**Lighter-Than-Air Systems**
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**Lecture - 74**
**Inputs to Airship Design Methodology – Part 1**

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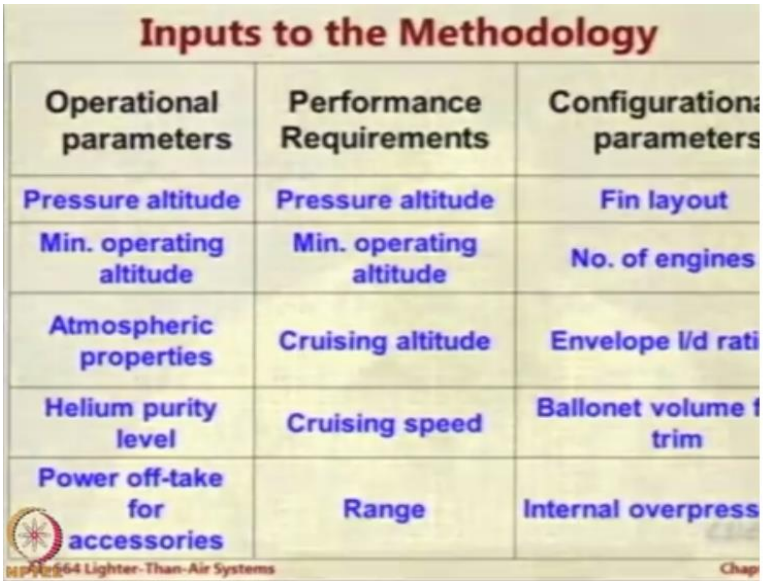


So, these are the inputs to the methodology. So, three kinds of parameters were used by us as inputs. The first are the operational parameters. Now, none of you mentioned pressure altitude which you should have mentioned. You mentioned operating altitude, but you did not say what it should be the pressure altitude, correct. So, it is important and also I expected somebody to say that from a height of so much I want to go so much $\Delta H$.

Because you know that the ballonet will be size based on the $\Delta H$. We have spent so much time in the inflation fraction calculation, I thought some of you will think and say this airship has to fly from this altitude let us say sea level to that to the operating altitude that can change from place to place. So, pressure altitude is an important parameter that is the equivalent of the operational ceiling.

Then minimum operating altitude, then atmospheric properties and then the purity level of the gas because this is something which is based on the availability of the gas. Helium gas as you know is not a very commonly available gas and if you insist on very high purity it becomes far

more difficult and also more expensive. So, you may have to make do with helium available at 95% purity or at 99.9% purity or 99.999% purity. This is not in your hands.

The cost and the availability are going to dictate. So, helium purity level is an important parameter which we have incorporated. In our 11 parameters, we also looked at helium purity or gas purity gamma as one of our parameters. Then an airship is going to have some accessories, is going to have some other systems which are going to be mounted on it. They will consume power and who will give the power to them, the same engine which is used for the airship.

So how much power is consumed by accessories. So of the engine power which I generate what percentage is consumed by other things like fuel preservation system, like air conditioning system and the remaining will be available to me as a user. Then performance requirements this pressure altitude is common and minimum is also common like cruising speed and range are important.

Now in our problem here we were not looking at keeping in the air for a long time as a requirement. This was not meant for surveillance, this was meant for transporting goods and passengers. So, therefore endurance is not there as a given requirement. Range is the given requirement. So, cruising altitude, cruising speed, range, minimum altitude from crusising which gives you the ballonet sizing rather sorry minimum altitude to pressure altitude give you the ballonet sizing.

And then there are some configurational parameters. Now, these parameters cannot be given by the user. User does not know, does not care about them, but the designer has to assume. Otherwise there will be so many things to calculate that you will never be able to make any progress. So certain parameters we have assumed as constants or fixed and we have to change. If you change them, you have to do the whole analysis again.

So what is fin layout? Now wat kinds of fins are available for airships? For large passenger carrying airships do we have any options about fins? What are you seeing? So, what type of fins have you seen the videos I showed you of airship flying with passengers? What is it? Yes delta. No, I am not talking about the shape of the fins, I am talking about configuration.

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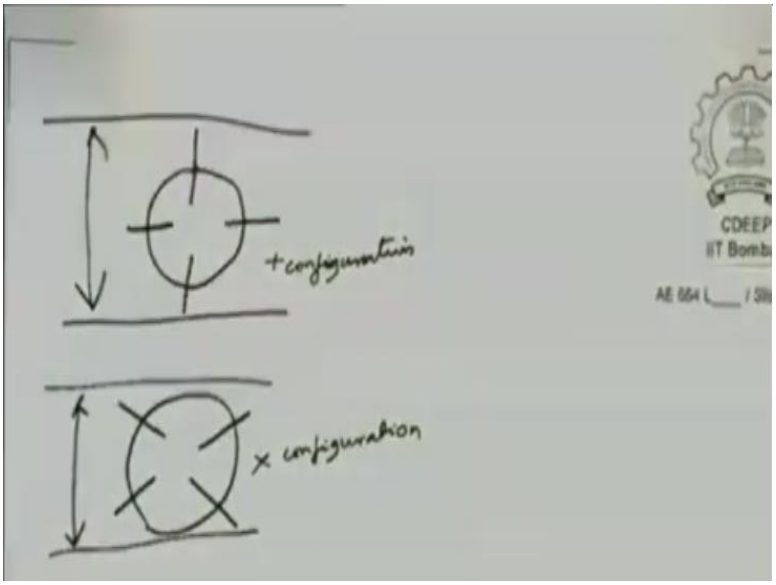


So there are basically if you look at the airships available there are two basic types of fin available in literature for conventional airships. Yes, so one is called as the conventional. This is a rear view of the airship. The other one are mounted this way. So, either you have a plus configuration, so this is called as a plus configuration and this is called as a cross configuration. Now, tell me what are the basic differences between these two types of configurations?

**"Professor – student conversation starts."** First of all which one will you prefer? A plus configuration or a cross configuration? Plus. So, most of you will prefer a plus configuration. Why would that be? Because the pitch and yaw are uncoupled. Because the pitch and yaw motions are uncoupled. Pitch and the yaw motions are uncoupled right because you have two distinct vertical surfaces, two distinct horizonatal surfaces.

But then if that is everybody's preference, then why do we have something with cross fins? High Maneuverability. How will a cross fin get you better maneuverability? So that is pure guesswork that is not correct. It is not correct. What would be the advantage of a cross fin? Sir the fin on the cross comes in so they continuously move than the plus configuration. See the wake of the bluff body is almost symmetric all around.

So, whether you put fin on the top or bottom, wakewise I do not think there will be lesser or more disturbances. Cross will be more stable than the plus. Cross will be more stable than plus sir, why? Because they are left on the horizontal. No, but if I have a dedicated vertical on top and bottom I think the stability of that will be the best compared to a mixed configuration. So, I have nothing horizontal, I have nothing vertical in the cross.

Yes, Chetan what do you think? Probably with the cross configuration you will have smaller area. Why, no? In fact no. The size of the fins may not be small because all the four fins are supposed to be used for both yawing as well as pitching. So, do you think that or whether your saying is that you will use all four, therefore you can have smaller area of each of them? But you know only a component, only a component of each is going to do the desired thing. Anybody else? Yes, Amir what do you think? Sir ground clearance. That is the main thing. **"Professor – student conversation ends."**

Remember we are looking at big and bluff bodies, large bodies. So, if I have a plus fin configuration everything is fine except that the ground clearance becomes a problem, bottom fin is going to. So the the maximum height of the airship is going to be more, so the size that goes inside the hangar so that is given.

So now when you have a cross fin configuration, the only advantage you have is a smaller height. Listen making a wide hanger is not a big problem. Making a high hanger is a bigger problem. Making a wide one is never a problem, you just need more area on the land that is okay, but the difficulty is when you want to make a very high hangar. So that is why the reduction in the vertical dimension because of cross fins is one advantage.

Many big airships larger ships have gone for cross configuration only for this particular feature. But then there is a complication that now the control system becomes complicated, it has to be mixed. So you require a mixing unit. The pilot will deflect the control stick in the desired fashion, but this control system must take over and do mixing so this leads to complexity.

However, in a big airship you anyway are going to have a fly-by-wire control system to make the system light. So, when you have that system or when you have a computer control system this mixing is not a really big additional complexity, it can be easily incorporated. So, now the Moodle question for you is identify actual man carrying airships or large airships which have gone for a cross fin configuration.

And I want to know that their names and maybe a picture and some data. And if you can get some literature which says yes a study was done and it was found that cross configuration works better than plus for this particular case it will be helpful for us to learn more about it. So, you can choose plus or you can choose cross.