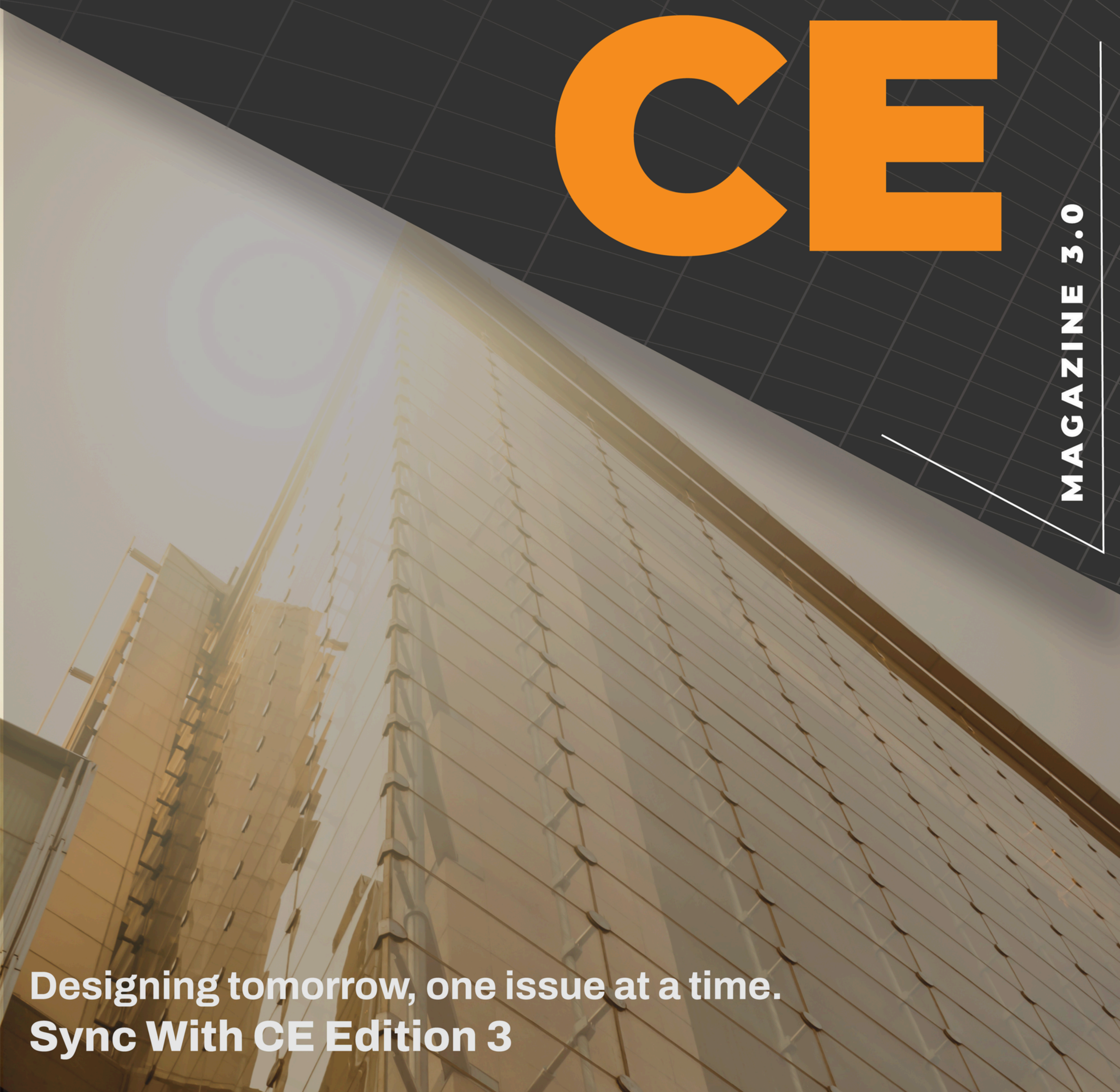
SYNOCE
SYNDICATE OF
CIVIL ENGINEERS
IIT GANDHINAGAR

2024-2025

SYNC WITH CE

MAGAZINE 3.0



Designing tomorrow, one issue at a time.

Sync With CE Edition 3

About SynoCE

Syndicate of Civil Engineers (SynoCE) is the civil engineering society of IIT Gandhinagar. With its foundation being laid in January 2020, the society is the first of its kind student-run initiative. Its primary aim is to provide guidance and resources to the students of the civil engineering discipline and help them pursue the career of their choice with utmost justice to their capabilities. The society's goal is to build a strong community that promotes a healthy and progressive work culture and prepares students for the professional world.

The society hosts career guidance sessions, workshops on a variety of software, organizes events and industry visits to provide support and peer-to-peer networking opportunities. It also hosts informal sessions with professors to promote smoother connections within the department and foster opportunities for mentorship and internships. The society further collaborates with various industries and launches semester-long projects to obtain industry experience and establish positive relations with them.

The society's annual magazine contains valuable insights and engaging content that serve as tidbits of information about IIT Gandhinagar and the happenings in the world of civil engineering.

We hope you enjoy reading the third edition of Sync with CE.

Thanks and Regards,
Team SynoCE

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FACULTY ADVISOR’S PEN

Dear Readers,

It gives me immense pleasure and honor to contribute to this year’s edition of our Civil Engineering Society’s magazine. Each edition beautifully captures the essence of innovation, dedication, and curiosity that define our vibrant student community.

We are at an extraordinary juncture in civil engineering, where rapid urbanization, climate uncertainty, and technological advancements intersect. Amid these transformative changes, our role as civil engineers extends beyond technical proficiency. We are called upon to address human-centered challenges, designing sustainable, resilient, and inclusive infrastructure solutions that profoundly impact society.

In this era of information abundance, propelled by advanced technologies like Large Language Models (LLMs) and artificial intelligence, it is crucial to recognize both the opportunities and responsibilities that come with these tools. While information is readily accessible, the essence of civil engineering remains rooted in our ability to ask meaningful questions, define critical problems, refine solutions, and lead impactful changes. Leveraging technology means ensuring its benefits are accessible to all, scaling solutions across society, and integrating advancements into daily practices.However, even as we embrace these technologies, it is vital to maintain intellectual humility, continuous curiosity, and an unwavering aspiration for excellence. The tools at our disposal should enhance our pursuit of knowledge, not create a false sense of complete understanding.

As a Faculty Advisor, I am continually inspired by your creativity, passion, and dedication. Your innovative projects and relentless pursuit of excellence exemplify the potential of engineering as a transformative force. I encourage each of you to view your education not just as a pathway to professional success but as a means to contribute meaningfully to society. Great engineering goes beyond technical capabilities—it encompasses empathy, ethical judgment, and collaboration. Let us strive to build not merely structures but bridges that connect ideas, disciplines, and communities.

Congratulations on assembling this thoughtful compilation of ideas and insights. May your curiosity and commitment guide you toward impactful innovations and meaningful careers.

Warm regards,
Dr. Udit Bhatia
Associate Professor
Department of Civil Engineering
Faculty Advisor, SynoCE
IIT Gandhinagar

PRESIDENT'S NOTE

Reviving SynoCE after two years of dormancy was not just about restarting a student society - it was about redefining what a civil engineering community should be. When I took on this role, I saw an opportunity to create something beyond a formal group - a platform that actively helps students gain industry-relevant skills, build meaningful connections, and understand the depth of their field beyond the classroom. Our vision for SynoCE was clear: empower students with practical exposure, bridge the knowledge gap between theory and real-world applications, and develop an environment of peer learning and professional growth. With this in mind, we set out to build structured initiatives that would provide long-term value to every civil engineering student at IIT Gandhinagar.

Some of the most defining milestones in this revival included re-establishing a structured leadership team, securing administrative approvals, and organizing impactful events that align with our core mission. Initiatives such as Chai Pe Charcha and Team dinner brought students and professors together for informal yet insightful discussions, while our workshops introduced participants to real-world geospatial applications. We also reinstated field trips, allowing students to witness civil engineering projects firsthand, and led key events like Teachers' Day, Engineers' Day, and junior-senior internship guidance sessions to strengthen the sense of community within our department.

Beyond events, laying the foundation for SynoCE's long-term sustainability was a priority. We secured an official email ID, worked on establishing a stronger social media presence, and introduced a well-defined structure for leadership and coordination, ensuring that SynoCE remains active and impactful for future batches.

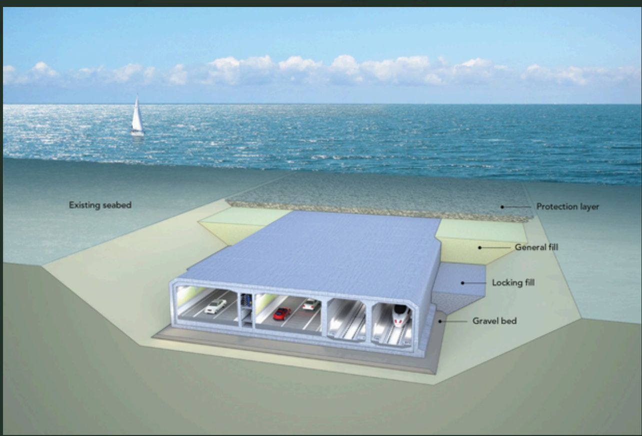
None of this would have been possible without the support of our faculty advisor, Prof. Udit Bhatia, the dedication of our founding coordinators Uday and Yashvardhan and other coordinators, and the enthusiasm of every student who engaged with our initiatives. Their collective efforts have helped turn this vision into reality.

SynoCE has been revived, but this is just the beginning. The groundwork has been laid, and the opportunities ahead are immense. I hope this platform continues to grow, adapt, and serve as a bridge between academic learning and real-world engineering for generations to come.

Manas Agrawal (B. Tech 2021)
President, SynoCE
Indian Institute of Technology Gandhinagar

Fehmarnbelt Tunnel

Imagine turning a 45-minute ferry ride into just 10 minutes by car or 7 by train - this is what the Fehmarnbelt Tunnel is designed to deliver. Stretching 18 kilometers beneath the Baltic Sea, it will be among the longest immersed tunnels in the world, connecting Fehmarn Island in Germany to Lolland Island in Denmark. Once operational, this dual road-and-rail link will redefine regional mobility and stand as a bold step toward seamless, high-speed European transportation infrastructure built for the demands of tomorrow.



Unlike traditional bored tunnels, the Fehmarnbelt Tunnel uses the immersed tunnel technique, a rare method for such a massive scale. Eighty-nine prefabricated concrete segments, each 217 meters long and weighing over 73,000 tons, are cast on land, floated into position, then submerged into a pre-dug seabed trench and sealed watertight. The tunnel will carry four lanes of road traffic and two railway tracks, supporting both cars and high-speed trains in separate, ventilated tubes. Engineers use high-performance concrete, corrosion-resistant materials, and advanced waterproofing systems to withstand seismic movement, hydrostatic pressure, and the harsh marine environment. Integrated safety features include emergency exits, fire-resistant linings, and automated monitoring systems that track pressure, temperature, and structural behavior in real-time. At over €7 billion, the project reflects one of Europe's largest and most technically demanding engineering efforts. The construction approach blends massive prefabrication with millimeter-precise installation, making the tunnel not just a transport route - but a showcase of civil engineering's capacity to overcome nature's most imposing barriers.

The Fehmarnbelt Tunnel is more than a shortcut beneath the sea - it's a statement. With its pioneering use of immersed tube construction at this scale, it sets new benchmarks in marine infrastructure, cross-border collaboration, and environmental resilience. It's a bold reminder of what's possible when engineering ambition meets innovation, pushing boundaries from below the surface.

- *18km undersea tunnel link*
- *Connects Denmark & Germany*
- *Cuts travel to 7–10 mins*
- *Immersed segment technique*
- *Dual rail-road design*
- *Advanced underwater safety*
- *Prefab sections, seabed laid*

https://en.wikipedia.org/wiki/Fehmarn_Belt_fixed_link

Jeddah Tower

Construction on the world's tallest buildings has officially resumed in Saudi Arabia. Beating the UAE's Burj Khalifa by about 172 meters, the Jeddah Tower will be over 1,000 meters in height and span 1.5 square kilometers in its first phase of growth. This project is described as the 'centerpiece' of the Jeddah Economic City (JEC) development, an ambitious project intended to revive Jeddah's urban core. Chicago-based practice Adrian Smith + Gordon Gill (AS+GG). Architecture took on the lead, envisioning a slender form conceptually derived from the fronds of a native flower emerging from the arid desert sand. The mixed-use tower will accommodate a Four Season hotel, apartments, office space, luxury condominiums, and the world's highest observatory overlooking the adjacent Red Sea. Located in the heart of Jeddah, the iconic skyscraper is set to redefine the city's skyline while positioning Saudi Arabia as a global hub for architectural innovation and economic growth. An overall cost of $20 billion USD is estimated for the project, with approximately $1.2 billion USD assigned solely for the tower.

Achieving such height requires advanced engineering techniques to achieving such height requires advanced engineering techniques to manage vertical loads, wind loads, and seismic forces. The tower's foundation is 200 feet deep and designed to withstand the soft, sandy soil and high salinity of the coastal site. A massive pile

- *1,000m+ record-breaking height*
- *200ft deep pile base*
- *Wind-cutting taper design*
- *Reinforced concrete core*
- *Live structural monitoring*
- *Slipform high-rise method*
- *Heat & salt-resistant mix*

foundation system with reinforced concrete piles provides stability for the enormous weight of the structure. The triangular, tapering design reduces wind resistance and vortex shedding, which are major challenges for super-tall skyscrapers. The design minimizes the effects of strong Red Sea winds and ensures structural safety at extreme heights. High-strength, reinforced concrete is used for the core and structure to support the vertical load. Special concrete mixtures are used to withstand the high temperatures and corrosive effects of the region's climate. Cutting-edge construction methods, such as slipforming, are used to build the reinforced concrete core. Real-time monitoring systems ensure precision in alignment and safety during construction. Jeddah Tower symbolizes human ambition and engineering ingenuity, demonstrating the possibilities of modern civil engineering in extreme environments.

https://thejeddahtower.org/

Self-Healing Concrete: The Future of Sustainable Infrastructure

Can Concrete Really Heal Itself? Welcome to the Future of Construction.

What if the next crack in a bridge didn't call for a repair crew - but healed itself?

This isn't science fiction. Self-healing concrete is emerging as a game-changer in civil engineering, fusing microbiology, smart materials, and chemistry to build smarter, longer-lasting infrastructure.

Why does concrete even need healing? Despite being the backbone of our cities - roads, buildings, tunnels - it's surprisingly fragile. Cracks caused by stress, weather, and time let in water, corroding internal steel reinforcements and speeding up deterioration. Repairing these faults is costly, especially in remote or high-risk environments. Enter self-healing concrete: a material that seals its own wounds extends its lifespan, and reduces maintenance costs.

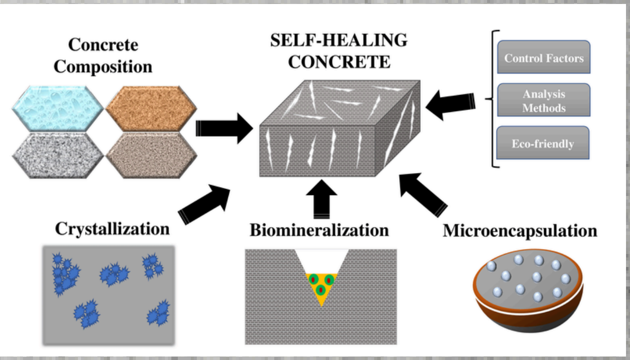
How does it work? Three mechanisms are leading the charge. Autogenous healing relies on leftover cement particles reacting with water to form calcium carbonate, filling fine cracks. Then there's encapsulated healing - tiny capsules inside the concrete burst when cracks appear, releasing substances like epoxy to glue the damage shut. But the most promising? Microbial-based healing. When exposed to moisture and oxygen, dormant bacteria such as *Bacillus* spring into action. They convert calcium compounds into limestone, naturally patching cracks up to 0.8 mm wide.

- *Fixes cracks with bacteria*
- *Activates on water contact*
- *Reduces repair frequency*
- *Boosts durability & life*
- *Lowers long-term costs*
- *Eco-smart material tech*

This innovation isn't the work of one discipline - it's a synergy. Engineers craft bacterial-friendly concrete mixes. Microbiologists select resilient bacterial strains. Chemists optimize nutrient blends. Together, they've made concrete smarter.

Already, self-healing concrete is being piloted in bridges and marine structures. It could become the industry norm with time, slashing repair costs and environmental impact by reducing cement demand and demolition waste.

So, can concrete really heal itself? The answer is a resounding YES- and it's rewriting the blueprint for sustainable, resilient infrastructure.



Credits: https://www.mdpi.com/1996-1073/16/4/1650

Kinetic Roads: Revolutionizing Sustainable Infrastructure

As cities expand and energy demands surge, the fusion of infrastructure and renewable energy is gaining momentum. One of the most groundbreaking innovations in this space is kinetic roads - smart highways that transform vehicular motion into electricity. These roads promise to reshape urban power generation by harnessing wasted kinetic energy while complementing existing renewable sources.

At the core of this innovation lies piezoelectric technology, which generates electricity when subjected to mechanical stress. Embedded piezoelectric transducers beneath the road surface capture the pressure exerted by moving vehicles, converting it into usable power. This electricity can be stored in batteries, used for street lighting, or fed into the power grid.
Field studies have demonstrated its effectiveness. In Israel, Innowattech's pilot project generated up to 200 kWh per kilometer daily, enough to power public lighting systems. Italy's Underground Power has tested similar systems in high-traffic zones, while Rutgers University has validated the technology's feasibility for large-scale applications.

Countries like Japan and the Netherlands have experimented with kinetic energy solutions in roads and pathways, integrating them into smart city frameworks. Beyond reducing reliance on fossil fuels, kinetic roads offer a low-maintenance, long-term energy solution. They also minimize transmission losses by generating power at the point of use, cutting infrastructure costs.

- *Converts motion to energy*
- *Generates power from traffic*
- *Smart surface tech embedded*
- *Used in urban test zones*
- Piezoelectric tech inside
- Supports smart lighting

Despite its potential, high installation costs ($500,000–$1 million per km) and durability concerns remain hurdles. Piezoelectric materials must withstand extreme road conditions, necessitating advanced coatings and resilient designs. Efficiency also depends on traffic density - making the technology more viable for highways and urban centers than rural areas.

Integrating kinetic roads with EV charging stations could create self-sustaining transit networks. With continued advancements, this technology may soon become a key pillar of urban energy infrastructure, driving cities toward a smarter, cleaner future.

https://www.sciencedirect.com/science/article/pii/S0306261919309158

Atal Pedestrian Bridge

- *300m cable-stayed steel span*
- *Corrosion, flood-resistant design*
- *LED-lit for safety & culture*
- *Biomimicry inspired by Rani ki Vav*

What if a bridge could connect more than just land?

Ahmedabad's Atal Pedestrian Bridge, inaugurated in 2022, spans 300 meters across the Sabarmati - blending Gujarat's architectural heritage with modern civil engineering. Inspired by the intricate latticework of Rani ki Vav, the undulating structure uses corrosion-resistant steel and elevated concrete foundations to withstand monsoons and intense heat. Energy-efficient LED lighting turns it into a cultural beacon during festivals.

Built during the pandemic, engineers overcame complex challenges - safeguarding the river's ecosystem, navigating dense urban infrastructure, and adapting to unpredictable delays. It now anchors the Sabarmati Riverfront Development, promoting walkability and public engagement. This is more than a footbridge. It's a case study in biomimicry, resilience, and collaborative design, a symbol of how India can fuse tradition with innovation and civil engineering with cultural identity.

Gift City Utility Tunnel

- *6.5 km reinforced concrete corridor*
- *Trenchless tunneling in wet ground*
- *IoT-based leak and pressure sensing*
- *Zero surface disruption, full scalability*

What if a city's lifeline ran silently beneath your feet - smarter than cables, cleaner than pipes, and more coordinated than any surface system?

Beneath GIFT City, India's global finance hub, lies the country's first operational utility tunnel, a 6.5 km subterranean corridor that consolidates electricity, water, gas, telecom, and drainage into one ultra-efficient backbone. Built with reinforced concrete, advanced fireproofing, and IoT-enabled monitoring, the tunnel ensures seamless, disruption-free utility maintenance while preserving the city's design integrity. Constructed under challenging conditions like high groundwater tables and waterlogged soil, engineers turned to trenchless methods—micro-tunneling and pipe-jacking—to build without disturbing the surface. Over 1,000 engineers and workers collaborated to weave this hidden network into GIFT's futuristic skyline. The tunnel doesn't just serve - it senses, adapts, and scales, embodying India's ambition to engineer smarter cities. Dubbed the "veins of the city," it redefines how infrastructure can be intelligent, resilient, and invisible - all at once.

Statue of Unity

- *182m tall, world's tallest statue*
- *Steel-core with 1,700t bronze cladding*
- *Wind & earthquake-resistant foundation*
- *3D scanning + modular construction*
- *Inside, elevators whisk visitors to a gallery*

Can a structure hold not just weight - but an entire nation's spirit?

Towering at 182 meters, the Statue of Unity does exactly that - standing as the world's tallest statue and a monumental tribute to Sardar Vallabhbhai Patel, India's architect of unity. Completed in 2018 on Sadhu Bet island, this engineering feat rises above the Narmada River with a steel-reinforced concrete core, 1,700 tons of bronze cladding, and a foundation designed to withstand cyclonic winds and earthquakes.

Precision came from 3D scanning, modular casting, and a workforce of 3,400 professionals who turned this ₹3,000 crore vision into reality in just 42 months. Inside, elevators whisk visitors to a gallery at 153m, offering sweeping views of the Sardar Sarovar Dam. Yet this isn't just about height - it's about legacy. The statue anchors a broader complex with museums and solar-backed sustainability systems, transforming Patel's resolve into a physical experience. It's not just an engineering marvel - it's a colossus of ideals echoing unity, resilience, and the permanence of national memory.

Rani ki Vav

- *7-tier, 64m x 27m stepwell*
- *500+ sandstone sculptural panels*
- *Year-round water access system*
- *Excavated & restored in the 1980s*

What if the grandest monument to water was built not above - but below the earth?

Descending 27 meters deep, Rani ki Vav in Patan, Gujarat, is not just an 11th-century stepwell - it's an inverted temple carved in sandstone, where utility, mythology, and engineering intersect. Built by Queen Udayamati in memory of King Bhima I, this UNESCO World Heritage Site stretches 64 meters in length and boasts seven architecturally tiered levels adorned with over 500 sculptures depicting deities, cosmic patterns, and medieval life. Precision-engineered to collect water from the Saraswati River, its stepped corridors ensured year-round groundwater access while resisting seasonal floods through its interlocking stone design. Buried in silt for centuries, it was rediscovered and meticulously restored in the 1980s, a triumph of conservation and craftsmanship. Every carving, from Vishnu's Dasavataras to the mysterious Vishkanya, whispers of a time when water structures were sacred. Today, featured on the ₹100 note, Rani ki Vav reminds us that even the most utilitarian civil works can transcend into living testaments of hydraulic wisdom and spiritual vision.

Chenab River Bridge, J&K

- *359m high - the world's tallest rail bridge*
- *467m free-span steel arch structure*
- *Designed for winds up to 260 km/h*
- *Blast-proof concrete & quake-safe base*
- *Smart sensors for real-time health monitoring*

What does it take to place steel and certainty over one of India's most unpredictable river gorges?

In Jammu & Kashmir's windswept highlands, the Chenab Railway Bridge rises 359 meters above the river it's named after - making it the world's highest rail arch bridge and one of the most audacious civil engineering achievements in modern India. Stretching 1,315 meters long with a central span of 467 meters, its sweeping 10,000-tonne steel arch defies not just gravity but decades of geographical isolation in the Pir Panjal range.

Completed in 2023 as part of the Udhampur-Srinagar-Baramulla Rail Link, the bridge wasn't just built - it was conjured into existence against the odds. Engineers operated under extreme temperature variations (-20°C to 40°C) and high-altitude conditions, deploying cable crane systems and millimeter-accurate sensors to erect its arch segment by segment. Blast-resistant concrete, deep anchors in fractured rock, and "health monitoring sensors" make this bridge a living structure - constantly aware, always adapting.

But the challenges weren't just technical. Before ever being lifted into position, materials had to be trucked across serpentine mountain roads through snow and landslides. For over 1,300 workers, every meter gained was a testament to grit and innovation.

Yet, Chenab is more than numbers and steel. It connects not just rail lines but also lives, economies, and histories. It's a thread binding Kashmir more tightly into the Indian mainland - an engineering symbol of inclusion, resilience, and ambition. Like the Statue of Unity or the Atal Bridge, the Chenab Railway Bridge turns infrastructure into a metaphor - standing not just above nature but withstanding within it.

Kolkata Metro's Underwater Tunnel

- *India's first underwater metro tunnel*
- *520m twin tunnels, 30m deep*
- *Built-in liquefaction-prone soil*
- *Reinforced concrete + watertight membrane*
- *AI-driven ventilation & disaster systems*

What does it take to carve a metro line through the belly of a river?

Beneath the swirling waters of the Hooghly River, the Kolkata Metro's East-West Corridor breaks ground - literally - as India's first underwater rail tunnel, completed in 2023. Spanning 520 meters and diving 30 meters below the riverbed, this engineering milestone connects Howrah to Kolkata in a matter of seconds, shrinking a 90-minute journey into a blink.

The twin tunnels - drilled by massive Tunnel Boring Machines (TBMs) nicknamed "Rachna" and "Prerna" - inchwormed through fragile alluvial soil known for liquefaction risk while precision sensors tracked groundwater ingress, pressure, and structural stress in real-time. Wrapped in reinforced concrete segments and watertight membranes, the tunnels are built to endure seismic tremors, hydraulic shocks, and the weight of history above. And there's plenty of that - routes were maneuvered beneath heritage zones like Howrah Station, requiring tight coordination with archaeologists to prevent damage to colonial-era structures.

More than 1,200 workers operated in tight, low-oxygen environments, with ventilation, disaster-resistant systems, and AI-driven controls ensuring both safety and continuity. But this tunnel isn't just about transit - it's about transformation. It links two distinct cultural and economic zones, serving as a metaphor for unity and modernization. Like the Chenab Bridge slicing through the Himalayas or the Statue of Unity rising from the Narmada, this tunnel doesn't just challenge nature - it collaborates with it, making way for a future where progress flows silently, just beneath the surface.

Millau Viaduct, France

- *343m tall - the world's tallest bridge*
- *2.46 km long cable-stayed structure*
- *200m deep limestone foundations*
- *Incremental deck launching technique*
- *Steel deck with wind-resistant profile*

What happens when civil engineering refuses to stay grounded?

Rising 343 meters above France's Tarn Valley - taller than the Eiffel Tower itself - the Millau Viaduct is more than a bridge; it's a ribbon of steel that blends engineering with elegance. Completed in 2004 and co-designed by Norman Foster and Michel Virlogeux, the viaduct spans 2.46 kilometers, linking the A75 motorway across dramatic terrain.

Its cable-stayed structure features a lightweight steel deck supported by seven slender concrete pylons, some anchored 200 meters deep into limestone. Engineers faced extreme altitudes, turbulent winds, and ecological restrictions. Their breakthrough? A launching technique where the deck was incrementally slid from both sides, meeting mid-air with satellite-guided precision.

Built by over 3,000 engineers and workers, the viaduct not only eased traffic between Paris and the Mediterranean but also boosted regional tourism. It exemplifies how infrastructure can be ambitious yet environmentally respectful. Like the Chenab Bridge or Burj Khalifa, it proves that civil engineering isn't just about spanning space - it's about elevating vision.

https://structurae.net/en/structures/millau-viaduct

Beyond Blueprints: The Role of Project Management

Often, the answer lies in project management - the silent force beneath every soaring skyline and civil megastructure. While civil engineering defines the form, it's project management that shapes the journey - ensuring execution is timely, cost-effective, resilient, and context-aware.

Take the Panama Canal, a century-defining marvel. Its success wasn't just about excavation - it was about logistical brilliance, where over 75,000 workers, tight resource allocation, and phased construction made the impossible possible. `Contrast that with the Channel Tunnel, a technically extraordinary project that stumbled due to underestimated risks, scope creep, and fragmented communication. Budget overruns exceeded £4.65 billion, and schedules stretched by six years - all symptoms of mismanaged complexity.

Aerial view of Panama Canal construction, capturing its scale and complexity.

Modern project management has evolved into a multi-disciplinary orchestration. Today, engineers must consider environmental regulations, community displacement, and climate resilience. Technologies like Modeling (BIM), Digital Twins, and GIS integration have transformed static plans into dynamic, data-rich ecosystems, enabling real-time decision-making and preemptive conflict resolution.

One critical yet often overlooked area is human resource coordination. Large-scale civil projects involve thousands of laborers, specialists, and subcontractors. Aligning these moving parts requires not only scheduling but on-site safety protocols, adaptive workforce planning, and cross-cultural communication especially in globally contracted projects. Delays in workforce mobilization alone can derail months of planning.

Civil engineers no longer work in silos. They collaborate with urban planners, sociologists, ecologists, and economists to align infrastructure with societal goals. In this synergy, project managers become translators of vision, turning technical ambition into coordinated action. Because in today's complex world, we must build smart, build sustainably - and above all, build forward.

A Syndicate of Structure and Motion

In today's engineered world, civil and mechanical engineering are not parallel lines - they are overlapping curves that shape how we live, move, and build. The Millau Viaduct stands as a modern marvel, not just for its slender pylons and elegant span but for the mechanical intelligence embedded within it. While civil engineers optimized material use, foundation design, and load distribution, it was mechanical expertise that enabled real-time wind load monitoring, vibration dampers, and cable tension adaptations - a harmony of force, feedback, and function. The result? A structure that stands firm not only in geometry but in responsiveness.

Conversely, the tragic collapse of the Quebec Bridge illustrates the perils of neglecting this synergy. Constructed with ambition but insufficient understanding of dynamic stresses, the bridge fell twice during construction, resulting in numerous fatalities. Investigations later revealed a fatal oversight in calculating material strain and structural deflection - something a mechanical-civil partnership might have caught early.

Archival photo of Quebec Bridge collapse, highlighting the impact of design flaws

Today, the bond between these disciplines is even more essential. Civil engineers push for net-zero buildings and rely on mechanical engineering for energy modeling, thermal efficiency, and smart control systems. Mechanical systems breathe life into architectural vision, from wind turbines and solar arrays to HVAC and greywater recycling systems.

Infrastructure is no longer static, whether it's a bridge that adjusts to the wind or a building that responds to human comfort. Together, these fields aren't just building structures but crafting intelligent, adaptive environments.

It's no longer "civil versus mechanical." It's "civil with mechanical" - an alliance where strength meets sensibility. and where innovation thrives through shared precision and vision, and seamless integration of systems and structure.

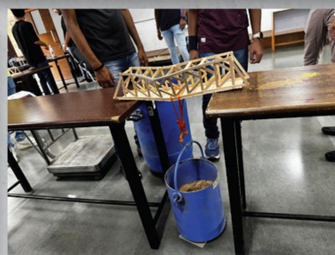
SynoCE Events

Chai Pe Charcha

An agenda-free series with professors over tea—blending mentorship, career insights, and honest conversations on student life, academia, and the civil engineering journey.







Teachers' Day

A vibrant evening where UG and PG students performed, celebrated, and honored professors with mementos and heartfelt moments—marking Teachers' Day with gratitude and joyful connection.

Civil Engineers' Day

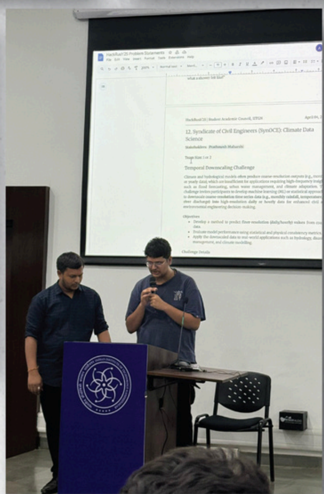
Hands-on competitions, quizzes, and research showcases brought creativity and technical spirit together, culminating in a powerful town hall by Col. Krishna Kishore.

Field Trips

Visits to Vinayak TMT Bars, IFFCO Kandla, and GAIMS Bhuj gave students practical exposure to structural systems, seismic design, and real-world construction technologies.

Google Earth Engine Workshop

A beginner-friendly workshop introducing students to satellite imagery, environmental analysis, and map-based data visualization using GEE - connecting geospatial tools to civil engineering applications.



Informal Sessions on Internships & Courses

Peer-led sessions in hostel and academic spaces offering honest, relatable guidance on internships, electives, prof-specific insights, and core vs. non-core career paths.

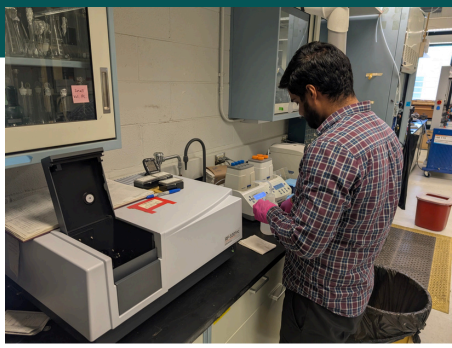
Hackathon Problem Statement

SynoCE introduced a real-world, data-centric civil engineering challenge in Hackrush 2025 - focusing on temporal data resolution for climate, infrastructure, and resource planning.

Designing Healthier Urban Futures

From clean air to clean industry, the Energy, Environment, and Exposure Laboratory (EEEL), led by Prof. Sameer Patel, addresses key environmental challenges by exploring the nexus between energy, environment, and human health. Research in EEEL spans measurement, modeling, and mitigation (3M) of air pollution, building energy optimization, indoor air quality, and thermochemical conversion of solid waste to fuels. He has led projects with multiple industries, focusing on air dispersion modeling and waste management - blending science, policy, and industrial application.

Prof. Sameer Patel



Prof. Patel's lab pioneers research at the intersection of air quality and public health. A key **SPARC-funded project** uses advanced toxicity testing to study how **particulate matter (PM)** affects health. In collaboration with UIUC and the University of Miami, his team links particle composition to oxidative potential - a proxy for health impacts. Ph.D. scholar Alok Kumar Thakur recently trained at UIUC on these methods. This data-driven work provides insights into whether the current air quality guidelines are appropriate.

From e-waste recycling to emission control and mitigation, Prof. Patel's consultancy bridges lab insight with practical application. For Hindalco, he led environmental studies for copper plant expansions and a greenfield e-waste recycling facility, covering feedstock, waste management, and air dispersion modeling. He helped Ashima Ltd. trace odor sources in their ETP systems. These projects show how IITGN's technical depth is actively solving real-world industrial challenges.

Prof. Patel's influence reaches far beyond national borders. He serves on the Scientific Committee for Healthy Buildings 2025 and the Technical Program Committee for the Asian Aerosol Conference 2025, hosted in Mumbai. His group also presented at the 42nd AAAR Conference in New Mexico, earning international recognition for their aerosols and air quality research. These roles reflect how his work is advancing global civil-environmental engineering through scholarly contributions and strategic dialogue.

AIResQ: AI-Powered Solutions for Urban Flood Resilience

Prof. Udit Bhatia

Flooding in India takes many forms—from intense urban waterlogging to large-scale riverine overflows. These events often lead to cascading effects: disrupted mobility, damaged infrastructure, sewage overflows, and heightened public health risks. As climate change intensifies rainfall extremes and urban expansion strains outdated systems, traditional approaches alone can't keep up. Urban flooding is no longer just an inconvenience—it's a recurring crisis in our cities. Overwhelmed drainage systems, garbage-clogged roads, and stranded commuters are now all-too-familiar scenes during the monsoon. AIResQ is addressing this issue through AI-driven, real-time flood forecasting and urban resilience tools. At its core is the use of physics-guided machine learning models—systems that combine the predictive power of AI with physical principles. This allows for more accurate flood risk assessments and realistic, real-time forecasting.

However, AIResQ sets itself apart by moving beyond flood prediction to developing a comprehensive decision-support system. Designed to integrate forecasting with mobility planning and risk assessment, this evolving platform is being shaped to assist municipalities, smart city projects, insurance companies, and SEZ developers. It enables strategic prioritization of interventions, traffic rerouting, and coordinated recovery planning—helping stakeholders take proactive steps before a flood escalates into a full-blown crisis. The founding team includes Prof. Udit Bhatia, Prof. Vivek P. Kapadia (Professor of Practice, IIT Gandhinagar and Former Secretary, Government of Gujarat), and Dr. Divya Upadhyay (Postdoctoral Fellow, IIT Gandhinagar). By combining advanced AI with on-ground realities, AIResQ is shaping the future of disaster resilience - designed in India, for India.

Prof. Udit Bhatia, Associate Professor at IIT Gandhinagar, works at the intersection of Civil and Computer Science Engineering. His research focuses on critical infrastructure resilience, network science, ecological dynamics, machine learning, and climate variability. Through AIResQ, Prof. Bhatia is working to turn years of research at the Machine Intelligence and Resilience (MIR) Lab into real-world solutions for flood prediction and planning. The aim is to help cities not only anticipate flood events, but also take informed, coordinated action to reduce their impact.

Alumni Corner

Ashwani Rai
BTech 19

Ashwani Rai is currently pursuing a Ph.D. at the University of Illinois Urbana-Champaign (UIUC) under Dr. Ana Barros. His research focuses on snow hydrology and remote sensing - studying snowpack dynamics and their implications for water resources in a changing climate. A B.Tech graduate in Civil Engineering from IIT Gandhinagar, Ashwani, was inspired by the institute's interdisciplinary curriculum, hands-on projects, and the mentorship of exceptional professors. These experiences sparked his interest in hydrology research and led him to apply for direct Ph.D. programs. The strong academic foundation and research culture at IITGN played a pivotal role in shaping his journey. "I carry forward the curiosity, work ethic, and collaborative spirit I cultivated there, and I'm always proud to represent IITGN in my academic journey."

Harsh Dudhatra is a second-year Ph.D. candidate at the University of Miami in the Department of Mechanical Engineering, where he works on modeling the first wall and blanket components of nuclear fusion reactors. His fascination with nuclear energy began during his B.Tech in Civil Engineering at IIT Gandhinagar, inspired by its potential as a clean and transformative energy source. Today, through his research funded by SciDAC (Scientific Discovery through Advanced Computing) under the U.S. Department of Energy, he studies defect behavior in high-temperature reactor materials using dislocation dynamics simulations. Harsh has collaborated with top researchers from institutions like Idaho National Laboratory - where he interned in Summer 2024—as well as ORNL, PNNL, SNL, and UCLA. He remains driven by the vision of making nuclear fusion a viable energy solution for the future.

Harsh Dudhatra
BTech 19

Aman Chaudhary
BTech 20

Aman graduated from IIT Gandhinagar in 2024 with a major in Civil Engineering and a minor in Computer Science. He developed a strong interest in GIS, spatial data, remote sensing, and open-source software. At IITGN, Aman worked with the Water and Climate Lab on national-scale GIS platforms for monitoring hydrological and climate challenges—an experience that deepened his passion for tech-driven water management. Through internships and research, he refined his skills in coding, spatial analysis, and geospatial tool development.
In 2024, Aman joined The World Bank as a Geospatial Specialist Consultant, where he builds digital tools for water accounting and irrigation assessment, leveraging satellite data to support global water governance.

"I'm currently working as a Research Assistant in the Department of Civil Engineering at the University of Illinois Urbana-Champaign (UIUC). My work focuses on sustainable construction materials. The journey here began at IIT Gandhinagar, where I completed my undergraduate studies. The supportive environment, challenging coursework, and, most importantly, the mentorship from the faculty at IITGN played a huge role in shaping my interests and research direction. I'm excited to continue learning, contributing to impactful research, and hopefully mentoring others the way I was mentored."

Bhuvesh Jaiswal
BTech 20

Tarun Yadav
BTech 20

"I graduated from IIT Gandhinagar in 2024 with a B.Tech in Civil Engineering. Recently, I secured AIR 9 in Civil Engineering and AIR 2 in Environmental Science in the GATE 2025 exam. My academic journey at IITGN laid a strong foundation, not just in technical knowledge but also in critical thinking and research skills. Looking back, my time on campus was filled with growth, learning, and some unforgettable memories. The academic challenges, late-night discussions with friends, and guidance from inspiring professors helped shape both my mindset and goals. This milestone isn't just a rank, it is a reflection of the journey, the people, and the place that shaped it."

A Chronicle of Dreams, Dust, and Redemption

I do not belong to a single creature—I belong to every being in universe. Born not of flesh but of fire and patience, I emerged when the first termite stacked mud and when feathered dinosaurs wove nests. I am more than bricks and beams; I am human dreams made real.

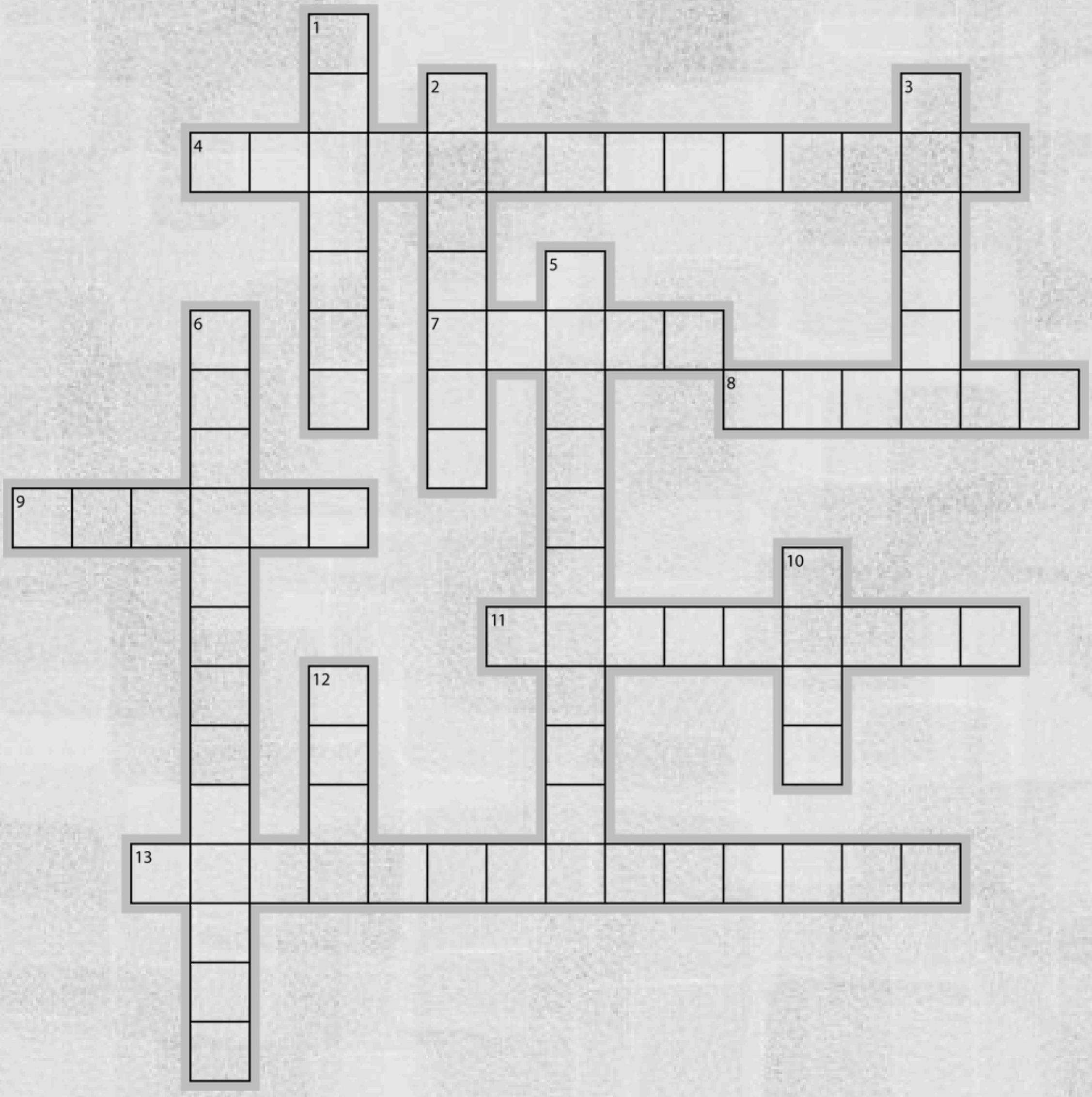
As early hands pressed wet clay into shape, I came into being and whispered, "This will last." I was born in the friction of their ambition. In those gentle days, I was nature's first shelter—a warm nest, a cave cradling stories told by firelight. I learned from beavers building dams and corals forming arches. A pufferfish carved patterns in the sand to attract mates. They called it instinct; I called it nature's call. Humans grew bolder, splitting mountains for pyramids and felling ancient trees for temples. In Rome, volcanic ash became concrete. In India, temples emerged from single rocks. They pushed me higher, defying time, even as wars and earthquakes shook my foundations. As empires rose and fell, steel and glass became my new language. Machines dug into the earth, lifting steel and threading my form with pipes and wires. Skyscrapers reached skyward while smokestacks choked the air. "This is progress," they declared. Behind gleaming towers, forests vanished, rivers were fouled, and the air grew heavy with regret. I felt their ambition's weight in every beam.

Children laughed in my halls; families painted memories on my walls. Monsoons cracked me, but caring hands repaired me like a loved one. Then factories stamped me into cheap, identical parts. Towers rose fast, fell faster. "Who lived here?" a child asked a crumbling wall. No one knew. Yet, a change began. People returned to building by hand, studying how ancients joined wooden beams without nails and crafting shelters from nature's materials. Engineers marveled at self-healing concrete; architects revived ways to naturally catch rain and cool air. They built with care, using recycled materials and designs honoring the earth. Then, humans looked to the stars, building orbital homes that broke free from gravity. These cosmic constructions echoed lessons from nature's shelters, carrying forward the spirit of building with care, not to conquer but to coexist, as nature first taught.

Today, a wrecking ball meets a factory wall. I watch a young girl tuck a faded brick into her bag like treasure. I whisper, "Build." She nods, replying, "Better." I have witnessed it all—from creatures' first nests, through ancient stonework and soaring glass towers, to a kinder way of building. I've felt builders' passion, children's laughter in small homes, and the quiet sorrow when structures return to dust. I am construction—eternal, yet never eternal enough. You build me to outlast you, yet your short life gives me meaning. I mirror you: bold yet fragile, bright but unsteady. Every shelter tells our endless story—ambitions born from nature, built with effort, lived in with love, and returned to dust so new dreams may rise. Now, as I stand before you—a mix of dreams and dust—I ask, where will we build next? Not just to shelter our dreams but to nurture them so they can live on.

By,
Sampreeth Gunda, M. Tech 2024

"Build, not just to last, but to live and grow."



1. Asphalt 2. Proctor 3. Column 4. Superelevation 5. Burjkhalifa 6. Hydrodynamics
7. Truss 8. Brunel 9. Howrah 10. Weir 11. Manometer 12. Pile 13. Impermeability

SIP & SOLVE

Down

1 - Material used for road surfacing
2 - Test used to determine soil compaction
3 - Vertical member in a frame resisting axial loads
5 - Tallest building in the world
6 - The study of fluids in motion
10 - A structure that controls water flow in a canal
12 - A deep foundation element used in constructio

Across

4 - A curve used in highway design
7 - A triangular structural framework
8 - The father of civil engineering
9 - The busiest railway station in India
11 - Device used to measure fluid pressure
13 - Soil property that prevents water from passing through

By,
Shrutika Yewale, B. Tech 2023

Editor

Manas Agarwal
B. Tech ‘21

Designer

Shrinivas Kulkarni
B. Tech ‘22

Contributors

Shrutika Yewale
B. Tech ‘23

Abhitej Singh
B. Tech ‘23

Ishani Kumar
B. Tech ‘22

Sanidhya Bhandari
B. Tech ‘24

Chahat Beniwal
B. Tech ‘22

Prathmesh Maharshi | Prof. Nivid Desai | Sampreeth Gunda | Shashank Patel | Keshav Bansal | Uday Maheshwari | Yashvardhan Soni | Rohan Jhariwal | Soham Biswas | Alumni | Faculties, Department of Civil Engineering