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APPENDIX 2

STRUCTURAL CALCULATIONS

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY	Project 20 WELLS ROAD LONDON NW3 1LH				Job Ref. 17 J02	
	Section STRUCTRAL CALCULATIONS				Sheet no./rev. 1	
	Calc. by TV	Date 03/10/2017	Chk'd by	Date	App'd by	Date

PITCHED ROOF	**KN/m^2**	**CEILING**	**KN/m^2**
Tiles	0.70	Ceiling Joists	0.10
Felt & battens	0.05	Plasterboard	0.15
Rafters	0.10	D. L.	0.25 KN/m^2
	0.85	I. L. where applicable	0.25 KN/m^2
30^0 on plan load D. L.	1.00 KN/m^2		0.50 KN/m^2
30^0 Imposed Load	0.60 KN/m^2		
	1.60 KN/m^2		

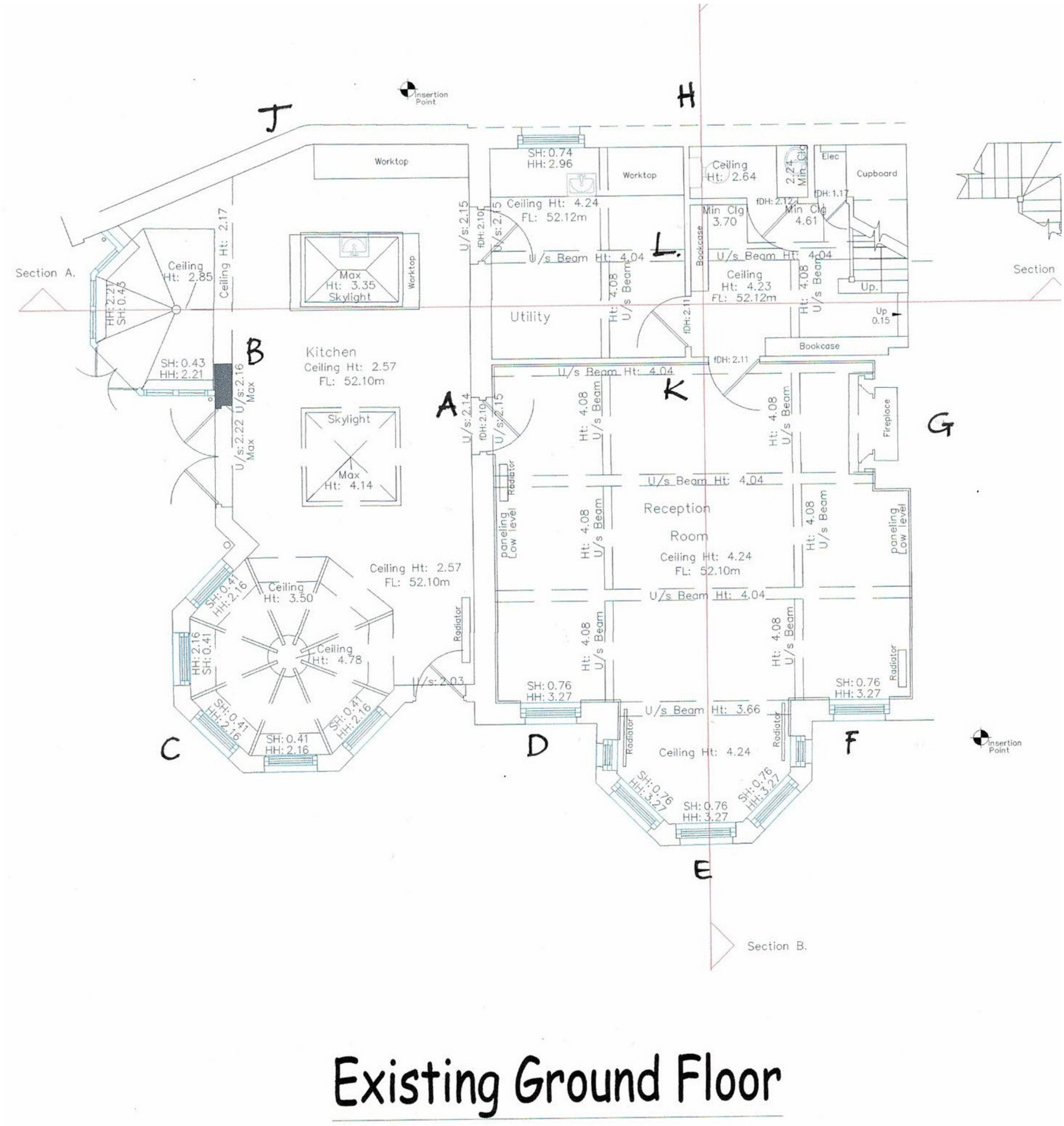
FLAT ROOF	**KN/m^2**	**TIMBER FLOORS**	**KN/m^2**
Felt	0.25	Boards	0.20
Boards	0.25	Joists	0.10
Joists & firrings	0.15	Ceiling	0.30
Ceiling	0.15	D. L.	0.60 KN/m^2
D. L.	0.80 KN/m^2	I. L.	1.50 KN/m^2
I .L.	0.75 KN/m^2		2.10 KN/m^2
	1.55 KN/m^2		

200 RIBDECK	**KN/m^2**
Finish	1.90
Self Weight	4.10
D. L.	6.00 KN/m^2
I. L.	1.50 KN/m^2
	7.50 KN/m^2

MASONRY	**KN/m^2**
102 Brick	2.20 KN/m^2
100 lt. wt blk + (1 x plaster)	1.10 KN/m^2
330 BRICK	6.80 KN/m^2
215 BRICK	4.60 KN/m^2

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY	Project 20 WELLS ROAD LONDON NW3 1LH			Job Ref. 17 J02	
	Section STRUCTRAL CALCULATIONS			Sheet no./rev. 2	
	Calc. by TV	Date 03/10/2017	Chk'd by	Date	App'd by	Date

KEY PLAN FOR WALL LOADING



Existing Ground Floor

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Project	20 WELLS ROAD NW3 1LH.
Portion	WALL LOADINGS
Job No.	
Sheet No.	03
Made by:	TV
Date:	OCT 2017
Checked by:	

WALL A.

WALL	= 8.5 × 6.8	=	57.80	
Roof DL	2.5 × 1.0	=	2.50	
Roof IL	2.5 × 0.6	=		1.50
FLAT ROOF DL	2.1 × 0.8	=	1.70	
FLAT ROOF IL	2.1 × 0.6	=		1.30
1st FLR DL	3.6 × 0.6	=	2.20	
1st FLR I	3.6 × 1.5	=		5.40
			64.20 kN/m	8.20 kN/m

WALL B

WALL	3.5 × 3.5	=	12.30	
FLAT RF DL	2.1 × 0.8	=	1.70	
FLAT RF IL	2.1 × 0.6	=		1.30
			14.00 kN/m	1.30 kN/m

WALL C.

WALL	3.5 × 3.5 × 0.6	=	7.4	
Roof DL	2 × 1.0	=	2.0	
Roof IL	2 × 0.6	=		1.20
			9.4 kN/m	1.20 kN/m

WALL D/F/H

WALL	8.5 × 6.8	=	57.80	
Roof DL	1.5 × 1.0	=	1.50	
Roof IL	1.5 × 0.6	=		0.90
FLOOR DL	1.0 × 0.6	=	0.60	
FLOOR IL	1.0 × 1.5	=		1.50
			59.3 kN/m	2.40 kN/m

WALL E

WALL	8.5 × 6.8 × 0.6	=	34.70	
Roof DL	1.0 × 1.0	=	1.00	
Roof IL	1.0 × 0.6	=		0.60
FLR DL	1.0 × 0.6	=	0.60	
FLR IL	1.0 × 1.5	=		1.50
			36.3 kN/m	2.10 kN/m

V&R VINCENT & RYMILL		
	Project: 20 WELLS ROAD NW3 1LH.	Job No.
		Sheet No. 04
		Made by: TV.
	Portion: WALL LOADINGS	Date: OCT 2017.
		Checked by:

WALL G.

WALL	8.5 x 6.8 =	57.80		
ROOF DL	5 x 1.0 =	5.00		
ROOF IL	5 x 0.6 =		3.00	
FLOOR DL	7.2 x 0.6 =			
FLOOR I	7.2 x 1.5 =			

WALL J. WALL = 3.5 x 3.5 = 12.30 kN/m

WALL K.

WALL	= 3.5 x 2.6 =	9.10	
FLR DL	= 3 x 0.6 =	1.80	
FLR I	= 3 x 1.5 =		4.50
		10.9 kN/m	4.50 kN/m

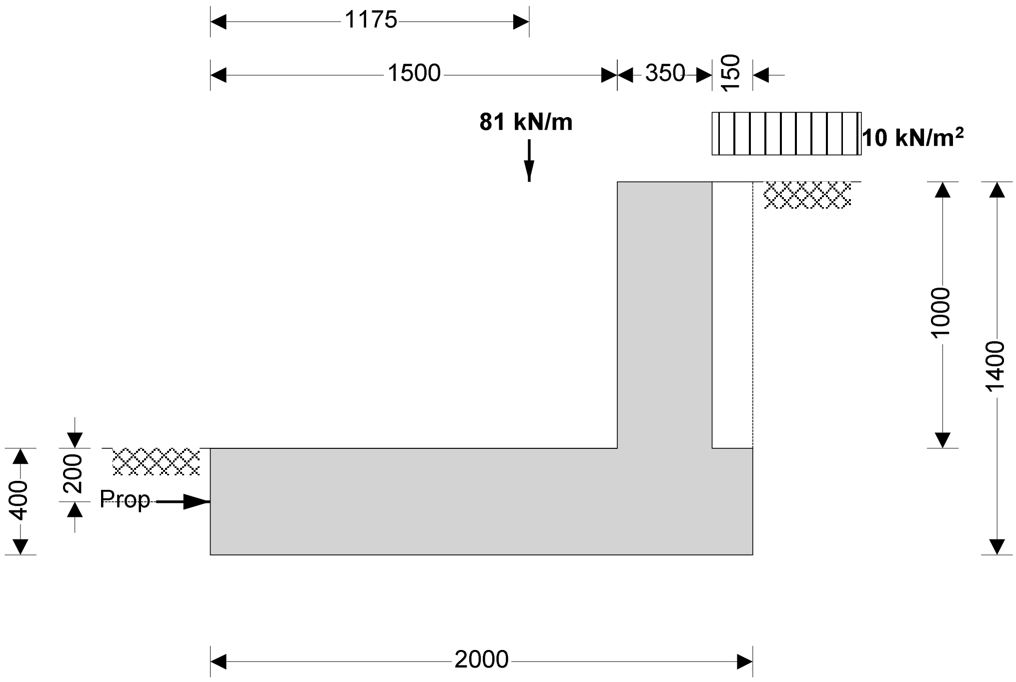
BASEMENT WALL AND BASE DESIGNS

WALL G – PARTY WALL

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} = **1000** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1500** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **2000** mm	Base thickness	t_{base} = **400** mm
Height of retaining wall	h_{wall} = **1400** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **400** mm
Position of downstand	l_{ds} = **1050** 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} = **0** 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} = **1400** 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**

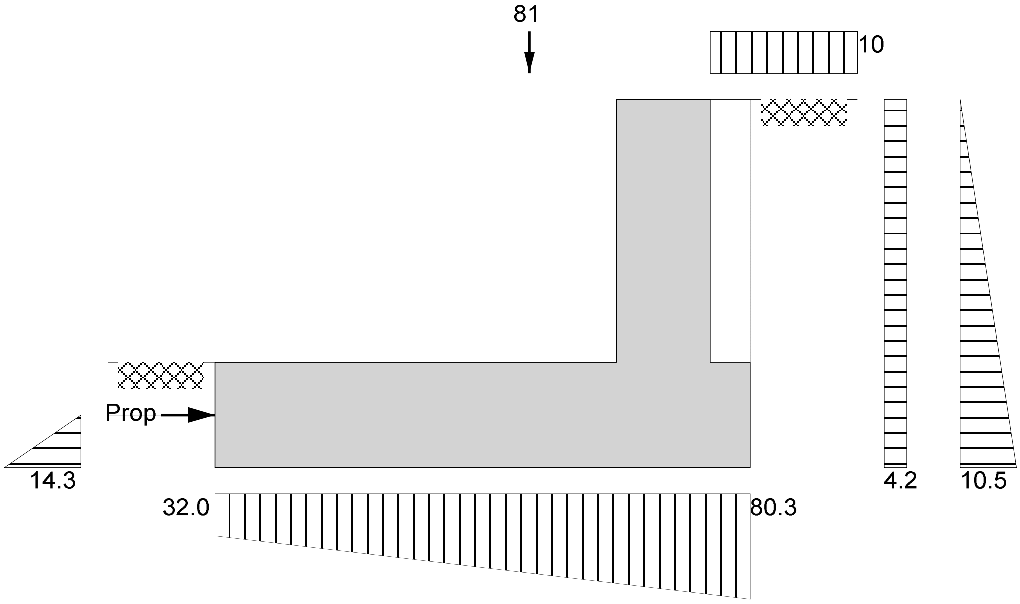
Loading details

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

Vertical dead load W_{dead} = **78.0** kN/m Vertical live load W_{live} = **3.0** 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} = **1175** 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} = **0.0** kN/m

Check bearing pressure

Total vertical reaction R = **112.3** kN/m Distance to reaction x_{bar} = **1143** mm

Eccentricity of reaction e = **143** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **32.0** kN/m^2 Bearing pressure at heel p_{heel} = **80.3** 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} = **0.0** 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} = **89.0** kN/m Moment at heel M_{toe} = **76.2** kNm/m

Compression reinforcement is not required

Check toe in bending

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

Area required $A_{s\_toe\_req}$ = **536.1** 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} = **0.259** 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} = **0.463** 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} = **16.9** kN/m Moment at base of stem M_{stem} = **10.6** 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} = **0.063** 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

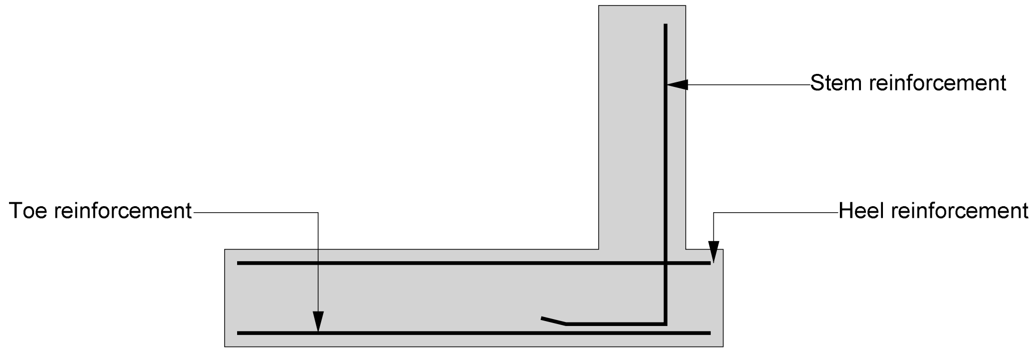
v_{stem} < v_{c_stem} - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **14.00** Actual span/depth ratio $ratio_{act}$ = **3.72**

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!

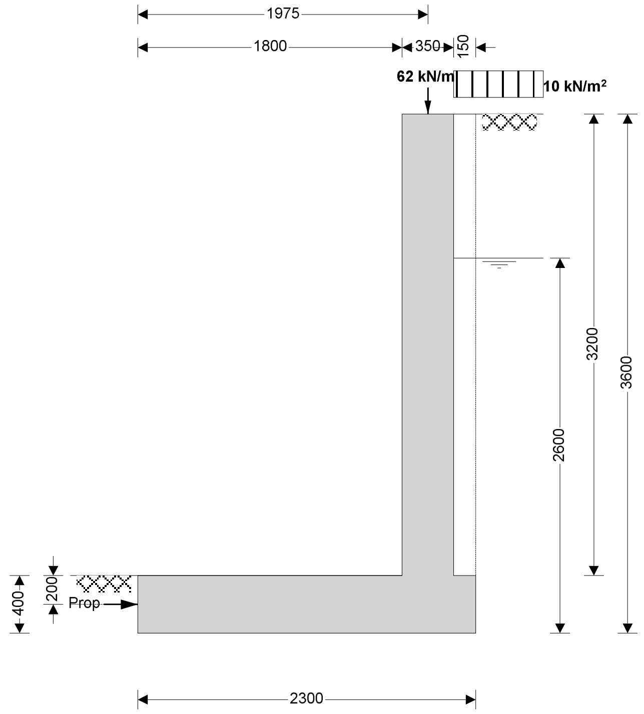
Stem bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)

WALL H – END WALL – WALL D SIMILAR

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} = **3200** mm	Wall stem thickness	t_{wall} = **350** mm
Length of toe	l_{toe} = **1800** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **2300** mm	Base thickness	t_{base} = **400** mm
Height of retaining wall	h_{wall} = **3600** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **400** 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} = **2600** 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} = **3600** 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**		

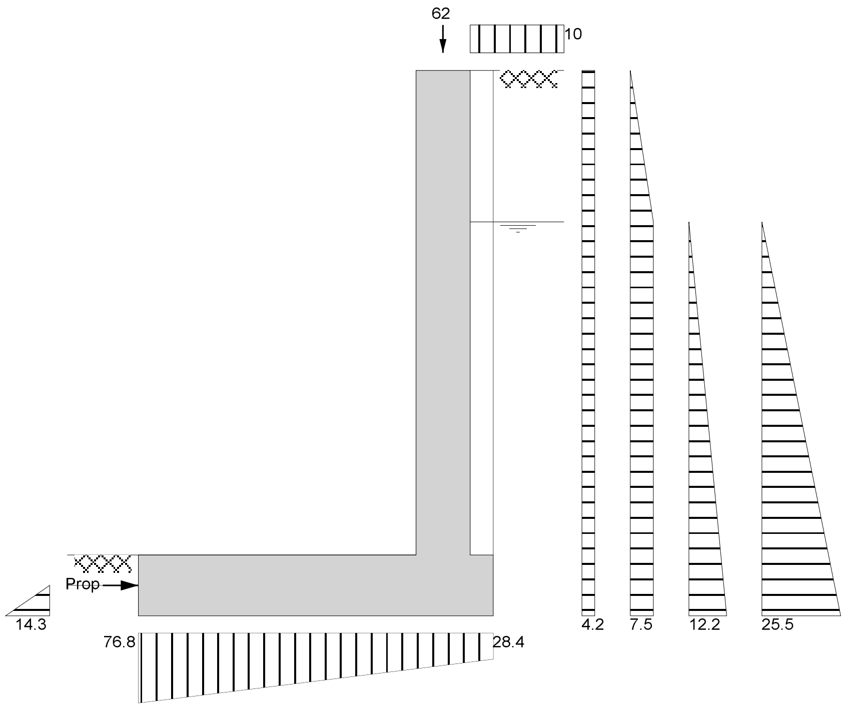
Loading details

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

Vertical dead load — W_{dead} = **59.3** kN/m — Vertical live load — W_{live} = **2.5** 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} = **1975** 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} = **46.6** kN/m

Check bearing pressure

Total vertical reaction — R = **121.1** kN/m — Distance to reaction — x_{bar} = **974** mm

Eccentricity of reaction — e = **176** mm

Reaction acts within middle third of base

Bearing pressure at toe — p_{toe} = **76.8** kN/m^2 — Bearing pressure at heel — p_{heel} = **28.4** 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} = **46.6** 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} = **144.5** kN/m Moment at heel M_{toe} = **195.9** kNm/m

Compression reinforcement is not required

Check toe in bending

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

Area required $A_{s\_toe\_req}$ = **1386.0** 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} = **0.422** 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} = **0.563** 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} = **17.9** kN/m Moment at heel M_{heel} = **4.7** kNm/m

Compression reinforcement is not required

Check heel in bending

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

Area required $A_{s\_heel\_req}$ = **520.0** 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} = **0.052** 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} = **0.463** 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} = **25.4** kN/m Moment at base of stem M_{stem} = **151.5** kNm/m

Compression reinforcement is not required

Check wall stem in bending

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

Area required $A_{s\_stem\_req}$ = **1391.8** 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

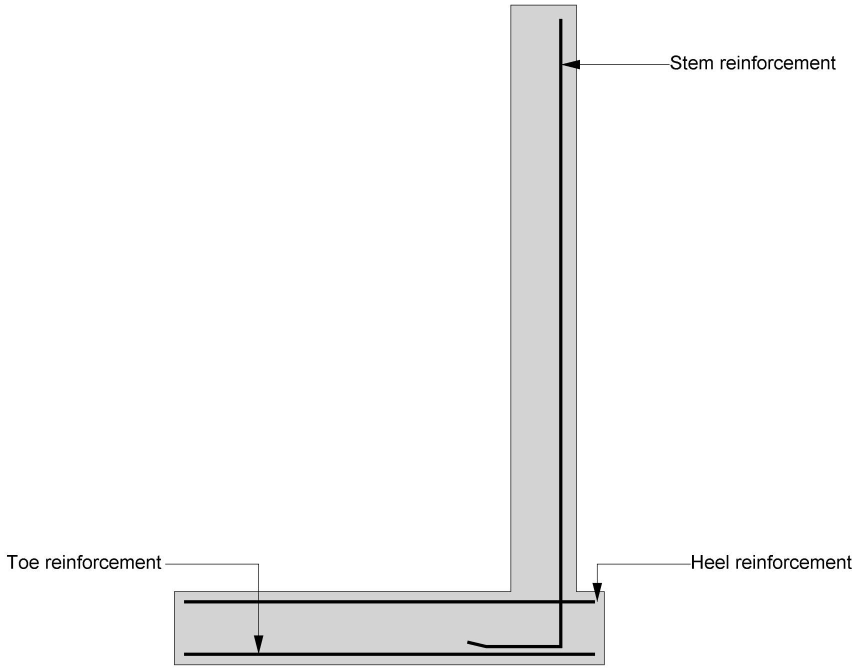
Design shear stress v_{stem} = **0.095** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

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



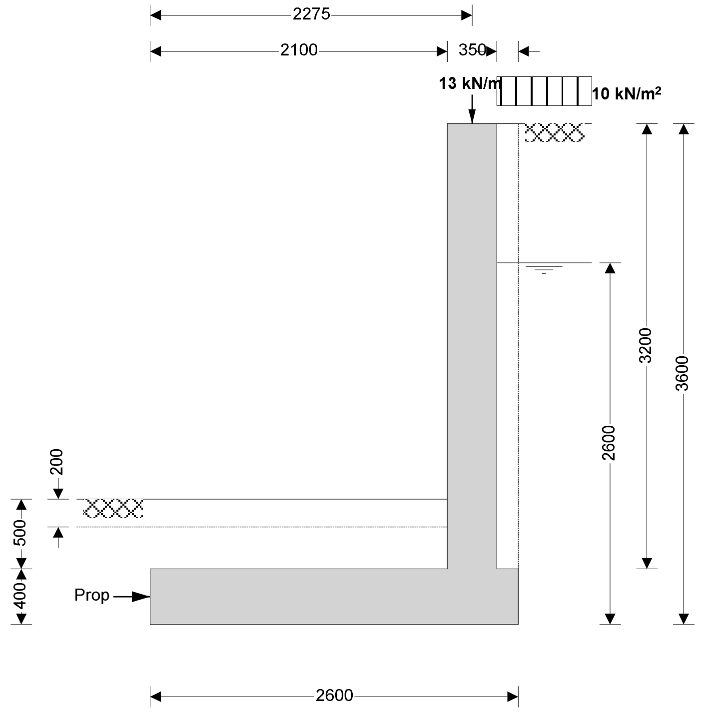
Toe bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)
Heel bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Stem bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)

WALL J

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} = **3200** 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} = **400** mm
Height of retaining wall	h_{wall} = **3600** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **400** mm
Position of downstand	l_{ds} = **1900** mm		
Depth of cover in front of wall	d_{cover} = **500** mm	Unplanned excavation depth	d_{exc} = **200** mm
Height of ground water	h_{water} = **2600** 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} = **3600** 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**		

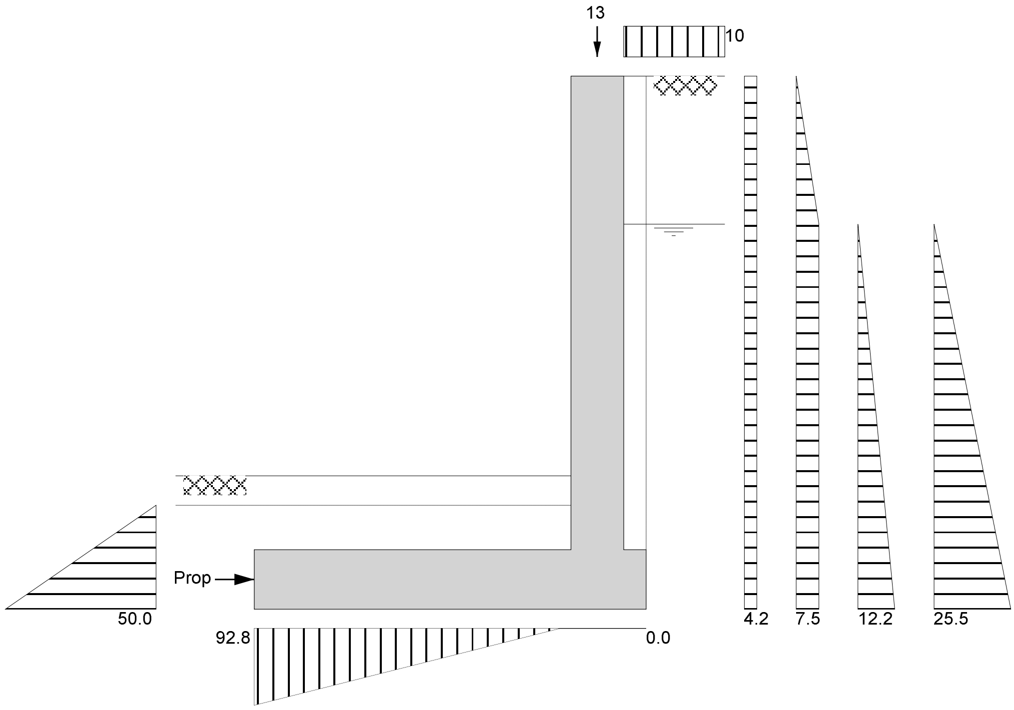
Loading details

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

Vertical dead load — W_{dead} = **13.0** 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} = **45.1** kN/m

Check bearing pressure

Total vertical reaction — R = **94.0** kN/m — Distance to reaction — x_{bar} = **675** mm

Eccentricity of reaction — e = **625** mm

Reaction acts outside middle third of base

Bearing pressure at toe — p_{toe} = **92.8** 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} = **45.1** 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} = **88.3** kN/m Moment at heel M_{toe} = **208.9** kNm/m

Compression reinforcement is not required

Check toe in bending

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

Area required $A_{s\_toe\_req}$ = **1481.4** 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} = **0.258** 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} = **0.644** 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} = **17.9** kN/m Moment at heel M_{heel} = **4.7** kNm/m

Compression reinforcement is not required

Check heel in bending

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

Area required $A_{s\_heel\_req}$ = **520.0** 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} = **0.052** 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} = **0.463** 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} = **27.4** kN/m Moment at base of stem M_{stem} = **151.5** kNm/m

Compression reinforcement is not required

Check wall stem in bending

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

Area required $A_{s\_stem\_req}$ = **1391.8** 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} = **0.103** N/mm^2 Allowable shear stress v_{adm} = **5.000** N/mm^2

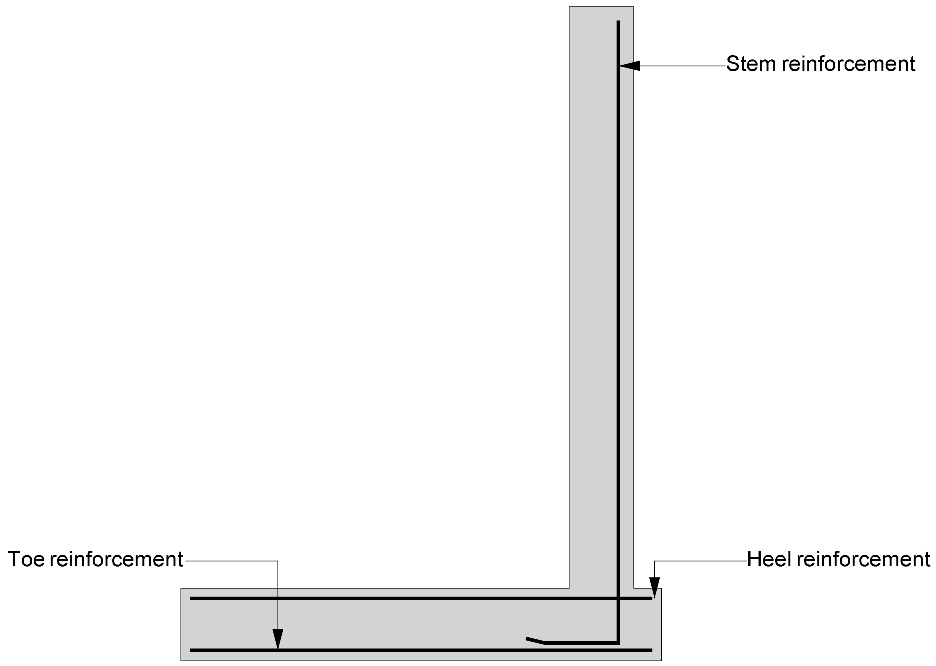
PASS - Design shear stress is less than maximum shear stress

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

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

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY	Project 20 WELLS ROAD LONDON NW3				Job Ref. 17J02	
	Section PRELIMINARY BASEMENT CALCS				Sheet no./rev. 19	
	Calc. by TV	Date 03/10/2017	Chk'd by	Date	App'd by	Date

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)

BASEMENT SLAB

UPLIFT = 2.6 X 10 = 26KN/m^2

SWT + FINISH = 6.8KN/m^2

DESIGN LOAD = 27KN/m^2 UPLIFT.

DowLOADING UNDER NORMAL CONDITION DESIGN LOAD = 12KN/m^2

TOP REINFT

BM = 27 X 2.75^2 /8 = 25.5KN.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 = **200** mm

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

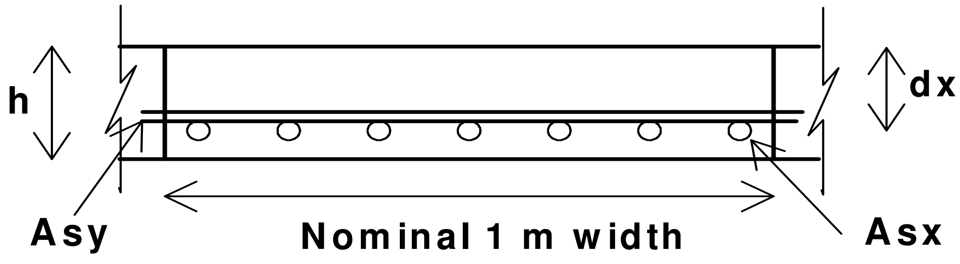
Trial bar diameter D_{tryx} = **10** mm

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 (simple)

ONE WAY SPANNING SLAB (CL 3.5.4)

MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab) m_{sx} = **26.0** kNm/m

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

Design sagging moment (per m width of slab) m_{sx} = **26.0** kNm/m

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

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu})$ = **0.035**

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

Outer compression steel not required to resist sagging

Slab requiring outer tension steel only - bars (sagging)

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

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

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x)$ = **434** mm²/m

Tension steel

Provide 10 dia bars @ 100 centres outer tension steel resisting sagging

$A_{sx\_prov} = A_{sx}$ = **785** mm²/m

Area of outer tension steel provided sufficient to resist sagging

TRANSVERSE BOTTOM STEEL - INNER

Inner layer of transverse steel

Provide 10 dia bars @ 100 centres

$A_{sy\_prov} = A_{sy}$ = **785** mm²/m

Check min and max areas of steel resisting sagging

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

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c$ = **260** mm²/m

$A_{st\_max} = 4 \% \times A_c$ = **8000** mm²/m

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **785** mm²/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **785** mm²/m

Area of inner steel provided (sagging) OK

CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)

Slab span length l_x = **2.750** m

Design ultimate moment in shorter span per m width m_{sx} = **26** kNm/m

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

Tension steel

Area of outer tension reinforcement provided A_{sx_prov} = **785** mm²/m

Area of tension reinforcement required A_{sx_req} = **434** mm²/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.

$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx})$ = **184.3** N/mm^2

$factor_{tens} = \min(2, 0.55 + (477 \text{ N/mm}^2 - f_s) / (120 \times (0.9 \text{ N/mm}^2 + m_{sx} / d_x^2)))$ = **1.691**

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 $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x$ = **4.91** m

Check the actual beam span

Actual span/depth ratio l_x / d_x = **18.97**

Span depth limit $ratio_{span\_depth} \times factor_{tens}$ = **33.83**

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 = **145.0** mm

Diameter of tension reinforcement D_x = **10** mm

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

Cover to outer tension reinforcement

$c_{tenx} = h - d_x - D_x / 2$ = **50.0** mm

Nominal cover to links steel

$c_{nomx} = c_{tenx} - L_{diax}$ = **50.0** mm

Permissable minimum nominal cover to all reinforcement (Table 3.4)

c_{min} = **35** mm

Cover over steel resisting sagging OK

2 LAYERS A393 TOP

BOTTOM REINFORCEMENT

BM = 12 X 2.75^2 / 8 = 11.4KN.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

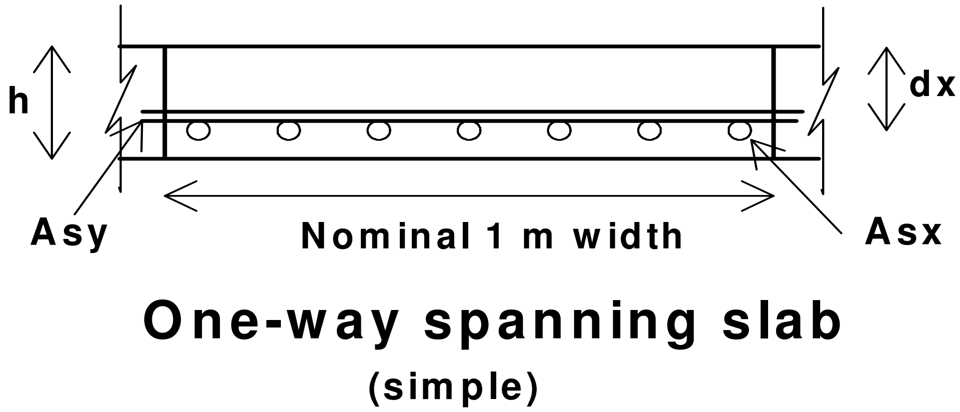
Trial bar diameter D_{tryx} = **10** mm

Depth to tension steel (resisting sagging)

$d_x = h - c_b - D_{tryx}/2$ = **160** 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} = **12.0** kNm/m

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

Design sagging moment (per m width of slab) m_{sx} = **12.0** kNm/m

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

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu})$ = **0.013**

$K'_x = \min(0.156, (0.402 \times (\beta_{bx} - 0.4)) - (0.18 \times (\beta_{bx} - 0.4)^2))$ = **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 $x_x = (d_x - z_x) / 0.45$ = **18** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x)$ = **182** mm^2/m

Tension steel

Provide 10 dia bars @ 200 centres outer tension steel resisting sagging

$A_{sx\_prov} = A_{sx}$ = **393** 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** mm²/m

Check min and max areas of steel resisting sagging

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

Minimum % reinforcement k = **0.13** %

$A_{st\_min} = k \times A_c =$ **260** mm²/m

$A_{st\_max} = 4\ \% \times A_c =$ **8000** mm²/m

Steel defined:

Outer steel resisting sagging $A_{sx\_prov} =$ **393** mm²/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging $A_{sy\_prov} =$ **393** mm²/m

Area of inner steel provided (sagging) OK

CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)

Slab span length $l_x =$ **2.750** m

Design ultimate moment in shorter span per m width $m_{sx} =$ **12** kNm/m

Depth to outer tension steel $d_x =$ **160** mm

Tension steel

Area of outer tension reinforcement provided $A_{sx\_prov} =$ **393** mm²/m

Area of tension reinforcement required $A_{sx\_req} =$ **182** mm²/m

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

Modification Factors

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

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

$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx}) =$ **154.0** N/mm²

$factor_{tens} = \min(2, 0.55 + (477\ N/mm^2 - f_s) / (120 \times (0.9\ N/mm^2 + m_{sx} / d_x^2))) =$ **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 $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x =$ **6.40** m

Check the actual beam span

Actual span/depth ratio $l_x / d_x =$ **17.19**

Span depth limit $ratio_{span\_depth} \times factor_{tens} =$ **40.00**

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 $d_x =$ **160.0** mm

Diameter of tension reinforcement $D_x =$ **10** 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

<u>A393 **BOTTOM**</u>