V&R VINCENT & RYMILL VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY GU16 6PT	Project 207 GOLDHURST TERRACE NW8			Job Ref. 15 F02	
	Section NEW BASEMENT - preliminary calculations			Sheet no./rev. 1	
	Calc. by TV	Date 16/06/2015	Chk'd by	Date	App'd by	Date

LOADINGS

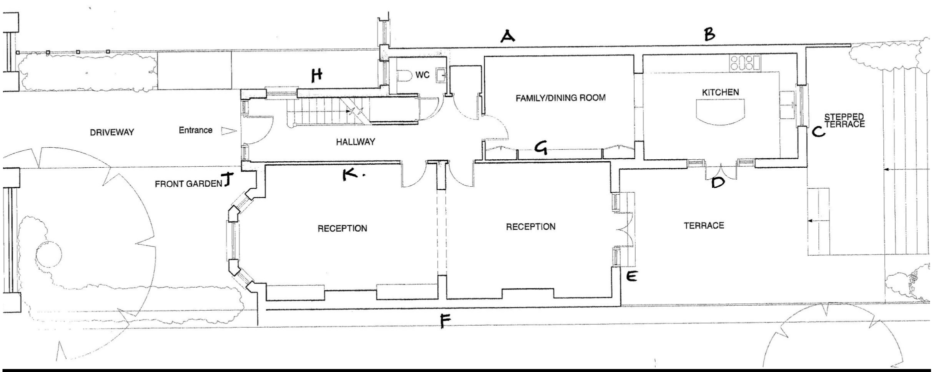
PITCHED ROOF	**KN/m²**	**CEILING**	**KN/m²**
Tiles	0.70	Ceiling Joists	0.10
Felt & battens	0.05	Plasterboard	0.15
Rafters	0.10	D. L.	0.25 KN/m^2
	0.85	I. L. where applicable	0.25 KN/m^2
30^0 on plan load D. L.	1.00 KN/m^2		0.50 KN/m^2
30^0 Imposed Load	0.75 KN/m^2		
	1.75 KN/m^2		

FLAT ROOF	**KN/m²**	**TIMBER FLOORS**	**KN/m²**
Felt	0.25	Boards	0.20
Boards	0.25	Joists	0.10
Joists & firrings	0.15	Ceiling	0.30
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/m²**	**STUDWORK**	0.60KN/m^2
Finish	1.80		
CONCRETE	4.20		
D. L.	6.00 KN/m^2		
I. L.	1.50 KN/m^2		
	7.50 KN/m^2		

MASONRY	**KN/m²**
102 Brick + plaster	2.20 KN/m^2
215 BRICK + (1 x plaster)	4.60 KN/m^2
215 BRICK + (2 x plaster)	4.80 KN/m^2
330 BRICK (2 x plaster)	7.00 KN/m^2

KEY PLAN



WALL LOADINGS

WALL A

WALL	10.5 X 4.80	=	50.40	
FLRS DL	2 X 0.6 X 1.75	=	2.10	
FLRS IL	2 X 1.5 X 1.75	=		5.25
ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=		1.50
			54.50KN/m	6.75KN/m

WALL B

WALL	3.5 X 3.3	=	11.55KN/m	
ROOF DL	1.75 X 0.8	=	1.40	
ROOF IL	1.75 X 0.75	=		1.30
			12.95KN/m	1.30KN/m

WALL C

WALL	3.5 X 3.3 X 80%	=	9.5KN/m

WALL D

WALL	3.5 X 3.3 X 80%	=	9.25KN/m	
ROOF DL	1.75 X 0.8	=	1.40	
ROOF IL	1.75 X 0.75	=		1.30
			12.95KN/m	1.30KN/m

WALL E

WALL	7.5 X 4.6 X 70%	=	24.15	
ROOF	3 X 1	=	3.00	
ROOF	3 X 0.75	=		2.25
			27.15KN/m	2.25KN/m

WALL F

WALL	10.5 X 4.80	=	50.40	
FLRS DL	2 X 0.6 X 2.25	=	2.70	
FLRS IL	2 X 1.5 X 2.25	=		6.75
ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=		1.50
			55.10KN/m	8.25KN/m

CHIMNEY BREASTS

MASONRY	2.4 X 1.25 X 12.5	=	37.50KN/m

WALL G

WALL	2.6 X 6.5	=	16.90	
STUD	0.6 X 2.5	=	1.50	
FLRS DL	4 X 0.6 X 2	=	4.80	
FLRS IL	4 X 1.5 X 2	=		12.00
			23.20KN/m	12.00KN/m

WALL K

WALL	2.6 X 6.5	=	16.90	
STUD	0.6 X 2.5	=	1.50	
FLRS DL	3 X 0.6 X 2	=	3.60	
FLRS IL	3 X 1.5 X 2	=	______	9.00
			22.00KN/m	9.00KN/m

WALL H

WALL	10.5 X 4.80	=	50.40	
FLRS DL	2 X 0.6 X 1	=	1.20	
FLRS IL	2 X 1.5 X 1	=		3.00
ROOF DL	2 X 1	=	2.00	
ROOF IL	2 X 0.75	=	______	1.50
			53.6KN/m	4.50KN/m

WALL J

WALL	7 X 4.6 X 70%	=	22.50KN/m	
ROOF DL	3 X 1	=	3.00	
ROOF IL	3 X 0.75	=	______	2.25
			25.50KN/m	2.25KN/m

WALLS AND BASES

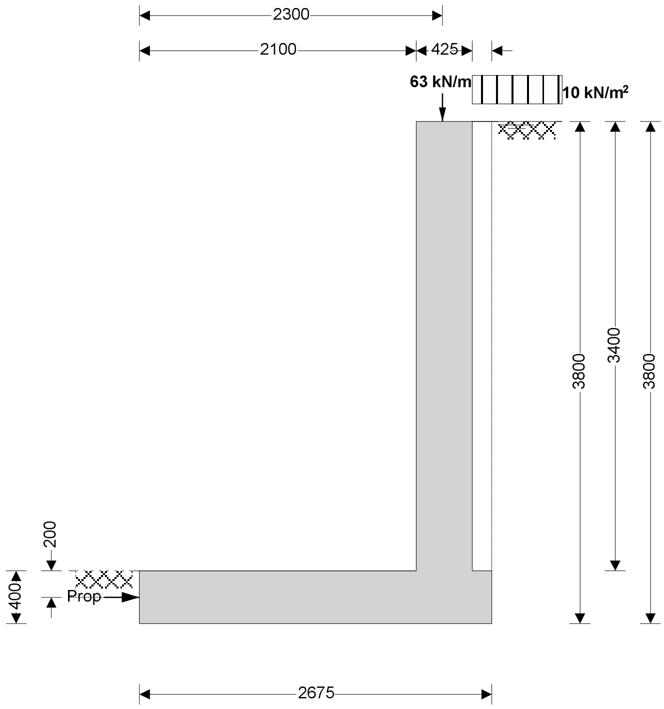
PARTY WALLS – WALLS A AND F

DL = 55.1KN/m, IL = 8.25KN/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} = **3400** mm	Wall stem thickness	t_{wall} = **425** mm
Length of toe	l_{toe} = **2100** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **2675** mm	Base thickness	t_{base} = **400** mm
Height of retaining wall	h_{wall} = **3800** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **400** mm
Position of downstand	l_{ds} = **1100** 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} = **3800** 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} = **3800** 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**

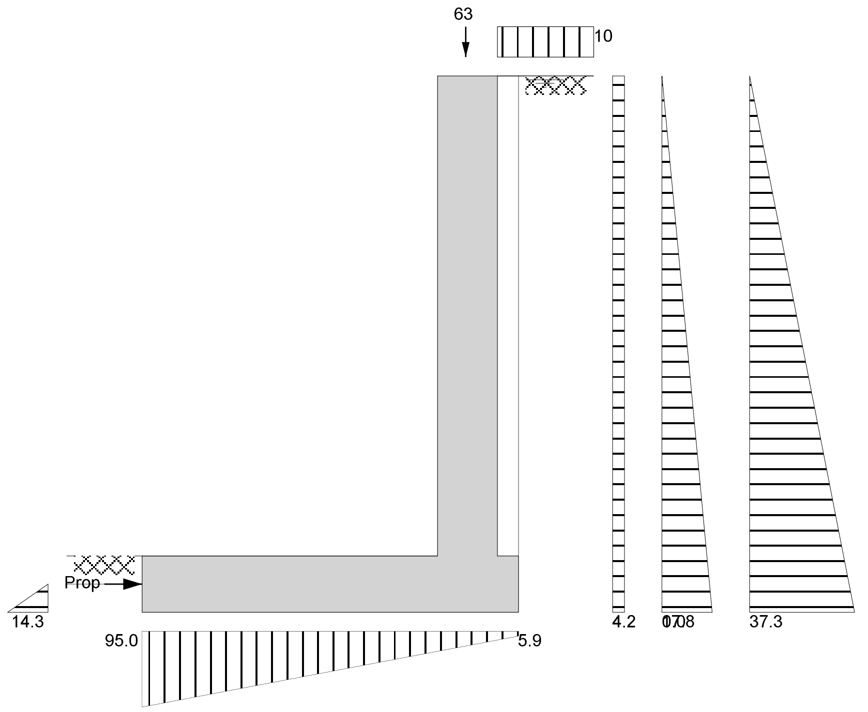
Loading details

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

Vertical dead load W_{dead} = **55.1** kN/m Vertical live load W_{live} = **8.3** 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} = **2300** 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} = **77.0** kN/m

Check bearing pressure

Total vertical reaction R = **134.9** kN/m Distance to reaction x_{bar} = **944** mm

Eccentricity of reaction e = **394** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **95.0** kN/m^2 Bearing pressure at heel p_{heel} = **5.9** 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} = **77.0** kN/m

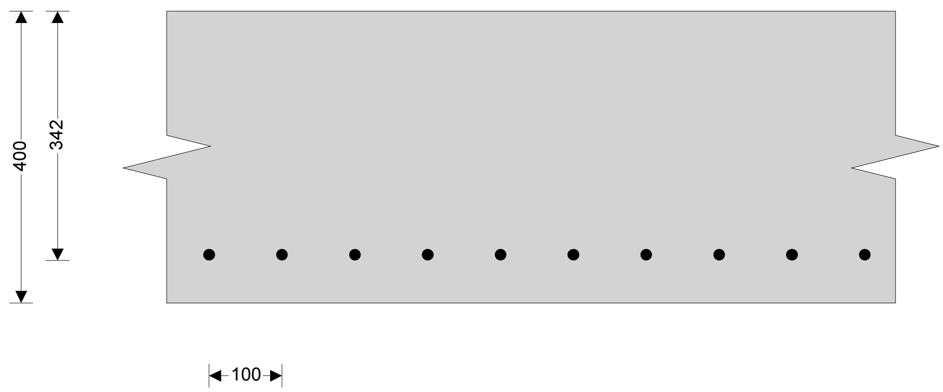
Design of reinforced concrete retaining wall toe (BS 8002:1994)

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} = **163.1** kN/m Moment at heel M_{toe} = **273.6** kNm/m

Compression reinforcement is not required

Check toe in bending

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

Area required $A_{s\_toe\_req}$ = **1977.0** 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} = **0.477** 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

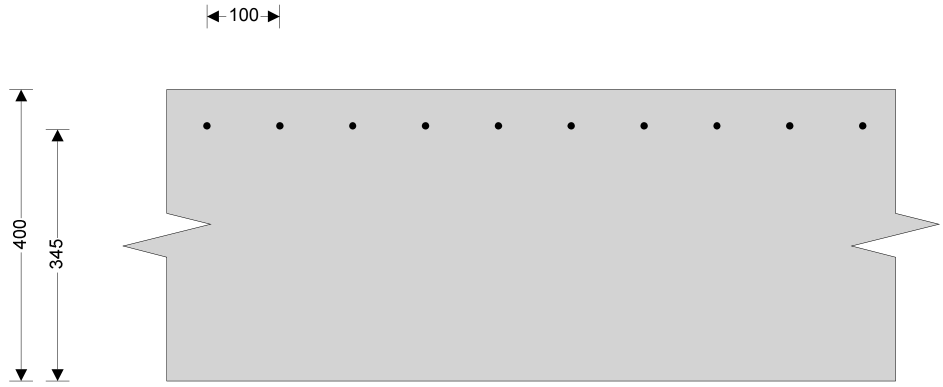
Design of reinforced concrete retaining wall heel (BS 8002:1994)

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} = **19.4** kN/m — Moment at heel M_{heel} = **5.9** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **B785 mesh**

Area required $A_{s\_heel\_req}$ = **520.0** 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} = **0.056** 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} = **0.468** N/mm^2

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

<u>Design of reinforced concrete retaining wall stem (BS 8002:1994)</u>

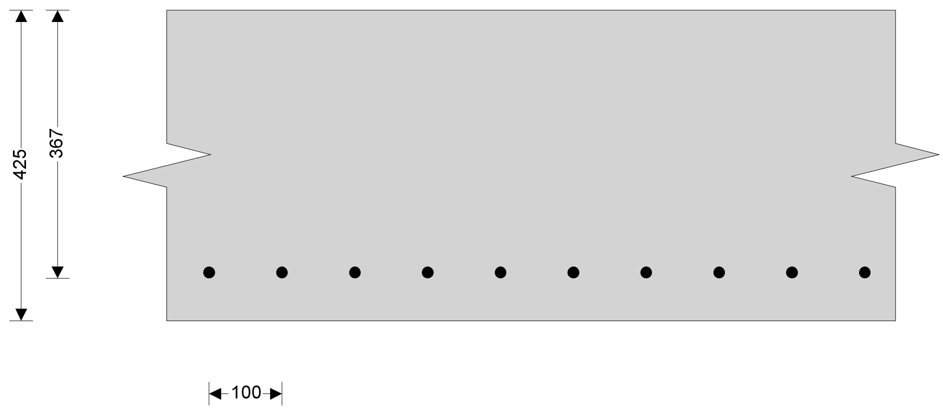
Material properties

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} = **50** mm — Cover in wall c_{wall} = **50** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **24.1** kN/m — Moment at base of stem M_{stem} = **211.5** kNm/m

Compression reinforcement is not required

Check wall stem in bending

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

Area required $A_{s\_stem\_req}$ = **1394.6** 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} = **0.066** 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} = **0.618** N/mm^2

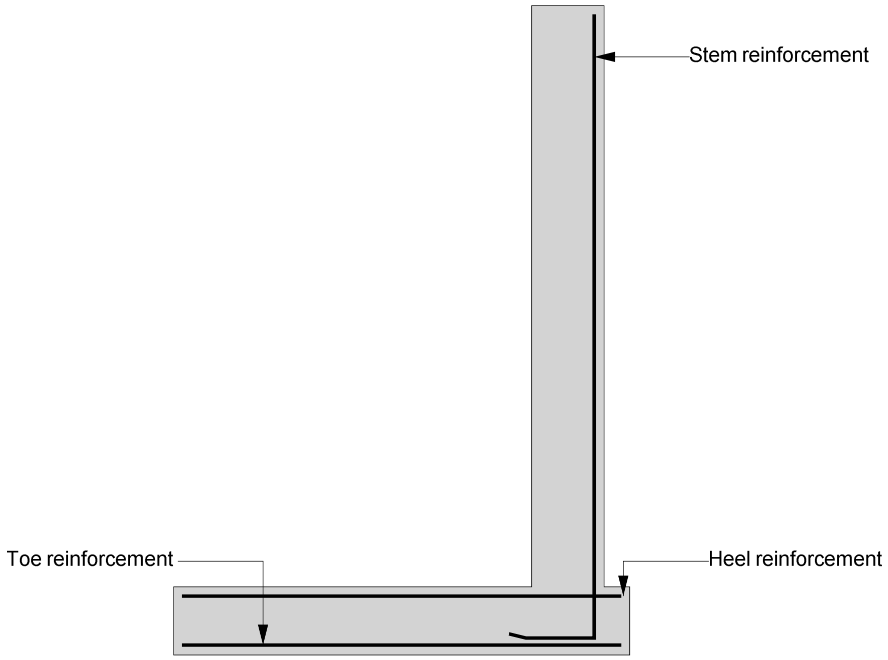
$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **9.65** Actual span/depth ratio $ratio_{act}$ = **9.26**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



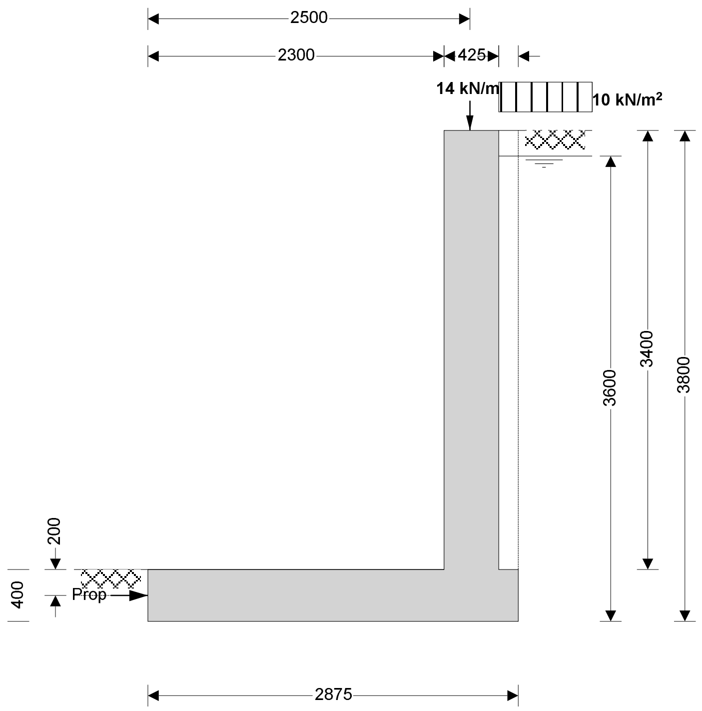
Toe bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)
Heel mesh - B785 - (785 mm^2/m)
Stem bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)

WALLS B

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} = **3400** mm	Wall stem thickness	t_{wall} = **425** mm
Length of toe	l_{toe} = **2300** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **2875** mm	Base thickness	t_{base} = **400** mm
Height of retaining wall	h_{wall} = **3800** 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} = **3600** 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} = **3800** 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**		

VINCENT & RYMILL LAKESIDE COUNTRY CLUB FRIMLEY GREEN SURREY GU16 6PT	Project 207 GOLDHURST TERRACE NW8				Job Ref. 15 F02	
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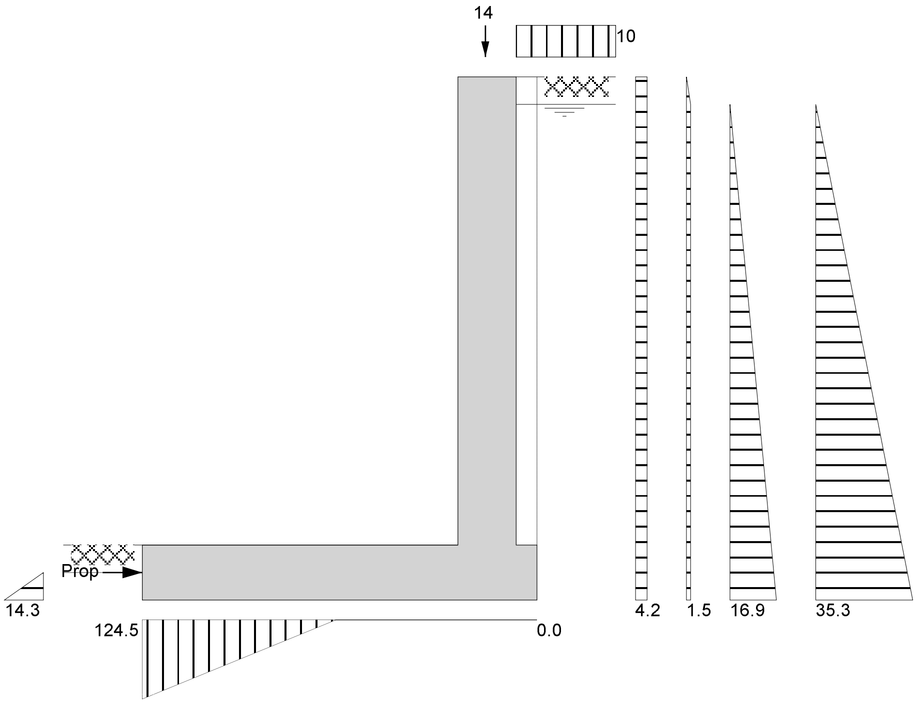
	Calc. by TV	Date 16/06/2015	Chk'd by	Date	App'd by	Date

Loading details

Surcharge load	Surcharge = **10.0** kN/m^2		
Vertical dead load	W_{dead} = **13.0** kN/m	Vertical live load	W_{live} = **1.3** 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} = **2500** 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} = **85.4** kN/m

Check bearing pressure

Total vertical reaction	R = **87.7** kN/m	Distance to reaction	x_{bar} = **469** mm
Eccentricity of reaction	e = **968** mm		

Reaction acts outside middle third of base

Bearing pressure at toe	p_{toe} = **124.5** 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} = **85.4** 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} = **92.9** kN/m Moment at heel M_{toe} = **261.6** kNm/m

Compression reinforcement is not required

Check toe in bending

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

Area required $A_{s\_toe\_req}$ = **1884.0** 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} = **0.272** 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} = **19.3** kN/m Moment at heel M_{heel} = **5.8** kNm/m

Compression reinforcement is not required

Check heel in bending

Reinforcement provided **B785 mesh**

Area required $A_{s\_heel\_req}$ = **520.0** 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} = **0.056** 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} = **0.468** 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} = **50** mm Cover in wall c_{wall} = **50** mm

Design of retaining wall stem

Shear at base of stem V_{stem} = **5.8** kN/m Moment at base of stem M_{stem} = **202.7** kNm/m

Compression reinforcement is not required

Check wall stem in bending

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

Area required $A_{s\_stem\_req}$ = **1336.8** 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} = **0.016** 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} = **0.618** N/mm^2

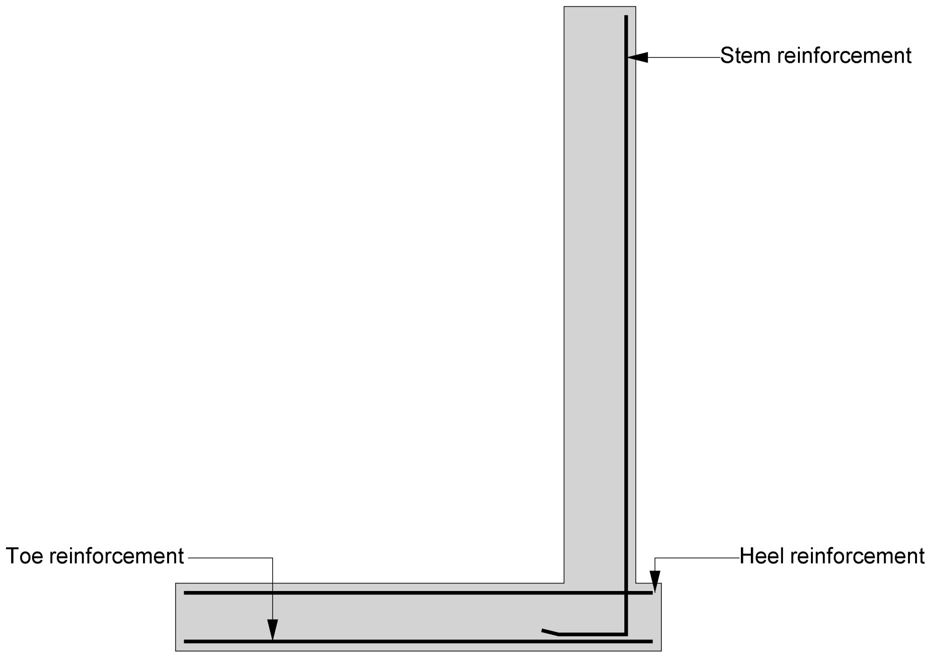
$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **10.04** Actual span/depth ratio $ratio_{act}$ = **9.26**

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 mesh - B785 - (785 mm^2/m)

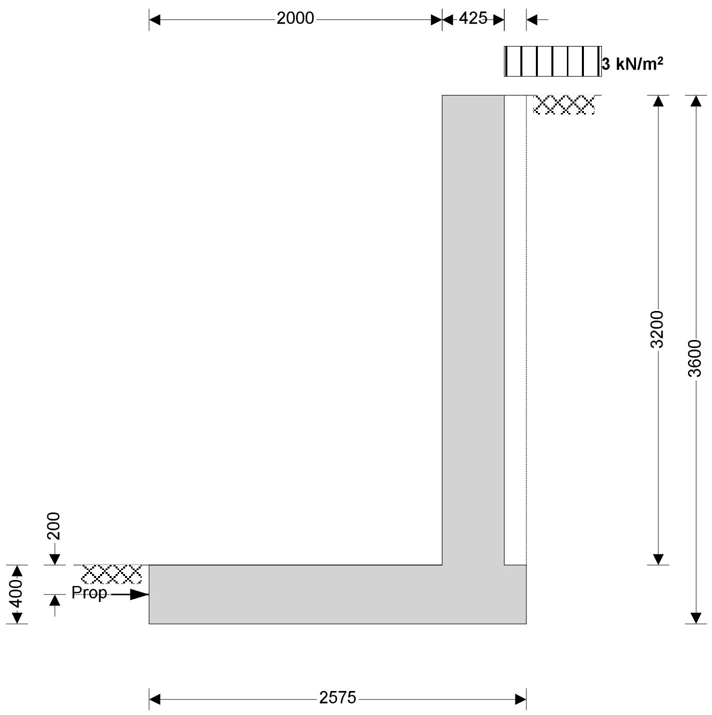
Stem bars - 16 mm dia.@ 100 mm centres - (2011 mm^2/m)

TYPICAL LIGHT WELL WALL

RETAINING WALL ANALYSIS & DESIGN (BS8002)

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

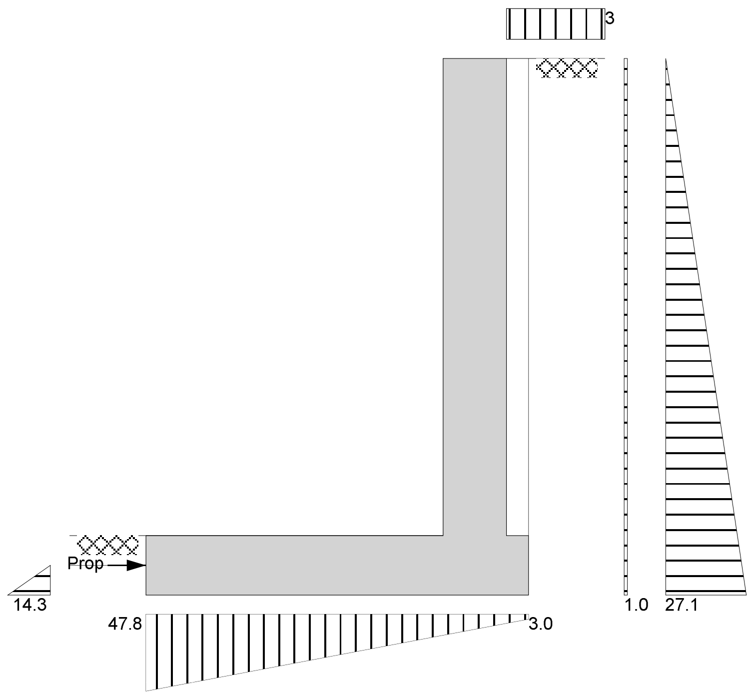
Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **3200** mm	Wall stem thickness	t_{wall} = **425** mm
Length of toe	l_{toe} = **2000** mm	Length of heel	l_{heel} = **150** mm
Overall length of base	l_{base} = **2575** mm	Base thickness	t_{base} = **400** mm
Height of retaining wall	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} = **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} = **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	$P_{bearing}$ = **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 = **2.5** kN/m^2		
Vertical dead load	W_{dead} = **0.0** 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} = **0** 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} = **29.3** kN/m

Check bearing pressure

Total vertical reaction	R = **65.4** kN/m	Distance to reaction	x_{bar} = **909** mm
Eccentricity of reaction	e = **378** mm		

Reaction acts within middle third of base

Bearing pressure at toe	p_{toe} = **47.8** kN/m^2	Bearing pressure at heel	p_{heel} = **3.0** 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} = **29.3** 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} = **65.2** kN/m Moment at heel M_{toe} = **126.4** kNm/m

Compression reinforcement is not required

Check toe in bending

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

Area required $A_{s\_toe\_req}$ = **894.4** 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} = **0.191** 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} = **14.7** kN/m Moment at heel M_{heel} = **4.5** 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} = **0.043** 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} = **50** mm Cover in wall c_{wall} = **50** mm

Design of retaining wall stem

Shear at base of stem V_{stem} = **11.5** kN/m Moment at base of stem M_{stem} = **110.0** kNm/m

Compression reinforcement is not required

Check wall stem in bending

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

Area required $A_{s\_stem\_req}$ = **725.5** 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} = **0.031** 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} = **0.618** N/mm^2

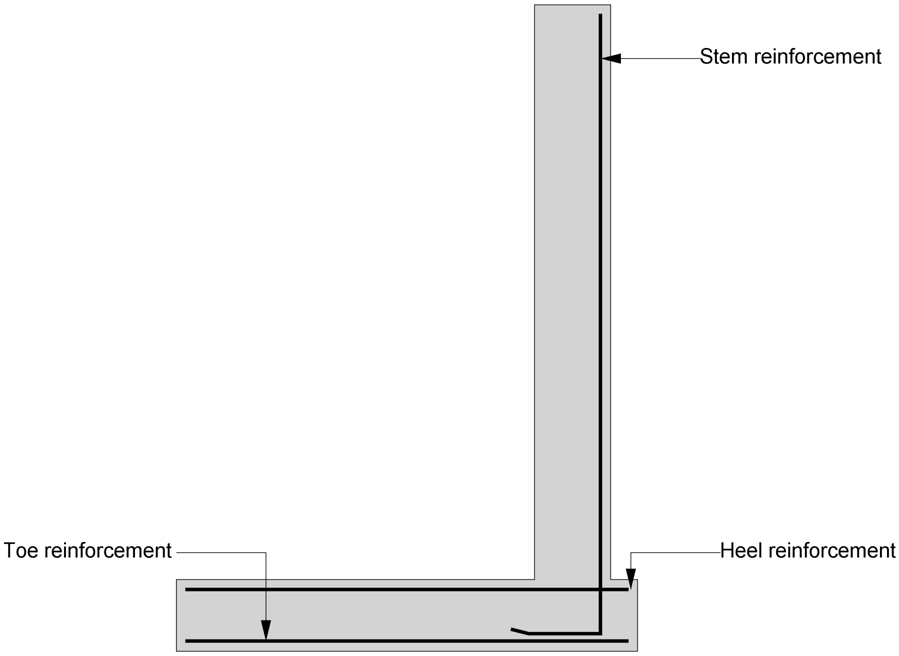
v_{stem} < v_{c_stem} - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **14.00** Actual span/depth ratio $ratio_{act}$ = **8.72**

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

BASE SLAB

CHECK UPLIFT FROM WATER PRESSURE
NETT PRESSURE AT ULS = 1.4((10 X 3.75) –(6.8)) = $43KN/m^2$

B.M. MAX = 43 X 2.5^2 /8 = 33.5KN.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 = **35** mm

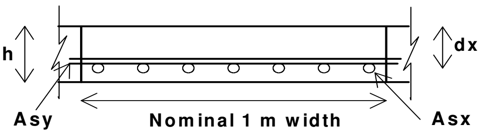
Trial bar diameter D_{tryx} = **10** mm

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
(simple)

ONE WAY SPANNING SLAB (CL 3.5.4)

MAXIMUM DESIGN MOMENTS IN SPAN

Design sagging moment (per m width of slab) m_{sx} = **33.0** kNm/m

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

Design sagging moment (per m width of slab) m_{sx} = **33.0** kNm/m

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

Area of reinforcement required

$K_x = abs(m_{sx}) / (d_x^2 \times f_{cu})$ = **0.037**

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

Outer compression steel not required to resist sagging

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

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

Neutral axis depth $x_x = (d_x - z_x) / 0.45$ = **18** mm

Area of tension steel required

$A_{sx\_req} = abs(m_{sx}) / (1/\gamma_{ms} \times f_y \times z_x)$ = **499** mm^2/m

Tension steel

Use B785 Mesh

$A_{sx\_prov} = A_{sl}$ = **785** mm^2/m $A_{sy\_prov} = A_{st}$ = **252** mm^2/m

$D_x = d_{sl}$ = **10** mm $D_y = d_{st}$ = **8** mm

Area of tension steel provided sufficient to resist sagging

Check min and max areas of steel resisting sagging

Total area of concrete $A_c = h$ = **200000** mm^2/m

Minimum % reinforcement k = **0.13** %

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

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

Steel defined:

Outer steel resisting sagging A_{sx_prov} = **785** mm^2/m

Area of outer steel provided (sagging) OK

Inner steel resisting sagging A_{sy_prov} = **252** mm^2/m

Less than min area of inner steel (sagging) FAIL

CONCRETE SLAB DEFLECTION CHECK (CL 3.5.7)

Slab span length l_x = **2.500** m

Design ultimate moment in shorter span per m width m_{sx} = **33** kNm/m

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

Tension steel

Area of outer tension reinforcement provided A_{sx_prov} = **785** mm^2/m

Area of tension reinforcement required A_{sx_req} = **499** 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.

$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_prov} \times \beta_{bx})$ = **212.0** N/mm^2

$factor_{tens} = \min(2, 0.55 + (477\ N/mm^2 - f_s) / (120 \times (0.9\ N/mm^2 + m_{sx} / d_x^2)))$ = **1.559**

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 $l_{max} = ratio_{span\_depth} \times factor_{tens} \times d_x$ = **4.99** m

Check the actual beam span

Actual span/depth ratio l_x / d_x = **15.63**

Span depth limit $ratio_{span\_depth} \times factor_{tens}$ = **31.17**

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

2 LAYERS A393 TOP 1 LAYER BOTTOM