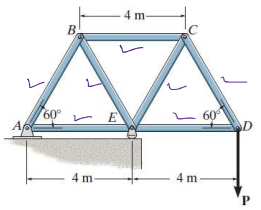
Truss Analysis by method of joints

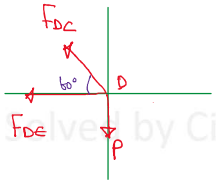
Monday, 7 April, 2025 10:35 AM

**6–17.** If the maximum force that any member can support is 8 kN in tension and 6 kN in compression, determine the maximum force $P$ that can be supported at joint $D$.




Probs. 6–16/17





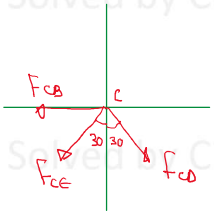

$F_{DC}\sin 60° - P = 0$

$\Rightarrow F_{DC} = \frac{P}{\sin 60°}$ (T)

$-F_{DE} - F_{DC}\cos 60° = 0$

$F_{DE} = -F_{DC}\cos 60° = -\frac{P}{\sin 60°}\cos 60°$

$\Rightarrow F_{DE} = -\frac{P}{\tan 60°}$ (C)




$-F_{CB}\cos 30° - F_{CE}\cos 30° = 0$

$F_{CE} = -F_{CD} = -\frac{P}{\sin 60°}$ (C)

$\left[\because F_{DC} = \frac{P}{\sin 60°}\ (T)\right]$

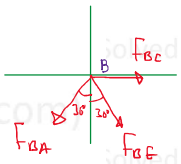
$-F_{CB} - F_{CE}\sin 30° + F_{CD}\sin 30° = 0$

$\Rightarrow F_{CB} = F_{CE}\sin 30° - F_{CD}\sin 30°$

$\Rightarrow F_{CB} = (F_{CE} - F_{CD})\sin 30°$

$\left(-\frac{P}{\sin 60°} - \frac{P}{\sin 60°}\right)\sin 30°$

$\Rightarrow F_{CB} = -2P\,\frac{\sin 30°}{\sin 60°}$




$-F_{BE}\cos 30° - F_{BA}\cos 30° = 0$

$\Rightarrow F_{BE} = -F_{BA}$

$F_{BC} + F_{BE}\sin 30° - F_{BA}\sin 30° = 0$

$F_{BC} + F_{BE}\sin 30° + F_{BE}\sin 30° = 0$

$F_{BC} = -2F_{BE}\sin 30°$

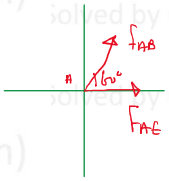
$\Rightarrow F_{BE} = \frac{-F_{BC}}{2\sin 30°} = \frac{2P\sin 30°/\sin 60°}{2\sin 30°}$

$\left[\because F_{CB} = -2P\,\frac{\sin 30°}{\sin 60°}\right]$

$\Rightarrow F_{BE} = \frac{P}{\sin 60°}$ [T]

$\Rightarrow F_{BA} = -\frac{P}{\sin 60°}$ [C]

$\left[\because F_{BE} = -F_{BA}\right]$




$F_{AB}\cos 60° + F_{AE} = 0$

$\Rightarrow F_{AE} = -F_{AB}\cos 60° = \frac{P}{\sin 60°}$ [T]

$\left[\because F_{BA} = -\frac{P}{\sin 60°}\ (C)\right]$

$F_{DC} = \frac{P}{\sin 60^\circ}$ (T) $= 1.1547P$ (T)

$F_{DE} = \frac{-P}{\tan 60^\circ}$ (C) $= 0.577P$ [C]

$F_{CE} = -\frac{P}{\sin 60^\circ}$ (C) $= 1.1547P$ [C]

$F_{CB} = -2P \frac{\sin 30^\circ}{\sin 60^\circ} = 1.1547P$ [C]

$F_{BE} = \frac{P}{\sin 60^\circ}$ [T] $= 1.1547P$ [T]

$F_{BA} = -\frac{P}{\sin 60^\circ}$ [C] $= 1.1547P$ [C]

$F_{AE} = \frac{P}{\sin 60^\circ}$ [T] $= 1.1547P$ [C]

Max internal force $= 1.1547P$

For safety, Max internal force = Minimum Allowed Force = 6 KN [Provided]

$\Rightarrow 1.1547P = 6$ KN

$\Rightarrow P = \frac{6}{1.1547}$ KN $= 5.196$ KN ANS.