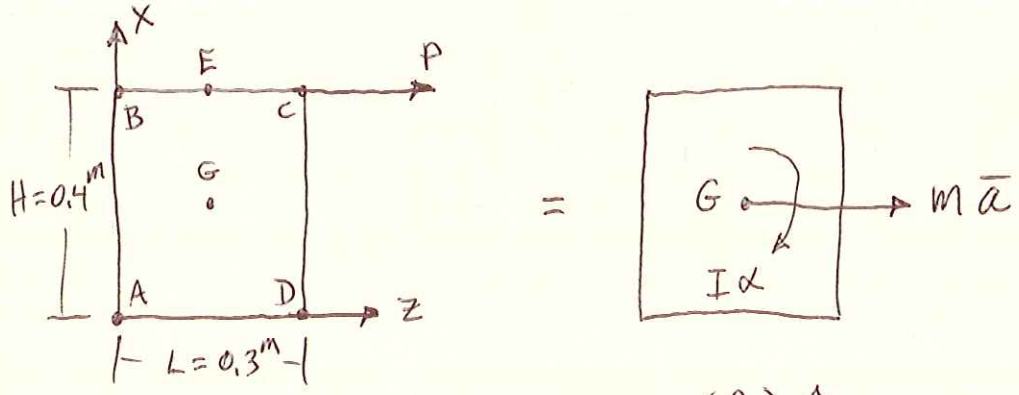
PROB. 16-54

$m = 5^{kg}$, $P = 6^{N}$, FIND a_E, a_B



$\Sigma F_z = ma_z$: $P = m\bar{a}$, $\bar{a} = \left(\frac{P}{m}\right)\hat{k}$

$\Sigma \vec{M}_G = \Sigma (\vec{M}_G)_{EFF}$ $+\circlearrowleft$: $-\left(\frac{H}{2}\right)P = -I\alpha$, $\alpha = \frac{PH}{2I}$

$\vec{\alpha} = \left(-\frac{PH}{2I}\right)\hat{j}$

$I = \frac{1}{12}m(H^2+L^2)$ THIN RECTANGULAR PLATE

$$\alpha = \frac{PH}{2\left[\frac{1}{12}m(H^2+L^2)\right]} = \frac{6PH}{m(H^2+L^2)}$$

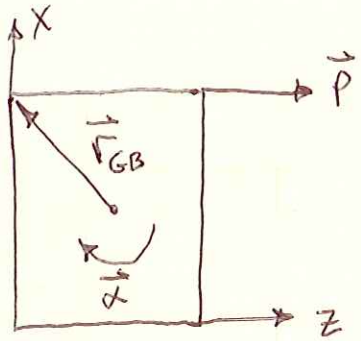
$$a_E = \bar{a} + \frac{H}{2}\cdot\alpha = \left(\frac{P}{m}\right) + \frac{H}{2}\left[\frac{6PH}{m(H^2+L^2)}\right]$$

$$a_E = \left(\frac{P}{m}\right)\left[1 + \frac{3H^2}{(H^2+L^2)}\right] = \left(\frac{P}{m}\right)\left[\frac{3}{\left\{1+\left(\frac{L}{H}\right)^2\right\}} + 1\right]$$

$$a_E = \left(\frac{6^N}{5^{kg}}\right)\left[1 + \frac{3}{\left\{1+\left(\frac{0.3}{0.4}\right)^2\right\}}\right] = \left(3.5\overline{04}\ \frac{m}{s^2}\right)\hat{k}$$

FIND a_B:

PROB. 16-54 CONT.



$$\vec{a}_B = \vec{a} + \vec{\alpha} \times \vec{r}_{GB}$$

$$\vec{a} = \frac{1}{m}\vec{P} = \left(\frac{1}{5\,kg}\right)(6^N)\hat{k} = (1.2)\hat{k}\ \frac{m}{s^2}$$

$$\vec{\alpha} = \left(-\frac{PH}{2I}\right)\hat{j}\ \frac{RAD}{s^2}$$

$$I = \frac{1}{12}(5^{kg})\left[(0.4)^2 + (0.3)^2\ m^2\right] = 0.1042\ kg\cdot m^2$$

$$\vec{\alpha} = \left[-\frac{(6^N)(0.4^m)}{2(0.1042\ kg\cdot m^2)}\right]\hat{j} = (-11.52)\hat{j}\ \frac{RAD}{s^2}$$

$$\vec{r}_{GB} = \left(\frac{H}{2}\right)\hat{i} + \left(-\frac{L}{2}\right)\hat{k} = \left(\frac{0.4^m}{2}\right)\hat{i} + \left(-\frac{0.3^m}{2}\right)\hat{k}$$

$$\vec{r}_{GB} = (0.2)\hat{i} + (-0.15)\hat{k}\ m$$

$$\vec{\alpha} \times \vec{r}_{GB} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -11.52 & 0 \\ 0.2 & 0 & -0.15 \end{vmatrix}$$

$$= \left[(-11.52)(-0.15)\right]\hat{i} + \left[0 - (-11.52)(0.2)\right]\hat{k}\ \frac{m}{s^2}$$

$$= (1.728)\hat{i} + (2.304)\hat{k}\ \frac{m}{s^2}$$

$$\vec{a}_B = (1.2)\hat{k} + (1.728)\hat{i} + (2.304)\hat{k}\ \frac{m}{s^2}$$

$$\boxed{\vec{a}_B = (1.728)\hat{i} + (3.504)\hat{k}\ \frac{m}{s^2}}$$