

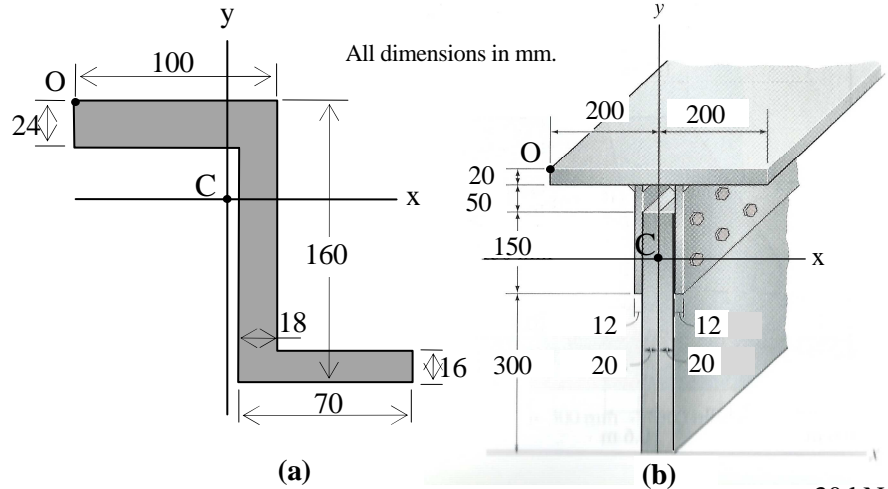
**UNIVERSITY OF TORONTO**  
**Department of Civil Engineering**

**CIV100F - MECHANICS – GROUP G (107)**

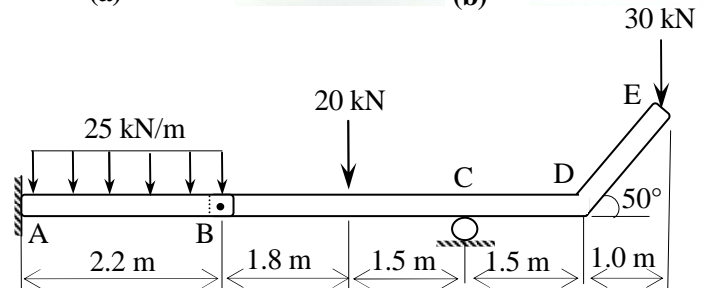
**Problem Set 12**

Due: 4:00 pm on Friday November 30, 2012  
 In SF3201

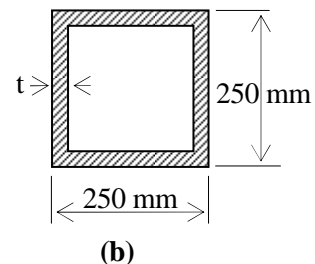
1. Determine the second moments of areas (i.e., moments of inertias) of the cross sections **(a)** and **(b)** for bending about their centroidal  $x$  and  $y$  axes. Determine the centroids of the cross sections with reference to origin  $O$ . (You may obtain the centroid location of **(a)** from Problem Set 9.)



2. Beam ABCDE, supported by a fixed connection at A, an internal pin at B and a roller at C, is subjected to a uniformly-distributed load and two point loads as shown in figure **(a)**. The beam is to be constructed from the structural steel with the yield strength of 350 MPa in both tension and compression.



- i.) Neatly draw the shear and bending moment diagrams for beam ABCD and indicate all key values.
- ii.) Beam ABCD is to be designed using a uniform-thickness hollow structural steel section shown in figure **(b)**. Using a load factor of 1.9, determine the minimum thickness  $t$  required. Thicknesses are only available in 2 mm increments.



3. The maximum internal service moment on a beam is calculated to be 50 kNm. This beam is to be designed for a load factor of 2.0 and using a channel section having the yield stress of 300 MPa in both tension and compression.
- i.) Select a suitable section to minimize the material cost.
- ii.) Select a suitable section to minimize the depth of the beam due to an overhead clearance requirement enforced by the city.