ME 202

LECTURE 15

TUE 8 FEB 2022

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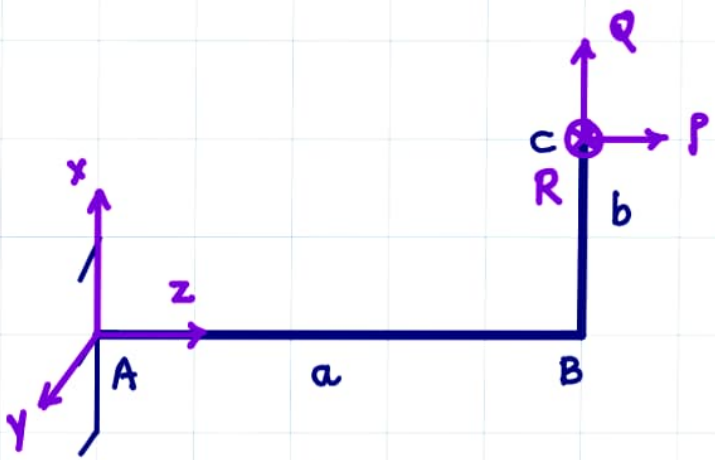
BENT BEAMS

TIRE IRON

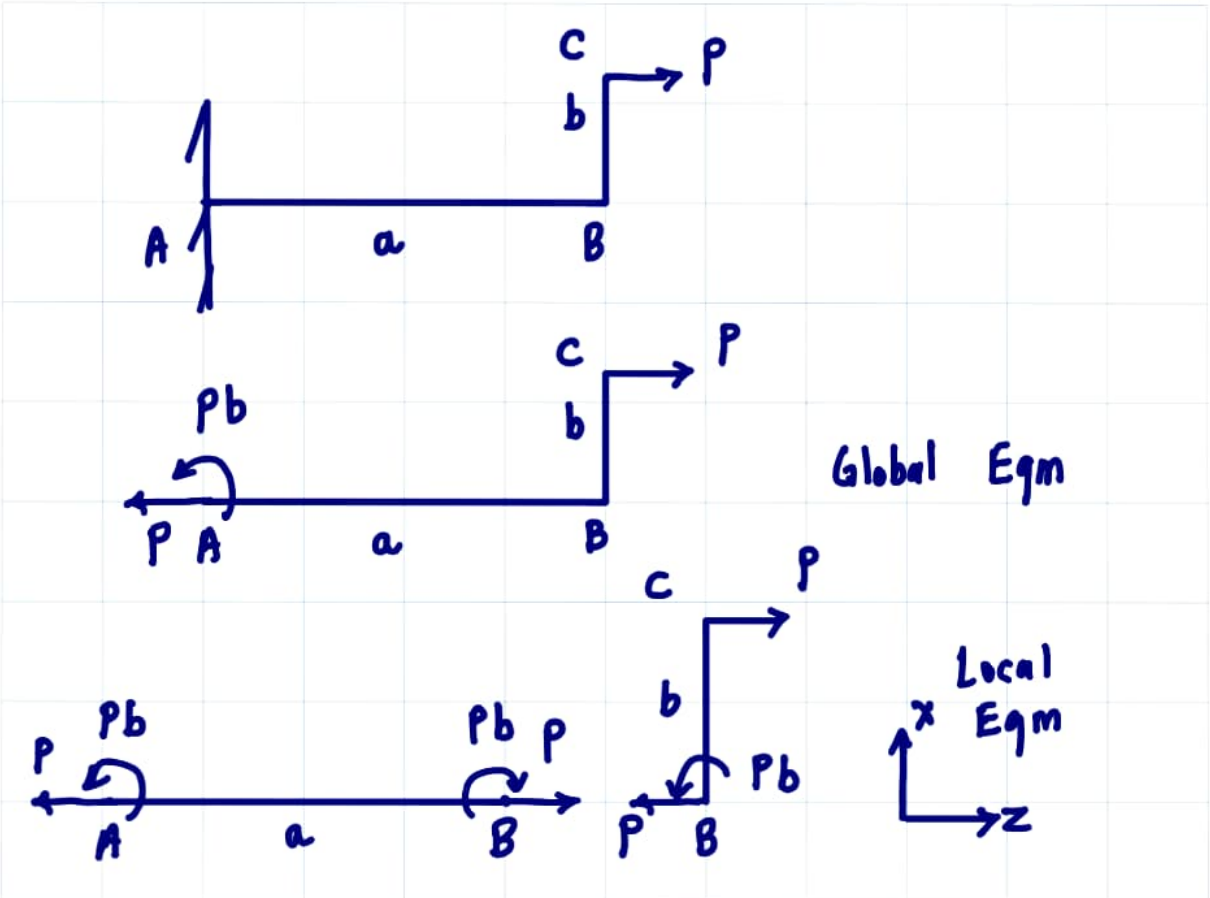
CRANE



Rigid joints

Beam properties EA, GJ, EI → flexural

rigidities → axial/ extensional, torsional


C
P
b
A
a
B
Pb
P
Global Eqm
Local Eqm
x
z

At B, disp along z $= \frac{Pa}{AE}$

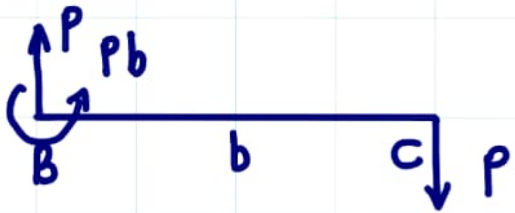
disp along x $= \frac{-Pba^2}{2EI}$

Recall

$\frac{M_0 L^2}{2EI} = u(L)$

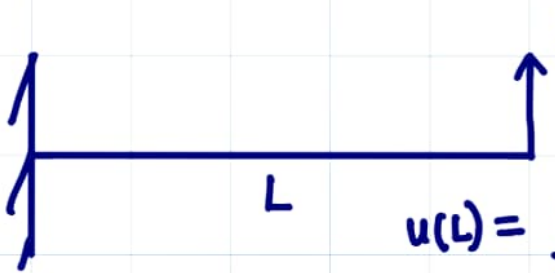
$\frac{M_0 L}{EI} = \theta(L)$

disp along y = 0



cantilever BCs

Recall,

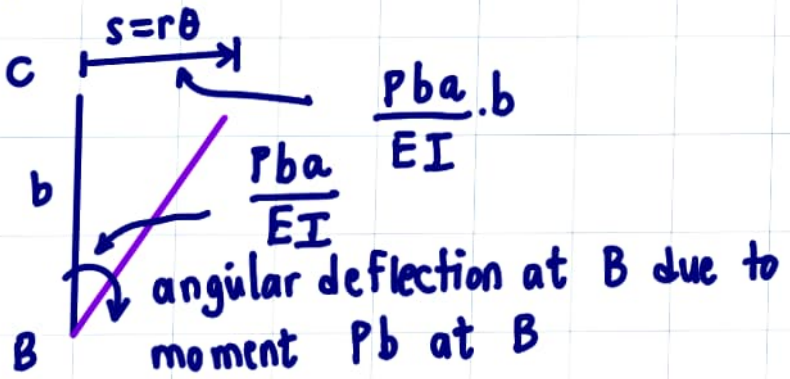


$$u(L) = \frac{PL^3}{3EI}$$

$$\theta(L) = \frac{PL^2}{2EI}$$

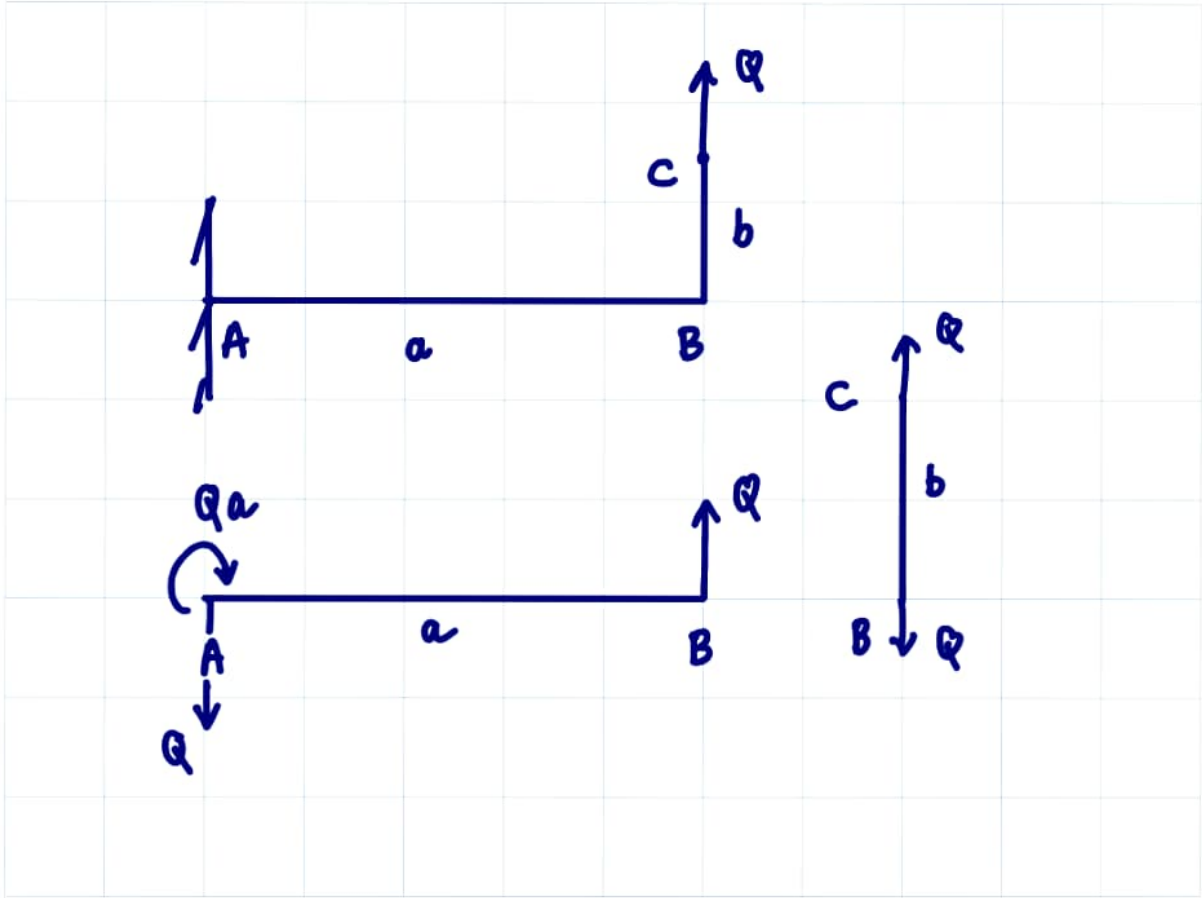
z disp of C

$$= \underbrace{\frac{Pb^3}{3EI}}_{\text{from bending of BC}} + \underbrace{\frac{Pa}{AE}}_{\text{extension of AB}} + \frac{Pba}{EI}b$$



x disp of C = x disp of B = $-\frac{Pba^2}{2EI}$

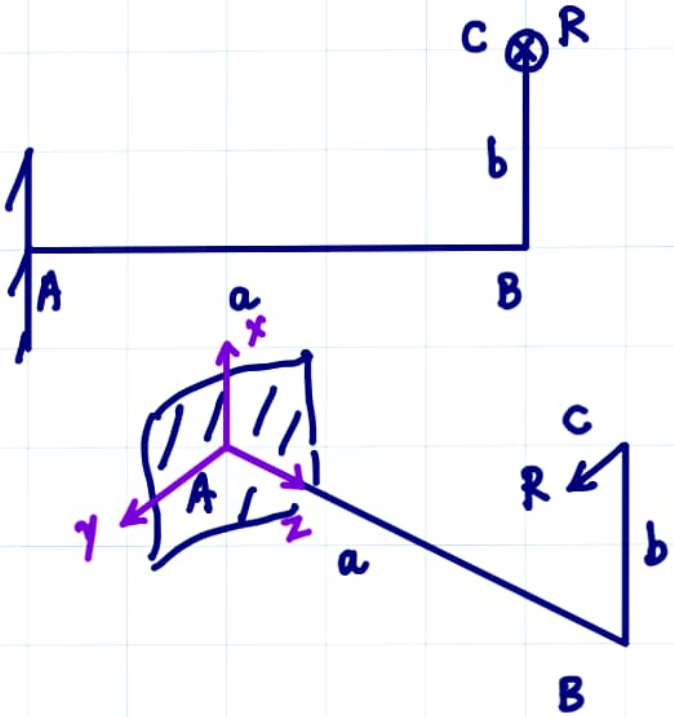
y disp of C = 0

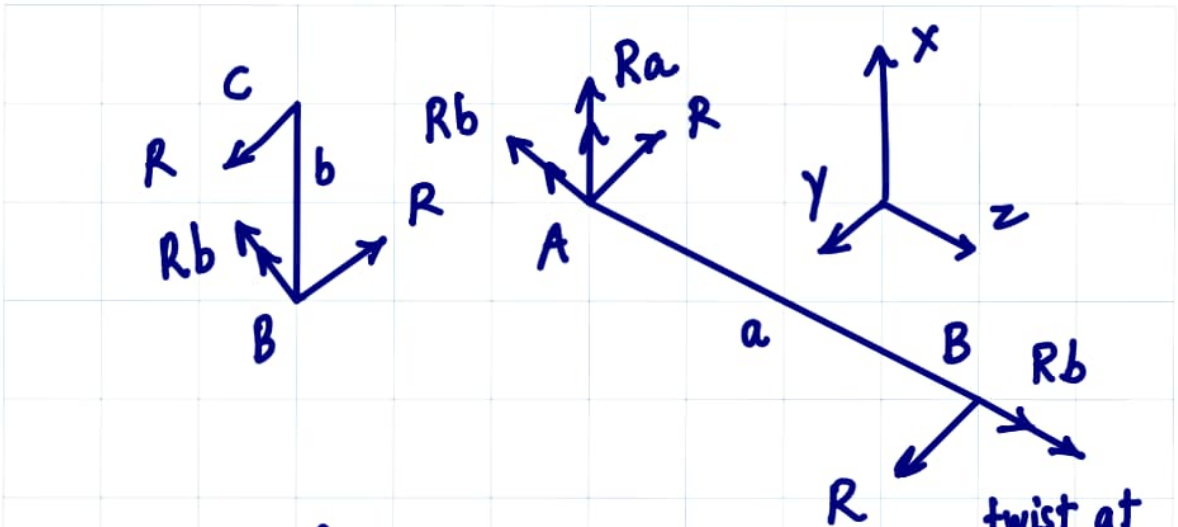

Q
C
b
A
a
B
Qa
Q
A
Q
C
Q
b
B
Q

x disp of C = $\underbrace{\frac{Qb}{AE}}_{\text{extension of BC}} + \underbrace{\frac{Qa^3}{3EI}}_{\text{bending of AB}}$

y disp of C = 0

z disp of C = $-\underbrace{\frac{Qa^2}{2EI}}_{\text{rotation at B due to bending of AB}} b$


C
R
b
A
B
a
x
y
z
A
a
C
R
b
B



x disp of C = 0

z disp of C = 0

y disp of C = $\frac{Rb^3}{3EI}$ + $\frac{Ra^3}{3EI}$ + $\frac{Rbab}{GJ}$

bending of BC → 3EI

bending of AB ↓

twist at B due to ↓ torque Rb