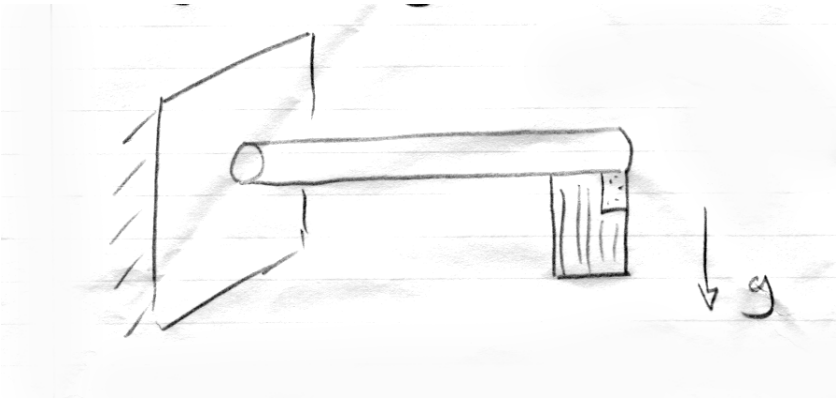
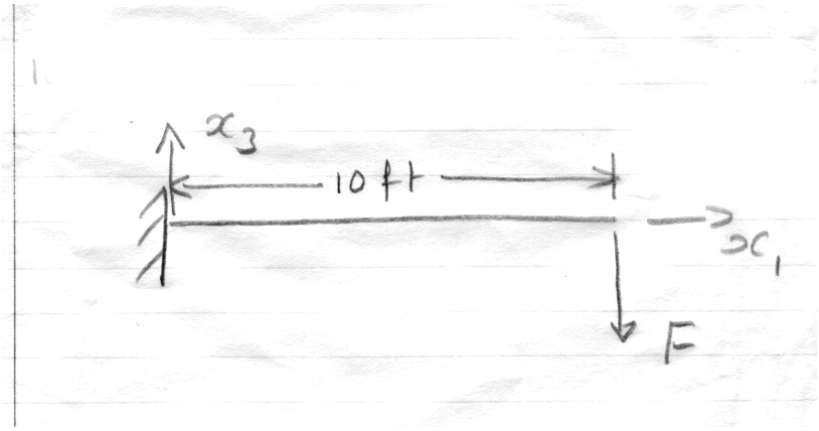
Lecture M4

Example of Use of Free Body Diagram

10 ft. flag pole (massless) in a wall with a weight (flag) at end

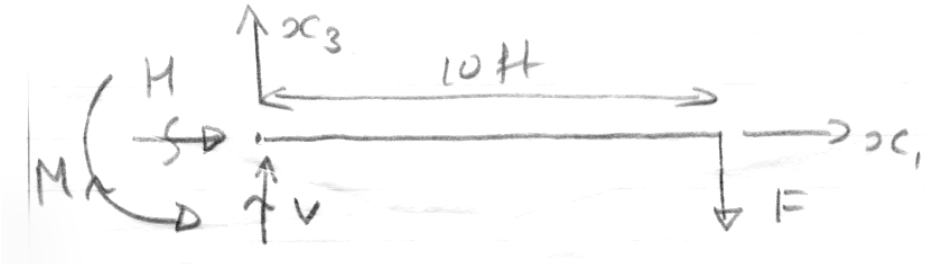


1 Idealize as 2-D structure



2 Replace supports by reactions which model them in the ideal case.

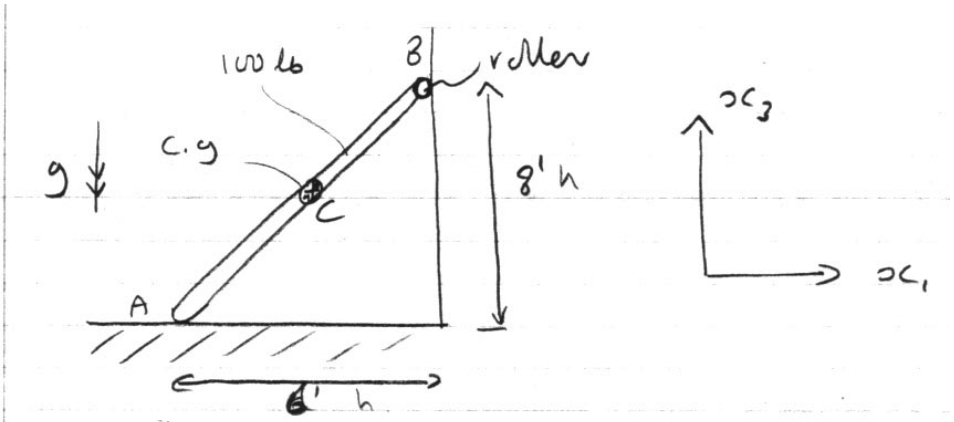
FBD



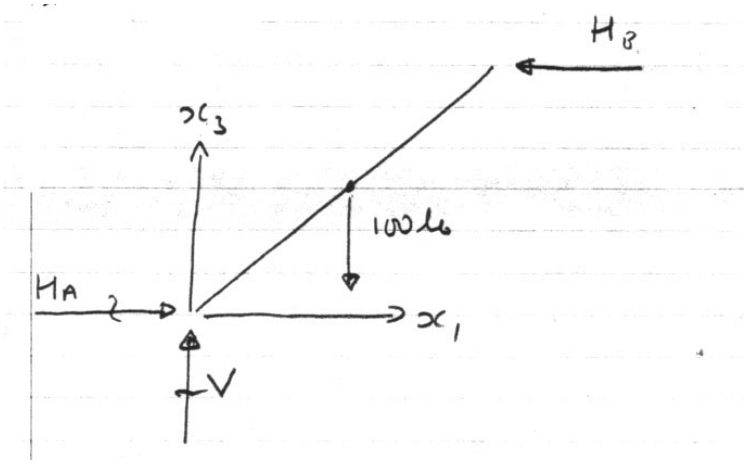
Example 2

Bar with roller leaning against wall.

friction = μ (find critical value)



Draw FBD



Before proceeding to apply equilibrium to analyze for the support reactions it is important to identify the potential categories of problem that may exist:

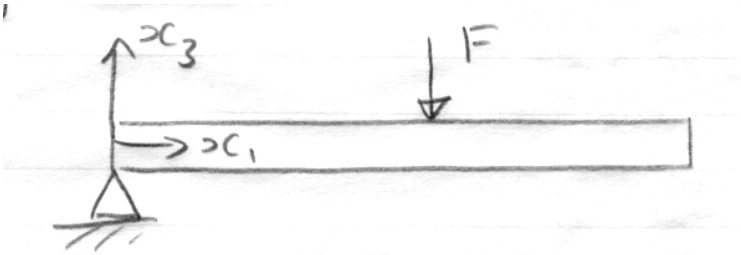
Three Problem Categories

1.) Dynamic:

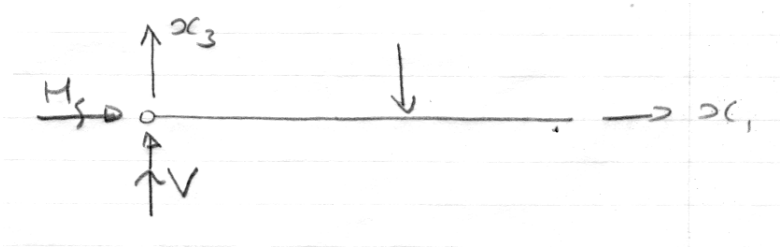
Number of rigid body degrees of freedom (DOF) > number of reactions

⇒ Body Moves

Example



FBD



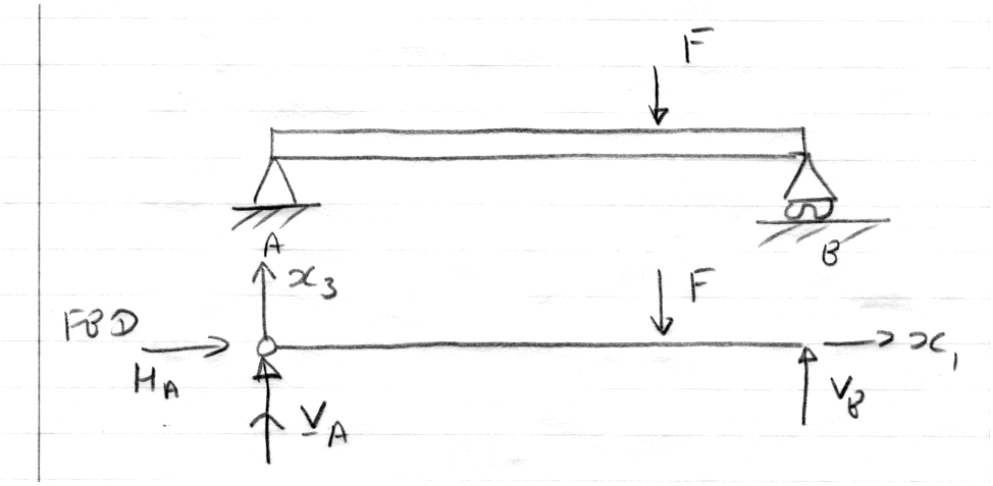
2 reactions
3 DoF two components of translation, one axis of rotation

∴ Dynamic

(Note, in 3-D there would be 6 degrees of freedom - 3 components of translation, 3 axes of rotation)

2. Statically Determinate

Number of rigid body Degrees of Freedom = number of reactions

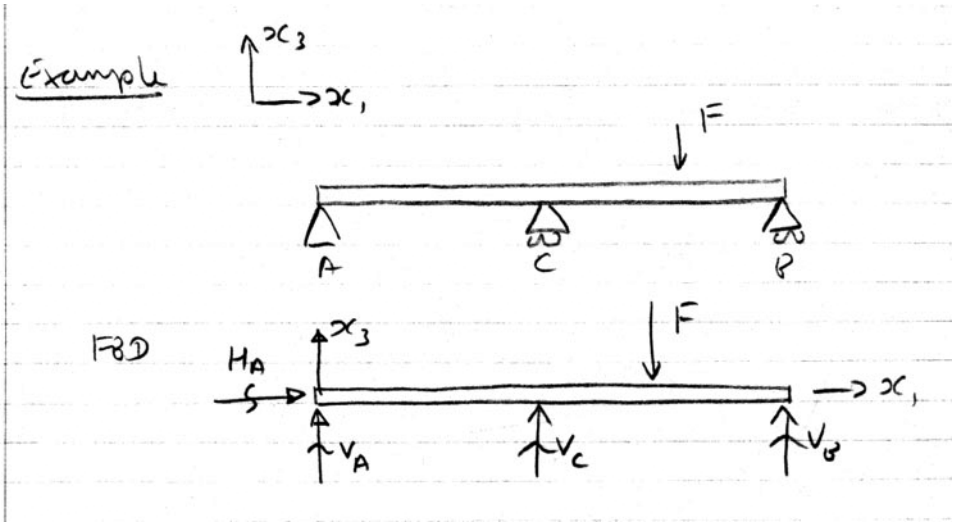


3 D of F as before, but now 3 reactions

Implication Can determine reactions and internal forces purely from Equilibrium considerations

3. Statically Indeterminate

Number of rigid body Degrees of freedom < Number of reactions



4 Reactions, 3 D o F (as before)

Implication Cannot determine reactions and internal forces from equilibrium but also need to include deformation of the structure - constitutive relations.

⇒Material does make a difference for internal and external reactions. (see block 3)