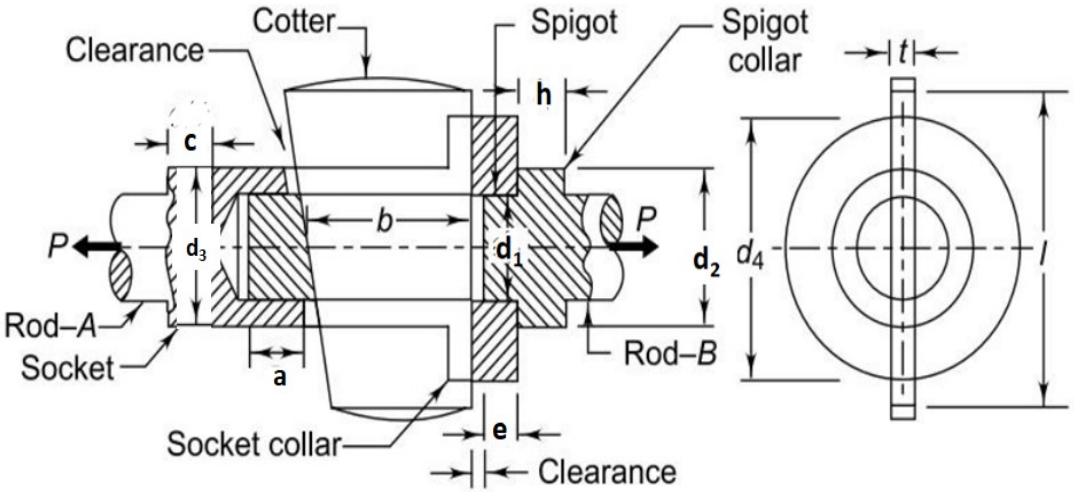
Standard size of Rod/Shaft/Tube/Bolts

Range of Size	Increment steps
0-10	1mm
10-24	2mm
24-45	3 mm
45-100	5 mm
>100	10 mm

Spigot & Socket Cotter Joint

Design 1: Design a cotter joint subjected to a tensile load of P=18/24/32/38 kN. The material of all the parts is 35C4 with σ_{UTS}= 380 MPa. Take FOS=5; τ_{per}=0.8 $(\sigma_t)_{per}$; $(\sigma_c)_{per}$= 1.25$(\sigma_t)_{per}$.



P = tensile force acting on rods (kN)
d = diameter of each rod (mm)

d_1= diameter of spigot or inside diameter of socket (mm) = 1.2d
d_2= diameter of spigot-collar (mm)= 1.5d
d_3= outside diameter of socket (mm) = 1.75d
h=**c**=thickness of spigot-collar (mm) =0.5d

d_4= diameter of socket-collar (mm)= 2.4d
a = distance from end of slot to the end of spigot on rod-B (mm)
b = mean width of cotter (mm)=1.6d

e =**a**=axial distance from slot to end of socket collar (mm)=0.75d
t = thickness of cotter (mm)= $d_1/4$

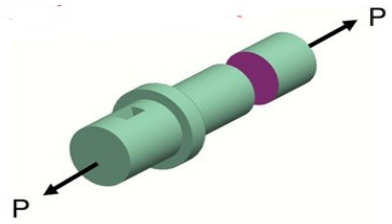
l = length of cotter (mm)=4d

Design Steps:

1. Rod in Tension:

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

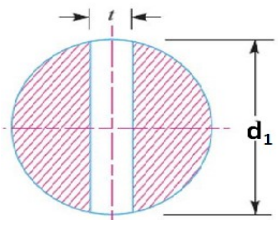
Choose standard size of rod diameter from the table

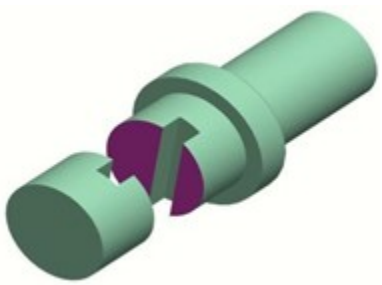


2. Spigot in Tension

$$P = \sigma_t . \left[\frac{\pi}{4} d_1^2 - d_1 t\right] \Longrightarrow d_1\ ?, take\ t = \frac{d_1}{4}$$

Empirically, d_1=1.2d





3. Checking of Crushing of Spigot

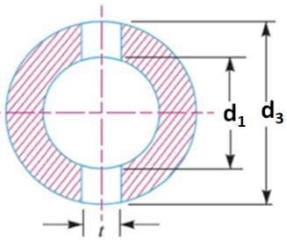
$$P \leq \sigma_c d_1 t$$

else increase 'd_1' and 't' suitably

4. Socket in Tension

$P = \sigma_t . \left[\frac{\pi}{4}(d_3^2 - d_1^2) - (d_3 - d_1)t\right] \Longrightarrow d_3$?

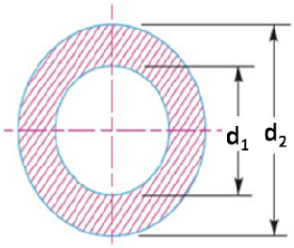
Empirically, d_3=1.75d



5. Crushing of collars of Spigot & Socket

$P = \sigma_c . \left[\frac{\pi}{4}(d_2^2 - d_1^2)\right] \Longrightarrow d_2$?

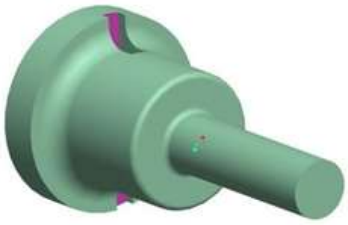
Empirically, d_2=1.5d

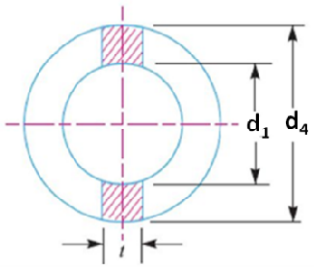


6. Crushing of Socket Collar by Cotter

$P = \sigma_c (d_4 - d_1)t \Longrightarrow d_4$?

Empirically, d_4=2.4d

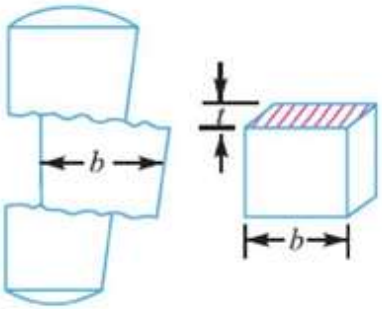




7. Double shear of Cotter

$P = \tau . 2bt \Longrightarrow b$?

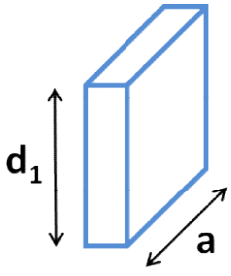
Empirically, b=1.6d

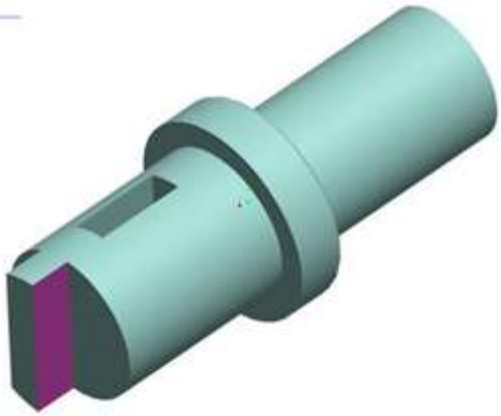


8. Shear of spigot

$P = \tau . 2ad_1 \Longrightarrow a$?

Empirically, a=0.75d





9. Shear of socket

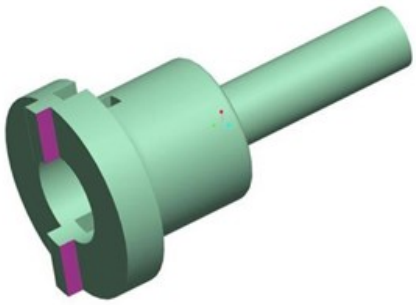
$$P = \tau.(\pi d)c \Longrightarrow c?$$

Empirically, c=0.5d

10. Shear of socket collar

$$P = \tau.2(d_4 - d_1)e \Longrightarrow$$

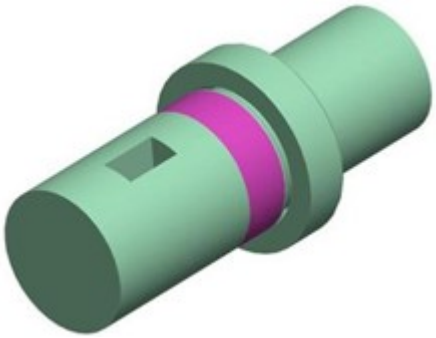
Empirically, e=0.75d



11. Shear of spigot collar

$$P = \tau.(\pi d)h \Longrightarrow h?$$

Empirically, h=0.5d



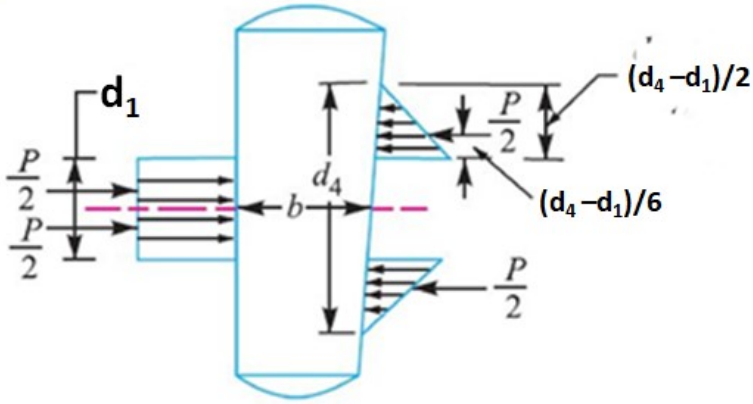
12. Bending of cotter

$$M = \frac{P}{2}\left[\frac{d_4 - d_1}{2 \times 3} + \frac{d_1}{2} - \frac{d_1}{4}\right]$$

$$\Rightarrow M = \frac{P}{2}\left[\frac{d_4 - d_1}{2 \times 3} + \frac{d_1}{4}\right]$$

$$z = \frac{I}{y} = \frac{tb^3/12}{b/2} = \frac{tb^2}{6}$$

$$\therefore Bending\ stress, \sigma_b = \frac{M}{z}$$



Check that $\sigma_b < \sigma_t$ else cotter is weak in bending.

VIVA QUESTIONS

Q1. Why is cotter designed as the weakest part in the spigot and socket cotter joint?

Q2. In a cotter or knuckle joint, if the applied load varies from X kN in tension to Y kN in compression, how will you design the rod?

Q3. What is the purpose of taper in cotter?

Q4. What is the purpose of clearances between cotter and other parts?