



Project Preface

Project name:	Calculations for the Foundations
Client name:	Nick Meaney
<u>Construction site address:</u> House no, Street: City/Town: Postcode:	Land near Six Bells, Hoelgerrig, Merthyr Tydfil
Document prepared by:	Marcin Krawucki BSc (Hons) MCIOB, MIET, ACABE, GMICE MCIOB Membership no : 7006632 MIET Membership no : 1101281027 ACABE Membership no : 80455303 GMICE Membership no : 92007313
Address:	50 Quarry Row Merthyr Tydfil, CF47 8PS
Date of preparation:	11-06-2025
Job reference number:	AUX511
Revision:	C01



Project:

Calculations for the Foundations

Address:

Land near Six Bells,
Hoelgerrig, Merthyr Tydfil

Job No.

AUX511

Sheet

1

Date:

11-06-2025

Rev.

C01

Design content

1 Introduction

1.1 Instructions

In accordance with instructions received from the client I have carried out a Structural calculations for the foundations of the house at

**Land near Six Bells,
Hoelgerrig, Merthyr Tydfil**

2 Construction works

All the construction works must be done by experienced builder or contractor.
the pressure below foundation is below 80kN/m² which is satisfactory.
The concrete grade of concrete to be minimum C30.
All the foundations to have A393 mesh at bottom with cover 50 mm each side.

If the builder/contractor has any queries regarding the above-mentioned works during the installation installation process, please contact me.

All sizes of the foundations are shown on the drawings

For more complex project a separate design for temporary works might be required.

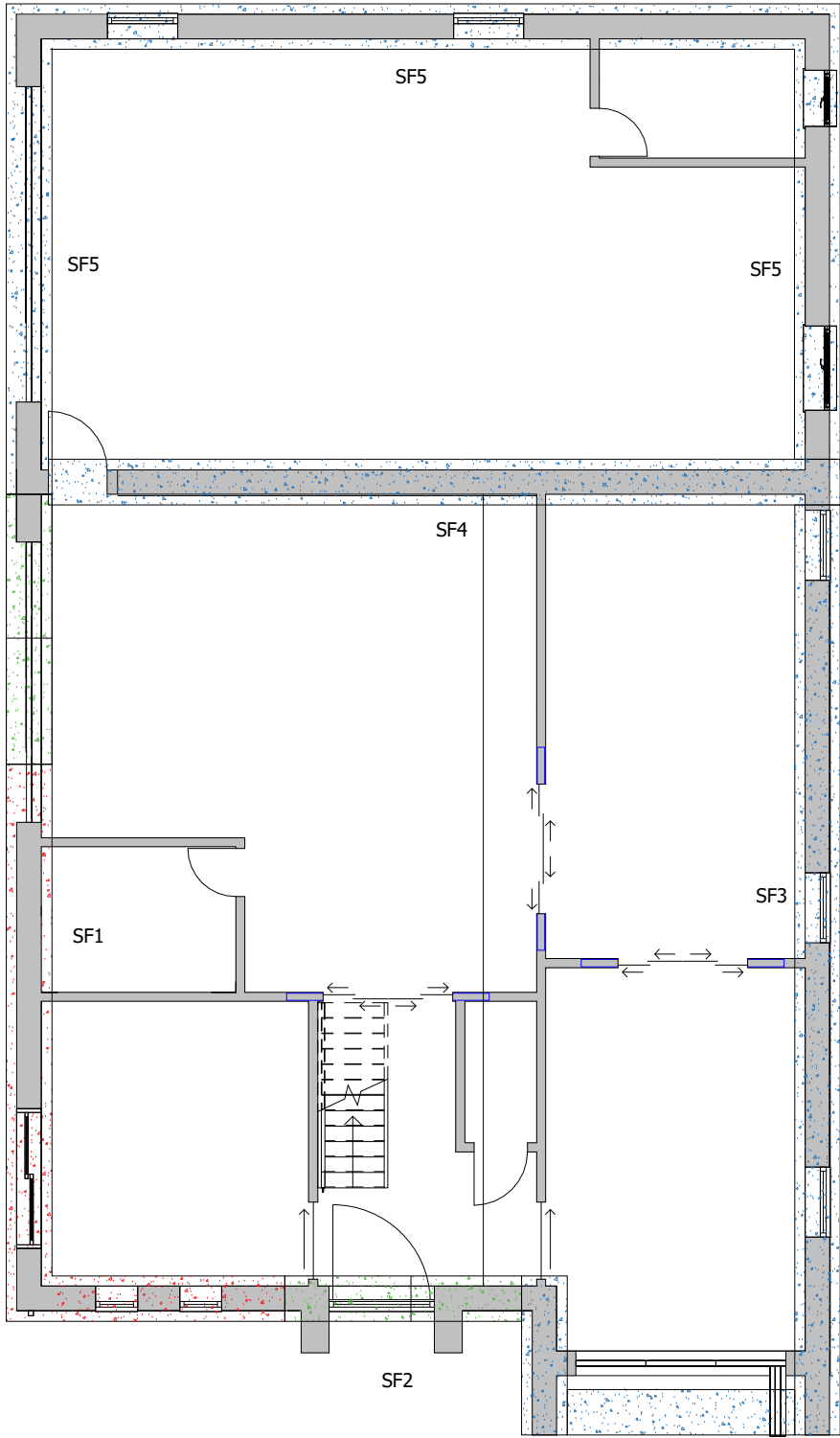
Marcin Krawucki

BSc (Hons) GMICE

ICE Membership: 92007313

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Ground floor plan shows foundation



- SF1 = 650x300mm deep Strip footing with A393 mesh at bottom

SF2 = 650x300mm deep Strip footing with A393 mesh at bottom

SF3 = 650x300mm deep Strip footing with A393 mesh at bottom

SF4 = 650x300mm deep Strip footing with A393 mesh at bottom

SF5 = 650x300mm deep Strip footing with A393 mesh at bottom



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Calculation for:

Loadings on beams

LOAD TAKEDOWN**Strip footing 1**

Wall
DL $4.00\text{kN/m}^2 \times 6.70\text{m} = 26.80\text{kN/m}$

Floor
DL $0.50\text{kN/m}^2 \times 2.10\text{m} = 1.05\text{kN/m}$
LL $2.00\text{kN/m}^2 \times 2.10\text{m} = 4.20\text{kN/m}$

Strip footing 2

Wall
DL $4.00\text{kN/m}^2 \times 5.70\text{m} = 22.80\text{kN/m}$

Floor
DL $0.50\text{kN/m}^2 \times 2.65\text{m} = 1.33\text{kN/m}$
LL $2.00\text{kN/m}^2 \times 2.65\text{m} = 5.30\text{kN/m}$

Pitched roof
DL $0.85\text{kN/m}^2 \times 2.00\text{m} = 1.70\text{kN/m}$
LL $0.75\text{kN/m}^2 \times 2.00\text{m} = 1.50\text{kN/m}$

Strip footing 3

Wall
DL $4.00\text{kN/m}^2 \times 7.20\text{m} = 28.80\text{kN/m}$

Floor
DL $0.50\text{kN/m}^2 \times 1.90\text{m} = 0.95\text{kN/m}$
LL $2.00\text{kN/m}^2 \times 1.90\text{m} = 3.80\text{kN/m}$

Strip footing 4

Wall
DL $4.00\text{kN/m}^2 \times 5.70\text{m} = 22.80\text{kN/m}$

Floor
DL $0.50\text{kN/m}^2 \times 2.50\text{m} = 1.25\text{kN/m}$
LL $2.00\text{kN/m}^2 \times 2.50\text{m} = 5.00\text{kN/m}$

Pitched roof
DL $0.85\text{kN/m}^2 \times 2.00\text{m} = 1.70\text{kN/m}$
LL $0.75\text{kN/m}^2 \times 2.00\text{m} = 1.50\text{kN/m}$

Flat roof
DL $0.85\text{kN/m}^2 \times 3.30\text{m} = 2.81\text{kN/m}$
LL $0.75\text{kN/m}^2 \times 3.30\text{m} = 2.48\text{kN/m}$

Strip footing 5

Wall
DL $4.00\text{kN/m}^2 \times 2.55\text{m} = 10.20\text{kN/m}$

Flat roof
DL $0.85\text{kN/m}^2 \times 3.30\text{m} = 2.81\text{kN/m}$
LL $0.75\text{kN/m}^2 \times 3.30\text{m} = 2.48\text{kN/m}$

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FOUNDATION ANALYSIS

In accordance with EN1997-1:2004 + A1:2013 incorporating corrigendum February 2009 and the UK National Annex incorporating corrigendum No.1

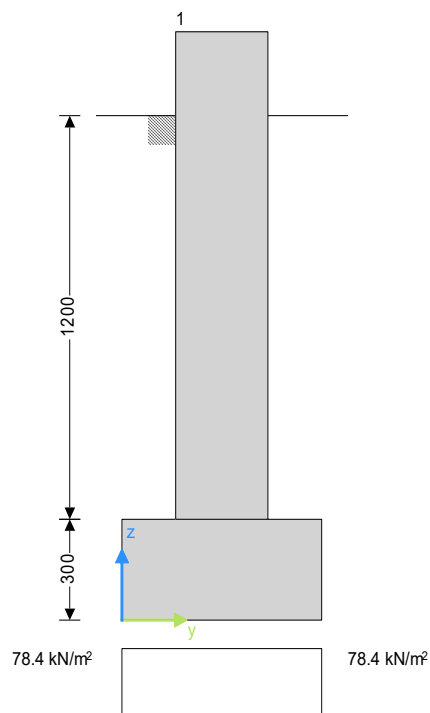
Tedds calculation version 3.3.06

Summary table

Description	Unit	Allowable	Actual	Utilisation	Result
Base pressure	kN/m ²	80	78.4	0.980	Pass
Description	Unit	Provided	Required	Utilisation	Result
Reinforcement y-direction	mm ²	393	369	0.940	Pass
Description	Unit	Allowable	Actual	Utilisation	Result

Strip foundation details - considering a one meter strip

Length of foundation	$L_x = 1000$ mm
Width of foundation	$L_y = 650$ mm
Foundation area	$A = L_x \times L_y = 0.650$ m ²
Depth of foundation	$h = 300$ mm
Depth of soil over foundation	$h_{\text{soil}} = 1200$ mm
Level of water	$h_{\text{water}} = 0$ mm
Density of water	$\gamma_{\text{water}} = 9.8$ kN/m ³
Density of concrete	$\gamma_{\text{conc}} = 25.0$ kN/m ³



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Wall no.1 details

Width of wall $l_{y1} = 300 \text{ mm}$
position in y-axis $y_1 = 325 \text{ mm}$

Soil properties

Density of soil $\gamma_{\text{soil}} = 18.0 \text{ kN/m}^3$
Characteristic cohesion $c'_k = 0 \text{ kN/m}^2$
Characteristic effective shear resistance angle $\phi'_k = 30 \text{ deg}$
Characteristic friction angle $\delta_k = 20 \text{ deg}$

Foundation loads

Self weight $F_{\text{swt}} = h \times \gamma_{\text{conc}} = 7.5 \text{ kN/m}^2$
Soil weight $F_{\text{soil}} = h_{\text{soil}} \times \gamma_{\text{soil}} = 21.6 \text{ kN/m}^2$

Wall no.1 loads per linear metre

Permanent axial load $F_{\text{Gz1}} = 27.9 \text{ kN}$
Variable axial load $F_{\text{Qz1}} = 4.2 \text{ kN}$

Bearing resistance (Section 6.5.2)

Forces on foundation per linear metre

Force in z-direction $F_{\text{dz}} = A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}} + F_{\text{Qz1}} = 51.0 \text{ kN}$

Moments on foundation per linear metre

Moment in y-direction $M_{\text{dy}} = A \times (F_{\text{swt}} + F_{\text{soil}}) \times L_y / 2 + F_{\text{Gz1}} \times y_1 + F_{\text{Qz1}} \times y_1 = 16.6 \text{ kNm}$

Eccentricity of base reaction

Eccentricity of base reaction in y-axis $e_y = M_{\text{dy}} / F_{\text{dz}} - L_y / 2 = 0 \text{ mm}$

Pad base pressures

$q_1 = F_{\text{dz}} \times (1 - 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 78.4 \text{ kN/m}^2$
 $q_2 = F_{\text{dz}} \times (1 + 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 78.4 \text{ kN/m}^2$
Minimum base pressure $q_{\text{min}} = \min(q_1, q_2) = 78.4 \text{ kN/m}^2$
Maximum base pressure $q_{\text{max}} = \max(q_1, q_2) = 78.4 \text{ kN/m}^2$

Presumed bearing capacity

Presumed bearing capacity $P_{\text{bearing}} = 80.0 \text{ kN/m}^2$

PASS - Presumed bearing capacity exceeds design base pressure

Design approach 1

Partial factors on actions - Combination1

Partial factor set A1
Permanent unfavourable action - Table A.3 $\gamma_G = 1.35$
Permanent favourable action - Table A.3 $\gamma_{\text{Gr}} = 1.00$
Variable unfavourable action - Table A.3 $\gamma_Q = 1.50$
Variable favourable action - Table A.3 $\gamma_{\text{Qr}} = 0.00$

Partial factors for spread foundations - Combination1

Resistance factor set R1
Bearing - Table A.5 $\gamma_{\text{R.v}} = 1.00$
Sliding - Table A.5 $\gamma_{\text{R.h}} = 1.00$

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Forces on foundation per linear metre

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil}) + F_{Gz1}) + \gamma_Q \times F_{Qz1} = \mathbf{69.4 \text{ kN}}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{22.6 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{106.8 \text{ kN/m}^2}$$

Design approach 1

Partial factors on actions - Combination2

Partial factor set

A2

Permanent unfavourable action - Table A.3

$$\gamma_G = \mathbf{1.00}$$

Permanent favourable action - Table A.3

$$\gamma_{Gr} = \mathbf{1.00}$$

Variable unfavourable action - Table A.3

$$\gamma_Q = \mathbf{1.30}$$

Variable favourable action - Table A.3

$$\gamma_{Qr} = \mathbf{0.00}$$

Partial factors for spread foundations - Combination2

Resistance factor set

R1

Bearing - Table A.5

$$\gamma_{R,v} = \mathbf{1.00}$$

Sliding - Table A.5

$$\gamma_{R,h} = \mathbf{1.00}$$

Forces on foundation per linear metre

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil}) + F_{Gz1}) + \gamma_Q \times F_{Qz1} = \mathbf{52.2 \text{ kN}}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{17.0 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{80.3 \text{ kN/m}^2}$$

FOUNDATION DESIGN

In accordance with EN1992-1-1:2004 + A1:2014 incorporating corrigenda January 2008, November 2010 and January 2014 and the UK National Annex incorporating National Amendment No.1 and No.2

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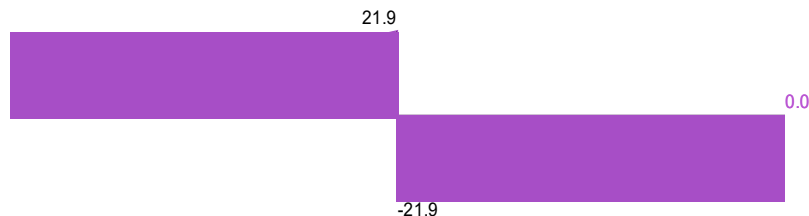
Concrete details (Table 3.1 - Strength and deformation characteristics for concrete)

Concrete strength class	C30/37
Characteristic compressive cylinder strength	$f_{ck} = 30 \text{ N/mm}^2$
Characteristic compressive cube strength	$f_{ck,cube} = 37 \text{ N/mm}^2$
Mean value of compressive cylinder strength	$f_{cm} = f_{ck} + 8 \text{ N/mm}^2 = 38 \text{ N/mm}^2$
Mean value of axial tensile strength	$f_{ctm} = 0.3 \text{ N/mm}^2 \times (f_{ck} / 1 \text{ N/mm}^2)^{2/3} = 2.9 \text{ N/mm}^2$
5% fractile of axial tensile strength	$f_{ctk,0.05} = 0.7 \times f_{ctm} = 2.0 \text{ N/mm}^2$
Secant modulus of elasticity of concrete	$E_{cm} = 22 \text{ kN/mm}^2 \times [f_{cm} / 10 \text{ N/mm}^2]^{0.3} = 32837 \text{ N/mm}^2$
Partial factor for concrete (Table 2.1N)	$\gamma_c = 1.50$
Compressive strength coefficient (cl.3.1.6(1))	$\alpha_{cc} = 0.85$
Design compressive concrete strength (exp.3.15)	$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_c = 17.0 \text{ N/mm}^2$
Tens. strength coeff. for plain concrete (cl.12.3.1(1))	$\alpha_{ct,pl} = 0.80$
Des. tens. strength for plain concrete (exp.12.1)	$f_{ctd,pl} = \alpha_{ct,pl} \times f_{ctk,0.05} / \gamma_c = 1.1 \text{ N/mm}^2$
Maximum aggregate size	$h_{agg} = 20 \text{ mm}$
Ultimate strain - Table 3.1	$\epsilon_{cu2} = 0.0035$
Shortening strain - Table 3.1	$\epsilon_{cu3} = 0.0035$
Effective compression zone height factor	$\lambda = 0.80$
Effective strength factor	$\eta = 1.00$
Bending coefficient k_1	$K_1 = 0.40$
Bending coefficient k_2	$K_2 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$
Bending coefficient k_3	$K_3 = 0.40$
Bending coefficient k_4	$K_4 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$

Reinforcement details

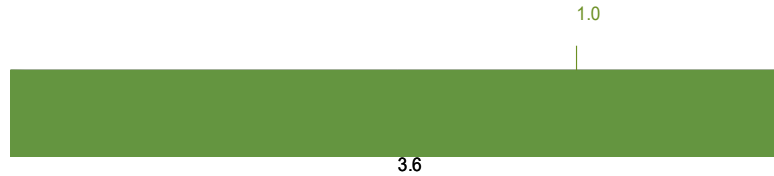
Characteristic yield strength of reinforcement	$f_{yk} = 500 \text{ N/mm}^2$
Modulus of elasticity of reinforcement	$E_s = 210000 \text{ N/mm}^2$
Partial factor for reinforcing steel (Table 2.1N)	$\gamma_s = 1.15$
Design yield strength of reinforcement	$f_{yd} = f_{yk} / \gamma_s = 435 \text{ N/mm}^2$
Nominal cover to top of foundation	$c_{nom_t} = 50 \text{ mm}$
Nominal cover to bottom of foundation	$c_{nom_b} = 50 \text{ mm}$
Nominal cover to side of foundation	$c_{nom_s} = 50 \text{ mm}$

Shear diagram (kN)



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Moment diagram (kNm)



Rectangular section in flexure (Section 6.1)

Design bending moment

$$M_{Ed,y,max} = 1 \text{ kNm}$$

Depth to tension reinforcement

$$d = h - c_{nom,b} - \phi_{y,bot} / 2 = 245 \text{ mm}$$

$$K = M_{Ed,y,max} / (L_x \times d^2 \times f_{ck}) = 0.001$$

$$K' = (2 \times \eta \times \alpha_{cc} / \gamma_c) \times (1 - \lambda \times (\delta - K_1) / (2 \times K_2)) \times (\lambda \times (\delta - K_1) / (2 \times K_2))$$

$$K' = 0.207$$

K' > K - No compression reinforcement is required

Lever arm

$$z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_c))^{0.5}, 0.95) \times d = 233 \text{ mm}$$

Depth of neutral axis

$$x = 2.5 \times (d - z) = 31 \text{ mm}$$

Area of tension reinforcement required

$$A_{s,y,bot,req} = M_{Ed,y,max} / (f_{yd} \times z) = 10 \text{ mm}^2$$

Tension reinforcement provided

$$10 \phi \text{ bars @ } 200 \text{ c/c bottom}$$

Area of tension reinforcement provided

$$A_{s,y,bot,prov} = 393 \text{ mm}^2$$

Minimum area of reinforcement (exp.9.1N)

$$A_{s,min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times L_x \times d = 369 \text{ mm}^2$$

Maximum area of reinforcement (cl.9.2.1.1(3))

$$A_{s,max} = 0.04 \times L_x \times d = 9800 \text{ mm}^2$$

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

Crack control (Section 7.3)

Limiting crack width

$$w_{max} = 0.3 \text{ mm}$$

Variable load factor (EN1990 – Table A1.1)

$$\psi_2 = 0.3$$

Serviceability bending moment

$$M_{sls,y,max} = 0.7 \text{ kNm}$$

Tensile stress in reinforcement

$$\sigma_s = M_{sls,y,max} / (A_{s,y,bot,prov} \times z) = 7.5 \text{ N/mm}^2$$

Load duration factor

$$k_t = 0.4$$

Effective depth of concrete in tension

$$h_{c,ef} = \min(2.5 \times (h - d), (h - x) / 3, h / 2) = 90 \text{ mm}$$

Effective area of concrete in tension

$$A_{c,eff} = h_{c,ef} \times L_x = 89792 \text{ mm}^2$$

Mean value of concrete tensile strength

$$f_{ct,eff} = f_{ctm} = 2.9 \text{ N/mm}^2$$

Reinforcement ratio

$$\rho_{p,eff} = A_{s,y,bot,prov} / A_{c,eff} = 0.004$$

Modular ratio

$$\alpha_e = E_s / E_{cm} = 6.395$$

Bond property coefficient

$$k_1 = 0.8$$

Strain distribution coefficient

$$k_2 = 0.5$$

$$k_3 = 3.4 = 3.4$$

$$k_4 = 0.425$$

Maximum crack spacing (exp.7.11)

$$s_{r,max} = k_3 \times c_{nom,b} + k_1 \times k_2 \times k_4 \times \phi_{y,bot} / \rho_{p,eff} = 559 \text{ mm}$$

Maximum crack width (exp.7.8)

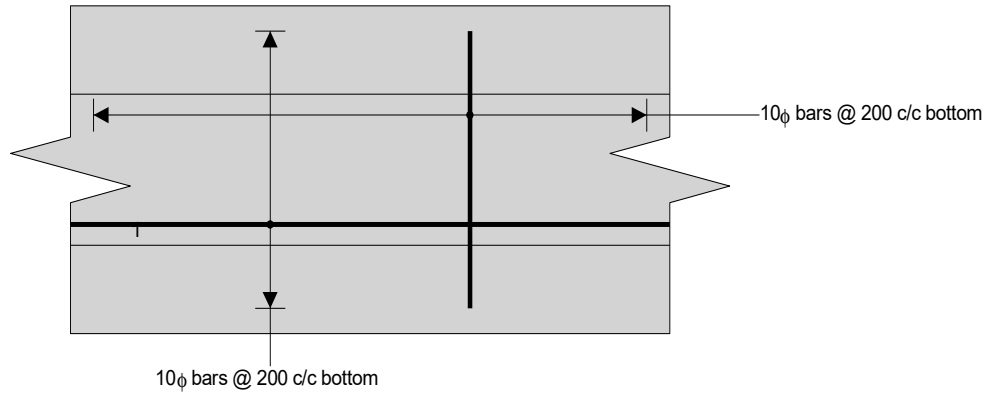
$$w_k = s_{r,max} \times \max([\sigma_s - k_t \times (f_{ct,eff} / \rho_{p,eff}) \times (1 + \alpha_e \times \rho_{p,eff})] / E_s,$$

$$0.6 \times \sigma_s / E_s) = 0.012 \text{ mm}$$

PASS - Maximum crack width is less than limiting crack width

Library item: Crack width output

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FOUNDATION ANALYSIS

In accordance with EN1997-1:2004 + A1:2013 incorporating corrigendum February 2009 and the UK National Annex incorporating corrigendum No.1

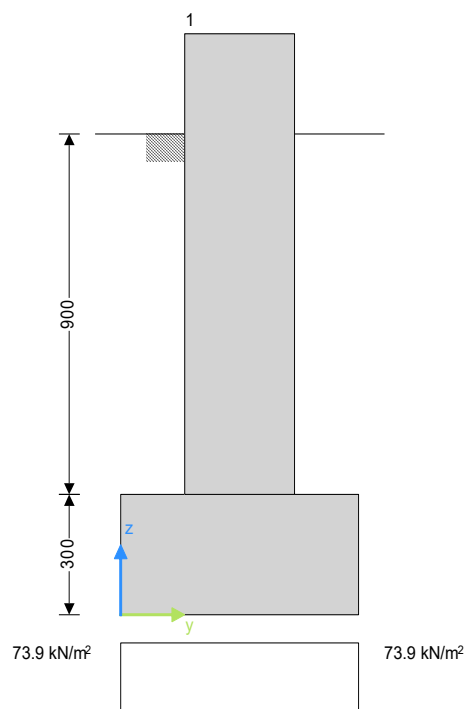
Tedds calculation version 3.3.06

Summary table

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Description	Unit	Provided	Required	Utilisation	Result
Reinforcement y-direction	mm ²	393	369	0.940	Pass
Description	Unit	Allowable	Actual	Utilisation	Result

Strip foundation details - considering a one meter strip

Length of foundation	$L_x = 1000$ mm
Width of foundation	$L_y = 650$ mm
Foundation area	$A = L_x \times L_y = 0.650$ m ²
Depth of foundation	$h = 300$ mm
Depth of soil over foundation	$h_{\text{soil}} = 900$ mm
Level of water	$h_{\text{water}} = 0$ mm
Density of water	$\gamma_{\text{water}} = 9.8$ kN/m ³
Density of concrete	$\gamma_{\text{conc}} = 25.0$ kN/m ³



Wall no.1 details

Width of wall	$l_{y1} = 300$ mm
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position in y-axis

$$y_1 = 325 \text{ mm}$$

Soil properties

Density of soil

$$\gamma_{\text{soil}} = 18.0 \text{ kN/m}^3$$

Characteristic cohesion

$$c'_k = 0 \text{ kN/m}^2$$

Characteristic effective shear resistance angle

$$\phi'_k = 30 \text{ deg}$$

Characteristic friction angle

$$\delta_k = 20 \text{ deg}$$

Foundation loads

Self weight

$$F_{\text{swt}} = h \times \gamma_{\text{conc}} = 7.5 \text{ kN/m}^2$$

Soil weight

$$F_{\text{soil}} = h_{\text{soil}} \times \gamma_{\text{soil}} = 16.2 \text{ kN/m}^2$$

Wall no.1 loads per linear metre

Permanent axial load

$$F_{\text{Gz1}} = 25.8 \text{ kN}$$

Variable axial load

$$F_{\text{Qz1}} = 6.8 \text{ kN}$$

Bearing resistance (Section 6.5.2)

Forces on foundation per linear metre

Force in z-direction

$$F_{\text{dz}} = A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}} + F_{\text{Qz1}} = 48.0 \text{ kN}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{\text{dy}} = A \times (F_{\text{swt}} + F_{\text{soil}}) \times L_y / 2 + F_{\text{Gz1}} \times y_1 + F_{\text{Qz1}} \times y_1 = 15.6 \text{ kNm}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-axis

$$e_y = M_{\text{dy}} / F_{\text{dz}} - L_y / 2 = 0 \text{ mm}$$

Pad base pressures

$$q_1 = F_{\text{dz}} \times (1 - 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 73.9 \text{ kN/m}^2$$

$$q_2 = F_{\text{dz}} \times (1 + 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 73.9 \text{ kN/m}^2$$

Minimum base pressure

$$q_{\text{min}} = \min(q_1, q_2) = 73.9 \text{ kN/m}^2$$

Maximum base pressure

$$q_{\text{max}} = \max(q_1, q_2) = 73.9 \text{ kN/m}^2$$

Presumed bearing capacity

Presumed bearing capacity

$$P_{\text{bearing}} = 80.0 \text{ kN/m}^2$$

PASS - Presumed bearing capacity exceeds design base pressure

Design approach 1

Partial factors on actions - Combination1

Partial factor set

$$A1$$

Permanent unfavourable action - Table A.3

$$\gamma_G = 1.35$$

Permanent favourable action - Table A.3

$$\gamma_{\text{Gf}} = 1.00$$

Variable unfavourable action - Table A.3

$$\gamma_Q = 1.50$$

Variable favourable action - Table A.3

$$\gamma_{\text{Qf}} = 0.00$$

Partial factors for spread foundations - Combination1

Resistance factor set

$$R1$$

Bearing - Table A.5

$$\gamma_{\text{R.v}} = 1.00$$

Sliding - Table A.5

$$\gamma_{\text{R.h}} = 1.00$$

Forces on foundation per linear metre

Force in z-direction

$$F_{\text{dz}} = \gamma_G \times (A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}}) + \gamma_Q \times F_{\text{Qz1}} = 65.9 \text{ kN}$$

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Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{21.4 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{101.3 \text{ kN/m}^2}$$

Design approach 1

Partial factors on actions - Combination2

Partial factor set

$$A2$$

Permanent unfavourable action - Table A.3

$$\gamma_G = \mathbf{1.00}$$

Permanent favourable action - Table A.3

$$\gamma_{Gf} = \mathbf{1.00}$$

Variable unfavourable action - Table A.3

$$\gamma_Q = \mathbf{1.30}$$

Variable favourable action - Table A.3

$$\gamma_{Qf} = \mathbf{0.00}$$

Partial factors for spread foundations - Combination2

Resistance factor set

$$R1$$

Bearing - Table A.5

$$\gamma_{R,v} = \mathbf{1.00}$$

Sliding - Table A.5

$$\gamma_{R,h} = \mathbf{1.00}$$

Forces on foundation per linear metre

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil}) + F_{Gz1}) + \gamma_Q \times F_{Qz1} = \mathbf{50.1 \text{ kN}}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{16.3 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{77 \text{ kN/m}^2}$$

FOUNDATION DESIGN

In accordance with EN1992-1-1:2004 + A1:2014 incorporating corrigenda January 2008, November 2010 and January 2014 and the UK National Annex incorporating National Amendment No.1 and No.2

Tedds calculation version 3.3.06

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

Concrete strength class

$$C30/37$$

Characteristic compressive cylinder strength

$$f_{ck} = \mathbf{30 \text{ N/mm}^2}$$

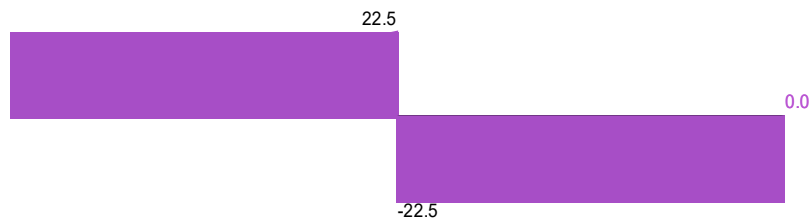
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Characteristic compressive cube strength	$f_{ck,cube} = 37 \text{ N/mm}^2$
Mean value of compressive cylinder strength	$f_{cm} = f_{ck} + 8 \text{ N/mm}^2 = 38 \text{ N/mm}^2$
Mean value of axial tensile strength	$f_{ctm} = 0.3 \text{ N/mm}^2 \times (f_{ck} / 1 \text{ N/mm}^2)^{2/3} = 2.9 \text{ N/mm}^2$
5% fractile of axial tensile strength	$f_{ctk,0.05} = 0.7 \times f_{ctm} = 2.0 \text{ N/mm}^2$
Secant modulus of elasticity of concrete	$E_{cm} = 22 \text{ kN/mm}^2 \times [f_{cm} / 10 \text{ N/mm}^2]^{0.3} = 32837 \text{ N/mm}^2$
Partial factor for concrete (Table 2.1N)	$\gamma_c = 1.50$
Compressive strength coefficient (cl.3.1.6(1))	$\alpha_{cc} = 0.85$
Design compressive concrete strength (exp.3.15)	$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_c = 17.0 \text{ N/mm}^2$
Tens.strength coeff.for plain concrete (cl.12.3.1(1))	$\alpha_{ct,pl} = 0.80$
Des.tens.strength for plain concrete (exp.12.1)	$f_{ctd,pl} = \alpha_{ct,pl} \times f_{ctk,0.05} / \gamma_c = 1.1 \text{ N/mm}^2$
Maximum aggregate size	$h_{agg} = 20 \text{ mm}$
Ultimate strain - Table 3.1	$\epsilon_{cu2} = 0.0035$
Shortening strain - Table 3.1	$\epsilon_{cu3} = 0.0035$
Effective compression zone height factor	$\lambda = 0.80$
Effective strength factor	$\eta = 1.00$
Bending coefficient k_1	$K_1 = 0.40$
Bending coefficient k_2	$K_2 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$
Bending coefficient k_3	$K_3 = 0.40$
Bending coefficient k_4	$K_4 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$

Reinforcement details

Characteristic yield strength of reinforcement	$f_{yk} = 500 \text{ N/mm}^2$
Modulus of elasticity of reinforcement	$E_s = 210000 \text{ N/mm}^2$
Partial factor for reinforcing steel (Table 2.1N)	$\gamma_s = 1.15$
Design yield strength of reinforcement	$f_{yd} = f_{yk} / \gamma_s = 435 \text{ N/mm}^2$
Nominal cover to top of foundation	$c_{nom_t} = 50 \text{ mm}$
Nominal cover to bottom of foundation	$c_{nom_b} = 50 \text{ mm}$
Nominal cover to side of foundation	$c_{nom_s} = 50 \text{ mm}$

Shear diagram (kN)



Moment diagram (kNm)



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Rectangular section in flexure (Section 6.1)

Design bending moment

$$M_{Ed,y,max} = 1.1 \text{ kNm}$$

Depth to tension reinforcement

$$d = h - c_{nom,b} - \phi_{y,bot} / 2 = 245 \text{ mm}$$

$$K = M_{Ed,y,max} / (L_x \times d^2 \times f_{ck}) = 0.001$$

$$K' = (2 \times \eta \times \alpha_{cc} / \gamma_c) \times (1 - \lambda \times (\delta - K_1) / (2 \times K_2)) \times (\lambda \times (\delta - K_1) / (2 \times K_2))$$

$$K' = 0.207$$

K' > K - No compression reinforcement is required

Lever arm

$$z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_c))^{0.5}, 0.95) \times d = 233 \text{ mm}$$

Depth of neutral axis

$$x = 2.5 \times (d - z) = 31 \text{ mm}$$

Area of tension reinforcement required

$$A_{sy,bot,req} = M_{Ed,y,max} / (f_{yd} \times z) = 10 \text{ mm}^2$$

Tension reinforcement provided

$$10 \phi \text{ bars @ 200 c/c bottom}$$

Area of tension reinforcement provided

$$A_{sy,bot,prov} = 393 \text{ mm}^2$$

Minimum area of reinforcement (exp.9.1N)

$$A_{s,min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times L_x \times d = 369 \text{ mm}^2$$

Maximum area of reinforcement (cl.9.2.1.1(3))

$$A_{s,max} = 0.04 \times L_x \times d = 9800 \text{ mm}^2$$

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

Crack control (Section 7.3)

Limiting crack width

$$w_{max} = 0.3 \text{ mm}$$

Variable load factor (EN1990 – Table A1.1)

$$\psi_2 = 0.3$$

Serviceability bending moment

$$M_{sls,y,max} = 0.7 \text{ kNm}$$

Tensile stress in reinforcement

$$\sigma_s = M_{sls,y,max} / (A_{sy,bot,prov} \times z) = 7.2 \text{ N/mm}^2$$

Load duration factor

$$k_t = 0.4$$

Effective depth of concrete in tension

$$h_{c,ef} = \min(2.5 \times (h - d), (h - x) / 3, h / 2) = 90 \text{ mm}$$

Effective area of concrete in tension

$$A_{c,eff} = h_{c,ef} \times L_x = 89792 \text{ mm}^2$$

Mean value of concrete tensile strength

$$f_{ct,eff} = f_{ctm} = 2.9 \text{ N/mm}^2$$

Reinforcement ratio

$$\rho_{p,eff} = A_{sy,bot,prov} / A_{c,eff} = 0.004$$

Modular ratio

$$\alpha_e = E_s / E_{cm} = 6.395$$

Bond property coefficient

$$k_1 = 0.8$$

Strain distribution coefficient

$$k_2 = 0.5$$

$$k_3 = 3.4 = 3.4$$

$$k_4 = 0.425$$

Maximum crack spacing (exp.7.11)

$$s_{r,max} = k_3 \times c_{nom,b} + k_1 \times k_2 \times k_4 \times \phi_{y,bot} / \rho_{p,eff} = 559 \text{ mm}$$

Maximum crack width (exp.7.8)

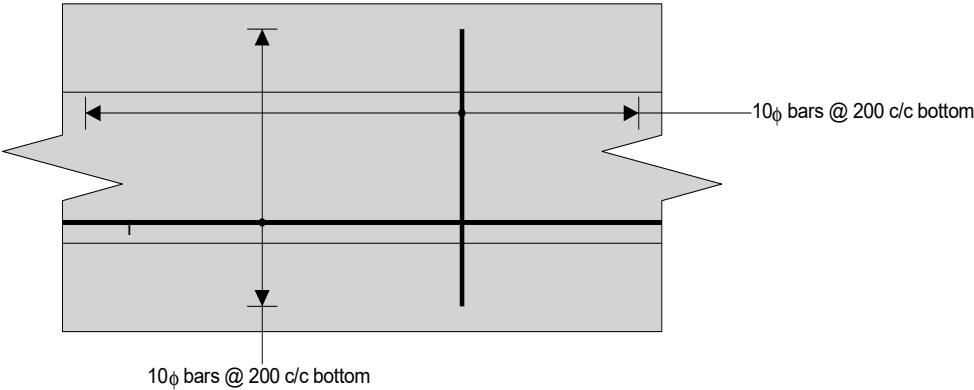
$$w_k = s_{r,max} \times \max([\sigma_s - k_t \times (f_{ct,eff} / \rho_{p,eff}) \times (1 + \alpha_e \times \rho_{p,eff})] / E_s,$$

$$0.6 \times \sigma_s / E_s) = 0.011 \text{ mm}$$

PASS - Maximum crack width is less than limiting crack width

Library item: Crack width output

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FOUNDATION ANALYSIS

In accordance with EN1997-1:2004 + A1:2013 incorporating corrigendum February 2009 and the UK National Annex incorporating corrigendum No.1

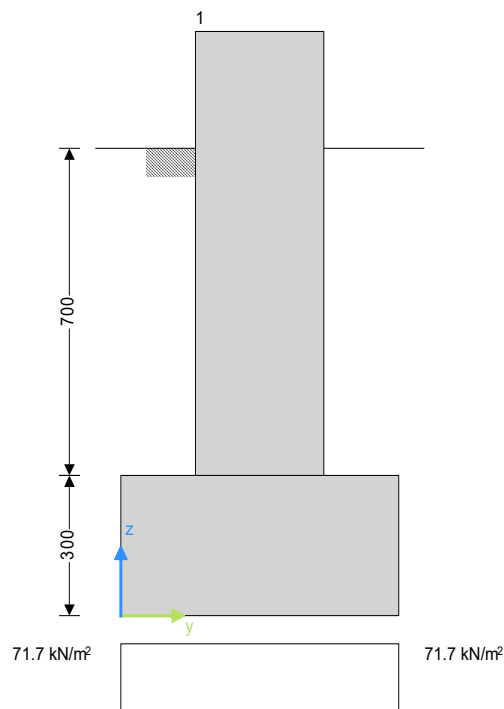
Tedds calculation version 3.3.06

Summary table

Description	Unit	Allowable	Actual	Utilisation	Result
Base pressure	kN/m ²	80	71.7	0.896	Pass
Description	Unit	Provided	Required	Utilisation	Result
Reinforcement y-direction	mm ²	393	369	0.940	Pass
Description	Unit	Allowable	Actual	Utilisation	Result

Strip foundation details - considering a one meter strip

Length of foundation	$L_x = 1000$ mm
Width of foundation	$L_y = 650$ mm
Foundation area	$A = L_x \times L_y = 0.650$ m ²
Depth of foundation	$h = 300$ mm
Depth of soil over foundation	$h_{\text{soil}} = 700$ mm
Level of water	$h_{\text{water}} = 0$ mm
Density of water	$\gamma_{\text{water}} = 9.8$ kN/m ³
Density of concrete	$\gamma_{\text{conc}} = 25.0$ kN/m ³



Wall no.1 details

Width of wall	$l_{y1} = 300$ mm
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position in y-axis

$$y_1 = 325 \text{ mm}$$

Soil properties

Density of soil

$$\gamma_{\text{soil}} = 18.0 \text{ kN/m}^3$$

Characteristic cohesion

$$c'_k = 0 \text{ kN/m}^2$$

Characteristic effective shear resistance angle

$$\phi'_k = 30 \text{ deg}$$

Characteristic friction angle

$$\delta_k = 20 \text{ deg}$$

Foundation loads

Self weight

$$F_{\text{swt}} = h \times \gamma_{\text{conc}} = 7.5 \text{ kN/m}^2$$

Soil weight

$$F_{\text{soil}} = h_{\text{soil}} \times \gamma_{\text{soil}} = 12.6 \text{ kN/m}^2$$

Wall no.1 loads per linear metre

Permanent axial load

$$F_{\text{Gz1}} = 29.8 \text{ kN}$$

Variable axial load

$$F_{\text{Qz1}} = 3.8 \text{ kN}$$

Bearing resistance (Section 6.5.2)

Forces on foundation per linear metre

Force in z-direction

$$F_{\text{dz}} = A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}} + F_{\text{Qz1}} = 46.6 \text{ kN}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{\text{dy}} = A \times (F_{\text{swt}} + F_{\text{soil}}) \times L_y / 2 + F_{\text{Gz1}} \times y_1 + F_{\text{Qz1}} \times y_1 = 15.1 \text{ kNm}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-axis

$$e_y = M_{\text{dy}} / F_{\text{dz}} - L_y / 2 = 0 \text{ mm}$$

Pad base pressures

$$q_1 = F_{\text{dz}} \times (1 - 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 71.7 \text{ kN/m}^2$$

$$q_2 = F_{\text{dz}} \times (1 + 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 71.7 \text{ kN/m}^2$$

Minimum base pressure

$$q_{\text{min}} = \min(q_1, q_2) = 71.7 \text{ kN/m}^2$$

Maximum base pressure

$$q_{\text{max}} = \max(q_1, q_2) = 71.7 \text{ kN/m}^2$$

Presumed bearing capacity

Presumed bearing capacity

$$P_{\text{bearing}} = 80.0 \text{ kN/m}^2$$

PASS - Presumed bearing capacity exceeds design base pressure

Design approach 1

Partial factors on actions - Combination1

Partial factor set

$$A1$$

Permanent unfavourable action - Table A.3

$$\gamma_G = 1.35$$

Permanent favourable action - Table A.3

$$\gamma_{\text{Gf}} = 1.00$$

Variable unfavourable action - Table A.3

$$\gamma_Q = 1.50$$

Variable favourable action - Table A.3

$$\gamma_{\text{Qf}} = 0.00$$

Partial factors for spread foundations - Combination1

Resistance factor set

$$R1$$

Bearing - Table A.5

$$\gamma_{\text{R.v}} = 1.00$$

Sliding - Table A.5

$$\gamma_{\text{R.h}} = 1.00$$

Forces on foundation per linear metre

Force in z-direction

$$F_{\text{dz}} = \gamma_G \times (A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}}) + \gamma_Q \times F_{\text{Qz1}} = 63.5 \text{ kN}$$

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Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{20.6 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{97.7 \text{ kN/m}^2}$$

Design approach 1

Partial factors on actions - Combination2

Partial factor set

$$A2$$

Permanent unfavourable action - Table A.3

$$\gamma_G = \mathbf{1.00}$$

Permanent favourable action - Table A.3

$$\gamma_{Gf} = \mathbf{1.00}$$

Variable unfavourable action - Table A.3

$$\gamma_Q = \mathbf{1.30}$$

Variable favourable action - Table A.3

$$\gamma_{Qf} = \mathbf{0.00}$$

Partial factors for spread foundations - Combination2

Resistance factor set

$$R1$$

Bearing - Table A.5

$$\gamma_{R,v} = \mathbf{1.00}$$

Sliding - Table A.5

$$\gamma_{R,h} = \mathbf{1.00}$$

Forces on foundation per linear metre

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil}) + F_{Gz1}) + \gamma_Q \times F_{Qz1} = \mathbf{47.8 \text{ kN}}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{15.5 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{73.5 \text{ kN/m}^2}$$

FOUNDATION DESIGN

In accordance with EN1992-1-1:2004 + A1:2014 incorporating corrigenda January 2008, November 2010 and January 2014 and the UK National Annex incorporating National Amendment No.1 and No.2

Tedds calculation version 3.3.06

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

Concrete strength class

$$C30/37$$

Characteristic compressive cylinder strength

$$f_{ck} = \mathbf{30 \text{ N/mm}^2}$$

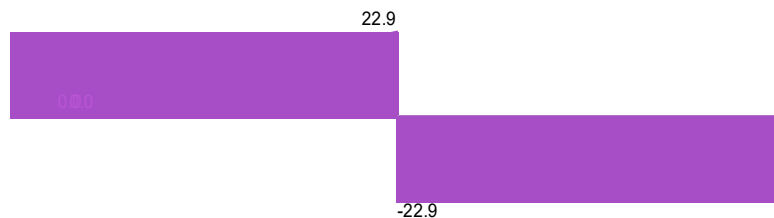
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Characteristic compressive cube strength	$f_{ck,cube} = 37 \text{ N/mm}^2$
Mean value of compressive cylinder strength	$f_{cm} = f_{ck} + 8 \text{ N/mm}^2 = 38 \text{ N/mm}^2$
Mean value of axial tensile strength	$f_{ctm} = 0.3 \text{ N/mm}^2 \times (f_{ck} / 1 \text{ N/mm}^2)^{2/3} = 2.9 \text{ N/mm}^2$
5% fractile of axial tensile strength	$f_{ctk,0.05} = 0.7 \times f_{ctm} = 2.0 \text{ N/mm}^2$
Secant modulus of elasticity of concrete	$E_{cm} = 22 \text{ kN/mm}^2 \times [f_{cm} / 10 \text{ N/mm}^2]^{0.3} = 32837 \text{ N/mm}^2$
Partial factor for concrete (Table 2.1N)	$\gamma_c = 1.50$
Compressive strength coefficient (cl.3.1.6(1))	$\alpha_{cc} = 0.85$
Design compressive concrete strength (exp.3.15)	$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_c = 17.0 \text{ N/mm}^2$
Tens. strength coeff. for plain concrete (cl.12.3.1(1))	$\alpha_{ct,pl} = 0.80$
Des. tens. strength for plain concrete (exp.12.1)	$f_{ctd,pl} = \alpha_{ct,pl} \times f_{ctk,0.05} / \gamma_c = 1.1 \text{ N/mm}^2$
Maximum aggregate size	$h_{agg} = 20 \text{ mm}$
Ultimate strain - Table 3.1	$\epsilon_{cu2} = 0.0035$
Shortening strain - Table 3.1	$\epsilon_{cu3} = 0.0035$
Effective compression zone height factor	$\lambda = 0.80$
Effective strength factor	$\eta = 1.00$
Bending coefficient k_1	$K_1 = 0.40$
Bending coefficient k_2	$K_2 = 1.00 \times (0.6 + 0.0014 / \epsilon_{cu2}) = 1.00$
Bending coefficient k_3	$K_3 = 0.40$
Bending coefficient k_4	$K_4 = 1.00 \times (0.6 + 0.0014 / \epsilon_{cu2}) = 1.00$

Reinforcement details

Characteristic yield strength of reinforcement	$f_{yk} = 500 \text{ N/mm}^2$
Modulus of elasticity of reinforcement	$E_s = 210000 \text{ N/mm}^2$
Partial factor for reinforcing steel (Table 2.1N)	$\gamma_s = 1.15$
Design yield strength of reinforcement	$f_{yd} = f_{yk} / \gamma_s = 435 \text{ N/mm}^2$
Nominal cover to top of foundation	$c_{nom_t} = 50 \text{ mm}$
Nominal cover to bottom of foundation	$c_{nom_b} = 50 \text{ mm}$
Nominal cover to side of foundation	$c_{nom_s} = 50 \text{ mm}$

Shear diagram (kN)



Moment diagram (kNm)



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Rectangular section in flexure (Section 6.1)

Design bending moment

$$M_{Ed,y,max} = 1.1 \text{ kNm}$$

Depth to tension reinforcement

$$d = h - c_{nom,b} - \phi_{y,bot} / 2 = 245 \text{ mm}$$

$$K = M_{Ed,y,max} / (L_x \times d^2 \times f_{ck}) = 0.001$$

$$K' = (2 \times \eta \times \alpha_{cc} / \gamma_c) \times (1 - \lambda \times (\delta - K_1) / (2 \times K_2)) \times (\lambda \times (\delta - K_1) / (2 \times K_2))$$

$$K' = 0.207$$

K' > K - No compression reinforcement is required

Lever arm

$$z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_c))^{0.5}, 0.95) \times d = 233 \text{ mm}$$

Depth of neutral axis

$$x = 2.5 \times (d - z) = 31 \text{ mm}$$

Area of tension reinforcement required

$$A_{sy,bot,req} = M_{Ed,y,max} / (f_{yd} \times z) = 11 \text{ mm}^2$$

Tension reinforcement provided

$$10 \phi \text{ bars @ 200 c/c bottom}$$

Area of tension reinforcement provided

$$A_{sy,bot,prov} = 393 \text{ mm}^2$$

Minimum area of reinforcement (exp.9.1N)

$$A_{s,min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times L_x \times d = 369 \text{ mm}^2$$

Maximum area of reinforcement (cl.9.2.1.1(3))

$$A_{s,max} = 0.04 \times L_x \times d = 9800 \text{ mm}^2$$

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

Crack control (Section 7.3)

Limiting crack width

$$w_{max} = 0.3 \text{ mm}$$

Variable load factor (EN1990 – Table A1.1)

$$\psi_2 = 0.3$$

Serviceability bending moment

$$M_{sls,y,max} = 0.7 \text{ kNm}$$

Tensile stress in reinforcement

$$\sigma_s = M_{sls,y,max} / (A_{sy,bot,prov} \times z) = 8 \text{ N/mm}^2$$

Load duration factor

$$k_t = 0.4$$

Effective depth of concrete in tension

$$h_{c,ef} = \min(2.5 \times (h - d), (h - x) / 3, h / 2) = 90 \text{ mm}$$

Effective area of concrete in tension

$$A_{c,eff} = h_{c,ef} \times L_x = 89792 \text{ mm}^2$$

Mean value of concrete tensile strength

$$f_{ct,eff} = f_{ctm} = 2.9 \text{ N/mm}^2$$

Reinforcement ratio

$$\rho_{p,eff} = A_{sy,bot,prov} / A_{c,eff} = 0.004$$

Modular ratio

$$\alpha_e = E_s / E_{cm} = 6.395$$

Bond property coefficient

$$k_1 = 0.8$$

Strain distribution coefficient

$$k_2 = 0.5$$

$$k_3 = 3.4 = 3.4$$

$$k_4 = 0.425$$

Maximum crack spacing (exp.7.11)

$$s_{r,max} = k_3 \times c_{nom,b} + k_1 \times k_2 \times k_4 \times \phi_{y,bot} / \rho_{p,eff} = 559 \text{ mm}$$

Maximum crack width (exp.7.8)

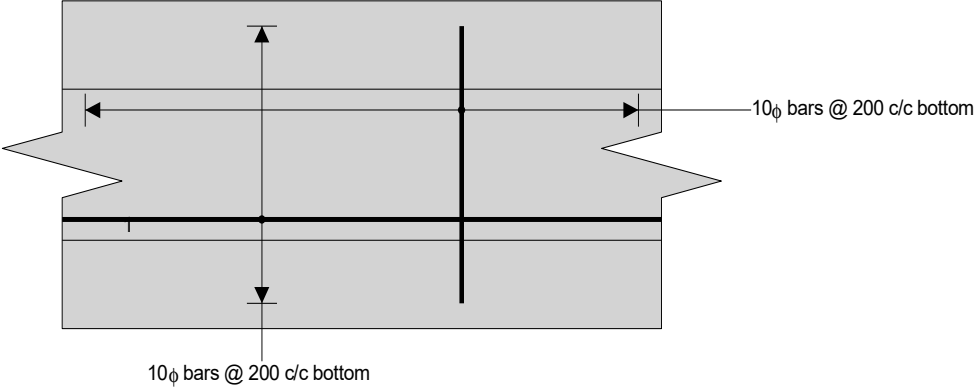
$$w_k = s_{r,max} \times \max([\sigma_s - k_t \times (f_{ct,eff} / \rho_{p,eff}) \times (1 + \alpha_e \times \rho_{p,eff})] / E_s,$$

$$0.6 \times \sigma_s / E_s) = 0.013 \text{ mm}$$

PASS - Maximum crack width is less than limiting crack width

Library item: Crack width output

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FOUNDATION ANALYSIS

In accordance with EN1997-1:2004 + A1:2013 incorporating corrigendum February 2009 and the UK National Annex incorporating corrigendum No.1

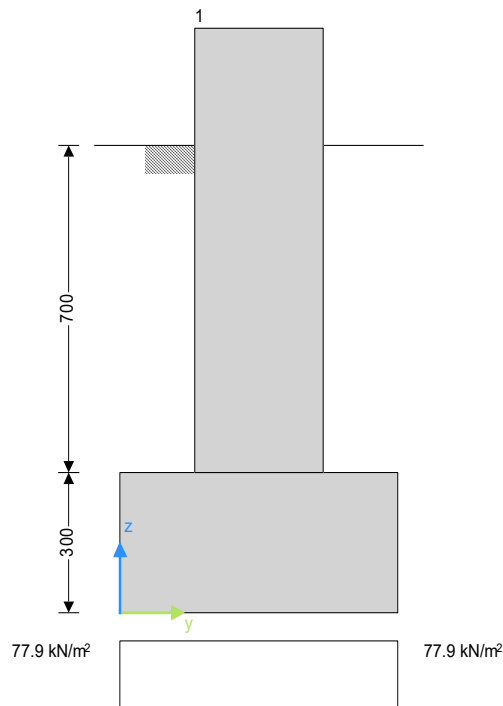
Tedds calculation version 3.3.06

Summary table

Description	Unit	Allowable	Actual	Utilisation	Result
Base pressure	kN/m ²	80	77.9	0.973	Pass

Strip foundation details - considering a one meter strip

Length of foundation	$L_x = 1000$ mm
Width of foundation	$L_y = 650$ mm
Foundation area	$A = L_x \times L_y = 0.650$ m ²
Depth of foundation	$h = 300$ mm
Depth of soil over foundation	$h_{\text{soil}} = 700$ mm
Level of water	$h_{\text{water}} = 0$ mm
Density of water	$\gamma_{\text{water}} = 9.8$ kN/m ³
Density of concrete	$\gamma_{\text{conc}} = 25.0$ kN/m ³



Wall no.1 details

Width of wall	$l_{y1} = 300$ mm
position in y-axis	$y_1 = 325$ mm

Soil properties

Density of soil	$\gamma_{\text{soil}} = 18.0$ kN/m ³
Characteristic cohesion	$c'_k = 0$ kN/m ²

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Characteristic effective shear resistance angle

$$\phi'_k = \mathbf{30 \text{ deg}}$$

Characteristic friction angle

$$\delta_k = \mathbf{20 \text{ deg}}$$

Foundation loads

Self weight

$$F_{\text{swt}} = h \times \gamma_{\text{conc}} = \mathbf{7.5 \text{ kN/m}^2}$$

Soil weight

$$F_{\text{soil}} = h_{\text{soil}} \times \gamma_{\text{soil}} = \mathbf{12.6 \text{ kN/m}^2}$$

Wall no.1 loads per linear metre

Permanent axial load

$$F_{\text{Gz1}} = \mathbf{28.6 \text{ kN}}$$

Variable axial load

$$F_{\text{Qz1}} = \mathbf{9.0 \text{ kN}}$$

Bearing resistance (Section 6.5.2)

Forces on foundation per linear metre

Force in z-direction

$$F_{\text{dz}} = A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}} + F_{\text{Qz1}} = \mathbf{50.6 \text{ kN}}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{\text{dy}} = A \times (F_{\text{swt}} + F_{\text{soil}}) \times L_y / 2 + F_{\text{Gz1}} \times y_1 + F_{\text{Qz1}} \times y_1 = \mathbf{16.4 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-axis

$$e_y = M_{\text{dy}} / F_{\text{dz}} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Pad base pressures

$$q_1 = F_{\text{dz}} \times (1 - 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = \mathbf{77.9 \text{ kN/m}^2}$$

$$q_2 = F_{\text{dz}} \times (1 + 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = \mathbf{77.9 \text{ kN/m}^2}$$

Minimum base pressure

$$q_{\text{min}} = \min(q_1, q_2) = \mathbf{77.9 \text{ kN/m}^2}$$

Maximum base pressure

$$q_{\text{max}} = \max(q_1, q_2) = \mathbf{77.9 \text{ kN/m}^2}$$

Presumed bearing capacity

Presumed bearing capacity

$$P_{\text{bearing}} = \mathbf{80.0 \text{ kN/m}^2}$$

PASS - Presumed bearing capacity exceeds design base pressure

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FOUNDATION ANALYSIS

In accordance with EN1997-1:2004 + A1:2013 incorporating corrigendum February 2009 and the UK National Annex incorporating corrigendum No.1

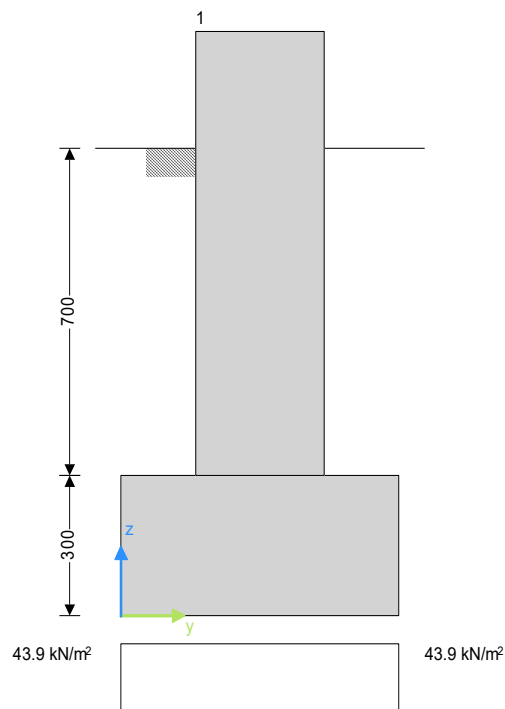
Tedds calculation version 3.3.06

Summary table

Description	Unit	Allowable	Actual	Utilisation	Result
Base pressure	kN/m ²	80	43.9	0.549	Pass
Description	Unit	Provided	Required	Utilisation	Result
		Allowable	Actual	Utilisation	
Description	Unit	Allowable	Actual	Utilisation	Result

Strip foundation details - considering a one meter strip

Length of foundation	$L_x = 1000$ mm
Width of foundation	$L_y = 650$ mm
Foundation area	$A = L_x \times L_y = 0.650$ m ²
Depth of foundation	$h = 300$ mm
Depth of soil over foundation	$h_{\text{soil}} = 700$ mm
Level of water	$h_{\text{water}} = 0$ mm
Density of water	$\gamma_{\text{water}} = 9.8$ kN/m ³
Density of concrete	$\gamma_{\text{conc}} = 25.0$ kN/m ³



Wall no.1 details

Width of wall $l_{y1} = 300$ mm

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position in y-axis

$$y_1 = 325 \text{ mm}$$

Soil properties

Density of soil

$$\gamma_{\text{soil}} = 18.0 \text{ kN/m}^3$$

Characteristic cohesion

$$c'_k = 0 \text{ kN/m}^2$$

Characteristic effective shear resistance angle

$$\phi'_k = 30 \text{ deg}$$

Characteristic friction angle

$$\delta_k = 20 \text{ deg}$$

Foundation loads

Self weight

$$F_{\text{swt}} = h \times \gamma_{\text{conc}} = 7.5 \text{ kN/m}^2$$

Soil weight

$$F_{\text{soil}} = h_{\text{soil}} \times \gamma_{\text{soil}} = 12.6 \text{ kN/m}^2$$

Wall no.1 loads per linear metre

Permanent axial load

$$F_{\text{Gz1}} = 13.0 \text{ kN}$$

Variable axial load

$$F_{\text{Qz1}} = 2.5 \text{ kN}$$

Bearing resistance (Section 6.5.2)

Forces on foundation per linear metre

Force in z-direction

$$F_{\text{dz}} = A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}} + F_{\text{Qz1}} = 28.6 \text{ kN}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{\text{dy}} = A \times (F_{\text{swt}} + F_{\text{soil}}) \times L_y / 2 + F_{\text{Gz1}} \times y_1 + F_{\text{Qz1}} \times y_1 = 9.3 \text{ kNm}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-axis

$$e_y = M_{\text{dy}} / F_{\text{dz}} - L_y / 2 = 0 \text{ mm}$$

Pad base pressures

$$q_1 = F_{\text{dz}} \times (1 - 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 43.9 \text{ kN/m}^2$$

$$q_2 = F_{\text{dz}} \times (1 + 6 \times e_y / L_y) / (L_y \times 1000 \text{ mm}) = 43.9 \text{ kN/m}^2$$

Minimum base pressure

$$q_{\text{min}} = \min(q_1, q_2) = 43.9 \text{ kN/m}^2$$

Maximum base pressure

$$q_{\text{max}} = \max(q_1, q_2) = 43.9 \text{ kN/m}^2$$

Presumed bearing capacity

Presumed bearing capacity

$$P_{\text{bearing}} = 80.0 \text{ kN/m}^2$$

PASS - Presumed bearing capacity exceeds design base pressure

Design approach 1

Partial factors on actions - Combination1

Partial factor set

$$A1$$

Permanent unfavourable action - Table A.3

$$\gamma_G = 1.35$$

Permanent favourable action - Table A.3

$$\gamma_{\text{Gf}} = 1.00$$

Variable unfavourable action - Table A.3

$$\gamma_Q = 1.50$$

Variable favourable action - Table A.3

$$\gamma_{\text{Qf}} = 0.00$$

Partial factors for spread foundations - Combination1

Resistance factor set

$$R1$$

Bearing - Table A.5

$$\gamma_{\text{R.v}} = 1.00$$

Sliding - Table A.5

$$\gamma_{\text{R.h}} = 1.00$$

Forces on foundation per linear metre

Force in z-direction

$$F_{\text{dz}} = \gamma_G \times (A \times (F_{\text{swt}} + F_{\text{soil}}) + F_{\text{Gz1}}) + \gamma_Q \times F_{\text{Qz1}} = 38.9 \text{ kN}$$

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Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{12.6 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{59.9 \text{ kN/m}^2}$$

Design approach 1

Partial factors on actions - Combination2

Partial factor set

$$A2$$

Permanent unfavourable action - Table A.3

$$\gamma_G = \mathbf{1.00}$$

Permanent favourable action - Table A.3

$$\gamma_{Gf} = \mathbf{1.00}$$

Variable unfavourable action - Table A.3

$$\gamma_Q = \mathbf{1.30}$$

Variable favourable action - Table A.3

$$\gamma_{Qf} = \mathbf{0.00}$$

Partial factors for spread foundations - Combination2

Resistance factor set

$$R1$$

Bearing - Table A.5

$$\gamma_{R,v} = \mathbf{1.00}$$

Sliding - Table A.5

$$\gamma_{R,h} = \mathbf{1.00}$$

Forces on foundation per linear metre

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil}) + F_{Gz1}) + \gamma_Q \times F_{Qz1} = \mathbf{29.3 \text{ kN}}$$

Moments on foundation per linear metre

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times F_{Qz1} \times y_1 = \mathbf{9.5 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in y-direction

$$e_y = M_{dy} / F_{dz} - L_y / 2 = \mathbf{0 \text{ mm}}$$

Effective area of base per linear metre

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{650 \text{ mm}}$$

Effective length

$$L'_x = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.650 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{45.1 \text{ kN/m}^2}$$

FOUNDATION DESIGN

In accordance with EN1992-1-1:2004 + A1:2014 incorporating corrigenda January 2008, November 2010 and January 2014 and the UK National Annex incorporating National Amendment No.1 and No.2

Tedds calculation version 3.3.06

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

Concrete strength class

$$C30/37$$

Characteristic compressive cylinder strength

$$f_{ck} = \mathbf{30 \text{ N/mm}^2}$$

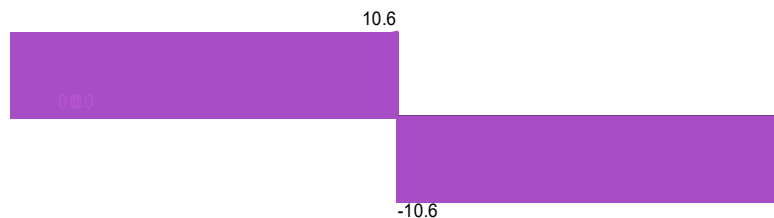
Project Land near Six Bells, Hoelgerrig, Merthyr Tydfil				Job Ref. AUX511	
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Characteristic compressive cube strength	$f_{ck,cube} = 37 \text{ N/mm}^2$
Mean value of compressive cylinder strength	$f_{cm} = f_{ck} + 8 \text{ N/mm}^2 = 38 \text{ N/mm}^2$
Mean value of axial tensile strength	$f_{ctm} = 0.3 \text{ N/mm}^2 \times (f_{ck} / 1 \text{ N/mm}^2)^{2/3} = 2.9 \text{ N/mm}^2$
5% fractile of axial tensile strength	$f_{ctk,0.05} = 0.7 \times f_{ctm} = 2.0 \text{ N/mm}^2$
Secant modulus of elasticity of concrete	$E_{cm} = 22 \text{ kN/mm}^2 \times [f_{cm} / 10 \text{ N/mm}^2]^{0.3} = 32837 \text{ N/mm}^2$
Partial factor for concrete (Table 2.1N)	$\gamma_c = 1.50$
Compressive strength coefficient (cl.3.1.6(1))	$\alpha_{cc} = 0.85$
Design compressive concrete strength (exp.3.15)	$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_c = 17.0 \text{ N/mm}^2$
Tens.strength coeff.for plain concrete (cl.12.3.1(1))	$\alpha_{ct,pl} = 0.80$
Des.tens.strength for plain concrete (exp.12.1)	$f_{ctd,pl} = \alpha_{ct,pl} \times f_{ctk,0.05} / \gamma_c = 1.1 \text{ N/mm}^2$
Maximum aggregate size	$h_{agg} = 20 \text{ mm}$
Ultimate strain - Table 3.1	$\epsilon_{cu2} = 0.0035$
Shortening strain - Table 3.1	$\epsilon_{cu3} = 0.0035$
Effective compression zone height factor	$\lambda = 0.80$
Effective strength factor	$\eta = 1.00$
Bending coefficient k_1	$K_1 = 0.40$
Bending coefficient k_2	$K_2 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$
Bending coefficient k_3	$K_3 = 0.40$
Bending coefficient k_4	$K_4 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$

Reinforcement details

Characteristic yield strength of reinforcement	$f_{yk} = 500 \text{ N/mm}^2$
Modulus of elasticity of reinforcement	$E_s = 210000 \text{ N/mm}^2$
Partial factor for reinforcing steel (Table 2.1N)	$\gamma_s = 1.15$
Design yield strength of reinforcement	$f_{yd} = f_{yk} / \gamma_s = 435 \text{ N/mm}^2$
Nominal cover to top of foundation	$c_{nom_t} = 50 \text{ mm}$
Nominal cover to bottom of foundation	$c_{nom_b} = 50 \text{ mm}$
Nominal cover to side of foundation	$c_{nom_s} = 50 \text{ mm}$

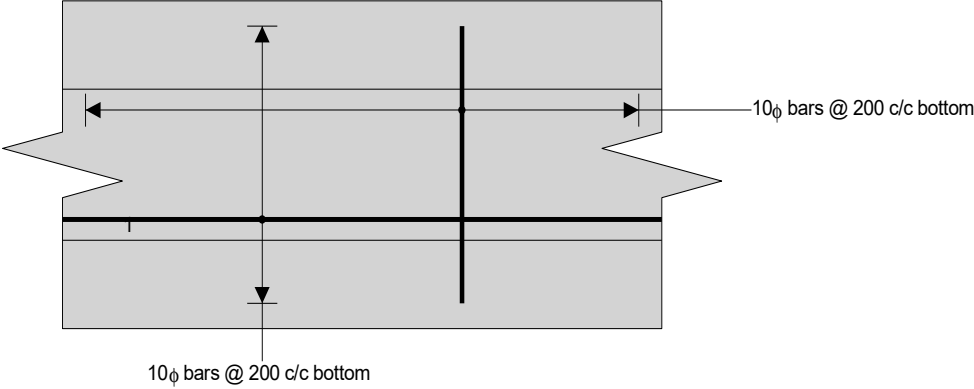
Shear diagram (kN)



Moment diagram (kNm)

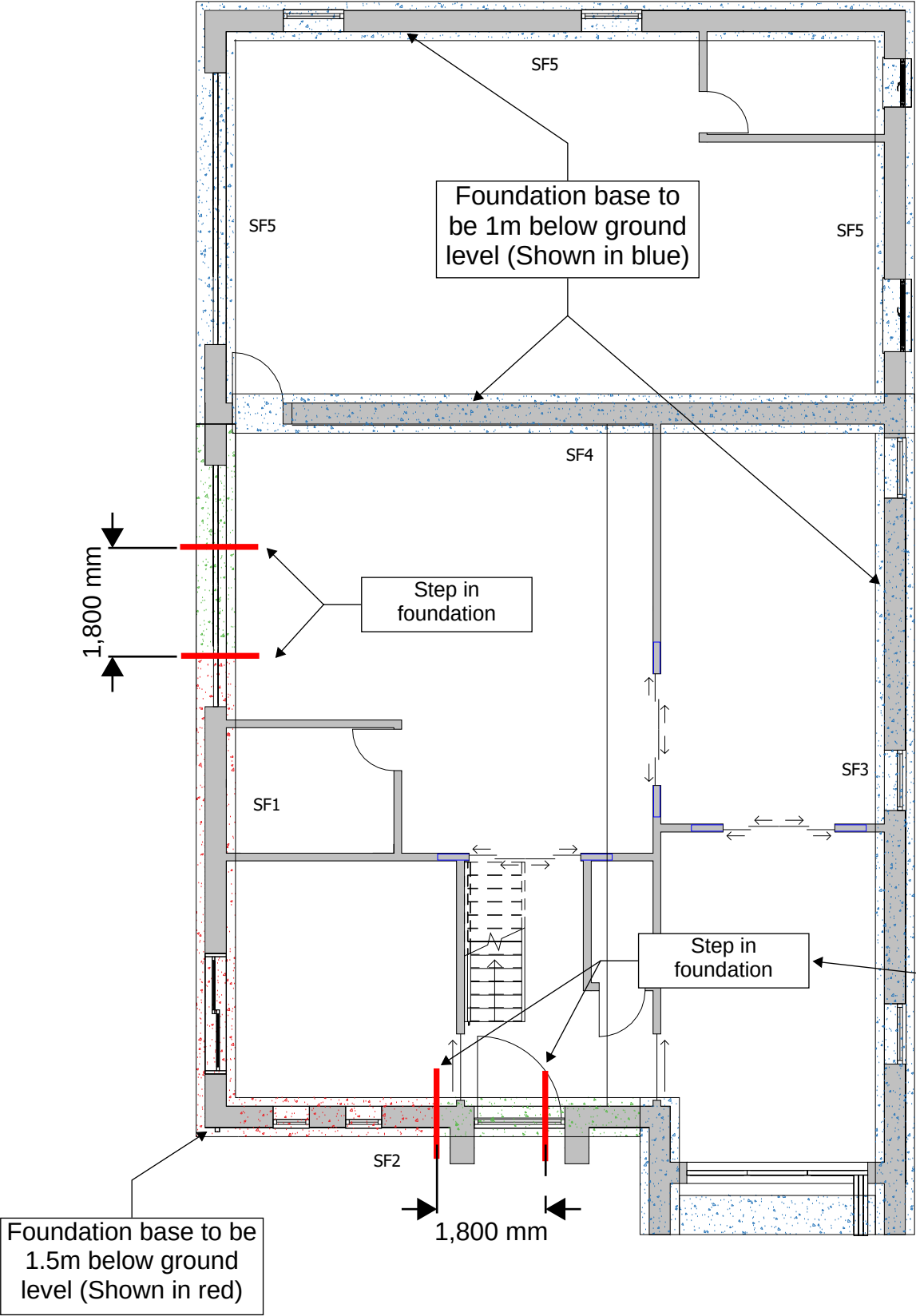


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Note : Contractor must take his own measurements prior to ordering any structural material.

- NOTES:
1. ALL DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
 2. DO NOT SCALE FROM THIS DRAWING.
 3. ALL DIMENSIONS TO BE VERIFIED ON SITE PRIOR TO COMMENCING WORKS

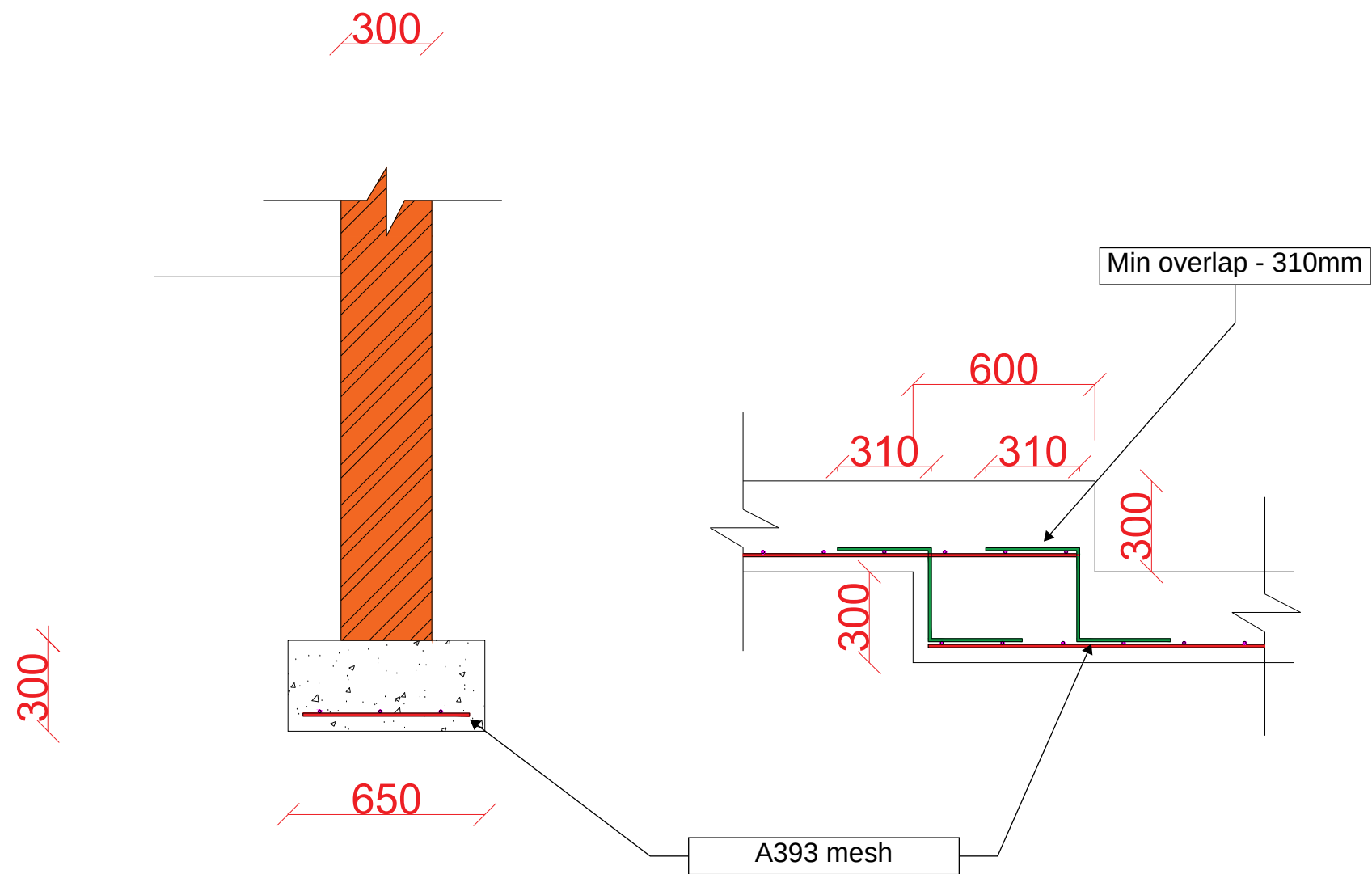


Ground floor plan shows foundation

			
Client			
Nick Meaney			
Project			
Land near Six Bells, Hoelgerrig, Merthyr Tydfil			
Drawing Title			
Ground floor plan shows foundation			
Drawing Status			
For Construction			
Drawn By:	Date:	Checked By:	Date:
MK	11/06/2025		
Original Size	Scale	Issue Date	
A3	NTS		
Project Number	Drawing Number	Revision	
AUX- 511	101	C01	

Note : Contractor must take his own measurements prior to ordering any structural material.

- NOTES:
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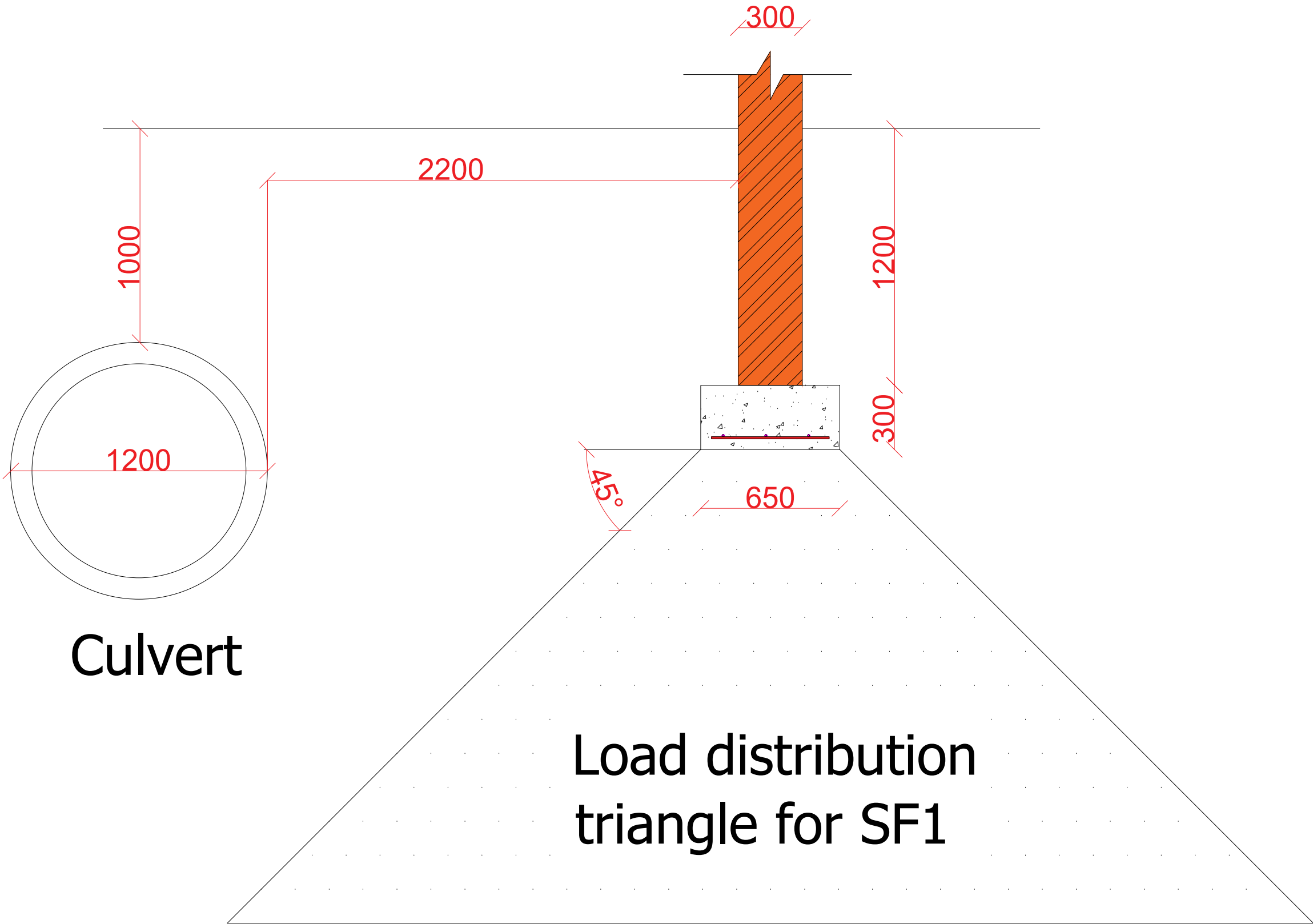


Step in foundation detail

			
Client			
Nick Meaney			
Project			
Land near Six Bells, Hoelgerrig, Merthyr Tydfil			
Drawing Title			
Detail 1			
Drawing Status			
For Construction			
Drawn By:	Date:	Checked By:	Date:
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A3	NTS		
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Note : Contractor must take his own measurements prior to ordering any structural material.

- NOTES:
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SECTION SHOWING SF1 LOAD DISTRIBUTION WITH REFERENCE TO CULVERT



Client
Nick Meaney

Project
Land near Six Bells, Hoelgerrig,
Merthyr Tydfil

Drawing Title
Detail 2

Drawing Status
For Construction

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Original Size	Scale	Issue Date
A3	NTS	

Project Number	Drawing Number	Revision
AUX- 511	102	C01