GARDEN		**EXISTING REAR WALL**		
FINISH	4.50	330 WALL	11 X 6.6 = 66KN/m	
SOIL	14.50			
	19.00KN/m^2			
IL	2.50KN/m^2			
GROUND FLOOR				
FINISH	2.00			
SLAB	3.60			
	5.60KN/m^2			
IL	1.50KN/m^2			
NEW EXTERNAL WALL	3.30KN/m^2			

ROOF SLAB UNDER GARDEN

DESIGN LOAD = 30.6KN/m^2

BM MAX = 30.6 X 3.8^{2} / 8 = 55.2KN.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 = **35** mm

Trial bar diameter D_{tryx} = **16** mm

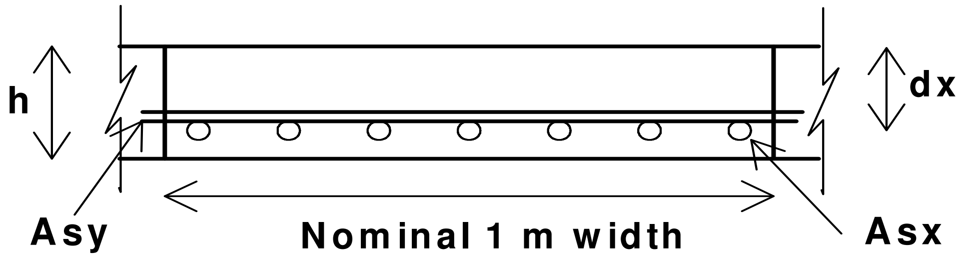
Depth to tension steel (resisting sagging)

$d_x = h - c_b - D_{tryx}/2$ = **157** mm

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

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

V&R VINCENT & RYMILL	Project				Job Ref.	
	28 MARESFIELD GARDENS NW3 5SX				16H02	
VINCENT & RYMILL	Section				Sheet no./rev.	
LAKESIDE COUNTRY CLUB	PRELIMINARY CALCULATIONS				2	
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY GU16 6PT	TV	11/09/2016				



One-way spanning slab

(simple)

<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} = **55.0** 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} = **55.0** kNm/m

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

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu})$ = **0.064**

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

Outer compression steel not required to resist sagging

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

$z_x = \min ((0.95 \times d_x),(d_x \times (0.5+\sqrt{(0.25-K_x/0.9)})))$ = **145** mm

Neutral axis depth $x_x = (d_x - z_x) / 0.45$ = **27** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x)$ = **873** mm^2/m

Tension steel

<u>Provide 16 dia bars @ 150 centres outer tension steel resisting sagging</u>

$A_{sx\_prov} = A_{sx}$ = **1340** 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 10 dia bars @ 200 centres</u>

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

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

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} = **1340** 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 = **3.800** m

Design ultimate moment in shorter span per m width m_{sx} = **55** kNm/m

Depth to outer tension steel d_x = **157** mm

Tension steel

Area of outer tension reinforcement provided A_{sx_prov} = **1340** mm^2/m

Area of tension reinforcement required A_{sx_req} = **873** 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.

$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx})$ = **217.1** N/mm^2

$factor_{tens} = \min(2, 0.55 + (477 \text{ N/mm}^2 - f_s) / (120 \times (0.9 \text{ N/mm}^2 + m_{sx} / d_x^2)))$ = **1.242**

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 $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x$ = **3.90** m

Check the actual beam span

Actual span/depth ratio l_x / d_x = **24.20**

Span depth limit $ratio_{span\_depth} \times factor_{tens}$ = **24.83**

Span/Depth ratio check satisfied

CHECK OF NOMINAL COVER (SAGGING) – (BS8110:PT 1, TABLE 3.4)

Slab thickness h = **200** mm

Effective depth to bottom outer tension reinforcement d_x = **157.0** mm

Diameter of tension reinforcement D_x = **16** mm

Diameter of links L_{diax} = **0** mm

Cover to outer tension reinforcement

$c_{tenx} = h - d_x - D_x / 2$ = **35.0** mm

Nominal cover to links steel

$c_{nomx} = c_{tenx} - L_{diax}$ = **35.0** mm

Permissable minimum nominal cover to all reinforcement (Table 3.4)

c_{min} = **35** mm

Cover over steel resisting sagging OK

H16 AT 150 BOTTOM , H10 200 DISTN

SLAB UNDER HOUSE

DESIGN LOAD = 10.3KN/m^2
BM ULT = 10.3 X 3.6^2 / 8 = 17KN.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 = **150** mm

Cover to tension reinforcement resisting sagging c_b = **35** mm

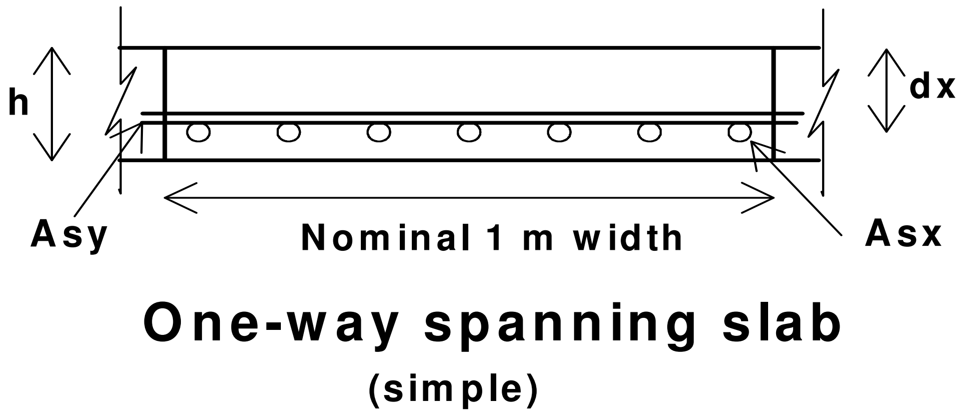
Trial bar diameter D_{tryx} = **12** mm

Depth to tension steel (resisting sagging)

$d_x = h - c_b - D_{tryx}/2$ = **109** 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} = **17.0** kNm/m

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

Design sagging moment (per m width of slab) m_{sx} = **17.0** kNm/m

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

Area of reinforcement required

K_x = abs(m_{sx}) / ($d_x^2 \times f_{cu}$) = **0.041**

K'_x = min (0.156 , (0.402 × (β_{bx} - 0.4)) - (0.18 × (β_{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 × d_x),(d_x×(0.5+√(0.25-K_x/0.9)))) = **104** mm

Neutral axis depth x_x = (d_x - z_x) / 0.45 = **12** mm

Area of tension steel required

A_{sx_req} = abs(m_{sx}) / (1/γ_{ms} × f_y × z_x) = **378** mm^2/m

Tension steel

<u>Provide 12 dia bars @ 150 centres outer tension steel resisting sagging</u>

A_{sx_prov} = A_{sx} = **754** 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 10 dia bars @ 200 centres</u>

A_{sy_prov} = A_{sy} = **393** mm^2/m

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

Total area of concrete A_c = h = **150000** mm^2/m

Minimum % reinforcement k = **0.13** %

A_{st_min} = k × A_c = **195** mm^2/m

A_{st_max} = 4 % × A_c = **6000** mm^2/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **754** 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

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

Slab span length l_x = **3.600** m

Design ultimate moment in shorter span per m width m_{sx} = **17** kNm/m

Depth to outer tension steel d_x = **109** mm

Tension steel

Area of outer tension reinforcement provided A_{sx_prov} = **754** mm^2/m

Area of tension reinforcement required A_{sx_req} = **378** 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 × f_y × A_{sx_req} / (3 × A_{sx_prov} × β_{bx}) = **166.9** N/mm^2

$factor_{tens}$ = min (2 , 0.55 + (477 N/mm^2 - f_s) / (120 × (0.9 N/mm^2 + m_{sx} / d_x^2))) = **1.659**

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} = $ratio_{span\_depth} \times factor_{tens} \times d_x$ = **3.62** m

Check the actual beam span

Actual span/depth ratio l_x / d_x = **33.03**

Span depth limit $ratio_{span\_depth} \times factor_{tens}$ = **33.17**

Span/Depth ratio check satisfied

CHECK OF NOMINAL COVER (SAGGING) – (BS8110:PT 1, TABLE 3.4)

Slab thickness h = **150** mm

Effective depth to bottom outer tension reinforcement d_x = **109.0** mm

Diameter of tension reinforcement D_x = **12** mm

Diameter of links L_{diax} = **0** mm

Cover to outer tension reinforcement

c_{tenx} = h - d_x - D_x / 2 = **35.0** mm

Nominal cover to links steel

c_{nomx} = c_{tenx} - L_{diax} = **35.0** mm

Permissable minimum nominal cover to all reinforcement (Table 3.4)

c_{min} = **35** mm

Cover over steel resisting sagging OK

H12 AT 150 BOTTOM AND H10 200 DISTN

SECONDARY BEAM UNDER GARDEN

SPAN = 5.50m

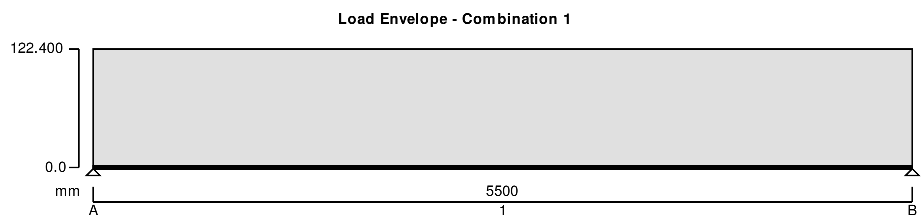
DL = 4 X 19 = 76KN/m

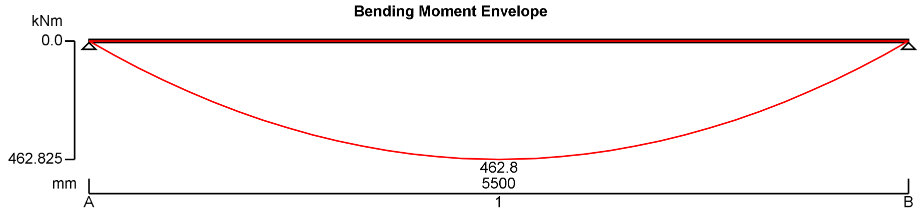
IL = 4 X 2.5 = 10KN/m

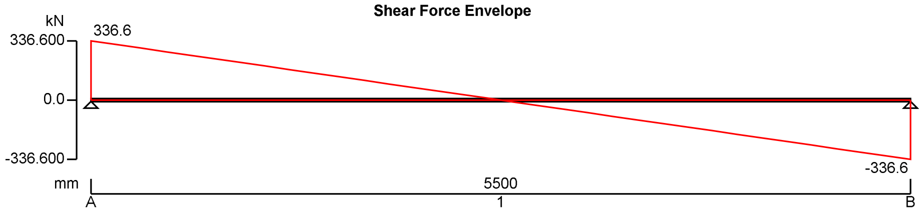
RC BEAM ANALYSIS & DESIGN (BS8110)

RC BEAM ANALYSIS & DESIGN BS8110

TEDDS calculation version 2.1.12







Support conditions

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

Applied loading

Dead full UDL 76 kN/m

Imposed full UDL 10 kN/m

Load combinations

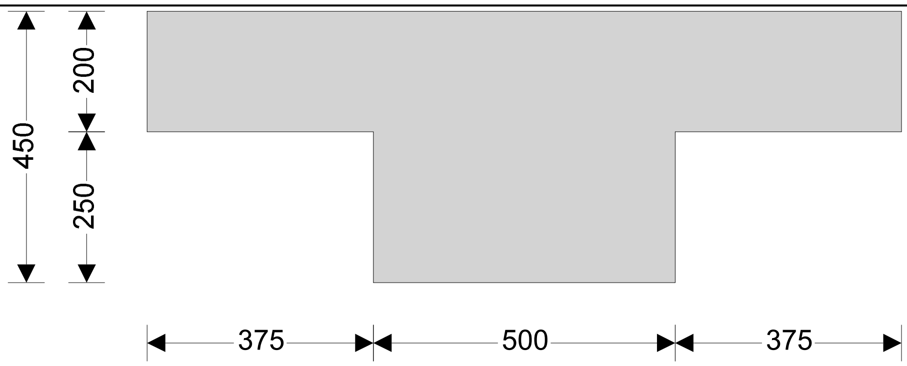
Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm
Maximum moment span 1 at 2750 mm	M_{s1_max} = **463** kNm	M_{s1_red} = **463** kNm
Maximum moment support B	M_{B_max} = **0** kNm	M_{B_red} = **0** kNm
Maximum shear support A	V_{A_max} = **337** kN	V_{A_red} = **337** kN
Maximum shear support A span 1 at 400 mm	$V_{A\_s1\_max}$ = **288** kN	$V_{A\_s1\_red}$ = **288** kN
Maximum shear support B	V_{B_max} = **-337** kN	V_{B_red} = **-337** kN
Maximum shear support B span 1 at 5100 mm	$V_{B\_s1\_max}$ = **-288** kN	$V_{B\_s1\_red}$ = **-288** kN
Maximum reaction at support A	R_A = **337** kN	
Maximum reaction at support B	R_B = **337** kN	

Flanged section details

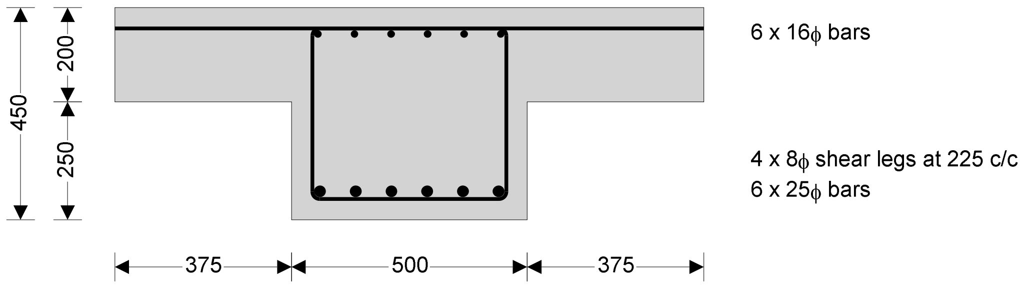
Section width	b = **500** mm	Section depth	h = **450** mm
Maximum flange width	b_f = **1250** mm	Flange depth	h_f = **200** mm



Material details

Concrete strength class	**C35/45**	Char comp cube strength	f_{cu} = **45** N/mm^2
Modulus of elasticity of conc	E_c = **29000** N/mm^2	Maximum aggregate size	h_{agg} = **20** mm
Char yield strength of reinf	f_y = **500** N/mm^2	Char yield str of shear reinf	f_{yv} = **500** N/mm^2
Nominal cover to top reinf	c_{nom_t} = **40** mm	Nominal cover to bottom reinf	c_{nom_b} = **40** mm
Nominal cover to side reinf	c_{nom_s} = **40** mm		

<u>Mid span 1</u>



Flanged section in flexure

Design bending moment M = **463** kNm K = **0.054** K' = **0.156**

K' > K - No compression reinforcement is required

Lever arm	z = **364** mm	Depth of neutral axis	x = **56** mm
Area of tension reinf req'd	$A_{s,req}$ = **2920** mm^2	Tension reinf provided	6 × 25ϕ bars
Area of tension reinf prov	$A_{s,prov}$ = **2945** mm^2	Minimum area of reinf	$A_{s,min}$ = **293** mm^2
Maximum area of reinf	$A_{s,max}$ = **?** mm^2		

Rectangular section in shear

Shear reinforcement provided 4 × 8ϕ legs at 225 c/c

Area of shear reinf provided $A_{sv,prov}$ = **894** mm^2/m Minimum area of shear reinf $A_{sv,min}$ = **460** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Max longitudinal spacing $s_{vl,max}$ = **292** mm

PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Spacing of reinforcement (cl 3.12.11)

Actual dist between bars s = **51** mm Min dist between bars s_{min} = **25** mm

PASS - Satisfies the minimum spacing criteria

Design service stress f_s = **330.4** N/mm^2 Max distance between bars s_{max} = **142** mm

PASS - Satisfies the maximum spacing criteria

Span to depth ratio (cl. 3.4.6)

Span to depth ratio (T.3.9) $span\_to\_depth_{basic}$ = **16.6**

Service stress in tension rein f_s = **330.4** N/mm^2

Modification for tension reinf f_{tens} = **0.916**

Modification for comp reinf f_{comp} = **1.076**

Modification for span > 10m f_{long} = **1.000**

Allowable span to depth ratio $span\_to\_depth_{allow}$ = **16.3**

Actual span to depth ratio $span\_to\_depth_{actual}$ = **14.1**

PASS - Actual span to depth ratio is within the allowable limit

<u>6 H25 BOTTOM H8 LINKS IN PAIRS AT 225</u>

<u>UNDER HOUSE</u>

Max span = 5.50m

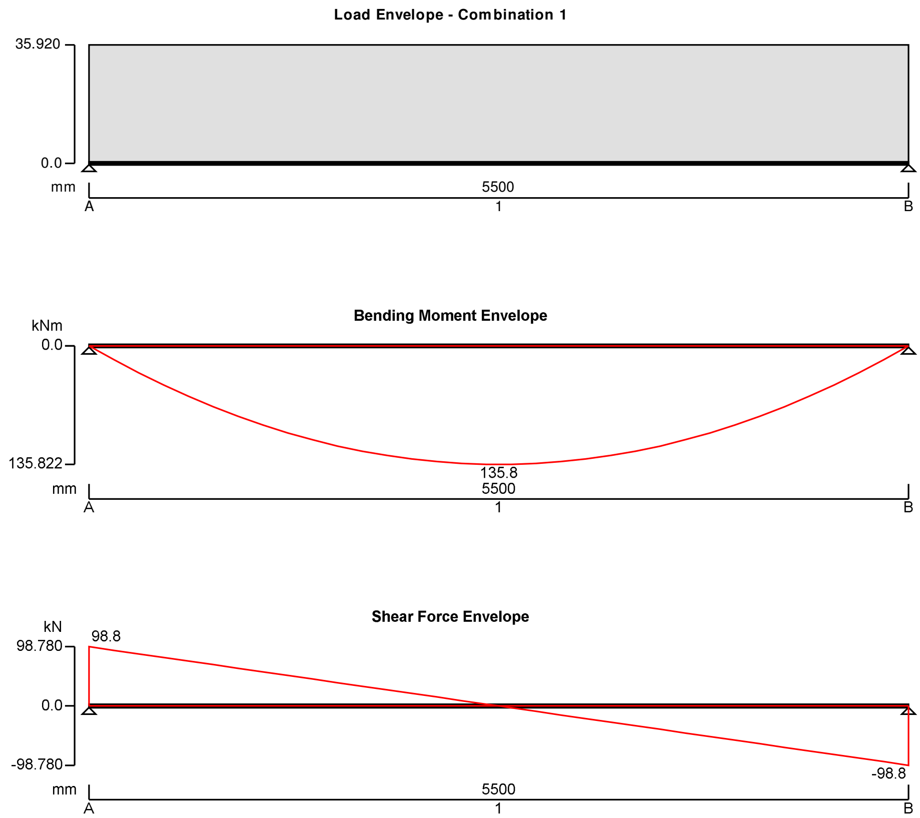
DL = 5.6 X 3.5 = 19.6KN/m

IL = 1.5 X 3.5 = 5.3KN/m

RC BEAM ANALYSIS & DESIGN (BS8110)

RC BEAM ANALYSIS & DESIGN BS8110

TEDDS calculation version 2.1.12



Support conditions

Support A Vertically restrained

Rotationally free

Support B Vertically restrained

Rotationally free

Applied loading

Dead full UDL 19.6 kN/m
Imposed full UDL 5.3 kN/m

Load combinations

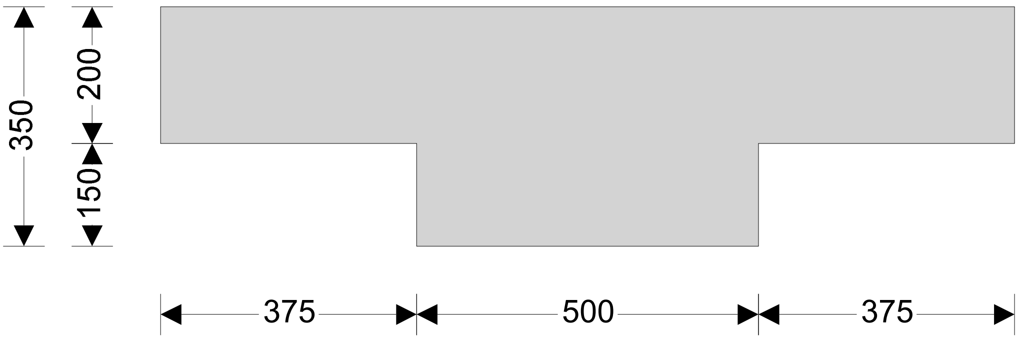
Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm
Maximum moment span 1 at 2750 mm	M_{s1_max} = **136** kNm	M_{s1_red} = **136** kNm
Maximum moment support B	M_{B_max} = **0** kNm	M_{B_red} = **0** kNm
Maximum shear support A	V_{A_max} = **99** kN	V_{A_red} = **99** kN
Maximum shear support A span 1 at 300 mm	$V_{A\_s1\_max}$ = **88** kN	$V_{A\_s1\_red}$ = **88** kN
Maximum shear support B	V_{B_max} = **-99** kN	V_{B_red} = **-99** kN
Maximum shear support B span 1 at 5200 mm	$V_{B\_s1\_max}$ = **-88** kN	$V_{B\_s1\_red}$ = **-88** kN
Maximum reaction at support A	R_A = **99** kN	
Maximum reaction at support B	R_B = **99** kN	

Flanged section details

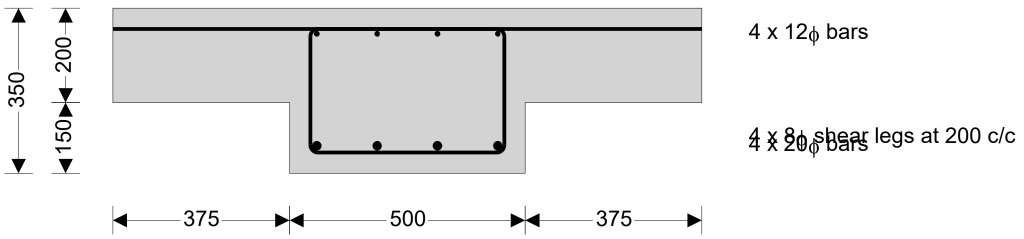
Section width	b = **500** mm	Section depth	h = **350** mm
Maximum flange width	b_f = **1250** mm	Flange depth	h_f = **200** mm



Material details

Concrete strength class	**C35/45**	Char comp cube strength	f_{cu} = **45** N/mm^2
Modulus of elasticity of conc	E_c = **29000** N/mm^2	Maximum aggregate size	h_{agg} = **20** mm
Char yield strength of reinf	f_y = **500** N/mm^2	Char yield str of shear reinf	f_{yv} = **500** N/mm^2
Nominal cover to top reinf	c_{nom_t} = **40** mm	Nominal cover to bottom reinf	c_{nom_b} = **40** mm
Nominal cover to side reinf	c_{nom_s} = **40** mm		

Mid span 1



Flanged section in flexure

Design bending moment M = **136** kNm K = **0.028** K' = **0.156**

K' > K - No compression reinforcement is required

Lever arm	z = **277** mm	Depth of neutral axis	x = **32** mm
Area of tension reinf req'd	$A_{s,req}$ = **1126** mm^2	Tension reinf provided	4 × 20ϕ bars
Area of tension reinf prov	$A_{s,prov}$ = **1257** mm^2	Minimum area of reinf	$A_{s,min}$ = **228** mm^2
Maximum area of reinf	$A_{s,max}$ = **?** mm^2		

Rectangular section in shear

Shear reinforcement provided 4 × 8ϕ legs at 200 c/c

Area of shear reinf provided $A_{sv,prov}$ = **1005** mm^2/m Minimum area of shear reinf $A_{sv,min}$ = **460** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Max longitudinal spacing $s_{vl,max}$ = **219** mm

PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Spacing of reinforcement (cl 3.12.11)

Actual dist between bars s = **108** mm Min dist between bars s_{min} = **25** mm

PASS - Satisfies the minimum spacing criteria

Design service stress f_s = **298.6** N/mm^2 Max distance between bars s_{max} = **157** mm

PASS - Satisfies the maximum spacing criteria

Span to depth ratio (cl. 3.4.6)

Span to depth ratio (T.3.9)	$span\_to\_depth_{basic}$ = **16.6**	Service stress in tension rein	f_s = **298.6** N/mm^2
Modification for tension reinf	f_{tens} = **1.234**	Modification for comp reinf	f_{comp} = **1.040**
Modification for span > 10m	f_{long} = **1.000**	Allowable span to depth ratio	$span\_to\_depth_{allow}$ = **21.3**
Actual span to depth ratio	$span\_to\_depth_{actual}$ = **18.8**		

PASS - Actual span to depth ratio is within the allowable limit

4 H20 BOTTOM + H8 LINKS IN PAIRS AT 200

MAIN SPINE BEAM

SPAN = 9.70m

TAKE SLBA AS UDL BETWEEN 1.8 AND 7.0m

DEAD LOAD = 5.5 /2 X (19 + 5.6) = 68KN/m

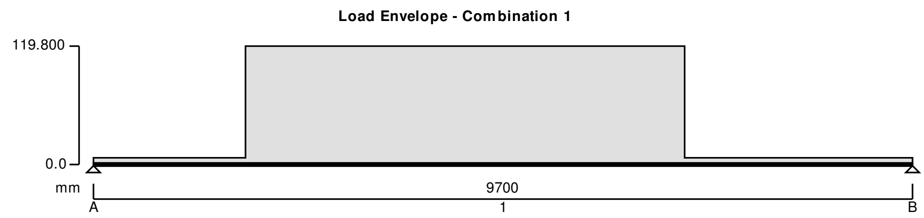
IL = 5.5 / 2 X (2.5 + 1.5) = 11KN/m

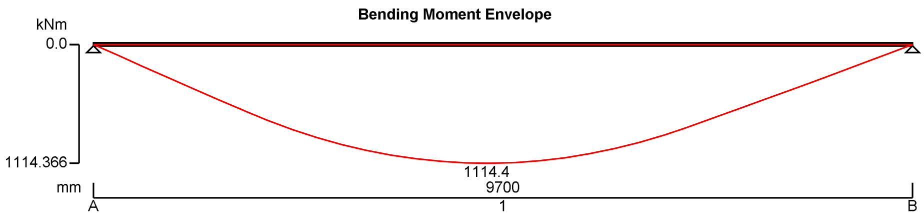
RC BEAM ANALYSIS & DESIGN (BS8110)

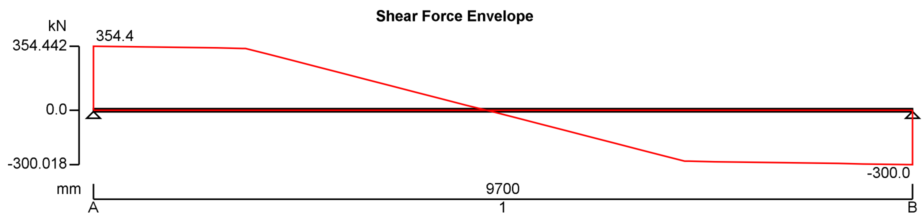
RC BEAM ANALYSIS & DESIGN BS8110

TEDDS calculation version 2.1.12

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY GU16 6PT	Project 28 MARESFIELD GARDENS NW3 5SX	Job Ref. 16H02
	Section PRELIMINARY CALCULATIONS	Sheet no./rev. 12
	Calc. by: TV · Date: 11/09/2016 · Chk'd by: · Date:	App'd by: · Date:







Support conditions

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

Applied loading

Dead partial UDL 68 kN/m from 1800 mm to 7000 mm
Imposed partial UDL 11 kN/m from 1800 mm to 7000 mm
Dead full UDL 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

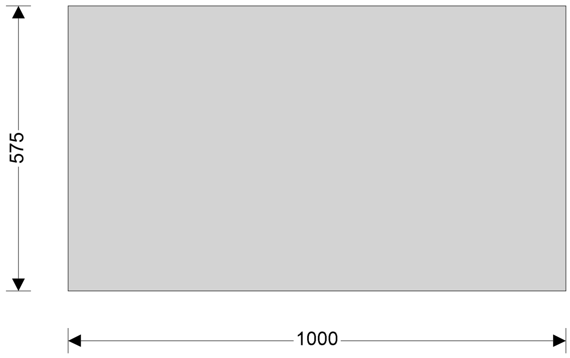
Analysis results

Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm
Maximum moment span 1 at 4653 mm	M_{s1_max} = **1114** kNm	M_{s1_red} = **1114** kNm
Maximum moment support B	M_{B_max} = **0** kNm	M_{B_red} = **0** kNm
Maximum shear support A	V_{A_max} = **354** kN	V_{A_red} = **354** kN
Maximum shear support A span 1 at 525 mm	$V_{A\_s1\_max}$ = **351** kN	$V_{A\_s1\_red}$ = **351** kN

Maximum shear support B	V_{B_max} = **-300** kN	V_{B_red} = **-300** kN
Maximum shear support B span 1 at 9175 mm	$V_{B\_s1\_max}$ = **-296** kN	$V_{B\_s1\_red}$ = **-296** kN
Maximum reaction at support A	R_A = **354** kN	
Maximum reaction at support B	R_B = **300** kN	

Rectangular section details

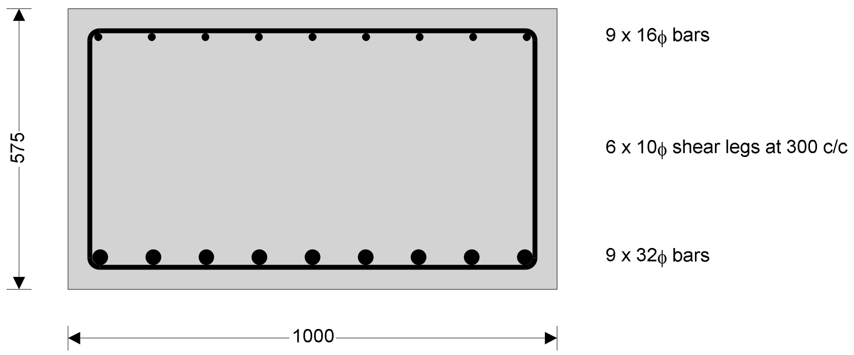
Section width	b = **1000** mm	Section depth	h = **575** mm



Material details

Concrete strength class	**C35/45**	Char comp cube strength	f_{cu} = **45** N/mm^2
Modulus of elasticity of conc	E_c = **29000** N/mm^2	Maximum aggregate size	h_{agg} = **20** mm
Char yield strength of reinf	f_y = **500** N/mm^2	Char yield str of shear reinf	f_{yv} = **500** N/mm^2
Nominal cover to top reinf	c_{nom_t} = **40** mm	Nominal cover to bottom reinf	c_{nom_b} = **40** mm
Nominal cover to side reinf	c_{nom_s} = **40** mm		

<u>Mid span 1</u>



Design moment resistance of rectangular section (cl. 3.4.4)

Design bending moment	M = **1114** kNm	Depth to tension reinf.	d = **509** mm
	K = **0.096**		K' = **0.156**

K' > K - No compression reinforcement is required

Lever arm	z = **448** mm	Depth of neutral axis	x = **137** mm
Area of tension reinf req'd	$A_{s,req}$ = **5724** mm^2	Tension reinf provided	9 × 32ϕ bars
Area of tension reinf prov	$A_{s,prov}$ = **7238** mm^2	Minimum area of reinf	$A_{s,min}$ = **748** mm^2
Maximum area of reinf	$A_{s,max}$ = **23000** mm^2		

PASS - Area of reinforcement provided is greater than area of reinforcement required

Rectangular section in shear

Shear reinforcement provided	6 × 10ϕ legs at 300 c/c		
Area of shear reinf provided	$A_{sv,prov}$ = **1571** mm^2/m	Minimum area of shear reinf	$A_{sv,min}$ = **920** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Max longitudinal spacing $s_{vl,max}$ = **382** mm

PASS - Longitudinal spacing of shear reinforcement provided is less than maximum

Spacing of reinforcement (cl 3.12.11)

Actual dist between bars s = **77** mm   Min dist between bars s_{min} = **25** mm

PASS - Satisfies the minimum spacing criteria

Design service stress f_s = **263.6** N/mm^2 Max distance between bars s_{max} = **178** mm

PASS - Satisfies the maximum spacing criteria

Span to depth ratio (cl. 3.4.6)

Span to depth ratio (T.3.9) $span\_to\_depth_{basic}$ = **20.0**   Service stress in tension rein f_s = **263.6** N/mm^2

Modification for tension reinf f_{tens} = **0.892**   Modification for comp reinf f_{comp} = **1.106**

Modification for span > 10m f_{long} = **1.000**   Allowable span to depth ratio $span\_to\_depth_{allow}$ = **19.7**

Actual span to depth ratio $span\_to\_depth_{actual}$ = **19.1**

PASS - Actual span to depth ratio is within the allowable limit

R C WALLS AND BASES

1. **UNDER HOUSE**

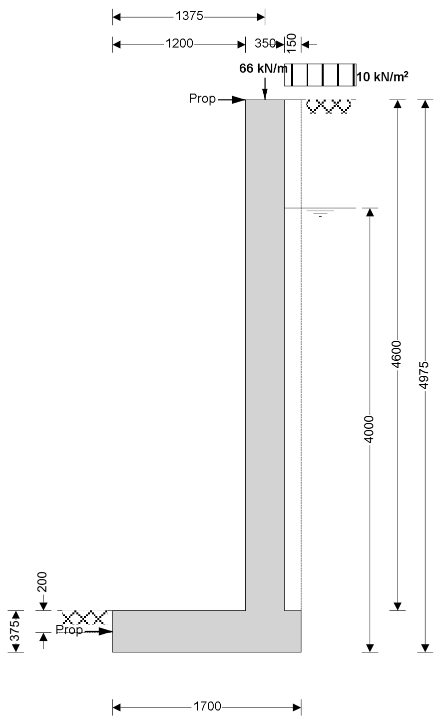
CANTILEVER PROOPED AT BASE LEVEL TO RESIST SLIDING

WT OF WALL OVER = 66KN/m

RETAINING WALL ANALYSIS & DESIGN (BS8002)

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

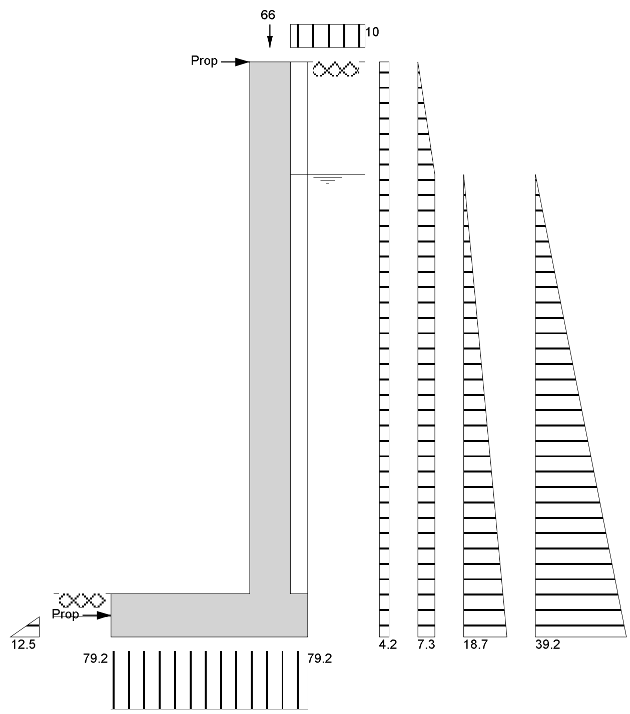
Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **4600** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1200** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **1700** mm	Base thickness	t_{base} = **375** mm
Height of retaining wall	h_{wall} = **4975** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **375** mm
Position of downstand	l_{ds} = **1325** 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} = **4000** 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} = **4975** 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	$P_{bearing}$ = **150** 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} = **66.0** 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} = **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} = **123.8** kN/m

Check bearing pressure

Total vertical reaction R = **134.6** 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} = **79.2** kN/m^2

Bearing pressure at heel p_{heel} = **79.2** 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} = **40.355** kN/m

Propping force to base of wall F_{prop_base} = **83.488** 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} = **123.8** kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop\_top\_f}$ = **77.602** kN/m Propping force to base of wall $F_{prop\_base\_f}$ = **154.016** 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} = **118.4** kN/m Moment at heel M_{toe} = **93.2** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 125 mm centres**

Area required $A_{s\_toe\_req}$ = **711.7** mm^2/m Area provided $A_{s\_toe\_prov}$ = **1608** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.373** 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} = **0.588** 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} = **7.3** kN/m Moment at heel M_{heel} = **0.3** kNm/m

Compression reinforcement is not required

Check heel in bending

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

Area required $A_{s\_heel\_req}$ = **487.5** 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} = **0.023** 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} = **0.484** 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} = **198.6** kN/m — Moment at base of stem M_{stem} = **160.0** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 125 mm centres**

Area required $A_{s\_stem\_req}$ = **1476.6** mm^2/m — Area provided $A_{s\_stem\_prov}$ = **1608** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.744** 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} = **0.650** N/mm^2

v_{stem} > v_{c_stem} - Shear reinforcement required

Design of retaining wall at mid height

Moment at mid height M_{wall} = **75.1** kNm/m

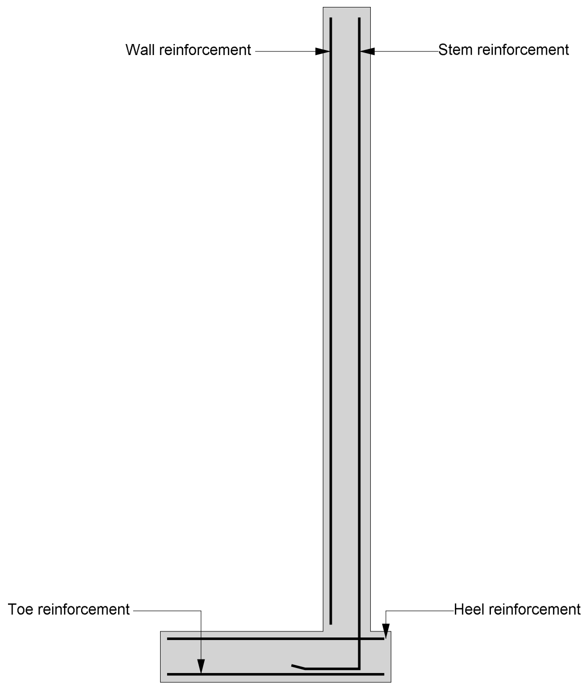
Compression reinforcement is not required

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

Area required $A_{s\_wall\_req}$ = **618.3** 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

Indicative retaining wall reinforcement diagram



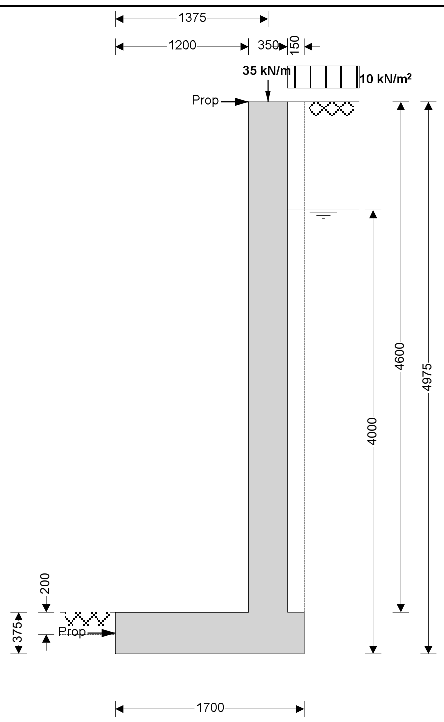
Toe bars - 16 mm dia.@ 125 mm centres - (1608 mm^2/m)
Heel bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Wall bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Stem bars - 16 mm dia.@ 125 mm centres - (1608 mm^2/m)

EXTERNAL WALL UNDER GARDEN

RETAINING WALL ANALYSIS & DESIGN (BS8002)

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

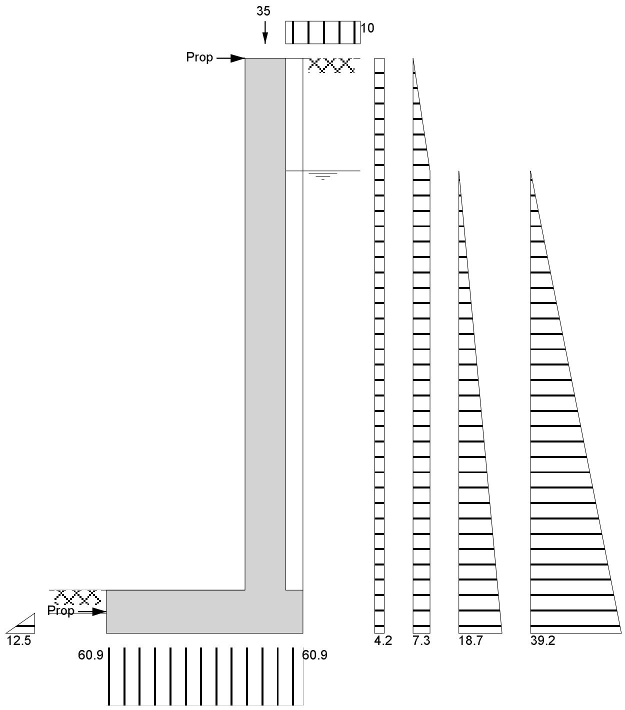
Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **4600** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1200** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **1700** mm	Base thickness	t_{base} = **375** mm
Height of retaining wall	h_{wall} = **4975** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **375** 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} = **4000** 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} = **4975** 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	$P_{bearing}$ = **150** 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} = **35.0** 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} = **1375** mm	Height of horizontal load	h_{load} = **0** mm



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

Calculate propping force

Propping force F_{prop} = **134.3** kN/m

Check bearing pressure

Total vertical reaction R = **103.6** 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} = **60.9** kN/m²

Bearing pressure at heel p_{heel} = **60.9** kN/m²

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} = **43.346** kN/m

Propping force to base of wall F_{prop_base} = **90.930** 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} = **134.3** kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop\_top\_f}$ = **81.790** kN/m Propping force to base of wall $F_{prop\_base\_f}$ = **164.434** 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} = **87.7** kN/m Moment at heel M_{toe} = **69.1** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 125 mm centres**

Area required $A_{s\_toe\_req}$ = **527.5** mm^2/m Area provided $A_{s\_toe\_prov}$ = **1608** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.277** 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} = **0.625** 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} = **11.1** kN/m Moment at heel M_{heel} = **1.7** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **B785 mesh**

Area required $A_{s\_heel\_req}$ = **487.5** mm^2/m Area provided $A_{s\_heel\_prov}$ = **785** mm^2/m

PASS - Reinforcement provided at the retaining wall heel is adequate

Check shear resistance at heel

Design shear stress v_{heel} = **0.035** 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} = **0.489** 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} = **198.6** kN/m | Moment at base of stem M_{stem} = **160.0** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 125 mm centres**

Area required $A_{s\_stem\_req}$ = **1476.6** mm^2/m | Area provided $A_{s\_stem\_prov}$ = **1608** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.744** 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} = **0.691** N/mm^2

v_{stem} > v_{c_stem} - Shear reinforcement required

Design of retaining wall at mid height

Moment at mid height M_{wall} = **75.1** kNm/m

Compression reinforcement is not required

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

Area required $A_{s\_wall\_req}$ = **618.3** mm^2/m | Area provided $A_{s\_wall\_prov}$ = **754** mm^2/m

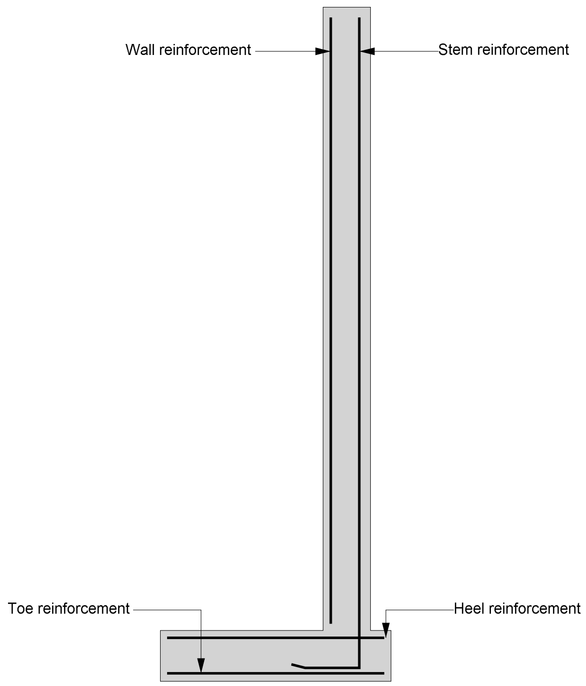
PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **20.06** | Actual span/depth ratio $ratio_{act}$ = **17.23**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 125 mm centres - (1608 mm^2/m)
Heel mesh - B785 - (785 mm^2/m)
Wall bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Stem bars - 16 mm dia.@ 125 mm centres - (1608 mm^2/m)

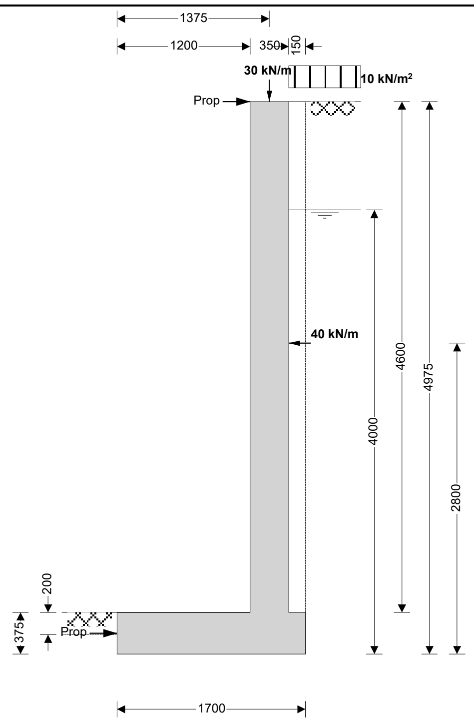
ADJACENT TO NO 26

SAY SURCHARGE WALL LOAD = 80KN/m
HORIZONTAL LOAD AT 2.000m BELOW GL = 80 X k = 40KN/m

RETAINING WALL ANALYSIS & DESIGN (BS8002)

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

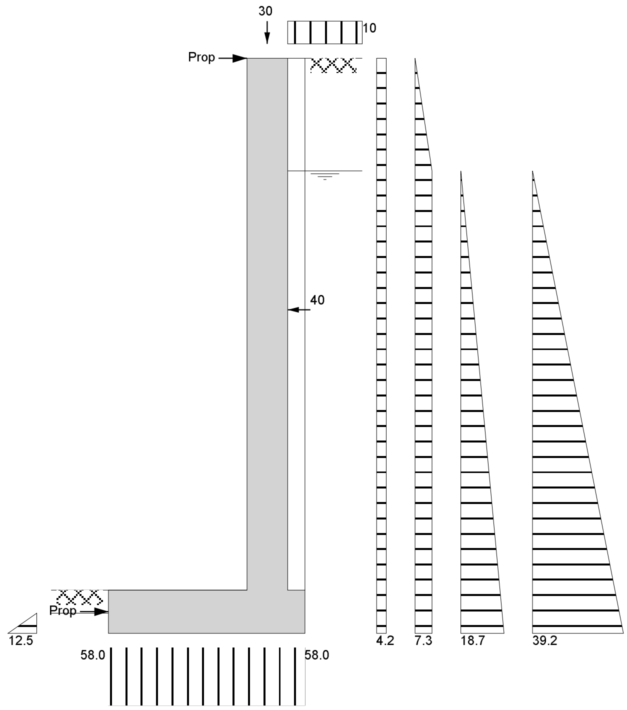
Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **4600** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1200** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **1700** mm	Base thickness	t_{base} = **375** mm
Height of retaining wall	h_{wall} = **4975** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **375** mm
Position of downstand	l_{ds} = **1325** 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} = **4000** 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} = **4975** 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	$P_{bearing}$ = **150** 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} = **30.0** kN/m	Vertical live load	W_{live} = **0.0** kN/m
Horizontal dead load	F_{dead} = **40.0** 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} = **2800** mm



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

Calculate propping force

Propping force F_{prop} = **176.0** kN/m

Check bearing pressure

Total vertical reaction R = **98.6** 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} = **58.0** kN/m^2

Bearing pressure at heel p_{heel} = **58.0** 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} = **65.656** kN/m

Propping force to base of wall F_{prop_base} = **110.303** 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} = **176.0** kN/m

Calculate propping forces to top and base of wall

Propping force to top of wall $F_{prop\_top\_f}$ = **113.024** kN/m Propping force to base of wall $F_{prop\_base\_f}$ = **191.556** kN/m

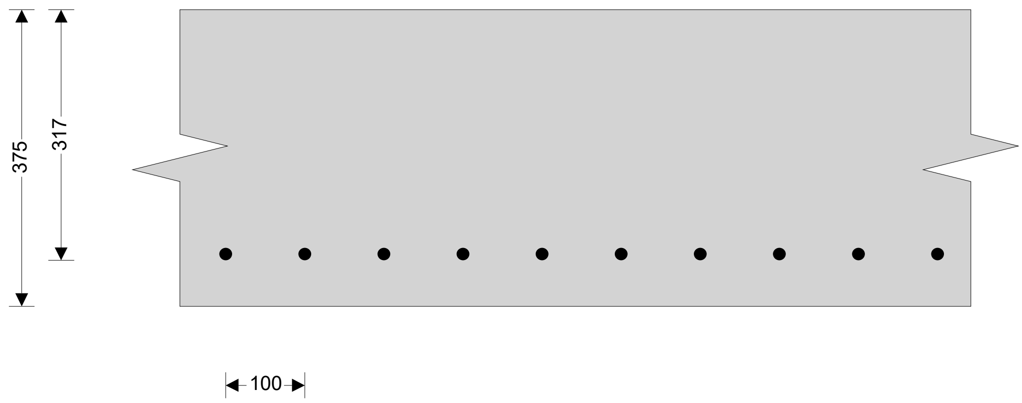
Design of reinforced concrete retaining wall toe (BS 8002:1994)

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} = **82.8** kN/m Moment at heel M_{toe} = **65.2** kNm/m

Compression reinforcement is not required

Check toe in bending

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

Area required $A_{s\_toe\_req}$ = **497.8** 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} = **0.261** 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} = **0.625** N/mm^2

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

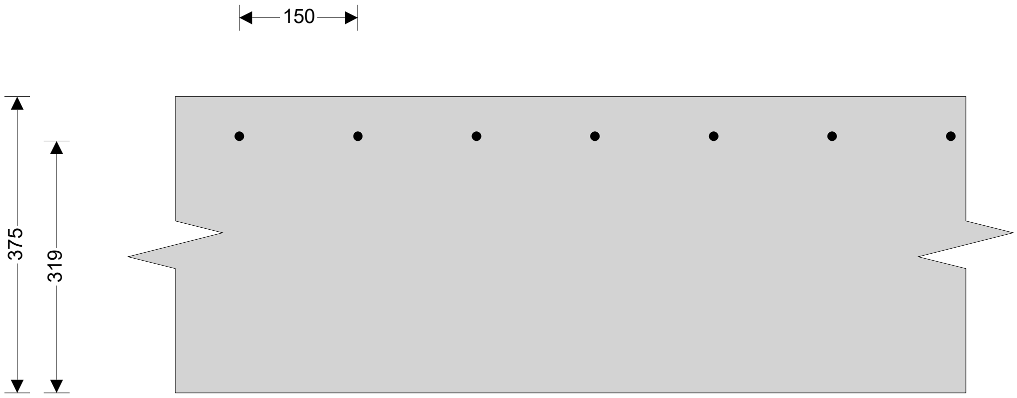
Design of reinforced concrete retaining wall heel (BS 8002:1994)

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} = **11.7** kN/m Moment at heel M_{heel} = **1.9** kNm/m

Compression reinforcement is not required

Check heel in bending

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

Area required $A_{s\_heel\_req}$ = **487.5** 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} = **0.037** 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} = **0.484** N/mm²

v_{heel} < v_{c_heel} - No shear reinforcement required

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

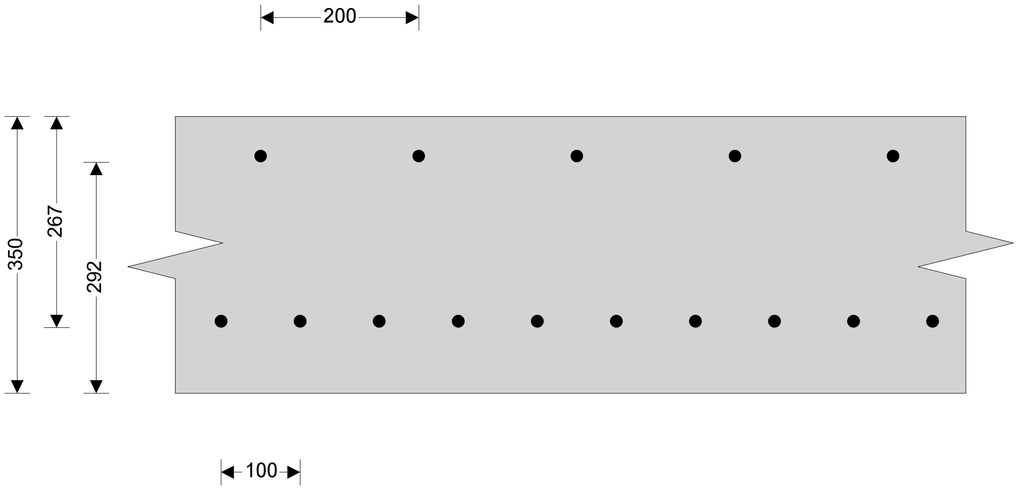
Material properties

Strength of concrete f_{cu} = **40** N/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} = **215.5** kN/m Moment at base of stem M_{stem} = **206.1** kNm/m

Compression reinforcement is not required

Check wall stem in bending

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

Area required $A_{s\_stem\_req}$ = **1945.8** mm²/m Area provided $A_{s\_stem\_prov}$ = **2011** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.807** 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_stem} = **0.691** N/mm²

$v_{stem} > v_{c\_stem}$ - Shear reinforcement required

Design of retaining wall at mid height

Moment at mid height M_{wall} = **121.1** kNm/m

Compression reinforcement is not required

Reinforcement provided **16 mm dia.bars @ 200 mm centres**

Area required $A_{s\_wall\_req}$ = **1003.5** mm²/m Area provided $A_{s\_wall\_prov}$ = **1005** mm²/m

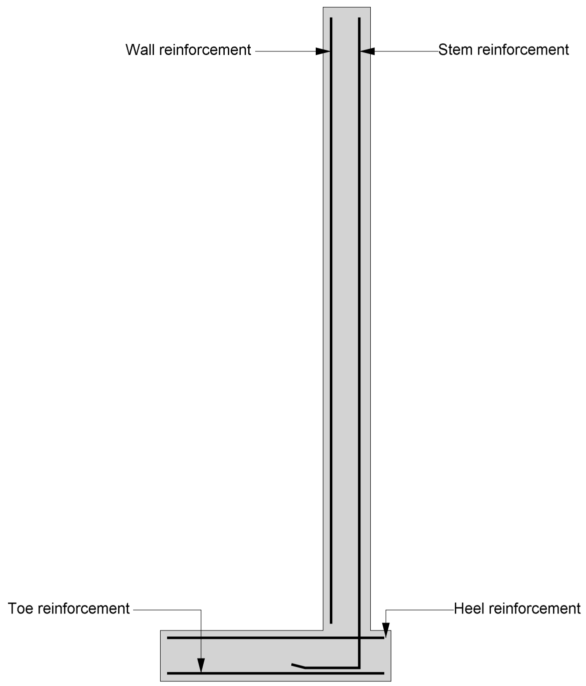
PASS - Reinforcement provided to the retaining wall at mid height is adequate

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **17.79** Actual span/depth ratio $ratio_{act}$ = **17.23**

PASS - Span to depth ratio is acceptable

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)
Wall bars - 16 mm dia.@ 200 mm centres - (1005 mm^2/m)
Stem bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)

BASE SLAB

MAX SPAN = 4.00m

MAX UPLIFT = (4.6 X 10) – 5.6 = 40.4KN/m^2

BM MAX = 40.4 X $4^{2\,/}$ 9 = 85KN.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 = **225** mm

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

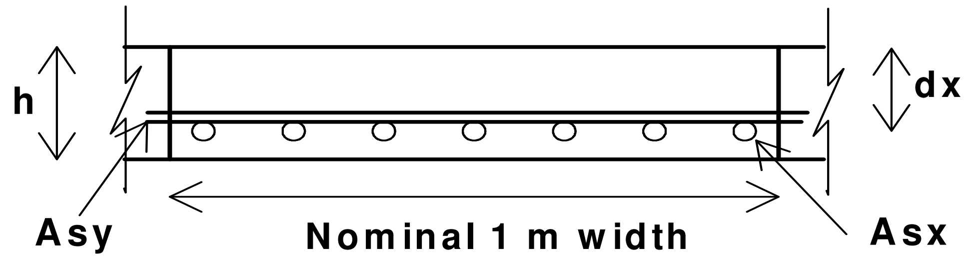
Trial bar diameter D_{tryx} = **10** mm

Depth to tension steel (resisting sagging)

$d_x = h - c_b - D_{tryx}/2 =$ **170** 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

(simple)

ONE WAY SPANNING SLAB (CL 3.5.4)

MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab) $m_{sx} =$ **85.0** kNm/m

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

Design sagging moment (per m width of slab) $m_{sx} =$ **85.0** kNm/m

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

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu}) =$ **0.084**

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

Outer compression steel not required to resist sagging

Slab requiring outer tension steel only - bars (sagging)

$z_x = \min ((0.95 \times d_x),(d_x\times(0.5+\sqrt{}(0.25-K_x/0.9)))) =$ **152** mm

Neutral axis depth $x_x = (d_x - z_x) / 0.45 =$ **39** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x) =$ **1284** mm^2/m

Tension steel

Provide 16 dia bars @ 125 centres outer tension steel resisting sagging

$A_{sx\_prov} = A_{sx} =$ **1610** mm^2/m

Area of outer tension steel provided sufficient to resist sagging

TRANSVERSE BOTTOM STEEL - INNER

Inner layer of transverse steel

Provide 10 dia bars @ 200 centres

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

Check min and max areas of steel resisting sagging

Total area of concrete $A_c = h =$ **225000** mm^2/m

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c =$ **293** mm^2/m

$A_{st\_max} = 4\ \% \times A_c =$ **9000** mm^2/m

Steel defined:

Outer steel resisting sagging $A_{sx\_prov} =$ **1610** 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 $l_x =$ **4.000** m

Design ultimate moment in shorter span per m width $m_{sx} =$ **85** kNm/m

Depth to outer tension steel $d_x =$ **170** mm

Tension steel

Area of outer tension reinforcement provided $A_{sx\_prov} =$ **1610** mm^2/m

Area of tension reinforcement required $A_{sx\_req} =$ **1284** mm^2/m

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

Modification Factors

Basic span / effective depth ratio (Table 3.9) $ratio_{span\_depth} =$ **26**

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

$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx}) =$ **265.8** N/mm^2

$factor_{tens} = \min(2, 0.55 + (477\ N/mm^2 - f_s) / (120 \times (0.9\ N/mm^2 + m_{sx} / d_x^2))) =$ **1.008**

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 $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x =$ **4.46** m

Check the actual beam span

Actual span/depth ratio $l_x / d_x =$ **23.53**

Span depth limit $ratio_{span\_depth} \times factor_{tens} =$ **26.21**

Span/Depth ratio check satisfied

CHECK OF NOMINAL COVER (SAGGING) – (BS8110:PT 1, TABLE 3.4)

Slab thickness h = **225** mm

Effective depth to bottom outer tension reinforcement $d_x =$ **170.0** mm

Diameter of tension reinforcement $D_x =$ **16** mm

Diameter of links $L_{diax} =$ **0** mm

Cover to outer tension reinforcement

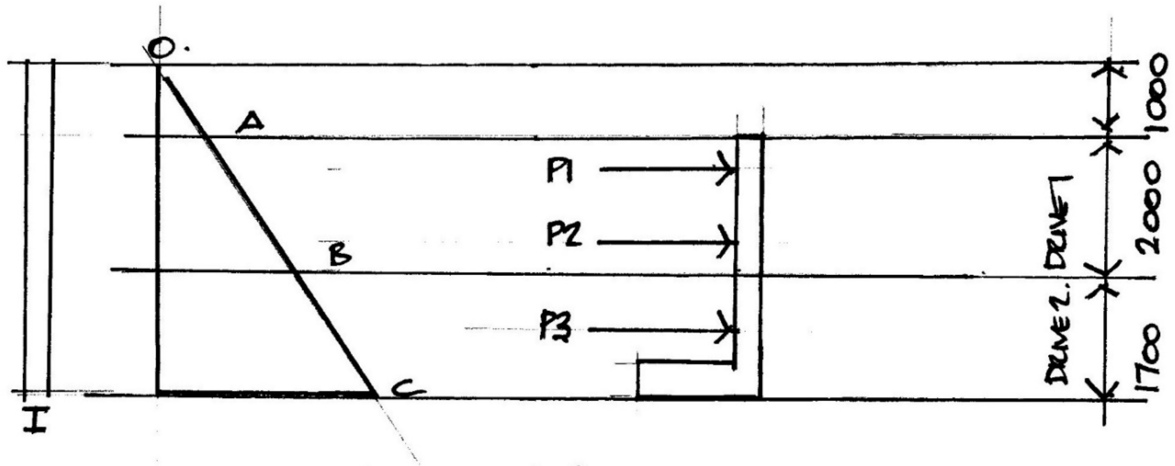
$c_{tenx} = h - d_x - D_x / 2 =$ **47.0** mm

Nominal cover to links steel

$c_{nomx} = c_{tenx} - L_{diax} =$ **47.0** mm

Permissable minimum nominal cover to all reinforcement (Table 3.4)

H16 AT 150 IN ADDITION TO A393 MESH



Take K = 0.5 $\gamma = 18\ kN/m^3$.

A = 0.5 × 18 × 1 = 9 kN/m²

B = 0.5 × 18 × 3 = 27 kN/m²

C = 0.5 × 18 × 4.7 = 42.3 kN/m².

I = 0.5 × 10 = 5.0 kN/m²

PROPPING DESIGN CASES.

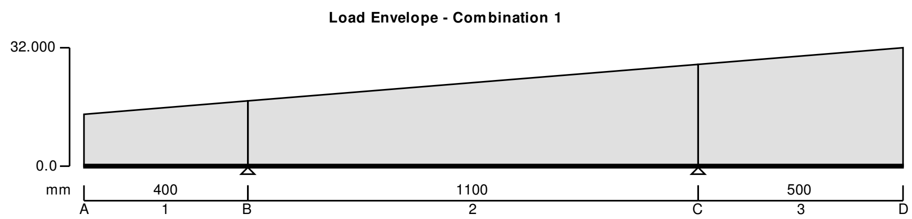
1. P1 + P2.
2. P1 + P3.

PROPPING AT P1 AND P2

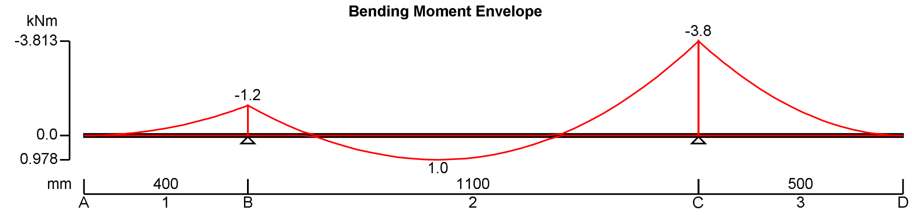
RC BEAM ANALYSIS & DESIGN (BS8110)

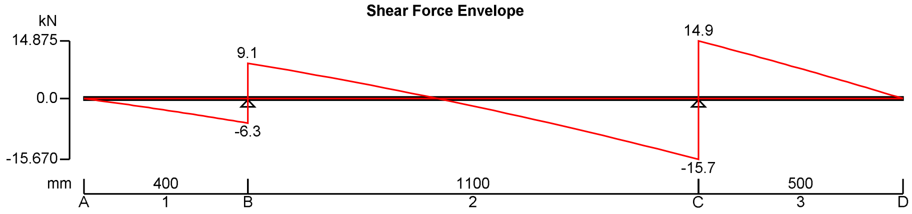
RC BEAM ANALYSIS & DESIGN BS8110

TEDDS calculation version 2.1.12



V&R VINCENT & RYMILL VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY GU16 6PT	Project 28 MAREFIELD GARDENS NW5 5SX			Job Ref. 16H02	
	Section T.WORKS DESIGN			Sheet no./rev. 2	
	Calc. by TV	Date 11/09/2016	Chk'd by	Date	App'd by	Date





Support conditions

Support A	Vertically free
	Rotationally free
Support B	Vertically restrained
	Rotationally free
Support C	Vertically restrained
	Rotationally free
Support D	Vertically free
	Rotationally free

Applied loading

	Imposed full UDL 5 kN/m
Span 1 loads	Dead VDL 9.000 kN/m at 0 mm to 12.600 kN/m at 400 mm
Span 2 loads	Dead VDL 12.600 kN/m at 0 mm to 22.500 kN/m at 1100 mm
Span 3 loads	Dead VDL 22.500 kN/m at 0 mm to 27.000 kN/m at 500 mm

Load combinations

Load combination 1	Support A	Dead × 1.00
		Imposed × 1.00
	Span 1	Dead × 1.00
		Imposed × 1.00
	Support B	Dead × 1.00
		Imposed × 1.00
	Span 2	Dead × 1.00
		Imposed × 1.00
	Support C	Dead × 1.00
		Imposed × 1.00
	Span 3	Dead × 1.00
		Imposed × 1.00
	Support D	Dead × 1.00
		Imposed × 1.00

Analysis results

Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm
Maximum moment span 1 at support	M_{s1_max} = **0** kNm	M_{s1_red} = **0** kNm
Maximum moment support B	M_{B_max} = **-1** kNm	M_{B_red} = **-1** kNm
Maximum moment span 2 at 464 mm	M_{s2_max} = **1** kNm	M_{s2_red} = **1** kNm
Maximum moment support C	M_{C_max} = **-4** kNm	M_{C_red} = **-4** kNm
Maximum moment span 3 at support	M_{s3_max} = **0** kNm	M_{s3_red} = **0** kNm
Maximum moment support D	M_{D_max} = **0** kNm	M_{D_red} = **0** kNm
Maximum shear support A	V_{A_max} = **0** kN	V_{A_red} = **0** kN
Maximum shear support A span 1 at 300 mm	$V_{A\_s1\_max}$ = **-5** kN	$V_{A\_s1\_red}$ = **-5** kN
Maximum shear support B	V_{B_max} = **9** kN	V_{B_red} = **9** kN
Maximum shear support B span 1 at 100 mm	$V_{B\_s1\_max}$ = **-1** kN	$V_{B\_s1\_red}$ = **-1** kN
Maximum shear support B span 2 at 300 mm	$V_{B\_s2\_max}$ = **3** kN	$V_{B\_s2\_red}$ = **3** kN
Maximum shear support C	V_{C_max} = **-16** kN	V_{C_red} = **-16** kN
Maximum shear support C span 2 at 800 mm	$V_{C\_s2\_max}$ = **-8** kN	$V_{C\_s2\_red}$ = **-8** kN
Maximum shear support C span 3 at 300 mm	$V_{C\_s3\_max}$ = **6** kN	$V_{C\_s3\_red}$ = **6** kN
Maximum shear support D	V_{D_max} = **0** kN	V_{D_red} = **0** kN
Maximum shear support D span 3 at 200 mm	$V_{D\_s3\_max}$ = **9** kN	$V_{D\_s3\_red}$ = **9** kN
Maximum reaction at support A	R_A = **0** kN	
Maximum reaction at support B	R_B = **15** Kn = **PROP P1**	
Maximum reaction at support C	R_C = **31** Kn = **PROP P2**	
Maximum reaction at support D	R_D = **0** kN	

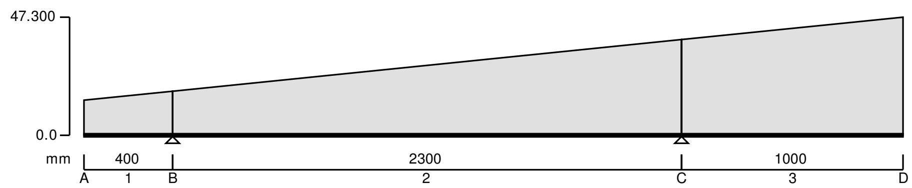
PROPPING AT P1 AND P3

RC BEAM ANALYSIS & DESIGN (BS8110)

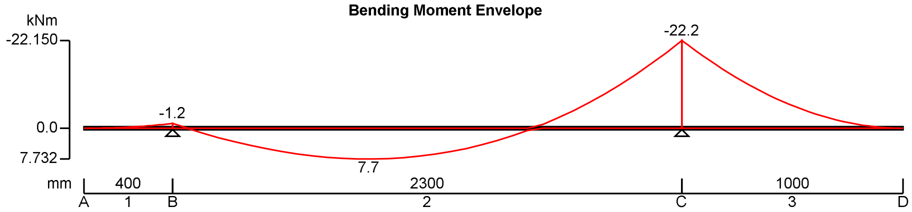
RC BEAM ANALYSIS & DESIGN BS8110

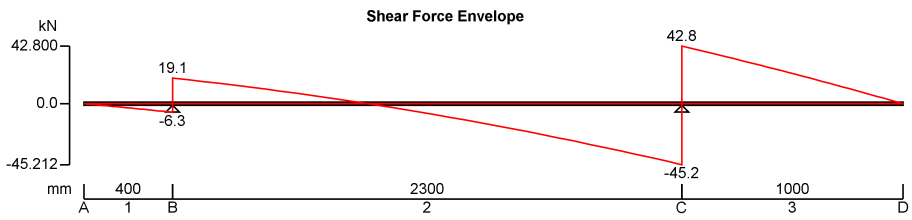
TEDDS calculation version 2.1.12

Load Envelope - Combination 1



Bending Moment Envelope





Support conditions

Support A	Vertically free
	Rotationally free
Support B	Vertically restrained
	Rotationally free
Support C	Vertically restrained
	Rotationally free
Support D	Vertically free
	Rotationally free

Applied loading

	Imposed full UDL 5 kN/m
Span 1 loads	Dead VDL 9.000 kN/m at 0 mm to 12.600 kN/m at 400 mm
Span 2 loads	Dead VDL 12.600 kN/m at 0 mm to 33.300 kN/m at 2300 mm
Span 3 loads	Dead VDL 33.300 kN/m at 0 mm to 42.300 kN/m at 1000 mm

Load combinations

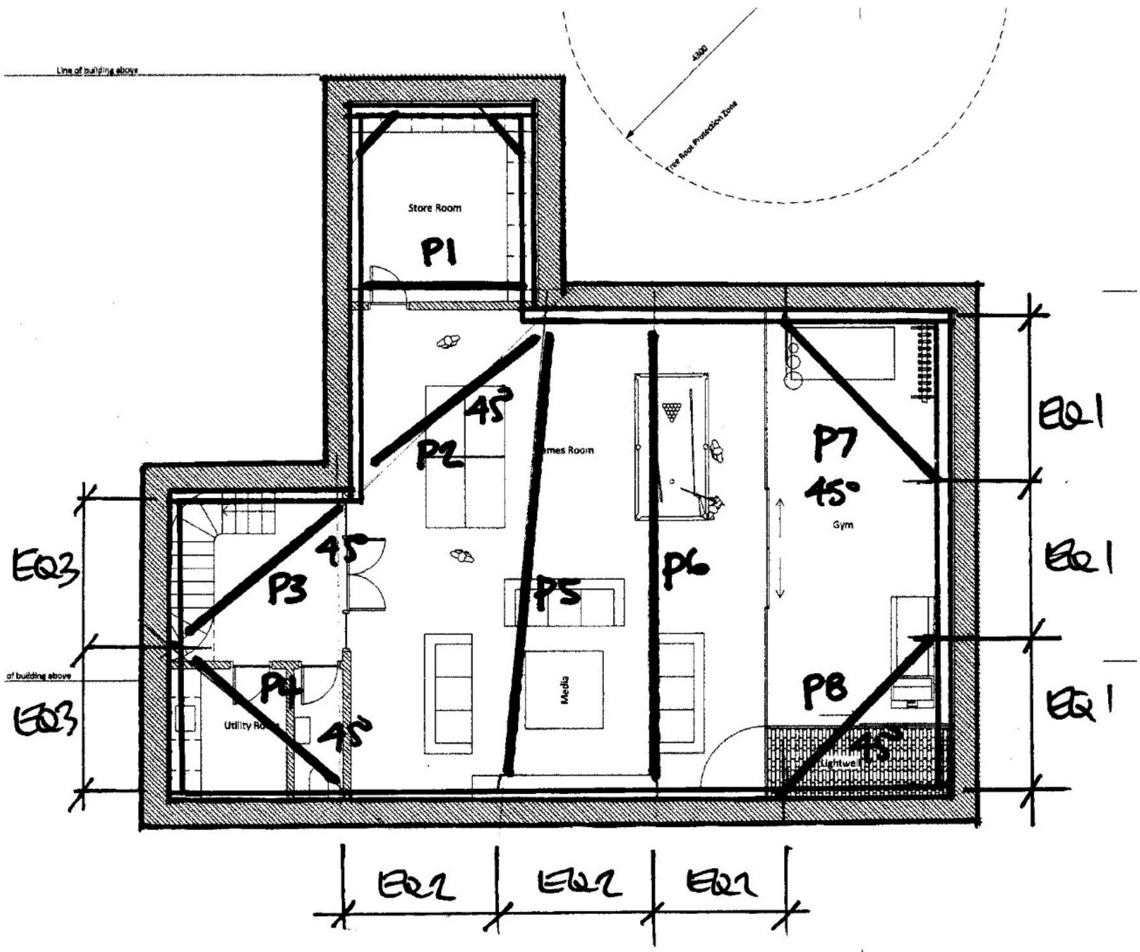
Load combination 1	Support A	Dead × 1.00
		Imposed × 1.00
	Span 1	Dead × 1.00
		Imposed × 1.00
	Support B	Dead × 1.00
		Imposed × 1.00
	Span 2	Dead × 1.00
		Imposed × 1.00
	Support C	Dead × 1.00
		Imposed × 1.00
	Span 3	Dead × 1.00
		Imposed × 1.00
	Support D	Dead × 1.00
		Imposed × 1.00

Analysis results

Maximum moment support A	M_{A_max} = **0** kNm	M_{A_red} = **0** kNm
Maximum moment span 1 at support	M_{s1_max} = **0** kNm	M_{s1_red} = **0** kNm
Maximum moment support B	M_{B_max} = **-1** kNm	M_{B_red} = **-1** kNm
Maximum moment span 2 at 884 mm	M_{s2_max} = **8** kNm	M_{s2_red} = **8** kNm
Maximum moment support C	M_{C_max} = **-22** kNm	M_{C_red} = **-22** kNm
Maximum moment span 3 at support	M_{s3_max} = **0** kNm	M_{s3_red} = **0** kNm
Maximum moment support D	M_{D_max} = **0** kNm	M_{D_red} = **0** kNm
Maximum shear support A	V_{A_max} = **0** kN	V_{A_red} = **0** kN

Maximum shear support A span 1 at 300 mm	$V_{A\_s1\_max}$ = **-5** kN	$V_{A\_s1\_red}$ = **-5** kN
Maximum shear support B	V_{B_max} = **19** kN	V_{B_red} = **19** kN
Maximum shear support B span 1 at 100 mm	$V_{B\_s1\_max}$ = **-1** kN	$V_{B\_s1\_red}$ = **-1** kN
Maximum shear support B span 2 at 300 mm	$V_{B\_s2\_max}$ = **13** kN	$V_{B\_s2\_red}$ = **13** kN
Maximum shear support C	V_{C_max} = **-45** kN	V_{C_red} = **-45** kN
Maximum shear support C span 2 at 2000 mm	$V_{C\_s2\_max}$ = **-34** kN	$V_{C\_s2\_red}$ = **-34** kN
Maximum shear support C span 3 at 300 mm	$V_{C\_s3\_max}$ = **31** kN	$V_{C\_s3\_red}$ = **31** kN
Maximum shear support D	V_{D_max} = **0** kN	V_{D_red} = **0** kN
Maximum shear support D span 3 at 700 mm	$V_{D\_s3\_max}$ = **14** kN	$V_{D\_s3\_red}$ = **14** kN
Maximum reaction at support A	R_A = **0** kN	
Maximum reaction at support B	R_B = **25** Kn = **PROPPING AT 1**	
Maximum reaction at support C	R_C = **88** Kn = **PROPPING AT 3**	
Maximum reaction at support D	R_D = **0** kN	

KEY PLAN



VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY GU16 6PT	Project 28 MAREFIELD GARDENS NW5 5SX				Job Ref. 16H02	
	Section T.WORKS DESIGN				Sheet no./rev. 6	
	Calc. by TV	Date 11/09/2016	Chk'd by	Date	App'd by	Date

PROP LOADS

PROP REF	PROP LOADS AT PROP 1 & 2			PROP LOADS AT PROP 3		
P1	31 X 3	=	93KN	88 X 3	=	264 KN
P2	2 X 1.1416 X 31	=	71KN	2 X 1.1416 X 88	=	201KN
P3	1.5 X 1.1416 X 31	=	54 KN	1.5 X 1.1416 X 88	=	151 KN
P4			DITTO			DITTO
P5	31 X 3	=	93KN	88 X 3	=	264KN
P6	31 X 3	=	93KN	88 X 3	=	264KN
P7	31 X 3 X 1.1416	=	107KN	88X3 X 1.1416	=	301KN
P8						

LEVEL 1 & 2

MAX WALER SPAN / LOAD, 3.0 m SPAN UDL = 31KN/m

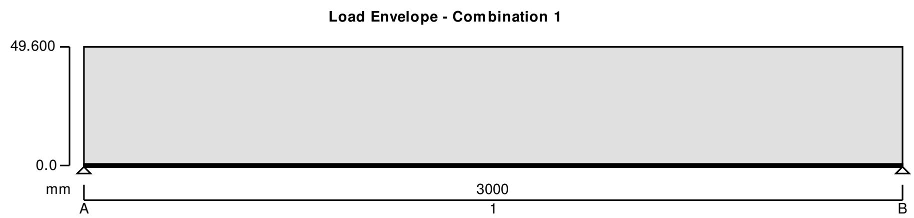
PROP CHECK PROP P6, L = 9.0m, AXIAL LOAD = 93

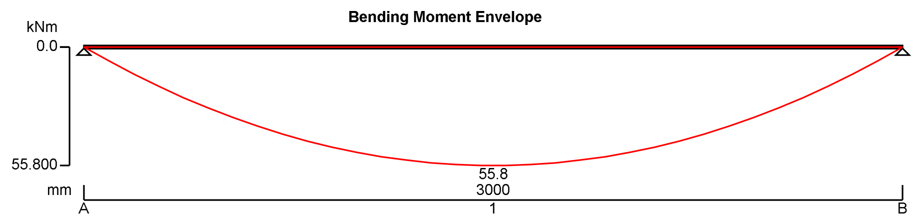
STEEL BEAM ANALYSIS & DESIGN (BS5950)

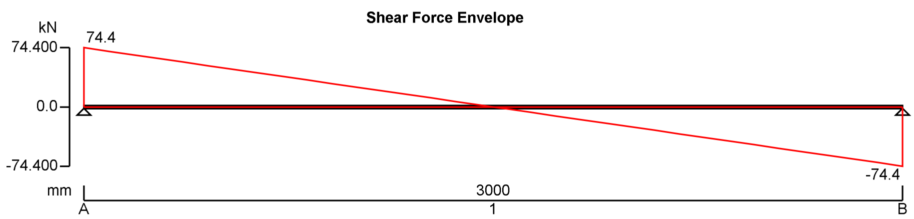
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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 — Imposed full UDL 31 kN/m

Load combinations

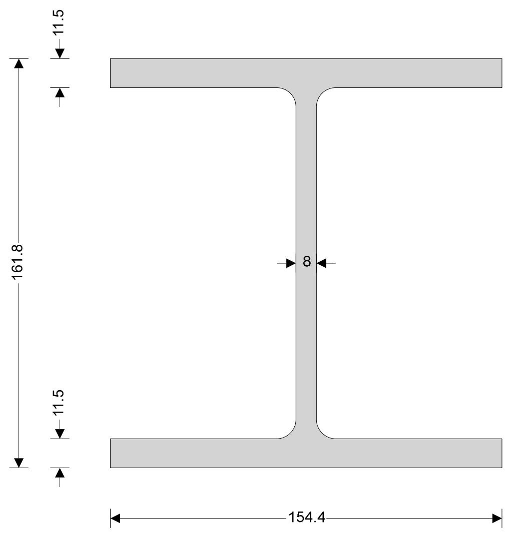
Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **55.8** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **74.4** kN	V_{min} = **-74.4** kN
Deflection	δ_{max} = **7.2** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **74.4** kN	R_{A_min} = **74.4** kN
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **46.5** kN	
Maximum reaction at support B	R_{B_max} = **74.4** kN	R_{B_min} = **74.4** kN
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **46.5** kN	

Section details

Section type **UC 152x152x37 (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 = **74.4** kN Design shear resistance P_v = **213.6** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **55.8** kNm Moment capacity low shear M_c = **84.9** 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} = **7.5** mm Maximum deflection δ = **7.215** mm

PASS - Maximum deflection does not exceed deflection limit

<u>USE 152 X 152 X 37 WALER</u>

STEEL MEMBER DESIGN (BS5950)

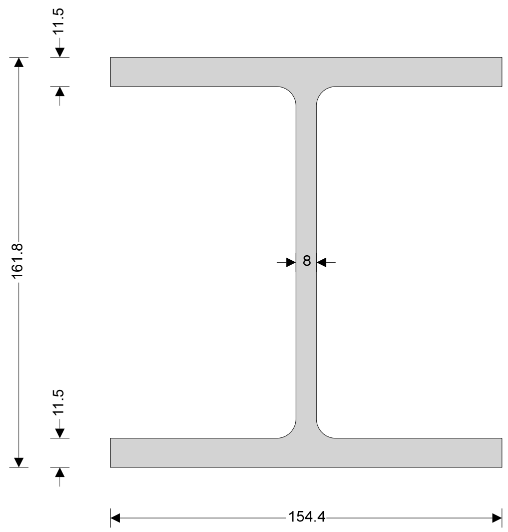
STEEL MEMBER DESIGN (BS5950)

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

TEDDS calculation version 3.0.05

Section details

Section type **UC 152x152x37 (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 = **100** kN Design shear resistance $P_{y,v}$ = **213.6** kN

PASS - Design shear resistance exceeds design shear force

Shear capacity - Section 4.2.3

Compression members - Section 4.7

Design compression force F_c = **150** kN Compression resistance P_{cx} = **439** kN

PASS - Compression resistance exceeds design compression force

<u>USE 152 X 152 X 37 UC PROPS</u>

PROPPING AT LEVEL 3

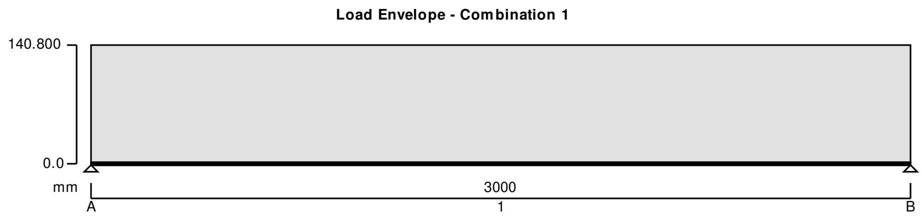
MAX WALER SPAN / LOAD, 3.0 m SPAN UDL = 88KN/m
PROP CHECK PROP P6, L = 9.0m, AXIAL LOAD = 264KN

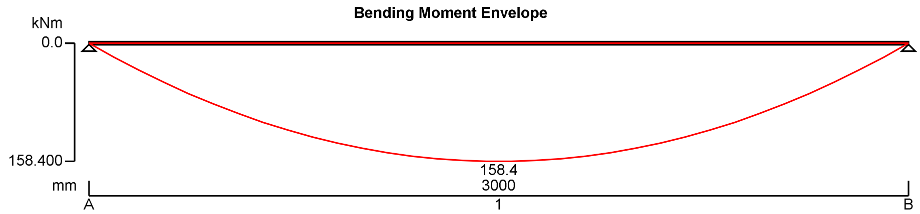
STEEL BEAM ANALYSIS & DESIGN (BS5950)

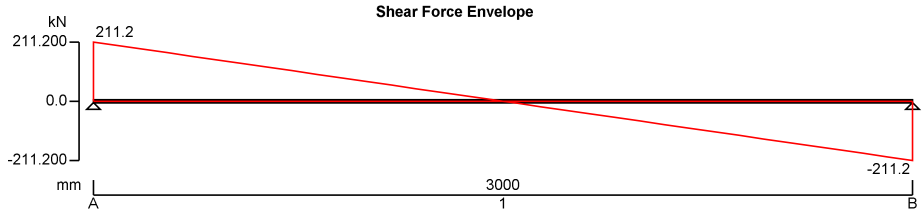
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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	Imposed full UDL 88 kN/m

Load combinations

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

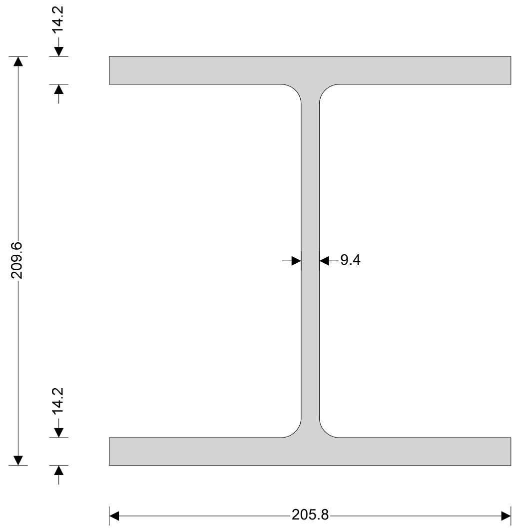
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **158.4** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **211.2** kN	V_{min} = **-211.2** kN
Deflection	δ_{max} = **7.4** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **211.2** kN	R_{A_min} = **211.2** kN
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **132** kN	
Maximum reaction at support B	R_{B_max} = **211.2** kN	R_{B_min} = **211.2** kN
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **132** kN	

Section details

Section type **UC 203x203x60 (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 = **211.2** kN Design shear resistance P_v = **325.1** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **158.4** kNm Moment capacity high shear M_c = **177.9** 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 = **7.392** mm

PASS - Maximum deflection does not exceed deflection limit

USE 203 X 203 X 60 WALER

STEEL MEMBER DESIGN (BS5950)

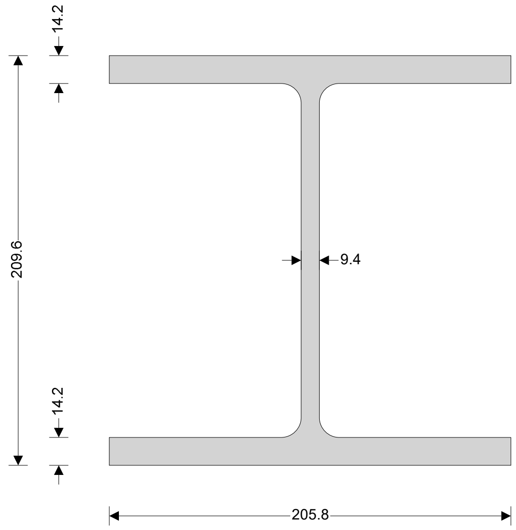
STEEL MEMBER DESIGN (BS5950)

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

TEDDS calculation version 3.0.05

Section details

Section type **UC 203x203x60 (BS4-1)** Steel grade **S275**



Classification of cross sections - Section 3.5

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

Compression members - Section 4.7

Design compression force F_c = **422** kN Compression resistance P_{cx} = **1068.1** kN

PASS - Compression resistance exceeds design compression force

USE 203 X 203 X 60 UC PROPS