

Department of Mechanical Engineering



MECH-MARVELS

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Ajay Binay Institute of Technology

MECH-MARVELS

Technical Magazine of
Department Of Mechanical Engineering



AJAY BINAY INSTITUTE OF TECHNOLOGY

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MECH-MARVELS

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From the desk of Head Governing Board



There has never been a more exciting time for technologists in the history of mankind. In the last few years, the world has witnessed rapid progress and proliferation of technologies across areas of mobility, communication, data storage, genetics, 3D printing, artificial intelligence, robotics and above all space technology. As engineers and professionals the scope and choices in front of you is unbounded. I urge all students and faculties to continuously invest time in understanding and utilizing contemporary technology for their own growth as well as the growth of the community they live in. Mech-Marvels is a first step towards that.

Er. Satyadarshi Mishra

From the desk of Director- Placement and New Initiatives



As we start our journey into a new decade, I am very excited for all the opportunities that lies ahead of us. Traditional engineering practices are paving way for new innovative and disruptive technologies. It is imperative to us hone our basics and move ahead to meet these challenges. This transition will be smooth if we keep abreast with the changing technical scenario and one critical and simple state ahead in this regard to keep oneself updated through self study and learning. It is thus important as an educational institute to come up with newsletter and study material that will address the reading requirements of the younger generation. I am sure this issue of Data Loop will enlighten our students on the various aspects of technical scenario. I would like to thank the editorial team with this issue.

Er. Payal Mohapatra

From the Desk of Principal



In its early stages, human mind is a coarse grain of sand, recurring a nurturing shell of broad spectrum of earning opportunities and experiences. It eventually gets nourishes into natures most gifted ominous pearl of creative ideas, knowledge and critical Hinging that ever revolutionized the world. I am extremely sanguine that ABIT has offered itself as a shell for sheltering & fostering human minds in their raw state to be matured into empowered innovators, inversionist and discovers. The Institution has unlocked the store house of taken and creative genius and set buoyant human spirit ever eroding and co-curricular activities. The wheel of excellence and continual progress has been steered with values and conventions as its fulcrum, quality education and constant improvement in infrastructure, educational technology, teaching and learning processes as its spokes to fortify innumerable efforts to set the wheel on its track.

Prof. (Dr.) Leena Samantaray

From the Desk of HOD (Mechanical Engineering)



It gives me immense pleasure to contribute a message for MECH-MARVELS, the Mechanical Engineering Departmental Magazine of Ajay Binay Institute of Technology, Cuttack. This platform not only showcases the technical prowess and creative flair of our budding engineers but also reflects the spirit of innovation and teamwork that defines our department. As we navigate through rapid advancements in technology, it becomes essential for students to engage in activities beyond the classroom to sharpen their skills and broaden their perspectives. I congratulate the editorial team and all contributors for their sincere efforts and encourage every student to continue striving for excellence in both academics and co-curricular pursuits. Let this magazine be a source of inspiration and pride for all.

Er. Chinmay Das

ABOUT ABIT

ABIT group operates an Architecture college and Engineering College with MBA and MCA at CDA in Cuttack, Odisha. This Institution was established in 1998 with the aim to improve availability of skilled technical manpower for industries as well as to enhance the reach of technical education to rural Odisha. The institution is approved by AICTE, New Delhi, affiliated to Biju Patnaik University of Technology, Rourkela and is NAAC accredited. ABIT has a balanced distribution of technical streams with equal emphasis on the core sector and IT sector. The institute actively operates a R&D cell, Incubation centres and ED cell to supplement the learning environment.

Institution Vision

To promote quality teaching, exploration, research and facilitate holistic development of students that would help create capable technical man power needed for industry and academia.

Institution Mission

M1: To enable efficiency and prosperity in society through application of technical knowledge in collaboration with industry and other institutions.

M2: Ensure an effective teaching on contemporary topics and a rational examination system.

M3: Support and create centers of excellence for exploratory technical and behavioural projects that would promote originality and uniqueness.

M4: Establish partnership with local industries for collaborating, understanding and addressing real life technical challenges.

DEPARTMENT OF MECHANICAL ENGINEERING

Department of Mechanical Engineering was established in the year 1998 with approval of AICTE. Over the last two decades the department has established itself as a centre of excellence for advanced education in the state of Odisha. The primary objectives of the department is to impart quality education, training and research at the Under Graduate levels. The department is cherished with full-fledged team of experienced, dynamic and highly qualified faculties and supporting staff for imparting quality education.

Vision of the Department

To become a Centre of Experiential Learning in the field of Mechanical Engineering.

Mission of Department

M1. To nurture a good eco-system that encourages students and faculty to engage in meaningful learning, research and development.

M2. To continually improve teaching-learning process using modern pedagogy that produces mechanical engineers having sound technical capabilities and human value.

M3. To make our students industry ready through hands-on skill training, industrial visits and project works facilitated by academia-industry linkage.

M4. To encourage students to convert ideas into products through innovation and entrepreneurship.

Program Educational Objectives (PEOs)

PEO1: Design, make, operate and maintain mechanical systems effectively and efficiently.

PEO2: Build successful career in mechanical engineering and allied fields utilizing appropriate industry specific knowledge and contemporary skills.

PEO3: Work effectively as a team member and plan, document and communicate properly.

PEO4: Demonstrate a professional approach to engineering practice that takes into account ethical, legal, social, environmental, and safety concerns.

PEO5: Demonstrate a lifelong learning attitude in order to accomplish professional, organizational, and entrepreneurial goals.

Program Specific Outcomes (PSOs)

PSO1: Identify, analyze and formulate solutions for engineering problems related to production, thermal, fluid and mechatronic systems.

PSO2: Apply technical and professional skills effectively and efficiently to pursue successful career.

Program Outcomes (POs)

Engineering Graduates will be able to:

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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SUSTAINABLE ENGINEERING AND RENEWABLE ENERGY

Alok Mishra
4th Year Student

I. Introduction

Definition

Sustainable engineering refers to the design, development, and implementation of technologies and systems that minimize environmental impact, conserve natural resources, and promote social responsibility. It involves a holistic approach to engineering, considering the entire lifecycle of a product or system, from conception to disposal. Sustainable engineering aims to balance economic, social, and environmental needs, ensuring that human activities are environmentally benign and sustainable for future generations. Renewable energy, on the other hand, refers to energy generated from natural resources that can be replenished over time, such as sunlight, wind, rain, and geothermal heat. Renewable energy sources are becoming increasingly important as the world transitions away from fossil fuels and mitigate climate change.

Importance of Sustainable Engineering and Renewable Energy in Modern Times

The importance of sustainable engineering and renewable energy cannot be overstated in modern times. As the world grapples with the challenges of climate change, environmental degradation, and energy security, sustainable engineering and renewable energy offer a critical pathway towards a more sustainable future. Sustainable engineering can help reduce greenhouse gas emissions, conserve natural resources, and promote eco-friendly practices. Renewable energy, in particular, can help decarbonize the energy sector, reduce air pollution, and enhance energy security. Furthermore, sustainable engineering and renewable energy can drive economic growth, create jobs, and improve public health. As the world continues to urbanize and industrialize, the need for sustainable engineering and renewable energy solutions will only continue to grow.

II. Principles of Sustainable Engineering

Minimizing Environmental Impact

Minimizing environmental impact is a critical principle of sustainable engineering. This involves designing systems, products, and processes that reduce harm to the environment and promote ecological balance. Sustainable engineers use various strategies to minimize environmental impact, such as using environmentally friendly materials, reducing emissions and waste, and promoting recycling and reuse. For instance, designing energy-efficient buildings that incorporate green roofs, solar panels, and rainwater harvesting systems can significantly reduce environmental impact. By minimizing environmental impact, sustainable engineers can help mitigate climate change, preserve biodiversity, and protect ecosystems.

Conserving Natural Resources

Conserving natural resources is another essential principle of sustainable engineering. This involves designing systems, products, and processes that minimize the use of natural resources,

such as water, energy, and raw materials. Sustainable engineers use various strategies to conserve natural resources, such as designing efficient systems that reduce energy and water consumption, using recycled and recyclable materials, and promoting sustainable agriculture practices. For example, designing irrigation systems that use drip irrigation and grey water can significantly conserve water resources. By conserving natural resources, sustainable engineers can help ensure that future generations have access to the resources they need to thrive.

Optimizing Energy Efficiency

Optimizing energy efficiency is a critical principle of sustainable engineering. This involves designing systems, products, and processes that minimize energy consumption while maintaining or improving performance. Sustainable engineers use various strategies to optimize energy efficiency, such as designing energy-efficient buildings, developing energy-efficient appliances, and promoting renewable energy sources. For instance, designing buildings with energy-efficient HVAC systems, LED lighting, and insulation can significantly reduce energy consumption. By optimizing energy efficiency, sustainable engineers can help reduce greenhouse gas emissions, mitigate climate change, and promote energy security.

Reducing Waste and Pollution

Reducing waste and pollution is another essential principle of sustainable engineering. This involves designing systems, products, and processes that minimize waste generation and pollution. Sustainable engineers use various strategies to reduce waste and pollution, such as designing products with recyclable materials, promoting recycling and composting, and developing pollution prevention technologies. For example, designing products with biodegradable materials or designing systems that convert waste to energy can significantly reduce waste and pollution. By reducing waste and pollution, sustainable engineers can help protect public health, preserve ecosystems, and promote sustainable development.

III. Renewable Energy Sources

Solar Energy

Solar energy is one of the most promising renewable energy sources, harnessing the power of the sun to generate electricity. Solar panels convert sunlight into electrical energy, providing a clean and sustainable source of power. Solar energy can be used for various applications, including heating, cooling, and generating electricity. With the cost of solar panels decreasing over the years, solar energy has become more accessible and affordable for individuals and businesses. Moreover, solar energy offers numerous benefits, including reducing greenhouse gas emissions, conserving water, and promoting energy independence.

Wind Energy

Wind energy is another vital renewable energy source, leveraging the power of wind to generate electricity. Wind turbines convert wind kinetic energy into electrical energy, providing a clean and sustainable source of power. Wind energy can be used for various applications, including generating electricity, pumping water, and powering homes. Wind energy offers numerous benefits, including reducing greenhouse gas emissions, conserving water, and promoting energy independence. Additionally, wind energy can create jobs, stimulate local economies, and provide a reliable source of energy.

Hydro Energy

Hydro energy is a renewable energy source that harnesses the power of water to generate electricity. Hydroelectric power plants convert the kinetic energy of moving water into electrical energy, providing a clean and sustainable source of power. Hydro energy can be used for various applications, including generating electricity, irrigating crops, and powering homes. Hydro energy offers numerous benefits, including reducing greenhouse gas emissions, conserving water, and promoting energy independence. Additionally, hydro energy can create jobs, stimulate local economies, and provide a reliable source of energy.

Geothermal Energy

Geothermal energy is a renewable energy source that harnesses the heat from the Earth's core to generate electricity. Geothermal power plants convert the thermal energy of hot water or steam into electrical energy, providing a clean and sustainable source of power. Geothermal energy can be used for various applications, including generating electricity, heating buildings, and powering homes. Geothermal energy offers numerous benefits, including reducing greenhouse gas emissions, conserving water, and promoting energy independence. Additionally, geothermal energy can create jobs, stimulate local economies, and provide a reliable source of energy.

Biomass Energy

Biomass energy is a renewable energy source that harnesses the energy stored in organic matter, such as wood, crops, and waste, to generate electricity or heat. Biomass power plants convert the chemical energy of biomass into electrical energy, providing a clean and sustainable source of power. Biomass energy can be used for various applications, including generating electricity, heating buildings, and powering homes. Biomass energy offers numerous benefits, including reducing greenhouse gas emissions, conserving water, and promoting energy independence. Additionally, biomass energy can create jobs, stimulate local economies, and provide a reliable source of energy.

IV. Applications of Sustainable Engineering and Renewable Energy

Energy Storage and Grid Management

The integration of renewable energy sources into the grid requires advanced energy storage and grid management systems. Energy storage technologies, such as batteries, pumped hydro storage, and compressed air energy storage, enable the efficient storage of excess energy generated by renewable sources. This stored energy can then be released into the grid during periods of high demand, reducing the strain on traditional power plants. Advanced grid management systems, such as smart grids and micro grids, enable real-time monitoring and control of energy distribution, ensuring efficient and reliable delivery of renewable energy to consumers.

Transportation (Electric Vehicles, Hybrid Vehicles)

The transportation sector is undergoing a significant transformation with the advent of electric vehicles (EVs) and hybrid vehicles. EVs, powered by batteries charged from renewable energy sources, offer a zero-emission alternative to traditional fossil fuel-based vehicles. Hybrid

vehicles, combining conventional engines with electric motors, provide improved fuel efficiency and reduced emissions. As the demand for EVs and hybrid vehicles grows, investments in charging infrastructure and battery technology are increasing, driving down costs and making these vehicles more accessible to consumers.

Building Design and Architecture

Building design and architecture play a crucial role in reducing energy consumption and promoting sustainability. Green building design incorporates features such as insulation, double-glazing, and solar panels to minimize energy consumption. Buildings can also be designed to maximize natural light and ventilation, reducing the need for artificial lighting and heating. Sustainable building materials, such as recycled materials and low-carbon concrete, can also reduce the environmental impact of construction. By incorporating these features, buildings can become more energy-efficient, reducing greenhouse gas emissions and promoting a healthier environment.

Industrial Processes and Manufacturing

Industrial processes and manufacturing are significant contributors to greenhouse gas emissions, primarily due to energy consumption and resource extraction. However, various sustainable technologies and practices can reduce the environmental impact of industrial activities. For instance, the use of renewable energy sources, such as solar and wind power, can reduce dependence on fossil fuels. Additionally, implementing energy-efficient technologies, such as LED lighting and advanced insulation, can minimize energy consumption. Sustainable manufacturing practices, such as recycling and remanufacturing, can also reduce waste and promote resource efficiency.

Agriculture and Food Production

Agriculture and food production are critical sectors that require sustainable practices to reduce their environmental impact. Sustainable agriculture practices, such as organic farming, permaculture, and regenerative agriculture, promote soil health, biodiversity, and efficient water use. These practices can also reduce synthetic fertilizer and pesticide use, minimizing water pollution and promoting ecosystem services. In addition, adopting precision agriculture techniques, such as precision irrigation and crop monitoring, can optimize resource use and reduce waste. By promoting sustainable agriculture and food production practices, we can ensure a more resilient and environmentally conscious food system.

V. Challenges and Opportunities

Technical Challenges (Energy Storage, Grid Integration)

The integration of renewable energy sources into the grid poses significant technical challenges. One of the primary challenges is energy storage. Renewable energy sources like solar and wind are intermittent, meaning that energy storage solutions are required to ensure a stable and reliable energy supply. Additionally, grid integration is another technical challenge that needs to be addressed. The existing grid infrastructure was designed to handle traditional fossil fuel-based power plants, and integrating renewable energy sources requires significant upgrades and modifications to the grid. Addressing these technical challenges will be crucial to ensuring a smooth transition to a renewable energy-based economy.

Economic Challenges (Cost, Investment)

The transition to a renewable energy-based economy also poses significant economic challenges. One of the primary challenges is the high upfront cost of renewable energy technologies. While the cost of renewable energy technologies has decreased over the years, they are still more expensive than traditional fossil fuel-based power plants. Additionally, the investment required to integrate renewable energy sources into the grid is substantial. Governments and private investors need to invest heavily in renewable energy infrastructure, including energy storage solutions and grid upgrades. Addressing these economic challenges will require innovative financing solutions and policy support.

Policy and Regulatory Challenges

The transition to a renewable energy-based economy also requires significant policy and regulatory support. One of the primary challenges is the lack of a coordinated policy framework to support the integration of renewable energy sources into the grid. Governments need to develop and implement policies that promote the adoption of renewable energy technologies, provide incentives for investment, and ensure grid stability. Additionally, regulatory frameworks need to be adapted to accommodate the integration of renewable energy sources into the grid. Addressing these policy and regulatory challenges will require coordination and cooperation among governments, regulators, and industry stakeholders.

Opportunities for Innovation and Job Creation

Despite the challenges, the transition to a renewable energy-based economy also presents significant opportunities for innovation and job creation. The renewable energy industry is driving innovation in areas like energy storage, grid management, and smart grids. This innovation is creating new opportunities for entrepreneurs, start-ups, and small businesses. Additionally, the renewable energy industry is creating new job opportunities in areas like installation, maintenance, and operation of renewable energy systems. Addressing the challenges and seizing the opportunities presented by the transition to a renewable energy-based economy will require collaboration and coordination among governments, industry stakeholders, and civil society.

VI. Conclusion

In conclusion, the significance of studying impulse purchases in the digital age cannot be overstated. As consumers increasingly turn to online platforms for their shopping needs, understanding the factors that drive impulse buying behavior is crucial for businesses to develop effective marketing strategies and optimize their online platforms. By examining the impact of various factors, such as social media, online advertising, and website design, on impulse purchases, researchers can provide valuable insights into the evolving nature of consumer behavior in the digital age. Ultimately, this knowledge can help businesses promote sustainable consumer behavior, reduce waste, and foster a more environmentally conscious approach to consumption.

BIOMECHANICAL ENGINEERING: ADVANCES IN PROSTHETICS, IMPLANTS, AND ASSISTIVE DEVICES FOR IMPROVED HUMAN HEALTH AND QUALITY OF LIFE

Asmit Mohanty
3rd Year Student

I. Introduction

Biomechanical engineering is a multidisciplinary field that combines principles from engineering, biology, and medicine to develop innovative solutions for improving human health and quality of life. It involves the application of mechanical principles to understand the structure, function, and movement of living organisms, and to design and develop medical devices, implants, and equipment that can restore or improve human function. Biomechanical engineers use a range of techniques, including computer modelling, experimental testing, and clinical trials, to develop and evaluate new medical technologies. Biomechanical engineering plays a vital role in improving human health and quality of life. By developing innovative medical devices, implants, and equipment, biomechanical engineers can help to restore or improve human function, enabling people to live healthier, more independent lives. For example, biomechanical engineers have developed prosthetic limbs that can be controlled by the user's thoughts, implants that can repair damaged heart tissue, and devices that can help people with paralysis to walk again. By pushing the boundaries of medical technology, biomechanical engineers can help to address some of the world's most pressing healthcare challenges, improving the lives of millions of people around the world.

II. Advances in Prosthetics

Prosthetic Devices

Prosthetic devices are artificial limbs or body parts designed to replace or support natural limbs or body parts that are missing, damaged, or diseased. Prosthetic devices can be customized to meet the specific needs of each individual, taking into account factors such as the location and extent of the amputation, the individual's lifestyle and goals, and their overall health and well-being. Prosthetic devices can be broadly categorized into several types, including upper-limb prosthetics, lower-limb prosthetics, and prosthetic joints. Each type of prosthetic device has its own unique characteristics, advantages, and challenges.

Recent Advancements in Prosthetic Technology

Recent advancements in prosthetic technology have revolutionized the field, enabling individuals with amputations to achieve greater mobility, independence, and quality of life. One of the most significant advancements is the development of mind-controlled prosthetics, which use electroencephalography (EEG) or electromyography (EMG) signals to control the prosthetic device. This technology enables individuals to control their prosthetic devices with greater precision and ease, allowing them to perform complex tasks and activities. Another significant advancement is the use of 3D printing technology to create customized prosthetic devices. This technology enables prosthetic devices to be created quickly and efficiently, reducing the time and cost associated with traditional prosthetic manufacturing methods.

Benefits and Challenges of Advanced Prosthetic Devices

Advanced prosthetic devices offer numerous benefits, including improved mobility, independence, and quality of life. Mind-controlled prosthetics, for example, enable individuals to control their prosthetic devices with greater precision and ease, allowing them to perform complex tasks and activities. 3D-printed prosthetics, on the other hand, can be created quickly and efficiently, reducing the time and cost associated with traditional prosthetic manufacturing methods. However, advanced prosthetic devices also pose several challenges, including high costs, limited accessibility, and the need for on-going maintenance and repairs. Additionally, there is a need for further research and development to improve the functionality, durability, and affordability of advanced prosthetic devices.

III. Implants and Tissue Engineering

Overview

Implantable devices are artificial components designed to be surgically inserted into the body to replace or support damaged or diseased tissues. Examples of implantable devices include joint replacements, dental implants, pacemakers, and cochlear implants. These devices are designed to mimic the natural function of the replaced tissue, improving the quality of life for individuals with injuries, disabilities, or chronic conditions. Implantable devices can be made from a variety of materials, including metals, ceramics, and polymers, and are often designed to be biocompatible and durable.

Recent Advancements in Tissue Engineering and Regenerative Medicine

Tissue engineering and regenerative medicine are rapidly evolving fields that involve the use of living cells, biomaterials, and bioactive molecules to create functional tissue substitutes. Recent advancements in these fields have led to the development of novel implantable devices, such as tissue-engineered heart valves, skin substitutes, and bone grafts. Additionally, researchers are exploring the use of stem cells, gene therapy, and biomaterials to promote tissue regeneration and repair. These advancements hold great promise for the treatment of a wide range of diseases and injuries, and are expected to revolutionize the field of implantable devices.

Benefits and Challenges of Implantable Devices and Tissue Engineering

Implantable devices and tissue engineering offer numerous benefits, including improved quality of life, enhanced functionality, and reduced morbidity and mortality. However, these technologies also pose several challenges, including biocompatibility issues, implant rejection, and the potential for adverse reactions. Additionally, the development and implementation of implantable devices and tissue engineering technologies are often hindered by regulatory, ethical, and economic challenges. Despite these challenges, researchers and clinicians are working tirelessly to overcome these hurdles and harness the full potential of implantable devices and tissue engineering to improve human health and well-being.

IV. Assistive Devices and Rehabilitation Engineering

Overview

Assistive devices are tools or equipment designed to help individuals with disabilities, injuries, or illnesses to perform daily tasks and activities with greater ease and independence. Examples of assistive devices include wheelchairs, walkers, canes, crutches, and prosthetic limbs. These

devices can be customized to meet the specific needs of each individual, taking into account factors such as the type and severity of the disability, the individual's lifestyle and goals, and their overall health and well-being. Assistive devices can greatly improve the quality of life for individuals with disabilities, enabling them to participate fully in their communities and to pursue their goals and aspirations.

Recent Advancements in Rehabilitation Engineering

Rehabilitation engineering is a field that focuses on the development of innovative technologies and devices to help individuals with disabilities or injuries to recover and regain their functional abilities. Recent advancements in rehabilitation engineering have led to the development of exciting new technologies, such as exoskeletons and robotic therapy. Exoskeletons are wearable devices that use artificial muscles or motors to enhance or restore mobility in individuals with paralysis or muscle weakness. Robotic therapy, on the other hand, uses robotic devices to provide repetitive and task-specific training to individuals with neurological or orthopaedic injuries. These technologies have shown great promise in improving outcomes and enhancing the quality of life for individuals with disabilities.

Benefits and Challenges of Assistive Devices and Rehabilitation Engineering

Assistive devices and rehabilitation engineering offer numerous benefits, including improved mobility, independence, and quality of life. These technologies can also enhance the rehabilitation process, improving outcomes and reducing recovery time. However, there are also several challenges associated with assistive devices and rehabilitation engineering, including high costs, limited accessibility, and the need for on-going maintenance and repairs. Additionally, there is a need for further research and development to improve the functionality, durability, and affordability of these technologies. Despite these challenges, assistive devices and rehabilitation engineering hold great promise for improving the lives of individuals with disabilities, and researchers and clinicians are working tirelessly to advance these fields and make these technologies more widely available.

V. Future Directions and Challenges

Emerging Trends and Technologies in Biomechanical Engineering

Biomechanical engineering is a rapidly evolving field, with emerging trends and technologies that hold great promise for improving human health and quality of life. One of the most significant emerging trends is the use of artificial intelligence (AI) and machine learning (ML) in biomechanical engineering. AI and ML can be used to analyze large datasets, simulate complex biological systems, and develop personalized medical devices and treatments. Another emerging trend is the use of 3D printing and bio printing to create customized prosthetics, implants, and tissue-engineered constructs. These technologies have the potential to revolutionize the field of biomechanical engineering, enabling the creation of personalized, complex, and functional biological systems.

Challenges and Limitations in the Field

Despite the many advances and opportunities in biomechanical engineering, there are several challenges and limitations that must be addressed. One of the primary challenges is regulatory issues, as biomechanical engineers must navigate complex and often conflicting regulatory frameworks to bring new medical devices and treatments to market. Another challenge is

funding, as biomechanical engineering research and development often requires significant investment and resources. Additionally, there are technical challenges associated with integrating biomechanical devices and systems with the complex and dynamic biological environment. Addressing these challenges will require collaboration and innovation among researchers, clinicians, industry leaders, and regulatory agencies.

Future Research Directions and Potential Applications

The future of biomechanical engineering holds great promise for improving human health and quality of life. Future research directions may include the development of personalized, adaptive, and responsive biomechanical systems that can integrate with the dynamic biological environment. Another potential area of research is the use of biomechanical engineering to develop new treatments and therapies for complex diseases and injuries, such as cancer, stroke, and spinal cord injury. Additionally, biomechanical engineers may explore the use of emerging technologies, such as nanotechnology, synthetic biology, and robotics, to create new biomechanical devices and systems. The potential applications of biomechanical engineering are vast and varied, and may include the development of new medical devices, treatments, and therapies that can improve human health and quality of life.

VI. Conclusion

In conclusion, biomechanical engineering is a multidisciplinary field that has the potential to revolutionize the way we approach healthcare and medicine. By combining principles from engineering, biology, and medicine, biomechanical engineers can develop innovative solutions to complex medical problems. From prosthetic devices and implants to tissue engineering and rehabilitation engineering, biomechanical engineering has the potential to improve the quality of life for millions of people around the world. As the field continues to evolve, we can expect to see new and exciting advancements that will transform the way we approach healthcare and medicine.

THE IMPACT OF COMPUTER SCIENCE ON MECHANICAL ENGINEERING IN THE MANUFACTURING INDUSTRY

Arjun Kumar Jha
4th Year Student

Brief Overview

Mechanical engineering is a diverse field that involves the design, construction, and use of machines. It is one of the oldest and broadest engineering disciplines, encompassing a wide range of subfields such as mechanics, kinematics, thermodynamics, and materials science. Computer science, on the other hand, is the study of the theory, design, and implementation of computer systems and algorithms. The integration of computer science in mechanical engineering has revolutionized the field, enabling the development of more complex and sophisticated machines.

Importance of Integrating Computer Science in Mechanical Engineering

The integration of computer science in mechanical engineering is crucial for several reasons. Firstly, computer science enables mechanical engineers to design and simulate complex systems, reducing the need for physical prototypes and improving the efficiency of the design process. Secondly, computer science provides mechanical engineers with the tools and techniques to analyze and optimize the performance of machines, leading to improved efficiency and productivity. Finally, the integration of computer science in mechanical engineering enables the development of intelligent machines that can interact with their environment and adapt to changing conditions.

Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM)

Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) are two essential tools in mechanical engineering. CAD software enables engineers to create detailed digital models of machines and systems, while CAM software uses these models to control machine tools and manufacturing processes. The use of CAD and CAM has revolutionized the manufacturing industry, enabling the rapid production of complex parts and systems with high precision and accuracy.

Role of CAD and CAM in Mechanical Engineering

CAD and CAM play a crucial role in mechanical engineering, enabling engineers to design and manufacture complex machines and systems. CAD software is used to create detailed digital models of machines and systems, while CAM software is used to control machine tools and manufacturing processes. The use of CAD and CAM enables mechanical engineers to optimize the design and manufacturing process, reducing the time and cost associated with traditional design and manufacturing methods.

Impact of CAD and CAM on Manufacturing Industry

The impact of CAD and CAM on the manufacturing industry has been significant. The use of CAD and CAM has enabled the rapid production of complex parts and systems with high precision and accuracy, improving the efficiency and productivity of manufacturing processes. Additionally, CAD and CAM have enabled the development of new manufacturing

technologies, such as 3D printing and computer numerical control (CNC) machining, which have transformed the manufacturing industry.

Artificial Intelligence (AI) and Machine Learning (ML) in Mechanical Engineering

Artificial intelligence (AI) and machine learning (ML) are increasingly being used in mechanical engineering to improve the design, development, and operation of machines and systems. AI and ML can be used to analyze complex data, simulate real-world conditions, and optimize system performance. In mechanical engineering, AI and ML can be applied to a wide range of fields, including robotics, control systems, and signal processing.

Applications of AI and ML in Mechanical Engineering

AI and ML have a wide range of applications in mechanical engineering, including predictive maintenance, quality control, and design optimization. For example, AI-powered sensors can be used to monitor machine performance and predict when maintenance is required, reducing downtime and improving overall efficiency. ML algorithms can also be used to analyze data from sensors and cameras to detect defects in products and improve quality control.

Impact of AI and ML on Manufacturing Industry

The impact of AI and ML on the manufacturing industry has been significant. AI and ML have enabled manufacturers to improve efficiency, reduce costs, and enhance product quality. For example, AI-powered robots can be used to automate repetitive tasks, freeing up human workers to focus on more complex and creative tasks. ML algorithms can also be used to analyze data from sensors and cameras to detect defects in products and improve quality control.

Robotics and Automation

Robotics and automation are increasingly being used in mechanical engineering to improve the efficiency and productivity of manufacturing processes. Robotics involves the use of robots to perform tasks that are typically performed by humans, while automation involves the use of technology to automate repetitive tasks. Robotics and automation can be used to improve the efficiency and productivity of manufacturing processes, reducing costs and improving product quality.

Role of Robotics and Automation in Mechanical Engineering

Robotics and automation play a crucial role in mechanical engineering, enabling manufacturers to improve efficiency, reduce costs, and enhance product quality. Robotics can be used to automate repetitive tasks, freeing up human workers to focus on more complex and creative tasks. Automation can also be used to improve the efficiency and productivity of manufacturing processes, reducing costs and improving product quality.

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to improve the efficiency and productivity of manufacturing processes, reducing costs and improving product quality.

Data Analytics and Internet of Things (IoT)

Data analytics and the Internet of Things (IoT) are increasingly being used in mechanical engineering to improve the efficiency and productivity of manufacturing processes. Data analytics involves the use of statistical and mathematical techniques to analyze data from sensors and other sources, while IoT involves the use of sensors and other devices to connect machines and systems to the internet.

Role of Data Analytics and IoT in Mechanical Engineering

Data analytics and IoT play a crucial role in mechanical engineering, enabling manufacturers to improve efficiency, reduce costs, and enhance product quality. Data analytics can be used to analyze data from sensors and other sources, providing insights into machine performance and manufacturing processes. IoT can be used to connect machines and systems to the internet, enabling real-time monitoring and control.

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The impact of data analytics and IoT on the manufacturing industry has been significant. Data analytics and IoT have enabled manufacturers to improve efficiency, reduce costs, and enhance product quality. For example, data analytics can be used to analyze data from sensors and other sources, providing insights into machine performance and manufacturing processes. IoT can be used to connect machines and systems to the internet, enabling real-time monitoring and control.

VI. Conclusion

Ultimately, the integration of computer science in mechanical engineering has revolutionized the field, enabling the development of more complex and sophisticated machines. The use of computer-aided design (CAD), computer-aided manufacturing (CAM), artificial intelligence (AI), machine learning (ML), robotics, and data analytics has improved the efficiency, productivity, and quality of manufacturing processes. As technology continues to evolve, it is likely that the integration of computer science and mechanical engineering will become even more pronounced, leading to new and innovative applications in a wide range of fields.

MECHANICAL ENGINEERING AND COMPUTER SCIENCE: A MATCH MADE IN THE AEROSPACE INDUSTRY

Babu Malik
4th Year Student

Brief Overview of Mechanical Engineering and Computer Science

Mechanical engineering is a diverse field that involves the design, construction, and use of machines. It is one of the oldest and broadest engineering disciplines, encompassing a wide range of subfields such as mechanics, kinematics, thermodynamics, and materials science. Computer science, on the other hand, is the study of the theory, design, and implementation of computer systems and algorithms. The integration of computer science in mechanical engineering has revolutionized the field, enabling the development of more complex and sophisticated machines.

Importance of Integrating Computer Science in Mechanical Engineering

The integration of computer science in mechanical engineering is crucial for several reasons. Firstly, computer science enables mechanical engineers to design and simulate complex systems, reducing the need for physical prototypes and improving the efficiency of the design process. Secondly, computer science provides mechanical engineers with the tools and techniques to analyze and optimize the performance of machines, leading to improved efficiency and productivity. Finally, the integration of computer science in mechanical engineering enables the development of intelligent machines that can interact with their environment and adapt to changing conditions.

Applications of Mechanical Engineering and Computer Science in Aerospace Industry

The aerospace industry is one of the most exciting and challenging fields where mechanical engineering and computer science come together. The design and development of aircraft and spacecraft require the expertise of mechanical engineers and computer scientists to create complex systems that can withstand extreme conditions. From the propulsion systems and control systems to materials science and structural analysis, mechanical engineering and computer science play a crucial role in the aerospace industry.

Design and Development of Aircraft and Spacecraft

The design and development of aircraft and spacecraft require the expertise of mechanical engineers and computer scientists to create complex systems that can withstand extreme conditions. Mechanical engineers use computer-aided design (CAD) software to design and simulate the performance of aircraft and spacecraft, while computer scientists develop algorithms and models to analyze and optimize their performance.

Propulsion Systems and Control Systems

Propulsion systems and control systems are critical components of aircraft and spacecraft. Mechanical engineers design and develop propulsion systems, such as engines and thrusters, while computer scientists develop control systems that enable the vehicle to navigate and

maneuver. The integration of mechanical engineering and computer science is essential for the development of efficient and reliable propulsion systems and control systems.

Materials Science and Structural Analysis

Materials science and structural analysis are critical components of aircraft and spacecraft design. Mechanical engineers use computer simulations to analyze the performance of materials and structures under various conditions, while computer scientists develop algorithms and models to optimize their performance. The integration of mechanical engineering and computer science enables the development of lightweight and durable materials and structures that can withstand extreme conditions.

Computational Fluid Dynamics and Aerodynamics

Computational fluid dynamics (CFD) and aerodynamics are critical components of aerospace engineering. CFD involves the use of numerical methods and algorithms to analyze and simulate the behavior of fluids and gases, while aerodynamics is the study of the interaction between air and solid objects. Mechanical engineers and computer scientists use CFD and aerodynamics to optimize the design of aircraft and spacecraft, reducing drag and improving overall performance.

Finite Element Analysis and Structural Analysis

Finite element analysis (FEA) and structural analysis are essential tools in aerospace engineering. FEA involves the use of numerical methods to analyze and simulate the behavior of complex systems, while structural analysis is the study of the behavior of structures under various loads. Mechanical engineers and computer scientists use FEA and structural analysis to optimize the design of aircraft and spacecraft, ensuring that they can withstand extreme conditions.

Control Systems and Navigation

Control systems and navigation are critical components of aerospace engineering. Control systems involve the use of sensors, actuators, and control algorithms to control the behavior of aircraft and spacecraft, while navigation involves the use of sensors and algorithms to determine the position and velocity of vehicles. Mechanical engineers and computer scientists use control systems and navigation to ensure that aircraft and spacecraft operate safely and efficiently.

Impact of Mechanical Engineering and Computer Science on Aerospace Industry

The impact of mechanical engineering and computer science on the aerospace industry has been significant. The integration of these two fields has led to improved efficiency and productivity, enhanced safety and reliability, and increased innovation and competitiveness. Mechanical engineers and computer scientists work together to design and develop new aircraft and spacecraft, using advanced tools and techniques to optimize their performance.

Improved Efficiency and Productivity

The integration of mechanical engineering and computer science has led to improved efficiency and productivity in the aerospace industry. Mechanical engineers and computer scientists use advanced

tools and techniques, such as CFD and FEA, to optimize the design of aircraft and spacecraft, reducing the time and cost associated with traditional design methods.

Enhanced Safety and Reliability

The integration of mechanical engineering and computer science has also led to enhanced safety and reliability in the aerospace industry. Mechanical engineers and computer scientists use advanced tools and techniques, such as control systems and navigation, to ensure that aircraft and spacecraft operate safely and efficiently.

Increased Innovation and Competitiveness

The integration of mechanical engineering and computer science has also led to increased innovation and competitiveness in the aerospace industry. Mechanical engineers and computer scientists work together to design and develop new aircraft and spacecraft, using advanced tools and techniques to optimize their performance.

NASA's Mars Exploration Program

NASA's Mars Exploration Program is a prime example of the successful integration of mechanical engineering and computer science in the aerospace industry. The program involves the design and development of complex systems, such as rovers and landers, that can withstand extreme conditions on Mars. Mechanical engineers and computer scientists work together to design and develop these systems, using advanced tools and techniques to optimize their performance.

Boeing's 787 Dreamliner

Boeing's 787 Dreamliner is another example of the successful integration of mechanical engineering and computer science in the aerospace industry. The 787 Dreamliner is a state-of-the-art commercial aircraft that features advanced materials and systems, such as composite materials and advanced avionics. Mechanical engineers and computer scientists worked together to design and develop the 787 Dreamliner, using advanced tools and techniques to optimize its performance.

Airbus's A350 XWB

Airbus's A350 XWB is a prime example of the successful integration of mechanical engineering and computer science in the aerospace industry. The A350 XWB is a state-of-the-art commercial aircraft that features advanced materials and systems, such as composite materials and advanced avionics. Mechanical engineers and computer scientists worked together to design and develop the A350 XWB, using advanced tools and techniques to optimize its performance.

VI. Conclusion

The integration of mechanical engineering and computer science has revolutionized the aerospace industry, enabling the development of complex and sophisticated systems. From the design and development of aircraft and spacecraft to the optimization of propulsion systems and control systems, mechanical engineering and computer science play a crucial role. As technology continues to evolve, it is likely that the integration of these two fields will become even more pronounced, leading to new and innovative applications in the aerospace industry.

THE HARMONY OF MACHINES: EXPLORING THE INTERSECTION OF MECHANICAL ENGINEERING AND MUSIC

Prem Kumar Karmakar
2nd Year Student

Mechanical Engineering in Music

Mechanical engineering plays a crucial role in the design and development of musical instruments. From the intricate mechanisms of pianos to the electronic components of synthesizers, mechanical engineers have contributed significantly to the evolution of music. The study of acoustics and sound engineering is also an essential aspect of music, and mechanical engineers have developed innovative solutions to improve sound quality and reproduction.

Design and Development of Musical Instruments

The design and development of musical instruments is a complex process that involves the application of mechanical engineering principles. Mechanical engineers work with musicians and instrument makers to design and develop instruments that meet the required standards of sound quality and playability. This involves the selection of appropriate materials, the design of mechanical components, and the testing of prototypes. Mechanical engineers have developed a wide range of musical instruments, from traditional instruments such as guitars and violins to electronic instruments such as synthesizers and drum machines.

Acoustics and Sound Engineering

Acoustics and sound engineering are critical aspects of music, and mechanical engineers play a key role in these fields. Acoustics is the study of sound and its behaviour in different environments, while sound engineering involves the recording, editing, and reproduction of sound. Mechanical engineers use their knowledge of acoustics and sound engineering to design and develop systems for recording and reproducing sound, including microphones, speakers, and amplifiers. They also work on the design and development of acoustic instruments, such as guitars and violins, to optimize their sound quality.

Music Technology and Innovation

Music technology and innovation are rapidly evolving fields that involve the application of mechanical engineering principles to create new and innovative musical instruments and systems. Mechanical engineers work with musicians and other stakeholders to develop new technologies and products that enhance the creation and enjoyment of music. This includes the development of electronic instruments, digital audio workstations, and other music technology products. Mechanical engineers also work on the development of new materials and technologies that can be used in musical instruments, such as advanced composites and smart materials.

Music in Mechanical Engineering

Music has also influenced mechanical engineering, with many mechanical engineers drawing inspiration from musical principles to develop innovative solutions. The study of vibration and

oscillation, for example, is a fundamental aspect of mechanical engineering, and music provides a unique perspective on these phenomena. Music has also been used in mechanical engineering education to illustrate complex concepts and principles.

Conclusion

The intersection of mechanical engineering and music has led to significant innovations and advancements in both fields. From the design and development of musical instruments to the application of musical principles in mechanical systems, the connection between mechanical engineering and music is multifaceted and profound. As technology continues to evolve, it is likely that the intersection of mechanical engineering and music will become even more pronounced, leading to new and exciting developments in both fields.

PHYSICS AND MECHANICAL ENGINEERING: TYPICAL CASE STUDIES

Chiranjib Pani
3rd Year Student

Case Study 1: Design of a Wind Turbine

A team of mechanical engineers applied principles of physics to design a more efficient wind turbine. They used computational fluid dynamics (CFD) to optimize the turbine's blade shape and angle, resulting in a 20% increase in energy production.

Case Study 2: Development of a Robotic Arm

Mechanical engineers used physics to design and develop a robotic arm for industrial applications. They applied principles of kinematics and dynamics to create a precise and efficient arm that could perform tasks with high accuracy.

Case Study 3: Optimization of a Car Engine

A team of mechanical engineers used physics to optimize the performance of a car engine. They applied principles of thermodynamics and mechanics to improve the engine's efficiency and reduce emissions.

Case Study 4: Design of a Medical Device

Mechanical engineers used physics to design a medical device for minimally invasive surgery. They applied principles of biomechanics and materials science to create a device that was both effective and safe.

Case Study 5: Development of a High-Speed Train

A team of mechanical engineers used physics to design and develop a high-speed train. They applied principles of aerodynamics and mechanics to optimize the train's shape and reduce air resistance.

Case Study 6: Optimization of a Solar Panel

Mechanical engineers used physics to optimize the performance of a solar panel. They applied principles of thermodynamics and electromagnetism to improve the panel's efficiency and increase energy production.

These case studies demonstrate the application of physics principles in mechanical engineering to solve real-world problems and improve the performance of various systems and devices.

THE FUTURE OF MECHANICAL ENGINEERING: WHERE ART, CRAFT, AND TECHNOLOGY MEET

Swayam Siddha Pradhan
4th Year Student

The future of mechanical engineering is an exciting and rapidly evolving field, where art, craft, and technology converge to create innovative solutions. As technology advances, mechanical engineers are no longer just focused on functionality, but also on aesthetics and user experience. The integration of art and craft into mechanical engineering has led to the development of new design methodologies, materials, and manufacturing techniques.

The Role of Art and Craft in Mechanical Engineering

Art and craft play a significant role in mechanical engineering, as they bring a creative and human-centered approach to design. Mechanical engineers who incorporate art and craft into their work are able to create products that are not only functional but also beautiful and user-friendly. This intersection of art, craft, and technology has led to the development of new fields, such as product design and industrial design.

The Impact of Technology on Mechanical Engineering

Technology has had a profound impact on mechanical engineering, enabling the development of new materials, manufacturing techniques, and design tools. Advances in computer-aided design (CAD) software, 3D printing, and simulation have allowed mechanical engineers to create complex systems and products that were previously impossible to design and manufacture.

The Future of Mechanical Engineering

The future of mechanical engineering is bright, with many exciting developments on the horizon. As technology continues to advance, mechanical engineers will be able to create even more innovative solutions that combine art, craft, and technology. Some of the key areas that will shape the future of mechanical engineering include robotics, artificial intelligence, and sustainable energy.

Conclusion

In conclusion, the future of mechanical engineering is an exciting and rapidly evolving field, where art, craft, and technology meet to create innovative solutions. As technology continues to advance, mechanical engineers will play a critical role in shaping the future of our world. By incorporating art and craft into their work, mechanical engineers can create products that are not only functional but also beautiful and user-friendly.

SIGNIFICANCE OF DESIGN FROM A CREATOR'S POINT OF CONCERN

Er. Smita Samantaray
Department of Mechanical Engineering

From a creator's perspective, design plays a crucial role in bringing their vision to life. Here are some key aspects of design that are significant to creators:

1. Expression and Identity

Design allows creators to express their unique perspective, style, and voice. It's a way to convey their message, values, and personality through their work.

2. Communication and Storytelling

Effective design helps creators communicate their ideas, tell stories, and connect with their audience. It's a powerful tool for conveying complex information in a clear and engaging way.

3. Emotional Connection

Design can evoke emotions, create empathy, and build a connection with the audience. Creators use design to craft an emotional experience that resonates with their viewers.

4. Innovation and Problem-Solving

Design thinking and problem-solving skills are essential for creators to develop innovative solutions. Design helps them approach challenges from different angles and find creative solutions.

5. Collaboration and Feedback

Design is often a collaborative process, and creators work with others to refine their ideas. Feedback from peers, mentors, and audience helps creators refine their design and improve their craft.

6. Personal Growth and Development

The design process allows creators to learn, experiment, and grow. It's an opportunity for them to develop their skills, explore new techniques, and push their creative boundaries.

7. Audience Engagement

Design helps creators engage with their audience, build a community, and foster a loyal following. Effective design can increase audience participation, sharing, and advocacy.

8. Brand Identity

Design plays a critical role in establishing a creator's brand identity. Consistent design elements, such as logos, colour schemes, and typography, help build recognition and establish their brand.

9. Monetization and Commercial Success

Well-designed products, services, or experiences can lead to commercial success and revenue generation. Creators can monetize their design skills through various channels, such as product sales, licensing, or advertising.

10. Legacy and Impact

Design can leave a lasting impact on society, culture, and the environment. Creators who prioritize design can make a meaningful contribution to the world, leaving a lasting legacy that inspires future generations.

Conclusion

In conclusion, design plays a vital role in a creator's work, serving as a means of expression, communication, and innovation. By understanding the significance of design, creators can harness its power to bring their vision to life, connect with their audience, and leave a lasting impact. Effective design can elevate a creator's work, setting them apart and contributing to their success. As the intersection of art, craft, and technology continues to evolve, the importance of design in a creator's work will only continue to grow.

ROLE OF ENGINEERING WORKSHOP FROM A PRACTICAL POINT OF CONCERN

Gudul Parida
3rd Year Student

Introduction

Engineering workshops play a crucial role in the practical development of engineering skills and knowledge. These workshops provide hands-on experience, allowing students and professionals to apply theoretical concepts to real-world problems.

Key Benefits

1. **Hands-on Experience:** Engineering workshops offer a platform for individuals to gain practical experience in various engineering disciplines.
2. **Skill Development:** Workshops help develop essential skills such as problem-solving, critical thinking, and collaboration.
3. **Innovation and Creativity:** Engineering workshops encourage innovation and creativity, allowing individuals to explore new ideas and solutions.
4. **Industry-Relevant Training:** Workshops often provide industry-relevant training, preparing individuals for the demands of the engineering profession.

Practical Applications

1. **Prototyping and Testing:** Engineering workshops enable the creation and testing of prototypes, allowing individuals to refine their designs and solutions.
2. **Project-Based Learning:** Workshops often focus on project-based learning, where individuals work on real-world projects to develop practical skills.
3. **Collaboration and Teamwork:** Engineering workshops promote collaboration and teamwork, essential skills for success in the engineering industry.

Conclusion

In conclusion, engineering workshops play a vital role in the practical development of engineering skills and knowledge. By providing hands-on experience, promoting innovation and creativity, and offering industry-relevant training, these workshops prepare individuals for success in the engineering profession.

MECHANICAL ENGINEERS' IMPACT ON SOCIETY

Subhasish Mohanty
4th Year Student

Mechanical engineers play a vital role in society building, contributing to the development of innovative solutions that improve people's lives. Here are some key ways mechanical engineers impact societies:

Improving Quality of Life

1. Designing and Developing Medical Devices: Mechanical engineers create innovative medical devices, such as prosthetics, implants, and diagnostic equipment, that improve healthcare outcomes and enhance the quality of life for individuals with disabilities or illnesses.
2. Creating Sustainable Solutions: Mechanical engineers work on developing sustainable solutions, such as renewable energy systems, sustainable buildings, and eco-friendly products, to reduce the environmental impact of human activities.

Driving Economic Growth

1. Developing New Products and Industries: Mechanical engineers contribute to the development of new products and industries, creating jobs and driving economic growth.
2. Improving Manufacturing Processes: Mechanical engineers work to improve manufacturing processes, making them more efficient, cost-effective, and environmentally friendly.

Addressing Global Challenges

1. Addressing Climate Change: Mechanical engineers play a crucial role in addressing climate change by developing sustainable solutions, such as renewable energy systems and carbon capture technologies.
2. Improving Access to Clean Water and Sanitation: Mechanical engineers work on developing solutions to improve access to clean water and sanitation, particularly in underserved communities.

Enhancing Infrastructure and Transportation

1. Designing and Developing Infrastructure: Mechanical engineers design and develop infrastructure, such as roads, bridges, and buildings, that are safe, efficient, and sustainable.
2. Improving Transportation Systems: Mechanical engineers work on improving transportation systems, such as vehicles, aircraft, and public transportation, to make them more efficient, safe, and environmentally friendly.

Supporting Advancements in Technology

1. Developing Robotics and Automation: Mechanical engineers contribute to the development of robotics and automation, which can improve manufacturing efficiency, reduce costs, and enhance product quality.

2. Creating Advanced Materials and Manufacturing Processes: Mechanical engineers work on developing advanced materials and manufacturing processes, which can lead to breakthroughs in various industries, such as aerospace, energy, and healthcare.

In summary, mechanical engineers play a vital role in society building by driving innovation, improving quality of life, supporting economic growth, addressing global challenges, enhancing infrastructure and transportation, and supporting advancements in technology. Their work has a significant impact on people's lives and the environment, making them essential contributors to the development of a more sustainable and equitable society.

TECHNICAL VS NON-TECHNICAL LIFE

Er. Sunil Lenka
Department of Mechanical Engineering

Technical Life

1. Focus on Science and Technology: A technical life often involves a strong emphasis on science, technology, engineering, and mathematics (STEM) fields.
2. Problem-Solving and Analytical Thinking: Technical individuals tend to approach problems with a logical and analytical mind-set, breaking down complex issues into manageable parts.
3. Career Paths: Technical careers might include software development, engineering, data analysis, and scientific research.

Non-Technical Life

1. Focus on Humanities and Social Sciences: A non-technical life may involve a stronger emphasis on humanities, social sciences, and arts.
2. Creative and Critical Thinking: Non-technical individuals often approach problems with a more creative and critical thinking style, considering multiple perspectives and nuances.
3. Career Paths: Non-technical careers might include writing, design, social work, and management.

Key Differences

1. Approach to Problem-Solving: Technical individuals tend to focus on logical and analytical solutions, while non-technical individuals may consider more creative and intuitive approaches.
2. Career Paths and Opportunities: Technical careers often require specialized education and training, while non-technical careers may offer more flexibility and diverse opportunities.

Interplay between Technical and Non-Technical Aspects

1. Intersection of Technology and Human Experience: Many areas, such as human-computer interaction and user experience design, require a blend of technical and non-technical skills.
2. Importance of Soft Skills: Both technical and non-technical professionals benefit from developing strong soft skills, such as communication, teamwork, and adaptability.

In summary, technical and non-technical lives differ in their focus, approach to problem-solving, and career paths. However, there is often an interplay between technical and non-technical aspects, and individuals can benefit from developing a range of skills that combine both perspectives.

TECHNICAL EDUCATION AND ITS NEGATIVE INFLUENCES

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3rd Year Student

Introduction

Technical education has become an essential part of modern society, providing individuals with the skills and knowledge necessary to succeed in a rapidly changing world. However, like any other form of education, technical education is not without its drawbacks. Despite its many benefits, technical education can also have some negative influences that can impact individuals, communities, and society as a whole. This article will explore some of the negative influences of technical education and discuss ways to mitigate these effects.

The Importance of Technical Education

Technical education has become increasingly important in today's technology-driven world. It provides individuals with the skills and knowledge necessary to succeed in a wide range of fields, from engineering and computer science to healthcare and manufacturing. Technical education can also provide individuals with a sense of purpose and direction, helping them to achieve their career goals and improve their socio-economic status.

The Negative Influences of Technical Education

Despite its many benefits, technical education can also have some negative influences. Some of the most significant negative influences of technical education include:

1. **Limited Focus on Soft Skills:** Technical education often prioritizes technical skills over soft skills, such as communication, teamwork, and problem-solving.
2. **Narrow Career Options:** Technical education can lead to narrow career options, making it challenging for individuals to transition to other fields or industries.
3. **Highly Specialized Knowledge:** Technical education can result in highly specialized knowledge, which may become out dated or obsolete quickly.
4. **Limited Emphasis on Creativity:** Technical education often focuses on rote memorization and formulaic problem-solving, which can stifle creativity and innovation.
5. **High Stress Levels:** Technical education can be highly demanding and stressful, particularly in fields like engineering or computer science.

The Impact of Technical Education on Individuals and Society

The negative influences of technical education can have a significant impact on individuals and society. Some of the most significant impacts include:

1. **Limited Career Opportunities:** The narrow focus of technical education can limit career opportunities for individuals, making it challenging for them to transition to other fields or industries.
2. **Skills Obsolescence:** The highly specialized nature of technical education can result in skills obsolescence, making it challenging for individuals to adapt to changing technologies and industries.
3. **Lack of Creativity and Innovation:** The limited emphasis on creativity and innovation in technical education can result in a lack of creative problem-solving skills, which are essential for success in many fields.
4. **Mental Health Concerns:** The high stress levels associated with technical education can lead to mental health concerns, such as anxiety and depression.

Conclusion

In conclusion, while technical education can provide individuals with valuable skills and knowledge, it also has some negative influences that should be considered. By understanding these negative influences, educators and policymakers can work to mitigate their effects and provide individuals with a more well-rounded education. This can be achieved by incorporating soft skills into technical education, encouraging interdisciplinary learning, and fostering creativity and innovation.

HIGH PERFORMANCE CONCRETE

Ashis Kumar Samal
2nd Year Student

High performance concrete provides more durability and better strength. Water cement ratio affect the workability of concrete. Increase in water cement ratio, increase the workability & slump ratio of the concrete. According to Kudar, Leman, concrete has remarkable consequence due to its availability and cost productive. As stated that concrete has not only the composition of cement, aggregate and water but it has various new consistent to overcome the construction requirements. Excessive water in concrete mixture can reduce the strength and to overcome this plasticizers are used to increase the bonding. High performance concrete has discontinuous pore structure leading to low permeability & high durability and low cost maintenance, concrete shrinks due to production of tensile stress by the loss of water. Therefore, temperature in summer can create a problem that leads to cracking & failure of structure. High performance concrete is sustainable the performance of concrete is improved by using less material & more durable with minimum maintenance cost. Fly ash & silica fume also play important role as these ingredients help in improving strength & durability and environment friendly. Furthermore mineral admixtures are waste products which cause environmental issues & health issues.

According to Fouad, the advantages of silica fume increases the bond strength & provides more resistance to chemical attack, increases abrasion resistance and reduction in permeability. According to Burkhart, now a day's using local materials, HPC may be more affordable for construction application. The literature review shows that, water-cement ratio, silica fume, plasticizers increases the strength of concrete. Concrete is the most adaptable material and can be made by using several ingredients in which ordinary Portland cement is basic. By using various technologies now a days many ingredients have been used for making concrete admixtures more workable and capable of bearing tensile and compressive strength. In recent days high performance concrete is used to increase the strength of structure. The main admixtures used in HPC are plasticisers, fly ash and silica fumes. Plasticisers are used for improving initial settlement and for improving workability. Therefore special admixtures can be used for betterment of strength, workability and reducing the period of curing and to overcome dry shrinkage. Portland cement, coarse and fine sand can be supplanted with plasticizers to quicken the quality picking up procedure of admixture and decrease the underlying setting time of cement. As per Regd, the utilization of super plasticizers allows the decrease of water to the degree up to 30 percent without decreasing usefulness as opposed to the conceivable decrease up to 15 percent on account of plasticizers.

Portland cement concrete can be supplanted with quartz and silica fume in high performance concrete to make concrete maintainable and lessen the dry shrinkage of the solid. Ordinary Portland cement contains coarse aggregate and sand, which does not fill the voids among bond and totals. These void outcomes in dry shrinkage of solid when the water concrete proportion in admixture is lessens with plasticizers to make it high performance. Dry silica exhaust is very synthetic safe, which makes them economical and decreases the CO₂ emanation. As indicated by Patel, solid blend containing 15% regular pozzolana, what's more, 15% silica fume demonstrates the best assurance in sulphates arrangement and ocean water by

holding 65% of its compressive quality. The creator likewise accepts that, superior solid two-way section with M60 evaluation concrete with W/C proportion 0.32% and 7.5% silica fume show great quality at that point strengthened bond concrete. Fly ash and silica fume helps in filling the voids between bond particles and coarse totals, which lessens the odds of dry shrinkage extensively. The dry shrinkage was seen in regular Portland bond solid, which is minor at introductory setting time however increments as solid admixture begins picking up quality with relieving period. Guneyisi expressed that supplanting Portland concrete by FA, GBFS, or MK astoundingly decreases the elite cement drying shrinkage at water concrete proportion of 0.32.

CONCLUSION

Taking everything into account, extraordinary admixtures can be utilized in common Portland concrete to streamline the functionality what's more, quality of solid, decline the relieving time frame and dry shrinkage of cement. Portland cement can be supplanted with quartz and silica fume in high performance concrete to make concrete feasible and diminish the dry shrinkage of the solid. High performance concrete is a substitution over regular Portland cement to give more solidarity to structures. Quality picking up procedure of high performance concrete can be expanded utilizing the plasticizers and super plasticizers. The bring down the water cement proportion, the higher is the quality picked up by admixture at 28days restoring period. Fly ash and silica fume are significant substitution for Portland cement concrete minerals to fill the voids between bond particles and coarse aggregate, which builds the quality of the solid and lessens the dry shrinkage disappointment. The quality picked up by superior cement in beginning setting time is more than Portland cement concrete. The super plasticizers in solid admixture decrease the water substance and increase the quality at starting setting time. High performance concrete is a urgent trade for Portland cement concrete for real building site. The toughness of the high performance concrete is longer than Portland concrete. High performance concrete gives longer life expectancy to supports, segments and slabs. The dry shrinkage of high performance concrete is lower than Portland concrete since fly ash remains fills the voids between coarse aggregate and concrete particles. So that high performance concrete can be replaced by ordinary Portland cement concrete.

DESIGN OF RCC STRUCTURE

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1-INTRODUCTION

1.1-ANALYSIS OF STRUCTURE

In design analysis of reinforced concrete (RC) members, there would be problems arising regarding how the material behaves in both tension & Compression and it can be considered in either elastic or inelastic nature are being completely neglected. (1-8). Analysis of structure is determination of the loads and their effects on physical structure with their different components. Structures that are subjected to above conditions are Buildings, Bridges, Soil Strata. These analysis has a very wide field of applications like applied mechanics, material science and applied mathematics so that it can be computed for structure deformation, different stresses, internal forces, accelerations. Analysis of structure or Structural Analysis is a key part for any Civil Engineer or Structural Engineer where he/she has to design the structure with different loadings and keeping in view the factor of safety with the structures serviceability for long time.(10).

1.2-STRUCTURAL CLASSIFICATION & LOADINGS

The classification of structure is the key combination of different structural elements with their materials. It is an essential part for any Civil Engineer to be able to classify the structure by either it's form or it's functions that should be by recognizing it's various elements which are included in that structure. The elements that comprises of forces from the materials are connecting rods, truss, beam, column it also includes cables, arch, cavity wall or channel, an angle or a frame etc.(9). Once the dimensional requirement for a structure has been defined, it is necessary to determine the loads that the structure must support. The structural design, therefore, begins with the specification of loads that act on the structure. The design load for a structure is often specified in building codes. There are two types of codes: general construction codes and design codes, engineers must comply with all the requirements of the code so that the structure remains reliable. There are two types of loads that the engineering of structures must find in the design. The first type of charges are dead charges consisting of the weights of the various structural members and the weights of any object that is permanently attached to the structure. For example, columns, beams, beams, the floor slab, ceilings, walls, windows, pipes, electrical accessories and other miscellaneous accessories. The second type of charges are live loads that vary in their magnitude and location

1.3-LIMITATIONS

Each method has notable limitations. The method of material mechanics is limited to very simple structural elements under relatively simple loading conditions. However, the structural elements and the permitted loading conditions are sufficient to solve many useful engineering problems. The theory of elasticity allows the solution of structural elements of general geometry in general load conditions, in principle. The analytical solution, however, is limited to relatively simple cases. The solution of elasticity problems also requires the solution of a

system of partial differential equations, which is considerably more mathematically demanding than the solution of problems of the mechanics of materials, which require at most the solution of a common differential equation. The finite element method is perhaps the most restrictive and most useful at the same time. This method itself is based on other structural theories (like the other two that are analyzed here) to solve equations.

2-CASE STUDY ON STRUCTURAL ANALYSIS METHODS

The simplest of the 3 methods discussed below:

2.1-CLASSICAL METHOD

The method of material mechanics is available for simple structural elements subject to specific loads, such as axially loaded bars, prismatic beams in pure bending state and circular axes subject to torsion. The solutions can be superimposed under certain conditions using the superposition principle to analyze a member that is in a combined charge. There are solutions for special cases for common structures, such as thin-walled pressure vessels. For the analysis of complete systems, this approach can be used together with the static ones, giving rise to the method of the sections and to the method of the junctions for the truss analysis, the moment distribution method for small rigid frames and the framework of the portal and Cantilever method for large rigid frames. Except for the moment distribution, which came into use in the 1930s, these methods were developed in their current forms in the second half of the nineteenth century.

2.2-ELASTICITY METHOD

Elasticity methods are generally available for an elastic solid of any shape. You can model individual members, such as beams, columns, axes, plates and casings. The solutions are derived from the linear elasticity equations. The elasticity equations are a system of 15 partial differential equations. Due to the nature of the mathematics involved, analytical solutions can only be produced for relatively simple geometries. For complex geometries, a numerical solution method is required as a finite element method.

2.3-ANALITICAL METHOD

To perform a precise analysis, a structural engineer must determine information such as structural loads, geometry, support conditions and material properties. The results of this analysis typically include support reactions, stresses and displacements. This information is compared with the criteria that indicate the failure conditions. Advanced structural analysis can examine the dynamic response, stability and nonlinear behavior. There are three approaches to analysis: the mechanics of materials approach (also known as material resistance), the elasticity theory approach (which is actually a special case of the more general field of continuity mechanics) and the finite element approach. The first two make use of analytical formulations that mostly apply simple linear elastic models, which lead to closed-form solutions, and which can often be solved by hand. The finite element approach is actually a numerical method to solve differential equations generated by theories of mechanics such as the theory of elasticity and the resistance of materials. However, the finite element method depends to a large extent on the processing power of computers and is more applicable to structures of arbitrary size and complexity. [11] Regardless of the approach, the formulation is based on the same three fundamental relationships: equilibrium, constitutive and compatibility. The solutions are

approximate when any of these relations are only satisfied approximately, or only an approximation of reality.

2.4-SAFETY PROVISION

The load factors are applied to the loads and a member that will have enough force to resist the factored loads is selected. In addition, the theoretical strength of the limb is reduced by the application of a resistance factor. The criterion that must be fulfilled in the selection of a member is the Factual Force \geq Factual Charge. The factored load is actually the sum of all the workloads that the member must support, each multiplied by its own load factor. For example, dead loads will have load factors that are different from those of live loads. The factorized force is the theoretical force multiplied by a force reduction factor. Therefore, it can be written as Nominal strength reduction factor \times force \geq Load factors \times load. Since the factored load is a failure load greater than the actual work load, the load of factors is generally greater than unity.

2.5-DESIGN OF STRENGTH

The strength of a particular structural unit calculated using the currently established procedures is called "nominal resistance". For example, in the case of a beam, the moment resistance capacity of the section calculated using the equilibrium equations and the properties of concrete and steel is called the "nominal momentum capacity" of the section.

The purpose of the force reduction factor f is:

- ✓ to allow members with little resistance due to variations in the strengths and dimensions of the material
- ✓ Allow inaccuracies in the design provisions.
- ✓ to reflect the degree of ductility and the required probability of the member under the load effects considered
- ✓ Reflect the importance of the member in the structure.

2.6-ALLOWABLE STRESSES DESIGN

- As an alternative to the resistance design method, the members can be provided so that the stresses in the steel and concrete resulting from the normal service loads are within the specified limits (a permissible or permissible voltage or load). These limits, known as allowable stresses, are only fractions of the material's fault voltages. The allowed voltage design is also known as "working voltage design".
- For example, in the design of steel structures, this allowable stress will be in the elastic range of the material and will be less than the yield stress F_y . A typical value could be $0.60F_y$. The permitted tension is obtained by dividing the yield stress F_y or the tensile strength F_u by a factor of safety. This design approach is also called elastic design or work stress design. The work voltages are those due to the workloads, which are the loads applied. A properly designed member will not be subject to more effort than the effort allowed when subjected to workloads. The work stress method can be expressed as follows:

Permissible stresses (f)

$$f \leq (1.2)$$

where:

f = An elastic tension calculated, for example, using the bending formula

$$f = M/I \text{ for beam.}$$

' f ' allow = A limit stress prescribed by a building code as a percentage of the compressive strength c_f for concrete, or of the yield stress, and f for steel reinforcing bars.

CONCLUSION

In this topic, we discuss the different loads that are being applied in any structure and the provision of security that is provided in accordance with the codes. The service capacity of the structure is the most important aspect for any civil engineer. The design must be such that it meets all the basic requirements for those problems due to which a structure reaches a failure stage before the time period is granted. The charges are needed to tell where and how the charges come and what are the different procedures adopted to calculate and counteract those charges. The main issue that is a major concern is the Security Factor, it is the part of the calculation where a structure is taken for additional loads in its service capacity and then they are designed.

GREEN CONCRETE IN MODERN TECHNOLOGY

Sanju Naik
4th Year Student

1-INTRODUCTION-

The color has nothing to do with green concrete. It is a concept of thinking environment in all aspects of raw materials. Manufacture on construction, mix of design to structural design and durability. Green concrete is very often considered be inexpensive to produce due to the use of recycled material so waste disposal costs are avoided, less energy consumption and greater durability. The buildings in which we live and work have a tremendous impact on our global environment. Sustainability or 'green building' seeks to balance the efficiency of resources, health and social concerns throughout the life cycle of a structure. Green Concrete has a variety of benefits to offer to achieve this goal. Cement is a gray powder that, when mixed with water, binds sand and stone to create concrete. Concrete is the most abundant construction material in the world, which is extremely resistant and durable. The longevity of concrete means less maintenance and replacement compared to other construction products. This contributes to the environmental value of this versatile construction material. More than six billion tons of concrete are produced annually-about one ton per person on the planet. Concrete is made from cement, water, sand and gravel. The cement is made by heating raw materials such as limestone and clay to very high temperatures until they chemically react.

2.1- GREEN CONCRETE

For today, Green Concrete means ecological concrete. During the concrete production phases, green concrete is another name for concrete that saves resources. Concrete that has a reduced environmental impact with respect to energy consumption and emissions in its manufacture, and the amount of CO₂ and other greenhouse gases generated. Green concrete can often also be less expensive to produce, because waste products are used as a partial substitute for cement, landfill taxes are avoided, energy consumption is reduced in production and durability is improved. In this way, in terms of conservation of resources and energy, green concrete has become very successful. In the production of "green" concrete, it contains at least 20 percent fly ash, a waste product from power plants that burn coal; Its production produces less CO₂ emissions. In addition, concrete can also be mixed with blast furnace slag, silica fume or recycled crushed concrete, giving manufacturers more environmentally friendly options.

2.2- SUSTAINABLE CONSTRUCTION

Sustainable constructions are those constructions which are concern with the minimizing of environmental impact, while optimizing it economically capability. Normal concrete are usually produce with the poor quality which results in a corrosion of reinforced concrete, alkali aggregate reaction, sulphate attack etc. The demolition and disposal of concrete structures, pavements, etc., contributes to the solid waste disposal problem, and concrete constitutes the largest single component. Lastly, requirement of water is so high that the concrete industry uses over one trillion gallon of water each year globally without including wash water and curing water, which becomes a problem in those region where the fresh water is not easily available. The above mention points seem to indicate that the concrete industry has become a victim of its own success and therefore is now faced with tremendous challenges but the scenario is not as bad as it might seem, because concrete is inherently an

environmentally friendly material, as can be demonstrated readily with study of life-cycle . The challenges, therefore lies in primarily to reduce impact of Portland cement's on the environment. It means, we should use as much as concrete yet with as little Portland cement as possible.

2.3- GREEN CONCRETE FOR SUSTAINABLE CONSTRUCTION

The turnout of the construction industry, in any infrastructure like public and commercial building has a major drawback on our ability to maintain a sustainable economy overall and has a major burden on our environment. Furthermore, it is clear that we cannot have a sustainable construction without bringing changes in the concrete technology as it is a major technology that is used by the construction industry. This paper will discuss how the green concrete would be able to achieve sustainable construction. Conventional concrete with well-known advantages has made huge popularity and is widely used material by the construction industry. Yet this popularity of concrete comes with huge impact on environment as well as making the construction unsustainable. More than 5 billion cubic yards of concrete are produced globally. Such quantity require huge amount of natural resources for the aggregate and cement production. Cement is one of the major components of the concrete and contributes to the urban heat island effect when used in concrete. The production of one ton of cement releases one ton of CO₂ into the atmosphere.

2.4- TOOLS AND STRATEGIES

- There are number of strategies whereby green concrete can help in achieving the sustainable construction:
- Increased dependence on recycled materials: Effective use of recycle material can help in reducing the dependence on virgin material.
- Effective use of supplementary cementations material: Partial replacement of cement can be done by the by products of industrial processes, such as fly ash and slag as the production of Portland of cement is responsible for generation of CO₂ and huge energy is consumed.
- Improved mechanical properties: Proper use of recycle material can help in improving the mechanical properties.
- Reuse of wash water: The recycling of wash water can be seen practice by the most of the construction industry and required by law in some countries.
- The above mention points clearly indicate that there are means to achieve sustainable construction with the help of green concrete. The means will be discussed in detailed under the following points.

3.1- GEO-POLYMER CONCRETE

An interesting new innovation in concrete is the use of a variety of geo-polymers. These materials can be combined with materials such as ground granulated slag, fly ash and natural pozzolanas, to produce concrete without the need to use Portland cement. It is said that the materials are strong and durable. It has been found that the geopolymers has a high resistance to acid attack. In addition, the concrete exhibits an expansion of zero alkaline aggregates, which is an important property in areas with potentially reactive aggregates. However, one of the main advantages of some types of geopolymers concrete is its greatly improved fire resistance compared to traditional Portland cement concretes. The

geopolymer concretes produce only about 7% of the carbon dioxide generated in the production of traditional OPC concretes, which gives the material the possibility of obtaining valuable carbon credits.

3.2-FLY-ASH

The use of fly ash has a number of advantages. In theory, it is possible to replace 100% of Portland cement with fly ash, but replacement levels above 80% generally require a chemical activator. In addition, fly ash can improve Properties of concrete, such as strength. Since it generates less heat of hydration, it is particularly suitable for dough Concrete applications Fly ash is also widely available, that is, where coal is burned. Another advantage is the fact that fly ash is even less expensive than Portland cement. Perhaps most importantly, since a byproduct of coal burning fly ash would be a waste product that will be disposed of at a high cost, if we do not make good use of it. By using its cementations properties of fly ash, we are making better use of its value.

3.3-GROUND GRANULATED BLAST-FURNACE SLAG

The use of granulated blast furnace slag in concrete has increased considerably in recent years, and this trend is expected to continue. However, the world production of granulated blast furnace slag is about 25 million tons per year. However, slag is not as available as fly ash. In general, the comparison of ground granulated blast furnace slag (GGBFS) with Portland cement concrete can be summarized as follows:

- ✓ Concrete with IS type cement (Pozzolana cement) or with higher doses of GGBFS added to the mixer will generally have a lower heat of hydration.
- ✓ Concrete containing slag may show a somewhat longer setting time than straight Portland cement mixtures, especially for moderate and high doses and at lower ambient temperatures.
- ✓ Concrete with IS type cement strengthens more slowly, tending to have a lower resistance at early ages and the same or Greater strength in later ages.

CONCLUSION

Do not forget to achieve sustainable construction. There are several means to achieve sustainable construction and one of the means is through green concrete. Green concrete technology is one of the main steps that a construction industry can implement to achieve sustainable construction with various means, as explained above. With green concrete technology, we can store natural materials for future use or future generations and keep them for a good amount of time. Over time, the virgin material will be exhausted and, therefore, the cost of the material will increase, which will increase the cost of construction, but if we use waste materials for construction, the virgin materials will become a sustainable material and In addition, the cost will be higher. reduced.

DESIGN OF HYBRID ELECTRIC VEHICLE

Amit Kumar Behera
3rd Year Student

I. INTRODUCTION

Gasoline and diesel has been considered as the main resource of fuel for combustion engine vehicles. With the excess use of these fuels it has started showing its negative impact on the ecosystem. Global warming, climate changes are some of its bad effects. Therefore the 21st century researchers and scientists are bound to find an alternate solution for automotive sector due to growing adverse effect on nature.

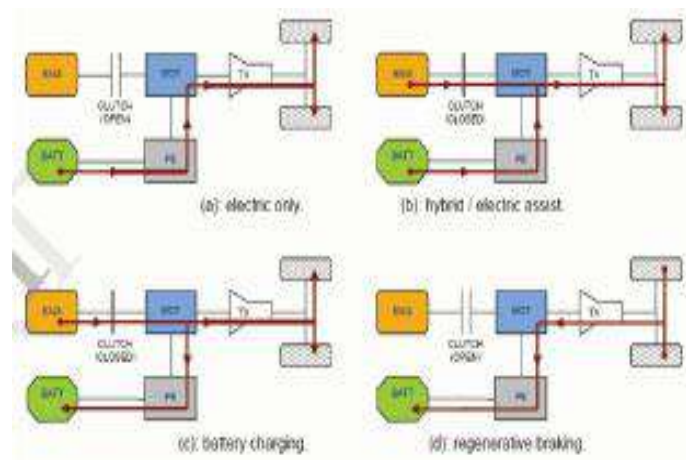


Fig.1.1 Working Principle of Hybrid Vehicle

1.1 ELECTRIC CAR CONVERSION FOR SALE

Maintaining a gasoline or petroleum powered automobile is a highly costly matter. Nowadays researchers have come up with a new technique called electric car conversion in which gasoline powered automobile can be converted into electric car by the use of rechargeable batteries. The only thing one has to do is charging the batteries which are quite cheaper and easier. Now instead of going for new electric cars, the fuel powered cars can be converted into electric cars by the electric car conversion kits which are readily available in markets. These come in two variants which are either DC motor or AC motor powered in nature.

1.2 HYBRID ELECTRIC VEHICLE

Hybrid electric vehicle is a type of hybrid vehicle which combines the internal combustion engine of a conventional vehicle and a high voltage battery and electric motor of an electric vehicle. It can be said that it combines the use of mechanical drive train and electric vehicle.

A mechanical drive consists of a fuel tank, combustion engine, gear box and transmission to the wheels. An electric drive consists of a battery, electric motor, power electronics for control. HEV basically consist of energy storage system, power unit and a vehicle

propulsion system. HEVs can attain twice the fuel economy than the conventional vehicles as well as offer environmental benefits.

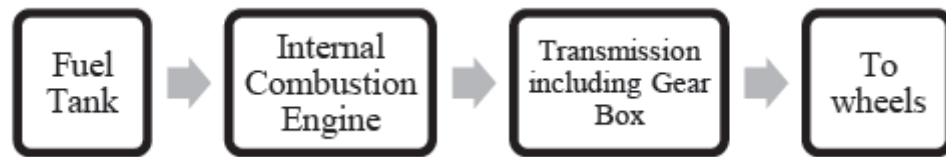


Fig 1.2 Flow of energy through mechanical drive

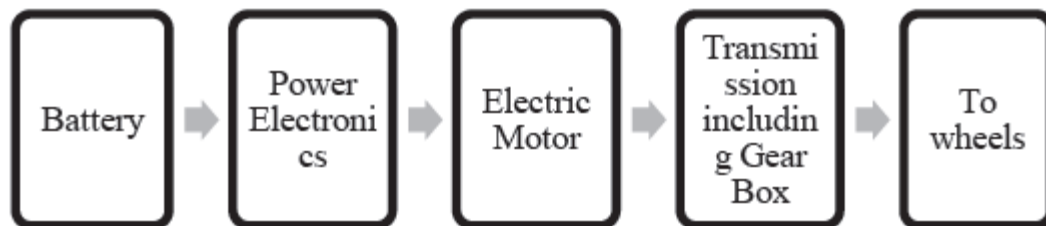


Figure 1.Flow of energy through electrical drive

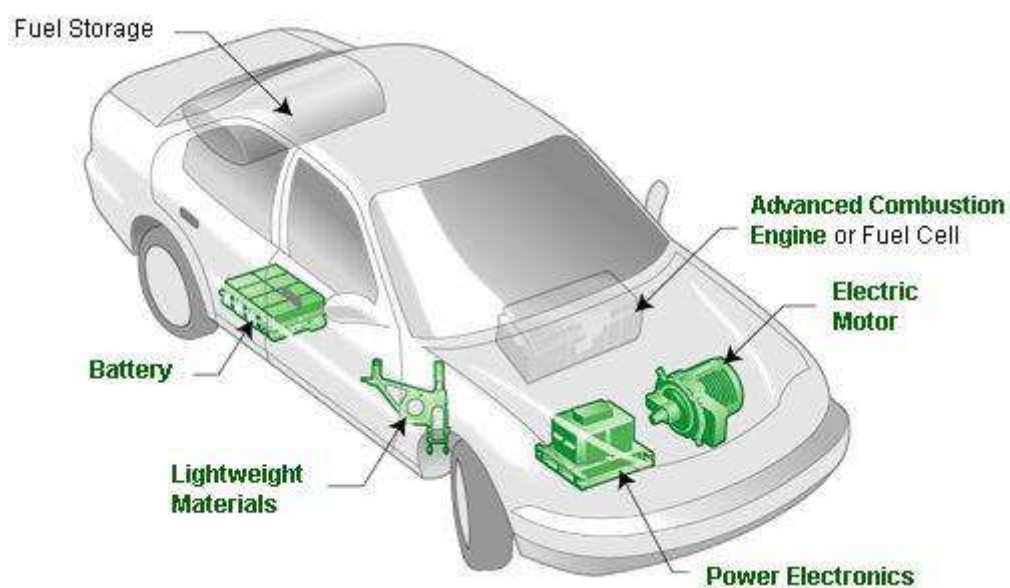


Figure 1.4 Schematic diagram of a hybrid electric vehicle

Advantages of HEV

- Because of regenerative braking HEVs has greater operating efficiency.
- HEVs have lighter engine
- It has greater fuel efficiency
- It has cleaner operation
- It is a light weighted vehicle.

II. POWER ELECTRONICS FOR HEV USING ANSYS

Thermal performance of the power electronics design can be increased by extracting the thermal network of the power electronics enclosure. The modeling can be done from the detailed information using the ANSYS software. It results in the formation of robust electro thermal simulations of the power electronic systems. These models also result other advantages I terms of performance battery systems incorporating mechanical components from finite element analysis and including frequency dependent magnetic models in the system simulation. Extraction of calculated impedances in power electronic system simulations using CFD simulation helps designers to increase power ratings. There is a flexible platform which provides the designer with the schematic view of the simulations. In one sentence it can be said that these new simulation technologies are useful to find out every aspect of the design can be easily found and accurate.

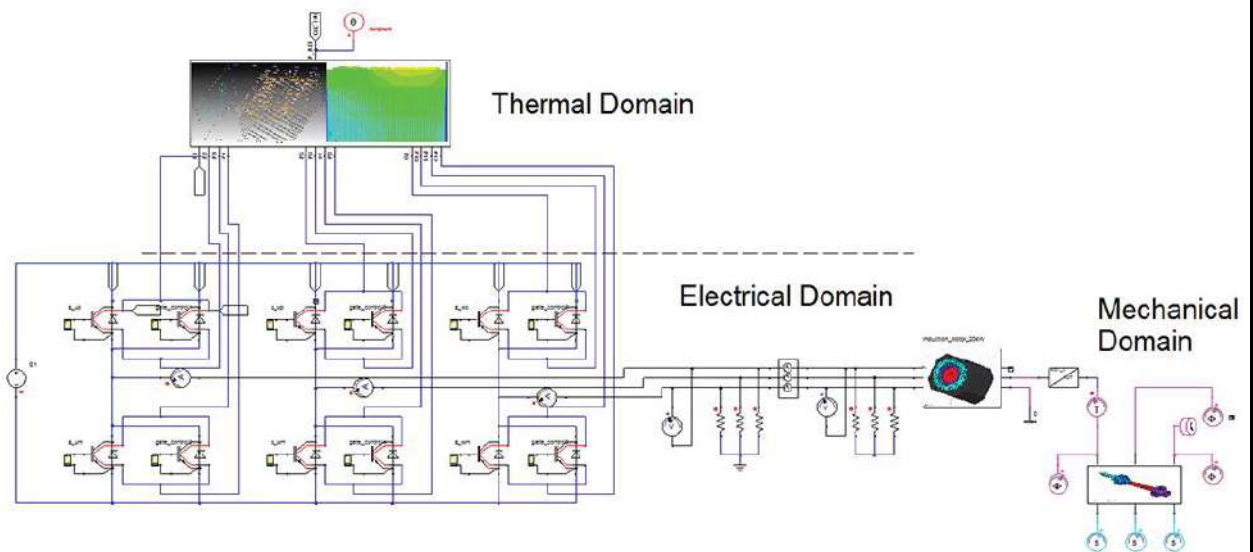


Figure 1.5. System simulation example of inverter, coupled with ANSYS® Icepack® thermal model, electric machine model and reduced-order model shaft

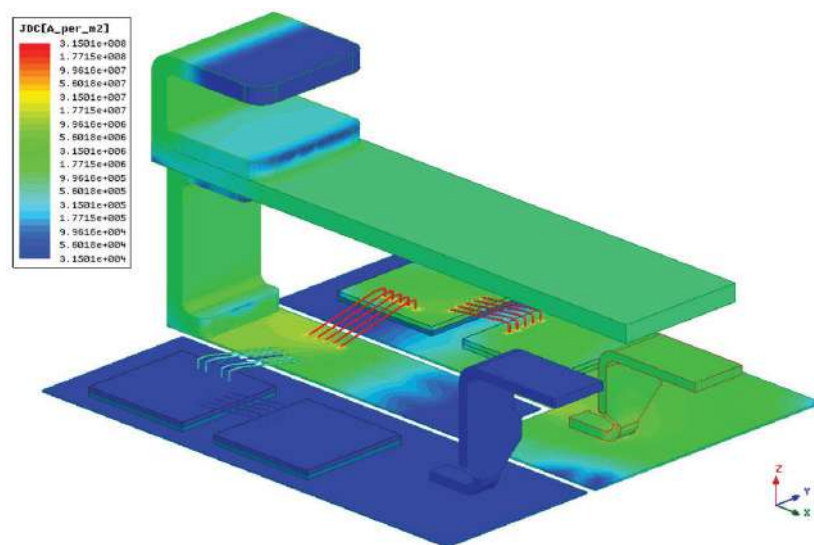


Figure 1.6 Single phase of IGBT leg showing current density

III.CONCLUSION

HEVs have several advantages over conventional cars including less consumption of energy, smog emission is eliminated, offers more mileage, acoustic pollution and carbon dioxide emission is reduced. However HEVs are very expensive as well as complex in construction, offer larger repairing costs and capacity of batteries is also not satisfactory. Hence for these demerits are to be overcome, future strategies are to be implemented soon for the successful development of HEVs.

Concrete Technology Functioning via Nanotechnology

Prasnjit Rout
4th Year Student

Introduction

To fulfill the needs of society toward housing and infrastructure in sustainable manner is a most important challenge for concrete industry today. There are some major factors which are affect sustainability. The factors are

- In different parts of the world extreme weather condition are occurring which are mostly responsible for the high emission rates of green house gases, primarily carbon dioxide, environmental concentrations which has increased from 280-370 parts per million. The Portland cement industry and the transportation industry are mainly produces carbon dioxide which affect the sustainable concrete technology.
- The concrete industry is the largest consumer of virgin materials such as sand, gravel, crushed rock, and fresh water. It is consuming portland and modified portland cements at an annual rate of about 1.6 billion metric tons. The cement production consumes vast amounts of limestone and clay besides being energy-intensive[1].
- Achieving a dramatic improvement in resource productivity through durability enhancement of products is, of course, a long-term solution for sustainable development. A short-term strategy that must be pursued simultaneously is to practice industrial ecology at a larger scale than is the case today. Simply defined, the practice of industrial ecology by a manufacturing industry involves the reclamation and re-use of its own waste products and, to the extent possible, the waste products of other industries which are unable to recycle them in their own manufacturing process[1].

What is Concrete?

Concrete is made up of three basic components that are water, aggregate (rocks, sand or gravels) and Portland cement. Cement is a component of concrete which is in powder form and act like a binding component. We can say that concrete is the most popular artificial material. It is in everywhere at road, houses, bridges, buildings, pipes, dams, etc. When cement mixed with water its result is a paste which is used to binding all other ingredients in concrete together. When aggregate are added with cement then its gives a new product i.e. either Mortar or Concrete (if fine aggregate added then MORTAR & if coarse aggregate added then CONCRETE) [6].

What is Nanotechnology?

Nanotechnology is science, engineering, and technology conducted at the Nano scale, which is about 1 to 100 nanometers. Nano science and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering[2]. We also say that nanotechnology is a technique towards fabrication of devices or materials with atomic or molecular scale precision[8].

What is Nano-Concrete?

S. Yuvaraj at all Nano-concrete is defined as “A concrete made with Portland cement particles that are less than 500 Nano-meters as the cementing agent. Currently cement particle sizes ranges from a few Nano-meters to a maximum of about 100 micro meters. In the case of micro-cement the average particle size is reduced to 5 micro meters. An order of magnitude reduction is needed to produce Nano-cement. The SEM image of the Nano silica we had taken for our investigation is shown in Fig.1 below[3,4]

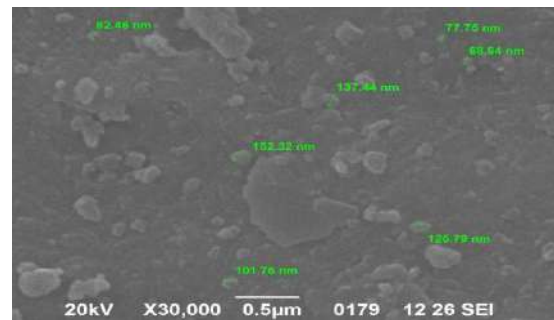


Fig.1 The

SEM image of Nano silica

High-Performance Concrete

P.Kumar Mehta What is high-performance concrete? According to a recent paper by what was known as high-strength concrete in the late 1970s is now referred to as high-performance concrete (HPC) because it has been found to be much more than simply stronger. ACI defines HPC as a specially engineered concrete, one or more specific characteristics of which have been enhanced through the selection of component materials and mix proportions. Note that this definition does not cover a single product but a family of high-tech concrete products whose properties have been tailored to meet specific engineering needs, such as high workability, very-high early strength (e.g. 30-40 MPa compressive strength in 24 hours), high toughness, and high durability to exposure conditions.

Implementation of Nanotechnology in Concrete Technology

Feldman R.F. at all Taking advantage of nanostructure characterization tools and materials, the optimal use of nano silica will create a new concrete mixture that will result in long lasting concrete structures in the future. Generally, concrete is two phase system with cement paste and aggregate, but the aggregates are inert in nature. The hydrated cement paste is composed of capillary pores and the hydration product - 'gel' pores, C-S-H, CH, Aft [Ettringite], AFm [Monosulfates] etc and one third of the pore space is comprised of gel pores and the rest are capillary pores. There are various indications that confirm the layered nature of C-S-H. Study conducted by Feldman and Sereda indicated that the cement paste inflow increases as water is removed until a point, at which the flow decrease. This point is the indication of a possible collapse in the nano-structure of hydration products and the C-S-H that is produced during the hydration of Portland cement has the microstructure as shown in Fig.2[3,5,7]

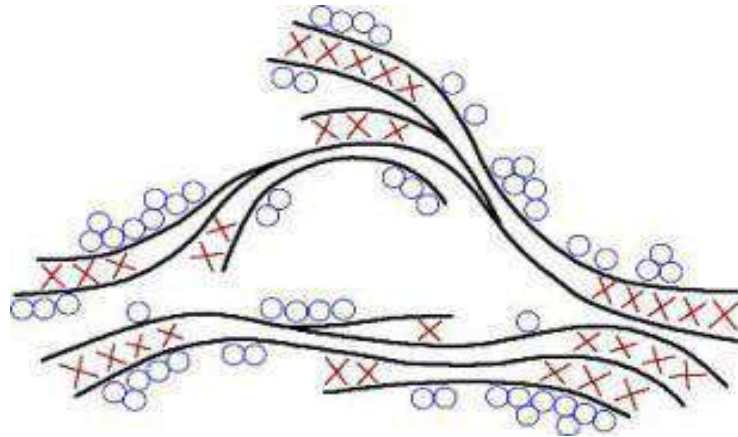


Fig.2 Feldman-Sereda model for the microstructure of C-S-H Black lines: C-S-H sheet, Circles: Adsorbed water, Crosses: Interlayer water

Table-1^[SEP] Ranges of pore sizes in concrete

Item	Size
Interparticle spacing between CSH sheets	1-4 nm
Capillary voids	10-1000 nm (0.01- μm)
Hexagonal crystals of $\text{Ca}(\text{OH})_2$	0.7 - 3 μm
Aggregation of CSH particles	0.7 - 3 μm
Entrained air bubbles	60-1000 μm (0.06-1 mm)
Entrapped air voids	1-5 mm

Table-1 depicts the relative sizes of pores in concrete. At one end of the scale are entrapped air voids, while on the lower extreme are the inter-particle spaces between sheets of C-S-H.

According to the above model of C-S-H, the cement paste is mostly having the gel pores, capillary pores, interlayer water etc. At the same time, in the concrete, there is an ITZ between the cement paste and aggregates, which is a weak link in the concrete usually the site of first occurrence of cracking. Therefore, avenues are available for further research towards the generation of crack free concrete with the possible incorporation of NS towards the promotion of cement hydration with high reactivity in the locations discussed earlier, with enhancement of the delay in development of micro crack, pore filling effect, creation of strong bond between the aggregates and cement paste and / or C-S-H.

Conclusion

The above paper describe about the implementation of nanotechnology in concrete. Considerably improvement of the property of permeability. Throughout the world, the waste disposal costs have escalated greatly. At the same time, the concrete construction industry has realized that coal fly ash is relatively inexpensive and widely available by-product that can be used for partial cement replacement to achieve excellent workability in fresh concrete mixtures. There are so many reasons that the construction in civil engineering are not sustainable. Because it consumes huge quantities of virgin materials.

Natural Convection Energy Shift through Vertical Cylinder

Chittaranjan Das
2nd Year Student

Natural convection heat transfer has constantly of particular interest among heat transfer problems. In natural convection, fluid action is caused by natural means such as buoyancy due to density variations resulting from temperature distribution. Natural convection plays vital role in heat transfer in case of many applications such as electrical components transmission lines, heat exchangers and many other places. Many experimental studies have been performed during the last three decades and interesting results have been presented. Cengel discussed the natural convection phenomenon in case of vertical cylinder and governing equations to determine heat transfer coefficient. Davidson studied the natural convection phenomenon in vertical shell and tube also the effect of different inlet conditions and geometrical dimensions on the developed thermal and velocity border layers. Also it was shown that the larger the inlet velocity, the larger the Nusselt number. Especially near the transition region this difference is large and gradually vanishes in the fully turbulent region. Crane studied the natural convection over the vertical cylinder at very large Prandtl number and discussed how, high Prandtl number affect free convection through vertical cylinder. C.O.Popie Studied the effect of curvature of the cylinder where the thickness of border layer is considerable i.e. thicker.

Also some result of calculations of border layer using customized integral method is obtained. Hari studied numerically unsteady natural convection of air and the effect of changeable viscosity over an isothermal vertical cylinder and concluded that as the viscosity increases the temperature and skin friction coefficient increases, while velocity near the wall and Nusselt number decrease. Ganesanet presented numerical solution for transient natural convection over the vertical cylinder under the merge buoyancy effect, also it is observed that time taken to reach steady state increases with Schmidt number and decreases as merge buoyancy ratio parameter increases. A. Shiite studied investigational analysis of natural convection in near wall region of vertical cylinder and measured the mean and turbulence quantities in the near wall region, where the varying thermal properties also affect the flow due to the strong temperature gradient there. A new set of border layer equations are established to represent the variable properties of the flow in this region. This experimental investigation also reveals that the strong temperature gradients adversely affect both the steady and unsteady temperature results because of the conduction. Mohammed studied mixed convection heat transfer inside a vertical circular cylinder for upward and downward flows, for hydro-dynamically fully developed and thermally developing laminar air flow under constant wall heat flux boundary conditions. The results show that the surface temperature values for downward flow were upper than that for upward flow but it was lower than that for horizontal cylinder. Wojthowak studied experimentally the laminar free convective average heat transfer in air from isothermal vertical slender cylinder having circular cross-section using a transient technique. The present experiment of natural convection through the vertical cylinder of brass having specific dimensions gives the study of temperature distribution along the length of cylinder. To measure temperature, at different stage the thermocouples are fitted. The average heat transfer coefficient and local heat transfer coefficient are estimated using energy balance in the system and the same are found out by using appropriate governing equations. The result indicate the

variation of heat transfer coefficient with the length of cylinder and this results are compared for both practically determined and theoretically evaluated heat transfer coefficient.

CONCLUSION

The heat transfer coefficient is having maximum value at the beginning because starting of development of border layer i.e. thin layer and decrease in upward direction due to thickening of border layer. This trend is maintained nearly up to half length and beyond this there is little variation in the value of local heat transfer coefficient because of the presence of transition and turbulent border layers. The last point shows somewhat increase in the value which is attributed to end loss causing a temperature drop.

BIO-FUEL- AN ALTERNATIVE ENERGY SOURCE IN THE CURRENT SOCIETY

Himanshu Dwivedi
4th Year Student

1.INTRODUCTION

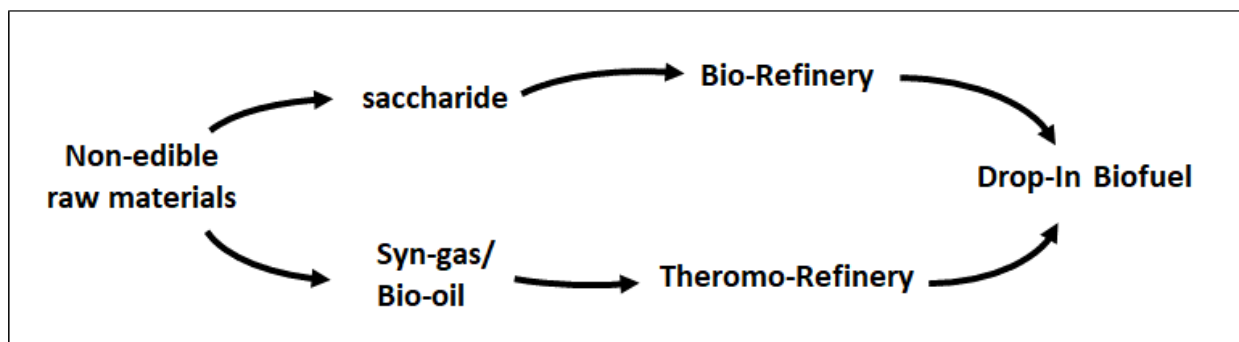
The thoughtless use of fossil fuel is causing numerous problems, such as the depletion of fossil fuel, Increase in the price of oil and air pollution. In particular, 27% of the main sources of energy are used worldwide to Transport and fossil fuels are mainly used as transportation fuel. The exhaust gas Fossil fuel is the key pollutant of the greenhouse gas that causes global warming. And the exhaust gas resulting from the combustion of said fossil fuel generates substances to human health. For the NO_x and PM that are the main exhaust gases, the emission standard has been strengthened in phases from EURO 1 (enforced in 1993) to EURO 6(enforces in 2014).EURO 6 is the highest level of exhaust gas control between the EURO controls applied previously, and the NO_x and PM controls have been strengthened to 80% and 60% of the Immediately before the control of EURO 5 respectively. New policies that support the dissemination of Many countries in the world have announced alternative fuels friendly to the environment.to overcome the limit of fossil fuels while solving the problems of global warming and environmental pollution. The biofuel that receives attention as a clean alternative energy source is more used as transport fuel due to its environmentally friendly characteristic. Biofuel can replace fossil fuel without causing a major change in the existing supply base and It can also substantially reduce the emission of environmental pollutants. On the other hand, high oil The price that continues recently makes that the countries that want to rescue the dependency of the oil of the Middle East enforces a policy of expansion of supply and support for Biofuel addition, as the concentration of ultra-fine dust in Korea caused by car exhaust the gas is at a very serious level, the government has applied the Operation of Polluting Vehicles Control system in old diesel vehicles according to "Emergency measures to reduce the fine Powder', and is programmed to gradually expand to other areas. According to the "First Annual report on Global Air announced by 'HEI (Health Effect Institute)', a private of EE. Environmental health organization, the annual average concentration of ultra-fine dust in Korea in the weight of the population that is reflected has increased from 26 (1 microgram per air) in 1990 to 2015. Following the promotion of the policies at home and abroad that make use of new renewable energy mandatory, use of bioenergy of which the percentage is the highest next to waste energy (67.7 % in 2012) among the total new renewable energy supply is planned to gradually increase. In this study, we intend to introduce the trends of studies carried out at home and abroad to solve such issues and the technologies related to the engines that exclusively use biofuel.

2. ADVANCED TREND OF BIOFUEL R&D

2.1. Utilization of unutilised raw materials:-

From the point of view of the raw material, as all existing biofuels use the grain as a raw material, all biofuels made from non-edible biomass are included in next-generation biofuels. Representative examples of said non-edible biomass include cellulose and marine algae. The process of manufacturing biofuels from non-edible raw materials can be divided into biological technology and thermochemical technology. As shown in Figure 1, when sugar is extracted

from biomass, microbes can convert it into fuel. Biofuel or synthetic gas can be manufactured by pyrolysis of lignocellulose materials in an oxygen-poor condition, and said intermediate can also be converted to biofuel through the conversion process using a chemical catalyst.



2.2. Marine algae used as raw materials

As the perception that not only limited land, but also the sea should be used to deal with the demand for bioenergy that will increase rapidly in the future, studies proliferate. Trying to mass produce marine biomass for use in the production of biofuels are also actively done. Unlike lignocellulose, which is a really existing biomass resource, in the case of marine biomass, it is found that the uncertainty about the acquisition of resources is an obstacle. In the case of microalgae being particularly revised as promising species among marine biomass, although there are autotrophic crops for which the source of energy is sunlight and heterotrophic culture for which the energy source is organic carbon, as stable supply of Organic carbon can be difficult in the case of a mass production process, studies on the development of autotrophic culture technology has been more invigorated. However, as the efficiency of use of sunlight, which is the main source of energy, falls rapidly when the reactor volume increases, no mass production technology has yet been developed. In addition, in the case of microalgae, a lot of energy is consumed for biomass harvesting. With existing technology because the cell density of the culture medium is very low Showing a value not higher than 2g / l, microalgae collection and enrichment technologies. More efficiently they are required to be developed. As not only a source of light, CO₂ and water, but also different nutrient salts are also required, such as nitrogen, phosphorus, etc. for the growth of microalgae, such nutrient salts must be added to the culture medium when they are grown microalgae As the nutritive salts added at this time have a direct effect on the production unit. The price of biodiesel, the unit price of the microalgae culture can be reduced if it is low Nourishing salts are added.

2.3. Properties of Biofuel being increased

The mixed use of bioethanol and biodiesel, which are the biofuels that are currently supplied, is allowed. Only at a very limited concentration due to the difference in material properties of those of petroleum-based fuel. Bioethanol and biodiesel can be mixed in the Concentration of maximum 10% and 7% respectively. For the mixture of high biofuel content, the improvement of biofuel properties is important. The key in said improvement of material. The properties are the de-oxidation, the elimination of the oxygen contained in the biofuel. The processes reviewed for de-oxidation include hydrogenation carried out with added hydrogen and decarboxylation It is carried out without adding hydrogen. Although hydro DE oxygenation has an advantage that you can increase the yield, you have the problem that the hydrogen must be supplied from the outside and, Although decarboxylation does not require an external source of hydrogen supply, it has a problem that the yield of the biofuel diminishes due to the loss of carbon. Consequently, if there are no large quantity available hydrogen supply source, de

oxidation technology by decarboxylation it is required to be applied. Regarding biofuels with improved material properties, only hydro treatment the bio-diesel (HBD) has been commercialized.

2.4. Carbon Dioxide Reduction Efficiency:-

In addition to the problem that the biofuels that are currently supplied are made of grain, many There are controversies about its CO₂ reducing effect. In the case of ethanol produced from corn. Of which the quantity actually supplied is the largest, it is informed through an LCA that It really exacerbates the problem of global warming because it generates 3% more CO₂ than gasoline It does so if the process fuel is used as coal. If the by-products generated in the corn plantations. Are used as a source of energy, it is shown that the rate of reduction of CO₂ can be increased in around 50% maximum.

3. ADVANCED BIOFUEL ISSUE:-

The unthinking use of fossil fuel causes numerous problems, such as the depletion of fossil fuel and oil. Increase in prices, etc., and new policies have been announced in many countries of the world that support the diffusion of alternative fuels friendly to the environment to overcome the fossil limit Fuels while solving the problems of global warming and environmental pollution. Thus, Biodiesel, which receives attention as a clean alternative energy source, is used more actively.as fuel for translation. Biodiesel can replace fossil fuel without causing a major change in the existing supply base and can also substantially reduce the emission of In addition, the high price of oil that continues recently makes countries that want rescue from the dependence on Middle Eastern oil to enforce an expansion policy Supply and support of biofuels. Though production of catalyst and C₅, C₆ fermentation were carried out by a different strain respectively in the case of lignocellulose ethanol manufacturing process in the past, studies are carried out recently to lower the ethanol manufacturing cost by simplifying the manufacturing process of lignocellulose ethanol through development of a customized strain that contains each and every gene related to fermentation.

4. BIOFUEL ENGINE:-

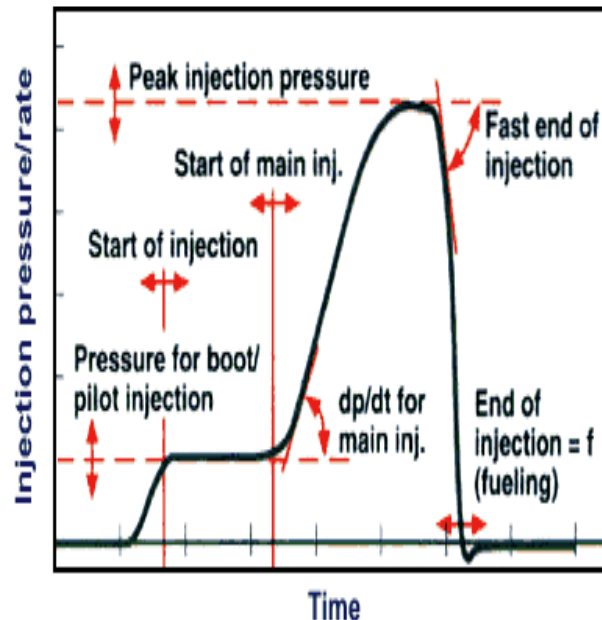
4.1. SI engine:-

The representative biofuel used for SI engine is ethanol and ethanol is used as mixed fuels of various forms rather than being used as pure ethanol. Up to 10 % ethanol is already used for the gasoline supplied in the market, and technology is being developed in the form of a leaded fuel car that can use up to E85 (mixture of 85 % ethanol and 15 % gasoline in volume ratio) in the form of a full-scale alternative fuel. Ethanol mixed fuels emit less volatile materials and carbon mono-oxide than gasoline does and emission of harmful materials such as benzene can be reduced considerably. On the other hand, it is known that emission of a toxic pollutant such as acetaldehyde increases. The US government positively recommend use of leaded fuel cars and recycled fuels by granting tax benefits to the users of leaded fuel cars. The representative US auto manufacturers are producing leaded fuel passenger cars of diverse models.

4.2. CI engine:-

As to the bio-diesel technology and status, biodiesel that is receiving attention as an environment-friendly fuel to replace diesel can be also manufactured from oil-based biomass including oil. Though bio-diesel fuel has sufficient calorie to be used as a vehicle fuel, it is difficult to be directly applied to a vehicle diesel engine as the viscosity is high because it is a

high polymer. Accordingly, the viscosity should be lowered to the level similar to that of diesel by depolymerizing the oil through a chemical reaction. When a catalyst is put into the fat (animal/ vegetable fat) to react it with alcohol, it is decomposed into 3 molecules of alkyl ester and glycerin, which can be applied to diesel engines (after removing glycerin) as it has material properties similar to those of diesel.



5-CONCLUSION:-

Advanced bio-fuels represent a promising alternative to traditional fossil fuels, offering potential benefits in terms of reduced greenhouse gas emissions, increased energy security, and sustainable resource use. The renewal of the bio-fuel eventually provides the basis and the possibility for becoming the basic fuel for energy-producing equipment that replaces fossil fuels. But we can say that much effort is still required in the policy and technology aspects until we have flexibility towards natural factors such as drought, flood and short-term scorching heat. Fuel supply problems. The trend in the price of crude oil shows more fluctuation than the technique. The factor causes many risks for the continuous use of alternative fuels and the establishment of Development plans / production of electrical machinery. Development of technologies that can reduce the cost of manufacturing fuel, as well as the establishment and application of several Policies for the stable supply of fuels are increasingly necessary so that even sudden environmental conditions.

HYDROGEN POWERED AUTOMOTIVES

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1. INTRODUCTION

Many companies are working to develop technologies that can efficiently exploit the potential of hydrogen energy for mobile users. The attraction of using hydrogen as an energy currency is that, if hydrogen is prepared without using fossil fuel inputs, propulsion of the vehicle would not contribute to carbon dioxide emissions. The disadvantages of the use of hydrogen are the low energy content per unit volume, the high weight of the age of the tank, the storage, transport and filling of gaseous or liquid hydrogen in the vehicles, the great investment in infrastructure that would be required to feed the vehicles and the inefficiency of the production processes. . Buses, trains, PHB bicycles, canal boats, cargo bicycles, golf carts, motorcycles, wheelchairs, boats, airplanes, submarines and rockets can now run on hydrogen, in various forms.

NASA uses hydrogen to launch space shuttles into space. There is even a car model that works with solar energy, which uses a regenerative fuel cell to store energy in the form of hydrogen and oxygen. Then you can convert the fuel back into water to release solar energy. The current ground speed record for a hydrogen-powered vehicle is 286,476 mph (461,038 km / h) set by Buckeye Bullet 2 of Ohio State University, which reached a "flying mile" speed of 280,007 mph (450,628 km / h) at the Bonneville Salt Flats in August 2008.

2. ABOUT HYDROGEN FUEL:-

In a flame of pure hydrogen gas, which burns in the air, hydrogen (H_2) reacts with oxygen (O_2) to form water (H_2O) and heat. It does not produce other chemical by-products, except for a small amount of nitrogen oxides. Therefore, a key characteristic of hydrogen as a fuel is that it is relatively non-polluting (since water is not a pollutant). Pure hydrogen does not occur naturally. It takes energy to make it. The energy is finally delivered as heat when the hydrogen is burned.

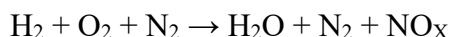
When burned in air, the temperature is approximately 2000 ° C. Hydrogen fuel can provide motive power for automobiles, ships and airplanes, portable fuel cell applications or stationary fuel cell applications, which can power an electric motor. Mainly because hydrogen fuel can be friendly to the environment, there are advocates of its more widespread use.

The proposed creation of sufficient technical and economic infrastructure to support widespread use of hydrogen is known as the hydrogen economy. With respect to the safety of unwanted explosions, hydrogen fuel in motor vehicles is at least as safe as gasoline.

2.1. Hydrogen internal combustion engine vehicle:-

A hydrogen internal combustion engine vehicle (HICEV) is a type of hydrogen vehicle that uses an internal combustion engine. Vehicles with internal combustion hydrogen engines are different from vehicles with hydrogen fuel cells (which use hydrogen + oxygen instead of hydrogen + air); The hydrogen internal combustion engine is simply a modified version of the traditional petrol internal combustion engine. The combustion of hydrogen with oxygen produces water as its only product: $2H_2 + O_2 \rightarrow 2H_2O$. The combustion of hydrogen with air can also produce nitrogen oxides, although in insignificant quantities. Adjustment of a

hydrogen engine to create the largest amount of emissions as possible emission results compared to gasoline engines operated by the consumer since 1976.



3. Hydrogen/oxygen generator:-

The hydrogen / oxygen generator housing is a round cylinder constructed with high temperature CPVC tubing, a material widely used by the construction industry in pipe systems. The generator housing contains a basic coil and two cylindrical electrodes; used to generate both hydrogen and oxygen. Each one can be made of a variety of materials such as stainless steel and / or ceramic, also very durable materials. However, two atomically different forms of hydrogen are produced inside the generator. Most of the hydrogen generated is Ortho-hydrogen, a very powerful and fast-burning gas created by the two electrodes. An electronically controlled high-frequency signal from the Histrionics module activates and controls the electrodes.

4. Storage:-Hydrogen can cause a series of corrosion problems. Hydrogen embrittlement is a problem with high strength steels, titanium and some other metals. The control is by removing hydrogen from the environment or by using resistant alloys.



4.1. Combustive Properties of Hydrogen: -The properties that to its use as a combustible fuel are its:

- ✓ wide range of flammability
- ✓ low ignition energy
- ✓ high auto ignition temp
- ✓ high diffusivity
- ✓ very low density

4.2. Pre-Ignition Problems and Solutions:-

The main problem that has been encountered in the development of operational hydrogen engines is premature ignition. Pre-ignition conditions can be reduced by thermal dilution techniques, such as exhaust gas recirculation (EGR).

5. Fuel Delivery Systems: -

Hydrogen fuel delivery system can be broken down into three main types: central injection, port injection and direct injection. Central and port fuel delivery systems injection forms the fuel-air mixture during the intake stroke. In the case of port injection, it is injected at the inlet port. Direct cylinder injection is more technologically sophisticated and involves forming the fuel-air mixture inside the combustion cylinder after the air intake valve has closed.

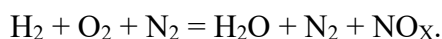
6. Engine Design: -

The most effective means to control pre-ignition and shock is to redesign the engine for the use of hydrogen. A disc-shaped combustion chamber can be used to reduce turbulence inside the chamber. The shape of the disc helps produce components of low radial and tangential velocity and does not amplify the input swirl during compression.

7. Emissions:-

The combustion of hydrogen with oxygen produces water as its only product: $2\text{H}_2 + \text{O}_2 = 2\text{H}_2\text{O}$

The combustion of hydrogen with air however can also produce oxides of nitrogen (NO_x):



8. Power Output:-

The theoretical maximum power of a hydrogen engine depends on the air / fuel ratio and the fuel injection method used. The stoichiometric ratio of air / fuel for hydrogen is 34: 1. In this air / fuel ratio, hydrogen will displace 29% of the combustion chamber, leaving only 71% for the air.

9. Advantages:-

Hydrogen vehicles have much more advantages than conventional gasoline fuelled engines.

- ❖ Hydrogen cars are beneficial for the environment since they do not emit greenhouse gasses.
- ❖ Hydrogen cars also give more mileage as compared to gasoline-powered vehicles.
- ❖ Another advantage of hydrogen cars is the engine's strength and durability.

Disadvantages:-

- ❖ Lack of cost and availability of hydrogen fuel. It would cost billions of dollars to replace all of the current gas stations with hydrogen fuelling stations.
- ❖ It is very difficult to obtain and use liquid hydrogen as a fuel as all are very expensive process.



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