

Shafts + shaft components: intro

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A **shaft** is a **rotating member**, usually of circular cross section, used to transmit power or motion.

It provides the **axis** of rotation, or oscillation, of elements such as gears, pulleys, flywheels, cranks, sprockets, ... and controls the geometry of their motion. (Budynas)

An **axle** is a **nonrotating member** that carries no torque and is used to support rotating wheels, pulleys, and the like. ... A nonrotating axle can readily be designed and analyzed as a static beam (Budynas)

No new analysis techniques will be required to analyze and design shafts. However, shafts are common enough to warrant a special discussion.

The following considerations are important for shaft design:

- **Material selection**
- **Geometric layout**
- **Stress and strength**
 - Static strength
 - Fatigue strength
- **Deflection and rigidity**
 - Bending deflection
 - Torsional deflection
 - Slope at bearings and shaft-supported elements
 - Shear deflection due to transverse loading of short shafts
- **Vibration** due to natural frequency (Budynas)

We will generally follow the following two-step design process:

1. size the shaft based on **stress analysis of critical points** and shaft-supported machine elements, and
2. analyze for **deflection** and iterate the design accordingly.