Introduction to Flight
Professor Rajkumar S. Pant
Department of Aerospace Engineering
Indian Institute of Technology Bombay
Lecture Number 02.4
Tutorial on Aircraft Component Nomenclature

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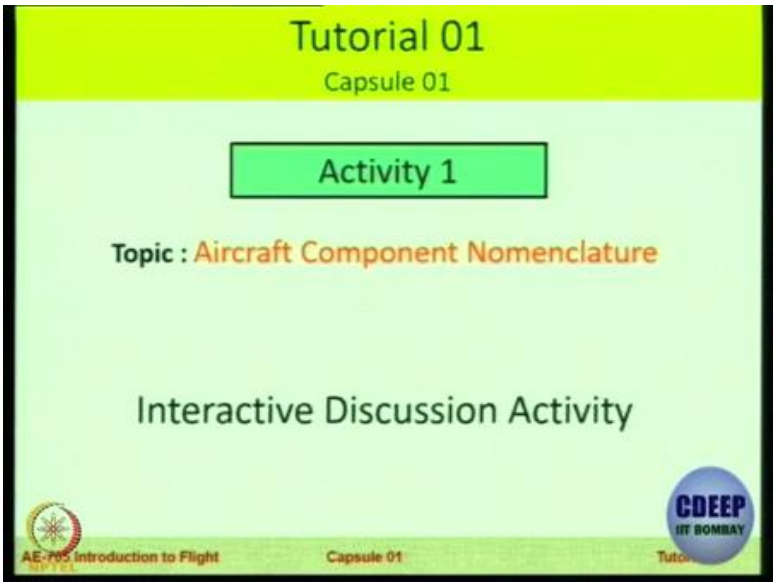

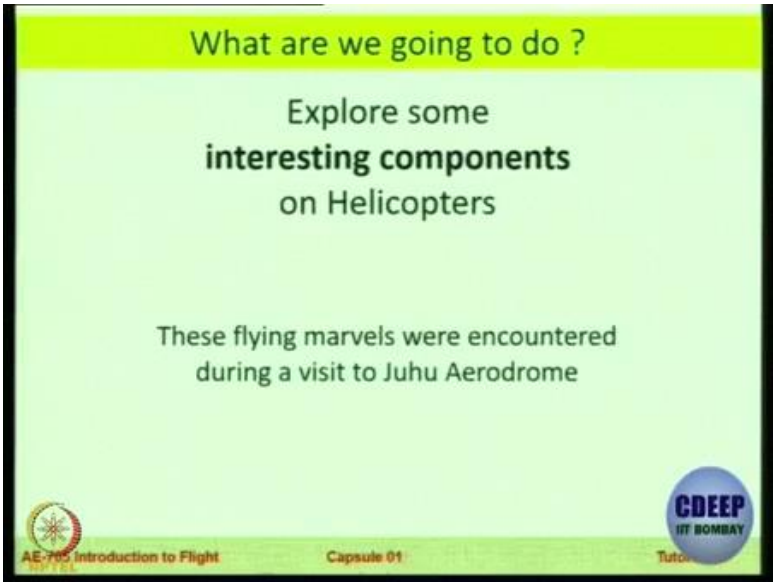

Okay, so we do a tutorial today in which we look at both the lecture that we have studied so far. First we start with this tutorial on aircraft component nomenclature. This tutorial is based on recent visit that has been conducted by us. So what are we going to do here is, we are going to explore some interesting components, but this components are not from the fixed wing

aircraft about which we spoke last time, but from four interesting helicopters. So during our recent visit to Juhu aerodrome, which took place on 15th of June.

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We visited this aerodrome. Okay, so this is the proof that we actually went there and we went to two companies, one is Raymond International, they had two helicopters on display at the time. These are being maintained and we also had a look at the Tata Power Company, where we also had another to two helicopters.

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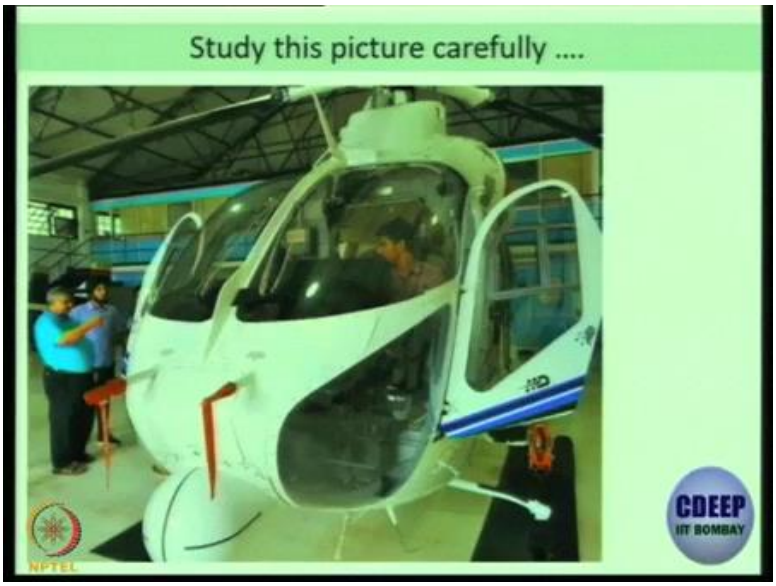

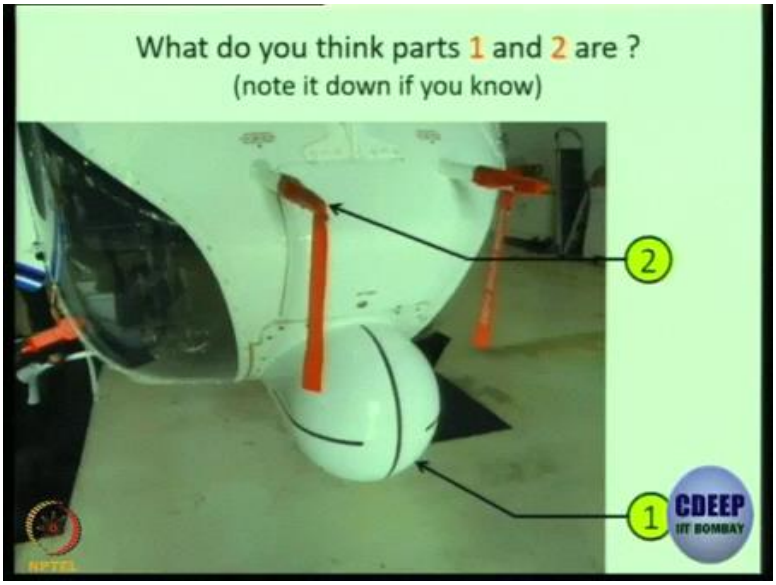

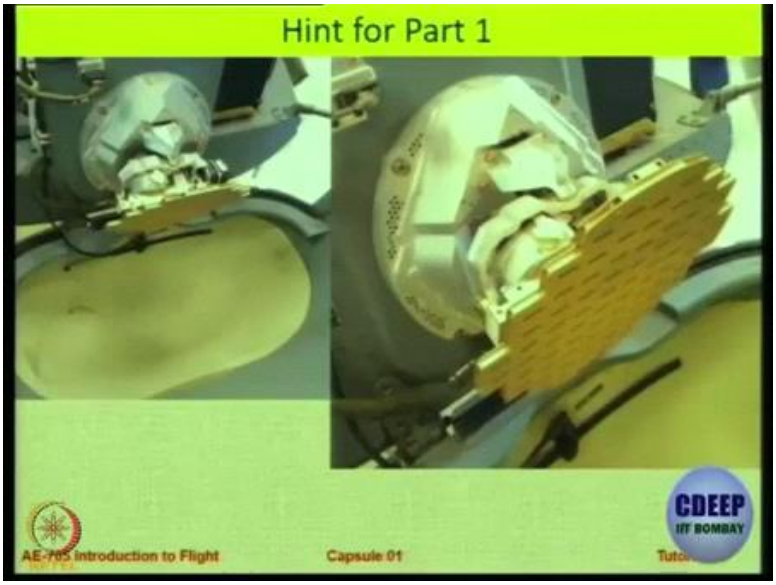

So the major discussion that will take place in this tutorial is about these four helicopters and then in the end I will show you another interesting aircraft. So, let us have a look at this picture and see if you can find some familiar components. Okay, so, for instance, what you think are these? Yes, how can you say it is a pitot tube? So anything in front of the aircraft is a pitot tube. It could also be a pitot static tube, is there a difference between pitot tube and a pitot static tube, so do not worry we will study about it. Okay? Ok right.

Then what about the thing on the bottom, yes, that is a radome, correct, that is a radome, so there are hints, so part 1, we also ask them to open it and show it to us, so you can see this is a scanning radar, so yes it is a radome and therefore the material that was used to make that part is not metallic, it is a glass fibre composites, if I remember correctly, what are those lines?

Those black lines, two lines are there because we are pointing out at them, but on the radome there are these lines printed, yes.

but notice they start from the front and end before the end, there is no continuity to the structure, the one on the left and the right there is no continuity, they start from the front of the radome and they end before the radome ends correct, so do not jump to conclusions and do not give a lot of wing to your imagination, its, its a good attempt, but that is not reason, that is not what it is. Okay, anything else yes

for.

visual indication, so that no one steps or hits it by mistake that is what it is, it is just a visual indication to prevent bumping. That is why, it is a weak structure, it does not have any backing part inside, so even if somebody kicks it, there can be damaged, so it is just an indication, I do not think there is any technical significance to that part okay.

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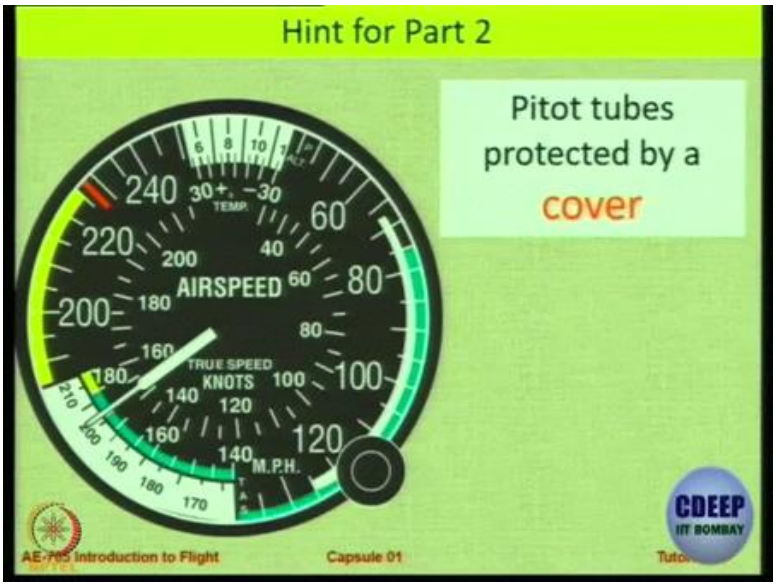

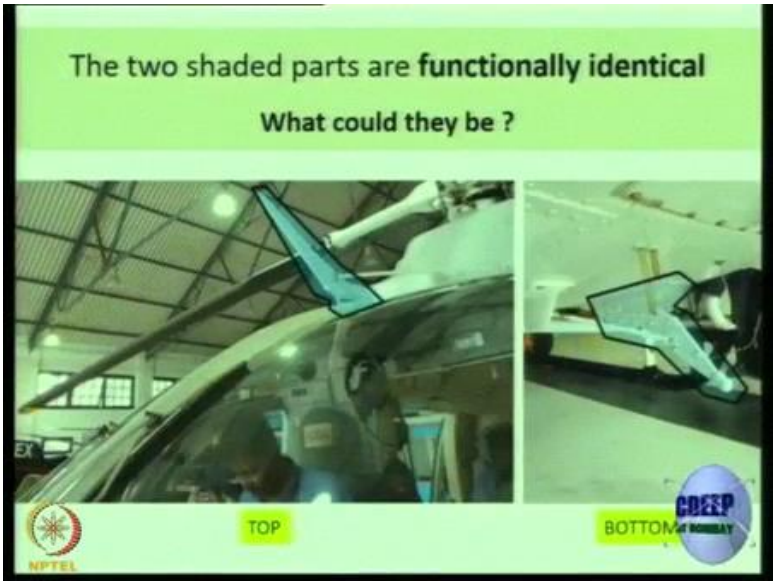

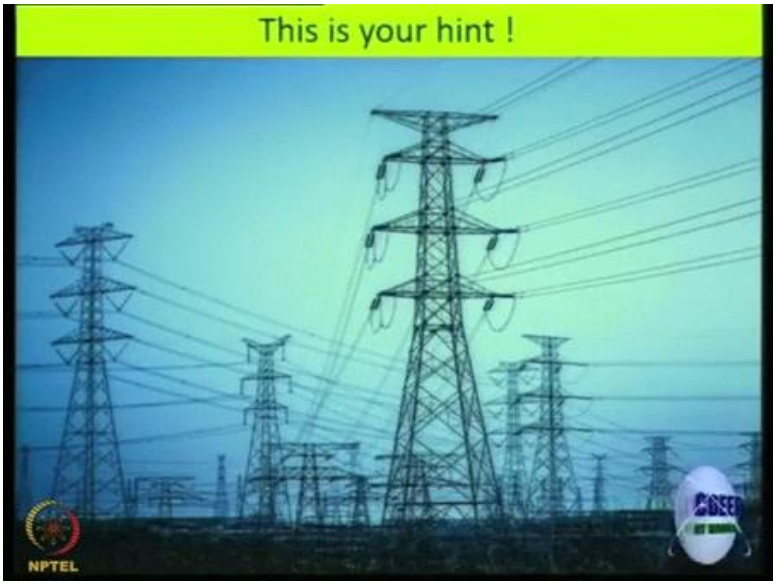

Right, let see what is the second part? That is a pitot tube cover. Now, we know it is a pitot tube because we saw static ports mounted on the side of the fuselage. So it is a cover alright. There are two parts which have been sketched okay, now this is a this is a bonus question, I must tell you one thing that even I had no idea what these parts are, with so many years of experience in aviation, I had no idea, so hang on a minute, experience people will come to you last. Can the students try to guess, what are these two jetting parts, one below and one above the helicopter? One of them is on the below, on the bottom side, the other one is on the side, topside.

So what could these parts be? Yes, no they look like antenna that is what I thought, but they are not antenna yes.

they are, no, no, no, it is a good guess. But why would do you have one below one above and let me tell you, both of them are functionally identical, so how would these two parts give you vertical speed, no, it just a metallic pieces, yes.

no, no, they are not lights, lights are mounted in a much bigger, they are much larger yes.

above the helicopter you want to have the tail skid, no, look, look, look, look listen both the parts are functionally identical, therefore, if one is a skid the other cannot be a skid and how can you have a skid on top of the helicopter, thing before you answer, think before you answer. yes.

above the door and below the fuselage to open the door? And why would be such a horrible shape? if it is a door, it will be a handle. yeah.

he is coming near to the answer. Can you now guess?

that is right. Wire Strike Protection System. When helicopter fly at low altitudes, then may encounter this kind of wires, so those two devices above and below helicopters are basically going to protect the helicopter from getting entangled in these wires. So this is a very interesting components wire strike protection system.

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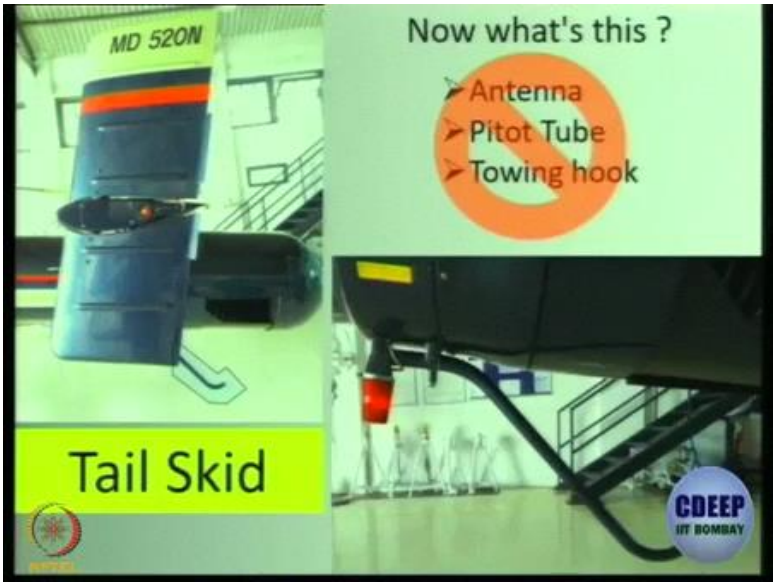

Alright, okay, what is this the thing on the bottom, which is curved? So is it antenna? Is it a pitot tube? Or is it towing hook to move the helicopter back and forward? What do you think? The answer is none of the above. So what is it? Yeah.

drainpipe, that is a good guess drainpipe for draining out excess water, but look it is coming from the light, so it cannot have any water elements near an electrical component, intentionally, by this way you will shot the light, so not a drainpipe. I will add that fourth point there, what do you think? Look at the location, look at the shape, it is not pointing forward, the helicopter is actually pointing towards the left in the figure on the left yeah.

that is what people think, it is an electronic, it is not. It is just the tail skid. It is just a tail skid, a devise, which will protect the helicopter rear boom from hitting the ground. Now this is a very special helicopter, I also wanted to observe the mounting of the horizontal tail, you can see a vertical tail with the red strip, you can also see a horizontal tail and this horizontal tail, this horizontal tail basically is mounted in a particular fashion, about that we will come again later okay.

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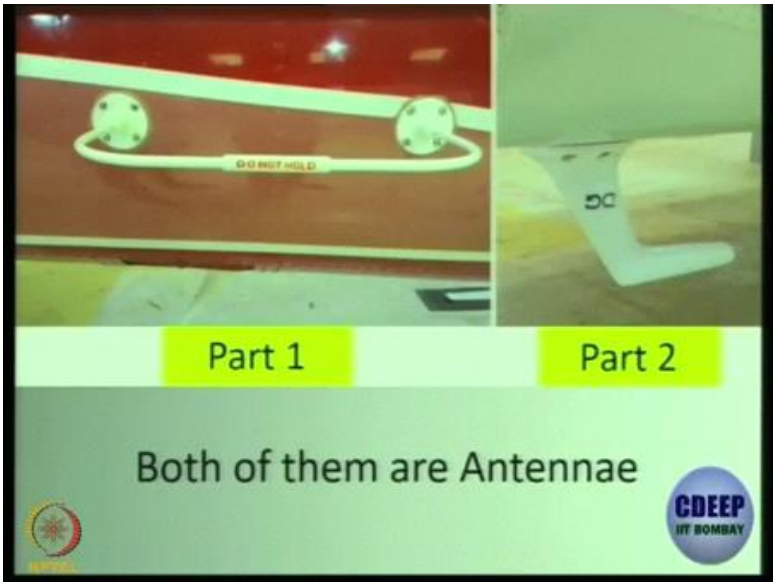

What do you think are these parts? The one on the left, which says do not hold, looks like a handle, but it is do not hold and one of the right is a simple giveaway, anyone can guess what these parts are? Both of them are antennae okay, right. Now, here we see inside the cockpit there is a stick which seems to be bent, it seemed to be having a curvature. So what is this stick and why is it bent? Yes.

Student: Sir, it can moves in four ways that is why it is bent, so as to give clearance to the drivers legs and seats

Prof: yes, pilots leg, please.

Student: sorry pilot's leg.

Prof: okay but pilot is also a driver anyway, it is not a not a problem, you are not technically wrong, but we call it we call the pilot, that driver of a aircraft as a pilot , so yes, this is to clear the knees of the pilot, because there is a situation of very cramped operation in the helicopter and this is the helicopter yoke which is used for giving the command except one on the bottom, you can see on the right picture, there is shaft like thing on the bottom, that is made for the collective pitch, I will talk about this when I talk about helicopters.

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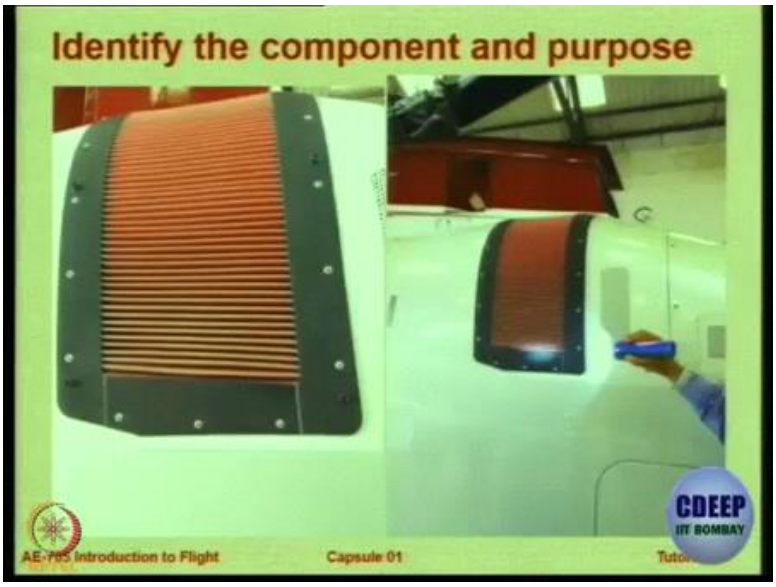

Okay, this is the very interesting component and we were given a huge description about this component and its cost implication, etc, I must give you some hints, this components is recommended only for India or mainly for India by the helicopter company. It was not there in the original design, when the aircraft was sold to countries like India, then they have recommended installation of this particular system, it is very expensive, what is it and what is the purpose? Yes, Mic please

Student: is it a radiator ?

Prof: what you mean by a radiator?

Student: temperature under under the hood can get quite rusty, so it is there to decrease it.

Prof: no, it is nothing to do with heat transfer, no, it is not a radiator. It is not a radiator, anybody else. There is a very fancy name for it and it is pretty expensive. This is not nothing but anybody else want to guess quickly. This is basically a dust cover. Okay, but it is a very high fidelity dust cover. It has got some active chemical insight, which does not allow the dust to go in, they

observe that when helicopters are flown in countries like India because of the tropical climate and the presence of dust and other particles, the engine was sucking a lot undesirable elements and when you put a filter, sometimes the filter get clogged, because the particle just stick.

So they came up with a very interesting design, where there is some kind of a fluid which is put in this part and it repels the dust. So it is a very expensive item and it has been recommended to about couple of months to get it retrofitted in the helicopter.

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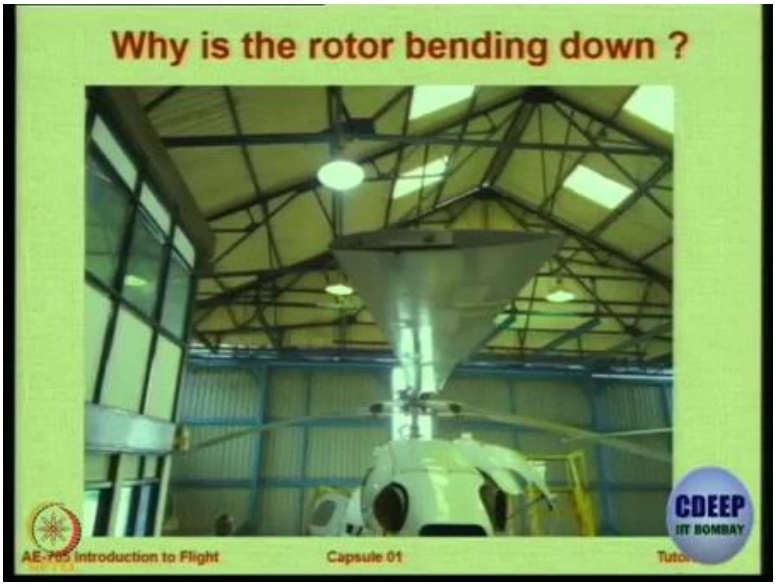

Alright, this is the photograph of the tail rotor, you can see that one rotor which is facing the camera or I should say cross-sectional of the rotor visible in the camera and then there are two of them which are, you know, bending down like this. Okay, so why they are bending down? Are they supposed to produce lift, are they supposed to be horizontal, why are these rotors bending downwards? Yes, just a minute. No one here can guess why are they bending down? Yes.

Student: Sir, they are bent they are bent down due to its self-weight and they are intentionally bend around so that in the case of producing producing lift they must not go up like this.

Prof: okay, so they are bending down just because of their own self weight, that is all it is, it is just because of the self-weight and when they start spinning, they will generate lift force and that will actually create a lot of stress. So this particular weight actually will act as a relief. It will be in the direction opposite to the direction in which the load is coming. What do you see at the edge of the helicopter rotor? There is a small metallic strip, with two nuts very clearly

visible and only in the front part, only in the front half, what is that and why is it there? What do you think? Just a protection.

So the most common problem in helicopters is when they fly in small areas that rotor starts hitting, it is not that if something hits the rotor it will not break, but if it just scrapes the rotor, at least this thing will give some protection. Okay, this also may be an excess, providing excess to some internal areas of the helicopter rotor for maybe maintenance purposes, observation, oiling etc, I do not know, but my guess is that this is just a protection plate yes. Why this metal?

Prof: yes, because helicopter does not, do not do not turn in the opposite direction, they turn only in one direction. So if something is creeping the front part will be hitting it first. Okay, that is why they put it only on the front half okay.

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Now this figure is not a question, this is just to give you an idea about how complex the tail rotor of the helicopter normally is. Okay and there is a reason why I am showing it. See, notice there are two links here, one on the top, one on the bottom. Okay, these allow these whole assembly to move forward and backward. Then we have one link here and one link below. That is meant for changing the angle of the rotors together. Okay, then you can see there is something here and there is something here, what are these? What you think are these? And there is a there is a kind of angle here, which allows you, so what is that, yes.

Prof: coupling, that is a coupling, so because it is a rotating part now, from the main helicopter rotor shaft, there is a shaft coming and then it turns 90 degree in this case and then it couples

to the shaft on the, so it is a very complicated system, so if possible, we should get rid of this complicated system, if possible, if it is visible, but why do we need a tail rotor is in a helicopter? Why is a tail rotor essentially in a helicopter? Let us have some new people, anybody would like to answer? Yeah.

Student: angular momentum.

Prof: angular momentum, can you explain?

Student: like the main rotor start protecting the helicopter, tends to counter rotate so.

Prof: So, it is basically meant to counter the autorotation of the helicopter body when the main rotor rotates. So you put the rotor on the back, give a force to counter that, so the moment created by the tail rotor is just enough to overcome, unless you want to intentionally move to the left or right. Okay, so that is why the RPM of the main rotor and the tail rotor, I mean the rotor have to be coupled, because as you increase the lift or the RPM you have to also have a corresponding change. So it is complicated and this is the most common reason for mechanical faults in helicopters, it is a nightmare for maintenance.

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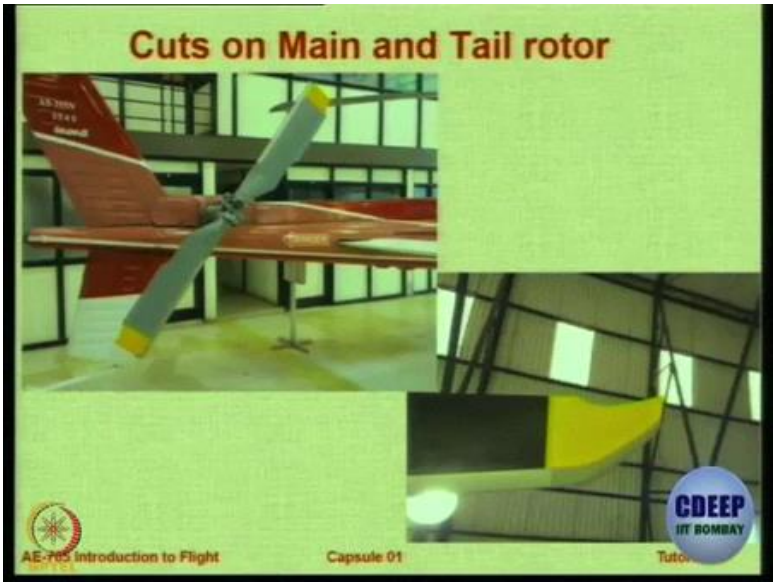

So we will see how people have attempted to modify this. I also was very, you know, enteric to see this kind of cuts, so you see the side view of another helicopter, from the Raymond hanger, you find that the tail rotor, if there is one member getting out here, you can see it here also prominently okay and then you see this very interesting shape on the tips. Similarly I took a photograph, not me, one student who went with me to took a photograph of the tip of the main rotor. So these are required for manipulating the tips, because the tips have tip vertices as we will study and providing such shapes helps in reducing.

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Now this is a photograph of the horizontal stabilizer of one of the helicopters and I observe that the top is flat and the bottom is curved. So I told you have made a mistake in mounting this. Okay, so it should be upside down right, because we never see airfoil swing like this, so what is the reason? Is it intentional? what do you think? Is it a mistake or is it intentional? what do you think of this? It is intentional, nobody makes such mistakes in aircraft design. Okay, that means what will happen if you have tail upside down like this? What is the result of this kind of a mounting? downward force, tail do not produce lift, tails produce force for balancing the aircraft.

So there will be lift by nature, so it is considered to be upwards, so if something is not upward, we do not call it lift generally. okay, you guys does not lift, so it pushing down. So from the point of view of balance of the helicopter, you needed a downward acting force always or mostly and hence they have mounted it upside down. The same thing you also see in aircraft. when I saw the aircraft DO228 for the first time in the hanger, I also was surprised, I found the tail to be mounted upside down and that is when I remembered the course of stability in controlled where I was taught that generally the tail carries downward force. So the one good way of doing that is to mount it such that it gives you downward force.

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This is the another helicopter, this is the helicopter in the Tata International hanger. Incidentally this helicopter is personally flown by Mr. Ratan Tata, he flies it himself. Now I do not see a tail rotor here. so has it gone for maintenance? or is it not there intentionally?

what do you think? Where is a tail rotor in this helicopter? Both sides are only fixed vertical tails and there is also a very small horizontal tail and also you can see a small tail skid, the white one, but the rotor is missing, so what is the reason? yes.

Prof: no, it does not have a twin rotor, you very right, if you have two rotors which are counter rotating like in the Kamov helicopters with the Indian air force, yes, you would not require a tail rotor, but I think if you had seen some earlier pictures, I do not know whether we have some earlier pictures of this helicopter. Maybe I have to just search, but believe me, it has only one main rotor. so it does not have two rotors. control by jet which the jet from the exhaust of the engine, no, no, no, that is not the things, this helicopter is very interesting, yes.

Prof: the exhaust gas from the engine.

Prof: yeah, that is exhaust of the engine, correct yes, at the tail that means somewhere here, so you mean to say, but I see the exhaust is here.

Prof: there might be, okay, there might be, but no, there is, this is not an exhaust hole. So that is that is not the reason. Okay, this this helicopter is called as a NOTAR, which means No Tail Rotor, that is a selling point of this helicopter. So what did do here is, they use an effect called as an coanda effect about which we will study, when I come to that portion, I am going to elaborate to you on that.

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So yes, there is a small duct there is a small duct and a small outing on the bottom. Okay and this particular this particular, you can say assembly rotates also but we do not have the engine exhaust from there. So we do not use that, I will explain this to you when I come down to the coanda effect.

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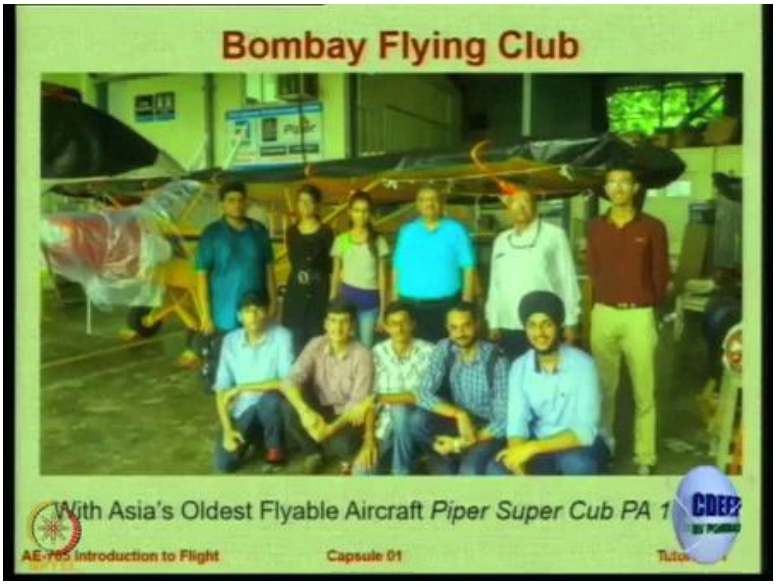

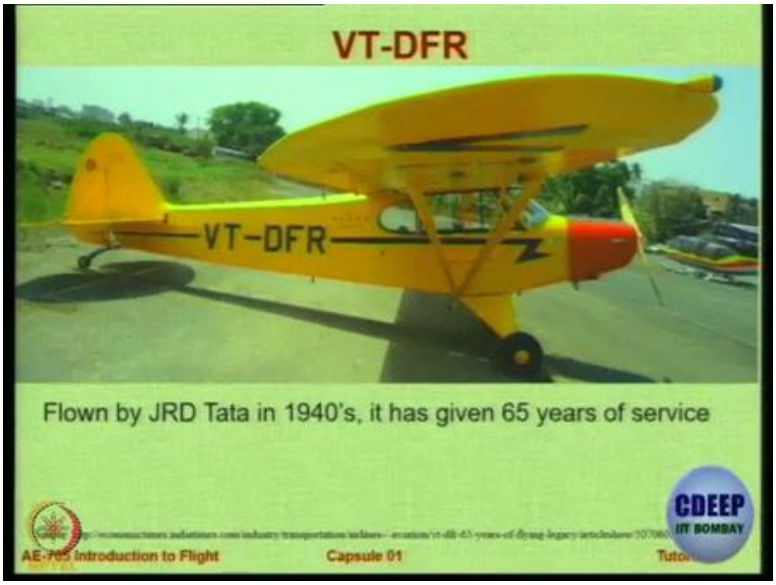

Okay, after this we went to the Bombay flying club, which is located in the same Juhu airport and this is a very historic aircraft behind us. This is considered to be Asia's oldest aircraft which can still be flown. It was fabricated in 1940s, brought to India in 1951, it came to Bombay flying club in 1955 and they have maintained it from that point onwards till today in very perfect condition. so look at this picture can you think this aircraft was 1940 aircraft? 65 years of service, it was also flown by JRD Tata himself.

So such a historic aircraft is available in Bombay flying club and we were very fortunate that on that particular day, we were able to go and have a look at this particular helicopter. This gentleman on the white shirt to my left is Mr. (A.K.) Ajay Kumar Bahadur, who is the chief engineer of Bombay flying club and he was our he was our host that day for this particular trip. So first we went to the two helicopter companies and then we went to this place and then they also gave us a very nice lunch, after which we came back. Alright, so that is it about the first capsule.