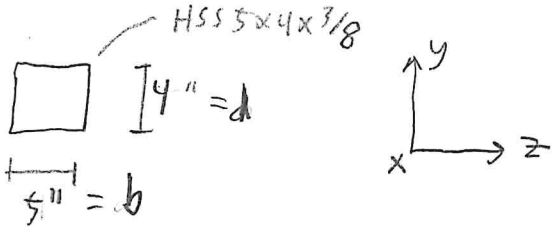
Given:



$F_{exx} = 70$ ksi

LRFD Factored Loads

$V_x = 14$ k (Tension)
$V_y = 3$ k
$V_z = 4$ k
$M_x = 4$ k-ft $= 48$ k-in
$M_y = 5$ k-ft $= 60$ k-in
$M_z = 8$ k-ft $= 96$ k-in

Required: Calculate the required weld size.

Sol.:

$S_y = bd + \frac{d^2}{3} = 5(4) + \frac{4^2}{3} = 25.333\ in^3$

$S_z = bd + \frac{b^2}{3} = 5(4) + \frac{5^2}{3} = 28.333\ in^3$

Sum weld $= 18\ in^2$

$I_p = \frac{(b+d)^3}{6} = \frac{(5+4)^3}{6} = 121.5\ in^4$

Allowable stress $= F_{exx}(0.6)(0.75) = 70(0.6)(0.75) = 31.5$ ksi

$f''_{x,y} = \frac{M_y}{S_y} = \frac{60\ k\text{-in}}{25.333} = 2.3684$ ksi

$f''_{x,z} = \frac{M_z}{S_z} = \frac{96\ k\text{-in}}{28.333} = 3.38824$ ksi

$f''_y = \frac{M_x(b/2)}{I_p} = \frac{48(5/2)}{121.5} = 0.98765$ ksi

$f''_z = \frac{M_x(d/2)}{I_p} = \frac{48(4/2)}{121.5} = 0.79012$ ksi

$f'_x = \frac{V_x}{Sum} = \frac{14}{18} = 0.77778$ ksi

$f'_y = \frac{V_y}{Sum} = \frac{3}{18} = 0.16667$ ksi

$f'_z = \frac{V_z}{Sum} = \frac{4}{18} = 0.2222$ ksi

$f_r = \sqrt{(f'_x + f''_{x,y} + f''_{x,z})^2 + (f''_y + f'_y)^2 + (f''_z + f'_z)^2}$

$f_r = \sqrt{(0.7778 + 2.3684 + 3.38824)^2 + (0.98765 + 0.16667)^2 + (0.79012 + 0.2222)^2}$

$f_r = 6.71234$ ksi

$t_e = \frac{f_r}{All.\ stress} = \frac{6.71234}{31.5} = 0.21309$ in

$a_{req} = t_e/0.707 = 0.21309/0.707 = 0.3014\ in \Rightarrow a = 0.3125"$

$\therefore$ use $\underline{D = 5/16}$