Knuckle Joint

↳ It's used to Connect two rods under the action of tensile loads.

Parts :
- Solid. Rod.
- Knuckle Pin.
- Single eye end. (or) rod.
- Double (fork end)

Various Properties

- Diameter of rod = d.
- Diameter of Pin = $d_1 = d$, Dia of Pin head (d_3) = $1.5d$
- Outer dia of eye, $d_2 = 2d$.
- Thickness of eye (t) = $1.25d$.
- Thickness of Pin head (t_2) = $0.5d$
- Thickness of fork (t_1) = $0.75d$

Design of Knuckle Joint : (Rod design)

(1) Failure of Solid rod in tension.

$$P = \frac{\pi}{4} d^2 \sigma_t$$

Knuckle Pin design

Failure of knuckle Pin by double shear.

$$P = 2 \times \frac{\pi}{4} d_1^2 \cdot \tau$$ → shear stress

Failure of knuckle Pin by bending.

$$\sigma_b = \frac{\frac{P}{2}\left(\frac{t_1}{3} + \frac{t}{4}\right)}{\frac{\pi d_1^3}{32}}$$

Single eye (or) rod end design

Failure of single eye in tension.

$$P = (d_2 - d_1)\, t \cdot \sigma_t$$

Failure of single eye in double shear.

$$P = 2 \times \frac{(d_2 - d_1)\, t}{2} \times \tau = (d_2 - d_1)\, t \cdot \tau$$

Failure of single eye in crushing.

$$P = d_1 \, t \cdot \sigma_c$$ → allowable stress in crushing.

Fork end design:

Failure of fork end in tension.

$$P = (d_2 - d_1) t_1 \times \sigma_t$$

Failure of fork end in double shear

$$P = (d_2 - d_1) t \times 2 \times \tau$$

Failure of fork end in crushing.

$$P = d_1 t_1 \times \sigma_c$$

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(1) A knuckle joint is transmit a force of 140kN allowable stresses in tension, shear and Compression are, 75 N/mm², 65 N/mm², 140 N/mm². Design a joint.

→ Gn:- $P = 140\ kN = 140 \times 10^3\ N$.

$\sigma_t = 75\ N/mm^2$

$\sigma_c = 140\ N/mm^2$

$\tau = 65\ N/mm^2$

∴ Soln:- → $d^2 = P \times \frac{4}{\pi} \times \frac{1}{\sigma_t}$

$d = 48.75 \approx \boxed{50\ mm}$