Lezione 4 - Detailed Design (Bearings and Seals)

- Check of previous homwork
- Power transmission
- Details in the Design of Gearbox
- Comparison of bearings types and characteristics
- Seals

4.0 → 3

PLM → 1 → Because it doesn't per se manage license, it doesn't have licences as part of it core functionality.

Power transmission

↳ We will use examples from the power transmission to learn about different elements.

Gear box : Nomenclature

Gears:

↳ Gears introduce rotation equivalent to two wheel rolling without sliding, the diameters of these two circles are called the pitch diameter, which describes the pitch circle.

In technical drawing we represent the pitch circle as a light mixed drawing line.

Line of Action → where the center instantaneous rotation is, also the line on which the force acts.

The action angle is the angles in which there is contact.

<! Types of gears >

Spur Gears → simplest & cheapest

Helical Gears → contact develops along the tooth, rather that the whole tooth together. ⇒ less small impacts so less vibrations and noise, but more complicated & expensive to produce. A helical gear generates axial force so that needs to be supported.

Multi-stage gearbox

↳ we can couple more gearbox, for which the gear ratio is the multiple of the individual composing gear sets.

↳ if we are limited in space

↳ above if we cannot make the small gear smaller due to have a limit of teeth due to proper meshing and a limit of tooth strength.

size ✓ → low speed tend to be higher diameter,

Stages : 3

Shafts : 4

$P_{IN} = P_{OUT}$ and since $P = \tau \omega$,

low speed ⇒ high torque ⇒ need larger diameter

3 2 2 2

↳ There is the maximum in the mix

We usually prefer 2 or 3 bearings since having a third means that we have to have them in a line which

is already done by 2. In the case on the left we have 3 for the purpose of reducing bending.

With the three bearing the three plates are required to be aligned for the 3 bearings. This is called a centering problem.

We cannot use the screw to guarantee the centering since screw holes are nominally larger than screws, the space allows the ability for adjustment but stops its ability to center.

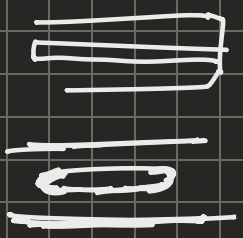
Dowel pin → it's not meant to provide any function other than the proper positioning of the parts it connects.
↳ It block all but the rotation, that mean that we need a second which in this case is out of the plane to add asymmetry so there are no mistakes in manufacturing if the part is accidentally flipped, there cannot be issues since the part will be asymmetric.

In this case 3 and 2 are aligned by the pin and not 2 and 3, they are aligned by a ring which is visible on the sides

Shaft Connection

↳ Spline key

↳ Feather key



Linguettes vs. Chiavette
↳ Difference in working principle of transfer of motion.

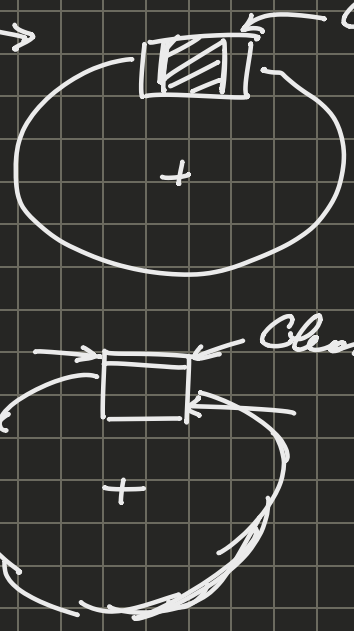
Linguette, reason we use them is because linguette don't

Chiavette → due to slight deviations they act like a

cause misalignment between the shaft and gear, which chiavette do due to their clearance on the sides.

wedge, generating a radial force and the torque is transmitted by friction.

diguette → they transmit torque through shear forces



<! Types of bearing >

Needle → rullini

Seeger Ring / Retaining rings

Circlips, retaining rings where radial dimensions are limited

Shim washers → they are used to define a specific distance.
↳ They are used to increase pressure on what they are placed.

Support washer → used to space different elements, they are used to bridge edge spacings and create sharp-edged