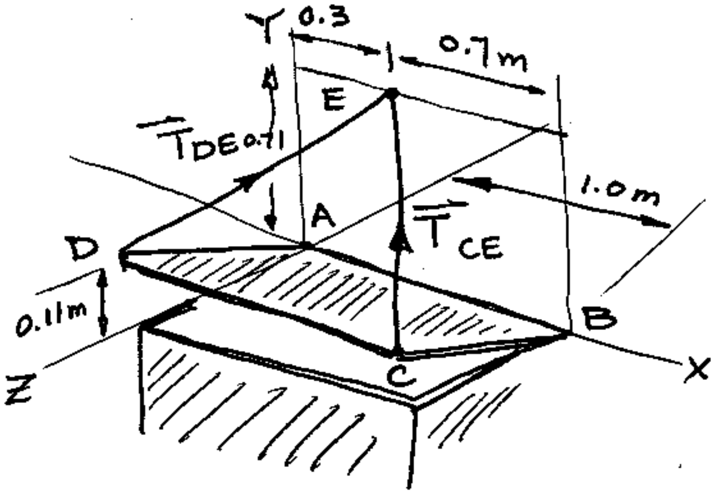
LID ON STORAGE BIN

MECH 234 | HW 3.48
MILANO 3/99 | p. 101

? MOMENTS due to FORCE at CORNER C.



LID = 0.61 × 1.00 m.
AB FIXED ON X-AXIS
$T_{CE} = T_{DE} = 66\ N.$
FORCE EXERTED AT C RUNS ALONG LINE of ACTION THRU PT. C and E.

$M_X, M_Y, M_Z = ?$

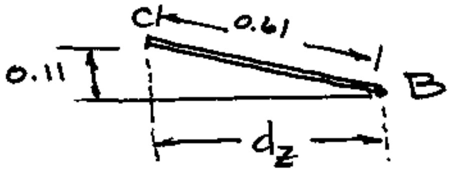
NEED MOMENT ABOUT ORIGIN.

$M_O = M_A$ from pt. C

$$\vec{M}_O = \vec{r} \times \vec{F}$$

$$= \vec{r}_{CA} \times \vec{F}_{CE} \quad \text{and} \quad \vec{r}_{CA} = \text{pt. C} - \text{pt. A}$$

$$= 1.0\hat{i} + 0.11\hat{j} + ?\,\hat{k}$$



$$(0.61)^2 = (0.11)^2 + (d_z)^2$$

$$\therefore d_z = \sqrt{(0.61)^2 - (0.11)^2} = 0.6\text{ m.}$$

$$\therefore \boxed{\vec{r}_{CA} = 1.0\hat{i} + 0.11\hat{j} + 0.6\hat{k}}$$

FORCE IN CORD from C to E = SPACE VECTOR, $\vec{T}_{CE}$

USE POSITION VECTOR, then UNIT VECTOR to get SPACE VECTOR.

$$\vec{CE} = \text{pt. E}\,[0.3\hat{i} + 0.71\hat{j} + 0\hat{k}]$$
$$-\text{pt. C}\,[1.0\hat{i} + 0.11\hat{j} + 0.6\hat{k}]$$
$$= -0.7\hat{i} + 0.6\hat{j} - 0.6\hat{k}$$

$$\therefore |\vec{CE}| = \sqrt{(.7)^2 + (.6)^2 + (.6)^2}$$

mag. $|\vec{CE}| = 1.1$ m.

$$\therefore \vec{T}_{CE} = \left(\frac{-.7}{1.1}\right)66^N\hat{i} + \left(\frac{.6}{1.1}\right)66^N\hat{j} + \left(-\frac{.6}{1.1}\right)66^N\hat{k}$$

$$\boxed{\vec{T}_{CE} = -42\hat{i} + 36\hat{j} - 36\hat{k}}$$

$$M_A = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & .11 & .6 \\ -42 & 36 & -36 \end{vmatrix} = \hat{i}[.11(-36) - .6(36)] - \hat{j}[1(-36) - .6(-42)] + \hat{k}[1(36) - .11(-42)]$$

$$= -25.56\hat{i} - (-10.8\hat{j}) + 40.62\hat{k}$$

$$M_A = -25.56\hat{i} + 10.8\hat{j} + 40.62\hat{k} = 49.19 \sim 49\text{ N-m}$$

TORQUE or TWIST

3.47
3.48

If you solved for the MOMENT about the HINGE, $\overline{AB}$ ∴ MOMENT ABOUT A LINE

USE THE RESULTS from HW. 3.48 and 3.47 for $\vec{M_A}$

$$\vec{M}_{line} = \left(M_{point} \cdot \hat{u}\right)\hat{u}_{line} \qquad \text{need } \hat{u}_{line\ \overline{AB}}$$

since $\overline{AB}$ lies on the X-axis, $\vec{r}_{AB} = 1.0\hat{i}$, $|\vec{r}_{AB}| = 1.0 m.$ $\Big\}\ \hat{u}_{AB} = 1\hat{i}$

due to $\vec{T}_{DE}$, $\vec{M_A} = -31.24\hat{i} + 13.2\hat{j} - 2.42\hat{k}$ N-m.

$$\vec{M}_{line_{AB}} = \left[(-34.24)(1) + 0 + 0\right] 1\hat{i} = \boxed{-34.24\hat{i}}$$

due to $\vec{T}_{CE}$, $\vec{M_A} = -25.56\hat{i} + 10.8\hat{j} + 40.62\hat{k}$ N-m

$$\vec{M}_{line_{AB}} = \left[(-25.56\hat{i})(1\hat{i}) + 0 + 0\right] 1\hat{i} = \boxed{-25.56\hat{i}}$$

$$\Sigma M_{line_{AB}} = \Sigma M_{x\text{-axis}} = -59.8\hat{i} \sim \boxed{-60\hat{i} \text{ N-m}}$$

Think about this!