PROF LEE CHACK FAN:

Thank you, Andrew. As the only engineer on the slate of speakers, so I guess it will be my obligation to touch upon the engineering aspects of heritage conservation.

The engineering community actually makes some contribution to urban heritage conservation through, for example, enhancing the structural safety of the type of historic building that our previous speaker mentioned earlier this afternoon. This is specifically done through, for example, strengthening of the building to meet the safety standard or upgrade the design standard.

Let me explain what I meant by that. You see, design standards do change every now and then. What used to be adequately safe 30 years ago would no longer be adequate by today's standard, so to meet the rising designs and sometimes you have to strengthen the building.

The other example of enhancing structural safety of historic building is to make seismic retro-fitting. That goes on in a big way in places like California, in western United States, in Japan and some other parts of the world. I'll show you some examples as we move on.

The other aspect is stabilising historic buildings against natural hazards such as differential settlement, land slide, excessive tilting, for example the case of the leaning tower of Pisa.

Let me start off with an example of structural safety enhancement, for example take the case of one of the earliest public housing estates we have in Hong Kong, a place called Shep Kip Mei. It was built in the year 1954, so more or less over half a century now. If you visit the place today, it looks something like that, if I could draw your attention to some of the structural reinforcement here. You see?

The buildings are now vacated and will be demolished in the next year or two and today it looks something like that. You look at the kind of structural reinforcement. But, exaggerated, but nevertheless it shows the impact of structural reinforcement.

There are lots of old historic building in Hong Kong including Buddhist temple, but every now and then we saw reference made in the media and cracking in the building foundation, deterioration and things like that, calling for fundraising effort to make sure that the buildings remain safe.

The case of seismic retro-fitting goes on in a big way, as I reported earlier, in Japan and United States, California. For example, take the case of the historic building completed in 1906, that's a century ago. This is the Imperial library, now the Library of Children's Literature, and what the engineer did was to introduce a system of what we call seismic isolation layer, to sort of isolate the earthward motion in the foundation from the building in order that the building would survive better during quite a big earthquake. A closer look at the kind of rubber isolator that we installed there.

Another example is an Osaka building, a public hall actually used as a concert hall, built in 1986. Again, the isolation technique that were used, it's a very nice historic building as you can see. There are lots of traditional wooden buildings in Japan, I'm sure some of you have visited some of these buildings.

Japanese engineers did a lot of vibration tests to reinforce this kind of historic wooden building.

Across the Pacific, here we have the well-known Golden Gate Bridge. There was a need for a seismic retro-fitting identified following an earthquake that occurred in the year 1989, what we called Loma Prieta earthquake, Loma Prieta referring to the location of the epi centre of that particular earthquake, which caused the bay bridge to collapse in segments like that.

So there was a programme of seismic retro-fitting that went on in the last several years, that will go on for several more years. Actually, the whole retro-fitting work was divided up into three phases.

The first phase included a north approach. That was completed some five years ago. Right now we are nearing completion in phase two and the third phase would be completed in the year 2012. Typically a phase would include strengthening of the foundation, replacement of the steel tower, lateral bracing and the isolation of earthquake motion through isolator bearing, as I mentioned earlier.

Across California, there are lots of beautiful historic buildings that went through you that kind of seismic retro-fitting in the last several years. This includes the Hearst Memorial Mining Building at the University of California at Berkeley. Again, base isolation using the type of isolator that I report earlier. The Martin Luther King Civic Centre in Berkeley, California, a very nice building, as you can see. 111 Sutter Street, San Francisco. The Asian art museum, probably many of you have visited this place when you were in San Francisco before. It was an old main library of the city when it opened for use in the year 1917, exactly 90 years ago. And there's the Letitia Building in San Jose, again seismic retro-fitting, it's a very nice-looking building. Many of you probably have been to Stanford University, the Memorial Church, of course a very memorial building, again a lot of seismic retro-fitting and a structural upgrading went into that in the last few years.

Pasadena City Hall, built 1927, 80 years ago. Again, seismic retro-fitting. And not just California. Salt Lake City in Utah, the whole building was retro-fit to accommodate a design basis earthquake of 0.2g, that's a seismic ground motion acceleration.

In doing all this seismic retro-fitting and structural upgrading, there are two important preservation principles involved. Historic materials should be preserved and retained to the greatest extent possible and not replaced wholesale, in other words you don't tear down the thing and rebuild using new material. And you respect, most importantly, the character and the integrity of the historic building.

So that's the basic principle.

For example, an earthquake occurred in Northridge California in 1994, destroyed this historic building and after restoration it looks something like that in the picture down there, basically retaining the kind of character of the building.

The engineer work, in addition to the structural appearance, a lot of this strengthening of the joints and between the columns and beams and what not to ensure the structural safety of the building is enhanced. So the work on increasing the strength of the joints to enhance the structural integrity of the building.

Of course, you can imagine that in this place, in this world, not just California and Japan are seismically active. There are lots of areas like southern part of Europe, Italy, Greek, Yugoslavia, very now and then you have earthquakes. There's a distinct need for seismic retro-fitting as well and we're aware of increasing interest in many research studies being reported in recent years.

Moving on to another subject of foundations, among the leaning tower of PISA of course is well known to everybody. What could you do about a historic building like this? You, of course, cannot strengthen it easily.

What happened in the late 1990s and in the early 20s, the engineer came up with a scheme of drilling incline boreholes into the foundation here, removing some of the soil from the borehole, in other words, that sort of enhanced the probability of the foundation to settle in this part of the foundation relative to here. You don't do anything over here but you remove some of the soil down here so the building sort of tilt the other way.

That, of course, does not decrease the inclination or the tilting of the building in a big way. You don't want to do that anyway, but it sort of help to stabilize it to reduce further tilting of the building.

Ladies and gentlemen, in summing up, the engineer measure taken in the mid-1990s is what we call the reversal of tilting movement by control the removal of soil through an incline borehole and induce subsidence of foundation on the other side of the building, the least compressed side, the least settled side. Then we also put in sub-horizontal anchors stays as temporary safeguard during this stablisation work.

Now, total reduction of inclination by half a degree from 5 and a half degree to 5 degree with little change in visual impact. You don't want to change the name of the building anyway.

Leaning Tower is not only found in Europe. In the city of Suzhou in eastern China, we also have a Leaning Tower of Huqiu, (Chinese spoken) and similar technique was used. This tower is standard, it was built about a thousand years ago. A similar kind of technique.

Another kind of historic buildings and treasure, engineers also used, for example many of you have probably travelled up and down the Silk Road, the famous

Buddhist grotto of (Chinese spoken), the cave town. Many of these paintings and Buddhist figures were housed in caves. Over the years, the cave deteriorate and a lot of rock anchors were used to stabilise the cave and make sure that the integrity of the cave is preserved.

Elsewhere in Europe, some time engineers were called up to help relocate ancient temples such as Abu Simbel in southern Egypt. Many of you probably have traveled along that portion of the Nile. During the construction of the damn, Aswan damn and Lake Nassar in the 1950s, whole temples were relocated through the huge engineering undertaking.

Such relocation exercise and preservation exercise is not confined of course to just Egypt. In the Three Gorges project in China would be completed next year, it's a 17-year hydro resources project. One of these historic work is called the Stone Fish in Fuling. It's needs a little bit of explanation. It is a sand-rich island in the middle of the river near a city called Fuling in Sichuan, it used to be Sichuan, now part of Chongqing. You don't normally see this island. Once every decade during the low water period, meaning January, February, when the water level is very low, then if you travel down the Yangtze River, chances are you might see a bit of this island. So it would come up to the surface only during the very low water period.

So in order to mark that time of the low water level, the Chinese over centuries have a way of doing it. They engrave a number of stone fishes altogether, 14 of these, and then in addition to the stone fish they would have engravings to mark the low water level of such and such a year, the water level was so many feet below the eye of the fish. What it actually is, is an Asian hydrographic record that went back to more than a thousand years ago, went back to the Tung dynasty, about thirteen centuries ago. What do you do with that? What the Chinese engineers ended up doing is put a reinforced concrete dome around the whole island and turn it into an underwater museum with tunnel access from both sides of the river. It is nearing completion now so in the future it will be known as an underwater museum for ancient hydrographic records, with all these stone fish and engravings. Quite an effort, as you can imagine.

Of course the stone fish is not the only cultural and historic value affected by the Three Gorges project. Here we have in Chang Fei temple. When the decision was made to relocate the temple, they numbered each and every beam and column and then we relocate it to another place some 36km away and it looks today like this and last couple of years we went back to make sure that this slopes here are stable to make sure that the new temple would be stable against the landslide hazard.

Speaking of landslide hazard, I move onto the last part of my presentation this afternoon, the subject of protecting historic building, against landslide hazard. That's exactly the kind of experience we have accumulated in Hong Kong over the last several decades. Hong Kong has more than two-thirds of its land on sloping ground with a sloping angle in the order of 30 degrees.

The buildings on a slope are often subject to landslide hazard and the historic record that went back to the 1920s, this is one of the buildings that were affected by landslide in the 1920s. Another typical example is the landslide that occurred in 1966 and here we have these historic buildings. We have to make sure that such buildings are protected against landslide hazard. Another example, large number of landslide occurred one year, near this Buddhist temple causing extensive damage.

This is one of the worst that occurred in Hong Kong. That occurred in the year 1972, June 18. The hill side came down, along with one highrise building, knocking down the (indistinct words). I don't need to tell you the kind of damage could result from such landslide.

So landslide hazard mitigation is part of life in an urban environment such as Hong Kong here, where lots of buildings, as you can see, are built on steep hill sides.

My university, called the University of Hong Kong which was officially founded in the year 1911 -- this is one of the buildings that were built in the 1911, 1912 period. That was also subject to landslide damage and was restored through a fair bit of engineering effort.

So Hong Kong spent a lot of effort in trying to stabilise land slides and this is one such effort on campus of the University of Hong Kong.

This kind of experience has actually put Hong Kong on the map of landslide hazard globally. A lot of the Hong Kong experience in stabilising slope is now being exported on Southeast Asia, for example, and also to hilly parts of China for construction of highways, new buildings on hill sides and what not.

So summing up, engineers do contribute to preservation of historic building through mitigation of that kind of hazard and the structural damage.

Thank you for your patience.