Lighter Than Air Systems
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Lecture - 27
Tutorial Problem 01 on Static Lift Estimation

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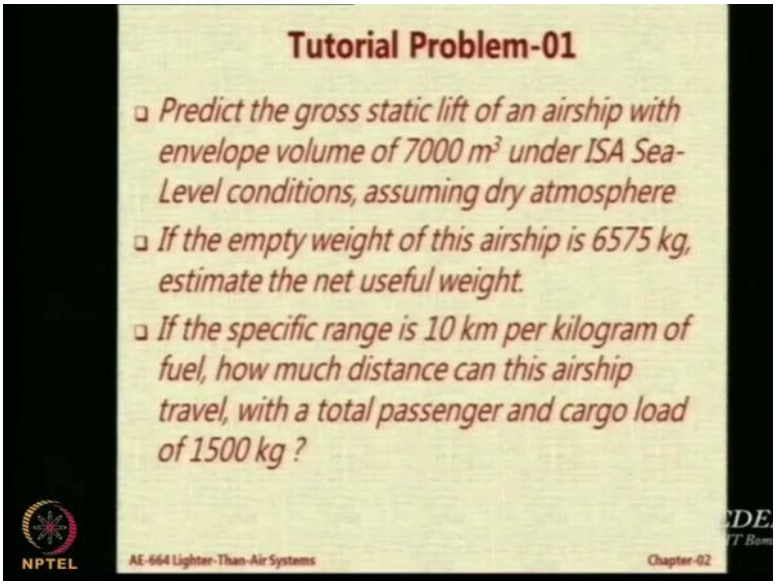

So now I look at the first simple problem. This should be a very very simple problem for all of you. So we want to predict how much is the gross static lift of an airship, envelope volume is 7000 meter cube. operating condition is ISA Sea level and we assume dry atmosphere. There is a reason for this. The effect of atmosphere being wet which means humidity. We will spend quite some time in the next two slides time to model it.

So right now I am assuming air is completely dry. Helium gas is perfectly pure and we were also assume that there is no bollonet. It cannot be simpler than this. So now what do you need for this? What is the formula will you apply for this? $\rho_A V_{env} g$. So what is the value of ρ_A? From now onwards, please remember the value of rho under ISA conditon at sea level or ρ_0 will be always taken as 1.2256 kg per meter cube. Write it down some where.

This is the correct number, 3rd decimal place etcetera be careful because in this calculation sometimes decimal places will matter a lot so 1.2256 kg per meter cube is ρ_A but only under ISA Sea level condition and V_{env} 7000 meter cube, g is 9.807. Please tell me how much is the

net; what is the gross static lift? 84.16 kilo Newtons number seems correct 84.16 note down. So, net lift is 84.16 kilonewtons everybody got it.

Any problem anybody has? So that is number now if the empty weight of the airship is 6575 kg. Then please tell me what will be the net useful weight? And this empty includes the payload, the fuel, the ballast all the items. So, I am sorry it does not include all the items. Items will be coming net useful way. It does not include fuel and payload but it includes the ballast and the structure and the operating requirements.

So the weight of the pilots will be a part of the operating empty weight. Now I want the answer in kilograms. So, you have to convert your 84.16 kilonewtons into kilograms 2004.2 kg, everybody got that number. So approximately 2000 kilograms, so you divide by g. So you will get the kg force and then you sub subaract 6.75 so you get around 2000 that is my feel around 2000 kg will be net useful weight which will be a combination of payload and the fuel.

Any problem, got it, so now this airship wants to carry passengers and cargo of 1500 kg the answer will be in kilometers. Pratik how far can you travel? You can do it orally very simple 2,000 kg is available. 1500 is gone remaining is 500 and each kg of fuel give you 10 km then 5000 kilometers, simple. So we hae started now looking at basic airship performance.

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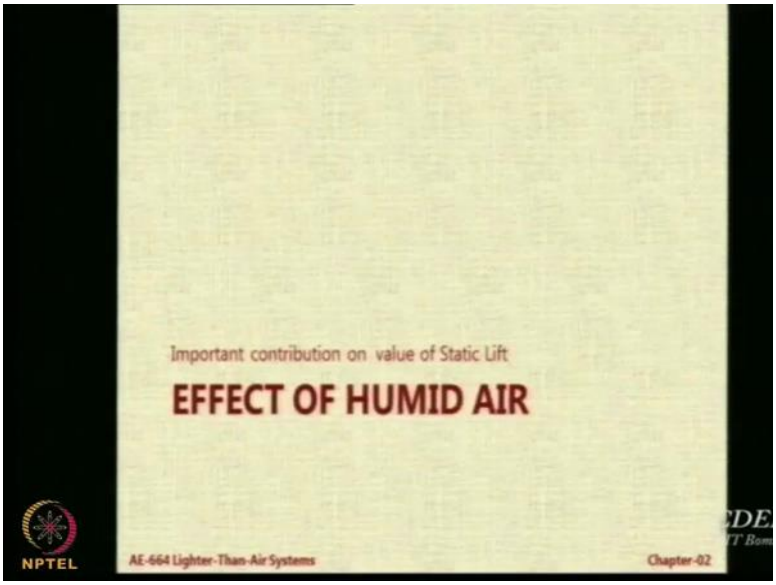

Now we look at one of the most complicated things that you will encounter in static lift calculation. I am surprised you asked this question because I have already explained the calculations that do not do double accounting of the weight of the gas. When you calculate

$(\rho_A - \rho_g)V_{env}g$, you already taken care of. That is what you understand that $\rho_A V_{env}g$, is the vertical force.

You subtract from that $\rho_g V_{env}g$. you have taken care of the weight of the Helium there. You do not have to subtract my friend that is what I am saying. Look the force you will get this is the concept between the static lift and the gross lift. Gross lift will be $\rho_A V_{env}g$,. Net lift will be $(\rho_A - \rho_g)V_{env}g$. Now that is interesting. So you are only calculated net lift sorry gross lift.

So you forgot to calculate net lift. So density of helium you need, yes density of helium 0.1639 if I remember rightly 0.164 kg per meter cube. So now the calculations will change then accordingly.