Lighter than Air Systems
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Module No # 01
Lecture No # 02
Difference between LTA and HTA systems

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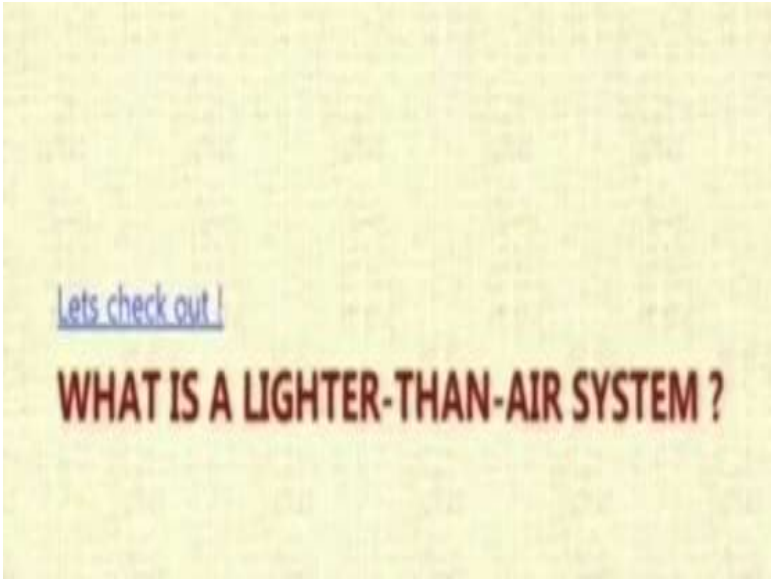

Let us come to the basic fundamentals of lighter than air systems okay.

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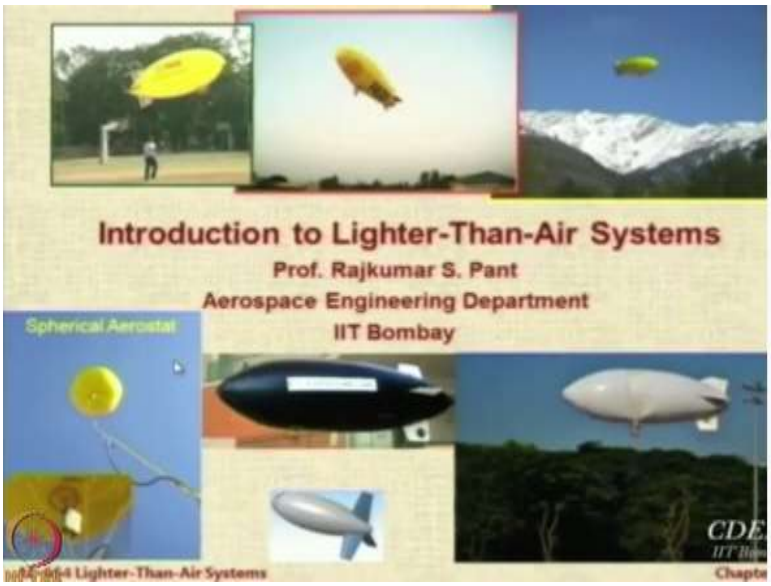

Now you will see a collage of pictures here and i want you to observe something and tell me is there something special about these pictures. Let me see if you can identify the specialty of these pictures of course one point is this that except for the bottom at the center the you know the pictures that you see are, simply photographs it does not have wings yes. The similar observation we are looking at a system that does not require wings.

You require wings and then aircraft to generate the lift force but lift force in LTA systems is free of cost without any effort by the presence of the gas inside the envelope which is what we will see now. So good observation there are no wings other than that yes the shape of them is all more or less same. There are variations in the shape but they are they look very similar okay and anything else?

Yes but okay the one of bottom as only 3 tails as you can see but that is the conceptual sketch. Generally you see a 4 tail structure 2 vertical, 2 horizontal okay I am talking of something more basic or more general then all these technical observations yes. No moving parts that is what you think because we do not see anything moving no I am asking you to tell me what you see not what you know about what you see?

That is the point of view to understand all of these are actual systems which have been developed in IIT Bombay by our students and researchers. So we are talking about a system about which we have some authority and experience we are not showcasing somebody else work. We are showcasing our work okay that is very important we are starting working in LTA systems in the year 2001. I use to download pictures from the internet and show it in presentation.

And in 1 presentation somebody said what have you done? I just said sorry I just put these things to work. From that day onwards stopped putting pictures from internet. And I said let that there be a day we will show a PPT with our pictures. So I am very happy to show you that I am in 12 years okay when we start we were 0 the picture that you see on the top left. I will talk about it in more detail this is during a techfest of IIT Bombay in 2002.

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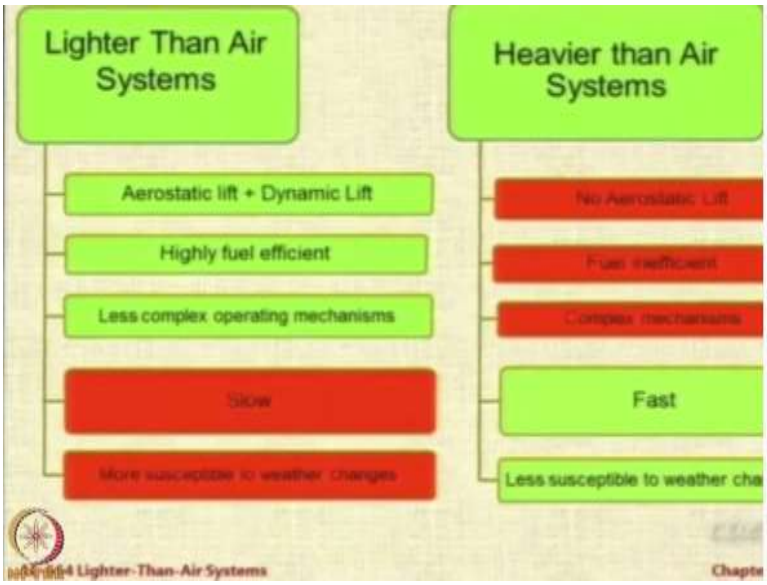

But more about that later let us look at the first question that always comes in the minds of people who hear about the LTA systems. And that is how are the different, from the conventional aircraft so the conventioal aircraft we call them as HTA heavier than air. Simply because if I lift an aircraft and if, I release it the aircraft will fall in ground because it is heavier than air quite simple. On the other hand if I lift and the LTA system and then release it what will happen what do you think will happen?

Yes, raise your hand so that I can talk to a specific person what will happen if I lift for example if this is an LTA system I lift it up and if I release it what will happen? Yes please what is your name? Vipin, what will happen Vipin to this system? Very good either it may remain where you leave it or it will go up okay correct. Because it is lighter than air if it is a perfectly balanced systems than we should say equal to air in a way, then it will remain where it is such systems are called as neutrally buoyant LTA system very funny language neutrally buoyant lighter than air systems.

So the word LTA is only applicable to those systems that use some kind of buoyancy as the main lifting force. But actually they may be heavier or equal to or lighter than the air got it? So you are right it will remain at this place in the neutrally buoyant or it will go up. Now what will you normally preferring in a system in an aircraft would you prefer it to be heavier than air lighter than air or neutrally buoyant.

You want to shift between these why did you, like to shift? Okay so because we want to know we want to change position sometimes you want to be heavier than air sometimes lighter than air and sometimes neutrally buoyant okay. This is the fairly acceptable answer in general if you are making an airship I would prefer it to be heavier than air what you think is the reason? If something goes wrong I wanted to come down to me and not hang up in the air I am wondering what to do how to bring it down okay.

So although we make lighter than air systems in reality we fly than to be slightly heavier than air and how heavy it is compared to its weight. There is a term for it is called as static heaviness okay. But now in front of you we have 2 boxes containing the names of the 2 systems and not very clear you will find that on the left hand side we have the lighter than air systems there are 3 green boxes and there are 2 red boxes okay.

Red boxes are undesirable green are desirable and since we are doing a course on LTA systems we biased in favor of LTA systems so there are 3 green boxes and 2 red boxes okay. On the other hand to make the balanced there are 3 red boxes on heavier than the systems and 2 green boxes. But these 2 red boxes on LTA systems are the basic reason why we do not see them so often okay. These are very serious limitation except especially the last box so what are the benefits first?

Benefits are that you get aerostatic lift that means we got lift even when we are stationary plus you also get additional lift when they move. So airship being an aerodynamic body when the airship move in an air it will generate some lift because of its shape that lift is called as dynamic lift that is 0 or 0 relative velocity between body and the air. So the dynamic lift is an extra thing you cannot depend on it because it is not always available.

Secondly since the air aerodynamic lift they do not have to be lot of work to generate force to overcome gravity. Therefore they consume less fuel you can assume that a typical aircraft does 2 things it does some work to create force to overcome weight and then it as extra work to create force to give propulsion. In the LTA system the first one is free so the force the power require to create the force of forward motion is just to overcome the drag weight is taken care by nature.

So if there is less work less consumption of fuel more fuel efficient and also as you will realize but many people also mentioned no moving parts because they thought there will be moving parts

actually there are few moving parts and they are very simple. Aircraft are far more complex because the same wing as to do many things here we are deflating there is no wing here. But then there is a problem these are bulky bodies because they need volume to generate lift and volume and large size makes you bulky and rest example of that by the way.

So therefore they are slow they cannot fly very far you cannot expect to have a hypersonic air ship okay not even supersonic not even high subsonic. Airships will only be lower subsonic well unless you go into an outer space you get Mach number because of simply because of you know density I am just talking purely on velocity airship always be low speed maximum arc number of airships times to be 0.2, 0.25 may be.

So these; are low speed vehicles and because they are bulky and because they are buoyant they are very highly susceptible to disturbances that happen in the atmosphere due to weather changes. So if I have steady wind blowing there is not much of a problem I can fight it by giving a power plant. The problem in LTA systems is wind changes direction rapidly then this body is going to also move in response to the disturbance.

And to create forces that can cancel out the disturbances completely requires a lot of effort and lot of weight. And maybe beyond a point we just cannot do it we have to simply ground the vehicle and store it in extreme cases deflate it. So that is the serious limitation it can never become all weather vehicle it is only going to be a fair weather vehicle and this is one reason where you will never see an airship being used for regular transportation between 2 places.

However efficient it is however low conception of fuel it can burst one of the most important aspects can you answer this questions? What is the most important aspect in a transportation system from the customer point of view? Safety is one, airships and all unsafe that is a wrong notion I will spell it very soon. Do not think airships are unsafe safety wise we can tackle safety no, I do not want to hear to murmurs I want to see hands okay comfort.

So do you think airships are uncomfortable I will not agree to this they are not uncomfortable if the weather is confortable if the weather is okay. Yes so customer wants to travel fast correct they people want to travel fast and airships cannot go beyond a particular speed however there is one

advantages of airships which other aircrafts do not we will see it there I cannot say it on anywhere it is okay over they can hover but that does not mean that can land anywhere.