conisbee | Consulting Structural Engineers
Consulting Civil Engineers

# The Coach House, 50A Belsize Square, London, NW3 4HN

## Structural Calculations


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**Ref:** 170013/K Hirst
**Approved By:** M Tulloch
**Date:** September 2017
**Version:** 1

## INTRODUCTION

Conisbee have been appointed to design the new single dwelling at the above address.

A ground investigation has been carried out by GEA.

The underlying ground conditions comprise of made ground overlying London Clay. The clay has a high volume change potential and the site investigation recommends various forms of suitable foundation types.

The superstructure comprises of a load bearing timber frame (potentially a specialist design element) and the loadings and spans have been assumed for the load run downs used in the ground floor and basement design.

We, Conisbee, have used developed an overall scheme and the following calculations are for the concrete sub-structure elements of the works.

CONTENTS

CONISBEE'S LOADINGS SCHEDULE

225mm GROUND SLAB (& SCREED)

| | |
|---|---|
| 0.225x24kN/m2 (& 1.5) | 7kN/m DL |

300mm BASEMENT SLAB (& SCREED)

| | |
|---|---|
| 0.30x24kN/m2 (& 1.5) | 8.7kN/m DL |

9m TALL BRICKWORK EXTERNAL WALLS & TIMBER INNER SKIN

| | |
|---|---|
| (9x0.1x20 (brick) + 1.0x9.0 (timber)) | 27kN/m DL |

250mm RETAINING WALLS

| | |
|---|---|
| 0.25x24kN/m3 | 6.0kN/m DL |

INTERMEDIATE TIMBER FLOOR ALLOWANCE

| | |
|---|---|
| 0.75kN/m2 (timber floor) + 0.25kN/m2 (finishes) | 1.0kN/m2 DL |

IMPOSED LOAD SCHEDULE FOR GROUND FLOOR

| | | |
|---|---|---|
| RESIDENTIAL | 1.5 (& 0.5) | 2.0kN/m2 LL |

GROUND FLOOR SLAB PANEL CHECK.

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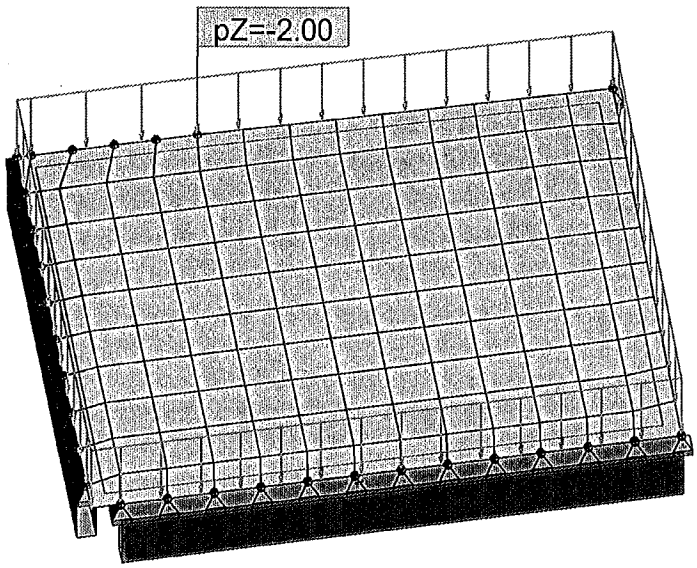
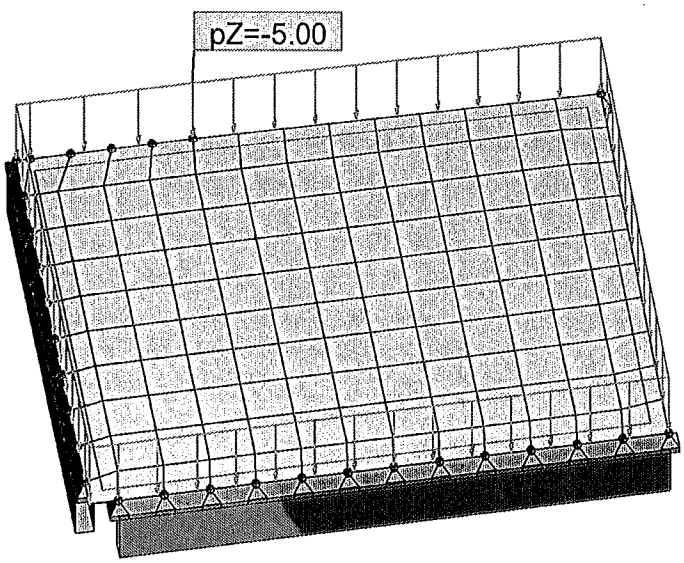
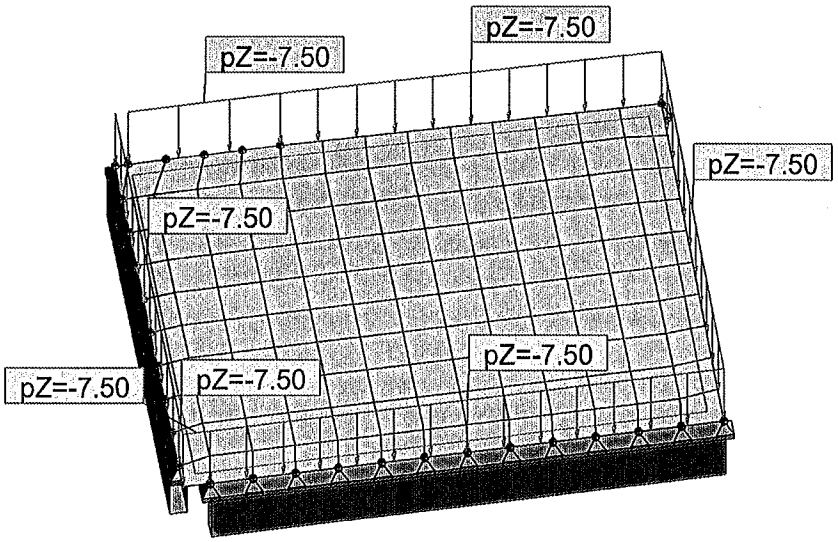
CONSIDER PANEL OF SLAB TO FRONT DRIVEWAY -(LARGEST PANEL AND LARGEST IMPOSED LOAD)



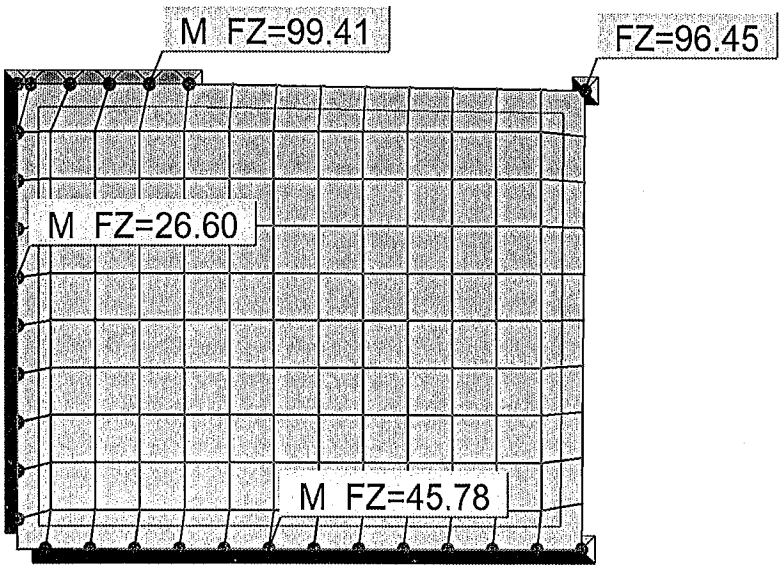

**GROUND FLOOR (WORSE CASE SLAB) DEAD LOAD (kN/m2)**



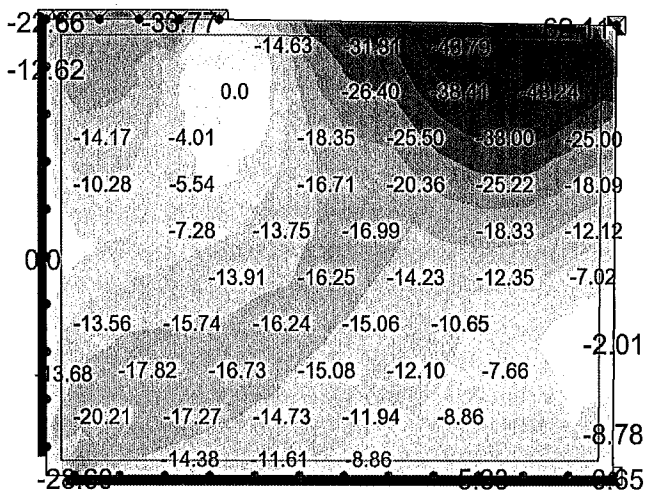

**GROUND FLOOR (WORSE CASE SLAB) LIVE LOAD (kN/m2)**



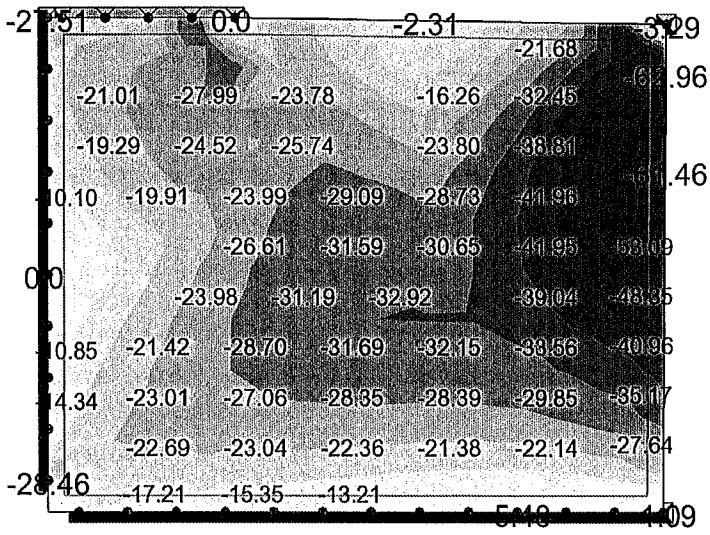

**GROUND FLOOR (WORSE CASE SLAB) CLADDING LOAD (kN/m2)**



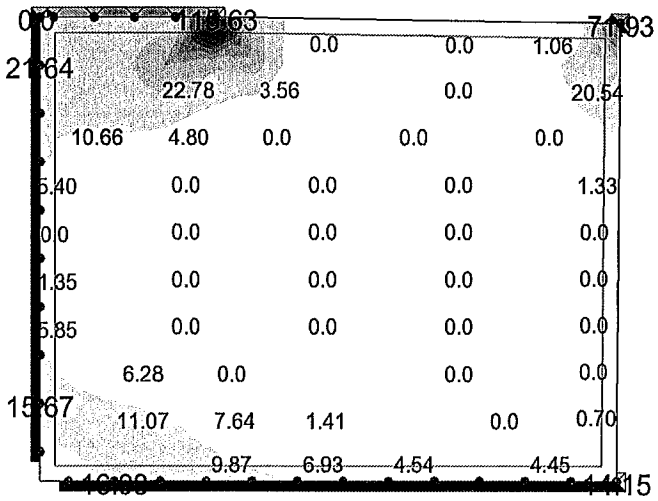

**ULS REACTIONS (kN & Kn/m)**



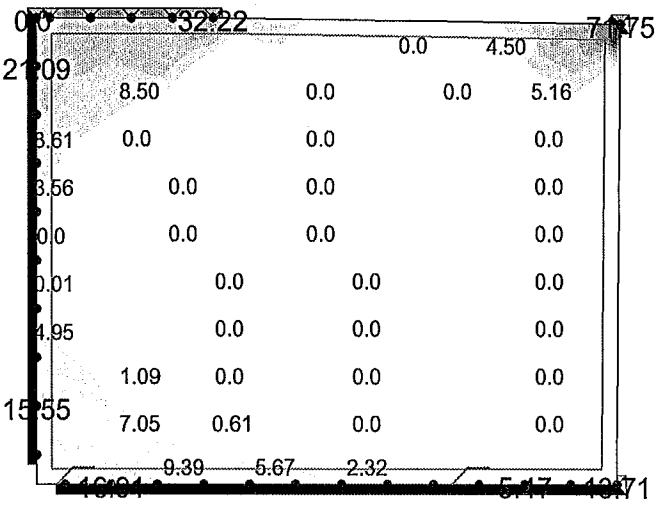

**ULS MOMENTS BOTTOM - X DIRECTION (kNm)**




**ULS MOMENTS BOTTOM - Y DIRECTION (kNm)**




**ULS MOMENTS TOP - X DIRECTION (kNm)**




**ULS MOMENTS TOP - Y DIRECTION (kNm)**

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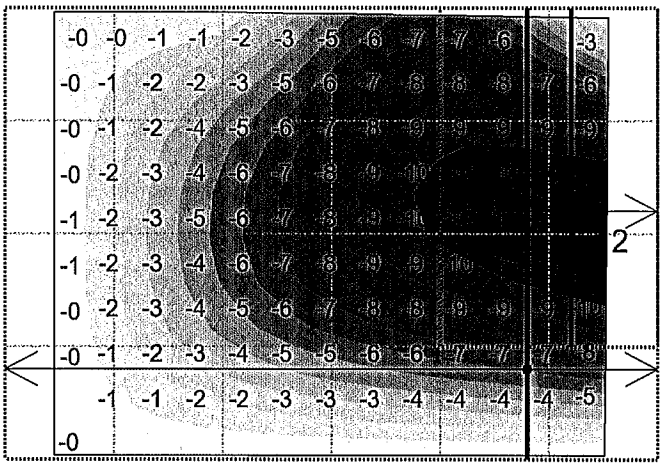


**LONG TERM SLS DEFLECTION MAP (BASED ON H12@ 200c/c Base Mat**

**+ Additional H10 @ 200c/c to Suit)**

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Project THE COACH HOUSE
50A BELSIZE SQUARE, LONDON, NW3 4HN

Title RAFT SLAB CHECK.

Project No 170013 | Sheet No RS1

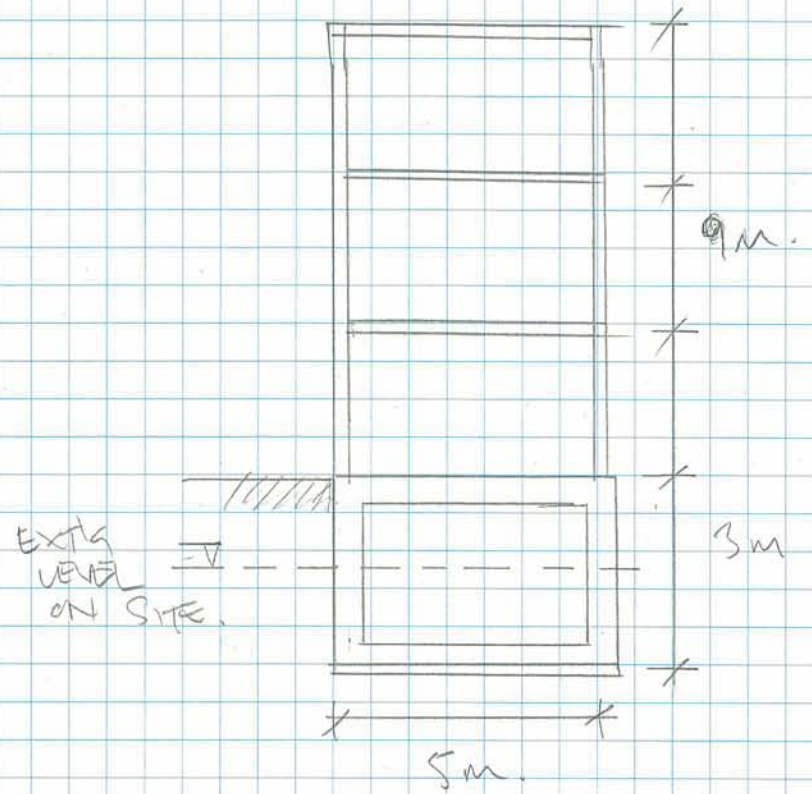
Date 9/17 | Revision

Engineer KH | Checked

Rev Date Description

CONSIDER LOWER GROUND FLOOR RAFT SLAB.

TYPICAL SECTION,




CONSIDER 2 LOAD CASES,

- VERTICAL DEAD + LIVE LOADS
- POTENTIAL UPLIFT.

CASE (1).

| | DL | LL |
|---|---|---|
| LOAD DOWN WALLS. | | |
| SUPERSTRUCTURE WALL | = 27 | |
| BASEMENT WALL 6×3 | = 18 | |
| UPPER FLOORS | | |

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Project THE COACH HOUSE, 50A BELSIZE SQUARE, ~~LONDON, NW3 4HN~~

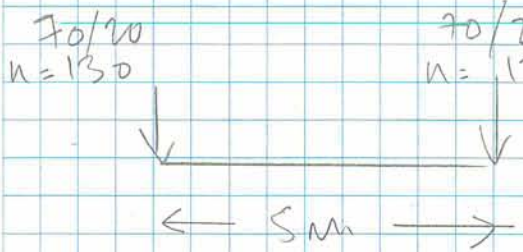
Title RAFT SLAB CHECK.

| Project No | Sheet No |
|---|---|
| 17003 | RS2 |
| Date | Revision |
| 9/17 | |
| Engineer | Checked |
| KH | |

Rev Date Description

(CONT...)

| | DL | LL |
|---|---|---|
| UPPER FLOORS. | | |
| 2.5x3x1.0 kN/m² | 7.5 | |
| x2.0 kN/m² | | 15. |
| GROUND SLAB. | | |
| 2.5 x 7.0 kN/m² | 17.5 | |
| 2.5 x 2.0 kN/m² | | 5.0. |
| | 70kN/m | 20 kN/m. |




$(130 \times 2)/5m = 52 kN/m^2$.

$M_{MAX} = 52 \times 5^2/8 = 162 kNm/m$.

SLAB IS 350, $d = 300mm$.

$K = 162^6/1000 \times 300^2 \times 40 = 0.045 \therefore z = 0.95d$.

$A_S = 162^6/0.95^2 \times 500 \times 300 = 1197 mm^2$

T16's @ 150 CTRS $\Rightarrow$ $1340mm^2$ $\therefore$ ok.

BEARING PRESSURE = $((70+20) \times 2/5) +$ (SWT OF B'MENT)

$= 48 kN/m^2 \therefore$ ok.

NB:- A MORE DETAILED F.E. RAFT MODEL WILL BE PRODUCED AS PART OF DETAILED DESIGN.

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Project: THE COACH HOUSE, 50A BELSIZE SQUARE. LONDON, NW3 4HN

Title: RAFT SLAB CHECK.

Project No: 17003 | Sheet No: RS3

Date: 9/17. | Revision:

Engineer: KH | Checked:

Rev | Date | Description

RAFT SLAB.

CHECK BUOYANCY.

ASSUME A 1m HEAD OF WATER AND 55% OVERBURDEN PRESSURE (AS ~45% WILL DISSIPATE PRIOR TO BASEMENT)

UPLIFT;

WATER = $1 \times 10 kN/m^3 = 10 kN/m^2$.

OVERBURDEN RELEASE = $1.5m \times 18 kN/m^2 \times 0.55 = 14.9 kN/m^2$.

$= 25.9 kN/m^2$.

SELFWEIGHT OF R.C CONSTRUCTION;

= 350 B'MENT SLAB. = 10
225 GROUND SLAB + 7

WALLS (R.C)

$\frac{(3m \times 0.25 \times 24) \times 2}{5m} = 7.2$

SUPERSTRUCTURE WALLS (SELFWEIGHT ONLY) = 10.8.

$27 kN/m \times 2 / 5m$

$= 35 kN/m$ ) 25.9

∴ ok.

(NB. SELFWEIGHT OF FLOORS EXCLUDED)

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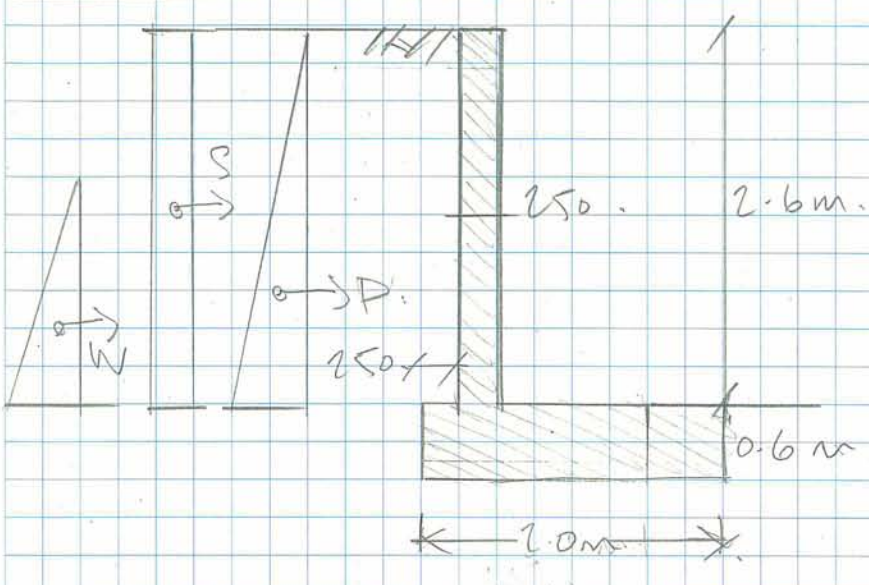
Project THE COACH HOUSE, BELSIZE SQUARE, LONDON, NW3 4HN.

Title RETAINING WALL DESIGN.

| Project No | Sheet No |
|---|---|
| 170013 | RW01. |
| Date | Revision |
| 9/17 | |
| Engineer | Checked |
| KH. | |

Rev Date Description

## UNDERPIN RC WALL DESIGN.




## TOTAL LATERAL LOAD, q

$P = 0.3 \times 16 \times 2.6^2/2 = 16.2$

$+ 0.3 \times 15 \times 2.6 = 3.9$

$0.3 \times 10 \times 1.6^2/2 = 3.8$

$= \underline{23.9}$

## MOMENT @ BASE OF STEM,

$16.2 \times 2.6/3 = 14.0$

$+3.9 \times 2.6/2 = 5.6$

$+3.8 \times 1.6/3 = 2.0$

$= \underline{21 \text{ kNm}}$

If 250, $d = 250 - 40 - 8 = 202$mm.

$k = M/bd^2$ fm.

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Project THE COACH HOUSE, 5A BLESSIE SQUARE, LONDON, NW3 4HN

Title RETAINING WALL DESIGN.

Project No 17003 | Sheet No RW2

Date 9/17 | Revision

Engineer ICH | Checked

Rev | Date | Description

$k = 21\times10^6/1000\times202^2\times40.$

$= 0.012 \therefore z = 0.95d.$

$A_s = 21\times10^6/0.95^2\times500\times202$

$= \underline{230\ mm^2/m.}$

T16's @200 $\Rightarrow$ $\underline{1005\ mm^2.}$

BASE DESIGN.

TOTAL HORIZONTAL LOAD,

$0.3\times16\times3^2/2 = 21.6$

$0.3\times5\times3. = 4.5$

$0.3\times10\times2^2/2 = 6.0.$

$= 32\ kN.$

TOTAL VERTICAL LOAD,

$2.6\times0.25\times16. = 10.4\ kN$ (SOIL)

$2.6\times0.25\times24 = 15.6\ kN$ (WALL)

$2.0\times0.6\times24 = 29.9\ kN.$ (BASE)

$2m\times0.25\times24 = 12.0\ kN:$ (GND. SLAB)

$= 67\ kN.$

F.S AGAINST SLIDING,

$= \dfrac{(67\times0.6)+(0.6\times16\times3\times0.6^2/2)}{32}$

$= \dfrac{40+5.2}{32} = 1.44 \therefore$ ok

NB – THIS IS INCREASED WITH SUPERSTRUCTURE LOADS AND REMAINDER OF BASEMENT SLAB CAST.

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Project THE COACH HOUSE, 5A BELSIZE SQUARE, LONDON, NW3 4HN

Title RETAINING WALL DESIGN

Project No 170013 | Sheet No RW3.

Date 9/17 | Revision

Engineer ICH. | Checked

Rev | Date | Description

BASE DESIGN.

O.M = 21.6 × 3/3 = 21.6
+ 4.5 × 3/2 = 6.8
+ 6.0 × 2/3 = 4.0
= 32.4 kNm.

R.M = 10.4 × 1.875 = 19.5
15.6 × 1.625 = 25.4
29 × 2/2 = 29
= 73.4 kNm

F.S AGAINST O/TURNING,
= 73.4/32.4 = 2.3

TOT. VERT. LOAD = 55 kN.

NETT MOMENT = 73.4 − 32.4 = 41 kNm.

RESULTANT ACTS $\frac{41}{55}$ FROM A = 0.75 m

= 0.25 FROM ℄ < b/6 = 0.33 i.e. NO TENSION.

BEARING PRESSURE,

$= \frac{55}{2 \times 1} \pm \frac{55 \times 0.25 \times 6}{2^2 \times 1}$

= 28 ± 20.6

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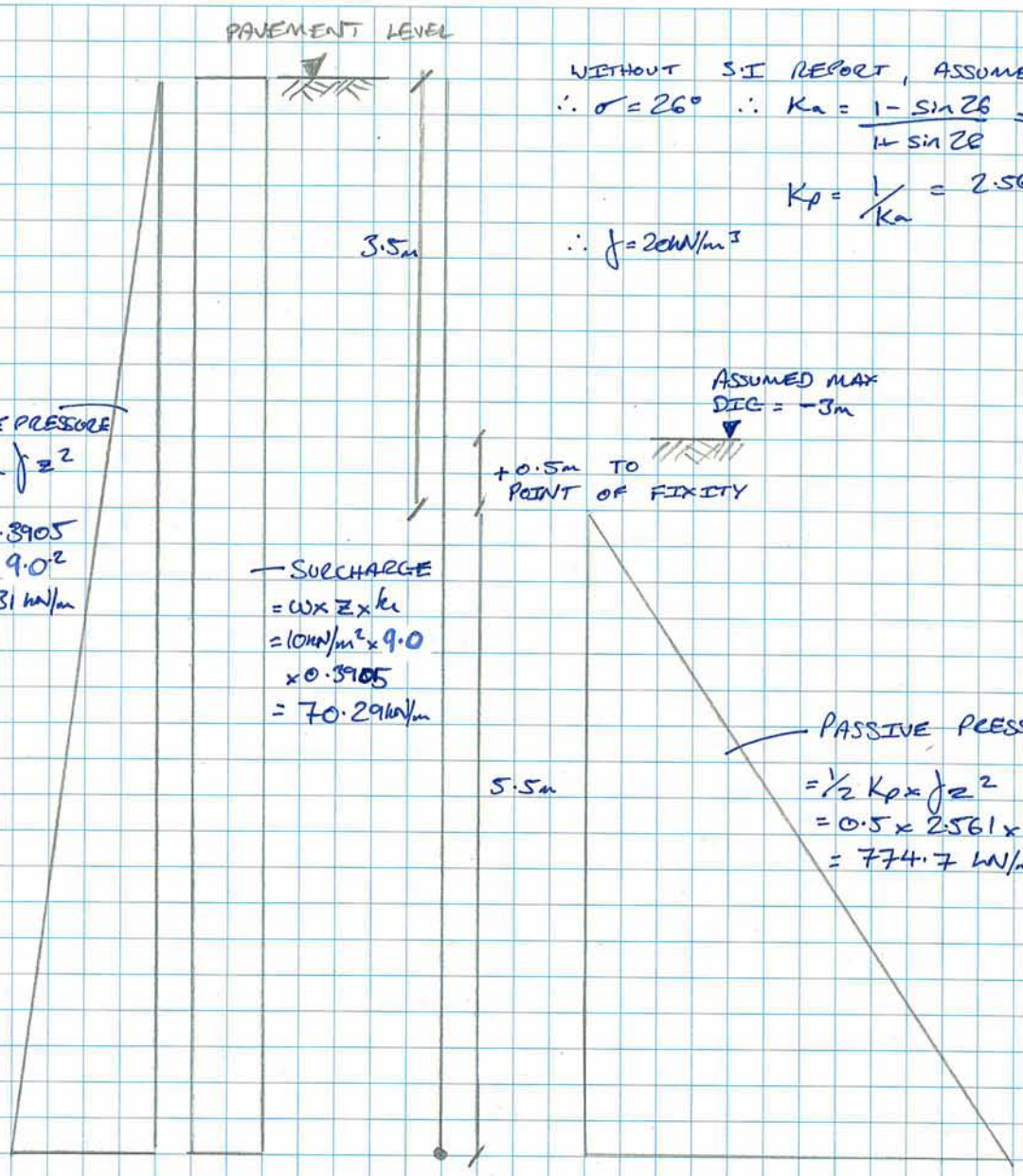
Project: THE COACH HOUSE, 50A BELSIZE SQUARE LONDON, NW3 4HN.

Title: PRELIM. SHEET PILE CHECK

| Project No | Sheet No |
|---|---|
| 170013 | P07. |
| Date | Revision |
| 20/9/17 | |
| Engineer | Checked |
| BT | |

Rev Date Description




WITHOUT S.I REPORT, ASSUMED CLAY STRATA

$\therefore \phi = 26° \quad \therefore K_a = \frac{1-\sin 26}{1+\sin 26} = 0.3905$

$K_p = \frac{1}{K_a} = 2.561$

$\therefore \gamma = 20 kN/m^3$

OVERTURNING CHECK $= \frac{774.7 \times 0.9 (F.S) \times \frac{5.5m}{3}}{(316.31 \times \frac{9}{3}) + (70.29 \times \frac{9}{2})} = \frac{1278.255}{1265.205} = 1.01$ F.S $\therefore$ O.K IN TEMP.

BENDING SHEET PILE (ASSUME FIXED POINT @ 0.5m BELOW MAX DIG DEPTH)

$\therefore = \left(\frac{1}{2} \times 0.3905 \times 20 \times 3.5^2\right) \times \left(\frac{3.5}{3}m\right) + \left(0.3905 \times 10 kN/m^2 \times 3.5\right) \times \left(\frac{3.5}{2}m\right) = 79.74 kNm$

ASSUMING HOT ROLLED STEEL SHEET $Z = 290 cm^3/m$ REQ'D

DEFLECTION CHECK (ASSUME ALL LOAD ACTS @ MID POINT)

$\therefore$ USE KSP 14 SHEET ($529 cm^3/m$ Z ; $4500 cm^4$ I) $\quad \delta = \frac{61.5 \times 10^3 \times 1750^3}{3 \times 210 \times 10^3 \times 4500 \times 10^4} \times \left(1 + \frac{3 \times 1.75}{2 \times 1.75}\right)$

$= 17.44mm < \frac{L}{180}$