MAE 343. Intermediate Mechanics

Chapter 3: Statics
Reticulated Structures

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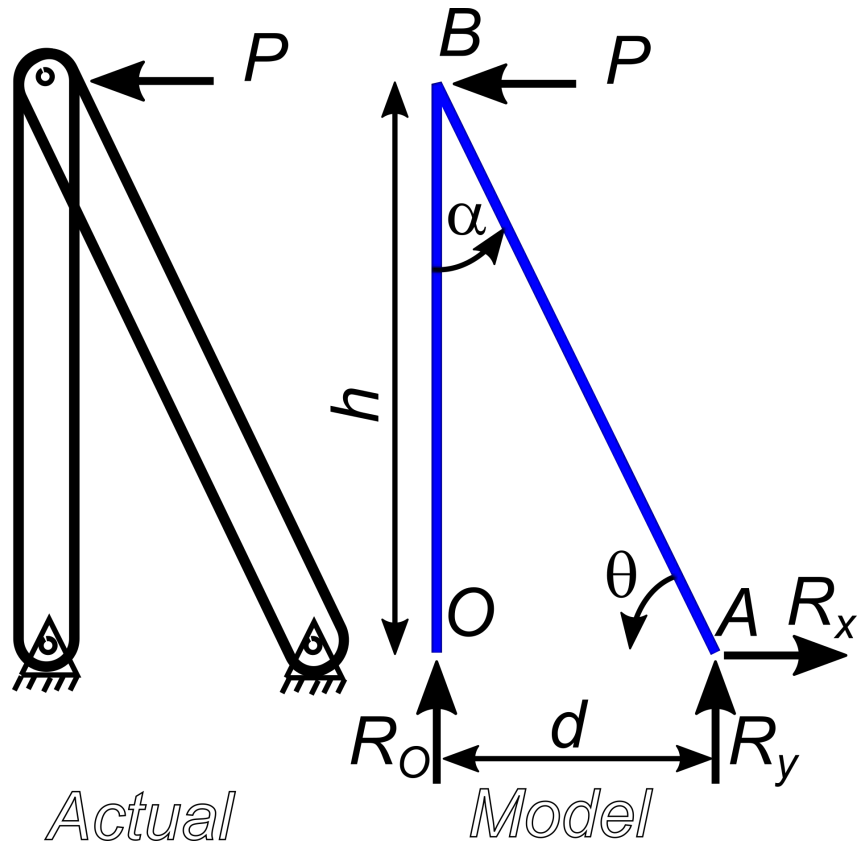
Reticulated Structures

New River Gorge Bridge, Fayetteville, West Virginia
3,030 feet long

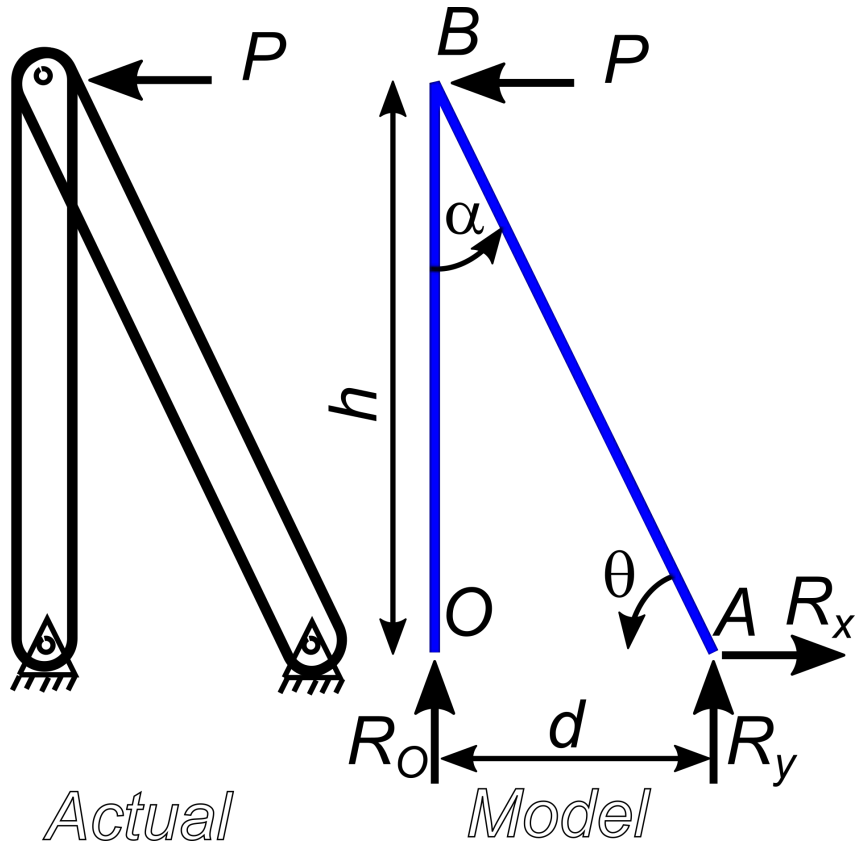
Problem statement

Calculate the displacement of point B in the direction of load P.



Notable Facts

In a reticulated structure all members are joined by pins. Since pins cannot transfer moment, all members are bending-free ($M = 0$). Members can hold only axial loads (tension or compression). Since member OB is vertical, all the force in OB equals the reaction R_O and the horizontal reaction at O is zero.



Calculate reactions

$$P = 800\ N, \theta = 60^o$$

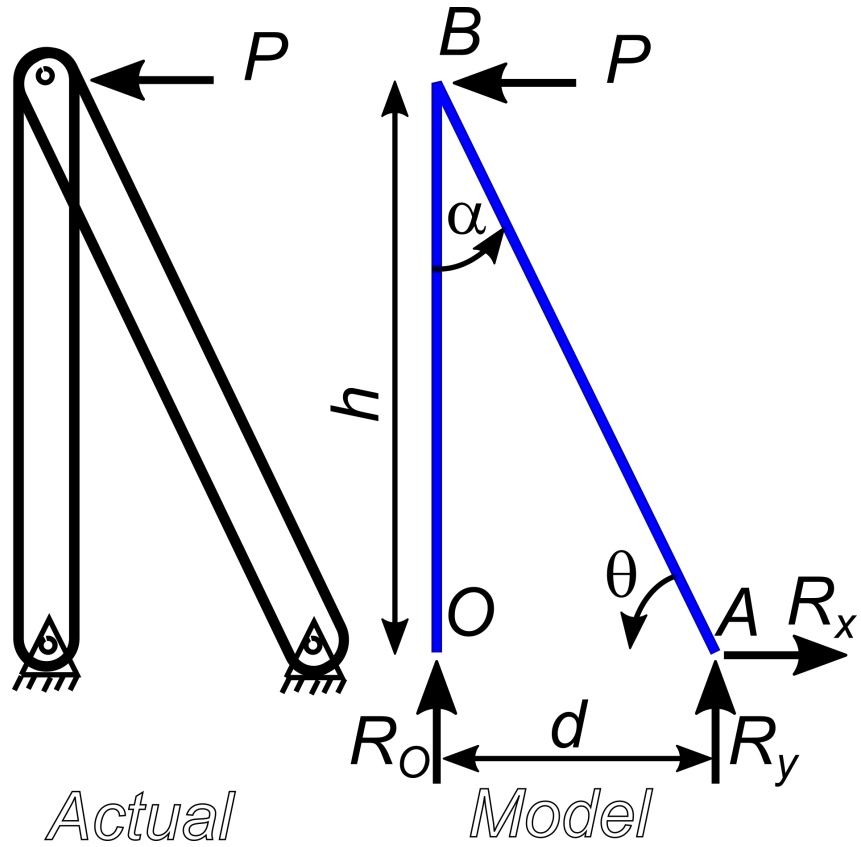
$$h = 900\ mm, d = 519.6\ mm$$

$$\sum F_x = 0 : R_x = 800N$$

$$\sum M_O = 0 : P\,h + R_y d = 0$$

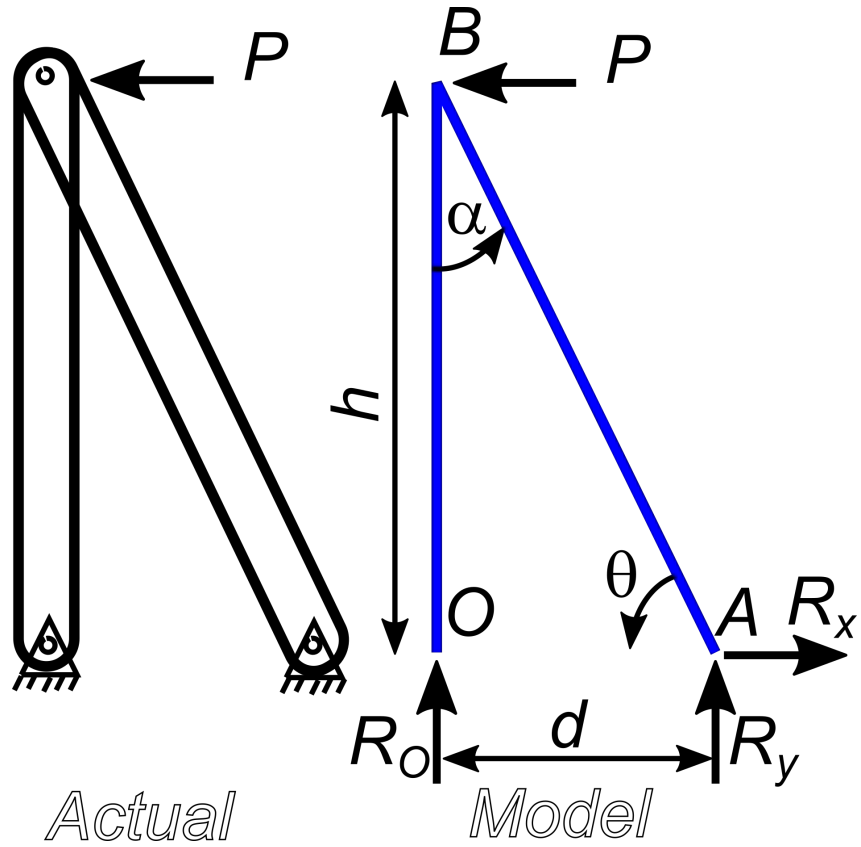
$$R_y = -P\ h/d = -1385N$$

$$\sum F_y = 0 : R_O = -R_y = 1385N$$



Calculate internal forces with sign (+ traction)

Member OB:
Since $R_O = 1385$ pushes on the bar, the internal force in the bar is compression
$F_{OB} = -1385$ N (compression)
Member AB:
$F_{AB} = \sqrt{R_x^2 + R_y^2} = \sqrt{800^2 + (-1385)^2} = 1600$ N (tensile)



Calculate the deformation of all members

Modulus $E = 207\ 10^3$ MPa. Cross-section area=81 mm^2

$\delta = F\,L/(E\,A)$

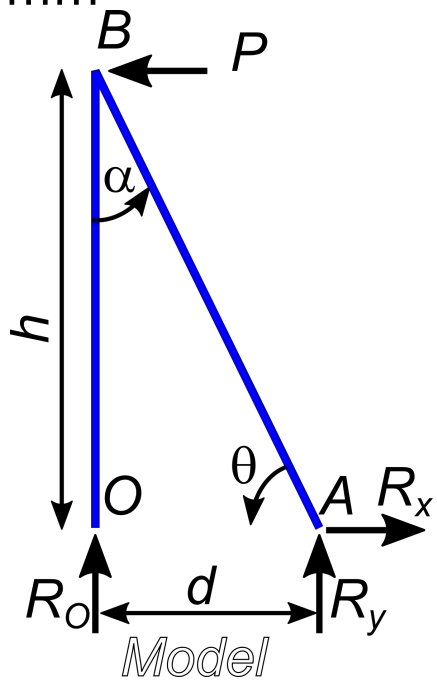
Member OB: $F_{OB} = -1385$

$\delta_{OB} = -1385 \times 900/(207\ 10^3 \times 81) = -0.07434$ mm

Member AB: $F_{AB} = 1600$ N

$L_{AB} = \sqrt{d^2 + h^2} = 1039$ mm

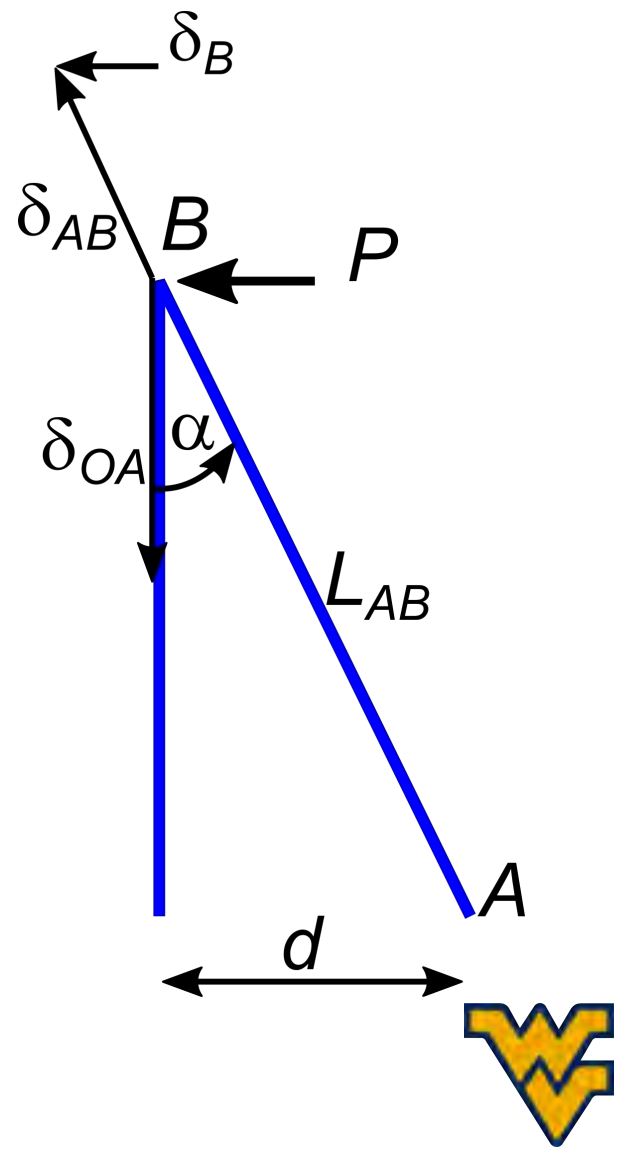
$\delta_{AB} = 1600 \times 1039/(207\ 10^3 \times 81) = 0.09915$ mm



Calculate the horizontal displacement of point B

$\sin\alpha = d/L_{AB} = 519.6/1039 = 0.5$

$\delta_B = \delta_{AB}\sin\alpha = 0.04958$ mm



Summary and Conclusions

- All members are in tension or compression only.
- Reactions are calculated as usual, including $\sum M = 0$ on the whole structure.
- This is a very simple example where calculating the reactions solved everything.
- More complex cases require additional techniques.
- Homework is on WebWork
- Next lecture: Internal Forces in Beams
- THANK YOU