Moment of a Force about a Line

\[ M^\vec{r}_\text{line} = (M^\vec{r}_\text{pt.} \cdot \lambda_\text{line}) \lambda_\text{line} = \left([\vec{F} \times \vec{F}'] \cdot \lambda\right) \lambda \]

where \( \lambda \) = unit vector in the direction of the line

**Method**

\[ \vec{F} = \hat{x} \]

\[ \vec{A} \]

\[ \vec{B} = (4,0,2) \]

\[ \vec{D} = (4,1,2) \]

\[ \vec{C} = (0,3,-4) \]

Determine the moment of the 8\textsuperscript{th} force about line \( \overline{CD} \).

To find \( M^\vec{r}_\text{line} \overline{CD} \), you need the moment with respect to any point on the line, such as pt. \( C \) or pt. \( D \).

Using pt. \( C \) as the "pivot", \( M^\vec{r}_C = \overline{FC}_A \times \overline{FA} \)

-moment arm or radial distance:

\[ \overline{FC}_A = \text{distance from pt. } C \text{ to pt. } A = (pt. A) - (pt. C) \]

and pt. \( A = (0, 0, 5) \), \[ \vec{C}_1 = (0, 0, 5) \]

\[ \vec{A}_1 = (0, 0, 5 \text{E}) \]

\[ \text{Start pt. } C, \quad \text{End pt. } A \]

\[ \overline{FC}_A = 3 \hat{j} + 9 \text{E} \]

Now determine the "position" of the Force along its "Line of Action" from A to B.

and pt. \( B = (-4\hat{i} + 0\hat{j} + 2 \text{E}) \)

- start pt. \( A \), \[ \overrightarrow{AB} = -4\hat{i} - 6\hat{j} - 3 \text{E} \]

\[ \overrightarrow{AB} = \sqrt{(-4)^2 + (-6)^2 + (-3)^2} = 7.81 \]

- Position Vector, \( \vec{r}_{AB} = \frac{-4}{7.81} \hat{i} - \frac{6}{7.81} \hat{j} - \frac{3}{7.81} \text{E} \)

\[ = -0.512 \hat{i} - 0.768 \hat{j} - 0.384 \text{E} \]