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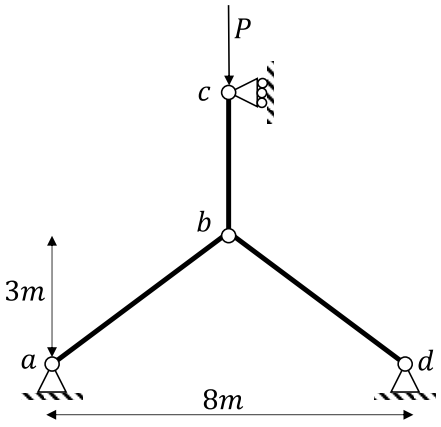
In-class Exercise Week #6: Load-displacement constraint methods

Exercise #1:

Consider the following truss structure:



The members have the following properties:

- $ab: E = 200\ GPa, l_{o,ab} = 5m$, square cross section of width $b_{ab} = 500mm$
- $bc: E = 200\ GPa, l_{o,bc} = l_{o,ab}$, square cross section of width b_{bc}
- $bd: E = 200\ GPa, l_{o,bd} = l_{o,ab}$, square cross section of width $b_{bd} = b_{ab}$

1) Determine analytically the minimum dimension bc_{min} such that the structure does not exhibit a snap-back response in the $P - v_c$ equilibrium path (v_c denotes the vertical displacement of node c).

Hint: Consider the tangent in the $P - v_c$ equilibrium path once members ab and bd are horizonal (i.e., when $P = 0$).

2) Derive the corotational formulation for a 2d truss element

3) Model the structure using 2d truss elements and simulate the response of the structure in the case where node c is displaced vertically up to $v_c = 4.0m$ downwards:

a) Using displacement control for $b_{bc} = 2 \cdot b_{ab}$
b) Using arc-length control for $b_{bd} = b_{ab}/2$