S-shape stiffness

$C_x = C_y = \frac{12EI}{L^3} = \frac{3\pi E d^4}{16L^3}$

$C_z = \frac{EA}{L}$ only if $u_x = 0$ $\qquad C_z = \frac{1}{\frac{L}{EA}+\frac{u_x^2 L}{700EI}}$ for $u_x \neq 0$

$$K_x = K_y = \frac{EI}{L} = \frac{\pi E d^4}{64L}$$
$$K_z = \frac{G\pi d^4}{32L} = \frac{E\pi d^4}{64(1+\nu)L}$$

S-shape motion characteristics

$u_x = \frac{F_x}{C_x} \qquad u_{xmax} = \frac{1}{3}\frac{L^2}{Ed}\sigma_{max}$

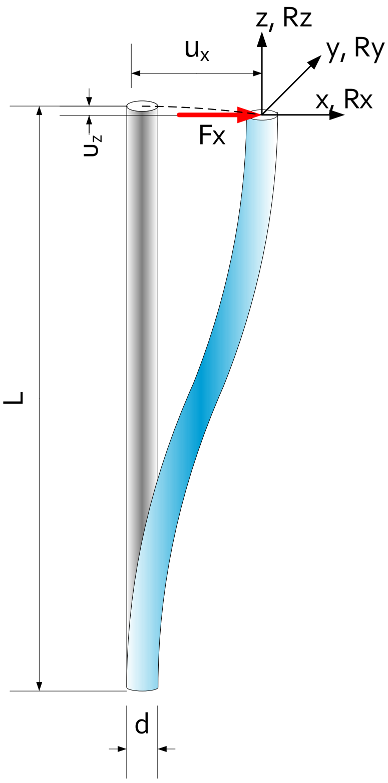
$u_z = \frac{3}{5}\frac{u_x^2}{L}$

S-shape force limits

$$\sigma_{max} = \frac{M_{max}}{I}\frac{1}{2}d = \frac{\frac{F_x L}{2}}{I}\frac{1}{2}d = \frac{F_x L d}{4I}$$

dynamic movements: σ_{max} < *fatigue stress limit*
static deformation: σ_{max} < *yield stress limit* ($\sigma_{0.2}$)

See *Beam Theory: Buckling* for equations to calculate the maximum buckling load.



Rod spring in s-shape deformation: $I = \frac{\pi d^4}{64}$

C-shape stiffness

$C_x = C_y = \frac{3EI}{L^3}$

$C_z = \frac{EA}{L}$ only if $u_x = 0$

$$K_x = K_y = \frac{EI}{L} = \frac{\pi E d^4}{64L}$$
$$K_z = \frac{G\pi d^4}{32L} = \frac{E\pi d^4}{64(1+\nu)L}$$

C-shape motion characteristics

$u_x = \frac{F_x}{C_x} \qquad u_{xmax} = \frac{2}{3}\frac{L^2}{Ed}\sigma_{max}$

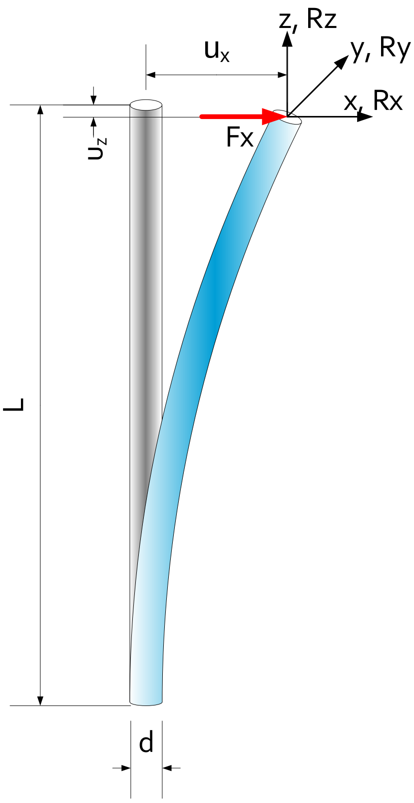
$u_z = \frac{3}{5}\frac{u_x^2}{L}$

C-shape force limits

$$\sigma_{max} = \frac{M_{max}}{I}\frac{1}{2}d = \frac{F_x L}{I}\frac{1}{2}d = \frac{F_x L d}{2I}$$

dynamic movements: σ_{max} < *fatigue stress limit*
static deformation: σ_{max} < *yield stress limit* ($\sigma_{0.2}$)

See *Beam Theory: Buckling* for equations to calculate the maximum buckling load.



Rod spring in c-shape deformation