Mechanics of Solids

Redundant -
One redundant

When it is removed the structure must remain stable and determinate

4 unknowns > 3 equations of equilibrium

Indeterminate to the 1st degree

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\[ \begin{align*}
- \delta & \leq F_x = 0 \quad \delta \leq F_y = 0 \\
A_x & = 0 \\
A_y - WL + B_y & = 0 \\
A_y & = WL - B_y \\
D & = M_A = 0 \\
M_A - WL \frac{L}{2} + B_y L & = 0 \\
M_A & = \frac{WL^2}{2} - B_y L
\end{align*} \]
Statically Indeterminate Beam

\[ D = M_{cut} = 0 \]

\[ M_{AB} + w \cdot x \cdot \frac{x}{2} + M_A - A_y \cdot x = 0 \]

\[ M_{AB} = A_y \cdot x - \frac{w}{2} \cdot x^2 = M_A \]

\[ EI \frac{d^2 y}{dx^2} = A_y \cdot x - \frac{w}{2} \cdot x^2 - M_A \]

\[ EI \frac{dy}{dx} = \frac{A_y}{2} \cdot x^2 - \frac{w}{6} \cdot x^3 - M_A \cdot x + C_1 \]

\[ EI \cdot y = \frac{A_y}{6} \cdot x^3 - \frac{w}{24} \cdot x^4 - \frac{M_A}{2} \cdot x^2 + C_1 \cdot x + C_2 \]

\[ @ \; x=0, \; \frac{dy}{dx} = 0 \]

\[ @ \; x=0, \; y = 0 \]

\[ \therefore \; C_1 = 0 \]

\[ \therefore \; C_2 = 0 \]
\[ \begin{align*}
@ \ x = L, \ y = 0 \\
0 &= \frac{Ay}{L^3} - \frac{W}{24} L - \frac{MA}{2} L^2 \\
0 &= \frac{W L - By}{L^3} - \frac{W}{24} L - \left( \frac{W L^2}{2} - By L \right) \frac{L^2}{2} \\
By &= \frac{3WL}{8} \\
Ay &= WL - By = \frac{3WL}{8} \\
Ay &= \frac{5}{8} WL
\end{align*} \]
Statically Indeterminate Beam

\[ \frac{5}{6} x L - \frac{5}{6} L = \frac{5}{6} L \]

\[ \frac{1}{2} w L + L = x = \frac{5}{6} L \]

\[ M_{\text{max}} \]

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