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Chester Terrace Balustrade

Summary of ABA Initial Review

1.0 Introduction

The Crown Estate Pavement Commission (CEPC) has appointed us to review and advise on potential remedial options for the retaining wall and balustrade to the west of Chester Terrace, which has experienced some movement issues. We visited the site to look at the wall and balustrade and briefly reviewed some previous reports as part of this work.

2.0 Summary of Existing Arrangement

The retaining walls at Chester Terrace extend for about 250m. On plan the walls step in and out with openings provided to allow access to the gardens. As such the maximum length of a single run of retaining wall is in the order of about 75m. There is a level change between the sunken landscaped gardens and Chester Terrace that is generally up to around 1m. The walls are a mixture of masonry and concrete construction and are generally about 450mm wide. The depth of the wall footings appear to vary between 350mm to about 700mm below the existing garden level. There is one length of retaining wall where concrete buttresses seem to have been previously introduced to improve the wall's stability.

The balustrade is formed from concrete elements consisting of a footrail, bottles and a handrail. It is understood that there are metal pins set into the top and bottom of the bottles to locate them into the foot and handrails. In addition, there are rectangular concrete piers between the footrail and handrail spaced between each group of approximately ten bottles.

The footrail and handrails are cast in relatively short lengths, with two dedicated bottles to each length. In addition, there is a shared bottle between each section of the handrail/ footrail with the next section. Where there are rectangular piers, these seem to provide the main support to the length of handrail/footrail centred on it.

It is likely that the original design was for each length of the balustrade to be independently stable. However, there is some ability for loads to be distributed between lengths due to the shared bottles.

We noted gaps in some of the joints between the lengths of handrails/footrails during our visit. These gaps have previously been infilled with a cementitious filler. There are also some areas where it appears that ferrous metal packers have been used to fill gaps – some of these appear to have corroded.

Within the garden are several large trees and shrubs. Some of these are located very close to the retaining wall. Based on previous site investigations, the retaining walls are likely founded on made-ground. We also understand that at least three Thames Water surface water sewers pass under the retaining wall and gardens. The condition of these sewers is unknown.

3.0 Evidence of Movement Seen During Brief Site visit

3.1 Retaining Wall

There are several locations where there is evidence of movement within the retaining wall. This movement is most evident where there are vertical cracks visible from the garden. Other defects associated with these movements may also exist, but parts of the wall are hidden by plant growth.

Cracking in retaining walls of this nature is not unusual. Typical causes of similar defects include lateral movements (bowing), vertical movement up (perhaps caused by roots growing under the foundations or heave due to swelling of the underlying soils), or vertical movements down caused by settlement in the underlying soils. Thermal expansion and contraction can also cause cracking of this type, particularly on long lengths of walls. It is often hard to tell the precise cause of such cracking without detailed surveys and monitoring over time.

3.2 Balustrade

Looking along the handrail, it is clear that there has been a history of small movements over time in the retaining wall. These historical movements have generally been accommodated by the regular joints between the handrail/footrails. Thus, using an inflexible filler within the joints does not appear to have inhibited this articulation.

The filling of the joints with hard cementitious material could have exacerbated any longitudinal movements (particularly in the handrail) due to thermal expansion.

There are areas where there seems to have been some movement between the different elements that make up each balustrade panel. In places, the pins that locate the bottles have failed so that the bottles are loose. There are also areas where movement has occurred due to corroding steel packers between the bottles / rectangular piers and the foot and handrails. The expansion of the corroded steel seems to have pushed up the handrail causing it to become loose to the touch. Also, in at least one area, it appears to have been an impact (potentially from a vehicle) that has misaligned the balustrade.

4.0 Potential for Future Deterioration and Consideration of Mitigation Options

If a new / reconditioned balustrade were to be built on the existing retaining wall, it would need to be detailed with movement joints to allow any future movement in the retaining walls to occur. Unfortunately, determining how much movement there might be in the future is difficult. In addition, unless the underlying causes of the wall's movements are addressed, a new balustrade would likely develop defects in the future.

Without mitigation, the scale and proximity of the trees and shrubs within the gardens means some continued movement will likely occur to the retaining walls. These movements could lead to more cracking and movement. However, the future movements would need to be large to compromise the stability of the retaining wall. If movement joints within the balustrade are restored/maintained, any relatively small movements in the retaining wall might be manageable within the ongoing maintenance cycle.

One approach to dealing with these issues that could avoid heavy and costly solutions is to implement low-key measures to mitigate the magnitude of future movements. This approach would aim to extend the useful life of the existing arrangement, but would require some ongoing maintenance as and when defects may arise. We have found that similar structures have responded well to this approach in the past, and we believe it could work well here. Mitigating measures that could be explored include:

- Removal of the trees and shrubs that are close to the wall and introduce root barriers to reduce risk of roots affecting the wall in the future.
- Pollard trees and shrubs with high water demand that are further away from the wall.
- Inspect and if necessary repair drainage that runs under the gardens
- Underpin parts of the retaining wall where there has been more movement
- Introduce small diameter piled underpinning through the footings of the existing retaining wall.

These options can be discussed further when we next meet.