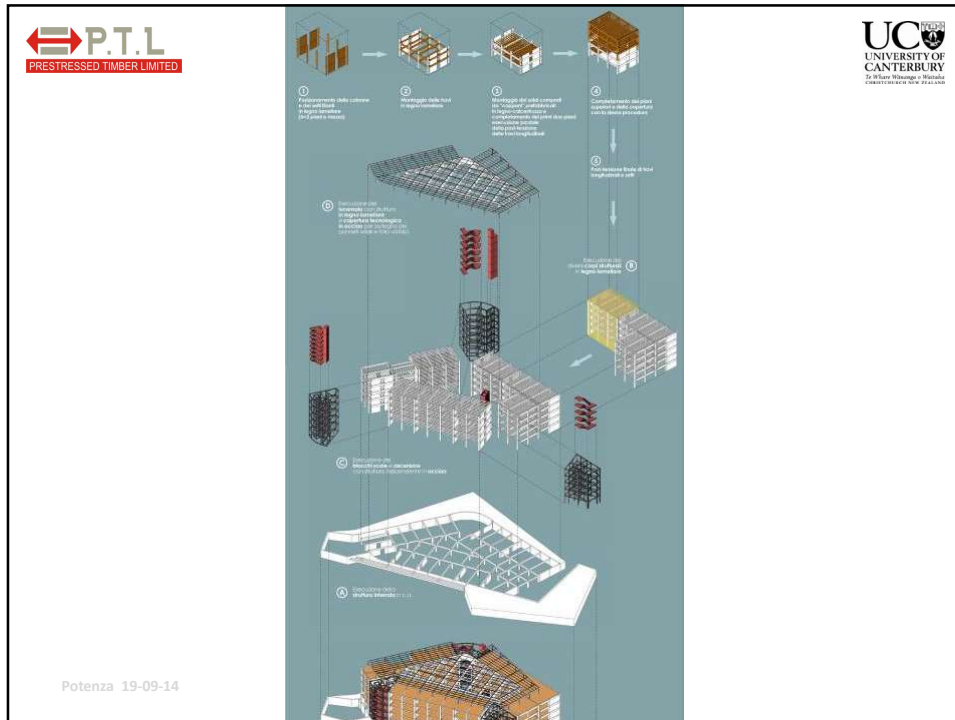


Courtesy of Archest



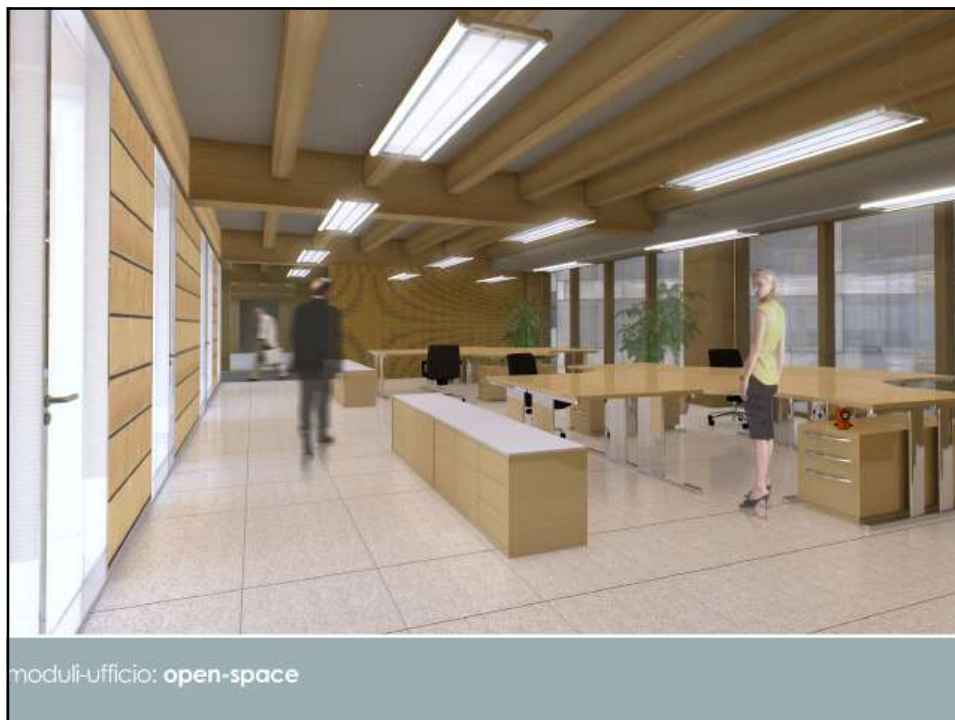
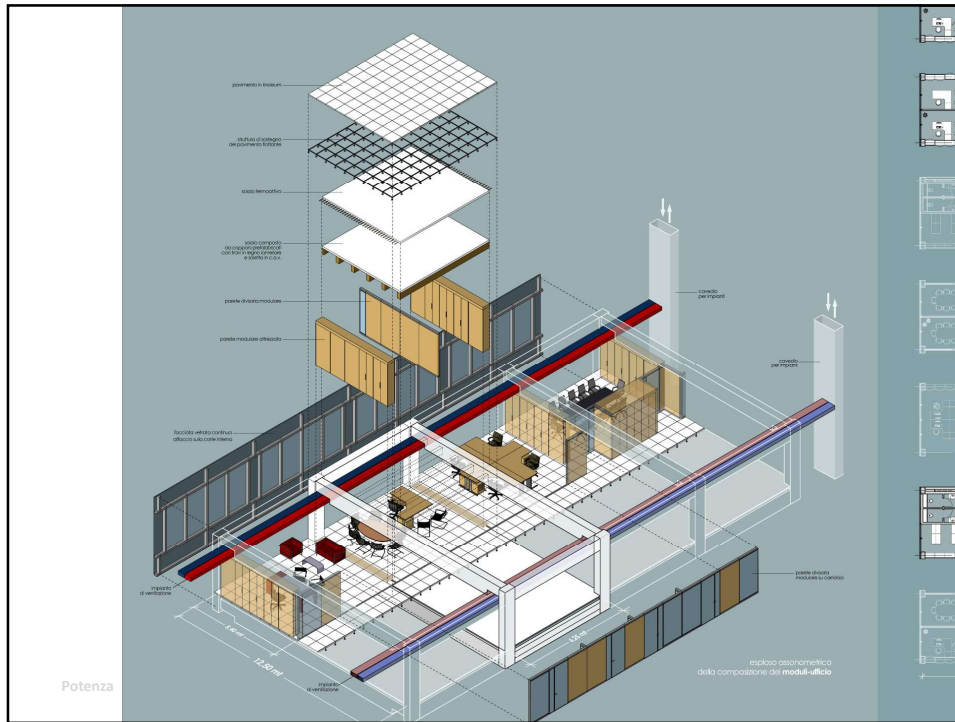
Sicurezza e Sostenibilita'

Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno

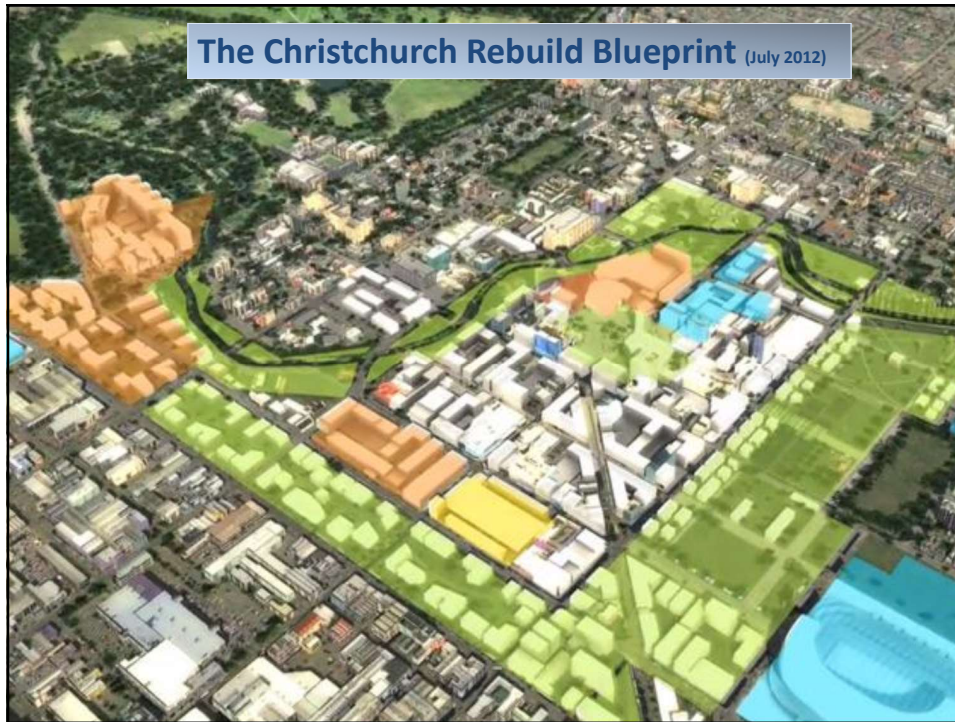


Christchurch Vision 2050: Ricostruire con soluzioni a bass danneggiamento

Potenza 19-09-14



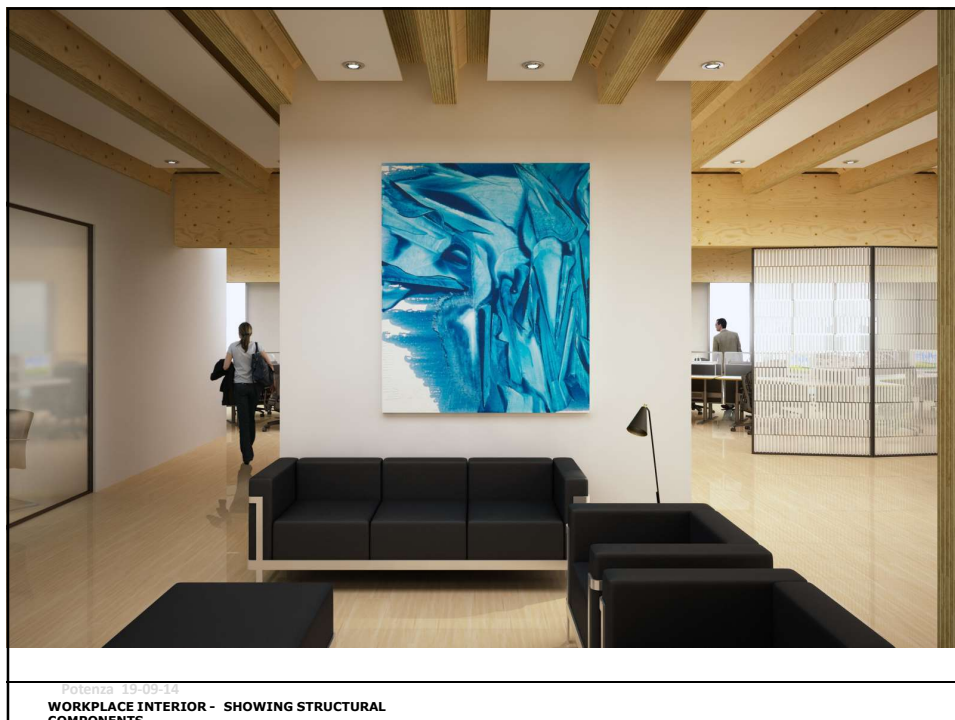
Nuove opportunita' per edifici multipiano in legno





Sicurezza e Sostenibilita'

Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno



Potenza 19-09-14
INTERIOR APARTMENT - SHOWING STRUCTURAL COMPONENTS



Warren & Mahoney
Potenza 19-09-14



Nuove opportunita' per edifici multipiano in legno

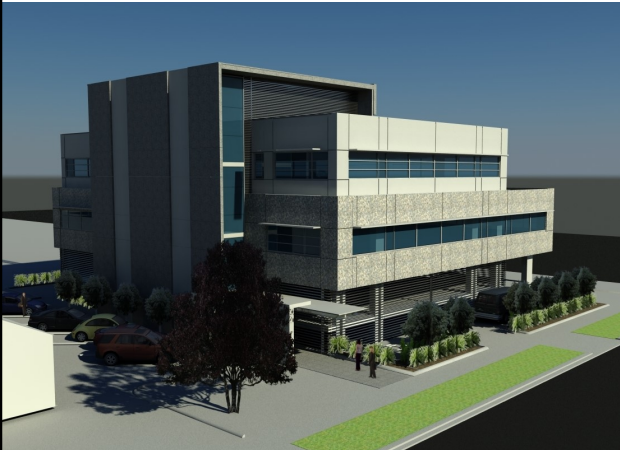




Sistemi anti-sismici innovativi
in cemento armato, legno, acciaio



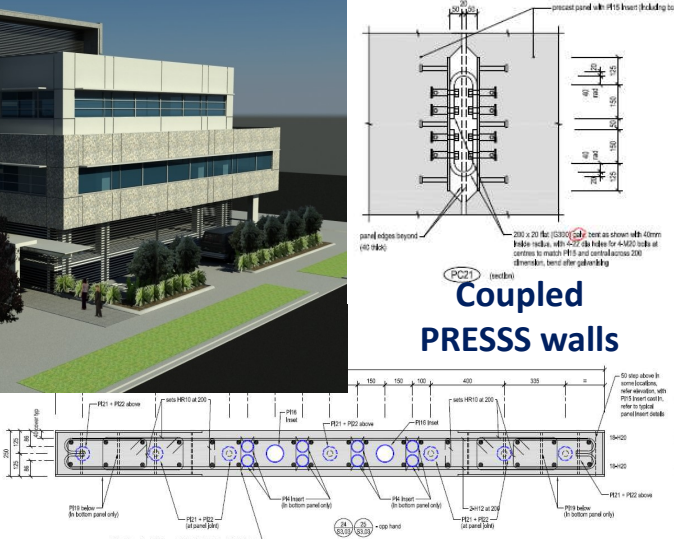


NZ's 2nd PRESSS Building



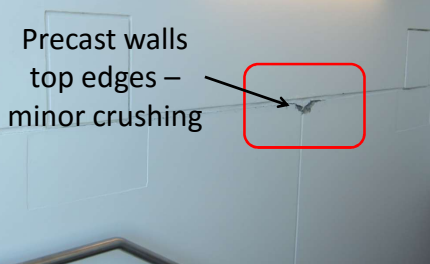
Coupled PRESS walls



Christchurch EQ (22 Feb 2011) performance



Precast walls top edges – minor crushing









Continuous functionality and immediate re-occupancy



Rotorua Police Station

PRESSS Walls with "Plug&Play" dissipaters



spiire



Nuove opportunita' per edifici multipiano in legno

Low-Damage Concrete+Timber

St. Elmo Court (1930, RC frame with infills) damaged & demolished



St Elmo Courts
(Artist impression -Ricky Proko/Ruaumoko Solutions)

The "New" St. Elmo
Base isolation+
PRESSS/Pres-Lam Superstructure



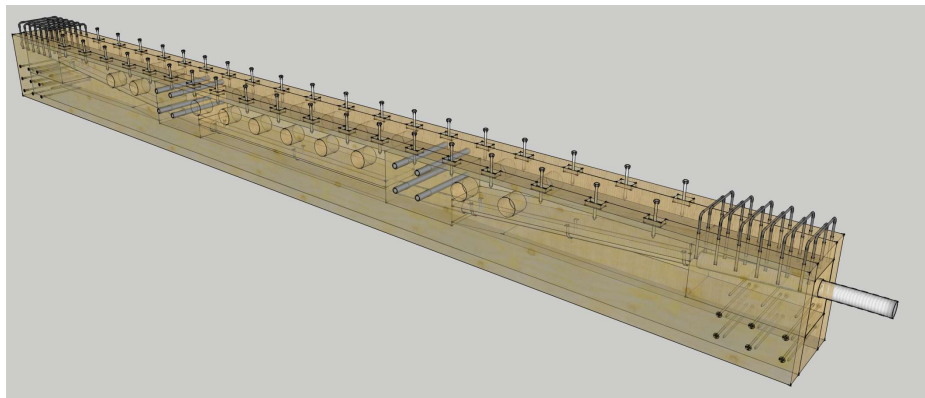
St Elmo Courts
(Artist impression -Ricky Proko/Ruaumoko Solutions)



Nuove opportunita' per edifici multipiano in legno



St Elmo Courts – LVL Beams





Nuove opportunita' per edifici multipiano in legno





Sicurezza e Sostenibilita'

Nuove opportunita' per edifici multipiano in legno



P.T.L.
PRESTRESSED TIMBER LIMITED

Low-Damage Post-tensioned Timber (Pres-Lam)

Merritt Building

SHEPPARD & ROUT ARCHITECTS LTD Structural Engineers: Kirk&Roberts 134 VICTORIA ST DEVELOPMENT VIEW 6



Prof. Ing. Stefano Pampanin
La Tecnologia Pres-Lam



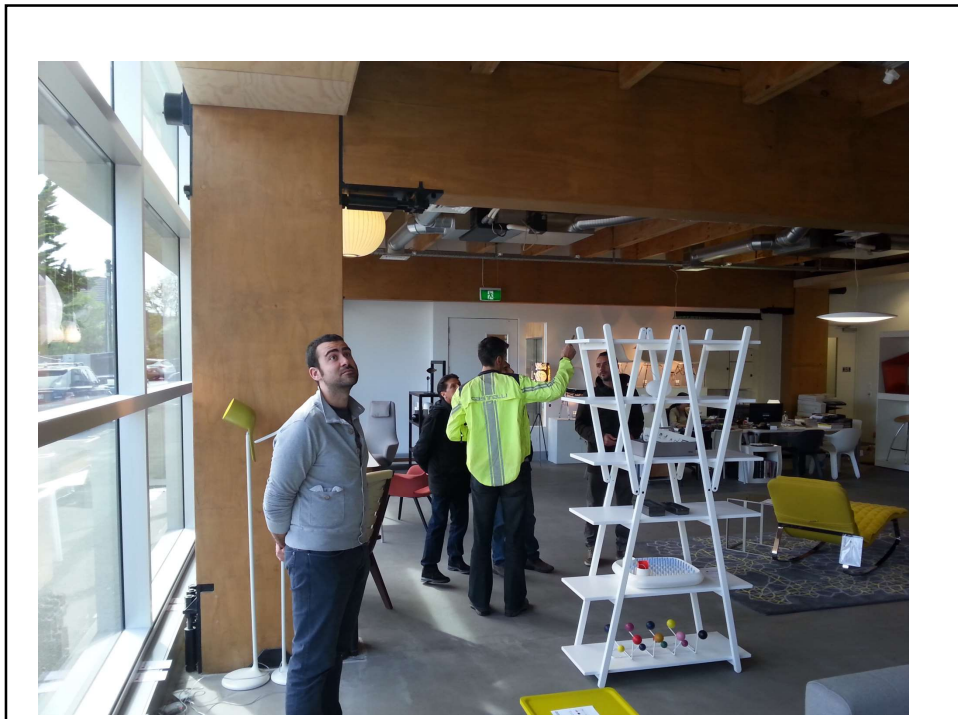
Nuove opportunita' per edifici multipiano in legno





Sicurezza e Sostenibilita'

Nuove opportunita' per edifici multipiano in legno



Prof. Ing. Stefano Pampanin
La Tecnologia Pres-Lam



Sicurezza e Sostenibilita'



Nuove opportunita' per edifici multipiano in legno



Spin-off Company of
University of Canterbury

www.prestressedtimberltd.co.nz
info@prestressedtimberltd.co.nz



Potenza 19-09-14 **Founders & Directors/Principal:**
Prof. Stefano Pampanin, Prof. Andrew Buchanan, Assoc. Prof. Dr. Alessandro Palermo

Prof. Ing. Stefano Pampanin
La Tecnologia Pres-Lam



Nuove opportunita' per edifici multipiano in legno

Low-Damage Post-tensioned Timber
(Pres-Lam) Trimble Building

UC
UNIVERSITY OF
CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

P.T.L.
PRESTRESSED TIMBER LIMITED

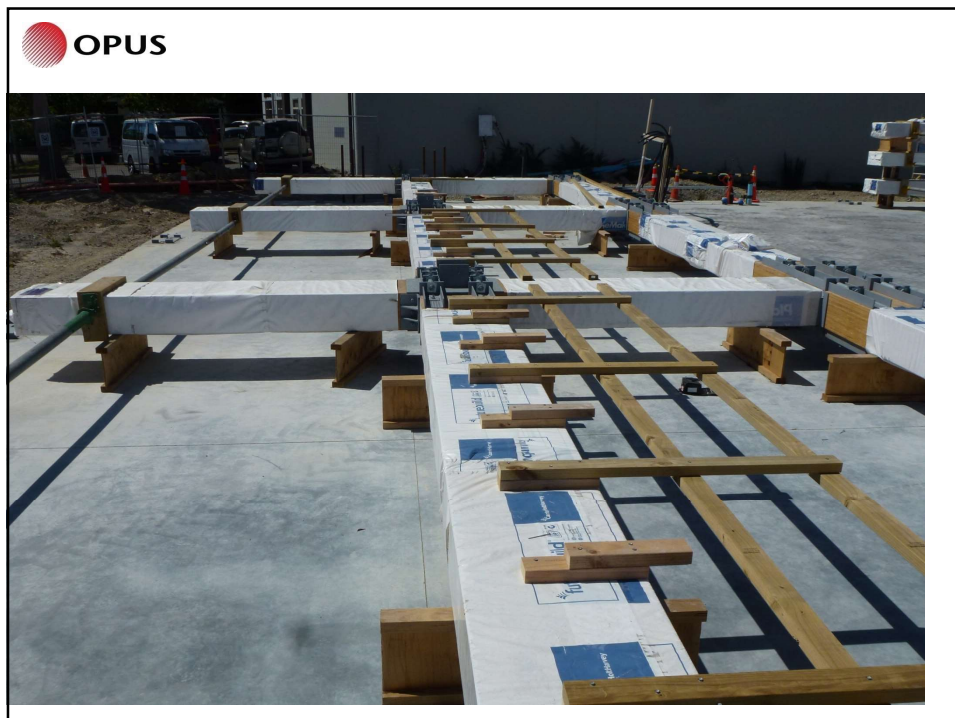
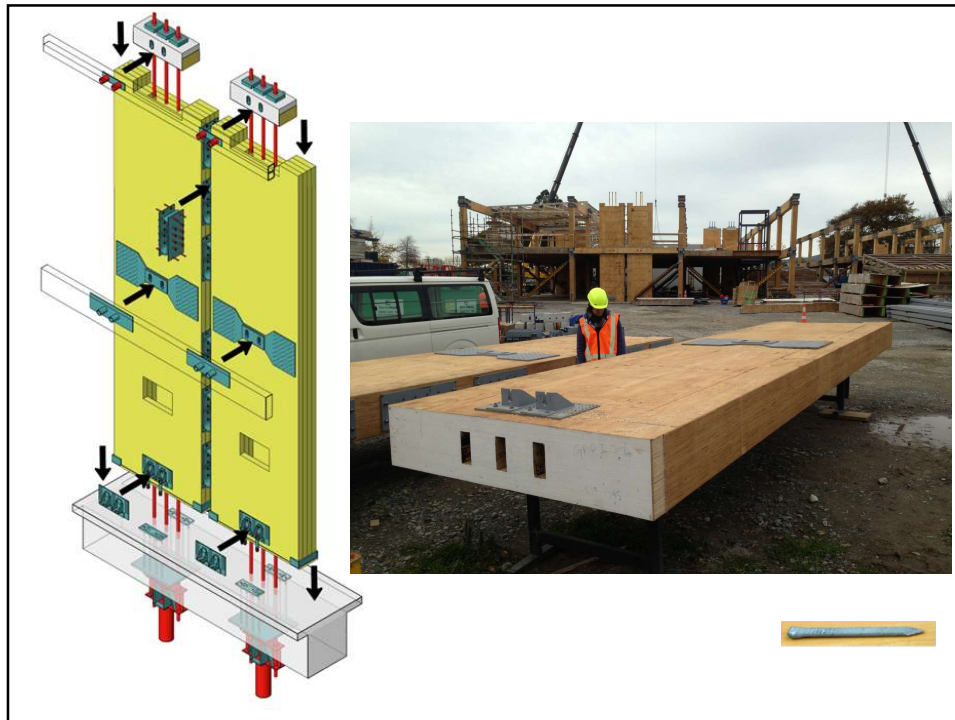
OPUS

potenza 19-09-14
Architecture and Engineering: Opus International





Nuove opportunita' per edifici multipiano in legno





Nuove opportunita' per edifici multipiano in legno

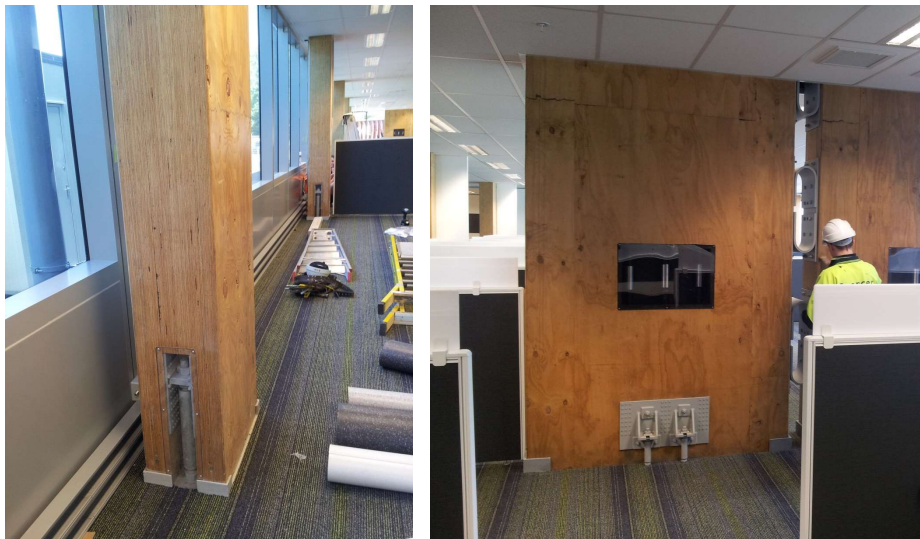




Nuove opportunita' per edifici multipiano in legno



Trimble Building, Christchurch



Potenza 19-09-14



Nuove opportunita' per edifici multipiano in legno

Trimble Building, Christchurch



Potenza 19-09-14





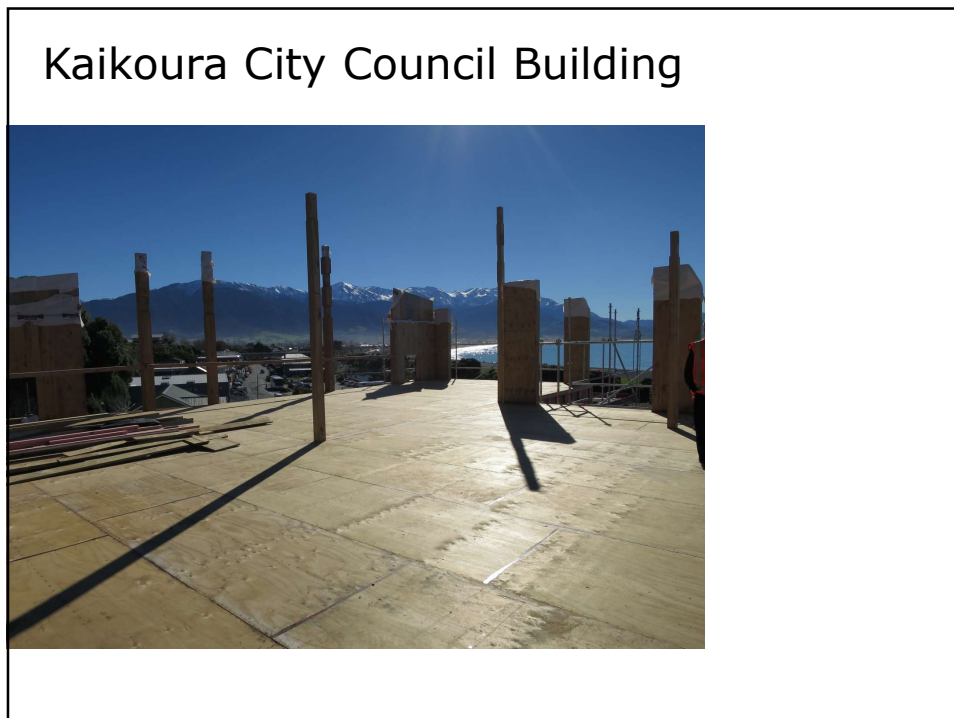
Nuove opportunita' per edifici multipiano in legno



Kaikoura City Council Building



Struttura realizzata interamente con pareti post-tese in legno Xlam





Sicurezza e Sostenibilita'



Nuove opportunita' per edifici multipiano in legno

P.T.L. PRESTRESSED TIMBER LIMITED Cathedral Hill 2 Project, Ottawa (Canada) **UC UNIVERSITY OF CANTERBURY**

Pres-Lam è versatile

1 piano

12 piani

Exterior Rendering (Day)

Douglas Consultants, Quebec City

100% Erzican, Turkey 1992

PGA = 0.769 g

UC UNIVERSITY OF CANTERBURY

PRES-LAM™

Prova su tavola Vibrante

Laboratorio di Universita' di Potenza



Nuove opportunita' per edifici multipiano in legno

