UNIT-1

"COLUMN"

"In a building structure a compressive member whose effective length are exceed three times of its least lateral dimension is called Column."

Column are classified mainly two types-

1. Short Column
2. Long Column

1. **Short Column** :- A Column is said to be short column if slenderness ratio are less than 12.

Slenderness ratio :- $\frac{effective\ length}{least\ lateral\ dimension} < 12$

2. ***Long Column*** :- A Column is said to be long column if slenderness ratio are greater than or equal to 12.

Slenderness ratio :- $\frac{\text{effective length}}{\text{least lateral dimension}} \geq 12$

Column classified according to "Ties":-

1. Lateral ties Column
2. Helical ties Column

LOAD CARRYING CAPACITY OF LATERAL & HELICAL TIES COLUMN:

TYPES OF COLUMN

(I) **Lateral ties column-**

(i) **Short column-**

$P_u = 0.40\ \sigma_c\ A_c + 0.67\ \sigma_y\ A_{sc}$

(ii) **Long column-**

$P_u = C_r(0.40\ \sigma_c\ A_c + 0.67\ \sigma_y\ A_{sc})$

C_μ = Reducation Factor= $1.25 - \frac{l_e}{48b}$ OR $1.25 - \frac{l_e}{160\ I_{\min}}$

l_e = effective length

(II) **Helical ties column-**

(i) **Short column**

$P_u = 1.05(0.40\ \sigma_c\ A_c + 0.67\ \sigma_y\ A_{sc})$

(ii) Long column

$P_u = 1.05 C_r(0.40\ \sigma_c\ A_c + 0.67\ \sigma_y\ A_{sc})$

Where,

σ_c = grade of conc.

A_c = Area of conc.

F_y OR σ_y = grade of steel

A_{sc} = Area of steel in column

A_c = Area of Column- Area of steel

- In case of square or Rectangular column minimum nos. of Longitudnal bar should not less than 4.
- In case of circular column the minimum nos. of Longitudnal bar should not less than 6.
- In case of Helical reinforcement column the minimum nos. of longitudnal bar should not less than 6.
- The spacing of longitudnal bar measured along the Periphery of the coloumn shall not exceed 300 mm.
- The minimum Area of longitudnal reinforcement in a column should not less than 0.8% of the crossection area of column.

= .8% of Acol.

$= \frac{.8}{100} A_{col.} = 0.008\ A_{col.}$

- The Maximum Area of longitudnal reinforcement in a column should not exceed 6% of the crossection area of column.

= 6% of $A_{col.}$

$= \frac{6}{100}\ A_{col.} = 0.06\ A_{col.}$

Range of Steel in a Column = .8% to 6%

Note- In case of lapped column (overlapping) column the maximum are of reinforcement should not exceed 4% of the column Area.

MINIMUM NOMINAL COVER IN A COLUMN

- **Should not less than longer dia of Bar -**
  - (i) dia of bar if equal bar are used
  - (ii) larger dia of bar if unequal bar are used
  - (iii) Should not less than 40 mm.

  Whichever is greater.

Note:- यदि column का size 200 mm से कम हो तो minimum Nominal cover 40 mm. की बजाए 25 mm ले सकते है।

MINIMUM DIAMETER OF LONGITUDAL BAR

- Minimum diameter of lognitudal bar in a column should not less than 12 mm.

Note:-यदि Column का size 200 mm से कम हो तो maximum diameter of longitudal bar 12 mm से अधिक नही होना चाहिए।

- **LATERIAL TIES -**

Minimum ties dia $Q_T \not< \frac{Q_L}{4}$ Q_L=longer dia of longitudal bar

$\not<$ 6mm

Q_L = Longer dia of longitudinal bar

Whichever is greater

- ***Availble dia in Market:-***

6 mm, 8 mm, 10 mm, 12 mm, 16 mm, 20 mm, 25 mm, 28mm, 32 mm, 36 mm .....

- ***MAXIMUM PITCH***

$\leq$ least lateral dimension

$\leq 16\phi_L$. (ϕ_L = Smaller dia of bar if unequal bar are used)

$\leq 48\phi_T$ (ϕ_T = dia of ties)

$\leq$ 300 mm

Whichever is less

Q. Find out the maximum pitch of column 200 x 400 mm with 2-16Q + 4-20Q Longitudnal bar and 8 mm dia lateral ties are used.

Sol. $\leq$ least lateral dimension = 200

$\leq 16Q_L$ = 16 x 16 = 256

$\leq 48\ Q_T$ = 48 x 8 = 384

$\leq$ 300 mm

Maximum pitch of column is 200 mm coz it is less.

HELICAL REINFORCEMENT

Ties dia $\phi_T \not< \frac{\phi_L}{4}$

$\not<$ 6 mm

Whichever is greater

Where ϕ_L =larger dia of bar if unequall bar are used.

PITCH :-

- **Minimum pitch in Helical reinforcement**

  Not less than 25 mm

  Not less than 3 x dia of helix bar

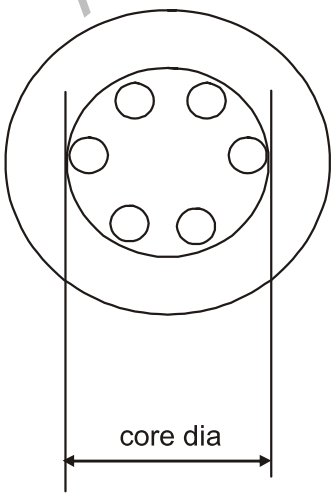
  Whichever is greater

- **Maximum pitch in Helical reinforcement=**

  (i) Not more than 75 mm

  (ii) Not more than $\frac{1}{6}$ x core dia of column

  Whichever is less



MINIMUM ECENTRICITY

प्रत्येक Column min. ecentricity के लिए design किया जाता है, और Column कि ECENTRICITY निम्न प्रकार से Calculate कि जाती है –

- ***Min. Ecentricity*** = $\frac{Un\,\text{supported length}}{500} + \frac{lateral\ \text{dime}nsion}{30} \not< 20$ mm

  Min. Ecent. = $\frac{L}{500} + \frac{D}{30} \not< 20$mm

- ***MAXIMUM LIMIT OF ECENTRICITY***

  Max. limit of ecentricity = 0.50 $\times$ least lateral dimension

MAXIMUM SLENDERNESS RATIO LIMIT FOR COLUMN

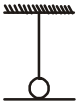
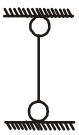
Case: I

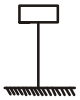
The unsupported length between end restrained of a column shall not exceed 60 times of least lateral dimension.

Case: II

If one end of column is unrestrained than unsupported length shall not exceed $\frac{100}{d}b^2$

END CONDITION OF COLUMN & EFFECTIVE LENGTH

S.No.	***End Condition***	***Figure***	***Effective Lenght***
1.	If a column effectively held in position and restrained against rotation at both ends.		Leff.= 0.65 L
2.	If a column effectively held in position at both ends but restrained against rotation at one end.		Leff. 0.80 L
3.	If a column effectively held in position at both ends but not restrained against rototion at any ends		Leff.= 1.0 L

4.	If a columan effectively held in position and restrained against rotation at one end at other end restrained against rotation but not held in position		Leff.= 1.20 L
5.	If a column effectively held in position and restrained against rotation at one end, and at other end partially restrained against rotation but not held in position		Leff.= 1.50 L
6.	If a column effectively held in position at and restrained against rotation one end at other not held in position nor restrained against rotation.		Leff.=2.0 L
7.	If a column effectivley held in position at one end but not restrained against rotation, and at the other end restrained against rotation but not held in position		Leff. =2.0 L

Note- In case of padestal minimum area of the minimum area of longitudnal bar shall not less than .15% of column area.