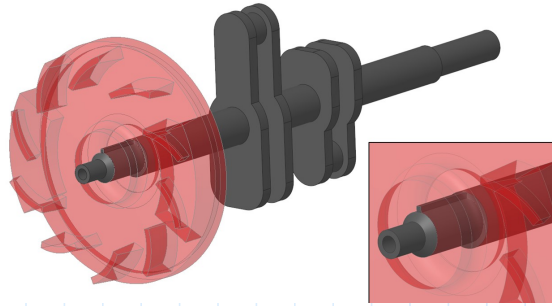


## Shaft Key Calculations

A key is a mechanical component used to transfer power between a rotating shaft and a machine component.



$$K_s = \frac{K_a \cdot K_d}{K_f}$$

Service Factor

$$K_d := 1$$

Design factor for fixed (close fit) loaded

$$K_a := 1$$

Application factor  
Uniform power source, uniform load

$$K_f := 0.3$$

Fatigue life factor for 10 million cycles

$$K_s := \frac{K_a \cdot K_d}{K_f} = 3.333$$

$$T := 150 \cdot N \cdot m$$

Torque

### Key Dimensions

$$w := 12.5 \cdot mm$$

$$l := 50 \cdot mm$$

$$h := 10 \cdot mm$$

### Shaft dimensions

$$d := 50 \cdot mm$$

Nominal diameter

$$d_{re} := d - \frac{h}{2} = 45 \text{ mm}$$

Reduced diameter

$$\sigma_{max} := 250 \cdot MPa$$

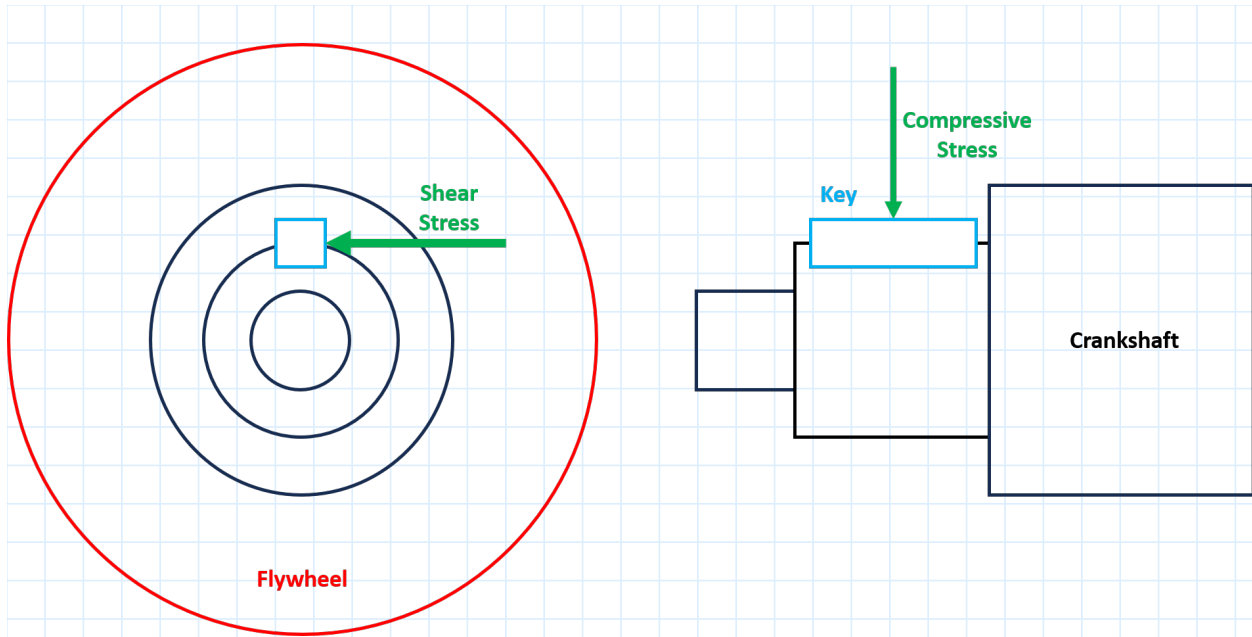
Steel yield strength

### Calculation of Torque for Reduced Diameter

$$T_{max} = \frac{\left(\frac{\sigma_{max}}{2}\right) \cdot I}{\frac{d_{re}}{2}} \qquad T_{max} = \frac{\sigma_{max} \cdot I}{d_{re}}$$

$$I := \frac{\pi}{4} \cdot \left(\frac{d_{re}}{2}\right)^4 = (2.013 \cdot 10^5) \text{ mm}^4$$

$$T_{max} := \frac{\sigma_{max} \cdot I}{d_{re}} = 1118.3 \text{ N} \cdot \text{m}$$



### Stress Calculations

#### Shear Stress

$$\tau := \frac{T \cdot K_s}{l \cdot w \cdot \frac{d_{re}}{2}} = 35.556 \text{ MPa}$$

#### Compressive Stress

$$\sigma_c := \frac{T \cdot K_s}{\left(\frac{h}{2}\right) \cdot l \cdot \frac{d_{re}}{2}} = 88.889 \text{ MPa}$$