CE 414-Quiz 3 Solution

(Random data set have been used to explain the calculation procedure)

Q1. A pretensioned member has a cross section of 11x20 in. It is concentrically prestressed with high tension steel wire of <u>0.8 sq. in.</u> which is anchored to the bulkheads of a unit prestress of <u>150,000 psi</u>. If n=5, calculate the stress in **concrete** immediately after transfer.

Solution: From Example 5.1

Stress in **concrete**, $fc = \dfrac{F_i}{A_c + (n-1)A_s} = \dfrac{0.8 \; x \; 150000}{11x20 + (5-1)x0.8} =$ **537.63 psi   (Ans.)**

Q2. A posttensioned concrete beam has a prestress of <u>176 kips</u> in the steel immediately after prestressing, which is eventually reduces by 40 kips due to losses. It is prestressed with <u>0.83 in^2</u> of steel through a point 5 in below the cgc. within a cross section of 10X18 inch. Determine the extreme bottom fibre stress of concrete at the midspan after transfer of loads by approximate solution method.

Solution: From Example 5.2

Stress in steel after loss, F = 176 – 40 = 136 kips

Extreme fiber Stress in **concrete**, $fc = \dfrac{F}{A} \pm \dfrac{Fey}{I}$

$fc = \dfrac{136}{180} \pm \dfrac{136x \; 5x \; 9}{\dfrac{10x \; 18^3}{12}}$ **OR** $= \dfrac{136,000}{180} \pm \dfrac{136,000x \; 5x \; 9}{\dfrac{10x \; 18^3}{12}}$

= - 0.756 ± 1.259   = - 755.56 ± 1259.26

= - 0.756 – 1.259   = - 755.56 - 1259.26

= - 2.015 ksi (Ans.)   **= - 2014.82 psi (Ans.)**

Q3. Find out the amount of uniformly distributed load that can be carried by a <u>31 ft</u> long and 15x25 inch prestressed concrete beam for a total cracking moment of <u>261 kip-ft</u>.

Solution: From Example 5.7

$M = \dfrac{wL^2}{8}$ => $261 = \dfrac{w \; x \; 31^2}{8}$ => $w = \dfrac{261 \; x \; 8}{31^2}$ = 2.17 kip/ft **(Ans.)**

OR, $M = \dfrac{wL^2}{8}$ => $261x1000 = \dfrac{wx31^2}{8}$ => $w = \dfrac{261,000x8}{31^2}$ = **2172.7 lb/ft   (Ans.)**

Q4. A 40 ft long posttensioned simple concrete beam is prestressed with 2.5 in^2 of parabolic cable through a point 6 in below the cgc. at mid-span. The final prestress after considering all losses is <u>127 ksi.</u> The beam has a cross section of 12X22 inch and assume, n=6.5. Compute the stress in **steel** at the mid-span for a net moment of <u>87.7 kip-ft</u> due to superimposed load and prestressing if the steel is bonded by grouting.

Solution: From Example 5.6

Stress in **concrete at the level of steel**, $fc = \dfrac{My}{I} = \dfrac{87.7x1000x12x6}{\dfrac{12x22^3}{12}}$ [here, y = e = 6]

$$= \dfrac{87.7x1000x12x6}{10648} = 593.01 \text{ psi}$$

Stress in steel is thus increased by, fs = nfc = 6.5 x 593.01 = 3854.56 psi

Resultant stress in **steel** = 127,000 + 3854.56 = **130,854.56 psi (Ans.)**