CIVIL BULLETIN

DEPARTMENT OF CIVIL ENGINEERING

K.S.R COLLEGE OF ENGINEERING TIRUCHENGODE - 637 215
(Autonomous)
Approved by AICTE, Affiliated to Anna University

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DEPARTMENT OF CIVIL ENGINEERING

B.E. – Civil Engineering

(REGULATIONS 2024)

Vision of the Institution

IV	We envision to achieve status as an excellent educational institution in the global knowledge hub, making self-learners, experts, ethical and responsible engineers, technologists, scientists, managers, administrators and entrepreneurs who will significantly contribute to research and environment friendly sustainable growth of the nation and the world.

Mission of the Institution

IM 1	To inculcate in the students self-learning abilities that enable them to become competitive and considerate engineers, technologists, scientists, managers, administrators and entrepreneurs by diligently imparting the best of education, nurturing environmental and social needs.
IM 2	To foster and maintain a mutually beneficial partnership with global industries and institutions through knowledge sharing, collaborative research and innovation.

Vision of the Department / Programme: (Civil Engineering)

DV	To impart knowledge and excellence in Civil Engineering and Technology with global perspectives to our students and to make them ethically strong engineers to create conducive environment.

Mission of the Department / Programme: (Civil Engineering)

DM 1	To promote innovative thinking in the minds of budding engineers and to make the department a centre of excellence in the field of Engineering.
DM 2	To provide knowledge base and moral autonomy to address regional, national and international needs in Civil Engineering.

Programme Educational Objectives (PEOs): (Civil Engineering)

The graduates of the programme will be able to	
PEO 1	**Successful Career:** Design and contribute to the infrastructure development project being undertaken by various sectors and evolves as a successful engineer.
PEO 2	**Lifelong Learning:** Pursue higher studies so that they can contribute to the society in terms of academic, research, sustainable development and other allied fields.
PEO 3	**Service to Society:** Work effectively and ethically in multicultural and multidisciplinary groups in accordance with technological change for the growth of Civil Engineering projects.

Programme Outcomes (POs) of B.E. Civil Engineering

Program Outcomes (POs)	
PO1	**Engineering Graduates will be able to:** **Engineering Knowledge:** Apply the knowledge of mathematics, natural science, engineering computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/ components/ processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.(WK8)
PO5	**Engineering Tool Usage:** Create, select, and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	**The Engineer and the World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5 and WK7)
PO7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion: adhere to national & international laws. (WK9)
PO8	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse / multi-disciplinary teams.
PO9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language and learning differences.
PO10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member in a team, and to manage projects and in multidisciplinary Environments.
PO11	**Life-long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK8).
Program Specific Outcomes (PSOs)	
PSO1	**Research Culture:** Update research knowledge in Civil Engineering to solve the unknown issues that they have not encountered before.
PSO2	**Core Values:** Contribute core Universal values and social good in the community by Civil Engineering Profession.

3D Concrete Printing

M.K.Akilan, III Year Student, Department of Civil Engineering,
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3D concrete printing is an emerging construction technology that automates the building process using robotic arms or gantry systems to layer specially designed concrete. This technique is being increasingly used to cast walls, low-rise homes, footbridges, and structural components with complex geometries.

The material used, known as **printable concrete**, is a fast-setting mixture that flows easily through the printer nozzle yet gains strength quickly to support successive layers. It often contains additives like fly ash, slag, or fibers to enhance workability and strength.

Key Benefits:

- **Reduced Labor**: Minimizes manual intervention, enhancing safety and efficiency.
- **Faster Construction**: Projects can be completed in days instead of weeks.
- **Sustainability**: Reduces material waste and allows the use of eco-friendly binders.

Case Study: India's First 3D Printed House

Developed by **Tvasta and IIT Madras**, India's first 3D-printed house was completed in 2021. The 600 sq. ft structure was built in just 21 days using a concrete 3D printer and cost-effective materials, showcasing the potential for affordable housing in rural and urban areas.This technology is poised to transform the future of civil engineering with its promise of speed, customization, and sustainability.

Technical Highlights

Layer-by-Layer Construction: 3D printing uses a pre-programmed path to extrude concrete in layers, eliminating the need for traditional formwork.

Customization: Complex geometries and architectural freedom can be easily achieved without extra cost.

Automation: Robotic arms or gantry systems are controlled using CAD/CAM models.

Materials and Mix Design

Printable concrete often contains:

- Cementitious materials (OPC, fly ash, GGBS)
- Superplasticizers for flow
- Accelerators for faster setting
- Fibers (like glass or basalt) for added strength

Applications

- Low-cost housing
- Disaster relief shelters
- Infrastructure elements (e.g., retaining walls, benches, manholes)
- Decorative architecture and urban furniture

Global Examples

- Dubai Municipality aims for 25% of buildings to be 3D printed by 2030.
- Apis Cor (USA) printed a complete house on-site in 24 hours.
- China built a 5-storey building using 3D printed modular blocks.

Challenges and Limitations

Material consistency and pumpability

Structural integrity and bonding between layers

Limited standards and codes for structural approval

Weather conditions affecting outdoor printing.

Self-Healing Concrete

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Self-healing concrete is a **next-generation construction material** designed to **repair its own cracks without external intervention**. It addresses one of the most common problems in civil engineering — the formation of micro-cracks in concrete, which can lead to water seepage, corrosion of reinforcement, and reduced durability.

How It Works

There are three primary types of self-healing mechanisms:

1. Biological/Bacterial-Based Healing

- **Microcapsules or spores** of *Bacillus* bacteria are embedded in the concrete mix along with nutrients like calcium lactate.
- When water enters through a crack, the dormant bacteria activate and produce **calcium carbonate ($CaCO_3$)**.
- This mineral seals the crack, mimicking natural limestone formation.

2. Chemical-Based Healing

- Capsules filled with **sodium silicate or epoxy resin** are added to the concrete.
- When cracks form, these capsules rupture and the chemical reacts with moisture to fill the gaps.

3. Polymeric Healing

- Concrete is infused with **polymeric fibers or gels** that swell on contact with water, effectively sealing small cracks.

Advantages

Longer Service Life: Structures last significantly longer with less degradation.

- **Reduced Maintenance**: Cuts down on costly repairs, especially in hard-to-access structures.
- **Improved Durability**: Enhanced resistance to corrosion and water penetration.
- **Environmental Benefits**: Fewer repair materials and less concrete production reduce the carbon footprint.

Applications

- Tunnels and subways
- Dams and hydraulic structures
- Coastal and marine structures
- Nuclear power plants
- Pavements and retaining walls

Real-World Implementations

- **Delft University (Netherlands)** developed one of the first practical bacterial concrete models.
- **BASF's "Healing Concrete"** product uses microencapsulation technology.
- In India, IITs and CSIR-SERC (Chennai) are conducting lab-scale and field trials, focusing on performance under Indian climate conditions.

Challenges

- **High Initial Cost**: Materials and techniques are currently expensive.
- **Limited Standards**: Not yet included in most national design codes.
- **Performance Limitations**: Effective mainly for micro-cracks (< 0.5 mm).

Use of Drones and AI in Civil Engineering Inspections

M.Kathirvel, III Year Student, Department of Civil Engineering,
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The integration of drones (UAVs) and artificial intelligence (AI) is transforming how civil engineers inspect, monitor, and maintain infrastructure. These technologies enable safe, efficient, and precise assessment of large or difficult-to-access structures like bridges, high-rise buildings, towers, and dams.

How It Works:

- ➢ Drones are equipped with high-resolution cameras, thermal sensors, and LiDAR scanners to collect aerial images and structural data.
- ➢ AI algorithms process this data to detect defects such as cracks, spalling, corrosion, or deformation.
- ➢ Inspection results are presented in 3D models or digital twins for easy visualization and decision-making.

Key Benefits:

Safety: Reduces the need for manual inspection in hazardous locations.

Time-Efficient: Covers large areas in minutes instead of hours or days.

High Accuracy: AI provides automated detection and monitoring of defects over time.

Applications:

- ➢ Structural health monitoring of bridges and flyovers.
- ➢ Monitoring construction progress and quality assurance.
- ➢ Post-disaster damage assessment.
- ➢ Land surveying and volumetric analysis.

Real-World Usage

- ➢ Delhi Metro Rail Corporation (DMRC) uses drones to survey metro corridors and construction progress.
- ➢ NHAI has mandated drone surveys for large infrastructure projects for record-keeping and transparency.
- ➢ CSIR-CBRI and various IITs are conducting research on integrating AI with drone data for structural health analysis.

Technological Components

1. Drones (UAVs)

Types used: **Multi-rotor, fixed-wing, and hybrid drones** depending on project scale.

Equipped with:

- ✓ **RGB cameras** for visual inspection
- ✓ **Thermal cameras** to detect heat loss, leaks, or electrical faults
- ✓ **LiDAR sensors** for topographical and structural mapping

2. AI-Based Analysis

- **Machine Learning (ML)**: Used to recognize patterns, cracks, surface defects, rust, etc.
- **Computer Vision**: Converts drone images into actionable insights.
- **Digital Twins**: AI creates a 3D virtual model of structures for real-time monitoring and simulation.

<u>Advanced Applications</u>

- **Bridge Inspections**: AI pinpoints crack width, corrosion spots, and joint displacements from aerial footage.
- **Road Condition Mapping**: Drones scan long stretches of highways to identify potholes, rutting, and surface wear.

Building Information Modeling (BIM): The Digital Backbone of Modern Construction

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Building Information Modeling (BIM) is a **3D model-based digital process** that enables architects, engineers, and construction professionals to **plan, design, construct, and manage buildings and infrastructure** more efficiently.

BIM integrates **geometry, spatial relationships, geographic information, quantities, and properties of building components** into a shared model that evolves through the project lifecycle — from concept to demolition.

Key Features:

- **3D Visualization**: Enables real-time visual understanding of the project.
- **Clash Detection**: Identifies design conflicts (e.g., pipes intersecting beams) before construction.
- **Data Integration**: Combines structural, electrical, plumbing, and architectural data in a single platform.
- **Lifecycle Management**: Supports facility management even after construction is complete.

Advantages:

- Improved collaboration and coordination among stakeholders.
- Reduces construction errors, delays, and rework.
- Enhances cost estimation and resource optimization.
- Enables sustainable design by analyzing energy performance and materials.

Applications:

- Building construction (residential, commercial, industrial)
- Infrastructure projects (roads, metros, bridges)
- Smart city planning and urban development

Indian Context:

Government bodies like CPWD and DMRC have started implementing BIM in large-scale infrastructure projects. Private companies and educational institutions are also adopting BIM tools like Autodesk Revit, Navisworks, and Bentley Systems.

BIM is **redefining the future of construction** by making it smarter, faster, and more collaborative.