

FBD Guidelines

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Free Body Diagrams (FBDs) are the cornerstone of static and dynamic analysis.

1. Draw a separate figure for each FBD.
2. Title your FBD with the name of the part or system of parts being analyzed.
3. Draw only **external** forces being applied onto the object being analyzed, in the direction they are applied **onto** the object being analyzed. The forces will visually show:

$$\Sigma F_{\text{on the body}} = m a_{\text{of the body}}$$

4. At every point where the object being analyzed touches an external part, there can be a force applied at that point.
5. Draw the force vectors tip or base at the **precise** location where the force is being applied.
6. Include a coordinate system on each FBD.
7. For dynamic analysis, always show the Center-of-Mass of the object.
8. Do not draw “imaginary” forces such as inertial or equivalent forces.

Visual Check of Your FBD

Visually add the forces in the x and y direction, and estimate clockwise and counter-clockwise torques. If your object is in equilibrium there should be balanced forces and torques. If your object is undergoing acceleration, there should be forces/torques in that direction.

Reoccurring Cases

- Pinned and bolted joints can have forces in both the x and y directions.
- Cables and belts apply only tension forces aligned with the cable or belt.

Why Do We Not Draw Internal Forces?

Every object has internal forces that hold it together, but we do not consider these forces when analyzing the motion of the object as a whole. If we need to analyze internal forces we will draw a separate FBD of the internal parts. If you draw internal forces in an FBD it will improperly portray the equation shown in step 3 above.