Lighter Than Air Systems
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Lecture - 48
Determination of Inflation Fraction

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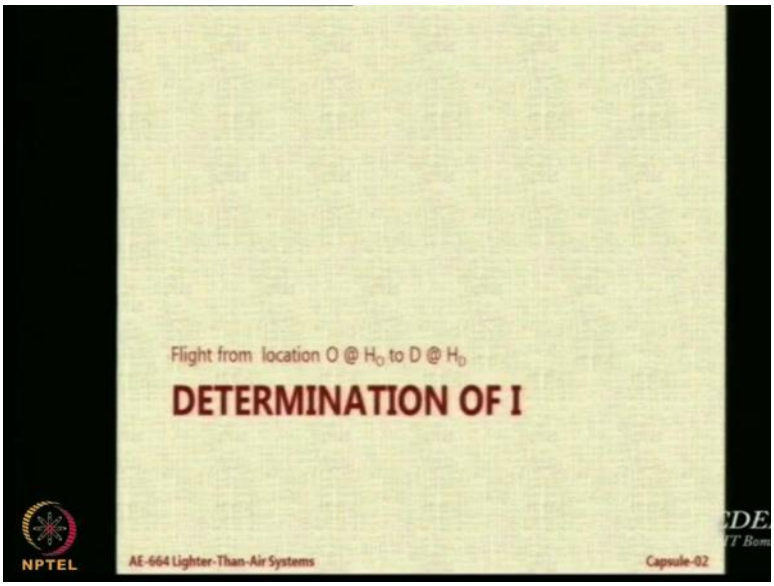

So, with this we looked at we have finished looking at all the variations in the atmosphere. Now will look at very important aspect and this is one of the limitations of airships which we have to understand. Tell me how do you decide the amount of volume that you want to give in a ballonet? Let us say we are designing an airship very soon you start looking at airship design. You are given some operating requirements to design the airship.

So, when you design the airship first thing, they would have been what is the envelope volume? Then you have to also decide what is the ballonet volume? First question I want to ask is, is provision of ballonet compulsory in an airship. Can we manage to handle the situation without providing a ballonet? Is it something that you cannot live without? What do you feel? So, recall what is the purpose of giving a ballonet? Can somebody help me with answers?

To control the lift, which lift static or gross? Gross lift you cannot control. Gross lift it simply a function of the weight of the air displaced which remains fixed. Which remains fixed if the amount

of; if the shape of envelope fixed, the weight of the gas, now, if the ambient temperature or pressure changes then the weight changes, but at a given condition you cannot. So, it is net lift not the gross lift.

Be very careful about these terms now onwards. So do you use a ballonet for changing the net lift. Is that the purpose of ballonet? To prevent over stretching of the envelope because of the difference in pressure, now when will this over pressure occur? Due to height is one reason. Can you experience the ambient pressure drop due to any other reason other than this? Weather changes do not change the ambient pressure that much, they do not. Does it change? Have you ever heard of ambient pressure drop or ambient pressure increase?

Across the weather front is a very macro analysis for an airship which is going to be very small compared to the big weather front? You will rarely encounter a situation where there is a change in the ambient pressure. What can happen is that you take an airship from Mumbai to Los Angeles due to some peculiar weather situation there may be a slight change but generally ambient pressure at sea level does not change you because I mean to say is mainly because of the weight of all the air acting above the earth which is same everywhere.

The earth is the oblate spheroid so there is a difference at the equator and the poles. If you go into that detail, yes, but generally we ignore it. So, the principal cause for stretching of the envelope will be because of change in the altitude as airship goes up. Just now done the calculation for change in the Delta P at a height of 1 km, so what was the pressure that you encounter at 1 km ambient pressure.

And at sea level 101325, what is the percentage change tell me? No that is in the inflation fraction. Percentage change in the pressure of the ambient air, 11.3% and so ambient pressure has fallen down by 11% from sea level to high altitude 1 kilometer now. Suppose we assume linear variation from 0 to 1 kilometer drop in the ambient air pressure or percentage drop in the ambient air pressure. So, if I restrict to 500 meters, it will be 5% so if I make a remotely controlled airship and I only flight to; how will I fly an RC airship?

What is the typical range of a remote control? What do you say Sandeep you had done so many UAVs. One and half kilometers it can be, but will you fly an airship at a distance of one and of half kilometer vertically up? Typically, airships are flown to be seen. They have to be seen because they carry your logo or yes, you may like to put a camera and a system to go high. So do not fly them beyond 500 meters or so, normally not.

100 meters is also quite a large height for a typical RC to fly a small airship. So from sea level to 100 meters height or 500 meters height. How much ΔP would you expect? Not much so therefore the envelope can probably strength slightly and take care. It will not reach those excruciatingly painful pressures it will tear. So, to take care of the ΔP effect you require a ballonet only and only if you go above around half kilometer, 1 kilometer etc.

This is one important observation. What is the second reason to have a ballonet? Pitch control so you can have two of them and then you can use them for pitch control agreed. Any other reason but if you look at now a ballonet operating at sea level and that is why we have two of them. How much of gas will actually go out and will you really get too much of pitch you might I do not want to discuss. I do not want to argue that there will be.

But there may be better way for getting pitch control for a low altitude airship because a ballonet is a very complicated system. Why is it complicated because it has to automatically detect the ΔP and start either sucking air or throwing air depending on the ΔP range. So, it is not easy to make a ballonet. This is making a ballonet for an airship is perhaps one of the most complicated tasks in LTA system.

So, therefore you can live without a ballonet if your ΔH is not very high. But how will you take care of expansion of the envelope because of let us say superheat or suspension of the airship in the atmosphere for long time due to which air gets heated really heated and then because it is hot and then it expands. So read the notes there is one section in the notes that would explains how you can live without a ballonet for low altitude airship or aerostats. So, I want you to understand that do you have a kind of things I expect you to know before the quiz which are explained in the notes