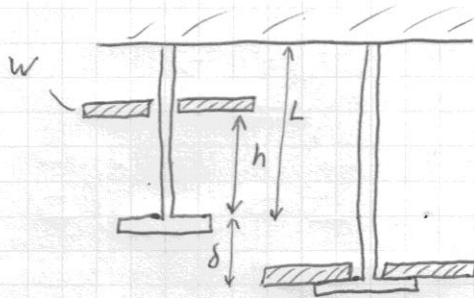


IMPACT LOADS IN AXIAL LOADING

(1)

SIMPLE BAR IN TENSION:

$$U = \frac{\sigma^2 AL}{2E}$$

P.E. = STRAIN ENERGY

$$\therefore \frac{\sigma^2 AL}{2E} = mgh$$

$$\frac{\sigma^2 AL}{2E} = W(h + \delta) \quad *$$

(2) If $\delta \approx 0$ THEN FROM *

$$\frac{\sigma^2 AL}{2E} = Wh$$

$$\sigma^2 AL = 2WEh$$

$$\sigma = \sqrt{\frac{2WEh}{AL}}$$

δ small compared
to h .

SEE (18)

(3) IF δ IS NOT SMALL FROM *

$$\frac{\sigma^2 AL}{2E} = w(h + \delta)$$

NOW ~~8PA~~ $E = \frac{\text{STRESS}}{\text{STRAIN}}$

$$\therefore E = \frac{\sigma}{\epsilon} = \frac{\sigma L}{\delta}$$

$$\therefore \delta = \frac{\sigma L}{E}$$

$$\therefore \frac{\sigma^2 AL}{2E} = w\left(h + \frac{\sigma L}{E}\right)$$

$$\frac{\sigma^2 AL}{2E} = wh + \frac{w\sigma L}{E}$$

$$\therefore \frac{\sigma^2 AL}{2E} - \frac{\sigma WL}{E} - wh = 0$$

$$\sigma^2 - \frac{\sigma WL \cdot 2E}{E AL} - wh \cdot \frac{2E}{AL} = 0$$

$$\sigma^2 - \frac{2W\sigma}{A} - \frac{2WEh}{AL} = 0 \quad \begin{matrix} a=1 \\ b=-\frac{2W}{A} \\ c=-\frac{2WEh}{AL} \end{matrix}$$

$$\text{USING } \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

IGNORING THE NEGATIVE SIGN

(SEE NEXT PAGE)

$$\sigma = \frac{1}{2} \left\{ \frac{2W}{A} + \sqrt{\left(-\frac{2W}{A}\right)^2 + 4\left(-\frac{2WEh}{AL}\right)} \right\}$$

$$= \frac{W}{A} + \sqrt{\left(\frac{W}{A}\right)^2 + \frac{2WEh}{AL}}$$

Eq (6)

$$\sigma^2 - \frac{2W\sigma}{A} - \frac{2WEh}{AL} = 0$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$a=1, \quad b = -\frac{2W}{A}, \quad c = -\frac{2WEh}{AL}$$

$$\therefore \sigma = \frac{-\left(-\frac{2W}{A}\right) \pm \sqrt{\left(-\frac{2W}{A}\right)^2 - 4(1)\left(-\frac{2WEh}{AL}\right)}}{2(1)}$$

$$= \frac{1}{2} \left(\frac{2W}{A} + \sqrt{4\left(\frac{W}{A}\right)^2 + 4\left(\frac{2WEh}{AL}\right)} \right)$$

$$= \frac{1}{2} \left(\frac{2W}{A} + 2\sqrt{\left(\frac{W}{A}\right)^2 + \left(\frac{2WEh}{AL}\right)} \right)$$

$$\boxed{\sigma = \frac{W}{A} + \sqrt{\left(\frac{W}{A}\right)^2 + \left(\frac{2WEh}{AL}\right)}}$$

IF $\frac{W}{A}$ IS NOT SMALL (COMPARED)
TO h : USE IF NOT SURE!

SEE (17)

$$\sigma = \frac{W}{A} + \sqrt{\left[\left(\frac{W}{A}\right)^2 + \frac{2WEh}{AL}\right]} \quad *$$

THIS SHOULD BE USED IF THE RELATIVE MAGNITUDE OF δ AND h ARE NOT KNOWN.

ONCE THE INSTANTANEOUS STRESS σ IS KNOWN THE INSTANTANEOUS EXTENSION CAN BE FOUND USING

$$\delta = \frac{\sigma L}{E}$$

FROM * IF WE CONSIDER THE LOAD IS SUDDENLY APPLIED FROM AN EFFECTIVELY ZERO HEIGHT, $h = 0$

$$\begin{aligned} \therefore \sigma &= \frac{W}{A} + \sqrt{\left[\left(\frac{W}{A}\right)^2 + 0\right]} \\ &= \frac{W}{A} + \frac{W}{A} \end{aligned}$$

$$\boxed{\sigma = \frac{2W}{A}}$$

IF STATICALLY APPLIED

$$\sigma = \frac{F}{A} = \frac{W}{A}$$

work done = FORCE ~~distance~~ ^{× DISTANCE}

$$\therefore mgh = F \times h$$

$$F = mg$$

$$F = W$$

IF INSTANTANEOUSLY APPLIED σ IS DOUBLED FOR THE SAME ~~weight~~ LOAD

IMPACT STRESSES FROM IMPACTS OF SIMILAR MAGNITUDE WILL BE EVEN HIGHER THAN 2

SO SAFETY FACTOR FOR IMPACT LOADING

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