



Contract/Job:

Burbage Field Farm

Job No:

FW2285

Part of Works

Bund Fence Foundation

Calc Sh. No:

4.1 1

Rev:

-

Drawing No:

N/A

Calculation By/Date:

CK 09/04/24

Checked by/Date:

EL 09/04/24

Ref

Calculations

Scope

Foundation design to acoustic fence to top of bund at new development, Burbage Fields Farm, Burbage, LE10 2HS. Design of acoustic fence and fixings by others. Foundation designed to suit a 75kN/m² Ground Bearing Pressure to be confirmed via a plate bearing test to formation level on bund.

Loading Summary**Fence Loading**

Fence Wind Loading (See Tedds design)

Fence Post Self weight (conservative)

TOTAL**PERMANENT**

0.10 kN

0.10 kN**VARIABLE/WIND**0.60 kN/m²**0.60 kN/m²****Fence Foundation Design**

Height of Fence = 2.00 m

Spacing Between Fence Posts = 2.50 m

Forces to each Foundation*Self weight - Vertical Force*

0.10 kN

*Wind - Shear Force*2.00 m x 2.50 m x 0.60 kN/m²

3.00 kN

Wind - Moment Force

3.00 kN x 1.50 m

4.50 kNm

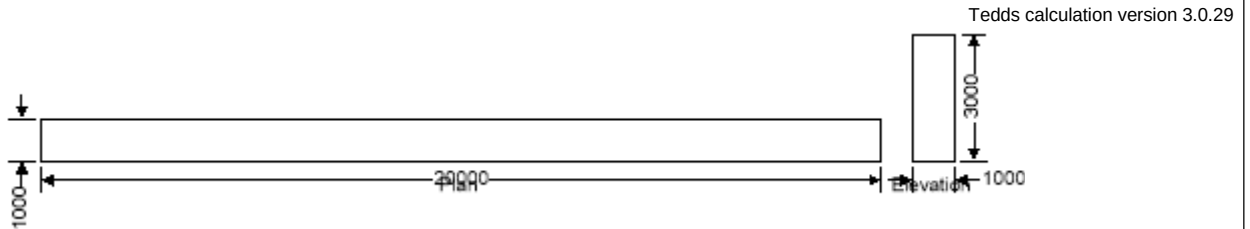
Shear force acting at mid height of fence + cover allowance

Tedds Design **1m x 1m x 0.45m thk 35N Concrete with A393 Mesh bottom (75mm cover), TOF to be min 300mm below Ground. Min 75kN/m² Bearing Capacity Required**

Project Burbage Field Farm				Job no. FW2285	
Calcs for Fence Wind Loading				Start page no./Revision 1	
Calcs by CK	Calcs date 09/04/2024	Checked by EL	Checked date 09/04/2024	Approved by	Approved date

WIND LOADING

In accordance with EN1991-1-4:2005+A1:2010 and the UK national annex



Building data

Type of roof	Flat
Length of building	L = 20000 mm
Width of building	W = 1000 mm
Height to eaves	H = 3000 mm
Eaves type	Sharp
Total height	h = 3000 mm

Basic values

Location	Leicester
Wind speed velocity (Figure NA.1)	$V_{b,map} = \mathbf{21.6}$ m/s
Distance to shore	$L_{shore} = \mathbf{114.00}$ km
Altitude above sea level	$A_{alt} = \mathbf{115.0}$ m
Altitude factor	$C_{alt} = A_{alt}/1m \times 0.001 + 1 = \mathbf{1.115}$
Fundamental basic wind velocity	$V_{b,0} = V_{b,map} \times C_{alt} = \mathbf{24.1}$ m/s
Direction factor	$C_{dir} = \mathbf{1.00}$
Season factor	$C_{season} = \mathbf{1.00}$
Shape parameter K	$K = \mathbf{0.2}$
Exponent n	$n = \mathbf{0.5}$
Air density	$\rho = \mathbf{1.226}$ kg/m ³
Probability factor	$C_{prob} = [(1 - K \times \ln(-\ln(1-p)))/(1 - K \times \ln(-\ln(0.98)))]^n = \mathbf{1.00}$
Basic wind velocity (Exp. 4.1)	$V_b = C_{dir} \times C_{season} \times V_{b,0} \times C_{prob} = \mathbf{24.1}$ m/s
Reference mean velocity pressure	$q_b = 0.5 \times \rho \times V_b^2 = \mathbf{0.356}$ kN/m ²

Orography

Orography factor not significant	$C_o = 1.0$
Terrain category	Country
Displacement height (sheltering effect excluded)	$h_{dis} = 0$ mm

The velocity pressure for the windward face of the building with a 0 degree wind is to be considered as 1 part as the height h is less than b (cl.7.2.2)

Peak velocity pressure - windward wall - Wind 0 deg and roof

Reference height (at which q is sought)	z = 3000 mm
Displacement height (sheltering effects excluded)	$h_{dis} = \mathbf{0}$ mm
Exposure factor (Figure NA.7)	$C_e = \mathbf{1.62}$
Peak velocity pressure	$q_p = C_e \times q_b = \mathbf{0.58}$ kN/m ²

Structural factor

Structural damping	$\delta_s = \mathbf{0.100}$
Height of element	$h_{part} = \mathbf{3000}$ mm

Project				Job no.	
Burbage Field Farm				FW2285	
Calcs for				Start page no./Revision	
Fence Wind Loading				2	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
CK	09/04/2024	EL	09/04/2024		

Size factor (Table NA.3)

$C_s = 0.904$

Dynamic factor (Figure NA.9)

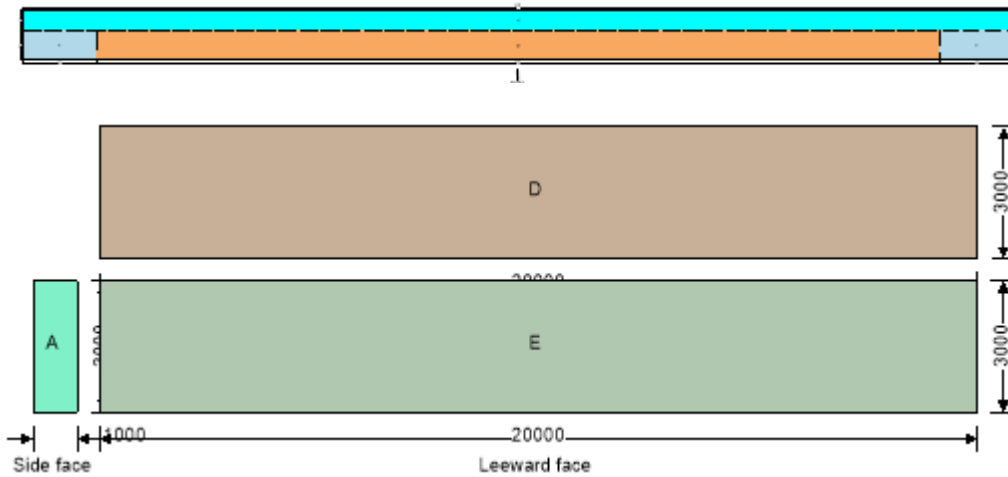
$C_d = 1.000$

Structural factor

$C_s C_d = C_s \times C_d = 0.904$

Peak velocity pressure for internal pressure

Peak velocity pressure – internal (as roof press.) $q_{p,i} = 0.58 \text{ kN/m}^2$



Project Burbage Field Farm				Job no. FW2285	
Calcs for Fence Foundation Design				Start page no./Revision 1	
Calcs by CK	Calcs date 09/04/2024	Checked by EL	Checked date 09/04/2024	Approved by	Approved date

FOUNDATION ANALYSIS

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

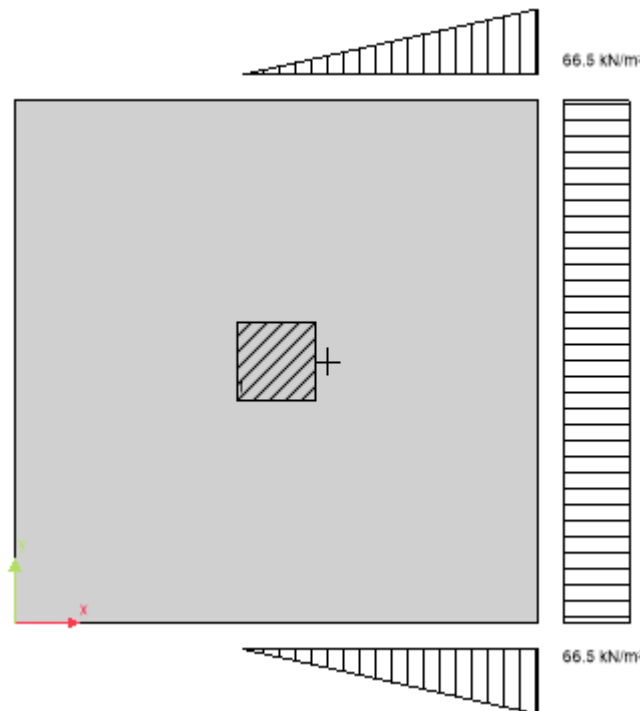
Tedds calculation version 3.3.05

Summary table

Description	Unit	Allowable	Actual	Utilisation	Result
Sliding	kN	5.2	3.9	0.755	Pass
Base pressure	kN/m ²	75	66.5	0.887	Pass
Concrete projection	mm	730	425	0.582	Pass

Pad foundation details

Length of foundation	$L_x = 1000$ mm
Width of foundation	$L_y = 1000$ mm
Foundation area	$A = L_x \times L_y = 1.000$ m ²
Depth of foundation	$h = 450$ mm
Depth of soil over foundation	$h_{\text{soil}} = 300$ 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



Column no.1 details

Length of column	$l_{x1} = 150$ mm
Width of column	$l_{y1} = 150$ mm
position in x-direction	$x_1 = 500$ mm
position in y-direction	$y_1 = 500$ mm

Project				Job no.	
Burbage Field Farm				FW2285	
Calcs for				Start page no./Revision	
Fence Foundation Design				2	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
CK	09/04/2024	EL	09/04/2024		

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

Permanent surcharge load	$F_{\text{Gsur}} = 1.0 \text{ kN/m}^2$
Variable surcharge load	$F_{\text{Qsur}} = 1.0 \text{ kN/m}^2$
Self weight	$F_{\text{swt}} = h \times \gamma_{\text{conc}} = 11.3 \text{ kN/m}^2$
Soil weight	$F_{\text{soil}} = h_{\text{soil}} \times \gamma_{\text{soil}} = 5.4 \text{ kN/m}^2$

Column no.1 loads

Permanent axial load	$F_{\text{Gz1}} = 0.1 \text{ kN}$
Wind horizontal load in x-direction	$F_{\text{Wx1}} = 3.0 \text{ kN}$
Wind moment in x-direction	$M_{\text{Wx1}} = 4.5 \text{ kNm}$

Bearing resistance (Section 6.5.2)

Forces on foundation

Force in x-direction	$F_{\text{dx}} = F_{\text{Wx1}} = 3.0 \text{ kN}$
Force in z-direction	$F_{\text{dz}} = A \times (F_{\text{swt}} + F_{\text{soil}} + F_{\text{Gsur}} + F_{\text{Qsur}}) + F_{\text{Gz1}} = 18.8 \text{ kN}$

Moments on foundation

Moment in x-direction	$M_{\text{dx}} = A \times (F_{\text{swt}} + F_{\text{soil}} + F_{\text{Gsur}} + F_{\text{Qsur}}) \times L_x / 2 + F_{\text{Gz1}} \times x_1 + M_{\text{Wx1}} + F_{\text{Wx1}} \times h = 15.2 \text{ kNm}$
Moment in y-direction	$M_{\text{dy}} = A \times (F_{\text{swt}} + F_{\text{soil}} + F_{\text{Gsur}} + F_{\text{Qsur}}) \times L_y / 2 + F_{\text{Gz1}} \times y_1 = 9.4 \text{ kNm}$

Eccentricity of base reaction

Eccentricity of base reaction in x-direction	$e_x = M_{\text{dx}} / F_{\text{dz}} - L_x / 2 = 312 \text{ mm}$
Eccentricity of base reaction in y-direction	$e_y = M_{\text{dy}} / F_{\text{dz}} - L_y / 2 = 0 \text{ mm}$

Pad base pressures

	$q_1 = 0 \text{ kN/m}^2$
	$q_2 = 0 \text{ kN/m}^2$
	$q_3 = 2 \times F_{\text{dz}} / (3 \times L_y \times (L_x / 2 - e_x)) = 66.5 \text{ kN/m}^2$
	$q_4 = 2 \times F_{\text{dz}} / (3 \times L_y \times (L_x / 2 + e_x)) = 66.5 \text{ kN/m}^2$
Minimum base pressure	$q_{\text{min}} = \min(q_1, q_2, q_3, q_4) = 0 \text{ kN/m}^2$
Maximum base pressure	$q_{\text{max}} = \max(q_1, q_2, q_3, q_4) = 66.5 \text{ kN/m}^2$

Presumed bearing capacity

Presumed bearing capacity	$P_{\text{bearing}} = 75.0 \text{ kN/m}^2$
<i>PASS - Presumed bearing capacity exceeds design base pressure</i>	

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
-----------------------	----

Project				Job no.	
Burbage Field Farm				FW2285	
Calcs for				Start page no./Revision	
Fence Foundation Design				3	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
CK	09/04/2024	EL	09/04/2024		

Bearing - Table A.5

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

Sliding - Table A.5

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

Forces on foundation

Force in x-direction

$$F_{dx} = \gamma_Q \times F_{Wx1} = \mathbf{4.5 \text{ kN}}$$

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil} + F_{Gsur}) + F_{Gz1}) + \gamma_Q \times A \times F_{Qsur} = \mathbf{25.5 \text{ kN}}$$

Moments on foundation

Moment in x-direction

$$M_{dx} = \gamma_G \times (A \times (F_{swt} + F_{soil} + F_{Gsur}) \times L_x / 2 + F_{Gz1} \times x_1) + \gamma_Q \times A \times F_{Qsur} \times L_x / 2 + \gamma_Q \times M_{Wx1} + (\gamma_Q \times F_{Wx1}) \times h = \mathbf{21.5 \text{ kNm}}$$

Moment in y-direction

$$M_{dy} = \gamma_G \times (A \times (F_{swt} + F_{soil} + F_{Gsur}) \times L_y / 2 + F_{Gz1} \times y_1) + \gamma_Q \times A \times F_{Qsur} \times L_y / 2 = \mathbf{12.7 \text{ kNm}}$$

Eccentricity of base reaction

Eccentricity of base reaction in x-direction

$$e_x = M_{dx} / F_{dz} - L_x / 2 = \mathbf{345 \text{ mm}}$$

Eccentricity of base reaction in y-direction

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

Effective area of base

Effective length

$$L'_x = L_x - 2 \times e_x = \mathbf{311 \text{ mm}}$$

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.311 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{81.9 \text{ kN/m}^2}$$

Sliding resistance (Section 6.5.3)

Forces on foundation

Force in x-direction

$$F_{dx} = \gamma_Q \times F_{Wx1} = \mathbf{4.5 \text{ kN}}$$

Force in z-direction

$$F_{dz} = \gamma_{Gf} \times (A \times (F_{swt} + F_{soil} + F_{Gsur}) + F_{Gz1}) + \gamma_{Qf} \times A \times F_{Qsur} = \mathbf{17.8 \text{ kN}}$$

Sliding resistance verification (Section 6.5.3)

Horizontal force on foundation

$$H = \text{abs}(F_{dx}) = \mathbf{4.5 \text{ kN}}$$

Design friction angle

$$\delta_d = \text{atan}(\tan(\delta_k) / \gamma_\phi) = \mathbf{20 \text{ deg}}$$

Sliding resistance (exp.6.3a)

$$R_{H,d} = F_{dz} \times \tan(\delta_d) = \mathbf{6.5 \text{ kN}}$$

$$H / R_{H,d} = \mathbf{0.697}$$

PASS - Foundation is not subject to failure by sliding

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

Force in x-direction

$$F_{dx} = \gamma_Q \times F_{Wx1} = \mathbf{3.9 \text{ kN}}$$

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil} + F_{Gsur}) + F_{Gz1}) + \gamma_Q \times A \times F_{Qsur} = \mathbf{19.1 \text{ kN}}$$

Project				Job no.	
Burbage Field Farm				FW2285	
Calcs for				Start page no./Revision	
Fence Foundation Design				4	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
CK	09/04/2024	EL	09/04/2024		

Moments on foundation

Moment in x-direction

$$M_{dx} = \gamma_G \times (A \times (F_{swt} + F_{soil} + F_{Gsur}) \times L_x / 2 + F_{Gz1} \times x_1) + \gamma_Q \times A \times F_{Qsur} \times L_x / 2 + \gamma_Q \times M_{wx1} + (\gamma_Q \times F_{wx1}) \times h = \mathbf{17.1 \text{ kNm}}$$

Moment in y-direction

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

Eccentricity of base reaction

Eccentricity of base reaction in x-direction

$$e_x = M_{dx} / F_{dz} - L_x / 2 = \mathbf{399 \text{ mm}}$$

Eccentricity of base reaction in y-direction

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

Effective area of base

Effective length

$$L'_x = L_x - 2 \times e_x = \mathbf{202 \text{ mm}}$$

Effective width

$$L'_y = L_y - 2 \times e_y = \mathbf{1000 \text{ mm}}$$

Effective area

$$A' = L'_x \times L'_y = \mathbf{0.202 \text{ m}^2}$$

Pad base pressure

Design base pressure

$$f_{dz} = F_{dz} / A' = \mathbf{94.5 \text{ kN/m}^2}$$

Sliding resistance (Section 6.5.3)

Forces on foundation

Force in x-direction

$$F_{dx} = \gamma_Q \times F_{wx1} = \mathbf{3.9 \text{ kN}}$$

Force in z-direction

$$F_{dz} = \gamma_G \times (A \times (F_{swt} + F_{soil} + F_{Gsur}) + F_{Gz1}) + \gamma_Q \times A \times F_{Qsur} = \mathbf{17.8 \text{ kN}}$$

Sliding resistance verification (Section 6.5.3)

Horizontal force on foundation

$$H = \text{abs}(F_{dx}) = \mathbf{3.9 \text{ kN}}$$

Design friction angle

$$\delta_d = \text{atan}(\tan(\delta_k) / \gamma_\phi) = \mathbf{16.234 \text{ deg}}$$

Sliding resistance (exp.6.3a)

$$R_{H,d} = F_{dz} \times \tan(\delta_d) = \mathbf{5.2 \text{ kN}}$$

$$H / R_{H,d} = \mathbf{0.755}$$

PASS - Foundation is not subject to failure by sliding

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 3.3.05

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

Concrete strength class

C28/35

Characteristic compressive cylinder strength

$$f_{ck} = \mathbf{28 \text{ N/mm}^2}$$

Mean value of axial tensile strength

$$f_{ctm} = 0.3 \text{ N/mm}^2 \times (f_{ck} / 1 \text{ N/mm}^2)^{2/3} = \mathbf{2.8 \text{ N/mm}^2}$$

5% fractile of axial tensile strength

$$f_{ctk,0.05} = 0.7 \times f_{ctm} = \mathbf{1.9 \text{ N/mm}^2}$$

Partial factor for concrete (Table 2.1N)

$$\gamma_C = \mathbf{1.50}$$

Tens.strength coeff.for plain concrete (cl.12.3.1(1))

$$\alpha_{ct,pl} = \mathbf{0.80}$$

Des.tens.strength for plain concrete (exp.12.1)

$$f_{ctd,pl} = \alpha_{ct,pl} \times f_{ctk,0.05} / \gamma_C = \mathbf{1.0 \text{ N/mm}^2}$$

Reinforcement details

Reinforcement in x-direction

A393 Square mesh 10 ϕ bars @ 200 c/c bottom

Reinforcement in y-direction

A393 Square mesh 10 ϕ bars @ 200 c/c bottom

Strip and pad footings (Section 12.9.3)

Design base pressure

$$f_{dz} = \mathbf{94.5 \text{ kN/m}^2}$$

Projection from column face

$$a = \mathbf{425 \text{ mm}}$$

Max.projection from column face - (exp.12.13)

$$a_{max} = 0.85 \times h / \sqrt{[3 \times f_{dz} / f_{ctd,pl}]} = \mathbf{730 \text{ mm}}$$

Project				Job no.	
Burbage Field Farm				FW2285	
Calcs for				Start page no./Revision	
Fence Foundation Design				5	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
CK	09/04/2024	EL	09/04/2024		

PASS - Projection from the column face doesn't exceed permissible limit for plain concrete

