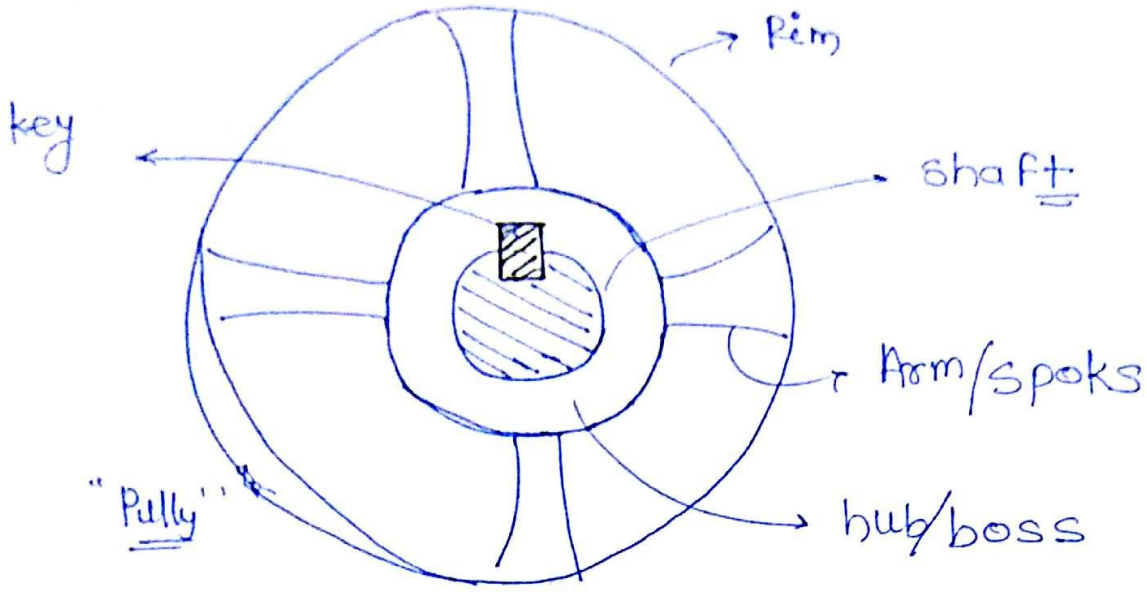
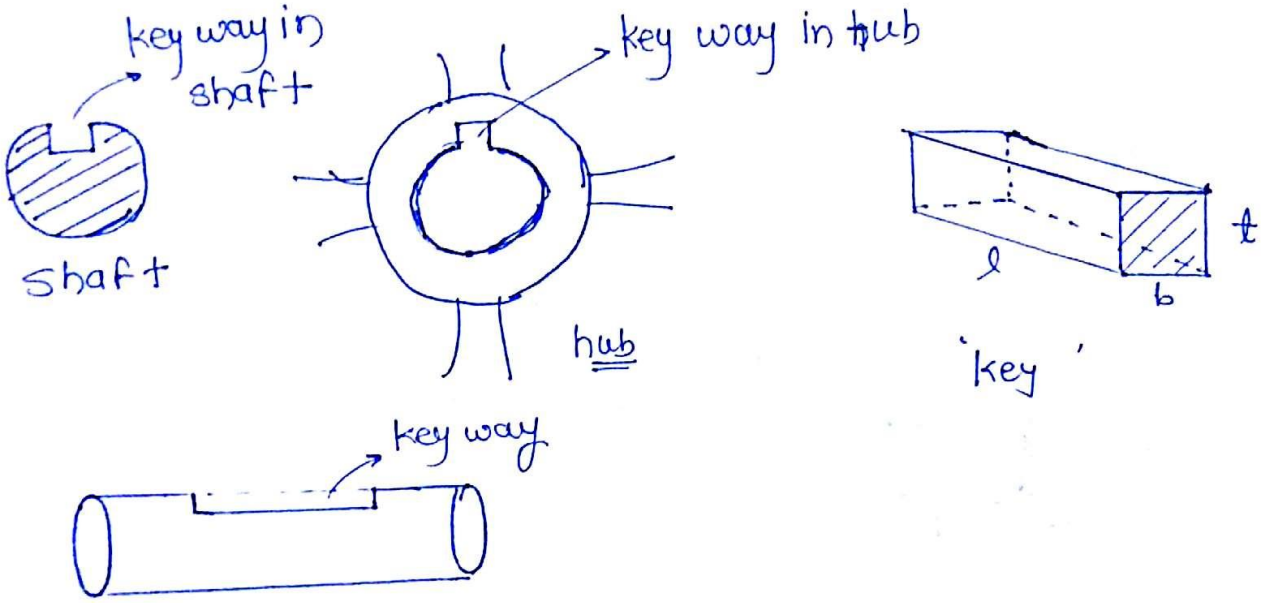
⇒ shaft, key, pully ⇒ key weakest element

Key Joint :-





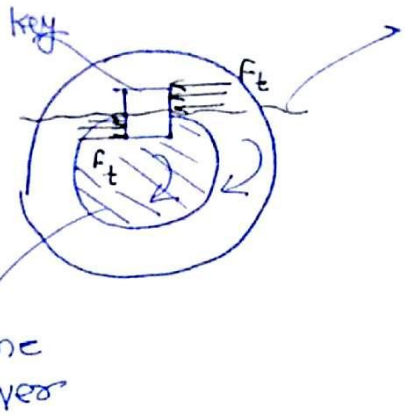
⇒ key is temporary fastners which is inserted b/w shaft and it's assembly (Pully, Gear, Clutch, Flywheel) to transmit power by preventing relative motion between them.

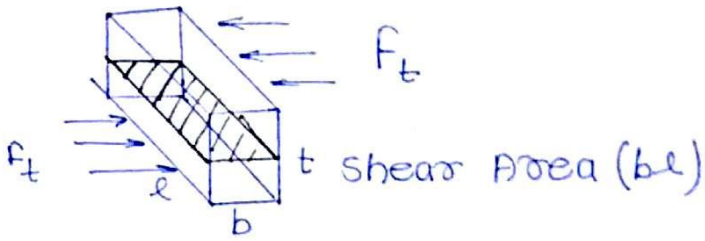
~~soldering~~ is done to avoid relative axial motion b/w shaft and it's assembly and to obtain stability.

* key is the weakest element among shaft, assembly and key.

* key is weak in both shear as well as crushing.

Shear design of key:-





$$\tau_{key} = \frac{F_t}{b.l}$$

$$T = F_t \times R$$

$$F_t = \frac{2T}{D}, \quad D = \text{shaft dia.}$$

$$\tau_{key} = \frac{2T}{Dbl}$$

Safe condⁿ

$$\tau_{key} \leq \tau_{perm}$$

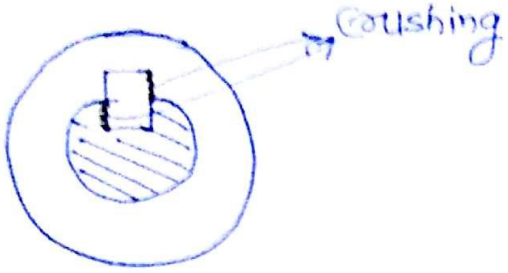
$$\boxed{\frac{2T}{Dbl} \leq \tau_{perm}}$$

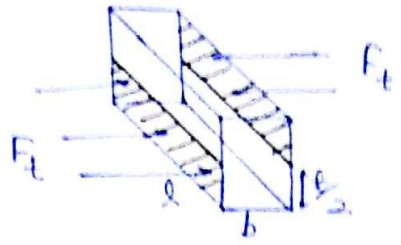
$$\left[\text{Generally } b = \frac{D}{4}\right]$$

Shear strength of key in terms of torque.

$$T_{max} = \left(\frac{Dbl}{2}\right)\tau_{perm}.$$

Crushing Design of key :-





Crushing Area $\left(\frac{t}{2} \cdot l\right)$

$$(\sigma_{ind})_{Crush} = \frac{F_t}{\frac{t}{2} \cdot l} = \frac{4T}{Dtl}.$$

Safe Cond^n

$$(\sigma_{ind})_{Crush} \leq \sigma_{per.}$$

$$\frac{4T}{Dtl} \leq \sigma_{per.}$$

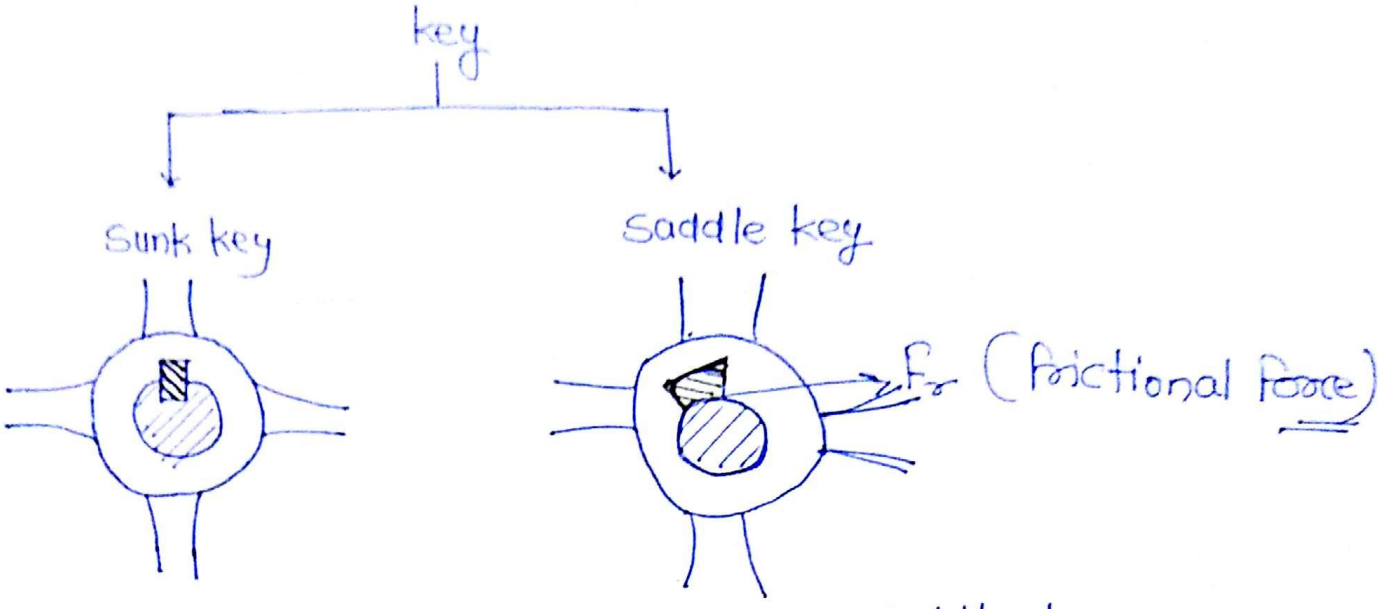
$$T_{max} = \frac{Dtl}{4} \cdot \sigma_{per.}$$

Crushing Strength of key in term of torque.

Actual strength of key = min of $\left[(T_{max})_{Shear}, (T_{max})_{Crush}\right]$

Actual length of key = Max. of $\left[l_{shear}, l_{Crush}\right]$

Type of key :- ⇒



Sunk key

① key is in both hub as well as shaft, hense key way in both hub & shaft.

② key is responsible to transmit power.

③ Used for high power transmission.

Saddle key

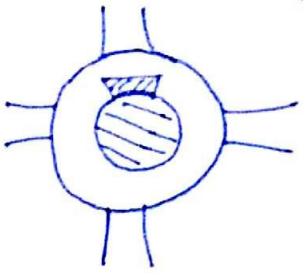
① key is only in the hub not in the shaft, hence key way in only ~~to~~ hub.

② friction force is responsible for power transmission.

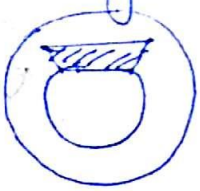
③ Used for low power transmission.

④ Because of no key way present in the shaft cost decrease and strength of shaft increases (stress concentration factor are less).

Saddle key → Hollow saddle key



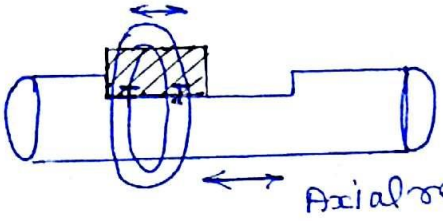
Saddle key → Flat saddle key

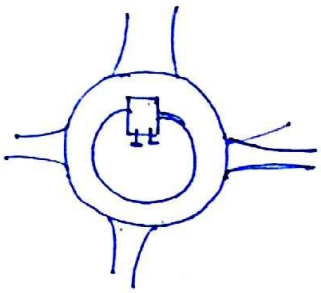


* Flat saddle key is more superior then hollow saddle key w.r.t. power transmission.

Types of sunk key :-

① Feather key :-





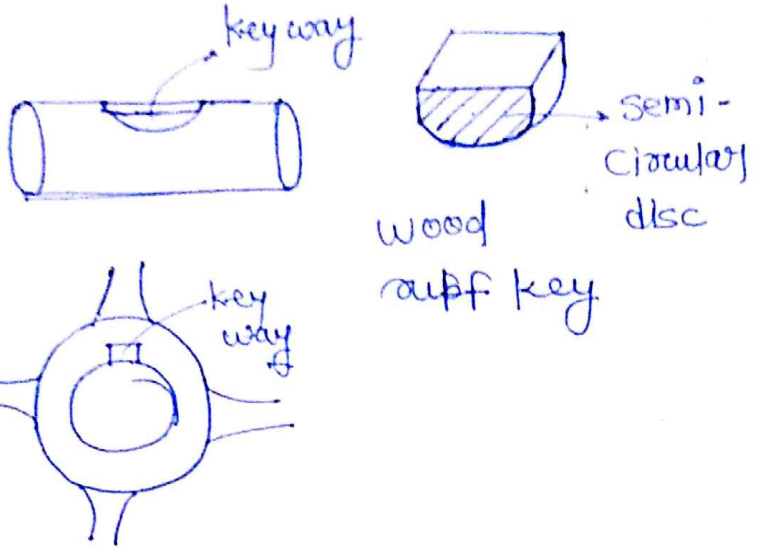
→ key is fixed with either shaft or hub.

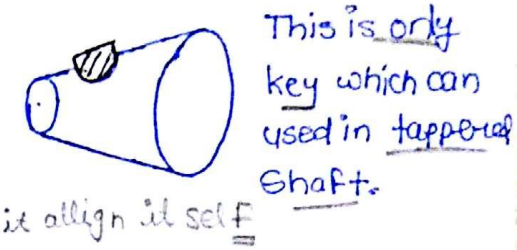
* → * Permit Axial relative motion between shaft and it's assembly

→ It is type of parallel key.

② ~~Woodd~~

② Wood ruff key :- Semi-Circular disc





This is only key which can used in tappered shaft.

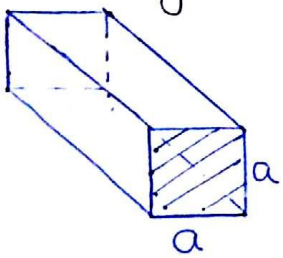
it allign it self

→ key contains semi-circular disc type portion hence key way is also semi-circular disc type.

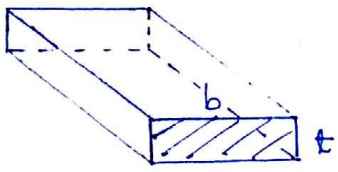
→ It can allign it self. hence can used in tappered shaft.

→ Extra depth of key in shaft provide more power transmission capacity.

③ Rectangular or Square key :-



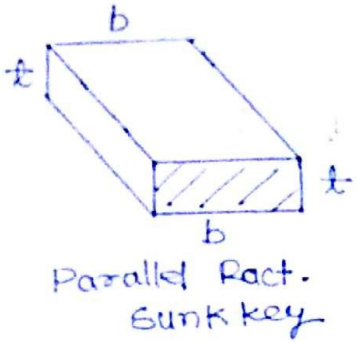
Squre sunk key



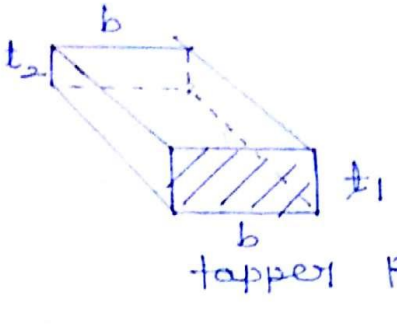
Rectangular Sunk key or Flat sunk key

→ Rectangular sunk key is more stable than squre sunk key and used in most of the industrial application.

④ Parallel & Tapper Sunk key:-



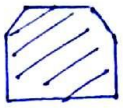
Parallel Fact. Sunk key



tapper Fact sunk key.

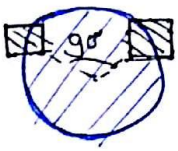
Tapper is provided into the thickness due to easy Fastening purpose.

⑤ Barth key:-



More stable.

⑥ kennedy key:-



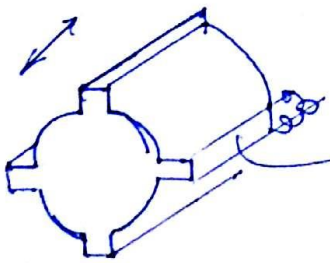
Two key's on Angle of 90°

Splined key / splined shaft:-

* Axial relative motion

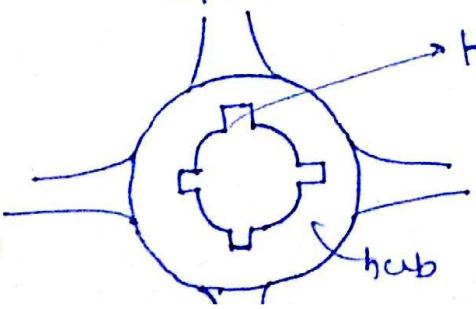
Power transmission cap. is more than Feather key

Automible Clutches & Gear box



key's are inbuilt in shaft.

Splined shaft



key way's are inbuilt in hub