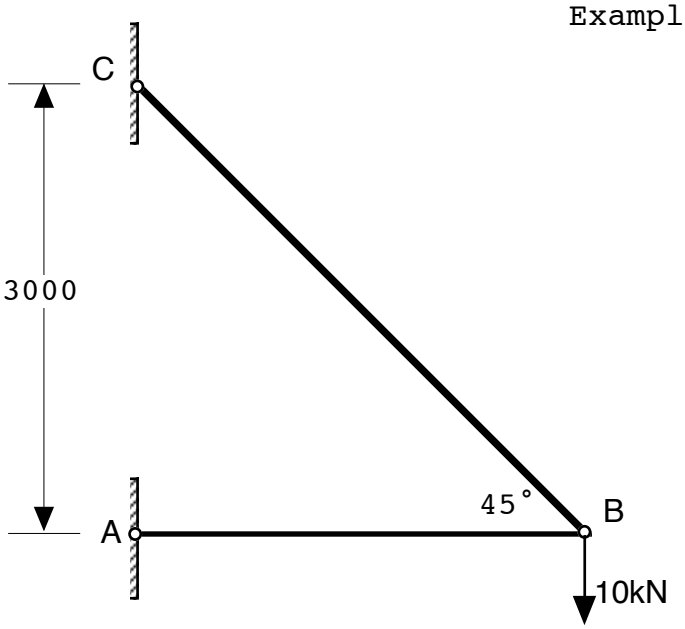
Pin-jointed Truss

Example #1



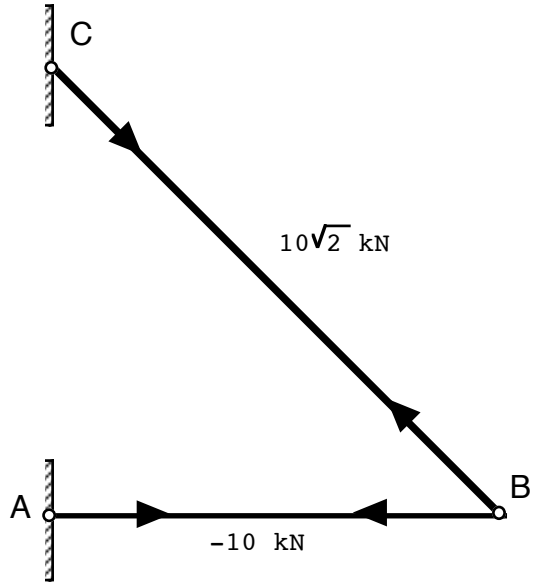

Geometry

$L_{AB}$ = 3000mm $L_{BC} = 3000\sqrt{2}$ mm

Statics

Joint equilibrium gives

$T_{AB}$ = -10kN TBC = $10\sqrt{2}$ kN




Member AB

$u_B - u_A$ = ext AB = -0.71 (1)

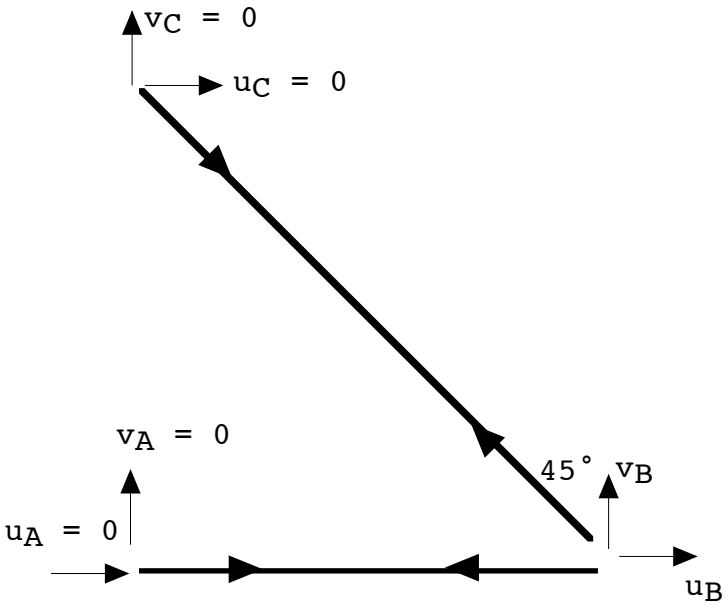
where $u_A$ =0

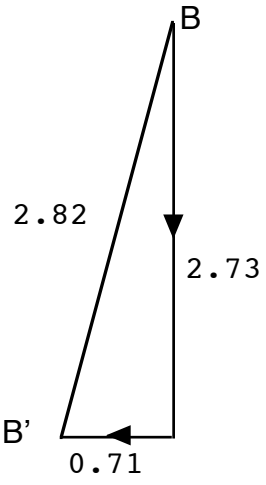
Member BC

$u_B \cos 45° - v_B \cos 45°$ = ext BC = 1.43 (2)

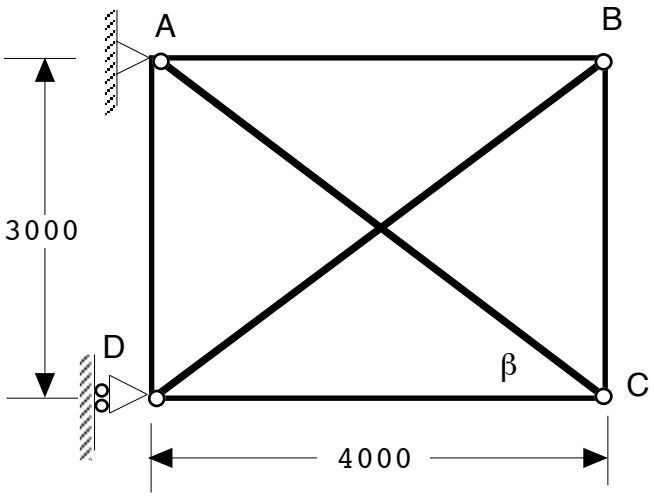
Equations (1) & (2) give

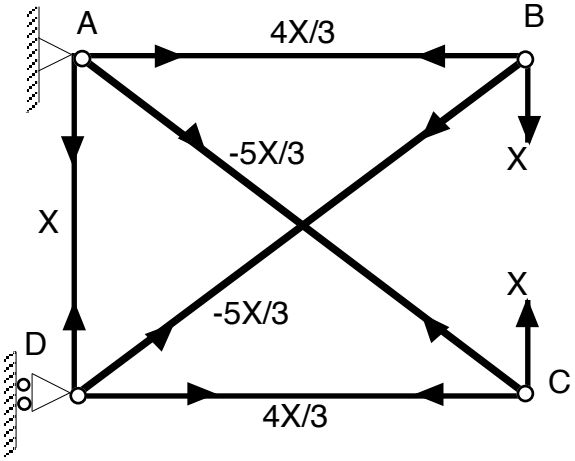
$u_B$ = -0.71 , $v_B$ = -2.73

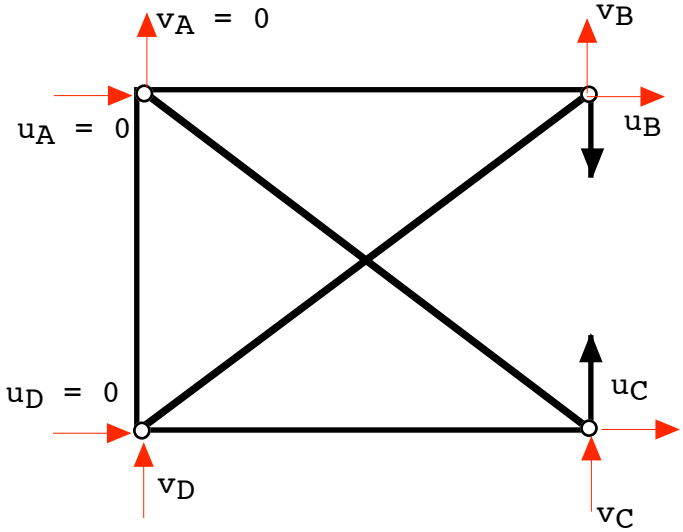


# Pin-jointed Truss - Example #2




Data

$\alpha = 7 \times 10^{-6}$ /°C  $\Delta T_{BC} = +30$°C

$E = 200 kN/mm^2$  $\sin\beta = 0.6$  $\cos\beta = 0.8$

Geometry

AC = BD = 5000mm

Statics

The frame is statically indeterminate:

$i = 6 + 3 - 2 \times 4 = 1$

i.e there is one redundant member. Cut member BC thereby releasing the internal forces X.

Joint equilibrium gives the forces as shown in the diagram.

Compatibility

Member AB: $u_B = 4X \times 10^{-4}/3$ [1

Member DC: $u_C = 4X \times 10^{-4}/3$ [2

Member AC:

$u_C \cos\beta - v_C \sin\beta = -25X \times 10^{-4}/12$ [3

Member AD: $-v_D = 3X \times 10^{-4}/4$ [4

Member DB:

$u_B \cos\beta + v_B \sin\beta - v_D \sin\beta$

$= -25X \times 10^{-4}/12$ [5

We get $v_C = 5.25X \times 10^{-4}$ [6

$v_B = -6X \times 10^{-4}$ [7

Extension BC = $-11.25X \times 10^{-4}$

Free expansion BC for 30° rise in temp

$= 7 \times 10^{-4} \times 3000 \times 30 = 0.63$mm

Net extension = $-11.25X \times 10^{-4} - 0.63$

$= 3000X/(EA)$

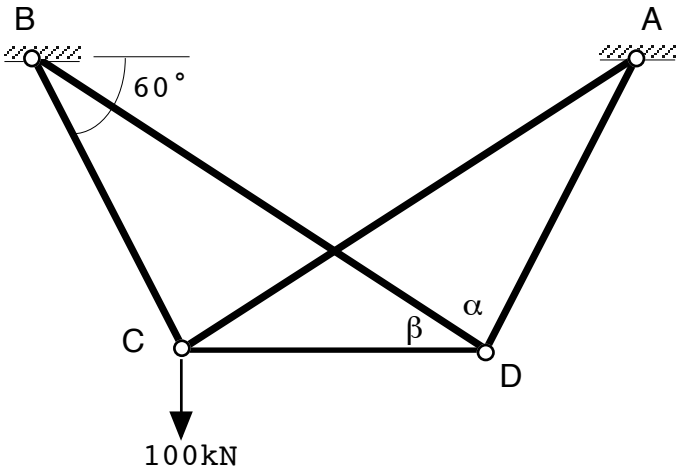
We obtain

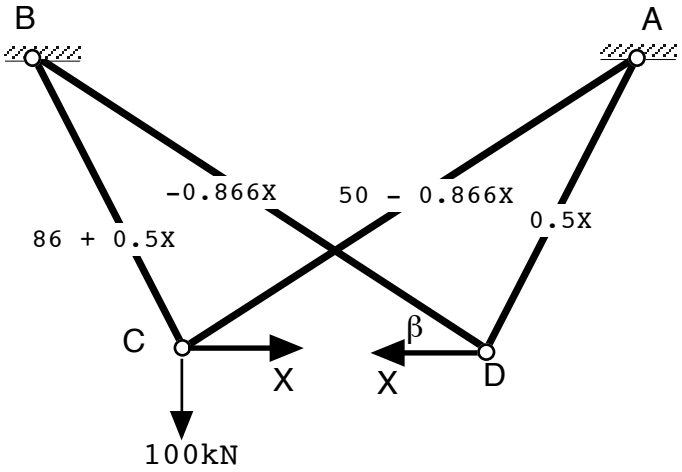
$-11.25X \times 10^{-4} - 0.63 = 0.75X \times 10^{-4}$

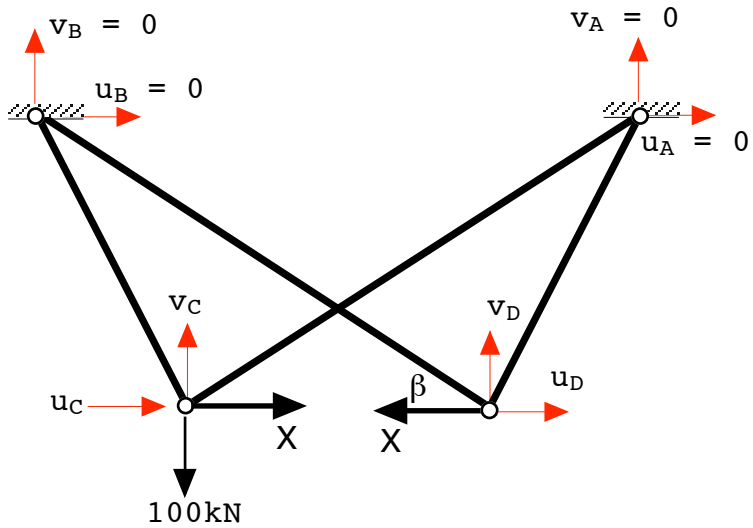
which gives

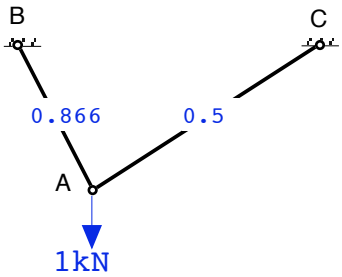
X = -525N

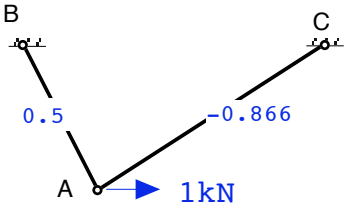
# Pin-jointed Truss - Example #3




## Data

$L_{BC} = L_{CD} = L_{DA} = 800mm$

$A_{BC} = A_{CD} = A_{DA} = 20mm^2$

$A_{CA} = A_{DB} = 30mm^2 \quad E = 200kN/mm^2$

## Geometry

$L_{CA} = L_{DB} = 1386mm$

$\alpha = 90° \quad \beta = 30°$

## Statics

The frame is statically indeterminate:

$$i = 5 + 4 - 2 \times 4 = 1$$

i.e there is one redundant member. Cut member CD thereby releasing the internal forces X.

Joint equilibrium gives the forces as shown in the diagram.

## Compatibility

Member CA

$-0.866u_C - 0.5v_C =$

$(50 - 0.866X) \times 0.231$ [1]

Member CB

$0.5u_C - 0.866v_C =$

$(86 + 0.5X) \times 0.200$ [2]

Member BD

$0.866u_D - 0.5v_D =$

$-0.866X \times 0.231$ [3]

Member AD

$0.5u_D + 0.866v_D =$

$0.5X \times 0.200$ [4]

We get on solving

$u_C = -1.41 + 0.223X$

$u_D = -0.223X$

Ext. CD $= -0.446 + 1.41$

$= X L_{CD}/(EA)_{CD}$

$= 0.2X$

Hence X = 2.2kN