

Preservation of Lung Tsun Stone Bridge (Longjin Bridge)

1 Introduction

Lung Tsun Stone Bridge was a landing pier built in 1873-1875 and its timber extension was modified/ dismantled in early 20th century. The Bridge not only signified the economic growth of that area but also illustrated its strategic position to uphold Chinese jurisdiction on Kowloon Walled City during British colonial period.

Lung Tsun Stone Bridge formerly projected from the original shoreline outside Kowloon Walled City into Kowloon Bay. The first phase was constructed in about 1875. Remnants of the Bridge were subsequently buried under reclamations on which former Kai Tak Airport was built. Parts of the original Bridge and a concrete extension to the Bridge constructed in the 1930s have recently been exposed in archaeological excavations. The proposed Shatin to Central Link (SCL) Base Alignment between Kai Tak Station (KAT) and To Kwa Wan Station (TKW) will pass under the 1930s construction, i.e. Former Kowloon City Pier (see **Figure 4.1.2A**).

Lung Tsun Stone Bridge is not yet listed as a declared historical monument on the AMO website (refer PNAP 175) nevertheless efforts will be made to preserve remnants of the Bridge in place. The current approved Kai Tak Development Outline Zoning Plan (OZP) does not show the existence of Lung Tsun Stone Bridge because the bridge was discovered after the preparation and approval of the relevant OZP. Remains of Lung Tsun Stone Bridge are recommended to be preserved in-situ under the Schedule 3 Environmental Impact Assessment (EIA) of Kai Tak Development (KTD). A Conservation Management Plan (CMP) has been presented to the Antiquities Advisory Board (AAB) in its meeting on 4 December 2009 (Hyperlink to the CMP: <http://www.amo.gov.hk/form/140meeting/AAB-30-2009-10%20Annex%20D.pdf>).

The rationale for the proposed horizontal and vertical alignments of SCL is presented, together with construction measures for SCL that preserve, in-situ, the remnants of Lung Tsun Stone Bridge and Former Kowloon City Pier.

2 Construction Details and History of Lung Tsun Stone Bridge

Construction details of Lung Tsun Stone Bridge, Former Kowloon City Pier and descriptions of the remnants discovered are contained in Appendix 12.3 of the Environmental Impact Assessment (Agreement No CE 35/2006 (CE) Kai Tak Development). (Hyperlink to Appendix 12.3 of the said EIA Report: http://www.epd.gov.hk/eia/register/report/eiareport/eia_1572008/EIA/EIA_PDF/Appendices/Appendix%2012.3.pdf) A further archaeological excavation for Lung Tsun Stone Bridge was undertaken during the period from October 08 to February 09 and a report titled 'Further Archaeological Excavation Report August 09' was prepared to present the findings of the further archaeological excavation for Lung Tsun Stone Bridge (Hyperlink to the Further Archaeological Excavation Report: <http://www.lcsd.gov.hk/CE/Museum/Monument/form/140meeting/AAB-30-2009-10%20Annex%20B.pdf>). The salient points of the findings from these two reports are summarised in the paragraphs below.

Lung Tsun Stone Bridge formerly projected from the original shoreline outside Kowloon Walled City into Kowloon Bay and was subsequently buried under reclamation. It was constructed in three phases over a period of about 35 years, commencing in 1875 (**Figure 4.1.2A**).

The second and third phases of Lung Tsun Stone Bridge were extensions built at an angle to the alignment of the first phase (**Figure 4.1.2A**). The second phase was a wooden structure and the third phase a concrete replacement of it, built in 1910.

Former Kowloon City Pier was about 60m long and projected obliquely from reclamation constructed before 1924. The initial archaeological investigations exposed the 1924 reclamation seawall and also remnants of the first phase of Lung Tsun Stone Bridge construction where the two crossed one another. The excavation also exposed part of a concrete nullah, constructed later across both features. Much of the phase one Bridge structure appears to have been removed before it was buried.

Dressed granite planks and masonry of six or seven spans and the Pier End Structure, of the first phase appear to have been incorporated into the construction of Former Kowloon City Pier. Rudimentary fragments of these spans, leading to Former Kowloon City Pier, were exposed in the initial archaeological excavations. The proposed SCL Alignment avoids these fragments.

The southern section of the Bridge and the Former Kowloon City Pier were likely to be demolished and buried in reclamation during the Japanese Occupation (1941 to 1945).

In 2008 remains of the first phase of the Bridge and two supporting concrete pillars of Former Kowloon City Pier were exposed in archaeological excavations.

A 1932 map (extracted from Appendix 12.3 of the Environmental Impact Assessment Report of Kai Tak Development) shows no visible traces of either second and third phases structure after construction of the Former Kowloon City Pier and no remnants were positively identified in the archaeological excavation. The SCL tunnels will pass under the presumed position of the second and third phases of Lung Tsun Stone Bridge, and the Former Kowloon City Pier.

Based on the archaeological background study referenced in the CMP as mentioned in Sec. 3.1.1, the presumed second and third phases of Lung Tsun Stone Bridge and the Former Kowloon City Pier were extending into the SCL Base Alignment. However, no evidence of remains of the second and third phases of Lung Tsun Stone Bridge was revealed from the further archaeological excavation carried out recently. As for the Former Kowloon City Pier, a total of 47 supporting pillars and two landing steps have been unearthed. Decking was likely to be demolished when reclamation works were conducted between 1942 and 1945. The Pier's remains with an overall length of 65m were discovered. As observed on site, all the remains exposed are apparently standalone elements at levels between +3.2mPD and +2.0mPD. Complicated structures involving structural member(s) supported on another member(s) (such as a bridge deck wholly supported by supporting pillars or abutments) were not discovered above the excavation level.

Deck level of the remnants of the first phase Bridge structure, which lie outside the SCL alignment, is about +2.3mPD. The further archaeological excavation carried out recently indicated that the Bridge remains would likely exist between +2.81mPD and -2.0mPD. The first phase Bridge structure does not extend into the SCL Base Alignment.

3 Construction of SCL Running Tunnels in the Vicinity of Lung Tsun Stone Bridge & Former Kowloon City Pier

The SCL alignment would pass directly under the Former Kowloon City Pier. The general construction method for SCL structures proposed in Kai Tak Development area is the open cut method. The SCL structures will be built inside a trench excavated with sloping sides. Groundwater will be controlled by dewatering wells in the side slopes of the excavation. As

shown on **Figures 4.1.2C** and **4.3**, open cut and cofferdam construction methods are proposed west and east of the mined tunnels underneath the Former Kowloon City Pier respectively. A buffer zone to the remains of the Former Kowloon City Pier will be maintained during SCL construction within which no at-grade construction activities to be carried out. The extent of open excavation will be further reviewed in the detailed design stage. To the east, between Former Kowloon City Pier and KAT, trench excavation within braced cofferdam walls is proposed and a buffer zone of Former Kowloon City Pier will be maintained as shown on **Figure 4.3**. This method has been adopted so as to preserve buried seawall steps of the 1924 seawall north of the SCL Alignment that would otherwise be disturbed by open cut excavation.

Based on the finding in the archaeological excavation, all the remains of the Former Kowloon City Pier exposed are apparently standalone elements at level between +3.2mPD and +2.0mPD. According to the information available including the results from PIT test by CEDD and recent test by MTR Corporation, the length of the piles are best estimated to be up to 9.5m. Based on the length of 9.5m, the SCL temporary canopy tubes at the tunnel crown area are 1.8m – 2.2m clear of the possible pile toe levels.

Moreover, based on the finding in the archaeological excavation, all the remains exposed are apparently standalone elements and complicated structures involving structural member(s) supported on another member(s) (such as a bridge deck wholly supported by supporting pillars or abutments) were not discovered above the excavation level. There is a possibility that linking structures may presence beneath the excavation level between Lung Tsun Stone Bridge and Former Kowloon City Pier. However, given the buffer zone from the edge of SCL tunnels, the differential settlement imposed to the linking structure between Lung Tsun Stone Bridge and Former Kowloon City Pier is expected to be small and has negligible impact to Lung Tsun Stone Bridge.

The mining method presented on **Figures 4.1.2C** is designed to cope with any obstructions that may be encountered. Canopy perforated hollow steel tubes are driven into the ground in advance of and above the tunnel face. Liquid cement (“grout”) is injected into each steel tubes to provide a solid, reinforced umbrella and consolidate the soil around the future tunnel. 5 nos. of bore hole logs at the adjacent area show that the SCL tunnels crown area are within alluvium stratum mainly with silty fine to coarse sand and thus grouting could be implemented effectively.

Indirect impacts on Lung Tsun Stone Bridge and the Former Kowloon City Pier due to ground-borne vibrations from construction equipment and SCL trains would not be significant as they do not possess sufficient power or energy to disrupt the relatively massive fragments.

4 Effects of SCL Construction on Lung Tsun Stone Bridge and Former Kowloon City Pier

As a result of being buried by the reclamation, it is estimated that Lung Tsun Stone Bridge and the Former Kowloon City Pier had settled uniformly. This has been caused by the weight of the reclamation material on the ground supporting and surrounding the Bridge. Remnants of the Bridge, exposed in the archaeological excavations, do not appear to have been damaged by this uniform settlement.

Excepting obviously deliberate damage, damage appears to have been caused to individual elements because of voids in the reclamation. Overloaded by the weight of reclamation above it and unsupported by fill under the span, the deck has cracked. These voids have long-since vanished: ground movements during construction of SCL by the proposed methods will not create new voids.

Because there are no longer any voids in the reclamation, the separated remnants of the Bridge are relatively free to flex. The remnants may be likened to separate beads on a string, the string being the soil supporting them. The supporting string (soil) can deflect, taking each bead with it, but individual beads (remnants) remain undamaged.

The bead analogy should not be extended too far. Damage can occur if the two ends of a single bead move different amounts and one end is clamped, so that the entire bead cannot flex. Relating that to a fragment of Lung Tsun Stone Bridge, it is difficult to see how this mechanism could be brought into play by excavations for SCL tunnels. The fragments are short, so that differential movements between their ends will be slight, and a clamping mechanism appears to be absent.

Those remaining granite blocks and planks of the Lung Tsun Stone Bridge deck and support piers are largely undisturbed and undamaged by reclamation and settlement (see Detail 1 on **Figure 4.1.2A**). This is testimony to the absence of a clamping mechanism and to the flexibility between fragments. From the condition of the fragments exposed in the archaeological excavation it can be confidently predicted that general soil settlement of two or even three times that which has already occurred will not damage the Lung Tsun Stone Bridge fragments.

The nearest Lung Tsun Stone Bridge pier is approximately 25m away from the SCL tunnel. The pier is in layers of dressed stones, each stone having roughly the appearance and dimensions of a granite kerbstone. It is flexible and not sensitive to settlement. As the SCL tunnels are approximately 25m away, impact to the Bridge's pier and Lung Tsun Stone Bridge, which is further away, will be negligible.

Unlike Lung Tsun Stone Bridge, the decking of Former Kowloon City Pier was likely to be demolished when reclamation works were conducted between 1942 and 1945. The remnants unearthed are supporting concrete pillars and 2 numbers of landing steps. These remains are identified as standalone elements. The mining method present in this working paper will have minimal disturbance to these remnants.

5 Potential Deleterious Effects from Vibration

Simple ground-borne vibrations from construction plant cannot damage the fragments of Lung Tsun Stone Bridge and Former Kowloon City Pier. They possess none of the characteristics of structures that can be damaged by ground-borne vibrations, namely:

- Fragility
- Sensitivity to particular frequencies
- Shapes that promote sympathetic vibration that can amplify movement in the fragments.

In accordance with the Project Proponent previous experience in railway construction and operation in several urban lines, ground-borne vibrations from construction equipment and SCL trains simply do not possess sufficient power or energy to disrupt the relatively massive fragments. For example, some sections of the Island Line tunnels which have been operating for near to 30 years have less than 300mm clearance between the tunnel lining and foundation of existing buildings. No detrimental effects had been reported during construction and operation stages.

6 Conclusions and Recommendations

The SCL Base Alignment passes under the Former Kowloon City Pier that is an extension to the Lung Tsun Stone Bridge. The SCL Alignment also passes under the presumed location of extensions to Lung Tsun Stone Bridge that were apparently removed at the time when Former Kowloon City Pier was built.

The reclamation covering Lung Tsun Stone Bridge and the Former Kowloon City Pier will be fenced off from construction works. The buried remnants of the Former Kowloon City Pier will be preserved by tunnelling underneath them. A proposed method is presented in this working paper.

The fragmented nature of the Lung Tsun Stone Bridge and the Former Kowloon City Pier remnants is favourable to the proposed construction methods. General settlement of soils in the area from open cut excavation and tunnelling should not damage the remnants of Lung Tsun Stone Bridge or the Former Kowloon City Pier. Differential settlement likewise should not cause any damage: the mechanisms that might cause damage appear to be absent.