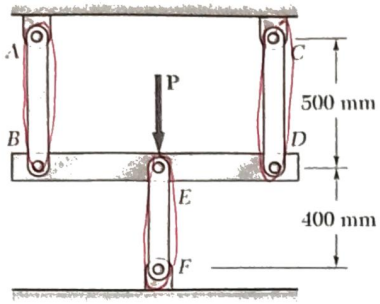
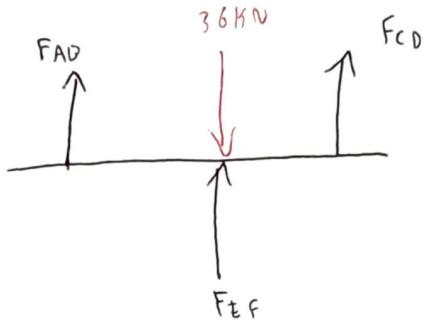
2.41 Three steel rods ($E = 200$ GPa) support a 36-kN load **P**. Each of the rods *AB* and *CD* has a 200-mm^2 cross-sectional area and rod *EF* has a 625- mm^2 cross-sectional area. Determine the (*a*) the change in length of rod *EF*, (*b*) the stress in each rod.



D. C. L



$F_{EF} = -P$

$$\sigma_{EF} = \frac{F_{EF}}{A} = \frac{36 \times 10^3\ N}{625 \times 10^{-6}\ m^2} = 57.6\ MPa$$

$$\delta_{EF} = \frac{F_{EF} L_{EF}}{A_{EF} E} = \frac{(36 \times 10^3\ N)(0.4\ m)}{(625 \times 10^{-6}\ m^2)(200 \times 10^9)} = 115.2 \times 10^{-6}\ m$$

$\Sigma F_y = 0$

$F_{AD} + F_{CD} - 36\ kN + 36\ kN$

$F_{AD} = -F_{CD}$

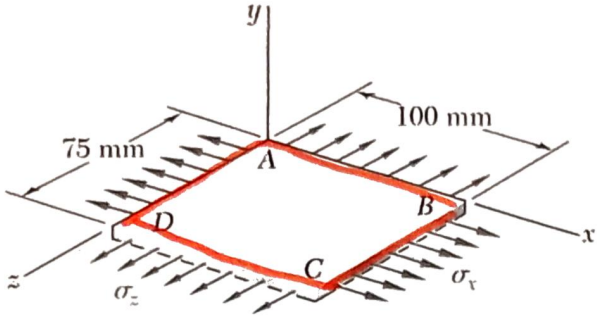
$F_{AD} = F_{CD}$

$\therefore F_{AD} = \frac{36\ kN}{2} = 18\ kN$

$F_{CD} = 18\ kN$

$$\therefore \sigma_{AB} = \sigma_{CD} = \frac{18\ kN}{200 \times 10^{-6}\ m^2} = 90\ MPa$$

2.68 A fabric used in air-inflated structures is subjected to a biaxial loading that results in normal stresses $\sigma_x = 120$ MPa and $\sigma_y = 160$ MPa. Knowing that the properties of the fabric can be approximated as $E = 87$ GPa and $\nu = 0.34$, determine the change in length of (*a*) side *AB*, (*b*) side *BC*, (*c*) diagonal *AC*.



$\sigma_x = 120\ MPa$

$\sigma_y = 160\ MPa$ $\quad E = 87\ GPa$

$\nu = 0.34$

$\delta_x = \varepsilon_x L_{ox} = \delta_{AB}$

$\delta_z = \varepsilon_z L_{oz} = \delta_{BC}$

$$\frac{\varepsilon_y}{\varepsilon_x} = \frac{\varepsilon_z}{\varepsilon_x}$$

$\therefore \varepsilon_y = \varepsilon_z$

$$\varepsilon_x = \frac{\sigma_x}{E} = \frac{1}{E}\left[\sigma_x - \nu(\sigma_y + \sigma_z)\right] = \frac{1}{87\times10^9}\left[120\times10^6 - 0.34\,(160\times10^6)\right]$$

$$\therefore \boxed{\varepsilon_x = 754\times10^{-6}}$$

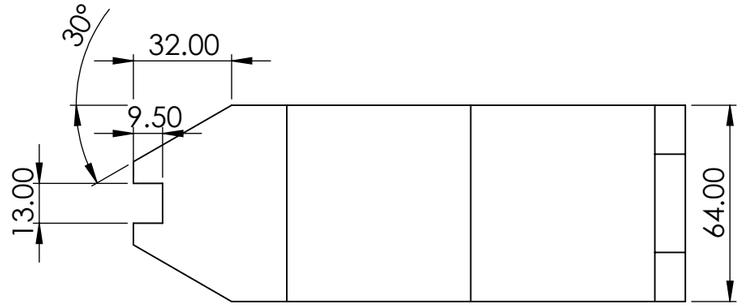
$$\varepsilon_y = \frac{1}{E}\left[\sigma_y - \nu(\sigma_x + \sigma_z)\right] = \frac{1}{87\times10^9}\left[160\times10^6 - 0.31\,(120\times10^6)\right]$$

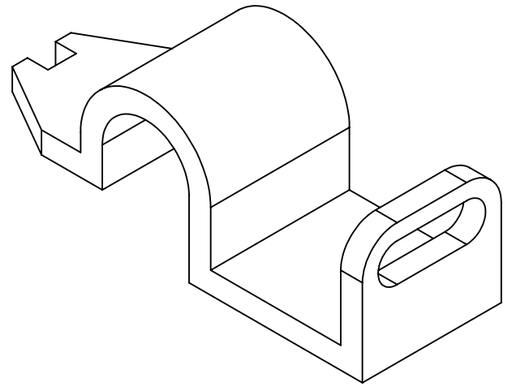
$$\therefore \boxed{\varepsilon_y = 1370\times10^{-6}}$$

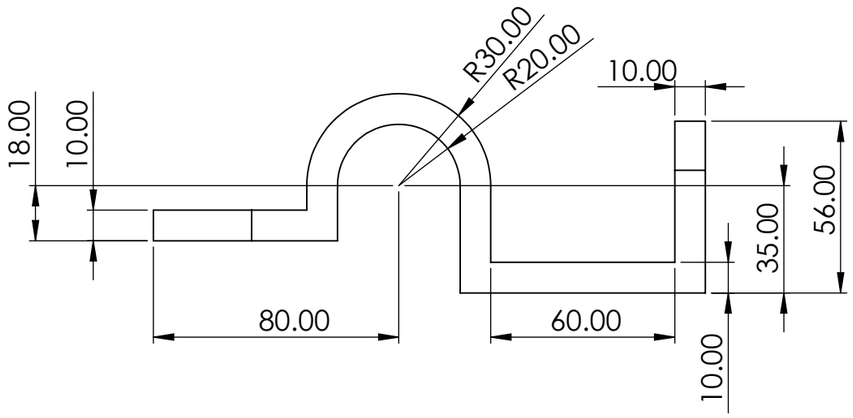
$\delta_{AB} = \varepsilon_x (0.1) = 75.4\times10^{-6}$ m

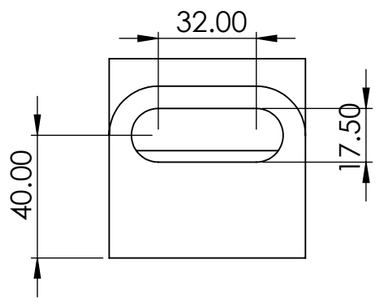
$\delta_{BC} = \varepsilon_y (0.075) = 102.8\times10^{-6}$ m

$$\delta_{AC} = \sqrt{(75.4\times10^{-6})^2 + (102.8\times10^{-6})^2} = \boxed{127.5\times10^{-6}\ m}$$

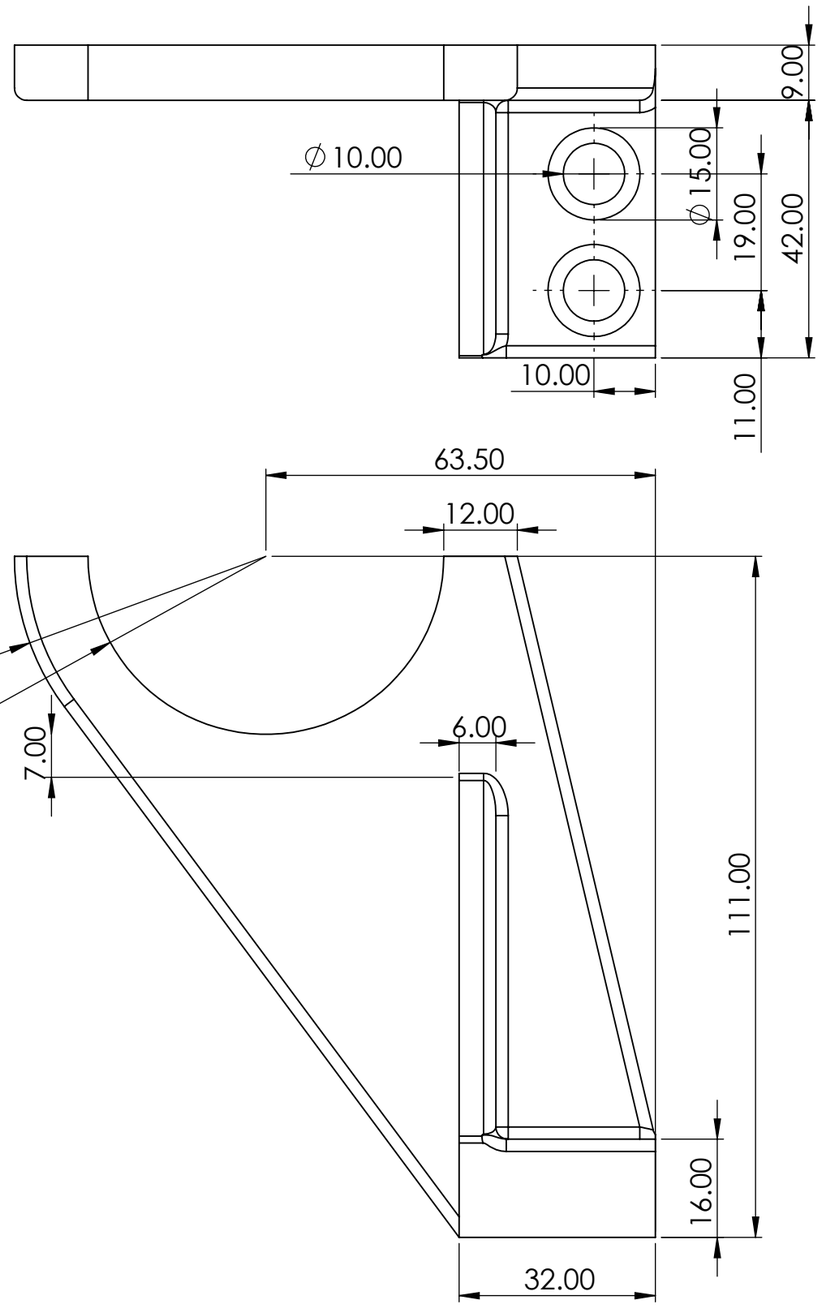


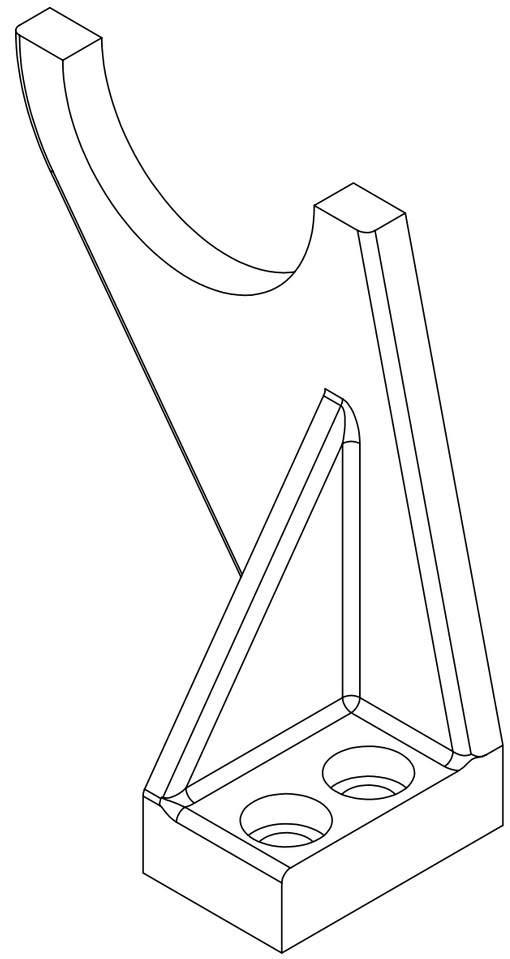


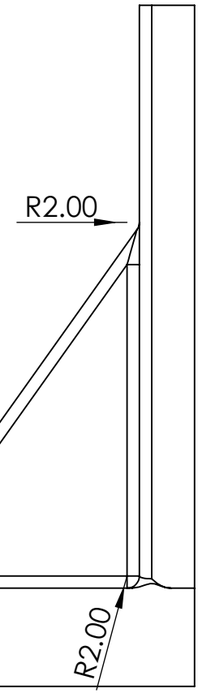




SI NO SE INDICA LO CONTRARIO: LAS COTAS SE EXPRESAN EN MM ACABADO SUPERFICIAL: TOLERANCIAS: LINEAL: ANGULAR:		ACABADO:			REBARBAR Y ROMPER ARISTAS VIVAS	1:2	REVISIÓN
	NOMBRE	FIRMA	FECHA			TÍTULO:	
DIBUJ.	Diego Joel Zuñiga Fragoso						
VERIF.							
APROB.							
FABR.							
CALID.				MATERIAL:		N.º DE DIBUJO ZFDJ_Ejercicio12	A3
				PESO:		ESCALA:1:2	HOJA 1 DE 1







SI NO SE INDICA LO CONTRARIO: LAS COTAS SE EXPRESAN EN MM ACABADO SUPERFICIAL: TOLERANCIAS: LINEAL: ANGULAR:		ACABADO:		REBARBAR Y ROMPER ARISTAS VIVAS		1:1	REVISIÓN
	NOMBRE	FIRMA	FECHA				TÍTULO:
DIBUJ.	Diego Joel Zuñiga Fragoso						
VERIF.							
APROB.							
FABR.							
CALID.				MATERIAL:		N.º DE DIBUJO ZFDJ_Ejercicio13	A3
				PESO:		ESCALA:1:1	HOJA 1 DE 1