

**61 REDINGTON ROAD, LONDON. NW3 7RP**

**BASEMENT IMPACT ASSESSMENT.**

**STRUCTURAL DESIGN , CONSTRUCTION SEQUENCE AND  
TEMPORARY WORKS**



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## 1. INTRODUCTION.

Vincent & Rymill, Consulting Engineers, have been appointed by the building owner to prepare a B.I.A. for Planning purposes. The author of this report T. J. Vincent Bsc C.Eng M.I.Struct. E. first worked with The London Basement Company in 2004, designing and detailing such retro fitted basements all over London. Since that time T. J. Vincent has designed over 450 basements, both single and multi storey.

Site Investigation and B.I.A. has been carried out by Messrs Ground and Water, signatory on this report will be F. Williams C.Geol FGS CEnv AGS Cgeol & T. J. Vincent BSc C.Eng M.I.Struct.E.

The property is a large four storey, detached residential property probably constructed around the 1905. The existing building is sited on a sloping site and the lowest storey at the rear of the property is a lower ground floor. The new development seeks to convert the existing 3 residential properties into one family dwelling and a one bedroom flat at lower ground floor. The proposed works will provide a lowered lower ground floor level below the whole footprint of the existing building, including light wells to the front. The lower ground floor will be extended to the rear of the property. The internal super structure will be totally replaced.

Details of the proposals are shown by the relative Griggs Architectural drawings.

The purpose of this report / statement is to provide Structural details as requested by the 'Camden Planning Guidance Basements and Light wells', together with details of the method and sequence of construction.

Site Investigation, Basement Impact Assessment (screening and scoping) and Report for groundwater and land stability has been carried out by Messrs. Ground and Water Ltd, their report GWPR 4656 April 2022v1.02 is appended to the Planning application as a separate document.

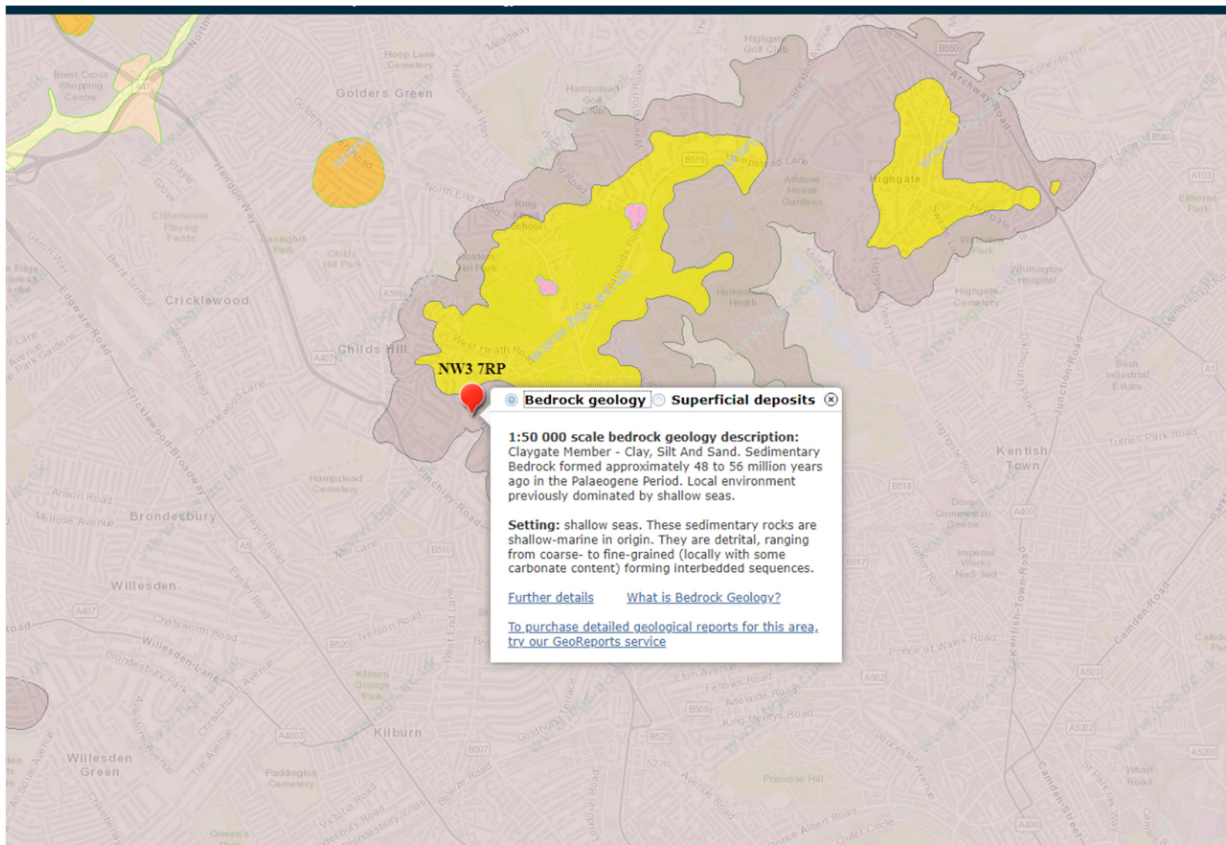
Surface Flow and Flooding Basement Impact Assessment has been carried out by Water Environmental Ltd, their report 22023-RPFRA-01/C01 is appended to the Planning application as a separate document.

## 2. DESK TOP STUDY

### History

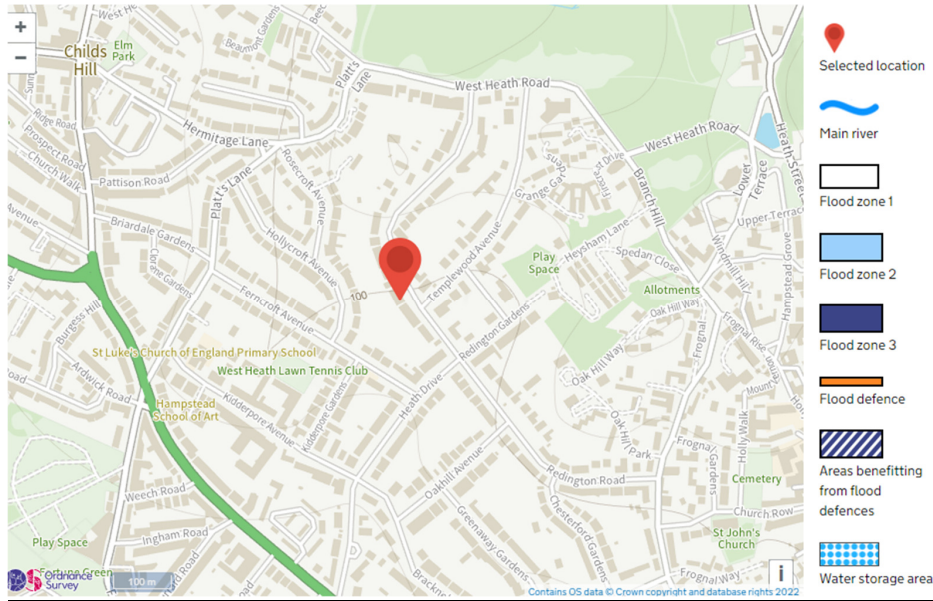
See Heritage Statement document by Heritage Information Ltd.

### Geology



British Geological Science Viewer shows the site to be sited over the Claygate Beds.

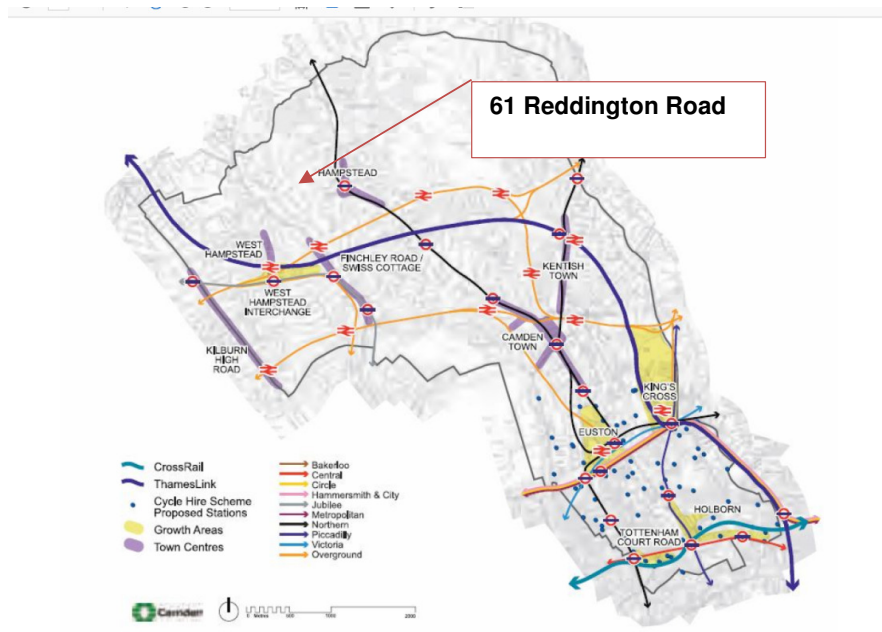
**Flood Risk**



E.A. map shows the site to not be in a flood risk area, that is the property is located in Flood Zone 1.

For flood risk assessment see Water Environmental Ltd, report 22023-RPFRA-01/C01 appended to the Planning application as a separate document.

**Underground / Railway**



From Figure 18, Arup Report, No underground or railway routes near the site.

### Public Highway and Other Utilities

Only utilities that cross the site are those which serve the dwelling, gas, water, electric. Telecom. The public highway, ( back of public footpath) is 9.0m away from any underpinning works. Utilities in the public highway are therefore more than 9.0m away from the works. As the front drive slopes down to the public footpath excavation levels at the front of the building will be at similar level to the public footpath. The utilities in the highway cannot be affected by the works.

### **3.IMPERMEABLE AREAS**

Existing surface water is discharged through drainage connected to the public system.

For surface water statement see Water Environmental Ltd, report 22023-RPFRA-01/C01 'Surface Flow and Flooding Basement Impact Assessment', appended to the Planning application as a separate document.

### **4.STRUCTURAL DESIGN PRINCIPLES**

#### External Walls

New concrete walls below the property are designed as laterally propped cantilevers in reinforced concrete, the lower ground floor slab acting as the lateral prop at wall base level. The walls will be designed using the soil parameters relative to the site. The walls will be designed for a water table at 1.0m below ground level.

The surcharge load allowed on the external walls of the property will be 10KN/m<sup>2</sup> .

#### Basement Slab

The slab will be formed in reinforced concrete. It will be designed for uplift due to water pressure below, or as a clear span as appropriate. The basement slab will act as a prop to the base of the basement walls. Lower ground floor slabs will be protected from heave by Cordek.

#### Design Criteria.

Basement walls and bases will be designed using the parameters for the retained soils and bearing soils as indicated by the Site Investigation.. The design is in accordance with BS 8002:1994.

The design will accomodate active and passive earth pressures. Pressure coeficients in the design will adopt ' at rest pressures'.

The wall and base will be designed for the following

- 1.Vertical loads from walls above.
2. Other external will be designed with a surcharge load of 10.00KN/m<sup>2</sup>.

3. The design adopts a water head behind the wall to 1.0m below ground level.

The sub soils at new lower ground floor formation level will be LondonClay, an SBP of 125KN/m<sup>2</sup> will be used in the design to limit differential foundation movements.

Concrete will generally be grade RC35/45 and Sulphate Class DS3 and ACEC class AC-3 in accordance with 'concrete in aggressive ground'. Reinforcement will be grade 500N/mm<sup>2</sup>.

Existing brickwork assumes 7N bricks in a lime mortar, CP.111 gives basic compressive stress for this makeup of 0.45N/mm<sup>2</sup>, and therefore allowable bearing stress will be 0.45N/mm<sup>2</sup>. Any bearings into existing external or party wall masonry will take account of this allowable stress.

Mortar will be class (ii) or (iii) as required.

#### Relevant Codes of Practice and British Standards

B.S. 8002	Code of Practise for Earth Retaining Structures
B.S. 8004	Code of Practice For Foundations
B.S. 6031	Code of Practice For Earthworks
B.S. 8110	Structural Use of Concrete
B.S. 5750	Structural Use of Steelwork in Buildings

### **5.PREDICTION OF DAMAGE TO ADJOINING PROPERTIES**

Works to form the new lower ground floor will have the construction sequenced in short sections. Excavations to form the walls and bases all soil faces will be continually temporarily laterally or vertically propped to avoid movement of soil during the construction stage. Permanent works will be designed to resist both pressures from the soils or structural loads from nearby buildings as appropriate.

Strict control of the construction method together with the structural design will limit any potential damage to the adjoining properties to categories 0 (nil) or 1 (slight) of the Burland Scale. Or none, or at worst, 'aesthetic' as described by the BRE document for movement in buildings.

Refer also to Ground and Water Ground Movement assessment clause 7.4.3 in their report GWPR 4656 April 2022v1.02.

### **6.BRIEF METHOD STATEMENT FOR CONSTRUCTION.**

The exact sequence of works will be agreed with Main Contractor and Structural Engineer, clauses for a typical Contruccion Method Statement for the works could be as follows.

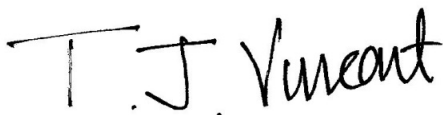
- a) The walls to the perimeter of the existing building will be underpinned in reinforced concrete. Underpins will take the vertical loads from the walls and horizontal loads from the earth. During their construction the walls and bases will require laterally propping in the temporary condition; propping will be made against the central earth pudding.
- b) Underpinning legs will be excavated in short sections not exceeding 1200mm in width.
- c) The sequence of the underpinning will be in the 1, 4, 2, 5, 3 sequence and such that any given underpin will be completed, dry packed, and a minimum period of 48 hours lapsed before an adjacent excavation commenced to form another underpin.
- d) In the event that the existing foundations to the wall are found to be unstable, sacrificial steel jacks will be installed underneath the foundation to prop the bottom few courses of bricks. These steel jacks will be left in place and will be incorporated into the concrete stem.
- e) Whilst forming the wall and in the event that the vertical soil face is unstable, lateral propping will be provided as required to the excavation and to the sides of the working trench. The front and side faces of the excavation will be propped using a sacrificial inert board and acrow props as appropriate.
- f) Concrete for the walls and bases shall be ready mixed delivered to site from an accredited source.
- g) Concrete will be chuted from the point of delivery into a 'holding bath' within the working areas and placed by wheelbarrow and /or bucket, or mixed on site. The exact arrangement will be finalised when works commence on site.
- h) Concrete will be placed within 30 minutes of batching on site, or delivery by lorry, concrete will be compacted with a mechanical hand held vibrator.
- i) Excavation for an underpin section will be excavated in a day, and the concrete to the base poured by the end of the same day.
- j) The concrete to the wall of the underpin will be poured the following day. This will be poured up to within 50 – 75mm of the underside of the existing wall foundations.
- k) On the following day, the gap between the concrete and the underside of the existing foundation will be dry packed with a mixture of sharp sand and cement (ratio 3 : 1).
- l) Once the dry pack has gained sufficient strength, any protrusions of the footings into the site will be carefully trimmed back using hand tools to avoid causing any damage to the foundation. The protrusions will be trimmed back to be flush in-line with the face of the wall above.
- m) A minimum of 48 hours will be allowed before adjacent sections will be excavated to form a new underpin.
- n) Once all pins are complete a temporary cross propping system will be introduced between the walls to allow bulk excavation will be carried out down to formation level.
- o) The below – slab drainage for foul & ground water, sumps and pumps will then be installed. The pumps will discharge the foul / ground water into the sewer system to the front of the properties. The drainage layout will be designed in due course.
- p) The basement slab will then be constructed, once cured this will provided the designed propping to the walls and the temporary cross propping can be removed.
- q) A cavity drainage layer will be laid to the slabs and walls.

## **7.CONSTRUCTION SEQUENCE**

1. Site set up will include a hoarding to the front garden; placement for skips will either be made within the front garden or on the public highway subject to Camden approval.
2. The site is only accessible from Redington Road, and therefore all site deliveries and operations will take place from here. This entrance will be manned throughout operational hours by a banksman to ensure construction deliveries do not pose a risk to other users of Reddington Road.



3. Construct site hoarding, entrance gates to provide protection to passers-by from site operations. Site accommodation including welfare facilities will be confined to within the site boundary throughout the site works.
4. Terminate / protect any incoming services temporarily divert any active drainage.
5. Install any tree protection measures as necessary.
6. Install enclosed skip to front on property and install conveyor to remove excavated soil to discharge soil into skip.
7. Carry out soft strip to whole building, remove all non-load bearing partitions.
8. Investigate sequence for either providing temporary support works to support existing structure at 1<sup>st</sup> floor or construct permanent structural works to 1<sup>st</sup> floor.
9. Once Lower ground floor / ground floor areas are clear of load bearing elements remove suspended part of ground floor to whole building.
10. Construction under the property will commence by taking out the ground floor and reducing ground levels to just above existing foundation formation.
11. Underpins will be carried out in the usual 1, 4, 2, 5, 3 underpinning sequence, the construction sequence for forming the pin is shown on the Vincent & Rymill drawings submitted for planning and attached within this document. Backfilling of the excavation will be made after each pin has been formed.
12. On completion of all underpinning and fixing of the structural steelwork supporting the upper ground floor, cross propping of the pin walls will be erected to allow release of the local pins that may be propped against the central dumpling so the lower ground floor slab can be constructed. The propping will be designed to suit the lateral loads behind the walls but generally takes the form of a series of horizontal props adequately laced and braced set approximately 1.5m from lower ground floor level.
13. Bulk excavation will be carried out down to lower ground floor slab formation level. Muck will continue to be removed from site via the conveyor belt.
14. The below – slab drainage for foul & ground water, sumps and pumps will then be installed. The pumps will discharge the foul / ground water into the sewer system to the front of the properties. The drainage layout will be designed in due course.
15. The lower ground floor slab (ground – bearing slab) will then be constructed.
16. After the new lower ground floor slabs have cured, the cross propping will be removed.
17. A drained – cavity layer will be laid to the slabs and walls.



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**T. J. Vincent BSc C.Eng M.I.Struct E.**  
**2 May 2023**



**APPENDIX 1**

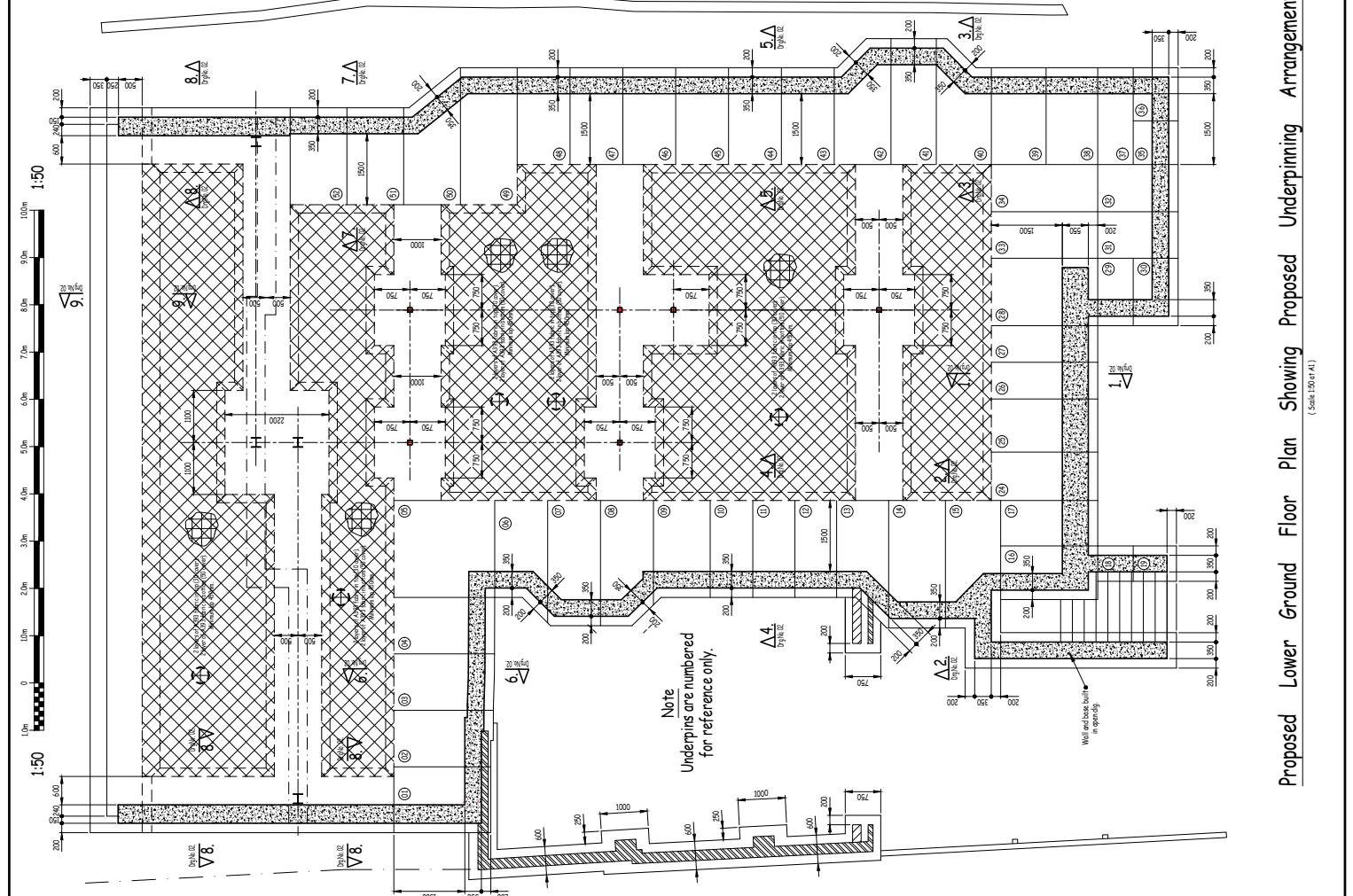
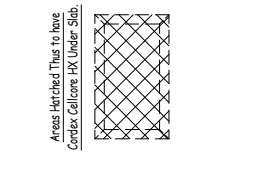
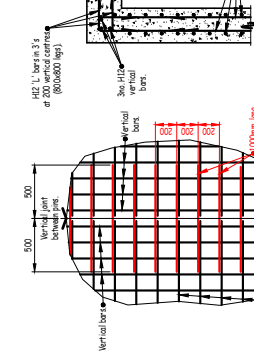
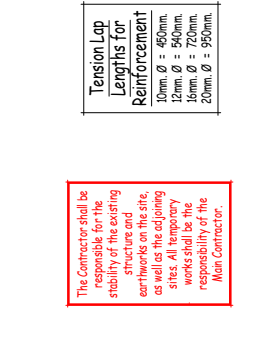
**STRUCTURAL DRAWINGS FOR LOWER GROUND FLOOR**

**Underpinning Notes**

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- U7. The underpinning shall be underpinning for the underpinning.
- U8. The underpinning shall be underpinning for the underpinning.

**Notes**

- 1. This drawing remains the copyright of Vincent and Rymill and shall not be copied, altered or changed without their permission.
- 2. All dimensions are in millimetres unless otherwise stated.
- 3. Dimensions are to the face of the work.
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61 Redington Road,  
London NW3 7RP

Rev.	Date	By	No	Date

Proposed Lower Ground Floor Plan Showing Proposed Underpinning Arrangement.

Sheet No. of 1	Date	By	No	Date
1:50	April 2022			22/07

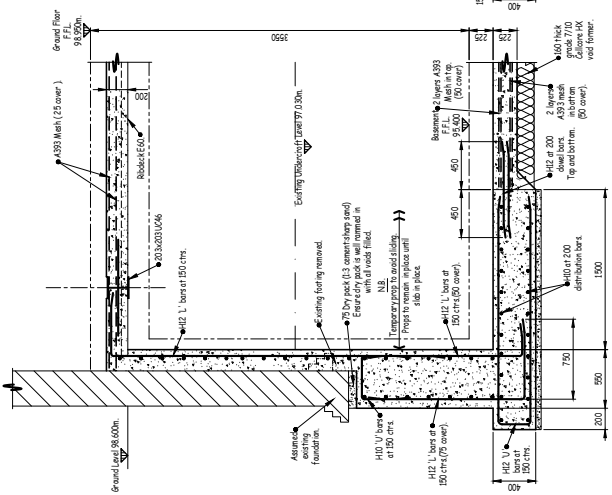
Proposed Lower Ground Floor Plan Showing Proposed Underpinning Arrangement.

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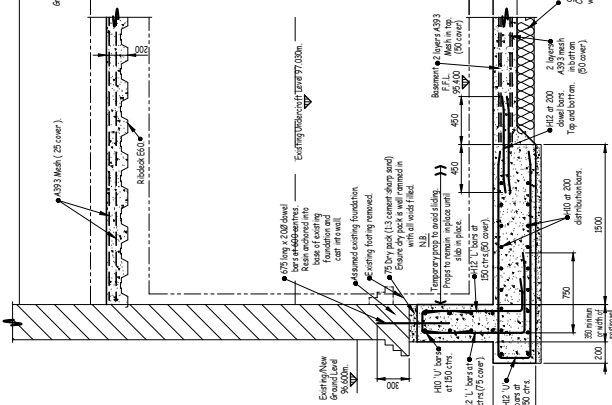
Proposed Lower Ground Floor Plan Showing Proposed Underpinning Arrangement.

**NOTES**

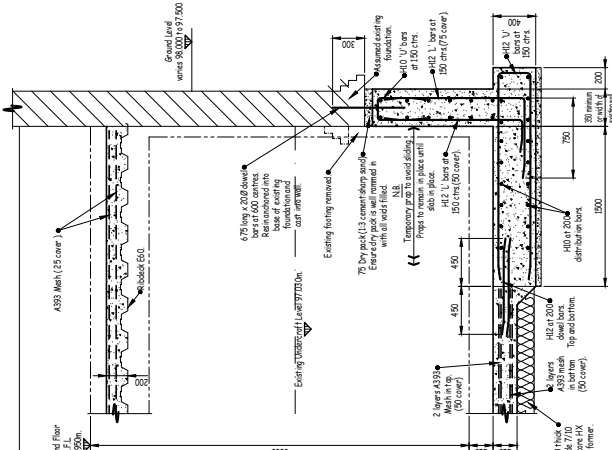
1. For notes see drawing number 22007 / 01.



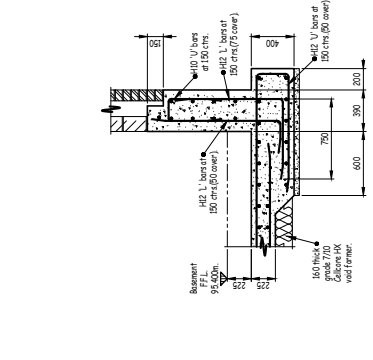
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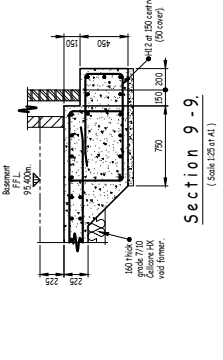
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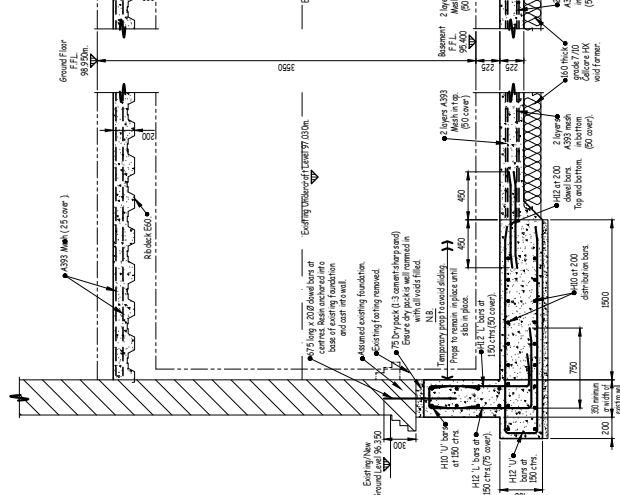
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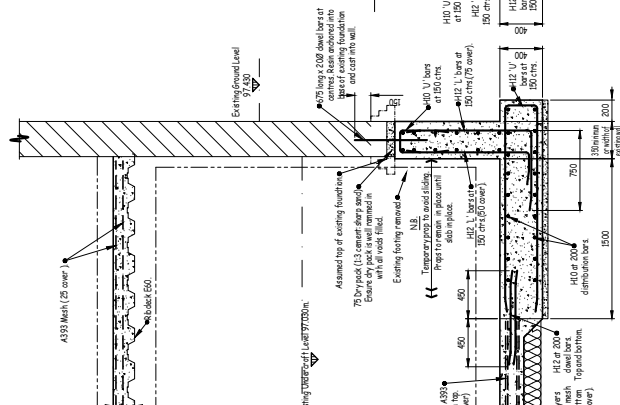
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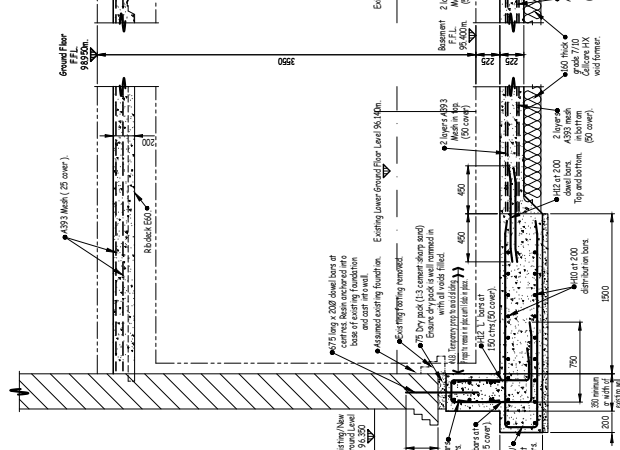
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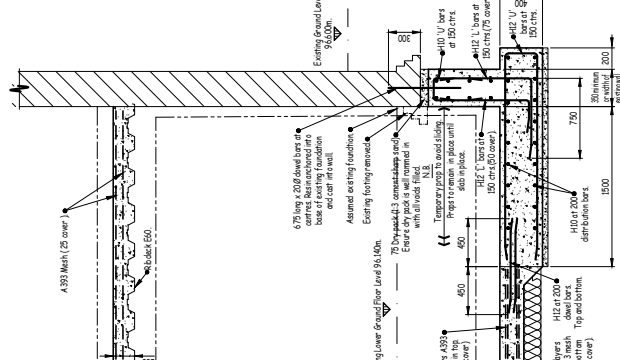
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(Scale 1:25 at A1)



**Section 5 - 5**  
(Scale 1:25 at A1)



**Section 6 - 6**  
(Scale 1:25 at A1)



**Section 7 - 7**  
(Scale 1:25 at A1)

77/02/33	Checked	Date
21/12/22	Drawn For Construction	
21/12/22	Revised For Tender	
	Rev	Details

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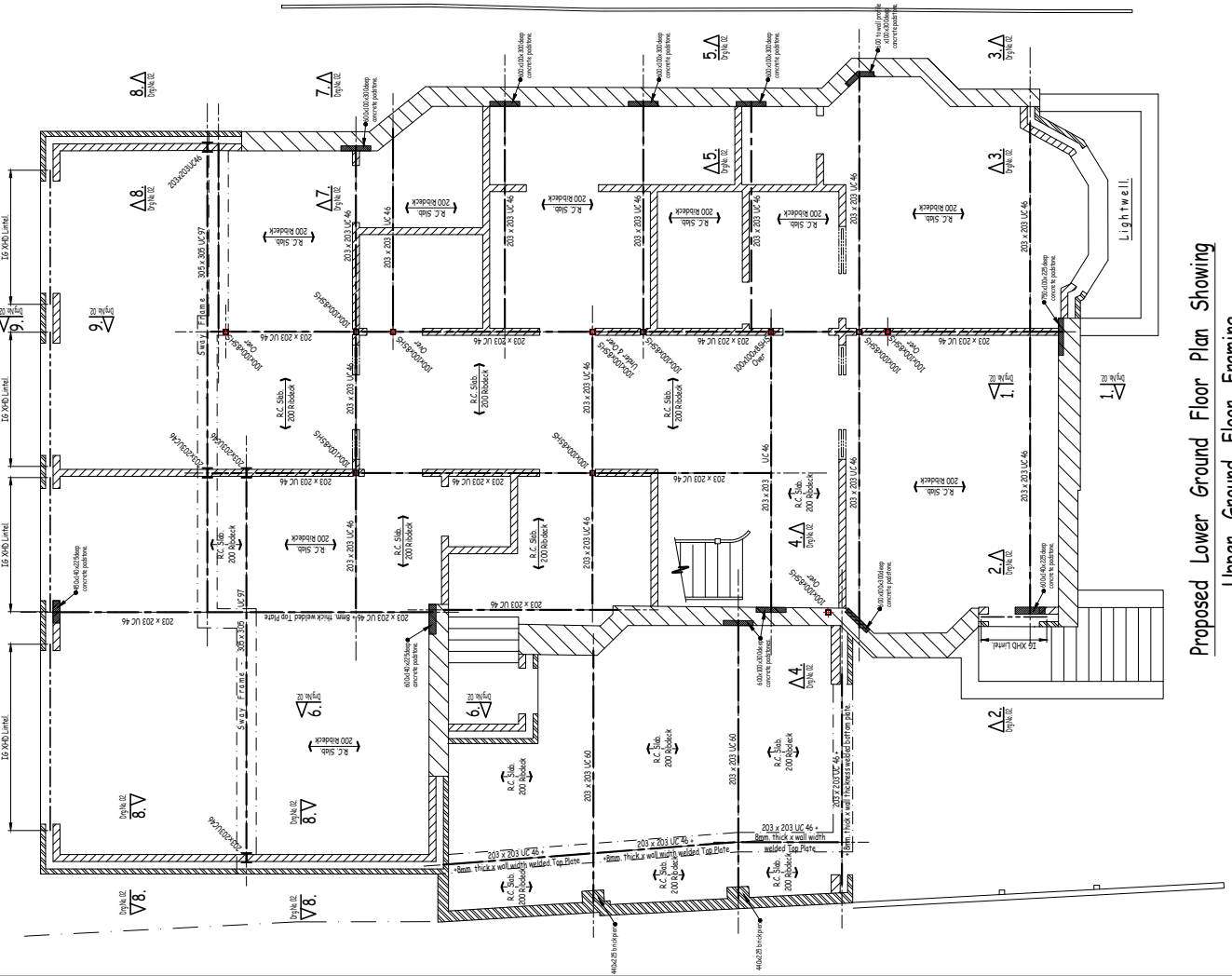
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London NW3 7RP

Lower Ground and Ground Floor Sections

Scale at A1	Date	Job No	Draw No
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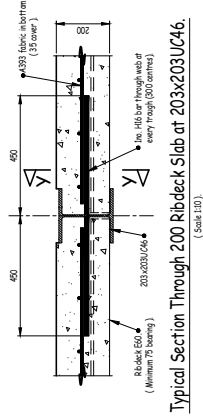
**Notes**

1. For notes see drawing number 22007 / 01.



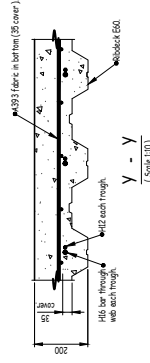
Proposed Lower Ground Floor Plan Showing  
Upper Ground Floor Framing.

(Scale 1:50 of A1)



Typical Section Through 200 Ribdeck Slab at 203x203UC46.

(Scale 1:10)



N.E. Ribdeck E60, 10mm thick decking. To be continuously propped at midspan during placing of concrete.

(Scale 1:10)

Rev	Date	Drawn	Checked
1	27/07/22		
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82	27/07/22		
83	27/07/22		
84	27/07/22		
85	27/07/22		
86	27/07/22		
87	27/07/22		
88	27/07/22		
89	27/07/22		
90	27/07/22		
91	27/07/22		
92	27/07/22		
93	27/07/22		
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97	27/07/22		
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99	27/07/22		
100	27/07/22		

**VINCENT & RYMILL**  
Consulting Civil & Structural Engineers  
Telephone : (01252) 854242

61 Redington Road,  
London NW3 7RP


Proposed Lower Ground Floor Plan Showing  
Ground Floor Structure

Scale of A1	Date	Job No	Draw No	Rev
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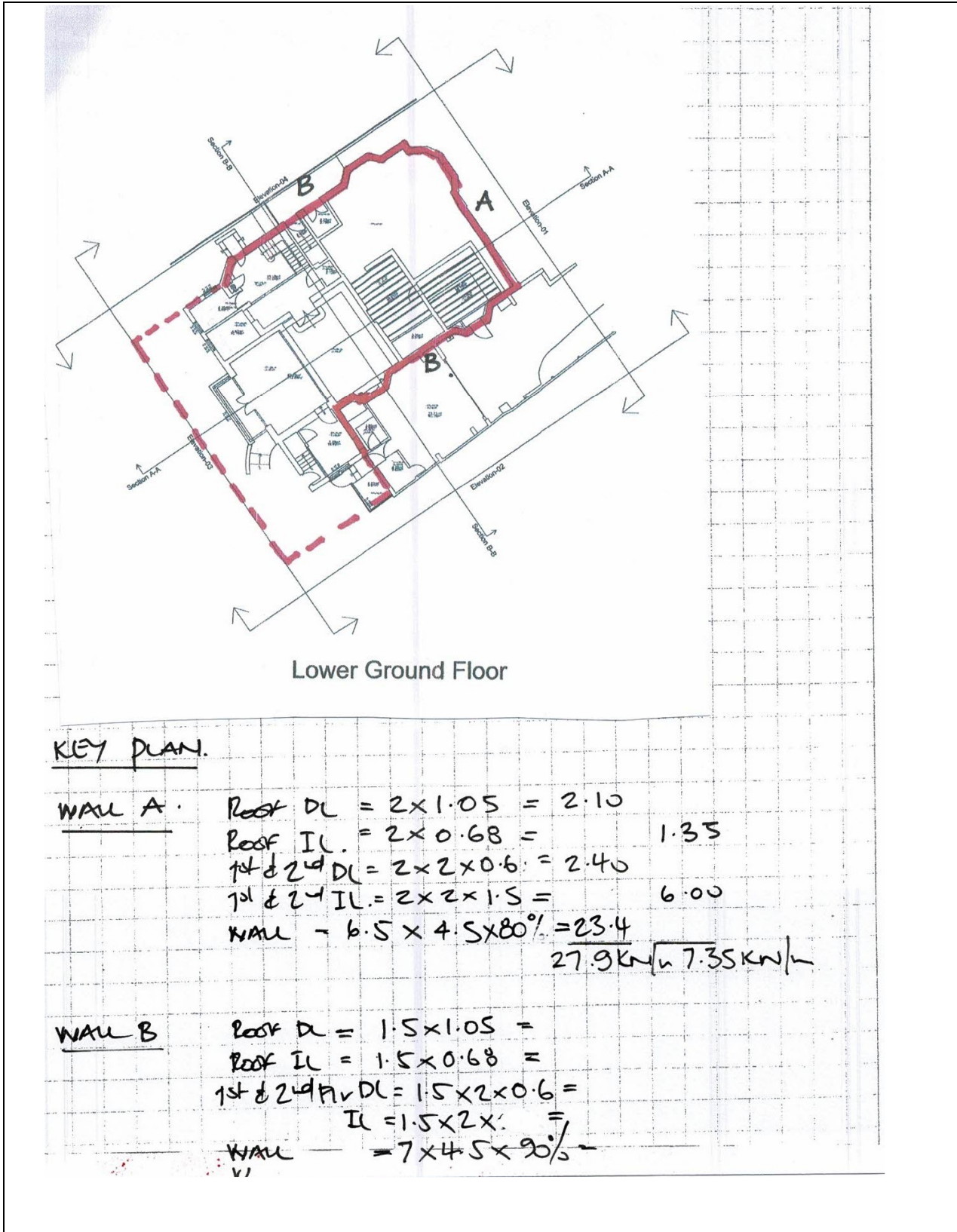
**APPENDIX 2**

**STRUCTURAL CALCULATIONS**


 <b>VINCENT &amp; RYMILL</b> 01252 834242 07854 370 181	Project			Job Ref.	
	61 REDDINGTOPN ROAD LONDON NW3 7RP			22D07	
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PRELIMINARY STRUCTURAL CALCULATIONS			1		
Calc. by	Date	Chk'd by	Date	App'd by	Date
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<b><u>PITCHED ROOF</u></b>	<b>KN/m<sup>2</sup></b>	<b><u>CEILING</u></b>	<b>KN/m<sup>2</sup></b>
Tiles	0.70	Ceiling Joists	0.10
Felt & battens	0.05	Plasterboard	<u>0.15</u>
Rafters	<u>0.10</u>	D. L.	0.25 KN/m <sup>2</sup>
	<u>0.85</u>	I. L. where applicable	<u>0.25</u> KN/m <sup>2</sup>
40° on plan load D. L.	1.10 KN/m <sup>2</sup>		0.50 KN/m <sup>2</sup>
40° Imposed Load	<u>0.50</u> KN/m <sup>2</sup>		
	1.60 KN/m <sup>2</sup>		
<b><u>FLAT ROOF</u></b>	<b>KN/m<sup>2</sup></b>	<b><u>TIMBER FLOORS</u></b>	<b>KN/m<sup>2</sup></b>
Felt	0.20	Boards	0.25
Boards	0.25	Joists	0.10
Joists & firrings	0.15	Ceiling	<u>0.25</u>
Ceiling	<u>0.15</u>	D. L.	0.60 KN/m <sup>2</sup>
D. L.	0.75 KN/m <sup>2</sup>	I. L.	<u>1.50</u> KN/m <sup>2</sup>
I. L.	<u>0.75</u> KN/m <sup>2</sup>		2.10 KN/m <sup>2</sup>
	1.50 KN/m <sup>2</sup>		
<b><u>MASONRY</u></b>	<b>KN/m<sup>2</sup></b>	<b><u>200 RIBDECK GRD FLR</u></b>	<b>KN/m<sup>2</sup></b>
102 Brick	2.20 KN/m <sup>2</sup>	FINISH	2.20
215 BRICK + PLASTER	4.50KN/m <sup>2</sup>	SLAB	4.20
330 BRICK + PLASTER	6.70KN/m <sup>2</sup>	PART'NS	<u>1.00</u>
100 lt. wt blk + (2 x plaster)	1.35 KN/m <sup>2</sup>		7.50KN/m <sup>2</sup>
100 dense blk + (1 x plaster)	1.85 KN/m <sup>2</sup>	I. L.	<u>1.50</u> KN/m <sup>2</sup>
			9.00KN/m <sup>2</sup>

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PRELIMINARY STRUCTURAL CALCULATIONS			2		
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PRELIMINARY STRUCTURAL CALCULATIONS			3		
Calc. by	Date	Chk'd by	Date	App'd by	Date
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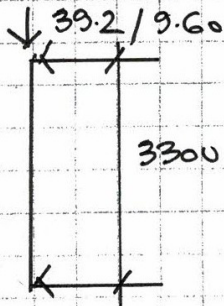
WALL B.

$$\begin{aligned} \text{ROOF DL} &= 1.5 \times 1.05 = 1.60 \\ \text{ROOF IL} &= 1.5 \times 0.68 = 1.02 \\ \text{1st \& 2nd FLOOR DL} &= 1.5 \times 2 \times 0.6 = 1.80 \\ \text{IL} &= 1.5 \times 2 \times 1.5 = 4.50 \\ \text{WALL} &= 7 \times 4.5 \times 90\% = 28.40 \\ \text{WALL} &= 2 \times 6.5 = 13.00 \\ \hline &44.8 \quad 5.52 \text{ kN/m} \end{aligned}$$

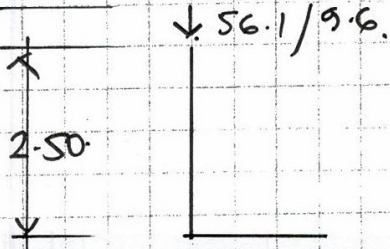
ADD SAY AVERAGE EACH WALL GRD FLX SUM


$$\begin{aligned} \text{SAY DL} &= 1.5 \times 7.5 = 11.3 \text{ kN/m} \\ \text{IL} &= 1.5 \times 1.5 = 2.25 \text{ kN/m} \end{aligned}$$

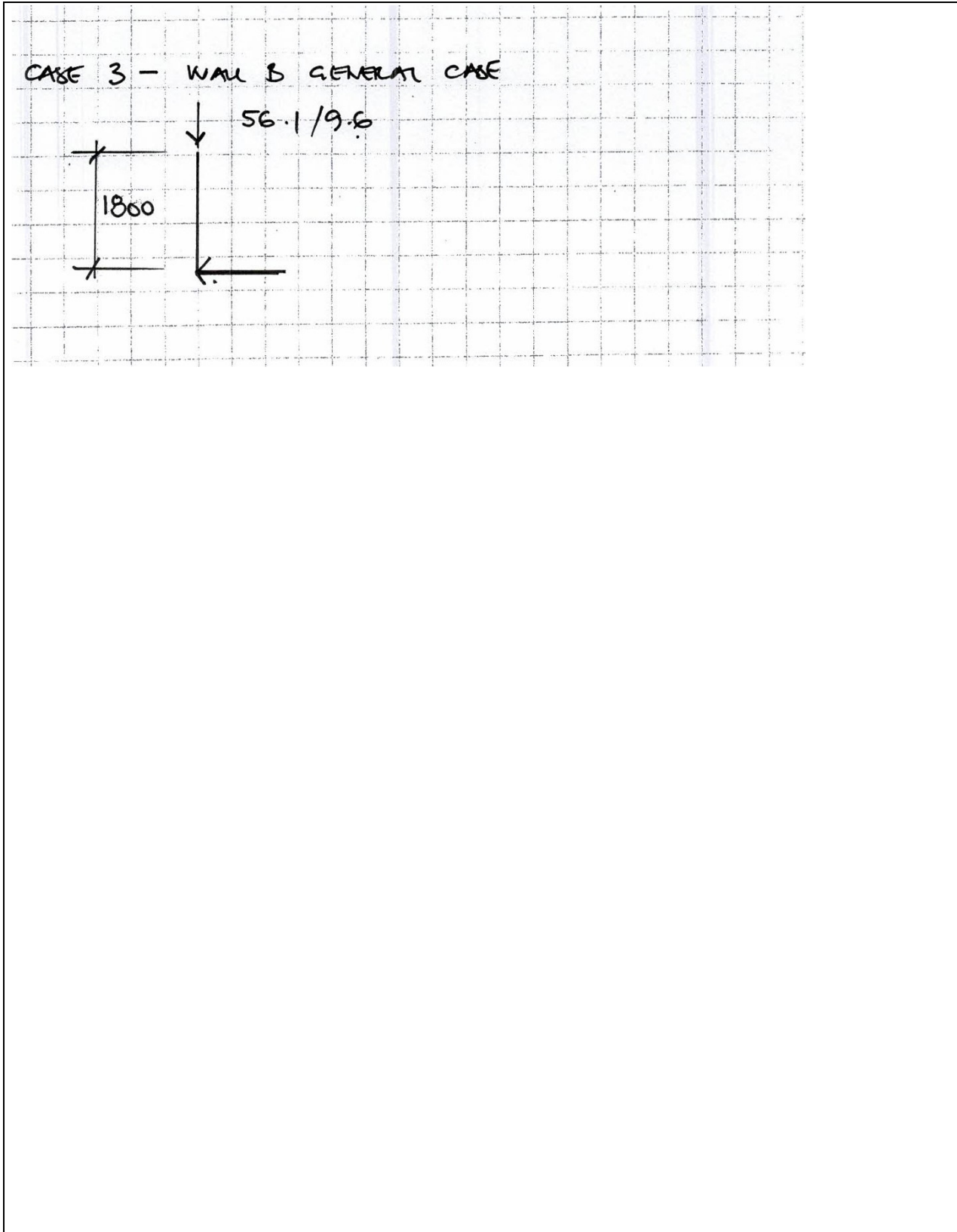
CASE 1 FRONT WALL A




CASE 2 MAX CASE WALL B.



 <b>VINCENT &amp; RYMILL</b> 01252 834242 07854 370 181	Project			Job Ref.	
	61 REDDINGTOPN ROAD LONDON NW3 7RP			22D07	
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PRELIMINARY STRUCTURAL CALCULATIONS			4		
Calc. by	Date	Chk'd by	Date	App'd by	Date
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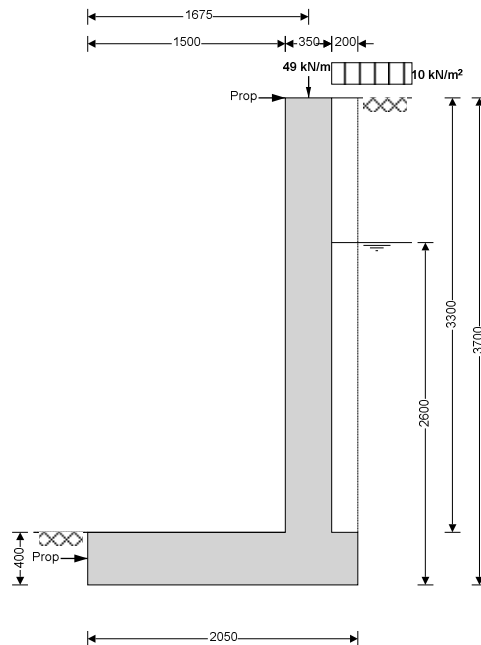
 <b>VINCENT &amp; RYMILL</b> 01252 834242 07854 370 181	Project			Job Ref.	
	61 REDDINGTOPN ROAD LONDON NW3 7RP			22D07	
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PRELIMINARY STRUCTURAL CALCULATIONS			5		
Calc. by	Date	Chk'd by	Date	App'd by	Date
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**CASE 1 FRONT WALL A**

**RETAINING WALL ANALYSIS & DESIGN (BS8002)**

**RETAINING WALL ANALYSIS (BS 8002:1994)**

TEDDS calculation version 1.2.01.08



**Wall details**

Retaining wall type  
Height of wall stem  
Length of toe  
Overall length of base  
Height of retaining wall  
Depth of downstand  
Position of downstand  
Depth of cover in front of wall  
Height of ground water  
Density of wall construction  
Angle of soil surface  
Mobilisation factor  
Moist density  
Design shear strength  
Design shear strength  
Moist density

**Cantilever**

$h_{stem} = 3300$  mm  
 $l_{toe} = 1500$  mm  
 $l_{base} = 2050$  mm  
 $h_{wall} = 3700$  mm  
 $d_{ds} = 0$  mm  
 $l_{ds} = 1100$  mm  
 $d_{cover} = 0$  mm  
 $h_{water} = 2600$  mm  
 $\gamma_{wall} = 23.6$  kN/m<sup>3</sup>  
 $\beta = 0.0$  deg  
**M = 1.5**  
 $\gamma_m = 18.0$  kN/m<sup>3</sup>  
 $\phi' = 24.2$  deg  
 $\phi'_b = 24.2$  deg  
 $\gamma_{mb} = 18.0$  kN/m<sup>3</sup>

Wall stem thickness  $t_{wall} = 350$  mm  
Length of heel  $l_{heel} = 200$  mm  
Base thickness  $t_{base} = 400$  mm  
Thickness of downstand  $t_{ds} = 400$  mm


Unplanned excavation depth  $d_{exc} = 0$  mm  
Density of water  $\gamma_{water} = 9.81$  kN/m<sup>3</sup>  
Density of base construction  $\gamma_{base} = 23.6$  kN/m<sup>3</sup>  
Effective height at back of wall  $h_{eff} = 3700$  mm

Saturated density  $\gamma_s = 21.0$  kN/m<sup>3</sup>  
Angle of wall friction  $\delta = 0.0$  deg  
Design base friction  $\delta_b = 18.6$  deg  
Allowable bearing  $P_{bearing} = 125$  kN/m<sup>2</sup>

**Using Coulomb theory**

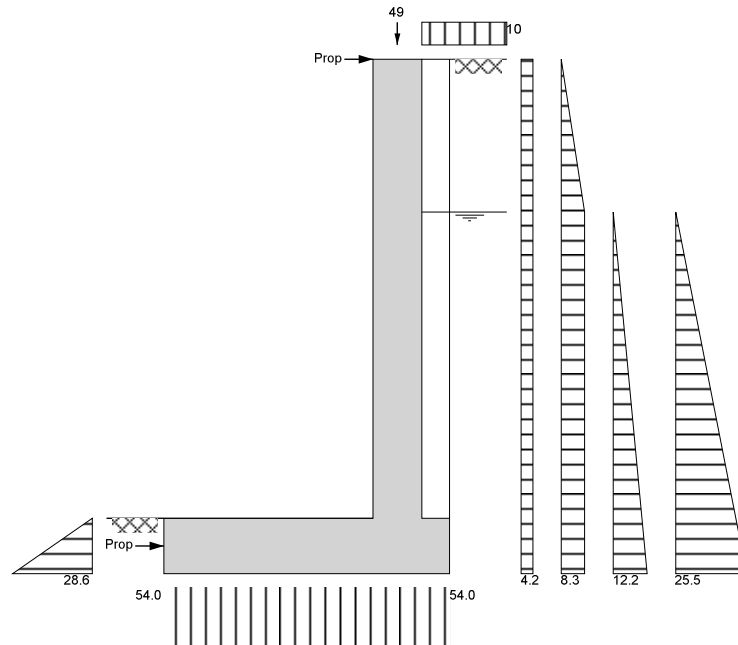
Active pressure  $K_a = 0.419$   
At-rest pressure  $K_0 = 0.590$

Passive pressure  $K_p = 4.187$

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PRELIMINARY STRUCTURAL CALCULATIONS			6		
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**Loading details**

Surcharge load	Surcharge = <b>10.0 kN/m<sup>2</sup></b>	Vertical live load	$W_{live} = 9.6 \text{ kN/m}$
Vertical dead load	$W_{dead} = 39.3 \text{ kN/m}$	Horizontal live load	$F_{live} = 0.0 \text{ kN/m}$
Horizontal dead load	$F_{dead} = 0.0 \text{ kN/m}$	Height of horizontal load	$h_{load} = 0 \text{ mm}$
Position of vertical load	$l_{load} = 1675 \text{ mm}$		



Loads shown in kN/m, pressures shown in kN/m<sup>2</sup>

**Calculate propping force**

Propping force  $F_{prop} = 51.5 \text{ kN/m}$

**Check bearing pressure**

Total vertical reaction	$R = 110.7 \text{ kN/m}$	Distance to reaction	$x_{bar} = 1025 \text{ mm}$
Eccentricity of reaction	$e = 0 \text{ mm}$		


**Reaction acts within middle third of base**

Bearing pressure at toe	$p_{toe} = 54.0 \text{ kN/m}^2$	Bearing pressure at heel	$p_{heel} = 54.0 \text{ kN/m}^2$
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**PASS - Maximum bearing pressure is less than allowable bearing pressure**

**Calculate propping forces to top and base of wall**

Propping force to top of wall	$F_{prop\_top} = 16.785 \text{ kN/m}$	Propping force to base of wall	$F_{prop\_base} = 34.722 \text{ kN/m}$
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PRELIMINARY STRUCTURAL CALCULATIONS			7		
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### RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.08

#### Ultimate limit state load factors

Dead load factor  $\gamma_{f_d} = 1.4$       Live load factor  $\gamma_{f_l} = 1.6$   
Earth pressure factor  $\gamma_{f_e} = 1.4$

#### Calculate propping force

Propping force  $F_{prop} = 51.5$  kN/m

#### Calculate propping forces to top and base of wall

Propping force to top of wall  $F_{prop\_top\_f} = 28.977$  kN/m      Propping force to base of wall  $F_{prop\_base\_f} = 80.451$  kN/m

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

#### Material properties

Strength of concrete  $f_{cu} = 40$  N/mm<sup>2</sup>      Strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

#### Base details

Minimum reinforcement  $k = 0.13$  %      Cover in toe  $C_{toe} = 50$  mm

#### Design of retaining wall toe

Shear at heel  $V_{toe} = 95.3$  kN/m      Moment at heel  $M_{toe} = 89.1$  kNm/m

**Compression reinforcement is not required**

#### Check toe in bending

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

Area required  $A_{s\_toe\_req} = 626.8$  mm<sup>2</sup>/m      Area provided  $A_{s\_toe\_prov} = 754$  mm<sup>2</sup>/m

**PASS - Reinforcement provided at the retaining wall toe is adequate**

#### Check shear resistance at toe

Design shear stress  $V_{toe} = 0.277$  N/mm<sup>2</sup>      Allowable shear stress  $V_{adm} = 5.000$  N/mm<sup>2</sup>

**PASS - Design shear stress is less than maximum shear stress**

Concrete shear stress  $V_{c\_toe} = 0.463$  N/mm<sup>2</sup>

**$V_{toe} < V_{c\_toe}$  - No shear reinforcement required**

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

#### Material properties

Strength of concrete  $f_{cu} = 40$  N/mm<sup>2</sup>      Strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

#### Base details

Minimum reinforcement  $k = 0.13$  %      Cover in heel  $C_{heel} = 50$  mm

#### Design of retaining wall heel

Shear at heel  $V_{heel} = 9.0$  kN/m      Moment at heel  $M_{heel} = 1.5$  kNm/m

**Compression reinforcement is not required**

#### Check heel in bending

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

Area required  $A_{s\_heel\_req} = 520.0$  mm<sup>2</sup>/m      Area provided  $A_{s\_heel\_prov} = 754$  mm<sup>2</sup>/m

**PASS - Reinforcement provided at the retaining wall heel is adequate**


#### Check shear resistance at heel

Design shear stress  $V_{heel} = 0.026$  N/mm<sup>2</sup>      Allowable shear stress  $V_{adm} = 5.000$  N/mm<sup>2</sup>

**PASS - Design shear stress is less than maximum shear stress**

Concrete shear stress  $V_{c\_heel} = 0.463$  N/mm<sup>2</sup>

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

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PRELIMINARY STRUCTURAL CALCULATIONS			8		
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**Design of reinforced concrete retaining wall stem (BS 8002:1994)**

**Material properties**

Strength of concrete  $f_{cu} = 40 \text{ N/mm}^2$       Strength of reinforcement  $f_y = 500 \text{ N/mm}^2$

**Wall details**

Minimum reinforcement  $k = 0.13 \%$   
Cover in stem  $C_{stem} = 75 \text{ mm}$       Cover in wall  $C_{wall} = 50 \text{ mm}$

**Design of retaining wall stem**

Shear at base of stem  $V_{stem} = 101.2 \text{ kN/m}$       Moment at base of stem  $M_{stem} = 60.1 \text{ kNm/m}$

***Compression reinforcement is not required***

**Check wall stem in bending**

Reinforcement provided **12 mm dia.bars @ 150 mm centres**  
Area required  $A_{s\_stem\_req} = 540.9 \text{ mm}^2/\text{m}$       Area provided  $A_{s\_stem\_prov} = 754 \text{ mm}^2/\text{m}$

***PASS - Reinforcement provided at the retaining wall stem is adequate***

**Check shear resistance at wall stem**

Design shear stress  $V_{stem} = 0.376 \text{ N/mm}^2$       Allowable shear stress  $V_{adm} = 5.000 \text{ N/mm}^2$

***PASS - Design shear stress is less than maximum shear stress***

Concrete shear stress  $V_{c\_stem} = 0.534 \text{ N/mm}^2$

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

**Design of retaining wall at mid height**

Moment at mid height  $M_{wall} = 29.4 \text{ kNm/m}$

***Compression reinforcement is not required***


Reinforcement provided **12 mm dia.bars @ 150 mm centres**  
Area required  $A_{s\_wall\_req} = 455.0 \text{ mm}^2/\text{m}$       Area provided  $A_{s\_wall\_prov} = 754 \text{ mm}^2/\text{m}$

***PASS - Reinforcement provided to the retaining wall at mid height is adequate***

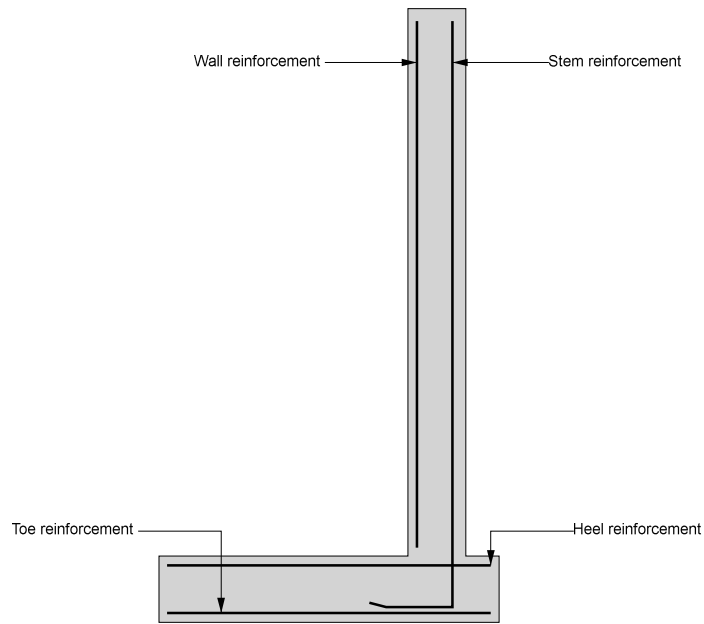
**Check retaining wall deflection**

Max span/depth ratio  $ratio_{max} = 33.90$       Actual span/depth ratio  $ratio_{act} = 12.27$


***PASS - Span to depth ratio is acceptable***

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PRELIMINARY STRUCTURAL CALCULATIONS			9		
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**Indicative retaining wall reinforcement diagram**



- Toe bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)
- Heel bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)
- Wall bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)
- Stem bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)

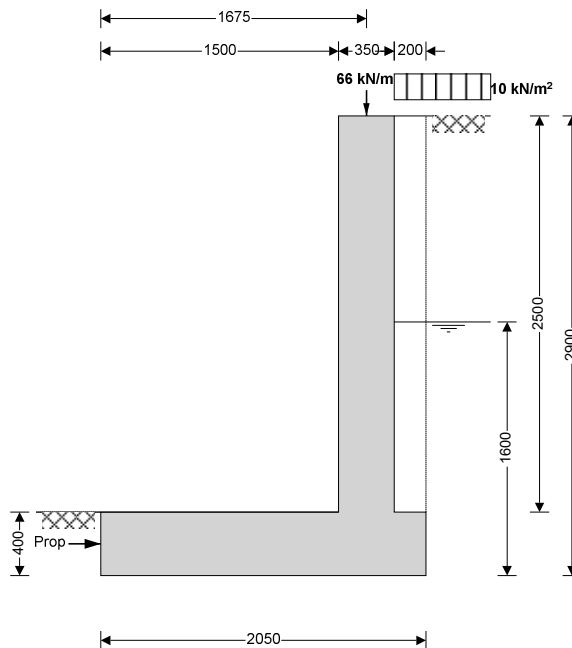
 <b>VINCENT &amp; RYMILL</b> 01252 834242 07854 370 181	Project			Job Ref.	
	61 REDDINGTOPN ROAD LONDON NW3 7RP			22D07	
	Section			Sheet no./rev.	
PRELIMINARY STRUCTURAL CALCULATIONS			10		
Calc. by	Date	Chk'd by	Date	App'd by	Date
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**CASE 2**

**RETAINING WALL ANALYSIS & DESIGN (BS8002)**

**RETAINING WALL ANALYSIS (BS 8002:1994)**

TEDDS calculation version 1.2.01.08



**Wall details**

Retaining wall type

Height of wall stem

Length of toe

Overall length of base

Height of retaining wall

Depth of downstand

Position of downstand

Depth of cover in front of wall

Height of ground water

Density of wall construction

Angle of soil surface

Mobilisation factor

Moist density

Design shear strength

Design shear strength

Moist density

**Using Coulomb theory**

Active pressure

At-rest pressure

**Cantilever**

$h_{stem} = 2500$  mm

$l_{toe} = 1500$  mm

$l_{base} = 2050$  mm

$h_{wall} = 2900$  mm

$d_{ds} = 0$  mm

$l_{ds} = 1650$  mm

$d_{cover} = 0$  mm

$h_{water} = 1600$  mm

$\gamma_{wall} = 23.6$  kN/m<sup>3</sup>

$\beta = 0.0$  deg

$M = 1.5$

$\gamma_m = 18.0$  kN/m<sup>3</sup>

$\phi' = 24.2$  deg

$\phi'_b = 24.2$  deg

$\gamma_{mb} = 18.0$  kN/m<sup>3</sup>

$K_a = 0.419$

$K_0 = 0.590$

Wall stem thickness

Length of heel

Base thickness

Thickness of downstand

Unplanned excavation depth

Density of water

Density of base construction

Effective height at back of wall

Saturated density

Angle of wall friction

Design base friction

Allowable bearing

Passive pressure

$t_{wall} = 350$  mm

$l_{heel} = 200$  mm

$t_{base} = 400$  mm

$t_{ds} = 400$  mm

$d_{exc} = 0$  mm

$\gamma_{water} = 9.81$  kN/m<sup>3</sup>

$\gamma_{base} = 23.6$  kN/m<sup>3</sup>

$h_{eff} = 2900$  mm

$\gamma_s = 21.0$  kN/m<sup>3</sup>


$\delta = 0.0$  deg

$\delta_b = 18.6$  deg

$P_{bearing} = 125$  kN/m<sup>2</sup>

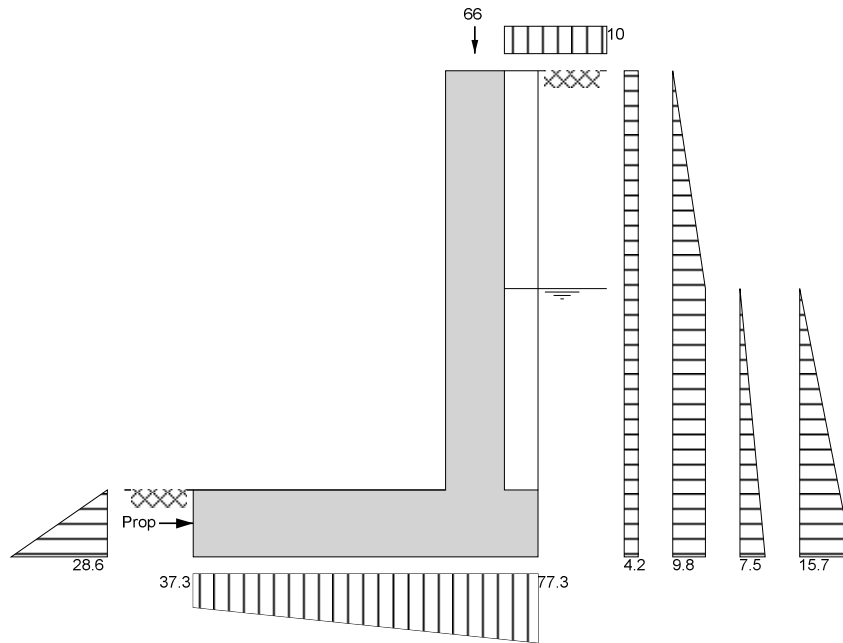
$K_p = 4.187$



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PRELIMINARY STRUCTURAL CALCULATIONS			11		
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**Loading details**

Surcharge load	Surcharge = <b>10.0 kN/m<sup>2</sup></b>	Vertical live load	$W_{live} = 9.6 kN/m$
Vertical dead load	$W_{dead} = 56.1 kN/m$	Horizontal live load	$F_{live} = 0.0 kN/m$
Horizontal dead load	$F_{dead} = 0.0 kN/m$	Height of horizontal load	$h_{load} = 0 mm$
Position of vertical load	$l_{load} = 1675 mm$		



Loads shown in kN/m, pressures shown in kN/m<sup>2</sup>

**Calculate propping force**

Propping force  $F_{prop} = **11.4 kN/m**$


**Check bearing pressure**

Total vertical reaction	$R = 117.4 kN/m$	Distance to reaction	$x_{bar} = 1144 mm$
Eccentricity of reaction	$e = 119 mm$		

**Reaction acts within middle third of base**

Bearing pressure at toe	$p_{toe} = 37.3 kN/m^2$	Bearing pressure at heel	$p_{heel} = 77.3 kN/m^2$
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**PASS - Maximum bearing pressure is less than allowable bearing pressure**

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	Section			Sheet no./rev.	
PRELIMINARY STRUCTURAL CALCULATIONS			12		
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### RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.08

#### Ultimate limit state load factors

Dead load factor  $\gamma_{f_d} = 1.4$       Live load factor  $\gamma_{f_l} = 1.6$   
Earth pressure factor  $\gamma_{f_e} = 1.4$

#### Calculate propping force

Propping force  $F_{prop} = 11.4$  kN/m

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

#### Material properties

Strength of concrete  $f_{cu} = 40$  N/mm<sup>2</sup>      Strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

#### Base details

Minimum reinforcement  $k = 0.13$  %      Cover in toe  $C_{toe} = 50$  mm

#### Design of retaining wall toe

Shear at heel  $V_{toe} = 108.1$  kN/m      Moment at heel  $M_{toe} = 104.9$  kNm/m

**Compression reinforcement is not required**

#### Check toe in bending

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

Area required  $A_{s\_toe\_req} = 738.2$  mm<sup>2</sup>/m      Area provided  $A_{s\_toe\_prov} = 754$  mm<sup>2</sup>/m

**PASS - Reinforcement provided at the retaining wall toe is adequate**

#### Check shear resistance at toe

Design shear stress  $V_{toe} = 0.314$  N/mm<sup>2</sup>      Allowable shear stress  $V_{adm} = 5.000$  N/mm<sup>2</sup>

**PASS - Design shear stress is less than maximum shear stress**

Concrete shear stress  $V_{c\_toe} = 0.463$  N/mm<sup>2</sup>

**$V_{toe} < V_{c\_toe}$  - No shear reinforcement required**

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

#### Material properties

Strength of concrete  $f_{cu} = 40$  N/mm<sup>2</sup>      Strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

#### Base details

Minimum reinforcement  $k = 0.13$  %      Cover in heel  $C_{heel} = 50$  mm

#### Design of retaining wall heel

Shear at heel  $V_{heel} = 5.8$  kN/m      Moment at heel  $M_{heel} = 0.7$  kNm/m

**Compression reinforcement is not required**

#### Check heel in bending

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

Area required  $A_{s\_heel\_req} = 520.0$  mm<sup>2</sup>/m      Area provided  $A_{s\_heel\_prov} = 754$  mm<sup>2</sup>/m

**PASS - Reinforcement provided at the retaining wall heel is adequate**


#### Check shear resistance at heel

Design shear stress  $V_{heel} = 0.017$  N/mm<sup>2</sup>      Allowable shear stress  $V_{adm} = 5.000$  N/mm<sup>2</sup>

**PASS - Design shear stress is less than maximum shear stress**

Concrete shear stress  $V_{c\_heel} = 0.463$  N/mm<sup>2</sup>

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

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

**Material properties**

Strength of concrete  $f_{cu} = 40 \text{ N/mm}^2$       Strength of reinforcement  $f_y = 500 \text{ N/mm}^2$

**Wall details**

Minimum reinforcement  $k = 0.13 \%$   
Cover in stem  $C_{stem} = 75 \text{ mm}$       Cover in wall  $C_{wall} = 50 \text{ mm}$

**Design of retaining wall stem**

Shear at base of stem  $V_{stem} = 33.5 \text{ kN/m}$       Moment at base of stem  $M_{stem} = 77.8 \text{ kNm/m}$

***Compression reinforcement is not required***

**Check wall stem in bending**

Reinforcement provided **12 mm dia.bars @ 150 mm centres**  
Area required  $A_{s\_stem\_req} = 699.8 \text{ mm}^2/\text{m}$       Area provided  $A_{s\_stem\_prov} = 754 \text{ mm}^2/\text{m}$

***PASS - Reinforcement provided at the retaining wall stem is adequate***

**Check shear resistance at wall stem**

Design shear stress  $V_{stem} = 0.124 \text{ N/mm}^2$       Allowable shear stress  $V_{adm} = 5.000 \text{ N/mm}^2$

***PASS - Design shear stress is less than maximum shear stress***


Concrete shear stress  $V_{c\_stem} = 0.534 \text{ N/mm}^2$

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

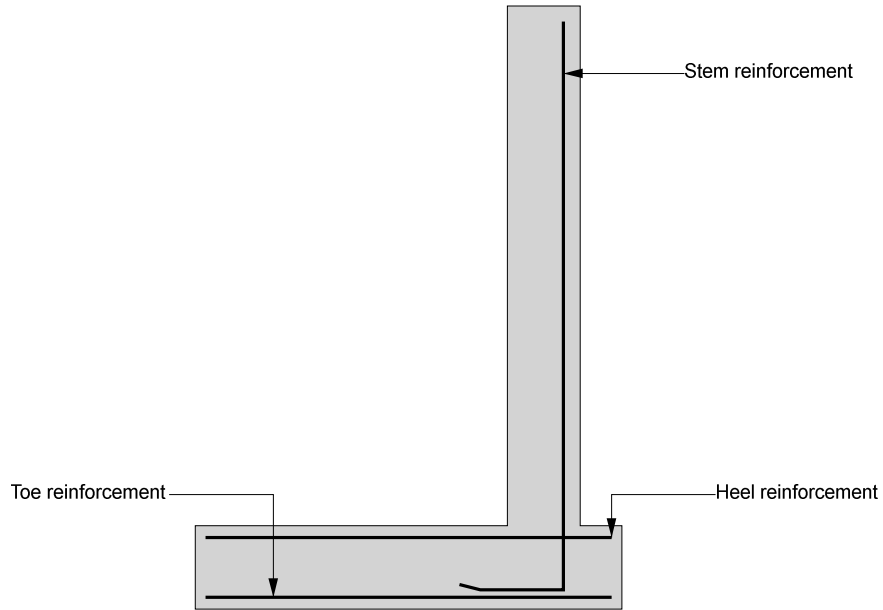
**Check retaining wall deflection**

Max span/depth ratio  $ratio_{max} = 8.80$       Actual span/depth ratio  $ratio_{act} = 9.29$


***FAIL - Span to depth ratio is unacceptable***

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**Indicative retaining wall reinforcement diagram**



Toe bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)  
Heel bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)  
Stem bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)

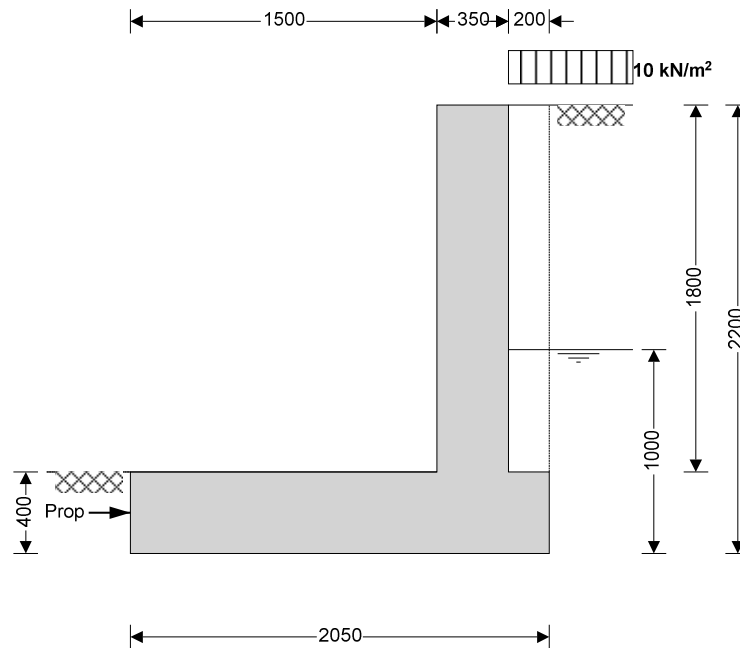
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**CASE 3 WALL B GENERAL CASE**

**RETAINING WALL ANALYSIS & DESIGN (BS8002)**

**RETAINING WALL ANALYSIS (BS 8002:1994)**

TEDDS calculation version 1.2.01.08



**Wall details**

Retaining wall type

**Cantilever**

Height of wall stem

$h_{stem} = 1800$  mm

Wall stem thickness

$t_{wall} = 350$  mm

Length of toe

$l_{toe} = 1500$  mm

Length of heel

$l_{heel} = 200$  mm

Overall length of base

$l_{base} = 2050$  mm

Base thickness

$t_{base} = 400$  mm

Height of retaining wall

$h_{wall} = 2200$  mm

Depth of downstand

$d_{ds} = 0$  mm

Thickness of downstand

$t_{ds} = 400$  mm

Position of downstand

$l_{ds} = 1150$  mm

Depth of cover in front of wall

$d_{cover} = 0$  mm

Unplanned excavation depth

$d_{exc} = 0$  mm

Height of ground water

$h_{water} = 1000$  mm

Density of water

$\gamma_{water} = 9.81$  kN/m<sup>3</sup>

Density of wall construction

$\gamma_{wall} = 23.6$  kN/m<sup>3</sup>

Density of base construction

$\gamma_{base} = 23.6$  kN/m<sup>3</sup>

Angle of soil surface

$\beta = 0.0$  deg

Effective height at back of wall

$h_{eff} = 2200$  mm

Mobilisation factor

$M = 1.5$

Moist density

$\gamma_m = 18.0$  kN/m<sup>3</sup>

Saturated density

$\gamma_s = 21.0$  kN/m<sup>3</sup>

Design shear strength

$\phi' = 24.2$  deg

Angle of wall friction

$\delta = 0.0$  deg

Design shear strength

$\phi'_b = 24.2$  deg

Design base friction

$\delta_b = 18.6$  deg

Moist density

$\gamma_{mb} = 18.0$  kN/m<sup>3</sup>

Allowable bearing

$P_{bearing} = 125$  kN/m<sup>2</sup>

**Using Coulomb theory**

Active pressure


$K_a = 0.419$

Passive pressure

$K_p = 4.187$

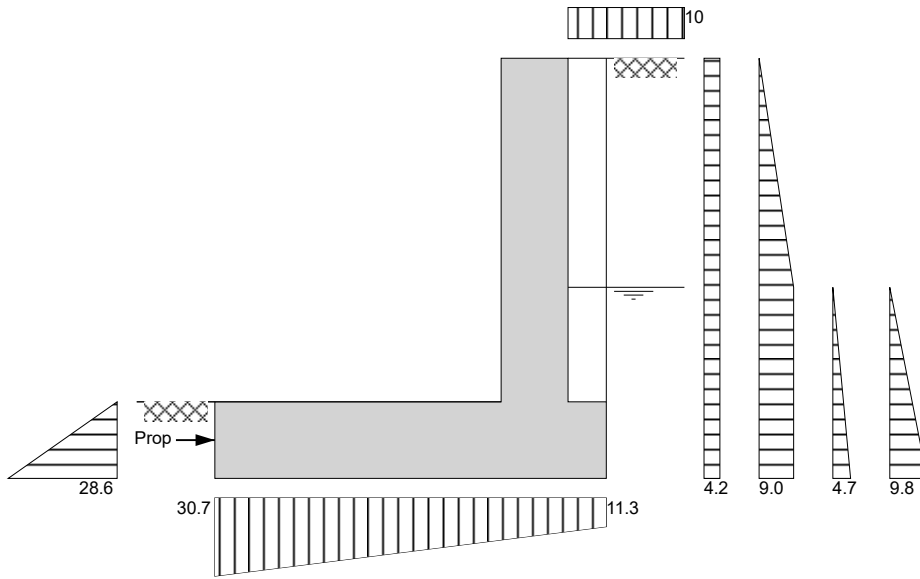
At-rest pressure

$K_0 = 0.590$

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**Loading details**

Surcharge load	Surcharge = <b>10.0</b> kN/m <sup>2</sup>	Vertical live load	$W_{live} = 0.0$ kN/m
Vertical dead load	$W_{dead} = 0.0$ kN/m	Horizontal live load	$F_{live} = 0.0$ kN/m
Horizontal dead load	$F_{dead} = 0.0$ kN/m	Height of horizontal load	$h_{load} = 0$ mm
Position of vertical load	$l_{load} = 0$ mm		



Loads shown in kN/m, pressures shown in kN/m<sup>2</sup>

**Calculate propping force**

Propping force  $F_{prop} = 11.4$  kN/m


**Check bearing pressure**

Total vertical reaction	$R = 43.1$ kN/m	Distance to reaction	$x_{bar} = 867$ mm
Eccentricity of reaction	$e = 158$ mm		

**Reaction acts within middle third of base**

Bearing pressure at toe	$p_{toe} = 30.7$ kN/m <sup>2</sup>	Bearing pressure at heel	$p_{heel} = 11.3$ kN/m <sup>2</sup>
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**PASS - Maximum bearing pressure is less than allowable bearing pressure**

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**RETAINING WALL DESIGN (BS 8002:1994)**

TEDDS calculation version 1.2.01.08

**Ultimate limit state load factors**

Dead load factor  $\gamma_{f_d} = 1.4$                       Live load factor  $\gamma_{f_l} = 1.6$   
Earth pressure factor  $\gamma_{f_e} = 1.4$

**Calculate propping force**

Propping force  $F_{prop} = 11.4$  kN/m

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

**Material properties**

Strength of concrete  $f_{cu} = 40$  N/mm<sup>2</sup>                      Strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

**Base details**

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

**Design of retaining wall toe**

Shear at heel  $V_{toe} = 38.9$  kN/m                      Moment at heel  $M_{toe} = 46.2$  kNm/m

***Compression reinforcement is not required***

**Check toe in bending**

Reinforcement provided **12 mm dia.bars @ 150 mm centres**  
Area required  $A_{s\_toe\_req} = 520.0$  mm<sup>2</sup>/m                      Area provided  $A_{s\_toe\_prov} = 754$  mm<sup>2</sup>/m

***PASS - Reinforcement provided at the retaining wall toe is adequate***

**Check shear resistance at toe**

Design shear stress  $V_{toe} = 0.113$  N/mm<sup>2</sup>                      Allowable shear stress  $V_{adm} = 5.000$  N/mm<sup>2</sup>

***PASS - Design shear stress is less than maximum shear stress***

Concrete shear stress  $V_{c\_toe} = 0.463$  N/mm<sup>2</sup>

***$V_{toe} < V_{c\_toe}$  - No shear reinforcement required***

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

**Material properties**

Strength of concrete  $f_{cu} = 40$  N/mm<sup>2</sup>                      Strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

**Base details**

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

**Design of retaining wall heel**

Shear at heel  $V_{heel} = 15.4$  kN/m                      Moment at heel  $M_{heel} = 4.4$  kNm/m

***Compression reinforcement is not required***

**Check heel in bending**

Reinforcement provided **12 mm dia.bars @ 150 mm centres**  
Area required  $A_{s\_heel\_req} = 520.0$  mm<sup>2</sup>/m                      Area provided  $A_{s\_heel\_prov} = 754$  mm<sup>2</sup>/m

***PASS - Reinforcement provided at the retaining wall heel is adequate***


**Check shear resistance at heel**

Design shear stress  $V_{heel} = 0.045$  N/mm<sup>2</sup>                      Allowable shear stress  $V_{adm} = 5.000$  N/mm<sup>2</sup>

***PASS - Design shear stress is less than maximum shear stress***

Concrete shear stress  $V_{c\_heel} = 0.463$  N/mm<sup>2</sup>

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

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

**Material properties**

Strength of concrete  $f_{cu} = 40 \text{ N/mm}^2$       Strength of reinforcement  $f_y = 500 \text{ N/mm}^2$

**Wall details**

Minimum reinforcement  $k = 0.13 \%$   
Cover in stem  $C_{stem} = 75 \text{ mm}$       Cover in wall  $C_{wall} = 50 \text{ mm}$

**Design of retaining wall stem**

Shear at base of stem  $V_{stem} = 9.1 \text{ kN/m}$       Moment at base of stem  $M_{stem} = 35.6 \text{ kNm/m}$

***Compression reinforcement is not required***

**Check wall stem in bending**

Reinforcement provided **12 mm dia.bars @ 150 mm centres**  
Area required  $A_{s\_stem\_req} = 455.0 \text{ mm}^2/\text{m}$       Area provided  $A_{s\_stem\_prov} = 754 \text{ mm}^2/\text{m}$

***PASS - Reinforcement provided at the retaining wall stem is adequate***

**Check shear resistance at wall stem**

Design shear stress  $V_{stem} = 0.034 \text{ N/mm}^2$       Allowable shear stress  $V_{adm} = 5.000 \text{ N/mm}^2$

***PASS - Design shear stress is less than maximum shear stress***

Concrete shear stress  $V_{c\_stem} = 0.534 \text{ N/mm}^2$


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

**Check retaining wall deflection**

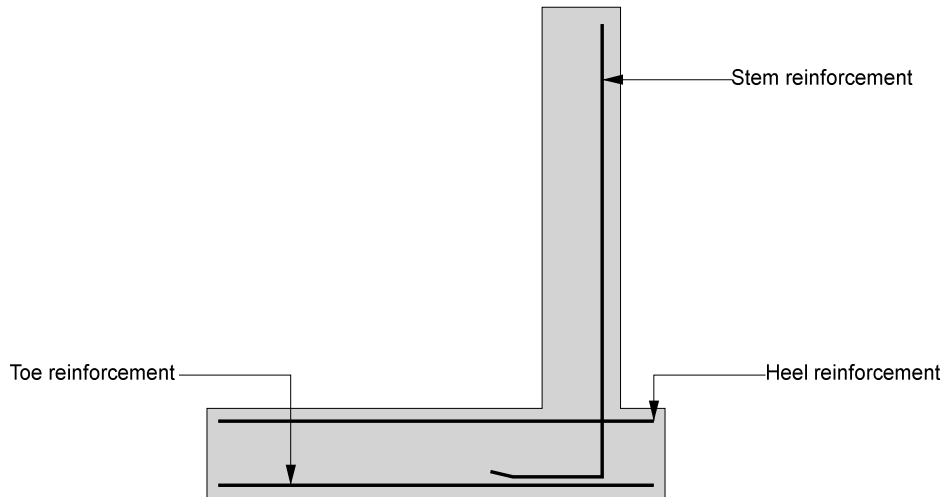
Max span/depth ratio  $ratio_{max} = 14.00$       Actual span/depth ratio  $ratio_{act} = 6.69$

***PASS - Span to depth ratio is acceptable***




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**Indicative retaining wall reinforcement diagram**



Toe bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)  
Heel bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)  
Stem bars - 12 mm dia.@ 150 mm centres - (754 mm<sup>2</sup>/m)

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**LOWER GROUND FLKOOR SLAB**

**FINISH + SWT = 7.4KN/m<sup>2</sup>**

**IMP LOAD = 1.50KN/m<sup>2</sup>**

**1. SPANNING**

MAX SPAN = 4.50m

DESIGN LOAD = 12.80KN/m<sup>2</sup>

BM ULT = 32.4KN.m

**RC SLAB DESIGN (BS8110)**

**RC SLAB DESIGN (BS8110:PART1:1997)**

TEDDS calculation version 1.0.04

**CONCRETE SLAB DESIGN (CL 3.5.3 & 4)**

**SIMPLE ONE WAY SPANNING SLAB DEFINITION**

Overall depth of slab  $h = 225$  mm

Cover to tension reinforcement resisting sagging  $c_b = 35$  mm

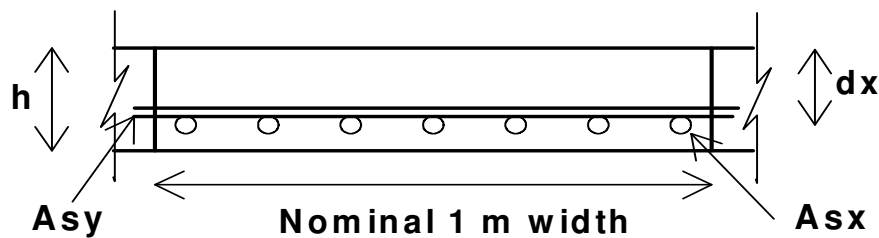
Trial bar diameter  $D_{tryx} = 10$  mm

Depth to tension steel (resisting sagging)

$$d_x = h - c_b - D_{tryx}/2 = 185 \text{ mm}$$

Characteristic strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

Characteristic strength of concrete  $f_{cu} = 35$  N/mm<sup>2</sup>



**One-way spanning slab  
(simple)**


**ONE WAY SPANNING SLAB (CL 3.5.4)**

**MAXIMUM DESIGN MOMENTS IN SPAN**

Design sagging moment (per m width of slab)  $m_{sx} = 32.4$  kNm/m

**CONCRETE SLAB DESIGN – SAGGING – OUTER LAYER OF STEEL (CL 3.5.4)**

Design sagging moment (per m width of slab)  $m_{sx} = 32.4$  kNm/m

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Moment Redistribution Factor  $\beta_{bx} = 1.0$

**Area of reinforcement required**

$$K_x = \text{abs}(m_{sx}) / (d_x^2 \times f_{cu}) = 0.027$$

$$K'_x = \min(0.156, (0.402 \times (\beta_{bx} - 0.4)) - (0.18 \times (\beta_{bx} - 0.4)^2)) = 0.156$$

*Outer compression steel not required to resist sagging*

**Slab requiring outer tension steel only - bars (sagging)**

$$z_x = \min((0.95 \times d_x), (d_x \times (0.5 + \sqrt{(0.25 - K_x/0.9)}))) = 176 \text{ mm}$$

$$\text{Neutral axis depth } x_x = (d_x - z_x) / 0.45 = 21 \text{ mm}$$

Area of tension steel required

$$A_{sx\_req} = \text{abs}(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x) = 424 \text{ mm}^2/\text{m}$$

**Tension steel**

**Provide 10 dia bars @ 100 centres outer tension steel resisting sagging**

$$A_{sx\_prov} = A_{sx} = 785 \text{ mm}^2/\text{m}$$

*Area of outer tension steel provided sufficient to resist sagging*

**TRANSVERSE BOTTOM STEEL - INNER**

Inner layer of transverse steel

**Provide 10 dia bars @ 100 centres**

$$A_{sy\_prov} = A_{sy} = 785 \text{ mm}^2/\text{m}$$

**Check min and max areas of steel resisting sagging**

Total area of concrete  $A_c = h = 225000 \text{ mm}^2/\text{m}$

Minimum % reinforcement  $k = 0.13 \%$

$$A_{st\_min} = k \times A_c = 293 \text{ mm}^2/\text{m}$$

$$A_{st\_max} = 4 \% \times A_c = 9000 \text{ mm}^2/\text{m}$$

Steel defined:

Outer steel resisting sagging  $A_{sx\_prov} = 785 \text{ mm}^2/\text{m}$

*Area of outer steel provided (sagging) OK*

Inner steel resisting sagging  $A_{sy\_prov} = 785 \text{ mm}^2/\text{m}$

*Area of inner steel provided (sagging) OK*

**CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)**

Slab span length  $l_x = 4.500 \text{ m}$

Design ultimate moment in shorter span per m width  $m_{sx} = 32 \text{ kNm/m}$

Depth to outer tension steel  $d_x = 185 \text{ mm}$

**Tension steel**

Area of outer tension reinforcement provided  $A_{sx\_prov} = 785 \text{ mm}^2/\text{m}$


Area of tension reinforcement required  $A_{sx\_req} = 424 \text{ mm}^2/\text{m}$

Moment Redistribution Factor  $\beta_{bx} = 1.00$

**Modification Factors**

Basic span / effective depth ratio (Table 3.9)  $\text{ratio}_{\text{span\_depth}} = 20$

The modification factor for spans in excess of 10m (ref. cl 3.4.6.4) has not been included.

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$$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx}) = 180.0 \text{ N/mm}^2$$

$$\text{factor}_{\text{tens}} = \min ( 2 , 0.55 + ( 477 \text{ N/mm}^2 - f_s ) / ( 120 \times ( 0.9 \text{ N/mm}^2 + m_{sx} / d_x^2 ) ) ) = 1.890$$

#### Calculate Maximum Span

This is a simplified approach and further attention should be given where special circumstances exist. Refer to clauses 3.4.6.4 and 3.4.6.7.

$$\text{Maximum span } l_{\text{max}} = \text{ratio}_{\text{span\_depth}} \times \text{factor}_{\text{tens}} \times d_x = 6.99 \text{ m}$$

#### Check the actual beam span

$$\text{Actual span/depth ratio } l_x / d_x = 24.32$$

$$\text{Span depth limit ratio}_{\text{span\_depth}} \times \text{factor}_{\text{tens}} = 37.80$$

*Span/Depth ratio check satisfied*

#### CHECK OF NOMINAL COVER (SAGGING) – (BS8110:PT 1, TABLE 3.4)

Slab thickness  $h = 225 \text{ mm}$

Effective depth to bottom outer tension reinforcement  $d_x = 185.0 \text{ mm}$

Diameter of tension reinforcement  $D_x = 10 \text{ mm}$

Diameter of links  $L_{\text{diax}} = 0 \text{ mm}$

Cover to outer tension reinforcement

$$c_{\text{tenx}} = h - d_x - D_x / 2 = 35.0 \text{ mm}$$

Nominal cover to links steel

$$c_{\text{nomx}} = c_{\text{tenx}} - L_{\text{diax}} = 35.0 \text{ mm}$$

Permissible minimum nominal cover to all reinforcement (Table 3.4)

$$c_{\text{min}} = 35 \text{ mm}$$

*Cover over steel resisting sagging OK*

#### 2 LAYERS A393 BOTTOM

#### UPLIFT

$$\text{SAY AVERAGE MAX} = 2 \times 10 = 20 \text{ KN/m}^2$$

$$\text{MINUS SWT} = 13.6 \text{ KN/m}^2$$

$$\text{DESIGN BM} = 1.4 \times 13.6 \times 4.5^2 / 8 = 48.2 \text{ KN.m}$$

### RC SLAB DESIGN (BS8110)


#### RC SLAB DESIGN (BS8110:PART1:1997)

TEDDS calculation version 1.0.04

#### CONCRETE SLAB DESIGN (CL 3.5.3 & 4)

#### SIMPLE ONE WAY SPANNING SLAB DEFINITION

Overall depth of slab  $h = 225 \text{ mm}$

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Cover to tension reinforcement resisting sagging  $c_b = 35$  mm

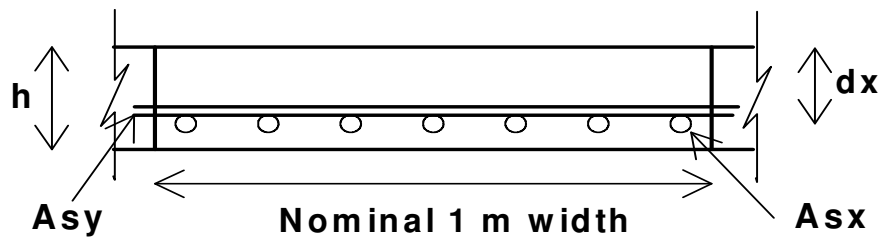
Trial bar diameter  $D_{tryx} = 10$  mm

Depth to tension steel (resisting sagging)

$$d_x = h - c_b - D_{tryx}/2 = 185 \text{ mm}$$

Characteristic strength of reinforcement  $f_y = 500$  N/mm<sup>2</sup>

Characteristic strength of concrete  $f_{cu} = 35$  N/mm<sup>2</sup>



## One-way spanning slab (simple)

### ONE WAY SPANNING SLAB (CL 3.5.4)

#### MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab)  $m_{sx} = 45.2$  kNm/m

#### CONCRETE SLAB DESIGN – SAGGING – OUTER LAYER OF STEEL (CL 3.5.4)

Design sagging moment (per m width of slab)  $m_{sx} = 45.2$  kNm/m

Moment Redistribution Factor  $\beta_{bx} = 1.0$

#### **Area of reinforcement required**

$$K_x = \text{abs}(m_{sx}) / (d_x^2 \times f_{cu}) = 0.038$$

$$K'_x = \min(0.156, (0.402 \times (\beta_{bx} - 0.4)) - (0.18 \times (\beta_{bx} - 0.4)^2)) = 0.156$$

*Outer compression steel not required to resist sagging*

#### Slab requiring outer tension steel only - bars (sagging)

$$z_x = \min((0.95 \times d_x), (d_x \times (0.5 + \sqrt{(0.25 - K_x/0.9)}))) = 176 \text{ mm}$$

$$\text{Neutral axis depth } x_x = (d_x - z_x) / 0.45 = 21 \text{ mm}$$

Area of tension steel required

$$A_{sx\_req} = \text{abs}(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x) = 592 \text{ mm}^2/\text{m}$$

#### **Tension steel**

#### Provide 10 dia bars @ 100 centres outer tension steel resisting sagging


$$A_{sx\_prov} = A_{sx} = 785 \text{ mm}^2/\text{m}$$

*Area of outer tension steel provided sufficient to resist sagging*

### TRANSVERSE BOTTOM STEEL - INNER

Inner layer of transverse steel

Provide 10 dia bars @ 100 centres

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PRELIMINARY STRUCTURAL CALCULATIONS			24		
Calc. by	Date	Chk'd by	Date	App'd by	Date
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$$A_{sy\_prov} = A_{sy} = 785 \text{ mm}^2/\text{m}$$

**Check min and max areas of steel resisting sagging**

Total area of concrete  $A_c = h = 225000 \text{ mm}^2/\text{m}$

Minimum % reinforcement  $k = 0.13 \%$

$$A_{st\_min} = k \times A_c = 293 \text{ mm}^2/\text{m}$$

$$A_{st\_max} = 4 \% \times A_c = 9000 \text{ mm}^2/\text{m}$$

Steel defined:

Outer steel resisting sagging  $A_{sx\_prov} = 785 \text{ mm}^2/\text{m}$

*Area of outer steel provided (sagging) OK*

Inner steel resisting sagging  $A_{sy\_prov} = 785 \text{ mm}^2/\text{m}$

*Area of inner steel provided (sagging) OK*

**CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)**

Slab span length  $l_x = 4.500 \text{ m}$

Design ultimate moment in shorter span per m width  $m_{sx} = 45 \text{ kNm/m}$

Depth to outer tension steel  $d_x = 185 \text{ mm}$

**Tension steel**

Area of outer tension reinforcement provided  $A_{sx\_prov} = 785 \text{ mm}^2/\text{m}$

Area of tension reinforcement required  $A_{sx\_req} = 592 \text{ mm}^2/\text{m}$

Moment Redistribution Factor  $\beta_{bx} = 1.00$

**Modification Factors**

Basic span / effective depth ratio (Table 3.9)  $\text{ratio}_{\text{span\_depth}} = 26$

The modification factor for spans in excess of 10m (ref. cl 3.4.6.4) has not been included.

$$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx}) = 251.2 \text{ N/mm}^2$$

$$\text{factor}_{\text{tens}} = \min ( 2 , 0.55 + ( 477 \text{ N/mm}^2 - f_s ) / ( 120 \times ( 0.9 \text{ N/mm}^2 + m_{sx} / d_x^2 ) ) ) = 1.397$$

**Calculate Maximum Span**

This is a simplified approach and further attention should be given where special circumstances exist. Refer to clauses 3.4.6.4 and 3.4.6.7.

$$\text{Maximum span } l_{\text{max}} = \text{ratio}_{\text{span\_depth}} \times \text{factor}_{\text{tens}} \times d_x = 6.72 \text{ m}$$

**Check the actual beam span**

Actual span/depth ratio  $l_x / d_x = 24.32$

Span depth limit  $\text{ratio}_{\text{span\_depth}} \times \text{factor}_{\text{tens}} = 36.33$

*Span/Depth ratio check satisfied*

**CHECK OF NOMINAL COVER (SAGGING) – (BS8110:PT 1, TABLE 3.4)**


Slab thickness  $h = 225 \text{ mm}$

Effective depth to bottom outer tension reinforcement  $d_x = 185.0 \text{ mm}$

Diameter of tension reinforcement  $D_x = 10 \text{ mm}$

Diameter of links  $L_{\text{diat}} = 0 \text{ mm}$

Cover to outer tension reinforcement

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$$C_{tenx} = h - d_x - D_x / 2 = \mathbf{35.0 \text{ mm}}$$

Nominal cover to links steel

$$C_{nomx} = C_{tenx} - L_{diax} = \mathbf{35.0 \text{ mm}}$$

Permissible minimum nominal cover to all reinforcement (Table 3.4)

$$C_{min} = \mathbf{35 \text{ mm}}$$

***Cover over steel resisting sagging OK***

**2 LAYERS A393 TOP**



## **APPENDIX 3**

### **TEMPORARY WORKS**





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TEMPORARY LATERAL PROPPING

Job No. 22007

Sheet No. TW1

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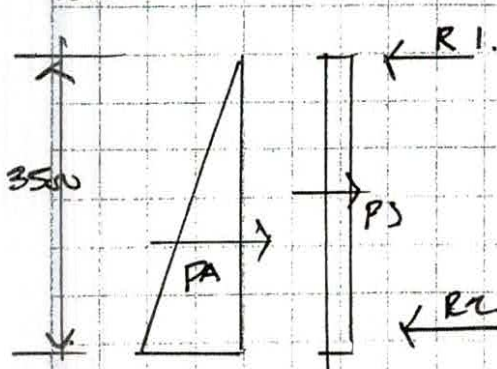
THERE WILL BE TWO TEMPORARY CASES, TO ALLOW REDUCTION OF LEVELS TO FORM L&F SLABS.

1. FRONT WALL & RETURNS.

2. SIDE WALLS.

1. FRONT WALL & LIGHTWELL

WORKS WILL BE SEQUENCED SUCH THAT SUSPENDED CONCRETE GROUND FLOOR SLABS WILL BE IN PLACE PRIOR TO REDUCING LEVELS



$$\gamma = 19 \text{ kN/m}^3 \quad K_0 = 0.5$$

$$I_L = 10 \text{ kN/m}^2$$

$$P_A = 19 \times 0.5 \times 3.5^2 / 2 = 58.2 \text{ kN}$$

$$P_S = 0.5 \times 10 \times 3.5 = 17.5 \text{ kN}$$

$$R_1 \text{ GROUND SLABS} = (58.2 \times \frac{1}{3}) + (17.5 / 2) = 28.2 \text{ kN/m}$$

$$R_2 \text{ L&F} = (58.2 \times \frac{2}{3}) + (17.5 / 2) = 47.6 \text{ kN/m}$$

PROPS AT SAY MAX 2.0M C/C.

$$\text{WALL BM} = 47.6 \times 2^2 / 8 = 24 \text{ kN}\cdot\text{m}$$

$$Z_{\text{REQ}} = 24 / 0.18 = 133 \text{ cm}^3 \quad \text{152 UC 30 WALL}$$

$$(Z = 222 > 133)$$



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TEMPORARY LATERAL PROPPING

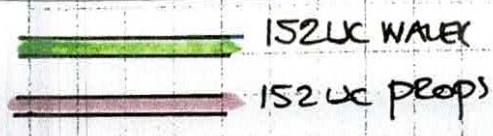
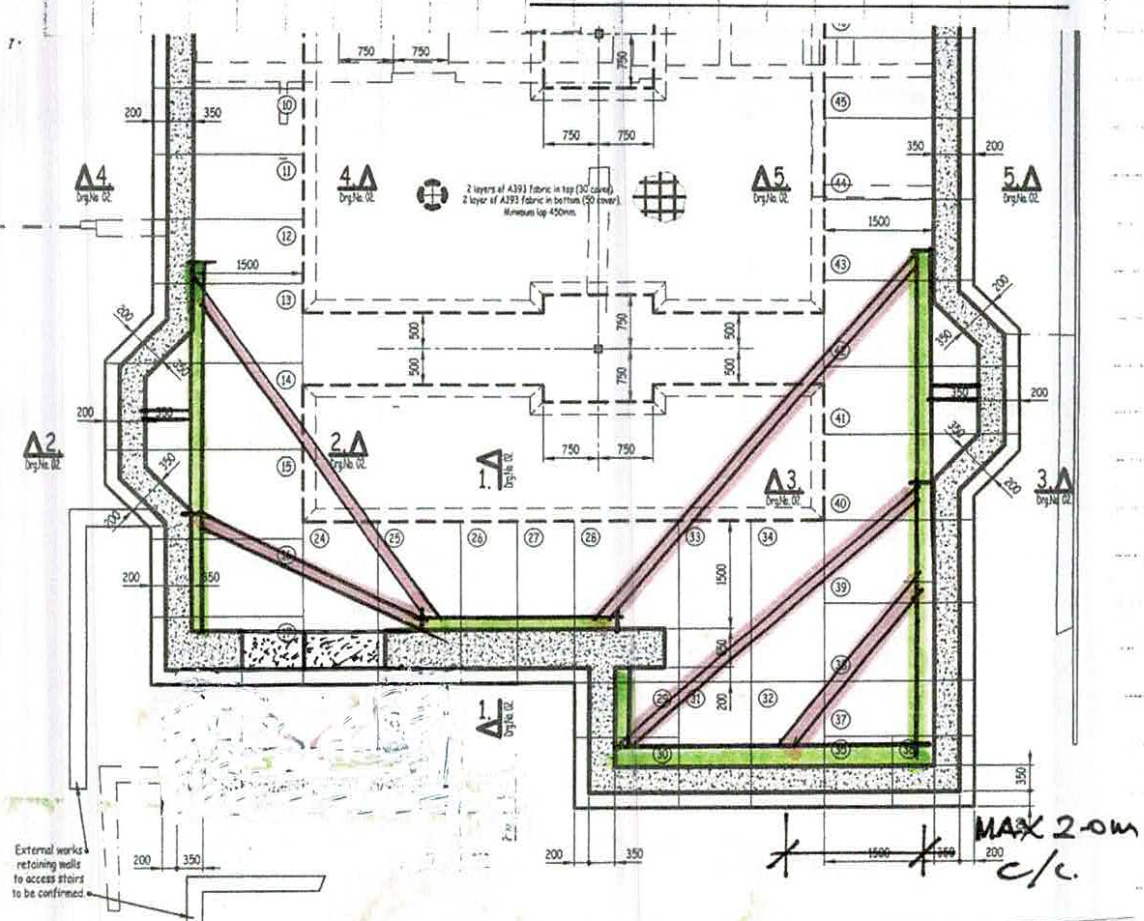
Job No. 22D07  
Sheet No. TW2  
Made by: TV  
Date: APRIL 2022  
Checked by:

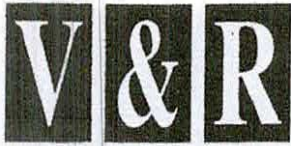
Props

$L_{MAX} = 4.0m$        $MAX\ LOAD = 2 \times 47.6 \times \sqrt{2} = 134\ kN.$

SAFE LOAD TABLES

152 UC30,  $L = 4.0m$   
SAFE LOAD = 283kN > 134 OK.





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TEMPORARY LATERAL PROPPING

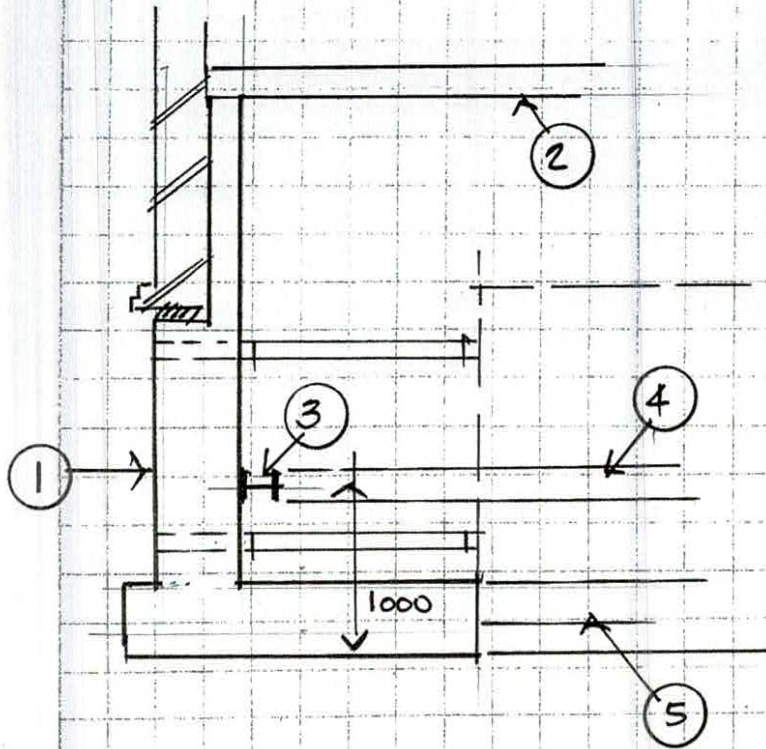
Job No. 22007

Sheet No. TN3

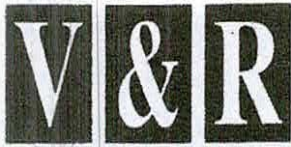
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1. IN SEQUENCE FORM WALL & BASE IN SEQUENCE KEEP PROPPED AGAINST INTERNAL 'DUMPING'. COMPLETE WALL & BASE.
2. FIX UPPER GROUND STEEL & CONCRETE SLAB TO FORM PROP AT TOP OF WALL
3. FIX 152x63x5 WALKER 1000 ABOVE FORMATION.
4. TRENCH 'DUMPING' AT PROP LOCATIONS & FIX PROPS
5. REDUCE LEVELS TO FORMATION & FIX DRAINAGE COMPLETE L.G.F. SLAB.
6. REMOVE PROPS & WALKERS



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## 2 SIDE WALLS

AVERAGE RETAINED HT 2.0m OR LESS.

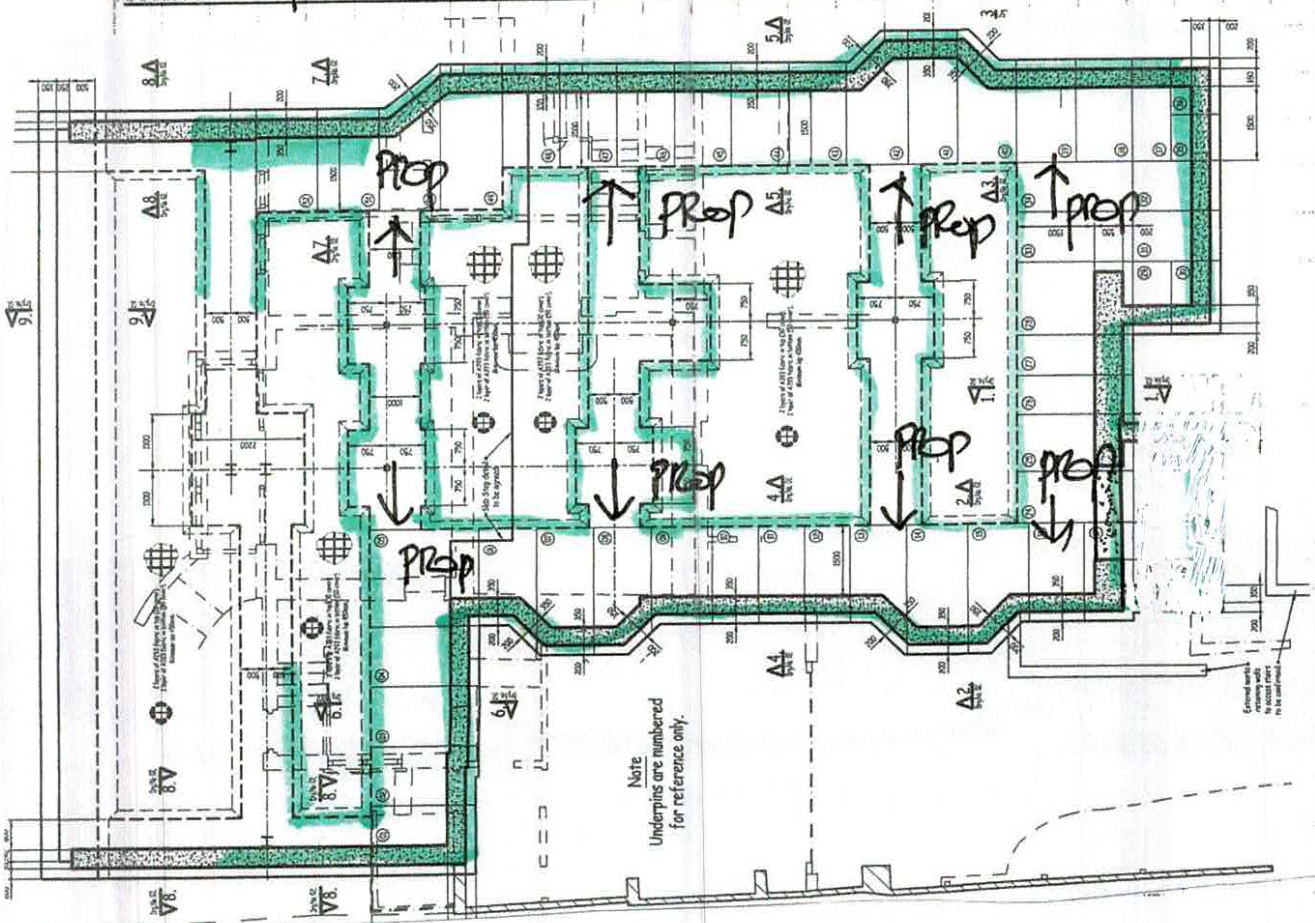
WALLS WILL BE PROPPED AGAINST CENTRAL DUMPING TEMPORARILY ONCE WALLS COMPLETE & INTERNAL CROSS GROUND BEAMS ARE CAST SLIDING OF WALL CANNOT OCCUR AS GROUND BEAMS WILL ACT AS PROPS.

$$\text{TOTAL LATERAL FORCE /m} = (0.5 \times 19 \times 2.0^2 / 2) + (0.5 \times 10 \times 2) \\ = 29 \text{ kN/m}$$

BASE 2050 DX 400 W - MAX SPAN HORIZONTALLY = 4.0m

$$BM_{MAX} = 29 \times 4.0^2 / 8 = 58 \text{ kN.m}$$

BY INSPECTION 400 X 2050 BASE ACTING AS RC BEAM O.K.





**APPENDIX 4**

**MOVEMENT MONITORING**

**61 REDDINGTON ROAD LONDON NW3 7RP**  
**MOVEMENT MONITORING**

**INTRODUCTION**

- Movement monitoring will be carried out by specialist sub- contractor.
- Recommendations of BRE Digest 343 Part 2 'Simple Measuring and monitoring of movement to low rise buildings' shall be followed.
- Movements in three planes (left to right, front to back and verticality) will be measured relative to remote and stable control stations.

**EQUIPMENT**

- All measurements will be made with suitable EDM equipment.

**ACCURACY**

- The accuracy (stated standard deviation to ISO 17123-4) in both level and plan position shall be +/- 1mm but this is dependent upon site conditions / weather at the time of survey.

**MONITORING STATIONS**

- Monitoring points shall be agreed between the party wall surveyors and consulting engineer. The targets to be monitored will be retro reflective targets fixed to the walls with resin adhesive See attached plans / photos for proposed positions.

**SURVEY CONTROL**

- Minimum of 3 reference points remote from the site. (At least 5.0m away from the site boundary)

**PROCEDURE**

- Survey equipment shall be set up on firm a base.
- Each location will be measured in turn and readings of distance and angle, and Northing, Easting and height will be recorded.
- Readings will be repeated on both faces of the instrument.

**FREQUENCY**

- Two sets of baseline readings will be taken before any excavation work commences, with an interval of no less than 5 days between the two sets of readings.
- Frequency of readings during the piling and basement excavation works will be weekly.
- One final reading will be taken 4 weeks after basement works are complete and ground floor and basement floor are in position.

**TRIGGER VALUES**

**Amber Level = 8mm**

- At Amber level basement construction work will cease and procedures reviewed by the project Structural Engineer to determine additional safeguards or working practices need to be implemented. Work will not restart until approval of project Engineer. The building owner's surveyor and adjoining owner's surveyor informed of level being reached, monitoring will become more frequent at weekly intervals.

**Red Level = 10mm**

- Construction works shall cease on site until a thorough review of working practice has been carried out by project Structural Engineer. Any additional temporary works shall be implemented by Contractor
- Works will not recommence until approval has been given by the Project Engineer and both the owner and adjoining owner surveyors.

**RESULTS**

- The recorded results shall be tabulated and graphically presents in report form and issued to all relative parties
- Monitoring results shall be presented within 24 hours of measuring.
- The contractor will identify trends in movement from the results before amber level is reached and assess the best course of action to take.

**NOTE TARGET POSITION ON NOS 59, 61 AND 63 TO BE AGREED AT PARTY WALL PROCESS**



## **APPENDIX 5**

### **DEWATERING OF EXCAVATIONS**

## **GROUNDWATER AND DE-WATERING**

Local perched groundwater may be encountered during excavation and a method for dewatering excavations will be confirmed and this will depend on the amount of groundwater and the depth at which it is found.

At this stage groundwater will be considered as either slight or significant.

Slight groundwater will be classified as an amount of water that can be dealt with by up to 30 minutes local pumping at the start of the working day and for a further 30 minutes at another time later that working day.

Significant groundwater is anything that cannot be dealt with by these two 30 minute periods of local dewatering.

### Slight groundwater

Slight groundwater will be dealt with as follows:

- Local dewatering using a portable electric pump.
- Refer also to method statement for prevention of loss of fines.

### Significant groundwater

In the event that significant groundwater is encountered a specialist dewatering arrangement may be required.

The most likely arrangement will be by controlling the water locally to each underpin excavation subject to strict control upon loss of fines in surrounding soils.

Should full time pumping be employed then a control should be in place to ensure pumping is not interrupted whilst site is not manned, see control document as below;

## **METHOD STATEMENT FOR PREVENTION OF LOSS OF FINES IN GRANULAR SOILS WHILST FORMING EXCAVATIONS IN WATER OR BELOW THE WATER TABLE.**

Excavations below the water table:

- All sides of the excavation shall be sheeted with ECO board or similar approved, adequately cross propped and braced.
- All joints in sheeting shall be as closed as possible to avoid water with fines leaking through. A layer of 1000g polythene should be laid behind each joint in the sheeting, lapping each side of the joint by 300mm.
- Tightness of props to be regularly checked.

Groundwater will be dealt with as follows:

- Local dewatering using a portable electric pump, placed in an excavated sump within the excavation. Or placed in another vessel with holes in its walls placed in the excavated sump.
- The pump, or the vessel in which the pump is placed, will be surrounded in geotextile material to filter ground from the groundwater before it enters the pump in order to reduce the migration of any soil / fines.





- The outflow from the pump will be pumped into a settlement container where any soils / fines in suspension will be allowed to settle and any soils / fines that have been removed can be collected.
- The amount of soil / fines removed from the ground will be monitored and recorded.
- The pumped water will be put back into the ground in a part of the site away from the current work area.