Analysis of a Two-Dimensional Body with a Two-Force Member

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The structure shown is pin supported at points A and E. Members ABCD and DE are connected by an internal hinge at point D. For the loading shown, find the reaction forces at the pin supports at points A and E. The weight of the members is negligible.
FBD of Entire Structure

4 Unknowns
3 Equations of Equilibrium
FBDs of ABCD and DE

Equal and opposite forces at D

DE is a two-force member

6 Unknowns
6 Equations of Equilibrium

8 kN

3 m

1 m

1 m

3 m

3 m

6 kN

1 m

1 m

4 m
FBDs of ABCD and DE recognizing that DE is a two-force member

Equal and opposite forces at D

F_D\text{DE}
FBD of ABCD

3 Unknowns
3 Equations of Equilibrium

\[ F_{DE} \cos \theta = F_{DE} \left( \frac{4}{5} \right) \]

\[ F_{DE} \sin \theta = F_{DE} \left( \frac{3}{5} \right) \]
Equilibrium of ABCD

\[ F_{CD} \left( \frac{4}{5} \right) \quad + \sum M_A = 0 \]

\[ F_{CD} \left( \frac{3}{5} \right) \]

\[ F_{CD} = -3 \text{ kN} \]
Equilibrium of ABCD

\[ A_y = -7.8 \, \text{kN} \]
Equilibrium of ABCD

\[ F_6 = 0 \]

\[ A_x = -5.6 \text{ kN} \]

\[ \sum F_x = 0 \]
Show results on a FBDs of ABCD and DE

No need for + or – signs!
Results in terms of components

Each piece is in equilibrium

- A: 5.6 kN
- B: 6 kN
- C: 1.8 kN
- D: 2.4 kN
- E: 2.4 kN

3 m, 4 m
FBD of Entire Structure

Entire Structure is in equilibrium