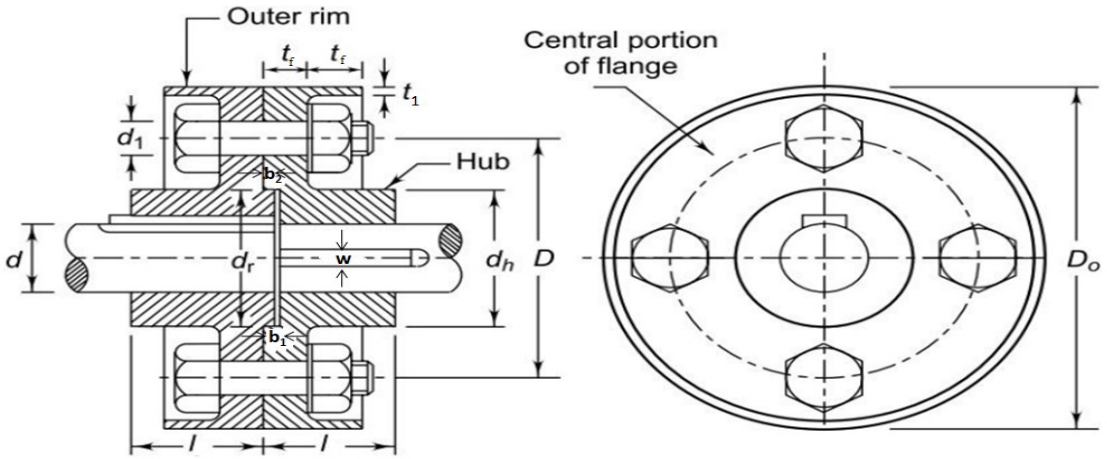
Standard size of Rod/Shaft/Tube/Bolts

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

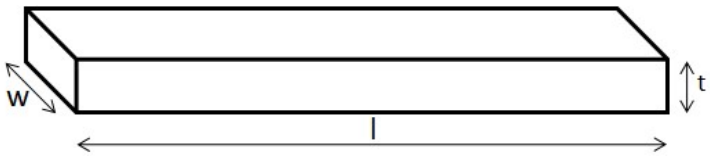
Protected Type Rigid Flange Coupling

Design 1: Design a protected type rigid flange coupling for joining shafts of 50 mm diameter rotating at 1200 rpm and transmitting a power of 40/50/60/70 kW. The allowable shear stress in bolts and flange is not to exceed 52 MPa. In key, τ_{per} = 50 MPa and $\sigma_{c_{per}}$= 85 MPa



Design Steps:

1. Diameter of shaft, **d** = 50 mm
   No. of bolts, **n** = 0.02d+3 (Even number)
   Nominal Diameter of bolts, $\boldsymbol{d_1} = \frac{0.5d}{\sqrt{n}}$ (std. size)
   Hub diameter, $\mathbf{d_h}$ = 2d
   Bolt pitch circle diameter, **D** = 3d
   Outer diameter of the flanges, $\mathbf{D_0}$ = 4d
   Hub length = Key Length = **l** = 1.25d to 1.5d
   Flange thickness,$\boldsymbol{t_f} = 0.5d$
   Diameter of register and recess, $\mathbf{d_r}$ = 1.5d
   Thickness of protecting rim, $\mathbf{t_1}$ = 0.25d
   Depth of groove, $\mathbf{b_1}$ = 6-8 mm
   Depth of register/solid projection, $\mathbf{b_2}$ = 4-6 mm
   Assuming rectangular key
   Width of key, **w** = $\frac{d}{4} to \frac{d+13}{4}$
   Thickness of key, **t** = $\frac{d}{6} to \frac{d+13}{6}$



2. Stresses in Hub
   $P = \frac{2\pi NT}{60}$ Watts, find torque 'T' in Nmm
   Check diameter of shaft
   $$\frac{16T}{\pi d^3} = \tau_{per\ shaft}$$
   Find'd', check d≤50 mm

Shear stress in hub

$$\tau_{hu} = \frac{16T}{\pi d_h^3(1-k^4)} \; where \; k = \frac{d}{d_h}$$

Check that $\tau_{hub} < \tau_{per\ hub}$

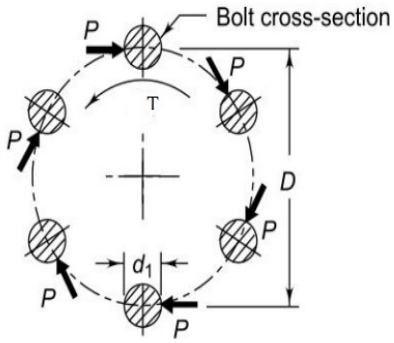
3. Shear stress in hub/flange section

$$\tau_{flange} = \frac{T}{\pi d_h t_f \left(\frac{d_h}{2}\right)}$$

Check that $\tau_{flange} < \tau_{per\ flange}$

4. Force per bolt

$$F = \frac{T}{n\left(\frac{D}{2}\right)}$$



Shear stress in bolts

$$\tau_{bolt} = \frac{F}{\frac{\pi}{4} d_1^2}$$

Check that $\tau_{bolt} < \tau_{per\ bolt}$

5. <u>Stresses in key</u>

Shear stress in key,

$$\tau_{key} = \frac{T}{(w \times l)\left(\frac{d}{2}\right)}$$

Check that $\tau_{key} < \tau_{per\ key}$

Compressive stress in key,

$$\sigma_{c_{key}} = \frac{T}{\left(\frac{t}{2} \times l\right)\left(\frac{d}{2}\right)}$$

Check that $\sigma_{c_{key}} < \sigma_{c_{per\ key}}$

6. Frictional torque

$$T_f = n\mu_c W r_m$$

where, as per Uniform Pressure Theory (UPT), mean radius,

$$r_m = \frac{1}{3}\left[\frac{D_0^3 - d_r^3}{D_0^2 - d_r^2}\right]$$

Coefficient of friction between flanges, $\mu_c = 0.15$

Initial tightening force, $W = 12\ kN$

Frictional Power

$$P_f = T_f \omega = T_f \left(\frac{2\pi N}{60}\right)$$

VIVA QUESTIONS

Q1. Why is it necessary to spot face the areas where nuts or bolts rest in a rigid coupling?

Q2. What purpose is served by register in a rigid coupling?

Q3. Why should finished bolts fitted into reamed holes be used in a rigid coupling?