



SOCIETY OF  
CIVIL ENGINEERS

## KEY HIGHLIGHTS

- PROFESSOR INTERVIEWS
- INTERVIEW WITH DISTINGUISHED ALUM
- SUMMER CAMP: CHITRAKOOT
- BEST PAPER/THESIS AWARDS
- PLACEMENTS 2022-23
- CIVIL ENGINEERING LABS

# STRENGTHS

## 2023

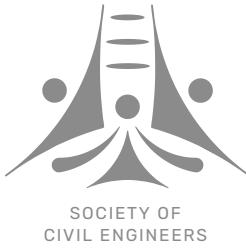
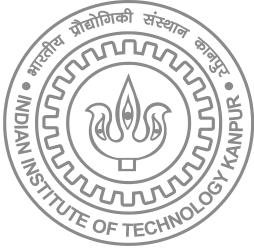
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EMBRACING ADVANCEMENTS

DEPARTMENT OF CIVIL ENGINEERING  
INDIAN INSTITUTE OF TECHNOLOGY KANPUR



SOCIETY OF  
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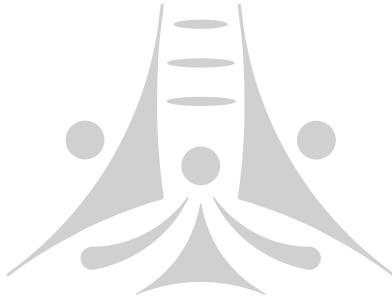


# STRENGTHS

A MAGAZINE FROM THE SOCIETY OF CIVIL ENGINEERS

EMBRACING  
ADVANCEMENTS

DEPARTMENT OF CIVIL ENGINEERING  
INDIAN INSTITUTE OF TECHNOLOGY KANPUR



SOCIETY OF  
CIVIL ENGINEERS

# ABOUT THE SOCIETY OF CIVIL ENGINEERS

The Society of Civil Engineers at IIT Kanpur is a non-profit student organization that fosters strong connections among civil engineering students, esteemed alumni, and esteemed professors. Recognizing the profound impact of student-alumni-faculty interaction on various aspects of student success, such as academic performance, graduation persistence, personal and intellectual growth, educational aspirations, faculty and department satisfaction, career prospects, and curriculum development, our society serves as a vital link within the civil engineering community at IIT Kanpur. We firmly believe that enhancing the interaction between students and faculty is paramount for the comprehensive development of any educational institution. Our society consistently organizes various events and activities to cultivate a thriving learning environment where students and faculty can engage in meaningful exchanges and forge lasting connections. By prioritizing this essential interaction, we strive to contribute to the holistic growth and success of civil engineering students at IIT Kanpur.

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## ABOUT STRENGTHS

STRENGTHS, the annual magazine published by the Society of Civil Engineers, stands as a commendable publication wholeheartedly supported and acknowledged by the Department of Civil Engineering. With a primary objective of offering a comprehensive glimpse into the diverse domains and fields within civil engineering, STRENGTHS also serves as a platform to recognize and showcase the remarkable activities and initiatives undertaken by the SoCE and department. Moreover, it proudly features the commendable works and contributions of the Society of Civil Engineers, effectively catering to the wider civil engineering community. By meticulously curating its content, STRENGTHS aims to provide readers with a rich assortment of articles, Interviews, and insights that encapsulate the dynamic nature of civil engineering. This magazine, born out of a strong commitment to excellence, serves as an invaluable resource for professionals and enthusiasts in the field, ensuring that the Society of Civil Engineers continues fostering knowledge-sharing and appreciation within the civil engineering community.

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# MESSAGE FROM HOD

Financial limitations are being experienced by the entire world, and their impacts are felt everywhere. Nevertheless, with a number of large infrastructure projects, India's civil engineering sector is growing steadily and on a steep trajectory. Thus, students of civil engineering must therefore possess both perseverance and hope. Civil engineering is rapidly evolving. The requirement for higher-quality technical staff, an increase in the amount of available funding, and the usage of higher technology are just a few of the key elements that civil engineering programmes must recognise and help students prepare for. But a graduate in civil engineering who has a balanced personality will be able to realise all of the aforementioned goals. The "STRENGTHS" magazine is a modest step towards helping graduates in creating a well-rounded personality. Now is the perfect time to reflect and put your emotional fortitude and self-belief to the test. These are also opportunities for faculty members to acquire insight into today's students' ideas and sentiments in order to better prepare them for life in the real world. On behalf of the civil engineering faculty, I applaud the "STRENGTHS" team on their latest creation and for letting in some fresh air.

With warm regards,  
P. Ghosh



# MESSAGE FROM FACULTY COORDINATOR

The Society of Civil Engineers (SoCE) has been an integral part of the department for a very long time. It has actively taken care of organising academic and social events over the years. The society has also contributed significantly towards professional development activities, like guest talks and mock interviews. For long time, SoCE has oriented more towards UG students. However, we are now also encouraging PG students' association with the society. This association is expected to lead towards organising more research activities in the department, e.g. research seminars and symposia. This will hopefully bring more exposure to the excellent research works that are being done by our PG students.

One area where we still need to work upon is our engagement with the alumni. Civil Engineering being an old department, the alumni base is large and spread. Through SoCE, we shall aim to reach out to them and get connected. Alumni engagement shall benefit both the current and future students and the department. By bringing together the past, present and future of the department, we shall be able to demonstrate our true STRENGTH!

Looking forward, I am very positive and encouraged about the events that are lined up for the upcoming year. I am also very hopeful that we will see more engagements within and outside the department through SoCE. I wish the SoCE coordinators and secretaries all the best and look forward to working together with them.

With warm regards,  
C.K. Sahu



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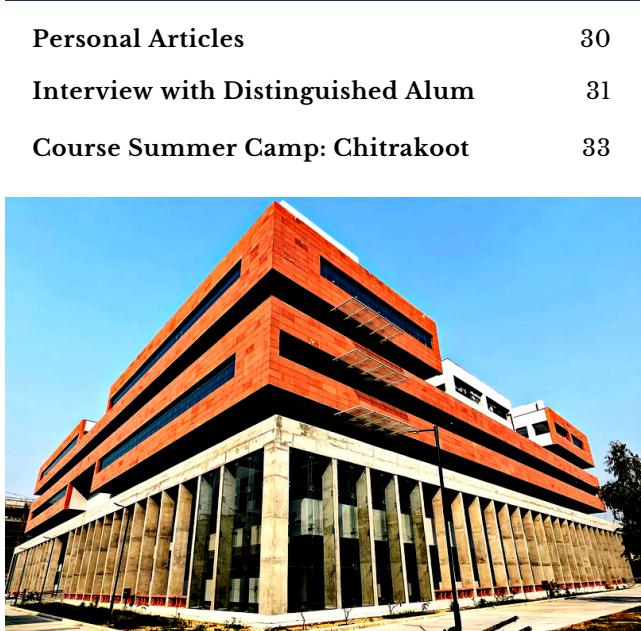
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## ARTICLES



# COMPUTER VISION IN CONSTRUCTION

- Sandipan Dutta, Srishti, Meet Saiya

Computer vision technology has significantly impacted the construction industry, as it uses artificial intelligence to analyze and measure real-world objects. This technology acts as an extra set of eyes to oversee all aspects of a project, leading to improved operational efficiency. Computer vision provides real-time information to guide decision-making processes by creating a layer of quantifiable data. Consequently, this technology facilitates machine visual learning, bringing about notable changes in business operations.

Quantifiable data validates the effectiveness of computer vision technology in construction. For example, it has been successfully employed to detect and monitor the quality of workers' safety equipment, reducing construction site accidents. Moreover, integration of computer vision into quality control has significantly reduced defects in building materials. Additionally, this technology automates laborious tasks like progress-tracking, saving time and enhancing efficiency by minimizing administrative work. Computer vision technology brings a data-driven approach to construction management, resulting in important safety, quality, and efficiency enhancements.

The fusion of artificial intelligence, computer vision, and building information modeling (BIM) has revolutionized project control and monitoring in construction. This integration has resulted in substantial cost and time savings. Using AI algorithms for BIM-based planning and design empowers project managers to generate real-time insights and predictions, enabling more informed decision-making. Additionally, computer vision can identify and analyze changes in construction sites, automatically updating the BIM model as needed. This facilitates a more accurate and efficient project schedule, promoting better stakeholder collaboration. By automating quality control, these technologies promptly detect defects, reducing the need for rework.

Here are some exciting applications of computer vision in the construction industry:

## 1. Enhancing productivity and safety practices:

Computer vision can analyze workers' activities, improving efficiency and detecting potentially unsafe body postures. Workers can be identified using object detection models like **YOLOv5** or **Faster-RCNN**, and joints can be tracked to determine posture. Supervised learning algorithms or deep neural networks can classify activities based on joint positions. This requires labeled data for training the algorithm.



Source: <https://www.analyticsinsight.net/computer-vision-to-change-the-outlook-of-construction-activities/>

For instance, a project at **IIT Kanpur** trained models to detect construction workers' helmets, achieving an accuracy of about 88%. This system can be quickly implemented on-site, allowing engineers to view CCTV feeds with detection on their mobile devices.

## 2. Quality control of raw materials:

Computer vision and artificial neural networks can improve quality control while producing building materials like stone aggregates. Use of camera sensors and laser profilers allow irregularities in the materials to be detected early on, saving time and money. Two-dimensional wavelet transforms can extract essential features from digital images of the particle surface, which are then used as inputs to an artificial neural network for classification. This enables plant operators to identify property variations and determine if the aggregates meet the required specifications.

## 3. Integration of images and point clouds for architectural conservation and progress monitoring:

Point cloud data, obtained from LIDAR scanners or depth images, is valuable for architectural conservation and progress monitoring. Digital twins of architectural monuments can be created using point cloud data, aiding their preservation and enabling virtual tours for visitors. Progress monitoring of construction projects can be done by integrating point cloud data into Building Information Models (BIM). Project delays can be accurately calculated by comparing the as-built condition with the planned condition. Additionally, point clouds can be used for crack detection and damage quantification, especially in inaccessible areas. This method is beneficial for quantifying irregularities in structural elements, such as detecting and measuring spalling in a column.



Source: <https://viso.ai/wp-content/uploads/2022/08/construction-worker-detection-computer-vision-1060x707.png>.

In India, the government has been actively promoting the use of computer vision technology in various construction projects. One notable government project is the Smart Cities Mission, which aims to develop 100 cities nationwide. Computer vision plays a crucial role in developing smart cities by enabling real-time monitoring and analysis of various aspects such as traffic management, waste management, and surveillance.

For example, Gujarat's **Surat Smart City** project has implemented computer vision-based video analytics to enhance traffic management. Cameras equipped with computer vision technology are installed at critical intersections to monitor traffic flow, detect violations, and optimize signal timings. This helps reduce congestion, improve traffic efficiency, and enhance road safety.

Another government project that utilizes computer vision is the **Pradhan Mantri Awas Yojana (PMAY)**, which focuses on providing affordable housing to the economically weaker sections of society. Computer vision is employed for quality control and monitoring during the construction of these housing projects. It helps detect and identify any construction defects or deviations from the approved plans, ensuring the houses are built according to the specified standards.

Moreover, the **Ministry of Road Transport and Highways** in India has initiated the use of computer vision technology for automated toll collection and traffic management. Advanced computer vision algorithms and machine learning techniques are employed to capture and process vehicle data, allowing for seamless toll collection without the need for physical toll booths. This technology improves traffic flow, reduces congestion, and enhances the overall efficiency of transportation systems.

**Conclusion:** Computer vision technology has revolutionized the construction industry by providing real-time data for decision-making, improving safety practices, enhancing productivity, and enabling efficient project control and monitoring. From analyzing workers' activities to quality control of raw materials and integrating point cloud data, computer vision has proven valuable in enhancing safety, quality, and efficiency in construction projects. With its data-driven approach, computer vision technology continues transforming the construction industry and driving advancements in the field.

# DATA SCIENCE AND HYDROLOGY

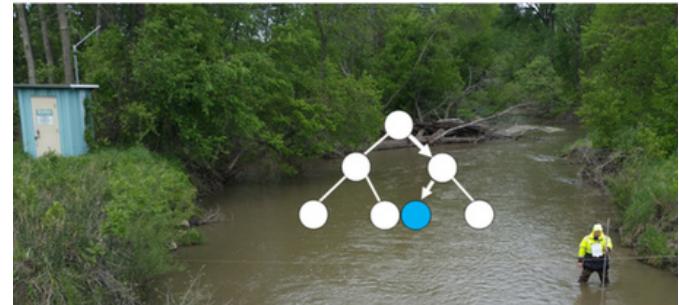
- Vanshika, Saurabh Meena, Vishal Singh

Hydrology, the scientific study of water and its various aspects, has witnessed significant advancements in recent years, particularly in the realm of data science. This interdisciplinary field has been revolutionized by the application of machine learning techniques, enabling more efficient hydrologic modeling, water resource management, and conservation efforts. Additionally, advancements in hydrology have led to the emergence of various sub-branches such as hydrogeology, chemical hydrology, hydroinformatics, isotope hydrology, hydrometeorology, drainage basin management, and water quality.

**One of the key challenges in hydrology lies in matching the nonlinear and nonadditive nature of hydrologic systems**, which traditional methods struggle to address. To overcome this, researchers are continuously exploring new methods for analyzing hydrologic data and developing approaches to model hydrologic systems. For example, numerical modeling techniques have significantly improved the detection of potential pipe leakages in water distribution networks by analyzing

spatial and temporal patterns of flow and pressure anomalies. These advancements help in minimizing physical and commercial losses by identifying and addressing water leakage issues.

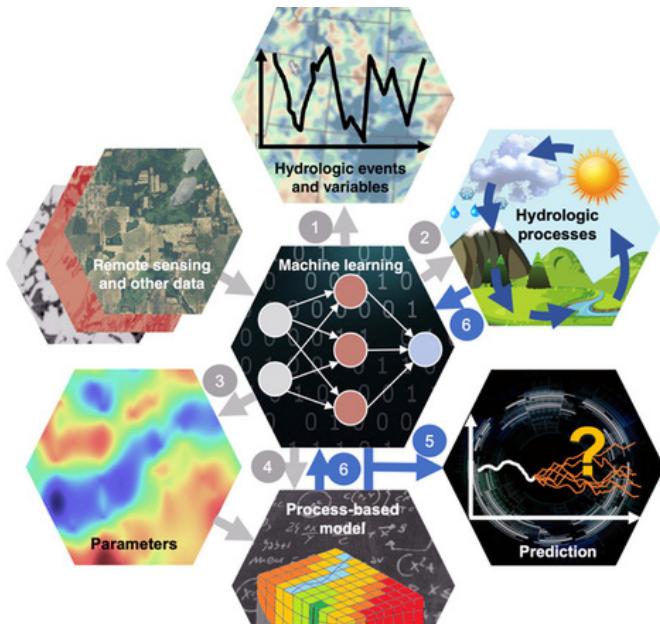
The integration of data science with conventional hydrology has immense potential to revolutionize the field. Artificial intelligence techniques, combined with other data-driven models, can be used to model water resources and predict streamflows with greater accuracy. This is particularly crucial in the face of global climate changes that impact rainfall patterns and weather conditions. By leveraging AI models, hydrologists can forecast and model unstable patterns in various hydrological fields, thereby enhancing reservoir operation and optimizing water balance.



Source: <https://onlinelibrary.wiley.com/cms/asset/70714444-8bfe-4b05-bc9e-5e9732319d0a/hypl4648-toc-0001-m.jpg>

Several recent advancements in hydrology have contributed to its progress. The **gridded meteorological ensemble tool (GMET)** generates high-quality, probabilistic meteorological fields that aid in quantifying uncertainties for climate and hydrologic model evaluation. The Intermediate Complexity Atmospheric Research (ICAR) model utilizes simplified wind dynamics to perform high-resolution simulations, enabling the characterization of uncertainties across climate models. The Structure for Unifying Multiple Modeling Alternatives (SUMMA) framework offers multiple options to simulate biophysical and hydrologic processes, while the **Multi-scale Parameter Regionalization Flex (MPR-flex) provides a flexible parameter estimation application for continental-domain hydrologic modeling**. MizuRoute, a continental-domain routing model, efficiently routes streamflow from any distributed hydrologic model through river networks. Finally, the System for Hydromet Analysis Research and Prediction (SHARP) integrates advancements to evaluate climate impacts and adaptation options, facilitating real-time streamflow predictions.

Data science also intersects with hydrology through weather forecasting technologies. Hydrological models enable scientists to predict water levels in rivers, aiding in flood prediction, while invasion models identify areas most likely to be affected by floods, helping prevent property damage and potential loss of life. Furthermore, remote sensing technologies play a pivotal role in hydrological monitoring and data gathering. Ground-based instruments, networked sensors, GPS-equipped sonar boats, radar rainfall stations, airborne platforms like LiDAR, and satellite missions provide valuable data for hydrological analysis. The proposed Surface Water Ocean Topography (SWOT) satellite mission, jointly developed by NASA and CNES, aims to create detailed floodplain water topography maps worldwide, utilizing repeated imaging to monitor surface water extent and elevation.



Source: <https://wires.onlinelibrary.wiley.com/cms/asset/433c0b6f-fb22-435c-afa2-a75581031d88/wat2!533-toc-0001-m.jpg>

–science and informatics. It integrates data from various sources, such as meteorology, hydrology, and water quality, to provide a comprehensive view of water resources. NWIC utilizes data analytics and modeling techniques to generate insights and support policy formulation.

**3. Flood Early Warning System (FEWS):** The FEWS project, implemented by the Central Water Commission (CWC), employs data science and hydrological modeling to predict and issue early warnings for floods in several river basins across the country. It integrates real-time hydrological data, weather forecasts, and satellite information to generate flood forecasts and alerts. This helps in minimizing the impact of floods by enabling timely evacuation and mitigation measures.

**4. National Monsoon Mission (NMM):** The NMM, led by the Ministry of Earth Sciences, utilizes data science techniques to improve monsoon rainfall prediction. It involves the assimilation of meteorological and hydrological data into numerical weather prediction models to enhance the accuracy of monsoon forecasts. This enables better planning and management of water resources during the monsoon season, particularly for agriculture and water supply sectors.

**5. Integrated Flood Management in Bihar:** This project is implemented by the Bihar State Disaster Management Authority (BSDMA) and supported by the World Bank, and it aims to enhance flood management in Bihar. It incorporates data science and hydrological modeling techniques to develop flood hazard maps, improve flood forecasting systems, and enhance early warning capabilities. The project utilizes remote sensing data and hydrological models to assess flood risks and support flood preparedness measures.

**Conclusion:** The integration of data science in hydrology has led to remarkable advancements, facilitating better water resource management, more accurate modeling and forecasting, and enhanced understanding of the intricate interactions between climate and hydrology. With ongoing research and technological developments, the field of hydrology is poised to continue progressing, ultimately contributing to more sustainable water management practices and the protection of this resource.

# CLOUD COMPUTING IN CONSTRUCTION

- Enna Gupta, Shalini Kurva

The construction industry is a highly fragmented and data-intensive sector that relies on the collaboration of various professionals and firms. Managing building data across the lifecycle of projects is complex due to the diverse storage locations, limited connectivity, and document management systems used. To address these challenges, cloud computing platforms offer efficient and robust data sharing and coordination solutions among construction professionals.

Cloud computing, which delivers hosted services over the internet, provides easy and scalable access to computing resources and IT services. It is categorized into infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). Cloud services can be private or public, depending on their accessibility and permissions.

In the construction industry, cloud computing enables professionals to collaborate and share data seamlessly.

**Architects and engineers can work on Building Information**

**Modeling (BIM) projects from different locations,**

**enhancing productivity and flexibility.** Cloud-BIM cost

estimate processes with simplified file structures reduce file space and improve access for the design team. Safety is a crucial aspect of construction, and cloud computing facilitates access to real-time safety information. It enables predictive and quantitative measures for identifying and eliminating hazards before incidents occur, improving overall safety performance on construction sites.

Energy management is another area where cloud computing plays a significant role. Cloud platforms effectively manage energy consumption during building construction and operation stages, contributing to **sustainable practices and reducing CO<sub>2</sub> emissions.**

Cloud computing also benefits supply chain management in construction. By utilizing cloud platforms, material movement can be tracked and coordinated, addressing supply gaps and minimizing project delays. Additionally, cloud technology enables better project management informatics, leading to improved design, construction, and project efficiency. Despite its advantages, adopting cloud computing in the construction industry faces challenges. The transfer rate and response time required for time-sensitive construction applications may only sometimes be guaranteed. Security concerns regarding storing sensitive construction data in shared resources and the perception of data accessibility by unknown parties need to be addressed.

Unforeseen resource shutdowns by cloud providers can lead to temporary unavailability of building data, emphasizing the importance of backup and data recovery plans. Contractual relationships between stakeholders must be clearly defined to establish ownership and responsibilities regarding contributed data. Internet connectivity is crucial for accessing cloud services on construction sites, which can be



Source: [https://www.worldconstructionnetwork.com/wp-content/uploads/sites/26/2023/04/shutterstock\\_2060073983-2.jpg](https://www.worldconstructionnetwork.com/wp-content/uploads/sites/26/2023/04/shutterstock_2060073983-2.jpg)

challenging in underdeveloped or rural areas with limited or no connectivity. Additionally, the accumulated cost of using cloud infrastructure over an extended period should be carefully considered, depending on the deployment type.

Despite these challenges, cloud computing in the construction industry presents future opportunities. Cloud-based collaboration enables real-time project performance monitoring and reporting, enhancing transparency and stakeholder involvement. Cost flexibility allows small and medium-sized construction businesses to access enterprise solutions without significant upfront investments, boosting their viability and growth potential. Cloud computing also provides improved security assurance through hardware-independent virtual servers replicating data across multiple data centers. It enables new business models, such as design-as-a-service, procurement-as-a-service, and facility management-as-a-service.



Source: <https://theconstructor.org/digital-construction/cloud-computing-construction-benefits/87574/>

Cloud computing is playing a significant role in construction projects in India, offering numerous benefits to the industry. **As of 2021, the adoption of cloud computing in the construction sector in India stood at around 48%. This figure is expected to increase rapidly, with estimates suggesting a CAGR of 29.7% from 2021 to 2026.** By 2026, the market size of cloud computing in the Indian construction industry is projected to reach approximately \$550 million. Cloud computing platforms allow construction professionals to collaborate and share data effectively, leading to improved productivity and

efficiency. Moreover, cloud-based Building Information Modeling (BIM) platforms enable real-time collaboration among architects, engineers, and other stakeholders, resulting in better design accuracy and reduced rework. Cloud infrastructure also facilitates cost savings, with construction companies experiencing an **average cost reduction of 12%** by utilizing cloud-based services. Additionally, cloud computing enhances data security and disaster recovery capabilities, addressing critical concerns in the construction industry. The growing adoption of cloud computing in construction projects in India demonstrates its transformative impact on the industry's operations. It sets the stage for further technological advancements in the coming years.

The Indian government has undertaken various initiatives to promote the adoption of cloud computing in the construction industry. Here are a few examples:

**1. Digital India:** The Digital India program, launched by the Government of India, aims to transform India into a digitally empowered society and knowledge economy. As part of this program, the government encourages using cloud computing services in various sectors, including construction, to enhance digital infrastructure and promote advanced technologies.

**2. National Informatics Centre (NIC):** Under the Ministry of Electronics and Information Technology, the NIC provides cloud-based infrastructure and services to support government projects and initiatives. It offers secure and scalable cloud computing resources to government departments and agencies, facilitating the adoption of cloud technology in various sectors, including construction.

**3. Smart Cities Mission:** The Smart Cities Mission focuses on developing intelligent and sustainable cities across India. Cloud computing plays a significant role in this initiative by enabling the integration of various systems and services in innovative city projects. Cloud-based platforms facilitate data sharing, real-time monitoring, and analytics for effective urban planning and infrastructure management.

**4. National Urban Information System (NUIS):** The NUIS project, implemented by the Ministry of Housing and Urban Affairs, aims to create a comprehensive database of urban areas in India. Cloud computing technology stores and manages the vast amount of data collected, including information related to infrastructure, buildings, land use, and demographics. This centralized data repository supports informed decision-making and planning for urban development, including construction projects.

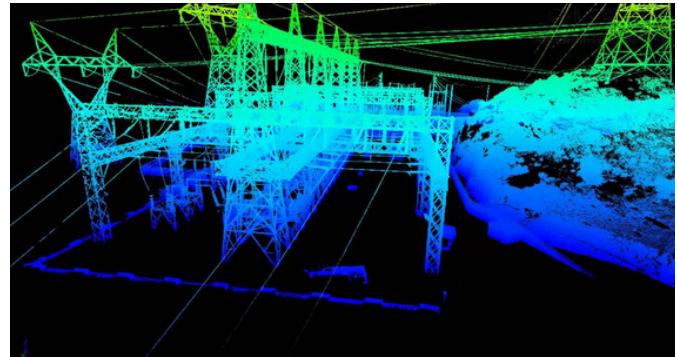
**Conclusion:** Cloud computing offers significant implications for the construction industry, addressing data management challenges and enhancing professional collaboration. Organizations must consider skill and competency development, cloud host locations, and efficiency impacts. By embracing cloud computing technologies, the construction industry can benefit from increased productivity, improved safety, enhanced supply chain management, and the emergence of new business models.

# LIDAR IN CIVIL ENGINEERING

- Aman Khilani, Moonis Ali

LiDAR (Light Detection and Ranging) is an increasingly popular technology revolutionizing the Civil and Construction Engineering field in India. Its non-invasive and accurate data collection capabilities make it an invaluable tool for making informed decisions in infrastructure projects. With advancements in LiDAR scanning and processing, its construction and civil engineering applications are rapidly expanding. By leveraging advanced point cloud data and camera sensors, LiDAR opens up opportunities beyond traditional surveying methods.

LiDAR data enables the **creation of high-resolution Digital Elevation Models (DEMs) and Digital Surface Models (DSMs)** that find application in various civil engineering activities. These include flood mapping, land-use planning, and the design of roads, bridges, and buildings. LiDAR's ability to generate dense point clouds of real-world structures facilitates accurate modeling for volume calculations, geological mapping, terrain analysis, archaeological mapping, biomass mapping, coastal mapping, traffic monitoring, and even autonomous vehicles.



Source: <https://e0.pxfuel.com/wallpapers/185/513/desktop-wallpaper-terrestrial-lidar-substation-scan-terrestrial-scan-engineering.jpg>

The limitless applications of LiDAR technology in civil engineering encompass several key areas. In the planning phase, LiDAR aids engineers in managing construction costs, adhering to government regulations, and identifying potential environmental hazards. By transforming the real world into a digital one, LiDAR allows for cross-checking results with planning data, benefiting applications such as urban planning, visualization, and collaboration. LiDAR's integration with Building Information Modeling (BIM) further enhances the planning process, improving productivity and quality through seamless teamwork.

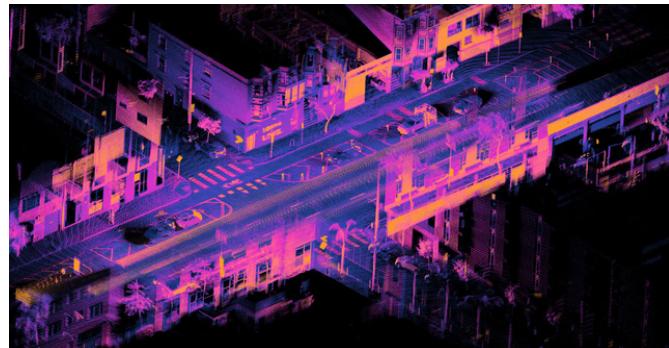
Monitoring is another critical aspect of civil engineering where LiDAR proves invaluable. Large-scale structures require continuous monitoring to ensure early detection of structural failures or the need for maintenance. **LiDAR's detailed analysis capabilities enable the identification of minor discrepancies in structural conditions**, providing timely warnings. Specific applications of LiDAR in monitoring include sewer surveys, where robotic vehicles or drones equipped with LiDAR can survey inaccessible areas, and tunnel surveying, which allows detailed analysis and modeling before construction commences.

Safety is paramount in any construction project, and LiDAR contributes to maintaining a safe work environment. By incorporating LiDAR data into the design phase, engineers can identify high-risk areas and include safety measures, such as anchor points, to prevent falls or accidents. Additionally, LiDAR aids in safety management through applications such as landslide analysis and flood risk mapping.

Sustainability is a crucial consideration in contemporary civil engineering projects, and LiDAR plays a vital role in achieving sustainable development goals. LiDAR-informed construction projects minimize errors, streamline workflows, and optimize resource usage, contributing to greener and more efficient practices.

LiDAR facilitates ecological, geological, and land classification, as well as the exploration of green materials and construction techniques.

Despite its numerous benefits, LiDAR presents challenges such as managing large amounts of data, requiring expertise for processing, and high costs that may limit accessibility for smaller organizations. However, ongoing advancements, including the development of algorithms leveraging artificial intelligence and the increasing application of mobile scanning techniques like SLAM (Simultaneous Localization and Mapping), are improving access and outcomes. As LiDAR technology continues to evolve and become more affordable, its usage is expected to grow exponentially.



Source:[https://images.ctfassets.net/go54bjdzbrgi/1d1eNY2lrkqeCdeGSJVx25/c5c8ab2afc0dfce810e1aefcae8fe66f/IMA\\_BLO\\_COUP\\_lidar-photogrammetry\\_lidar\\_pointcloud.jpg?w=1600&m=jpg&q=80](https://images.ctfassets.net/go54bjdzbrgi/1d1eNY2lrkqeCdeGSJVx25/c5c8ab2afc0dfce810e1aefcae8fe66f/IMA_BLO_COUP_lidar-photogrammetry_lidar_pointcloud.jpg?w=1600&m=jpg&q=80)

for rainwater harvesting structures using airborne LiDAR, urban forest mapping using mobile and airborne LiDAR, and multi-sensor fusion of LiDAR with other sensors for indoor positioning and mapping.

LiDAR technology has been instrumental in various construction projects in India, showcasing its significant impact. For instance, LiDAR has been utilized in urban planning to create detailed 3D models of cities, aiding in the development of intelligent cities and efficient infrastructure. **The Mumbai Coastal Road Project, spanning 29.2 kilometers, utilized LiDAR data to analyze coastal conditions**, assess environmental impact, and optimize road design, resulting in a **cost savings of approximately ₹2,000 crores (\$276 million)** and reducing the project duration by six months. LiDAR-based monitoring systems have also been employed in major infrastructure projects such as the Mumbai Metro Line 3, facilitating real-time assessment of structural health and ensuring safety. The use of LiDAR technology has contributed to a significant reduction in accidents and enhanced the efficiency of these projects.

The Indian government has undertaken various LiDAR technology projects to support infrastructure development and environmental conservation efforts. Here are a few examples:

**1. National Highways Authority of India (NHAI) Projects:** The NHAI has utilized LiDAR technology in several highway projects nationwide. LiDAR surveys have been conducted to obtain accurate topographic data for designing and planning highways, reducing errors, and optimizing road alignments. LiDAR data has also been used to assess highway construction's environmental impact and monitor road construction projects' progress.

**2. Smart Cities Mission:** The Smart Cities Mission in India aims to develop 100 smart cities with efficient infrastructure and enhanced quality of life for citizens. LiDAR technology has been instrumental in creating digital 3D models of cities, which form the basis for various innovative city initiatives. LiDAR data helps in intelligent cities' urban planning, transportation management, infrastructure optimization, and disaster management.

**Conclusion:** LiDAR technology holds immense potential for India's construction and civil engineering industry. Its ability to provide fast, detailed, and accurate data opens new avenues for project planning, safety management, and sustainability. Ongoing research and advancements in LiDAR are further driving its adoption, paving the way for a more efficient and technologically advanced future in civil engineering.

# ZERO ENERGY BUILDING

- Shruti Goyal, Mohd. Hashim

The scientific consensus on global warming and the increasing demand for energy due to technological advancements and population growth have led to exploring solutions to balance energy needs. One such solution is the concept of Net-Zero Energy Buildings (ZEBs), which aim to minimize energy consumption and generate renewable energy to meet the building's needs. By reducing energy consumption and mitigating CO<sub>2</sub> emissions, ZEBs are crucial in promoting sustainable development and combating climate change. ZEBs can be defined in several ways:

**1. Net zero site energy:** A site ZEB produces at least as much energy as it uses in a year when accounted for at the site.

**2. Net zero source energy:** A source ZEB produces at least as much power as it uses in a year when accounting for the primary fuel used to extract, process, generate, and deliver energy to the site.

**3. Net zero energy costs:** The utility pays the building owner for the energy the building exports to the grid, equal to or more than the amount the owner pays the utility for the energy services and energy used over the year.

**4. Net zero energy emissions:** A net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.

To achieve net zero energy, several factors need to be considered. The location of the building plays a crucial role regarding climate, sun and wind patterns, temperature, and rain patterns. Proper orientation of the building is essential, with south-facing buildings taking advantage of renewable energy generation mechanisms like solar panels. Design strategies focused on passive techniques, such as maximizing natural lighting and ventilation, **selecting effective insulation materials, and implementing energy-efficient HVAC** (Heating, Ventilation, and Air-Conditioning) systems, contribute to minimizing energy consumption.



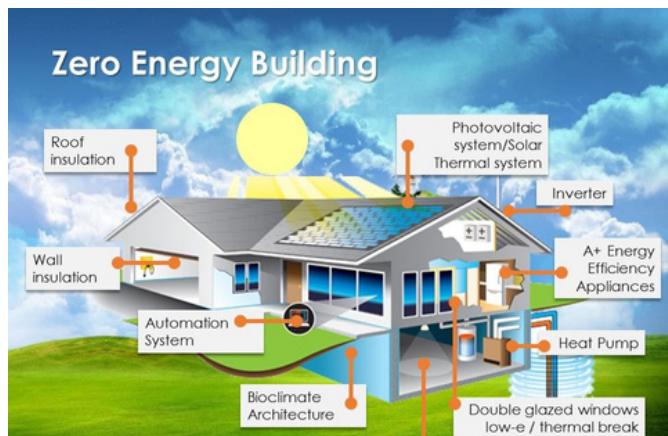
Source: <https://cdn.britannica.com/88/205188-050-32C85663/Beddington-Zero-Energy-Development-borough-housing-development.jpg>

Integrating active strategies, such as renewable energy generation, is essential in reducing energy consumption during the building process. Technologies like hydroelectric power, biomass, geothermal power, solar power, and solar thermal power can be utilized to harness renewable energy and reduce reliance on fossil fuels.

The importance of net zero energy buildings lies in their ability to reduce carbon footprints and decrease reliance on finite fossil fuel resources. By embracing the concept of ZEBs and transitioning existing and newly designed buildings to become energy-efficient, society can significantly mitigate the adverse impacts of energy consumption on the environment. **Net zero energy buildings align with sustainability**

principles and provide a clear and understandable idea for the general public to **contribute to a more sustainable future**. ZEBs offer reliability through their own power supply, reducing concerns about outages and blackouts. Additionally, ZEBs are environmentally friendly, with low carbon emissions and reliance on renewable energy sources. These factors contribute to higher resale value, as potential buyers are attracted to the cost-saving benefits of reduced energy expenses.

However, there are some challenges associated with net zero energy buildings. The initial building costs can be higher due to the use of expensive materials and features like solar panels. Additionally, renewable energy resources may be limited, requiring some building owners to rely on the grid for power.



capacity building, training and awareness programs to promote the adoption of NZEB concepts among architects, engineers, and stakeholders in the construction sector.

**2. Solar City Program by the Ministry of Housing and Urban Affairs, Ministry of New and Renewable Energy, and Ministry of Power:** The Solar City Program promotes the development of cities and urban areas with a strong focus on renewable energy, including ZEBs. The program aims to increase energy efficiency, reduce greenhouse gas emissions, and promote renewable energy generation. It provides financial incentives, technical support, and policy frameworks to encourage the implementation of ZEBs and solar power systems in urban areas.

**3. Eco-Niwas Samhita by the Bureau of Energy Efficiency (BEE):** The Bureau of Energy Efficiency (BEE) has developed the Eco-Niwas Samhita, a building energy efficiency code, to promote energy-efficient buildings, including ZEBs. The regulation provides guidelines, specifications, and energy performance standards for residential buildings, encouraging the adoption of renewable energy systems, energy-efficient appliances, and building envelope design strategies to achieve energy neutrality.

**4. Energy Conservation Building Code (ECBC) by the Bureau of Energy Efficiency (BEE):** The Energy Conservation Building Code (ECBC) is a mandatory code that sets energy performance standards for commercial buildings in India. It includes provisions and requirements for achieving energy efficiency and encourages the adoption of renewable energy technologies, such as solar power systems, to move towards ZEBs. The ECBC applies to new commercial and existing buildings undergoing a major renovation.

**5. Green Rating for Integrated Habitat Assessment (GRIHA):** GRIHA is a national rating system for green buildings in India, developed by the Energy and Resources Institute (TERI). GRIHA promotes sustainable and energy-efficient building design, construction, and operation. It encourages the integration of renewable energy systems, energy-efficient technologies, and passive design strategies to achieve ZEBs. GRIHA certification provides recognition and incentives for buildings that meet the required energy performance criteria.

**Conclusion:** The demand for net zero energy buildings has steadily increased. They offer a promising solution to reduce energy consumption and promote using renewable energy sources. By prioritizing energy efficiency and sustainable practices, ZEBs preserve our planet's resources for future generations. The transition towards net zero energy buildings aligns with the goals of environmental preservation and ensures a healthier and more sustainable future for all.

# INTEGRATED TRANSPORT SYSTEM

- Shruti Goyal, Sandipan Dutta

In today's era of rapid communication advancements, the concept of integrated transportation has gained significant importance. Integrated transportation refers to the seamless combination and coordination of various subsystems, functions, and computational tools within transportation systems. It plays a **crucial role in optimizing transportation solutions**, enhancing efficiency, and addressing complex transportation challenges.

The integration of subsystems is a key aspect of transportation systems. This involves integrating components such as urban traffic control (UTC), public transport (PT), car park management and guidance (PGM), environmental monitoring and prediction systems (EMP), traffic and transport supervision (TTS), and information service systems (PAT, ATIS, radio RDSTM, TV, VMS). By creating an integrated multi-central technical system architecture with open standards, **transportation systems can achieve efficient and harmonious operation**.

Furthermore, integration involves the consolidation of systems, functions, and computational power. This includes integrating different operational tools for analysis, monitoring, supervision, control, decision support systems (DSS), visualization, maintenance, and diagnosis. By integrating these tools, transportation systems can leverage their combined capabilities to improve overall performance.

To illustrate the practical applications of integration in transportation, let's consider a couple of examples:

**1. PIACON traffic adaptive control tool:** The PIACON multi-criteria control method effectively addresses conflicts in real traffic situations where the demands of various users cannot be met simultaneously.

This method allows for trade-offs between control criteria, such as minimizing the number of vehicle stops, delays, capacity reserve, queue length, drivers' discomfort, and deviations from occasional requirements. The control modes, such as stop, delay, capacity, queue, jam, and dedicated modes, represent different control aspects. By selecting appropriate working points on the non-dominated index surface, which represents the optimal solutions, adaptive control actions can be performed in real-time based on the current traffic conditions. This approach allows for robust and efficient traffic control, accommodating diverse traffic situations and minimizing fuel consumption and pollutant emissions.

**2. Integrated pro-ecological traffic planning and management approach:** This methodology follows an advanced hierarchical integrated individual and public transport system. It utilizes recent technologies, intelligent network analysis, management, and real-time control tools, along with high-quality real-time information from integrated data and knowledge bases. The approach includes estimation methods,



Source: <https://media.istockphoto.com/id/1331571740/photo/transportation-and-technology-concept-its-mobility-as-a-service-telematics.jpg?Expires=612x612&w=0&k=20&c=BIDnmMPtOkuqXpYMLMb8A26d35kCQbMJ-2hktxGBrqc=>

multi-criteria intelligent planning, management, and control actions supported by automatic decision assistance tools. The planning process is integrated with real-time operation, allowing for continuous feedback on system performance. It also incorporates intelligent coordination support at different levels to improve efficiency and quality in decision-making processes. The control structure involves selecting optimal traffic signal green splits and cycle times, as well as implementing strategies through variable message signs (VMS) and onboard route guidance equipment (RGE). This integrated control approach aims to enhance the efficiency of transportation systems while minimizing environmental impact.

Integrating transportation systems brings numerous benefits, including improved efficiency, enhanced safety, reduced environmental impact, and better user experience. Transportation systems can optimize traffic flow, reduce congestion, and respond effectively to changing conditions by integrating subsystems, functions, and computational tools. Integrated transportation enables seamless coordination between different modes of transport, such as public transport, private vehicles, and non-motorized options, resulting in improved connectivity and accessibility for users.

Moreover, integrated transportation systems contribute to sustainable development by promoting efficient resource utilization and reducing greenhouse gas emissions. By incorporating real-time data, traffic monitoring, and predictive modeling, transportation systems can **proactively manage and mitigate environmental impacts**. Additionally, integrated transportation planning allows for incorporating eco-friendly strategies, such as promoting green materials, sustainable infrastructure, and alternative modes of transport.

The Indian government has undertaken various projects to promote integrated transport systems and address urban mobility challenges. Here are some notable government projects in India involving integrated transport systems:

**1. Delhi Integrated Multi-Modal Transit System (DIMTS):** DIMTS is a joint venture company formed by the Government of Delhi and the Infrastructure Development Finance Company (IDFC) to develop and implement integrated transport solutions in Delhi. It focuses on improving public transport systems, including developing Bus Rapid Transit (BRT) corridors, integrating metro rail with other modes of transport, and implementing intelligent transport systems for efficient traffic management.

**2. Mumbai Integrated Ticketing System (MITS):** MITS is an integrated ticketing system implemented by the Mumbai Metropolitan Region Development Authority (MMRDA) to enable seamless travel across multiple modes of transport in Mumbai. It allows passengers to use a single ticket or smart card for traveling on suburban trains, metro rail, buses, and other public transport modes. The system aims to enhance convenience, reduce transaction time, and improve the overall efficiency of the transport network.

**3. Bengaluru Intelligent Transport System (BITS):** BITS is an intelligent transport system implemented in Bengaluru by the Bangalore Metropolitan Transport Corporation (BMTC). It integrates various technologies, such as automatic vehicle tracking, passenger information systems, and electronic ticketing, to enhance the efficiency and reliability of public transport. The system provides real-time information to passengers, enables better fleet management, and improves the commuter experience.

**4. Kochi Unified Metropolitan Transport Authority (KUMTA):** KUMTA is an initiative by the Government of Kerala to establish a unified authority for planning, coordinating, and regulating different modes of transport in the Kochi metropolitan region. It aims to integrate various transport systems, including buses, metro rail, water transport, and non-motorized transport, to provide seamless connectivity and improve the efficiency of the urban transport network.

**5. Ahmedabad Bus Rapid Transit System (BRTS):** The Ahmedabad BRTS is a dedicated bus corridor system developed by the Ahmedabad Municipal Corporation. It aims to provide efficient, reliable, and sustainable public transport by creating dedicated bus lanes, implementing intelligent transport systems, and integrating with other modes of transportation. The BRTS project has improved the accessibility and connectivity of public transport in Ahmedabad.

**Conclusion:** The integration of transportation systems is vital for addressing the challenges of modern transportation. It enables efficient coordination between subsystems, functions, and computational tools, leading to optimized solutions and improved overall performance. Integrated transportation systems enhance efficiency and safety, contribute to sustainable development, and provide a better experience for users. Embracing integration in transportation is crucial for building intelligent and resilient transportation networks that can meet the demands of growing urbanization and evolving mobility patterns.

# DEDICATED FREIGHT CORRIDOR

- Om Jee

The Indian Railways is **one of the world's largest railway networks, comprising over 67,000 kilometers** of tracks and serving more than 23 million passengers daily. The system has undergone significant modernization and development over the years, focusing on improving the quality and speed of transportation. One of the most critical developments in this regard has been the creation of high-speed freight corridors, which have transformed how goods are transported across the country. The high-speed freight corridor project was first proposed in 2005 to address India's growing freight transportation demand. The country's economy was booming, and the existing railway network needed help to keep up with the increased volume of goods. The government recognized the need for a dedicated freight corridor that could handle large volumes of cargo quickly and efficiently. The **project's first phase was launched in 2006** and focused on constructing a **1,504-kilometer** corridor between Delhi and Mumbai. The gallery, known as the Western Dedicated Freight Corridor (WDFC), was designed to handle heavy freight trains carrying up to 12,000 tons of cargo at up to 100 kilometers per hour. The WDFC would also feature advanced signaling and communication systems, allowing for safe and efficient operation.

Construction of the WDFC took several years and was completed in phases. The first phase, which covered the **stretch between Rewari and Vadodara, was opened to traffic in August 2018**. The second phase, extending the corridor to Mumbai and Kandla ports, was opened in January 2021. The WDFC has significantly impacted freight transportation in India, reducing transit times and costs and improving supply chain efficiency. The success of the WDFC has led to the development of other high-speed freight corridors in India. The **Eastern Dedicated Freight Corridor (EDFC) is currently under construction** and will connect Ludhiana in the north with Dankuni near Kolkata in the east. The EDFC will cover a distance of 1,856 kilometers and can transport up to 13,000 tons of cargo at speeds of up to 100 kilometers per hour. The project is expected to be completed in phases, with the first section scheduled to open in 2022.

Another proposed corridor is the **South Western Dedicated Freight Corridor (SWDFC), which will connect Delhi with Chennai and pass through several cities of Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, and Andhra Pradesh**. The SWDFC will cover a distance of 2,327 kilometers and can transport up to 15,000 tons of cargo at speeds of up to 100 Kmph. The project is currently in the planning stages, and construction is expected to begin soon. The high-speed freight corridors are expected to bring numerous benefits to India's economy. First and foremost, they will reduce transit times for goods and lower transportation costs, making Indian products more competitive in global markets. The corridors will also create jobs and spur economic growth in the regions they pass. The improved logistics and supply chain efficiency will also help reduce congestion on India's roads and highways, reducing air pollution and greenhouse gas emissions. The high-speed freight corridors will also benefit the Indian Railways itself. Freight transportation is a significant source of revenue for the Railways, and the dedicated corridors will allow the system to handle more cargo and do so more efficiently. The improved infrastructure and technology will also improve safety and reliability, reducing the risk of accidents and derailments.

One of the critical factors in the **success of high-speed freight corridors has been the use of advanced technology and engineering**. The dedicated halls feature state-of-the-art signaling and communication systems allowing safe and efficient operation. The trains have modern locomotives and wagons designed to carry heavy loads and travel at high speeds. The tracks are built to exacting standards, with advanced signaling and train control systems ensuring trains can travel at high speeds without compromising safety. The construction of high-speed freight corridors has also required **significant investment in infrastructure**. This includes constructing new rail lines, bridges, and tunnels, as well as the acquisition of new locomotives and rolling stock. The government has been a significant investor in the project to create a world-class freight transportation system that can support the needs of India's growing economy.

In addition to the investment in infrastructure, the success of the high-speed freight corridors has also been **driven by a focus on innovation and collaboration**. The project has brought together a range of stakeholders, including the Indian Railways, the Ministry of Railways, private sector companies, and international partners, to collaborate on the design and construction of the corridors. This collaboration has allowed for exchanging ideas and best practices, resulting in a more efficient and effective project. The success of the high-speed freight corridors has been challenging. The project has faced several delays, cost overruns, and concerns about land acquisition and environmental impact. However, the government and project stakeholders have worked to address these challenges, and the project is now moving ahead at full steam.

One of the critical challenges facing high-speed freight corridors is the need to ensure the safety and security of the cargo being transported. India has faced several challenges related to cargo theft and pilferage, and the high-speed freight corridors must be equipped with advanced security measures to prevent these types of incidents. This includes using **CCTV cameras, trained security personnel, and other advanced technologies to ensure the safety and security** of the transported cargo. Another challenge facing high-speed freight corridors is ensuring they are financially sustainable over the long term. The halls require significant investment in infrastructure and technology, and the government and project stakeholders will need to find ways to generate sufficient revenue to cover these costs. This may involve innovative financing models, such as public-private partnerships or other forms of private investment.

Despite these challenges, the high-speed freight corridors represent a **significant step forward for India's economy and transportation system**. The galleries have the potential to transform the way goods are transported across the country, reducing transit times and costs, improving logistics and supply chain efficiency, and creating new economic opportunities. As the project progresses, it is clear that the high-speed freight corridors will play a critical role in India's continued economic growth and development.

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# INTERVIEWS

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# DR. ABHAS SINGH

*Environmental Engineering*

**About:** Dr. Abhas Singh completed his Ph.D. at Washington University in Saint Louis, U.S.A., in 2010, specializing in Chemical Engineering. Before this, Prof. Singh pursued a year-long Ph.D. coursework in Chemical Engineering from IIT Bombay in 2004-2005. His educational journey began with his undergraduate studies at IIT Bombay, where he graduated in Chemical Engineering in 1999. His interest lies in the Environmental geochemistry of heavy metals and inorganic contaminants, investigation of physical and chemical processes such as adsorption, precipitation, and reduction-oxidation occurring at mineral-water-microbial interfaces, and relating them to larger scales, prediction of inorganic contaminant fate and transport through surface complexation and flow-through reactor modeling, and the development of tools to target contaminant remediation in natural as well as engineered environments.

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## SoCE: Can you tell a brief story about your journey?

**Dr. Abhas:** Well it's a long and circuitous professional journey. The entry system to IITs was similar at our times in that the top rankers used to go for mostly computer science or electronics, although it was more choice-based than what it is today. I had no preferences except not wanting to take up a branch that primarily confined me to desk work so I largely followed the ranking norm.

I initially got Civil Engineering. What I learned at the time was that Civil Engineering placements were not as much into the core area, and a lot of people felt that Chemical Engineering can give you more options, including opportunities for higher studies in the top schools abroad. So, after my first year of my BTech, I changed my branch to Chemical Engineering. And so I'm a trained Chemical Engineer, not a Civil Engineer, which many of you might not know.

During my B.Tech. I was not really exposed to something industry-specific, but I wanted to apply my knowledge to some real-world practical problems. I felt at the time that research was more theoretical. In fact, at the time of my graduation, I thought I would never do a Ph.D.. I even distributed my notes to everybody. Then I got into a public sector core chemical engineering job through campus placements.

We were placed in a remote area where a new chemical plant was just built by the organization, and we were a part of the first team to be deployed there with the task to commission the plant. This was as challenging as it possibly could be, literally with not even a drinking water facility available at the site, what to talk of a canteen. We had to learn the plant design and operations from the contractor who had overseen the plant's construction and was there to help us initiate the processes and "hand over" the plant to our firm. So after a year and a half, when we did all these tasks and we got the plant to work, it was considered commissioned with the first batch of products made and sent to the market. This was quite satisfying.

However, there was soon to be a downside. While performing these duties, I realized that our activities were not always in sync with the environmental responsibilities that as a production unit we ought to have shouldered. For example, we were at times producing certain batches of products, which when we tested were not of the expected quality to be sold in the market. We were not handling them responsibly, such as disposing of the bad product as a waste after treatment, once it was deemed unrecyclable. I mean, we knew how to operate the plants. Ultimately, managers have to show that these many drums were produced. But as an organization we were not worried about the environmental cost? My inability to impress upon the management to act the responsible way made me question my long term association in that organization and look for an alternate role.

And so because of reading about our environmental responsibilities, I got interested in writing the forest services exam. I resigned from my job and prepared and wrote these exams seriously for two years, but could not ultimately succeed. But in the process of preparing for this exam, I came

to know a lot about the environmental issues and our possible role as engineers. And I felt, well, if you see the skillset that I possess, very few people in the country can actually solve the challenging technical problems that I can solve. So, I decided to go back to IIT Bombay and work on those skills. I had one faculty member in the chemical department who was working on an environmental project and he was kind enough to mentor me for a year and encouraged me to take up chemical engineering courses to brush up my concepts.

And this time, with a different focus, I was surprised that after five years of gap, I was not finding the subject as if I've left it for a long time just because the focus was there and I really enjoyed the process. After then, I was never turning back. I applied to a Ph.D. program in Environmental Engineering at Washington University in Saint Louis. After that I did a postdoc at a National Lab in the US and then came to IIT Kanpur.

## SoCE: Sir, India has committed in the COP26 summit to reach net zero by 2070. So how would we be able to achieve it? What are the challenges associated with it and how can the civil engineers contribute significantly?

**Dr. Abhas:** Oh, I think these talks about carbon neutrality have been around for a long time, and at that level, it is primarily political, I would say, because the developing world keeps saying that first we want to be like you (developed world) and then we'll start controlling our carbon emissions. The developed world says, well, you are so much in numbers, so what difference will it make if only we do it alone and you (the developing world) don't? The bottom line is that every person has to look at their own carbon emissions from the lifestyle one is leading or wishes to lead.

We can do many things as civil engineers, for example, if you're going to construct a building, can we construct it in a way that minimizes the damage to the environment or uses the least resources possible? The assumption often is that you will cut a set of trees to generate these resources (land, energy) and plant 10x more somewhere else, but then nobody talks about who is going to nurture those 10 saplings, and whether they will actually become trees or not. According to reports by the Forest department itself, the percentage of trees that survive by this method is less than 20 %.

And whereas if you practice something like a transplantation or some other technique you could actually save up to 80% of the trees. So in various domains, be it water, be it energy, be it building, civil engineering profession can play a big role in achieving COP26 targets.

## SoCE: What are your views on water management strategies in India? Like, are they outdated? Do we need to update it? Should we shift to localized STPs instead of centralized ones?

**Prof. Abhas:** In terms of water management, everybody knows that there's hardly any water management for the whole country. We care about supply to some extent, but then we

never care how to take care of whatever comes out as wastewater from our use. Can we recycle a part of it, or treat it locally and then maybe not send it out to a local waste stream but collect it for secondary purposes? So a lot has to be done. But even from the source point of view, we are in a crisis today because many places don't have a perennial water supply. And also, wherever there is some amount of water available, it gets contaminated because of various anthropogenic activities that result in contamination.

Rationing of water and control in terms of some pricing based on the actual value of water is missing. And that's why we see much water being wasted.

On local versus centralized STPs, one size does not fit all. So it depends. If you're planning for a population that is concentrated in a small area, it is efficient, to begin with a centralized STP, set up a recycled water line and collect all this treated water in a central facility which is localized to that city as a whole can benefit. But if you have a distributed population then you should have localized STPs to avoid the enormous costs of transportation of wastewater and associated infrastructure. It depends on the kind of field you encounter, not necessarily one size that will work everywhere. But, what we learned from the western world, which went aggressively for the centralized water treatment, is that it is not sustainable because energy costs will outcompete anything else.



ICP-MS Facility within the Environmental Engineering Laboratory

**SoCE: In research there is a lot of uncertainty. You might work for two or three months, you might not get the desired outcome, but the next day the idea may strike and you get all the results. So how to keep yourself motivated. Did this happen to you?**

**Prof. Abhas:** Yes. It happened to me, not in terms of lack of motivation, but lack of results. During my PhD, I was trying something for almost a year. It was not working but it never popped up in my mind that why am I doing research in the first place? I guess it was probably because I went through all this, so I had the focus or maybe I had no other option (as I had already exhausted other options). Now, but more importantly, I think the question is more about how do you view this journey of research?

Many times what I find in students, which is my personal understanding of interacting with a lot of students, is that at some stage it becomes a drag that you are doing studies because you have to do it. It's not because you like it; there is no further joy. Students tend to think that after I've cracked JEE, I think my life will be rosy. But I'm still studying and that too structural dynamics?

Why am I supposed to do this? Whereas then somebody will say, there is no application of this. I like this escapist idea, and then I start justifying my lack of commitment to academics. But if you look deep down, you have lost interest in studies, you have lost interest in what you were doing. So the question you have to & everyone has to ask is "why?"

So today, most students do not give themselves a chance.

They think that whatever is being taught has no real world value. They don't want to put in extra effort. So they shut the doors of learning very early in life.

And that's the reason why I think when it comes to even doing research later on, you have picked up research because of job security, because you did not find anything else rather than you wanting to do research in a particular area. As soon as you find interest in a particular area, you will never have this question.

The question will be how differently I should now do it. So that brings the answer. So I also ended up losing one year but I think I eventually gained it because I learned other things. The average graduation time in my lab group was four years. But I took five years to finish my Ph.D., but it was because I tried something new that even my advisor did not do earlier. My advisor even advised me to not get into it as he also did not know much about it. But I said, no, I want to learn this. I am eternally grateful to my advisor that he still supported my learning by putting me in touch with an expert in that technique I wanted to learn. And then once I got into the subject, I got stuck, and it apparently seemed like I wasted a year in terms of something not tangible coming out of it, but in the end I could learn a lot. I could not apply the new learning then, but now I'm able to apply that learning with my students.

#### **SoCE: Any message you want to convey through SoCE?**

**Prof. Abhas:** I often tell my students that you all have immense potential, much more than what people like me had 20 years ago. It's important to identify what we are truly interested in and not just follow what others have done. With the rise of startups and government support, it's possible for anyone to start their own business and create job opportunities. To channelize our skills and capabilities, we need to introspect and engage in learning activities. Following a disciplined routine, attending classes, and absorbing what is being taught is crucial for our growth. We should attempt to learn from our peers, and as much as from the professors. This routine and disciplined learning will eventually place you in the best position to introspect and help you find your interest and avenues to maximize your potential. All the best!



Environmental Geochemistry Laboratory in CESE

# DR. AMAR NATH ROY CHOWDHURY

Structural Engineering

**About:** Dr. Amar Nath Roy Chowdhury is an Assistant Professor in the Department of Civil Engineering. He completed his Ph.D. from the Department of Civil and Environmental Engineering at the National University of Singapore from 2010 to 2014. Prior to that, he obtained a Master of Technology (M.Tech.) degree from the Department of Civil and Environmental Engineering at the Indian Institute of Technology Bombay, Mumbai, India, between 2006 and 2008. He also holds a Bachelor of Engineering from the Department of Civil Engineering at Jadavpur University, Kolkata, India, from 2002 to 2006.

He specializes in Structural Engineering. His research interests revolve around the stability of Plate and Shell Structures, Mechanics and Design of Thin-walled Structures, and Molecular Dynamics Simulation of Materials. Through his expertise in these areas, he contributes to the understanding and development of structural engineering principles and applications.

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## SoCE: Can you please share your journey, how you got into IITK and why you chose structural engineering out of all the subdomains in civil engineering?

**Dr. Amar:** My journey to civil engineering starts before my undergraduate. My uncle was a practicing civil engineer. He used to tell me stories, but I was not interested in civil engineering at that time. I was interested in chemical engineering because I enjoyed chemistry while I was in college. For my undergraduate, I opted for Civil Engineering as I wanted to study in Jadavpur University and did not want to move out of my hometown. Eventually, I started gaining interest in Civil Engineering especially in Structural Engineering due to my interest in interesting shapes of structures such as bridges, shells etc. and their behavior. Various UG courses that sparked my interest in structural engineering are theory of structure and the theory of shells and plates. In my UG I got a junior structural engineering job in L&T. However, I decided to pursue MTech from IIT Bombay. After MTech, I worked as a structural engineer in Meinhardt Singapore for 2 years to be able to financially support myself, and gain experience. I was lucky enough to be part of a few iconic projects namely Reflection towers, Gardens by the Bay etc. Eventually, I moved to NUS to pursue a Ph.D.

After my PhD, I joined IIT Ropar as a professor, after working in IIT Ropar for 2 years I moved to IIT Kanpur.



## SoCE: If somebody wants to pursue career in the core, what are the current opportunities in the industry?

**Dr. Amar:** After discussing with a few practicing engineers, I came to know that they look for a student who not only understands structural engineering but also is capable of automating the repetitive design tasks, and develop tools that can expedite the design process. However, they seldom get someone who has both these qualities. For instance, IIT graduates are excellent in coding but most of the time they are not that conversant with structural mechanics, analysis, and design. Therefore, they prefer to hire M.Tech students who are expected to have knowledge in structural mechanics with coding skills. Then again, these companies are also struggling to get the MTech students who are suitable to work with as most of the MTech students are not good in automating tasks through coding or writing small scripts. Still they prefer to hire MTech, as they can train someone having a strong fundamental knowledge in structures.

Moreover, there exists various sectors who hire structural engineers for instance, power, offshore, nuclear, stress analysis, application engineer oil and gas etc. So if someone is interested she/he could explore the various types of jobs available to structural engineers. One may look at the activities by the Institute of Structural Engineers, UK for getting an idea regarding what is going on in the field of structural engineering. Furthermore, there are many good structural engineering companies, while exploring their projects one may also know the types of work a structural engineer can carry out.

## SoCE: What are some of the most significant projects you have been involved in or are currently undertaking here?

**Dr. Amar:** We work on sponsored and consultancy projects. I have a research project from DST, which is supposed to end this year. The project aims to study the mechanics of bi-stable composite laminates and develop functional structures. Furthermore, for long span tensile fabric structures, we are trying to develop a design code which is not there in India. There are a few Ph.D. students who I am co-supervising among them two are from IIT Kanpur and another one is from IIT Ropar. One of the students is working on developing moment resistant cold formed structures for rapid housing. A student is working on modelling of ultra-high strength concrete and its structural applications. The student from IIT Ropar, is working on the design of seismic resistant mid-rise pre-cast concrete structures. Apart from these research projects, among the different consultancy projects, I would like to mention a project where I am a co-PI. In this project, we have to assess the strength of old masonry and concrete arch bridges. The major challenge in this project is to determine the strength of the existing bridges without disturbing the structures. Through some non-destructive measurements, we are trying to find out the properties of the structure for carrying out structural strength assessment.

**SoCE: There is some open-source software and some paid software. So which one do people in industry or academia generally prefer?**

**Dr. Amar:** In academia, people always prefer open source because academicians do not have the money. The industry does not demand that you learn all the software. Learning one analysis software like SAP 2000, Staad Pro, or ETABS and one drawing software like AutoCAD is fine. More importantly, working with any analysis software will not be challenging if you understand the basic principles. However, if you know how to link multiple software that can help you to perform advanced analysis that is beneficial to the industry.

**SoCE: What advice would you give to the students interested in pursuing a career in structural engineering, and how can they best prepare themselves?**

**Dr. Amar:** It's not that one medicine will work for all; if you enjoy the subject, give it a try and maybe you will find a kick. If you are enjoying structural engineering, then stick to structural engineering. Do not get thwarted by thoughts of low initial salary etc. If you are sticking with structural engineering, clear your fundamentals with basic courses like mechanics of solid (ESO202A) and structural analysis (CE272A). Whatever you are learning in design courses CE371A and CE372A, try to code it and clarify the concepts. You may not need very advanced stuff. Whatever stuff you are learning is sufficient. Topics that will be helpful in industry are matrix and finite element methods.

**SoCE: We have a lot of language models coming up, like ChatGPT and many more. What are your concerns regarding it?**

**Dr. Amar:** These language models are based on the training database they are using. So, we have to be a little smarter when giving assignments. Therefore, the assignment problems can get tricky and complex. Maybe in the future, AI will be so smart that it will be able to think like human beings making their own decisions. But, by then we will not have the present model of education. In addition, when AI will become very smart, we don't need to teach students anymore the AI operated robots will.

**SoCE: If a student wants to do research in college, how should he/she approach you? Are there any requirements?**

**Dr. Amar:** I am interested in the mechanics of slender structures. For my research I primarily focus on semi-analytical or finite element methods in addition to small experimental works. A student having interests similar to mine is welcome to approach me.

**SoCE: Any message you want to convey through SoCE?**

**Dr. Amar:** After coming to IIT you will experience many course works and some of them may make you dis-interested in the field. Or maybe you have other objectives after graduation. In case you are unsure what you like and what to do after choosing civil engineering, try exploring all the specializations for choosing the profession that you will prefer after graduating. Listen to everyone but follow your own path that is what I can say. Taking too much stress worrying about the future will not be beneficial so I would like to say enjoy your graduation days, study to learn, and listen to everyone but follow your own path. All the best.



# DR. BHARAT LOHANI

*Geoinformatics Engineering*

**About:** Dr. Bharat Lohani obtained his Ph.D. from ESSC at the University of Reading, UK, in 1999. Prior to that, he completed his M.E. from the prestigious Indian Institute of Technology Roorkee in 1990 and earned his Bachelor of Engineering (B.E.) degree from M.M.M. Engineering College Gorakhpur in 1988.

Professor Lohani's research interests lie in 3D laser imaging and LCS measurement, technology for motion correction and error analysis in laser scanning, and propagation modeling using high-resolution LiDAR data for various applications, including flood, sound, and GPS signal analysis. He has also focused on as-built mapping using terrestrial laser scanning, especially for complex structures and heritage sites. Additionally, Professor Lohani is involved in the development of LiDAR simulators for both airborne and spaceborne applications. His contributions extend to the utilization of Geographic Information Systems (GIS) for optimized land consolidation.

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## **SoCE: What inspired you to pursue a career in professorship related to fields of remote sensing and LiDAR?**

**Dr. Lohani:** In my childhood, I taught kids in my neighbourhood. They praised my teaching skills, which made me consider becoming a teacher. So that was the idea behind why I came to teach. Then why use remote sensing? As an undergraduate in civil engineering, I had various options for my master's specialisation. My percentile was not that good. Just back in 1972, the first satellite was launched, so not many people knew about it. Then I started talking about it with my seniors. What is the right area to go into? So someone told me, "This is a new area. It'll have a lot of potential in the future; you can go for that. So that was the only thing. Otherwise, I had not thought of anything. Just some advice, and I landed in remote sensing.

## **SoCE: How have you seen the field of remote sensing evolve over the years and how do you stay updated with all the latest technologies that are there in your field?**

**Dr. Lohani:** That's a very good question. During my master's, remote sensing was in its early stages with limited satellite data. It mainly involved mapping land use and covers, measuring city areas, and river meandering. The satellite data had low resolutions of 18 or 30 m. Although remote sensing and GIS were conceptualized in the late '60s, significant progress occurred in the late '80s and early '90s. In my thesis, I developed image enhancement software in Pascal, working with a limited 64x64 image. Obtaining data was challenging, making remote sensing a difficult endeavor. Remote sensing is primarily focused on mapping land use and cover. Photogrammetry, which originated during World War II, involved aerial photography, XYZ coordinate measurement, and map creation. It served as an early stage for both remote sensing and GIS, where maps were commonly generated.

During my master's, someone sought business advice, and I shared my vision of a fully computerized world where environmental processes like landslides, flooding, and deforestation would be simulated digitally. This foresight was based on the evolving data and growing interest in these possibilities as observed in the literature. During that time, there was no GNSS or GPS in my lab. Geospatial technology has evolved significantly over the years and has become ubiquitous today. We now realize the usefulness of geospatial information in our daily lives, as our teachers had mentioned, with its application in about 80% of our activities. From Google Maps and Google Earth to navigation systems used by companies like Amazon and Blinkit for deliveries, maps and GPS signals play a crucial role. The emergence of autonomous vehicles further highlights the importance of geospatial technology. While the fundamental technologies remain the same, they have evolved, leading to numerous new applications.

Today, GNSS is readily available on mobile phones, along with map applications like Google Maps and Mappls. Location-related activities heavily rely on these technologies, and a wide range of software and solutions leverage satellite data, GNSS signals, algorithms, and even deep learning to solve various problems. The remarkable evolution from the past to the present in this field is truly phenomenal.

To stay updated with the latest advancements, I employ various methods. Firstly, I subscribe to remote sensing journals and receive abstracts and titles of new publications. This helps me identify papers of interest, which I then read in detail. Additionally, I subscribe to technical magazines that provide technology developments in a concise and accessible language. Industry magazines also offer insights into the latest trends in the field. Furthermore, I use Twitter to follow technology companies and researchers who share their findings. This platform serves as a source of information, allowing me to explore new developments and delve deeper into relevant literature. Having students around me also aids in staying abreast of current topics. When assigning tasks, students often explore related subjects extensively, and through their discussions, I gain knowledge about additional concepts. Students possess quick grasping powers and ample time for reading and synthesizing information. As professors, we encourage them to share their findings, enabling us to learn from their strengths. This collaborative approach enhances our understanding and keeps us informed.



## **SoCE: Can you describe some of the innovative solutions that you have developed in the field of LiDAR?**

**Dr. Lohani:** After completing my Ph.D. in the UK in 1999, where I focused on LiDAR, I returned to India. However, LiDAR data was not available in India at that time. Despite this setback, I chose to continue working with LiDAR due to its potential for India. Since no data was accessible, we decided to simulate LiDAR data, making our group the first in the world to do so. Around 2002–2003, while at IIT Kanpur, I collaborated with my undergraduate students on the initial paper about the LiDAR simulator. We progressively improved and expanded the simulator, ensuring that the generated data mimicked the characteristics of real LiDAR data for a given terrain. Although our simulation was basic in those days, with simple ground and tree models as well as trajectory models, we successfully generated data identical to field data.



This simulation system gained widespread usage worldwide as we made it available online. We continued to publish several versions of the LiDAR simulation system, and I have been working on its development ever since. Due to its availability online, many individuals worldwide downloaded and used the simulation system for academic purposes. For instance, educators used it to provide laboratory resources to their students when actual data was unavailable. However, the simulator is no longer accessible online.

We continued our work on the simulation with a team consisting of MTech and undergraduate students. Looking back, I truly value our decision to focus on simulation. Initially, we viewed it as a tool for academic training or industry assessment, where companies could determine the type of data generated and the coverage area before conducting actual flights. This was its early application. However, in the past few years, with the emergence of deep learning, our current focus has been using deep learning for point cloud segmentation. Training a deep learning model requires a substantial amount of labelled data, which is a costly and time-consuming process. Without this labelled data, the success of the deep learning model is compromised.

Realizing the potential of simulated data, I began exploring its use for training deep learning models in 2017 and 2018. This idea gained more traction when I joined IIT Kanpur in 2019. Simulated data, with its pre-existing labels, could be generated by creating terrains, adjusting parameters, and employing different configurations. We delved deeper into this concept, and its value for training purposes is now globally recognized. In a recent publication by a reputable market research firm, it was stated that 60% of the data used for training deep learning models will be simulated data. This recognition stems from the challenges of obtaining real-world field data.

Additionally, the rise of autonomous vehicles further emphasized the need for simulated data. Training an autonomous vehicle to handle all possible road scenarios would require collecting and labelling an impractical 11 billion miles of real-world data. Consequently, the notion of using simulated data for training purposes is gaining traction worldwide.

In the past few years, researchers from prestigious institutions like MIT, Tokyo University, and Michigan, as well as major companies such as NVIDIA, Microsoft, and Oracle, have been actively working on simulators. There are now several reliable simulators available for generating training data for autonomous vehicles. Our work in simulation has been innovative and ongoing.

Furthermore, we are currently exploring a new approach to simulation by integrating deep learning. Instead of relying solely on physics-based equations, we aim to simulate data using deep learning techniques. This transition marks an important phase in our research. With a team of students and project members, we are developing an advanced simulation engine capable of training various autonomous systems. Our ultimate goal is to create a versatile simulation platform that can benefit a wide range of autonomous applications, considering that autonomous vehicles represent just one type of autonomous system.

In addition, we addressed the challenge of data conversion between different formats. We developed software that allows for easy conversion and visualization of LiDAR data. This software has been widely downloaded worldwide, and we continue to receive requests for it.

Furthermore, I collaborated with Prof. Salil Goel on a novel method for laser scanning. Traditionally, the object being scanned had to be stationary, but our method introduced a new approach to overcome this limitation.

We developed a method to address the challenge of scanning moving objects. For example, when working with the Defense Research and Development Organization (DRDO), they required a 3D model of a ship while it was anchored in the sea, which naturally moves and wobbles. To overcome the distortions caused by the ship's movement during scanning, we placed instruments on the ship itself. This allowed us to eliminate the distortions and obtain accurate data. We filed a patent for this method, and it has been transferred to the defense sector for their use. Additionally, we have filed another patent that is currently being explored for commercialization. A team is working on converting this patent into a product or establishing a company based on its technology.

We developed a system similar to Google Earth but focused on capturing the soundscape of different locations. Instead of just visual images, users can experience the sounds of various places. We call it a soundscape layer, which adds a layer of sound over the base imagery. By collecting sound samples from different areas, we can create an immersive auditory experience. This system has been patented, and we are currently exploring the possibility of developing it into a marketable product.

These are some of the interesting innovations we have been working on, alongside numerous other research projects conducted here



# DR. MUKESH SHARMA

*Environmental Engineering*

**About:** Dr. Mukesh Sharma completed his BTech degree from the University of Indore in 1980 and joined IIT Kanpur in 1997. His primary focus is on environmental engineering, specializing in air quality management, air quality modeling, and understanding the dispersion and impacts of pollutants. He possesses extensive expertise in assessing how pollutants disperse, their effects on human health, and available control options. He is particularly skilled in utilizing smart strategies to maximize the reduction of pollutant concentrations during human exposure. His contributions include the development of the "Air Quality Index," a tool that measures pollution levels in cities. This index was created by his team at IIT Kanpur and was launched by the Prime Minister in 2015. Through his research and expertise, he actively assists the government in formulating effective policies and making informed decisions related to air quality management. His involvement in policy decisions greatly contributes to addressing environmental challenges and improving air quality in the country.

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**SoCE: You have earlier served as the Vice President in Indian Air Pollution Control Association, Delhi. So can you explain something about your role over there?**

**Dr. Mukesh:** There were professional associations meant to promote air pollution, identify issues and the policies and decisions to be made. So to make the body functional, there was a need for a few executives. So, voluntarily I became Vice-President for the period of 2 years.

My team had 300 people with some background in air pollution control. From them, many were students and professionals from industry and private entrepreneurs. My job was largely to assist in terms of academic activities, organizing certain conferences, meetings. For a journal on a tri-monthly basis, we had to write articles. It was a nice platform to let the government or system hear about the difficulties, issues, and problems, which are the way forward for air pollution control.

**SoCE: How did you balance your research and teaching responsibilities as an environmental engineering professor and what are some strategies you used to ensure that you were able to make meaningful contributions in both areas?**

**Dr. Mukesh:** Time is the same for everyone, i.e. 24 hours. So, somehow we rationalize our teaching and research and also contribute to various projects that are at the government level or the national level or the international level.

For me, the teaching part is the most important thing. The second part is research which is nothing but knowledge creation. Knowledge creation always comes from universities and academia, and industries. The third thing is to help the system, which is at the government, industry, or even international levels.

**SoCE: What advice would you give to students who are interested in pursuing a career in environmental engineering and how can they best prepare themselves for success in the field?**

**Dr. Mukesh:** Advice for any subject, in fact, Environmental Engineering is to read a lot and travel a lot. Of course, once you focus on environmental engineering, you must keep up-to-date with what is happening. What are the issues, what are the challenges? What are the difficulties? What we are not able to achieve is what we want to achieve. So that analysis is essential. You should know your desires, goals, and objectives, and then you have to draw the path to reach to that objective. So the direction of the path is important. In fact, more than speed, the direction is important. Of course, Environmental Science is a very professional thing to pursue. But this subject takes it directly, letting you interact with the health issues and the suffering of the people. Therefore, if you're emotionally attached to the subject, you think that directly working in environmental engineering, you're actually helping people. Afterwards, as you become senior, you have the experience

and contribute a great deal to policy-making. And which your state or your city or your country should go so that you help. So it's a very exciting thing because it's directly for the people, by the people, of the people, the environmental engineering.

Whenever a new technology comes up, the new technology will always bring certain backlashes, something which is not good about that technology because there'll be some residual or something. So environmental engineering is a support for all engineering. So whatever the backlashes of another engineering, or other technology, they do the cleaning part of it and make other technologies or issues more sustainable because environmental engineers clean some of the other problems or the other technology.

**SoCE: Can you please put some light on Masters' and research preparation strategies in this field? What opportunities can they get if they want to pursue this field as a career and will it promise a rewarding career for them ?**

**Dr. Mukesh:** The subject matter in this field was limited to certain; we call it environmental engineering or public health engineering, or sewage treatment, which was limited. Now, the environmental issues are on a global level. We talk about climate change.

To handle this problem, both in terms of the market and in terms of the individuals who will lead the profession, they will always find the leaders in the profession; that is what is, the need and that is what the, is the direction of our bright students from our, especially our institute can go in that direction and lead the profession.

As far as the jobs are concerned, the market in environmental engineering is way too high because India is still working and moving forward for environmental pollution control. Our efforts were different before. Now suddenly, there is a massive shift towards environmental engineering, so the job opportunities, whether you are a private consultant or you want to work for the government or a private company.

Nowadays, all projects require environmental clearances. You can only start something if you have the environmental clearance in terms of assessing the environmental pollution, but at the same time, finding the solution and thirdly designing the solution because an engineer is expected to design the whole thing. So, there is a lot of scope in this field in India as well.

**SoCE: You have worked on many International and National projects like Air Quality Modelling of Agra and many other cities as well. Can you tell us about those projects , how was your experience?**

**Dr. Mukesh:** Firstly, talking about my experience working in the cities was like, we have national air quality standards. So, when for some reason, these standards are not met, or standards are not attained, it means we should find and understand the issues why we are not able to achieve these

standards. For example, we have to understand what the sources are, how big they are, and their impact on public health at the ground-level concentrations. It is essential to develop a linkage between the pollution level and different sources, so we have to do the measurements and apportion the contribution of the various sources to the breathing level. Once we know the contribution distinctly, then we can prioritize the sources, and we can control those particular sources which are causing the bigger problem.

Secondly, we have to prepare various specific action plans as to what specific cities have to do, which pollution source they have to cut down, how much they have to cut down, and the time frame. The third thing is what it may potentially cost. After all, it will help them plan the strategies or make the implementation effective when they know how much money is required because budgeting is crucial for any city or individual. So, working on national projects was like working from scratch, trying to find some productive solution for the issue, and helping implement the plans.

**SoCE: You have done a lot of Indian Projects. So, what was the basic difference between international projects you have done and the Indian projects? Can you brief something about the success of International projects you have been involved in so far?**

**Dr. Mukesh:** Most international projects are done for the Indians, in the Indian context, only because the international bodies want to know what possibly should be done in India. For example, WHO (World Health Organization) helps them with the air pollution levels in India. For example, what is the exposure, and what could potentially be health effects, so that WHO can take up that particular thing for India and other developing nations. So, we have done the other projects.

One big project was done for what we call the ICCT (International Council for Clean Transport). How to shift and advance to electric vehicles and what will be the issues in India for moving the electric vehicles, and then what are the solutions? Then there are other agencies like Clean Air Asia, which have done a lot of projects for IIT Kanpur; what are the issues in the small-scale industry? Then we have projects from international agencies for many of the issues in India. Then they come up with more futuristic things. What should be the policy for the future?

For example, in the next 20 years, our markets will be flooded with electric vehicles. That is where the working, decision-making, modeling, and even finance part is being done today. Lastly, we were also an international issue of decarbonization because the big decision the government has taken by 2070 will be carbon neutral. For International projects, we have the right idea and objective, and the funds would never be an issue at that level.

**SoCE: As you might have observed the air quality standards in India and other measures as well, what measure would be required to improve the air quality. In your opinion which state government has seriously worked on these measures?**

**Dr. Mukesh:** Let us start from the reverse direction, which state government has worked better because it is a little difficult because then you need to know what all the governments are doing, then only you can compare, but I think I can because I understand the issue very well. So, especially for the last couple of years, the UP government has been working very seriously, and they have taken a different approach. Other states are most focused on city-specific planning.

So, the UP government now considers it not just an individual city because pollutants can travel from one place to another. So, therefore they have got to work based on the air shed rather than a point. So, they are taking significant steps. They are looking at the various sectors, for example, the transport sector, the issues with the trucks and passenger cars, what

technology should be brought into the trucks, and how the bad trucks, which are very old, can be scrapped.

Similarly, they are looking at industrial emissions as well. So, I think the state of UP, especially in the last two and half years, is very serious, and they are working not just at the city level and finding the local solution

We have a lot of dust problems in the country. We have to look into vehicle congestion because some of our cities have very low average vehicle speeds. So, it means we spend more time on the road than required with our engine on. So, that is another thing. Another big issue in our cities, not all cities, is the tendency to burn municipal solid waste. Whatever we want to get rid of. So, the solid waste should not be burnt. It should be properly collected and disposed of. So, these are the actions we have reported, and then we have asked them to use satellite and other means to judge. And even to do the mass balancing of the municipal solid waste collected and disposed of. So, we need to work at three levels: the local, regional, and hot spots.

**SoCE: Majority of students who enroll in civil engineering either go for government positions or train for the civil services but very few of them seek higher education in this discipline. Can you explain the real reason behind that?**

**Dr. Mukesh:** Initially, the job and initial financial resources attract the students, so they go for that. But only some students know it is a good course for learning jobs. If you go initially, it might be less attractive to you, but then with the experience because this civil engineering is a very specialized job. It takes work to make a bridge. You cannot sit on the computer and make a bridge. You know it is hugely complex, and you don't have any experience of the work in core. So, they go into different jobs other than civil engineering.

This is a lack of understanding. You know they should ask, and they should ask and listen and understand what all the big civil engineering companies do. After all, nation-building is also from civil engineering.

All the massive roads, infrastructure in terms of the railways, irrigation system, and water supply to large cities are products of civil engineering. So Civil Engineers are indeed nation builders. So, it is probably not the mistake of the students. There is undoubtedly a need for a proper education as to what you can do as a civil engineer.

Personally, getting a higher education and getting back into teaching is hugely satisfying and very good. You cannot compare it with any of the available jobs.

Lastly, people do go for non-civil engineering jobs initially and later on; they come back to me after one year saying, sir, we do not like it. We want to change, and they might even come back after 1-2 years if they want to do their master's degree or go abroad for that. Students need more clarity about what they want to do, but eventually, they settle in a good place.

**SoCE: Any message you want to convey through SoCE?**

**Dr. Mukesh:** "Well, apart from that, you all are very good. There is little to add, but the only thing is if you want to be very good and successful in your life rather than in your career or something. Read a lot and Travel a lot."



# DR. PARTHA NARAYAN MISHRA

Geotechnical Engineering

**About:** Dr. Partha Narayan Mishra completed his BTech-MTech dual degree from NIT Rourkela and PhD from the University of Queensland. He joined the esteemed institution, IIT Kanpur, on 9th December 2022. Prof. Mishra's research interests span across four key areas. Firstly, he focuses on employing electromagnetic measurements to characterize soil properties and processes. These methods are fundamental in developing early warning systems for various geohazards, including landslides and the health monitoring of tailings storage facilities. Secondly, he is actively involved in studying the reuse of industrial waste, particularly mine waste and its storage. Additionally, he explores the utilization of bio-mediated approaches, often referred to as green approaches, for soil stabilization. Finally, he researches on and imparts his knowledge and expertise in the mechanics of unsaturated soil to the students at IIT Kanpur.

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**SoCE: We've witnessed a decline in student enthusiasm in research. How can they grow their interest?**

**Dr. P. N. Mishra:** Motivation must come from inside. I believe that money cannot be the driver to undertake and sustain a career in research. You have to be genuinely interested in developing something while working on an aspect that has not yet been explored. The outcomes may either be advancements at a fundamental level or a practical implementation of a technology while solving a "meaningful problem".

**SoCE: How will we know that a particular topic or field is still unexplored?**

**Dr. P. N. Mishra:** I got into research on the unsaturated state of soil because I was keen to know about the interaction between the pore water and pore air phases. This aspect was not usually taught in undergraduate classes. During my undergraduate studies, soil was introduced as a three-phase medium consisting of air, water, and soil solids, but most of the formulations were based on a two-phase idealization. Inspired by my surroundings and driven by curiosity, I embarked on my research journey to delve deeper into this subject. Through this example, I wanted to convey that students should draw inspiration from their surroundings and question the concepts they are being taught.

**SoCE: What are the career opportunities available in Geotechnical engineering?**

**Dr. P. N. Mishra:** Since my professional experience is from Australia, I do not know much about the Indian perspective of a career. However, outside India, there are abundant opportunities in both academia and industry for individuals who are genuinely interested in their field. While academia is becoming increasingly competitive, post-PhD students should maintain an open outlook regarding non-academic career paths. I firmly believe that students can secure excellent opportunities in their respective fields, as long as their fundamentals are strong, they possess an active interest in the discipline, and they have good interpersonal skills.

**SoCE: What projects are you currently working on?**

**Dr. P. N. Mishra:** One of the projects that I am currently leading and working on relates to soil shrinkage characteristic curve (SSCC). SSCC is the relation between the change in soil volume with changes in the percentage of moisture in soil. A consortium of 15 Australian and Indian universities are involved in the project where the aim is to find the variability in SSCC of fine grained soils while addressing the question "How characteristic is soil shrinkage characteristic curve?".

**SoCE: What points should a student keep in mind, when applying for research under your mentorship?**

**Dr. P. N. Mishra:** I would advise a few points. If a student approaches me for a research project they must know my

basic research areas. If there is a mutual interest, they should come up with a problem statement relating to the research theme, and send me a mail to schedule a discussion.

Students should not bulk mail the professors for internships/positions. They must approach only those professors with matching research interests.

**SoCE: How Geotechnical Engineering became part of the society?**

**Dr. P. N. Mishra:** Modern geotechnical engineering started in the early 1900s. Being a Geotechnical Engineer is sort of being an iceberg; no one sees the hard work, everyone sees the success, just like that everyone sees the fancy buildings but rarely pays attention to the foundation it sits on. Geotechnical engineering is an applied science; the application component of it is an art mastered over years of experience.

Foundation design is one aspect where geotechnical engineers predominantly work. Also, as a Geotechnical Engineer we deal with environmental problems like landfills looking at minimizing the interaction of the waste with geosphere and hydrosphere. Here, geotechnical engineer plays a role where they design an EBS(Engineered Barrier System). There are many other applications and practically it is impossible to list all during the limited time we have got.

Geotechnical engineering links to society in the sense that it is a part of Civil Engineering and it somehow helps to maintain a civil society.

**SoCE: What according to you would a student prefer studying here in India in an eminent university or should he consider going abroad?**

**Dr. P. N. Mishra:** For research, you don't choose a university you choose an advisor. In academic or research journey, the relationship between student and professor fluctuates temporally; sometimes you will find your professor is the best and sometimes you will not like them. But, it is important to maintain and actively nurture this relationship. If you get a good advisor, be it anywhere, they are going to make all the research facilities required for your research available to you. There are several variables that are important; we can't just look at only the name of the university. Ranking doesn't really help much. Indian Institutes like IIT Kanpur are doing well. The structure at IIT Kanpur is flat relative to Indian standards, and helps you to grow while allowing you to question openly when you don't like or understand anything. Even if you get an opportunity to go abroad make sure you do enough research on your advisor.

For example, when you go for a job interview, they are not going to hire you for the sake of the name or rank of the university but on the basis of what you know. A degree from a good university is going to push you a little bit but if your performance is not good it will not help much then.

Choosing between a good professor and a good university, I would prefer choosing a good professor. I would say at an

undergraduate level one should go for a good university but at postgraduate level one should go for a good advisor.

### **SoCE: Since we know geotechnical fields have a lot of career opportunities, what can the institute do to highlight these opportunities for students?**

**Dr. P. N. Mishra:** I would say a major chunk of the responsibility lies with the instructors. During the lectures the professor can educate students about the opportunities that lie within this field. If you find geotech. interesting, do a project to find more about it; drop in the labs and ask "why and how"? In geotechnical engineering, we still deal with a lot of empirical stuff - a lot of relationships derived based on observing how soils behave and trying to fit a correlation. However, we are now trying to find the physics-chemistry-biology behind it. Geotechnical engineering has several flavours. It depends on the individual which flavour interests you more. Earthquake geotechnical engineering, foundation engineering, probability and reliability analysis are some of the different areas that departmental colleagues at IIT Kanpur work on. Try Looking at professors' websites if you find something interesting, speak to them and discuss what you like even if it is not taught yet. "Inquisitiveness" is the keyword here.



### **SoCE: How did you develop interest in this field?**

**Dr. P. N. Mishra:** I wanted to be a doctor, but you know the drill with our entrance examination system. I had a decent rank in the entrance exam but not good enough to get into a government medical college. With much agony, I joined the civil engineering program at NIT Rourkela as I did not want to waste a year for preparation. The choice of civil engineering was simply hinged to the fact that civil-electrical-mechanical are evergreen core branches. Ignorance is a bliss sometimes, and that's how a medical aspirant who did not know what NITs/IITs were, ended up getting enrolled in a core branch at a NIT. I was not happy and even prepared for medical entrance in my first year of NIT (my grades in the first two semesters would explain this better - 8.8, 8.27, 9.28, 9.48, 9.63, 9.92, 9.79, 9.88, 10, 10). However, towards the end of first year, I had sort of settled and made peace with the choice of engineering as a career. I did not sit in AFMC and AIPMT which I was meaning to after first year. Many things triggered the decision, but most importantly I listened to a good advice by a family member who suggested that whatever you do, try to do be the best at it. 5 years later, I had done a couple of research internships, was almost certain that I am going to pursue geotechnical engineering as a career, and graduated with the institute gold medal for being rank 1 amongst all dual degree branches. There was no looking back thereafter.

### **SoCE: Most of the students go abroad for research work and settle there. What was your motive to come back?**

**Dr. P. N. Mishra:** You can settle wherever you want; it is important to follow your passion. Opportunities will come along the way if you are good at what you do. Besides, I am not a big fan of the word "settle". In 2019, when I was finishing up my PhD, I got approached by the faculty search committee of the department of civil engineering at IIT Kanpur. Things kind of aligned as the "Swiss cheese" model and 3 years later now I find myself here.

Please understand that education at IITs/NITs is highly subsidized from tax payers' money. If you are educated from one such institute, it should be your moral obligation to "give it back to the society". This is my chance of "giving back" while pursuing my passion and being relatively closer to family (still 2 flights away though!).

### **SoCE: What are your views about students going to civil services?**

**Dr. P. N. Mishra:** Before going for civil services, students should question themselves if they really want to go into civil services (is the push instinctive or societal pressure driven?) and if they are ok with the fact that they may not secure a position even after 5-6 years of preparation. If they have asked these questions to themselves, they will have a much clear mindset. I will stress on the fact that try to pursue the field that you have been trained in. There is a saying in Gita "स्वधर्मे निधनं श्रेयः परधर्मो भयावह् ।", which roughly translates to the following - it is better to die discharging your own duty (something that you are trained for) than following someone else's path.

### **SoCE: We have seen most of the students in Civil Engineering don't want to go into the core, rather they want to go into software or consulting or finance. What do you think could be the reason behind it?**

**Dr. P. N. Mishra:** It is the conditioning imposed on the students by the society and the newspaper blowing the "concept of monetary package equivalent of professions" out of proportion. Students don't take time to ponder over "what is their inner calling? What is their swadharma?". This is the key question to be addressed by the person themselves, but many take shortcuts by simply following what they are told to do or doing what everyone does/seems to be the norm. If you are enrolled in civil engineering, whether by interest or not, try to give it a chance. There is a possibility that you will like it. The reason could also link to the Industry/sector that is in demand in a given country. Like in India, the IT industry is huge so everyone wants to go there. In Australia, where the mining industry is big, most of the time you will either work for a mine owner or a consultant serving a mine owner. PS. Unlike IT, where your knowledge in the core disciplines (civil, electrical, mechanical) do not hold much value, mining sector needs and values experiences for all major disciplines (civil, electrical, Mechanical, IT, data science etc.)

### **SoCE: Any message you want to convey through SoCE?**

**Dr. P. N. Mishra:** Be proud of the institute that you are in. Take interest in whatever you are doing. Give civil engineering a chance even if it was not your first preference. Rejections are a part of life; use them as opportunities to "pause-reflect-improve". If you want some inspiration, maybe watch the lecture called "The Last Lecture" by Randy Pausch - a former professor of computer science at Carnegie Mellon. The lecture is on YouTube. There is a book summarizing the lecture, if you rather prefer reading over watching.



# DR. PRABIN KUMAR ASHISH

Transportation Engineering

**About:** Prof. Prabin Kumar Ashish currently serves as an Assistant Professor in the Department of Civil Engineering at the prestigious Indian Institute of Technology (IIT) Kanpur, India. Prior to this, he held the position of Post-doctoral Fellow at the Department of Civil and Environmental Engineering at The Hong Kong Polytechnic University, Hong Kong. Dr. Ashish also served as a Research Associate at the Department of Civil Engineering, IIT Bombay, India. He earned his Ph.D. in Civil Engineering from IIT Bombay in 2021, following which he pursued his M.Tech. degree from the Academy of Scientific and Innovative Research (AcSIR), CSIR-Central Road Research Institute (CRRI), New Delhi, in 2014. Prof. Ashish's educational journey began with a Bachelor's degree in Civil Engineering from the School of Engineering, Cochin University of Science and Technology (CUSAT), Kerala, in 2011.

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**SoCE: Did you consider going for gov./private jobs after graduation? If yes, why did you switch your career path to research? Can you please also elaborate on your academic journey so far?**

**Dr. Ashish:** I thought of going for higher studies after my undergraduate degree. However, I attempted Engineering Services Exam (ESE) in the beginning. I reached the interview stage but couldn't make it to the final list. I think this happened for a good reason. Later I joined the postgraduate program at CSIR-CRRI, considering my prior research interest and other personal reasons. I was fortunate enough to have excellent thesis advisors who introduced me to the fascinating world of research. Subsequently, I joined IIT Bombay for the doctoral program. Thanks to my advisor, along with my PhD thesis work, I had the privilege to engage in (a) multiple collaborative research projects, (b) mentoring new UG/PG candidates, (c) real-world road-related consultancy projects, etc. I subsequently joined as a PDF at PolyU in Hong Kong. Exposure to the research culture at PolyU was a highly satisfying experience for me. I started applying to different universities in India and abroad after spending a significant amount of time at PolyU. I got the faculty position offer from IIT Jammu, IIT Kanpur and KFUPM, Saudi Arabia. Finally, I decided to return to India and joined IIT Kanpur.

**SoCE: What was the motivation behind your decision to go for higher studies in pavement materials and designs?**

**Dr. Ashish:** Although there was no clarity on my future research direction, it was clear that I would go for a domain where I can play with mechanics. Although I liked all subjects in Civil Engg., I did some background checks on future prospects in different domains, especially from research and associated employability perspective and finally decided to go for transportation engineering. Within transportation engineering, I decided to go for pavement engineering as it has heavy dosages of engineering mechanics. At the same time, I do understand that sometimes, even if you didn't like a particular field initially, once you start working on it, you start liking it. Regarding current and future perspectives, I can see huge potential to grow in this domain as a professional engineer/full-time researcher, especially in India.

**SoCE: Can you please elaborate on your exposure towards working on field-related problems in your domain? In addition, kindly talk about your ongoing research projects.**

**Dr. Ashish:** I am glad that you brought up this point. This is something which is substantially missing in our domain in most of the institutes in India. Students don't really get enough opportunities to work on real field-related projects during their master's or doctoral degree. On the contrary, I was lucky enough to have advisors who provided enough opportunity to get exposure to field-related projects.

To highlight some of the major works, I essentially worked on a road widening project and waste materials utilization in road based research projects during my Master's degree (in addition to my thesis work). Similarly, during my doctoral degree, I worked on several field-related projects such as (a) inspection of national highway to identify reasons behind premature failure, (b) quality control, distress mapping and forensic investigation of cement concrete roads, (c) identification of reasons behind different types of failures on roads across Mumbai, (d) overlay thickness design, (e) pavement design for fighter planes, etc. I do get exposure to a couple of other research projects during my postdoctoral stay at PolyU HK (other than my postdoctoral research direction). Currently, my research revolves around (a) understanding the mechanics of semi-flexible pavement composite materials, (b) development of high-performance cold asphalt technology, (c) thermodynamics of aggregate-asphalt interface, and (d) rubberized asphalt binder/mixture, among a few to highlight.

**SoCE: Can you please shed some light on pursuing a Master's degree and related research field related preparation strategies? What opportunities can students have if they want to pursue civil engineering as a career?**

**Dr. Ashish:** The first and foremost requirement is your interest towards the respective subject/domain. Moreover, although you need not to appear for GATE to pursue Master's degree in IITs/IISc, you need to maintain grade above a certain level. Nonetheless, you really need to understand the basics of the subject matter so that you can understand and appreciate the advanced level of respective courses at the Master's level. The opportunity to pursue Master's degree in an overseas university is also very good. Since IITs have a very good reputation, getting admission to premier institutes outside India is not a difficult task; however, it requires some effort. I suggest identifying a specific domain of the broader civil engineering field that you find relatively interesting. Get in touch with the respective faculty and start working with him, perhaps from 2nd year itself (or as soon as you decide to go for research). By the time you graduate, you have already developed a much better understanding of that subject compared to your peers. I have personally seen this kind of model working exceptionally well for several UG students at IITB. As far as career opportunity is concerned, I can see a great future ahead in all domains of civil engineering. For example, environmental engineering/climate studies have good prospects considering global warming-related challenges ahead. Similarly, India has many practical challenges in the transportation sector. Therefore, transportation engineering-related researchers have a great future and an important role in nation-building.

**SoCE: As you have appeared for the engineering services exam , what is your opinion about students switching their path from engineering to UPSC CSE or ESE ?**

**Dr. Ashish:** Choosing CSE/ESE, or anything else is a personal preference. While CSE will shift you to a nontechnical domain, you will still be involved with the technical stuff if you are targeting ESE. I think our society itself is one of the prime reasons behind such a shift because people in general, are extremely ill-informed about the role played by researchers for societal development. As a result, an individual might feel less/no recognition by their respective society if they choose research as a career. On the other hand, UPSC jobs are highly regarded by society in general, and hence people at a young age get influenced. Although many candidates are genuinely interested in serving the nation through CSE/ESE, many are more concerned about power and the illusive societal acceptance stamp. It is also important to note that although someone has cleared ESE, he can't handle heavy dosages of technical stuff because of a limited understanding of the subject matter at the UG level.

**SoCE: How can an undergraduate student get an opportunity to work on a project under your supervision and what would you expect as the prerequisites?**

**Dr. Ashish:** Simple prerequisite is an interest in the pavement engineering domain. In addition, as I am an experimentalist; therefore, she/he should be hardworking to deal with different kinds of materials, such as bitumen, aggregate, etc., along with careful handling of heavy and sophisticated equipment. Some of the students I guided for their research project (during my own doctoral degree) are doing exceptionally well (<https://sites.google.com/view/prabinashish/team>). Also, dedication to their work is paramount because I have seen some UG students working on different projects just because they want their CV look glossy without putting serious effort. However, this doesn't apply to everyone because I also know students who did a fantastic job. The only promise I can make is that you will be having rewarding experience if you get involved with dedication and hard work.

**SoCE: Nowadays Civil Engineering is not only about building structures but also we have to focus on sustainability as well. What type of challenges a professor or a researcher has to do so , also how the implementation of it can be done on the ground level because we are having technologies globally but the implementation of these is much lesser?**

**Dr. Ashish:** As far as implementation is concerned, we have the necessary technology backed by substantial research to implement various aspects (including sustainability). However, there exists a significant gap between industry and academia. While we conduct a lot of research and develop technologies, it is ultimately the professionals working in the field who need to implement them. This disconnect between academia and industry has been a challenge; however, significant improvement has taken place on this front, especially in the last couple of years. Moreover, industries often face a shortage of technically skilled manpower. Therefore, bridging this gap by fostering collaboration between academia and industry, and skill development to practicing engineer is crucial. As far as sustainability is concerned, there has been a strong thrust on developing sustainable technologies by researchers as well as policymakers in recent times. In fact, I keep sustainability as one of the major requirements before fixing any research direction with my students/collaborators. Talking about challenges, while the situation of research funding has improved, we substantially lag behind the required level of financial support. This becomes even more challenging for new faculties.

**SoCE: Sir, as you have recently completed your academic journey and joined IIT Kanpur as an assistant professor. So, do you want to follow the same path as you had pursued your degree or you think that some changes are required while teaching or mentoring someone?**

**Dr. Ashish:** I think there is a substantial communication gap between professors and students in our Institute; however, I may be wrong also. Therefore, one thing I want to do is to reduce this gap and make a familiar environment for my students. I feel like I have been trained for a couple of more years and have relatively more exposure to a subject than my students. Therefore, there is no point for students to be hesitant/fearful/anything like that before reaching out to me. I strongly believe that my students are my family; therefore, I must take care of them in the best possible way while ensuring excellent training for their professional growth. Thanks to my PhD and postdoctoral advisor for imbibing such a positive thought process. In addition, I feel that our scholars (especially in my domain) are substantially missing the required exposure to additional collaborative research projects (other than their own thesis) along with necessary industrial projects. This is something which also needs serious work for their overall development/grooming as a researcher. From classroom teaching point of view, I think we need to highlight the importance of certain theoretical components to students in terms of practical implementation/utility so that they can appreciate their classroom learning in a much better way.

**SoCE: Right now in our curriculum, we have optional UGPs, some people do that if they are interested, they opt for it but it's not compulsory. So people don't like to go for it. So, do you think it is apt if we make it compulsory, like some colleges may have the criteria of compulsory internships or research projects for completion of degree ?**

**Dr. Ashish:** I certainly believe that UGP and an internship are paramount to fully appreciate what they have learned in the classroom. Getting a UG degree without a project/internship is similar to playing a video game involving constructing a building without seeing construction materials in real life. At the same time, I do believe that one can't do a good research project/internship if he/she is doing it just because he has been forced to do so for the sake of a degree.

**SoCE: Nowadays students are always in a dilemma in choosing their career path and finally land in the profession which they regret later. What are your views about this and how can they overcome this dilemma and choose the appropriate path?**

**Dr. Ashish:** I would suggest that everyone should try to get involved in research works and explore it whether you are planning to go for technical or non technical fields. You will feel much more satisfied if you have more exposure to the domain. I'm not sure how much time you have to do that but I'm sure that you have the opportunity to do that. If you start doing it, there may be a good conversion rate from non-technical to technical fields whether you go for some kind of core jobs or research.

# DR. RAJESH SRIVASTAVA

Hydraulics and Water Resources Engineering

**About:** Prof. Rajesh Srivastava completed his B.Tech. in Civil Engineering in 1980 and his M.Tech. in Civil Engineering in 1982 at the University of Roorkee. In his thesis, he investigated how free-stream turbulence affected the properties of a turbulent boundary layer on a flat plate. He later completed his Ph.D. in 1992 from the University of Arizona in the United States with a focus on salt-water intrusion in groundwater. Flow and transport in variably saturated porous media and flow through open channels are his primary areas of interest. His extracurricular interests include tennis, which he regularly played while in US, and badminton, which he started after joining IIT Kanpur.

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**SoCE: Could you please share your experiences over the years since you have worked at IITK for a very long time?**

**Dr. Rajesh:** I joined IIT Kanpur nearly 25 years back. At that time, there were only about 40–45 students in a UG class. It was a very different experience compared to now, when there are 150 students in a class. Earlier, I used to know the names of almost all students and could easily identify students who needed special attention. Most of us used to teach using the blackboard, which gave students time to think and take notes. The interaction during the lectures was also livelier. The method of teaching has now changed significantly and most of us now use PowerPoint slides for teaching. Even though there are some advantages, like the ability to show animations, videos, etc., to explain things better, the pace of instruction is generally faster and it becomes hard for the students to understand the material during the lecture. Another change which I have noticed over the years is in the objectives of the students. Earlier, quite a few students were interested in the learning aspect of a course but now it seems that grades have become more important to a majority of the students, probably because of the fierce competition. The laboratory experiments have also been affected by the large size of classes. When there were fewer students, they could perform the experiments in a smaller group and everyone was fully involved in the conduct of the experiments. Now, due to the larger group size, some students may not be that much involved. The objectives of the professors have also undergone a change over the years. Since the government assistance has steadily declined, the Institute is expected to generate much more funds than earlier. Also, the ranking at national and international level has become more important. These require a significant effort by the faculty members towards writing research papers and getting research/consultancy projects, compared to what it was a few decades ago.

**SoCE: What options are there for students to pursue a rewarding career in core?**

**Dr. Rajesh:** I have seen that most core companies prefer students with a master's degree, since they have experience of working on their own during the theses and also may have more specialized knowledge related to the company's work. I would recommend students to get a dual degree to save a year. Also, in the beginning, core job may not look very attractive, but things usually turn out to be better in long run.

**SoCE: In the United States, you went to the University of Arizona. How did you like your time there? Will you suggest that a student do research there, or do you prefer IIT Kanpur?**

**Dr. Rajesh:** I thoroughly enjoyed my time at the University of Arizona and recommend to most students, who seek my input, to do research from US or Europe. Although exceptions exist, the research work for PhD there is generally better than what we do here, possibly because of the difference in student quality, academic interaction, and computational and

experimental facilities. For example, even a relatively small US university used to have much better computing power, it was very quick and easy to order equipment and get it repaired, and there was a great degree of interaction among PhD students working in different fields. And it is not just the quality of work which is important, but the exposure to a different culture, way of life, and work-ethic. We used to get a lot of assignments and take-home exams, and no one even thought about using unfair means. This integrity was seen not only in academics, but in the overall conduct also, and made a big impression on me. During my last few trips to US, however, I did notice some change for the worse in the society, probably because of the economic downturn. As for Europe, during my one-month stay in Germany, I noticed that Europeans are a bit more laid-back at work than Americans, who are more competitive or work-driven. However, the quality of work done in Europe is also quite good.

**SoCE: As the climate changes, there are more and more extreme events. One of these is a lack of water. In many parts of the country, the groundwater table has been going down. What causes groundwater to become contaminated and run dry?**

**Dr. Rajesh:** There is only a limited amount of water and the number of people using it is growing. There is also a large spatial and temporal variation in the availability of water, causing mismatch between demand and supply. Indiscriminate use of groundwater and smaller recharge due to reduction of permeable area, cause the water table to go down. Most houses pump groundwater for their household demand because the municipal supply is unreliable, irrigation relies heavily on groundwater, and there is lack of awareness about efficient use of water resources. For example, till a few years back, our campus used about three to four times as much water as an average colony of this size would. Use of reclaimed water for watering the lawns has reduced our consumption significantly.



As far as groundwater contamination is concerned, it is not accorded a high priority because it is not as visible as river/lake pollution. Moreover, the issue of quality comes after quantity: if you do not have access to enough water, you will use whatever is available. Some sources of groundwater contamination are industrial (waste disposal), agricultural (fertilizers, pesticides), municipal (landfills), and natural (rock/soil). There is a village nearby, where the water is yellowish because it has a lot of chromium in it from the tannery waste disposal. It caused a lot of health problems, but the villagers kept on using it due to lack of other sources. Groundwater contamination from leaking underground petrol storage tanks, which has already affected groundwater in several developed nations, is going to be a major concern in near future. Proper monitoring, rules related to groundwater use and its pollution and, more importantly, their strict enforcement, are needed to effectively address the contamination problem.

**SoCE: Many civil engineering students find it hard to decide on a career because they don't know about the opportunities in the hydraulics sector. What do you think the job prospects are in this field?**

**Dr. Rajesh:** Although there are a few private sector companies in the field of hydraulics, majority of jobs are in the public sector, since most projects in hydraulics are of a very large size and government-managed. Slowly, however, the government organizations are moving towards outsourcing their design, construction, and maintenance work, which will lead to a greater demand for hydraulic engineers. Another area in which job-prospects are going to improve significantly is the pollution of surface- and ground-water. The environmental clearance given to an industry mandates it to perform a hydraulic study and assess its effect on the nearby water resources. With the emphasis on inland waterways, the need for hydraulic engineers is also likely to increase.

**SoCE: Is the summer surge program really helpful for students? Can a student in their second year do good research in two months?**

**Dr. Rajesh:** Even though 2nd year students have not taken many civil engineering courses yet, they do really well if they get a little training. What they lack in academic background is made up by their eagerness to learn and willingness to put in long hours. A SURGE student worked with me a few years ago on a project related to identification of groundwater pollution sources using samples collected from a well. She quickly picked up the basics of what was required in the project and did very good work, which was recently published as a journal paper. I think the project was really helpful in creating a research aptitude in her. Most of the summer research students are good at analysis of data and interpretation of results, which is needed for these projects.



**SoCE: What kinds of internships and work placements are there in civil engineering?**

**Prof. Rajesh Srivastava:** It largely depends on your goal. If you are more research-oriented, internship in foreign universities would be a good option, although it is becoming increasingly difficult to get these. In some areas, like Computer Science, companies like Google and Microsoft may do better research than academic institutes, but in Civil Engineering, academic institutes perform better research. If you are more interested in a core job, internship in the relevant industry should be better, but the opportunities are limited in our discipline, and have not grown as fast as the student strength.



**SoCE: Any message you want to convey through SoCE?**

**Dr. Rajesh:** I am of the opinion that keeping a good health, both physical and mental, should be our top priority and taking care of it should not be put off. When you are a student, the priorities are academic performance and getting a good job. When you join a job, the career advancement becomes a priority. Based on my experience, as one gets older, good health appears to become the top priority. Of course, one should not neglect his/her primary goals, but it should not be at the expense of one's health. Even little bit of regular physical activity would go a long way. If you can play sports, it not only keeps you physically active, but also socially active, which is important in these days of dwindling direct interaction. Finally, my suggestion to the students is to do what you like, do it to your best ability, and enjoy doing it.



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DISTINCTIVE  
COMPOSITIONS

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# PERSONAL ARTICLES

## लक्ष्य

हो दिन में तपता हुआ सूरज या रात हो कंपकंपाती सी  
हो फूलों की सेज रस्ते में या कोई कांठों भरा पथ हो  
सिमटकर या थककर बैठ जाना विकल्प हो नहीं सकता  
दांव पर सब कुछ लगा है, लक नहीं सकता

तारीख के पन्नों में हो दर्ज ऐसा किस्सा कोई हो  
जो पथ हो सरल, सुगम क्यों उसका इस्सा कोई हो  
जो लक्ष्य अप्राप्य गोचर हो, उस पथ पर पदचिन्ह रखना है  
दांव पर सब कुछ लगा है, लक नहीं सकता।

हाट का खयाल न आए हरिगिज ऐसी रणनीति रखनी है  
बाधाओं का पथ पर होना तो लाजिम है  
डटकर मुकाबला न हो, ऐसा हो नहीं सकता  
दांव पर सब कुछ लगा है, लक नहीं सकता।

गति मद्दिम करता है उम्मीदों का ये भार कांधे पर  
पांव जकड़ती हैं जमाने की देखकर होती अनदेखियाँ सारी  
मगर फिर भी मुकुराते हुए लक्ष्य से मैं नजरें हटा सकता नहीं  
दांव पर सब कुछ लगा है, लक नहीं सकता।

- Arush Kumar Rai

## दीमक

आवो सभा सम पंच गण, चुप्पी धरो त्रुटि-पंच भर  
एकत्र हम यदि हों सभी, होगा नियत लहू-रंज रण,  
मित आगमन प्रति बुद्धि-वर्का, आगमन हो भात का  
तुमको कथानक मैं सुनाता, डक भयावह रात का  
सब शांत थे, सम्यक सभा, सम थूर्न्य शब्दाचार था  
गंधार, पुन्य प्रणीत था, औ चंद्रवंश व्यामिचार था  
थे तात आहत, रक्तरिक, हृद पार उसका तीर था  
सज्जित चला मित मलिन लहू, गांगेय, तुच्छित वीर था  
गंधारपति और पुत्र लुचित, धूलि कारावास में  
केवल बचा एक पुत्र थामे अस्थि-पिंजर हाथ में  
यह पाप, कौटर नाथ है, यह भीष्म पश्चाताप है,  
उन अस्थियों का चूर्ण है, और तात शकुनी साथ है,  
यदि धूल में कम था लवण, थी लोप सुबाला-नंदिनी  
वह इंद्रप्रस्थाचल हुई, बन नेत्रहीन नृप बंदिनी  
जाऊँ उपहासित भेट बन यदि, हस्तिनापुर राज्य में  
है साक्ष्य बन बैठी सभा और, शपथ करता आज मैं  
जो मूकदर्शी थे बने, दर्शक सुबाला वध रहे  
यह थाप बनकर काल उनकी वंश माला में बहे  
यह सिद्ध होगा पीढ़ियों को, शकुनी सम कोई वीर था  
जब शकुनी होगा हंस रहा, प्रति मूक दर्शकदीर्घा  
जब दीमकों और दानवों को, रसा मिलेगा बैर का  
जब खोखला होगा सिंहासन, नृप विना सिर पैट का  
तब पाप पलटेगा सिरहाने, अंक मेरे आयेंगे  
अक्षौहिणी तब दीमकों की, हस्तिनापुर खायेंगे  
लज्जा गिरी होगी धरा पर, विष्णु हों लज्जित, सखे  
बस एक हंसता हो, सौबाला, पाप हाथों में रखे  
ओ क्षृष्टीन शासक सुनो, कुरुकंश सांसे गिन रहा  
पाकर जगा से सांधि भी, ना हाथ आरी निर्जिरा  
होगा तटस्थित भी यदि, तू गिर्गिड़ा ले भक्त आ  
दिन भर सुनेगा तू कथानक, वंशजों के रक्त का  
होगा बड़ा यदि अंशभागी, खेल मेरी गोद में,  
सुत है सुनिश्चित, मत मिलेगा, तोड़ जंघा क्रोध में  
निन्यानवे भाई मेरे, शत पुत्र वान कुरु राज हों  
युग युग मनुज काँपे थराथर, शकुनि यदि अभिशाप हो  
धृतराष्ट्र तू अपभ्रंश बन, मृत पुत्र हों, मृत राष्ट्र हो

- Mudit Chand

## Overthinking about Overthinking

We spend our entire lives fretting about the worst-case scenario; we never choose the proper option when faced with a moral dilemma. Instead, we spend our time obsessing over what could possibly go wrong. This leads to nothing more than trying to figure out what, exactly, is right and wrong. Is there a choice that is either good or bad? Or are they the good and real choices? And at times like this, it feels as though thinking too much is a disease, a real and actual disease. It seems that the act of expressing or communicating anything is itself incommunicable. What I feel in my bones can only be experienced by those bones. The only thing that is truly, invulnerably, and irrevocably mine is the ability to ponder, to wonder if something is good or real, to dream about it. Is it possible that my thoughts and dreams are the very things that make the difference between merely existing and actually living? Is it possible that overthinking is not as harmful as it is commonly believed to be? And what if that moment is also the moment when I am most truly myself? Would it still be wrong to dream, then? Maybe that's the fire that keeps hopeful dreamers like us warm in the cold. To me, it seems like I have a blank canvas overhead. Yet perhaps in this dream, we sometimes wonder if we are monsters or if this is what it is to be human. In these dreams, the pressure to continue being the same person I was the day before sometimes is too much to bear. These dreams and thoughts, however, end abruptly, much like real-life ends, which often occur without warning or explanation.

"I remained too much inside my head and ended up losing my mind," Edgar Allan Poe said, and when Sylvia Plath referred to the mind as a prison, I wondered if it truly was the place where I would be lost forever. It was at those moments that I was thankful for the abrupt ends since they made me feel more human than I ever had before in my interactions with other people, and I did not ever want to be that raw in my feelings.

The desire for love is replaced by a need for understanding at times like these. When there is no mutual understanding, all the affection in the world is for naught. In spite of their extensive knowledge, even those closest to you do not fully get who you are.

But what truly is understanding? "Whoever thought that he had understood something of me had only made something out of me after his own image," Nietzsche once said. So perhaps when the weight of the world becomes too much, they try to forget the complexions of people's understanding and love. They retreat to their dreams, where they are tenderhearted and appreciative of life and treat it with compassion and care. It's possible that's how nature creates beautiful people.

In that case, why does society view excessive thought as a flaw? Is it not only just real? Maybe all that the dreamers seek is to be beautiful, to believe in the magic of comprehending the things they love.

Perhaps in the process of making sense of the world, we strive to forgive ourselves for all that we did not accomplish. Perhaps we tell ourselves that this is the only place where good things can happen. Maybe it is us trying to convince ourselves that we are not animals. Maybe we try to decipher who will be lost in the story we tell ourselves.

Who will be lost in ourselves?

And perhaps most of all, we give it a lot of thought because somehow our words feel wrong everywhere, even in our mouths. Maybe because when we think, we think and feel in colors. Not words, but shades. To maybe remember the day I first found myself beautiful in the land where my only judge was me.

We are told not to start our sentences with "because." But I am not trying to make sentences; I am trying to break free. Because in my thoughts, I could live several lives, but inside a single-use life, there are no second chances, but we live anyway.

Because in our thoughts, we aren't afraid of anybody- not even ourselves.

- Srishti

# INTERVIEW WITH DISTINGUISHED ALUM: SHRI. RAJENDRA P. BHATTARAI

- Team SoCE

**About:** Mr. Rajendra Bhattarai received his B.Tech. in Civil Engineering from IIT Kanpur in 1976 and his M.S. in Environmental Health Engineering from the University of Texas at Austin in 1980. He worked at the Texas Department of Water Resources from 1980–1984 and at Austin Water of the City of Austin from 1984–2018. After retiring from Austin Water in September 2018, he has been serving as the President of Clean Water Strategies. He served as the President of the Water Environment Association of Texas, and the Texas Association of Clean Water Agencies, and as a Board member of the Water Environment Federation, of the National Association of Clean Water Agencies, and of the Water Environment Research Foundation. He is the recipient of many awards, notable among them Fellow of the Water Environment Federation, Distinguished Alumnus of the Civil, Architectural and Environmental Engineering Department of the University of Texas at Austin, and the Distinguished Alumnus Award from IIT Kanpur.



Image: DoRA, IITK

Shri Rajendra Bhattarai (left) receiving the Distinguished Alumnus Award from Dr. Abhay Karandikar, Director, IIT Kanpur (center) and Dr. K Radhakrishnan, Chairman, BoG (right)

## SoCE: What sparked your interest in water research and led you to many accomplishments in this area?

**Shri. Bhattarai:** What got me started was Dr. Malay Chaudhuri's environmental engineering class at IIT Kanpur. Initially, I intended to pursue a specialization in structures. In the second semester of civil engineering, I enrolled in my first environmental engineering course: water and wastewater treatment. I liked the class so much that in the first week, I decided that this was the field I wanted to be in. We all understand that life depends on water and that no life exists without it, so I felt studying water is essential.

Another major factor was Dr. G.D. Agrawal, who taught me two classes at IIT Kanpur. His teaching style and passion left a powerful impression on me. I liked physics and chemistry, but I didn't care much about biology in high school. Dr. G.D. Agrawal was teaching a microbiology class here, and I absolutely loved his style and suddenly realized what I had been missing in biology. I've never encountered a great teacher like him. Based on what little I know, he could teach anything and do it better than anybody else since he was a natural-born instructor.

So I quickly concluded that water is what I should specialize in, and I chose most of my electives from environmental engineering. I was fortunate to be accepted into IIT Kanpur and to graduate in five years. Back then, we had a five-year B.Tech. Program until the fast Fourier transformation changed it into a four-year program for you.

Dr. Malay Chaudhuri and Dr. G.D. Agrawal were the primary sources of my inspiration, but all our professors were top-notch. Once I got interested in water, I kept going. I have always found it appealing; I am passionate about water and wastewater treatment. When I applied to graduate studies in the US, I focused on water, which became my career. I wish to reiterate what Dr. G.D. Agrawal taught us. He consistently emphasized that whatever we do, we must remember that civil engineering is the name of our department.

It starts with the word "civil." Therefore, whatever we do must be for the benefit of the civil society. I have used that as my guiding principle. It has helped me throughout my career.

## SoCE: Can India implement the same model that you did in the Austin water system, which significantly improved the management of wastewater and the city's water quality?

**Shri. Bhattarai:** We shouldn't simply replicate what has been done elsewhere. We must figure out what is appropriate for every location and environment. Austin is significantly more prosperous economically. People can pay because they are financially well off. In Austin, the average monthly water cost is currently around \$40, the average monthly wastewater bill is around \$50, and the residents are prepared to pay it. People will likely rebel if we charge that amount here.

The public drinking water in Austin is safe and of good quality. You can drink water directly from the faucet and not get sick. We are also fortunate to be able to drink from the tap here at IITK. In the five years I spent studying here, and every time I have come back after that, I never fell ill. This speaks highly of the campus and how well-kept I found it.

## SoCE: Machine Learning and Artificial Intelligence are used today in almost every field. How have these tools affected the field you are currently in?

**Shri. Bhattarai:** Machine learning and artificial intelligence are useful tools, but they can't solve all your problems. You still require domain expertise. These are tools that you can employ in almost any field, in my opinion. Even Austin Water has used some of that technology. For instance, when performing sewer inspections, we insert a camera into a wastewater collection line to check for pipe cracks. Spending countless hours on something like monitoring video footage can be tiresome. As a result, you need AI for these types of

occupations, but you also need humans with subject matter experience to train the computer because a computer cannot make wise policy judgments on its own. So, just like any other object, we may use it as a tool, as though we were using a calculator. But eventually, the machine won't ever be able to fix the issue, we will have to.

**SoCE: In spite of the fact that water is essential to human survival, it is frequently mismanaged, and as if it were an annoyance, according to your observations, what do you believe the possible reason for this behaviour is?**

**Shri. Bhattarai:** A ubiquitous term in economics is the diamond-water paradox. Diamond is useless for us; there is no practical use except for some scientific research. It costs tremendous money, which people are willing to pay for. Whereas water is essential for life, somehow people think water should be of excellent quality and available wherever and whenever they demand it, and it should be free. So even though it is essential, they want to avoid paying anything. But the same people are willing to spend crores of rupees for a piece of diamond.

There is another more fundamental, ethical, and moral issue because water is essential for everyone. It's different from electricity, cable TV, or mobile phones that people should profit from. It's sad to see that people are benefiting from selling water. So water should be in the public sector, owned by the people, and not privatized. Unfortunately, when the public water supply is not good, private industries step into profit. And the private bottled water industry has done an excellent job of making a villain out of the public water supplies that even if the public water supply is good, people don't trust it and use bottled water. And that's another paradox, even though people expect water from the taps to be free, they are willing to pay vast sums of money for bottled water, which causes environmental damage. We have to change our thinking and behavior, which is a slow process, but we have to start somewhere at some point in time. Why not start here and now?

**SoCE: Sir, we spoke with Mr. K. Shri Harsha, creator of Kritsnam Technologies and an alum of IIT Kanpur. They are a water-focused business and have won numerous accolades for their innovations and contributions. So Mr. Harsha discussed attempting to identify the low-hanging fruits which is identifying the problems that are easier to solve. And then devoting time to figuring out and implementing a solution for these problems. Where can we look for these low-hanging fruits? And how do you recommend the students of today go about finding them?**

**Shri. Bhattarai:** Thank you for asking this important question. I don't know Mr. Harsha, and I am not familiar with the work done by Kritsnam Technologies, but I like their idea of targeting low-hanging fruits because, with them, you get the most significant return for your efforts. Generally, people want to know about the latest technology and the most glittery stuff whenever I travel and talk. But I want to discuss fundamental issues, sustainability, and appropriate technology to help as many people as possible. There are many low-hanging fruits for managing water and wastewater, from source water protection, treatment, and distribution of drinking water to wastewater collection, treatment, and resource recovery. Wastewater has numerous resources - water, first and foremost, followed by energy, nutrients, and many other resources. We could start by recycling water and recovering other resources depending on site-specific conditions. Another area we need to work on is managing our existing physical assets. Our philosophy appears to be, "build - neglect - and rebuild at a greater cost." Our culture glorifies people who design and build new things. However, after something is created, we ignore it and don't want to invest effort in adequately operating and maintaining it.

Hence, the asset fails long before its expected design life. Managing and maintaining something to have a long, productive, and economic life is challenging but essential. Sadly, our culture doesn't recognize the hard work of operation and maintenance - there is no glory or money in it. It requires behavioral changes, and unfortunately these are very difficult to implement and take a long time to take effect.

**SoCE: What are your views on future hydroelectric power plants? Why are they losing their popularity and why aren't any hydropower projects coming in recent times? Do we need design changes? Or does it have something to do with the environmental issues or do we have more efficient alternatives available?**

**Shri. Bhattarai:** Several factors. First, a dam and the associated reservoir require a large swath of land. And so there is a price for it, which is not free. Building a dam and creating a lake submerges many lands - possibly villages, towns, people's livelihood, and their whole cultural heritage- destroyed. Also, environmental implications existed for plants, wildlife, and everything living there; their habitat is disturbed. And the river completely changes its characteristics. So you must consider these social, economic, and environmental factors, not just the potential profit from hydropower. The biggest problem, especially in our region here, is that our mountains here - especially in northern India - are much younger, geologically speaking. Because these are relatively young mountains, we get a lot of seismic activity and landslides that could lead to catastrophic dam failures. That's going to create a lot more problems. If there is significant soil erosion or a major landslide near a lake, it gets silted very quickly. And once a lake gets silted up, there is no storage capacity for the water. So if we can have renewable resources like solar and wind, they may be better solutions for the future. However, hydropower could be appropriate for some areas depending on the geology and other site-specific conditions. It's challenging to categorize whether it is good or bad for all locations.

**SoCE: How did you spend your student days at IITK?**

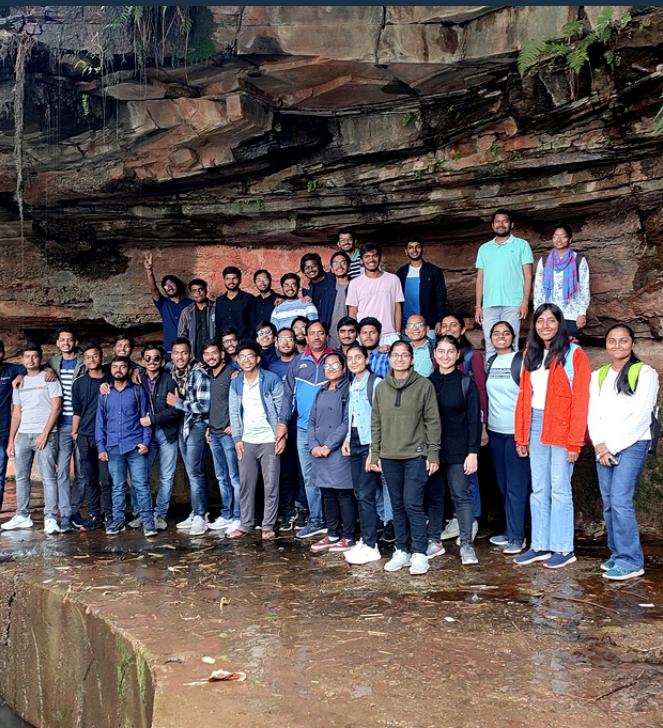
**Shri. Bhattarai:** Arriving here overwhelmed me. Everyone around me was younger, more innovative, and almost magical. I thought I couldn't keep up. I worried I wouldn't fit in and had to go home. Luckily, it didn't. Excellent, friendly instructors. They were beneficial whenever we asked. Always encouraging and helpful. When I needed aid, all my pals were great. My buddies never said, "No, I'm busy," or "I won't teach you because it would curve the grade." They always helped me comprehend. Unlike professors, friends' explanations are pleasant and remembered. My friends and teachers helped me have the best five years at IIT Kanpur. Everyone wanted to help. So I succeeded. I didn't do many extracurriculars when I barely kept up with my grades. Unfortunately, they would have made me more well-rounded and better. IITK equipped us for the world stage and gave us the skills to handle difficult situations everywhere. IITK opened my eyes to the world when I initially came.

I wish I had studied more social sciences and humanities as they help you communicate. Regardless of your position, that affects your relationships, collaboration, communication, and job advancement.

No terrible memories. Most recollections are good. I need help remembering anything wrong about IITK. I'm lucky, and earning the Distinguished Alumnus Award astonished me. I'm stunned. I'm overjoyed. I keep pinching myself to make sure I'm getting this honor. I must live up to the high standards set by other highly successful recipients.

# COURSE SUMMER CAMP: CHITRAKOOT

- Smriti Tripathi



**After years of passiveness and distress,** the much-anticipated Survey Camp voyage of Ours—the Civil Engineering Students of IIT Kanpur, began, thanks to Prof. Onkar Dixit, with utmost zeal and enthusiasm. We set out on a captivating excursion to Chitrakoot for our Survey Camp course, CE332A which was offered to us as a UGP. With a mixture of exhilaration and apprehension, we embarked on this extraordinary expedition, aware that it was a once-in-a-lifetime opportunity.

**On the morning of the 27th,** we left the campus and began our voyage towards Chitrakoot, a tranquil and picturesque location in Uttar Pradesh, India. This charming town, nestled on the banks of the Mandakini River and surrounded by verdant hills and dense forests, boasts breathtaking natural beauty. With cascading waterfalls, lush greenery, and diverse wildlife, Chitrakoot is renowned for its religious and cultural significance, which draws visitors worldwide. Although the journey was lengthy, our spirits remained high as we eagerly anticipated future adventures. During our bus ride, we paused at the "Shitla Dhaba," where we indulged in delectable "parathas" and savored hot cups of "chai." This break allowed us to stretch our legs and engage in refreshing conversations with one another while also getting to know our professors. We knew then that this week would be etched in our memories forever.

Upon our arrival at Arogyadham in Chitrakoot by evening, we were instantly captivated by the enchanting scenery surrounding us. Established in 1978, Arogyadham is a well-known health center renowned for its Ayurvedic medicinal expertise and is considered one of India's oldest and most prestigious institutions. In addition to its historical and cultural significance, Arogyadham is also renowned for its natural splendor. The center is nestled amidst a beautiful landscape, sprawling over a vast area featuring stunning gardens, fruit orchards, and medicinal plantations. Our lodging was at Panchvati, a hotel beside the serene Mandakini River. Two individuals shared the girls' room while the boys' room had eight individuals, which delighted us as the accommodation was comfortable and spacious. The breathtaking beauty of the Mandakini River also enticed us to plan a swim in its crystal clear waters.

The culinary delights at Panchvati left us thoroughly satisfied. The food was not only delectable but also diverse, featuring items such as paneer, dal, salad, pickle, gulab jamun, kheer, kadhi, rice, rotis, parathas, jalebi, curd, chai, raita, sabzi. The communal meals were an excellent opportunity to bond and share stories. Our group was composed of 8 undergraduate groups, each consisting of 5 individuals, as well as two postgraduate groups of the same size.



**Throughout the trip,** we were accompanied by our teaching assistants, Prashant Chauhan and Rohit Rajput, whom Shitla Tripathi and Hari Babu Sir joined in guiding us through the journey. At the outset, we were acquainted with the tasks assigned to us for our stay at Arogyadham. These tasks included creating a topographical map of Arogyadham, conducting a road profile analysis from the petrol pump to the main gate, and utilizing the JUNO device to chart the route up to Kamadgiri Parikrama. After a brief reconnaissance phase, the groups decided on their respective closed loops for the topographical map.

**Some of us finished our work early in the evenings** and headed to Ram Ghat to witness the grand Ganga Aarti and procure souvenirs. In contrast, others opted for the thrilling ropeway ride at Hanuman Dhara. It was an immensely spiritual experience that left a lasting impression on us. We played games like UNO, BLUFF, and Truth or Dare at night, which helped us forge stronger bonds. Some days, we went for walks, exploring the city and experiencing its majestic aura. The Mandakini River Banks at night were incredibly serene, providing the perfect setting for self-reflection and letting go of negative thoughts. Overall, the city's alluring skies and charming views made us realize the virtues of self-love and gratitude.

**On a subsequent day**, the groups embarked on their tasks armed with paint to mark their control points. Later in the day, some groups traversed, and some went for their JUNO expedition. All the groups used to work from 8 AM to 1 PM and then used to go and have lunch at Panchvati. After lunch, they returned and continued their work till 6 PM. All of us were dedicated to our tasks and worked hard to finish them.

**On the third day**, some groups undertook Auto leveling while others continued their JUNO expeditions. Despite the fatigue, we remained focused and dedicated to our tasks. These afternoons were always challenging, but we found ways to lift our spirits. Some students played short games, while others shared music and engaged in lively conversations, and all these days ended with us returning to our rooms and enjoying a cup of tea with our fellow batchmates. These tea sessions are then converted into discussions on what work we'll do on an upcoming day.

**On the fourth day**, some groups continued traversing and feature mapping while others continued their JUNO expeditions. We were advised to record at least a hundred features at each control point during feature mapping. The JUNO expedition was a 12 km walk (6 km each way) that allowed students to experience the spiritual aura of Chitrakoot. The groups would pack lunches from Panchvati to sustain us during these walks, fueling us for the long journey ahead.

**On the fifth day**, the groups used the GNSS receiver to acquire global coordinates, which were crucial for creating the topographical map. The following day, we focused on concluding our feature mapping task, as Onkar sir promised to take us on a picnic only if we finished our assigned work. With a collaborative effort, the groups were determined to complete their work and eagerly anticipated the promised outing.

**The much-awaited picnic day finally arrived**, and everyone was dressed in their finest attire, eagerly boarding the bus that would take them to the mystical and magnificent sites of Chitrakoot. The Gupt Godavari Caves, a natural wonder of India, were the first destination on our itinerary. Flowing through the caves, the Godavari River created a magical atmosphere that left us in awe. The river's reputed healing powers drew many visitors, who bathed in its waters and meditated in the serene surroundings. We couldn't resist the urge to drench ourselves in the holy water and receive its blessings.

**Next, we visited Sati Anusuya**, the legendary site where Anusuya, the wife of Rishi Atri, demonstrated her hospitality towards the three gods, Brahma, Vishnu, and Mahesh. Her act of devotion and selflessness serves as a reminder of the significance of these values in Hindu culture. Then, we went to see the renowned Mahabharat Kund, a sacred place surrounded by stunning mountains and lush green forests.

**Our picnic lunch was at a school**, where we interacted with the adorable children who captured our hearts. On the bus, we sang songs and conversed among ourselves while heading to the next destination, the Dharkundi Ashram. The ashram was dedicated to the teachings and principles of the Hindu saint and philosopher Swami Shri Ramdas Ji Maharaj. His disciples and followers continued to propagate his teachings and philosophy. Lastly, we visited Sabri Jalpatra, where Sabri, a devout follower of Lord Rama, offered him a pot of water. The incident is believed to have occurred at this spot, and Lord Rama blessed her with his divine presence.

After an exhilarating day, we returned to Panchvati around 8 pm, still basking in the euphoria of our experiences. It was a memorable day filled with awe-inspiring sights, spiritual experiences, and heartwarming interactions.

**As the sun set on our last day in Chitrakoot**, we gathered around to witness the fruits of our labor. The road profiling exercise was grueling, but we all worked tirelessly together to complete it. As we looked at the results of our hard work, we felt a sense of pride and accomplishment wash over us.

**As we prepared to leave on the morning of the 6th**, we couldn't help but feel a twinge of sadness at the thought of leaving behind this incredible experience. The journey had been more than just a field trip; it had been a journey of personal growth, cultural immersion, and camaraderie.

**As we return to the campus**, we carry the memories of this unforgettable adventure. We will forever cherish the moments we spent exploring the natural beauty of Chitrakoot, bonding with our fellow students and professors, and learning about the history and significance of this place. This journey has enriched our knowledge and skills and touched our hearts and souls in ways that words cannot express. We are truly grateful for this once-in-a-lifetime opportunity and will always hold it dear to our hearts.



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# HIGHLIGHTS

## 2022-23

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# BEST PAPER/THESIS AWARDS

Several students were honored with awards across different categories at various Awards Conferences from 2022-23. Some Awardees are listed below.

## Mr. Shubham Rathi

### **Best paper award in his section at the 2nd Asian Conference on Indoor Environmental Quality (ACIEQ 2023)**

Hi, my name is Shubham Rathi, PhD scholar. I recently won the best paper award at the Asian Conference on Indoor Environmental Quality (ACIEQ) 2023, held in New Delhi on the 24th and 25th of February. I was proud to win the best paper award at the conference. I am grateful for recognizing my and my team's work on indoor air quality (IAQ) in offices at the Indian Institute of Technology (IIT) Kanpur.

The Research team consisting of me, **Dr. Anubha Goel, and Deepshikha Ola**, monitored particulate matter (PM) during office hours in five offices on different floors of the faculty building. We also administered a questionnaire survey to office occupants to obtain feedback on health-related discomfort indoors. Our findings showed that at least one-fifth of the employee in four offices complained about health-related affliction due to high PM levels in the air.

Our study highlighted the potential health risks associated with exposure to high PM levels in the air and the importance of interventions such as air purifiers to improve IAQ. We found that only one location marginally met the current World Health Organization (WHO) guidelines for PM10, and all others far exceeded it. Our research showed that meeting the WHO guidelines for PM10 could increase the efficiency of workers in these offices by 12 to 45%.

Winning the best paper award at ACIEQ 2023 was an incredible experience. It was an honor to have our work recognized by experts in the field. This award motivates us to continue our research and contribute further to the IAQ and environmental health field.

I am grateful for my team's support and the resources IIT Kanpur provided, which played a crucial role in our research. I could only have achieved this with their support and guidance throughout the research process.

My award-winning paper is a testament to the importance of research in promoting public health and environmental sustainability. Our work highlights the need for greater awareness and action on IAQ in office environments where people spend significant time. With further research and intervention, it is possible to create healthier and more productive indoor environments for everyone.

In conclusion, I am proud of our team's work on indoor air quality and our achievement at ACIEQ 2023. Our research has provided valuable insights into the potential health risks associated with indoor air pollution and the need for interventions to improve IAQ. Our work will inspire others to pursue innovative solutions for environmental health challenges.

## Mr. Naveed Ul Hassan Bhat

### **Prof. U.C. Kothiyari - ISH Best M Tech thesis Award' from the The Indian Society for Hydraulics**

The Indian Society for Hydraulics (ISH) conducts the Best Thesis Awards (Ph.D. and M.Tech.) in Hydraulics and allied water resources every year as a part of its flagship Hydro conference. In the 27th edition of the meeting, my master's thesis titled "Diffusion Wave Approximation of Depth-Averaged Flow Interaction with Porous Media" was awarded the "Prof. U.C. Kothiyari - ISH Best M Tech thesis Award". The award carries a certificate and a token cash prize.

I am an integrated MTech - Ph.D. student in the department working with **Prof. Gourabandha Pahar**, and this thesis is independent of my Ph.D. topic. The thesis details the development of an integrated diffusion wave model for surface and sub-surface flows. The model is derived by volume averaging followed by the depth averaging of the basic conservation laws and the subsequent assumption of negligible convective and temporal accelerations. The resistance in and outside the porous media is incorporated in terms of a single diffusivity coefficient. Further, the model is solved through a finite volume grid through different schemes for temporal discretization in the presence of a substantial variety of diffusivity coefficients.

The work effectively a numerical study led to development of a computationally frugal framework with certain assumptions which remain valid across a range of physical processes. Additionally, this work has been published as a journal article by" Bhat, N., Pahar, G., 2021. "Diffusion Wave Approximation of Depth-averaged Flow Interaction with Porous Media" Journal of Hydrologic Engineering, 26(2), 04020064." The thesis touches on an essential point of the complexity required in developing numerical models for large-scale hydrologic processes. The model presented in the study can readily simulate a moving flood front through and outside porous media in a basin-scale catchment with suitable minor modifications. The vegetal cover (e.g., mangrove forests in the Ganga delta) can be conceptualized as porous media, and the proposed model could be used to simulate the progression of tidal motion.

I acknowledge my advisor's constant support and guidance in pursuing this work. I hope that the HWRE group fetches many of these and brighter awards in the future. Cheers!

## Ms. Vaishali Jain

### **Best paper award (oral) at the ICESE 2022 conference held at IIT Bombay**

I am pursuing Ph.D. in Environmental Engineering at the Department of Civil Engineering of the Indian Institute of Technology, Kanpur, under the guidance of **Dr. S. N. Tripathi**. I am delighted to share that I received the best paper award and prize money at the International Conference on Environmental Science and Engineering (ICESE) conference held at IIT Bombay in 2022. I presented my paper titled 'Seasonal variation of NMVOCs with ozone formation potential at an urban site of Delhi, India' at the conference. I also received the Best Thesis award at the Student's Research Convention (SRC), IIT Kanpur, in 2022.

As we know, Air pollution in India and the world is one of the leading causes of premature death and health risks such as lung cancer, asthma, and Chronic Obstructive Pulmonary Disease. Being devasted by the number of its effect (7 million premature deaths annually), I decided to understand the problem and contribute to it closely. Therefore, I choose Air pollution as my Ph.D. topic. I have divided my Ph.D. thesis into two parts; firstly, I am working on chemical characterization using real-time high-end instruments to apportion the sources of the non-methane volatile organic compounds (NMVOCs) in Delhi and Lucknow during different seasons. These two urban centers in Indo-Gangetic plains are crucial to understanding the transport, sources, and role of meteorology in air quality. Secondly, I am using deep-learning techniques to predict the microsatellite imageries-based PM2.5 in Lucknow at a finer resolution of a few meters (500m by 500m). The satellite-based prediction of PM2.5 has been attempted up to a few kilometers. For the first time, I am leveraging the benefits of machine learning models in air pollution studies to identify the sources, local hotspots, and cool spots of the air pollutants in the city. The results and inferences from my thesis and studies will help the stakeholders, city authorities, and administration to make informative decisions regarding air quality policies at the micro-level covering intracity and intercity, facilitating further epidemiological studies and citizen science.

I was happy that I got an opportunity to discuss my current going on research with eminent scientists and professors for their feedback. Fortunately, my research idea and study were selected for the best paper award. I am genuinely obliged that the judges, professors, and others liked my concept, study, and research perspective. The journey toward any research problem is challenging; it requires constant dedication, effort, and mind-frowning sessions. I would thank my thesis supervisor for his continuous support and guidance. Presenting your research at the conference is a great platform to have critical comments on your experiments and constructive suggestions to improve.

I have been selected to share my research at an international conference, EGU2023, held in Vienna, Austria, in April 2023. My submitted abstract was chosen as a 'highlight' of the session for an oral presentation at the event. I am looking forward to it, and the exchange of ideas on fields of interest seeds the links for future collaborations. It will surely help me to get focused on the academic discipline, updates on new findings, new technological advancements, and collaboration with like-minded individuals who are experts in my field of research.

## Latest News and Announcements

- Prof. Abhas Singh and Prof. Sudib K Mishra have been awarded Excellence-in-Teaching Award 2023.
- Dr. Suparno Mukhopadhyay has been selected as the prestigious Professor R.N. Biswas Young Faculty Fellowship in Teaching Excellence.
- Abhilasha Tripathi, PhD student of Prof. P. Bose has received Science innovation award at the International Conference on Agriculture and Rural development, held at Bhubaneswar.
- Surya Sujathan (PhD student) and Prof. Abhas Singh published an article titled, "Investigation of Potential Drivers of Elevated Uranium Prevalence in Indian Groundwaters with a Unified Speciation Model" in the top journal Environmental Science and Technology.
- Patent Granted to Dr. Tarun Gupta and Mr. Anand Kumar (student) || Patent No.- 418343 || Title: MULTIPLE SLIT NOZZLE-BASED HIGH VOLUME PM2.5 IMPACTOR ASSEMBLY || IPA No.- 2088/DEL/2014
- New technology for retrofitting non-earthquake-resistant buildings can prevent major damage in old settlements
- Dr. K.K. Bajpai, Scientific Officer, has been promoted to the post of Chief Scientific Officer at IIT Kanpur in the department of Civil Engineering.
- M.Tech student Anshul Rawat, Prof. Mukesh Sharma and Prof. Anubha Goyal granted a patent for developing technology for growing fresh veggies in high-altitude areas.

## Latest Publications

- Ganesh, R., & Sahoo, J. P. (2023). Kinematic horizontal slice method for uplift capacity analysis of plate anchors in nonhomogeneous soils with a nonlinear failure criterion. In Computers and Geotechnics (Vol. 159, p. 105407). Elsevier BV. <https://doi.org/10.1016/j.compgeo.2023.105407>
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# DEPARTMENT NEWS/PUBLICATIONS

- <https://www.iitk.ac.in/ce/>

- Chaudhary, A., & Akhtar, A. (2022). Template for Evaluating Cradle-to-Site Environmental Life Cycle Impacts of Buildings in India. In ACS Environmental Au (Vol. 3, Issue 2, pp. 94–104). American Chemical Society (ACS). <https://doi.org/10.1021/acsevironau.2c00035>
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- Chauhan, P., Kanagaraj, V., & Asaithambi, G. (2022). Understanding the mechanism of lane changing process and dynamics using microscopic traffic data. In Physica A: Statistical Mechanics and its Applications (Vol. 593, p. 126981). Elsevier BV. <https://doi.org/10.1016/j.physa.2022.126981>
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<https://www.iitk.ac.in/ce/>



## Placement Statistics 2022-23:

Note: Based on the information provided by **Students' Placement Office, IIT Kanpur**

Breakdown of the Civil Engineering batch of 2022-23:

- **Total number of students: 202**
- UG (Undergraduate): 126 students
- PG (Postgraduate): 63 students
- Dual Degree: 6 students
- Ph.D.: 7 students

For SPO (Student Placement Office) placements:

- **Total number of registered students: 140**
- Number of students who secured placements: **114 (81.4% of registered students)**

Breakdown of placements:

1.Core Placements:

- Total core placements: 16.7%
- UG students: 5.3% of total placements
- PG students: 11.4% of total placements

2.Non-Core Placements (Including Software, Analytics, and other roles):

- Total non-core placements: 83.3%
- UG students: 62.3% of total placements
- PG students: 21.0% of total placements

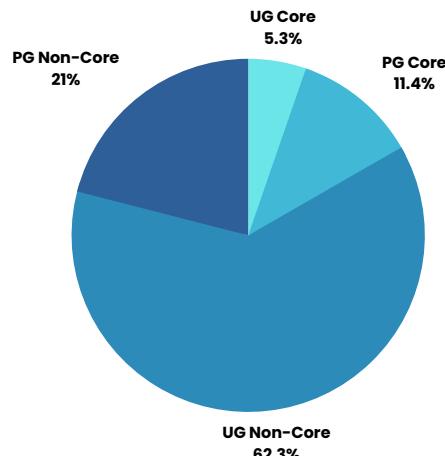


Fig. Sector wise breakdown of placed(114) UG and PG Civil Engineering

## Placement Postulates 2022-23:

Visit [soceiitk.org/postulates](https://soceiitk.org/postulates) and read all the placement postulates in detail.

Some of the highlights of placement postulates are mentioned below of the Batch of 2023.

### Mr. Aditya Gupta, Y19 B.Tech

#### Software Engineer, Squarepoint Capital

Hey everyone, I am Aditya Gupta, a Y19 BT/CE student, and I will be joining Squarepoint Capital as a Software Engineer in Paris. Over the past four years of my journey at IIT Kanpur, I have seen a lot of ups and downs. Many things happened during these four years, and placements were undoubtedly one of the most significant moments, and for many of you, that would be the same. So let me start with some background first. I didn't secure any internship from the SPO in my third year, and neither I tried off-campus. My CPI was 8.2, and over the years, I focussed on my academics and was involved with clubs and the SNT council, so I understood what I would be doing going ahead. My preparations began in June 2022 as I had no internships, so I focused on learning DSA and practising interview bit questions. However, I had a basic understanding of DSA as I had done it in during the internship season, so I started directly with the questions, which was a terrible idea if I think of it now. For you all, I would ...

### Mr. Sandipan Mitra, Y19 B.Tech

#### Analyst profile, Auronova Consulting

Hey everyone! I am Sandipan Mitra (Y19, CE), and I got an offer from Auronova Consulting in the Analyst profile on Day 2 of the Placement season 2022-23. My preparation journey isn't remarkably different from most people who sat for placements, but I believe every person's journey has unique takeaways worth sharing. I was (and still am :p) an indecisive kid who didn't know which career to pursue. I know many people with goals set from their first year, and I was not one of them. In my first year, I was thinking about an MBA later, so I avoided most of the technical stuff. Although later on, I surrendered to the rat race of coding and started preparing for the same before the internship season, mainly because leading companies required a coding test for an interview shortlist, and also, being from Civil, there were limitations on the available opportunities. Since this is a placement blog, I won't elaborate much on my internship experience. I secured an on-campus intern offer from Truminds in the SDE role. My work was in the backend team, and by the end of the ...

### Mr. Srajan Jain, Y19 B.Tech

#### Sales and Trading Associate, Morgan Stanley

Hello everyone, I am Srajan Jain, a final year UG student in civil engineering, currently placed in Morgan Stanley for the Sales and Trading Associate role. Through this blog, I would like to share my college journey focusing on the placement side of it. In the initial semesters, I was determined to explore everything we do here at IITK. So, I worked in fests, Aero club, E-cell, practiced with the swimming team, participated in Galaxy/Takneek, etc. One of those things was competitive coding; I liked it and kept doing it as a hobby for some time. Then came the pandemic, and every activity on the campus stopped temporarily. At that time, I started focusing on academics and understanding courses, unlike first-year classes. In the summers, I wanted to do an internship but couldn't find one due to a lack of skills. So I decided to explore different fields. I started with web dev and learned it for a while but found it boring. Then, I examined ML and DL and also did a related project. Along with these, I was also doing competitive programming. I found DL interesting, but ...

### Mr. Meet Saiya, Y21 - M. Tech (Infrastructure Engineering and Management)

#### Jr. Engineer, AECOM-GDC India

This blog will stand out from the other postulates in many ways. But let's get introductions out of the way before we dive in. I'm Meet, final year M. Tech in Infrastructure Engineering and Management. My placement journey has been one hell of a rollercoaster ride, from being unaware in the first semester to rejecting an off-campus offer in the last. So, tag along for the ride; hopefully, it will be helpful for your placements! First semester: I joined the college through... Zoom (Trust me, it's as disappointing as it sounds). Covid was at an all-time high and the semester went through, entirely online. We had no real interaction with seniors or other students. This was detrimental because I had no idea how quickly placements would creep up on us and how rigorous they can get. This is usually the case with most PG students and for the few reading this, it would definitely not hurt to be aware about the process, as early as possible. Back to the story, I had no background on how to prepare, what roles were there for PGs or even the first clue about placements...

## Mr. K. Sri Harsha

### B.Tech - M.Tech Hydrology and Water Management (Y8 Alumnus)

In the series of talks on "Career choice for Civil Engineers," the session on the entrepreneurial journey in civil engineering was **conducted on 12th September 2022.**

This talk was explicitly on Core startups, and we had Mr. K. Sri. Harsha, Y8 Alum, from the civil engineering department. He is the founder of Krtsnam Technologies, a company in water resources management. DIPP recognized him as an official startup for the Make-In-India initiative. He was also the senior project associate and led the project 'Establishing a critical zone observatory (CZO) in the Ganga Basin,' a collaborative initiative of the Ministry of earth sciences and IIT Kanpur. He has expertise in river engineering and hydrologic instrumentations.

Some major take away from the session:

- The core of entrepreneurship is the excitement of solving real-life problems and persistence to touch and explore every angle of the problem statement to realize its commercial opportunities. Further, make a small prototype and minimum viable product. To get into a startup, read 'The lean startup' as the first book to go ahead with so
- To build a career in a job profile is always a way to settle in life as it provides freedom of money in your hand, but if you want to be original and don't want to work in a limited space, then build a career as an entrepreneur
- core the career has significant scope to understand technologies and make them fit for real-world applications. Initially, it will start with a slow pace, but after growing, it will add value to the community and provides you with a very unique and dynamic life
- In an entrepreneurial journey, there will be high and low points, so it requires people with enough hunger to solve the problem and have the courage to make huge decisions.

**Key Point:** *"Interactions with different people, understanding and learning how to negotiate to make an empathetic route in which you make others win, and you win."*

## Mr. Shubham Gupta

### B.Tech - M.Tech Environmental Engineering (Y11 Alumnus)

In the series of talks on "Career choices for Civil Engineers," the consulting and data analyst session was **conducted on 21st January 2023.**

This talk was on consulting profiles, and we had Mr. Shubham Gupta, a Y11 alum from the civil engineering department. He is currently working as an associate managing consultant at MasterCard. He has also worked with ZS associates as a business analyst. He joined IIT Kanpur in 2011 as a civil engineering undergraduate and extended it to a dual degree program in environmental engineering because of his research interest. Then he also did a research internship at Hokkaido University Japan in his third year. Some major take away from the session:

- "If you feel that opportunities are coming to you by chance and you are putting effort and some money in it, it's a mere liability, but you actually choose something and plan accordingly, it's an investment of your time, efforts, and money and that would lead you to a longer run."
- The excellent choice is to explore the career path and plan your action accordingly instead of following the mainstream, which looks easier and confirms the society.
- To build a management and consulting profile in engineering, learn software, python SQL Excel and diversify the skills by doing courses in product strategies. One can do studies from Coursera and Gate, a flavor of management and consultancy.
- To get a step ahead of other, learn to present the presentation by building a story around the points, do courses from Harvard University, and London business school in Coursera, case studies a must requirement, and use online resources to learn and develop some mini groups to question each other as it's a collaborative process
- There is a paradox in choosing a career. You can never be sure about doing this in your life, so try to explore the zone you like and get sure about it; your subconscious will start to get the answer.

**Key point:** *"Take a decision by exploring and trust it; never question your decisions."*

## Ft. Lt. Devvrat Singh Jagawat

### B.Tech - M.Tech Construction Management (Y12 Alumnus)

In the series of talks on "Career Choices," a session on career options after graduation was **conducted on 10th March 2023.**

The session was specifically on career options after graduating from college, and Mr. Flt Lt Devvrat Singh Jagawat, an alumnus from the Department of Civil Engineering, took the session. He is currently deployed as an Officer in the Indian Airforce, serving in the country's North Eastern region. He joined IIT Kanpur in 2012 as a civil engineering undergraduate and extended it to a dual degree program in Construction Management. He had also served as Deputy General Secretary, Games and Sports during his time at IIT Kanpur. At that time, he had also played Inter IIT and won a gold medal. Being active in sports for seventeen years, he chose his path in defense services.

Some major takeaways from the session are:

- "Placement interviews are not more about personality testing, but in SSB interviews, it is more of personality testing because no one owns skills required for defense service, but for placements, you must have skills at the time of your interview."
- If you are willing to join the defense, whether it is the Navy, army, or air force, you have to be strong enough to get screened in plenty of tests, written, verbal, medical, physical, or mental pressures, etc.
- In defense services, one gets more responsibilities and privileges like quality of life, social status, everyday salutes, medical facilities, and travel allowance. You will also inculcate qualities like loyalty, discipline, and stories of lifetime achievement, which you might not get in other civil jobs.
- The knowledge and analytical skills you get from IIT will help you in any domain you will appear. For instance, due to his education in IITK, he could learn Aerodynamics much more manageable than his batchmates.

**Key point-** *"Never Regret In Your Life Because Regret Is One Thing Which Will Never Let You Live In Peace For Your Entire Life."*

## Convocation: Class of 2020

IIT Kanpur organized a reunion of the class of 2020 in offline mode. Unlike the other batches, the class of 2020 had their convocation held online due to the then ongoing covid-19 pandemic. On the occasion, the SoCE team made an attempt to make this event more memorable by distributing mementos to the Civil Engineering students. We hope the mementos will forever remind them of their unforgettable and wonderful journey through IITK.

Status: Conducted successfully on June 11, 2022

## Session: Informal Session for Y21 UG

To assist Y21-UG students with any uncertainties they may have regarding the upcoming pre-registration process for the 2022–23 odd semester, the Society of Civil Engineers (SoCE) organized an informal session. The aim of this session was to address queries and provide clarity on various types of courses such as DEs, OEs, ESO/SO, and more.

Status: Conducted virtually on June 14, 2022

## Projects: Summer Projects 2022

With the assistance of undergraduate and postgraduate students, we efficiently delivered and concluded a total of five projects during the summer term. Through these projects, a significant number of students enrolled and gained valuable insights into their respective assigned topics. Our initiative aimed to provide students with learning opportunities and in-depth knowledge related to their chosen projects.

Status: Released on June 18, 2022

## Merchandise: Summer Merchandise release

We organized the release of Civil Engineering T-Shirts for everyone, aiming to foster a sense of belonging within the CE family and commemorate the shared memories. As part of this initiative, we offered two exclusive options for the Civil Engineering IITK T-Shirt: one without a name for Rs. 300, and another option customized with the individual's name for Rs. 330. This effort was undertaken to provide a tangible representation of the CE community and the bonds formed within it. Got a great response from UG and PG batch.

Status: Released on June 21, 2022

## Session: Intern Chats

We conducted a series of informative sessions titled *Intern Chats* as part of our internship season guidance. These sessions specifically focused on the Software, Quant, Analyst and Finance Profile aiming to address various doubts and concerns students may have. We covered topics such as what to expect, essential do's and don'ts, and valuable insights to help participants prepare for these profiles before appearing for internship drives. All the speakers were Y19 UG students who have completed their internships in their respective companies.

### Profile: Software

Speaker: Devansh Mishra (EdgeVerve), Shubhi Kant (EdgeVerve), Sourav Agarwal (EdgeVerve), Sandipan Mitra (Truminds Software Systems)

Status: Conducted virtually on June 26, 2022

### Profile: Quant

Speaker: Sravan Jain (WorldQuant), Chirag Sharma (WorldQuant), Sparsh Sihotiya (WorldQuant)

Status: Conducted virtually on June 29, 2022

### Profile: Analyst Intern Chats-Analytics.pptx

Speaker: Palak Khandelwal (AmEx), Yatharth Gupta (AB InBev)

Status: Conducted virtually on July 2, 2022

### Profile: Finance Intern Chats-Finance.pptx

Speaker: Akash Kar (Axcela)

Status: Conducted virtually on July 5, 2022

## Social Media: Article

Topic: Panama Canal

Credits: Sandipan Dutta (Y21 UG)

Status: Released on June 28, 2022

## Session: Resume Building Session

Speaker: Mr. Ankit Kumar (Y18 Alumni)

In anticipation of the upcoming internship drive for the 2022–23 term, we organized this session to assist students who may have had various doubts and concerns regarding crafting an effective resume. The aim was to provide valuable guidance and support to help participants create impressive resumes tailored to their internship applications.

Status: Conducted virtually on July 8, 2022

## Session: 3rd Semester Informal Session for Y21 UG

Recognizing that students may have concerns and doubts about their enrolled courses, an informal session was conducted by us to address these issues. The purpose of the session was to provide comprehensive reviews of the upcoming courses, including discussions on course content, difficulty level, previous grading schemes, and additional resources. This initiative was taken to ensure that students had the necessary information and support to navigate their chosen courses successfully.

Status: Conducted virtually on July 27, 2022

## Session: MITACS Globalink Research Intern session

Speaker: Yatish Goel (Y19 UG) MITACS intern @Athabasca University, Edmonton

Recognizing the significance of the MITACS Globalink Research Intern Program in offering research opportunities and fostering collaboration with renowned faculty members, a session was conducted to address any doubts or concerns among students. The aim of the session was to promote participation in this competitive initiative, which provides international undergraduates with a 12-week research internship at Canadian universities under the guidance of faculty members from various academic disciplines. This initiative was undertaken to encourage and support research-oriented students in making informed decisions about participating in the program.

Status: Conducted in L14 on September 6, 2022

## Session: Career Choices

Speaker: Mr. K. Shri. Harsha (Y8 Alumni) Founder @Kritsnam Technologies

The session focused on addressing doubts and offering guidance to students regarding their career choices, particularly in the context of core-related startups. The alumni, drawing from their personal experiences and insights, provided valuable advice, motivation, and inspiration to the students, urging them to pursue their career aspirations. The objective of this initiative was to assist students in making informed decisions and navigating their future paths effectively, especially within the realm of core-related startups.

Status: Conducted virtually on September 12, 2022

## Social Media: Conversations

Topic: Passive Solar Building

Credits: Sandipan Dutta (Y21 UG)

Status: Released on October 2, 2022

## Magazine: Distribution of Strengths'22

"Strengths" is an annual magazine published by the Society of Civil Engineers, showcasing the highlights of the civil engineering field and showcasing the work of both our team, Team 2021-22, and civil department. As the team for the year 2022–23, we took charge of distributing the magazine. It is now available in the P.K. Kelkar Library, as well as in Halls 2, 3, 5, 6, 10, and 12. Additionally, we distributed copies to professors and alumni from the Civil Department, ensuring wider access and visibility for the publication.

Status: Released on October 5, 2022

## Social Media: The Historic Line

Topic: Eads Bridge

Credits: Srishti (Y21 UG)

Status: Released on October 8, 2022

## Social Media: Conversations

Topic: Soil Stabilizer

Credits: Eshika (Y21 UG)

Status: Released on October 22, 2022

## Session: Possibility for students in the industry

Speaker: Mr. Prithvi Raj (Y14 M.Des. Alumni) UX Design Manager at Trimble Inc.

In this session, Mr. Prithvi shared his industry experiences and provided valuable insights into the latest technologies and advancements in the infrastructure automation industry. The session aimed to facilitate an informal discussion, enabling students to gain a glimpse into the future of the industry. This initiative was undertaken with the objective of providing students with firsthand knowledge and fostering their understanding of the direction in which the infrastructure automation industry is heading.

Status: Conducted virtually on November 11, 2022

## Social Media: Conversations

Topic: Kinetic Football

Credits: Arpit Raj (Y21 UG)

Status: Released on November 12, 2022

## Social Media: The Historic Line

Topic: Bridgewater Canal

Credits: Aman Khilani (Y21 UG)

Status: Released on November 18, 2022

## Session: Introduction to Profiles

A series of online sessions titled 'Introduction to Profiles' was organized. Y20 UG from the civil department got interns in SPO intern drive 2022–23, representing various intern profile backgrounds, conducted interactive sessions to provide in-depth explanations of their respective profiles and address any doubts or queries. This initiative was undertaken to offer valuable guidance, insights, helping them navigate the intricacies of different internship profiles and make informed decisions.

### Profile: Software

Speaker: Tejas warade (Amazon) & Prem Bharwani (Oracle)

### Profile: Core

Speaker: Payal Singh (JSW)

### Profile: Consulting

Speaker: Shivangi Yadav (Bain & Company)

### Profile: Analytics

Speaker: Smriti Tripathi (AmEx) & Siddharth Govil (Citi bank)

Status: Conducted virtually on December 4, 2022

## Social Media: Conversations

Topic: Bio Batteries

Credits: Saurabh Meena (Y21 UG)

Status: Released on December 6, 2022

## Social Media: The Historic Line

Topic: The Indian Parliament House

Credits: Saurabh Meena (Y21 UG)

Status: Released on December 12, 2022

## Merchandise: Winter Merchandise release

We conducted the release of winter merchandise for Civil Engineering, including Hoodies and Jackets, with the intention of fostering a sense of belonging and commemorating shared memories within the CE community. Hoodie and Jacket: Rs. 700/- with the option to customize with an individual's name. Hoodie and Jacket: Rs. 680/- without customization of name. This initiative aimed to provide tangible representations of the CE community and strengthen the bonds formed within it through the winter merchandise. Got a great response from UG and PG batch.

Status: Released on December 17, 2022

# SoCE DIARY 2022-23

<https://socieiitk.org/>

## Social Media: Article

Topic: Application of GIS-GPS in Civil Engineering  
Credits: Srishti, Sandipan Dutta  
Status: Released on December 12, 2022

## Social Media: Conversations

Topic: Self Healing Concrete  
Credits: Harsh Vardhan (Y2I UG)  
Status: Released on December 28, 2022

## Competition: Game Night

Recognizing the fatigue and stress that accompany assignments, quizzes, and midterms during a new semester. While primarily aimed at Y2I, other CE batches were also invited to participate, providing an opportunity to unwind and momentarily shift their focus away from studies. The GAMES NIGHT featured popular games such as Among Us, Chess, Skribbl.io, Smashkart, and Valorant, offering an immersive and relaxing experience. Participants had the chance to win exciting prizes and receive shoutouts for their achievements. This initiative was conducted to provide students with a well-deserved break and create an enjoyable atmosphere amidst the demands of the semester.  
Status: Conducted virtually on December 30, 2022

## Competition: Architectural Photography competition

We organized the first-ever Architectural Photography Competition. This four-day contest catered to photography enthusiasts who sought to capture stunning architectural shots. Participants were encouraged to showcase their skills using smartphones or cameras, exploring different angles and perspectives. Exciting prizes awaited the top three performers, providing an added incentive for participation. It is worth noting that the best entries, regardless of their scores, were considered for inclusion in the upcoming edition of the Strengths magazine. Proper credits were given to the photographers, subject to their consent. This initiative was undertaken to encourage artistic expression, foster a sense of community, and showcase the talent within the civil engineering department.

Status: Conducted on January 9, 2023

## Social Media: The Historic Line

Topic: Aqueduct of Segovia  
Credits: Shruti Goyal (Y2I UG)  
Status: Released on January 19, 2023

## Session: Career Choices

Speaker: Mr. Shubham Gupta (YII Alumni) Associate Managing Consultant @Mastercard  
The session aimed to address doubts and provide guidance to students regarding their career choices, specifically focusing on the management profile. Esteemed alumni, leveraging their personal experiences and insights, shared valuable advice, motivation, and inspiration with the students, encouraging them to pursue their career aspirations in the management field. The primary objective of this initiative was to support students in making informed decisions and successfully navigating their future paths, particularly within the realm of management profiles.  
Status: Conducted virtually on January 21, 2023

## Seminar: Sustainability practices on campus

Speaker: Prof. Abhas Singh and Prof. Rajat Mittal  
The conducted session revolved around important topics such as tree transplantation, waste management and recycling, water harvesting, preservation of green areas, and other sustainable activities on the campus. Distinguished professors, along with undergraduate and postgraduate students, actively participated in this engaging lecture, showcasing their interest and enthusiasm for the subject matter. This initiative was undertaken with the objective of promoting and fostering sustainability practices within the campus community, contributing to a greener and more eco-friendly environment.  
Status: Conducted in L1I on January 28, 2023

## Website: Updating of domain and complete structure and UI/UX

Credits: Saurabh Sahay (Y2O UG), Shubham Kumar (Y2O UG), Aashruti Raj (Y2I UG), Arpit Kaithwar (Y2I UG), Rishi Ratn (Y2I UG), Saurav Kumar (Y2I UG)  
View Here: <https://socieiitk.org/>  
Status: Released on February 1, 2023

## Social Media: Conversations

Topic: Modular Construction  
Credits: Aashruti Raj (Y2I UG)  
Status: Released on February 7, 2023

## Seminar: Lessons from Austin's Full-Scale Step-Feed Biological Nutrient Removal Demonstration

Speaker: Distinguished Alumnus Shri Rajendra P. Bhattacharai, President of the Water Environment Association of Texas  
The seminar focused on the background and significance of BNR (Biological Nutrient Removal) demonstration, providing a concise introduction to step-feed and the biological nutrient removal process. It covered the plant modifications made for the full-scale study and summarized the results obtained from the two-year research. The session also addressed the difficulties, challenges, and valuable lessons learned during the study. The Step-Feed BNR process has gained global recognition and is now widely implemented worldwide. The Society of Civil Engineers actively contributed to publicizing the event within the student community, raising awareness and encouraging participation.  
Status: Conducted by Dept. of Civil Engg. in L18 on February 9, 2023

## Social Media: The Historic Line

Topic: Pont Du Gard  
Credits: Pratham Srivastava  
Status: Released on February 16, 2023

## Social Media: Conversations

Topic: Translucent Concrete  
Credits: Saurabh Meena  
Status: Released on March 2, 2023

## Session: Career Choices

Speaker: Fit. Lt. Devvrat Singh Jagawat (YII Alumni)  
Session was conducted with the intention of addressing doubts and providing guidance to students regarding their career choices. The alumni shared their personal experiences and valuable insights, offering advice, motivation, and inspiration to the students, encouraging them to pursue their career aspirations. This initiative was undertaken to support students in making informed decisions and charting their future paths successfully.  
Status: Conducted virtually on March 10, 2023

## Workshop: Introduction to OpenLCA

Speaker: Mr. Mohd. Kamil Vakil (Ph.D. scholar @IIT Kanpur) Associate LCA analyst @Mondra, London  
The conducted workshop focused on the importance of Life Cycle Assessment (LCA) as a tool for evaluating environmental impacts throughout a product's or process's life cycle. It emphasized the significance of sustainability in various engineering fields and the role of LCA in achieving sustainable development. The workshop introduced participants to the OpenLCA software, which is used for conducting LCA assessments. By organizing this workshop, we provided participants with the opportunity to learn from industry experts, gain insights into current trends, and develop a deeper understanding of LCA and sustainability practices.  
Status: Conducted in L14 on March 15, 2023

## Social Media: Article

Topic: Optimization Using Quantum Computing  
Credits: Srishti (Y2I UG)  
Status: Released on March 16, 2023

## Social Media: The Historic Line

Topic: Panama Canal  
Credits: Vanshika Yadav (Y2I UG)  
Status: Released on March 24, 2023

## Seminar: Insights into Urban Transport needs and Role of modern Metros in Indian Cities

Speaker: Shri Kumar Keshav, CEO of DB RRTS Operations India Pvt. Ltd  
The lecture presented a valuable opportunity to gain insights into the contemporary metro systems in Indian cities and their crucial role in addressing urban transportation requirements. The Society of Civil Engineers actively contributed to publicizing the event within the student community, ensuring maximum participation and engagement. In addition, the coordinators of SoCE expressed their gratitude by presenting a memento as a token of appreciation.  
Status: Conducted by Dept. of Civil Engg. in L18 on March 31, 2023

## Farewell: Class of 2023

The Society of Civil Engineers proudly organized and hosted the farewell event for the esteemed UG and PG class of 2023 of civil engineering in the evening. The event was a memorable occasion, featuring captivating performances of junior batches, inspiring speeches from respected professors, and the distribution of well-deserved mementos.  
Status: Conducted in L17 on March 31, 2023

## Social Media: Conversations

Topic: Carbon Trading  
Credits: Shrey Patel (Y2I UG)  
Status: Released on April 4, 2023

## Social Media: Article

Topic: The cost Analysis of Geothermal Energy Generation  
Credits: Pratham Srivastava  
Status: Released on April 20, 2023

## Projects: Summer Projects 2023

With the assistance of undergraduate and postgraduate students, for the first time we efficiently offered a total of fourteen projects during the summer term 2023. A significant number of students enrolled and will be getting valuable insights into their respective assigned projects. Our initiative aimed to provide students with learning opportunities and in-depth knowledge related to their chosen projects.  
Status: Released on May 10, 2023

## Blog: Placement Postulates

SoCE offers a series of informative blogs where graduating seniors generously share their placement experiences, providing valuable insights and guidance on navigating the entire process. These blogs cover various aspects, including tips on handling interviews and recounting personal experiences. They serve as a valuable resource for students preparing for their own placement interviews. This year, we are excited to release the blog featuring the experiences and insights of the graduating class of 2023.  
Read Here: <https://socieiitk.org/postulates>

## Magazine: Strengths'23

STRENGTHS, the esteemed annual magazine by the Society of Civil Engineers, has garnered recognition and approval from the Department of Civil Engineering. With a primary focus on showcasing the activities of SoCE and highlighting significant developments in the field of civil engineering, STRENGTHS aims to provide a comprehensive overview. In this year's edition, we have made an effort to incorporate the essence of the civil department at IIT Kanpur, featuring the department's ongoing initiatives and noteworthy activities. We also take the opportunity to acknowledge and appreciate the achievements of the best papers and awardees (PG batch of civil engineering) of the 2022-23 academic year in civil engineering. The magazine encompasses a wide range of engaging articles and captivating content, promising an intriguing read.  
Read Here: <https://socieiitk.org/strengths>



## EPILOGUE



# CIVIL ENGINEERING LABS

- Meet Saiya

Established in 1961, the Department of Civil Engineering at IIT Kanpur has been dedicated to producing highly skilled technical professionals essential for industry, research and development organizations, and academic institutions. The department offers various programs, including B. Tech. in Civil Engineering, B. Tech.-M. Tech. Dual degree in Civil Engineering, MS (Research), and M. Tech. in Civil Engineering with seven specialized fields: Environmental Engineering, Geoinformatics, Geotechnical Engineering, Hydraulics & Water Resources Engineering, Infrastructure Engineering And Management, Structural Engineering, and Transportation Engineering. Additionally, the department boasts a dynamic Ph.D. program covering the aforementioned specializations as well as Infrastructure Engineering and Management.

The academic focus of the department revolves around nurturing a profound comprehension of fundamental principles, fostering creative problem-solving abilities for real-world challenges in Civil Engineering, and developing analytical skills to address interdisciplinary issues. To complement their education, students are encouraged to participate in extra-curricular and co-curricular activities, fostering teamwork and organizational capabilities.

Notably, the faculty members are actively engaged in high-quality research and consultancy projects. They serve on national-level committees, providing academic leadership within the country. The department's dedication to innovation is evident with over 485 industry projects and 624 published papers in the last seven years, solidifying its position at the forefront of the field.

## Environmental Engineering || <https://www.iitk.ac.in/ce/environmental-engineering>

With 8 renowned faculties, environmental engineering group does some of the leading research in contaminant fate modelling and control. Several instruments are also designed indigenously. Focus to water and waste water as well as climate change and sustainability are at the forefront of department



## Geoinformatics Engineering || <https://www.iitk.ac.in/ce/geoinformatics>

House to the National Centre of Geodesy, Geoinformatics department leads the way in the field of advanced surveying. Major areas of research are Geodetic GPS surveys, Satellite data processing and application, Airborne and terrestrial data capture methodologies, Flight planning, Errors in LiDAR data, 3D laser imaging and LCS measurement, Development of LiDAR simulators, LiDAR data visualization methods and software.



# CIVIL ENGINEERING LABS

- Meet Saiya

## Geotechnical Engineering || <https://www.iitk.ac.in/ce/geotech/index.html>

Spanning over ≈900 sqm, geotechnical group conducts innovative research in foundation engineering, geotechnical earthquake engineering and ground improvement techniques. Advanced research facilities for rock mass and tunneling are also developed.



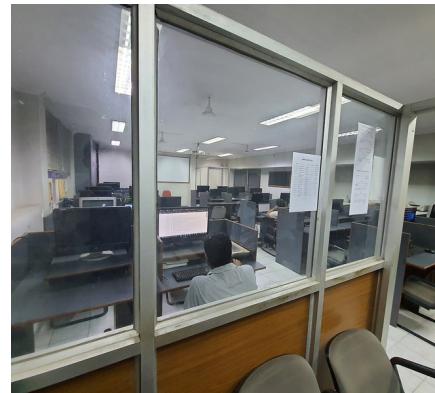
## Hydraulics and Water Resources Engineering || <https://www.iitk.ac.in/ce/hydrowater/>

One of the largest labs at IITK with ≈1000 sqm area. HWRE group works on subsurface flow modelling and allied fields, sediment transport and experimental hydraulics. Prime importance is also given to effect of Climate change on surface and subsurface flows.



## Infrastructure Engineering And Management || <https://www.iitk.ac.in/ce/infrastructure-engineering-and-management>

Interdisciplinary branch of IEM stemmed out of need for cross specialization integration to make projects a success. The group focuses on traditional project management as well as contracts, stakeholder, asset and environment management & planning on facility & system levels



# CIVIL ENGINEERING LABS

- Meet Saiya

## Structural Engineering || <https://www.iitk.ac.in/civil/strgrp/>

With 9 faculties &  $\approx$ 1500 sqm of labs, structural engineering group conducts state of the art research from to scale experiments for seismic & dynamic loads to studying material behaviours and modelling them. Much research is also on SHM, IoT, sensor tech and AI for asset management



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## Transportation Engineering || <https://www.iitk.ac.in/transEL/>

Transportation group works on some of the most advanced IT technologies available and their applications in Traffic systems, smart transportation system & infrastructure management. Sophisticated research on materials, pavement engineering, safety and networks is also carried out.



# GALLERY



Formal farewell photograph of the esteemed Civil Engineering students from the Class of 2023.



Class of 2023 attending their Farewell Ceremony organised by SoCE



2022-23 Secretaries and Coordinators in their own meeting room(WLE301)



Group photo of SoCE secretaries, and Coordinator with Class of 2023 Civil Engineering Students.



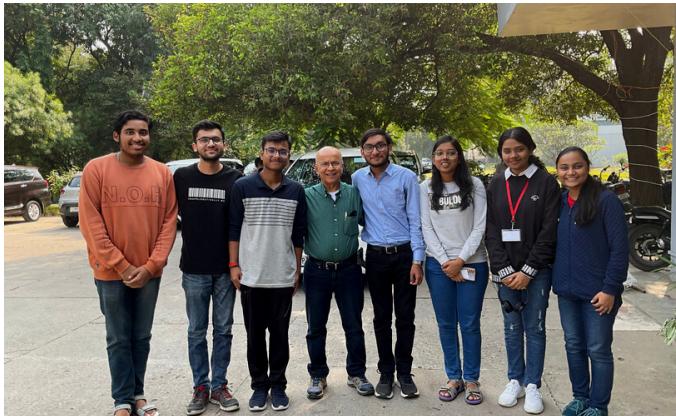
Summer Camp: Chitrakoot group photo



Secretaries and Coordinators

**SoCE  
2022-23**

# GALLERY



Secretaries and Coordinators with Distinguished  
Alum Shri. Rajendra P. Bhattarai



Winning photograph of Architectural  
Photography Competition by Shubham (B.Tech CE Y22)



SoCE Coordinator Shubham presenting a commemorative token to  
the CEO of Deutsche Bahn RRTS Operations India Pvt. Ltd.



Prof. Abhas Singh and Prof. Rajat Mittal presenting lecture on Sustainable  
Campus Practices at the seminar



Students and Professors attending the Seminar on  
Sustainability Practices on Campus



UG and PG students attending the Workshop on  
OpenLCA by Mohd. Kamil Vakil

**SoCE  
2022-23**

# TEAM 2022-23



**HOD:** Dr. P. Ghosh (*current*) and Dr. Tarun Gupta(*till july, 2023*)

**Faculty Coordinator:** Dr. Chunendra Kumar Sahu (*current*) and Dr. Aditya Medury (*till april, 2023*)

**Coordinators (B.Tech Y20):** Faiza Khan, Om Jee, Shubham Kumar

**PG Representative (M.Tech Y21):** Meet Saiya

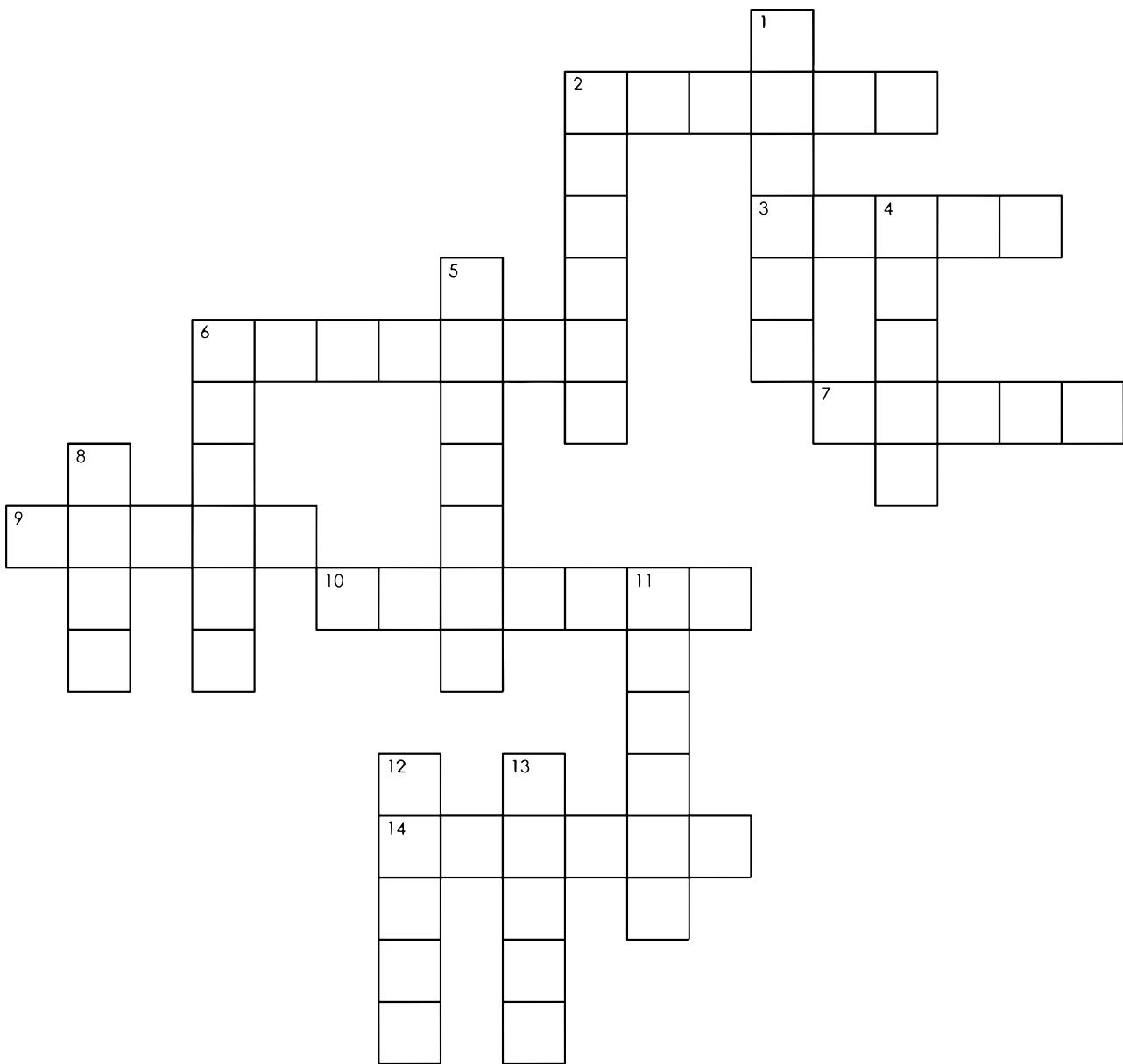
**Secretaries (B.Tech Y21):** Aadya Umrao, Aashruti, Abhimanyu Jain, Akarsha, Aman Khilani, Arpit Kaithwar, Dharmraj, Enna Gupta, Eshika Yadav, Harsh Vardhan, Ishu Singh, Kurva Shalini, Mayank shekhar, Prateek Mishra, Pratham Srivastava, Rishi Ratn, Sanchit Hari, Sandipan Dutta, Sanju Kakerwar, Saurabh Meena, Saurav Kumar, Shambhavi Agarwal, Shrey Patel, Shruti Goyal, Srishti, Vanshika

**Images Credits:** Front Cover- <https://www.iitk.ac.in/new/despite-pandemic-blues>, Labs- Meet Saiya (M.Tech CE Y21), Table of Content - Aryan Gautam (B.Tech CE Y22), Harshit Kant (B.Tech ME Y21)

**Design Credits:** Shubham Kumar (B.Tech CE Y20)



# CROSSWORD



## ACROSS

2. What is the name of the elevated expressway connecting Chennai and Ennore? (6 letters)
3. What is the longest river bridge in India? (5 letters)
6. Which Indian city recently experienced a major flyover collapse?
7. Which disaster-prone country is known for its advancements in earthquake-resistant building designs? (5 letters)
9. Which city's skyline features the tallest man-made structure, the Burj Khalifa? (7 letters)
10. What is the name of the engineering project that connects England and France through an underwater tunnel? (7 letters)
14. What is the name of the engineering feat that redirected the course of the Colorado River in the United States? (6 letters)

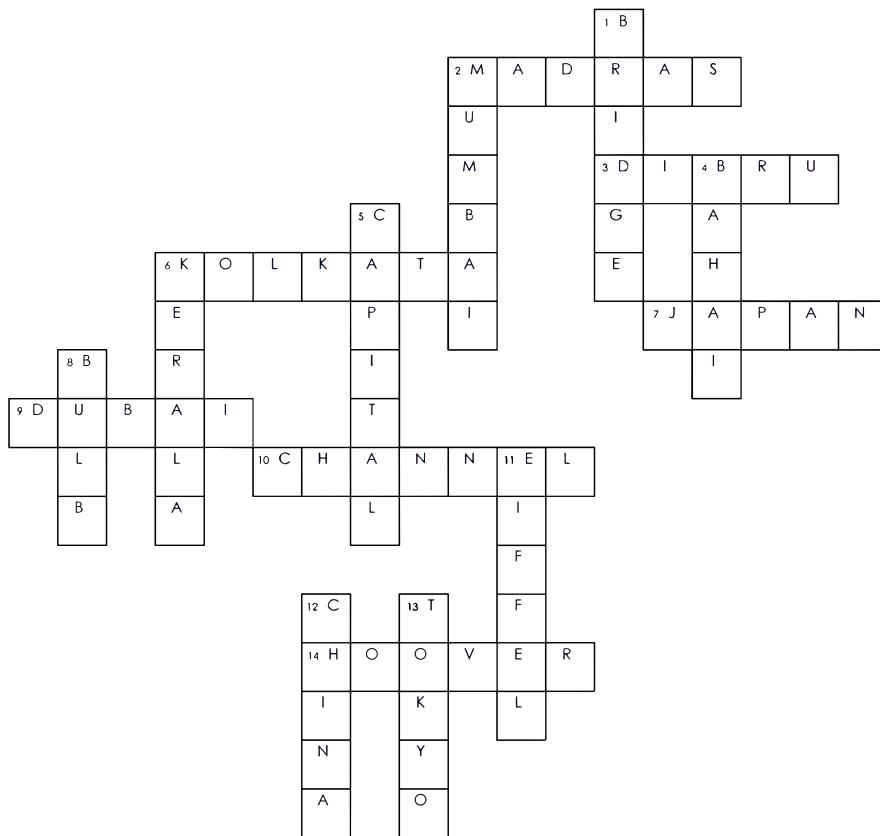
## DOWN

1. What is the name of the engineering marvel that spans the Golden Gate Strait in San Francisco? (6 letters)
2. Which Indian city is known for its iconic infrastructure project, the Bandra-Worli Sea Link? (6 letters)
4. Which Indian architect is renowned for designing the Lotus Temple in Delhi? (6 letters)
5. Which Indian city is home to the Delhi Metro, one of the largest metro networks in the world? (7 letters)
6. Which Indian state faced severe flooding due to dam breaches in recent years? (7 letters)
8. What is the name of the high-speed rail project connecting Mumbai and Ahmedabad? (4 letters)
11. Which iconic tower in Paris is an engineering marvel with its iron lattice structure? (8 letters)
12. Which country is home to the innovative Three Gorges Dam, the world's largest hydropower project? (6 letters)
13. Which city's subway system faced a devastating earthquake in 2011, resulting in significant damage? (6 letters)

## WORD BANK

MUMBAI, DUBAI, CHANNEL, MADRAS, DIBRU, HOOVER, BAHAI, CHINA, EIFFEL, KOLKATA, BULB, BRIDGE, JAPAN, TOKYO, CAPITAL, KERALA

# CROSSWORD: ANSWERS/EXPLANATIONS



## ACROSS:

- 2. MADRAS:** The elevated expressway connecting Chennai and Ennore, known as the Chennai Ennore Elevated Expressway, aims to improve connectivity and reduce travel time. Its construction commenced on October 15, 2017.
- 3. DIBRU:** The Dibrus-Saikhowa Bridge, spanning the Brahmaputra River, holds the title of the longest river bridge in India, with a length of 4.94 kilometers. It was inaugurated on March 26, 2022.
- 6. KOLKATA:** Kolkata, one of India's major cities, witnessed a tragic incident on March 31, 2021, when a flyover collapsed near the Ganesh Talkies area, leading to several casualties and significant infrastructure damage.
- 7. JAPAN:** Japan, a country prone to earthquakes, has made significant advancements in earthquake-resistant building designs to mitigate the impact of seismic events.
- 9. DUBAI:** Dubai, a city in the United Arab Emirates, is home to the Burj Khalifa, the tallest man-made structure globally. It was officially opened on January 4, 2010.
- 10. CHANNEL:** The Channel Tunnel, also known as the "Chunnel," connects England and France through an underwater tunnel. It was opened for passenger services on November 14, 1994.
- 14. HOOVER:** The Hoover Dam, an engineering feat on the Colorado River in the United States, redirected the river's course and was completed on March 1, 1936.

## DOWN:

- 1. BRIDGE:** The Golden Gate Bridge, an engineering marvel spanning the Golden Gate Strait in San Francisco, was opened to the public on May 27, 1937.
- 2. MUMBAI:** The Bandra-Worli Sea Link, an iconic infrastructure project in Mumbai, connects Bandra and Worli. This cable-stayed bridge was opened for public use on June 30, 2009.
- 4. BAHAI:** The Lotus Temple, a stunning architectural masterpiece in Delhi, was designed by the renowned Indian architect, Bahai. The temple was completed in 1986 and has since become a significant landmark.
- 5. CAPITAL:** Delhi, the capital city of India, boasts one of the world's largest metro networks. The Delhi Metro, with an extensive network covering various parts of the city, began its operations on December 24, 2002.
- 6. KERALA:** Kerala, a southern state in India, faced severe flooding due to dam breaches in August 2018. The devastating floods caused widespread destruction, resulting in the loss of lives and extensive damage to infrastructure.
- 8. BULB:** The high-speed rail project connecting Mumbai and Ahmedabad, known as the Bullet Train project, is a joint venture between India and Japan. The project's construction began on September 14, 2017.
- 11. EIFFEL:** The Eiffel Tower, an iconic iron lattice structure located in Paris, France, was completed on March 15, 1889, and has become a symbol of engineering marvel.
- 12. CHINA:** China is home to the Three Gorges Dam, the world's largest hydropower project. Construction began in 1994 and was completed on May 20, 2012.
- 13. TOKYO:** Tokyo, the capital city of Japan, experienced a devastating earthquake on March 11, 2011, which resulted in significant damage to its subway system and other infrastructure.

## **NOTES**

## **NOTES**

The End



# STRENGTHS

A magazine from the Society of Civil Engineers

"The way to build a nation is to build a good citizen. The majority of the citizens should be efficient, of good character and possess a reasonable high sense of duty"

**Bharat Ratna Mokshagundam Visvesvaraya**

Contact us:

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