EGSPEC 2025

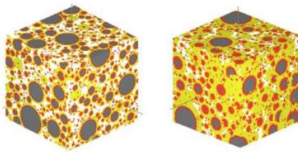
DEPARTMENT OF CIVIL ENGINEERING

10, October 2025

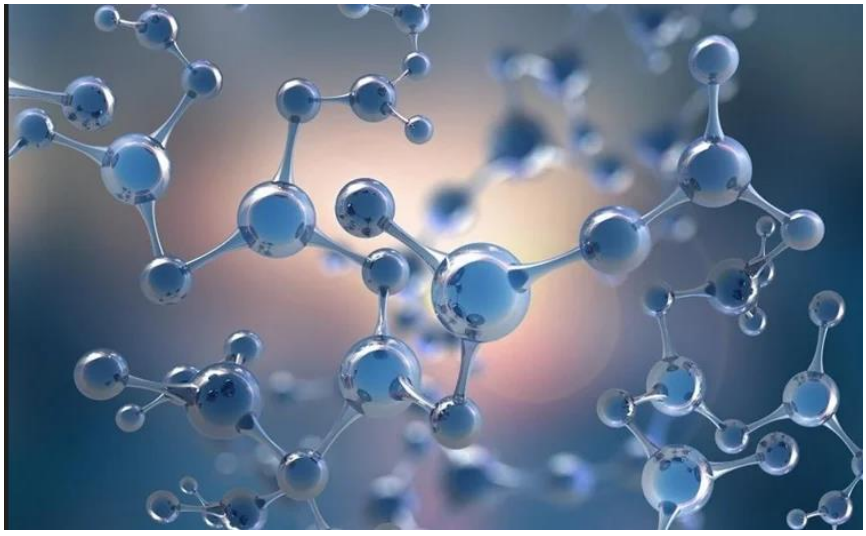
Strive for perfection in everything you do. Take the best that exists and make it better. When it does not exist, design it.

K. THAVASI RAJ

BE-CIVIL -FINAL YEAR



ADVANCED NANO MATERIALS IN CONCRETE REACT AS A SELF HEALING



Nanomaterials are used in concrete to significantly improve its strength, durability, and other performance properties by filling pores, enhancing the cement hydration process, and refining the microstructure. By using only small quantities of nanomaterials like nano silica or carbon nanotubes, engineers can create stronger, more sustainable, and longer-lasting concrete structures with reduced porosity and enhanced resistance to cracking and deterioration. Nanomaterials such as NS, nano alumina, NMK, CNTs, and nano–titanium oxide have been shown to effectively improve the compressive strength of concrete [29–31]. These nanomaterials enhance the mechanical characteristics of concrete by increasing its strength and durability.

Micro silica is added to concrete to significantly improve its strength, durability, and resistance to chemical attack and abrasion. It functions as both a filler, filling microscopic voids, and a pozzolanic material, reacting with cement to create denser hydration products. This process reduces permeability, protects steel reinforcement from corrosion

Nano Materials in concrete

Nanomaterials are increasingly used in concrete to improve its mechanical properties (strength, durability) and add new functions like self-cleaning. Common nanomaterials include nano-silica and nano-titanium dioxide, which fill voids and enhance the cement hydration process, and carbon nanotubes, which improve strength and electrical conductivity. While offering significant benefits, researchers are also addressing challenges like cost, proper dispersion, and the need for specific standards for wide spread practical application.

The nano-silica particles being a finer material occupy the cavity. The structure & behave as a nucleus to make a stronger bond with calcium silicate hydrate gel particles thereby increasing the denseness of the matrix. Hence increases the durability and concrete characteristics. Concrete workability and strength have been developed by using nano-silica as it resists water penetration & controls the leaching action, which leads to the degradation of concrete. Nano-silica is not only

B. THAMIZH KUMARAN
BE-CIVIL IV YEAR

D-CENTRALIZATION REAL TIME HOUSE HOLD REAL TIME MONITORING WATER

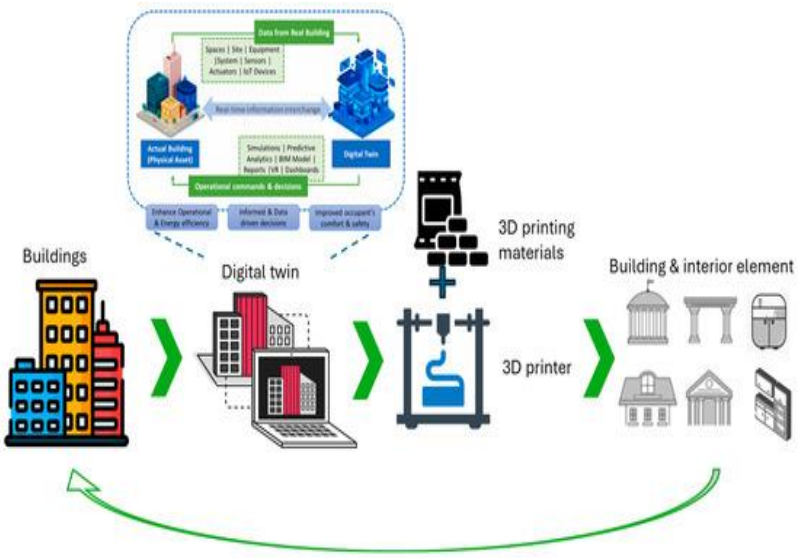
This is a unique approach that is Programmable Logic Controller (PLC) based, most of the researchers done this thing through micro controllers. PLC is a robust controller for monitoring, control and optimizing a process. By using PLC, it is very easy to modify the setup. In this existing setup it is possible to add more monitoring parameters by adding the respective sensor. For that, only the PLC programming need to be modified. In the hardware part, only the respective sensor needs to be added with the existing setup. Real-time trends and historical trends also novel approach. In most of the researchers has not developed such kind of facilities. This setup can also be utilized to monitor the various points river for the river water quality. By utilizing this setup a central monitoring system can possible to developed through which multiple ETPs as well as various points of river can possible to monitor through a cloud server. The integration of IoT technology into water treatment plants offers significant advantages in terms of enhanced monitoring capabilities, improved responsiveness, and informed decision-making. This paper explores the design, implementation, and benefits of an IoT-based real-time water quality monitoring system in WTPs, highlighting their potential to revolutionize water quality management practices and safeguard public c health.

A decentralized, real-time household water contamination monitoring system uses a network of Internet of Things (IoT) sensors, local controllers, and a communication network to provide continuous water quality assessment and alert users to potential contamination. Unlike traditional centralized models that require manual lab testing, this approach is faster and more efficient. For households without internet access, communication can be handled via a GSM module that sends SMS alerts to users when a contamination event is detected. In areas with internet connectivity, the local controller transmits the data to a cloud server using a Wi-Fi module. Some systems use low-power, wide-area network (LPWAN) technologies like Lora WAN for long-range communication in rural areas. When a sensor reading crosses a predefined threshold, the system triggers real-time alerts via SMS, email, or a mobile app. Some systems can also automatically shut off the water supply to prevent the use of contaminated water.

Assembling low-cost sensors with open-source platforms like Arduino and Raspberry Pi makes this a highly affordable and flexible solution, adaptable to varying needs.

EXTERNAL PARTICIPANTS- AVANI KUR KARNI,

INTEGRATING AI, HCI, MULTI-MATERIAL 3D PRINTING, AND ADVANCED MATERIALS FOR SUSTAINABLE SMART



The construction sector is under growing pressure from rapid urbanization, resource scarcity, and the urgent need to deliver infrastructure that is durable, adaptive, and environmentally responsible. Conventional building approaches, while widely practiced, are highly resource intensive and generate substantial carbon emissions. Meanwhile, advances in artificial intelligence (AI), human–computer interaction (HCI), additive manufacturing, and materials science—including nanotechnology and bio-based composites—have largely progressed in isolation, limiting their capacity to create systemic change in construction practices. This research addresses that gap by proposing an integrated framework that combines AI-driven optimization, immersive HCI interfaces, multi-material 3D printing, and next-generation materials such as nano-reinforced concretes, agro-waste-based composites, moss-infused bio cements, and self-healing formulations.

- **Maximizing resource efficiency**: multi-material printing with recycled and low-carbon alternatives drastically reduces waste and the embodied carbon of a building.
- **Optimizing energy consumption**: AI-powered design and operational management dramatically decrease a building's energy use throughout its lifecycle.
- **Improving building longevity**: Self-healing materials and predictive maintenance extend the lifespan of structures, preventing resource-intensive repairs and replacements.

This proposed system integrates AI, Human-Computer Interaction (HCI), multi-material 3D printing, and advanced materials to create a holistic approach to sustainable, smart construction. The synergy of these technologies can optimize every phase of a building's lifecycle, from design to maintenance, significantly reducing costs, waste, and carbon emissions.

Implementation in the construction lifecycle

1. Design and planning

Generative AI creates optimized building designs based on sustainability parameters.

The final design, in the form of a BIM, is used to program the multi-material 3D printing robots.

2. Manufacturing and prefabrication

Automated, AI-controlled systems fabricate optimized, multi-material components off-site, reducing construction time, cost, and on-site labor. Computer vision performs continuous quality control during fabrication.

3. On-site construction

AI-powered robots autonomously assemble and install the prefabricated components.

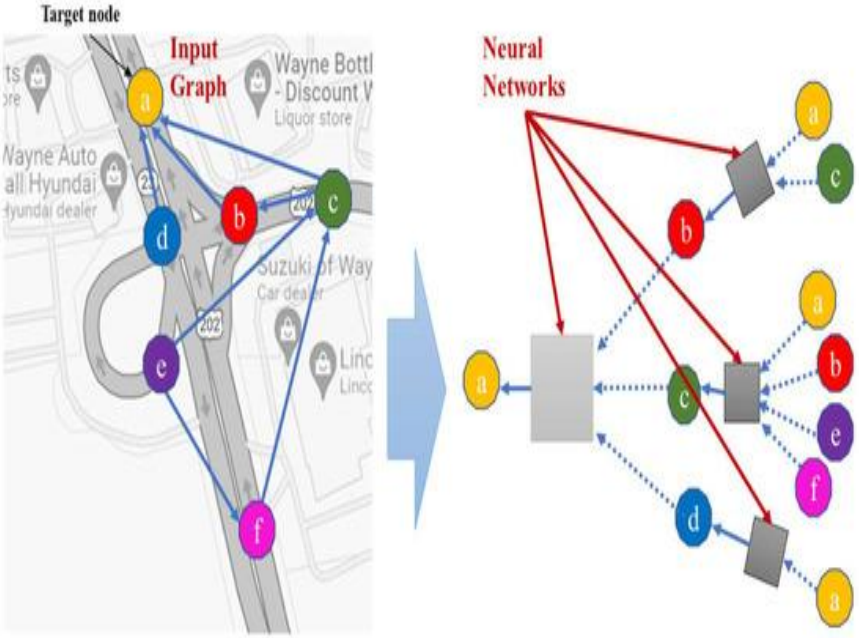
AR interfaces guide human workers, enabling real-time collaboration and access to critical project data.

Sensors and AI monitor construction progress, worker safety, and potential hazards.

EXTERNAL PARTICIPANTS- BHARATH VELAN.S

AI-ENABLED DYNAMIC MULTI-MODAL TRANSPORT

An integrated and intelligent approach to urban transport is necessary for managing the new demand congestion and transport interconnectivity and integration gaps. As the transport system from buses and trains to ride shares, bicycles, and walking becomes a flexible and adaptive system, the challenges for transport management are endless. Advanced AI integrated and real-time data management, from IoT and GPS and user feedback, automates AI predictive modeling to minimize travel times, congestion, and environmental impacts through optimized routes and dynamically scheduled vehicles. Demand forecasting and proactive adjustability are achieved through ML, predictive analytics, and AI driven real-time adjustments to traffic patterns, and balance load shifting and routes to service. Edge computing at transport hubs and decentralized management through the cloud allow large analytics and predictive modeling to run for real-time control. Personal trip planning through predictive modeling AI and inclusive mobility control is integrated to promote the user experience of the intelligent transport AI. According to initial simulations, this AI-driven, multi-modal system framework is likely to be foundational to smart cities of the future, given the improvements in travel efficiency, energy use, and system resilience.



An AI-enabled dynamic multi-modal transport ecosystem is an intelligent network that uses artificial intelligence (AI) to optimize and integrate different modes of transport in real time. This dynamic system coordinates vehicles, infrastructure, and people, responding to changing conditions and user needs to improve safety, efficiency, and sustainability.

Dynamic route optimization: AI algorithms analyze real-time traffic, weather, and demand to provide passengers with the fastest and most efficient multi-modal routes. These routes can combine buses, metro, taxis, and ride-sharing services.

Enhanced public transit: AI systems can dynamically adjust bus and metro schedules and vehicle allocation based on predicted passenger demand and real-time traffic flow, improving reliability and reducing wait times.

Personalized services: Mobility-as-a-Service (MaaS) platforms use AI to offer personalized travel plans, real-time updates, and integrated payment solutions through a single app.

Smart traffic management: AI-driven traffic systems can predict congestion, adapt traffic signal timings, and prioritize emergency and public transport vehicles to keep traffic flowing smoothly.

Enhanced safety: Real-time monitoring, predictive analytics, and autonomous systems help prevent accidents and reduce human error.

EXTERNAL PARTICIPANTS- VENNILA.S

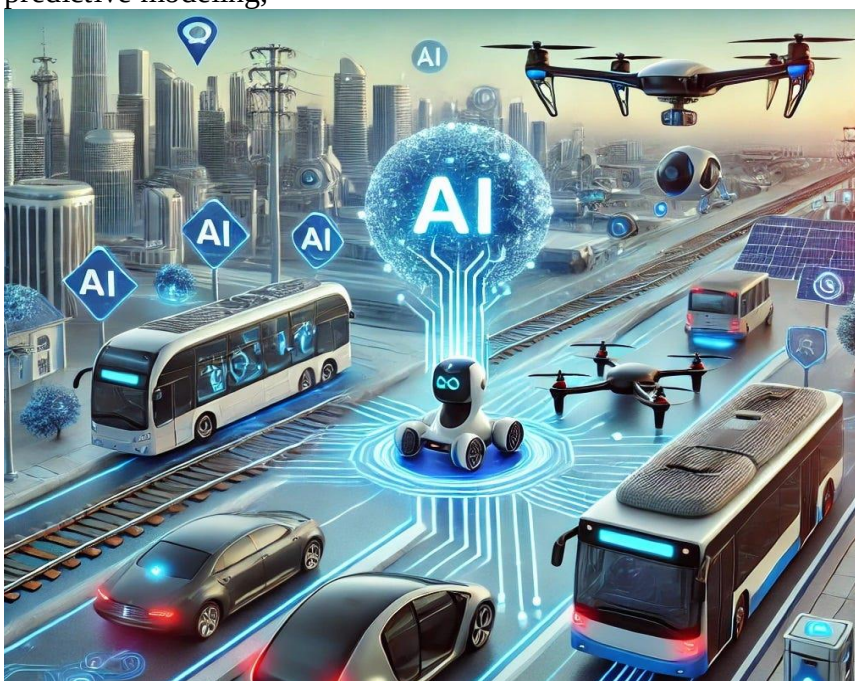
SMART TRANSPORATATION AND DIGITAL TECHNOLOGY

Smart transportation uses digital technologies like the Internet of Things (IoT), 5G, and Artificial Intelligence (AI) to create integrated systems that improve traffic management, public safety, and environmental sustainability. Key innovations include connected vehicles, autonomous driving, and smart parking, which enable real-time data collection and communication to enhance overall mobility and efficiency. Internet of Things (IoT): Sensors in vehicles and infrastructure collect and communicate data, allowing for remote interaction with vehicles (e.g., remote locking, starting), real-time monitoring of vehicle status, and comprehensive traffic flow management.

Artificial intelligence (AI) in smart transportation uses machine learning and real-time data to improve efficiency, safety, and user experience through applications like autonomous vehicles, predictive traffic management, optimized public transport, and proactive maintenance. By analyzing data from sensors, cameras, and connected devices, AI systems can predict congestion, adapt traffic signals, enable self-driving features, and provide real-time updates for travelers.

AI-based traffic management is revolutionizing how cities address congestion. Traditional systems operate on static rules or pre-set time intervals. In contrast, AI-driven systems analyze real-time traffic data under knowledge of historic traffic patterns and prediction of future traffic states to make dynamic decisions that respond instantly to current conditions.

The city of York in the UK has implemented PTV Optima to create a city-wide real-time transport model - one of the first of its kind in the country. The system integrates live data from traffic sensors, GPS probes, and signal controllers to continuously monitor road conditions. Using AI-powered algorithms and predictive modeling,



Applications of AI in Smart Transportation

Autonomous Vehicles: AI enables self-driving cars and trucks to perceive their surroundings using computer vision, LiDAR, and machine learning to make real-time driving decisions.

Real-Time Traffic Management: AI systems can predict congestion, adjust traffic light timings, and prioritize emergency vehicles by integrating data from traffic cameras, sensors, and connected vehicles.

Optimized Public Transport: AI helps in developing more efficient public transport by analyzing data to create demand-responsive schedules, reduce wait times, and optimize routes for buses and trains. Predictive Maintenance: AI can monitor vehicle health and predict potential maintenance issues, allowing for proactive repairs and reducing breakdowns in transportation fleets.

Enhanced Safety: AI enhances safety by monitoring traffic patterns, detecting hazardous conditions, and alerting drivers to potential dangers through real-time data analysis and predictive modeling. Route Optimization: AI algorithms find the most efficient routes for travel, considering factors like real-time traffic, weather, and delivery schedules.

Improved Customer Service: AI-powered chatbots and digital assistants provide personalized travel information and support for passengers. AI significantly enhances transportation safety through real-time data analysis and predictive modeling. By monitoring traffic patterns and detecting hazardous conditions, it can alert drivers to potential dangers.

From data to action | By integrating data from sensors, connected vehicles, traffic cameras, weather systems and transport models, AI traffic management systems can: Predict congestion before it occurs. Adapt traffic light timings in real time.

EXTERNAL PARTICIPANTS- CHIRAG SUHAIKA

WORLD'S LARGEST ANIMAL RESCUE, REHABILITATION, AND CONSERVATION

This document outlines the investment rationale for establishing the world's largest animal rescue, rehabilitation, and conservation centre. The centre aims to provide a sanctuary for animals in need, focusing on rescue, rehabilitation, and conservation services. It emphasizes animal welfare, biodiversity protection, and addressing the global animal crisis. The document explores how such a centre aligns with carbon finance criteria, potential impacts, risks, scalability, and monitoring metrics, ultimately concluding that it presents a significant opportunity for sustainable and impactful investment.

Investment Reasoning Investing in an animal rescue, rehabilitation, and conservation centre aligns with carbon finance criteria through several key avenues:

- Biodiversity Conservation: Protecting and restoring habitats for endangered species is crucial for enhancing carbon sequestration and overall ecosystem resilience. A dedicated centre can actively manage and expand these habitats.
- Ecosystem Services: Healthy ecosystems provide invaluable services, including pollination, water purification, and climate regulation. By preserving and restoring these ecosystems, the centre contributes to the maintenance of these essential services.

Rescue and Rehabilitation: The center focuses on rescuing animals in distress, providing them with immediate veterinary care, and creating a safe, natural habitat for their recovery and long-term well-being.

Conservation Efforts: Vantara is dedicated to biodiversity conservation, aiming to restore balance for threatened species like the Asiatic lion and the one-horned rhinoceros.

Advanced Facilities: The center features advanced medical technology, including MRI and CT scanners, and is home to the world's largest hospital for elephants.

Scale and Scope: Vantara's vast area of over 3,500 acres provides a sanctuary-like environment, housing more than 150,000 rescued animals from thousands of species.

Mission: With a name that means "Star of the Forest," Vantara's mission is to provide comprehensive care for rescued animals and to demonstrate a model for coexistence between humans and nature.

Biodiversity Conservation: Protecting and restoring habitats for endangered species is crucial for enhancing carbon sequestration and overall ecosystem resilience. A dedicated center can actively manage and expand these habitats.

Ecosystem Services: Healthy ecosystems provide invaluable services, including pollination, water purification, and climate regulation. By preserving and restoring these ecosystems, the center contributes to the maintenance of these essential services.

India Market Size: The Indian market for animal welfare and conservation is currently valued at approximately $70 million USD (Rs. 611 crore), demonstrating a substantial domestic demand for these services.