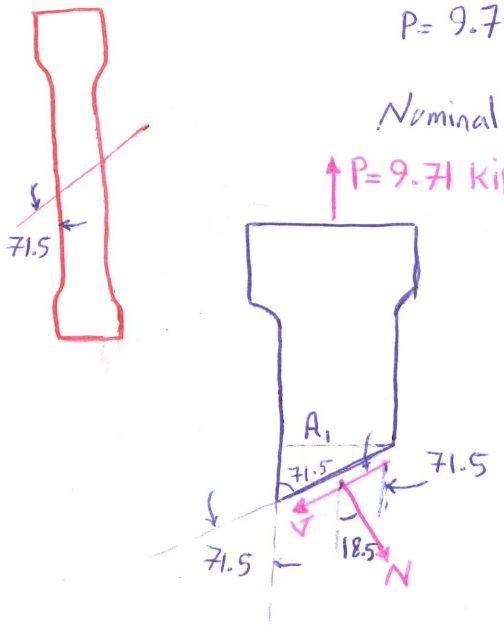
E02-1) a

Given:

P = 9.71 kip

Nominal Diameter = 0.35 in



A_1 = Area before failure = $\frac{\pi}{4} d_1^2 = \frac{\pi}{4}(0.35)^2 = 0.096 \text{ in}^2$

A_2 = cross sectional Area at inclined plane = $\frac{A_1}{\sin(71.5)} = \frac{0.096}{0.948} = 0.101 \text{ in}^2$

$\pm \sum F_x = 0 \quad -V \sin(71.5) + N \sin(18.5) = 0 \rightarrow 0.317\, N = 0.948\, V$

$\rightarrow N = \frac{0.948}{0.317} V = 3V$

$\uparrow \sum F_y = 0$

$\rightarrow \quad 9.71 - N\cos(18.5) - V\cos(71.5) = 0$

$\rightarrow 9.71 - 3V\cos(18.5) - V\cos(71.5) = 0 \rightarrow 9.71 = 0.317V + 2.845V$

$\rightarrow V = 3.07 \text{ kip}$

$\rightarrow N = 3V = 3 \times 3.07 = 9.21 \text{ kip}$

a) average Normal Stress = $\frac{N}{A_2} = \frac{9.21}{0.101} = 91.188 \text{ ksi}$

average Shear Stress = $\frac{V}{A_2} = \frac{3.07}{0.101} = 30.39 \text{ ksi}$

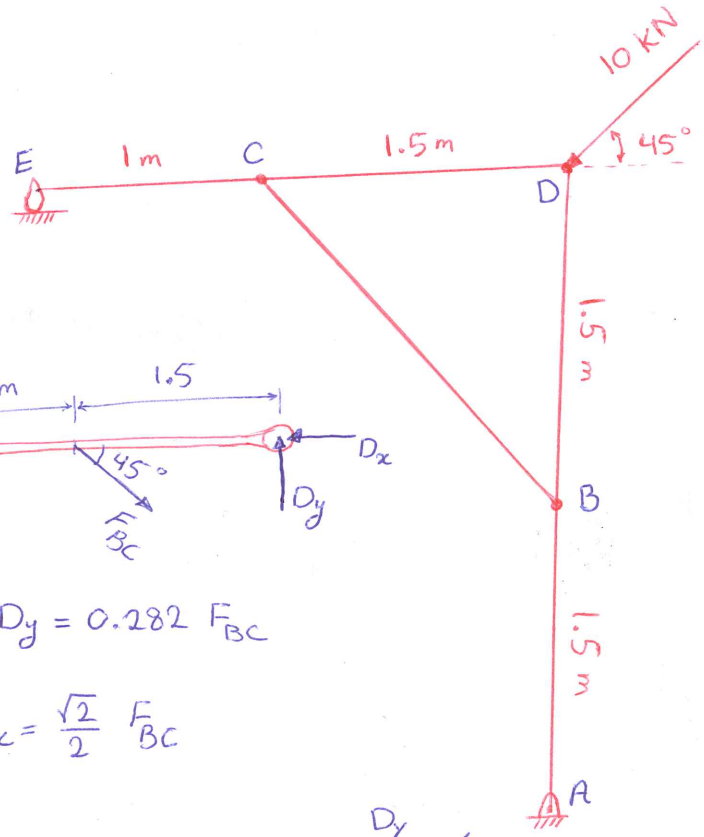
E02-1)b

b)

$$\sigma = \frac{P}{A_1} = \frac{9.71}{0.096} = 101.14 \text{ KSi}$$

$$\tau = \frac{V}{A_1} \xrightarrow{\text{since V is zero}} \tau = 0$$

E02-2)



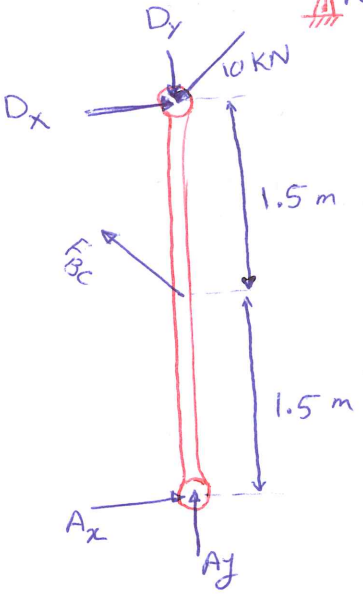
Referring to the FBD of ECD:

$+\circlearrowleft \sum M_E = 0$

$\rightarrow D_y(2.5) - F_{BC}\sin 45(1) = 0 \quad \rightarrow D_y = 0.282\, F_{BC}$

$\pm \rightarrow \sum F_x = 0 \quad F_{BC}\cos 45 - D_x = 0 \quad \rightarrow D_x = \frac{\sqrt{2}}{2} F_{BC}$

Referring to FBD of ABD



$+\circlearrowleft \sum M_{A=0} \rightarrow 10\cos 45(3) - D_x(3) + F_{BC}\sin 45(1.5) = 0$

$D_x = \frac{\sqrt{2}}{2} F_{BC} \rightarrow \quad 21.21 - 2.12\, F_{BC} + 1.06\, F_{BC} = 0$

$\rightarrow F_{BC} \cong 20$ KN , $D_x = 14.14$ KN

$D_y = 5.64$ KN

$$F_D = \sqrt{D_x^2 + D_y^2} = \sqrt{14.14^2 + 5.64^2} = 15.223 \text{ KN}$$

F_D is the resultant force acting on pin D

As the question said, Pin B is subjected to double shear, whereas pin D is single shear.

thus: $V_C = \frac{F_{BC}}{2} = \frac{20}{2} = 10$ KN $\quad V_B = \frac{F_{BC}}{2} = \frac{20}{2} = 10$ KN $\quad F_D = V_D = 15.223$ KN

For Pin C: $\tau_{all} = \frac{V_C}{A_C} \rightarrow 40\times10^6 = \frac{10\times10^3}{\frac{\pi}{4} d_C^2} \rightarrow d_C = 0.0178\ m$

$d_C = 17.8\ mm \simeq 18\ mm$

$\rightarrow d_C = 18\ mm$

For Pin D: $\tau_{all} = \frac{V_D}{A_D} \rightarrow 40\times10^6 = \frac{15223}{\frac{\pi}{4} d_D^2}$

$\rightarrow d_D = 0.022\ m = 22\ mm$

For Pin B, the same as pin C $\rightarrow d_B = 18\ mm$