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Announcements

- Quiz 3 retry this week

- Upcoming deadlines:
- Friday (3/1)
  - Written Assignment
- Tuesday (3/5)
  - PL HW

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Objectives

- Truss Analysis
  - Zero-force member
  - Method of section

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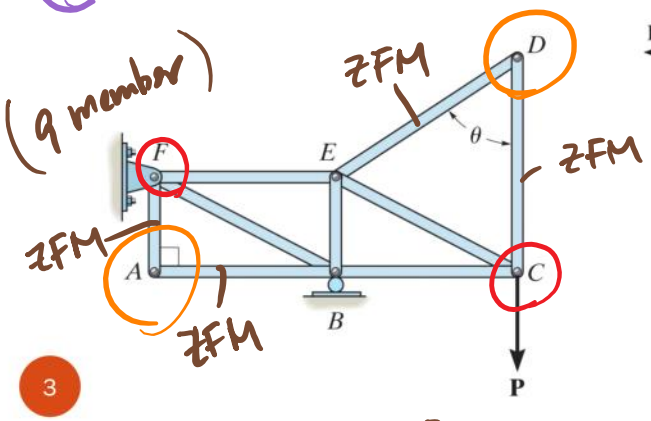
Zero-force members (ZFM)

- Particular members in a structure may experience no force for certain loads.
- Zero-force members are used to increase stability.
- Identifying members with zero-force can expedite analysis.
- Requirement: No external force/support reaction on the pin for analysis.
- Two cases (use pin analysis):

1. Two non-collinear members.
2. Two collinear members + a third non-collinear member.

collinear



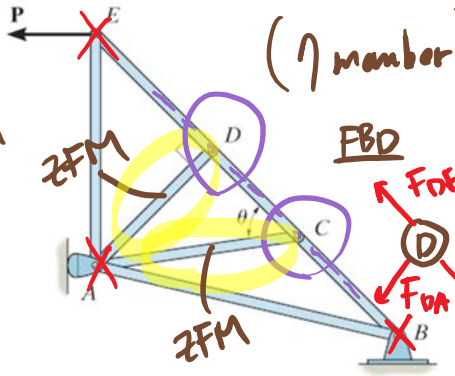
(9 member)

ZFM

ZFM

ZFM

ZFM



(7 member)

ZFM

ZFM

FBD

EoE

F_{DE}

F_{DA}

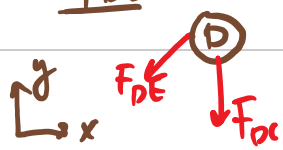
F_{DC}

$\Sigma F_x = -F_{DA} = 0$

3

FBD

EoE

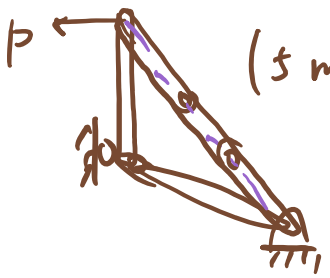


$\Sigma F_x = F_{DE}\sin\theta = 0$

$\rightarrow F_{DE} = 0$

Reduced/simplified truss

(5 members)



(5 members, 3 unique)

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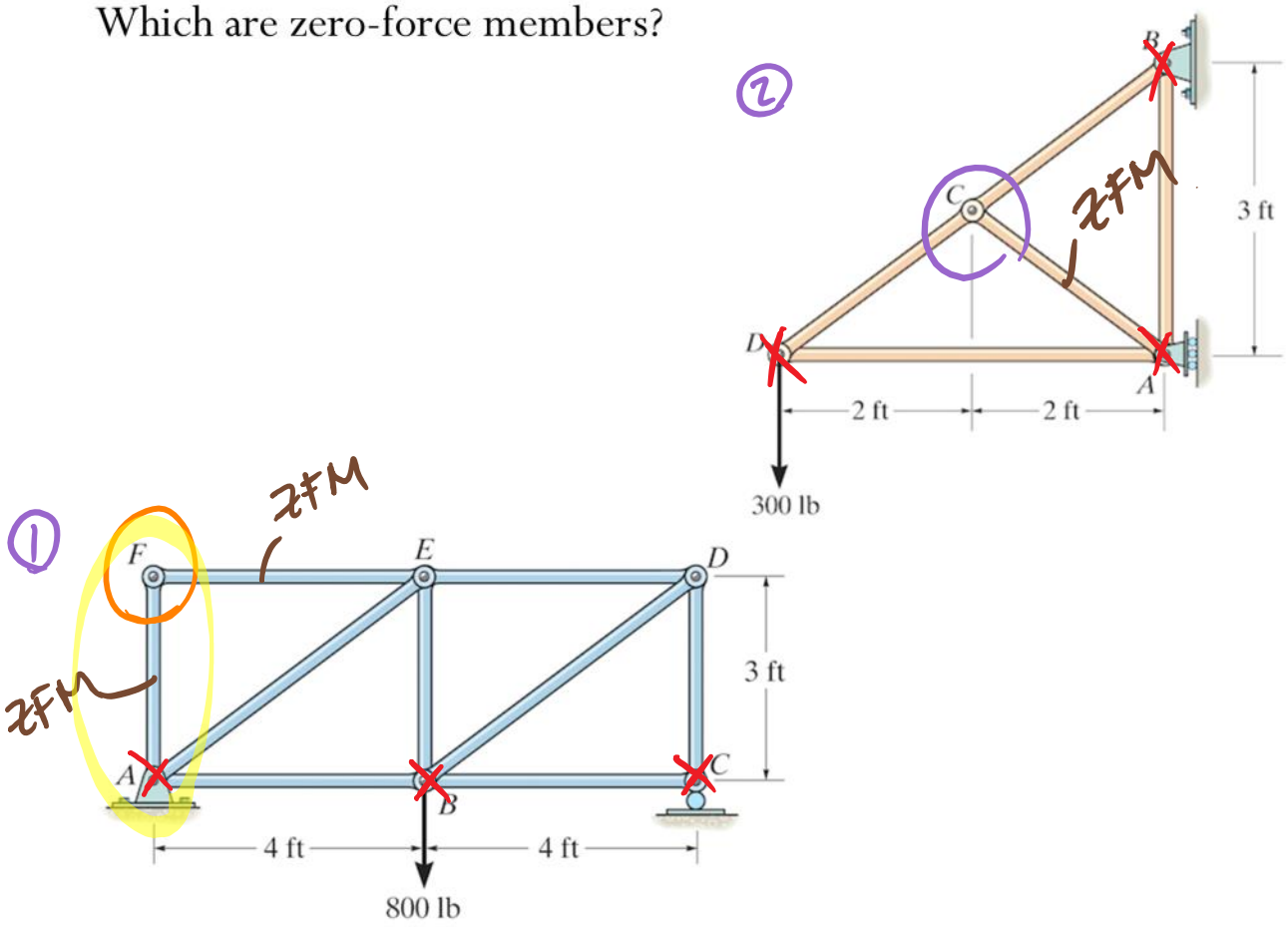
Which are zero-force members?



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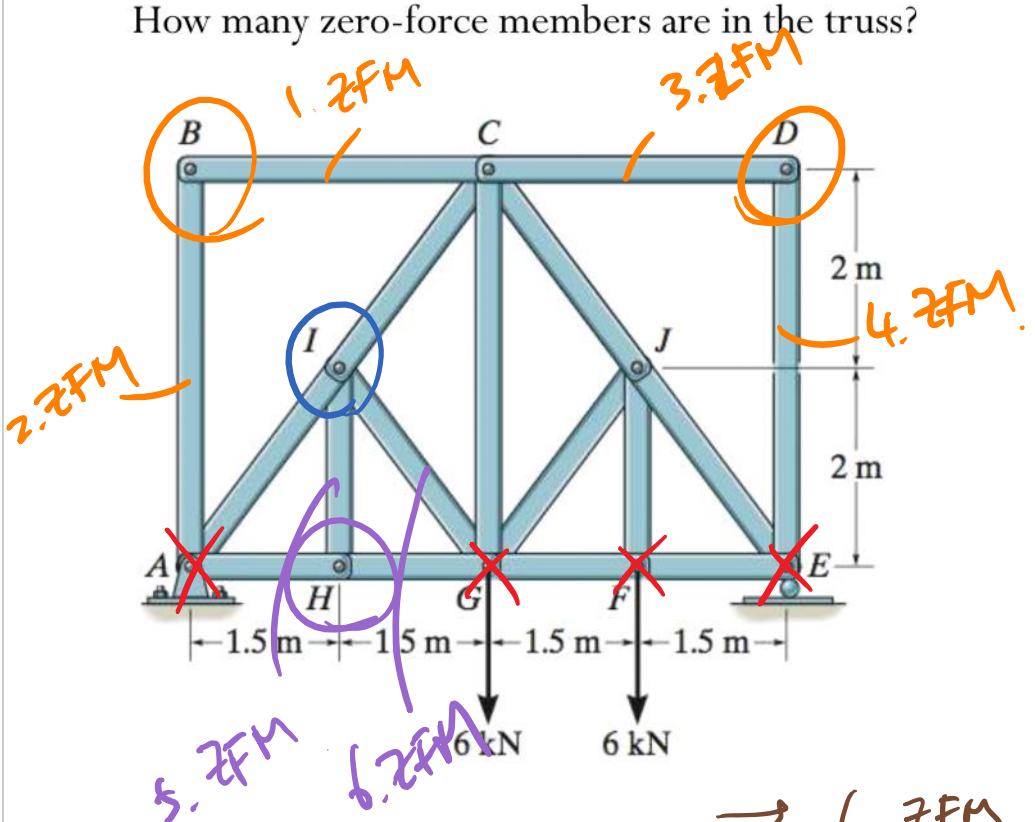
How many zero-force members are in the truss?



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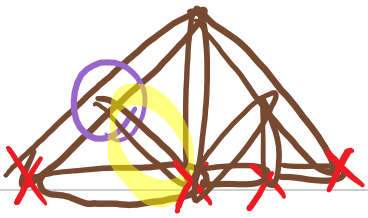

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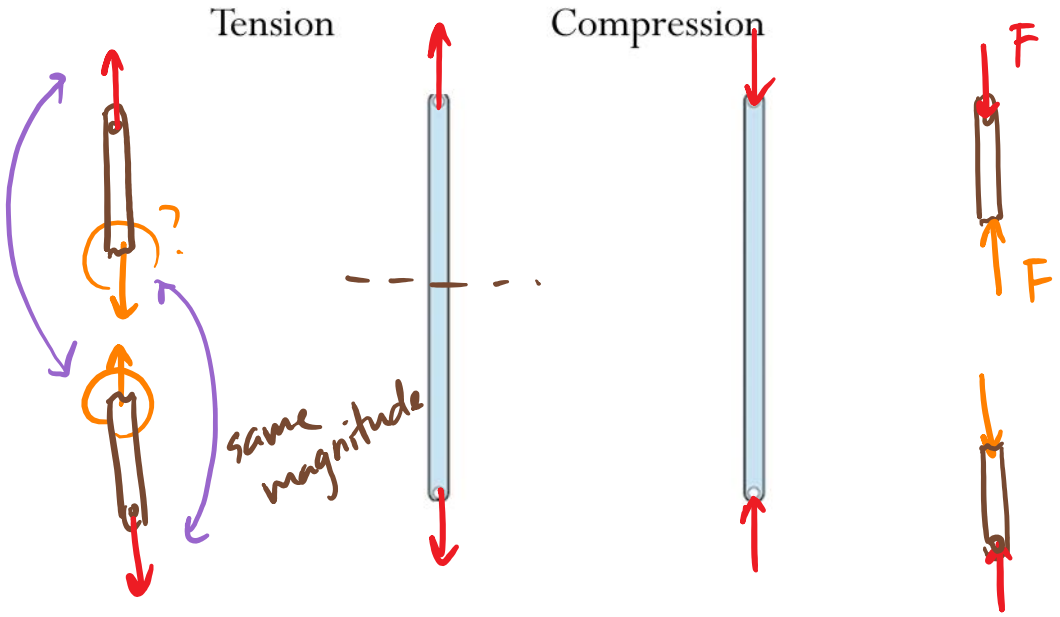
Internal forces

- How are two-force members being held together internally?



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→ external forces & internal forces of truss members are the same.

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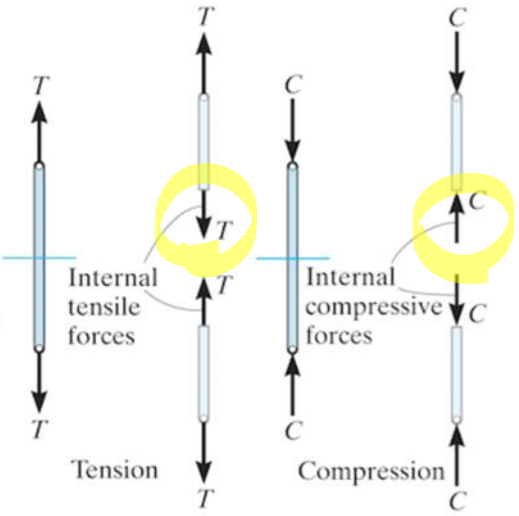
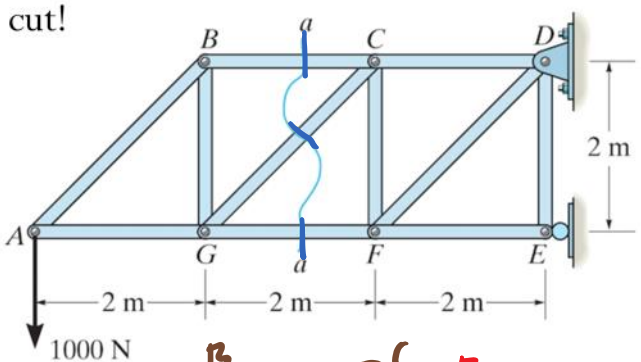
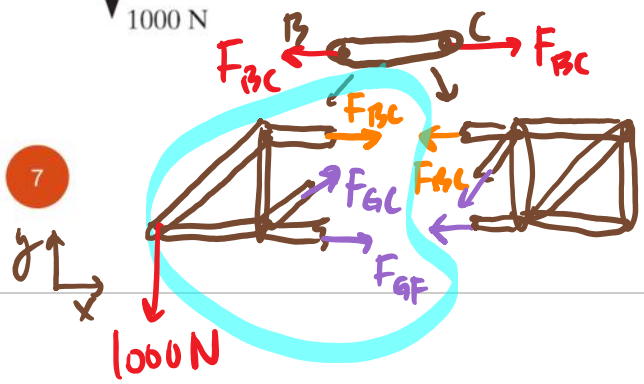
Method of sections

- Determine external support reactions
- "Cut" the structure at a section of interest into two separate pieces and set either part into force and moment equilibrium
- Be aware of number of unknowns after your cut!







EoE (left half)

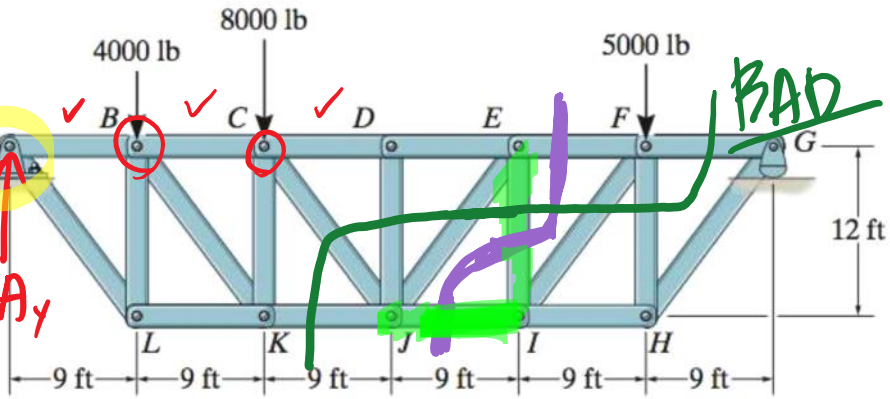
$\Sigma F_x = 0 = F_{BC} + F_{GC}\cos 45° + F_{GF}$

$\Sigma F_y = 0 = F_{GC}\sin 45° - 1000\,N$

$\Sigma M_G = 0 = -F_{BC}(2m) + (1000\,N)(2m)$

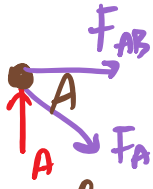
→ 3 equation of equilibrium are sufficient to solve for the 3 unknown forces on members BC, GC, and GF.

Determine the force in members *EI* and *JI* of the truss which serves to support the deck of a bridge. State if these members are in tension or compression.



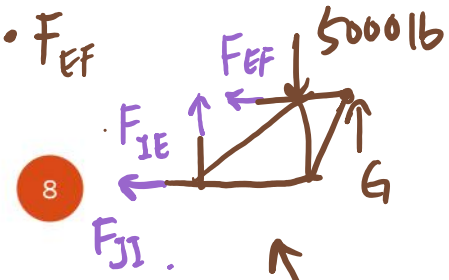
Method of Pin

- F_{AB}.



Method of section

- F_{EF}



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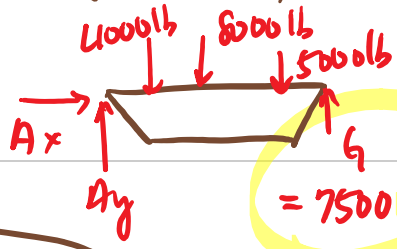
* Note: when using method of section, cut through at most 3 members at a time.

- Use FBD of the whole truss to find G.



$\Sigma M_A = -(9\text{ ft})(4000\text{ lb}) - (18\text{ ft})(8000\text{ lb}) - (45\text{ ft})(5000\text{ lb}) + (54\text{ ft})\,G = 0$

$G = 7500\text{ lb}$

- Use the right section to find F_{EF}.

$\Sigma M_I = (12\text{ ft})F_{EF} - (9\text{ ft})(5000\text{ lb}) + (18\text{ ft})(7500\text{ lb}) = 0$

$\rightarrow F_{EF} = -90000\text{ lb}$ (compression)