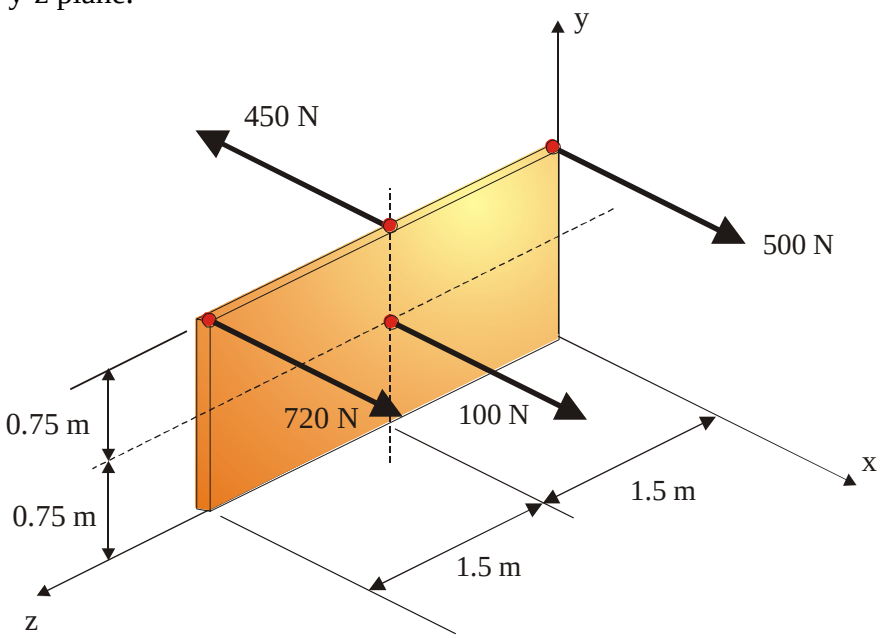
PLEASE INCLUDE THIS PAGE WITH YOUR SUBMISSION

NAME:_____Student #_____ GROUP:_____

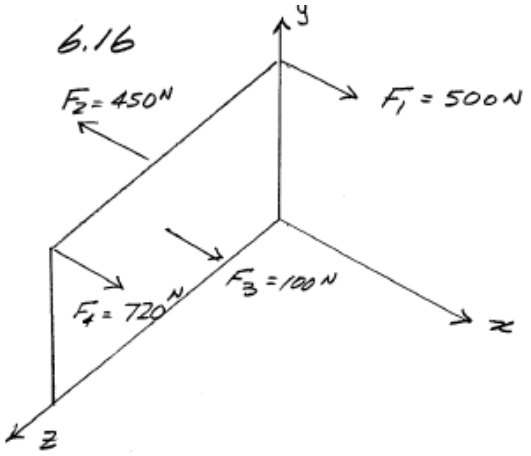
ENG 1440 Lab # 11

1) Determine the resultant, **R**, of the parallel force system acting on the rectangular plate shown below and determine the intersection of the line of action of **R** with the y-z plane.



Force	Position vector	Force vector	Moment vector $\mathbf{M_o}$
$\mathbf{F_1}$			
$\mathbf{F_2}$			
$\mathbf{F_3}$			
$\mathbf{F_4}$			
R			

6.16



6.17

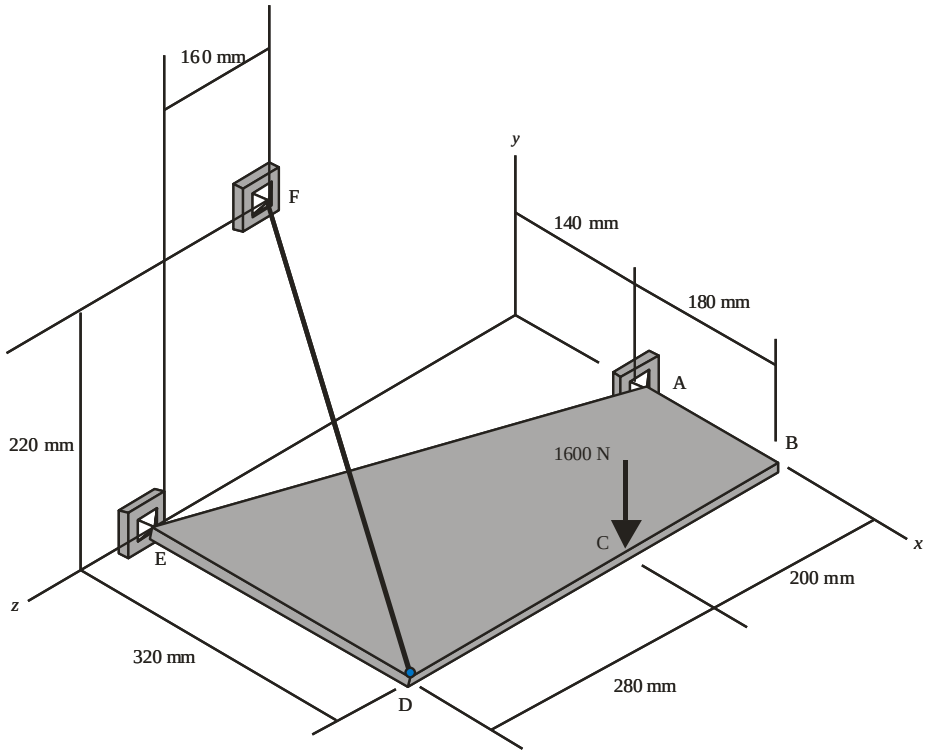
Force	Position	Force	$\vec{M}_o$
F_1	$1.5\hat{j} + 0\hat{k}$	$500\hat{i}$	$-750\hat{k}$
F_2	$1.5\hat{j} + 1.5\hat{k}$	$-450\hat{i}$	$675\hat{k} - 675\hat{j}$
F_3	$0.75\hat{j} + 1.5\hat{k}$	$100\hat{i}$	$-75\hat{k} + 150\hat{j}$
F_4	$1.5\hat{j} + 3.0\hat{k}$	$720\hat{i}$	$-1080\hat{k} + 2160\hat{j}$
		$\vec{R} = 870\hat{i}$	$\vec{M}_o = -1230\hat{k} + 1635\hat{j}$

$$(y\hat{j} + z\hat{k}) \times 870\hat{i} = -1230\hat{k} + 1635\hat{j}$$

$-870y = -1230$ $\quad y = 1.414\ m$ ◀

$870z = 1635$ $\quad z = 1.879\ m$ ◀

2) A flat plate is supported by ball-and-socket joints at A and E and by a cable DF. A 1600 N load is applied at point C. Neglecting the weight of the plate, determine the tension in the cable.

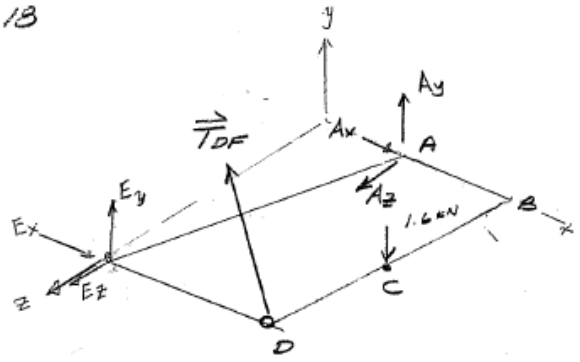


$\sum M_{EA} = 0$ (moment about line EA =0 since A and E are pins)

$M_{EA} = \boldsymbol{\lambda}_{EA} \bullet \mathbf{M}_E = M_{EA} = \boldsymbol{\lambda}_{EA} \bullet (\mathbf{r}_{BD} \times \mathbf{T}_{DF} + \mathbf{r}_{BC} \times \mathbf{W})$

$= \boldsymbol{\lambda}_{BA} \bullet (\mathbf{r}_{BD} \times \mathbf{T}_{DF}) + \boldsymbol{\lambda}_{BA} \bullet (\mathbf{r}_{BC} \times \mathbf{W})$

6.18



A : (0.14, 0, 0)
B : (0.32, 0, 0)
C : (0.32, 0, 0.2)
D : (0.32, 0, 0.48)
E : (0, 0, 0.48)
F : (0, 0.22, 0.32)

$\Sigma M_{EA} = 0$ Moment about line EA = 0 (A & E are pins)

$$M_{EA} = \vec{\lambda}_{EA} \cdot (\vec{r}_{ED} \times \vec{T}_{DF}) + \vec{\lambda}_{EA} \cdot (\vec{r}_{EC} \times -1.6\hat{j})$$

$$\vec{\lambda}_{EA} = \frac{\vec{EA}}{EA} \qquad \vec{EA} = 0.14\hat{i} + 0\hat{j} - 0.48\hat{k}$$

$$EA = \sqrt{(0.14)^2 + (-0.48)^2} = 0.5$$

$$\vec{\lambda}_{EA} = \frac{0.14}{0.5}\hat{i} - \frac{0.48}{0.5}\hat{k}$$

$$\vec{T}_{DF} = T_{DF}\vec{\lambda}_{DF}$$

$$\vec{\lambda}_{DF} = \frac{\vec{DF}}{DF} \qquad \vec{DF} = -0.32\hat{i} + 0.22\hat{j} - 0.16\hat{k}$$

$$DF = \sqrt{(-0.32)^2 + (0.22)^2 + (-0.16)^2} = 0.42$$

$$\vec{T}_{DF} = T_{DF}\left(\frac{-0.32\hat{i} + 0.22\hat{j} - 0.16\hat{k}}{0.42}\right)$$

$$= -\frac{0.32}{0.42}T_{DF}\hat{i} + \frac{0.22}{0.42}T_{DF}\hat{j} - \frac{0.16}{0.42}T_{DF}\hat{k}$$

$$\vec{r}_{ED} = 0.32\hat{i}$$

$$\vec{r}_{EC} = 0.32\hat{i} + 0\hat{j} - 0.28\hat{k}$$

$$M_{BA} = \frac{T_{OF}}{0.42}\begin{vmatrix} \frac{0.14}{0.5} & 0 & -\frac{0.48}{0.5} & \frac{0.14}{0.5} & 0 \\ 0.32 & 0 & 0 & 0.32 & 0 \\ -0.32 & 0.22 & -0.16 & -0.32 & 0.22 \end{vmatrix}$$

$$+ \begin{vmatrix} \frac{0.14}{0.5} & 0 & -\frac{0.48}{0.5} & \frac{0.14}{0.5} & 0 \\ 0.32 & 0 & -0.28 & 0.32 & 0 \\ 0 & -1.6 & 0 & 0 & -1.6 \end{vmatrix}$$

$$= \frac{T_{OF}}{0.42}\left\{[-0.098304] - [0]\right\}$$

$$+ [0.49152] - [0.12544]$$

$$0.234057\, T_{OF} = 0.36608$$

$$T_{OF} = 1.564 \text{ kN}$$