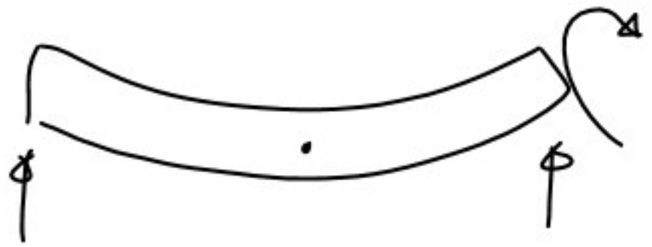
Critical Speed

$$\omega_1 = \left(\frac{\pi}{l}\right)^2 \sqrt{\frac{EI}{m}} = \left(\frac{\pi}{l}\right)^2 \sqrt{\frac{gEI}{A\gamma}}$$

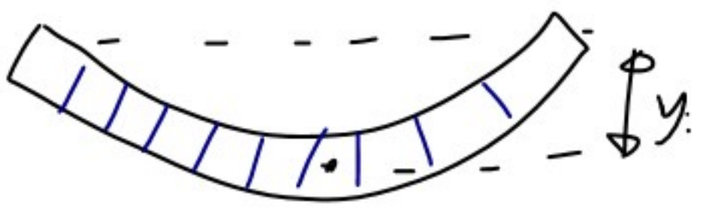
Simply supported shafts

constant cross section



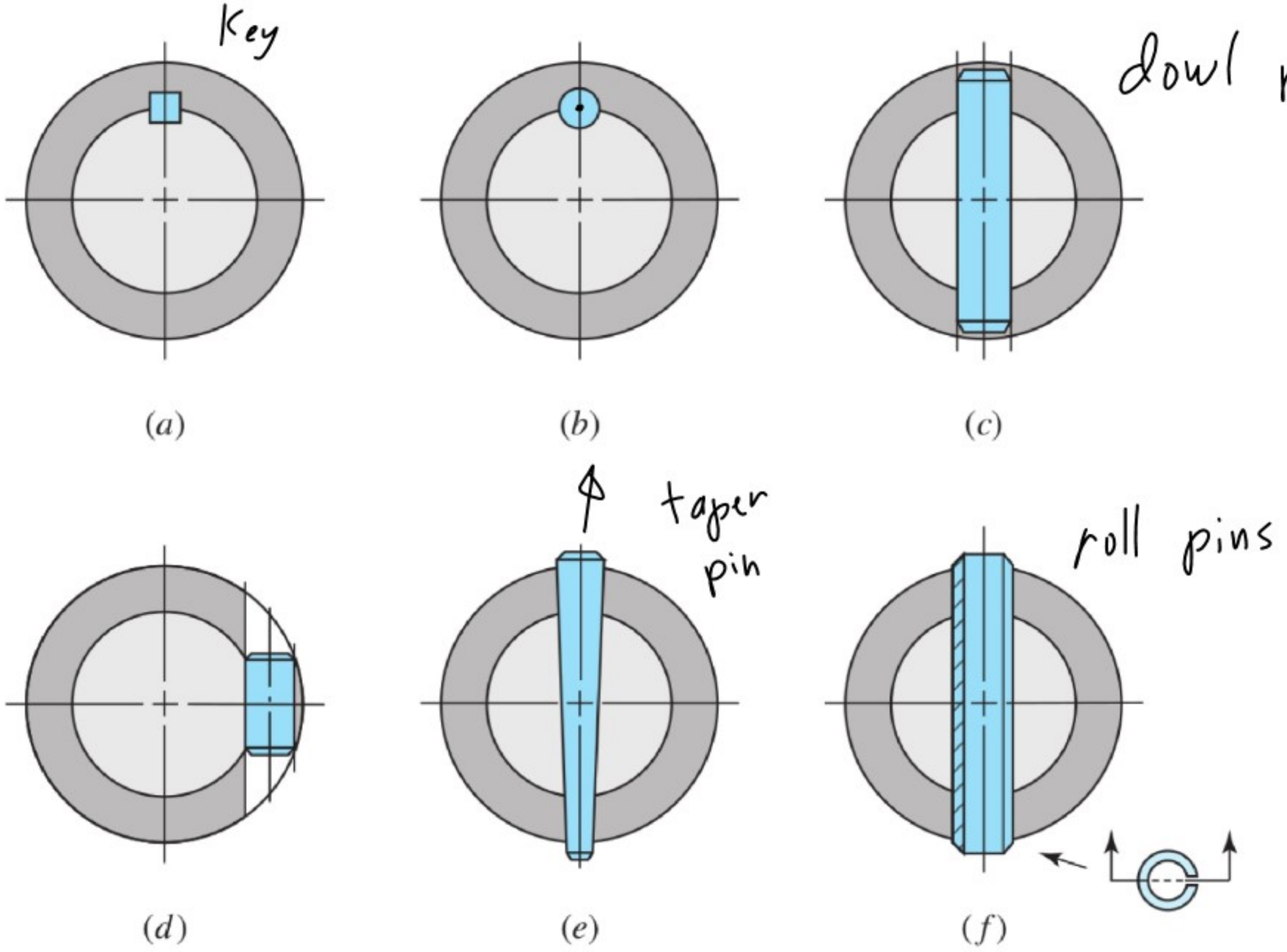
l	length
m	mass
g	gravity
A	cross sectional area
γ	Specific weight

$$w_1 = \sqrt{\frac{g \sum w_i y_i}{\sum w_i y_i^2}}$$

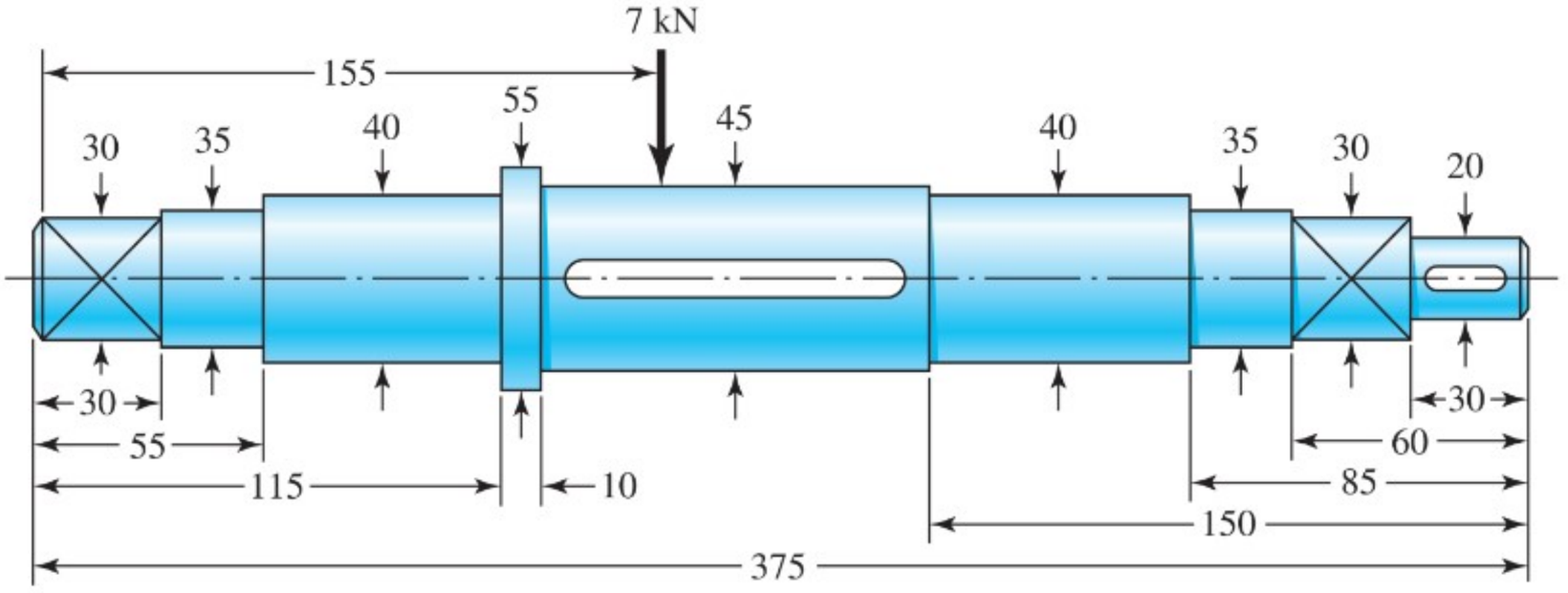


Weight w_i

Keys and Pins



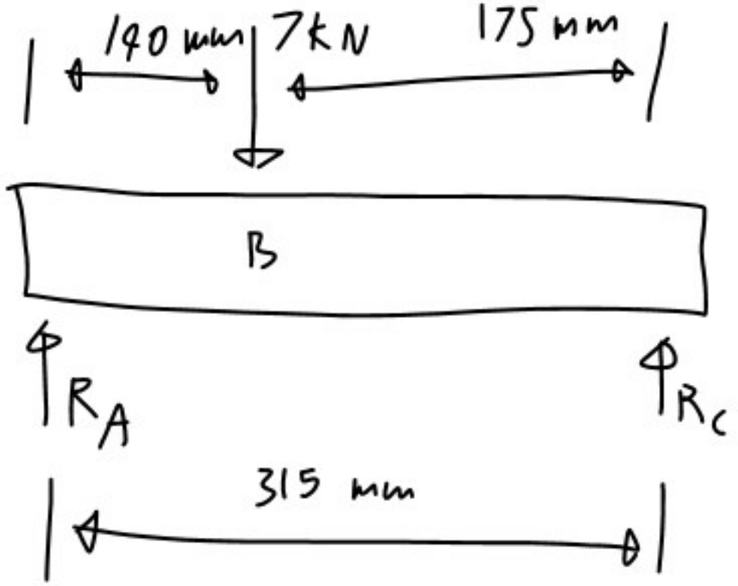
7–29 An AISI 1020 cold-drawn steel shaft with the geometry shown in the figure carries a transverse load of 7 kN and a torque of 107 N · m. Examine the shaft for strength and deflection. If the largest allowable slope at the bearings is 0.001 rad and at the gear mesh is 0.0005 rad, what is the factor of safety guarding against damaging distortion? Using the DE-Goodman criterion, what is the factor of safety guarding against a fatigue failure? If the shaft turns out to be unsatisfactory, what would you recommend to correct the problem?



Problem 7–29

Dimensions in millimeters.

All fillets 2 mm



$$M_{AB} = \frac{Fbx}{\ell} = \frac{7000 \cdot 0.175\, x}{0.315} = 3889\, x$$

$$M_{BC} = \frac{Fa}{\ell}(\ell - x) = \frac{7000 \cdot 0.14}{0.315}(0.315 - x)$$

$$= 3111(0.315 - x)$$

$$= 980 - 3111x$$

$$\frac{d^2y}{dx^2} = \frac{M}{EI} \qquad I = \frac{\pi d^4}{64} \qquad \sigma = \frac{Mc}{I}$$

$$y(0) = 0 \qquad y(0.315) = 0$$