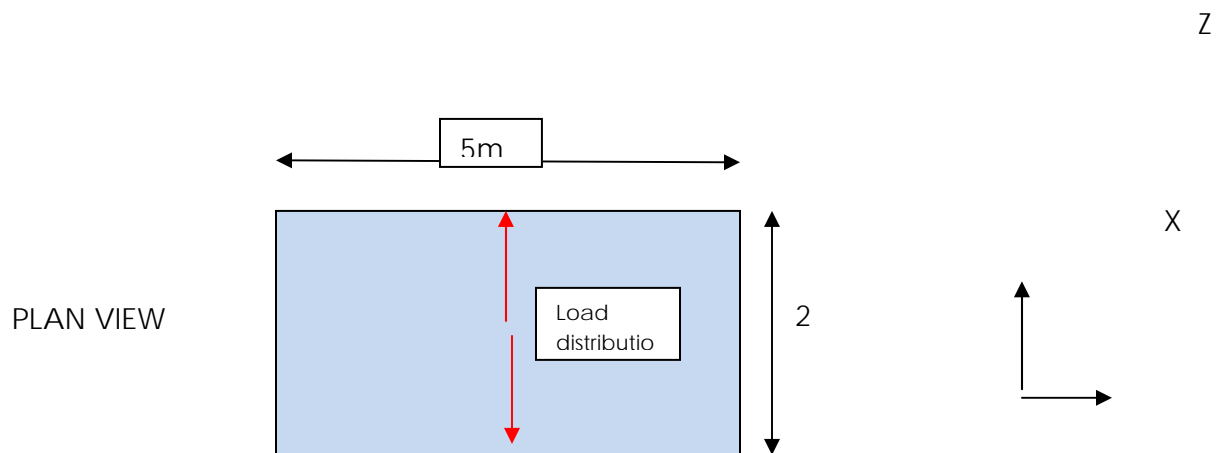


## FLOOR SYSTEMS (PLATES)

1. Solid Slabs - normally made of reinforced concrete but other materials are called plates . Thickness of PLATE depends on span ( refer span / depth ratio for slabs BS8110 for RC design ) but 200 mm is common in residential houses or buildings.
2. Other types of materials such as timber and steel can also be used to make on floors. However they may have different spans and geometrical arrangement due to properties of these materials ( refer to L/d ratios for timber , steel , plastics etc ).
3. S.Slabs ( plates ) can be **ONE WAY OR 2 WAY SPANNING** . One-way means that loads are distributed in one direction due to the aspect ratio of slab.



4. The aspect ratio of above slab is  $5/2 = 2.5 > 2$  so its one way . if this ratio is less than 2 then the distribution of loads is 2 way ( in both directions x & z ).

5. If a typical weight of slab is  $24\text{kN}/\text{m}^3$  then a 200 mm slab will weigh ;  $24 \times 0.2 = 4.8 \text{ kN}/\text{m}^2$  . if the area of slab is  $10\text{m}^2$  then a total load of ;  $10 \times 4.8 = 48 \text{ kN}$  is acting due to self load.
6. Each side of the slab ( if one way span ) will take  $48/2 = 24 \text{ kN}$  ( taken by beams / wall )
7. If the slab is 2 way (  $5 \text{ m} \times 3 \text{ m}$  ) then the sharing of loads is in both x and Z directions . However the values of this distribution depend on end conditions and has to be calculated from formulas (BS8110, Reynolds handbook design) , tables or CAD.
8. Slabs can have various end support conditions similar to beams e.g continuous and simply supported or free. If a slab is continuous then more loads will tend to go to this side compared with simply support. Continuous slabs means that there is another slab adjacent to them and moments & other forces can be transferred.
9. Example calc of 2 way slab formula from BS 8110 ;

$$V_{sy} = B_{vy} \cdot n \cdot l_x \dots\dots\dots (1)$$

$$V_{sx} = B_{vx} \cdot n \cdot l_x \dots\dots\dots (2)$$

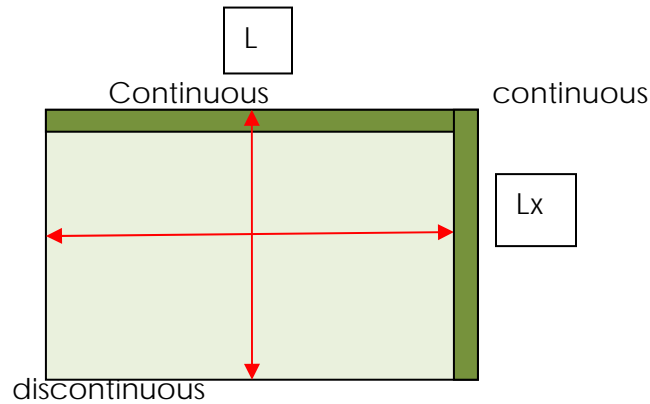
Where  $V_{x,y}$  are the respective loads on supporting elements of slab.

$B_{vy}, v_x$  are the shear coefficients UDL panels

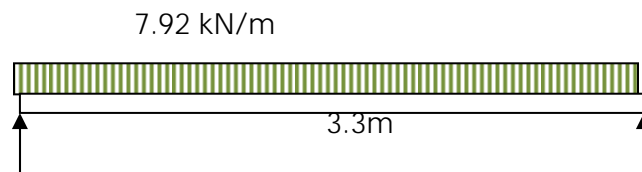
$l_x$  is the shorter length of the panel

$n$  is the uniform design load on the panel,  $\text{kN}/\text{m}^2$

From the table 3 of BS8110; if  $l_y = 5\text{m}$  and  $l_x = 3.3\text{m}$  then  $l_y/l_x = 1.51$  . If the slab has 2 adjacent edges discontinuous, then  $B_{vx} = 0.54$  &  $0.35$  ( continuous & discontinuous edges) and  $B_{vy}$  is  $0.4$  &  $0.26$  respectively for continue & discontinue edges. If  $n = 6\text{ kN/m}^2$



10. From equation (1) above the  $V_{sy} = 0.4 * 6 * 3.3 = 7.92\text{ kN/ m}$  . Spread this load on the whole length of side beam ; (if follow BS8110, spread only  $0.75L$  )



Therefore the maximum moment is  $wly^2 / 8 = 7.92 * 3.3^2 * / 8 = 10.78\text{kNm}$

The above moment is used in the beam design to calculate its size & reinforcement .

11. **Moments in 2 way slabs** can be calculated from table 3.15 in BS8110 . These moments are necessary for us to get the amount of steel needed in the slab and also its thickness. BS 8110 gives a simple formula for restrained slabs ;

$$M_{sx} = B_{sx} \cdot n \cdot l_x^2$$

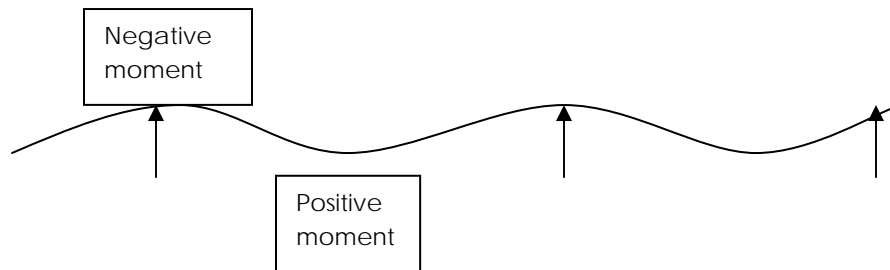
$$M_{sy} = B_{sy} \cdot n \cdot l_x^2$$

$M_{sx}$  ,  $M_{sy}$  - Moment per unit width in x , y direction

$B_{sx}$  ,  $B_{sy}$  – bending coeff from tables for x and y direction

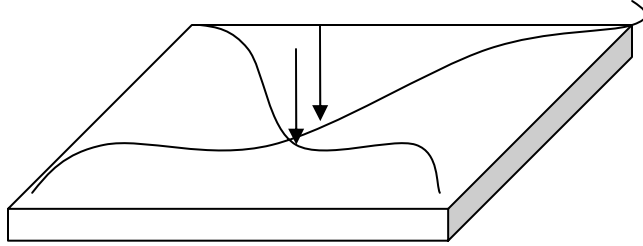
$l_x$  - short length of the slab

12. If same slab above is considered then  $B_{sx} = 0.078$  ;  $0.059$  ( -ve moment at continuous edge , positive moment at midspan ) ;  $B_{sy} = 0.045$  ;  $0.034$  ( -ve moment at continuous edge , positive moment at midspan ).



Bending shape of the slab and moments at supports and mid span

12 . Torsional action happens in slabs where corners are being restrained and sides simple supported

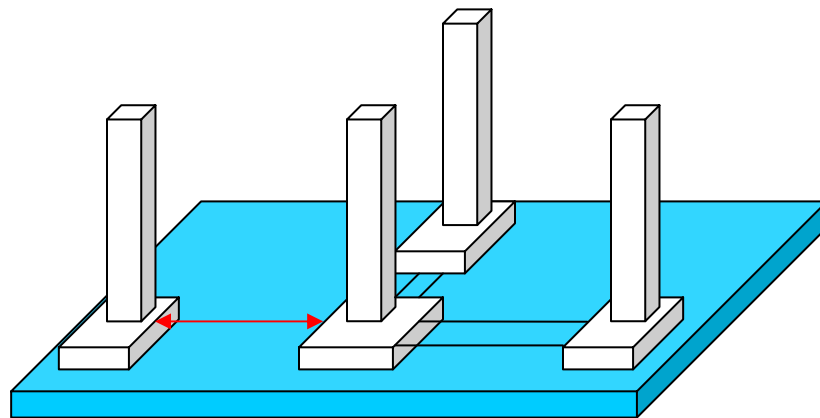


If a plate / slab is restrained as above deflections at mid span are less . Bending at mid span are also less compared to slabs which are not restrained . If sides are rigid then plate is more rigid . This is an advantage in normal house design since we want to reduce deflections and steel in slabs .

Notes :

- Boundary ( continuous, discontinuous, fixed , free ) conditions of slab can affect the moment distribution.
- Maximum moments in slabs depends on the aspect ratio (  $l_y/l_x$  )
- Negative moments and positive moments possible in slabs
- Torsional action in slabs can cause nearly 50 % of loads attracted to the supports

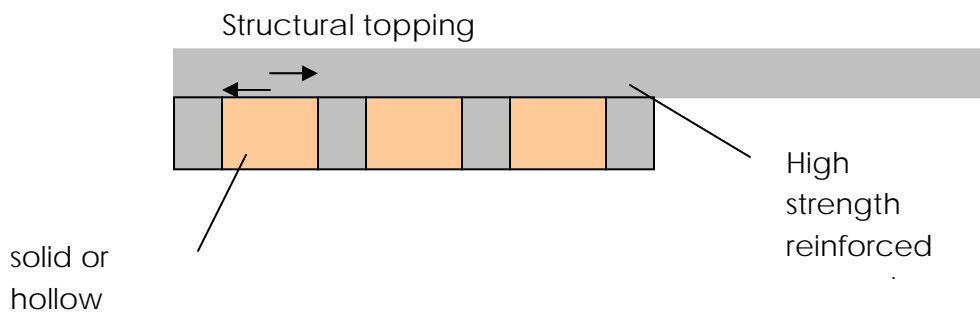
FLAT SLABS



1. There are no beams under this type of slabs . There is large clearance for services.
2. There are columns supporting rectangular pieces of panels with each columns taking the loads from the slab . Normally 2 way flat slabs.
3. The analysis is similar to continuous slabs or can analyse as column frames. Refer to BS8110 ; section 3.7

4. At each columns there may be a column head / widening of the column in order to take up the punching shear stress . width and thickness of column head is important and have to be designed.
5. The load transfer is in 2 directions just as in the 2 way S.Slab. Table 3.19 gives the bending moment and shear force coeff for flat slabs of 3 or more spans.

### RIBBED SLAB WITH SOLID OR HOLLOW BLOCKS



1. insitu slabs cast with reinforcement placed at distances which enable hollow blocks to put in between them.
2. Slab is analyzed as ribbed one way spanning plate. Typical Span between ribs is about 0.6m
3. Total Depth of slab from 120 to 150 mm