

## Design of column bases Plate and Gusseted bases for Axially loaded columns

The columns are supported on the column bases. The column bases transmit the column load to the concrete or masonry foundation blocks. The column load is spread over large area on concrete or masonry blocks. The intensity of bearing pressure on concrete or masonry is kept within the maximum permissible bearing pressure. The safety of the structure depends upon stability of foundation. The column bases should be designed with utmost care and skill. In the column bases, intensity of pressure on concrete block is assumed to be uniform. The column bases shall be of adequate strength, stiffness and area to spread the load upon the concrete, masonry, other foundation or other supports without exceeding the allowable stress on such foundation under any combination of the load and bending moments. The column bases are of two types;

- Slab base, and
- Gusseted bases

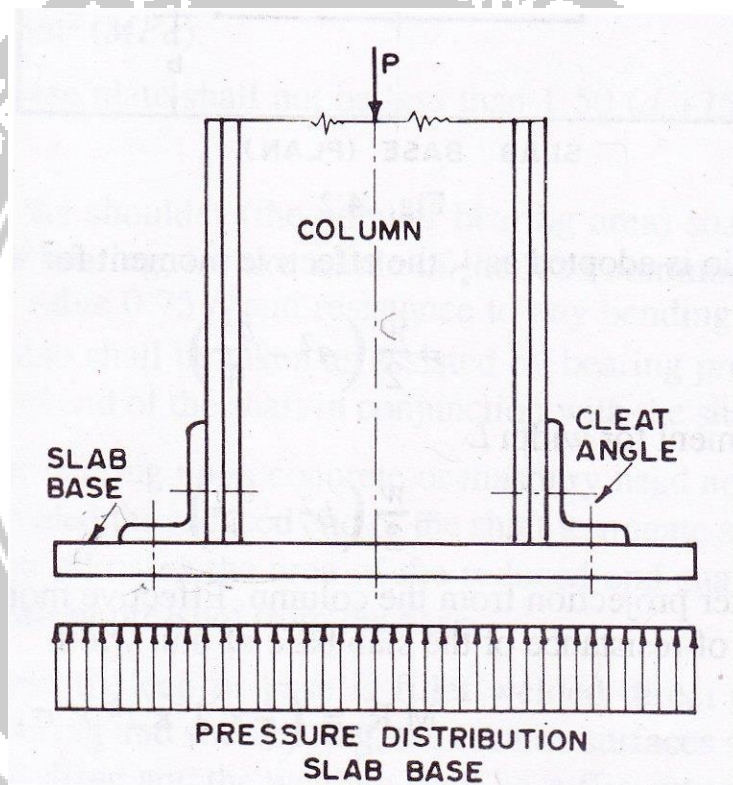
The column footings are designed to sustain the applied loads, moments and forces and the induced reactions. The column load is spread over large area, so that the intensity of bearing pressure between the column footing and soil does not exceed the safe bearing capacity of the soil. it is ensured that any settlement which may occur shall be as nearly uniform as possible and limited to an accepted small amount. The column load is first transmitted to the column footing through the column base. It is then spread over the soil through the column footing. The column footings are of two types;

- Independent footings, and
- Combined footings.

### SLAB BASE

The slab base as shown in Fig. 12.1 consists of cleat angles and base plate. The column end is faced for bearing over the whole area.

The gussets (gusset plates and gusset angles) are not provided with the column with slab bases. The sufficient fastenings are used to retain the parts securely in plate and to resist all moments and forces, other than the direct compression. The forces and moments arising during transit, unloading and erection are also considered. When the slab alone distributes the load uniformly the minimum thickness of a rectangular slab is derived as below;



1. A column section HB 250, @ 0.510 kN/m carries an axial load of 600 kN. Design a slab for the column. The allowable bearing pressure on concrete is  $4 \text{ N/mm}^2$ . The allowable bending stress in the slab base is  $185 \text{ N/mm}^2 (\text{MPa})$ .

Design:

### Step 1: Area of slab base required

Axial load of column = 600 kN

It is assumed uniformly distributed under the slab

Area of the slab base required

$$= \left( \frac{600 \times 1000}{4} \right) = 15 \times 10^4 \text{ mm}^2$$

The length and width of slab base are proportioned so that projections on either side beyond the column are approximately equal.

Size of column section HB 250, @ 0.510 kN/mm is 250 mm x 25 mm

Area of slab base  $= (250 + 2a)(250 + 2b) \text{ mm}^2$

### Step 2: Projections of base plate

Let projections a and b are equal

Area of slab  $(250 + 2a)^2 = 15 \times 10^4$ . Therefore  $a = 68.45 \text{ mm}$

Provide projections  $a = b = 70 \text{ mm}$

Provide slab base  $(250 + 2 \times 70) (250 + 2 \times 70) = 390 \text{ mm} \times 390 \text{ mm}$

Area of slab provided  $= 390 \times 390 = 1,52,100 \text{ mm}^2$

Intensity of pressure from concrete under

slab  $w = \left( \frac{600 \times 1000}{152100} \right) = 3.945 \text{ N/mm}^2$

### Step 3: Thickness of slab base:

Thickness of slab

$$= \left[ \frac{3 \times 3.945}{185} \left( 70^2 - \frac{70^2}{4} \right) \right]^{1/2} = 15.33 \text{ mm}$$

Provide 16 mm thick slab base. The fastenings are provided to keep the column in position.

2.A column section SC 250, @ 85.6 carries an axial load of 600 kN. Design a slab base for the column. The allowable bearing pressure on concrete is  $4 \text{ N/mm}^2$ . The allowable bending stress in the slab base is  $185 \text{ N/mm}^2$  (MPa).

Design:

### Step 1: Area of slab base required

Axial load of column is 600 kN. It is assumed uniformly distributed under the slab.

$$\text{Area of slab base required} = \left( \frac{600 \times 1000}{4} \right) = 15 \times 10^4 \text{ mm}^2$$

The length and width of slab base are proportioned so that the projections on either side beyond the column are approximately equal.

Size of column section SC 250, @ 85.6 kg/m = 250 mm x 250 mm

$$\text{Area of slab base} = (250 + 2a)(250 + 2b) \text{ mm}^2$$

### Step 2: Projections of base plate

Let the projections a and b be equal.

$$\text{Area of slab} (250 + 2a)^2 = 15 \times 10^4. \text{ Therefore } a = 68.45 \text{ mm}$$

$$\text{Provide projections } a = b = 70 \text{ mm}$$

$$\text{Provide slab base } (250 + 2 \times 70) (250 + 2 \times 70) = 390 \text{ mm} \times 390 \text{ mm}$$

$$\text{Area of slab provided} = 390 \times 390 = 1,52,100 \text{ mm}^2$$

Intensity of pressure from concrete under slab

### Step 3: Thickness of slab base:

Thickness of slab

$$= \left[ \frac{3 \times 3.945}{185} \left( 70^2 - \frac{70^2}{4} \right) \right]^{1/2} = 15.33 \text{ mm}$$

Provide 16 mm thick slab base. The fastenings are provided to keep the column in position.

### **Splices for columns.**

Splices should not be placed at potential plastic hinge regions. Hence they are not placed at the end of columns in earthquake regions. Bars having diameter greater than 36mm should not be spliced but must be spliced by welding or by using mechanical couplers. Assuming Grade 415 steel and M25 concrete, the development length is  $41d$  in tension and  $32d$  for compression. As per IS 13920, the lap splice has to be provided only in the central half of the member length, and should be proportioned as a tension splice. Hoops should be provided over the entire splice length at spacing not greater than 150 mm, as per IS 13920.

Moreover not more than 50% of the bars should be spliced at one section. Laps should always be staggered. Terminating several bars at one particular section induces large transverse strains resulting in wider crack widths

A column splice means the joining of two parts of a column whereas a column base transfers forces and moments at the lower end of a column to a foundation. The common thing between these is the use of bearing plates since to splice columns of different sizes bearing plates are used as is also the case with column bases.

