Symmetrys Limited
Consulting Structural Engineers

6 The Courtyard, Lynton Road,
London. N8 8SL
T: 020 8340 4041
W: www.symmetrys.com
E: info@symmetrys.com

Structural Calculations
For
13 Glenmore Road
NW3 4BY
London

2016203 **October 2016**

Company No. 5873122
VAT Registration No. 894 2993 61
Registered In England And Wales

ARCHITECT

AR Architecture Ltd

CODES USED

- NHBC
- BS 648: 1964 – Weights of Building Materials
- BS 6399: Pt 1: 1984 – Design Loads
- BS 5950: Pt 1: 1990 – Structural Steel
- BS 5628: Pt 1: 1992 – Masonry
- BS 5268: Pt 2: 1991 – Structural Timber
- BS 8110: 1985 – Reinforced Concrete

IMPOSED LOADS

- Domestic Floors – 1.5 kN/m^2

GROUND CONDITIONS

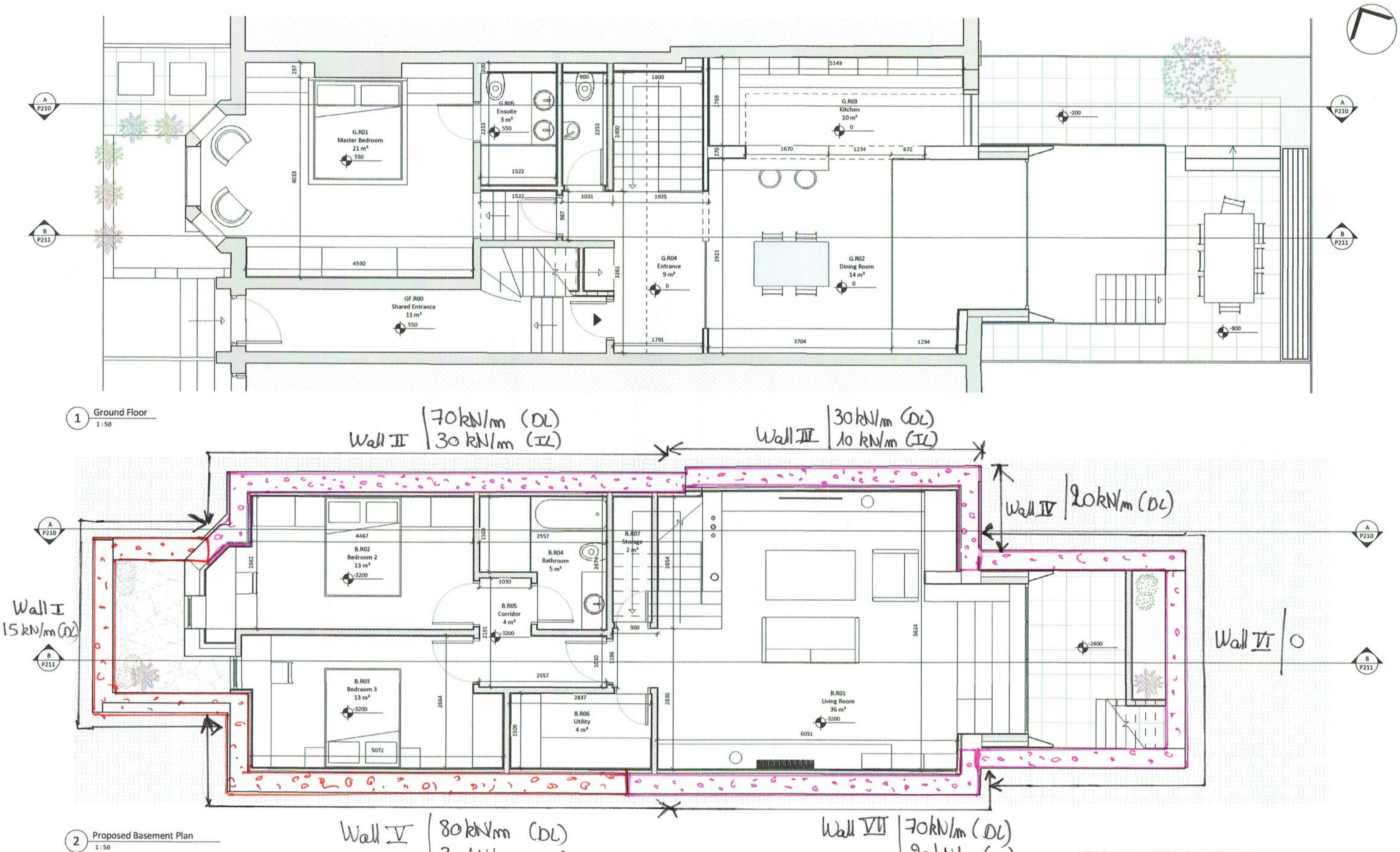
- London Clay– Allowable Safe Ground Bearing Pressure – 150kN/m^2
  (Provided by LMB Geosolutions in their report from September 2016)

LOADS		**kg/m²**		**DEAD kN/m²**	**LIVE**
Tiled Roof -	Tiles	75			
	Felt & Battens	6			
	Rafters	6			
		87 kg/m²			
	Plan Load	20º	=	0.92	0.75
		30º	=	0.95	0.75
		35º	=	1.06	0.67
		40º	=	1.13	0.58
		45º	=	1.23	0.5
		50º	=	1.35	0.42

Note: Natural slates generally 50 kg/m²(unless Westmorland thick)
Artificial Slates generally 25 kg/m²

Ceilings -	Joists	8		
	Insulation	2		
	Plasterboard & Skim	15		
		25kg/m²	0.25	0.25
New Cavity -	102 Brick	210		
	100 Block	80		
	Plasterboard & Skim	24		
		314 kg/m²	3.14	
Older Cavity (or 215 Solid)	102 Brick	210		
	102 Brick	210		
	12mm Plaster	24		
		444kg/m²	4.44	

LOADS (Cont'd)		kg/m^2	DEAD kN/m^2	LIVE
Stud Walls	Plasterboard x 2	20		
	Skim Coat x 2	10		
	Studs 75x50@400c/c's	10		
		40 kg/m^2	0.4	
Timber Floor	Boards	15		
	Joists	15		
	Plasterboard & Skim	15		
		45 kg/m^2	0.45	
			Domestic	1.5



1 Ground Floor 1:50

2 Proposed Basement Plan 1:50

0m 1m 2m 3m 4m 5m

Job Title:	13 Glenmore Road
Drawing Status:	Pre-Planning
Drawing:	Proposed Plans
Date:	09/09/16
Scale at A3:	1:50
Drawn:	GG
Checked by:	SV
Project No:	16003
Drawing No:	P200
Revision:	

AR-Architecture.
213 Haverstock Hill
London NW3 4QP, UK
T: +44 207 209 2851
E: info@ar-arch.co.uk

COMMERCIAL HOSPITALITY RESIDENTIAL

Symmetrys Limited
Consulting Structural Engineers

W: www.symmetrys.com
E: info@symmetrys.com

Job No.	Sheet No.	Revision
2016203	01	

Job Title: 13 Glenmore Road

Section: Planning Calculations

Date	Made By	Checked By
10/16	CC	

Expected heave forces

Detailed analysis has been undertaken by LMB Geosolutions Ltd, See Appendix C for further details.

Approximate conservative heave forces

Excavation depth: 3.7m

Hydrostatic pressure = $3.7 \times 10\,kN/m^3 = 37\,kN/m^2$

Overburden pressure = $3.7m \times 18\,kN/m^3 = 66.6\,kN/m^2$

Heave = $37\,kN/m^2 + 0.5 \times (66.6 - 37) = 29.6\,kN/m^2$

Slab S.W

- $0.400\,m \times 24\,kN/m^3 = 9.6\,kN/m^2$
  ↑ assumption

Overall uplift = $29.2 - 9.6 = 19.6\,kN/m^2$

Ultimate = $19.6 \times 1.6 = 31.4\,kN/m^2$

$M = \frac{wL^2}{8} = \frac{31.4 \times 2.9\,m^2}{2} = 132.03\,kN.m$

See design of basement slab on excel spreadsheet.

ELEMENT DESIGN to BS 8110:2005

SOLID SLABS

Originated from RCC11.xls v4.0

mpa The Concrete Centre

INPUT Location Glenmore Road

Design moment, M	132.0	kNm/m	fcu	40	N/mm²	γ_c =	1.50
ßb	1.00		fy	500	N/mm²	γ_s =	1.15
span	5900	mm	steel class	A			
Height, h	300	mm	Section location	CONTINUOUS SPAN			
Bar Ø	12	mm	Compression steel	NOMINAL			
cover	50	mm to these bars		(deflection control only)			

ONE or TWO WAY SLAB

OUTPUT Glenmore Road Compression steel = NOMINAL 0.13%

	d = 300 - 50 - 12/2 = 244.0 mm
(3.4.4.4)	K' = 0.156 > K = 0.055 ok
(3.4.4.4)	z = 244.0 [0.5 + (0.25 - 0.055 /0.893)]^½ = 227.9 < 0.95d = 231.8 mm
(3.4.4.1)	As = 132.00E6 /500 /227.8 x 1.15 = 1333 > min As = 390 mm²/m
	PROVIDE H12 @ 75 = 1508 mm²/m
(Eqn 8)	fs = 2/3 x 500 x 1333 /1508 /1.00 = 294.6 N/mm²
(Eqn 7)	Tens mod factor = 0.55 + (477 - 294.6) /120 /(0.9 + 2.217) = 1.038
(Equation 9)	Comp mod factor = 1 + 0.130/(3 + 0.130) = 1.042
(3.4.6.3)	Permissible L/d = 26.0 x 1.038 x 1.042 = 28.097
	Actual L/d = 5900 /244.0 = 24.180 ok

Symmetrys Limited
Consulting Structural Engineers

W: www.symmetrys.com
E: info@symmetrys.com

Job No.	Sheet No.	Revision
2016203		
Date	**Made By**	**Checked By**
10/16	CC	

Job Title: 13 Glenmore Road

Section: Planning calculations

Design of the retaining walls

Maximum line load onto retaining wall : 80kN/m (DL), 30kN/m (IL)

Soils properties : London Clay 150kN/m² allowable bearing pressure.

→ Cantilever retaining wall on 2,8 meters.

↳ See Tedds calculation next page.

Temporary works design

Design props to top of basement

Prop Force = 14.4kN/m (from Tedds)

Ultimate = 1.6 × 14.4 = 23 kN/m

Provide S3/10 Maybey props = 140kN at 1.5 centres

$$F = \frac{140}{1.5} = 93.3 > 23 \rightarrow \text{Ok.}$$

push pull props - lengths and capacities

Prop Loading Chart

Head of prop will comprise S3/10 or S310A used viz:
S3/10 Use A - To prop Mk3 soldiers
S3/10A Use B - To prop vertical members other than soldiers
S3/10A Use C - To prop Mk2 soldiers

For general use a Factor of Safety of 2 is recommended. However, for controlled situations where the loading is predictable a Factor of Safety of 1.7 may be used.

The safe working loads shown in the table are for props used in compression either vertically or horizontally. In horizontal applications, the props should always be used with the soldier webs/lightening holes in the vertical plane.

When used in tension the safe working load should not exceed 120kN.

Mabey tubular props are an alternative to Mk3 Soldiers for any of the applications shown. Tubular props and soldiers should not be combined in any single prop.

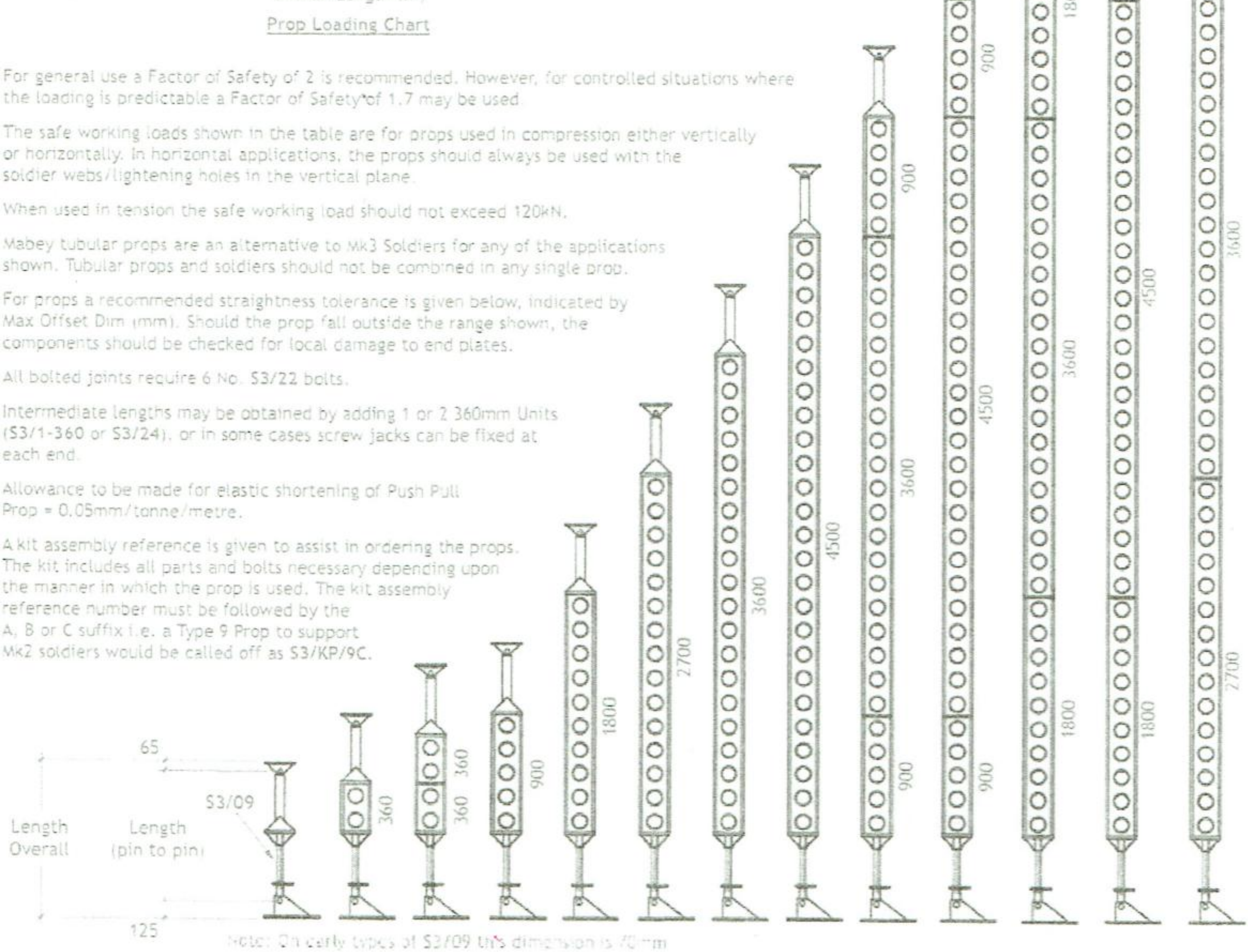
For props a recommended straightness tolerance is given below, indicated by Max Offset Dim (mm). Should the prop fall outside the range shown, the components should be checked for local damage to end plates.

All bolted joints require 6 No. S3/22 bolts.

Intermediate lengths may be obtained by adding 1 or 2 360mm Units (S3/1-360 or S3/24), or in some cases screw jacks can be fixed at each end.

Allowance to be made for elastic shortening of Push Pull Prop = 0.05mm/tonne/metre.

A kit assembly reference is given to assist in ordering the props. The kit includes all parts and bolts necessary depending upon the manner in which the prop is used. The kit assembly reference number must be followed by the A, B or C suffix i.e. a Type 9 Prop to support Mk2 soldiers would be called off as S3/KP/9C.

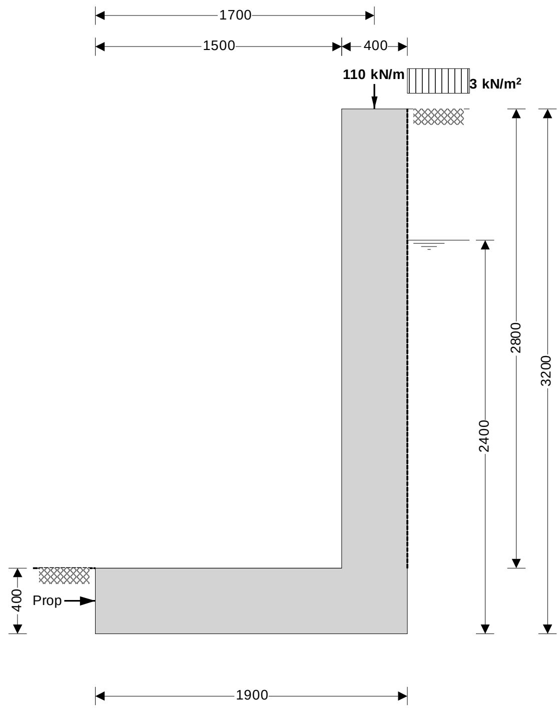


Note: On early types of S3/09 this dimension is 70mm

PROP	1	2	3	4	5	6	7	8	9	10	11	12	13
KIT ASSEMBLY REF	S3/KP/1	S3/KP/2	S3/KP/3	S3/KP/4	S3/KP/5	S3/KP/6	S3/KP/7	S3/KP/8	S3/KP/9	S3/KP/10	S3/KP/11	S3/KP/12	S3/KP/13
MAX LENGTH Overall (mm)	1279	1639	1999	2179	3079	3979	4879	5779	6679	7579	8479	9379	10279
MIN LENGTH Overall (mm)	830	1190	1550	1730	2630	3530	4430	5330	6230	7130	8030	8930	9830
WEIGHT (kg)	50	69	87	75	90	113	132	151	182	201	212	231	257
LOAD CAPACITY (FOS 2.0) (kN)	200	200	200	200	170	140	120	100	80	70	60	50	45
LOAD CAPACITY (FOS 1.7) (kN)	200	200	200	200	200	165	140	118	94	82	70	59	53
MAX OFFSET DIM (mm)	2.0	3.0	3.5	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **2800** mm	Wall stem thickness	t_{wall} = **400** mm
Length of toe	l_{toe} = **1500** mm	Length of heel	l_{heel} = **0** mm
Overall length of base	l_{base} = **1900** mm	Base thickness	t_{base} = **400** mm
Height of retaining wall	h_{wall} = **3200** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **400** mm
Position of downstand	l_{ds} = **1050** mm		
Depth of cover in front of wall	d_{cover} = **0** mm	Unplanned excavation depth	d_{exc} = **0** mm
Height of ground water	h_{water} = **2400** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **3200** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **0.0** deg
Design shear strength	ϕ'_b = **24.2** deg	Design base friction	δ_b = **18.6** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **150** kN/m^2

Using Coulomb theory

Active pressure	K_a =**0.419**	Passive pressure	K_p = **4.187**
At-rest pressure	K_0 = **0.590**		

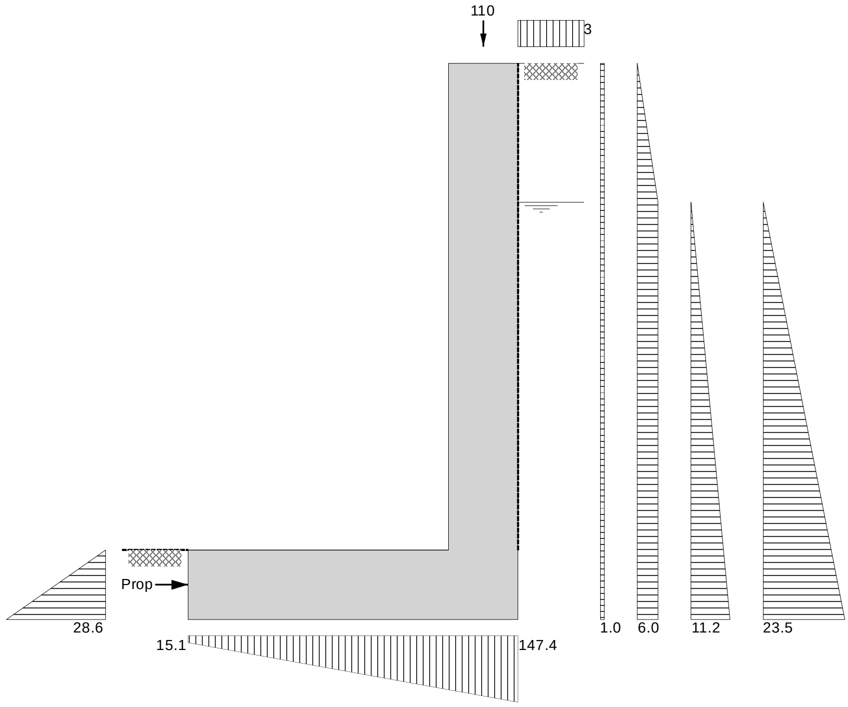
Loading details

Surcharge load — Surcharge = **2.5** kN/m^2

Vertical dead load — W_{dead} = **80.0** kN/m — Vertical live load — W_{live} = **30.0** kN/m

Horizontal dead load — F_{dead} = **0.0** kN/m — Horizontal live load — F_{live} = **0.0** kN/m

Position of vertical load — l_{load} = **1700** mm — Height of horizontal load — h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Calculate propping force

Propping force — F_{prop} = **14.4** kN/m

Check bearing pressure

Total vertical reaction — R = **154.4** kN/m — Distance to reaction — x_{bar} = **1208** mm

Eccentricity of reaction — e = **258** mm

Reaction acts within middle third of base

Bearing pressure at toe — p_{toe} = **15.1** kN/m^2 — Bearing pressure at heel — p_{heel} = **147.4** kN/m^2

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4** Live load factor γ_{f_l} = **1.6**

Earth pressure factor γ_{f_e} = **1.4**

Calculate propping force

Propping force F_{prop} = **14.4** kN/m

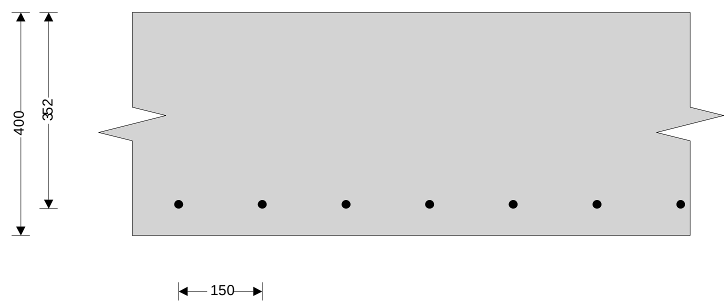
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in toe c_{toe} = **40** mm



Design of retaining wall toe

Shear at heel V_{toe} = **136.8** kN/m Moment at heel M_{toe} = **115.2** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 150 mm centres**

Area required $A_{s\_toe\_req}$ = **791.6** mm^2/m Area provided $A_{s\_toe\_prov}$ = **1340** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.388** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.529** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

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

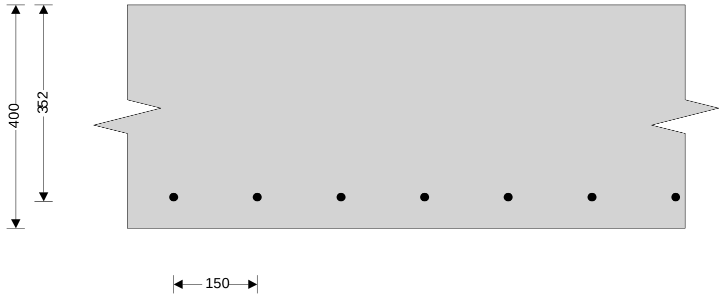
Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Wall details

Minimum reinforcement k = **0.13** %

Cover in stem c_{stem} = **40** mm Cover in wall c_{wall} = **40** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **40.7** kN/m   Moment at base of stem M_{stem} = **76.7** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 150 mm centres**

Area required $A_{s\_stem\_req}$ = **527.6** mm^2/m   Area provided $A_{s\_stem\_prov}$ = **1340** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.116** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.529** N/mm^2

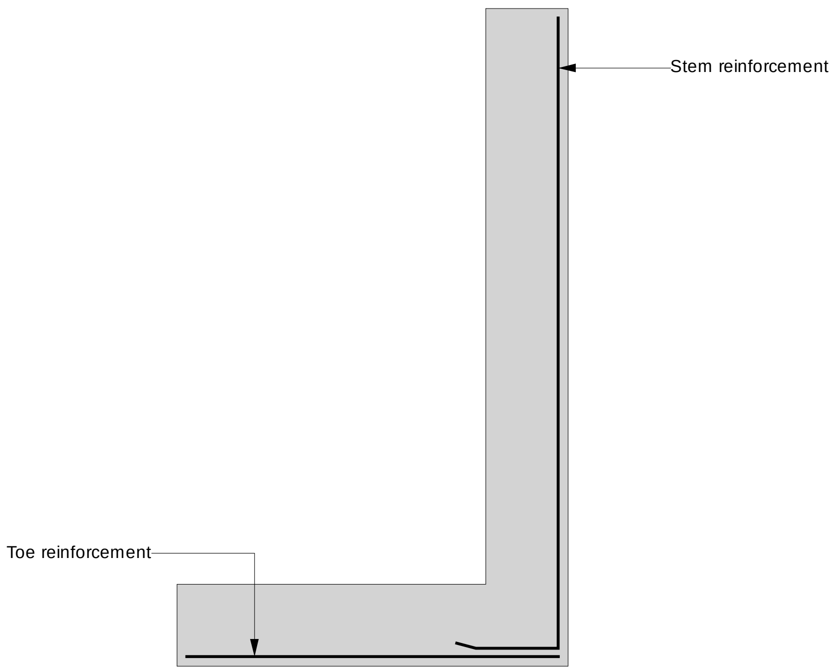
$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **14.00**   Actual span/depth ratio $ratio_{act}$ = **7.95**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 150 mm centres - (1340 mm^2/m)
Stem bars - 16 mm dia.@ 150 mm centres - (1340 mm^2/m)