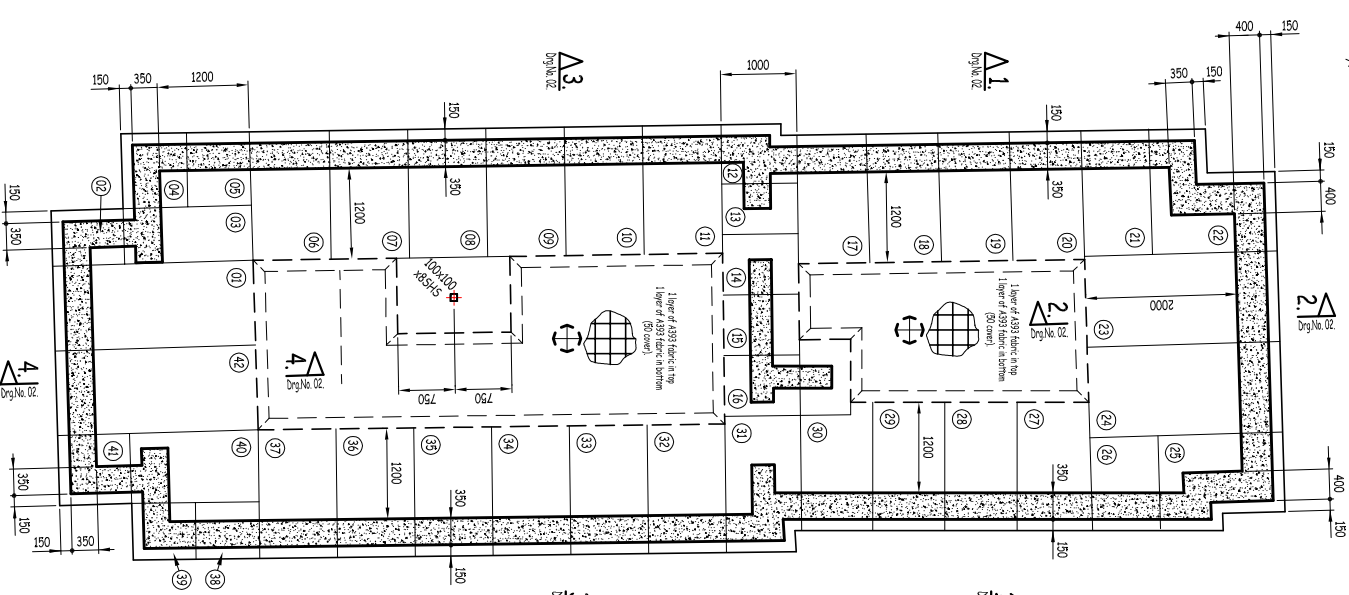


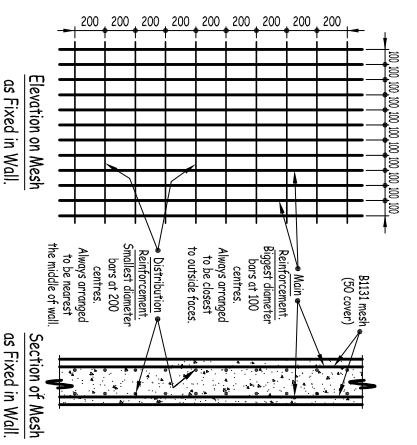
APPENDIX 1

STRUCTURAL DRAWINGS



Proposed Basement Plan Showing.
Proposed Underpinning Plan.
(Scale 1:50 of A1)

Tension Lap Lengths for Reinforcement
10mm ϕ = 450mm,
12mm ϕ = 540mm,
16mm ϕ = 720mm,
20mm ϕ = 950mm.



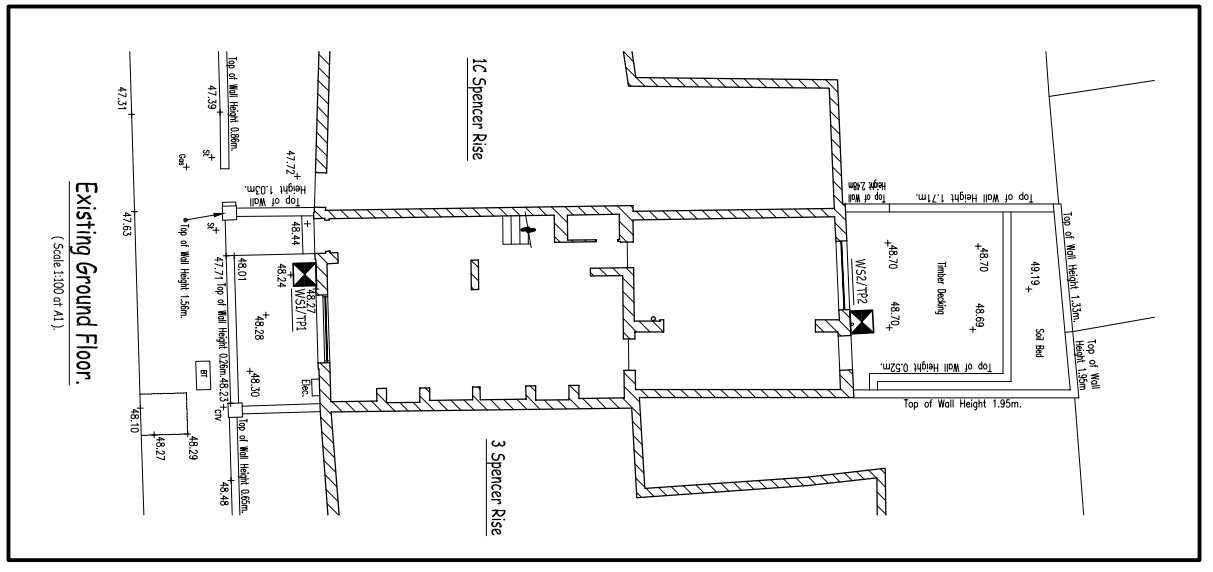
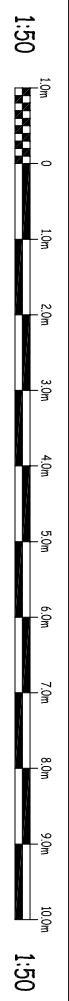
Orientation of Structural Mesh, (Prefix 'B'), in Wall.

The Contractor shall be responsible for the stability of the existing structure on the site, as well as the adjoining sites. All temporary works shall be the responsibility of the Main Contractor.

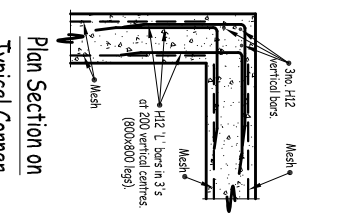
Underpinning Notes

- U1. The underpin underpinning is for identification purposes only.
- U2. The sequence of underpinning should follow the traditional 1, 4, 2, 5, 3 pattern. The Contractor is to provide drawings to show their proposed sequence for the Engineer to approve, a minimum of 14 days before work is commenced.
- U3. Underpinning to be a maximum length of 1200mm, subject to the Engineer's approval.
- U4. Provide corner bars in underpinning stems, to ensure mesh reinforcement is held in place, during concreting.
- U5. All reinforced concrete cast on the ground shall be placed on 50mm, GBN 1 concrete mix.
- U6. Foundations have been designed to impose a net bearing pressure of 100kN/m² on all dry fill. All dry fill should be approved by the Engineer. The bearing strength should be approved by the Engineer. Any additional excavation shall be replaced with a GBN 1 concrete mix. Bar in the event of extensive additional excavation being required. The Engineer must be immediately and fresh instructions obtained.
- U7. Concrete mix for foundations shall be a RC35/45 mix with a minimum Ordinary Portland cement content of 320kg/m³ and a maximum water/cement ratio of 0.50. Concrete shall cure for at least 48 hours before dry packing.
- U8. Concrete cover to the reinforcement shall be as detailed on the drawings but never less than 35mm.
- U9. The minimum depth of the underpinning, (measured from the underside of the existing footing, to the underside of the new) shall be 300mm and shall be of 100kN/m² or below dry.
- U10. The underside of the existing wall or foundation shall be trimmed and cleared of all mud and debris before dry packing. The trim pack shall be a 1:3 mix and well compacted in several layers, not exceeding 75mm thick. Dry packing shall be left 24 hours before works are commenced on adjacent underpin.
- U11. The central area of excavation shall not be carried out until the perimeter underpinning has been completed.
- U12. If necessary backfilling behind retaining walls shall be a 1:2:1 mix, using Ordinary Portland Cement.
- U13. Services. The Contractor is to carry out a survey of the property and adjacent areas to establish the location of obstructions, such as service pipes or drains. Any obstructions found are to be brought to the attention of the Architect and Engineer. The Contractor is to allow for any temporary support to the services or obstructions during the underpinning.
- U14. Excavations. The excavation shall be to the depth and width shown on the drawings. However where trees roots are encountered, new underpins are to extend 600mm below the last trace of any root activity. The sides of the excavation, shall be adequately shored and propped to prevent subsidence or slip of the soil faces behind the pin end of foundation level shall be underfooted.

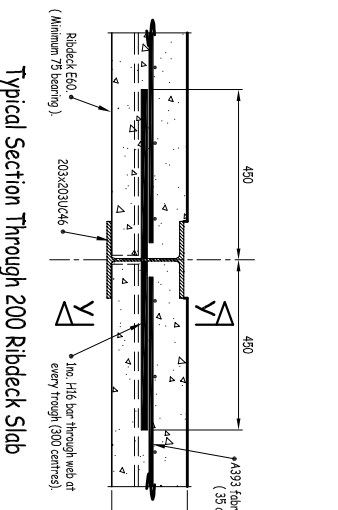
Reinforcement Note
Wall and Foundation reinforcement shall be continuous. If the area of loose bars shall be less than the area of reinforcement specified. Laps shall be not less than 45 times the lesser bar diameter.



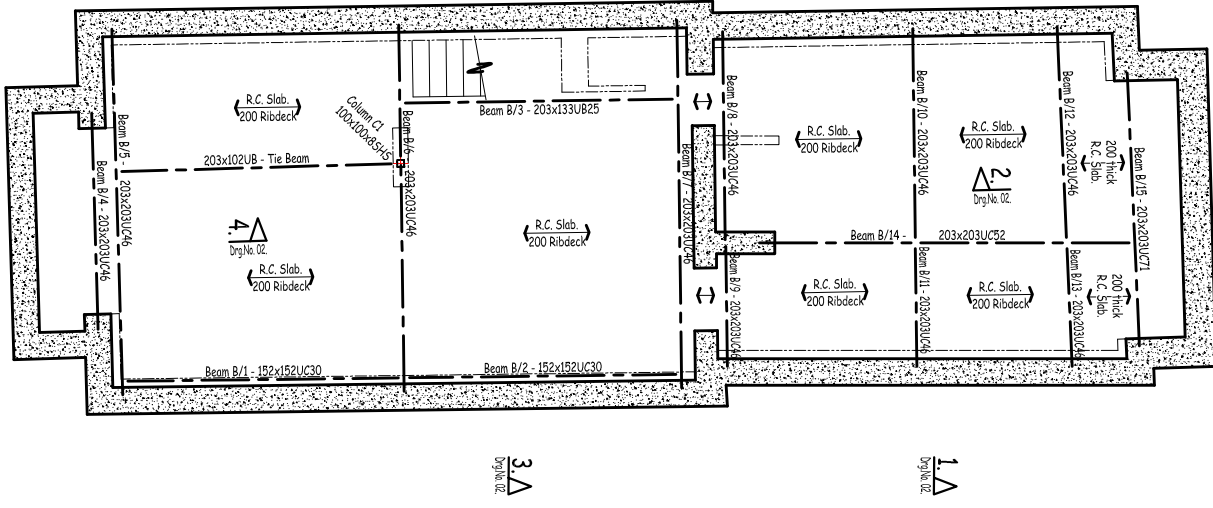
Proposed Basement Plan Showing.
Ground Floor Structure.
(Scale 1:50 of A1)



Part Elevation on Wall Showing Lacing Reinforcement Between Pins.



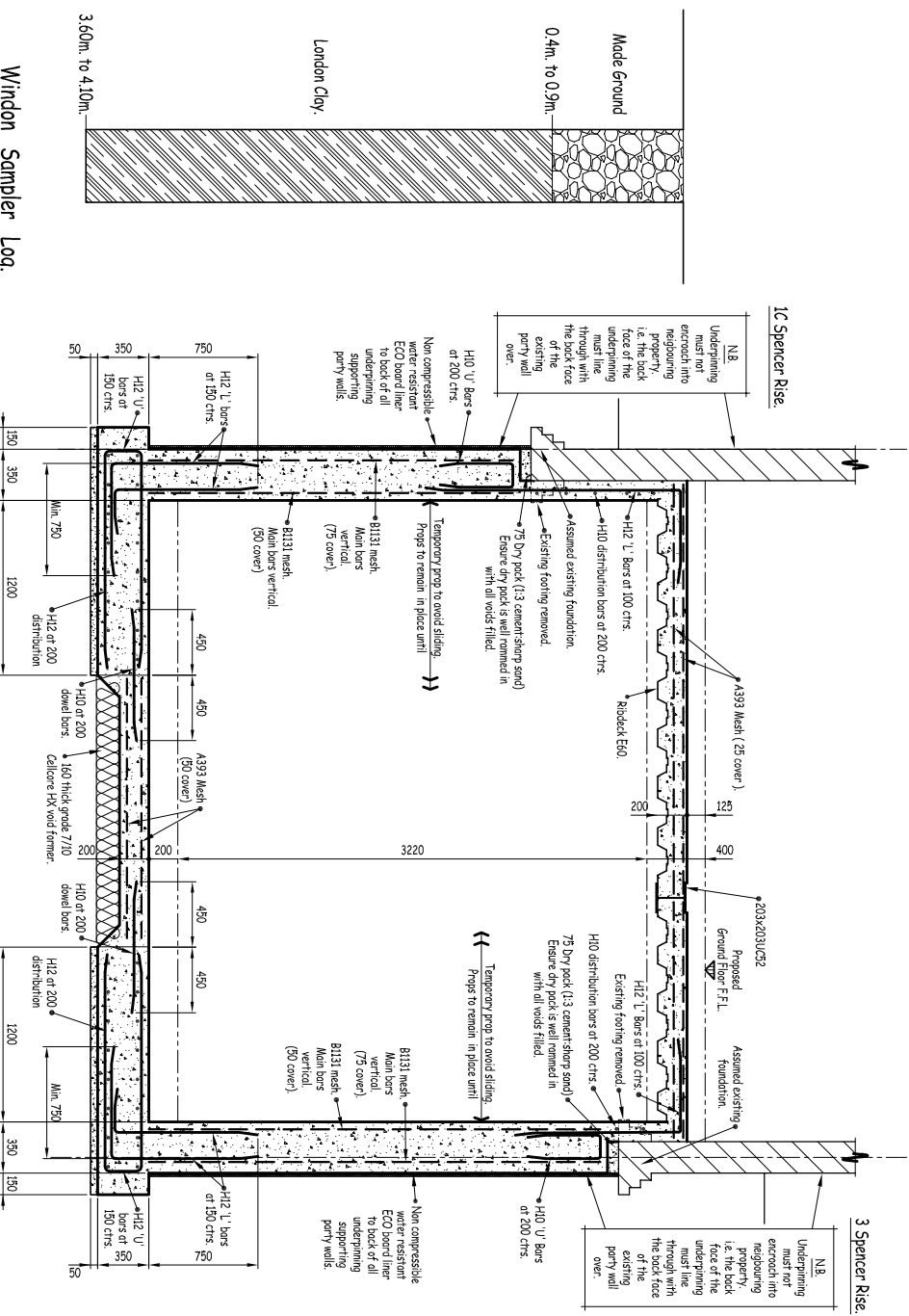
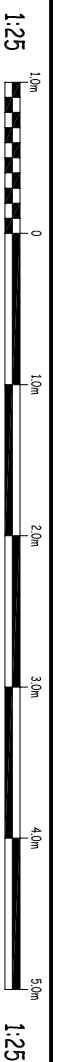
Typical Section Through 200 Ribdeck Slab at 203x203UC46
(Scale 1:100)



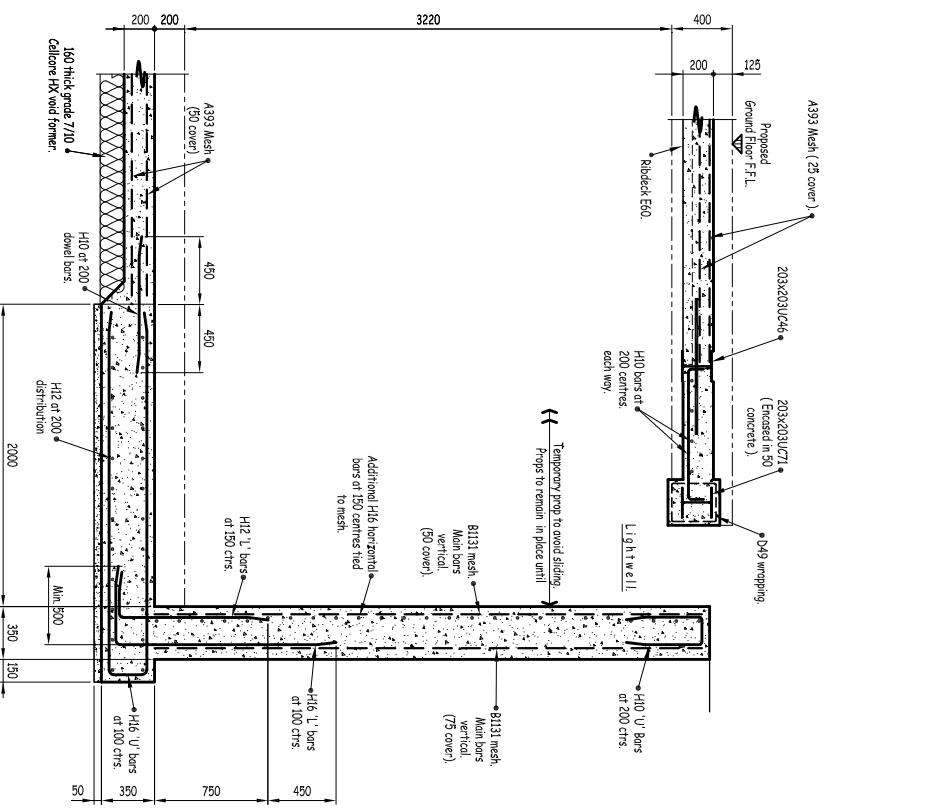
Notes
1. This drawing remains the copyright of Vincent and Rymill and is not to be copied, altered or changed without permission.
2. All dimensions are in millimetres unless otherwise noted.
3. Do not scale off this drawing.
Structural Steelwork Notes
1. Generally all structural steel shall be grade S355 and shall be in accordance with the National Specification for Structural Steelwork in all necessary respects.
2. Steelwork connections shall comply with the relevant British Standard for all other members. Design where otherwise specified on this drawing. Where connection nodes are provided by the Engineer, the Contractor shall design connections, which will be subject to approval by the Engineer.
3. Steel beam size of steel shall have the minimum bearings or moment joints as shown on the drawings. All steelwork shall be designed to the minimum bearing or moment joints as shown on the drawings. All steelwork shall be designed to the minimum bearing or moment joints as shown on the drawings.
4. Steel columns shall be made from normal 25mm thickness of steel. The column baseplates and foundation/masonry supports. Ground shall take the form of neat concrete slurry with no shrink additive and should be just fluid enough to pour.
5. All structural steelwork shall be blast cleaned to S 5.7079 Part A1 preparation grade SA 4.5 and except where specified as galvanised, shall be primed with a suitable good quality high build epoxy zinc phosphate primer. To provide a dry film thickness of not less than 75 microns. A fire retardation primer may be used at the Contractor's discretion. The Contractor shall ensure that the primer used is compatible with subsequent coatings specified by others (e.g. intumescent paint).
6. Steelwork specified as galvanised shall be blast cleaned as above and hot dip galvanised to BS 5729 Minimum coating thickness 85 microns.
7. All steelwork below d.p.c. level or built within the masonry wall cavity, shall be site primed with a compatible high build epoxy zinc phosphate primer, to provide a dry film thickness of not less than 125 microns, to achieve an overall primer coating of 200 microns, i.e. 2 layers of epoxy zinc phosphate primer. The primer shall be applied to the steelwork below d.p.c. level and shall be enclosed in a non-breathable 100mm of concrete, or masonry, then specified on the drawings.
8. Structural steelwork to be connected with the Main Contractor to provide adequate bracing during the sequence of erection.
9. The protection to steel by Architect details.
Concrete
1. Generally all structural concrete works to be in accordance with the National Specification for Concrete in all necessary aspects.
2. Concrete mix for foundations shall be a RC35/45 mix with a minimum Ordinary Portland cement content of 320kg/m³ and a maximum water/cement ratio of 0.50.
3. All concrete below ground level (cobbles walls and foundations) to be designed for a design sulphate class of S5-1.
4. Under no circumstances is concrete to be poured, if expected temperature within the following 24 hour period is expected to be 5°C or less.
5. No admixtures of any form, to be added to the concrete, without the written permission of the Structural Engineer. It is STRICTLY forbidden to add water to premixed concrete on site.
6. Site batching of concrete to be approved by the Engineer before its use.
Structural Masonry Notes
1. Refer to Architect's drawings and the specification for masonry requirements, in respect of acoustic, thermal insulation and durability requirements. The Engineer shall be notified immediately if conflicts with the structural requirements.
2. Blockwork below ground level to have a minimum compressive strength of 7.3N/mm² and to be set in 1:3 cement-sand mortar. All blockwork to be solid, unless specified otherwise on the drawings and is to comply with BS 5628 Table 4 Requirements for Special Category Manufacture.
3. Blockwork below ground to have a minimum compressive strength of 30N/mm² and is to comply with BS 5628 Requirements for Special Category of Manufacture.
4. Mortar designation as follows: - Above d.p.c. Mortar Designation III Below d.p.c. Mortar Designation II
5. Refer to the Architect's drawings for details of d.p.c., d.p.m., waterproofing and insulation.
6. Linings
1. Refer to Architect's drawings and the specification for masonry requirements, in respect of acoustic, thermal insulation and durability requirements. The Engineer shall be notified immediately if conflicts with the structural requirements.
2. Blockwork below ground level to have a minimum compressive strength of 7.3N/mm² and to be set in 1:3 cement-sand mortar. All blockwork to be solid, unless specified otherwise on the drawings and is to comply with BS 5628 Table 4 Requirements for Special Category Manufacture.
3. Blockwork below ground to have a minimum compressive strength of 30N/mm² and is to comply with BS 5628 Requirements for Special Category of Manufacture.
4. Mortar designation as follows: - Above d.p.c. Mortar Designation III Below d.p.c. Mortar Designation II
5. Refer to the Architect's drawings for details of d.p.c., d.p.m., waterproofing and insulation.

Rev	Details	Date

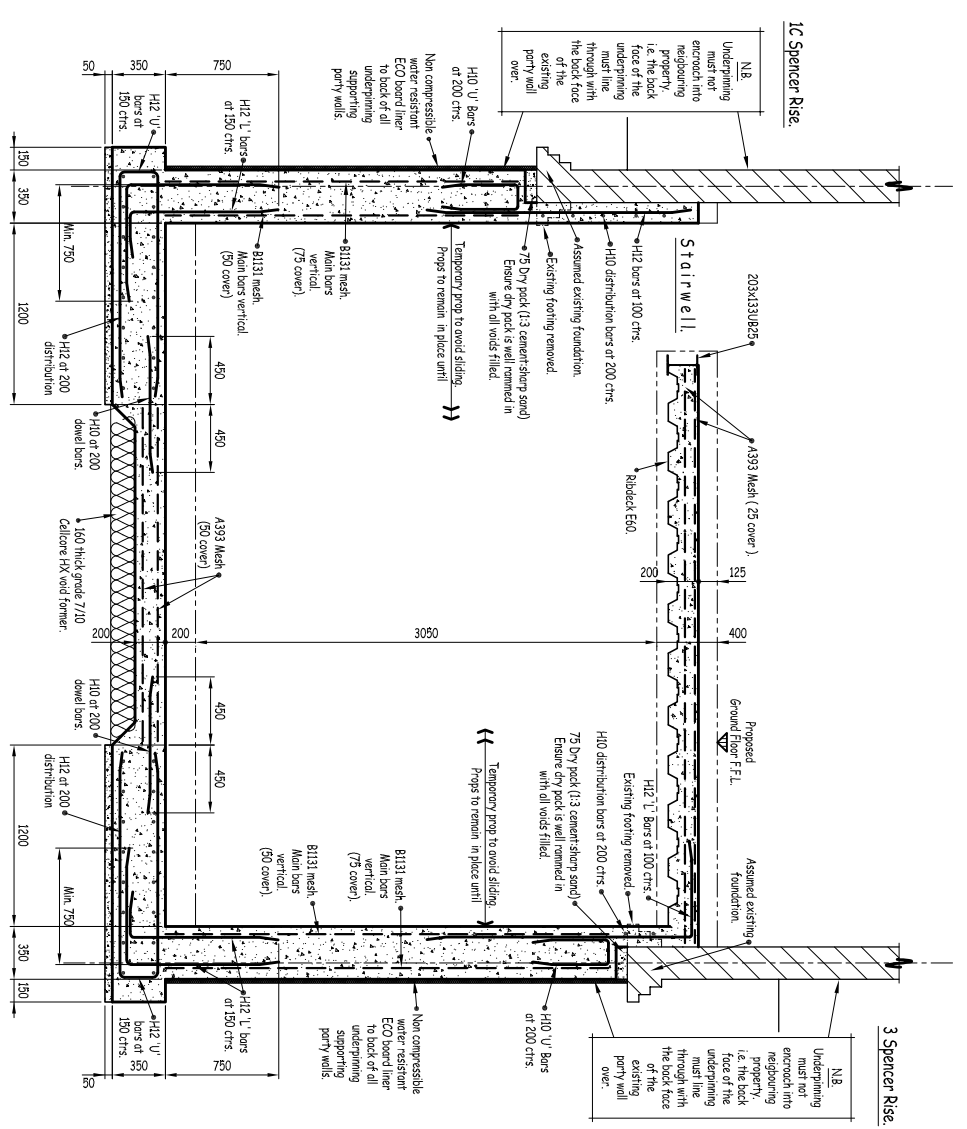
	Consulting Civil & Structural Engineers Lakeside Country Club, Whatat Road, Fimley Green, Camberley, Surrey GU16 6PT Telephone: 01252 834 242 Fax: 01252 838 888 mailto:info@vincentrymill.co.uk			
1 Spencer Rise, Camden, London NW5 1AR				
Basement Plans Showing Underpinning and Ground Floor Structure				
Scale of A1 1:50 1:100 1:25 1:10	Date March 2018	Job No 18B06	Dwg No 01	Rev



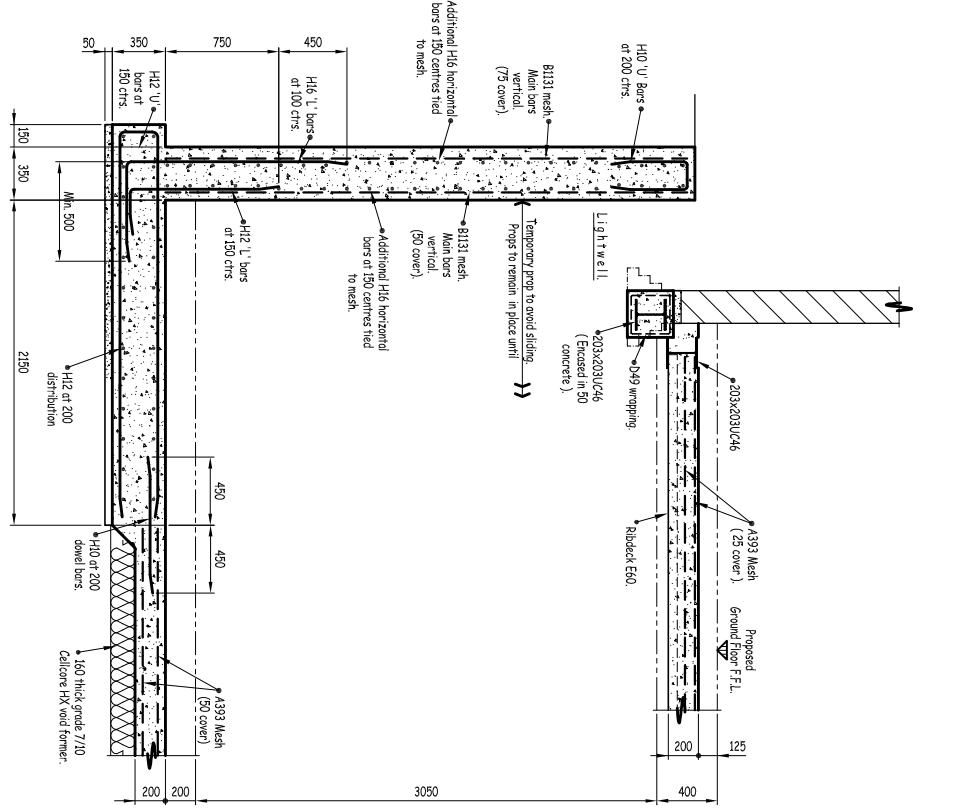
Section 1-1
(Scale 1:25 at A1)



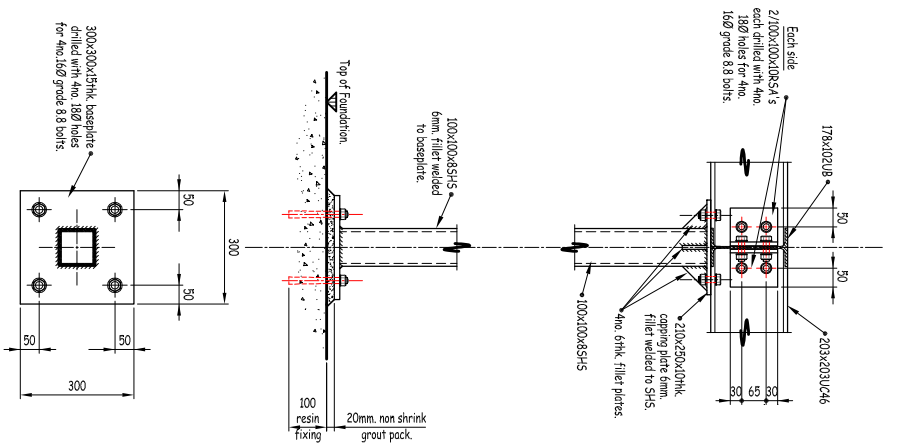
Section 2-2
(Scale 1:25 at A1)



Section 3-3
(Scale 1:25 at A1)



Section 4-4
(Scale 1:25 at A1)



Internal Column
and Capping Plate.
(Scale 1:10 at A1)

Notes
1. For notes see drawing number 18906 / 01.

Scale at A1	Date	Job No	Draw No	Rev
1:25 1:10	March 2018	18806	02	

V & R VINCENT & RYMILL
 Consulting Civil & Structural Engineers
 Lakeside Country Club,
 What Road, Fimley Green,
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 info@vincentrymill.co.uk

**1 Spencer Rise,
Camden,
London NW5 1AR**

Basement and Ground Floor Sections

APPENDIX 2

STRUCTURAL CALCULATIONS



VINCENT & RYMILL
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FRIMLEY GREEN
SURREY

Project				Job Ref.	
1 SPENCER RISE LONDON NW5 1AR				18B06	
Section				Sheet no./rev.	
NEW BASEMENT STRUCTURE				1	
Calc. by	Date	Chk'd by	Date	App'd by	Date
TV	23/03/2018				

PITCHED ROOF**KN/m²**

Tiles	0.70
Felt & battens	0.05
Rafters	<u>0.10</u>
	<u>0.85</u>
30° on plan load D. L.	1.00 KN/m ²
30° Imposed Load	<u>0.75</u> KN/m ²
	1.75 KN/m ²

CEILING**KN/m²**

Ceiling Joists	0.10
Plasterboard	<u>0.15</u>
D. L.	0.25 KN/m ²
I. L. where applicable	<u>0.25</u> KN/m ²
	0.50 KN/m ²

FLAT ROOF**KN/m²**

Felt	0.25
Boards	0.25
Joists & firrings	0.15
Ceiling	<u>0.15</u>
D. L.	0.80 KN/m ²
I. L.	<u>0.75</u> KN/m ²
	1.55 KN/m ²

TIMBER FLOORS**KN/m²**

Boards	0.20
Joists	0.10
Ceiling	<u>0.20</u>
D. L.	0.50 KN/m ²
I. L.	<u>1.50</u> KN/m ²
	2.00 KN/m ²

200 RIBDECK**KN/m²**

Finish	2.00		
Self Weight	<u>4.10</u>	200 SLAB	4.80KN/m ²
D. L.	6.10 KN/m ²		
I. L.	<u>1.50</u> KN/m ²		
	5.50 KN/m ²		

MASONRY**KN/m²**

102 Brick + PLASTER	2.40 KN/m ²
215 BRICK + PLASTER	4.60 KN/m ²



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FRIMLEY GREEN
SURREY

Project 1 SPENCER RISE LONDON NW5 1AR				Job Ref. 18B06	
Section NEW BASEMENT STRUCTURE				Sheet no./rev. 2	
Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date

GROUND FLOOR

BEAM B1 AND B2

SPAN = 3.60 m

CHIMNEY BREAST UDL 1.15 TO 2.45m

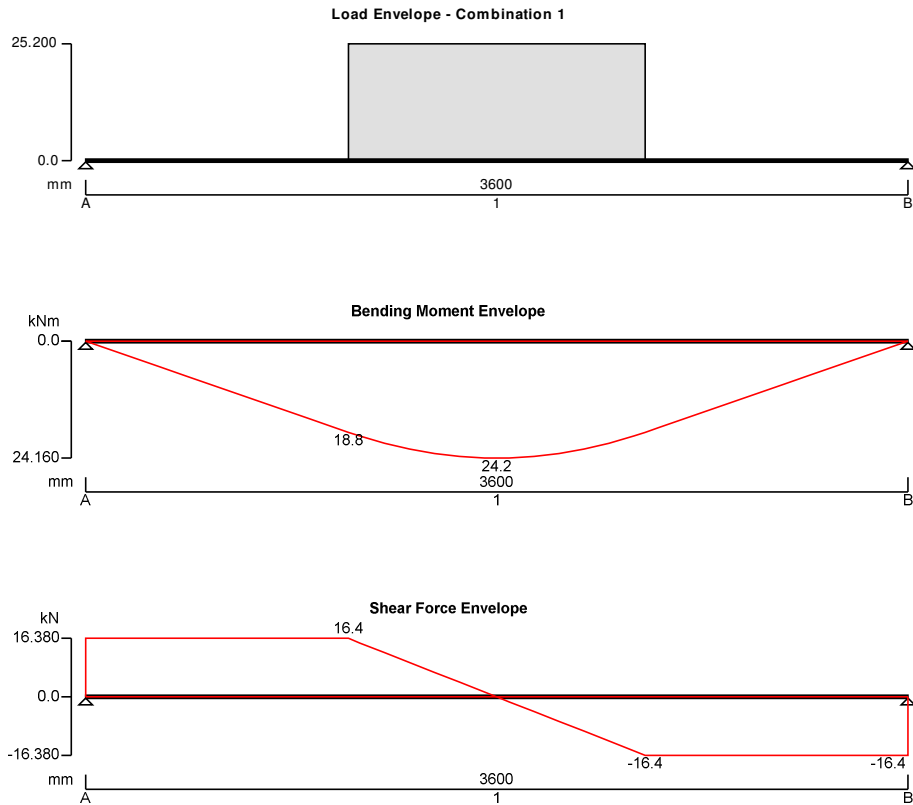
DL = 6 X 2.4 X 1.25 = 18KN/m

STEEL BEAM ANALYSIS & DESIGN (BS5950)

STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.05



Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads Dead partial UDL 18 kN/m from 1150 mm to 2450 mm

Load combinations

Load combination 1 Support A Dead x 1.40



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SURREY

Project 1 SPENCER RISE LONDON NW5 1AR				Job Ref. 18B06	
Section NEW BASEMENT STRUCTURE				Sheet no./rev. 3	
Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date

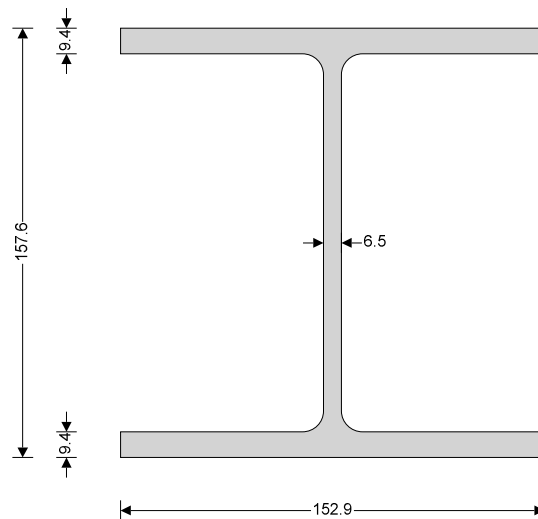
Span 1	Imposed × 1.60
	Dead × 1.40
Support B	Imposed × 1.60
	Dead × 1.40
	Imposed × 1.60

Analysis results

Maximum moment	$M_{max} = 24.2$ kNm	$M_{min} = 0$ kNm
Maximum shear	$V_{max} = 16.4$ kN	$V_{min} = -16.4$ kN
Deflection	$\delta_{max} = 0$ mm	$\delta_{min} = 0$ mm
Maximum reaction at support A	$R_{A_max} = 16.4$ kN	$R_{A_min} = 16.4$ kN
Unfactored dead load reaction at support A	$R_{A_Dead} = 11.7$ kN	
Maximum reaction at support B	$R_{B_max} = 16.4$ kN	$R_{B_min} = 16.4$ kN
Unfactored dead load reaction at support B	$R_{B_Dead} = 11.7$ kN	

Section details

Section type **UC 152x152x30 (BS4-1)** Steel grade **S275**



Classification of cross sections - Section 3.5

Tensile strain coefficient $\epsilon = 1.00$ Section classification **Plastic**

Shear capacity - Section 4.2.3

Design shear force $F_v = 16.4$ kN Design shear resistance $P_v = 169$ kN
PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment $M = 24.2$ kNm Moment capacity low shear $M_c = 68.1$ kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment $M_b = 51.5$ kNm $M_b / m_{LT} = 58.3$ kNm
PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads
Limiting deflection $\delta_{lim} = 10$ mm Maximum deflection $\delta = 0$ mm
PASS - Maximum deflection does not exceed deflection limit



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FRIMLEY GREEN
SURREY

Project 1 SPENCER RISE LONDON NW5 1AR				Job Ref. 18B06	
Section NEW BASEMENT STRUCTURE				Sheet no./rev. 4	
Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date

USE 152 X 152 X 30 UC

BEAM B3

SPAN = 3.60m

BY INSPECTION CARRYS SMALL AREA OF TIMBER STAIR LANDING – USE 203 X 133 X 25 UB TO SUIT DEPTH OF 200 RIBDECK FLOOR

BEAM B4

SPAN = 2.60 m

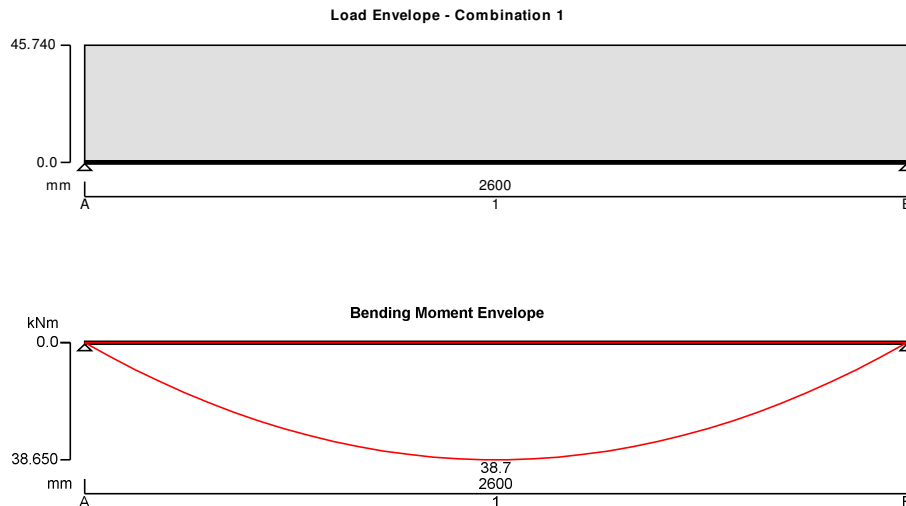
ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=		1.50
1 ST & 2 ND FLR DL	2 X 0.5 X 2	=	2.00	
1 ST & 2 ND FLR IL	2 X 1.5 X 2	=		6.00
WALL	5 X 4.6 X 0.85	=	19.60	
CEILING	2 X 0.25	=	0.50	
			24.10 KN/m	7.50KN/m

STEEL BEAM ANALYSIS & DESIGN (BS5950)

STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

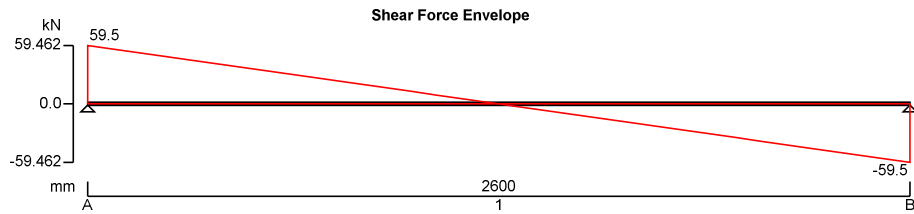
TEDDS calculation version 3.0.05





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FRIMLEY GREEN
SURREY

Project 1 SPENCER RISE LONDON NW5 1AR				Job Ref. 18B06	
Section NEW BASEMENT STRUCTURE				Sheet no./rev. 5	
Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date



Support conditions

Support A	Vertically restrained Rotationally free
Support B	Vertically restrained Rotationally free

Applied loading

Beam loads	Dead full UDL 24.1 kN/m Imposed full UDL 7.5 kN/m
------------	--

Load combinations

Load combination 1	Support A	Dead × 1.40 Imposed × 1.60
	Span 1	Dead × 1.40 Imposed × 1.60
	Support B	Dead × 1.40 Imposed × 1.60

Analysis results

Maximum moment	$M_{max} = 38.7$ kNm	$M_{min} = 0$ kNm
Maximum shear	$V_{max} = 59.5$ kN	$V_{min} = -59.5$ kN
Deflection	$\delta_{max} = 0.5$ mm	$\delta_{min} = 0$ mm
Maximum reaction at support A	$R_{A_max} = 59.5$ kN	$R_{A_min} = 59.5$ kN
Unfactored dead load reaction at support A	$R_{A_Dead} = 31.3$ kN	
Unfactored imposed load reaction at support A	$R_{A_Imposed} = 9.8$ kN	
Maximum reaction at support B	$R_{B_max} = 59.5$ kN	$R_{B_min} = 59.5$ kN
Unfactored dead load reaction at support B	$R_{B_Dead} = 31.3$ kN	
Unfactored imposed load reaction at support B	$R_{B_Imposed} = 9.7$ kN	

Section details

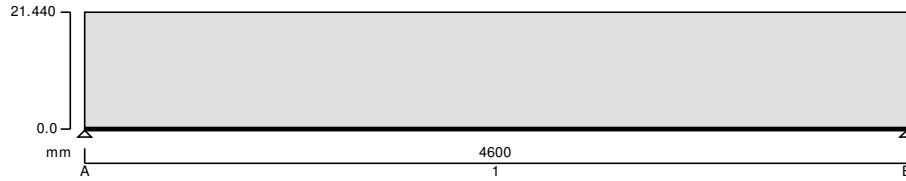
Section type	UC 203x203x46 (BS4-1)	Steel grade	S275
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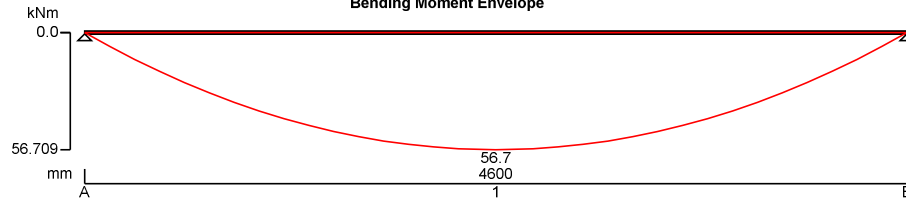
VINCENT & RYMILL
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FRIMLEY GREEN
SURREY

Project		1 SPENCER RISE LONDON NW5 1AR		Job Ref.		18B06	
Section				NEW BASEMENT STRUCTURE			
Sheet no./rev.		7		App'd by		Date	
Calc. by	Date	Chk'd by	Date	App'd by	Date	App'd by	Date
TV	23/03/2018						

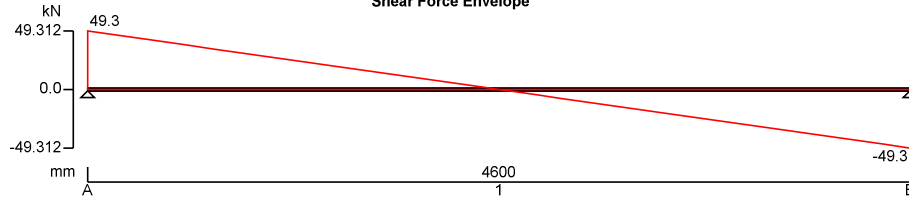
Load Envelope - Combination 1



Bending Moment Envelope



Shear Force Envelope



Support conditions

Support A	Vertically restrained Rotationally free
Support B	Vertically restrained Rotationally free

Applied loading

Beam loads	Dead full UDL 12 kN/m Imposed full UDL 2.9 kN/m
------------	--

Load combinations

Load combination 1	Support A	Dead × 1.40 Imposed × 1.60
	Span 1	Dead × 1.40 Imposed × 1.60
	Support B	Dead × 1.40 Imposed × 1.60

Analysis results

Maximum moment	$M_{max} = 56.7$ kNm	$M_{min} = 0$ kNm
Maximum shear	$V_{max} = 49.3$ kN	$V_{min} = -49.3$ kN
Deflection	$\delta_{max} = 1.8$ mm	$\delta_{min} = 0$ mm
Maximum reaction at support A	$R_{A_max} = 49.3$ kN	$R_{A_min} = 49.3$ kN
Unfactored dead load reaction at support A	$R_{A_Dead} = 27.6$ kN	
Unfactored imposed load reaction at support A	$R_{A_Imposed} = 6.7$ kN	



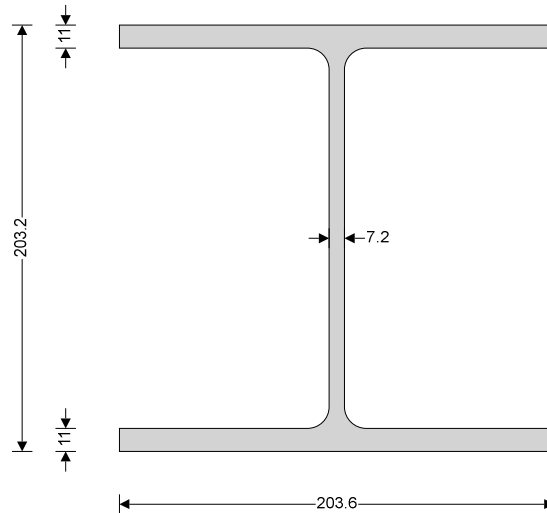
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SURREY

Project 1 SPENCER RISE LONDON NW5 1AR				Job Ref. 18B06	
Section NEW BASEMENT STRUCTURE				Sheet no./rev. 8	
Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date

Maximum reaction at support B $R_{B_max} = 49.3$ kN $R_{B_min} = 49.3$ kN
 Unfactored dead load reaction at support B $R_{B_Dead} = 27.6$ kN
 Unfactored imposed load reaction at support B $R_{B_Imposed} = 6.7$ kN

Section details

Section type **UC 203x203x46 (BS4-1)** Steel grade **S275**



Classification of cross sections - Section 3.5

Tensile strain coefficient $\epsilon = 1.00$ Section classification **Compact**

Shear capacity - Section 4.2.3

Design shear force $F_v = 49.3$ kN Design shear resistance $P_v = 241.4$ kN
PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment $M = 56.7$ kNm Moment capacity low shear $M_c = 136.8$ kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment $M_b = 103.9$ kNm $M_b / m_{LT} = 112.3$ kNm
PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection $\delta_{lim} = 12.778$ mm Maximum deflection $\delta = 1.806$ mm
PASS - Maximum deflection does not exceed deflection limit

USE 203 X 203 X 46 UC BEARINGS ONTO CONCRETE WALL



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FRIMLEY GREEN
SURREY

Project 1 SPENCER RISE LONDON NW5 1AR				Job Ref. 18B06	
Section NEW BASEMENT STRUCTURE				Sheet no./rev. 9	
Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date

BEAM B6

MAX SPAM = 3.00m

UDL

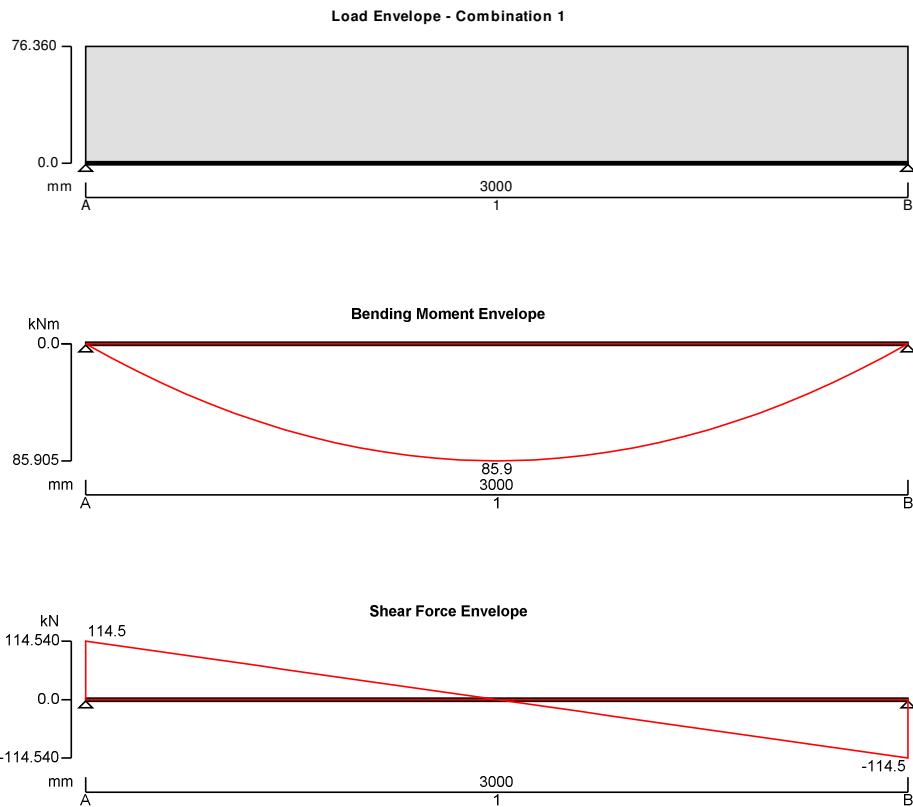
STUD	2.5 X 0.6	=	1.50	
100 BRICK	2.5 X 2.6	=	6.50	
FLOORS DL	3.8 X 0.5 X 2	=	3.80	
FLOORS IL	3.8 X 1.5 X 2	=	11.40	
RIB DECK DL	3.8 X 6.1	=	23.20	
GRD FLR IL	3.8 X 1.5	=	<u>5.70</u>	
			35.00KN/m	17.1KN/m

STEEL BEAM ANALYSIS & DESIGN (BS5950)

STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.05



Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free



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Applied loading

Beam loads
Dead full UDL 35 kN/m
Imposed full UDL 17.1 kN/m

Load combinations

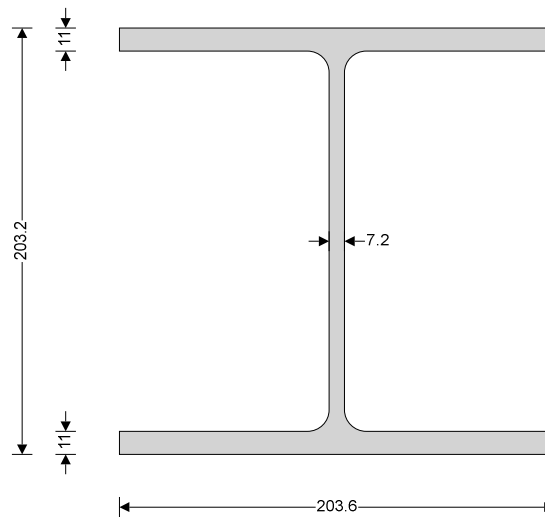
Load combination 1	Support A	Dead × 1.40 Imposed × 1.60
	Span 1	Dead × 1.40 Imposed × 1.60
	Support B	Dead × 1.40 Imposed × 1.60

Analysis results

Maximum moment	$M_{max} = 85.9$ kNm	$M_{min} = 0$ kNm
Maximum shear	$V_{max} = 114.5$ kN	$V_{min} = -114.5$ kN
Deflection	$\delta_{max} = 1.9$ mm	$\delta_{min} = 0$ mm
Maximum reaction at support A	$R_{A_{max}} = 114.5$ kN	$R_{A_{min}} = 114.5$ kN
Unfactored dead load reaction at support A	$R_{A_{Dead}} = 52.5$ kN	
Unfactored imposed load reaction at support A	$R_{A_{Imposed}} = 25.7$ kN	
Maximum reaction at support B	$R_{B_{max}} = 114.5$ kN	$R_{B_{min}} = 114.5$ kN
Unfactored dead load reaction at support B	$R_{B_{Dead}} = 52.5$ kN	
Unfactored imposed load reaction at support B	$R_{B_{Imposed}} = 25.7$ kN	

Section details

Section type UC 203x203x46 (BS4-1) Steel grade S275



Classification of cross sections - Section 3.5


Tensile strain coefficient $\epsilon = 1.00$ Section classification **Compact**

Shear capacity - Section 4.2.3

Design shear force $F_v = 114.5$ kN Design shear resistance $P_v = 241.4$ kN
PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment $M = 85.9$ kNm Moment capacity low shear $M_c = 136.8$ kNm
PASS - Moment capacity exceeds design bending moment

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Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection $\delta_{lim} = 8.333$ mm

Maximum deflection $\delta = 1.926$ mm

PASS - Maximum deflection does not exceed deflection limit

USE 203 X 203 X 46 UC BEARINGS DOWN ONTO CONCRETE WALLS.

POST

Utl load = 176KN

BM DUE TO ECC = 45.8 X 0.1 = 5KN.m

STEEL MEMBER DESIGN (BS5950)

STEEL MEMBER DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.05

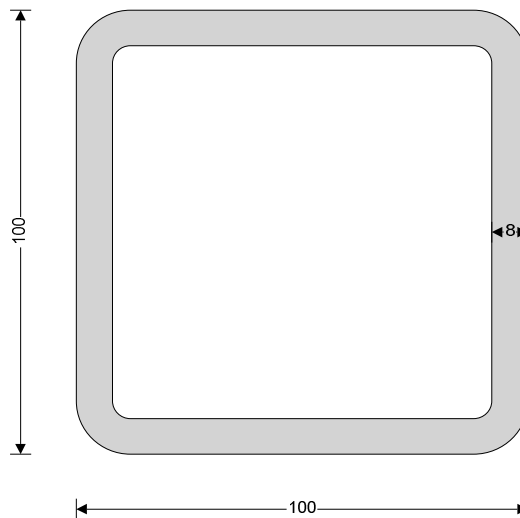
Section details

Section type

SHS 100x100x8.0 (Tata Steel Celsius)

Steel grade

S275



Classification of cross sections - Section 3.5

Tensile strain coefficient $\epsilon = 1.00$

Section classification

Semi-compact

Moment capacity - Section 4.2.5

Design bending moment $M = 5$ kNm

Moment capacity low shear

$M_c = 26.4$ kNm

Buckling resistance moment - Section 4.3.6.4

Bending strength $p_b = 275$ N/mm²

Buckling resistance moment

$M_b = 27$ kNm

PASS - Moment capacity exceeds design bending moment

Compression members - Section 4.7

Design compression force $F_c = 176$ kN

Compression resistance

$P_{cx} = 492.6$ kN

PASS - Compression resistance exceeds design compression force

Design compression force $F_c = 176$ kN

Compression resistance

$P_{cy} = 492.6$ kN



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PASS - Compression resistance exceeds design compression force

Compression members with moments - Section 4.8.3

Comp.and bending check $F_c / (A \times p_y) + M / M_c = 0.412$

PASS - Combined bending and compression check is satisfied

Member buckling resistance - cl.4.8.3.3.3

Buckling resistance checks $F_c / P_{cx} + m_x \times M / M_c \times (1 + 0.5 \times F_c / P_{cx}) = 0.581$

$F_c / P_{cy} + 0.5 \times m_{LT} \times M_{LT} / M_{cx} = 0.452$

PASS - Member buckling resistance checks are satisfied

100 X 100 X 8.0 SHS POST

BEAM B7

BY INSPECTION SIMILAR TO BEAM B5 – USE 203 X 203 X 46 UC

BEAM B8 / B9

SPANS = 2.5 AND 1.5 RESPECTIVELY.

BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK FLOOR

BEAM B10

SPAN = 2.80m

DI = 2.25 x 6.1 = 13.7KN/m

IL = 2.25 X 1.5 = 3.40 KN/m

BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK

RN DL = 19.2 KN, IL = 4.8KN

BEAM B11

SPAN = 1.50m

DI = 2.25 x 6.1 = 13.7KN/m

IL = 2.25 X 1.5 = 3.40 KN/m

BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK

RN DL = 10.3 KN, IL = 2.60KN

BEAM B12


SPAN = 2.80m

DI = 1.40 x 6.45 = 9.00KN/m

IL = 1.40 X 1.5 = 2.10 KN/m

BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK

RN DL = 12.60 KN, IL = 3.00KN

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BEAM B13

SPAN = 1.50m

DI = 1.40 x 6.45 = 9.00KN/m

IL = 1.40 X 1.5 = 2.10 KN/m

BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK

RN DL = 6.80 KN, IL = 1.60KN

BEAM B14

SPAN = 4.80m

UDL AT 1ST FLOOR ASSUMING EXTENSION ABOVE 1ST FLOOR CEILING

ROOF DL	2.4 X 1	=	2.40	
ROOF IL	2.4 X 0.75	=		1.80
CEILING	2.4 X 0.25	=	0.60	
FLR DL	2 X 1.4 X 0.5	=	1.40	
FLR IL	2 X 1.4 X 1.5	=		4.20
WALL	4.2 X 4.6	=	<u>19.30</u>	
			23.70KN/m	6.00KN/m

EX PIER ON OUTER WALL 675 LONG

UDL TO PIER

DL = 2.6 X 23.7 / 0.675 = 91.3KN/m

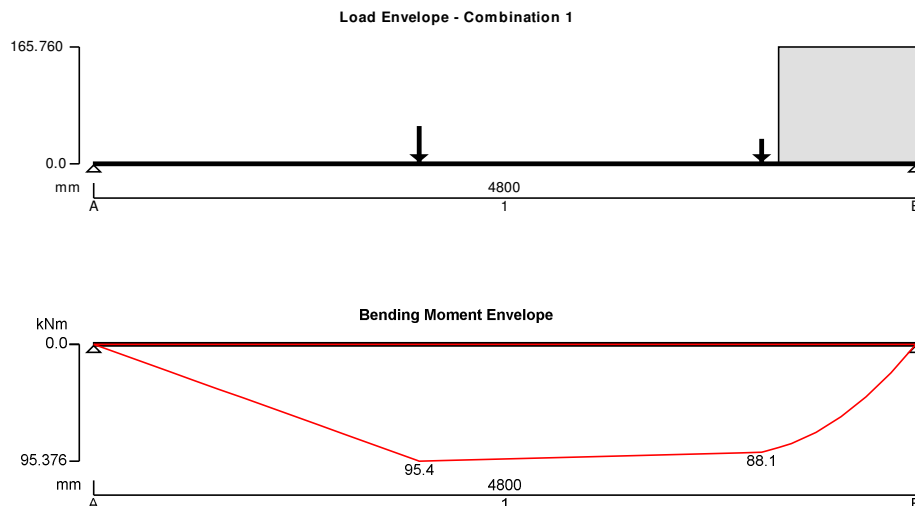
IL = 2.6 X 6 / 0.675 = 23.1KN/m

STEEL BEAM ANALYSIS & DESIGN (BS5950)

STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

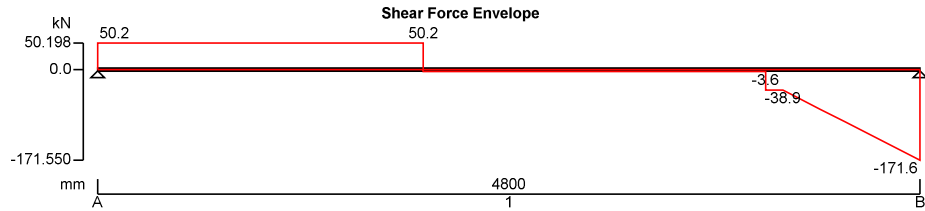
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Support conditions

Support A	Vertically restrained Rotationally free
Support B	Vertically restrained Rotationally free

Applied loading

Beam loads	Dead point load 30 kN at 1900 mm Imposed point load 7.4 kN at 1900 mm Dead point load 19.5 kN at 3900 mm Imposed point load 5 kN at 3900 mm Dead partial UDL 92 kN/m from 4000 mm to 4800 mm Imposed partial UDL 23.1 kN/m from 4000 mm to 4800 mm
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Load combinations

Load combination 1	Support A	Dead \times 1.40 Imposed \times 1.60
	Span 1	Dead \times 1.40 Imposed \times 1.60
	Support B	Dead \times 1.40 Imposed \times 1.60

Analysis results

Maximum moment	$M_{max} = 95.4$ kNm	$M_{min} = 0$ kNm
Maximum shear	$V_{max} = 50.2$ kN	$V_{min} = -171.6$ kN
Deflection	$\delta_{max} = 3$ mm	$\delta_{min} = 0$ mm
Maximum reaction at support A	$R_{A_max} = 50.2$ kN	$R_{A_min} = 50.2$ kN
Unfactored dead load reaction at support A	$R_{A_Dead} = 27.9$ kN	
Unfactored imposed load reaction at support A	$R_{A_Imposed} = 6.9$ kN	
Maximum reaction at support B	$R_{B_max} = 171.6$ kN	$R_{B_min} = 171.6$ kN
Unfactored dead load reaction at support B	$R_{B_Dead} = 95.2$ kN	
Unfactored imposed load reaction at support B	$R_{B_Imposed} = 23.9$ kN	

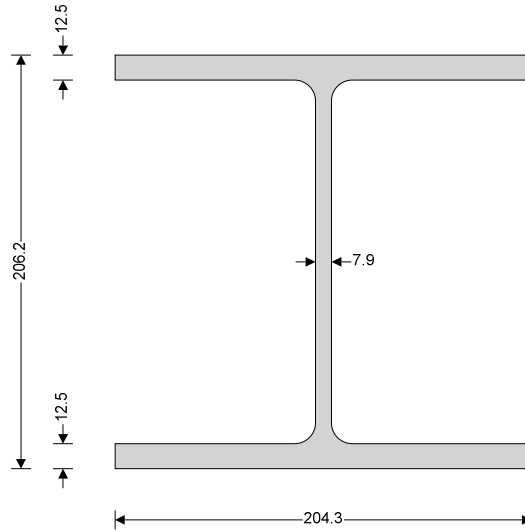
Section details

Section type	UC 203x203x52 (BS4-1)	Steel grade	S275
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Classification of cross sections - Section 3.5

Tensile strain coefficient $\epsilon = 1.00$ Section classification **Plastic**

Shear capacity - Section 4.2.3

Design shear force $F_v = 171.6$ kN Design shear resistance $P_v = 268.8$ kN
PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment $M = 95.4$ kNm Moment capacity high shear $M_c = 154.3$ kNm
PASS - Moment capacity exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads
Limiting deflection $\delta_{lim} = 13.333$ mm Maximum deflection $\delta = 3.032$ mm
PASS - Maximum deflection does not exceed deflection limit

USE 203 X 203 X 52 UC

BEAM B15

SPAN = 3.50m

UDL AT 1ST FLOOR FROM GABLE WALL

DL = 5 X 4.6 = 23 KN/m

POINT LOAD AT 2.10m INC PIER = (23 X 1.2) + (0.675 X 2.5 X 4.6) = 35.4KN

BEAM REACTION AT 2.10m, DL = 95.2 KN, IL = 23.9KN

SLAB

DL = 6.8 X 0.5 = 3.4KN/m

IL = 1.5 X 0.5 = 0.75KN/m

STEEL BEAM ANALYSIS & DESIGN (BS5950)

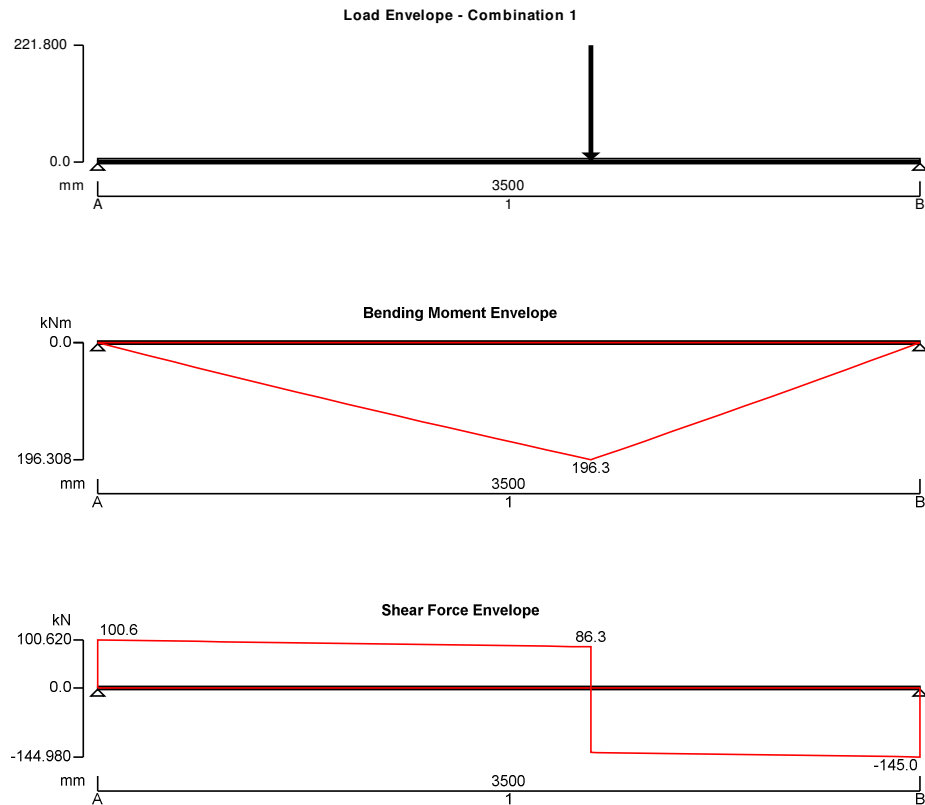
STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1



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Support conditions

Support A	Vertically restrained Rotationally free
Support B	Vertically restrained Rotationally free

Applied loading

Beam loads	Dead full UDL 4 kN/m Imposed full UDL 0.75 kN/m Dead point load 131 kN at 2100 mm Imposed point load 24 kN at 2100 mm
------------	--

Load combinations

Load combination 1	Support A	Dead × 1.40 Imposed × 1.60
	Span 1	Dead × 1.40 Imposed × 1.60
	Support B	Dead × 1.40 Imposed × 1.60

Analysis results

Maximum moment	$M_{max} = 196.3$ kNm	$M_{min} = 0$ kNm
Maximum shear	$V_{max} = 100.6$ kN	$V_{min} = -145$ kN
Deflection	$\delta_{max} = 1.4$ mm	$\delta_{min} = 0$ mm
Maximum reaction at support A	$R_{A_max} = 100.6$ kN	$R_{A_min} = 100.6$ kN



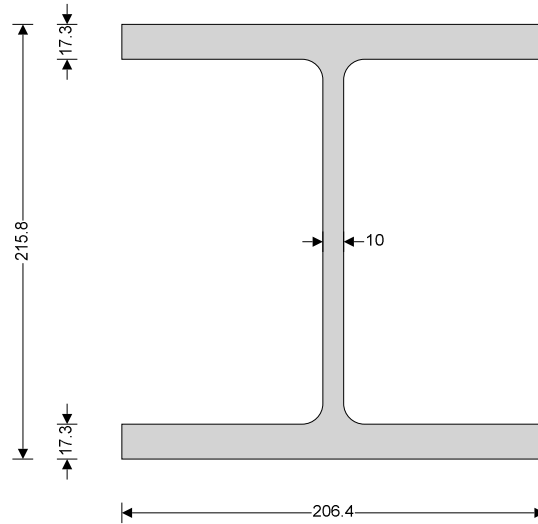
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Unfactored dead load reaction at support A $R_{A_Dead} = 59.4$ kN
 Unfactored imposed load reaction at support A $R_{A_Imposed} = 10.9$ kN
 Maximum reaction at support B $R_{B_max} = 145$ kN $R_{B_min} = 145$ kN
 Unfactored dead load reaction at support B $R_{B_Dead} = 85.6$ kN
 Unfactored imposed load reaction at support B $R_{B_Imposed} = 15.7$ kN

Section details

Section type **UC 203x203x71 (BS4-1)** Steel grade **S355**



Classification of cross sections - Section 3.5

Tensile strain coefficient $\epsilon = 0.89$ Section classification **Plastic**

Shear capacity - Section 4.2.3

Design shear force $F_v = 145$ kN Design shear resistance $P_v = 446.7$ kN
PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment $M = 196.3$ kNm Moment capacity low shear $M_c = 275.6$ kNm
PASS - Moment capacity exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads
 Limiting deflection $\delta_{lim} = 9.722$ mm Maximum deflection $\delta = 1.395$ mm
PASS - Maximum deflection does not exceed deflection limit

203 x 203 x 71 UC



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BASEMENT

WALL UDLS

(BASED UPON NEW EXTENSION TO UPPER FLOORS)

PARTY WALLS

WALL	10 X 4.6	=	46.00	
ROOF DL	2.5 X 1	=	2.50	
ROOF IL	2.5 X 0.75	=		1.90
GROUND FLOOR DL	2.5 X 6.1	=	15.30	
GROUND FLOOR IL	2.5 X 1.5	=		<u>3.80</u>
			63.80KN/m	5.70KN/m

FRONT WALL

ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=		1.50
1 ST & 2 ND FLR DL	2 X 0.5 X 2	=	2.00	
1 ST & 2 ND FLR IL	2 X 1.5 X 2	=		6.00
WALL	5 X 4.6 X 0.85	=	19.60	
CEILING	2 X 0.25	=	<u>0.50</u>	
			24.10 KN/m	7.50KN/m

CENTRAL WALL

ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=		1.50
1 ST & 2 ND FLR DL	2 X 0.5 X 2	=	2.00	
1 ST & 2 ND FLR IL	2 X 1.5 X 2	=		6.00
WALL	5 X 4.6 X 0.85	=	19.60	
CEILING	2 X 0.25	=	<u>0.50</u>	
			24.10 KN/m	7.50KN/m



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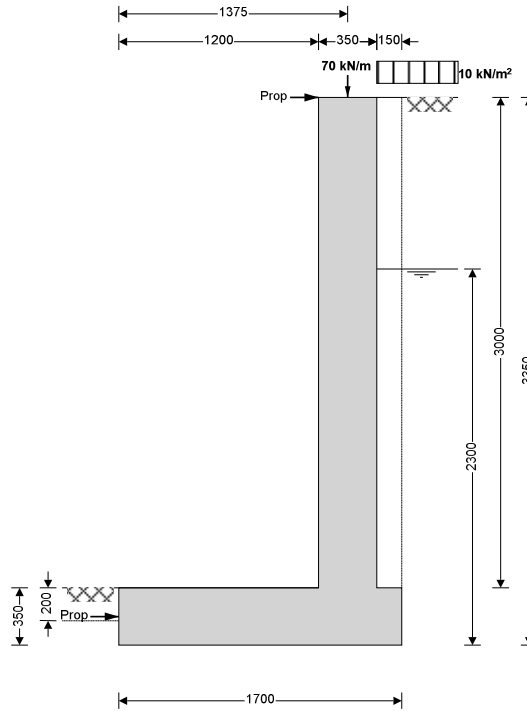
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PARTY WALL WITH 1C

RETAINING WALL ANALYSIS & DESIGN (BS8002)

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type

Height of wall stem

Length of toe

Overall length of base

Height of retaining wall

Depth of downstand

Position of downstand

Depth of cover in front of wall

Height of ground water

Density of wall construction

Angle of soil surface

Mobilisation factor

Moist density

Design shear strength

Design shear strength

Moist density

Using Coulomb theory

Active pressure

At-rest pressure

Cantilever

$h_{stem} = 3000$ mm

$l_{toe} = 1200$ mm

$l_{base} = 1700$ mm

$h_{wall} = 3350$ mm

$d_{ds} = 0$ mm

$l_{ds} = 1250$ mm

$d_{cover} = 0$ mm

$h_{water} = 2300$ mm

$\gamma_{wall} = 23.6$ kN/m³

$\beta = 0.0$ deg

$M = 1.5$

$\gamma_m = 18.0$ kN/m³

$\phi' = 24.2$ deg

$\phi'_b = 24.2$ deg

$\gamma_{mb} = 18.0$ kN/m³

$K_a = 0.419$

$K_0 = 0.590$

Wall stem thickness

Length of heel

Base thickness

Thickness of downstand

Unplanned excavation depth

Density of water

Density of base construction

Effective height at back of wall

Saturated density

Angle of wall friction

Design base friction

Allowable bearing

Passive pressure

$t_{wall} = 350$ mm

$l_{heel} = 150$ mm

$t_{base} = 350$ mm

$t_{ds} = 350$ mm

$d_{exc} = 200$ mm

$\gamma_{water} = 9.81$ kN/m³

$\gamma_{base} = 23.6$ kN/m³

$h_{eff} = 3350$ mm

$\gamma_s = 21.0$ kN/m³

$\delta = 0.0$ deg

$\delta_b = 18.6$ deg

$P_{bearing} = 100$ kN/m²

$K_p = 4.187$

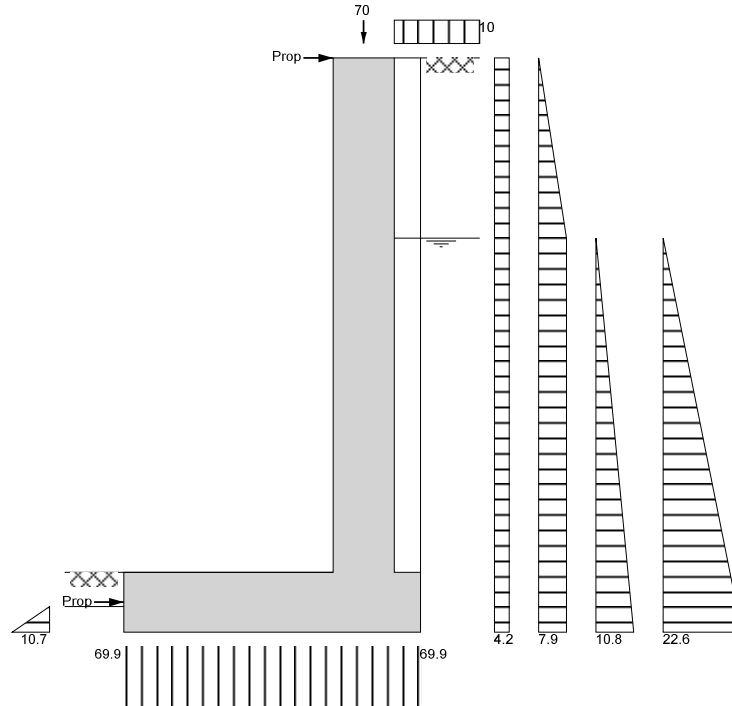


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Loading details

Surcharge load Surcharge = **10.0 kN/m²**
 Vertical dead load $W_{dead} = \mathbf{63.8 \text{ kN/m}}$ Vertical live load $W_{live} = \mathbf{5.7 \text{ kN/m}}$
 Horizontal dead load $F_{dead} = \mathbf{0.0 \text{ kN/m}}$ Horizontal live load $F_{live} = \mathbf{0.0 \text{ kN/m}}$
 Position of vertical load $l_{load} = \mathbf{1375 \text{ mm}}$ Height of horizontal load $h_{load} = \mathbf{0 \text{ mm}}$



Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force $F_{prop} = \mathbf{36.3 \text{ kN/m}}$

Check bearing pressure

Total vertical reaction $R = \mathbf{118.8 \text{ kN/m}}$ Distance to reaction $x_{bar} = \mathbf{850 \text{ mm}}$
 Eccentricity of reaction $e = \mathbf{0 \text{ mm}}$

Reaction acts within middle third of base

Bearing pressure at toe $p_{toe} = \mathbf{69.9 \text{ kN/m}^2}$ Bearing pressure at heel $p_{heel} = \mathbf{69.9 \text{ kN/m}^2}$

PASS - Maximum bearing pressure is less than allowable bearing pressure

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop_top} = \mathbf{9.795 \text{ kN/m}}$ Propping force to base of wall $F_{prop_base} = \mathbf{26.545 \text{ kN/m}}$



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RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor $\gamma_{f,d} = 1.4$ Live load factor $\gamma_{f,l} = 1.6$
Earth pressure factor $\gamma_{f,e} = 1.4$

Calculate propping force

Propping force $F_{prop} = 36.3$ kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop_top_f} = 20.978$ kN/m Propping force to base of wall $F_{prop_base_f} = 61.830$ kN/m

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Base details

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

Design of retaining wall toe

Shear at heel $V_{toe} = 104.5$ kN/m Moment at heel $M_{toe} = 82.4$ kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **12 mm dia.bars @ 150 mm centres**
Area required $A_{s_toe_req} = 677.8$ mm²/m Area provided $A_{s_toe_prov} = 754$ mm²/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress $V_{toe} = 0.356$ N/mm² Allowable shear stress $V_{adm} = 5.000$ N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress $V_{c_toe} = 0.507$ N/mm²

V_{toe} < V_{c,toe} - No shear reinforcement required

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Base details

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

As the moment is negative the design of the retaining wall heel is beyond the scope of this calculation

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Wall details

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

Design of retaining wall stem

Shear at base of stem $V_{stem} = 84.6$ kN/m Moment at base of stem $M_{stem} = 45.7$ kNm/m

Compression reinforcement is not required

Check wall stem in bending

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



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SURREY

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Area required $A_{s_stem_req} = 455.0 \text{ mm}^2/\text{m}$ Area provided $A_{s_stem_prov} = 754 \text{ mm}^2/\text{m}$
PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress $v_{stem} = 0.314 \text{ N/mm}^2$ Allowable shear stress $v_{adm} = 5.000 \text{ N/mm}^2$
PASS - Design shear stress is less than maximum shear stress

Concrete shear stress $v_{c_stem} = 0.534 \text{ N/mm}^2$
 $v_{stem} < v_{c_stem}$ - No shear reinforcement required

Design of retaining wall at mid height


Moment at mid height $M_{wall} = 22.5 \text{ kNm/m}$
Compression reinforcement is not required

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

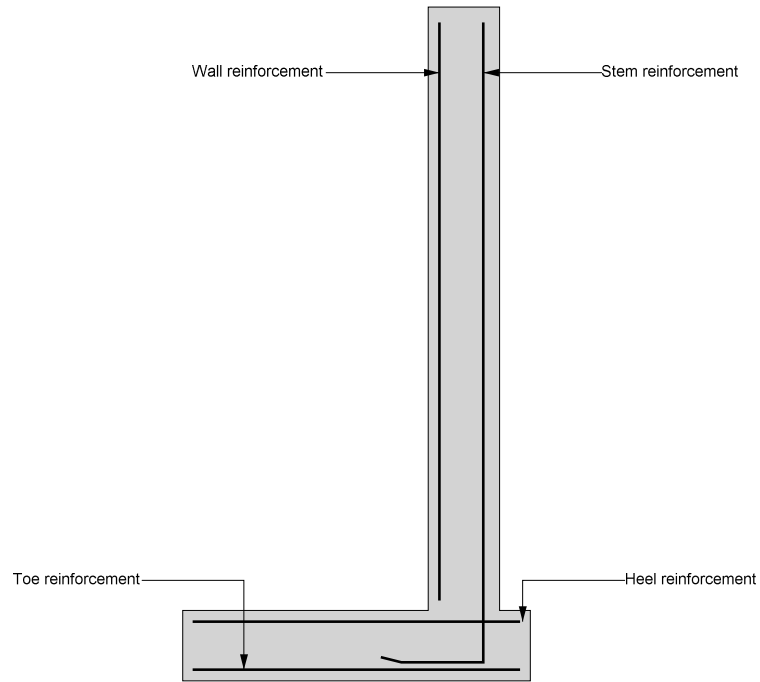
Area required $A_{s_wall_req} = 455.0 \text{ mm}^2/\text{m}$ Area provided $A_{s_wall_prov} = 754 \text{ mm}^2/\text{m}$
PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Max span/depth ratio $ratio_{max} = 40.00$ Actual span/depth ratio $ratio_{act} = 11.15$
PASS - Span to depth ratio is acceptable

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Indicative retaining wall reinforcement diagram



Toe bars - 12 mm dia.@ 150 mm centres - (754 mm²/m)

The design of the retaining wall heel is beyond the scope of this calculation!

Wall bars - 12 mm dia.@ 150 mm centres - (754 mm²/m)

Stem bars - 12 mm dia.@ 150 mm centres - (754 mm²/m)



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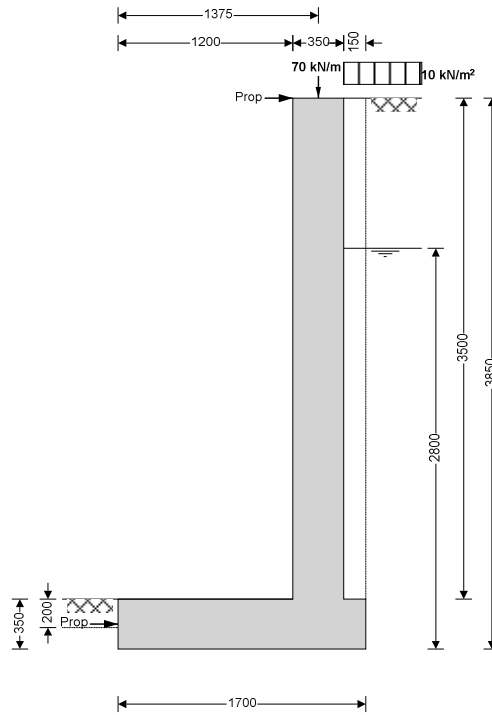
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PARTY WALL WITH NO 3

RETAINING WALL ANALYSIS & DESIGN (BS8002)

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type

Height of wall stem

Length of toe

Overall length of base

Height of retaining wall

Depth of downstand

Position of downstand

Depth of cover in front of wall

Height of ground water

Density of wall construction

Angle of soil surface

Mobilisation factor

Moist density

Design shear strength

Design shear strength

Moist density

Cantilever

$h_{stem} = 3500$ mm

$l_{toe} = 1200$ mm

$l_{base} = 1700$ mm

$h_{wall} = 3850$ mm

$d_{ds} = 0$ mm

$l_{ds} = 1250$ mm

$d_{cover} = 0$ mm

$h_{water} = 2800$ mm

$\gamma_{wall} = 23.6$ kN/m³

$\beta = 0.0$ deg

$M = 1.5$

$\gamma_m = 18.0$ kN/m³

$\phi' = 24.2$ deg

$\phi'_b = 24.2$ deg

$\gamma_{mb} = 18.0$ kN/m³

Wall stem thickness

Length of heel

Base thickness

Thickness of downstand

Unplanned excavation depth

Density of water

Density of base construction

Effective height at back of wall

Saturated density

Angle of wall friction

Design base friction

Allowable bearing

$t_{wall} = 350$ mm

$l_{heel} = 150$ mm

$t_{base} = 350$ mm

$t_{ds} = 350$ mm

$d_{exc} = 200$ mm

$\gamma_{water} = 9.81$ kN/m³

$\gamma_{base} = 23.6$ kN/m³

$h_{eff} = 3850$ mm

$\gamma_s = 21.0$ kN/m³

$\delta = 0.0$ deg

$\delta_b = 18.6$ deg

$P_{bearing} = 100$ kN/m²

Using Coulomb theory

Active pressure

At-rest pressure

$K_a = 0.419$

$K_0 = 0.590$

Passive pressure

$K_p = 4.187$

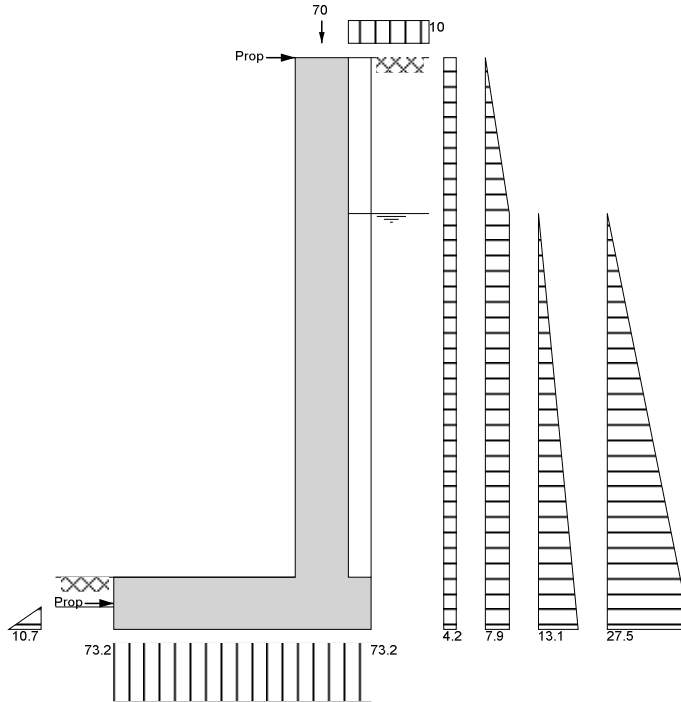


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Loading details

Surcharge load Surcharge = **10.0 kN/m²**
 Vertical dead load $W_{dead} = \mathbf{63.8 \text{ kN/m}}$ Vertical live load $W_{live} = \mathbf{5.7 \text{ kN/m}}$
 Horizontal dead load $F_{dead} = \mathbf{0.0 \text{ kN/m}}$ Horizontal live load $F_{live} = \mathbf{0.0 \text{ kN/m}}$
 Position of vertical load $l_{load} = \mathbf{1375 \text{ mm}}$ Height of horizontal load $h_{load} = \mathbf{0 \text{ mm}}$



Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force $F_{prop} = \mathbf{58.9 \text{ kN/m}}$

Check bearing pressure

Total vertical reaction $R = \mathbf{124.5 \text{ kN/m}}$ Distance to reaction $x_{bar} = \mathbf{850 \text{ mm}}$
 Eccentricity of reaction $e = \mathbf{0 \text{ mm}}$

Reaction acts within middle third of base

Bearing pressure at toe $p_{toe} = \mathbf{73.2 \text{ kN/m}^2}$ Bearing pressure at heel $p_{heel} = \mathbf{73.2 \text{ kN/m}^2}$

PASS - Maximum bearing pressure is less than allowable bearing pressure

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop_top} = \mathbf{18.254 \text{ kN/m}}$ Propping force to base of wall $F_{prop_base} = \mathbf{40.692 \text{ kN/m}}$



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RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

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

Calculate propping force

Propping force $F_{prop} = 58.9$ kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop_top_f} = 36.323$ kN/m Propping force to base of wall $F_{prop_base_f} = 85.622$ kN/m

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Base details

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

Design of retaining wall toe

Shear at heel $V_{toe} = 110.2$ kN/m Moment at heel $M_{toe} = 86.8$ kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **12 mm dia.bars @ 150 mm centres**
Area required $A_{s_toe_req} = 714.4$ mm²/m Area provided $A_{s_toe_prov} = 754$ mm²/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress $V_{toe} = 0.375$ N/mm² Allowable shear stress $V_{adm} = 5.000$ N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress $V_{c_toe} = 0.507$ N/mm²

$V_{toe} < V_{c_toe}$ - No shear reinforcement required

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Base details

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

As the moment is negative the design of the retaining wall heel is beyond the scope of this calculation

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Wall details

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

Design of retaining wall stem

Shear at base of stem $V_{stem} = 114.6$ kN/m Moment at base of stem $M_{stem} = 71.3$ kNm/m

Compression reinforcement is not required

Check wall stem in bending

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



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Area required $A_{s_stem_req} = 641.3 \text{ mm}^2/\text{m}$ Area provided $A_{s_stem_prov} = 754 \text{ mm}^2/\text{m}$
PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress $v_{stem} = 0.426 \text{ N/mm}^2$ Allowable shear stress $v_{adm} = 5.000 \text{ N/mm}^2$
PASS - Design shear stress is less than maximum shear stress

Concrete shear stress $v_{c_stem} = 0.534 \text{ N/mm}^2$
 $v_{stem} < v_{c_stem}$ - No shear reinforcement required


Design of retaining wall at mid height

Moment at mid height $M_{wall} = 34.5 \text{ kNm/m}$
Compression reinforcement is not required

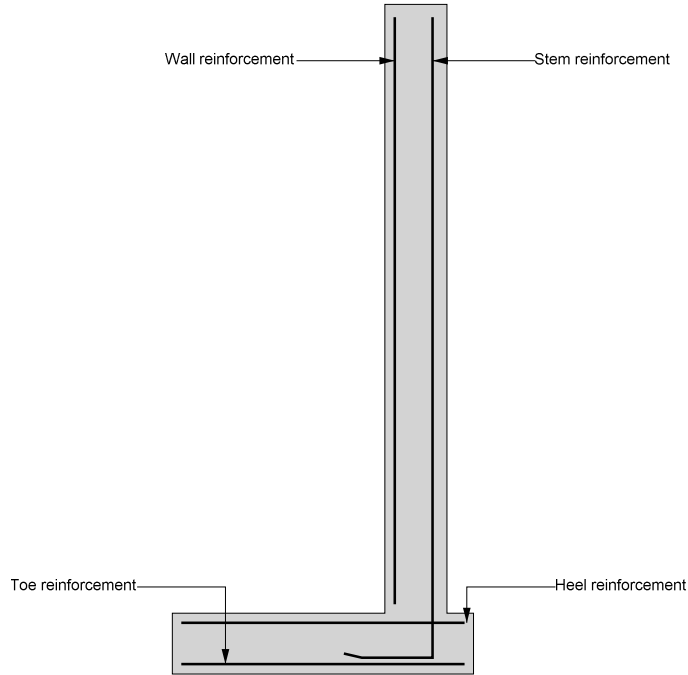
Reinforcement provided **12 mm dia.bars @ 150 mm centres**
 Area required $A_{s_wall_req} = 455.0 \text{ mm}^2/\text{m}$ Area provided $A_{s_wall_prov} = 754 \text{ mm}^2/\text{m}$
PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Max span/depth ratio $ratio_{max} = 28.10$ Actual span/depth ratio $ratio_{act} = 13.01$
PASS - Span to depth ratio is acceptable

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Indicative retaining wall reinforcement diagram



Toe bars - 12 mm dia.@ 150 mm centres - (754 mm²/m)

The design of the retaining wall heel is beyond the scope of this calculation!

Wall bars - 12 mm dia.@ 150 mm centres - (754 mm²/m)

Stem bars - 12 mm dia.@ 150 mm centres - (754 mm²/m)

FRONT WALL AND REAR WALL RETURNS.

BY INSPECTION WILL BE NO MORE ONEROUS THAT PARTY WALLS THEREFORE USE SAME CONCRETE SECTIONS AND REINFORCEMENT.

FRONT AND REAR LIGHTWELL WALLS

RETAINING WALL ANALYSIS & DESIGN (BS8002)

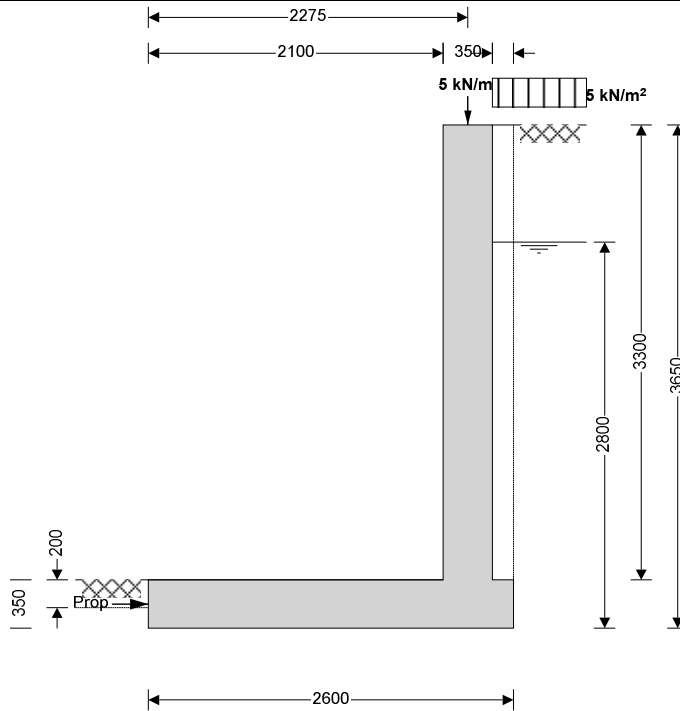
RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



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Wall details

Retaining wall type

Height of wall stem

Length of toe

Overall length of base

Height of retaining wall

Depth of downstand

Position of downstand

Depth of cover in front of wall

Height of ground water

Density of wall construction

Angle of soil surface

Mobilisation factor

Moist density

Design shear strength

Design shear strength

Moist density

Cantilever

$h_{stem} = 3300$ mm

$l_{toe} = 2100$ mm

$l_{base} = 2600$ mm

$h_{wall} = 3650$ mm

$d_{ds} = 0$ mm

$l_{ds} = 1900$ mm

$d_{cover} = 0$ mm

$h_{water} = 2800$ mm

$\gamma_{wall} = 23.6$ kN/m³

$\beta = 0.0$ deg

$M = 1.5$

$\gamma_m = 18.0$ kN/m³

$\phi' = 24.2$ deg

$\phi'_b = 24.2$ deg

$\gamma_{mb} = 18.0$ kN/m³

Wall stem thickness

Length of heel

Base thickness

Thickness of downstand

Unplanned excavation depth

Density of water

Density of base construction

Effective height at back of wall

Saturated density

Angle of wall friction

Design base friction

Allowable bearing

$t_{wall} = 350$ mm

$l_{heel} = 150$ mm

$t_{base} = 350$ mm

$t_{ds} = 350$ mm

$d_{exc} = 200$ mm

$\gamma_{water} = 9.81$ kN/m³

$\gamma_{base} = 23.6$ kN/m³

$h_{eff} = 3650$ mm

$\gamma_s = 21.0$ kN/m³

$\delta = 0.0$ deg

$\delta_b = 18.6$ deg

$P_{bearing} = 100$ kN/m²

Using Coulomb theory

Active pressure

At-rest pressure

$K_a = 0.419$

$K_0 = 0.590$

Passive pressure

$K_p = 4.187$

Loading details

Surcharge load

Vertical dead load

Horizontal dead load

Position of vertical load

Surcharge = **5.0** kN/m²

$W_{dead} = 5.0$ kN/m

$F_{dead} = 0.0$ kN/m

$l_{load} = 2275$ mm

Vertical live load

Horizontal live load

Height of horizontal load

$W_{live} = 0.0$ kN/m

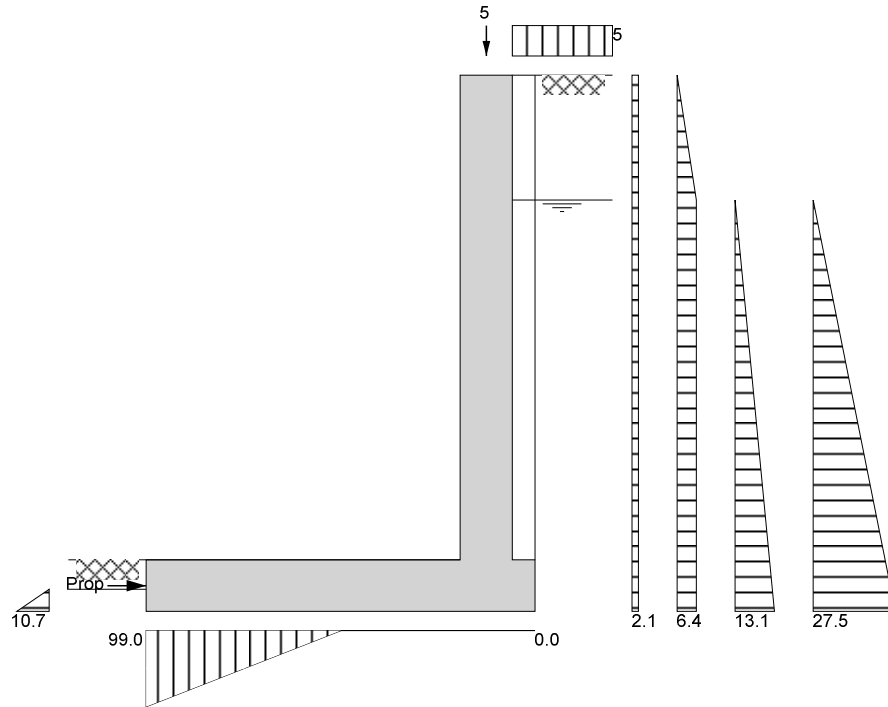
$F_{live} = 0.0$ kN/m

$h_{load} = 0$ mm



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Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force $F_{prop} = 62.8 \text{ kN/m}$

Check bearing pressure

Total vertical reaction $R = 64.5 \text{ kN/m}$ Distance to reaction $x_{bar} = 435 \text{ mm}$
 Eccentricity of reaction $e = 865 \text{ mm}$

Reaction acts outside middle third of base

Bearing pressure at toe $p_{toe} = 99.0 \text{ kN/m}^2$ Bearing pressure at heel $p_{heel} = 0.0 \text{ kN/m}^2$

PASS - Maximum bearing pressure is less than allowable bearing pressure



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RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor $\gamma_{f,d} = 1.4$ Live load factor $\gamma_{f,l} = 1.6$
Earth pressure factor $\gamma_{f,e} = 1.4$

Calculate propping force

Propping force $F_{prop} = 62.8$ kN/m

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Base details

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

Design of retaining wall toe

Shear at heel $V_{toe} = 24.3$ kN/m Moment at heel $M_{toe} = 29.9$ kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 100 mm centres**

Area required $A_{s,toe,req} = 455.0$ mm²/m Area provided $A_{s,toe,prov} = 2011$ mm²/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress $V_{toe} = 0.083$ N/mm² Allowable shear stress $V_{adm} = 5.000$ N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress $V_{c,toe} = 0.706$ N/mm²

$V_{toe} < V_{c,toe}$ - No shear reinforcement required

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

Material properties

Strength of concrete $f_{cu} = 40$ N/mm² Strength of reinforcement $f_y = 500$ N/mm²

Base details

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

Design of retaining wall heel

Shear at heel $V_{heel} = 17.0$ kN/m Moment at heel $M_{heel} = 4.4$ kNm/m

Compression reinforcement is not required

Check heel in bending

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

Area required $A_{s,heel,req} = 455.0$ mm²/m Area provided $A_{s,heel,prov} = 754$ mm²/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress $V_{heel} = 0.058$ N/mm² Allowable shear stress $V_{adm} = 5.000$ N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress $V_{c,heel} = 0.507$ N/mm²

$V_{heel} < V_{c,heel}$ - No shear reinforcement required



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

Material properties

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

Wall details

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

Design of retaining wall stem


Shear at base of stem $V_{stem} = 4.0 \text{ kN/m}$ Moment at base of stem $M_{stem} = 138.3 \text{ kNm/m}$
Compression reinforcement is not required

Check wall stem in bending

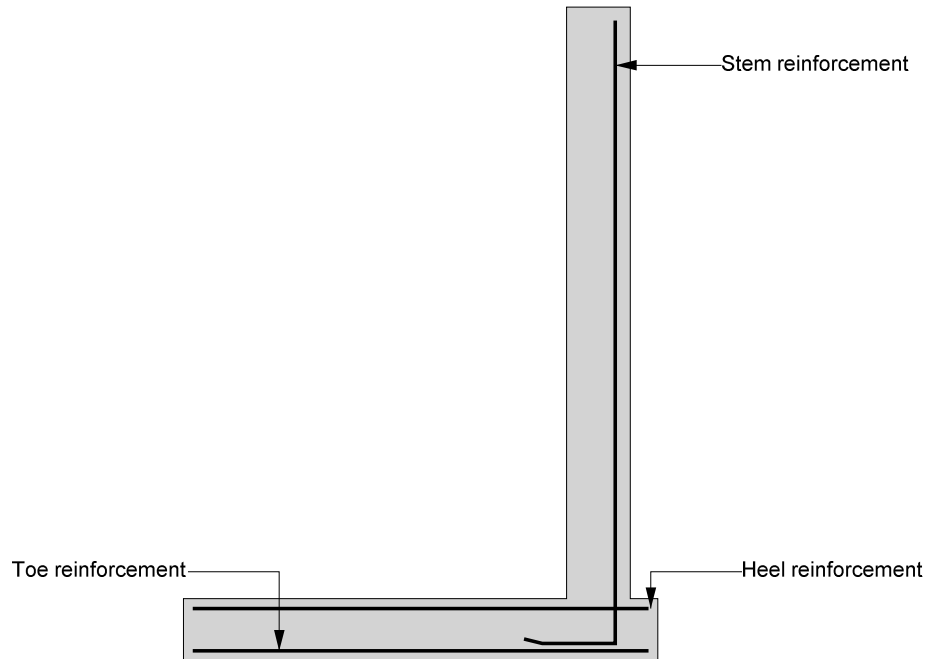
Reinforcement provided **16 mm dia.bars @ 100 mm centres**
Area required $A_{s_stem_req} = 1263.0 \text{ mm}^2/\text{m}$ Area provided $A_{s_stem_prov} = 2011 \text{ mm}^2/\text{m}$
PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress $V_{stem} = 0.015 \text{ N/mm}^2$ Allowable shear stress $V_{adm} = 5.000 \text{ N/mm}^2$
PASS - Design shear stress is less than maximum shear stress
Concrete shear stress $V_{c_stem} = 0.744 \text{ N/mm}^2$
 $V_{stem} < V_{c_stem}$ - No shear reinforcement required

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Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 100 mm centres - (2011 mm²/m)
 Heel bars - 12 mm dia.@ 150 mm centres - (754 mm²/m)
 Stem bars - 16 mm dia.@ 100 mm centres - (2011 mm²/m)

SPAN TO DEPTH RATIO EXCEEDED SLIGHTLY SO ADD ADDITIONAL REBAR ON ISIDE FACE TO HELP WALL SPAN L TO R BETWEEN RETURN WALLS

SAY MAX P AT BASE = (0.35 X 3.4 X 18 x1.4) + (0.35 X 5 X 1.6) = 33KN/m ULT

B.M MAX LATERALLY (CONSERVATIVE AS TAKEN AT BASE OF WALL AND APPLIED OVER WHOLE HEIGHT)

= 33 X 3.5² / 8 = 50.5KN.m

RC SLAB DESIGN (BS8110)

RC SLAB DESIGN (BS8110:PART1:1997)

TEDDS calculation version 1.0.04

CONCRETE SLAB DESIGN (CL 3.5.3 & 4)

SIMPLE ONE WAY SPANNING SLAB DEFINITION

Overall depth of slab h = 350 mm

Cover to tension reinforcement resisting sagging c_b = 50 mm

Trial bar diameter D_{tryx} = 16 mm

Depth to tension steel (resisting sagging)

$$d_x = h - c_b - D_{tryx}/2 = 292 \text{ mm}$$



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Characteristic strength of reinforcement $f_y = 500 \text{ N/mm}^2$

Characteristic strength of concrete $f_{cu} = 35 \text{ N/mm}^2$

ONE WAY SPANNING SLAB (CL 3.5.4)

MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab) $m_{sx} = 51.0 \text{ kNm/m}$

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

Design sagging moment (per m width of slab) $m_{sx} = 51.0 \text{ kNm/m}$

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

Area of reinforcement required

$$K_x = \text{abs}(m_{sx}) / (d_x^2 \times f_{cu}) = 0.017$$

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

Outer compression steel not required to resist sagging

Slab requiring outer tension steel only - bars (sagging)

$$z_x = \min((0.95 \times d_x), (d_x \times (0.5 + \sqrt{(0.25 - K_x/0.9)}))) = 277 \text{ mm}$$

$$\text{Neutral axis depth } x_x = (d_x - z_x) / 0.45 = 32 \text{ mm}$$

Area of tension steel required

$$A_{sx_req} = \text{abs}(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x) = 423 \text{ mm}^2/\text{m}$$

Tension steel

Provide 16 dia bars @ 200 centres outer tension steel resisting sagging

$$A_{sx_prov} = A_{sx} = 1010 \text{ mm}^2/\text{m}$$

Area of outer tension steel provided sufficient to resist sagging

TRANSVERSE BOTTOM STEEL - INNER

Inner layer of transverse steel

Provide 12 dia bars @ 100 centres

$$A_{sy_prov} = A_{sy} = 1130 \text{ mm}^2/\text{m}$$

Check min and max areas of steel resisting sagging

Total area of concrete $A_c = h = 350000 \text{ mm}^2/\text{m}$

Minimum % reinforcement $k = 0.13 \%$

$$A_{st_min} = k \times A_c = 455 \text{ mm}^2/\text{m}$$

$$A_{st_max} = 4 \% \times A_c = 14000 \text{ mm}^2/\text{m}$$

Steel defined:

Outer steel resisting sagging $A_{sx_prov} = 1010 \text{ mm}^2/\text{m}$

Area of outer steel provided (sagging) OK


Inner steel resisting sagging $A_{sy_prov} = 1130 \text{ mm}^2/\text{m}$

Area of inner steel provided (sagging) OK

CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)

Slab span length $l_x = 3.500 \text{ m}$

Design ultimate moment in shorter span per m width $m_{sx} = 51 \text{ kNm/m}$

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Depth to outer tension steel $d_x = 292$ mm

Tension steel

Area of outer tension reinforcement provided $A_{sx_prov} = 1010$ mm²/m

Area of tension reinforcement required $A_{sx_req} = 423$ mm²/m

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

Modification Factors

Basic span / effective depth ratio (Table 3.9) $ratio_{span_depth} = 20$

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

$$f_s = 2 \times f_y \times A_{sx_req} / (3 \times A_{sx_prov} \times \beta_{bx}) = 139.6 \text{ N/mm}^2$$

$$factor_{tens} = \min (2 , 0.55 + (477 \text{ N/mm}^2 - f_s) / (120 \times (0.9 \text{ N/mm}^2 + m_{sx} / d_x^2))) = 2.000$$

Calculate Maximum Span

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

$$Maximum \text{ span } l_{max} = ratio_{span_depth} \times factor_{tens} \times d_x = 11.68 \text{ m}$$

Check the actual beam span

$$Actual \text{ span/depth ratio } l_x / d_x = 11.99$$

$$Span \text{ depth limit } ratio_{span_depth} \times factor_{tens} = 40.00$$

Span/Depth ratio check satisfied

H16 INSIDE FACE AT 200 HORIZONTALLY TIED TO MESH

BASEMENT SLAB

SPAN = 2.20m

PROTECTED FROM HEAVE BY CORDEK.

DOWN FORCE

DL = 6.8KN/m², IL = 1.50 KN/m²

ULT BM = 7.2KN.m

UPLIFT

WATER – DL = 28 – 6.8 = 21.2KN/m

ULT BM = 21.2 X 2.2² X 1.4 / 8 = 18KN.m

RC SLAB DESIGN (BS8110)

RC SLAB DESIGN (BS8110:PART1:1997)

TEDDS calculation version 1.0.04

CONCRETE SLAB DESIGN (CL 3.5.3 & 4)

SIMPLE ONE WAY SPANNING SLAB DEFINITION

Overall depth of slab $h = 200$ mm



VINCENT & RYMILL
LAKESIDE COUNTRY CLUB
FRIMLEY GREEN
SURREY

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Cover to tension reinforcement resisting sagging $c_b = 50$ mm

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

Depth to tension steel (resisting sagging)

$$d_x = h - c_b - D_{tryx}/2 = 145 \text{ mm}$$

Characteristic strength of reinforcement $f_y = 500$ N/mm²

Characteristic strength of concrete $f_{cu} = 35$ N/mm²

ONE WAY SPANNING SLAB (CL 3.5.4)

MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab) $m_{sx} = 18.0$ kNm/m

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

Design sagging moment (per m width of slab) $m_{sx} = 18.0$ kNm/m

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

Area of reinforcement required

$$K_x = \text{abs}(m_{sx}) / (d_x^2 \times f_{cu}) = 0.024$$

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

Outer compression steel not required to resist sagging

One-way Spanning Slab requiring tension steel only (sagging) - mesh

$$z_x = \min((0.95 \times d_x), (d_x \times (0.5 + \sqrt{(0.25 - K_x/0.9)}))) = 138 \text{ mm}$$

$$\text{Neutral axis depth } x_x = (d_x - z_x) / 0.45 = 16 \text{ mm}$$

Area of tension steel required

$$A_{sx_req} = \text{abs}(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x) = 301 \text{ mm}^2/\text{m}$$

Tension steel

Use A393 Mesh

$$A_{sx_prov} = A_{sl} = 393 \text{ mm}^2/\text{m} \quad A_{sy_prov} = A_{st} = 393 \text{ mm}^2/\text{m}$$

$$D_x = d_{sl} = 10 \text{ mm} \quad D_y = d_{st} = 10 \text{ mm}$$

Area of tension steel provided sufficient to resist sagging

Check min and max areas of steel resisting sagging

Total area of concrete $A_c = h = 200000$ mm²/m

Minimum % reinforcement $k = 0.13$ %

$$A_{st_min} = k \times A_c = 260 \text{ mm}^2/\text{m}$$

$$A_{st_max} = 4 \% \times A_c = 8000 \text{ mm}^2/\text{m}$$

Steel defined:

Outer steel resisting sagging $A_{sx_prov} = 393$ mm²/m

Area of outer steel provided (sagging) OK


Inner steel resisting sagging $A_{sy_prov} = 393$ mm²/m

Area of inner steel provided (sagging) OK

CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)

Slab span length $l_x = 2.200$ m

Design ultimate moment in shorter span per m width $m_{sx} = 18$ kNm/m

 VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY	Project				Job Ref.	
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Depth to outer tension steel $d_x = 145$ mm

Tension steel

Area of outer tension reinforcement provided $A_{sx_prov} = 393$ mm²/m

Area of tension reinforcement required $A_{sx_req} = 301$ mm²/m

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

Modification Factors

Basic span / effective depth ratio (Table 3.9) $ratio_{span_depth} = 20$

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

$$f_s = 2 \times f_y \times A_{sx_req} / (3 \times A_{sx_prov} \times \beta_{bx}) = 254.9 \text{ N/mm}^2$$

$$factor_{tens} = \min (2 , 0.55 + (477 \text{ N/mm}^2 - f_s) / (120 \times (0.9 \text{ N/mm}^2 + m_{sx} / d_x^2))) = 1.604$$

Calculate Maximum Span

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

$$Maximum \text{ span } l_{max} = ratio_{span_depth} \times factor_{tens} \times d_x = 4.65 \text{ m}$$

Check the actual beam span

$$Actual \text{ span/depth ratio } l_x / d_x = 15.17$$

$$Span \text{ depth limit } ratio_{span_depth} \times factor_{tens} = 32.08$$

Span/Depth ratio check satisfied

1 LAYER A393 FABRIC TOP AND BOTTOM 50 COVER