**METHOD OF JOINTS**

1. ENTIRE TRUSS IS IN STATE OF EQUILIBRIUM.
2. EACH INDIVIDUAL JOINT IS ITSELF IN A STATE OF EQUILIBRIUM, SUCH THAT THE FORCES ACTING UPON IT ARE EQUAL AND OPPOSITE TO EACH OTHER (N3).
3. GO AROUND TRUSS IDENTIFYING DIRECTION OF FORCES.
4. EQUILIBRIUM ON TRUSS AS A WHOLE.

\[ \sum F_y = 0 \quad : \quad R_A + R_B - 30k = 0. \]

\[ \sum M_A = 0 \quad : \quad 27\cdot3'(R_B) - 10'(30k) = 0. \]

\[ R_B = 11k \]

\[ R_A + 11k - 30k = 0. \]

\[ R_A = 19k \]

**Note:**
- ALL JOINTS PINNED.
- EXTERNAL FORCE ACTS ON JOINT.

**Reaction:**
- HERE
- CAN ONLY BE VERTICAL
- SO REACTION AT B MUST BE ALSO!
5. Establish direction of forces in members. Whole truss acts like a beam; top guy. (true for any top-loaded truss) Bottom tens.

6. Apply cons of equil. to each joint. Usually begin with joint with fewest unknowns. Here, just pick "A".

\[ + \uparrow \equiv F_y = 0 \quad \Rightarrow 19k - F_{AC}\cos 45^\circ = 0 \]
\[ 0.707F_{AC} = 19k \]
\[ F_{AC} = \frac{19k}{0.707} \]
\[ F_{AC} = 26.9k \]

\[ \Rightarrow F_x = 0 \quad \Rightarrow F_{AB} - F_{AC}\sin 45^\circ = 0 \]
\[ \Rightarrow F_{AB} - 26.9k\sin 45^\circ = 0 \]
\[ F_{AB} = 19k \]

26.9k
A

\[ \Rightarrow 45^\circ \]

19k

Note: Could have done by sight due to 45°.
Now only unknown member is $BC$.

At joint $B$,

$-F_Y = 0 \quad \Rightarrow \quad 11k - F_{BC} \sin 30^\circ = 0$

$0.5F_{BC} = 11k$

$F_{BC} = 22k$.

Check the calculation by applying equil at "C".

$+F_Y = 0 \quad \Rightarrow \quad 26.9k (\sin 45^\circ) + 22k (\sin 30^\circ) - 30k = 0$

$19k + 11k - 30k = 0 \quad \checkmark$

$-F_X = 0 \quad \Rightarrow \quad 26.9k (\cos 45^\circ) - 22k (\cos 30^\circ) = 0$

$19k - 19k = 0 \quad \checkmark$
**Method of Sections**

1. Find reactions at supports.

2. Determine directions of member forces.
   - **One of two ways**
     - **2A** — Simply supported beam: C Top, T Bottom
   - Or by analyzing the free-body diagrams of the sub-assemblies of the truss:

   **Note:** Both sub-assemblies of truss must be in equilibrium for stability.

   The internal forces of the 'cut' members (blood & guts) still released to counter P and RA, RB.
Total Moment of External + Internal Forces Must = 0

\[ \text{DE} \]

We can see that for rotational equilibrium, \( F_{DE} \) must be in direction of joint E. 'DE' is in compression.

\[ \text{BD} \]

Consider equilibrium in y-dirn, \( F_{BD} \) must be upward, as component balances net downward force of 0.5P.

'BD' is in tension.

\[ \text{BC} \]

Reaction \( R_C \) generates counterclockwise moment about joint D. Both DE and CD pass through D, so do not resist the moment.

'force in BC is towards 'B'. Tension
BEGIN WITH AN EQUATION WITHONLY ONE UNKNOWN.

LEFT SUBASSEMBLY:

\[ \sum F_y = 0 \implies RA - P + F_{BD} \sin 45^\circ = 0 \]
\[ 0.5P - P + 0.707F_{BD} = 0 \]
\[ F_{BD} = 0.707P \text{ (Tension)} \]

THERE ARE 2 UNKNOWNS FOR \( \sum F_x \) HERE, SO
MOVE ON TO MOMENT EQUILIBRIUM ABOUT A
JOINT WITH ONLY ONE VARIABLE.

\[ \sum M_B = 0 \implies -(dx \cdot 0.5P) + (0.5d \cdot F_{DE}) = 0 \]
\[ F_{DE} = P \text{ (compression)} \]

NOW DO \( \sum F_x = 0 \):

\[ -F_{DE} + F_{BD} \cos 45^\circ + F_{BC} = 0 \]
\[ -P + 0.5P + F_{BC} = 0 \]
\[ F_{BC} = 0.5P \text{ (Tension)} \]
Use same methods for right sub-assembly.

\[ F_{BD} \]
\[ F_{BD} \sin 45^\circ \]
\[ O \]
\[ 0.5d \]
\[ C \]
\[ 0.5p \]

\[ \uparrow \leq F_y = 0 \quad \therefore \quad -F_{BD} \sin 45^\circ + R_C = 0 \]

\[ -0.707F_{BD} + 0.5p = 0 \]

\[ F_{BD} = 0.707p \quad (\uparrow) \quad \text{OK} \]

\[ \leq M_0 = 0 \quad \therefore \quad -F_{DE} - F_{BD} \cos 45^\circ - F_{BC} = 0 \]

\[ -F_{DE} - 0.5p - 0.5p = 0 \]

\[ F_{DE} = p \quad (\uparrow) \quad \text{OK} \]
1. **Overall Equilibrium**

\[ +15F_y = 0 \]

\[ R_{AY} + R_{By} - P = 0 \]

\[ \sum M_A = 0 \]

\[ -P(1.5d) + R_{Cy}(2d) = 0 \]

\[ R_{Cy} = \frac{1.5dP}{2d} = 0.75P \]

\[ R_{AY} = 0.25P \]

2. **Start on Joint with Fewest Unknowns**

   i.e. 'A' or 'C',

**Joint A**

\[ \Rightarrow F_y = 0 \]

\[ 0.25P - F_{AE} \sin 60^\circ = 0 \]

\[ 0.37 + F_{AE} = 0.25P \]

\[ F_{AE} = 0.29P \]

\[ F_{AB} - F_{AE} \cos 60^\circ = 0 \]

\[ F_{AB} = 0.5F_{AE} \]

\[ F_{AC} = 0.5(0.29)P \]

\[ F_{AB} = 0.14P \]
3. Do same at Joint C.

4. **Joint E**

\[
\begin{align*}
\uparrow \sum F_y &= 0 \quad 0.29P \sin 60^\circ - F_{BE} \sin 60^\circ = 0 \\
\sum F_x &= 0 \quad 0.29P - F_{BE} = 0 \\
\hline
F_{BE} &= 0.29P \\
\hline
\end{align*}
\]

\[
\begin{align*}
\sum F_y &= 0 \quad 0.29P \cos 60^\circ + F_{BE} \cos 60^\circ - F_{DE} = 0 \\
\sum F_x &= 0 \quad 0.29P \cos 60^\circ + 0.29P \cos 60^\circ - F_{DE} = 0 \\
F_{DE} &= 2(0.29P \cos 60^\circ) \\
\hline
F_{DE} &= 0.29P \\
\hline
\end{align*}
\]

Etc!!