Singapore

Here is the footage from “Site Safety Seminar for Capital Works New Works Contracts”
organised by the Hong Kong Housing Authority on 26 April 2016.

The speaker is Mr Lam King-chi Stephen, Senior Architect of the Housing Department.
He is going to speak about the “Benchmarking Study on Infrastructure Projects and Design for Safety in Singapore”.

Good afternoon.
I am Lam King-chi Stephen, a Senior Architect of the Housing Department.
Today, I’ll talk about
the Benchmarking Study on Infrastructure Projects and Design for Safety I participated in Singapore earlier.
It was organised by the OSHC.
My presentation will be divided into two parts.
I will start with an overview and examples of Design for Safety.
Then I will talk about the visits to particular infrastructure projects.
In Singapore, three government departments are
responsible for workplace safety and health (WSH).
The Ministry of Manpower makes laws and regulates the industry.
WSH Council and WSH Institute are responsible for promotion and providing insights within the industry.
They uphold three key principles in Design for Safety.
Firstly, reduce risk at source;
secondly, greater industry ownership;
thirdly, penalties for poor safety management.
Singapore has proactively enforced WSH since 2004.
They have implemented a number of WSH measures,

including legislation of Risk Management System,
promotion of safety culture,
safety certification,
prosecution and penalties
and Design for Safety.
With these measures in place,
WSH related fatality rate has been declining.
Design for Safety, DFS in short,
refers to reducing WSH risks in the design stage,
especially for working at height.
According to the draft legislation at the time,
the developer, assisted by professionals and contractors, was required
to record all DFS items in the DFS Register
in order to ensure that the DFS items could be implemented effectively.
Common examples of DFS
include gondola systems for maintenance of windows and claddings,
maintenance platforms for maintenance of building services,
as well as movable maintenance platforms designed
to be a part of the building.
As you can see in this slide,
there are rails above and below this maintenance platform.
The platform can move horizontally along the rails,
allowing workers to clean the windows and carry out maintenance work safely.
In Singapore, green walls are very common.
While they beautify the environment,
they make maintenance work challenging.
In case there are no safe access and maintenance platforms –
as shown in this slide, the worker has to stand on the planter once he is outside the building,
while the access door swings outwards
and there is no guard-rail.
It is very dangerous.
Therefore in the design stage, safe access and maintenance platforms

should be provided
behind the green walls.
In this way, there is no need to build scaffolding or use gondolas
whenever maintenance work is carried out.
It is safer and more convenient,
and can reduce the risk of working at height.
We were introduced to three common vertical greenery systems.
In the first type, from right to left, the planter for the climbers is placed at the rear side.
There are checkered plates or perforated plates on the planter,
allowing workers to carry out maintenance work safely.
In the second type, the green wall is made up of individual planters.
Sufficient space is provided between the planters,
allowing the worker's hands to go through and carry out maintenance work.
The third type is a green panel
that can be turned to face the maintenance platform at the back using rollers or hinges.
You can see the components of the green panel in this slide:
the rollers, the rails and the knobs.
You can see the entire green panel being turned towards the inside for safe maintenance work.
Another type of green panel uses hinges.
The entire green panel swings inwards to face the working platform,
so that maintenance work can be carried out safely.
This is an example of indoor vertical greenery systems
on the ground floor of a commercial building.
As you can see, access and working platforms have been
ingeniously hidden behind the green walls.
While this is safe,
the appearance of the green walls is not affected.
This is an example of roof edge planting.
As you can see, there are railings outside the planter.
This prevents the worker from falling off

while maintenance work is carried out.
Meanwhile, the railings are curved inwards,
such that the greenery is not visually blocked.
This is an illustration of greenery zoning:
the closer the plant to the roof edge,
the shorter it should be;
so that different machineries can be used at different heights
to carry out maintenance work safely.
In the second part, we visited four infrastructure projects.
Firstly, we visited a Singapore Power Ltd. project,
constructing a cable tunnel running North-South across the country,
In order to enhance risk management,
cable tunnel with an inner diameter of 6 metres is used.
The tunnel was wide enough for maintenance vehicles
to go through.
The tunnel is constructed at 60 to 80 metres below ground level
to ensure that it would not be affected by other utilities.
Tunnel boring machines (TBM) are used
to secure construction programme.
Next, we visited a private residential project.
There were four residential blocks
with a podium and a three-level basement
going about 11 metres below ground level.
With Design for Safety in mind,
diaphragm wall is adopted
as structural wall for the basement,
and as temporary support required during basement excavation,
namely the conventional ELS.
Firstly, during the piling stage,
the diaphragm wall
was driven deep into the ground along with the piles.
When the foundation was completed,
the diaphragm wall had also been installed.
There was no need to spend time on ELS for excavation.

Excavation could begin straightaway.
During excavation, no further ELS was required.
Excavation could be carried out right through the end.
Then the pile caps could be constructed.
Diaphragm walls are more expensive,
but they provide a safe and strut free working area.
Also, they only need to be installed once.
In this case, the permanent basement walls, the temporary works
and ELS were completed all at one go.
There was no need to spend extra time building the structures.
Compared with traditional methods,
where the ELS is built during excavation
and the work has to be halted from time to time,
this solution saves a lot of time.
Transportation space is also saved, and the work site is safer and more convenient.
You can see the diaphragm wall in this slide.
It was completed in advance.
No struts were needed during excavation.
There was an indent on the ridge of the diaphragm wall
that served as a surface channel
to drain water on the ground surface.
You can see the working area was safe, and strut free.
Work was convenient and time saving.
As to environmental friendliness,
this work site had a treatment plant that reused waste water
for washing vehicles and shoes.
Dormitory facilities were also provided to foreign workers,
including laundry facilities, kitchen, residential rooms, canteen and fitness facilities.
Moreover, there were bicycle parking facilities.
Hooks on the wall allowed the bicycles to be hung up vertically,
saving a lot of space.
The last two infrastructure projects

belonged to the Land Transport Authority,
similar to the railway works of MTR in Hong Kong.
One of the projects was a 7.5 km long integrated viaduct.
An overhead railway ran on the upper deck,
while the lower deck carried automobile traffic.
Construction work had to be carried out above highway.
This was a major concern in
Design for Safety.
Therefore the bridge used precast segments,
and special mobile cranes were used to
lift the segments up while balancing the two ends.
From this slide, you can see that the mobile crane
was approximately 100 metres long.

It was used to lift the segments,
and it could move forward from one pier to another.
Throughout the construction process,
there was no need for the equipment to touch the ground.
It moved from pier to pier.
This was good for safety as well as work progress.
In order to enhance safety on the work site,
the staircase treads were painted in contrasting colours of red and yellow.
As you can see, the two treads at either end were painted red,
and those in the middle were yellow.
The alternating colours red and yellow helped enhance safety and
prevented falls.
A mechanical platform was used for laying block works,
so that workers could work in a safer environment.
A site audit system is implemented in all LTA work sites.
It is like a simplified version of PASS.
Notably, the contract specifies that
if the contractor obtains a low score during the construction process,
fees will be deducted.

In terms of environmental management,
noise barriers of 7 m high were installed
in work areas close to residential buildings,
so as to reduce noise nuisance.
That’s all for my presentation.