Method Statement for Reconstruction / Strengthening of Existing Nullah Structures for Tsui Ping River

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Abstract. Revitalization of Tsui Ping River project needs demolition part of nullah structures and reconstruction of it. According to the particular specification and Drainage Service Department requirement, fully closure of Tsui Ping River are not allowed. Any construction work for the river bed in the wet season need to get approval. This article shows the method statement for reconstruction / strengthening of existing nullah structures for Tsui Ping River.

1. Introduction
Revitalization of Tsui Ping River project will be one of the most significant projects under Energizing Kowloon East. The biggest challenge will be to maintain hydraulic flow of Tsui Ping River and complete the works within the tight Contract time frame.

2. Potential Risks / Constraints and Mitigation Measures
Having thoroughly reviewed the tender documents, we are fully aware of the potential risks and site constraints for the reconstruction/strengthening of existing nullah structures. As such, we have proposed the most effective and suitable construction method and mitigation measures to overcome these risks / constraints. The details are described below:

Hydraulic impact to the river – To maintain the function of the existing Tsui Ping River during construction, we will conduct Drainage Impact Assessment and submit a Temporary Drainage and Sewerage Management Plan as per PS1.24A prior to construction. Temporary flow diversion measures will be implemented and the river bed reconstruction works will be scheduled in dry seasons only to avoid overflow of the river. We will also remove the existing flow obstruction, i.e. existing ramp of Footbridge KF90 at early stage to improve the drainage performance.

Tight construction programme – To overcome the tight programme due to restrictions for working in the nullah during wet seasons, the reconstruction or strengthening works of the river bed and nullah wall structures will be scheduled in dry seasons only. We will arrange the piling works to be carried out in wet seasons on temporary piling platform above the nullah to provide programme assurance. Multiple concurrent construction work fronts will be arranged at different areas within the existing nullah in both wet and dry seasons.

Tidal influence to construction activities within river bed – The construction activities within the nullah may be affected by the high tidal water. To eliminate the impact, we will implement temporary tidal management measures by installing sheet piles to form a cofferdam in the nullah in order to ensure work in dry condition. The top level of the cofferdam will be carefully designed at +2.8mPD.
which is higher than the tidal water at +2.6mPD by referring to the predicted tidal level by Hong Kong Observatory at different construction periods. A flap valve will be installed at drainage outlet to prevent back water flow effect.

Maintaining the stability of existing nullah walls – Various nullah walls will have to be trimmed prior to reconstruction or strengthening works of the nullah structures and the stability may be affected. In order to maintain its stability, we will adopt wire saw-cutting method for partial demolition to minimise vibration impact on the existing nullah wall. Robust temporary support measures will be in place to stabilise the existing nullah wall by using temporary waling and strutting system. Grouting will be carried out beneath the existing nullah wall prior to the excavation of the river bed. Instrumentation monitoring points such as settlement markers and tilt meters will be installed and regular monitoring will be conducted for the structure to ensure no exceedance of the allowable limits.

3. Measures to Maintain the Stability of the Existing Nullah Walls During Reconstruction / Strengthening of Nullah Structures

As the existing nullah wall is in the form of gravity retaining structure, its stability needs to be maintained during partial demolition of the existing nullah wall and excavation of existing river bed by proper temporary strengthening and supporting works which consist of the following 3 major elements:

1) Lateral support system consisting of soldier pile / pipe pile wall, waling and strutting system; 2) Grout curtain underneath the existing nullah wall; 3) Steel lagging plate to be installed between soldier piles / pipe piles. The details of the proposed measures are described below:

Prior to the start of the partial demolition of the existing nullah wall, the excavation & lateral support system (ELS) will be installed to stabilize the existing structure. The ELS consists of soldier pile or pipe pile to be installed to -3.0mPD, depending on the extent of partial demolition of nullah wall, which is supported by 1 to 2 layers of waling and raking struts at 4m c/c spacing horizontally as shown in Figure 1. Grout curtain will be installed underneath the existing nullah wall to fill the pores and cavities of soil after installation of the soldier pile or pipe pile wall and prior to excavation of river bed. The grout curtain not only serves as effective cut-off to groundwater flow, but also strengthens the foundation of the existing nullah wall thereby enhancing the overall stability of the partially demolished nullah wall during deepening of river. During the excavation below the existing river bed, steel lagging plates between the soldier piles or pipe piles will be installed by welding in stages as shown in Figure 2 while the excavation proceeds. Owing to different natures of construction works and the extent of partial demolition of the existing nullah walls at various locations, four types of temporary strengthening and support system are proposed to support the existing nullah wall during partial demolition of the nullah wall and excavation of the river bed, which are elaborated as follows:

3.1. Type 1 – Soldier piles supported by raking struts in Zone A and B

![Figure 1. Typical Section for ELS System.](image-url)
At locations where nullah wall strengthening works are carried out, we propose to install soldier piles behind the portion of nullah wall to be demolished by cutting vertical slots of 400mm width into the nullah wall at 4m c/c horizontally. Soldier piles will be installed by coring method. 2 layers of raking struts will then be installed to laterally support the soldier pile wall as shown in Figure 1.

3.2. Type 2 – Pipe piles supported by raking struts in Zone A, Zone B
Pipe piles spaced at 700mm c/c are proposed to be installed behind the portion of nullah wall to be demolished at cross-river walkways and landscape decks where substantial demolition of existing nullah wall takes place. To minimize vibration and damage to the existing nullah wall, coring method is proposed for installation of pipe piles. 2 layers of raking struts will then be installed to laterally support the pipe pile wall as shown in Figure 1.

3.3. Type 3 – Soldier piles supported by horizontal struts and lagging plates in Zone C
At locations where U-shaped retaining structure is to be constructed in Zone C, we propose to install soldier piles by coring method at 4m c/c prior to excavation of river bed. Steel lagging plates between the soldier piles will then be installed by welding in stages while the excavation proceeds.

3.4. Type 4 – Lagging plates supported by permanent pipe pile wall in Zone C
In Zone C where permanent pipe pile wall will be constructed in Zone C, we propose to make use of the permanent pipe pile wall as temporary support for installation of steel lagging plates by welding for excavation of river bed. In addition to ELS system mentioned above, we also propose other measures to maintain the stability of the existing nullah wall which include partial demolition of nullah walls in alternate bays, evaluation of the existing nullah structure prior to partial demolition, minimization of surcharge load behind partially demolished nullah walls.

4. Method Statement for the Partial Demolition and Strengthening of Nullah Walls with New Base Slab Along Tsui Ping Road and King Yip Lane

4.1. Method for Partial Demolition of Nullah Walls
Partial demolition of nullah walls will take place in dry season after implementation of the temporary flow diversion measures. Soldier piles, sheetpiles at the middle of river and grout curtain underneath the existing nullah wall will be installed in the preceding wet season with an aim to expedite the construction programme in dry season. As the partial demolition along Tsui Ping Road and King Yip Lane involves trimming of existing nullah walls, conventional demolition method with the use of hydraulic breakers is not desirable for such nature of works because of significant vibration and potential damage to the existing nullah wall. To this end, we propose to adopt wire saw cutting method for partial demolition of the nullah wall, which is a quick, versatile, low noise, dust and vibration-free method for removing large sections of concrete. The details of partial demolition by wire saw cutting method are described below:

- 150mm dia. horizontal and vertical core holes are drilled into the nullah wall at pre-determined positions.
- Wire saw will then be fed through the core holes around the portion of the structure to be cut.
- Pulling force will then be applied to the spinning wire by a series of pulleys to cut concrete chunk in rectangular shape. The cut lines will be formed such that the size of each demolished concrete piece will be limited to 2 to 3 ton by weight.
- The partial demolition will be proceeded from the top to the base of the wall. The demolished concrete pieces will then be removed by crane lorry.

4.2. Method for Strengthening of Nullah Walls with New Base Slab
After partial demolition of nullah walls, deepening of existing river will be proceeded and construction of new base slab and nullah wall will be carried out in the sequence described below:
Excavation to Final Excavation Level – Excavation will be carried out with the use of hydraulic excavator. Lagging plates will be installed between the soldier piles while excavation of river bed proceeds. The excavation and installation of lagging plates will repeat until reaching the final excavation level.

Construction of new base slab (first half) – Grade 200 rock fill will be laid and first half of the new base slab with kickers will then be constructed by cast in-situ method. After the newly constructed base slab attains adequate strength, the bottom layer of struts will be removed.

Construction of new nullah wall (first half) – The new nullah wall will be constructed up to soffit level of top strut. The top layer of strut will be removed after the newly constructed nullah wall attains sufficient strength. The upper portion of new nullah wall will then be constructed.

Construction of new base slab and nullah wall (second half) – Construction of second half of the new base slab and nullah wall along the other side of the river will be carried out in the next dry season after the implementation of temporary flow diversion. The same procedures for partial demolition and construction of new base slab and nullah wall as described above will be repeated to complete the strengthening of nullah walls with new base slab for the whole section of the river.

5. Method Statement for the Construction of the New Nullah Walls Along King Yip Street
There are three types of new nullah walls along King Yip Street in Zone C, namely the U-shaped retaining structure, the pipe pile wall (north side) and inverted T-shaped wall (south side).

5.1. Construction of U-shaped Retaining Structure (both north and south sides)
To fast track the construction programme, we will erect temporary working platform over the river for installation of soldier piles, install soldier piles of ELS system by coring method and carry out grout curtain beneath the existing nullah wall at both sides of the river in wet season. Sheet pile will also be installed in the middle of river as partition wall for temporary flow diversion. In the following dry season, we will divert the river flow to the north side of the river to provide a dry condition for excavation of river bed at the south side. Excavation of the river bed will then be carried out to 500mm below the strut level for the installation of raking struts. Further excavation will be proceeded with steel lagging plates installed in stages between the soldier piles until final excavation level is reached. Construction of base slab and half of the tie beam of the U-shaped retaining structure at south side will then be carried out. After removal of struts, the new nullah wall will be constructed to the soffit of the new cantilever slab. Concrete blocks will be installed as temporary flow diversion and we will divert the river flow to the south side of the river. In the next dry season, sheet piles will be extracted and the same construction method and sequence will be adopted for the construction of the U-shaped retaining structure at the north side. Upon completion of the U-shaped retaining structure, cantilever slabs on both sides of the river will be constructed in the following wet season. Temporary bracket will be erected on the new nullah wall as support for soffit formwork of cantilever slab. After that, the RC structure of cantilever slab will be constructed.

5.2. Construction of Inverted T-shaped wall (south side)
Considering the tight construction programme, we will arrange to install socketed H-pile, pipe pile and carry out grout curtain beneath existing nullah wall in the wet season on temporary working platform installed over the river. Meanwhile, sheet pile will also be installed in the middle of river as partition wall for temporary flow diversion. In the next dry season, the river flow will be diverted to the north side of the river so that the river bed works at the south side can be carried out in dry condition. River bed will be excavated using hydraulic excavator down to the final excavation level and the pile head of socketed H-pile will then be trimmed to the cut-off level. Half of tie beam and base slab of inverted T-shaped wall will be constructed after laying of Grade 200 rockfill. River wall will then be constructed, followed by mass concrete fill for aeration cascade in front of the river wall. The gap between the new river wall and the existing nullah wall will be backfilled with compacted soil.
5.3. *Construction of Pipe Pile Wall / Lagging Wall (north side)*

![Installation of Vertical Posts](image)

Figure 2. Installation of Vertical Posts.

In the next dry season, we will divert river flow to the south side of the river. In order to stabilize the existing nullah wall, we will install vertical posts through the rockfill foundation of existing nullah wall by coring method prior to the river bed excavation, and horizontal struts between the permanent pipe piles and vertical posts as shown in Figure 2. Excavation will be carried out in stages followed by the installation of the lagging wall between vertical posts, until the final excavation level is reached. The walier beam and half of the tie beam will be constructed after laying of Grade 200 rockfill. Subsequent to the removal of the horizontal strut, the lagging wall will be constructed up to the underside of the capping beam. In the following wet season, the temporary bracket will be mounted to the previously constructed lagging wall as a support for construction of the capping beam and cantilever walkway.

6. **Measures to Monitor and Minimise the Settlement to the Existing Nullah Walls, Adjacent Footpath and Roads, Existing Utilities and Buildings**

6.1. **Measures to Monitor the Settlement to the Sensitive Receivers**

In addition to the instrumentation points indicated in the tender drawing, we will install additional ground settlement monitoring points and utility settlement monitoring points to the existing nullah walls, adjacent footpath and roads, existing utilities and buildings and carry out intensive and frequent monitoring to ensure that AAA levels are not exceeded during construction. We will also increase our frequency of visual inspections on adjacent structures and facilities which are critical and high-risk such as Kwun Tong Bypass.

6.2. **Measures to Minimise the Settlement to the Sensitive Receivers**

Installation of Temporary Waling and Strutting System to Stabilize the Existing Nullah Wall – Prior to partial demolition of the nullah wall and excavation of the river bed, we propose to install temporary waling and strutting system as stabilization measures of the existing nullah wall. The two layers of raking strut together with the soldier pile or pipe pile wall resist the nullah wall against sliding and overturning. The robustness of the lateral support system reduces the settlement behind the existing nullah wall to within 23mm.

Installation of lagging plates underneath the existing nullah wall – When the excavation reaches the bottom level of the existing nullah wall, the lagging plates will be installed at every 500mm excavation depth between the soldier piles or pipe piles in the existing nullah wall. The lagging plates protect the founding material of the nullah wall from being scoured.
Ground treatment underneath the existing nullah wall – We will carry out ground treatment to the soil underneath the existing nullah wall before partial demolition of the nullah wall and excavation of river bed to minimize wall movement and ground settlement.

Construction of the river bed and nullah wall in alternative bay – We will carry out partial demolition and reconstruction of the existing nullah wall in alternative bay manner. Such construction method will minimize ground disturbance.

7. Potential Measures in Expediting the Construction Programme
In order to expedite the construction programme, we propose to adopt the following potential measures:

Use of prefabricated modular temporary working platform – To shorten the construction period required for installation of the working platform, prefabricated modular platform will be used for piling works and temporary works such as installation of the soldier piles or pipe piles. Because of the modular type, it can be easily assembled, erected and dissembled.

Arrangement of piling works and temporary works in wet season – To fully utilize the wet season, we will arrange to carry out piling works and grout curtain, and installation of soldier piles or pipe piles with the use of prefabricated modular temporary working platform erected over the river in the wet season while maintaining the flow capacity of Tsui Ping River. Such construction arrangement allows the river bed and nullah wall construction to be carried out in the next dry season.

Adoption of precast shell for tie beam construction – We will adopt precast shell for construction of the tie beam which is part of the sub-structure in U-shaped retaining structures in Zone C. The precast shell serves as both permanent formwork and the outer component of the tie beam structure. With this method, no formwork erection is required so that the construction time can be reduced.

Concurrent construction in different areas – To speed up the construction programme, we will arrange multiple concurrent construction work fronts at different areas within the existing nullah in both wet and dry seasons. For example, we will deploy sufficient resources to carry out piling works and temporary works installation in the wet season while both river bed and nullah wall construction and piling works can be arranged concurrently in the dry season.

Extra merits: The use of modular working platform to allow the piling works to be carried out in wet seasons and precast elements for tie beams and cantilever walkway can expedite the construction programme. 2) Partial demolition and reconstruction of the existing nullah wall will be carried out in alternative bay manner. Such construction method will minimize ground disturbance and impact on the stability of sensitive receivers.

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