

UNIT-V.

(IS 1905-1987)

BRICK MASONRY!

Brick masonry is a useful material obtained by systematic arrangement of laying bricks and bonding together with mortar.

Classification of wall:- (page No: 4)

- 1) Cavity wall. IS
- 2) Faced wall.
- 3) Veneered wall.
- 4) Partition wall.
- 5) Pannelled wall.
- 6) Shear wall.
- 7) Load bearing wall.

lateral Support & stability → (page No: 5)

1. to limit the slenderness ratio of a masonry element so as to give to reduce possibility of buckling of the member due to vertical loads.

2. to resist horizontal component of the force so as to ensure stability of structure against over turning.

STABILITY: (page No: 6)

i. Simple static reaction at the point of lateral support to all the lateral load and

25% of total vertical load that wall (or) column is designed to carry at point of lateral support

Column masonry:

An isolated vertical load bearing member, width of which does not exceed 4 times of thickness.

Pier:

a thick section forming integral part of a wall placed at intervals along the wall to resist stiffness of wall (or) to carry vertical concentrated load.

Buttress:

a pier of masonry built as an integral part of wall and projecting from either or both surfaces.

Slenderness ratio:

It is the ratio of effective length (or) effective height to effective thickness of masonry wall.

Design loads:- → (page No: 15)

load to be taken is to consideration for designing masonry component of a structure of dead load.

- (i) dead load of wall, dead load of floor + dead load of roof.
- (ii) live load of floor & roof.
- (iii) wind load on wall & sloping roof.
- (iv) seismic force.

effective height: (page No: 11)

—x—

determine the allowable axial load on the column of size $30\text{ cm} \times 60$ constructed in first class brick work in 1:6 cement mortar, using modular brick size of $200 \times 100 \times 200$, height of pier b/w the footing and rough slab 5.1 m strength of unit may be taken as 10 MPa

given:-

column size = $300 \times 600\text{ mm}$.

height of pier = 5.1 m .

Strength of unit = 10 N/mm^2

Cement mortar = 1:6

Step 1:

effective height of column.

Condition: 3.

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⇒ effective height = $1.00 H$.

$$= 14.5 \cdot 1$$

$$= 5.1 \text{ m.}$$

Step 2: Basic compressive stress :- (f_c).

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for M_1, M_2, M_3, L_1, L_2 → Table 1

from table 1 the grade of mortar was confirmed as M_2 for cement mortar ratio 1:6

from table No: 8 the basic compressive stress =

⇒ Basic compressive stress = 0.81 N/mm^2

Step 3: Area of Reduction factor:

Area of column = 300×600

$$= 180000 \text{ mm}^2 = 0.18 \text{ m}^2.$$

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The net sectional area of the column

the calculation of compression stress.

$$K_a = 0.7 + 1.5 A_1 / A$$

$$= 0.7 + 1.5 (1/3)$$

$$K_a = 0.97$$

Step 4: Shape modification factor for masonry unit:

height to width ratio \Rightarrow

$$200 \times 200 \times 100$$

$$\Rightarrow \frac{200}{200} \Rightarrow 1.$$

\therefore from table 10

\therefore Shape modification factor is = 1.1

$$\Rightarrow K_p = 1.1$$

Step 5: Load Factor.

a for axial load $\Rightarrow 1.$

for eccentric $\Rightarrow 1.2.$

$$\Rightarrow K_L = 1 \rightarrow (\text{for axially loaded})$$

2. A column of size 300×550 mm, constructed in 1st class brick in 1:6 cement mortar using modular brick size of $200 \times 100 \times 200$ height of pier b/w footing and top slab is 4.5 m., the strength of unit may be taken as 10 N/mm^2 . Calculate compressive stress load for applied at eccentricity of 100 mm.

(i) Size = 300×550
 height = 4.5
 Size of brick = $200 \times 100 \times 200$
 Strength = 10 N/mm^2
 Cement mortar = 1:6.

(i) effective height

\Rightarrow effective height = 1×4.5
 $= 4.5 \text{ m.}$

(ii) Basic compression stress.

$\Rightarrow 0.81 \text{ N/mm}^2$

\Rightarrow Area of reduction factor:

$$\Rightarrow A = 300 \times 550 = 165000 \text{ mm}^2$$

$$= 0.165 \text{ m}^2$$

$\Rightarrow K_a = 0.7 + 1.5 A$

$$\Rightarrow 0.7 + 1.5 (0.165)$$

$$= 0.94$$

\Rightarrow shape modification factor.

$$\Rightarrow \frac{200}{300} \Rightarrow 1$$

$\Rightarrow K_p = 1.1$

Step 5:- Load factor:

$$K_L = 1.25 \text{ (for eccentric column).}$$

Step 6:- Slenderness $\Rightarrow \frac{4.5}{0.3} = 15$. $\frac{e}{k} = \frac{100}{600} = 0.16$.

stress reduction factor $\Rightarrow 0.66$.

\Rightarrow

Step 7 Compressive stress:-

$$f_{ca} = f_c \times K_A \times K_p \times K_L \times K_{SF}$$

* design a brick column of height 3 m to carry an axial load of 100 kN width of pier is limited to $1\frac{1}{2}$ of normal brick for architectural reason, adopt cement lime mortar of proportion 1:1:6 & first class brick, with 10 MPa strength. the column may be taken as fixed restrained.

Given:

axial load :- 100 kN.

height = 3 m ; mix ratio : 1:1:6

Strength of unit = 10 MPa.

end condition : fixed restrained.

Class of brick = 1st class.

Step 2 : eff height page no: 11.

Table - 4

Condition - 2

$$\Rightarrow \text{eff hgt} > 3 \times 0.85$$

$$= 2.55 \text{ m.}$$

Step 2 :: slenderness ratio :-

width of normal buck = 228 mm.

$$\Rightarrow \frac{\text{eff } l_t}{L D} = \frac{2.55}{1.5 \times 228} = 7.45.$$

Step 3 Compression stress.

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\Rightarrow Basic compressive stress $\geq 0.96 \text{ N/mm}^2$.

$$\Rightarrow f_c = 0.96 \text{ N/mm}^2$$

from table-3 the grade of mortar was conferred as M1 \Rightarrow for cement mortar ratio 1:1:6,

from table-8, the basic compressive stress = 0.96 N/mm^2

Step 4 Area of reduction factor.

unless the length of pier $= d$ is known, the area A cannot be found. \therefore

hence $\rightarrow K_A$ is unknown.

Normally K_A is varied b/w 0.7 to 1, let us

take the average value of 0.875

Step 5: shape ^{Modification} reduction factor:

page No: 17 table: 10

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Step 6: Stress reduction factor

$$\Rightarrow K_{sf} = 0.97 \quad \frac{1.00 + 0.95}{2} \cdot 0.97$$

Step 7: load factor

$\Rightarrow K_L = 1$ for axial loaded column.

Step 8: Compress stress:

$$f_{ca} = f_c + K_A + K_P \times K_{sf} \times K_L$$

$$= 0.96 \times 0.875 \times 1 \times 0.97 \times 1$$

$$= 0.814$$

$\Rightarrow \text{Stress} = \frac{P}{A}$

$$0.814 = \frac{110 \times 10^3}{342 \times d}$$

$\Rightarrow d = 395.13 \text{ mm}$

the size of the column is $228 \times 395 \text{ mm}$.

Hence the column section of $1\frac{1}{2} \times 2$ circle

check.

$K_A = 0.7 + 1.5 \times A$

$K_A = 0.835 < 1$

hence Safe.

97.

$\frac{P \times e}{A}$

$\frac{P}{A}$

25 mm.

check

1. Design an interior cross wall of two story building to carry 100m thick R.C.C. slab. with 3m sealing height the wall is stiff and it support 2.65m wide slab. the live load on roof + floor is $1.5 \text{ kN/m}^2 + 2 \text{ kN/m}^2$ the height of floor finish and line terrace $0.2 \text{ kN/m}^2 + 2 \text{ kN/m}^2$. adopt curing strength. mix 10 MPa + M20 grade M_{10} .

Given data:

No. of story = 2.

Slab $t_k = 100$

L.L on floor = 2 kN/m^2

L.L on slab = 1.5 kN/m^2

wt of floor finish = 0.2 kN/m^2

wt of line terrace = 2 kN/m^2

Curing $\sigma_t = 10 \text{ MPa}$.

Step 1: Basic compressive stress.

$$f_c = 0.96 \text{ N/mm}^2$$

Step 2: Load calculation

Roof Self weight of Roof slab = $1 \times 0.1 \times 25$
 $= 2.5 \text{ kN/m}^2$
 live load : 1.5 kN

floor slab:

$$\text{S.w. of slab} = 1 \times 0.1 \times 25 \\ = 2.5$$

$$\text{live load} = 2 \text{ kN/m}^2$$

$$\text{wt. of fl} = 0.2 \text{ kN/m} \\ \hline 4.7 \text{ kN/m}^2$$

wall

wt of wall:

adopt Thickness of wall = 100 mm.

$$\text{wt of wall} = 1 \times 0.1 \times 3 \times 2 \times 20 = 12. \quad \left(20 \text{ units weight of brick} \right)$$

Total load on wall

$$\Rightarrow [(6 + 4.7) 2.65] + 12 \\ = 40.35 \text{ kN/m}$$

step 3: effective height.

Both end fixed.

$$\Rightarrow \text{effect height} = 0.75 H \\ = 0.75 \times 3000 \\ = 2250 \text{ mm}$$

step 4. Slenderness ratio:

$$\frac{\text{eff height}}{t} = \frac{2250}{100}$$

From table 7 the maximum slenderness ratio for two storey building should not be greater than 27.

Step 5. Stress reduction factor.

$$k_f = 0.53 \text{ N/mm}^2$$

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79.

Step 6 :- Permissible compressive stress :-

$$f_{ac} = k_s \times f_c$$

$$= 0.58 \times 0.96$$

$$= 0.508 \text{ N/mm}^2$$

$$\text{actual compressive stress} = P/A$$

$$\Rightarrow \frac{40.3}{(1000 \times 100)} = \sigma$$

Area: (Thickness \times length)

$$\Rightarrow \sigma = 0.403 \text{ N/mm}^2$$

$$\Rightarrow 0.4 < 0.508$$

Hence safe.

2. Design exterior wall of a building to carry
 100 mm thick R.C. slab. 3 m rising height. Support
 condition is fixed, unrestrained, live load on
 roof is 2 kN/m^2 , ultimate crushing strength of
 brick unit is 10 N/mm^2 , $M_1 \rightarrow \text{mortar}$, ...

Given data:-

height = 3 m.

live load on roof = 2 kN/m^2 .

Strength = 10 N/mm^2 .

100 mm thick R.C. slab.

M_1 - mortar.

Brick Compression stress:

$$\geq 0.96 \text{ N/mm}^2.$$

load calculation:-

Roof \Rightarrow

$$\text{Self weight} \Rightarrow 1 \times 0.1 \times 25 \\ = 2.5 \text{ kN/m}.$$

$$\text{live load} = 2 \text{ kN/m}.$$

$$\overbrace{\quad\quad\quad} \\ 4.5 \text{ kN/m}.$$

floor.

$$\text{Self weight} = 2.5$$

wall:

$t = 230 \text{ mm. (exterior wall).}$

$$\Rightarrow 1 \times 0.1 \times 3 \times 2 \times 20$$

$$\Rightarrow 12.$$

Total load.

$$\Rightarrow (4.5 + 4.7) 3 + (12).$$

$$= 39 \text{ kN/m.}$$

Step 3

eff height

$$\Rightarrow \Rightarrow \cancel{k_{eff}} H \quad 0.85 H$$

$$\Rightarrow 2.550 \text{ m.}$$

Slenderness ratio

$$\Rightarrow \frac{2550}{230} = 11.08 < 27.$$

Hence safe.

5. stress reduction factor

$$K_s = 0.86$$

6. permissible compressive stress

$$\Rightarrow \text{fac} = 0.86 \times 0.96$$

$$\begin{aligned}
 \Rightarrow \sigma &= \frac{P}{A} \\
 &= \frac{39 \times 10^3}{(1000 \times 230)} \\
 &= 0.16 < 0.86
 \end{aligned}$$

Here Safe.

Step 6: Stress reduction factor:

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⇒

$$\text{Slenderness ratio} = \frac{\text{effective height}}{\text{least lateral dimension}}$$

$$\Rightarrow \frac{5.1}{0.3} = 17.$$

$$\Rightarrow \text{stress reduction factor} = 0.7. \quad \frac{0.73 + 0.67}{2} = 0.7$$

Step 7:

Compressive stress:

$$f_{ca} = f_c \times K_A \times K_p \times K_L \times K_{SF}$$

$$= 0.81 \times 0.97 \times 1.1 \times 1 \times 0.7$$

$$= 0.604 \text{ N/mm}^2$$

axial load.

$$f_{ca} = \frac{P}{A}$$

$$\Rightarrow P = f_{ca} \times A$$

$$= 0.604 \times (0.48 \times 300 \times 600)$$

$$= 108.72 \times 10^3$$

$$= 108.72 \text{ kN}$$