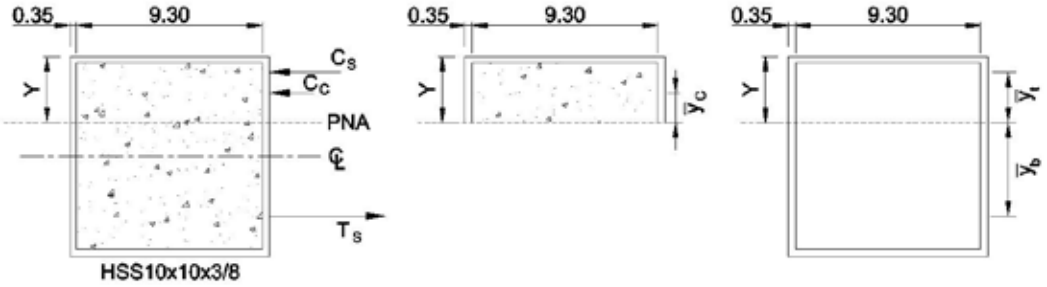
# steel quiz

If you thought this month's Quiz would allow you to fill in the blanks and/or choose from a list of options or between true and false for each question, we're happy to disappoint you! Instead, we'll put your equations skills to the test using a sample HSS design.

Use the information and framework provided below to approximate the design flexural strength of a composite HSS10×10×3/8 member. Neglect the corner radius of the HSS shape. $F_y$ = 50 ksi and $f'_c$ = 5 ksi.




Write expressions for the tension and compression components of the moment couple as a function of depth, *Y*:

Example: $C_c = 0.85f'_c\,[9.3 \times (Y - 0.35)] = 39.53Y - 13.83$

$C_s$ =

$T_s$ =

With the sum of the forces equal to zero, solve for *Y*:

$C_s + C_c = T_s$

$C_s + 39.53Y - 13.83 = T_s$ Solve for *Y*, *Y* = _____

Determine $\bar{y}_c$ for concrete area:

$\bar{y}_c$ =

Determine $\bar{y}_t$

| Area | A | y | Ay |
|---|---|---|---|
| 1 | 3.25 | | |
| 2 | | | |
| 3 | | | |

$\bar{y}_t = \frac{(\Sigma A_y)}{(\Sigma A)}$ =

Determine $\bar{y}_b$

| Area | A | y | Ay |
|---|---|---|---|
| 1 | 3.25 | | |
| 2 | | | |
| 3 | | | |

$\bar{y}_b = \frac{(\Sigma A_y)}{(\Sigma A)}$ =

Finally, calculate the design flexural strength.

$\phi M_n = 0.9 \times [(C_c \times \bar{y_c}) + (C_s \times \bar{y_t}) + (T_s \times \bar{y_b})]$

$\phi M_n$ =

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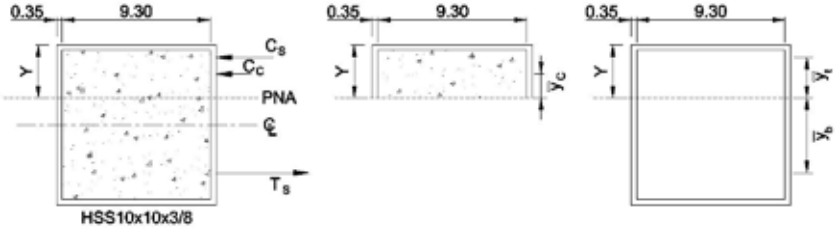
# steel quiz ANSWERS

The V15.0 *Design Examples*, a free download at **www.aisc.org/designexamples**, provides composite HSS tables with a design flexural strength of 198 kip/ft (see page IV-71/page 1057 of the PDF).




Write expressions for the tension and compression components of the moment couple as a function of depth, *Y*:

$C_c = 0.85f'_c\,[9.3 \times (Y - 0.35)] = 39.53Y - 13.83$

$C_s = 0.35(9.3 + 2Y)\,F_y = 162.75 + 35Y$

$T_s = 0.35(9.3 + 2(10 - Y))\,F_y = 512.75 - 35Y$

With the sum of the forces equal to zero, solve for *Y*:

$C_s + C_c = T_s$

$162.75 + 35Y + 39.53Y - 13.83 = 512.75 - 35Y$

Solve for *Y*, $Y = 3.32$ in.

Determine $\bar{y}_c$ for concrete area:

$$\bar{y}_c = \frac{(Y - t)}{2} = \frac{(3.32 - 0.35)}{2} = 1.49$$

Determine $\bar{y}_t$

| Area | A | y | Ay |
|---|---|---|---|
| 1 | 3.25 | 3.14 | 10.21 |
| 2 | 1.16 | 1.66 | 1.93 |
| 3 | 1.16 | 1.66 | 1.93 |

Determine $\bar{y}_b$

| Area | A | y | Ay |
|---|---|---|---|
| 1 | 3.25 | 6.51 | 21.16 |
| 2 | 2.33 | 3.34 | 7.78 |
| 3 | 2.33 | 3.34 | 7.78 |

$$\bar{y}_t = \frac{(\Sigma A_y)}{(\Sigma A)} = \frac{14.07}{5.57} = 2.53 \qquad \bar{y}_b = \frac{(\Sigma A_y)}{(\Sigma A)} = \frac{36.72}{7.91} = 4.64$$

Calculate the design flexural strength.

$\phi M_n = 0.9 \times [(C_c \times \bar{y_c}) + (C_s \times \bar{y_t}) + (T_s \times \bar{y_b})]$

$\phi M_n = 0.9 \times [(117.41 \times 1.49) + (278.95 \times 2.53) + (396.55 \times 4.64)] = 2449$ kip-in $= 204$ kip-ft

Steel SolutionsCenter

Anyone is welcome to submit questions and answers for the Steel Quiz. If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or at **solutions@aisc.org**.