

1.051 Structural Engineering Design**Problem Set 2**

(Assigned: 9/29; Due: 10/8)

- Q1) Being a structural engineer in an engineering design office, you are asked to design a typical internal rectangular beam for a parking lot construction project near Logan. The beams are expected to carry, in addition to its own weight, a service load of 1500 lb/ft and a dead load of 300 lb/ft from the bituminous materials on the slabs. The typical span length is 26 ft and it is simply supported. Material properties are specified below:

Steel	Concrete
$f_y = 60,000 \text{ psi}$	$f'_c = 5,000 \text{ psi}$

(Additional material properties are to be obtained from associated known values and relations provided in the textbook)

- (a) Due to the headroom constraints, the beam thickness shall be limited to 22". Ductile behavior is required. Perform the beam design and sketch your design with proper rebar arrangements. The design shall conform to ACI-318.
 - (b) What are the major assumptions you have made in the above beam design? How could you help achieve such assumptions in practice? What would be the consequence if such assumptions were invalid?
 - (c) Determine the load level at which the first flexural crack forms in the above section. Where is the neutral axis just before such crack formation? How would the neutral axis move after the first crack is formed?
 - (d) Does the crack width under service loading, w , satisfy the ACI requirement (10.6.4)? Why do we want to control the crack width? How would you reduce the crack width if it exceeds the ACI limit?
- Q2) Solve Problem 3.11 in the textbook.
- Q3) Solve Problem 3.12 in the textbook.