

*Canterbury Earthquakes
Royal Commission*



**New Technologies in
Timber Buildings**

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Earthquake fundamentals

Design philosophy

Minor earthquake

No damage

Moderate
earthquake

Repairable
damage

Big earthquake

No deaths.
Damage is ok

We have to find a better solution

Rebuild for damage resistance

1. Overdesign (expensive)
2. Base isolation
3. Energy dissipation
4. Rocking frames and walls

How do we do this with timber?

Why not wood?

We have done it before



Old Government Buildings, Wellington, 1870

New Technologies in Timber

- Damage to houses and timber buildings
- New wood materials
Plywood, LVL, CLT, piles
- New fasteners
Epoxy, post-tensioning, screws, rivets
- New structural systems
Base isolation, rocking systems
- Examples

Liquefaction damage



Differential settlement



Differential settlement, veneer damage, timber structure OK

Vertical accelerations



Roof
shaken off

Timber
house
structurally
safe

Internal linings

Gib plasterboard

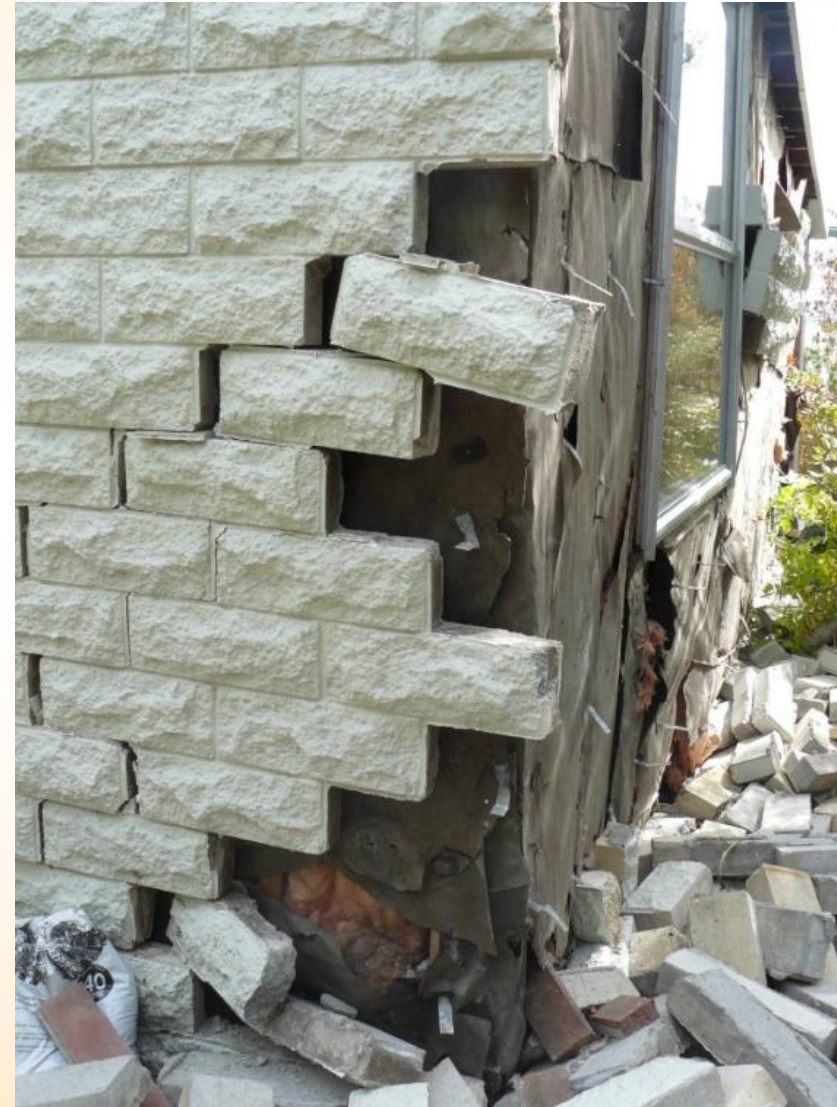
Provided bracing for most houses



Veneer failure



Veneer ties



Wall bracing failures



Old timber building collapse



Before

After



Soft storey collapse



Before



After

Solid wood houses



Good performance despite differential slab movement

Concrete slab floors



Lateral spreading



Differential sinking



No reinforcing

Engineered timber buildings

Most performed
very well



Lateral spreading of portal bases

Engineered timber buildings



Shear cracks
in column

Engineered timber buildings



EXPAN building, UC campus
No structural damage. Immediate occupancy.

New Technologies in Timber

- Damage to houses and timber buildings
- New wood materials
LVL, CLT, foundation piles
- New fasteners
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- New structural systems
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- Examples

LVL - Laminated veneer lumber



Veneers 3mm thick



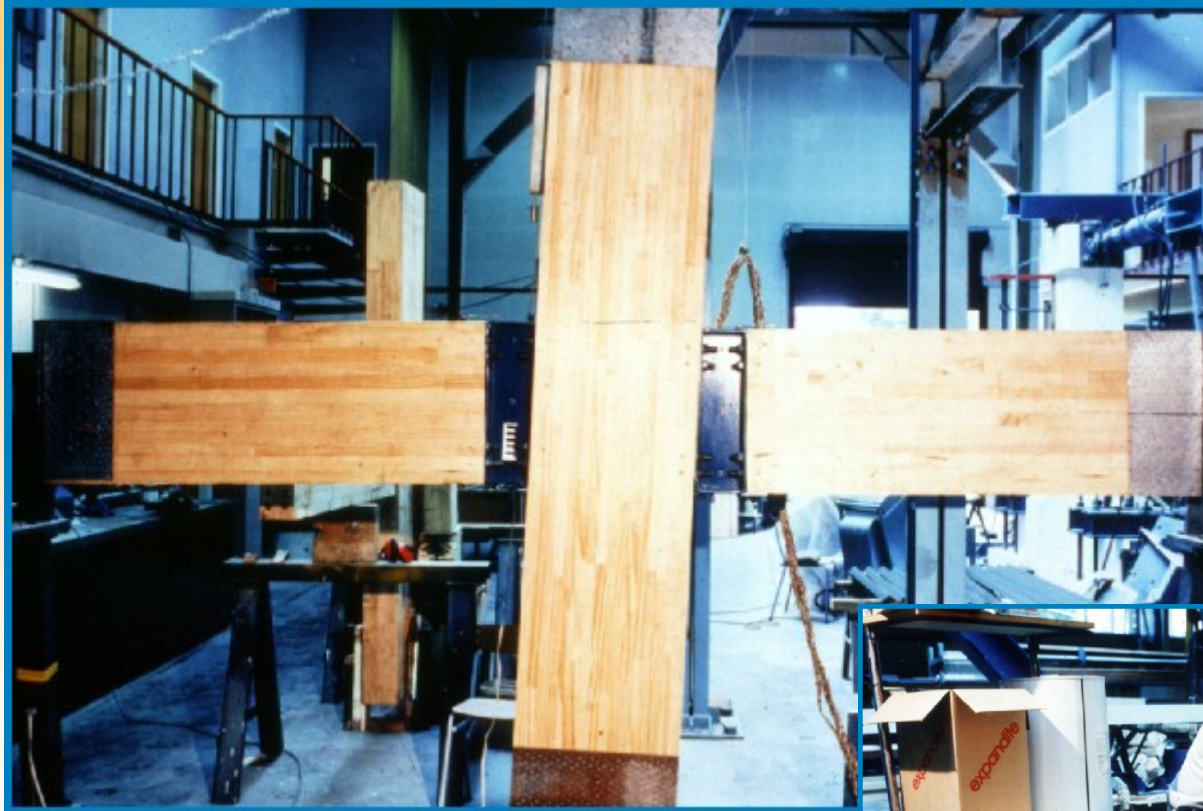
CLT - Cross laminated timber



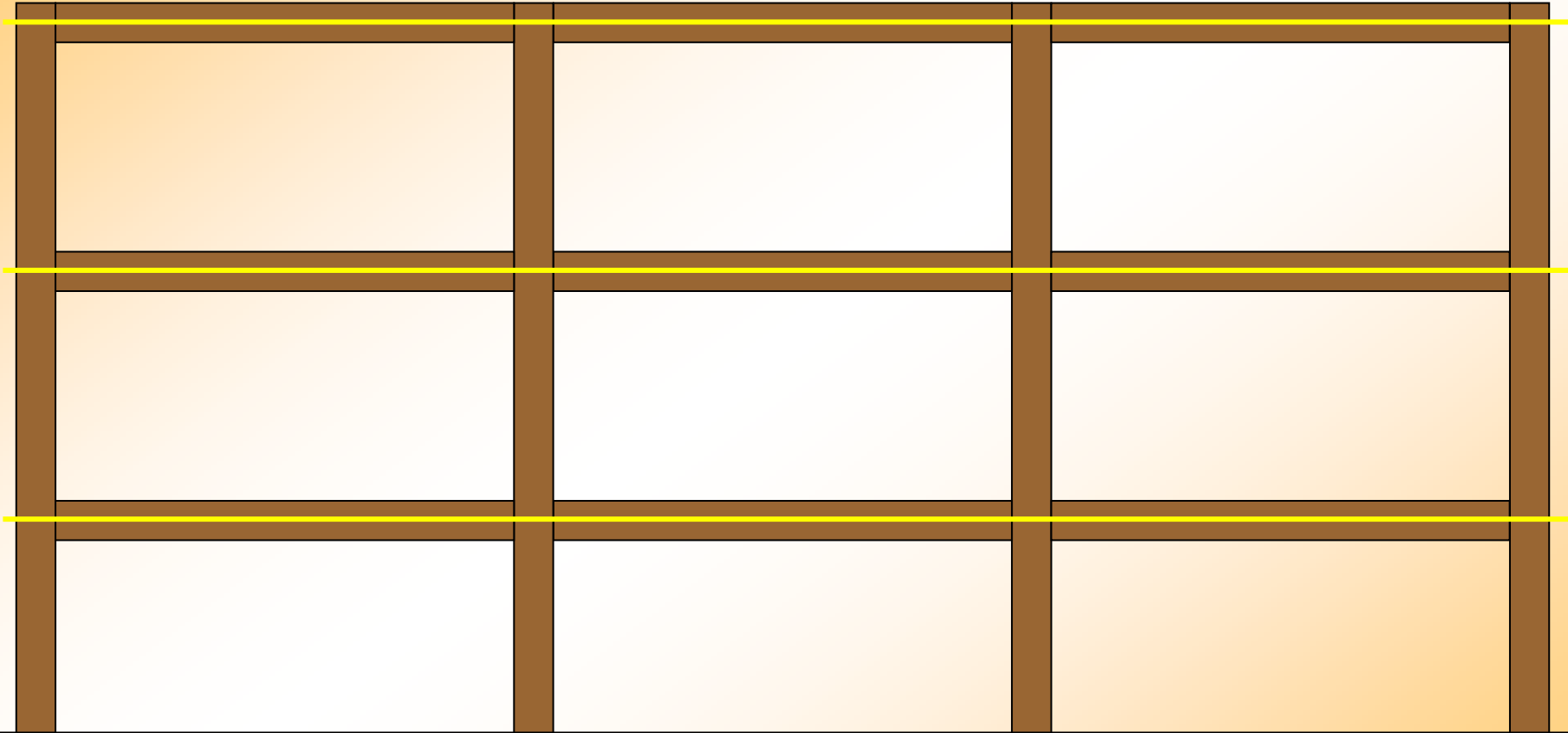
New Technologies in Timber

- Damage to houses and timber buildings
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Epoxied steel rods

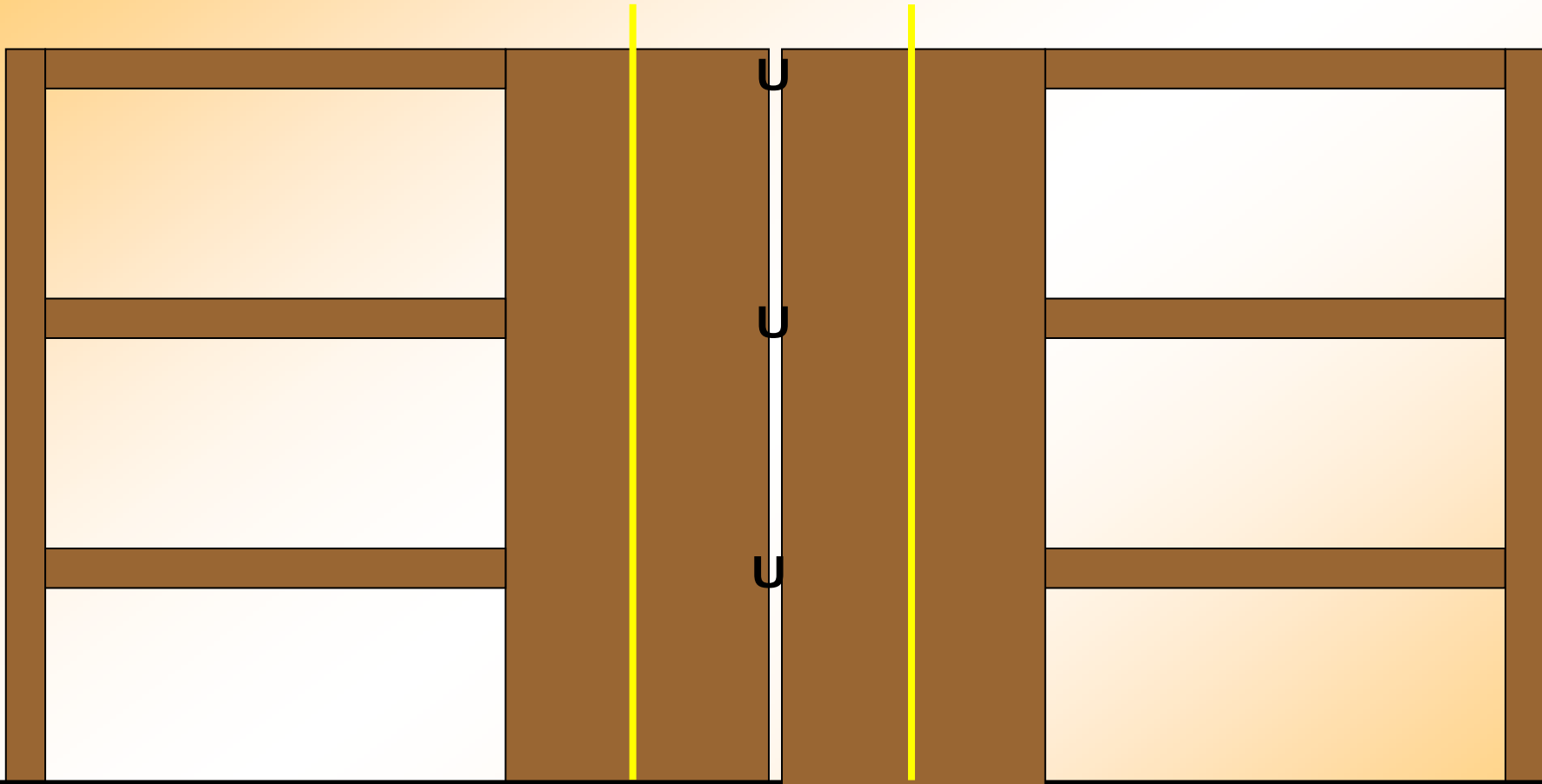


Post-tensioned timber frames



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

Post-tensioned timber walls



New Technologies in Timber

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- **New structural systems**
Base isolation, rocking systems
- Examples

Base isolation

L'Aquila, Italy. 2009



Base isolation

L'Aquila, Italy. 2009

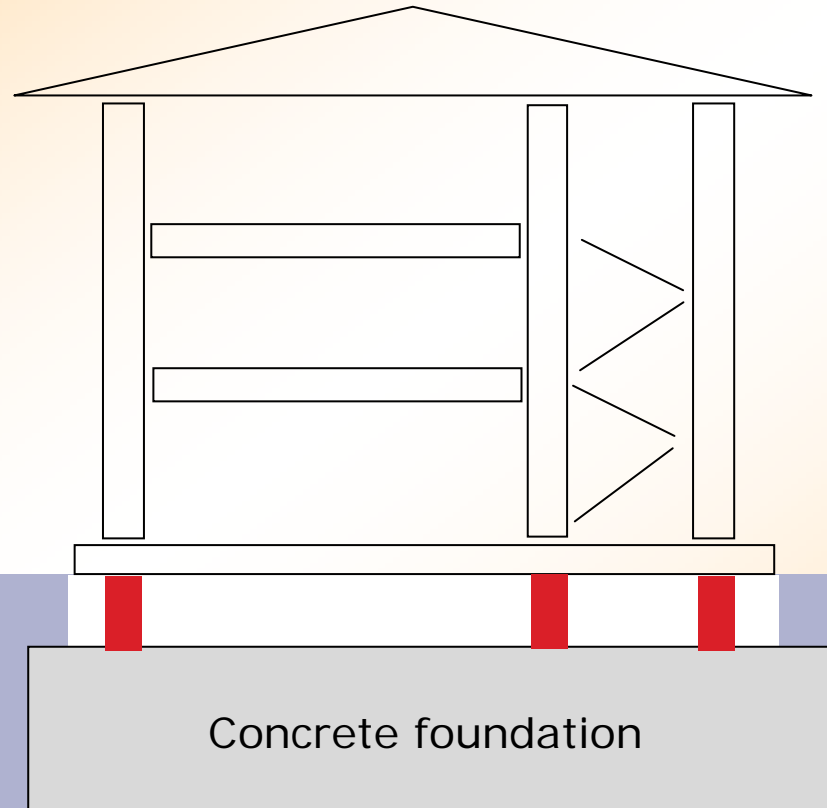


Re-levelable buildings

Light
building

Adjustment

Strong
foundation

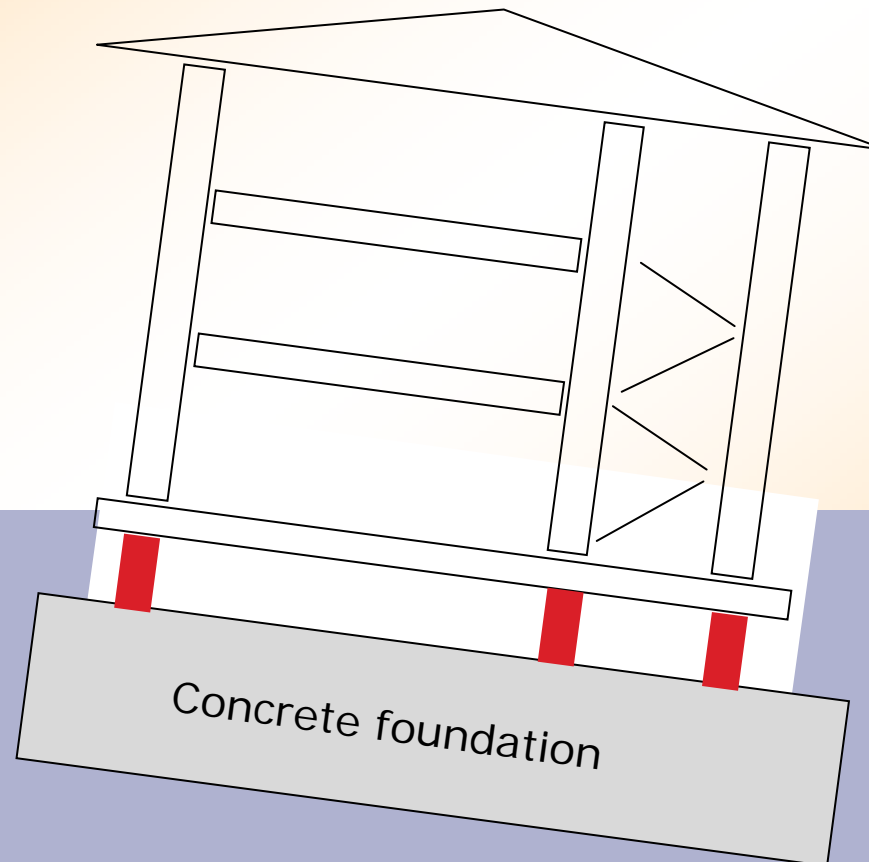


Re-levelable buildings

Light
building

Adjustment

Strong
foundation

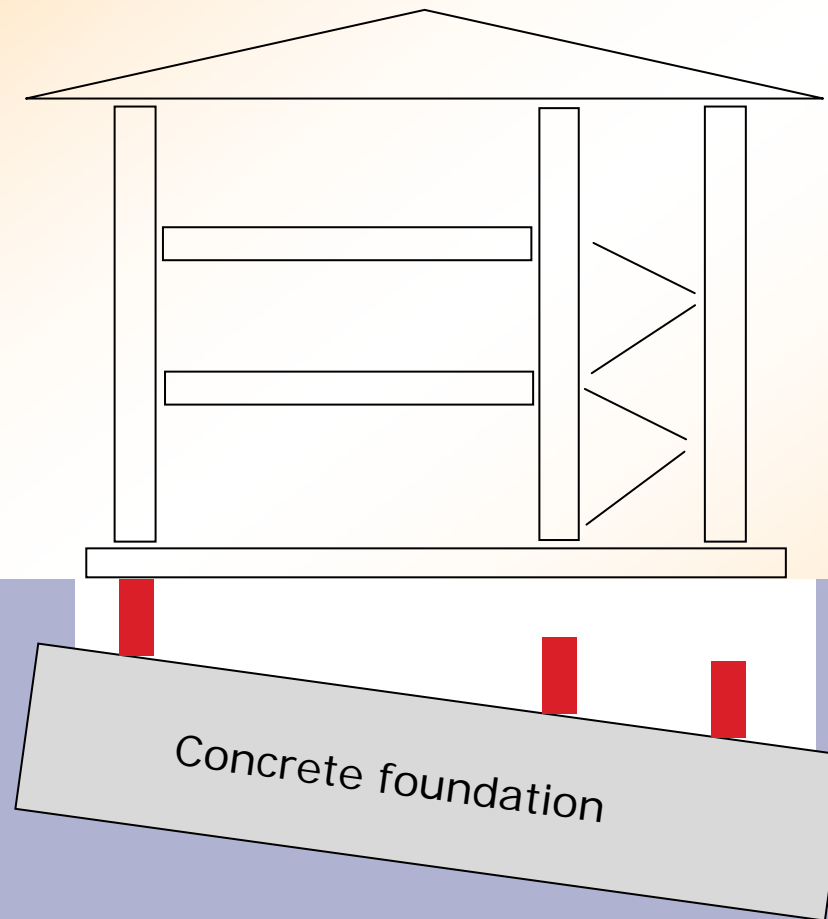


Re-levelable buildings

Light
building

Adjustment

Strong
foundation

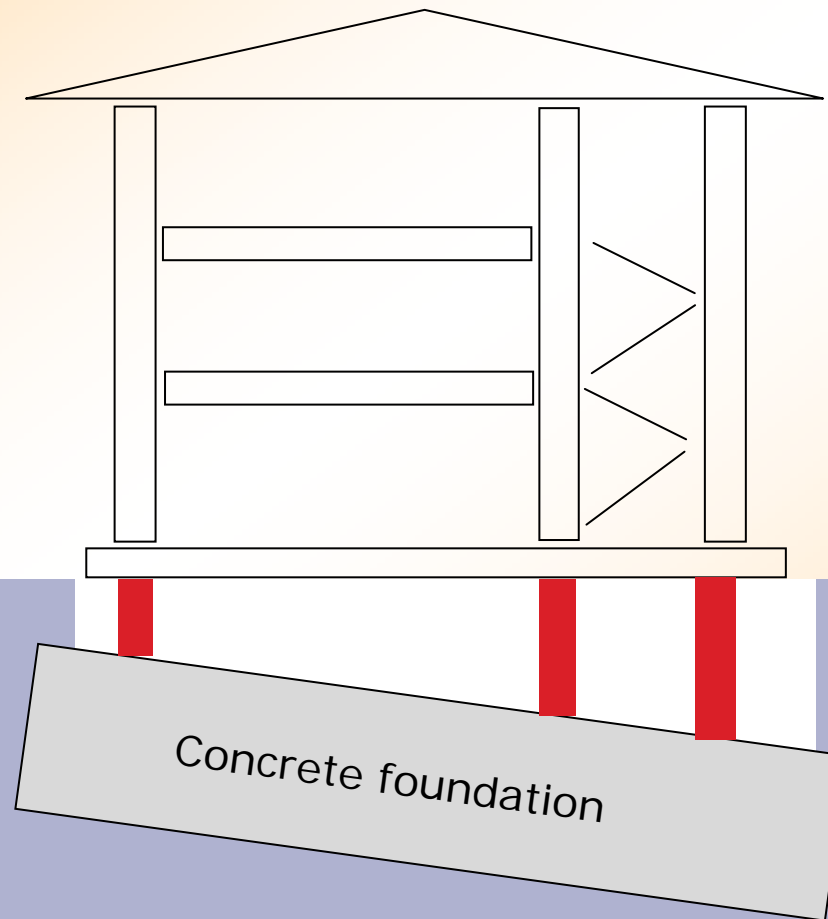


Re-levelable buildings

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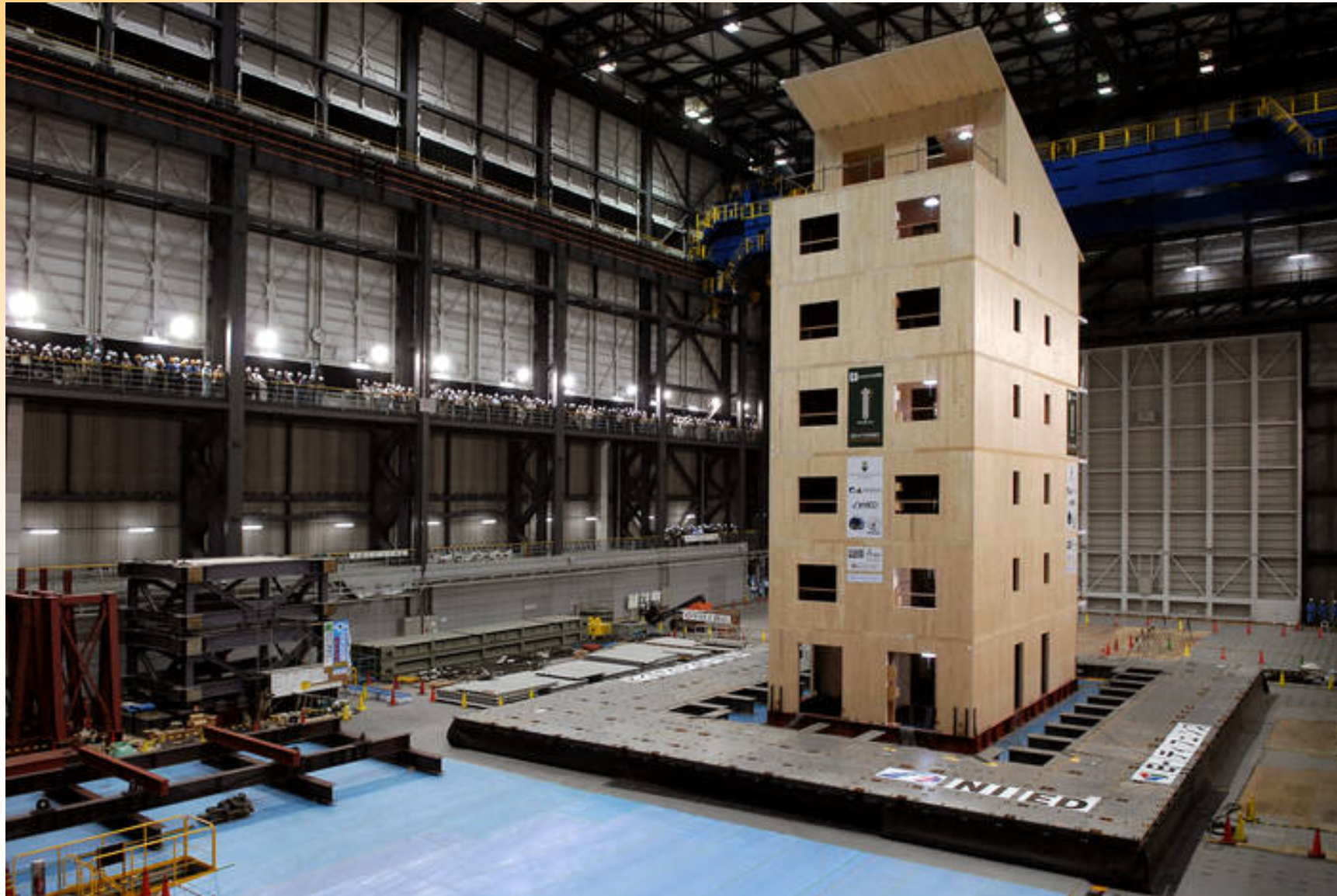
CLT buildings



7 storey CLT building, London



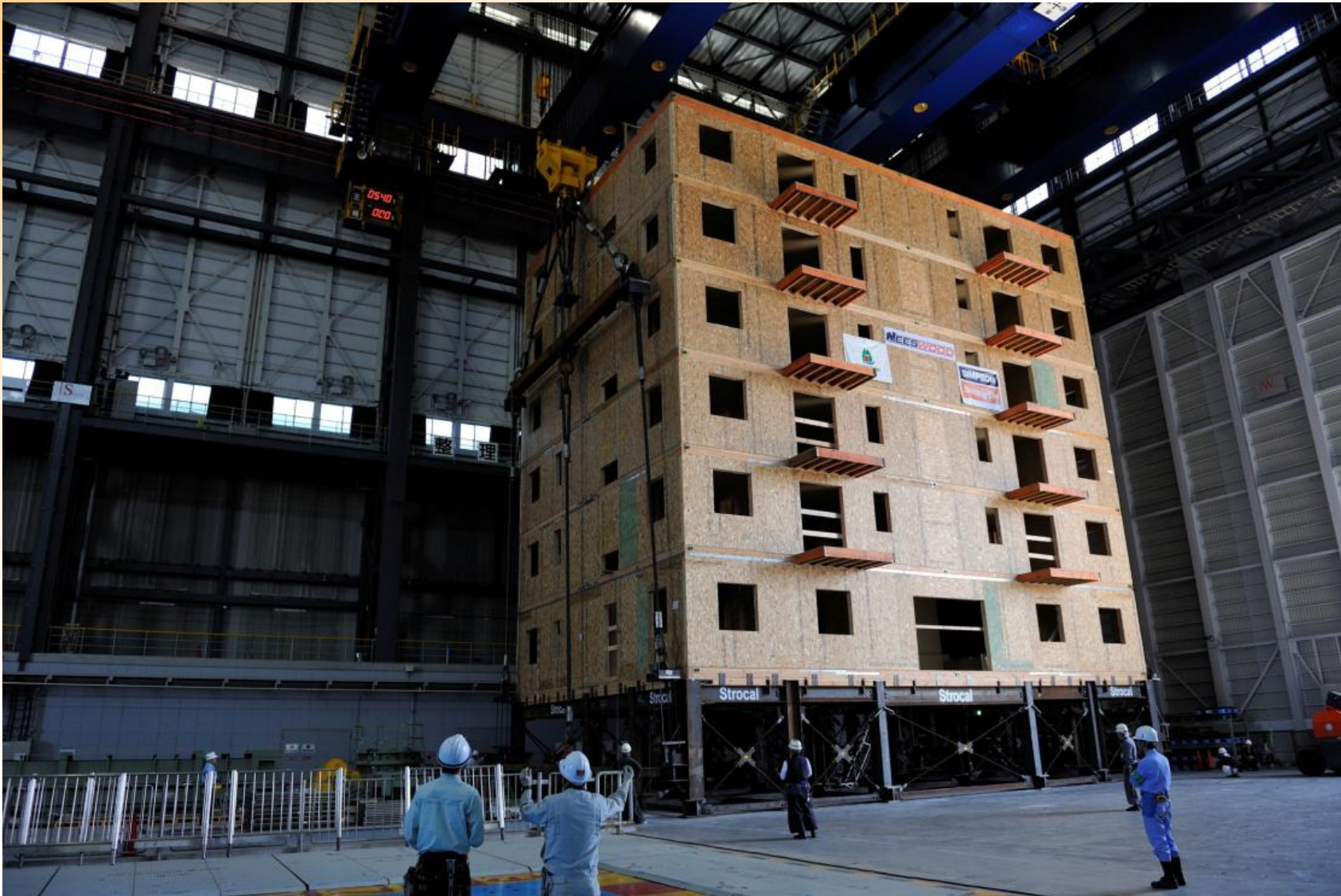
7 storey CLT shake test



Light timber frame



Light timber frame test



Post-tensioned beams



Long spans (draped tendons)
Fewer columns



Post-tensioned timber building



Post-tensioned timber building



Post-tensioning



Post-tensioned timber



Post-tensioned timber walls



Post-tensioned timber frames



International



7 storeys – Berlin
(Glulam)



6 storeys – Switzerland
(Light timber frame)



9 storeys – London
(CLT panels)

International



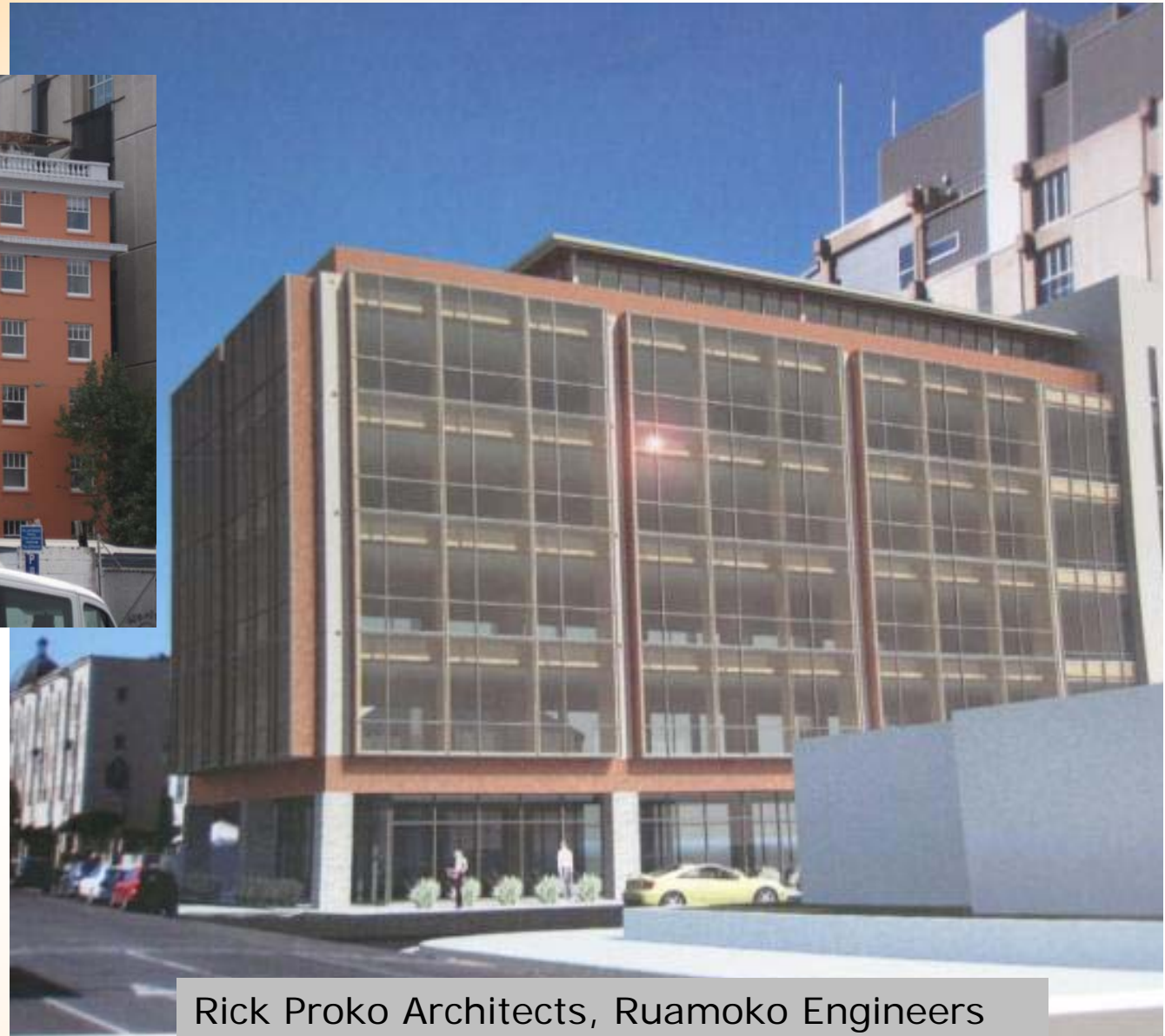
Re-building Christchurch



Sheppard and Rout Architects, Kirk Roberts Engineers

134 VICTORIA ST DEVELOPMENT VIEW 6

Re-building Christchurch



Rick Proko Architects, Ruamoko Engineers

Conclusions

- New wood materials
LVL, CLT
- New fasteners
Epoxy, post-tensioning
- New structural systems
Base isolation, rocking systems

Timber solutions are available