(5) Dec

Date:

Grillage foundation

This is provided to support heavy load where Bearing capacity of soil is low. This consist of two tiers of steel beam. lower tiers has 10 to 12 no. of beams and upper tiers no. beams is 8 to 5. upper tier beams are placed at right angle over the lower tiered beams. Steel beams are embedded in cement concrete with sufficient cover at bottom embedded's. A base plate is placed at the centre of lower tier beam. The heavy column is placed on the base plate

Num Design a G.F for a column I.S.H.B 400 with flenge plate 300 × 20. Total load on column is 2000 KN. Size of base plate 650 × 800 mm bearing capacity of soil is 120 N/m². Permissible σ_b is 0.88 times yield stress, and τ_s = 0.4 time yield stress

Step-1 :- Load 2000 kN

assumed self weight 10% = 200 kN

Total weight = 2200 kN

$$\text{Area of foundation} = \frac{\text{total load}}{\text{bearing capacity}} = 18.33 \, m^2$$

let us provide square foundation therefor size of foundation is $\sqrt{18.33} = 4.28 \, m \approx 4.3 \, m$

$l = 4.3$ m.

Design of top tier beam :- These beam are subjected to a bending moment

$$m = \frac{W}{8}\left[l - l_1\right] = \frac{W}{8}\left[4300 - 650\right]$$

$$m = \frac{2000}{8}\left[4800 - 650\right] \times 10^3 = 9.125 \times 10^8 \text{ Nmm}$$

let us provide 3 beams of I-section in top tier. therefor bending moment per beam $= \frac{9.125 \times 10^8}{3}$

$= 3.042 \times 10^8$ N mm

Max. Per. bending stress $\sigma_b = 0.88 \times 250 = 220 \text{ N/mm}^2$

Therefor section modulus $Z_{xx} = \frac{3.04 \times 10^8}{220} = 1382727.3$

$= 1.38 \times 10^6$

$\simeq 1382 \times 10^3$ mm^3

$= 1382 \text{ cm}^3$

ISLB 500 @ 735.8 N

$t_w = 9.2$ mm

$I_{xx} = 38579 \text{ cm}^4$

Max. shear force for top tier beam,

$$S.F = \frac{W}{l}\left[\frac{l - l_1}{2}\right]$$

$$S.F = \frac{2000 \times 1000}{4300}\left[\frac{4300 - 650}{2}\right] = 8.48 \times 10^5 \text{ N}$$

S.F for 1 beam = $\frac{8.48 \times 10^5}{3}$ = 2.82×10^5 N.

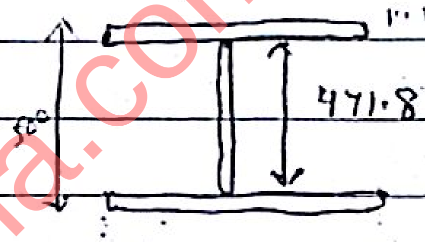
$q = \frac{S.F}{Area} = \frac{282945}{500 \times 9.2} = 61.5$

$\tau_1 = 0.4 \times 250 = 100$

$q < \tau_1$ section is safe

3 check for vertical buckling

Flange thickness = 14.1



$h = 500 - 14.1 \times 2$

$h = 471.8$

$T_w = 9.2$

Slenderness ratio $= \frac{l}{r_{mini}} = \frac{h}{t}\sqrt{3} = \frac{471.8}{9.2}\sqrt{3}$

$\lambda = 88.82$

λ	p_c
80	101
90	90
10	11
1 ——	1.1

$1.1 \times 8.82 = 9.68$

$p_c = 101 - 9.61 = 91.33$.

The length over which load is distributed length of bearing plate + $\frac{1}{2}$ web

= 650 + 250 = 900

Page No.
Date:

Bearing area for the load = $900 \times 9.2 = 8280 \text{ mm}^2$

Total bearing area = $8280 \times 3 = 24840 \text{ mm}^2$

∴ Bearing stress actually developed = $\frac{\text{load}}{\text{bearing area}}$

$= \frac{2000 \times 1000}{24840} = 80.5$

$80.5 < 91.32$ It is safe

1 check for diagonal buckling :- for D.B. Slenderness ratio $= \frac{h}{t}\sqrt{6} = \frac{471.8}{9.2}\sqrt{6} = 125$

λ	p_c
120	64
130	57
10	7
1	.7

$5 \times .7 = 3.5$

$p_c = 64 - 3.5 = 60.5 \text{ N/mm}^2$

Actual bearing stress = $\frac{\text{S.F}}{\text{Bearing area}} = \frac{282 \times 10^5}{24840}$

$= 11.4$

$11.4 < 60.5$

∴ Top ties is safe.

Design of the Bottom Tier Beam :-

Use 10 no. beam for bottom tier of

$$B.M = \frac{W}{8}[l_p - l_d]$$

$$= \frac{2000 \times 1000}{8}[4300 - 800]$$

$$= 875 \times 10^6 \text{ Nmm}$$

$$B.M. \text{ for each beam} = \frac{875 \times 10^6}{10} = 875 \times 10^5 \text{ Nmm.}$$

$$\text{Section Modulus} = \frac{B.M}{\text{Bending Stress}} = \frac{875 \times 10^5}{220}$$

$$= 397727.27 \text{ mm}^3$$

$$= 397.727 \text{ cm}^3$$

Provide ISMB 250

$$Z_{xx} = 410 \text{ cm}^3$$

Check for shear :- $S.F. = \frac{W}{l}\left[\frac{l - l_d}{2}\right]$

$$= 813953.49 \text{ N}$$

$$S.F. \text{ for one beam} = 81395.349 \text{ N}$$

$$\text{Shear Stress} = \frac{S.F.}{d\, t_w} = \frac{81395.349}{250 \times 6.9}$$

$$= 47.18 \text{ N/mm}^2$$

It is less than $100\,\tau_{vq}$ so it is safe.

Check for Vertical Buckling :-

$$h = 250 - [2 \times 12.5]$$
$$= 225 \text{ mm}$$

Slenderness Ratio

$$= \frac{225\sqrt{3}}{6.9}$$

$$= 56.5$$

From Tables

for $\lambda = 56.5$

$f_c = 125$

length over which load spread = length of bearing plate + $\frac{\text{depth}}{2}$

$$B = 800 + 250/2 = 925 \text{ mm}$$

Bearing area $= 925 \times 6.9$

$= 6382.5 \text{ mm}^2$

Total Bearing area for 10 beams

$= 6382.5 \times 10 = 63825 \text{ mm}^2$

Bearing stress $= \frac{\text{load}}{\text{Area}} = \frac{2000 \times 10^3}{63825} = 31.4 \text{ N/mm}^2$

It is less than 125 N/mm², so it is safe.

Check for Diagonal Buckling :-

Slenderness Ratio :- $\frac{h\sqrt{6}}{t}$

$= \frac{225\sqrt{6}}{6.9}$

$\Rightarrow \lambda = 80$

For $\lambda = 80$, $p_c = 101\ N/mm^2 < 125\ N/mm^2$
section is safe.