Lighter-Than-Air Systems
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Lecture - 57
Tutorial Problem 12 on Lifting Gas Loss

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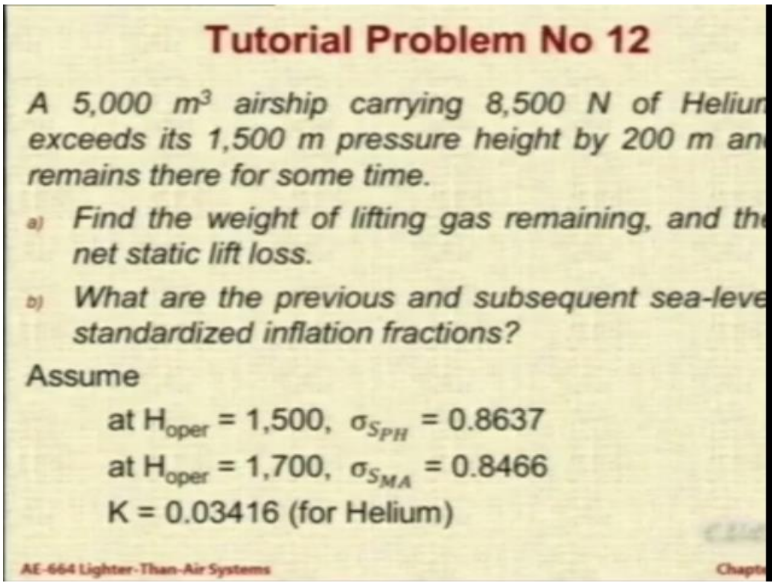

So, now let us apply all what we have learned today to look at a real life operating problem. There is an airship which has got an envelope volume of 5000 meter cube. At the ground level it carries 8500 Newtons of helium. Its pressure height is 1500 meters, but it exceeds by 200 meters and goes to 1700 meters and then remains there for some time. This means it is a sustained case. It is not a transient case, it is sustained, it remains there for some time.

So, now the question is what would be the weight of the lifting gas remaining? First of all how much lifting gas will be thrown out? And therefore what will be the weight of the lifting gas remaining? And then what is the inflation fraction earlier when it goes to the pressure altitude and what is the inflation fraction when it goes to higher pressure altitude. So, to make life easy for you I have given you the numerical values of the sigma at 1500 meters and sigma at 1700 meters.

Notice that σ is 0.8637 and 0.8466 respectively. And for helium the value of K is 0.03416. So, let us see if you can solve this question. If you want me to show some formula, I can scroll back and show you the formula.

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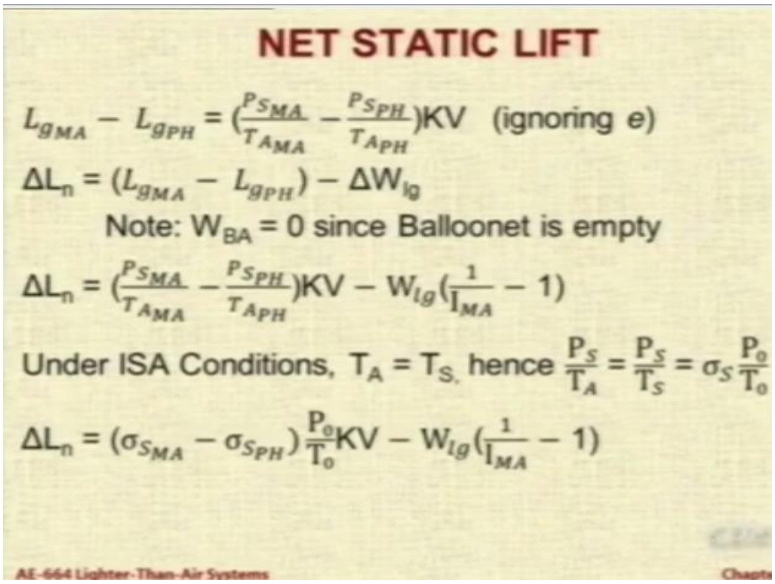

You can note down this formula if you wish. The last line in this slide is the one that is of relevance to you because this is applicable for a sustained exceedence. In fact, this is applicable for both the cases. However, you need to know the formula to be applied for I_{MA}.

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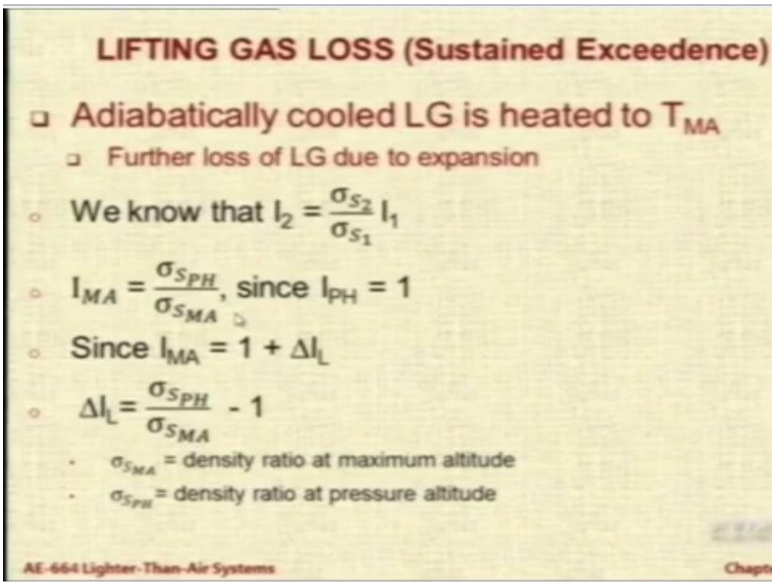

So, I will go once one step back. This is what you need.

$$\Delta I_L = \frac{\sigma_{SPH}}{\sigma_{SMA}} - 1$$

So, I_{MA} will be equal to 1 plus this particular ratio or it will be simply I_{MA} will be equal to the ratio of the two sigmas. So, let us see.

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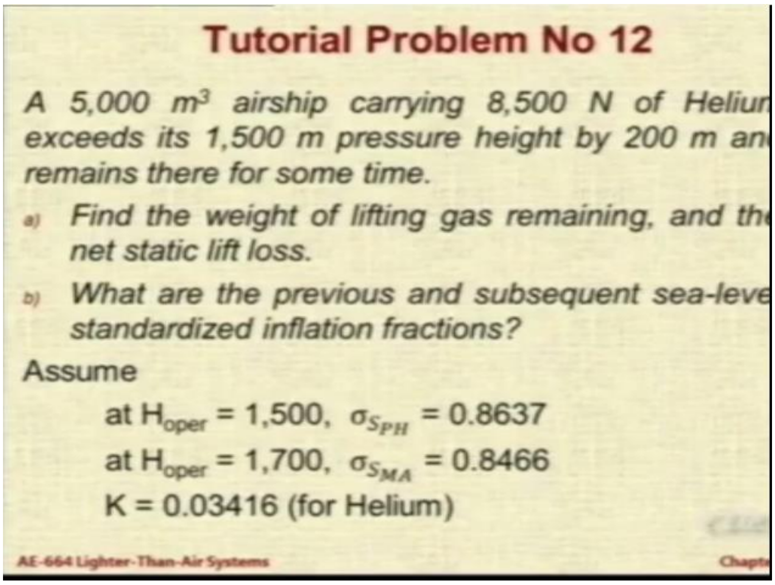

Now I_{MA} is going to be the ratio of the two sigmas. So, it is going to be $\frac{\sigma_{SPH}}{\sigma_{SMA}}$ = 1.0202 that is a value. So, those of you who do not have the calculator you can follow the calculations with me, others should do it so that you learn, otherwise you will stare at the screen and say yes, but you wouldn't understand. Now, the weight of the lifting gas at the maximum altitude is going to be the weight of lifting gas under the ground which is 8500 meters divided by I_{MA} which is 1.0202.

So, the weight of the lifiting gas is going to be 8322 Newtons. If there are any mistakes in these calculations, you can correct me, right. So, this is the first thing that we got. Now, the airship has lost 2% of its original lifting gas that is why it is 1.0202, nearly 2.02% is gone.

So, σ_{SMA} is 0.8466, σ_{SPH} is 0.8637, P_0 101325, T_0 288.16, K is 0.03416, V is 5000 meter cube already given in the question minus lifting gas weight at ground was 8500 Newtons. So, calculate this number and tell me the value of ΔL_N**,** 168.3. Let us wait for somebody else to get the answer, yes how much 858.49. Right. So, two people have got 858.49, I got it as 895 and it is negative negative.

So, the net static lift has been reduced because 8500 – 8322 Newtons of gas has been thrown away that much of gas has been thrown away. Now, the question number b was what are the previous and subsequent sea level standardized inflation fractions?

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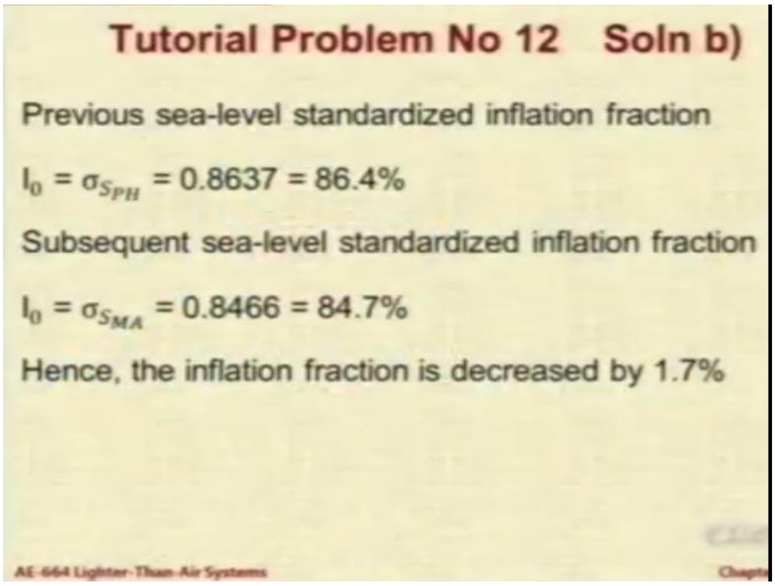

This is very straightforward, this is equal to sigma. So, the inflation fraction is decreased by 1.7%. We know that the inflation fraction is simply equal to the sigma. So, it was supposed to have 86.4% gas and the remaining air, but because pressure height has gone to 1700 or operating altitude is gone to 1700, the inflation fraction is decreased by 1.7%. It should actually carry more air to go there.