CampbellReith
consulting engineers

1 Dunollie Road, London, NW5 2XN

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 13398-05
Revision: F1

June 2020

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Planning Reference	2019/5649/P

Contents

Appendix

1.0 NON-TECHNICAL SUMMARY

1.1. CampbellReith was instructed by London Borough of Camden, (LBC) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for the land adjacent to 1 Dunollie Road, London, NW5 2XN (planning reference 2019/5649/P). The basement is considered to fall within Category B as defined by the Terms of Reference.

1.2. The Audit reviewed the Basement Impact Assessment (BIA) for potential impact on land stability and local ground and surface water conditions arising from basement development in accordance with LBC's policies and technical procedures.

1.3. CampbellReith was able to access LBC's Planning Portal and gain access to the latest revision of submitted documentation and reviewed it against an agreed audit check list.

1.4. The planning statement should be amended to remove the suggestion that the BIA was carried out in association with CampbellReith.

1.5. The BIA has been carried out in two parts; the hydrogeology, land stability and ground movement was undertaken by Maund Geo-Consulting and the hydrology assessment and structural engineering appraisal were undertaken by Croft Structural Engineers. The individuals who completed each part of the BIA are considered to hold suitable qualifications as required by CPG4.

1.6. The BIA has confirmed that the proposed basement will be founded within London Clay, with a maximum excavation depth of 3m.

1.7. The BIA identifies no potential sources of flood risk for the site. It is accepted that the proposed development will not increase the surface water discharge from the site or adversely impact the hydrology at the site.

1.8. It is accepted that the development will not impact the hydrogeology at the site and that the surrounding slopes to the development site are stable.

1.9. Revised BIA submissions present a consistent approach regarding soil parameters, construction method and sequence of works.

1.10. The revised Maund BIA submission presents an updated GMA and corresponding damage category assessment, which indicates a maximum damage category 1 'very slight'.

1.11. Based on the revised submission, it is confirmed that the proposal adheres to the requirements of the CPG Basements.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 29 January 2020 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for the land adjacent to 1 Dunollie Road, London NW5 2XN.

2.2. The Audit was carried out in accordance with the Terms of Reference set by LBC. It reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development.

2.3. A BIA is required for all planning applications with basements in Camden in general accordance with policies and technical procedures contained within

- Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.
- Camden Planning Guidance Basements. March 2018.
- Camden Development Policy (DP) 27: Basements and Lightwells.
- Camden Development Policy (DP) 23: Water.
- Local Plan Policy A5 Basements.

2.4. The BIA should demonstrate that schemes:

a) maintain the structural stability of the building and neighbouring properties;

b) avoid adversely affecting drainage and run off or causing other damage to the water environment;

c) avoid cumulative impacts upon structural stability or the water environment in the local area;

and evaluate the impacts of the proposed basement considering the issues of hydrology, hydrogeology and land stability via the process described by the GSD and to make recommendations for the detailed design.

2.5. LBC's Audit Instruction described the planning proposal as *"Erection of two storey (plus basement) 2-bed dwelling house (Class C3) with hard and soft landscaping to front following demolition of existing garages*"

2.6. CampbellReith accessed LBC's Planning Portal in February and March 2020 and gained access to the following relevant documents for audit purposes:

- Basement Impact Assessment (BIA), Croft Structural Engineers, ref. 190611, rev 1, dated 6th November 2019.
- Basement Impact Assessment: Hydrogeology, Land Stability and Ground Movement Assessment, Maund Geo-Consulting, ref. MGC-BIA-19-21-V1, dated 1 August 2019.
- Design and Access Statement (DAS), Francis Birch Architect, rev 6, dated November 2019.
- Planning Statement, Francis Birch Architect, rev 6, dated November 2019.
- Planning Application Drawings by Francis Birch Architect, consisting of Existing and Proposed Plans and sections.
- Sustainability Statement, Francis Birch Architect, rev 1, dated September 2019.
- Pre-development Arboricultural Survey and Report, Wassells, ref. WAS 131/2019, dated 10 October 2019.
- Planning Consultation responses.

2.7. The following additional documents were provided to CampbellReith in April and May 2020 in response to the initial audit report and queries summarised in Appendix 2:

- Basement Impact Assessment: Hydrogeology, Land Stability and Ground Movement Assessment, Maund Geo-Consulting, ref. MGC-BIA-19-21-V5, dated 21 May 2020.
- Basement and Ground Plan and Sections drawing by Croft Structural Engineers, drawing no. PL-10, rev 3, dated 21 May 2020.
- Lightwell Retaining Wall – Worst Case structural calculations by Form Structural Engineers, dated 31/03/2020.
- Planning Statement, Francis Birch Architect, rev 7, dated April 2020.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	
Is data required by Cl.233 of the GSD presented?	Yes	
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	
Are suitable plan/maps included?	Yes	
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	
Is a conceptual model presented?	Yes	
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	

Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	N/A	No items carried forward to scoping.
Is factual ground investigation data provided?	Yes	
Is monitoring data presented?	Yes	
Is the ground investigation informed by a desk study?	Yes	
Has a site walkover been undertaken?	Yes	
Is the presence/absence of adjacent or nearby basements confirmed?	Yes	
Is a geotechnical interpretation presented?	Yes	
Does the geotechnical interpretation include information on retaining wall design?	Yes	
Are reports on other investigations required by screening and scoping presented?	Yes	Arboricultural Report provided.
Are the baseline conditions described, based on the GSD?	Yes	
Do the base line conditions consider adjacent or nearby basements?	Yes	
Is an Impact Assessment provided?	Yes	
Are estimates of ground movement and structural impact presented?	Yes	

Item	Yes/No/NA	Comment
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	
Has the need for monitoring during construction been considered?	Yes	Monitoring strategy provided.
Have the residual (after mitigation) impacts been clearly identified?	Yes	
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	
Does report state that damage to surrounding buildings will be no worse than Burland Category 1?	Yes	
Are non-technical summaries provided?	Yes	

4.0 DISCUSSION

4.1. The BIA has been carried out in two parts; the hydrogeology, land stability and ground movement assessments were undertaken by Maund Geo-Consulting and the hydrology assessment and structural appraisal were undertaken by Croft Structural Engineers. The individuals who completed each part of the BIA are considered to hold suitable qualifications as required by CPG4.

4.2. The BIA identified that the site is located within a Conservation Area, however no listed buildings are present either on site or in the immediate vicinity.

4.3. The proposed development comprises the construction of a new dwelling with two above-ground floors and a single basement level immediately adjacent to 1 Dunollie Road, which belongs to the applicant. The maximum basement excavation depth is given as 3.00m.

4.4. The site currently comprises two single garages and hardstanding. It is accepted that the proposed development will therefore not increase the surface water discharge from the site and, due to the incorporation of SUDS, may reduce it. It is accepted that the proposed development will not adversely impact the hydrology at the site.

4.5. A ground investigation was carried out and confirms the ground conditions to comprise Made Ground to a depth of 0.40m, with London Clay below. Groundwater monitoring identified only limited groundwater present at depth, 2.88m below the excavation depth of the basement.

4.6. In the absence of an aquifer, it is accepted that the development will not impact the hydrogeology at the site.

4.7. It is accepted that there are no slope stability concerns regarding the proposed development and it is not in an area prone to flooding.

4.8. A geotechnical interpretation, including soil parameters derived from the site investigation data, is provided in the Maund BIA and is considered appropriate for the site. The revised submissions from Croft Structural Engineers use the parameters identified in the Maund BIA.

4.9. Structural drawings and a temporary works sequence, presented in Appendices D and E of the Croft BIA, and Appendix A of the Maund BIA, indicate mass concrete underpinning beneath the party wall with No. 1 Dunollie Road. An RC wall is to be constructed inside the underpinning along that side. Elsewhere an RC wall is to be constructed in an underpinning type sequence. Excavation for the construction of the basement walls is to take place in bays not exceeding 1m wide with the excavation faces supported by trench sheeting and propped against the central soil mass. The central soil mass is to remain in place during the construction of the party wall and the walls at the front and back of the property. The remaining soil mass will then be

removed during the construction of the final wall opposite No. 1 Dunollie Road, with temporary propping extended to brace the full width of the property as construction progresses.

4.10. Section 10.1 of the revised Maund BIA has been updated to refer to the construction sequence presented in the Croft BIA. Reference to a *'sacrificial concrete strip'* and driving trench sheeting has been removed. Appendix A of the Croft BIA presents structural calculations for the basement wall. Revised submissions from Form Structural Design indicate a 200mm long heel will be used for the lightwell retaining wall only, with no heel in the general arrangement of the retaining wall forming the rest of the basement.

4.11. A ground movement assessment (GMA) and building damage assessment are presented in Sections 10 and 11 of the Maund BIA. Section 10.1 indicates that horizontal and vertical movement resulting from installation of the wall and subsequent excavation have been assessed in accordance with CIRIA C760. Whilst CIRIA C760 is not intended to be directly applicable to underpinning, it is recognised that the reference is commonly used to provide an estimate of ground movements.

4.12. The predicted magnitude of the horizontal movement is considered reasonable. The subsequent clarification states that vertical movements associated with construction only affect underpinned foundations. While this is not accepted in all cases it is noted to be an acceptable assumption for this situation.

4.13. The GMA also includes an estimation of short term and long term vertical movements due to unloading from the excavation of the basement using PDISP software. It is noted that the short term assessment considers the excavation as occurring over the full basement area before the underpins are constructed. However, the construction sequence presented in the Croft drawings indicates the central soil mass will remain in place as underpinning progresses on three sides of the development, to support the temporary props. The PDisp model also does not reflect the fact that the loading will occur instantaneously at the party wall, however, in this case, estimates of vertical ground movements and building damage are accepted.

4.14. Section 11 and Table 11.2 present a damage category assessment for the adjacent wall at 1 Dunollie Road and indicates ground movement resulting from the development will fall into Damage Category 1. The revised Maund BIA also includes consideration of the public highways and indicates negligible movement.

4.15. Section 8.5.3 of the Croft BIA presents a movement monitoring strategy for the existing structures and includes proposed trigger values for vertical and horizontal movement. A drawing showing the proposed monitoring locations is presented in Appendix F of the Croft BIA. A monitoring strategy is also proposed in Section 12 of the Maund BIA, and is generally

consistent with the approach given in the Croft BIA. The Maund BIA includes monitoring of the adjacent garden walls, as well as 1 Dunollie Road.

5.0 CONCLUSIONS

5.1. The planning statement should be amended to remove the suggestion that the BIA was carried out in association with CampbellReith.

5.2. The BIA has been carried out in two parts; the hydrogeology, land stability and ground movement was undertaken by Maund Geo-Consulting and the hydrology assessment and structural engineering appraisal were undertaken by Croft Structural Engineers. The individuals who completed each part of the BIA are considered to hold suitable qualifications as required by CPG4.

5.3. The BIA has confirmed that the proposed basement will be founded within London Clay.

5.4. The BIA identifies no risk of flooding for the site. It is accepted that the proposed development will not increase the surface water discharge from the site or adversely impact the hydrology at the site.

5.5. It is accepted that the development will not impact the hydrogeology at the site and that the surrounding slopes to the development site are stable.

5.6. Revised BIA submissions present a consistent approach regarding soil parameters, construction method and sequence of works.

5.7. The revised Maund BIA submission presents an updated GMA and corresponding damage category assessment, which indicates a maximum damage category 1 'very slight'.

5.8. Based on the revised submissions it is confirmed that the proposal adheres to the requirements of the CPG Basements.

Appendix 1: Residents' Consultation Comments

Residents' Consultation Comments

Surname	Address	Date	Issue raised	Response
Fletcher	Unknown	11/01/20	Ground subsidence relating to construction	This is addressed in the BIA
Symons	Unknown	11/01/20	Basement excavation causing subsidence of neighbouring properties.	A ground movement assessment has been undertaken to assess the damage and is appraised in the BIA audit.
Taylor	Unknown	06/01/20	Basement impact associated with adjacent tree	Tree protection is not within the remit of the BIA audit, however an arboricultural survey has been provided in the planning submission
Martin	Unknown	10/01/20	Basement excavation compromising adjacent foundations	This is addressed in the BIA
Hall	Unknown	08/01/20	Basement excavation	This is addressed in the BIA

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	Stability	Parameters for Ka and Kp should be clarified and used consistently through all analyses.	Closed	01/05/2020
2	Stability	Conflicting construction methods and sequences of work are presented and should be clarified such that both BIAs present consistent information.	Closed	21/05/2020
3	Stability	Structural drawings and calculations should be revised to reflect the revised construction method and sequence of work.	Closed	21/05/2020
4	Stability	Further information is required to support the conclusions of the ground movement assessment presented in the Maund BIA.	Closed	01/05/2020
5	Stability	Further details of the PDisp output should be provided and the GMA should be updated in accordance with the comments in Section 4.	Closed	01/05/2020
6	Stability	The damage category assessment should be updated based on the revised GMA.	Closed	01/05/2020

Appendix 3: Supplementary Supporting Documents

Audit responses to CampbellReith

Lightwell Retaining Wall Calculations

Updated page 17 of Croft BIA

Croft Drawings TW-11 rev1 and PL-10 rev 3

4.0 DISCUSSION

4.1. Section 2 of the Planning Statement suggests the Basement Impact Assessment (BIA) was carried out *'in association with CampbellReith'*. This is incorrect and any suggestion that CampbellReith was involved in the compilation of the BIA should be removed.

4.2. The BIA has been carried out in two parts; the hydrogeology, land stability and ground movement assessments were undertaken by Maund Geo-Consulting and the hydrology assessment and structural appraisal were undertaken by Croft Structural Engineers. The individuals who completed each part of the BIA are considered to hold suitable qualifications as required by CPG4.

4.3. The BIA identified that the site is located within a Conservation Area, however no listed buildings are present either on site or in the immediate vicinity.

4.4. The proposed development comprises the construction of a new dwelling with two above-ground floors and a single basement level immediately adjacent to 1 Dunollie Road, which belongs to the applicant. The maximum basement excavation depth is given as 3.00m.

4.5. The site currently comprises two single garages and hardstanding. It is accepted that the proposed development will therefore not increase the surface water discharge from the site and, due to the incorporation of SUDS, may reduce it. It is accepted that the proposed development will not adversely impact the hydrology at the site.

4.6. A ground investigation was carried out and confirms the ground conditions to comprise Made Ground to a depth of 0.40m, with London Clay below. Groundwater monitoring identified only limited groundwater present at depth, 2.88m below the excavations depth of the basement.

4.7. In the absence of an aquifer, it is accepted that the development will not impact the hydrogeology at the site.

4.8. It is accepted that there are no slope stability concerns regarding the proposed development and it is not in an area prone to flooding.

4.9. A geotechnical interpretation, including soil parameters derived from the site investigation data, is provided in the Maund BIA and is considered appropriate for the site.

4.10. There is some discrepancy between the Ka and Kp values given in Table 5.3 of the Maund BIA (0.35 and 2.5 respectively), Section 8.1 of the Croft BIA (0.4217 and 2.3711 respectively) and the TEDDs retaining wall design output for the basement wall, presented in Appendix A of the Croft BIA (calculated as 0.384 and 3.237 respectively). Appropriate values should be confirmed and the various assessments updated as necessary. A consistent value of Ka 0.35 and kp 2.5 will be adopted.

4.11. Structural drawings and a temporary works sequence, presented in Appendices D and E of the Croft BIA, indicate mass concrete underpinning beneath the party wall with No 1 Dunollie Road. An RC wall is to be constructed inside the underpinning along that side. Elsewhere an RC wall is to be constructed in an underpinning type sequence. Excavation for the construction of the basement walls is to take place on a hit and miss basis with the excavation faces supported by trench sheeting. The central soil dumpling is to be excavated once the retaining wall is complete.

4.12. Section 10.1 of the Maund BIA describes the intention to *'drive trench sheets around the open faces'* and excavate the soil mass before casting a reinforced concrete retaining wall in bays. It notes that the retaining wall is to be cast on a *'sacrificial concrete strip'*. The sequence differs from that described by Croft and, while it does not refer to underpinning, underpinning is discussed later in the Maund BIA. Clarification of the construction methodology for the basement is required. 'sacrificial concrete strip' has been removed from Maund BIA.

4.13. Depending on the confirmed construction methodology, further detail regarding the *'sacrificial concrete strip'*, the impact of ground movement and vibration from driving the trench sheets, and what is referred to by the term *'open faces'* may be required.

4.14. Appendix A of the Croft BIA presents structural calculations for the basement wall. Clarification is required regarding the use of a 200mm long heel in the general arrangement of the retaining wall design. The subsequent structural drawings presented in Appendix D do not show a heel to the retaining wall. Drawings, calculations and the construction methodology should all be consistent. Please refer to attached document "lightwell retaining wall revised Ka&Kp values". The design presented is the worst case which is for the lightwell to the front.
Please refer to attached document "190611 A3 PL-10" for a revised drawing to show the heel to the front. The section shown is taken from side to side

4.15. A ground movement assessment (GMA) and building damage assessment are presented in Sections 10 and 11 of the Maund BIA. Section 10.1 indicates that horizontal and vertical movement resulting from installation of the wall and subsequent excavation have been assessed in accordance with CIRIA C760. Whilst CIRIA C760 is not intended to be directly applicable to underpinning (if it is confirmed that underpinning is to be utilised), it is recognised that the reference is commonly used to provide an estimate of ground movements. In this instance, the method of estimating ground movements is not consistently applied, for example, the presence of firm or stiff clay and the distance beyond the retaining walls over which movement occurs. Reference should be to Figure 6.15b for stiff soils not 6.11b.

4.16. The GMA also includes an estimation of short term and long term vertical movements due to unloading from the excavation of the basement using PDISP software. The results of the PDISP analysis presented in Sections 10.2.1 and 10.2.2 identify undrained (short term) heave of 5mm and a drained (long term) heave of 4mm at the site boundary with 1 Dunollie Road. The graphical representation in Figures 6.3 and 6.4 show these values to be approximately 4.8mm and 6.0mm respectively. It should be clarified whether the 'long term' movement represents the

total settlement or the residual settlement component after immediate settlement has been subtracted. Heave estimates should be confirmed once the construction sequence is clarified as the stage at which mass excavation takes place will have a significant bearing.

The text in section 6.3 has been clarified with reference to Figure 6.1 to 6.4. To confirm the ground moment at the external wall of 1 Dunollie is 4.8mm not 5mm for short term and 6mm for long term. These movements have been applied to the GMA. There is no change to the damage assessment of less than 1. The GMA show the cumulative effect of the vertical ground movements from short and long term.

4.17. The PDisp output presented in Appendix E of the Maund BIA only presents the analysis input data. Once the construction and assessment methodologies are confirmed, the results of the analysis should be provided to support the conclusions of the GMA.

The results of the analysis are shown in Figures 6.1 to 6.4. which have been referenced in Section 11.1 We will provide the tabular output in Appendix D.

4.18. Section 11 and Table 11.2 present a damage category assessment for the adjacent wall at 1 Dunollie Road. A diagram should be provided indicating which wall was assessed, to show that the most critical situation has been considered. The damage assessment should be updated based on the revised GMA.

Figure 11.1 shows the section for 1 Dunollie Rd. The text explains where the section is as referred to and indicated in Figures 6.1 to 6.4, where it is shown diagrammatically. There is no change to the damage assessment which is still within the 0 to 1 range.

4.19. Consideration of the impact to the highway should also be included in the assessment.

The ground movement at the highway is considered in section 9.2.3

4.20. Section 8.5.3 of the Croft BIA presents a movement monitoring strategy for the existing structures and includes proposed trigger values for vertical and horizontal movement. A drawing showing the proposed monitoring locations is presented in Appendix F of the Croft BIA. A monitoring strategy is also proposed in Section 12 of the Maund BIA, and is generally consistent with the approach given in the Croft BIA. The Maund BIA includes monitoring of the adjacent garden walls, as well as 1 Dunollie Road. Trigger values should be confirmed once the GMA has been updated.

LIGHTWELL RETAINING WALL - WORST CASE

RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.07

Retaining wall details

Stem type	Cantilever		
Stem height	h_{stem} = **2500** mm		
Stem thickness	t_{stem} = **350** mm		
Angle to rear face of stem		α = **90** deg	
Stem density	γ_{stem} = **25** kN/m^3		
Toe length	l_{toe} = **1250** mm		
Heel length	l_{heel} = **200** mm		
Base thickness	t_{base} = **350** mm		
Base density	γ_{base} = **25** kN/m^3		
Height of retained soil	h_{ret} = **2500** mm	Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm		
Height of water	h_{water} = **1500** mm		
Water density	γ_w = **9.8** kN/m^3		

Retained soil properties

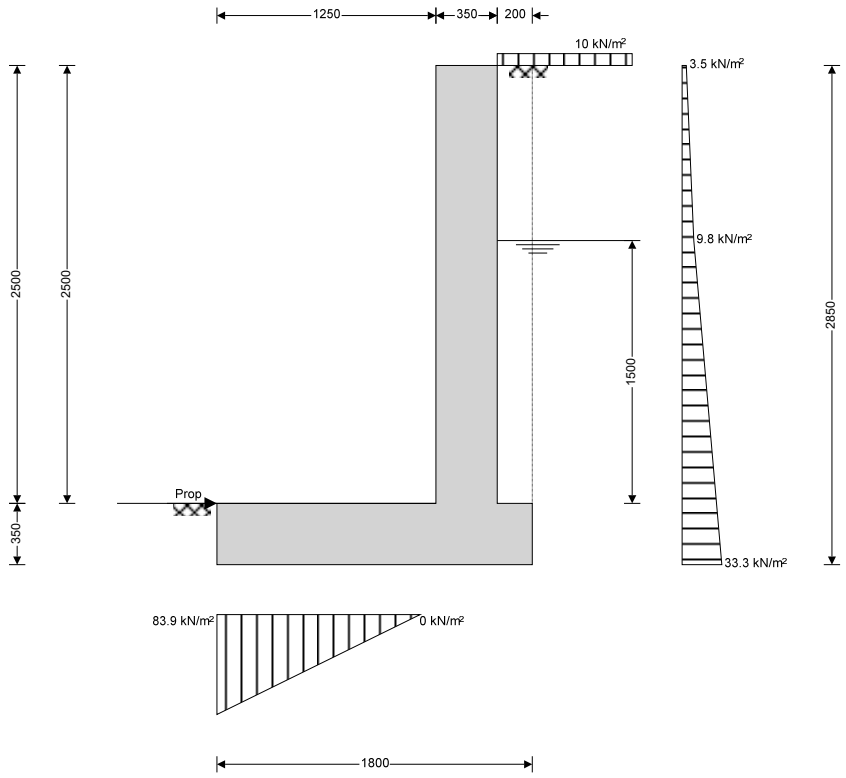
Soil type	Firm silty clay
Moist density	γ_{mr} = **18** kN/m^3
Saturated density	γ_{sr} = **18** kN/m^3

Base soil properties

Soil type	Firm silty clay		
Soil density	γ_b = **18** kN/m^3		
Presumed bearing capacity		$P_{bearing}$ = **100** kN/m^2	

Loading details

Variable surcharge load	$Surcharge_Q$ = **10** kN/m^2



General arrangement

Calculate retaining wall geometry

Base length	l_{base} = **1800** mm		
Saturated soil height	h_{sat} = **1500** mm		
Moist soil height	h_{moist} = **1000** mm		
Length of surcharge load	l_{sur} = **200** mm		
Vertical distance	x_{sur_v} = **1700** mm		
Effective height of wall	h_{eff} = **2850** mm		
Horizontal distance	x_{sur_h} = **1425** mm		
Area of wall stem	A_{stem} = **0.875** m²	Vertical distance	x_{stem} = **1425** mm
Area of wall base	A_{base} = **0.63** m²	Vertical distance	x_{base} = **900** mm
Area of saturated soil	A_{sat} = **0.3** m²	Vertical distance	x_{sat_v} = **1700** mm
		Horizontal distance	x_{sat_h} = **617** mm
Area of water	A_{water} = **0.3** m²	Vertical distance	x_{water_v} = **1700** mm
		Horizontal distance	x_{water_h} = **617** mm
Area of moist soil	A_{moist} = **0.2** m²	Vertical distance	x_{moist_v} = **1700** mm
		Horizontal distance	x_{moist_h} = **1193** mm

Retained soil properties

Design moist density γ_{mr}' = **18** kN/m³ Design saturated density γ_{sr}' = **18** kN/m³

Base soil properties

Design soil density γ_b' = **18** kN/m³

Soil coefficients

Coeff.friction to back of wall K_{fr} = **0.325**

Coeff.friction to front of wall K_{fb} = **0.325** Coeff.friction beneath base K_{fbb} = **0.325**

Active pressure coefficient K_A = **0.350** Passive pressure coefficient K_P = **2.500**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base} + F_{sur\_v} + F_{sat\_v} + F_{water\_v} + F_{moist\_v}$ = **48.6** kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{sur\_h} + F_{sat\_h} + F_{water\_h} + F_{moist\_h} + F_{pass\_h}$ = **43.7** kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{sur} + M_{sat} + M_{water} + M_{moist}$ = **18.8** kNm/m

Check bearing pressure

Propping force F_{prop_base} = **43.7** kN/m

Bearing pressure at toe q_{toe} = **83.9** kN/m² Bearing pressure at heel q_{heel} = **0** kN/m²

Factor of safety FoS_{bp} = **1.193**

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.9.07

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class C30/37

Char.comp.cylinder strength f_{ck} = **30** N/mm² Mean axial tensile strength f_{ctm} = **2.9** N/mm²

Secant modulus of elasticity E_{cm} = **32837** N/mm² Maximum aggregate size h_{agg} = **20** mm

Design comp.concrete strength f_{cd} = **17.0** N/mm² Partial factor γ_C = **1.50**

Reinforcement details

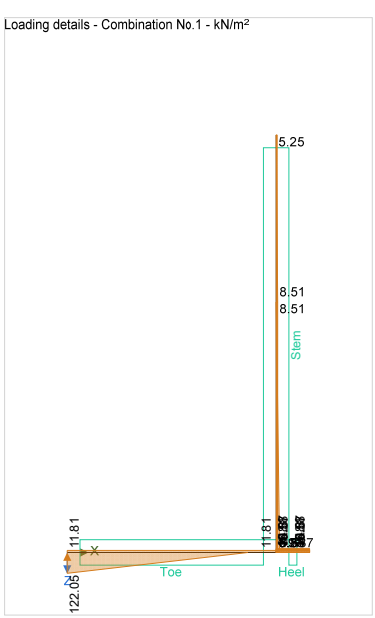
Characteristic yield strength f_{yk} = **500** N/mm² Modulus of elasticity E_s = **200000** N/mm²

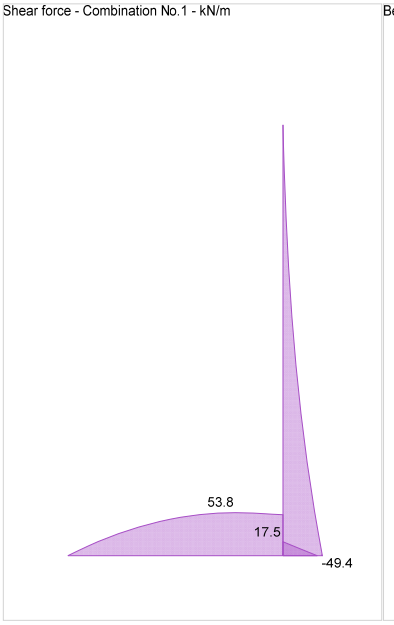
Design yield strength f_{yd} = **435** N/mm² Partial factor γ_S = **1.15**

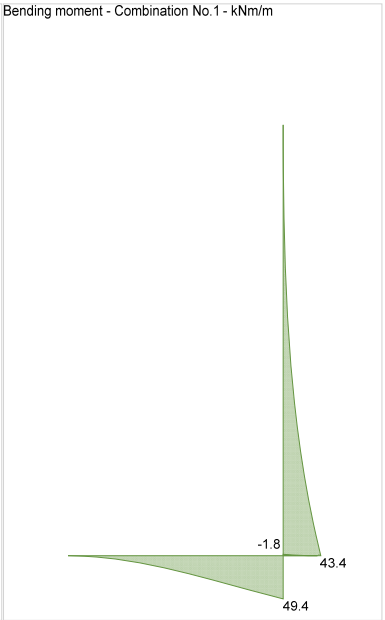
Cover to reinforcement

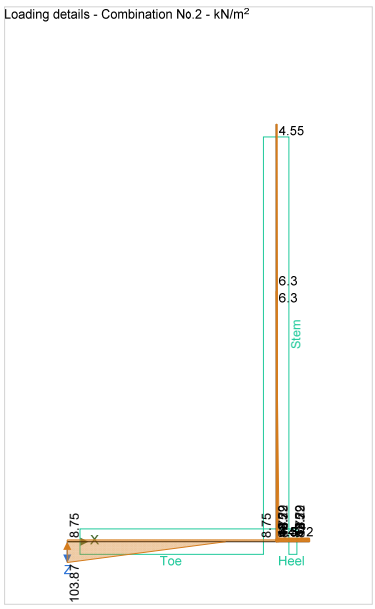
Front face of stem c_{sf} = **40** mm Rear face of stem c_{sr} = **50** mm

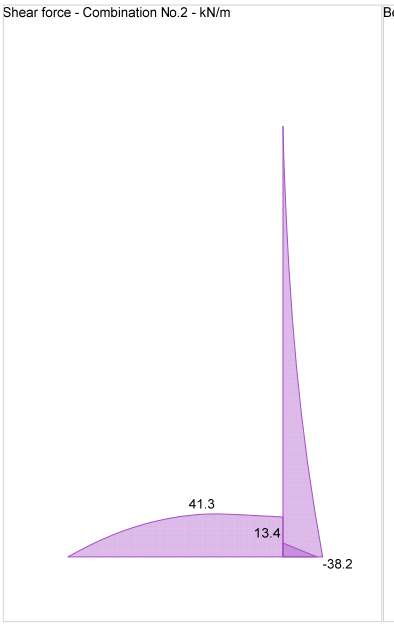
Top face of base c_{bt} = **50** mm Bottom face of base c_{bb} = **75** mm

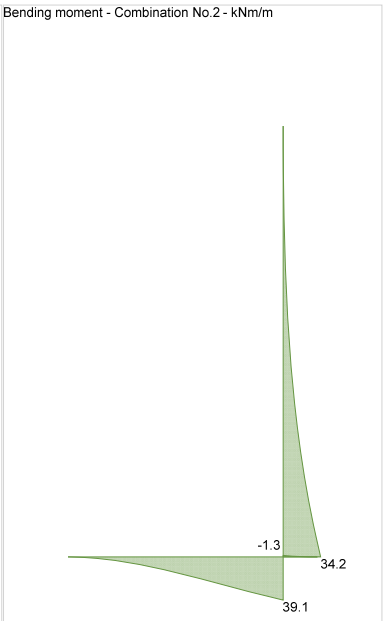












Check stem design at base of stem

Depth of section h = **350** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **43.4** kNm/m K = **0.017** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req}$ = **357** mm²/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr.prov}$ = **565** mm²/m

Min.area of reinforcement $A_{sr.min}$ = **443** mm²/m Max.area of reinforcement $A_{sr.max}$ = **14000** mm²/m

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single summary

Deflection control - Section 7.4

Limiting span to depth ratio 16 Actual span to depth ratio 8.5

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.276** mm

PASS - Maximum crack width is less than limiting crack width**Rectangular section in shear - Section 6.2**

Design shear force V = **49.4** kN/m Design shear resistance $V_{Rd.c}$ = **138.9** kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req}$ = **350** mm²/m Max.spacing of reinforcement s_{sx_max} = **400** mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{sx.prov}$ = **393** mm²/m

PASS - Area of reinforcement provided is greater than area of reinforcement required

Check base design at toe

Depth of section h = **350** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **49.4** kNm/m K = **0.023** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bb.req}$ = **448** mm²/m

Tens.reinforcement provided 16 dia.bars @ 150 c/c Tens.reinforcement provided $A_{bb.prov}$ = **1340** mm²/m

Min.area of reinforcement $A_{bb.min}$ = **402** mm²/m Max.area of reinforcement $A_{bb.max}$ = **14000** mm²/m

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single summary

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.146** mm

PASS - Maximum crack width is less than limiting crack width **Rectangular section in shear - Section 6.2**

Design shear force V = **53.8** kN/m Design shear resistance $V_{Rd.c}$ = **147.6** kN/m

PASS - Design shear resistance exceeds design shear force

Check base design at heel

Depth of section h = **350** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **1.8** kNm/m K = **0.001** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bt.req}$ = **14** mm²/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{bt.prov}$ = **565** mm²/m

Min.area of reinforcement $A_{bt.min}$ = **443** mm²/m Max.area of reinforcement $A_{bt.max}$ = **14000** mm²/m

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single summary

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.012** mm

PASS - Maximum crack width is less than limiting crack width **Rectangular section in shear - Section 6.2**

Design shear force V = **17.5** kN/m Design shear resistance $V_{Rd.c}$ = **138.9** kN/m

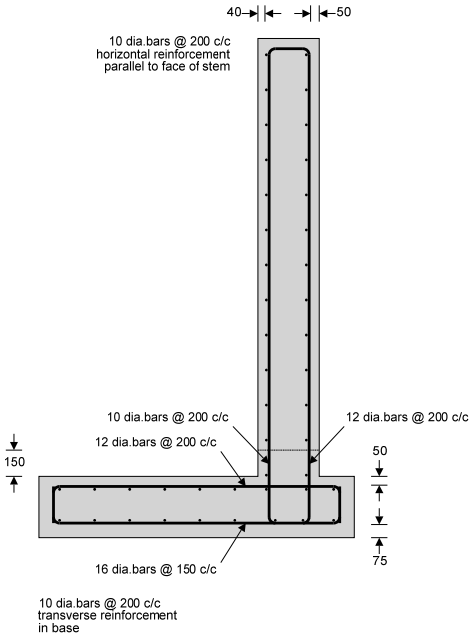
PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement $A_{bx.req}$ = **268** mm²/m Max.spacing of reinforcement s_{bx_max} = **450** mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{bx.prov}$ = **393** mm²/m

PASS - Area of reinforcement provided is greater than area of reinforcement required



Reinforcement details

8. Construction Methodology and Engineering Statements

8.1. Outline Geotechnical Design Parameters

From the Geological report and soil investigation reasonably conservative geotechnical parameters have been determined, based on the soil investigation: design overall stability to K_a & K_p values.

K_a = 0.35 , K_p = 2.5

8.2. Hydro Static Pressure

Design temporary condition for water table level, If deeper than basement ignore.

Design permanent condition for water table level:

If deeper than existing, design reinforcement for water table at full basement depth to allow for local failure of water mains, drainage and storm water. Global uplift forces can be ignored when the water table is lower than the basement. BS8102 only indicates guidance.

8.2.1. Intended Use & Loadings

	UDL kN/m²	Concentrated Load kN
Domestic Single Dwellings	1.5	2.0

Below ground level, the reinforced concrete retaining walls are designed to carry the lateral loading applied from above.

The lateral earth pressure exerts a horizontal force on the retaining walls. The retaining walls will be checked for resistance to the overturning force this produces.

Lateral forces will be applied from:

- Soil loads
- Hydrostatic pressures
- Surcharge loading from behind the wall

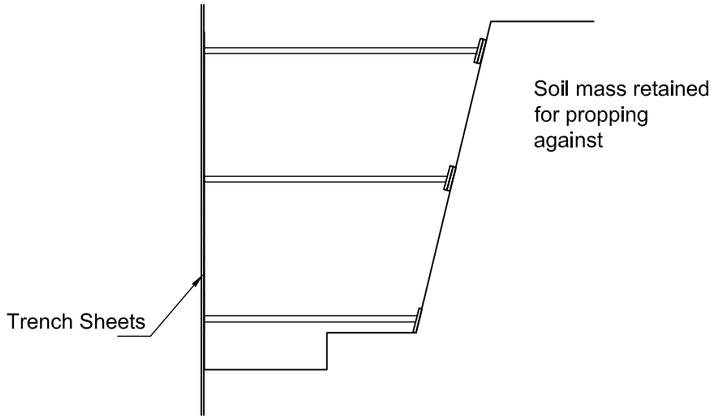
These produce retaining wall thrust. This will be restrained by the opposing retaining wall.

8.2.1.1. Surcharge Loading

The following will be applied as surcharge loads to the front/ front lightwell retaining walls:

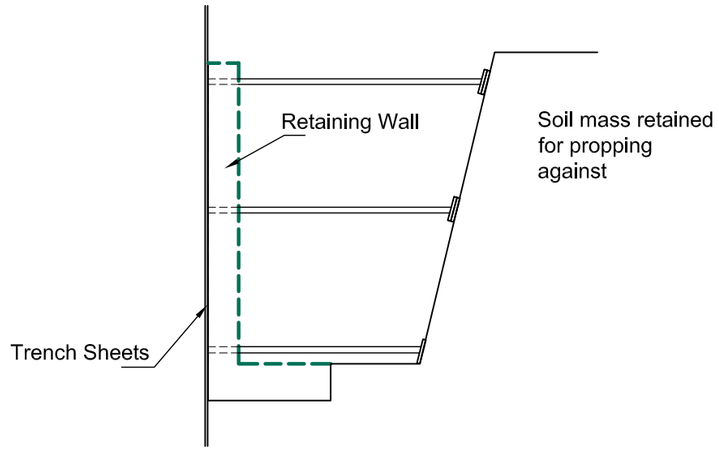
- 10kN/m² if within 45° of road
- 100kN point loads if under road or within 1.5m
- 5kN/m² if within 45° of Pavement

Planning issue
Not for construction



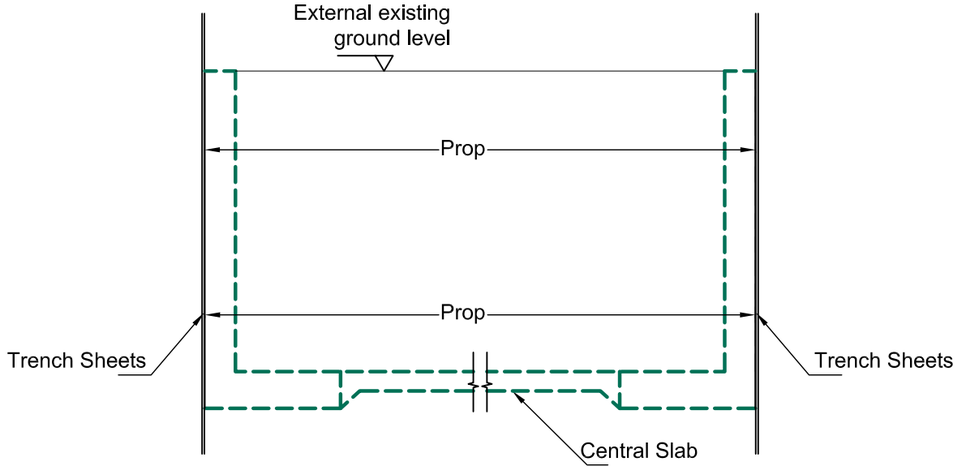
Phase 1

1. Excavate in 1m width maximum and install props and trench sheets as excavation progresses.



Phase 2

1. Install reinforcement and cast Retaining wall and Base.
3. Proceed with this process until walls 1, 2 and 1A underpinning is complete



Phase 3

1. Start the underpinning to wall 1B.
2. Start the excavation of the soil and install trench sheets and full cross props extending to wall 2.
3. Continue the excavation of the soil until the founding level is reached. Install trench sheets and cross props as the the excavation progresses.
4. Cast Retaining wall and Base to wall 1B.
6. Install reinforcement and cast basement slab.
7. Proceed with above ground construction

Rev	Date	Amendments
1	21/05/2020	Issued for planning
-	09/07/2019	Issued for planning

Job Number	Date
190611	July '19
Dwg Number	Rev
TW-11	1
Drawn	Ch'kd
SB	EP
Scale	As shown @ A3

Client: Ms Kerena Mond

Project: 1 Dunollie Road

Title : Temporary works

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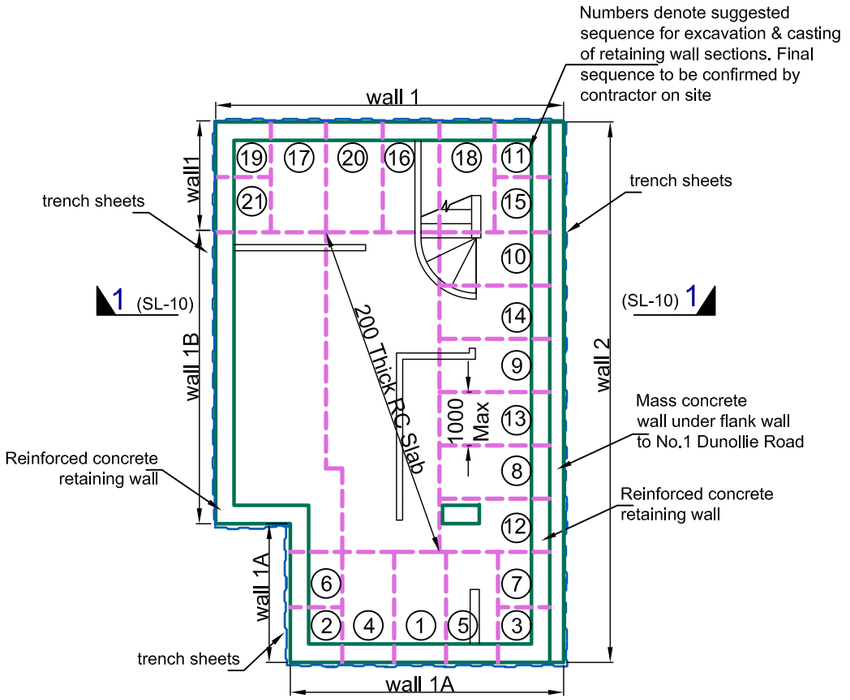
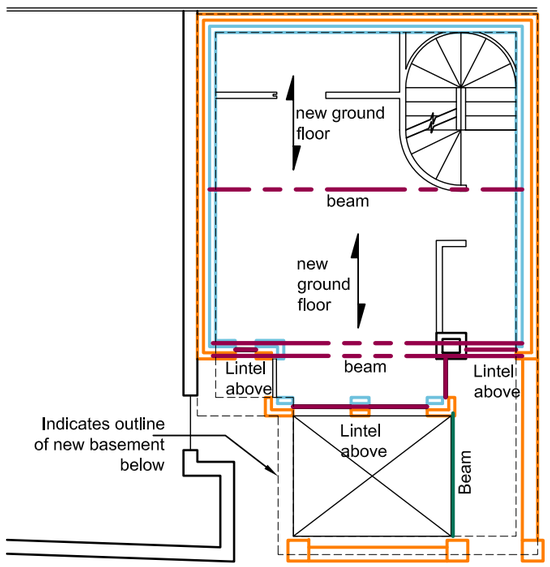
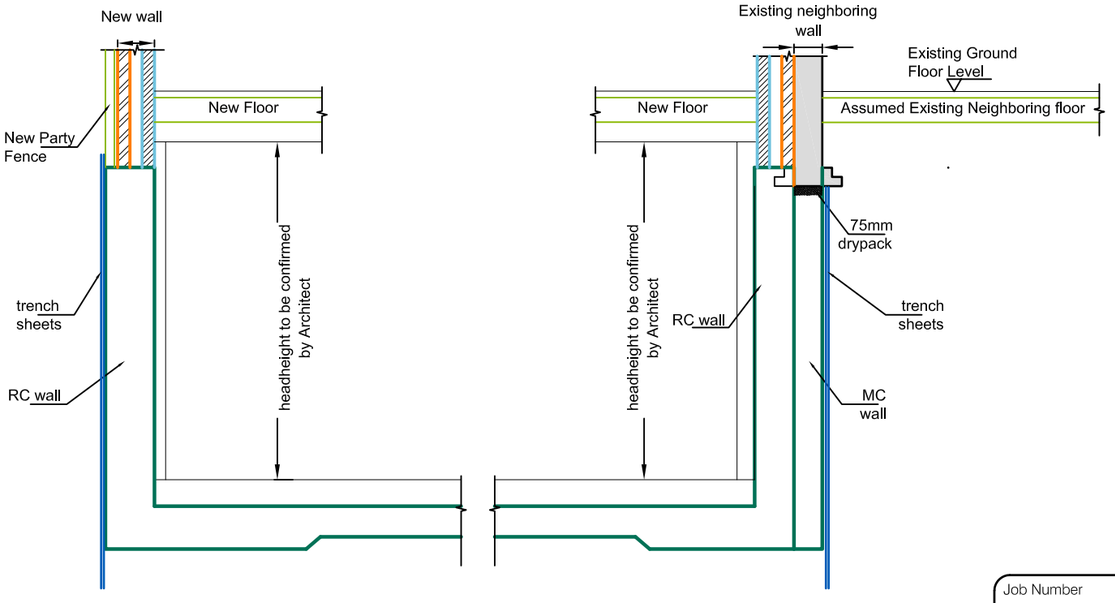
Planning issue
Not for construction







Section 1-1
(Scale 1:50)

Job Number	Date
190611	July '19
Dwg Number	Rev
PL-10	3
Drawn	Ch'kd
SB	EP
Scale	As shown @ A3

Client: Ms Kerena Mond

Project: 1 Dunollie Road

Title : Basement and Ground Plan and Sections

Rev	Date	Amendments
3	21/05/2020	Issued for planning minor amendments
2	09/08/2019	Issued for planning minor amendments
1	10/07/2019	minor amendments
-	09/07/2019	Issued for planning

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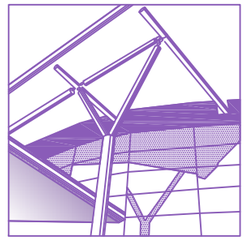

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