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CALCULATIONS FOR RETAINING WALLS FOR 102 CAMDEN MEWS LONDON NW1 9AG

12.568 October 2014

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Date 01/10/14	Sheet No. 1
Eng. JC	
Job No. 12.568	

102 CAMDEN MEWS
LONDON
NW1 9AG

RETAINING WALLS

	kN/m PI	kN/m VL
Party wall:		
s/w b/wk = (5.1kN/m² x 4.9m) + (7.8kN/m² x 3.0m)	48.4	
s/w roof: 0.75kN/m² x 2.0m x 2	3.0	
VL roof: 0.75kN/m² x 2.0m x 2		3.0
s/w floor: 0.5kN/m² x 2.0m x 2 x 3	6.0	
VL floor: 1.5kN/m² x 2.0m x 2 x 3		18.0
	57.4	21.0
Front and rear wall:		
s/w b/wk: (5.1kN/m² x 3.4m) + (7.8kN/m² x 5.0m)	40.8	
s/w stud: 1.0kN/m² x 1.5m	1.5	
s/w roof: 0.75kN/m² x 1.55m MAX LOADING	1.2	
VL roof: 0.75kN/m² x 1.55m		1.2
s/w floor: 0.5kN/m² x 1.55m x 3	2.4	
VL floor: 1.5kN/m² x 1.55m x 3		7.0
	45.9	8.2
s/w b/wk: (5.1kN/m² x 2.7m) + (7.8kN/m² x 2.8m) MIN LOADING worst case	35.6	

RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.4.08

Retaining wall details

Stem type	Cantilever		
Stem height	h_{stem} = **2400** mm		
Prop height	h_{prop} = **0** mm		
Stem thickness	t_{stem} = **330** mm		
Angle to rear face of stem	α = **90** deg		
Stem density	γ_{stem} = **25** kN/m^3		
Toe length	l_{toe} = **1200** mm		
Heel length	l_{heel} = **100** mm		
Base thickness	t_{base} = **350** mm		
Base density	γ_{base} = **25** kN/m^3		
Height of retained soil	h_{ret} = **2400** mm	Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm		
Height of water	h_{water} = **1600** mm		
Water density	γ_w = **9.8** kN/m^3		

Retained soil properties

Soil type	Soft clay	
Moist density	γ_{mr} = **17** kN/m^3	
Saturated density	γ_{sr} = **17** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{r.k}$ = **18** deg
Characteristic wall friction angle		$\delta_{r.k}$ = **9** deg

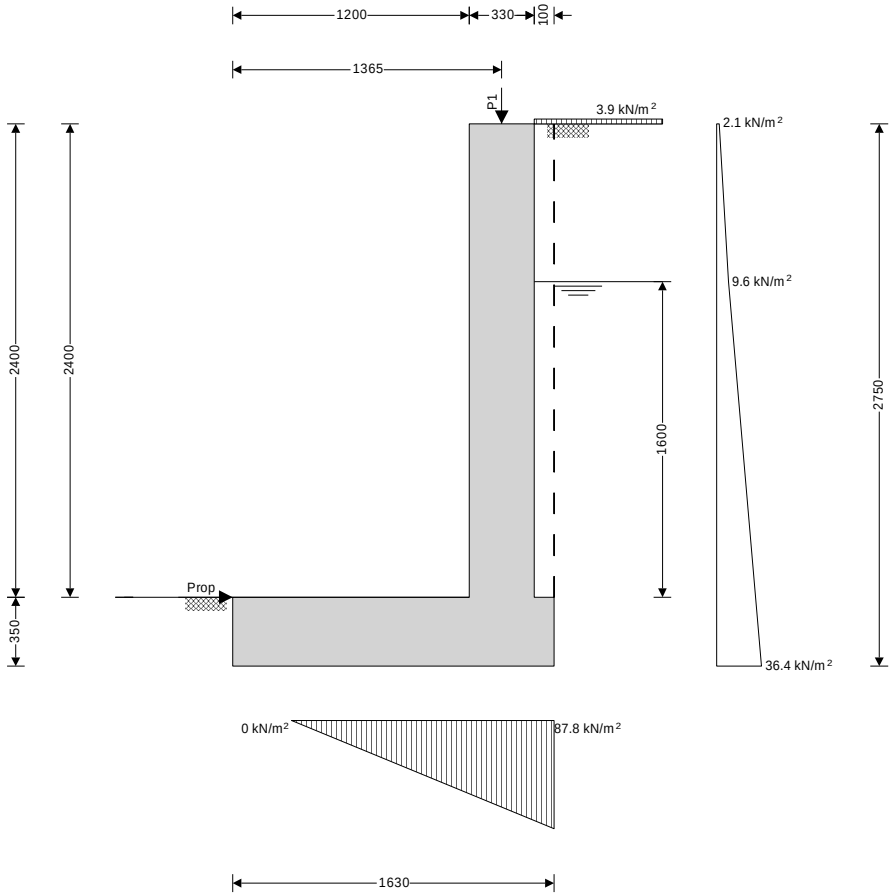
Base soil properties

Soil type	Firm clay	
Moist density	γ_{mb} = **18** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{b.k}$ = **18** deg
Characteristic wall friction angle		$\delta_{b.k}$ = **9** deg
Characteristic base friction angle		$\delta_{bb.k}$ = **12** deg
Presumed bearing capacity	$P_{bearing}$ = **100** kN/m^2	

Loading details

Variable surcharge load	$Surcharge_Q$ = **3** kN/m^2
Vertical line load at 1365 mm	P_{G1} = **57.4** kN/m
	P_{Q1} = **21** kN/m

Martin Redston Associates 6 Hale Lane London NW7 3NX	Project 102 Camden Mews, London, NW1 9AG			Job no. 12.568	
	Calcs for Party Wall Retaining Wall			Start page no./Revision 3	
	Calcs by J	Calcs date 01/10/2014	Checked by	Checked date	Approved by	Approved date



Calculate retaining wall geometry

Base length	l_{base} = **1630** mm		
Saturated soil height	h_{sat} = **1600** mm		
Moist soil height	h_{moist} = **800** mm		
Length of surcharge load	l_{sur} = **100** mm		
Vertical distance	x_{sur_v} = **1580** mm		
Effective height of wall	h_{eff} = **2750** mm		
Horizontal distance	x_{sur_h} = **1375** mm		
Area of wall stem	A_{stem} = **0.792** m²	Vertical distance	x_{stem} = **1365** mm
Area of wall base	A_{base} = **0.571** m²	Vertical distance	x_{base} = **815** mm
Area of saturated soil	A_{sat} = **0.16** m²	Vertical distance	x_{sat_v} = **1580** mm
		Horizontal distance	x_{sat_h} = **650** mm
Area of water	A_{water} = **0.16** m²	Vertical distance	x_{water_v} = **1580** mm
		Horizontal distance	x_{water_h} = **650** mm
Area of moist soil	A_{moist} = **0.08** m²	Vertical distance	x_{moist_v} = **1580** mm
		Horizontal distance	x_{moist_h} = **1186** mm

Using Coulomb theory

Active pressure coefficient	K_A = **0.483**	Passive pressure coefficient	K_P = **2.359**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base} + F_{sat\_v} + F_{moist\_v} + F_{water\_v} + F_{sur\_v} + F_{P\_v}$ = **116.8** kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{sat\_h} + F_{moist\_h} + F_{water\_h} + F_{sur\_h} = \mathbf{44.4}$ kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{sat} + M_{moist} + M_{water} + M_{sur} + M_P = \mathbf{112.7}$ kNm/m

Check bearing pressure

Propping force $F_{prop\_base} = \mathbf{44.4}$ kN/m

Bearing pressure at toe $q_{toe} = \mathbf{0}$ kN/m^2 Bearing pressure at heel $q_{heel} = \mathbf{87.8}$ kN/m^2

Factor of safety $FoS_{bp} = \mathbf{1.139}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.4.08

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class C32/40

Char.comp.cylinder strength $f_{ck} = \mathbf{32}$ N/mm^2 Mean axial tensile strength $f_{ctm} = \mathbf{3.0}$ N/mm^2

Secant modulus of elasticity $E_{cm} = \mathbf{33346}$ N/mm^2 Maximum aggregate size $h_{agg} = \mathbf{20}$ mm

Design comp.concrete strength $f_{cd} = \mathbf{18.1}$ N/mm^2 Partial factor $\gamma_C = \mathbf{1.50}$

Reinforcement details

Characteristic yield strength $f_{yk} = \mathbf{500}$ N/mm^2 Modulus of elasticity $E_s = \mathbf{200000}$ N/mm^2

Design yield strength $f_{yd} = \mathbf{435}$ N/mm^2 Partial factor $\gamma_S = \mathbf{1.15}$

Cover to reinforcement

Front face of stem $c_{sf} = \mathbf{20}$ mm Rear face of stem $c_{sr} = \mathbf{75}$ mm

Top face of base $c_{bt} = \mathbf{20}$ mm Bottom face of base $c_{bb} = \mathbf{75}$ mm

Check stem design at base of stem

Depth of section h = **330** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **36.1** kNm/m K = **0.019** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req} = \mathbf{354}$ mm^2/m

Tens.reinforcement provided 16 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr.prov} = \mathbf{1005}$ mm^2/m

Min.area of reinforcement $A_{sr.min} = \mathbf{388}$ mm^2/m Max.area of reinforcement $A_{sr.max} = \mathbf{13200}$ mm^2/m

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

Crack control - Section 7.3

Limiting crack width $w_{max} = \mathbf{0.3}$ mm Maximum crack width $w_k = \mathbf{0.165}$ mm

PASS - Maximum crack width is less than limiting crack width **Rectangular section in shear - Section 6.2**

Design shear force V = **45.6** kN/m Design shear resistance $V_{Rd.c} = \mathbf{128.1}$ kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req} = \mathbf{330}$ mm^2/m Max.spacing of reinforcement $s_{sx\_max} = \mathbf{400}$ mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{sx.prov} = \mathbf{393}$ mm^2/m

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

Check base design at toe

Depth of section h = **350** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **42.2** kNm/m K = **0.019** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bb.req}$ = **383** mm²/m

Tens.reinforcement provided 16 dia.bars @ 200 c/c Tens.reinforcement provided $A_{bb.prov}$ = **1005** mm²/m

Min.area of reinforcement $A_{bb.min}$ = **420** mm²/m Max.area of reinforcement $A_{bb.max}$ = **14000** mm²/m

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

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.196** mm

PASS - Maximum crack width is less than limiting crack width **Rectangular section in shear - Section 6.2**

Design shear force V = **86.7** kN/m Design shear resistance $V_{Rd.c}$ = **137** kN/m

PASS - Design shear resistance exceeds design shear force

Rectangular section in shear - Section 6.2

Design shear force V = **7.9** kN/m Design shear resistance $V_{Rd.c}$ = **134.7** kN/m

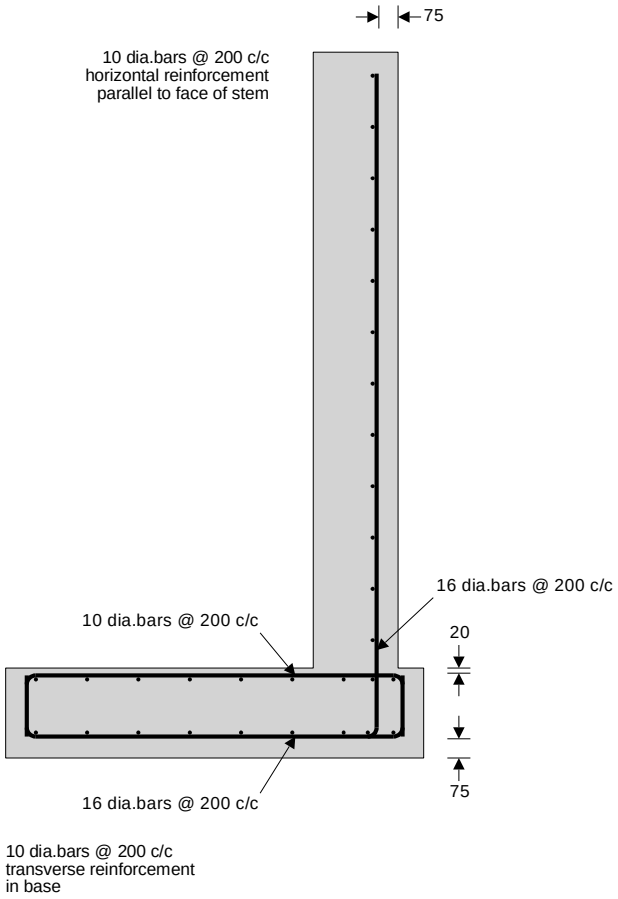
PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement $A_{bx.req}$ = **201** mm²/m Max.spacing of reinforcement s_{bx_max} = **450** mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{bx.prov}$ = **393** mm²/m

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



RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.4.08

Retaining wall details

Stem type	Cantilever		
Stem height	h_{stem} = **2400** mm		
Prop height	h_{prop} = **0** mm		
Stem thickness	t_{stem} = **330** mm		
Angle to rear face of stem	α = **90** deg		
Stem density	γ_{stem} = **25** kN/m^3		
Toe length	l_{toe} = **1200** mm		
Heel length	l_{heel} = **100** mm		
Base thickness	t_{base} = **350** mm		
Base density	γ_{base} = **25** kN/m^3		
Height of retained soil	h_{ret} = **2400** mm	Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm		
Height of water	h_{water} = **1600** mm		
Water density	γ_w = **9.8** kN/m^3		

Retained soil properties

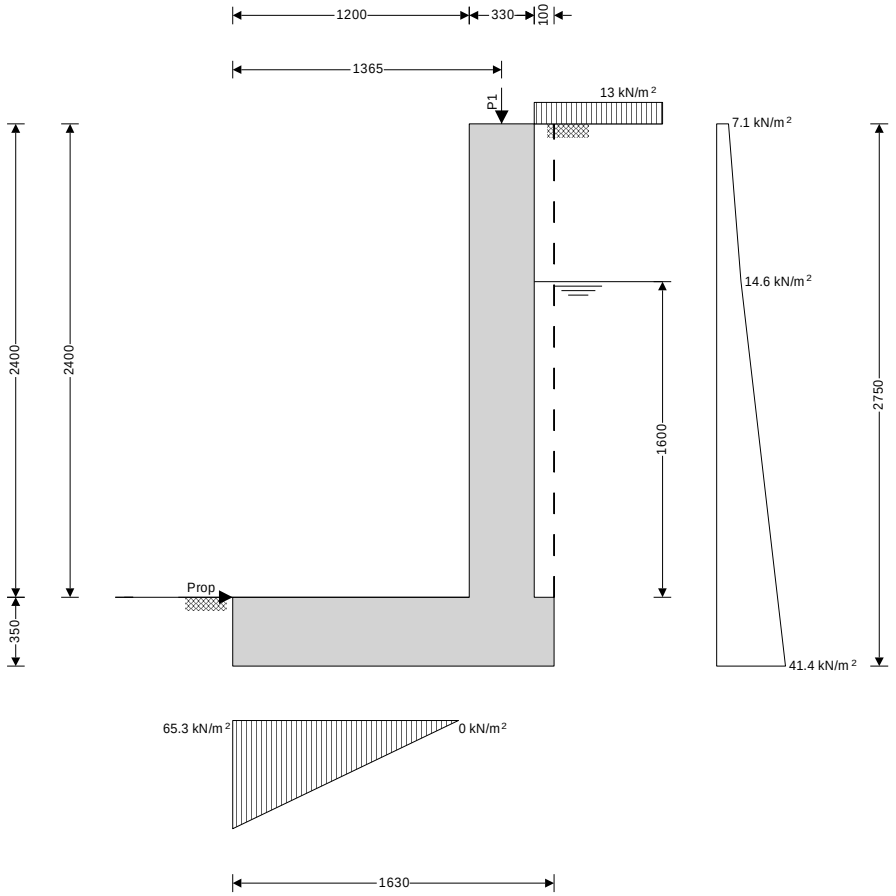
Soil type	Soft clay	
Moist density	γ_{mr} = **17** kN/m^3	
Saturated density	γ_{sr} = **17** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{r.k}$ = **18** deg
Characteristic wall friction angle		$\delta_{r.k}$ = **9** deg

Base soil properties

Soil type	Firm clay	
Moist density	γ_{mb} = **18** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{b.k}$ = **18** deg
Characteristic wall friction angle		$\delta_{b.k}$ = **9** deg
Characteristic base friction angle		$\delta_{bb.k}$ = **12** deg
Presumed bearing capacity	$P_{bearing}$ = **100** kN/m^2	

Loading details

Variable surcharge load	$Surcharge_Q$ = **10** kN/m^2
Vertical line load at 1365 mm	P_{G1} = **35.6** kN/m



Calculate retaining wall geometry

Base length	l_{base} = **1630** mm		
Saturated soil height	h_{sat} = **1600** mm		
Moist soil height	h_{moist} = **800** mm		
Length of surcharge load	l_{sur} = **100** mm		
Vertical distance	x_{sur_v} = **1580** mm		
Effective height of wall	h_{eff} = **2750** mm		
Horizontal distance	x_{sur_h} = **1375** mm		
Area of wall stem	A_{stem} = **0.792** m²	Vertical distance	x_{stem} = **1365** mm
Area of wall base	A_{base} = **0.571** m²	Vertical distance	x_{base} = **815** mm
Area of saturated soil	A_{sat} = **0.16** m²	Vertical distance	x_{sat_v} = **1580** mm
		Horizontal distance	x_{sat_h} = **650** mm
Area of water	A_{water} = **0.16** m²	Vertical distance	x_{water_v} = **1580** mm
		Horizontal distance	x_{water_h} = **650** mm
Area of moist soil	A_{moist} = **0.08** m²	Vertical distance	x_{moist_v} = **1580** mm
		Horizontal distance	x_{moist_h} = **1186** mm

Using Coulomb theory

Active pressure coefficient	K_A = **0.483**	Passive pressure coefficient	K_P = **2.359**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base} + F_{sat\_v} + F_{moist\_v} + F_{water\_v} + F_{sur\_v} + F_{P\_v}$ = **74.7** kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{sat\_h} + F_{moist\_h} + F_{water\_h} + F_{sur\_h} = \mathbf{53.5}$ kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{sat} + M_{moist} + M_{water} + M_{sur} + M_P = \mathbf{42.8}$ kNm/m

Check bearing pressure

Propping force $F_{prop\_base} = \mathbf{53.5}$ kN/m

Bearing pressure at toe $q_{toe} = \mathbf{65.3}$ kN/m^2 Bearing pressure at heel $q_{heel} = \mathbf{0}$ kN/m^2

Factor of safety $FoS_{bp} = \mathbf{1.531}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.4.08

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class C32/40

Char.comp.cylinder strength $f_{ck} = \mathbf{32}$ N/mm^2 Mean axial tensile strength $f_{ctm} = \mathbf{3.0}$ N/mm^2

Secant modulus of elasticity $E_{cm} = \mathbf{33346}$ N/mm^2 Maximum aggregate size $h_{agg} = \mathbf{20}$ mm

Design comp.concrete strength $f_{cd} = \mathbf{18.1}$ N/mm^2 Partial factor $\gamma_C = \mathbf{1.50}$

Reinforcement details

Characteristic yield strength $f_{yk} = \mathbf{500}$ N/mm^2 Modulus of elasticity $E_s = \mathbf{200000}$ N/mm^2

Design yield strength $f_{yd} = \mathbf{435}$ N/mm^2 Partial factor $\gamma_S = \mathbf{1.15}$

Cover to reinforcement

Front face of stem $c_{sf} = \mathbf{20}$ mm Rear face of stem $c_{sr} = \mathbf{75}$ mm

Top face of base $c_{bt} = \mathbf{20}$ mm Bottom face of base $c_{bb} = \mathbf{75}$ mm

Check stem design at base of stem

Depth of section h = **330** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **50.6** kNm/m K = **0.026** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req} = \mathbf{496}$ mm^2/m

Tens.reinforcement provided 16 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr.prov} = \mathbf{1005}$ mm^2/m

Min.area of reinforcement $A_{sr.min} = \mathbf{388}$ mm^2/m Max.area of reinforcement $A_{sr.max} = \mathbf{13200}$ mm^2/m

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

Crack control - Section 7.3

Limiting crack width $w_{max} = \mathbf{0.3}$ mm Maximum crack width $w_k = \mathbf{0.203}$ mm

PASS - Maximum crack width is less than limiting crack width **Rectangular section in shear - Section 6.2**

Design shear force V = **57.6** kN/m Design shear resistance $V_{Rd.c} = \mathbf{128.1}$ kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req} = \mathbf{330}$ mm^2/m Max.spacing of reinforcement $s_{sx\_max} = \mathbf{400}$ mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{sx.prov} = \mathbf{393}$ mm^2/m

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

Check base design at toe

Depth of section h = **350** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **58.5** kNm/m K = **0.026** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bb.req}$ = **535** mm²/m

Tens.reinforcement provided 20 dia.bars @ 200 c/c Tens.reinforcement provided $A_{bb.prov}$ = **1571** mm²/m

Min.area of reinforcement $A_{bb.min}$ = **417** mm²/m Max.area of reinforcement $A_{bb.max}$ = **14000** mm²/m

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

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.153** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **79.6** kN/m Design shear resistance $V_{Rd.c}$ = **158.5** kN/m

PASS - Design shear resistance exceeds design shear force

Rectangular section in flexure - Section 6.1

Design bending moment M = **0.4** kNm/m K = **0.000** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bt.req}$ = **3** mm²/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{bt.prov}$ = **565** mm²/m

Min.area of reinforcement $A_{bt.min}$ = **509** mm²/m Max.area of reinforcement $A_{bt.max}$ = **14000** mm²/m

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

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.001** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **7.7** kN/m Design shear resistance $V_{Rd.c}$ = **153.1** kN/m

PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement $A_{bx.req}$ = **314** mm²/m Max.spacing of reinforcement s_{bx_max} = **450** mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{bx.prov}$ = **393** mm²/m

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

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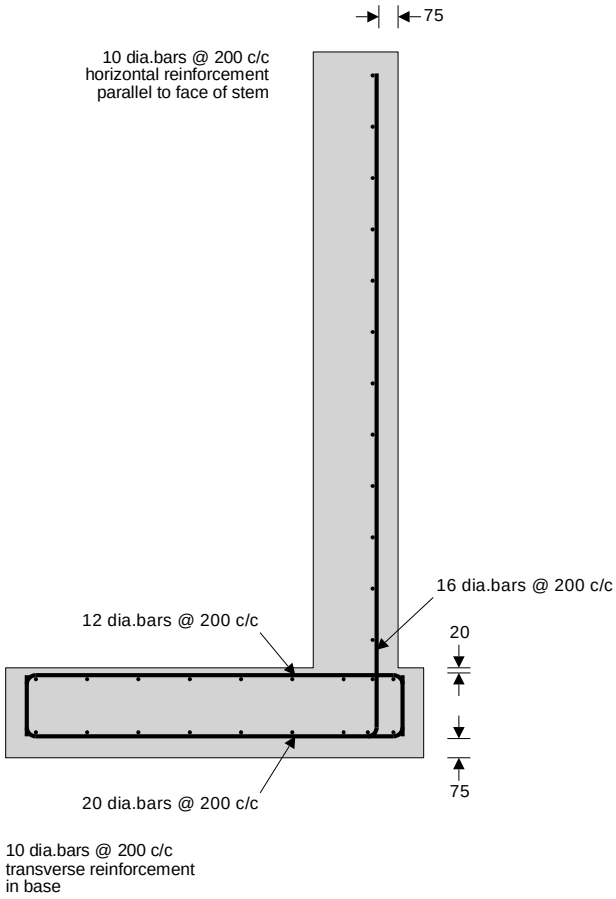
	Calcs for Front Wall Retaining Wall			Start page no./Revision 10	
	Calcs by J	Calcs date 01/10/2014	Checked by	Checked date	Approved by	Approved date



RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.4.08

Retaining wall details

Stem type	Cantilever		
Stem height	h_{stem} = **2400** mm		
Prop height	h_{prop} = **0** mm		
Stem thickness	t_{stem} = **330** mm		
Angle to rear face of stem	α = **90** deg		
Stem density	γ_{stem} = **25** kN/m^3		
Toe length	l_{toe} = **1200** mm		
Heel length	l_{heel} = **100** mm		
Base thickness	t_{base} = **350** mm		
Base density	γ_{base} = **25** kN/m^3		
Height of retained soil	h_{ret} = **2400** mm	Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm		
Height of water	h_{water} = **1600** mm		
Water density	γ_w = **9.8** kN/m^3		

Retained soil properties

Soil type	Soft clay	
Moist density	γ_{mr} = **17** kN/m^3	
Saturated density	γ_{sr} = **17** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{r.k}$ = **18** deg
Characteristic wall friction angle		$\delta_{r.k}$ = **9** deg

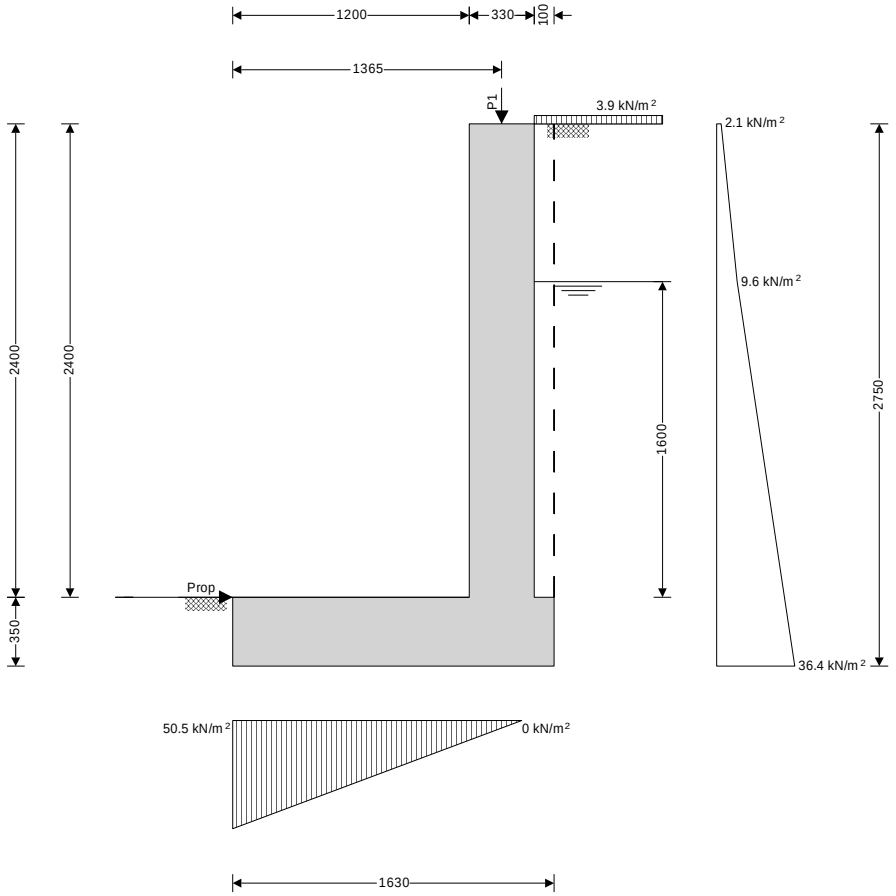
Base soil properties

Soil type	Firm clay	
Moist density	γ_{mb} = **18** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{b.k}$ = **18** deg
Characteristic wall friction angle		$\delta_{b.k}$ = **9** deg
Characteristic base friction angle		$\delta_{bb.k}$ = **12** deg
Presumed bearing capacity	$P_{bearing}$ = **100** kN/m^2	

Loading details

Variable surcharge load	$Surcharge_Q$ = **3** kN/m^2
Vertical line load at 1365 mm	P_{G1} = **35.6** kN/m

Martin Redston Associates 6 Hale Lane London NW7 3NX	Project 102 Camden Mews, London, NW1 9AG			Job no. 12.568	
	Calcs for Rear Wall Retaining Wall			Start page no./Revision 12	
	Calcs by J	Calcs date 01/10/2014	Checked by	Checked date	Approved by	Approved date



Calculate retaining wall geometry

Base length	l_{base} = **1630** mm		
Saturated soil height	h_{sat} = **1600** mm		
Moist soil height	h_{moist} = **800** mm		
Length of surcharge load	l_{sur} = **100** mm		
Vertical distance	x_{sur_v} = **1580** mm		
Effective height of wall	h_{eff} = **2750** mm		
Horizontal distance	x_{sur_h} = **1375** mm		
Area of wall stem	A_{stem} = **0.792** m²	Vertical distance	x_{stem} = **1365** mm
Area of wall base	A_{base} = **0.571** m²	Vertical distance	x_{base} = **815** mm
Area of saturated soil	A_{sat} = **0.16** m²	Vertical distance	x_{sat_v} = **1580** mm
		Horizontal distance	x_{sat_h} = **650** mm
Area of water	A_{water} = **0.16** m²	Vertical distance	x_{water_v} = **1580** mm
		Horizontal distance	x_{water_h} = **650** mm
Area of moist soil	A_{moist} = **0.08** m²	Vertical distance	x_{moist_v} = **1580** mm
		Horizontal distance	x_{moist_h} = **1186** mm

Using Coulomb theory

Active pressure coefficient	K_A = **0.483**	Passive pressure coefficient	K_P = **2.359**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base} + F_{sat\_v} + F_{moist\_v} + F_{water\_v} + F_{sur\_v} + F_{P\_v}$ = **74** kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{sat\_h} + F_{moist\_h} + F_{water\_h} + F_{sur\_h} = \mathbf{44.4}$ kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{sat} + M_{moist} + M_{water} + M_{sur} + M_P = \mathbf{54.3}$ kNm/m

Check bearing pressure

Propping force $F_{prop\_base} = \mathbf{44.4}$ kN/m

Bearing pressure at toe $q_{toe} = \mathbf{50.5}$ kN/m^2 Bearing pressure at heel $q_{heel} = \mathbf{0}$ kN/m^2

Factor of safety $FoS_{bp} = \mathbf{1.981}$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.4.08

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class C32/40

Char.comp.cylinder strength $f_{ck} = \mathbf{32}$ N/mm^2 Mean axial tensile strength $f_{ctm} = \mathbf{3.0}$ N/mm^2

Secant modulus of elasticity $E_{cm} = \mathbf{33346}$ N/mm^2 Maximum aggregate size $h_{agg} = \mathbf{20}$ mm

Design comp.concrete strength $f_{cd} = \mathbf{18.1}$ N/mm^2 Partial factor $\gamma_C = \mathbf{1.50}$

Reinforcement details

Characteristic yield strength $f_{yk} = \mathbf{500}$ N/mm^2 Modulus of elasticity $E_s = \mathbf{200000}$ N/mm^2

Design yield strength $f_{yd} = \mathbf{435}$ N/mm^2 Partial factor $\gamma_S = \mathbf{1.15}$

Cover to reinforcement

Front face of stem $c_{sf} = \mathbf{20}$ mm Rear face of stem $c_{sr} = \mathbf{75}$ mm

Top face of base $c_{bt} = \mathbf{20}$ mm Bottom face of base $c_{bb} = \mathbf{75}$ mm

Check stem design at base of stem

Depth of section h = **330** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **36.1** kNm/m K = **0.019** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req} = \mathbf{354}$ mm^2/m

Tens.reinforcement provided 16 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr.prov} = \mathbf{1005}$ mm^2/m

Min.area of reinforcement $A_{sr.min} = \mathbf{388}$ mm^2/m Max.area of reinforcement $A_{sr.max} = \mathbf{13200}$ mm^2/m

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

Crack control - Section 7.3

Limiting crack width $w_{max} = \mathbf{0.3}$ mm Maximum crack width $w_k = \mathbf{0.165}$ mm

PASS - Maximum crack width is less than limiting crack width **Rectangular section in shear - Section 6.2**

Design shear force V = **45.6** kN/m Design shear resistance $V_{Rd.c} = \mathbf{128.1}$ kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req} = \mathbf{330}$ mm^2/m Max.spacing of reinforcement $s_{sx\_max} = \mathbf{400}$ mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{sx.prov} = \mathbf{393}$ mm^2/m

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

Check base design at toe

Depth of section h = **350** mm

Rectangular section in flexure - Section 6.1

Design bending moment — M = **43.1** kNm/m — K = **0.019** — K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required — $A_{bb.req}$ = **391** mm²/m

Tens.reinforcement provided — 16 dia.bars @ 200 c/c — Tens.reinforcement provided — $A_{bb.prov}$ = **1005** mm²/m

Min.area of reinforcement — $A_{bb.min}$ = **420** mm²/m — Max.area of reinforcement — $A_{bb.max}$ = **14000** mm²/m

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

Crack control - Section 7.3

Limiting crack width — w_{max} = **0.3** mm — Maximum crack width — w_k = **0.2** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force — V = **65.8** kN/m — Design shear resistance — $V_{Rd.c}$ = **137** kN/m

PASS - Design shear resistance exceeds design shear force

Rectangular section in flexure - Section 6.1

Design bending moment — M = **0.2** kNm/m — K = **0.000** — K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required — $A_{bt.req}$ = **1** mm²/m

Tens.reinforcement provided — 12 dia.bars @ 200 c/c — Tens.reinforcement provided — $A_{bt.prov}$ = **565** mm²/m

Min.area of reinforcement — $A_{bt.min}$ = **509** mm²/m — Max.area of reinforcement — $A_{bt.max}$ = **14000** mm²/m

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

Crack control - Section 7.3

Limiting crack width — w_{max} = **0.3** mm — Maximum crack width — w_k = **0** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force — V = **3.3** kN/m — Design shear resistance — $V_{Rd.c}$ = **153.1** kN/m

PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement — $A_{bx.req}$ = **201** mm²/m — Max.spacing of reinforcement — s_{bx_max} = **450** mm

Trans.reinforcement provided — 10 dia.bars @ 200 c/c — Trans.reinforcement provided — $A_{bx.prov}$ = **393** mm²/m

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

Tedds	Project				Job no.	
Martin Redston Associates 6 Hale Lane London NW7 3NX	102 Camden Mews, London, NW1 9AG				12.568	
	Calcs for				Start page no./Revision	
	Rear Wall Retaining Wall				15	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	J	01/10/2014