Quiz 2 Solution

Q1: Compute the extreme bottom fibre stress for 500 x 1800 mm cross sectional prestressed concrete beam by the **concept of transformed concrete into an elastic material**. The beam is 10.5m long simply supported prestressed concrete beam and loaded by a uniform load of 42 kN/m. It is prestressed with unbonded tendon through the point 600 mm above from the extreme **bottom fibre** with a total prestress of 1400 kN.

Solution: Given

F=1400 kN and uniform load = 42 kN/m (Assuming)

A=500x1800 =9,00,000 mm^2

y=1800/2 = 900 mm

e=1800/2 – 600 =300 mm

$I=\frac{bh\text{^}3}{12}=\frac{500*1800^3}{12}=$ 2.43 x 10^{11} mm^4

Self weight = $\frac{(500*1800)*25}{1000*1000}$ **= 22.5 kN/m (Self weight is not included with the applied load, so it needs to be calculated)**

Total load, w = 42 + 22.5 = 64.5 kN/m

Moment at midspan, $M=\frac{wl\text{^}2}{8}=\frac{64.5*(10.5)\text{^}2}{8}$ =888.89 kN-m

From first concept or concept of transformed concrete into an elastic material.

$$f=\frac{F}{A}\pm\frac{Fey}{I}\pm\frac{My}{I}$$

$$f=-\frac{1400*1000}{900000}\pm\frac{(1400*1000)*300*900}{2.43\ x\ 10^{11}}\pm\frac{(888.89*1000*1000)\ x\ 900}{2.43\ x\ 10^{11}}$$

f=−1.556 ± 1.556 ± 3.292

=−1.556 – 1.556 + 3.292 = **0.18 Mpa for bottom fiber** **(Answer)**

Q2. A 23.5 ft long simply supported prestressed concrete beam has 15 in x 36 in dimension and loaded by a uniform load of 4.0 kip/ft. It is prestressed with bonded tendon through the point 5 inch below the neutral axis of the cross section, with a total prestress of 450 kip. Compute the extreme **top fibre stress** by the **concept of load balancing.**

Solution: Given

F= 450 kip and uniform load = 4 k/ft (Assuming)

A=15 x 36 = 540 in^2

y =36/2 = 18 in

h = e = 5 (directly given in question)

$I=\frac{bh\text{^}3}{12} = \frac{15*36^3}{12} = 58320\ in^4$

Self weight = $\frac{(15*36)*150}{12*12}$ **= 0.5625 k/ft** **(Self weight is not included with the applied load, so it needs to be calculated)**

Total load, w = 4.0 + 0.5625 = 4.5625 k/ft

Balancing load, $W_b= \frac{8Fh}{L^2} = \frac{8*450*(5/12)}{23.5^2}$ = 2.72 kip/ft

Unbalanced load, = w - w_b = 4.5625 – 2.72 = 1.8425 kip/ft

Moment at midspan, M = $\frac{wl\text{^}2}{8} = \frac{1.8425*(23.5)\text{^}2}{8}$ =127.19 k-ft

From third concept or concept of load balancing

$f = \frac{F}{A} \pm \frac{My}{I}$

$f=- \frac{450*1000}{540} \pm \frac{(127.19*1000*12)\ x\ 18}{58320}$

f=−833.33 ± 471.07

f = −833.33 – 471.07 = **- 1304.04 psi for top fiber** **(Answer)**