MCR - ESP 1
23ϕ2

① $\vec{M} = \vec{r}_{AB} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.5 & 0 & 0 \\ 0 & -386.4 & -103.53 \end{vmatrix} = \{51.8\,\hat{j} - 193.2\,\hat{k}\}$ N·m

$\vec{r}_{AB} = \{0.5\,\hat{i}\}$ m

$\vec{F}_B = \{-400\cos 15°\,\hat{j} - 400\,\text{sen}\,15°\,\hat{k}\} = \{-386.4\,\hat{j} - 103.53\,\hat{k}\}$ N

② $\vec{M}_{OA} = \left[\hat{u}_{OA} \cdot (\vec{r}_{AB} \times \vec{F})\right] \hat{u}_{OA} = \begin{vmatrix} 0 & 0.8 & 0.6 \\ -0.3 & 0 & 0 \\ 80 & -40 & -120 \end{vmatrix}$ $\quad \hat{u}_{OA} = \left[-0.8(36) + 0.6(12)\right] \hat{u}_{OA}$

$\hat{u}_{OA} = \dfrac{\vec{r}_{OA}}{|\vec{r}_{OA}|} = \dfrac{\{0.8\,\hat{j} + 0.6\,\hat{k}\}\,m}{\sqrt{0.8^2 + 0.6^2}\,m} = \{0.8\,\hat{j} + 0.6\,\hat{k}\}$

$= -21.6\,\hat{u}_{OA}$

$\vec{r}_{AB} = \{-0.3\,\hat{i}\}$ m

$\therefore \vec{M}_{OA} = \{-17.28\,\hat{j} - 12.96\,\hat{k}\}$ N·m

③ $\vec{F}_R = \Sigma\vec{F} = \vec{F}_D + \vec{F}_B$

$(\vec{M}_R)_O = \Sigma\vec{M}_O + \Sigma\vec{M} = \vec{M}_O^{F_D} + \vec{M}_O^{F_B} = \vec{r}_{OC} \times \vec{F}_D + \vec{r}_{OA} \times \vec{F}_B$

Formando br vetores:

$\vec{F}_B = F_B\,\hat{u}_{AB} = 5\left(\dfrac{\{6\,\hat{j} - 8\,\hat{k}\}\,m}{\sqrt{6^2 + 8^2}\,m}\right) = 5\left(\dfrac{\{6\,\hat{j} - 8\,\hat{k}\}\,m}{10\,m}\right) = \{3\,\hat{j} - 4\,\hat{k}\}$ kN

$F_D = F_D\,\hat{u}_{CD} = 7\left(\dfrac{\{2\,\hat{i} - 3\,\hat{j} - 6\,\hat{k}\}\,m}{\sqrt{2^2 + 3^2 + 6^2}\,m}\right) = 7\left(\left\{\frac{2}{7}\,\hat{i} - \frac{3}{7}\,\hat{j} - \frac{6}{7}\,\hat{k}\right\}\right) = \{2\,\hat{i} - 3\,\hat{j} - 6\,\hat{k}\}$ kN

$\vec{r}_{OC} = \{6\,\hat{k}\}$ m $\quad \vec{r}_{OA} = \{8\,\hat{k}\}$ m

$\vec{M}_O^{F_D} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 6 \\ 2 & -3 & -6 \end{vmatrix} = \{18\,\hat{i} + 12\,\hat{j}\}$ kN·m

$\vec{M}_O^{F_B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 8 \\ 0 & 3 & -4 \end{vmatrix} = \{-24\,\hat{i}\}$ kN·m

$\therefore \vec{F}_R = \{2\,\hat{i} - 10\,\hat{k}\}$ kN ✓

$(\vec{M}_R)_O = \{-6\,\hat{i} + 12\,\hat{j}\}$ kN·m ✓

AC | A-11a → $\vec{F}_R = \{-210\,\hat{k}\}$ N

$(\vec{M}_R)_O = \{-15\,\hat{i} + 225\,\hat{j}\}$ N·m

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