# 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 point*s

*(NOTE: The cross section basic shapes, holes, dimensions and reference origin <u>can and will</u> 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..

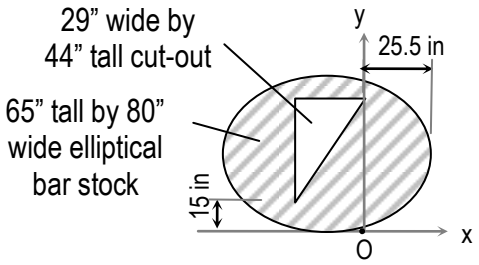



Figure 3a.

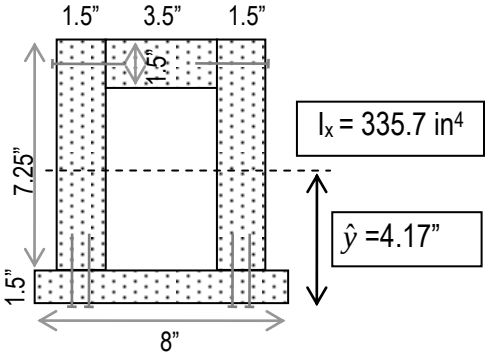



Figure 3b

| | 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 | 4084.1 | -14.5 | -59219 | 32.5 | 132732.3 | 1078450 | | |
| hole | | | | | | | | |

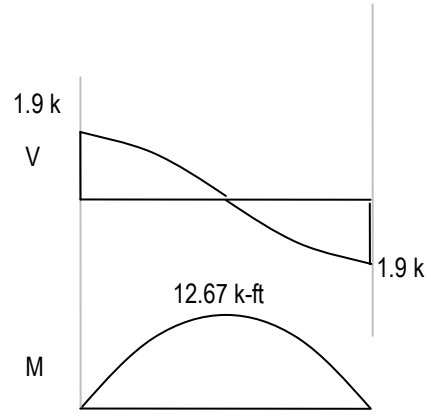



Figure 3c

*Answers – <u>Not provided on actual quiz!</u>*

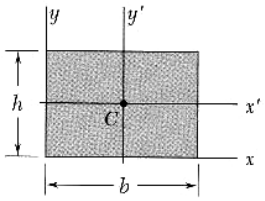
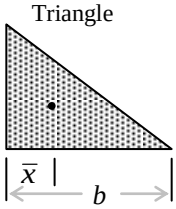
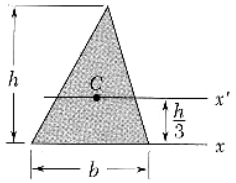
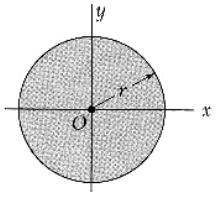
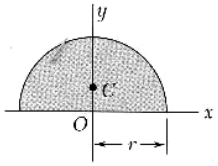
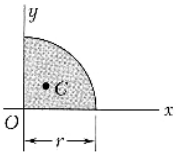
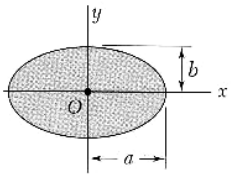
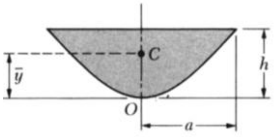
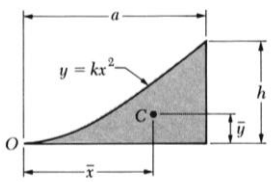
**Disclaimer: Answers have NOT been painstakingly researched.**

a) $\hat{x}$ = -13.6 in, $\hat{y}$ = 30.3 in b) $I_x$ = 903951 in$^4$ [*or* $I_y$ = 1586156 in$^4$]

c) $f_b$ = 2.07 ksi d) $F \geq$ 256.0 lb ($Q_{top}$ = 20.1 in$^2$) [*or* 261.3 lb ($Q_{bottom}$ = 41.04 in$^2$)]

# REFERENCE CHART FOR QUIZ 3

*Geometric Properties of Areas*

| | | | |
|---|---|---|---|
| Rectangle |  | $\bar{I}_{x'} = \frac{1}{12}bh^3$<br>$\bar{I}_{y'} = \frac{1}{12}b^3h$<br>$I_x = \frac{1}{3}bh^3$ about bottom<br>$I_y = \frac{1}{3}b^3h$ left<br>$J_C = \frac{1}{12}bh(b^2 + h^2)$ | Area = bh<br>$\bar{x}$ = b/2<br>$\bar{y}$ = h/2 |
| Triangle  |  | $\bar{I}_{x'} = \frac{1}{36}bh^3$<br>$I_x = \frac{1}{12}bh^3$<br>$\bar{I}_{y'} = \frac{1}{36}b^3h$ | Area = $bh/2$<br>$\bar{x} = b/3$<br>$\bar{y} = h/3$ |
| Circle |  | $\bar{I}_x = \bar{I}_y = \frac{1}{4}\pi r^4$<br>$J_O = \frac{1}{2}\pi r^4$ | Area = $\pi r^2 = \pi d^2/4$<br>$\bar{x}$ = 0<br>$\bar{y}$ = 0 |
| Semicircle |  | $\bar{I}_x$ = 0.1098r⁴<br>$\bar{I}_y = \pi r^4/8$ | Area = $\pi r^2/2 = \pi d^2/8$<br>$\bar{x}$ = 0 $\bar{y} = 4r/3\pi$ |
| Quarter circle |  | $\bar{I}_x$ = 0.0549r⁴<br>$\bar{I}_y$ = 0.0549r⁴ | Area = $\pi r^2/4 = \pi d^2/16$<br>$\bar{x} = 4r/3\pi$<br>$\bar{y} = 4r/3\pi$ |
| Ellipse |  | $\bar{I}_x = \frac{1}{4}\pi ab^3$<br>$\bar{I}_y = \frac{1}{4}\pi a^3b$<br>$J_O = \frac{1}{4}\pi ab(a^2 + b^2)$ | Area = $\pi ab$<br>$\bar{x}$ = 0<br>$\bar{y}$ = 0 |
| Semiparabolic area<br>Parabolic area |  | $\bar{I}_x$ = 16ah³/175<br>$\bar{I}_y$ = 4a³h/15 | Area = $4ah/3$<br>$\bar{x}$ = 0 $\bar{y} = 3h/5$ |
| Parabolic spandrel |  | $\bar{I}_x$ = 37ah³/2100<br>$\bar{I}_y$ = a³h/80 | Area = $ah/3$<br>$\bar{x} = 3a/4$ $\bar{y} = 3h/10$ |