Walchand Institute of Technology, Solapur
(An Autonomous Institution)
Department of Civil Engineering Organizes

‘Civil WITchar- 2026’

Name of Event: - Innoverse (Problem Solver)

1. The student shall submit Solutions / Design/ Ideas for the following topics
   - Identification and mitigation of landslide-prone zones along hill roads using Remote Sensing and GIS
   - Optimization of Public Transport Corridors using Intelligent Transportation Systems (ITS) and Data-driven Planning.
   - Planning and Design of Green, Energy-Efficient, and Sustainable Buildings Using Integrated Smart Technologies.
   - Advanced Construction Methods and Processes.
   - Smart and Sensor Enabled Infrastructure for Cities
2. Maximum participants: 2 per team
3. Registration fees: Rs. 300/- per team
4. Permissible time for presentation- 7 minutes followed by questions and answers
5. PPT shall contain a maximum of 20 slides
6. Bring two hard copies of slides/presentation
7. For all Communications, include the group name as a part of the subject

For Details Contact:

Faculty Event Coordinator- Dr. S. K. Kulkarni (9561568456)

Student Coordinators- Mr. Atharava Dixit (TY Civil)- 8010817501 & Miss. Hegade Asmita Ranjit (SY Civil)-9404599788

➢ **Problem Statement-1-** Development of Low-Carbon Concrete Mixes using Industrial By-Products for Sustainable Infrastructure

(A) Low-Carbon Material Innovation

- Replace traditional Ordinary Portland Cement (OPC) with industrial by-products like **Fly Ash, GGBS, Silica Fume**, or **Recycled Glass Powder**.
- Focus on a **"Circular Economy"** model that repurposes industrial waste to lower the carbon intensity of concrete mixes.

(B) Infrastructure Reinforcement

- Incorporate **geosynthetics** such as geogrids, geocells, or geotextiles to improve tensile strength and soil stability.
- Utilize **recycled plastic fibers** to enhance crack resistance and the structural longevity of the infrastructure.

(C) Sustainable Alternatives

- Explore biodegradable reinforcements like **Coir, Jute, or Bamboo-based** materials for erosion control and slope stabilization.
- Analyze how these natural bio-materials can serve as eco-friendly options in sensitive environmental zones.

(D) Performance & Engineering Standards

- Ensure the integrated system meets strict engineering standards for **compressive strength** and **permeability**.
- Test the resistance of new mixes to environmental degradation and chemical stress.

(E) Environmental Impact Analysis

- Quantify the reduction in greenhouse gas emissions compared to traditional concrete production.
- Assess the minimization of the depletion of natural aggregates through the use of waste materials.

(F) Target Outcome & Scalability

- Deliver a comprehensive design for **"Green Infrastructure"** that is both scalable and cost-effective.
- Provide a roadmap for applying these low-carbon technologies to modern civil engineering projects.

Problem Statement-2- Identification and Mitigation of Landslide-Prone Zones Along hill Roads using Remote Sensing and GIS

- **(A) Data Integration & Mapping**
  - Utilize satellite imagery and **Digital Elevation Models (DEM)** to identify slope steepness, aspect, and curvature.
  - Reference historical landslide inventories to understand past hazard patterns in specific terrains.
- **(B) Thematic Layer Analysis**
  - Overlap GIS layers including geological formations, soil types, and **Land Use/Land Cover (LULC)**.
  - Determine the influence of drainage patterns on overall slope stability.
- **(C) Trigger Factor Assessment**
  - Incorporate dynamic data such as **rainfall intensity (TRMM/GPM data)** and seismic activity.
  - Analyze anthropogenic factors like road cutting and deforestation that destabilize hill roads.
- **(D) Susceptibility Zonation**
  - Develop a **Landslide Hazard Zonation (LHZ)** map categorizing road segments into low, moderate, and high-risk zones.
  - Apply statistical or machine learning models to predict potential failure points.
- **(E) Mitigation Planning**
  - Propose engineering solutions like retaining walls and specialized drainage systems for "hotspots".
  - Integrate biological solutions such as bio-engineering and geosynthetics for natural slope stabilization.
- **(F) Target Outcome & Safety**
  - Design an intelligent spatial decision-support system to prioritize maintenance and implement timely evacuations.
  - Minimize the socio-economic impact of landslide events through safer road alignment designs.

Problem Statement-3- Planning of a Green & Energy-Efficient Sustainable Building Design

- **A) Passive Design Strategy**
  - Optimize building orientation and window-to-wall ratios to maximize natural lighting.
  - Utilize natural ventilation and the **"stack effect"** to reduce artificial heating and cooling needs.
- **(B) Net-Zero Energy Integration**
  - Incorporate **Building-Integrated Photovoltaics (BIPV)** and small-scale wind turbines.
  - Utilize geothermal heat pumps to achieve energy self-sufficiency for the structure.
- **(C) Smart Building Management**
  - Use **IoT-based sensors** and AI to automate lighting, HVAC, and water usage.
  - Adjust building systems in real-time based on occupancy levels and external weather conditions.

- **(D) Sustainable Material Selection**
  - Prioritize materials with low embodied energy, such as **cross-laminated timber (CLT)** and recycled steel.
  - Integrate low-carbon concrete mixes into the primary structural design.
- **(E) Water Conservation & Reuse**
  - Design systems for **rainwater harvesting** and greywater recycling for landscaping purposes.
  - Install low-flow plumbing fixtures to minimize the building's overall water footprint.
- **(F) Indoor Environmental Quality (IEQ)**
  - Ensure thermal comfort and air quality using non-toxic materials and biophilic **"living walls"**.
  - Establish a blueprint that significantly outperforms traditional building codes for carbon-neutral development

Problem Statement-4- Advanced Construction Methods & Processes

- **(A) 3D Concrete Printing (3DCP)**
  - Explore additive manufacturing to create complex structural elements directly from digital files.
  - Reduce material waste and formwork usage while enabling greater architectural freedom.
- **(B) Modular & Off-site Manufacturing**
  - Design **Pre-fabricated Volumetric Construction (PPVC)** systems for factory-based manufacturing.
  - Focus on rapid on-site assembly to drastically cut down traditional construction timelines.
- **(C) Robotics & Automation**
  - Integrate robotic systems for hazardous tasks like **autonomous masonry** and rebar tying.
  - Utilize **exoskeletons** to enhance worker safety and improve manual lifting capacity.
- **(D) Digital Twin & BIM Integration**
  - Use **Building Information Modeling (BIM)** to simulate the construction process before breaking ground.
  - Detect design "clashes" and manage **4D (time) and 5D (cost)** project aspects efficiently.
- **(E) Smart Quality Control**
  - Implement **AI-powered computer vision** and scanners to monitor site progress in real-time.
  - Compare the physical build against digital designs to ensure zero-defect construction.
- **(F) Target Outcome & Efficiency**
  - Develop a roadmap to reduce "design-to-delivery" time by **30-50%**.
  - Apply these solutions to both mass housing and complex infrastructure projects

Problem Statement-5- Smart & Sensor Enabled Infrastructure

- **(A) Real-Time Structural Monitoring**
  - Utilize **Accelerometers, Strain Gauges, and Piezoresistive sensors** for continuous monitoring.
  - Detect cracks, vibrations, or stress levels in critical assets like bridges and dams.
- **(B) Environmental & Load Sensing**
  - Integrate sensors to track traffic load, temperature fluctuations, and moisture levels.
  - Monitor long-term material degradation caused by external environmental factors.
- **(C) Wireless Data Acquisition**
  - Develop low-power networks using **LoRaWAN, NB-IoT, or 5G** for remote data transmission.
  - Centralize data collection into a cloud dashboard for easy access by engineers.
- **(D) Predictive Analytics**
  - Use AI and Machine Learning to identify patterns indicating potential structural fatigue.
  - Transition from manual inspections to automated predictions of infrastructure failure.
- **(E) Emergency Response Integration**
  - Design automated triggers to alert authorities or shut down access during earthquakes or floods.
  - Ensure data-driven decision-making during critical safety events.
- **(F) Target Outcome & Asset Lifespan**
  - Create a functional architecture for a **"Self-Sensing"** infrastructure system.
  - Increase the lifespan of public assets while significantly reducing long-term maintenance costs.

6. AI in Material Science and Testing

- AI-Based Material Selection – AI recommends sustainable and cost-effective construction materials.
- AI in Concrete Mix Design – AI optimizes concrete mixtures for durability and eco-friendliness.
- Non-Destructive Testing (NDT) – AI analyzes material defects using ultrasonic and infrared techniques.

Problem Statement-6-Optimization of public transport corridors Using Intelligent transportation systems and data driven planning

- **(A) Real-Time Data Integration**
  - Utilize data from **GPS-enabled Transit Vehicles** and **Automated Fare Collection (AFC)** systems.
  - Analyze passenger flow and vehicle positions in real-time using mobile GPS pings.
- **(B) Intelligent Routing & Scheduling**
  - Develop **Dynamic Scheduling** algorithms to deploy extra vehicles during sudden demand spikes.
  - Adjust routes in real-time to bypass temporary road bottlenecks or construction zones.
- **(C) Commuter Information Systems**
  - Design a dashboard providing commuters with accurate **Estimated Time of Arrival (ETA)**.
  - Implement "Bus Fullness" indicators based on live occupancy sensors for better trip planning.
- **(D) Signal Priority & Optimization**
  - Propose **Bus Signal Priority (BSP)** strategies where traffic signals prioritize public transit vehicles.
  - Use AI-linked sensors to adjust major intersections and reduce corridor delays.
- **(E) Infrastructure & Transit Deserts**
  - Use GIS-based heatmaps to identify underserved areas known as **"Transit Deserts"**.
  - Suggest optimal locations for new transit hubs or "First and Last Mile" connectivity like e-scooters.
- **(F) Target Outcome & Ridership**
  - Create a scalable transit model that makes public transport more reliable and time-efficient.
  - Reduce private vehicle usage to lower urban carbon emissions and traffic congestion.