

**APPENDIX B
SCHEME CALCULATIONS
REVISION P2 – 18.09.2018**

14 QUEEN'S GROVE – Scheme Calculations

The existing property is terraced house. The construction of house comprises solid external and internal loadbearing brick walls and timber floors. The main roof is butterfly construction.

The structural works include refurbishment to the existing property including internal alteration, roof lights installation and introduction of steel beams to support existing floors and construction of basement extension at front garden and rear house, which is partly under existing rear closet wing.

Imposed Loads Taken: Refer to next pages for detailed assessment

Roof = 0.75 kN/sq.m or refer to calculations

All floor areas = 1.5 kN/sq.m, 2.0 Bathrooms

References

The subsequent calculations make use of some or all of the following documents:

BS 649:	Material Weights
BS 6399-1:1996	Loadings for Buildings – Part 1: Code of Practice for Dead and Imposed Loads
BS 6399-2:1997	Loadings for Buildings – Part 2: Code of Practice for Wind Loads
BS 6399-3:1988	Loadings for Buildings – Part 3: Code of Practice for Imposed Roof Loads
BS 5268-2:2002	Structural Use of Timber – Part 2: Code of Practice for Permissible Stress Design, Materials and Workmanship
BS 5628-1:2005	Code of Practice for Use of Masonry – Part 1: Structural Use of Unreinforced Masonry
BS 5950-1:2000	Structural Use of Steelwork in Building – Part 1: Code of Practice for Design – Rolled and Welded Sections
BS 5977-1:1981	Lintels – Part 1: Method for Assessment of Load
BS 8110-1, 2:1997	Structural Use of Concrete

CP111 and CIRIA 111 for bearing stresses capacity of the existing masonry walls = 0.43N/mm² allowable service stress on brickwork with lime mortar joints, unless noted otherwise.

Supporting Documents:

London Geological Survey Maps, walkover survey.

Lateral Stability, Load Path & Disproportionate Collapse:

Lateral Stability of the building is sustained by a number of existing solid masonry walls (front and rear walls) that are to be retained in both cross directions. The existing floors are covered with structural decking to form a stiff plate to transfer horizontal forces down to existing walls and further to foundations.

Disproportion Collapse

The building is not to be extended upwards and it is currently recorded as a single dwelling so there is no intended change of use. However, with the additional lower stories of the new sub-basement construction this will be designed in accordance with Section A3 of the current Approved Building Regulations. This should be relatively straight forward as the RC box is classified as a "robust" structure and any accidental lateral loading applied to the new sub-basement structure can be resisted / absorbed by the new RC structure.

Soil Type & Foundation:

Following desk study of the Geological Map for London and SI report, site is located at Clay. Allowable ground bearing pressure is assumed to be **100kN/m² + additional 25kN/m² (unloading)** and to be approved and confirmed by Building Control Officer on site before forming any foundations and underpinning works. The lower value was chosen to account for near water level and to limit the settlements. Note that foundations bases and raft slab are rigid connected as per plan and calculations hence long-term settlement or overall bearing pressures are not critical by inspection of unloading soil.

AXIOM STRUCTURES

BASEMENT AND RETAINING WALLS DESIGN PARAMETERS AND REMARKS

Ground parameters (Clay) assumed based on SI.

Ground parameters (CLAY) =

$$\varphi = 24 \Rightarrow K_a = 0.42, K_o = 0.59$$

Weights:

Density of ground = 20kN/m³, Submerged density of retained mat = 13.3kN/m³, Saturated Soil = 23.3kN/m³

Water = 10kN/m³

Concrete = 24kN/m³

Basement Walls designed as cantilevers or propped (garden).

Factors of safety = γ_f = 1.2 Earth and Water
= 1.4 Dead
= 1.6 Imposed

Surface Surcharge = Side Walls Gardens/Adjacent Building Ps => Qk = 5.0 kN/m² or 2.5 kN/m²
Road wall => Qk = 10.0 kN/m²

Refer to calculation pages for surcharge values and other design parameters.

Sliding – by inspection of fully buried new sub-basement construction, sliding is sustained by friction effect of a basement raft and passive pressure of new walls.

Sliding during construction is to be resisted by braces and struts to contractor's design and details.

Heave – basement rafts are designed to withstand buoyancy and heave. Half of the heave is assumed to be released during excavation as the excavation is to be carried out 'slowly' with perimeter trenches and in a number of stages. Refer to next pages for simplified checks.

Buoyancy – please refer to calculations pages for flotation checks.

The slab is designed to allow for raise of water to 3.0m above formation level. Note that walls are designed for accidental flooding to side and hence ground water level is assumed higher up.

Differential settlement – The new basement structure is to be very stiff RC box with perimeter walls at 300 – 340 thick. Moreover sub-basement raft is reinforced internally and at perimeters with a number of returns.

Ground bearing under the basement is not critical due to unloading of the soil by excavated ground. Refer to next pages for simplified calculation of ground bearing pressure assuming just perimeter bases which is conservative.

AXIOM STRUCTURES

Next stage of design works:

1. Detailed designs are to be carried out at next stage of design. Geotechnical and structural basic analysis will be carried out to predict ground movements at excavation, construction and in the long term condition. This works to assist setting up allowable movement parameters and structural monitoring strategy.
2. Detailed assessment of dead and imposed surcharge loadings including – guidance from the Highway Agency, appraisal of adjacent structures, neighbours extensions, boundary wall.
3. Detailed load run downs and foundation designs.
4. Basement structural design and optimisation of thicknesses of substructure elements – wall, rafts...
5. Scheme design for temporary works during basement construction.
6. Superstructure design and co-ordination with interior design and M&E.

Loading Allowances

Thicknesses of the walls as surveyed on site

Loading:

	Dead: kN/m ²	Imposed	Total
150thk RC slab			
Finishes = allowance inc screed	2.0	1.5	
150thk RC	3.6		
Partitions allowance	0.5		
SLS=	6.1	1.5	7.6
ULS=	8.5	2.4	10.9

	Dead: kN/m ²	Imposed	Total
250thk RC raft			
Finishes = allowance inc screed	2.0	1.5	
250thk RC	6.0		
Partitions allowance	0.5		
SLS=	8.5	1.5	10.0
ULS=	11.9	2.4	14.3

	Dead: kN/m ²	Imposed	Total
300thk RC slab			
Finishes = allowance inc screed	1.0	1.5	
200thk RC	7.2		
1.2m soil over slab	24		
SLS=	32.2	1.5	33.7
ULS=	45.1	2.4	47.5

	Dead: kN/m ²	Imposed	Total
350thk RC raft			
Finishes = allowance inc screed	2.0	1.5	
350thk RC	8.4		
Partitions allowance	0.5		
SLS=	10.9	1.5	12.4
ULS=	15.3	2.4	17.7

	Dead: kN/m ²	Imposed	Total
Concrete on metal deck floor with screed floor			
Finishes = allowance	0.50	1.5	
75mm screed	1.50		
150mm NW concrete (0.117)	2.69		
ComFlor60 (g=1.2mm)	0.14		
Ceiling and finishes	0.50		
Partitions allowance	0.50		
SLS=	5.83	1.5	7.3
ULS=	8.2	2.4	10.6

	Dead: kN/m ²	Snow	Total
Roof Structure			
Slate Tiles	0.50	on plan	
Battens, roof underlay, boarding	0.07	sb = 0.6	
Roof Rafters	0.05	pitch= 27	
100mm Insulation Boards	0.02	0.6x(60-27)/30 =	
Plasterboard ceiling	0.13	0.66	
F=	0.8		
On plan = F / cos27°=	0.86		
SLS=	0.9	0.7	1.5
ULS=	1.2	1.1	2.3

	Dead: kN/m2	Imposed	Total
Flat Roof - Timber:			
Metal cladding	0.4	0.75	
Timber Joists with decking	0.2		
Ceiling, Insulation and Services	0.15		
SLS=	0.75	0.75	1.5
ULS=	1.1	1.2	2.3
	Dead: kN/m2	Imposed	Total

	Dead: kN/m2	Imposed	Total
Timber Staircase:			
Finishes = Lightweight	0.25	1.5	
Timber Structure	0.25		
Ceiling and Services	0.25		
SLS=	0.75	1.5	2.3
ULS=	1.1	2.4	3.5
	Dead: kN/m2	Imposed	Total

	Dead: kN/m2	Imposed	Total
Timber Floors:			
Finishes = allowance	0.10	1.5	
18mm T&G floor deck	0.10		
Floor Joists	0.15		
12.5mm Ceiling p/board finish at 10kg/m3	0.15		
Partitions allowance	0.25		
SLS=	0.75	1.5	2.3
ULS=	1.1	2.4	3.5

	Dead: kN/m2	Imposed	Total
Timber Floors with underfloor heating:			
Finishes = allowance	0.10	1.5	
18mm T&G floor deck	0.10		
Floor Joists	0.15		
12.5mm Ceiling p/board finish at 10kg/m3	0.15		
Underfloor heating, allow for 50kg/m2	0.50		
Partitions allowance	0.25		
SLS=	1.25	1.5	2.8
ULS=	1.8	2.4	4.2

	Dead: kN/m2	Imposed	Total
Timber Floors for Outdoors Terrace:			
Finishes = allowance timber	0.60	(terrace)	
18mm T&G floor deck	0.10	2.5	
Floor Joists	0.15		
12.5mm Ceiling p/board finish at 10kg/m3	0.15		
SLS=	1.00	2.5	3.5
ULS=	1.4	4.0	5.4

Wall Line Loads

	Dead: kN/m2	Height	Total
Existing Brick Walls: 225 Brickwork (at 20kN/m3) Internal S/C/L finish plaster	4.5 0.5		DLxH
SLS=	5.0	3.0	15.0
ULS=	7.0	3.0	21.0

	Dead: kN/m2	Height	Total
Existing Brick Walls: 340 Brickwork (at 20kN/m3) Internal S/C/L finish plaster	6.7 0.5		DLxH
SLS=	7.2	3.0	21.6
ULS=	10.1	3.0	30.2

	Dead: kN/m2	Height	Total
New Internal non-LB Walls: Framing 50x75 at 400c/c 0.10 2x12.5mm plasterboard (10kN/m2)	0.1 0.2		DLxH
SLS=	0.3	2.6	0.8
ULS=	0.4	2.6	1.1

or distributed on plan = 0.25kN/m2

	Dead: kN/m2	Snow	Total
Dormer Wall Structure			
Metal cladding	0.50		
Battens, underlay, boarding	0.15		
Timber Studs	0.08		
100mm Insulation Boards	0.02		
Plasterboard lining	0.13		
F=	0.9		
SLS=	0.9	0.0	0.9
ULS=	1.2	0.0	1.2

	Dead: kN/m2	Height	Total
Existing wall partitions			DLxH
Timber Framing 47x97 at 400c/c	0.1		
Insulation	0.2		
2x12.5mm plasterboard	0.2		
SLS=	0.6	3.0	1.5
ULS=	0.7	3.0	2.1

Load Run Down to Foundations

w1 - Party wall (main house) - EXISTING

	L	Dead	Live	DL+IL
BO+AO= Roof x 4.8m/2 x 2	2.40 =	4.80	0.75	3.6 0.75 3.6 7.2
BO+AO= Ceiling x 4.8m/2 x 2	2.40 =	4.80	0.30	1.4 0.25 1.2 2.6
BO+AO= 2nd Floor x 0.4 x 2	0.80 =	1.60	1.25	2.0 1.50 2.4 4.4
BO+AO= 1st Floor x 0.4 x 2	0.80 =	1.60	1.25	2.0 1.50 2.4 4.4
BO+AO= Ground Floor x 0.4m x 2	0.80 =	1.60	1.25	2.0 1.50 2.4 4.4
BO+AO= Lower Ground Floor x 4.8m/2 x 2	2.40 =	4.80	0.75	3.6 1.50 7.2 10.8
Wall (225) x 7.8m	7.8 =	7.80	5.0	39.0 0.00 0.0 39.0
Wall (340) x 6.3m	6.3 =	6.30	7.2	45.4 0.00 0.0 45.4
		sum kN	99	19

SLS= 118
ULS= 169

w1 - Party wall (main house)

	L	Dead	Live	DL+IL
BO+AO= Roof x 4.8m/2 x 2	2.40 =	4.80	0.75	3.6 0.75 3.6 7.2
BO+AO= Ceiling x 4.8m/2 x 2	2.40 =	4.80	0.30	1.4 0.25 1.2 2.6
BO+AO= 2nd Floor x 0.4 x 2	0.80 =	1.60	1.25	2.0 1.50 2.4 4.4
BO+AO= 1st Floor x 0.4 x 2	0.80 =	1.60	1.25	2.0 1.50 2.4 4.4
BO+AO= Ground Floor x 4.8m/2 x 2	2.40 =	4.80	1.25	6.0 1.50 7.2 13.2
BO+AO= Lower Ground Floor x 4.8m/2 x 2	2.40 =	4.80	0.75	3.6 1.50 7.2 10.8
Wall (225) x 7.8m	7.8 =	7.80	5.0	39.0 0.00 0.0 39.0
Wall (340) x 6.3m	6.3 =	6.30	7.2	45.4 0.00 0.0 45.4
		sum kN	103	24

SLS= 127
ULS= 183

w2 - Front wall (main house) - EXISTING

	L	Dead	Live	DL+IL
BO= Roof x 4.4/2	2.20 =	2.20	0.75	1.7 0.00 0.0 1.7
BO= Ceiling x 4.4/2	2.20 =	2.20	0.30	0.7 0.25 0.6 1.2
BO= 2nd Floor x 4.4/2	2.20 =	2.20	1.25	2.8 1.50 3.3 6.1
BO= 1st Floor x 4.4/2	2.20 =	2.20	1.25	2.8 1.50 3.3 6.1
BO= Ground Floor x 4.4/2	2.20 =	2.20	1.25	2.8 1.50 3.3 6.1
BO= Lower Ground Floor x 4.0/2	2.00 =	2.00	1.25	2.5 1.50 3.0 5.5
Wall (225) x 7.0m	7.0 =	7.00	5.0	35.0 0.00 0.0 35.0
Additional pilasters and framing on front façade	11.0 =	11.00	0.5	5.6 0.00 0.0 5.6
Wall (340) x 6.3m	6.3 =	6.30	7.2	45.4 0.00 0.0 45.4
		sum kN	99	13

SLS= 112
ULS= 160

w2 - Front wall (main house)

	L	Dead	Live	DL+IL
BO= Roof x 4.4/2	2.20 =	2.20	0.75	1.7 0.00 0.0 1.7
BO= Ceiling x 4.4/2	2.20 =	2.20	0.30	0.7 0.25 0.6 1.2
BO= 2nd Floor x 4.4/2	2.20 =	2.20	1.25	2.8 1.50 3.3 6.1
BO= 1st Floor x 4.4/2	2.20 =	2.20	1.25	2.8 1.50 3.3 6.1
BO= Ground Floor x 4.4/2	2.20 =	2.20	1.25	2.8 1.50 3.3 6.1
BO= Lower Ground Floor x 4.0/2	2.00 =	2.00	1.25	2.5 1.50 3.0 5.5
Wall (225) x 7.0m	7.0 =	7.00	5.0	35.0 0.00 0.0 35.0
Additional pilasters and framing on front façade	11.0 =	11.00	0.5	5.5 0.00 0.0 5.5
Wall (340) x 6.3m	6.3 =	6.30	7.2	45.4 0.00 0.0 45.4
		sum kN	99	13

SLS= 112
ULS= 160

w3 - Rear wall (main house) - EXISTING

	L	Dead	Live	DL+IL
BO= Roof x 3.8/2	1.90 = 1.90	0.75	1.4	0.00 0.0 1.4
BO= Ceiling x 3.8/2	1.90 = 1.90	0.30	0.6	0.25 0.5 1.0
BO= 2nd Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= 1st Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Ground Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Lower Ground Floor x 3.6/2	1.80 = 1.80	1.25	2.3	1.50 2.7 5.0
Wall (225) x 7.0m	7.0 = 7.00	5.0	35.0	0.00 0.0 35.0
Wall (340) x 6.3m	6.3 = 6.30	7.2	45.4	0.00 0.0 45.4
		sum kN	92	12

SLS= 103
ULS= 147

w3 - Rear wall (main house)

	L	Dead	Live	DL+IL
BO= Roof x 3.8/2	1.90 = 1.90	0.75	1.4	0.00 0.0 1.4
BO= Ceiling x 3.8/2	1.90 = 1.90	0.30	0.6	0.25 0.5 1.0
BO= 2nd Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= 1st Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Ground Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Lower Ground Floor x 3.6/2	1.80 = 1.80	1.25	2.3	1.50 2.7 5.0
Wall (225) x 7.0m	7.0 = 7.00	5.0	35.0	0.00 0.0 35.0
Wall (340) x 6.3m	6.3 = 6.30	7.2	45.4	0.00 0.0 45.4
BO= 1.0m deep underpinning to existing wall	1.0 = 1.00	19.2	19.2	0.00 0.0 19.2
		sum kN	111	12

SLS= 123
ULS= 174

w3.1 - Rear wall (main house) - rear extension area - EXISITNG

	L	Dead	Live	DL+IL
BO= Roof x 3.8/2	1.90 = 1.90	0.75	1.4	0.00 0.0 1.4
BO= Ceiling x 3.8/2	1.90 = 1.90	0.30	0.6	0.25 0.5 1.0
BO= 2nd Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Rear extension roof x 0.4	0.40 = 0.40	0.75	0.3	0.75 0.3 0.6
BO= 1st Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Rear extension 1st floor x 0.4	0.40 = 0.40	1.25	0.5	1.50 0.6 1.1
BO= Ground Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Rear Extension Ground Floor x 0.4	0.40 = 0.40	1.25	0.5	1.50 0.6 1.1
BO= Lower Ground Floor x 3.6/2	1.80 = 1.80	1.25	2.3	1.50 2.7 5.0
BO= Rear Extension Lower Ground Floor x 0.4	0.40 = 0.40	1.25	0.5	1.50 0.6 1.1
Wall (225) x 7.0m	7.0 = 7.00	5.0	35.0	0.00 0.0 35.0
Wall (340) x 6.3m	6.3 = 6.30	7.2	45.4	0.00 0.0 45.4
		sum kN	94	14

SLS= 107
ULS= 153

w3.1 - Rear wall (main house) - rear extension area

	L	Dead	Live	DL+IL
BO= Roof x 3.0/2	1.90 = 1.90	0.75	1.4	0.00 0.0 1.4
BO= Ceiling x 3.8/2	1.90 = 1.90	0.30	0.6	0.25 0.5 1.0
BO= 2nd Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Rear extension roof x 0.4	0.40 = 0.40	0.75	0.3	0.75 0.3 0.6
BO= 1st Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Rear extension 1st floor x 0.4	0.40 = 0.40	1.25	0.5	1.50 0.6 1.1
BO= Ground Floor x 3.8/2	1.90 = 1.90	1.25	2.4	1.50 2.9 5.2
BO= Rear Extension Ground Floor x 0.4	0.40 = 0.40	1.25	0.5	1.50 0.6 1.1
BO= Lower Ground Floor x 3.6/2	1.80 = 1.80	1.25	2.3	1.50 2.7 5.0
BO= Rear Extension Lower Ground Floor x 0.4	0.40 = 0.40	1.25	0.5	1.50 0.6 1.1
Wall (225) x 7.0m	7.0 = 7.00	5.0	35.0	0.00 0.0 35.0
Wall (340) x 6.3m	6.3 = 6.30	7.2	45.4	0.00 0.0 45.4
BO= 1.0m deep underpinning to existing wall	1.0 = 1.00	19.2	19.2	0.00 0.0 19.2
		sum kN	113	14

SLS= 127
ULS= 180

w4 - Rear extension - Party wall = Existing

	L	Dead	Live	DL+IL
BO= Rear extension roof x 1.8/2	0.90 =	0.90	0.75	0.7
BO= Rear extension 1st floor x 1.8/2	0.90 =	0.90	1.25	1.1
AO= Ground Floor Terrace x 2.8/2	1.40 =	1.40	1.25	1.8
BO= Rear Extension Ground Floor x 1.8/2	0.90 =	0.90	1.25	1.1
AO= Rear Extension Lower Ground Floor x 2.8/2	1.10 =	1.10	1.25	1.4
BO= Rear Extension Lower Ground Floor x 1.8/2	0.90 =	0.90	1.25	1.1
Wall (225) x 8.0m	8.0 =	8.00	5.0	40.0
		sum kN	47	11

SLS= 58
ULS= 83

w4 - Rear extension - Party wall = Proposed

	L	Dead	Live	DL+IL
BO= Rear extension roof x 2.2/2	1.10 =	1.10	0.75	0.8
BO= Rear extension 1st floor x 2.2/2	1.10 =	1.10	1.25	1.4
AO= Ground Floor Terrace x 2.8/2	1.40 =	1.40	1.25	1.8
BO= Rear Extension Ground Floor x 2.2/2	1.10 =	1.10	1.25	1.4
AO= Rear Extension Lower Ground Floor x 2.8/2	1.40 =	1.40	1.25	1.8
BO= Rear Extension Lower Ground Floor x 2.2/2	1.10 =	1.10	1.25	1.4
Wall (225) x 8.0m	8.0 =	8.00	5.0	40.0
		sum kN	48	12

SLS= 61
ULS= 87

Underpinning (300) x 4.3h	4.3 =	4.3	7.2	31.0	0.00	0.0	31
			sum kN	79		12	

SLS= 91
ULS= 130

Unloading soil pressure say = 20kN/m² x 3.5m (h) =

25 kN/m²

Conservatively, reduced to 25kN/m²

Allowable pressure =

100 kN/m²

with unloading allowance =

125 kN/m²

0.73 m

use min. 1.0m base

0.35 m

Base height =

Moment on corner from eccentricity to c/L of theoretical base as per sketch

T_wall = 0.34 m

e = (B-T)/2 = 0.20 m

Number of rebars

4 12 Muls = F x e =

Rebars #

26 kNm

Provide 4H12, c=50, t=0.35m

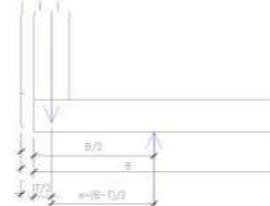
208.5 mm²/m

As req =

452.4 mm²/m

As prov=

OK



w4.1 - Rear extension - PW with AO extension

	L	Dead	Live	DL+IL
AO= Rear extension roof x 2.8/2	1.40 =	1.40	0.75	1.1
AO= Rear extension 1st floor x 2.8/2	1.40 =	1.40	1.25	1.8
AO= Rear Extension Ground Floor x 2.8/2	1.40 =	1.40	1.25	1.8
AO= Rear Extension Lower Ground Floor x 2.8/2	1.40 =	1.40	1.25	1.50
Wall (225) x 8.0m	8.0 =	8.00	5.0	40.0
	sum kN	46		7

SLS= **54**
ULS= **77**

Underpinning (300) x 4.3h	4.3 =	4.3	7.2	31.0	0.00	0.0	31
	sum kN	77				7	

SLS= **85**
ULS= **120**

Unloading soil pressure say = 20kN/m² x 3.5m (h) = **25 kN/m²**
Allowable pressure = **100 kN/m²**
with unloading allowance = **125 kN/m²**

Base height = **0.68 m** **use min. 1.0m base**
0.35 m

w4.2 - Rear extension - Inner wall

	L	Dead	Live	DL+IL
BO= Rear extension roof x 2.2/2	1.10 =	1.10	0.75	0.8
BO= Rear extension 1st floor x 2.2/2	1.10 =	1.10	1.25	1.4
BO= Rear Extension Ground Floor x 2.2/2	1.10 =	1.10	1.25	1.4
BO= Rear Extension Lower Ground Floor x 2.2/2	1.10 =	1.10	1.25	1.50
Wall (225) x 8.0m	8.0 =	8.00	5.0	40.0
	sum kN	45		6

SLS= **51**
ULS= **72**

w5 - Rear extension area - rear wall = Proposed = Existing

	L	Dead	Live	DL+IL
BO= Rear extension roof x 3.8/2	1.90 =	1.90	0.75	1.4
BO= Rear extension 1st floor x 3.8/2	1.90 =	1.90	1.25	2.4
BO= Rear Extension Ground Floor x 3.8/2	1.90 =	1.90	1.25	2.4
BO= Rear Extension Lower Ground Floor x 3.8/2	1.90 =	1.90	1.25	1.50
Wall (225) x 8.0m	8.0 =	8.00	5.0	40.0
	sum kN	49		10

SLS= **59**
ULS= **84**

w6 - Rear extension - basement extension - side wall

	L	Dead	Live	DL+IL
BO= 300thk Slab inc finishes x 4.0/2	2.00 = 2.00	8.20	16.4	1.50 3.0 19.4
BO= 1.2m thk soil over slab x 4.0/2	2.00 = 2.00	24.00	48.0	0.00 0.0 48.0
		sum kN	64	3

SLS= **67**
ULS= 95

Basement Wall (300) x 3.0h	3 = 3.0	7.2	21.6	0.00	0.0	22
Basement Base (350) (1.0 x 1.0)	1 = 1.00	8.4	8.4	0.00	0.0	8
		sum kN	94		3	

SLS= **97**
ULS= 137

Unloading soil pressure say = $20\text{kN/m}^2 \times 3.5\text{m}$ (h) = **25 kN/m²**
Allowable pressure = **100 kN/m²**
with unloading allowance = **125 kN/m²**

Base height = **0.78 m** **use min. 1.0m base**
0.35 m

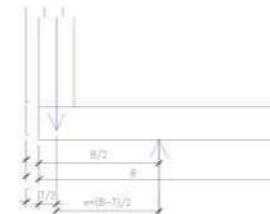
Moment on corner from eccentricity to c/L of theoretical base as per sketch

T_wall = **0.34 m**

e = $(B-T)/2$ = **0.22 m**

Number of rebars **4**
Rebars # **12**
Provide 4H12, c=50, t=0.35m

12 Muls = $F \times e$ = **30 kNm**
As req = **245.3 mm²/m**
As prov= **452.4 mm²/m**
OK



w7 - Rear extension - basement extension - rear wall

	L	Dead	Live	DL+IL
BO= 300thk Capping Slab inc finishes x 1.0	1.00 = 1.00	8.20	8.2	1.50 1.5 9.7
BO= 1.2m thk soil over slab x 1.0	1.00 = 1.00	24.00	24.0	0.00 0.0 24.0
		sum kN	32	2

SLS= **34**
ULS= 47

Basement Wall (300) x 3.0h	3 = 3.0	7.2	21.6	0.00	0.0	22
Basement Base (350) (1.0 x 1.0)	1 = 1.00	8.4	8.4	0.00	0.0	8
		sum kN	62		2	

SLS= **64**
ULS= 89

Unloading soil pressure say = $20\text{kN/m}^2 \times 3.5\text{m}$ (h) = **25 kN/m²**
Allowable pressure = **100 kN/m²**
with unloading allowance = **125 kN/m²**

Base height = **0.51 m** **use min. 1.0m base**
0.35 m

w8 - Front vault

	L	Dead	Live	DL+IL
BO= New RC steps 0.3m thk x 4.0/2	2.00 = 2.00	7.00	14.0	1.50 3.0 17.0
BO= 200thk Capping Slab inc finishes x (4.0+3.4)/6	1.23 = 1.23	5.80	7.2	0.00 0.0 7.2
0.5m thk infill (soil) over slab x 1.0m	1.00 = 1.00	10.00	10.0	0.00 0.0 10.0
		sum kN 31		3

SLS= 34
ULS= 48

Basement Wall (300) x 3.4h	3.4 = 3.4	7.2	24.5	0.00	0.0	24
Basement Base (350) (1.0 x 1.0)	1 = 1.00	8.4	8.4	0.00	0.0	8
		sum kN 64		3		

SLS= 67
ULS= 94

Unloading soil pressure say = 20kN/m² x 3.5m (h) = 25 kN/m²

Allowable pressure = 100 kN/m²
with unloading allowance = 125 kN/m²

Conservatively, reduced to 25kN/m²

Base height =

0.54 m
0.35 m use min. 1.0m base

Moment on corner from eccentricity to c/L of theoretical base as per sketch

T_wall = 0.34 m

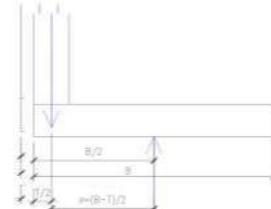
e = (B-T)/2 = 0.10 m

Number of rebars

Rebars #

Provide 4H12, c=50, t=0.35m

4 12 Muls = F x e = 9 kNm
As req = 75.59 mm²/m
As prov= 452.4 mm²/m
OK



w10 - Front vault - EXISTING

	L	Dead	Live	DL+IL
BO= Ex. Stairs (Capping Slab) 0.25m thk x 2.4/2	1.20 = 1.20	6.00	7.2	3.00 3.6 10.8
Assumed front vault slab x 0.15m thk	1.00 = 1.00	5.1	5.1	0.00 0.0 5.1
Wall (125) x 0.5m	0.5 = 0.50	2.5	1.3	0.00 0.0 1.3
Wall (340) x 3.0m	3.0 = 3.00	7.2	21.6	0.00 0.0 21.6
		sum kN 35		4

SLS= 39
ULS= 55

w(x) - Rear extension - additional loading from lining walls and capping slab

	L	Dead	Live	DL+IL
BO= 200thk Capping Slab inc finishes x 4.4/2	2.20 = 2.20	5.80	12.8	1.50 3.3 16.1
		sum kN 13		3

SLS= 16
ULS= 20

Basement Wall (300) x 3.8h	3.8 = 3.8	7.2	27.4	0.00	0.0	27
		sum kN 40		3		

SLS= 43
ULS= 61

AXIOM

STRUCTURES

FLOTATION CHECK

Flotation force:

BASEMENT

Basement Area, rear ext. = 4.6m x 11m =
Basement Area = 4.5m x 4.3m - vault area

50.6 m²19.4 m²

Assumed raise of ground water

4.0 m

4m raise (low basement)

2.0 m

2m raise (front vault)

10 kN/m³GW above low level basement =
GW above vault formation level =

Water weight =

F up =

2411.0 KN

Sum F = UPLIFT

2411.0 KN

Resistance

BASEMENT

Reference	Area / L	Dead kN/m kN/m ²	kN
Roof x 2nd Floor+1st Floor (Timber)	3x8.0x4.8 = 115.2	0.75	86
Roof & 1st Floor extension (Timber)	2x4.0x2.2 = 17.6	0.75	13
Ground Floor (Timber)	8x4.8+4x2.2 = 47.2	0.75	35
Lower Ground Floor 150thk RC	8x4.8+4x2.2 = 47.2	3.60	170
Vault Capping Slab inc finishes (0.25)x4.5x4.3	19 = 19.35	6.00	116
Walls (225thk) (2x8.4m+2x5.0m) x 7.0(h)	188 = 187.6	5.00	938
Walls (340thk) (2x8.4m+2x5.0m) x 6.3(h)	168.8 = 168.8	7.20	1216
Rear Ext. Walls (225thk) (4.0+2.2+4.0) x 8.0(h)	82 = 81.6	7.20	588
Capping RC G slab (0.3) x 4.4 x 0.5	29 = 20.0	7.20	200
Vault RC Walls 0.3m (2x4.5m+2x4.3m) x 3.0(h)	18 = 17.6	7.20	127
Basement Walls 0.3m (2x11m+2x4.6m)x3.0(h)	94 = 93.6	7.20	674
U/pin Vault Base thickening (0.35) x 1.0m	18 = 17.6	3.60	63
U/pin Base (0.35) x 1.0m / included in slab	31 = 31.2	8.40	262
Vault Slab (0.20) x 4.5 x 4.3	19 = 19.4	4.80	93
Main Basement Slab (0.35) x 4.6 x 11	51 = 50.6	8.40	425
Basement Slab Screed (0.05)	70 = 70.0	1.00	70
		sum kN	5082

F.o.S = R / F

2.11 > 1.2

Acceptable

Anchor piles are not required

Rear extension basement

Refer to next page for RC Raft design under High Groundwater Pressure or Heave (critical)

Case 1:

Design for = water = 4.0 x 10

40 kN/m²

SWT of 350thk raft + screed = 0.35 x 24 + 1.5 =

-9.9

30.1 kN/m² uplift

Case 2: HEAVE UPLIFT

Design for = heave of (5.0m excavation) x 20 x (50% area max heave) =

50 kN/m²

SWT of 350thk raft = 0.35 x 24 =

-8.4

41.6 kN/m² uplift

Vault basement

Refer to next page for RC Raft design under High Groundwater Pressure or Heave (critical)

Case 1:

Design for = water = 2.0 x 10

20 kN/m²

SWT of 200thk raft + screed = 0.20 x 24 + 1.5 =

-6.3

13.7 kN/m² uplift

Case 2: HEAVE UPLIFT

Design for = heave of (3.5m excavation) x 20 x (50% area max heave) =

35 kN/m²

SWT of 200thk raft = 0.20 x 24 =

-4.8

30.2 kN/m² uplift

Heave overall F.o.S = R / F

1.58 > 1.2

Acceptable

Loading assessment on rear capping slab

AXIOM STRUCTURES

Assumed one-way slab, 300thk

Loadings:

	L	DL+IL kN/m	DL+IL
Imposed load on slab	1.0 x	1.5 =	1.5 kN/m
Slab swt = 0.3 x 24kN/m3 =	0.3 x	24 =	7.2 kN/m
Finishes and ceiling to slab, say =	1.0 x	1 =	1.0 kN/m
1.2m of solid over slab, say 20kN/m3 =	1.2 x	20 =	24.0 kN/m
Swt inc			kN/m
		Sum sls:	33.7 kN/m



L = span = 4.0 m

From Calcs below RC slab to be min. = 300thk RC slab with min. H16 at 200crs Top and H16 at 200crs Bottom

Loading assessment on vault capping slab**Assumed two-way slab, 250thk**

Loadings:

	L	DL+IL kN/m	DL+IL
Imposed load on slab	1.0 x	2.5 =	2.5 kN/m
Slab swt = 0.25 x 24kN/m3 =	0.3 x	24 =	6.0 kN/m
Finishes and ceiling to slab, say =	1.0 x	1 =	1.0 kN/m
1.2m of solid over slab, say 20kN/m3 =	1.2 x	20 =	24.0 kN/m
Swt inc			kN/m
		Sum sls:	33.5 kN/m



Lx = span = 4.0 m

From Calcs below RC slab to be min. = 250thk RC slab with min. H16 at 200crs Top and H16 at 200crs Bottom

FLOTATION CHECK - REAR UNDERPINNED BASEMENTFlotation force:**BASEMENT**

Basement Area, rear ext. = 4.6m x 11m =	50.6 m ²	Assumed raise of ground water
GW above low level basement =	4.0 m	4m raise (low basement)
Water weight =	10 kN/m ³	
F up =	2024.0 KN	

Sum F = UPLIFT 2024.0 KN

Resistance**BASEMENT**

Reference	Area / L	Dead kN/m	Dead kN/m ²	kN
Granular infill on slab x 1.2m x 4.5m x 7.0m	32 = 31.5	21.60		680
Rear Capping RC Slab 0.3m x 4.4 x 6.5	29 = 28.6	7.20		206
Capping RC Slab 0.2m x 4.0 x 4.8	19 = 19.2	4.80		92
Basement Walls 0.3m (2x11m+2x4.6m)x3.0(h)	94 = 93.6	7.20		674
Main Basement Slab (0.35) x 4.6 x 11	51 = 50.6	8.40		425
Basement Slab Screed (0.05)	51 = 50.6	1.00		51
		sum kN		1242

AXIOM STRUCTURES

Rear extension basement

Refer to next page for RC Raft design under High Groundwater Pressure or Heave (critical)

Case 1:

Design for = water = 4.0 x 10	40 kN/m ²
SWT of 350thk raft + screed = 0.35 x 24 + 1.5 =	-9.9

30.1 kN/m² uplift

Case 2: HEAVE UPLIFT

Design for = heave of (5.0m excavation) x 20 x (50% area max heave) =	50 kN/m ²
SWT of 350thk raft = 0.35 x 24 =	-8.4

41.6 kN/m² uplift

Heave overall F.o.S = R / F 0.49 > 1.2 Use Heave Mats

Heave check with Cellcore:

Depth of excavation =	5 m
Heave force x 50% =	50 kN/m ²
Expected max ground movement in the middle of excavation =	40 mm

90mm thick Cellcore HX S 13/18

deadweight / downward load	8.4 kN/m ²
350thk slab	1.5 kN/m ²
Live load allowance	Total Load: 9.9 kN/m ²

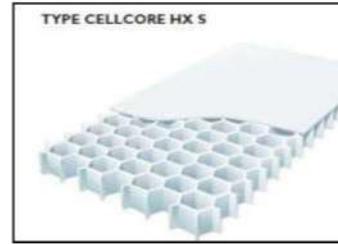


Table 1 (Cordek) Safe load value is 13 kN/m²
Fail load of 18kN/m²
The appropriate Cellcore XS S Grade 13/18

Residual Upward Force is derived as follows:

Cellcore fail load =	18 kN/m ²
self weight of slab	8.4 kN/m ²
Residual appward force=	9.6 kN/m ²

Check 1:

F=Resudial appward force x A= 485.76 kN
R=Resistance=total= 1242 kN

Heave overall F.o.S = R / F 2.56 > 1.2 OK

Check 2:

Depth of excavation=5.0m
Heave force x 50% = 50 kN/m²

66 % Area of Slab = 0.66*50m ² =	33.396 m ²	Max area of heave
Area of Cellcore = 1.8 x 5.8 + 2.4 x 2.4=	16.2 m ²	
A=	17.196 m ²	

F=Total Heave force = A x Heave = 859.8 kN
R=Resistance=total= 1242 kN

Heave overall F.o.S = R / F 1.44 > 1.2 OK

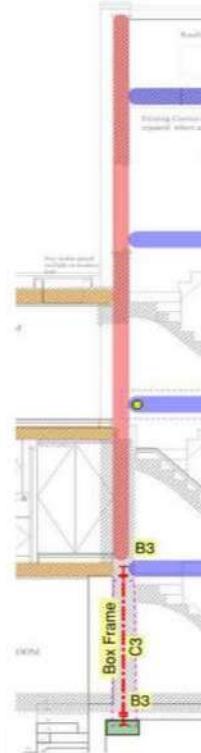
Rear extension basement - cellcore heave former included

Case 2: HEAVE UPLIFT with CELLCORE HEAVE FORMER
Design for = heave of (5.0m excavation) x 20 x (50% area max heave) = 50 kN/m²
Cellcore fail load = 18 kN/m² 32.0 kN/m² uplift

SCHEME CALCULATIONS

Steel Box Frame - Loadings and sections assessment

Loading:	L/H	DL+IL	
Ex. RR x 0.4	0.4 x	1.5	= 0.6 kN/m
Ex. 2nd Floor Joists x 3.8/2	1.9 x	2.25	= 4.3 kN/m
2nd Rear extension FJ x 0.4/2	0.2 x	2.25	= 0.5 kN/m
Ex. Ceiling x 3.8/2	1.8 x	0.55	= 1.0 kN/m
Ex. 1st Floor Joists x 3.8/2	1.9 x	2.25	= 4.3 kN/m
1st Rear extension FJ x 0.4/2	0.2 x	2.25	= 0.5 kN/m
Ex. GF Floor Joists x 3.8/2	1.9 x	2.25	= 4.3 kN/m
GF Rear extension FJ x 0.4/2	0.2 x	2.25	= 0.5 kN/m
13" Masonry Wall over x 3.0	3.0 x	7.2	= 21.6 kN/m
9" Masonry Wall over x 7.5	7.5 x	5.0	= 37.5 kN/m
Swt			0.8 kN/m
Extra loading	1.0 x	15.0	= 15.0 kN/m
	Sum sls:		90.7 kN/m



Wind load:

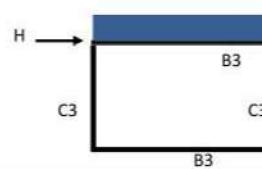
WL = 0.7 x A	Rear house = $4.0/2 \times 10.5 =$	21.0 m ²
	Rear addition = $4.2/2 \times 8 =$	16.8 m ²
	Sum:	37.8 m ²

Point loads from adjoining beams to be included at next stage of calculations conservatively, 15kN/m of extra loading assumed on frame

$$H = 26.5 \text{ kN}$$

Span of frame = 3.1 m
Height of frame = 2.8 m

According to SCI Publication 264 "Wind Moment Design for Unbraced Frames" under gravity loads connection behave as pinned and under horizontal wind load as fixed.



Head beam B3:

Loadings: as per above

$L = \text{span} = 3.1 \text{ m}$

Muls = 163.4 kNm for 203x203x71 UC 5355
 Mb = (le = 4 m) 231 kNm (from Blue Book) Ok

$$R_s \text{ ls A} = 140.5 \text{ kN}$$

Column C3:

$$F_{ls} = 140.5 \text{ kN}$$

$$F_{uls} = 210.8 \text{ kN}$$

Column end moment M_x :

Mx, 1 = end restraint moment =	16.3 kNm	(0.1 x Muls from 1B2)	
Mx, 2 = moment due to wind loads =	25.9 kNm	(1.4 x H x 2.8 x 0.25)	<- for box frame - rigid connection between
Mx, 3 = moment due to ecc. of con. =	15.8 kNm	(e = 150/2 = 75mm)	ground beam and column
Mx, tot =	58.1 kNm		

203x203x46 UC S355

Le = 3.0 m
 Pcy = 1470.0 kN (Blue book)
 Mb = 143.0 kNm

Interaction check compression with bending

Mxx/Mbs + Myy/Mcy + F/Pcy = Mxx/Mbs = 0.41
 Myy/Mcy = 0.00
 F/Pcy = 0.14 0.55 < 1 OK

Use: 203x203x46 UC S355

Check Sway Frame:

$h =$	2.8 m
$L =$	3.1 m
$I_b =$	7620 cm ⁴
$I_c =$	4570 cm ⁴
$E =$	205000 N/mm ²

1) Pinned connection at base and head:

$$\Delta = \beta \frac{F \cdot h^3}{12EI_c}$$

with $\beta = 2 + 1/k$
for pinned feet frame

$k = 1.51$ $\kappa = \frac{h \cdot I_c}{L \cdot I_c}$

beta = 2.66

Delta = 27.53 mm

$h/102 < 300$, not Ok, check fixed connection

2) Fixed connection at base and head:

$$\Delta = \beta \frac{F \cdot h^3}{12EI_c}$$

with $\beta = \frac{2 + 3k}{1 + 6k}$ for
frame with fixed feet

$k = 1.51$ $\kappa = \frac{h \cdot I_c}{L \cdot I_c}$

beta = 0.65

Delta = 6.71 mm Deflection multiplied by 2.0 by as an approximate allowance
 $h/417 > 300$, OK for connection flexibility.

Check Connection Beam B3 with Column C3

Fix connection at base and head:

Mx, 1 = end restraint moment =	16.3 kNm
Mx, 2 = moment due to wind loads =	25.9 kNm
Mx, tot =	42.3 kNm

Connection 4M20 bolts at 200 crs =

Ps (shear capacity)=	4 x 91.9kN = (blue book)	367.6 kN	>	26.5 kN	OK
Mc for 4M20 8.8 grade =	2 x 137kN x 0.20m =	54.8 kNm	>	42.3 kNm	OK

Provide 15mm thick Steel end plate S275, 6CFW

Check Foundations under Steel Box Frame:



tot/L	L	DL+IL	=	90.7 kN/m
Swt found = 0.5*0.45*8	0.23 x 8	=	1.8 kN/m	
	Sum:		92.5 kN/m	

London Clay Formation

width of footing = sum / 125GBP =	0.74 m
say = B =	0.8 m

F sls =	92.5 kN
e = (F x L) / F - L/2 =	0.00 m

Stress on soil = F/LxB + Fxe/L^2xB = 116 kN/m² < 125 kN/m² Use 800mm wide

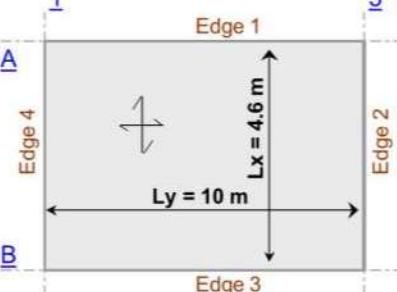
Check Ground Beam GB1:

Loading:	90.7 kN/m
L = span =	3.1 m

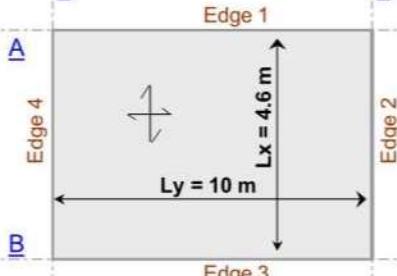
Muls = w*L^2/8 = 163.4 kNm

By inspection of Head Beam use: 203x203x71 UC S355 (Mb = (Le = 4m) = 231 kNm)

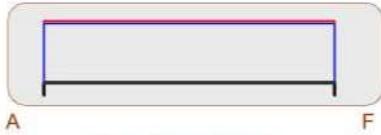
Project	14 Queens Grove			The Concrete Centre																																						
Client	Private				Made by	Date																																				
Location	200 Vault Slab - heave check	1 to 5: A to B			AS	09-Aug-2018																																				
2-WAY SPANNING INSITU CONCRETE SLABS to BS 8110:2005 (Table 3.14)																																										
Originated from RCC9.xls v4.0 © 2006 TCC																																										
DIMENSIONS	MATERIALS			STATUS	VALID DESIGN																																					
short span, l_x m	3.70	fcu N/mm ²	40	$\gamma_c = 1.50$	1	5																																				
long span, l_y m	4.00	fy N/mm ²	500	$\gamma_s = 1.15$																																						
h mm	200	steel class	A																																							
Top cover mm	50	Density kN/m ³	0	Plan																																						
Btm cover mm	30	(Lightweight concrete)																																								
LOADING characteristic	EDGE CONDITIONS																																									
Self weight kN/m ²	0.00	Edge 1	d	C = Continuous																																						
Extra dead kN/m ²	30.20	Edge 2	d	D = Discontinuous																																						
Total Dead, gk kN/m ²	30.20	Edge 3	d																																							
Imposed, qk kN/m ²	0.00	Edge 4	d																																							
Design load, n kN/m ²	36.24	See Figure 3.8 and clauses 3.5.3.5-6																																								
MAIN STEEL	SHORT SPAN x	LONG SPAN y	EDGE 1 Free	EDGE 2 Free	EDGE 3 Free	EDGE 4 Free																																				
β_s	0.063	0.056	0.000	0.000	0.000	0.000																																				
M kNm/m	31.5	27.8	0.0	0.0	0.0	0.0																																				
d mm	164.0	152.0	145.0	135.0	145.0	135.0																																				
k'	0.156	0.156	0.156	0.156	0.156	0.156																																				
k	0.029	0.030	0.000	0.000	0.000	0.000																																				
Z mm	155.8	144.4	137.8	128.3	137.8	128.3																																				
As req mm ² /m	465	443	0	0	0	0																																				
As min mm ² /m	260	260	260	260	260	260																																				
As deflection mm ² /m	546	520	~	~	~	~																																				
\emptyset mm	12	12	10	10	10	10																																				
Layer	B 1	B 2	T 1	T 2	T 1	T 2																																				
@ mm	200	200	300	300	300	300																																				
As prov mm ² /m	565	565	262	262	262	262																																				
= %	0.345	0.372	0.181	0.194	0.181	0.194																																				
S max mm	504	468	445	415	445	415																																				
Subclause	(a)	(a)	(a)	(a)	(a)	(a)																																				
DEFLECTION	fs	274	261	0	0	0																																				
	Mod factor	1.367																																								
	Permit L/u	23.23	Actual L/u	22.56	ASX enhanced 17.4% for deflection control																																					
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				-		18063																								
DIMENSIONS	MATERIALS			STATUS	VALID DESIGN																									
short span, l_x m	4.60	fcu N/mm ²	40	$\gamma_c = 1.50$	1	5																								
long span, l_y m	10.00	fy N/mm ²	500	$\gamma_s = 1.15$																										
h mm	300	steel class	A																											
Top cover mm	50	Density kN/m ³	0	Plan																										
Btm cover mm	30	(Lightweight concrete)																												
LOADING characteristic	EDGE CONDITIONS																													
Self weight kN/m ²	0.00	Edge 1	d	C = Continuous																										
Extra dead kN/m ²	32.00	Edge 2	d	D = Discontinuous																										
Total Dead, gk kN/m ²	32.00	Edge 3	d																											
Imposed, qk kN/m ²	0.00	Edge 4	d																											
Design load, n kN/m ²	38.40	See Figure 3.8 and clauses 3.5.3.5-6																												
																														
MAIN STEEL	SHORT SPAN x	LONG SPAN y	EDGE 1 Free	EDGE 2 Free	EDGE 3 Free	EDGE 4 Free																								
β_s	0.115	0.056	0.000	0.000	0.000	0.000																								
M kNm/m	93.7	45.5	0.0	0.0	0.0	0.0																								
d mm	262.0	248.0	244.0	232.0	244.0	232.0																								
k'	0.156	0.156	0.156	0.156	0.156	0.156																								
k	0.034	0.018	0.000	0.000	0.000	0.000																								
Z mm	248.9	235.6	231.8	220.4	231.8	220.4																								
As req mm ² /m	866	444	0	0	0	0																								
As min mm ² /m	390	390	390	390	390	390																								
As deflection mm ² /m	866	444	~	~	~	~																								
\emptyset mm	16	12	12	12	12	12																								
Layer	B 1	B 2	T 1	T 2	T 1	T 2																								
@ mm	225	250	275	275	275	275																								
As prov mm ² /m	894	452	411	411	411	411																								
= %	0.341	0.182	0.169	0.177	0.169	0.177																								
S max mm	456	756	744	708	744	708																								
Subclause	(b)	(a)	(a)	(a)	(a)	(a)																								
DEFLECTION	fs	323	327	0	0	0																								
	Mod factor	1.116																												
	Permit L/u	18.98	Actual L/u	17.56	Asx enhanced 0.0% for deflection control																									
<table border="1"> <thead> <tr> <th colspan="2">BOTH EDGES DISCONTINUOUS</th> <th colspan="2">ONE EDGE DISCONTINUOUS</th> </tr> <tr> <th>X</th><th>Y</th><th>X</th><th>Y</th> </tr> </thead> <tbody> <tr> <td></td><td>650</td><td></td><td>390</td></tr> <tr> <td>411</td><td>411</td><td>5000</td><td>5000</td></tr> <tr> <td>298</td><td>298</td><td>0</td><td>0</td></tr> <tr> <td>894</td><td>452</td><td>894</td><td>452</td></tr> </tbody> </table> <p>Bottom steel not curtailed in edge strips at free edges</p>							BOTH EDGES DISCONTINUOUS		ONE EDGE DISCONTINUOUS		X	Y	X	Y		650		390	411	411	5000	5000	298	298	0	0	894	452	894	452
BOTH EDGES DISCONTINUOUS		ONE EDGE DISCONTINUOUS																												
X	Y	X	Y																											
	650		390																											
411	411	5000	5000																											
298	298	0	0																											
894	452	894	452																											
SUPPORT REACTIONS (kN/m char uno) (See Figure 3.10)																														
	EDGE 1	EDGE 2	EDGE 3	EDGE 4	Sum $\beta_{vx} = 1.027$																									
	A, 1-5	5, B-A	B, 1-5	1, B-A	Sum $\beta_{vy} = 0.667$																									
β_v	0.513	0.333	0.513	0.333	Table 3.15																									
Dead kn/m	75.56	49.07	75.56	49.07	equations																									
Imposed kn/m	0.00	0.00	0.00	0.00	19 & 20																									
Vs kn/m	90.7	58.9	90.7	58.9																										
OUTPUT/SUMMARY <table border="1"> <thead> <tr> <th>PROVIDE MAIN STEEL</th><th>SHORT SPAN</th><th>LONG SPAN</th><th>EDGE 1</th><th>EDGE 2</th><th>EDGE 3</th><th>EDGE 4</th> </tr> </thead> <tbody> <tr> <td>H16 @ 225 B1</td><td>H12 @ 250 B2</td><td>H12 @ 275 T1</td><td>A, 1-5</td><td>5, B-A</td><td>B, 1-5</td><td>1, B-A</td> </tr> </tbody> </table>							PROVIDE MAIN STEEL	SHORT SPAN	LONG SPAN	EDGE 1	EDGE 2	EDGE 3	EDGE 4	H16 @ 225 B1	H12 @ 250 B2	H12 @ 275 T1	A, 1-5	5, B-A	B, 1-5	1, B-A										
PROVIDE MAIN STEEL	SHORT SPAN	LONG SPAN	EDGE 1	EDGE 2	EDGE 3	EDGE 4																								
H16 @ 225 B1	H12 @ 250 B2	H12 @ 275 T1	A, 1-5	5, B-A	B, 1-5	1, B-A																								
ADDITIONAL TORSION STEEL <table border="1"> <thead> <tr> <th>X direction</th><th>CORNER 1</th><th>CORNER 2</th><th>CORNER 3</th><th>CORNER 4</th> </tr> </thead> <tbody> <tr> <td>3 H10 T</td><td>1A</td><td>5A</td><td>5B</td><td>1B</td> </tr> <tr> <td>Y direction</td><td>3 H10 T</td><td>3 H10 T</td><td>3 H10 T</td><td>3 H10 T</td> </tr> </tbody> </table> <p>placed in edge strips</p>							X direction	CORNER 1	CORNER 2	CORNER 3	CORNER 4	3 H10 T	1A	5A	5B	1B	Y direction	3 H10 T	3 H10 T	3 H10 T	3 H10 T									
X direction	CORNER 1	CORNER 2	CORNER 3	CORNER 4																										
3 H10 T	1A	5A	5B	1B																										
Y direction	3 H10 T	3 H10 T	3 H10 T	3 H10 T																										
CHECKS <table border="1"> <thead> <tr> <th>Lx > Ly</th><th>BAR Ø</th><th>SINGLY REINFORCED</th><th>MIN SPACING</th><th>MAX SPACING</th><th>DEFLECTION</th><th>GLOBAL STATUS</th> </tr> </thead> <tbody> <tr> <td>OK</td><td>< COVER</td><td>OK</td><td>OK</td><td>OK</td><td>OK</td><td>VALID DESIGN</td> </tr> </tbody> </table>							Lx > Ly	BAR Ø	SINGLY REINFORCED	MIN SPACING	MAX SPACING	DEFLECTION	GLOBAL STATUS	OK	< COVER	OK	OK	OK	OK	VALID DESIGN										
Lx > Ly	BAR Ø	SINGLY REINFORCED	MIN SPACING	MAX SPACING	DEFLECTION	GLOBAL STATUS																								
OK	< COVER	OK	OK	OK	OK	VALID DESIGN																								

Project	14 Queens Grove	The Concrete Centre					
Client	Private	Made by AS Date 09-Aug-2018 Page 1					
Location	350 Basement Slab - heave check 1 to 5: A to B	Checked AP Revision - Job No 18063					
	2-WAY SPANNING INSITU CONCRETE SLABS to BS 8110:2005 (Table 3.14)						
	Originated from RCC94.xls v4.0 © 2006 TCC						
DIMENSIONS	MATERIALS	STATUS VALID DESIGN					
short span, l_x m <u>4.60</u>	fcu N/mm ² <u>40</u>	$\gamma_c = 1.50$ 1 5					
long span, l_y m <u>10.00</u>	fy N/mm ² <u>500</u>	$\gamma_s = 1.15$					
h mm <u>350</u>	steel class <u>A</u>						
Top cover mm <u>50</u>	Density kN/m ³ <u>0</u>	Plan					
Btm cover mm <u>30</u>	(Lightweight concrete)						
LOADING characteristic	EDGE CONDITIONS						
Self weight kN/m ² <u>0.00</u>	Edge 1 <u>d</u> C = Continuous						
Extra dead kN/m ² <u>41.60</u>	Edge 2 <u>d</u> D = Discontinuous						
Total Dead, gk kN/m ² <u>41.60</u>	Edge 3 <u>d</u>						
Imposed, qk kN/m ² <u>0.00</u>	Edge 4 <u>d</u>						
Design load, n kN/m ² <u>49.92</u>	See Figure 3.8 and clauses 3.5.3.5-6						
MAIN STEEL	SHORT SPAN x <u>0.115</u>	LONG SPAN y <u>0.056</u>	EDGE 1 Free <u>0.000</u>	EDGE 2 Free <u>0.000</u>	EDGE 3 Free <u>0.000</u>	EDGE 4 Free <u>0.000</u>	BS8110 Reference Table 3.14
β_s	0.115	0.056	0.000	0.000	0.000	0.000	
M kNm/m	121.8	59.2	0.0	0.0	0.0	0.0	
d mm	312.0	298.0	294.0	282.0	294.0	282.0	
k'	0.156	0.156	0.156	0.156	0.156	0.156	
k	0.031	0.017	0.000	0.000	0.000	0.000	
Z mm	296.4	283.1	279.3	267.9	279.3	267.9	
As req mm ² /m	946	481	0	0	0	0	3.4.4.4
As min mm ² /m	455	455	455	455	455	455	Table 3.25
As deflection mm ² /m	946	481	~	~	~	~	
\emptyset mm	<u>16</u>	<u>12</u>	<u>12</u>	<u>12</u>	<u>12</u>	<u>12</u>	
Layer	<u>B 1</u>	B 2	<u>T 1</u>	T 2	T 1	T 2	
@ mm	200	225	225	225	225	225	
As prov mm ² /m	1005	503	503	503	503	503	
= %	0.322	0.169	0.171	0.178	0.171	0.178	%
S max mm	511	762	762	762	762	762	Clause
Subclause	(b)	(a)	(a)	(a)	(a)	(a)	3.12.11.2.7
DEFLECTION	fs	314	319	0	0	0	
Mod factor	1.183						Eqn 8
Permit L/u	20.11	Actual L/u	14.74	Asx enhanced 0.0% for deflection control			
TORSION STEEL	BOTH EDGES DISCONTINUOUS		ONE EDGE DISCONTINUOUS				
\emptyset mm	<u>10</u>	X <u>709</u>	X <u>455</u>	Y	Y		3.5.3.5
As req mm ² /m		503	5000	503	5000		
As prov T mm ² /m		258	0	258	0		
Additional As T req mm ²		1005	1005	503	503		
As prov B mm ² /m							
Bottom steel not curtailed in edge strips at free edges							
SUPPORT REACTIONS (kN/m char uno)	(See Figure 3.10)						
	EDGE 1 <u>A, 1-5</u>	EDGE 2 <u>5, B-A</u>	EDGE 3 <u>B, 1-5</u>	EDGE 4 <u>1, B-A</u>			
β_v	0.513	0.333	0.513	0.333			
Dead kN/m	98.23	63.79	98.23	63.79			
Imposed kN/m	0.00	0.00	0.00	0.00			
V_s kN/m	117.9	76.5	117.9	76.5			
OUTPUT/SUMMARY							
PROVIDE MAIN STEEL	SHORT SPAN <u>H16 @ 200 B1</u>	LONG SPAN <u>H12 @ 225 B2</u>	EDGE 1 <u>A, 1-5</u>	EDGE 2 <u>5, B-A</u>	EDGE 3 <u>B, 1-5</u>	EDGE 4 <u>1, B-A</u>	Table 3.15
ADDITIONAL TORSION STEEL X direction	CORNER 1 <u>1A</u>	CORNER 2 <u>5A</u>	CORNER 3 <u>5B</u>	CORNER 4 <u>1B</u>			
Y direction	3 H10 T	3 H10 T	3 H10 T	3 H10 T			
CHECKS	BAR Ø <u>< COVER</u>	SINGLY REINFORCED <u>OK</u>	MIN SPACING <u>OK</u>	MAX SPACING <u>OK</u>	DEFLECTION <u>OK</u>	GLOBAL STATUS <u>VALID DESIGN</u>	
Lx > Ly OK	OK	OK	OK	OK	OK	VALID DESIGN	



Project	14 Queen's Grove	 The Concrete Centre	The Concrete Centre		
Client	Private		Made by	Date	Page
Location	300th capping slab at rear extension		AS	09-Aug-2018	1
	1-WAY SOLID CONCRETE SLAB DESIGN to BS 8110:2005 Table		Checked	Revision	Job No
	Originated from RCC91.xls v4.0 on CD	© 2006 TCC	AP	-	18063

LOCATION	Supports from grid A to grid F	STATUS				
	End support condition is S (C)ontinuous or (S)imple	VALID DESIGN				
DIMENSIONS	MATERIALS					
Nº of spans	Nº 1	fy N/mm ² 500				
Max Span	m 4.000	fcu N/mm ² 35				
Thickness, h	mm 300	Density kN/m ³ 23.6				
cover	mm 30	(Normal weight concrete)				
LOADING						
Self Weight	kN/m ² 7.08					
Additional Dead	kN/m ² 25.00					
Total Dead, gk	kN/m ² 32.08					
Imposed Load, qk	kN/m ² 1.50					
Design load, n =	kN/m ² 47.31					
MAIN STEEL	Geometry and Loading	Indicative Bending Moment Diagram				
						
Factor	END SUPPORTS (A & F)	END SPANS	FIRST INT SUPPORTS	INTERIOR SPANS	INTERNAL SUPPORTS	BS 8110 Reference
M	0.000	0.125	0.000	0.000	0.000	Table 3.12
d	0.0	94.6	0.0	0.0	0.0	
K	262	262				
z	0.000	0.039				
As mm ² /m	248.9	248.9				
Rebar	0	874				
\varnothing mm	H	H				
@ mm c/c	16	16	12	16	12	
As prov mm ² /m	500	225				
= %	402	894				
Max S	0.153	0.341				
subclause	766	448				
(a)	(b)					
DEFLECTION						
fs N/mm ²	0	326				Eqn 8
Top stcc provided % bd		0				
Comp Mod factor		1.000				Table 3.11
Tens Mod factor		1.102				Eqn 7
Perm L/d		22.1				Table 3.9
Actual L/d		15.2				
DISTRIBUTION STEEL	As = 0.13% = 390 mm ² /m	Provide H 10 at 200 = 393 mm ² /m				Table 3.25
SHEAR	END SUPPORT	FIRST INT SUPT	INTERNAL SUPTS			
V kN/m	94.6					Table 3.12
As prov %	0.171					
v N/mm ²	0.361					equation 3
vc N/mm ²	0.436					Table 3.8
OUTPUT/SUMMARY						
PROVIDE	END SUPPORTS	END SPANS	FIRST INT SUPPORTS	INTERIOR SPANS	INTERNAL SUPPORTS	DISTRIBUTION
	H16 @ 500 T1	H16 @ 225 B1				H10 @ 200
CHECKS	BAR Ø < COVER OK	SINGLY REINFORCED OK	BAR SPACING OK	DEFLECTION OK	NO SHEAR LINKS OK	GLOBAL STATUS VALID DESIGN

Project 14 Queens Grove
 Client private
 Location basement wall with surcharge
 Basement wall design to BS8110:2005
 Originated from 'RCC61 Basement Wall.xls' v4.0



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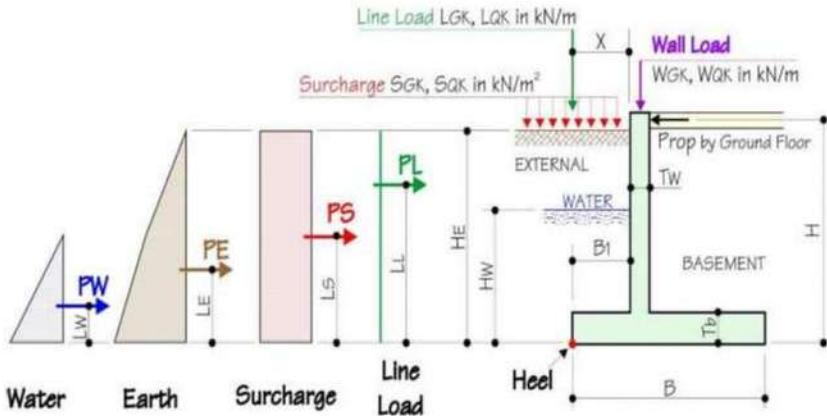
The Concrete Centre

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IDEALISED STRUCTURE and FORCE DIAGRAMS

DESIGN STATUS : VALID

Surcharge load from adjoining box frame included



DIMENSION (mm)

H = 4750 B = 1000 Tw = 340
 Hw = 3750 BI = 0 Tb = 350
 He = 4750

MATERIAL PROPERTIES

steel class A

f_c = 40 N/mm² γ_m = 1.50 concrete
 f_y = 500 N/mm² γ_m = 1.15 steel

Cover to tension reinforcement (co) = 50 mm

Max. allowable design surface crack width (W) = 0.3 mm (0.2 or 0.3 mm only)
 Concrete density = 24.0 kN/m³



Wall Geometry

SOIL PROPERTIES

Design angle of int'l friction of retained mat'l (Ø) = 24 degree
 Design cohesion of retained mat'l (C) = 0 kN/m² (Only granular backfill considered, ie "C" = 0)

Density of retained mat'l (q) = 20 kN/m³

Submerged Density of retained mat'l (qs) = 13.33 kN/m³ (default=2/3 of q), only apply when Hw > 0

= 13.33

Design angle of int'l friction of base mat'l (Ø_b) = 20 degree

Design cohesion of base mat'l (C_b) = 10 kN/m²

Density of base mat'l (q_b) = 10 kN/m³

Allowable gross ground bearing pressure (GBP) = 125 kN/m²

LOADINGS (unfactored)

Surcharge load -- live (SQK) = 5 kN/m²

Surcharge load -- dead (SGK) = 0 kN/m²

Line load -- live (LQK) = 0 kN/m

Line load -- dead (LGK) = 92.5 kN/m

Distance of line load from wall (X) = 300 mm

Wall load -- live (WQK) = 0 kN/m

Wall load -- Dead (WGK) = 0 kN/m

ASSUMPTIONS

a) Wall friction is zero

b) Minimum active earth pressure = 0.25qH

c) Granular backfill

h) Design not intended for walls over 3.5 m high

i) Does not include check for temp or shrinkage

LATERAL FORCES

K_o = 0.59 default K_o = (1-SIN Ø) 0.59
 K_{ac} = 1.54 = 2K_o^{0.5}

Force (kN)	Lever arm (m)	γ _f	Ultimate Force (kN)
PE = 106.05	LE = 1.671	1.20	127.25
PS(GK) = 0.00	LS = 2.38	1.40	0.00
PS(QK) = 14.09	LS = 2.38	1.60	22.54
PL(GK) = 54.88	LL = 4.50	1.40	76.83
PL(QK) = 0.00	LL = 4.50	1.60	0.00
PW = 70.31	LW = 1.25	1.20	84.38
Total	245.32		311.00

Project	14 Queens Grove	The Concrete Centre		
Client	private	Made by	Date	Page
Location	basement wall with surcharge	AS	09-Aug-2018	3
	Basement wall design to BS8110:2005	Checked	Revision	Job No
	Originated from 'RCC61 Basement Wall.xls' v4.0	AP	-	18063

STRUCTURAL DESIGNS (ultimate)

DESIGN CHECKS :

OK

BS8110

reference

3.4.4.1

WALL (per metre length)

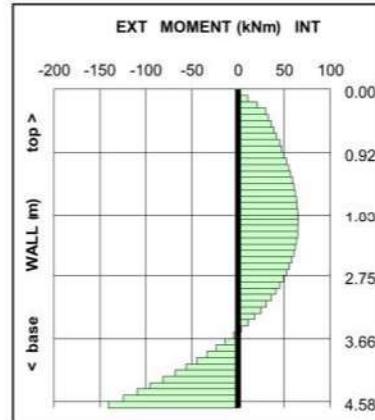
AXIAL LOAD CAPACITY (Limited to 0.1fcu) = 1360.00 kN

OK

Lateral Force	Force (kN)	γ_f	Ultimate Force (kN)	Ult. Moment at base (kNm)	Ult. Shear at base (kN)	Ult. Shear at top (kN)
PE =	98.90	1.20	118.68	-72.62	92.78	25.90
PS(GK) =	0.00	1.40	0.00	0.00	0.00	0.00
PS(QK) =	13.57	1.60	21.71	-12.42	13.57	8.14
PL(GK) =	54.88	1.40	76.83	-9.64	6.33	70.49
PL(QK) =	0.00	1.60	0.00	0.00	0.00	0.00
PW =	63.90	1.20	76.68	-46.20	66.81	9.88
Total	231.25		293.90	-140.88	179.50	114.41

Design Bending Moments

On INTERNAL face due to lateral forces, $M_{int} = 65.01$ kNm
On EXTERNAL face due to lateral forces, $M_{ext} = -140.88$ kNm



Eccentricity of Axial Loads = 170 mm

LATERAL DEFLECTION "Δ" = 1.7 mm

Due to eccentricity of axial loads, $M_{ecc} = 0.0$ kNm

Due to $P\Delta$ effect, $M_p = 0.00$ kNm

Total Mmt on INTERNAL face ($M_{int}+0.5M_{ecc}+M_p$) = 65.0 kNm
Total Mmt on EXTERNAL face ($M_{ext}+0.5M_{ecc}$) = -140.9 kNm

WALL REINFORCEMENT :	EXTERNAL FACE		INTERNAL FACE		mm ²	Table 3.25
	Min. As =	442	442	mm		
	ϕ =	20	12	mm		
	centres =	100	< 320	100	< 735	OK
	As =	3142	> 442	1131	> 442	OK
MOMENT of RESISTANCE :	d =	280	284	mm		3.12.11.2.7(b)
	z =	242	270	mm		3.4.4.4
	As' =	0	0	mm ²		3.4.4.4
	M _{res} =	330.2	> 140.88	132.7	> 65.01	OK

SHEAR RESISTANCE:	BASE of WALL		TOP of WALL		mm ² /m	Table 3.8
	As =	3142	ϕ =	12 @100 mm 1131		
	100As/bd =	1.12%	=	0.40%		
	vc =	0.84		0.59 N/mm ²		
	V _{res} =	235.1	> 179.50	168.3 > 114.41 kN	OK	3.5.5.2

ACK WIDTH to BS8100/8007
Temp & shrinkage effects not included X = 119.26 mm $\varepsilon_m = 0.00087$
Acr = 68.10 mm $W = 0.15 < 0.30$ mm OK BS8007
App. B.2

REINFORCEMENT SUMMARY for WALL

	Type	ϕ mm	centres mm	As mm ²	Min. As mm ²
INTERNAL FACE	H	12	100	1131	442
EXTERNAL FACE	H	20	100	3142	442
TRANSVERSE	H	12	200	565	442

Project	14 Queens Grove	 The Concrete Centre	The Concrete Centre		
Client	Privat		Made by	Date	Page
Location	Retaining Wall - Party Wall		AS	09-Aug-2018	
	RETAINING WALL design to BS 8110:2005		Checked	Revision	Job No

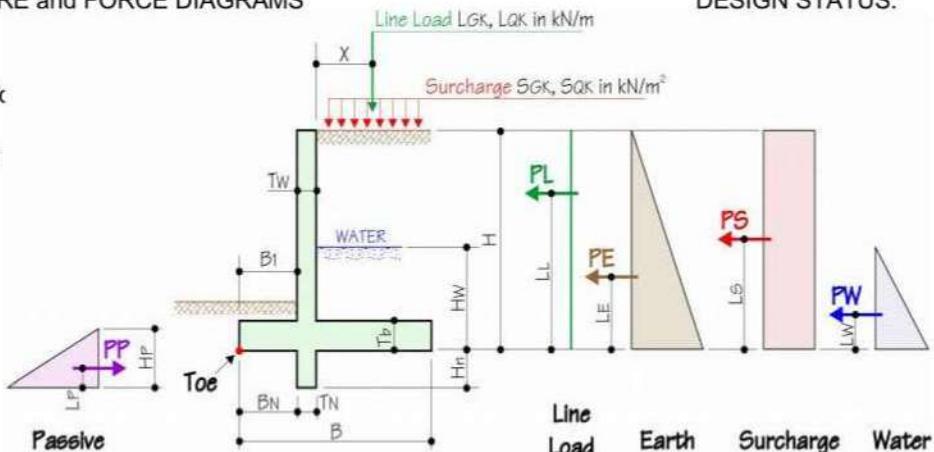
Originated from 'RCC62.xls' v4.0 © 2006 TCC

IDEALISED STRUCTURE and FORCE DIAGRAMS

DESIGN STATUS: **VALID**

WARNING :

Passive pressure should only be considered if it can be guaranteed that there will be no future excavation in front of the wall.



DIMENSIONS (mm)

H = <u>4150</u>	B = <u>1000</u>	Tw = <u>340</u>
Hw = <u>3150</u>	BI = <u>660</u>	Tb = <u>350</u>
Hp = <u>0</u>	BN = <u>0</u>	TN = <u>0</u>
Hn = <u>0</u>		

MATERIAL PROPERTIES

fcu = <u>35</u> N/mm ²	fy = <u>500</u> N/mm ²	steel class <u>A</u>
γm = <u>1.5</u>	γm = <u>1.15</u>	concrete steel
cover to tension steel = <u>50</u> mm		
Max allowable design surface crack width (W) = <u>0.3</u> mm		(0.2 or 0.3 mm only)
Concrete density = <u>24</u> kN/m ³		

SOIL PROPERTIES

Design angle of int'l friction of retained mat'l (ϕ) = <u>24</u> degree
Design cohesion of retained mat'l (C) = <u>0</u> kN/m ²
Density of retained mat'l (q) = <u>20</u> kN/m ³
Submerged Density of retained mat'l (qs) = <u>13.33</u> kN/m ³
Design angle of int'l friction of base mat'l (ϕ_b) = <u>20</u> degree
Design cohesion of base material (Cb) = <u>10</u> kN/m ²
Density of base material (qb) = <u>10</u> kN/m ³
Allowable gross ground bearing pressure (GBP) = <u>125</u> kN/m ²



Wall Geometry

LOADINGS	Surcharge load -- live (SQK) = <u>10</u> kN/m ²
	Surcharge load -- dead (SGK) = <u>0</u>
	Line load -- live (LQK) = <u>3</u> kN/m
	Line load -- dead (LGK) = <u>33</u> kN/m
	Distance of line load from wall (X) = <u>-170</u> mm

(Only granular backfill considered, "C" = zero)

LATERAL FORCES (unfactored)	Ka = <u>0.42</u>	[default ka = (1-SIN ϕ)/(1+SIN ϕ) 0.42]
	Kp = <u>2.04</u>	[default kp = (1+SIN ϕ_b)/(1-SIN ϕ_b) 2.04]
	Kpc = <u>2.86</u>	[default kpc = 2kp ^{0.5}] = <u>2.86</u>
	Kac = <u>1.30</u>	[2ka ^{0.5}]

[default=2/3*q (only apply when $\phi \geq 13.33$)

ASSUMPTIONS

- a) Wall friction is zero
- b) Minimum active earth pressure = $0.25qH$
- c) Granular backfill
- d) Does not include check of rotational slide/slope
- e) Does not include effect of seepage of ground water beneath the wall.
- f) Does not include deflection check of wall due to lateral earth pressures
- h) Design not intended for walls over 3.0 m high
- i) Does not include check for temp. or shrinkage

	Force (kN)	Lever arm (m)	Moment about TOE (kNm)	γ_f	F_{ult} (kN)	M_{ult} (kNm)
PE =	58.68	LE = 1.463	85.83	<u>1.20</u>	70.42	102.99
PS(GK) =	0.00	LS = 2.08	0.00	<u>1.40</u>	0.00	0.00
PS(QK) =	17.50	LS = 2.08	36.32	<u>1.60</u>	28.00	58.11
PL(GK) =	0.00	LL = 4.29	0.00	<u>1.40</u>	0.00	0.00
PL(QK) =	0.00	LL = 4.29	0.00	<u>1.60</u>	0.00	0.00
PW =	49.61	LW = 1.05	52.09	<u>1.20</u>	59.54	62.51
Total	125.80		174.24		157.96	223.61
PP =	0.00	(LP-HN) = 0.00	0.00	<u>1.00</u>	0.00	0.00

Project	14 Queens Grove				The Concrete Centre		
Client	Privat				Made by AS	Date 09-Aug-2018	Page 2
Location	Retaining Wall - Party Wall				Checked AP	Revision -	Job No 18063
	RETAINING WALL design to BS 8110:2005						
	Originated from 'RCC62.xls' v4.0		© 2006 TCC				

STRUCTURAL DESIGNS (ultimate)

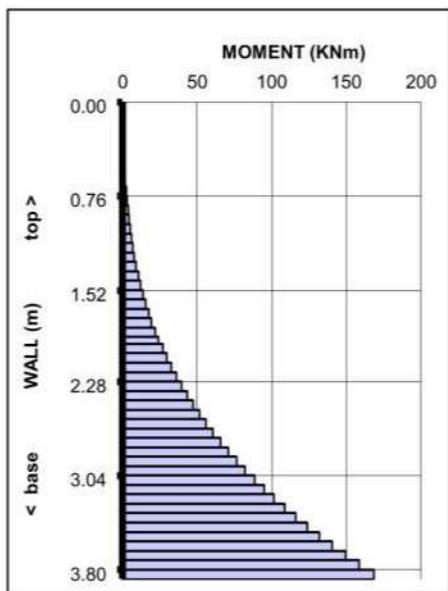
DESIGN CHECKS : OK

WALL (per metre length)

	Force (kN)	Lever arm (m)	Moment (kNm)	γ_f	V ult (kN)	M ult (kNm)
EARTH	49.88	1.34	66.85	1.2	59.85	80.22
SURCHARGE(GK)	0.00	1.90	0.00	1.4	0.00	0.00
SURCHARGE(QK)	16.03	1.90	30.45	1.6	25.64	48.72
LINE LOAD(GK)	0.00	3.94	0.00	1.4	0.00	0.00
LINE LOAD(QK)	0.00	3.94	0.00	1.6	0.00	0.00
WATER	39.20	0.93	36.59	1.2	47.04	43.90
Total	105.10		133.89		132.53	172.84

BS8110

reference



MAIN REINFORCEMENT :

Min. As = 442 mm²

Table 3.25

ϕ = 16 mm

centres = 100 mm

< 270

OK

3.12.11.2.7(b)

Asprov = 2011 mm²

> 442

OK

MOMENT of RESISTANCE :

d = 282 mm

3.4.4.4

z = 254.04 mm

As' = 0 mm²

Mres = 222.08 kNm

> 172.84

OK

SHEAR RESISTANCE:

100 As/bd = 0.71%

Table 3.8

vc = 0.69 N/mm²

Vres = 194.38 kN

> 132.53

OK

3.5.5.2

Ultimate Bending Moment Diagram

CHECK CRACK WIDTH TO BS8110/BS800
(temperature and shrinkage effects not included)

X = 103.85 mm

BS8007

Acr = 68.58 mm

ϵ_m = 0.001525

W = 0.27 mm

< 0.30

OK

App. B.2

REINFORCEMENT SUMMARY for WALL

	Type	ϕ mm	Centres mm	As mm ²	Min. As mm ²
VERTICAL EXT. FACE	H	12	200	565	442
VERTICAL INT. FACE	H	16	100	2011	442
TRANSVERSE	H	12	200	565	442

OK

OK

OK

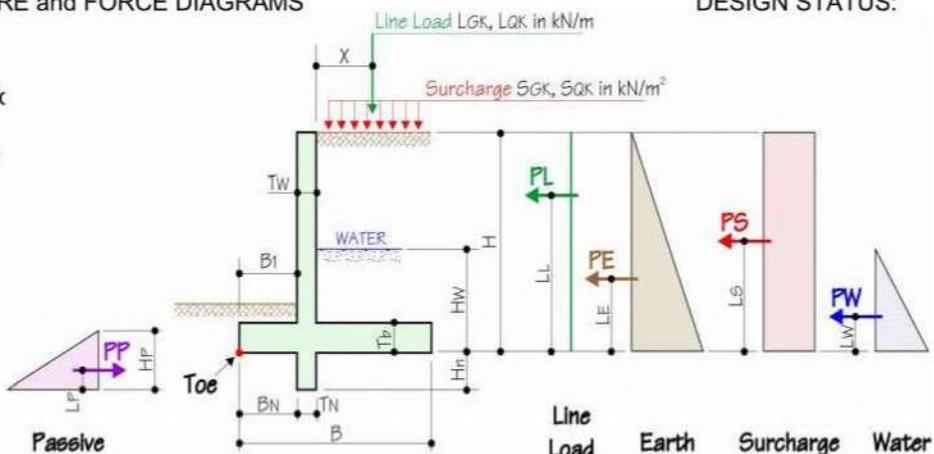
Project	14 Queens Grove	The Concrete Centre
Client	Privat	Made by
Location	Retaining Wall - Party Wall	Date
	RETAINING WALL design to BS 8110:2005	Page
Originated from 'RCC62.xls' v4.0	© 2006 TCC	1
		Checked
		AP
		Revision
		Job No
		18063

IDEALISED STRUCTURE and FORCE DIAGRAMS

DESIGN STATUS: **VALID**

WARNING :

Passive pressure should only be considered if it can be guaranteed that there will be no future excavation in front of the wall.



DIMENSIONS (mm)

H = <u>4750</u>	B = <u>1000</u>	Tw = <u>340</u>
Hw = <u>3750</u>	Bl = <u>660</u>	Tb = <u>350</u>
Hp = <u>0</u>	BN = <u>0</u>	TN = <u>0</u>
Hn = <u>0</u>		

MATERIAL PROPERTIES

fcu = <u>35</u> N/mm ²	steel class <u>A</u>
fy = <u>500</u> N/mm ²	$\gamma_m = \frac{1.5}{1.15}$ concrete
	$\gamma_m = \frac{1.15}{1.5}$ steel
	cover to tension steel = <u>50</u> mm
Max allowable design surface crack width (W) = <u>0.3</u> mm	(0.2 or 0.3 mm only)
Concrete density = <u>24</u> kN/m ³	

SOIL PROPERTIES

Design angle of int'l friction of retained mat'l (ϕ) = <u>24</u> degree
Design cohesion of retained mat'l (C) = <u>0</u> kN/m ²
Density of retained mat'l (q) = <u>20</u> kN/m ³
Submerged Density of retained mat'l (qs) = <u>13.33</u> kN/m ³
Design angle of int'l friction of base mat'l (ϕ_b) = <u>20</u> degree
Design cohesion of base material (Cb) = <u>10</u> kN/m ²
Density of base material (qb) = <u>10</u> kN/m ³
Allowable gross ground bearing pressure (GBP) = <u>125</u> kN/m ²



Wall Geometry

LOADINGS	Surcharge load -- live (SQK) = <u>5</u> kN/m ²
	Surcharge load -- dead (SGK) = <u>0</u>
	Line load -- live (LQK) = <u>24</u> kN/m
	Line load -- dead (LGK) = <u>103</u> kN/m
	Distance of line load from wall (X) = <u>-170</u> mm

(Only granular backfill considered, "C" = zero)

LATERAL FORCES (unfactored)	Ka = <u>0.42</u>	[default ka = $(1-\sin \phi)/(1+\sin \phi)$ 0.42]
	Kp = <u>2.04</u>	[default kp = $(1+\sin \phi_b)/(1-\sin \phi)$ 2.04]
	Kpc = <u>2.86</u>	[default kpc = $2kp^{0.5}$] = <u>2.86</u>
	Kac = <u>1.30</u>	[$2ka^{0.5}$]

[default=2/3*q (only apply when $\phi < 13.33$)

ASSUMPTIONS

- a) Wall friction is zero
- b) Minimum active earth pressure = $0.25qH$
- c) Granular backfill
- d) Does not include check of rotational slide/slope
- e) Does not include effect of seepage of ground water beneath the wall.
- f) Does not include deflection check of wall due to lateral earth pressures
- h) Design not intended for walls over 3.0 m high
- i) Does not include check for temp. or shrinkage

	Force (kN)	Lever arm (m)	Moment about TOE (kNm)	γ_f	F_{ult} (kN)	M_{ult} (kNm)
PE =	75.38	LE = 1.671	125.95	<u>1.20</u>	90.46	151.14
PS(GK) =	0.00	LS = 2.38	0.00	<u>1.40</u>	0.00	0.00
PS(QK) =	10.02	LS = 2.38	23.79	<u>1.60</u>	16.03	38.06
PL(GK) =	0.00	LL = 4.89	0.00	<u>1.40</u>	0.00	0.00
PL(QK) =	0.00	LL = 4.89	0.00	<u>1.60</u>	0.00	0.00
PW =	70.31	LW = 1.25	87.89	<u>1.20</u>	84.38	105.47
Total	155.71		237.63		190.86	294.67
PP =	0.00	(LP-HN) = 0.00	0.00	<u>1.00</u>	0.00	0.00

Project	14 Queens Grove						The Concrete Centre
Client	Privat	Made by AS	Date 09-Aug-2018	Page 2			
Location	Retaining Wall - Party Wall				Checked AP	Revision -	Job No 18063
	RETAINING WALL design to BS 8110:2005						
	Originated from 'RCC62.xls' v4.0			© 2006 TCC			

STRUCTURAL DESIGNS (ultimate)

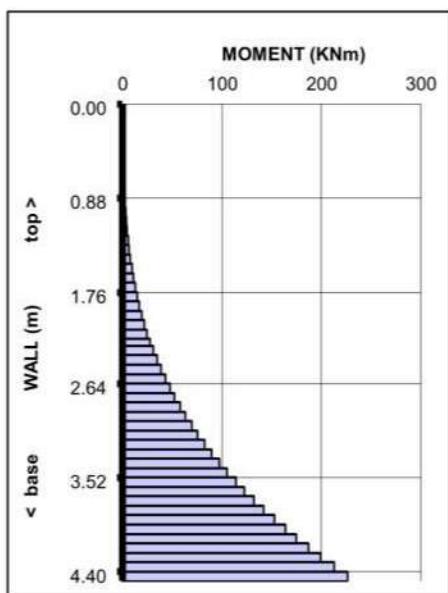
DESIGN CHECKS : OK

WALL (per metre length)

	Force (kN)	Lever arm (m)	Moment (kNm)	γ_f	V ult (kN)	M ult (kNm)
EARTH	65.40	1.55	101.33	1.2	78.48	121.60
SURCHARGE(GK)	0.00	2.20	0.00	1.4	0.00	0.00
SURCHARGE(QK)	9.28	2.20	20.41	1.6	14.84	32.66
LINE LOAD(GK)	0.00	4.54	0.00	1.4	0.00	0.00
LINE LOAD(QK)	0.00	4.54	0.00	1.6	0.00	0.00
WATER	57.80	1.13	65.51	1.2	69.36	78.61
Total	132.47		187.25		162.68	232.86

BS8110

reference



MAIN REINFORCEMENT :

Min. As = 442 mm²

Table 3.25

ϕ = 20 mm

centres = 100 mm

< 215

OK

3.12.11.2.7(b)

Asprov = 3142 mm²

> 442

OK

MOMENT of RESISTANCE :

d = 280 mm

3.4.4.4

z = 236.31 mm

As' = 0 mm²

Mres = 322.78 kNm

> 232.86

OK

SHEAR RESISTANCE:

100 As/bd = 1.12%

Table 3.8

vc = 0.80 N/mm²

Vres = 224.89 kN

> 162.68

OK

3.5.5.2

Ultimate Bending Moment Diagram

CHECK CRACK WIDTH TO BS8110/BS800
(temperature and shrinkage effects not included)

X = 122.19 mm

BS8007

Acr = 68.10 mm

ε_m = 0.00156

W = 0.27 mm

< 0.30

OK

App. B.2

REINFORCEMENT SUMMARY for WALL

	Type	ϕ mm	Centres mm	As mm ²	Min. As mm ²
VERTICAL EXT. FACE	H	12	200	565	442
VERTICAL INT. FACE	H	20	100	3142	442
TRANSVERSE	H	12	200	565	442

OK

OK

OK