Lighter Than Air Systems
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Lecture - 42
Effect of Rapid change in Atmospheric Temperature

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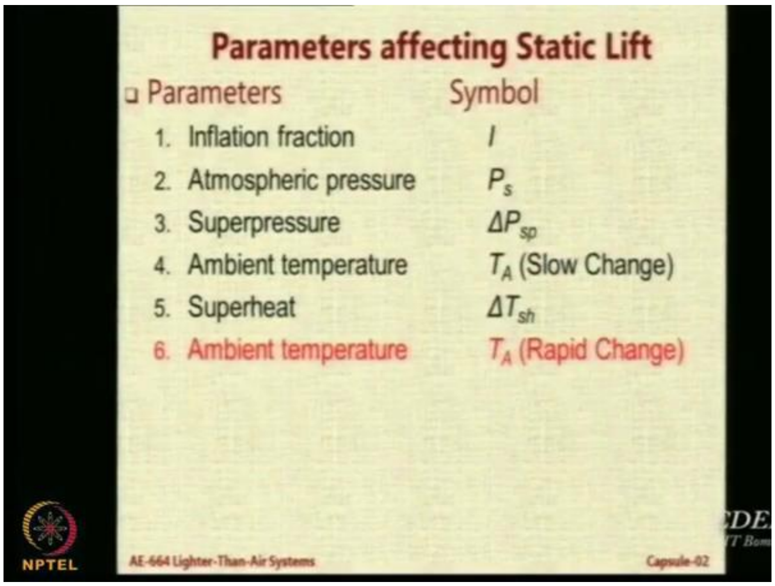

This is what we have seen. Now, let us see what are the Rapid change in temperature? Now you will not allow it to equalize. You are going to bring it suddenly.

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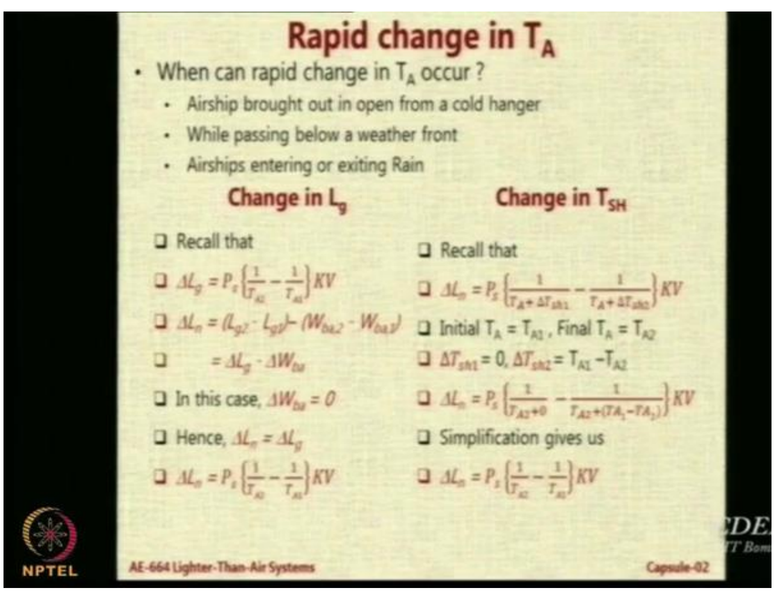

Question is when can you have a situation when the Rapid changes in temperature can occur? I do not give time so you have an airship with air condition Hangar and take out suddenly. It will take some time for it to stabilize during that time what will happen, that is what you will see now. So, you are flying in the airship and suddenly it starts raining. Suddenly encounter very cold condition. So, during the time when the whole envelope cools down to the ambient condition. It will take during that time this will be applicable.

Similarly, if you are flying on a cold weather so in the long distance along endurance flight airship can come to situations where there is a sudden change in temperature without giving the time for the equilibrium to take place. During these cases there will be a change in the gross and net lift let us see. So, you can look at this problem from two angles one angle will be there is a change in the gross lift.

So let us recall the ΔL_g or the change in the gross lift is

$$\Delta L_g = P_s \left\{ \frac{1}{T_{A2}} - \frac{1}{T_{A1}} \right\} KV$$

this you have seen last time. So, the net lift difference I am repeating again is the gross lift difference and the ballonet air difference. I am showing the same thing as ΔL_g and ΔW_{ba}. Now ΔW_{ba} is equal to 0 in this case because there is no time available for the system to respond in the ballonet air to go out.

If you give time then of course the system will go into equilibrium but right now $\Delta W_{ba} = 0$. So, therefore then net lift change will be equal to the gross lift change so the net lift, so there will be a change in the lift. This is like you are not allowing the system to respond and suddenly the temperature is changed therefore net lift will change it will become

$$\Delta L_n = P_s \left\{ \frac{1}{T_{A2}} - \frac{1}{T_{A1}} \right\} KV$$

What will happen will it reduce or increase if you go to a cold place?

If T_{A2} is less than T_{A1} what is it, increase. If you go to a cold place it will increase. Why T_{A2} less than T_{A1} one more way of looking at whole thing is that subjecting an airstrip to sudden change in the ambient temperature is like giving it a sudden superheat or super cooling depending whether you are going to hot place or cool place. So, from that angle looks the expression there is a T_A component there.

So now what you will do is we will assume that T_A is constant but there is superheat applied. Now initially the airship is T_{A1} and suddenly it goes up T_{A2} therefore ΔT_{SH1} will be 0 to start with and that will be suddenly T_{A1} and T_{A2} you can consider it as zero superheat when you are flying and suddenly you are exposed to a superheat of $T_{A1} - T_{A2}$ because temperatures become T_{A2} from T_{A1}.

Put them in the expression and ultimately will get the same expression. So, whether you look at it as sudden superheat or you look at it as instantaneous change in T_A the expressions are the same. See the physics will not change just because how you take it. Physics will remain the same, there will be change in the net lift but over a period of time when T_{A1} and T_{A2} equalize there will be no change in the net left which is the situation for slow change in temperature.

So, for a sudden shock change in temperature there will be changed in the net lift for a gradual change the change is 0.