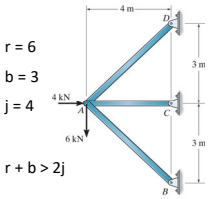
Chapter 9

Analysis of statically indeterminate **trusses** by the force method



r = 6

b = 3

j = 4

r + b > 2j

indeterminate

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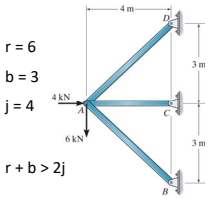
Objectives:

- To show how to apply the force or flexibility method to analyze statically indeterminate ***trusses***.



r = 6

b = 3

j = 4

r + b > 2j

indeterminate

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Statically indeterminate trusses

- The force method can also be used to analyze a ***truss*** that is statically indeterminate to the first or second degree.
- The following examples illustrate application of this method using the procedure for analysis outlined in the textbook.

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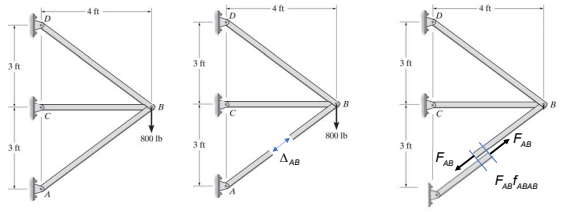
- **Example 9.5** - Consider the following indeterminate truss



- In this case, the redundant is F_{AB} $\quad \Delta_{AB} + F_{AB}f_{ABAB} = 0$

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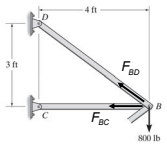
- **Example 9.5** - Let's find the displacement Δ_{AB} using virtual work: ***real forces***



$$+\uparrow \sum F_y = 0 = \tfrac{3}{5}F_{BD} - 800\,lb$$

$$\boxed{F_{BD} = 1{,}333.3\,lb}$$

$$\rightarrow^{+} \sum F_x = 0 = -F_{BC} - \tfrac{4}{5}F_{BD}$$

$$\boxed{F_{BC} = -1{,}066.7\,lb}$$

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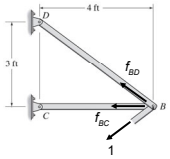
- **Example 9.5** - Let's find the displacement Δ_{AB} using virtual work: ***virtual forces***



$$+\uparrow \sum F_y = 0 = \tfrac{3}{5}f_{BD} - \tfrac{3}{5}(1)$$

$$\boxed{f_{BD} = 1}$$

$$\rightarrow^{+} \sum F_x = 0 = -f_{BC} - \tfrac{4}{5}f_{BD} - \tfrac{4}{5}(1)$$

$$\boxed{f_{BC} = -1.6}$$

$$\Delta_{AB} = \sum \frac{FfL}{AE} = \underbrace{\frac{1(1.333\,k)(5\,ft)}{AE}}_{F_{BD}f_{BD}} + \underbrace{\frac{(-1.6)(-1.067\,k)(4\,ft)}{AE}}_{F_{BC}f_{BC}}$$

$$\boxed{\Delta_{AB} = \frac{13.495\,kft}{AE}}$$

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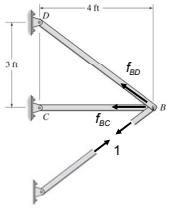
Analysis of statically indeterminate structures by the **force method**

➢ **Example 9.5** - Let's find the f_{ABAB} coefficient using ***virtual work***



$$+\uparrow \sum F_y = 0 = \tfrac{3}{5} f_{BD} - \tfrac{3}{5}(1)$$

$$\boxed{f_{BD} = 1}$$

$$\rightarrow^{+} \sum F_x = 0 = -f_{BC} - \tfrac{4}{5} f_{BD} - \tfrac{4}{5}(1)$$

$$\boxed{f_{BC} = -1.6}$$

$$f_{ABAB} = \sum \frac{ffL}{AE} = \frac{1(1)(5\,ft)}{AE} + \frac{1(1)(5\,ft)}{AE} + \frac{(-1.6)(-1.6)(4\,ft)}{AE}$$

$f_{BD} f_{BD}$ $f_{BA} f_{BA}$ $f_{BC} f_{BC}$

$$\boxed{f_{ABAB} = \frac{20.24\,ft}{AE}}$$

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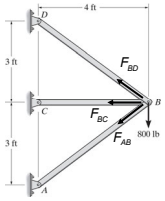
Analysis of statically indeterminate structures by the **force method**

➢ **Example 9.5 –** Compute the force F_{AB} $\quad \Delta_{AB} + F_{AB} f_{ABAB} = 0$



$$\frac{13.495\,kft}{AE} + F_{AB}\left(\frac{20.24\,ft}{AE}\right) = 0$$

$$\boxed{F_{AB} = -0.667\,k}$$

$$+\uparrow \sum F_y = 0 = \tfrac{3}{5} F_{BD} - \tfrac{3}{5} F_{AB} - 0.8\,k$$

$$\boxed{F_{BD} = 0.667\,k}$$

$$\rightarrow^{+} \sum F_x = 0 = -F_{BC} - \tfrac{4}{5} F_{BD} - \tfrac{4}{5} F_{AB}$$

$$\boxed{F_{BC} = 0}$$

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Analysis of statically indeterminate structures by the **force method**

Let's work some problems

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