Lighter-Than-Air Systems
Prof. Rajkumar S. Pant
Department of Aerospace Engineering
Indian Institute of Technology - Bombay

Lecture – 16
Overview of PADD

So let us start with the discussion on the basic genesis of studies about LTA systems in IIT, Bombay. And they are taken up essentially in response to this particular project called as PADD or program on airship design and development. So this program was started in the year 2001.

(Refer Slide Time: 00:53)

And the basic aim of this project was to do a techno-economic evaluation of the technology of LTA systems in general and airships in particular. My senior colleague, S. K. Sane was the lead of this particular project. And there were 4 faculty members plus there were 3 industry experts who were assigned to work with us. One of them was from the ADRDE laboratory that deals with LTA systems.

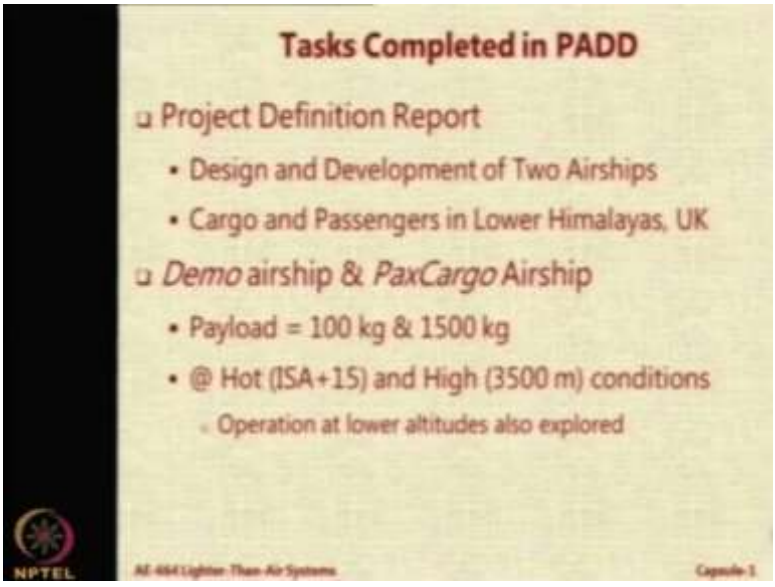
One was from ADA who did the project management of this particular project. And there was one expert from the Airports Authority of India to look at the weather related issues. We also hired one independent consultant an ex-professor of IIT Bombay aerospace department, who helped us with a lot of design calculations. So, this was the basic task assigned to us. It was initially a 6 months study, which was then extended and it went on for close to 3 years.

And during this period, most of us did nothing else but look at airships very closely. So, the idea was to see if we can promote the usage of airships in the country for various applications and for this many of us went around the country, in fact all over the world to meet people who design, operate, fabricate airships. And also we gave lectures like this to many places encouraging them to look at airships as one important technological system.

We also visited and met all the major industrial houses in the country both in the government and the private sector to see if we can identify what is available in the country and how it can be used. And the mandate was to look at various modes of developing these systems, national and global partners as well as the private sector organizations in the country. So, we went to Larsen and Toubro, we went to Mahindra.

We went to several other organizations Tatas and we wanted to encourage them to get into this technology. And in the end we submitted what is called as Project Definition Report, which outlined the roadmap for available technology in the country.

(Refer Slide Time: 03:22)



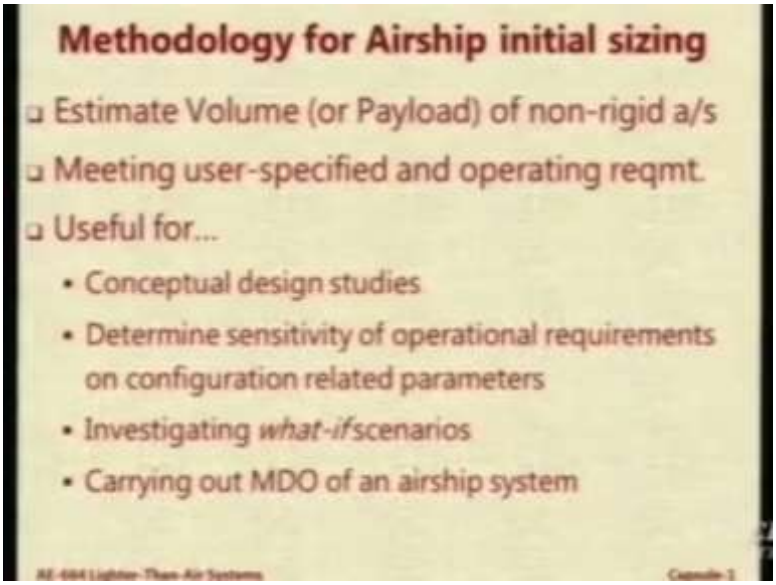
And we were given specific tasks to look at or two airships. One was the application was the same and that was to try and address the needs of the new state of Uttarakhand, which was formed at that time. Those of you who might know the state of Uttarakhand was formed on 9 th October 2001. And one of the mandates was can we try to use systems like airships rather than building roads in these mountainous terrains, which are prone to landslides disturbances because of heavy accumulation of snow and weather?

So can you bypass all that by flying people and cargo using airships? The conclusions was no, it is not economically viable because the payload capacity of airships reduces drastically with altitude. So, an airship which would lift one and a half thousand kilogram under those conditions at sea level could lift around. So it was concluded that this particular application is not suitable for airships and no airship available in the world could be used directly as it is.

And the costs involved in modifying or enhancing or developing the brand new airships were prohibitively high okay. We also gave a feasibility report for leasing of few airships and again the conclusion was too expensive and not cost effective. However, while carrying out this particular project because we were supposed to deal with airship manufacturers and we were supposed to interact with operators.

We wanted to get a very close look and first hand information about airship technology. So, as part of this particular project, we developed a methodology which does the initial sizing of an airship.

(Refer Slide Time: 05:31)



Initial sizing as some of you who have done a course in aircraft design would appreciate basically means arriving at the baseline dimensions and the gross weight estimate for a system to meet a particular requirement specified by the user or by the airworthiness or regulatory bodies. So, it works in two modes, either you say I have this airship with this much enveloped volume, what can it do?

That is how much payload can it lift at these operating conditions? Or we could say look I want to carry so much payload, what should be the volume needed? So, it works in two modes. And it tries to look at the effect of various requirements which are specified by the user. By the way, another reason why we did not recommend airships for the Uttarakhand was that it is an area which is very much prone to disturbing weather.

Mountain patterns, you know the hilly areas have huge amount of valley wind. And these valley winds can make life very difficult for a buoyant object like an airship. So, therefore it was not considered to be very safe. Our studies indicated that the time window in which airships could fly in these areas was very limited. And if you missed that window flight has to be canceled. And as I mentioned to you dispatch reliability is very important in transportation systems.

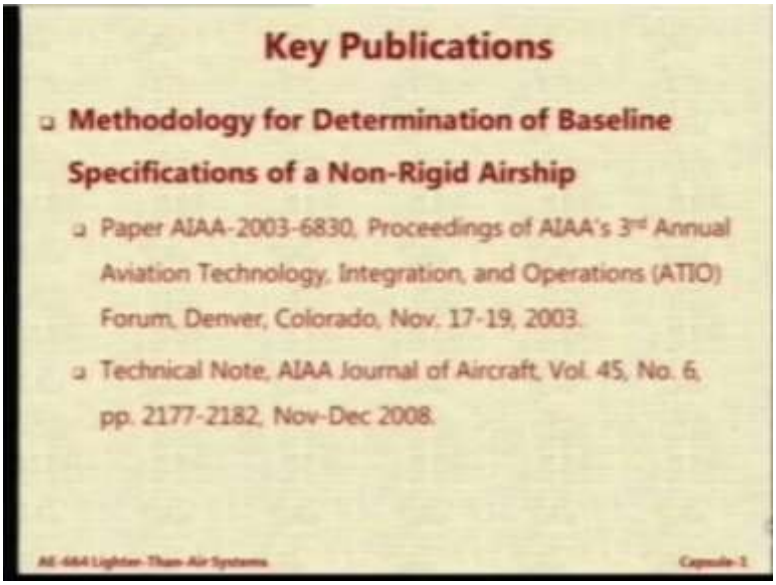
However, for cargo there is not much of a problem because cargo can wait and cargo is not so much time sensitive. Over a month, you want to transport so many tons of log from a site to the ground. So you can do it today or tomorrow or day after does not make too much difference because the alternative was to take it by a bus or by a truck, which would take a week. So, within a week if you come it is as good as coming by truck okay.

Now, this methodology that we developed and I will talk about this, I will give you the details of this methodology as part of this course because this is what you need to learn. If you are given a requirement and if you are given a specific dimension of a system, you should be able to size the system. So, it is very useful for carrying out conceptual design studies.

And it can also be used to identify if this requirement changes or that requirement becomes easier, what is the effect on the airship characteristics? It also helps you in looking at what if scenarios, what if hydrogen is not permitted to be used, but helium is available? Will that affect? Of course, it will affect the payload carrying capacity, but how much? Under what conditions will it become difficult to maintain?

Similarly, if you want to carry out a multidisciplinary design optimization that is MDO, this methodology was considered to be very useful because it had a structure by which you can plug in various modules to improve the various estimates and also the entire system was coupled to each other very nicely.

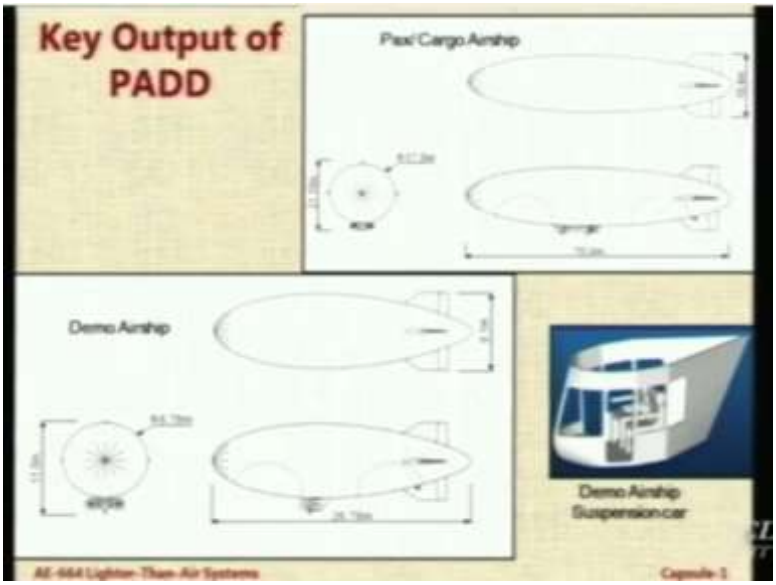
(Refer Slide Time: 08:46)



So, this particular work has appeared as two publications. This is the first publication in open literature on sizing of an airship. So, it was presented by me in a conference in 2003. And then, we modified this methodology further and we improved it, tweaked it a little bit and then published it as a technical note in a journal. And then many people are citing it now because they are using it for carrying out their initial studies.

So, this was one of the academic outputs of 3 year effort apart from a lot of insight and understanding about LTA systems and what they can do, what they cannot do, where they are? It came from these concentrated effort of 3 years.

(Refer Slide Time: 09:37)



Now, this was the key. I have just taken some pictures from the report which is submitted. This is just a key output of the designs. So as students of design would understand the typical output

from a design study is a dimension 3 view diagram as well as complete specifications of the system which are there in my project report and I will be happy to share parts of it.

In fact, the papers which I mentioned, I will put them on a Moodle page so you can go through them at leisure and get more idea about this methodology, but no need to worry it will be taught as part of this course as one of the important capsules.