Job Number: 160215
Date: 03.03.2016

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Structural Scheme for Planning

Property Details:

8A Belmont Street
London
NW1 8HJ

Client Information:

Francis Williams
Ground and Water Limited

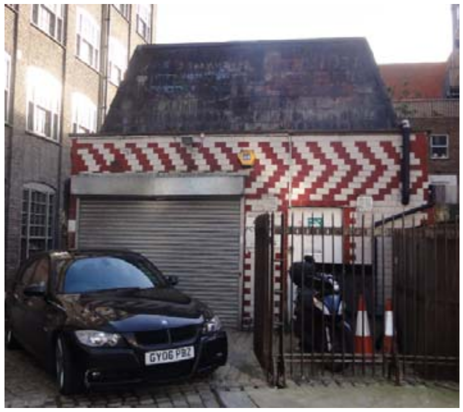
Revision	Date	Comment
-	03.03.2016	Issue for planning

Table of Contents

1. Structural Design Information

Structural Summary

The existing property is a single storey storage building.



Existing property

Proposed works:

The storage within the site boundary will be demolished to give way for a new residential property. The new building will be two storeys high above ground level and will also include a basement. For further details of the architectural design, refer to Architectural drawings

Intended use of structure and user requirements

Family/domestic use

Loading (BS 6399-1)

	UDL kN/m²	Concentrated Loads kN
Domestic Single Dwellings	1.5	1.4

Is Live Load Reduction included in design No

Progressive Collapse

Number of Storeys

Two storeys above basement

Is the Building Multi Occupancy?

Yes

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Part A3 Progressive collapse	EN 1991-1-7:1996 Table A1 Class 2A — Flats, apartments and other residential buildings not exceeding 4 storeys
Additional Design Requirements to Comply with Progressive Collapse	Class 2A – Design provision of effective horizontal ties or , or effective anchorage of suspended floor to walls. Check requirements in EN 1991-1-7 clauses A.5.1 and A.5.2

	Lateral Stability
Exposure and wind loading conditions	0.6 kN/m^2
Stability Design	Lateral stability in the basement is provided by the reinforced retaining walls and slabs which form a complete box.
Lateral Actions	Lateral Forces applied from; Wind on to super structure Soil pressure, Hydro static pressure and surcharge on basement

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	Basement Design and Construction Impacts and Initial Design Considerations
Structural Scheme	A reinforced concrete slab and a contiguous piled wall will form the new foundation of the property. The piled wall, to be designed at detailed design stage, will resist the lateral pressures on the side of the basement. The investigations highlight that water is not present. The walls are designed to cope with the hydrostatic pressure. It is possible that a water main may break causing a local high water table. To account for this, the wall is designed for water at full height. The detailed design should consider floatation as a risk. However, by inspection, the weight of the building is likely to be greater than the uplift forces from the water, resulting in a stable structure. The site is within 5m of a road surface; the basement wall is further away. However, to account for the possibility of emergency services vehicles occupying the pavement, highways loading should be allowed for. Drawings are appended. The details given on these should not be used for construction: detailed design will follow after the planning application process.
Water Table	Has a soil investigation been carried out Yes No water is present in the borehole. Design permanent condition for water table level: If deeper than existing, design reinforcement for water table at full basement depth to allow for local failure of water mains, drainage and storm water. Global uplift forces can be ignored when the groundwater table is lower than the basement. BS8102 only indicates guidance.
Retained soil Parameters	Design overall stability to K_a & K_p values. Lateral movement necessary to achieve K_a mobilisation is height/500 (from Tomlinson). This is tighter than the deflection limits of the concrete wall.
Temporary Works	Where possible walls are designed to be temporarily stable. Temporary propping details will be required for the ground and soil and this must be

	provided by the contractor. Their details should be forwarded to the Engineers responsible for the permanent design. The contractor must provide calculations, drawings and method statements of their temporary works proposals prior to beginning work.

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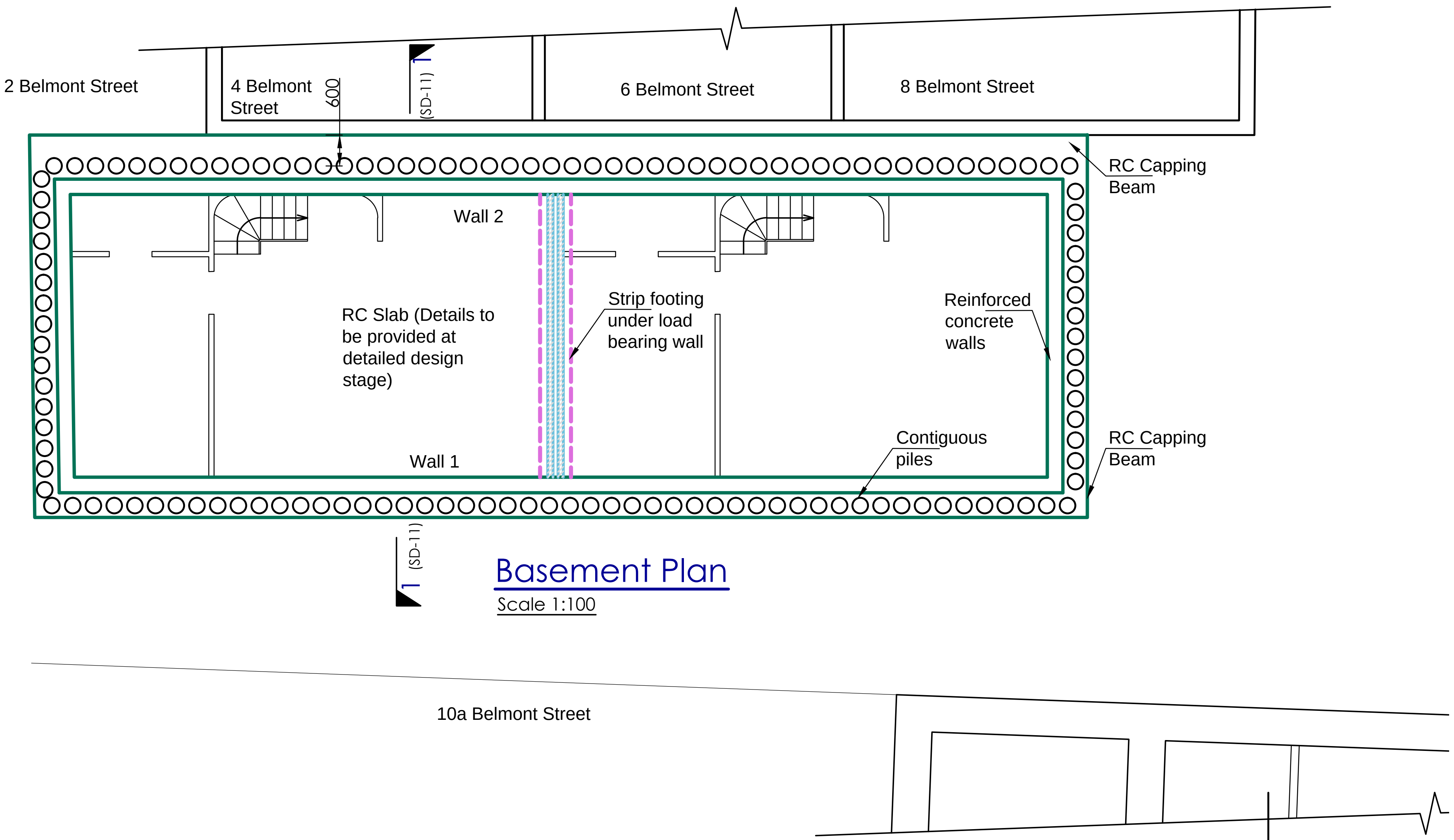
2. Structural Drawings

(The attached drawings in this section are for use at planning stage. They are not expect to be the final construction. Do not use these drawings as the construction issue.)



Basement Plan

Scale 1:100

PLANING ISSUE. NOT FOR CONSTRUCTION

Rev	Date	Amendments
-	03/03/2016	First issue for comment

Job Number: 160215	Date: Mar '16
Dwg Number: SL-10	Rev: -
Drawn: VLD	Ch'kd: CT
Scale: As shown @ A3	

Client: Francis Williams

Project: 8A Belmont Street

Title : Basement Plan

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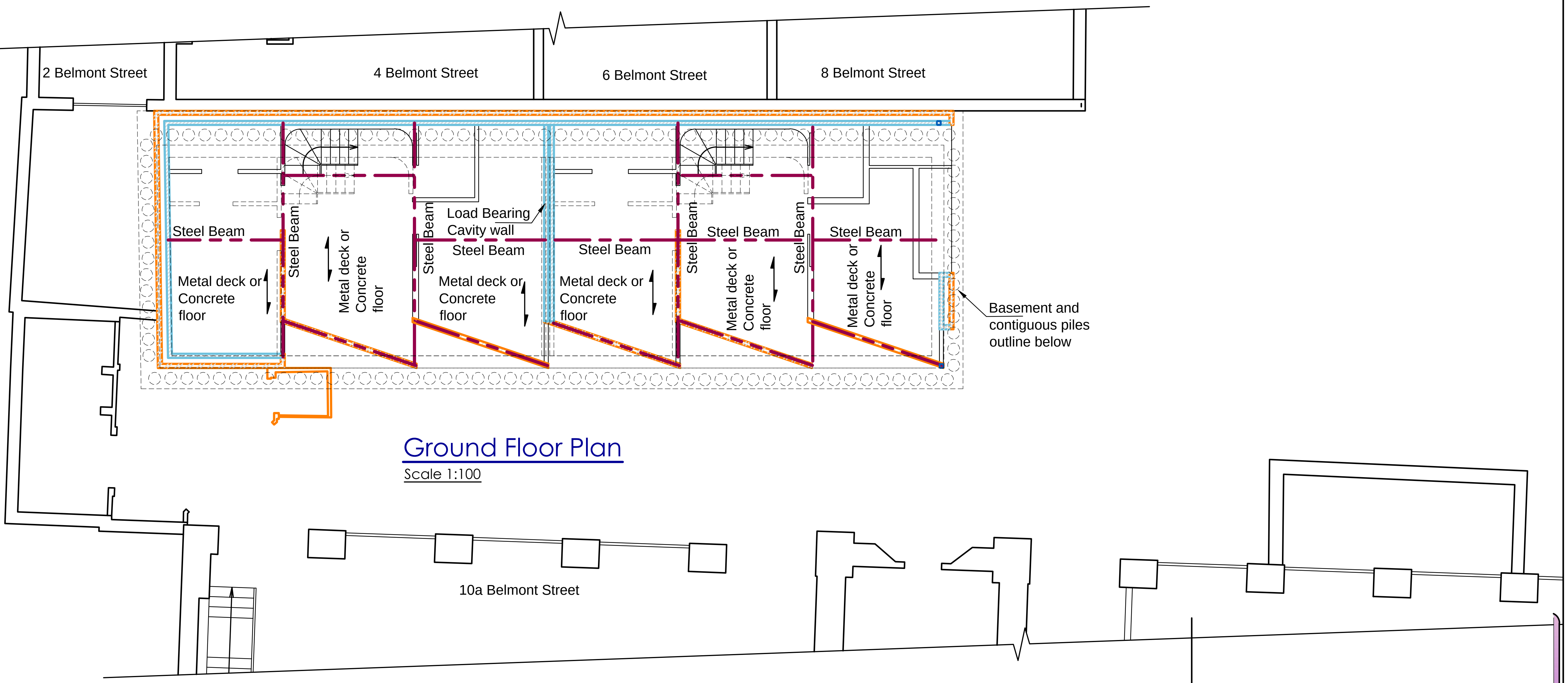

Ground Floor Plan

Scale 1:100

Rev	Date	Amendments
-	03/03/2016	First issue for comment

PLANING ISSUE. NOT FOR CONSTRUCTION

Job Number 160215	Date Mar '16
Dwg Number SL-20	Rev -
Drawn VLD	Ch'kd CT
Scale As shown @ A3	

Client: Francis Williams

Project: 8A Belmont Street

Title : Ground Floor Plan

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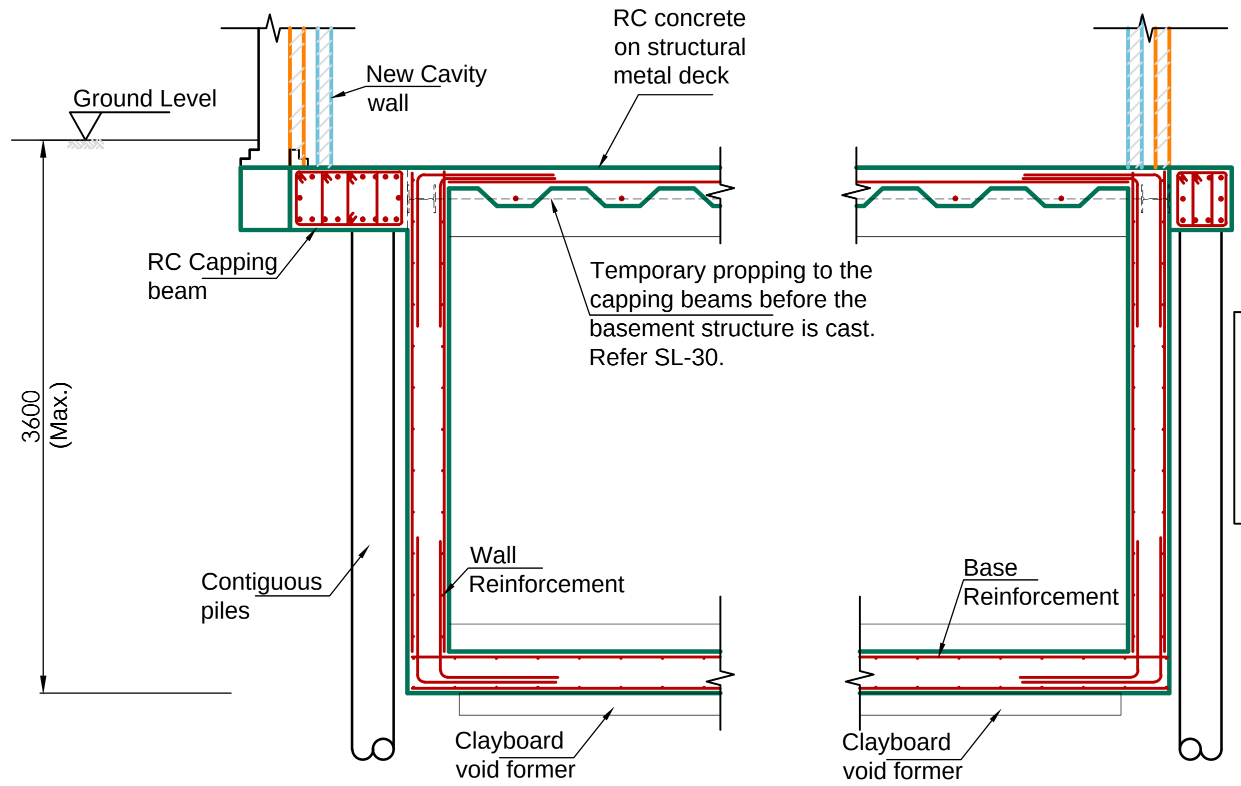

Details for piling, reinforcement, temporary works and other structural items TBA at detailed design stage

Proposed Ground Floor Plan

Scale 1:50

Rev	Date	Amendments
-	03/03/2016	First issue for comment

PLANING ISSUE. NOT FOR CONSTRUCTION

Job Number 160215	Date Mar '16
Dwg Number SD-11	Rev -
Drawn VLD	Ch'kd CT
Scale As shown @ A3	

Client: Francis Williams

Project: 8A Belmont Street

Title : Section Details

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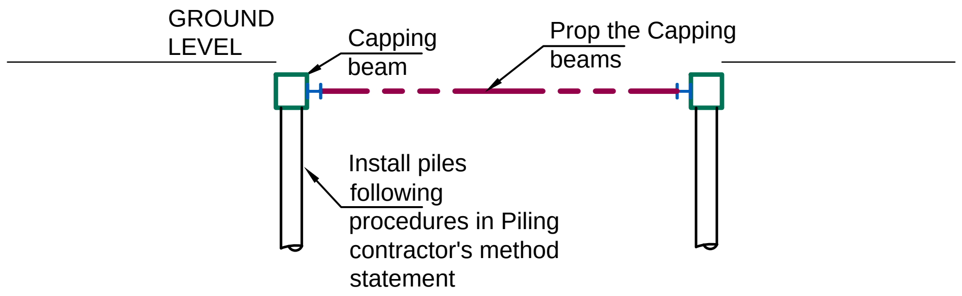
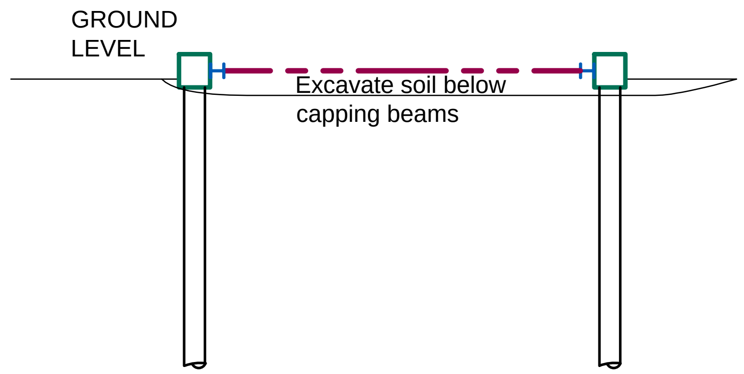


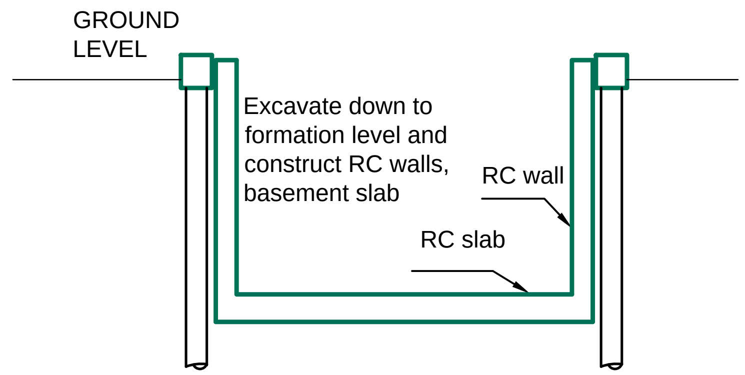
Temporary Works - Phase 1 - Piling & capping beam construction
Typical Section through building

Scale (1:100)



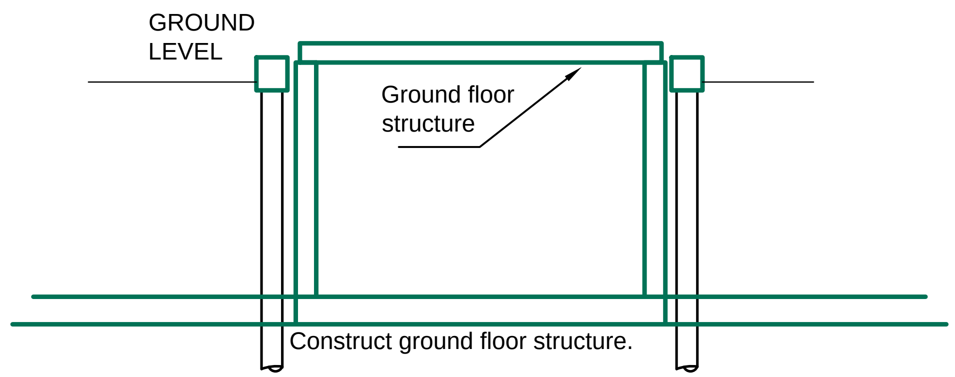
Temporary Works - Phase 2 - Excavation and propping
Typical section through building

Scale (1:100)



Temporary Works - Phase 3 - RC wall construction
Typical section through building

Scale (1:100)



After ground floor structure is complete, props may be removed

Temporary Works - Phase 4 - Ground Floor construction
Typical section through building

Scale (1:100)

PLANING ISSUE

NOT FOR

CONSTRUCTION

USE IN CONJUNCTION WITH BASEMENT CONSTRUCTION METHOD STATEMENT

Rev	Date	Amendments
-	03/03/2016	First issue for comment

Job Number 160215	Date Mar '16
Dwg Number SL-30	Rev -
Drawn VLD	Ch'kd CT
Scale As shown @ A3	

Client: Francis Williams

Project: 8A Belmont Street

Title : Outline Basement Construction Sequence

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3. Loadings

Gravity Loads

Load Run Down Tables

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CROFT STRUCTURAL ENGINEERS	Project:	8A Belmont Street		Section 01	Sheet 01
	Date	Mar-16	Rev	Date	Description
	By	VLD			
Enquiries@croftse.co.uk	Cheked	CT			
Tel 0208 684 4744	Job Numbe	160215	Status		Rev
Referenc					

General Loadings

Sloped Roof

Slate =	0.6	kN/m²
Battens =	0.02	
Rafers	0.1125	
Felt =	0.02	
Insulation =	0.02	
Plaster=	0.18	
	0.9525	**kN/m2**
Roof Angle =	25	deg
Plan Dead load =	**1.051**	**kN/m2**
Live Load =	**0.6**	**kN/m2**

Flat Roof

20mm Asphalt =	0.46	
Felt underlay =	0.02	
insulation =	0.04	
Ply Sheeting =	0.1	
Firring =	0.1	
of joists 50x200@400 =	0.15	
Plaster & Skim =	0.18	
Plan Dead load =	**1.05**	**kN/m2**
Live Load =	**0.75**	**kN/m2**

Green roof

ceiling (plaster)=	0.20	
200 RC slab=	5.00	
65mm screed=	1.30	
200m insulation =	1.20	
Membrane=	0.03	
Green Roof(sedum)=	2.50	
Plan perm., g_k =	10.23	kN/m²
Plan Var., q_k =	1.50	kN/m²
Roof Angle =	45	deg
Plan Dead load =	**2.122**	**kN/m2**
Live Load =	**0.3**	**kN/m2**

Metal deck Floor on Steel

150dp Ribdeck 60 =	2.736	
60 Screed =	1.2	
Finishes =	0.1	
Steelwork =	0.6	
Dead Load =	**4.636**	**kN/m²**
Live Load =	**3.5**	**kN/m²**

Cavity Walls

100 Facing Brick =	2.2	
100 Block (16kN/m3)=	1.6	
Plaster & Skim =	0.18	
Dead Load =	**3.98**	**kN/m2**

Internal Walls

100 Block (20kN/m3)=	2	
Plaster & Skim =	0.36	
Dead Load =	**2.36**	**kN/m2**

Existing Internal Walls

100 Brick (20kN/m3)=	2.1	
Plaster & Skim =	0.36	
Dead Load =	**2.46**	**kN/m2**

Timber Floors

18mm Ply	0.15	
Joists 50x225@400 =	0.16875	
100 Insulation =	0.05	
Plaster & Skim =	0.18	
Dead Load =	**0.54875**	**kN/m2**
Live Load =	**1.5**	**kN/m2**

Terrace Floor

Promonade Tiles =	0.4	
20mm Asphalt =	0.46	
Felt underlay =	0.02	
insulation =	0.04	
Ply Sheeting =	0.1	
Firring =	0.1	
Roof joists 50x200@400 =	0.175	
Plaster & Skim =	0.18	
Dead Load =	**1.475**	**kN/m2**
Live Load =	**1.5**	**kN/m2**

Ceiling

50x100 Joists =	0.075	
100 Insulation =	0.06	
Plaster & Skim =	0.18	
Dead Load =	**0.315**	**kN/m2**
Live Load =	**0.25**	**kN/m2**

Timber Partitions

50x100 Studs @ 400 =	0.15
Insulation =	0.04
Plaster & Skim =	0.36
Dead Load =	**0.55**

Existing Brick Walls

225 Facing Brick =	4.5
Plaster & Lathe =	0.15
Dead Load =	**4.65**

Beam & Block Ground Floors

Beam & Block	3.1
Screed	1.4
Insulation	0.07
Finishes	0.05
Dead Load =	4.62
Live Load =	1.5

Standing Seam

Roof Sheet	0.08
Insulation	0.07
Decking	0.2
Steelwork	0.6
Dead Load =	**0.95**
Live Load =	**0.6**

Filler joist Floor

Finishes	1.2
Filler Joist Floor	2.5
Ceiling	0.18
Steel	0.3
Dead Load =	**4.18**
Live Load =	**3.5**

Table 3 Live Load Reduction

Area			Floors	
0	0%		1	0%
50	5%		2	10%
100	10%		3	20%
150	15%		4	30%
200	20%		5 to 10	40%

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4. Structural Design

5. Contiguous piles around the perimeter of the building will resist lateral loading from the retained soil. This should include full height hydrostatic pressures. The piled wall will be propped at the head by temporary props in the temporary condition (as indicated in drawing SL-50, appended) and by the ground floor structure in the permanent case (refer to drawings SL-10 and SL-30, appended). The ground floor structure will transfer theses horizontal loads to the opposite wall.
6.
7. At detailed design stage, the contiguous piled wall should resist highways surcharge loads ($10kN/m^2$).

WALL 1(TEMPORARY CONDITION-NO WATER)

Wall 1

Wall 1										
Roof	2.9	1	2.9	g_k		10.23	29.7	kN/m		
				q_k		1.50			4.4	kN/m
First Floor	2.9	1	2.9	g_k		4.64	13.4	kN/m		
				q_k		2.12			6.2	kN/m
Ground Floor	2.9	1	2.9	g_k		4.64	13.4	kN/m		
				q_k		3.50			10.2	kN/m
Cavity wall	7	1	7	g_k		3.98	27.9	kN/m		
							84.4	kN/m	**20.7**	kN/m

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 2.6.05

Retaining wall details

Stem type Propped cantilever
Stem height h_{stem} = **3300** mm
Prop height h_{prop} = **3200** mm
Stem thickness t_{stem} = **300** mm
Angle to rear face of stem α = **90** deg
Stem density γ_{stem} = **25** kN/m^3
Toe length l_{toe} = **1000** mm
Base thickness t_{base} = **300** mm
Base density γ_{base} = **25** kN/m^3
Height of retained soil h_{ret} = **3300** mm Angle of soil surface β = **0** deg
Depth of cover d_{cover} = **0** mm

Retained soil properties

Soil type Medium dense well graded sand
Moist density γ_{mr} = **21** kN/m^3
Saturated density γ_{sr} = **23** kN/m^3
Characteristic effective shear resistance angle $\phi'_{r.k}$ = **30** deg
Characteristic wall friction angle $\delta_{r.k}$ = **0** deg

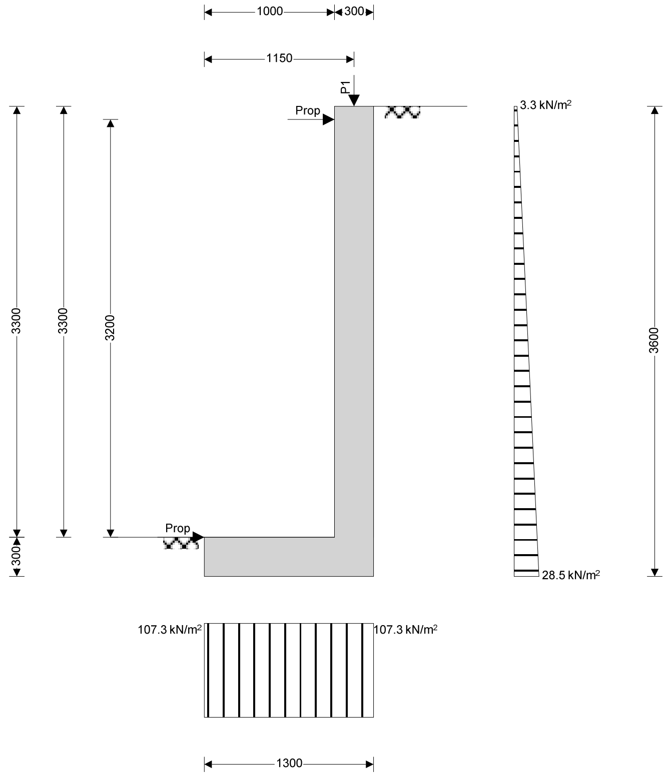
Base soil properties

Soil type Medium dense well graded sand
Soil density γ_b = **18** kN/m^3
Characteristic effective shear resistance angle $\phi'_{b.k}$ = **30** deg
Characteristic wall friction angle $\delta_{b.k}$ = **15** deg
Characteristic base friction angle $\delta_{bb.k}$ = **30** deg
Presumed bearing capacity $P_{bearing}$ = **125** kN/m^2

Loading details

Variable surcharge load $Surcharge_Q$ = **10** kN/m^2
Vertical line load at 1150 mm P_{G1} = **85** kN/m

P_{Q1} = **20** kN/m



Calculate retaining wall geometry

Base length l_{base} = **1300** mm

Moist soil height h_{moist} = **3300** mm

Length of surcharge load l_{sur} = **0** mm

Vertical distance x_{sur_v} = **1300** mm

Effective height of wall h_{eff} = **3600** mm

Horizontal distance x_{sur_h} = **1800** mm

Area of wall stem A_{stem} = **0.99** m^2 Vertical distance x_{stem} = **1150** mm

Area of wall base A_{base} = **0.39** m^2 Vertical distance x_{base} = **650** mm

Using Coulomb theory

Active pressure coefficient K_A = **0.333** Passive pressure coefficient K_P = **4.977**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base} + F_{P\_v}$ = **139.5** kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{moist\_h} + F_{pass\_h} + F_{sur\_h}$ = **53.5** kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{moist} + M_{sur} + M_P$ = **79.5** kNm/m

Check bearing pressure

Propping force to stem F_{prop_stem} = **3.2** kN/m Propping force to base F_{prop_base} = **50.3** kN/m

Bearing pressure at toe q_{toe} = **107.3** kN/m^2 Bearing pressure at heel q_{heel} = **107.3** kN/m^2

Factor of safety FoS_{bp} = **1.165**

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

Wall 1

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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 2.6.05

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

Concrete strength class C28/35

Char.comp.cylinder strength f_{ck} = **28** N/mm² — Mean axial tensile strength f_{ctm} = **2.8** N/mm²

Secant modulus of elasticity E_{cm} = **32308** N/mm² — Maximum aggregate size h_{agg} = **20** mm

Design comp.concrete strength f_{cd} = **15.9** N/mm² — Partial factor γ_C = **1.50**

Reinforcement details

Characteristic yield strength f_{yk} = **500** N/mm² — Modulus of elasticity E_s = **200000** N/mm²

Design yield strength f_{yd} = **435** N/mm² — Partial factor γ_S = **1.15**

Cover to reinforcement

Front face of stem c_{sf} = **40** mm — Rear face of stem c_{sr} = **50** mm

Top face of base c_{bt} = **50** mm — Bottom face of base c_{bb} = **75** mm

Check stem design at 1690 mm

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **13.4** kNm/m — K = **0.008** — K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sfM.req}$ = **132** mm²/m

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

Min.area of reinforcement $A_{sfM.min}$ = **352** mm²/m — Max.area of reinforcement $A_{sfM.max}$ = **12000** mm²/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 795.6 — Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm — Maximum crack width w_k = **0.15** mm

PASS - Maximum crack width is less than limiting crack width

Check stem design at base of stem

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **28.2** kNm/m — K = **0.017** — K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req}$ = **280** mm²/m

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

Min.area of reinforcement $A_{sr.min}$ = **351** mm²/m — Max.area of reinforcement $A_{sr.max}$ = **12000** mm²/m

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

Library item: Rectangular single summary

Deflection control - Section 7.4

Limiting span to depth ratio 245.4 — Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm — Maximum crack width w_k = **0.212** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **50.6** kN/m — Design shear resistance $V_{Rd.c}$ = **118.9** kN/m

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **0** kNm/m K = **0.000** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr1.req}$ = **0** mm^2/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr1.prov}$ = **565** mm^2/m

Min.area of reinforcement $A_{sr1.min}$ = **351** mm^2/m Max.area of reinforcement $A_{sr1.max}$ = **12000** mm^2/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 3503242.6 Actual span to depth ratio 0.4

PASS - Span to depth ratio is less than deflection control limit

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 = **16.8** kN/m Design shear resistance $V_{Rd.c}$ = **118.9** kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req}$ = **300** mm^2/m Max.spacing of reinforcement s_{sx_max} = **400** mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{sx.prov}$ = **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 = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **68.5** kNm/m K = **0.052** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bb.req}$ = **765** mm^2/m

Tens.reinforcement provided 16 dia.bars @ 100 c/c Tens.reinforcement provided $A_{bb.prov}$ = **2011** mm^2/m

Min.area of reinforcement $A_{bb.min}$ = **312** mm^2/m Max.area of reinforcement $A_{bb.max}$ = **12000** 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} = **0.3** mm Maximum crack width w_k = **0.137** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **137** kN/m Design shear resistance $V_{Rd.c}$ = **151.1** kN/m

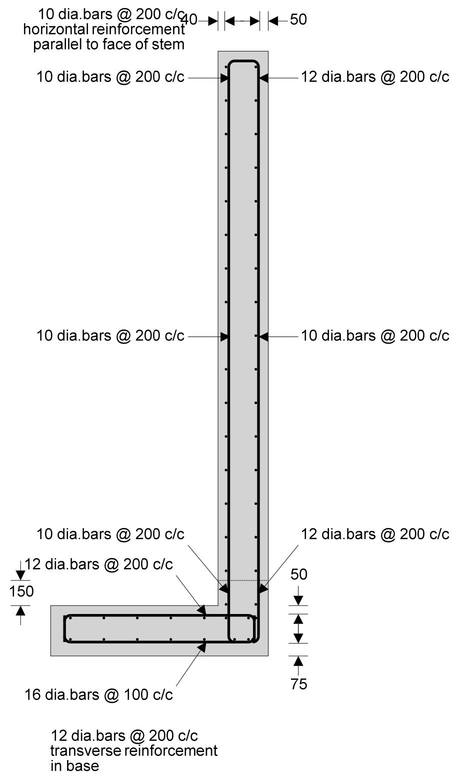
PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement $A_{bx.req}$ = **402** mm^2/m Max.spacing of reinforcement s_{bx_max} = **450** mm

Trans.reinforcement provided 12 dia.bars @ 200 c/c Trans.reinforcement provided $A_{bx.prov}$ = **565** mm^2/m

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



WALL 1 (PERMANENT CONDITION)

Location	Area			Type	L	Load	Load kN			
	L	W	m2			kN/m2	Dead	%	Live	Total
Wall 1										
Roof	2.9	1	2.9	g_k		10.23	29.7	kN/m		
				q_k		1.50			4.4	kN/m
First Floor	2.9	1	2.9	g_k		4.64	13.4	kN/m		
				q_k		2.12			6.2	kN/m
Ground Floor	2.9	1	2.9	g_k		4.64	13.4	kN/m		
				q_k		3.50			10.2	kN/m
Cavity wall	7	1	7	g_k		3.98	27.9	kN/m		
							84.4	kN/m	**20.7**	kN/m

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 2.6.05

Retaining wall details

Stem type	Propped cantilever		
Stem height	h_{stem} = **3300** mm		
Prop height	h_{prop} = **3200** mm		
Stem thickness	t_{stem} = **300** mm		
Angle to rear face of stem	α = **90** deg		
Stem density	γ_{stem} = **25** kN/m^3		
Toe length	l_{toe} = **1000** mm		
Base thickness	t_{base} = **300** mm		
Base density	γ_{base} = **25** kN/m^3		
Height of retained soil	h_{ret} = **3300** mm	Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm		
Height of water	h_{water} = **3300** mm		
Water density	γ_w = **9.8** kN/m^3		

Retained soil properties

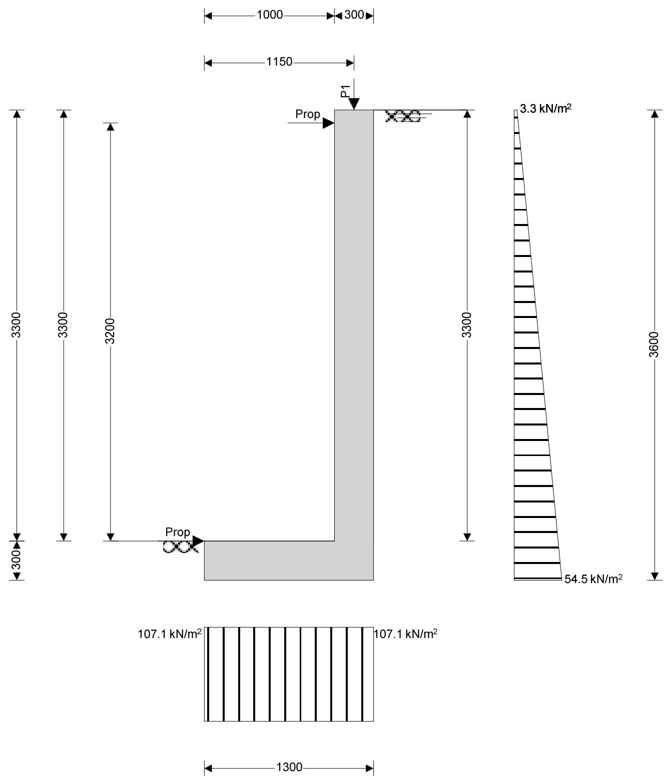
Soil type	Medium dense well graded sand	
Moist density	γ_{mr} = **21** kN/m^3	
Saturated density	γ_{sr} = **23** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{r.k}$ = **30** deg
Characteristic wall friction angle	$\delta_{r.k}$ = **0** deg	

Base soil properties

Soil type	Medium dense well graded sand	
Soil density	γ_b = **18** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{b.k}$ = **30** deg
Characteristic wall friction angle	$\delta_{b.k}$ = **15** deg	
Characteristic base friction angle		$\delta_{bb.k}$ = **30** deg
Presumed bearing capacity	$P_{bearing}$ = **125** kN/m^2	

Loading details

Variable surcharge load	$Surcharge_Q$ = **10** kN/m^2
Vertical line load at 1150 mm	P_{G1} = **84** kN/m
	P_{Q1} = **20.7** kN/m



Calculate retaining wall geometry

Base length	l_{base} = **1300** mm		
Saturated soil height	h_{sat} = **3300** mm		
Moist soil height	h_{moist} = **0** mm		
Length of surcharge load	l_{sur} = **0** mm		
Vertical distance	x_{sur_v} = **1300** mm		
Effective height of wall	h_{eff} = **3600** mm		
Horizontal distance	x_{sur_h} = **1800** mm		
Area of wall stem	A_{stem} = **0.99** m^2	Vertical distance	x_{stem} = **1150** mm
Area of wall base	A_{base} = **0.39** m^2	Vertical distance	x_{base} = **650** mm

Using Coulomb theory

Active pressure coefficient	K_A = **0.333**	Passive pressure coefficient	K_P = **4.977**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base} + F_{water\_v} + F_{P\_v}$ = **139.2** kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{sat\_h} + F_{moist\_h} + F_{pass\_h} + F_{water\_h} + F_{sur\_h}$ = **100.2** kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{sat} + M_{moist} + M_{water} + M_{sur} + M_P$ = **23.1** kNm/m

Check bearing pressure

Propping force to stem	F_{prop_stem} = **19.2** kN/m	Propping force to base	F_{prop_base} = **80.9** kN/m
Bearing pressure at toe	q_{toe} = **107.1** kN/m^2	Bearing pressure at heel	q_{heel} = **107.1** kN/m^2
Factor of safety	FoS_{bp} = **1.167**		

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 2.6.05

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

Concrete strength class C30/37

Char.comp.cylinder strength f_{ck} = **30** N/mm^2 | Mean axial tensile strength f_{ctm} = **2.9** N/mm^2

Secant modulus of elasticity E_{cm} = **32837** N/mm^2 | Maximum aggregate size h_{agg} = **20** mm

Design comp.concrete strength f_{cd} = **17.0** N/mm^2 | Partial factor γ_C = **1.50**

Reinforcement details

Characteristic yield strength f_{yk} = **500** N/mm^2 | Modulus of elasticity E_s = **200000** N/mm^2

Design yield strength f_{yd} = **435** N/mm^2 | Partial factor γ_S = **1.15**

Cover to reinforcement

Front face of stem c_{sf} = **40** mm | Rear face of stem c_{sr} = **50** mm

Top face of base c_{bt} = **50** mm | Bottom face of base c_{bb} = **75** mm

Check stem design at 1666 mm

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **23.6** kNm/m | K = **0.013** | K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sfM.req}$ = **233** mm^2/m

Tens.reinforcement provided 10 dia.bars @ 200 c/c | Tens.reinforcement provided $A_{sfM.prov}$ = **393** mm^2/m

Min.area of reinforcement $A_{sfM.min}$ = **369** mm^2/m | Max.area of reinforcement $A_{sfM.max}$ = **12000** mm^2/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 360.9 | Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm | Maximum crack width w_k = **0.28** mm

PASS - Maximum crack width is less than limiting crack width

Check stem design at base of stem

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **50.7** kNm/m | K = **0.028** | K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req}$ = **503** mm^2/m

Tens.reinforcement provided 12 dia.bars @ 100 c/c | Tens.reinforcement provided $A_{sr.prov}$ = **1131** mm^2/m

Min.area of reinforcement $A_{sr.min}$ = **368** mm^2/m | Max.area of reinforcement $A_{sr.max}$ = **12000** mm^2/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 105.2 | Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm | Maximum crack width w_k = **0.135** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **92.4** kN/m | Design shear resistance $V_{Rd.c}$ = **134.2** kN/m

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **0** kNm/m K = **0.000** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr1.req}$ = **0** mm^2/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr1.prov}$ = **565** mm^2/m

Min.area of reinforcement $A_{sr1.min}$ = **368** mm^2/m Max.area of reinforcement $A_{sr1.max}$ = **12000** mm^2/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 3494411.2 Actual span to depth ratio 0.4

PASS - Span to depth ratio is less than deflection control limit

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 widthRectangular section in shear - Section 6.2

Design shear force V = **28** kN/m Design shear resistance $V_{Rd.c}$ = **123** kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req}$ = **300** mm^2/m Max.spacing of reinforcement s_{sx_max} = **400** mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{sx.prov}$ = **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 = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **68.4** kNm/m K = **0.048** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bb.req}$ = **763** mm^2/m

Tens.reinforcement provided 16 dia.bars @ 100 c/c Tens.reinforcement provided $A_{bb.prov}$ = **2011** mm^2/m

Min.area of reinforcement $A_{bb.min}$ = **327** mm^2/m Max.area of reinforcement $A_{bb.max}$ = **12000** 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} = **0.3** mm Maximum crack width w_k = **0.136** mm

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

Design shear force V = **136.8** kN/m Design shear resistance $V_{Rd.c}$ = **154.6** kN/m

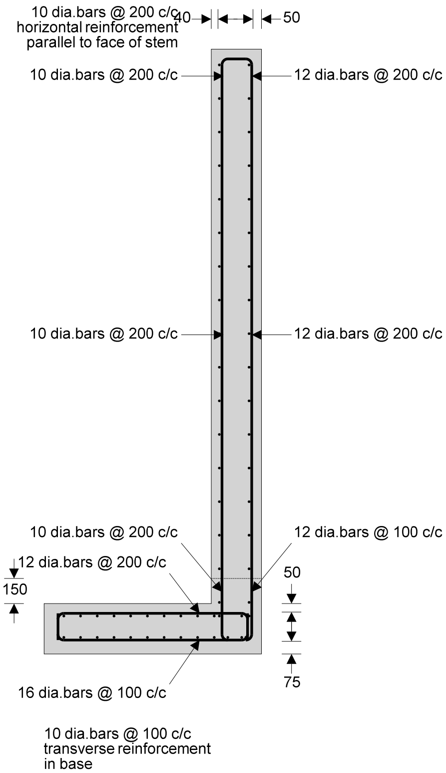
PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement $A_{bx.req}$ = **402** mm^2/m Max.spacing of reinforcement s_{bx_max} = **450** mm

Trans.reinforcement provided 10 dia.bars @ 100 c/c Trans.reinforcement provided $A_{bx.prov}$ = **785** mm^2/m

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



WALL 2 (TEMPORARY CONDITION)

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 2.6.05

Retaining wall details

Stem type	Propped cantilever		
Stem height	h_{stem} = **3300** mm		
Prop height	h_{prop} = **3200** mm		
Stem thickness	t_{stem} = **300** mm		
Angle to rear face of stem	α = **90** deg		
Stem density	γ_{stem} = **25** kN/m^3		
Toe length	l_{toe} = **1000** mm		
Base thickness	t_{base} = **300** mm		
Base density	γ_{base} = **25** kN/m^3		
Height of retained soil	h_{ret} = **3300** mm	Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm		

Retained soil properties

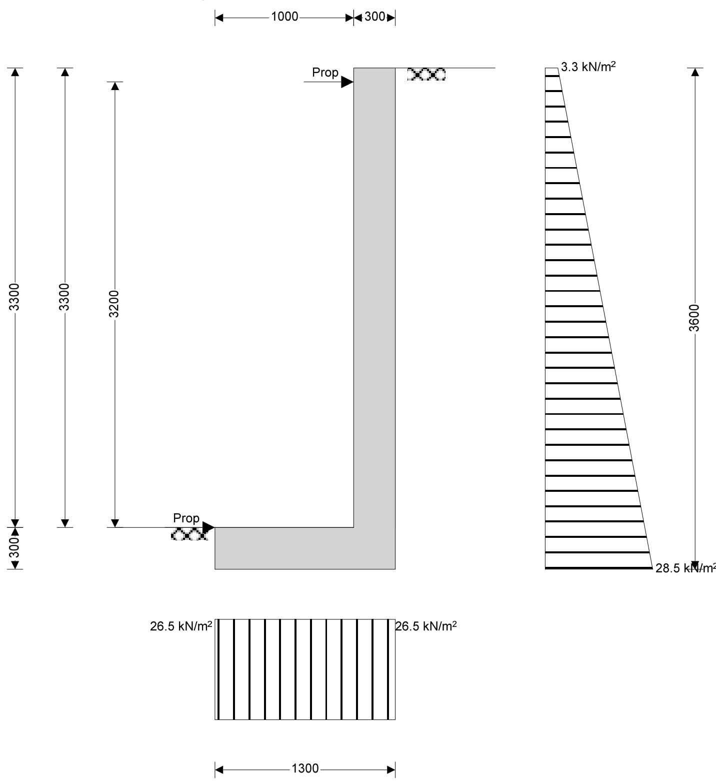
Soil type	Medium dense well graded sand	
Moist density	γ_{mr} = **21** kN/m^3	
Saturated density	γ_{sr} = **23** kN/m^3	
Characteristic effective shear resistance angle		$\phi'_{r.k}$ = **30** deg
Characteristic wall friction angle	$\delta_{r.k}$ = **0** deg	

Base soil properties

Soil type	Medium dense well graded sand		
Soil density	γ_b = **18** kN/m^3		
Characteristic effective shear resistance angle		$\phi'_{b.k}$ = **30** deg	
Characteristic wall friction angle	$\delta_{b.k}$ = **15** deg		
Characteristic base friction angle		$\delta_{bb.k}$ = **30** deg	
Presumed bearing capacity	$P_{bearing}$ = **125** kN/m^2		

Loading details

Variable surcharge load — $Surcharge_Q$ = **10** kN/m^2



Calculate retaining wall geometry

Base length	l_{base} = **1300** mm		
Moist soil height	h_{moist} = **3300** mm		
Length of surcharge load	l_{sur} = **0** mm		
Vertical distance	x_{sur_v} = **1300** mm		
Effective height of wall	h_{eff} = **3600** mm		
Horizontal distance	x_{sur_h} = **1800** mm		
Area of wall stem	A_{stem} = **0.99** m^2	Vertical distance	x_{stem} = **1150** mm
Area of wall base	A_{base} = **0.39** m^2	Vertical distance	x_{base} = **650** mm

Using Coulomb theory

Active pressure coefficient K_A = **0.333** — Passive pressure coefficient K_P = **4.977**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base}$ = **34.5** kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{moist\_h} + F_{pass\_h} + F_{sur\_h}$ = **53.5** kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{moist} + M_{sur}$ = **-41.2** kNm/m

Check bearing pressure

Propping force to stem F_{prop_stem} = **18.2** kN/m — Propping force to base F_{prop_base} = **35.3** kN/m

Bearing pressure at toe q_{toe} = **26.5** kN/m² — Bearing pressure at heel q_{heel} = **26.5** kN/m²

Factor of safety FoS_{bp} = **4.71**

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 2.6.05

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

Concrete strength class C30/37

Char.comp.cylinder strength f_{ck} = **30** N/mm² — Mean axial tensile strength f_{ctm} = **2.9** N/mm²

Secant modulus of elasticity E_{cm} = **32837** N/mm² — Maximum aggregate size h_{agg} = **20** mm

Design comp.concrete strength f_{cd} = **17.0** N/mm² — Partial factor γ_C = **1.50**

Reinforcement details

Characteristic yield strength f_{yk} = **500** N/mm² — Modulus of elasticity E_s = **200000** N/mm²

Design yield strength f_{yd} = **435** N/mm² — Partial factor γ_S = **1.15**

Cover to reinforcement

Front face of stem c_{sf} = **40** mm — Rear face of stem c_{sr} = **50** mm

Top face of base c_{bt} = **50** mm — Bottom face of base c_{bb} = **75** mm

Check stem design at 1690 mm

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **13.4** kNm/m — K = **0.007** — K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sfM.req}$ = **132** mm²/m

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

Min.area of reinforcement $A_{sfM.min}$ = **369** mm²/m — Max.area of reinforcement $A_{sfM.max}$ = **12000** mm²/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 867.8 — Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm — Maximum crack width w_k = **0.15** mm

PASS - Maximum crack width is less than limiting crack width

Check stem design at base of stem

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **28.2** kNm/m — K = **0.016** — K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req}$ = **280** mm²/m

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

Min.area of reinforcement $A_{sr.min}$ = **368** mm²/m — Max.area of reinforcement $A_{sr.max}$ = **12000** mm²/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 267.7 — Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.212** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **50.6** kN/m Design shear resistance $V_{Rd.c}$ = **123** kN/m

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **0** kNm/m K = **0.000** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr1.req}$ = **0** mm^2/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr1.prov}$ = **565** mm^2/m

Min.area of reinforcement $A_{sr1.min}$ = **368** mm^2/m Max.area of reinforcement $A_{sr1.max}$ = **12000** mm^2/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 3818380.7 Actual span to depth ratio 0.4

PASS - Span to depth ratio is less than deflection control limit

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 = **16.8** kN/m Design shear resistance $V_{Rd.c}$ = **123** kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req}$ = **300** mm^2/m Max.spacing of reinforcement s_{sx_max} = **400** mm

Trans.reinforcement provided 10 dia.bars @ 200 c/c Trans.reinforcement provided $A_{sx.prov}$ = **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 = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **12.9** kNm/m K = **0.009** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bb.req}$ = **142** mm^2/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{bb.prov}$ = **565** mm^2/m

Min.area of reinforcement $A_{bb.min}$ = **330** mm^2/m Max.area of reinforcement $A_{bb.max}$ = **12000** 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} = **0.3** mm Maximum crack width w_k = **0.141** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **25.7** kN/m Design shear resistance $V_{Rd.c}$ = **114.8** kN/m

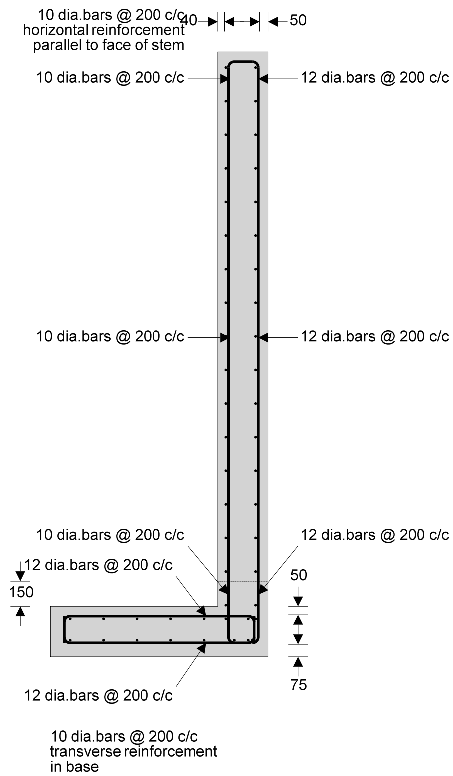
PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement $A_{bx.req}$ = **113** mm^2/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** mm^2/m

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



WALL 2 (PERMANENT CONDITION)

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 2.6.05

Retaining wall details

Stem type	Propped cantilever		
Stem height	h_{stem} = **3300** mm		
Prop height	h_{prop} = **3200** mm		
Stem thickness	t_{stem} = **300** mm		
Angle to rear face of stem	α = **90** deg		
Stem density	γ_{stem} = **25** kN/m^3		
Toe length	l_{toe} = **1000** mm		
Base thickness	t_{base} = **300** mm		
Base density	γ_{base} = **25** kN/m^3		
Height of retained soil	h_{ret} = **3300** mm	Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm		
Height of water	h_{water} = **3300** mm		
Water density	γ_w = **9.8** kN/m^3		

Retained soil properties

Soil type	Medium dense well graded sand

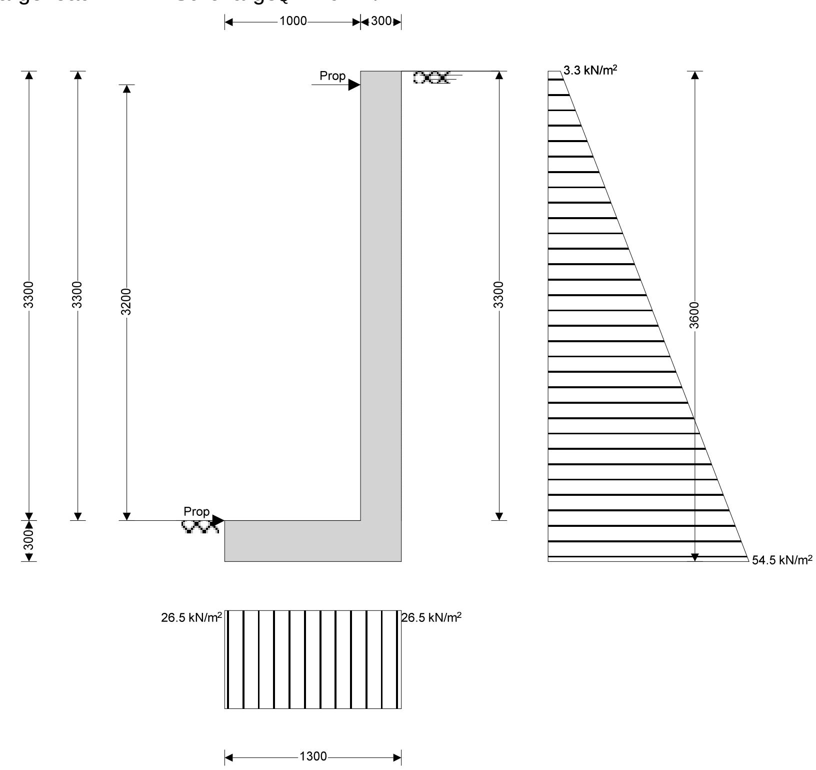
Moist density	γ_{mr} = **21** kN/m^3		
Saturated density	γ_{sr} = **23** kN/m^3		
Characteristic effective shear resistance angle		$\phi'_{r.k}$ = **30** deg	
Characteristic wall friction angle	$\delta_{r.k}$ = **0** deg		

Base soil properties

Soil type	Medium dense well graded sand		
Soil density	γ_b = **18** kN/m^3		
Characteristic effective shear resistance angle		$\phi'_{b.k}$ = **30** deg	
Characteristic wall friction angle	$\delta_{b.k}$ = **15** deg		
Characteristic base friction angle		$\delta_{bb.k}$ = **30** deg	
Presumed bearing capacity	$P_{bearing}$ = **125** kN/m^2		

Loading details

Variable surcharge load	$Surcharge_Q$ = **10** kN/m^2		



Calculate retaining wall geometry

Base length	l_{base} = **1300** mm		
Saturated soil height	h_{sat} = **3300** mm		
Moist soil height	h_{moist} = **0** mm		
Length of surcharge load	l_{sur} = **0** mm		
Vertical distance	x_{sur_v} = **1300** mm		
Effective height of wall	h_{eff} = **3600** mm		
Horizontal distance	x_{sur_h} = **1800** mm		
Area of wall stem	A_{stem} = **0.99** m^2	Vertical distance	x_{stem} = **1150** mm
Area of wall base	A_{base} = **0.39** m^2	Vertical distance	x_{base} = **650** mm

Using Coulomb theory

Active pressure coefficient	K_A = **0.333**	Passive pressure coefficient	K_P = **4.977**

Bearing pressure check

Vertical forces on wall

Total $F_{total\_v} = F_{stem} + F_{base} + F_{water\_v} = \mathbf{34.5}$ kN/m

Horizontal forces on wall

Total $F_{total\_h} = F_{sat\_h} + F_{moist\_h} + F_{pass\_h} + F_{water\_h} + F_{sur\_h} = \mathbf{100.2}$ kN/m

Moments on wall

Total $M_{total} = M_{stem} + M_{base} + M_{sat} + M_{moist} + M_{water} + M_{sur} = \mathbf{-97.3}$ kNm/m

Check bearing pressure

Propping force to stem $F_{prop\_stem} = \mathbf{34.2}$ kN/m Propping force to base $F_{prop\_base} = \mathbf{66}$ kN/m

Bearing pressure at toe $q_{toe} = \mathbf{26.5}$ kN/m^2 Bearing pressure at heel $q_{heel} = \mathbf{26.5}$ kN/m^2

Factor of safety $FoS_{bp} = \mathbf{4.71}$

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 2.6.05

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

Concrete strength class C28/35

Char.comp.cylinder strength $f_{ck} = \mathbf{28}$ N/mm^2 Mean axial tensile strength $f_{ctm} = \mathbf{2.8}$ N/mm^2

Secant modulus of elasticity $E_{cm} = \mathbf{32308}$ N/mm^2 Maximum aggregate size $h_{agg} = \mathbf{20}$ mm

Design comp.concrete strength $f_{cd} = \mathbf{15.9}$ 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 $c_{sf} = \mathbf{40}$ mm Rear face of stem $c_{sr} = \mathbf{50}$ mm

Top face of base $c_{bt} = \mathbf{50}$ mm Bottom face of base $c_{bb} = \mathbf{75}$ mm

Check stem design at 1666 mm

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **23.6** kNm/m K = **0.014** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sfM.req} = \mathbf{233}$ mm^2/m

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

Min.area of reinforcement $A_{sfM.min} = \mathbf{352}$ mm^2/m Max.area of reinforcement $A_{sfM.max} = \mathbf{12000}$ mm^2/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 330.8 Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width $w_{max} = \mathbf{0.3}$ mm Maximum crack width $w_k = \mathbf{0.28}$ mm

PASS - Maximum crack width is less than limiting crack width

Check stem design at base of stem

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **50.7** kNm/m K = **0.030** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr.req} = \mathbf{503}$ mm^2/m

Tens.reinforcement provided 12 dia.bars @ 100 c/c Tens.reinforcement provided $A_{sr.prov}$ = **1131** mm²/m

Min.area of reinforcement $A_{sr.min}$ = **351** mm²/m Max.area of reinforcement $A_{sr.max}$ = **12000** mm²/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 96.7 Actual span to depth ratio 13.1

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width w_{max} = **0.3** mm Maximum crack width w_k = **0.135** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **92.4** kN/m Design shear resistance $V_{Rd.c}$ = **131.1** kN/m

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **0** kNm/m K = **0.000** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{sr1.req}$ = **0** mm²/m

Tens.reinforcement provided 12 dia.bars @ 200 c/c Tens.reinforcement provided $A_{sr1.prov}$ = **565** mm²/m

Min.area of reinforcement $A_{sr1.min}$ = **351** mm²/m Max.area of reinforcement $A_{sr1.max}$ = **12000** mm²/m

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

Deflection control - Section 7.4

Limiting span to depth ratio 3206019.9 Actual span to depth ratio 0.4

PASS - Span to depth ratio is less than deflection control limit

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 = **28** kN/m Design shear resistance $V_{Rd.c}$ = **118.9** kN/m

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Min.area of reinforcement $A_{sx.req}$ = **300** mm²/m Max.spacing of reinforcement s_{sx_max} = **400** mm

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

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

Check base design at toe

Depth of section h = **300** mm

Rectangular section in flexure - Section 6.1

Design bending moment M = **12.9** kNm/m K = **0.010** K' = **0.207**

K' > K - No compression reinforcement is required

Tens.reinforcement required $A_{bb.req}$ = **142** mm²/m

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

Min.area of reinforcement $A_{bb.min}$ = **315** mm²/m Max.area of reinforcement $A_{bb.max}$ = **12000** 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 = **0.141** mm

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force V = **25.7** kN/m Design shear resistance $V_{Rd.c}$ = **110.9** kN/m

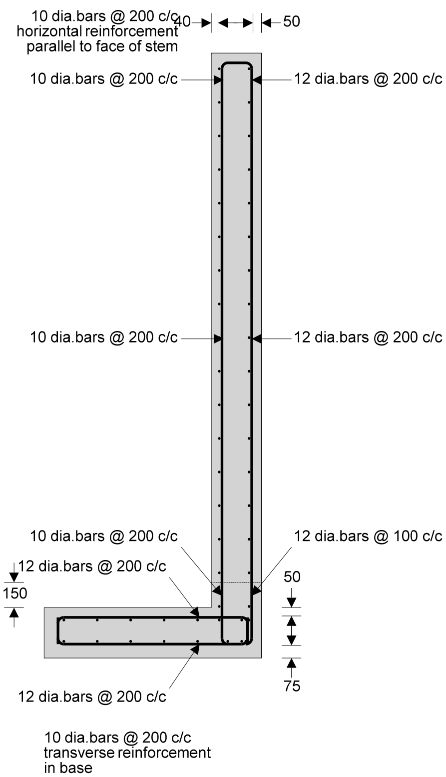
PASS - Design shear resistance exceeds design shear force

Secondary transverse reinforcement to base - Section 9.3

Min.area of reinforcement $A_{bx.req}$ = **113** mm^2/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** mm^2/m

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



RC CAPPING BEAM

The propping force is 81 kN/m

RC member analysis & design (EN1992-1-1:2004)

In accordance with EN1992-1-1:2004 incorporating Corrigenda January 2008 and the UK national annex

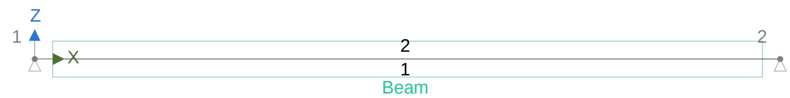
Tedds calculation version 3.0.01

Analysis

Tedds calculation version 1.0.13

Geometry

Geometry



Nodes

Node	Co-ordinates		Freedom			Coordinate system		Spring		
	X (m)	Z (m)	X	Z	Rot.	Name	Angle (°)	X (kN/m)	Z (kN/m)	Rot. kNm/°
1	**0**	**0**	**Fixed**	**Fixed**	**Free**		**0**	**0**	**0**	**0**
2	**2**	**0**	**Fixed**	**Fixed**	**Free**		**0**	**0**	**0**	**0**

Materials

Name	Density (kg/m³)	Youngs Modulus kN/mm²	Shear Modulus kN/mm²	Thermal Coefficient °C⁻¹
Concrete (C28 2500 Quartzite)	**2500**	**32.3082497**	**13.4617707**	**0.00001**

Sections

Name	Area	Moment of inertia		Shear area	
		Major	Minor	A_y	A_z
	(cm²)	(cm⁴)	(cm⁴)	(cm²)	(cm²)
R 450x450	**2025**	**341719**	**341719**	**1688**	**1688**

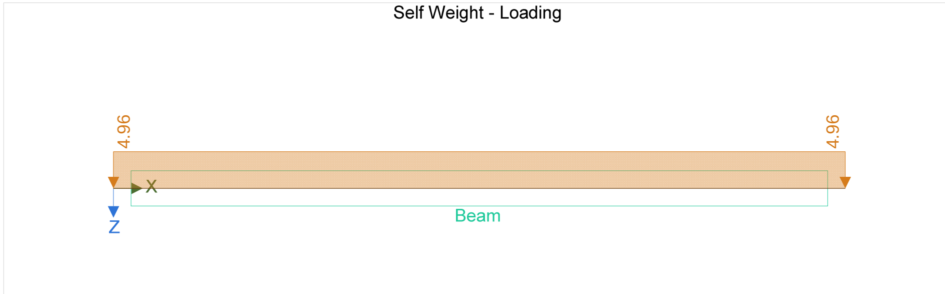
Elements

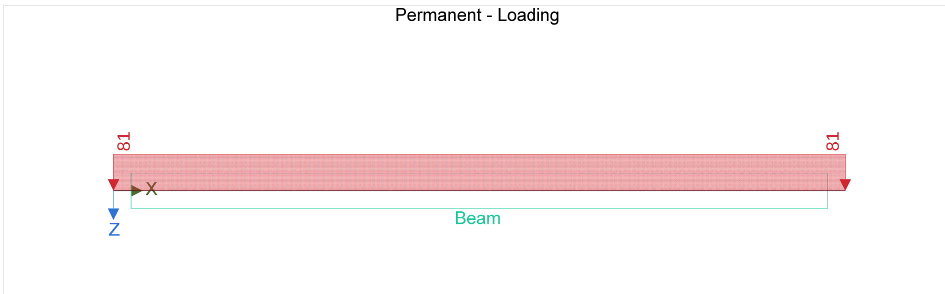
Element	Length (m)	Nodes		Section	Material	Releases			Rotated
		Start	End			Start moment	End moment	Axial	
1	2	1	2	R 450x450	Concrete (C28 2500 Quartzite)	Fixed	Fixed	Fixed	

Members

Name	Elements	
	Start	End
Beam	**1**	**1**

Loading





Load cases

Name	Enabled	Self weight factor	Patternable
Self Weight	yes	1	no
Permanent	yes	0	no
Imposed	no	0	no

Load combinations

Load combination	Type	Enabled	Patterned
LoadCombination1	Quasi	yes	no
LoadCombination2	Service	yes	no

Load combination: LoadCombination1 (Quasi)

Load case	Factor
Self Weight	1.35
Permanent	1.35

Load combination: LoadCombination2 (Service)

Load case	Factor
Self Weight	1
Permanent	1

Member UDL loads

Member	Load case	Position			Load	Orientation
		Type	Start	End	(kN/m)	
Beam	**Permanent**	**Ratio**	**0**	**1**	**81**	**GlobalZ**

Results

Forces

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

Concrete strength class C28/35 Char. comp. cylinder strength f_{ck} = **28** N/mm^2

Design comp conc. strength f_{cwd} = **18.7** N/mm^2 | Maximum aggregate size h_{agg} = **20** mm

Reinforcement details

Char. yield strength of rinf. f_{yk} = **500** N/mm^2 | Partial factor for reinf. steel γ_S = **1.15**

Design yield strength of reinf. f_{yd} = **435** N/mm^2

Nominal cover to reinforcement

Nominal cover to top reinf c_{nom_t} = **35** mm | Nominal cover to bottom reinf c_{nom_b} = **50** mm

Nominal cover to side reinf c_{nom_s} = **50** mm

Fire resistance

Standard fire resistance period R = **60** min | No. sides exposed to fire 3

Minimum width of beam b_{min} = **120** mm

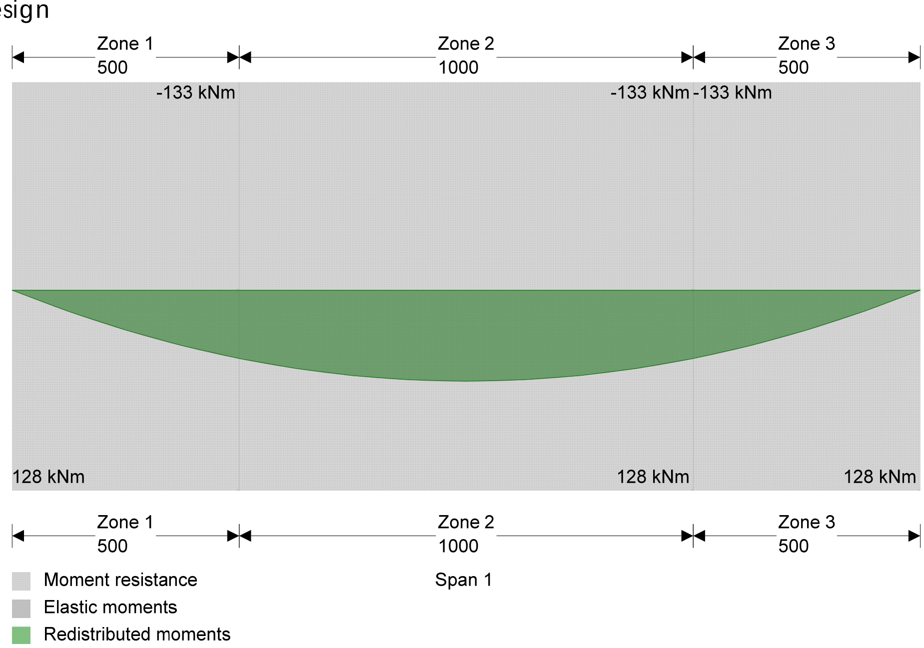
Beam - Span 1

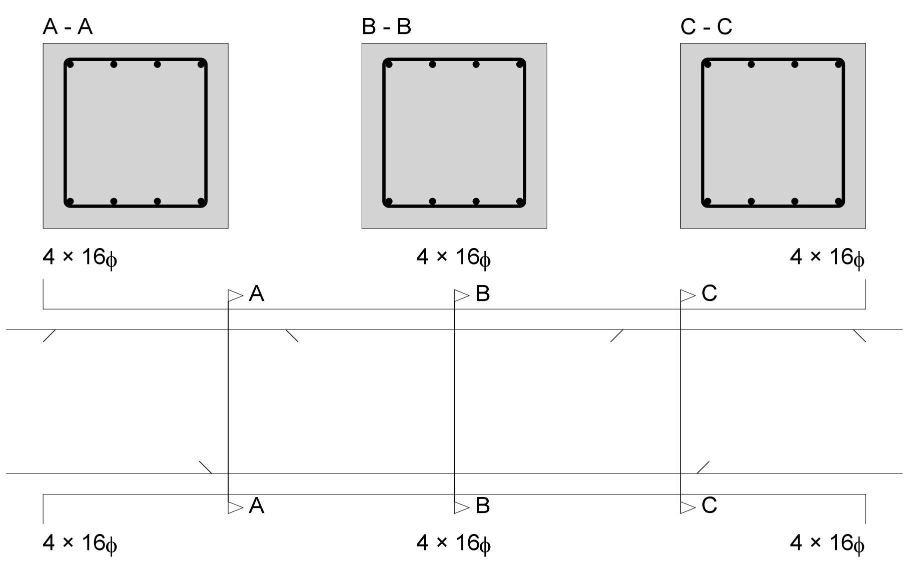
Rectangular section details

Section width b = **450** mm | Section depth h = **450** mm

PASS - Minimum dimensions for fire resistance met

Moment design





Zone 1 (0 mm - 500 mm) Positive moment - section 6.1

Design bending moment M = **43.5** kNm Effective depth tension reinf. d = **384** mm
Area of tension reinf. req'd $A_{s,req}$ = **274** mm^2 Area of tension reinf. prov $A_{s,prov}$ = **804** mm^2
Min area of reinf. (exp.9.1N) $A_{s,min}$ = **249** mm^2 Max area reinf. (cl.9.2.1.1(3)) $A_{s,max}$ = **8100** mm^2

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

Crack control - Section 7.3

Maximum crack width w_k = **0.3** mm Min area reinf req'd (exp.7.1) $A_{sc,min}$ = **314** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment M_{QP} = **43.5**kNm
Actual tension bar spacing s_{bar} = **106** mm Max bar spacing (Table 7.3N) $s_{bar,max}$ = **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Zone 1 (0 mm - 500 mm) Negative moment - section 6.1

Design bending moment M = **14.5** kNm Effective depth tension reinf. d = **399** mm
Area of tension reinf. req'd $A_{s,req}$ = **88** mm^2 Area of tension reinf. prov $A_{s,prov}$ = **804** mm^2
Min area of reinf. (exp.9.1N) $A_{s,min}$ = **258** mm^2 Max area reinf. (cl.9.2.1.1(3)) $A_{s,max}$ = **8100** mm^2

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

Crack control - Section 7.3

Maximum crack width w_k = **0.3** mm Min area reinf req'd (exp.7.1) $A_{sc,min}$ = **313** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment M_{QP} = **0.0**kNm
Actual tension bar spacing s_{bar} = **106** mm Max bar spacing (Table 7.3N) $s_{bar,max}$ = **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Minimum bar spacing (Section 8.2)

Top bar spacing s_{top} = **90.0** mm Min allow. top bar spacing $s_{top,min}$ = **25.0** mm

PASS - Actual bar spacing exceeds minimum allowable

Bottom bar spacing s_{bot} = **90.0** mm Min allow. bottom bar spacing $s_{bot,min}$ = **25.0** mm

PASS - Actual bar spacing exceeds minimum allowable

Zone 2 (500 mm - 1500 mm) Positive moment - section 6.1

Design bending moment M = **58.0** kNm Effective depth tension reinf. d = **384** mm
Area of tension reinf. req'd $A_{s,req}$ = **366** mm^2 Area of tension reinf. prov $A_{s,prov}$ = **804** mm^2
Min area of reinf. (exp.9.1N) $A_{s,min}$ = **249** mm^2 Max area reinf. (cl.9.2.1.1(3)) $A_{s,max}$ = **8100** mm^2

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

Crack control - Section 7.3

Maximum crack width w_k = **0.3** mm Min area reinf req'd (exp.7.1) $A_{sc,min}$ = **314** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment M_{QP} = **58.0**kNm
Actual tension bar spacing s_{bar} = **106** mm Max bar spacing (Table 7.3N) $s_{bar,max}$ = **252.8** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Deflection control - Section 7.4

Allow. span to depth ratio $span\_to\_depth_{allow}$ = **40.000** Actual span to depth ratio $span\_to\_depth_{actual}$ = **5.208**

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

Minimum bar spacing (Section 8.2)

Top bar spacing s_{top} = **90.0** mm Min allow. top bar spacing $s_{top,min}$ = **25.0** mm

PASS - Actual bar spacing exceeds minimum allowable

Bottom bar spacing s_{bot} = **90.0** mm Min allow. bottom bar spacing $s_{bot,min}$ = **25.0** mm

PASS - Actual bar spacing exceeds minimum allowable

Zone 3 (1500 mm - 2000 mm) Positive moment - section 6.1

Design bending moment M = **43.5** kNm Effective depth tension reinf. d = **384** mm
Area of tension reinf. req'd $A_{s,req}$ = **274** mm^2 Area of tension reinf. prov $A_{s,prov}$ = **804** mm^2

Min area of reinf. (exp.9.1N) $A_{s,min}$ = **249** mm^2 Max area reinf. (cl.9.2.1.1(3)) $A_{s,max}$ = **8100** mm^2

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

Crack control - Section 7.3

Maximum crack width w_k = **0.3** mm Min area reinf req'd (exp.7.1) $A_{sc,min}$ = **314** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment M_{QP} = **43.5**kNm

Actual tension bar spacing s_{bar} = **106** mm Max bar spacing (Table 7.3N) $s_{bar,max}$ = **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Zone 3 (1500 mm - 2000 mm) Negative moment - section 6.1

Design bending moment M = **14.5** kNm Effective depth tension reinf. d = **399** mm

Area of tension reinf. req'd $A_{s,req}$ = **88** mm^2 Area of tension reinf. prov $A_{s,prov}$ = **804** mm^2

Min area of reinf. (exp.9.1N) $A_{s,min}$ = **258** mm^2 Max area reinf. (cl.9.2.1.1(3)) $A_{s,max}$ = **8100** mm^2

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

Crack control - Section 7.3

Maximum crack width w_k = **0.3** mm Min area reinf req'd (exp.7.1) $A_{sc,min}$ = **313** mm^2

PASS - Area of tension reinforcement provided exceeds minimum required for crack control

Quasi-permanent moment M_{QP} = **0.0**kNm

Actual tension bar spacing s_{bar} = **106** mm Max bar spacing (Table 7.3N) $s_{bar,max}$ = **300** mm

PASS - Maximum bar spacing exceeds actual bar spacing for crack control

Minimum bar spacing (Section 8.2)

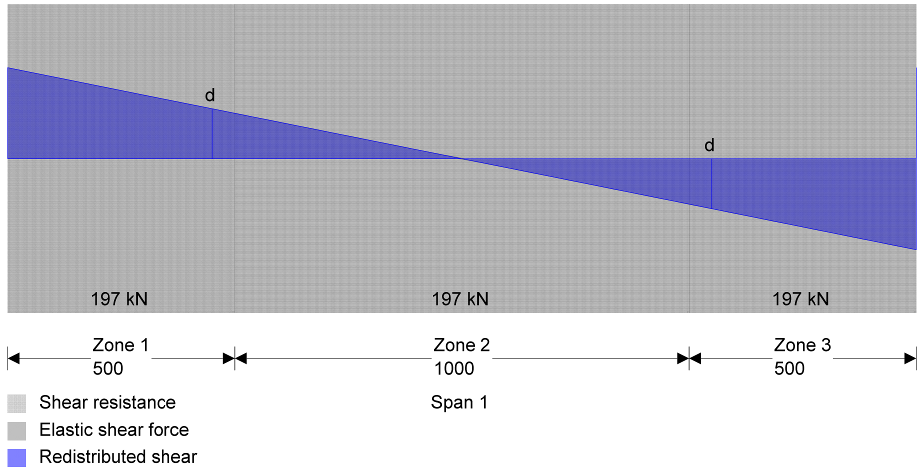
Top bar spacing s_{top} = **90.0** mm Min allow. top bar spacing $s_{top,min}$ = **25.0** mm

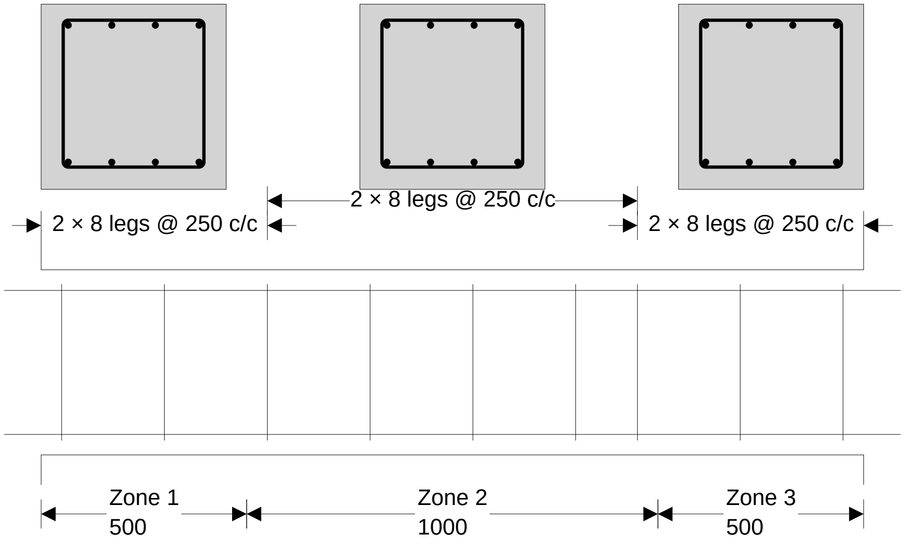
PASS - Actual bar spacing exceeds minimum allowable

Bottom bar spacing s_{bot} = **90.0** mm Min allow. bottom bar spacing $s_{bot,min}$ = **25.0** mm

PASS - Actual bar spacing exceeds minimum allowable

Shear design





Angle of comp. shear strut θ_{max} = 45 deg
Strength reduction factor v_1 = **0.533**
Compression chord coefficient α_{cw} = **1.00**
Minimum area of shear reinf. $A_{sv,min}$ = **381** mm^2/m

Zone 1 (0 mm - 500 mm) shear - section 6.2

Shear force at support $V_{Ed,max}$ = **116** kN
Max design shear resistance $V_{Rd,max}$ = **1007** kN

PASS - Design shear force at support is less than maximum design shear resistance

Design shear force V_{Ed} = **64** kN
Area shear reinf. req'd $A_{sv,req}$ = **381** mm^2/m
Area of shear reinf prov. $A_{sv,prov}$ = **402** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Max. long. spacing - exp.9.6N $s_{vl,max}$ = **338** mm

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

Zone 2 (500 mm - 1500 mm) shear - section 6.2

Design shear force V_{Ed} = **58** kN
Area shear reinf. req'd $A_{sv,req}$ = **381** mm^2/m
Area of shear reinf prov. $A_{sv,prov}$ = **402** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Max. long. spacing - exp.9.6N $s_{vl,max}$ = **338** mm

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

Zone 3 (1500 mm - 2000 mm) shear - section 6.2

Shear force at support $V_{Ed,max}$ = **116** kN
Max design shear resistance $V_{Rd,max}$ = **1007** kN

PASS - Design shear force at support is less than maximum design shear resistance

Design shear force V_{Ed} = **64** kN
Area shear reinf. req'd $A_{sv,req}$ = **381** mm^2/m
Area of shear reinf prov. $A_{sv,prov}$ = **402** mm^2/m

PASS - Area of shear reinforcement provided exceeds minimum required

Max. long. spacing - exp.9.6N $s_{vl,max}$ = **338** mm

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

8. Basement Method Statement

Contents

1. Basement Formation Suggested Method Statement.

1.1. This method statement provides an approach which will allow the basement design to be correctly considered during construction, and the temporary support to be provided during the works. The Contractor is responsible for the works on site and the final temporary works methodology and design on this site and any adjacent sites.

1.2. This method statement for the development of 8A Belmont Street. It has been written by a Chartered Engineer. The overall sequence is shown on drawing SL-30.

1.3. This proposed method has been developed to allow for improved costings and for inclusion in the Party Wall Award. Should the contractor provide alternative methodology the changes shall be at their own costs, and an Addendum to the Party Wall Award will be required.

1.4. Contact party wall surveyors to inform them of any changes to this method statement.

1.5. Contact the developers of any adjacent or nearby sites to inform them of the proposed works.

1.6. The approach followed in this design is:

i. demolish the existing structures (Storage building)
ii. install a contiguous piled wall with capping beam around the perimeter
iii. excavate within the contiguous piled walls;
iv. provide adequate propping, with propping to the head and include mass concrete thrust blocks for prop support at base
v. construct the new building from basement level upwards.

1.7. A soil investigation has been undertaken. The soil conditions are London Clay formation

1.8. No ground water encountered in the borehole taken at site. Local dewatering may be required. Following piling around the perimeter, and during the subsequent excavations, dewater locally (create sumps from which water can be pumped out of).

1.9. The structural water proofer (not Croft) must comment on the proposed design and ensure that this will provide adequate water proofing.

1.1. Provide engineers with concrete mix, supplier, deliver and placement methods 2 weeks prior to first pour. Site mixing of concrete should not be employed apart from in small sections <1m^3. Contractor must provide method on how to achieve site mixing to the correct specification; the contractor must undertake tool box talks with staff to ensure site quality is maintained.

2. Enabling Works

2.1. The site is to be hoarded with ply sheet to 2.2m to prevent unauthorised public access.

2.2. Demolish the storage building. Refer to Section 4 for demolition proposals.

2.3. Licences for skips and conveyors to be posted on hoarding

2.4. On commencement of construction, the contractor should report any discrepancies to the structural engineer in order that the detailed design may be modified as necessary.

3. Piling Sequencing

For general piling procedures, refer to the piling contractor's method statement. The anticipated sequence is as follows:

3.1. Piles are to be installed at different levels and positions around the development. All piles are installed from the same level and cut down as required.

3.1.1. Prior to bringing the piling rig on site, check with the piling contractor the requirements of a working platform and install to their design and specification if required.

3.1.2. Mark out datum line to determine various surface heights

3.1.3. Mark out pile sequence locations as specified by Engineer's detailed design stage drawings.

3.1.4. Following the sequencing guidance from the Engineers detailed design stage drawings, mark out proposed pile position with a pair of reference markers at 1.0m from the pile pin, each forming a line to the pile, mutually rotated at 90 degrees.

3.1.5. Rig operator to set up over the pile pin position and position auger relative to reference marks. Directed and checked by banks man.

3.1.6. The flap at the tip of the auger is closed and secured. Auger tip lowered to ground level and position rechecked. Drilling to commence upon banks man approval.

3.1.7. Concrete is prepared while piling operatives grout up concrete pump, hoses and flight, concrete pump operator to check concrete complies with design mix. Concrete held in agitator.

3.1.8. Rig operator augers to require design depth. Reference makers are to be used to check pile position during the first few metres of drilling.

3.1.9. If obstruction encountered, Engineer to be notified of pile number and depth. Move rig to next pile position whilst obstruction removal is dealt with. Contractor to be advised on procedure should obstruction not be removable. If necessary, pile bores to be backfilled and made safe. Open excavation to be protected when open.

3.1.10. When design depth reached, the auger is to be kept rotating to allow spoil in the bore to rise.

3.1.11. Concrete can be pumped to rig while rig operator monitors instrumentation and adjust auger rate of withdrawal accordingly.

3.1.12. Pressure, concrete flow and over-break to be monitored throughout operation.

3.1.13. During the withdrawal the rig operator is to activate the flight cleaner. If an automatic cleaner is not fitted to the rig then the piling gang must clean the flight manually to prevent spoil/ arising travelling above head height – this will be controlled by the piling foreman who must ensure the auger is not rotating when it is manually cleaned.

3.1.14. When auger tip reaches platform level, concrete pumping is stopped.

3.1.15. Attendant excavator as directed by the banks man clears spoil and concrete slurry from pile heap.

3.1.16. Banks man to check position of the cage in the pile, centring where necessary. Reinforcement generally to be installed flush with Piling Platform Level (PPL). Anchor pile reinforcement or threaded bars that project above piling platform to have protective caps.

3.1.17. Concrete testing cube samples to be taken as per engineering specification.

3.1.18. Rig is moved onto next pile in the sequence and positioned as above, with piles installed as per points 3.1.5 – 3.1.12

3.1.19. Equipment to be cleaned and maintained as per normal methods.

3.1.20. This sequence of piling is to continue until all perimeter piles have been installed. As piling progresses wound perimeter, construct reinforced concrete capping beam to piles.

3.1.21. Excavate within the contiguous piled wall perimeter, and install props as excavations progress.

3.1.21.1. <u>The piled wall should be propped until the permanent structure is complete (refer to item 3.2). Propping should include props to the head, ie to the capping beam. The contractor should provide proposals for propping to the structural engineer who is responsible for the detailed design of the permanent structure at least two weeks before the excavations commence.</u>

3.2. Once all piles have been installed& propped, complete the excavation. Cast bases for internal load bearing walls. The next step sequence is to install the steelwork at ground level. In the permanent condition, this will prop the external perimeter of the basement.

3.3. When steelwork has been set up, the cross props may be removed.

4. Demolition, Recycling, Dust/Noise Control and Site Hoarding

4.1. Demolition work is to take place within the hoarded confines of the materials such as stock bricks, timber etc. are to be recycled where possible. To minimise dust and dirt from demolition the following measures shall be implemented:

4.1.1. Any debris or dust or dirt falling on the street and public highway will be cleared as it occurs by designated cleaners and washed down fully every night.

4.1.2. Demolished materials are to be removed to a skip placed in front of the site which will be emptied regularly as required.

4.1.3. All brickwork and concrete demolition work is to be constantly watered to reduce airborne dust

4.2. Building work which can be heard at the boundary of the site will not be carried out on Sundays or bank holidays and will be carried out within working hours as agreed by the council.