CMR INSTITUTE OF TECHNOLOGY	USN	1	C	R			C	V				INSTITUTE OF TECHNOLOGY

Internal Assesment Test –2

Sub:Design of RCC & Steel Structures				Code: 15CV72
Date:15/10/2018	Duration: 90 mins	Max Marks: 50	Sem: VII	Sections:CV (A & B)

Answer ***any one*** questions. Good luck!

		Marks	OBE	
			CO	RBT
1	Design a combined footing for two columns of size 300mm x 300mm and 400mm x 400mm subjected to loads of 500KN and 700KN respectively. The columns are spaced at 3.50m C/C. The width of the footing should be restricted to 1.50m. Take SBC of the soil as 150KPa and use M25 concrete with HYSD bars.	50	4,2,3	L1,L2, L3
2	Design a Cantilever type retaining wall to retain an earth embankment of 5m high above the ground level. The density of earth is $18KN/m^3$ and the angle of repose is 30°. The embankment is to be horizontal at the top. The safe bearing capacity of the soil can be taken as 200KPa and the coefficient of friction between concrete and the soil is 0.50. Use M20 concrete and Fe415 steel.	50	4,2,3	L1,L2, L3

C.I **C.C.I.** **HOD**

CMR INSTITUTE OF TECHNOLOGY	USN	1	C	R			C	V				INSTITUTE OF TECHNOLOGY

Internal Assesment Test –2

Sub: Design of RCC & Steel Structures				Code: 15CV72
Date:15/10/2018	Duration: 90 mins	Max Marks: 50	Sem: IV	Sections:CV (A & B)

Answer ***any one*** questions. Good luck!

		Marks	OBE	
			CO	RBT
1	Design a combined footing for two columns of size 300mm x 300mm and 400mm x 400mm subjected to loads of 500KN and 700KN respectively. The columns are spaced at 3.50m C/C. The width of the footing should be restricted to 1.50m. Take SBC of the soil as 150KPa and use M25 concrete with HYSD bars.	50	4,2,3	L1,L2, L3
2	Design a Cantilever type retaining wall to retain an earth embankment of 5m high above the ground level. The density of earth is $18KN/m^3$ and the angle of repose is 30°. The embankment is to be horizontal at the top. The safe bearing capacity of the soil can be taken as 200KPa and the coefficient of friction between concrete and the soil is 0.50. Use M20 concrete and Fe415 steel.	50	4,2,3	L1,L2, L3

C.I **C.C.I.** **HOD**

15/10/18

15CV72, Design of RCC & Steel Structures
2nd IAT Scheme and Solution

Qn 1. (i) Loads = 1200 kN (Column)

Selfwt = 120 kN (10 %)

Service load = 1320 kN

(ii) Area of footing = $\frac{1320}{150}$ = 8.8 m²

Adopt L = 8.80 m, B = 1.50 m.

Width of strap beam = 500 mm

p = intensity of soil pressure = $\frac{1320}{13.2}$ = 100 kN/m².

Cantilever projection = 0.5 (1.5 − 0.4) = 0.55 m.

$$d = \sqrt{\frac{M_u}{0.138 f_{ck} B}} = \sqrt{\frac{1.5 \times 22.5 \times 10^6}{0.138 \times 20 \times 10^3}} = 110.58 \text{ mm}.$$

$\tau_c = \frac{V_u}{bd}$, $V_u = 0.1665 \times 10^3 (550 - d)$

Solving, d = 205 mm ≃ 250 mm (20) marks

(iii) $M_u = 0.87 f_y A_{st} \cdot d \left[1 - \frac{A_{st} f_y}{bd f_{ck}}\right]$

$$25.2 \times 10^6 = 0.87 \times 415 \times A_{st} \times 250 \left[1 - \frac{A_{st} \cdot 415}{1000 \times 250 \times 20}\right]$$

Solving, A_{st} = 285 mm²

min rft = 0.0012 × 1000 × 300 = 360 mm²

Provide 10 mm ϕ bars, A_{st} = 400 mm²

$\tau_v = \frac{V_u}{bd} = \frac{49.95}{1000 \times 250} = 0.2\ N/mm^2$ (10) marks

(iv) Design of Strap beam:

$(w) = 166.5\ kN/m.$

Factored load $= w_u = 1.5w = 1.5 \times 166.5 = 250\ kN/m.$

$M_u = 0.125\, w_u L^2 = 500\ kN\text{-}m.$

$V_u = 0.5\, w_u L = 500\ kN$

$(d) = \frac{V_u}{b\,\tau_c} = \frac{500}{400} \times \frac{1000}{1.2} = 1042\,mm$

Cover 60mm, $D = 1100\,mm.$

$M_u = 500 \times 10^6\ N\text{-}mm = 0.87\ 415\ A_{st} \times 1100 \left[1 - \frac{415 A_{st}}{400 \times 1100 \times 20}\right]$

$A_{st} = 1288\,mm^2.$

Provide 4 bars of 22mm ϕ (10) marks

(v) Shear design: $\tau_v = \frac{500 \times 1000}{400 \times 1100} = 1.14\ N/mm^2 < \tau_c$

shear reinforcement is reqd.

$V_{us} = \left[500 - \frac{0.4 \times 400 \times 1150}{100}\right] = 316\ kN$

$S_v = \frac{0.87 \times 415 \times 4 \times 50 \times 150}{316 \times 1000} = 262 \simeq 250\ mm\ c/c$

Provide 4 legged, 10mm ϕ stirrups @ 250 mm c/c.

(10) marks

Qn 2. (i) Design of Foundation:

$$D_f = \frac{P}{\omega}\left(\frac{1-\sin\phi}{1+\sin\phi}\right)^2, \quad \phi = 30^\circ, \quad = 1.20\,m.$$

$$M = \frac{K_a\, \omega h^3}{6} = 107.2\ KN\text{-}m.$$

$$M_u = 1.5M = 162\ KN\text{-}m.$$

$$d = \sqrt{\frac{162\times10^6}{0.138\times20\times1000}} = 242mm, \quad D = 300\,mm.$$

$$M_u = 162\times10^6\ N\text{-}mm = 0.87\, f_y\, A_{st}\, d\left[1 - \frac{A_{st}\, f_y}{bd\, f_{ck}}\right]$$

Solving, $A_{st} = 540\ mm^2$.

(10) marks

(ii) Design of Heel slab: & Toe slab.

$$M = \frac{1}{3}\times162 = 54\ KN\text{-}m.$$

$$M_u = 1.5M = 81\ KN\text{-}m = 0.138\, f_{ck}\, b d^2,$$

$$d = 484 \simeq 500\,mm.$$

$$M_u = 81\times10^6\ N\text{-}mm = 0.87\, f_y\, A_{st}\cdot d.\left[1 - \frac{A_{st}\, f_y}{bd\, f_{ck}}\right]$$

Solving, $A_{st} = 270mm^2 < 0.12\%\ bd.$

Provide min rft $(A_{st})_{min} = \frac{0.12}{100}\times1000\times500 = 600\,mm^2$

Provide 12mm ϕ bars @ 180 mm c/c. (10) marks

(iii) Design of shear key:

$$F.S. = \left(\frac{\mu N + P_p}{P}\right) = \left(\frac{100.975 + 97}{81.12}\right) = 2.4 > 1.50$$

$$A_{st} = 3\% \text{ of } bD = \frac{3}{100} \times 1000 \times 500 = 1500\ mm^2.$$

(10) marks

Provide 16 mm ϕ bars @ 180 mm c/c.

(iv) Stress at junction: $V = 1.5 \Sigma P - \mu W$

$= 1.5 \times 81 - 100.975$

$= 20.7\ KN.$

$V_u = 1.5 V = 1.5 \times 20.7 = 31.05\ KN$

$\tau_v = \frac{V_u}{bd} = 0.08\ N/mm^2.$ $\tau_c = \frac{100 A_s}{bd} = 0.4\ N/mm^2$

$\tau_c > \tau_v$. Safe.

(10) marks

(V) Stability Analysis:

$$Z = \frac{\Sigma M}{\Sigma W} = \frac{322.81}{201.95} = 1.6 m.$$

$$e = \frac{b}{6} = \frac{3}{6} = 0.5. \quad e < \frac{b}{6}.$$

$$\sigma_{max} = \frac{\Sigma W}{b}\left(1 + \frac{6e}{b}\right) = 80.76\ KN/m^2$$

Safe

$$\sigma_{min} = \frac{\Sigma W}{b}\left(1 - \frac{6e}{b}\right) = 53.84\ KN/m^2$$

(10) marks