## SHEAR:

A rectangular reinforced concrete beam is simply supported on masonry walls 300mm thick and 7m c/c. The beam has to carry, in addition to its own weight, a distributed live load of 8kN/m and a dead load of 4kN/m. The simply supported beam is provided with 3 nos. 16mm diameter at bottom. Design a beam for shear. Consider size of the beam is 250 x 500mm. M20 & Fe415 combinations are used.

## GIVEN:

Live load = 8kN/m, Dead load (excluding self.wt) = 4kN/m

Area of tension steel, $A_{st}$ = 3-16mm $\phi$

Overall size of beam = 250x500mm

Span, L = 7m c/c. Width = 300mm.

Grade, $f_{ck}$ = 20 N/mm², $f_y$ = 415 N/mm²

## 1. LOAD CALCULATION:

Live load = 8kN/m

Dead load (excluding self-weight) = 4kN/m

Self.weight of beam = 0.25 x 0.5 x 25 = 3.125 kN/m

Total load, w = 15.125 kN/m.

Factored load = 1.5 x 15.125 = 22.69 kN/m.

Shear force at support A } = $\frac{W_u l}{2}$ = $\frac{22.69 \times 7}{2}$

= 79.415 kN.

Critical shear occurs at a distance effective depth 'd' from face of a masonry wall.

Overall depth of beam, D = 500mm and also

Provide 20mm $\phi$ bar.

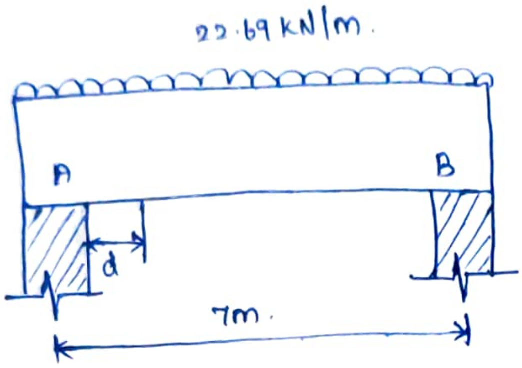
Effective depth, $d = D - \text{clear cover} - \phi/2$

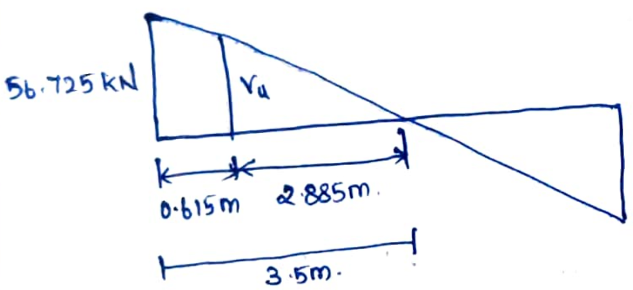
$= 500 - 25 - 20/2 = 465$

Critical shear location from centre of support

$= d + \dfrac{\text{masonry wall thickness}}{2}$

$= 465 + \dfrac{300}{2} = 615\,mm = 0.615\,m$




Factored shear force, Vu at critical section can be calculated by similar triangle principle.

$\dfrac{79.415}{3.5} = \dfrac{V_u}{2.885} \Rightarrow V_u = 65.46\,kN.$

Nominal shear stress, $\tau_v = \dfrac{V_u}{bd}$

$\tau_v = \dfrac{65.46 \times 10^3}{250 \times 465} = 0.56\,N/mm^2$

From Pg. no. 73, Table 20.

Maximum shear stress, $\tau_{c\,max} = 2.8\,N/mm^2$.

$\tau_v < \tau_{cmax}$, hence given section size is adequate.

Shear resisted by concrete } $V_{uc}$ = Shear stress x Eff. c/s area

$$V_{uc} = \tau_c \times bd.$$

$$P_t = \frac{100 A_{st}}{bd} = \frac{100 \times 3 \times \pi/4 \times 16^2}{250 \times 465} = 0.52\%.$$

From pg.no-73, Table 19.

| $P_t$ | $\tau_c$ |
|---|---|
| $x_1 = 0.5$ | $y_1 = 0.48$ |
| $x_2 = 0.75$ | $y_2 = 0.56$ |
| $x = 0.52$ | $y = ?$ |

$$y = y_1 + \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) = 0.48 + \frac{0.56 - 0.48}{0.75 - 0.50}(0.52 - 0.5)$$

$$y = \tau_c = 0.4864\ N/mm^2$$

$$V_{uc} = 0.4864 \times 250 \times 465 = 56544\,N = 56.54\,kN.$$

Shear to be resisted by stirrups, } $V_{us} = V_u - V_{uc}$

$$V_{us} = 65.46 - 56.54 = 8.92\,kN.$$

Spacing between stirrups, $S_v$ can be determined by taking least value of the following 4 cases.

Provide 2 legged 8mm $\phi$ stirrups.

a) $S_v = \dfrac{0.87 f_y A_{st} d}{V_{us}}$

$= \dfrac{0.87 \times 415 \times 2 \times \pi/4 \times 8^2 \times 465}{8.92 \times 10^3} = 1882.15\,mm$

$S_v < 1882.15$ mm c/c

b) $S_v < 0.75d \Rightarrow S_v = 0.75 \times 465 = 348.75\,mm$.

c) $S_v = 450mm$.

d) $S_{vmax} = \dfrac{2.175 f_y A_{st}}{b}$

$= \dfrac{2.175 \times 415 \times 2 \times \pi/4 \times 8^2}{250}$

$= 361.05\,mm$.

Provide 2 legged 8mm $\phi$ stirrups at 340mm c/c.