



SNS COLLEGE OF TECHNOLOGY

DEPARTMENT OF AGRICULTURAL ENGINEERING

23AGT205-STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING

NOTES UNIT III

SLOPE & DEFLECTION OF SSB @ UDL

Slope at ends $\theta_A = \theta_B = -\frac{WL^2}{24EI}$

Deflection at centre,

$$y_c = \frac{5WL^3}{384EI}$$

4. A beam of length 5m and of uniform rectangular section is simply supported at its ends. It carries a UDL of 9 kN/m run over the entire length. Calculate the width & depth of the beam if permissible bending stress is 7 N/mm^2 & central deflection is not to exceed 1 cm. Take $E = 1 \times 10^4 \text{ N/mm}^2$

Given

$L = 5\text{ m} = 5000\text{ mm}$

UDL, $w = 9\text{ kN/m}$

Total load $W = w \times L$

$$= 9 \times 5 = 45\text{ kN} = 45000\text{ N}$$

$\sigma = 7\text{ N/mm}^2$

$y_c = 1\text{ cm} = 10\text{ mm}$

$E = 1 \times 10^4 \text{ N/mm}^2$

Soln

Let, $b = \text{width of beam}$

$d = \text{Depth of beam}$

$$I = \frac{bd^3}{12}$$



$$\begin{aligned} \text{W.K.T } y_c &= \frac{5WL^3}{384EI} \\ 10 &= \frac{5}{384} \times \frac{45000 \times 5000^3}{1 \times 10^4 \times \left(\frac{bd^3}{12}\right)} \\ bd^3 &= \frac{5}{384} \times \frac{45000 \times 5000^3 \times 12}{1 \times 10^4 \times 10} \\ &= 878.906 \times 10^7 \text{ mm}^4 \quad \text{--- (1)} \\ \text{Max. BM, } M &= \frac{w \cdot L^2}{8} = \frac{W \cdot L}{8} \\ &= \frac{45000 \times 5}{8} \text{ N.m} \\ &= \frac{45000 \times 5 \times 1000}{8} \text{ N.mm} \\ &= 28125000 \text{ N.mm} \\ \text{Bending equation, } \frac{M}{I} &= \frac{\sigma}{y} \quad [\because y = d/2] \\ \frac{28125000}{\left(\frac{bd^3}{12}\right)} &= \frac{7}{(d/2)} \\ \frac{28125000 \times 12}{bd^3} &= \frac{14}{d} \\ bd^2 &= \frac{28125000 \times 12}{14} \\ &= 24107142.85 \text{ mm}^3 \quad \text{--- (2)} \end{aligned}$$



Divide equation ① by ②,

$$d = \frac{838.906 \times 10^7}{24107142.85}$$
$$= 364.58 \text{ mm}$$

Sub d in ②,

$$b (364.58)^2 = 24107142.85$$
$$b = \frac{24107142.85}{(364.58)^2}$$
$$= 181.36 \text{ mm}$$