**Lighter-Than-Air Systems**
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**Lecture - 96**
**Overview of Aerostat Design Methodology**

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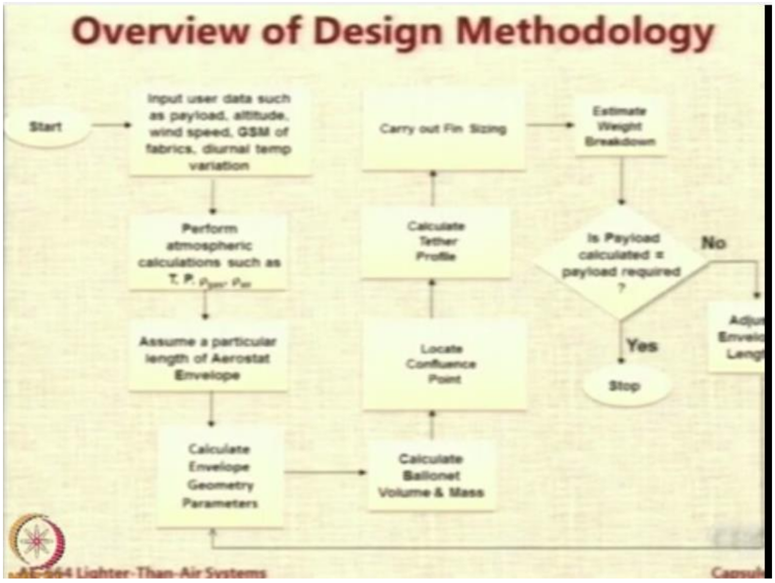


So now we have come to a stage where we look at the various elements of the methodology. I thought this time I will go box by box because last time when I discussed the airship design methology, I showed you the whole thing and I saw the effect of that in the examination. Very few people were even able to name correctly the elements and what they do. Some of you could name what the elements are, but you cannot explain what they do only.

One or two students have been able to answer that question correctly. So, I thought this time I am going to go slow. First thing is we start the process and the first block is the input block. In the input block the values of design constants, the input parameters are all read, so that the methodology can start doing its calculations. Then first thing we do is we use the aerostatics calculation formula using the Ambient temperature, Ambient pressure.

Density of the gas, density of the air, then there are other things like the effect of humidity, effect of superpressure, effect of lifting gas purity. All those calculations are coded in this particular box so that for any operating condition you are able to get the correct values of net lift available. So, this I do not want to repeat, we already spent probably 3 or 4 classes in looking at all the details formula, right.

Once we do this, we now say okay we have to assume a particular shape. This methodology works only for a given shape. So, let us say we have chosen the shape to be sphere. So okay for a sphere, we assume a particular dimension. So, it will be diameter because diameter length are same for a sphere. If you use a shape like GNVR or something else, you will say okay length. The GNVR shape of length l = 2 meters.

You start with some number, with that number and with the geometry of the envelope, you can get the envelope geometrical parameters like max dia, surface area, volume for that particular envelope. Then using the data available regarding the atmospheric properties and the net static lift available under the operating conditions, you can calculate the volume of the ballonet. And assuming now in aerostat we never have two ballonet because there is no need to trim.

Why not? Because you have a confluence point. It will automatically trim to a particular angle as you will see very soon. So, no need to have two ballonet, you normally have only one in the center. So, once you know the volume needed to meet the aerostatic requirements, you can calculate the geometry of the ballonet and hence its weight because the weight per unit area of ballonet material is also known to you.

You have chosen the material based on available information. Next thing that you do is you locate the confluence point. So, how do you do it? You can say equal to diameter from the nose and diameter below starting point. So, this is not the end point, it is a start point. Once you do that the next thing is I now know the confluence point location, likely position or the desirable position or I should say the first estimate.

I also know the operating height, I know geometry hence aerodynamics of the data of the envelope. So, I can do the profile calculation which I will demonstrate to you after some time. So, with this you will come to know the actual length of tether needed under the operating conditions. Then we carry out fin sizing. So, again for that there is a procedure. One procedure is the fin shape is fixed and look at aerostats which have been designed and they are stable.

Work out the distance between the aerodynamic center of the fin and the centre of pressure of the envelope and use that to get the relationship. You can scale up or scale down the existing fins or you can do it in a more elaborate method. So now that you know the size of the fins, therefore you know the fin weight, you know the ballonet weight, you know the tether weight, you know the self weight.

So you can get weight of each component of the aerostat. Balanced weight will be payload. And remember we have to keep free lifts to 15% or whatever number you assume. So, you will come to know how much is the payload which I can carry. Now, if this particular thing is meeting your requirement you stop. If you find that the payload required is 300 kg, but what I am getting here only 50 kg, obviously I must increase the size and vice versa.

So, you adjust the envelope length as needed, go back and keep on iterating till you come to a convergence for your payload. Everything is clear.

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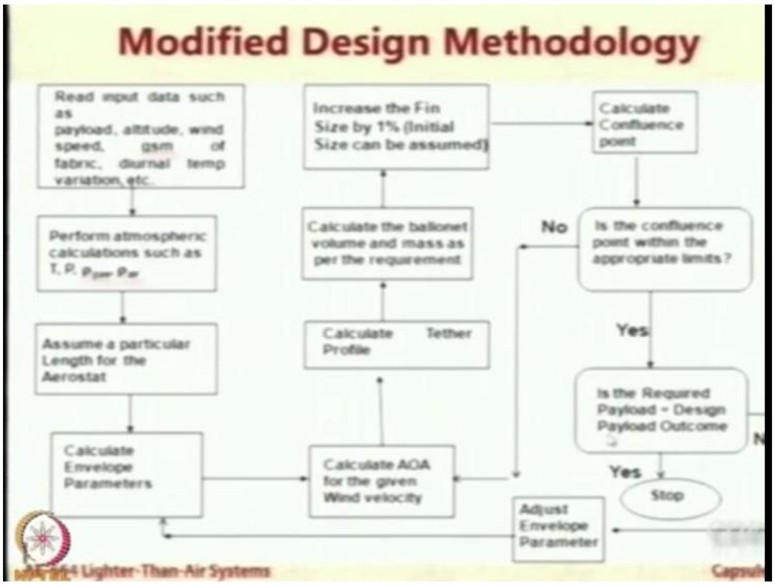


So, the same methdology is not shown in one shot with small variation here. You can do a little bit of alteration inside on the confluence point location also which I will elaborate.