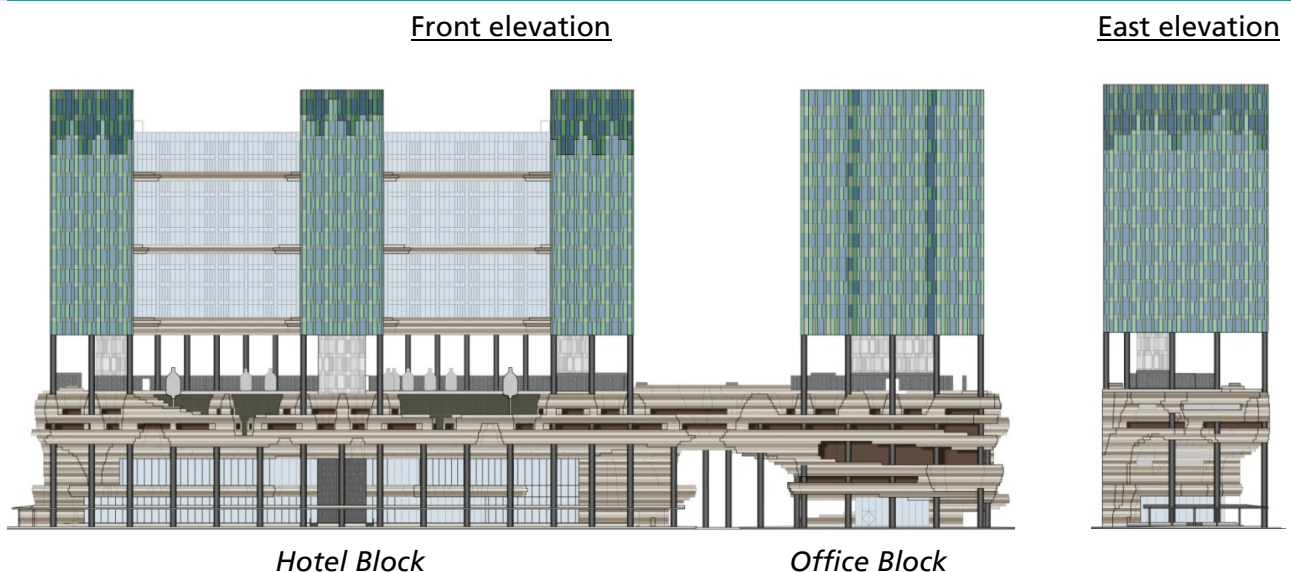


## Mixed Use Complex – “Park Royal” Hotel and Offices at Upper Pickering Street, Singapore

### Project key data:

- Developer: Hotel Plaza Property
- Architects: WOHA
- C&S Consultants: TEP
- Contractor: Tiong Seng
- Execution period: 12.2009 – 05.2012
- Building contract value: undisclosed
- Estimated site area: 6,959 m<sup>2</sup>
- Estimated construction floor areas:
  - Podium : 23,690 m<sup>2</sup>
  - Office: 11,565 m<sup>2</sup>
  - Hotel: 32,901 m<sup>2</sup>
  - Total: 68,804 m<sup>2</sup>

### Visualization:



### Project brief:

The development consists of a hotel and an office block placed on a podium. Designed by Singaporean WOHA architects the building's outstanding feature are hanging gardens forming part of the façade and contributing to the green and sustainable concept of the building. Cobiax void formers were used in the hotel and office block floor slabs leading to an eased execution of the highly complex structure and furthermore allowing to reduce its carbon footprint. Thanks to the dead load reduction incurred by the Cobiax void formers the podium which acts as a load transfer structure could be further optimized. Furthermore, the conversion of the floor slabs from a slab-beam system into Cobiax flat plate slabs contributed to increase the construction site's productivity.



### Cobiax key data:

- Void former types used: CBCM-S-100, CBCM-S-120, CBCM-S-140
  - Combined with pre-cast half slabs in podium (2 floors)
  - Cast-in place slabs for office block (9 floors) and hotel block (10 floors)
- Direct dead weight savings through the use of Cobiax: 2'900 tons

## Value engineering approach:

The initial structural concept foreseen for the hotel and office slabs was a slab-beam system with a 200 mm deep slab sitting on 500 x 750 mm beams for the hotel and 350 x 900 mm beams for the office block.

Tiong Seng's value engineering approach was to replace this slab-beam system by flat plate slabs enabling them to make use of their highly productive PERI SKYDECK formwork combined with the PERI ST100 shoring system. The use of such system formwork significantly reduces the requirement for labor and also impacts the cycle times since the system is rapid in installation and at the same time the additional shoring and rebar placing for beams is eliminated.

While the conversion of slab-beam systems into flat plates has a positive effect on productivity it usually leads to higher dead loads since flat slabs tend to increase in depth due to deflection control.

This is where the use of Cobiax would contribute with its dead load reduction capabilities and hence allowing a redesign of the initially foreseen concept into flat slabs without increasing the dead load. This was an important criteria since the piling foundation was already executed ahead of the building tender and designed to carry a given design load based on the slab-beam system.

The Cobiax flat slab design led to flat slabs of 200 mm depth for the hotel and 250 / 300 mm depths for the office block which would allow to even reduce the dead load compared to the initial system.

This additional dead load reduction was used to streamline the design of the load transfer structure of level 2 where the mega-beams could be re-arranged such to be in parallel direction. The use of pre-cast half slabs for this floor would further eliminate the need of shoring which was a major safety concern since the headroom below level 2 is 18 meter. Pre-cast half slabs were also used in the other podium slabs (two of them using Cobiax) which would allow to streamline the cycle-times.

## Productivity and time gain:

The number of required labor for the concrete works for the whole site could be cut down to 75 men (carpenters and steel fixers). Compared to traditional execution methods (slab-beam system) this corresponds to a reduction of about 50% in number of labor.

The estimated time savings from using flat plate system formwork and Cobiax for the site is in an order of magnitude of 3 months. A relevant contribution to this time saving stems as well from the use of the PERI SRS column formwork which allowed to cast the 18 meter long columns supporting the podium in one stage. The time savings were used by the contractor as a safety buffer for the extremely tight 30 months construction program and to reduce the risks of penalties.

## Green merits:

The concrete volume displaced specifically by the Cobiax void formers in the slabs equals to 440 m<sup>3</sup>. Additional concrete volume savings due to the elimination of beams are in an order of magnitude of 760 m<sup>3</sup>. The associated reduction of CO<sub>2</sub> for this concrete savings can be calculated with the Cobiax-specific ratio of 210 kg of CO<sub>2</sub> per m<sup>3</sup>. This equals to a reduction of over 250 tons of CO<sub>2</sub> for this site.

From a logistics perspective the 1'200 m<sup>3</sup> of concrete saved equals to about 200 concrete truck trips which is a welcome reduction in traffic movements in the congested CBD where the site is located.

## Economic assessment:

The total concrete savings from using Cobiax in the flat slabs and at the same time eliminating the beams in the hotel and office slabs equals to about 1'200 m<sup>3</sup>. At the same time the reinforcement amount could be optimized due to the reduction in dead load of the slabs. Its reduction is estimated to about 40 tons.

Further material savings not rated here but relevant for the project stem from the fact that the M&E installations are streamlined in combination with flat slabs and the design coordination is eased.

Finally, the productivity gain and time savings allow for an optimized site management and thus reduce the contractor's risks associated to delays and subsequent penalties. Overall, the direct cost of implementation of Cobiax was more than offset by the various benefits it brings to this project.