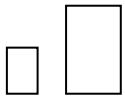
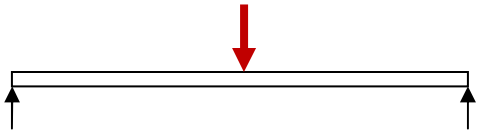
RISD ARCH 2154 STEEL STRUCTURES **Fall 2017**
HW 4

Reading:
Read AISC 14th Ed Spec Section F, G and H
Read AISC 14th Ed Design Examples - Spec Ch F

Problem 1
What is the ASD bending moment capacity of a solid square bar 1" wide x 2" deep? What is the relative increase in bending capacity if the cross-sectional dimensions are doubled (so 2" x 4")? Assume A36 steel and you will need to find the plastic modulus first to compare.



Problem 2
From you answer in problem #1, related to the solid rectangular bar 1" x 2", how long can this rod span assuming it is supporting a person weighing 300 pounds in the center? (To get the moment, feel free to draw shear and moment diagram)



Problem 3
What is a LRFD moment capacity of a W12x50 beam in the strong axis (use Zx)? If this beam was 30 ft long, how much load can it support in pounds per linear foot? See Example F.1-1B to help.

Problem 4
Design simple span 20ft long steel beam 'B-2' below using the following loads…

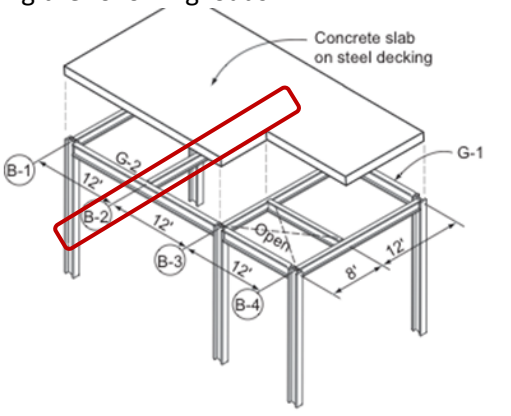
Live Load	= 50 psf
Dead Loads:	
Concrete	= 150 #/ft.^{3}
Steel decking	= 5 psf
Mechanical equipment	= 10 psf
Suspended ceiling	= 5 psf
Steel beams	= 25 #/ft.
Steel girders	= 35 #/ft.

Loads:

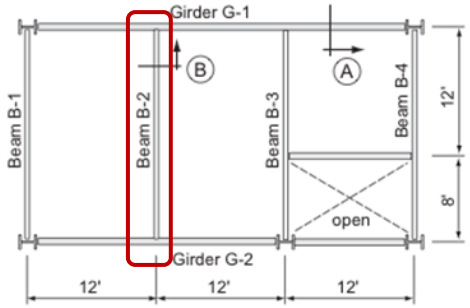
$$\text{Slab load} = \left(\frac{4\text{ in.}}{12\ ^{\text{in}}/_{\text{ft.}}}\right) \times \left(150\ ^{\text{lb}}/_{\text{ft.}^3}\right) = 50\ ^{\text{lb}}/_{\text{ft.}^2}$$

Dead loads:	= 50 psf (slab)
	+ 5 psf (decking)
	+ 10 psf (mech. equip.)
	+ 5 psf (ceiling)
Total DL	= 70 psf

Dead Load + Live Load = 70 psf + 50 psf = 120 psf



) Isometric view of partial steel framing arrangement



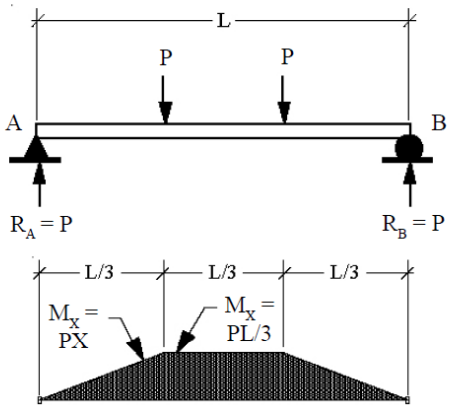
Problem 5

With respect to bending moment considerations only, draw a sketch of the shape variation present in a beam carrying two equal concentrated loads located at third points in the structure such that a constant bending-stress level is maintained on the top and bottom surfaces of the member. Draw one sketch assuming the width of the beam is held constant and the depth varies (see below solution), and another assuming the depth of the beam is held constant and the width allowed to vary (try your best).

Step 1: Find the reactions.

$$R_{Ax} = R_{Bx} = P \text{ (symmetry)}$$

Step 2: Draw the moment diagram.



When $0 \leqq X \leqq L/3$:

$$M_X = PX$$

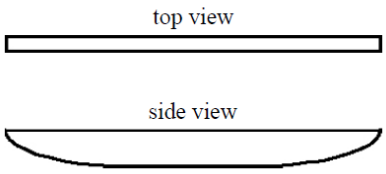
When $L/3 \leqq X \leqq 2L/3$:

$$M_X = PX - P(X - L/3)$$
$$M_X = PX - PX + PL/3$$
$$M_X = PL/3$$

When $2L/3 \leqq X \leqq L$:

$$M_X = PX - P(X - L/3) - P(X - 2L/3)$$
$$M_X = PX - PX + PL/3 - PX + 2PL/3$$
$$M_X = PL - PX$$

Step 3: Assume the width is constant and the depth varies.



$$S_x = bd^2/6$$
$$S_x = M/F_b$$
$$bd^2/6 = M/F_b$$
$$d^2 = 6M/bF_b$$
$$d^2 = 6PX/bF_b$$

If P, b, F_b are all constant:

$$d \text{ x } X^{1/2}$$

Suppose L = 12 ft:

When X = 0, d = 0

When X = 2 ft, d = 1.4

When X = 4 ft, d = 2

Problem 6

Select an ASTM A992 W-shape flexural member by the moment of inertia, to limit the live load deflection to 1in. The span length is 30 ft. The loads are a uniform dead load of 0.80 kip/ft and a uniform live load of 3 kip/ft. The beam is continuously braced. See Example problem F.4 for help (I just changed the live load).