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CIVIL ENGINEERING DESIGN PROJECT (ECS 316)

ESTEEM REPORT

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BAD FOOTING

CODE OF PRACTICE USED IS BS8110:1985

D.L/L.L-kN		fcu	fy	cover	Load incre.	Soil pressure-kN/m2
1.4	1.6	50	460	50	10	100

COLUMN FOUNDATION DESIGN:

Grid	D.L.	L.L.	W.L.	Mxy-kNm/m		Footing,B,L,H			Area,mm2		Rebar	
A-X	-37	7	0	1	1	350	350	250	771	771	T12-125	T12-125
A-4a	12	1	0	2	2	400	400	250	771	771	T12-125	T12-125
A-3	77	2	0	13	13	900	900	250	771	771	T12-125	T12-125
A-1	141	10	0	25	25	1250	1250	250	771	771	T12-125	T12-125
B-X	368	37	0	65	65	2000	2000	350	1066	1066	T12-100	T12-100
B-3a	533	43	0	89	89	2400	2400	450	1269	1269	T12-75	T12-75
C-1	197	19	0	35	35	1500	1500	250	786	786	T12-125	T12-125
C-1a	47	3	0	8	8	750	750	250	771	771	T12-125	T12-125
D-X	712	59	0	117	117	2750	2750	500	1464	1464	T12-75	T12-75
D-3a	942	97	0	155	155	3200	3200	550	1672	1672	T12-50	T12-50
D-1	515	44	0	87	87	2350	2350	400	1250	1250	T12-75	T12-75
D-1a	15	5	0	3	3	450	450	250	771	771	T12-125	T12-125
F-3	833	56	0	134	134	2950	2950	500	1558	1558	T12-50	T12-50
F-1	95	11	0	18	18	1050	1050	250	771	771	T12-125	T12-125
G-X	264	13	0	45	45	1700	1700	300	885	885	T12-125	T12-125
G-4	73	3	0	13	13	900	900	250	771	771	T12-125	T12-125

4786; 409; SUM OF THE ABOVE: With Load Allowance of 10 percent,
4351; 372; SUM OF THE ABOVE: Without Load Allowance

SUMMARY OF COLUMN LOADING WITHOUT LOAD ALLOWANCE OF 10 PERCENT:

Total Footing SelfWeight = 593 kN
Total Column Dead Load Reaction by Convention Design Method, DLcd 4351 kN
Total Column Live Load Reaction by Convention Design Method, LLcd 372 kN
Total Column Dead Load Reaction with Footing SelfWeight, TDLcd 4944 kN

SUMMARY OF COLUMN LOADING WITH LOAD ALLOWANCE OF 10 PERCENT:

Total Dead Load (with SelfWeight) = 5438.82 kN

Total Live Load from floors above = 409.28 kN

SUMMARY OF TOTAL LOADING WITHOUT LOAD ALLOWANCE OF 10 PERCENT:

Total Footing SelfWeight of Whole Keyplan 593 kN
Total Dead & Live Load of Whole Keyplan 4723 kN

Total Dead Load Reaction from Stump and Wall = 4351 + 0 = 4351 kN
Total Live Load Reaction from Stump and Wall = 372 + 0 = 372 kN

Pad Footing Detailed Design Calculation:

Code of Practice Used: BS8110:1985

The Design Parameters used:

Allowable soil pressures used =100 kN/m^2
Steel fy = 460 N/mm^2; Concrete fcu = 50 N/mm^2
Concrete cover, cov = 50 mm
Rebar maximum spacing = 250 mm, Minimum spacing 50 mm
Steel maximum bar size 32 mm, Minimum bar size 12 mm
Shear capacity at stump face, 0.8*sqrt(fcu) = 5.66 N/mm^2
Rebar percentage used for Shear Design = 0.30
Design Shear Stress, vc = 0.79*(100As/bd)^(1/3)*(400/d)^(1/4)/Ym

The Following Design Parameters are used for Bending Moment Design:
Maximum Concrete strain, Ecc = 0.0035
Average Concrete Stress Above Neutral Axis, k1 = 19.53 N/mm^2
Concrete Lever Arm Factor, k2 = 0.4390
Limiting Effective Depth Factor, cb = 0.50
Limiting Concrete Moment Capacity Factor, kk1
= cb*k1*(1-cb*k2) = 0.50*19.53(1-0.50*0.4390) 7.6217 N/mm^2
k2/k1 Factor, kkk = 0.0225

COLUMN FOUNDATION DESIGN:

Location of Footing: A-X

Dead Load, DL = -33.9; Live Load, LL = 6.4; Wind Load, WL 0.0

After additional 10 percent load allowance
Dead Load, DL = -37.3; Live Load, LL = 7.0

Total Unfactored Load = -37.3 + 7.0 + 0.0 = -30.2 kN

After round-up, Footing Size, X & Y Dimensions,mm = 350 mm x 350 mm

Trial selfweight of Pad Footing,SW = 1.10 x(0.35X0.35X0.10)x24x1.2 = 0.4 kN
Soil pressure(include footing selfweight) = (0.4+-30.2)/(350x350/1000000) = -244 kN/m^2

Total Ultimate Gravity Load = 1.40*-37.3+1.60*7.0 = -40.9 kN
Total Ultimate Gravity+Lateral Load = 1.20*(-37.3+7.0+0.0) = -36.3 kN
Ultimate soil pressure for design, Wu = 10.0x1000/(350*350) = 0.082 N/mm^2

Calculate Effective Depth, d to Satisfy Punching Shear:

Refer to BS8110:Part 1:1985 Table 3.9
Shear Capacity,vc = 0.79*((100As/(bd))^1/3)*(400/d)^1/4)*((fcu/25)^1/3)/1.25
Effective depth ratio = max(1,400/d) = max(1,400/7) = 57.736
Concrete Grade ratio = min(40,fcu)/25 = min(40,50)/25 1.600
Steel Percentage, 100As/(bd) = min(3,0.30) = 0.30
vc = (0.79*(0.30)^1/3*(57.736)^1/4*(1.600)^1/3)/1.25 1.364 N/mm^2

Stump Size, A & B Dimensions,mm = 200 mm x 150 mm

Design Shear stress based on d, 7 mm = 1.364 N/mm^2
Ratio of shear plane from stump face to effective depth, p = 1.001
Distance of shear plane from stump face, a = 7 mm
Enhanced shear stress,v = fVcFac*d*vc/a = 1.0*7*1.364/7 = 1.364 N/mm^2
Ultimate Shear Capacity = 2v.d(4p.d+A+B)/1000 kN =
2*1.364*7*(4*1.001*7+200+150) = 7.1 kN
Load Within Shear Perimeter, Pi = Wu(2p.d+A)*(2p.d+B)/1000 kN =
0.082 *(2*1.001*7+200)*(2*1.001*7+150) = 2.9 kN
Ultimate Load = Total load,P - Pi = 10.0 - 2.9 ***= 7.1 kN <= 7.1 kN --> O.K. !!***

Required effective depth to satisfy punching shear, d = 7 mm

Calculate Effective Depth, d to Satisfy Stump Face Shear:

Ultimate Load, Pu = 10.0-0.082*200*150/1000 = 7.6 kN
Stump Face Shear Capacity, Pc = 2*5.657*2(200+150)/1000 7.6 kN

Effective Depth required at stump face = 2 mm

Refer to BS8110:Part 1:1985 Table 3.9
Shear Capacity,vc = 0.79*((100As/(bd))^1/3)*(400/d)^1/4)*((fcu/25)^1/3)/1.25
Effective depth ratio = max(1,400/d) = max(1,400/50) = 8.000
Concrete Grade ratio = min(40,fcu)/25 = min(40,50)/25 = 1.600
Steel Percentage, 100As/(bd) = min(3,0.30) = 0.30
vc = (0.79*(0.30)^1/3*(8.000)^1/4*(1.600)^1/3)/1.25 = 0.832 N/mm^2

Calculate Effective Depth, d to Satisfy Flexural Shear:

Design Shear stress based on d,50 mm = 0.832 N/mm^2
Ratio of shear plane from stump face to effective depth, p = 0.500
Enhanced shear stress,v = fVcFac*vc/p = 1.0*0.832/0.500 = 1.664 N/mm^2
Required effective depth to satisfy flexure shear, d = 50 mm