NOC: Introduction to Airplane Performance
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Lecture - 02
George Cayley: Concept of Lift and Drag

Good morning dear friends, I welcome you for this course titled introduction to airplane performance. And, you could see that I am standing inside our flight lab hanger which is one of the unique facility of IIT, Kanpur, Aerospace department. And, you could see that I am surrounded by so many aircraft.

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This is the pride of India, the Hansa 3 aircraft designed, built and fabricated by national aerospace laboratory in association with so many private people, private companies - one of them Taneja aerospace. And, you could see there that plane is Cessna 206. It is named as station air, wonderful aircraft. And, farther there we could see which is a motorised glider which is sinus 123. And, we have such more aircraft here. And, I will be showing you those aircraft as the lecture progresses.

But, what is our basic aim for this course? The basic aim is if you see this airplane, Hansa 3 aircraft, there is a engine, incidentally it has rotax engine. As I switch on the throttle, the propeller rotates; it generate a thrust. So, it gives it a forward velocity. But what is more important that I need to take, I do need to generate lift which should lift the

aircraft upwards. And, for that we have which is the wing, the large huge surface where once the pressure acts beneath this wing surface it generates lift and we cruise.

And, now we will explain you what exactly you mean by cruise? And, if we see at the end, if you come along with me here, you could see the error control surfaces which are deflected as and when required to turn the plane right or left like this. And, similarly, we have here elevator, is also a control surface which is used to pitch up or pitch down the airplane. And, similarly, we have (02:32)) which I can turn this way or that way to turn the plane towards right or towards left. All this will be explained in this course by one of our quality control manager Miss.Rekha. We will have soon; we will find one module will be dedicated for this part only.

What is our basically aim? We would like to know, how do I utilize this area to generate lift? Now, we will go back the olden times when George Cayley gave us this idea that if I put a flat plate at an angle of a tack that is I move the flat plate like this and the pressure acting on the lower surface will be responsible to not only generate lift, but also it would try to drag the plate. So, we need a engine to overcome that. All this detail will be in our discussing in the classroom.

The same time you do not forget this the cockpit; there will be dedicated lecture on the cockpit where we will see what are the instruments available in the cockpit which helps the pilot to know what is his status, what is the speed with which he is flying, what is the altitude he is flying, what is the bank angle he is flying, what is the throttle level - all this details engine details he will be getting, so that he is comfortable and used all the information to complete a mission requirement, right; thank you.

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So, now, you go back to the classroom and you start asking a question, how does an airplane generate lift and how manage this lift for our useful purpose, right. Before we go to the classroom let us have a closure look on the wing structure. If you see this portion we call wing leading edge. And, ((04:26)) wing is decided by this ribs which forms very important part of the wing and we call it aerofoil. At every, if I take every cross section I will be seeing a shape like this. And, depending upon the cross section the quality of lift will be deducted.

And, you could see that here there is a strut. This strut is because to support the weight of this wing. And, one of the important aspect once you put a strut is that ok, it is fine, it will withstand or take the load of the wing, but same time it should not create drag. So, you could see that even the covering of this strut is having a aerofoil shape, ok. So, aerofoil shape and knowing about aerofoil will be extremely important when you think about airplane performance.

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Also, you could see that these are the landing gear, and they are not retractable type. We have Piper Saratoga where the landing gear goes in. So, once it is flying in air, landing gear is out, then that offers resistance. So, that is and now what you will find for such airplane. But, for bigger airplane or even for Saratoga what happens; the moment I take off, the landing gear goes in, so the drag part is reduced.

So, we have aircraft where we have got a fixed landing gear; we have got a retractable landing gear with the purpose that once you have cruising I want to fly at a drag minimum. So, I prefer that the landing gear should be taken inside the belly of the fuel gauge so that overall drag reduction is there, right. You could also see, this is a Piper Saratoga airplane. Here in the other airplane you have seen the part of the surface moves as an elevator, but here the whole tail moves as an elevator, but this is called all movable tail.

So, you will have 2 types of airplane – one, in which part of the surface moves as elevator; unlike other airplane, this airplane Piper Saratoga where you will see we have seen that this, as I was mentioning this is the whole tail moves as an elevator unlike the other airplane where part of the surface moves as an elevator. So, these are the basic important points we need to know before you start discussing about the airplane, how does it fly, how does we control an airplane.

So, now from here we now go back to the classroom. And, keep back of your mind 2 important things when I am talking about wing - that wing and aerofoil they have got

implicit relationship. A good aerofoil will ensure that a wing is highly lift effective. So, we will be starting from this in the next session.

Thank you.