Report for 3 Days National Level Workshop on "Design and Sizing of Lighter Than Air Systems"

Name of the Event	:	National Level Workshop (3 days)
Resource Person	:	**Dr. Rajkumar.S. Pant** **Professor, IIT Bombay.**
Date & Time	:	27,28 &29 December 2022, 9.30 AM to 4.00 PM
Venue	:	IV Floor Seminar Hall
No.of Participants	:	65 students + 15 Faculty members

About the Workshop

The department of Aerospace Engineering has organized a 3-days national level workshop on Design and Sizing of Lighter Than Air Systems(LTA)in the 4th floor seminar hall. Prof. Rajkumar S. Pant from Aerospace Department from IIT Bombay is the resource person. Students were asked to register for participating in the workshop prior to the commencement to ensure a smooth conduction of the event. The name DeSiLTA was coined by Prof Rajkumar that stands for Design and Sizing of Lighter than Air systems (LTA). It required us to think and wander all around our knowledge of basic physics to understand the concept of Lighter than Air systems and the complex procedure of their designing and sizing. The following will give a detailed report of each session conducted in between 8:30am to 4pm in the seminar hall.

Opening Ceremony - (9:30am to 10am, 27th Dec 2022):

All the participants are assembled in Seminar Hall and the program starts at 9.30 am. Ms. Pratheeksha, III year Aerospace Engineering has delivered the welcome address. Then Prof. A.K. Sarkar and Dr. Ramanan G of Aeronautical Engineering has felicitated the Resource Person with Bouquet and Shawl. Ms. Sinchana of III Year Aerospace Engineering has introduced the Chief Guest followed by the Resource Person has taken over the main session.

Day 1 Session 1: Introduction to LTA systems (10:00am to 11am, 27th Dec 2022):

The first technical talk was about answering what Lighter than air meant. Prof. Rajkumar helped the participants to gain an understanding of what LTA systems are, and then showed the examples of LTA- Aerostats, Airships and Hot Air Balloons.

The definition, properties, principles of flying, requirements and the uses of Aerostats and Airships were explained through real life examples showcased through a presentation in the first session.

Aerostats are a part of LTA systems that use the principle of buoyancy to stay afloat in the air which is held in position by a tether or a cable. The Aerostat can be fitted with a payload of our requirement and sent to heights to aid problems that cannot be solved on the ground. Mobile connection antenna, Wi-fi antenna and other such communication-based applications, surveillance using a camera as the payload, advertisements on the envelope of aerostats and many other such applications are possible using aerostats.

It consists of an envelope, a tether and a payload. The envelope is the chamber that houses an LTA gas such as hydrogen or helium, a tether is a cable that is used to connect the aerostat to the ground to maintain its position in air and the payload is the instrument that can vary according to the use.

Airships however are basically aircrafts without the lifting mechanism of wings. The lift is achieved through buoyancy by filling the airship's envelope with an LTA gas. The airship, unlike aerostat is a mobile device that can move around with no restriction of degree of freedom, remotely controlled or manually controlled (for large passenger airships). The advantage of airships over aerostat is that airships can move around while carrying the same payload. The payload can be a surveillance camera, an advertisement board, human payload for tourism, metal detectors for safe landmine counter measures and visual aids for helping in sporting events etc.

It consists of an envelope, fins, the gondola and control surfaces. The envelope is a chamber filled with an LTA gas to achieve lift. The fins are of two types; horizontal and vertical and serve two purposes; housing control surfaces and providing stability while in air. The gondola is the structure housing the payload and sometimes, a control surface. Control surfaces are motors, propellers and instruments to maneuver the airship while in air. There are different types of airships based on their structure:

Rigid: Consist of structural members and has a composite strong envelope surface.

Non-Rigid: No structure or framework and is made of fabric surface

Semi-Rigid: Structure is used and is enveloped with fabric surface.

The airships can be used for advertisements, surveillance from air, tourism and corporate hospitality, landmine counter measures, law enforcement and sports tracking etc.

Day 1 Session 2: Support and Safety Systems for LTA (11:30am to 1pm, 27th Dec 2022):

This session was about the safety and support systems required by the LTA vehicles. Since its primary principle is buoyancy, it can float away if not held upon by ground support such as a mast. If it rises up to higher altitudes, it poses a potential threat to the air vehicles such as airplanes and government UAVs, which can cause catastrophic accidents and loss of important government data and equipment. When it rises to high altitude unnoticed, the payload, which is the most expensive and vital component and is a must to be retrieved is in danger of damage, and hence complete failure of mission. Hence, an onboard safety system should be present to recover the payload safely and securely.

PAYLOAD RECOVERY SYSTEM: A system onboard the airship or aerostat to recover the all-important payload. It should be automatic, low weight, scalable, reliable, the recovery system once deployed should not let the LTA drift too far away and bring down the payload with slow impact velocity to reduce impact damage on payload.

It should also be deployed without supervision, rain/snow proof, should be less visible to avoid the people aiming at it, should not fire at unwanted scenarios such as downward gusts etc.

The gas should be released from the top as the lighter gas tends to stay and move up. It should have its own thrust to counter winds to not let the LTA drift too far. It should be independent of size and shape of the LTA.

The options for Payload recovery Systems are:

Tether breaking sensor- Can be done by pressure sensors in the cable or electrical circuit break.

Signal Transmission- A radio signal to deploy the mechanism through push switch, wireless remote or an OFC cable.

Device Actuation- Heated nichrome wire, valves or a simple mechanical cut in the envelope.

This knowledge was further grown by Prof. Rajkumar after he showed the actual footage of his teams' experiments on this topic of Safety and Support system in LTA.

Day 1 Session 3: Sizing of Hot Air Balloons (2pm to 4pm, 27th Dec 22)

This session dealt with the third LTA, the hot air balloon. The history of hot air balloons, how they work, how they were made by the people way back in 18th century was explained. Students were asked the parameters that would affect the lift capacity of the hot air balloon.

Participants were also shown quite a few examples of how to make a hot air balloon and estimating the amount of fuel required for some given amount of time etc.

The participants were given a problem statement, to design a hot air balloon that required maximum of 2 minutes inflation time could travel 20 metres up in the air and touch the ceiling and come back down, within 4 minutes. Hence, the participants had to calculate the amount of fuel required by the balloon.

Day 2 Session 1: Sizing of Indoor R-C Airship – 1 (9:30am to 11:30 am, 28th Dec 2022)

The next day, students were shown a systematic procedure for designing and sizing of an indoor Remotely controlled Airship through another presentation. Since Prof Pant was experienced in this field, he shared his experiences of failures and successes in this session.

The first process is the choosing of a shape and size of an airship, based on the requirement. Choosing the shape depended a lot on drag factor of the shape, surface area, volume and other such parameters.

The next step is to select a material to build the envelope. Metallized Polymer, PVC sheets, Bin Covers, Kite paper, Butter paper are all candidates for the material. Metallized polymer is taken because of its characteristics such as light weight and availability along with flexibility. The session ended here after choosing the material, now needing to be assembled.

Day 2 Session 2: Sizing of Indoor R-C Airships – 2 (11:30am to 1pm, 28th Dec 2022)

Joining 2-D petals to create a 3-D shape using joining processes is the next step. Assembling or Fabrication is the following step that is needed to complete the basic shape of the envelope. This session showed us the types of joints, their disadvantages and advantages to the airship, real life videos of fabrication process done by students of Prof. Pant at IIT Bombay, which helped us gain a little more practical knowledge.

The first step in fabrication is to make a model, or a hull profile cut to provide a platform for the petals to be placed.The next step is to mount the petals over the hull and join them.Strips must be placed to seal the petals together to prevent any leakage of gas.Hydrogen gas should be very carefully filled to avoid icing near the valve.

The two sessions made the participants understand how to make an R-C indoor airship using materials available in the market.

Day 2 Session 3: Student Design Projects in LTA systems (2pm to 4pm, 28th Dec 2022)

This session was used to show the videos of student design projects in LTA systems. It showed how the students made it, how they could fabricate it, how they calculated, how they had embedded different systems in their airships etc.

It gave an idea of the design and fabrication of an indoor R-C airship and then helped us in understanding the theoretical knowledge gained in the preceding two sessions. Prof. Pant then cleared any doubts that arose in the students' minds during the session.

Prof Pant then spoke about the internships and projects that one can do at IIT Bombay, after a request from the students. He also spoke about the procedure to apply for them and answered questions regarding the internships and projects. This session was valuable for its practical exposure and the opportunities for students at IIT Bombay.

Day 3 Session 1: Tutorial: Aerostatic Lift Estimation (9:30am to 11am, 29th Dec 2022)

This session was started on the 3rd and last day of the three-day workshop. Prof Pant chose 3 shapes for the airship and students were divided into 11 groups of 5 people each. Teams 1-6 and Teams 7-11 were assigned with a shape and all the teams, along with Prof. Pant had to work on one of the shapes together. The first shape chosen was NPL, a double ellipsoid that was used as a tutorial by Prof. Pant to show us the systematic approach required to estimate the drag and lift achieved by the airship of the chosen shape. Teams 1-6 were assigned to calculate the same for another shape, GNVR and teams 7-11 were assigned with the Lynx shape.

After the calculation of some parameters, the students had to calculate the same parameters for the shape they were assigned with. This session was full of theoretical calculations and so was the next session.

Day 3 Session 2: Tutorial: **Airship Subsystem Sizing (11:30am to 1pm, 29th Dec 2022)**

The next session consisted of calculating the total mass of the airship, that included the envelope weight, gondola, avionics and the payload weight with a certain given parameters such as length, speed and payload of the airship.

The students were required to calculate the numbers for their own shape as well along with the NPL shape with the help of Prof. Pant. It helped us understand which shape was the best for the airship.

Prof. Pant showed us his spreadsheets to verify our answers for respective shapes and showed us a comparison of all three. This helped us understand that NPL shape is better for an airship aerodynamically, economically and meeting the requirements. The students were relieved when the calculations paid out as meeting the requirements as per the problem statement.

Day 3 Session 3: Tutorial: **Sensitivity and Fabrication Tips (2pm to 3:30 pm, 29th Dec 2022)**

This session was about the sensitivity and fabrication tips for making an indoor R-C airship. Prof Pant showed us various what if scenarios by changing certain changeable parameters of the airship and the results obtained at the end.

The next part of the session was completely based on the experiences of Prof. Pant that involved R-C airships which were available as videos. It was a lighthearted and fun session.

Prof Pant on request of students then talked about his ambitious future projects and answered queries related to them and took ideas from the students, when incoming.

Closing Ceremony(3:30 pm to 4:15pm, 29th Dec 2022)

The last session was spent to bring this amazing three-day national level workshop to an end. Prof. Pant was felicitated with a memento by the principal, who gave inspiring words for the students and thanked all the members involved in the managing and conduction of the workshop.

Then the certificates of students for participating in the workshop were collected from the hands of Prof. Pant and the event concluded with a few photos of all the people involved in workshop with Prof. Pant.

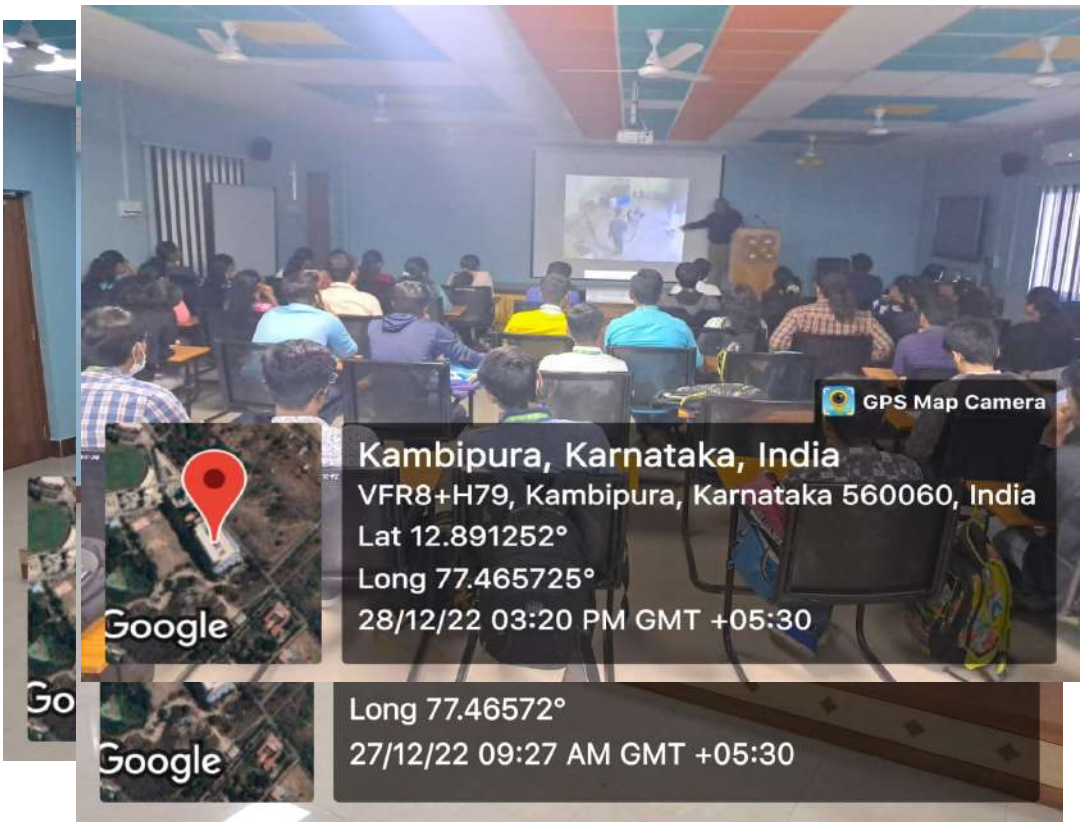
Concluding Remarks:

This event was an amazing event for the students as it had piqued the interest of students with something outside of the curriculum. It was an exposure for the students to see and understand what kinds of projects and advancements were made in their field of study. The participant expressed their gratitude for organizing the 3 days Workshop to motivate and enhance their skills.

Event Poster :


GPS Map Camera
Kambipura, Karnataka, India
VFR8+H79, Kambipura, Karnataka 560060, India
Lat 12.891231°
Long 77.465699°
28/12/22 03:19 PM GMT +05:30
Google

Gallery:


GPS Map Camera
Kambipura, Karnataka, India
VFR8+H79, Kambipura, Karnataka 560060, India
Lat 12.891252°
Long 77.465725°
28/12/22 03:20 PM GMT +05:30
Google
Long 77.46572°
27/12/22 09:27 AM GMT +05:30
Google

ACS College of Engineering

#207, Kambipura, Mysore Road, Bangalore – 560 074.
Affiliated to VTU, Belgaum. Approved by AICTE, New Delhi & Govt. of Karnataka

NAAC 'A' GRADE

DEPARTMENT OF AEROSPACE ENGINEERING