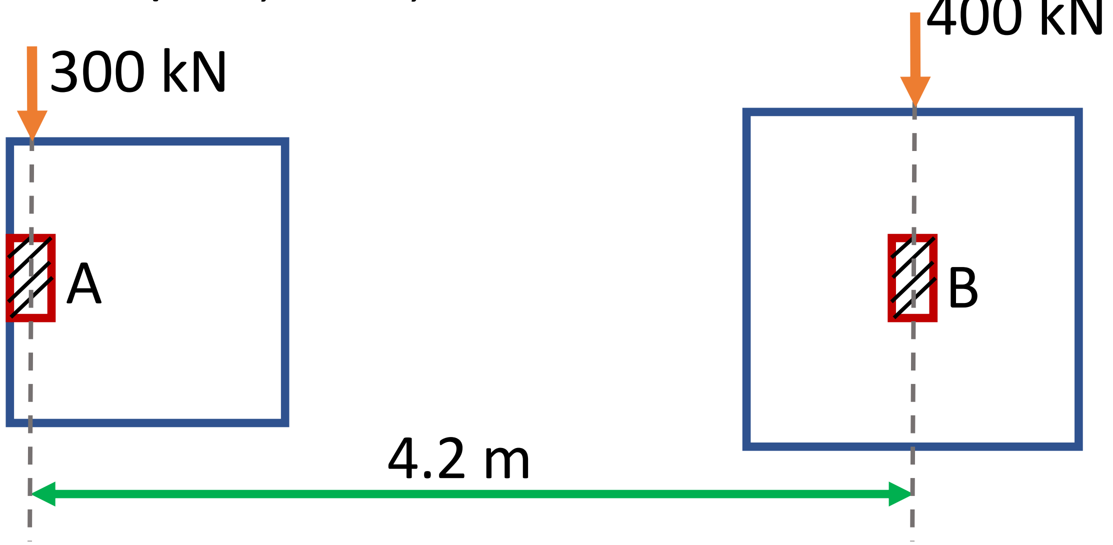
# Design of Eccentric footing with Strap Beam

Load on Column A – 300 kN, Column B – 400 kN

Column size – 230 x 300 mm

SBC – 200 kN/$m^2$ , M25, Fe415

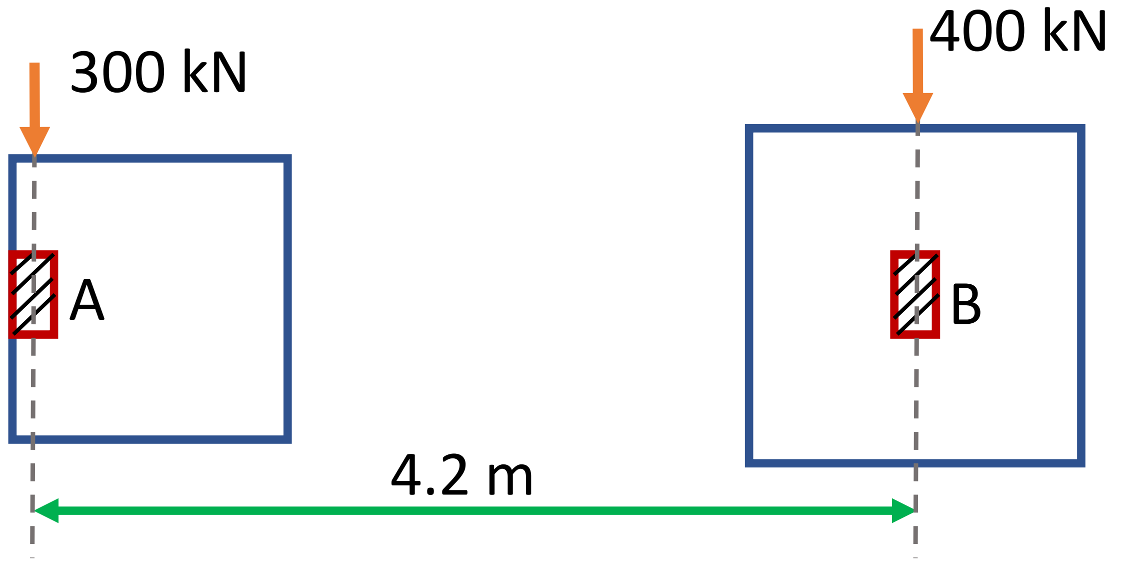


# Design of Eccentric footing with Strap Beam

Load on Column A – 300 kN, Column B – 400 kN

Column size(A&B) – 230 x 300 mm

SBC – 200 kN/$m^2$, M25, Fe415




## Design of Footing A

### Step -1

Area of footing = P / SBC = 300 X 1.1 / 200 = 1.65$m^2$

Provide 1.22m x 1.52m

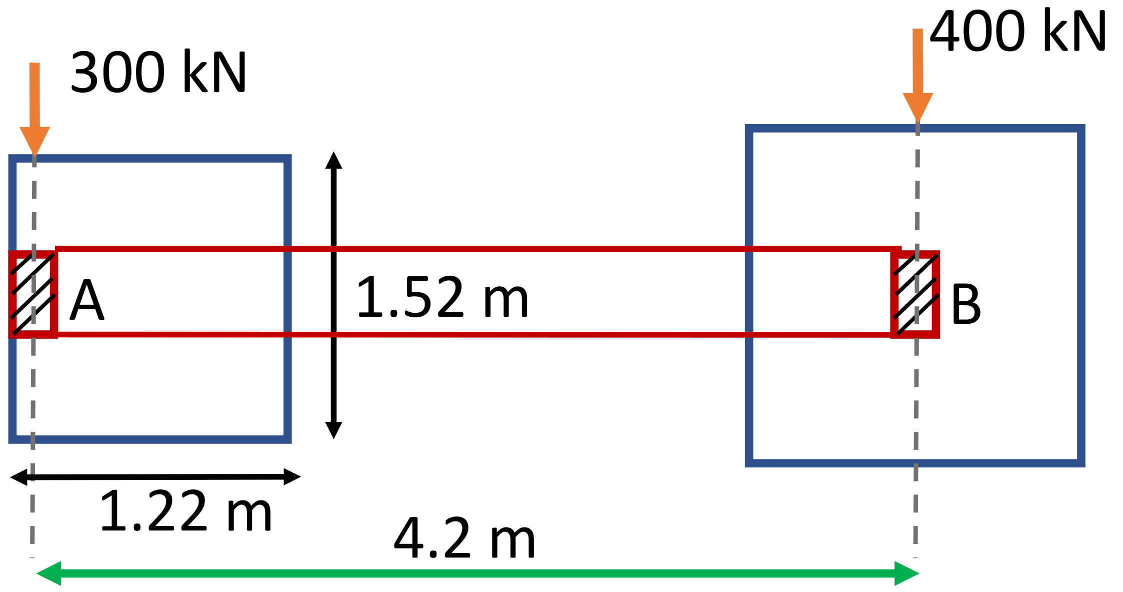
Area provided = 1.85$m^2$

# Design of Eccentric footing with Strap Beam

Load on Column A – 300 kN, Column B – 400 kN

Column size(A&B) – 230 x 300 mm

SBC – 200 kN/m$^2$ , M25, Fe415



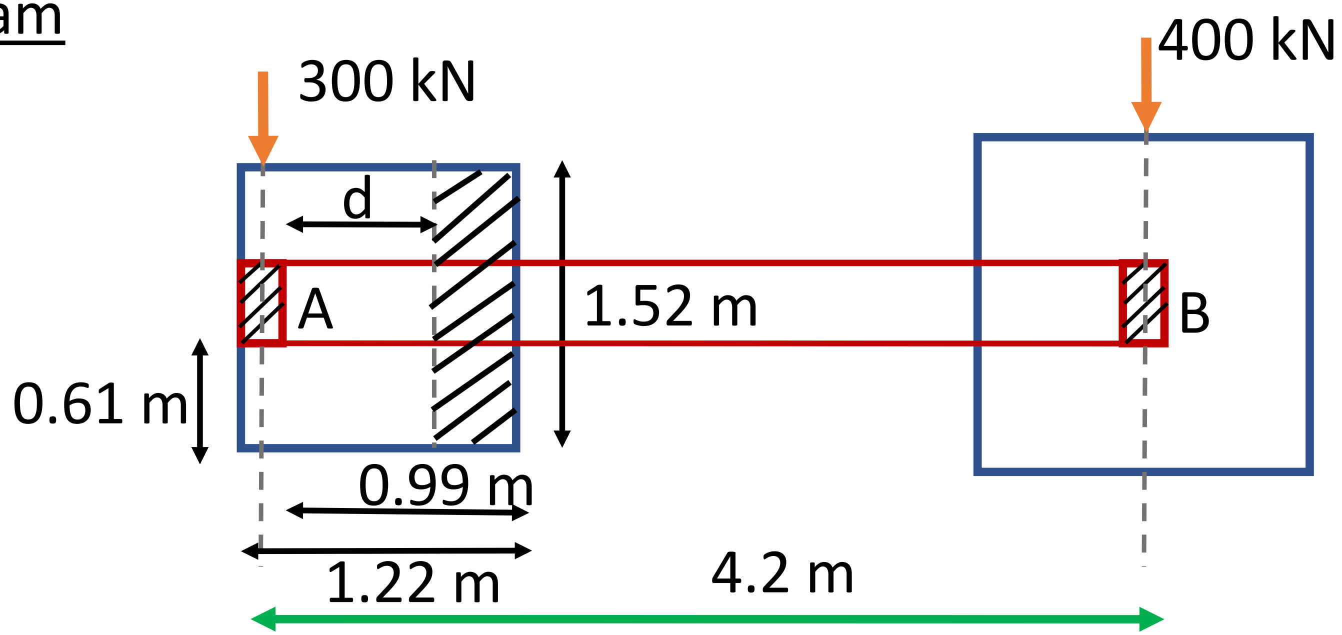

## Design of Footing A

## Step -2

Net upward soil pressure

$q = P / Area = 300 / 1.85 = 108.10\ kN/m^2 < 200\ kN/m^2$

# Design of Eccentric footing with Strap Beam




## Step -3

One-way Shear Check

Assume Pt as 0.2%

$\tau_c = 0.36\ N/mm^2$

( M25, from Table – 19 of IS-456:2000)

Factored shear force $V_{u1} = 0.108 \times 1.5 \times 1520 \times (990-d)$

$= 243.78 \times 10^3 - 246.24\ d$

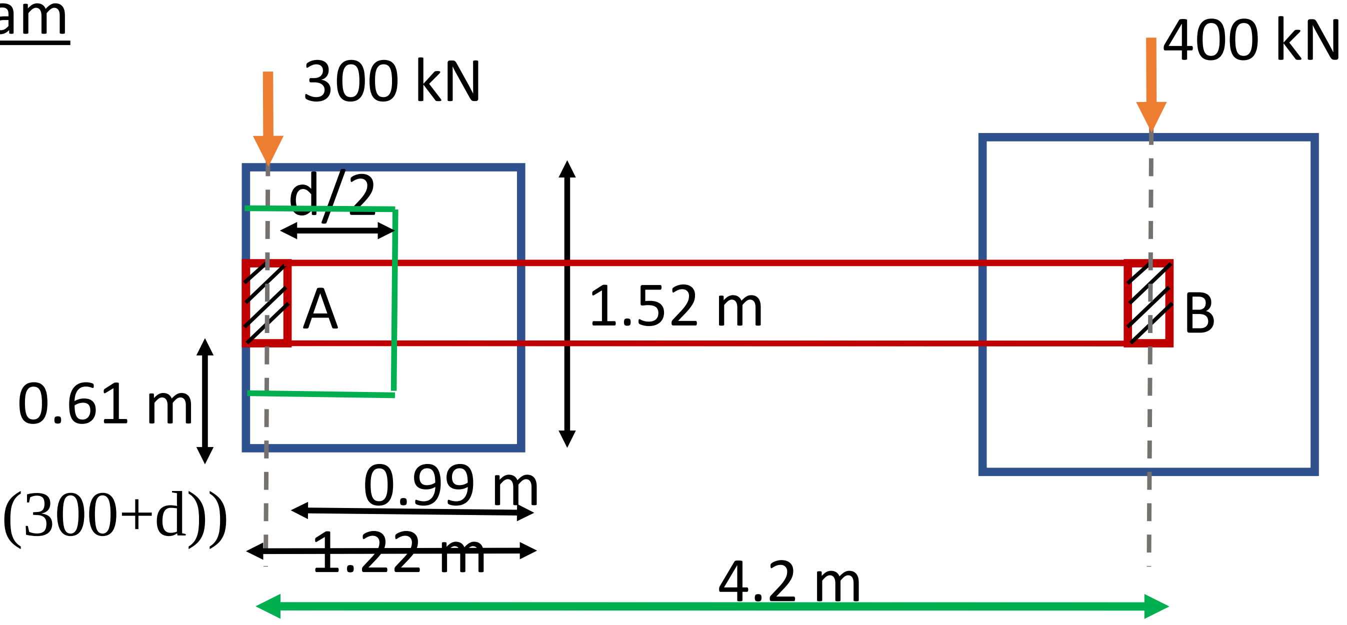
One way shear resistance $V_{c1} = \tau_c Bd = 0.36 \times 1520 \times d = 547.2d\ N$

$V_{u1} < V_{c1}$ , $243.78 \times 10^3 - 246.24\ d = 547.2d$

$243.78 \times 10^3 = 547.2d + 246.24d$

$d = 243.78 \times 10^3 / 793.44 = 307.24\ mm$

# Design of Eccentric footing with Strap Beam




## Step -4

Two-way Shear Check

Factored shear force

$V_{u2}$ = 0.108 x (1520 x1220 – 2(230+d/2)+(300+d))

d = 307 mm (from one-way shear check)

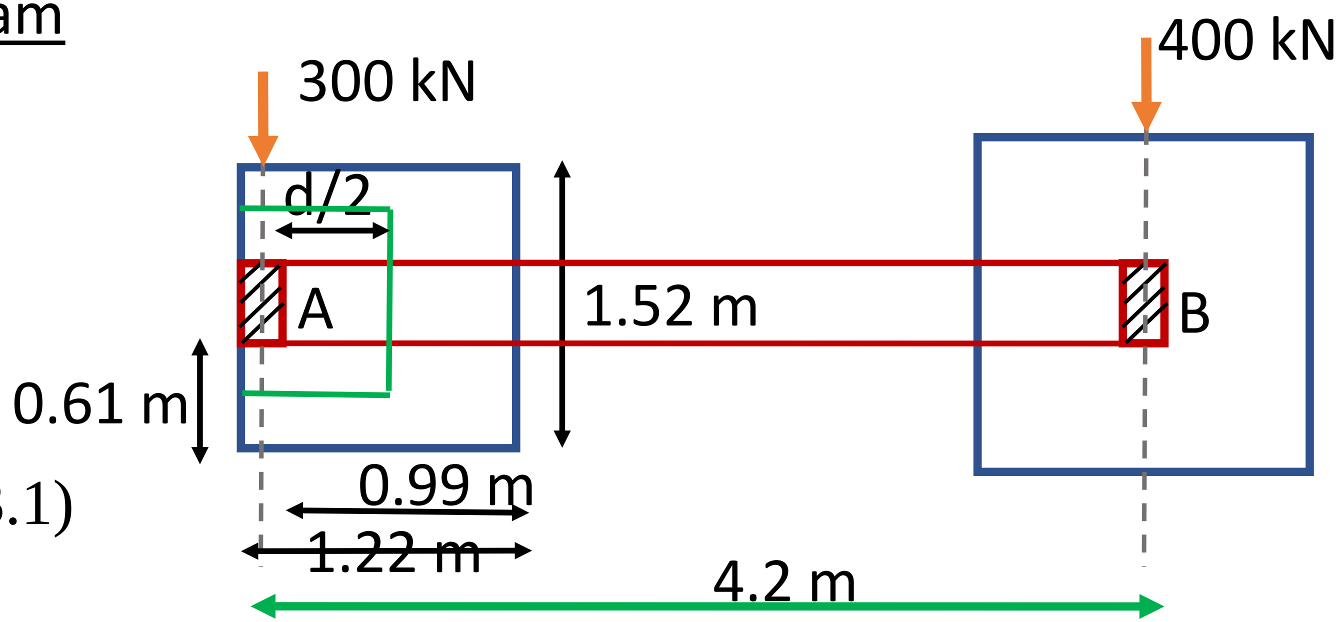
$V_{u2}$ = 200.126 x $10^3$ N

As per Cl.31.6.2 of IS-456:2000

Nominal Shear stress $\tau_v = V_u/bd$

$\tau_v$ = 200.126 x $10^3$ / 2(230+307)+(300+307) x 307 = 0.387 N/mm$^2$

# Design of Eccentric footing with Strap Beam




## Step -4

Permissible shear stress

$\tau_c' = k_s \times \tau_c$ (As per IS456-2000 Cl.31.6.3.1)

$K_s = (0.5+\beta_C)$ but not greater than 1

$\beta_C$ – Ratio of shorter side to longer side of the column

$\tau_c = 0.25\sqrt{fck}$

$k_s = (0.5+ \beta_C) \leq 1$ , $\beta_C = 230/300 = 0.76$

$k_s = 1$

$\tau_c' = 1 \times 0.25\sqrt{fck} = 1 \times 0.25 \times \sqrt{25} = 1.25 N/mm^2$

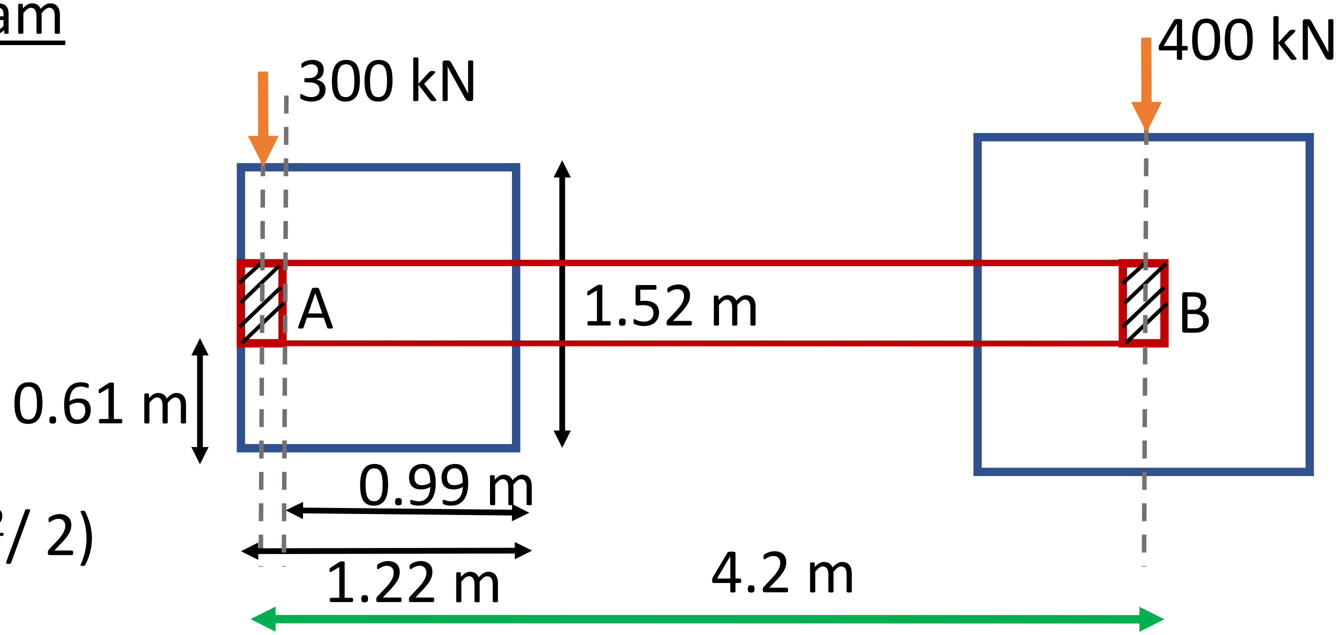
$\tau_v = 0.387 N/mm^2$

$\tau_v \leq \tau_c'$

*Hence assumed depth ok.*

# Design of Eccentric footing with Strap Beam

## Step -5




Design of footing slab

Effective depth = 315 mm

Bending moment M = $108.1 \times 1.52 \times (0.99^2 / 2)$

= 80.52 kN-m

$Mu / bd^2 = 80.52 \times 1.5 \times 10^6 / 1520 \times 315^2$

= 0.80

From SP-16, Table -3

Pt = 0.231 %

Ast = 0.231 x 1520 x 315 / 100 = 1106.02 $mm^2$

Provide T12 @ 100 mm c/c on both ways

Assume 10mm dia bar

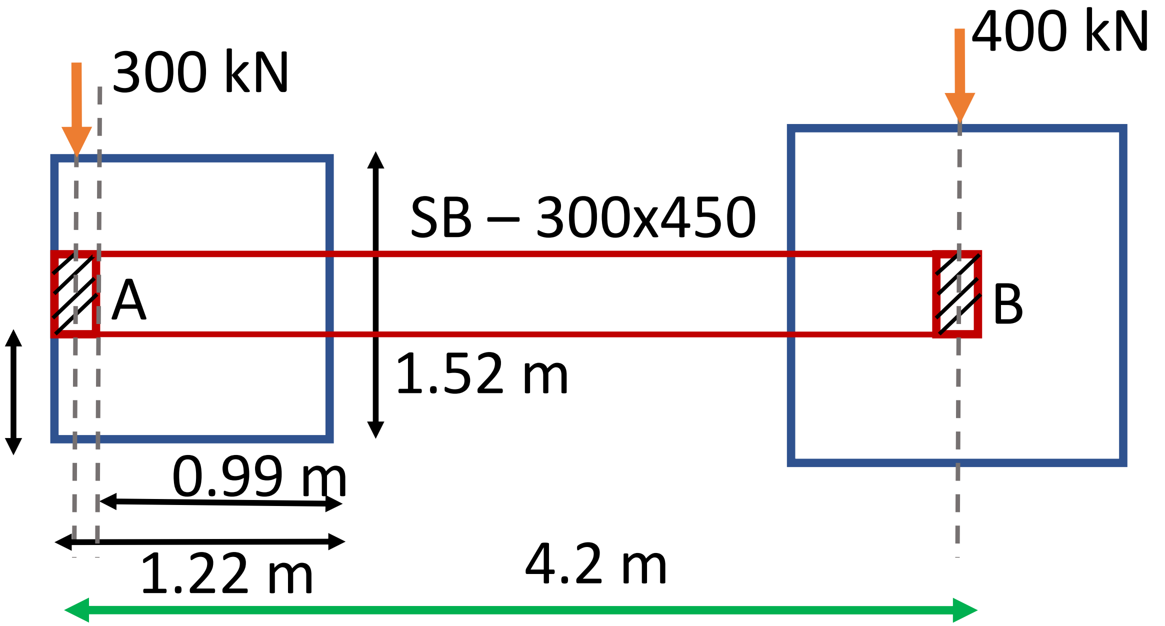
Overall depth = 307 + 50 + 10/2

Overall depth = 362 mm

Overall depth = 370 mm

Effective depth = 370 - 50 -5 = 315 mm

# Design of Eccentric footing with Strap Beam




## Step -6

Design of Strap Beam

Width of Strap beam = 300 mm

Assume depth of Strap beam as 450 mm

Eccentric distance = (1.22/2) – (0.23/2) = 0.495 m

Eccentric moment M = 300 x 0.495

= 148.5 kN-m

$Mu / bd^2 = 148.5 \times 1.5 \times 10^6 / 300 \times 417^2$

= 4.26

From SP-16, Table -51, d'/d = 0.10

Pt = 1.44 %

Ast = 1.44 x 300 x 417 / 100 = 1801.44 $mm^2$

Provide 9 T16 at Top

5 T 12 at bottom

Assume 16mm dia bar

Overall depth = 450 mm

Effective depth = 450 - 25 -8 = 417 mm

# Design of Eccentric footing with Strap Beam

## Step -6

Design of Strap Beam (Shear)

Width of Strap beam = 300 mm

Assume depth of Strap beam as 450 mm

Load = 300 kN = Shear Force

Factored Shear Force $V_u$ = 300 x 1.5 = 450 kN

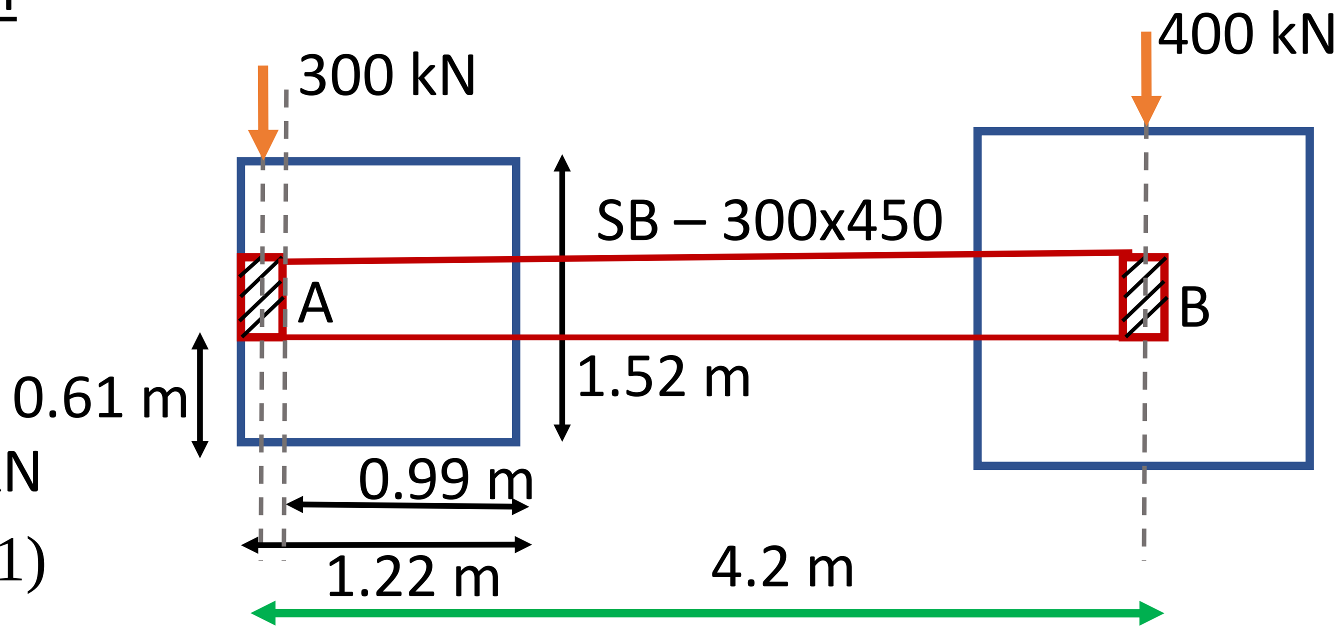
Nominal Shear Stress (IS-456:2000, Cl.40.1)

Shear stress $\tau_v = V_u / bd = 450 \times 10^3 / 230 \times 417$

$= 4.69\ N/mm^2$

$\tau_{cmax} = 3.1\ N/mm^2$

$\tau_v > \tau_{cmax}$




Assume 16mm dia bar

Overall depth = 450 mm

Effective depth = 450 - 25 -8 = 417 mm

# Design of Eccentric footing with Strap Beam

## Step -6

Shearing capacity of the concrete section

$\tau_{cbd}$

$P_t = 1.44\ \%$ (Tension reinforcement)

$\tau_c$ from table – 61, SP-16

$\tau_c = 0.73\ N/mm^2$

$\tau_{cbd} = 0.73 \times 230 \times 417 / 1000 = 70.01\ kN$

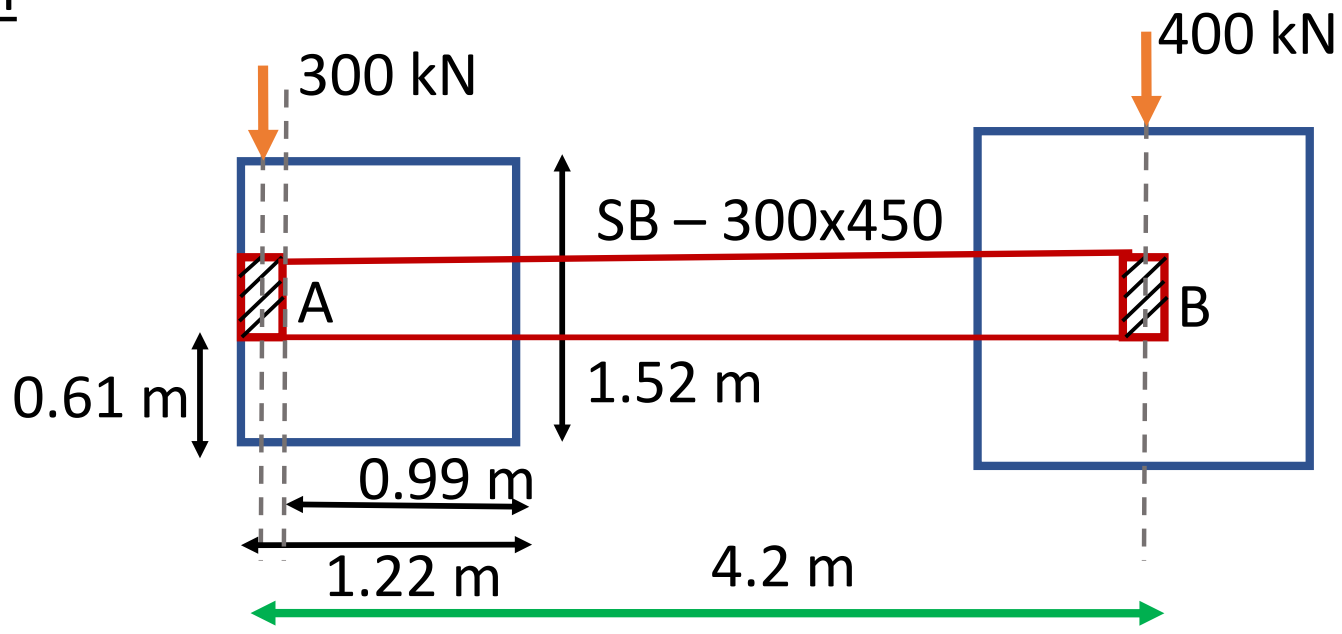
Shear to be carried by stirrups

$V_{us} = V_s - \tau_{cbd}$

$= 450 – 70.01 = 379.99\ kN$

$V_{us} / d = 379.99 / 41.7 = 9.1\ kN/cm$

Refer Table – 62, from SP-16




Assume 16mm dia bar

Overall depth = 450 mm

Effective depth = 450 - 25 -8 = 417 mm

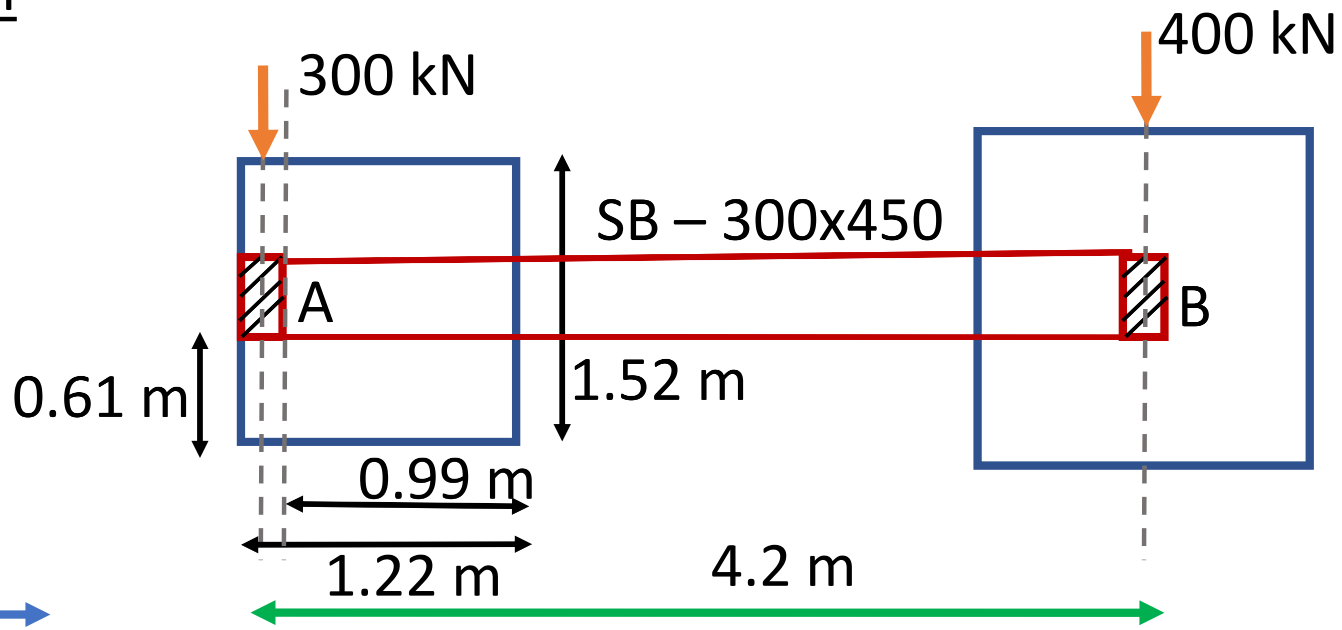
# Design of Eccentric footing with Strap Beam

## Step -6

$V_{us} / d = 379.99 / 41.7 = 9.1$ kN/cm

Refer Table – 62, from SP-16

4 legged stirrup $V_{us} / d = 9.1/2 = 4.55$




Provide 4L T8 @ 4” c/c