MARINE ENGINEERING

By

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Lecture73

Seals and Bearings

good morning today I will start the topic seals and bearing so bearing origin is formed to bear this word so it will be holding lots of loads that's why the name is bearing role is to support one part or one part with another so one will be fixed part another will be moving or sliding or rotating part so those parts will be hold by bearing it limits relative motion and minimizes friction between moving parts enables linear rotational motion or restrict motion by controlling normal forces. it will allow only certain directional motion, but it may not allow all directional motion.

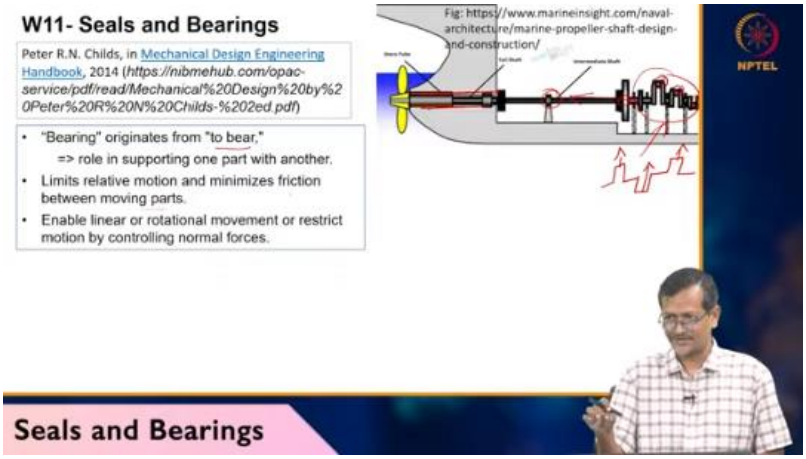
normally degree of freedom 60 degree of freedom will be there in any body. it will be restricting all the degree of freedom, only rotational it will be allowing sometime or sliding will be allowing. you can see in this picture also stun tube we have seen already we discussed. one stun tube is there. there will be stun tube bearing.

there will be another bearing. There will be many bearings here. Bearing will be here. This is actually I already have shown you that this is crank shaft. Crank shaft will have different shapes like this.

multiple cylinder engine will have crank shaft like this. one piston is here. Another piston is here. So, whenever it is rotating piston will have smooth power output. And that power will be transferred to this shaft towards propeller.

And whenever it is transferred, it should be hold by the bearings. Again, inside the crank, there will be lubricating oil. lubricating oil should not go out. you should have a certain sealing arrangement. that lubricating oil, whatever is there inside the engine, it should be inside only.

It should not go out. Otherwise, again, you have to refill. However you need to refill again and again the lubricating oil again because at certain operations that oil will be contaminated because of carbon deposition and other issues will be there. you have to replace the oil and you have to put again fresh lubricating oil system will work properly then. so there will be several types of bearing.



I already told that there will be journal bearing or muff bearing or sleeve bearing. so these are sliding bearing. Sliding bearing is like one hole is there, one shaft is here, it is rotating. It may be axial rotation will be there, axial motion will be there or rotational motion will be there. there will be no ball or anything.

And another option is that rolling contact bearing. You see the right side rolling contact bearing. Here shaft I have drawn here. If you rotate shaft, shaft will be rolling over balls. So balls will be giving very low friction.

These are called anti-friction bearing normally. Anti-friction. Technically how much correct I do not know but they say the anti-friction bearing. sliding friction bearing is this surface will be touching over another and sliding. friction will be higher.

But when you have rolling bearing, rolling element is there. it is trying to rotate, rub, but ball will be rolling. friction will be very low. So, sliding bearing will have friction higher relatively. And, but rolling element friction will be lower relatively.

But another difference is that, that journal bearing or slip bearing, this one, it will have very high load carrying capacity. High load carrying capacity, journal bearing. Where is that? Journal bearing will have high load carrying capacity and very high speed also, there is no problem. But rolling element bearing, what is happening?

Load carrying capacity will be lower because you can see balls are touching at point. One ball is here and you are giving load from here. This is your shaft, right? So it is touching a point. So wear tear will be more.

And at a very high speed ball will have its own momentum. So it will try to go out from the race. Race means that this outer casing and will be another inner casing will be there. Inside balls will be rolling. So this is called race.

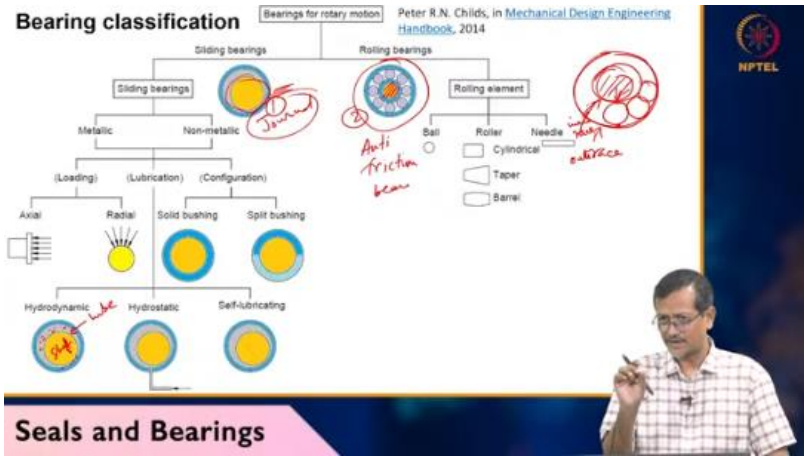
This is also race. Inner race, outer race. Inner, this outer. Okay, so balls will be there inner race, outer race. So ball will try to go out of the race because high centrifugal force will be there at higher speed.

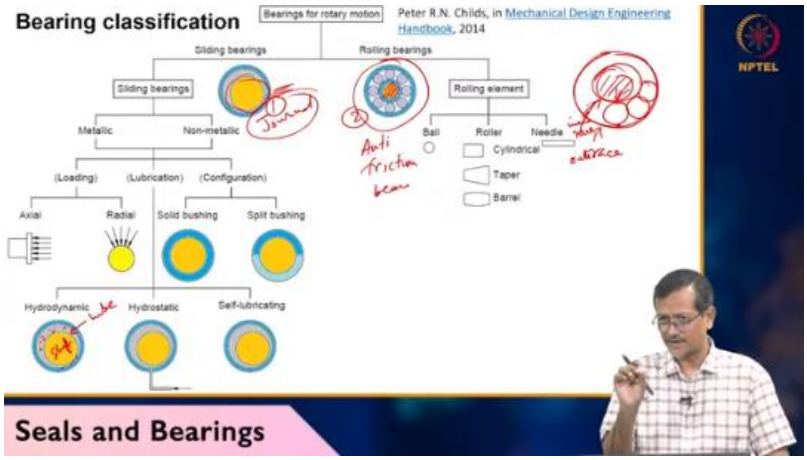
So lower speed, lower load is okay for anti-friction bearing one. Very high load, high temperature you are applying. For example, stand tube, very high load is there and high, some axial motion also will be there. So in that case, you use journal bearing, it will be safer. It will be working for longer time.

All the friction load will be, losses will be higher. Sliding contact pairing, there can be metallic, non-metallic, many types will be there. And lubrication type like hydrodynamic lubrication, like one thin film will be created. This is lubricating oil. So lubricating oil, sometimes they say lube oil or lube oil or engine oil.

So when shaft is rotating. shaft will be creating one thin film over it so because of thin film creation two metal will not be touching the thin film will be there because of thin film shaft will be rotating smoothly friction will lower okay so another is hydrostatic bearing hydrostatic bearing actually externally you are pressurizing a high pressure fluid so the shaft will not touch another metal okay when metal to metal touch is not there friction will lower so forcefully uh that hydrostatic Bearing, forcefully you are giving that much of thin film over the bearing, over the two, between two surfaces so that friction will be lower. And the self-lubricating, self-lubricating bearing actually, initially metal to metal touch will be there. When machine will be starting, so then shaft will be rotating.

When shaft is rotating, already inside lots of lubricating oil or grease will be there. So, that will be soaking continuously. So, that will be self-lubricating bearing they say. And whenever I talk about rolling bearing, rolling bearing will be rolling like ball type and roller type. I will have picture.



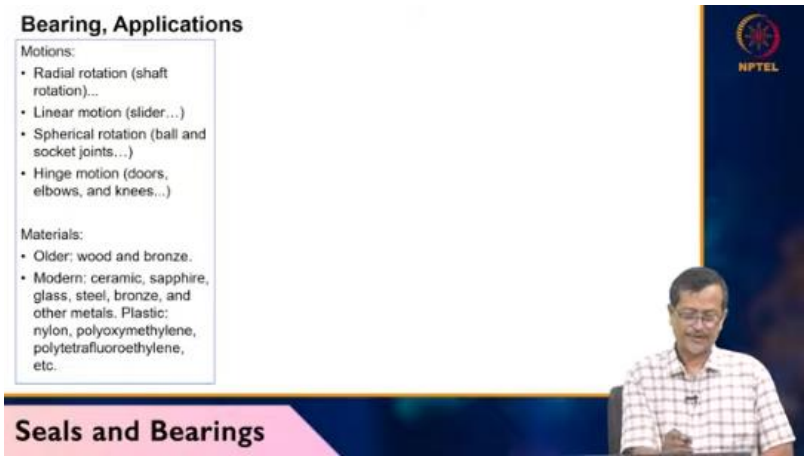


Here you see. Rolling type you can see this cylindrical roller bearing. So I have race here. Another race I have like this. So rollers will be like this.

Lots of rollers will be there. You can see this one. So it is not ball. Another case you see is the ball. So roller contact actually you have long line contact.

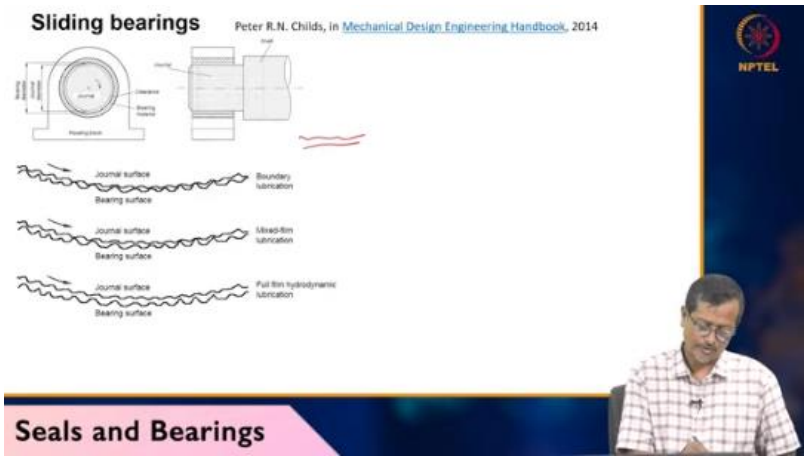
Whenever you are studying machinery you are considering that contact surface. Contact surface is journal bearing is having contact surface. So journal bearing contact surface. But ball bearing, contact point, point contact, surface contact I say, point contact. And your roller bearing, you have line contact.

whenever you have point contact your friction wear rate will be higher and very high load carrying capacity not possible. But if you have journal bearing high load carrying capacity possible surface contact friction will be higher. So they are having their positive and negative merits. So you have to study that. So bearing application, radial location, sharp rotation, linear motion, some cases linear motion also required.



So that sort of bearing also there, spherical rotation like we have hinges, femur bone connected, those also having bearing actually. All direction rotation possible. and material older type like wood and bronze people are used to use modern type ceramics sapphire glass steel bronze other metal plastic nylon many other type of material also is being used for bearing application so sliding contact bearing looks when two bearings are there so bearing surface In naked eye, you can see very smooth. But if you say microscope, then the surface will be like this.

Lots of unevenness will be there. And if you put any lubricating oil, so lubricating oil will be filled in between these gaps. And lubricating oil will be sliding over each other. So they will not allow metals to touch. When metals are not touching, the friction will be very lower.



So lubricant already we had discussed. Just quickly we can go through. Lubricating oil we will have on base chemical and there will be additives. Base chemical like it can be hydrocarbon and additive based on your requirement. For example corrosion inhibit corrosion and other thing you can add some other chemical also.

So 18-19% hydrocarbon is still 10-20% additives normally used for your lubricating system. So, solid lubricant like graphite, molybdenum, disulfide also used as a solid lubricant. And the basic type of lubricant like fluid-filled, hydrostatic, hydrodynamic lubricating system also there. Okay, let us go through one problem. An engine has a speed 1200 rpm, a single reduction gearbox, it is speed 500 rpm.

The small gear, so I have one small gear, I have one big gear and engine has speed 1200. So, engine is speed 1200 rpm. okay and small gear should have more than 16 teeth okay teeth should be 16 and while the big gear should have less than 50. so you have to calculate number of teeth possible okay the limit is given 1200 rpm to 500 rpm you have to do so how to do so So, number of teeth 12 sorry speed of A and B speed of A 1200 speed of B 500. So, N A by N B 1200 divided by 500 equals 2.4.

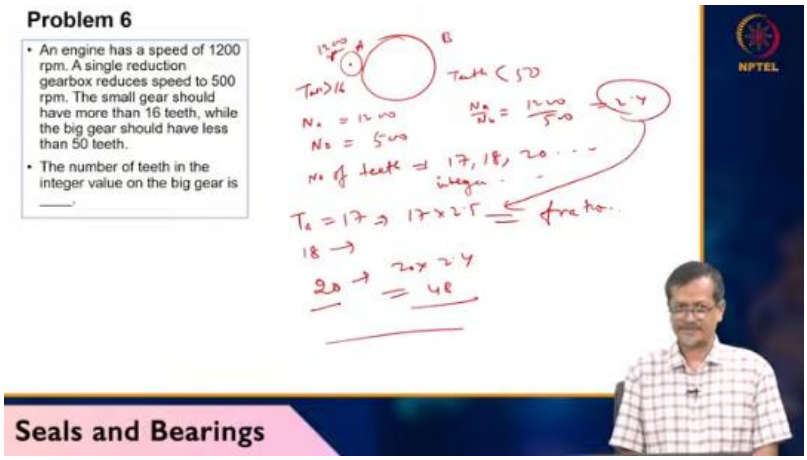
So, assume number of teeth less than 16 not possible. So, 17 you can start. teeth assume 17, 18, 20, 1 by 1 you can try. So, you have to find integer number of teeth, whole number. So, let us say first TA 17.

T, say TA equals 17, implies 17 into 2.4. This is 2.4 already there. it is giving 17 into 2. How much?

it will be fraction. Right? must select even number. even number next even number 18. 18 also not giving proper number.

actual number is coming 20. So, 48. So, big gear will have 48 teeth. accordingly small gear will have 28 teeth. this is very simple problem.

thank you very much for today's lecture. Next day we will start new topic. Thank you very much.



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