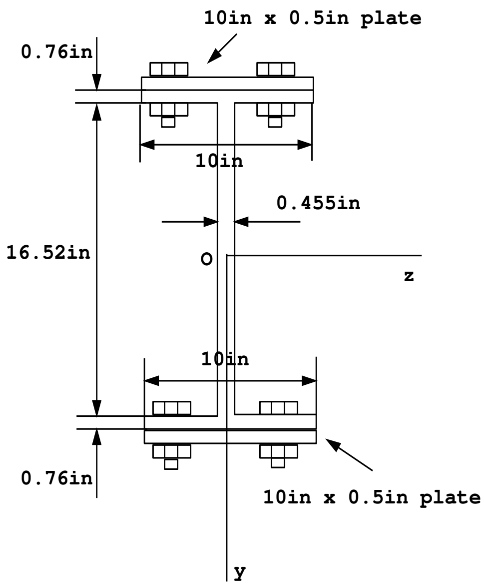
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF OCEAN ENGINEERING AND CIVIL AND ENVIRONMENTAL ENGINEERING
13.10J/1.573J Introduction to Structural Mechanics
Fall 1999
Problem Set 7

Assigned : October 21, 1999
Due : October 28, 1999

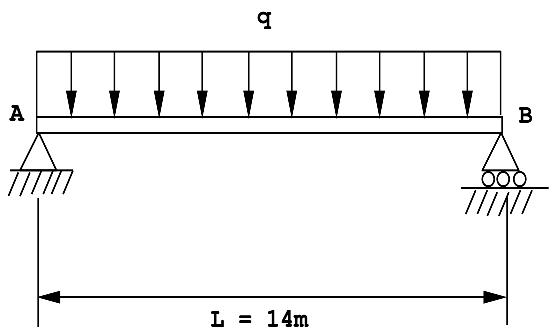
1. A built-up beam is fabricated from a wide-flange beam and two 10in. $\times$ 0.5in cover plates. The allowable load in shear on each bolt is 2.8 kips. What is the required bolt spacing s if the shear force V = 40 kips?

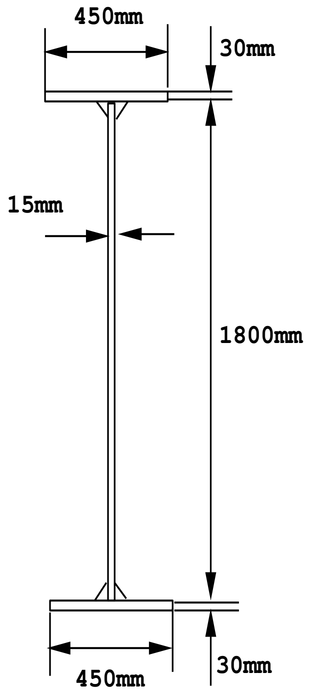


2. A simple beam AB with span length L=14m supports a uniform load of intensity q that includes the weight of the beam. The beam is constructed of three plates welded together to form the cross section shown. Determine the maximum permissible load q based upon:

   (a) an allowable bending stress $\sigma_{allow} = 110MPa$.

   (b) an allowable shear stress $\tau_{allow} = 50MPa$.





3. A 3-hold steel barge is loaded with ore of density $\rho_c = 2000kg/m^3$. The longitudinal and transverse cross-sections of the barge are shown in the figure. The density, Young's modulus of elasticity and Poisson's ratio of steel are $\rho_s = 7800kg/m^3$, $E = 200GPa$, and $\nu = 0.3$.
Notes:

- Use Table "Appendix IV-D" in the textbook for properties of standard angle cross-section beams.
- You may like to use MATLAB for this problem.

(a) What is the draft of the barge?

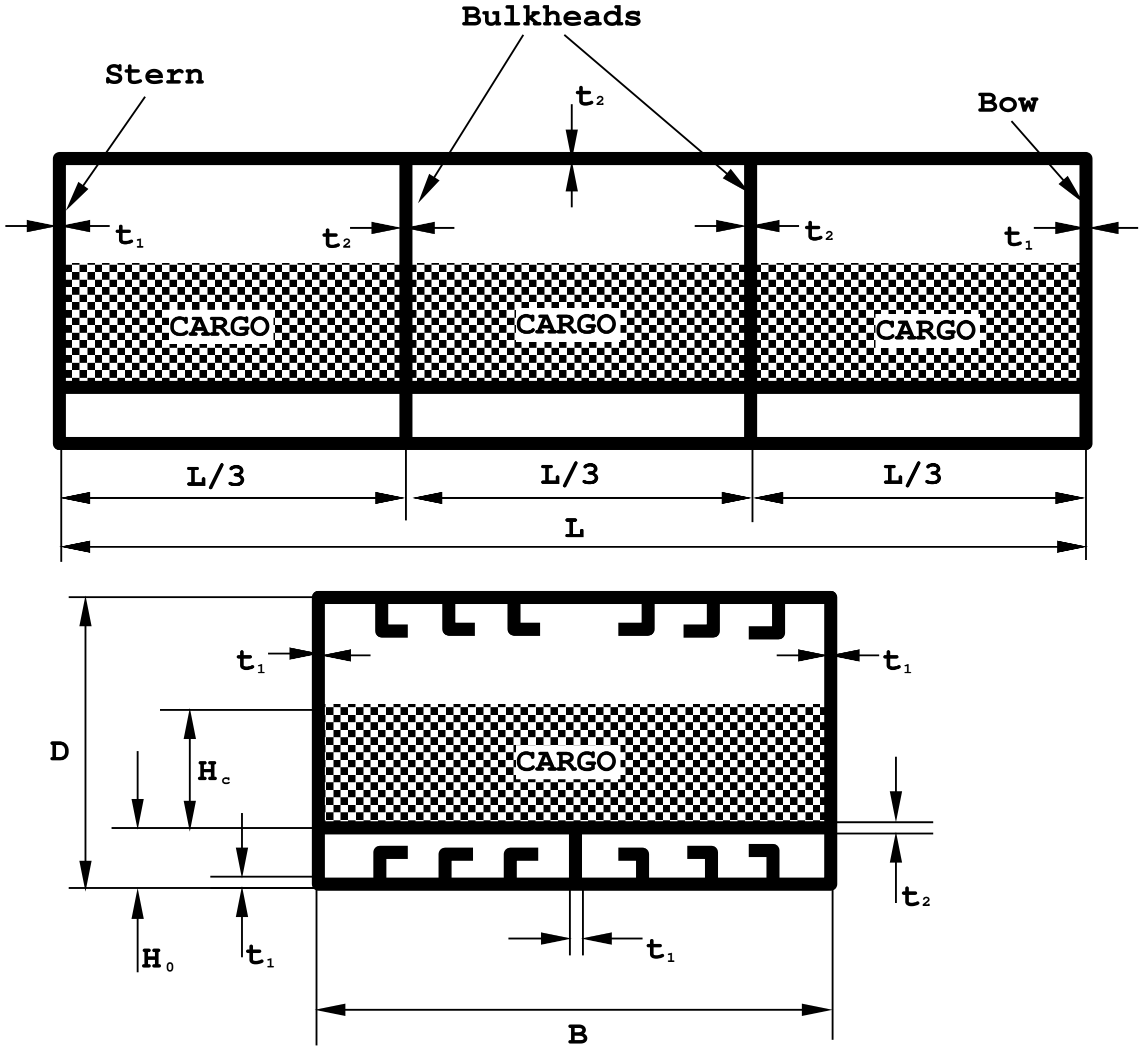
(b) Locate the neutral axis of the transverse cross-section of the barge with respect to the bottom.

(c) Derive the shear force and bending moment functions. Assume that the weight of bow, stern and two bulkhead plates to be concentrated loads.

(d) Compute the maximum bending stress.

(e) Compute the maximum shear stress.

(f) Compute the deflection due to bending and shear, and the total deflection.



$L = 50m$ $\quad$ $t_1 = 0.02m$

$B = 20m$ $\quad$ $t_2 = 0.016m$

$D = 8m$

$H_c = 3m$ $\quad$ L2x2 standard angles with

$H_0 = 1m$ $\quad$ 3/8 in. thickness

Problem sets are available also in the course homepage.