$$J = \frac{\pi}{32} d^4$$

$$= \frac{\pi}{32} d^4$$

$$\frac{T}{J} = \frac{C\theta}{l}$$

$$\frac{517.25 \times 10^3}{\frac{\pi}{32} d^4} = \frac{80 \times 10^3 \times 0.0174}{3000}$$

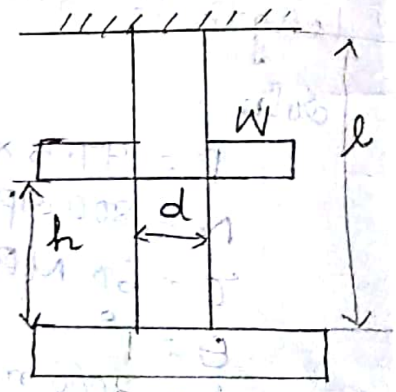
$$d^4 = \frac{517.25 \times 10^3 \times 32 \times 3000}{80 \times 10^3 \times 0.0174 \times \pi}$$

$$d = 59 \text{ mm}.$$

Impact Stress

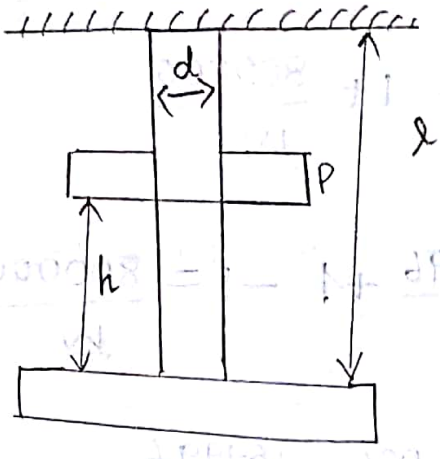
The machine element subjected to load with impact, the stress produced in the member due to falling load is known as impact stress.

$$\sigma_i = \frac{W}{A}\left[1 + \sqrt{1 + \frac{2hAE}{Wl}}\right]$$



1. A unknown weight falls through 10 mm on the collar rigidly attached to lower end of vertical bar 3m length and 600 mm² in cross section. The maximum extension is to be 2 mm

What is the corresponding stress value of unknown weight. $E = 200\ kN/mm^2$.



$h = 10\ mm$

$l = 3000\ mm$

$A = 600\ mm^2$

$\delta l = 2\ mm$

$E = 200 \times 10^3\ N/mm^2$.

$$\sigma_i = \frac{W}{A}\left[1 + \sqrt{1 + \frac{2hAE}{Wl}}\right]$$

$$e = \frac{\delta l}{l} = \frac{2}{3000} = 6 \cdot 6 \times 10^{-4}$$

$$\sigma_i = E \times e$$
$$= 200 \times 10^3 \times 6 \cdot 6 \times 10^{-4}$$

$$\sigma_i = 133 \cdot 33$$

$$133 \cdot 33 = \frac{W}{600}\left[1 + \sqrt{1 + \frac{2 \times 10 \times \cancel{600}^{200} \times 200 \times \cancel{10^3}}{W \times \cancel{3000}_{1}}}\right]$$

$$79998 = W\left[1 + \sqrt{1 + \frac{800000}{W}}\right]$$

$$\frac{79998}{W} = 1 + \sqrt{1 + \frac{800000}{W}}$$

$$\frac{79998}{W} - 1 = \sqrt{\frac{800000}{W} + 1}$$

$$\left(\frac{79998}{W} - 1\right)^2 = 1 + \frac{800000}{W}$$

$$\frac{6399\times10^6}{W^2} - \frac{159996}{W} + \cancel{1} - \cancel{1} = \frac{800000}{W}$$

$$\frac{6399\times10^6}{W^2} = \frac{800000}{W} + \frac{159996}{W}$$

$$\frac{6399\times10^6}{W^2} = \frac{959996}{\cancel{W}}$$

$$W = 6665.6\ N$$

1. Unknown weight falls from 15 mm on to the collar rigidly attached to lower end of the vertical bar 2.5 m long and 500 mm² in section. The maximum instantaneous extension is to be 2 mm. Find the corresponding stress and the value of weight falling. Assume $E = 2\times10^5\ N/mm^2$.

$h = 15$ mm

$l = 2.5$ m $= 2500$ mm

$A = 500\ mm^2$

$\delta l = 2$ mm

$E = 2\times10^5\ N/mm^2$

$$\sigma_i = W/A \left[1+\sqrt{1+\frac{2hAE}{Wl}}\right]$$

$$\therefore e = \frac{\delta l}{l} = \frac{2}{2500} = 8\times10^{-4}$$

$$\sigma_i = E\times e$$

$$= 2\times10^{5}\times8\times10^{-4}$$

$$= 160 \ N/mm$$

$$160 = \frac{W}{500}\left[1+\sqrt{1+\frac{2\times15\times500\times2\times10^{5}}{W\times2500}}\right]$$

$$80000 = W\left[1+\sqrt{1+\frac{1200000}{W}}\right]$$

$$\frac{80000}{W} = 1+\sqrt{1+\frac{1200000}{W}}$$

$$\left[\frac{80000}{W}-1\right]^2 = 1+\frac{1200000}{W}$$

$$\frac{64\times10^{8}}{W^2} - \frac{160000}{W} + \cancel{1} - \cancel{1} = \frac{1200000}{W}$$

$$\frac{64\times10^{8}}{W^2} = \frac{1360000}{\cancel{W}}$$

$$W = 4705.8 \ N$$

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