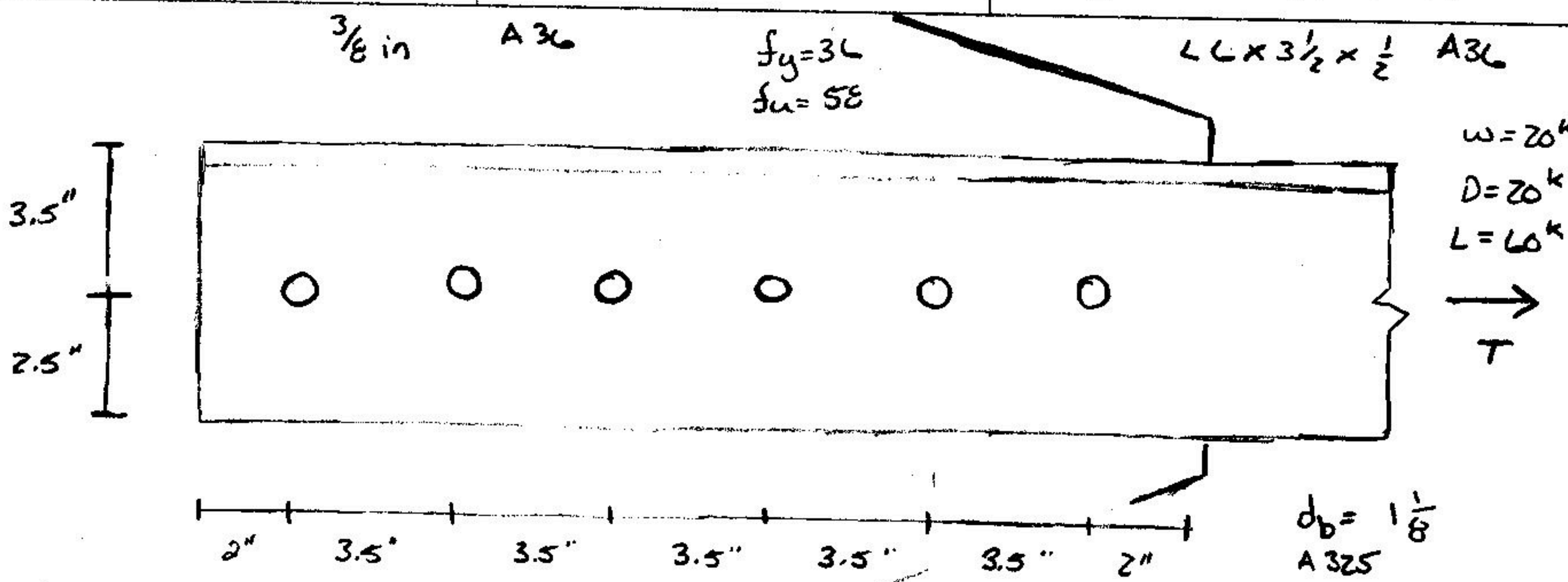
1)



Service And Factored Loads:

Service Load = D + L + ω = 20 + 60 + 20 = 100k

Factored design Load = 1.2D + 1.6ω + 0.5L = 86

1.2D + 1.6L = 120 ← USE

SLIP-CRITICAL SPLICE CONNECTION

$\phi R_n = \phi \mu D_u h_{sc} T_b N_s$, $T_b = 56^k$

$d_b = 1\frac{1}{8}$ in

$\phi R_n = (1.0)(0.35)(1.13)(1.00)(56)(1) = 22.148^k$

$\phi R_n (n) = 22.148(6) = 132.89^k > 100^k \therefore$ OK

Edge distances

$L_e = 1.5''$ (Table J3.4)

Design edge distance $L_e = 2'' > 1.5'' \therefore$ OK

Spacing

Minimum spacing = s = $2.67 d_b = 2.67(1\frac{1}{8}) = 3.0$ in

Preffered spacing = s = $3.0 d_b = 3.38$ in

Design = $3.5'' > 3.38'' > 3.0''$ $\therefore$ OK

Member (Gross Yeilding)

$A_g = 4.50$ in^2

$A_n = 4.50 - (1\frac{1}{8} + \frac{1}{8})(\frac{1}{2}) = 3.875$ in^2

$A_e = u A_n$

$u = 1 - \frac{\bar{x}}{L}$, $L = 17.5$; $\bar{x} = 0.829$ in

$u = 0.95263$

$A_e = (0.95263)(3.875) = 3.6914$

Gross yeilding = $\phi_t A_g f_y = 0.9(4.5)(36) = 145.8^k > 120^k \therefore$ OK er (Net section fracture)

$\phi_t A_e f_u = (0.75)(3.6914)(58) = 160.58^k > 120^k \therefore \underline{\underline{OK}}$

$L = 105^k$ $1.2D + 1.6L = 222$ A36 steel is to be used.
$D + L = 150^k$

FROM TABLE 5-8 : I will choose a 2L 4×3 × 5/8
$A_g = 7.78 in^2$

FROM TABLE 7-1 : I will choose $d_b = 1$ in A325 STD
$\phi R_n = 34.3^k$
This connection will be at least 5 bolts
171.5 > 150 ∴ OK

Edge spacing of bolt holes

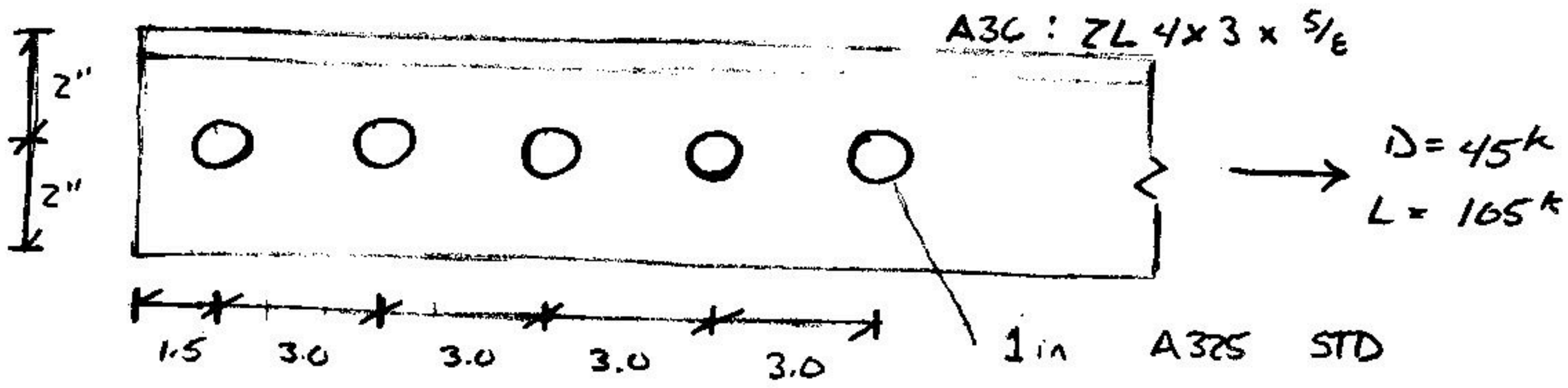
$Le_{min} = 1\frac{1}{4}$ (Table J3.4)

I will Design 1.5 in

Spacing

$Le_{min} = 2.67(d_b) = 2.67$
$Le_{preffered} = 3.0(d_b) = 3.00$

I will design s = 3.0 in



Slip Critical spice connection

$d_b = 1$ in

$\phi R_n = 34.3^k$ / bolt
$n = 5$
$(\phi R_n)(n) = 171.5^k > 150$ ∴ OK

Member

$A_g = 7.78 in^2$
$A_n = 7.78 - (1 + \frac{1}{8})(1) = 6.655$
$A_e = U A_n$ $U = 1 - \frac{\bar{x}}{L}$ $\bar{x} = 0.867$ $L = 12''$
$U = 0.92775$
$A_e = 6.1742$

Gross yeilding = $\phi_t F_y A_g = 0.9(36)(7.78) = 252.07 k > 222k$ ∴ OK

Net section = $\phi_t F_u A_e = (0.75)(58)(6.17) = 268.58^k > 222k$ ∴ OK

Problem 3

From table J2.4 $a_{min} = 1/8 in < a = 1/4 in \therefore$ O.K.

$a_{max} = t - 1/16 = 5/16 in - 1/16 in = 1/4 in$

$a_{max} = 1/4 in \geq a = 1/4 in \therefore$ O.K.

Base metal

$\phi R_n = \phi_R F_u A_{bm} \leq \phi_y F_y A_{bm}$

$\phi R_n = (0.75)(58 ksi)(0.6)(30 in)(\frac{5}{16} in) \leq (1.0)(36 ksi)(0.6)(30 in)(\frac{5}{16} in)$

$\phi R_n = 244.69 k \leq 202.5 k$

$\phi R_n = 202.5 k$

Weld

$\phi R_{nt} = \phi F_{wt} A_{wt}$

$\phi R_{nt} = (\phi)(0.6)(F_{EXX})(1 + \frac{1}{2} \sin^{1.5} \theta)(0.707)(L_{wt})(a)$

$\phi R_{nt} = (0.75)(0.6)(70 ksi)(1 + \frac{1}{2} \sin^{1.5} 90°)(0.707)(10 in)(0.25 in) = 83.51 k$

$\phi R_{nl} = \phi F_{wl} A_{wl}$

$\phi R_{nl} = (\phi)(0.6)(F_{EXX})(1 + \frac{1}{2} \sin^{1.5} \theta)(0.707)(L_{wl})(a)$

$\phi R_{nl} = (0.75)(0.6)(70 ksi)(1 + \frac{1}{2} \sin^{1.5} 0°)(0.707)(20 in)(0.25 in) = 111.35 k$

$\phi R_n = \phi R_{nt} + \phi R_{nl} \geq 0.85 \phi R_{nl} + 1.5 \phi R_{nt}$

$\phi R_n = 83.51 k + 111.35 k \geq (0.85)(111.35 k) + (1.5)(83.51 k)$

$\phi R_n = 194.86 k \geq 219.91 k$

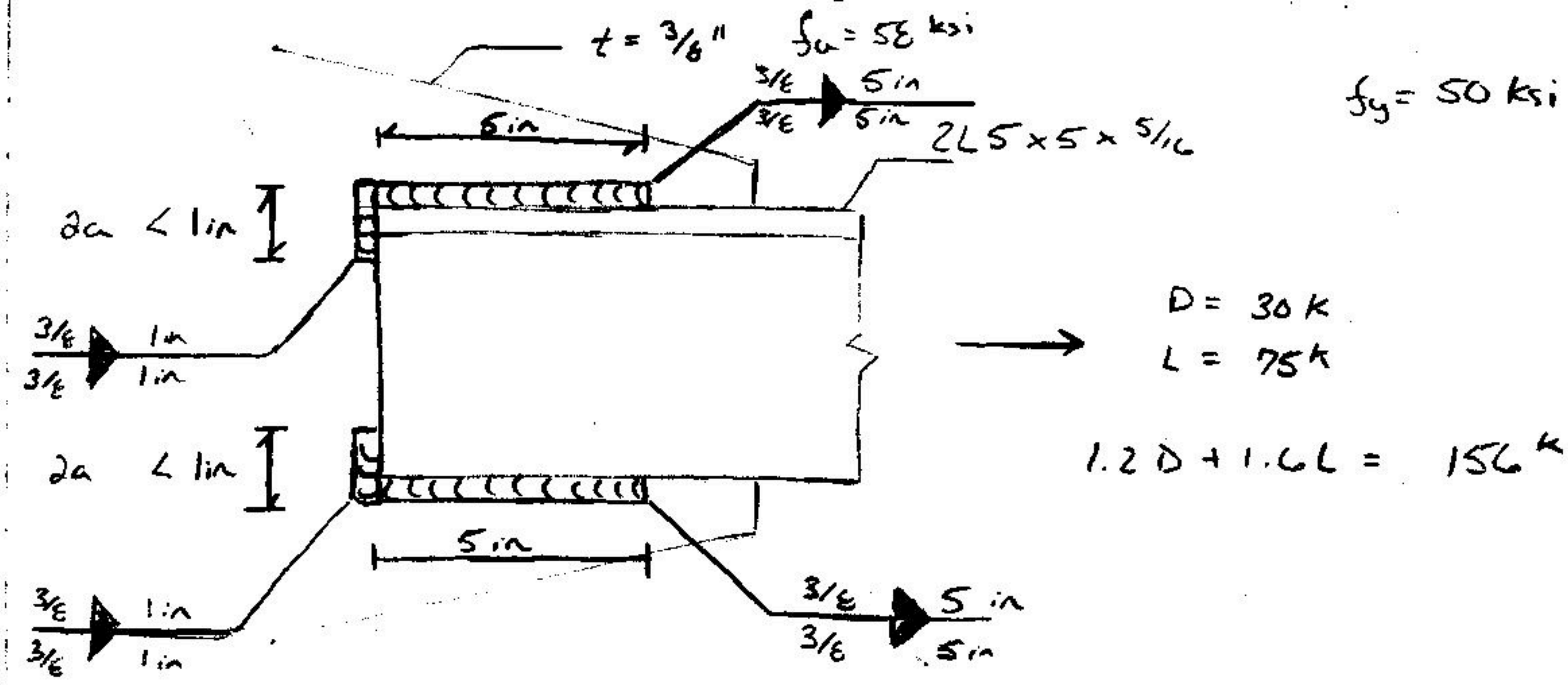
$\phi R_n = 219.91 k$

Total

$\phi R_n = 202.5 k$ controls

$T_u = 1.2 \frac{S}{4} + 1.6 \frac{3S}{4} = 1.5 S$

$S_{max} = \phi R_n / 1.5 = 202.5 k / 1.5 = \boxed{S_{max} = 135 k}$



Assume:
E70XX

$a_{min} = 3/16"$

$a_{max} = 5/16 - 1/16 = 1/4"$

Design $a = 3/8$ in $= 0.375$ in

- Shear strength of weld metal $= \phi R_n = 0.75(0.60)F_{EXX}(0.707)a(L_w)$
  $= 8.35$ k
- Strength of the base metal in shear:

$$\min \begin{cases} (\phi)(0.6)(f_y)(L_w)(t) = (1.0)(0.6)(36)(L_w)(3/8) = 8.1\,L_w \leftarrow * \\ (\phi)(0.6)(f_u)(L_w)(t) = (0.75)(0.6)(58)(L_w)(3/8) = 9.79\,L_w \end{cases}$$

$\phi R_n = 8.1\,L_w$

$\phi R_n > 156^k \Rightarrow 8.1\,L_w > 156^k \Rightarrow L_w = 19.259$ in

- Design, length of 3/8 in E70XX fillet weld = 20 in

  Shear strength of fillet weld $= 162^k$

length of weld required = 20 in
total weld length for each angle = 10 in (Look to drawing above)

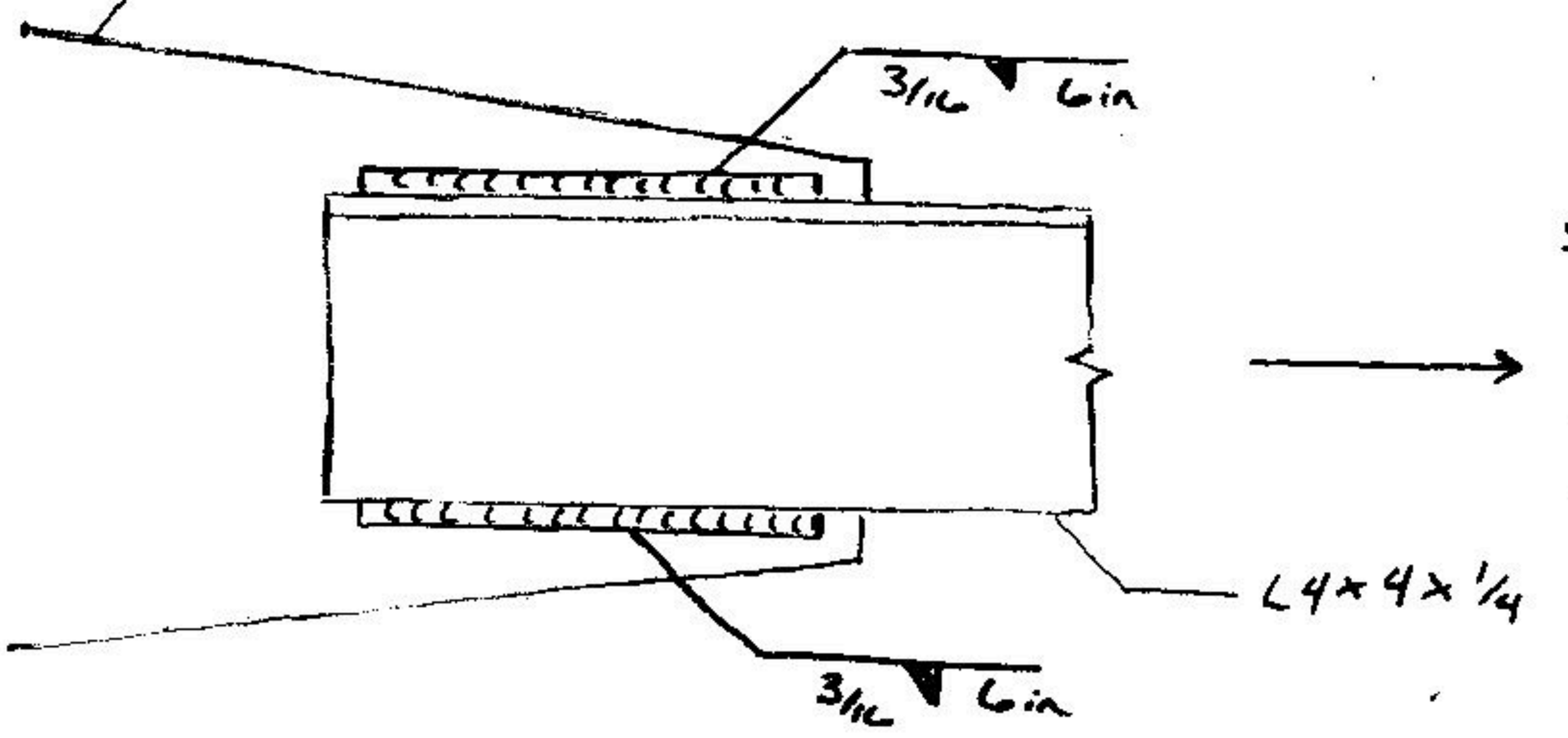
- Fracture strength of member:

$A_g = 6.13$
$A_e = U A_g$ $\quad U =$
$= 4.47\,in^2$

$\bar{x} = 1.35$ in

$\phi R_n = (0.75)(4.47)(50) = 167^k > 156^k \quad \therefore$ ok

$S_u = 58$ ksi



* Available strength
Table 5-2
- Rupture 42.3^k ← use*
- Yeilding 41.8^k
with: $U = 0.75$

$a_{min} = 3/16$ in
$a_{max} = 1/4 - 1/16 = 3/16$ in

* Asume E70xx electrode

Design $a = \underline{\underline{3/16 \text{ in}}}$

Shear Strength of weld metal:

$\phi R_n = 0.75(0.60)(70)(0.707)(3/16) L_w = 4.1757\, L_w{}^k$ ←

Strength of the base metal in shear:

$$\min \begin{cases} (1.0)(0.6)(36)(0.25)(L_w) = 5.4\, L_w{}^k \\ (0.75)(0.6)(58)(0.25)(L_w) = 6.5\, L_w{}^k \end{cases}$$

$\phi R_n = 4.1757\, L_w$ kips

$\phi R_n > 42.3$ kips $\Rightarrow 4.1757\, L_w > 42.3^k \Rightarrow L_w = 10.13$

Design length of 3/16 in E70xx fillet weld = $\underline{\underline{12 \text{ in}}} = \underline{\underline{2 \times 6 \text{ in}}}$

Shear strength of fillet weld = 50.109

CHECK: $U = 1 - \dfrac{\bar{x}}{L}$, $\bar{x} = 1.08$

$U = 1 - \dfrac{1.08}{6\text{in}} = 0.82 > 0.75 \therefore$ OK