

# Flexural Analysis and Design of Beams

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Solutions of Examples and Exercise of "Design of Concrete Structures" — Arthur H. Nilson, David Darwin, Charles W. Dolan.

## Example 3.1

A rectangular beam has the dimensions  $b = 10$  in,  $h = 25$  in and  $d = 23$  in and is reinforced with three No. 8 bars so that  $A_s = 2.37$  in<sup>2</sup>. The concrete cylinder strength  $f'_c$  is 4000 psi and the tensile strength in bending is 475 psi. The yield point of the steel  $f_y$  is 40,000 psi, the stress-strain curves of the materials being of those of Fig. 1.8. Determine the stress caused by a bending moment  $M = 45$  kip-ft



We know, modular ratio,  $n = \frac{E_s}{E_c} = \frac{29 \times 10^6}{3.6 \times 10^6} \left( \frac{f_y}{f'_c} \right) = 8.055 \approx 8$   
transform area  $(n-1)A_s = (8-1) \times 2.37 = 16.59$  in<sup>2</sup>

$$A_c = 25 \times 10 = 250 \text{ in}^2$$

Centroid from top  $\bar{y} = \frac{250 \times 12.5 + 16.59 \times 23}{250 + 16.59} = 13.15$

Moment of Inertia  $I = \frac{b h^3}{12} + A_c \bar{y}^2 = \frac{10 \times 25^3}{12} + 250 \times (13.15)^2$   
 $= 14630.44 \text{ in}^4$

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**Xiaolong Qi**



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