DESIGN OF EDGE FOOTING @ GRIDS-A1

[A] DESIGN INPUT:

(a) Loads:

(i) Unfactored Support Reactions:

Comp. (C) = 200.00 kN; Tension (T) = 150.00 kN

Shear (V) = 50.00 kN; BM (M) = 25.00 kN.m

(ii) Blockwall on Plinth Beam:

Length (Wl) = 7.30 m; Height (Wh) = 1.50 m

Thk. (Wt) = 0.20 m; Density (Wd) = 7.5 kN/cu.m

(iii) Plinth Beam/ Wall:

Net length (Lnet) = 7.30 - 0.35 = 6.95 m

Width (Tb) = 0.20 m; Depth (TD) = 2.15 m

(c) Approx. Pedestal Size (for load calculations):

Pl (dimension in the direction of shear) = 0.45 m

Pb (other dim.) = 0.35 m

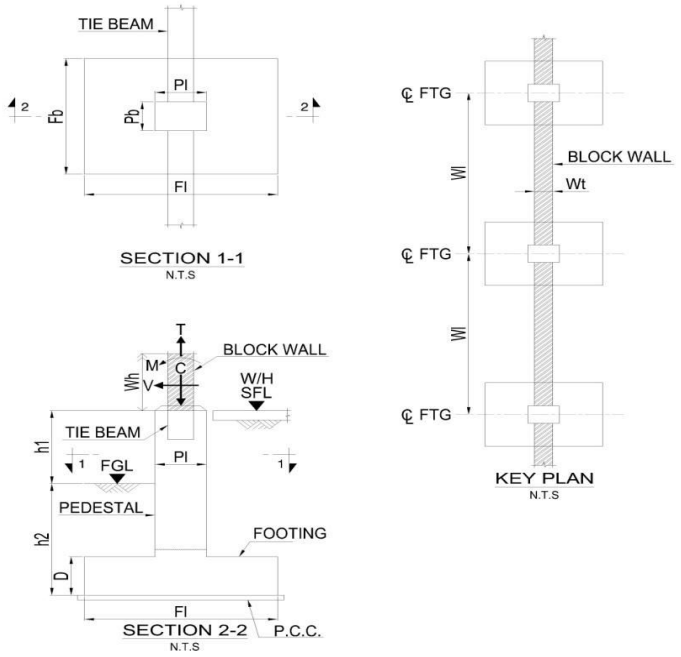
(d) Concrete & Steel:

fcu = 20 MPa; fy = 500 MPa

Concrete cover (cc) = 50 mm

Bot. bar dia. (db) = 16 mm; Top bar dia. (dt) = 12 mm

FOOTING DESIGN



(e) Levels/ Elevations:

Plinth ht. (h1) = 1.20 m; Ftg. depth (h2) = 1.50 m

(f) Soil Properties:

Soil density (Sd) = 18.0 kN/cu.m; Gross SBC of soil @ ftg. depth (SBC) = 200 KPa

(g) Footing Dimensions (assumed):

Ftg. length (in the direction of shear) (Fl) = 2.30 m; Ftg. width (Fb) = 2.00 m; Ftg. depth (D) = 0.400 m

[B] BASE PRESSURE (-ve heel pressures not allowed):

Vol. of soil above the ftg. (VS)

= 0.5 x {(h2 - D) x (Fl x Fb - Pl x Pb)} + 0.5 x {(h1 + h2 - D) x (Fl x Fb - Pl x Pb)} = 7.55 cu.m

Wt. of soil (Sw) = Sd x Vs = 135.94 kN

Self-wt. of ftg. (Fw) = 25 x Fl x Fb x D = 46.00 kN

Self-wt. of pedestal (Pw) = 25 x Pl x Pd x (h1 + h2 - D) = 9.06 kN

Self-wt. of blockwall (Ww) = Wd x Wl x Wh x Wt = 16.43 kN

Self-wt. of tie-beam/wall (Wb) = 25 x Lnet x Tb x TD = 74.71 kN

Hence, total wt. on the soil (Psbc) = C + Sw + Fw + Pw + Ww + Wb = 482.13 kN

BM @ u/s of ftg. (Msbc) = M + V x (h1 + h2) = 160.00 kN.m

Eccentricity, (e) = Msbc/Psbc = 0.332 m < Fl/6 (No loss of contact)

Pmax = {Psbc/ (Fl x Fb)} + {6 x Msbc/ (Fb x Fl^2)} = 195.55 KPa < SBC (Safe)

Pmin = {Psbc/ (Fl x Fb)} - {6 x Msbc/ (Fb x Fl^2)} = 14.07 KPa < SBC (Safe)

[C] PUNCHING SHEAR:

Critical section is at 'd/2' dist. from ped. face.

d = D - cc - Ø/2 = 342.0 mm

Net ftg. area for punching shear (Anet):

= (Fl x Fb) - {(Pl + d) x (Pb + d)} = 4.05 sq.m

Factored punching force (based on avg base pressure) (FPun):

= 1.5 x Anet x {Psbc/(Fl x Fb)} = 637.04 kN

Tauc = 0.25 x sqrt(fck) = 1.12 MPa

Bc = 0.45/0.35 = 1.29; 0.5 + Bc = 1.79

ks = Min (1.79, 1) = 1.00

ks.Tauc = 1.12 MPa

Shear stress (Tau,v):

= Fpun/[d x {2 x (Pl + Pb + 2 x d)}] = 0.63 MPa

Tau,v < ks.Tauc, Hence OK (Cl. 31.6.3.1 of IS 456:2000)

[D] FLEXURE:

Critical section is at pedestal face.

Bending length, Lben = Fl/2 - Pl/2 = 0.92 m

Soil press. @ crit. section (Pcrit):

Pcrit = [Pmin + {(Pmax - Pmin) x (Fl/2 + Pl/2)}/Fl] = 123.00 KPa

BM, M = (Pcrit x $Lben^2$/2) + {(2/3 x Lben) x 1/2 x (Pmax - Pcrit) x Lben}

= 73.31 kN.m

Mu = 1.5 x (M - 25 x D x $Lben^2$/2) = 103.55 kN.m

Steel assumed: T16 @ 175 mm c/c => Pt = 0.34%

MR = 0.87 x Fy x (As/(b x d) x [1 - 1.005 x {As/(b x d) x Fy/Fcu}] x (b x d^2)

= 156.50 kN.m > Mu (OK)

[E] BENDING SHEAR:

Critical section is at 'd' dist. from pedestal face.

Shear length (Ls):

Ls = Fl/2 - Pl/2 - d = 0.58 m

Soil press. @ crit. section (Pcrit):

Pcrit = [Pmin + {(Pmax - Pmin) x (Fl/2 + Pl/2 + d)}/Fl] = 150.00 KPa

pt = 0.34% & Fcu = 20 MPa

=> Tauc = 0.40 MPa

k = 1.00...Cl. 40.2.1.1 of IS 456:2000

=> k.Tauc = 0.40

Shear stress (v):

v = [Ls x {Pcrit + 0.5 x (Pmax - Pcrit)}]/d = 0.29 MPa

Fact. shear stress (vu):

vu = 1.5 x (v - 25 x D - Sd x hs) = 0.40 MPa < k.Tauc ... Hence, OK

[F] UPLIFT:

Net uplift @ top of ftg, Unet

= -T + Pw + Ww = -124.52 kN < 0 => Net Uplift => Top steel reqd.

Base area of frustrum of soil pyramid (A1) = Fl x Fb = 4.60 sq.m

With angle of repose 'X',

Top area of frustrum of soil pyramid with outer soil depth (A2)

= {Fl + 2 x (h2 - D) x TanX} x {Fb + 2 x (h2 - D) x TanX} = 11.68 sq.m

Gross vol. of soil pyramid with outer soil depth, Vgo

= {A1 + A2 + (h2 - D)/3 x Sqrt(A1 x A2} = 8.65 cu.m

Net vol. of soil pyramid with outer soil depth, Vno

= Vgo - (h2 - D) x Pl x Pb = 8.48 cu.m

Top area of frustrum of soil pyramid with inner soil depth, A3

= {Fl + 2 x (h1 - D) x TanX} x {Fb + 2 x (h1 - D) x TanX} = 23.07 sq.m

Gross vol. of soil pyramid with inner soil depth, Vgi

= A1 + A3 + (h1 - D)/3 x Sqrt(A1 x A3) = 29.11 cu.m

Net vol. of soil pyramid with inner soil depth, Vni

= Vgi - (h1 - D) x Pl x Pb = 28.75 cu.m

Vol. of soil overburden, Vs

= 0.5 x Vno + 0.5 x Vni = 18.62 cu.m

Wt. of soil overburden, Su

= Sd x Vs = 335.10 kN

Resistance against uplift, Ru

= Su + Fw + Pw + Ww = 406.58 kN

F.O.S against uplift, Ru/T

= 406.58/150.00 = 2.71 kN > 1.5 (OK)

Downward pressure, Pdn

= Unet/(Fl x Fb - Pl x Pb) + 25 x D = 38.03 KPa

Critical section is at pedestal face; Hence, l = Fl/2 - Pl/2 = 0.92 m

Mu = 1.5 x Pdn x l^2/2 = 24.40 kN.m

Steel assumed: 12 dia bars @ 200.0 mm c/c

MR = 0.87 x Fy x (As/(b x d) x [1 - 1.005 x {As/(b x d) x Fy/Fcu}] x (b x d^2)

= 80.63 kN.m > Mu (OK)

Ftg. Size: 2.00m x 2.30m x 0.400m

Bot. Bars: T16-175-B1; T12-200-B2

Top Bars: T12-200-T1; T12-200-T2

epicenter Consulting Engineers Pvt. Ltd.

Project:	ABC,Hyd	Client:				Element: Footing
Structure:	Buildinig-B	Project:		Doc. No.:		Location/ Grids: A2
Type:	Sub-structure	Rev.	Ppd. by	Date	Chd. by	Date
		2				Designation:
		1				
		0	S.K	11.01.2018	S.H.H	12.01.2018

Sht. 3 of 3