

# Memo

To:	██████████	Job No:	86201.001
From:	██████████	Date:	31 August 2017
cc:	████████████████████		
Subject:	High Level Review of AuzCon Stepped Concrete Wall Option		

Kāpiti Coast District Council (KCDC) has asked Tonkin + Taylor (T+T) to provide a high level review of the AuzBlock stepped precast concrete wall option by AuzCon Pty Ltd (AuzCon) as presented by John Mills of the Paekākāriki Community Design Group. A sketch of the proposed wall option is attached for reference.

## Option Overview

The wall comprises a set of precast concrete blocks that are installed to create a wall with large steps founded on a cement stabilised base. The base of the large steps is installed at RL 0m and the crest is at RL 2.55m (Wellington Vertical Datum, 1953). The cement stabilised base would need to be constructed using Deep Soil Mixing procedures, where augers penetrate into the sand and inject a grout mix to the insitu material to create a stronger soil matrix. This stabilised block would need to be protected from scour with PVC Sheet Piles installed at the toe to RL -2.4m. From the crest level of the concrete stepped wall, the mid-level pathway and upper rock wall would replicate the wall arrangement for Preliminary Design Option B as set out in the Preliminary Design Options Report, Revision 4, dated July 2017. Five stepped access way locations are included in the proposed concrete step wall that will reduce the height of the precast block steps using a timber infill.

This wall design was considered (by Beca, the consenting consultant) as a potential design option prior to lodging for Resource Consent, however it was discounted at the time in favour of a vertical wall option. The option was also presented once more in November 2016 at a Community Board Meeting with T+T by John Mills and the option was also discounted based on the cost estimate expected for the stepped wall option and the expected requirement for a new Resource Consent, refer Meeting Minutes dated 11 November 2016.

## Consenting

The stepped concrete wall option presented by John Mills includes a series of smaller level changes from The Parade walkway to the beach. In T+T's opinion there is no longer a requirement to address clause F4 of the NZ Building Code to provide Safety from Falling. This would need to be confirmed with the KCDC Building Controls Manager.

However, the stepped option presented is not considered to be in general accordance with the Resource Consent granted and we believe it would need to have a new consent application for the specific option. This could be tested with Greater Wellington Regional Council (GWRC) to confirm.

## Geometry of site and proposed wall

It is not clear what the overall stepped seawall footprint would be based on the information provided and further work would be required to confirm it. The toe of the stepped wall would need

to project further seaward than the existing seawall and consented seawall design unless the upper rock armour slope is replaced with a vertical wall.

Should a full height stepped wall be considered (i.e. remove the upper rock armour and have the precast stepped wall continue from the beach to The Parade walkway), this may reduce the overall seawall footprint and allow the toe of the wall to sit nearer to the alignment of the existing wall. However this would have to be investigated further to confirm. Please note that it is expected that the wave run up and wall overtopping volumes will increase for a full height stepped option when compared to both a full height rock wall (Option D) and a vertical wall option (Option B) as presented in the Preliminary Design Options Report. The run-up and overtopping would need to be reviewed against the EurOtop guidelines in respect of damage and for safety.

Consideration of areas for proposed vegetation would need to be looked at in detail if the option of a full height concrete seawall is considered, as this is unlikely to meet the requirement of other aspects of the community's design brief.

## **Construction**

### Temporary Works

All of the options presented in the Preliminary Design Options Report allow for the existing wall to remain in place whilst the new wall is constructed. For the concrete stepped wall it is expected that temporary works, such as installation of a sheet pile wall, will be required to mitigate the risk of damage to The Parade and provide environmental compliance during construction.

Deep Soil Mixing is the process of injecting grout into the insitu ground to strengthen the material so it is suitable as a founding base. This process can be a messy procedure with grout and water ponding at the ground surface and requiring bunds to contain the grout. It is anticipated that undertaking this procedure in an open coast environment will require temporary works to both restrict any grout from entering the sea and to protect the Deep Soil Mixing area from damage by the sea at high tide. This is also a high environmental risk. We understand that there is no allowance for temporary works in the cost estimates provided. The costs and form of temporary works required should be confirmed by a Contractor/Quantity Surveyor before proceeding with this option.

In order to install the toe of the steps to RL 0m, a large trench will need to be excavated from beach level to reach founding level. The average beach level is RL 1.8m, with the typical range varying from RL 2.3m to RL 1.3m, resulting in a trench that may be typically around 2m and up to 2.8m deep at some times. The temporary works and/or staged nature of construction are likely to be achievable, but consideration of the programme and cost of this work should be confirmed before proceeding.

### Use of PVC Sheet Piles

The proposed stepped design uses PVC Sheet Piles in the proposed design. We note that similar procurement and design risks identified for the Preliminary Design Option B3 are still relevant to this design option. It is possible that the depth of the PVC Sheet Piles will need to be increased in order to offer adequate scour protection and global stability of the wall, however this is not based on any calculations and would need to be confirmed during the initial design phase should this option be developed further. The specification of the sheet pile is not included in the cost estimates and its capacity based on the site specific loading would also need to be confirmed in the initial design of the option if requested.

### Specialist Construction Techniques

It is anticipated that the Deep Soil Mixing will need to be carried out by a specialist subcontractor with experience in this method of ground stabilisation, i.e. a standard piling contractor may not be able to complete the work.

As discussed in the Preliminary Design Options Report, the installation of PVC Sheet Piles are not common in New Zealand. Installing PVC sheet piles will require a specialist contractor with experience in installing the vinyl sheets to drive them in to place. The use of specialist construction methods may limit the procurement options for New Zealand based contractors (and suppliers) for the work when tendering. This would need to be investigated further to confirm the options for such experienced contractors.

### **Performance of stepped wall**

#### Accessibility

The stepped concrete wall option maximises pedestrian access to the beach, allowing able bodied persons to walk/jump up and down the large steps (step height approximately 300mm) to access the beach from The Parade walkway. Smaller stepped access ways are provided at five locations along the wall with timber infills to the large precast concrete steps. We note that the proposed design option does not provide any access for less able bodied users or wheel chair users. The addition of a ramp access will need to be considered to provide access for a wider range of users. The cost estimates provided for the access ways from AuzCon have been replaced with those costed in the Preliminary Design Options Report as these have been developed specifically for the site and are in accordance with the Resource Consent.

After a large design storm event, the lowest design beach level is RL -1.0m which is 1m below the toe of the stepped wall. The PVC Sheet Pile located at the toe of the steps will then be exposed and will be retaining up to 1m of the stabilised foundation base, creating a vertical 1m drop. A drop of 1m or higher is to be managed under F4 of the Building Code and access may need to be limited until the beach recovers to a more typical level. It is unclear how access to the beach will be restricted during this period of beach replenishment with the stepped design option. For the options presented in the Preliminary Design Report, the localised access ways are able to be fenced off individually should access to the beach need to be restricted temporarily.

#### Overtopping

As discussed briefly above, it is expected that a stepped wall will increase wave run up and overtopping of waves onto The Parade when compared to a rock wall or vertical wall. This is due to the fact that the wave energy will not be dissipated, such as for the rock, or will not be restricted by an obstacle such as the lower vertical wall for the stepped option. Overtopping volumes have not been calculated for this option and this is only an expected consequence.

### **High Level Base Cost Estimates**

The following high level base estimates for a stepped concrete wall has been provided for both a lower stepped wall option (Option E1) and a full height stepped wall (Option E2). This is based on the information received by John Mills only and no further discussion with AuzCon has taken place to confirm estimates. It is assumed that the cost estimates provided by AuzCon are in New Zealand Dollars.

The preliminary design option rates have been used instead of the AuzCon rates for site specific elements (such as site enhancement, excavation and access ways) as they have been prepared in more detail. The AuzCon rates for the stepped wall itself have been used and we have not reviewed these for this high level review.

It is noted that the AuzCon rates for the cement stabilisation and PVC Sheet Piles (rate/m) seem low, however these have not been investigated further.

Option E1 – Lower stepped wall - \$12.8M excluding GST

Option E2 – Full height stepped wall - \$13.8M excluding GST

These base estimates do not include:

- Allowance of the temporary works discussed above. An additional temporary works indicative cost of \$1.2M (excluding GST) may be appropriate, based on the Preliminary Design Option report, if sheet piles are to be used to create a series of 150m length work areas at the base of the wall. This assumes that the sheets are reused and moved over to stage the construction along the length of the wall.
- Removal of obstructions, as was highlighted as an issue at the recent constructability workshop between T+T and KCDC. This is because the rates for obstruction removal were included in the overall rates for the lower wall construction and have not been itemised separately. When the lower wall construction has been removed from the Preliminary Design Cost Estimates and replaced with the AuzCon rates, the cost to remove obstructions has been omitted.
- Any changes to the PVC Sheet Pile specification.
- Design or consenting costs.

Please refer to the attached estimate summary to provide more detail on the breakdown of these high level estimates.

We confirm that contingency should be included in addition to these base cost estimates which we recommend a minimum of 20-30% at this early stage.

### **Attachments**

Paekakariki Seawall - Concrete Stepped Wall Option - High Level Construction Estimate Summary, including sketch

1-Sep-17

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**Paekakariki Seawall - Concrete Stepped Wall Option - High Level Construction Estimate Summary**

To accompany memo - High Level Review of AuzCon Stepped Concrete Wall Option - Paekakariki Seawall - 31 August 2017

Section	Description	Option E1	Option E2	
1.0	Site Preparation and Excavation	\$694,000	\$694,000	Removed extra excavation allowance for deadman installation.
2.0	Upper wall	\$1,073,592	\$3,839,738	
3.0	Rock Revetment Protection	\$1,568,000	\$0	
4.0	Lower wall	\$6,573,356	\$6,573,356	Excluding footpath costs
5.0	Site Enhancement	\$961,870	\$961,870	Footpaths
6.0	Secondary Access way	\$188,124	\$145,524	Reduced to remove lower steps (E1) / upper and lower steps (E2).
7.0	Primary Access way	\$456,071	\$316,111	Reduced to remove lower steps (E1) / upper and lower steps (E2). Ramps incl.
8.0	Stormwater	\$90,920	\$90,920	Likely to increase as need to accommodate pipes through precast concrete steps
9.0	Preliminary & General	\$1,175,135	\$1,175,135	
10.0	Tertiary Access way	\$45,100	\$0	Remove for E2 only as still need where rock armour upper slope in place
11.0	Temporary Works	n/a	n/a	\$1.2M additional for sheet Piles to be allowed for in 150m sections. Reuse and move over.
	<b>Total</b>	<b>\$12,826,168</b>	<b>\$13,796,654</b>	

**E1 - Concrete stepped lower wall (crest RL=3.0m)**

**E2 - Concrete stepped lower and upper walls (crest RL=5.0m)**

**Changes from Cost Estimates from the Preliminary Design Options Report**

**Adjustments to AuzCon price estimate (prior to substituting into item 4.0 above)**

(Assume all costs are in NZD)

Adjust wall from 960m to 930m length	\$5,933,400	Excluding footpath costs
Allowances	\$1,890,000	Remove and use detailed estimates from Option Report

**Lower wall:**

Height adjustment from 8 to 9 steps for crest RL =	2.85 m	<b>Toe RL=0.15m</b>
Additional cost/m	5913 \$/m	includes a small amount for additional cement stabilised backfill
Additional cost for extra step	\$639,956	
<b>Total</b>	<b>\$6,573,356</b>	

**Upper wall in place of rock armour & timber wall (assume additional 6 steps):**

Total without foundation and sheets	4128.75 \$/m
<b>Total</b>	<b>\$3,839,738</b>

