Excellence in Higher Education

# AKSHAYA COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, Recognized by UGC and Affiliated to Anna University)

Accredited by NAAC | Accredited by NBA : UG programmes of CSE, ECE & CIVIL

Kinathukadavu, Coimbatore-642109. www.acetcbe.edu.in

AN AUTONOMOUS INSTITUTION

# DEPARTMENT OF CIVIL ENGINEERING

## TECHNICAL MAGAZINE

### ACADEMIC YEAR 2025-2026 [EVEN SEMESTER]

**Issue 2 [MAY, 2026]**

## Message from the Head of Department

The Department of Civil Engineering, established in 2010, currently offers an Undergraduate Programme in Civil Engineering with an approved intake of 30 students. The programme was accredited by the National Board of Accreditation (NBA) in 2024, reflecting the department's commitment to academic excellence and quality education.

The Department is supported by a team of highly qualified and experienced faculty members, along with dedicated technical staff, with expertise in key domains such as Environmental Engineering and Management, Structural Engineering, Infrastructure Engineering, Water Resources Engineering and Environmental Engineering

With a strong focus on outcome-based education, the department strives to equip students with comprehensive knowledge and practical skills in planning, analysis, design, construction methodologies, and maintenance of civil engineering structures.

The Department is well-equipped with state-of-the-art laboratory facilities, including the Highway Engineering Laboratory, Material Testing Laboratory, Soil Mechanics Laboratory, Surveying Laboratory, Hydraulics Engineering Laboratory, Water and Wastewater Laboratory, Civil Engineering Computer Laboratory and Advanced Structural Laboratory, providing students with ample opportunities for hands-on learning and research.

**Dr. R. Premsudha**
**Professor & Head**
**Department of Civil Engineering**

## Vision and Mission of the department

### Vision of the Department

To produce quality Civil Engineers having domain knowledge embedded with design, analysis, and research capability, ethical and moral values, for the welfare of society and humanity**.**

### Mission of the Department

**DM 1:** To produce knowledge based Civil Engineers by focusing theoretical and practical studies with field orientation.

**DM 2:** To engage the students in creating design solutions for real life problems associated with industry and society.

**DM 3:** To inculcate entrepreneurship culture along with professional ethics among Civil Engineering students and also promote the use of modern tools and techniques for sustainable economic growth.

## Program Educational Objectives (PEOs)

**PEO 1: Design Techniques:** The graduates will be able to apply the concepts of basic geometrical construction, preparation of plans, design of structural elements, specification, and prepare estimates.

**PEO 2: Construction Quality & Control:** The graduates will be able to build the infrastructure required for the country and apply the tools for quality in construction, cost effective construction materials and methods.

**PEO 3: Leadership:** The graduates will be able to work as a member and leaders in a team, prepare and present reports, and employ project management tools for the evaluation and review of projects globally.

## Program Specific Outcomes (PSOs)

**PSO 1: Professional skills:** Students shall have skills and knowledge to work on projects on urban and rural housing infrastructure, environment, and sustainability.

**PSO 2: Competency:** Students shall qualify at the state, national, and international level competitive examination for employment, higher studies, and research.

## Program Outcomes (POs)

**PO 1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO 2: 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.

**PO 3: 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

**PO 4: 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.

**PO 5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO 6: 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.

**PO 7: 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.

**PO 8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO 9: Individual and Team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO 10: 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.

**PO 11: 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.

**PO 12: 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.

## Message from Editorial Team

Welcome to an exciting edition of the Technical Magazine of the Department of Civil Engineering, where innovation, creativity, and technology converge. In this issue, we delve into a wide array of topics from the latest advancements in construction materials and sustainability to cutting-edge developments in Construction techniques and practices. Our mission with this magazine is to create a platform where ideas can flourish where students and faculty alike can showcase their work, share their knowledge and contribute to the ever-evolving world of technology. We believe that through collaboration and the exchange of ideas, we can foster an environment that nurtures innovation and drives progress. We would like to extend our heartfelt gratitude to all contributors who have taken the time to share their insights and expertise. Your work is the keystone of this publication and it is your dedication that makes each edition of our Magazine a success.

As you explore the content within these pages, we encourage you to think beyond the boundaries to question to innovate and to contribute to the vibrant tapestry of ideas that defines our institution.

Thank you for your continued support and enthusiasm. We hope you enjoy this issue as much as we have enjoyed putting it together.


**Chief Editor:**

Dr.R.Premsudha,Professor & Head

**Faculty Advisors:**

Mrs.Priyanka M, AP/ Civil,

Ms. D. Kalaimathi, AP/Civil,

Dr.S.Pratheba, AP/Civil.

**Faculty Editor:**

Mrs.Priyanka M, AP/ Civil.

**Student Editors:**

Ms. R Santhya, – IV Civil,

Mr.M.Paramasivam – III Civil.

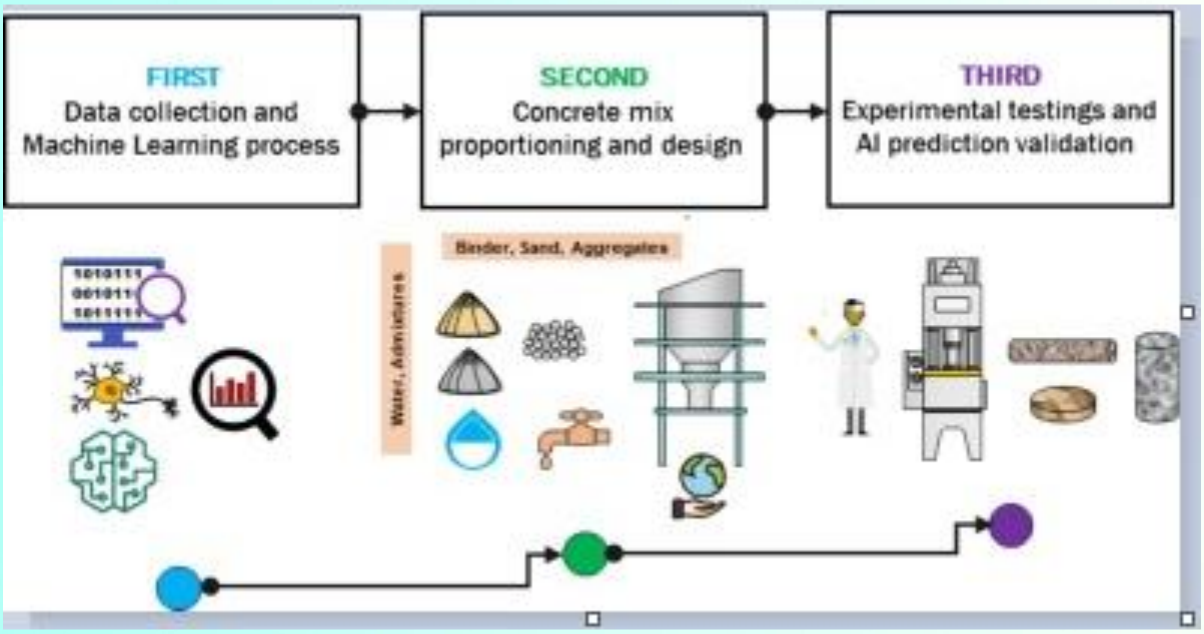
**Design Team:**

Mr. S Hariskumar – IV Civil,

Mr. V Prajin – III Civil

## TABLE OF CONTENTS

# 1. MACHINE LEARNING-DRIVEN PREDICTIVE MODELING OF CONCRETE COMPRESSIVE STRENGTH USING MIX DESIGN PARAMETERS




**ABSTRACT**

The prediction of concrete compressive strength is essential for ensuring structural safety and optimizing material usage in civil engineering projects. Traditional experimental methods are time-consuming and costly. This study proposes a machine learning-driven predictive model that estimates concrete compressive strength using mix design parameters such as cement content, water-cement ratio, aggregates, and admixtures. Various regression-based algorithms are trained on historical datasets to identify nonlinear relationships between input variables and strength outcomes. The model improves accuracy in strength prediction, reduces dependency on laboratory testing, and supports efficient mix optimization for sustainable construction practices.

## 1. Introduction

Concrete is a heterogeneous material whose strength depends on complex nonlinear interactions between its components. Traditional experimental methods require 7-day, 14-day, and 28-day curing tests, which are time-consuming and expensive. Machine learning provides an alternative approach by learning patterns from historical datasets and predicting strength efficiently.

## 2. System Architecture

The system consists of:

- Data Collection Module (experimental mix datasets)
- Data Preprocessing Unit (handling missing values, normalization)
- Feature Selection Module (important mix parameters)
- ML Prediction Engine (regression models)
- Output Interface (strength prediction results)

## 3. Methodology

- Dataset collection from concrete mix experiments
- Data cleaning and preprocessing
- Feature scaling and correlation analysis
- Training ML models (Linear Regression, Random Forest, XGBoost, ANN)
- Model evaluation using MAE, RMSE, $R^2$ score
- Deployment for real-time prediction

**4. Role of Artificial Intelligence**

AI models capture nonlinear relationships between mix proportions and compressive strength. Ensemble models improve accuracy by combining multiple learners, while neural networks model complex dependencies.

**5. Advantages**

- Eliminates repeated lab testing
- Faster mix design optimization
- Cost reduction in material experimentation
- Higher prediction accuracy compared to empirical formulas

**6. Applications**

- High-rise building construction
- Road and bridge design
- Ready-mix concrete industry
- Material testing laboratories

**7. Future Scope**

Integration with IoT-based curing sensors, real-time data acquisition from batching plants, and deep learning models for microstructure-based prediction.

**8. Conclusion**

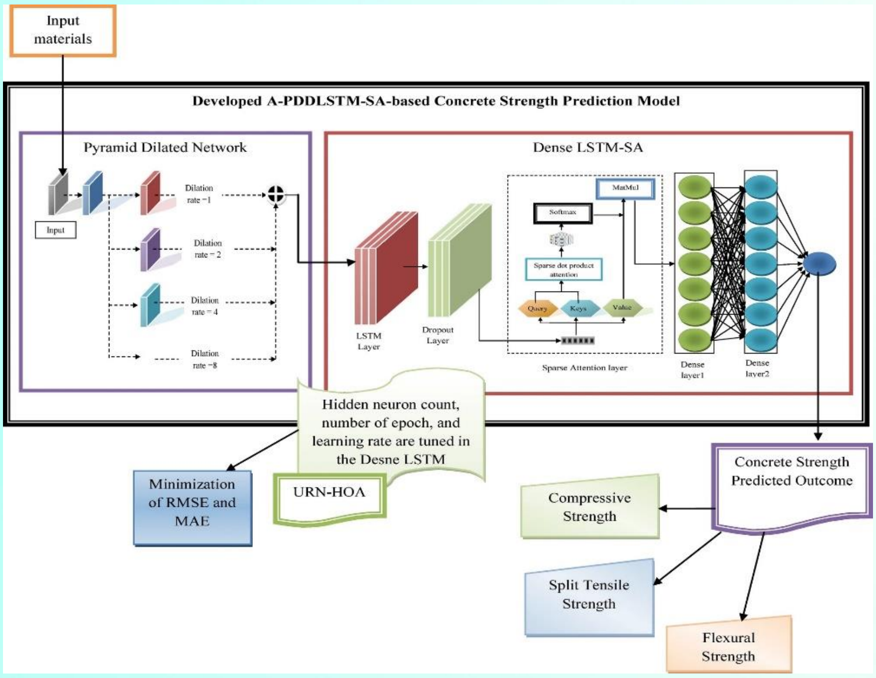
The proposed ML-based system significantly improves prediction accuracy and reduces dependency on physical testing, making concrete mix design more efficient and intelligent.

**By**

- Ms. Meena V
- Mr. Mujiph Rahman M
- Ms. Pavithra B
- Mr. Maria Naveensingh S

**BE- II YEAR / CIVIL.**

## 2. AI-BASED GENERATIVE OPTIMIZATION FRAMEWORK FOR STRUCTURAL COMPONENT DESIGN





**ABSTRACT**

Structural component design is a critical process that directly influences the safety, cost, and performance of civil engineering projects. Conventional design approaches often involve multiple iterations and extensive engineering calculations. This study presents an AI-based generative optimization framework capable of automatically generating and evaluating multiple structural design alternatives. The framework integrates artificial intelligence techniques with optimization algorithms to achieve lightweight, cost-effective, and structurally efficient designs while satisfying engineering constraints. Performance metrics such as strength, stiffness, and material consumption are considered during the optimization process. The proposed system significantly reduces design time, improves decision-making, and promotes sustainable infrastructure development through intelligent structural optimization.


### 1. Introduction

Traditional structural design methods rely on manual iteration and engineering judgment. With increasing complexity in modern infrastructure, AI-based generative design provides a powerful alternative by automating design exploration.

### 2. System Architecture

- Input Constraint Module
- Generative Design Engine
- Finite Element Analysis (FEA) Validator
- Optimization Engine
- Final Design Output System

### 3. Methodology

- Define structural constraints and loading conditions
- Generate multiple design geometries using AI models
- Evaluate designs using simulation tools (FEA)
- Optimize based on weight, strength, and cost
- Select best-performing structure

### 4. Role of Artificial Intelligence

AI uses generative models and optimization algorithms (Genetic Algorithm, Neural Networks, and Reinforcement Learning) to explore design space efficiently.

### 5. Advantages

- Reduced material consumption
- Faster structural design cycle
- Improved safety factor optimization
- Automated engineering decision support

### 6. Applications

- Bridge design
- Building frames
- Industrial structures
- Aerospace components

### 7. Future Scope

Integration with BIM systems, digital twins, and real-time structural monitoring.

### 8. Conclusion

AI-based generative design transforms structural engineering by enabling automated, optimized, and efficient design solutions.

**By**

- Ms. Akila R
- Ms. Arisiya Vajila M
- Mr. Bhathreesan S M
- Mr. Paramasivam M

**BE- III YEAR / CIVIL.**

## 3. INTELLIGENT SOIL CLASSIFICATION AND BEARING CAPACITY ESTIMATION USING ADVANCED MACHINE LEARNING TECHNIQUES


**ABSTRACT**

Accurate soil classification and bearing capacity estimation are essential for safe and economical foundation design. Traditional geotechnical investigations require extensive laboratory testing and expert interpretation, which can be time-consuming and expensive. This study proposes an intelligent machine learning-based framework for automated soil classification and bearing capacity prediction using soil properties such as moisture content, grain size distribution, plasticity index, and density. Advanced machine learning algorithms analyze the collected data and identify patterns that influence soil behavior. The system provides reliable predictions with reduced testing requirements and faster analysis. The proposed approach enhances geotechnical decision-making, improves foundation design accuracy, and supports efficient site investigation processes.

### 1. Introduction

Soil behavior varies widely depending on composition and environmental conditions. Traditional classification methods such as IS soil classification require manual interpretation, making them slow and subjective.

### 2. System Architecture

- Soil Data Input Module
- Feature Extraction Unit
- Classification Model
- Regression Model for Bearing Capacity
- Output Visualization System

### 3. Methodology

1. Collection of soil parameters (moisture content, grain size, plasticity index)
2. Data preprocessing and encoding
3. Classification using ML algorithms
4. Bearing capacity prediction using regression models
5. Model validation and accuracy testing

## 4. Role of Artificial Intelligence

AI models such as SVM, Random Forest, and Gradient Boosting classify soil types and estimate load-bearing capacity efficiently.

## 5. Advantages

- Faster geotechnical analysis
- Reduced field testing cost
- High prediction reliability
- Automated decision support

## 6. Applications

- Foundation design
- Road construction
- Tunnel engineering
- Site investigation

## 7. Future Scope

Integration with drone-based soil mapping and remote sensing data.

## 8. Conclusion

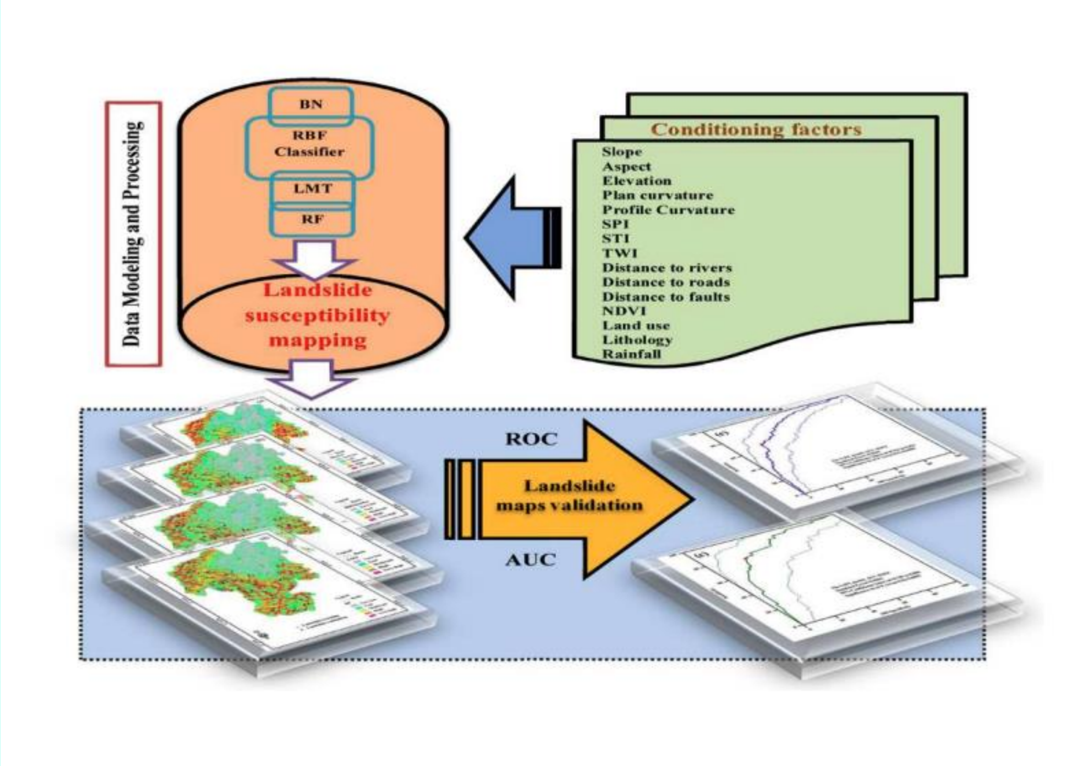
The AI-based system enhances geotechnical engineering by providing fast and accurate soil analysis.

**By**

- Ms. Deepa M
- Ms. Mohana R
- Mr. Prajin V
- Mr. Pongaleeswaran K

**BE- III YEAR / CIVIL.**

# 4. HYBRID AI AND GIS-BASED LANDSLIDE SUSCEPTIBILITY MODELING




**Abstract:**

Landslides are among the most destructive natural hazards, causing significant damage to infrastructure, property, and human life. Accurate prediction of landslide-prone areas is crucial for disaster mitigation and risk management. This study presents a hybrid Artificial Intelligence and Geographic Information System (GIS)-based framework for landslide susceptibility modelling and risk assessment. The model utilizes spatial and environmental parameters such as slope, elevation, rainfall, geology, and land-use patterns to identify vulnerable regions. Machine learning algorithms are employed to analyze historical landslide data and generate susceptibility maps. The integration of AI and GIS improves prediction accuracy and supports authorities in implementing effective disaster preparedness and land-use planning strategies.

## 1. Introduction

Landslides are natural disasters influenced by slope, rainfall, soil type, and vegetation. Predictive modelling is essential for risk reduction and planning.

## 2. System Architecture

- ❖ GIS Data Layer
- ❖ Data Preprocessing Unit
- ❖ Hybrid ML Model
- ❖ Spatial Analysis Engine
- ❖ Risk Map Generator

## 3. Methodology

1. Collection of spatial datasets (DEM, rainfall, land use)
2. GIS-based spatial feature extraction
3. Training hybrid AI models
4. Susceptibility prediction
5. Risk map generation

**4. Role of Artificial Intelligence**

AI integrates multiple models (ANN, SVM, Random Forest) for improved prediction stability and accuracy.

**5. Advantages**

- High accuracy risk prediction
- Early disaster warning
- Improved land-use planning
- Better hazard visualization

**6. Applications**

- Disaster management
- Urban development planning
- Highway construction
- Hill region safety planning

**7. Future Scope**

Integration with satellite imagery and real-time rainfall monitoring systems.

**8. Conclusion**

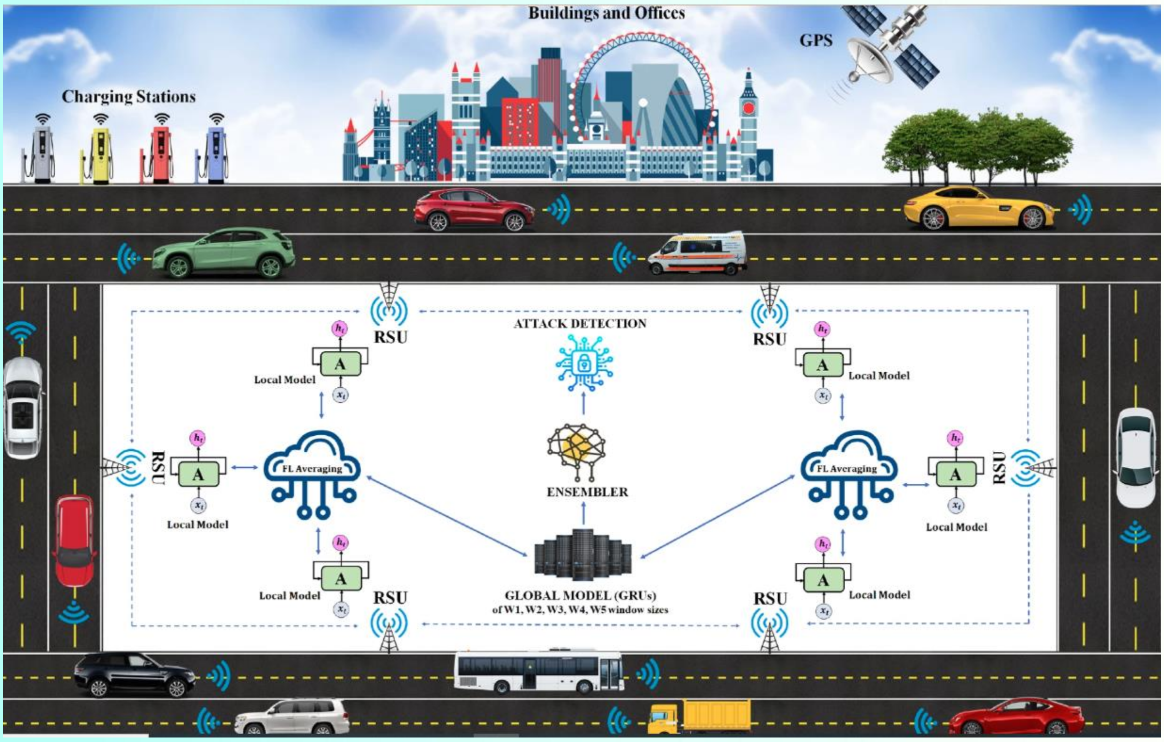
Hybrid AI-GIS models significantly enhance landslide susceptibility prediction and disaster preparedness.


**By**

- Ms. Devika C
- Ms. Deepika A
- Ms. Jothi S
- Ms. Pavithra P

**BE- III YEAR / CIVIL.**

## 5. LEARNING FOR AUTONOMOUS CONSTRUCTION EQUIPMENT CONTROL




**Abstract**

The construction industry is increasingly adopting automation technologies to improve productivity, safety, and operational efficiency. This study explores the application of reinforcement learning for autonomous control of construction equipment such as excavators, bulldozers, and loaders. Reinforcement learning enables machines to learn optimal actions through continuous interaction with their environment and reward-based feedback mechanisms. The proposed system improves task execution accuracy, reduces human intervention, and adapts to changing site conditions. Simulation-based training allows the equipment to develop efficient operational strategies before deployment..

### 1. Introduction

Construction machinery operations are traditionally manual and require skilled operators. Automation using RL enables machines to learn optimal control strategies.

### 2. System Architecture

- ❖ Simulation Environment
- ❖ RL Agent
- ❖ Reward Function System
- ❖ Control Policy Network
- ❖ Execution Module

### 3. Methodology

1. Define environment (construction site simulation)
2. Initialize RL agent
3. Train using reward-based feedback
4. Optimize action policy
5. Deploy in real-world scenarios

## 4. Role of Artificial Intelligence

Reinforcement learning enables machines to learn from trial and error and improve performance over time.

## 5. Advantages

- Reduced human dependency
- Higher operational efficiency
- Improved safety
- Continuous learning capability

## 6. Applications

- Excavators
- Bulldozers
- Mining equipment
- Automated earthwork systems

## 7. Future Scope

Fully autonomous construction sites with AI coordination systems.

## 8. Conclusion

RL enhances automation and efficiency in construction machinery operations.

**By**

- Mr. Premkumar A
- Mr. Rajakaviyarasan D
- Mr. Kavinkumar M

**BE- III YEAR / CIVIL.**

# 6. DAIRY INDUSTRY WASTEWATER TREATMENT IN INDIA: PROCESSES, CHALLENGES AND EMERGING TECHNOLOGIES

**Abstract**

The dairy industry is one of the largest agro-based sectors and generates significant quantities of wastewater during milk processing, equipment cleaning, packaging, and production operations. Dairy effluent contains high concentrations of organic matter, suspended solids, fats, oils, grease, proteins, and nutrients that can adversely affect water bodies if discharged without proper treatment. This article evaluates the performance characteristics and treatment efficiency of wastewater treatment processes employed in dairy industries. The study focuses on key operational parameters such as Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), pH, and nutrient removal efficiency.

## 1. Introduction

The dairy industry plays a vital role in food production and economic development. However, dairy processing operations consume large quantities of water and generate wastewater characterized by high organic loads. Untreated dairy effluent can cause oxygen depletion in receiving water bodies and create environmental pollution. Therefore, effective wastewater treatment systems are essential to maintain environmental quality and comply with regulatory standards.

## 2. Objectives

- To study the characteristics of dairy wastewater.
- To evaluate treatment efficiency at various treatment stages.
- To analyze the removal of BOD, COD, TSS, and nutrients.
- To assess the performance of dairy wastewater treatment systems.
- To recommend sustainable wastewater management practices.

## 3. Characteristics of Dairy Wastewater

| Parameter | Typical Range |
|---|---|
| pH | 6.0 – 8.5 |
| BOD | 800 – 3000 mg/L |
| COD | 1500 – 5000 mg/L |

| | |
|---|---|
| TSS | 200 – 1500 mg/L |
| Oil & Grease | 100 – 1000 mg/L |
| Nitrogen | 10 – 100 mg/L |
| Phosphorus | 5 – 50 mg/L |

Major sources include:

- ❖ Milk spillage
- ❖ Equipment washing
- ❖ Tank cleaning
- ❖ Floor washing
- ❖ Packaging operations
- ❖ Process water discharge

## 4. Methodology

### Phase 1: Wastewater Sampling

Wastewater samples are collected from:

- ❖ Equalization Tank
- ❖ Primary Treatment Unit
- ❖ Aeration Tank
- ❖ Secondary Clarifier
- ❖ Final Discharge Point

Samples are preserved and analyzed in accordance with standard laboratory procedures.

### Phase 2: Laboratory Analysis

The following parameters are measured:

**Physical Parameters**

- ❖ Temperature
- ❖ pH
- ❖ Total Suspended Solids (TSS)

**Chemical Parameters**

- ❖ Biological Oxygen Demand (BOD)
- ❖ Chemical Oxygen Demand (COD)
- ❖ Oil and Grease
- ❖ Total Nitrogen
- ❖ Total Phosphorus

**Biological Parameters**

- ❖ Microbial activity
- ❖ Biomass concentration

### Phase 3: Treatment Process Evaluation

**Preliminary Treatment**

- ❖ Screening
- ❖ Grit Removal

**Primary Treatment**

- ❖ Sedimentation Tank
- ❖ Oil and Grease Separation

Purpose:

- Reduction of suspended solids.

**Secondary Treatment**

- Activated Sludge Process
- Aeration Tank

Purpose:

- Biological degradation of organic pollutants.

**Tertiary Treatment**

- Sand Filtration
- Activated Carbon Filtration
- Disinfection

## 5. Expected Results

The treatment plant is expected to achieve:

| Parameter | Expected Removal Efficiency |
|---|---|
| BOD | 90 – 98% |
| COD | 85 – 95% |
| TSS | 90 – 99% |
| Oil & Grease | 85 – 95% |
| Nitrogen | 60 – 80% |
| Phosphorus | 50 – 75% |

## 6. Benefits of Effective Dairy Wastewater Treatment

**Environmental Benefits**

- Reduced water pollution
- Protection of aquatic ecosystems
- Improved water quality

**Economic Benefits**

- Water reuse opportunities
- Reduced disposal costs
- Resource recovery

**Social Benefits**

- Improved public health
- Sustainable industrial operations
- Regulatory compliance

## 7. Future Scope

**Emerging technologies include:**

- Membrane Bioreactors (MBR)
- Moving Bed Biofilm Reactors (MBBR)
- Anaerobic Digesters for Biogas Production
- AI-Based Process Monitoring
- IoT-Enabled Smart Treatment Plants

## Conclusion

Dairy industries generate wastewater with high organic content that requires efficient treatment before disposal. The performance of wastewater treatment systems can be assessed through the removal efficiencies of BOD, COD, TSS, nutrients, and oil & grease. Properly designed treatment plants significantly reduce environmental impacts while promoting water conservation and sustainable industrial development. Advanced treatment technologies and continuous monitoring can further improve treatment efficiency and resource recovery, making dairy wastewater management an essential component of sustainable dairy production.


**By**

- Ms. Kamtachi G
- Ms. Sandhiya R
- Mr. Karthikeyan S
- Mr. Ramamoorthi V

**BE- IV YEAR / CIVIL**

## 7. ASSESSMENT OF SOLID WASTE GENERATION IN AKSHAYA COLLEGE OF ENGINEERING AND TECHNOLOGY



### Abstract

The rapid growth of educational institutions has led to an increase in solid waste generation, creating environmental and management challenges. This study presents an assessment of solid waste generation at Akshaya College of Engineering and Technology to evaluate the quantity, composition, and sources of waste generated within the campus. Waste samples were collected from various locations, including classrooms, laboratories, administrative offices, canteens, hostels, and common areas. The collected waste was categorized into biodegradable, recyclable, and non-recyclable components to understand waste generation patterns and disposal practices.


### 1. Introduction

Solid waste management is one of the major environmental concerns in educational institutions. Colleges generate different types of waste through academic activities, food services, administrative operations, and student gatherings. Improper handling and disposal of waste can lead to environmental pollution, health hazards, and inefficient resource utilization. Therefore, assessing the quantity and characteristics of solid waste generated on campus is essential for planning an effective waste management system.

### 2. Objectives

- To estimate the quantity of solid waste generated within the campus.
- To identify the major sources of waste generation.
- To classify waste into biodegradable, recyclable, and non-recyclable categories.
- To evaluate existing waste collection and disposal practices.
- To recommend sustainable waste management strategies for the campus.

### 3. Methodology

#### Phase 1: Campus Survey

A preliminary survey was conducted to identify major waste generation locations:

- Classrooms
- Laboratories
- Administrative Offices
- Library

- ❖ Open Grounds and Common Areas

**Phase 2: Waste Collection**
Waste was collected from designated collection points for a period of one week.

**Equipment Used**

- ❖ Weighing Balance
- ❖ Collection Bags
- ❖ Gloves
- ❖ Data Recording Sheets

The collected waste was weighed daily and recorded.

**Phase 3: Waste Segregation and Characterization**
The collected waste was segregated into:

**Biodegradable Waste**

- ❖ Food waste
- ❖ Vegetable waste
- ❖ Garden waste
- ❖ Paper tissues

**Recyclable Waste**

- ❖ Paper
- ❖ Cardboard
- ❖ Plastic bottles
- ❖ Metal cans

**Non-Recyclable Waste**

- ❖ Multi-layer packaging
- ❖ Contaminated plastics
- ❖ Disposable materials

The percentage composition of each category was calculated.

**Phase 4: Data Analysis**

The following parameters were analyzed:

**Phase 5: Evaluation of Existing Waste Management Practices**
**Assessment of:**

- ❖ Collection System
- ❖ Segregation Practices
- ❖ Transportation Methods
- ❖ Disposal Techniques

## 4. Future Scope

Future studies can incorporate:

- ❖ Smart Waste Bins with Sensors
- ❖ IoT-Based Waste Monitoring Systems
- ❖ AI-Based Waste Classification
- ❖ Carbon Footprint Assessment & Zero-Waste Campus Initiatives

## 5. Conclusion

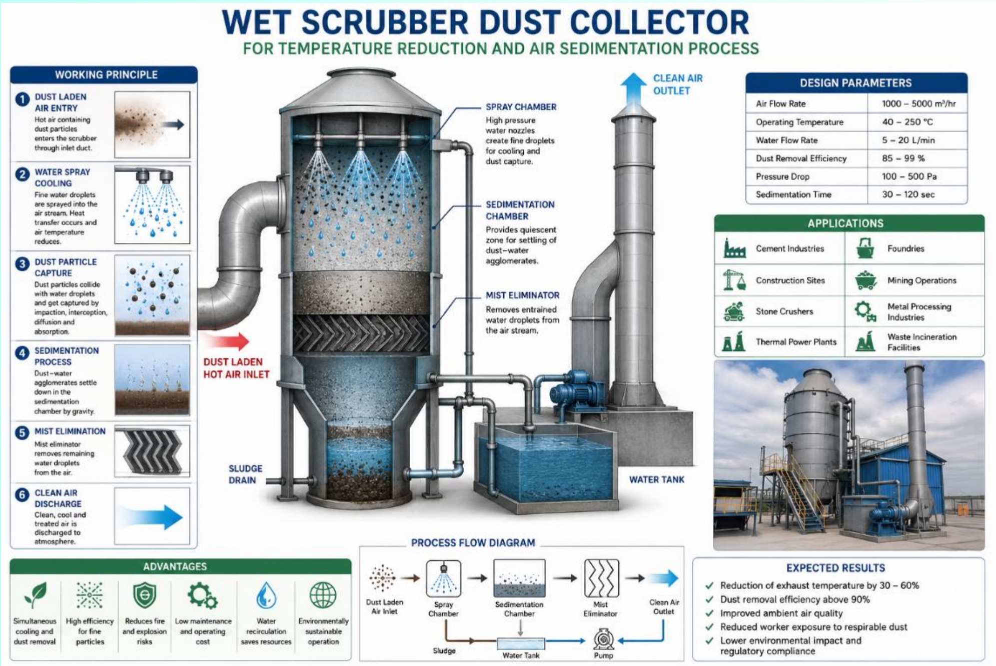
The assessment of solid waste generation at Akshaya College of Engineering and Technology provides valuable insights into campus waste characteristics and management practices. By implementing waste segregation, recycling, composting, and awareness programs, the institution can significantly reduce its environmental impact and move toward becoming a sustainable green campus. The study serves as a practical model for effective waste management in higher educational institutions.


By

- Ms. Maheswari E
- Mr. Regupathiraja J
- Mr. Harishkumar S
- Ms. Moovanthika G

**BE- IV YEAR / CIVIL**

# 8. DESIGN CONCEPT OF A WET SCRUBBER DUST COLLECTOR FOR TEMPERATURE REDUCTION AND AIR SEDIMENTATION PROCESS




**Abstract**

Industrial activities such as construction, mining, cement production, and material handling generate large quantities of dust and hot exhaust gases that adversely affect air quality and worker health. Wet scrubber dust collectors are effective pollution control devices that simultaneously remove particulate matter and reduce the temperature of contaminated air streams. This article presents the design concept of an innovative wet scrubber dust collector that integrates temperature reduction and air sedimentation processes within a single system. The proposed design utilizes water spray nozzles to cool hot air and capture airborne particles through impaction and absorption mechanisms. A sedimentation chamber is incorporated to enhance particle settling and improve collection efficiency. The system is designed to reduce dust concentration, improve workplace safety, minimize environmental pollution, and comply with emission standards. The study discusses the working principle, design parameters, operational methodology, advantages, and potential applications of the proposed system in industrial and construction environments.

## 1. Introduction

Airborne dust particles generated from industrial operations pose significant environmental and health concerns. High-temperature exhaust gases further contribute to air pollution and equipment degradation. Conventional dust collection systems often focus solely on particulate removal without addressing thermal pollution. Wet scrubber technology offers an integrated solution by using water as a medium for both cooling and particle capture. The proposed design aims to improve air quality while reducing exhaust temperature through an efficient sedimentation-assisted wet scrubbing process.

## 2. Objectives

- ❖ To reduce dust concentration in industrial exhaust streams.
- ❖ To lower the temperature of hot air emissions.
- ❖ To enhance particulate removal efficiency through sedimentation.
- ❖ To develop a cost-effective and environmentally friendly pollution control system.
- ❖ To improve worker safety and regulatory compliance.

## 3. Methodology

### Phase 1: Problem Identification

- ❖ Study dust generation sources in industrial and construction environments.
- ❖ Analyze the effects of high-temperature exhaust gases on air quality.

**Phase 2: System Design**

The proposed wet scrubber consists of:

1. Air Inlet Duct
2. Spray Chamber
3. Water Nozzle System
4. Sedimentation Chamber
5. Mist Eliminator
6. Water Collection Tank
7. Recirculation Pump
8. Clean Air Outlet

**Phase 3: Working Principle**

*Step 1: Hot Dust-Laden Air Entry*

Contaminated air enters the scrubber through the inlet duct.

*Step 2: Water Spray Cooling*

High-pressure nozzles spray fine water droplets into the airflow. Heat transfer occurs between the hot air and water droplets, reducing air temperature.

*Step 3: Dust Particle Capture*

Dust particles collide with water droplets through:

- Inertial Impaction
- Interception
- Diffusion
- Absorption

*Step 4: Sedimentation Process*

The air-water mixture enters a sedimentation chamber where heavier dust-water agglomerates settle due to gravity.

*Step 5: Mist Elimination*

A mist eliminator removes remaining water droplets from the cleaned air stream.

*Step 6: Clean Air Discharge*

Treated air is released into the atmosphere through the outlet stack.

**Phase 4: Water Recirculation**

Settled sludge is collected at the bottom while clarified water is recirculated through the pump, reducing water consumption.

**4. Design Considerations**

| Parameter | Typical Range |
|---|---|
| Air Flow Rate | 1000–5000 m³/hr |
| Operating Temperature | 40–250°C |
| Water Flow Rate | 5–20 L/min |
| Dust Removal Efficiency | 85–99% |
| Pressure Drop | 100–500 Pa |
| Sedimentation Time | 30–120 seconds |

**5. Expected Results**

- Reduction of exhaust temperature by 30–60%.
- Dust removal efficiency above 90%.
- Improved ambient air quality.
- Reduced worker exposure to repairable dust.
- Lower environmental impact and regulatory compliance.

## 6. Applications

- Cement Industries
- Construction Sites
- Stone Crushers
- Thermal Power Plants
- Foundries
- Mining Operations
- Metal Processing Industries
- Waste Incineration Facilities

## 7. Advantages

- Simultaneous cooling and dust removal.
- High collection efficiency for fine particles.
- Reduced fire and explosion risks.
- Lower maintenance cost.
- Water recirculation minimizes resource consumption.
- Environmentally sustainable operation.

## 8. Future Scope

Future developments may include integration of:

- IoT-based monitoring systems
- AI-driven control algorithms
- Automated sludge removal systems
- Solar-powered recirculation pumps
- Smart sensors for real-time emission analysis

## Conclusion

The proposed wet scrubber dust collector integrates temperature reduction and air sedimentation into a single pollution control system. By combining water-based cooling, particulate capture, and gravitational settling mechanisms, the design provides an efficient and sustainable solution for industrial air pollution management. Its adaptability, high efficiency, and environmental benefits make it a promising technology for future industrial applications.

**By**

- Ms. Venila E
- Mr. Kiruthicrosan S
- Mr. Sivaranjan K
- Mr.Dhanushkumar S

**BE- IV YEAR / CIVIL.**