

EngiNexus

Articles
Drawings
Poems
Review Paper
Photography

STEPPING INTO
THE NEXUS OF
ENGINEERING
INGENUITY



CIVIL ENGINEERING DEPARTMENT MAGAZINE – 2023

St. Thomas College of Engineering & Technology
Mattanur, Kannur, Kerala

EngiNexus'23

CIVIL ENGINEERING MAGAZINE

ST. THOMAS COLLEGE OF ENGINEERING AND TECHNOLOGY



EngiNexus'23

Civil Engineering Association St. Thomas College of
Engineering and Technology, Kannur

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MESSAGE FROM CEO



It gives me immense pleasure to extend my warm greetings on the release of the Civil Engineering Department Magazine. This publication stands as a reflection of the knowledge, creativity, and dedication of both students and faculty members. Civil Engineering plays a pivotal role in shaping the infrastructure and sustainable development of our society. This magazine is not just a compilation of articles, but a platform that showcases emerging ideas, research insights, and the collective efforts of the department.

I congratulate the editorial team, contributors, and faculty coordinators for their hard work and commitment in bringing out this excellent publication. Such initiatives encourage students to think beyond classrooms and contribute meaningfully to the profession. I am confident that this initiative will inspire students to explore new ideas, enhance their skills, and contribute meaningfully to the engineering profession. Wishing the department continued success

Er. Rijo Thomas Jose

CEO

MESSAGE FROM PRINCIPAL



It gave great pride and satisfaction for St. Thomas College of Engineering and Technology to bring out the first magazine “EngiNexus” released from the department of civil engineering for the academic year 2022-23. The college had shown remarkable progress in academic and non-academic activities related to staff and students over these years. I took this opportunity to congratulate civil engineering staff and students who had taken interest in publishing this technology-based activity report.

In today’s rapidly evolving world, technological advancements are progressing at an unprecedented pace, often making traditional theoretical curricula outdated. Instead of resisting these changes, it is essential to embrace and utilize technology for the betterment of society. Therefore, budding civil engineers must develop a forward-thinking mindset that enables them to adapt to emerging trends and apply innovative solutions for real-world challenges.

I encourage the students of the Civil Engineering Department to identify and address pressing societal issues through the effective application of technology. It is commendable that the department has actively engaged in such initiatives during this academic year. Activities like Inauguration of Civil Engineering Association SATTVA, Expert talk on Road Safety and Mitigation measures, Expert talk on Stability of soil, Workshop on Essential requirements of high performance concrete, workshop on proposal of central library building, site visit to Kannur Municipal corporation building, workshop on total station. In our region, the extensive use of laterite stone in construction has led to environmental concerns. This opens up opportunities for students to undertake research on alternative construction materials as part of their final year projects and develop sustainable solutions. By focusing on solving societal problems, students can evolve from being job seekers to becoming job creators, contributing significantly to the nation’s development.

Once again, I would like to appreciate the staff and student editors for their invaluable efforts in collecting the articles and timely publication of this magazine.

Dr. Shinu Mathew John
PRINCIPAL

MESSAGE FROM HOD



Congratulations were extended to the students and faculty members associated with the magazine committee for successfully publishing our departmental magazine for the academic year 2022-23. EngiNexus created a platform that provided an opportunity for the students and staff to express their original thoughts on technical as well as cultural topics. This magazine served as a platform to celebrate our success, share our insights and inspire one another to reach new heights of achievement.

I would like to express my sincere gratitude to Dr. Shinu Mathew John, the Principal of STM for his proper guidance and encouragement in all activities of our department. The huge support from Er. Rijo Thomas Jose, CEO of STM also deserved a special mention here as his continuous inspiration was pivotal for the department. I also extended my heartfelt gratitude to the editorial team and those who had contributed to the creation of this magazine. Your dedication and team work had been crucial in achieving the timely completion. As we navigated the challenges and opportunities that lay ahead, let us remain united in our commitment to academic excellence, innovation and service to the society.

Vijila Balakrishnan

HOD,CE

EDITORIAL

EngiNexus is a technical magazine published by the Department of Civil Engineering, St. Thomas College of Engineering and Technology, Kannur, with the support of the Civil Engineering Association, 'SATTVA'.

Civil Engineering is a vital branch of engineering that plays a fundamental role in all development activities related to both the built and natural environment.

Although Civil Engineering emerged as a distinct discipline in the 17th century, its origins can be traced back to ancient civilizations. Since then, the field has continuously evolved, adapting to changing times and technological advancements. In today's era, where technology drives innovation and development, Civil Engineering has effectively integrated modern technologies into its wide-ranging scope.

This magazine aims to highlight the latest advancements across various domains of Civil Engineering. To become a competent civil engineer, a student must go beyond the academic curriculum and stay updated with emerging technologies, innovative materials, and current regulations. The magazine also includes details of site visits conducted to support this objective and enhance practical understanding.

I extend my sincere gratitude to all the staff members and students of the Civil Engineering Department for their valuable cooperation and dedicated efforts in successfully bringing out this magazine.

Manasa Mukundan
Staff Editor



MANASA MUKUNDAN
STAFF EDITOR



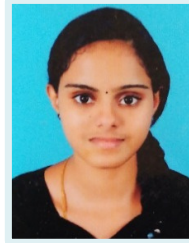
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VISION

To grow as a globally recognized centre in civil engineering with a focus on innovation and research by combining technical and ethical qualities.

MISSION

M1 : Professional Skills

To provide a better environment to encourage innovative and research thinking among students.

M2 : Life-Long Learning

Instill in students contemporary knowledge in order to achieve academic and professional excellence with global perspective through experience of lifelong learning.

M3 : Engage with Society

Impart a sense of community responsibility and leadership qualities to better meet the challenges of sustainable growth.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1

Achieve excellence in the professional practices of Civil Engineering by utilizing the acquired knowledge and technical skills supported by modern day tools.

PEO2

Participation in decision making and nation building by adopting energy efficient and sustainable practices in Civil Engineering.

PEO3

Encourage innovative thinking and entrepreneurship by research and higher studies in advanced areas of Civil Engineering.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1

To solve engineering problems related to Civil Engineering by systematic techniques, skills and tools to meet the ever growing needs of sustainable infrastructural development.

PSO2

Design and build Civil Engineering-based systems in the context of structural, geotechnical, transportation and environmental requisites.

PROGRAM OUTCOMES (POs)

PO1

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2

Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10

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

PO11

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

PO12

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

Soft Storeys in Buildings and Their Behavior

Adithya K, S8CE

A soft storey in a building refers to a level that is significantly weaker or more flexible compared to the floors above it. This condition usually occurs when the storey has large openings, fewer walls, reduced stiffness, or insufficient structural bracing. Soft storeys are commonly found in buildings where the ground floor is used for parking, shops, office spaces, or lobbies. In such cases, the ground floor lacks the same number of partition walls and structural elements as the upper floors, making it a vulnerable point during lateral load actions such as earthquakes.

The presence of a soft storey creates an imbalance in the structural stiffness of the building. When a building experiences horizontal forces, such as wind or seismic loads, the deformation is expected to be distributed uniformly across all floors. However, if one floor is much weaker, most of the deformation gets concentrated at that level. This causes the soft storey to sway more than the others, leading to excessive drift. Over time or under sudden forces, this concentration of movement can lead to serious damage, including cracking of columns, failure of joints, or even complete collapse of the building.

Soft storeys gained major attention after several earthquake disasters around the world. Buildings with open ground floors, commonly known as “pilotis structures,” showed poor performance during earthquakes in places like Turkey, India, Japan, and Nepal. The 2001 Bhuj earthquake in India and the 1999 Turkey earthquake are widely studied examples where soft-storey collapses were common. The failure pattern usually included buckling of columns, shear cracks, and sudden punching failure. These events highlighted the need for better design considerations and strict building regulations to avoid soft-storey weaknesses in new constructions.

One of the main reasons soft storeys are dangerous is because earthquakes generate large horizontal forces that buildings must resist. While upper storeys have brick infill walls or

partitions that provide additional stiffness, the ground floor often has none. This sudden change in stiffness creates a weak plane. When seismic waves strike, the upper floors move together, but the soft storey is forced to undergo large displacements. This mismatch leads to what is known as a “storey mechanism,” where the soft storey behaves like a hinge and becomes the point of collapse.

Another contributing factor is inadequate column design. Columns in soft storey areas are often slender or designed only for vertical loads. But under seismic action, columns must resist bending, shear, and lateral drift. If they are not reinforced properly, they fail quickly. The lack of shear walls or bracing systems further worsens the situation. In many residential and commercial buildings, architects prioritize open spaces on the ground floor for parking or shops, unintentionally compromising structural stability. Modern building codes recognize the dangers of soft storeys and provide guidelines to avoid them. Structural engineers are encouraged to maintain uniform stiffness and strength across all storeys. One common solution is to use shear walls or braced frames on the ground floor. These elements provide the necessary rigidity and help distribute lateral forces evenly throughout the structure. Another method is to provide strong columns and beams in the soft storey, ensuring they can resist high seismic demands. Retrofitting techniques such as jacketing, steel bracing, and base isolation are also effective for strengthening existing buildings.

Retrofitting soft storey buildings has become an important practice in earthquake-prone regions. Column jacketing, where steel or reinforced concrete jackets are added around existing columns, significantly increases their strength and ductility. Steel bracing introduces diagonal members that resist horizontal forces and reduce storey drift. In some cases, engineers install new shear walls at strategic locations, improving overall stiffness. Base isolation systems can also be used for large or important structures,

reducing the intensity of ground motion transferred to the building. Retrofitting not only improves structural safety but also extends the life of older buildings.

The behavior of soft storeys during earthquakes is highly influenced by dynamic characteristics such as natural frequency, mode shapes, and damping. When the soft storey is much more flexible, it attracts a larger portion of displacement demands. This amplifies the seismic force acting on its structural components. Numerical modelling and shaking-table experiments show that soft storey collapse usually happens rapidly and without much warning. Due to the sudden nature of this failure, modern design approaches focus heavily on improving ductility, stiffness distribution, and redundancy. The concept of performance-based earthquake engineering is now widely used to evaluate buildings with soft storeys. Instead of designing only for strength, engineers analyse how the building will perform under different levels of seismic intensity. This approach helps identify weak zones such as soft storey levels and guides the selection of strengthening measures. Advanced simulation tools also help predict drift demands, shear forces, and potential failure modes. Such techniques have improved the understanding of how soft storeys behave and how they can be safely designed.

In recent years, awareness among builders, architects, and homeowners has increased. Government authorities have updated building regulations to control the creation of soft storeys. Many urban regions now mandate the use of lateral load-resisting systems for buildings with open ground floors. Public safety campaigns also emphasize the risks of soft storey construction, especially in high-rise residential complexes. These efforts aim to reduce earthquake-related damage and prevent loss of life. In conclusion, soft storeys represent a serious structural weakness that can significantly impact the safety and stability of a building. Their behavior during seismic events shows that they are highly vulnerable due to sudden changes in stiffness and inadequate lateral load resistance. However, with proper design, use of shear walls or bracing, strong column detailing, and modern retrofitting techniques, the dangers associated with soft storeys can be minimized. As urban populations grow and more multi-storey buildings are constructed, understanding and addressing soft storey behavior is essential for ensuring long-term structural safety and resilience.



Thermal bridge is an important concept in building construction and energy efficiency, and it refers to a part of a structure where heat flows more easily than in surrounding areas. This occurs mainly because of a difference in material conductivity. Buildings are composed of different materials such as concrete, steel, timber, and insulation, each having its own thermal properties. When a highly conductive material like metal or dense concrete passes through an insulated area, it creates a shortcut for heat movement. This shortcut is known as a thermal bridge. The presence of thermal bridges in buildings, even in small areas, can significantly increase energy loss, affect indoor comfort, and lead to surface condensation problems that weaken the structural components over time. As buildings become more advanced and energy codes become stricter, understanding thermal bridges becomes essential for engineers, architects, and construction professionals.

Thermal bridges occur for several reasons. Modern construction practices involve connections, joints, beams, slabs, and penetrations, all of which may disrupt the continuity of insulation layers. When insulation is not continuous, heat quickly passes through the path of least resistance. In cold climates, heat moves from inside to outside, causing unnecessary loss of heating energy, while in hot regions, heat from the outside enters the building, increasing the cooling load. Many buildings have hidden thermal bridges at balcony slabs, window frames, wall-to-wall junctions, roof-wall joints, and mechanical penetrations such as pipes and ducts. Without proper design considerations, these bridges become significant energy leak points. The effect may not be immediately visible, but long-term performance of the building is reduced as the HVAC system struggles to maintain indoor temperature, resulting in higher electricity bills. The consequences of thermal bridging extend beyond energy loss. One major issue is surface condensation. When warm indoor air touches a cold surface created by a thermal bridge, the

the temperature drops below the dew point and water droplets begin to form. Over time, this moisture can support mold growth, fungal activity, and surface staining. Mold is a serious health hazard because it releases spores that can cause respiratory problems, allergies, and general discomfort. Additionally, the presence of continuous dampness weakens the durability of wall paints, plaster finishes, and structural components. In many older buildings, black spots on corners or edges of walls are signs of thermal bridges and the condensation they cause. Preventing such damage becomes crucial, especially in buildings that house sensitive materials, healthcare facilities, or older occupants who may be vulnerable to indoor air quality issues. Design plays a critical role in managing thermal bridges. Traditional construction methods often gave less priority to insulation continuity, but modern energy-efficient designs focus on minimizing conductive paths. Thermal breaks, insulating brackets, external wall insulation, and specialized cladding systems are used to interrupt heat flow. Engineers evaluate building envelopes using tools such as heat transfer simulations and thermographic imaging to detect weak points. These tools allow professionals to visualize heat patterns and identify locations of thermal bridges, making it easier to adopt corrective measures during design or renovation. Increasing awareness of sustainable building practices has led to the development of advanced materials with low thermal conductivity, such as aerogel insulation, rigid foam boards, and insulated structural panels, which help reduce bridging even in complex structures.

In structural systems, one of the most common thermal bridges occurs at balconies. The balcony slab usually extends from the interior to the exterior of the building without insulation. This continuous concrete element acts as an excellent conductor of heat, and during winter, the cold from outside travels into the interior slab, making indoor floors cold.

To solve this issue, thermal break connectors are placed between the interior and exterior slab portions. These connectors maintain structural strength while reducing heat flow. Similarly, steel columns and beams can act as thermal bridges if they extend across insulated layers. Cladding supports, lintels, parapets, and roof joints are also prone to bridging. Engineers must carefully design these connections using thermal isolation pads, insulated structural blocks, and properly aligned insulation to limit conductive heat transfer.

In addition to structural elements, doors and windows are major sources of thermal bridging due to their frames and installation gaps. Metal window frames, especially aluminum without thermal breaks, conduct heat rapidly. In modern construction, thermally broken frames are designed with plastic or insulating materials separating the inner and outer parts of the frame. Glazing cavities, weatherstrips, and properly filled installation gaps are essential to avoiding unwanted heat flow. Even small gaps around windows, if left unsealed, can create thermal bridges that increase heating and cooling loads. Therefore, airtightness and proper sealing practices are necessary during installation to achieve good thermal performance.

Building codes and energy rating systems around the world now emphasize thermal bridge reduction. Certification systems like LEED, BREEAM, and national energy codes encourage designers to evaluate thermal transmittance (U-values) and account for linear thermal bridges in calculations. Ignoring thermal bridges while designing walls and roofs can lead to underestimating energy loss by as much as 20–30%. Hence, accurate calculations are necessary to ensure the building meets energy-efficiency requirements. Envelope commissioning and post-construction thermal imaging have also become common to verify whether the insulation was installed correctly.

Retrofitting existing buildings to reduce thermal bridges is a growing area of interest. Older buildings often have poor insulation and many conductive paths, making them energy-inefficient.

Retrofitting methods include adding external insulation, internal post-insulation, replacing old frames with modern thermally broken windows, and sealing air gaps. External insulation is often considered the most effective because it treats the entire building envelope and eliminates most thermal bridges. Internal insulation, though easier to install, must be done carefully to prevent condensation within the wall layers.

Thermal bridging not only affects energy consumption but also the environmental footprint of buildings. Buildings consume a large share of global energy, and reducing heat loss contributes to lower greenhouse gas emissions. As countries move toward net-zero energy buildings, minimizing thermal bridges becomes a necessary component of sustainable development. The integration of renewable energy systems such as solar panels becomes more effective when the building envelope is already efficient. Thermal bridge control ensures that the energy generated is not wasted due to poor insulation performance.

In conclusion, thermal bridges are crucial yet often overlooked elements of building performance. They allow heat to escape or enter more easily, leading to increased energy consumption, discomfort, condensation, and long-term structural and health problems. Through thoughtful design, advanced materials, and proper construction practices, thermal bridges can be effectively minimized. As building standards continue to evolve, addressing thermal bridging becomes an essential part of creating durable, comfortable, and energy-efficient buildings for the future.

Chenani Nashri Tunnel

Sneha K, S8CE

The Chenani–Nashri Tunnel, officially named the Dr. Syama Prasad Mookerjee Tunnel, is one of India's most remarkable engineering achievements and a landmark in the development of transportation infrastructure in the Himalayan region. Located on National Highway-44 in Jammu & Kashmir, the tunnel connects Chenani in the Udhampur district with Nashri in Ramban district. Before its construction, this stretch of road was known for severe traffic congestion, landslides, and unpredictable weather, which often resulted in long delays. The tunnel has drastically improved travel safety, reliability, and economic connectivity across the region.

Opened to the public in April 2017, the 9.28-kilometre tunnel holds the distinction of being India's longest road tunnel at the time of completion. It forms a crucial part of the four-laning project of the Jammu–Srinagar National Highway, reducing the travel distance by nearly 31 kilometres and the travel time by about two hours. By bypassing high-altitude passes, sharp curves, and landslide-prone areas, the Chenani–Nashri Tunnel has provided an all-weather, safer alternative for commuters and freight transporters. This has been particularly beneficial for the Kashmir Valley, which heavily depends on this highway for supplies throughout the year.

Constructing the Chenani–Nashri Tunnel in the young and fragile Himalayan mountains was a challenging task for engineers and geologists. The region is known for its complex geological strata, unpredictable rock formations, and high seismic activity. Engineers adopted the New Austrian Tunnelling Method (NATM) for construction, which allows continuous monitoring of ground conditions and adjustment of support measures during excavation. This method ensured safety, cost-effectiveness, and adaptability in response to sudden geological variations. Despite difficult working conditions, the project was successfully completed within scheduled time, showcasing the advanced tunnelling expertise of Indian engineers and

international collaborators.

One of the most notable features of the Chenani–Nashri Tunnel is its twin-tube design. It consists of a two-lane main tunnel for vehicles and a parallel escape tunnel for emergency evacuation. The two tubes are interconnected by 29 cross-passages placed at intervals of 300 metres. This world-class system significantly enhances safety and ensures quick response during accidents or fire incidents. The escape tunnel and cross passages enable rapid access for rescue teams, offering a level of safety comparable to international highway tunnels.

The tunnel is equipped with an advanced ventilation system, designed to maintain clean air and remove vehicle emissions efficiently. This system uses longitudinal ventilation with massive exhaust fans that constantly monitor and adjust air quality. Sensors installed throughout the tunnel measure carbon monoxide levels, visibility, and particulate matter, triggering automatic responses to maintain safe conditions. Fire detection and suppression systems, including high-sensitivity smoke detectors, hydrants, and firefighting equipment, ensure maximum protection for passengers. CCTV cameras placed every 75 metres and communication systems integrated along the entire route reinforce continuous monitoring and rapid incident management.

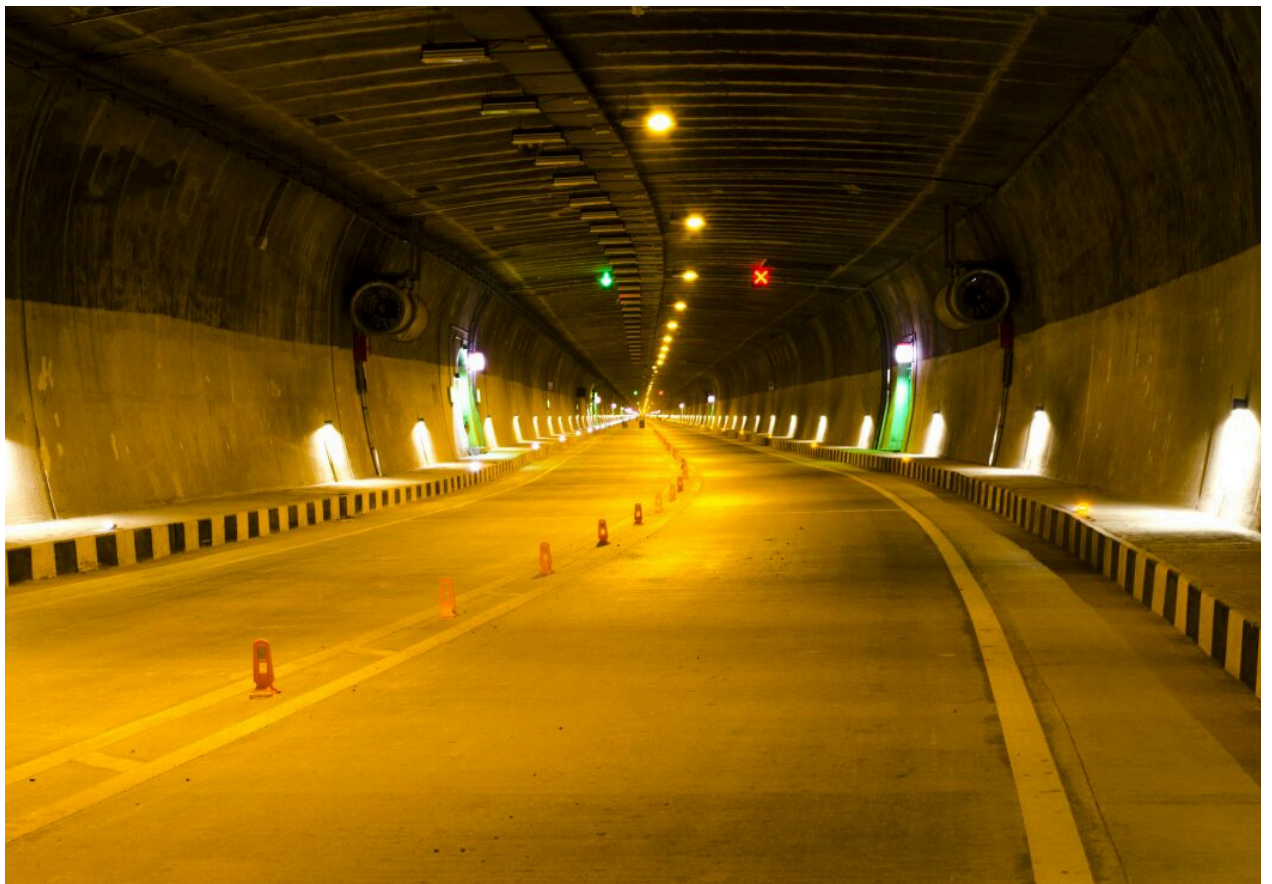
Lighting and power supply in the tunnel are also designed for maximum efficiency and safety. The illumination levels automatically adjust depending on the time of day to prevent sudden brightness changes that could affect driver visibility. High-quality LED lights are used to reduce energy consumption. Continuous power backup ensures that critical systems remain functional at all times. The road surface inside the tunnel is designed with proper drainage and skid-resistant paving to reduce the chances of accidents, especially in winter when water can enter the tunnel from nearby valleys.

Economically, the Chenani–Nashri Tunnel has brought significant benefits to the Jammu and Kashmir region.

Environmentally, the tunnel has helped reduce fuel consumption and vehicle emissions by eliminating long detours and reducing idle time caused by traffic jams. Fewer vehicles now need to climb steep mountain roads, which previously consumed more fuel and caused pollution. Additionally, the tunnel bypasses areas prone to landslides and heavy snowfall, reducing the need for frequent road maintenance and environmental disruption. Overall, the project contributes to sustainable transportation by improving efficiency and reducing ecological impact.

The Chenani–Nashri Tunnel is considered a modern marvel of engineering in India due to its combination of advanced technology, safety features, and large-scale execution. It demonstrated India’s capability to handle complex infrastructure projects in difficult terrains. The successful completion of the tunnel has also paved the way for future tunnelling projects in the Himalayan region, including the Zojila and Z-Morh tunnels. These upcoming projects will further enhance connectivity and strategic mobility across northern India.

In conclusion, the Chenani–Nashri Tunnel stands as a symbol of engineering excellence and regional development. Its construction has transformed the travel experience on the Jammu–Srinagar highway, making it safer, faster, and more reliable. With advanced safety systems, state-of-the-art ventilation, and strong structural design, the tunnel meets international standards and sets a new benchmark for future infrastructure projects in India. Its impact on transportation, economy, environment, and regional connectivity highlights its significance as one of the most important tunnels ever built in the country. The Chenani–Nashri Tunnel is not only a technological achievement but also a crucial step toward the modernization of India’s mountain highways.





BUOYANT FOUNDATION

Sariga Jayaraj, S6CE

In the face of escalating global climate change, the frequency and severity of flooding events have increased dramatically, threatening coastal and low-lying inland communities. Traditional static defenses, such as levees and permanent elevation, are often insufficient or economically unviable. Consequently, the field of civil engineering has turned towards adaptive flood mitigation strategies. One such innovation is the Buoyant Foundation system, a method that allows structures to adapt dynamically to rising water levels rather than resisting them rigidly. This system is critical because it offers a resilient alternative to permanent displacement. In many flood-prone regions, the soil bearing capacity is low, making heavy, elevated concrete structures risky due to potential subsidence. Buoyant foundations, which rest on the ground during dry periods and float during floods, decouple the house from the ground temporarily. This capability is vital for preserving the socio-economic fabric of communities, allowing residents to remain in their ancestral lands without the constant threat of catastrophic property loss.

Amphibious construction refers to a design philosophy where a building is capable of functioning on both land and water. Flood damage in conventional structures typically results from hydrostatic pressure pushing against walls, water saturation destroying materials, and structural shifting. Amphibious construction mitigates these risks by simply removing the structure from the flood zone vertically. By lifting the house above the water line, the destructive forces of the flood are neutralized, ensuring the structural integrity remains intact even during severe inundation. The fundamental concept relies on Archimedes' Principle of buoyancy. The system is designed so that the weight of the water displaced by the foundation is greater than the total weight of the house. When floodwaters rise, this upward buoyant force lifts the structure. Unlike a boat, however, an amphibious house is constrained to a specific footprint. It moves only vertically, guided by a system of telescopic or static poles, ensuring that when the waters recede, the house returns exactly to its original position on its foundation piers.

The successful operation of a buoyant foundation depends on three synergistic components. First, Buoyancy Blocks, typically made of Expanded Polystyrene (EPS) geofoam, provide the necessary lift. These are lightweight, durable, and resistant to water absorption. Second, the Structural Sub-frame acts as a chassis, tying the house and buoyancy blocks together into a rigid unit. Third, the Vertical Guidance System consists of steel columns anchored into the ground and sliding sleeves attached to the house. This system prevents the house from floating away with the current or rotating during the flood.

Constructing an amphibious foundation involves either retrofitting an existing structure or building a new one from scratch. The process requires precise calculation of the building's dead and live loads to determine the volume of buoyancy foam required. The construction sequence prioritizes stability, ensuring the house remains level both when resting on the ground and when floating. The construction process is divided into several critical stages. Initially, it involves setting up piers by installing concrete or timber footings. These piers support the house during non-flood seasons, ensuring the buoyancy blocks are kept off the damp ground to prevent degradation and allow airflow. Next, a rigid platform is constructed on top of the sub-frame to distribute the load of the house evenly across the buoyancy elements. Following this, metal frames are attached underneath the platform, designed to securely hold the buoyancy blocks in place and prevent them from dislodging under the pressure of rising water. The most critical structural step is setting the vertical guidance poles. These poles are driven deep into the ground at the corners of the structure and must be perfectly vertical to prevent binding. Buoyancy blocks are then inserted into the metal frames beneath the house. Sliding sleeves are subsequently installed around the guidance poles; these sleeves serve as the interface between the moving house and the static poles, often lined with low-friction materials to ensure smooth elevation. Finally, the buoyant foundation structure is completed by installing breakaway or flexible utility connections for water, sewage, and electricity that extend as the house rises, ensuring vital services are not ruptured during a flood.

While innovative, buoyant foundations present a specific set of trade-offs compared to traditional static elevation. The primary advantage is that the house remains close to the ground, which preserves accessibility for the elderly and disabled as no long staircases are required. Furthermore, the structure is less susceptible to hurricane damage; because it sits low, it is less exposed to high wind shears compared to houses on tall stilts. The system also aids in alleviating the problems of soil subsidence by distributing loads effectively. Crucially, it allows for original traditional architecture to be maintained, ensuring the neighborhood retains its original character. Finally, the system automatically elevates the house to the required height based on the specific flood level, rather than a predicted maximum. However, there are disadvantages. The initial cost can be high due to the specialized materials and engineering required. Regular maintenance is essential to ensure the space beneath the house is free of debris that could obstruct the landing. Additionally, the system has a maximum elevation limit defined by the height of the guidance poles; if a flood exceeds this height, the system could fail.

To illustrate the effectiveness of this system, a case study was conducted in a flood-prone region of the Mekong Delta where traditional homes faced annual inundation. A pilot project selected a cluster of timber homes for retrofitting. The team installed a steel sub-frame containing EPS foam blocks beneath the existing floorboards and anchored four steel guidance posts at the corners. During the subsequent monsoon season, water levels rose by 1.2 meters. The retrofitted houses successfully floated, keeping the living areas dry. The project demonstrated that amphibious retrofitting is a technically feasible and culturally acceptable solution for riverine flood zones.

In conclusion, the buoyant foundation represents a paradigm shift in civil engineering—working with water rather than fighting it. By utilizing simple physical principles, it provides a robust, sustainable solution for low-lying areas. While maintenance and initial costs are factors, the ability to protect property while maintaining community structure and accessibility makes it a superior alternative to permanent static elevation in the era of climate change.

Modern civil engineering constantly seeks construction methods that maximize efficiency, strength, and durability while minimizing material usage. One of the most significant advancements in composite construction is the Concrete-Filled Steel Tube (CFST) column. As outlined in the fundamental background of composite structures, a CFST consists of a steel hollow section filled with concrete. This combination is not merely additive; it is synergistic. The steel tube acts as permanent formwork and provides confinement to the concrete, while the concrete core delays the local buckling of the steel tube. This structural marriage addresses the weaknesses of both materials individually: the susceptibility of thin steel to buckling and the brittle nature of high-strength concrete.

The structural behavior of CFST columns is distinct from traditional reinforced concrete or structural steel. Understanding the failure modes is critical for design. Typically, short CFST columns fail due to crushing of the concrete core or yielding of the steel, whereas slender columns are prone to overall buckling. However, the presence of the concrete core changes the local buckling mode of the steel tube from an inward collapse to an outward ripple, which is significantly more stable. The shape of the CFST element plays a pivotal role in this behavior. While circular, square, and rectangular sections are common, circular tubes offer the most effective confinement because the hoop stresses are distributed

uniformly, providing consistent inward pressure on the concrete core. Square and rectangular sections, while easier to connect to beams, provide less effective confinement, particularly along the flat sides where the steel tends to bow outward.

The core engineering principle behind CFSTs lies in the load transfer mechanism and the stress-strain relationship of the composite column. In the initial stages of loading, the steel and concrete behave somewhat independently. However, as the longitudinal load increases, the concrete core expands laterally due to the Poisson effect. When the stress in the concrete becomes high, its lateral expansion exceeds that of the steel tube. At this critical juncture, the steel tube restrains the concrete, creating a state of triaxial compression within the core. This confinement significantly enhances the compressive strength and ductility of the concrete.

Theoretical analysis and experimental comparisons between CFST columns and hollow steel columns reveal the magnitude of this benefit. A hollow tube is prone to sudden, catastrophic buckling. In contrast, the concrete filling absorbs energy and forces the steel to yield gradually. Furthermore, the bond between the steel and concrete is essential for ensuring that the two materials act as a single unit. If the bond is broken or if there is shrinkage separation, the load transfer is compromised, leading to reduced capacity. Mechanical shear connectors or expansive concrete additives

are often used to ensure a robust bond interface.

The design of CFST columns is governed by specific codes and standards, such as Eurocode 4 or AISC 360, that rely on fundamental assumptions. The primary assumption is that plane sections remain plane during bending and that there is full interaction (perfect bond) between the steel and concrete up to failure. Designers must account for material non-linearity and geometric imperfections. The design codes provide formulas to calculate the "squash load"—the ultimate capacity of the cross-section—by summing the contributions of the steel and the concrete, often adding a coefficient to account for the confinement effect in circular columns. These codes ensure that the columns are safe against both axial loads and combined axial-bending moments, which are common in high-rise frames and bridge piers.

The adoption of CFST columns is driven by their compelling advantages, particularly in bridge construction. For bridges, CFSTs offer a high strength-to-weight ratio, which reduces the dead load on foundations. The steel tube serves as its own formwork, eliminating the labor and time costs associated with timber or steel shuttering and reinforcement cage assembly. This allows for rapid construction, often referred to as "top-down" construction in bridge piers. Additionally, the steel casing protects the concrete from environmental degradation, such as chloride attack in marine environments.

However, there are disadvantages that engineers must mitigate. The primary concern is fire resistance; while the concrete

core acts as a heat sink, the external steel is directly exposed to fire and loses strength rapidly at high temperatures, often requiring external fireproofing. Additionally, construction challenges exist, particularly regarding the compaction of concrete inside deep tubes. Ensuring there are no voids or honeycombing deep inside a steel tube requires high-slump, self-compacting concrete and rigorous quality control.

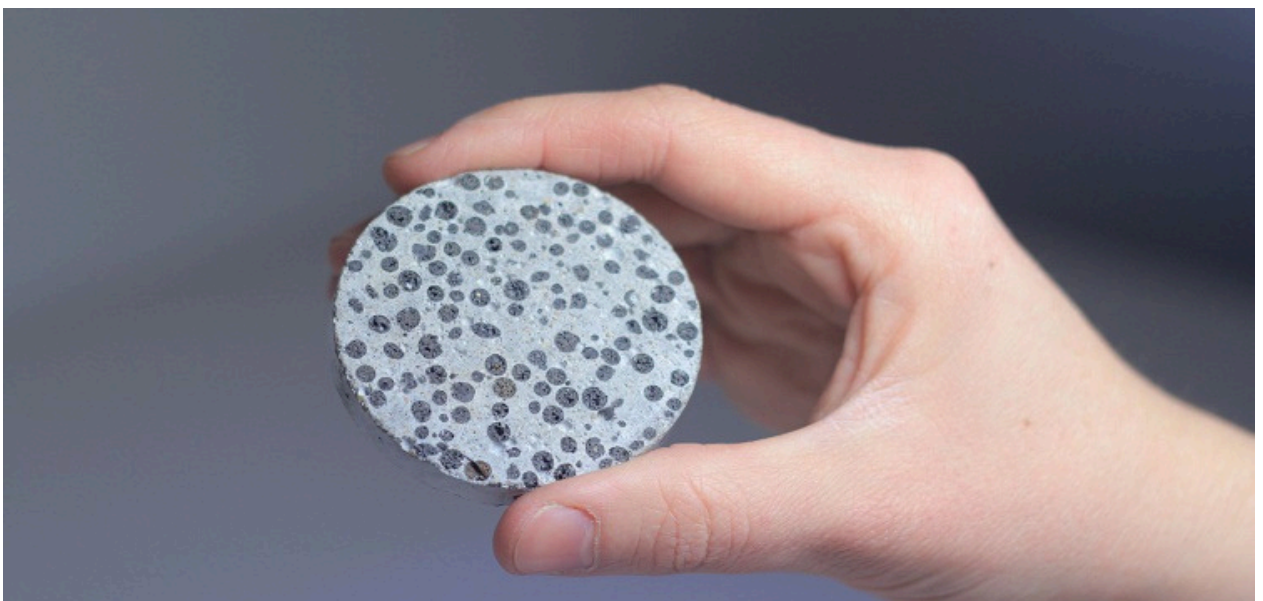
Real-world application through case studies demonstrates the efficacy of CFST technology. High-profile projects, such as large-span arch bridges and mega-tall skyscrapers, utilize CFSTs to handle massive vertical loads while keeping column dimensions manageable. These case studies validate the theoretical models, showing that CFST structures exhibit superior seismic performance due to their high ductility and energy absorption capabilities. In conclusion, the Concrete-Filled Steel Tube represents a highly efficient structural solution that leverages the best properties of steel and concrete. By understanding the complex interplay of confinement, bond strength, and load transfer, engineers can design structures that are lighter, stronger, and faster to build. While challenges regarding fire protection and construction quality control remain, the benefits of CFSTs make them an indispensable component of modern infrastructure design.

BACTERIAL CONCRETE

Abhimanue K, S6CE

To fully understand the potential of bacterial concrete, one must look beyond the general concept and examine the intricate material science and biological preparation involved in its creation. The experimental investigation begins with the precise selection of ingredients, where the role of the bacteria is paramount. In most successful studies, the bacteria selected are from the genus *Bacillus*, specifically strains like *Bacillus subtilis*, *Bacillus pasteurii*, or *Bacillus sphaericus*. These are chosen not randomly, but for their resilience; they are distinctively alkaliphilic, allowing them to survive the high pH environment of concrete which typically ranges between 12 and 13. Furthermore, their ability to form endospores is the key survival mechanism. These spores act as biological sleeping pods, enduring the mechanical shear forces during mixing and the heat of hydration as the concrete cures, remaining dormant until a crack provides the necessary oxygen and moisture to trigger their metabolic activity.

The preparation of the test specimens involves a rigorous cultivation process before any mixing occurs. The bacteria are typically grown in a laboratory setting using a nutrient broth—a liquid medium rich in peptone and beef extract—incubated at specific temperatures (often around 37°C) to maximize population density. However, simply pouring this bacterial liquid into a cement mixer is often insufficient due to the harshness of the concrete matrix. Therefore, advanced methods of mixing, particularly encapsulation, are frequently employed. In this technique, the bacteria and their nutrient source (commonly calcium lactate) are impregnated into porous aggregates, such as expanded clay or diatomaceous earth, or encapsulated in hydrogels.



This acts as a protective housing, shielding the biological agents from the crushing forces of the mixing process and ensuring they remain viable for years within the hardened structure.

Once the bacteria are successfully embedded, the chemical mechanism that drives the self-healing process is a fascinating display of biochemistry known as ureolytic activity. When a micro-crack forms, water seeps in and dissolves the nutrients embedded alongside the bacteria. The dormant spores, sensing the moisture and incoming oxygen, germinate into vegetative cells. These active bacteria begin to produce an enzyme called urease. This enzyme catalyzes the hydrolysis of urea (if present) or metabolizes the calcium lactate. The metabolic process increases the local pH and produces carbonate ions. These carbonate ions react with the free calcium ions available in the concrete matrix (specifically from calcium hydroxide, a byproduct of cement hydration) to precipitate calcium carbonate. This precipitate crystallizes as calcite, a hard, limestone-like material that physically bridges the gap of the crack, sealing it watertight and restoring the structural integrity.

The validation of this technology relies on a comprehensive suite of testing procedures that go beyond standard compressive strength tests. While compressive strength is measured to ensure the addition of bacteria hasn't weakened the concrete (in fact, it often slightly improves strength due to pore filling), the true measure of success lies in durability and healing efficiency. Researchers employ Split Tensile Strength tests to see how the material behaves under tension, which is where cracks typically originate. More specific to self-healing, water permeability tests are conducted where water is forced against the concrete surface; a successful bacterial concrete will show a significant reduction in water flow over time as the cracks heal.

Advanced microscopic analysis, such as Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD), acts as the final verification step. Through high-magnification imaging, engineers can visually confirm the presence of calcite crystals growing inside the cracks, distinct from the surrounding cement paste. These images often show a dense network of crystals weaving across the fissure, providing visual proof of the biological repair mechanism. Furthermore, ultrasonic pulse velocity tests are used as a non-destructive method to assess the internal quality of the concrete. By sending sound waves through the block, engineers can detect whether internal voids and cracks have been filled, as sound travels faster through solid, healed matter than through air-filled cracks. Collectively, these experimental steps—from the cultivation of microscopic spores to the macroscopic testing of hardened beams—demonstrate that bacterial concrete is not just a theoretical concept, but a scientifically viable solution engineered to extend the lifespan of modern infrastructure.

Soundless demolition is a modern and innovative construction technique that enables the breaking of concrete and rocks without generating noise, vibration, or significant dust. In conventional demolition practices, methods such as blasting, jackhammers, and heavy machinery are commonly used. While effective, these techniques often produce high levels of noise and ground vibrations, which can damage nearby structures and create discomfort for people living in surrounding areas. Such methods are also not suitable for densely populated urban environments or sensitive locations. In contrast, soundless demolition offers a safer, quieter, and more environmentally friendly alternative, making it highly valuable in today's rapidly developing world where construction activities are increasing in close proximity to residential and commercial spaces.

The core principle of soundless demolition lies in the use of a non-explosive material known as Soundless Chemical Demolition Agent (SCDA). This material is typically composed of calcium oxide (quicklime) along with other chemical additives that enhance its expansive properties. When the SCDA powder is mixed with water, it forms a slurry that can be easily poured into pre-drilled holes in the concrete or rock surface. After placement, a chemical hydration reaction begins, generating heat and causing the material to expand gradually. This expansion creates extremely high pressure within the confined space of the drilled holes, often reaching values strong enough to overcome the tensile strength of the surrounding material. As a result, internal stresses develop, leading to the formation of cracks. These

cracks slowly propagate and widen over time, eventually causing the structure to split or break apart in a controlled and predictable manner without any sudden shock or explosion.

The process of soundless demolition involves several important steps that require careful planning and precision. Initially, holes are drilled into the structure at specific intervals, depths, and diameters based on the nature of the material and the desired pattern of cracking. The spacing and alignment of these holes play a crucial role in ensuring effective and uniform demolition. After drilling, the SCDA is mixed with water in the correct proportion to achieve a consistent slurry. This mixture is then poured into the holes, ensuring that they are properly filled without leaving air gaps. Once the slurry is placed, the reaction begins, and the material is left undisturbed for several hours or even up to a day, depending on factors such as temperature, humidity, and the type of material being broken. Over this period, cracks gradually appear and expand, leading to the controlled disintegration of the structure.

Soundless demolition finds wide application in various fields of civil engineering and construction. It is commonly used in building renovation and repair works where selective removal of concrete is required without affecting the stability of the remaining structure. It is also extensively applied in bridge and dam dismantling, rock excavation for foundations, quarrying operations, and tunnel construction projects. In addition, it is highly useful in areas where traditional blasting is restricted, such as near hospitals, schools, residential zones, and historical

monuments. The ability to carry out demolition without noise and vibration makes it an ideal choice for projects in environmentally sensitive and densely populated regions.

One of the major advantages of soundless demolition is its high level of safety. Since it does not involve explosives, the risk of accidental blasts or flying debris is significantly reduced. The absence of vibration ensures that nearby structures remain unaffected, preventing cracks or structural damage. Furthermore, the method is environmentally friendly as it produces minimal dust and noise pollution, contributing to a healthier and more comfortable working environment. Another important benefit is the precision it offers, allowing engineers to control the direction and extent of cracking according to the project requirements. This makes it particularly useful for delicate and specialized demolition tasks.

However, soundless demolition also has certain limitations. The process is relatively slower compared to traditional blasting methods, which may not be suitable for projects requiring rapid demolition. It also requires careful planning, proper drilling techniques, and skilled labor to achieve effective results. Additionally, the performance of SCDA can be influenced by environmental conditions such as temperature, as extreme heat or cold may affect the rate of expansion. Despite these challenges, the advantages of safety, control, and environmental protection often outweigh the limitations, making it a preferred choice in many modern construction scenarios.

In conclusion, soundless demolition represents a significant advancement in construction technology, offering a safe, efficient, and eco-friendly solution for breaking concrete and rocks. As urbanization continues to expand and the demand for sustainable construction

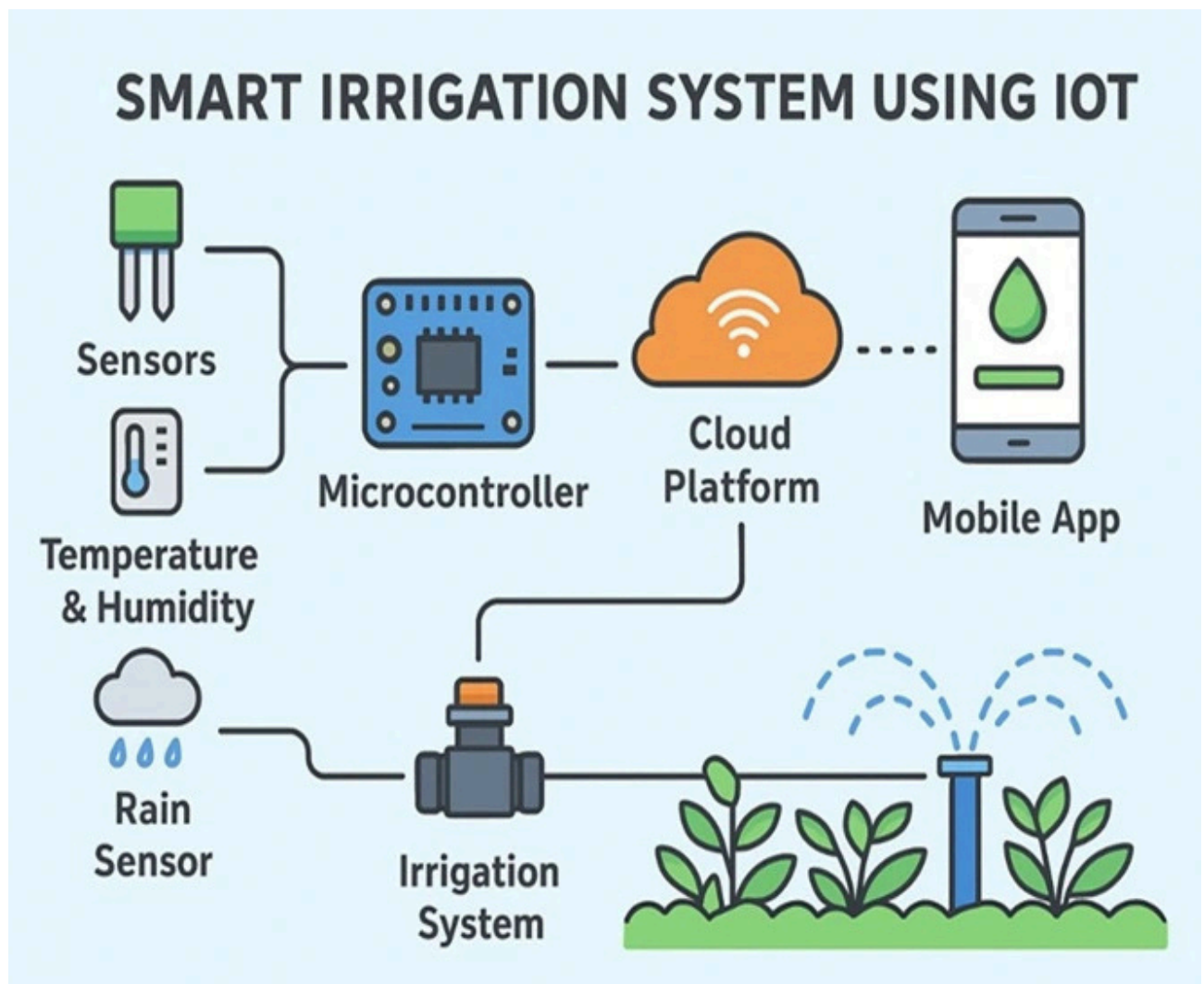
practices increases, this technique is becoming increasingly important in engineering projects worldwide. Its ability to provide controlled demolition without disturbing the surrounding environment makes it an essential tool for the future of construction and infrastructure development.

Smart irrigation using the Internet of Things (IoT) is an innovative and efficient approach to water management in modern agriculture, designed to optimize the use of water resources while improving crop productivity. In traditional irrigation practices, water is often applied uniformly across fields without considering the actual moisture requirements of the soil or the specific needs of crops. This results in significant water wastage, over-irrigation, and sometimes even damage to crops due to waterlogging. With the growing challenges of water scarcity, unpredictable rainfall patterns, and climate change, there is an urgent need for smarter and more sustainable agricultural practices. Smart irrigation systems address these challenges by integrating advanced technologies such as sensors, microcontrollers, and internet connectivity to ensure precise and controlled water usage. At the core of this system are soil moisture sensors that are strategically placed in the agricultural field to continuously monitor the moisture content of the soil in real time. These sensors collect accurate data and transmit it to a microcontroller, which acts as the brain of the system. The microcontroller is connected to the internet through IoT technology, enabling seamless communication between the field and the user. Based on the data received, the system automatically determines whether irrigation is required and activates the water pump only when the soil moisture level falls below a predefined threshold. This automated decision-making process ensures that crops receive the exact amount of water needed for optimal growth, avoiding both under-irrigation and over-irrigation.

In addition to automation, smart irrigation systems provide remote monitoring and control capabilities, allowing farmers to manage their fields from anywhere using a smartphone, tablet, or computer. Through mobile applications or web-based platforms, farmers can access real-time information about soil moisture levels, temperature, humidity, and even weather forecasts. This helps them make informed decisions and adjust irrigation schedules according to changing environmental conditions. Some advanced systems also incorporate weather prediction data and artificial intelligence to further enhance efficiency by preventing irrigation during rainfall or optimizing watering schedules based on crop type and growth stage. The benefits of IoT-based smart irrigation are significant and wide-ranging. One of the most important advantages is water conservation, as the system minimizes wastage by supplying water only when necessary. This is particularly crucial in regions facing water shortages. Additionally, it leads to improved crop yield and quality, as plants receive consistent and adequate moisture levels essential for healthy growth. The reduction in manual labor is another key benefit, as the system operates automatically, saving time and effort for farmers. It also contributes to energy efficiency by reducing the unnecessary operation of irrigation pumps.

Furthermore, smart irrigation supports sustainable agriculture by promoting the responsible use of natural resources and reducing environmental impact.

Despite its many advantages, the adoption of smart irrigation systems may face certain challenges, including initial installation costs, the need for technical knowledge, and dependence on reliable internet connectivity. However, with the rapid advancement of technology and increasing awareness among farmers, these challenges are gradually being overcome. Governments and agricultural organizations are also promoting the use of smart farming technologies through various initiatives and subsidies. In conclusion, smart irrigation using IoT represents a significant step forward in the evolution of agriculture, combining technology and sustainability to address one of the most critical issues of our time—efficient water management. As the global demand for food continues to rise and water resources become increasingly limited, the adoption of such intelligent systems will play a vital role in ensuring food security and sustainable development for future generations.



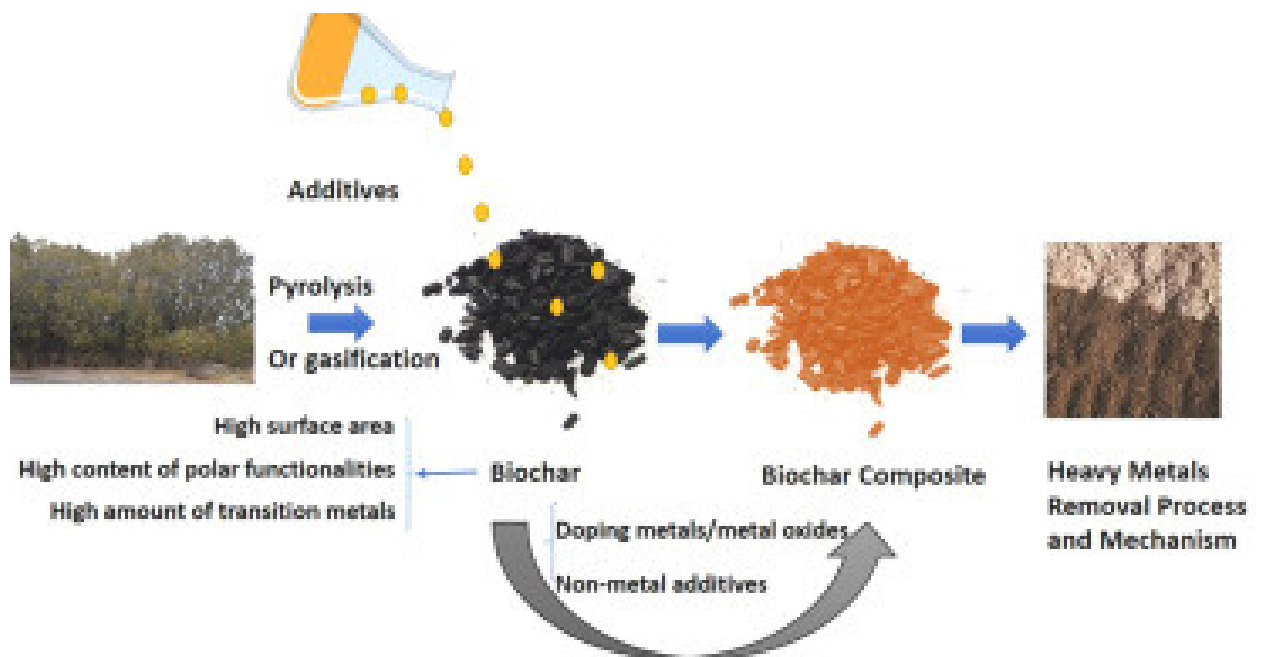
Removal of heavy metals using biochar has gained significant attention in recent years as an effective and sustainable solution to one of the most pressing environmental problems caused by rapid industrialization and urban development. Heavy metal contamination in soil and water arises from various sources such as mining activities, industrial discharge, agricultural chemicals, and improper waste disposal. Toxic metals including lead (Pb), cadmium (Cd), mercury (Hg), and arsenic (As) are non-biodegradable and persist in the environment for long periods. These contaminants can accumulate in soil and water bodies, eventually entering the food chain through plants and aquatic organisms, posing serious health risks such as organ damage, neurological disorders, and even cancer in humans. Therefore, the need for efficient, eco-friendly, and cost-effective methods to remove or reduce heavy metal contamination has become increasingly important. Among the various techniques developed, biochar has emerged as a highly promising material due to its unique physical and chemical properties.

Biochar is a carbon-rich material produced through the pyrolysis process, in which organic biomass such as agricultural residues, wood chips, crop waste, or even animal manure is heated in a low or no oxygen environment. This process not only converts waste materials into a valuable product but also enhances the properties of the resulting biochar, making it highly suitable for environmental applications. One of the key features of biochar is its highly porous structure and large surface area, which provide numerous active sites for the adsorption of heavy metal ions. Additionally, biochar

contains various functional groups such as hydroxyl, carboxyl, and carbonyl groups on its surface, which play a crucial role in binding metal ions. When biochar is introduced into contaminated soil or water, it interacts with heavy metals through multiple mechanisms including adsorption, ion exchange, electrostatic attraction, and surface complexation. These processes effectively immobilize the metals, reducing their mobility and bioavailability, thereby preventing their uptake by plants and minimizing their movement into groundwater systems.

Another significant advantage of using biochar is its environmental sustainability. Since it is produced from agricultural and organic waste materials, it offers a cost-effective and eco-friendly alternative to conventional remediation methods such as chemical treatments or physical removal techniques, which can be expensive and sometimes harmful to the environment. Furthermore, biochar contributes to carbon sequestration by storing carbon in a stable form, thereby helping to mitigate climate change. Its application in soil also improves soil fertility, enhances water retention capacity, and promotes microbial activity, providing additional benefits for agricultural productivity. Despite these advantages, certain factors such as the type of biomass used, pyrolysis temperature, and environmental conditions can influence the efficiency of biochar in heavy metal removal. Ongoing research is focused on modifying and enhancing biochar properties to improve its adsorption capacity and effectiveness under different conditions. In conclusion, the use of biochar for the removal of heavy metals

represents a sustainable and innovative approach to environmental remediation. With its ability to reduce toxicity, improve soil health, and support waste recycling, biochar stands out as a powerful tool in achieving cleaner and safer ecosystems, making it an important technology for the future of environmental engineering and sustainable development.



മാനസസ്തമനം

ശ്രീവല്ലഭത്തിൽ വിശ്വലോകത്തിൽ
ഏതൊരു സുന്ദരിയെ കിട്ടിയാൽ നമ്മൾ
തലമുറകൊന്നാണെന്നു വിവരമില്ലാതെ
ഉണങ്ങിയെലപ്പും ചിന്തകളിൽ
ഏതൊരു കിടപ്പിൽ കൂട്ടുണ്ടെന്നോ
കാലം മനസ്സാണു ഏതൊരു.

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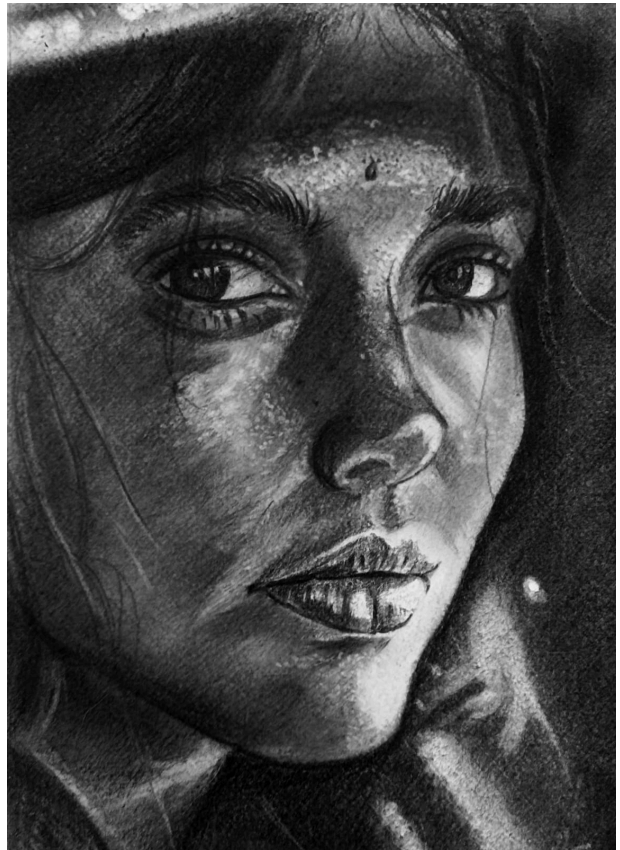
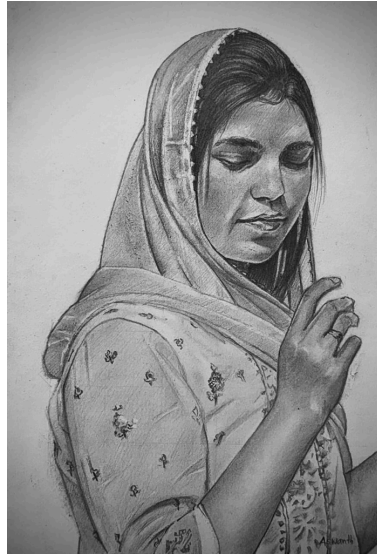
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Date / /

The Solitude we are Born to

In a silent Breath, we enter Alone
Unaware of the world we call our own.
Eyes unopened, futures still unknown
Yet watched by many, though we are alone.
Soon the heart learns the weight of life,
The restless race, the constant strife.
We chase our dreams with all our might,
Competing for a place in fading light.
But every story bends towards its end.
Crowds grow distant, noise begins to bend
And just as softly as we first came,
We leave this world the very same.
For solitude is the truth we find -
The quiet strength of humankind.
Born alone and go alone
Yet in that loneliness, we become our own.
- Thushara P.V

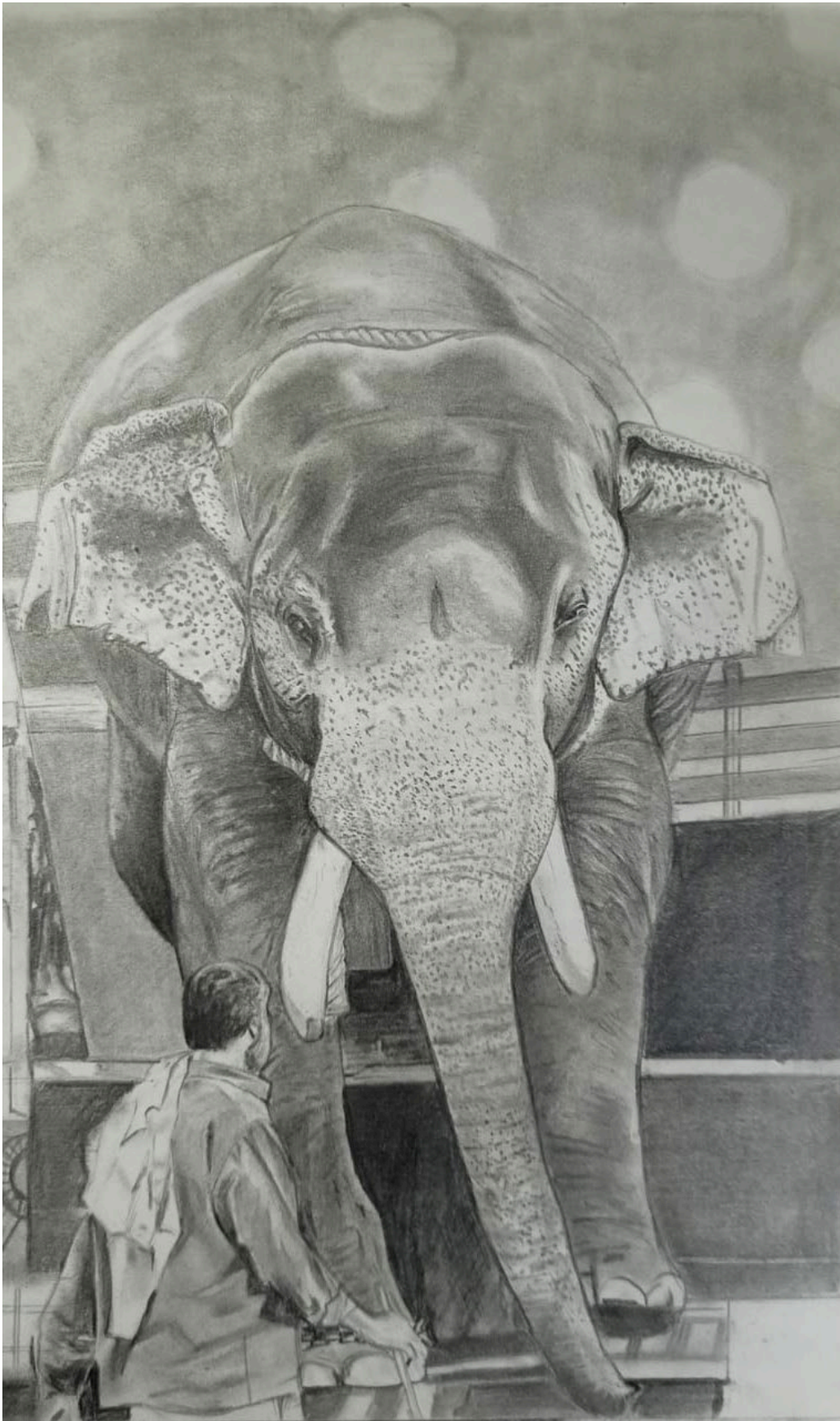
Thushara P V ,S8CE



Aswanth Anish
S4CE

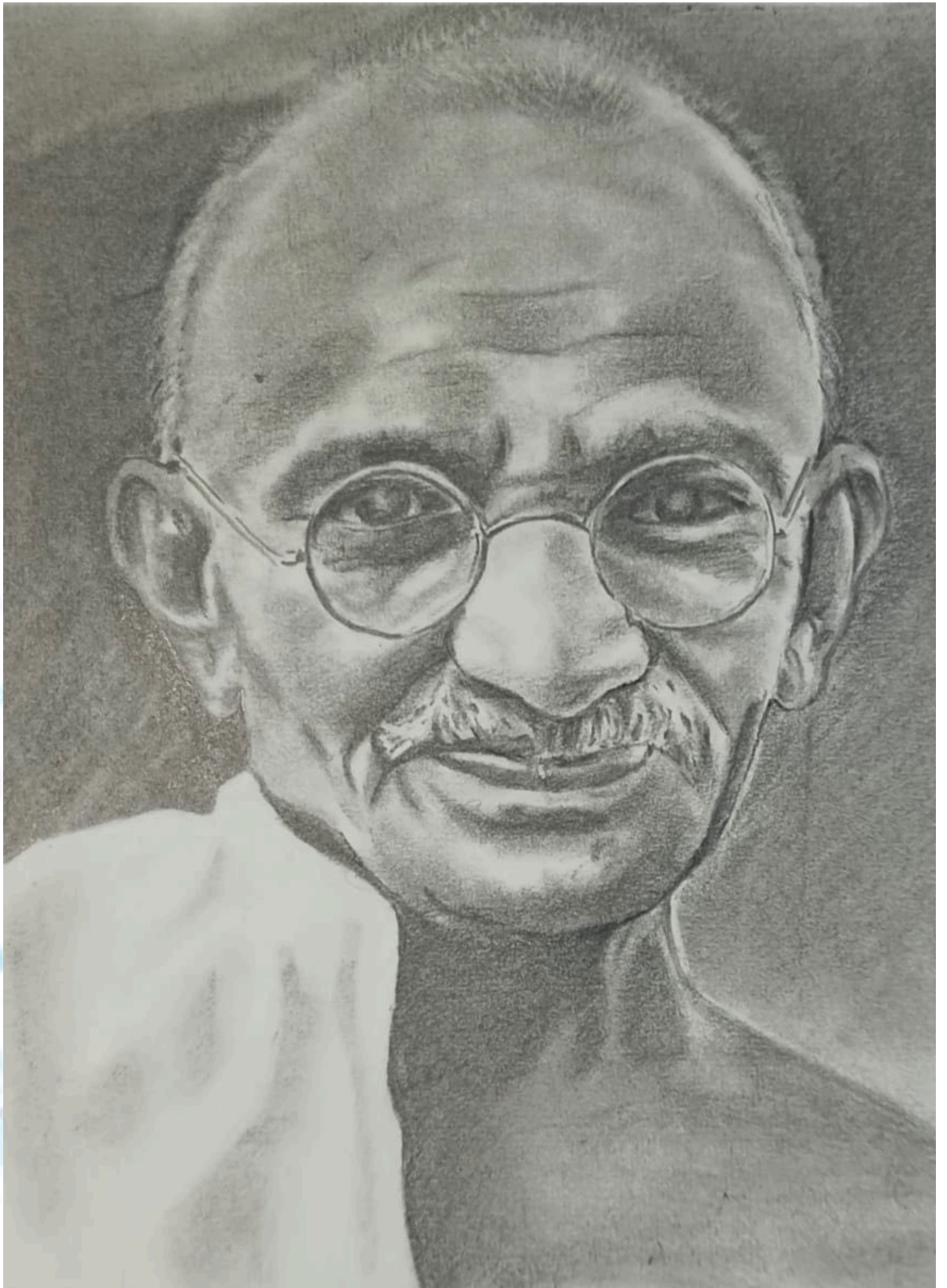


Aswanth Anish
S4CE





Aswanth Anish
S4CE



EVENTS



Expert talk entitled "Essential Requirements and Properties of High-Performance Concrete." The session took place in person and featured Mr. Hemanth Kumar T, the State Technical Head at India Cement Ltd, as the esteemed speaker.



Students during their Industrial visit at NAC Hyderabad



The decision by NATPAC (National Transportation Planning and Research Centre) in association with STM College, Conducting Surveying at Muzhappilangad

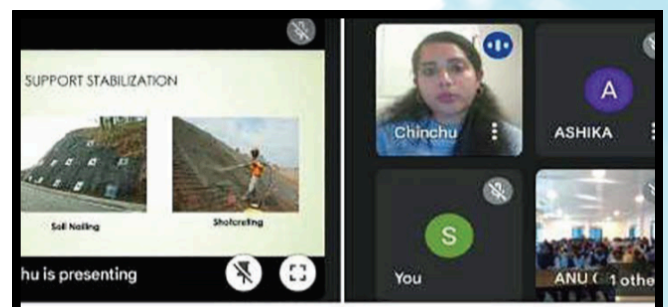
EVENTS



A photo from the Inauguration ceremony of the Department Association, SATTVA, the Department Association for Civil Engineering, was inaugurated on 03.11.2022, by the esteemed Er. Sabu K. Philip, alongside Dr. Shinu Mathew John and other distinguished dignitaries. This significant event, attended by both faculty and students, included the unveiling of the association's logo,



Site Visit- Kannur Municipal Corporation Building



Expert Talk on "Stability of Soil"

EVENTS



Expert Talk on "Road Safety and Mitigation Measures" Marks Department Association Inauguration



Workshop on the proposal for central library, The workshop's comprehensive structure, seamlessly moving from theory to practical application, culminated in several significant educational outcomes for the students involved.



Workshop on Total Station surveying was organized specifically for second-year students of the Civil Department. This initiative aimed to bridge the gap between theoretical knowledge and practical application in the field of surveying.



St. Thomas College of Engineering & Technology
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Approved by AICTE New Delhi, Govt. Of Kerala and Affiliated to APJ Abdul Kalam Technological University



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CLASS PHOTO OF 2019-23 BATCH



CONVOCATION OF 2019-23 BATCH