Tips – Free Body Diagramme

1. **Imagine the body to be isolated or "cut free" from its constraints and connections and sketch its outlined shape.**

2. **Identify all the external forces and couple moments that act on the body. Those generally encountered are:**

    a. Applied **loadings**

    b. **Reactions** occurring at the supports or at points of contact with other bodies

    c. The **weight** of the body (applied at the body's centre of gravity).

3. **Labeling:**

    a. Forces and couple moments should be labeled with their proper magnitudes and directions. **Letters** are use to represent the magnitudes and direction angles of forces and couple moments that are **unknown**.

    b. Establish and x, y, and z-**coordinate system** so that these unknowns e.g. A_x, A_y, etc. can be identified.

    c. Indicate the **dimensions** of the body necessary for computing the moments of external forces.

    d. Indicate if a force or couple moment has a **known line of action but unknown magnitude**, the arrowhead which defines the sense of the vector can be assumed. The correctness of the assumed sense will become apparent after solving the equilibrium equations for the unknown magnitude. By definition, the magnitude of a vector is **always positive**, so that if the solution yields a negative scalar, the minus **sign** indicates that the vector's sense is **opposite** to that which was originally assumed.

4. Other Tips

a. No equilibrium problem should be solved without first drawing the free-body diagramme, so as to account for all the external forces and moments that act on the body.

b. If a support **prevents translation** of a body on a particular direction, then the support exerts a force on the body in that direction.

c. If **rotation is prevented** then the support exerts a couple moment on the body.

d. Internal forces are never shown on the free-body diagram, since they occur in equal but opposite collinear pair and therefore cancel each other out.

e. The weight of a body is an external force and its effect is shown as a single resultant forces acting through the body's centre of gravity **G.**

f. **Couple moments** can be placed anywhere on the free-body diagramme since they are **free vectors**. **Forces** can act at any point along their lines of action since they are **sliding vectors**.

g. When applying the force equilibrium equations orient the z and y-axis along lines that will provide the simplest resolution of the forces into their z and y components.

h. Apply the moment equation of equilibrium about a point that lies at the intersection of the lines of action of two unknown forces. In this way, the moments of these unknowns are zero about the point and a direct solution for the third unknown can be determined.

i. If the solution of the equilibrium equations yields a negative scalar for a force or couple moment magnitude, this indicates that the sense is opposite to that which was assumed on the free-body diagramme.

5. Equilibrium in 2-dimensional Coordinate System

$$\sum F_x = 0$$

$$\sum F_y = 0$$

$$\sum M_o = 0$$