

THE MECH INSIGHT



ISSUE 01

**Department of Mechanical
Engineering
MARCH 2024**

ABOUT US

THE DEPARTMENT OF MECHANICAL ENGINEERING OF THE NATIONAL INSTITUTE OF TECHNOLOGY, MEGHALAYA, WAS ESTABLISHED IN THE YEAR 2013 AND CURRENTLY OFFERS B.TECH, MTECH AND PHD PROGRAMMES IN VARIOUS FIELDS OF MECHANICAL ENGINEERING.

THE B.TECH PROGRAM OF THE DEPARTMENT IS ACCREDITED BY THE NATIONAL BOARD OF ACCREDITATION (NBA). THE STUDENTS OF THE DEPARTMENT ARE PLACED THROUGH THE LEADING INDUSTRIES AND JOIN THE INTERNATIONALLY RECOGNIZED INSTITUTIONS FOR HIGHER STUDIES.



THE BASIC AIM OF THE DEPARTMENT IS TO IMPART QUALITY EDUCATION TO THE STUDENTS THROUGH THE UNDERSTANDING OF THE BASIC PRINCIPLES AND PRACTICES IN MECHANICAL ENGINEERING, WHICH HELPS THEM TO SERVE SOCIETY AND ADDRESS A VARIETY OF NEEDS. THE DEPARTMENT ALSO PROMOTES INDUSTRY-ACADEMIA COLLABORATION SO THAT BOTH CAN COMPLEMENT EACH OTHER IN STUDY, RESEARCH, AND OVERALL DEVELOPMENT.

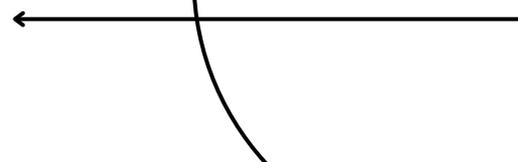


CONTENT

ISSUE 1

• MESSAGE FROM THE DIRECTOR	1
• MESSAGE FROM THE HOD	2
• MESSAGE FROM THE CHIEF-EDITOR	3
• MEET THE TEAM	4
• INDUSTRIAL VISIT	5
• HEAT PIPES	7
• CHANDRAYAAN - 3	10
• FUTURE OF ENERGY	13
• INTEGRATING SAFETY STANDARDS	16
• ENGINEERING THE WORLD FOR TOMORROW	18
• COGNITIA 2023	27
• STUDENT ACHIEVEMENTS	29
• LOOK BACK INTO HISTORY	30
• DEPARTMENTAL EVENTS	31

ISSUE 1



FROM THE DIRECTOR'S DESK

“
On the behalf of the Mechanical Engineering Department of National Institute of Technology, Meghalaya, I am pleased to introduce you all to the First Edition of “The Mech Insight”, the Mechanical Engineering Departmental Magazine. It is my great pleasure to present the magazine as it reflects to the aspirants of the Mechanical Engineering department of NIT Meghalaya.

The Mech Insight is a place where you can explore the wondrous world of mechanical engineering through essays, articles and images on scholarly milestones, innovative research, latest developments and more, all presented by the highly motivated students of the department and leading professionals in the field. I congratulate the faculty members and students who have devoted their energies to the magazine, particularly the editorial team, writers and printers who laboured over every word, ensuring that “The Mech Insight” is truly a publication worthy of our institute and its readers.

I invite everyone to get involved with the magazine and contribute your experiences to it; to share your story; learn from it, and help others to do the same, as we intend to involve the community as much as possible and build on community relationships.

I hope you enjoy visiting The Mech Insight, and we look forward to hearing your thoughts in subsequent publications.”



**PROF. PINAKESWAR MAHANTA
DIRECTOR
NIT MEGHALAYA**

FROM THE HOD'S DESK



DR. KISHORE DEBNATH
ASSOCIATE PROFESSOR & HOD
MECHANICAL ENGINEERING

A Chronicle of Our Collective Journey

It gives me immense joy and pleasure to introduce "The Mech Insight" - the magazine of the Mechanical Engineering Department of the National Institute of Technology Meghalaya. As the Head of the Department, I am pleased to introduce this insightful magazine that encapsulates the magnificent world of mechanical engineering.

"The Mech Insight" is a complete package of thought-provoking ideas, captivating articles, and visuals that shed light on the various facets of mechanical engineering, as well as the academic achievements and research breakthroughs, our students and faculty members have accomplished.

"The Mech Insight" aims to be a chronicle of our collective journey, capturing the essence of our academic prowess, cultural diversity, and the indomitable spirit that defines our departmental activities.

I want to express my sincere gratitude to the hardworking team of editors and writers who have dedicated their time and effort to design this amazing magazine. Their commitment to excellence is evident on every page and I am confident that "The Mech Insight" will be a source of inspiration and pride for our entire college community.

As we embark on this exciting journey, I encourage you to actively engage with the magazine, contribute your stories, and share your feedback. Let us use this platform to strengthen the bonds within our community and foster a sense of belonging.

EDITORIAL

It is with great pleasure I introduce "The Mech Insight," the official magazine of the Mechanical Engineering department at NIT Meghalaya, to you.

I am proud to say that "The Mech Insight" is more than just a publication; it pays homage to our collective pursuit of excellence in the Mechanical Engineering department of NIT Meghalaya. Through this platform, we aim to celebrate the innovative spirit, research endeavours, and accomplishments of our department while fostering a sense of community and collaboration.

Our magazine features a diverse range of content, including thought-provoking articles, interviews with industry experts and groundbreaking research in the field of Mechanical Engineering. "The Mech Insight" is not just about showcasing achievements; it's about igniting curiosity, sparking discussions, and inspiring the next generation of engineers. It's about creating a platform where ideas thrive, connections are forged, and knowledge is shared.

As the Chief Editor, I am committed to ensuring that "The Mech Insight" serves as a valuable resource for our community, providing insights, inspiration, and opportunities for collaboration. Together, let us make this magazine a true reflection of the ingenuity and passion that define our department's vision.

I invite each of you to join us on this journey as we unveil "The Mech Insight" and embark on a quest to explore the boundless possibilities of our field.

I convey special thanks to each member of the Magazine's team. Thank you for your support, and I look forward to your active participation in shaping the future of our department's magazine.

Warm regards,
Sambit



DR. SAMBIT MAJUMDER
ASSISTANT PROFESSOR
MECHANICAL ENGINEERING

TEAM



Chief Editor
Dr. Sambit Majumder



Associate Editor
Sourabh Paul



Associate Editor
Anirban Das



Content Editor
Betdahunlin Sohkhia



Design Editor
Jaswant Bojja



Member
Manisha Kumari



Member
Mushfiqu Ahmed

INDUSTRIAL VISIT

KOPILI HYDRO-POWER PLANT

Introduction

The field of Mechanical Engineering at NIT Meghalaya offers a multitude of opportunities for students to explore and learn about various industries. One such enriching experience was the recent (15th September 2023) industrial tour visit to the North Eastern Electric Power Corporation (NEEPCO) Hydro Power Station in Umrangso, Dima Hasao, Assam. The tour provided us with a unique opportunity to witness the intricate workings of a hydroelectric power plant and gain valuable insights into the world of mechanical engineering.

The Setting: NEEPCO Hydro Power Station

Nestled amidst the lush greenery of Assam, the NEEPCO Hydro Power Station is a testament to human innovation harnessing the power of nature. Situated in the picturesque Dima Hasao district, this hydropower plant has been a vital source of clean and renewable energy for the region for several decades.

EXPLORING THE
POWER OF
NATURE:
A JOURNEY TO
NEEPCO HYDRO
POWER STATION,
UMRANGSO,
ASSAM.

A Glimpse into the Hydro Power Generation Process

Our tour commenced with a briefing on the basics of hydroelectric power generation. We learned about the dam, penstock, turbines, and generators – the core components of the power station. The dam serves as a reservoir that stores water, which is then released through the penstock, a massive pipeline, and directed towards the turbines. The force of the flowing water drives the turbines, which, in turn, generate electricity through the connected generators.

The Marvel of Turbines

For mechanical engineering enthusiasts like us, the highlight of the tour was the close-up encounter with the hydro turbines, penstock, generators and other components inside the powerhouse station. The sheer size and precision of these machines left us in awe. We had the opportunity to witness how these turbines efficiently convert the kinetic energy of water into mechanical energy, which ultimately results in electrical power generation. The knowledge we gained about the different types of components and their operational intricacies was invaluable.



Environmental Benefits and Challenges

The visit also shed light on the environmental advantages of hydropower. Unlike fossil fuels, hydropower is a clean, renewable energy source that produces no harmful emissions. It significantly contributes to reducing carbon footprints and is crucial in the fight against climate change. However, the ecological impact of dam construction and reservoir formation was also discussed, highlighting the need for responsible engineering practices.

Safety Measures and Maintenance

Our tour guide emphasized the importance of safety in such power plants. We were briefed on the strict safety protocols in place to protect both workers and the environment. Additionally, we gained insights into the regular maintenance and inspection procedures required to keep the power station in optimal condition.

Conclusion

Our visit to the NEEPCO Hydro Power Station was an eye-opening experience for all of us. It showcased the harmony between mechanical engineering and nature, where human

innovation and environmental conservation go hand in hand. The tour not only deepened our understanding of hydropower generation but also inspired us to consider the role of mechanical engineers in creating sustainable solutions for the future. This industrial tour was a reminder of the boundless opportunities and challenges awaiting aspiring mechanical engineers in the field. We left the NEEPCO Hydro Power Station with a newfound appreciation for the synergy between technology and nature and a commitment to contributing to the sustainable development of our society.

Submitted by - Batch 2020 of Mechanical Engineering

Edited and Compiled by - Betdahunlin Sohkhia



DR. KOUSHIK DAS
ASSOCIATE PROFESSOR
NIT MEGHALAYA

Heat pipes are like the unsung heroes of thermal management. You might not think about them much, but they play a massive role in keeping our electronics cool and are vital in various other applications, too. They are the tools of passive cooling. In the world of heat pipe research, scientists and engineers work tirelessly to understand how they work, make them work even better, and find new ways to use them. Through the process of evaporation and condensation, this two-phase heat transfer device transfers thermal energy from the source to a sink. It utilizes the latent heat of vaporization of the working fluid.

HEAT PIPES ARE LIKE THE UNSUNG HEROES OF THERMAL MANAGEMENT.

The heat pipes are commonly employed in space and ground applications as standard thermal control equipment. A typical heat pipe comprises an evacuated sealed container with a capillary structure, called wick that is filled with a suitable working fluid. The maximum heat flow rate and the effective thermal conductivity are the common parameters that are used to describe the thermal performance of heat pipes. However, the maximum heat transmission rate in such devices is limited by a variety of different failure scenarios. Let's dive into the goals, methods, and key findings of this fascinating field.

Research Goals

In the world of heat pipes, there are some clear objectives in mind:

- **Boost Efficiency:** First and foremost, my team of researchers are willing to make heat pipes more efficient. That means finding ways to transfer heat more effectively while using less energy.



- **Material Magic:** The materials used in a heat pipe matter a lot. We wish to find the perfect combination of materials for different situations, whether it's cooling a computer or managing the temperature of a spaceship.
- **Thermal Understanding:** It's crucial to figure out how heat moves within a heat pipe. It is essential to know exactly where the heat goes and how it affects the temperature. That's the key to designing better heat pipes.

Research Methods

Hands-On Testing: This is where scientists build actual heat pipe prototypes and run experiments on them. They measure things like heat transfer rates and how well the heat pipes perform under different conditions. This part is in our future bucket list.



Number Crunching: Computers are a research tool too. We are using numerical models or computer simulations to simulate how heat pipes work. These simulations help understand the intricacies of heat transfer, fluid flow, and temperature changes inside the pipes.

Material Trials: Finding the right materials is a big part of the research. Using different materials for properties like thermal conductivity and how well they "wet" the inside of the pipe is one of the major focuses.

Application Areas: Currently our targeted areas of research include cooling of electronic components, solar PV-cells and cutting tools in high-speed machining.



Key Findings

Research in the heat pipe world has led to some exciting discoveries by various experts, including the current group at NIT Meghalaya:

- **Nanofluids:** Mixing tiny nanoparticles into the fluid inside a heat pipe can significantly boost heat transfer. It's a game-changer for improving thermal performance.
- **Wick Structures:** Engineers have found new ways to improve the capillary action inside heat pipes, making them even better at moving heat. From our current work at NIT Meghalaya, it is found that a tapered and stepped corrugated wick provides a better performance.
- **Small but Mighty:** Miniature heat pipes are now a thing. These tiny versions are called microheats. pipes are perfect for keeping small devices like laptops and smartphones cool.
- **Integration Success:** Researchers have successfully integrated heat pipes into various systems, making electronics and renewable energy devices more efficient by managing heat effectively.

- **Advanced Materials:** The development of super-tough materials has expanded the applications of heat pipes. They can now withstand extreme temperatures and harsh environments, especially in space applications, opening up new possibilities for these cooling marvels.

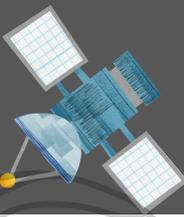
Conclusions

The world of heat pipe research might not be as glamorous as some other scientific fields, but it's incredibly important. As our devices get smaller and more powerful, the need for efficient thermal management becomes critical. Ongoing research will continue to push the boundaries of what heat pipes can do, ensuring our gadgets stay cool, and our technology keeps advancing. Following are some of the key findings of the work done at NIT Meghalaya. A tapered wick heat pipe outperforms a cylindrical wick heat pipe in terms of equivalent thermal conductivity by approximately 62%.

A newly coined parameter called the temperature-pressure index (TPI) provides an idea about improvement in cooling surface temperature vs. enhancement in pressure drop inside the heat pipe, compared to a cylindrical wick heat pipe. The current design of tapered wick heat pipe yields an approx. 80% higher TPI. A step corrugated heat pipe is found to provide an excellent heat transfer performance, even better than a tapered wick heat pipe. However, it comes at the cost of higher pressure drop. The TPI of a step corrugated heat pipe is around 2.13. It means the modified configuration has 213% improved cooling than enhancement in pressure drop.



CHANDRAYAAN - 3



Space, the final frontier, is a vast, everlasting breadth filled with nebulae, stars and planets. The allure of space is as old as humanity itself. Our ancient cultures looked up at the night sky and saw patterns in the stars, creating amazing myths and legends to explain the unexplained universe. Today our scientific understanding of space has grown exponentially, allowing us to send spacecrafts across vast distances through space, landing humans on moon and capturing images of black holes. Space, the final frontier, is a vast, everlasting breadth filled with nebulae, stars and planets. The allure with space is as old as humanity itself. Our ancient cultures looked up at the night sky and saw patterns in the stars, creating amazing myths and legends to explain the unexplained universe.



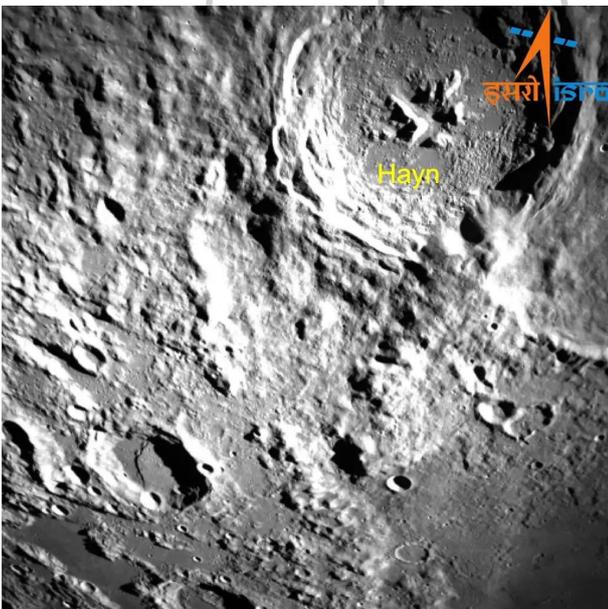
Compile By
Anirban Das

**SPACE : THE FINAL FRONTIER,
A VAST,
EVERLASTING BREADTH
FILLED WITH NEBULAE,
STARS AND PLANETS.**

Today our scientific understanding of space has grown exponentially, allowing us to send spacecrafts across vast distances through space, landing humans on moon and capturing images of black holes.

Chandrayaan- 3 was developed to address the shortcoming of the former missions, along with to achieve new scientific ambitions. Chandrayaan- 3 was launched aboard an Launch Vehicle Mark- 3(LVM3- M4) from the Second Launch Pad of the Satish Dhawan Space Centre and entered an Earth parking orbit a temporary orbit where a rocket coasts for a while before entering the final desired flight path) with a perigee(since the moon's orbit around the Earth is elliptical, perigee refers to the point of the orbit closest to Earth, while apogee refers to the point farthest to Earth) of 170 kms and an apogee of 36,500 kms.

After a series of earth- bound manoeuvres, Chandrayaan- 3 was placed in a trans- lunar injection orbit (an orbit at which some specific propulsive manoeuvres are performed on a craft to set it on a flight path to the moon). This operation was carried out from the ISRO Telemetry, Tracking and Command Network (ISTRAC) in Bengaluru.



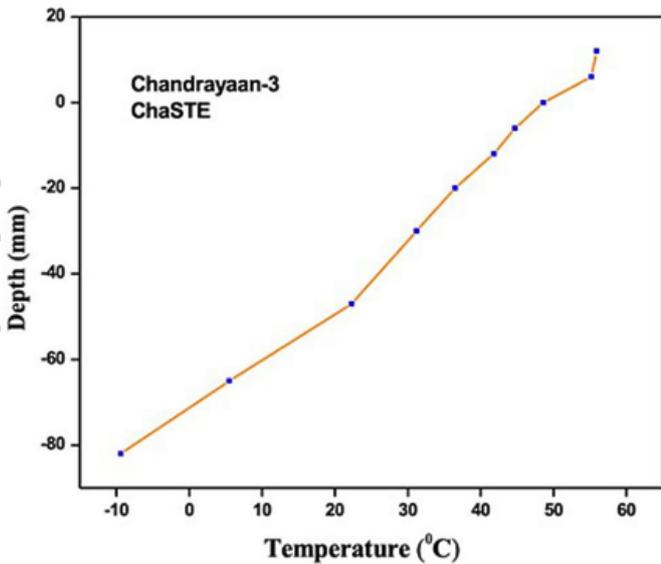
Lunar far side area as imaged from the Lander Hazard Detection and Avoidance Camera (LHDAC) onboard Chandrayaan-3 on August 19, 2023

During the landing phase of the mission, on 23rd August 2023, as the lander approached the low point of its orbit, the four engines on the lander fired as a retardation manoeuvre at 30 km above the moon's surface. After 11.5 minutes, the lander Vikram was 7.2 km above the lunar surface, when it stabilised itself using eight smaller thrusters and rotated from a horizontal to a perpendicular position, while continuing the descent. At a distance of 150 metres above the lunar surface, the lander hovered for about 30 seconds to determine the optimal docking spot, before continuing descent and touching down at 1233 UTC (Coordinated Universal Time).

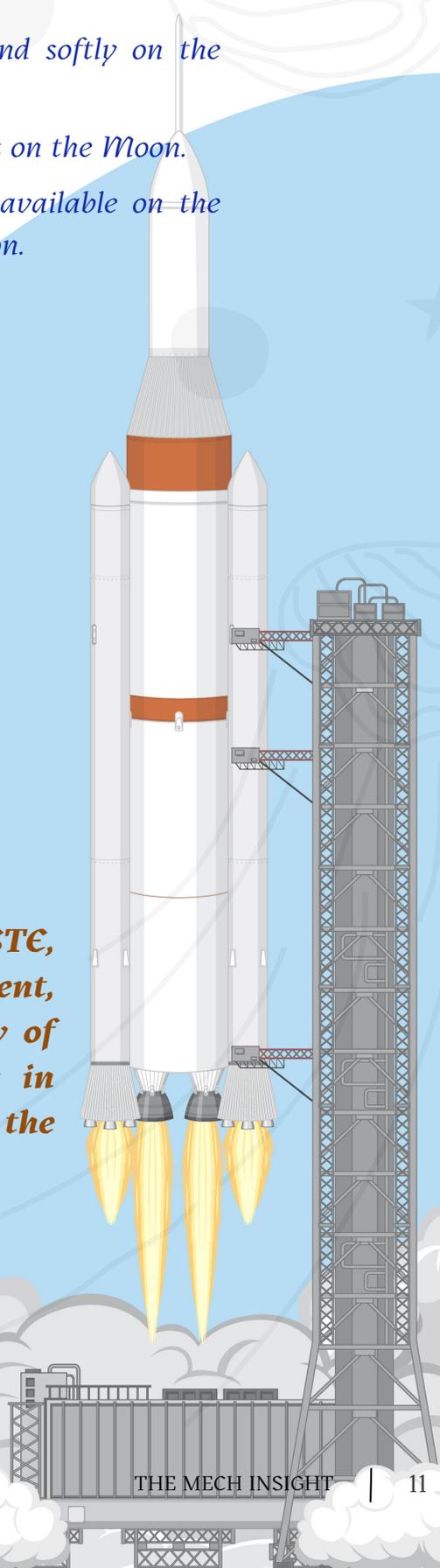
ISRO's mission objectives for the Chandrayaan-3 mission are:

1. Engineering and implementing a lander to land safely and softly on the surface of the Moon.
2. Observing and demonstrating the rover's driving capabilities on the Moon.
3. Conducting and observing experiments on the materials available on the lunar surface to better understand the composition of the Moon.

Variation of temperature on lunar surface with increase in depth



The Lander Module, Vikram, contained the ChaSTE, or the Chandra's Surface Thermophysical Experiment, which was designed to study the heat conductivity of the Moon's surface and measure the differences in temperatures at different points on and below the surface.





The rover, Pragyan, also confirmed the presence of sulphur in the lunar surface near the south pole, through “first ever in-situ measurements”. Although the presence of sulphur on lunar surface was known before, its presence was detected for the first time by Pragyan. Apart from sulphur, the rover also detected other elements including Aluminium, Calcium, Iron, Chromium, Titanium, Manganese, Silicon and Oxygen.

The lander, Vikram, also detected vibration on the lunar surface which is presumed to be a natural event similar to an earthquake.

Present Status

On 3rd September, after the completion of all assignments, the rover Pragyan was put to sleep mode with its batteries charged and receiver left on, in preparation for the impending lunar night, when temperatures were to fall as low as -120 Degree Centigrade. On 22nd September, the lander and rover missed their wake-up calls, and by 28th, all hopes for further surface explorations were extinguished. The Chandrayaan-3 mission had come to an premature end with only the orbiter functioning, and it had created a place for itself in the history of mankind.



FUTURE OF ENERGY



In an era marked by growing environmental concerns and the need to reduce greenhouse gas emissions, clean energy technologies have emerged as the beacon of hope for a sustainable future.

DR. PANKAJ KALITA

ASSISTANT PROFESSOR
CENTRE FOR ENERGY
IIT GUWAHATI

CLEAN ENERGY TECHNOLOGIES AND THEIR PROSPECTIVE IMPACT ON THE FUTURE

These innovation solutions harness renewable resources, minimize the environmental footprint, and offer a promising alternative to fossil fuels. As we explore the landscape of clean energy technologies, it becomes evident that they hold immense promise for transforming our world and shaping a more sustainable future.

Solar energy is a standout in the realm of clean energy technologies. Solar panels, composed of photovoltaic cells, capture sunlight and convert it into electricity. The sun's abundant and virtually inexhaustible energy source has made solar power one of the fastest-growing energy sectors. Its impact on the future is profound. As technology advances, solar panels are becoming more efficient and affordable, making solar energy accessible to more people. In the future, we can envision a world where solar panels adorn rooftops, power cars and even contribute to the generation of electricity on a massive scale. The potential of solar energy to reduce our reliance on fossil fuels and curb carbon emissions is immense. Solar thermal power plants, which involve the collection of solar heat, are utilized to increase the temperature of a fluid in a turbine operating on the Rankine or Brayton cycle.



They have three temperature life cycles: Low-temperature life cycle: of 60 to 100°C, Medium temperature life cycle up to 400°C, and High-temperature life cycle above 400°C.

Wind energy is another prominent player in the clean energy game. Wind turbines capture the kinetic energy of the wind and convert it into electricity.

With ongoing technological advancements, wind turbines have become more efficient and less costly to manufacture. Turbines are classified into six categories based on the size of their rotor diameter(m): Micro Turbine (0.5–1.25), Mini Turbine (1.25–3), Domestic Turbine (3–10), Commercial Turbine (10–20), Medium Turbine (20–50), Large Turbine (50–100). A single wind turbine unit is now capable of producing 3MW energy, and it is predicted that around 2035, a single unit will be capable of producing 17MW. As a result, wind energy is becoming increasingly competitive with traditional power sources. Wind farms can be found around the globe, providing clean electricity to communities. In the future, we can expect even more substantial growth in the wind energy sector.



Hydropower has been a reliable source of clean energy for decades. It not only generates electricity but also offers water management solutions. The perspective i impact of hydropower lies in its capacity to supply renewable energy while mitigating the risks associated with climate change. In the future, technological innovations and a focus on sustainable practices will be crucial to maximize the benefits of hydropower while minimizing its ecological impact. There are three classes of Hydro Power Generation: Micro hydro with a capacity of up to 100kW, Mini hydro with a capacity of 101kW to 2MW, and Small hydro with a capacity of 2MW to 25MW.

Biomass energy, which derives from organic materials such as wood, crop residues, and waste, is an essential component of the clean energy landscape. Biomass-derived fuels for sustainable power generation through thermochemical and biochemical conversion processes are one of the promising areas of research.

Furthermore, many value-added products like chemicals can be extracted from the waste residues, which has plenty of industrial applications. The prospective impact of biomass lies in its ability to reduce waste and provide an alternative to fossil fuels. Also, the conversion of biomass into energy is a carbon-neutral process. The challenge is to ensure sustainable sourcing and processing to avoid adverse environmental impacts. Future advancements in biomass technology will likely make it a more reliable and environmentally friendly energy source. The possibility of harnessing energy from Geothermal energy, oceans may be explored in India to meet future energy demands, and create job opportunities in the renewable energy sector. Generation of energy from renewable resources with appropriate storage systems is the key to future sustainability. Research in the field of energy storage is essential to fully utilize renewable sources such as solar, wind, and biomass for sustainable power generation due to their intermittent nature.



In conclusion, the future of clean energy technologies is bright. Solar, wind, hydropower, biomass, geothermal, and ocean energy are poised to play pivotal roles in reducing our carbon footprint and mitigating the effects of climate change. With continued research, development, and a concerted global effort, we can expect to see a shift towards a cleaner, more sustainable energy landscape that will benefit current and future generations. These clean energy technologies not only promise to reduce our reliance on fossil fuels but also to reshape our future towards a greener, more sustainable world.

Integrating Safety Studies into Modern Education

A Vital Component of India's National Education Policy



MR. VIKAS BARFA

ENGINEER (SAFETY)
POWERGRID

Introduction :

As we navigate through the complexities of the 21st century, the importance of safety has emerged as a critical consideration, not only in our daily lives but also in the field of education. Recognizing this, India's National Education Policy (NEP) has taken a significant step forward by acknowledging the need for safety studies as an integral part of the modern education system. The article explores the imperative of incorporating safety studies into education and how the NEP aligns with this essential aspect.

Understanding Safety Studies:

Safety studies include a multidisciplinary approach, covering areas such as :

1. Awareness of potential hazards in a respective technical field,
2. Disaster preparedness,
3. Risk management, and
4. First-aid etc.

In the context of education, imparting knowledge and skills related to 'safety' is crucial for preparing students to navigate a world where unforeseen challenges and emergencies can arise.

The NEP's Recognition of Safety Studies:

India's NEP recognizes the dynamic nature of contemporary challenges and addresses the 'need for safety studies in the education system'. By emphasizing the inclusion of safety and disaster management in academic curriculums, the policy takes a proactive stance in preparing students to handle emergencies, both within and outside the educational environment.

Disaster Preparedness and Risk Management:

Safety studies play a pivotal role in equipping students with the knowledge and skills required for disaster preparedness and risk management. The NEP encourages the development of educational modules that cover aspects such as evacuation procedures, first-aid training, and understanding the potential risks in various environments. This proactive approach ensures that students are not only academically proficient but also capable of responding effectively to unforeseen circumstances.



Promoting a Culture of Safety:

Beyond specific safety protocols, safety studies contribute to developing a culture of awareness and responsibility. The NEP acknowledges the importance of creating an environment where students actively engage in safety practices, promoting a sense of collective responsibility. This cultural shift is instrumental in introducing lifelong habits that prioritize safety in various frameworks.



Integration with STEM Education

Safety studies seamlessly align with the principles of STEM (Science, Technology, Engineering, and Mathematics) education. The NEP recognizes the interdisciplinary nature of safety-related knowledge, encouraging collaboration between these fields. Integrating safety studies into STEM education not only enhances students' problem-solving skills but also prepares them for real-world challenges where scientific and technological knowledge intersects with safety concerns.

Conclusion

The incorporation of safety studies into the modern education system is a testament to India's commitment to holistic and forward-thinking education. By recognizing the need for safety education, the National Education Policy not only prepares students for academic success but also equips them with the skills and knowledge required to navigate a world where safety is a paramount concern.

In doing so, India sets the stage for a generation that is not only academically adept but also resilient, responsible, and well-prepared to contribute to a safer and more secure future.

TALK WITH SHIBANANDA CHOUDHURY

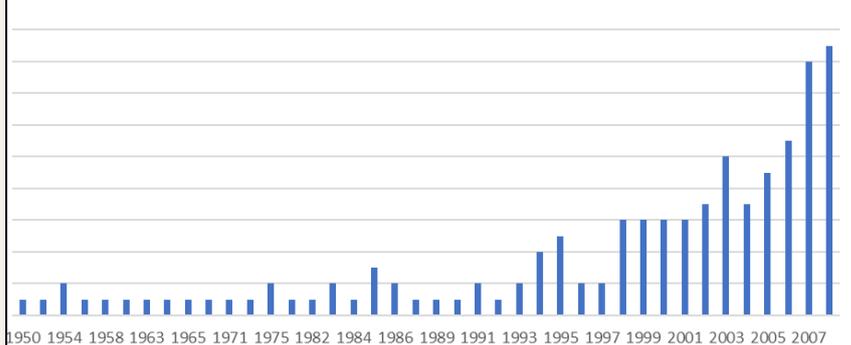
MANAGER- PROCESS, METAL & MINING BU
TATA CONSULTING ENGINEERS, KOLKATA, INDIA

**ENGINEERING, AT ITS ESSENCE,
IS THE ART AND SCIENCE OF
PROBLEM-SOLVING,
A DYNAMIC DISCIPLINE
EVOLVING WITH TIME**



Let us break it down and understand this statement before diving deep into the topic of this article. When we talk about engineering, we can classify it into two segments- 'engineering a product that meets the requirements', and 'engineering to produce the product efficiently on a large scale'. So, it would not be wrong to say that through the science of engineering, we produce an art which is the product. Further, we create another art, which is the industry that produces the product and helps shape society. History teaches us that the progression of human civilization and advancements in technology are intricately intertwined, unfolding hand in hand throughout the ages.

Car Models Released in India Over Years





An exponential increase is visible from the data and the pattern can be seen in almost all segments. These imperatives require today's engineers to be ready and embrace the challenge. Thus, let's begin by grasping the fundamentals and swiftly progress towards a roadmap to equip ourselves for engineering a superior world for the future.

Revolutions in industries and the world of engineering have picked up speed ever since. The exponential speed of change in requirements and our awareness towards our surroundings has grown, more so now, than ever before. A survey done by motor vehicle-related website 'team-bhp.com', reveals the tentative number of four-wheeler models offered in India from the 1950s to 2008.

Engineering a product:

Let us understand how any product reaches us, starting its journey from conceptualization. Focusing our discussion on the products that are more physical and mechanical in nature, we can broadly say a product is either an evolution of its earlier generations or a completely new concept from scratch and more often, it is a mixed approach of the two. Either way, first, requirements for the intended product are understood and recorded, and then the concept of a product is jolted down in sketch and concept notes, which can meet the requirements. Before the concept is given a physical form, it is detailed and analyzed—what would work and what would not. Design changes are made in this stage according to the analysis and once design engineers are satisfied with the concept design. It is time to make prototypes and test them for every possible aspect and to check for their failure modes and effects. Design changes also happen at this stage and prototypes may be modified or rebuilt till they meet all the criteria for the product are met. The final prototype is sometimes called a production-ready model. The product, however, is still far away from reaching the hands of intended customers. It must be clearly understood that producing an item in the laboratory and manufacturing facility are much more different processes than it is usually perceived. The difference grows larger as the complicity of the item and the scale of production grows. A prototype that works as intended is not always manufactured. Let us now understand the engineering behind a product that is manufactured in industries.

Engineering a manufacturing facility that produces the product:

Once a proven prototype is intended to be produced in a manufacturing facility, the procedure and sequences of processes are planned, and prototypes of the planned facility are made as and when required. Techno techno-commercial feasibility of such processes is also checked in this phase while attempts are also made to stabilize the process of production. Once the manufacturing process is found viable, then feasibility is checked for the location where the manufacturing plant is to be set up. Once the technology to produce the intended product is proven and found viable for the location, detailed designing of the manufacturing plant as per the intended capacity is carried out including the selection of all the machineries and components which are to be procured for setting up of the plant. Then eventually the plant is erected, installed, and commissioned for operation. This Engineering, Procurement, and Construction (EPC) process encapsulates the meticulous planning and execution of projects, but it is much more than erecting structures—it is about orchestrating a symphony of equipment, assets and interdisciplinary works to provide optimal output.

During operation, this is the task of another group of engineers to ensure that the intended process for production is maintained within the recommended range. The machinery is also to be maintained in good condition throughout their lives to ensure that they perform optimally and that no breakdowns are hampering the smooth operation of the facility. The items produced in such plants are handled and distributed through a properly designed supply chain network to finally reach the market and the hand of the customer.

Throughout the lifecycle of such manufacturing units, spanning through decades, it often sees some capacity of technology upgrades and overhauls within its limits, to remain relevant. It is to be remembered that once a system is designed and erected, it is very difficult to make any changes to it. Hence it is always preferred to carry out the design as carefully as possible. All such works discussed till now are done through the hands of engineers and engineering is fundamentally about envisioning the broader context, considering how all components interact harmoniously. It's a strategic puzzle where each piece must align to achieve the desired outcome. This approach requires a holistic perspective, emphasizing not just the product but the entire lifecycle of a project.

Let us understand this with the help of an imaginary situation operation of a furnace in an industry depends upon selecting proper feed and operating parameters, which are usually done by chemical or metallurgical engineers. Now the operating parameters set will be realized only if the burners, the gas supply systems, and the material handling systems are working properly, which are looked after by mechanical engineers. The sensors and control equipment need to function properly, and the PLC programming should be done with correct logic according to the operational philosophy and interlocks in place for the system to be monitored as needed and data to be recorded for analysis, which comes under the domain of instrumentation and IT engineers respectively. The foundation on which the entire system stands should be designed adequately considering the dynamic loading and changing operating environment in mind, which involves the civil engineers. So, engineering's role extends beyond the physical realm and its discipline; it's about leveraging the knowledge of not only their domain but also understanding and collaborating with others on the same job to enhance the quality of the final deliverable.

Understanding the need of tomorrow for a product and manufacturing facility of the future

Before entering any work of engineering, it is immensely important to understand the requirements or the problem in every detail possible, which is to be addressed. Then the ability to apply engineering knowledge and experiences to come up with solutions for those comes into the picture. Ill-defined problems lead to suboptimal solutions or, worse, they can even complicate existing issues. To mitigate this, tools like Design Failure Modes and Effects Analysis (DFMEA), Hazard and Operability (HAZOP) studies, Root Cause Analysis (RCA) etc. tools become essential, allowing engineers to foresee potential challenges and proactively address them. So, to engineer the world of tomorrow, we must anticipate future requirements.

This demands a clear vision, adherence to standards, and the expertise of subject matter experts. It's about systematically addressing current shortcomings, innovating to fill gaps, and being ready to adapt to future upgrades. The requirement of today and more of the future is sustainability. Our resource deposits are limited, and the environment is fragile. At the same time, we cannot stop the journey of our civilization to continuously evolve into their better selves. The option here is to become more responsible while engineering our way into the future. While this is discussed at all levels and by everyone, the responsibility lies on the engineers to execute this idea into reality. Time has always posed challenges to engineers, and we have always come across solutions to meet the challenges and beyond. Pulling it all together, it would be safe to say that a world for tomorrow can be engineered only when a clear vision and understanding of the needs of the future are processed through the time-tested engineering tools of today and the evolving ones of tomorrow.

How to achieve these ?

While exposure and experience can only be gathered through facing the hardships of the industrial environment, we can poise ourselves to strengthen the remaining requirements and be more efficient and effective in our work and learnings. In addition to time-tested practices, engineers must embrace modern tools to gain deeper insights and ensure precision in their work.

1. Digital Approach

More than a tool, it is an approach and a platform for almost everything that an engineer should do related to his job. Starting from taking notes to developing sketches, and drawings, reviewing them, taking readings of equipment, analyzing reports and data, and communicating with each other everything should be done digitally and recorded in cloud platforms – wherever possible and allowed by the associated system. All such digital information should also be kept systematically and abiding by adequate digital security norms.

By doing so, we are generating useful data and keeping it for our needs in future. In addition to that, while doing engineering work, we come across many calculations and formulation work with a given set of inputs. We should create formats to carry out those calculations with minimum inputs next time, in easily available platforms such as Google Sheets, excel workbooks etc. and preferably in clouds. Many companies and startups are offering software which carries out many such calculations for different purposes with a small number of inputs, which would otherwise have to be done manually each time.

The intent and thumb rule here is, that if efforts have been made in doing something, it should be recorded properly in such a way that it eases my work the next time I do it and they should also be available whenever and wherever required.

2. Document Control Software:

A project and plant generate many documents starting from the conceptualization to every detail related to the engineering project and even the operation and maintenance-related records of running plants. It includes engineering drawings, specification details of equipment and their master list, standard operating and maintenance procedures, checklist and logs of operation and maintenance, data recorded over time, records of changes made in the system etc.

From project inception to plant decommissioning, meticulous document control ensures that crucial information is readily available, minimizing errors and streamlining processes. Any information recorded in a system with due integrity always needs to be given more weightage than any verbal information received from individuals. Information over mouth will always get degraded, the 'Chinese whisper game' is a good example of that. Without proper information and understanding of the facts, good engineering can never be achieved. Some of the renowned document control software are Wrench, Aconex etc.

3. 3D-Based Engineering:

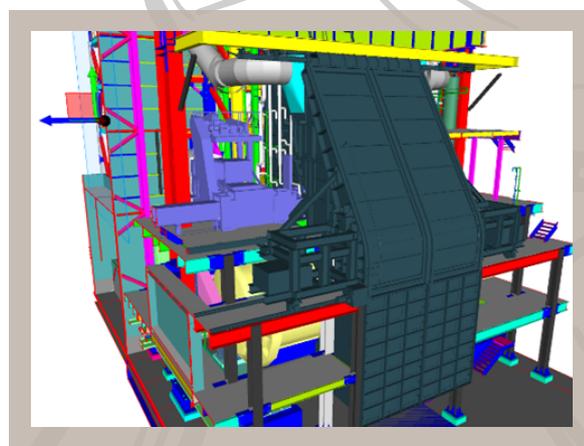
Although 2D drawings are still the backbone of designing and for a good reason. Contrasting with traditional 2D models, 3D-based engineering provides a richer visualization. The study of interacting systems and the whole system as one can only be done properly with 3D models and their reviews reducing errors and fostering improved collaboration among stakeholders. The insight and understanding of a system that a 3D model is able to provide is unparallel, more so, when virtual reality and augmented reality is added to the picture.

Let us understand this with the help of a scenario. Imagine, we are designing and reviewing a furnace and its components. 3D images of the furnace are given are given below for easy understanding.

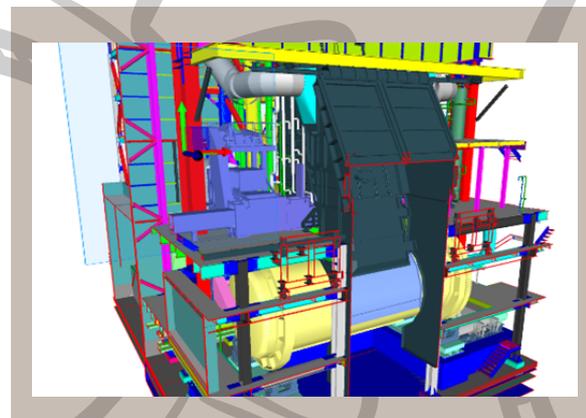
Fig.(a) refers to the furnace as it is with its assemblies individually.

Fig. (b) refers to the same furnace, but here we are trying to inspect or understand the inner construction of it at the section of our convenience.

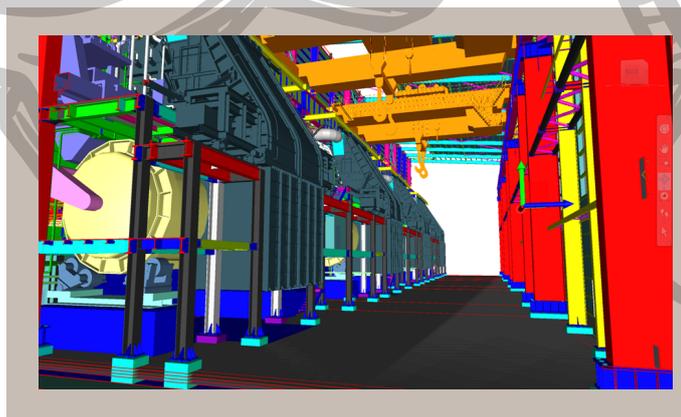
Fig. (c) refers to a group of such furnaces inside the shop floor as they would be installed in reality along with cranes and other machinery that would be there.



(A)



(B)



(C)

Now let us try visualizing the same furnace with a set of 2D drawings with this much clarity; it is hard to do so for someone who has seen the equipment for the first time. Added to this insight, the ability to see the system in isolation, in sections as required and in interaction with its surroundings gives the designer an advantage that is virtually impossible to obtain with only 2D drawings. With these, many errors can be avoided before the actual components are made and installed, saving precious time and resources. Some 3D design and review software are- Autodesk- AutoCAD, Inventor, Navisworks, PTC-Creo, Solidworks etc.



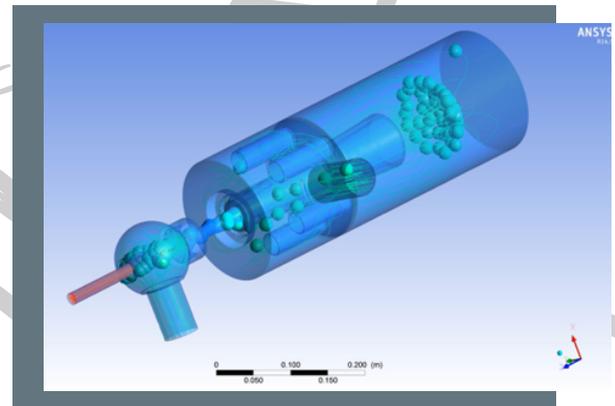
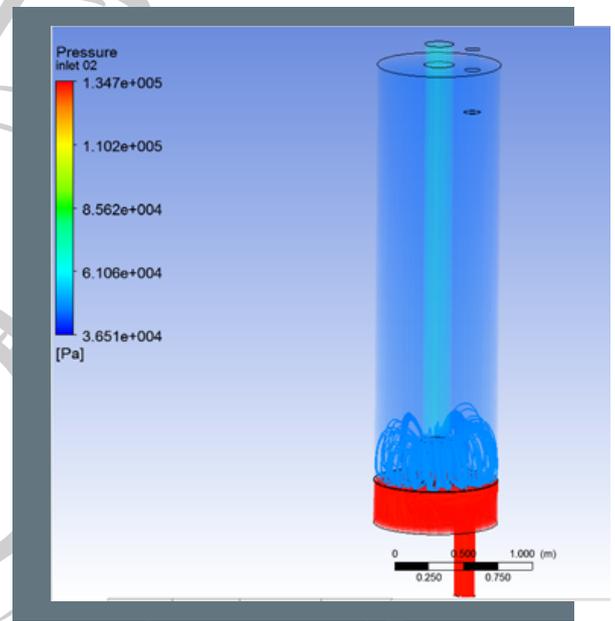
4. Simulation – FEA (Finite Element Analysis):

At times only the visualization of components and their systems is not sufficient. An engineer needs to clearly understand and visualize how the machine or component would behave as an individual and how simultaneous operation of all the machineries would impact each other and the operation as a whole.

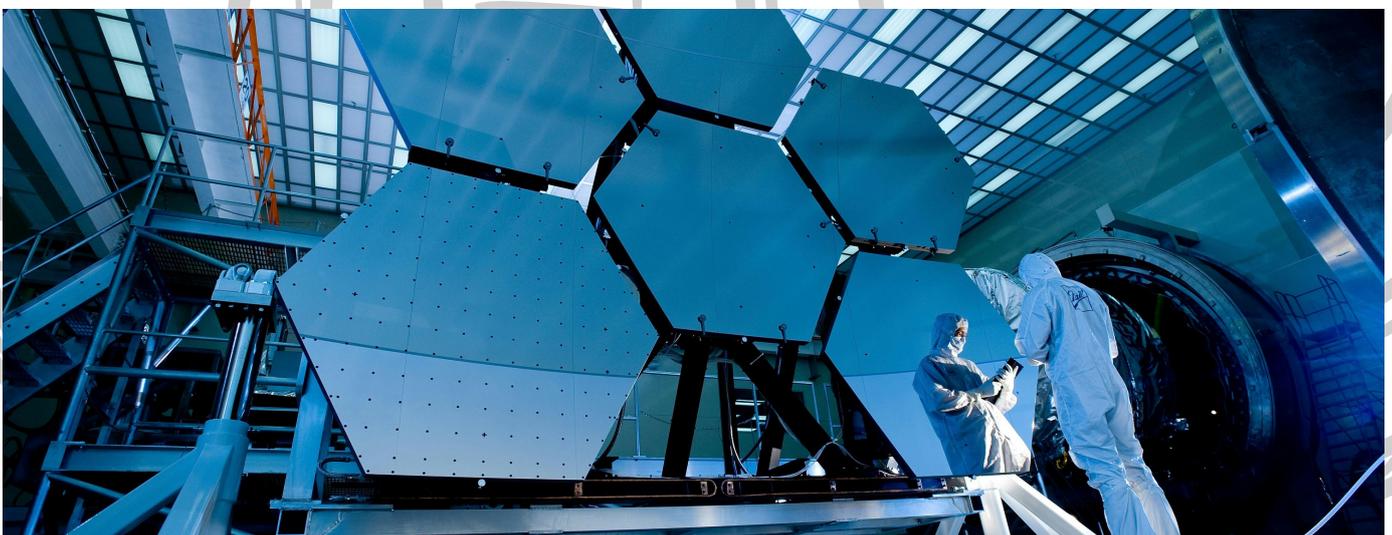
FEA becomes a powerful tool in the engineer's arsenal for in-depth analysis of structural, mechanical components and fluid flow etc. The following two diagrams shows fluid flow analysis of two pneumatic equipment, (a) compressed air driven vacuum injector and (b) airlift for pneumatic conveying.

5. Simulation – DES (Discrete Event Simulation)

While FEA simulation depicts how a certain equipment or its component would behave in given operating parameters, Discrete Event Simulation or DES facilitates the modelling and simulation of a broader system and complex processes interacting with each other. Here, however, in DES simulation, the input, outputs and operational logics of different machines or rather process centres are predefined. Components which are otherwise not analyzed in FEA simulation, such as human, cranes, robots, forklifts and other technological vehicle operations and their impact on each other's work jurisdiction and the whole system are analyzed through this platform. The objective here is to study the material flow throughout the system, identify bottlenecks and finally optimise efficiency, and offer insights that lead to process improvements.



Such platforms when connected to the sensor or PLC inputs in real-time, can also form digital twins, very accurately emulating the happenings of the floor in real-time. Such digital twins provide unparalleled insight into the operation help collect data which are otherwise very difficult to obtain and help in preparing predictive modelling. DES is a comparatively less popular simulation platform, which is gaining popularity very rapidly nowadays. The image below shows a packaging line simulated in 'FlexSim', DES software. Some DES software are Flesxsim, Anylogic, Technomatix Plant Simulation etc.





6. Collaborative Working:

Collaborative working is another tool which has been available for a while now, and is surprisingly well within reach, but is less explored and utilized. It is not specifically an engineering tool but more of a tool of digital approach. We have discussed the digital approach but still this needs to be discussed separately. Collaborative working in this context refers to a style of working where multiple people work on a document together on a real-time basis, irrespective of their physical location. This involves cloud-based working through a proper platform.

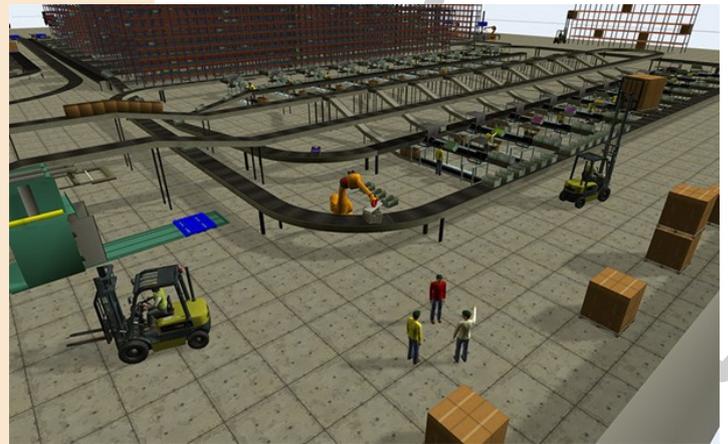
Two very popular sources that provide such platforms include Google's Workspace and Microsoft's Office 365.

Consider a design document requiring input from engineers of various disciplines for the next improvement. Passing the document between engineers or organizing a physical meeting could be time-consuming. In contrast, digital collaborative platforms enable simultaneous access for all engineers, allowing real-time comments and feedback. This not only saves valuable time but also ensures seamless communication, fostering innovation and preventing isolated decision-making. Additionally, it encourages the exchange of ideas, ultimately facilitating efficient engineering on time.

Case Study: Setting Up an Electric Bike Factory

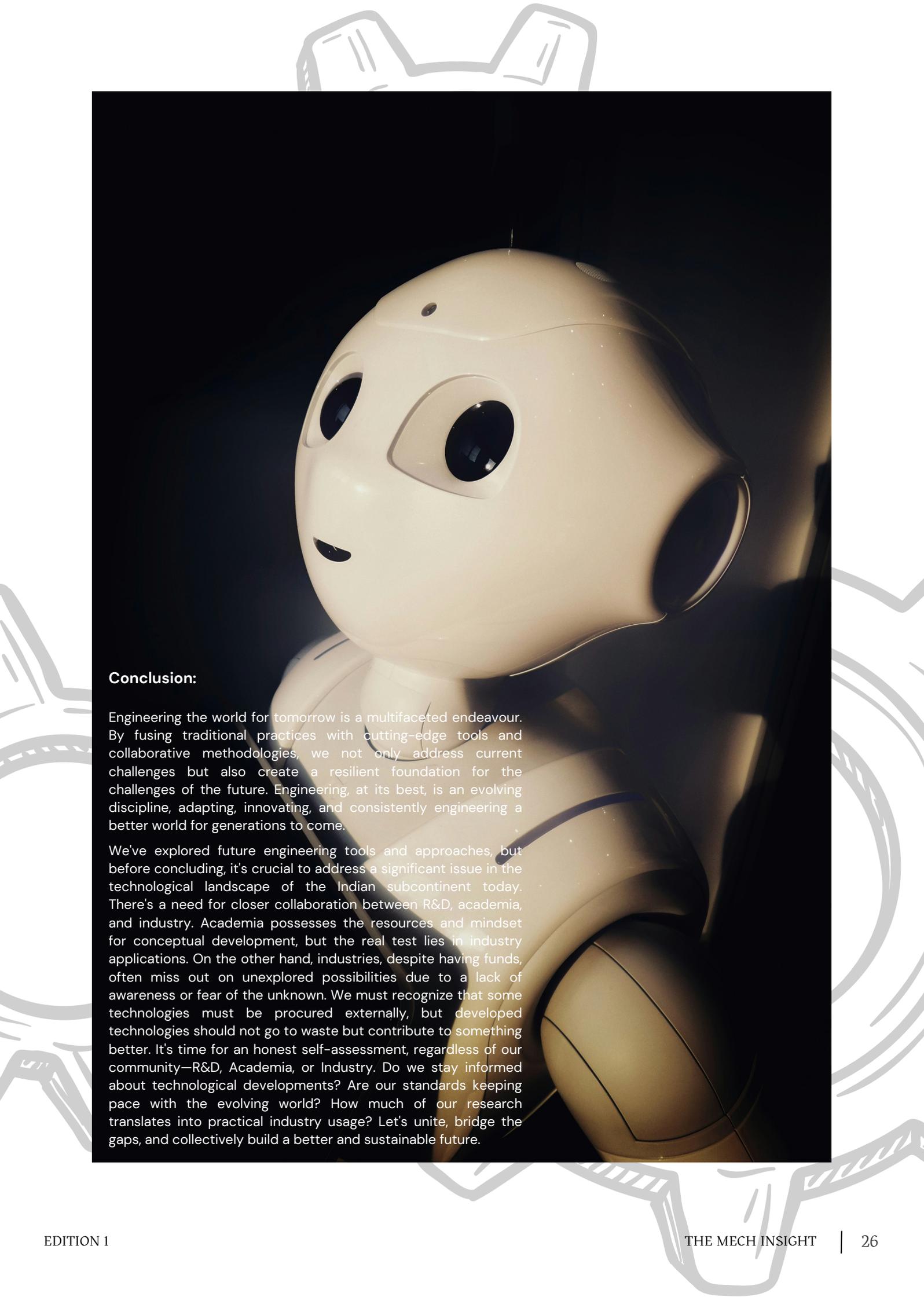
Let's bring it all together and see how the discussed approaches enhance engineering. Imagine establishing an advanced electric bike manufacturing facility. Integrating digital methods, a cloud-based collaborative platform, and document control software ensures streamlined design engineering phases with timely communication and systematic document availability for quick issue resolution. 3D-based engineering allows a virtual walkthrough, optimizing spatial arrangements and identifying clashes, especially when adapting to new technology changes. FEA aids in designing bike components for enhanced performance and durability, extending to the manufacturing facility when integrating new technologies. This ensures constant readiness for upgrades to meet future requirements.

DES optimizes the assembly line, machine centre placement, and capacity, reducing production time and resource waste. Simulating the introduction of new equipment, ensures optimal asset utilization, producing bikes with optimal quality and efficiency.



Collaborative working with a digital approach and Industry 4.0 during operations ensures seamless coordination, data collection, and meaningful analysis, sustaining optimal production throughout the life cycle. Without these modern tools, issues like an inefficient layout, delayed production, and suboptimal product quality may arise in both the project and operations.





Conclusion:

Engineering the world for tomorrow is a multifaceted endeavour. By fusing traditional practices with cutting-edge tools and collaborative methodologies, we not only address current challenges but also create a resilient foundation for the challenges of the future. Engineering, at its best, is an evolving discipline, adapting, innovating, and consistently engineering a better world for generations to come.

We've explored future engineering tools and approaches, but before concluding, it's crucial to address a significant issue in the technological landscape of the Indian subcontinent today. There's a need for closer collaboration between R&D, academia, and industry. Academia possesses the resources and mindset for conceptual development, but the real test lies in industry applications. On the other hand, industries, despite having funds, often miss out on unexplored possibilities due to a lack of awareness or fear of the unknown. We must recognize that some technologies must be procured externally, but developed technologies should not go to waste but contribute to something better. It's time for an honest self-assessment, regardless of our community—R&D, Academia, or Industry. Do we stay informed about technological developments? Are our standards keeping pace with the evolving world? How much of our research translates into practical industry usage? Let's unite, bridge the gaps, and collectively build a better and sustainable future.



#COGNITIA 2023

-UNVEILING THE MECHANICAL MARVELS: COGNITIA 2023 HIGHLIGHTS

Cognitia 2023, the annual technical festival of our esteemed institution National Institute of Technology Meghalaya, unfolded with a symphony of innovation, intellect, and sheer engineering prowess. Different events were being held by different clubs. The Mechanical Engineering department has captivated both participants and spectators with the Mech Kriti and the Cycle Assembler events, where it holds a huge standout competition.



#Mech Kriti: A Showcase of Ingenuity

Mech Kriti, a flagship event of Cognitia, served as a platform for budding engineers to showcase their ingenuity and problem-solving skills. The competition comprised a series of challenging tasks designed to test participants' theoretical knowledge and practical application in the field of mechanical engineering.



From intricate design challenges to hands-on fabrication tasks, Mech Kriti provided a holistic experience that brought together theoretical concepts and their real-world implications. Participants engaged in intense brainstorming sessions, applying principles of mechanics, thermodynamics, and material science to develop innovative solutions.



The event not only fostered healthy competition but also encouraged collaboration and knowledge exchange among participants. It highlighted the interdisciplinary nature of mechanical engineering, emphasizing the importance of integrating diverse skills for comprehensive problem-solving.

Students from different departments were allowed to participate in which the 1st prize was bagged by Binnada Yamuna (CE) and Gowthaboina Trisha (ME), the 2nd prize was bagged by Sravani (ME) and Meghana (CS) and the 3rd prize was bagged by Shweta Singh (CE).

#Cycle Assembler: Precision in Motion



Cycle Assembler, another highlight of Cognitia 2023, celebrated the essence of precision engineering. This competition challenged participants to assemble a functional bicycle from individual components within a stipulated time frame. The assembled cycle had to meet stringent quality and performance standards.

This event tested participants' skills in assembly techniques, attention to detail, and their understanding of the dynamics involved in creating a smoothly functioning system. From aligning gears to ensuring proper tension in the chain, participants navigated through the intricacies of cycle assembly with finesse.



The Cycle Assembler competition not only showcased the technical proficiency of participants but also emphasized the importance of precision and craftsmanship in mechanical engineering. It underscored the significance of meticulous attention to detail, a characteristic that defines excellence in the field.

In this particular event, the 1st prize was bagged by Aditya Yadav (CE) and Manisha Kumari (ME), 2nd prize by Aibansansanu Kharbani (CS) and Mebanker Khongstia (CE) and the 3rd prize was bagged by Boda Prashant (ME) and R.Dharam Singh (EE).

#Beyond the Competitions: Learning and Networking

Cognitia 2023 was not just about competitions; it was a melting pot of learning, networking, and inspiration. Workshops, expert talks, and panel discussions enriched participants with insights into the latest advancements in mechanical engineering. Renowned professionals and scholars shared their experiences, providing a glimpse into the future of the field.

The event served as a bridge between academia and industry, offering students the opportunity to interact with professionals and gain practical insights into the application of their theoretical knowledge. It ignited a spark of curiosity and ambition, motivating participants to strive for excellence in their academic and professional pursuits.

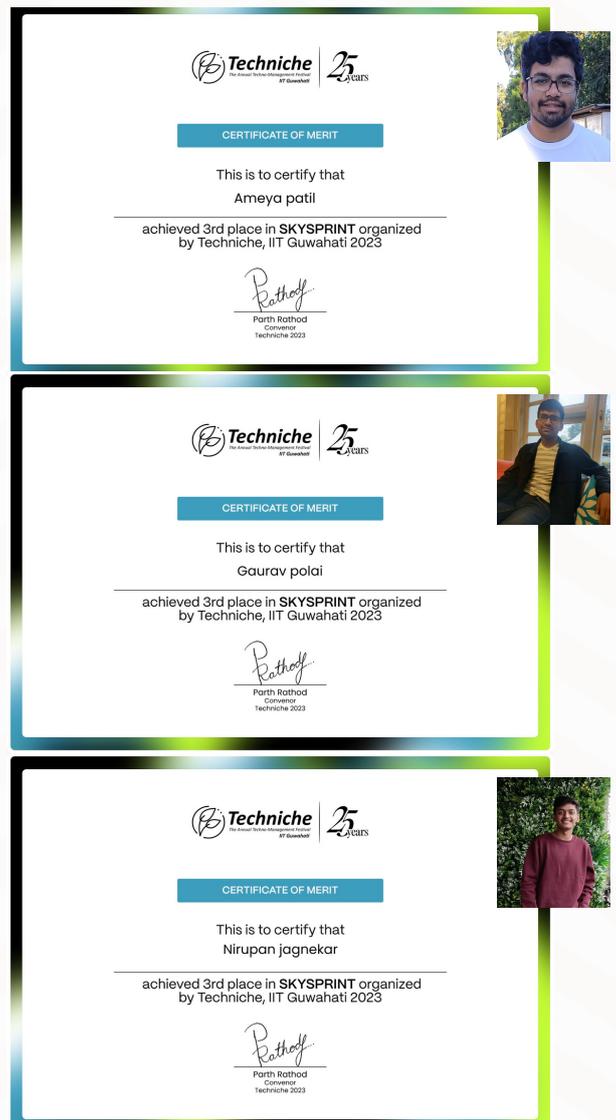
In conclusion, Cognitia 2023, through Mech Kriti and Cycle Assembler, showcased the multifaceted nature of mechanical engineering. It celebrated innovation, precision, and the collaborative spirit that defines our discipline. As we reflect on the success of these events, we look forward to the continued growth and excellence that will undoubtedly shape the future of mechanical engineering at our institution.

STUDENT ACHIEVEMENTS



ARUSH RAMAN SHINES ON
THE CRICKET FIELD,
PROUDLY REPRESENTING
MEGHALAYA WITH SKILL
AND DEDICATION IN
SEASONS 2018-19 AND 2019-20.

NIT MEGHALAYA STUDENTS
SHINE AT IIT GUWAHATI'S
TECHNICAL FEST,
TRIUMPHING IN DIVERSE
COMPETITIONS AGAINST
TOP COLLEGES



LOOK BACK INTO HISTORY

DEPARTMENT OF MECHANICAL ENGINEERING, NIT MEGHALAYA ORGANISED
INTERNATIONAL CONFERENCE ON
RECENT INNOVATIONS AND DEVELOPMENTS IN MECHANICAL ENGINEERING

NOVEMBER 8-10, 2018

Researchers, engineers asked to innovate

By Our Reporter

SHILLONG: Discovering an innovation space with out of the box ideas to launch India into a dominant position in the world was an ardent call made at the International Conference on Recent Innovations and Developments in Mechanical Engineering (IC-RIDME) at the State Convention Center, on Thursday.

Speaking as the chief guest at the inaugural session of the programme organised by the Department of Mechanical Engineering, National Institute of Tech-



Director IIT Gauhati Gautam Biswas speaks at the conference in the city on Thursday. (ST)

nology, Meghalaya, Director of IIT (Guwahati), Gautam Biswas urged the re-

searchers and engineers to be innovative and to think out of the box to make India at par with other parts of the world.

Guest of honour, NEEPCO CMD AG West Kharkongor, said there has to be an engineering solution as he spoke about the engineering challenge faced by NEEPCO in the 600 MW Kameng Hydro Electric Project which was due to commission within March 2019 as there were problems in the penstock.

He later told *The Shillong Times* that there has been a leakage in the penstock and added, "We are

facing a challenge in repairing the penstock as the pressure is high. It is not simple repair work because it is very intricate."

Kharkongor said NEEPCO need to interact with the academicians to find a permanent solution to the problem.

IC-RIDME seeks to provide a platform for researchers, academicians, scientists, practicing engineers and industry professionals to showcase and deliver their research work, studies, contributions, developments and new concepts related to the field of mechanical engineering.

FEATURED IN SHILLONG TIMES ON NOV 09, 2018

DEPARTMENTAL EVENTS

AUG 06, 2023



INTERACTION WITH **PROF. U. K. SAHA** (PROFESSOR, DEPARTMENT OF MECHANICAL ENGINEERING, IIT GUWAHATI) ON CAREER IN THE MECHANICAL ENGINEERING SECTOR

OCT 10, 2023



SHIBANADA CHOUDHARY (MANAGER, TATA CONSULTING ENGINEERS) INSPIRES STUDENTS WITH UNLOCKING INDUSTRIAL INSIGHTS: A PRIMER FOR UNDERGRADUATES

