Further Submission to the Canterbury Earthquake Royal Commission On Base Isolation

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Foreword

I attended the hearing on Monday 12 March 2012 as a member of the public as several eminent speakers on base isolation including Mr Trevor E Kelly were speaking.

I came away from the hearing concerned that Base Isolation had been presented to the Commission from the pyridine of present thinking and technology. There is MUCH more to Base Isolation then current thinking. And there are underlying solutions for Christchurch.

The present thinking is based around lead / rubber bearings where the system has an inherent period of about 2 ½ seconds and is likely to get into resonance with the peak seismic resonances generated by the ground bowl effect underlying Christchurch.

However WE NEED to step outside the pyridine of current thinking.

Cost

Current thinking is “tunnel visioned” on lead / rubber bearings requiring suspended floors, basements and expensive bearings.

The Chinese use cheep sliding systems for buildings up to 4 stories high.

A system currently being developed by the writer Colin W. Ashby is so cheap it could be “used on mud huts in Africa”. It is envisaged that this system would not be restricted to Hospitals and expensive buildings but could be used on houses, commercial and light industrial buildings.

Three Base Isolation Systems

There are possibly three basic types of base isolation systems.

1. The first including the Lead /Rubber bearing type and similar systems have an inherent period of about 2 ½ seconds which happens to coincide closely with the peak seismic response under Christchurch conditions and is likely to set up a dangerous resonance. And unlikely to respond well on soils subject to liquefaction

2. The second, the Friction or sliding systems do not have a period and are unlikely to suffer from resonance. And may? Prove satisfactory on liquefiable soils.

   The Ancient Greeks, used a friction system in temples.

   The Chinese found in their cheap housing developments that where wall reinforcing was not carried into the floor slab and the superstructure could slide at the wall base/ floor slab interface, the buildings survived much better than where the steel was continuous into the floor. – this was a friction system.

   The system currently under development by Colin W. Ashby is a friction system which can be tuned to not have a period.

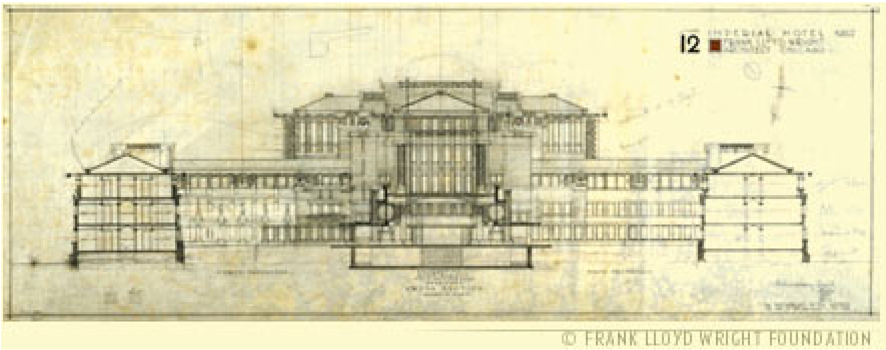
3. The third is Ground modification systems.

In his opening address, Trevor E. Kelly alluded to; the Imperial Hotel designed by Frank Lloyd Wright in Tokyo in the great 1923 earthquake with "base isolation designed to float like a battle ship on a sea of mud.**"**

This comment at the hearing got me thinking and so I have researched it. If base isolation is supposedly no good on liquefiable soils, then how is it that Frank Lloyd Wright's base isolation design survived the Magnitude 8.3 earthquake on a sea of Mud?

From my internet research, I outline the following:

Frank Lloyd Wright, The Imperial Hotel and the 1923 Great Tokyo Earthquake



Frank Lloyd Wright said; *"I deem the original Japanese culture to have been as perfect in its own way as that of the ancient Greeks, exemplifying as it did the finest and most fastidious taste in matters of detail".*

The writer considers it highly probable that like the Greeks, the Ancient Japanese living in a country suffering from seismic activity may well have come up with their own base isolation system that Frank may have stumbled across in his 6 years of research, and applied. Throughout his working life he apparently often borrowed architectural features from other cultures. It would seem a pretty brave thing to do even for Frank Lloyd Wright, to implement a completely novel base isolation system under such a Grand building if it had never been attempted before.

Wright had intended the hotel to float on the site's alluvial mud *"as a battleship floats on water"*.

Work began on the hotel in 1916, and Wright spent much of the next six years in Japan. While in Japan, he examined traditional Japanese architecture.

He determined that; *"As this is an earthquake country, the buildings should not be higher than three or four storeys, and the principal material employed in construction should undoubtedly be reinforced concrete which would offer the most successful resistance to earthquakes."*

Experience in the San Francisco disaster had shown Wright, *"... that while the steel framework would undoubtedly remain standing, everything on it would be shaken off, and the floors inside would collapse, so that the danger to the inmates was as great as if the entire building had fallen down."*

Frank Lloyd Wright's design was in complete contrast to accepted practice at the time and was extremely controversial. Under the site was an 8' (2.4 m) layer of fairly good soil and below that a layer of soft mud. He tied the building to the upper layer of good soil by closely spaced short piles that penetrated only as far as the top of the soft mud. The building performed extremely well in the devastating 8.3 magnitude 1923 Tokyo earthquake. Wright believed the soft mud would be, *"...a good cushion to relieve the terrible shocks. Why not float the building above it."*

"September 8, 1923

Dear Mr. Wright,

The first shock was enough to lay many buildings flat, and ... the second shock easily levelled what the first had loosened...Fire billowed from every house and those people who survived the crush and sought places of safety out in the open were killed by the smoke and scorching hot air, roasted by hundreds and thousands.

All steel buildings proved fatal, enough to show that our architects were fools.

What a glory it is to see the Imperial standing amidst the ashes of a whole city!

Glory to you!

Sincerely,
Arata Endo
(Sab Shimono)"

<u>Conclusion</u>

It is pretty evident from the above that Frank Lloyd Wright got something right, with a 4 storey building that survived virtually intact a 8.3 Magnitude Earthquake , founded on liquefiable soils (demolished 42 years later as the land was too valuable). <u>And</u> he was not using our current Lead/Rubber base isolation technology.

The lesson is, do not be limited by the pyridine of the current thinking when it comes to Base Isolation, there is scope here for Christchurch and we have not scratched the surface.

Colin Ashby

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