IMPACT RISK ASSESSMENT REPORT

23 ROBERTSON ROAD, SCOTLAND ISLAND

SCOPE OF WORKS:

This report was written to demonstrate that the construction of the proposed Sea Wall will not have a negative effect on the existing structures including the existing villa and Jetty foundations, or on the existing landscape through changes to tidal forces.

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1 December 2020

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Division:	Engineering				

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B	1 Dec. 20	Dr Bala Muhunthan	Final

Contents

1. INTRODUCTION

As requested, a structural inspection was carried out on 26 August 2020 at No 23, Robertson Road, Scotland Island NSW 2105 by Mahfujur Rahman, Senior Structural Engineer of Neilly Davies Consulting Engineers and Joshua McLeod, intern of Neilly Davies Consulting Engineers. The purpose of this inspection was to inspect the existing jetty, proposed sea wall location and surrounding area including adjacent existing villa. Several photographs have been taken. Based on the inspection, risk assessment of the proposed sea wall has been prepared considering the impact of wave tidal on the proposed sea wall and the associated risk of existing adjacent villa and jetty.

2. DESCRIPTION OF STRUCTURE

The aerial view of the property is given below.

Figure 1: Site Location

3. SITE PLAN

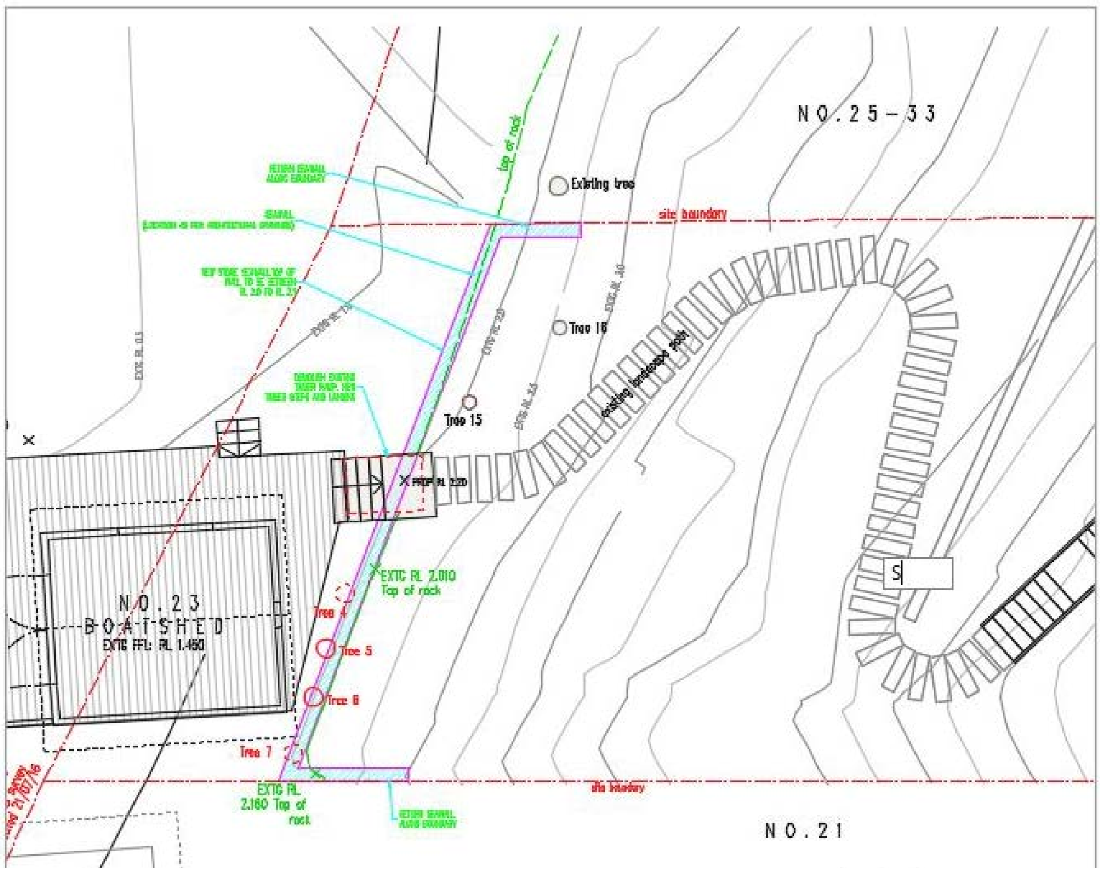


Figure 2: Plan View

The plan pictured above illustrates the key elements of this report, as well as giving context to the site. The area highlighted is the position of the proposed seawall, where there is currently a rock retaining wall (See photos 57-73 of Appendix A). Also pictured is the existing boat shed, and jetty. See clause 5.2 of the report, photographs 58-70 for reference. The plan involved topographical lines demonstrating height, and the slope of the grounds can also be viewed in appendix A.

4. LOADING

AS 1170.1 and AS 4997 were both used for the below calculations. Clause references to these documents where the information refers directly to the corresponding section of the standard.

Below are sets of provided data with reference to the standard:

AS 1170.1 2002

Dead Load 1 KPa

AS 4997 2005

Table 5.1 Maritime Structure Class 5 Imposed 5 KPa

Clause 5.6 Debris Action = 10 KN/m

AS/4997-2005 - Wave tidal Action Load

Clause 5.5.2 Current Actions - Calculation

This Section of the standard states that “for structures and vessels up to 10 000 t subject to currents, t equation”

$$F_S = \frac{1}{2} \times C_{SD} A \rho \times 10^{-3}$$

The Coefficient of Stream Drag (CSD), was provided in Table 5.3 of the Australian Standard, given that the Proposed Jetty would be utilizing circular Piles.

$$C_{SD} = 1.04$$

Assume, $\upsilon = 3ms^{-1}$

Assume , $A = bh$

h= 1.3m

b= 1.0 m

ρ = 1026kg/m^3 for sea water

$$A = 1.3m^2$$

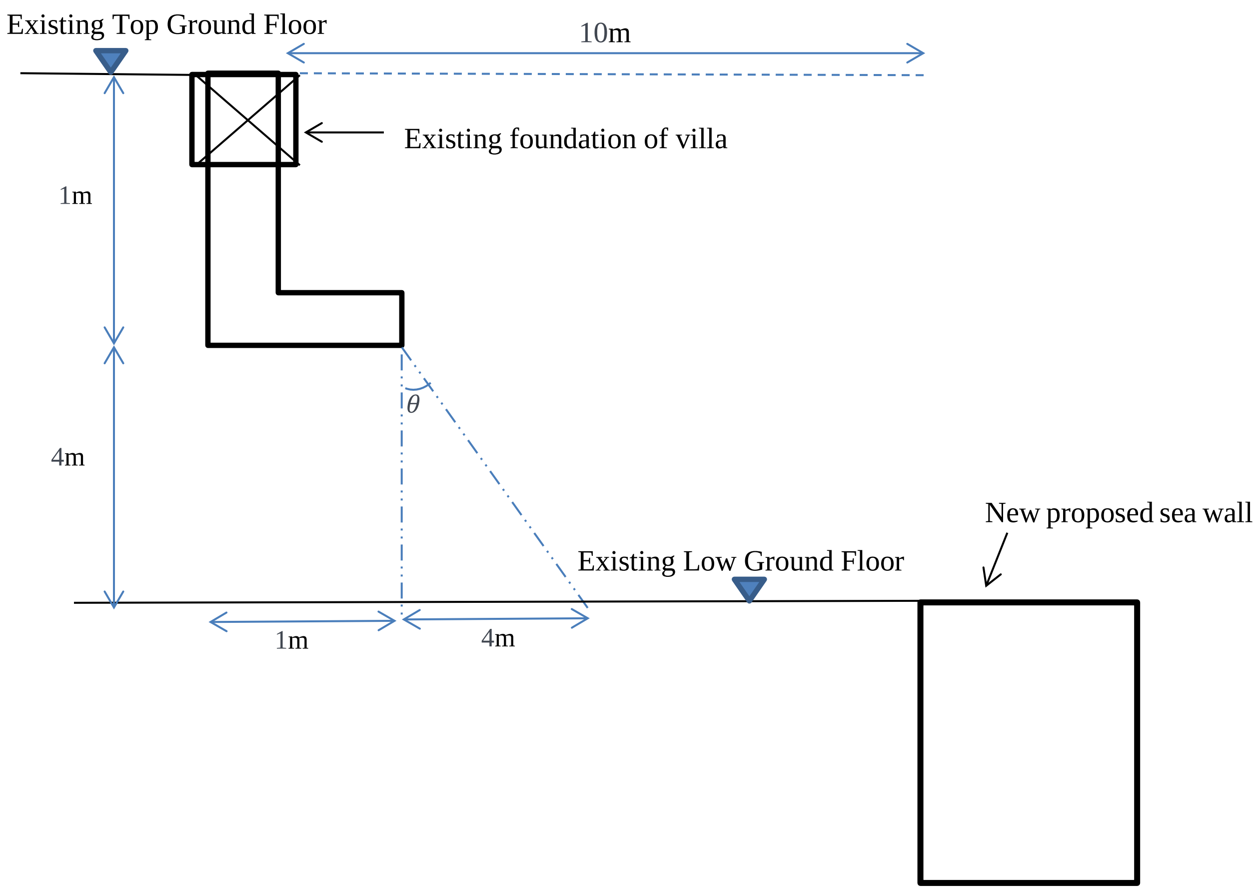
$$F_s = \frac{1}{2} \times 1.04 \times 3^2 \times 1.3 \times \frac{1026}{1000}$$

$$F_s = 6.25kN$$

From these calculations, we can consider the Wave impact Load to be = 6.25kN

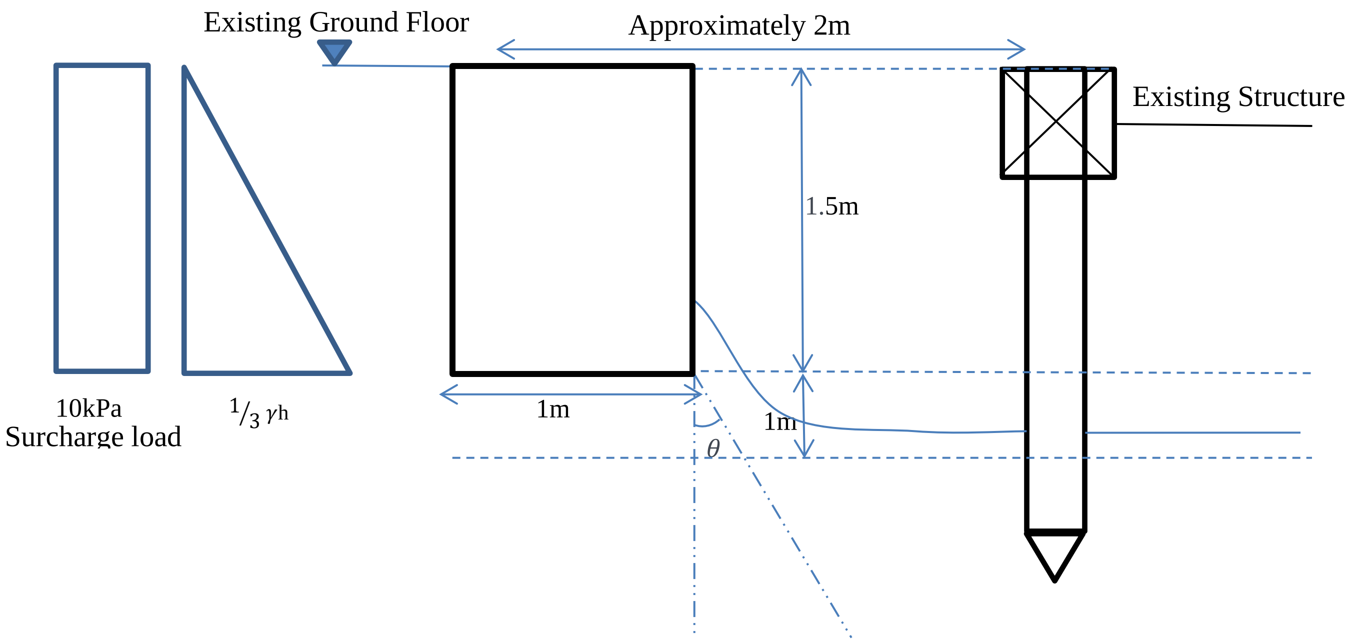
5. Impact Risk Assessment

5.1 Check for existing foundation of villa building



Existing foundation is situated more than 10m from the proposed foundation. In the above diagram it can be clearly seen that the inclined line isn't going to meet the new proposed sea wall and construction. This demonstrates that the new construction will not affect the existing foundation. There will be no effect on the existing villa building foundation because of the new construction works.

5.2 CHECK FOR EXISTING STRUCTURE (JETTY)



Load Assessment of existing structure

Resultant pressure due to loads (P)

$$= 10\text{kPa} + {}^1/_3\,\gamma \text{h}$$

$$= 10\text{kpa} + \left({}^1/_3 \times 18 \times 1.5\right)$$

$$= 10\text{kPa}+9\text{kPa}$$

$$P = 19\text{kPa}$$

Say, 19kN/m

Assume θ = 45,

At the depth of 2.5m,

$P_{2.5}$ =25kN/m

So, impact pressure at the column/pile (S_1)

$$S_1 = \frac{25}{9} = 2.78\text{kPa} < \text{fc}' = 18\text{kPa for F8 grade}$$

And inclined line stress line is not going to touch the column/pier due to the new sea wall/ retaining wall construction. According to Risk Assessment check the proposed construction is safe.

5.3 CHECK FOR WAVE TIDAL IMPACT

In accordance with AS4678-2002 incorporating Amendment No.2 dated August 2008

Retaining wall details

Stem type;	Cantilever
Stem height;	h_{stem} = **1300** mm
Stem thickness;	t_{stem} = **200** mm
Angle to rear face of stem;	α = **90** deg
Stem density;	γ_{stem} = **23.6** kN/m^3
Toe length;	l_{toe} = **288** mm
Heel length;	l_{heel} = **608** mm
Base thickness;	t_{base} = **500** mm
Base density;	γ_{base} = **23.6** kN/m^3
Height of retained soil;	h_{ret} = **1300** mm
Angle of soil surface;	β = **0** deg
Depth of cover;	d_{cover} = **0** mm
Height of water;	h_{water} = **0** mm
Water density;	γ_w = **9.8** kN/m^3

Retained soil properties

Soil conditions;	In situ
Moist density;	γ_{mr} = **18** kN/m^3
Saturated density;	γ_{sr} = **20.8** kN/m^3
Effective internal friction angle;	ϕ'_r = **30** deg
External wall friction angle;	δ_r = **15** deg

Base soil properties

Soil type;	Medium dense coarse and medium sand
Soil conditions;	In situ
Soil density;	γ_b = **17.5** kN/m^3
Effective cohesion;	c'_b = **0** kN/m^2
Effective internal friction angle;	ϕ'_b = **30** deg
External wall friction angle;	δ_b = **15** deg
External base friction angle;	δ_{bb} = **20** deg
Ultimate design bearing capacity;	$P_{bearing}$ = **250** kN/m^2

Loading details

Live surcharge load;	$Surcharge_Q$ = **5** kN/m^2
Horizontal Debris Action load at 300 mm;	P_{Q1} = **-10** kN/m
Horizontal Wave Tidal Impact load at 500 mm;	P_{Q2} = **-6.2** kN/m

Calculate retaining wall geometry

Base length;	$l_{base} = l_{toe} + t_{stem} + l_{heel}$ = **1095** mm
Saturated soil height;	$h_{sat} = h_{water} + d_{cover}$ = **0** mm
Moist soil height;	$h_{moist} = h_{ret} - h_{water}$ = **1300** mm
Length of surcharge load;	$l_{sur} = l_{heel}$ = **608** mm
- Distance to vertical component;	$x_{sur\_v} = l_{base} - l_{heel} / 2$ = **791** mm
Effective height of wall;	$h_{eff} = h_{base} + d_{cover} + h_{ret}$ = **1800** mm
- Distance to horizontal component;	$x_{sur\_h} = h_{eff} / 2$ = **900** mm
Area of wall stem;	$A_{stem} = h_{stem} \times t_{stem}$ = **0.26** m^2
- Distance to vertical component;	$x_{stem} = l_{toe} + t_{stem} / 2$ = **388** mm
Area of wall base;	$A_{base} = l_{base} \times t_{base}$ = **0.548** m^2
- Distance to vertical component;	$x_{base} = l_{base} / 2$ = **548** mm
Area of moist soil;	$A_{moist} = h_{moist} \times l_{heel}$ = **0.79** m^2
- Distance to vertical component;	$x_{moist\_v} = l_{base} - (h_{moist} \times l_{heel}^2 / 2) / A_{moist}$ = **791** mm
- Distance to horizontal component;	$x_{moist\_h} = (h_{moist} \times (t_{base} + h_{sat} + h_{moist} / 3) / 2 + (h_{sat} + t_{base})^2/2) / (h_{sat} + t_{base} + h_{moist} / 2)$ = **636** mm

Material strength uncertainty factors for Soil - Table 5.1(A)

Uncertainty factor for friction of the retained soil;	$\Phi_{u\phi r}$ = **0.85**
Uncertainty factor for friction of the base soil;	$\Phi_{u\phi b}$ = **0.85**
Uncertainty factor for cohesion of the base soil;	Φ_{uc} = **0.7**

Retained soil properties

Design effective internal friction angle;	$\phi^*_r = \text{atan}(\Phi_{u\phi r} \times \tan(\phi'_r))$ = **26.1** deg
Design external wall friction angle;	$\delta^*_r = \text{atan}(\Phi_{u\phi r} \times \tan(\delta_r))$ = **12.8** deg

Base soil properties

Design effective internal friction angle;	$\phi^*_b = \text{atan}(\Phi_{u\phi b} \times \tan(\phi'_b))$ = **26.1** deg
Design cohesion;	$c^*_b = \Phi_{uc} \times c'_b$ = **0** kN/m^2
Design external wall friction angle;	$\delta^*_b = \text{atan}(\Phi_{u\phi b} \times \tan(\delta_b))$ = **12.8** deg
Design external base friction angle;	$\delta^*_{bb} = \text{atan}(\Phi_{u\phi b} \times \tan(\delta_{bb}))$ = **17.2** deg

Using Coulomb theory

Active pressure coefficient;	$K_A = \sin(\alpha + \phi^*_r)^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta^*_r) \times [1 + \sqrt{[\sin(\phi^*_r + \delta^*_r) \times \sin(\phi^*_r - \beta) / (\sin(\alpha - \delta^*_r) \times \sin(\alpha + \beta))]}]^2)$ = **0.352**
Passive pressure coefficient;	$K_P = \sin(90 - \phi^*_b)^2 \times \cos(\delta^*_b) / (\sin(90 + \delta^*_b) \times [1 - \sqrt{[\sin(\phi^*_b + \delta^*_b) \times \sin(\phi^*_b) / (\sin(90 + \delta^*_b))]}]^2)$ = **3.696**

Load combinations for stability limit states - Appendix J3

Load combination 1;	$1.25 \times Dead^C + 1.5 \times Live^C < 0.8 \times Dead^R$

Overturning check

Vertical forces on wall

Wall stem;	$F_{stem} = 0.8 \times A_{stem} \times \gamma_{stem}$ = **4.9** kN/m
Wall base;	$F_{base} = 0.8 \times A_{base} \times \gamma_{base}$ = **10.3** kN/m
Moist retained soil;	$F_{moist\_v} = 0.8 \times A_{moist} \times \gamma_{mr}$ = **11.4** kN/m
Total;	$F_{total\_v} = F_{stem} + F_{base} + F_{water\_v} - F_{water\_u} + F_{moist\_v}$ = **26.6** kN/m

Horizontal forces on wall

Surcharge load;	$F_{sur\_h} = K_A \times \cos(\delta_r) \times 1.5 \times Surcharge_Q \times h_{eff} =$ **4.6** kN/m
Saturated retained soil;	$F_{sat\_h} = 1.25 \times K_A \times \cos(\delta_r) \times (\gamma_{sr} - \gamma_w) \times (h_{sat} + h_{base})^2 / 2 =$ **0.6** kN/m
Water;	$F_{water\_h} = \gamma_w \times (h_{water} + d_{cover} + h_{base})^2 / 2 =$ **1.2** kN/m
Moist retained soil;	$F_{moist\_h} = 1.25 \times K_A \times \cos(\delta_r) \times \gamma_{mr} \times ((h_{eff} - h_{sat} - h_{base})^2 / 2 + (h_{eff} - h_{sat} - h_{base}) \times (h_{sat} + h_{base})) =$ **11.4** kN/m
Base soil;	$F_{exc\_h} = -0.8 \times K_P \times \cos(\delta_b) \times \gamma_b \times (h_{pass} + h_{base})^2 / 2 =$ **-6.2** kN/m
Total;	$F_{total\_h} = F_{sur\_h} + F_{sat\_h} + F_{water\_h} + F_{moist\_h} + F_{exc\_h} =$ **11.6** kN/m

Overturning moments on wall

Surcharge load;	$M_{sur\_OT} = F_{sur\_h} \times x_{sur\_h} =$ **4.1** kNm/m
Saturated retained soil;	$M_{sat\_OT} = F_{sat\_h} \times x_{sat\_h} =$ **0.1** kNm/m
Water;	$M_{water\_OT} = F_{water\_h} \times x_{water\_h} + 0$ kNm/m = **0.2** kNm/m
Moist retained soil;	$M_{moist\_OT} = F_{moist\_h} \times x_{moist\_h} =$ **7.3** kNm/m
Total;	$M_{total\_OT} = M_{sur\_OT} + M_{sat\_OT} + M_{water\_OT} + M_{moist\_OT} =$ **11.7** kNm/m

Restoring moments on wall

Wall stem;	$M_{stem\_R} = F_{stem} \times x_{stem} =$ **1.9** kNm/m
Wall base;	$M_{base\_R} = F_{base} \times x_{base} =$ **5.7** kNm/m
Moist retained soil;	$M_{moist\_R} = F_{moist\_v} \times x_{moist\_v} =$ **9** kNm/m
Base soil;	$M_{exc\_R} = -F_{exc\_h} \times x_{exc\_h} =$ **1** kNm/m
Total;	$M_{total\_R} = M_{stem\_R} + M_{base\_R} + M_{moist\_R} + M_{exc\_R} =$ **17.6** kNm/m

Check stability against overturning

Factor of safety;	$FoS_{ot} = M_{total\_R} / M_{total\_OT} =$ **1.505**

PASS - Maximum restoring moment is greater than overturning moment

Therefore the Sea wall is safe & adequate against any Wave impact load & Debris action

6 RECOMMENDATION

As requested, a structural inspection was carried out on 26 August 2020 at No 23, Robertson Road, Scotland Island NSW 2105 by Mahfujur Rahman, Senior Structural Engineer of Neilly Davies Consulting Engineers and Joshua McLeod, Engineering Intern of Neilly Davies Consulting Engineers. The purpose of this inspection was to inspect the existing jetty, proposed sea wall location and surrounding area including the adjacent existing villa. Based on the inspection, risk assessment of the proposed sea wall has been prepared considering the impact of wave and tidal effect on the proposed sea wall and the associated risk of existing adjacent villa and jetty.

The existing nearest villa is about 10m away from the proposed sea wall. The influence line of foundation load of the villa is away from the proposed sea wall. It indicates that the proposed construction of sea wall will have no effect on the existing villa. (Appendix 5.1).

The existing nearest jetty is about 2m away from the proposed sea wall. The influence line of foundation load of the proposed sea wall is away from the existing jetty. It indicates that the proposed construction of sea wall will have no effect on the existing jetty structure. (Appendix 5.2).

A detailed analysis of sea wave tidal effect on the proposed sea wall has been carried out as per Australian Standard AS4678. The proposed sea wall is safe & adequate against the wave impact load & debris action (Appendix 5.3).

In conclusion, there is no adverse effect or potential risk involved with the proposed sea wall.

Appendices:

- **Appendix A** – Estuarine Risk Management report for “Yamba”, by Dr David Wainwright of SAM Crawford Architects
- **Appendix B** – Inspection Photographs
- **Appendix C** – Geotechnical Report
- **Appendix D** – Structural Drawings – J200093, S01 - S02 Rev C (Dated 23-11-2020)

References:

- AS 1170.1 2002
- AS 4997 2005
- AS 4678.2 2008