Frames – Load Applied at a Joint

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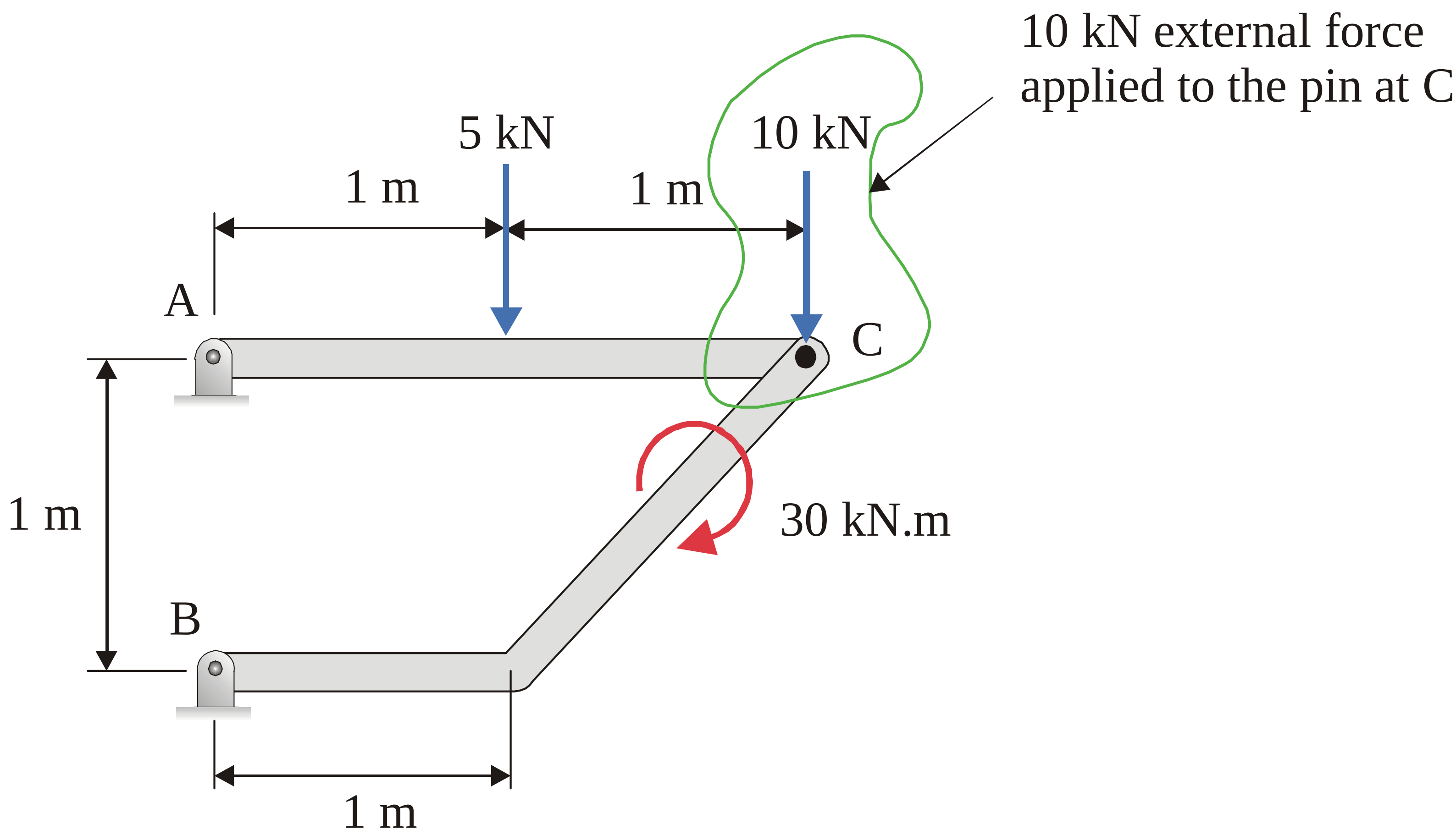
What to Do With the Load applied at a Joint when Sub-structuring?

If a load is applied at a joint where <u>**TWO**</u> members are pinned together, assign it to either one of the members attached at the joint but **NOT BOTH**. This is the same as applying the load to the pin and leaving the pin attached to that member.

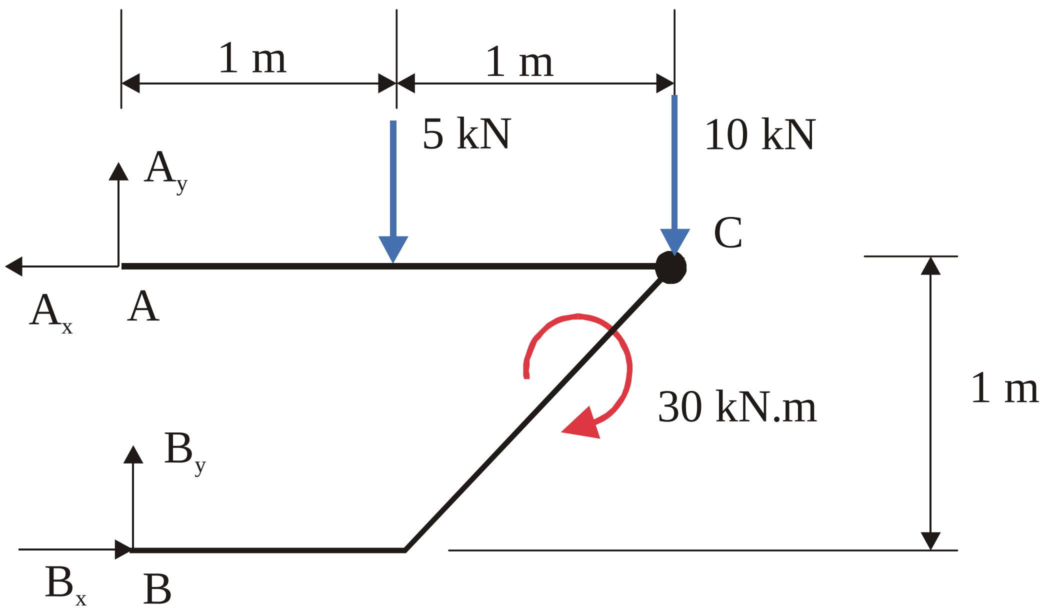
Alternately, you could draw a **SEPARATE** Free Body Diagram of the pin and apply the load to the pin along with the member reactions applied to the pin.

If there are <u>**THREE**</u> or more members (could include a pulley) attached at a pin, draw a separate Free Body Diagram of the pin (even if there is no load appiied at the pin).

10 kN load applied at Joint C and 30 kN.m clockwise couple-moment shown applied to member BC



Draw FBD of entire frame and apply equilibrium equations



Free-Body Diagram of Frame ABC

$$\sum M_A = 0 \circlearrowleft$$

$$B_x(1) - 5(1) - 10(2) - 30 = 0$$

$$B_x = +55 \text{ kN} \qquad \therefore\ \mathbf{B_x} = 55 \text{ kN} \rightarrow$$

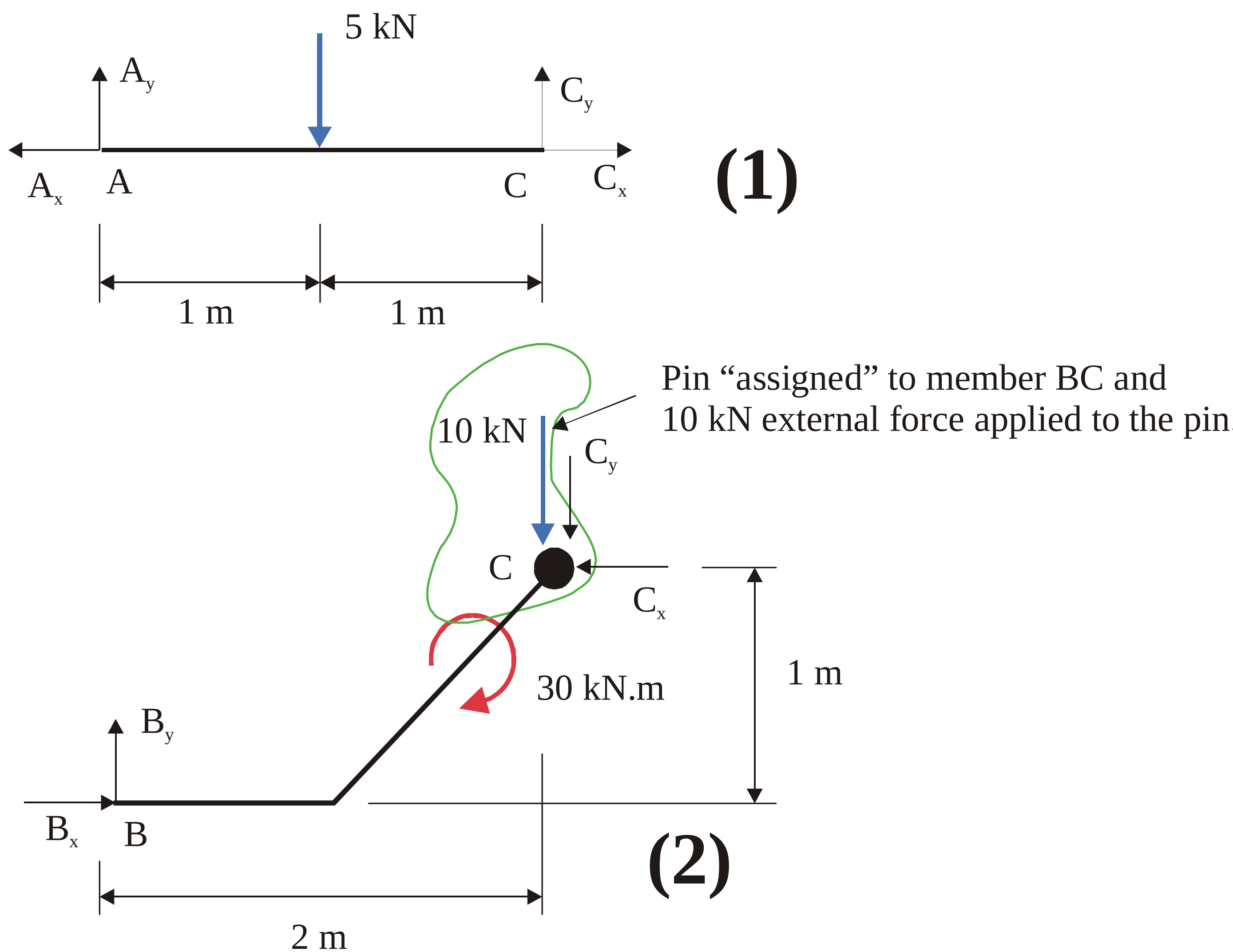
$$\sum F_x = 0 \rightarrow$$

$$-A_x + 55 = 0 \qquad A_x = +55 \text{ kN}$$

(Sense of A_x inFBD assumed correctly.)

$$\therefore \mathbf{A_x} = 55 \text{ kN} \leftarrow$$

Substructure an **<u>leave the pin attached to Member BC</u>** and apply the 10 kN to the pin. Leave the 30 kN.m couple-moment on member BC.



From FBD (1):

$$\sum M_A = 0 \circlearrowleft$$

$$-5(1) + C_y(2) = 0$$

$$C_y = +2.5 \text{ kN} \qquad \therefore\ \mathbf{C_y} = 2.5 \text{ kN} \uparrow \text{ on AC}$$

$$\sum F_x = 0 \rightarrow$$

$$-55 + C_x = 0 \qquad C_x = +55 \text{ kN}$$

$$\therefore \mathbf{C_x} = 55 \text{ kN} \rightarrow \text{on AC}$$

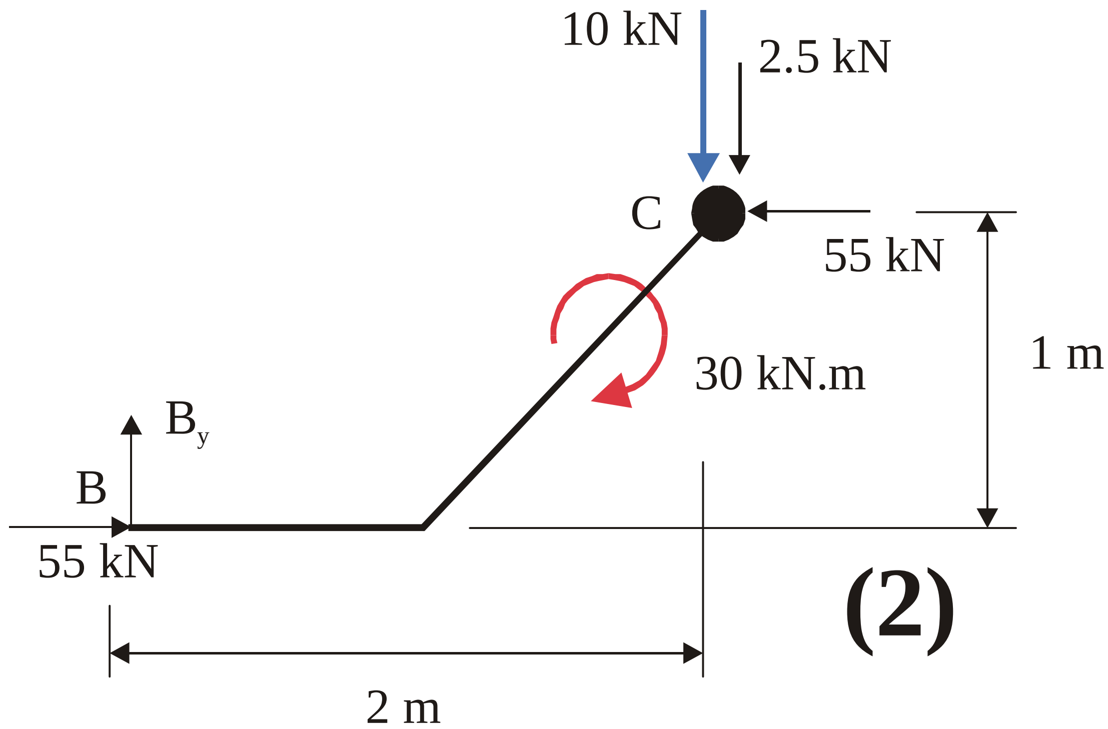
$$\sum F_y = 0 \uparrow$$

$$A_y - 5 + 2.5 = 0 \qquad A_y = +2.5 \text{ kN}$$

$$\therefore\ \mathbf{A_y} = 2.5 \text{ kN} \uparrow$$

From FBD (2):

(We re-draw FBD of BC now indicating all known forces.)



$$\sum F_y = 0 \uparrow$$

$$B_y - 10 - 2.5 = 0 \qquad B_y = +12.5 \text{ kN}$$

$$\therefore \ \mathbf{B_y} = 12.5 \text{ kN} \uparrow$$