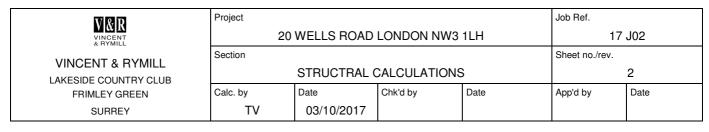


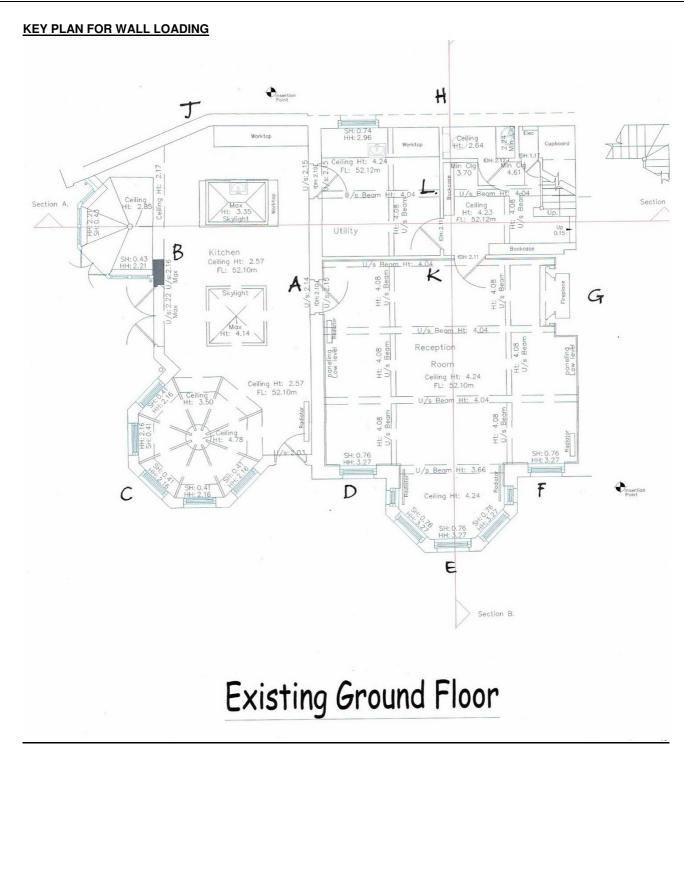
## APPENDIX 2

# STRUCTURAL CALCULATIONS

20 WELL ROAD, NW3 1LH. PROPOSED BASEMENT NOV 2018. - ISSUE 3

V & R	Project					Job Ref.	
VINCENT & RYMILL	20	WELLS ROAD	LONDON N	W3 1LH			17 J02
VINCENT & RYMILL	Section					Sheet no./rev	
LAKESIDE COUNTRY CLUB		STRUCTRAL	CALCULATIO	ONS			1
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date		App'd by	Date
SURREY	TV	03/10/2017					
PITCHED ROOF	KN/m <sup>2</sup>	(	EILING		KN/	/m <sup>2</sup>	
Tiles	0.70		Ceiling Joists		0.10		
Felt & battens	0.05		Plasterboard		<u>0.15</u>	5	
Rafters	<u>0.10</u>	Γ	). L.			5 KN/m <sup>2</sup>	
	0.85	I	. L. where ap	plicable	0.25	<u>5</u> KN/m <sup>2</sup>	
30 <sup>0</sup> on plan load D. L.	1.00 KN/m <sup>2</sup>				0.50	) KN/m <sup>2</sup>	
30 <sup>0</sup> Imposed Load	<u>0.60 </u> KN/m <sup>2</sup>						
	1.60 KN/m <sup>2</sup>						
FLAT ROOF	KN/m²	-		OPE	KN/	(m <sup>2</sup>	
Felt	0.25		Boards	013	0.20		
Boards	0.25		loists		0.20		
Joists & firrings	0.25		Ceiling		<u>0.30</u>		
Ceiling			). L.			<u>)</u> 0 KN/m²	
D. L.	<u>0.15</u> 0.80 KN/m²		. L.			<u>0 KN/m²</u>	
Б. Е. І.L.	0.80 KN/m <sup>2</sup>	I	. L.			) KN/m <sup>2</sup>	
Ι.Ε.	1.55 KN/m <sup>2</sup>				2.10	J ININ/III	
200 RIBDECK	KN/m²						
Finish	1.90						
Self Weight	<u>4.10</u>						
D. L.	6.00 KN/m <sup>2</sup>						
I. L.	<u>1.50</u> KN/m <sup>2</sup>						
	7.50 KN/m <sup>2</sup>						
MASONRY	KN/m <sup>2</sup>						
102 Brick	2.20 KN/m <sup>2</sup>						
100 lt. wt blk + (1 x plaster)	1.10 KN/m <sup>2</sup>						
330 BRICK	6.80 KN/m <sup>2</sup>						
215 BRICK	4.60 KN/m <sup>2</sup>						





Project

Portion

Job No.

2.10 mm

36.3Mm



20 WELLS ROAD NW3 ILH.

Sheet No. 03

Made by: TV

Date: 007 2017

RYMI	LL WAL	LOADIN	G 2	- 	Checked by:	
WALL A	. WALL =	8.5 x	L.B	= 57.9	2.0	
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	and the second	2.5 × 0	and the second second second	the state of the second second second second		
		x 2.1 × (		1	e	
	FLAT ROOF1	2.1 ×	0.6		1.3.3	
	1stfur br	3.6 ×	5.C	2.2.		1
51- *	Construction of the second statement of the second sta	3.6×		and the second s	and the second	+
					8.20 mm	
				12/2		
S.						
	WALL	3.5× 3.5		17.3.	2	
	and the second se	2.1 × 0.8			the second of the second s	
	and a special sector of the sector	2.1× 0.6	a strength of the state of the particular		1.30	
					1.30 mh	
				ININ		
NAUC.	WAL	3.5×3.5×6	· 6 =	7.4		
	Roof DL Roof II.	2×0.6	2	1	.20	
			9.41	min I	20m/n	
NAU D	1F/H					
		8.5 × 6.8	E	57.80		
1 0.000 (0.000) (0.000		1.5 × 1.0				
					0.90	
	toola	1.5 × 0.6	-	0.60		
	Land H B H	1.0 × 1.5			1.50	
			5	3.24 1/4	1.50 2.40m/n	
			<b>y</b>	). Junio		*
NALLE	WALL B.S	5x 6.8×0.	6 =	34.70		
	a second a s	0 × 0.6		the second	0.60	
		0. C				
		0 × 1.5			150	

Project

Portion

Job No.



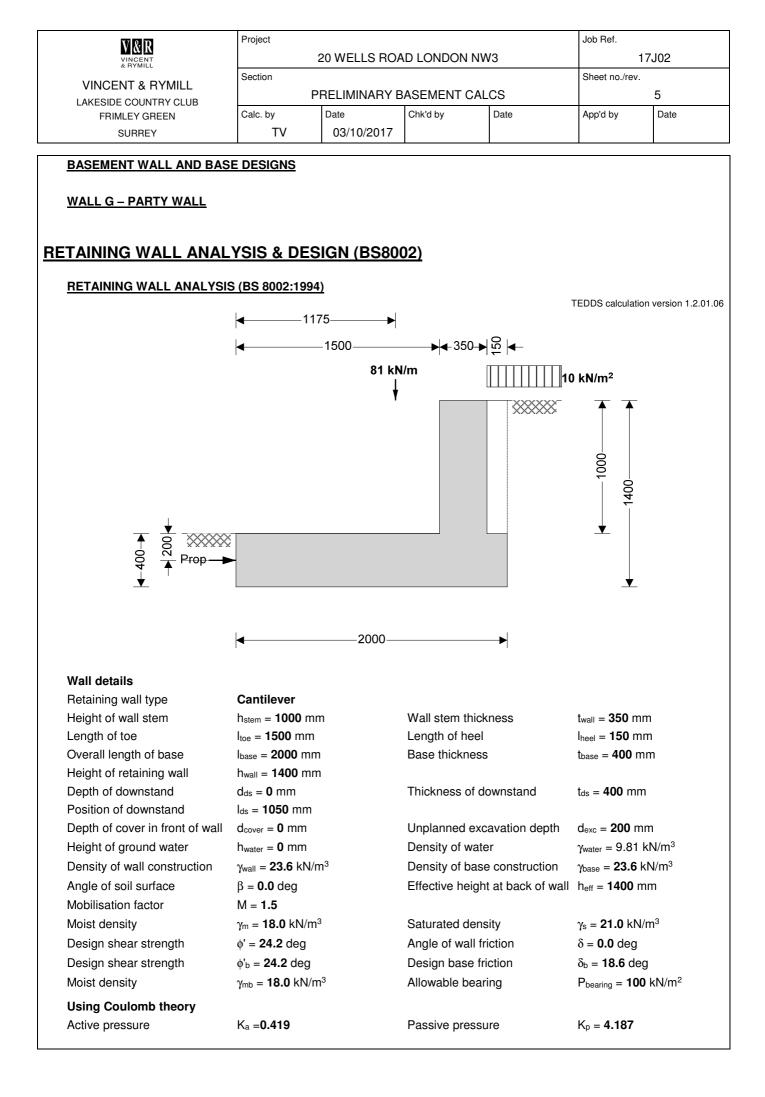
20 WELLS ROAD NW3 ILH.

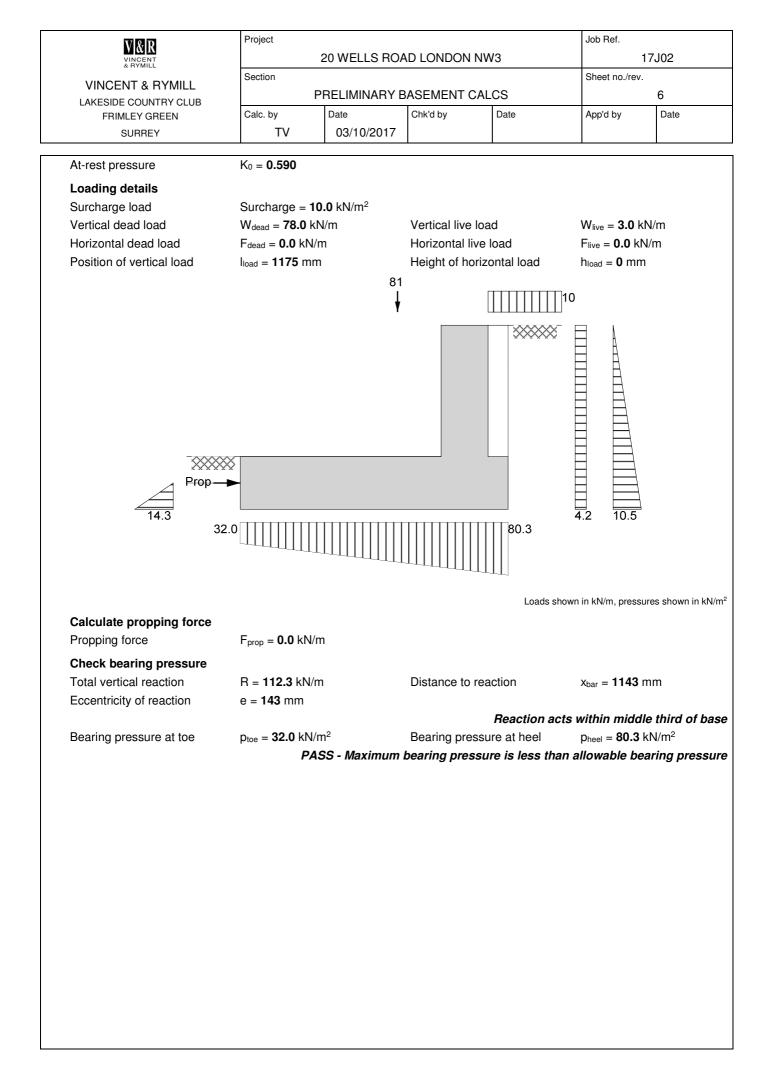
Sheet No. 04

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Date: OCT 2017.

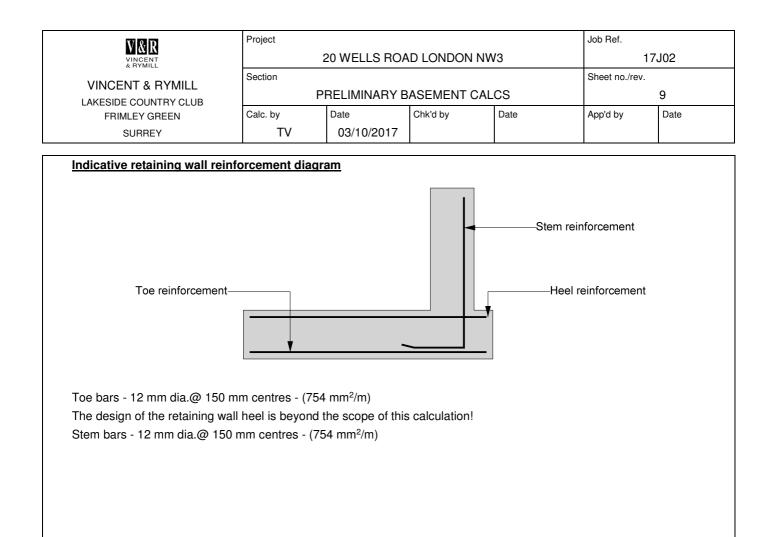
WAL	C	161 4.	8.5 x 6.8 =	57 0 -		
WALL			5 × 1.0 =			
	•					
			5 x 6.6 =		3.00	
		The second s	7.2 × 0.6 =			
		noor I	7.2×1.5' =			
NAU	J.	WALL =	= 3.5×35 =	12.30	m)	
WALL	К.		3.5 × 2.6 =			
		FRD =	3× 6.6 =	1.80		
		FIR I =	3×6.6 = 3×1.5' =		4.50	
	•		k	. Swih	4.50 m/2.	
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	Project	20 WELLS RO		IW3	Job Ref.	17J02
& RYMILL	Section	20 WELLO HO			Sheet no./rev.	
VINCENT & RYMILL	Coolion	PRELIMINARY E	BASEMENT CA	ALCS		7
LAKESIDE COUNTRY CLUB FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY	TV	03/10/2017				
RETAINING WALL DESIGN	(BS 8002:1994)	1			TEDDS calculati	on version 1.2.0
Ultimate limit state load fac	tors				TEDDS Calculati	
Dead load factor	γ <sub>f d</sub> = <b>1.4</b>		Live load fact	tor	γ <sub>f I</sub> = <b>1.6</b>	
Earth pressure factor	γ <sub>f e</sub> = <b>1.4</b>				1	
Calculate propping force	. –					
Propping force	F <sub>prop</sub> = <b>0.0</b> kN	//m				
Design of reinforced concr			1007)			
	ele relaining wa	an ioe (BS 6002.	<u>1994)</u>			
Material properties Strength of concrete	f <sub>cu</sub> = <b>40</b> N/mm	2	Strongth of m	einforcement	f <sub>v</sub> = <b>500</b> N/n	nm <sup>2</sup>
	icu = 4 <b>U</b> IN/I/I/I	1	Suchgulor	ennorcement	iy = <b>300</b> N/N	
Base details						_
Minimum reinforcement	k = <b>0.13</b> %		Cover in toe		c <sub>toe</sub> = <b>50</b> mr	n
Design of retaining wall toe						
Shear at heel	V <sub>toe</sub> = <b>89.0</b> kN	J/m	Moment at he		M <sub>toe</sub> = <b>76.2</b>	
				Compression	reinforcement	is not requi
Check toe in bending						
Reinforcement provided		ars @ 150 mm c				
Area required	$A_{s\_toe\_req} = 53$		Area provide		A <sub>s_toe_prov</sub> =	
		PASS - Rei	nforcement pl	rovided at the	retaining wall t	ioe is adequ
Check shear resistance at t						
Design shear stress	Vtoe = <b>0.259</b> N		Allowable she		Vadm = 5.000	
Concrete shear stress	v <sub>c toe</sub> = <b>0.463</b>		- Design snea	ar stress is les	s than maximu	m snear str
Concrete shear stress	$v_{c_{toe}} = 0.403$	IN/11111	V	ion < Va ton - NO	shear reinforce	ement reaui
						ement requi
Design of reinforced concr	ete retaining wa	all neel (BS 8002	<u>:1994)</u>			
Material properties	( <b>10</b> ) ) /	2			( 500 NI/	0
Strength of concrete	f <sub>cu</sub> = <b>40</b> N/mm	1-	Strength of re	einforcement	f <sub>y</sub> = <b>500</b> N/n	nm²
Base details						
Minimum reinforcement	k = <b>0.13</b> %		Cover in heel	-	Cheel = <b>50</b> m	
As the momen	nt is negative th	e design of the l	retaining wall	neel is beyond	i the scope of i	inis calculat
Design of reinforced concr	ete retaining wa	all stem (BS 8002	<u>2:1994)</u>			
Material properties						
Strength of concrete	f <sub>cu</sub> = <b>40</b> N/mm	1 <sup>2</sup>	Strength of re	einforcement	f <sub>y</sub> = <b>500</b> N/n	nm²
Wall details						
Minimum reinforcement	k = <b>0.13</b> %					
Minimum remorcement	c <sub>stem</sub> = <b>75</b> mm	ו	Cover in wall		$c_{wall} = 50 m$	m
Cover in stem						
Cover in stem		:N/m	Moment at ba	ase of stem	M <sub>stem</sub> = <b>10.6</b>	kNm/m
Cover in stem Design of retaining wall ste	em	N/m			M <sub>stem</sub> = 10.6 reinforcement	
Cover in stem Design of retaining wall ste Shear at base of stem	em V <sub>stem</sub> = 16.9 k	N/m				
Cover in stem Design of retaining wall ste	em V <sub>stem</sub> = 16.9 k	:N/m ars @ 150 mm c				

V&R	Project				Job Ref.	
VINCENT & RYMILL		20 WELLS ROA	D LONDON NW	/3		7J02
VINCENT & RYMILL	Section			00	Sheet no./rev.	
LAKESIDE COUNTRY CLUB		1	ASEMENT CAL			8
FRIMLEY GREEN	Calc. by TV	Date	Chk'd by	Date	App'd by	Date
SURREY	IV	03/10/2017				
Check shear resistance at v	wall stem					
Design shear stress	v <sub>stem</sub> = <b>0.063</b> N/	mm²	Allowable shea	r stress	Vadm = <b>5.000</b>	N/mm <sup>2</sup>
		PASS	- Design shear	stress is less	than maximur	m shear stre
Concrete shear stress	Vc_stem = 0.534	N/mm²	V.	v - No d	haar rainfaraa	mont roquir
Check retaining wall deflec	tion		Vstem <	: V <sub>c_stem</sub> - No sl	lear reinforce	ement requir
Max span/depth ratio	ratio <sub>max</sub> = <b>14.00</b>		Actual span/de		ratio <sub>act</sub> = <b>3.7</b> 2	
				PASS - Span	to depth ratio	o is acceptal

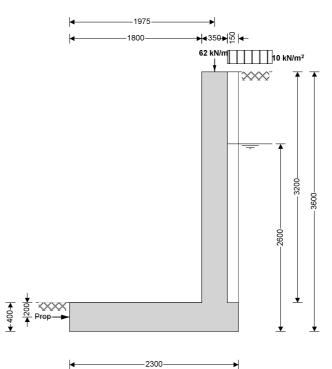


V&R	Project				Job Ref.	
	2	20 WELLS ROA	D LONDON NW	/3	17.	J02
VINCENT & RYMILL	Section				Sheet no./rev.	
	PI	RELIMINARY B	ASEMENT CAL	CS		10
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY	TV	03/10/2017				

## WALL H - END WALL - WALL D SIMILAR

# **RETAINING WALL ANALYSIS & DESIGN (BS8002)**

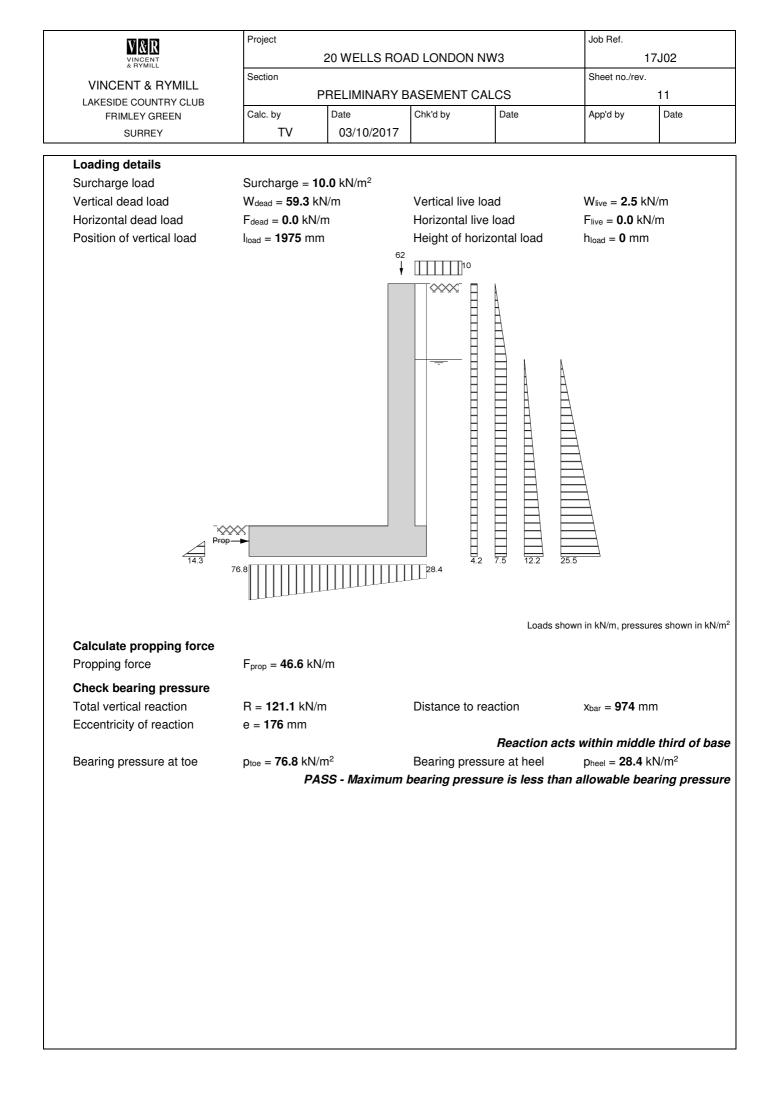
## RETAINING WALL ANALYSIS (BS 8002:1994)



TEDDS calculation version 1.2.01.06

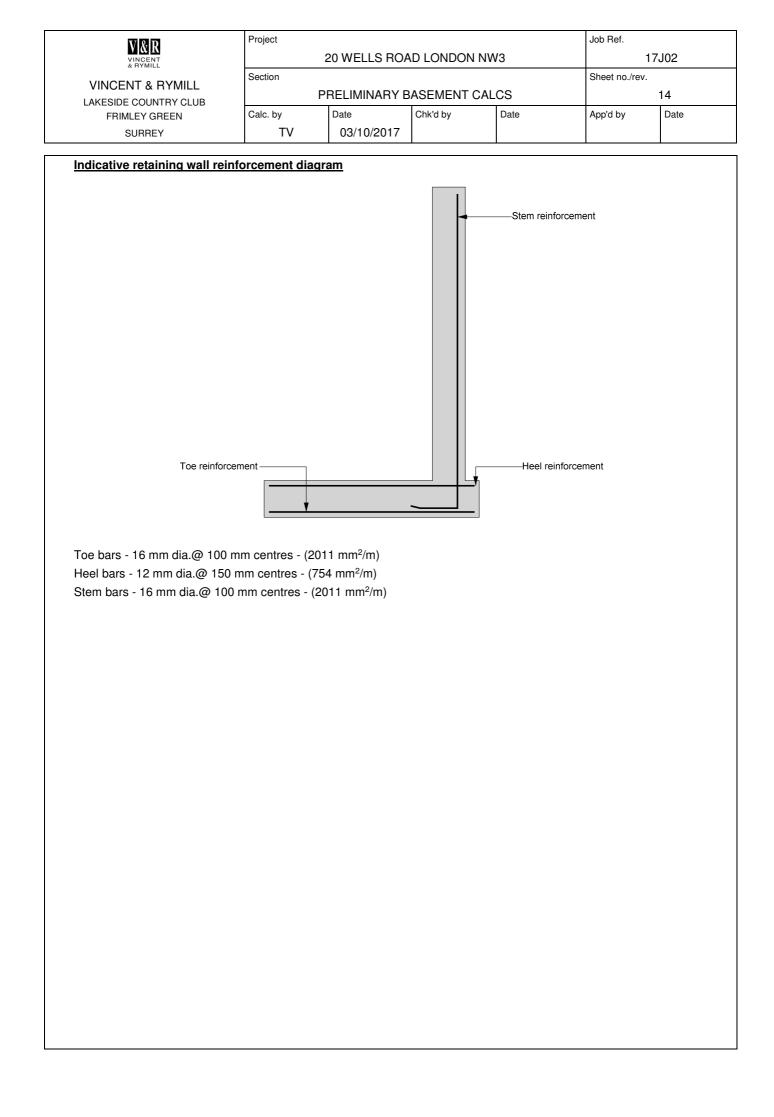
#### Wall details

wall details			
Retaining wall type	Cantilever		
Height of wall stem	h <sub>stem</sub> = <b>3200</b> mm	Wall stem thickness	t <sub>wall</sub> = <b>350</b> mm
Length of toe	I <sub>toe</sub> = <b>1800</b> mm	Length of heel	I <sub>heel</sub> = <b>150</b> mm
Overall length of base	I <sub>base</sub> = <b>2300</b> mm	Base thickness	t <sub>base</sub> = <b>400</b> mm
Height of retaining wall	h <sub>wall</sub> = <b>3600</b> mm		
Depth of downstand	d <sub>ds</sub> = <b>0</b> mm	Thickness of downstand	t <sub>ds</sub> = <b>400</b> mm
Position of downstand	l <sub>ds</sub> = <b>1900</b> mm		
Depth of cover in front of wall	d <sub>cover</sub> = <b>0</b> mm	Unplanned excavation depth	d <sub>exc</sub> = <b>200</b> mm
Height of ground water	h <sub>water</sub> = <b>2600</b> mm	Density of water	$\gamma_{water} = 9.81 \text{ kN/m}^3$
Density of wall construction	$\gamma_{wall} = 23.6 \text{ kN/m}^3$	Density of base construction	$\gamma_{\text{base}} = 23.6 \text{ kN/m}^3$
Angle of soil surface	$\beta = 0.0 \text{ deg}$	Effective height at back of wall	h <sub>eff</sub> = <b>3600</b> mm
Mobilisation factor	M = <b>1.5</b>		
Moist density	γm = <b>18.0</b> kN/m <sup>3</sup>	Saturated density	$\gamma_{s} = 21.0 \text{ kN/m}^{3}$
Design shear strength	φ' = <b>24.2</b> deg	Angle of wall friction	$\delta = \textbf{0.0} \text{ deg}$
Design shear strength	φ' <sub>b</sub> = <b>24.2</b> deg	Design base friction	$\delta_b = 18.6 \text{ deg}$
Moist density	$\gamma_{mb} = \textbf{18.0} \text{ kN/m}^3$	Allowable bearing	$P_{\text{bearing}} = 100 \text{ kN/m}^2$
Using Coulomb theory			
Active pressure	Ka = <b>0.419</b>	Passive pressure	Kp = <b>4.187</b>
At-rest pressure	K <sub>0</sub> = <b>0.590</b>		



	20	WELLS ROA	AD LONDON NV	/3		17J02
	Section				Sheet no./rev.	
LAKESIDE COUNTRY CLUB	PR	ELIMINARY E	BASEMENT CAL	.CS		12
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY	TV	03/10/2017				
RETAINING WALL DESIGN	N (BS 8002:1994)				TEDDS calculation	on version 1.2.0
Ultimate limit state load fa	ctors					
Dead load factor	$\gamma_{f_d} = 1.4$		Live load factor	ſ	$\gamma_{f\_l} = 1.6$	
Earth pressure factor	γ <sub>f_e</sub> = <b>1.4</b>					
Calculate propping force Propping force	F <sub>prop</sub> = <b>46.6</b> kN/m	I				
Design of reinforced conc	rete retaining wall to	be (BS 8002:1	<u>1994)</u>			
Material properties Strength of concrete	f <sub>cu</sub> = <b>40</b> N/mm <sup>2</sup>		Strength of reir	nforcement	f <sub>y</sub> = <b>500</b> N/m	nm²
Base details Minimum reinforcement	k = <b>0.13</b> %		Cover in toe		c <sub>toe</sub> = <b>50</b> mn	n
Design of retaining wall to	e					
Shear at heel	V <sub>toe</sub> = <b>144.5</b> kN/n	า	Moment at hee	1	M <sub>toe</sub> = <b>195.9</b>	kNm/m
			С	ompression	reinforcement	is not requ
Check toe in bending						
Reinforcement provided	16 mm dia.bars	@ 100 mm ce	entres			
Area required	As_toe_req = <b>1386.0</b>	<b>)</b> mm²/m	Area provided		$A_{s\_toe\_prov} = 2$	<b>2011</b> mm²/m
		PASS - Rei	nforcement pro	vided at the	retaining wall t	oe is adequ
Check shear resistance at	• • •					
encen encui recoletance at	toe					
Design shear stress	toe v <sub>toe</sub> = <b>0.422</b> N/mr	n²	Allowable shea	r stress	Vadm = <b>5.000</b>	) N/mm²
			Allowable shea - <b>Design shear</b>			
		PASS				
Design shear stress	v <sub>toe</sub> = <b>0.422</b> N/mr	PASS	- Design shear	stress is les		m shear str
Design shear stress	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_{toe}} = 0.563 \text{ N/n}$	PASS	- Design shear v <sub>toe</sub>	stress is les	s than maximu	m shear str
Design shear stress Concrete shear stress Design of reinforced conc	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_{toe}} = 0.563 \text{ N/n}$	PASS	- Design shear v <sub>toe</sub>	stress is les	s than maximu	m shear str
Design shear stress Concrete shear stress	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_{toe}} = 0.563 \text{ N/n}$	PASS	- Design shear v <sub>toe</sub>	stress is less < v <sub>c_toe</sub> - No	s than maximu	m shear str ement requ
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete	v <sub>toe</sub> = <b>0.422</b> N/mr v <sub>c_toe</sub> = <b>0.563</b> N/n rete retaining wall h	PASS	- Design shear V <sub>toe</sub> :1994)	stress is less < v <sub>c_toe</sub> - No	s than maximu	m shear str ement requ
Design shear stress Concrete shear stress Design of reinforced conce Material properties	v <sub>toe</sub> = <b>0.422</b> N/mr v <sub>c_toe</sub> = <b>0.563</b> N/n rete retaining wall h	PASS	- Design shear V <sub>toe</sub> :1994)	stress is less < v <sub>c_toe</sub> - No	s than maximu	m shear str ement requi
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement	v <sub>toe</sub> = <b>0.422</b> N/mr v <sub>c_toe</sub> = <b>0.563</b> N/n rete retaining wall h f <sub>cu</sub> = <b>40</b> N/mm <sup>2</sup> k = <b>0.13</b> %	PASS	- Design shear V <sub>toe</sub> :1994) Strength of reir	stress is less < v <sub>c_toe</sub> - No	s than maximu shear reinforce fy = <b>500</b> N/n	m shear str ement requi
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/n}$ rete retaining wall h $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 %	PASS nm <sup>2</sup> eel (BS 8002	- Design shear V <sub>toe</sub> :1994) Strength of reir Cover in heel	stress is less < v <sub>c_toe</sub> - No	s than maximu shear reinforce fy = <b>500</b> N/m c <sub>heel</sub> = <b>50</b> m	m shear str ement requi
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement	v <sub>toe</sub> = <b>0.422</b> N/mr v <sub>c_toe</sub> = <b>0.563</b> N/n rete retaining wall h f <sub>cu</sub> = <b>40</b> N/mm <sup>2</sup> k = <b>0.13</b> %	PASS nm <sup>2</sup> eel (BS 8002	- Design shear V <sub>toe</sub> :1994) Strength of reir Cover in heel Moment at hee	stress is less < v <sub>c_toe</sub> - No nforcement	s than maximu shear reinforce fy = 500 N/m Cheel = 50 mi Mheel = 4.7 k	m shear str ement requi nm² m
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/n}$ rete retaining wall h $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 %	PASS nm <sup>2</sup> eel (BS 8002	- Design shear V <sub>toe</sub> :1994) Strength of reir Cover in heel Moment at hee	stress is less < v <sub>c_toe</sub> - No nforcement	s than maximu shear reinforce fy = <b>500</b> N/m c <sub>heel</sub> = <b>50</b> m	m shear str ement requi nm² m
Design shear stress Concrete shear stress Design of reinforced concre- Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/m}$ rete retaining wall h $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 % rete $V_{heel} = 17.9 \text{ kN/m}$	<i>PASS</i> nm <sup>2</sup> eel (BS 8002)	- Design shear v <sub>toe</sub> :1994) Strength of reir Cover in heel Moment at hee C	stress is less < v <sub>c_toe</sub> - No nforcement	s than maximu shear reinforce fy = 500 N/m Cheel = 50 mi Mheel = 4.7 k	m shear str ement requi nm² m
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/m}$ rete retaining wall h $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 % eel $V_{heel} = 17.9 \text{ kN/m}$ 12 mm dia.bars	PASS nm <sup>2</sup> eel (BS 8002 @ 150 mm ce	- Design shear Vtoe :1994) Strength of reir Cover in heel Moment at hee C entres	stress is less < v <sub>c_toe</sub> - No nforcement	s than maximu shear reinforce fy = 500 N/m cheel = 50 m Mheel = 4.7 k reinforcement	<i>m shear str</i> ement requi nm² m kNm/m <i>is not requ</i>
Design shear stress Concrete shear stress Design of reinforced concre- Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/m}$ rete retaining wall h $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 % rete $V_{heel} = 17.9 \text{ kN/m}$	PASS nm <sup>2</sup> eel (BS 8002) @ 150 mm ce 0 mm <sup>2</sup> /m	- Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee C entres Area provided	stress is less < v <sub>c_toe</sub> - No nforcement	s than maximu shear reinforce fy = 500 N/m Cheel = 50 mi Mheel = 4.7 k reinforcement	m shear str ement requ nm² m KNm/m <i>is not requ</i> 754 mm²/m
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/m}$ rete retaining wall h $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 % eel $V_{heel} = 17.9 \text{ kN/m}$ 12  mm dia.bars $A_{s_heel_req} = 520.0$	PASS nm <sup>2</sup> eel (BS 8002) @ 150 mm ce 0 mm <sup>2</sup> /m	- Design shear Vtoe :1994) Strength of reir Cover in heel Moment at hee C entres	stress is less < v <sub>c_toe</sub> - No nforcement	s than maximu shear reinforce fy = 500 N/m Cheel = 50 mi Mheel = 4.7 k reinforcement	m shear str ement requi nm² m KNm/m <i>is not requ</i>
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required Check shear resistance at	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/m}$ $rete retaining wall h$ $f_{cu} = 40 \text{ N/mm}^2$ $k = 0.13 \%$ $V_{heel} = 17.9 \text{ kN/m}$ $12 \text{ mm dia.bars}$ $A_{s_heel_req} = 520.0$ heel	PASS nm <sup>2</sup> eel (BS 8002) @ 150 mm ca mm <sup>2</sup> /m PASS - Rein	- Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee C entres Area provided forcement prov	stress is less < v <sub>c_toe</sub> - No forcement i ompression	s than maximu shear reinforce $f_y = 500 \text{ N/m}$ $C_{heel} = 50 \text{ m}$ $M_{heel} = 4.7 \text{ k}$ reinforcement $A_{s\_heel\_prov} =$ etaining wall he	m shear str ement requi nm² m kNm/m <i>is not requi</i> 754 mm²/m eel is adequ
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/m}$ rete retaining wall h $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 % eel $V_{heel} = 17.9 \text{ kN/m}$ 12  mm dia.bars $A_{s_heel_req} = 520.0$	PASS nm <sup>2</sup> eel (BS 8002) @ 150 mm ce 0 mm <sup>2</sup> /m PASS - Rein m <sup>2</sup>	- Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee C entres Area provided forcement prov Allowable shea	stress is less < v <sub>c_toe</sub> - No forcement i ompression fided at the re- ar stress	s than maximu shear reinforce fy = 500 N/n Cheel = 50 mi Mheel = 4.7 k reinforcement As_heel_prov = etaining wall he Vadm = 5.000	m shear str ement requi nm² m KNm/m <i>is not requi</i> 754 mm²/m eel is adequ
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required Check shear resistance at Design shear stress	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/n}$ $rete retaining wall h$ $f_{cu} = 40 \text{ N/mm}^2$ $k = 0.13 \%$ $eel$ $V_{heel} = 17.9 \text{ kN/m}$ $12 \text{ mm dia.bars}$ $A_{s_heel_req} = 520.0$ $heel$ $v_{heel} = 0.052 \text{ N/m}$	PASS nm <sup>2</sup> eel (BS 8002) eel (BS 8002) eel (BS 8002) nm <sup>2</sup> /m PASS - Rein m <sup>2</sup> PASS	- Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee C entres Area provided forcement prov	stress is less < v <sub>c_toe</sub> - No forcement i ompression fided at the re- ar stress	s than maximu shear reinforce fy = 500 N/n Cheel = 50 mi Mheel = 4.7 k reinforcement As_heel_prov = etaining wall he Vadm = 5.000	m shear str ement requi nm² m KNm/m <i>is not requi</i> 754 mm²/m eel is adequ
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required Check shear resistance at	$v_{toe} = 0.422 \text{ N/mr}$ $v_{c_toe} = 0.563 \text{ N/m}$ $rete retaining wall h$ $f_{cu} = 40 \text{ N/mm}^2$ $k = 0.13 \%$ $V_{heel} = 17.9 \text{ kN/m}$ $12 \text{ mm dia.bars}$ $A_{s_heel_req} = 520.0$ heel	PASS nm <sup>2</sup> eel (BS 8002) eel (BS 8002) eel (BS 8002) nm <sup>2</sup> /m PASS - Rein m <sup>2</sup> PASS	- Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee C entres Area provided forcement prov Allowable shear	stress is less $< v_{c_toe} - No$ inforcement i ompression fided at the re- ar stress stress is less	s than maximu shear reinforce fy = 500 N/n Cheel = 50 mi Mheel = 4.7 k reinforcement As_heel_prov = etaining wall he Vadm = 5.000	m shear str ement requi nm <sup>2</sup> m KNm/m <i>is not requi</i> 754 mm <sup>2</sup> /m eel is adequ 0 N/mm <sup>2</sup> m shear str

V&R	Project				Job Ref.	
VINCENT & RYMILL		20 WELLS ROA	AD LONDON NW	/3		17J02
VINCENT & RYMILL	Section				Sheet no./rev	
	1	PRELIMINARY E	BASEMENT CAL	CS		13
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY	TV	03/10/2017				
Design of reinforced cond	rete retaining wal	I stem (BS 8002	<u>2:1994)</u>			
Material properties						
Strength of concrete	f <sub>cu</sub> = <b>40</b> N/mm <sup>2</sup>	2	Strength of rein	forcement	f <sub>y</sub> = <b>500</b> N/r	nm²
Wall details						
Minimum reinforcement	k = <b>0.13</b> %					
Cover in stem	c <sub>stem</sub> = <b>75</b> mm		Cover in wall		c <sub>wall</sub> = <b>50</b> m	m
Design of retaining wall s	tem					
Shear at base of stem	V <sub>stem</sub> = <b>25.4</b> kN	N/m	Moment at base	e of stem	M <sub>stem</sub> = <b>151</b>	<b>.5</b> kNm/m
					reinforcement	
Check wall stem in bendir	ng					
Reinforcement provided	16 mm dia.ba	rs @ 100 mm ce	entres			
Area required	As_stem_req = 13	<b>91.8</b> mm²/m	Area provided		As_stem_prov =	= <b>2011</b> mm²/m
		PASS - Reinf	orcement provid	ded at the re	taining wall st	em is adequa
Check shear resistance a	t wall stem					
Design shear stress	Vstem = 0.095 N	J/mm²	Allowable shea	r stress	Vadm = 5.00	<b>0</b> N/mm²
		PASS	- Design shear s	stress is les	s than maximu	ım shear stre
Concrete shear stress	Vc_stem = <b>0.744</b>	N/mm <sup>2</sup>				
			Vstem <	Constem - No	shear reinforc	ement requir



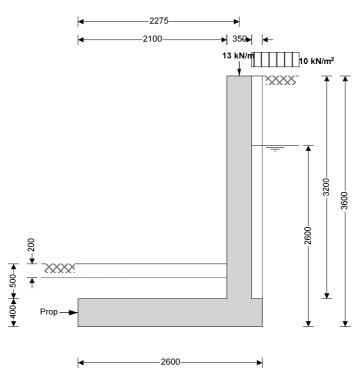
V&R	Project				Job Ref.	
	2	20 WELLS ROA	D LONDON NW	/3	17.	J02
VINCENT & RYMILL	Section				Sheet no./rev.	
	PI	RELIMINARY B	ASEMENT CAL	CS		15
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY	TV	03/10/2017				

TEDDS calculation version 1.2.01.06

WALL J

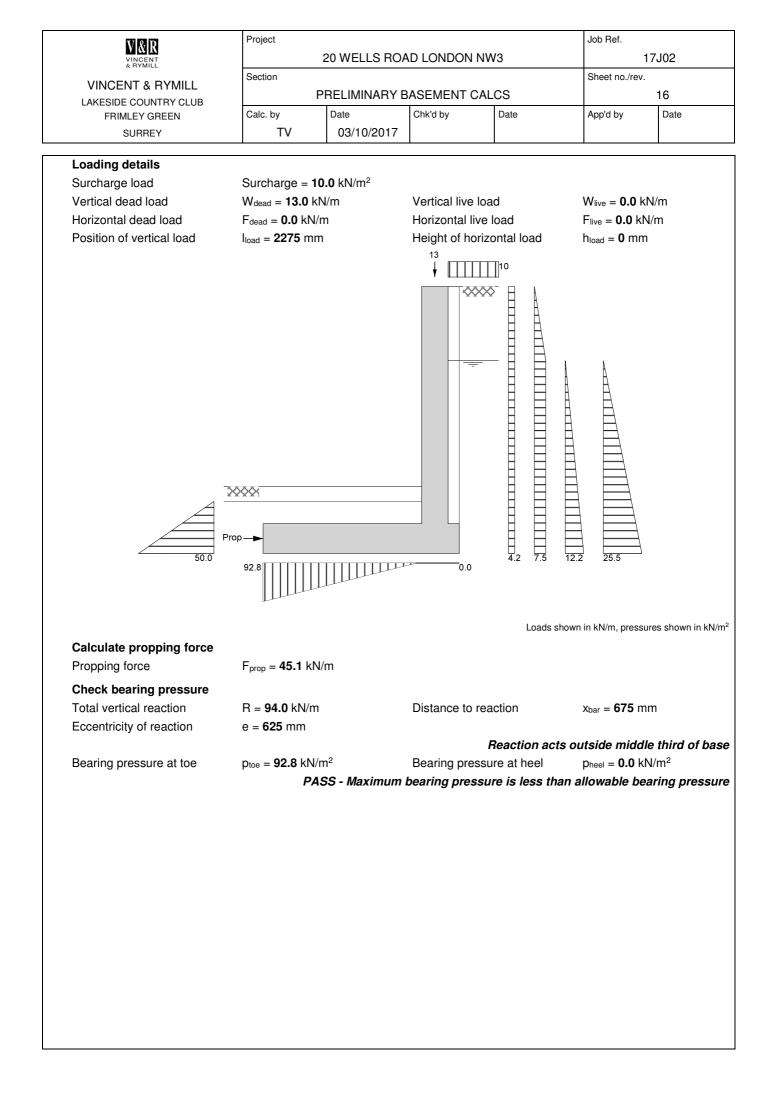
# **RETAINING WALL ANALYSIS & DESIGN (BS8002)**

## RETAINING WALL ANALYSIS (BS 8002:1994)



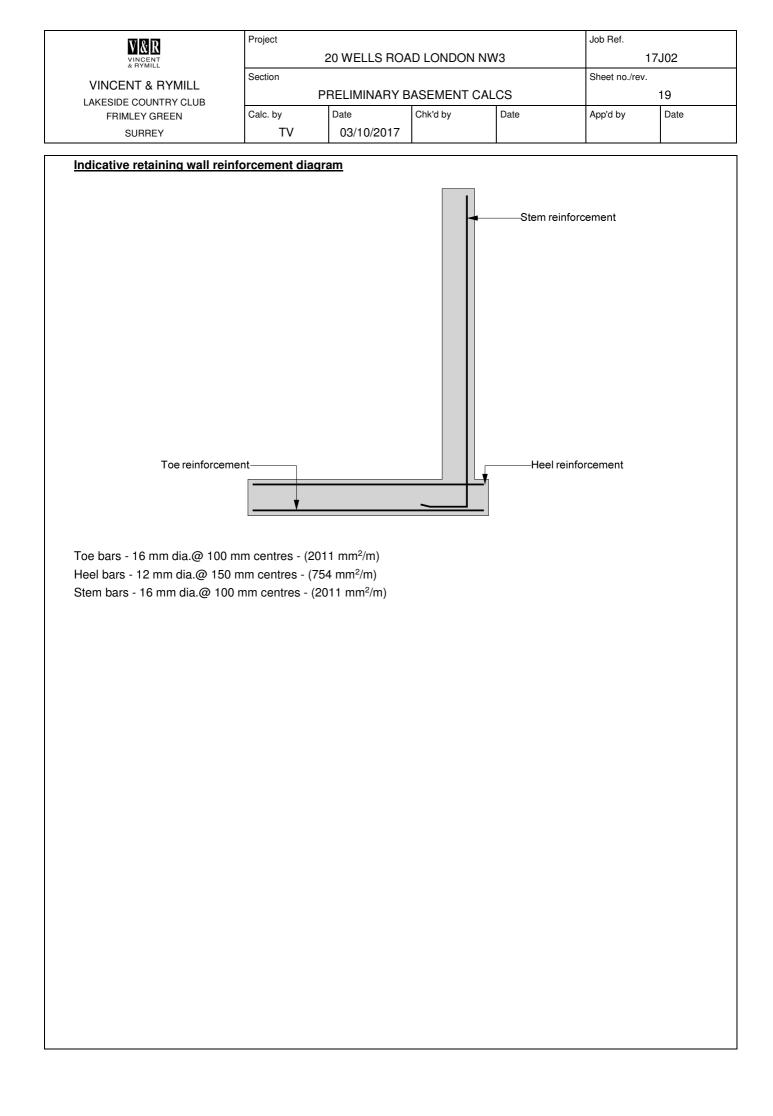
#### Wall details

wan details			
Retaining wall type	Cantilever		
Height of wall stem	h <sub>stem</sub> = <b>3200</b> mm	Wall stem thickness	t <sub>wall</sub> = <b>350</b> mm
Length of toe	I <sub>toe</sub> = <b>2100</b> mm	Length of heel	I <sub>heel</sub> = <b>150</b> mm
Overall length of base	l <sub>base</sub> = <b>2600</b> mm	Base thickness	t <sub>base</sub> = <b>400</b> mm
Height of retaining wall	h <sub>wall</sub> = <b>3600</b> mm		
Depth of downstand	$d_{ds} = 0 mm$	Thickness of downstand	t <sub>ds</sub> = <b>400</b> mm
Position of downstand	l <sub>ds</sub> = <b>1900</b> mm		
Depth of cover in front of wall	d <sub>cover</sub> = <b>500</b> mm	Unplanned excavation depth	d <sub>exc</sub> = <b>200</b> mm
Height of ground water	h <sub>water</sub> = <b>2600</b> mm	Density of water	$\gamma_{water} = 9.81 \text{ kN/m}^3$
Density of wall construction	γ <sub>wall</sub> = <b>23.6</b> kN/m <sup>3</sup>	Density of base construction	$\gamma_{\text{base}} = 23.6 \text{ kN/m}^3$
Angle of soil surface	$\beta = 0.0 \text{ deg}$	Effective height at back of wall	h <sub>eff</sub> = <b>3600</b> mm
Mobilisation factor	M = 1.5		
Moist density	$\gamma_{m} = 18.0 \text{ kN/m}^{3}$	Saturated density	γs = <b>21.0</b> kN/m <sup>3</sup>
Design shear strength	φ' = <b>24.2</b> deg	Angle of wall friction	$\delta = \textbf{0.0} \text{ deg}$
Design shear strength	φ' <sub>b</sub> = <b>24.2</b> deg	Design base friction	$\delta_{b} = 18.6 \text{ deg}$
Moist density	$\gamma_{mb}$ = <b>18.0</b> kN/m <sup>3</sup>	Allowable bearing	$P_{\text{bearing}} = 100 \text{ kN/m}^2$
Using Coulomb theory			
Active pressure	Ka = <b>0.419</b>	Passive pressure	Kp = <b>4.187</b>
At-rest pressure	K <sub>0</sub> = <b>0.590</b>		



VINCENT & RYMILL	Project 2	0 WELLS ROA	AD LONDON NV	/3	Job Ref.	17J02
	Section				Sheet no./rev.	
VINCENT & RYMILL LAKESIDE COUNTRY CLUB	PF	RELIMINARY E	BASEMENT CAL	.CS		17
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY	ΤV	03/10/2017				
RETAINING WALL DESIGN	I (BS 8002:1994)					
Ultimate limit state load fa	ctors				TEDDS calculation	on version 1.2.0
Dead load factor	γ <sub>f d</sub> = <b>1.4</b>		Live load factor	·	γ <sub>f</sub> ι = <b>1.6</b>	
Earth pressure factor	γ <sub>f e</sub> = <b>1.4</b>				<i>i</i>	
	<u>h=</u> 0					
Calculate propping force Propping force	F <sub>prop</sub> = <b>45.1</b> kN/r	n				
Design of reinforced conc	rete retaining wall t	toe (BS 8002:1	<u>1994)</u>			
Material properties Strength of concrete	f <sub>cu</sub> = <b>40</b> N/mm <sup>2</sup>		Strength of reir	nforcement	f <sub>y</sub> = <b>500</b> N/n	nm²
Base details						
Minimum reinforcement	k = <b>0.13</b> %		Cover in toe		Ctoe = <b>50</b> mm	n
Design of retaining wall to	e					
Shear at heel	V <sub>toe</sub> = <b>88.3</b> kN/m		Moment at hee	1	M <sub>toe</sub> = <b>208.9</b>	kNm/m
			С	ompression	reinforcement	is not requ
Check toe in bending						
Reinforcement provided	16 mm dia.bars	@ 100 mm ce	entres			
Area required	$A_{s_{toe_{req}}} = 1481.$	<b>4</b> mm²/m	Area provided		$A_{s\_toe\_prov} = 2$	<b>2011</b> mm²/m
		PASS - Rei	nforcement pro	vided at the	retaining wall t	toe is adequ
Check shear resistance at	toe	PASS - Rei	nforcement pro	vided at the	retaining wall t	toe is adequ
Check shear resistance at Design shear stress	toe v <sub>toe</sub> = <b>0.258</b> N/m		nforcement pro Allowable shea		retaining wall t <sub>Vadm</sub> = 5.000	-
		m²	-	r stress	Vadm = <b>5.000</b>	) N/mm <sup>2</sup>
		m² <b>PASS</b>	Allowable shea	r stress	Vadm = <b>5.000</b>	) N/mm <sup>2</sup>
Design shear stress	v <sub>toe</sub> = <b>0.258</b> N/m	m² <b>PASS</b>	Allowable shea - Design shear	r stress <b>stress is les</b> :	Vadm = <b>5.000</b>	) N/mm² <i>m shear str</i>
Design shear stress	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$	m² PASS mm²	Allowable shea - Design shear V <sub>toe</sub>	r stress <b>stress is les</b> :	V <sub>adm</sub> = 5.000 s than maximu	) N/mm² <i>m shear str</i>
Design shear stress Concrete shear stress	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$	m² PASS mm²	Allowable shea - Design shear V <sub>toe</sub>	r stress <b>stress is les</b> s	V <sub>adm</sub> = 5.000 s than maximu	) N/mm² <i>m shear str</i>
Design shear stress Concrete shear stress Design of reinforced conc	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$	m² PASS mm²	Allowable shea - Design shear V <sub>toe</sub>	ur stress <b>stress is les</b> < v <sub>c_toe</sub> - No	V <sub>adm</sub> = 5.000 s than maximu	) N/mm² <i>m shear str</i> ement requ
Design shear stress Concrete shear stress Design of reinforced conce Material properties	v <sub>toe</sub> = 0.258 N/m v <sub>c_toe</sub> = 0.644 N/n rete retaining wall I	m² PASS mm²	Allowable shea - Design shear V <sub>toe</sub> :1994)	ur stress <b>stress is les</b> < v <sub>c_toe</sub> - No	V <sub>adm</sub> = 5.000 s than maximu shear reinforce	) N/mm² <i>m shear str</i> ement requ
Design shear stress Concrete shear stress Design of reinforced concr Material properties Strength of concrete	v <sub>toe</sub> = 0.258 N/m v <sub>c_toe</sub> = 0.644 N/n rete retaining wall I	m² PASS mm²	Allowable shea - Design shear V <sub>toe</sub> :1994)	ur stress <b>stress is les</b> < v <sub>c_toe</sub> - No	V <sub>adm</sub> = 5.000 s than maximu shear reinforce	) N/mm² <i>m shear str</i> ement requi
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement	v <sub>toe</sub> = <b>0.258</b> N/m v <sub>c_toe</sub> = <b>0.644</b> N/m rete retaining wall I f <sub>cu</sub> = <b>40</b> N/mm <sup>2</sup> k = <b>0.13</b> %	m² PASS mm²	Allowable shea - <i>Design shear</i> <i>V<sub>toe</sub> :1994)</i> Strength of reir	ur stress <b>stress is les</b> < v <sub>c_toe</sub> - No	V <sub>adm</sub> = 5.000 s than maximu shear reinforce f <sub>y</sub> = 500 N/n	) N/mm² <i>m shear str</i> ement requi
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ rete retaining wall I $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 %	m <sup>2</sup> PASS mm <sup>2</sup> neel (BS 8002:	Allowable shea - <i>Design shear</i> <i>v<sub>toe</sub> :1994)</i> Strength of reir Cover in heel	ar stress <i>stress is les</i> <i>&lt; v<sub>c_toe</sub> - No</i> hforcement	V <sub>adm</sub> = 5.000 s than maximu shear reinforce f <sub>y</sub> = 500 N/n <sub>Cheel</sub> = 50 m	) N/mm² <i>m shear str</i> ement requi
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ rete retaining wall I $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 %	m <sup>2</sup> PASS mm <sup>2</sup> neel (BS 8002:	Allowable shea - Design shear V <sub>toe</sub> :1994) Strength of reir Cover in heel Moment at hee	r stress <b>stress is les</b> <b>v</b> <sub>c_toe</sub> - <b>No</b> nforcement	V <sub>adm</sub> = 5.000 s than maximu shear reinforce f <sub>y</sub> = 500 N/n C <sub>heel</sub> = 50 m M <sub>heel</sub> = 4.7 k	) N/mm <sup>2</sup> <i>m shear str</i> <i>ement requ</i> nm <sup>2</sup> m
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ rete retaining wall I $f_{cu} = 40 \text{ N/mm}^2$ k = 0.13 %	m <sup>2</sup> PASS mm <sup>2</sup> neel (BS 8002:	Allowable shea - Design shear V <sub>toe</sub> :1994) Strength of reir Cover in heel Moment at hee	r stress <b>stress is les</b> <b>v</b> <sub>c_toe</sub> - <b>No</b> nforcement	V <sub>adm</sub> = 5.000 s than maximu shear reinforce f <sub>y</sub> = 500 N/n <sub>Cheel</sub> = 50 m	) N/mm <sup>2</sup> <i>m shear str</i> <i>ement requ</i> nm <sup>2</sup> m
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I$ $f_{cu} = 40 \text{ N/mm}^2$ $k = 0.13 \%$ retel $V_{heel} = 17.9 \text{ kN/m}$	m <sup>2</sup> PASS mm <sup>2</sup> heel (BS 8002)	Allowable shea - Design shear Vtoe :1994) Strength of reir Cover in heel Moment at hee C	r stress <b>stress is les</b> <b>v</b> <sub>c_toe</sub> - <b>No</b> nforcement	V <sub>adm</sub> = 5.000 s than maximu shear reinforce f <sub>y</sub> = 500 N/n C <sub>heel</sub> = 50 m M <sub>heel</sub> = 4.7 k	) N/mm <sup>2</sup> <i>m shear str</i> <i>ement requ</i> nm <sup>2</sup> m
Design shear stress Concrete shear stress Design of reinforced concernant Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I f_{cu} = 40 \text{ N/mm}^2k = 0.13 %welV_{heel} = 17.9 \text{ kN/m}12  mm dia.bars$	m <sup>2</sup> PASS mm <sup>2</sup> neel (BS 8002) n s @ 150 mm ca	Allowable shea - Design shear Vtoe :1994) Strength of reir Cover in heel Moment at hee Coverset	r stress <b>stress is les</b> <b>v</b> <sub>c_toe</sub> - <b>No</b> nforcement	V <sub>adm</sub> = 5.000 s than maximu shear reinforce f <sub>y</sub> = 500 N/n C <sub>heel</sub> = 50 m M <sub>heel</sub> = 4.7 k reinforcement	) N/mm <sup>2</sup> <i>m shear str</i> ement requ nm <sup>2</sup> m KNm/m <i>is not requ</i>
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I$ $f_{cu} = 40 \text{ N/mm}^2$ $k = 0.13 \%$ retel $V_{heel} = 17.9 \text{ kN/m}$	m <sup>2</sup> PASS mm <sup>2</sup> neel (BS 8002: n n n s @ 150 mm ca 0 mm <sup>2</sup> /m	Allowable shea - Design shear Vtoe - 1994) Strength of reir Cover in heel Moment at hee Comment at hee Moment at hee Comment at hee	ar stress stress is less $< v_{c_toe} - No$ hforcement l ompression	Vadm = 5.000 s than maximu shear reinforce fy = 500 N/n Cheel = 50 m Mheel = 4.7 H reinforcement As_heel_prov =	) N/mm² <i>m shear str</i> ement requi nm² m kNm/m <i>is not requ</i>
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I f_{cu} = 40 \text{ N/mm}^2k = 0.13 %reteV_{heel} = 17.9 \text{ kN/m}12  mm dia.barsA_{s_heel_req} = 520.4$	m <sup>2</sup> PASS mm <sup>2</sup> neel (BS 8002: n n n s @ 150 mm ca 0 mm <sup>2</sup> /m	Allowable shea - Design shear Vtoe :1994) Strength of reir Cover in heel Moment at hee Coverset	ar stress stress is less $< v_{c_toe} - No$ hforcement l ompression	Vadm = 5.000 s than maximu shear reinforce fy = 500 N/n Cheel = 50 m Mheel = 4.7 H reinforcement As_heel_prov =	) N/mm² <i>m shear str</i> ement requi nm² m kNm/m <i>is not requ</i>
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required Check shear resistance at	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I$ $f_{cu} = 40 \text{ N/mm}^2$ $k = 0.13 \%$ $v_{heel} = 17.9 \text{ kN/m}$ $12 \text{ mm dia.bars}$ $A_{s_heel_req} = 520.4$ heel	m <sup>2</sup> pASS mm <sup>2</sup> neel (BS 8002: n n a @ 150 mm ca 0 mm <sup>2</sup> /m PASS - Rein	Allowable shea - Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee Cover in heel Moment at heel Cover in heel C	ar stress stress is less $< v_{c_toe} - No$ forcement i ompression rided at the re	$V_{adm} = 5.000$ s than maximu shear reinforce $f_y = 500 \text{ N/m}$ $C_{heel} = 50 \text{ m}$ $M_{heel} = 4.7 \text{ k}$ reinforcement $A_{s\_heel\_prov} =$ etaining wall he	) N/mm² <i>m shear str</i> ement requi nm² m kNm/m <i>is not requi</i> 754 mm²/m eel is adequ
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I f_{cu} = 40 \text{ N/mm}^2k = 0.13 %reteV_{heel} = 17.9 \text{ kN/m}12  mm dia.barsA_{s_heel_req} = 520.4$	m <sup>2</sup> pASS mm <sup>2</sup> neel (BS 8002) neel (BS 8002) neel (BS 8002) neel (BS 8002) nm <sup>2</sup> n PASS - Rein	Allowable shea - Design shear Vtoe :1994) Strength of reir Cover in heel Moment at hee Cover Area provided forcement prov Allowable shea	ar stress <b>stress is less</b> <b>v</b> <sub>c_toe</sub> - No forcement <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b>	$v_{adm} = 5.000$ s than maximu shear reinforce $f_y = 500 \text{ N/n}$ $c_{heel} = 50 \text{ m}$ $M_{heel} = 4.7 \text{ k}$ reinforcement $A_{s\_heel\_prov} =$ etaining wall he $v_{adm} = 5.000$	) N/mm <sup>2</sup> <i>m shear str</i> <i>ement requ</i> nm <sup>2</sup> m (Nm/m <i>is not requ</i> 754 mm <sup>2</sup> /m <i>eel is adequ</i> ) N/mm <sup>2</sup>
Design shear stress Concrete shear stress Design of reinforced concernation Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required Check shear resistance at Design shear stress	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I f_{cu} = 40 \text{ N/mm}^2k = 0.13 %k = 0.13 %v_{heel} = 17.9 \text{ kN/m}12  mm dia.barsA_{s_heel_req} = 520.0heelv_{heel} = 0.052 \text{ N/m}$	m <sup>2</sup> pASS mm <sup>2</sup> neel (BS 8002) neel (BS 8002) neel (BS 8002) neel (BS 8002) nm <sup>2</sup> pASS - Rein	Allowable shea - Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee Cover in heel Moment at heel Cover in heel C	ar stress <b>stress is less</b> <b>v</b> <sub>c_toe</sub> - No forcement <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b> <b>forcement</b>	$v_{adm} = 5.000$ s than maximu shear reinforce $f_y = 500 \text{ N/n}$ $c_{heel} = 50 \text{ m}$ $M_{heel} = 4.7 \text{ k}$ reinforcement $A_{s\_heel\_prov} =$ etaining wall he $v_{adm} = 5.000$	) N/mm <sup>2</sup> <i>m shear str</i> <i>ement requ</i> nm <sup>2</sup> m (Nm/m <i>is not requ</i> 754 mm <sup>2</sup> /m <i>eel is adequ</i> ) N/mm <sup>2</sup>
Design shear stress Concrete shear stress Design of reinforced conce Material properties Strength of concrete Base details Minimum reinforcement Design of retaining wall he Shear at heel Check heel in bending Reinforcement provided Area required Check shear resistance at	$v_{toe} = 0.258 \text{ N/m}$ $v_{c_toe} = 0.644 \text{ N/m}$ $rete retaining wall I$ $f_{cu} = 40 \text{ N/mm}^2$ $k = 0.13 \%$ $v_{heel} = 17.9 \text{ kN/m}$ $12 \text{ mm dia.bars}$ $A_{s_heel_req} = 520.4$ heel	m <sup>2</sup> pASS mm <sup>2</sup> neel (BS 8002) neel (BS 8002) neel (BS 8002) neel (BS 8002) nm <sup>2</sup> pASS - Rein	Allowable shea - Design shear Vtoe (1994) Strength of reir Cover in heel Moment at hee Cover Allowable shear - Design shear	ar stress stress is less $< v_{c_toe} - No$ offorcement ompression rided at the re- ar stress stress is less	$v_{adm} = 5.000$ s than maximu shear reinforce $f_y = 500 \text{ N/n}$ $c_{heel} = 50 \text{ m}$ $M_{heel} = 4.7 \text{ k}$ reinforcement $A_{s\_heel\_prov} =$ etaining wall he $v_{adm} = 5.000$	) N/mm <sup>2</sup> <i>m shear str</i> <i>ement requi</i> nm <sup>2</sup> m (Nm/m <i>is not requi</i> <i>754</i> mm <sup>2</sup> /m <i>eel is adequ</i> ) N/mm <sup>2</sup> <i>m shear str</i>

V & R	Project				Job Ref.		
VINCENT & RYMILL	2	20 WELLS ROAD LONDON NW3				17J02	
VINCENT & RYMILL	Section	Section					
LAKESIDE COUNTRY CLUB	PI	PRELIMINARY BASEMENT CALCS			18		
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date	
SURREY	TV	03/10/2017					
Design of reinforced conc	rete retaining wall	stem (BS 8002	::1994 <u>)</u>				
Material properties							
Strength of concrete	f <sub>cu</sub> = <b>40</b> N/mm <sup>2</sup>		Strength of rein	nforcement	f <sub>y</sub> = <b>500</b> N/n	nm²	
Wall details							
Minimum reinforcement	k = <b>0.13</b> %						
Cover in stem	c <sub>stem</sub> = <b>75</b> mm		Cover in wall		c <sub>wall</sub> = <b>50</b> mm		
Design of retaining wall st	em						
Shear at base of stem $V_{stem} = 27.4 \text{ kN/m}$		m	Moment at base of stem		M <sub>stem</sub> = <b>151.5</b> kNm/m		
			C	ompression	reinforcement	is not requir	
Check wall stem in bendir	ng						
Reinforcement provided	16 mm dia.bars	s @ 100 mm ce	entres				
Area required	As_stem_req = <b>139</b>	<b>1.8</b> mm²/m	Area provided		As_stem_prov =	<b>2011</b> mm²/m	
		PASS - Reinf	orcement prov	ided at the re	taining wall st	em is adequa	
Check shear resistance at	wall stem						
Design shear stress	Vstem = 0.103 N/r	mm²	Allowable shea	ar stress	Vadm = 5.000	) N/mm²	
		PASS	- Design shear	stress is less	s than maximu	m shear stre	
Concrete shear stress	Vc_stem = 0.744 N	I/mm²					
			Vstem	< Vc_stem - NO	shear reinforc	ement requir	
				· ···			

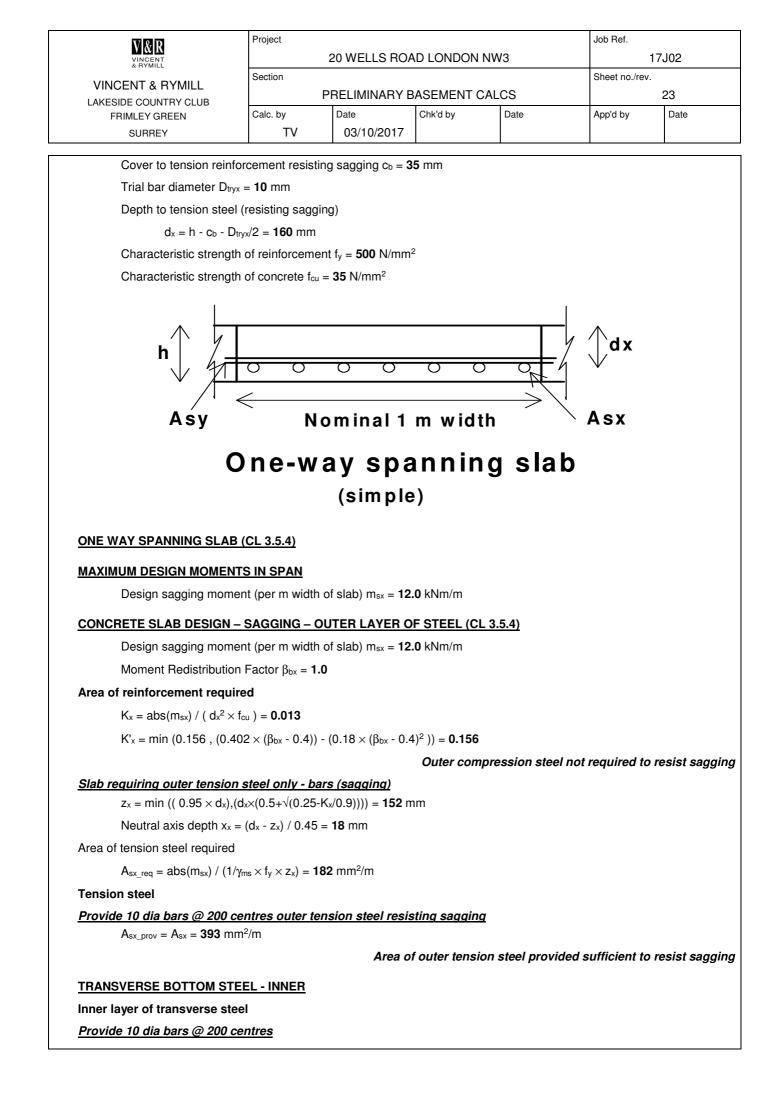


& RYMILL	Project	20 WELLS ROA		NW3	Job Ref.	17J02
	Section	Sheet no./rev.				
VINCENT & RYMILL	PF		20			
LAKESIDE COUNTRY CLUB FRIMLEY GREEN		Date	Chk'd by	Date	App'd by	Date
SURREY	TV	03/10/2017				
			l	I		
BASEMENT SLAB						
UPLIFT = 2.6 X 10 = 26KN/m	1 <sup>2</sup>					
SWT + FINISH = $6.8$ KN/m <sup>2</sup>						
DESIGN LOAD = 27KN/m <sup>2</sup> U	PLIFT.					
DowLOADING UNDER NOR	MAL CONDITION [	DESIGN LOAD	= 12KN/m <sup>2</sup>			
TOP REINFT						
BM = 27 X 2.75 <sup>2</sup> /8 = 25.5KN	.m					
RC SLAB DESIGN (BS8	<u>110)</u>					
RC SLAB DESIGN (BS8110)	:PART1:1997)					
					TEDDS calcu	lation version 1.0.04
CONCRETE SLAB DESIGN	<u>(CL 3.5.3 &amp; 4)</u>					
SIMPLE ONE WAY SPANNI		ΓΙΟΝ				
Overall depth of slab						
Cover to tension rein	forcement resisting	sagging cb = 5	<b>0</b> mm			
Trial bar diameter D <sub>tr</sub>	<sub>yx</sub> = <b>10</b> mm					
		1)				
Trial bar diameter D <sub>tr</sub> Depth to tension stee		1)				
Trial bar diameter D <sub>tr</sub> Depth to tension stee	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm					
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D_b$	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm th of reinforcement	f <sub>y</sub> = <b>500</b> N/mm <sup>2</sup>				
Trial bar diameter D <sub>tr</sub> Depth to tension stee d <sub>x</sub> = h - c <sub>b</sub> - D Characteristic strengt	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm th of reinforcement	f <sub>y</sub> = <b>500</b> N/mm <sup>2</sup>		1		
Trial bar diameter D <sub>tr</sub> Depth to tension stee d <sub>x</sub> = h - c <sub>b</sub> - D Characteristic strengt	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm th of reinforcement	f <sub>y</sub> = <b>500</b> N/mm <sup>2</sup>			•	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm th of reinforcement	f <sub>y</sub> = <b>500</b> N/mm <sup>2</sup>			dx	
Trial bar diameter D <sub>tr</sub> Depth to tension stee d <sub>x</sub> = h - c <sub>b</sub> - D Characteristic strengt	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm th of reinforcement	f <sub>y</sub> = <b>500</b> N/mm <sup>2</sup>			d x	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm th of reinforcement	f <sub>y</sub> = <b>500</b> N/mm <sup>2</sup>			<b>d</b> x	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt	el (resisting sagging $D_{tryx}/2 = 145 \text{ mm}$ th of reinforcement th of concrete $f_{cu} = 3$	f <sub>y</sub> = <b>500</b> N/mm <sup>2</sup>	2 O (	th	∲ dx Asx	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt h h Asy	el (resisting sagging $D_{tryx}/2 = 145 \text{ mm}$ th of reinforcement th of concrete $f_{cu} = 3$	f <sub>y</sub> = 500 N/mm <sup>2</sup> 35 N/mm <sup>2</sup>	<sup>2</sup> m wid		√ Asx	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt h h Asy	el (resisting sagging $D_{tryx}/2 = 145 \text{ mm}$ th of reinforcement th of concrete $f_{cu} = 3$	f <sub>y</sub> = 500 N/mm <sup>2</sup> 35 N/mm <sup>2</sup> minal 1 NY SPa	<sup>2</sup> m widt		√ Asx	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt h h Asy	el (resisting sagging $D_{tryx}/2 = 145 \text{ mm}$ th of reinforcement th of concrete $f_{cu} = 3$	f <sub>y</sub> = 500 N/mm <sup>2</sup> 35 N/mm <sup>2</sup>	<sup>2</sup> m widt		√ Asx	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt h h Asy	el (resisting sagging D <sub>tryx</sub> /2 = <b>145</b> mm th of reinforcement th of concrete $f_{cu}$ = 3 $\sim$ No <b>No</b>	f <sub>y</sub> = 500 N/mm <sup>2</sup> 35 N/mm <sup>2</sup> minal 1 NY SPa	<sup>2</sup> m widt		√ Asx	
Trial bar diameter $D_{tr}$ Depth to tension stee $d_x = h - c_b - D$ Characteristic strengt Characteristic strengt h h A $s$ $y$	el (resisting sagging Dtryx/2 = 145 mm th of reinforcement th of concrete $f_{cu}$ = 3 $\sim$ No <b>Dne-wa</b> <u>B (CL 3.5.4)</u>	f <sub>y</sub> = 500 N/mm <sup>2</sup> 35 N/mm <sup>2</sup> minal 1 NY SPa	<sup>2</sup> m widt		√ Asx	

V & R	Project				Job Ref.	17 100		
VINCENT & RYMILL	Section	20 WELLS ROAD LONDON NW3 Section				17J02 Sheet no./rev.		
VINCENT & RYMILL		PRELIMINARY I	BASEMENT C	ALCS	Uncer no./rev	21		
LAKESIDE COUNTRY CLUB FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date		
SURREY	TV	03/10/2017						
CONCRETE SLAB DESIGN	– SAGGING – O	UTER LAYER C	OF STEEL (CL	. 3.5.4)				
Design sagging mon	nent (per m width	of slab) m <sub>sx</sub> = 26	<b>5.0</b> kNm/m					
Moment Redistribution	on Factor $\beta_{bx} = 1$ .	0						
Area of reinforcement requ	ired							
$K_x = abs(m_{sx}) / (d_x^2)$	≺ f <sub>cu</sub> ) = <b>0.035</b>							
K' <sub>x</sub> = min (0.156 , (0.	$402 \times (\beta_{bx} - 0.4))$	- (0.18 × (β <sub>bx</sub> - 0.	4) <sup>2</sup> )) = <b>0.156</b>					
		X U		pression ste	el not required to	resist sado		
Slab requiring outer tensio	n steel onlv - ba	rs (saaaina)			<b>,</b>			
$z_x = \min \left( (0.95 \times d_x) \right)$			nm					
Neutral axis depth x <sub>x</sub>								
Area of tension steel required	d							
$A_{sx reg} = abs(m_{sx}) / (1)$	$1/\gamma_{\rm ms} \times f_{\rm v} \times z_{\rm x}$ = 43	<b>34</b> mm²/m						
Tension steel	• • • • • • • • • • • • • • • • • • •							
Provide 10 dia bars @ 100	contros outor to	nsion steel resi	stina saaaina	Y				
			sting sagging	1				
$A_{sy, proy} = A_{sy} = 785 \text{ m}$	1111-/111							
A <sub>sx_prov</sub> = A <sub>sx</sub> = 785 m <u>TRANSVERSE BOTTOM ST</u> Inner layer of transverse st	<u>TEEL - INNER</u> teel	Area o	of outer tensio	on steel prov	ided sufficient to	resist sag <u>o</u>		
TRANSVERSE BOTTOM ST	<u>FEEL - INNER</u> teel <u>centres</u>	Area o	of outer tensio	on steel prov	ided sufficient to	resist sagg		
TRANSVERSE BOTTOM ST Inner layer of transverse st Provide 10 dia bars @ 100	r <u>EEL - INNER</u> teel <u>centres</u> nm²/m		of outer tensio	on steel prov	ided sufficient to	o resist sagg		
TRANSVERSE BOTTOM ST Inner layer of transverse st <u>Provide 10 dia bars @ 100</u> A <sub>sy_prov</sub> = A <sub>sy</sub> = 785 m	TEEL - INNER teel <u>centres</u> nm²/m of steel resisting	g sagging	of outer tensio	on steel prov	ided sufficient to	resist sagg		
TRANSVERSE BOTTOM ST Inner layer of transverse st <u>Provide 10 dia bars @ 100</u> A <sub>sy_prov</sub> = A <sub>sy</sub> = 785 m <u>Check min and max areas</u>	TEEL - INNER teel c <u>entres</u> nm²/m of steel resisting = 200000 mm²/n	<b>g <u>sagging</u></b> n	of outer tensio	on steel prov	ided sufficient to	resist sagg		
TRANSVERSE BOTTOM ST Inner layer of transverse st <u>Provide 10 dia bars @ 100</u> A <sub>sy_prov</sub> = A <sub>sy</sub> = 785 m <u>Check min and max areas</u> Total area of concrete A <sub>c</sub> = h	<u>FEEL - INNER</u> teel <u>centres</u> nm²/m <u>of steel resisting</u> = 200000 mm²/n ement k = 0.13 %	<b>g <u>sagging</u></b> n	of outer tensio	on steel prov	ided sufficient to	resist sagg		
TRANSVERSE BOTTOM ST Inner layer of transverse st <u>Provide 10 dia bars @ 100</u> A <sub>sy_prov</sub> = A <sub>sy</sub> = 785 m <u>Check min and max areas</u> Total area of concrete A <sub>c</sub> = h Minimum % reinforce	<u>FEEL - INNER</u> teel <u>centres</u> nm²/m <u>of steel resisting</u> = 200000 mm²/n ement k = 0.13 %	<b>g <u>sagging</u></b> n	of outer tensio	on steel prov	ided sufficient to	o resist sagg		
TRANSVERSE BOTTOM STInner layer of transverse stProvide 10 dia bars @ 100 $Asy_prov = Asy = 785 \text{ m}$ Check min and max areasTotal area of concrete $A_c = h$ Minimum % reinforce $Ast_min = k \times A_c = 260$	<u>FEEL - INNER</u> teel <u>centres</u> nm²/m <u>of steel resisting</u> = 200000 mm²/n ement k = 0.13 %	<b>g <u>sagging</u></b> n	of outer tensio	on steel prov	ided sufficient to	resist sagg		
TRANSVERSE BOTTOM STInner layer of transverse stProvide 10 dia bars @ 100 $A_{sy\_prov} = A_{sy} = 785 \text{ m}$ Check min and max areasTotal area of concrete $A_c = h$ Minimum % reinforce $A_{st\_min} = k \times A_c = 260$ $A_{st\_max} = 4 \% \times A_c = 4$	<u>FEEL - INNER</u> teel <u>centres</u> nm <sup>2</sup> /m <u>of steel resisting</u> = 200000 mm <sup>2</sup> /n ement k = 0.13 % 0 mm <sup>2</sup> /m 8000 mm <sup>2</sup> /m	n n	of outer tensio	on steel prov	rided sufficient to	resist sagg		
TRANSVERSE BOTTOM STInner layer of transverse stProvide 10 dia bars @ 100 $A_{sy\_prov} = A_{sy} = 785 \text{ m}$ Check min and max areasTotal area of concrete $A_c = h$ Minimum % reinforce $A_{st\_min} = k \times A_c = 260$ $A_{st\_max} = 4 \% \times A_c = 4$ Steel defined:	<u>FEEL - INNER</u> teel <u>centres</u> nm <sup>2</sup> /m <u>of steel resisting</u> = 200000 mm <sup>2</sup> /n ement k = 0.13 % 0 mm <sup>2</sup> /m 8000 mm <sup>2</sup> /m	n n	of outer tensio		ided sufficient to uter steel provide			
TRANSVERSE BOTTOM STInner layer of transverse stProvide 10 dia bars @ 100 $A_{sy\_prov} = A_{sy} = 785 \text{ m}$ Check min and max areasTotal area of concrete $A_c = h$ Minimum % reinforce $A_{st\_min} = k \times A_c = 260$ $A_{st\_max} = 4 \% \times A_c = 4$ Steel defined:	TEEL - INNER teel centres $nm^2/m$ $of steel resistingr = 200000 mm^2/nement k = 0.13 %0 mm2/m8000 mm2/msagging Asx_prov =$	<u>a saqqinq</u> n <b>≅ 785</b> mm²/m	of outer tensio					
TRANSVERSE BOTTOM STInner layer of transverse st <b>Provide 10 dia bars @ 100</b> $A_{sy\_prov} = A_{sy} = 785 \text{ m}$ <b>Check min and max areas</b> Total area of concrete $A_c = h$ Minimum % reinforce $A_{st\_min} = k \times A_c = 260$ $A_{st\_max} = 4 \% \times A_c = 4$ Steel defined:Outer steel resisting	TEEL - INNER teel centres $nm^2/m$ $of steel resistingr = 200000 mm^2/nement k = 0.13 %0 mm2/m8000 mm2/msagging Asx_prov =$	<u>a saqqinq</u> n <b>≅ 785</b> mm²/m	of outer tensio	Area of ou		d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse stProvide 10 dia bars @ 100Asy_prov = Asy = 785 mCheck min and max areasTotal area of concrete $A_c = h$ Minimum % reinforceAst_min = k × $A_c = 260$ Ast_max = 4 % × $A_c = 4$ Steel defined:Outer steel resistingInner steel resisting	TEEL - INNER teel centres $nm^2/m$ $of steel resisting= 200000 mm^2/nement k = 0.13 %0 mm2/m8000 mm2/msagging Asx_prov =sagging Asy_prov =$	n <b>785</b> mm²/m	of outer tensio	Area of ou	ıter steel provide	d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse stProvide 10 dia bars @ 100Asy_prov = Asy = 785 mCheck min and max areasTotal area of concrete $A_c = h$ Minimum % reinforceAst_min = k × $A_c = 260$ Ast_max = 4 % × $A_c = 3$ Steel defined:Outer steel resistingInner steel resisting stateCONCRETE SLAB DEFLECC	<b>TEEL - INNER</b> teel $centres$ $nm^2/m$ of steel resisting $=$ 200000 mm <sup>2</sup> /n         ement k = 0.13 %         0 mm <sup>2</sup> /m         8000 mm <sup>2</sup> /m         sagging A <sub>sx_prov</sub> =         sagging A <sub>sy_prov</sub> =         Stillon CHECK ((	n <b>785</b> mm²/m	of outer tensio	Area of ou	ıter steel provide	d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse st <i>Provide 10 dia bars @ 100</i> Asy_prov = Asy = 785 m <i>Check min and max areas</i> Total area of concrete $A_c = h$ Minimum % reinforceAst_min = k × $A_c = 260$ Ast_max = 4 % × $A_c = 4$ Steel defined:Outer steel resistingInner steel resistingSlab span length $I_x =$	TEEL - INNERteel $centres$ $nm^2/m$ of steel resisting $= 200000 \text{ mm}^2/m$ ement k = 0.13 %0 mm²/m8000 mm²/msagging $A_{sx_prov}$ =sagging $A_{sy_prov}$ =sagging $A_{sy_prov}$ =CTION CHECK (G2.750 m	<u>a sagging</u> n <b>785</b> mm²/m <b>785</b> mm²/m <u>CL 3.5.7)</u>		Area of ou Area of in	ıter steel provide	d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse st <i>Provide 10 dia bars @ 100</i> Asy_prov = Asy = 785 mCheck min and max areasTotal area of concrete $A_c = h$ Minimum % reinforceAst_min = k × $A_c = 260$ Ast_max = 4 % × $A_c = 260$ Ast_max = 4 % × $A_c = 260$ Steel defined:Outer steel resistingInner steel resistingSteel defined:Outer steel resistingStab span length $I_x =$ Design ultimate more	<b>TEEL - INNER</b> teel $centres$ $nm^2/m$ <b>of steel resisting</b> $=$ 200000 mm²/n         ement k = 0.13 % $0$ mm²/m <b>8000</b> mm²/m         sagging A <sub>sx_prov</sub> =         sagging A <sub>sy_prov</sub> = <b>CTION CHECK (G a</b> ent in shorter space	n • <b>785</b> mm²/m <b>785</b> mm²/m <b>CL 3.5.7)</b> an per m width m		Area of ou Area of in	ıter steel provide	d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse st <i>Provide 10 dia bars @ 100</i> Asy_prov = Asy = 785 m <i>Check min and max areas</i> Total area of concrete $A_c = h$ Minimum % reinforceAst_min = k × $A_c = 260$ Ast_max = 4 % × $A_c = 4$ Steel defined:Outer steel resistingInner steel resistingSlab span length $I_x =$	<b>TEEL - INNER</b> teel $centres$ $nm^2/m$ <b>of steel resisting</b> $=$ 200000 mm²/n         ement k = 0.13 % $0$ mm²/m <b>8000</b> mm²/m         sagging A <sub>sx_prov</sub> =         sagging A <sub>sy_prov</sub> = <b>CTION CHECK (G a</b> ent in shorter space	n • <b>785</b> mm²/m <b>785</b> mm²/m <b>CL 3.5.7)</b> an per m width m		Area of ou Area of in	ıter steel provide	d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse st <i>Provide 10 dia bars @ 100</i> Asy = 785 m <i>Check min and max areas</i> Total area of concrete $A_c = h$ Minimum % reinforceAst_max areasTotal area of concrete $A_c = h$ Minimum % reinforceAst_max = 4 % × $A_c = 260$ Ast_max = 4 % × $A_c = 40$ Steel defined:Outer steel resistingInner steel resistingStab span length $I_x =$ Design ultimate monDepth to outer tensionTension steel	TEEL - INNER teel centres $nm^2/m$ of steel resisting $r = 200000 \text{ mm}^2/m$ $r = 200000 \text{ mm}^2/m$ $r = 200000 \text{ mm}^2/m$ r = 0.13 % r = 0	n <b>785</b> mm²/m <b>785</b> mm²/m <b>CL 3.5.7)</b> an per m width m mm	n <sub>sx</sub> = <b>26</b> kNm/r	Area of ou Area of in	ıter steel provide	d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse stProvide 10 dia bars @ 100Asy_prov = Asy = 785 mCheck min and max areasTotal area of concrete $A_c = h$ Minimum % reinforceAst_min = k × $A_c = 260$ Ast_max = 4 % × $A_c = 260$ Outer steel resistingInner steel resistingInner steel resistingSteel defined:Outer steel resistingInner steel resistingSlab span length $l_x =$ Design ultimate monDepth to outer tensionTension steelArea of outer tension	<b>TEEL - INNER</b> teel $centres$ $nm^2/m$ $of steel resisting$ $= 200000 \text{ mm}^2/m$ ement k = 0.13 % $0 \text{ mm}^2/m$ <b>8000</b> mm²/m         sagging $A_{sx_prov}$ = <b>Stripper CHECK (G 2.750</b> m         nent in shorter spin         on steel $d_x$ = 145 m         on reinforcement prime	n 5 <u>sagging</u> n 785 mm²/m 785 mm²/m <u>CL 3.5.7)</u> an per m width m mm	n <sub>sx</sub> = <b>26</b> kNm/r <b>785</b> mm²/m	Area of ou Area of in	ıter steel provide	d (sagging)		
TRANSVERSE BOTTOM STInner layer of transverse st <i>Provide 10 dia bars @ 100</i> Asy = 785 m <i>Check min and max areas</i> Total area of concrete $A_c = h$ Minimum % reinforceAst_max areasTotal area of concrete $A_c = h$ Minimum % reinforceAst_max = 4 % × $A_c = 260$ Ast_max = 4 % × $A_c = 40$ Steel defined:Outer steel resistingInner steel resistingStab span length $I_x =$ Design ultimate monDepth to outer tensionTension steel	<b>TEEL - INNER</b> teel $centres$ $nm^2/m$ of steel resisting $e = 200000 \text{ mm}^2/m$ $e = 200000 \text{ mm}^2/m$ $e = 0.13 \%$ $e = mm^2/m$ <b>8000</b> mm²/m <b>8000</b> mm²/m         sagging $A_{sx_prov} =$ sagging $A_{sy_prov} =$ <b>CTION CHECK ((Comparison of the storter space)</b> ent in shorter space)         on steel $d_x = 145 \text{ m}$ entrinforcement procement required	<b>a</b> sagging n <b>785</b> mm <sup>2</sup> /m <b>785</b> mm <sup>2</sup> /m <b>CL 3.5.7</b> ) an per m width m mm rovided A <sub>sx_prov</sub> = d A <sub>sx_req</sub> = <b>434</b> m	n <sub>sx</sub> = <b>26</b> kNm/r <b>785</b> mm²/m	Area of ou Area of in	ıter steel provide	d (sagging)		

V&R	Project				Job Ref.		
VINCENT & RYMILL		20 WELLS ROA	AD LONDON	NW3	17J02		
VINCENT & RYMILL	Section	PRELIMINARY E		CALCS	Sheet no./rev. 22		
LAKESIDE COUNTRY CLUB FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date	
SURREY	TV	03/10/2017					
Basic span / effective depth r	atio (Table 3.9) ra	atiospan depth = 20					
The modification factor for sp			.4) has not b	een included.			
$f_s = 2 \times f_y \times A_{sx\_req} / (3 \times A_{sx\_pr})$			,				
$factor_{tens} = min(2, 0.55 + (4$			1m² + m <sub>sx</sub> / d <sub>x</sub>	<sup>2</sup> ))) = <b>1.691</b>			
Calculate Maximum Span	,						
This is a simplified approach 3.4.6.4 and 3.4.6.7.	and further attent	tion should be giv	ven where sp	ecial circumstance	es exist. Refer	to clauses	
Maximum span I <sub>max</sub> =	$ratio_{span_depth}  imes f$	$actor_{tens} \times d_x = 4.$	<b>91</b> m				
Check the actual beam spa	n						
Actual span/depth rat	tio $I_x / d_x = 18.97$						
Span depth limit ratio	$O_{span_depth}  imes factor_{te}$	ens = <b>33.83</b>					
				Spa	n/Depth ratio	check satis	
CHECK OF NOMINAL COVE	ER (SAGGING) -	(BS8110:PT 1,	TABLE 3.4)				
Slab thickness h = 20	<b>)0</b> mm						
Effective depth to bot	ttom outer tensior	n reinforcement c	l <sub>x</sub> = <b>145.0</b> mn	n			
Diameter of tension r Diameter of links $L_{diax}$ Cover to outer tension reinfor $c_{tenx} = h - d_x - D_x / 2 =$ Nominal cover to links steel $c_{nomx} = c_{tenx} - L_{diax} = 5$ Permissable minimum nomina	x = 0 mm rcement 50.0 mm		e 3.4)				
c <sub>min</sub> = <b>35</b> mm					w atool realist	na coasina	
Cmin = <b>35</b> MM				Cover ove	er steel resisti	ng sagging	
Cmin = <b>35</b> MM <u>2 LAYERS A393 TOP</u>				Cover ove	er steel resisti	ng sagging	
	I			Cover ove	er steel resisti	ng sagging	
<u>2 LAYERS A393 TOP</u> BOTTOM REINFORCEMEN	_			Cover ove	er steel resisti	ng sagging	
<u>2 LAYERS A393 TOP</u>	_			Cover ove	er steel resisti	ng sagging	
<u>2 LAYERS A393 TOP</u> BOTTOM REINFORCEMEN	J.m			Cover ove	er steel resisti	ng sagging	
2 LAYERS A393 TOP BOTTOM REINFORCEMEN BM = 12 X 2.75 <sup>2</sup> / 8 = 11.4KN	J.m <b>110)</b>			Cover ove			
2 LAYERS A393 TOP BOTTOM REINFORCEMEN BM = 12 X 2.75 <sup>2</sup> / 8 = 11.4KN SLAB DESIGN (BS8	J.m <b>110)</b>			Cover ove		ng sagging	
2 LAYERS A393 TOP BOTTOM REINFORCEMEN BM = 12 X 2.75 <sup>2</sup> / 8 = 11.4KN SLAB DESIGN (BS8	1.m 110) :PART1:1997)			Cover ove			

Overall depth of slab h = 200 mm



	Project	20 WELLS RO	AD LONDON	NW3	Job Ref.	17J02	
	Section					Sheet no./rev.	
LAKESIDE COUNTRY CLUB	PRELIMINARY BASEMENT CALCS					24	
FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date	
SURREY	TV	03/10/2017					
A <sub>sy_prov</sub> = A <sub>sy</sub> = <b>393</b> m	1m²/m						
Check min and max areas	of steel resistin	<u>q sagging</u>					
Total area of concrete $A_c = h$	= <b>200000</b> mm <sup>2</sup> /r	n					
Minimum % reinforce	ement k = <b>0.13</b> %	<b>b</b>					
$A_{st\_min} = k \times A_c = 260$	mm²/m						
$A_{st_max} = 4 \% \times A_c = 8$	<b>3000</b> mm²/m						
Steel defined:							
Outer steel resisting	sagging A <sub>sx_prov</sub> =	= <b>393</b> mm²/m					
				Area of out	er steel provide	d (sagging	
Inner steel resisting	sagging A <sub>sy_prov</sub> =	<b>393</b> mm²/m					
				Area of inn	er steel provide	d (sagging	
CONCRETE SLAB DEFLEC		CL 3.5.7)					
Slab span length $l_x =$		<u>or o.o., j</u>					
Design ultimate mor		an ner m width m		m			
Depth to outer tensic							
Tension steel							
Area of outer tension	reinforcement n	rovided A	<b>303</b> mm <sup>2</sup> /m				
Area of tension reinfo		_					
			11 /111				
Moment Redistribution	$p_{\text{DX}} = 1$	.00					
Basic span / effective depth r	atio (Table 2.0) (	ratio <b>20</b>					
The modification factor for sp		. – .	(1) has not b	oon included			
		,	0.4) Has Hot D				
$f_{s} = 2 \times f_{y} \times A_{sx\_req} / (3 \times A_{sx\_p})$				2)))			
factor <sub>tens</sub> = min ( $2, 0.55 + (4)$	+// IN/M/11111 Is )/	(120×(0.9 N/m	Im <sup>2</sup> + m <sub>sx</sub> / 0 <sub>x</sub>	-))) = <b>2.000</b>			
Calculate Maximum Span				!-! -!			
This is a simplified approach 3.4.6.4 and 3.4.6.7.	and luriner aller	nion should be gr	ven where sp	ecial circumsta	nces exist. Reier	to clauses	
Maximum span I <sub>max</sub> =	$-$ ratio <sub>span_depth</sub> ×	factor <sub>tens</sub> $\times$ d <sub>x</sub> = 6	. <b>40</b> m				
Check the actual beam spa	n						
Actual span/depth ra	tio I <sub>x</sub> / d <sub>x</sub> = <b>17.19</b>						
Span depth limit ratio	$O_{span\_depth}  imes factor$	tens = <b>40.00</b>					
				Sj	pan/Depth ratio	check satis	
CHECK OF NOMINAL COV	ER (SAGGING)	<u>- (BS8</u> 110:PT 1.	TABLE 3.4)				
Slab thickness h = 2							
Effective depth to bo		n reinforcement o	d <sub>x</sub> = <b>160.0</b> mn	n			
Diameter of tension r	einforcement Dx	= <b>10</b> mm					
Diameter of links Ldia							

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	20 WELLS ROAD LONDON NW3				17J02	
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FRIMLEY GREEN	Calc. by	Date	Chk'd by	Date	App'd by	Date
SURREY	TV	03/10/2017				

#### $c_{tenx} = h - d_x - D_x / 2 = 35.0 \text{ mm}$

Nominal cover to links steel

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

Permissable minimum nominal cover to all reinforcement (Table 3.4)

c<sub>min</sub> = **35** mm

Cover over steel resisting sagging OK

### A393 BOTTOM