

CALCULATION PREFACE SHEET

CLIENT: DR REDDY	SHEET 01 OF 05	
PROJECT: NEW BOILER STACK FOUNDATION	PROJECT No: 23065	
SUBJECT: STRUCTURAL CALCULATIONS	CALC. No: 23065-C-01	REV: 0

DETAILS OF DESIGN CODES, DATA, ETC.

DETAILS OF COMPUTER PROGRAMME/FILE REFERENCES

TEKLA TEDDS

0	AGH	SEP 23	MS	AGH		BUILDING CONTROL
REV	BY	DATE	CHK' D	APPV'D	APPV'D	DESCRIPTION

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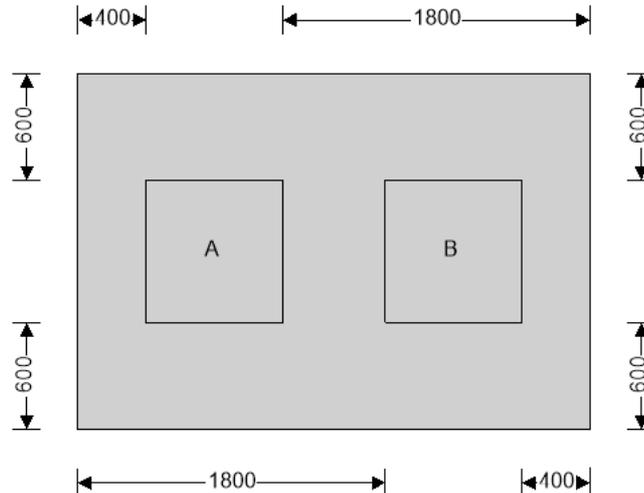
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PAD FOOTING ANALYSIS AND DESIGN (BS8110-1:1997)

Tedds calculation version 2.0.07



Pad footing details

Length of pad footing	$L = 3000$ mm	Width of pad footing	$B = 2000$ mm
Depth of pad footing	$h = 400$ mm	Depth of soil over pad footing	$h_{\text{soil}} = 200$ mm
Density of concrete	$\rho_{\text{conc}} = 23.6$ kN/m ³		

Column details

	Column A	Column B
Column base length	$l_A = 800$ mm	$l_B = 800$ mm
Column base width	$b_A = 800$ mm	$b_B = 800$ mm
Column eccentricity in x	$e_{PxA} = -700$ mm	$e_{PxB} = 700$ mm
Column eccentricity in y	$e_{PyA} = 0$ mm	$e_{PyB} = 0$ mm

Soil details

Depth of soil over pad footing	$h_{\text{soil}} = 200$ mm	Density of soil	$\rho_{\text{soil}} = 20.0$ kN/m ³
Allowable bearing pressure	$P_{\text{bearing}} = 100$ kN/m ²		

Axial loading on columns

	Column A	Column B
Dead axial load	$P_{GA} = 10.5$ kN	$P_{GB} = 10.5$ kN
Imposed axial load	$P_{QA} = 0.0$ kN	$P_{QB} = 0.0$ kN
Wind axial load	$P_{WA} = 0.0$ kN	$P_{WB} = 0.0$ kN
Total axial load	$P_A = 10.5$ kN	$P_B = 10.5$ kN

Foundation loads

Dead surcharge load	$F_{G_{\text{sur}}} = 0.000$ kN/m ²	Imposed surcharge load	$F_{Q_{\text{sur}}} = 0.000$ kN/m ²
Pad footing self weight	$F_{\text{swt}} = 9.440$ kN/m ²		
Soil self weight	$F_{\text{soil}} = 4.000$ kN/m ²	Total foundation load	$F = 80.6$ kN

Horizontal loading

	Column A	Column B
Dead load in x direction	$H_{GxA} = 0.0$ kN	$H_{GxB} = 0.0$ kN
Imposed load in x direction	$H_{QxA} = 0.0$ kN	$H_{QxB} = 0.0$ kN
Wind load in x direction	$H_{WxA} = 0.0$ kN	$H_{WxB} = 0.0$ kN
Total load in x direction	$H_{xA} = 0.0$ kN	$H_{xB} = 0.0$ kN
Dead load in y direction	$H_{GyA} = 4.4$ kN	$H_{GyB} = 4.4$ kN
Imposed load in y direction	$H_{QyA} = 0.0$ kN	$H_{QyB} = 0.0$ kN
Wind load in y direction	$H_{WyA} = 0.0$ kN	$H_{WyB} = 0.0$ kN

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Total load in y direction	$H_{yA} = 4.4$ kN	$H_{yB} = 4.4$ kN
Moment on column bases	Column A	Column B
Dead moment in x direction	$M_{GxA} = 0.000$ kNm	$M_{GxB} = 0.000$ kNm
Imposed moment in x direction	$M_{QxA} = 0.000$ kNm	$M_{QxB} = 0.000$ kNm
Wind moment in x direction	$M_{WxA} = 20.000$ kNm	$M_{WxB} = 20.000$ kNm
Total moment in x direction	$M_{xA} = 20.000$ kNm	$M_{xB} = 20.000$ kNm
Dead moment in y direction	$M_{GyA} = 0.000$ kNm	$M_{GyB} = 0.000$ kNm
Imposed moment in y direction	$M_{QyA} = 0.000$ kNm	$M_{QyB} = 0.000$ kNm
Wind moment in y direction	$M_{WyA} = 0.000$ kNm	$M_{WyB} = 0.000$ kNm
Total moment in y direction	$M_{yA} = 0.000$ kNm	$M_{yB} = 0.000$ kNm

Check stability against sliding

Passive pressure coefficient $K_p = 2.464$

Stability against sliding in y direction

Total sliding resistance in y dir $H_{yres} = 59.2$ kN

PASS - Resistance to sliding is greater than horizontal load in y direction

Check stability against overturning in x direction

Total overturning moment $M_{xOT} = 40.000$ kNm Total restoring moment $M_{xres} = 152.460$ kNm

PASS - Restoring moment is greater than overturning moment in x direction

Check stability against overturning in y direction

Total overturning moment $M_{yOT} = 3.520$ kNm Total restoring moment $M_{yres} = 101.640$ kNm

PASS - Restoring moment is greater than overturning moment in y direction

Calculate pad base reaction

Total base reaction $T = 101.6$ kN

Base reaction eccentricity in x $e_{Tx} = 394$ mm

Base reaction eccentricity in y $e_{Ty} = 35$ mm

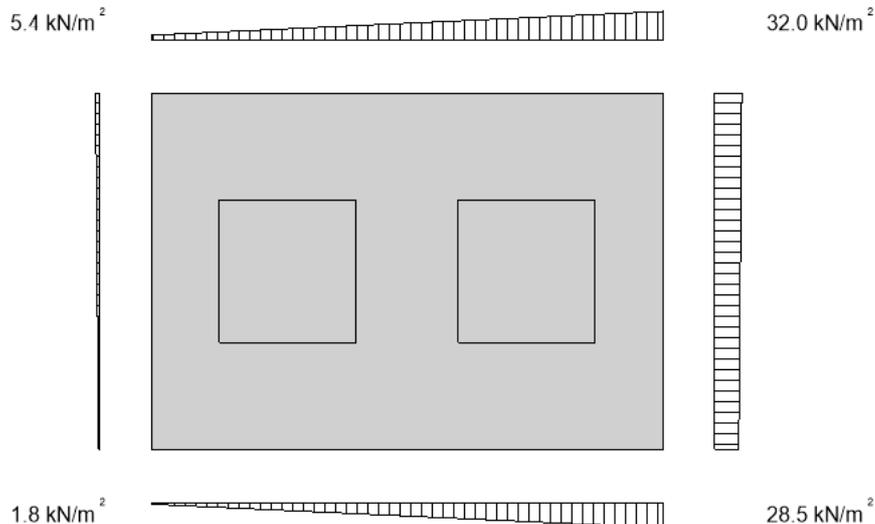
Base reaction acts within combined middle third of base

Calculate pad base pressures

$q_1 = 1.847$ kN/m² $q_2 = 5.367$ kN/m² $q_3 = 28.513$ kN/m² $q_4 = 32.033$ kN/m²

Minimum base pressure $q_{min} = 1.847$ kN/m² Maximum base pressure $q_{max} = 32.033$ kN/m²

PASS - Maximum base pressure is less than allowable bearing pressure



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Partial safety factors for loads

Dead loads	$\gamma_{fG} = 1.40$	Imposed loads	$\gamma_{fQ} = 1.60$
Wind loads	$\gamma_{fW} = 0.00$		

Ultimate axial loading

Ultimate axial load on column	Column A $P_{uA} = 14.7$ kN	Column B $P_{uB} = 14.7$ kN
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Ultimate foundation loads

Ultimate foundation load	$F_u = 112.9$ kN
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Ultimate horizontal loading

Ult.horizontal load in x dir	Column A $H_{xuA} = 0.0$ kN	Column B $H_{xuB} = 0.0$ kN
Ult.horizontal load in y dir	$H_{yuA} = 6.2$ kN	$H_{yuB} = 6.2$ kN

Ultimate moment

Ult.moment on column in x dir	Column A $M_{xuA} = 0.000$ kNm	Column B $M_{xuB} = 0.000$ kNm
Ult.moment on column in y dir	$M_{yuA} = 0.000$ kNm	$M_{yuB} = 0.000$ kNm

Ultimate pad base reaction

Ultimate base reaction	$T_u = 142.3$ kN		
Ecc.of ult.base reaction in x	$e_{Txu} = 0$ mm	Ecc.of ult.base reaction in y	$e_{Tyu} = 35$ mm

Calculate ultimate pad base pressures

$q_{1u} = 21.252$ kN/m ²	$q_{2u} = 26.180$ kN/m ²	$q_{3u} = 21.252$ kN/m ²	$q_{4u} = 26.180$ kN/m ²
Minimum ult.base pressure	$q_{minu} = 21.252$ kN/m ²	Maximum ult.base pressure	$q_{maxu} = 26.180$ kN/m ²

Library item: Ultimate pressures summary **Ultimate moments**

Ultimate moment in x dir	$M_x = 3.136$ kNm	Ultimate moment in y dir	$M_y = 9.814$ kNm
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Material details

Char.strength of concrete	$f_{cu} = 30$ N/mm ²	Char.strength of reinfnt	$f_y = 500$ N/mm ²
Char.strength of shear reinfnt	$f_{yv} = 500$ N/mm ²	Nom.cover to reinforcement	$c_{nom} = 30$ mm

Moment design in x direction

Tens.reinforcement diameter	$\phi_{xB} = 10$ mm	Tens.reinforcement depth	$d_x = 355$ mm
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Design formula for rectangular beams (cl 3.4.4.4)

$$K_x = 0.000 \quad K_x' = 0.156$$

$K_x < K_x'$ compression reinforcement is not required

Tens.reinforcement required	$A_{s_x_req} = 21$ mm ²	Minimum tens.reinforcement	$A_{s_x_min} = 1040$ mm ²
Tens.reinforcement provided	20 No. 10 dia. bars btm	$A_{s_xB_prov} = 1571$ mm ²	

PASS - Tension reinforcement provided exceeds tension reinforcement required

Moment design in y direction

Tens.reinforcement diameter	$\phi_{yB} = 10$ mm	Tens.reinforcement depth	$d_y = 365$ mm
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Design formula for rectangular beams (cl 3.4.4.4)

$$K_y = 0.001 \quad K_y' = 0.156$$

$K_y < K_y'$ compression reinforcement is not required

Tens.reinforcement required	$A_{s_y_req} = 65$ mm ²	Minimum tens.reinforcement	$A_{s_y_min} = 1560$ mm ²
Tens.reinforcement provided	30 No. 10 dia. bars btm	$A_{s_yB_prov} = 2356$ mm ²	

PASS - Tension reinforcement provided exceeds tension reinforcement required

Calculate ultimate shear force at d from top face of column A

Ult.pressure for shear	$q_{su} = 25.890$ kN/m ²		
Area loaded for shear	$A_s = 0.705$ m ²	Ult.shear force	$V_{su} = 4.988$ kN

Shear stresses at d from top face of column A (cl 3.5.5.2)

Design shear stress	$v_{su} = 0.005$ N/mm ²		
Design concrete shear stress	$v_c = 0.415$ N/mm ²	Allowable design shear stress	$v_{max} = 4.382$ N/mm ²

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PASS - $v_{su} < v_c$ - No shear reinforcement required

Calculate ultimate punching shear force at face of column A

Ult.press.for punching shear	$q_{puA} = 23.716 \text{ kN/m}^2$	Avg.effective reinf.depth	$d = 360 \text{ mm}$
Area loaded	$A_{pA} = 0.640 \text{ m}^2$	Length of shear perimeter	$U_{pA} = 3200 \text{ mm}$
Ult.punching shear force	$V_{puA} = 11.564 \text{ kN}$	Eff.punching shear force	$V_{puAeff} = 11.564 \text{ kN}$

Punching shear stresses at face of column A (cl 3.7.7.2)

Design shear stress $v_{puA} = 0.010 \text{ N/mm}^2$

PASS - Design shear stress is less than allowable design shear stress

Calculate ultimate punching shear force at face of column B

Ult.press.for punching shear	$q_{puB} = 23.716 \text{ kN/m}^2$	Avg.effective reinf.depth	$d = 360 \text{ mm}$
Area loaded	$A_{pB} = 0.640 \text{ m}^2$	Length of shear perimeter	$U_{pB} = 3200 \text{ mm}$
Ult.punching shear force	$V_{puB} = 11.564 \text{ kN}$	Eff.punching shear force	$V_{puBeff} = 11.564 \text{ kN}$

Punching shear stresses at face of column B (cl 3.7.7.2)

Design shear stress $v_{puB} = 0.010 \text{ N/mm}^2$

PASS - Design shear stress is less than allowable design shear stress

Calculate ultimate punching shear force at perimeter of 1.5 d from face of column A and B

Ult.press.for punching shear	$q_{puC1.5d} = 23.716 \text{ kN/m}^2$	Avg.effective reinf.depth	$d = 360 \text{ mm}$
Area loaded	$A_{pC1.5d} = 5.640 \text{ m}^2$	Length of shear perimeter	$U_{pC1.5d} = 6000 \text{ mm}$
Ult.punching shear force	$V_{puC1.5d} = 1.764 \text{ kN}$	Eff.punching shear force	$V_{puC1.5deff} = 2.205 \text{ kN}$

Punching shear stresses at perimeter of 1.5 d from face of column A and B (cl 3.7.7.2)

Design shear stress $v_{puC1.5d} = 0.001 \text{ N/mm}^2$

PASS - $v_{puC1.5d} < v_c$ - No shear reinforcement required

