V&R VINCENT & RYMILL

APPENDIX 2

STRUCTURAL CALCULATIONS

PITCHED ROOF	**KN/m²**		**CEILING**	**KN/m²**
Tiles	0.70		Ceiling Joists	0.10
Felt & battens	0.05		Plasterboard	0.15
Rafters	0.10		D. L.	0.25 KN/m²
	0.85		I. L. where applicable	0.25 KN/m²
30⁰ on plan load D. L.	1.00 KN/m²			0.50 KN/m²
30⁰ Imposed Load	0.75 KN/m²			
	1.75 KN/m²			

FLAT ROOF	**KN/m²**		**TIMBER FLOORS**	**KN/m²**
Felt	0.25		Boards	0.20
Boards	0.25		Joists	0.10
Joists & firrings	0.15		Ceiling	0.20
Ceiling	0.15		D. L.	0.50 KN/m²
D. L.	0.80 KN/m²		I. L.	1.50 KN/m²
I .L.	0.75 KN/m²			2.00 KN/m²
	1.55 KN/m²			

200 RIBDECK	**KN/m²**		
Finish	2.00		
Self Weight	4.10	200 SLAB	4.80KN/m²
D. L.	6.10 KN/m²		
I. L.	1.50 KN/m²		
	5.50 KN/m²		

MASONRY	**KN/m²**
102 Brick + PLASTER	2.40 KN/m²
215 BRICK + PLASTER	4.60 KN/m²

VINCENT & RYMILL LAKESIDE COUNTRY CLUB 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 UDL1.15 TO 2.45m

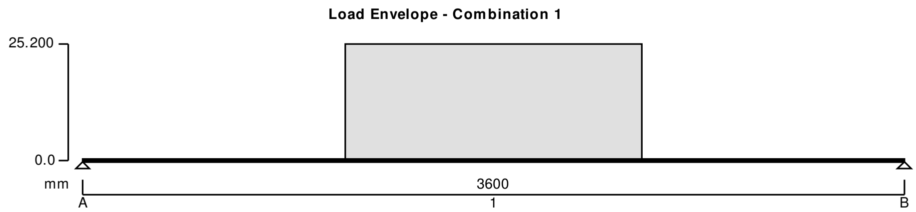
DL = 6 X 2.4 X 1.25 = 18KN/m

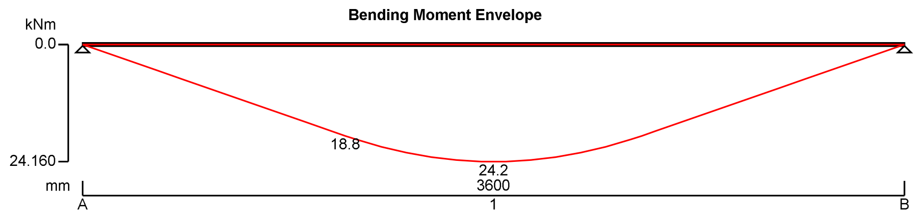
STEEL BEAM ANALYSIS & DESIGN (BS5950)

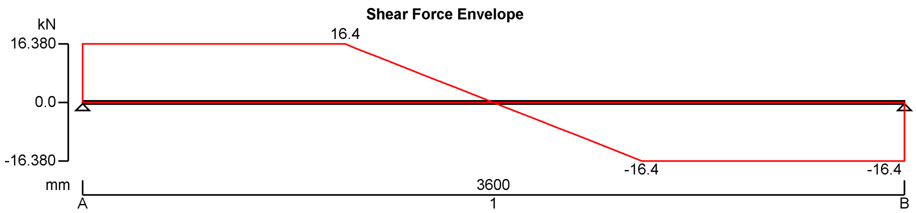
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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 × 1.40

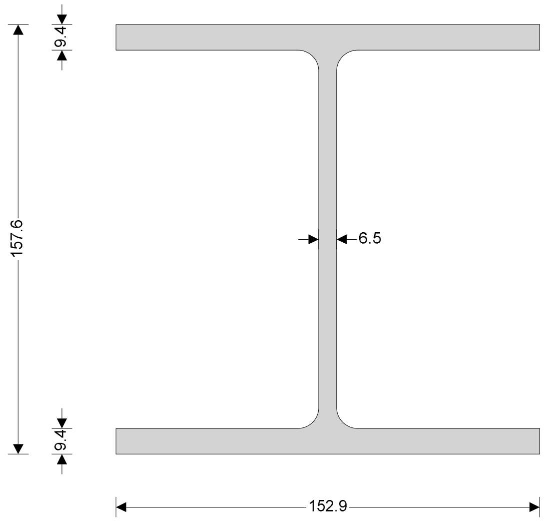
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **24.2** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **16.4** kN	V_{min} = **-16.4** kN
Deflection	δ_{max} = **0** mm	δ_{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 ε = **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 δ_{lim} = **10** mm Maximum deflection δ = **0** mm

PASS - Maximum deflection does not exceed deflection limit

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

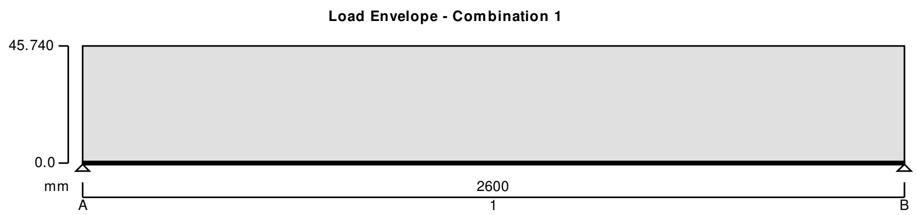
ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=		1.50
1^{ST} & 2^{ND} FLR DL	2 X 0.5 X 2	=	2.00	
1^{ST} & 2^{ND} FLR IL	2 X 1.5 X 2	=		6.00
WALL	5 X 4.6 X 0.85	=	19.60	
CEILING	2 X 0.25	=	0.50	
			24.10 KN/m	7.50KN/m

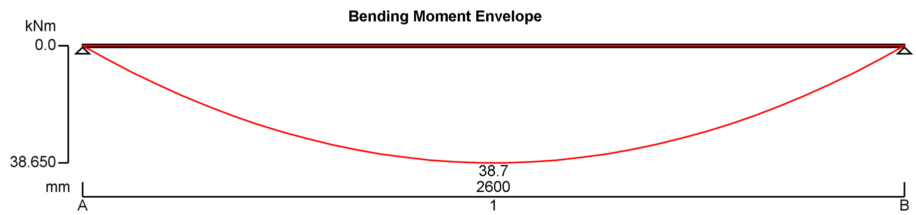
STEEL BEAM ANALYSIS & DESIGN (BS5950)

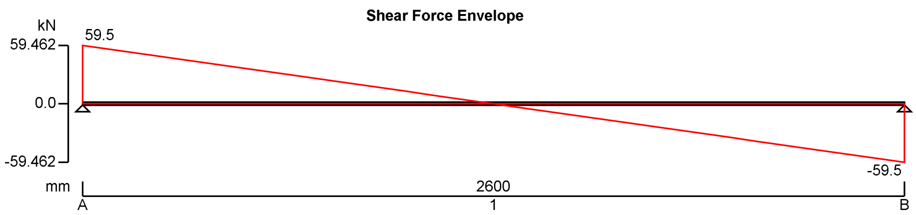
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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

TEDDS calculation version 3.0.05







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

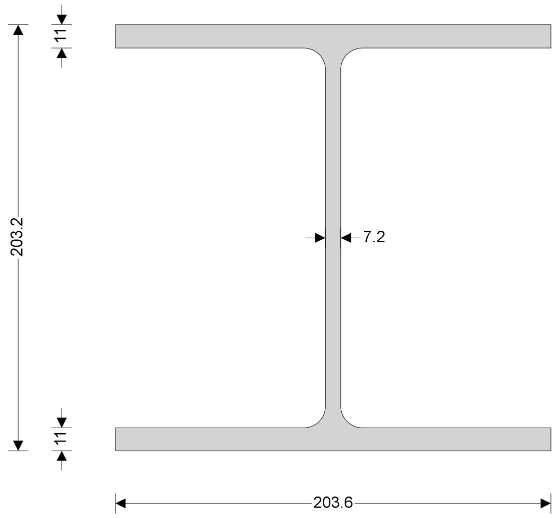
Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

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	δ_{max} = **0.5** mm	δ_{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**



Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **1.00** Section classification **Compact**

Shear capacity - Section 4.2.3

Design shear force F_v = **59.5** 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 = **38.7** kNm Moment capacity low shear M_c = **136.8** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **131** kNm M_b / m_{LT} = **141.6** kNm

PASS - Moment capacity exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection δ_{lim} = **7.222** mm Maximum deflection δ = **0.477** mm

PASS - Maximum deflection does not exceed deflection limit

USE 203 X 203 X 46 UC

TAKE BEARING ONTO MASS CONCRETE PAD ONTO TOP OF PINS

BEAM B5

SPAN = 4.60m

SLAB DL = 1.9 X 6.1 = 11.6KN/m

SLAB IL = 1.9 X 1.5 = 2.9KN/m

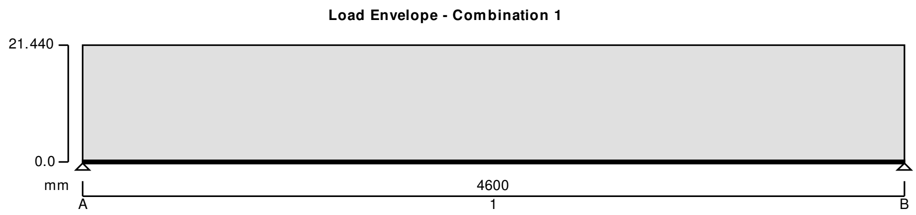
STEEL BEAM ANALYSIS & DESIGN (BS5950)

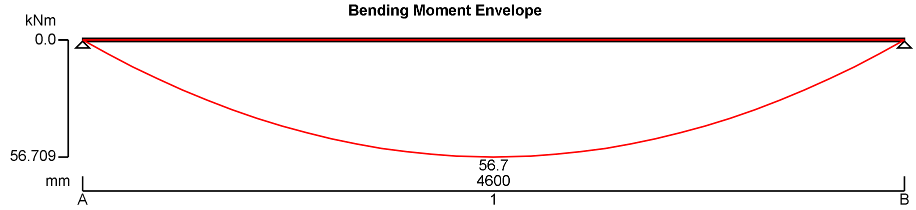
STEEL BEAM ANALYSIS & DESIGN (BS5950)

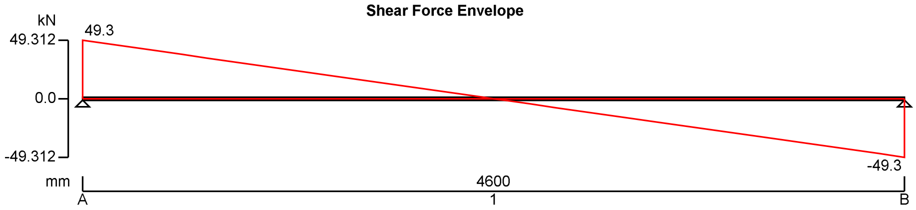
In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.05

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY	Project 1 SPENCER RISE LONDON NW5 1AR			Job Ref. 18B06	
	Section NEW BASEMENT STRUCTURE			Sheet no./rev. 7	
	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 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	δ_{max} = **1.8** mm	δ_{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	

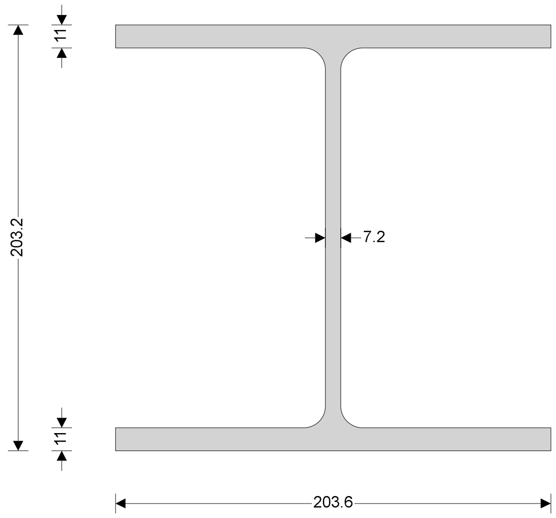
Maximum reaction at support B R_{B_max} = **49.3** kN R_{B_min} = **49.3** kN

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 ε = **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 δ_{lim} = **12.778** mm Maximum deflection δ = **1.806** mm

PASS - Maximum deflection does not exceed deflection limit

<u>USE 203 X 203 X 46 UC BEARINGS ONTO CONCRETE WALL</u>

BEAM B6

MAX SPAM = 3.00m

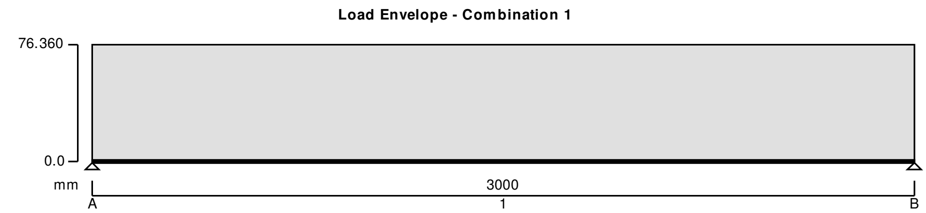
UDL				
STUD	2.5 X 0.6	=	1.50	
100 BRICK	2.5 X 2.6	=	6.50	
FLOORS DL	3.8 X 0.5 X 2	=	3.80	
FLOORS IL	3.8 X 1.5 X 2	=		11.40
RIB DECK DL	3.8 X 6.1	=	23.20	
GRD FLR IL	3.8 X 1.5	=	______	5.70
			35.00KN/m	17.1KN/m

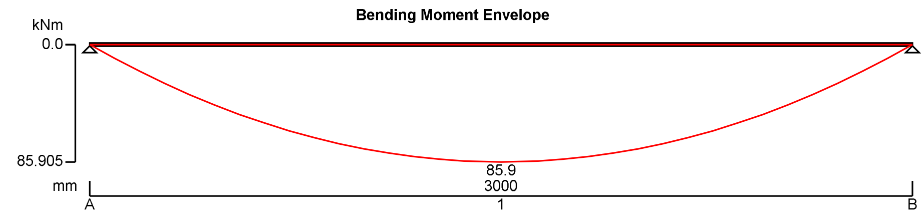
STEEL BEAM ANALYSIS & DESIGN (BS5950)

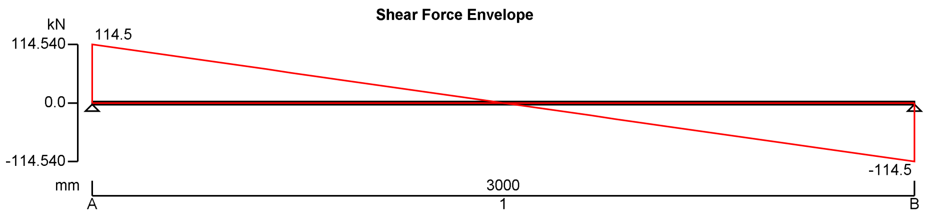
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY	Project 1 SPENCER RISE LONDON NW5 1AR			Job Ref. 18B06	
	Section NEW BASEMENT STRUCTURE			Sheet no./rev. 10	
	Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date

Applied loading

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

Load combinations

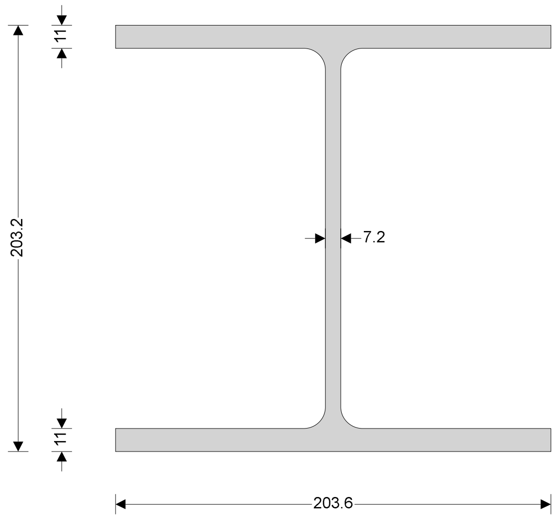
Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

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	δ_{max} = **1.9** mm	δ_{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 ε = **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

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection δ_{lim} = **8.333** mm   Maximum deflection δ = **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)

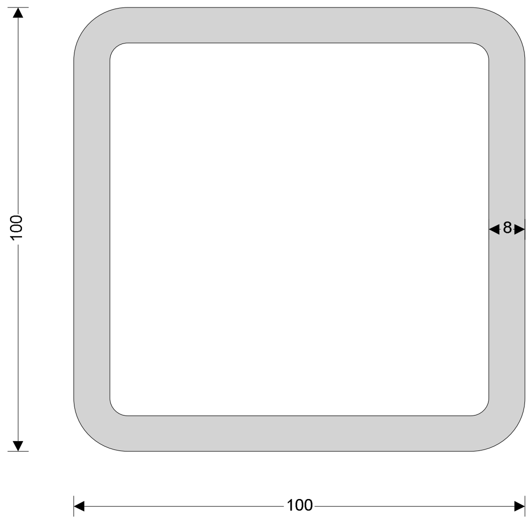
STEEL MEMBER DESIGN (BS5950)

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 ε = **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/mm^2 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

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

<u>100 X 100 X 8.0 SHS POST</u>

<u>BEAM B7</u>

<u>BY INSPECTION SIMILAR TO BEAM B5 – USE 203 X 203 X 46 UC</u>

<u>BEAM B8 / B9</u>

SPANS = 2.5 AND 1.5 RESPECTIVELY.

<u>BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK FLOOR</u>

<u>BEAM B10</u>

SPAN = 2.80m

Dl = 2.25 x 6.1 = 13.7KN/m

IL = 2.25 X 1.5 = 3.40 KN/m

<u>BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK</u>

<u>RN DL = 19.2 KN, IL = 4.8KN</u>

<u>BEAM B11</u>

SPAN = 1.50m

Dl = 2.25 x 6.1 = 13.7KN/m

IL = 2.25 X 1.5 = 3.40 KN/m

<u>BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK</u>

<u>RN DL = 10.3 KN, IL = 2.60KN</u>

<u>BEAM B12</u>

SPAN = 2.80m

Dl = 1.40 x 6.45 = 9.00KN/m

IL = 1.40 X 1.5 = 2.10 KN/m

<u>BY INSPECTION USE 203 X 203 X 46 UC TO SUIT RIBDECK</u>

<u>RN DL = 12.60 KN, IL = 3.00KN</u>

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	=	19.30	______
			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

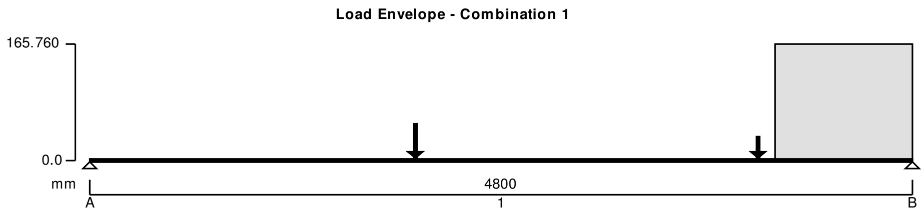
IL = 2.6 X 6 / 0.675 = 23.1KN/m

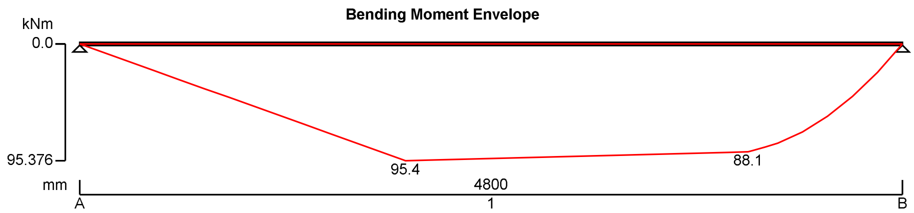
STEEL BEAM ANALYSIS & DESIGN (BS5950)

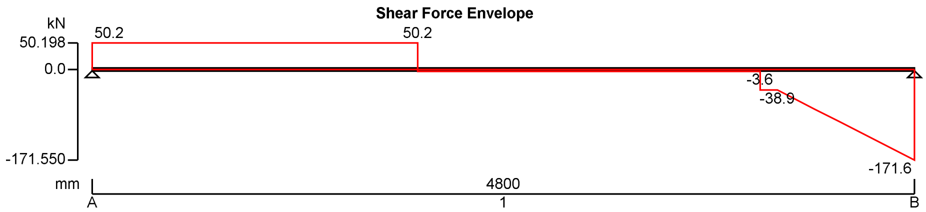
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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

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 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

Load combinations

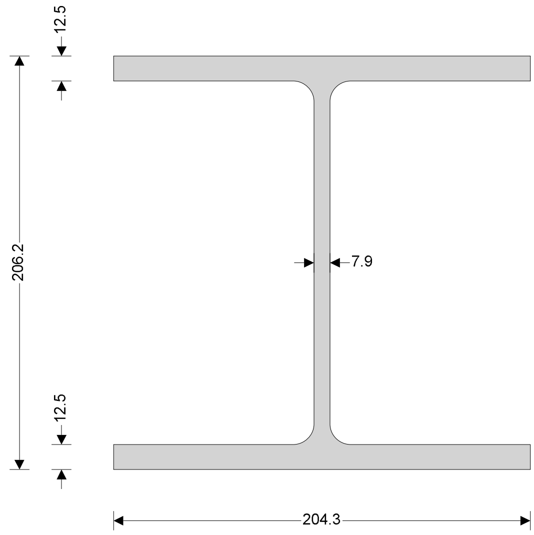
Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **95.4** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **50.2** kN	V_{min} = **-171.6** kN
Deflection	δ_{max} = **3** mm	δ_{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**



Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **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 δ_{lim} = **13.333** mm Maximum deflection δ = **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 1^{ST} 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

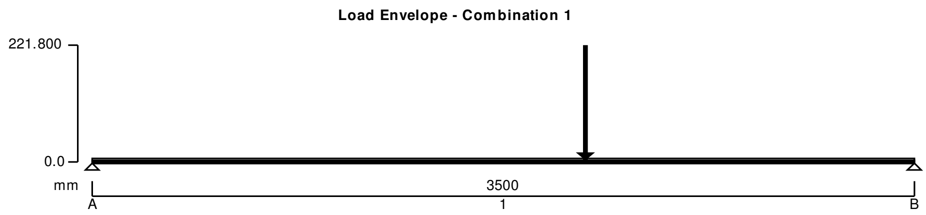
IL = 1.5 X 0.5 = 0.75KN/m

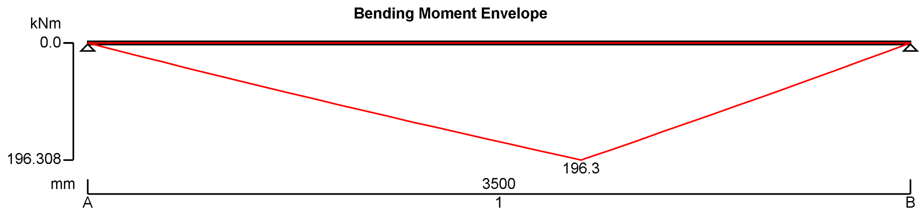
STEEL BEAM ANALYSIS & DESIGN (BS5950)

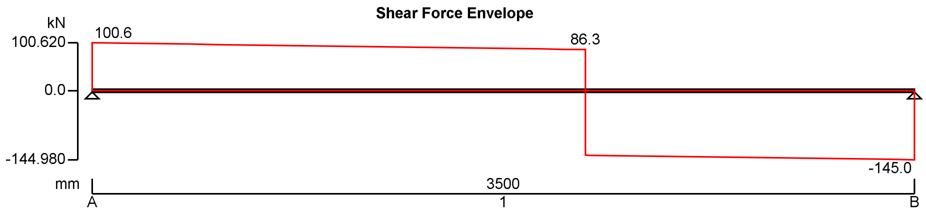
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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

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 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	δ_{max} = **1.4** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **100.6** kN	R_{A_min} = **100.6** kN

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

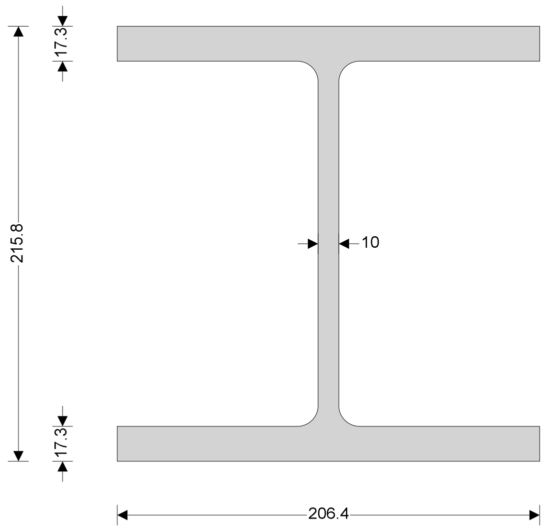
Maximum reaction at support B R_{B_max} = **145** kN R_{B_min} = **145** kN

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 ε = **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 δ_{lim} = **9.722** mm Maximum deflection δ = **1.395** mm

PASS - Maximum deflection does not exceed deflection limit

<u>203 x 203 x 71 UC</u>

BASEMENT

WALL UDLS

(BASED UPON NEW EXTENSION TO UPPER FLOORS)

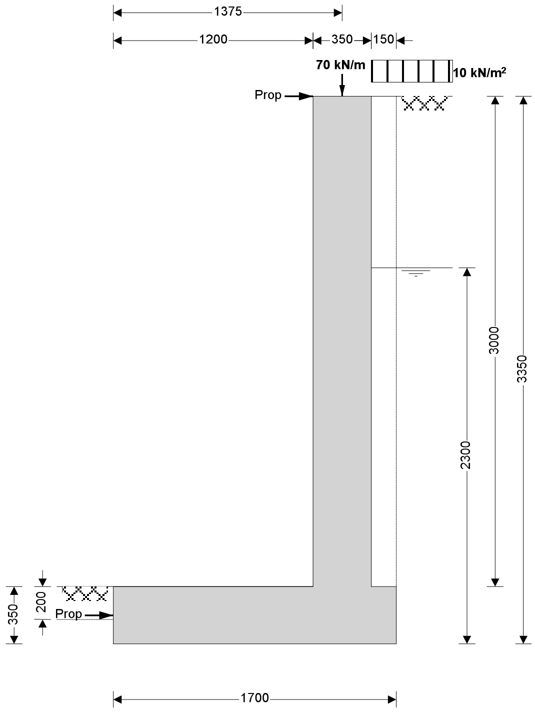
PARTY WALLS				
WALL	10 X 4.6	=	46.00	
ROOF DL	2.5 X 1	=	2.50	
ROOF IL	2.5 X 0.75	=		1.90
GROUND FLOOR DL	2.5 X 6.1	=	15.30	
GROUND FLOOR IL	2.5 X 1.5	=	____	3.80
			63.80KN/m	5.70KN/m
FRONT WALL				
ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=		1.50
1^{ST} & 2^{ND} FLR DL	2 X 0.5 X 2	=	2.00	
1^{ST} & 2^{ND} 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	=	0.50	____
			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	=	0.50	____
			24.10 KN/m	7.50KN/m

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	**Cantilever**		
Height of wall stem	h_{stem} = **3000** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1200** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **1700** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3350** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **1250** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **200** mm
Height of ground water	h_{water} = **2300** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3350** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **0.0** deg
Design shear strength	ϕ'_b = **24.2** deg	Design base friction	δ_b = **18.6** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **100** kN/m^2

Using Coulomb theory

Active pressure	K_a =**0.419**	Passive pressure	K_p = **4.187**
At-rest pressure	K_0 = **0.590**		

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY	Project 1 SPENCER RISE LONDON NW5 1AR				Job Ref. 18B06	
	Section NEW BASEMENT STRUCTURE				Sheet no./rev. 20	
	Calc. by TV	Date 23/03/2018	Chk'd by	Date	App'd by	Date

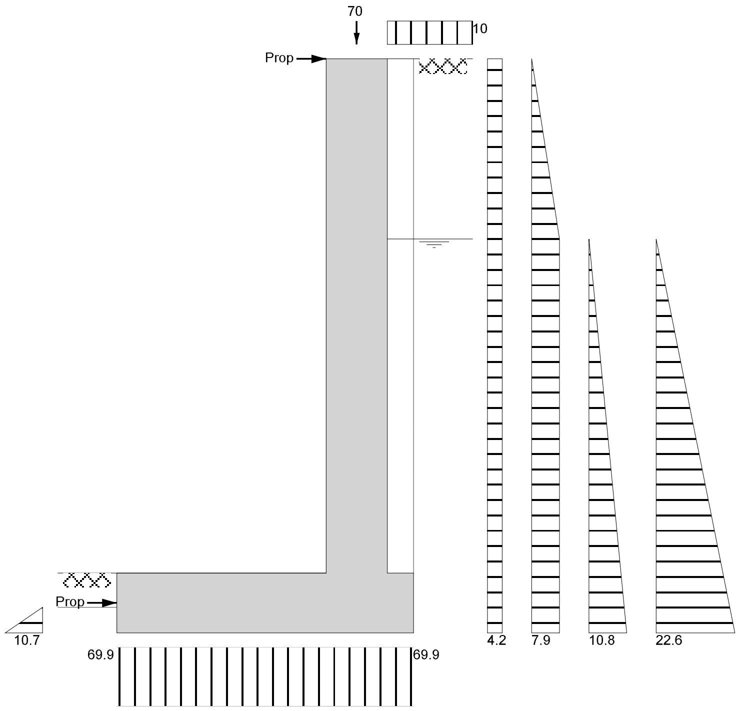
Loading details

Surcharge load — Surcharge = **10.0** kN/m^2

Vertical dead load — W_{dead} = **63.8** kN/m — Vertical live load — W_{live} = **5.7** kN/m

Horizontal dead load — F_{dead} = **0.0** kN/m — Horizontal live load — F_{live} = **0.0** kN/m

Position of vertical load — l_{load} = **1375** mm — Height of horizontal load — h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Calculate propping force

Propping force — F_{prop} = **36.3** kN/m

Check bearing pressure

Total vertical reaction — R = **118.8** kN/m — Distance to reaction — x_{bar} = **850** mm

Eccentricity of reaction — e = **0** mm

Reaction acts within middle third of base

Bearing pressure at toe — p_{toe} = **69.9** kN/m^2 — Bearing pressure at heel — p_{heel} = **69.9** 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} = **9.795** kN/m — Propping force to base of wall — F_{prop_base} = **26.545** kN/m

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4** Live load factor γ_{f_l} = **1.6**

Earth pressure factor γ_{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/mm^2 Strength of reinforcement f_y = **500** N/mm^2

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** mm^2/m Area provided $A_{s\_toe\_prov}$ = **754** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.356** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.507** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

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

Material properties

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

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/mm^2 Strength of reinforcement f_y = **500** N/mm^2

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**

Area required $A_{s\_stem\_req}$ = **455.0** mm^2/m Area provided $A_{s\_stem\_prov}$ = **754** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.314** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.534** 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** kNm/m

Compression reinforcement is not required

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

Area required $A_{s\_wall\_req}$ = **455.0** mm^2/m Area provided $A_{s\_wall\_prov}$ = **754** mm^2/m

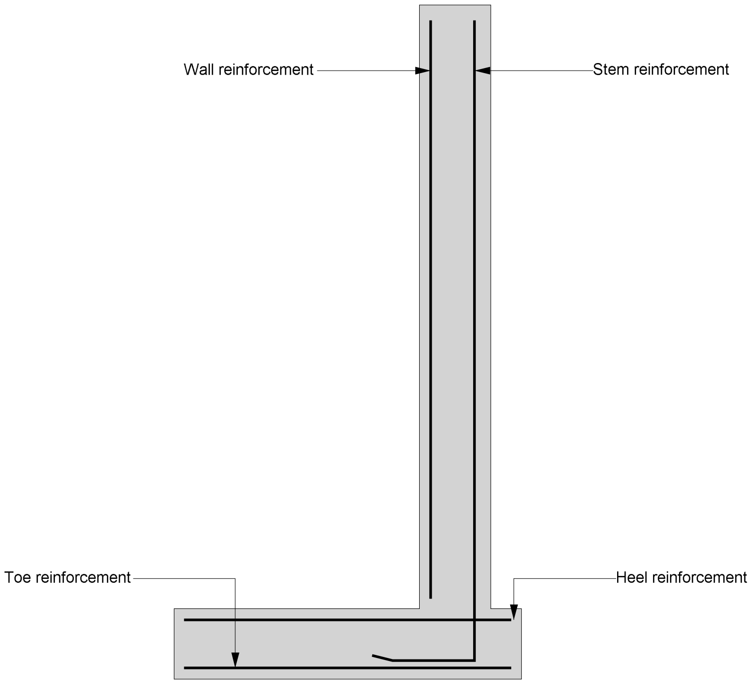
PASS - Reinforcement provided to the retaining wall at mid height is adequate

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

Indicative retaining wall reinforcement diagram



Toe bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)

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

Wall bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)

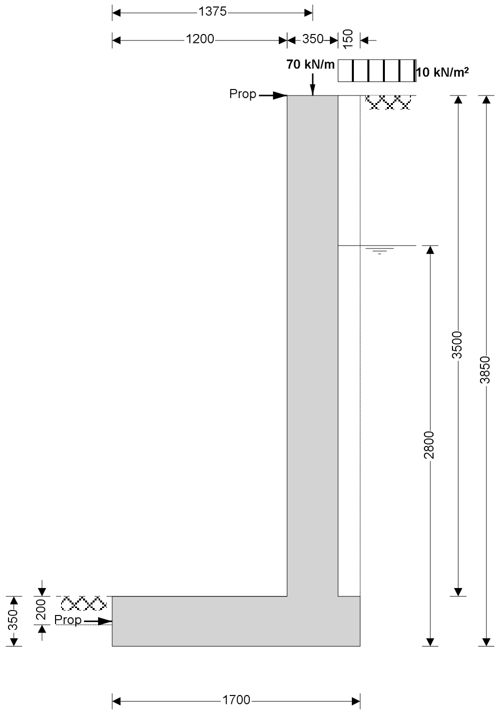
Stem bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)

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	**Cantilever**		
Height of wall stem	h_{stem} = **3500** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1200** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **1700** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3850** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **1250** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **200** mm
Height of ground water	h_{water} = **2800** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3850** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **0.0** deg
Design shear strength	ϕ'_b = **24.2** deg	Design base friction	δ_b = **18.6** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **100** kN/m^2

Using Coulomb theory

Active pressure	K_a =**0.419**	Passive pressure	K_p = **4.187**
At-rest pressure	K_0 = **0.590**		

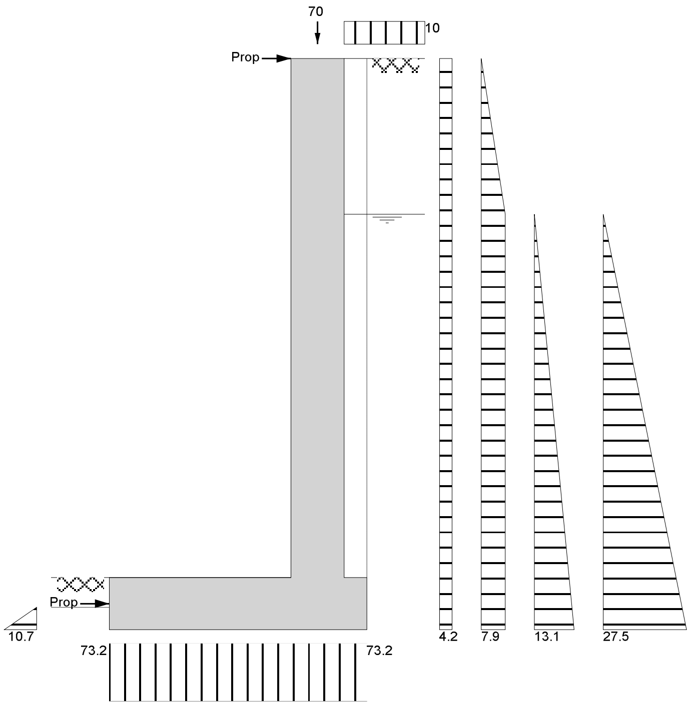
Loading details

Surcharge load — Surcharge = **10.0** kN/m^2

Vertical dead load — W_{dead} = **63.8** kN/m — Vertical live load — W_{live} = **5.7** kN/m

Horizontal dead load — F_{dead} = **0.0** kN/m — Horizontal live load — F_{live} = **0.0** kN/m

Position of vertical load — l_{load} = **1375** mm — Height of horizontal load — h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Calculate propping force

Propping force — F_{prop} = **58.9** kN/m

Check bearing pressure

Total vertical reaction — R = **124.5** kN/m — Distance to reaction — x_{bar} = **850** mm

Eccentricity of reaction — e = **0** mm

Reaction acts within middle third of base

Bearing pressure at toe — p_{toe} = **73.2** kN/m^2 — Bearing pressure at heel — p_{heel} = **73.2** 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} = **18.254** kN/m — Propping force to base of wall — F_{prop_base} = **40.692** kN/m

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4** Live load factor γ_{f_l} = **1.6**

Earth pressure factor γ_{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/mm^2 Strength of reinforcement f_y = **500** N/mm^2

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** mm^2/m Area provided $A_{s\_toe\_prov}$ = **754** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.375** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.507** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

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

Material properties

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

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/mm^2 Strength of reinforcement f_y = **500** N/mm^2

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**

Area required $A_{s\_stem\_req}$ = **641.3** mm^2/m Area provided $A_{s\_stem\_prov}$ = **754** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.426** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.534** 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** kNm/m

Compression reinforcement is not required

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

Area required $A_{s\_wall\_req}$ = **455.0** mm^2/m Area provided $A_{s\_wall\_prov}$ = **754** mm^2/m

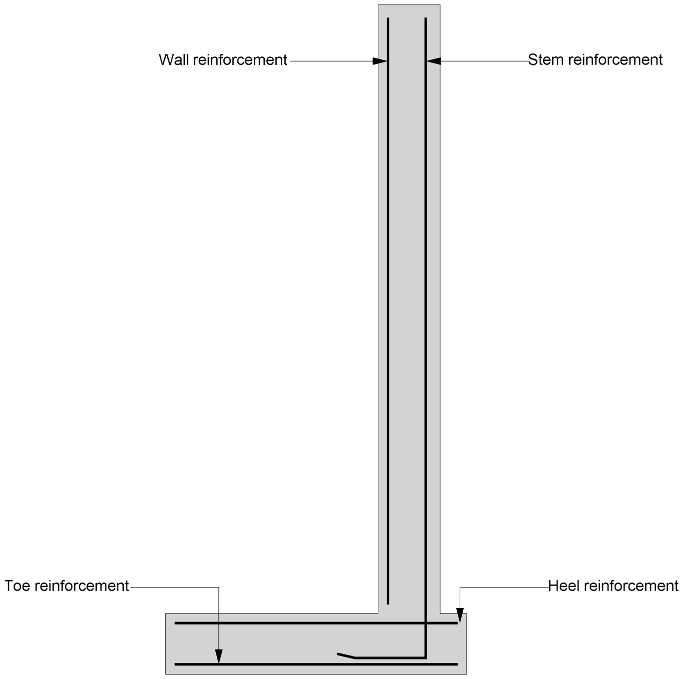
PASS - Reinforcement provided to the retaining wall at mid height is adequate

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

Indicative retaining wall reinforcement diagram



Toe bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
The design of the retaining wall heel is beyond the scope of this calculation!
Wall bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Stem bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)

FRONT WALL AND REAR WALL RETURNS.

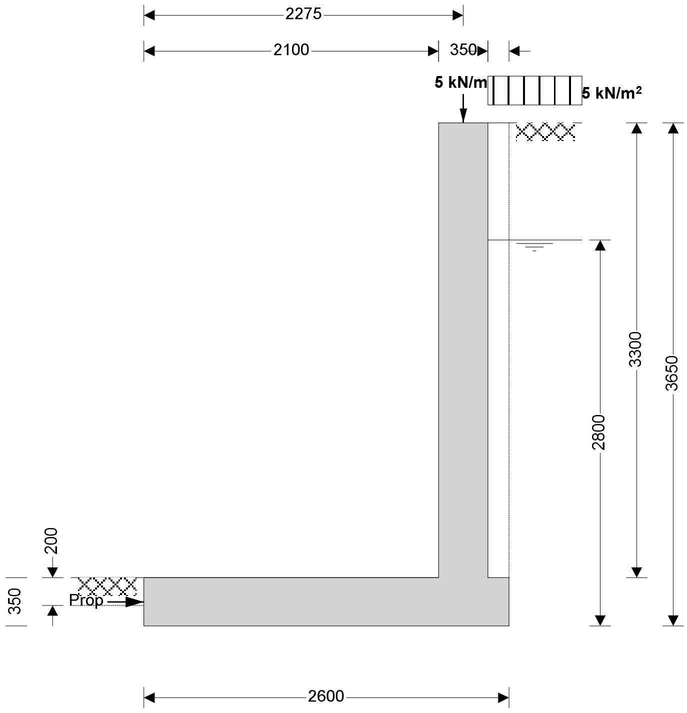
BY INSPECTION WILL BE NO MORE ONEROUS THAT PARTY WALLS THEREFORE USE SAME CONCRETE SECTIONS AND REINFORCEMENT.

FRONT AND REAR LIGHTWELL WALLS

RETAINING WALL ANALYSIS & DESIGN (BS8002)

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

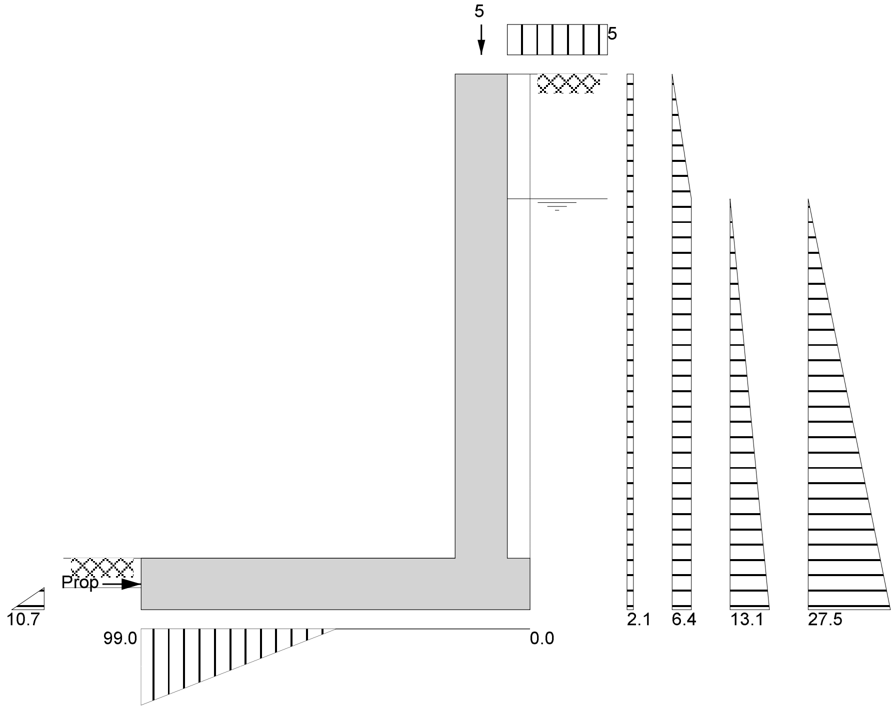
Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **3300** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **2100** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **2600** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **3650** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **1900** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **200** mm
Height of ground water	h_{water} = **2800** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3650** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **0.0** deg
Design shear strength	ϕ'_b = **24.2** deg	Design base friction	δ_b = **18.6** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **100** kN/m^2

Using Coulomb theory

Active pressure	K_a =**0.419**	Passive pressure	K_p = **4.187**
At-rest pressure	K_0 = **0.590**		

Loading details

Surcharge load	Surcharge = **5.0** kN/m^2		
Vertical dead load	W_{dead} = **5.0** kN/m	Vertical live load	W_{live} = **0.0** kN/m
Horizontal dead load	F_{dead} = **0.0** kN/m	Horizontal live load	F_{live} = **0.0** kN/m
Position of vertical load	l_{load} = **2275** mm	Height of horizontal load	h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Calculate propping force

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

Check bearing pressure

Total vertical reaction R = **64.5** kN/m Distance to reaction x_{bar} = **435** mm

Eccentricity of reaction e = **865** mm

Reaction acts outside middle third of base

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

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4** Live load factor γ_{f_l} = **1.6**

Earth pressure factor γ_{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/mm^2 Strength of reinforcement f_y = **500** N/mm^2

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** mm^2/m Area provided $A_{s\_toe\_prov}$ = **2011** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.083** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.706** N/mm^2

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

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

Material properties

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

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** mm^2/m Area provided $A_{s\_heel\_prov}$ = **754** mm^2/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.058** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_heel} = **0.507** N/mm^2

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

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

Material properties

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

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} = **4.0** kN/m Moment at base of stem M_{stem} = **138.3** 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** mm^2/m Area provided $A_{s\_stem\_prov}$ = **2011** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

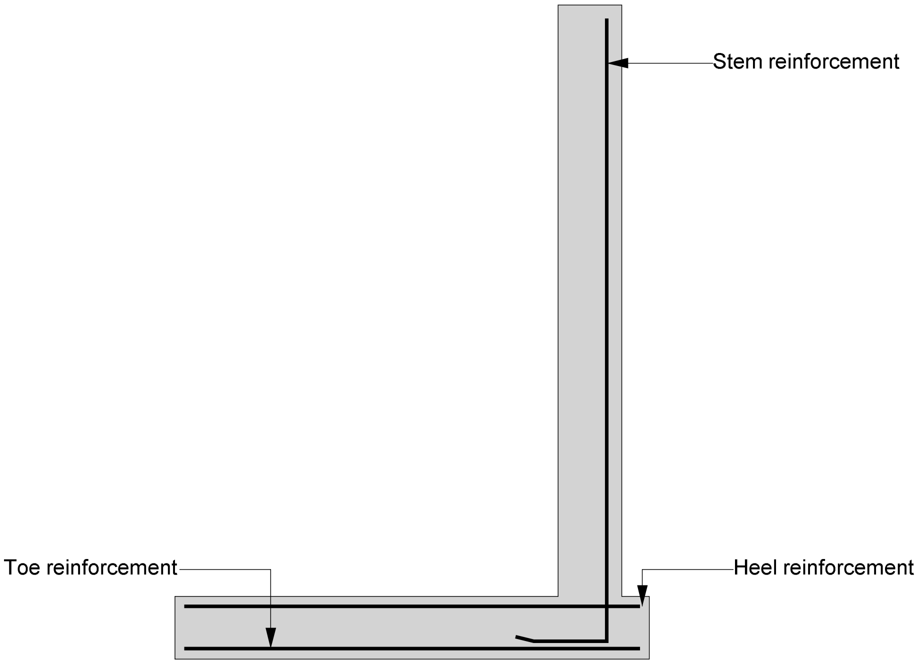
Design shear stress v_{stem} = **0.015** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.744** N/mm^2

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

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)
Heel bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Stem bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/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 3.5 ^{2} / 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** mm

Characteristic strength of reinforcement f_y = **500** N/mm^2

Characteristic strength of concrete f_{cu} = **35** N/mm^2

<u>ONE WAY SPANNING SLAB (CL 3.5.4)</u>

<u>MAXIMUM DESIGN MOMENTS IN SPAN</u>

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

<u>CONCRETE SLAB DESIGN – SAGGING – OUTER LAYER OF STEEL (CL 3.5.4)</u>

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

Moment Redistribution Factor β_{bx} = **1.0**

Area of reinforcement required

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

<u>Slab requiring outer tension steel only - bars (sagging)</u>

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

Neutral axis depth $x_x = (d_x - z_x) / 0.45$ = **32** mm

Area of tension steel required

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

Tension steel

<u>Provide 16 dia bars @ 200 centres outer tension steel resisting sagging</u>

$A_{sx\_prov} = A_{sx}$ = **1010** mm^2/m

Area of outer tension steel provided sufficient to resist sagging

<u>TRANSVERSE BOTTOM STEEL - INNER</u>

Inner layer of transverse steel

<u>Provide 12 dia bars @ 100 centres</u>

$A_{sy\_prov} = A_{sy}$ = **1130** mm^2/m

<u>Check min and max areas of steel resisting sagging</u>

Total area of concrete $A_c = h$ = **350000** mm^2/m

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c$ = **455** mm^2/m

$A_{st\_max} = 4\ \% \times A_c$ = **14000** mm^2/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **1010** mm^2/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **1130** mm^2/m

Area of inner steel provided (sagging) OK

<u>CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)</u>

Slab span length l_x = **3.500** m

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

Depth to outer tension steel d_x = **292** mm

Tension steel

Area of outer tension reinforcement provided A_{sx_prov} = **1010** mm^2/m

Area of tension reinforcement required A_{sx_req} = **423** mm^2/m

Moment Redistribution Factor β_{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** N/mm^2

$factor_{tens} = \min(2, 0.55 + (477 N/mm^2 - f_s) / (120 \times (0.9 N/mm^2 + m_{sx} / d_x^2)))$ = **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 span $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x$ = **11.68** m

Check the actual beam span

Actual span/depth ratio l_x / d_x = **11.99**

Span 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/m^2, IL = 1.50 KN/m^2
ULT BM = 7.2KN.m

UPLIFT
WATER – DL = 28 – 6.8 = 21.2KN/m

ULT BM = 21.2 X 2.2^2 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

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** mm

Characteristic strength of reinforcement f_y = **500** N/mm^2

Characteristic strength of concrete f_{cu} = **35** 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} = **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 β_{bx} = **1.0**

Area of reinforcement required

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

Neutral axis depth $x_x = (d_x - z_x) / 0.45$ = **16** mm

Area of tension steel required

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

Tension steel

Use A393 Mesh

$A_{sx\_prov} = A_{sl}$ = **393** mm^2/m $A_{sy\_prov} = A_{st}$ = **393** mm^2/m

$D_x = d_{sl}$ = **10** mm $D_y = d_{st}$ = **10** 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** mm^2/m

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c$ = **260** mm^2/m

$A_{st\_max} = 4 \% \times A_c$ = **8000** mm^2/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **393** mm^2/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **393** mm^2/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

Depth to outer tension steel d_x = **145** mm

Tension steel

Area of outer tension reinforcement provided A_{sx_prov} = **393** mm^2/m

Area of tension reinforcement required A_{sx_req} = **301** mm^2/m

Moment Redistribution Factor β_{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** N/mm^2

$factor_{tens} = \min (2 , 0.55 + (477 N/mm^2 - f_s) / (120 \times (0.9 N/mm^2 + m_{sx} / d_x^2)))$ = **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 span $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x$ = **4.65** m

Check the actual beam span

Actual span/depth ratio l_x / d_x = **15.17**

Span depth limit $ratio_{span\_depth} \times factor_{tens}$ = **32.08**

Span/Depth ratio check satisfied

<u>1 LAYER A393 FABRIC TOP AND BOTTOM 50 COVER</u>