GATE-2018

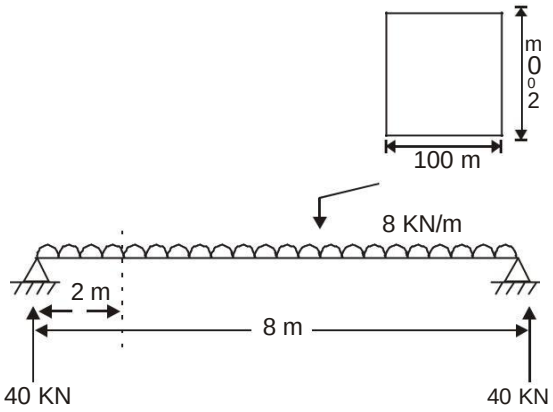
Afternoon Shift-2

(FOLLOWING QUESTIONS MAY BE CHALLENGED)

Section: Civil Engineering

GATE (Q.48) An 8 m long simply-supported elastic beam of rectangular cross-section (100 mm × 200 mm) is subjected to a uniformly distributed load of 10 kN/m over its entire span. The maximum principal stress (in MPa, up to two decimal places) at a point located at the extreme compression edge of a cross-section and at 2 m from the support is

Sol: (90)



at 2 m from support,

Bending moment, M = $40 \quad 2 \quad 10 \quad 2 \quad 1$

= 60 KN-m

Shear force, V = 40 (10 2) = 20KN

At external compression edge (top fibre)

Shear stress P = 0

Bending stress, $= \frac{MY}{I}$

$$= \frac{(60 \quad 10^{6} N \quad mm) \quad 100mm}{\frac{100 \quad 200^{3}}{12} mm^{4}}$$

$= 90N / mm^{2}$

= 90 MPa

Since this edge is free from shear stress, hence it is a principal plane.

Thus maximum principal stress = 90 MPa

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GATE (Q.50) At a small water treatment plant which has 4 filters, the rate of filtration and backwashing are 200 $m^3/d/m^2$ and 1000 $m^3/d/m^2$, respectively. Backwashing is done for 15 min per day. The maturation, which occurs initially as the filter is put back into service after cleaning, takes 30 min. It is proposed to recover the water being wasted during backwashing and maturation. The percentage increase in the filtered water produced (up to two decimal places) would be _____

Sol: (7.53)

Rate of filteration = $200m^3 / d / m^2$

Backwashing rate = $1000m^3 / d / m^2$

Time for backwashing = 15 min/day

Time wasted in maturation = 30 min

Let the area of filter to be unity

Total water to be produced = $200m^3/d/m^2 \times \frac{23.25}{24} = 193.75$

Water wasted in backwashing

$$\frac{1000 \quad 15}{24 \quad 60} = 10.4167\ m^3$$

Water wasted during maturation

$$= \frac{200 \quad 30}{24 \quad 60}$$

$= 4.1667\ m^3$

Total filter water to be produced

$= 193.75 + 10.4167 + 4.1667$

$= 208.3334\ m^3$

Hence percentage increase in filtered water produced = $\frac{208.3334 \quad 193.75}{193.75}$

= 7.53%