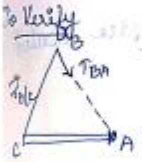
* Moment of force exerted at B about C

Moment is opposite to the moment of force exerted at A.

$$\vec{M_C} = -750j + 375k$$

To Verify

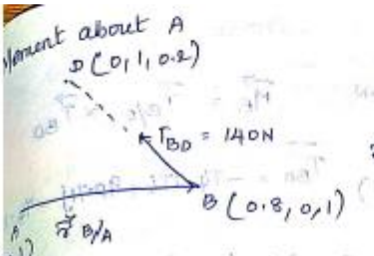


$$\lambda_{BA} = \frac{(6-0)i+(0-1)j+(0+2)k}{\sqrt{6^2+1^2+2^2}}$$

$$= \frac{6i-j+2k}{6.40}$$

$$\therefore \vec{T_{BA}} = T_{BA} \cdot \lambda_{BA}$$

Moment about A



$\vec{M}_A = \vec{r}_{B/A} \times \vec{T}_{BD}$

$\vec{r}_{B/A} = (0.8-0)i + (0-0)j + (1-1)k$

$= 0.8i$

$\vec{T}_{BD} = T_{BD} \cdot \lambda_{BD}$

$$= 140\left[\frac{(0-0.8)i + (1-0)j + (0.2-1)k}{\sqrt{(-0.8)^2 + 1^2 + (-0.8)^2}}\right]$$

$$= \frac{140}{1.51}\left[-0.8i + j - 0.8k\right]$$

$$= -74.17i + 92.71j - 74.17k.$$

$\therefore \vec{M}_A = \vec{r}_{B/A} \times \vec{T}_{BD}$

$$= (0.8i) \times (-74.17i + 92.71j - 74.17k)$$

$$= \begin{vmatrix} i & j & k \\ 0.8 & 0 & 0 \\ -74.17 & 92.71 & -74.17 \end{vmatrix}$$

$$= i(0-0) - j(-59.34-0) + k(74.17-0)$$

$$= 59.34j + 74.17k$$

$$= 400\left[\frac{6i - j + 2k}{6.40}\right]$$

$$= 375i - 62.5j + 125k$$

$$\vec{r}_{B/C} = (0-0)i + (1-0)j + (-2-0)k$$

$$= 1j + 2k$$

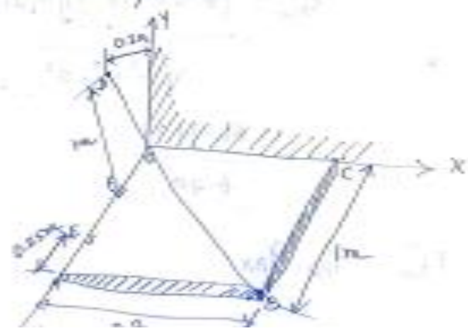
$$\vec{M}_C = \vec{r}_{B/C} \times \vec{T}_{BA}$$

$$= (1j - 2k) \times (375i - 62.5j + 125k)$$

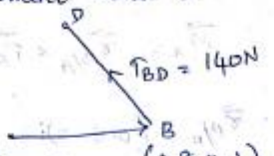
$$= \begin{vmatrix} i & j & k \\ 0 & 1 & -2 \\ 375 & -62.5 & 125 \end{vmatrix}$$

$$= -750j - 375k.$$

4. A rectangular plate 1m × 0.8m is supported by two pins & by a wire BD as shown in figure. If the tension in the wire is 120N, determine the moment about A & about E of the force exerted by the wire on point B.



Moment about E



$\vec{M}_E = \vec{r}_{B/E} \times \vec{T}_{BD}$

B (0.8, 0, 1) E (0, 0, 0.75)

$\vec{T}_{BD} = -74.17i + 92.71j - 74.17k$

$$\vec{r}_{B/E} = (0.8-0)i + (0-0)j + (1-0.75)k$$

$$= 0.8i + 0.25k$$

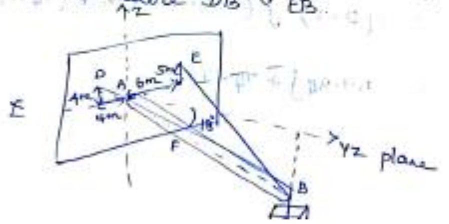
$$\vec{M}_E = \vec{r}_{B/E} \times \vec{T}_{BD}$$

$$= (0.8i + 0.25k) \times (-74.17i + 92.71j - 74.17k)$$

$$= \begin{vmatrix} i & j & k \\ 0.8 & 0 & 0.25 \\ -74.17 & 92.71 & -74.17 \end{vmatrix}$$

$$= -23.18i + 40.8j + 74.17k.$$

5. A Rod AB as shown in figure below is held by a ball and socket joint at A and supports a mass C weighing 1000N at end B. The rod is in xy plane & is inclined at an angle of 18°. The rod is 12m long & has negligible weight. Find the forces in the cable DB & EB.



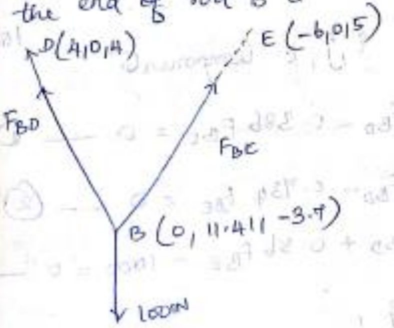
The coordinates of various points are

(0,0,0) ; E (−6, 0, 5) ; D(4, 0, 4) ; B (0, 12 Cos 18°, 12 Sin 18°) ⇒ B (0, 11.41, −3.7)

F_{BD} ⇒ Force on cable BD

F_{BE} ⇒ Force on cable BE

FBD of the end of rod B is



writing the forces in vector Quantities

$$\vec{F_{BD}} = F_{BD} \cdot \lambda_{BD}$$

$$= F_{BD} \cdot \left[\frac{(4-0)i + (0-11.41)j + (4+3.7)k}{\sqrt{4^2 + (-11.41)^2 + (7.7)^2}} \right]$$

$$= F_{BD} \cdot (0.279i - 0.796j + 0.537k)$$

$$\vec{F_{BE}} = F_{BE} \cdot \lambda_{BE}$$

$$= F_{BE} \cdot \left[\frac{(-6-0)i + (0-11.41)j + (5+3.7)k}{\sqrt{6^2 + (-11.41)^2 + (8.7)^2}} \right]$$

$$= F_{BE} \cdot (-0.386i - 0.734j + 0.56k)$$

Supported load = -1000 kN

Joint B is in equilibrium (ie) $\vec{R} = 0$

But $\vec{R} = \vec{F_{BD}} + \vec{F_{BE}} + (-1000)$

$$0 = \left[F_{BD}\left(0.279i - 0.796j + 0.537k\right)\right] + \left[F_{BE}\left(-0.386i - 0.734j + 0.56k\right)\right] - 1000$$

Adding i, j, k Components

$0.279\,F_{BD} - 0.386\,F_{BE} = 0$ — (1)

$-0.796\,F_{BD} - 0.734\,F_{BE} = 0$ — (2)

$0.537\,F_{BD} + 0.56\,F_{BE} - 1000 = 0$ — (3)

Solving,

$F_{BD} = 1063.35N$

$F_{BE} = 768.59N$