Announcements

- Mid-semester evaluation this week during discussion sections

Be on time!

- Upcoming deadlines:
- Tuesday (10/2)
  - PL HW
- Friday (10/5)
  - Written Assignment

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Objectives

- Two-force members
- Three-force members
- Reaction vs. resultant force/moment

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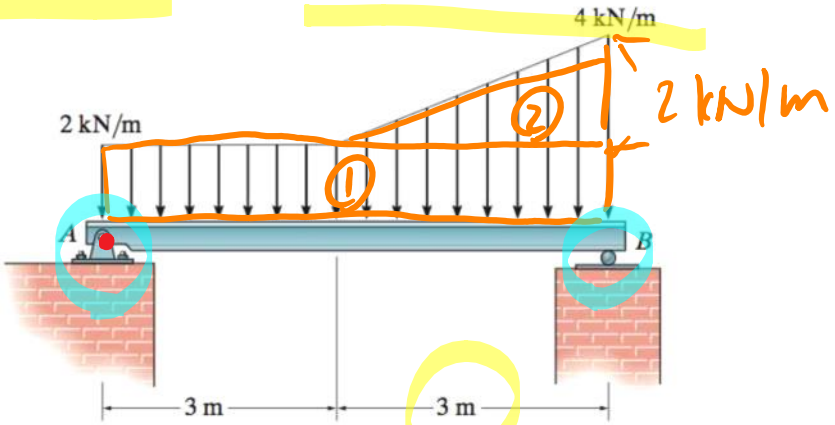
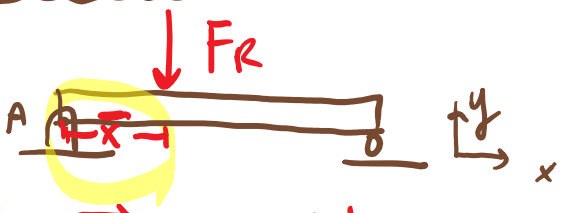
Equivalent/resultant vs. Support Reaction



1) Find the equivalent force and its location from point *A*.

2) Find the support reactions at *A*.

1) Draw FBD



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$\vec{M}_R = \vec{x} \times \vec{F}_R$

⇕ equilent systems.

2.) Find $F_R = F_{R1} + F_{R2}$

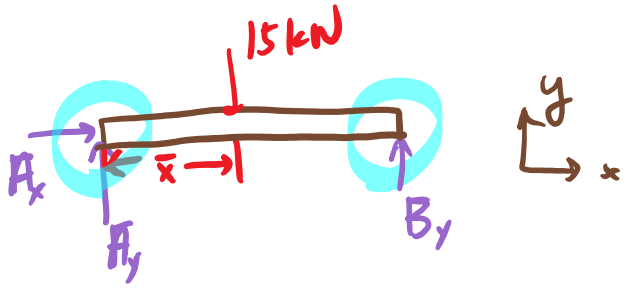
F_{R1} (resultant from ①)

$= bh = (6m)(2kN/m)$

$= 12\ kN$

F_{R2} (resultant from ②)

1) FBD



2) Apply Eq. of Equilibrium.

$\Sigma F_x = 0 = A_x$

$\Sigma F_y = 0 = A_y + B_y - 15kN$

$\Sigma M_A = (15kN)\bar{x} + B_y(6m) = 0$

$B_y = \dfrac{(15kN)\bar{x}}{6m} = 8.5\ kN$

$A_y = 15kN - B_y = 6.5\ kN$

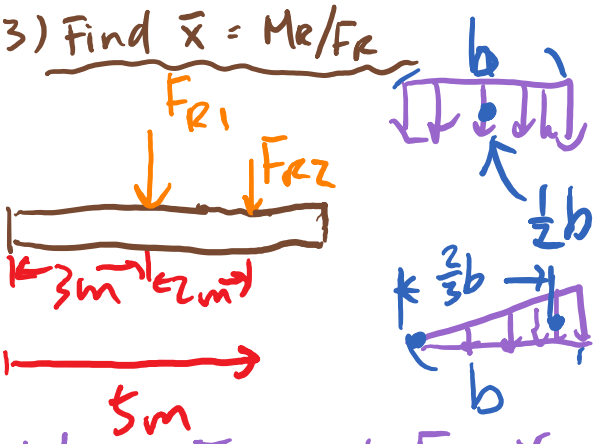
F_{R2} (resultant from ②)

$= \frac{1}{2}bh = \frac{1}{2}(3m)(2\,kN/m$

$= 3\,kN$

$\rightarrow F_R = F_{R1} + F_{R2} = 15\,kN$

3) Find $\bar{x} = M_R / F_R$



$M_R = F_{R1}x_1 + F_{R2}x_2$

$= (12\,kN)(3m) + (3\,kN)(5m)$

$= 51\,kN \cdot m$

$\bar{x} = \frac{M_R}{F_R} = \frac{51\,kN \cdot m}{15\,kN} = 3.4m$

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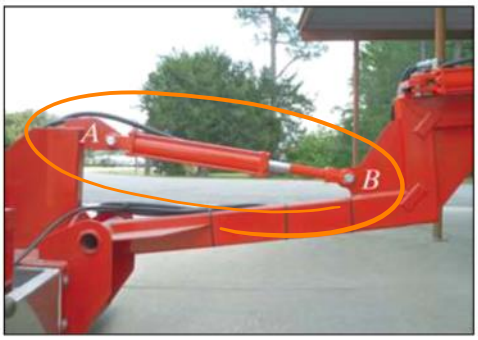
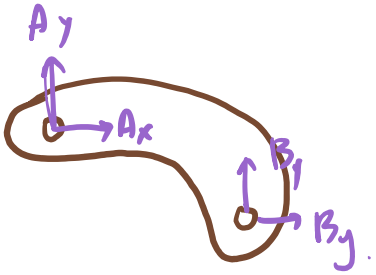
Two-force members

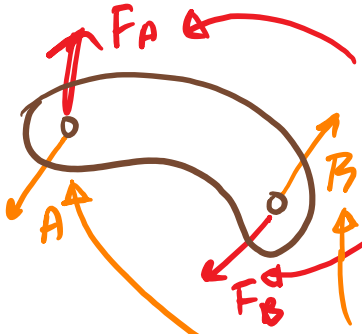


In the cases above, members AB can be considered as two-force members, provided that their weight is neglected.

FBD



Cannot satisfy $\vec{F}$ eq. of equil.



$\Sigma F_x \neq 0$

$\Sigma F_y \neq 0$

Cannot satisfy $\Sigma M_A \neq 0$.

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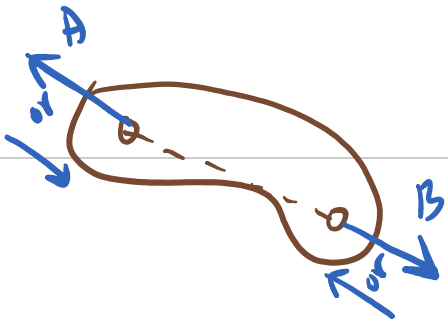
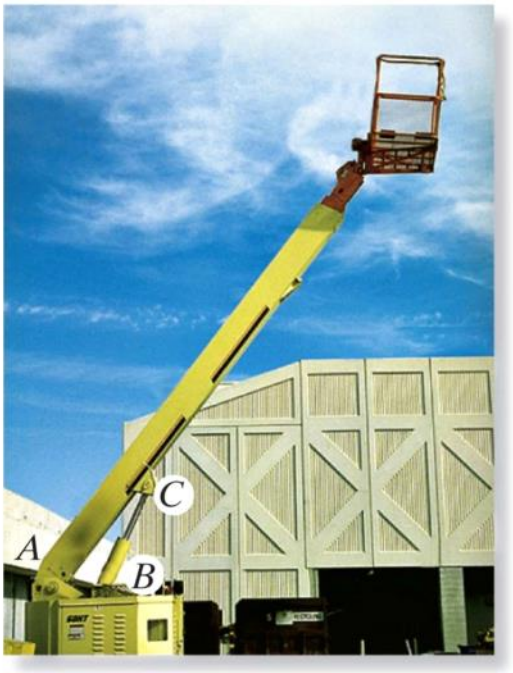
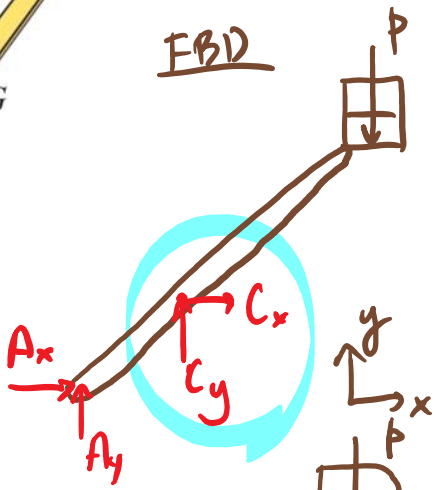


A & B must be collinear!

Find the support reactions at *A*, given the force applied at the cage, **P**, is 300 lb.



FBD



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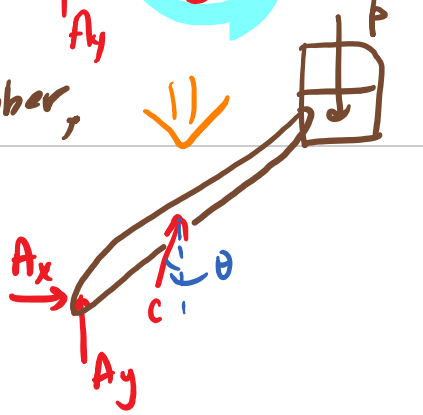
BC is a 2-force member,

FBD becomes



→ C_x & C_y are related,

$C_x = C\sin\theta$

$C_y = C\cos\theta$

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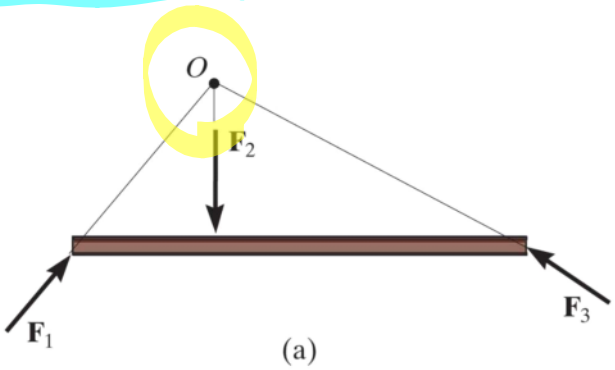
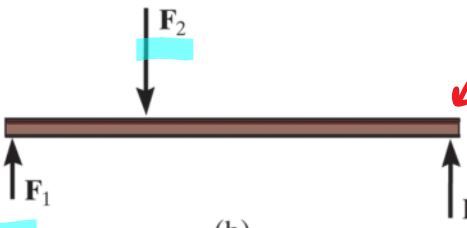
Three-force members (No moment)

As the name implies, three-force members have forces applied at only three points.

Moment equilibrium can be satisfied only if the three forces are concurrent or parallel force system



(a)



(b)

Three-force member

If F_3 is not parallel to F_1 & F_2

$\rightarrow \sum F_x \neq 0$

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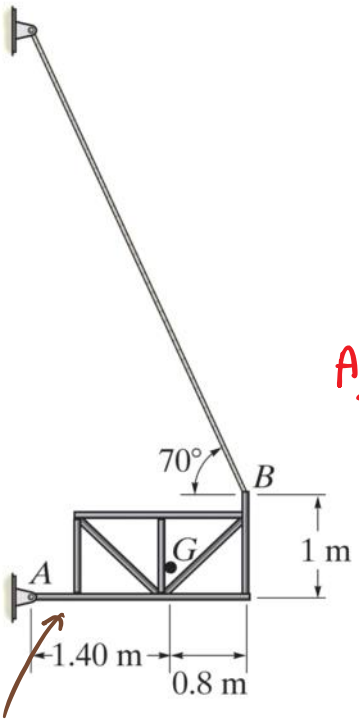
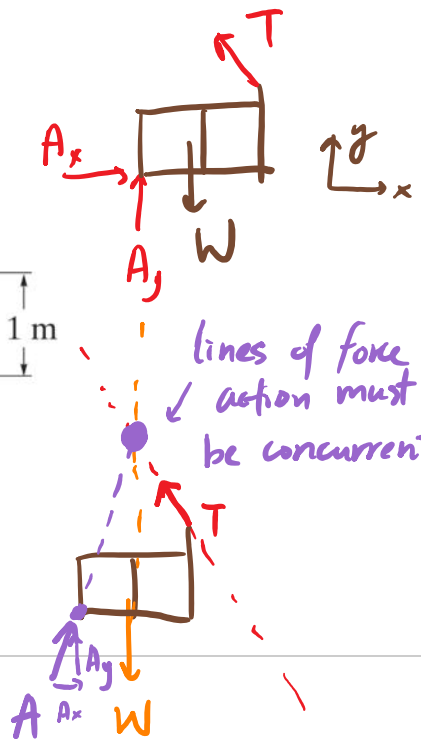
Example

The platform has a mass of 200 kg. Find the support reactions.



Cage is a 3-force member.

FBD



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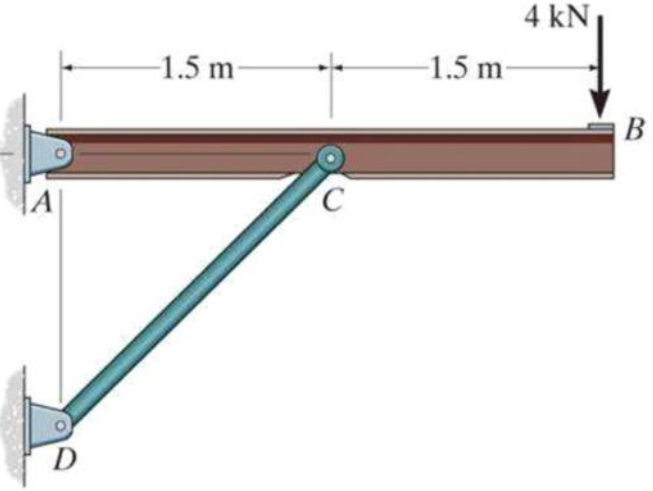
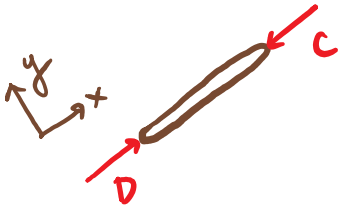
Given the load at B of the beam is supported by pins at A and C. Find the support reactions at A and C.



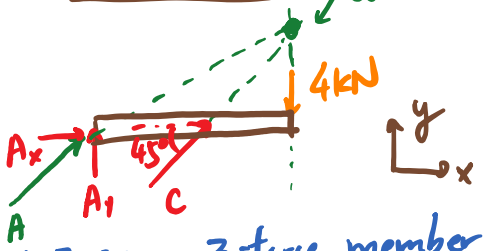
① FBD CD

Notice BC is a 2-force member



FBD ACB

Concurrent.



ACB is a 3-force member.

② Use eq. of equilibrium (EoE) for ACB (solve for A_x, A_y, & C)

$\Sigma F_x = A_x + C\cos 45° = 0$

$\Sigma F_y = A_y + C\sin 45° - 4\,kN = 0$

$\Sigma M_A = (1.5m)(C\sin 45°) - (3m)(4\,kN) = 0$

$\rightarrow C = \frac{12\,kN\cdot m}{1.5\sin 45°} = 8\sqrt{2}\ kN = C$

$A_y = -(8\sqrt{2}\ kN)(1/\sqrt{2}) + 4\,kN$

$A_y = -4\,kN$

$A_x = -(8\sqrt{2}\ kN)(1/\sqrt{2}) = -8\,kN = A_x$

③ CD EoE

(Notice different use of FBD coordinate system)

$\Sigma F_x = D - C = 0$

$\rightarrow D = C = 8\sqrt{2}\ kN$