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PROJECT: ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT
AT THE FORMER ST. KEVIN'S HOSPITAL AND GROUNDS
SHANAKIEL
CORK

PROJECT NO. 19.305

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ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT
AT THE FORMER ST. KEVIN'S HOSPITAL AND GROUNDS
SHANAKIEL
CORK
STRUCTURAL REPORT ON
SOUTH RETAINING WALL

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1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The Land Development Agency intend to apply to An Bord Pleanála (the Board) for permission for a Strategic Housing Development with a total application site area of c. 5.7 ha, on lands located at the Former St. Kevin's Hospital and Grounds, Shanakiel, Cork (A Protected Structure, 'Our Lady's Hospital' RPS Ref. PS620). The development, with a total gross floor area of c 24,344 sq m, will provide 266 no. residential units, a crèche and office enterprise centre. The development will consist of 46 no. town houses (32 no. 3 bedroom units and 14 no. 4 bedroom units) arranged in 11 no. two storey blocks; 54 no. ground floor 2 bedroom duplex apartments and 36 no. 3 bedroom and 18 no. 4 bedroom duplex townhouses above arranged in 7 no. three storey blocks; 52 no. walk-up apartments (11 no. 1 bedroom apartments and 41 no. 2 bedroom apartments) arranged in 3 no. four storey blocks. The development will also include the conversion and renovation of the former St. Kevin's Hospital building to provide 60 no. apartments (26 no. 1 bedroom and 34 no. 2 bedroom apartments) and a 440 sq m crèche at ground floor level, with ancillary outdoor play area; The conversion of the 630 sq m former chapel building to provide a new Office Enterprise Centre. The proposed development will include 241 no. surface car parking spaces and 563 no. bicycle parking spaces.

The existing landscaping includes an old masonry retaining wall to the south of the old St Kevin's Hospital building that it would appear was constructed in the past to create a level area in front of it that was used as a pathway linking Atkins Hall and Rose Hill Upper. This report assesses the structural condition and capacity of this wall and makes recommendations regarding its treatment in the proposed scheme being submitted for planning.

1.2 SCOPE OF THIS REPORT

Section 2 of this report describes the construction of the wall and summarises its structural capacity with reference to structural calculations given in Appendix II. It also lists observations on the condition of the wall with reference to the elevation and photographs given in Appendix I.

Section 3 of the report gives an assessment of the condition and capacity of the wall and also gives recommendations regarding the proposed scheme being submitted for Planning.

2 OBSERVATIONS

2.1 GENERAL DESCRIPTION & STRUCTURAL SUMMARY

The wall was surveyed and a typical section is given in Appendix II. It is typically 500mm wide at the top and the front face is battered outwards to give a thickness of 800mm at its base on the lower side. There are buttresses that on average are 600 x 600mm at 5.3m crs approx. The top of the wall is at an average height of 37.8mOD approximately 0.9m above the retained level at 36.9mOD average. The average level on the lower side of the retaining wall = 34.0m OD.

The wall acts as a gravity retaining structure and a check on its stability with regard to the Overturning and Sliding failure modes was carried out - see calculations given in Appendix II. The capacity of the buttresses to affect the overturning depends on the capacity of the wall to span horizontally and hold together in the ultimate limit state which is dubious given its age and general condition- see evidence of past failures & collapse given in section 2.2.

In summary the factors of safety are as follows:

Structural Assumptions	Failure Mode	Factor of Safety (FOS)	Remarks
Buttresses ineffective	Overturning	0.57	Significantly Unstable against overturning. Required FOS=1.5. In summary only has 38% of the required capacity.
Buttresses Effective	Overturning	1.3	Stable against overturning but FOS = 1.3 < 1.5 required by codes. In summary only has 87% of the required capacity
Buttresses Effective	Sliding	0.7	Significantly unstable against sliding. Code requires FOS = 1.5 In summary only has 47% of the required capacity.

In summary the stability of the wall cannot be verified by calculation as adequate. These deficiencies are evidenced by systemic horizontal cracking and sections where complete collapse has occurred -see section 2.2. The fact that more extensive collapse has not occurred suggests that the buttresses, in places, are effective in enhancing stability (albeit with inadequate factor of safety) and that the coefficient of friction mobilised to resist sliding is, in places, greater than the standard value of 0.4 used in the check calculation.

2.2 OBSERVATIONS

A list of defects noted during the survey are noted in the table below which are also drawn up on the elevation given in Appendix I along with reference Photographs.

Location	Photo Ref	Description of Defect
Buttresses 1-2	1	Significant horizontal crack approx. 1m from lower level. Small cracks emanating from this crack.
Buttresses 2-3	2	Significant horizontal crack approx. 1m from lower level. Open joints in buttress 3.
Buttresses 3-4	3	Overgrown with ivy. Some minor horizontal cracks..
Buttresses 4-5	4	Horizontal crack visible where not overgrown.
Buttresses 5-6	5	Buttresses need to be repointed. Minor diagonal crack.
Buttresses 6-7	6	Open joints in buttresses & Buddleia growth in buttress 6.
Buttresses 7-8	7	Open joints in buttresses. Minor Horizontal cracks
Buttresses 8-9	8	Significant horizontal crack approx. 1.5m from lower level. Open joints in buttress.
Buttresses 9-10	9	Collapsed section at top of buttress 9. Significant horizontal cracking.
Buttresses 10-11	10	Significant horizontal crack approx. 1.5m from lower level.
Buttresses 11-12	11	Buttress 12 has largely been removed- wall significantly weakened. Horizontal cracking.
Buttresses 12-13	12	As above - Buttress 12 has largely been removed- wall significantly weakened.
Buttresses 13-14	13	Vertical & horizontal cracking.
Buttresses 14-15	14	Top section of buttress 15 has fallen away.
Buttresses 15-16	15	Significant horizontal cracking approx. 1.5m from lower level.
Buttresses 16-17	16	Open joints in buttress 16
Buttresses 17-18	17	Top section of buttress 17 has fallen away.
Buttresses 18-19	18	Major failure of wall between buttresses with body of wall fallen away and earth behind wall exposed and coming through to lower level. Horizontal cracking on remaining section of wall.

Buttresses 19-20	19	Similar but more extensive failure of wall between buttresses with body of wall fallen away and earth behind wall exposed and coming through to lower level. Old formed opening in wall to left of collapsed section.
Buttresses 20	20	Diagonal crack near buttress 20. No other significant defects.
Buttresses 21	21	opes in wall to left hand side of buttress 21
Buttresses 21-22	22	Largely overgrown with ivy. No significant defects evident.
Buttresses 22-23	23	Two cavities visible where stone has fallen away.
Buttresses 23-24	24	Section of top of wall has fallen away over buttress 24
Buttresses 24-25	25	Same comment as for photo 24
Buttresses 25-26	26	Wall completely overgrown with ivy and mature tree adjacent to this section of wall.

3 ASSESSMENT & RECOMMENDATIONS

3.1 ASSESSMENT

The wall is in very poor condition which is unsurprising given its age and the fact that the site has been derelict and not maintained over the last few years.

There are several significant horizontal cracks evident between buttresses consistent with failure of the bed joints due to flexural stresses caused by overturning moments or possibly local shear failure due to horizontal forces. Particularly concerning is the areas between buttresses 18 to 20 where complete collapse of a section of the wall panel between buttresses has occurred and the retained earth has fallen through onto the lower level.

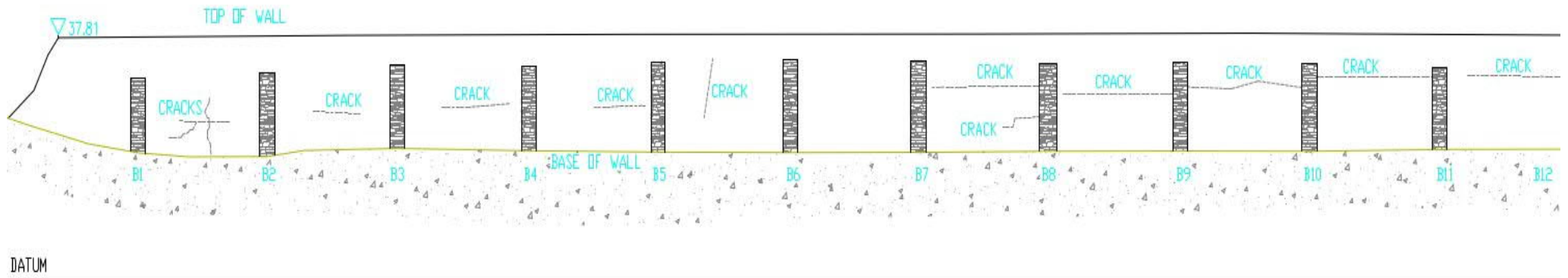
The fact that a section has collapsed raises concerns over the other sections where cracking has occurred. The fact that the wall cannot be verified by calculation as stable, with an adequate factor of safety against overturning, and is unstable with regard to sliding forces is also a major concern.

3.2 RECOMMENDATIONS

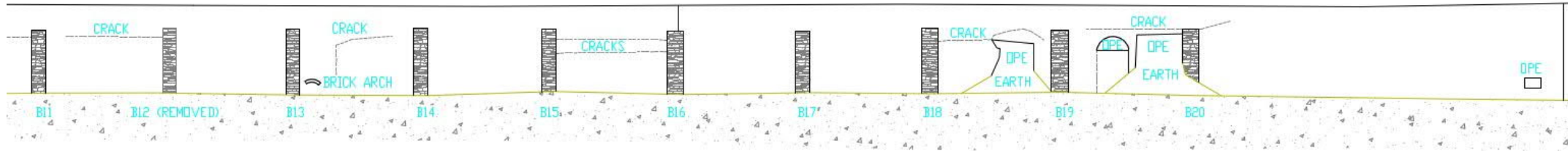
Given that there are both theoretical and evidential concerns regarding the stability of the wall it must be regarded as dangerous and a threat to Health & Safety. The original design had inherent flaws and was significantly unstable ($FOS < 1$) with regard to sliding and with regard to overturning if the effect of the buttresses is discounted. Even assuming the buttresses are mobilised the design is still significantly below the Factors of Safety required by modern codes of practice as set out in section 2.1. This is evidenced by the systemic horizontal cracking and sections where complete collapse has occurred as noted in see Section 2.2.

Given the inherent deficiencies in the wall and the history of sectional collapse it is the recommendation of this report that the wall should be demolished. There is, however, enough space to bank back the earth from the lower level at a safe slope of 1 vertical to 3 horizontal which is generally available. This removes the requirement for a retaining wall and provides a much more sustainable approach to the landscaping. It is the recommendation of this report, therefore, that the wall is demolished and the retained side is banked back at a safe angle so that no new retaining structure is required.

APPENDIX I: REFERENCE ELEVATION & PHOTOGRAPHS

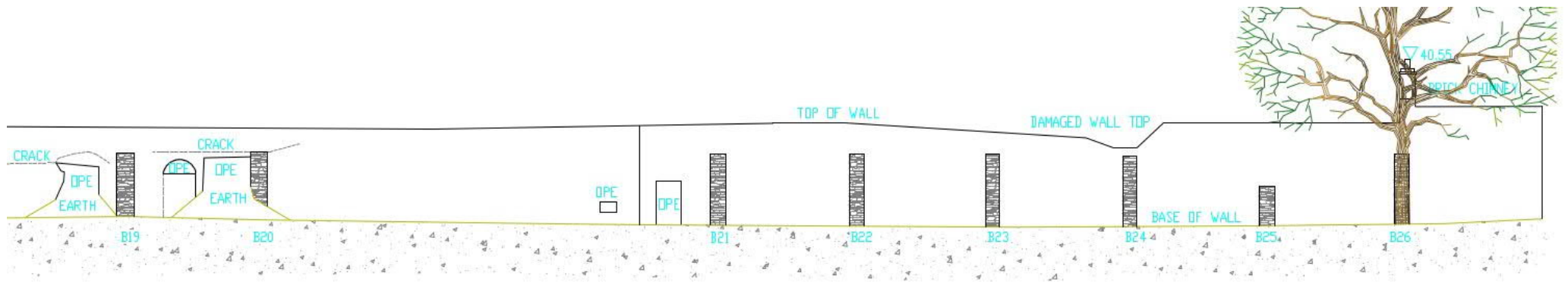


Wall elevation B1 to B11



SOUTHERN STONE RETAINING WALL

Wall Elevation B 11 to B20



Wall Elevation B20 to B26



Photo 1- Buttress 1-2



Photo 2- Buttress 2-3



Photo 3- Buttress 3-4



Photo 4- Buttress 4-5



Photo 5- Buttress 5-6



Photo 6- Buttress 6-7



Photo 7- Buttress 7-8



Photo 8- Buttress 8-9



Photo 9- Buttress 9-10



Photo 10- Buttress 10-11



Photo 11- Buttress 11-12



Photo 12- Buttress 12-13



Photo 13- Buttress 13-14



Photo 14- Buttress 14-15



Photo 15 Buttress 15-16



Photo 16- Buttress 16-17



Photo 17- Buttress 17-18



Photo 18- Buttress 18-19



Photo 19- Buttress 19-20



Photo 20- Buttress 20

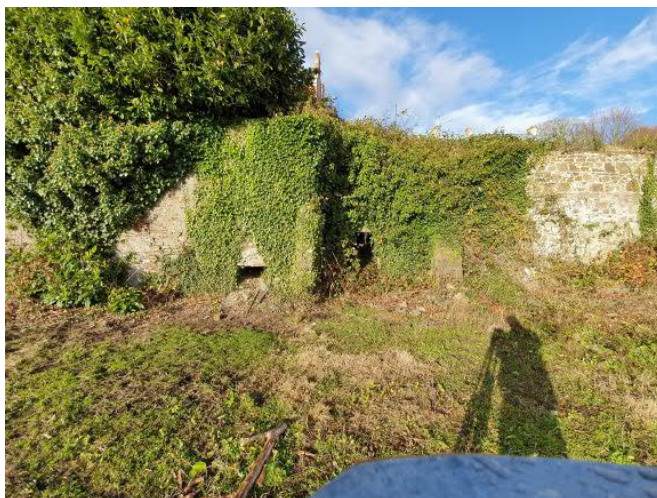


Photo 21- Buttress 21



Photo 22- Buttress 21-22



Photo 23- Buttress 22-23



Photo 24- Buttress 23-24

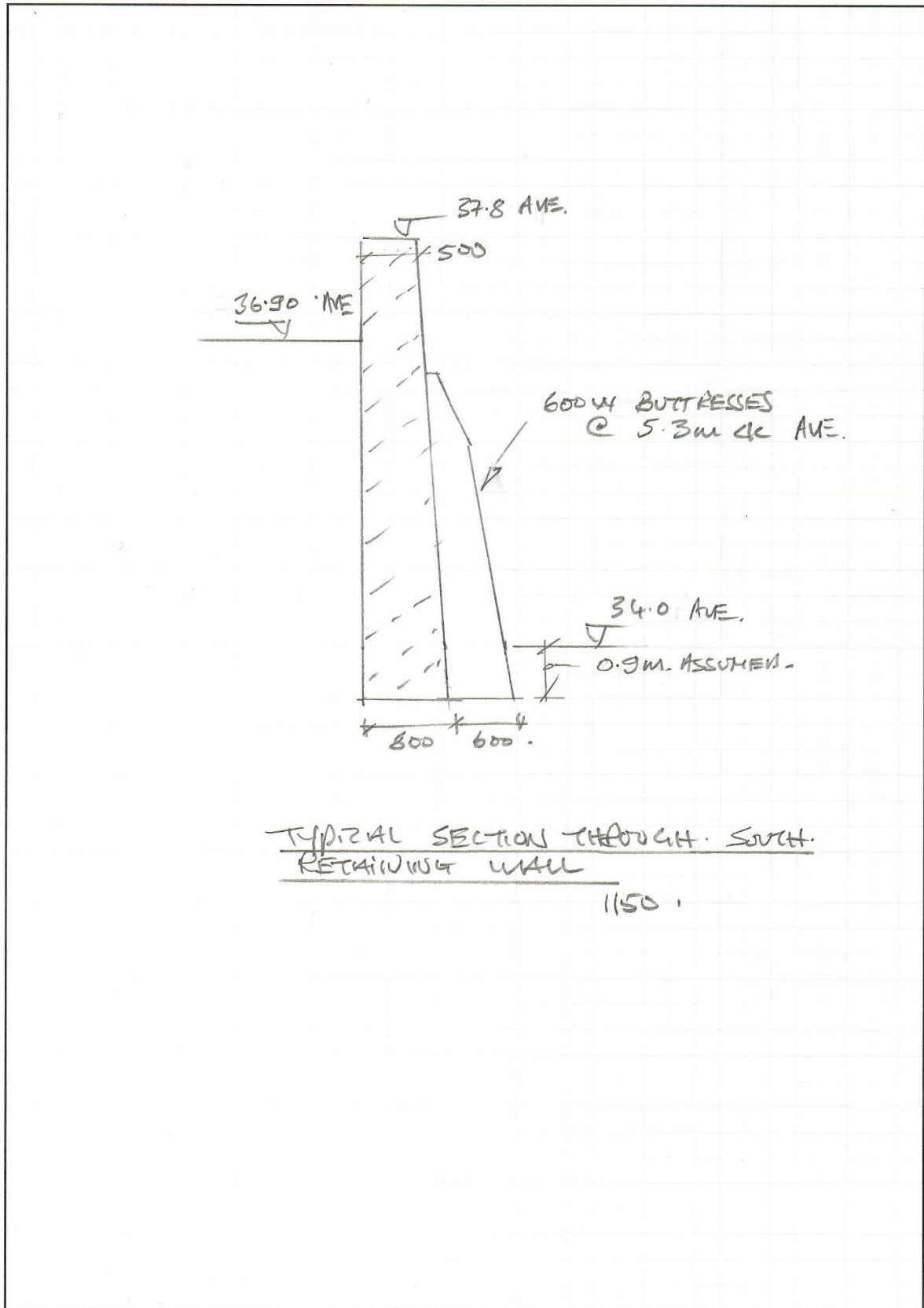


Photo 25- Buttress 24-25



Photo 26- Buttress 25-26

APPENDIX II: TYPICAL WALL SECTION & STRUCTURAL CALCULATIONS



TYPICAL SECTION THROUGH SOUTH RETAINING WALL

1150

Project Title: ST. KEVIN'S DEVELOPMENT Job No: 19-305

Sketch Title: EXISTING SOUTH RETAINING WALL Sketch No: SK RW/01

Scale: 1150 Date: 17/11/20 Revision: - Sketch By: BML

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BARRETT MAHONY

Project Title: ST. KEVIN'S DEVELOPMENT. Job No: 19-305

Part of Structure: ASSESSMENT OF EXISTING RETAINING WALL.

Originator: BML Checker: POW. Date: 17/11/20 Sheet No: RW/01.

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Calculation Status: Preliminary Planning Tender Construction

REF.	CALCULATIONS	OUTPUT
	<p style="text-align: center;"><u>CHECK WALL AS GRAVITY RETAINING WALL.</u></p> <p><u>SOIL PRESSURES</u></p> <p>Assume: $\gamma_s = 18 \text{ kN/m}^3$ $-K_a = 0.5$ - ASSUME NO WATER BUILD-UP BUTTRESSES @ 53 CRS. 34.0. (0.9 ASSUMED) (PASSIVE PRESSURE IGNORED AS UNRELIABLE).</p> <p> $(3.8 \times 18) \times K_a$ $= (3.8 \times 18) \times 0.5$ $= 20.5 \text{ kN/m}^2 \text{ (soil)}$ $= 5 \times 3 = 1.5 \text{ kN/m}^2 \text{ (SURCHARGE)}$ </p> <p> $R_{SOIL} = \frac{20.5 \times 3.8}{2} = 38.9 \text{ kN/m.}$ $R_{SUR} = 1.5 \times 3.8 = 5.7 \text{ kN/m.}$ </p> <p><u>SELF WEIGHT OF WALL.</u></p> <p> ①. RECTANGULAR SECTION OF WALL. - SW/m LENGTH $= 4.7 \times 0.5 \times 24 = 56.4 \text{ kN/m.}$ ②. Triangular section of wall. $= 4.7 \times \frac{0.3}{2} \times 24 = 16.9 \text{ kN/m.}$ ③. Buttress. $= 3.3 \times \left(\frac{0.24 + 0.6}{2}\right) \times \frac{0.6}{5.3} \times 24 = 3.6 \text{ kN/m}$ Area Centres. </p>	

Project Title: ST. KEVIN'S DEVELOPMENT. Job No: 19-305.

Part of Structure: ASSESSMENT OF EXISTING RETAINING WALL.

Originator: BM Checker: POD Date: 17/11/20 Sheet No: RW/02.

Calculation Status: Preliminary Planning Tender Construction

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REF.	CALCULATIONS	OUTPUT
	<p><u>CHECK STABILITY</u></p> <p><u>OVERTURNING MOMENT.</u></p> <p>= $(38.9 \times 1.27) + 5.7(1.9) = 60 \text{ kNm/m.}$</p> <p><u>SLIDING FORCE</u></p> <p>= $38.9 + 5.7 = 44.6 \text{ kN/m}$</p> <p><u>RESTORING MOMENT. (ABOUT X)</u></p> <p>IGNORING BUTTRESSES.</p> <p>= $56.4(1.55) + 16.9(1.2).$</p> <p>= 34.4 kNm.</p> <p>FACTOR OF SAFETY = $34.4/60 = 0.57 < 1.5 \text{ (REQD)}$</p> <p><u>WITH BUTTRESSES</u></p> <p>= $56.4(1.55+1.6) + 16.9(2.16) + 3.6(1.6/3).$</p> <p>= 79.1 kNm.</p> <p>FACTOR OF SAFETY = $79.1/60 = 1.3$ - STABLE, BUT FOS < 1.5 - DOES NOT COMPLY WITH CODES</p> <p><u>RESISTANCE TO SLIDING</u></p> <p>INCLUDING BUTTRESSES.</p> <p>= $(56.4 + 16.9 + 3.6)(0.4)$ COEFFICIENT OF FRICTION</p> <p>= 30.8</p> <p>FACTOR OF SAFETY = $\frac{30.8}{44.6} = 0.7 < 1.5$</p>	<p><u>WITHOUT BUTTRESSES</u></p> <p><u>UNSTABLE AGAINST OVERTURNING</u></p> <p><u>WITH BUTTRESSES</u></p> <p><u>UNSTABLE AGAINST SLIDING.</u></p>

