OSBORNE EDWARDS

CONSULTING STRUCTURAL ENGINEERS

39-41 NORTH ROAD
LONDON
N7 9DP

TELEPHONE 020 7226 2444

REPORT ON STRUCTURE

FOR

BASEMENT CONSTRUCTION

22 HOLMES ROAD

LONDON NW5

19088/JO **JULY 2019**

OSBORNE EDWARDS LTD
DIRECTORS JACQUI OSBORNE BSC CENG MISTRUCTE
JOHN EDWARDS GRAD DIPL CONS (AA)

REGISTERED IN ENGLAND 04173590

1.0 GENERAL INTRODUCTION.

This report has been commissioned by Norton Mayfield Architects in support of a planning application for the refurbishment and extension of an existing building and the construction of three new houses. The existing building has a lower ground floor and the three new houses will each have a basement under part of the building footprint.

A key part of the planning application to Camden Council is a requirement to address key issues about the affect the basement could have on the site and surrounding sites/buildings to ensure the work can be carried out safely and that movement caused by the construction method can be kept to a minimum.

The reports on hydrology/hydrogeology and the soil investigation were commissioned by the Architect, Norton Mayfield Architects before our appointment was confirmed. We have summarised the findings of the two reports in section 3.0.

This report addresses a specific request from Camden Council for information relating to the sequence of construction, methodology and some key design items such as retaining walls.

For the proposals we have worked from the drawings submitted by Norton Mayfield Architects for planning consent.

2.0 EXECUTIVE SUMMARY.

From the results of the investigations, the reports covering soil conditions and hydrology/hydrogeology, an assessment of the existing buildings on the site and consideration of adjoining buildings, a construction methodology has been developed. This is set out later in this report. We have shown that by careful planning and execution of the construction work and employing a sufficiently stiff bracing system during the formation of the basement a means of forming the basement without the risk of significant lateral movements is both possible and practical. We also conclude the construction of the new basements can be carried out so as not to cause harm or affect the stability of surrounding buildings.

3.0 SUMMARY OF SOIL AND HYDROLOGY/HYDROGEOLOGY.

Two reports were commissioned during the Spring of 2019, these being:

- Surface and Ground Water by Stantec UK Ltd dated May 2019.
- Land Stability and Site Investigation by Key GS Ltd dated April 2019.

3.1 Surface and Ground Water by Stantec UK Ltd.

This report looked at and commented upon the likely presence of water on or nearby the site and the site investigation by Key GS Ltd was planned around queries highlighted by a scoping and screening exercise.

The findings of the report are that the likelihood of a flood on site from rivers, reservoirs or ground water are low. The excavation depth will be in the clay strata which is relatively impermeable and it is not likely to reach a level where ground water ingress will occur. If water is encountered it is likely to be in isolated lenses of sandy soil or from fissures in the clay.

SUDs is covered in the screening table of the report.

3.2 Land Stability and Site Investigation by Key GS Ltd.

This report covers the results of three window sample holes within the site and one trial pit on the eastern boundary.

The window sample holes don't have a measured ground level given with the results but they appear to be at approximately the same level as the proposed ground floor of the new houses. The conditions found can be summarised as 0.5 to 0.9m of made ground above London clay.

The shortest window sample hole was 1.0m and the deepest 5.45m

Two boreholes were dry and a third one (WS02) showed a water level of 3.23m below ground level. The water was drained and it returned slowly, suggesting a pocket of inflow.

The trial pit alongside the adjoining building at 24-26 Holmes Road shows a brick wall constructed off a concrete strip foundation. The underside of the concrete foundation is approximately 900mm below ground level bearing onto London clay and the concrete is approximately 400mm thick. A section through the foundation shows concrete projecting beyond the face of the wall.

A movement assessment suggests there will not be movement that would be detrimental to the adjoining properties and the damage assessment according to CIRIA C580 Table 2.5 (after Burland, 1995), will be Category 1, or very slight.

3.3 Further work recommended by Stantec Report.

Recommendations made within the report include further monitoring of the water level in WS02 to reach a conclusion about the possibility of water flowing into the excavation during the work.

We do not propose to comment further on the scope of the investigations as both reports are included with the planning application and are therefore available to be read in full.

4.0 DESCRIPTION OF THE PROPOSALS.

The existing building dates from the Victorian era and is formed with timber floors and roof and solid brick external walls, including retaining walls to the lower ground floor. The internal walls are likely to be timber studwork. The building is predominantly unaltered apart form a new two-storey rear addition, to give additional accommodation in the lower ground and ground floors. One of the new houses is to directly connect to the existing building, requiring underpinning along the flank wall.

All three new houses will have timber floors, a timber roof and masonry walls with some parts cavity construction and a visible brick outer leaf, and some parts clad in zinc. We would expect the ground floor to be concrete construction along with the basement walls.

All basements to the new houses will have a piled perimeter. Investigations have shown groundwater is not likely to be found during the excavation, or where encountered, mostly from sandy lenses and fissures in the clay. In this case contiguous piles will be adequate to form the basement walls, exclude water from the excavation and, when used in conjunction with a concrete lining wall and tanking (to details by a specialist), to give a sufficiently waterproof barrier for residential accommodation.

General existing site levels are reduced in the proposed scheme and it is likely that most of the party walls will need to be underpinned to allow this to happen.

The existing level in Regis Road and the proposed ground floor level of the two houses at that end of the site differ by approximately 2.2m, meaning the need for a retaining wall alongside Regis Road.

To brace the walls of the basement and to help prevent long-term lateral ground movement we recommend the ground floor of the houses is formed in concrete and all the house foundations are piled.

We have shown the principles of our scheme for the foundation and ground floor design in **Appendix 1** on sketches 19088/SK1 to SK4. We have developed a sequence of construction from the sketches.

5.0 SEQUENCE OF CONSTRUCTION

Appendix 2 shows a sequence of construction for the site from the existing arrangement to completion of the basement on sketches SQ1 to SQ6:

Key issues in the design will be water, retaining of the boundary with Regis Road, and the sequence of piling and propping to prevent lateral movement up to the point where the sub-structure is complete and the boundaries fully supported.

5.1 Water

The water level given in the site investigation initial results was 3.25m below ground level at the location of the Window Sample WS2. We estimate this relates to an existing ground level of approximately 35.2m. We also estimate the underside of the basement excavation equate to a level of 31.35m, some 3.85m below ground level. The site investigation went on to say a rising head test showed the likelihood of localised areas of more permeable soil.

It is likely that any perched water, if encountered, or sandy lenses bearing water may be present in the bottom 500mm of the excavation but it is not described as being evidence of a significant inflow of water.

The construction of a sump and use of pumps with filters, to avoid a loss of fines in the soil, may be needed and are considered adequate prevention measures for the described conditions.

5.2 Retaining wall along Regis Road

The design of the retaining wall will need to consider soil, water and traffic loads. We note that Howdens, the Builders Merchant in Regis Road is likely to give rise to regular significant vehicle loads that will need to be taken itno account.

5.1 Piling

The excavation for the main basement areas is likely to be approximately 3.4m deep and contiguous piles will be adequate to support the load encountered from the soil, site traffic and pressure from the foundation of adjoining buildings. A conservative estimate of water pressure will also be used in the design to cover site water conditions but also, for example, for the unlikely event of a burst water main.

6.0 DESIGN:

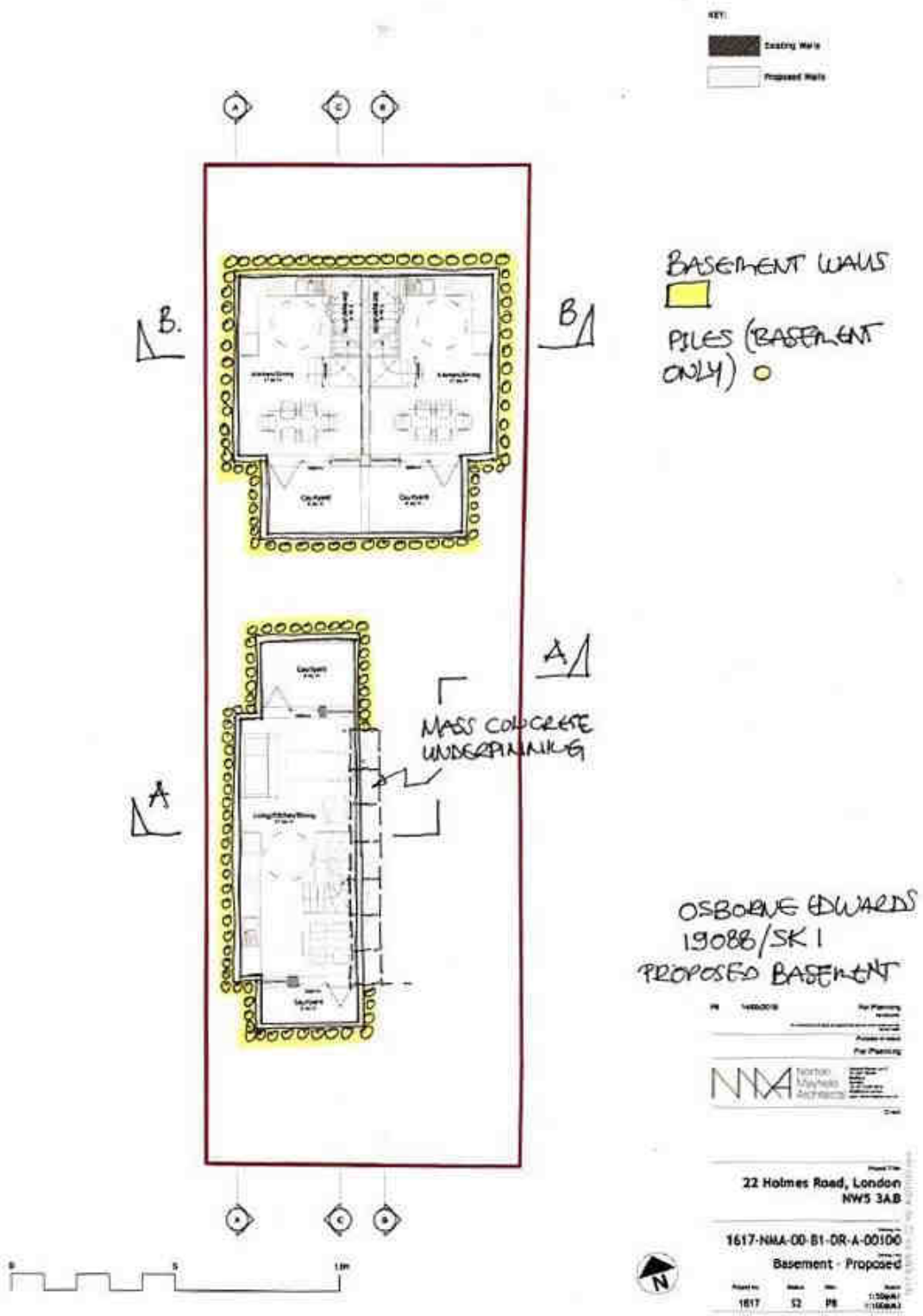
Calculations are attached in **Appendix 3** for typical basement wall design, typical prop loads for the excavation, retaining wall along the boundary with Regis Road.

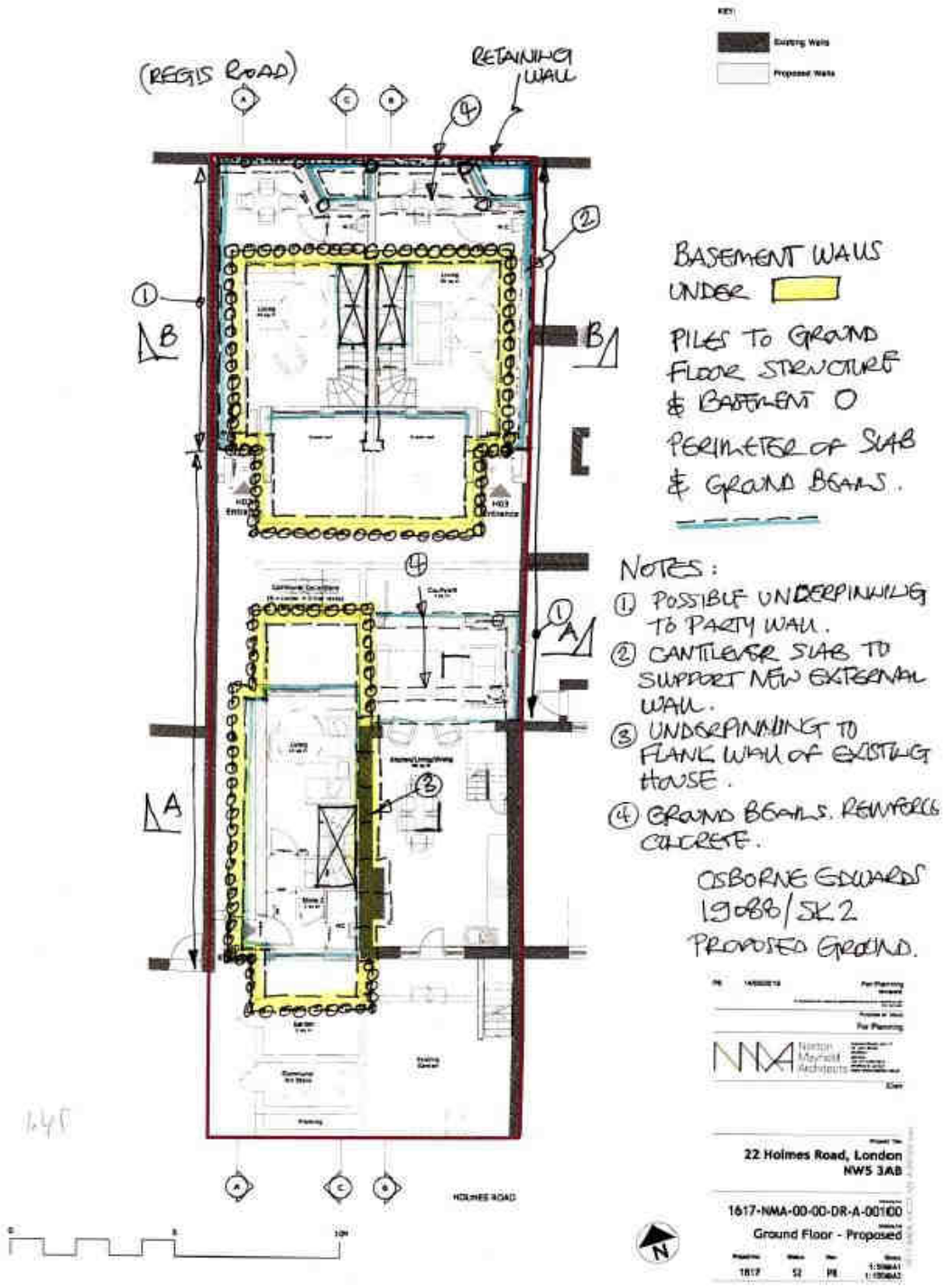
7.0 QUALIFICATIONS

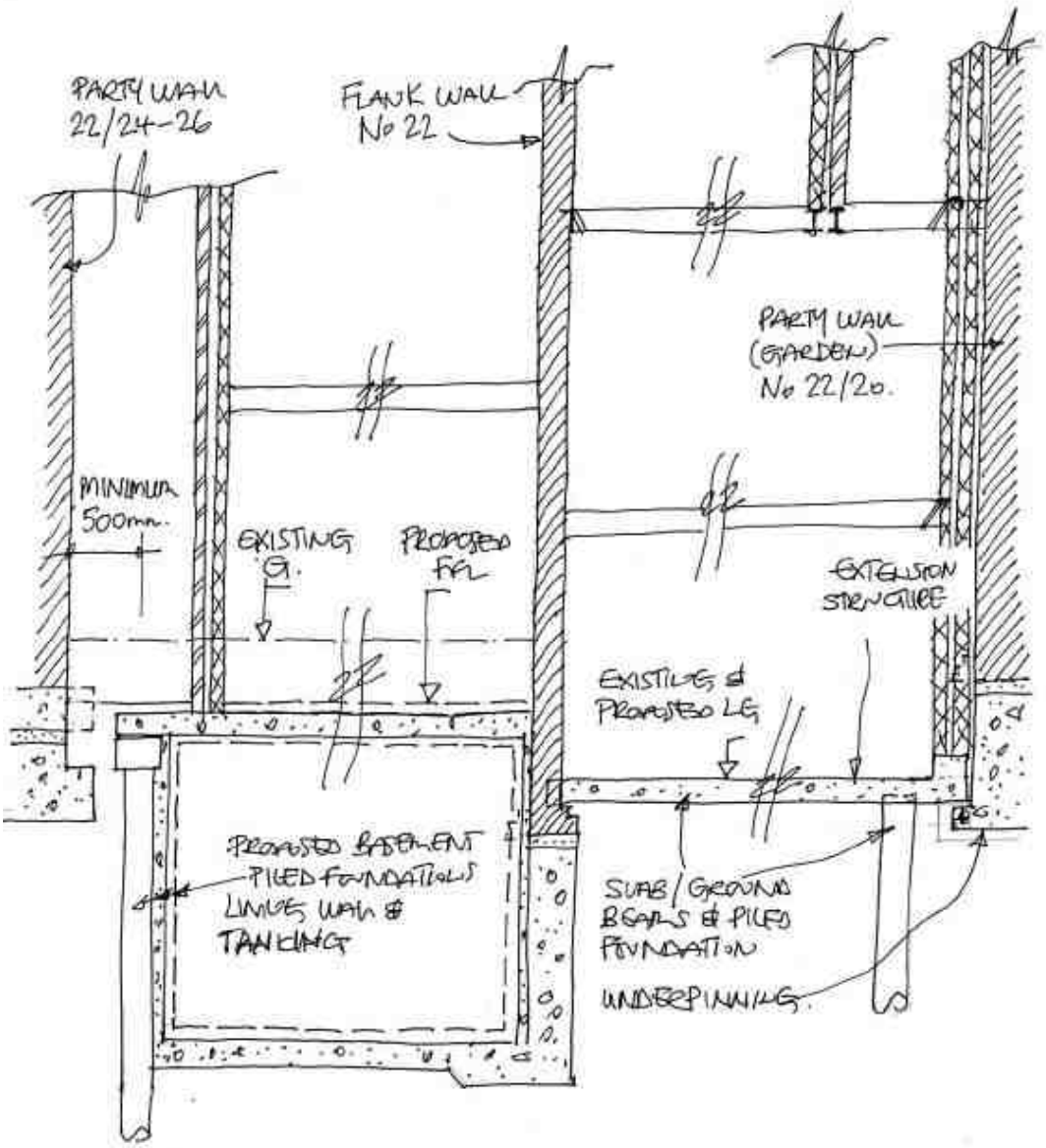
Report written by Jacqui Osborne Bsc Hons MiStructE CEng. July 2019

APPENDIX 1

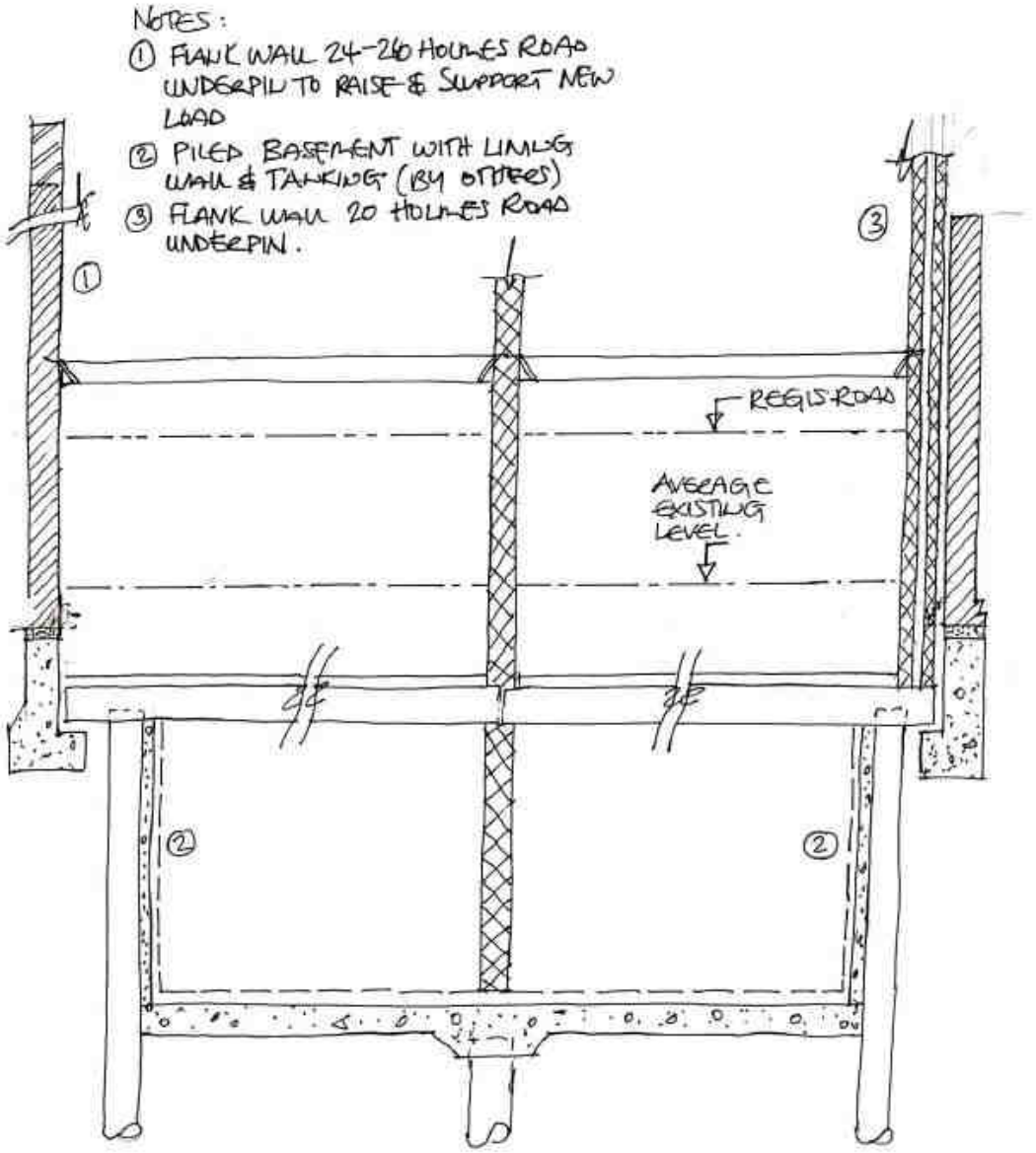
OUTLINE SCHEME


KEY:
Existing Walls
Proposed Walls
B.
B
A
A
MASS CONCRETE UNDERPINNING
BASEMENT WALLS
PILES (BASEMENT ONLY)
OSBORNE EDWARDS
19088/SK1
PROPOSED BASEMENT
22 Holmes Road, London
NW5 3AB
1617-NMA-00-B1-DR-A-00100
Basement - Proposed
1617
S2
P8
N


(REGIS ROAD)
RETAINING WALL
HOLMES ROAD
BASEMENT WALLS UNDER
PILES TO GROUND FLOOR STRUCTURE & BASEMENT O
PERIMETER OF SLAB & GROUND BEAMS.
NOTES:
1. POSSIBLE UNDERPINNING TO PARTY WALL.
2. CANTILEVER SLAB TO SUPPORT NEW EXTERNAL WALL.
3. UNDERPINNING TO FLANK WALL OF EXISTING HOUSE.
4. GROUND BEAMS. REINFORCED CONCRETE.
OSBORNE EDWARDS
19088/SK2
PROPOSED GROUND.
22 Holmes Road, London
NW5 3AB
1617-NMA-00-00-DR-A-00100
Ground Floor - Proposed



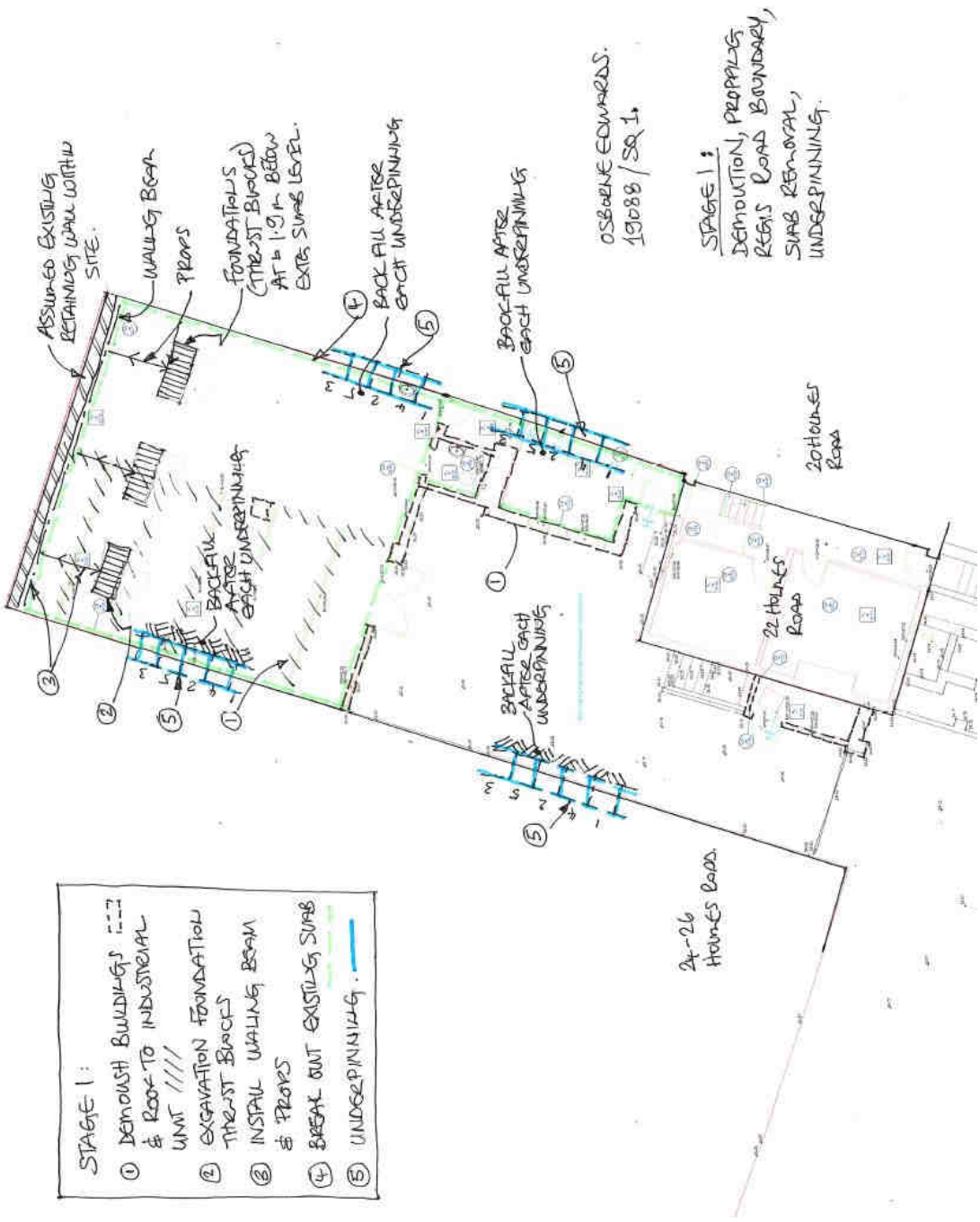
Osborne Edwards Ltd CONSULTING STRUCTURAL ENGINEERS OMNIBUS BUSINESS CENTRE 39/41 NORTH ROAD LONDON N7 9DP TELEPHONE 020 7226 2444	PROJECT TITLE 22 Holmes Road . NW5		JOB NO 19088
	DRG TITLE SECTION A-A		DRG NO SK3
	SCALE ≈ 1:50	DATE July '19	REV

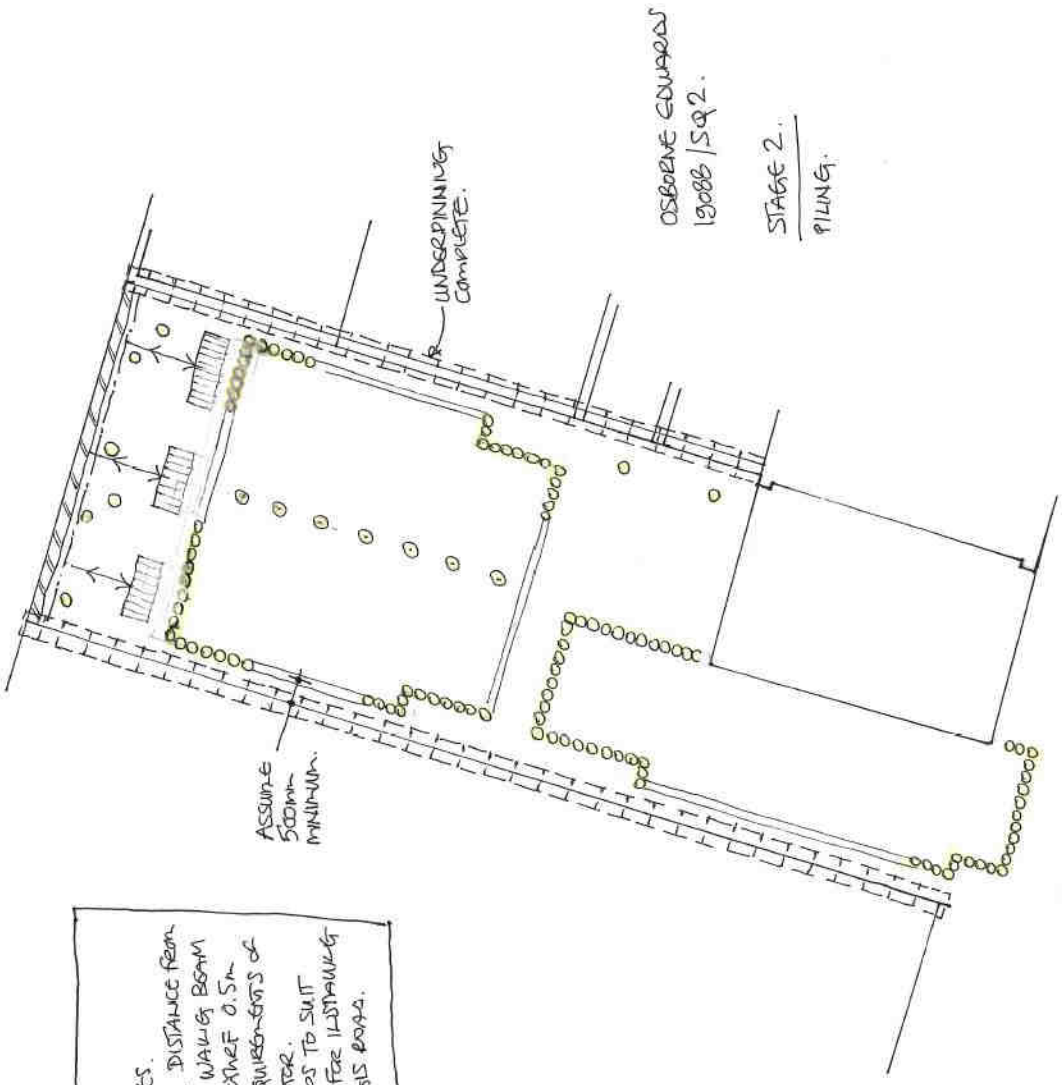


Osborne Edwards Ltd CONSULTING STRUCTURAL ENGINEERS OMNIBUS BUSINESS CENTRE 39/41 NORTH ROAD LONDON N7 9DP TELEPHONE 020 7226 2444	PROJECT TITLE 22 HOLMES ROAD		JOB NO 19088
	DRG TITLE SECTION B-B		DRG NO SK4
	SCALE ≈ 1:50	DATE JULY '19.	REV

APPENDIX 2

SEQUENCE OF CONSTRUCTION


ASSUMED EXISTING RETAINING WALL WITHIN SITE.
WALLING BEAM
PROPS
FOUNDATIONS (THRUST BLOCKS) AT 1:2m BELOW EXIST. SLAB LEVEL.
BACK FILL AFTER EACH UNDERPINNING
BACKFILL AFTER EACH UNDERPINNING
OSBORNE EDWARDS. 13088 / SK 1.
STAGE 1: DEMOLITION, PROPPING REAR BOUNDARY, SLAB REMOVAL, UNDERPINNING.
20 HOLMES ROAD
22 HOLMES ROAD
24-26 HOLMES ROAD.
BACKFILL AFTER EACH UNDERPINNING
BACKFILL AFTER EACH UNDERPINNING
STAGE 1:
① DEMOLISH BUILDINGS & ROOF TO INDUSTRIAL UNIT ////
② EXCAVATION FOUNDATION THRUST BLOCKS
③ INSTALL WALING BEAM & PROPS
④ BREAK OUT EXISTING SLAB
⑤ UNDERPINNING.

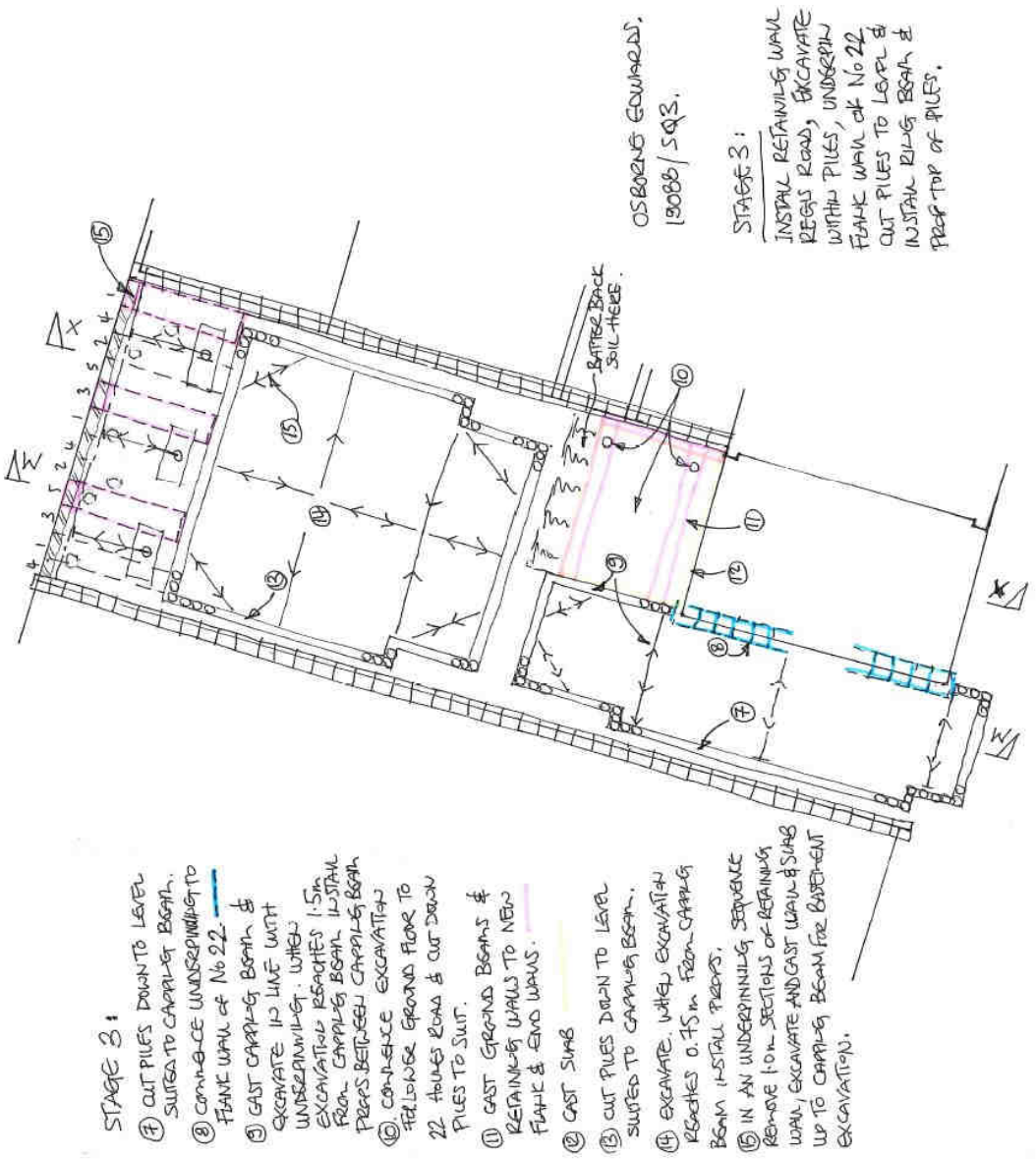


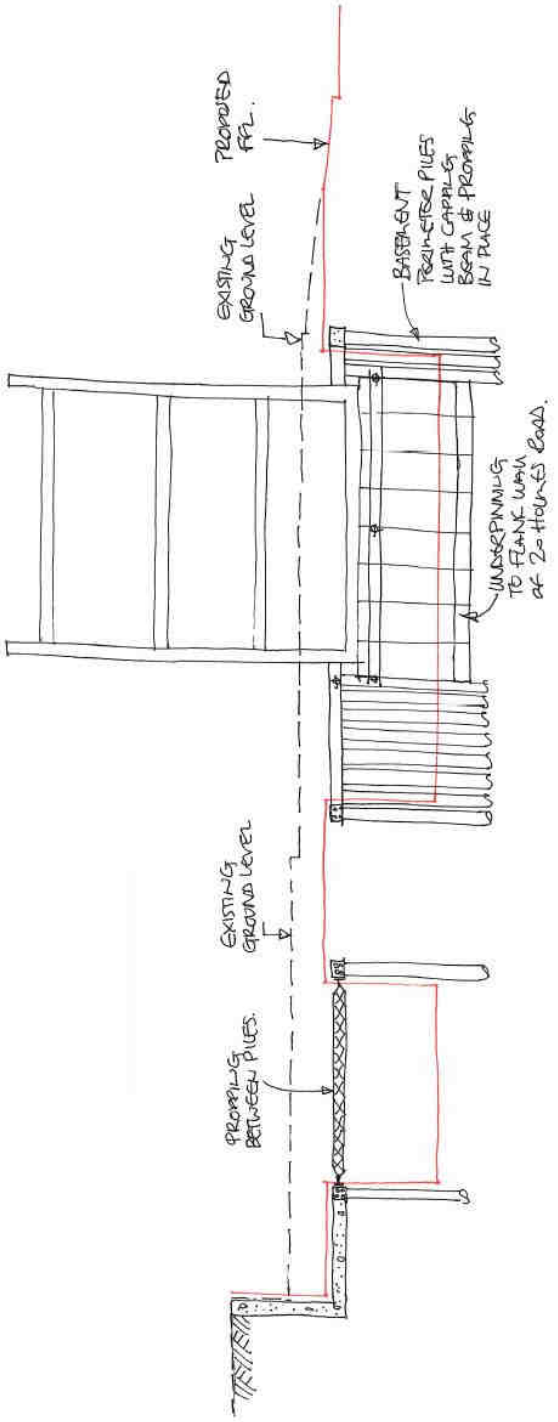
STAGE 2:

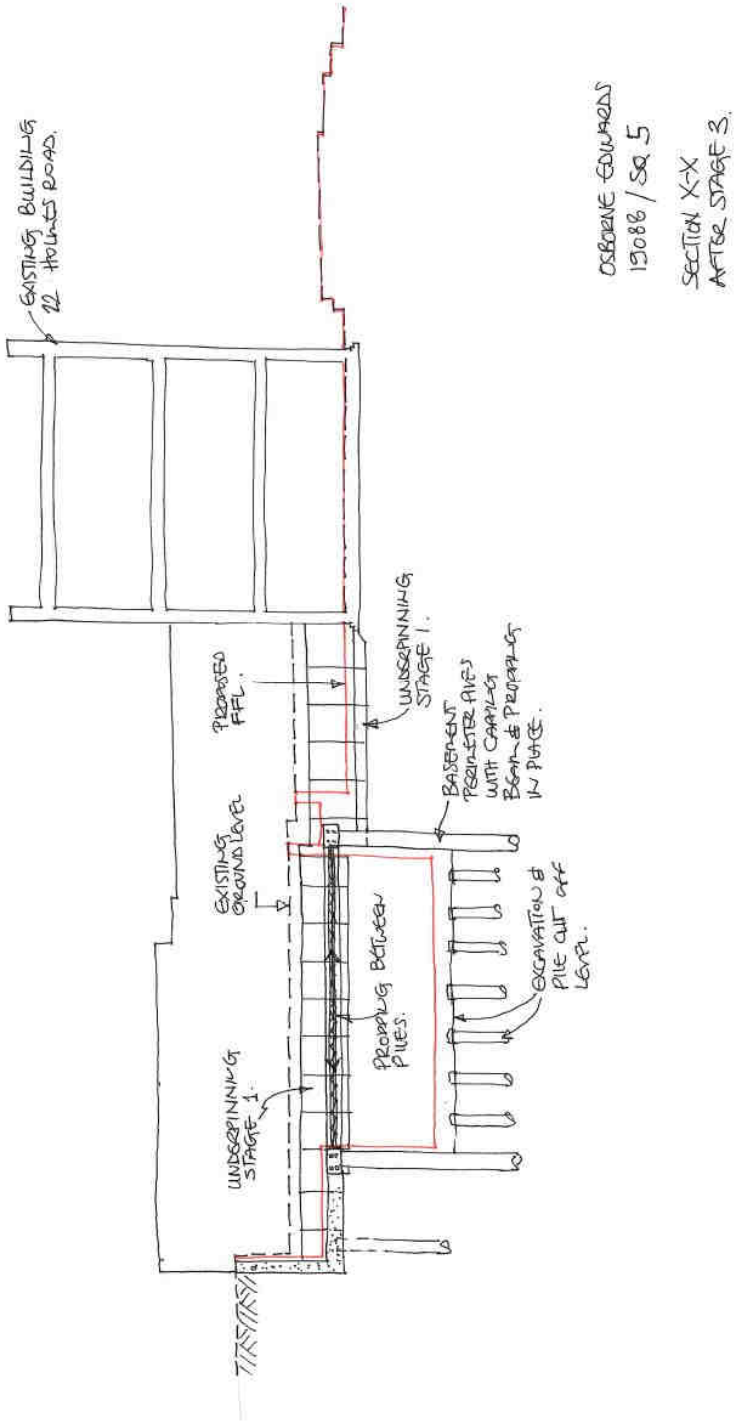
(6) INSTALL PILES.

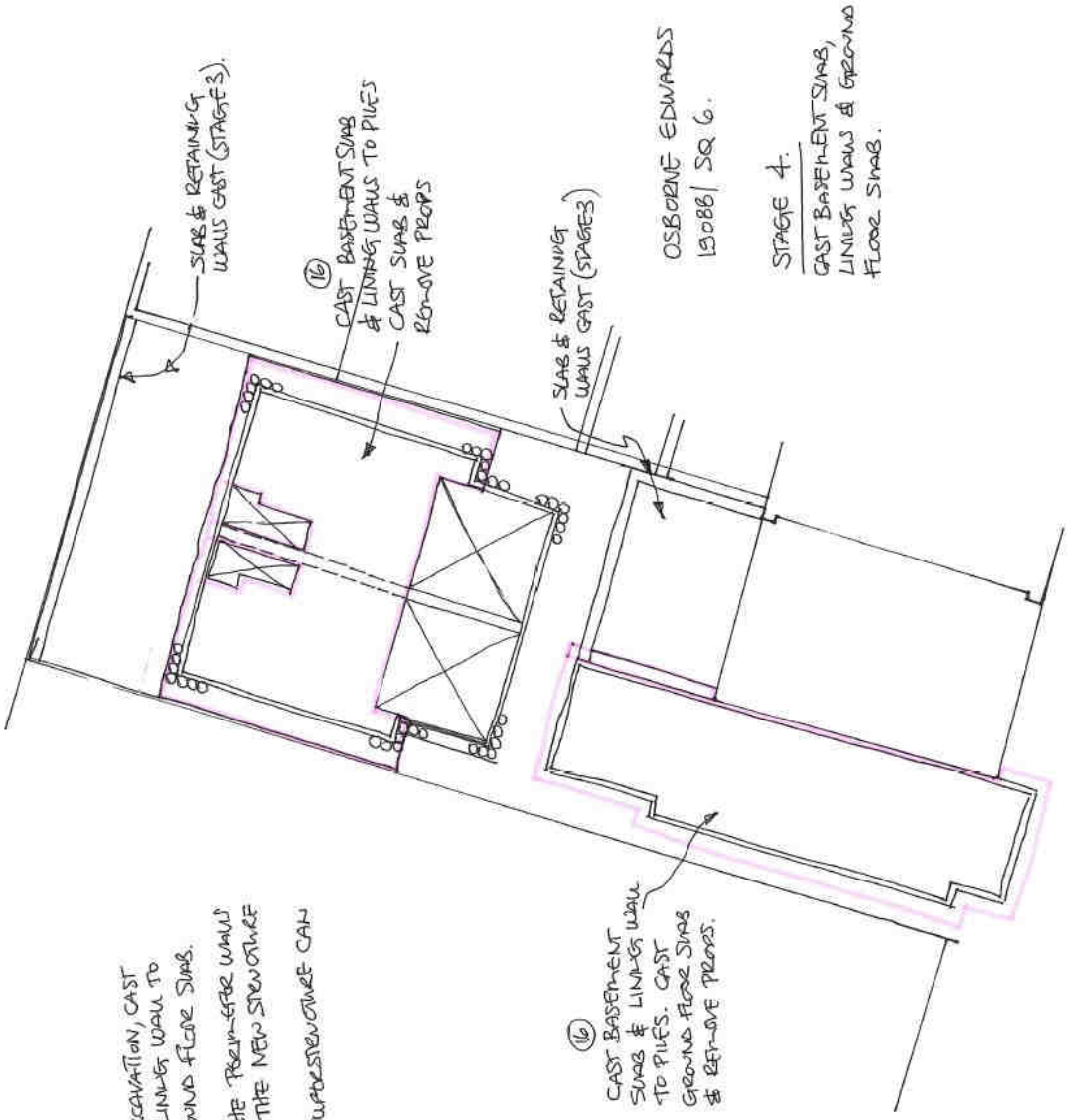
NOTE: MINIMUM DISTANCE FROM FACE OF WALL, WALING BEAM OR OTHER STRUCTURE 0.5m MINIMUM, TO BE CONFIRMED ON PILING CONTRACTOR.

: MOVE PILES TO SUIT REQUIREMENTS FOR UNDERPINNING PILES MAY BE DEEP.


OSBORNE EDWARDS.
19088/SQS.
STAGE 3:
INSTALL RETAINING WALL BEGIN ROAD, EXCAVATE WITHIN PILES, UNDERPIN FRONT WALL OF No 22.
CUT PILES TO LEVEL & INSTALL RING BEAM AT PROP TOP OF PILES.
BATTER BACK SOIL HERE.
Road
STAGE 3:
⑦ CUT PILES DOWN TO LEVEL SUITED TO CAPPING BEAM.
⑧ COMMENCE UNDERPINNING TO FRONT WALL OF No 22.
⑨ CAST CAPPING BEAM & EXCAVATE TO LINE WITH UNDERPINNING. WHEN EXCAVATION REACHES 1.5m INSTALL RING CAPPING BEAM PROPS BETWEEN CAPPING BEAM PILES BETWEEN EXCAVATION
⑩ COMMENCE EXCAVATION TO LOWER GROUND FLOOR TO 22 HOUSES ROAD & CUT DOWN PILES TO SUIT.
⑪ CAST GROUND BEAMS & RETAINING WALLS TO NEW FRONT & END WALLS.
⑫ CAST SLABS
⑬ CUT PILES DOWN TO LEVEL SUITED TO CAPPING BEAM.
⑭ EXCAVATE WHEN EXCAVATION REACHES 0.75m FROM CAPPING BEAM INSTALL PROPS.
⑮ IN AN UNDERPINNING SEQUENCE REMOVE 1.0m SECTIONS OF RETAINING WALL EXCAVATE AND CAST WALL & SLAB UP TO CAPPING BEAM FOR BASEMENT EXCAVATION.


PROPOSED FFL.
EXISTING GROUND LEVEL
BASEMENT RETAINING PILES WITH CAPPING BEAM & PROPPING IN PLACE
UNDERPINNING TO FLANK WALL OF 2a HOWES Road.
EXISTING GROUND LEVEL
PROPPING BETWEEN PILES.
OSBORNE EDWARDS 19088/SK4
SECTION W-W AFTER STAGE 3.


EXISTING BUILDING
12 HOLMES ROAD.
PROPOSED FFL.
EXISTING GROUND LEVEL
UNDERPINNING STAGE 1.
PROPPING BETWEEN PILES.
UNDERPINNING STAGE 1.
BASEMENT REINFORCED PILES WITH CAPPING BEAM & PROPPING IN PLACE.
EXCAVATION & PILE CUT OFF LEVEL.
OSBORNE EDWARDS
13088 / Sk 5
SECTION X-X
AFTER STAGE 3.



STAGE 4.

(16) COMPLETE EXCAVATION, CAST BASEMENT, LINING WALL TO PILES & GROUND FLOOR SLAB.

AT THIS POINT THE PRELIMINARY WALLS ARE BRACED BY THE NEW STRUCTURE AND STABLE. WORK TO THE SUPERSTRUCTURE CAN COMMENCE.

APPENDIX 3

CALCULATIONS

Osborne Edwards Ltd
CONSULTING STRUCTURAL ENGINEERS
39-41 NORTH ROAD
LONDON
N7 9DP
TELEPHONE 020 7226 2444

PROJECT TITLE		
22 HOLMES ROAD		
JOB NO 19088	SHEET NO L1	
BY JO	DATE JULY '19	CKD

LOADING FOR RETAINING WALLS.

FOR CONSERVATIVE DESIGN ASSUME SOIL IS SANDY GRAVEL $k_2 = 0.33$. SOIL DENSITY 20 kN/m².

- WATER LEVEL 2/3 HEIGHT OF RETAINED SOIL
- PLANT & MACHINERY 2.5 kN/m²
- LOAD FROM ADJOINING BUILDING FOUNDATION (2 STOREY) 100 kN/m² ON 450mm WIDE STRIP.

FOR HIGHWAY LOAD REGIS ROAD ALLOW 5 kN/m².*

(* DETAILED DESIGN WILL REQUIRE CONSIDERATION OF AXLE LOADS FOR GOODS VEHICLES).

DESIGN CASES CONSIDERED.

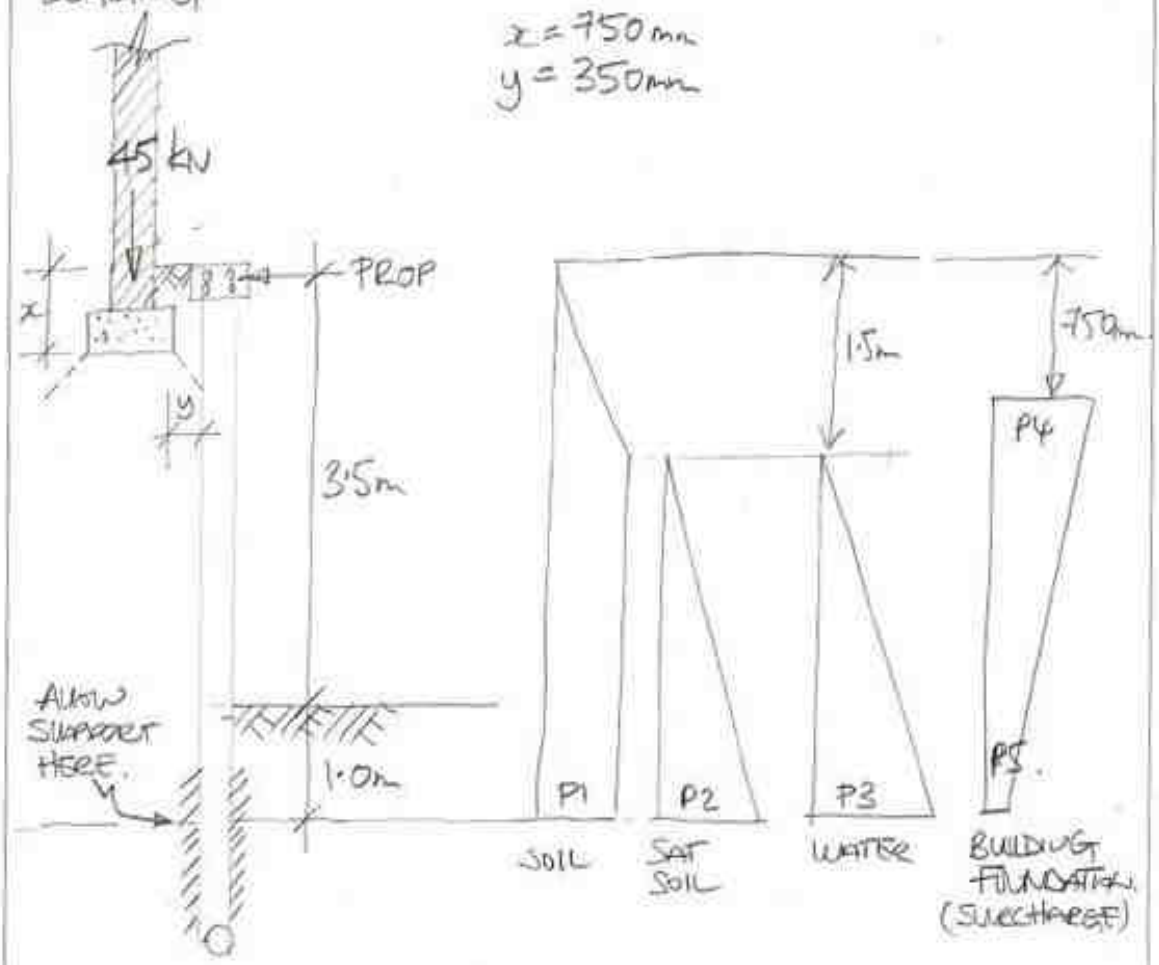
① PILED PERIMETER OF BASEMENT WITH CAPPING BEAM & PROPS. PILES TO BE EMBEDDED & PROPPED.
CHECK: PILE DIAMETER
: PROP LOADS
: CAPPING BEAM SIZE.

② RETAINING WALL REGIS ROAD BOUNDARY.
CANTILEVER WALL IN TEMPORARY CONDITION WITH PROPS IF REQUIRED
PROPPED CANTILEVER IN PERMANENT CONDITION VIA FIRST FLOOR SLAB.

Osborne Edwards Ltd
CONSULTING STRUCTURAL ENGINEERS
39-41 NORTH ROAD
LONDON
N7 9DP
TELEPHONE 020 7226 2444

PROJECT TITLE		
22 Hounts Road.		
JOB NO 19088		SHEET NO R1.
BY JO	DATE JULY '19	CKD

LOADING



$P_1 = 20 \times 0.33 \times 1.5 = 9.9\ kN/m^2$. (GL)

$P_2 = (20-10) \times 0.33 \times 3.0 = 9.9\ kN/m^2$, (GL)

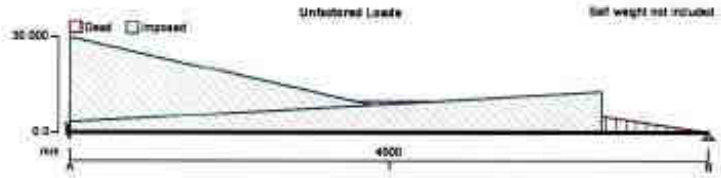
$P_3 = 10 \times 3 = 30.0\ kN/m^2$. (QL)

$P_4 = 39 \times 0.33 = 12.9\ kN/m^2$. (GL)

$P_5 = \frac{45 \times 1 \times 0.33}{(3.75 + 0.45 + 0.3)} = 3.3\ kN/m^2$ (GL)

IGNORE VERTICAL LOAD FOR TEMPORARY CONDITION.

Tedds Osborne Edwards Ltd Omnibus Business Centre 39-41 North Road London N7 9DP	Project: 22 HOLMES ROAD				Job no: 19088
	Calcs for: PILED WALL				Start page no./Revision: R2
	Calcs by: A	Calcs date: 11-Jul-2019	Checked by	Checked date	Approved by	Approved date



CONTINUOUS BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = **1**

Material Properties:

Modulus of elasticity = **205** kN/mm² Material density = **7860** kg/m³

Support Conditions:

Support A Vertically **"Restrained"** Rotationally **"Restrained"**

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

Span Definitions:

Span 1 Length = **4500** mm Cross-sectional area = **1000** mm² Moment of inertia = **1.00×10⁹** mm⁴

LOADING DETAILS

Beam Loads:

Load 1 Partial UDL Dead load **9.9** kN/m from **0.000** m to **3.000** m

Load 2 Partial VDL Dead load **9.9** kN/m at **3.000** m to **0.0** kN/m at **4.500** m

Load 3 Partial VDL Dead load **9.9** kN/m at **0.000** m to **0.0** kN/m at **3.000** m

Load 4 Partial VDL Imposed load **30.0** kN/m at **0.000** m to **0.0** kN/m at **3.000** m

Load 5 Partial VDL Imposed load **3.3** kN/m at **0.000** m to **12.9** kN/m at **3.750** m

LOAD COMBINATIONS

Load combination 1

Span 1 1.35×Dead + 1.5×Imposed

CONTINUOUS BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

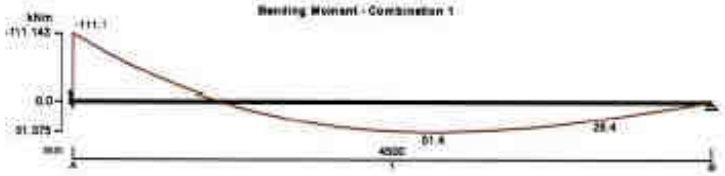
Support A	Max react = **-144.6** kN	Min react = **-144.6** kN	Max mom = **-111.1** kNm	Min mom = **-111.1** kNm
Support B	Max react = **-38.7** kN	Min react = **-38.7** kN	Max mom = **0.0** kNm	Min mom = **0.0** kNm

Beam Max/Min results - Combination Summary

Maximum shear = **144.6** kN Minimum shear F_{min} = **-38.7** kN

Maximum moment = **51.4** kNm Minimum moment = **-111.1** kNm

Maximum deflection = **404.5** mm Minimum deflection = **0.0** mm



Tedds Osborne Edwards Ltd Omnibus Business Centre 39-41 North Road London N7 9DP	Project: 22 Hounes Road				Job no.: 19086
	Calcs for: PILED WALL				Start page no./Revision: R3
	Calcs by: A	Calcs date: 11-Jul-2019	Checked by:	Checked date:	Approved by:	Approved date:

Osborne Edwards Ltd
CONSULTING STRUCTURAL ENGINEERS
39-41 NORTH ROAD
LONDON
N7 9DP
TELEPHONE 020 7226 2444

PROJECT TITLE		
22 Homes Road		
JOB NO 9088		SHEET NO R4
BY JD	DATE JULY '19	CKD

PROP LOAD : P_{ULT} = 38.7 kN/m.

M MAX @ BASE OF CANTILEVER = 111.1 kNm.

M MAX CANTILEVER SPAN = 51.4 kNm.

SHEAR @ BASE OF CANTILEVER : 144.5 kN.

450 ϕ PILES @ 525 mm cc

EACH PILE : M = 58.3 kNm (CIRCULAR COLUMN)

$\frac{M}{h^3 f_{ck}} = \frac{58.3 \times 10^6}{450^3 \times 35} = 0.018$ $d/h = 0.7$.

∴ MINIMUM STEEL REQUIRED.

SPAN/DEPTH ALLOWED = 12

SPAN/DEPTH $\frac{4500}{390} = 11.5$ ∴ OK.

FOR THINNER RETAINING WALL/PILE THICKNESS PROP AT BASE OF WALL BETWEEN MAXIMUM EXCAVATION & CASTING OF BASEMENT FLOOR SLAB.

PROPS @ 3m CENTRES : PROP LOAD $\frac{38.3 \times 3}{1.45} = 80$ kN/m.

∴ MABEY MASS 22 PROPS UP TO APPROX 7m LONG. OK.

Osborne Edwards Ltd
CONSULTING STRUCTURAL ENGINEERS
30-41 NORTH ROAD
LONDON
N7 9DP
TELEPHONE 020 7226 2444

PROJECT TITLE: 22 Hounes Road.

JOB NO: 19086 | SHEET NO: R5

BY: JD | DATE: July '19 | CKD:

CAPPING BEAM:

LOAD ONTO CAPPING BEAM. $\ell = 38.7$ k/m ULS.

SPAN BETWEEN PROPS 3m

$\therefore M = 38.7 \times 3^2/8 = 38.7$ kNm.

$\frac{M}{bd^2 f_{cu}} = \frac{38.7 \times 10^6}{300 \times 542^2 \times 35} = 0.012$

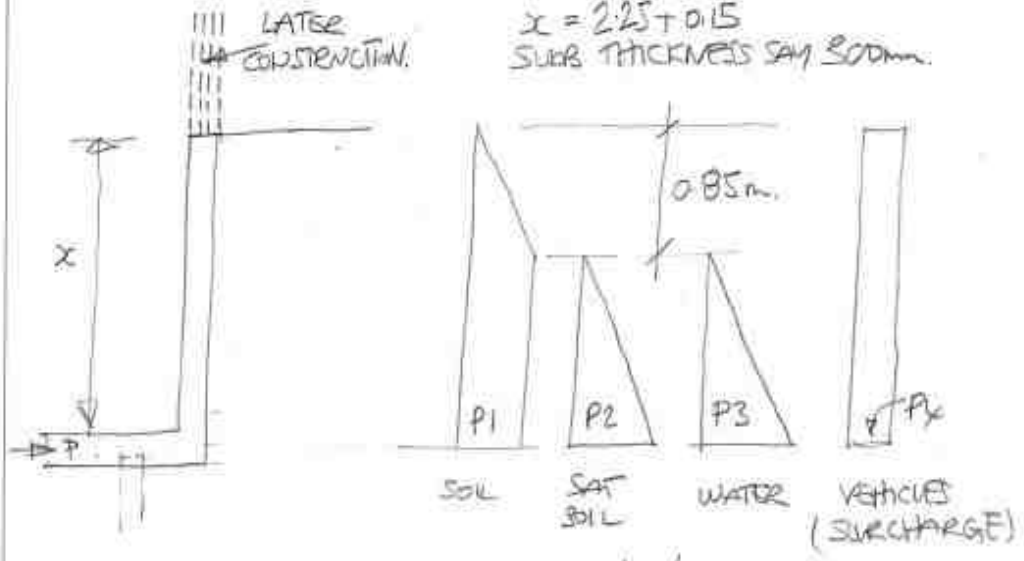
$d = (450 + 150 - 40 - 10 - 8)$
$= 542$ mm
$b = 300$mm

$A_s > \frac{38.7 \times 10^6}{0.87 \times 500 \times 0.95 \times 542} = 172$mm.

$\therefore$ MINIMUM STEEL REQUIRES
PROVIDE ATLEAST 6 No M16's.
MINIMUM LINKS.

Osborne Edwards Ltd
CONSULTING STRUCTURAL ENGINEERS
35-41 NORTH ROAD
LONDON
N7 9DP
TELEPHONE 020 7226 2444

PROJECT TITLE: 22 HOLMES ROAD.
JOB NO: 19088
SHEET NO: R6
BY: JD
DATE: JULY '19
CKD:



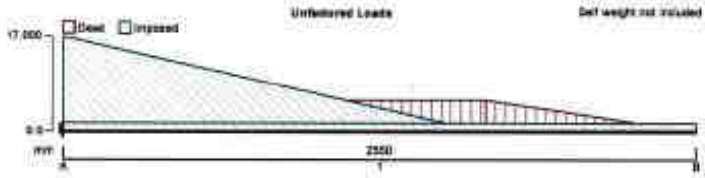
P1 $20 \times 0.33 \times 0.85 = 5.6\ kN/m^2$. Gk
P2 $(20-10)0.33 \times 1.7 = 5.6\ kN/m^2$. Gk
P3 $10 \times 1.7 = 17\ kN/m^2$ Gk
Px $5 \times 0.33 = 1.65\ kN/m^2$ Qk

IGNORE VERTICAL LOAD FOR TEMPORARY CONDITION

AT PROP LOCATION SUBB SUPPORTED ON PILES TO BASEMENT.

a) CHECK WALL THICKNESS
b) CHECK REQUIREMENT FOR PROP AT TOP OF WALL IN TEMPORARY CONDITION.

Tedds Osborne Edwards Ltd Omnibus Business Centre 39-41 North Road London N7 9DP	Project 22 Hounes Road				Job no. 19088
	Calcs for RETAINING WALL, REES ROAD				Start page no./Revision R7
	Calcs by A	Calcs date 11-Jul-2019	Checked by	Checked date	Approved by	Approved date



CONTINUOUS BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = 1

Material Properties:

Modulus of elasticity = 205 kN/mm² Material density = 7860 kg/m³

Support Conditions:

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

Span Definitions:

Span 1 Length = 2550 mm Cross-sectional area = 1000 mm² Moment of inertia = 1.00×10⁶ mm⁴

LOADING DETAILS

Beam Loads:

Load 1	Partial UDL Dead load 5.6 kN/m from 0.000 m to 1.700 m
Load 2	Partial VDL Dead load 5.6 kN/m at 1.700 m to 0.0 kN/m at 2.550 m
Load 3	Partial VDL Dead load 5.6 kN/m at 0.000 m to 0.0 kN/m at 1.700 m
Load 4	Partial VDL Imposed load 17.0 kN/m at 0.000 m to 0.0 kN/m at 1.700 m
Load 5	UDL Imposed load 1.7 kN/m

LOAD COMBINATIONS

Load combination 1

Span 1 1.35×Dead + 1.5×Imposed

CONTINUOUS BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

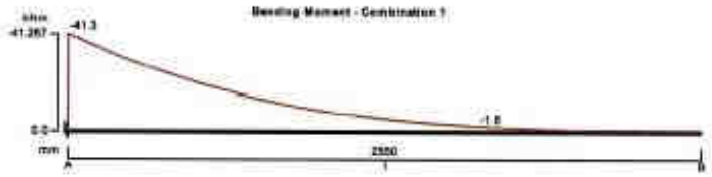
Support A	Max react = -50.5 kN	Min react = -50.5 kN	Max mom = -41.3 kNm	Min mom = -41.3 kNm
Support B	Max react = 0.0 kN	Min react = 0.0 kN	Max mom = 0.0 kNm	Min mom = 0.0 kNm

Beam Max/Min results - Combination Summary

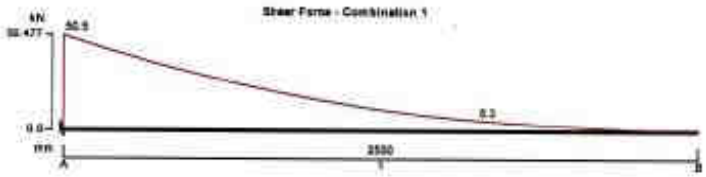
Maximum shear = 50.5 kN Minimum shear F_{min} = 0.0 kN

Maximum moment = 0.0 kNm Minimum moment = -41.3 kNm

Maximum deflection = 259.3 mm Minimum deflection = 0.0 mm



Tedds Osborne Edwards Ltd Omnibus Business Centre 39-41 North Road London N7 8DP	Project: 22 HOLMES ROAD				Job no: 19088
	Calcs for: RETAINING WALL. REGIS ROAD				Start page no./Revision: R8
	Calcs by: A	Calcs date: 11-Jul-2019	Checked by	Checked date	Approved by	Approved date



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PROJECT TITLE		
22 Holmes Road		
JOB NO 19088	SHEET NO R9	
BY JO	DATE July '19	CKD

SUPPORTED ON PILES THEREFORE BEARING PRESSURES ETC ARE IRRELEVENT AS IS OVER-TURNING & SLIDING

DESIGN AS CANTILEVER.

$M_{MAX\ CANT} = 41.3\ kNm$

$\frac{M}{bd^2 fcu} = 0.018$ $\quad d = 300-40-5 = 255mm$

$\therefore As > 359\ mm^2/m$

$\therefore$ H10's @ 200 mm $\quad 100As/bd = 0.15$

(DURABILITY USE H12's @ 250mm)

ALLOWABLE SPAN/DEPTH = 12.

ACTUAL $= \frac{2550}{255} = 10.$ 300mm WALL ACCEPTABLE TEMPORARY CONDITION.

LATERAL LOAD ESTIMATE SPAN/300 OR = 8mm.

PILE LOADS $= \pm \frac{41.3}{2} = 21.0\ kN/m$

SAY 3m : 6 No PILES

EACH PILE AVERAGE $\pm 31.5\ kN$ (EXCLUDING BUILDING LOADS)