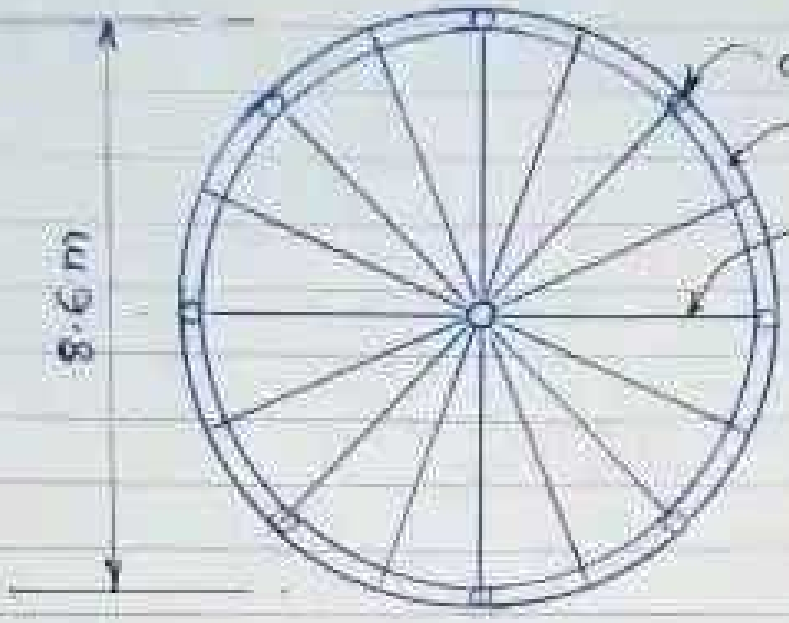
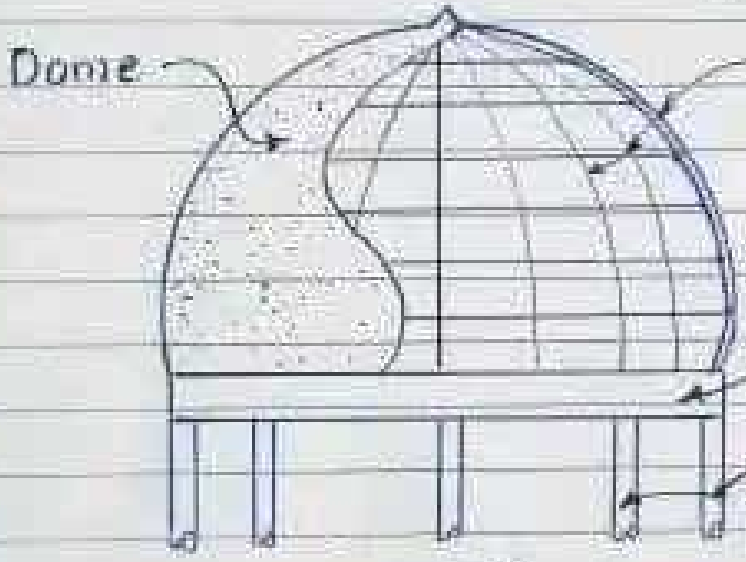
How To Calculate Steel Dome Design

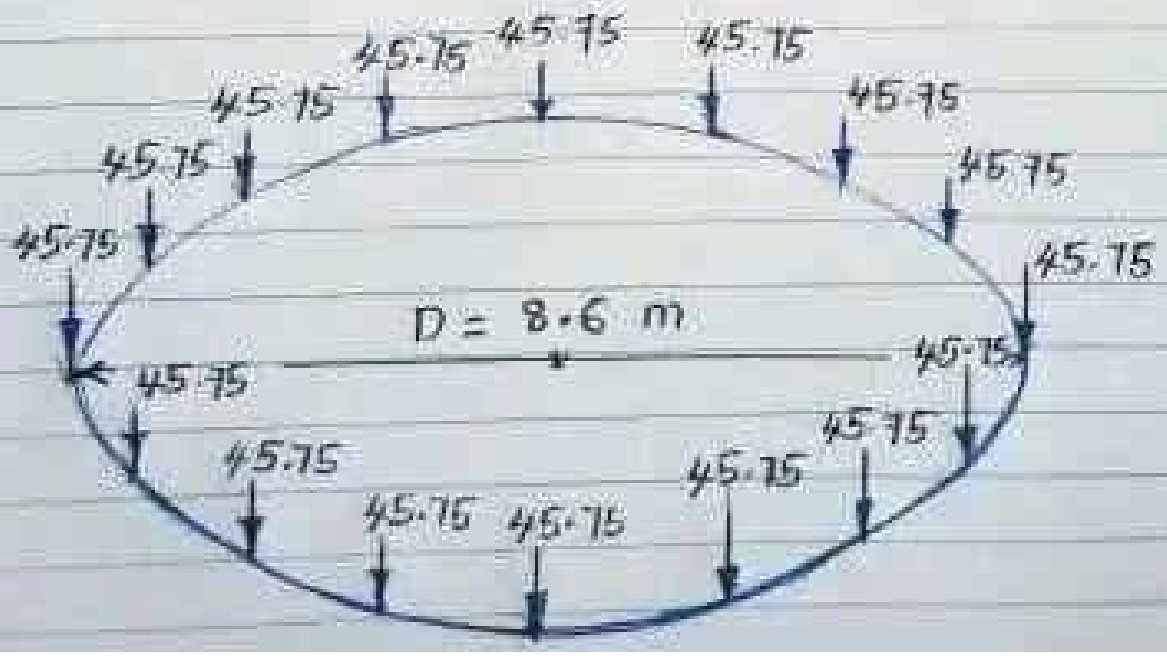


Reaction :

$R_a = 45.75$ kN

$R_b = 45.75$ kN





Design of RCC Roof Beam

Data
a. conc strength, $f_{cu} = 30\ N/mm^2$
b. steel bar, $f_y = 460\ N/mm^2$
c. shear bar $f_{yv} = 250\ N/mm^2$
d. Cover $c = 30\ mm$
e. $\gamma_{con} = 25\ KN/m^3$

Length of roof beam $L = \pi D$

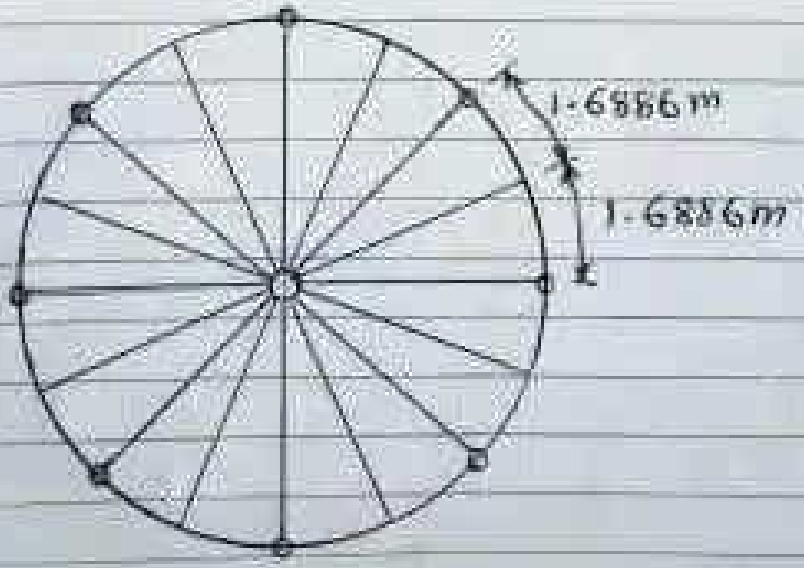
$L = \pi(8.6) = 27.0177\ m$

Column to column Span :

$l_c = 27.0177 / 8 = 3.3772\ m$

Arch truss Spacing, l_t

$l_t = 27.0177 / 16 = 1.6886\ m$



Size of roof Beam

$h = \frac{L}{26}$ (for continues)

$= 33772/26 = 1299$

$\triangleq 1300$ mm

use

$h = 1300$

$b = 450$

Loading to roof beam

Reaction each truss leg, $R = 45.75$ KN

Self weight of beam:

$w = 1.4 \times \gamma_{con} \times A_b$

$= 1.4 \times 24 \times (1.3 \times 0.45)$

$w = 19.656$ KN/m

SFD & BMD Formula

Kes 1

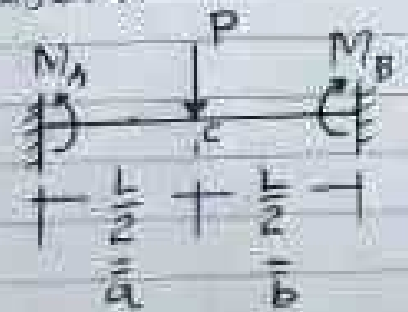
$R_A = R_B = wL/2$

$-M_A = +M_B = wL^2/12$

$L = 3.3772$ m

$M_c = wL^2/24$

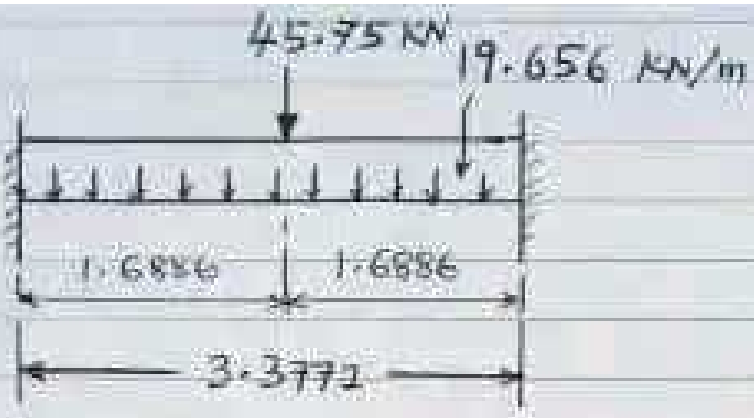
Case 2:



$R_A = R_B = P/2$

$-M_A = +M_B = Pab^2/L^2$

$M_c = 2Pa^2b^2/L^3$



Reaction at Support:

$$R_A = \frac{19.656(3.3772)}{2} + \frac{45.75(1.6886)}{3.3772}$$

$$R_A = 56.0661 \text{ KN}$$

$$\therefore R_B = 56.0661 \text{ KN}$$

Moment:

$$M_A = -\frac{19.656(3.3772)^2}{12} - \frac{45.75 \times 1.6886^3}{3.3772^2}$$

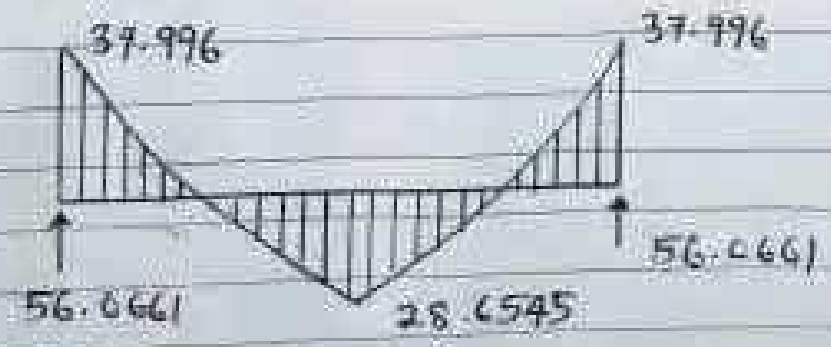
$$M_A = -37.996 \text{ KN m}$$

$$M_B = +37.996 \text{ KN m}$$

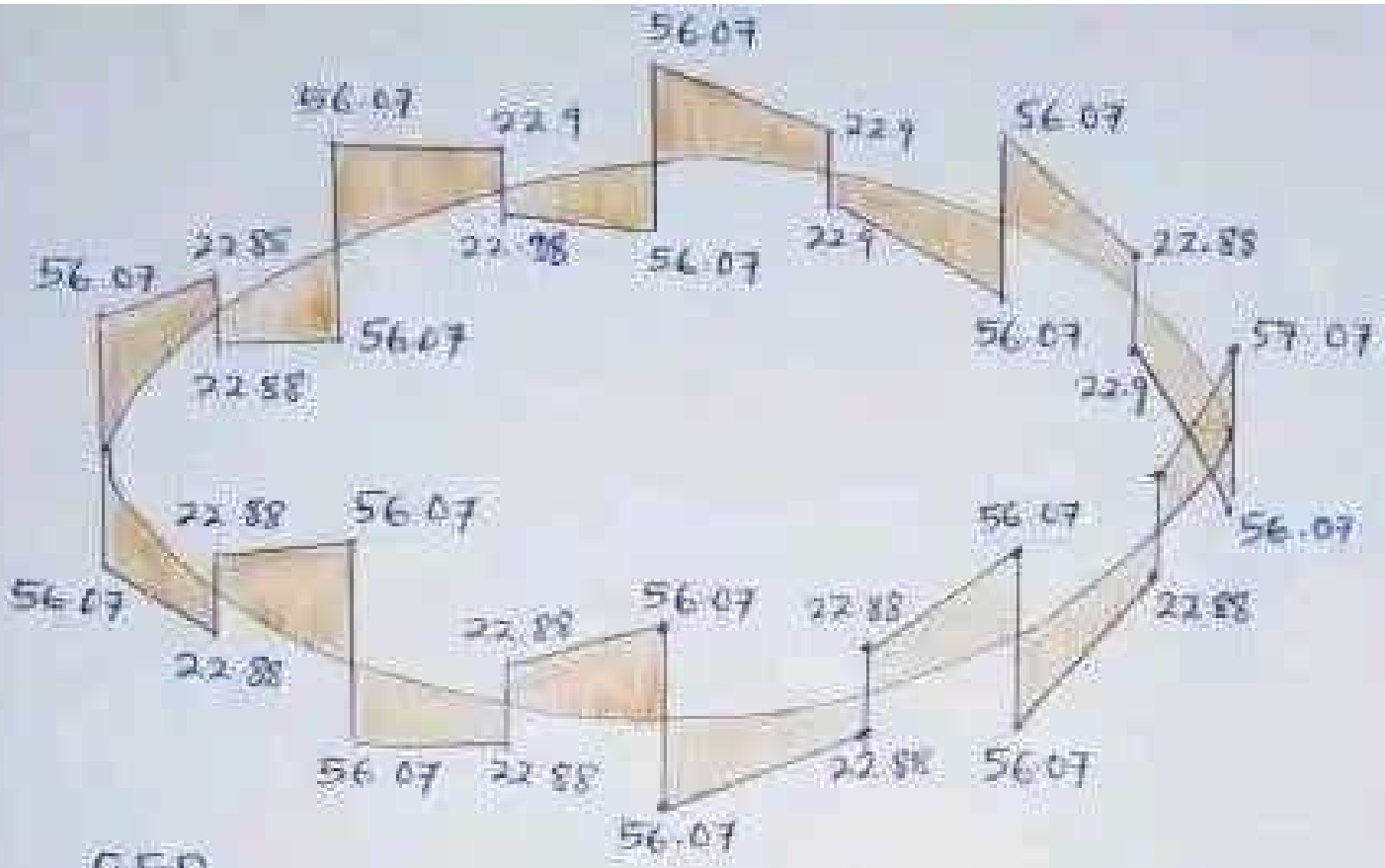
at centre

$$M_C = \frac{19.656(3.3772)^2}{24} + \frac{2(45.75) \times (1.6886)^3}{(3.3772)^3}$$

$$M_C = 28.6545 \text{ KNm}$$



BMD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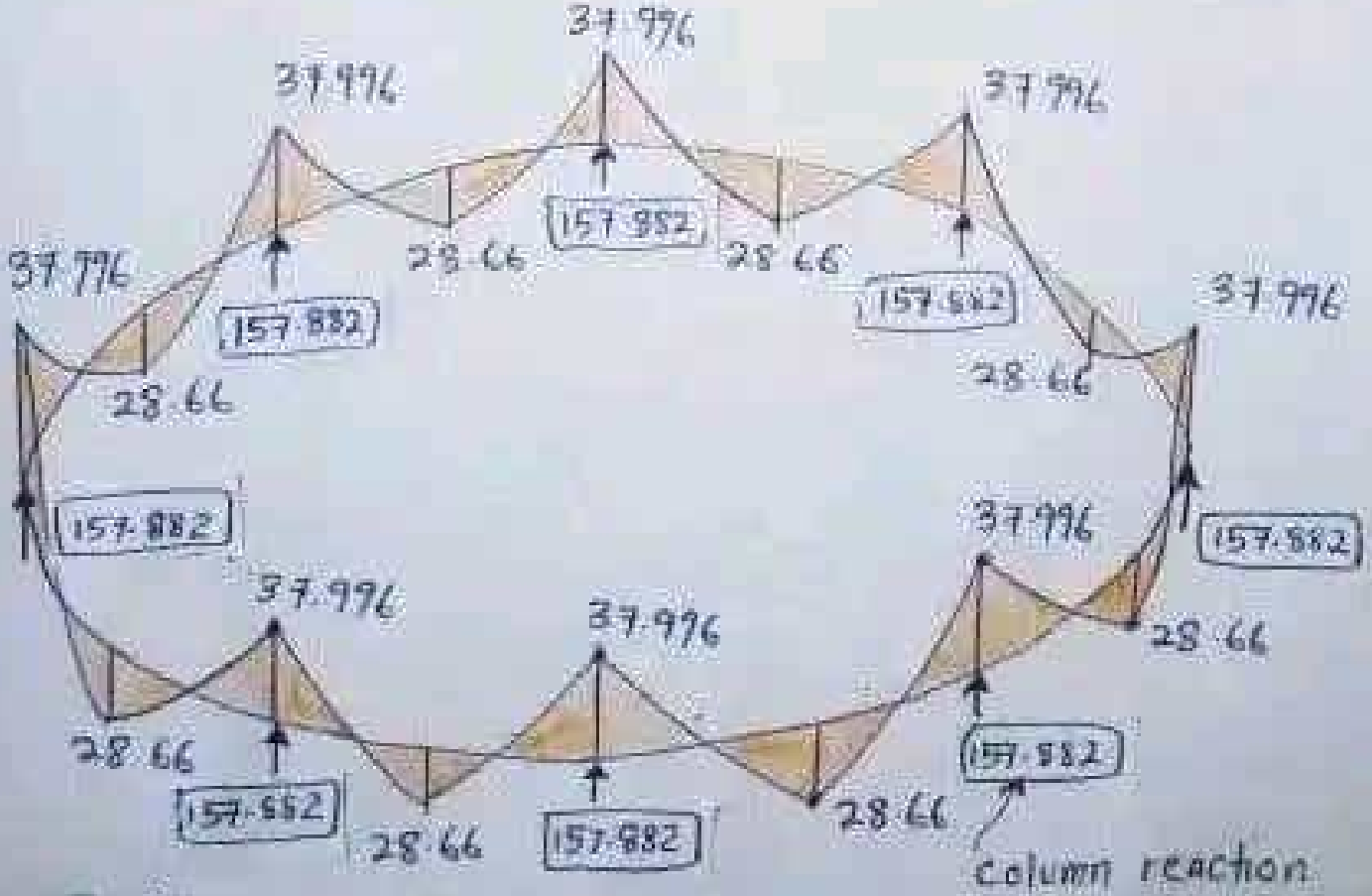
SFD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column reaction

BMD

Roof Beam Design

Given $f_{cu} = 30\ N/mm^2$

$f_y = 460\ N/mm^2$

$f_{yv} = 250\ N/mm^2$

cover, $c = 30\ mm$

Beam size, $b \times h = 400 \times 1300$

Bar size $\phi = 25\ mm$

$\phi_v = 16\ mm$

Effective depth, $d = 1300 - 30 - 16 - 25/2$

$d = 1241.5\ mm$

Momen Resistant

$M_{rc} = 0.156 f_{cu} bd^2$

$= 0.156 (30 \times 400 \times 1241.5^2)$

$M_{rc} = 2885.36\ kNm$

$M_{max} = 37.996\ kNm < M_{rc}$

(Single reinforcement)

$K = M \times 10^6 / bd^2 f_{cu}$

$= 38 \times 10^6 / 400 \times 1241.5^2 \times 30$

$K = 0.002055$ & $Z_1 = 0.95d$

lever arm $Z_2 = d\left[0.5 + \left(0.25 - \frac{K}{0.9}\right)^{1/2}\right]$

$Z_2 = 0.998d > Z_1$

use $Z_1 = 0.95d$

$$A_{st} = \frac{M \times 10^6}{0.87 f_y \cdot z}$$

$$= \frac{38 \times 10^6}{0.87 \times 460 \times 0.95 \times 1241.5}$$

$A_{st} = 80.5075 \ mm^2$

use 3T25 at top & 3T25 at bottom

Shear reinforcement design

$V_{max} = 56.07 \ kN \quad \phi_v = 16 \ mm$

Shear stress $v = \frac{V}{bd} = \frac{56.07 \times 10^3}{400 \times 1241.5}$

$v = 0.1129 \ N/mm^2$

Design Shear stress, v_c

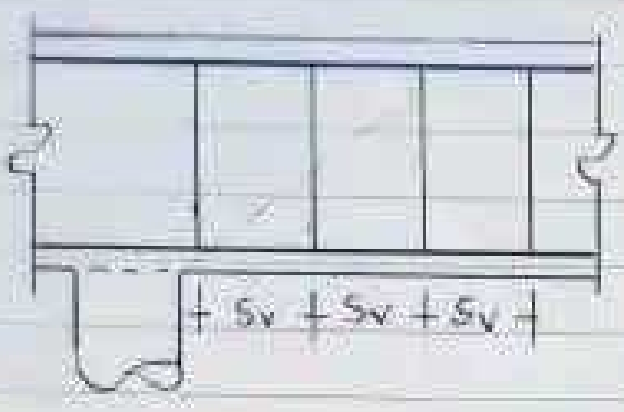
$$v_c = \frac{0.79(100 A_s/bd)^{1/3}(400/d)^{1/4}(f_{cu}/25)^{1/3}}{1.25}$$

$A_s = 3 \times \pi(25)^2/4 = 1472.622 \ mm^2$

$v_c = 11.889 \ N/mm^2 > v$

use Nominal shear bar link

Spacing, $S_v = \frac{A_{sv} \times 0.87 f_{yv}}{0.4 b_v}$



$\phi_v = 16$ mm

$A_{sv} = 2 \times \pi (6_v)^2/4$

$= 2 \times \pi (16)^2/4 \quad = 402.124 \text{ mm}^2$

Spacing, $S_v = \dfrac{402.124 \times 0.87 \times 250}{0.4 \times 400}$

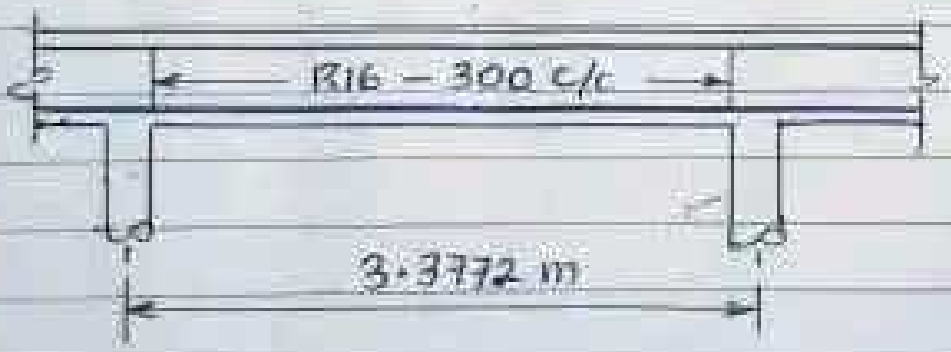
$S_v = 546$ mm c/c

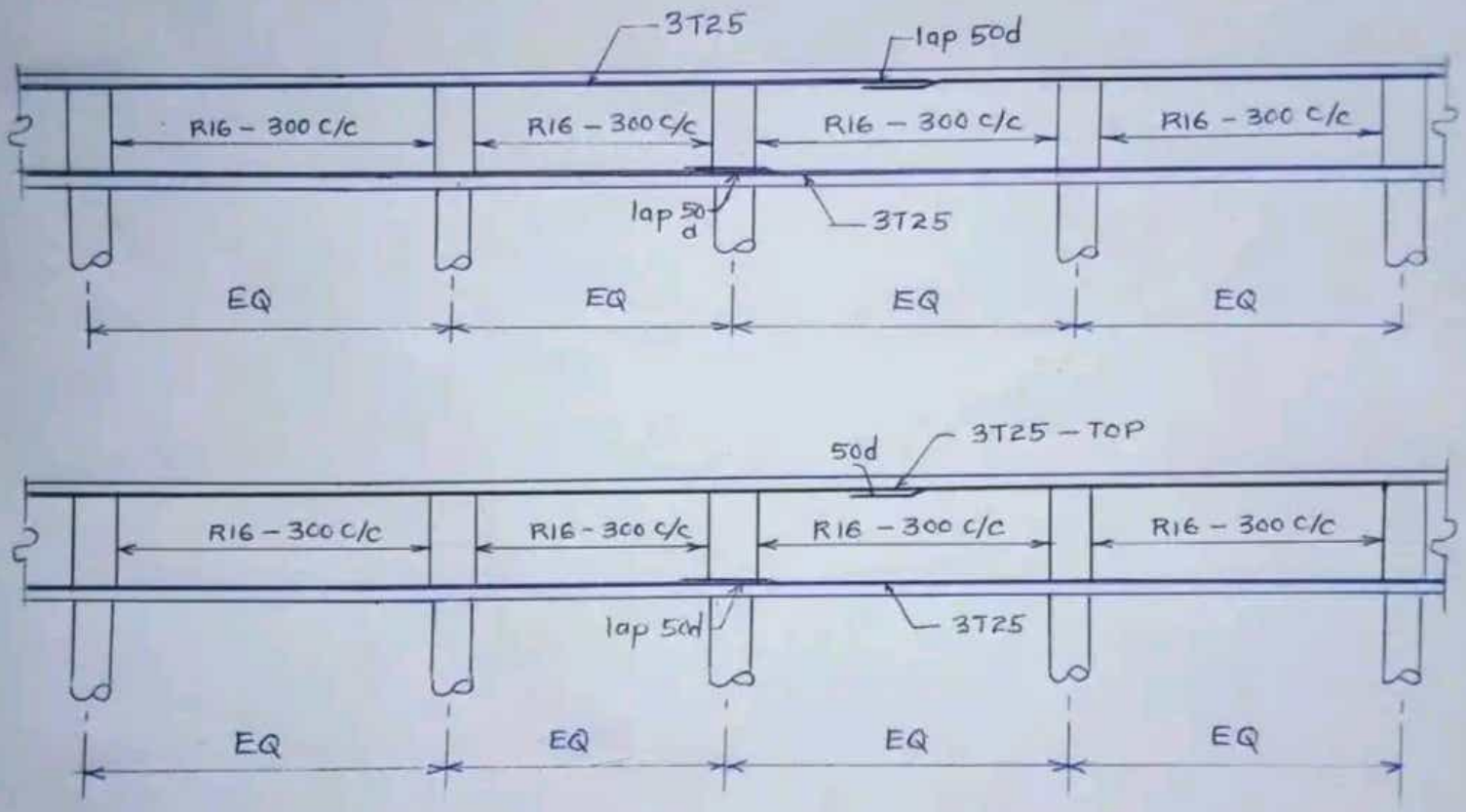
use $S_v = 300$ mm c/c

(R16 – 300 c/c)

Link

R16 – 300 c/c





ROOF BEAM STRUCTURE DETAIL

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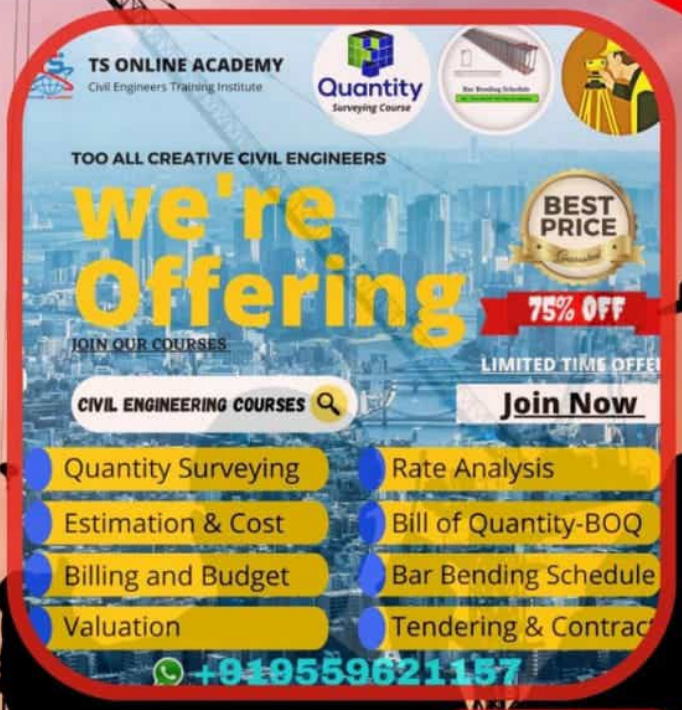

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