

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..

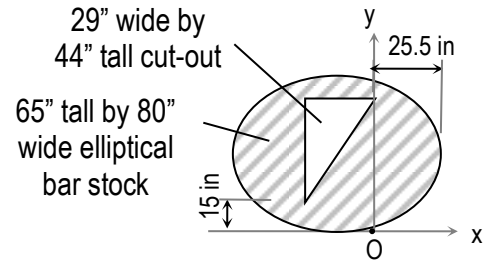


Figure 3a.

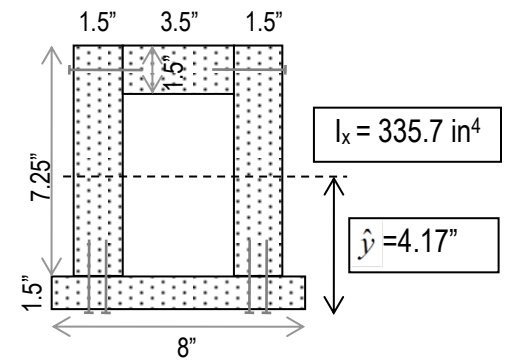


Figure 3b

	A (in ²)	\bar{x} (in)	$\bar{x}A$ (in ³)	\bar{y} (in)	$\bar{y}A$ (in ³)	I_x (in ⁴)	d_y (in)	Ad_y^2 (in ⁴)
ellipse hole	4084.1	-14.5		44.33		1078450		

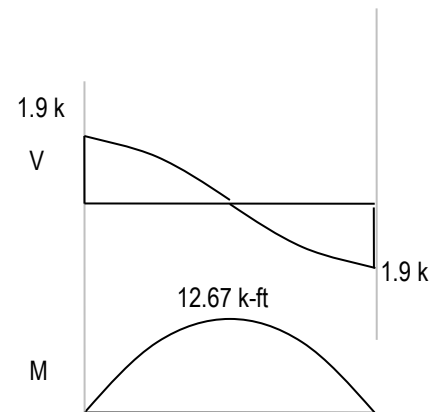


Figure 3c

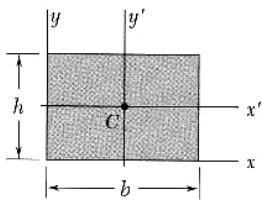
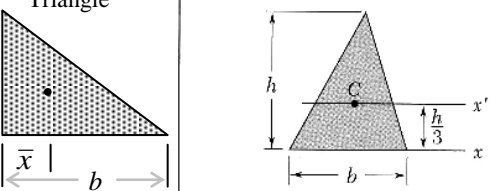
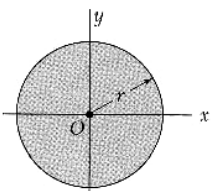
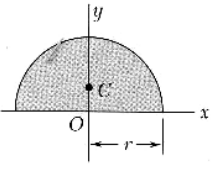
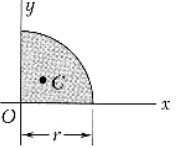
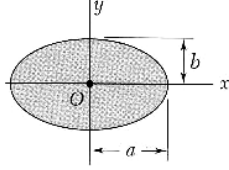
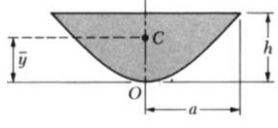
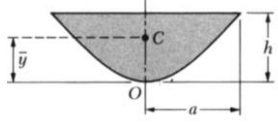
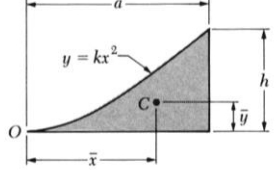
Answers – Not provided on actual quiz!

- 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)]

Disclaimer: Answers have NOT been painstakingly researched.

REFERENCE CHART FOR QUIZ 3

Geometric Properties of Areas

Rectangle		$\bar{I}_{x'} = \frac{1}{12}bh^3$ $\bar{I}_{y'} = \frac{1}{12}b^3h$ $I_x = \frac{1}{3}bh^3 \text{ about bottom}$ $I_y = \frac{1}{3}b^3h \text{ left}$ $J_C = \frac{1}{12}bh(b^2 + h^2)$	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 $\bar{x} = 0$ $\bar{y} = 0$
Semiparabolic area		$\bar{I}_x = 16ah^3/175$	Area = $\frac{4ah}{3}$ $\bar{x} = 0$ $\bar{y} = \frac{3h}{5}$
Parabolic area		$\bar{I}_y = 4a^3h/15$	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 = $\frac{ah}{3}$ $\bar{x} = \frac{3a}{4}$ $\bar{y} = \frac{3h}{10}$