

## Design of Bearing Pad

Given

$$\text{Max. Dead Load} = 1660 \text{ kN}$$

$$f_{ck} = 30$$

$$\text{Thickness} = 75 \text{ mm}$$

$$\begin{aligned} \text{Live load} &= 365 \\ &= 365 \text{ kN} \end{aligned}$$

$$\text{Horizontal force due to live load} = 80 \text{ kN}$$

Assumed Size of bearing pad

$$\text{Effective Breadth of pad}(bp) = 550 \text{ mm}$$

$$\text{Effective Length of pad}(Lp) = 950 \text{ mm}$$

$$\text{Side cover}(Sc) = 6 \text{ mm}$$

$$\text{Thickness of steel} = 10 \text{ mm}$$

Step 1-

$$\begin{aligned} \text{Thickness should be between} & \quad \text{breadth of pad}(bp)/10 \text{ to Length of pad}(Lp)/5 \\ & \quad 55 \quad \text{to} \quad 110 \\ & \quad \text{O.K} \end{aligned}$$

Step 2-

$$\text{Live load} = 400 \text{ kN}$$

$$\begin{aligned} \text{Loaded area} &= (bp \cdot Lp) - (2(bp + Lp) \cdot Sc) \\ &= 5E+05 \text{ mm}^2 \end{aligned}$$

$$\begin{aligned} \text{Total load (Nmax)} &= DL + LL \\ &= 1390 \text{ kN} \end{aligned}$$

$$\text{Approx.} \sim 1400 \text{ kN}$$

$$N_{min} = 1025 \text{ kN}$$

$$A1 = 4$$

$$A2 = 2$$

$$A1/A2 = 2$$

Step 3- Grade Provided M30 :-

$$0.25 \times f_{ck} \times \sqrt{\frac{A1}{A2}}$$

Allowable contact pressure =

$$10.61 \text{ Mpa}$$

$$\text{Effective area of bearing required} = 1400 \cdot 1000 / 10.61$$

$$= 13.2 \text{ mm}^2$$

$$\sigma_m = \text{total load} / \text{loaded area}$$

$$= 2.775 \text{ Mpa}$$

Step 4- Thickness of individual Elastomer layer

$$h_i = 15 \text{ mm}$$

$$\text{No.} = 5$$

$$\text{Thickness of steel Laminates} = 10 \text{ mm}$$

$$\text{Overall thickness of bearing} = 75 \text{ mm}$$

$$\text{Side cover} = 6 \text{ mm}$$

$$\text{Total thickness of elastomer}(t) = 55 \text{ mm}$$

$$\text{Shear modules assumed, } d = 1 \text{ N/mm}^2$$

$$\begin{aligned} \text{Shear strain due to creep,} \\ \text{shrinkage, temperature}(L) &= 5E-04 \end{aligned}$$

$$\text{From temp. sheet}(K) = 41000$$

$$\begin{aligned} \text{Shear strain per bearing due to} \\ \text{creep, shrinkage, temperature} &= (L \cdot K) / 2t \end{aligned}$$

$$= 0.186$$

Shear strain due to longitudinal force =  $80 \cdot 1000 / 504500$

$$= 0.159$$

Shear strain due to translation =  $B / \text{loaded area}$

$$= 0.345 \quad \text{Safe}$$

Step 5- Calculation of rotation,

$$\sigma_{,min} = 0.5 \cdot \sigma_m \cdot h_i / b \cdot s^2$$

Effective Breadth of pad(bp) N =  $550 - 12$

$$= 538 \quad \text{mm}$$

Effective Length of pad(Lp) O =  $950 - 12$

$$= 938 \quad \text{mm}$$

$$s = 15$$

(I) Shape factor (s) =  $\text{Loaded area} / (2(N+O)h_i)$

$$= 11.39 \quad \text{safe}$$

(ii) Assume,  $\sigma_m, \text{max.} = 10 \quad \text{MPa}$

$$\alpha_{b_i}, \text{max.} = 0.5 \cdot \sigma_m \cdot h_i / b \cdot s^2$$

$$= 0.001 \quad \text{radians}$$

$$P = 2.973$$

$$\beta = P / 10$$

$$= 0.297 \quad \text{MPa}$$

Permissible rotation =  $\beta \cdot \text{Effective Breadth of pad(bp)} \cdot N \cdot \alpha_{b_i}, \text{max.}$

$$= 0.002 \quad \text{MPa}$$

Step 6- Friction

Shear strain(Z) =  $0.345 \quad \text{MPa}$

Check:-

$$= 0.2 + 0.1 \cdot \sigma_m$$

$$= 0.478 \quad \text{safe}$$

where,  $\sigma_m = 2.775$

Check:-  $2 \text{MPa} < \sigma_m < 10 \text{MPa}$  satisfied

Total Shear Stress

Shear stress due to

Step 7- compression(X) =  $(1.5 \cdot \sigma_m) / s$

$$= 0.365 \quad \text{MPa}$$

Shear Stress due to Horizontal deformation(Y) =  $0.5 \cdot b / h_i^2 \cdot \alpha_{b_i}$

$$= 0.688 \quad \text{MPa}$$

Shear Stress due to Horizontal rotation =  $X + Y + Z$

$$= 1.398 \quad \text{MPa safe}$$

