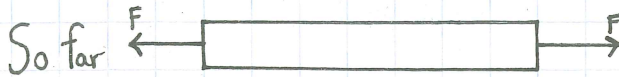


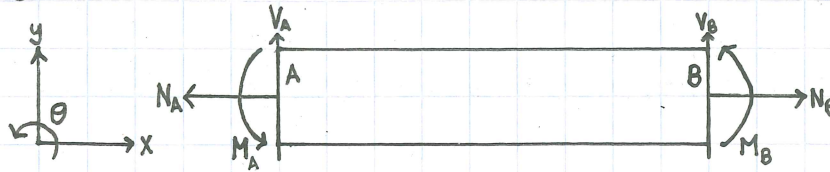
CIVIO2 - STRUCTURES and MATERIALS

Topic: Analysis of Structures

1) Structural Members = Components



Now



N = Axial Load, kN

↳ Aligned with Axis

V = Shear Force, kN

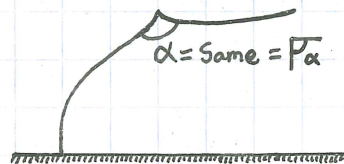
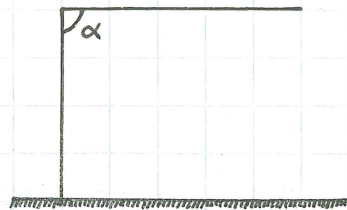
↳ \perp to longitudinal axis

M = Internal Bending Moment, kN·m

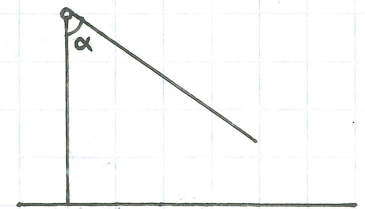
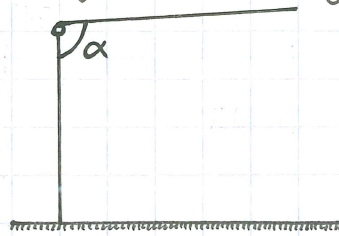
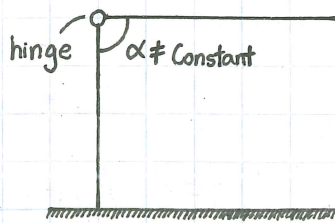
} Internal Forces

2) Connect Components

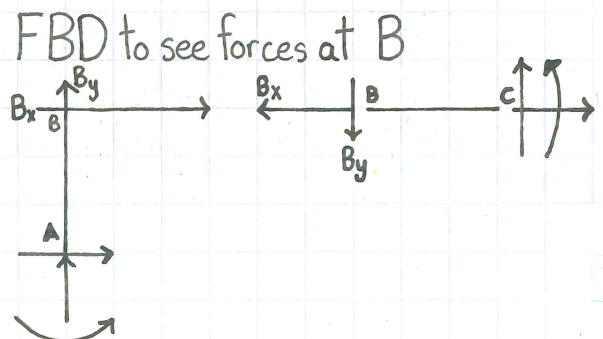
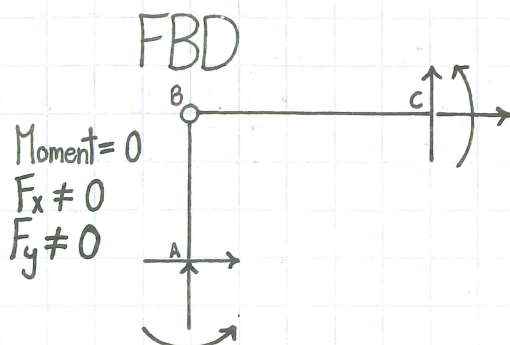
i) Rigid Connection (Connection = Where they touch)



ii) Hinged Connection (Internal Bending Moment at the Hinge = Zero kN·m by Definition)

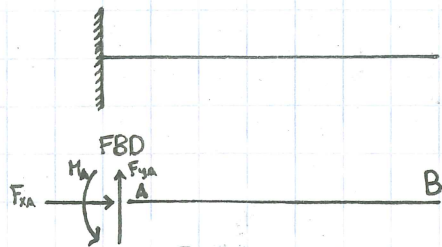


Forces at Hinge

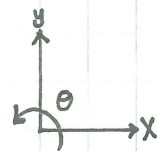


3) Connecting to the Ground (Boundary Conditions/Supports)

i) Fixed End - Fully Connected to Ground



(Cantilevers)



Reaction Forces = Ground Pushing on the Structure

ii) Pin



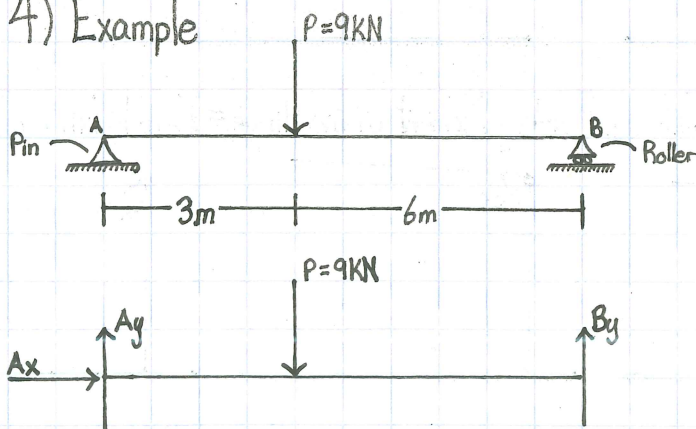
Resist Force in $x = F_x$
Resist Force in $y = F_y$
Cannot Resist a Moment

iii) Roller



Cannot Resist a Moment
Cannot Resist a Horizontal Force
Can Resist a F_y Force

4) Example



$$\sum F_x = 0$$

$$0 = A_x$$

$$\sum M_A = 0$$

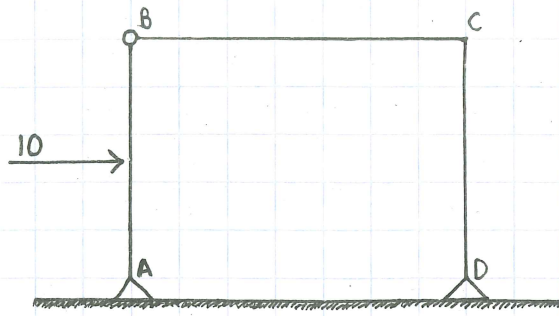
$$0 = -9\text{kN} \cdot 3\text{m} + B_y \cdot 9\text{m}$$

$$\sum F_y = 0, A_y = 6\text{kN}$$

5) Determinacy

- i) Fewer Unknowns than Equations \longrightarrow Unstable
- ii) Same Number of Equations as Unknowns \longrightarrow Statically Determinate
- iii) More Unknowns than Equations \longrightarrow Statically Indeterminate

6) Example with Internal Hinge



FBD

