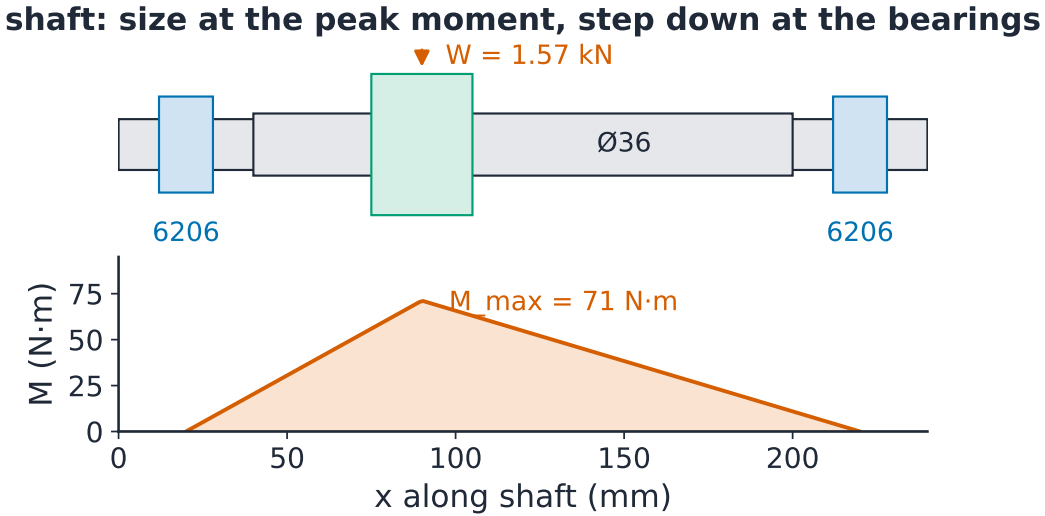
Exercise walk-through

9.4
Shafts and bearings

University Mechanical Engineering

The shaft and its moment diagram



Gear 70 mm from the left bearing on a 200 mm span: $R_1 = \mathbf{1.02}$ kN, $M_{max} = \mathbf{71.2}$ N · m at the gear seat.

Sizing the seat and choosing the bearing

1. **Diameter** DE-Goodman with $n = 2$ gives $d = \mathbf{29.0}$ mm $\rightarrow$ choose $\mathbf{30}$ mm ($n = 2.21$).
2. **Life** 180 rpm $\times$ 60 $\times$ 20 000 h $= \mathbf{2.16 \times 10^{8}}$ rev.
3. **Rating** $C_{req} = 2.94 \times 216^{1/3} = \mathbf{17.6}$ kN.
4. **6206** $C = 19.5$ kN $\rightarrow$ $L_{10} = \mathbf{27\,000}$ h on the 30 mm seat.

Decision

One bearing meets both the bore and the life, with 35% margin.

Exercises 2.1·2.2

2.1 A shoulder carries $M_a = 90\ \text{N}\cdot\text{m}$ ($K_f = 1.8$) and a steady $T_m = 250\ \text{N}\cdot\text{m}$ ($K_{fs} = 1.5$). Find the diameter for $n = 2$ (one decimal, mm) and choose a standard size from 30, 35 and 40 mm. [4]

2.2 A 6207 carries $P = 3.2$ kN at 300 rpm. Find its L_{10} life (nearest hundred hours). [3]

Exercises 2.1·2.2

2.1 A shoulder carries $M_a = 90\ \text{N}\cdot\text{m}$ ($K_f = 1.8$) and a steady $T_m = 250\ \text{N}\cdot\text{m}$ ($K_{fs} = 1.5$). Find the diameter for $n = 2$ (one decimal, mm) and choose a standard size from 30, 35 and 40 mm. [4]

2.1

- $d = \left[\frac{16n}{\pi}(2K_f M_a/S_e + \sqrt{3}K_{fs}T_m/S_{ut})\right]^{1/3} = \left[\frac{32}{\pi}(2 \times 1.8 \times 90\,000/220 + \sqrt{3} \times 1.5 \times 250\,000/630)\right]^{1/3}$ (N · mm and MPa).
- $= [10.19 \times (1472.7 + 1031.0)]^{1/3} = \mathbf{29.4}$ mm.
- Choose the next standard size up: **30** mm.

2.2 A 6207 carries $P = 3.2$ kN at 300 rpm. Find its L_{10} life (nearest hundred hours). [3]

2.2

- $L_{10} = (C/P)^3 \times 10^6/(60N) = (25.5/3.2)^3 \times 10^6/(60 \times 300) = \mathbf{28\,100}$ h.

Exercise 3.1

3.1 The drive of 2.2 must last 30 000 h. Find the revolutions needed and C_{req} (two decimals, kN). Does the 6207 meet it? Find the life of the 6208, and state the knock-on change its larger bore forces on the shaft. [6]

Exercise 3.1

3.1 The drive of 2.2 must last 30 000 h. Find the revolutions needed and C_{req} (two decimals, kN). Does the 6207 meet it? Find the life of the 6208, and state the knock-on change its larger bore forces on the shaft. [6]

3.1

- $L = 300 \times 60 \times 30\,000 = \mathbf{5.40} \times \mathbf{10^8}$ rev.
- $C_{req} = P(L/10^6)^{1/3} = 3.2 \times 540^{1/3} = \mathbf{26.06}$ kN.
- The 6207's 25.5 kN falls short.
- 6208: $L_{10} = (30.7/3.2)^3 \times 10^6/18\,000 = \mathbf{49\,100}$ h.
- Its 40 mm bore needs 40 mm seats and a larger shoulder, so the shaft drawing (and its parameters) changes.