Lighter Than Air Systems
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Lecture - 35
Tutorial Problem 04 on Net Static Lift Estimation

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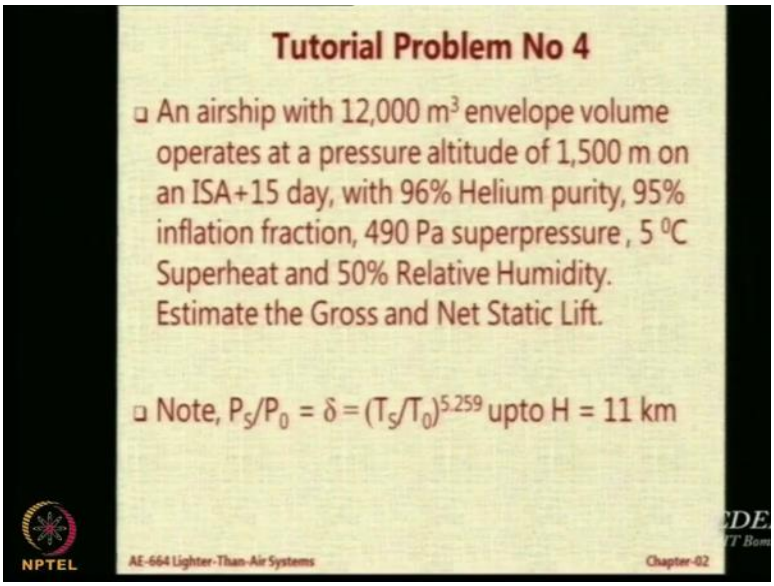

Now what we will do is have you learnt all this it is time now for us to figure out how much do we actually know. So, I am going to give you a problem which I give you as a homework problem. How many of you are able to solve it? You are able to solve it you got the right answers, anybody else? How many of you try to solve the problem? So, where you get stuck? What is that equation with the height, yes, instead of 4.25 it is 5.256 correct.

So, only two people in the class have to go back and check that is very low score. And that is not a good idea. this is elective course; you have chosen to do this course and if you do not show interest and do the course do the things given to you then it is basically going to harm you only.

Let us have a look at this problem today again. So please note down that the problem first of all. This problem we have to solve today and right now. Do you have calculators all of you? So, prepare with your calculator. So, V_{env} that is envelope volume is 12000 meter cube. Pressure altitude of

1500 meter what does it mean? What is meant by the term pressure altitude of 1500 meters? Someone should to raise their hand and explain to me.

Omkar any idea what is meant by pressure altitude of 1500 meters, that is pressure height what you say that when the ballonet is completely flush that is pressure altitude this is pressure height. This is something else that is why I asked this question. This is not the pressure height. This is if the pressure altitude of 1500 meters what information is communicated to you. So, the airship is operating at some altitude at which the ambient air pressure is equal to what you see under ISA conditions at 1500 meters. This is the meaning of pressure altitude of 1500 meters.

It does not mean that airship is operating at 1500 meter. The airship may be able to get 5000 meters but it so happens that the ambient air pressure at that altitude is equal to ambient pressure that you see under the ISA conditions at 1500 meters correct. That is ISA+15 so that means the ambient temperature also is not ISA it is ISA + 15. Then you have Y helium purity 0.96 then you I equal to 0.95 then ΔP_{SP} is 490 Pascals then ΔT_{SH} is 5 degree centigrade.

And $\frac{e}{e_s}100$ is equal to 50%. So, we are supposed to estimate the gross and net static lift and now we can actually remove this because now we have a formula for ballonet air weight. So, this is the equation that we were discussing that P_s/P_0 that is the pressure of the ambient air at some altitude upon the pressure at sea level is called δ, pressure ratio of the atmosphere and that is going to be $\left(\frac{T}{T_0}\right)^{5.259}$ this formula holds only in the gradient level atmosphere which starts from sea level and stops at 11 kilometers.

Now no ISA goes beyond 11 kilometers so does not have to bother about heights above the 11 kilometers. So, you can assume this for your calculation, as everybody copied it down. Let us go ahead then let us solve it.

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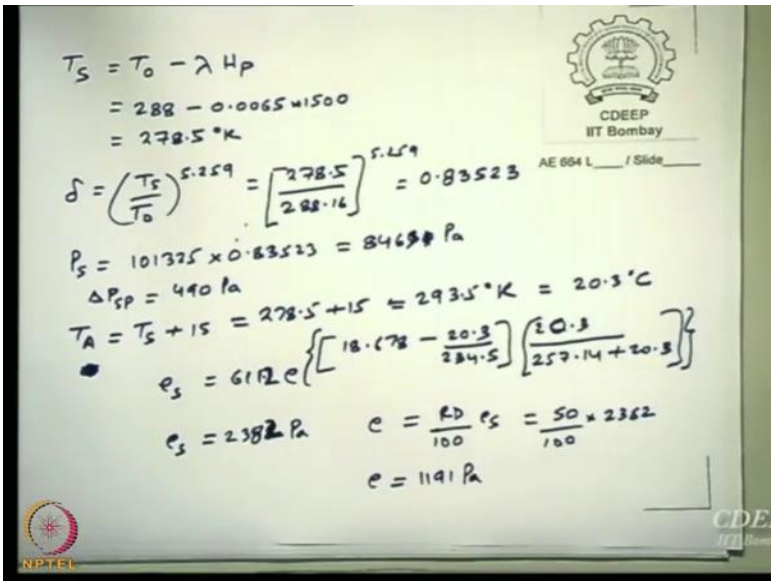

So, the first thing that we need to understand is that T_s that is the ambient air temperature and T_s is going to be 278.5 degrees Kelvin this is the first thing that we have to calculate. solve this expression, calculator? 0.83 this is what you will get.

So therefore, what is the value of P_s? That will be 101325, correct. Now the next thing is what is the value of ΔP_{SP}? This is 490 Pascals. What about the ambient temperature will it be equal to T_s, T_s is standard temperature? So, what it will be? This will be equal to T_s + 15 that is 278.5 plus this is the value of T_A, 293. So now how much is the value of T_A in centigrade? 20.3. You remember there is a formula for getting e_s? Do you remember this formula?

That formula which we have for calculating the value of e_s. Do you remember this formula or not? Yes or no? So that is the case then I want the value of e_s, what is the value of e_s? 2375 Pascals. Anybody with some other number yeah, I am waiting, 2382 that is what I got into calculator 2382.

Now what is the value of e? $e = \frac{RD}{100} e_s$ what will be 50% into what is e? 1191 Pascal unless you solve it yourself you not understand what is happening? Alright let move ahead now.

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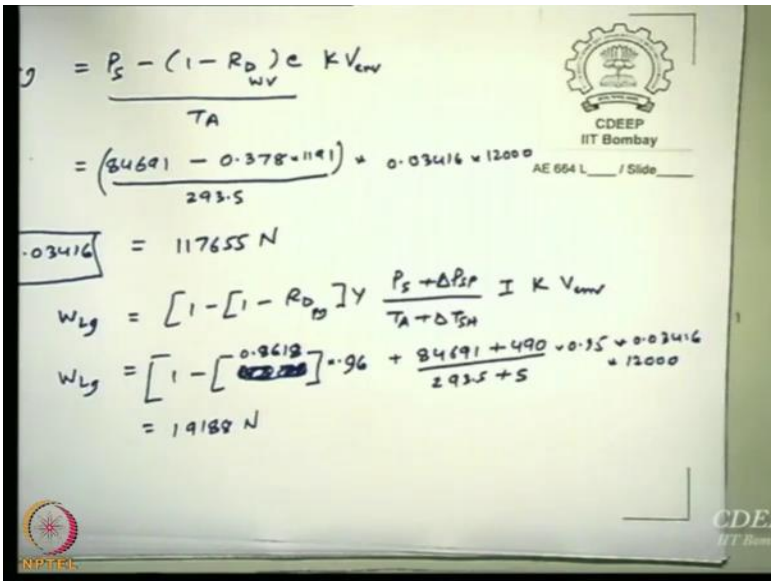

how much is P_s? 84691 minus; what about (1 – RD)? What is (1 – RD) for this? what is T_A ambient temperature? Now how will you get value of K? $K = \frac{T_0}{P_0}\rho_0 g$. that is value of K is actually known to us. This is the value of K. so you multiply that by 0.03416 times and envelope volume which is 12000 meter cube. The what is the value of L_g? 117655 what is the units? No, it will be in Newton because g is taken care.

Remember this K contains g also and then a unit in Newtons. Now what is the lifting gas weight? W_{lg} for that you have a expression. now what is the value of (1 – RD)? So, (1 – RD) is itself is group. Now, K which is 0.03416 into 12000 this is W_{Lg}, lifting gas weight. So, how much is lifting gas weight? So, from the gross weight of 117655 Newtons the lifting gas weight itself is 19188 Newtons. Now the next thing that you need to see is weight of the air in the ballonet.

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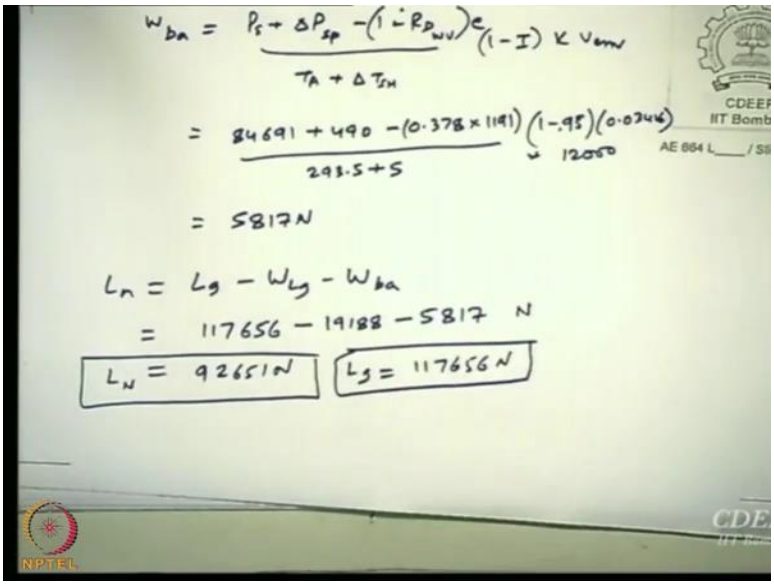

What will be $P_s + \Delta P_{sp}$. how much is W_{ba}, weight of air in the ballonet? 58 that is it. now you have everything. Now $L_N = L_g - W_{lg} - W_{ba}$. so, this will be equal to what is the L_g we got was? How much was the L_g, W_{lg} and W_{ba}. So, what is L_N? The units are going to be Newton, So, that is the answer we are looking for.

The net static lift is 92651 Newton and the gross static lift was 117656 Newton. Now you yourself check what happens if you ignore humidity. What will be the percentage error? So, with that we come to the end of today's lecture. In the next class we will look at the effect of certain variation in the atmospheric properties on the net static lift, how it changes. Thank you.