Session 2017-2018 C.P.C, ALWAR [Depth of civil Engg.]

II CLASS Test CE-201 II year civil Engg

M.M = 15 5.M

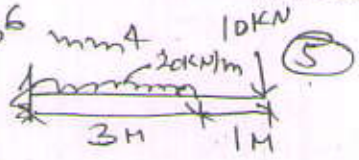
time = 1 hour Date 15/1/18 10.30 - 11.30

Solve All Questions, Carry Equal Marks

1. Calculate the Dimension of the Strongest Rectangular beam that can be cut-out of Log of a wood 500 mm in Dia. (5)

2. Calculate Shear Stress at Important points of T-section width 80mm, Total Depth 130 mm, Thickness of flange 10MM, Thickness of web 10MM Subjected to Shear force 10KN. Draw the Shear Stress Diagram Also (5)

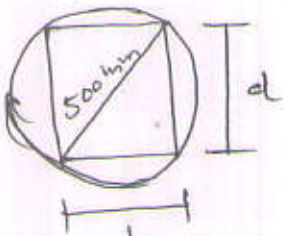
3. Calculate the Deflection at free end of Cantilever Beam shown in figure, $E = 2\times10^5\ N/mm^2$ and $I = 250\times10^6\ mm^4$ (5)



SOLUTION: →

1. ⟹ b = width of Beam

d = depth of Beam



for least wastage Log of wood to be carved out should have diagonal 500mm

$$500^2 = b^2 + d^2$$

$$d^2 = 500^2 - b^2$$

Section Modulus $Z = \frac{bd^2}{6}$

$$\frac{b(250000 - b^2)}{6} = \frac{250000b - b^3}{6}$$

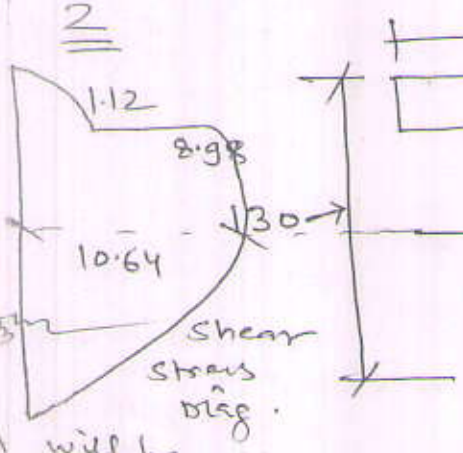
The Beam to be Strongest the Z must be maximum. Hence Z = Maximum

$$\frac{dz}{db} = 0 \qquad \frac{dz}{db} = \frac{d}{db}\left(\frac{250000b - b^3}{6}\right) = 0$$

$$\frac{250000 - 3b^2}{6} = 0$$

$$b = 288.7\ mm, \quad d = 408.20\ mm$$

Sol: 2



Shear force V = 10KN, 10000N

Let $\bar{y}$ = Distance of C.G of Section from the top of flange.

$$\bar{y} = \frac{a_1y_1 + a_2y_2}{a_1 + a_2} = \frac{80\times10\times5 + 120\times10\times70}{80\times10 + 120\times10} = 44\ mm$$

N.A will be at a distance of 44 mm from top of flange

M.O.I of the total Section about N.A

$$I = \frac{80\times10^3}{12} + 80\times10\times(44-5)^2 + \frac{10\times120^3}{12} + 120\times10\times(70-44)^2$$

$$I = 3474667 \text{ mm}^4$$

(I) Shear Stress at top of flange = 0

(II) Shear Stress in the flange at the Junction with web

$$A = 80\times10 = 800 \text{ mm}^2 \qquad \bar{y} = 44 - \frac{10}{2} = 39 \text{ mm}$$

$$b = 80 \text{ mm}$$

$$\tau = \frac{V A\bar{y}}{Ib} = \frac{10{,}000\times800\times39}{3474667\times80} = 1.12 \text{ N/mm}^2$$

(III) Shear Stress in web $A = 800 \text{mm}^2$, $\bar{y} = 44 - \frac{10}{2} = 39$ mm

$b = 10$ mm

$$\tau = \frac{VA\bar{y}}{Ib} = \frac{10000\times800\times39}{3474667\times10} = 8.98 \text{ N/m}$$

(IV) Shear Stress at N.A

$$A\bar{y} = 80\times10\times39 + 10\times(44-10)\times\left(\frac{44-10}{2}\right) = 36980 \text{ m}$$

$b = 10$ mm

$$\tau = \frac{10000\times36980}{3474667\times10} = 10.64 \text{ N/mm}^2$$

(V) Shear Stress at Bottom of Web is Zero. Diagram is shown with Section.

Sol. 3 The Max. Deflection at the free end.

I = Deflection Due to Point LOAD $= \frac{Wl^3}{3EI} = \frac{10{,}000\times(4000)^3}{3\times2\times10^5\times250\times10^6} \Rightarrow 4.$

II = Deflection Due to U.D.L $\Rightarrow \frac{wa^4}{8EI} + \frac{wa^3}{6EI}(l-a)$

Suresh Kumar
LCE 18-1-18

$$\frac{20\times(3000)^4}{8\times2\times10^5\times250\times10^6} + \frac{20\times(3000)^3}{6\times2\times10^5\times250\times10^6}(4000-3000)$$

$\Rightarrow 5.85$

Max. Deflection at the free end is = $4.27 + 5.85 = 10.12$ mm