Lighter-Than-Air Systems
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Lecture – 104
Introduction to Hybrid Airships

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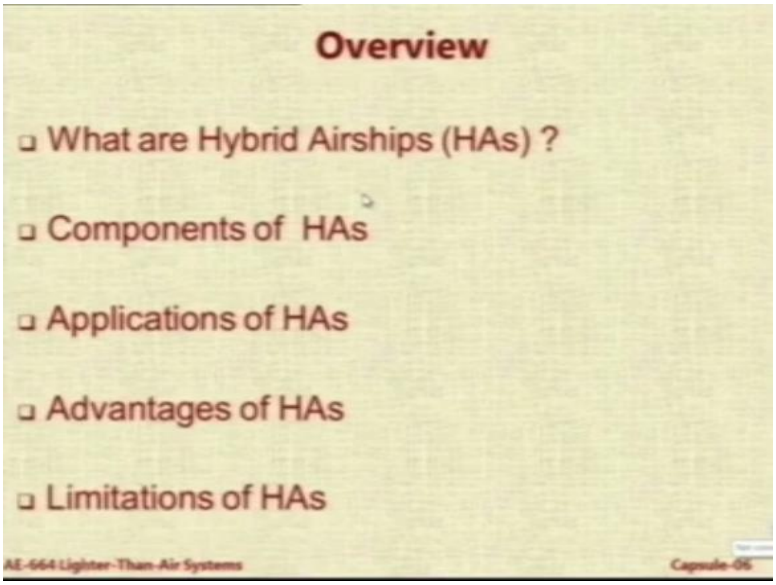

So, today we have a look at hybrid airships and our aim is to first look at an overview of what these airships are? What their components are? What are their possible applications? And advantages and disadvantages as compared to the conventional airships or aircraft.

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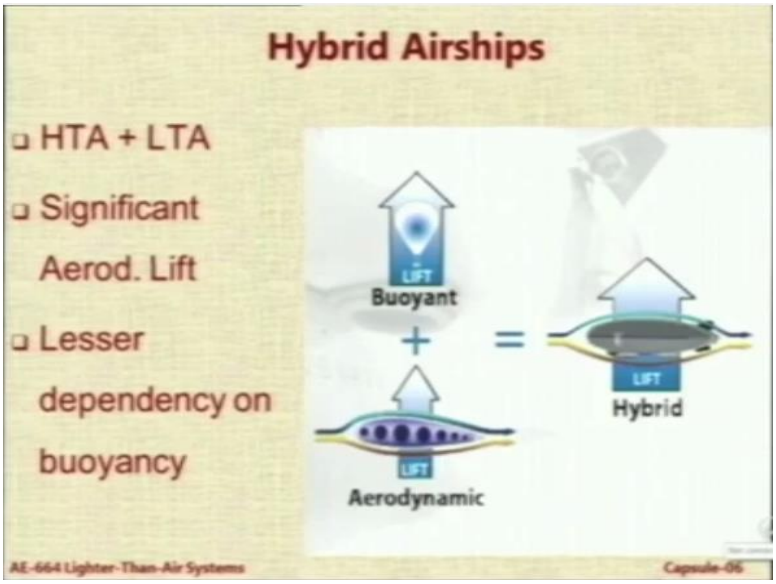

So, when you have a system in which the buoyant lift is not the main source or not the only source of lift, a substantial amount of dynamic lift is also generated. Then that system is a combination of HTA and LTA. The main motivation being reducing the size of the flying vehicle because if you depend on buoyancy alone then volume is the single major component that affects the capability. And hence if you want more lift, you have to make it large in size. And then there are so many problems with large scale systems.

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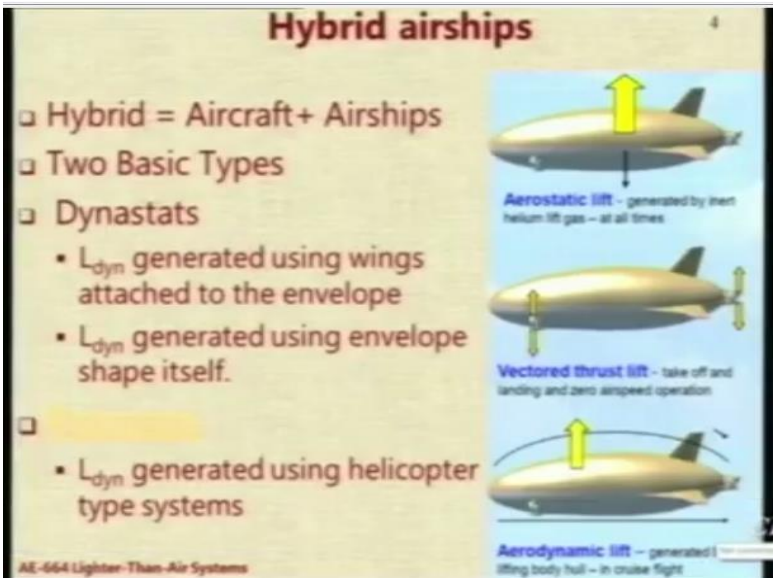

So, as I mentioned hybrid airship basically means aircraft plus airship. Now, it depends on whether it is more aircraft or more airship. So, although there is no written rule, but generally it is felt that if dynamic lift is 40% or more, then we can call the system as a hybrid airship. If the dynamics lift in less than 40% it will still be classified more towards the conventional airship. And in a typical conventional airship, the dynamic lift can be between around 10 to 20%.

So, we already know from our first quiz that there are two basic types of hybrid airships. First of them are typically called as dynastats which generally dominate lift using either wings attached to the envelope or by shaping the envelope itself like lifting body. In fact a conventional airship envelope also is a lifting body, but it is not a very good lifting body. By shaping the envelope appropriately you can make it a very much better lifting body and hence get dynamic lift.

And then we have rotostats which are essentially trying to mimic the lifting system of a helicopter. So, I found a very interesting video of the toy system. It is basically a toy system.

(Video Starts: 02:52) on which two types of envelopes have been attached. So in this, the buoyancy of the two balloons will give some minimum lift and the additional lift. So it is just a demonstration of a small project done by some kids. So you can see that they are able to return to the land which tells the maneuverability of a helicopter.

At the same time because we have additional buoyant lift, we should be able to carry more payload as compared to plane helicopter. But do you see any problem with this configuration? Yes, what is it? Controlling. Controlling will be a problem because the dynamics of this vehicle are neither going to be purely helicopter nor purely airship, it will be a mix in between . Controllability is one major issue. Anything else?

Even the stability is also going to be a big issue. Any disturbing force acting on it, it will be not very easy to make it stable. Anything else? Yes. The weight is more but that is understandable because you have more capacity or capability also. The other problem arises is that the size is very large. Instead of this suppose you get rid of the helicopter, move these balloons together and make a double lobed structure. Then in the same height you have more width.

And below that you put conventional propellers. So, will that be called as a hybrid airship again. It will be because the balloon, we are not just adding buoyancy, we are also getting some aerodynamic shaping. **(Video Ends: 05:25).** So, many experiments like this have been tried by various people. Now, when I was in Virginia Tech for a year, I actually gave a small presentation on flight performance of hybrid airships and in that I gave a small introduction. So, I just wanted to use those slides to save time.

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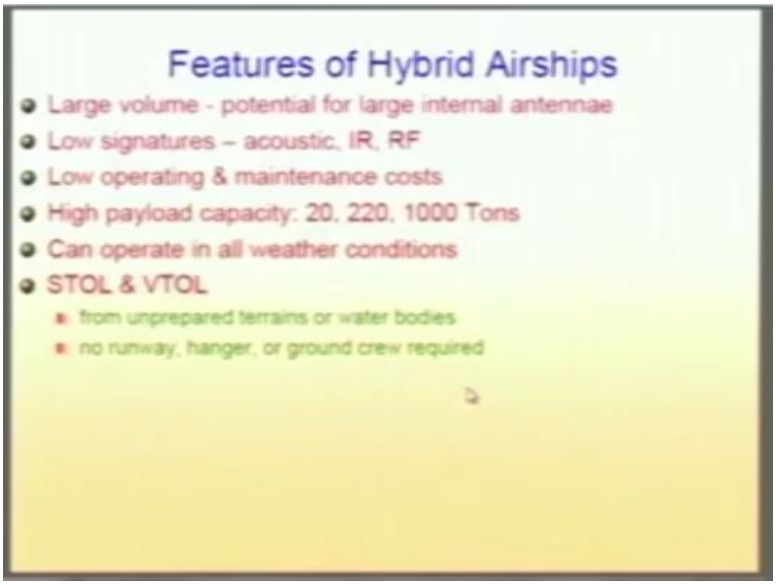

So, one of the basic advantages of hybrid airships is that these airships can be used for multiple applications for which the conventional airships may not be that much suitable. If you want to have extremely large sizes 220 tons, 1000 tons payload capacity, a conventional airship will become very large so so large that it will become very unwieldy for it to handle and operate.

But if you are able to provide capability of generating dynamic list you can actually provide a short takeoff and landing facility. And we will see the demonstration of one such airship.

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So, in the year 2000 in Cardington near Cranfield in UK, this particular small prototype called SkyKitten was flown by a company and their basic idea was to promote use of hybrid airships for multiple applications, where commercial airships may become a little bit unsuitable due to

their size and their operating limitations. So, what are the features of this particular system? First of all as you can see the envelope is not hemispherical or body of revolution.

It is flattish. Second the engines are not mounted on the gondola, but on the sides. They give you larger moment arm. Thirdly it has got the air cushion vehicle type system on the bottom like a hovercraft which allows it to operate from water bodies, land terrains. But is there any other advantage of providing a hovercraft and a feature other than just allowing it to operate from water bodies as well as land?

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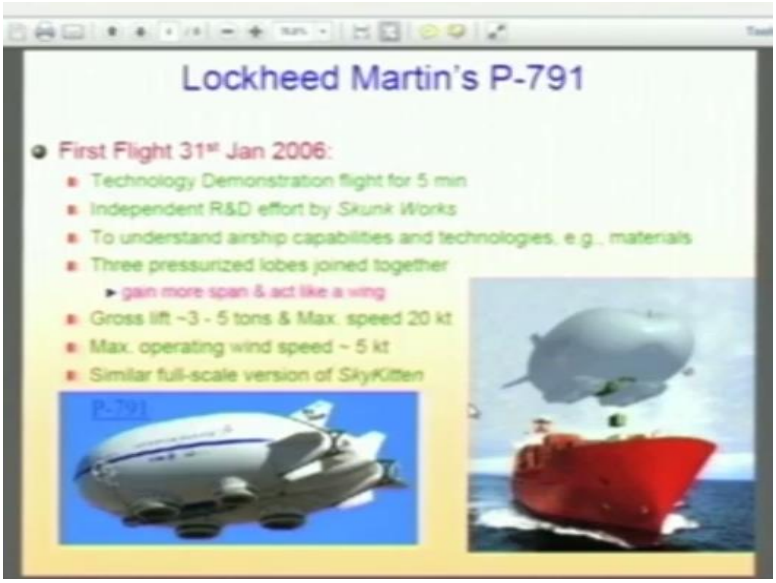

So, one of the very famous modern hybrid airships is this Lockheed Martin's P791 about which you will study in some more detail. This was flown in 2006 for the first time. And this was basically a project given to Lockheed Martin by the US Defense because since many years people have been talking about hybrid airships and promising lots of good features. So the project was given to Lockheed Martin to make a system. And with the money available Lockheed Martin was able to build a small working protoype which tests very beautifully.

We will see a film about it. So, this already we have seen. One could have airship with wings or lifting body shapes or one could have multiple hulls joined together or could have hulls with rotors. Here, we have some pictures of an airship called Dynalifter. We will study about this in more detail today. So let us have a quick look at some of the hybrid airship types which either have been proposed or they have been suggested by various agencies.

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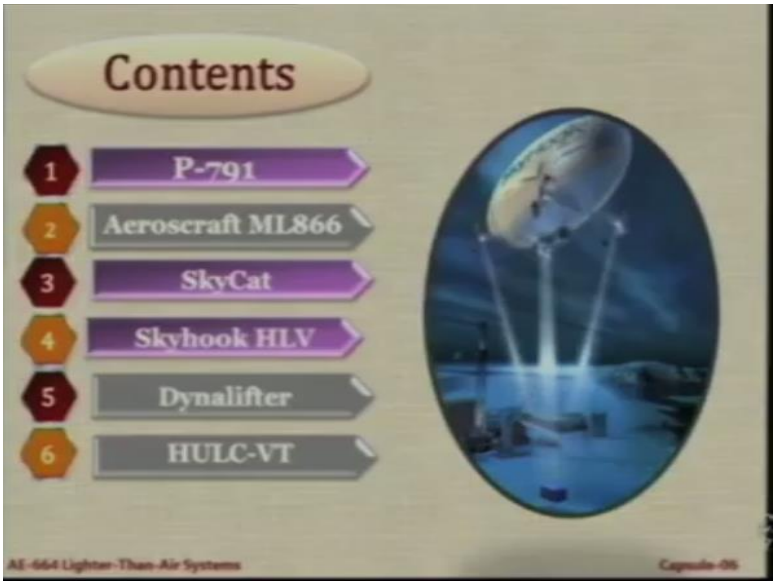

So they are hybrid and you can see the list which I have got is 5 aircrafts which are taken up by some private companies or organizations. Some of them are also made working prototypes. The sixth one is a student project about which I will talk to you again.