Worked Examples of

Design for Safety

職業安全健康局
Occupational Safety & Health Council

發展局
Development Bureau

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District Open Space, Sports Centre and Library in Area 74, Tseung Kwan O

Architectural Services Department

DESIGN FOR SAFETY
WORKED EXAMPLE NO. 1

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1. Project Information

1.1 Scope of work

The Project **District Open Space, Sports Centre and Library in Area 74, Tseung Kwan O** aimed to construct a joint-user complex building with a public open space, a sports centre and a district library for the population in Tseung Kwan O.

1.2 Project location and nature of the works

The Joint-user complex building was proposed to be located at a site of about 1.7 hectares, in Tseung Kwan O. The proposed project site is in a densely populated residential area surrounded by high-rise public and private residential developments such as Choi Ming Court, Tong Ming Court, Kin Ming Estate, Park Central, Metro Town and Ocean Shores. The project fulfilled the high demand of public space for leisure activity and local public library service from the residents in Tseung Kwan O district. (See Figure 1) The project was anticipated to be completed by 2015.

Figure 1 Simulation of the complex building

1.3 Roles of duty holders

Client

Leisure and Cultural Services Department (LCSD) was the client of this Project. The Project is managed by the Architectural Services Department (ArchSD). ArchSD was responsible for appointing a Project Supervisor and checking the competence of everyone appointed project team member.

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Project Supervisor

The senior architect of Ronald Lu & Partners (Hong Kong) Ltd. was appointed as the Project Supervisor in the CDM Process. The Project Supervisor was responsible for advising and assisting the client, co-ordination, liaison, and ensuring proper record in Health and Safety File. After assembly all the safety concerns, the project supervisor then had to coordinate with different designers for the solution to the health and safety problems pointed out.

Designer

The senior architect of Ronald Lu & Partners (Hong Kong) Ltd. was appointed as the Designer. They had to consider the concerns in our design and minimize hazards which may give rise to risks inform relevant parties of the remaining risks. Yet not all risks are possible to be eliminated by design, the residual risk is then communicated to the contractors prior to the construction stage.

Contract Supervisor

ArchSD was the contract supervisor of this Project. The contract supervisor was responsible for monitoring the implementation of CDM during the construction stage. The Contract Supervisor also ensured that all significant relevant information is included in the Health and Safety File.

Contractor

The Lanon Development Ltd. was the contractors of this project. The Contractors were responsible for planning, managing and monitoring the construction phase in liaison with other contractors and preparing, developing and implementing a construction health and safety plan.

Figure 2 Structure of the design team

2. Safety by Design Process

2.1 Summary of Health and Safety Concerns

Brainstorming Sessions with the relevant stakeholders, including the representatives of the LCSD as the end users, was conducted on 30 July 2008 to identify the potential risk items for this project. A Summary of Health and Safety Concerns was prepared.

Major issues raised by stakeholders		Responses	Any Action Required	
			Yes/No	Action Parties
a.	Crowd control	• Adequate size of queuing area provided in the booking area of the sports hall (50 people) and study room (200 people).	Yes	RLP/ LCSD/ PBA
		• Consideration of separate and smaller toilets rather than large ones at the sports hall for crowd control as well as easy maintenance and energy saving.		
		• Sufficient ventilation/ air movement at queuing area.		
		• Provide sufficient weather protection and shelter.		
		• PA system for announcement/ broadcasting.		
		• Prominent signage/ sign boxes showing the Emergency exits.		
b.	Spectator Stand	• Handrails provided along all staircases.	Yes	RLP/ PBA
		• Contrasting nosing colour.		
		• Avoid steep steps.		
		• Evenly distributed PA system.		
		• Emergency exit with lighting and directional signs.		
		• Spacing and access for disabled person with wheel chair at spectator stand are required.		
		• Good ventilation.		
		• Selection of easily operable retractable seating for occupational safety.		

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Major issues raised by stakeholders		Responses	Any Action Required	
			Yes/No	Action Parties
c.	Slippery surfaces in wet areas, changing rooms and queuing areas	• Non-slip floor tiles to be used.	Yes	RLP/ LCSD/ PBA
		• Provide adequate drainage to avoid accumulation of water on floor surface. • Provide conspicuous signage and warning notices against running.		
		• Good ventilation with air blowers on floor.		
d.	Floor finishes and trolleys at Library	• Select suitable floor finishes and trolleys to allow easy maneuvering and transportation of books.	Yes	RLP/ LCSD
e	Sliding acoustic partitions	• Provide electrical / mechanical means to facilitate the opening and closing of the partitions at Dance room/ multi-purpose room at the sports hall and extension activities room at the library.	Yes	RLP/ PBA
f.	Exposed corners/ items	• Adopt round corners for fixtures in the children's library.	Yes	RLP/ LCSD
		• Protection guard / pad around the exposed corners at library and sports hall.		
		• Avoid use of exposed sockets / HR that may be of potential hazard.		
g.	Storerooms	• Proper ventilation for storerooms used to store chemicals.	Yes	RLP/ PBA
		• Use of roller shutter and separate proper swing doors for transportation of materials and equipment inside the sports hall.		
h.	Disabled access Site vehicles' traffic might be dangerous to students near to the site/ pedestrians.	• The design of the project is to follow Barrier Free Access Code of Practice.	Yes	RLP/ LCSD
		• Call bells at the main entrances of the sports centre and library to contact general office for special assistance.		
		• Provide sufficient weather protection and shelter for waiting area.		

i.	Light pollution Reflection of sunlight / artificial lights from the complex and district open space may create nuisance to neighbouring buildings.	• Careful selection of building materials to prevent glare to the taller neighbouring buildings. • Careful planning of location of lights to prevent high concentration of light source. • Light source of lower intensity in the DOS instead of strong lights to avoid glare.	Yes	RLP/ PBA
j.	Green Roofs Danger of visitors/ workers falling from green roof. As confirmed with LCSD, the green roof at the sports hall shall be used as a maintenance roof and that at the library shall be used for guided tours with controlled access.	• Parapet walls or railings with landscape features around the green roofs to allow view yet prevent falling of objects / persons. • Minimize duration time of workers being on top of green roofs by use of automated irrigation systems and plant species that are of low maintenance. • Provide fall arrestors at green roofs. • Good drainage system for prevention of flooding. • Good water proof layer to avoid water leakage at roofs. • Careful planning of the irrigation and drainage points to avoid tripping. • Allow sufficient space for maintenance and transportation of materials, e.g., solar panels / tubes • Outdoor furniture at the library to be properly bolted down to avoid potential hazard during bad weather or typhoon season • Select roofing / landscaping materials that can be easily cleaned • Careful planning of roof cleaning mechanism	Yes	RLP/ PBA/ ACLA
k.	Glass Wall	• Careful planning of glass wall cleaning mechanism • Allow sufficient space for maneuvering of hydraulic platform	-	RLP/ LCSD

2.2 Hazard and Impact Summary

		Task	Hazards and Impacts	Risk Assessment Rating	Safe Design Principles
1.	Design for Operational Safety	Crowd control in queues	• Injury of users • Poor air quality	2	• To prevent large crowd blocking the circulation within the premise • To provide sufficient ventilation for large number of people in the queue
2.		Safe access and discharge at Spectator Stand	• Injury of users using the spectator stand • Poor air quality • Injury of workers for operation of retractable seating	4	• To avoid domino effect or stampeding • To provide sufficient ventilation for large number of spectators • To facilitate the staff's repeated routine of setting up / retracting the seats to cater for different numbers of spectators to avoid injury
3.		Surface treatment in wet areas, changing room and queuing areas	• Injury of users / staff	2	• To minimize risk of slipping of users / staff
4.		Transportation of books inside the Library	• Injury of staff when maneuvering books	2	• To facilitate the staff's repeated daily routine of lifting / transportation of books to avoid injury • To minimize the wear and tear / maintenance of the floor finish

Control Measures		Hazards Resolved (Yes/No)	Risk Assessment Rating after implementation of measures
Measures taken by Architect / Consultants	Measures taken by Contractor		
• Queuing areas are provided for Sports Centre Booking Office and Library Study Room. The queuing areas are provided with shelter and ventilation. • The changing rooms and toilets at Sports Centre are divided into two zones. Its operation would depend on number of users.	• Construct as per architectural layout	Yes	1
• Aisles at spectator stand are provided with contrasting nosing and self-illuminated directional signs. • Designated areas for wheelchair user provided, it is easily accessible (without ramp). • The retractable seating is provided with electrical operation.	• Sharp edge was avoided in handrail manufacture • The nosing is in contrasting color (Dark Grey) comparing with the floor tile (Light Grey). Recesses were also provided in the nosing tile in order to provide more friction	Yes	2
• Floor tiles at wet areas are with slip resistance	• All R-rating of floor tiles are at least R10	Yes	1
• Individual lift is provided for staff at each floor • The route between book stacking areas and lift are without steps and ramps • The floor finishes of staff area are heavy duty	• The R-rating BoH corridor is R10	Yes	1

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		Task	Hazards and Impacts	Risk Assessment Rating	Safe Design Principles
5.	Design for Operational Safety	Use of sliding acoustic partitions	• Injury of staff when maneuvering partitions	2	• To facilitate the staff's repeated routine of setting up the multi-purpose rooms to avoid injury
6.		Safety inside Children's Library	• Injury of children	4	• To avoid falling from height • To avoid sharp corners
7.		Transportation of goods and equipment	• Injury of staff	1	• To minimize distance of transportation • To provide flat surface to enhance ease of transportation
8.		Storage for chemicals	• Spill of chemicals Poor air quality	1	• To minimize risk of spilling during transportation of chemicals • Provide sufficient ventilation for the janitor rooms
9.		Access and assistance for Disabled access	• Injury of the disabled	1	• To provide sufficient guidance and maneuvering space for the disabled

Control Measures		Hazards Resolved (Yes/No)	Risk Assessment Rating after implementation of measures
Measures taken by Architect / Consultants	Measures taken by Contractor		
• Multi-purpose rooms and dance rooms at Sports Centre, and the Extension Activities Room at Library are provided with sliding acoustic partition • The weight of partition panel was considered so that it would be manually operated by staffs	• The heaviest panel is about 90kg	Yes	1
• All parapets (1.3mH) are higher than statutory requirements (1.1mH) • Children's Library is provided with safety padding	• Sharp edge was avoided at corners	Yes	2
• Light Good Vehicle parking spaces are provided at Library and loading / Un-loading Bays are provided at Sports Centre • Sufficient storage spaces were provided to avoid excessive stacking • Lifts are provided at Library and Sports Centre	• Construct as per architectural layout	Yes	1
• Individual janitor rooms are provided for each toilets	• Construct as per architectural layout	Yes	1
• Code of Practice for Barrier Free Access is followed • ArchSD's additional requirements on Universal Accessibility are followed • Individual accessible toilets are provided at each usable floor of Sports Centre and Library	• Construct as per architectural layout	Yes	1

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		Task	Hazards and Impacts	Risk Assessment Rating	Safe Design Principles
10.	Design for Operational Safety	Safe use of rock climbing wall	• Injury of public and users	3	• To prevent unauthorized access to the rock climbing area. • To provide safe access for maintenance.
11.		Use of water cooling tower	• Disease in water circulation system • Noise and visual nuisance	1	• To provide 'safe' water for the public. • To prevent noise and nuisance.
12.		Safety at carpark	• Danger for drivers and pedestrians	1	• To segregate vehicular and pedestrian circulation.
13.		Public safety	• Danger to public during construction	3	• To fence off the construction site to minimize risk to the public.
14.		Light pollution to neighbourhood	• Reflection of sunlight / artificial lights / facade lights / flood lights from the complex and district open space may create nuisance to neighbouring buildings	1	• To minimize glare to the neighbourhood.

Control Measures		Hazards Resolved (Yes/No)	Risk Assessment Rating after implementation of measures
Measures taken by Architect / Consultants	Measures taken by Contractor		
• Fence with lock is provided to prevent unsupervised or unauthorized access to rock climbing wall. • Cat ladder is provided behind the rock climbing wall for maintenance.	• Construct as per architectural layout.	Yes	2
• Proper monitoring of water circulation system to prevent Legionnaires' Disease. • Acoustic measures are provided	• Detail acoustic calculation was conduct to stimulate the performance of acoustic measure.	Yes	1
• Speed humps are provided at the intersection of pedestrian path and vehicular path. • Drop bars are provided to control the vehicular access. • CCTV cameras and security guard room are provided at carpark area.	• Clear demarcation for construction vehicular access within the site during construction. • Directional Signage was provided for the Construction vehicles ingress / egress. • Flag man was provided our Run-in / out of our site entrance.	Yes	1
• Provide hoarding to protect the pedestrian walkway from falling object. • Additional hoarding was added at common boundary with adjacent site.	• Provide additional visual and audio signal to the pedestrian near site run-in / out and pedestrian crossing.	Yes	1
• The selected external light fittings are downward lighting to avoid glare. • Alternate circuit is provided so that half of the external light fittings could be switched off when necessary.	• Diffuser would be provided at external light fitting. • Detail lighting stimulation was conducted to achieve balanced lighting distribution.	Yes	1

		Task	Hazards and Impacts	Risk Assessment Rating	Safe Design Principles
15.	Design for Operational Safety	Nuisance to general public	• Nuisance of noise to the public during construction	1	• To minimize noise and nuisance to the public.
16.		Metal roof truss	• Falling of heavy building components	4	• To minimize / simplify the lifting procedures of heavy building components.
17.		MTR protection zone	• Adverse effect / damage to MTR tunnel	4	• To ensure no encroachment into the MTR protection zone and no effect. On the MTR due to the construction of this project
18.		Maintenance of Green Roofs/ Metal Roof	• Danger of visitors/ workers falling from green roofs/ metal roof. As confirmed with LCSD, the green roof at the sports hall shall be used as a maintenance roof and that at the library shall be used for guided tours with controlled access.	3	• To provide safety measures for the maintenance team at the roofs. • To provide safe access for maintenance.
19.		Landscape irrigation/ cleaning of outdoor areas	• Injury of workers in maintaining the landscaped areas	2	• To provide safety measures for the maintenance team at the outdoor areas. • To minimize manual irrigation.
20.		Maintenance in Plant Rooms	• Injury of workers during maintenance work	3	• To provide safety measures for the maintenance team at the plantrooms. • To provide safe access for maintenance.

Control Measures		Hazards Resolved (Yes/No)	Risk Assessment Rating after implementation of measures
Measures taken by Architect / Consultants	Measures taken by Contractor		
• Noise barriers was adopted during piling construction • Routine noise measurements were taken to monitor the construction noise.	• Neighbor survey was conducted to collect the opinions and suggestions from neighbor • The construction period was tally with examination schedule of adjacent school to minimized the nuisance.	Yes	1
• Design the building components in such a manner to minimize parts that have to be lifted.	• Pre-fabricated trusses to minimize on-site works and frequency / duration of lifting of building components.	Yes	1
• Design of building footprint and • Foundation system outside of the MTR protection zone.	• Implementation monitoring points and submission of monitoring results to MTRC on regular basis.	Yes	1
• All green roofs and metal roofs are accessible by stairs. • Fall arrest systems are provided at green roofs, and maintenance walkways are provided at metal roof. • Inspection chambers are provided at green roof for easier inspection of drainage.	• Additional protection screeding was proposed on waterproofing of green roof. • Additional flashing was provided at metal roof at its interface detail with main R.C. structure.	Yes	2
• Auto irrigation and mechanical irrigation are provided at the project. • The allocation of irrigation provision was discussed with end users.	• Construct as per architectural layout.	Yes	1
• Coordinate with users and maintenance agents on the maintenance requirement. • Provide adequate maintenance space and access to all plant rooms.	• Carefully consider the maintenance access during the design of CSD.	Yes	1

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		Task	Hazards and Impacts	Risk Assessment Rating	Safe Design Principles
21.	Design for Operational Safety	Safe access for lighting and building services installation locations at the ceilings of library and sports centre	• Workers falling from high positions	4	• To provide safe access for maintenance.
22.		Mounting of floor piping	• Tripping hazard caused by pipes mounted on floor across the access	2	• To provide safe access during construction and maintenance stages.
23.		Location of floor opening	• Tripping hazard caused by floor openings	3	• To provide safe access during construction and maintenance stages.
24.		Maintenance Headroom	• Head injury due to insufficient head room at maintenance platforms.	3	• To provide sufficient headroom for maintenance.
25.		Maintenance platforms	• Hazard of "falling of persons from height" at maintenance platforms	4	• To provide safety measures for the maintenance team at the platforms.
26.		Use of access ladders	• Hazard of "fall of person from height" while climbing on access ladders	3	• To provide safety measures for the maintenance team at the cat ladders
27.		Operation of valves for equipment	• Muscle-skeleton hazard while operating valves	3	• To provide safe access during construction and maintenance stages

Control Measures		Hazards Resolved (Yes/No)	Risk Assessment Rating after implementation of measures
Measures taken by Architect / Consultants	Measures taken by Contractor		
• Individual hydraulic platform would be provided at Sports Centre and Library. • The selection of hydraulic platform was based on the corridor width, lift car size, door height and maintenance height.	• Portable Working platforms were provided for the B.S and ceiling works for rooms. • For the installation at Double height ceiling and Arena, A bamboo ceiling platform were erected, which were designed and checked by our RSE.	Yes	2
• Walking platforms are provided in plant rooms to cover the pipes. • No pipe work is mounted on floor at usable areas.	• Provide temporary platform to cover the floor mounted pipe during construction.	Yes	1
• All floor openings are protected by balustrade or cover.	• Provide temporary balustrade and Temporary coverage to floor openings during construction.	Yes	1
• All usable areas would have headroom not less than 2m	• Verify the as-built headroom at all usable areas.	Yes	1
• Fall arrest system is provided at maintenance walkway for metal roof at Sports Centre	• Temporary bamboo maintenance platforms were provided. • Besides, Independent safety line with RSE certification were provided for the worker to use in the platforms.	Yes	2
• Safety hoops shall be provided for access ladders with height greater than 2.5m	• A- Ladder more than 2m height was prohibited to use in our site under our in-house rule. • Ladders less than 2m height were under our Safety Officer registration before use • Portable Working platforms were provided for the B.S. and ceiling works.	Yes	1
• Working platforms shall be provided for all valves	• Temporary platform was provided for the valves.	Yes	1

2.3 Pre-tender Health and Safety Plan

The main purpose for the Pre-tender Health and Safety Plan provides information on managing the identified safety and health issues throughout the design and construction of the project. Although the Pre-tender Health and Safety Plan will not be part of the contract requirement for the contractor, but it will served as a guideline to the tenderers for their preparation of the outline safety plan. This will enable contractors to respond more specifically on how to deal with and control any residual hazards and risks which could not be eliminated in the design stage. The contractor should not be commence the construction works until he has adopted and developed his Safety Plan and reviewed by the Designer.

In this project, the Health and Safety concern are focused maintaining safety such as the maintenance work on the landscape irrigation / cleaning of outdoor areas and the danger of visitors / workers falling from green roof, as the end user (LCSD) will be using the green roof at the sports hall as a maintenance roof and that at the library shall be used for guided tours with controlled access.

3 Examples of Safe Design in this Project

The followings examples of issues raised in Summary of Health & Safety Concerns and Hazard & Impact Summary and realized in Construction Stage illustrated the adopted design considerations on safety aspects.

3.1 Example 1- Maintenance for Green Roofs and Metal Roof

3.1.1 Area of health and safety concerns

After the completion of the building, the workers need to perform routine maintenance work at the green roof at the sport hall. Hence, these maintenance workers are exposed to the risk of falling from heights. Also, the green roof at the sports should be used for guided tours with controlled access.

3.1.2 Identify the special risk problems

Regard to this, the high risk of falling from heights and falling objects are identified when the workers and visitors accessing the work area and performing their work tasks.

3.1.3 Improvement in design

Consequently, the design team has taken the following control measures during construction stage and maintenance stage. All green roofs and metal roofs are accessible by stairs; fall arrest systems are provided at green roofs, and maintenance walkways are provided at metal roof and inspection chambers are provided at green roof for easier inspection of drainage. (See Figure 3) Furthermore, the contractor provided additional protection screeding on waterproofing of green roof and additional flashing was provided at metal roof at its interface detail with main R.C. structure.

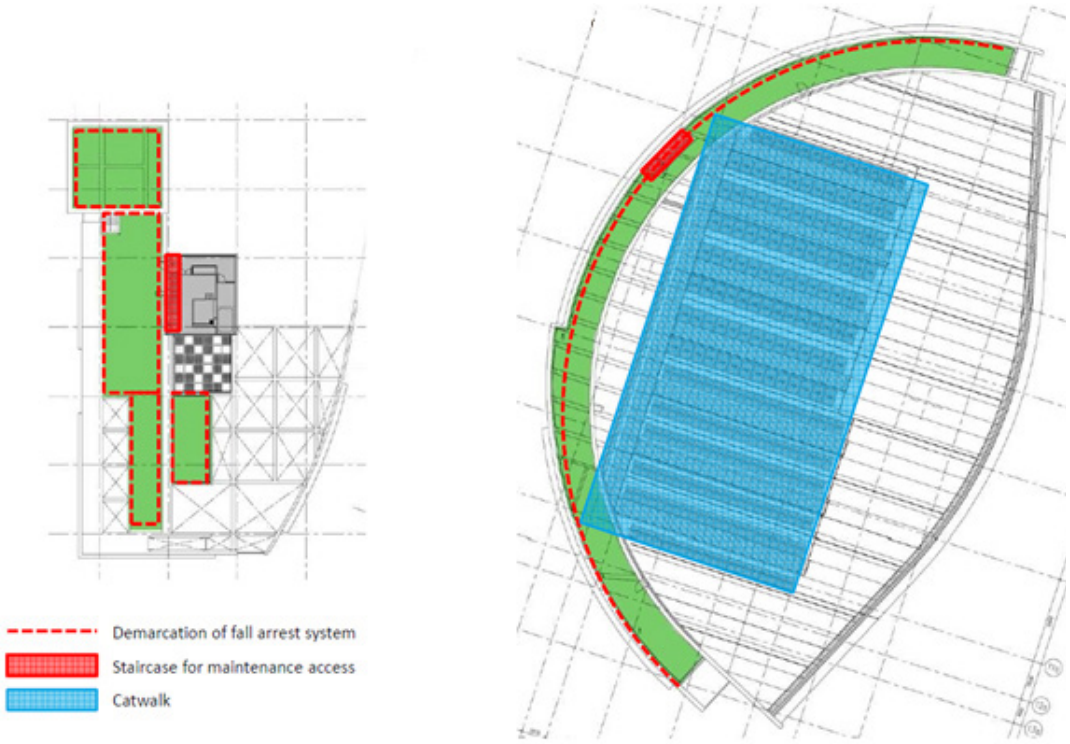

Figure 3 The floor plan of metal green roof

3.2 Example 2- Landscape Irrigation / Cleaning of Outdoor Areas

3.2.1 Area of health and safety concerns

The outdoors maintenance workers and the gardeners need to manage the landscape of the district open space area. Therefore, they would be exposed to high risk of falling from the landscape and get injured when accessing the work area.

3.2.2 Identify the special risk problems

Regard to this, the high risk of falling from heights and falling from the landscape are identified when the outdoors maintenance workers and gardeners to access their work area and perform their work tasks.

3.2.3 Improvement in design

Thus, the design team carried out the following control measures to minimize manual irrigation by providing auto irrigation and mechanical irrigation for most of the landscape area. Also, the allocation of irrigation provision was discussed with the end users in order to ensure the arrangements are suited for their need. (See Figure 4 & 5)

Figure 4 The layout of auto and manual irrigation

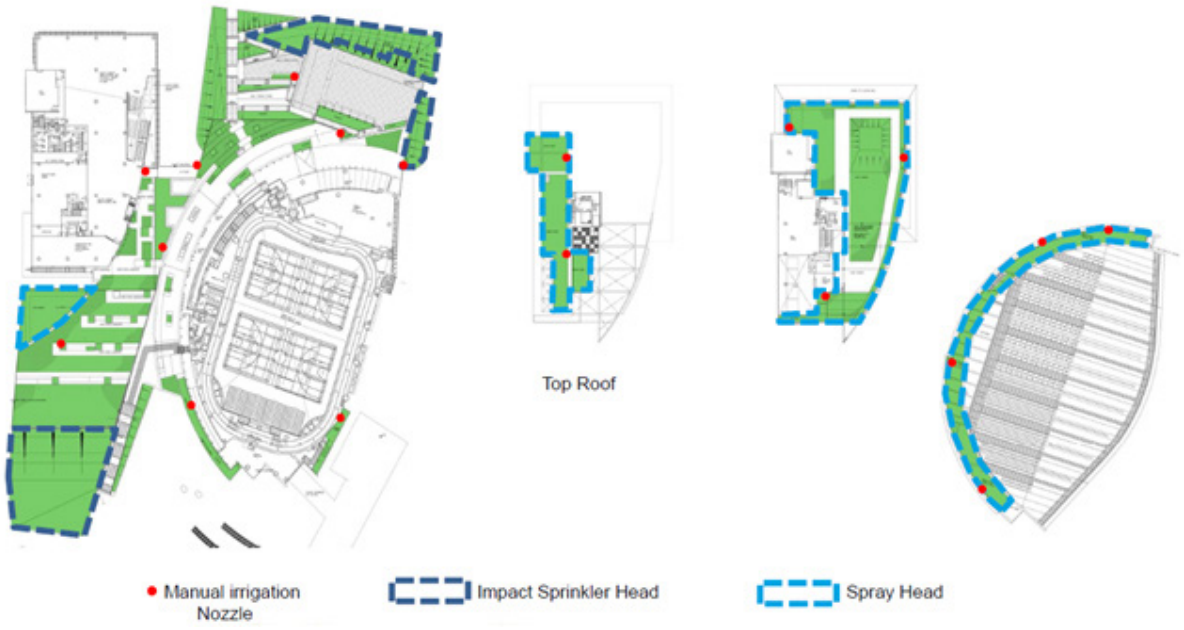

Figure 5 The layout of auto and manual irrigation at the top roof area

3.3 Example 3- Safe use of rock climbing wall

3.3.1 Area of health and safety concerns

The area of health and safety concerns for the rock climbing wall included the unauthorized access to the rock climbing wall and to provide safe access for maintenance. As they would be exposed to high risk of falling from the climbing wall area.

3.3.2 Identify the special risk problems

Therefore, the high risk of falling from heights is identified when the maintenance workers access into the rock climbing wall area and perform their work tasks.

3.3.3 Improvement in design

Accordingly, the design team added fence with lock to prevent the unsupervised or unauthorized to access the rock climbing wall. Besides, cat ladder is provided behind the rock climbing wall for maintenance. (See Figure 6)

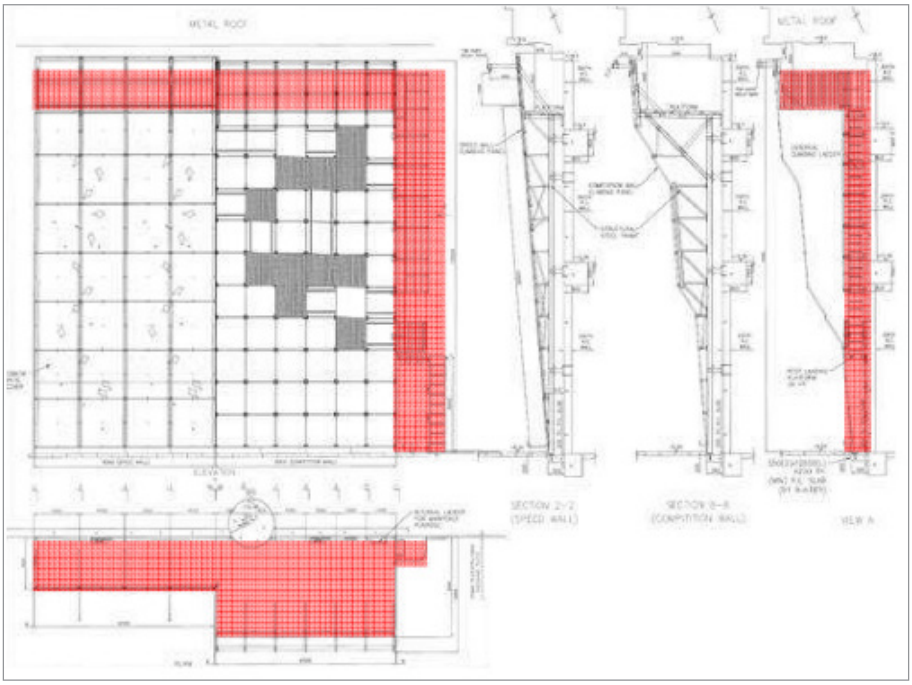

Figure 6 The layout of cat ladder and maintenance platform

Key Message

- Designing to reduce or to minimize the risks by using the auto irrigation and mechanise irrigation to replace the manual irrigation process.
- Safe access and set up controlled area at the external of the complex building in design stage to ensure the safety of the maintenance and reduce the risk of falling from height.

WORKED EXAMPLE NO.2

Joint-user Complex at Bailey Street,

To Kwa Wan Reclamation

Architectural Services Department

DESIGN FOR SAFETY
WORKED EXAMPLE NO.2

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3.1 Example 1 - Maintenance corridor on external facades

3.2 Example 2 - Use of electric trolley in the multipurpose hall

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1. Project Information

1.1 Scope of work

The project **Joint-user Complex at Bailey Street, To Kwa Wan Reclamation** is a ten-storey complex accommodating two co-users, namely Department of Health (DH) and Home Affairs Department (HAD). The Architectural Services Department (ArchSD) was in charge of the project.

1.2 Project location and nature of the works

The project is located at 42 Bailey Street, Hung Hom, Kowloon and site is about 2 200 square metres (m^2). The building consists of a Hung Hom Community Hall and Kowloon City District Office for HAD which located on top floors and ground floors and while the Dental Clinics, Maternal and Child Health Centre and Families Clinic for DH at middle floors respectively.

Figure 1 Overall of the ten-storey high complex building

1.3 Roles of duty holders

Client

ArchSD was the client of this Project. The client was responsible for checking the competence of everyone he appointed and allowing enough time and resources for all stages of the project.

Project Supervisor

The Senior Architect/ Architect of ArchSD was appointed as the Project Supervisor in the CDM Process. The Project Supervisor was responsible for advising, co-ordination, liaison, and ensuring proper record in Health and Safety File.

Designer

The Senior Architect/ Architect of ArchSD was the Designer in the CDM process. The Designer had to consider the concerns in our design and minimize hazards which may give rise to risks inform relevant parties of the remaining risks.

Contract Supervisor

The Senior Architect/ Architect of ArchSD was the contract supervisor of this Project. Despite most of the focus of CDM was placed in the design stage, CDM also played an important role during construction. The Contract Supervisor also ensured that all significant relevant information is included in the Health and Safety File.

Contractor

The China State Construction Engineering (HK) Ltd. was the contractor of this project. The Contractors were responsible for planning, managing and monitoring the construction phase in liaison with other contractors and preparing, developing and implementing a construction health and safety plan. Furthermore, the Contractors were mainly focused on the cost and time control for the project.

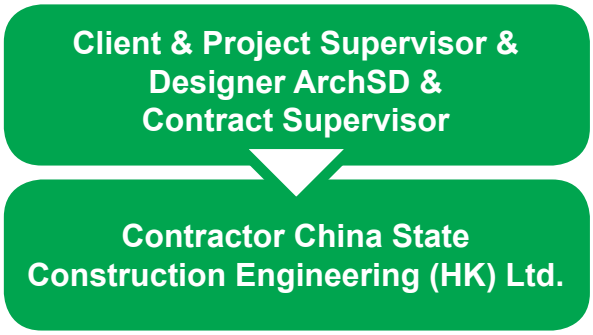

Figure 2 Structure of design team

2. Safety by Design Process

2.1 Summary of Health and Safety Concerns

Brainstorming Sessions with the relevant stakeholders, including the representatives of the HAD and DH as the end users, was conducted on 20 Feb 2009 to identify the potential risk items for this project. A Summary of Health and Safety Concerns was prepared.

Major issues raised by stakeholders		Responses	Any Action Required	
			Yes/No	Action Parties
	Construction issue			
a.	Construction noise pollution specially from piling works would affect the existing neighbourhood.	• Piling works are programmed during summer holidays to lower the adverse effect to existing school; • Permit would be sought from EPD for piling works; • Noise mitigation measures would be recommended and to be included in Tender for contractor to follow up.	Y	PA & PSE, ArchSD/ Contractor
b.	Construction work would affect school operation;	• Pre-construction meeting to be arranged between Project Team and school to advise the school on the forthcoming works schedule; • Regular meetings with school during the construction period to be included in Tender for contractor to follow up	Y	Design Team, ArchSD/ Contractor/ HAD
c.	Site vehicles' traffic might be dangerous to students near to the site / pedestrians.	• Liaison with TD and DLO to obtain a safe temporary site access; • Contractor is required to carry out safe traffic arrangement as part of Contractual requirements.	Y	PA & PM, ArchSD / Contractor
d.	Public roads contamination caused by dirty site vehicles	• Contractor is required to clean up site vehicle before leaving the site to prevent contamination to roads as part of Contractual requirement.	Y	PA, Arch SD/ Contractor

Major issues raised by stakeholders		Responses	Any Action Required	
			Yes/No	Action Parties
	Construction issue			
e	Provision of barrier free access for disabled.	• The building layout would be designed according to the latest Design Manual – Barrier Free Access 2008 e.g. Tactile guide path would be provided;Lift no.3 to 6 would be designated as Disabled Lift with confirmation by HAD and DH.	Y	PA, ArchSD
f.	DH queried access to Clinical Waste Store on G/F is dangerous to staff.	• Only low vehicular traffic would be involved at L.U bay on the way to Clinical Waste Store.	N	-
g.	HAD pointed out that DG Store located and facing pavement is not safe to the public	• DH clarified that only alcohol and oxygen cylinder would be stored and their daily logistic is normal practice and would cause minimal risk to public. • HAD confirmed it is acceptable for such arrangement.	N	-
h.	Main Cleaner's Room is requested by DH on G/F	• To be incorporated	Y	PA, ArchSD
i.	Glare and reflection from glass wall or window would cause nuisance	• No reflective glass will be used in the windows / glass wall of this building	Y	PA, ArchSD
j.	Independent lift ventilation for transportation of infectious patients is requested by DH	• Whether an air filtration system to be installed within the lift will be reviewed	Y	PBSE, ArchSD

2.2 Hazard and Impact Summary

Task		Hazards and Impacts	Risk Assessment Rating +	Control Measures	Hazards Resolved Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to Be Notified
1.	On-site installation/ Maintenance of plant material at terraces and podium	• Falling from height when doing pruning or replacement of plant	4	• Install cable / anchor hook at planter for anchoring of safety belt. • Review contractor's delivery and installation methods	Y	Y	Nil
2.		• Falling objects when installing soil and plant at terraces and podium	4	• Ditto	Y	Y	Nil
3.	Transplanting of existing tree	• Falling object from existing tree when doing crown pruning / uplifting	3	• Review contractor's tree transplanting method statement	Y	Y	Nil
4.	On-site installation of curtain wall / cladding	• Injury by collapsing	3	• Specify requirements of competent site safety supervision • Review the Contractor's method statement of installation	Y	Y	Nil
5.		Falling from height	4	• Ditto	Y	Y	Nil
6.		Electric shock at welding	4	• Ditto	Y	Y	Nil
7.		Gondola tilting	4	• Ditto	Y	Y	Nil

WORKED EXAMPLE NO.2

Task		Hazards and Impacts	Risk Assessment Rating +	Control Measures	Hazards Resolved Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to Be Notified
8.	Restricted site access (One vehicular access)	• Vehicles queue will cause traffic Jam on Sung On Road and block the EVA of the site and the neighbouring premises	2	• Inform Transport Department / Police to extend the non-parking area on Sung On Road to avoid unauthorized parking outside the access point	Y	Y	Police & TD
9.	Piling and Sub-structural Works	• Collapse of piling rig	6	• Review the Contractor's safety plan and method statement	Y	Y	N/A
		• Collapse of temporary shoring works during excavation	6	• To include the requirement of an independent checking engineer in the Contract to check and certify the Contractor's temporary works design and construction	Y	Y	N/A
		• Excessive ground settlement and vibration during piling operation	4	• To include the requirement of ground movement monitoring and control in the Contract	Y	Y	DSD
		• Excessive noise generated during driving of steel H-piles	4	• To include the requirement of noise mitigation measures around piling rigs in the Contract	Y	Y	N/A

10.	Construction of double floor height structures (e.g. Enclosure walls and Roof of Hall and some area of floor / column structures below 3/F)	• Fall from height and Collapse of formwork and falsework	6	• Review the Contractor's safety plan and method statement • To include the requirement of an independent checking engineer in the Contract to check and certify the Contractor's temporary works design and construction	Y	Y	N/A
11.	Construction of Transfer Beam above stage of hall	• Fall from height and Collapse of formwork and falsework	6	• Review the Contractor's safety plan and method statement • To include the requirement of an independent checking engineer in the Contract to check and certify the Contractor's temporary works design and construction	Y	Y	N/A

WORKED EXAMPLE NO.2

Task		Hazards and Impacts	Risk Assessment Rating +	Control Measures	Hazards Resolved Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to Be Notified
12.	On-site installation of plant material at height, e.g. installation at ceiling level,	• Falling from heights	3	• Provide guarded stairs, catwalks, working platform, etc. for equipment require regular service/ maintenance • Equip workers with safety harness,safety belt, fall arrestor and independent lifelines attached to secure anchorage points, in particular installation and maintenance of lightning protection system on the roof • Review the Contractor's safety plan and method statement	Y	Y	Nil

13.	Manual handling of heavy and bulky equipment	• Cause harm / injury to workers, e.g. sprains, strains and back pain.	3	• Locate main equipment rooms at outer walls of buildings to facilitate transportation of heavy and bulky equipment such as switchboard and generator. • Design modular switchboards with smaller components. • Provide adequate lifting facilities such as lifting beam/eye for heavy parts (pumps, motors, compressors and fans) need to be lifted for maintenance. • Provide mobile trolley for transporting bulky machine parts, such as ACB or MCCB in switch rooms. • Review the Contractor's safety plan and method statement.	Y	Y	Nil

2.3 Pre-tender Health and Safety Plan

The Pre-tender Health and Safety Plan contained the information of the existing site environment and site constraint of the project. Also, the briefing sessions were held to discuss the existing hazards, design considerations and the issues which needed the contractor to pay attention into during construction stage, were recorded in the Pre-tender Health and Safety Plan. Additionally, the residual risks will be addressed into the contractor's safety plan.

In this project, the health and safety concerns are focused on the maintenance of plant material at terraces and podium as well as the heavy workload for the workers in manual handling of heavy and bulky equipment during operation.

3. Examples of Safe Design in this Project

The followings examples of maintenance corridor on external facades and use of electric trolley in the multipurpose hall illustrated the adopted design considerations on safety aspects.

3.1 Example 1- Maintenance corridor on external facades

3.1.1 Area of health and safety concerns

After the completion of the building, the workers need to perform routine maintenance work and planting work at the external of the building. Therefore, these maintenance workers and gardeners are exposed to the risk of falling from heights.

3.1.2 Identify the special risk problems

In this case, the high risk of falling from heights and falling objects are identified when the workers accessing the work area and performing their work tasks.

3.1.3 Improvement in design

In order to improve the safety and access for the workers during maintenance of the external facade and windows etc., the maintenance corridors are provided at typical floors. As the maintenance corridors are wide enough to facilitate safe and easy access for the workers to the areas to maintain soft landscape or to clean windows, etc. as it provided the protective barriers to minimize the hazards of falling. (See Figure 3)

Figure 3 The view of Maintenance corridor

3.2 Example 2 -Use of electric trolley in the multipurpose hall

3.2.1 Area of health and safety concerns

In order to make use of the space for the multipurpose hall, the audience chairs are stored under the stage. The chairs are used for carrying out various activities in the hall. However, there are possible risk of muscular injury when carrying the manual handling operation frequently.

3.2.2 Identify the special risk problems

In this regard, the maintenance works would be subject to a high risk when carrying out the manual handling operation when placing and stacking up the audience chairs.

3.2.3 Improvement in design

To facilitate safe and easy operations for the workers when storing and retrieving the large numbers of audience chairs, an electric trolley is provided to assist the workers. (See Figure 4 & 5) The electric trolley allowed the workers to move the chairs quickly and easily to the designated place without carrying out overloading with manual handling work. The electric trolley is stored in a small room in the hall and located near the stage which is easy to access.

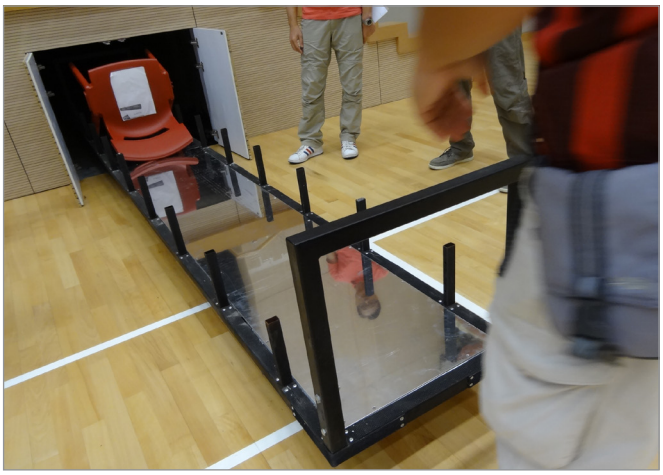

Figure 5 The electric trolley transporting the chairs

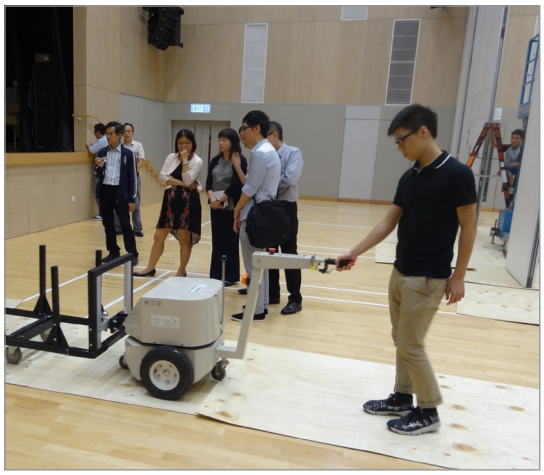

Figure 4 The view of electric trolley

Key Message

- Designing the structure so that maintenance a structure can be performed safely from the structure.
- Designing safe access and sufficient space to undertake structure maintenance activities.
- Designing to avoid or reduce the risks by using mechanise or auto make the manual handling process.

WORKED EXAMPLE NO.3

Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O

Architectural Services Department

DESIGN FOR SAFETY
WORKED EXAMPLE NO.3

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3.2 Example 2 – Link Lift System

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1. Project Information

1.1 Scope of work

The project **Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O** is to build a cycling track in Tseung Kwan O in Hong Kong. The Indoor velodrome will provide a 200-metre long and 7-metre wide (with another 4 to 5.5-metre wide safety zone) cycling track and other ancillary facilities (including changing rooms for cyclists, cycle stores and cycle workshop) which meet standards for international competition. The track centre will accommodate a multi-purpose arena for use as basketball, volleyball, badminton courts and venue for gymnastics, etc. The spectator stand has 2000 permanent seats and 1000 portable seats.

1.2 Project location and nature of the works

The project is to provide a town park and an indoor velodrome-cum-sports centre in Hong Kong's Area 45 Tseung Kwan O bounded by Wan Po Road at the Northeast and Po Hong Road at the Southwest. The site has an area of about 6.6 hectares and has adjoined the site of Tseung Kwan O Sports Ground at the southeast end. It is in the midway between Hang Hau and Tseung Kwan O MTR stations.

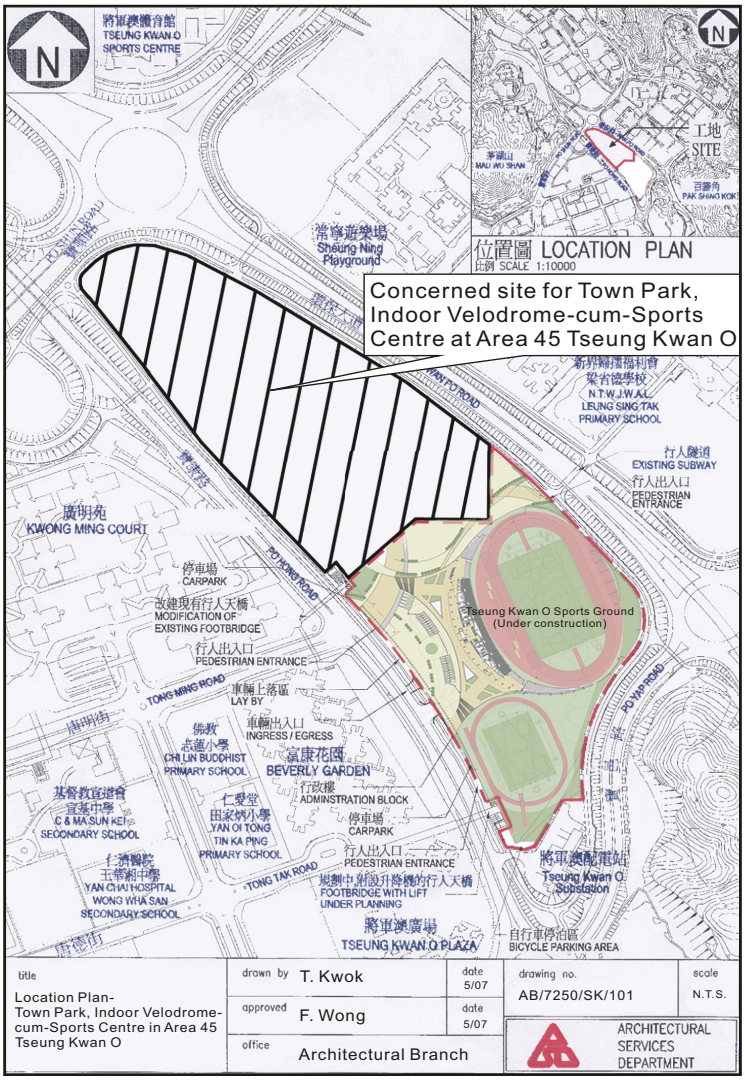

Figure 1 Location Plan for the Project

1.3 Roles of duty holders

Client

Leisure and Cultural Services Department (LCSD) was the client of this Project. The Architectural Services Department (ArchSD) was the project manager for this project. ArchSD was responsible for checking the competence of everyone appointed project team member.

Project Supervisor

The lead architect of P&T Architects and Engineers Limited (PTAE) was appointed as the Project Supervisor in the CDM Process. The Project Supervisor was responsible for advising and assisting the client, co-ordination and ensuring the essential are recorded in Health and Safety File.

Designer

The project team of P&T Architects and Engineers Limited (PTAE) was appointed as the Designer. The Designer had to consider the concerns in our design and minimize hazards which may give rise to risks inform relevant parties of the remaining risks.

Contractor

Shui On Construction Co., Ltd. was the main contractor for this project. The Contractors were responsible for planning, managing and monitoring the construction phase in liaison with other contractors and to prepare a Construction Health and Safety Plan, detailing his plans for managing the health and safety of the construction site.

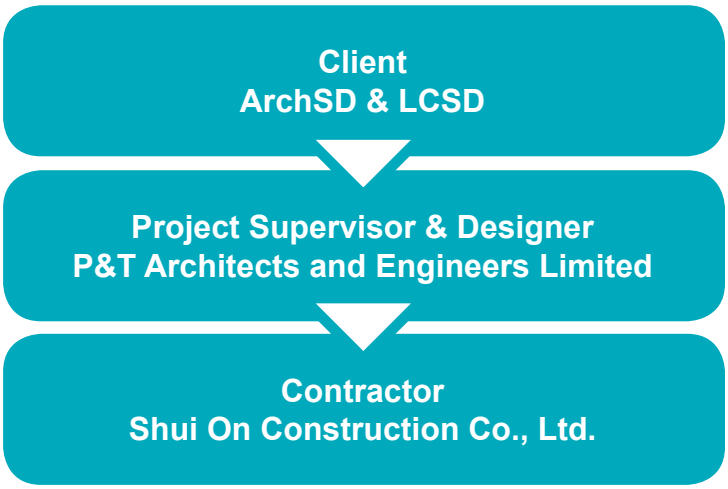

Figure 2 Structure of design team

2. Safety by Design Process

2.1 Summary of Health and Safety Concerns

This document records the major potential concerns or hazards identified by stakeholders, including end-users, maintenance agents (if available), etc., at the sketch design stage. The designer's initial responses and any strategic decisions taken or actions required, together with the appropriate action parties will be documented. This document also provides an important basis to facilitate subsequent risk assessment and identification of cost-effective control measures as per the CDM process at the later stage of the Project.

Major Issues Raised by Stakeholders		Responses [see Note (1)]	Any Action Required [see Note (2)]	
			Yes /No	Action Parties
A. General Planning (Surrounding Environment, Site clearance / demolition, site investigation, site access (onto / within site), site layout				
a.	Site located adjoining Tseung Kwan O Sports Ground (now under construction)	• Close coordination with users to avoid noisy construction works to be conducted during EAG period (Dec 2009)	Yes	PTAE
		• Proper planning on the site ingress / egress location on Po Hong Road to minimize the impact to TKO Sports Ground		
		• Provision of proper physical isolation of dust and noise from site boundary (e.g. canvas for enclosure) to avoid debris leaking into the sports ground [Post meeting note: Construction is scheduled to commence in early 2010 in latest Master Programme, i.e. after EAG period]		
b.	Site near schools	• Close coordination with school principals, e.g. check with school calendar, to avoid any noisy works to be conducted during examination period	Yes	PTAE
		• Proper planning on the construction site ingress / egress location to minimize the impact poses to students		

c.	Bus terminus on Po Hong Road is about 60 m away from the site access point which may have impact due to passengers queuing	• Design to avoid the façade of the building to line up with the bus terminus • Hoarding to separate the public from the site during construction	Yes	PTAE
d.	Site access and construction vehicular movements which may pose potential hazards to public	• Design to provide safe ingress and egress onto public road • Proper traffic control / diversion mechanism • Provide a well-defined pedestrian path	Yes	PTAE / BMT
e.	Existing underground utilities, drainage and manholes within the site area	• Conduct an underground utility mapping to locate the position of any existing utility • Liaison with utility companies to arrange for service diversion ahead of main work	Yes	PTAE / WSP
f.	Tree transplant / felling - a lot of existing trees within the site	• Tree survey will be conducted • Strategic design to minimize the number of trees to be affected • The spatial requirement for tree transplantation will be reviewed and coordinate with LCSD for reception area for the transplanted trees • Contractor to provide a method statement before commencement of tree transplanting and removal • Provide adequate works area for trees transplantation / removal	Yes	PTAE / ADI / LCSD
g.	Site clearance before construction works	• Part of the site is now being used as a temporary car park, no demolition works anticipated except tree removal / transplanting	No	NIL

	Major Issues Raised by Stakeholders	Responses [see Note (1)]	Any Action Required [see Note (2)]	
			Yes /No	Action Parties
B. Excavations and Foundations (General excavation, deep basement and shafts, trenches for foundation / services, retaining walls, ground stabilization, piling, underpinning				
a.	Vibration / ground movement affecting the adjacent structures	• Current design has no basement structure and this could reduce excavation works	Yes	OAP
		• Ground investigation to propose the best foundation scheme for the proposed structures		
		• Close monitoring during construction on vibration and ground settlement		
b.	Collapse of trench/ excavation or falls into trench / excavation	• Consider other construction techniques to avoid the use of trench excavation if possible	Yes	OAP
		• Provide adequate ground conditions information to contractor		
		• Provide adequate support to the trench and identify safe working space for excavation works		
		• Proper covering of trench and guard rails to be provided		
		• Warning notice to be placed to alert others from falling into the trench / excavation		
c.	Noise / dust arise from excavation and foundation	• Due consideration on noise impact when choosing the foundation system	Yes	PTAE / OAP
		• Close coordination with school principals, e.g. check with school calendar to avoid any noisy works to be conducted during examination period		
		• Provision of proper physical isolation of dust and noise from site boundary (e.g. canvas for enclosure)		
		• Water spraying onto the work surface to reduce dust problem		
d.	Access requirement for piling machines within the workspace	• Design to review the type of piling system to be used with due consideration on the spatial requirement and noise impact	Yes	OAP

WORKED EXAMPLE NO.3

	Major Issues Raised by Stakeholders	Responses [see Note (1)]	Any Action Required [see Note (2)]	
			Yes /No	Action Parties
C. Primary structure (General concrete, in-situ concrete, pre-cast concrete, pre-stressed, post-tensioned concrete, general steel work, stability and erection of structural steelworks				
a.	Fall from height during concreting frame of building	• Encourage the use of pre-fabricated elements off site	Yes	PTAE / OAP
		• Provision of safe working platform with proper personal protection equipment		
b.	Fall from height during erection of structural steelwork	• Consider pre-assembly on ground level	Yes	PTAE / OAP
		• Ensure adequate bracing is provided to temporary structure		
		• Design to provide a safe access		
		• Close monitoring to ensure no excessive loading (including machines) exerted on the steel roof		
		• Contractor to provide the detail sequence of erection for approval		
		• Due consideration on sequencing of roof construction which will attract risk of falling, temporary instability, weather hazards and temporary storage problems on roof		
c.	Collapse of scaffolding and temporary supporting structures in case of typhoon	• Contractor to ensure the mechanical strength of scaffolding is adequate	Yes	OAP
		• Contractor to provide sufficient lateral tie to the scaffolding to secure its stability		
d.	Long span roof structure (over 100 m)	• Due structural consideration to provide adequate load bearing capacity of the heavy roof structure	Yes	OAP
		• Lightweight roof material to be considered		
		• Temporary measures to avoid immature collapse during construction		
		• Consider pre-assembly on ground level to minimize the time to work at height		

Major Issues Raised by Stakeholders		Responses [see Note (1)]	Any Action Required [see Note (2)]	
			Yes /No	Action Parties
D. Building Elements and Building Services during Construction and Maintenance (External cladding, roof coverings and finishes, atria, windows/ glazing including window cleaning, cleaning of building, mechanical services, electrical services, public health service, lifts, escalators and auto walks				
a.	Fall from height during construction	• Design to maximize the use of pre-fabricated cladding	Yes	PTAE
		• Design to avoid the use of features that are difficult to construct or difficult to carry out maintenance works		
		• Provision of safe working platform with proper personal protection equipment		
b.	Installation of major BS equipment within the Velodrome	• The sequence of installation to be well planned to minimize the time to work at height	Yes	PTAE / WSP
		• Design to minimize major BS items to be installed on roof which could reduce the loading and risk of falling		
		• Provision of adequate space for maintenance / manual handling of equipment in plant room and along ingress / egress route		
d	Tripping / slipping hazard	• Design to minimize the low level piping / fixing and sharp edges	Yes	WSP
e.	Flammability of Electrical services	• Design to consider non-combustible material for all electrical equipment to guard against construction / electrical fire	Yes	WSP
f.	Scoreboard installation	• Design to ensure the support of loading of the scoreboard and its associated facilities are adequate	Yes	WSP / OAP
		• Proper catwalk system will be provided		
g.	Material selection of cycling track and arena	• Material selection should take into account of maintenance concern	Yes	PTAE
h.	Water cooling tower on roof of Velodrome	• Design to comply with the hygienic and maintenance guidelines for prevention of Legionnaires' disease in cooling towers	Yes	PTAE / WSP
		• Locate the cooling tower so that the exhaust is directed away from the air-intake system / adjacent occupants		
		• Proper acoustic provision to minimize the noise impact		

WORKED EXAMPLE NO.3

Major Issues Raised by Stakeholders		Responses [see Note (1)]	Any Action Required [see Note (2)]	
			Yes /No	Action Parties
E1. Operation of Velodrome				
a.	Emergency access inside the Velodrome	• Design to provide emergency access for vehicles and work machines. The access should be adequate for bulky equipment (e.g. large stage props, scene settings) to be moved in and out of the infield	Yes	PTAE / WSP/ AEC
b.	Danger of players during ball games and flying of balls out of the infield to the cycling track	• A safety net or protective mechanism in harmony with the architectural design	Yes	PTAE
		• A safety margin of at least 2m will be provided in the design		
c.	Spectator circulation	• Adequate circulation area will be provided	Yes	PTAE
		• Adequate ventilation with localized air conditioning will be provided		
d.	Spectator stand	• Handrails to be provided	Yes	PTAE
		• Design to avoid steep steps		
		• Consider to use contrast nosing coloring scheme		
e.	Ventilation	• Adequate ventilation is maintained with consideration of the heat generated from other services	Yes	WSP
f.	Disable access inside the Velodrome	• Design to provide some spectator seats to be wheelchair accessible seating and with a companion seat for persons accompanying	Yes	PTAE
		• Design to comply with Barrier Free Access Code of Practice and Universal Accessibility Practice and Guidelines		
g.	Noise	• Design of the Velodrome will adopt acoustic material to minimize the noise impact from the centre	Yes	WSP/ AEC/ PTAE
		• Design to explore acoustic provision to minimize the noise generated from cycling activities to the in-field users		

h.	Equipment storage room / machineries room	• Adequate headroom shall be provided for each type of store room as listed in Schedule of Accommodation	Yes	PTAE
i.	Lighting	• Lightings to be designed to minimize glare	Yes	WSP
		• Emergency lighting will be provided in spectator area leading to exit points in case of power failure.		
j.	Children play room	• Matting and non-sharp edged furniture will be used	Yes	PTAE
		• Special treatments to minimize the noise		
k.	Loading capacity of arena	• Structural design of the arena to take account for the loading capacity of the maintenance equipment	Yes	OAP
l.	Toilets / shower	• Proper selection on non-slip floor tile which is slip-resistant when it is wet	Yes	PTAE / WSP
		• Good floor drainage system		
		• Good ventilation		
		• Warning signage		
m.	Emergency evacuation procedures during events	• Emergency lighting will be provided in all activity areas leading to exit points in case of power failure	Yes	WSP / LCSD
		• Emergency generator will provide backup power for fire fighting equipment		
		• LCSD to develop an evacuation procedure		
E1. Operation of Town Park				
n.	Trees planting in the Town Park	• Proper tree species to minimize pest growing	Yes	ADI
		• Ensure the soil depth is enough for each type of trees		
		• No poisonous trees will be planted		
o.	Location of covered amphitheatre	• Design layout to locate the covered amphitheatre to be far away from residents to avoid nuisance to nearby residents	Yes	PTAE / WSP/ AEC
		• Proper material and orientation to minimize the noise impact		

p.	Artificial lake and modal boat pool	• Proper circulation and filtration system to ensure no standing water during Town Park closure and ensure the pool water quality	Yes	PTAE/ WSP/ ADI
		• The maximum water depth of artificial lake is about 400mm which can minimize drowning risk		
		• Shallow water zone or soft landscape on the peripheral of the lake and pool to prevent falling into the water and being drowned		
		• Warning signboard		
q.	Skateboard area	• Good surface drain to be provided	Yes	PTAE / LCSD
		• Toilets and first aid room are provided		
		• EVA allows fast access to the area in case of emergency		
		• The area is locked after opening hours to ensure security of the park.		
r.	Security of the town park	• Public Address System to be provided for broadcasting emergency messages	Yes	WSP
s.	Ergonomics - muscular-skeletal injuries from posture/ manual handling	• Lifting appliances / trolleys will be provided for transportation of materials	Yes	LCSD
		• An outline of policy of ergonomics to be provided		
t.	Slips and trips	• Consider non-slippery finishing / low-slip	Yes	PTAE
		• risk materials		
		• Design to smoothen sharp edges or to provide padding if necessary		
u.	Parking spaces/ loading and unloading	• Convex mirrors at turning points	Yes	PTAE
		• Speed bumper		
v.	Toilets / showers	• Proper selection on non-slip floor tile which provide good anti-slippery performance when it is wet	Yes	PTAE / WSP
		• Good floor drainage system		
		• Good ventilation		
		• Warning signage		

Major Issues Raised by Stakeholders		Responses [see Note (1)]	Any Action Required [see Note (2)]	
			Yes /No	Action Parties
F. Maintenance				
a.	Fall from height while carrying out maintenance works / cleaning	• Design to take due consideration on the cleaning strategy, e.g. form and geometry of the facade to be cleaned	Yes	PTAE/ LCSD
		• Provide proper maintenance platform / hydraulic platform / access route for maintenance works		
		• Proper material to lengthen the lifespan of cladding and avoid materials / finishing that require aggressive cleaning		
		• Proper personal protective equipment to be provided		
b.	Falling objects / edge protection	• Design to consider parapet to avoid falling / dropping objects	Yes	PTAE
		• Design to consider permanent installed roof mounted cleaning equipment to avoid access away from roof edge		
		• Design to consider proper maintenance walkway, fall arrest system, adequate edge protection (e.g. handrails)		
c.	Tripping / slipping hazard	• Design to minimize the low level piping / fixing and sharp edges	Yes	PTAE/ WSP
d.	Ergonomics - space requirement while carrying out maintenance works	• Adequate space will be provided for fixing pipe and duct works	Yes	PTAE/ LCSD
		• Design to minimize the low level piping / fixing and sharp edges		
		• Design to provide enough headroom		
		• Extensive manual lifting will be avoided		
e.	Climbing wall	• Design to consider proper access and strategy for inspection and maintenance works	Yes	PTAE
		• Ensure enough space for different zoning (e.g. call zone, isolation zone and warm up area) with outdoor safety landing mats of approved type beneath the wall for wall climbing activities		
		• Enough headroom for carrying out maintenance works		

2.2 *Hazard and Impact Summary*

During the detailed design stage, Project designers have to conduct risk assessment to their own design, to ensure that the major health and safety concerns identified in Work Stage 2 are adequately addressed and risk control measures are established in the hierarchy of avoidance, minimisation and control.

Project: Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O Programme No. 054RG Workstage 3 - Hazard and Impact Summary Mode B: Construction - Excavations and Foundations (General excavation and trenches for foundation/ services)

	Task	Hazards and Impacts	Likelihood	Consequences	Risk Assessment Rating (Before Control Measures)#
1.	Site located adjoining Tseung Kwan O Sports Ground (now under construction)	During construction, big construction vehicles and heavy traffic may have safety impacts to the adjacent Sports Ground users; the noisy works may also affect the East Asian Games at Dec 2009	2	1	2
2.	Site near schools	During construction, the noisy works may affect the daily school activities; the movement of construction vehicles may also pose hazards to students	2	2	4
3.	Bus terminus on Po Hong Road is about 60 m away from the site access point which may have impact due to passengers queuing	A lot of people queue up at the bus terminus; construction vehicle/ traffic may result in safety hazard to them	2	2	4

This document records the methodology of the risk assessment and the hazards and impact associated with this Project. It also provides an important basis to the extent of information to be contained in the Pre-tender Health and Safety Plan.

Control Measures	Hazards Resolved (Yes/ No)	Necessity to Notify Contractor (Yes/ No)	Other relevant parties to be notified
Architectural (PTAE): • Construction works are scheduled at early 2010, which is after the EAG • Provision of proper hoarding along the site boundary to avoid dust / debris leaking into the Sports Ground • It is agreed with TD/ HyD that proposed run-on / run-out is at Po Hong Road which is 60m away from the Bus Terminus • It will be specified in the tender that the contractor must comply with all relevant statutory requirements regarding noise control	Yes	No	No
Architectural (PTAE): • The run-in/ run-out is located far away from the schools • Coordination with schools to avoid noisy works to be carried out during examination period • It will be specified in the tender that the contractor must comply with all relevant statutory requirements regarding noise control	No	Yes - Contractor shall liaise with school principals for the noisy works schedule	Schools Principals
Architectural (PTAE): • Design to avoid the facade of the Velodrome to line up with the bus terminus • Hoarding to separate the public from the site during construction. • Liaison with TD, HyD and bus companies will be carried out prior to erection of hoarding. Provision for additional precautionary measures will be provided if required and relocation of bus terminus will be carried out by bus companies if TD, HyD or bus companies considered necessary.	No	Yes - Contractor shall note that additional precautionary measures shall be provided if required.	Bus companies, TD, HyD

4.	Site access and construction vehicular movements which may pose potential hazards to public	Construction vehicle movements may pose threats to public	2	2	4
5.	Existing underground utilities, drainage and manholes within the site area	Excavation / trenching works may damage the existing utilities/ drainage leading to suspension of utility supply and workers injury;	2	2	4
6.	Tree transplant / felling - a lot of existing trees within the site	The use of bulky machines during tree transplant / removal may injure workers in vicinity	1	2	2
7.	Site clearance before construction works	Part of the site is being used as a temporary car park, no extensive demolition works anticipated	-	-	-

Architectural (PTAE): • Design to locate the site access / egress safely onto the public road • Proper traffic control / diversion system shall be provided by the Contractor • Design to provide a well-defined and protected pedestrian path	No	Yes - Contractor shall be required to provide a proper traffic diversion system during construction	No
Building Services (WSP): • Enquiry letters were sent to utility undertakers to locate the existing / planned utilities within / in close vicinity of the site • Liaise with utility companies to arrange for service diversion ahead of main construction works • The live cable is to be removed by CLP Contractor shall allow sufficient time in their programme	No	Yes - Contractor shall note the removal of the CLP cables at their own cost and allow time for the removal in the programme	No
Landscape (ADI): • Strategic design to minimize the no. of trees affected • The spatial requirements for trees transplantation will be reviewed to ensure adequate works are provided • Contractor to provide method statement for tree transplanting / removal prior commencement of works • Ensure adequate works area for tree transplant / removal • Recommend to install CCTV at the back of the construction vehicles	No	Yes - Contractor to ensure enough space for maneuvering trees transplant / removal vehicles	No
	Yes	No	No

WORKED EXAMPLE NO.3

Project: Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O Programme No. 054RG Workstage 3 - Hazard and Impact Summary Mode B: Construction - Excavations and Foundations (General excavation and trenches for foundation/ services)

	Task	Hazards and Impacts	Likelihood	Consequences	Risk Assessment Rating (Before Control Measures)#
1.	Foundation system of Velodrome	Ground movement affecting adjacent structures stability	2	2	4
2.	Trench/ excavation for piles / underground utility laying	Collapse of trench/ excavation or falls into trench / excavation or falling objects resulting into injuries or even fatality	1	3	3

Control Measures	Hazards Resolved (Yes/ No)	Necessity to Notify Contractor (Yes/ No)	Other *relevant* parties to be notified
Structural (OAP): • Current design has no basement structure which reduce the extent of excavation works • The works are to be carried out within the site and the closest distance of excavation works will be about 17 metres from site boundary, ground movement induced by the excavation work to properties outside site boundary should be negligible • Contractor to choose a suitable foundation system to minimize noise and vibration disturbance to adjacent structure during construction • Review as-built drawings of nearby buildings and underground utilities • Close monitoring during construction on the dewatering and ground settlement	Yes	Yes -Contractor shall always ensure the safety from all excavations works	No
Structural (OAP): • Provide adequate information on ground conditions • Provide adequate support to the trench and identify safe working space for excavation • Proper covering of trench, shoring and guard rails to be provided • Warning notices to be placed to alert others from falling into trenches • Provide dewatering equipment where necessary **Architectural (PTAE):** • Identify safe working space for excavation with OAPNo	No	Yes - Contractor shall always ensure the safety from all excavations works	No

3.		Noise/dust arise from excavation and foundation works causing nuisance to nearby public and the TKO Sports Ground users	2	1	2
4.	Access requirement for piling machines within the workspace	Inadequate space for piling machines during construction could lead to accidents	1	3	3

Architectural (PTAE): • Close coordination with school principals, e.g. check with school calendar to avoid any noisy works to be conducted during examination period and TKO Sports Ground Management **Structural (OAP):** • Contractor shall have due consideration on choosing the foundation system • Ensure that the contractor will have provision of proper physical isolation of dust and noise from site boundary (e.g. canvas for enclosure)	Yes	Yes - Contractor shall ensure noisy works would not be conducted during school examination period and special event days of TKO Sports Ground; dust generated will be handled with care for reducing or preventing the distribution to nearby public and TKO Sports Ground users	School principals / TKO Sports Ground Management
Structural (OAP): • Contractor to choose a suitable foundation system with due consideration on the spatial requirement and noise impact. **Architectural (PTAE):** • To coordinate with OAP on the spatial requirement of the piling machines.	Yes	Yes - Contractor shall note the spatial requirements of the piling machines	No

WORKED EXAMPLE NO.3

Project: Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O Programme No. 054RG Workstage 3 - Hazard and Impact Summary Mode C: Construction - Primary structure (General concrete stability and erection of structural steelworks) and Building Elements

	Task	Hazards and Impacts	Likelihood	Consequences	Risk Assessment Rating (Before Control Measures)#
1.	Fall from height during concreting frame of building	Fall from height during construction leading to injuries	2	3	6
2.	Fall from height during erection of structural steelwork (including the long span roof)	Erection of roof truss (metal) may have safety impact on workers (such as injuries) or fall from height	2	3	6
3.	Collapse of scaffolding and temporary supporting structures in case of typhoon	Collapse of scaffolding in typhoon and temporary supporting structure may fall off leading to accidents or injuries	2	3	6

Control Measures	Hazards Resolved (Yes/ No)	Necessity to Notify Contractor (Yes/ No)	Other *relevant* parties to be notified
Architectural (PTAE) / Structural (OAP): • Maximize the use of pre-fabricated cladding to avoid the duration to work at height • Provision of safe working platform with proper personal protection equipment	No	Yes -Contractor shall comply with the CSSR on proper provision of the working platform and the personal protective equipment	No
Architectural (PTAE) / Structural (OAP): • Encourage pre-assemble on ground level to reduce the time to work at height • Design to have a safe access / egress from the workplace • Contractor to provide safe erection sequence and assemble method during construction for approval, with due consideration on the stability of temporary structure, weathers, temporary storage • Adequate support shall be provided to avoid immature collapse during construction • Close monitoring to ensure no excessive loading (including machines) exerted on the steel roof during construction	No	Yes - Contractor to submit the method statement of the erection sequence for approval and ensure safety when working at height	No
Structural (OAP): • Contractor to ensure the scaffolding is appropriate for use • Sufficient lateral tie-in to the scaffolding to be provided to secure the stability	Yes	Yes - Contractor shall ensure safe system of works and personal protective equipment are provided to workers	No

WORKED EXAMPLE NO.3

Project: Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O Programme No. 054RG Workstage 3 - Hazard and Impact Summary Mode D: Construction - Building Elements and Building Services during Construction and Maintenance (External cladding, roof coverings and finishes, atria, windows / glazing including window cleaning, cleaning of building, mechanical services, electrical services, public health service, lift, escalators and auto walks)

	Task	Hazards and Impacts	Likelihood	Consequences	Risk Assessment Rating (Before Control Measures)#
1.	Fall from height during concreting frame of building	Fall from height during construction leading to injuries	2	3	6
2.	Installation of major BS equipment within the Velodrome	The bulky BS equipment installed may have potential to fall if not adequately anchored and supported.	2	2	4
3.	Tripping / slipping hazard	Trip and slip leading to injury	2	2	4
4.	Flammability of Electrical services	In occasion of fire, the electrical services may burn and emit toxic fume. Over-loading of electrical services may result in fire	1	3	3

Control Measures	Hazards Resolved (Yes/ No)	Necessity to Notify Contractor (Yes/ No)	Other *relevant* parties to be notified
Architectural (PTAE) / Structural (OAP): • Encourage the use of pre-fabricated elements off-site and maximize the use of pre-fabricated cladding • Design to avoid the use of features that are difficult to construct or difficult to carry out maintenance works • Provision of safe working platform with proper personal protective equipment	No	Yes -Contractor shall comply with the CSSR on proper provision of the working platform and the personal protective equipment	No
Structural (OAP)/ Building Services (WSP): • The loading of the BS equipment will be accounted in the design of the structural loading • The sequence of the installation of the BS equipment will be well planned to reduce the time to work at height. • Safe access and egress will be provided with proper catwalk and enough head room for carrying out of the maintenance works	No	Yes - Contractor to ensure the erection sequence of the BS equipment is safe	No
Architectural (PTAE): • Design to minimize the low level piping / fixing / sharp edges as far as possible • All access / egress to be kept in good, dry condition	Yes	No	No
Building Services (WSP): • Design to consider non-combustible material for all electrical equipment to guard against construction fire • Proper fire hydrant / extinguishers to be provided as per FSD standards	Yes	No	No

5.	Scoreboard installation	The bulky BS equipment installed may have potential to fall if not adequately anchored and supported.	2	3	6
6.	Material selection of cycling track and arena	Improper / substandard cycling track and arena material may result in slipping / tripping and lead to injury	2	1	2
7.	Water cooling tower on roof of Velodrome	Location of cooling tower will affect the air intake and adjacent residents. Noise generated from water cooling towers may cause disturbance to nearby residents The spatial provision / noise generated will affect the health / safety of workers during maintenance issues; also potential for Legionnaire's disease	2	2	4

Structural (OAP)/ Building Services (WSP)/ Environmental (AEC): • The loading of the scoreboard will be accounted in the design of the structural loading • The sequence of the installation of the scoreboard will be well planned to reduce the time to work at height. • Safe access and egress will be provided with proper catwalk and enough head room for carrying out of the maintenance works	Yes	No	No
Architectural (PTAE): • Materials of the cycling track and arena will be complied with UCI Category 1 standard	Yes	No	No
Building Services (WSP): • Design to locate the cooling tower exhaust far away from the air-intake and the adjacent occupants • Acoustic provision is provided to minimize the noise impact • Ensure contractor design comply with the hygienic and maintenance guidelines for prevention of Legionnaire disease in cooling towers **Architectural (PTAE):** • No unauthorized entry to the plant room	No	Yes - Check the Contractor design on compliance with the EMSD CoP of Cooling Tower	Maintenance Agent - Ensure personnel involved should be well trained in safety procedures and ensure cooling towers would be cleaned regularly and frequently

WORKED EXAMPLE NO.3

Project: Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O Programme No. 054RG Workstage 3 - Hazard and Impact Summary Mode E: Operation

Operation of Velodrome

	Task	Hazards and Impacts	Likelihood	Consequences	Risk Assessment Rating (Before Control Measures)#
1.	Emergency access inside the Velodrome	Inadequate width / height would result in difficulty during evacuation	2	2	4
2.	Danger of players during ball games and flying of balls out of the infield to the cycling track	The incidental fly out of balls may result in injury or players or audience	2	1	2
3.	Spectator circulation	In adequate circulation area or evacuation plan may result in injury or even fatality of spectators during emergency	1	3	3
4.	Spectator stand	Potential fall from height and result in injury	1	3	3
5.	Ventilation	Potential health and safety hazards from ventilation within the complex - e.g. inside store rooms, for complex users; impacts of the ventilation inlet location near nearby residents	2	2	4

Control Measures	Hazards Resolved (Yes/ No)	Necessity to Notify Contractor (Yes/ No)	Other *relevant* parties to be notified
Architectural (PTAE): • The emergency access is designed to be adequate for bulky equipment	Yes	No	No
Architectural (PTAE): • A safety net / protective mechanism will be provided to prevent fly out of balls • Design with a safety margin of at least 2m	Yes	No	No
Architectural (PTAE): • Design to provide sufficient circulation area • Design to have adequate ventilation in the circulation area • Directional signs and exit signs to be provided **- User (LCSD):** • Emergency evacuation plan will be developed	Yes	No	LCSD to develop emergency evacuation plan
Architectural (PTAE): • Handrails to be provided in spectator stand • Consider using contrast nosing coloring scheme, which is agreeable to LCSD, in spectator stand for easy evacuation **- User (LCSD):** • Emergency evacuation plan will be developed	Yes	No	LCSD to develop emergency evacuation plan
Building Services (WSP): • Adequate ventilation will be provided in Velodrome, and also the washrooms and changing rooms, with consideration of the heat generated from other services • Mechanical ventilation will be provided in store rooms and plant rooms • Well-planned design to prevent ventilation outlet nearby or close to residential buildings	Yes	No	No

6.	Disable access inside the Velodrome	Inadequate ramps or tactile provision etc. result in injury of the disabled	1	2	2
7.	Noise	Excessive exposure to noise result in complaints / nuisance to workers / nearby residents	2	1	2
8.	Equipment storage room / achineries room	Inadequate ventilation may lead to faint; not enough headroom may lead to injury while carrying out maintenance work	1	2	2
9.	Lighting	Glare effect may lead to disturbance to players / spectators	2	1	2
10.	Children play room	Potential safety hazards (e.g. hurt by sharp concerns or falling onto the ground); also the noise generated may affect other users	2	1	2
11.	Loading capacity of arena	Bulky equipment would be used for aintenance. Inadequate loading would lead to damage of the arena	1	1	1
12.	Toilets / shower	Inadequate drain points would result in slippery floor leading to injury	2	2	4

Architectural (PTAE): • Design comply with Barrier Free Access Code of Practice and Universal Accessibility Practice / Guidelines • Design has provided wheelchair accessible seating with a companion seat • Disable lift is provided • Ramps are provided for easy access throughout the town park Yes	Yes	No	No
Architectural (PTAE): • Acoustic material will be adopted in the Velodrome design to minimize the noise pollution **Environmental (AEC):** • Further acoustic provision will be explored to minimize the noise generated from the in-field	Yes	No	No
Architectural (PTAE): • Adequate headroom and spatial requirements are provided in the equipment store room / machineries rooms **Building Services (WSP):** • Design to have adequate ventilation	Yes	No	No
Building Services (WSP): • Lights used are chosen according to the LCSD standard and avoid indoor glaring effect • Energy efficient lights to be adopted to minimize the need for maintenance • Emergency lighting to be provided to lead to the exit in case of power failure / emergency	Yes	No	No
Architectural (PTAE): • Matting and non-sharp edged furniture to be used • Padding is provided around the walls **Environmental (AEC):** • Proper acoustic provision to minimize the noise	Yes	No	No
Structural (OAP) • Loading capacity of the arena has accounted the load imposed by the bulky maintenance equipment	Yes	No	No
Architectural (PTAE) / Building Services (WSP): • Non-slip floor tiles that are slip resistant when wet to be adopted • Good drainage system • Good ventilation • Warning signage	Yes	No	No

13.	Emergency evacuation procedures during events	Chaos during emergency events resulting in injury	1	3	3
Operation of Town Park					
14.	Trees planting in the Town Park	Certain tree species would attract pest and adversely affect the health of trees	2	1	2
15.	Location of covered mphitheatre	Noise generated from amphitheatre would lead to complaints	2	1	2
16.	Artificial lake and model boat pool	Potential fall into the lake/ pool causing drowning; poor water quality could also transmit disease	1	3	3

Building Services (WSP): • Emergency lighting system to be provided in all activity area leading to exit • Design to have emergency generator to provide backup power for firefighting equipment **Users (LCSD)** • Develop an emergency evacuation plan	Yes	No	emergency evacuation plan
Landscape (ADI) • Regular tree inspection and method statements for pest and disease control measures should be submitted by the Contractor • Proper tree species to be selected to avoid pest (The types of trees shall be agreed with LCSD) • Proper tree guying and securing to prevent tree collapse during adverse weather conditions	Yes	No	No
Architectural (PTAE) / Environmental (AEC): • The location of amphitheatre is far from residential area • Stage and seating of amphitheatre are sunken within the bermed landscape area with extensive tree planting which provide as an additional acoustic barrier • Noise from stage and amphitheatre is contained by tensile roof structure, landscape bermed over stage & on two sides of seating. • Acoustic louvers with 1500mm deep horizontal baffles should be installed to reduce the sound leakage	Yes	No	No
Landscape (ADI) • As requested by LCSD, the max. depth of water is 400mm which could minimize the risk of drowning • Water depth of 100mm to be provided along the peripheral of the lake / pool which are assessible by public to prevent the **Building Services (WSP):** • Proper circulation / filtration system to be provided to ensure water quality as per WSD's standard requirement. **Architectural (PTAE):** • Warning signboard to be provided **User (LCSD):** • Artificial lake and model boat pool are to be closed at night	No	No	LCSD to consider to have regular patrol

17.	Skateboard area	Slippery floor could result in accident. Skateboard park entrance is provided at the 24-hour passageway, this may pose a security concern	1	2	2
18.	Security of the town park	Chaos during emergency evacuation	1	2	2
19.	Ergonomics - muscular-skeletal injuries from posture/ manual handling	Potential hazards (e.g. health hazard due to inadequate spatial equirements) while carrying out maintenance works	2	2	4
20.	Slips and trips	Trip and slip leading to injury	2	2	4
21.	Parking spaces/ loading and unloading	Car crash accidents leading to injury	2	2	4
22.	Toilets / showers	Inadequate drain points would result in slippery floor leading to injury	2	2	4

Architectural (PTAE): • Toilets and first aid room are provided • EVA allows fast access to the area in case of emergency **Building Services (WSP):** • Sump pumps are provided to facilitate the removal of rain water **User (LCSD):** • The area is locked after opening hours to ensure security of the Park	No	No	LCSD to consider the need for CCTV at the entrance
User (LCSD): • Emergency evacuation plan will be developed	No	No	LCSD to develop the emergency evacuation plan
User (LCSD): • Proper lifting appliance / trolleys will be provided for transportation of materials • An outline of policy of Ergonomics to be provided	No	No	LCSD to provide the necessary appliance and PPE for workers
Architectural (PTAE): • Non-slippery finishing / low-slip risk material to be employed • Design to smoothen sharp edges or to provide padding if necessary	No	No	LCSD
Architectural (PTAE): • Convex mirrors provided at turning points	No	No	No
Architectural (PTAE) / Building Services (WSP): • Non-slip floor tiles that are slip resistant when wet to be adopted - Good drainage system • Good ventilation - Warning signage	Yes	No	No

WORKED EXAMPLE NO.3

Project: Town Park, Indoor Velodrome-cum-Sports Centre in Area 45, Tseung Kwan O Programme No. 054RG Workstage 3 - Hazard and Impact Summary Mode F: Maintenance

	Task	Hazards and Impacts	Likelihood	Consequences	Risk Assessment Rating (Before Control Measures)#
1.	Fall from height while carrying out aintenance works / cleaning	Fall from height while carrying out maintenance works / cleaning / watering of green roofs - especially the bottom of cycling track	2	3	6
2.	Falling objects / edge protection	Potential safety hazards to staff by falling objects / edge protection	2	3	6
3.	Tripping / slipping hazard	Tripping / slipping hazard during maintenance	2	2	4

Control Measures	Hazards Resolved (Yes/ No)	Necessity to Notify Contractor (Yes/ No)	Other *relevant* parties to be notified
Architectural (PTAE) • Design to take due consideration on the cleaning strategy, e.g. form and geometry of the facade to be cleaned • Fall arrest system is installed on the metal roof for maintenance access of PV panels and solar panels. Access for maintenance of building services inside the Velodrome will be facilitated by Mobile Elevated Working Platform and maintenance catwalk. These provisions will be further developed and kept in view so as to meet the requirement for occupational safety. • Proper material to lengthen the lifespan of cladding and avoid materials/ finishing that require aggressive cleaning	Yes	No	No
Architectural (PTAE): • Design to consider parapet to avoid falling/ dropping objects • Design to consider proper maintenance walkway, fall arrest system, adequate edge protection (e.g. handrails)	Yes	No	No
Building Services (WSP): • Design to minimize the low level piping / fixing and sharp edges.	Yes	No	No

4.	Ergonomics - space requirement while carrying out aintenance works	Potential hazards (e.g. health hazard due to inadequate space equirements) while carrying out maintenance works	2	2	4
5.	Climbing wall	Potential fall from height while carrying out maintenance of the climbing wall	2	3	6

Architectural (PTAE) / Users (LCSD): • Adequate space will be provided for maintenance works: fixing pipe and duct • Design to minimize the low level piping / fixing and sharp edges - Design to provide enough headroom (conform with SoA) • Proper lifting appliance or lifting gear will be provided for large and heavy equipment & installations • Proper access/egress and working platform for the maintenance and operation of fans, motor and control panels of the NC plants and AHU especially for those located in high level. • Extensive manual lifting is avoided	Yes	No	LCSD
Architectural (PTAE) • Design to provide proper access / egress and headrooms for regular climber wall inspection and maintenance • Ensure appropriate safety mats are provided	Yes	No	No

2.3 Pre-tender Health and Safety Plan

The Pre-tender Health and Safety Plan should be completed before invitation for tender which contained sufficient details on significant hazards and impacts for a tender to produce accurate pricing plans and assess the health and safety risks that need to be addressed during construction. Also, highlights any unusual or unresolved hazards and impacts requiring the tenderer's particular attention.

In this project, the health and safety concerns are focused on the maintenance safety when carrying out maintenance works, cleaning and watering of green roofs especially at the bottom of the cycling track.

3. Examples of Safe Design in this Project

The followings examples are highlighted in the Hazard and Impact Summary which encountered in the project:

3.1 Example 1 – Catwalks and Maintenance Platform

3.1.1 Area of health and safety concerns

Since the height of the general building main roof will be up to 30 metres, therefore, it is necessary to provide the safe access and platform for maintenance purposes. The Catwalks and Maintenance Platform platforms are provided for installation and maintenance of all ceiling mounted services including fire services facilities, lighting system, ventilation louvers system and acoustic panels.

3.1.2 Identify the special risk problems

The risks of fall from height is identified while carrying out maintenance works, cleaning and watering of green roofs – especially the bottom of cycling track.

3.1.3Improvement in design

The catwalk will be pre-fabricated off site in China and delievered to site in segments by trucks. The catwalk segments (4.87m max. length with 2 tonne max. per each) will be lifted up by tower cranes and temporary stored at the first floor by passing through the area between Truss 4 and Truss 5. (See Figure 3) Then the catwalk segments will be moved closely to their relative permanent location. Then the segments will be lifted up at height by chain blocks which the chain blocks will be used to fine adjust the catwalk segments before bolt to the pre-welded cleat. Connection works between catwalk segments at high level will be carried out immediately after the catwalk segments connected into the pre-welded cleats. (See Figure 4 &5)

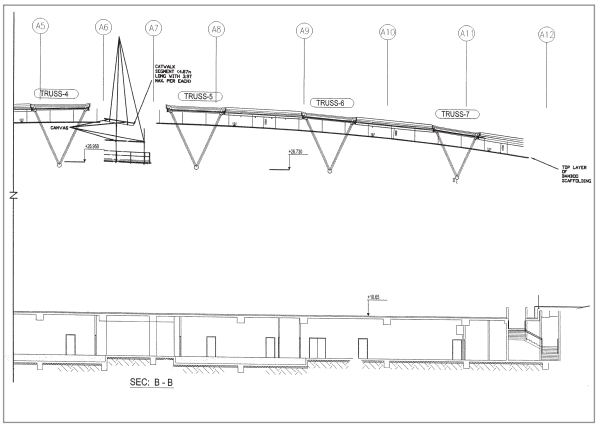

Figure 3 Catwalk segments installation

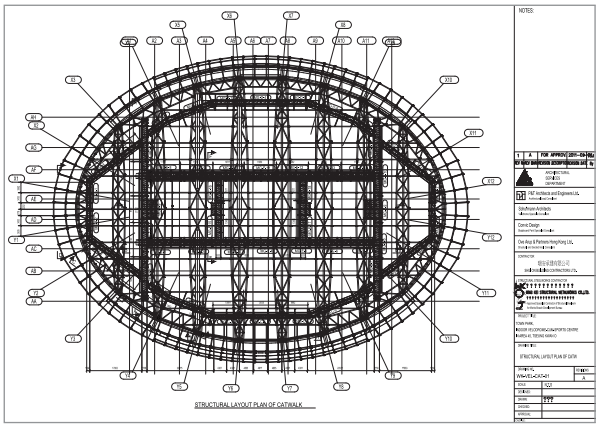

Figure 4 Layout of the cat walk system

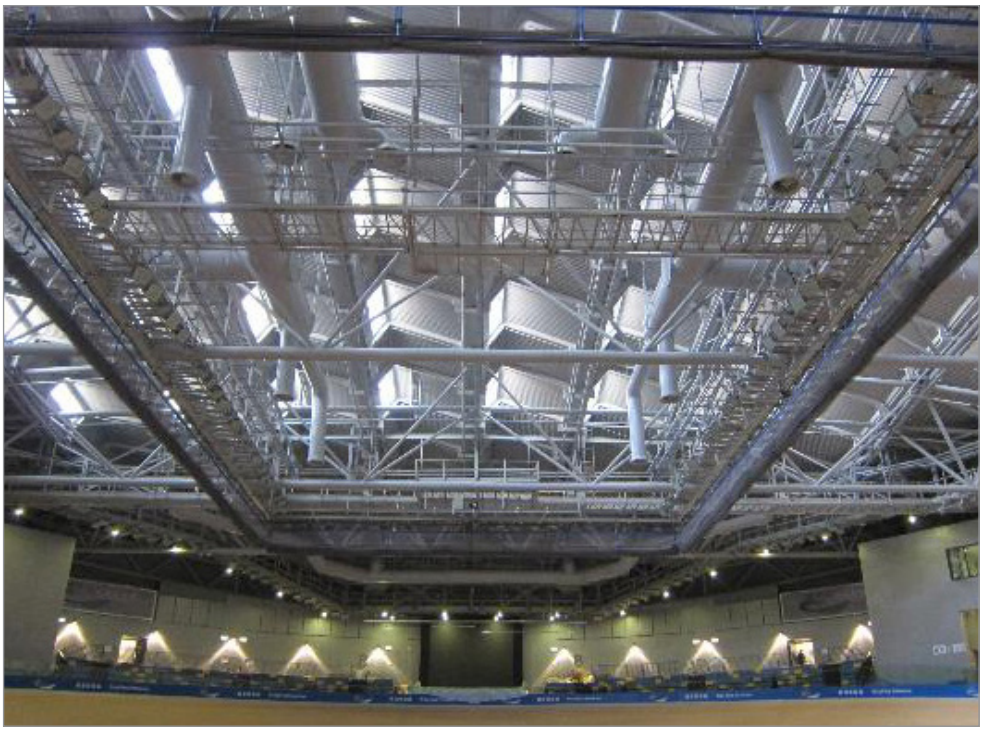

Figure 5 Overview of the cat walk system

3.2 Example 2 - Link Lift system

3.2.1 Area of health and safety concerns

During the design stage, the design team recognised that the track centre will accommodate a multi-purpose arena for use as basketball, volleyball, badminton courts and venue for gymnastics, and the operator need to transport the bulky equipment frequently.

3.2.2 Identify the special risk problems

Regard to this, the risk of transportation accident may induced including trapping of worker into the equipment etc., therefore, there is a need to provide a lift system for the operator and maintenance workers to transport bulky equipment from the storage area to the designated area.

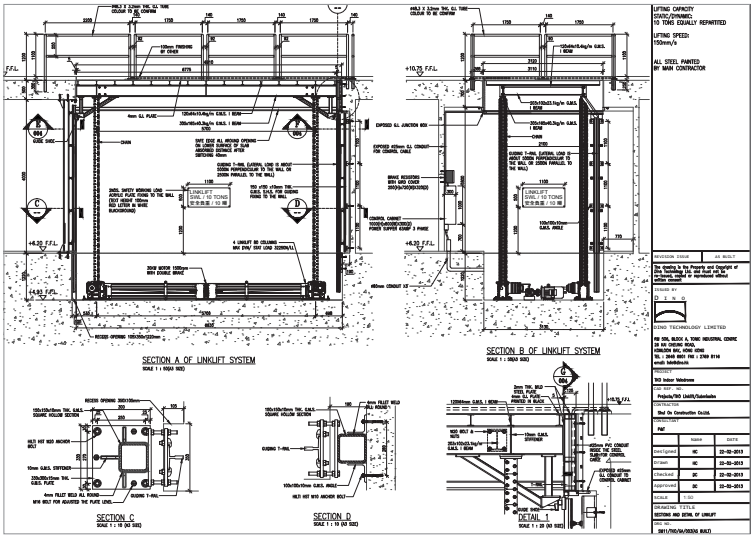

Figure 6 Structural of the link lift system

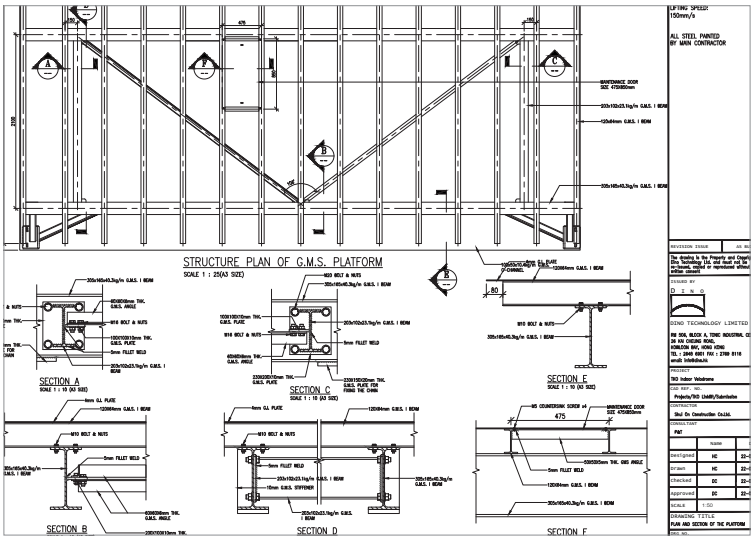

Figure 7 Structural of the link lift platform

3.2.3 Improvement in design

The Link lift system is the hydraulic elevator driving systems which is suitable for multi-purpose venues. The lifting system for one platform consists of 4 chains, 1 main electrical motor, 4 safe edge frame and other safety measures. (See figure 5 & 6) The platform will be operated between G/F to 1/F. The platform could not be operated without all guardrails in places and signalers are in placed to ensure all the guardrails to be installed completely to prevent risk of fall during operation. The operators should be trained before using the link lift system and only authorized personnel are permitted inside the operating zone. All the operators should be equipped with handheld transceiver so that the operation could be stopped immediately when required.

Figure 8 Overview of the link lift platform

Key Message

- Designing and positioning the catwalk system into permanent structures where maintenance needs to be undertaken at height.
- Use engineering control measures to minimise the risk, for example, the link lift platform in the design for the multi-purpose venues can reduce the risk induced when the operator and maintenance workers transport the bulky equipment from the storage area to the designated area.

WORKED EXAMPLE NO.4

Kai Tak Development - Infrastructure at
North Apron Area of Kai Tak Airport

Civil Engineering and Development Department

DESIGN FOR SAFETY
WORKED EXAMPLE NO.4

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3.1 Example 1 - Drainage diversion scheme including 2 stage construction of desilting compound

3.2 Example 2 - Temporary traffic diversion scheme near Kai Tak Tunnel portal including temporary deck construction

4. Key Message 100

1. Project Information

1.1 Scope of work

The works in this project of Reconstruction and Upgrading and Kai Tak Nullah are summarized below (See Figure 1):

- Construction of approximately 1.3km long box culvert ranging from 7-cell to 12-cell in connection with the existing Kai Tak Nullah and twin-cell bypass box culvert (under construction) from Prince Edward Road East and a section crossing the Kai Fuk Road;
- Construction of a 18m wide open channel (Kai Tak River) from Road D1 to Road D2 approximately 0.8km long;
- Provision of connections for the drainage networks from planned development to the Kai Tak River;
- Construction of primary and secondary desilting compounds (DC1 and DC2);
- Landscaping works for the Kai Tak River; and
- Modification of existing seawall for construction of outfall of Kai Tak Nullah.

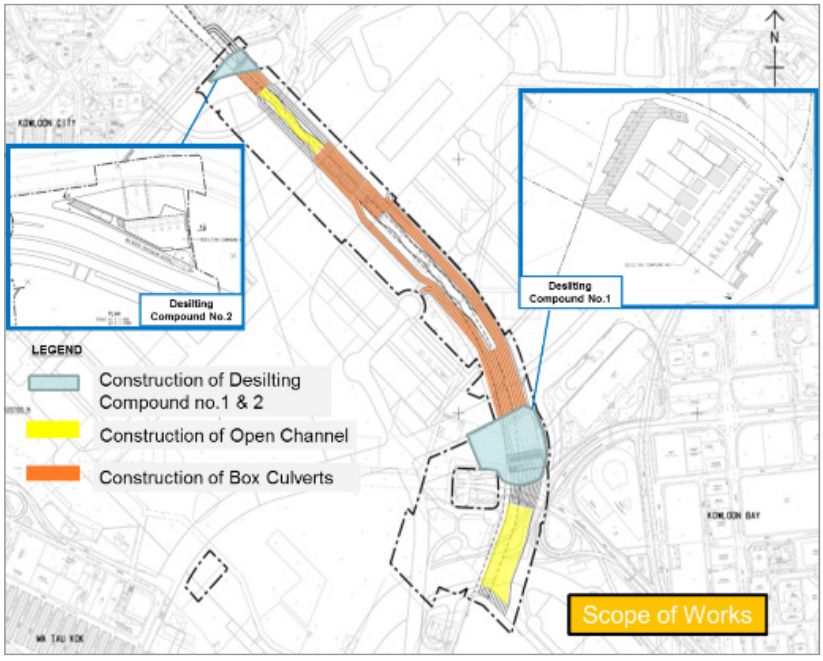

Figure 1 Location Plan for the Project

1.2 Project location and nature of the works

The site of the project is the Kai Tak development Kai Tak Development - Infrastructure at Former Runway and Remaining Areas of North Apron.

WORKED EXAMPLE NO.4

1.3 Roles of duty holders

The CDM project team were invited to attend the consultation / Brainstorming Session in conjunction with SRM Workshop was Held on 23 Dec 2008 and the Hazards identified and the Summary of Health and Safety Concerns. (See Figure 2) Furthermore, the CDM & SRM Workshop was held on 11 Dec 2011, the Hazard and Impact Summary was prepared including Review of hazards; investigation of cause and consequence of hazards; evaluation of hazards and exploration of ideas to treat those hazards.

Client's Duties:-

Civil Engineering and Development Department (CEDD) and Kowloon Development Office (KDevO) were the client of this Project. The clients were responsible for appoint a competent Project Supervisor and allocate resources throughout the project.

Project Supervisor's Duties:-

The Project Manager of AECOM Asia Co. Ltd. was appointed as the Project Supervisor, he was responsible for coordinating the health and safety aspects of the project and ensuring Health and Safety File is created, updated and properly managed.

Designer's & Contract Supervisor's Duties:-

AECOM Asia Co. Ltd. was also appointed as the designer as well as the contract supervisor, they were responsible for preparing various document including the hazard and impact summary during the preliminary design stage.

Contractor's Duties:-

Chit Cheung Construction Co. Ltd. was appointed as contractor for the project and liable for prepare, develop and implement the construction health and safety plan.

Maintenance Supervisor's Duties:–

Drainage Services Department (DSD) was the maintenance supervisor within the project. They were responsible to provide any information required for the Health and Safety File.

Figure 2 Structure of design team

2. Safety by Design Process

2.1 Summary of Health and Safety Concerns

The consultation / brainstorming sessions were held on 23 December 2008 in conjunction with the Systematic Risk Management Workshop for Kai Tak Development. The participants mainly consisted of representatives from various Government Departments including the Highways Department (HYD), (Drainage Services Department DSD) and Health Department (HD) etc. All participants are invited to express views on potential issues on health and safety. The un-resolved hazards are outlined in the Hazard and Impact Summary, as shown as below table. These risks will be analysed, evaluated and recorded into the Health and Safety File. The updated Health and Safety File will be distributed to their project team.

	Major Issues Raised by Stakeholders	Responses [See Note (1)]	Any Action Required [See Note (2)]	
			Yes/No	Action Parties
a.	Pollution to the environment during construction stage	• PS Clause and safety and environmental plan should be provided.	Yes	Detailed Design Consultant / Contractor
b.	Falling Objects	• Temporary works not properly secured may cause fatality to public / workers. Additional early and regular safety checks should be carried out.	Yes	Contractor
c.	Noise	• EM&A; Resident site staff are required to closely monitor the construction noise.	Yes	Resident Site staff / Contractor
d.	Flooding of site and adjacent properties that may cause delay to the project	• Provide a temporary works drainage management plan and independent checking is required.	Yes	Contractor
e.	Tripping	• Site not sufficiently tidy may cause accidents to the workers. Safety Plan and contract provision are required.	Yes	Contractor
f.	Fire and explosion hazard of fuel dolphin	• This may cause loss of material and added cost and delay. Safety Plan and contract provision are required.	Yes	Contractor
g.	Interface with other underground utilities	• Safety Plan and contract provision are required.	Yes	Contractor

WORKED EXAMPLE NO.4

Notes

1) The designer's response to any risks identified will vary according to the stage of design development. There is more flexibility to avoid or reduce risks at the start of the design process during preliminary stage, than during the detail stage when control measures may be more appropriate for dealing with any remaining risks.

2) At preliminary design stage, the designers of a project can do a great deal to avoid and reduce significant risks. One approach to achieve this is to alter the way the construction is planned including the sequence of construction that is assumed. This is a powerful tool, but it requires in-depth understanding of the construction process and the options that are feasible. For instance, designers can reduce the need to work at height by adopting modular sections, which can be pre-fabricated at ground level and sequentially lifted into place. This does not eliminate working at height entirely but should reduce it significantly.

2.2 Hazard and Impact Summary

Task	Hazards and Impacts	Risk Assess-ment Rating	Control Measure	Hazards Resolved Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to Be Notified
Ingress/ Egress *arrange-ments*	• Safety of road users at site access	3	• left-in left-out" restriction at the site access should be adhered to during construction works	No	Yes	Yes. The road users at site access.
Pedestrian traffic	• Safety of pedestrian	2	• Specify the requirements such as erection of hoarding and provision of alternative pedestrian routes will be provide during construction	No	Yes	Yes.The operators being affected.
Construction noise	• Construction noise may affect the adjacent area. • Construction noise affect workers	2 3	• The contract will specify that the contractor has to comply with the construction noise standards in the EIA Ordinance • Specify the guidelines of ear protection	No	Yes	Yes.The noise receiver.
Waste Management	• Temporary storage and transportation of construction waste	1	• The contract will specify the requirement of waste management	No	Yes	-
Hygiene	• There is lack of toilet facilities in the north apron area	1	• The contract will specify the requirement of hygiene	No	Yes	-

WORKED EXAMPLE NO.4

Drinking water	• Shortage of drinking water supply to the worker at north apron area	1	• The contract will specify the requirement of drinking water supply	No	Yes	-
Erection of Site Hoarding	• Trapped by collapsing or overturning object. • Fall of person from height	2 2	• Specify hoarded area for access and erection of protection works • Specify the requirements of competent site supervision • Consider public expectation in the design	No	Yes	
Installation of sheet piles and micro-tunneling	• Trapped by collapsing or overturning object • Vibration and settlement • Damage of existing utilities	3 3 2	• Specify the requirements of competent site Supervision • Obtain information about the existing and planned utility works from relevant utility undertakers	No	Yes	
Excavation near Utilities	• Damage to Utilities • Contact with electricity or electric discharge	3 3	• Obtain information about the existing and planned utility works from relevant utility undertakers • Revise design to minimize the potential interface with utilities	No	Yes	Yes. Utilities undertakers.
Excavation	• Noise pollution to sensitive receivers and workers	2	• Reduce the depth of excavation by keeping the invert level of the proposed drainage pipes higher	No	Yes	Yes. The noise receiver.

	• Dust Emission • Fall of person from height • Falling object from height • Drowning	3 3 3 3	• Specify the requirements of facilities to minimize the risk of falling from height • Specify the guidelines of tools / material handling • Design with high ground water table			
Stockpiling of excavated material for on-site use	• Dust Emission • Trapped by collapsing or overturning object	2 2	• Specify the requirements of competent site supervision	No	Yes	-
Transportation of excavated material off the site	• Dust Emission	3	• Specify the requirements of competent site supervision	No	Yes	-
Pipe installation	• Drowning • Fall of person from height • Struck by falling objects • Environmental Nuisances	2 3 3 2	• Specify the requirements of competent site supervision • Design with high ground water table	No	Yes	-
Cutting and filling of earth to form the access road	• Dust emission • Struck by falling object • Fall of person from height • Striking against or struck by moving object	3 3 3 3	• Specify the requirements of competent site supervision	No	Yes	-

WORKED EXAMPLE NO.4

Construction of road pavement	• Accidents caused by vehicles and pedestrian • Injured whilst lifting or carrying	3 2	• Specify the location of the entrance of the maintenance access and include in the design • Minimize the interface with the public road. • Incorporate a vehicular gate with lock in the design enclosing the maintenance access and footpath to prevent unauthorized entry	No	Yes	-
Demolition of Structures	• Falling of person from height • Striking against or struck by moving object • Struck by falling objects • Dust emission Environmental Nuisances	3 3 3 3	• Specify the requirements of competent site supervision	No	Yes	-
Site management	• Tripping due to untidy site condition • Fire Hazard due to burning of on site material	3 3	• Specify the requirements of competent site supervision	No	Yes	-

Construction of open channel / box culvert	• Damage to Utilities • Contact with electricity or electric discharge • Drowning • Fall of person from height • Struck by falling objects • Dust emission • Environmental Nuisances • Contamination to existing drainage channels • Affect the existing traffic	3 3 2 3 3 3 3 3 3	• Specify the requirements of competent site supervision • Design some facilities to ensure the safety working at height • Requirements to minimize the dust • Specify the requirements to minimize the dust nuisance • Measures to minimize flooding e.g. provision of temporary drainage diversion. Avoid discharge of muddy water into existing drainage channels • Closely monitoring the road condition at the section of Kai Cheung Road/ Kai Fuk Road/ Kai Fuk Road that the box culvert crossing	No	Yes	-
Construction of desilting compounds	• Damage to Utilities • Contact with electricity or electric discharge • Fall of person from height • Struck by falling objects • Dust emission • Environmental Nuisances	3 3 3 3 3 3	• Specify the requirements of competent site supervision • Design some facilities to ensure the safety environment of working at height • Specify the requirements to minimize the dust nuisance	No	Yes	-

2.3 Pre-tender Health and Safety Plan

The Pre-tender Health and Safety Plan provide information on managing safety and health throughout the design and construction of a project. Its purpose is to highlight the main safety and health issues in connection with the construction work on the project. The existing services, traffic systems and restrictions as well as the adjacent local residents and projects are considered in the Pre-tender Health and Safety Plan. Then, the contractor was able to develop a suitable management system to enable those related and affected parties to be well informed in reasonable time before the commencement of construction works, such that they can make appropriate necessary arrangement.

In this project, the health and safety concerns are focused on the workers safety when carry construction on the box culvert for the part of the existing drainage system of the Kai Tak Nullah.

3. Examples of Safe Design in this Project

3.1 Example 1 - Drainage diversion scheme including 2 stage construction of desilting compound:

3.1.1 Area of health and safety concerns

In order to carry out the desilting process and the construction of box culvert for the part of the existing drainage system of the Kai Tak Nullah, the design team needed to select the preferable work method by evaluate the risk of the workers in health and safety aspects. (See Figure 3)

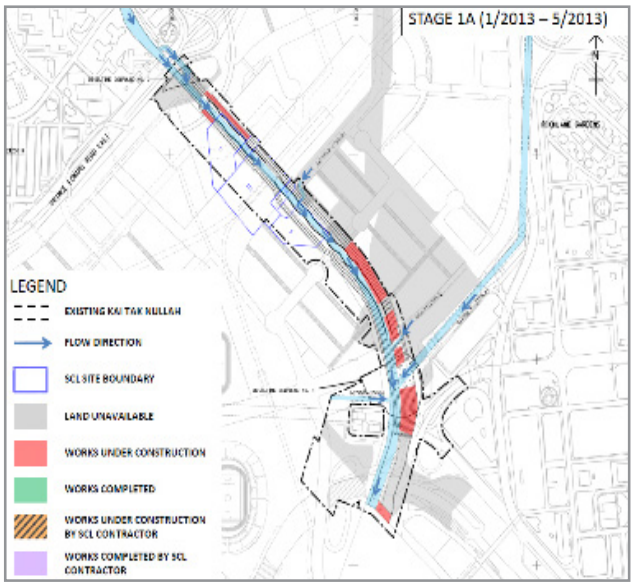

Figure 3 Floor plan of the construction site

3.1.2 Identify the special risk problems

As the Kai Tak Nullah was impractical to close down during the construction period, therefore, it was suggested to build a temporary channel for flow diversion during the desilting process. (See Figure 4) The main health and safety concern for the workers were the hazards of falling into the Kai Tak Nullah during construction.

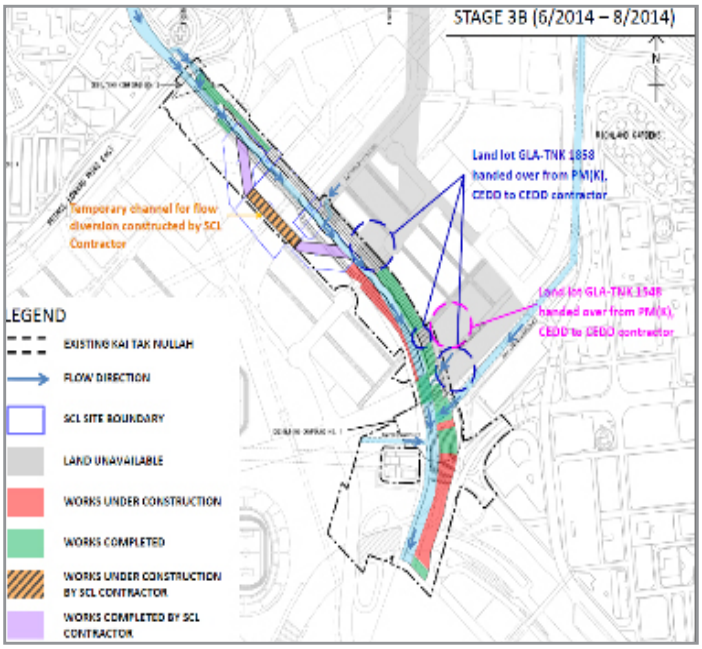

Figure 4 Floor plan to illustrate the temporary channel

3.1.3 Improvement in design

After the temporary channel was built, the section of the Kai Tak Nullah will be blocked and the water flow of the Kai Tak Nullah will be by-passed into the temporary channel. (See Figure 5) The water within the closed section will be drained out and the box culvert construction was carried out during the dry season period. (See Figure 6)The temporary channel will be removed after the completion of the whole processes. (See Figure 7) The risk for the site workers can be reduced by using the cut and cover method which provided a dry working area for contractor to work.

WORKED EXAMPLE NO.4

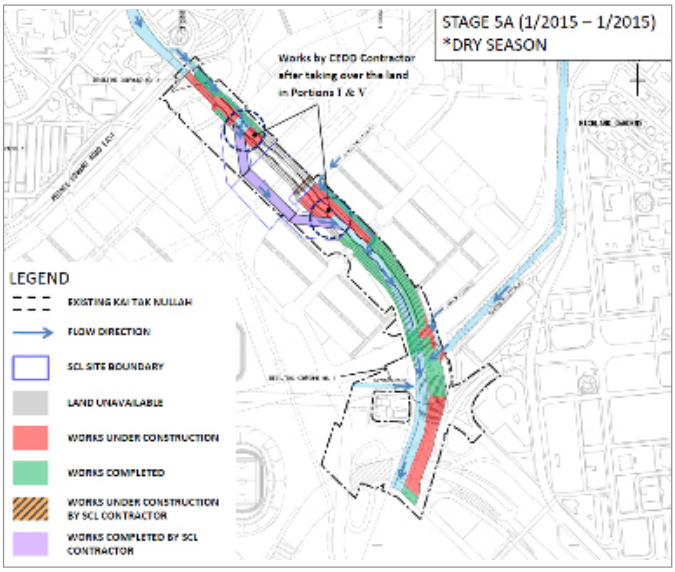

Figure 5 Floor plan to show part of the Kai Tak Nullah was temporary closed

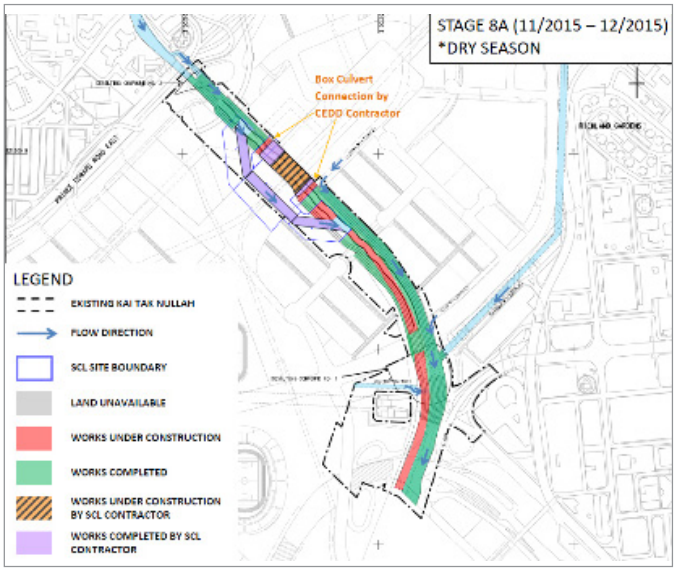

Figure 6 Floor plan to indicate the box culvert construction site

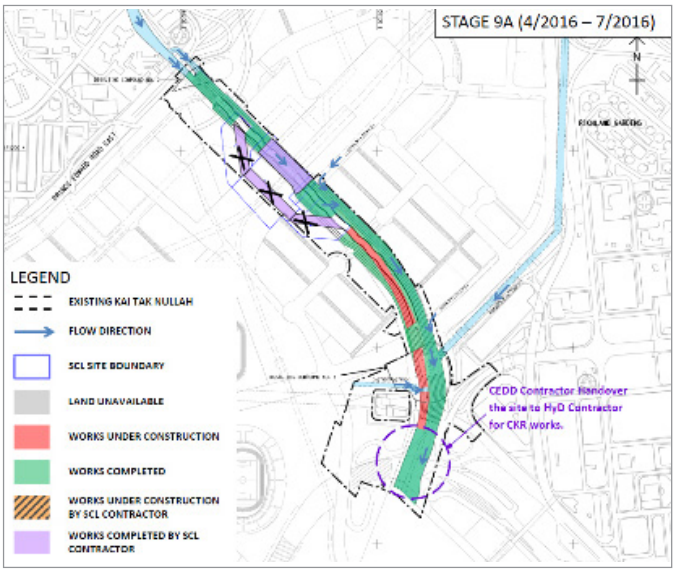

Figure 7 Floor plan to indicate the removal section of temporary channel

3.2 Example 2 - Temporary traffic diversion scheme near Kai Tak Tunnel portal including temporary deck construction:

3.2.1 Area of health and safety concerns

In the proposed project arrangement, the Reconstruction of Existing Decked Nullah and Retention of Existing Decked Nullah will be carried out at the Kai Tak River across Kai Fuk Road work area by using the no-dig method and cut and cover method to demolish and construe the box culvert in the designated area. (See Figure 8 & 9) The design team required to consider the construction procedure for this specific work area as it was part of the highway with busy traffic. The temporary traffic diversion with temporary decking and temporary traffic closure with night works were selected and the design team needed to deliberate the health and safety issues each work arrangement.

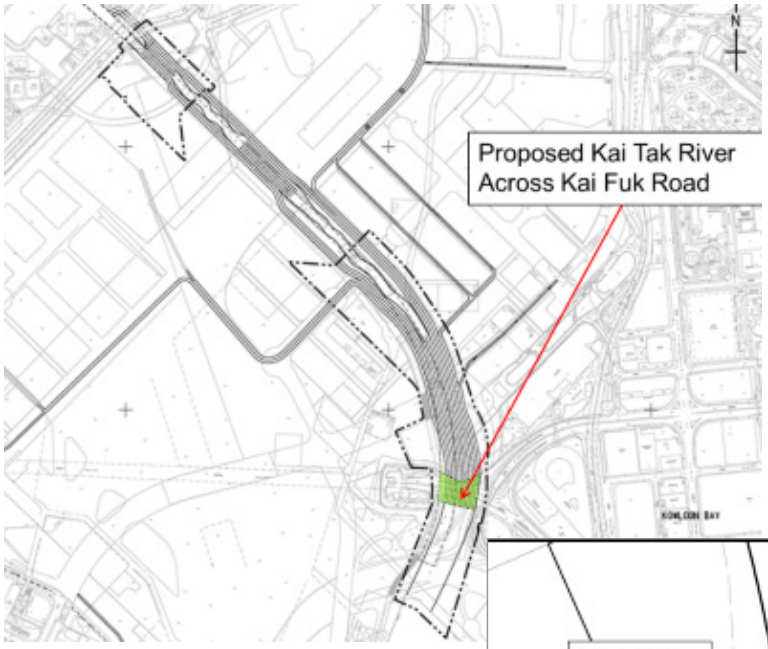

Figure 8 Floor plan of the proposed construction work area

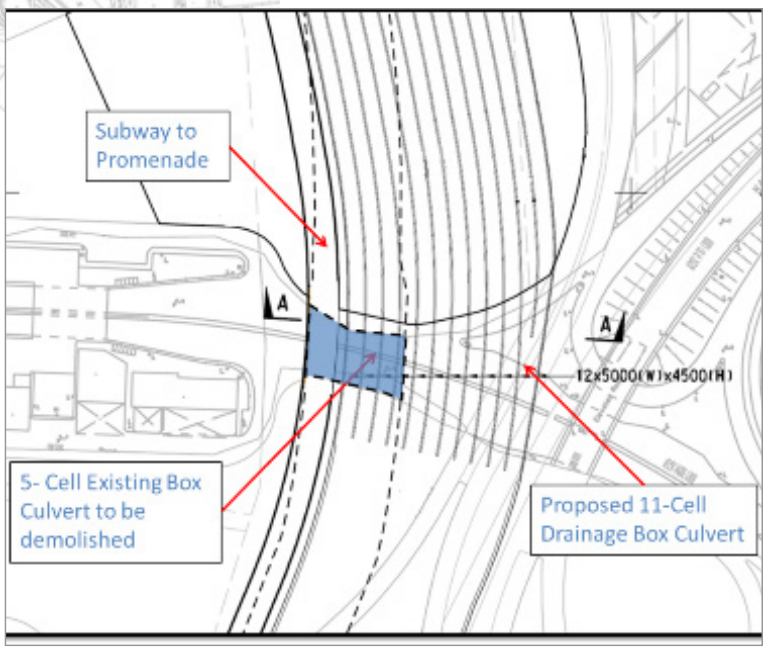

Figure 9 Overview of the construction area for Reconstruction of Existing Decked Nullah at Approaching Ramp to Kai Tak Tunnel

3.2.2 Identify the special risk problems

For the temporary traffic diversion with temporary decking work arrangement, the temporary decking could divert some the traffic flow and to reduce the risk of accidents caused by vehicle's and workers. On the other hand, for the temporary traffic closure with night works work arrangement, the workers had to work nearby the high speed traffic area with an insufficient lighting work environment. The workers would be exposed into a higher risk of being injured when operating a machine or by traffic accident. Furthermore, the Temporary Traffic Diversion with Temporary Decking required 8 years to complete meanwhile the Temporary Traffic Closure with Night Works methods needed 13 years to accomplish. In conclusion, the temporary traffic diversion with temporary decking method is preferred.

3.2.3 Improvement in design

The temporary decking will be able to divert part of the east bound traffic. The traffic diversion for the work area was used to ensure sufficient working space for the contractor which was included in the contract document. (See Figure 10) The traffic diversion plan were implement by 6 stages. (See Figure 11-15)

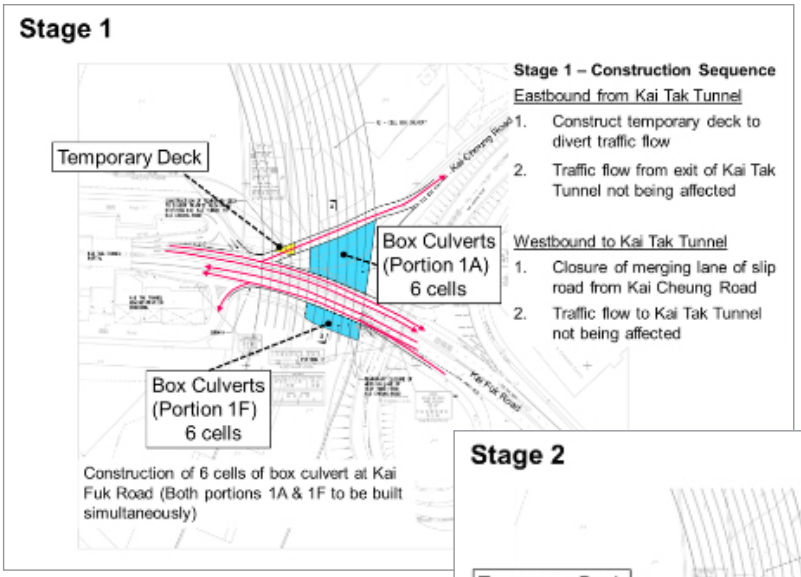

Figure 10 First stage of the construction sequence

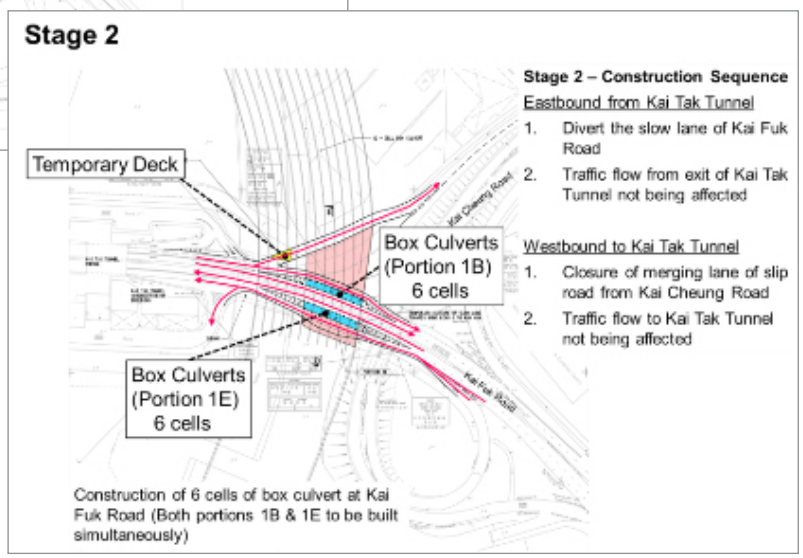

Figure 11 Second stage of the construction sequence

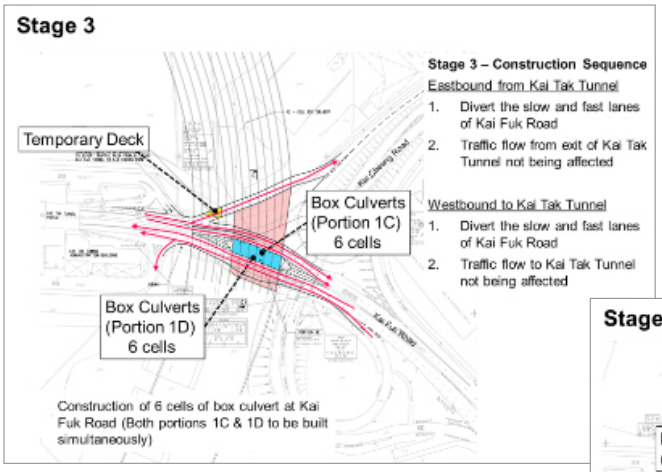

Figure 12 Third stage of the construction sequence

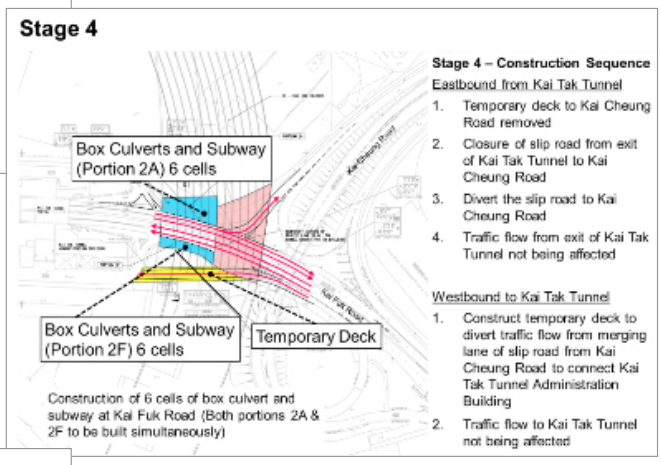

Figure 13 Fourth stage of the construction sequence

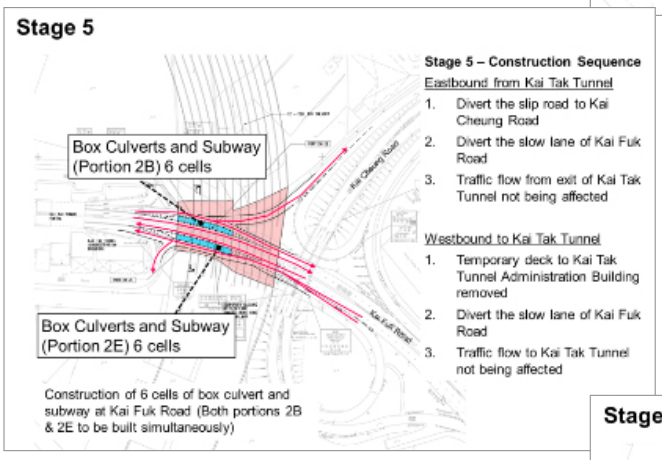

Figure 14 Fifth stage of the construction sequence

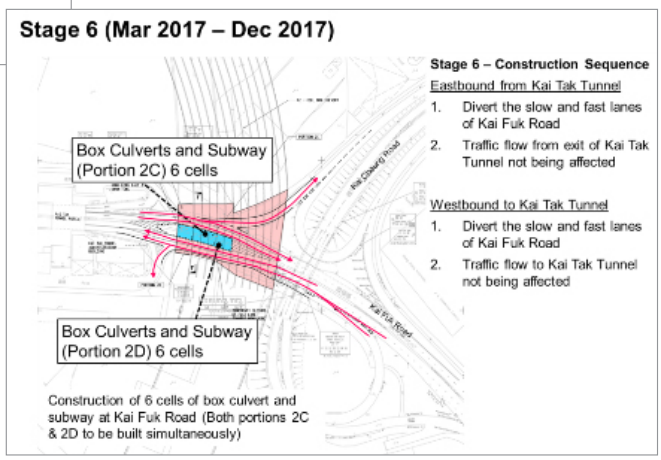

Figure 15 Sixth stage of the construction sequence

Key Message

- The risks by workplace drainage diversion and transport must be identified, minimized and controlled in the design phase.

WORKED EXAMPLE NO.5

Kai Tak Development - Kai Tak Approach Channel and Kwun Tong Typhoon Shelter Improvement Works (Phase 1)

Civil Engineering and Development Department

WORKED EXAMPLE NO.5

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3. Examples of Safe Design in this Project 117

3.1 Example 1 - Dredging and Disposal of Sediment works

3.2 Example 2 - In-situ Bioremediation Treatment of seabed sediment

4. Key Message 120

1. Project Information

1.1 Scope of work

The project **Kai Tak Development - Kai Tak Approach Channel and Kwun Tong Typhoon Shelter Improvement Works (Phase 1)** comprised the following major items:

- Maintenance dredging and disposal of about 150,000 m3 of sediment;
- Bioremediation treatment to about 90 hectares of seabed sediments in Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS);
- Demolition of an existing disused fuel dolphin in To Kwa Wan Typhoon Shelter (TKWTS) and filling its associated fuel pipelines connecting to the former Kai Tak Runway; and
- Making good damaged portions of the existing embankment along the KTAC and KTTS.

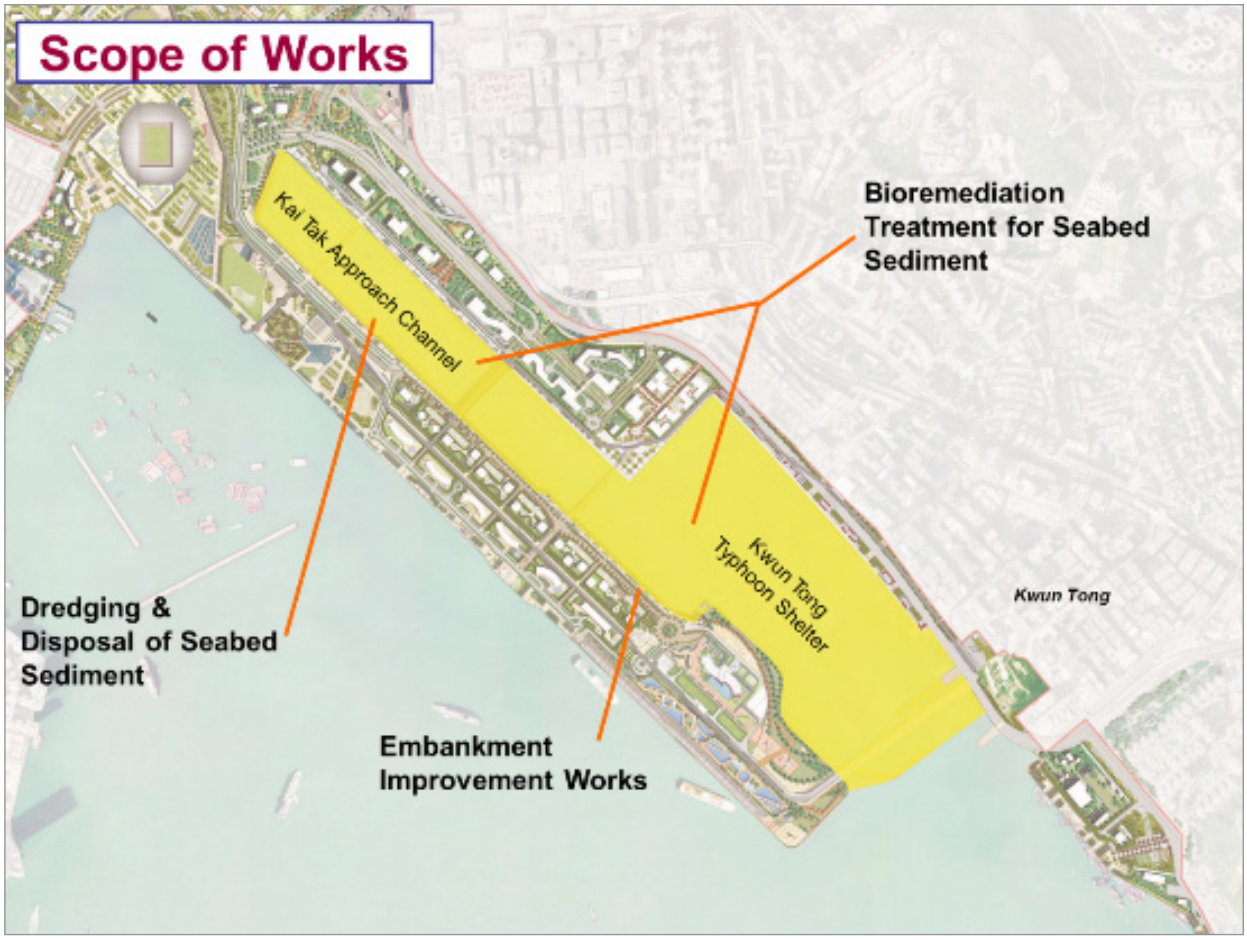

Figure 1 Location Plan for the Project

1.2 Project location and nature of the works

The project was to apply the bioremediation process in order to remove the odour from the sediments in the KTAC and KTTS.

Figure 2 Aerial view for the project location

1.3 Roles of duty holders

A Brainstorming Session with the relevant stakeholders was conducted on 23 Dec 2008 to identify the potential risk items for overall works in Kai Tak Development. A Summary of Health and Safety Concerns was prepared and the Project Supervisor was appointed.

Issue raised by stakeholders	Measures Required
Pollution by leakage of dredged sediment	To specify in the contract provision on the requirements for safety and environmental measures to be provided during the construction
Pollution by bioremediation agent	

Client's Duties:-

Civil Engineering and Development Department (CEDD) and Kowloon Development Office (KDevO) were the client of this Project. The clients were responsible for appoint a competent Project Supervisor and a competent contractor for the works as well as allocate resources for all stage of the project.

Project Supervisor's Duties:-

The Project Manager of AECOM Asia Co. Ltd. was appointed as the Project Supervisor, he was responsible for coordinating the health and safety aspects of the project and ensuring Health and Safety File is created, updated and properly managed.

Designer's Duties:-

AECOM Asia Co. Ltd. was also appointed as the designer as well as the contract supervisor, they were responsible for identifying and minimizing potential hazards as well as addressing the risks within the constraints at the time of preparation of the design

Contractor's Duties:-

Penta - Ocean - Concentric - Alchmex JV was appointed as contractor for the project and responsible for prepare, develop and implement the construction health and safety plan.

2. Safety by Design Process

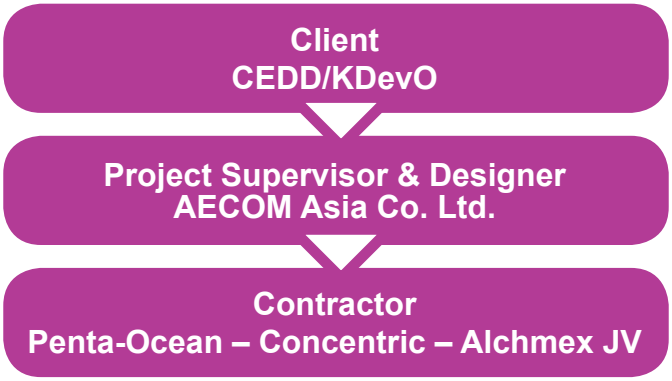

Figure 2 Structure of design team

2.1 Summary of Health and Safety Concerns

The aim of this section is to list those hazardous operations / hazards, design assumptions, of work sequences which may be a risk to construction workers' health and safety, and which cannot be avoided or designed out. It may not be a comprehensive list of every hazard that may be present, but rather those hazards are considered the most important, and the information that Contractors may not be reasonably expected to know.

The un-resolved hazards identified in the detailed design stage to be addressed by the Contractor are outlined in the Hazard and Impact Summary, as shown as below:

WORKED EXAMPLE NO.5

Major Issues Raised by Stakeholders		Responses [see Note (1)]	Any Action Required [see Note (2)]	
Activities	Hazard of Design		Yes/ No	Action Parties
Ingress / Egress arrangements	• Safety of road users at site access	• "left-in left-out" restriction at the site access should be adhered to during construction works	Yes	Contractor
		• Sufficient road signage should be provided		
Pedestrian traffic	• Safety of pedestrian	• Specify the requirements such as erection of hoarding and provision of alternative pedestrian routes will be provide during construction	Yes	Contractor
Construction noise	• Construction noise may affect the adjacent area • Construction noise affect workers	• The contract will specify that the contractor has to comply with the statutory construction noise standards	Yes	Contractor
		• Specify the guidelines of ear protection		
		• Contractor is required to plan his works, use suitable construction plant and provide necessary temporary noise mitigation measures to comply with the contractual and legal requirements		
		• Contractor is required to provide ear protection instrument to workers		
Hygiene	• There is lack of toilet facilities in the south apron and runway area	• The contract will specify the requirement of hygiene	Yes	Contractor
		• The Contractor should provided temporary toilet facilities for the use of worker		
Drinking water	• Shortage of drinking water supply to the worker at runway area	• The contract will specify the requirement of drinking water supply	Yes	Contractor
		• Contractor is requested to supply portable water to the workers		

Erection of Site Hoarding	• Trapped by collapsing or overturning object • Fall of person from height	• Specify hoarded area for access and erection of protection works	Yes	Contractor
		• Specify the requirements of competent site supervision		
		• Consider public expectation in the design		
		• Complete the erection of site hoarding before site clearance works		
		• Maintain proper access with adequate safety measures such as barriers		
Dredging & Disposal of Sediment	• Drowning • Fall of person into water • Accidents caused by marine traffic • Pollution to the seabed • Toxicity of Type H sediments • Burst of geosynthetic containers • Hazards related to the installation of silt curtains.	• Play special attention to the headroom limit due to Taxiway Bridge	Yes	Contractor
		• Contractor is required to plan his works, use suitable construction plant and provide necessary precautionary measures to comply with the contractual and legal requirements		
		• Contractor is required to submit details of the silt curtain design to the Engineer for approval to the commencement of silt curtains installation		
		• To reflect plant use in method statement & work sequences in the master programme		

WORKED EXAMPLE NO.5

Major Issues Raised by Stakeholders		Responses [see Note (1)]	Any Action Required [see Note (2)]	
Activities	Hazard of Design		Yes/ No	Action Parties
In-situ Bioremediation Treatment of seabed sediment	• Contact with chemical / hazardous material • Spoilage of chemical • Pollution to the harbour • Algae bloom due to spread of calcium nitrate	• Specify the requirements of competent site supervision	Yes	Contractor
		• Specify the guideline of chemical handling		
		• Contractor is required to plan his works, use suitable construction plant and provide necessary precautionary measures to comply with the contractual and legal requirements		
		• Contractor is required to measure the nitrate concentration in water three times a week during bioremediation period. If the nitrate concentrations exceed the action and limit levels, the Contractor is required to implement mitigation measures or slow down the injection rate in accordance with Event and Action Plan of the EM&A Manual.		
		• To reflect plant use in method statement & work sequences in the master programme		
Embankment/ Seawall Improvement Works	• Drowning • Fall of person into water • Accidents caused by marine traffic • Local land slippage of embankments / seawalls	• Specify the requirements of competent site supervision	Yes	Contractor
		• Liaise with Marine Department / Port Works Division before commencement of works		
		• Specify requirement of waste management		
		• Adopt appropriate construction method and procedures		
		• Provide life-saving equipment such as life-jacket		
		• To reflect plant use in method statement & work sequences in the master programme		

Cutting of piles and demolition of superstructure of the Disused Fuel Dolphin	• Drowning • Fall of person into water • Accidents caused by marine traffic • Pollution to marine	• Specify the requirements of competent site supervision • Erect a temporary working platform at the work area • Provide safety equipment at the working spaces of workers • Adopt appropriate construction method and procedures • To reflect plant use in method statement & work sequences in the master programme	Yes	Contractor
Site management	• Tripping due to untidy site condition • Fire Hazard due to burning of on site material	• Specify the requirements of competent site supervision • Provide guidelines of site logistics • Install firefighting instrument on site • To address in the Safety Plan	Yes	Contractor
Storage of hazardous material	• Contact with hazardous material • Cause fire or explosion	• Specify the requirement of storage of hazardous material • Provide protection equipment at the working spaces of workers • Install firefighting instrument on site • Provide guidelines for hazardous material handling • To address in the Safety Plan	Yes	Contractor
Protection of Taxiway Bridge	• Accident by Marine traffic • Damage due to construction plants / vessels	• Specify the requirements of competent site supervision • Liaise with Marine Department before commencement of works • Use geotechnical instrument such as settlement marker to monitor the effect on the existing Taxiway Bridge • Adopt appropriate construction method and procedures • To address in the Safety Plan • To reflect plant use in method statement	Yes	Contractor

WORKED EXAMPLE NO.5

Major Issues Raised by Stakeholders		Responses [see Note (1)]	Any Action Required [see Note (2)]	
Activities	Hazard of Design		Yes/ No	Action Parties
Damage to existing submarine gas mains	• Existing submarine gas mains of HKCG interfacing with the demolition of the disused dolphin at To Kwa Wan Typhoon Shelter	• Demolition works shall not commence until all precautionary and protection measures are properly put in place	Yes	Contractor
		• Safety Plan and contract provision		
		• Contractor is required to note No-Dredging and No-Anchoring zone at 100 metres wide centered at gas mains		
		• To address in the Safety Plan		
Interface with submarine gas main diversion	• Delay in planning of the lands reserved for gas main diversion but not finally adopted	• Close liaison with HKCGC	Yes	Contractor
		• Contractor is required to note the alignment of the submarine gas main diversion		
Handling calcium nitrate	• Harmful when swallowed, irritating if contact with eyes or skin. • Strong oxidizing. • Evolving toxic gas when heated. • Absorb heat when dissolved in water	• Specify the requirements of Handling calcium nitrate	Yes	Contractor
		• Contractor is required to noted manufacturer's storing and handling recommendations		
		• Contractor is required to provide suitable protective clothing		

2.2 Hazard and Impact Summary

Task	Hazards and Impacts	Risk Assessment Rating	Control Measure	Hazards Resolved Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to Be Notified
Traffic Impact	• Disturbance to marine traffic at KTTS	4	• Early coordination with MD and current operators at KTAC & KTTS. • Proper planning of construction sequences and deployment of construction vessels.	No	Yes	-
Access constraint	• Damage to Taxiway Bridge Limitation in mobility of construction plants / vessels due to Taxiway Bridge	4	• Closely monitor during the construction works. Submit method statement according to Contract requirement	No	Yes	-
Pollution	• Pollution during dredging operation	4	• Proper installation of silt curtain during dredging. • Continue monitoring of the water quality	No	Yes	-
Pollution	• Pollution due to leakage of contaminated sediment during transportation to the disposal site	4	• Carry out a trial to demonstrate the proper handling procedure for sediment disposal prior full-scale execution. • RSS to monitor closely during the construction works.	No	Yes	-

WORKED EXAMPLE NO.5

Task	Hazards and Impacts	Risk Assessment Rating	Control Measure	Hazards Resolved Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to Be Notified
Pollution	• Pollution due to excessive dosage / spillage of bioremediation agent during injection which may cause algae bloom	4	• Proper housekeeping & chemical handling measures carried out by the Contractor.	No	Yes	-
Pollution	• Pollution by chemical (fuel etc) Spillage / disposal • Hazard to public health, safety and environment	3	• Provide PS Clause and safety and environmental plan	No	Yes	-
Temporary Works	• Falling Objects	4	• Carry out early and regular safety checks to strengthen implementation of recommend measures	No	Yes	-
Noise	• Construction noise exceed the allowable limits • Public complaints may affect the progress of the works	2	• EM&A ; Resident site staff to closely monitor the construction noise	No	Yes	-
Temporary Works	• Flooding	2	• Provide a temporary works drainage management plan and Independent checking is required.	No	Yes	-

Health and Safety Management	• Explosion Hazard	4	• All precautionary and protective measures shall be properly in place before commencement of demolition works • Contractor to carry out investigation to the structures	No	Yes	-
Health and Safety Management	• Damage to submarine gas mains	4	• All precautionary and protective measures shall be properly in place before commencement of demolition works • Early coordination with HKCG	No	Yes	-
Health and Safety Management	• Tripping	2	• Safety Plan and contract provision	No	Yes	-
Health and Safety Management	• Fire Hazard	2	• Safety Plan and contract provision	No	Yes	-
Environmental	• Change in Environmental Impact Assessment	2	• Close liaison with all stakeholders	No	Yes	-

WORKED EXAMPLE NO.5

Task	Hazards and Impacts	Risk Assessment Rating	Control Measure	Hazards Resolved Yes/No	Necessity to Notify Contractor Yes/No	Other Relevant Parties to Be Notified
Dredging & Disposal of Sediment	• Pollution due to leakage of contaminated sediment during transportation to the disposal site	4	• Design Consideration: 1. Notify the Marine Department on commencement of the works. 2. Specify the requirements of sediments handling and disposal in the Contract document. For example: • Using close grab; • Provision of silt curtain; • Requirements of geosynthetic containers; • Measures to monitor leakage of sediments from the containers; • Environmental monitoring during the works. • Residual Risk Control: 1. Carry out a trial to demonstrate the proper handling procedure for sediment disposal prior full-scale execution. 2. RSS to monitor closely during the construction works.	No	Yes	-

In-situ Bioremediation Treatment of seabed sediment	• Pollution due to excessive dosage / spillage of bioremediation agent during injection which may cause algae bloom	4	• Design Consideration 1.Specify the requirements of competent person for the bioremediation works. 2.Specify the requirements of chemical injection in the Contract document. For example: • Set the maximum dosage for each injection • Environmental monitoring during the works • Conduct optimization trial for bioremediation injection. 3.Adopting marking scheme tendering for selection of competent contractor for the works. • Residual Risk Control 1.Proper housekeeping & chemical handling measures carried out by the Contractor.	No	Yes	-

2.3 Pre-tender Health and Safety Plan

The Pre-tender Health and Safety Plan provide information on managing safety and health throughout the design and construction of a project. Its purpose is to highlight the main safety and health issues in connection with the construction work on the project. This will enable tendering contractors to respond more specifically on how to deal with and control any residual hazards and risks which cannot be eliminated in design stage.

WORKED EXAMPLE NO.5

3. Examples of Safe Design in this Project

The followings examples are highlighted in the Hazard and Impact Summary which encountered in the project, in preliminary design stage, in detailed design stage as well as in construction stage:

3.1 Example 1 - Dredging and Disposal of Sediment works:

3.1.1 Area of health and safety concerns

One of the health and safety concern when dredging and disposal of sediment was the water pollution problem due to leakage of contaminated sediment during transportation to the disposal site.

3.1.2 Identify the special risk problems

The high risk of drown the workers when they falling into the sea and damage to Taxiway Bridge during construction works were identified. Also, there was a high risk of leakage of the high toxicity of Type H sediments from the busted geosynthetic containers and cause pollution to the seabed.

In this regard, notifications were sent to the Marine Department on commencement of the works and specific requirement of sediments handling and disposal in the Contract document. Besides, a marking scheme tendering approach was used in the selection of competent contractor for the works.

3.1.3 Improvement in design

The geosynthetic containers are installed in the hopper barge and will be adopted for the loading; transportation and dumping of dredged sediments. (See Figure 4)

Figure 4 Excavation of sediments using close grab mounted on flat top pontoon

The silt curtain installed at the surrounding of the dredging area to prevent the leakage of contaminated sediment. Excavation of sediments using close grab mounted on flat top pontoon to minimise the leakage of sediments during operation.

The deodorizing unit for dredging operation to reduce the environment impact of odour nuisance may cause to the public. (See Figure 5)

Figure 5 The deodorizing unit for dredging operation

Water quality monitoring program is implemented during the operation. There were 7 monitoring stations at the site. Baseline monitoring and post-disposal monitoring are used to monitor the water quality at the first disposal operation of the day and after the completion of the last disposal operation of the day. Contingency plan should be carried out accordingly when deterioration in water quality due to the dumping activities at the disposal site detected. (See Figure 6)

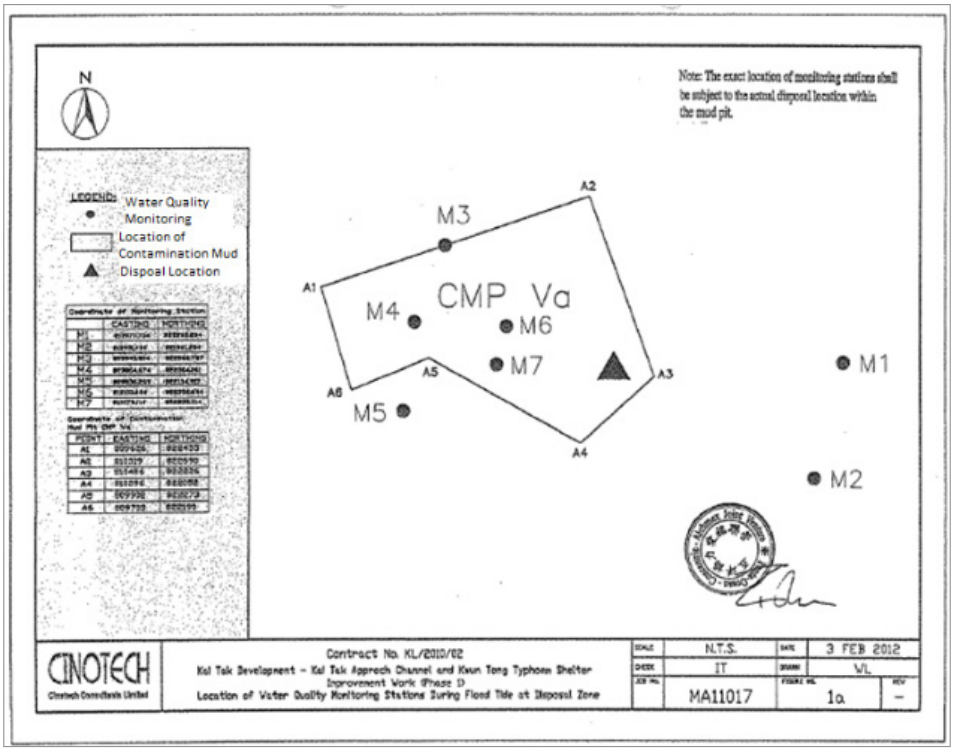

Figure 6 Water quality monitoring program

For the marine traffic aspect, the Contractor needed to submit a temporary marine traffic management plan (TMTM) for each stage of the proposed marine construction works to include the following adjacent marine traffic users for the Engineer's and Marine Department. Notify the Contractor that there were headroom limit due to Taxiway Bridge. Also, personal protection equipment such life jackets to the workers and erect suitable guard rails or fencing for edges of over waters and other opening to prevent persons from falling into the water.

3.2 Example 2 - In-situ Bioremediation Treatment of seabed sediment:

3.2.1 Area of health and safety concerns

Bioremediation treatment was the in-situ sediment remediation technique involving the injection of calcium nitrate solution into appropriate depths of the sediment layer. Pollution due to excessive dosage or spillage of bioremediation agent during injection which may cause algae bloom.

3.2.2 Identify the special risk problems

Regard to this, the workers had to withstand a risk when handling the hazardous materials and harmful chemical of calcium nitrate. As calcium nitrate will absorb heat when dissolved in water and gradually evolve toxic gas when heated. Also, it is harmful when swallowed, irritating if contact with eyes or skin.

3.2.3 Improvement in design

Therefore, the specify requirements of competent person for the bioremediation works and the chemical injection task were written in the contract document. For instance, the maximum dosage for each injection was sat; environmental monitoring was carried out during the works and the optimization trial for bioremediation injection was conducted. Furthermore, the marking scheme tendering was implemented for selection of competent contractor for the works.

Figure 7 Provision of earth bund surrounding the chemical storage yard

Figure 8 Dry calcium nitrate stored in a shed

Specify measures were implemented to reduce the risk when handling the calcium nitrate. For instance, solid form of calcium nitrate are used to prevent spillage of bioremediation agent while delivery to the designated location. Provision of earth bund surrounding the chemical storage yard to detect any spillage of chemical to the environment. (See Figure 7) Dry calcium nitrate stored in a shed to protect from weather. The shed is situated nearby the chemical mixing facility to reduce the distances for transportation. (See Figure 8) Emergency washing facilities was provided to workers in case of any accidental spillage on worker. (See Figure 9)

Figure 9 Emergency washing facilities

During the bioremediation treatment, calcium nitrate is added to the sediments in order to minimize the nitrate release to the environment. Water quality monitoring stations are used to monitor the water quality within the site during operation. (See Figure 10)

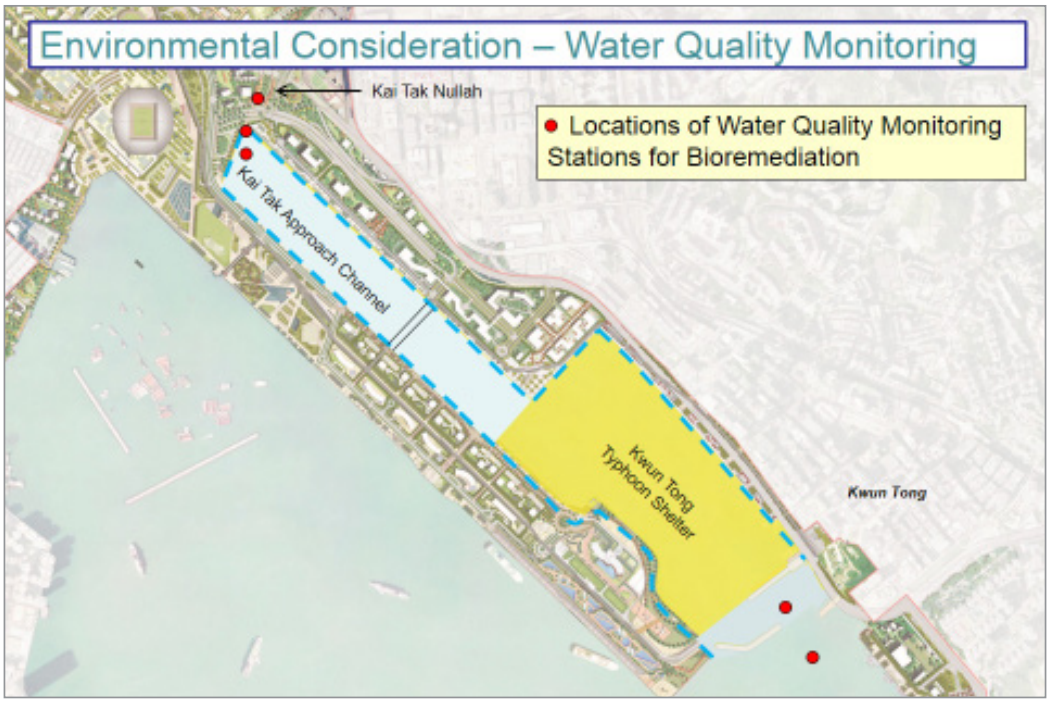

Figure 10 Water quality monitoring stations

Key Message

- Engineering control measures were used to minimize the risk when handling the chemicals on site. Also, administrative controls were implemented to control the residue risk from the hazardous chemicals such as the Water quality monitoring program.

WORKED EXAMPLE NO.6

In-situ Reprovisioning of
Sha Tin Water Treatment Works –
South Works - Design and Construction

Water Supplies Department

WORKED EXAMPLE NO.6

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3.1 Example 1 - Chemical delivery in Logistics Centre

3.2 Example 2 - Dust control in Logistics Centre

4. Key Message 130

1. Project Information

1.1 Scope of work

The Water Supplies Department (WSD) commissioned the consultant on 23 August 2010 to carry out detailed design and construction supervision to reprovision the existing Sha Tin Water Treatment Works (STWTW) South Works with an increasing treated water output from 360 MLD to 550 MLD. During the reprovisioning of South Works, the output from the existing North Works of STWTW is required to be maintained.

The capacity of the South Works has to be increased by more than 50% from 360 MLD to 550MLD. However works area of the project is basically confined to the footprint of the existing STWTW only, except minimal cut-back of the existing slope to the west of the site is allowed. The chemical handling facilities are common facilities to both the South and North Works of STWTW. They cannot be suspended and demolished until the new handling facilities at the alternative location is commissioned for the continuous operation of the North Works. Hence, the WTW Logistics Centre equipped with chemical handling facilities needs to be re-located to the alternative site adjoining to the existing STWTW where the slope is cut back for the formation of required land.

1.2 Project location and nature of the works

The project entails the reprovisioning of Sha Tin Water Treatment Works South Works to the proposed reliable output of 550MLD and common facilities including pre-treatment facilities, logistics centre (equipped with chemical handling facilities), administration building (equipped with regional laboratory), pumping station and residual management facilities.

1.3 Roles of duty holders

Client's Duties:-

Water Supplies Department (WSD) was the client of this Project. The client was responsible for appointing a competent Project Supervisor and a competent contractor for the works as well as resources allocations for all stage of the project.

Project Supervisor's Duties:-

Project director of AECOM Asia Co. Ltd. was appointed as the Project Supervisor at very early stage, he was responsible for coordinating the health and safety aspects of the project and ensuring Health and Safety File is created, updated and properly managed.

Designer's Duties:-

AECOM Asia Co. Ltd. was also appointed as the designer, they were responsible for identifying and minimizing potential hazards as well as addressing the risks within the constraints at the time of preparation of the design

Figure 1 Structure of design team

2. Safety by Design Process

2.1 Summary of Health and Safety Concerns

According to the project brief, the consultant was required to implement the Construction Design and Management (CDM) process in accordance with Guidance Notes on Construction Design and Management to encourage and facilitate systematic consideration and management of safety and health issues from preliminary design to project completion and subsequent maintenance and operation stages. The consultant has appointed a suitably experienced professional as the Project Supervisor who is capable of handling the complexity of the project to exercise his duty including the creation, updating and proper management of Health and Safety File. Designers of design teams in various disciplines are responsible to: identify and minimize hazards which may give rise to risks; reduce risks due to design and inform relevant parties of the remaining risks; and conduct other reviews as recommended in the Guidance Notes. Making improvement for an awkward working environment on both construction and operation stages is never easy and will be costly too. Provision of appropriate measures at design stage should be the most cost effective way to manage the issue.

The extracts from the Summary of Health and Safety Concerns for the project prepared at the preliminary design stage and the Hazard and Impact Summary under preparation in the detailed design stage are shown as follows for reference.

Major Issues Raised by Stakeholders	Responses [See Note (1)]	Any Action Required. [See Note (2)]	
		Yes/No	Action Parties
Dust caused by alum delivery. Manual handling and dust issues of loading of lime bags to silo. Chemical spillage.	Technical meetings and design workshops have been held with WSD's internal stakeholders including Safety Unit to review the proposed layout of Logistics Centre. The delivery logistics has been agreed.	No	-

2.2 Hazard and Impact Summary

Task	Hazards & Impacts	Risk Assessment Rating	Control Measures	Hazards Resolved Yes/No	Necessity to notify Contractor Yes/No	Other Relevant Parties to be notified
Enhance chemical delivery logistics in new Logistics Centre	Dust caused by alum delivery. Manual handling and dust issues of loading of lime bags to silo.	2	Technical meetings and design workshops have been held with WSD's internal stakeholders including Safety Unit to review the proposed layout of Logistics Centre. The delivery logistics has been agreed.	yes	no	-
Enhance chemical delivery logistics in new Logistics Centre	Chemical spillage.	2	Consideration for smooth and safe maneuvering of forklift trucks has been taken into consideration at the design for the logistics arrangements from the chemical reception points to the stock storage areas and to reduce the chances of chemical leakage.	yes	no	-

2.3 Pre-tender Health and Safety Plan

The project has not reached to this stage during the consultation period.

3. Examples of Safe Design in this Project

3.1 Example 1 - Chemical delivery to Logistics Centre:

3.1.1 Area of health and safety concerns

Space is limited on site especially in the footprint for the Logistics Centre equipped with chemical handling facilities. Unique and spatial arrangements of the site formation, road layout, building layout and stacking arrangements had been incorporated in the design of the WTW Logistics Centre to optimise the space requirements for the handling facilities and storage of each type of chemicals. It is further achieved through the effective arrangements on the numbers and height of the floor as well as the building layout to tie in with different functions in the building.

After delivery to the WTW, the chemicals stored in bags will be kept in stock and subsequently loaded by handling machinery to the top of the silos for discharging and preparation of the chemicals in solution form in the tanks before being transferred to the various treatment units. The silos take up significant space. Means of reducing the space requirements for the tank and associated handling equipment are explored. Furthermore, the design team needed to consider the health and safety concern for the workers when they are handling the chemical substances including the storage of the chemical substances and transporting the chemical to the designated area.

3.1.2 Identify the special risk problems

Regard to this, the operation workers had to withstand risk associated with the handling of chemicals when working inside the logistics centre.

3.1.3 Improvement in design

For the sake of minimizing double handling for chemical stockpiling, the stocks of chemicals will be stored at the level where the chemicals either in bags or pallets are off-loaded. So, consideration for smooth and safe maneuvering of forklift trucks has been taken into consideration at the design for the logistics arrangements from the chemical reception points to the stock storage areas.

WORKED EXAMPLE NO.6

With all chemicals delivered to site by land transport through the existing site access roads, the new slip road branches off from the existing road within the limited area of the site. The design of the new slip road takes account of the level of the existing road, the maximum gradient, minimum turning circles, and compliance with the emergency vehicular access requirements without compromising the safety and operation of the chemicals deliveries. Hence there is a restriction on the level of the at-grade elevated loading/unloading area (First Level) and the height difference between the first and ground levels of the WTW Logistics Centre is constrained. It in turn limits the height of the chemical handling facilities located on the ground and basement levels given that the volume, time and risks of excavation for the construction and basement of the building should be minimized to save the time and cost of the project. (See Figure 2 & 3)

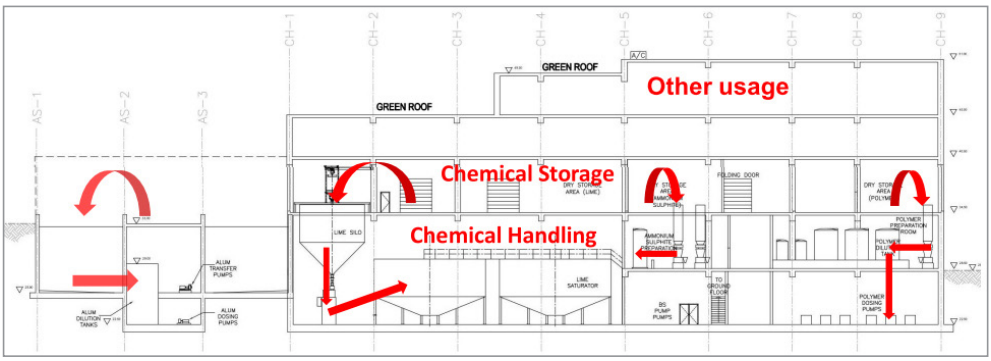

Figure 2 Floor plan of the logistics centre

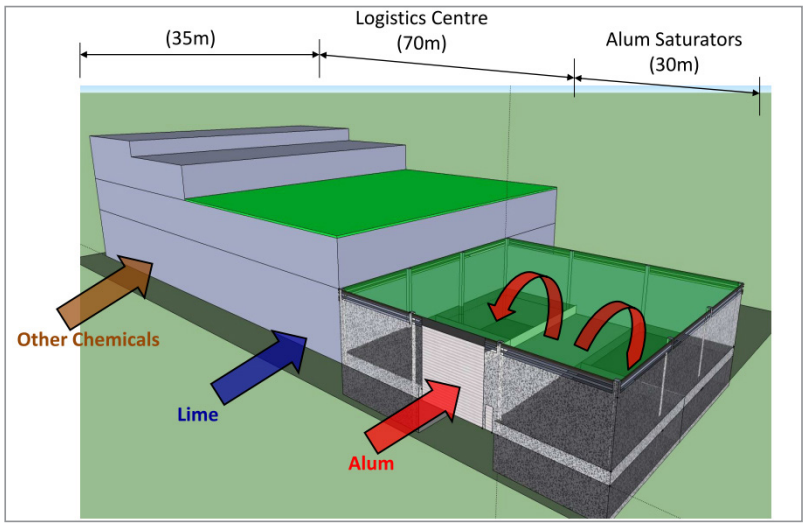

Figure 3 Landscape view of the logistics centre

In this connection, the First Level for chemical reception and storage is set at +34.5mPD, and the floors below for chemical handling at the Ground and Basement Levels are fixed at +28.5mPD and +22.5mPD respectively. The plan and section below show the access road leading to the First Level of Logistics Centre for chemical delivery.

3.2 Example 2 – Dust control in Logistics Centre:

3.2.1 Area of health and safety concerns

Silos are used to receive powdered chemicals and to prepare for chemical solution. The feeding intake is normally situated at top of the silos. As such, mechanical systems such as conveyors to lift up bags of powdered chemicals from the floor level to a higher level for feeding to the silos are used in traditional designs. The major disadvantage of the traditional process is that a dusty working environment is created due to frequent and large area of lifting and subsequent bag splitting and feeding of powdered chemicals into the silos. This caused health and safety concern to the workers, and increasing risks for works at height. In addition, the operation cost and maintenance cost of the additional lifting equipment forming part of the whole life cost of the system are also increased.

3.2.2 Identify the special risk problems

In this regard, the operating workers are exposed to a risk of dusty environment during handling process.

3.2.3 Improvement in design

The design approach for dust control to the new chemical handling facilities is to eliminate the source of dust as far as possible. By enhancing the design of the appropriate chemical delivery logistics, the chemical storage area/discharging points and the handling facilities will be stacked up at different levels within the multi-storey Logistics Centre respectively. With the arrangement of placing the silos below the floor for chemical storage/discharge and extending the feeding intake upwards to the floor level of the chemical storage area, the need of lifting up the chemicals at height for feeding to the silos will be avoided by effectively utilising the benefits of the gravity by the height difference from the first level to the ground and basement levels. Hence, the dust generated is minimized and simplicity in operation is also offered. The wet chemicals are mixed, handled and processed at the lower floors and their movement is driven by gravity flow. As such, energy input for lifting of powdered chemicals and conveying wet chemicals will be saved for a long run. The spatial constraint for grouping all essential facilities into the limited footprint of the site is also resolved.

Key Message

- Design the building layout according to the operation process in advance, in order to reduce the risk exposed to the workers during operational stage.
- Control risks of dust at source by re-design the location of plant and process.

WORKED EXAMPLE NO.7

North District and Tolo Harbour Sewerage,
Sewage Treatment and Disposal
– Regional Sewerage Works,
Part 1 - Sewerage Upgrade

Drainage Services Department

WORKED EXAMPLE NO.7

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3.2 Example 2 - 1.5km Long Rising Main along Ting Kok Road
3.3 Example 3 - Kau To Shan Road Underground Sewer
3.4 Example 4 - Tai Po Tai Wo Road Sewer
3.5 Example 5 - Construction of Sewer at Tai Po Road

4. Key Message 150

1. Project Information

1.1 Scope of work

The project **North District and Tolo Harbour Sewerage, Sewage Treatment and Disposal - Regional Sewerage Works, Part 1 - Sewerage Upgrade (NDTHRS)** aimed at upgrading the existing sewers, sewage pumping stations and associated rising mains in Sha Tin, Tai Po and North District as recommended by <Review of North District and Tolo Harbour Sewerage Master Plans>. AECOM Asia Co. Ltd. was appointed by Drainage Services Department (DSD) to carry out the investigation, design and construction assignment for the upgrading works.

1.2 Project location and nature of the works

The project was to construct / upgrade a total of 14 km of sewers and 3 sewage pumping stations in the areas as shown in Figure 1, with over 20 work sites scattered among three districts. The project was anticipated to be completed by 2015.

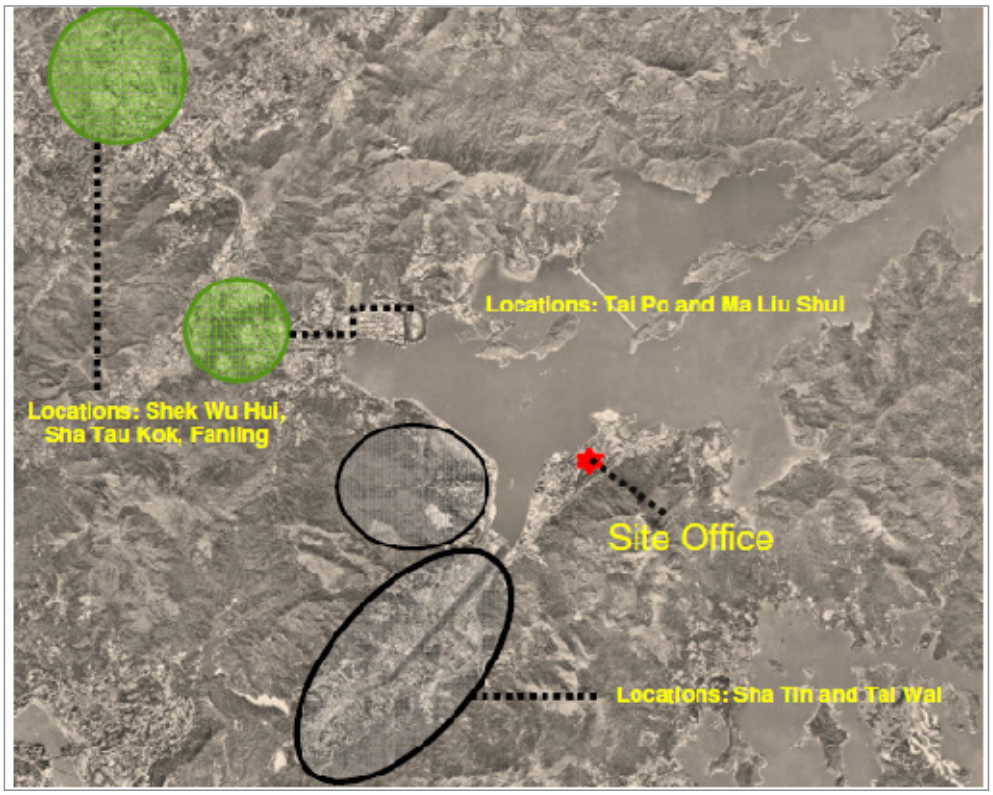


Figure 1 Location Plan for NDTHRS Project

1.3 Roles of duty holders

The structure of design team is illustrated in Figure 2. The duties to implement CDM are divided to 6 roles: Client, Project Supervisor, Designer, Contract Supervisor, Contractor and Maintenance Supervisor, of which the key responsible parties are stated below:

Client

DSD was the client of this Project. The Director's Representative was the Assistant Director the Projects and Development Branch of DSD. The Project is managed by the Consultants Management Division of the Projects and Development Branch of DSD (DSD/CM). DSD/CM was responsible for appointing a Project Supervisor and checking the competence of everyone he appointed.

Project Supervisor

The Project Manager of AECOM Asia Co. Ltd. was appointed as the Project Supervisor in the CDM Process. The Project Supervisor was responsible for advising and assisting the client, co-ordination, liaison, and ensuring proper record in Health and Safety File. The Project Supervisor started involving in the CDM Program of the NDTHRS project from the Preliminary Design Stage, to liaise with a number of stakeholders which could be potentially affected by the proposed works to identify hazards during the upcoming construction, operation and maintenance phases. After gathering all the safety concerns, the project supervisor then had to coordinate with different designers for the solution to the health and safety problems pointed out.

Designer

The project engineers of AECOM Asia Co. Ltd. were appointed as the Designer. The Designer had to consider the concerns in our design and minimize hazards which may give rise to risks inform relevant parties of the remaining risks. Example 1 to 4 in Section 3 shall demonstrate our effort in eliminating the risks to both construction and maintenance workers. Yet not all risks are possible to be eliminated by design, the residual risk is then communicated to the contractors prior to the construction stage.

Contract Supervisor

AECOM Asia Co. Ltd. was the Engineer of the Contract and acted as the Contract Supervisor for the CDM in the construction stage. Despite most of the focus of CDM was placed in the design stage, CDM also played an important role during construction. The Contract Supervisor would ensure that all significant information relevant is included in the Health and Safety File. The Contract Supervisor also had to ensure that all major design alterations ordered by the client or the designers during the construction period should take into account the resulting risk and impact on subsequent operation and maintenance of the project, as in Example 5.

Contractor

The NDTHRS project was packaged into 2 contracts (DC/2009/07 and DC/2009/14), and awarded to 2 contractors, China Road & Bridge Corporation - Dix Construction & Transportation Ltd. Joint Venture and Sang Hing Civil Contractors Co., Ltd., respectively. The Contractors were responsible for planning, managing and monitoring the construction phase in liaison with other contractors and preparing, developing and implementing a construction health and safety plan.

Maintenance Supervisor

End users of the sewerage works (i.e. Mainland South Division, Mainland North Division, Sewage Treatment Division 1 and Hong Kong and Islands Division (Buildings/Civil Maintenance Team) of DSD were the Maintenance Supervisors in the CDM process. They would have to assure their own competence, cooperate with others, report obvious risks, and provide any information required for the Health and Safety File.

Figure 2 Structure of design team

2. Safety by Design Process

CDM does not only assign duties to different roles to eliminate risks and pass on hazard information. CDM also focuses on the flow of risk information in a systematical way and we have established the system accordingly.

2.1 Summary of Health and Safety Concerns

The document recorded major potential concerns or hazards identified by stakeholders at the preliminary design stage. The Project Team circulated a briefing pack in explaining what happens in CDM and the background of our project, and invites them to provide their concerns for our further consideration. The Project Team has also conducted separate meetings with individual stakeholder for works in close proximity with them. The Project Team gathered the concerns of each stakeholder and formulated a table as the Summary of Health and Safety Concerns. For instance, safety concern was raised by the maintenance parties for maintenance of deep SPSs and sewers. Maintenance difficulty for longer rising mains and large diameter sewers were also noted.

As in the CDM guideline, the designer's initial responses were also included in the Summary of Health and Safety Concerns. In most case, detailed consideration would be left to detailed design stage, but there were cases which was so directional that the Designer had to consider and create an alternative approach early at the preliminary design stage. The classic example was the choice of site in Example 1 which will be elaborated later.

	Major Issues Raised by Stakeholders	Responses	Any Action Required	
			Yes / No	Action Parties
A.	Underground facilities within and adjacent to the sites, and possible risk for damage of existing utilities, including power cables, water mains and gas mains.	• Verification by digging trial pits • Early notice to utilities undertakers for action. • Protective equipments for workers	Y	Main Contractor
B.	Works in vicinity of and within major traffic zone, including Tolo Highway	• Seek approval from HyD • Selection of appropriate construction method • Close monitoring by condition survey and vibration / settlement monitoring • Maximizing the separating distance	Y	Designer / Main Contractor
C.	Works at Ma Lui Shui close to the Hong Kong Railway	• Seek approval from MTR • Selection of appropriate construction method • Close monitoring by condition survey • Maximizing the separating distance	Y	Designer / Main Contractor
D.	Unforeseen discovery of objects / items which are of potential hazards	• Verification by digging trial pits • Protective equipment for workers	Y	Main Contractor
E.	Works at Po Wan Road in vicinity of methane storage tanks of Shek Wu Hui Sewage Treatment Works	• Seek approval from DSD • Selection of appropriate construction method • Close monitoring by condition survey and vibration / settlement monitoring • Maximizing the separating distance	Y	Designer / Main Contractor
F.	Intrusion of excessive ground water in construction of deep sewers (e.g. sewer across Lam Tsuen River)	• Avoid deep sewer • Ground water preventive measures • Monitoring of water level	Y	Designer / Main Contractor
G.	Diversion of flows for on-line upgrading of existing sewers	• Temporary sewage diversion • Use of personnel protective equipment and clothing	Y	Designer / Main Contractor

WORKED EXAMPLE NO.7

	Major Issues Raised by Stakeholders	Responses	Any Action Required	
			Yes / No	Action Parties
H.	Damage / interference on the apparatuses due to fire, flooding, immense heat, corrosive chemicals, poor support / protection, soil subsiding, excessive, vibration, bursting of adjacent gas / water / drainage pipes, presence of vermin, such as termite, etc.	• Setting up site rules • Emergency team	Y	Main Contractor
I.	Working in confined spaces during construction and operation stages for sewers and SPSs	• Avoiding working in confined space • Following safety guidelines and measure for works in confined space • Use of personnel protective equipment and clothing	Y	Main Contractor
J.	Works in vicinity of heritage sites which are sensitive to vibrations	• Selection of appropriate construction method • Close monitoring by condition survey and vibration / settlement monitoring • Maximizing the separating distance	Y	Designer / Main Contractor
K.	Works outside police station and fire station (at Hin Keng Street) interfere the entrance / exit of emergency vehicles	• Selection of appropriate site location and construction method preventing obstruction of emergency vehicles • Close liaison with HKPF and HKFS	Y	Main Contractor
L.	Flooding of site during construction	• Close monitoring of weather report • Dewatering equipment made available at site	Y	Main Contractor
M.	Flooding of the system during maintenance (e.g. impractical to isolate huge flow for large diameter sewer)	• Temp. shut off of upstream flow • Diversion of flow by overland pumping • Avoid large diameter sewer	Y	Designer / Main Contractor

N.	Noise nuisance from construction equipment during construction stage	• Prevent using noisy machinery • Isolation of noise source during construction • Controlling the number of work hours at site	Y	Main Contractor
O.	Noise nuisance from E&M equipment during operation stage of SPSs	• Increasing separation distance from sensitive receivers • Isolation of noise source within SPS • Controlling the duration between on-off for the equipment	Y	Designer / Main Contractor / Maintenance Contractor
P.	Extreme weather conditions during construction and maintenance of the works	• Close monitoring of weather report • Setting up procedure for extreme weather • Prevent construction / maintenance in extreme weather	Y	Designer / Main Contractor / Maintenance Contractor
Q.	Road safety during diversion of traffics, including vehicular, pedestrian and cyclist traffics, during construction stage	• Consult TD and RMO • Conduct TIA • Conduct trial run	Y	Designer / Main Contractor
R.	Stability of slopes and retaining walls affected by construction works and installation of water carrying facilities	• Consult GEO • Conduct Geotechnical Assessment	Y	Designer
S.	Potential hazards due to contact of sewage	• Temp. shut of upstream flow • Diversion of flow by overland pumping • Use of personnel protective equipment and clothing	Y	Main Contractor
T.	Construction and safety concern for deep sewer	• Avoiding deep sewer in design	Y	Designer
U.	Safety concern for maintenance of long rising main	• Providing sufficient inspection chamber	Y	Designer

2.2 Hazard and Impact Summary

The significant hazards and impacts listed out in the Summary of Health and Safety Concerns were considered by the Designer in the detailed design stage and the corresponding risk control measures and key decisions are recorded in the Hazard and Impact Summary.

The hierarchy of risk control, i.e. avoidance, minimization and control, is strictly followed. The focus of design is mainly to avoid or minimize the dangerous situation by deriving alternative to traditional approach (Example 2 - 4). Despite more work had to be carried out in deriving further solution and more resource had to be spent for a safer option, the Project Team considered it worthy to do so under the essence of CDM. Yet not every risk could be eliminated with an economically feasible option. Residual risks unable to be dealt with by the design were also highlighted with proposed control measure. The residual risks here not only mean the risk under the original scheme, but also the dangerous situation that might be created by the alternative options.

2.3 Pre-tender Health and Safety Plan

The information contained on the Hazard and Impact Summary Pre-tender Health and Safety Plan was then included in the Pre-tender Health and Safety Plan as a tender documents for reference by the tenderers. However, not all the information was recorded in the Pre-tender Health and Safety Plan. The general risk to construction was not included so as to avoid the loss of focus of contractor on significant issues. Also, the risks that had been eliminated would not be mentioned. Only significant health and safety risks that were unlikely to be obvious to a competent contractor or such risks which are difficult to manage effectively would mention in the Pre-tender Health and Safety Plan.

	Task	Hazards and Impacts	Risk Assessment Rating	Control Measures	Hazards Resolved (Yes/No)	Necessity to Notify Contractor (Yes/No)	Other Relevant Parties to Be Notified
1.	Maintenance In large diameter trunk sewer	• Impractical to isolate large flow • Long-distance Pumping infeasible	4	• Construction of Sewer at Tai Po Road • Develop diversion scheme for the proposed trunk sewers. Tai Po Tai Wo Road Sewer • Provision of twin pipes.	Yes	No	DSD
2.	Construction and Maintenance for Deep Sewer	• Ground water intrusion during construction • Work at height during construction • Risk of falling during access of manhole • Higher risk in confined space	4	• CUSPS • Alternative design scheme of a double-storey SPS was proposed and deep sewer was avoided Kau To Shan • Alternative design scheme of steeper sewer with epoxy lining and grade 40 concrete manhole instead of relying on backdrop manholes	Yes	No	DSD
3.	Maintenance for Long Rising Main	• Higher risk in confined space	3	• 1.5km Long Rising Main along Ting Kok Road • Providing sufficient inspection chamber	Yes	No	DSD

WORKED EXAMPLE NO.7

3. Examples of Safe Design in this Project

The followings examples are highlighted in the Hazard and Impact Summary which encountered in the project, in preliminary design stage, in detailed design stage as well as in construction stage:

3.1 Example 1 – Chinese University Sewerage Pumping Station

3.1.1 Area of health and safety concerns

One of the key elements of the Project was to upgrade the Chinese University Sewerage Pumping Station (CUSPS). Where conventionally it would build a new pumping station at the most suitable location nearby to serve the sewerage network and abolish the old one (See Figure 4), the existing site of CUSPS had a very limited area and the new feasible location was at approx. 400m away. Should this conventional approach be adopted, a deep sewer would need to be constructed and the new CUSPS would also be deepened by about 3m due to the longer travel distance for gravity flow of sewage.

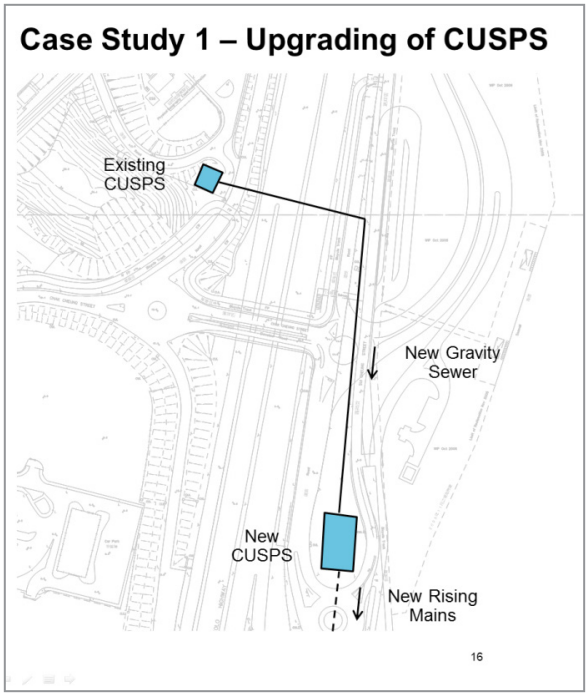


Figure 4 The conventional approach to would build a new pumping station at an alternative location

3.1.2 Identify the special risk problems

In this regard, construction and maintenance works would be subject to a high risk in confined spaces and falling from heights. During the construction, ground water might also intrude to the deep excavated area and drown the workers.

As the choice of site is one of the schematic issues, it has to be fixed in preliminary design stage. The Designer was involved at an earlier stage to consider whether the health and safety would have implication on the preliminary design and change the preliminary design if necessary.

3.1.3 Improvement in design

When the risk could not be avoided totally, it had to be minimized. AECOM Asia Co. Ltd. adopted an innovative approach to upgrade the existing CUSPS on-site. To cater the problem of congested site, the Project Team designed a double-storey pumping station with a transformer room at the 1st floor and minimized its footprint. This created another question to the CLP workers: how to lift the transformer of approximately 9 tones to the first floor? To ease the construction and maintenance, after liaison with CLP, the Project Team incorporated a retractable crane in the design which could extend out of the structure for safe lifting of the heavy transformers. (See Figure 5)

Yet, the function of existing CUSPS could not be interrupted during construction. Instead of keeping the existing CUSPS functioning, AECOM Asia Co. Ltd. proposed to build a temporary sewage pumping facilities next to the existing CUSPS to maintain continuous conveyance of sewage. Sequence of the upgrading works is shown in Flowchart 1. In exchange of innovative ideas in brain storming processes and liaison works, the risk level to construction and maintenance workers could be greatly reduced.

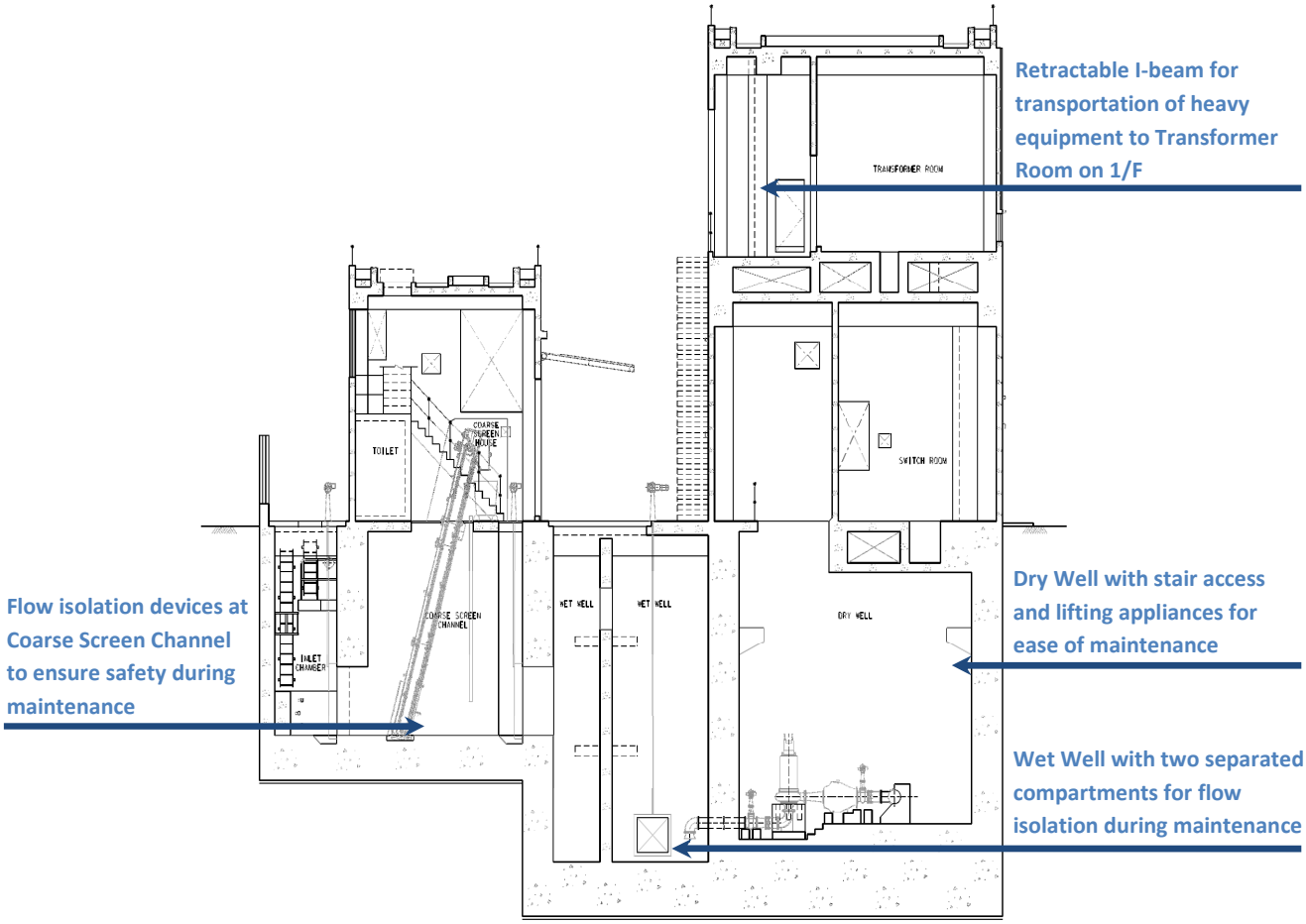
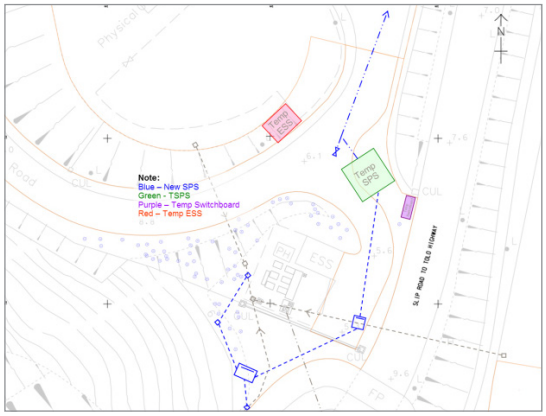


Figure 5 Design of a Double-Storey SPS

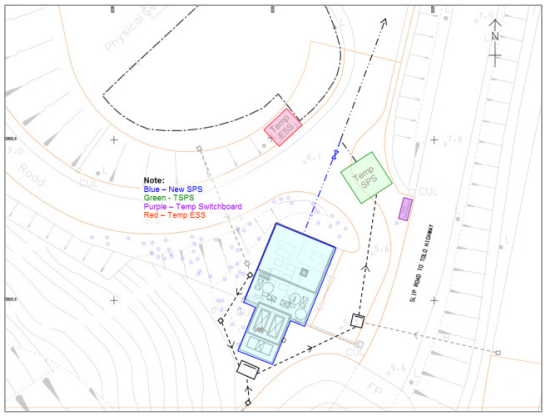
WORKED EXAMPLE NO.7

Flowchart 1 - Sequence of the upgrading works



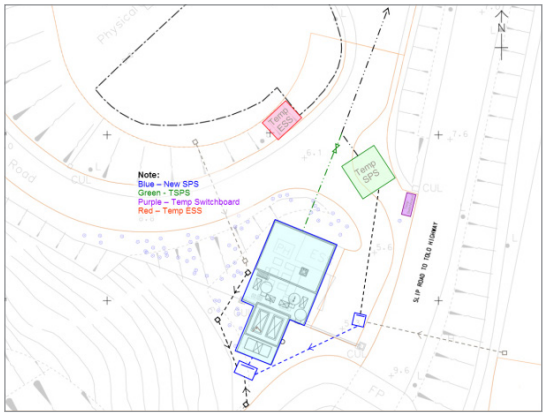
Stage 1

Construction of temporary sewage pumping facilities, including the temporary power supply units and deodorization unit



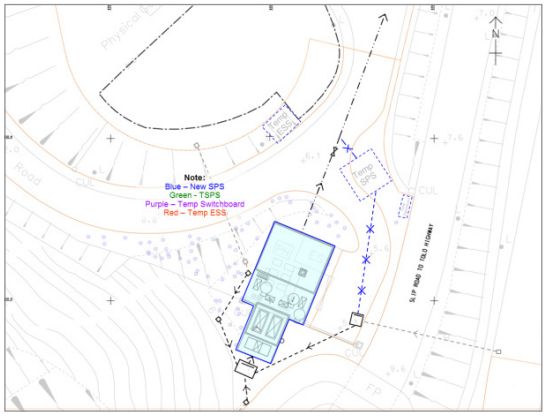
Stage 2

Construction of the new CUSPS while functioning of temporary sewage pumping facilities



Stage 3

Diversion of sewage flow to the new CUSPS after commissioning of the new facilities



Stage 4

Demolition of the temporary sewage pumping facilities after full operation of the new CUSPS

3.2 Example 2 - 1.5km Long Rising Main along Ting Kok Road

3.2.1 Area of health and safety concerns

For design of rising mains, washout pits or air valve chambers were not normally required when the profile of the rising mains was sloping all the way upward to the discharge point. Yet the construction safety and maintenance difficulty was often a concern for such long pressured pipe. Without intermediate access manholes to be constructed, contractor would conventionally have a long trenchless tunnel to construct the rising main, which imposed grievous safety concern for emergency escape and confined space. During maintenance, the inspection of pipes could not be practicable for such a long distance rising main.

3.2.2 Identify the special risk problems

Regard to this, the construction workers and the maintenance workers had to withstand a high risk when working inside the confined space environment of 1.5 km trenchless tunnel to perform pipes inspection which was not a reasonably practicable work environment.

3.2.3 Improvement in design

The Project Team therefore proposed to build inspection chambers in every 100m to 200m intervals (See Figure 6), which could serve as access points for trenchless works during construction and safe means of inspection in maintenance. This could definitely provide a safer working environment in both construction and maintenance phases of the Project.

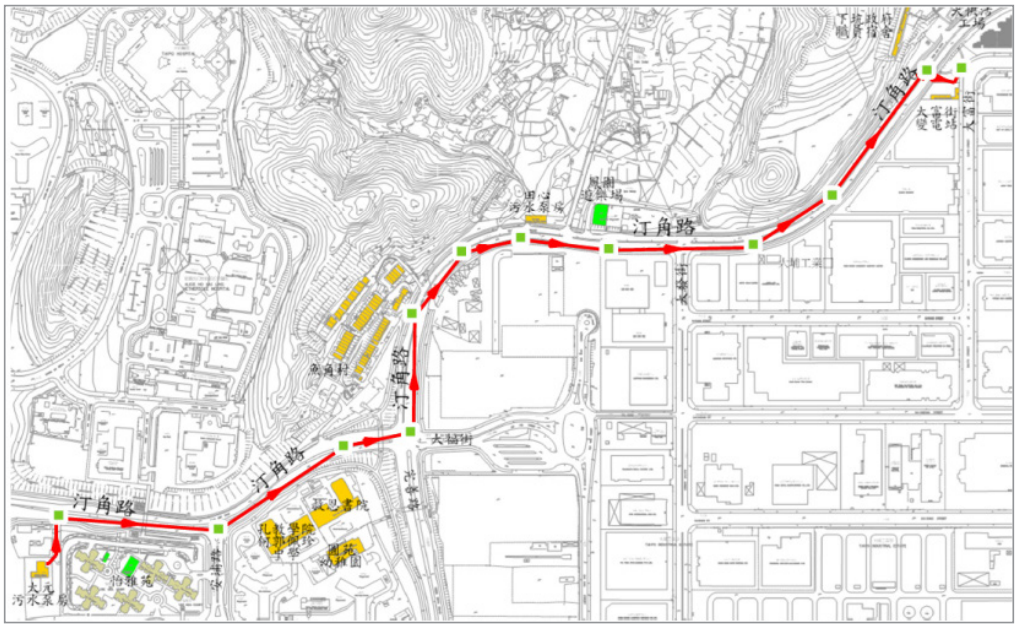


Figure 6 Provision of Inspection Chambers for Long Rising Main

3.3 Example 3 - Kau To Shan Road Underground Sewer

3.3.1 Area of health and safety concerns

A new sewer was to be built in a steep road to serve the catchment in the Kau To Shan region. Conventionally, sewers had to be built with gentle gradients as the fast and aggressive sewage may erode the pipes and the manholes. Sewerage Manual published by Drainage Services Department has therefore imposed a maximum sewage flow velocity of 3m/s. This has limited the gradient of the sewers and the gradient of the sewer cannot be built to follow the gradient of the road. Backdrop manholes exceeding 6m in depth would be required in order to suit the manual requirement (See Figure 7). Such deep excavation posed significant risk to construction and maintenance workers (same for that outlined in Example 1).

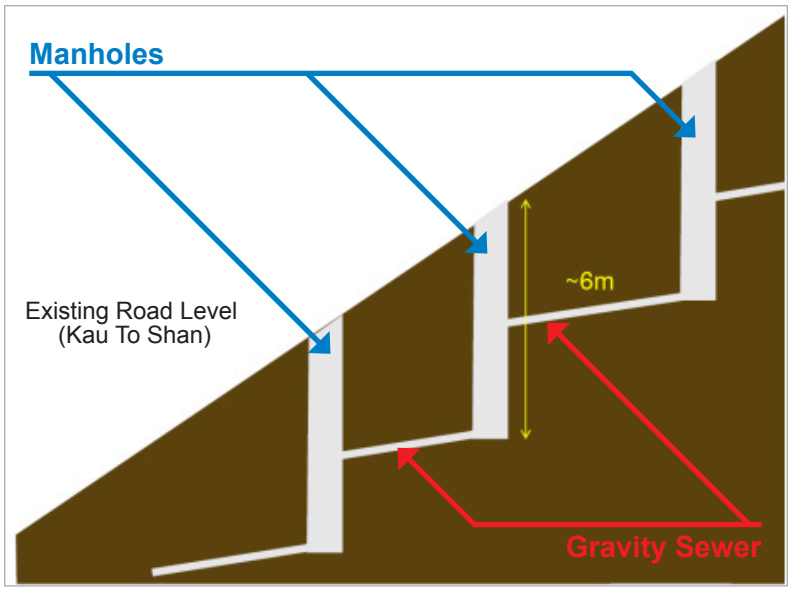


Figure 7 Schematic Diagram for Conventional Design of Sewers at Slopy Location

3.3.2 Identify the special risk problems

Apart from the risk of ground water intrusion during construction, there were risk of falling when the workers access or egress the manhole; the workers needed to withstand higher risk when working inside the confined space of the manhole and risk of fall from height.

To minimize the hazard, the Project Team liaised with the maintenance party to explore the way for constructing the sewers with a steeper gradient and hence shallower depth from road level.

3.3.3 Improvement in design

To achieve this, special provision was provided to the sewers and manholes. Sewers were coated with epoxy protective lining against the corrosion of high speed sewage. Manholes were also constructed with Grade 40 concrete with PFA to strengthen the corrosion resistance. As a result, the excavation required reduced to 3-4m (See Figure 8). Although Designer's work is increased, safety of workers could be assured.

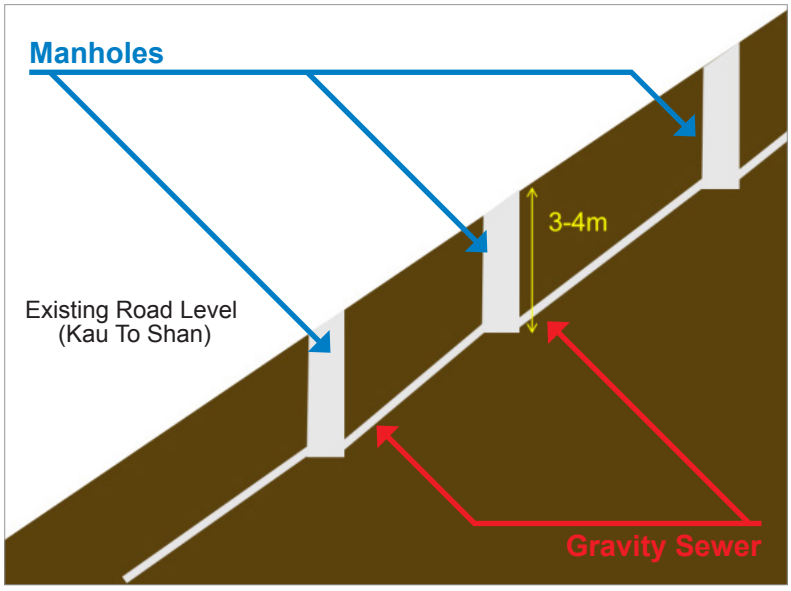


Figure 8 Schematic Diagram for Alternative Design of Sewers at Slopy Location

3.4 Example 4 - Tai Po Tai Wo Road Sewer

3.4.1 Area of health and safety concerns

The original proposal of the captioned work was to build a new sewer with a 900mm-diameter to replace the existing 600mm-diameter sewer. For sewer inspection and maintenance, it could be much safer to be carried out in dry condition. Therefore, whenever man-entry inspection and maintenance is required, the sewer has to be temporarily shut off and upstream flow is diverted by overland pumping.

3.4.2 Identify the special risk problems

Yet, for sewers with large diameter, it is impractical to isolate the large flow for maintenance due to the limitation of pumping devices. Long-distance pumping would also be not feasible due to site constraints. If the original proposal was adopted, maintenance workers would be exposed in a high risk with large amount of flowing sewage. This might be very dangerous due to the potential flushes and accumulation of toxic gas.

3.4.3 Improvement in design

To eliminate the safety hazard from the potential sudden flushes and accumulation of toxic gas, the Project Team proposed a twin-pipe system which was an innovative arrangement in Hong Kong during the design stage. It consisted of a newly built sewer with same diameter as the original sewer. (See Figure 9) Diversion switch arrangement was installed in the upstream and downstream manholes. In case of inspection and maintenance, one of the twin pipes could be shut and the sewage could be temporary conveyed by the other one without interruption to the overall sewerage system. Safety hazard was therefore eliminated by allowing workers to work in dry condition.

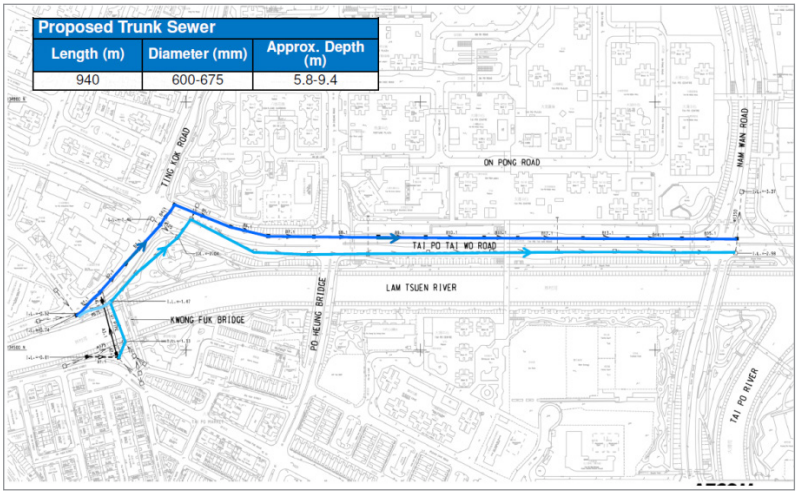


Figure 9 Twin Pipe System

3.5 Example 5 - Construction of Sewer at Tai Po Road

3.5.1 Area of health and safety concerns

An underground sewer was to be constructed at Tai Po Road under the scope of the project. During desktop study, utility records were studied and the sewer alignment was proposed away from the nearby utilities for the ease of construction and maintenance. During construction stage, trial pits were excavated and it was revealed that a water main was located in close proximity to the proposed alignment. (See Figure 10)

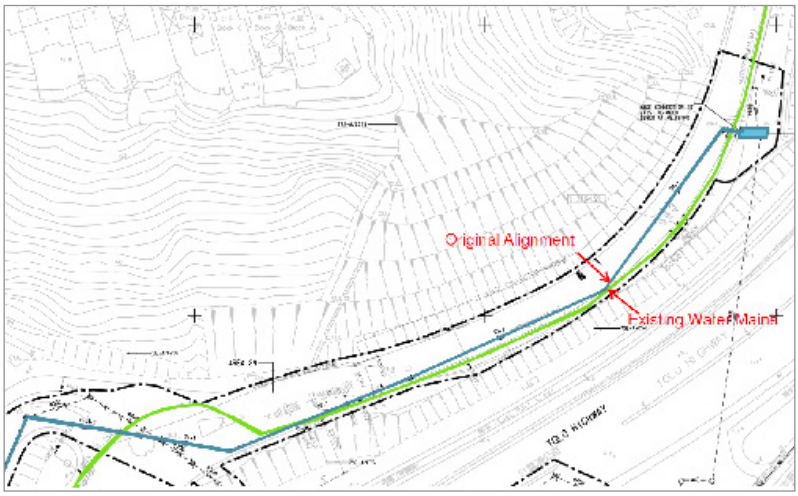


Figure 10 Original Alignment in Close Proximity of the Existing Water Mains

3.5.2 Identify the special risk problems

Although the proposed sewer could still be constructed beside the proposed alignment by providing protection to the water main, the risk of water mains leakage was considered significant as the water main might be affected by the vibration during driving and

extracting of sheet piling. Any slight disturbance to the water main might eventually lead to pipe burst, which would not only flood the site but also affect the stability of the temporary works of the excavated trench. The worker would then have to work in the risk of pipe burst which might come at any time.

3.5.3 Improvement in design

This risk was notified by Contractor's risk assessment in the Construction Health and Safety Plan. Despite the works could be carried in accordance of the contract, the Contract Supervisor considered that the risk should be eliminated wherever possible. After studying the result of trial pits and the utility record, the Contract Supervisor proposed an alternative alignment at the opposite of the road away from the water main in concern. (See Figure 11) This relieved the risk to workers in construction.

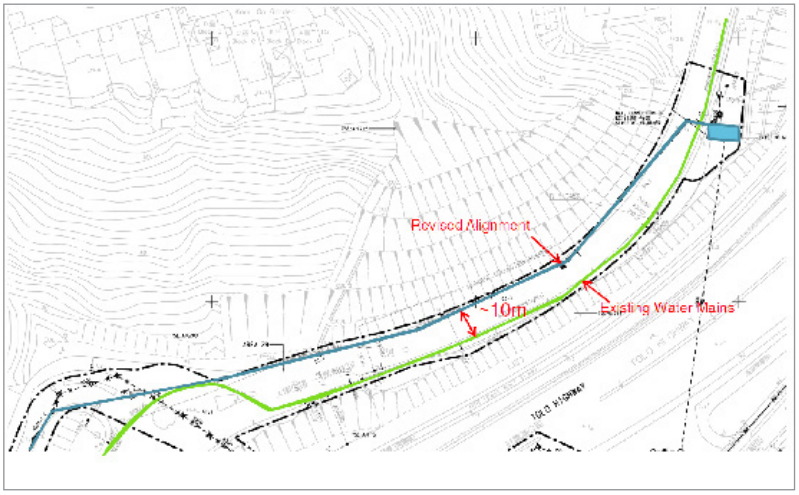
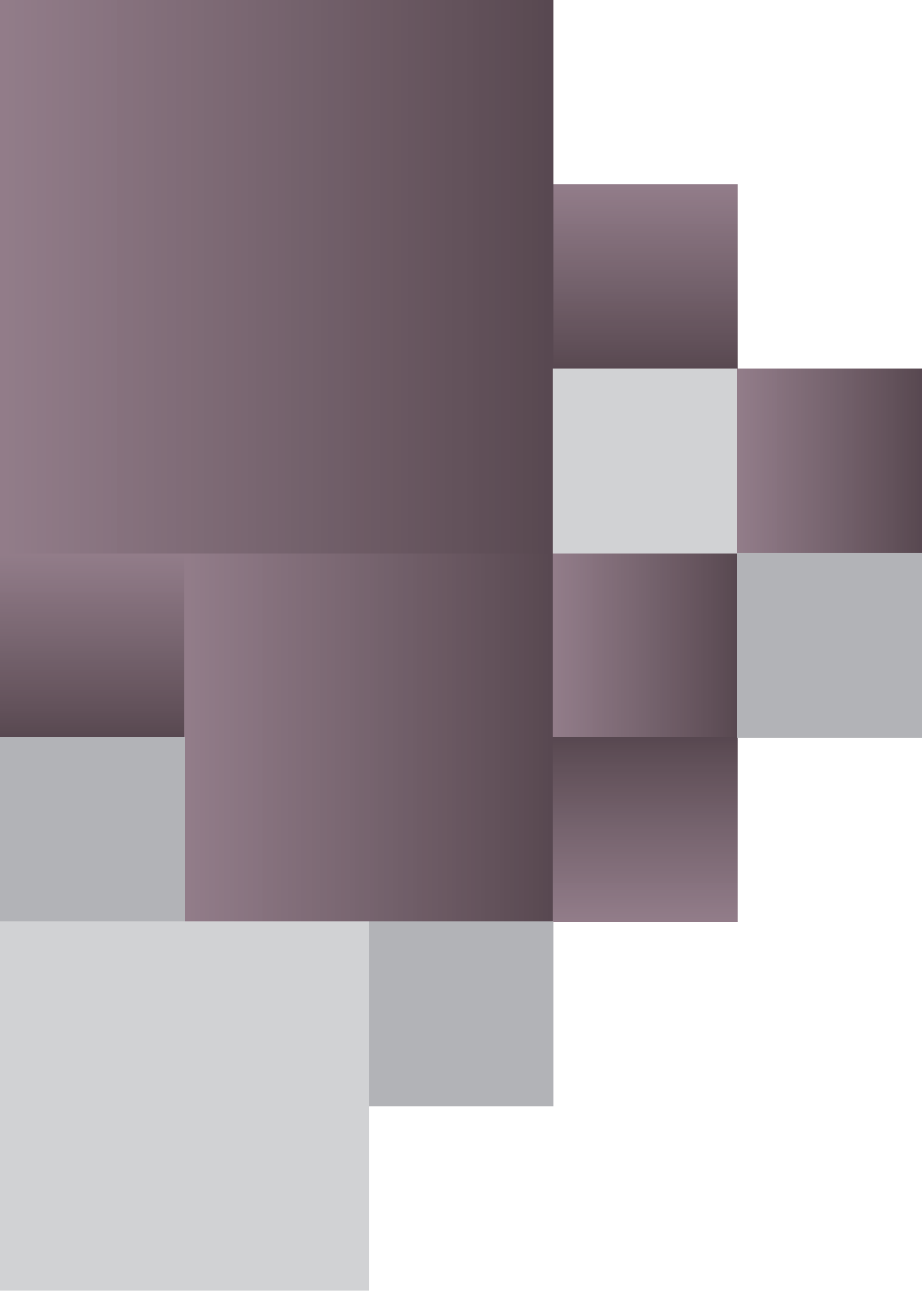


Figure 11 Revised Alignment in Opposite of the Road

Key Message

- Design for safer construction by using the engineering control to minimize the hazard. The Project Team explored the way for constructing the sewers with a steeper gradient and hence shallower depth from road level.
- Elimination of the hazard and associated risk from the potential accumulation of toxic gas during sewer pipe inspection and maintenance, the project team proposed to use a twin-pipe system and the sewage could be temporary conveyed to the other sewer pipe without interruption.



WORKED EXAMPLE NO.8

Construction of
Public Rental Housing Development at
Anderson Road Site E Phase 1 & 2

Housing Department

WORKED EXAMPLE NO.8

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1.1 Scope of work 154

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3.2 Example 2 - Footbridge

3.3 Example 3 - 1/F Canopy

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4. Key Message 162

1. Project Information

1.1 Scope of work

This project consists of 7 domestic blocks, welfare facilities, retail shops, estate management office, kindergarten, refuse collection point and pedestrian footbridge.

Figure 1 Simulation of the housing development

1.2 Project location and nature of the works

The 3.97 hectare site is newly formed by Civil Engineering and Development Department at the existing Anderson Road Quarry site in East Kowloon. Building works include the construction of 39 to 43-storeys domestic blocks, various low-rise ancillary facilities, retaining walls and mini-piles.

WORKED EXAMPLE NO.8

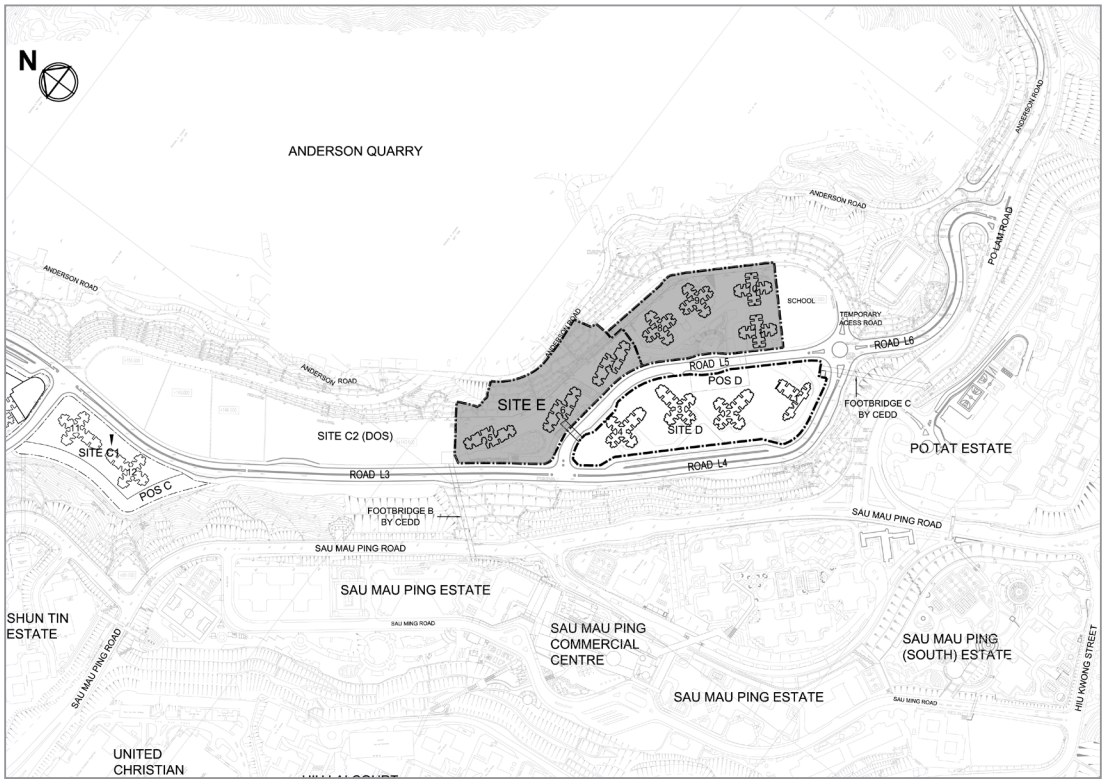

Figure 2 Location Plan for the Project

1.3 Design Team

The Hong Kong Housing Authority is the developer for this public housing project. As its executive arm, the Housing Department formed a Design / Project Team to design and deliver the project. The Design Team comprises of Architects, Planners, Structural Engineers, Building Services Engineers, Quantity Surveyors, Civil Engineers, Geotechnical Engineers, Landscape Architects and Environmental Consultants.

2. Safety by Design Process

Housing Department is committed to “Planning and Design for Safety”. Throughout the entire design development process from conceptual layout to detailed design stages, in-house design guides, design checklists and audit findings are the major sources of reference for design for safety. Moreover, the Project Design Review Committee and Detailed Design Review Panel of the Housing Department represented by the Development & Construction and Estate Management Divisions actively vet the design proposals and raise project specific comments on sustainability, buildability and maintainability with a view to avert potential safety, health and environmental hazards at the onset.

3. Examples of Safe Design in this Project

The followings examples are highlighted which encountered in the project.

3.1 Example 1 - Noise Barrier:

A 8.1m high noise barrier has to be erected along the western boundary to provide protection against traffic noise from Road L3. The upper portion of the noise barrier consists of transparent panels which would occasionally require cleansing and maintenance. To minimize the need for maintenance work at height, the projecting roof of the noise barrier was slanted to enhance self-cleansing. (See Figure 3)

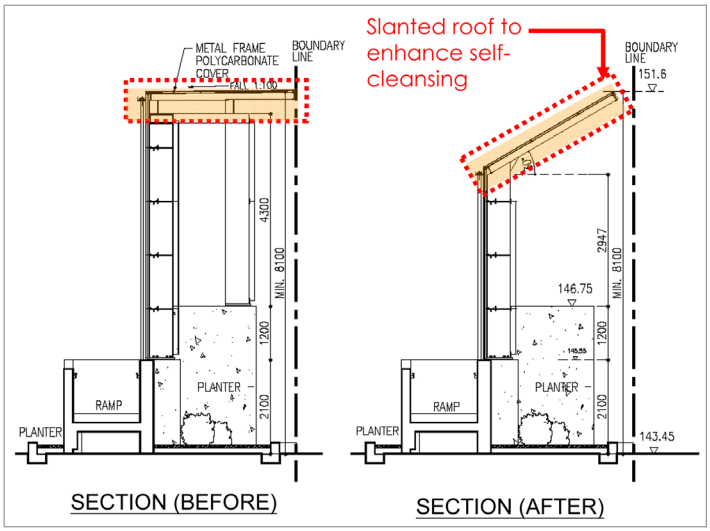

Figure 3 Horizontal view of the noise barrier section

In consultation with the Management Branch, the landing size of the adjoining ramp was enlarged to provide big enough levelled surface to accommodate maintenance platform for clearing blocked drains and carrying out repair works. (See Figure 4)

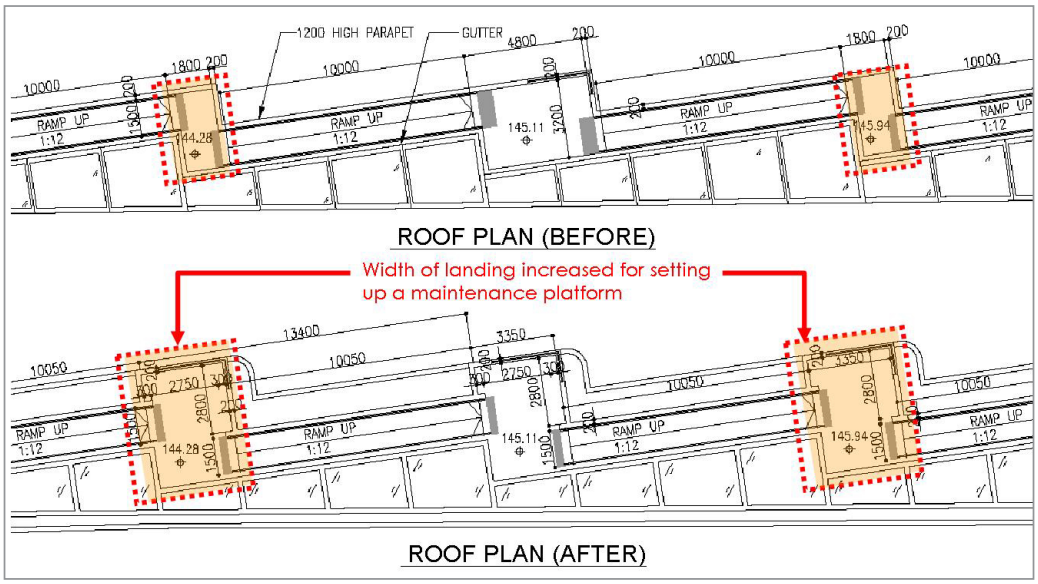

Figure 4 Vertical view of the noise barrier section

3.2 Example 2 - Footbridge:

A 30m long steel footbridge spans across Road L5 to provide safe and convenient pedestrian crossing between two sides of an estate. (See Figure 5) To maximize greening opportunity and enhance visual merit, planters are provided on the roof as well as both sides of the footbridge. (See Figure 6)

Figure 5 Simulation of the footbridge

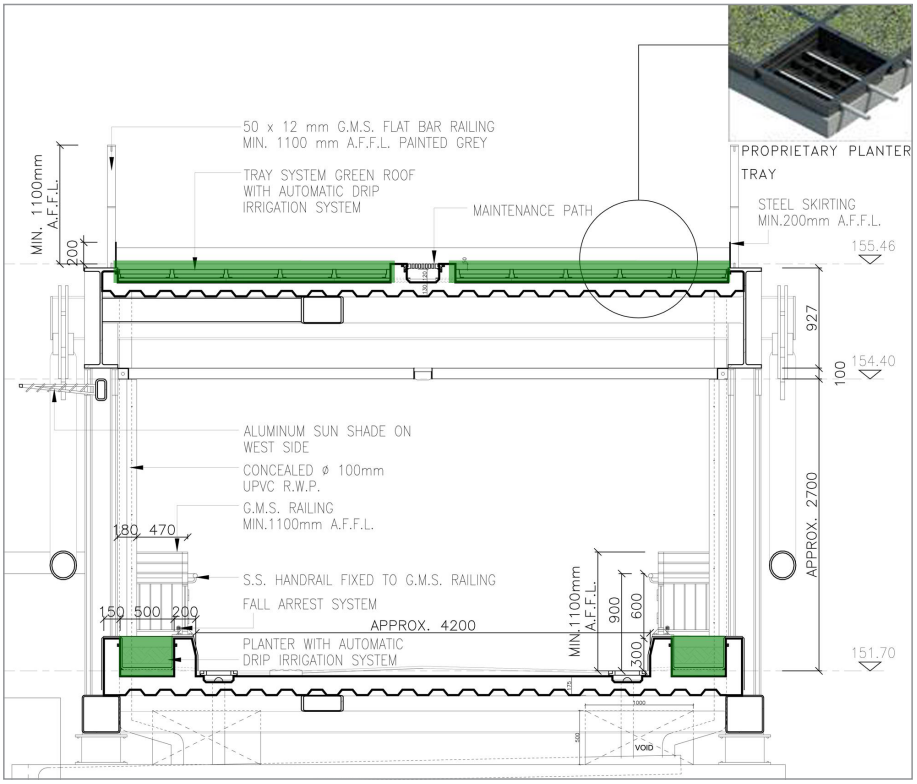

Figure 6 Horizontal view of the footbridge

Maintenance access to these footbridge planters is a major safety concern where the consequences of accidents are potentially serious. (See Figure 7) In addition to providing fall arrest system, the hazard of working at height is further reduced by providing openable railing panels at regular intervals for accessing the planters from inside the footbridge. (See Figure 8)

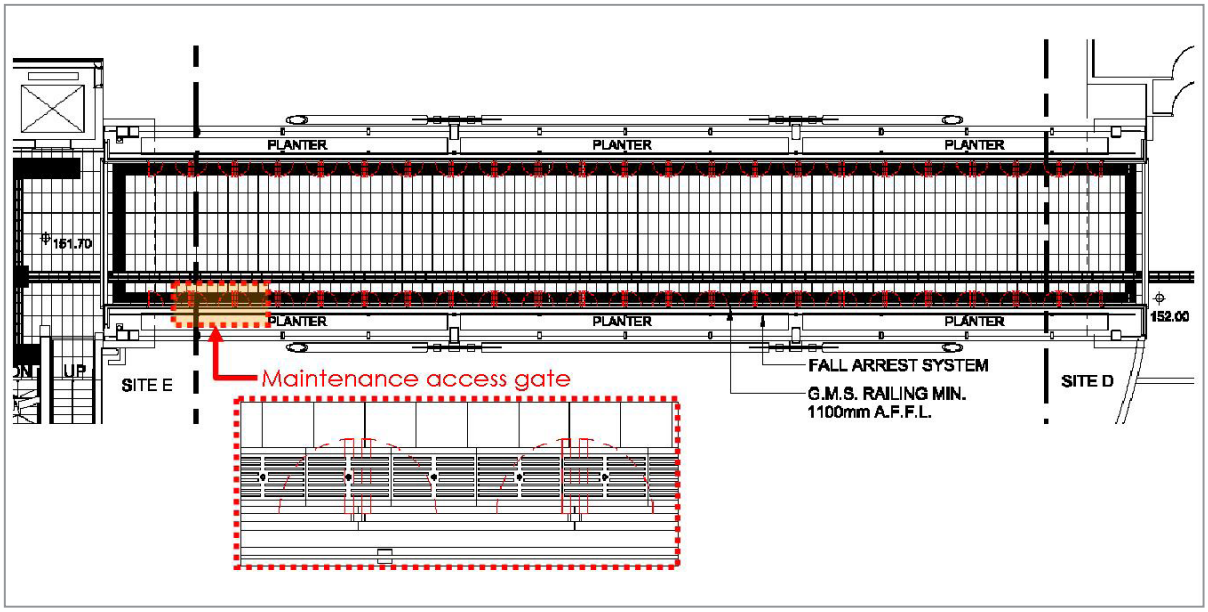

Figure 7 Vertical view of the footbridge

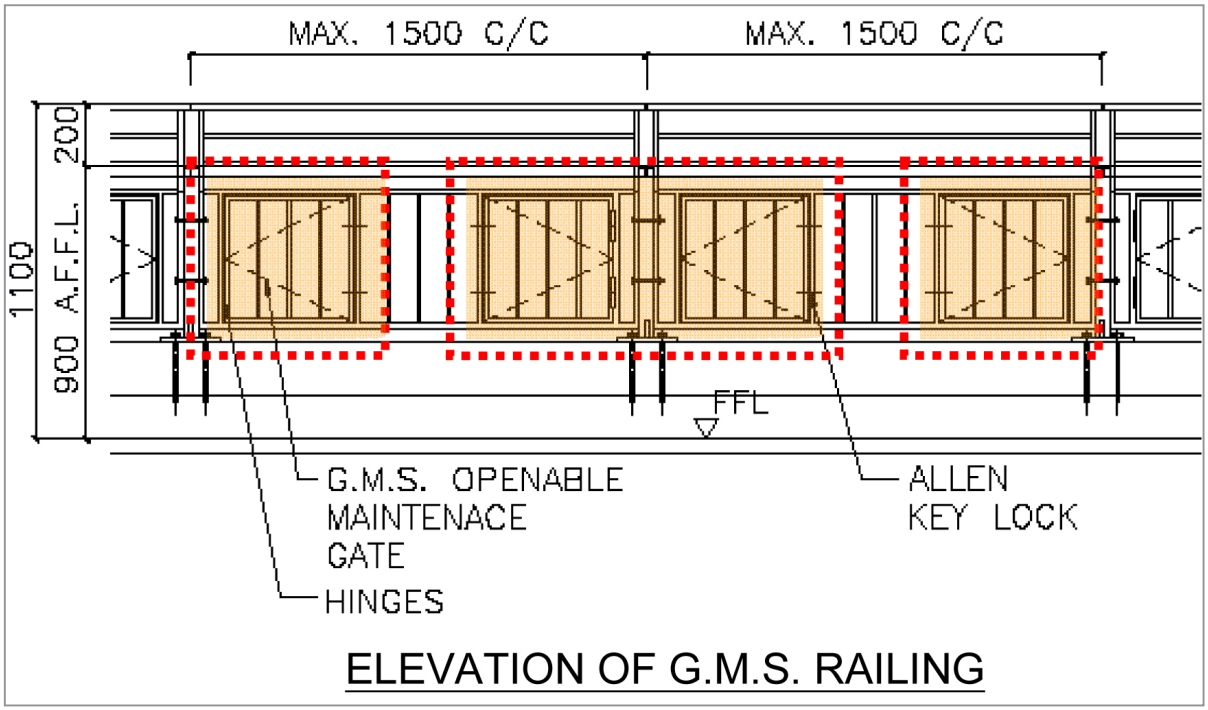

Figure 8 Vertical view of the footbridge showing the elevation of G.M.S. Railing

WORKED EXAMPLE NO.8

A safe and convenient access is also provided to the roof of the footbridge by extending a nearby staircase by another flight to reach the roof level. This access is controlled by a lockable gate to prevent unauthorized entry. (See Figure 9&10)

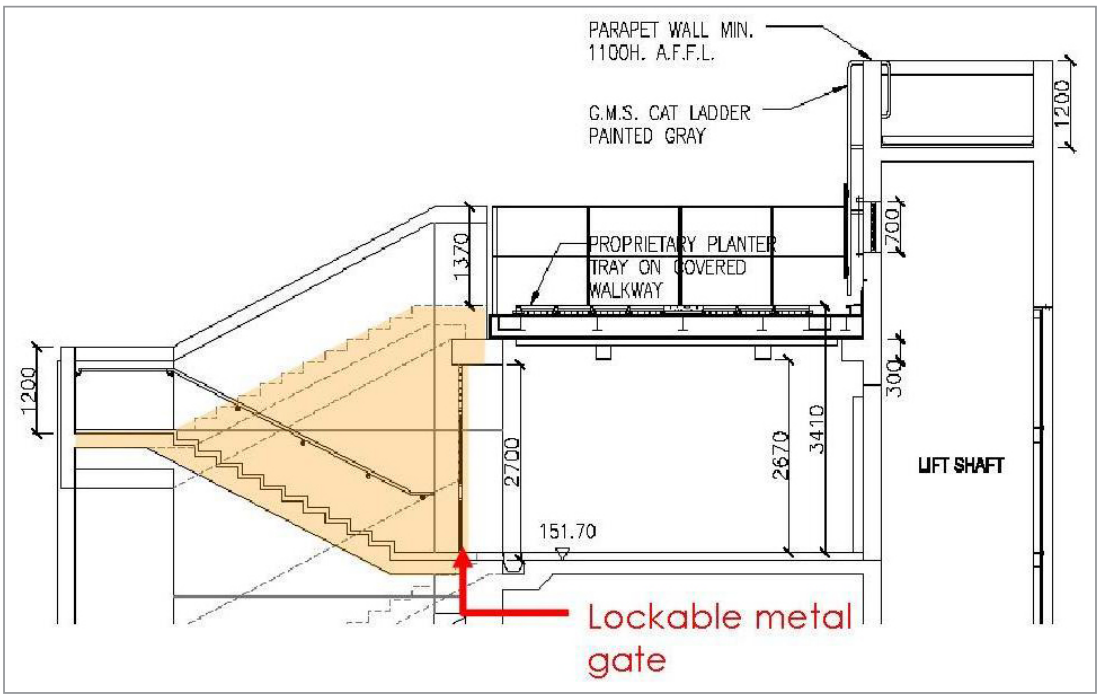

Figure 9 Vertical view of the roof of footbridge access

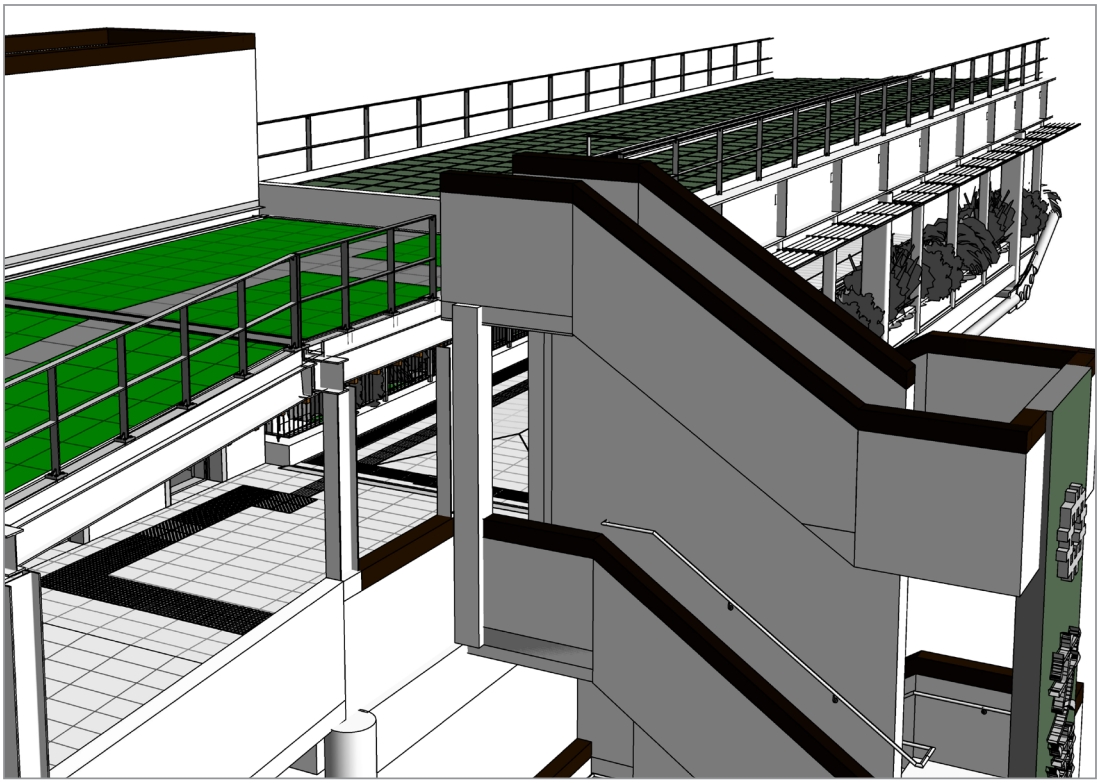

Figure 10 Simulation of the roof of footbridge access

3.3 Example 3 - 1/F Canopy:

In the past, the projecting canopy at 1/F of domestic block was unfenced and workers relied on fall arrest system to prevent falling from height. However, a number of accidents of workers falling from height aroused the Department's concern on the limitation of using fall arrest system as a safety measure as it relied heavily on human factor in proper use of the system as well as robustness of the system design.

In September 2012 metal railing became a mandatory provision along the edges of footbridge roofs, covered walkways and canopies for protection of personnel from falling from height. (See Figure 11-13) Only in the case of very special circumstances, where railing is proved to be impossible or impracticable will the provision of fall arrest system be considered after carrying out risk assessment.

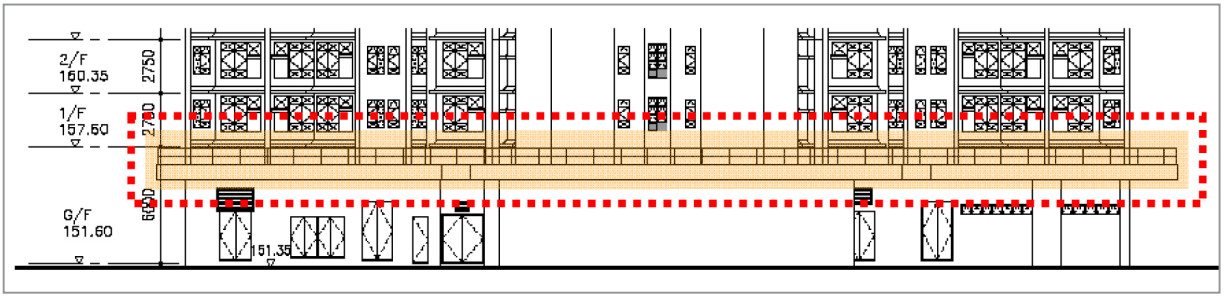

Figure 11 Metal railing shown in the floor plan

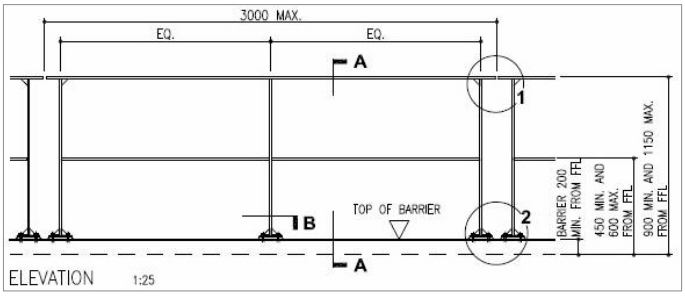

Figure 12 Dimension of the metal railing

Figure 13 Simulation of the metal railing at the building

3.4 Example 4 - Temporary Protective Canopy - during construction:

As a contract requirement, our contractor is responsible for designing, building, and maintaining temporary protective canopies at the first floor level around the edges of the buildings except where there is already a 3m wide concrete canopy.

An indicative sketch was provided to the contractor at tender stage for reference. Such sketch showed a plan of the canopy and typical sections consisting of timber boarding of 20 mm (min.) thick covered by a layer of galvanized metal sheeting 0.8 mm (min.) thick as minimum requirements for the canopy. The contractor was required to design the protective canopy in accordance with the Building (Construction) Regulations in Hong Kong and design codes satisfying such Regulations.

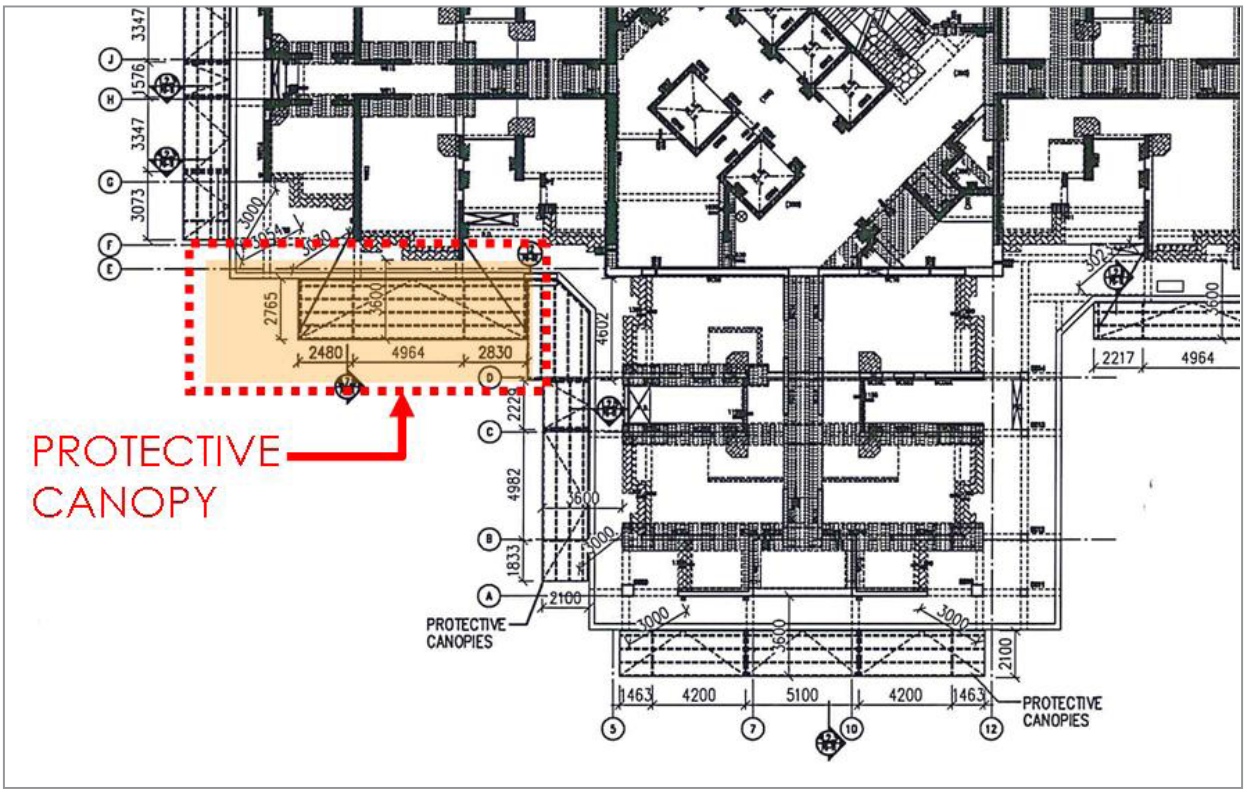

Figure 14 Temporary Protective Canopy shown in the floor plan

The contractor further modified the design into a canopy that can be raised to cater for local lifting operation. (See Figure 14 &15) Chain blocks with chain links are installed to raise/lower the main beam of the protective canopy. In addition, hinge joints are provided at the connection between the main beam and the lower steel bracket to facilitate the raising/lowering operation.

Figure 15 Temporary Protective Canopy used in the construction site

Key Message

- In the initial design, safe access, egress and permanent working platform are provided for maintenance to carry out their routine work at the footbridge and canopy etc. are the engineering control measures to minimise the risk of fall from height.

WORKED EXAMPLE NO.9

Construction of Public Rental Housing Development at Kwai Shing Circuit

Housing Department

WORKED EXAMPLE NO.9

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3. Examples of Safe Design in this Project 168

3.1 Example 1 - Construction cycle for superstructure with precast facade and large panel formwork

3.2 Example 2 - On site assembly of the footbridge / link bridge

4. Key Message 171

1. Project Information

1.1 Scope of work

This project consists of 2 domestic blocks, a community garden at Kwai Luen Road, pedestrian footbridge connecting Blocks 1 & 2 and Block 2 Kwai Luen Road & lift towers. (See Figure 1 & 2)

Figure 1 Simulation of the housing project

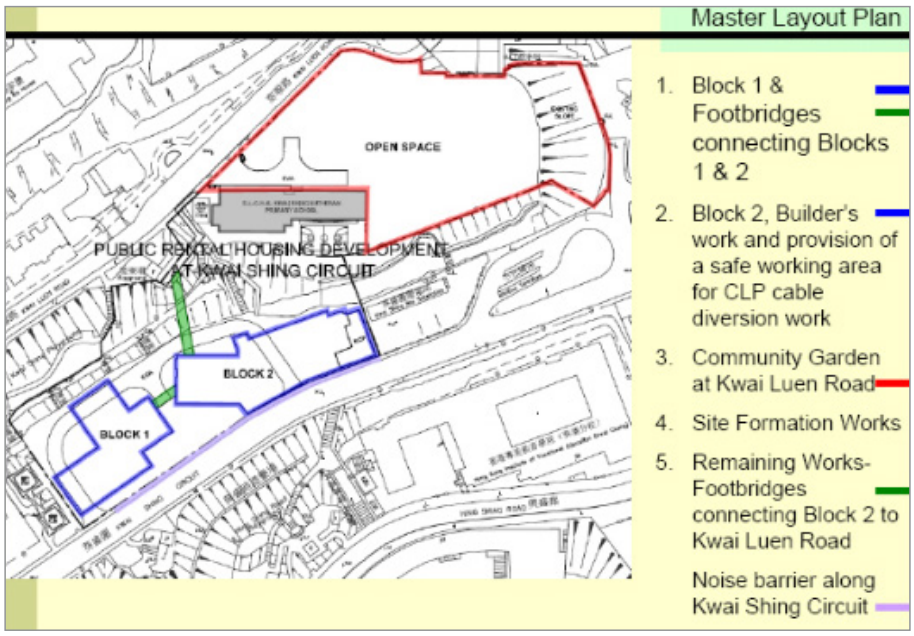

Figure 2 Floor plan of the housing project

1.2 Project location and nature of the works

Building works for this project include the construction of 38-39-storeys domestic blocks, noise barrier along Kwai Shing Circuit and various low-rise ancillary facilities. (See Figure 3)

Figure 3 Aerial view for the Project

1.3 Design Team

The Hong Kong Housing Authority is the developer for this public rental housing project. As its executing agency, the Housing Department formed a Design / Project Team to design and deliver the project. The Design Team comprises of Architects, Planners, Structural Engineers, Civil Engineers, Building Services Engineers, Geotechnical Engineers, Quantity Surveyors, Landscape Architects and Environmental Consultants.

2. Safety by Design Process

Housing Department is committed to "Planning and Design for Safety". The in-house design guides and design checklists are the main design for safety reference during the design development process from conceptual layout to detailed design stages. The project team would hold regularly meeting to discuss any safety issues during the design stage and construction stage. Additionally, the Project Design Review Committee and Detailed Design Review Panel of the Housing Department represented by the Development & Construction and Estate Management Divisions 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. The residual risks information will be passed on to the estate management team who in charge of estate maintenance.

3. Examples of Safe Design in this Project

The followings examples are highlighted which encountered in the project.

3.1 Example 1 - Construction cycle for superstructure with precast facade and large panel formwork:

Building information modeling (BIM) was used to demo the construction life cycle in order to stimulate the construction method with take into the account of safety measures and other matter such as construction costing. (See Figure 4) The risk assessment can be applied during the BIM process in order to increase the safety standard during the construction stage. The construction cycle required six days to complete which included the procedures of installation of large panel formwork, bar bending, metal formwork and concrete pouring.

The precast element, large panel formwork and aluminum platform are used and erected during the construction cycle. The precast element including the whole unit of facade, staircase and wall allow easier installation without intensive working at height. Also the risk of person falling from height will be reduced.

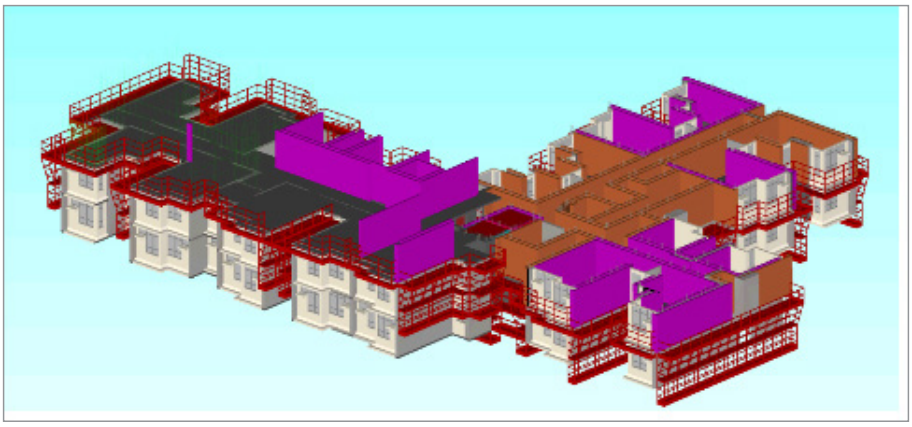

Figure 4 Installation of facade simulation by the BIM model

3.2 Example 2 - On site assembly of the footbridge:

In this project, there were two footbridges need to be installed, including one between building of Block 1 & Block 2 and the other one link between Kwai Luen Road and Block 2 building. (See Figure 5) The potential risks of falling objects and personal falling hazard can be avoided, welding, precast offsite fabrication footbridge / link bridge were also provided and erected to minimize the time and risk of working at height.

Figure 5 Simulation of the footbridge / link bridge

Building Information Modeling (BIM) was used to stimulate the process of lifting footbridge and link footbridge. (See Figure 6) The floor plan shown that the whole section of the footbridge, weighted around 20 tons with a dimension of 4m x 14 m, was lifted up and installed to the designation position.

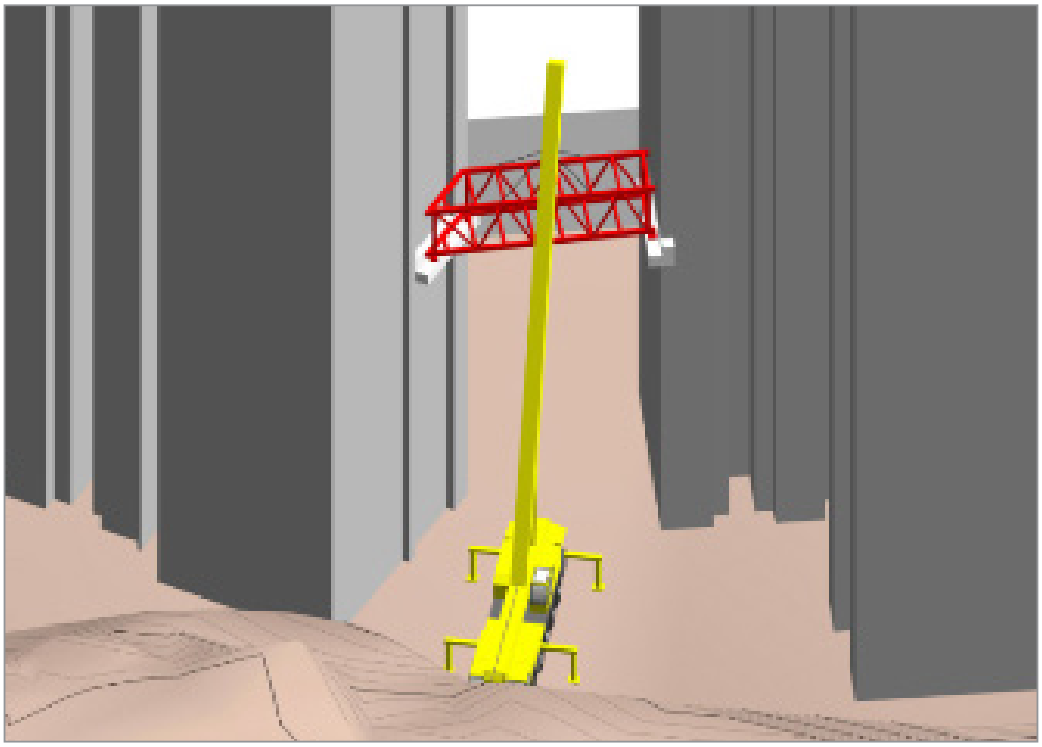

Figure 6 Lifting operation the footbridge between Block 1 & Block 2 simulated by the BIM model

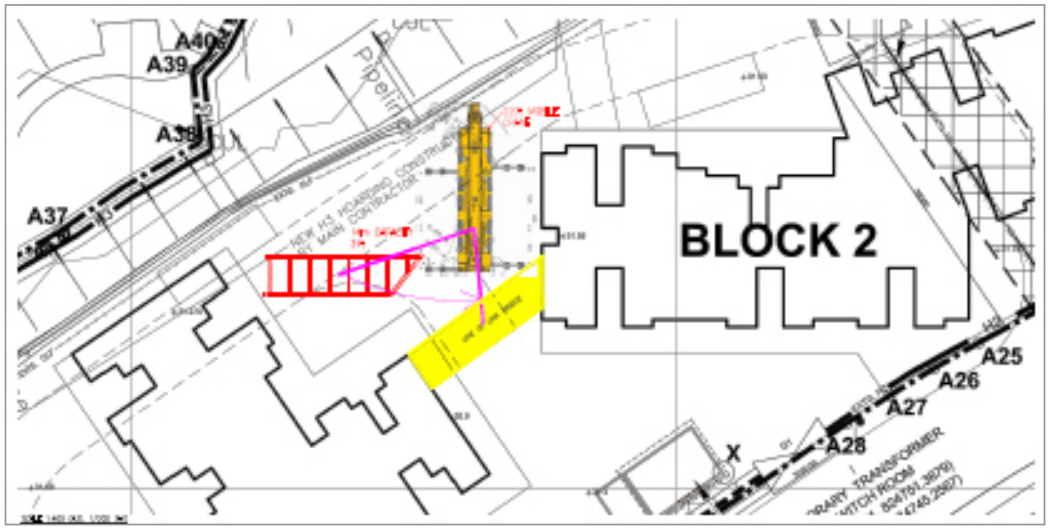

Figure 7 Floor plan to show the process for the footbridge installation

WORKED EXAMPLE NO.9

The link footbridge between Kwai Luen Road and Block 2 was also simulated by the BIM. The whole section of the link footbridge, weight 55 tons with 4m x 30m span, was lifted up by the mobile crane. (See Figure 8 & 9)

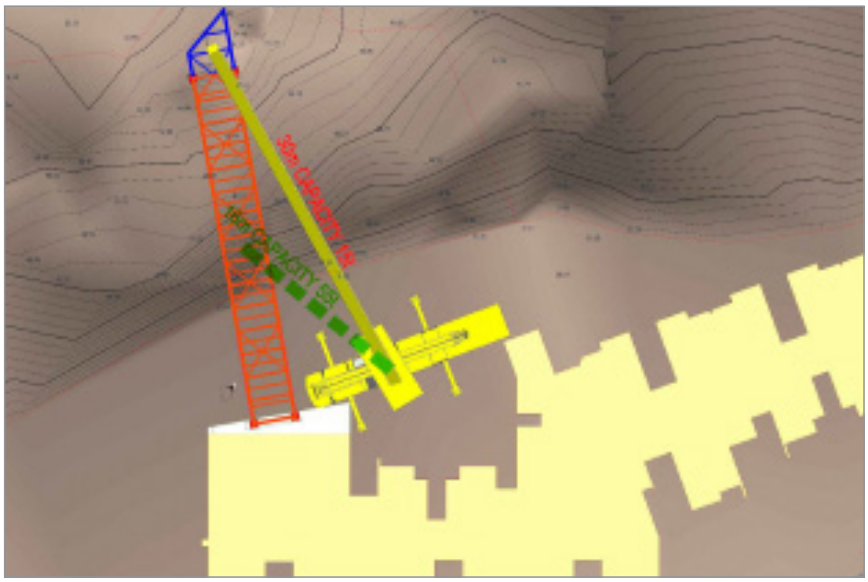

Figure 8 Stimulation of the installation process for link footbridge

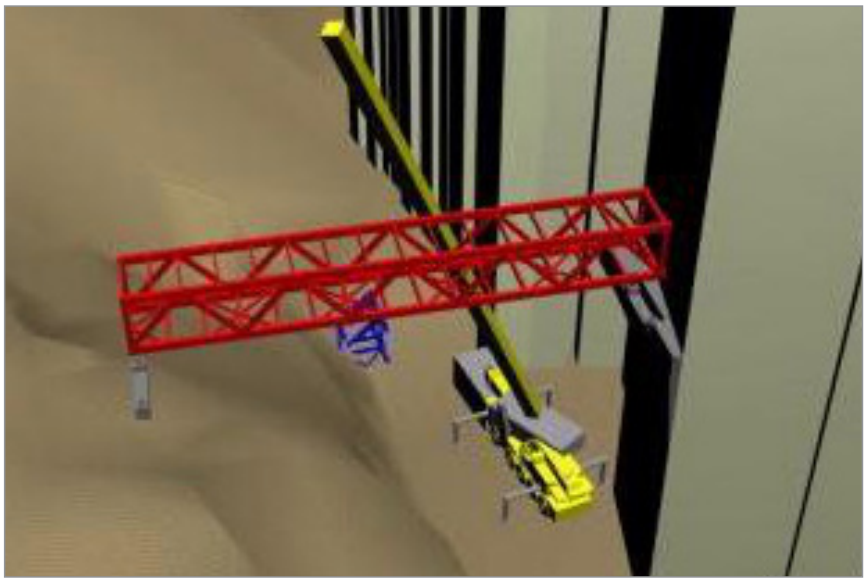

Figure 9 Horizontal view of the footbridge in BIM

Key Message

- Building Information Modeling (BIM) is the process of generating and managing building data during its life cycle.
- Integrate BIM techniques into sequence of stages in construction project safe design planning and work process can identify major hazards at early stage and determining the safety and health implications of the choice of project from the options available.

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