EXAMPLE 6.8.1
Structural Steel Corbel

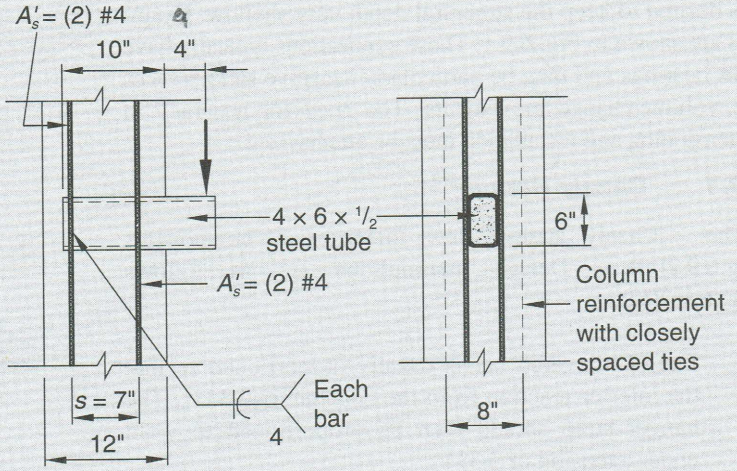
Given:
The structural steel corbel shown.

f'_c = 5000 psi, normalweight

f_y (reinforcement) = 60,000 psi (weldable - ASTM A706)

F_y (structural steel) = 46,000 psi E80 electrodes-rebar to HSS

Problem:
Find the design strength.



Solution:

Effective width b = confined width (8 in.) or

$b = 2.5w = 2.5(4) = 10$ in.

Use $b = 8$ in.

$e = 4 + 10/2 = 9$ in.

$$V_c = \frac{0.85f'_c b\ell_e}{1+3.6e/\ell_e} = \frac{0.85(5)(8)(10)}{1+3.6(9)/(10)} = 80.2 \text{ kip}$$ G-75

Since the A_s bars are anchored above and below, they can be counted twice.

$A_s = (2)\ \#4 = 2(2)(0.2) = 0.80$ in.^{2}

$$V_r = \frac{2A_s f_y}{1+\dfrac{6e/\ell_e}{(4.8s/\ell_e)-1}} = \frac{2(0.80)(60)}{1+\dfrac{6(9)/(10)}{[4.8(7)/(10)]-1}} = 29.2 \text{ kip}$$ G-76

$\phi V_n = 0.75(80.2 + 29.2) = 82.0$ kip

Alternatively, using Design Aids 6.15.10 and 6.15.11:

For $b = 8$ in.; $a = 4$ in.; $\ell_e = 10$ in.
Read $\phi V_c = 60$ kip

For A_s = (2) #4, anchored above and below: $V_r = 4(7) = 28$ kip
$\phi V_n = 60 + 0.75(28) = 81$ kip

Steel section flexural capacity:

From AISC *Steel Construction Manual*:

$Z_p = 14.6$

Assume $V_u = 85$ kip.

$$\phi V_n = \frac{\phi Z_p F_y}{a+0.5V_u/(0.85f'_c b)} = \frac{0.9(14.6)(46)}{4+0.5(85)/(0.85)(5)(8)} = 115.1 \text{ kip} > 82.0 \text{ kip}$$ G-77

Since the bar must be anchored for forces above and below, twice the minimum length of weld from Design Aid 6.14.3 is required: 2(1.75) = 3.5 in. each bar.