Presentation to the Canterbury Earthquakes Royal Commission

COSTS AND BENEFITS OF SEISMIC / BASE ISOLATION

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Slide 1 – Header

- Technology developed by Dr Bill Robinson in NZ in late 1970s
- Slow uptake in NZ but increasing use overseas
- Robinson Seismic Ltd based in Wellington, only NZ developer and supplier of base isolation devices
- Balance cost against the benefits
- Discussion limited to new structures
- Base isolation can be retrofitted to suitable existing structures but too many variables to give meaningful indication of cost
- Structures can include buildings, bridges, storage containers, tanks, power facilities and most other structures requiring protection from damaging forces of earthquakes, and vibration in general

- Widely held misconception that seismic isolation is expensive
- When viewed against the savings it can in some cases result in a slightly lower construction cost overall
- E.g. Union House built in Auckland in 1983 with base isolation produced an estimated 7% cost saving in the total construction cost of $6.6m which included a construction time saving of 3 months due to the structural form requiring less seismic force, ductility demands and structural deformations
- As a general rule the inclusion of all aspects of seismic isolation in a new structure will add no more than 3% to total construction cost and considerably less when assessed against the benefits of isolation.

Slide 2 – Wellington Hospital External View

- Wellington Regional Hospital:-
- Completed in December 2008
- Fitted with 135 lead rubber bearings and 132 slider bearings

Slide 3 - Summary

- 7 storey building, total floor area of 44,700m^2
- Designed to withstand M7.8 on Wellington-Hutt fault and M8.3 on Wairarapa fault
- Total construction cost $165m
- Cost of seismic isolation bearings on their own was 1% of total construction cost
- Cost of all components of the seismic isolation system (including installation, seismic gap and gasement) was around 3% of total construction cost
- Translates to approximately $110/m^2

Slide 4 – Car Park View

- Basement has been turned into a car park which recoups cost

Slide 5 – Whanganui Hospital External View

- Whanganui Hospital Peri-Operative Block :-
- Completed in 2008

Slide 6 – Installation View

- 2 single storey buildings
- First in the world to be base isolated with a newly-patented device called the RoGlider.
- RoGliders are designed specifically for smaller, lighter buildings where the load is between 5-100 tonnes per column
- Can still accommodate large displacements so are as effective in earthquakes to the same magnitude as the lead rubber bearing

Slide 7 – Summary

- Total construction cost $18m

- Cost of devices on their own was 2%; total cost of the base isolation system was 3% of total construction cost or approximately $140/m^2

Slide 8 – Summary of 4 Buildings and Costs

- Of 2 other buildings (Christchurch Women's Hospital and Hutt Hospital) the total cost of the base isolation systems, incorporating all factors (e.g. installation, seismic gap) were all 3% or less of the total construction cost
- Documents on Christchurch Women's Hospital have been lost so we can only confirm cost of the lead rubber bearings themselves at 1.3% of total construction cost

- Benefits and savings :-
- Base isolation allows for a reduction in structural elements of the building with less ductile detailing needed
- Crawl spaces or basements can have multiple benefits e.g. in siting services, additional income from a carpark, flexibility for future development
- Protection of the CONTENTS – with controlled movement caused by seismic isolators contents are not subject to violent and sudden shakes thereby reducing the impact on the contents
- Protection of the integrity of the internal structures e.g. stairs, internal walls, partitions
- Building is safer for occupants and contents are protected
- Continuity of operations is much more likely

Slide 9 – Video of base isolation simulation

- Insurance :-
- There is not yet significant premium reductions offered to seismically isolated structures in NZ but we are commencing discussion and education of the insurance industry
- E.g. in Japan, owners of base isolated apartments enjoy a 30% discount in insurance premiums
- Initial approaches to insurers reveal an “increased interest” in insuring buildings which are seismically isolated
- Likely that in future seismic isolation will be an important factor in the acceptance of building, contents and business interruption insurance
- This issue is also being addressed with insurers in the USA based on discounts for protection measures such as fire-resistant construction and fire and theft alarms

- At least one municipal authority in NZ is considering self-insurance of municipal buildings through retrofit of seismic isolation.

- Maintenance :-
- Contrary to belief, seismic isolation devices require no maintenance during the life of the building
- Following any significant event they should be inspected to ensure bolts and load plates are still in place
- Devices do not need replacing after an earthquake unless the event was in excess of their design specification in which case we recommend the removal of some devices for testing
- Because the building is protected from major damage, repair costs following an earthquake will be lower to non-existent

- We remain convinced of the effectiveness ONLY of seismic isolation in the protection not only of the external structure but also the contents and in maximising the potential for immediate business continuation

- Historic and heritage buildings :-
- Traditional earthquake strengthening methods can detract from the aesthetics of historic and heritage buildings
- Many heritage buildings are appropriate for base isolation
- Base isolation can be retrofitted to achieve earthquake protection without compromising the aesthetic integrity of the building

Slide 10 – Supreme Court, Wellington

- Supreme Court originally built in 1881 and restored in 2007 including retrofit of lead rubber bearings
- Building was literally cut off its foundations at ground level, and the floors removed and excavated so the bearings could be installed

- Since the strengthening work was done at its foundations there was no need for intrusive strengthening methods to take away from the beauty of the exterior or interior walls and ceilings

- Economic and social benefits :-
- If we can ensure uninterrupted functionality of buildings and places of work then for many their continued employment is secured and they will be able to stay and assist in the rebuild and recovery of their community

Slide 11 – Summary of Benefits

- Recent new buildings in NZ fitted with seismic isolation during construction indicated a total gross cost of around 3% or less of total construction cost
- Consider that against cost savings from a reduction in structural elements, savings in contents replacement, reduced to non-existent repair costs and the benefits of maximising the potential for immediate continuation of business

- Also the likelihood of insurance and deductibles benefits cannot be discounted
- Consider too intangible considerations such as economic and social benefits

- Reference to “Design of Conventional Structural Systems Following the Canterbury Earthquakes” prepared by SESOC for submission to this Commission in December 2011.
- Paper notes that although most buildings have achieved the primary objective of saving lives, levels of damage have been high
- Their recommendation is if a building contains high value or critical contents consideration could be given to using base isolation
- We contend that given the cost-benefit analysis, base isolation should be considered for ALL appropriate structures in the rebuild of Christchurch

- Seismic isolation can increase the performance expectations of structures to be both ‘life safe’ and minimise damage, reducing the time required for a city to recover and resume normality

While we believe it is vital that IL4 buildings are seismically isolated so they remain fully functional during and immediately following earthquakes, the benefits of seismic isolation for other buildings cannot be underestimated and neither should the value of peace of mind for building occupants be. Canterbury is in a unique position of needing to rebuild a city and should aim to build to the highest levels of earthquake resistance possible.