Rigid Body in Equilibrium

Background (learnt in the previous chapter)

1. External forces acting on a rigid body can be reduced to a force-couple system at any arbitrary point “O”
2. The body is in equilibrium if both force and moment are zero

Free Body Diagram

Why:
It is essential to consider all forces acting on the body and exclude any force not directly applied to the body ----> The first step is to draw a FBD

Steps in drawing FBD:

1. Clear decision about the body --> detach the body the other bodies/parts and ground-->Sketch the isolated body
2. All external forces (including the weight and the reactions from the ground and other detached bodies) should be shown on the FBD
3. The magnitude and directions of all known external forces should be clearly marked; forces shown on FBD are the forces acting *on* the body not exerted by the body

Free Body Diagram

Steps in drawing FBD (in continuation):

4. Unknown external forces are usually the reactions from the ground or other supports through which the possible motions of FBD is restricted; Reactions are also known as *constraining* forces; they act at the points where the FBD is supported by or connected to other bodies

5. FBD should include dimensions

Supports

Different Types of Supports and Nature of Unknown Reactions

Reactions equivalent to a force with known lines of action (Magnitude is unknown)
E.g., rollers, rockers, frictionless surfaces, collars on frictionless rods, and pins in slots, short links and cables

Ref: Slide 4-5

Reactions Equivalent to a Force of Unknown Direction and Magnitude
E.g., Frictionless pins in fitted holes, hinges, and rough surfaces
Translation of the body is prevented but not rotation, forces are marked in component form (unknown direction)
Ref: Slide 4-6

Reactions Equivalent to a Force and a Couple (fixed supports which oppose any motion of the free body and constrain it completely)
Three unknowns: Magnitude and direction of the force and the moment of the couple.

Truss

1. One of the major types of engineering structures
2. These are designed to support loads
3. They are usually stationary, fully constrained structures
4. Straight members connected at joints located at the ends of each member
5. *Two force members* acted upon by two equal and opposite forces along the member

https://www.arworld089.com/2019/05/narasimha-konda-travel-guide.html#gsc.tab=0

Definitions

Two force members: Rigid bodies, in equilibrium, subjected to two forces are called as two force members. "*If a two-force body is in equilibrium, the two forces must have the same magnitude, the same line of action, and opposite **sense**.*"

Three force member: "A rigid body in equilibrium, subjected to three forces or, more generally, *a rigid body subjected to forces acting at only three points.*"

Sense of a vector: Specifies the direction of the vector in which it moves along the line of action.