Lighter-Than-Air Systems
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Lecture - 56
Effect of Change in Operating Altitude

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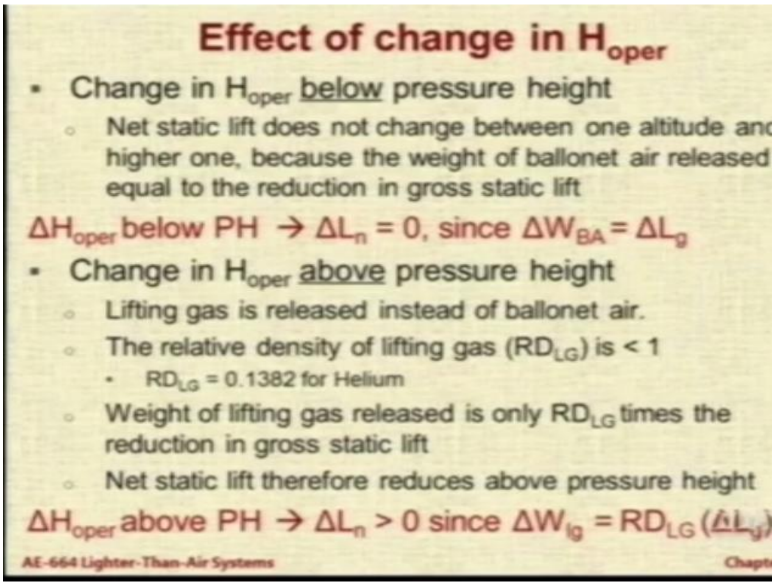

Now let us see the effect of change. We will look at two scenarios now. One scenario is the airship is operating from some altitude to an altitude which is below the pressure altitude. Now listen very carefully. You have to apply your mind and understand what is happening. So, let us say the pressure altitude is 1500 meters. You are operating from 500 meters to 600 meters. The airship changes altitude from 500 meters to 600 meters.

So, I would like to know the net static lift will not change as long as you operate below the pressure altitude, gross will change. Gross static lift is going to what, decrease or increase? Somebody is saying increase, somebody saying decrease, decrease or increase, decrease, no decrease fine. Why will it decrease? Because the density of the air is decreasing with the altitude. So, the gross static lift will decrease.

Basically gross static lift is what? Volume into density difference. So, density difference density of the gas inside is not changing, we are not assuming superpressure, superheat etc. We are assuming the density inside remains same. So, density outside is falling. So, the difference is decreasing. Therefore, the gross static lift will decrease. However, as you go up what do you do with the ballonet? You throw out some air.

So, what is the increase in the volume of the lifting gass? It is equal to a decrease in the volume of the ballonet. So, the net static lift will not change as long as you maintain below pressure altitude because the weight of the ballonet air released is equal to the reduction in the gross static lift. Some amount of ballonet air is thrown out by that amount the lifting gas volume is increasing.

So, as long as you maintain your altitude from any altitude up to pressure height, there is no change in the net static lift, but there is change in the gross static lift and there is change in the ballonet air volume and hence weight. In the previous slide, so under ISA conditions the temperature that is prevailing at a particular altitude is equal to the temperature in the ISA table. And essentially I have actually replaced the pressure also, P_S is standard, $T_A = T_S$ and P_A is anway equal to P_S.

So, both the pressure and temperature are going to be as you have in the ISA table that is how we got the ratio of pressure by temperature as equal to the ratio of pressure temperature at sea level and σ. So, we will assume both of them to change. So, this is clear. So, we can summarize that if delta operating that is change in the operating altitude is below pressure altitude, then ΔL_N of net lift change is 0 since $\Delta W_{ba} = \Delta L_g$. Now, this thing is not true when you go above the pressure altitude because above the pressure altitude we are not throwing out the air.

We are throwing out the gas and gas is lighter than air. So, to that amount there will be lesser weight loss. So, there will be a change in net static lift. So, above pressure height what are we doing lifting gas is release instead of ballonet air. Now, the density of the lifting gas has to be less than the density of the ambient air that is why we are getting buoyancy. So, there is something called as relative density is always less than 1 and farther you are from 1 better is the lifting gas.

Hydrogen is the best one, but helium is normally used. So, it is 0.1382. So, the density of a given amount or given volume of Helium only 13.82% of the density right. So, therefore if you throw out helium instead of air, you are not going to throw out heavy things, you are going to throw lighter things. So, the weight of the lifting gas released is only RD_{lg} times reduction in gross static lift.

So, the net static lift therefore will be reducing. So, the net static lift is going to reduce above pressure height because the change in the lifting gas is going to be not equal to the change in the gross lift but a small percentage of that. So, this is an important observation which we should understand and keep in our minds.