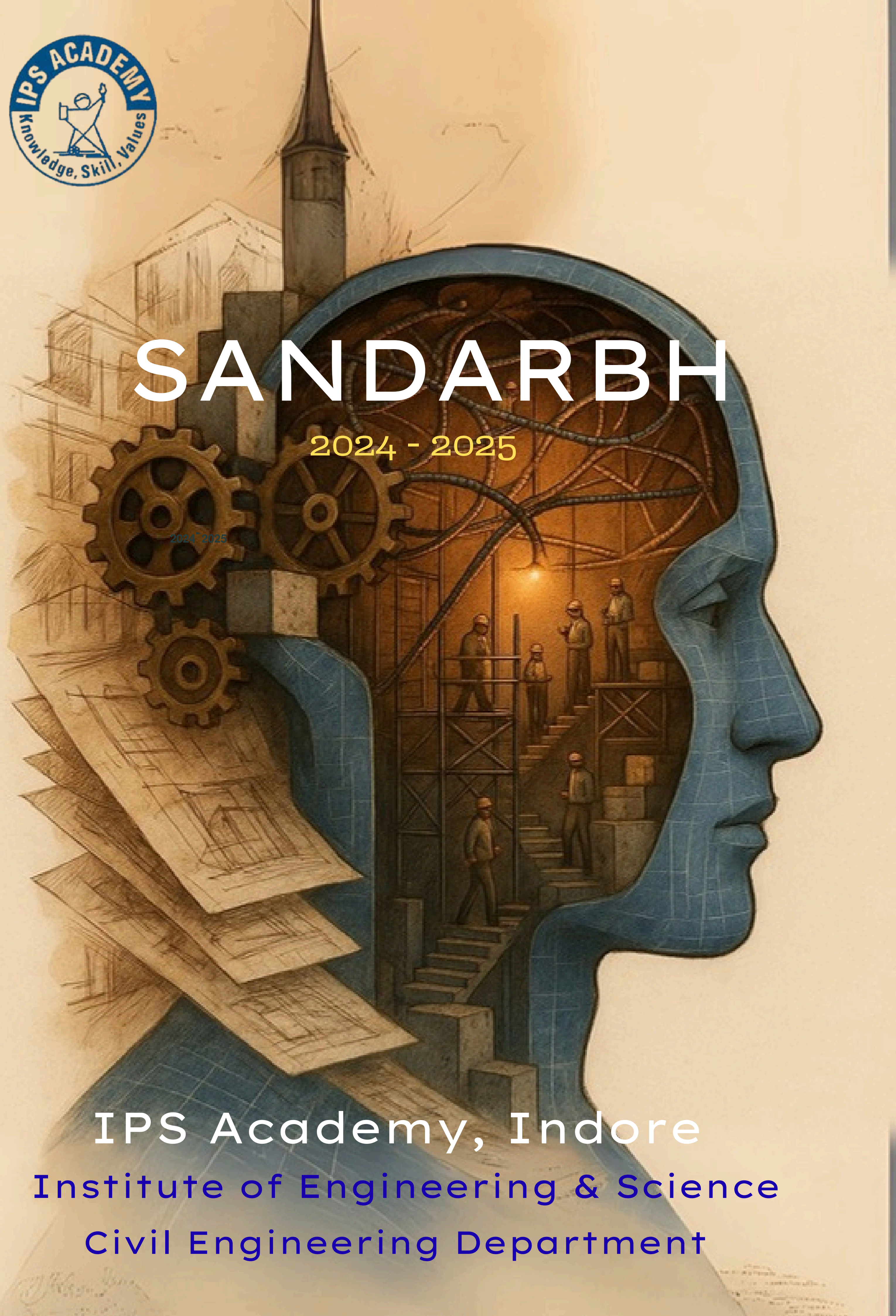

SANDARBH

2024 - 2025

IPS Academy, Indore

Institute of Engineering & Science

Civil Engineering Department

Minds behind THE MAGIC

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Mr. Dhruv Kanhua

CONTENTS

From the Principal

It is a great pleasure to see the creative expressions of students who had contributed to Sandarbh. Civil Engineering Department has grown abundantly in the recent past. It continues to sustain its growth. People reading this magazine will realize the tremendous changes that are happening in the Department. The magazine is presenting a glimpse of the growth of the Department on many fronts. The Department has been simply unstoppable in its progress as it has been actively involved in various activities that have brought to light the hidden talents of the students and staff. The highly qualified and dedicated members of staff have always stood shoulder with the management and of commitment. This magazine has recorded achievements such as: conferences attended by staff members and students, competitions won by the hugely talented students, innovative projects carried out by students with the guidance of staff, among others. They stand as a witness to the monumental efforts taken by the management to make the college a centre of excellence in education and research. I wish the management, staff and students of the college success in their future endeavors.

Dr. Archana Keerti Chowdhary Principal

From the HOD

It has given enormous gratification to coordinate the editorial team of ―SANDARBH , our Civil Engineering Department magazine in all aspects, covering academic activities, technical events of the magazine. This magazine would not have been concluded without the constant support of our principal who stood as a pillar of strength and support at all times. We would genuinely place thanks to our editorial team whose dedication and diligent towards completion of magazine was always part of the process. We would like to congratulate and express our hearty thanks and gratitude to our head of the department in believing the quality policy of educate enrich and excel in imparting professional education. This magazine is reflecting of our department quality in terms of all round excellence. Last but not the least we want to faculty members who gave constant support and guidance to enlighten young minds of the people through this magazine.

Dr. Amit Sharma

Vision

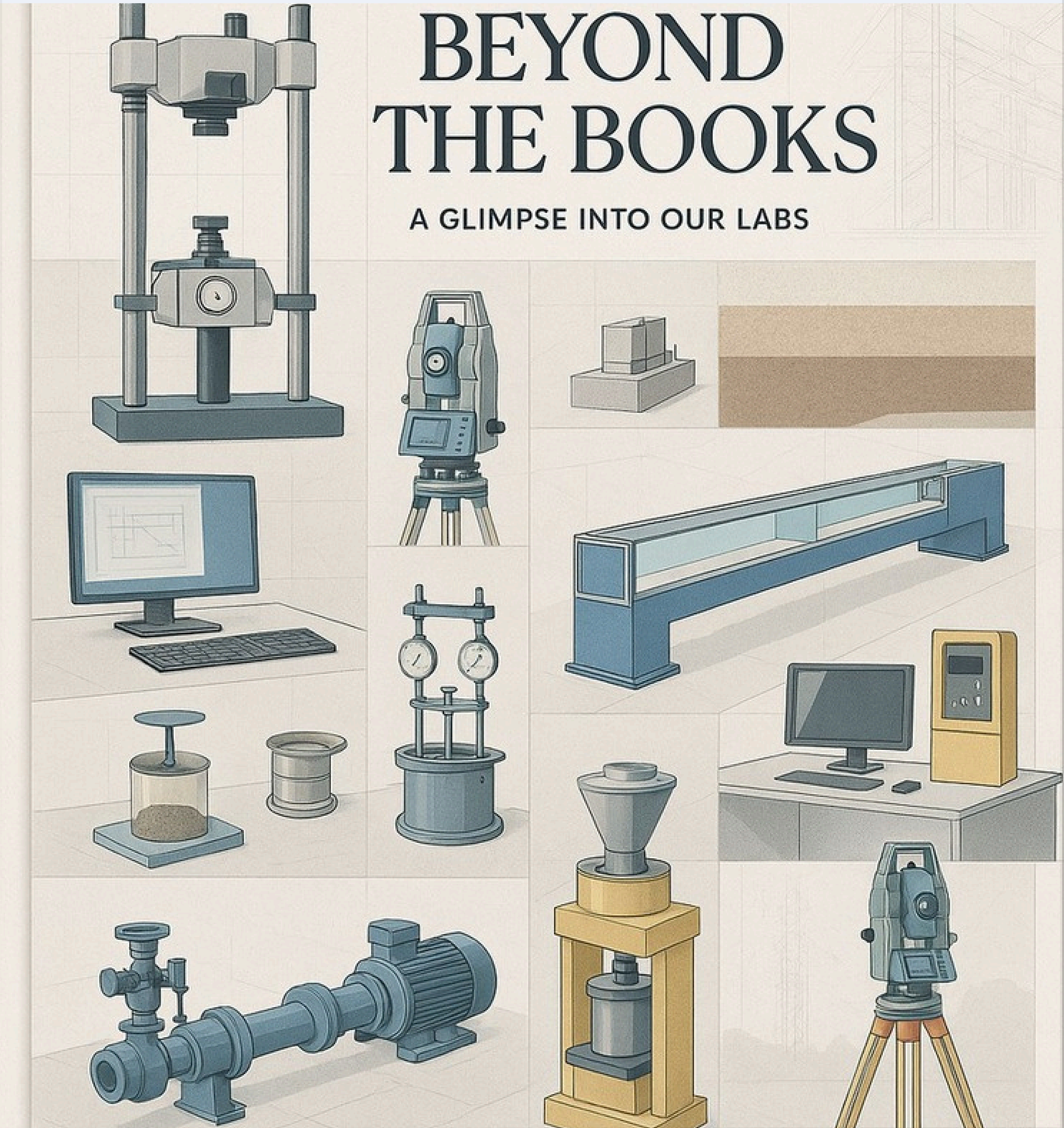
Be the preferred destination locally, regionally and internationally for the Civil Engineering society as a leading department providing high quality programs and services in Civil Engin--eering fields.

Mission

M1. To offer value based education to meet global standards to the students to develop their professional skills.

M2. To inculcate a spirit of entrepreneu--rship and innovation in students so that they can better serve the society.

M3. To prompt sponsored research and provide Testing/Consultancy services in Civil Engineering fields for society.


BEYOND
THE BOOKS
A GLIMPSE INTO OUR LABS

Existing Laboratories

1. Engineering Mechanics Lab
2. Strength of Material Lab
3. Structures Lab
4. Transportation Lab
5. Geotechnical Engineering Lab
6. Engineering Geology Lab
7. Fluid Mechanics & Machinery Lab
8. Environmental Engineering Lab
9. Materials Testing Lab
10. Survey Lab
11. Instrumentation Lab
12. Computer Lab
13. Software Lab
14. Heavy Structural Lab

Major Softwares Available

CIVIL 3D
PRIMAVERA
ANSYS SAP 2000 GMS 6.5 Abaqus 6.12 LS-DYNA
MIDAS-Gen

Major Equipments Available

Total Station
UTM & CTM
Pumps & Turbines
Benkingum Beam
Bituminous testing apparatus
Plate Load test apparatus
SCPT
DCPT
CBR
FFT ANALYSER
DATA LOGER
POLARISCOPE

MAJOR EQUIPMENT

Weather Station

Total Station

UTM &CTM

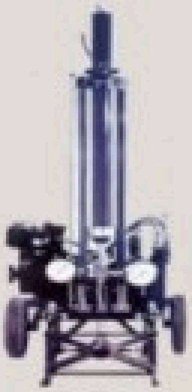
CBR Test Apparatus

Pumps and Turbines

Bituminous Testing Apparatus

Polariscope

DCPT



SCPT

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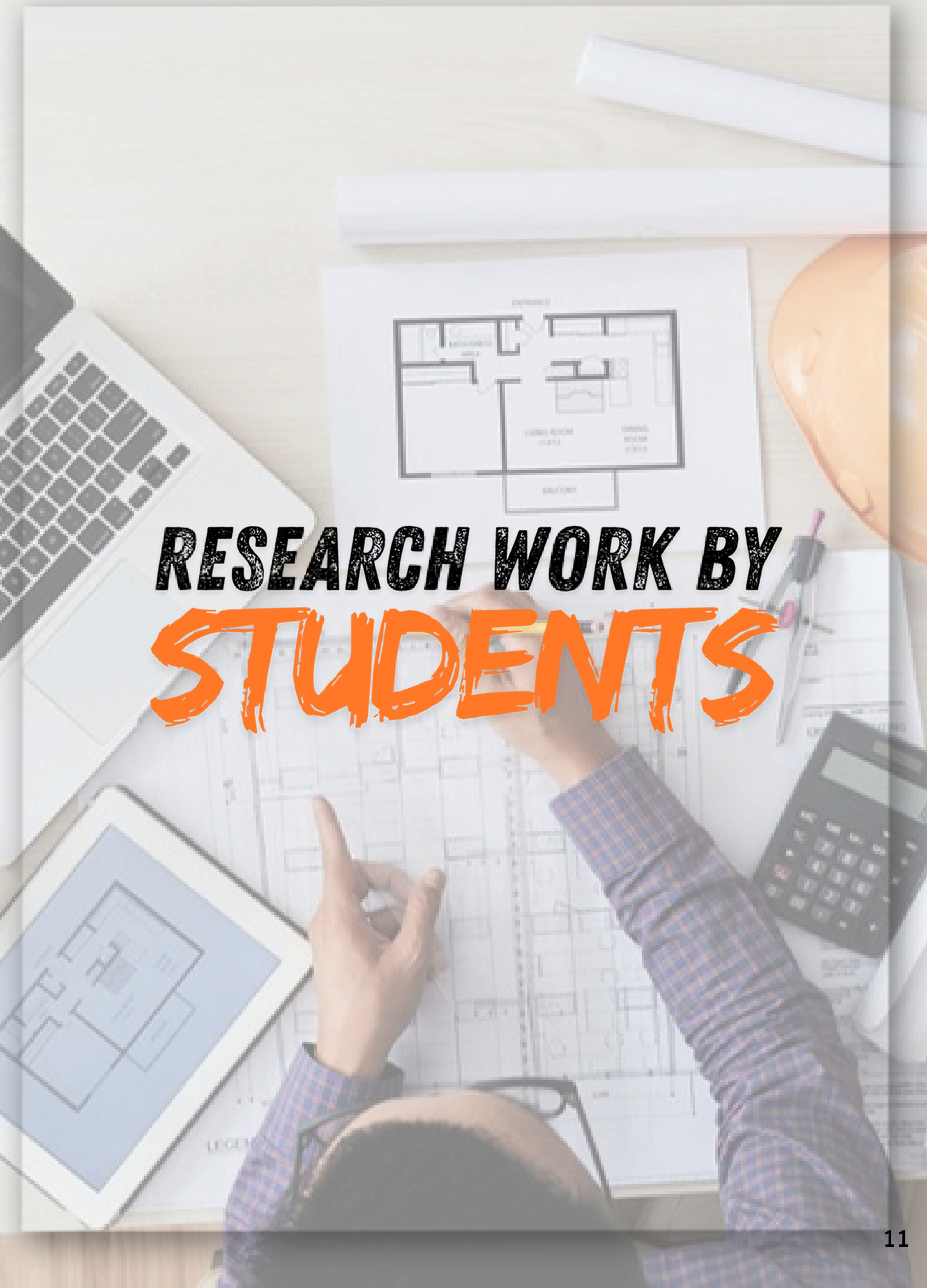

RESEARCH WORK BY STUDENTS

INTEGRATED WETLAND AND GROUNDWATER MANAGEMENT

Mahendra Singh Thakur (0808CE221013), Department of Civil Engineering IPS Academy,
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Abstract: *Effective management of wetlands and groundwater resources is crucial for maintaining ecosystem health, ensuring water security, and supporting human well-being. However, traditional management approaches often focus on individual components of the water cycle, neglecting the interconnectedness of wetlands and groundwater. This study presents an integrated approach to managing wetlands and groundwater, using the Sirpur Lake wetland.*

INTRODUCTION

Wetlands and groundwater are two interconnected components of the water cycle that play critical roles in maintaining ecosystem health, ensuring water security, and supporting human well-being. Wetlands, which include marshes, swamps, and lakes, provide numerous ecosystem services, including water filtration, flood control, and habitat creation. Groundwater, which accounts for approximately 22% of the world's freshwater resources, supplies drinking water, irrigates crops, and supports industrial activities.

Despite their importance, wetlands and groundwater resources are facing numerous threats, including climate change, land use alteration, and over-extraction. Climate change is altering precipitation patterns, leading to changes in wetland water levels and groundwater recharge. Land use alteration, such as the conversion of natural habitats to agricultural land or urban areas, is reducing wetland areas and altering groundwater flow paths. Over-extraction of groundwater is causing land subsidence, reducing water tables, and increasing the risk of water scarcity.

Traditional management approaches have often focused on individual components of the water cycle, neglecting the interconnectedness of wetlands and groundwater. This has led to a lack of coordination and integration in management decisions, resulting in suboptimal outcomes for ecosystem health and water security. In recent years, there has been a growing recognition of the need for integrated management approaches that consider the interactions between wetlands and groundwater.

This study aims to contribute to the development of integrated wetland and groundwater management approaches by investigating the hydrological and ecological interactions between a wetland and an aquifer system. The specific objectives of the study are to:

1. Investigate the hydrological interactions between the wetland and aquifer system.

2. Evaluate the ecological implications of different management scenarios on the wetland and aquifer system.

3. Develop an integrated management framework for the wetland and aquifer system.

OBJECTIVES

1: Investigating the Hydrological Interactions between the Wetland and Aquifer System

This objective aims to understand the complex hydrological relationships between the wetland and aquifer system. Specifically, the study will:

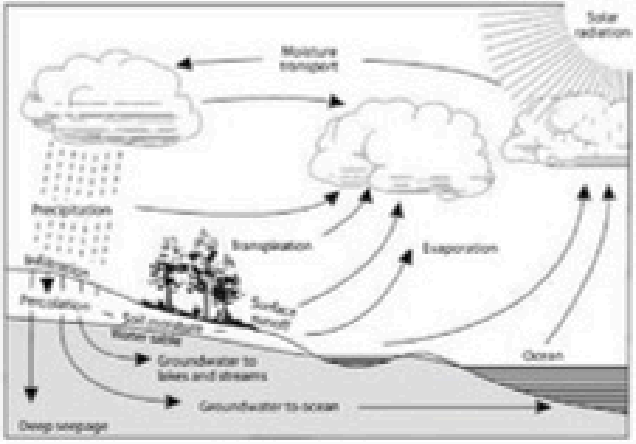
<u>1.1 Characterize the Hydrological Processes</u>

- Precipitation: Investigate the precipitation patterns and amounts in the study area, including the frequency and intensity of rainfall events.

- Evapotranspiration: Evaluate the evapotranspiration rates from the wetland and surrounding vegetation, including the effects of temperature, humidity, and wind.

- Infiltration: Investigate the infiltration rates and processes in the wetland and surrounding soils, including the effects of soil type, moisture content, and vegetation.

- Groundwater Flow: Evaluate the groundwater flow patterns and rates in the aquifer system, including the effects of hydraulic conductivity, storativity, and boundary conditions.



1.2 Quantify the Water Balance

- Water Balance Equation: Develop a water balance equation that accounts for all the inputs, outputs, and storage changes in the wetland and aquifer system.

- Precipitation and Evapotranspiration: Quantify the precipitation and evapotranspiration components of the water balance, including the effects of climate variability and change.

- Surface and Subsurface Flow: Evaluate the surface and subsurface flow components of the water balance, including the effects of infiltration, runoff, and groundwater flow.

- Storage Changes: Investigate the storage changes in the wetland and aquifer system, including the effects of water level fluctuations, soil moisture changes, and groundwater storage.

1.3 Analyze the Groundwater Recharge

- Recharge Mechanisms: Investigate the mechanisms of groundwater recharge from the wetland, including the effects of infiltration, percolation, and preferential flow.

- Recharge Rates: Evaluate the rates of groundwater recharge from the wetland, including the effects of precipitation, evapotranspiration, and soil moisture.

- Recharge Areas: Identify the areas of the wetland that contribute most to groundwater recharge, including the effects of land use, land cover, and soil type.

1.4 Evaluate the Impacts of Climate Change

- Climate Change Scenarios: Develop climate change scenarios that reflect different projections of temperature, precipitation, and evapotranspiration changes.

- Impacts on Hydrological Processes: Evaluate the impacts of climate change on the hydrological processes in the wetland and aquifer system, including the effects on precipitation, evapotranspiration, infiltration, and groundwater flow.

- Impacts on Water Balance: Investigate the impacts of climate change on the water balance of the wetland and aquifer system, including the effects on storage changes, surface and subsurface flow, and groundwater recharge.

2: Evaluating the Ecological Implications of Different Management Scenarios on the Wetland and Aquifer System

This objective aims to evaluate the ecological implications of different management scenarios on the wetland and aquifer system. Specifically, the study will:

2.1 Develop Ecological Scenarios

- Scenario Development: Develop a range of ecological scenarios that reflect different management strategies, including changes in water levels, flow rates, and water quality.

- Scenario Parameters: Identify the key parameters that define each scenario, including the effects on vegetation, wildlife habitats, and ecosystem processes.

2.2 Assess the Impacts on Wetland Ecosystems

- Vegetation Response: Evaluate the response of wetland vegetation to different management scenarios, including the effects on species composition, diversity, and biomass.

- Wildlife Habitat Response: Investigate the response of wildlife habitats to different management scenarios, including the effects on habitat quality, quantity, and connectivity.

- Ecosystem Process Response: Assess the response of ecosystem processes to different management scenarios, including the effects on nutrient cycling, primary production, and decomposition.

2.3 Evaluate the Impacts on Groundwater-Dependent Ecosystems

- Groundwater-Dependent Ecosystems: Identify the ecosystems that are dependent on groundwater, including the effects on vegetation, wildlife habitats, and ecosystem processes.

- Impacts of Groundwater Changes: Evaluate the impacts of changes in groundwater levels, flow rates, and water quality on groundwater-dependent ecosystems.

2.4 Identify Ecological Thresholds

- Ecological Thresholds: Identify the ecological thresholds beyond which the wetland and aquifer system may experience significant and irreversible changes.

- Threshold Indicators: Develop indicators that can be used to monitor the approach of ecological thresholds, including the effects on vegetation, wildlife habitats, and ecosystem processes.

3: Developing an Integrated Management Framework for the Wetland and Aquifer System

This objective aims to develop an integrated management framework that considers the hydrological and ecological interactions between the wetland and aquifer system. Specifically, the study will:

3.1 Develop a Conceptual Model

- Conceptual Model: Develop a conceptual model that integrates the hydrological and ecological components of the wetland and aquifer system.

- Model Parameters: Identify the key parameters that define the conceptual model, including the effects on water balance, ecosystem processes, and ecological thresholds.

3.2 Identify Management Objectives

- Management Objectives: Identify the management objectives for the wetland and aquifer system, including ecological, hydrological, and social objectives.

- Objective Hierarchy: Develop a hierarchy of management objectives, including primary, secondary, and tertiary objecti

3.3 Develop Management Scenarios

- Management Scenarios: Develop a range of management scenarios that reflect different management strategies, including changes in water levels, flow rates, and water quality.

- Scenario Evaluation: Evaluate the effectiveness of each management scenario in achieving the management objective

3.4 Evaluate the Effectiveness of the Management Framework

- Management Framework Evaluation: Evaluate the effectiveness of the integrated management framework in achieving the management objectives and maintaining the ecological and hydrological integrity of the wetland and aquifer system.

- Framework Refinement: Refine the management framework based on the evaluation results, including the identification of areas for improvement and the development of new management strategies.

METHODOLOGY

The study combined field observations, remote sensing, and modelling techniques to investigate the hydrological and ecological interactions between the wetland and aquifer. A coupled surface water-groundwater model was developed to simulate the impacts of different management scenarios on wetland water levels, groundwater recharge, and ecosystem health.

Here are some sustainable methodologies for integrated wetland and groundwater management in civil engineering:

1. Green Infrastructure

- Permeable pavements: Design permeable pavements that allow rainwater to infiltrate and recharge groundwater.

- Green roofs: Implement green roofs that reduce stormwater runoff and provide habitat for wildlife.

- Rain gardens: Create rain gardens that capture and filter stormwater runoff, reducing the burden on drainage systems.

2. Wetland Restoration and Enhancement

- Wetland design: Design wetlands that mimic natural systems, including ponds, marshes, and swamps.

- Wetland restoration: Restore degraded or destroyed wetlands to maintain ecosystem services.

- Wetland enhancement: Enhance existing wetlands through the introduction of native vegetation, habitat creation, and hydrological restoration.

3. Groundwater Management Systems

- Artificial recharge systems: Design artificial recharge systems that replenish groundwater aquifers.

- Groundwater harvesting systems: Implement groundwater harvesting systems that collect and store rainwater for non-potable uses.

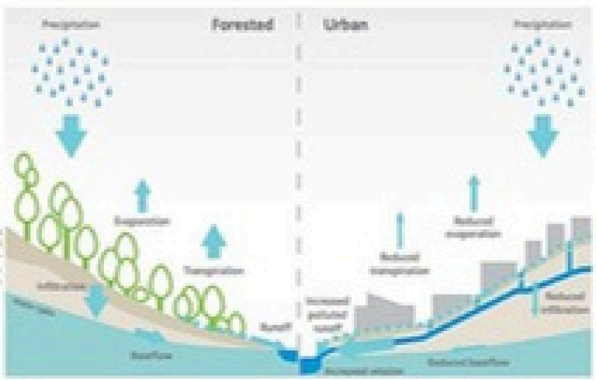
- Groundwater monitoring systems: Establish groundwater monitoring systems that track water levels, quality, and flow.

4. Water Sensitive Urban Design (WSUD)

- WSUD principles: Apply WSUD principles that prioritize water conservation, efficient use, and protection of water resources.

- Storm water management: Design storm water management systems that reduce runoff, increase infiltration, and protect water quality.

- Water-efficient appliances: Specify water-efficient appliances and fixtures in buildings to reduce water demand

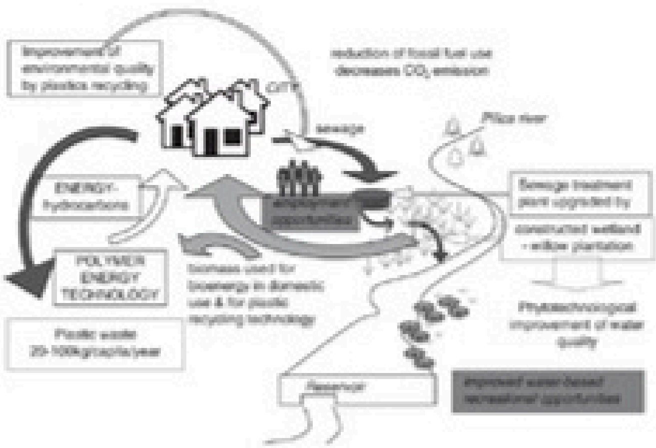


5. Ecohydrological Modeling and Analysis

- Ecohydrological models: Develop ecohydrological models that simulate the interactions between hydrological processes, vegetation, and wildlife habitats.

- Water balance analysis: Conduct water balance analysis to understand the interactions between surface water, groundwater, and wetlands.

- Sensitivity analysis: Perform sensitivity analysis to identify the most critical factors affecting the integrated wetland and groundwater system.



6. Adaptive Management and Monitoring

- Adaptive management framework: Establish an adaptive management framework that allows for flexibility and adjustment in response to changing environmental conditions.

- Monitoring programs: Develop monitoring programs that track water quality, quantity, and ecosystem health.

- Stakeholder engagement: Engage stakeholders in the decision-making process to ensure that management decisions reflect local needs and priorities.

7. Sustainable Materials and Technologies

- Sustainable materials: Specify sustainable materials in construction projects, such as recycled materials, low-carbon concrete, and sustainably sourced timber.

- Water-efficient technologies: Implement water-efficient technologies, such as grey water reuse systems and rainwater harvesting systems.

- Renewable energy systems: Incorporate renewable energy systems, such as solar and wind power, to reduce dependence on fossil fuels.

8. Integrated Water Resources Management (IWRM)

- IWRM principles: Apply IWRM principles that prioritize the integrated management of surface water, groundwater, and wetlands.

- Stakeholder participation: Encourage stakeholder participation in the decision-making process to ensure that management decisions reflect local needs and priorities.

- Water allocation planning: Develop water allocation plans that balance human and environmental needs, including water for irrigation, drinking water, and ecosystem maintenance.

Functions of wetland in Groundwater recharging

1. Infiltration and Percolation

- Infiltration: Wetlands allow rainwater and surface water to infiltrate into the soil, recharging groundwater aquifers.

- Percolation: Wetlands facilitate percolation, the downward movement of water through the soil profile, which helps to recharge groundwater.

2. Water Storage and Release

- Water storage: Wetlands can store water during periods of high rainfall or flooding, reducing peak flows and preventing erosion.

- Water release: Wetlands release stored water during dry periods, maintaining base flows in streams and rivers, and recharging groundwater.

3. Sediment Trapping and Filtration

- Sediment trapping: Wetlands trap sediments and particulate matter, preventing them from entering groundwater and maintaining water quality.

- Filtration: Wetlands filter water through vegetation, soil, and microorganisms, removing pollutants and improving water quality.

4. Aquifer Recharge and Discharge

- Aquifer recharge: Wetlands recharge groundwater aquifers through infiltration and percolation, maintaining aquifer levels and water quality.

- Aquifer discharge: Wetlands can also discharge groundwater into streams, rivers, and lakes, maintaining base flows and supporting aquatic ecosystems.

5. Hydrological Buffering

- Peak flow reduction: Wetlands reduce peak flows during heavy rainfall events, preventing erosion and flooding.

- Base flow maintenance: Wetlands maintain base flows during dry periods, supporting aquatic ecosystems and recharging groundwater.

6. Biogeochemical Processes

- Nutrient cycling: Wetlands cycle nutrients through vegetation, soil, and microorganisms, maintaining water quality and supporting aquatic ecosystems.

- Carbon sequestration: Wetlands sequester carbon through vegetation and soil, mitigating climate change.

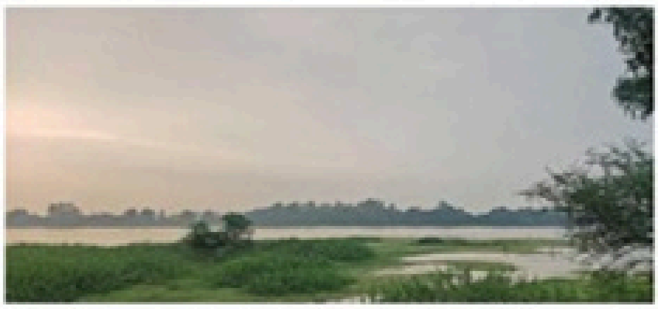
7. Ecological Connectivity

- Habitat creation: Wetlands create habitats for aquatic plants and animals, supporting biodiversity and ecological connectivity.

- Migration corridors: Wetlands provide migration corridors for aquatic species, maintaining ecological connectivity and supporting population dynamics.

Case Study: Sirpur Lake rejuvenation; Encroached lake to Ramsar Wetland –

The present study deals with the Sirpur Lake in Indore district situated in south west co Indore district. Sirpur Lake is said to be the gift of Holkar family to the city more than a hundred years ago which covers 600 acres in Indore Dhar highway, which was the natural habitat forbirds till the 80's and from where its decline began. The lake which comes under the Indore Municipal Corporation. Sirpur Lake is a fully secured water body and a safe bird habitat where migratory birds continue to come on their seasonal visits every year. Large birds like Greater Flamingo and Seniors Crane both visit Sirpur Lake. The flora & fauna of lake and tranquility of the place was just like manna from heaven to the visitors. But because of huge industrialization since from last few decades in the nearby area of lake will contributes much towards the contamination of water because of the harmful wastes coming from these industries containing so many toxic wastes along with them which directly or indirectly makes an impact on human health and also to the bird sanctuary lives in the vicinity of lake. Because of such industrialization it causes massive killing of fish since from last few decades and birds continue to decline from this lake. Therefore we need to protect the quality of lake water so that it can be used for different purposes like drinking, domestic, irrigation, industrial and Recreational purposes.



The People of Sirpur

Along with the growth and expansion of the city limits, Sirpur Lake also underwent a cycle of haphazard development and colonisation in its vicinity and surroundings. Today, an urban population of around one million lives around the lake and it is facing tremendous pressure from legal and illegal settlements within its catchment areas. For the last 28 years, The Nature Volunteers (an NGO formed by Indore's passionate environmentalists) has been working tirelessly for the conservation of Sirpur Lake. The NGO organises regular programmes and initiatives to increase awareness about the wetland and its importance, such as water conservation awareness drives, biodiversity conservation workshops, birdwatching camps, water testing drives and bird count surveys, to name a few. The relentless efforts of The Nature Volunteers have generated genuine awareness amongst locals and state residents. Today, communities around the lake have joined hands with the NGO and the government to restore the lake to its former glory. The Ramsar Site designation for Sirpur Wetland is a result of their work with the Environmental Planning & Coordination Organisation (EPCO) and Indore Municipal Corporation (IMC). A significant step that will come to the rescue of all the birds, butterflies, reptiles, amphibians and mammals that call this wetland home.

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- Nature Volunteers NGO Members
- Indore Municipal Corporation

Integrating Nature in Flood Risk Management

Case Studies in Flood Risk Reduction with Ecosystem-Based Solutions

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Abstract: Flood risk is an ever-growing challenge given rapid urbanization and climate change. Traditional infrastructure—such as concrete channels and levees—often provides short-term solutions but may lack the adaptability, ecological benefits, and community value needed for long-term resiliency. In contrast, Nature-Based Solutions (NBS) harness natural processes and ecosystem functions to manage floods sustainably while delivering multiple socio-economic and environmental benefits. This case study includes multiple cities which have implemented or conducted research on Nature Based Solutions for flood risk management

1. INTRODUCTION

Nature-based solutions (NBS) are well established as an approach that responds to the needs of climate change , the threats of biodiversity loss and broader issues such as u. Associated expectations emerge from definitions of NBS, which constitute 'actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits. The focus of NBS is on 'win-win' solutions for tackling climate change, biodiversity loss and society, representing an eye-catching approach, but one with significant knowledge gaps around effective indicators of success and systematic assessment.

In literature on flood risk management (FRM), debates have focused on the efficacy and multiple benefits of NBS both in contrast and complementary to conventional, engineered forms of flood interventions. Less well-documented is how different FRM practitioner's attitudes extend to two forms of NBS: Natural Flood Management (NFM) and Sustainable Drainage Systems (SuDS). NFM is based upon the principle that, instead of locally defending floodplains from inundation, it is possible to manipulate river flow at the catchment-scale to reduce downstream inundation

Nature-Based Solutions are strategies that use natural processes and ecosystem functions to reduce flood risks. Instead of relying solely on conventional "grey" infrastructure (like concrete channels and levees), NBS work with nature to store, slow, and filter water before it causes damage.

Core Concepts:

- Mimicking Natural Systems: NBS replicate and restore processes such as water infiltration, evapotranspiration, and natural storage provided by vegetation and soils.
- Multi-functionality: These solutions provide additional benefits such as improved air quality, enhanced biodiversity, urban cooling, and recreational space.
- Sustainability and Adaptability: As they are based on living systems, many NBS can adapt to changing conditions, making them inherently resilient to climate change.

2. Key NBS Approaches for Flood Risk Management

2.1 Urban NBS: Urban settings face unique challenges due to impervious surfaces and high population density. Several innovative approaches can mitigate urban flooding:

➢ Green Roofs: Vegetated surfaces on roofs absorb and delay runoff, reduce building energy demands, and transform unused roof spaces into green oases.
Green roofs, sometimes known as living roofs, are building rooftops that are partially or completely covered with vegetation. They typically comprise a multi-layered system that includes a waterproof membrane, drainage layers, a growing medium (soil substitute), and the vegetation itself. When rainfall occurs, the vegetation on a green roof captures a

significant portion of the water before it even reaches the structure's surface. Leaves, branches, and other plant parts act like a natural umbrella, intercepting raindrops.

During a precipitation event, GR systems intercept rainwater, which allows its infiltration into the growing substrate, promoting its storage in the drainage layer. After reaching saturation capacity, the excess water that precipitated into the system will run off into the urban drainage systems, or evaporate due to vegetation evapotranspiration. As such, GR system design is extremely important and must pay attention to the climate characteristics of the region. This will limit the vegetation species that can be installed and reach healthy development, as well as the materials used for the growing substrate and drainage layer disposal, giving preference for materials with high water-retention capacity

Green Roofs (GR) help with heavy rainfall events, reducing the risk of peak water flow and flood events that arise in urban areas through water harvesting and retention in their structure, thus reducing the pressure on the city water management systems.

Unlike many ground-level sustainable drainage strategies, the great advantage of GRs is that they do not require additional land besides that of the building where they will be implemented. In highly urbanized areas, rooftops cover almost 40–50% of impermeable surface area, which is an area not used and could thus be taken advantage of to improve on-site source reduction stormwater management and to increase the permeable surface area. The reported study by Brandão et al. 2017 described that if 75% of Lisbon's city roofs were covered by vegetation, then a maximum of 224,000 m3 of rainwater could be stored, helping the sewage systems deal with intense precipitation events and thus preventing floods.

Full-scale GR studies have reported that mean rainwater retention is dependent on multiple aspects such as local climatic situations (air temperature, days of antecedent dry weather and precipitation events' pattern and intensity). Usually, a higher retention of precipitation volume is observed in low-intensity rainfall events of moderate duration, which is opposed to a lower precipitation retention volume for heavy events

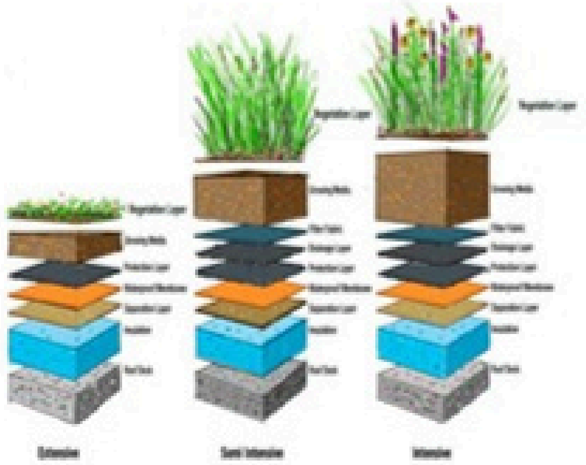


Figure 1: Structures of various green roof installations.

- Rain Gardens and Bioswales: Bioretention, also called "rain gardens or bioswales", is defined as a practice that allows infiltration with the main goal of decreasing total runoff, storing part of the water, contributing thus to subsurface flow recharge.

These shallow, landscaped depressions collect, filter, and slowly release stormwater. They also help in pollutant removal and groundwater recharge. Rainwater is directed into the garden where it is stored in the shallow depression.

Various studies have reported bioretention performance in improving watershed hydrology. Bioretention systems typically holds water only during and following a rainfall event, being dry most of the time. Compared to a conventional lawn, bioretention systems allow for 30% more water infiltration into the ground. Batalini de Macedo et al. 2019 reported average efficiencies of 70% for a bioretention system.

It has been described that the hydrological performance of a vegetated swale to increased storm events is similar to the traditional catchment system, reaching thus a limit above which the bioretention swale was unsuccessful. This response shows that for rain events of a high intensity and magnitude, several solutions (New and Old) should work together to accomplish the defined hydrology goals for the management system

Peak flow delay and reduction and a decrease in runoff volume are other important hydrological benefits reported in bioretention systems' performance, depending mainly on the system design. It has been reported that higher substrate depth provides larger runoff storage capacity, and consequently volume and flow peak reduction and peak delay, appearing thus to be the main feature contributing to achieving a better performance. Batalini de Macedo et al. 2019 reported a peak flow attenuation of 80% by bioretention systems. The experimental study described by Chai et al. 2014 presented a peak flow reduction of 50% from a rain garden and an 83.7% control rate of total annual rainfall runoff volume.

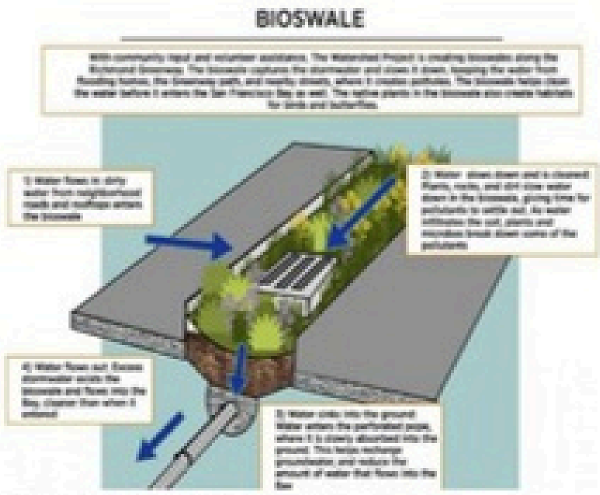


Figure 2: Structure of Bioswale.

Bioretention facilities in general provide proven hydrological advantages in runoff management by decreasing runoff and promoting storage, infiltration and groundwater recharge, and thus contributing to flood control in urbanized areas and sustainable hydrological cycles

- Permeable Pavements: Replacing conventional concrete with materials that allow water infiltration, easing pressure on storm drainage systems. These are specialized surfaces designed to allow water to infiltrate through them rather than running off. Unlike conventional asphalt or concrete, these pavements incorporate materials and design features that create pores or voids, enabling water to pass through to a sub-base layer.
Permeable pavements are considered a SUDS infrastructure offering surface urban runoff and peak flow reduction, and therefore drainage system overflow reduction. Porous pavements provide storage (detention and infiltration) of a large proportion of the rainwater precipitation that falls on their surface, functioning as a reservoir that temporarily stores water during the time needed to infiltrate the underlying soil or under-drains, which will then transfer infiltrated water to the conveyance system Several research studies have reported permeable pavements' potential for surface runoff reduction, pointing out that differences in infiltration capacities of NBS arise from the materials diversity. Valinski and Chandler 2015 tested the infiltration capacity of porous pavements' common materials and found that engineered porous pavements performed better than natural silt loam soils.

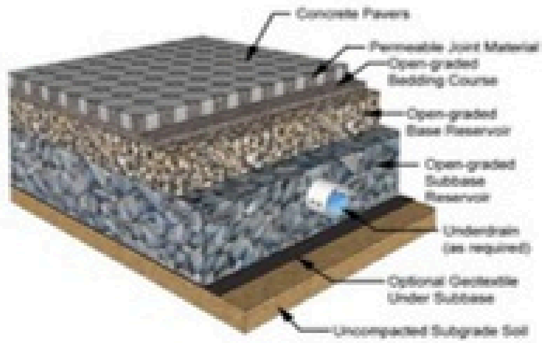


Figure 3: Structure of permeable pavement

- Urban Wetlands: Constructed or restored wetlands serve as natural sponges that temporarily retain floodwater and improve water quality.
Urban wetlands are natural or engineered landscapes that mimic the functions of natural wetlands within urban settings. They play a vital role in flood management by acting as natural buffers that capture, store, and gradually release excess stormwater. Here's how they work in detail Urban wetlands function like sponges. When heavy rainfall occurs, these wetlands absorb and store a significant amount of water, reducing the immediate volume of runoff that reaches city streets and drainage systems. The wetland's shallow water bodies and saturated soils hold excess water during peak rainfall. This temporary storage prevents sudden surges in downstream areas that can lead to flooding.

2.2 River and Watershed Approaches: Managing riverine systems with NBS involves restoring natural channel forms and reconnecting rivers with their floodplains:

- Floodplain Restoration: Removing or modifying flood defences to re-establish natural floodplains, allowing rivers to overflow in controlled ways that reduce peak flows. Floodplain restoration is a Nature-Based Solution (NBS) that works with the natural dynamics of river systems to effectively manage flood risks. By reestablishing a river's natural floodplain—an area adjacent to the river that is periodically inundated—the system gains a dynamic buffer that mitigates high flows while offering ecological and social benefits.

- Floodplains serve as natural reservoirs that absorb and store excess water during heavy rainfall or snowmelt. When a river floods its banks naturally, the water spreads over the floodplain, reducing the overall volume and speed of water downstream.

Attenuation of Peak Flows: By allowing water to spread out over a broader area, floodplains effectively reduce the height and velocity of floodwaters. This "peak flow attenuation" means that the highest rush of water is lower than it would be in a channelized river confined by levees or hard infrastructure.

Infiltration into Soil: Floodplain soils, often rich and healthy, allow water to infiltrate slowly. This process not only increases groundwater recharge but also ensures that the excess water is gradually released rather than contributing to sudden surges in downstream channels.

Evapotranspiration Contribution: The vegetation on restored floodplains transpires water, releasing it into the atmosphere over time. This natural drying process further reduces the amount of standing water and moderates flood durations.

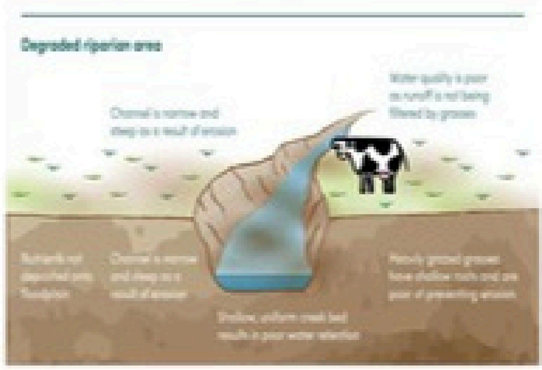
Sediment and Nutrient Trapping: As floodwaters move over the floodplain, sediments and pollutants are trapped by the vegetation and local soils. This natural filtration improves water quality before it reaches downstream water bodies.

Biodiversity Boost: Floodplain restoration rejuvenates habitats by reintroducing native plants and creating a diverse ecosystem. Healthy ecosystems not only support wildlife but also increase the resilience of the landscape to climatic variations.

- Riparian Buffer Zones: Reforesting or creating vegetated buffers along riverbanks helps stabilize banks, intercept sediments, and slow down water flow.

  Riparian buffer zones are areas adjacent to water bodies that are planted or left in a natural state. They typically consist of trees, shrubs, grasses, and other native vegetation. These zones act as a transitional area between aquatic and terrestrial ecosystems, protecting water bodies from excessive runoff, sedimentation, and pollution while providing habitat for diverse species.

  Vegetation in riparian buffers slows down the velocity of surface water runoff. As water moves through the zone, the roughness created by roots, stems, and leaves reduces its speed, which helps minimize the energy that would otherwise cause erosion or sudden surges downstream. By slowing water and promoting its spread out over a broader area, these zones help delay and reduce the peak flow during flood events. The water is temporarily stored in the soil and vegetation, which then gradually releases it.



Additional Benefits of riparian zones

Pollutant Removal: As runoff flows through the buffer, the vegetation and soil trap nutrients, heavy metals, and other pollutants. This purification process reduces the load on the main water body, leading to better overall water quality.

Habitat Creation: Riparian zones provide diverse habitats for wildlife, serving as corridors for species movement and enhancing the overall ecological connectivity of the landscape.

Microclimate Regulation: The vegetation moderates air and water temperatures, offering a cooling effect that benefits both the urban environment and local ecosystems.

NbS Type	Location	Summary of Results	Advantages	Disadvantages/Limitations
Permeable pavements	China	Flood reduction gradually increases with increasing rainfall amount.	LID designs coupled with conventional flood control techniques reduce urban flooding from heavier and longer storms.	Permeable pavement has the lowest storage capacity among LID designs.
	Taiwan	Water retention rates ranged from 9.1% to 61.0% (from three studied sites).	Permeable pavement can minimize stormwater drainage system load.	Retention and infiltration are constrained by a prompt runoff outflow at high rainfall intensity.
	Spain	Permeable pavements retain more rainwater volume (16–66%) than impervious pavement.	After six months of functioning, the NbS is still capable of infiltrating the full water volume at low rainfall intensity.	Drained water releases non-negligible load nutrients (e.g., nitrates).
Bioretention	Brazil	Average runoff retention efficiency of 70%. Outflow water with low pollutant concentration reduction.	Runoff may be used for non-potable applications, lowering the catchment's water demand during the dry season. Flood risks and pollutant contamination reduction.	Pollutant removal with low efficiency (concentrations of Fe, Pb, Ni and Cd above the water guideline limits).
	Brazil	Bioretention system retained 9–100% of runoff. Dry vs. wet seasons: runoff retention efficiency averaged 73% vs. 61%.	Bioretention system delays by 10 min and reduce peak flow by 4–100%.	Bioretention device's storage was constantly below its maximum capacity, demonstrating the system's performance.
Infiltration systems	South Korea	As rainfall progressed, runoff and flow peaks decreased in magnitude, frequency and duration. Maximum peak flow reduction achieved of 61% (rainfall amount = 40 mm).	Runoff infiltrates into the soil, providing groundwater recharge. Runoff can be temporarily stored or used by the plants.	Volume decrease and peak flow reduction were limited by rainfall intensity and volume. Land use imperviousness, slope, and runoff interceptors also limit the runoff and peak flows.

3. BARRIERS TO NBS

Policy and Regulatory Barriers

- Inflexible Urban Planning Codes: Many cities are built around traditional infrastructure models. Zoning laws, building codes, and planning practices often prioritize or mandate conventional grey solutions, leaving little room for integrating or converting to nature-based approaches.

- Lack of Clear Guidelines and Standards: The relatively innovative nature of NBS means that many regions still lack standardized design guidelines, performance metrics, or regulations specific to these solutions. Without clear standards, both policymakers and practitioners remain uncertain about the best practices for implementation.

- Regulatory Disincentives: Existing legal frameworks may inadvertently favor quickly constructed grey infrastructure over time-intensive NBS projects. Additionally, liability issues—such as determining responsibility if a nature-based system underperforms—can discourage investment.

2. Economic and Financial Barriers

- Upfront Costs and Investment Risks: While NBS often provide long-term cost savings through reduced maintenance and ancillary benefits (e.g., improved air quality, enhanced biodiversity), their initial capital outlay can be significant. Decision-makers may be hesitant to invest in solutions with longer payback periods compared to the perceived immediacy of grey infrastructure benefits.

- Challenges in Valuing Ecosystem Services: Quantifying non-market benefits—like carbon sequestration, recreational value, and improved mental well-being—is inherently complex. The difficulty in placing concrete economic value on these services leads to underinvestment and conservative cost-benefit analyses.

- Funding and Financial Mechanisms: Traditional funding streams, such as municipal budgets or conventional infrastructure grants, are often not structured to support multi-benefit, adaptive projects like NBS. Innovative financing solutions such as green bonds or public-private partnerships are emerging, but they are not yet widespread.

3. Institutional and Coordination Barriers

- Fragmented Governance: Implementing NBS often involves multiple stakeholders—urban planners, environmental agencies, water utilities, and community groups. A lack of integrated management structures or coordination between these bodies can slow down or derail projects.

- Limited Expertise and Capacity: Many local governments and planning agencies have limited experience with designing, implementing, and monitoring ecosystem-based approaches. This knowledge gap can create hesitation and reduce the effectiveness of early-stage projects.
- Resistance to Change: Institutional inertia—rooted in historical reliance on grey solutions—may cause resistance to adopting new practices. Decision-makers and practitioners might prefer proven, standardized methods over experimental, ecosystem-based designs.

4. Technical and Performance Barriers

- Uncertainty in Performance Outcomes: Unlike traditional infrastructure—which often has predictable outputs modeled through decades of data—NBS are dynamic systems. Their performance can vary with local ecological conditions, seasonal changes, and long-term climate shifts, creating an inherent uncertainty.
- Data and Monitoring Gaps: Successful implementation of NBS relies on understanding local hydrology, soil conditions, and ecological interactions. In many cases, there is a lack of detailed data or long-term monitoring frameworks to assess the effectiveness of NBS over time, which complicates design and justifies skepticism.
- Site-Specific Design Challenges: The functionality of NBS is highly context-dependent. Factors such as terrain, soil type, urban density, and existing infrastructure dictate design choices. Tailoring projects to the local environment requires flexible, iterative design processes that can be technically challenging.

5. Social and Cultural Barriers

- Public Perception and Acceptance: Communities may be unfamiliar with nature-based approaches, leading to concerns about aesthetics, reliability, or maintenance. For instance, a rain garden or urban wetland might be seen as less "robust" than a traditional retention basin.
- Stakeholder Engagement: Effective NBS projects often require strong community involvement and stakeholder buy-in. Securing consistent engagement and support can be challenging, especially in areas where environmental awareness is low or where there are competing land-use priorities.
- Cultural Attitudes Toward Nature: In some places, there is a cultural predisposition to value engineered solutions over "messier" natural systems. Changing these attitudes requires extensive outreach, education, and demonstration projects to show the efficacy and benefits of NBS.

6. Land Use and Spatial Constraints

- Limited Availability of Land: Particularly in densely populated urban areas, finding sufficient space for nature-based infrastructure can be a significant hurdle. Competing interests (residential, commercial, or industrial properties) often limit the available area for installing green roofs, rain gardens, or urban wetlands.
- Integration with Existing Infrastructure: Retrofitting NBS into well-established urban fabrics requires rethinking and sometimes reconfiguring existing systems. Integrating natural systems with conventional infrastructure can be technically complex and financially burdensome.

4. CONCLUSION

Nature-Based Solutions represent a paradigm shift in flood risk management, offering a sustainable, multifunctional alternative to conventional infrastructure. From urban green roofs and rain gardens to coastal mangrove restorations and restored floodplains, NBS not only mitigate flood risks but also enhance biodiversity, create community value, and contribute to a resilient future. Moving forward, fostering interdisciplinary collaboration, policy support, and community engagement will be key to fully realizing the potential of these innovative solutions.

While Nature-Based Solutions offer diverse and multi-faceted benefits—from flood mitigation to enhancing urban biodiversity—they face a range of barriers. Overcoming these challenges requires a concerted effort across policy, economics, institutional coordination, technical planning, and community engagement. Addressing and mitigating these barriers can pave the way for broader adoption of NBS, ultimately resulting in more resilient and sustainable urban landscapes.

Grey Water Treatment and Reuse

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Abstract

The global challenge of water scarcity necessitates innovative strategies for managing wastewater resources. Greywater, a significant component of domestic effluent, offers considerable potential for reuse when subjected to appropriate treatment processes. This investigation explores the composition of greywater produced in urban residences and assesses diverse treatment methodologies to optimize its reusability. The research examines sustainable approaches to water management, with a particular emphasis on filtration techniques, biological remediation, and chemical treatments designed to eliminate contaminants and enhance water quality. Findings suggest that efficient greywater treatment can substantially decrease potable water consumption and alleviate strain on traditional water resources. Incorporating decentralized greywater treatment systems into urban infrastructure presents an environmentally viable solution for water conservation efforts. This study highlights the critical role of regulatory frameworks, technological innovations, and public education in facilitating the widespread adoption of greywater reuse practices.

Introduction

Water security is increasingly threatened by climate change, urbanization, and population growth, making sus- sustainable water management a global priority. Greywater, which accounts for 50–80 Decentralized treatment technologies, offers a promising approach to greywater management by enabling wastewater to be treated and reused near its point of origin. However, small-scale systems face challenges such as uneven flow distribution, potential contamination, and the necessity of nutrient and pathogen removal. By implementing source separation, treatment processes can be simplified, improving efficiency and enhancing the potential for source recovery. A variety of treatment technologies exist to process grey- water, including physical, chemical, and biological meth- ods. Physical methods, such as membrane filtration, help remove suspended solids, while chemical processes like co- agulation target dissolved contaminants. Biological treatments, including biofilm reactors and constructed wetlands, utilize microbial activity for pollutant degradation. Despite the availability of these technologies, widespread implementation is hindered by infrastructural limitations, public perception, and regulatory barriers. Greywater is typically derived from household activities such as bathing, laundry, dishwashing, and kitchen use. While it constitutes a substantial portion of domestic wastewater, its pollutant load is comparatively lower than blackwater (toilet wastewater). In developed countries, greywater generation ranges between 60–200 liters per capita daily, offering significant water conservation opportunities. If effectively treated, greywater can be repurposed for non-potable uses such as irrigation, toilet flushing, car washing, and firefighting, potentially consuming 50–80% reducing freshwater. Greywater reuse presents a sustainable solution to water scarcity. Yet, its adoption is often limited by challenges such as legal uncertainties, lack of monitoring frameworks, and consumer skepticism. Public concerns about hygiene and safety, alongside regulatory inconsistencies, further impede large-scale adoption. Addressing these issues through policy development, public awareness, and technological advancements can facilitate the integration of greywater reuse into mainstream water management strategies, ultimately contributing to global water sustainability efforts.

Methodology

1.) **A residential household in Nagpur, Maharashtra, India, was chosen as the study site for greywater collection and treatment analysis.**

• various household sources, including:

– Bathing wastewater (collected from bathrooms)– Laundry wastewater (from washing machines and hand-washed clothes)

– Kitchen wastewater (excluding solid food waste nd oil residue)

– Washbasin wastewater (from handwashing and dental hygiene activities)

• Separate drainage pipes were used to isolate greywater from blackwater (toilet waste) to ensure uncontaminated sample collection.

Collection tanks with a 5-liter capacity were installed in the backyard to store greywater from different sources.

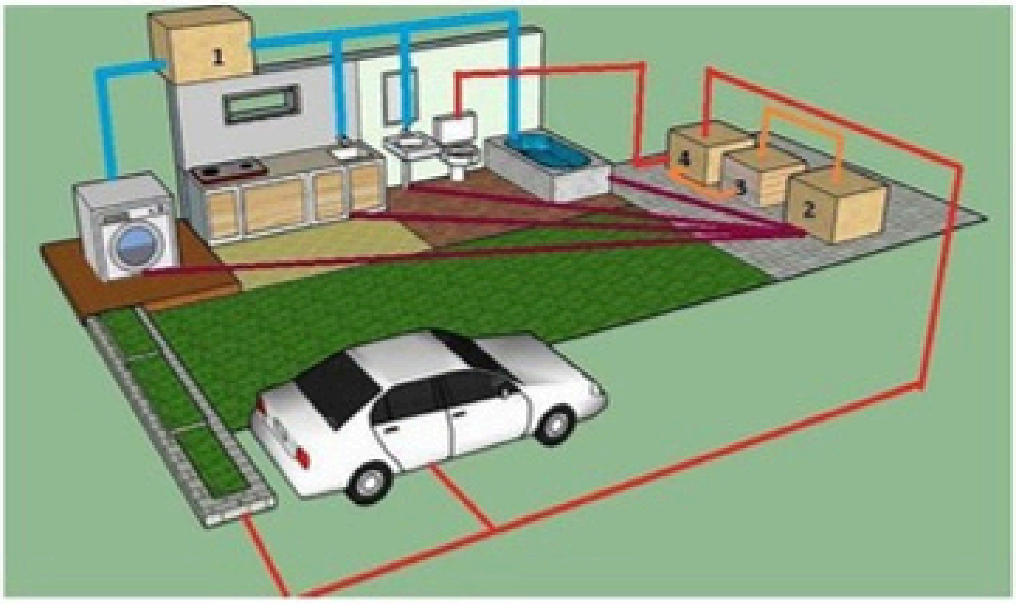
An integrated collection tank was used for mixed grey water, which combined wastewater from all household sources.

Identification of Greywater Sources:

- Greywater was collected from multiple household sources, including:
- Washbasins
- Kitchen sinks
- Laundry wastewater
- Bathing and shower runoff
- Each source was evaluated separately to determine variations in contamination levels and composition.

Sampling and Storage:

- Separate 5L tanks were installed in the backyard to isolate and analyze greywater from different sources.
- A centralized collection tank was set up to assess the characteristics of mixed greywater.
- Samples were collected every 12 hours to ensure consistency and to capture daily variations in greywater composition.
- Storage conditions were controlled to prevent microbial activity from altering the sample composition before analysis.



2.) Data Collection and Characterization of Greywater

Data Collection and Characterization of Greywater are:

Parameter Analysis:

- Various physicochemical and biological parameters were measured, including:
- pH: To assess the acidity or alkalinity of the greywater. Chemical Oxygen Demand (COD): To measure the amount of organic pollutants present.
- Biological Oxygen Demand (BOD): To evaluate the biodegradability of the greywater.
- Turbidity: To determine the presence of suspended particles and organic matter.
- Total Suspended Solids (TSS): To measure solid particles that contribute to cloudiness in the water.
- Chlorine Levels: To check for residual disinfectants or cleaning agents present in the wastewater.

pH: To assess the acidity or alkalinity of the greywater.

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3.) Design and Installation of Treatment System

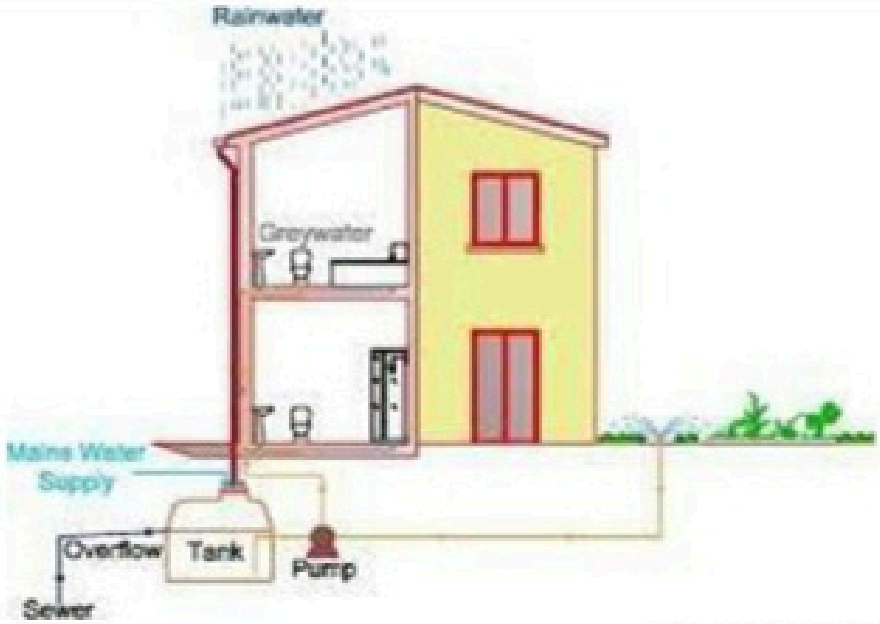
The greywater treatment system was designed to remove contaminants efficiently and allow for the safe reuse of water in various household applications. The process involved the careful selection of filtration media, system layout optimization, and structural design considerations. The installation process was carried out in multiple stages, ensuring efficiency, durability, and ease of maintenance. System Components and Setup.

The greywater treatment system consisted of the following major components:

- **Primary Collection Unit:**
  - A separate collection system for various greywater sources (bathroom, laundry, kitchen) to allow better treatment customization.
  - A centralized tank with a sedimentation section to separate heavy particles and reduce turbidity before filtration.
- Filtration System:
  - A PVC container (100 cm height, 30 cm width) designed to house multiple filtration layers.

Filtration layers arranged in the following sequence:

- Base Layer: Large-sized gravel (15 cm) to provide structural support and initial particle filtration.



- Intermediate Layers:
  - Medium and small-sized gravel (10 cm) to aid in further particle removal.
  - Powdered fly ash bricks (6 cm) to help remove fine suspended solids.
  - Additional gravel layer (8 cm) for improved flow distribution.
- Adsorption and Biological Filtration Layers:
  - Coconut husk (10 cm) for organic pollutant absorption.
  - Wood chips (8 cm) to support microbial biofilm growth.
  - Banana peels (8 cm) for additional organic matter removal.
- Final Filtration Layer: Fine sand (20 cm) to polish the water and remove any residual particulates.
- Structural Enhancements:
  - Nylon meshes (1 mm pore size) placed between layers to prevent material displacement and clogging.
  - An elevated outlet system to facilitate gravity-based water flow and ease of effluent collection.
  - A removable top lid for maintenance access and cleaning.

Installation Process

The installation was carried out in a step-by-step manner:

1.) Site Selection & Preparation:
- A stable, level surface was selected for the installation to prevent tilting or system imbalance.
- The area was cleared of debris, and a foundation was created to support the system's weight.

2.) Assembly of the Collection Unit:
- Individual drainage pipelines were rerouted to direct greywater sources into the collection tank.
- A primary sedimentation chamber was integrated to allow heavy solids to settle before filtration.

3.) Layer-by-Layer Construction of the Filtration System:
- The PVC container was positioned securely on an elevated stand.
- The base layers (gravel) were carefully added to ensure uniform distribution

- A removable top lid for maintenance access and cleaning.

Table 1
Height of various filter layers used.

Filter layer	Height
Large size gravel (at the bottom)	15 cm
Small and medium sized gravels	10 cm
Powdered fly ash bricks	6 cm
Small sized gravels	8 cm
Coconut husk	10 cm
Wood chips	8 cm
Banana peels	8 cm
Fine sand (top most layer)	20 cm

- Adsorption and biological layers were layered systematically to maximize contact time.
- Fine sand was added as the final filtration layer, ensuring an even distribution.

Final Connections and System Testing:

- An outlet pipe was attached at the base of the filter to collect treated water.
- The system was flushed with clean water to settle the layers and remove excess dust.
- Initial greywater samples were introduced to test filtration efficiency and detect any leaks or blockages.

Optimization and Maintenance Considerations

- Flow Rate Adjustment:
  - The filtration rate was optimized to balance treatment efficiency and water throughput.
  - Hydraulic retention time was adjusted to approximately 3 minutes per cycle to ensure adequate purification

- Clogging Prevention Measures:
  - The system was designed with easy-to remove top access for routine maintenance.
  - Periodic backflushing was planned to prevent fine particle accumulation.
- Long-Term Stability Enhancements:
  - The use of bio-adsorbents like coconut husk and banana peels required replacement every 4-6 months to maintain efficiency.
  - Gravel and sand layers were cleaned bi annually to prevent saturation with organic matter.

System Benefits and Expected Performance

The designed filtration system offered several advantages:

- Cost-effectiveness: Utilized locally available materials, reducing setup expenses.
- Scalability: Can be modified for small-scale households or larger community-based applications.
- Sustainability: Employed natural filtration media that support biological treatment processes.
- High Treatment Efficiency: Achieved over 85% COD removal and 94% TSS removal, making the treated water suitable for non-potable reuse applications.

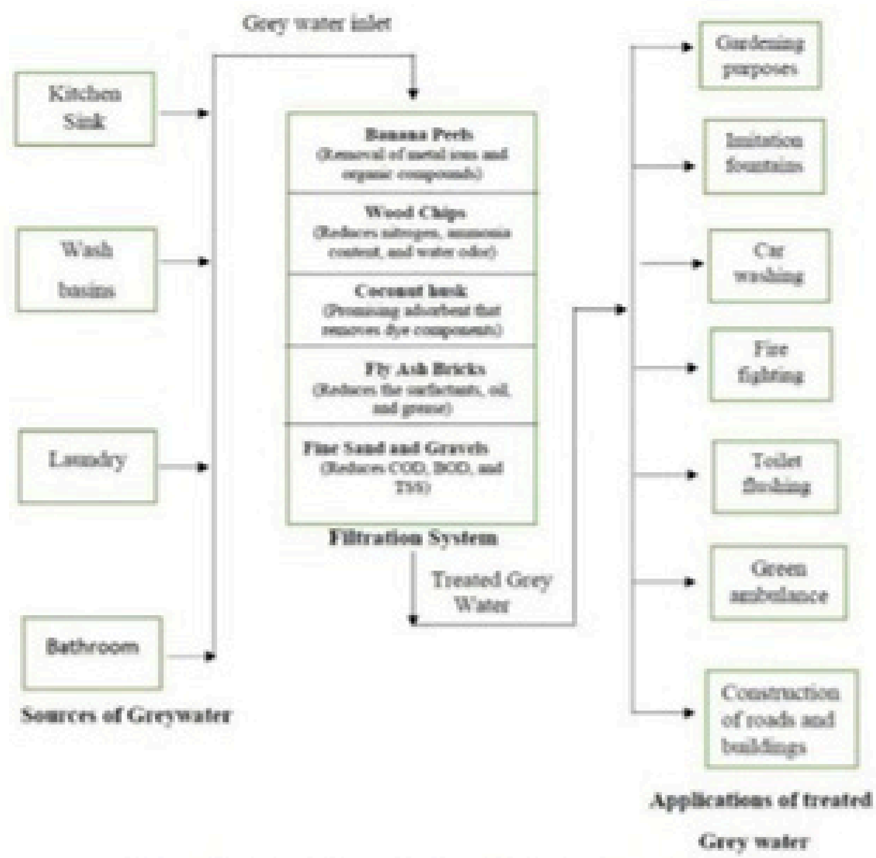
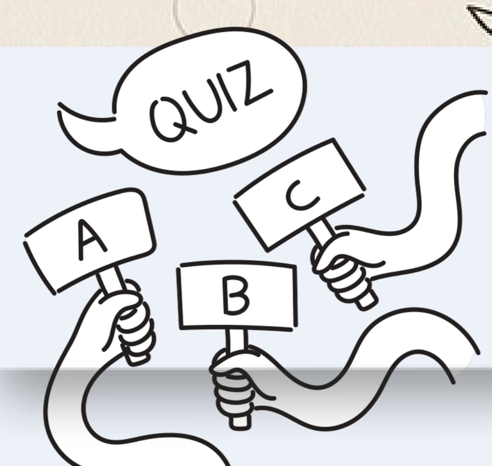


Fig. 2. A schematic diagram of the mechanism of removing pollutants to supplement the system.

SAMEEKSHA 2024

CIVIL ENGINEERING QUIZ



SAMEEKSHA

……..annual quiz event.

Sameeksha tests the normal intelligentsia and knowledge in general civil engineering. The quiz is conducted for teams comprising of two members each. There is no limit to the number of teams from one college.

Civilipsa organises its annual quiz event “SAMEEKSHA” since 2009.

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"Are You Ready to Be Quizzed?"
THEME: GENERAL TO ADVANCE QUESTIONS RELATED TO CIVIL ENGG.
Brainstorm
CIVIL IPSA'S SAMEEKSHA 2024
QUIZ COMPETITION
16 october 2024
VENUE: AUDI-3
AYUSH DHURVE: 9630140444
DHURVE_AYUSH2003
NAMAY YELMULE: 6260195944
ABOUT_NAMAY20


INSTITUTE OF ENGINEERING & SCIENCE
CIVIL ENGINEERING DEPARTMENT


50:50

Memories


SRUJAN
2024

SRUJAN

…………………. National Seminar.

"SRUJAN" aims to bring mutually professionals, architects, engineers, academicians, research scholars and students on a widespread dais and have interactive brain storming sessions and thereby attempts to be made for overlay technique to innovation with economy, quality and safety in the field of Civil Engineering .

The seminar is symphony of various events including Expert lectures, Panel Discussion, Paper presentation, Technical Hunt , Conundrum Model making, Bridg IT & various on the spot events.

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"SRUJAN 2024"
ANNUAL Departmental Event
THEME - INNOVATIVE Solutions for Smooth Traffic flow in Metropolis
Dates : - 17- 18 October 2024
Venue : Auditorium 1, Ground floor
Activities -
• Poster Making and Presentation
• Plantech
• Panel Discussions
• Debates
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Student Coordinators :-
NIKHIL KUMAR VYAS (8251054300)
MAHENDRA SINGH THAKUR (8989935551)
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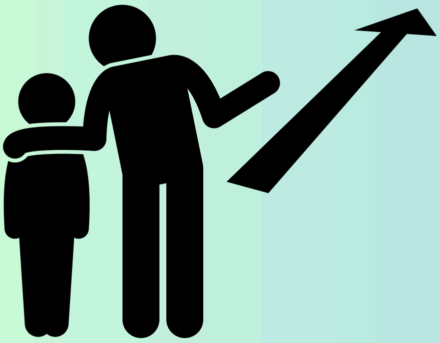
VS


Latitude: 22.65568
Longitude: 75.826615
Elevation: 596.82±1 m
Accuracy: 14.1 m
Time: 18-10-2024 14:36
Note: srujan24
Powered by NoteCam

poster MAKING

TEACHER'S Guidance



SRUJAN-2024 National Seminar-“Innovative solution for smooth traffic flow in metropolis”

आई.पी.एस.एकेडमी में नेशनल सेमिनार सृजन-2024 का आयोजन

इन्दौर । आई.पी.एस.एकेडमी इंस्टीट्यूट ऑफ इंजीनियरिंग एंड साइन्स इंदौर के सिविल इंजीनियरिंग विभाग द्वारा अपने वार्षिक कार्यक्रम ''नेशनल सेमिनार सृजन 2024'' का आयोजन हुआ। सेमिनार इनोवेटिव सॉल्यूशन फॉर स्मूथ ट्रैफिक थीम पर था । एक सप्ताह वाले इस सेमिनार का मुख्य उद्देश्य विद्यार्थियों को स्वयं के विकास के साथ-साथ राष्ट्र के विकास में उनकी महत्वपूर्ण भूमिका से अवगत करना था।


NEEV
2025

NEEV

……….National Level Student's Paper Presentation.

"NEEV " aims to stimulate the spirit of inventiveness & managerial skill among students and to encourage innovative thoughts, creativity, exploration, technological & presentation skills and also to expand the decision-making skills among the students so that the creative talent of individuals could be harnessed for the benefit of the nation.

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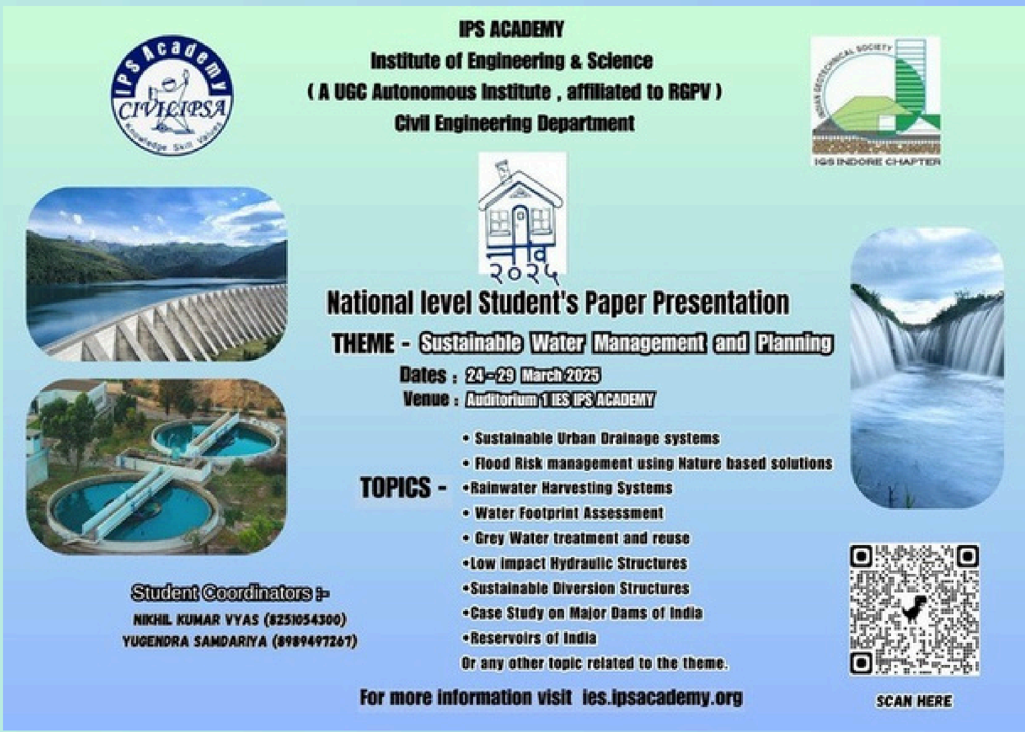
RESEARCH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Civil Engineering Department
National level Student's Paper Presentation
THEME - Sustainable Water Management and Planning
Dates : 24-29 March 2025
Venue : Auditorium 1 IES IPS ACADEMY
TOPICS -
• Sustainable Urban Drainage systems
• Flood Risk management using Nature based solutions
•Rainwater Harvesting Systems
• Water Footprint Assessment
• Grey Water treatment and reuse
•Low impact Hydraulic Structures
•Sustainable Diversion Structures
•Case Study on Major Dams of India
•Reservoirs of India
Or any other topic related to the theme.
Student Coordinators :-
NIKHIL KUMAR VYAS (8251054300)
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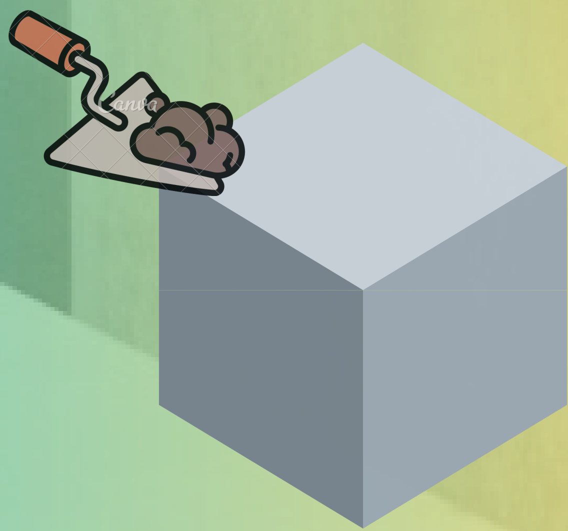
Educational

WORKSHOPS

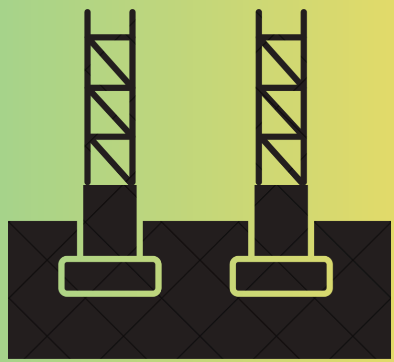
> Workshop on Concrete Mix Design by UltraTech

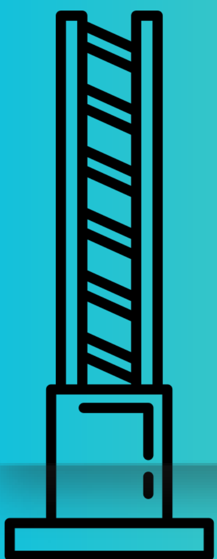


} ***Slump Cone test***

} ***Compressive strength of Concrete***

> Workshop on Foundation Engineering





> Skill Development Training Program on Geotechnical Investigation & Highway Material Testing

> SAKRIYA 2025
"Software Training"



ATAL Faculty Development Program (FDP) "Risk to Resilience: Innovative Resilient Strategies for Mitigating Climate Change"

INDUSTRIAL VISITS

> Visit to RRCAT, Indore

Main Building of Chemical Treatment Facility Lab

Thank you!