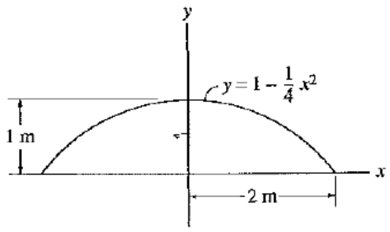
CE 221 ENGINEERING MECHANICS I (FALL 2014 – 2015)
Home Exercise VI –Equilibrium
(http://www2.ce.metu.edu.tr/~ce221)

Q1.

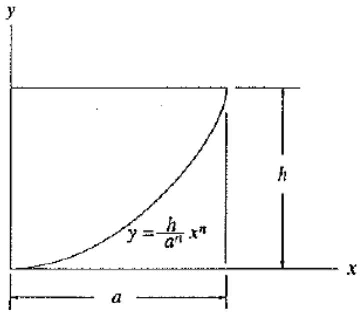
Locate the centroid ($\bar{x}$, $\bar{y}$) of the shaded area.



ANS: 2/5 m

Q2.

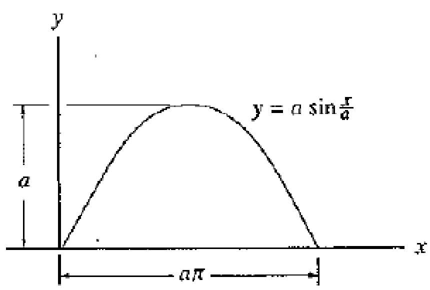
Locate the centroid $\bar{x}$ of the shaded area.



ANS: x'= a(n+1)/(2(n+2))

Q3.

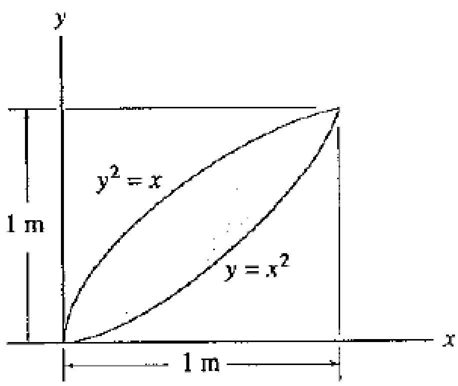
Locate the centroid ($\bar{x}$, $\bar{y}$) of the shaded area.



ANS: x'= aπ/2 , y'=aπ/8

Q4.

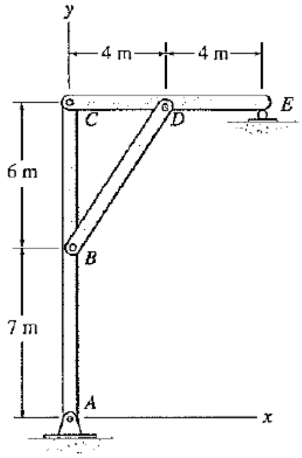
Locate the centroid $\bar{y}$ of the shaded area.



ANS: y'=0.45 m

Q5.

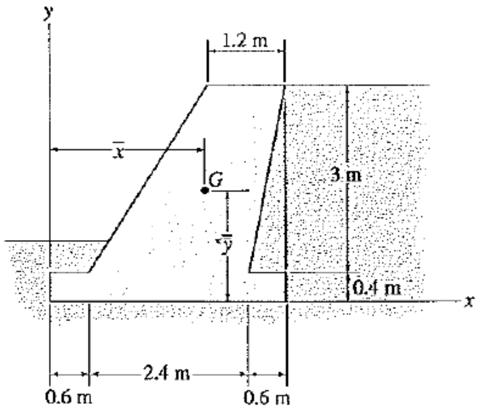
Each of the three members of the frame has a mass per unit length of 6 kg/m. Locate the position ($\bar{x}$, $\bar{y}$) of the center of gravity. Neglect the size of the pins at the joints and the thickness of the members. Also, calculate the reactions at the pin A and roller E.



ANS: x'= 1,65 m, y'= 9,24 m, Ey= 342 N, Ay= 1,32kN, Ax=0

Q6.

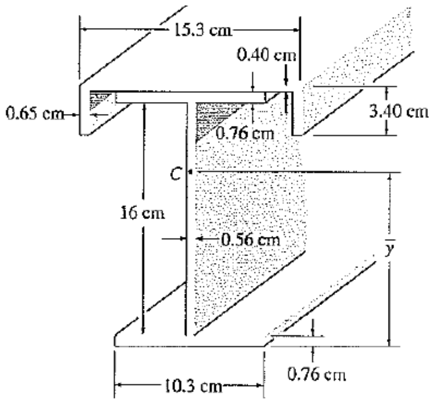
The gravity wall is made of concrete. Determine the location ($\bar{x}$, $\bar{y}$) of the center of gravity G for the wall.



ANS: x'=2.22m, y'=1.41 m

Q7.

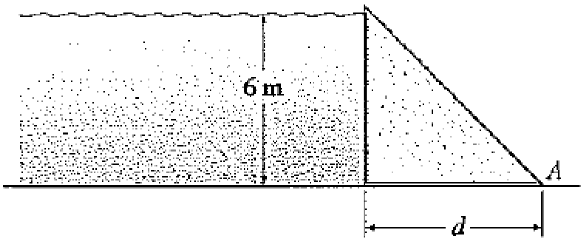
Locate the centroid $\bar{y}$ of the beam's cross-section built up from a channel and a wide-flange beam.



ANS: y'=102.4 mm

Q8.

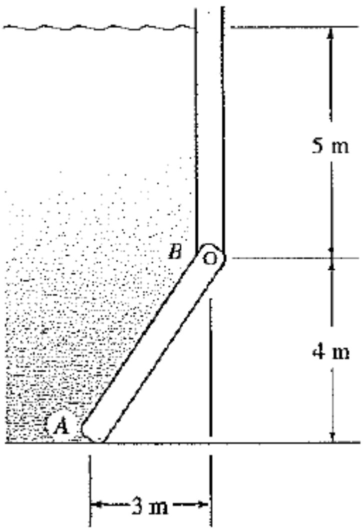
The concrete "gravity" dam is held in place by its own weight. If the density of concrete is $\rho_c = 2.5\ \mathrm{Mg/m^3}$, and water has a density of $\rho_w = 1.0\ \mathrm{Mg/m^3}$, determine the smallest dimension d that will prevent the dam from overturning about its end A.



ANS: d=2.68 m

Q9.

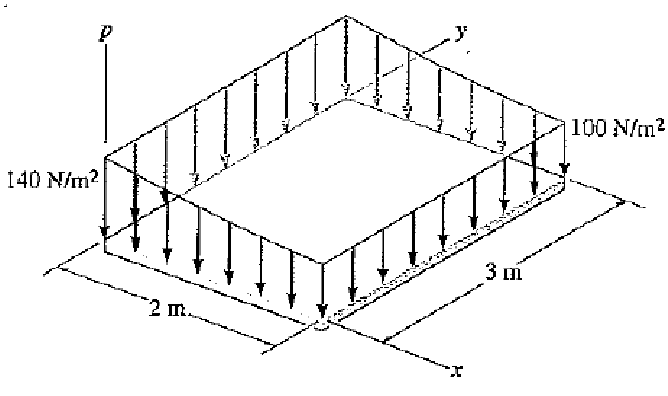
The gate AB is 8 m wide. Determine the hoı zontal and vertical components of force acting on tł pin at B and the vertical reaction at the smooth suppo A. $\rho_w = 1.0\ \mathrm{Mg/m^3}$.



ANS: Ay=2.51 MN, Bx= 2.20 MN, By= 859 kN

Q10.

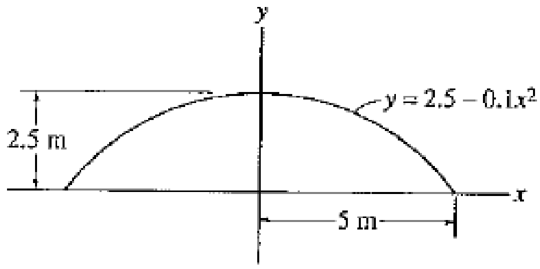
The pressure loading on the plate is described by the function $p = 10[6/(x+1) + 8]\ \mathrm{N/m^2}$. Determine the magnitude of the resultant force and the coordinates $(\bar{x}, \bar{y})$ of the point where the line of action of the force intersects the plate.



ANS:F=678 N, x'= 0.948 m, y'= 1.50 m

Q11.

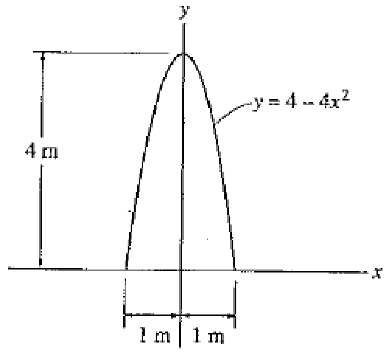
Determine the moment of inertia of the area about the x axis. Solve the problem in two ways, using rectangular differential elements: (a) having a thickness dx and (b) having a thickness of dy.



ANS: a) Ix= 23.8 m^4, b) Ix= 23.8 m^4

Q12.

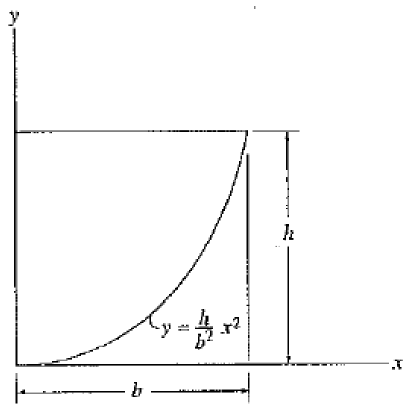
Determine the moment of inertia of the area about the y axis. Solve the problem in two ways, using rectangular differential elements: (a) having a thickness of dx, and (b) having a thickness of dy.



ANS: a) Ix= 1.07 m^4, Ix= 1.07 m^4

Q13.

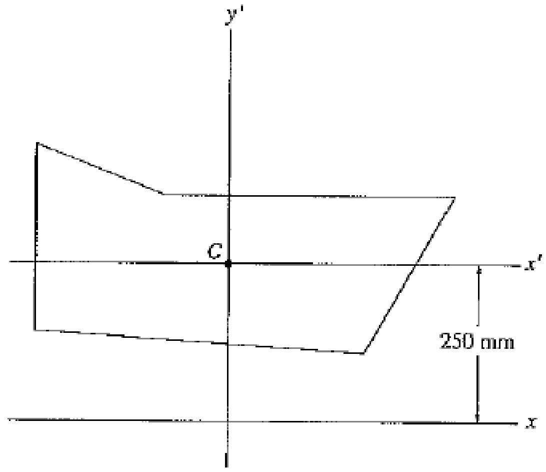
Determine the moment of inertia of the shaded area about the y axis.



ANS: Iy= (2/15) hb3

Q14.

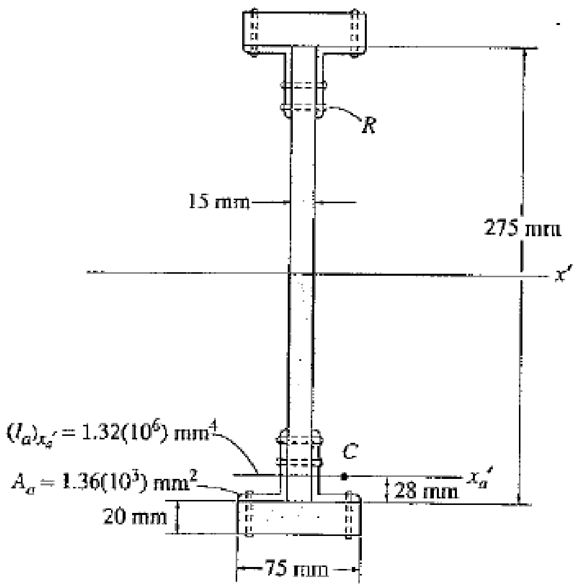
The polar moment of inertia of the area is $\bar{J}_C = 548(10^6)$ mm^4, about the z' axis passing through the centroid C. The moment of inertia about the y' axis is $383(10^6)$ mm^4, and the moment of inertia about the x axis is $856(10^6)$ mm^4. Determine the area A.



ANS:A= 11100 mm^2

Q15.

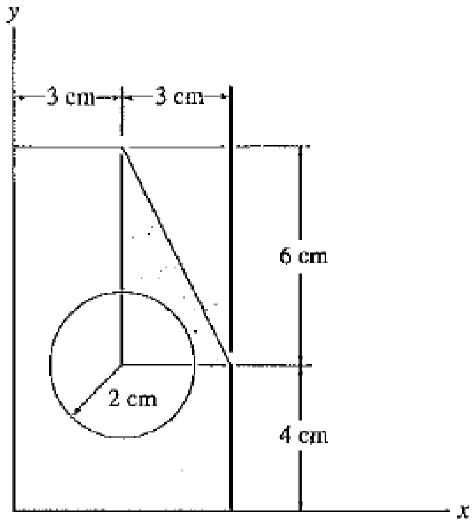
Determine the moment of inertia of the beam's cross-sectional area with respect to the x' centroidal axis. Neglect the size of all the rivet heads, R, for the calculation. Handbook values for the area, moment of inertia, and location of the centroid C of one of the angles are listed in the figure.



ANS: Ix'= 162 x 10^6 mm^4

Q16.

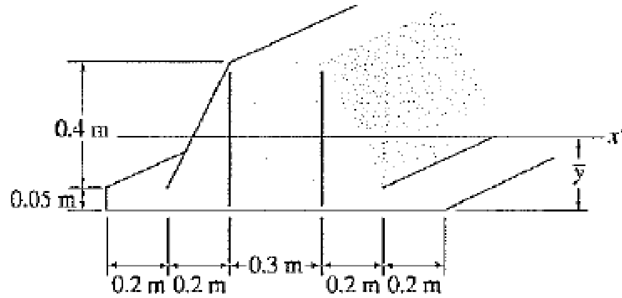
Determine the moments of inertia of the shadec area about the x and y axes.



ANS: Ix'= 1.217 x 10^3 cm^4 Iy'= 367.8 cm^4

Q17.

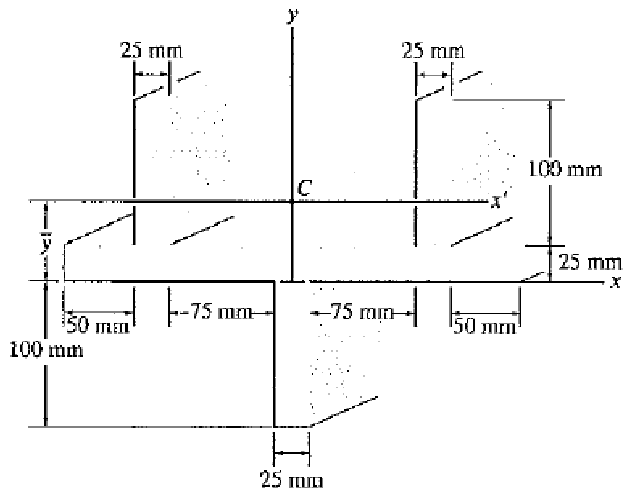
Locate the centroid $\bar{y}$ of the cross section and determine the moment of inertia of the section about the x' axis.



ANS: y'= 0.181 m, Ix'= 4.23 x 10^-3 mm^4

Q18.

Determine the moment of inertia of the beam's cross-sectional area about the y axis.



ANS: Iy'= 122 x 10^6 mm^4