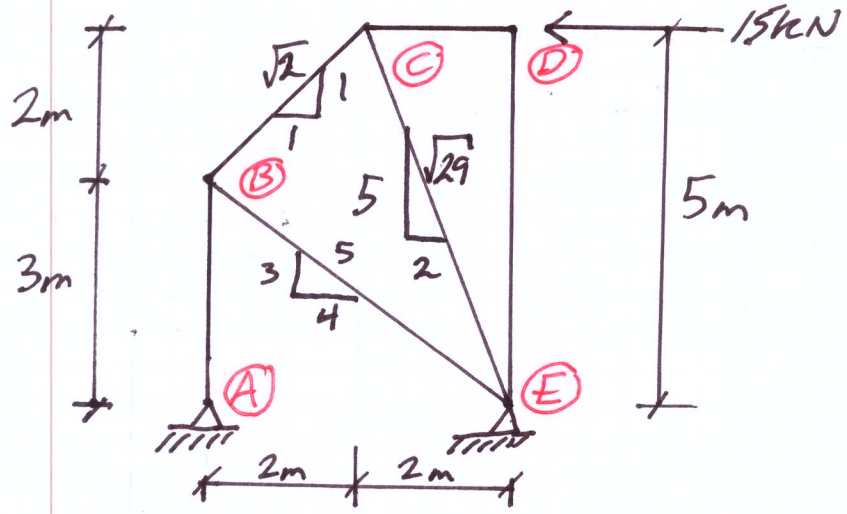
For the truss below:
- Assess determinacy & stability
- Solve for ALL member forces.




**SUPPORTS**
A: Pin
E: Pin

- Stability and determinacy
  - Determinacy $SI = b + r - 2j$

$b = 6$
$r = 4$
$j = 5$

$SI = 6 + 4 - 2(5)$
$SI = 0$

∴ determinate

  - Stability
    - $SI \geq 0$ ✓
    - not all reactions are
      - parallel ✓
      - concurrent ✓
    - do not have internal collapse mechanism ✓

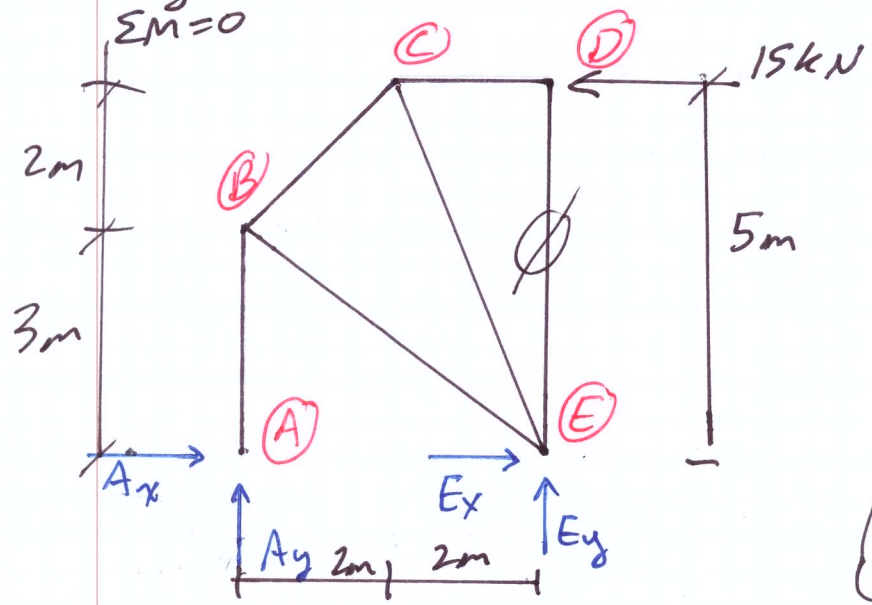
∴ Stable

- Can we find reactions

- 4 reactions
- 3 equations

} we can not solve for reactions now

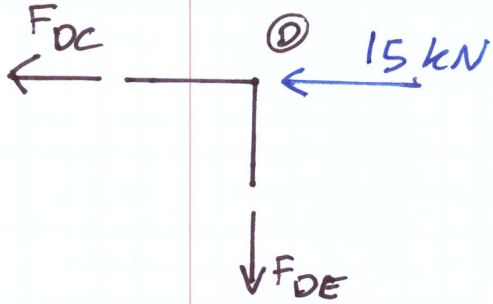
$\Sigma F_x = 0$
$\Sigma F_y = 0$
$\Sigma M = 0$





## Method of Joints

### JOINT D




$\Sigma F_x = 0 \quad -F_{DC} - 15\,kN = 0$

$$F_{DC} = -15\,kN$$

$F_{DC}$ is acting to the right

$F_{DC}$ is in Compression.

$$F_{DC} = 15\,kN \text{ (c)}$$

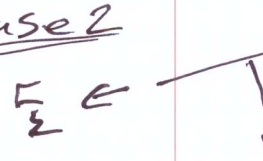
$\Sigma F_y = 0 \quad F_{DE} = 0$

$F_{DE}$ is Zero-force member

**Case 1**

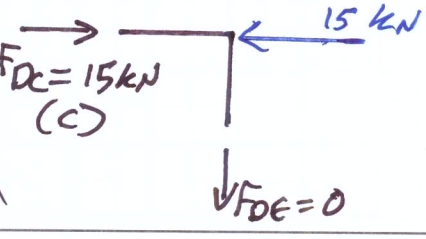

- non-colinear
- no external force or reaction
- Both are zero force

**Case 2**

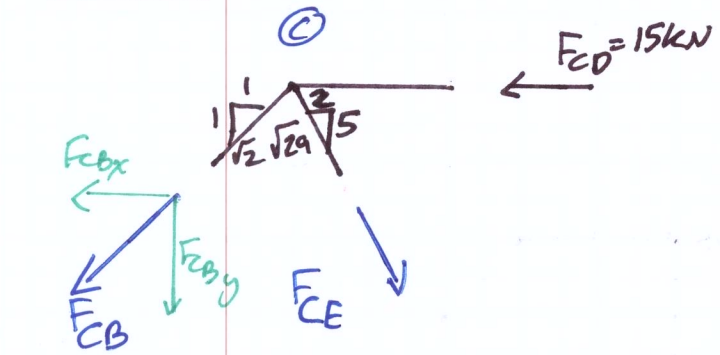



- 3 members
- 2 colinear
- no external loads or reactions

→ non-colinear mem. is Zero-force



## JOINT C



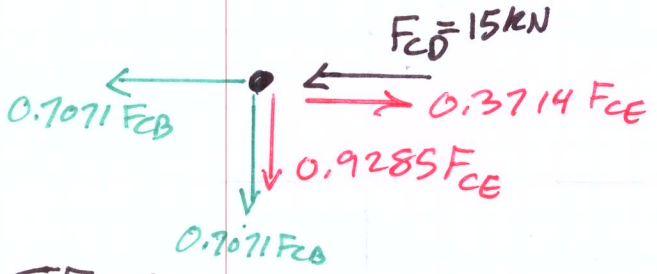

**Components of $F_{CB}$, $F_{CE}$**

$F_{CE}$: $F_{CE_x} = \frac{2}{\sqrt{29}} F_{CE} = 0.3714 F_{CE}$

$F_{CE_y} = \frac{5}{\sqrt{29}} F_{CE} = 0.9285 F_{CE}$

$F_{CB}$: $F_{CB_x} = \frac{F_{CB}}{\sqrt{2}} = 0.7071 F_{CB}$

$F_{CB_y} = \frac{F_{CB}}{\sqrt{2}} = 0.7071 F_{CB}$




$\Sigma F_x = 0$

$\Sigma F_y = 0$

$\Sigma F_x = 0$

$-0.7071 F_{CB} - 15 + 0.3714 F_{CE} = 0$

Eq 1 $\quad F_{CE} = 40.388\ kN + 1.9039 F_{CB}$

$\Sigma F_y = 0$

$-0.7071 F_{CB} - 0.9285 F_{CE} = 0$

Eq 2 $\quad F_{CB} = -1.3131 F_{CE}$

Sub. Eq 2 into Eq 1

$F_{CE} = 40.388 + 1.9039(-1.3131 F_{CE})$

$F_{CE} = +11.539\ kN \quad (T)$

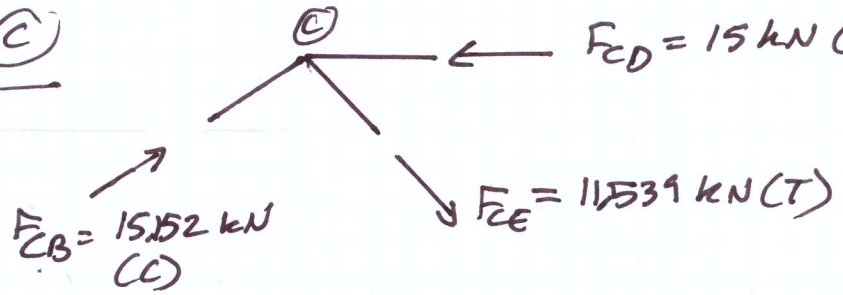
Sub ~~F~~ $F_{CE}$ into Eq 2

$F_{CB} = -1.3131 F_{CE}$

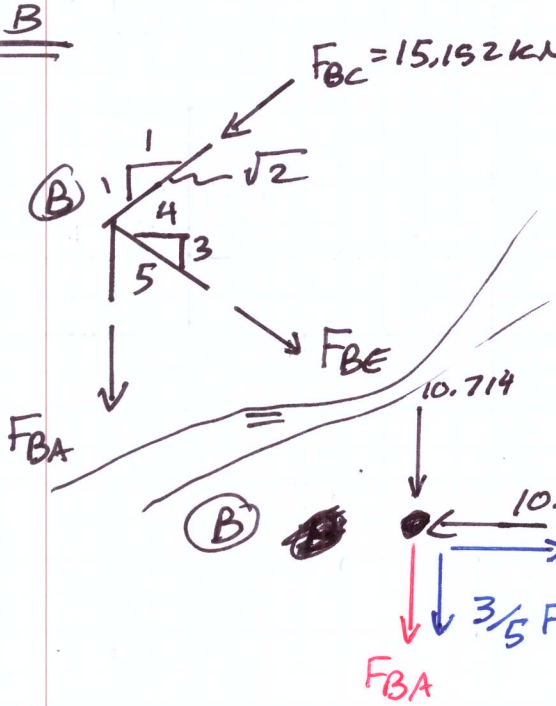
$F_{CB} = (-1.3131)[11.539]$

$F_{CB} = -15.1524\ kN = 15.1524\ kN\ (C)$

Still at (C)




JOINT B




$F_{BE_x} = \frac{4}{5} F_{BE}$

$F_{BE_y} = \frac{3}{5} F_{BE}$

$F_{BC_x} = \frac{F_{BC}}{\sqrt{2}} = 10.714\ kN$

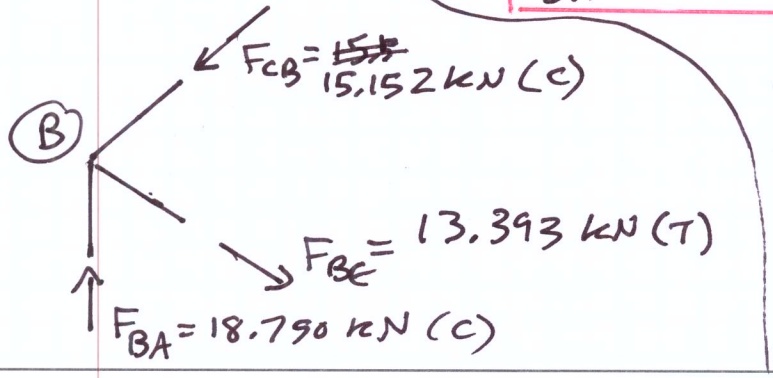
$F_{BC_y} = \frac{F_{BC}}{\sqrt{2}} = 10.714\ kN$

$\Sigma F_x = 0$ $\quad \frac{4}{5} F_{BE} - 10.714 = 0$ $\quad F_{BE} = 13.393\ kN\ (T)$

$\Sigma F_y = 0$ $\quad -10.714 - F_{BA} - \frac{3}{5} F_{BE} = 0$

$-10.714 - F_{BA} - \frac{3}{5}(13.393) = 0$

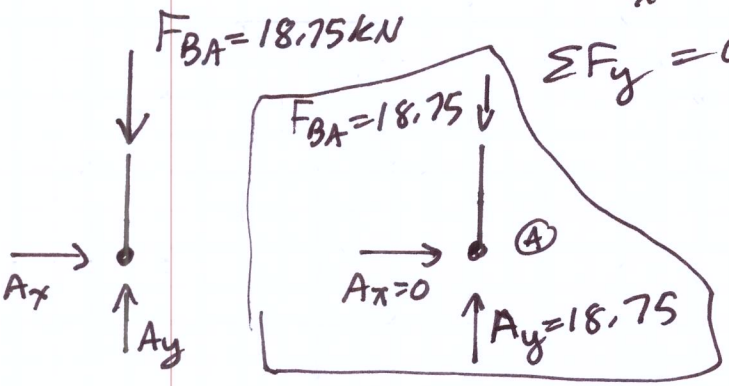
$F_{BA} = -18.750\ kN = 18.750\ kN\ (C)$



## JOINT A

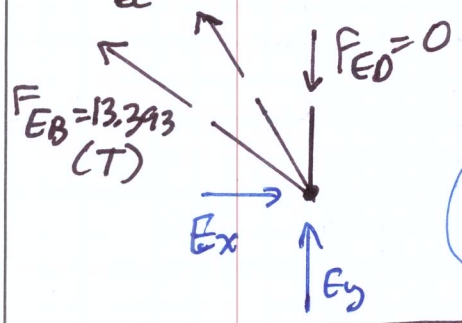
$\Sigma F_x = 0 \rightarrow A_x = 0$

$\Sigma F_y = 0 \rightarrow A_y = 18.75\ kN \uparrow$




FROM JOINT C

## JOINT E



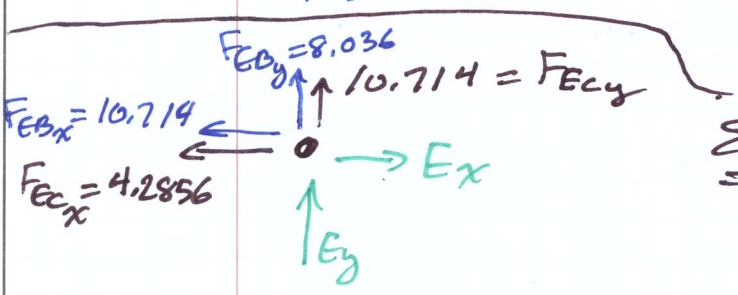

$F_{EC_x} = 0.3714 F_{EC} = 4.2856\ kN$

$F_{EC_y} = 0.9285 F_{EC} = \cancel{10.741}\ 10.714\ kN$

$F_{EB_x} = \frac{4}{5} F_{EB} = 10.714\ kN$

$F_{EB_y} = \frac{3}{5} F_{EB} = 8.036\ kN$

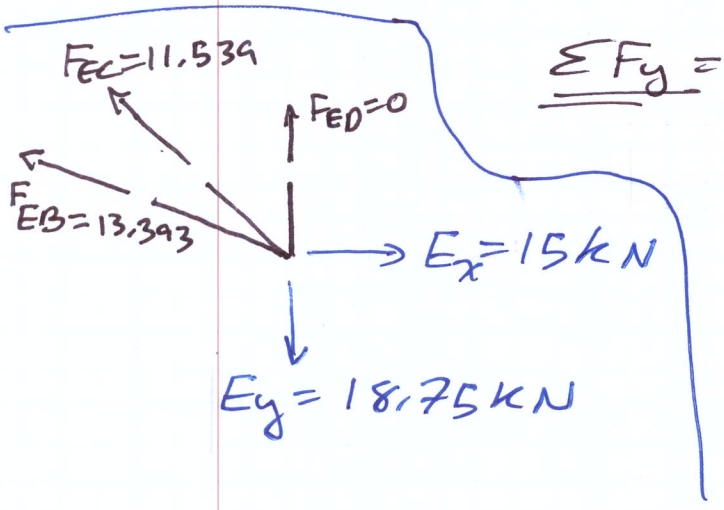
FROM JOINT B




$\Sigma F_x = 0$

$E_x - 4.2856 - 10.714 = 0$

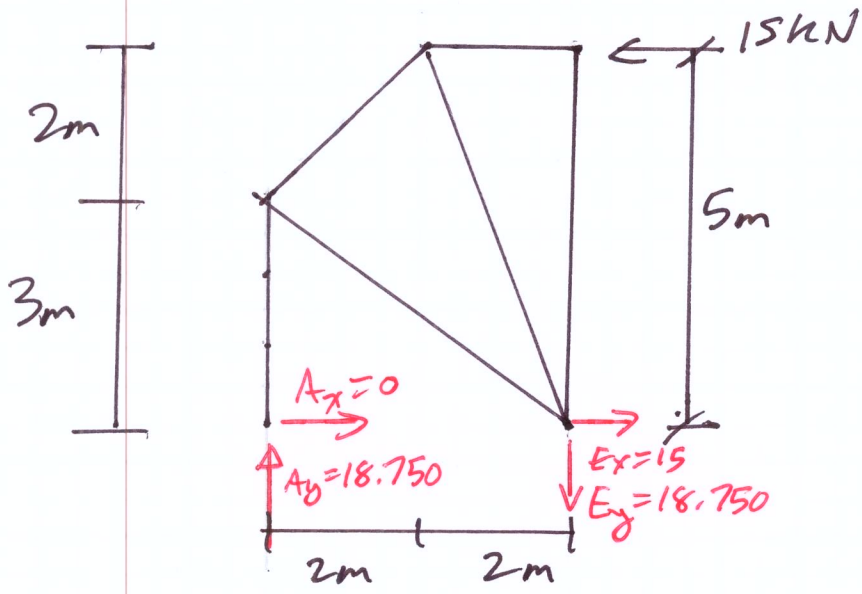
$E_x = 15\ kN$




$\Sigma F_y = 0$

$E_y + 10.714 + 8.036 = 0$

$E_y = -18.75\ kN$




## Check our answer

- We Analyzed all joints but never took Global Equilibrium

Note: you always have an additional joint or global equilibrium check

$\Sigma F_x = 0$

$A_x + E_x - 15 = 0$

$0 + 15 - 15 = 0$ ✓

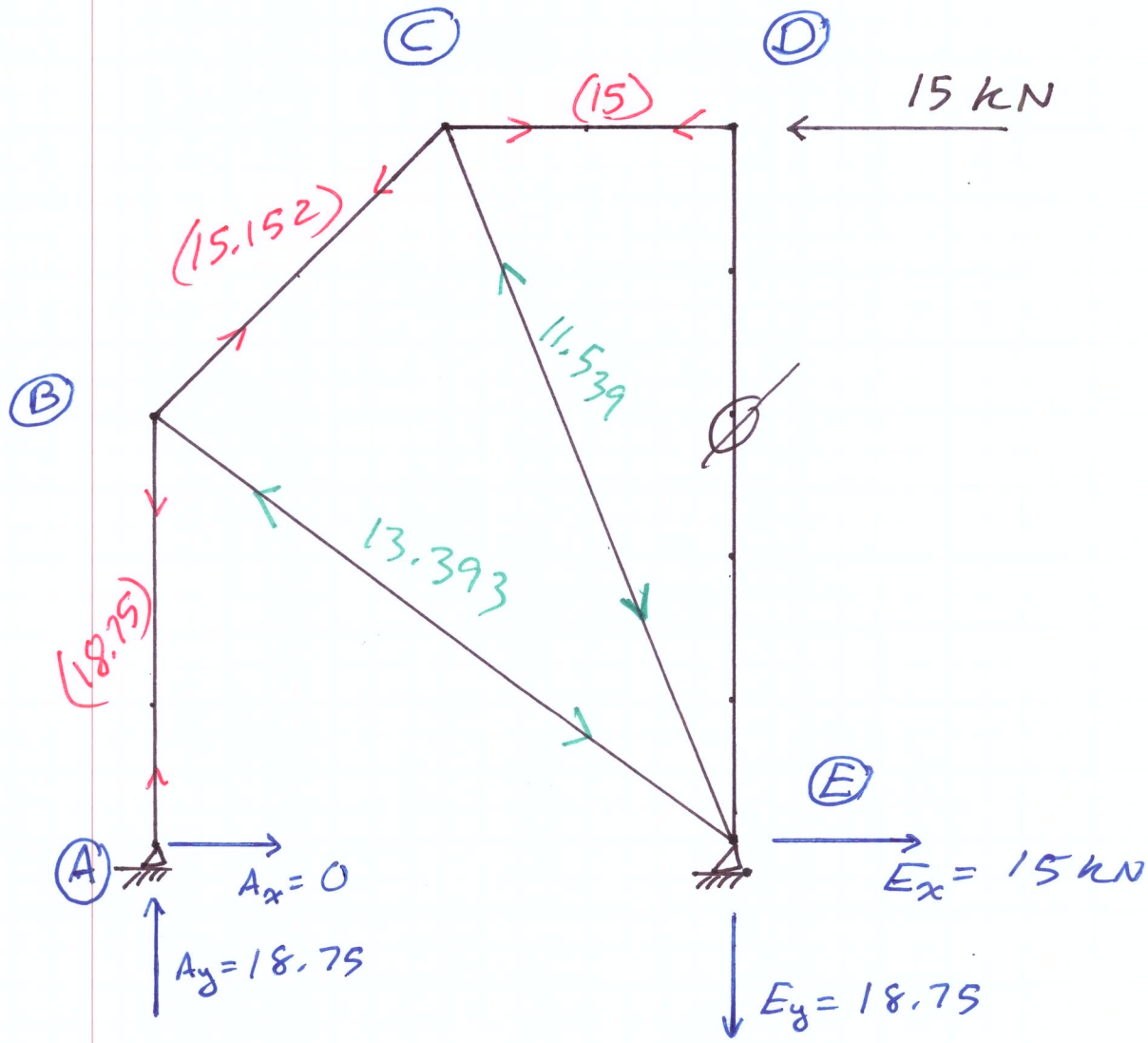
$\Sigma F_y = 0$ $A_y - E_y = 0$

$15 - 15 = 0$ ✓

$\Sigma M_E = 0$ $-A_y(4) + 15(5) = 0$

$A_y = +18.75$ kN ✓

## SUMMARY DIAGRAM




(Compression)

Tension

∅ → zero-Force