CampbellReith
consulting engineers

231 Goldhurst Terrace, NW6 3EP

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12066-33
Revision: F1

November 2015

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Document History and Status

Revision	Date	Purpose/Status	File Ref	Author	Check	Review
D1	28/08/15	Comment	SKjw12066-33-280815 D1.doc	SK	EMB	EMB
D2	20/10/2015	Comment	SKjw12066-33-201015-231 Goldhurst Terrace-D2.doc	SK	EMB	EMB
D3	22/10/2015	Comment	SKjw12066-33-221015-231 Goldhurst Terrace-D3.doc	SK	EMB	EMB
F1	11/11/2015	For planning	SKjw12066-33-151111-231 Goldhurst Terrace-F1.doc	SK	EMB	EMB

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Document Details

Last saved	11/11/2015 17:58
Path	SKjw12066-33-151111-231 Goldhurst Terrace-F1.doc
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Project Number	12066-33
Project Name	Camden BIA Audits
Planning Reference	2015/2384/P

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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 231 Goldhurst Terrace, London NW6 3EP (planning reference 2015/2384/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 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 BIA and BSMS have been carried out by engineering consultants using individuals who possess suitable qualifications, other than the authors of the BSMS not identifying suitable expertise in engineering geology.

1.5. The BIA has confirmed that the proposed basement will be founded within the London Clay. It has been confirmed that the bearing strata has an adequate bearing capacity.

1.6. It is unlikely that the groundwater table will be encountered during basement foundation excavation. However, proposals for the removal of water from the excavation during construction are provided.

1.7. It is recommended that further investigation of the neighbouring foundations is carried out as noted in the BIA.

1.8. There are numerous references in the BSMS and programme to the retaining walls being cantilevered and propping is not described in the Basement Sequencing. CSE have stated that underpins will be propped in the temporary case as shown in the structural calculations. However, in view of the discrepancy in the supplied information, it is recommended that the details of the temporary and permanent works are confirmed in a Basement Construction Plan.

1.9. Outline proposals are provided for a movement monitoring strategy during excavation and construction have been provided with a proposal to record conditions before and after construction. Monitoring is recommended. The outline proposals will have to be developed and agreed with the Party Wall Surveyor.

1.10. Further investigation should be undertaken to identify the cause (location of damaged drainage runs) of the foul water encountered in the bore holes. It is proposed that the drainage runs will be repaved.

1.11. An outline Construction Programme was provided, although it should be noted that it refers to a cantilevered wall.

1.12. It is that there will be no additional surface water run-off to the public sewer, in which case the development will not impact on the wider hydrology and hydrogeology of the area.

1.13. Earlier audits queried whether heave pressures on the proposed ground bearing slab had been considered and a slab uplift calculation was subsequently presented by CSE which showed a requirement for heave protection below the slab. Revision 5 of the BSMS shows suspended slab with heave protection placed beneath, although it should be noted that the text of the document still refers to a ground bearing slab. Due to this discrepancy, it is recommended that the design of the slab is confirmed in a Basement Construction Plan.

1.14. The ground movement and building damage assessment was resubmitted in order to close out a query raised by the audit so that the assessment within the BSMS Revision 5 is superseded. It is accepted that predicted damage to neighbouring structures should not exceed Burland Category 1 provided they are in sound condition and there is good control of membership.

1.15. It is accepted that the surrounding slopes to the developed site are stable.

1.16. Queries and matters that required further information or clarification and have subsequently been carried out are summarised in Appendix 2. A Basement Construction Plan including detailed design of the temporary and permanent works and the basement slab is recommended.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 17/07/15 to carry out a Category B Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 231 Goldhurst Terrace, NW6 3EP, 2015/2384/P.

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 (CPG) 4: Basements and Lightwells.
- Camden Development Policy (DP) 27: Basements and Lightwells.
- Camden Development Policy (DP) 23: Water

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; and,

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 *"Excavation at basement level for ancillary floorspace with front and rear lightwells, erection of a single storey rear extension with bay window and roof lantern, installation of external staircases between the ground floor and basement, new lift platform to the front, disabled ramp to the rear elevation and new decking area to the rear."*

2.6. CampbellReith accessed LBC's Planning Portal on 18th August 2015 and gained access to the following relevant documents for audit purposes:

- 231 Goldhurst Terrace Basement Structural Method Statement Rev 2 – Croft Structural Engineers, November 2014
- Basement Impact Assessment – Ashton Bennett Consultancy, June 2015
- Block Plan
- Location Plan18112014
- Existing Drawings
- Proposed Drawings.

2.7. Further to the issue of CampbellReith's draft BIA audit report, a number of the queries raised were addressed in an email dated 7 September 2015 and sent by RPR Planning to CampbellReith and LBC. Subsequently, Revision 4 of the Basement Structural Method Statement was issued to CampbellReith by email on 16 September 2015. Revisions D2 and D3 of this audit report were issued on 20th and 22nd October 2015 in response to this additional information and identified that some queries remained.

2.8. Revision 5 of the BSMS was provided by email to CampbellReith on 23 October 2015. Further information was received, covering ground movement assessment and heave protection on 30th October and 10th November 2015. Following further telephone and email correspondence, a clarification was issue by Croft Structural Engineers on 12th November 2015. This further information is discussed in the following sections and presented in Appendix 3.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	YES	See page 1 of BIA
Is data required by Cl.233 of the GSD presented?	YES	Indicative programme provided by email on 7.9.15 however, suggests 2 days for underpinning.
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	Various maps and plans throughout BIA and appendices
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	YES	See BIA table 4, Section 10.1
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	YES	See BIA table 4, Section 10.1
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	YES	See BIA table 4, Section 10.1
Is a conceptual model presented?	YES	Not referred to as a Conceptual Model, however, detailed Site Description (section 2.1), Ground Conditions (Section 12.2) and Site Settings (Section 13.2) are provided.

Item	Yes/No/NA	Comment
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	YES	See BIA table 5, Section 10.2
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	YES	See BIA table 5, Section 10.2
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	YES	See BIA table 5, Section 10.2
Is factual ground investigation data provided?	YES	See BIA Section 12 and Appendix C
Is monitoring data presented?	YES	See BIA Section 12.5
Is the ground investigation informed by a desk study?	YES	See BIA Section 13.1
Has a site walkover been undertaken?	YES	Stated in BIA Section 13.1
Is the presence/absence of adjacent or nearby basements confirmed?	NO	Not confirmed. Refer to BIA Section 13.8. Not considered significant in light of absence of significant subterranean flows.
Is a geotechnical interpretation presented?	YES	See BIA Section 12
Does the geotechnical interpretation include information on retaining wall design?	YES	See BIA Section 13.6
Are reports on other investigations required by screening and scoping presented?	YES	See BIA Section 11 and 12, and Appendix C and D for FRA and GI.
Are baseline conditions described, based on the GSD?	YES	See BIA Table 4
Do the base line conditions consider adjacent or nearby basements?	YES	See BIA Table 4, although further investigation required.

Item	Yes/No/NA	Comment
Is an Impact Assessment provided?	YES	See BIA Section 13
Are estimates of ground movement and structural impact presented?	YES	See Section 1 of the 'Basement Structural Method Statement', however methodology not clear.
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	YES	See BIA Section 13
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	YES	See BIA Table 5
Has the need for monitoring during construction been considered?	YES	See Section 1 of the 'Basement Structural Method Statement'
Have the residual (after mitigation) impacts been clearly identified?	YES	See BIA Section 10.2
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	YES	See Section 1 of the 'Basement Structural Method Statement' and responses to the Audit Query Tracker.
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	YES	Attenuation and grey water recycling proposed to minimise additional run-off to public sewer. This will require agreement with Thames Water.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	YES	Ground Movement Assessment provided following issue of the Audit Query Tracker. Basement slab to be suspended to accommodate heave.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	YES	Ground movement and building damage assessment provided by Bennett Ashton on 9.11.15.
Are non-technical summaries provided?	YES	Overall summary provided on page 2 of the BIA.

4.0 DISCUSSION

4.1. The Basement Impact Assessment (BIA) has been carried out by engineering geologists, Ashton Bennett, and the individuals concerned in its production have suitable qualifications.

4.2. The Basement Structural Method Statement (BSMS) has been carried out by engineering consultants, Croft Structural Engineers. The reviewer is a chartered structural engineer. No evidence is provided that the structural assessment has been made in conjunction with a Chartered Geologist (as required in CPG4), however, the report lists that they have extensive experience in completing 120 basements in the last 4 years.

4.3. The LBC Instruction to proceed with the audit identified that there are no listed buildings present and the BIA agrees with this statement.

4.4. The proposed works include lowering an existing undercroft to form a basement under the entire footprint of the building. This basement will also extend to the rear of the property. A new lightwell will form a separate entrance at the front. It is proposed to excavate approximately 1.5m to form a 2.5m deep basement space.

4.5. The BIA has identified the basement (and associated underpins) will extend into the London Clay Formation. The Ground Investigation confirms that the depth of Made Ground is relatively shallow at 0.20-0.80m, beneath which is London Clay of increasing strength.

4.6. The BSMS discusses the underpinning construction sequence. This sequence is described in detail with mention of maximum dimensions for underpins that can be carried out in each dig as well as timescales between pours. Sequence of underpinning drawings are also provided. Structural analysis has been carried out to confirm reinforcement of pins and propping positions. Despite numerous references in the BSMS and programme to constructing cantilevered underpins, CSE have stated that they will be propped in the temporary case. CSE's analysis makes suitable assumptions on loading including hydrostatic pressures from the water table rising.

4.7. It is noted that the Ground Investigation suggests maximum allowable bearing pressures should be assumed to be 70-112kN/m^2. However, the BSMS uses a value of 120kN/m^2. As reported previously, Ashton Bennet confirmed by email on 7 September 2015 that this was acceptable.

4.8. The design of the basement has been checked for overall buoyancy of the structure during peak groundwater levels. This concludes that the structure is not buoyant.

4.9. Groundwater was encountered in the boreholes, although, this was later confirmed through testing, to be foul water. It is suggested, in the BIA, that this is from damaged or leaking foul drainage runs in the local vicinity of the site. These are to be repaired as part of the construction works. We accept this is a sensible assumption and solution.

4.10. Although groundwater is not expected to be encountered during excavation, provision for sump pumping has been suggested and the BIA states that any softened materials should be removed. The design of the underpin retaining walls has allowed for worst case water levels at ground level. The basement is to be tanked to account for any water that penetrates through the underpin retaining wall.

4.11. An updated assessment of expected movement to adjacent properties was provided by Ashton Bennett on 10 November 2015 and has classified anticipated damage as Category of Damage 1 (see Appendix 3). This supersedes the damage assessment provided in the BSMS Rev 5. It is stated in the BIA that minor repairs to hairline cracks to neighbouring properties will be carried out where required. No assessment has been made of the settlement of the underpins, however, this is considered unlikely to alter the predicted damage category.

4.12. It is noted that the current adjacent foundations are unknown, and it is recommended that further investigation is undertaken to confirm foundations depths in this area. However, the assumption of the absence of a basement is conservative with respect to the building damage assessment.

4.13. No proposals were provided for a movement monitoring strategy during excavation and construction in the original BIA. Revision 4 of the BSMS contains an indicative monitoring regime. This will have to be developed further to include trigger levels and mitigation measures and agreed as part of the Party Wall awards.

4.14. It is accepted that there are no slope stability concerns regarding the proposed development.

4.15. A calculation of slab uplift was provided by CSE with subsequent clarifications. The calculations show a requirement for heave protection below the slab. It should be noted that whilst CSE drawing 141002 SL-10 Rev 3 shows a suspended slab with heave protection, the BSMS itself refers to a ground bearing slab. The provision of heave protection requires the basement slab to be capable of transferring uplift forces to the basement retaining walls either side. This will need to be carried through to detail design.

4.16. An indicative programme was provided which is presented in Appendix 3. It should be noted that it also refers to a cantilevered wall.

5.0 CONCLUSIONS

5.1. The BIA and BSMS have been carried out by engineering consultants using individuals who possess suitable qualifications, other than the authors of the BSMS not identifying suitable expertise in engineering geology.

5.2. The BIA has confirmed that the proposed basement will be founded within the London Clay. It has been confirmed that the bearing strata has an adequate bearing capacity.

5.3. It is unlikely that the groundwater table will be encountered during basement foundation excavation. However, proposals for the removal of water from the excavation during construction are provided.

5.4. It is recommended that further investigation of the neighbouring foundations is carried out as noted in the BIA.

5.5. There are numerous references in the BSMS and programme to the retaining walls being cantilevered and propping is not described in the Basement Sequencing. CSE have stated that underpins will be propped in the temporary case as shown in the structural calculations. However, in view of the discrepancy in the supplied information, it is recommended that the details of the temporary and permanent works are confirmed in a Basement Construction Plan.

5.6. Outline proposals are provided for a movement monitoring strategy during excavation and construction have been provided with a proposal to record conditions before and after construction. Monitoring is recommended. The outline proposals will have to be developed and agreed with the Party Wall Surveyor.

5.7. Further investigation should be undertaken to identify the cause (location of damaged drainage runs) of the foul water encountered in the bore holes. It is proposed that the drainage runs will be repaved.

5.8. An outline Construction Programme was provided, although it should be noted that it refers to a cantilevered wall.

5.9. It is that there will be no additional surface water run-off to the public sewer, in which case the development will not impact on the wider hydrology and hydrogeology of the area.

5.10. Earlier audits queried whether heave pressures on the proposed ground bearing slab had been considered and a slab uplift calculation was presented by CSE which showed a requirement for heave protection below the slab. Drawing 141002 SL-10 Revision 3 in Revision 5 of the BSMS shows suspended slab with heave protection placed beneath, although it should be noted that the text still refers to a ground bearing slab. Due to this discrepancy, it is recommended that the design of the slab is confirmed in a Basement Construction Plan.

5.11. The ground movement and building damage assessment was resubmitted in order to close out a query raised by the audit so that the assessment within the BSMS Revision 5 is superseded. It is accepted that predicted damage to neighbouring structures should not exceed Burland Category 1 provided they are in sound condition and there is good control of membership.

5.12. It is accepted that the surrounding slopes to the development site are stable.

Appendix 1: Resident's Consultation Comments

Residents' Consultation Comments

Surname	Address	Date	Issue raised	Response
Nasser	233 Goldhurst Terrace, NW6 3EP	07/06/15	The actual plans and outline are fine with me provided we negotiate a party wall agreement with the Zur-Spiros. In addition I would like to see more details of the construction plan, how long it will take and environmental impact during construction. We have a new baby on the way and we would want to make sure that safeguards are put in place to reduce noise, dust etc etc. Knowing the Zur-Spiros personally and therefore knowing they are responsible and good neighbours we believe they will keep inconvenience to a minimum but would still like to see the timeline etc etc.	A construction Sequence is provided in the 'Basement Structural Method Statement', however, there does not appear to be an indication of time scales or Construction Programme dates. We note that the method of construction is underpinning which, although generally has a longer construction phase, will be less noise intrusive than other methods such as piling. The request to provide a Construction Programme has been added to the Audit Query Tracker in Appendix 2.

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status/Response	Date closed out
1	Stability	The ground investigation has suggested maximum bearing capacities at the level of the basement of 70-112kN/m^2. The Basement Structural Method Statement has used 120kN/m^2. Please confirm why a higher value has been used.	Clarification and confirmation provided by email (see Appendix 3).	07/09/15
2	Stability	Construction Programme required.	Indicative programme provided by email although it indicated 8 days to complete underpinning.	16/09/15
3	Stability	Depth and type of adjacent foundations to be confirmed.	It is accepted that the approach is conservative and appropriate.	16/09/15
4	Stability	The Ground Investigation has identified the need for heave protection below the basement slab. This is not covered in the design of the basement.	Closed, however, the calculations show a requirement of monolithic behaviour between the slab and the basement walls, to resist heave. This will need to be considered during detailed design.	10/11/15
5	Stability	Movement Assessment to be reviewed and re-issued for comment. See Section 4.13 of this report.	Closed	10/11/15
6	Surface Flow and Flooding	Agreement required from Thames Water in order to discharge additional run off to the public sewer.	Confirmed by Ashton Bennett on 7 September that no additional flows to network.	07/09/15
7	Stability	Discrepancies exist within the BSMS with respect to temporary works and the design of the basement slab.	Detailed design of temporary and permanent works and basement slab to be provided in Basement Construction Plan.	N/A

Appendix 3: Supplementary Supporting Documents

Job Number: 141002
27th October 2014

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Basement Structural Method Statement – Structural Calculations & drawings

231 Goldhurst Terrace
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Structural Design Reviewed by
Chris Tomlin
MEng CEng MIStructE

Revision	Date	Comment
-	27/10/14	First Issue
1	05/11/14	Minor alterations to structural drawings
2	17/11/14	Designer's reference added
3	02/09/15	Monitoring added
4	16/09/15	Minor alterations to Audit comments
5	21/10/15	Minor alterations to ground movement calculations

Table of Contents

1. Design Information - Structural

Structural Summary

231 Goldhurst Terrace is a single occupancy Victorian Property Located in the borough of Camden. The structure of the property is load bearing masonry external walls, internal load bearing masonry walls on the ground floor and masonry & stud walls on the first floor. Timber floors on each floor and timber roof.

Figure 1: 231 Goldhurst Terrace: Front

Proposed works

The proposed works require the insertion of a new basement under the property.

Croft Structural Engineers Ltd Structural Engineers has extensive knowledge of inserting new basements. Over the last 4 years we have completed over 150 basements in and around the local area. The method developed is:

1. Excavate front to allow for conveyor to be inserted.

2. Form lightwell with cantilevered retaining walls

3. Slowly work from the front to the rear inserting 1200 long

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	cantilevered retaining walls sequentially. 4. Cast ground slab 5. Waterproof internal space with a drained cavity system. **Structural Defects Noted** No defects were noted during the Chartered Engineers first visit.
Progressive Collapse	Family/domestic use

	UDL kN/m^2	Concentrated Loads kN
Domestic Single Dwellings	1.5	1.4

4

Is Live Load Reduction included in design No

Reinforced concrete cantilevered retaining walls

The designs for the retaining walls have been calculated using Finite element software TEDDS. The software is specifically designed for retaining walls and ensures the design is kept to a limit to prevent damage to the adjacent property.

Results can be found in appendix B.

The overall stability of the walls are design using K_a & K_p values, while the design of the wall uses K_o values. This approach minimise the level of movement from the concrete affecting the adjacent properties.

The Investigations have highlight that water is a present. The walls are designed to cope with the hydrostatic pressure. The water table was low. The design of the walls however considers the long term items. It is possible that a water main may break causing local high water table. To account for this the wall is designed for water 1m from the top of the wall.

The Design also considers floatation as a risk. The design of has considered the weight of the building and the uplift forces from the water. The weight of the building is greater than the uplift resulting in a stable structure.

The building does not undermine the highway, but car parking is present

	to the front of the property. It is possible for heavier goods vehicles to reverse on to the property to allow for this risk loadings are to be taken from the Highways loading code. 5kN/m² to front light well Garden Surcharge 2.5kN/m² Surcharge for adjacent property 1.5kN/m² + 4kN/m² for concrete ground bearing slab
Is the Building Multi Occupancy? Lateral Stability	No EN 1991-1-7:1996 Table A1 Class 1 — Single occupancy houses not exceeding 4 storeys Class1 – Design to satisfy EN 1990 to EN 1999 stability requirements
Exposure and wind loading conditions	Basic wind speed Vb = 21 m/s to EC1-2 Site level +75.000 m above sea level. Topography not considered significant.
Stability Design	The cantilevered walls are suitable to carry the lateral loading applied from above
Lateral Actions	The soil loads apply a lateral load on the retaining walls. Hydrostatic pressure will be applied to the wall Imposed loading will surcharge the wall.

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<table>
<tr><td>Adjacent Properties</td><td>

Any ground works pose an elevated risk to adjacent properties. The proposed works undermines the adjacent property along the party wall line:

The party wall is to be underpinned. Underpinning the party wall will remove the risk of the movement to the adjacent property.

The works must be carried out in accordance with the party wall act and condition surveys will be necessary at the beginning and end of the works.

The method statement provided at the end of this report has been formulated with our experience of over 120 basements completed without error.

The design of the retaining walls is completed to K_O lateral design stress values. This increases the design stresses on the concrete retaining walls and limits the overall deflection of the retaining wall.

It is not expected that any cracking will occurring during the works. However our experience informs us that there is a risk of movement to the neighbours.

To reduce the risk the development:

- Employ a reputable firm for extensive knowledge of basement works.
- Employ suitably qualified consultants. Croft Structural engineer has completed over 120 basements in the last 4 years.
- Design the underpins to the stable without the need for elaborate temporary propping or needing the floor slab to be present.
- Provide method statements for the contractors to follow
- Investigate the ground, now completed.
- Record and monitor the external properties. This is completed by a condition survey on under the Party Wall Act before and after the works are completed. See end of method statement.
- Allow for unforeseen ground conditions: Loose ground is always a concern. The method statement and drawings show the use of precast lintels to areas of soft ground; this follows the guidance by the underpinning association.

</td></tr>
</table>

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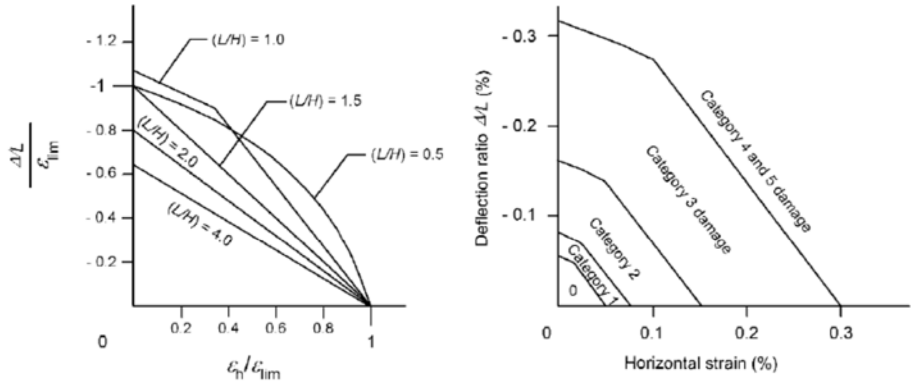
With the above the maximum level of cracking anticipated is Hairline cracking which can be repaired with decorative cracking and can be repaired with decorative repairs. Under the party wall Act damage is allowed (although unwanted) to occur to a neighbouring property as long as repairs are suitability undertaken to rectify this. To mitigate this risk The Party Wall Act is to be followed and a Party Wall Surveyor will be appointed.



(b) Influence of horizontal strain on Δ/L / ε_{lim} (after Burland, 2001)

(c) Relationship between damage category and deflection ratio and horizontal tensile strain for hogging for (L/H) = 1.0 (after Burland, 2001)

Extract from The Institution of Structural Engineers "Subsidence of Low-Rise Buildings"

Table 6.2 Classification of visible damage to walls with particular reference to type of repair, and rectification consideration

Category of Damage	Approximate crack width	Limiting Tensile strain	Definitions of cracks and repair types/considerations
0	**Up to 0.1**	0.0-0.05	**HAIRLINE – Internally cracks can be filled or covered by wall covering, and redecorated. Externally, cracks rarely visible and remedial works rarely justified.**
1	0.2 to 2	0.05-0.075	FINE – Internally cracks can be filled or covered by wall covering, and redecorated. Externally, cracks may be visible, sometimes repairs required for weather tightness or aesthetics. NOTE: Plaster cracks may, in time, become visible again if not covered by a wall covering.
2	2 to 5	0.075-0.015	MODERATE – Internal cracks are likely to need raking out and repairing to a recognised specification. May need to be chopped back, and repaired with expanded metal/plaster, then redecorated. The crack will inevitably become visible again in time if these measures are not carried out. External cracks will require raking out and repointing, cracked bricks may require replacement.

3	5 to 15	0.15-0.3	SERIOUS – Internal cracks repaired as for MODERATE, plus perhaps reconstruction if seriously cracked. Rebonding will be required. External cracks may require reconstruction perhaps of panels of brickwork. Alternatively, specialist resin bonding techniques may need to be employed and/or joint reinforcement.
4	15 to 25	>0.3	SEVERE Major reconstruction works to both internal and external wall skins are likely to be required. Realignment of windows and doors may be necessary.
5	Greater than 25		VERY SEVERE –Major reconstruction works, plus possibly structural lifting or sectional demolition and rebuild may need to be considered. Replacement of windows and doors, plus other structural elements, possibly necessary. NOTE – Building & CDM Regulations will probably apply to this category of work, see sections 10.4, 10.6 and Appendix F.

Monitoring

Monitoring - In order to safeguard the existing structures during underpinning and new basement construction movement monitoring is to be undertaken.

Monitoring Level proposed	Type of Works.
Monitoring 1 Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works.	Loft conversions, cross wall removals, insertion of padstones Survey of LUL and Network Rail tunnels. Mass concrete, reinforced and Piled foundations to new build properties
Monitoring 2 Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate.	Removal of lateral stability and insertion of new stability fames Removal of main masonry load bearing walls. Underpinning works less than 1.2m deep
Monitoring 3 Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works. Visual inspection of existing party wall during the works. Inspection of the footing to ensure that the footings are stable and adequate. Vertical monitoring movement by standard optical equipment	Lowering of existing basement and cellars more than 2.5m Underpinning works less than 3.0m deep in clays Basements up to 2.5m deep in clays

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Risk Assessment

Monitoring 4

Visual inspection and production of condition survey by Party wall surveyors at the beginning of the works and also at the end of the works.

Visual inspection of existing party wall during the works.

Inspection of the footing to ensure that the footings are stable and adequate.

Vertical monitoring movement by standard optical equipment

Lateral movement between walls by laser measurements

New basements greater than 2.5m and shallower than 4m Deep in gravels

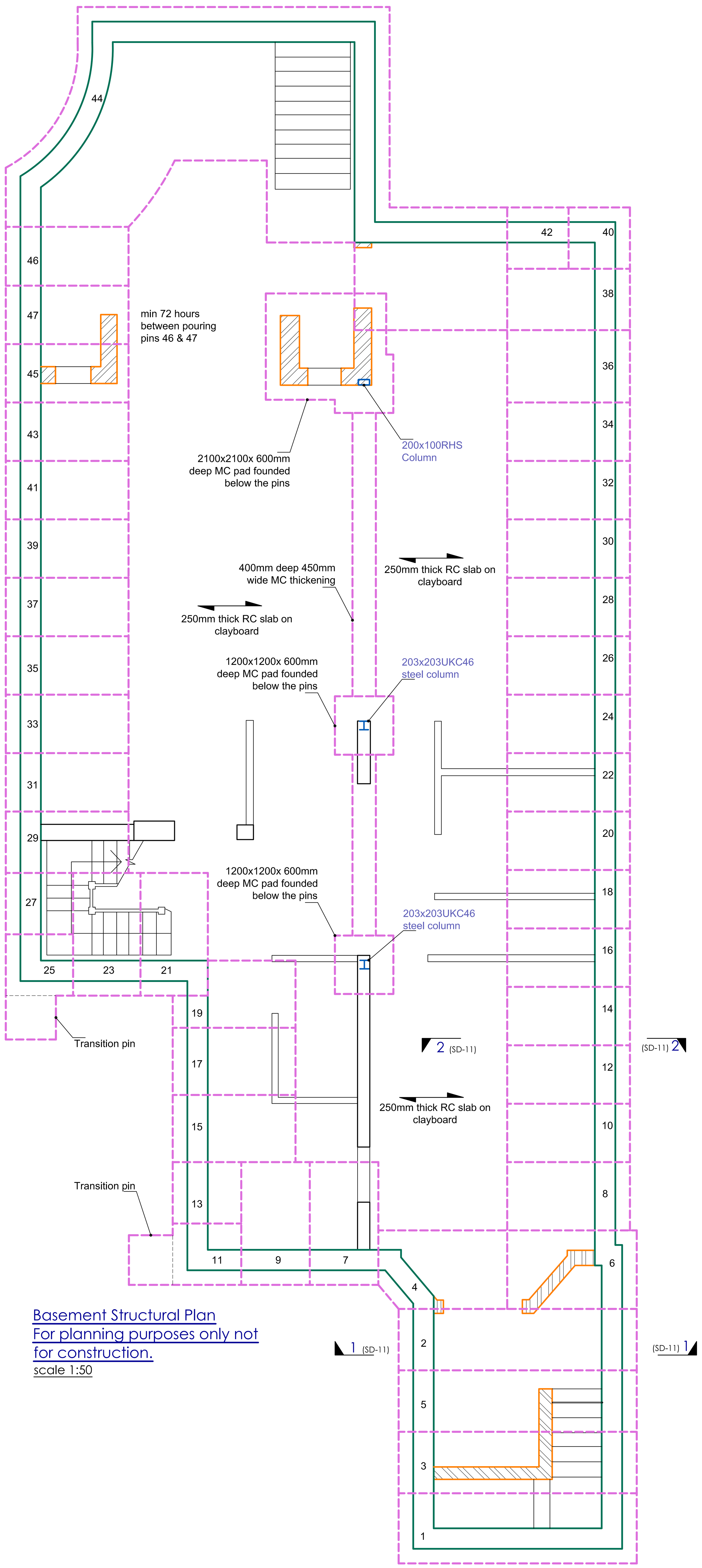
Basements up to 4.5m deep in clays

Underpinning works to grade I listed building

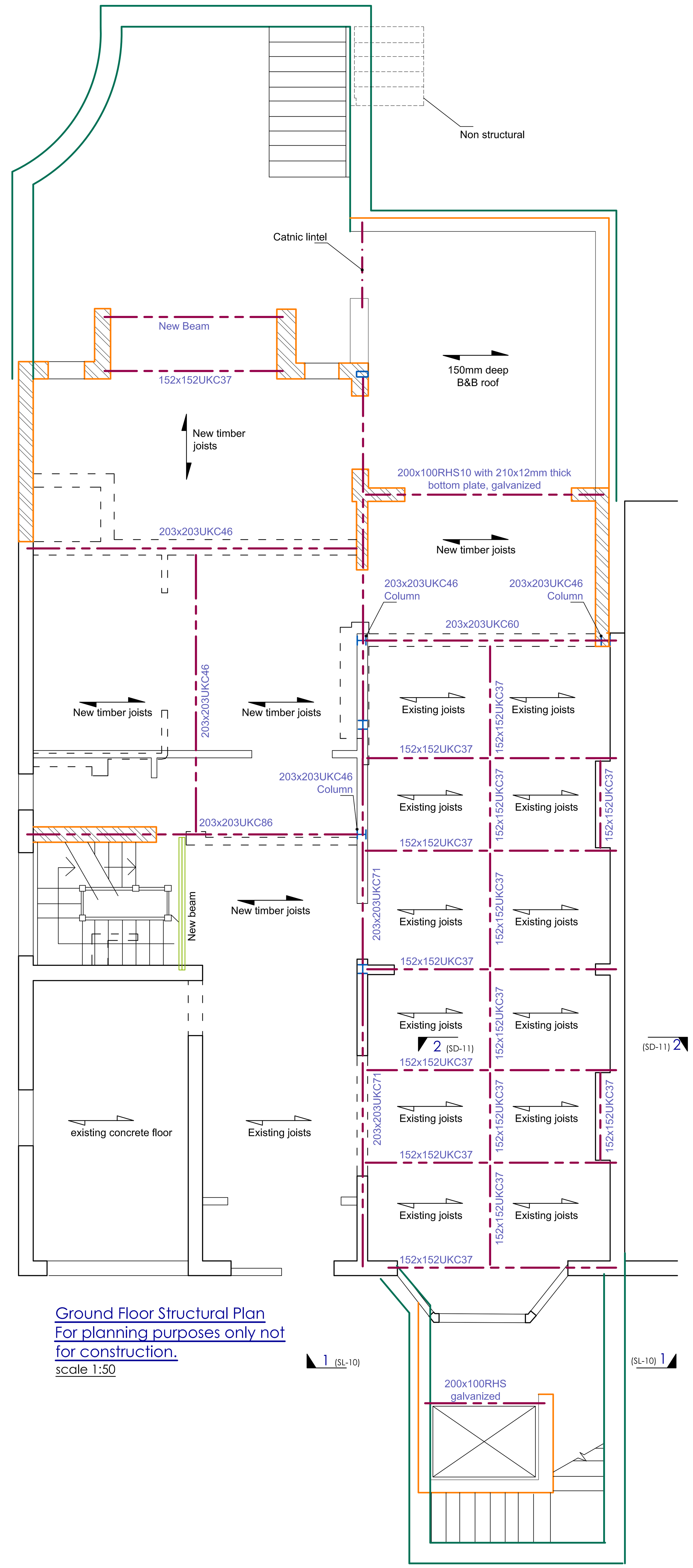
Appendix A

Structural Scheme Drawings

This information is provided for Planning use only and is not to be used for Building control submissions



Basement Structural Plan
For planning purposes only not for construction.
scale 1:50



Ground Floor Structural Plan
For planning purposes only not for construction.
scale 1:50

For Planning Purposes only not for construction

Rev	Date	Amendments
3	21/10/15	Minor alteration to plans
2	05/11/14	Minor alteration to ground floor plan
1	04/11/14	Altered to architect's drawings.
-	27/10/14	First issue for comment

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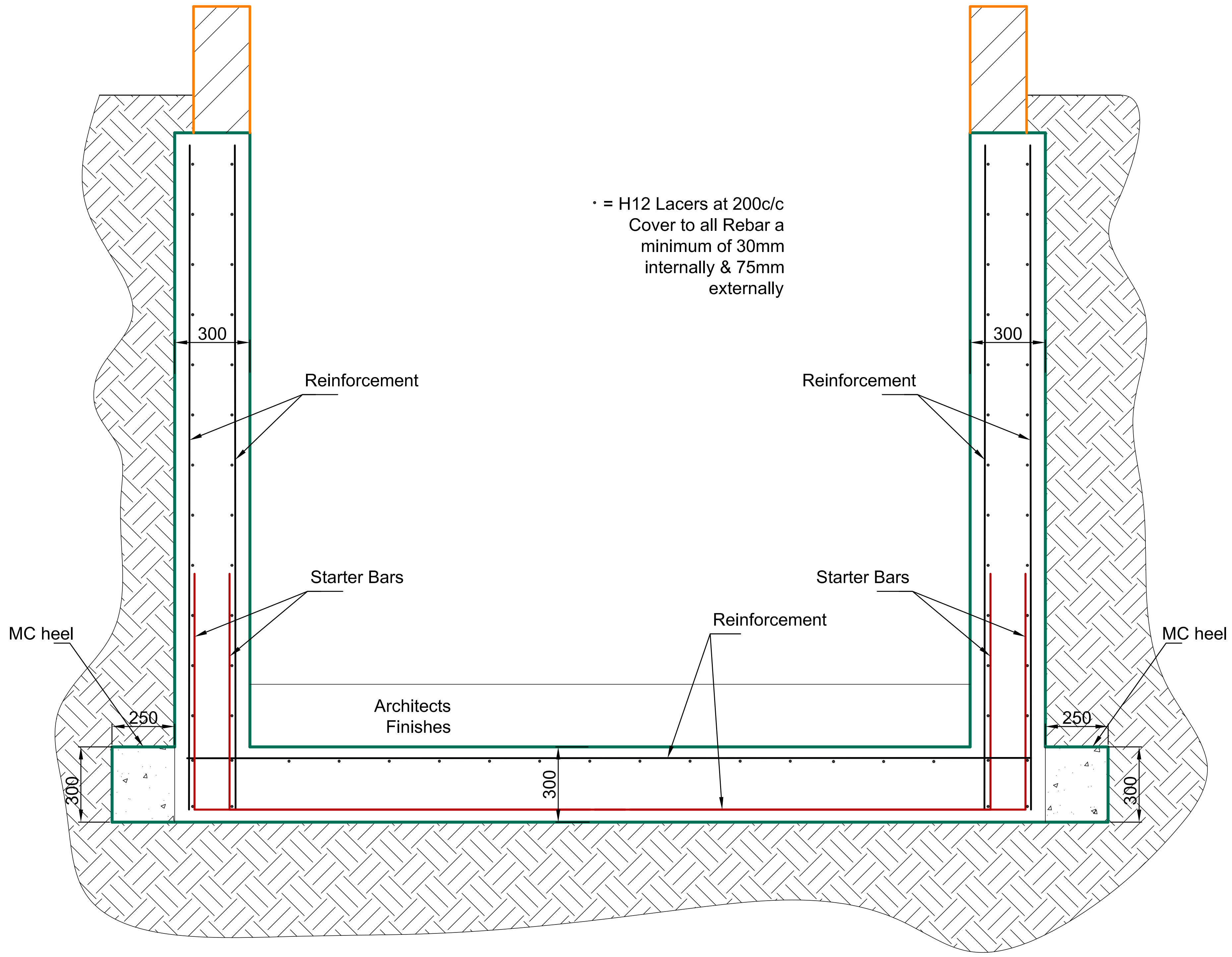
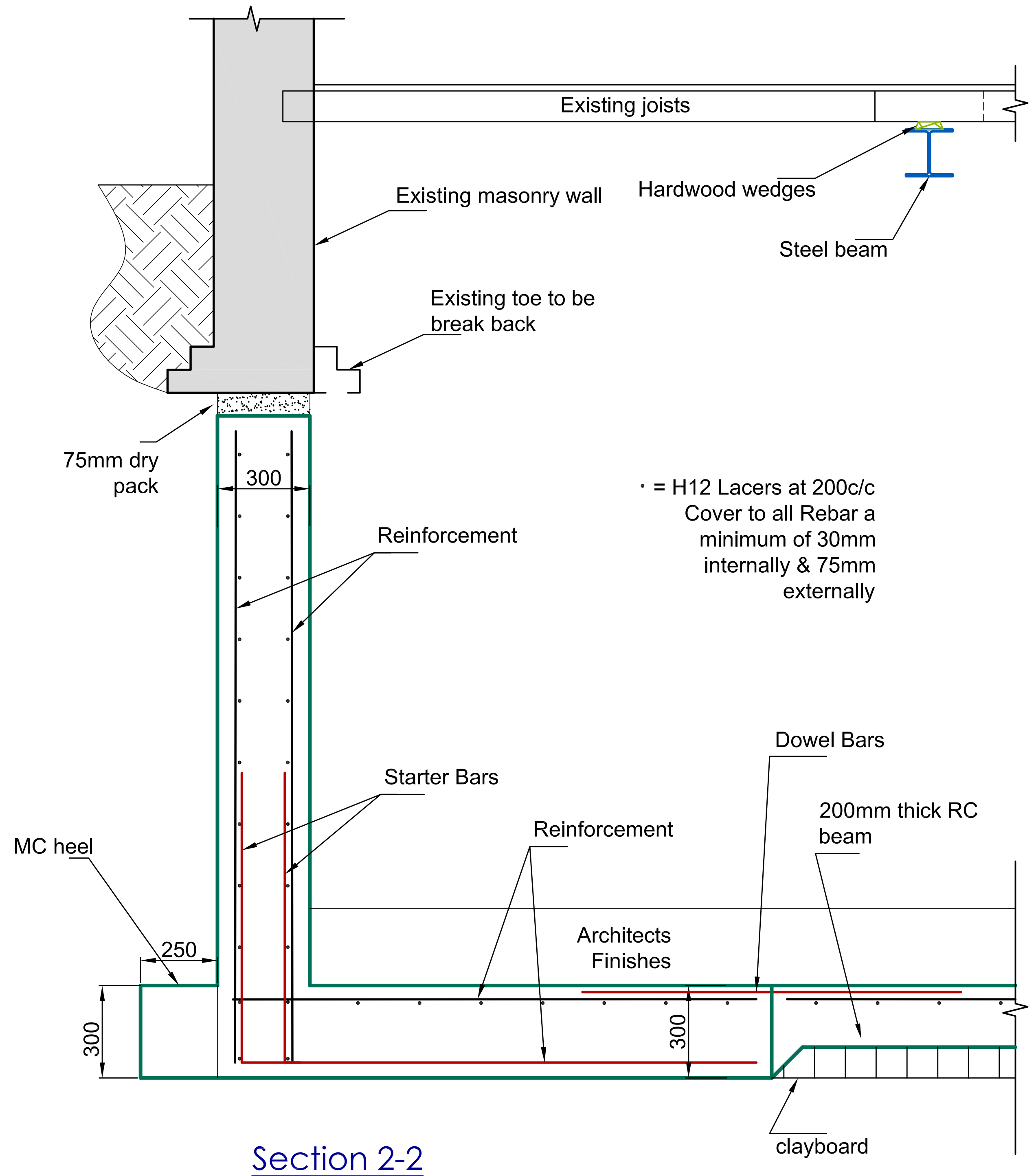
Client: Francis Bennett
Project: 231 Goldhurst Terrace
Title : Basement and ground floor Plans

Job nos	drawn	Scale
141002	pr	1:50 (u.n.o.)
	Chk'd CT	
Dwg Nos	Rev	date
SL-10	3	OCT 14



Section 1-1
For planning purposes only,
not for construction
scale 1:20



Section 2-2
For planning purposes only,
not for construction
scale 1:20

For Planning Purposes only not for construction

Rev	Date	Amendments
1	05/11/14	Section 2-2 altered
-	27/10/14	First Issue for comments

Client: Francis Bennett
Project: 231 Goldhurst Terrace
Title : Structural Sections 1-1 & 2-2

Job nos: 141002	date: Oct 14
Dwg Nos: SD-11	Rev: 1
drawn: pr	Ch'kd: CT
Scale: 1:50 @ A2	

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Appendix B

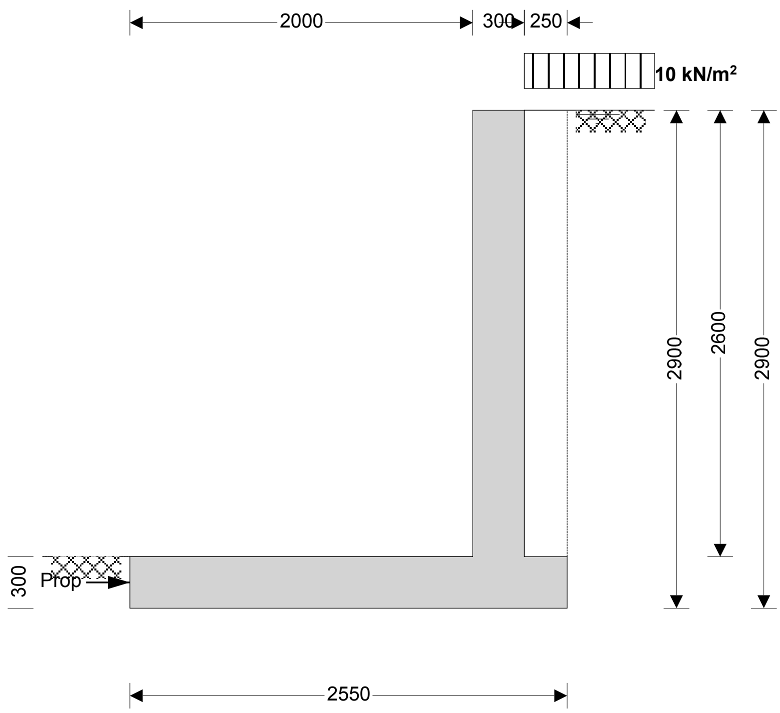
Structural Basement Calculations

This information is provided for Planning use only and is not to be used for Building control submissions

RC retaining wall 1 design

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **2600** mm	Wall stem thickness	t_{wall} = **300** mm
Length of toe	l_{toe} = **2000** mm	Length of heel	l_{heel} = **250** mm
Overall length of base	l_{base} = **2550** mm	Base thickness	t_{base} = **300** mm
Height of retaining wall	h_{wall} = **2900** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **300** mm
Position of downstand	l_{ds} = **1650** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **0** mm
Height of ground water	h_{water} = **2900** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **2900** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **0.0** deg
Design shear strength	ϕ'_b = **24.2** deg	Design base friction	δ_b = **18.6** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **120** kN/m^2

Using Coulomb theory

Active pressure	K_a =**0.419**	Passive pressure	K_p = **4.187**
At-rest pressure	K_0 = **0.590**		

Loading details

Surcharge load	Surcharge = **10.0** kN/m^2		
Vertical dead load	W_{dead} = **0.0** kN/m	Vertical live load	W_{live} = **0.0** kN/m

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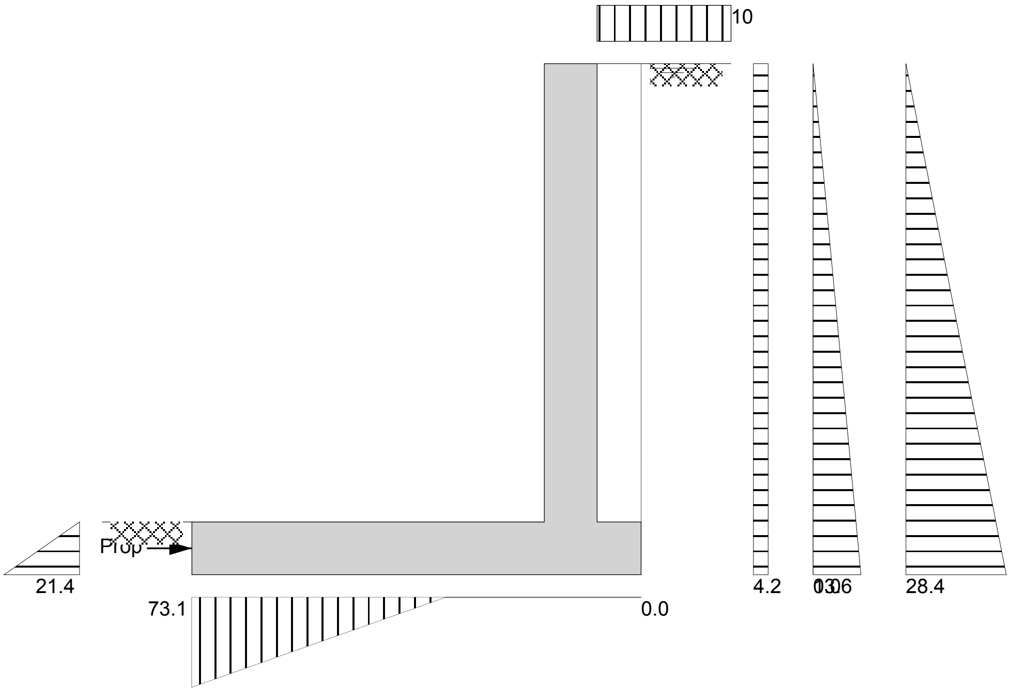
Horizontal dead load	F_{dead} = **0.0** kN/m	Horizontal live load	F_{live} = **0.0** kN/m
Position of vertical load	l_{load} = **0** mm	Height of horizontal load	h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force F_{prop} = **53.0** kN/m

Check bearing pressure

Total vertical reaction	R = **52.6** kN/m	Distance to reaction	x_{bar} = **480** mm
Eccentricity of reaction	e = **795** mm		

Reaction acts outside middle third of base

Bearing pressure at toe	p_{toe} = **73.1** kN/m²	Bearing pressure at heel	p_{heel} = **0.0** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor	γ_{f_d} = **1.4**	Live load factor	γ_{f_l} = **1.6**
Earth pressure factor	γ_{f_e} = **1.4**		

Calculate propping force

Propping force F_{prop} = **53.0** kN/m

Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete	f_{cu} = **35** N/mm²	Strength of reinforcement	f_y = **500** N/mm²

Base details

Minimum reinforcement	k = **0.13** %	Cover in toe	c_{toe} = **50** mm

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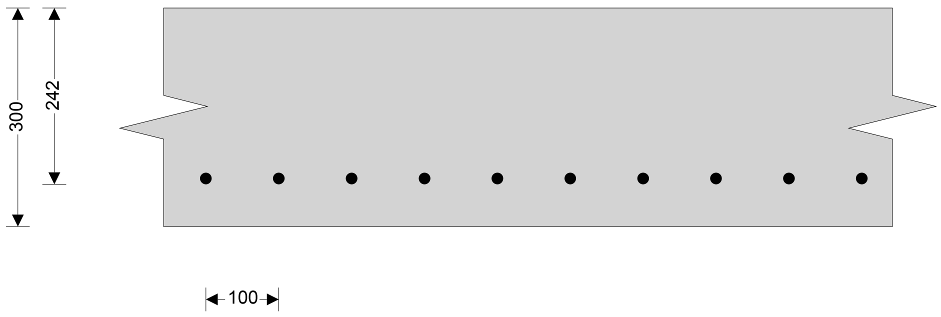


Design of retaining wall toe

Shear at heel V_{toe} = **54.3** kN/m Moment at heel M_{toe} = **126.0** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 100 mm centres**

Area required $A_{s\_toe\_req}$ = **1291.7** mm^2/m Area provided $A_{s\_toe\_prov}$ = **2011** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.225** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.754** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

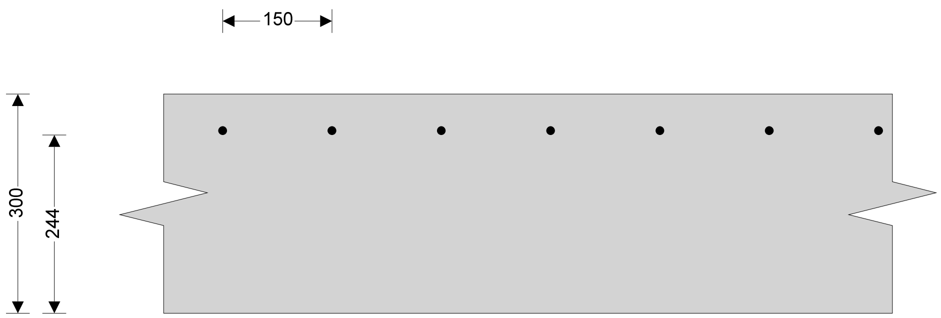
Design of reinforced concrete retaining wall heel (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in heel c_{heel} = **50** mm



Design of retaining wall heel

Shear at heel V_{heel} = **25.6** kN/m Moment at heel M_{heel} = **7.1** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **12 mm dia.bars @ 150 mm centres**

Area required $A_{s\_heel\_req}$ = **390.0** mm^2/m Area provided $A_{s\_heel\_prov}$ = **754** mm^2/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.105** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.541** N/mm^2

v_{heel} < v_{c_heel} - No shear reinforcement required

Design of reinforced concrete retaining wall stem (BS 8002:1994)

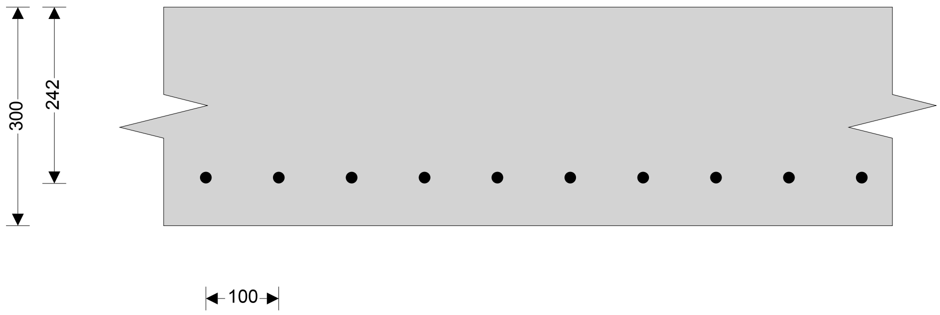
Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Wall details

Minimum reinforcement k = **0.13** %

Cover in stem c_{stem} = **50** mm Cover in wall c_{wall} = **50** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **6.3** kN/m Moment at base of stem M_{stem} = **102.9** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 100 mm centres**

Area required $A_{s\_stem\_req}$ = **1039.1** mm²/m Area provided $A_{s\_stem\_prov}$ = **2011** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.026** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.754** N/mm²

v_{stem} < v_{c_stem} - No shear reinforcement required

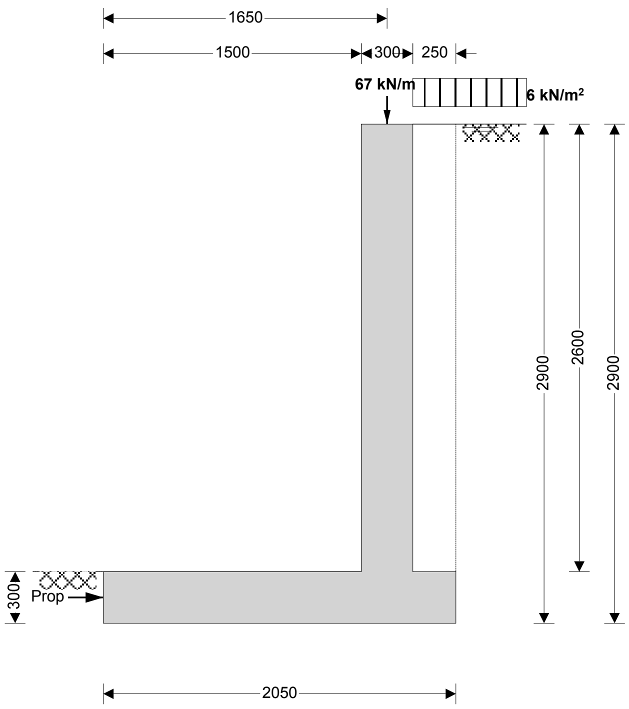
RC retaining wall 2 design

Floor & roof loads doubled to allow for load from neighbouring property.
Loading:

Masonry wall	DLmasonry = 5kN/m^2 × 6.5m = **32.500**kN/m
Timber joists (2nd, 1st, ground floor) DL	DLfloor = 3 × 0.7kN/m^2 × 4.1m / 2 × 2 = **8.610**kN/m
Roof Load DL	DLroof = 1.1kN/m^2 × 4.1m / 2 × 2 = **4.510**kN/m
Total Dead Load	DL = DLmasonry + DLfloor + DLroof = **45.620**kN/m
Timber joists (2nd, 1st, ground floor) LL	LLfloor = 3 × 1.5kN/m^2 × 4.1m / 2 × 2 = **18.450**kN/m
Roof Load DL	LLroof = 0.6kN/m^2 × 4.1m / 2 × 2 = **2.460**kN/m
Total Dead Load	LL = LLfloor + LLroof = **20.910**kN/m

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **2600** mm	Wall stem thickness	t_{wall} = **300** mm
Length of toe	l_{toe} = **1500** mm	Length of heel	l_{heel} = **250** mm
Overall length of base	l_{base} = **2050** mm	Base thickness	t_{base} = **300** mm
Height of retaining wall	h_{wall} = **2900** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **300** mm
Position of downstand	l_{ds} = **1650** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **0** mm
Height of ground water	h_{water} = **2900** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **2900** mm

Mobilisation factor — M = **1.5**

Moist density — γ_m = **18.0** kN/m^3; Saturated density — γ_s = **21.0** kN/m^3

Design shear strength — ϕ' = **24.2** deg; Angle of wall friction — δ = **0.0** deg

Design shear strength — ϕ'_b = **24.2** deg; Design base friction — δ_b = **18.6** deg

Moist density — γ_{mb} = **18.0** kN/m^3; Allowable bearing — $P_{bearing}$ = **120** kN/m^2

Using Coulomb theory

Active pressure — K_a =**0.419**; Passive pressure — K_p = **4.187**

At-rest pressure — K_0 = **0.590**

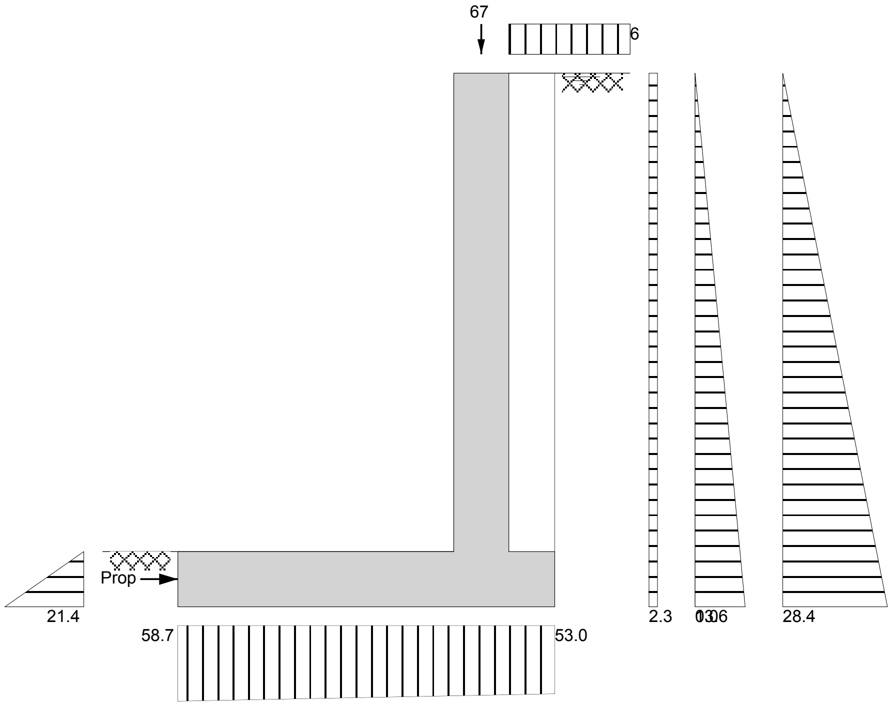
Loading details

Surcharge load — Surcharge = **5.5** kN/m^2

Vertical dead load — W_{dead} = **45.6** kN/m; Vertical live load — W_{live} = **20.9** kN/m

Horizontal dead load — F_{dead} = **0.0** kN/m; Horizontal live load — F_{live} = **0.0** kN/m

Position of vertical load — l_{load} = **1650** mm; Height of horizontal load — h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Calculate propping force

Propping force — F_{prop} = **33.4** kN/m

Check bearing pressure

Total vertical reaction — R = **114.5** kN/m; Distance to reaction — x_{bar} = **1008** mm

Eccentricity of reaction — e = **17** mm

Reaction acts within middle third of base

Bearing pressure at toe — p_{toe} = **58.7** kN/m^2; Bearing pressure at heel — p_{heel} = **53.0** kN/m^2

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor — γ_{f_d} = **1.4**; Live load factor — γ_{f_l} = **1.6**

Earth pressure factor — γ_{f_e} = **1.4**

(Library item: ULS load factors summary)

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Calculate propping force

Propping force F_{prop} = **33.4** kN/m

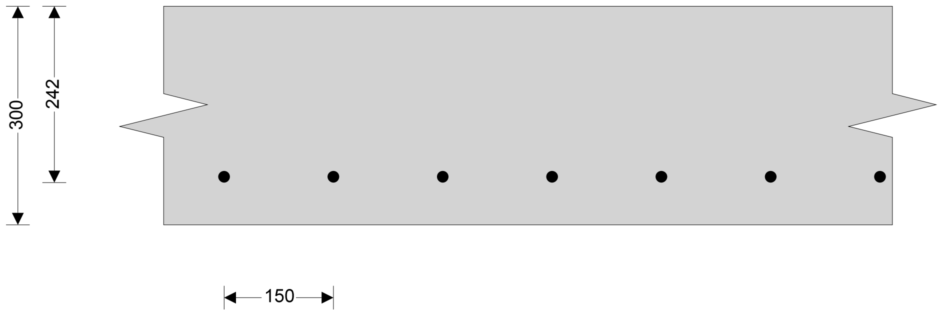
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in toe c_{toe} = **50** mm



Design of retaining wall toe

Shear at heel V_{toe} = **116.7** kN/m Moment at heel M_{toe} = **113.1** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 150 mm centres**

Area required $A_{s\_toe\_req}$ = **1150.0** mm^2/m Area provided $A_{s\_toe\_prov}$ = **1340** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.482** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.658** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

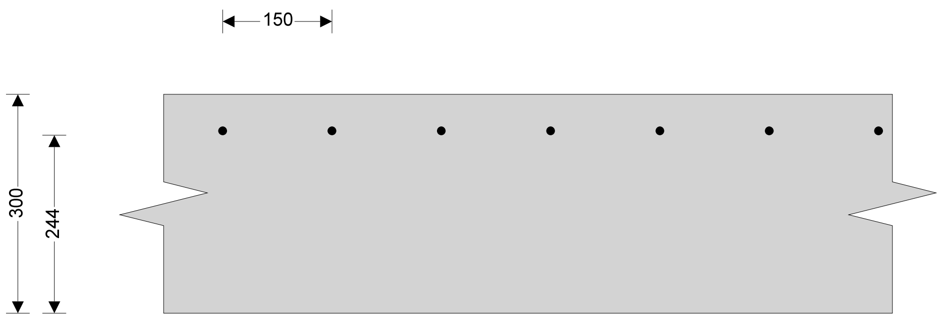
Design of reinforced concrete retaining wall heel (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in heel c_{heel} = **50** mm



Design of retaining wall heel

Shear at heel V_{heel} = **9.7** kN/m Moment at heel M_{heel} = **2.1** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **12 mm dia.bars @ 150 mm centres**

Area required $A_{s\_heel\_req}$ = **390.0** mm²/m Area provided $A_{s\_heel\_prov}$ = **754** mm²/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.040** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.541** N/mm²

$v_{heel} < v_{c\_heel}$ - No shear reinforcement required

Design of reinforced concrete retaining wall stem (BS 8002:1994)

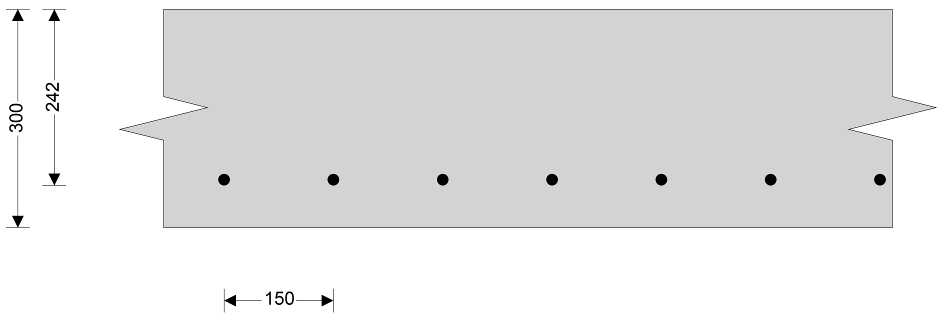
Material properties

Strength of concrete f_{cu} = **35** N/mm² Strength of reinforcement f_y = **500** N/mm²

Wall details

Minimum reinforcement k = **0.13** %

Cover in stem c_{stem} = **50** mm Cover in wall c_{wall} = **50** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **27.4** kN/m Moment at base of stem M_{stem} = **86.9** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 150 mm centres**

Area required $A_{s\_stem\_req}$ = **868.8** mm²/m Area provided $A_{s\_stem\_prov}$ = **1340** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.113** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.658** N/mm²

$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Engineering Information Sheet

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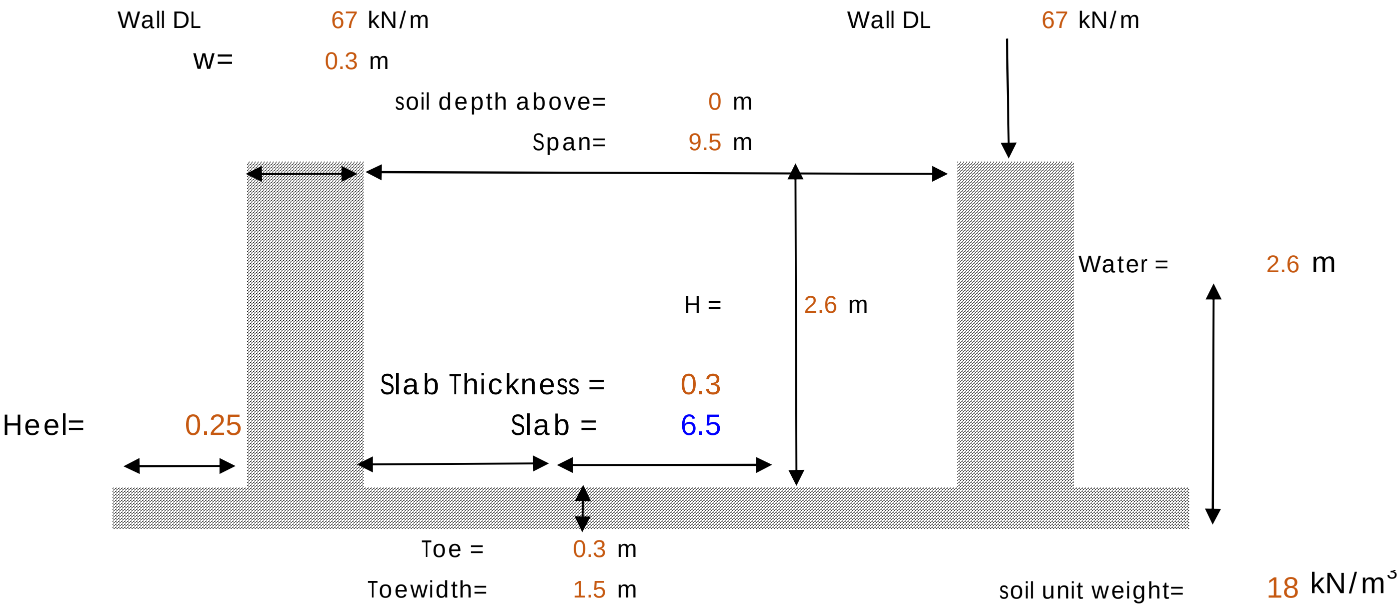
Project: 231 Goldhurst Terrace		Section	Sheet
Date: Oct-15	Rev	Date	Description
By: pr			
Checked			
Job No: 141002	Status		Rev

Ref

Slab Uplift



Uplift Calc

Total Dead Load =

Slab=	48.75 kN/m				
Toe and heel =	30.75 kN/m				
Wall =	39				
Soil=(	5.2 +	5.2) x 2 +	0 =	20.8	5.2
Total Dead load =	273.3 kN/m				

Total Uplift Force= 262.6 kN/m f.o.s.= **1.04 No Global Uplift**

Slab Uplift

Slab = 7.5 kN/m Uplift = 26

Service Moment = -208.703 kNm/m

Factored Design moment= -246.495 kNm/m

Factored Design shear = -103.788 kN/m

Global Heave

Weight of building = 273.3 kN/m

Weight of soil removed = 472.68

% change 42% place 42% of Slab area as heave protection

width of heave protection = 4.26026 m place 4.26 m of Slab area as heave protection

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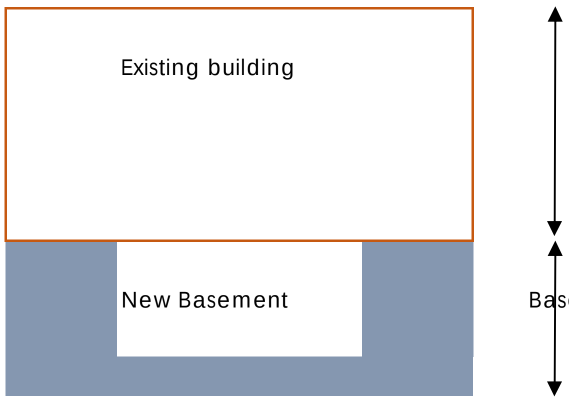
Date Oct-15 / By pr / Checked	Rev / Date / Description	
Job No 141002	Status	Rev

Ref

Movement

Width, L= 10100 mm
of neighbouring building

L/H = 1.44



Height H= 7000 mm

Basement Hb= 2900 mm

Movement Assessment CIRIA C580: Embedded retaining walls - guidance for ecomonic design

Horizontal Surface Movement due to installation of wall = 0.05%

max δ_h = 0.05% x 2900 = 1.45 mm

Distance behind wall wall to neglibible movement (mulitple of wall depth) = 1.5

L = 2900 x 1.5 = 4350 mm

x = 0 x = 4350 mm (distances are measured from underpinned wall)

δ_h = 1.5 mm at x = 0 δ_h = 0.0 mm at x = L ϵ_h 0.0144%

Horizontal Surface Movementdue to excavation = 0.15%

max δ_h = 0.15% x 2900 = 4.35 mm

Distance behind wall wall to neglibible movement (mulitple of wall depth) = 4

L = 2900 x 4 = 11600 mm

x = 0 x = 11600 mm (distances are measured from underpinned wall)

δ_h = 4.4 mm δ_h = 0.6 mm ϵ_h 0.0375%

Total Horizontal Movement Eh 0.0519%

Vertical Surface Movement due to wall installation = 0.05%

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Date Oct-15	Rev Date Description	
By pr		
Checked		
Job No 141002	Status	Rev

Ref

Movement

max δ_v =	0.05%	x	2900	=	1.45	mm
Distance behind wall wall to neglibible movement (mulitple of wall depth)				=	1.5	
L =	2900	x	1.5	=	4350	mm

Vertical Surface Movement due to excavation

max δ_v =	0.05%	x	2900	=	1.45	mm
Distance behind wall wall to neglibible movement (mulitple of wall depth)				=	3.5	
L =	2900	x	3.5	=	10150	mm

Maximum vertical movement 2.9 mm

House Slope at 1m distance from wall 2.614286 mm
Hence deflection at 1m distance from wall 0.285714 mm

By plotting house sloope for full 10150mm distance the maximum deflection calculated is 0.56mm at 6mm distance from wall therefore take 0.56mm for deflection to be conservative

ϵ_h	=	0.0519%	$\epsilon_h/\epsilon_{lim}$	=	0.69
Δ/L	=	0.0055%	$\Delta/L/\epsilon_{lim}$	=	0.07

TOTAL STRAIN (EXCAVATION AND INSTALLATION)

Table 2.5 CIRIA C580

Category of Damage	Normal Degree	Limiting Tensile Strain %		
0	Negligible	0.00%	-	0.05%
1	Very slight	0.05%	-	0.075%
2	Slight	0.075%	-	0.15%
3	Moderate	0.15%	-	0.30%
4 to 5	Severe to Very Servere		>	0.30%

Anticipated Damage May be Categorised as **'Negligible' to 'Very Slight' ; Category 0-1**

ϵ_{lim} = 0.075%

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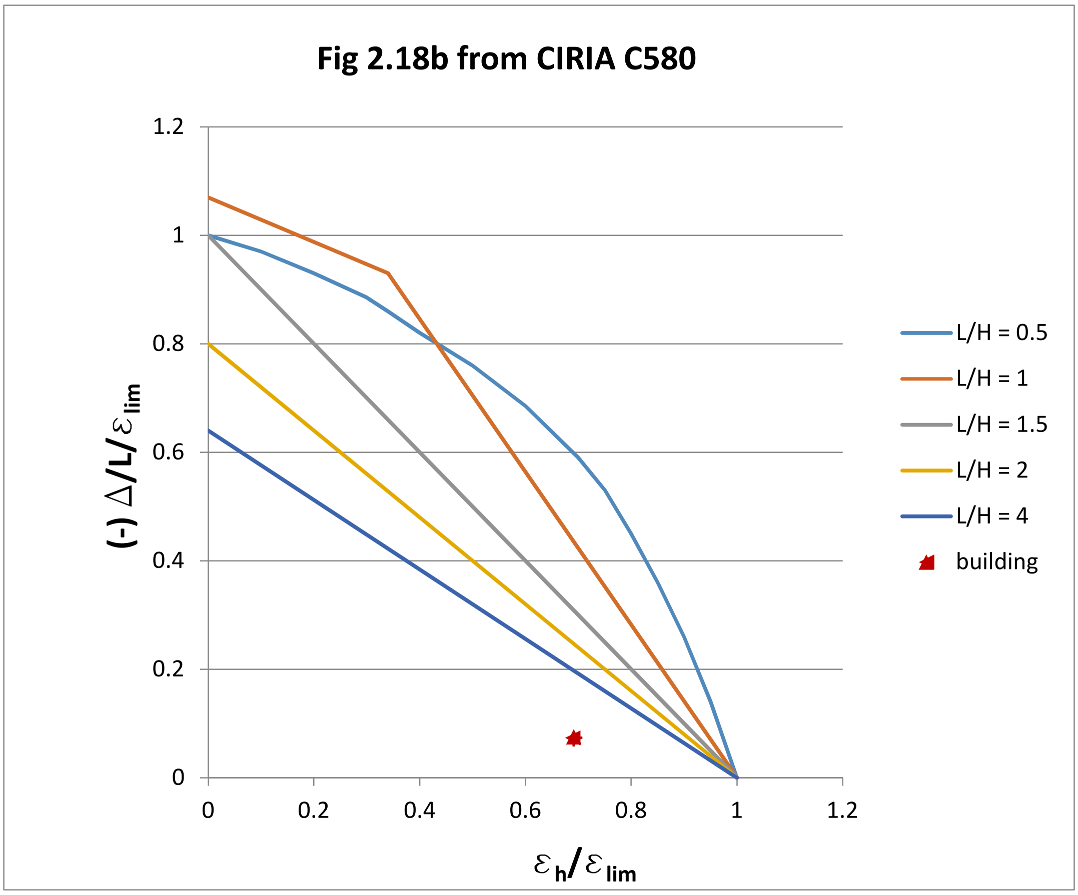
Checked			
Job No	141002	Status	Rev

Ref

Movement



Appendix C

Method Statement

CROFT STRUCTURAL ENGINEERS

231 Goldhurst Terrace

Revision	Date	Comments
-	27/10/14	First Issue for Comment

1. Basement Formation Suggested Method Statement.

1.1. This method statement provides an approach which will allow the basement design to be correctly considered during construction, and the temporary support to be provided during the works. The contractor is responsible for the works on site and the final temporary works methodology and design on this site and any adjacent sites.

1.2. This method statement 231 Goldhurst Terrace has been written by a Chartered Engineer and in accordance with the recommendations stated in the Royal Borough of Kensington and Chelsea Town Planning policy on Subterranean Development & Camden New Basement Development Guidance Notes. The sequencing has been developed considering guidance from ASUC.

1.3. This method has been produced to allow for improved costings and for inclusion in the party wall Award. Should the contractor provide alternative methodology the changes shall be at their own costs, and an Addendum to the Party Wall Award will be required.

1.4. Contact party wall surveyors to inform them of any changes to this method statement.

1.5. The approach followed in this design is; to remove load from above and place loads onto supporting steelwork, then to cast cantilever retaining walls in underpin sections at the new basement level.

1.6. The base benefits from propping, this is provided in the final condition by the ground slab. In the temporary condition the edge of the slab is buttressed against the soil in the middle of the property, also the skin friction between the concrete base and the soil provides further resistance. The central slab is to be poured in a maximum of a 1/3 of the floor area.

1.7. A soil investigation has been undertaken. The soil conditions are London clays.

1.8. The bearing pressures have been limited to 120kN/m^2. This is standard loadings for local ground conditions and acceptable to building control and their approvals.

2. Enabling works

2.1. The site is to be hoarded with ply sheet to 2.2m to prevent unauthorised public access.

2.2. Licenses for Skips and conveyors to be posted on hoarding

3. Basement Sequencing

3.1. Excavate Light well to front of property down to 600mm below external ground level.

3.2. Excavate first front corner of light well. (Follow methodology in section 4)

3.3. Excavate second front corner of light well. (Follow methodology in section 4)

3.4. Continue excavating section pins to form front light well. (Follow methodology in section 4)

3.5. Place cantilevered retaining wall to the left side of front opening. After 72 hours place cantilevered retaining wall to the right side of front opening.

3.6. Needle and prop bay/front wall. Insert support

3.7. Excavate out first 1.2m around front opening prop floor and erect conveyor.

3.8. Continue cantilevered wall formation around perimeter of basement following the numbering sequence on the drawings.

3.8.1. Excavation for the next numbered sections of underpinning shall not commence until at least 8 hours after drypacking of previous works. Excavation of adjacent pin to not commence until 24 hours after drypacking. (24hours possible due to inclusion of Conbextra 100 cement accelerator to dry pack mix)

3.8.2. Floor over to be propped as excavations progress. Steelwork to support Floor to be inserted as works progress.

3.9. Excavate a maximum of a 1/3 of the middle section of basement floor. Place reinforcement to central section of ground bearing slab and pour concrete. Excavate next third and cast slab. Excavate and cast final third and cast.

3.10. Provide structure to ground floor and water proofing to retaining walls as required.

4. Underpinning – Cantilevered Wall Creation

4.1. Excavate first section of retaining wall (no more than 1200mm wide). Where excavation is greater than 1.2m deep provide temporary propping to sides of excavation to prevent earth collapse (Health and Safety). A 1200mm width wall has a lower risk of collapse to the heel face.

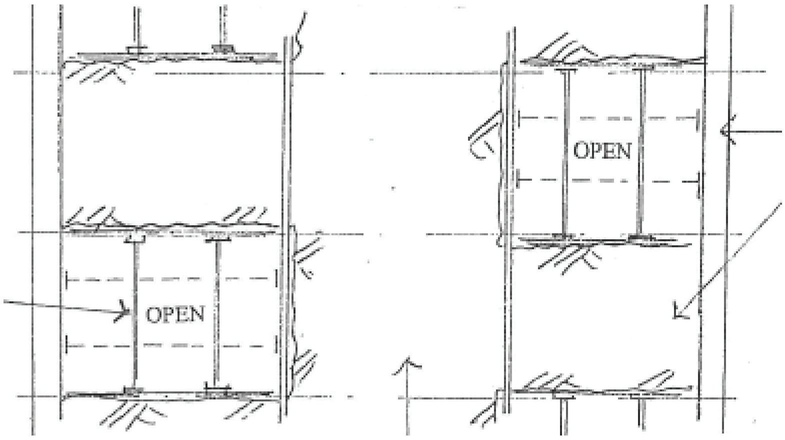
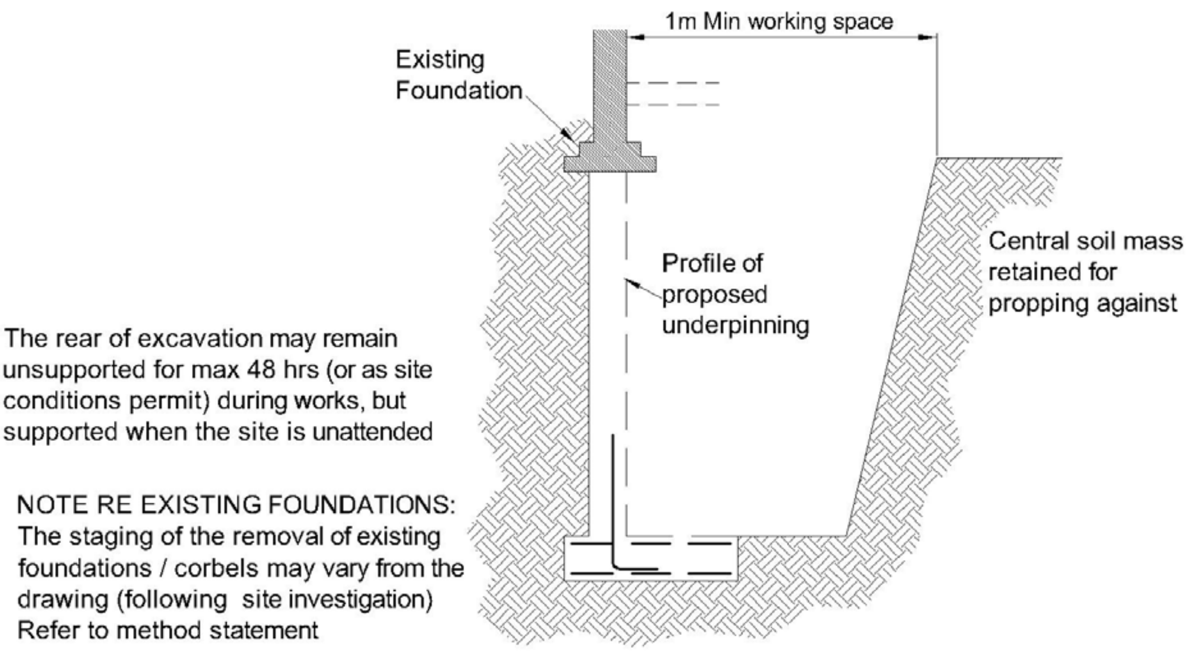
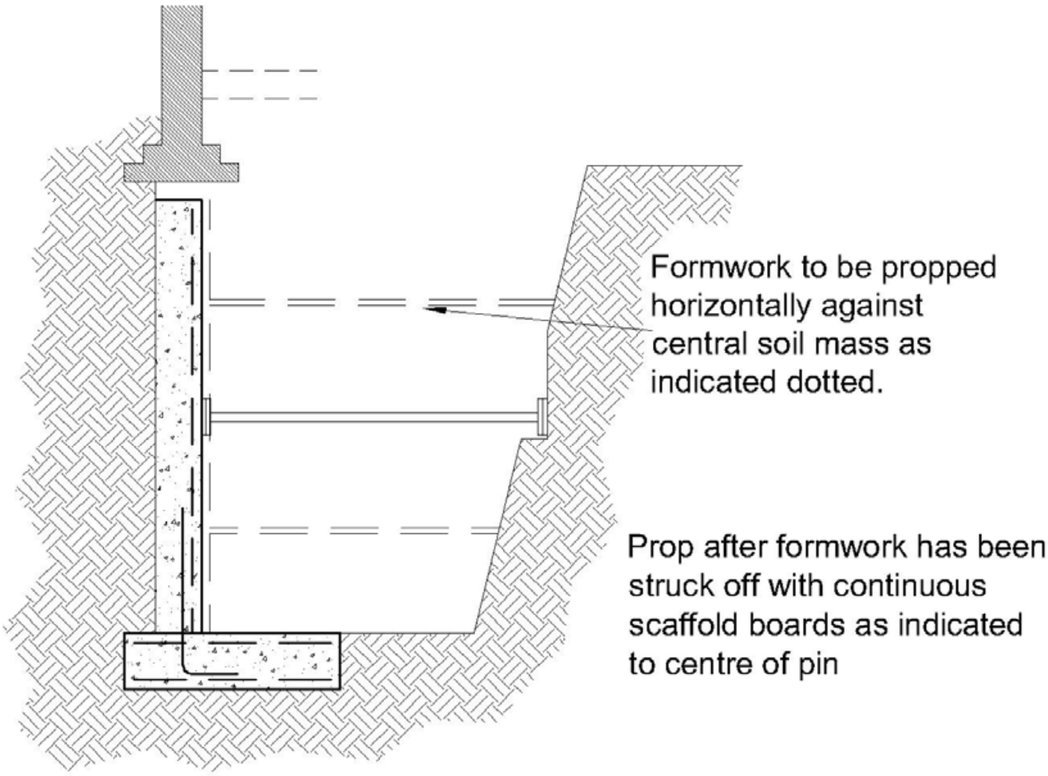


Figure 2 – Schematic Plan view of Soil Propping

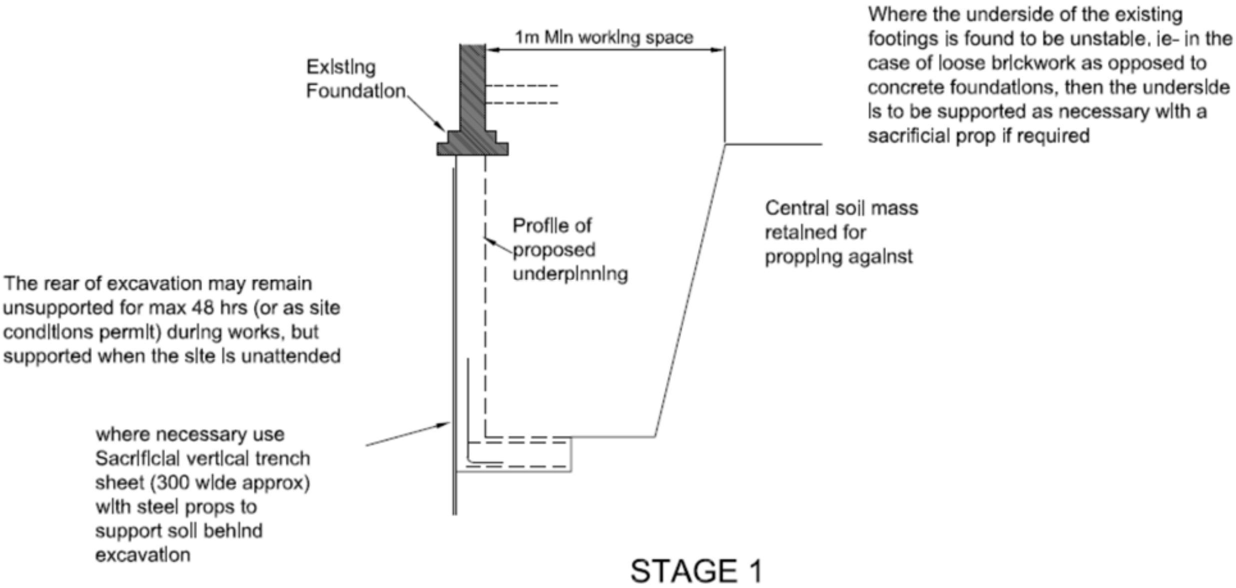
Figure 3 Propping



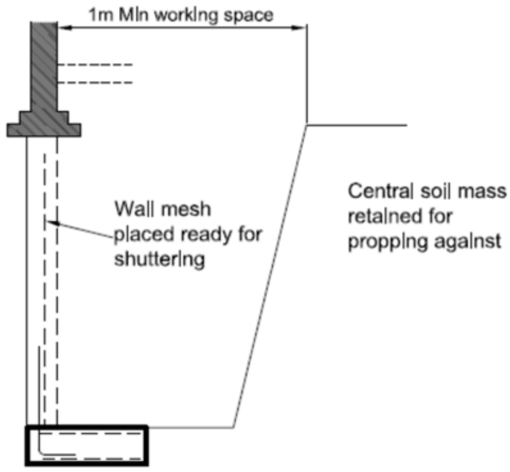


CLAY SOILS - STAGE 3

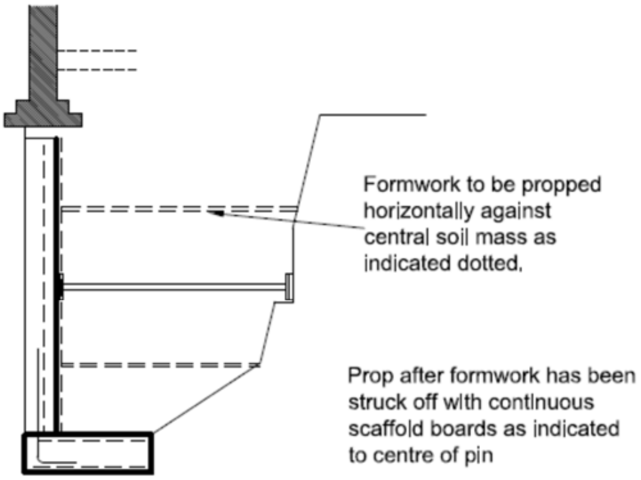
Granular soils:



STAGE 1

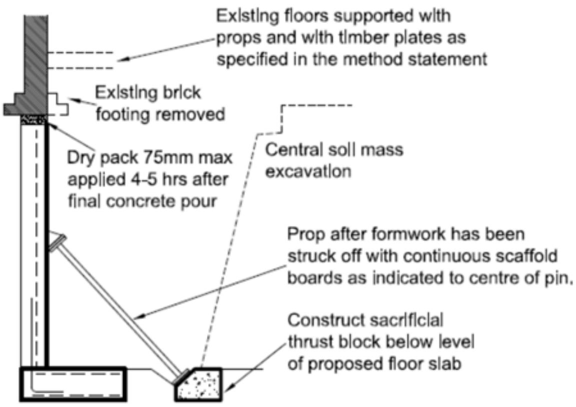


STAGE 2



STAGE 3

Image of Stage 3 on Site



STAGE 4

4.1.1. Where soft spots are encountered back prop with Precast lintels or trench sheeting. Where voids are present behind the lintels (or trench sheeting) grout behind. Prior to casting place layer of DPM between PC lintels (or trench sheeting) and new concrete. The lintels are to be cut into the soil by 150mm either side of the pin. A site stock of a minimum of 10 lintels to be present for to prevent delays due to ordering. . .

4.1.2. If the soil support to the ends of the lintels is insufficient then brace the ends of the PC lintels with 150x150 C24 Timbers and prop with Acrows diagonally back to the floor.

4.2. Visually inspect the footings and provide propping to local brickwork, if necessary props to be sacrificial and cast into the retaining wall.

4.3. Provide propping to floor where necessary.

4.4. Excavate base. Mass concrete heels to be excavated. If soil over unstable prop top with PC lintel and sacrificial prop.

4.5. Clear underside of existing footing.

4.6. Local authority inspection to be carried for approval of excavation base.

4.7. Place blinding.

4.8. Place reinforcement for retaining wall base & toe. Site supervisor to inspect and sign off works for proceeding to next stage.

4.9. Cast base. (on short stems it is possible to cast base and wall at same time)

4.10. Take 2 cubes of concrete and store for testing. Test one at 28 days if result is low test second cube. Provide results to client and design team on request or if values are below those required.

4.11. Horizontal temporary prop to base of wall to be inserted. Alternatively cast base against soil.

4.12. Place reinforcement for retaining wall stem. Site supervisor to inspect and sign off works for proceeding to next stage.

4.13. Drive H16 Bars UBars into soil along centre line of stem to act as shear ties to adjacent wall.

4.14. Place shuttering & pour concrete for retaining wall. Stop a minimum of 75mm from the underside of existing footing. Take 2 cubes of concrete and store for testing

4.15. Ram in drypack between retaining wall and existing masonry. (24 hours after pouring the concrete pin the gap shall be filled using a dry pack mortar.)

4.16. Trim back existing masonry corbel and concrete on internal face.

4.17. Site supervisor to inspect and sign off for proceeding to the next stage.

5. Approval

5.1. Building control officer/approved inspector to inspect pin bases and reinforcement prior to casting concrete.

5.2. Contractor to keep list of dates pins inspected & cast

5.3. One month after work completed the contractor is to contact adjacent party wall surveyor to attend site and complete final condition survey and to sign off works.

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This calcualtion has been provided for the trench sheet and prop design of standard underpins in the temporary condition. There are gaps left between the sheeting and as such no water pressure will occur. Any water present will flow through the gaps betweenthe sheeting and will be required to pump out.

Trecnh sheets should be placed at centers to deal with the ground. It is expected that the soil between the trench sheeting will arch. Looser soil will required tighter centers. It is typical for udnerpins to be placed at 1200c/c, in this condition the highest load on a trench sheet is when 2 nos trench sheets are used. It is for this design that these calculations have been provided.

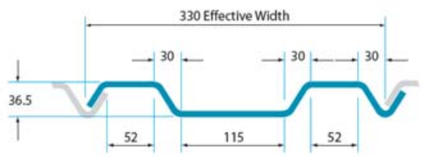
Soil and ground conditions are variable. Typically one finds that in the temporary condition clays are more stable and the C_u (cohesive) values in clay reduce the risk of collapse. It is this cohesive nature that allows clays to be cut into a vertical slope. For these calculations weak snad and gravels have been assummed The soil properties are:

Surcharge	sur = **10.** kN/m^2	
Soil density	δ = **20** kN/m^3	
Angle of friction	ϕ = **25** °	
Soil depth	Dsoil = **3000.000** mm	
	$k_a = (1 - \sin(\phi)) / (1 + \sin(\phi))$	= **0.406**
	$k_p = 1 / k_a$	= **2.464**
Soil Pressure bottom	soil = $k_a * \delta *$ Dsoil	= **21.916**kN/m^2
Surcharge pressure	surcharge = sur * k_a	= **4.059** kN/m^2

Standard Lap Trench Sheeting

STANDARD LAP

The overlapping trench sheeting profile is designed primarily for construction work and also temporary deployment.



Technical Information

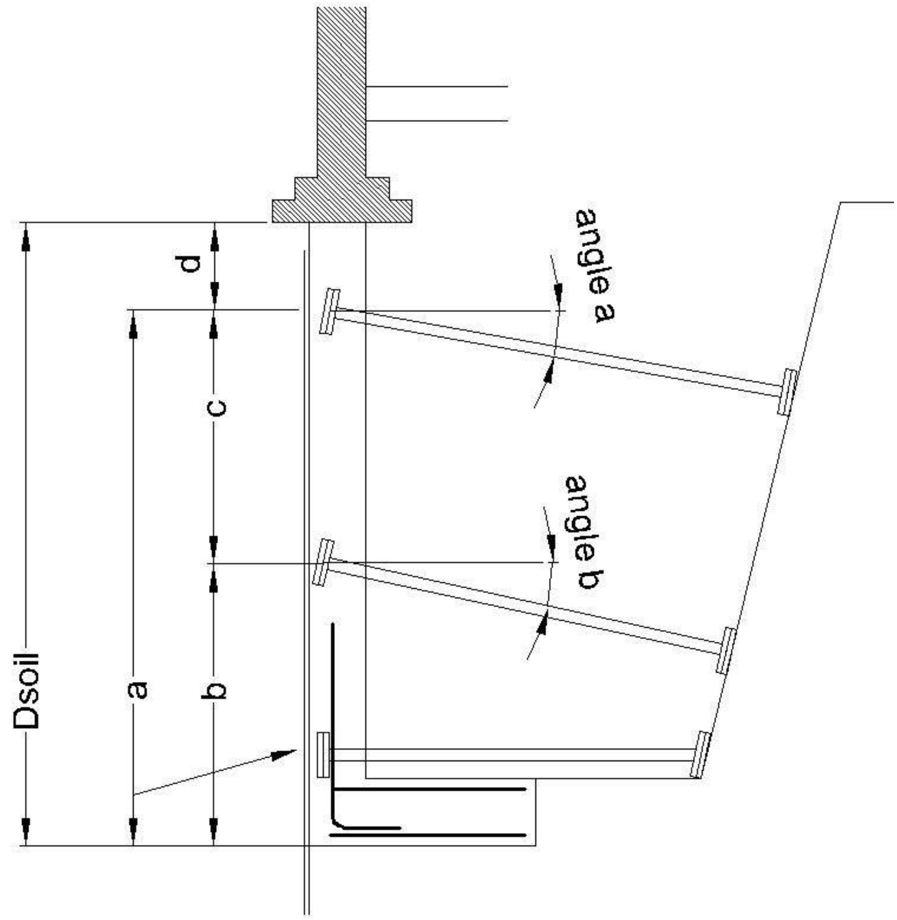
Effective width per sheet (mm)	330
Thickness (mm)	3.4
Depth (mm)	35
Weight per linear metre (kg/m)	10.8
Weight per m² (kg)	32.9
Section modulus per metre width (cm³)	48.3
Section modulus per sheet (cm³)	15.9
I value per metre width (cm⁴)	81.7
I value per sheet (cm⁴)	26.9
Total rolled metres per tonne	92.1

Sxx = 15.9 cm^3

py = 275N/mm^2

Ixx = 26.9cm^4

A = (1m^2 * 32.9kg/m^2) / (330mm * 7750kg/m^3) = **12864.125**mm^2

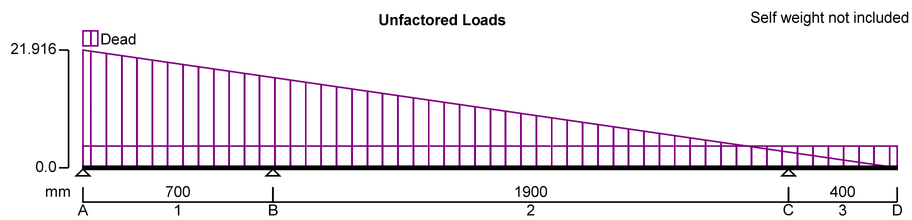


Length a a = **2.600** m

Length b bottom b = **0.700** m

Length c Middle c = a – b = **1.900**m

Length d top d = Dsoil – a = **0.400**m



CONTINUOUS BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **3**

Material Properties:

Modulus of elasticity = **205** kN/mm^2 Material density = **7860** kg/m^3

Support Conditions:

Support A	Vertically **"Restrained"**	Rotationally **"Free"**
Support B	Vertically **"Restrained"**	Rotationally **"Free"**
Support C	Vertically **"Restrained"**	Rotationally **"Free"**

CROFT STRUCTURAL ENGINEERS

Support D Vertically **"Free"** Rotationally **"Free"**

Span Definitions:

Span 1 Length = **700** mm Cross-sectional area = **12864** mm^2 Moment of inertia = **269.×10^3** mm^4

Span 2 Length = **1900** mm Cross-sectional area = **12864** mm^2 Moment of inertia = **269.×10^3** mm^4

Span 3 Length = **400** mm Cross-sectional area = **12864** mm^2 Moment of inertia = **269.×10^3** mm^4

LOADING DETAILS

Beam Loads:

Load 1 UDL Dead load **4.1** kN/m

Load 2 VDL Dead load **21.9** kN/m to **0.0** kN/m

LOAD COMBINATIONS

Load combination 1

Span 1 1×Dead

Span 2 1×Dead

Span 3 1×Dead

CONTINUOUS BEAM ANALYSIS - RESULTS

Unfactored support reactions

	Dead (kN)							
Support A	**-1.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Support B	**-32.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Support C	**-10.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Support D	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Support Reactions - Combination Summary

Support A Max react = **-1.4** kN Min react = **-1.4** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

Support B Max react = **-32.8** kN Min react = **-32.8** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

Support C Max react = **-10.8** kN Min react = **-10.8** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

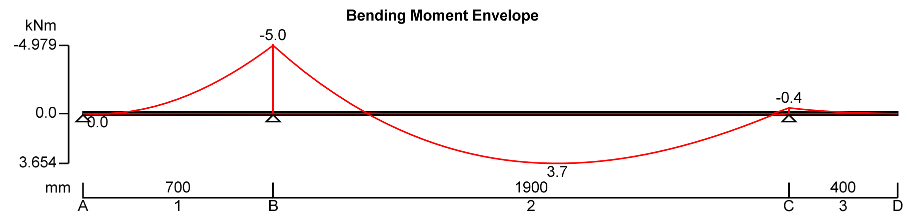
Support D Max react = **0.0** kN Min react = **0.0** kN Max mom = **0.0** kNm Min mom = **0.0** kNm

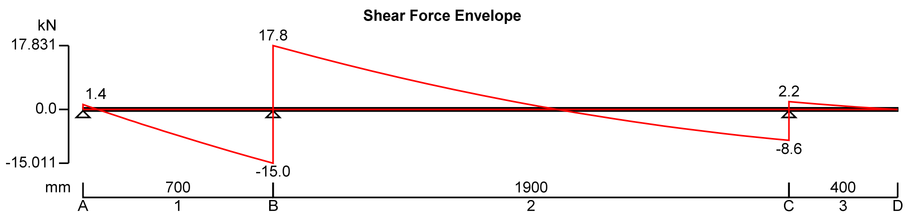
Beam Max/Min results - Combination Summary

Maximum shear = **17.8** kN Minimum shearF_{min} = **-15.0** kN

Maximum moment = **3.7** kNm Minimum moment = **-5.0** kNm

Maximum deflection = **21.0** mm Minimum deflection = **-14.3** mm





Number of sheets Nos = 2

Mallowable = Sxx * py * Nos = **8.745**kNm

SRU4.0

Safe working loads for Acrow Props — loads given in kN

For normal purposes 1 kilo Newton (kN) = 100 kg	Height m / ft	2.0 / 6.6	2.25 / 7.4	2.5 / 8.2	2.75 / 9.0	3.0 / 9.8	3.25 / 10.7	3.5 / 11.5	3.75 / 12.3	4.0 / 13.1	4.25 / 13.9	4.5 / 14.8	4.75 / 15.6
TABLE A Props loaded concentrically and erected vertically	Prop size 1 or 2	35	35	35	34	27	23						
	Prop size 3				34	27	23	21	19	17			
	Prop size 4						32	25	21	18	16	14	12
TABLE B Props loaded concentrically and erected 1½° max. out of vertical	Prop size 1 or 2 or 3	35	32	26	23	19	17	15	13	12			
	Prop size 4						24	19	15	12	11	10	9
TABLE C Props loaded 25 mm eccentricity and erected 1½° max. out of vertical	Prop size 1 or 2 or 3	17	17	17	17	15	13	11	10	9			
	Prop size 4						17	14	11	10	9	8	7
TABLE D Props loaded concentrically and erected 1½° out of vertical and laced with scaffold tubes and fittings	Prop size 3				35	33	32	28	24	20			
	Prop size 4						35	35	35	35	27	25	21

Shear V = (14.6kN + 13.4kN) /2 = 14.000kN

Any Acro Prop is accetpable

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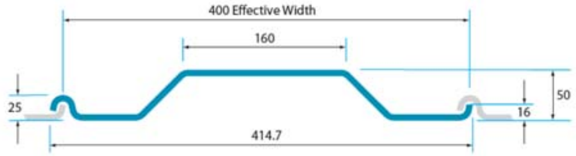
KD4 sheets

KD4

The overlapping trench sheeting profile is a heavier version of the Standard Lap, with a wider gauge and width coverage, designed in large for construction work.



Technical Information

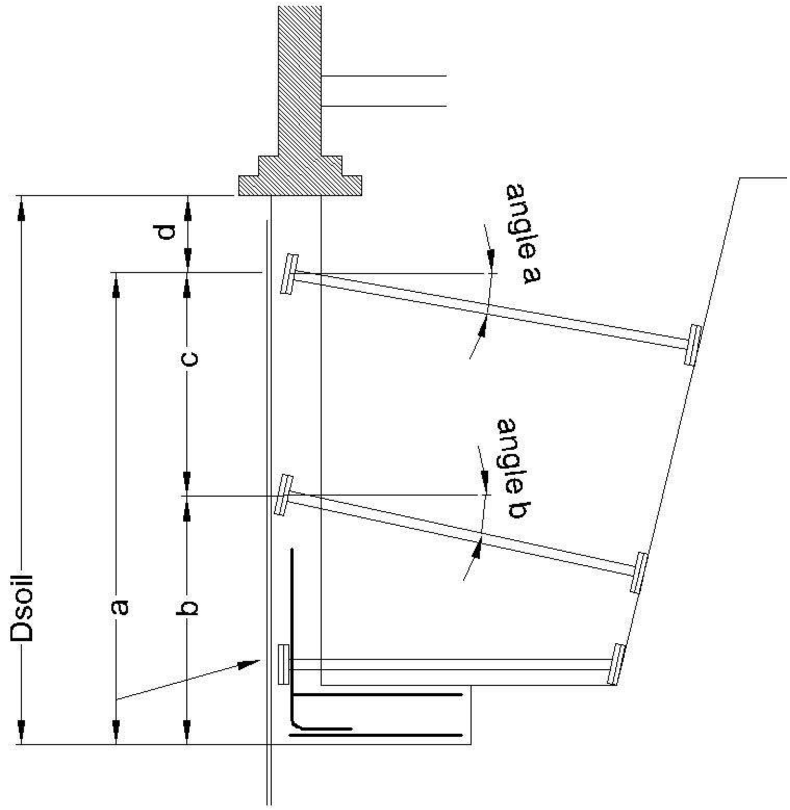
Effective width per sheet (mm)	400
Thickness (mm)	6.0
Depth (mm)	50
Weight per linear metre (kg/m)	21.90
Weight per m² (kg)	55.2
Section modulus per metre width (cm³)	101
Section modulus per sheet (cm³)	40.34
I value per metre width (cm⁴)	250
I value per sheet (cm⁴)	101
Total rolled metres per tonne	45.659

Sxx = 48.3cm^3

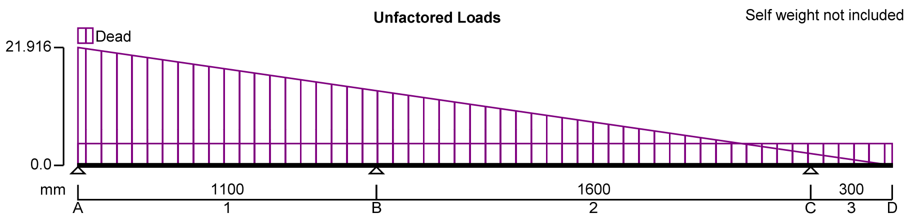
py = 275N/mm^2

Ixx = 26.9cm^4

A = (1m^2 * 55.2kg/m^2) / (400mm * 7750kg/m^3) = **17806.452**mm^2



Length a	a = **2.700** m
Length b bottom	b = **1.100** m
Length c Middle	c = a – b = **1.600**m
Length d top	d = Dsoil – a = **0.300**m



CONTINUOUS BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **3**

Material Properties:

Modulus of elasticity = **205** kN/mm^2 Material density = **7860** kg/m^3

Support Conditions:

Support A	Vertically **"Restrained"**	Rotationally **"Free"**
Support B	Vertically **"Restrained"**	Rotationally **"Free"**
Support C	Vertically **"Restrained"**	Rotationally **"Free"**
Support D	Vertically **"Free"**	Rotationally **"Free"**

Span Definitions:

Span 1	Length = **1100** mm	Cross-sectional area = **17806** mm^2	Moment of inertia = **269.×10^3** mm^4
Span 2	Length = **1600** mm	Cross-sectional area = **17806** mm^2	Moment of inertia = **269.×10^3** mm^4

Span 3 Length = **300** mm Cross-sectional area = **17806** mm^2 Moment of inertia = **269.×10³** mm^4

LOADING DETAILS

Beam Loads:

Load 1 VDL Dead load **21.9** kN/m to **0.0** kN/m

Load 2 UDL Dead load **4.1** kN/m

LOAD COMBINATIONS

Load combination 1

Span 1 1×Dead

Span 2 1×Dead

Span 3 1×Dead

CONTINUOUS BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

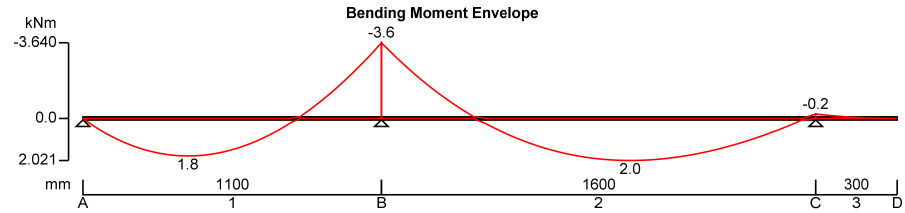
Support A	Max react = **-9.5** kN	Min react = **-9.5** kN	Max mom = **0.0** kNm	Min mom = **0.0** kNm
Support B	Max react = **-28.0** kN	Min react = **-28.0** kN	Max mom = **0.0** kNm	Min mom = **0.0** kNm
Support C	Max react = **-7.5** kN	Min react = **-7.5** kN	Max mom = **0.0** kNm	Min mom = **0.0** kNm
Support D	Max react = **0.0** kN	Min react = **0.0** kN	Max mom = **0.0** kNm	Min mom = **0.0** kNm

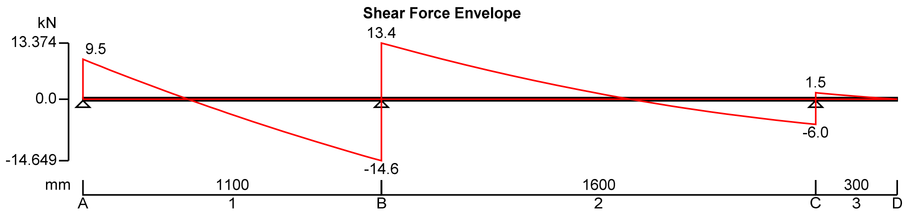
Beam Max/Min results - Combination Summary

Maximum shear = **13.4** kN Minimum shearF_{min} = **-14.6** kN

Maximum moment = **2.0** kNm Minimum moment = **-3.6** kNm

Maximum deflection = **7.7** mm Minimum deflection = **-4.9** mm





Number of sheets Nos = 2

Mallowable = Sxx * py * Nos = **26.565**kNm

SRU 4.0

Safe working loads for Acrow Props — loads given in kN

For normal purposes 1 kilo Newton (kN) = 100 kg	Height	m / ft	2.0 / 6.6	2.25 / 7.4	2.5 / 8.2	2.75 / 9.0	3.0 / 9.8	3.25 / 10.7	3.5 / 11.5	3.75 / 12.3	4.0 / 13.1	4.25 / 13.9	4.5 / 14.8	4.75 / 15.6
TABLE A Props loaded concentrically and erected vertically	Prop size 1 or 2		35	35	35	34	27	23						-
	Prop size 3					34	27	23	21	19	17			
	Prop size 4							32	25	21	18	16	14	12
TABLE B Props loaded concentrically and erected 1½° max. out of vertical	Prop size 1 or 2 or 3		35	32	26	23	19	17	15	13	12			
	Prop size 4							24	19	15	12	11	10	9
TABLE C Props loaded 25 mm eccentricity and erected 1½° max. out of vertical	Prop size 1 or 2 or 3		17	17	17	17	15	13	11	10	9			
	Prop size 4							17	14	11	10	9	8	7
TABLE D Props loaded concentrically and erected 1½° out of vertical and laced with scaffold tubes and fittings	Prop size 3					35	33	32	28	24	20			
	Prop size 4							35	35	35	35	27	25	21

Shear V = (14.6kN + 13.4kN) /2 = 14.000kN

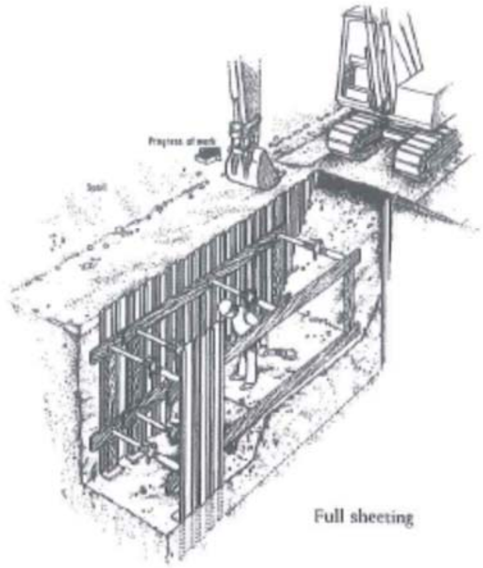
Any Acro Prop is accetpable

Sheeting requirements

Ground Type	Trench Depth, D: less than 1.2m(1)	1.2 to 3m	3 to 4.5m	4.5 to 6m
Sands and gravels Silt Soft Clay High compressibility Peat	Close, ½, ¼, ⅛ or nil	Close	Close	Close
Firm/stiff Clay Low compressibility Peat	¼, ⅛ or nil	½ or ¼	½ or ¼	Close or ½
Rock(2)	From ½ for incompetent rock to nil for competent rock(3)			

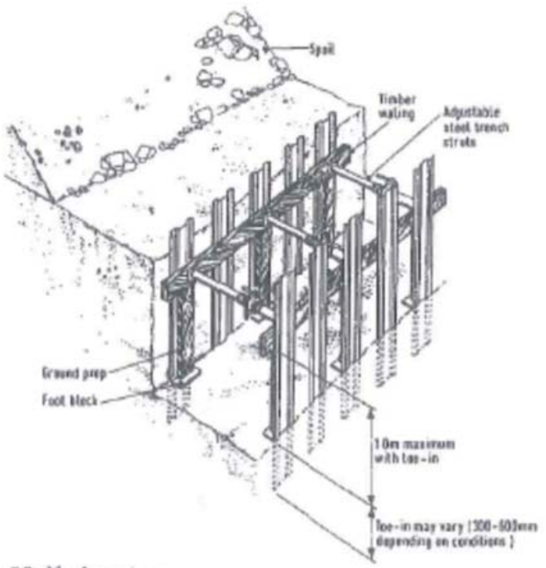
CROFT STRUCTURAL ENGINEERS

Sheeting requirements



Full sheeting

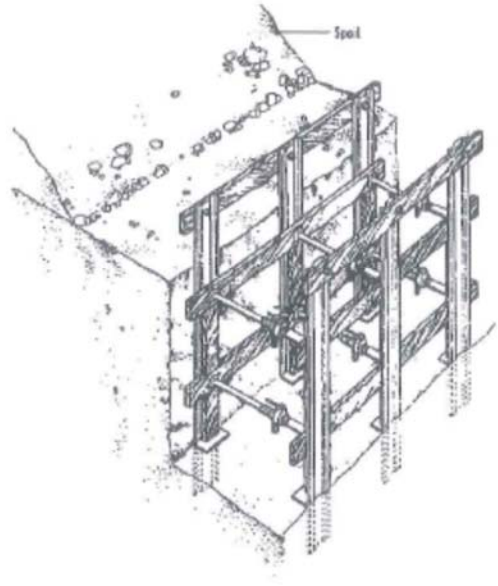
Sheeting requirements



Half sheeting
shown for 1.5 m deep trench

11/04/2012

Sheeting requirements

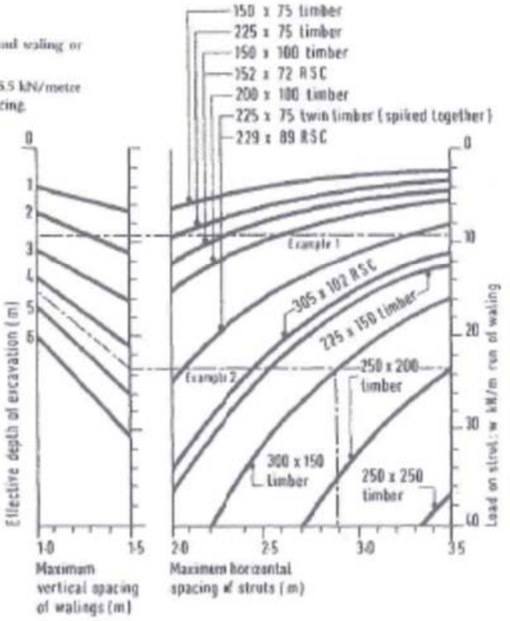


11/0 Quarter sheeting

Design to CIRIA 97

Note:
For standard Speedshore hydraulic strut and waling or equivalent use the curve for 229 x 89 RSC.
Heavy duty Speedshores have a capacity of 35.5 kN/metre run of waling at 3.2 m horizontal strut spacing.

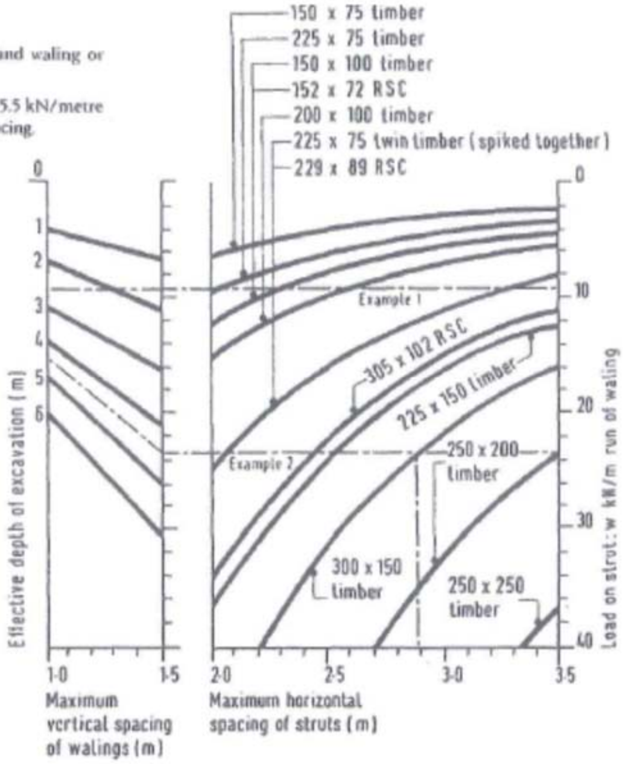
Any propriatory system should be checked against manufacturer's latest information.



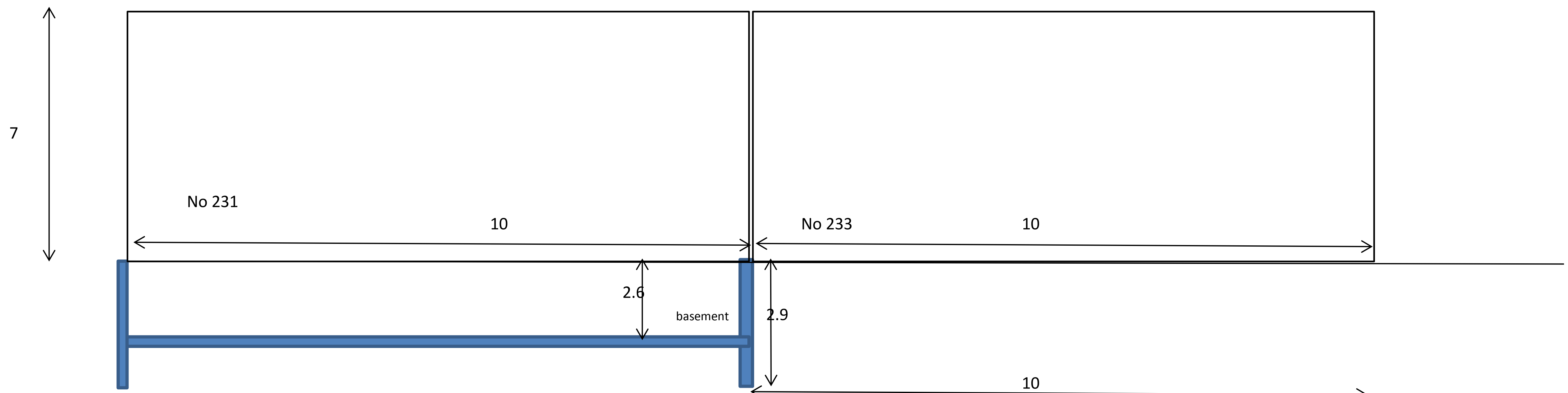
Use for:
Granular soils
Mixed soils
Short term trenches in clay
(see notes opposite)

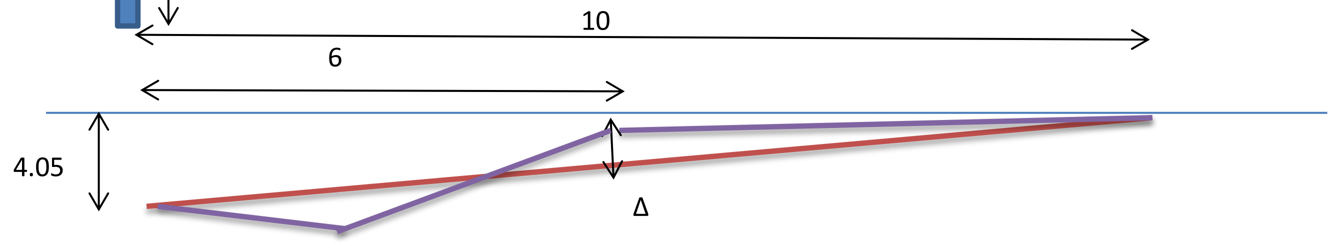
Note:
For standard Speedshore hydraulic strut and waling or equivalent use the curve for 229 x 89 RSC.
Heavy duty Speedshores have a capacity of 35.5 kN/metre run of waling at 3.2 m horizontal strut spacing.

Any proprietary system should be checked against manufacturer's latest information.



Use for:
- Granular soils
- Mixed soils
- Short term trenches in clay (see notes opposite)





No 233

Max Δ at	6 m	-0.99	
Δ/L			-0.011
Ɛh %	0.050481		
CAT1 0.075			
Δ/L/Ɛlim			0.11337
Ɛh/Ɛlim	0.673077		

231 Goldhurst Terrace

Horizontal movement due to installation of wall

0.05% x 2900m = 1.45mm

Distance to negligible movement 1.5 x 2900m = 4350mm

Horizontal movement due to excavation

0.15% x 2900 = 4.35mm

Distance to negligible movement 4 x 2900 = 11600mm

Maximum horizontal movement is 5.80mm

Horizontal strain is 5.80mm /11600mm x100 = 0.05%

Vertical movement due to installation of wall

0.05% x 2900m = 1.45mm

Distance to negligible movement 1.5 x 2900m = 4350mm

Vertical movement due to excavation

0.10% x 2600 = 2.60mm

Distance to negligible movement 3.5 x 2600 = 9000mm

Maximum vertical movement is 2.60mm

By plotting house slope for full 9000mm distance the maximum deflection calculated is 0.99mm at 6m distance from the wall.

Therefore take 0.99mm for deflection to be conservative.

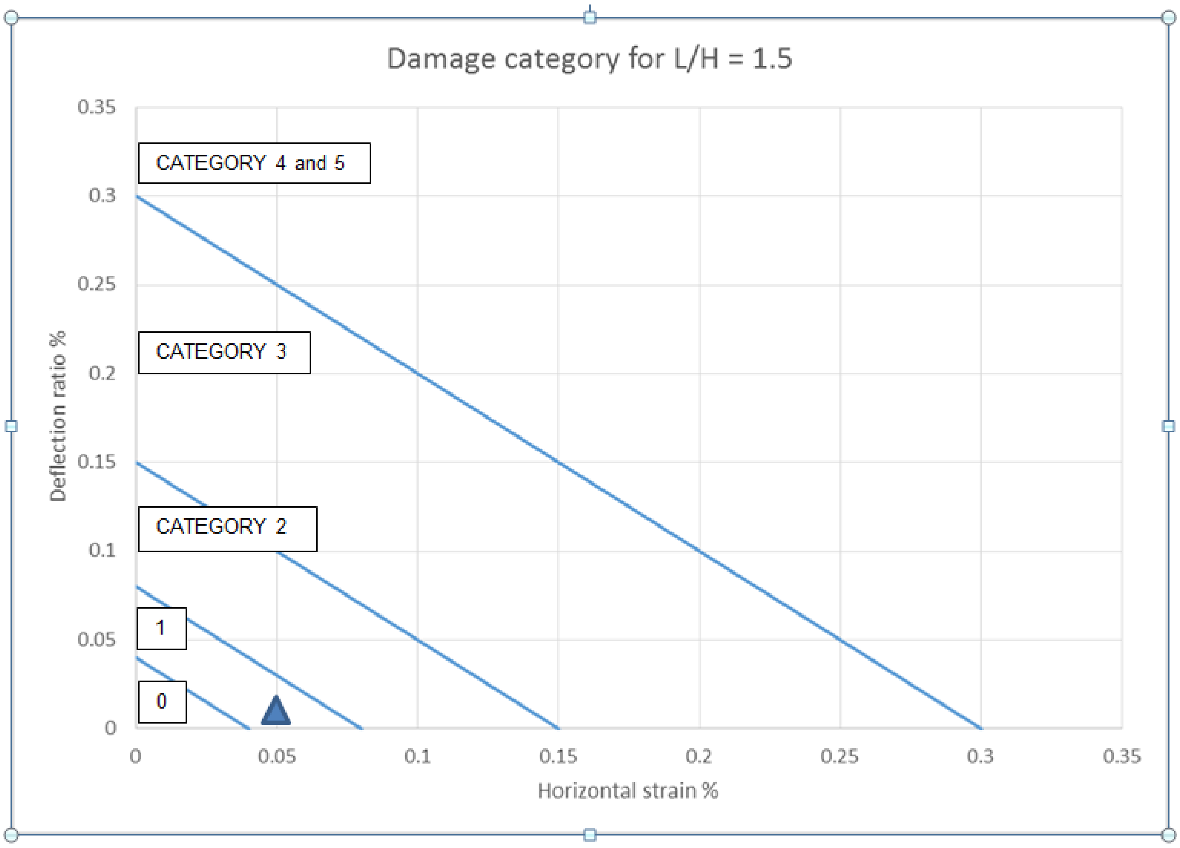
Deflection/length = 0.99/9000 = 0.011%

Deflection/length/Elim for Category 1 = 0.011/0.075 = 0.1467

Horizontal strain/Elim for Category 1 = 0.05/0.075 = 0.67

The above plotted on Fig 2.18b fall below the L/H = 1.5 line as required.

Deflection ratio v horizontal strain plotted on Fig 2.18c drawn for L/H=1.5 fall within Category 1 as shown below.


Damage category for L/H = 1.5
CATEGORY 4 and 5
CATEGORY 3
CATEGORY 2
1
0
Deflection ratio %
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Horizontal strain %

231 Goldhurst Terrace

Horizontal movement due to installation of wall

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Maximum horizontal movement is 5.80mm

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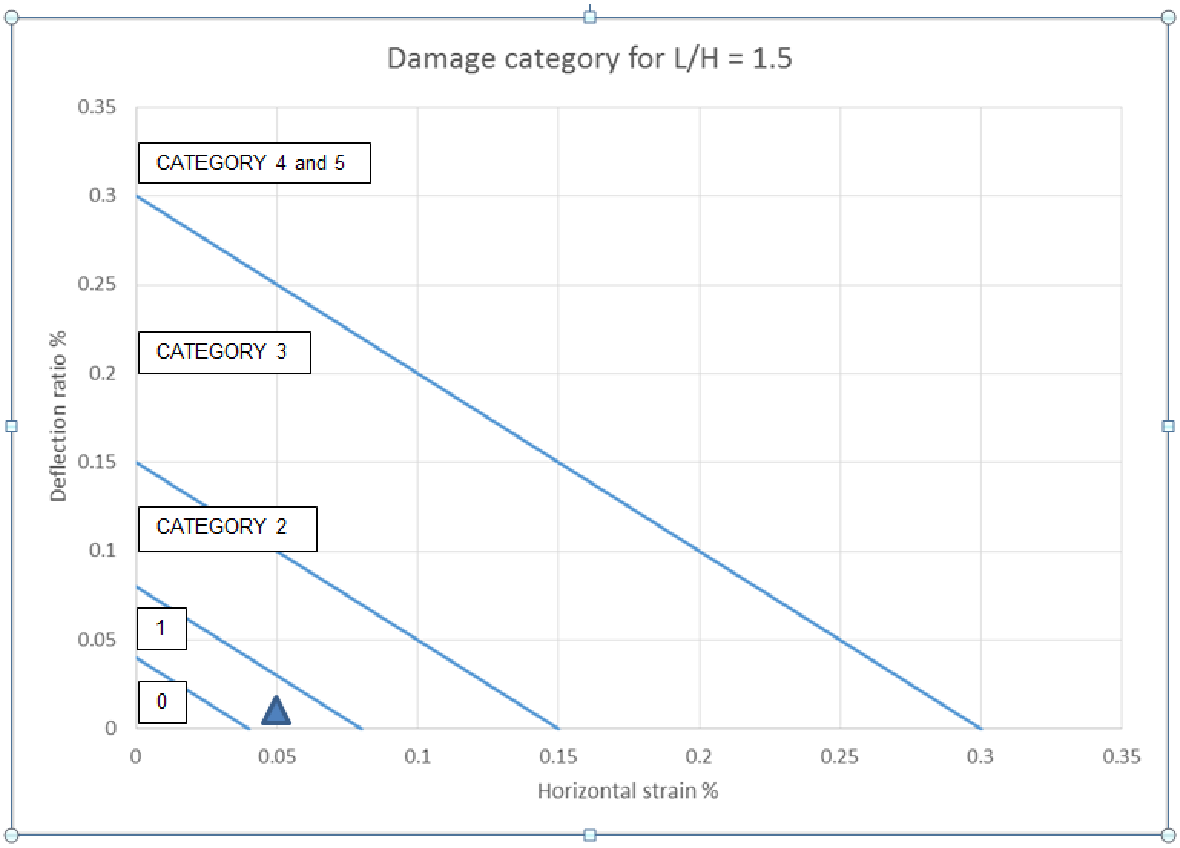
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CATEGORY 3
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Deflection ratio %
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0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Horizontal strain %