

Glen Innes to Tamaki Drive Shared Path

Section 3 – Orakei Basin Boardwalk Widening Structural Design Statement

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Rev. No.	Date	Description	Prepared By	Reviewed By	Approved By
1	24/9/15	Design Statement	MM	PS	MD
2	24/3/16	Design Statement	MM		

The following information outlines the design criteria which will be used in the detailed design of the boardwalk widening and new footbridge on the Glen Innes to Tamaki Drive Shared Path – Section 3. Major assumptions associated with the geotechnical assessment are also outlined.

Bridge Structural Design Standards

The bridge structural design will be carried out in accordance with the following New Zealand Standards and Building Code documentation;

- New Zealand Building Code, Clauses, B1 – Structures, B2 – Durability, D1 – Access Routes, F4 – Safety from Falling
- AS/NZS1170 Structural Design Actions

Previous Documentation

The following documents will be utilised during the development of detailed design;

- MWH Concept design statement – Glen Innes to Tamaki Drive Shared Path Section 3 dated 12/05/2015.
- MWH Sea level rise designs statement dated 24/03/16
- Soil and Rock Consultants Ltd Geotechnical Investigation Report for the proposed walkway (dated September 2004, Revision 2)
- Frame Group Ltd plans for the Stage 1 walkway from Orakei Road to Purewa Road titled 'Auckland City Council Orakei Basin Stage 1 Walkway' and numbered 09/071-00, 07/071-26 (dated September 2009)
- Tonkin and Taylor Ltd report (T&T report) prepared for Frame Group titled 'Peer review of the proposed Stage 1 & 2 walkways and footbridges, Orakei Basin, Auckland' (dated October 2009)

Bridge Structural Design Assumptions

In accordance with the Preliminary Design Philosophy Statement provided in the Scheme Assessment Report dated January 2015, assumptions that have been applied to the structural design for the widening of the Orakei Basin Boardwalk and Footbridge are as follows;

- The existing structures were designed in accordance with SNZ HB 8630:2004 for the Urban Resident user group. As part of the widening works, no new vertical loads will be imposed on the existing structures. Therefore, in accordance with the Building Act 2004 Clause 112, the existing structures will continue to comply with the provisions of the building code immediately before the alteration works began.
- A design working life of 50 years has been selected for the widening of the boardwalk and footbridge structure.
- The boardwalk and footbridge structures have been designed as an area without obstacles for moving people and will have adequate structural capacity for a 4.0kPa or 4.5 kN concentrated pedestrian load in accordance with AS/NZS 1170. The area is not expected to be subjected to any overcrowding. As agreed with Auckland Transport, a viewing platform is not included in the design.
- The boardwalk and footbridge structures have not been designated for use by a maintenance vehicle.
- Terrain factors for wind loading in accordance with AS/NZS 1170.2 will be Terrain Category 1.5 (ie Open Water Surface).

- Wave heights were approximated following McCartney's (1976) wind setup relationship; this showed that based on the limited fetch, assumed reservoir depth and design wind speed, a critical wave that could generate significant wave uplift forces would not develop in the Orakei Basin. This is based on natural assumed conditions and does not consider the effects of waves generated during recreational activities. As a result, the effects of wave action will not be considered further in the design of the boardwalk or footbridge.
- The boardwalk and footbridge structures will be designed to provide a 4.5m clear width between handrails.
- Following urban design recommendations from Boffa Miskell, a new 1.4m high steel handrail with no openings larger than a 100mm dia sphere will be provided on both sides of the boardwalk and footbridge structure.

Geotechnical Considerations

The existing boardwalk and bridge structure have been constructed based on the recommendations made in the Tonkin and Taylor report. A summary of the recommendations are as follows;

Basin Boardwalk

Thirteen Scala Penetrometer tests were completed alongside the railway embankment to determine founding conditions. The results showed that the ground profile is extremely variable with no definitive depth for solid end bearing. As a result Tonkin and Taylor had recommended that the boardwalk be founded on short driven timber piles, with a minimum embedment depth of 3 meters. Driven pile ultimate capacities are provided in section 5.1.1 of Tonkin and Taylor report.

Drawings provided by Frame Group show a stone wall approximately 1.6 meters away from the existing piles along some eastern section of the boardwalk. The extent of this will be confirmed during construction.

Footbridge over basin outlet

There does not appear to be any geotechnical investigations completed by Soil & Rock Consultants or Tonkin and Taylor for the footbridge foundations. The Institute of Geological and Nuclear Sciences (GNS) geological map classifies the area as Auckland Volcanic Field and this consists of ash, lapilli, and tuff. This was confirmed by visual inspections documented in the T&T report that describe material on either side of the outlet as welded tuff.

At the western abutment, Tonkin and Taylor have described bedding partings dipping at approximately 30 degrees in the tuff. Frame Group had proposed a 2.8m wide shallow concrete foundation on the welded tuff. Additional to this, Tonkin and Taylor had recommended installing 3m long Reidbar (RB20) rock bolts drilled and grouted vertically into the tuff at 1.0 meter centres and tied into the concrete foundation.

At the eastern abutment, Tonkin and Taylor reported that a cavity had formed in the tuff as a result of scour. A cross section showing the approximate extent of the cavity has been provided in Appendix B of the T&T report. Tonkin and Taylor had recommended installing a 500mm diameter bored concrete pile set back 3m from the exposed tuff face, and extending 1m below a 45 degree line extending from the rear of the cavity in the tuff.

Recommendations

The existing timber boardwalk and footbridge have been constructed using foundation recommendations provided in the Tonkin and Taylor report dated October 2009. MWH completed a site walkover and visual inspection in July 2015 in fine conditions; from this it appears that the structure is in good condition and there is no evidence of differential movement in the decking material that would be indicative of inadequate founding conditions. Based on these observations, the ground conditions beneath the proposed widening extents appear to be consistent with what was investigated by Soil & Rock Consultants and Tonkin and Taylor.

On this basis MWH propose to design the foundation for the boardwalk and footbridge using the recommendations made in the Tonkin and Taylor report dated October 2009, with the following criteria to be measured during construction;

- Boardwalk piles to be driven to an appropriate set using the Hiley formula/Auckland Structural Group piling specification dated 12 March 2002 (<http://www.sesoc.org.nz/Regional-Groups/ASGPILES-Rev%20G.pdf>). The set shall be derived to achieve an ultimate capacity which will be referenced on the construction drawings.
- The widened footbridge foundations on the eastern abutment will replicate the existing substructure. The widened structure will be designed such that there is no load transferred to the existing foundations. The new foundations will be set back from the tuff face to match the existing pile set out and will extend a minimum of 1 metre below a 45 degree line extending from the rear of the cavity in the tuff. During construction, the material extracted from the piling operation will be visually verified by a geologist to confirm the design assumptions.

- The widened footbridge foundations on the western abutment will consist of a concrete column that is piled into the tuff. The column may be tied into the welded tuff with a tensile anchor. The widened structure will be designed such that there is no load transferred to the existing foundations.

As recommended by Auckland Transport, the above design recommendations have been discussed with the preferred physical works contractor during detailed design.

Released under the Official Information Act 1982

Glen Innes to Tamaki Drive Shared Path - Section 3 Structural Design Statement

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1	15/02/16	Design Statement	MM	PS	MD
2	24/03/16	Design Statement	MM		

The coastal processes specialist has recommended that the design accommodate a 200 mm – 400 mm rise in sea level by the middle of this century. The boardwalk and footbridge over the basin outlet will be designed for a 50 year working life. Based on existing surveyed information shown on the Frame Group Ltd drawings dated November 2009, the Mean High Spring Tide is at RL 1.490 meters. Therefore, by 2050, the mean high spring tide is assumed to increase to RL 1.890 meters, based on a 400mm rise.

Over a 500 meter section, the existing boardwalk deck level is at RL 1.90 meters. Once the widening work is completed, and assuming a 46mm deep GRP plank system is used, the final deck level on the boardwalk will be RL 1.896 meters. This indicates that over a 500 meter length, approximately 6 mm of the structure is likely to be above the assumed mean high spring tide in 2050. Note that this does not allow for changes in water level due to wave action or storm events.

We have evaluated the implications of this water level rise on the existing superstructure for the above mentioned conditions. The structural risks and recommendations made as follows;

- Pile capacity: Based on the geotechnical recommendations made in the Tonkin and Taylor report dated October 2009, the existing piles will have sufficient capacity to resist buoyancy forces that are generated as a result of the assumed sea level rise in 2050.
- Operation: Over-topping may be an issue during a significant weather event or due to waves generated during water activities in the basin. This may result in failures of the structural element fixings. In these cases the boardwalk will need to be closed to the public for safety reasons.
- Larger increase in water level: If the sea level increases further than that assumed above, the boardwalk is likely to be flooded over the 500 meter length section during high tide and will not be operational. This would have structural implications as it may result in failure in the structural element fixings.

We recommend that the structural design continue on the basis of the above assumptions and the recommendations made in the structural design statement dated 24 March 2016.

Glen Innes to Tamaki Drive Shared Path - Section 3 Sea Level Rise Design Statement

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1	15/02/16	Design Statement	MM	PS	MD
2	24/03/16	Design Statement	MM		
3	27/04/16	Design Statement	MM	MD	

The coastal processes specialist has recommended that the design accommodate a 200 mm – 400 mm rise in sea level by the middle of this century. The boardwalk and footbridge over the basin outlet will be designed for a 50 year working life. Based on existing surveyed information shown on the Frame Group Ltd drawings dated November 2009, the Mean High Spring Tide is at RL 1.490 meters. Therefore, by 2050, the mean high spring tide is assumed to increase to RL 1.890 meters, based on a 400mm rise.

Over a 500 meter section, the design drawings indicate that the existing boardwalk deck level is at RL 1.90 meters. Once the widening work is completed, and assuming a 46mm deep GRP plank system is used, the final deck level on the boardwalk will be RL 1.896 meters. This indicates that over a 500 meter length, approximately 6 mm of the structure is likely to be above the assumed mean high spring tide in 2050. Note that this does not allow for changes in water level due to wave action or storm events.

We have evaluated the implications of this water level rise on the existing superstructure for the above mentioned conditions. The structural risks and recommendations made are as follows;

- Pile capacity: Based on the geotechnical recommendations made in the Tonkin and Taylor report dated October 2009, the existing piles will have sufficient capacity to resist buoyancy forces that are generated as a result of the assumed sea level rise in 2050.
- Operation: Over-topping may be an issue during a significant weather event or due to waves generated during water activities in the basin. This may result in failures of the structural element fixings. In these cases the boardwalk will need to be closed to the public for safety reasons.
- Larger increase in water level: If the sea level increases further than that assumed above, the boardwalk is likely to be flooded over the 500 meter length section during high tide and will not be operational. This would have structural implications as it may result in failure of the structural elements and their fixings.

The structural design has been completed in accordance with the above assumptions and the recommendations made in the structural design statement dated 27 April 2016.