ARCH 331: Practice Quiz 3

*Note: No aids are allowed for part 1. One side of a letter sized paper with notes is allowed during part 2, along with a silent, **non-programmable** calculator. There is a reference chart for part 2, shown on page 2.*

Clearly show your work and answer.

Part 1)   Worth 5 points   (conceptual questions)

Part 2)   Worth 45 points

(NOTE: The cross section basic shapes, holes, dimensions and reference origin can and will be changed for the quiz! The beam section information and diagrams will be provided.)

For the cross section shown in Figure 3a complete the chart to find:

a) The location of the centroid of the shape from the reference origin given.

b) The moment of inertia about the x axis, I_x, of the section [**or about the y axis, I_y**]

For a 20 ft long beam with the following cross section properties in Figure 3b, and the shear and bending moment diagrams shown in Figure 3c find:

c) The maximum bending stress, f_b, about the x axis

d) The required shear capacity of the nails, F, for the top [**or bottom**] connected piece if the pitch spacing, p, is 4.5 in..
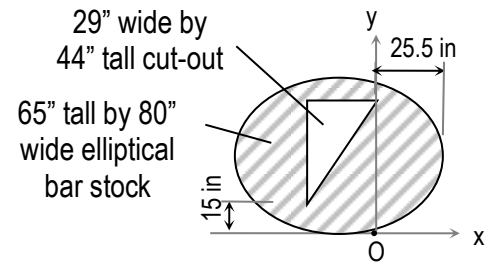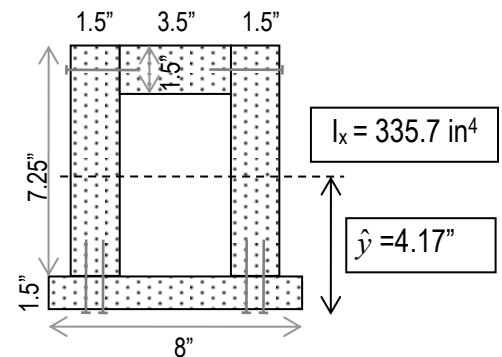
29" wide by 44" tall cut-out

65" tall by 80" wide elliptical bar stock

15 in   25.5 in

Figure 3a.

1.5"   3.5"   1.5"

I_x = 335.7 in⁴

$\hat{y}$ =4.17"

7.25"   1.5"   8"

Figure 3b

	A (in²)	$\bar{x}$ (in)	$\bar{x}A$ (in³)	$\bar{y}$ (in)	$\bar{y}A$ (in³)	I_x (in⁴)	d_y (in)	Ad_y^2 (in⁴)
ellipse	4084.1	-14.5				1078450		
hole				44.33				

1.9 k

V

12.67 k-ft

M

1.9 k
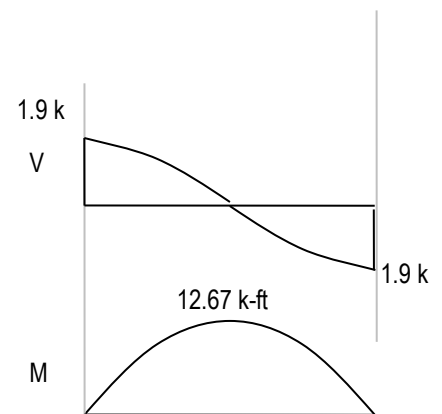
Figure 3c
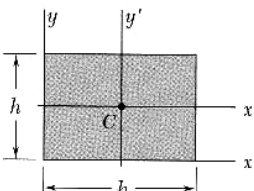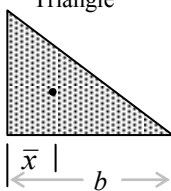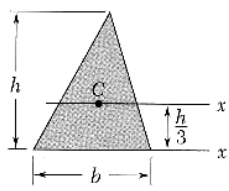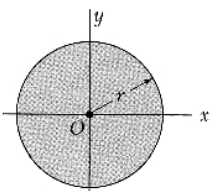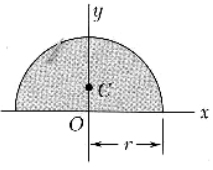
Answers – Not provided on actual quiz!

a) $\hat{x}$ = -13.6 in, $\hat{y}$ = 30.3 in   b) I_x = 903951 in⁴ [*or* I_y = 1586156 in⁴]
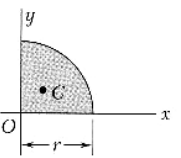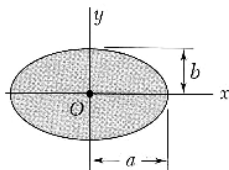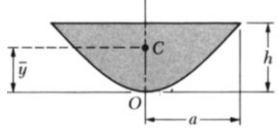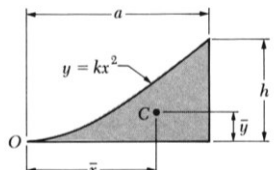
c) f_b = 2.07 ksi   d) $F \geq$ 256.0 lb (Q_{top} = 20.1 in²) [*or* 261.3 lb (Q_{bottom} = 41.04 in²)]

<p align="center"><u>REFERENCE CHART FOR QUIZ 3</u></p>

Geometric Properties of Areas

Rectangle		$\bar{I}_{x'} = \frac{1}{12}bh^3$ $\bar{I}_{y'} = \frac{1}{12}b^3h$ $I_x = \frac{1}{3}bh^3$ *about* $I_y = \frac{1}{3}b^3h$ *bottom* *left* $J_C = \frac{1}{12}bh(b^2 + h^2)$	Area = bh $\bar{x}$ = b/2 $\bar{y}$ = h/2
Triangle		$\bar{I}_{x'} = \frac{1}{36}bh^3$ $I_x = \frac{1}{12}bh^3$ $\bar{I}_{y'} = \frac{1}{36}b^3h$	Area = $\frac{bh}{2}$ $\bar{x} = \frac{b}{3}$ $\bar{y} = \frac{h}{3}$
Circle		$\bar{I}_x = \bar{I}_y = \frac{1}{4}\pi r^4$ $J_O = \frac{1}{2}\pi r^4$	Area = $\pi r^2 = \frac{\pi d^2}{4}$ $\bar{x}$ = 0 $\bar{y}$ = 0
Semicircle		$\bar{I}_x = 0.1098r^4$ $\bar{I}_y = \pi r^4 / 8$	Area = $\frac{\pi r^2}{2} = \frac{\pi d^2}{8}$ $\bar{x}$ = 0 $\bar{y} = \frac{4r}{3\pi}$
Quarter circle		$\bar{I}_x = 0.0549r^4$ $\bar{I}_y = 0.0549r^4$	Area = $\frac{\pi r^2}{4} = \frac{\pi d^2}{16}$ $\bar{x} = \frac{4r}{3\pi}$ $\bar{y} = \frac{4r}{3\pi}$
Ellipse		$\bar{I}_x = \frac{1}{4}\pi ab^3$ $\bar{I}_y = \frac{1}{4}\pi a^3b$ $J_O = \frac{1}{4}\pi ab(a^2 + b^2)$	Area = πab $\bar{x}$ = 0 $\bar{y}$ = 0
Parabolic area		$\bar{I}_x = 16ah^3 / 175$ $\bar{I}_y = 4a^3h / 15$	Area = $\frac{4ah}{3}$ $\bar{x}$ = 0 $\bar{y} = \frac{3h}{5}$
Parabolic spandrel		$\bar{I}_x = 37ah^3 / 2100$ $\bar{I}_y = a^3h / 80$	Area = $\frac{ah}{3}$ $\bar{x} = \frac{3a}{4}$ $\bar{y} = \frac{3h}{10}$