CASE STUDY

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1. Project Information

1.1 Scope of work

The Public Housing Development at Kai Lung Wan North is one of the reception estates for Wah Fu Estate Redevelopment. The project is a large-scale residential development consists of more than 4,200 domestic flats, welfare facilities, retail shops, kindergartens, a public library, carpark and ancillary facilities, etc.

1.2 Project location and nature of works

The site, with a gross area of about 3.3 hectares (ha), is bounded by Shek Pai Wan Road to the southwest, Wah Fu Road to the south, a maintenance road maintained by Water Supplies Department which links Kai Lung Wan Fresh Water Reservoir and Wah Fu Cable Tunnel with Shek Pai Wan Road, to the northwest respectively. The site is situated on vegetated hillside. There are 4 domestic towers with over 40 storeys sitting on a 9-storey podium.

2. Safety by Design Process

The project has participated in the Construction Industry Council's (CIC) Design for Safety pilot run Phase 2. Other than in-house design guides and design checklists, CIC also provide a list of templates and tools such as red, amber, green list, design risk register, health and safety file, etc. for project team to input throughout the design development process from design stage to construction stage. Project team would hold regular meeting to discuss safety issues and identify potential hazards and review mitigation measures. Contractors will also join the meeting regularly once appointed. The project team and the future estate management team actively evaluate the design proposals and raise project specific comments on sustainability, buildability and maintainability based on the potential safety, health and environmental hazards aspects.

3. Examples of Safe Design in this Project

The following examples are highlighted which encountered in the project.

3.1 Example 1 – Holistic Design for Safety Strategies for Tree Preservation – from planning, design, construction to maintenance

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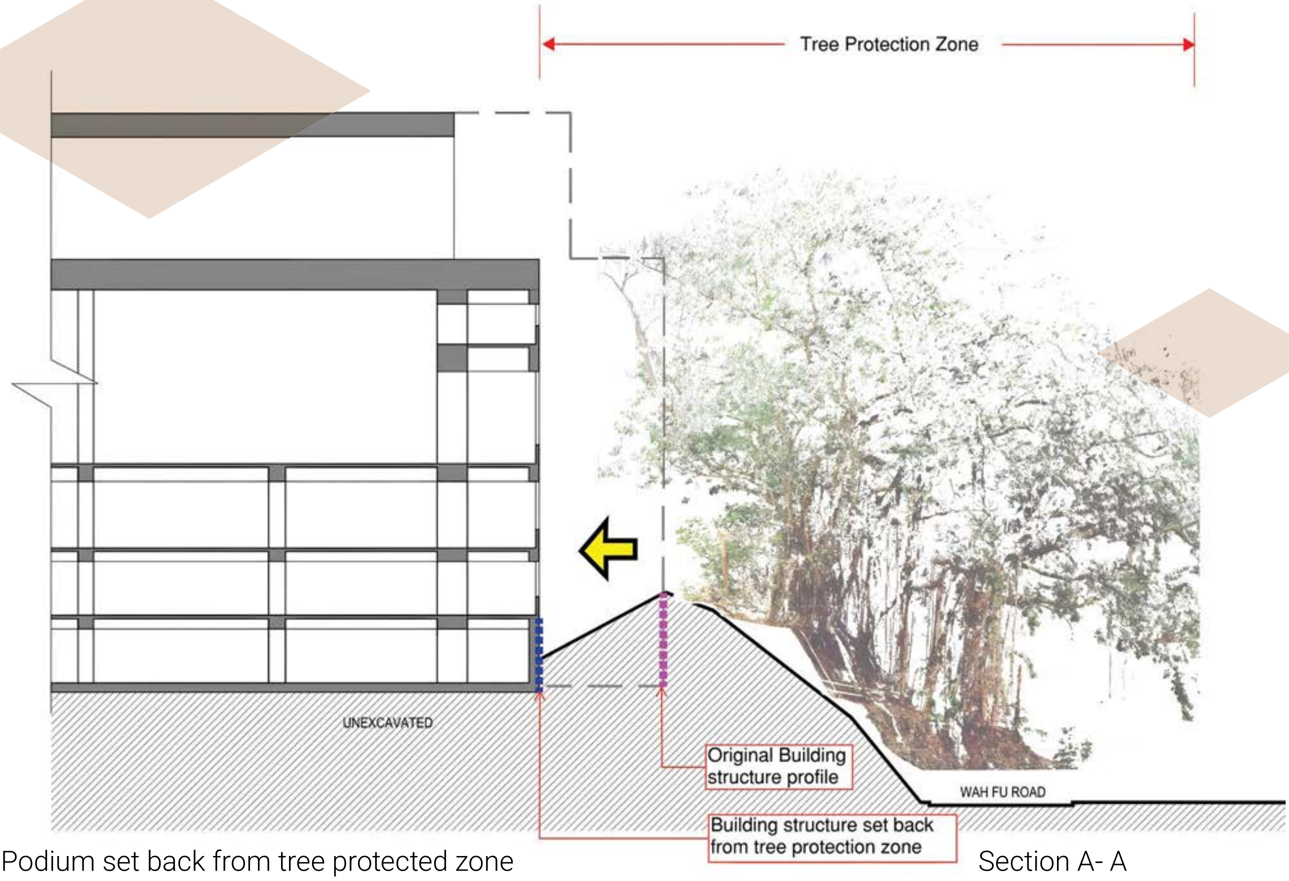
a. **Building Design** - To ensure the health and stability of the largest existing tree, which sits on the slope adjacent to the driveway, the basement layout with its excavation works and pipe pile walls is strategically set back from the slope crest and away from the tree protection zone, aiming to minimize the adverse impact on the tree.

b. **3D Technology** - A 3D point cloud model of the existing tree is used to determine the tree protection zone (i.e., the tree crown outline) and to assist in the section study for the building works.



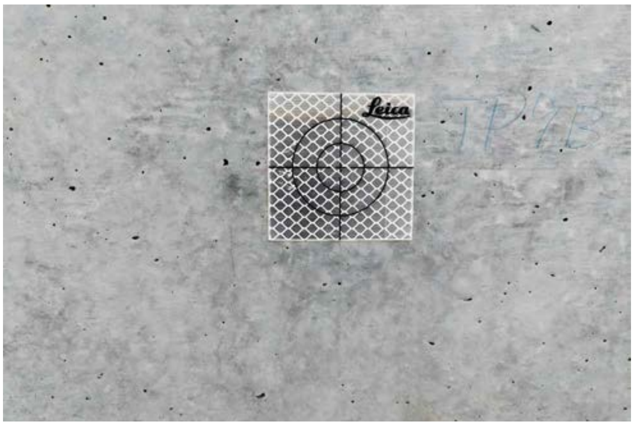
Podium set back from tree protected zone

Section A- A

c. **Tree Expert** - Qualified Arborist and Independent Tree Expert with construction works experience involving Old and Valuable Trees (OVTs) are employed under the Contractor and Consultant Team to provide arboricultural advice to minimize the impact to trees during the construction stage.

d. **Tree Monitoring** - To assess tree stability, the contractors are required to install monitoring checkpoint markers on the main trunks and major branches of existing slope trees. Measurement of tree tilting will be included in the Monthly Tree Monitoring Report, prepared by the Qualified Arborist and reviewed by the Independent Tree Expert. If monitoring shows ongoing abnormal tilting, the contractor must promptly investigate the cause, review construction methods and sequence, and report to the project team to determine practical steps to prevent further tilting.

Proposed monitoring points on existing tree



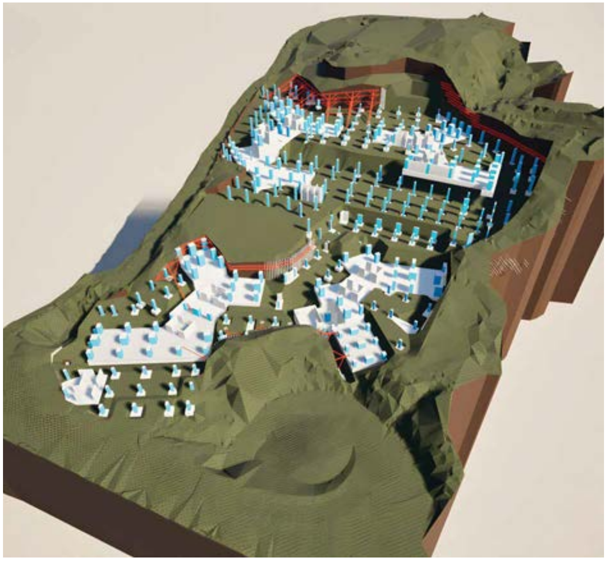
Monitoring check point

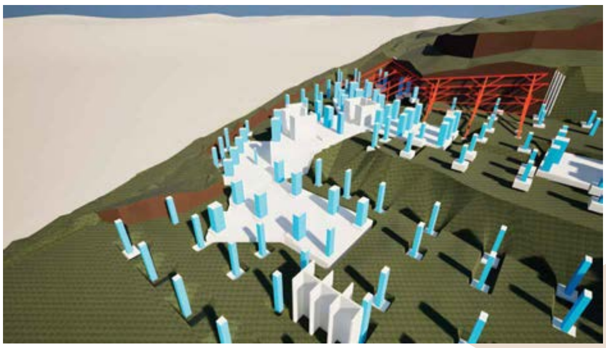
e. **Maintenance Route** - The large existing trees are located along the building edge, necessitating regular annual tree pruning. To ensure the safety of tree workers performing crown pruning, the design team has incorporated a dedicated route for elevated work platform, which is specifically planned to provide sufficient headroom, adequate turning radius, and appropriate load capacity, thereby facilitating safe and efficient maintenance operations while preserving both workers' safety and trees' health.

3.2 Example 2 – Enhance safety with BIM & GIS

BIM and GIS are used in the project to enhance safety through comprehensive data integration and effective lifecycle management. The integration of detailed 3D BIM building model with spatial data from GIS facilitates better risk assessment and design optimization. This integration helps identify potential safety hazards early in the design stage. BIM also supports the entire lifecycle of the building, enabling on going management and maintenance, which ensures safety standards are upheld over time.

The Building Information Modelling (BIM) was applied in the project to enhance the design and construction of foundation works. The adoption of BIM-enabled Semi-Automated Foundation Design system (BIM-SAFD) enabled 3D visualization of the existing topography, underground geological conditions and rock head profiles. This capability facilitated early identification and optimization of works on problematic areas such as underground obstructions, complex geological condition, that could significantly influence foundation design and construction cost. By integrating BIM, the project team could visualize both the foundation design and construction sequence in 3D, allowing design optimization and ensuring an efficient construction programme and enhance site safety.





In addition, BIM was utilized for the design, planning and coordination of temporary works associated with foundation construction. The complex Excavation and Lateral Support Works (ELSW) on the site's hilly terrain were simulated using the 3D model, allowing accurate logistical planning and effective haul road layouts across various construction stages. Through the BIM visualization, the project team could proactively identify potential difficulties and risks, including areas with significant excavation depth that might affect adjacent carriageway, sensitive structure or underground utilities. This early insight enabled precise design adjustments to eliminate adverse impacts or hazards, leading to improved safety and cost savings. With these applications, safety considerations are seamlessly embedded throughout the design and construction stages.

3.3 Example 3 – Avoid flooding and landslide hazard

The site is located on a hilly terrain, necessitating measures to manage surface run-off from the upslope catchment area and to mitigate potential landslide risks. To address these challenges, a wide surface drainage channel was constructed along the slope to effectively collect run-off and prevent flooding, in accordance with the Drainage Design Manual issued by the Drainage Services Department (DSD). Simultaneously, a rigid barrier was installed to cater the natural terrain hazard. A key integrated design feature is the 1200mm deep drainage channel, which also serves as a shared maintenance access path. This dual function was developed in requests from both DSD and the Housing Department (HD), each of which required maintenance access for their respective assets. Through coordination among the Civil Engineering and Development Department (CEDD), HD and DSD, the maintenance path requirements are holistically considered resulting in a width to allow machinery access for future maintenance work on both the drainage channel and the rigid barrier, demonstrating efficient inter-departmental collaboration and a holistic approach to design for safety.

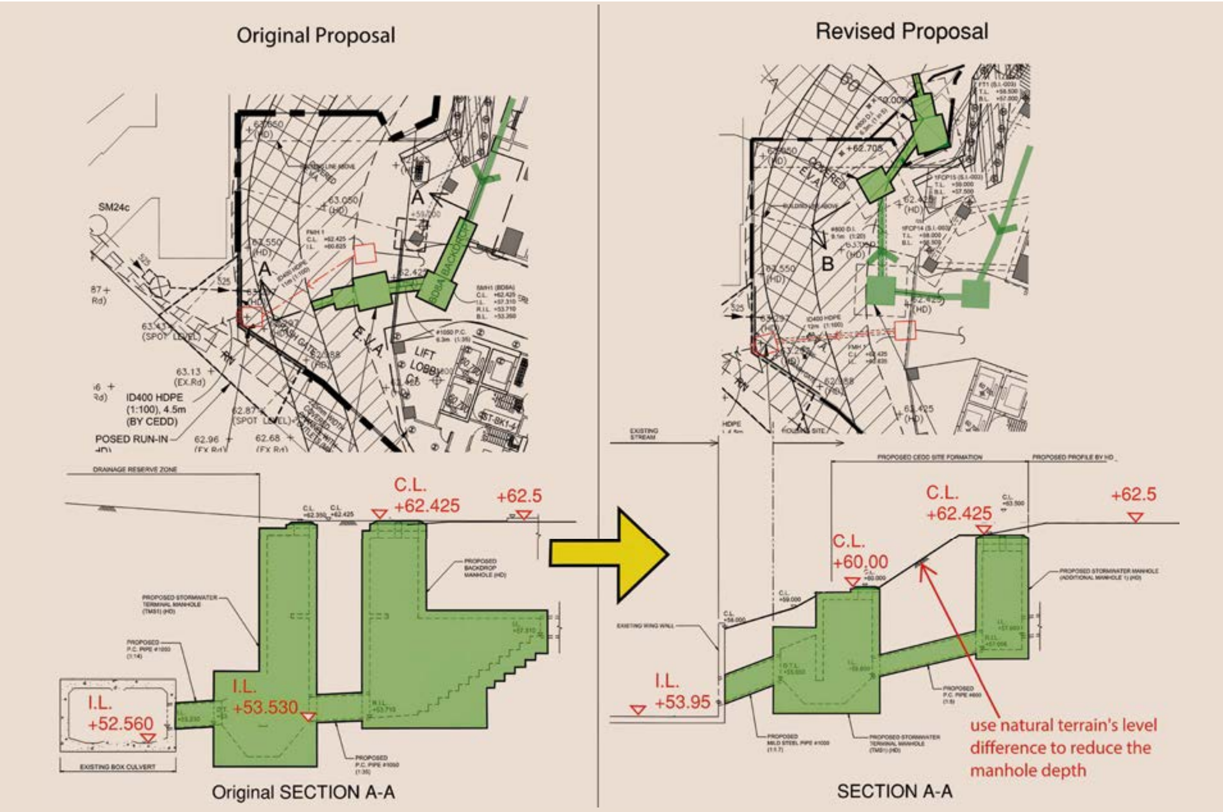
Wide surface channel and rigid barrier next to site boundary

3.4 Example 4 – Minimize rock excavation extent

The site has a high rock head level. To ensure safety, the excavation extent of the carpark has been reduced to minimize the potential nuisances and risks such as flying rock fragments during the rock breaking process.

3.5 Example 5 – Avoid deep terminal manhol

The original proposed terminal manhole was designed with a depth of about 10m to connect to an existing box culvert. This depth raises safety concerns regarding ELS works and access for future maintenance. To address these concerns, the terminal manhole has been relocated to a lower elevation, bringing it closer to the box culvert. This adjustment takes advantage of the natural slope's level difference of the site and reduces the overall depth of the terminal manhole to less than 6m.



3.6 Example 6 – Enhance site monitoring

During construction, drones can provide a "bird's-eye view" and conduct regular, pre-programmed flights over the entire site to monitor site progress, quality and safety. It can reduce physical inspections at height. In addition, contractor will be requested to use drones for real time detection of unsafe acts or conditions and send real time site data and live videos to site office and transmit data to a server for remote access by HD. This empowers site managers and project teams to monitor and enforce safety protocols with unprecedented efficiency and accuracy.

Drones to monitor site progress and quality

3.7 Example 7 – Improve lifting operation in a congested site

The site is highly congested, making lifting operations particularly challenging. Advanced site planning is essential for both the lifting zone and storage of materials, including the bathrooms and kitchens by Modular Integrated Construction. To ensure site safety, a pre-lift risk assessment should be conducted and late-cast concrete will be required for certain areas of the podium to accommodate the complex site logistics and lifting process.

Late-cast concrete for certain areas of the podium

3.8 Example 8 – Design strategy to minimize maintenance at high level

There is a jogging bridge that runs across the new access road at about 20m above road level. Building services are designed not to run underneath the jogging brridge to avoid the need for maintenance at height. Surface fall is directed towards the two ends of the bridge, and floor drains are strategically placed close to the podium edge for easy maintenance.

In areas with high headroom, such as the double volume cetnral plaza on ground floor, wall mounted lights will be proposed in lieu of ceiling lights. This approach minimizes the need for high level maintenance and to simplify maitnenance and enhances safety.