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Basement Impact Assessment
Audit

For

London Borough of Camden

Project Number: 12066-40
Revision: F1

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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 10A Oakhill Avenue, London, NW3 7RE (planning reference 2015/1628/P). The basement is considered to fall within Category C 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 Basement Impact Assessment has been carried out by well-known firms of engineering consultants using individuals who possess suitable qualifications. A subsequent SER and further clarifying information have similarly been prepared by appropriately qualified engineers.

1.5. Much of the information required by a BIA was not originally provided but has been presented in subsequent reports and letters (refer to Appendix 3). No desk study, geotechnical interpretation or design advice for retaining walls have been provided, although it has been stated that further ground investigation and an interpretative report have been commissioned.

1.6. The proposed basement is to be founded close to the boundary between the Claygate Member and the London Clay with the proposed secant piled retaining wall extending into the London Clay Formation below. The exploratory holes extended only a short distance below the proposed basement level. The ground investigation contains insufficient information for the detailed design of the basement. However, as noted above, it has been stated that further ground investigation and an interpretative report have been commissioned.

1.7. It is likely that the groundwater table will be encountered during basement foundation excavation. Measures for permanent exclusion were provided in supplementary information submitted in December 2015 and the secant piled wall will exclude groundwater during construction.

1.8. The BIA states proposed basement will be constructed using a secant piled wall with top down construction techniques. This forms the basis of assumptions made in the reports concerning ground movements etc. and has been confirmed with outline details for temporary and permanent works presented in the SER.

1.9. The groundwater assessment predicts groundwater level rises of up to 0.40m and it has been stated that further monitoring is being carried out to determine baseline levels. Further enquiries have indicated that neither of the neighbouring properties has a basement which could be affected by predicted rise in groundwater levels. Basement design conservatively assumes the groundwater to be 1m below ground level.

1.10. Information provided in December 2015 indicates that retaining wall movements will be limited to 10mm. It is accepted that this is reasonable for the proposed construction. Whilst there are still queries over the building damage assessments, it is also accepted that that level of movements should restrict building damage to no greater than Burland category 1 provided there is good control of workmanship and that the affected properties are in sound condition.

1.11. The SER states that a movement monitoring strategy will be agreed with the party wall surveyor. This should include the monitoring of movement during excavation and construction. Condition surveys of potentially affected properties are also required.

1.12. It is accepted that there are no adverse impacts on slope stability, surface water flows or flooding.

1.13. It can be confirmed that he queries and requests for clarification or additional information arising out of this audit (summarised in Appendix 2) have been addressed and that the BIA adequately identifies the potential impacts from the basement proposals and provides sufficient mitigation. It is considered that the final design and predictions of ground movement/building damage can be agreed as part of the party wall awards.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 09/07/2015 to carry out a Category C Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 10A Oakhill Avenue, London, NW3 7RE (2015/1628/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

2.5. 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.

2.6. LBC's Audit Instruction described the planning proposal as *"Erection of a 3 storey building with lower ground and basement levels to accommodate 2 x 4-beds and 3 x 3-bed units (Class C3)……."*

2.7. CampbellReith accessed LBC's Planning Portal on 21st September 2015 and gained access to the following relevant documents for audit purposes:

- 'Land Stability' report by Soil Consultants.
- 'Factual Report on Ground Investigation' By Soil Consultants.
- 'Slope Stability and Ground Movement Assessment' by KEY GS.
- BIA (Surface Water and Groundwater) by esi.
- Planning Application Drawings consisting of:-

- Location Plan

- Proposed Plans, Sections and Elevations.

- Planning Consultation Responses.

2.8. Subsequent to the issue of the initial audit report, a Structural Engineers Report (SER) prepared by Parkman Lucas Engineers LLP, was provided to CampbellReith by email on 21 October 2015. CampbellReith has reviewed this additional information and it is discussed in this revised audit report. The SER is presented in Appendix 3

2.9. Further clarifications were received from the structural engineer on 21 December 2015 following the issue of Revision D2 of the audit report. Those further clarifications, which are also presented in Appendix 3, are considered in this updated report.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are Individual report (from Section 1.4) Author(s) credentials satisfactory?	Yes	Chartered Geologists, Chartered Engineers, and Chartered Institute of Water and Environmental Management members.
Is data required by Cl.233 of the GSD presented?	Yes	Originally missing information provided in subsequent clarifications.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	See accompanying report documents mentioned in section 1.4 above.
Are suitable plan/maps included?	Yes	See accompanying report documents mentioned in section 1.4 above.
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	See accompanying report documents mentioned in section 1.4 above.
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See accompanying report documents mentioned in section 1.4 above.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See accompanying report documents mentioned in section 1.4 above.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	See accompanying report documents mentioned in section 1.4 above.

Item	Yes/No/NA	Comment
Is a conceptual model presented?	Yes	See accompanying report documents mentioned in section 1.4 above.
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	See accompanying report documents mentioned in section 1.4 above.
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	See accompanying report documents mentioned in section 1.4 above.
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	See accompanying report documents mentioned in section 1.4 above.
Is factual ground investigation data provided?	Yes	See accompanying report documents mentioned in section 1.4 above.
Is monitoring data presented?	Yes	See accompanying report documents mentioned in section 1.4 above.
Is the ground investigation informed by a desk study?	No	No desk study provided.
Has a site walkover been undertaken?	Yes	Not mentioned in any of the BIA reports. Level of detail in reports suggests that a site walkover BIA is likely to have occurred. SER refers to a site walkover.
Is the presence/absence of adjacent or nearby basements confirmed?	No	Information provided in December notes that the neighbours on either side of the proposed basement were contacted and have confirmed that they do not have basements.

Item	Yes/No/NA	Comment
Is a geotechnical interpretation presented?	No	Information presented in December 2015 notes that an interpretative site investigation report has been commissioned.
Does the geotechnical interpretation include information on retaining wall design?	NA	No interpretation provided.
Are reports on other investigations required by screening and scoping presented?	No	Not required.
Are baseline conditions described, based on the GSD?	Yes	To extent commensurate with scale of basement proposals.
Do the base line conditions consider adjacent or nearby basements?	Yes	SER notes that a walkover survey did not identify any basements.
Is an Impact Assessment provided?	Yes	See accompanying report documents mentioned in section 1.4 above.
Are estimates of ground movement and structural impact presented?	Yes	But no evidence to support conclusions.
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	Yes	See accompanying report documents mentioned in section 1.4 above, although clarification of ground movement and building damage assessments required.
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	Although future details required.
Has the need for monitoring during construction been considered?	Yes	An outline monitoring regime is presented in the SER.

Item	Yes/No/NA	Comment
Have the residual (after mitigation) impacts been clearly identified?	Yes	Previously identified omissions have been dealt with in supplementary information (refer to Appendix 3).
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	Yes	Refer to supplementary information in Appendix 3.
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	Surface water run-off will be increased. Recommendations are made for a proposed sustainable drainage system.
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	Yes	Refer to supplementary information in Appendix 3.
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	Yes	Refer to supplementary information in Appendix 3 and Section 4
Are non-technical summaries provided?	Yes	

4.0 DISCUSSION

4.1. The Basement Impact Assessment is an amalgamation of various reports listed in section 1.4 of this report. The report authors appear to have suitable qualifications. Subsequent to the issue of CampbellReith initial audit report, a Structural Engineers Report was provided which contained a construction methodology and some design assumptions.

4.2. The BIA indicates that the proposed basement (approximately 6.5m bgl) will be constructed using a secant piled wall and top down construction techniques, and will be founded at the boundary of the Claygate Member and the London Clay. The proposed secant piled walling will extend significantly into the London Clay Formation below. The exploratory holes extended to a maximum depth of 7m. No desk study, geotechnical interpretation or design information for retaining walls have been provided. Supplementary information provided in December 2015 states that an interpretative report has been commissioned.

4.3. The site investigation report identifies that the basement will be formed close to boundary between is the Claygate Member (Secondary Aquifer A) and the London Clay (Non-productive Aquifer).

4.4. The SER notes that no evidence of basements to surrounding properties was observed during a walkover survey. However, the esi BIA makes reference to neighbouring basements. The clarifications issued in December 2015 state that enquiries to the two immediate neighbours have indicated that neither have basements beneath their properties.

4.5. The conclusions reached in the Surface and Groundwater report is that the proposed basement will have a damming effect and could cause the water level to adjacent properties to rise by approximately 0.4m, which is stated as below ground level and within the seasonal fluctuation of the existing groundwater level. It is not known what groundwater level was assumed for the baseline condition, nor has the seasonal fluctuation was determined as water monitoring was only reported for one month. The BIA did not include a discussion of how a rise in the water table could affect nearby basements. This issue has been resolved by confirmation of the absence of basements in close proximity to the applicant's property. It is also noted in the December 2015 clarifications that groundwater monitoring is continuing and that designs will conservatively assume a groundwater level at 1m below ground level.

4.6. An assessment of vertical and horizontal ground movements has been produced which estimates that the effect on neighbouring properties will be negligible, whilst the SER notes that damage will not exceed Burland Category 2. It can be confirmed that the assumed methodology within the Key GS GMA concurs with the SER. However, no supporting evidence is provided for the conclusions of the assessment such as assumed soil parameters. The full input and output data for the software analysis are required together with the assumptions and calculations used

to derive the building damage assessment. It appears that only heave movements have been considered and not settlement and horizontal movements as suggested by CIRIA C580. Whilst the Key GS GMA still cannot be verified, the information provided in December 2015 includes a further ground movement and building damage assessment. Again, there are some questions over the methodology applied, but it is accepted that it should be possible to restrict ground movements to those suggested in the assessment and that building damage should not exceed Category 1 assuming good control of workmanship and that the surrounding properties are in sound condition.

4.7. The SER states that a movement monitoring regime will be agreed with the party wall surveyor. This should be carried out for both the excavation and construction phases of the project. Condition surveys of potentially affected properties are also required.

4.8. The BIA (Surface and Groundwater) noted that the increase in impermeable surface areas is just around 13% and that, subject to an assessment of SUDs, this is unlikely to cause any detrimental impact. Additional information presented in December 2015 includes proposals for waterproofing the basement.

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

5.0 CONCLUSIONS

5.1. The Basement Impact Assessment has been carried out by well-known firms of engineering consultants using individuals who possess suitable qualifications. A subsequent SER and further clarifications have similarly been prepared by appropriately qualified engineers.

5.2. Much of the information required by a BIA was not originally provided. The SER contains a construction methodology and proposed mitigation measures. The BIA still contains no desk study, geotechnical interpretation or design advice for retaining walls, however it has been confirmed that an interpretative report has been commissioned. A programme has been provided.

5.3. The proposed basement is to be founded close to the boundary between the Claygate Member and the London Clay with the proposed secant piled retaining wall extending into the London Clay Formation below. The exploratory holes extended only a short distance below the proposed basement level. The ground investigation contains insufficient information for the detailed design of the basement. Information presented in December confirms that a more extensive GI has been commissioned.

5.4. It is likely that the groundwater table will be encountered during basement foundation excavation. Measures for permanent water exclusion have been provided in supplementary information and the secant piled wall will exclude groundwater during construction.

5.5. The BIA states proposed basement will be constructed using a secant piled wall with top down construction techniques. This forms the basis of assumptions made in the reports concerning ground movements etc. and has been confirmed with outline details for temporary and permanent works presented in the SER.

5.6. The groundwater assessment predicts groundwater level rises of up to 0.40m. The assessment states this is within seasonal fluctuations. Seasonal fluctuations have not been determined, although information provided subsequently confirmed that groundwater monitoring is continuing. Further enquiries have confirmed that neither of the neighbouring properties have basements which could be affected by the predicted rise in groundwater levels.

5.7. Horizontal and vertical ground movement analysis predicts negligible impact on neighbouring properties provided the construction technique mentioned in 5.5 is adopted. The SER states that damage will not exceed slight. No supporting evidence for the conclusions is provided. No further information was provided to allow the original GMA to be verified, however the additional information supplied in December confirms that the movement of the retaining walls will be limited to 10mm resulting in negligible damage to neighbouring properties. Whilst there are some queries over the assumptions made in the building damage assessment, it is accepted

that the proposed construction method should limit ground movements and that, assuming good control of workmanship, damage to neighbouring properties should not exceed Burland category 1.

5.8. The SER states that a movement monitoring strategy will be agreed with the party wall surveyor. This should include the monitoring of movement during excavation and construction. Condition surveys of potentially affected properties are also required.

5.9. It is accepted that there are no adverse impacts on slope stability, surface water flows or flooding.

5.10. It can be confirmed that the further considerations of the impact of basement requested in earlier audit reports have been addressed by the information provided subsequently by the structural engineer.

Appendix 1: Residents' Consultation Comments

Residents' Consultation Comments

Surname	Address	Date	Issue raised	Response
Safit	Flat 4, 10 Oakhill Avenue	03/05/15	Groundwater flow Soil subsidence	Refer to 4.4 – 4.7
Khadavi	Flat 5, 10 Oakhill Avenue	28/05/15	Groundwater flow	Refer to 4.4 and 4.5
Brafman	Flat 6, 10 Oakhill Avenue	28/04/15	Groundwater flow Soil subsidence	Refer to 4.4 – 4.7
Oakhill RA	10 Oakhill Avenue	15/05/15	Surface run off Building damage	Refer to 4.6 – 4.8

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	BIA	Significant information required for the BIA has not been provided.	BIA to be updated and completed with reference to Camden guidance.	11.12.15
2	Hydrogeology/Stability	No information is presented with respect to neighbouring basements.	Suitable mitigation provided in SER.	11.12.15
3	Hydrogeology	Assumed baseline condition not stated and impact not assessed.	Confirm potential impact for nearby basements, baseline and seasonal variation.	21.01.16
4	Stability	No information provided for design of retaining walls and piles.	Outline information presented. To be refined in BCP.	11.12.15
5	Stability	No information presented to support conclusions with respect to predicted ground movement and building damage.	To be provided.	21.01.16
6	Stability	No proposals for condition surveys, mitigation measures or monitoring.	Outline information presented. To be refined in BCP.	11.12.15

Appendix 3: Supplementary Supporting Documents

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Structural Engineers Report

10a Oakhill Avenue, London NW3 7RE
Basement Impact Assessment
and Structural Feasibility Study

Report in response to Campbell Reith Basement Impact Assessment Audit

Reference: 5390 12 151012
Date: 16th October 2015

packmanlucas

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Appendices:

Appendix A – Outline structural proposal drawings
Appendix B – Suggested works sequence - visual study

1.0 Summary

1.1 This report has been prepared to address the requirements of the London Borough of Camden Planning Guidance document reference CPG4 - Basements and Lightwells, and specifically addresses matters not covered within pre-existing reports prepared by others. This is in response to points raised in the specialist consulting engineers Audit report by Campbell Reith Hill LLP; dated September 2015, reference 12066-40-D1.

1.2 This report offers the most appropriate form of construction and construction methodology, so as to assess the viability and potential impact that the proposed basement has on structural stability in the vicinity of the property.

1.3 The proposals are considered entirely feasible using normal top down techniques with only minor risk of non-structural damage to nearby structures.

1.4 The effects of the basement on the water table and on surface water flows have been considered by others and are covered in other supporting documents.

1.5 This document is to be read in conjunction with the following specialist report documents:

1.5.1 *Hydrology and hydrogeological basement impact assessment* prepared by environmental consultants ESI Ltd, report document reference 63451R1, dated March 2015, where specialist advice on geology, hydrology and hydrogeology has been provided. The effects of the proposed basement on the water table and on surface water flows have been considered by environmental consultants ESI Ltd.

1.5.2 *Factual Report on ground investigation* prepared by geotechnical consultants Soil Consultants Ltd. Reference 9374/MC/AW, dated February 2015. The site soil profile horizons, laboratory analysis soil data and groundwater levels have been measured and recorded by direct observation utilising window sampling boreholes and standpipe measuring.

1.5.3 *Interim Basement Impact Assessment Screening Report: 'land stability'* prepared by geotechnical consultants Soil Consultants Ltd. Reference 9374D/MC/AW, dated February 2015. The impact of the proposed development on slope stability has been addressed in accordance with Figure 2 of Camden Council guidance document CPG4.

1.5.4 *Slope stability and Ground Movement Assessment* by Key GeoSolutions Ltd. Reference 15-061-R-001, dated February 2015. Considering the potential for ground movements local to the proposed development, and so evaluate the potential permanent works impact on local property, as measured on the Burland scale.

2.0 Basement Impact Assessment summary

2.1 Stage 1 – Screening: Refer to ESI Ltd. report reference 63451R1, dated March 2015.

2.2 Stage 2 – Scoping: Refer to ESI Ltd. report reference 63451R1, dated March 2015.

2.3 Stage 3 – Site Investigation and Study: Refer to Soil Consultants Ltd. report reference 9374/MC/AW ESI, Dated February 2015 for site investigation factual reporting, and to ESI Ltd. report reference 63451R1, dated March 2015, for interpretative reporting.

2.4 Stage 4 – Impact Assessment: Refer to reports listed above in clause reference 1.2 for an assessment of predicted local hydrogeological behaviour and anticipated local ground movements. This report will assess other structural matters defined in Camden Council guidance document reference CDG4.

2.5 Stage 5 – Review and decision making – Refer to Campbell Reith Consulting Engineers Basement Impact Assessment Audit report reference 12066-40, dated September 2015. The audit document highlights additional information required, which this report shall address.

3.0 Structural Design Proposals

3.1 The proposed development at 10a Oakhill Terrace will form a two storey apartment building above ground with a two level basement below. The site specific topography, hydrology, existing form of structure and other pertinent proposal summary details are described extensively in the accompanying reports described in point 1.5 above.

3.2 The superstructure will most likely be formed using a steel braced frame construction, utilising profile metal deck flooring inset and set flush to steel beam profiles.

3.3 The basement will be formed using 'top-down' construction techniques, formed using a secant pile wall construction of hard and soft piles to form the perimeter retaining walls. The ground floor level, the lower ground floor, and the foundation level slab will be formed in reinforced concrete, and will provide propping restraint of the perimeter retaining walls in order to minimise lateral wall deflections and so control local ground movements. A works sequence proposal summary follows in section four of this report.

3.4 The secant pile wall will be formed using 450mm diameter piles, set in a 'hard/soft' construction sequence. When considering the structural envelope we must allow for an internal lining wall and for permissible pile position tolerance, which defines a capping beam width of 850mm. This capping beam width has been set out on the outline proposal drawings and produces in a basement perimeter envelope which is located comfortably within the site boundary.

3.5 The passive and active soil coefficients which are used in the design of retaining walls will be determined using shear strength parameter values obtained from pocket penetrometer shear strength testing, as undertaken and recorded by Soil Consultants Ltd. The average Pocket Penetrometer Test results are 1.9 kg/cm^2, but will be adjusted according to local soil horizons and substructure storey heights.

3.6 The existing anticipated ground water table level has been defined by ESI Ltd. at an adverse case level of 92.530m AOD, which translates to approximately 2.1m below ground level. This is above the proposed basement level, and as such is classified as a high water table level. The design of the basement and the building foundations will require we consider lateral hydrostatic pressure on the perimeter retaining walls, and uplift hydrostatic pressure on the lower basement slab. The Retaining walls will be designed to resist lateral hydrostatic pressure and ground and surcharge loads by way of increased reinforcement density in the piles. Hydrostatic uplift pressures will be resisted in the temporary condition by way of tension resisting piles, which in the general case will be overcome by gravity loading as the superstructure develops to the completed permanent works condition.

3.7 The retaining walls of the development will be propped at ground floor level, lower ground level and basement level by utilising the suspended concrete slab as a diaphragm floor in compression. In areas adjacent lightwells and similar perimeter penetrations the reinforced concrete capping beam will act as a whaler member to offer propping restraint, and so deliver lateral forces back to the body of the permanent works slab.

3.8 The lower basement slab will give due consideration to heave and overburden relief, and this will be accommodated by suspending the basement slab over an expanded polystyrene type compression material.

3.9 Outline substructure general arrangement proposal drawings follow at the end of this report. The overlying superstructure proposal drawings have not been provided as they do not inform on the proposed basement arrangement.

3.10 The ESI report has identified that there will be an increase in the area of impermeable hard-standing as a result of the proposed development. As such a drainage and groundwater management scheme which considers the use of Sustainable Urban Drainage Systems in its implementation has been identified. This will be considered as a part of normal design development, and proposals will be developed and agreed with the appropriate authorities.

4.0 Construction Sequence

4.1 The proposed sequence and method of construction will take account of temporary stability during construction, to ensure integrity of the excavation and to safeguard adjacent properties.

4.2 An outline visual study of the proposed top-down substructure construction methodology is included at the end of this report. The site topography is omitted from this study for clarity.

4.3 The works will be undertaken by a contractor familiar with specialist piling methods and top down construction techniques.

4.4 The proposed outline structural sequence would be as follows, assuming other site set up has been completed:

4.4.1 Isolate services to existing building and make safe or terminate as required.

4.4.2 Demolish existing buildings; grub out foundations and ground floor, filling any resulting voids with suitable material arising or replaced material to ensure that a suitable piling platform is provided.

4.4.3 Install Secant pile wall to perimeter of building as shown on concept layout, including internal piles and any temporary piles as plunge columns. Details of pile installation techniques will need to take into account the likely presence of water in the shaft, and will be subject to the specialist advice of a piling contractor and pile designer.

4.4.4 Excavate to ground floor level and cast ground floor reinforced insitu slab with perimeter capping beams and any down stand beams supported on temporary internal piles. Leave a temporary slab void for access to lower levels and excavation as necessary.

4.4.5 After sufficient curing of ground floor slab, excavate below ground floor level to formation of lower ground floor. Excavated material to be removed through the access void to ground level and disposed of using normal earth moving equipment.

4.4.6 Groundwater may be encountered on excavation, and although the secant wall will minimise water ingress as much as practicable, some ground water management may be required. This can be accommodated with normal submersible pumps and attenuation for managed discharge into the local Thames Water infrastructure as required.

4.4.7 Cast reinforced concrete lower ground floor slab, including any reinforced concrete down stand beams which may be required. The lower level slab will be designed to provide lateral restraint to the piles at this level, using the internal temporary plunge column piles for vertical support as necessary.

4.4.8 After sufficient curing of lower ground floor slab, excavate below lower ground floor level to formation of basement floor. Excavated material to be removed through the access void to ground level and disposed of using normal earth moving equipment.

4.4.9 Cast reinforced concrete lower ground floor slab, including any reinforced concrete down stand ground beams and pile caps under columns. The lower ground floor basement slab will be designed to provide lateral restraint to the secant piled wall at this level.

4.4.10 Install internal reinforced concrete lining wall to the internal perimeter of the basement construction.

5.0 Conclusions

5.1 The perimeter retaining walls will remain propped at ground floor level throughout works and prior to any excavation works taking place, which will ensure that any lateral ground movements are minimised.

5.2 There will be several transitional stages which are described in the works sequence proposal above. The potential temporary and permanent condition movement can be predicated and controlled in accordance with the guidance set out in CIRIA Report C580, which describes a three stage method for assessing potential damage to buildings near excavations supported by embedded retaining walls. The works sequencing and method of temporary propping will be able to limit maximum predicted head deflections in order to ensure the potential effect on neighbouring properties is minimised.

5.3 As with all construction of this type, some adjoining structures may suffer minor movement. We are able to ensure the potential damage arising is limited to Category 2 (Slight) in accordance with table 2.5 of CIRIA document C580, commonly referred to as the Burland scale.

5.4 A regimen for movement monitoring will be observed and defined as a result of the Party Wall Act. Broadly put this will include a series of monitoring points and stations, where total station observation equipment will record any movement as works progress. These values will be translated to action or trigger values, which will define any action which may be required as works progress.

5.5 The groundwater Basement Impact assessment anticipates a local increase in ground water level of approximately 400mm on the up-gradient side of the property adjacent to 8 Oakhill Avenue, which would decrease in variation relative to distance from the new basement. It has been noted that the anticipated variation in water table level is in line with expected seasonal variations, but it should also be noted that this median value would also affect maximum seasonal variations.

5.6 The neighbouring properties have been reviewed externally by Packman Lucas during a walkover survey on the 15th October 2015, and no evidence of neighbouring basements has been discovered. Neighbouring properties were reviewed for the presence of lightwells, coal holes, or similar external evidence of subterranean development. Access to the inside the neighbour properties is not possible at this time, and our initial findings will be confirmed as part of the party wall process.

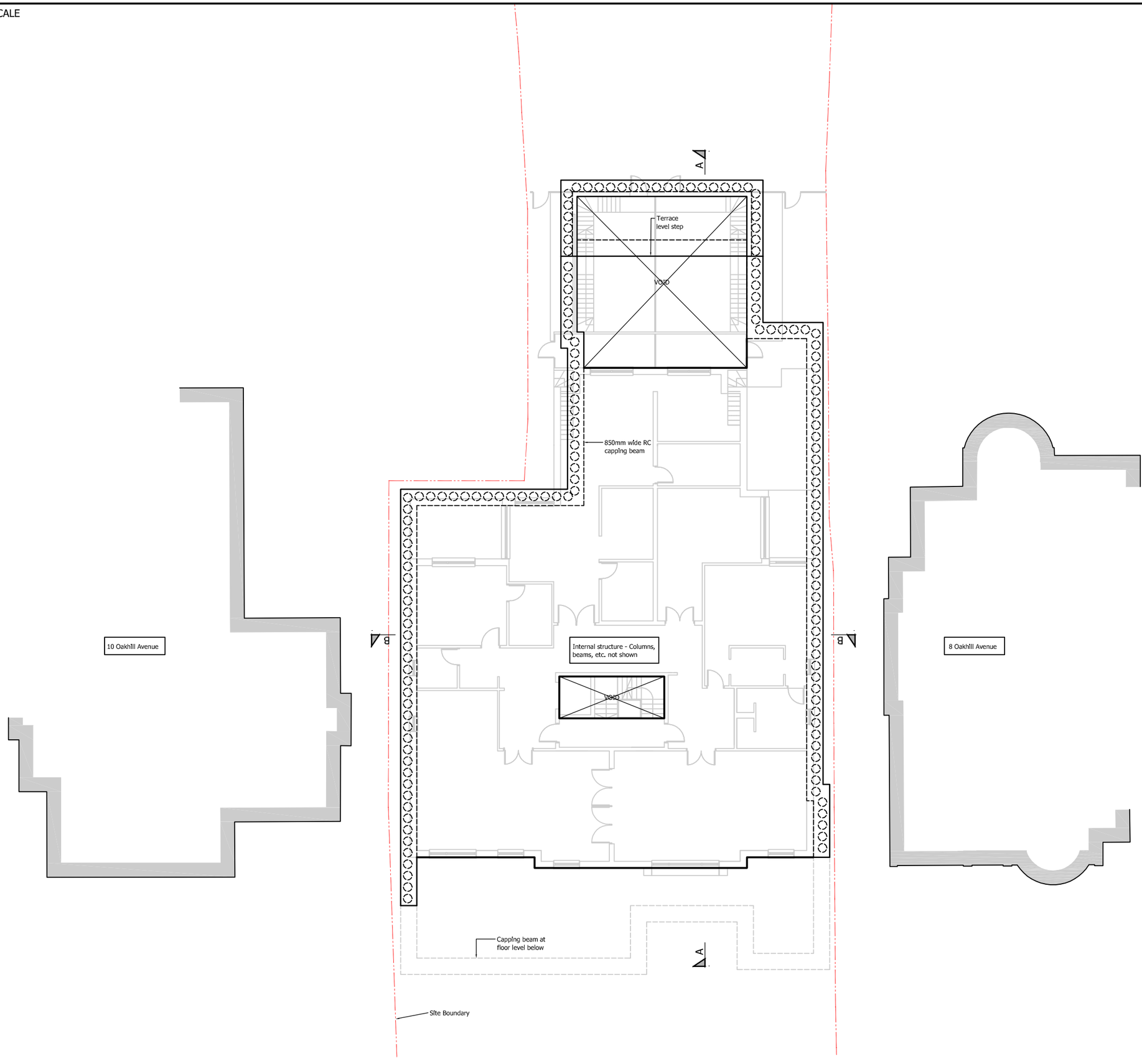
5.7 Notwithstanding the above, should neighbouring basements be discovered during the Party Wall agreement process, we will be able to make an specific assessment of the potential effect an increased water table may have on the neighbouring properties. Should an existing basement be discovered we would anticipate that the potential local increase in ground water level be unlikely to have a detrimental effect on the neighbouring properties, as the existing water table level would be classed as a high water table in any event. Any increase in local water table would impart an increase in hydrostatic pressure, which may be assessed in detail once the existing condition is definitively confirmed. In the unlikely event that an increased local water table could adversely affect the neighbouring properties, we would be able to introduce an under slab permeable drainage layer, which would be feed through locally broken out female secant wall piles, and sized according to calculation such that the potential damming effect of the basement on groundwater flow is regulated. This would result in a ground water table level which would be unaltered by the proposed development.

5.8 A Sustainable Drainage System Assessment and detailed drainage design will be prepared as part of the detailed development design to assess and manage the additional surface water run-off that will need to be attenuated on site and/or discharged appropriately.

5.9 Given the above we are able to conclude that the proposed works will not adversely affect the structural stability or integrity of the neighbouring structures.

Appendix A

DO NOT SCALE



REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

The contractor is to verify all dimensions on site before commencing work. All errors and omissions are to be reported to the Engineer. This drawing is to be read in conjunction with all relevant Architects, Services Engineers and Engineers drawings and specifications.

Project

10a Oakhill Avenue

Title

Structure Proposal Drawing
Upper Ground Floor Level

Client

Fitzroy Developments

Scale	Drawn	Date	Checked
1:100 @ A1	BB	Oct - 15	

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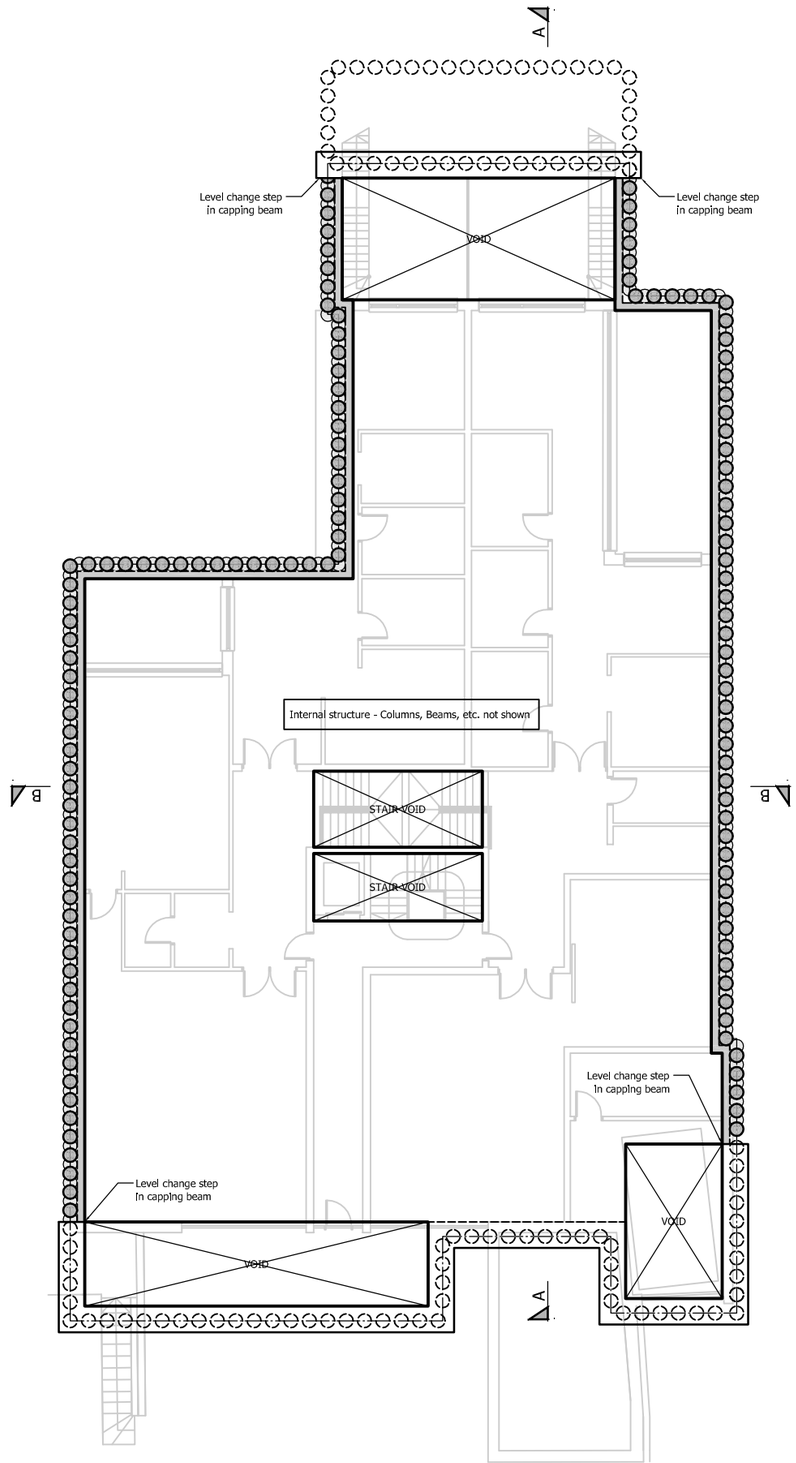
Drawing No.	Revision
5390 / SK / 001	P1

Drawing Status

- [x] INFORMATION
- [ ] APPROVAL
- [ ] COSTING
- [ ] TENDER
- [ ] CONSTRUCTION
- [ ] AS CONSTRUCTED

A1

DO NOT SCALE



REV	DATE	DESCRIPTION	DRAWN	CHKD

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Project

10a Oakhill Avenue

Title

Structure Proposal Drawing
Lower Ground Floor Level

Client

Fitzroy Developments

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Drawing No.	Revision
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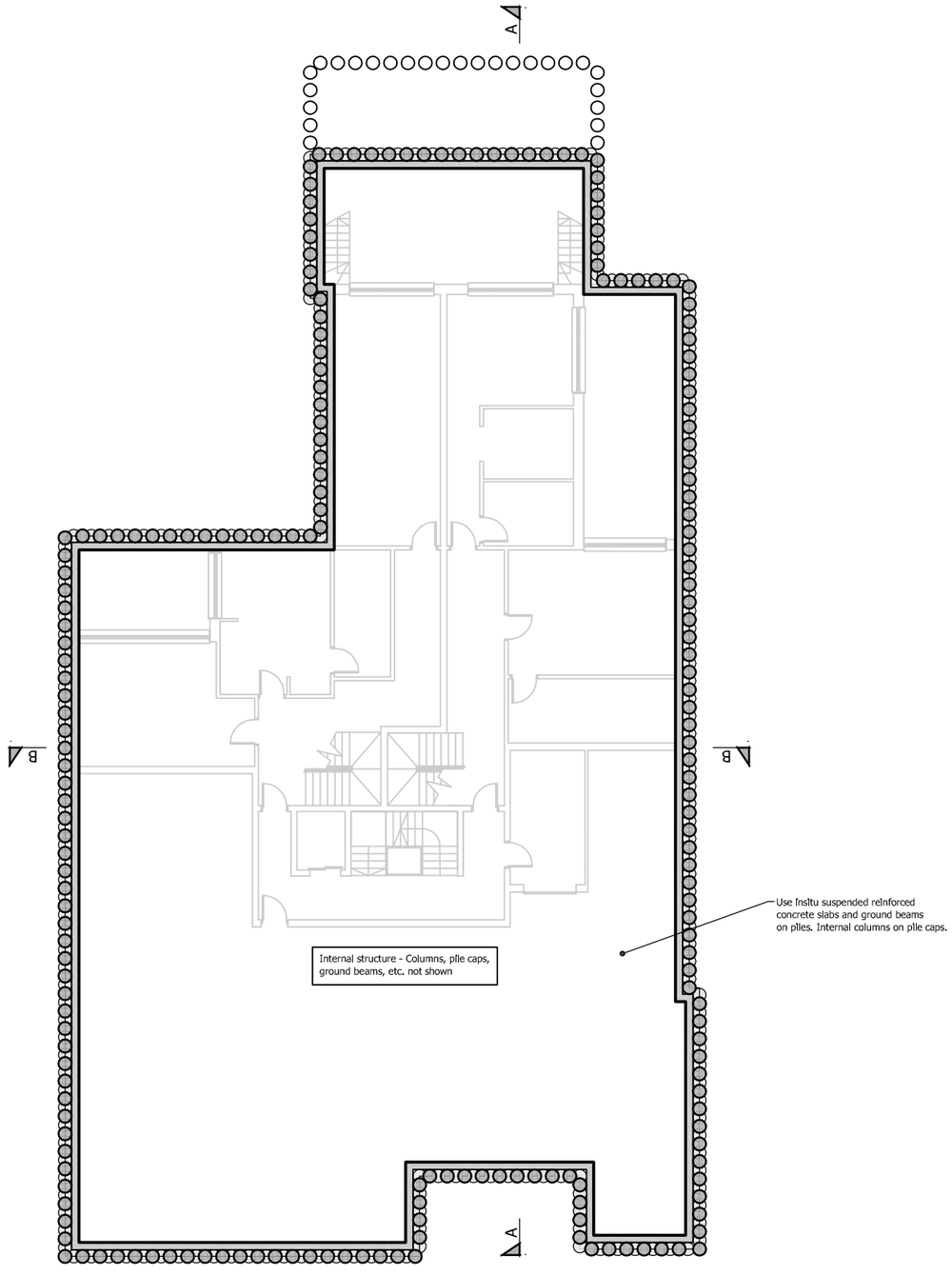

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Project

10a Oakhill Avenue

Title

Structure Proposal Drawing
Basement Level

Client

Fitzroy Developments

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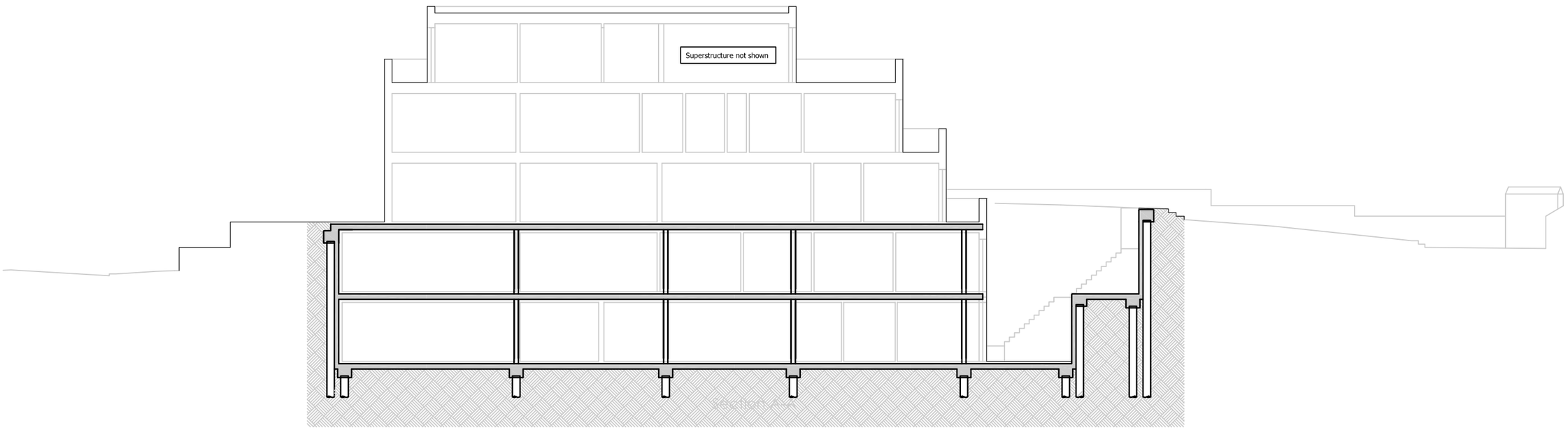
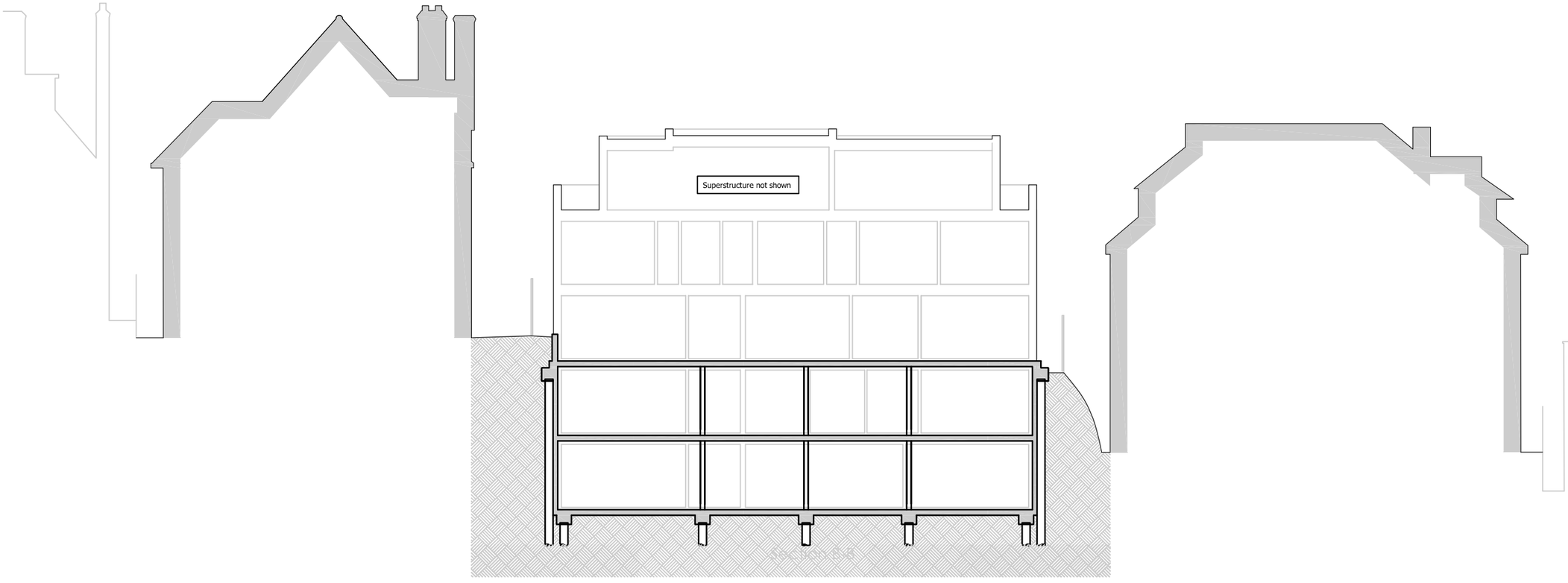


SECTION A-A
SCALE: 1:50



SECTION B-B
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REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

The contractor is to verify all dimensions on site before commencing work. All errors and omissions are to be reported to the Engineer. This drawing is to be read in conjunction with all relevant Architects, Services Engineers and Engineers drawings and specifications.

Project

10a Oakhill Avenue

Title

Structure Proposal Drawing
Indicative Sections

Client

Fitzroy Developments

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Drawing Status

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- [ ] COSTING
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- [ ] CONSTRUCTION
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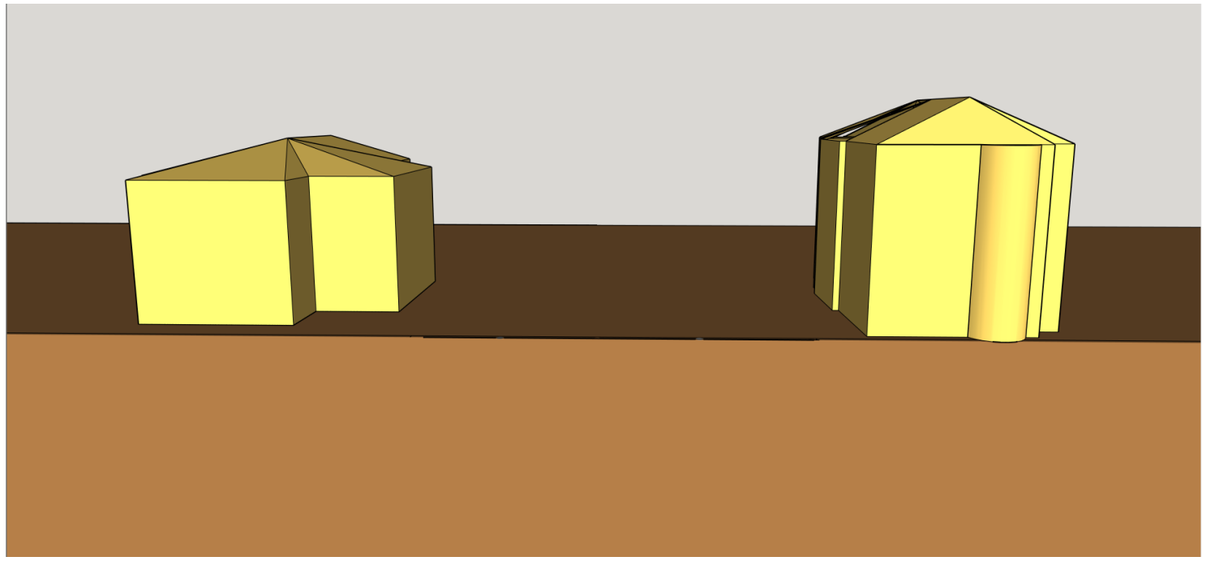
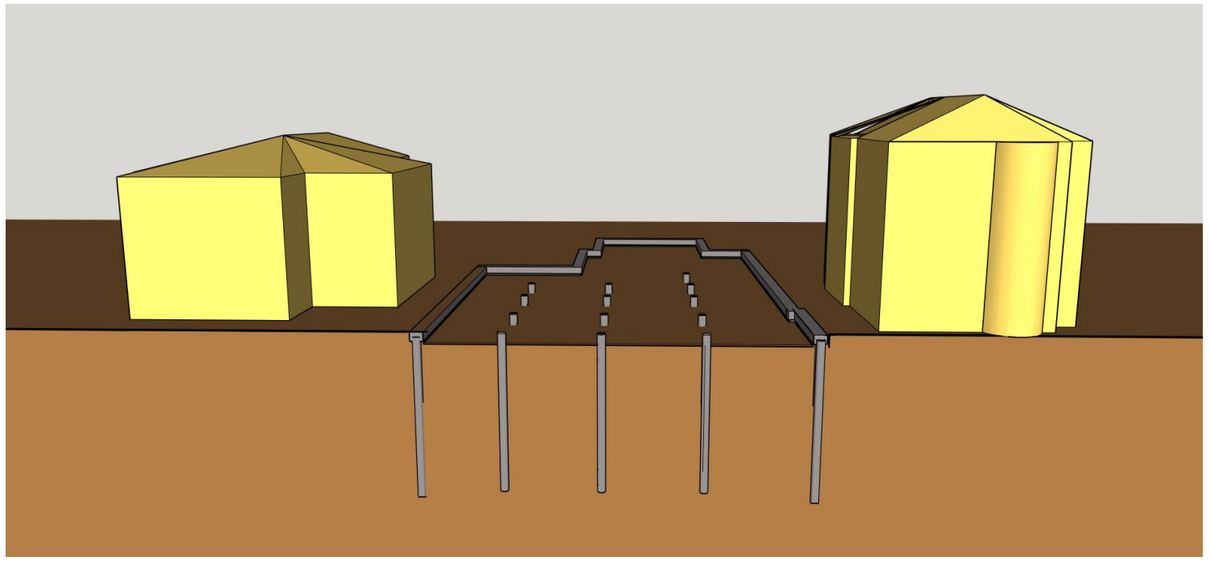
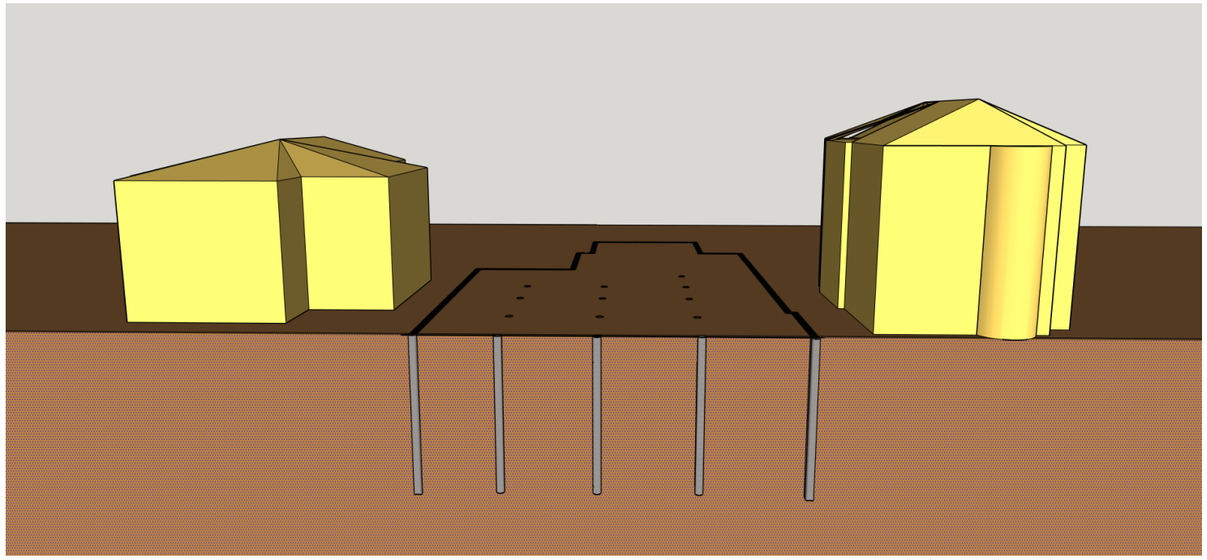
Appendix B



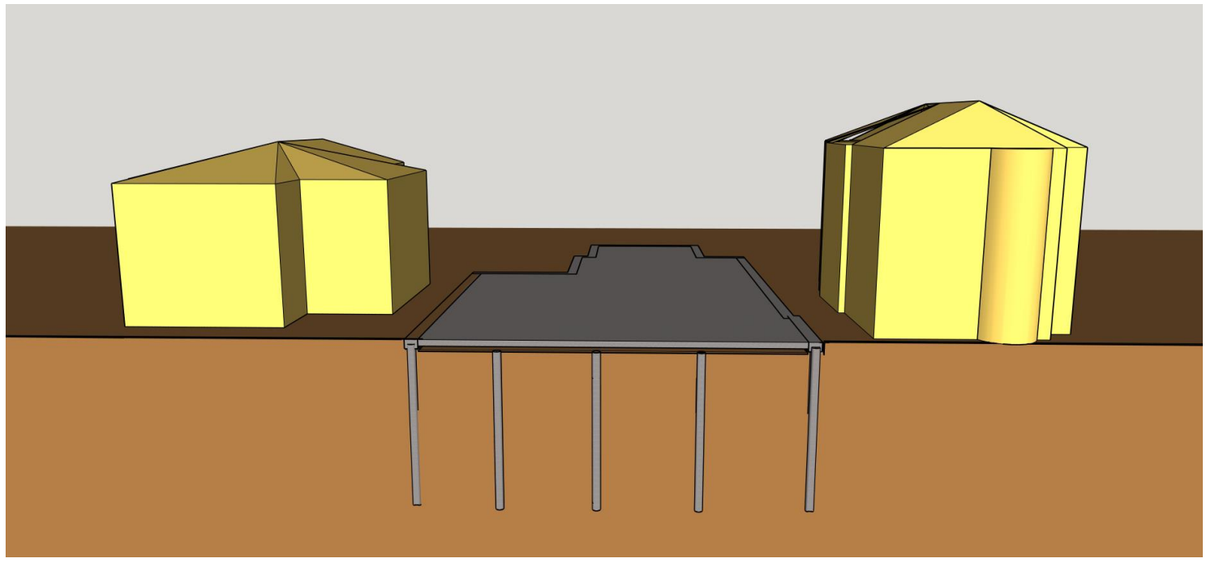
Stage one – demolition and site preparation, including piling mat and plant access.



Stage three - install capping beam and reduce site for ground floor slab installation.



Stage two – Secant pile wall installation and load bearing and tension pile installation.



Stage four – Install ground floor slab and beams, penetrations etc. for earthworks removal not shown.

Note – Site topography not shown for clarity. Actual installation will be formed over varying AOD levels.

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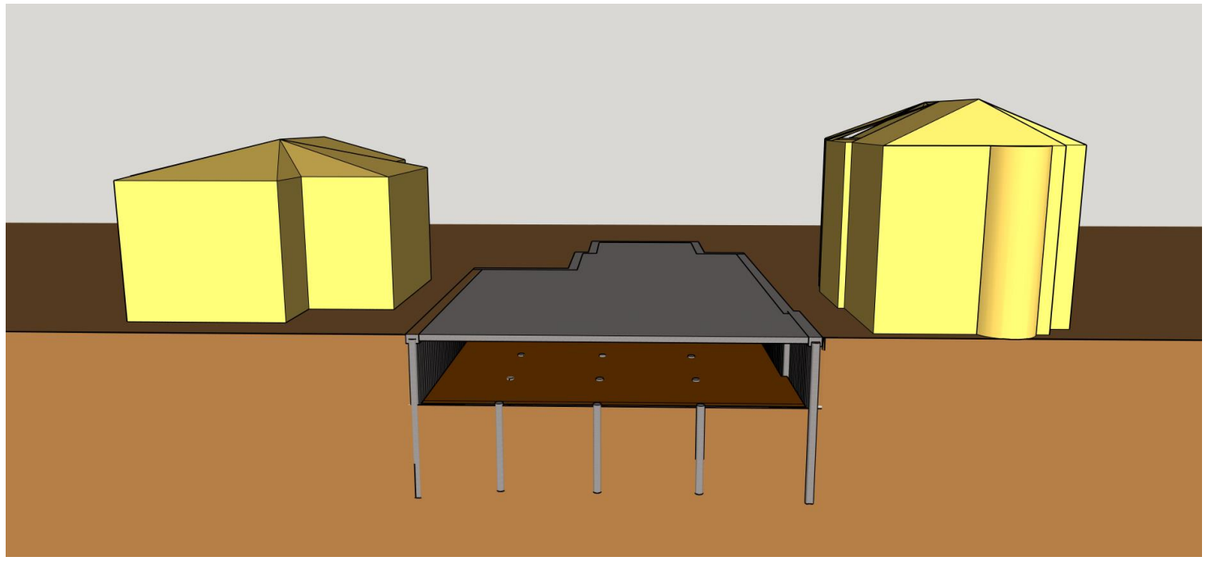
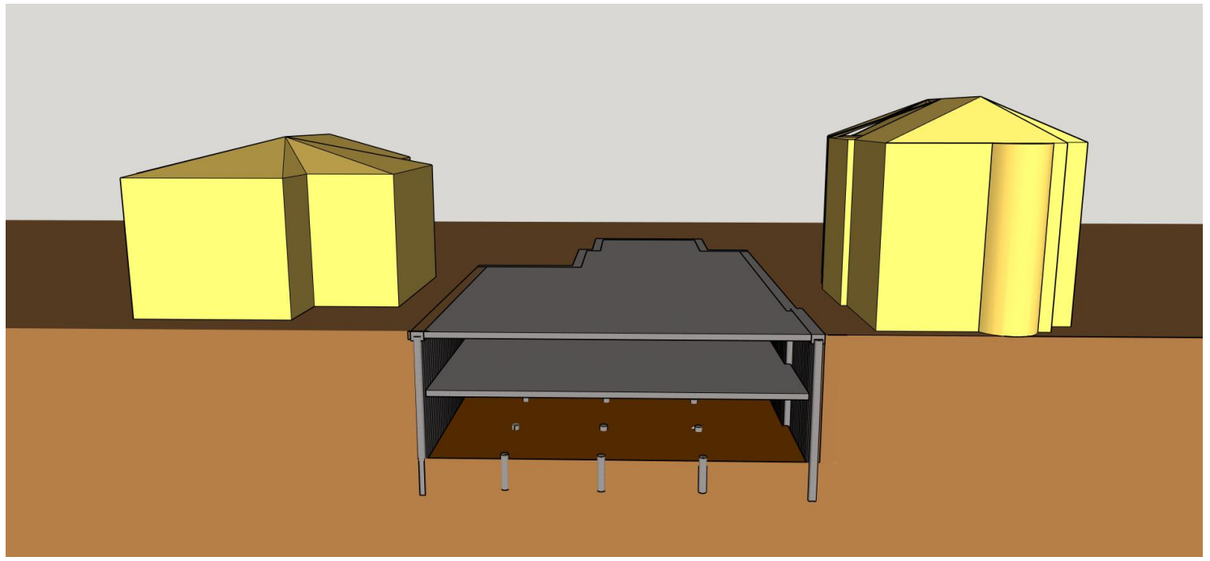
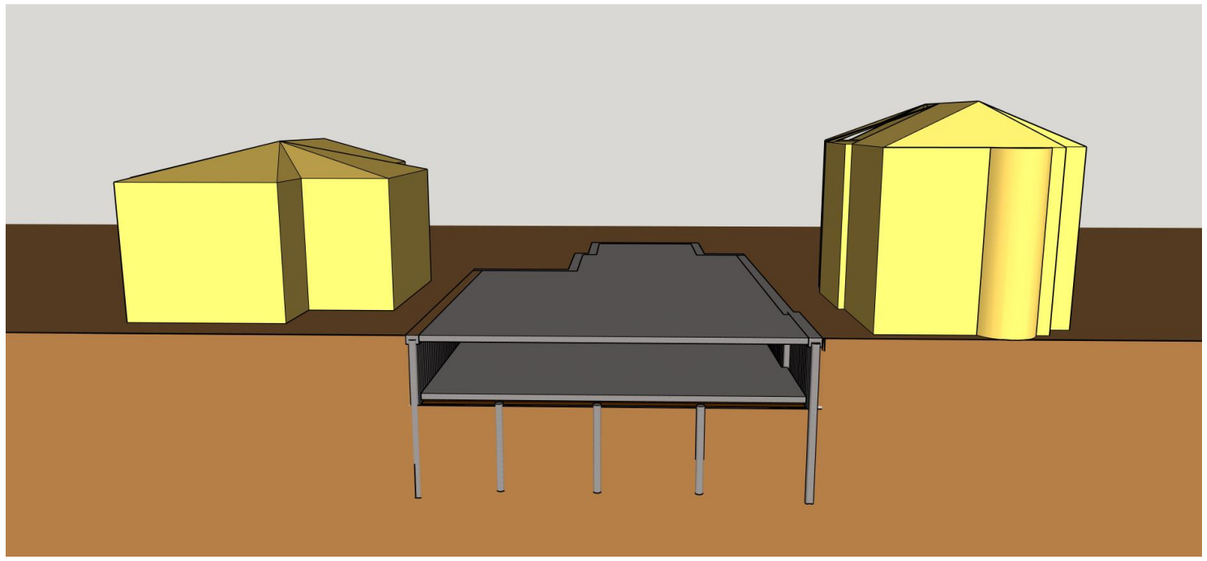
Project: 10a Oakhill Avenue, London NW3 7RE		Job Ref.: 5390
Section: Basement Works Sequence		Sheet No./Rev: B-1
Originator: BB	Date: Oct-15	Chk'd by: BB



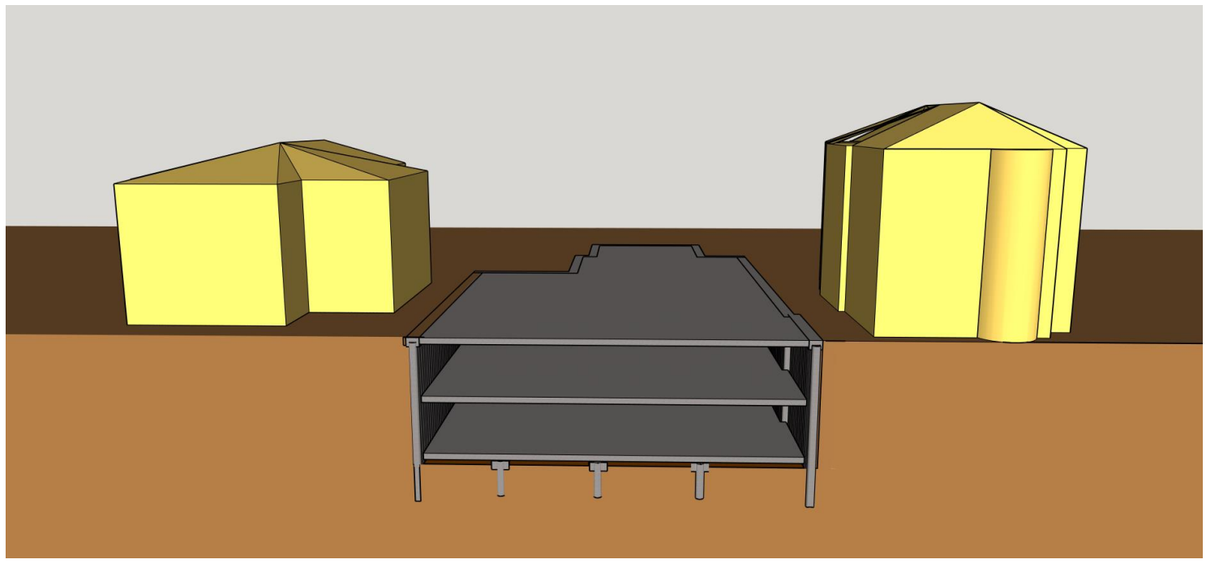
Stage five – Excavate to lower ground floor level. Retain plunge columns as required.



Stage seven - Excavate to basement level.



Stage six – Install lower ground floor slab and suspended , key to perimeter secant pile wall to offer restraint. Retain plunge columns as required.



Stage eight– Complete suspended basement slab on pile caps and ground beams.

Note – Site topography not shown for clarity. Actual installation will be formed over varying AOD levels.

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Project: 10a Oakhill Avenue, London NW3 7RE		Job Ref.: 5390
Section: Basement Works Sequence		Sheet No./Rev: B-2
Originator: BB	Date: Oct-15	Chk'd by: BB

5390 12 151217

17th December 2015

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Mr. A. Bavcic
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Dear Almas,

10A OAKHILL AVENUE, LONDON

We have been in receipt of a Basement Impact Assessment Audit report prepared by Consulting Engineers; Campbell Reith (the reporter), on the behalf of local authority planners at the London Borough of Camden. The report is titled 12066-40 revision D2, and was issued in December 2015.

The received report relates to our most recent Planning Application for this site and the accompanying supporting Engineering reports, specifically our report reference 5390 12 151012 dated 16th October 2015, and the third party reports named therein. The Campbell Reith report 12066-40-D2 highlights several items which require clarification, and this letter will serve to answer all points raised. We will address items raised using Campbell Reith's conclusions as a prompt, reiterated here for ease of reading:

5.1 The Basement Impact Assessment has been carried out by well-known firms of engineering consultants using individuals who possess suitable qualifications. A subsequent SER has similarly been prepared by appropriately qualified engineers.

No action is required.

5.2 Much of the information required by a BIA was not originally provided. The SER contains a construction methodology and proposed mitigation measures. No desk study, geotechnical interpretation, design advice for retaining walls, or programme have been provided.

The site investigation reports prepared in support of the planning application serve to address issues relating to site topography, hydrology, ground movement and viability. As such the report commissioned in advance of planning is a factual ground investigation study only, as detail design information is not required in advance of design development.

An interpretive ground investigation has been commissioned separately, and has been undertaken by consulting Geotechnical Engineers RSA Geotechnics. The results from this investigation include borehole explorations to a depth of 25m from the lowest existing site datum, supplemented by window sampling generally, and include interpretive discussion including all relevant design data; including pressure coefficient values and tabulated Atterberg limits.

We include with this letter an accompanying programme of works for the proposed development.

5.3 The proposed basement is to be founded close to the boundary between the Claygate Member and the London Clay with the proposed secant piled retaining wall extending into the London Clay Formation below. The exploratory holes extended only a short distance below the proposed basement level. The ground investigation contains insufficient information for the detailed design of the basement.

We are aware that an interpretive site investigation report is required in addition to the existing factual report, and so this additional report has been commissioned outside of the Basement Impact Assessment. We do not believe the interpretive report is relevant to the Basement Impact Assessment, and that the pre-existing data is adequate to appraise the impact the proposed development will have on the locale and on neighbouring property.

5.4 It is likely that the groundwater table will be encountered during basement foundation excavation. No measures for permanent exclusion have been provided, although the secant piled wall will exclude groundwater during construction.

The basement space will be a Grade Three habitable environment, as defined by BS 8102.

We are proposing the use of a 300mm thick water tight concrete basement slab with a 200mm thick water tight concrete lining wall formed to the face of the secant pile perimeter, in order to form a type B (structurally integral) barrier. This barrier will be achieved with the use of a plasticising concrete additive agent provided by Xypex or similar approved substitute. All joints, service penetrations and material specifications will be to Xypex (or similar approved) specialist details.

We will also utilise a cavity drain system in addition to the water tight lining wall in order to form a type C (drained) barrier, which will be applied to line both the basement floor slab and all perimeter retaining walls. The supplier of the cavity drain system is not confirmed at this time, but will likely be a Delta Drain membrane cavity.

In terms of structural design at this time we will be adversely assuming a head of groundwater at 1.0m below existing ground level, in accordance with the guidance offered in BS 8102, and subject in addition to hydrology investigation findings which are ongoing. Until the hydrology monitoring is complete to a suitable time period we are adversely assuming a 1.0m head depth. This hydrostatic pressure will be taken to design against uplift of the suspended basement slab, and lateral pressure on all retaining walls.

5.5 The BIA states proposed basement will be constructed using a secant piled wall with top down construction techniques. This forms the basis of assumptions made in the reports concerning ground movements etc. and has been confirmed with outline details for temporary and permanent works presented in the SER.

No action is required.

5.6 The groundwater assessment predicts groundwater level rises of up to 0.40m. The assessment states this is within seasonal fluctuations. However, seasonal fluctuations have not been determined. Further investigation of the neighbouring properties construction is still required to ascertain whether there are existing basements which could be affected by the predicted rise in groundwater levels caused by the proposed basement construction.

The reporter identifies that the groundwater assessment report does not define a seasonal high point water table datum; standpipe monitoring is ongoing, but adverse assumption has been made in lieu of detailed results. We are aware of this point also, and as such have previously undertaken a walkover survey to identify any evidence of neighbouring basements which might be affected by an adverse change in water table level (our previous report '5390 12 151012' elaborated on this point).

The reporter highlights that a walkover survey is not adequate to draw a robust conclusion as to the presence of neighbouring basements, and to that end we agree; our original proposal was to address and finalise this concern during the Party Wall process, where access might be granted as part of a condition survey. Given that this concern has been raised again by the reporter, we have since instructed our clients Party Wall surveyor to contact the owners of both number 8 and number 10 Oakhill Avenue to confirm directly if the properties have any subterranean development on site. Both owners responded and have confirmed that their properties do not have basements. In addition to

this we have obtained record drawings from the planning portal for both properties which show the developments in full, both of which show that no basements are present in either property.

5.7 Horizontal and vertical ground movement analysis predicts negligible impact on neighbouring properties provided the construction technique mentioned in 5.5 is adopted. The SER states that damage will not exceed slight. No supporting evidence for the conclusions is provided. All assumptions and input/output data for software analysis must be clearly presented together with evidence that all possible causes of ground movement have been considered.

We enclose with this letter our Damage Assessment analysis based on predicted ground movements.

In order to allow for potential unforeseen temporary condition lateral and/or vertical condition local ground movements we have assumed a set of adverse behaviours, and have so reviewed the boundary displacements assuming horizontal and vertical displacement of 10mm each. The ground movement assessment report prepared by Key GS reference 15-061-R-001 describes maximum vertical and horizontal displacements adjacent excavations to be less than 10mm, and the analysis result values are in fact ~3mm both horizontally and vertically. The result of our damage assessment concludes the predicted category of damage to be zero – negligible, according to the Burland scale. Given the above, our conclusion in point 5.3 of report reference 5390 1 151016 stands as prudent and conservative.

Additionally the reporter asks that all possible causes of ground movement be considered; we have considered all possible adverse ground movements as a result of erecting the proposed scheme, in both the temporary condition and the permanent condition, as follows:

1. Permanent condition settlement and gravity load displacements have been considered as part of Key GS report reference 15-061-R-001. A subsequent damage assessment has been given in this study.

2. Temporary condition ground movements are limited to loading and behavioural parameters which are not as onerous as the permanent condition. The vertical displacements will be lower in the temporary condition as the building dead load will not apply, and so permanent condition settlement will not manifest. The horizontal displacements will be limited by the 'top-down' construction methodology which ensures that the embedded retaining walls will remain propped at ground floor level throughout all stages. There will be a transitional stage in the excavation process where passive embedment will be responsible for arresting the perimeter in lieu of the lower ground floor construction, and then basement slab construction. In this instance a deflection limit will be imposed and the pile design will include excavation shoring and temporary propping as required to adhere to this limit of 10mm.

3. Demolition phase works may involve partially re-grading the site with a view to providing a piling mat for construction. We have determined that a split two tier piling mat at the existing AOD levels of 95.350m and 96.150m is viable, and has been approved by ground works specialist contractors Trenchco, including an approval of required traffic ramp gradients. As such no temporary condition piling mat shoring or excavation is required.

4. There may be unplanned excavation as part of the site preparation works, and in the preparation of perimeter capping beams. We have determined that any such unplanned excavation would be less than 1m in depth at the site boundary. As such, and given this restriction, we can conclude that any un-planned excavation within these limits would be outside of the zone of influence of neighbouring foundations, and as such would not affect the formation level of the neighbouring properties.

5.8 The SER states that a movement monitoring strategy will be agreed with the party wall surveyor. This should include the monitoring of movement during excavation and construction. Condition surveys of potentially affected properties are also required.

No action is required.

5.9 It is accepted that there are no adverse impacts on slope stability, surface water flows or flooding.

No action is required.

5.10 Further consideration of the impact of the predicted groundwater level rise is required, together with justification for the building damage assessment. It is considered that other matters such as an appropriate ground investigation, detailed design of the substructure (temporary and permanent works) and basement waterproofing can be closed out in Basement Construction Plan.

This item summarises the above raised points, hence no specific action is required.

We hope that the above serves to answer all the points highlighted for attention.

Yours Sincerely,

Ben Bradshaw BEng CEng MIStructE
Associate
Packman Lucas

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Project		Job Ref.
10a Oakhill Avenue		5390
Section		Sheet No./Rev
Damage Assessment		1
Originator	Date	Chk'd By
CF	Dec-15	BB

Damage Assessment

The following classifies the potential damage to the neighbouring properties of 10a Oakhill Avenue due to the construction of the basement. The classification follows CIRIA Report C580; a 3 stage procedure.

Stage 1

Estimate the ground movements.

Limit horizontal & vertical deflection to 10mm.

Estimate zone of influences.

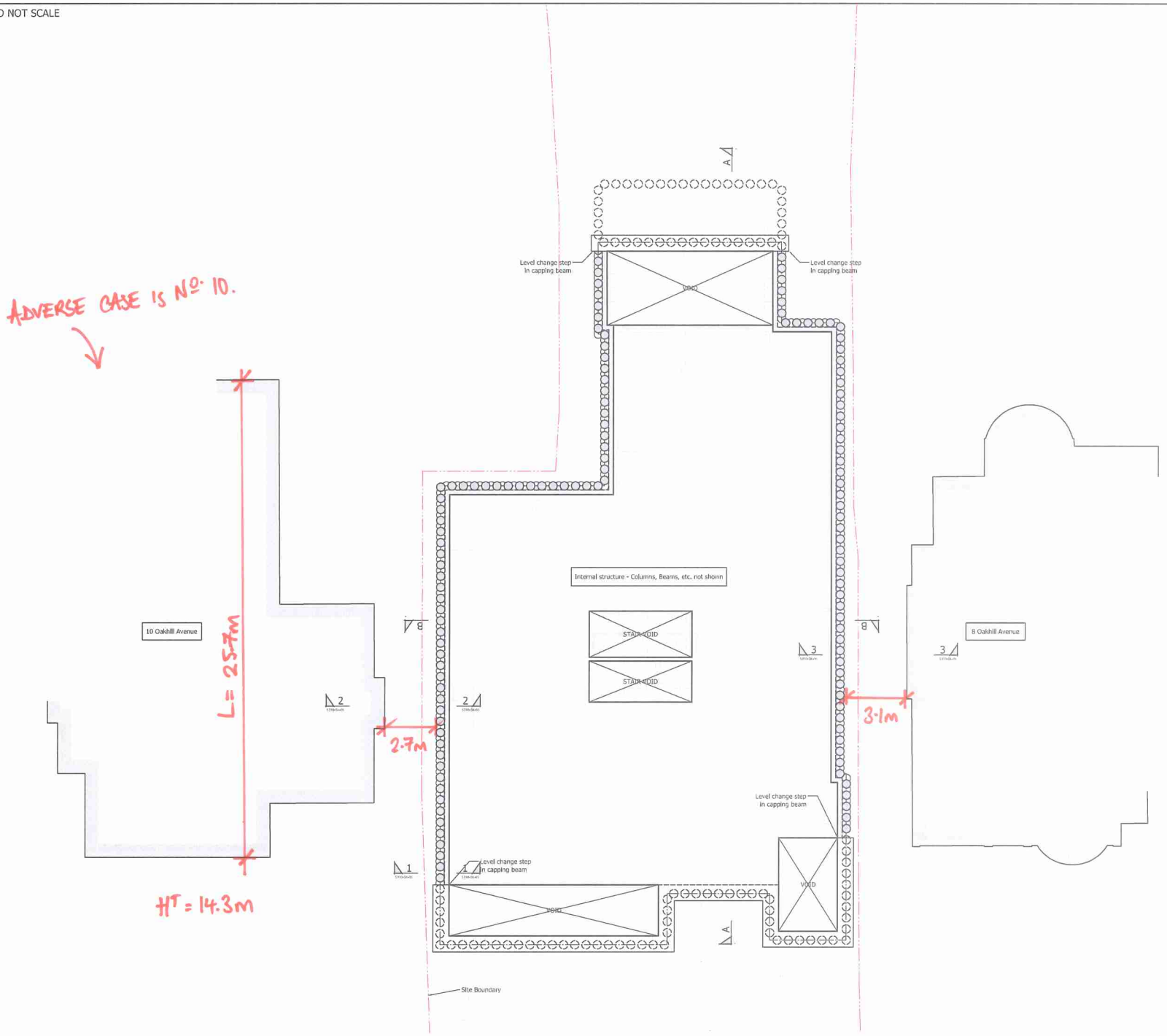
Use Box 2.3 in Chapter 2.5 of C580. The typical horizontal displacement of a low stiffness embedded retaining wall is assumed.

Stage 2

Determine the effect on structures within the zone of influence.

- The following sketch (5390-SK-02) shows a site plan.
- No. 10 Oakhill is considered the adverse case within the zone of influence.
  - The property is a masonry structure.
  - The distance from the piled wall is 2.7m
  - The length of the property is 25.7m
  - The height of the property is 14.3m
- No. 8 Oakhill is also within the zone of influence.
  - The property is a masonry structure.
  - Distance from the piled wall is 3.1m
  - The length of the property is 23.8m
  - The height of the property is 14.0m

DO NOT SCALE



REV	DATE	DESCRIPTION	DRAWN	CHKD
P2	23.11.15	ISSUED FOR DISCUSSION	BB	BB
P1	16.10.15	ISSUED FOR DISCUSSION	BB	BB

REVISIONS

This contractor is to verify all dimensions on site before commencing work. All errors and omissions are to be reported to the Engineer. This drawing is to be read in conjunction with all relevant Architects, Services Engineers and Engineers drawings and specifications.

Project

10a Oakhill Avenue

Title

Structure Proposal Drawing
Lower Ground Floor Level

Client

Fitzroy Developments

Scale	Drawn	Date	Checked
1:100 @ A1	BB	Oct - 15	

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Drawing No.	Revision
~~5390 / SK / 02~~	P2

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Project	Job Ref.
10a Oakhill Avenue	5390
Section	**Sheet No./Rev**
Damage Assessment	2
Originator / **Date**	**Chk'd By**
CF / Dec-15	BB

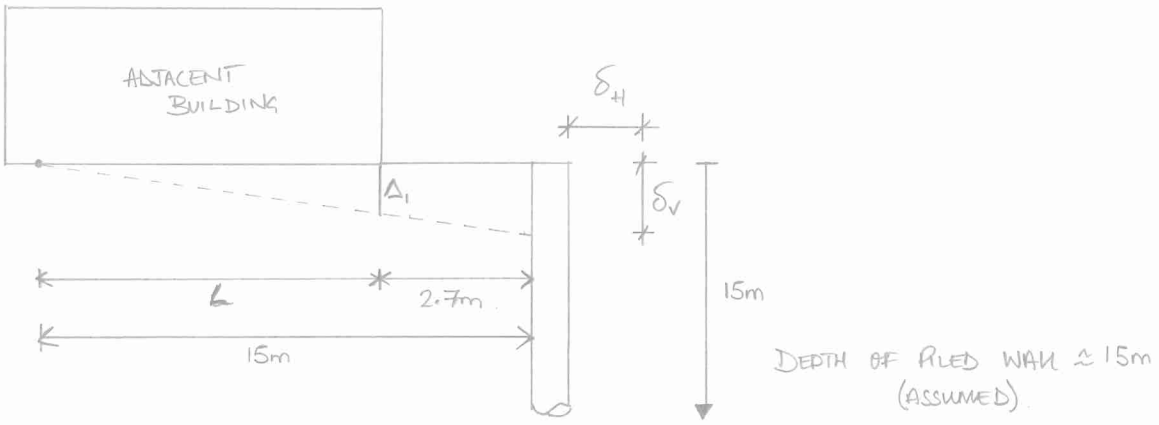
- USE MILLIGANS FIELD OF PLASTIC DEFORMATION, 1983

A METHOD OF DISTRIBUTION FOR THE SOIL PARTICLES BEHIND THE WALL. ALL PARTICLES ARE ASSUMED TO MOVE AT 45°.

PROCEDURE FROM BOX 2.5, C580

$\delta_H = \delta_V = 10mm$

RELATIVE BUILDING MOVEMENT



$L = 15 - 2.7m$
$= 12.3m$

$\therefore \Delta_1 = \frac{10}{15000} \times 12300 = 8.2mm.$

$\frac{\Delta}{L} = \frac{8.2mm}{12300mm} = 0.00067 = 0.067\%$

$\varepsilon_H = \frac{\delta_H}{L} = \frac{10}{12300} = 0.00081 = 0.081\%$

BUILDING PROPERTIES, $\frac{L}{H} = \frac{25.7}{14.3} = 1.80$

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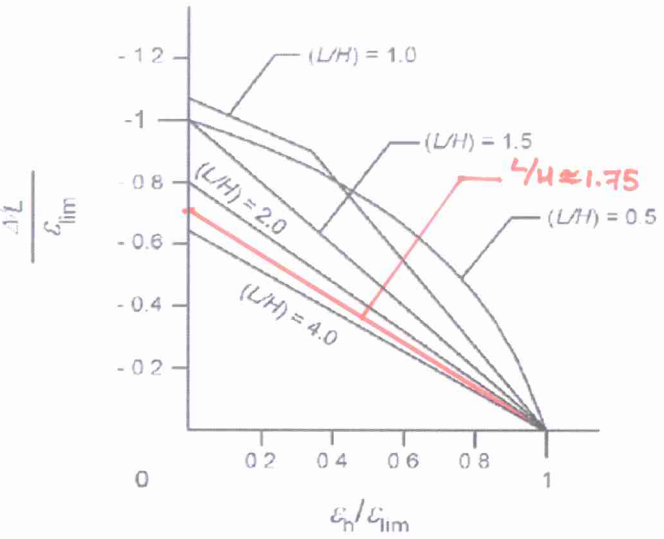
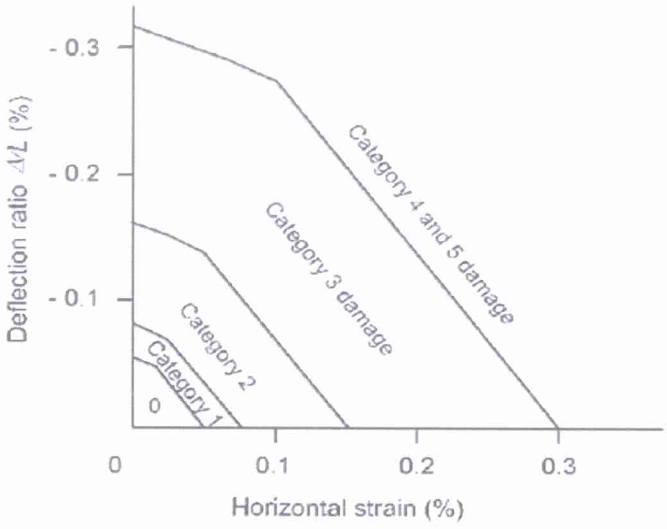
Project	Job Ref.
10a Oakhill Avenue	5390
Section	**Sheet No./Rev**
Damage Assessment	3
Originator / **Date**	**Chk'd By**
CF / Dec-15	BB



(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)

By adopting values of ε_{lim} associated with the various damage catgories given in Table 2.5, Figure (b) can be developed into an interaction diagram showing the relationship between Δ/L and ε_h for a particular value of L/H Figure (c) shows such a diagram for $(L/H) = 1.0$.

Figure 2.18 *Relationship between damage category, deflection ratio and horizontal tensile strain (after Burland, 2001)*

REFERRING TO FIG 2.18(b). SOLVE TO FIND ε_{lim}.

$y = mx - 0.9$. WHERE $y = \frac{\Delta/L}{\varepsilon_{lim}}$ $x = \frac{\varepsilon_h}{\varepsilon_{lim}}$ $m = \frac{\Delta x}{\Delta y}$

$\therefore$

$$\frac{\Delta/L}{\varepsilon_{lim}} = \left(\frac{1}{0.9} \times \frac{\varepsilon_h}{\varepsilon_{lim}}\right) - 0.9$$ - MULTIPLY BY ε_{lim}

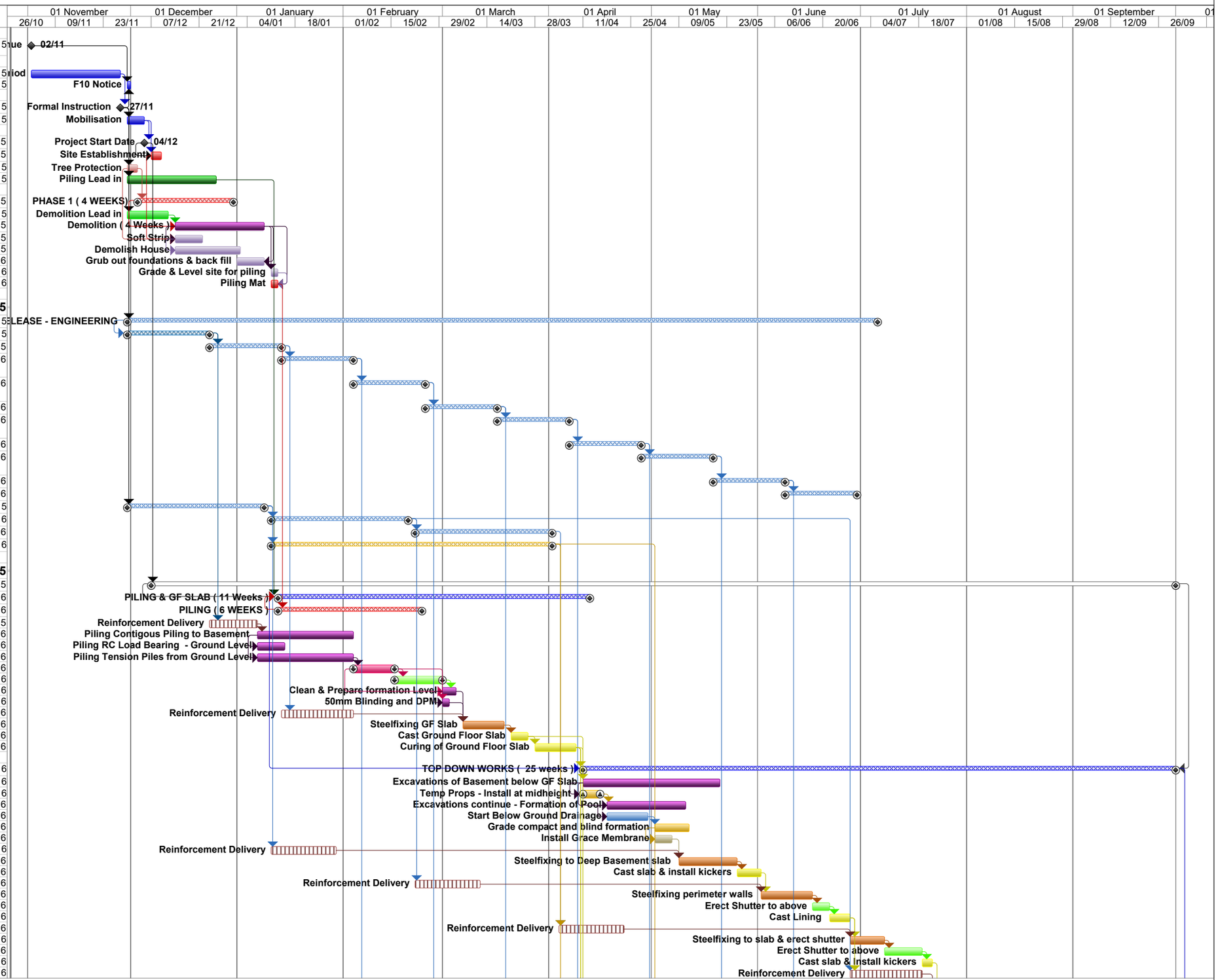
$\Delta/L = \varepsilon_h/0.9 - 0.9\varepsilon_{lim}$. - SUBSTITUTE VALUES. $\Delta/L = 0.067$, $\varepsilon_h = 0.081$

$\varepsilon_{lim} = 0.026$

- REFER TO TABLE 2.5 OF C580. CATEGORY OF DAMAGE IS 0 - NEGLIGABLE.
- STAGE 3 INVOLVES REFINING ESTIMATES BUT AS THE ESTIMATED DAMAGE IS NEGLIGABLE WITH CONSERVATIVE ESTIMATES - NO FURTHER ASSESSMENT REQUIRED.

10A OAKHILL AVENUE

ID	Task Name	Duration	Start
1			
2	**10a Oakhill Avenue**	0 days	Mon 02/11/15
3			
4	CDM Planning Period	20 days	Mon 02/11/15
5	F10 Notice	1 day?	Mon 30/11/15
6			
7	**Formal Instruction**	0 days	Fri 27/11/15
8	Mobilisation	5 days	Mon 30/11/15
9			
10	**Project Start Date**	0 days	Fri 04/12/15
11	**Site Establishment**	3 days	Mon 07/12/15
12	Tree Protection	3 days	Mon 30/11/15
13	Piling Lead in	20 days	Mon 30/11/15
14			
15	**PHASE 1 (4 WEEKS)**	20 days	Thu 03/12/15
16	Demolition Lead in	10 days	Mon 30/11/15
17	**Demolition (4 Weeks)**	20 days	Mon 14/12/15
18	Soft Strip	6 days	Mon 14/12/15
19	Demolish House	15 days	Mon 14/12/15
20	Grub out foundations & back fill	6 days	Fri 01/01/16
21	Grade & Level site for piling	2 days	Mon 11/01/16
22	Piling Mat	2 days	Mon 11/01/16
23			
24	**ENGINEERING DESIGN**	**1 day?**	**Mon 26/10/15**
25	**DESIGN RELEASE - ENGINEERING**	157 days	Mon 30/11/15
26	**REBAR DESIGN - Piling**	18 days	Mon 30/11/15
27	**REBAR DESIGN - Ground floor**	15 days	Thu 24/12/15
28	**REBAR DESIGN - Cols-walls Gd - 1st Flr**	15 days	Thu 14/01/16
29	**REBAR DESIGN - Lift Shaft & Staircase walls**	15 days	Thu 04/02/16
30	**REBAR DESIGN - First Floor Slab**	15 days	Thu 25/02/16
31	**REBAR DESIGN - Columns & walls 1st to 2nd**	15 days	Thu 17/03/16
32	**REBAR DESIGN - 2nd Floor slab**	15 days	Thu 07/04/16
33	**REBAR DESIGN - 2nd to Roof walls & columns**	15 days	Thu 28/04/16
34	**REBAR DESIGN - Roof slab**	15 days	Thu 19/05/16
35	**REBAR DESIGN - STEELWORK**	15 days	Thu 09/06/16
36	**REBAR DESIGN - Pool Slab**	30 days	Mon 30/11/15
37	**REBAR DESIGN - Basement walls**	30 days	Mon 11/01/16
38	**REBAR DESIGN - Basement slab**	30 days	Mon 22/02/16
39	**STEEL FRAME DESIGN**	60 days	Mon 11/01/16
40			
41	**SUBSTRUCTURE**	**1 day?**	**Mon 26/10/15**
42	**PHASE 1 & 2 (43 WEEKS)**	215 days	Mon 07/12/15
43	**PILING & GF SLAB (11 Weeks)**	65 days	Wed 13/01/16
44	**PILING (6 WEEKS)**	30 days	Wed 13/01/16
45	Reinforcement Delivery	10 days	Thu 24/12/15
46	Piling Contigous Piling to Basement	20 days	Thu 07/01/16
47	Piling RC Load Bearing - Ground Level	6 days	Thu 07/01/16
48	Piling Tension Piles from Ground Level	20 days	Thu 07/01/16
49	Trim down top of piles & Test	8 days	Thu 04/02/16
50	ring beam	10 days	Tue 16/02/16
51	Clean & Prepare formation Level	4 days	Tue 01/03/16
52	50mm Blinding and DPM	2 days	Tue 01/03/16
53	Reinforcement Delivery	15 days	Thu 14/01/16
54	Steelfixing GF Slab	10 days	Mon 07/03/16
55	Cast Ground Floor Slab	5 days	Mon 21/03/16
56	Curing of Ground Floor Slab	10 days	Mon 28/03/16
57			
58	**TOP DOWN WORKS (25 weeks)**	125 days	Mon 11/04/16
59	Excavations of Basement below GF Slab	30 days	Mon 11/04/16
60	Temp Props - Install at midheight	5 days	Mon 11/04/16
61	Excavations continue - Formation of Pool	17 days	Mon 18/04/16
62	Start Below Ground Drainage	10 days	Mon 18/04/16
63	Grade compact and blind formation	8 days	Mon 02/05/16
64	Install Grace Membrane	5 days	Mon 02/05/16
65	Reinforcement Delivery	15 days	Mon 11/01/16
66	Steelfixing to Deep Basement slab	13 days	Mon 09/05/16
67	Cast slab & install kickers	5 days	Thu 26/05/16
68	Reinforcement Delivery	15 days	Mon 22/02/16
69	Steelfixing perimeter walls	11 days	Thu 02/06/16
70	Erect Shutter to above	3 days	Fri 17/06/16
71	Cast Lining	4 days	Wed 22/06/16
72	Reinforcement Delivery	15 days	Mon 04/04/16
73	Steelfixing to slab & erect shutter	8 days	Tue 28/06/16
74	Erect Shutter to above	7 days	Fri 08/07/16
75	Cast slab & Install kickers	3 days	Tue 19/07/16
76	Reinforcement Delivery	15 days	Tue 28/06/16

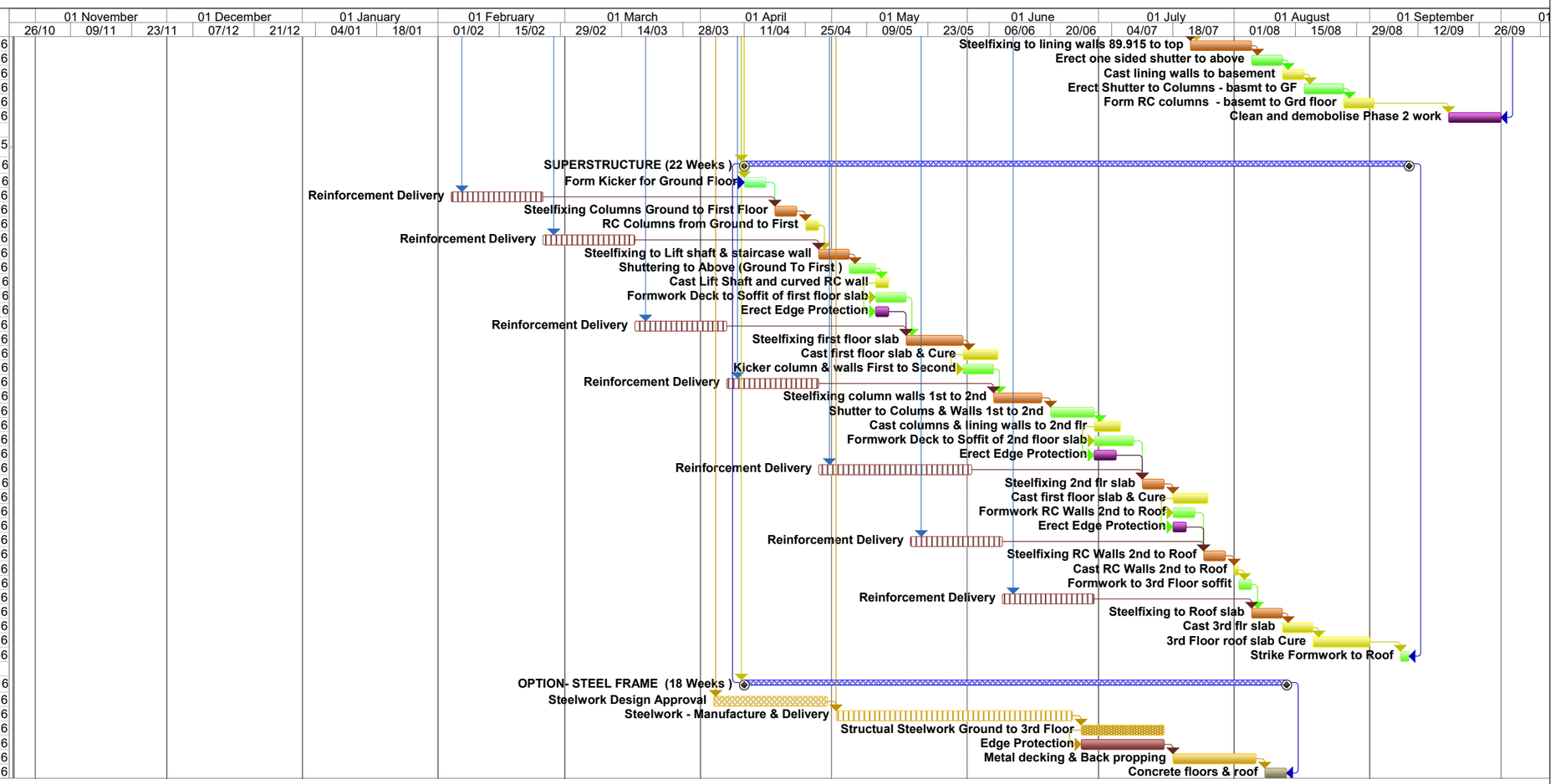


Project: Ridgefield, Courtenay Ave
Date: Tue 27/10/15

Task	Summary	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Progress
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Deadline

10A OAKHILL AVENUE

ID	Task Name	Duration	Start
77	Steelfixing to lining walls 89.915 to top	10 days	Fri 22/07/16
78	Erect one sided shutter to above	5 days	Fri 05/08/16
79	Cast lining walls to basement	3 days	Fri 12/08/16
80	Erect Shutter to Columns - basmt to GF	7 days	Wed 17/08/16
81	Form RC columns - basemt to Grd floor	5 days	Fri 26/08/16
82	Clean and demobolise Phase 2 work	10 days	Mon 19/09/16
83			
84	**SUPERSTRUCTURE**	1 day?	Mon 26/10/15
85	**SUPERSTRUCTURE (22 Weeks)**	110 days	Mon 11/04/16
86	Form Kicker for Ground Floor	5 days	Mon 11/04/16
87	Reinforcement Delivery	15 days	Thu 04/02/16
88	Steelfixing Columns Ground to First Floor	5 days	Mon 18/04/16
89	RC Columns from Ground to First	3 days	Mon 25/04/16
90	Reinforcement Delivery	15 days	Thu 25/02/16
91	Steelfixing to Lift shaft & staircase wall	5 days	Thu 28/04/16
92	Shuttering to Above (Ground To First)	4 days	Thu 05/05/16
93	Cast Lift Shaft and curved RC wall	3 days	Wed 11/05/16
94	Formwork Deck to Soffit of first floor slab	5 days	Wed 11/05/16
95	Erect Edge Protection	3 days	Wed 11/05/16
96	Reinforcement Delivery	15 days	Thu 17/03/16
97	Steelfixing first floor slab	9 days	Wed 18/05/16
98	Cast first floor slab & Cure	6 days	Tue 31/05/16
99	Kicker column & walls First to Second	5 days	Tue 31/05/16
100	Reinforcement Delivery	15 days	Thu 07/04/16
101	Steelfixing column walls 1st to 2nd	9 days	Tue 07/06/16
102	Shutter to Colums & Walls 1st to 2nd	8 days	Mon 20/06/16
103	Cast columns & lining walls to 2nd flr	4 days	Thu 30/06/16
104	Formwork Deck to Soffit of 2nd floor slab	7 days	Thu 30/06/16
105	Erect Edge Protection	3 days	Thu 30/06/16
106	Reinforcement Delivery	25 days	Thu 28/04/16
107	Steelfixing 2nd flr slab	5 days	Mon 11/07/16
108	Cast first floor slab & Cure	6 days	Mon 18/07/16
109	Formwork RC Walls 2nd to Roof	5 days	Mon 18/07/16
110	Erect Edge Protection	3 days	Mon 18/07/16
111	Reinforcement Delivery	15 days	Thu 19/05/16
112	Steelfixing RC Walls 2nd to Roof	5 days	Mon 25/07/16
113	Cast RC Walls 2nd to Roof	1 day	Mon 01/08/16
114	Formwork to 3rd Floor soffit	3 days	Tue 02/08/16
115	Reinforcement Delivery	15 days	Thu 09/06/16
116	Steelfixing to Roof slab	5 days	Fri 05/08/16
117	Cast 3rd flr slab	5 days	Fri 12/08/16
118	3rd Floor roof slab Cure	9 days	Fri 19/08/16
119	Strike Formwork to Roof	2 days	Thu 08/09/16
120			
121	**OPTION- STEEL FRAME (18 Weeks)**	90 days	Mon 11/04/16
122	Steelwork Design Approval	20 days	Mon 04/04/16
123	Steelwork - Manufacture & Delivery	40 days	Mon 02/05/16
124	Structual Steelwork Ground to 3rd Floor	15 days	Mon 27/06/16
125	Edge Protection	15 days	Mon 27/06/16
126	Metal decking & Back propping	15 days	Mon 18/07/16
127	Concrete floors & roof	5 days	Mon 08/08/16



Project: Ridgefield, Courtenay Ave
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Task		Summary		External Milestone		Inactive Summary		Manual Summary Rollup		Finish-only	
Split		Project Summary		Inactive Task		Manual Task		Manual Summary		Progress	
Milestone		External Tasks		Inactive Milestone		Duration-only		Start-only		Deadline	

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