बिरला प्रौद्योगिकी संस्थान
BIRLA INSTITUTE OF TECHNOLOGY

(वि॰अनु॰आ॰ अधिनियम १९५६ की धारा ३ के तहत मानित विश्वविद्यालय | A Deemed to be University u/s 3 of UGC Act, 1956)

मेसरा, राँची- ८३५२१५ (भारत) ‖ MESRA, RANCHI - 835 215 (INDIA)

Department of Civil and Environmental Engineering

Specializations

Environmental Science

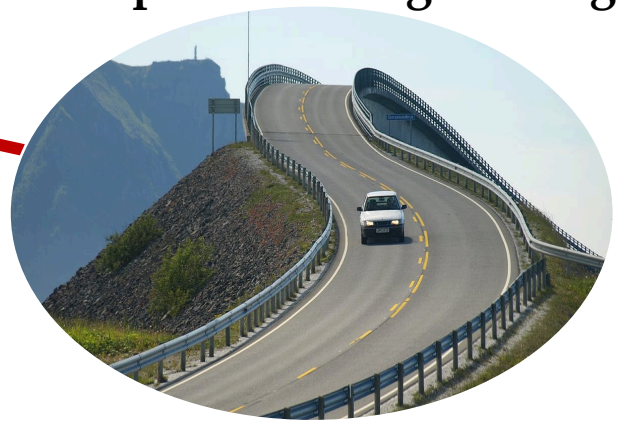
Structural Engineering

Geotechnical Engineering

Civil & Environmental Engineering

Water Resource Engineering

Transportation Engineering



Laboratory facilities

- Concrete and Road Materials Laboratory
- Hydraulics Laboratory
- Soil Mechanics Laboratory
- Structural Engineering Laboratory
- Surveying Laboratory
- Environmental Engineering Laboratory
- Computer Laboratory

Soil Mechanics Laboratory

Facilities/ Equipment in Soil Mechanics Laboratory

1. Apparatus for moisture content determination
2. Specific gravity testing apparatus
3. Consistency limits testing apparatus
4. Grain size analysis apparatus
5. Laser diffraction particle size analyzer
6. Constant and Variable head Permeability determination apparatus
7. Proctor compaction test (Standard and Modified) apparatus
8. California Bearing Ratio testing equipment
9. Direct shear testing apparatus
10. Unconfined compressive strength testing equipment
11. Static triaxial testing equipment
12. Cyclic triaxial testing equipment
13. Large box shear testing equipment
14. Consolidation testing equipment (3-gang)
15. Relative density testing equipment
16. Automatic soil compactors (3 Nos.)
17. Standard Penetration testing equipment
18. Apparatus for conducting Plate Load test
19. Apparatus for determination of field density

Computerized direct shear testing apparatus

Cyclic triaxial testing machine

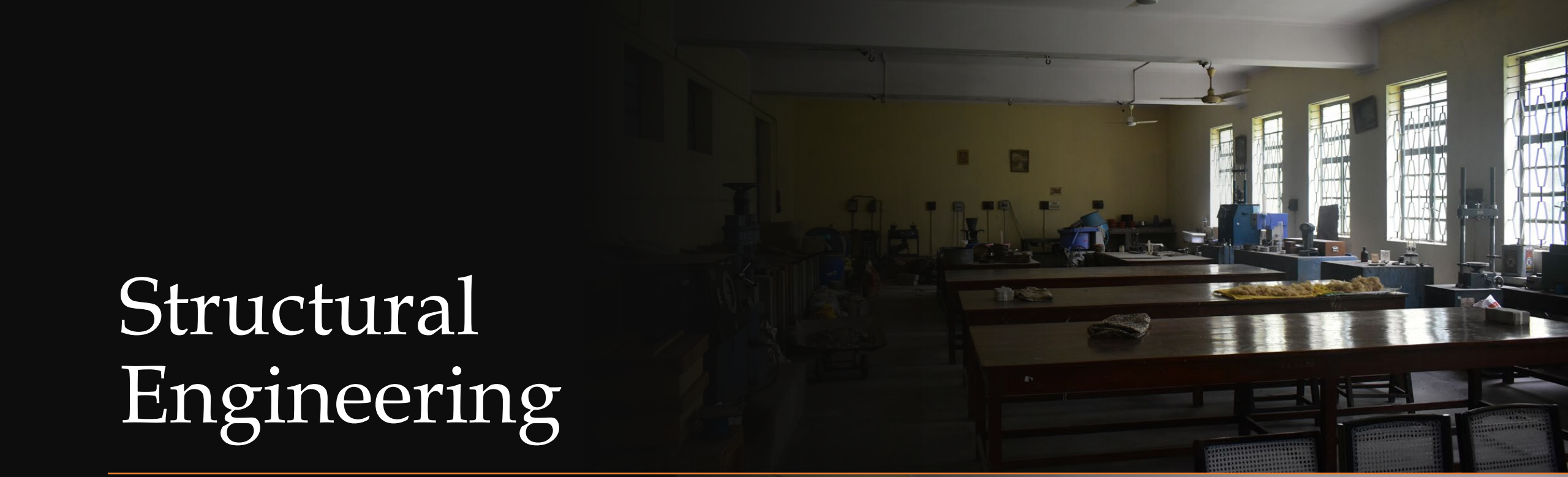
Computerized CBR testing machine

Consolidation testing equipment

Relative density testing apparatus

Laser diffraction particle size analyzer

Structural Engineering



Concrete and Road Materials Laboratory

Structural Engineering Laboratory

Specific gravity apparatus

Automatic Blaine's apparatus

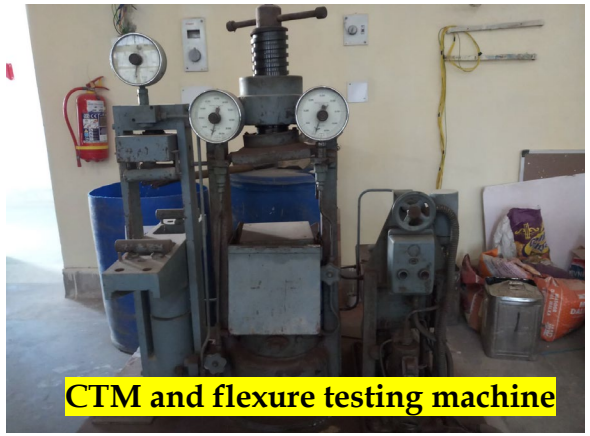
ACM instrumentation

RCPT apparatus

Ultrasonic pulse velocity apparatus

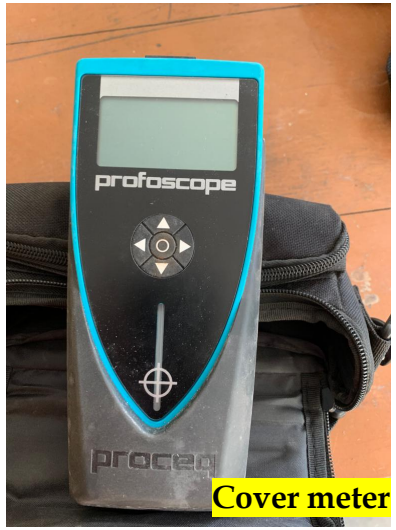
Concrete permeability apparatus

Accelerated curing tank


CTM and flexure testing machine

Automatic Vicat apparatus

Rebound Hammer



Cover meter


Heat of Hydration apparatus


Carbonation chamber


J Ring


CTM – 2000kN

Humidity chamber


Vee Bee Consistometer

Oven

Concrete Maturity meter


Cement Mortar Cube Vibrating Machine


Crusher and pulverizer


Moulds


Concrete Pan Mixer

Digi Mortar Mixer

Transportation Engineering

Concrete and Road Materials Laboratory

Instruments Available

- *Benkelman beam*
- *Ductility test of bitumen*
- *Penetration test of bitumen*
- *Softening test of bitumen*
- *Viscosity test of bitumen*
- *Bitumen extraction test*
- *Marshall test of mix design*

Benkelman Beam

Ductility Test of Bitumen

Penetration Test of Bitumen

Softening Test of Bitumen

Viscosity Test of Bitumen

Bitumen extraction test

Marshall Test of Mix design

Hydraulics Laboratory

The setup is used to get more discharge of flow and also used for mixing of chemicals.

Hydraulic Jump

The setup is done to measure the discharge of flow due to head over the rectangular crest.

Ogee Weir

The setup is to measure some losses that will occur during the flow of water through pipes.

Minor Losses in Pipes

It is the barrier put across a river so that water level at upstream (U/S) is raised and excess water flows in downstream side (D/S).

Flow over Weir

Flow over Notch

Different notches like Rectangular Notch, V-Notch, Triangular Notch are used to measure the discharge of flow

The setup is used to know the seepage occurring through dam. It should be very less so that piping action can be prevented against the failure of dam.

Earthen Dam

Hele Shaw Apparatus

The setup is used to know the flow pattern of viscous fluid.

Surveying Laboratory

Instruments Available

- *Compass*
- *Plane table*
- *Levelling Instrument (Dumpy level & Auto level)*
- *Theodolite*
- *Total station*

Compass

Plane table

Levelling Instrument

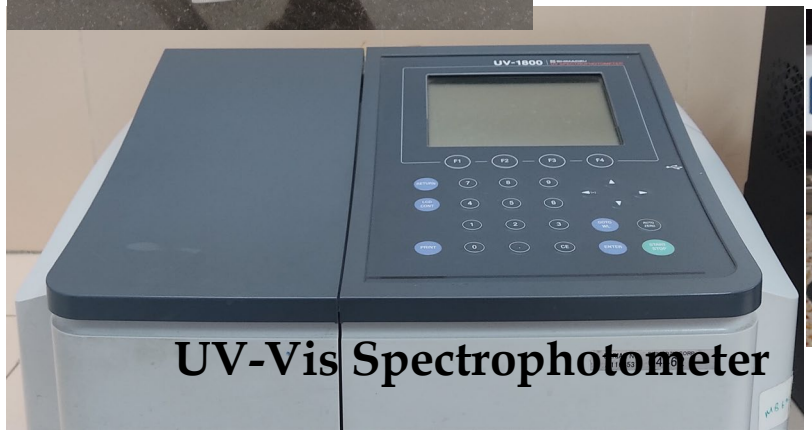
Dumpy level

Auto level

Theodolite

Total station

Environmental Engineering Laboratory



Benchtop Digital pH, DO meter with Ion selective electrodes

Water/wastewater monitoring and remediation studies

Autoclave

Safety Cabinet

Orbital shaker

Rotary Agitator

Environmental Microbiology

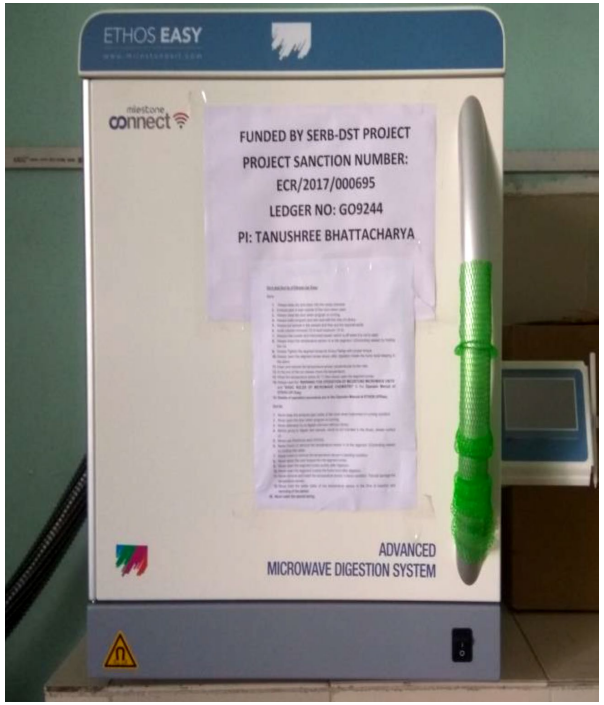
Analytical balance

Cooling Centrifuge

Temperature controlled Magnetic stirrer

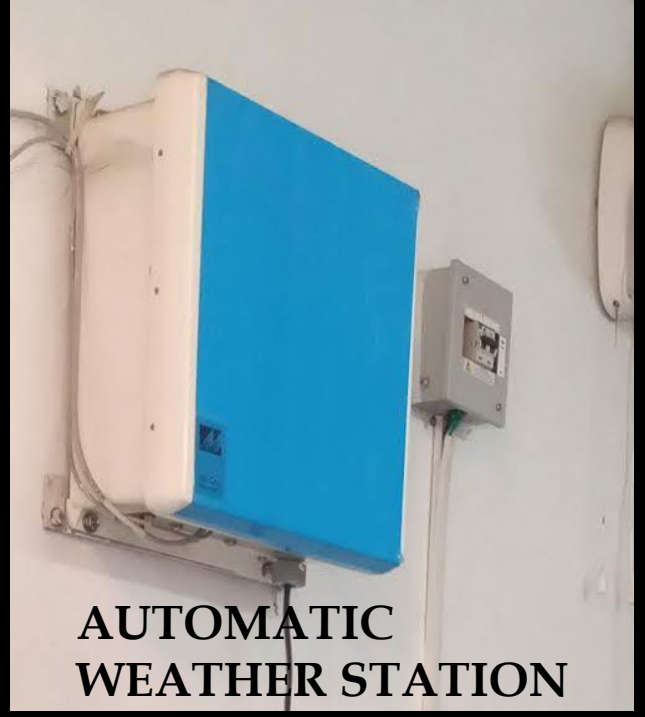
Probe Ultrasonicator

Peristaltic pump



Microwave digester for metal analysis

Use of Biochar and Nanocomposites for water pollution remediation



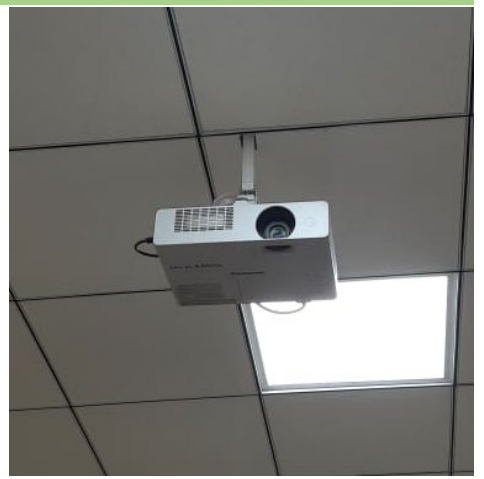
Air quality/pollution monitoring studies

Computer Laboratory

Softwares	Softwares	Softwares
Building Information Modeling	AutoCAD Land Development Desktop	**Offshore**
AECOsim Building Designer V8i	AutoCAD 2000	Bentley Maxsurf Enterprise
AECOsim Energy Simulator V8i	STAAD III	SACS Marine Enterprise
Bentley Navigator	SEWER (Pipe Network-DOS Based)	SACS offshore Structure Enterprise
Bentley Connections Passports	ASAP (Advanced Systems Analysis and Programme-DOS based)	SEWER GEMS V8i
STRUCTURAL	QSB (Quantitative Systems for Business)	WATER GEMS V8i
STADD PRO. V8i	MODFLOW(GroundWater Modelling)	STORM CAD V8i
STADD Foundation Advanced	3D Home	CIVIL STORM V8i
STADD GLOBAL Design Code	STRUDS (Building Design) (2.Nos.)	HAMMER V8i
Bentley Power Reber	ESRGSR (Water Tank Design)	Plaxis (10 Nos.)
RAM Concept V8i	Bentley Academic Perpetual (18 No.s)	SPSS (10 Nos.)
IMAGING, POINT CLOUDS AND MAPPING	**3D CAD Design and Modeling**	ARC GIS (10 Nos.)
Bentley Descartes V9.1	Microstations Powerdrafts V8i	Geo Studio (10 Nos.)
Bentley MAP Enterprise	Microstation V8i	Ansys(4 Nos.)
Bentley Pointtools v8i		
Transportation		
Bentley MX Road Suit V8		
Bentley PowerCivil for Country		

Lab Facilities:

- Equipped for Research and Academic Purpose.
- Individual Locker facilities



Departmental Research Activities

Experimental and Numerical Study of Two Stage Energy Dissipator with Different Blocks for Reducing Width of Basin and Trajectory Length of Basin

Prof. Anand Kr. Sinha

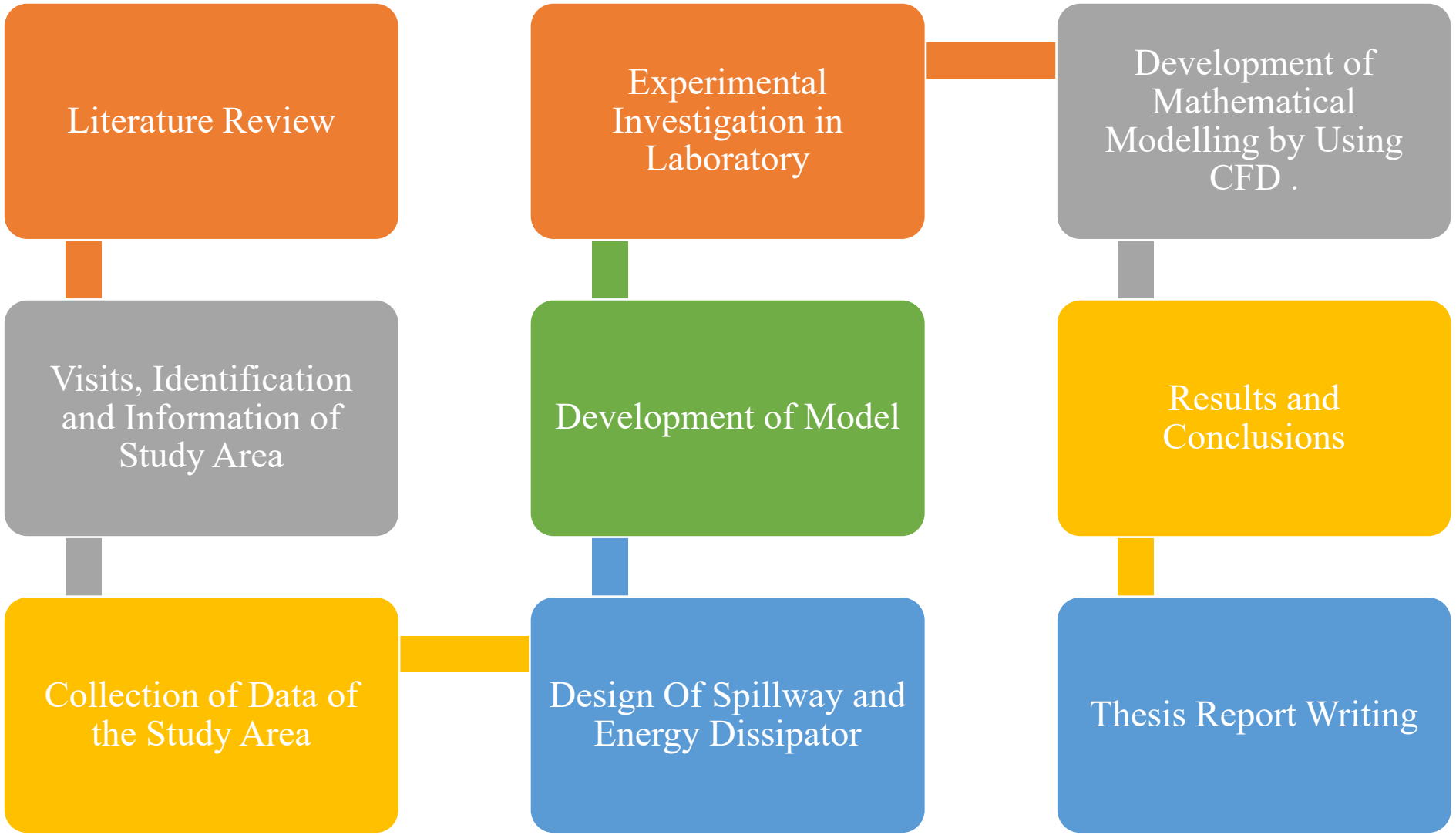
Background of the work:

It is necessary to dissipate the kinetic energy produced at the base of a spillway to carry the flow into the downstream river as far as possible to the normal-almost pre-dam-condition. This is important not only to protect the riverbed and banks from flooding, but also to ensure that the high-speed turbulent flow does not damage the dam itself and neighbouring facilities such as the powerhouse, canal, etc. Different Energy dissipator forms are used to dissipate kinetic energy, water turbulence in the downstream potential range.

Objectives:

1. To design and develop working model for Ogee Profile Spillway with modified energy dissipator.
2. To identify the problem of existing spillway structure.
3. To understand the existing methods of energy dissipation used for Ogee profile Spillway.
4. To identify the best option to rectify the existing problem as well as for maximum energy dissipation on Ogee profile Spillway with deflector.
5. To Design and develop different shapes of deflector.
6. To perform experiments in the laboratory with models of deflector.
7. To perform numerical analysis of the above by using soft computing tools.

Methodology



Findings so far

- **Key findings of the study:**

✓Understanding and redefining problems in previous attempt of designing.

✓Pick out an alternative strategies and solutions to design and develop suitable energy dissipator device.

✓Spot of location and flow depth measurement.

✓Establishment of correlation between depth and Froud no.

- **Implication on environment/ society :**

Hydraulic structures are subject to immense hydraulic pressure and energy dissipation is required to cope with such pressure. This is done to avoid downstream scouring or erosion that could cause or pose a possible danger to the protection of the dam. The current state of the downstream channel should be protected.

Outcome

25th HYDRO 2020, INTERNATIONAL CONFERENCE,
NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA, ODISHA, INDIA
26-28, March 2021

Paper ID – 005

FLOW PATTERN AROUND MULTIPLE VANE ARRANGEMENT

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[2]*Assistant Professor, Department of Civil Engineering, Institute of Infrastructure Technology, Research and Management, Ahmedabad, Gujarat, India-380026.*
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Abstract

Submerged vanes are the foils placed skewed to the flow direction and are utilized to manage the sediment by altering the shear stress on the bed by generating the secondary currents on account of pressure difference between the two sides of vane. The range of angle of attack at which submerged vanes can be placed in the flow with respect to flow direction varies in between 10° to 40°. Since, there are few studies which consider non-rectangular submerged vanes but mostly with single tapered vane. Thus, present study studies the optimization of tapered vanes arranged as a vane pair and multiple vanes per rows. Numerical modelling of present study was done in ANSYS-CFX software using K-ε turbulence closure model to simulate the vortical flow. In present study it was observed that due to high vortical interaction for δ_s = H &2H, the vane is not able to work independently with one vane vortex suppressing another one's while for δ_s = 4H, the vanes induced the vortices individually and made a more efficient system.

Keywords: *Secondary currents, Tapered Vanes, Ansys-CFX, Computational Fluid Dynamics.*

Paper ID – 024

Study of Energy Dissipator with Different Blocks to Reduce Basin Width and Trajectory: A Review

Shilpi Sippi Bhuinyan[1], Prof. Dr. Anand Kr. Sinha[2]
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[2]*Professor, Birla Institute of Technology, Mesra, Ranchi (Jharkhand), INDIA*
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Abstract

One of the most powerful and cost-effective strategies for dissipating hydraulic energy from flood waters is to project the flows into a free trajectory jet shape to a position where the impact produces a downstream river bed dip pool. If take-off speeds are increasing, ski jumps are standard features of dam spillways for efficient energy dissipation. A significant result of the Froud No. range approach flow, the relative height of the bucket and therefore the angle of the device is found. Using a physical hydraulic model, energy dissipation by a ski-jump can be assessed by evaluating several identified contributing parameters. Important parameters include;1) Geometric water jet trajectory profile such as distance of trajectory, trajectory height, horizontal and transverse impact width;2) Distribution of dynamic impact pressure; 3) average dynamic head of impact; 4) head of impact velocity; and 5) air entrainment. Deflectors are the element that is provided at the outlet to deflect the trajectory into a plunge pool area where sound rock is present so that less erosion occurs.

Keywords: *Energy dissipation, Kinetic turbulence, Ski jump, stilling basin.*

Outcome

HYDRO-2020 INTERNATIONAL

[Silver Jubilee Year]

Certificate of Participation

This is to certify that Dr./ Mr./ Ms. **Shilpi Sippi Bhuinyan** has presented a paper titled

"Study of Energy Dissipator with Different Blocks to Reduce Basin Width and Trajectory : A Review" in the HYDRO-2020, 25th International Conference on Hydraulics, Water Resources and Coastal Engineering, organized by Department of Civil Engineering, National Institute of Technology Rourkela, India in association with the Indian Society for Hydraulics (ISH) held during 26th to 28th March 2021.

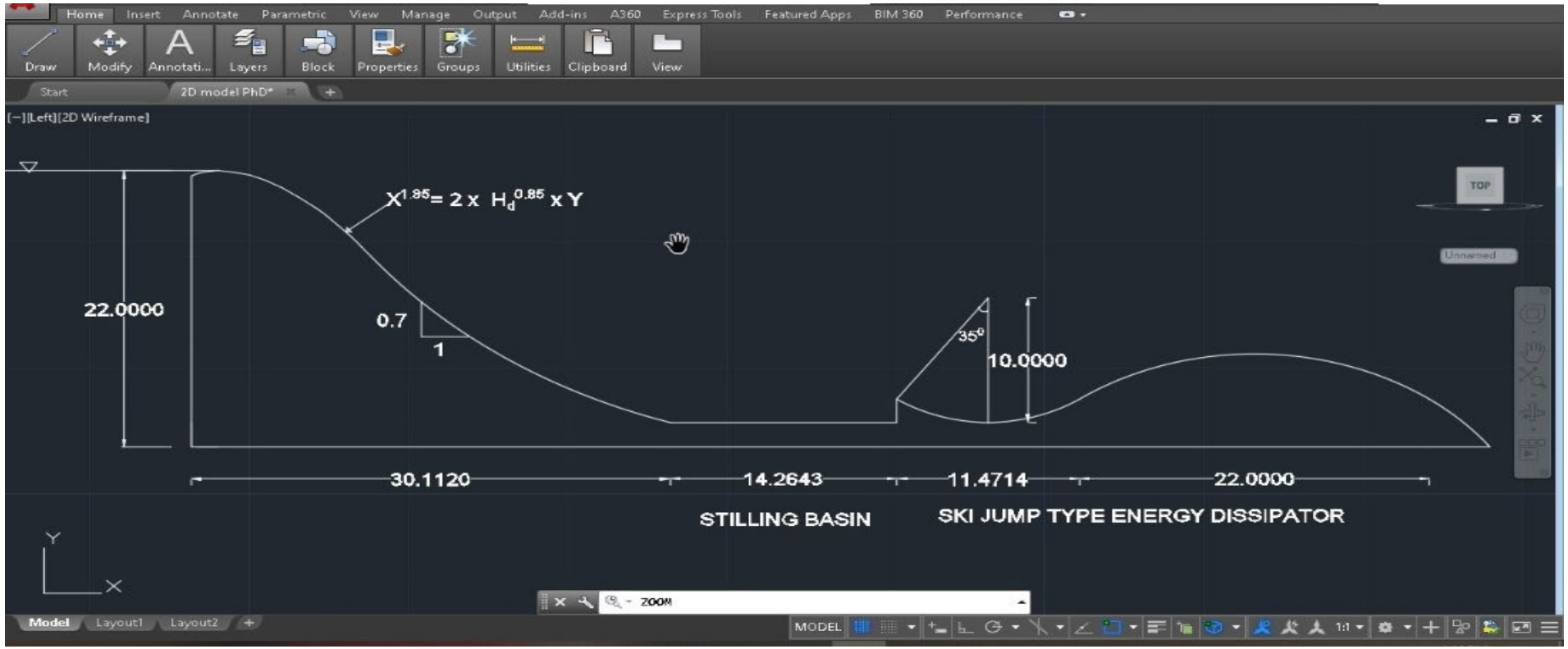
Prof. Kishanjit Kumar Khatua
Organizing Secretary, HYDRO 2020

Dr. L. R. Rangnath
Secretary, ISH

Prof. K. C. Patra
Chairman, HYDRO 2020

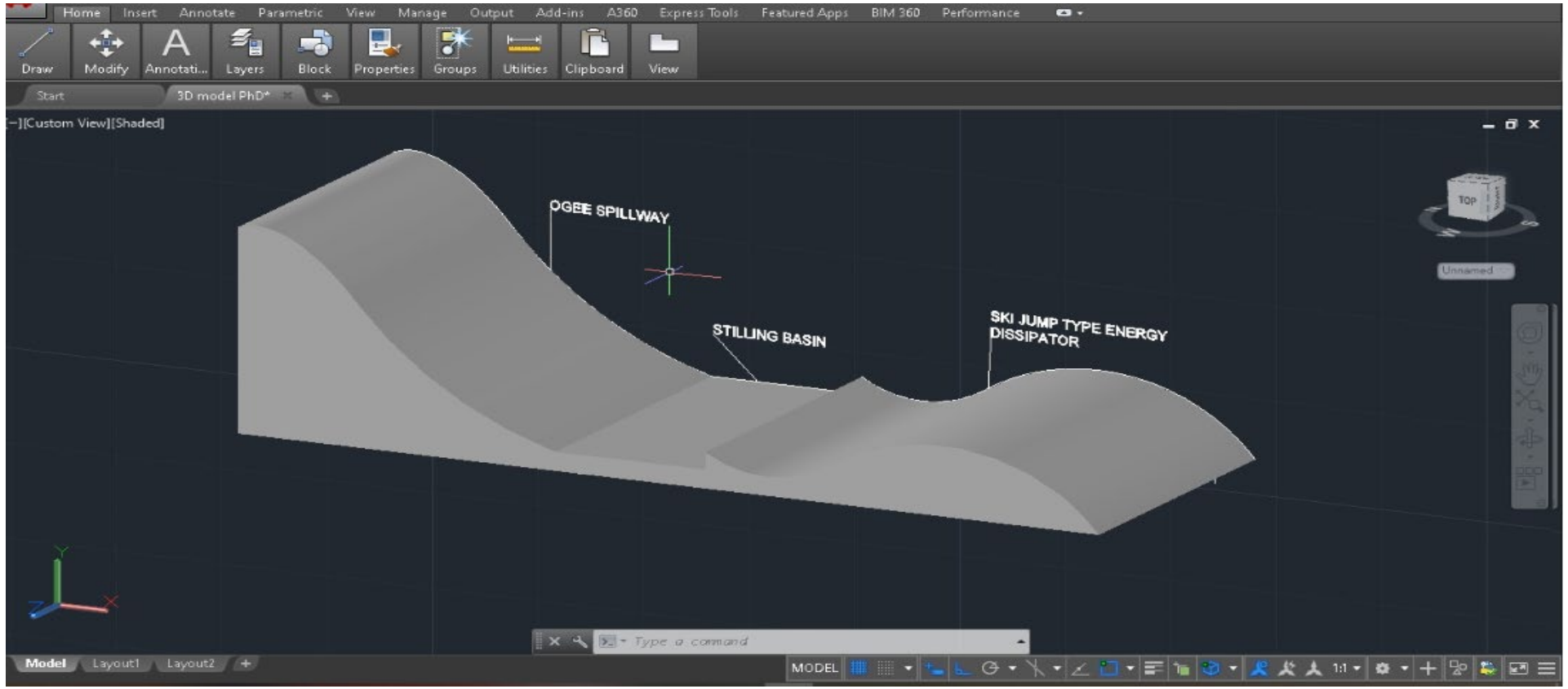
Outcome

- **2D Hydraulic Model**



Outcome

- 3D Hydraulic Model



future plans

- **What's next?**

- Fabrication of Model and Experimental Investigation.
- The results obtained from the experimental work will be validated with the established numerical models.

Water Resources Engineering

Prof. Rajeev Sahay

- Having publications in International Journals, National Journals, International Conferences, National Conferences
- PI of Sponsored Projects
- Fellow of Institution of Engineers (India)
- Member of Editorial Board
- Reviewer of Research Papers

Soft Computing and Soil Stabilization

Prof. Bindhu Lal

Background of the work:

Soft Computing	Soil Stabilization
In geotechnical engineering and air pollution analysis, many results are obtained by conducting experiments which are cumbersome and time taking. Predictive models developed by using soft computing techniques can solve this problem to a great extent.	The strength characteristics of soil is increased by adding admixtures. The common admixtures like cement, lime bitumen etc. are replaced by environmental pollutants like waste products from industries and agricultural wastes.

Objectives

1. **Soft Computing**

a. Geotechnical Engineering

I. To develop models to predict shear strength parameters/ strength characteristics of different types of soil from the index properties of soil using neural networks.

II. Compare the performance of models using statistical parameters.

III. Compare the values predicted by the model and experimental values.

IV. Sensitivity Analysis.

Objectives (contd.)

b. Air Pollution

i) To develop models to predict concentration of air pollutants in coal mines/vehicular emissions from the meteorological data using neural networks.

ii) Compare the performance of models using statistical parameters.

iii) Compare the values predicted by the model and observed values.

iv) Sensitivity Analysis.

Objectives (contd.)

2. Soil Stabilization

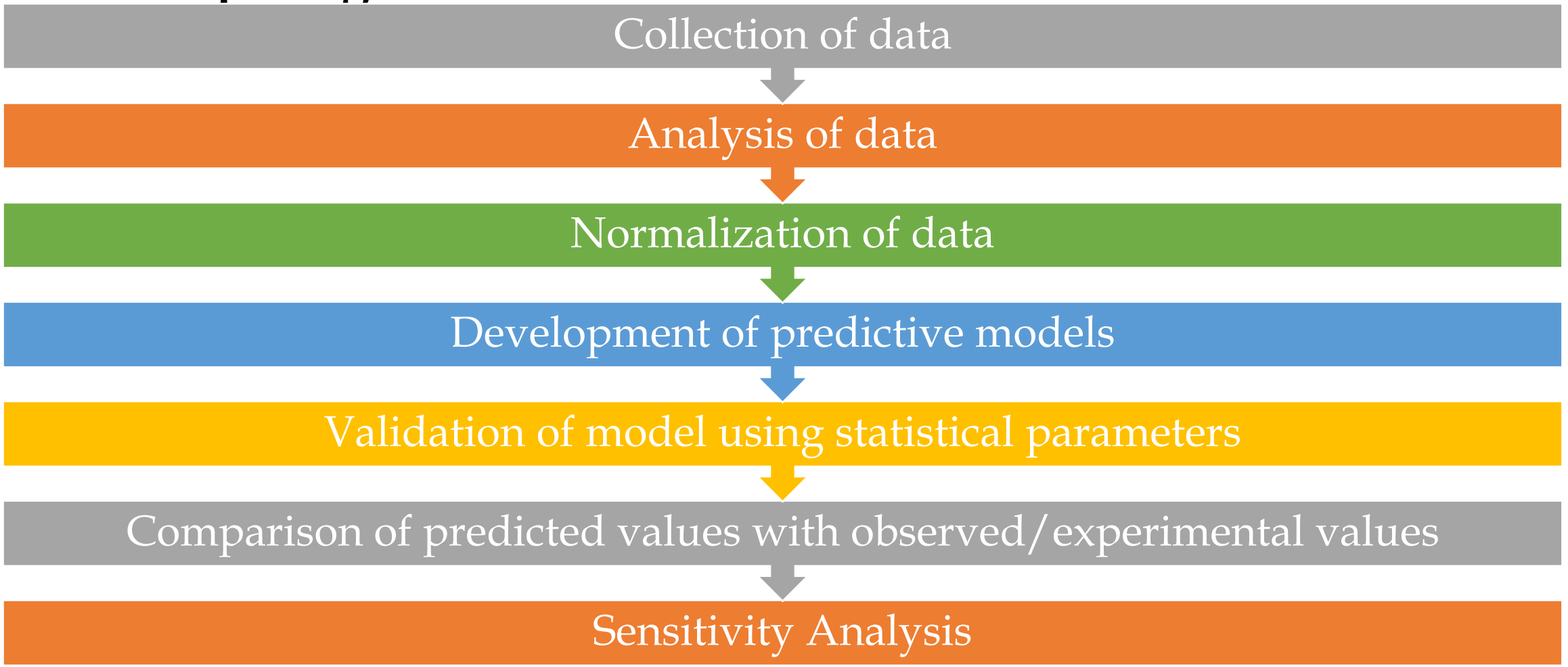
i) To select the appropriate environmental pollutant to stabilize the soil.

ii) To determine the optimum amount of pollutant needed to get the desired strength characteristics required for a particular construction.

iii) Microlevel Investigation.

Methodology

Soft Computing



Methodology

Soil Stabilization

Selection of pollutant

↓

Determination of physical and chemical properties of pollutant and soil

↓

Classification of soil

↓

Experiments to determine the optimum amount of Admixture (Pollutant) to be added to soil to get the desired strength characteristics

↓

Microlevel investigation (SCM,EDS,TGA etc.)

Findings so far

Soft Computing

- Models developed could successfully predict the concentration of air pollutants from meteorological data and emission rate and determine the strength characteristics of soil from its index properties.

Soil stabilization

- Strength of weak soils is improved with the addition of environmental pollutants as admixtures (rice husk ash, brick kiln dust and garlic skin) and the soil after stabilization can be used for flexible pavement construction

Implication on environment/ society

- Models can replace instruments to measure (which may take many days) the concentration of air pollutants or determine strength characteristics of soil thus saving time.
- By using more environmental pollutants as admixtures, the problems arising due to the disposal of the pollutants is taken care.

Outcome

1.Soft Computing

a)Air Pollution

No. of publications –5

Received a project from Coal India Ltd. Amount Rs.83.50 lakhs.

b)Geotechnical Engineering

No. of publications –4

2.Soil stabilization

No. of publications-5

A project proposal has been submitted to NRIDA combining both soil stabilization and soft computing.

Future plans

A. Development of models can be extended

1. To more sites like industrial areas, thermal power plants and for vehicular emission
2. By increasing the number of input parameters

B. Other computing techniques can be utilized.

C. Stabilization of soil can be done with different type of pollutants which are harmful to environment and difficult to dispose.

Problems on Slope Stability

Dr. Indrajit Roy

- Surface mining technology contributes to 94% of India's total coal and lignite production. Coal and Lignite from Surface mining technology has the largest share (about 61.51%) of India's power generation which is followed by hydro-electric power(15.42%), renewable energy(11.84%), natural gas(8.61%), nuclear(2.16%). and oil(0.44%).
- Land requirement due to Surface coal mining in India has been estimated to reach 2925 square km in 2025 including 730 square km of forest cover as against the present requirement of total land of 1470 square km for surface mining. It is also estimated that 0.85 million people will be displaced by the opencast coal mining projects by the year 2025 and would require to be suitably rehabilitated.
- The only solution is to increase the Opencast mining slope by reducing the land requirement leading to frequent landslides in opencast coal and lignite mines.
- CEE department is responsible for undertaking a number of research & Development and also consultancy projects to solve the above problem.

Bina opencast mine,Singrauli,UP.


Dump from view point


Accident occurred in December,2008 at Jayant due to movement of 1,46,000 cu.m of waste rock causing death of 5 mine employees


Failure Surface in Sasti, Maharashtra

R&D projects completed

- Guidelines for dragline dump profiles of Indian coal mines (2010-13) – 57 lakhs.
- Guidelines for distance between dragline and shovel-dumper dump (2013- 16) – 27 lakhs
- Guidelines for internal dump (2018 – 2022, Jan) - 75.30 lakhs
- Following is the on-going R&D project
- Effect of blast vibration on dump stability – 33.0 lakhs
- Following Consultancy jobs of 120 lakhs (2018 to 2021) were undertaken
- Slope Stability Study of Eastern Coalfield, Bharat Coking Coal, South Eastern Coalfield, Northern coalfield, Western Coalfield, Gujrat Mineral Development Corporation, West Bengal Mineral Development Corporation

Liquefaction of polypropylene reinforced-fly ash blended sand

Dr. Siddhartha Sengupta

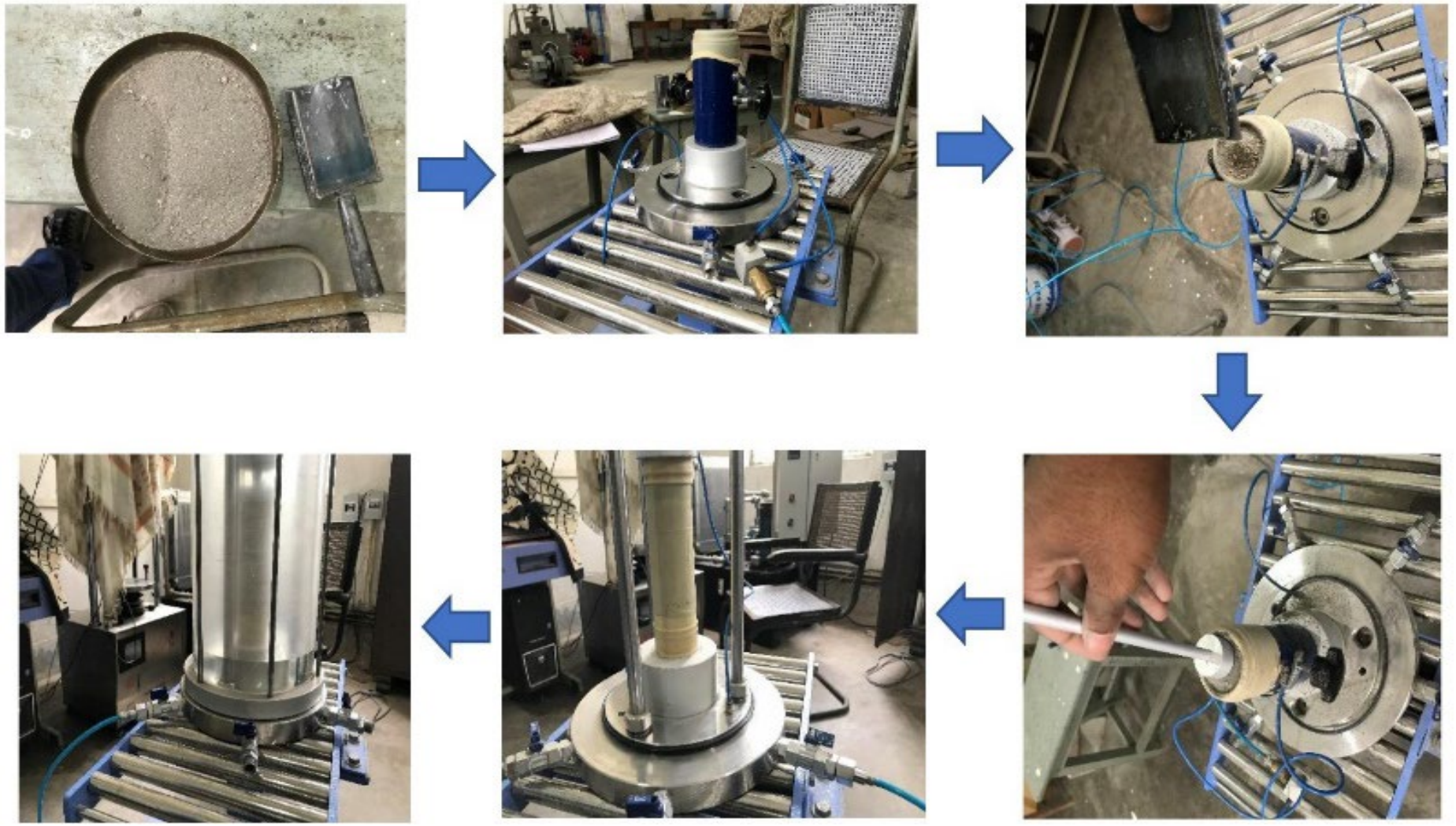
Background of the work:

Liquefaction is a devastating phenomenon of earthquake. In this research liquefaction behaviour of sand is studied under strain-controlled conditions.

Objectives:

1. To study the effect of fine grain addition on liquefaction behaviour of fiber reinforced sand.
2. To observe the effect of relative density, confining pressure, frequency of loading on the liquefaction behaviour of fiber reinforced sand.
3. To observe the change in shear modulus on the liquefaction of sand.

Methodology



Sample preparation

Methodology (Contd…)

- The fly ash was mixed in different proportions (up to 50%) of the dry weight of sand.

- Three independent sets of experiments were performed, first for sand-fly ash mixture without reinforcement, second by adding polypropylene strips @ 0.5 % of the weight of sand only; and third by mixing the polypropylene strips @ 0.5 % of the total weight of sand-fly ash blend.

- The specimens were tested under cyclic loading at a shear strain of 0.75% and a frequency of 1 Hz.

Findings so far

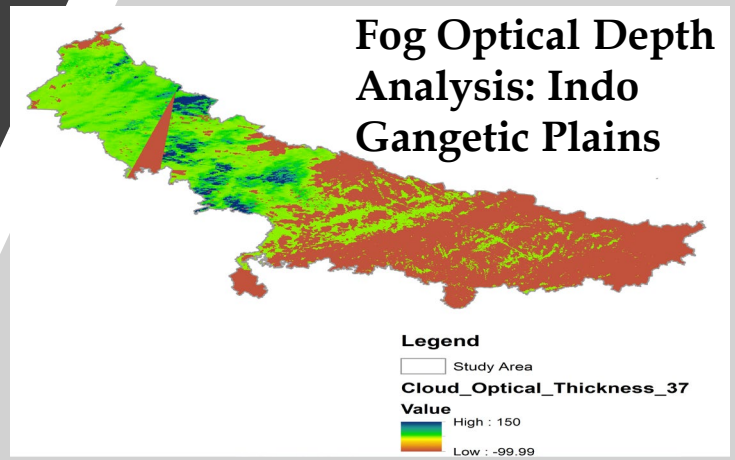
The results indicated an inconsistent correlation between the liquefaction resistance of sand and the percentage of fly ash. The number of cycles to initiate liquefaction at first decreased and then increased and again reduced, on increasing the fly ash proportion. The shear modulus of the mixture also adhered to a similar trend. The addition of polypropylene strips helped to delay the initiation of liquefaction and significantly postponed the deformation of the sand-fly ash matrix.

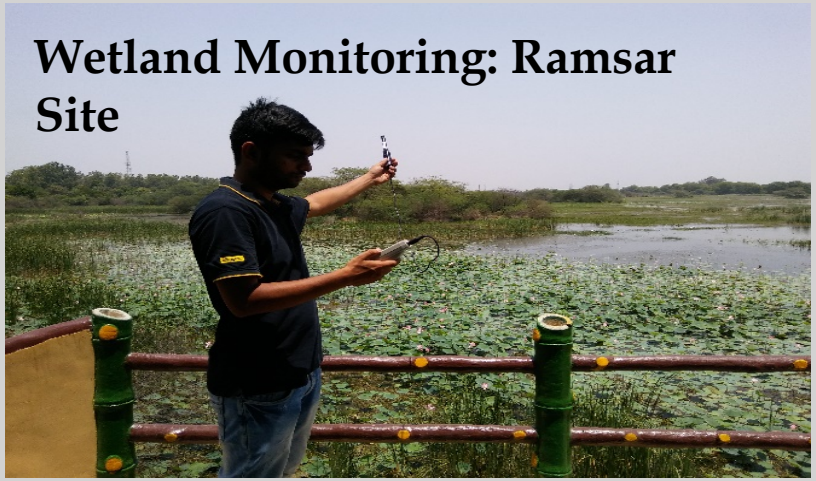
Outcome and future plans

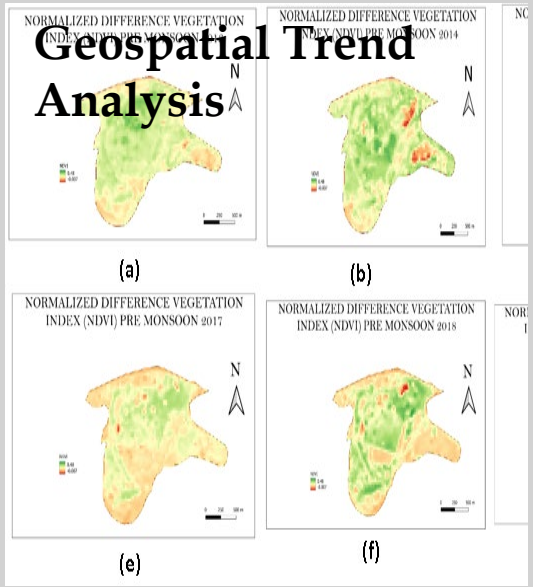
The outcome of the present study can be used with great advantages in design of foundations of different structures in earthquake-prone zones. One of the specific applications may be design of foundation of dams having loose state of the fines mixed with sandy soils. Reinforcing the sand with fly ash and polypropylene can mitigate liquefaction effectively. Also, polypropylene fibers are cost-effective, easy to use, and are very less affected due to climate change, which are the significant advantages of using it as reinforcement over the other liquefaction mitigation methods. However, the lack of specific engineering standards and non-adhesive properties of polypropylene are some gaps in the implications of the same.

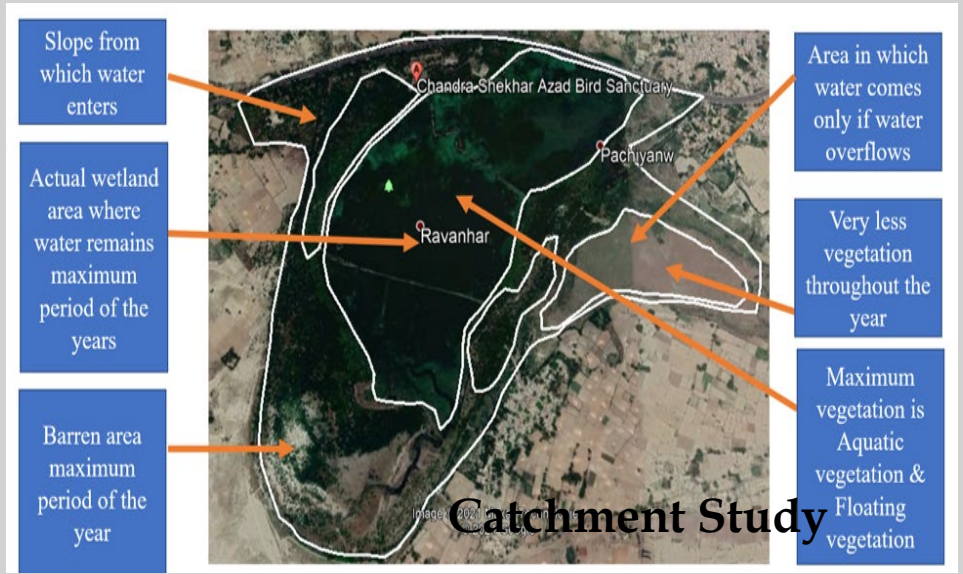
Ecosystem Management & Climate Studies

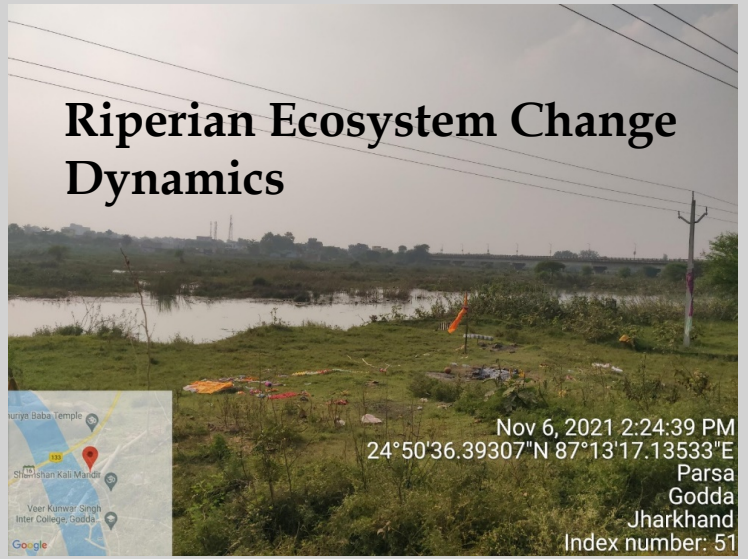
Dr. Kirti Avishek











Electrocoagulation for Water Treatment for Removal of Emerging Contaminants

Dr. R Naresh Kumar

Background of the work:

- Conventional water treatment plants: coagulation-flocculation-sedimentation-sand filtration-activated carbon-disinfection - fate of emerging contaminants (ECs) remains poorly understood, often not very efficient for ECs
- Expensive technologies not a feasible option at all areas, need for decentralized small scale treatment plants
- Electrocoagulation has been reported to be ideal for small scale treatment plants including removal of Ecs

Objectives:

- To assess electrocoagulation in batch mode to optimize the process and gain mechanistic insights on removal of ECs
- To assess the electrocoagulation process in continuous mode operation to assess the process for water treatment efficiency
- To develop sequential processes for efficient water treatment for removal of conventional and emerging contaminants
- To carry out pilot scale studies for assessing process stability for long term operation

Methodology

Batch mode experiments

- Experimental Unit - 1 L reactor, magnetic stirrer, DC power unit, electrodes (anode & cathode)
- Optimization studies - reaction time, electrode materials, electrode space, voltage, drug concentration
- Sludge analysis - XRD, FT IR, EDX SEM, FESEM

Continuous mode experiments

- Experimental unit - 1 L reactor, electrodes (anode & cathode), 4 L sedimentation unit, magnetic stirrer, DC power unit, peristaltic pump
- optimization studies - detention time, drug concentration
- Sludge analysis - XRD, FT IR, EDX SEM, FESEM

Data analysis

- Statistical analysis - Mean ± S.D., ANOVA (one way & two way), correlation-regression
- Reaction kinetics
- Process cost estimation

Findings - Electrocoagulation - Acetaminophen & NOM Removal

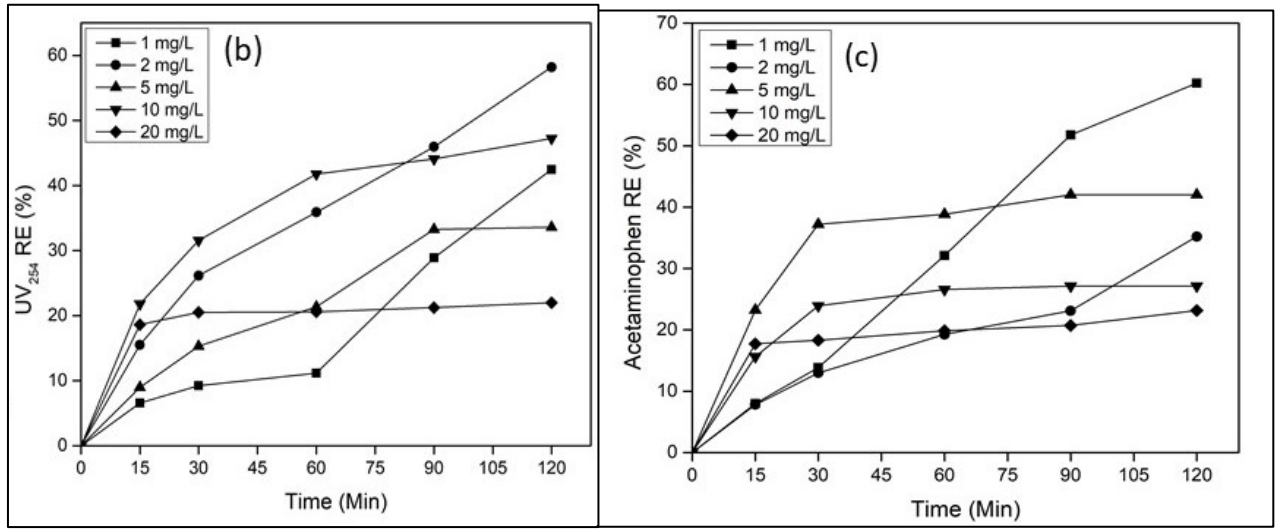


Fig 1: Acetaminophen and NOM removal from river water using electrocoagulation

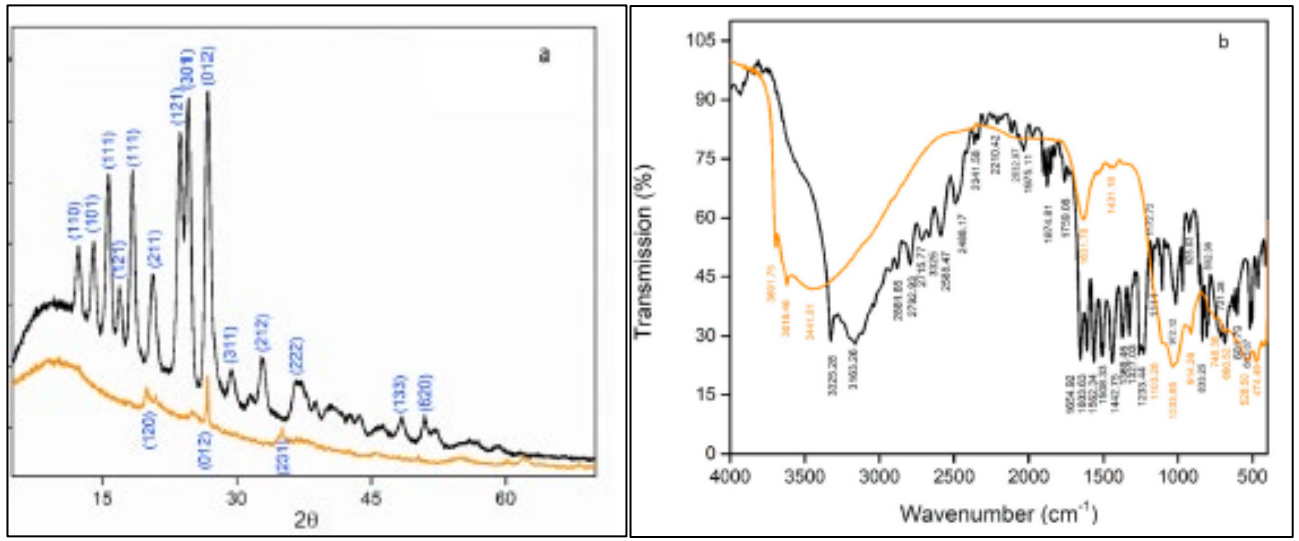


Fig 2. XRD and FT IR analysis of electrocoagulation sludge

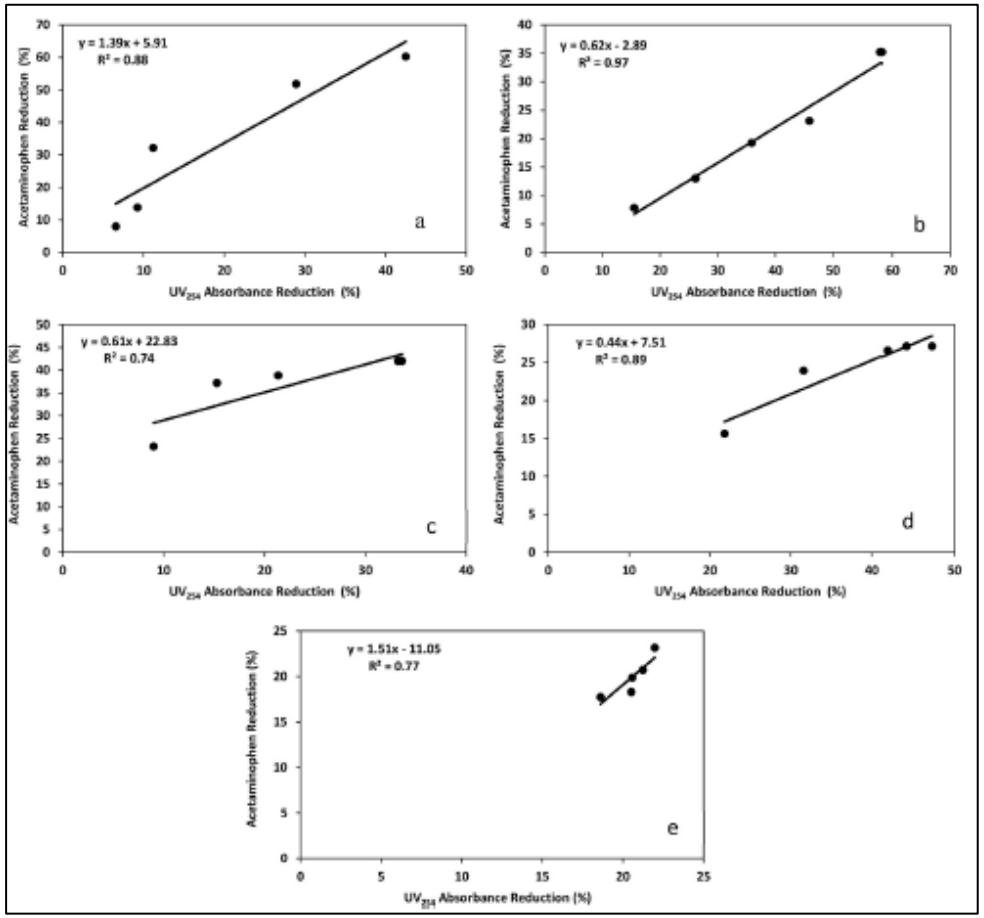


Fig 3: Linear correlation between acetaminophen and NOM at different drug concentration (1, 2, 5, 10 & 20 mg/L)

Shweta Kumari, R. Naresh Kumar (2021). Chemosphere, 273, 128571

Outcome and future plans

Publications (Electrocoagulation only)

1. Shweta Kumari, **R. Naresh Kumar** (2022). Natural organic matter, acetaminophen and elements removal from river water by continuous electrocoagulation process using aluminium electrodes. Water Supply (IF: 1.275)
2. Kumari, S. and **R. Naresh Kumar** (2021). River water treatment using electrocoagulation for removal of acetaminophen and natural organic matter. *Chemosphere*, 273, 128571 (IF: 7.086)
3. Shweta Kumari and **R. Naresh Kumar** (2020). Electrocoagulation for COD, turbidity, ammonia and phosphate removal from municipal wastewater. *Journal of Indian Chemical Society*, 97, 527-532. (IF: 0.284)
4. Chakraborty, C., P.K. Mohanty, J. Iqbal and **R. Naresh Kumar** (2020). Can electrocoagulation be an effective post-treatment option for SBR treated landfill leachate and municipal wastewater mixture? *Journal of Water, Sanitation and Hygiene for Development*, 10, 86-95. (IF: 1.250)
5. Verma, M. and **R. Naresh Kumar** (2018). Coagulation and electrocoagulation for co-treatment of stabilized landfill leachate and municipal wastewater. *Water Reuse*, 8, 234-243. (IF: 3.154)

Future Plans

- Many studies are on batch mode operations, and studies on continuous mode are limited
- Sequential EC-EO operations in continuous mode are limited
- Research has focused mainly on drug residues, whereas drug resistant bacteria are comparatively lesser focused
- Studies on removal of multiple drugs from water using electrochemical techniques are scarce
- Pilot level studies - process stability and longevity

Green synthesis of Biochar based Nanocomposite and its application for environmental remediation

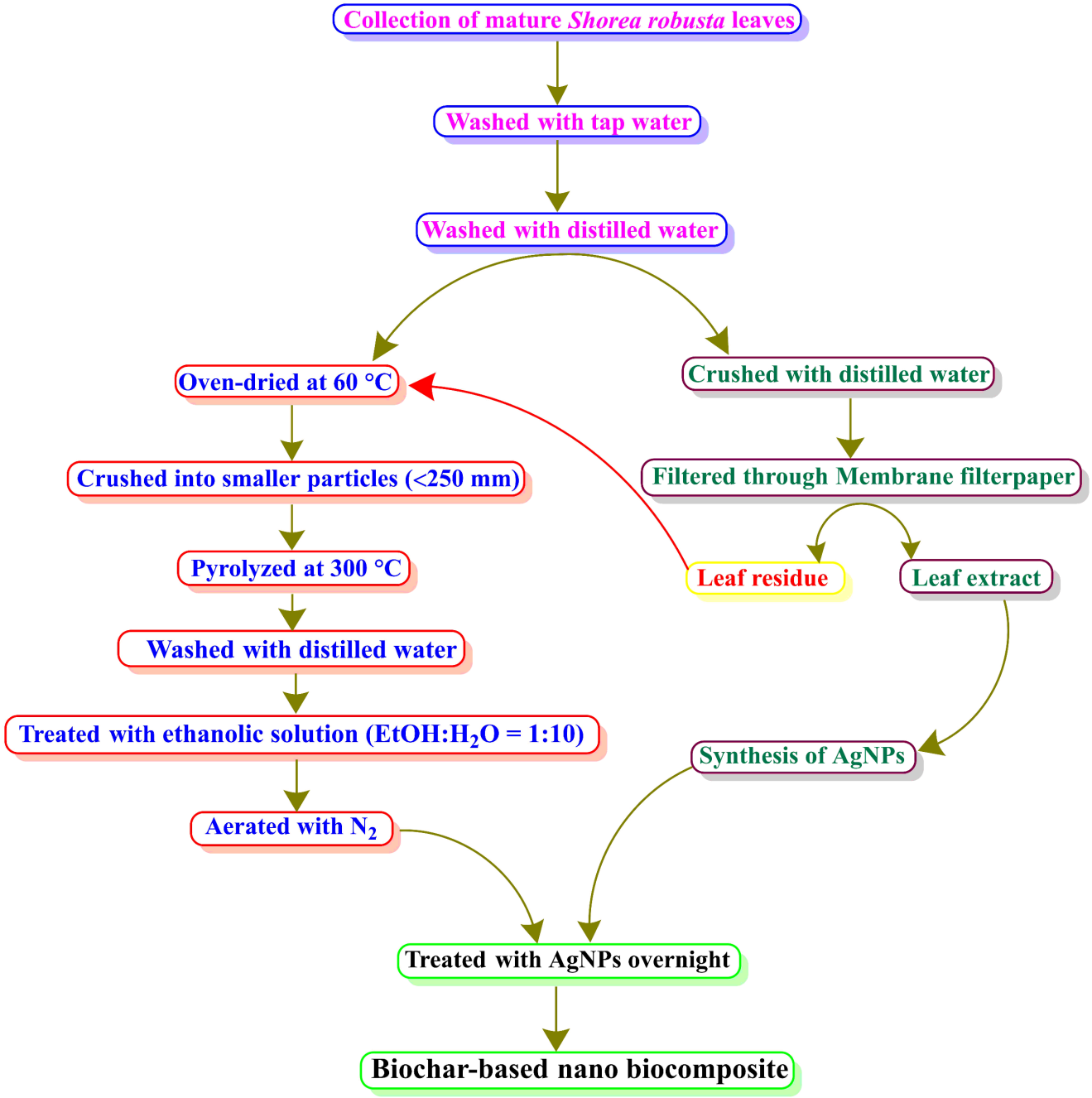
Dr. Sukalyan Chakraborty

Background of the work:

- Industrial as well as domestic effluents discharged into natural waterbodies contaminate them with emerging contaminants like dyes, antibiotics along with several others.
- Conventional treatment methods and materials poses various disadvantages.
- Application of nano particles can offer effective treatment options, with minimum disadvantages. The disadvantages can be taken care of by certain modifications as presented here

Objectives:

- To synthesize metallic/ metal oxide nano particles through green synthesis pathway to avoid impacts on environment
- To produce biochar-based nanocomposites by doping the nanoparticles on biochar produced from biomass waste
- To apply the material synthesized for treatment of emerging contaminants (here dye/antibiotics) laden wastewater

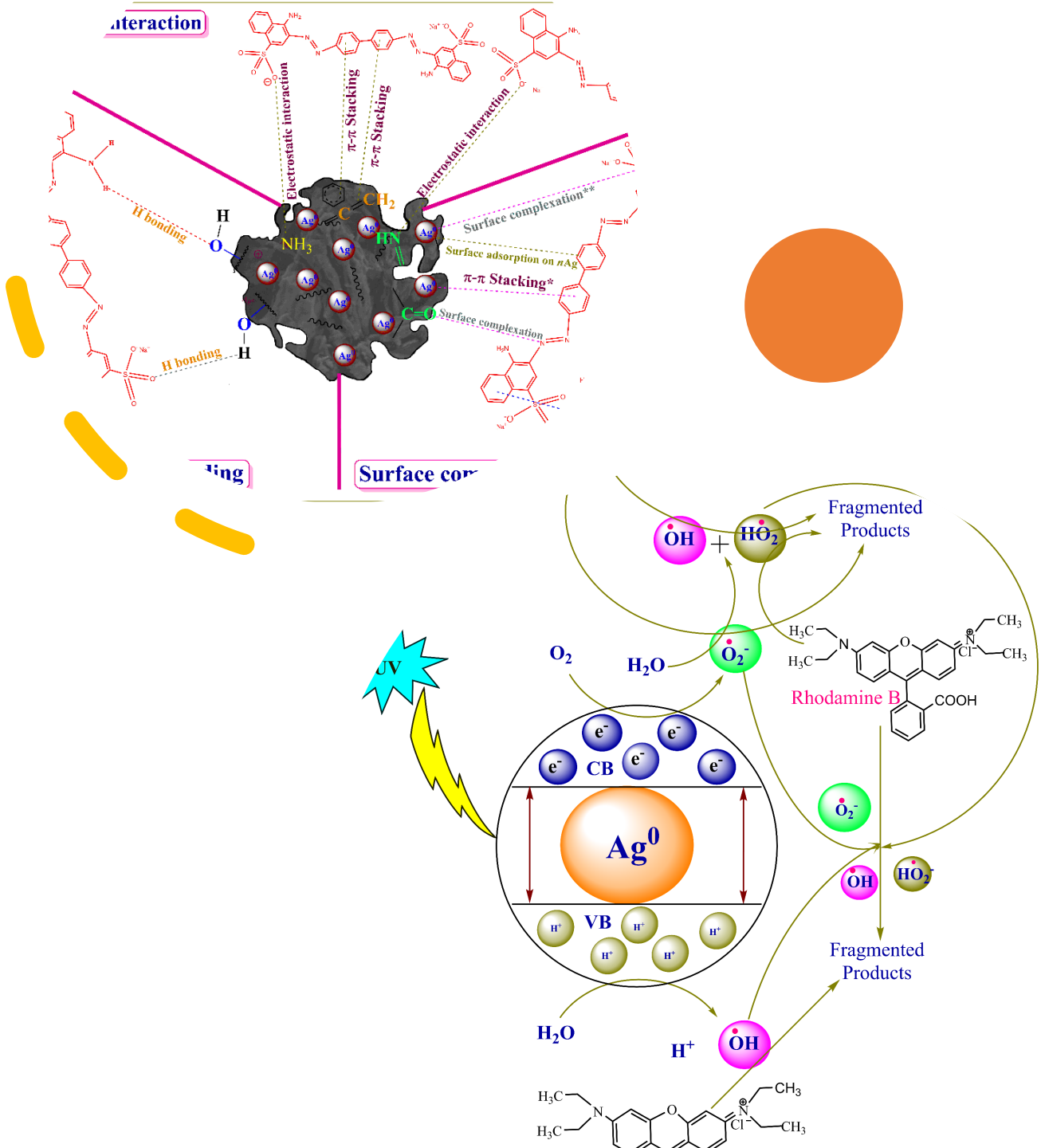


Methodology

1. Biosynthesis and characterization of Nanoparticles with plant extract (Sal, Neem) on precursors
2. Synthesis of Biochar from biomass by slow thermal pyrolysis
3. Doping of the nano particles on biochar to produce biochar-based nanocomposites and its characterization
4. Photocatalytic degradation and Adsorptive removal with parameter optimization
5. Study on desorption-based reusability potential and applicability on real effluents

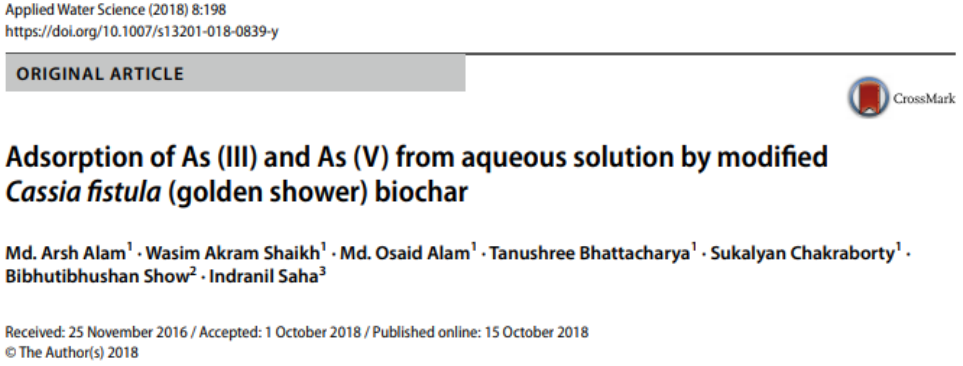
Findings so far

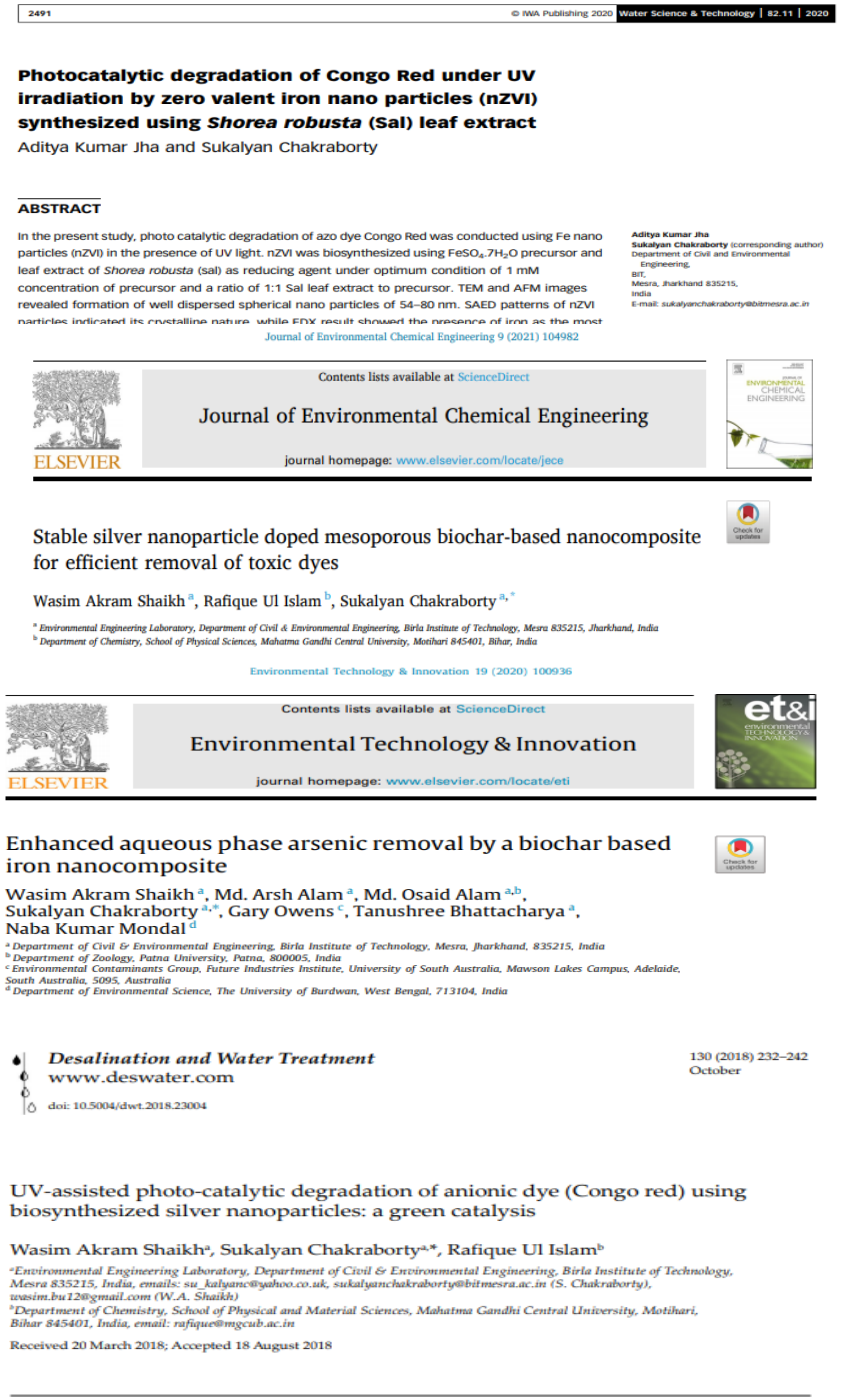
- Successful synthesis of stable nanoparticles (within 30nm) by plant extract as evident from characterizations
- Congo Red and Rhodamine Dye degraded and removed not only from synthetic solution (around 90%), but also real effluents (around 70%).
- Significant reusability was observed.
- Thus, can be an effective and sustainable material for treatment of the emerging contaminants



Outcome and Future plans

- Working on this topic since 2016
- Publications: 06
- Citations: 57
- Two MTech students awarded
- Two PhD students currently working
- Future plan: To design cost-effective water treatment filter for domestic use





Heavy Metal Pollution and Remediation of Water, Soil And Air

Dr. Tanushree Bhattacharya

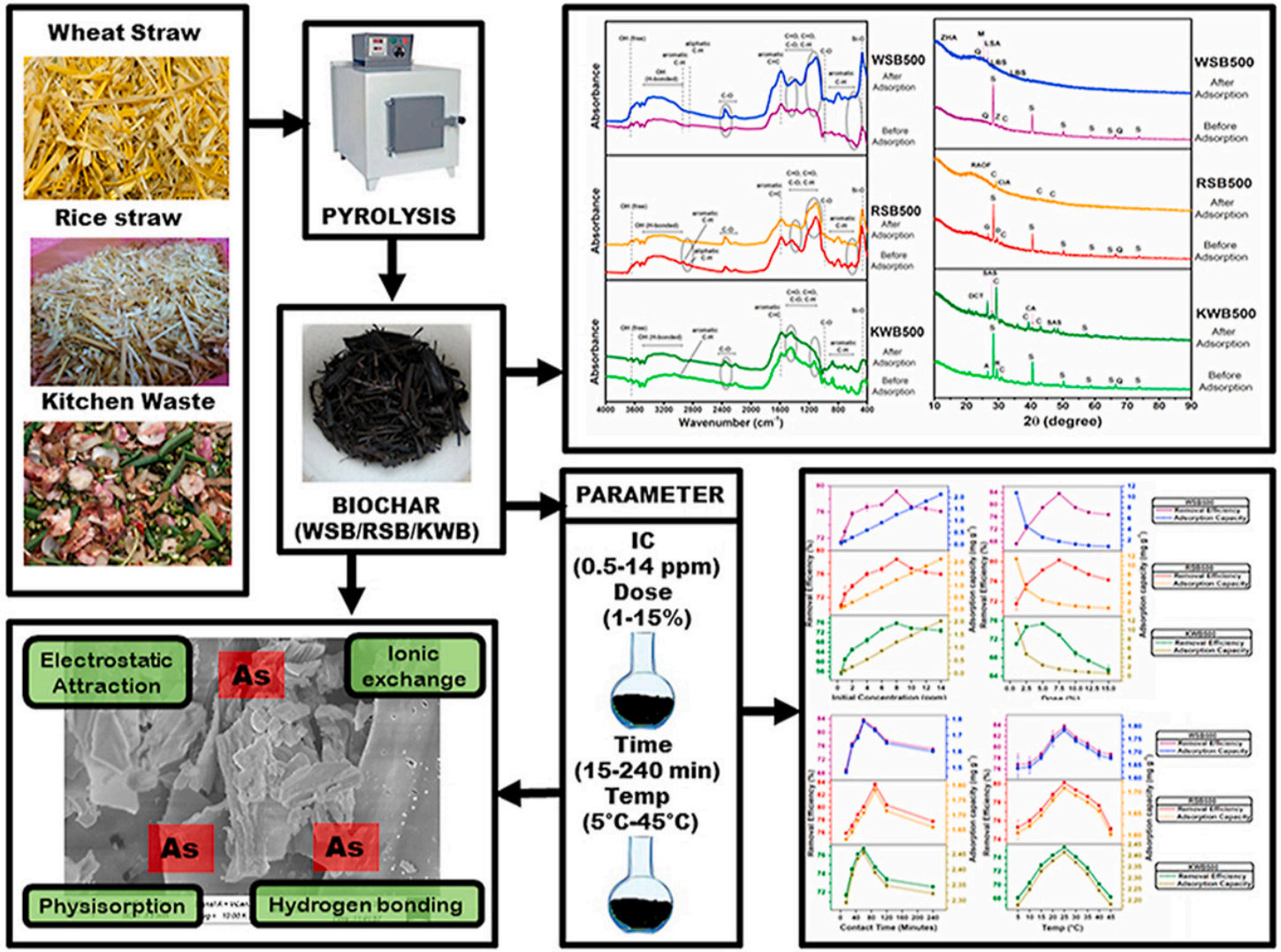
Background of the work:

- Use of agricultural waste into biochar, which can be used for remediation of soil: a waste to wealth approach
- Identifying plant species with air pollution tolerance and dust capturing capacity and metal accumulation capacity, who can serve as a bioindicator.
- Currently also working on development of air pollution prediction by neural network.
- Previously worked on groundwater and surface water monitoring and remediation.

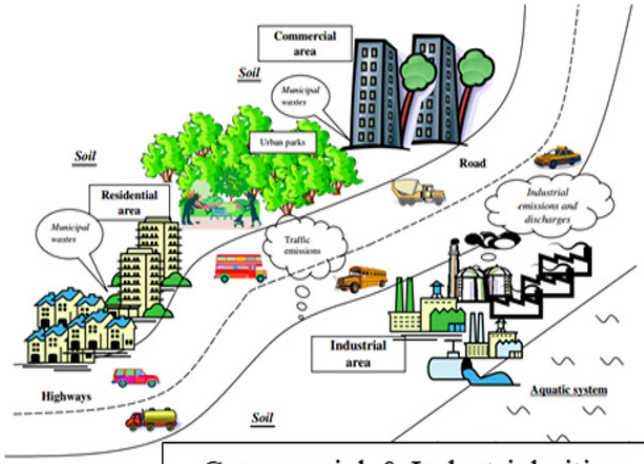
Objectives of the current research work:

- Use of waste derived biochar for remediation of heavy metals in soil (Study 1).
- List out native species with air pollution and metal tolerance (Study 2).
- Prediction of air pollution in coal mining areas using neural network models and validation of AERMOD and CALPUFF in Indian geo-mining condition (Study 3).

Methodology for arsenic removal by biochar (Study 1)



Methodology for air pollution tolerant species identification (study 2)



Commercial & Industrial cities

Air Pollution

Plants as biomonitors of air & metal pollution in soil

Among the tropical species studied Highest Air Pollution Tolerance Index, Anticipated Pollution Index

Mangifera indica

Highest Metal Accumulation Index & Dust Capturing Capacity

Ficus bengalensis

Highest Metal Transfer Coefficient

Psidium guajava

High Geoaccumulation Index, Enrichment Factor, Conncentration Factor

Metal Uptake

Soil with heavy metal

Methodology for prediction of air pollution in coal mines (study 3)

Collection of air pollution data from CAAQMS, Singrauli.

↓

Training of Network for model development and choosing the most appropriate model.

↓

Validation of the model

↓

Comparison of output data of developed model with conventionally used software (CALPUFF and AERMOD) output.

↓

Comparison and validation of the prediction accuracy of the developed soft computing models and conventionally used softwares AERMOD and CALPUFF

Figure: Stepwise methodology for Model Development

Findings so far

Key findings of the study-1:

- Rice straw-based biochar showed maximum arsenic sorption capacity of 11.4 mg g^{-1}.
- Arsenic sequestration potential of biochars could be arranged as WSB ≈ RSB > KWB.
- Negative values of ΔG, ΔS, and ΔH show spontaneous and exothermic arsenic sorption.
- Arsenic immobilization followed pseudo-second order, multi, and monolayer sorption.
- Removal of arsenic is mediated by physisorption, diffusion, and ionic interaction.

Key findings of the study-2:

- *M. indica, A. indica* and *F. religiosa* were most tolerant while *F. bengalensis* and *A. scholaris* were intermediately tolerant towards air pollution.
- *F. bengalensis, F. religiosa* and *M. indica* have the best dust capturing capacity.
- *P. guajava, M. indica, A. scholaris* and *F. religiosa* were found to be good phytoextractors of Cu. So, they can be recommended as Cu bioindicators.

Key findings of the study-3:

- The emission of air pollutants in Singrauli coal mine complex is very high.
- AERMOD predictions of different mines shows high air pollutant concentration in residential areas

Environmental implications

The findings of study -1 will help to address a prominent problem of arsenic contamination in soil and to find an environmental friendly solution for Indo-Gangetic plain.

To combat air pollution role of vegetation is immensely important, so a listing (study-2) of local native species which can serve as indicator as well as remediator of pollution will help all the Government implementing agencies to develop a green belt.

The findings of study-3 will help to validate currently used prediction methods of coal-mine air pollution under geo-mining conditions.

Outcome

Relevant publications:

- Abhishek Kumar, Tanushree Bhattacharya, Wasim Akram Shaikh, Arpita Roy, Santanu Mukherjee, Manish Kumar, Performance evaluation of crop residue and kitchen waste-derived biochar for eco-efficient removal of arsenic from soils of the Indo-Gangetic plain: A step towards sustainable pollution management, Environmental Research, Volume 200,2021, 111758, ISSN 0013-9351, https://doi.org/10.1016/j.envres.2021.111758.
- Tanushree Bhattacharya & Shikha Kumari Pandey & Vimal Chandra Pandey & Abhishek Kumar. Potential and safe utilization of Fly ash as fertilizer for Pisum sativum L. Grown in phytoremediated and non-phytoremediated amendments. Environmental Science and Pollution Research https://doi.org/10.1007/s11356-021-14179-9.2021.
- Lenka, S.P., Shaikh, W.A., Owens, G., Lokesh P. Padhye, Sukalyan Chakraborty & Tanushree Bhattacharya* . Removal of Copper from Water and Wastewater Using Dolochar. *Water Air Soil Pollut* **232,** 167 (2021). https://doi.org/10.1007/s11270-021-05135-x.
- Kumar, A., Bhattacharya *, T. Removal of Arsenic by Wheat Straw Biochar from Soil. *Bull Environ Contam Toxicol* (2021). https://doi.org/10.1007/s00128-020-03095-2.
- Wasim Akram Shaikh, Md. Arsh Alam, Md. Osaid Alam, Sukalyan Chakraborty, Gary Owens, Tanushree Bhattacharya, Naba Kumar Mondal, Enhanced aqueous phase arsenic removal by iron nano bio-composite, Environmental Technology & Innovation, 2020, 100936, ISSN 2352-1864, https://doi.org/10.1016/j.eti.2020.100936. SCI.
- A. Kumar, T. Bhattacharya, S.M. Mozammil Hasnain, A. Kumar Nayak, S. Hasnain, Applications of biomass-derived materials for energy production, conversion, and storage, Materials Science for Energy Technologies (2020), doi: https://doi.org/10.1016/j.mset.2020.10.012, ISSN: 2589-2991
- Tripta, Tanushree Bhattacharya*, Soubhik Chakraborty, S.Konar. Application of Multiple Linear Regression and Geographically Weighted Regression Model for Prediction of PM2.5". Proceedings of the National Academy of Sciences, India Section A: Physical Sciences. SCI indexed, 2020, https://doi.org/10.1007/s40010-020-00718-5, Electronic ISSN 2250-1762, Print ISSN 0369-8203.
- Abhishek Kumar, Tanushree Bhattacharya. Biochar a sustainable solution. Environment development and sustainability,2020, https://doi.org/10.1007/s10668-020-00970-0. SCI indexed, Impact factor, Electronic ISSN 1573-2975, Print ISSN 1387-585X.
- Arpita Roy, Tanushree Bhattacharya*, Mala Kumari, Air pollution tolerance, metal accumulation and dust capturing capacity of common tropical trees in commercial and industrial sites, Science of The Total Environment, 2020, ISSN 0048-9697, ttps://doi.org/10.1016/j.scitotenv.2020.137622.
- Tanushree Bhattacharya, Tripta Narayan, Soubhik Chakraborty, Swapan Konar, Shilpi Singh. Statistics as a Technology to Predict the Seasonal Variation of Air Pollution. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-3, January 2020. Scopus indexed.

National Carbonaceous Aerosol Programme (NCAP) Working Group n Modeling Carbonaceous Aerosol Source Influence And Atmospheric Effects

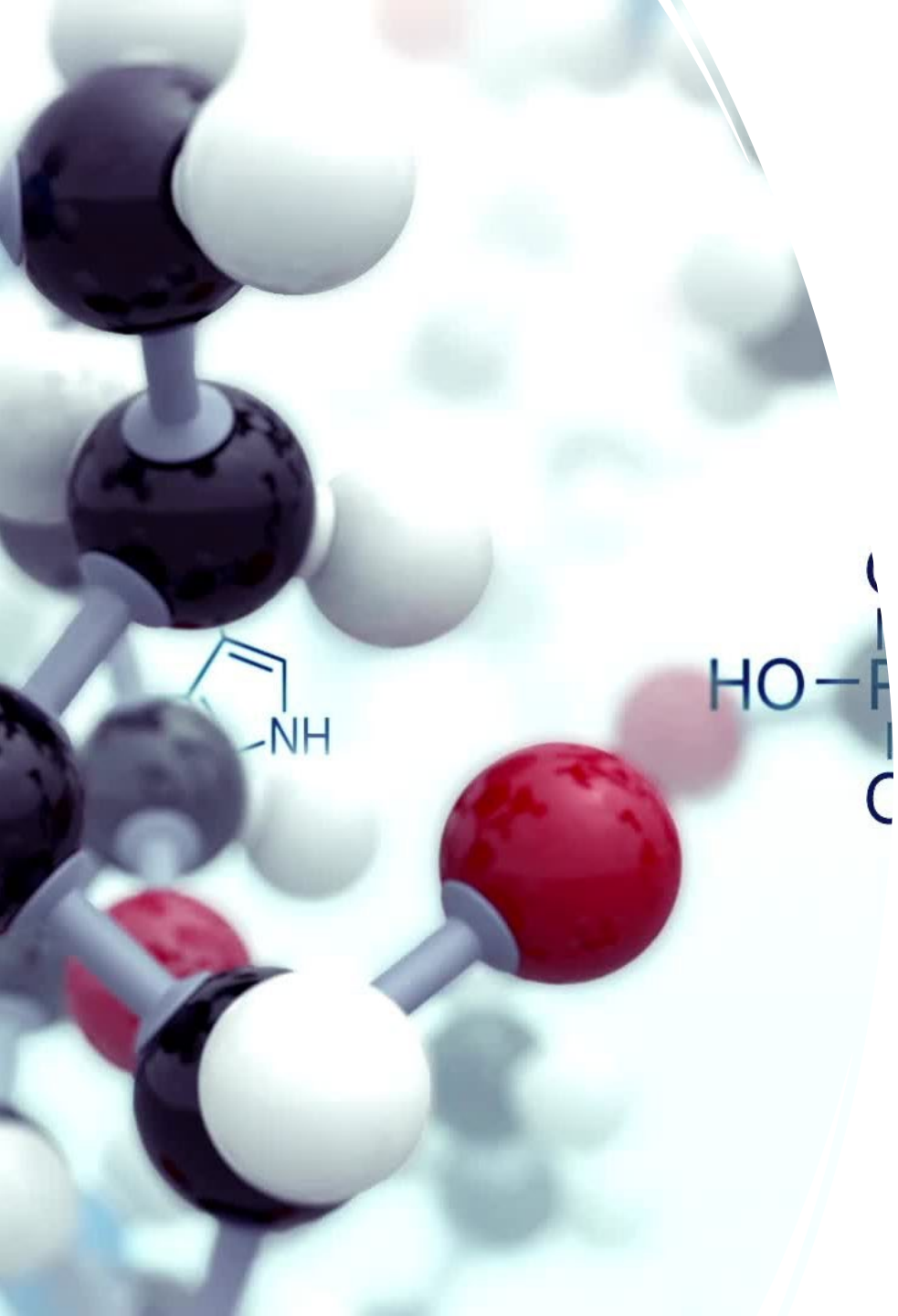
Dr. Jawed Iqbal

Background of the work:

- The National Carbonaceous Aerosol Program (NCAP) of the Indian Network for Climate Change Assessment (INCCA) was launched in March 2011 by the Ministry of Environment Forests and Climate Change.
- The NCAP seeks to further our understanding of regional carbonaceous aerosols in terms of major sources and their influence, atmospheric transformations and processes, impact on clean air and climate and impact on vulnerable ecosystems.

Objectives:

- Understanding the role of carbonaceous aerosols in regional climate change over India, using source apportionment (top-down approach) to constrain emissions-driven climate modelling (bottom-up approach



Methodology

- Aerosol and meteorological measurements for receptor modeling, 2-y period.
- Chemical, absorption and special marker measurements (source and ambient samples).
- Receptor model (PMF) estimated BC-OC source-sector influence by season and region.
- Combined approaches using trajectory modeling (PSCF/CPF) and inventory data to understand BC-OC sources.

Findings so far

- PM2.5 mass concentration measurement for continuous 2 years
- Chemical Characterization of particulate

Implication on environment/ society

- emission source identification.
- national carbonaceous aerosol emission inventory.
- Field emission factor measurement.
- influence of carbonaceous aerosols on the regional atmosphere.
- National policy making

Monitoring and Modelling of soil and water quality in and around Jumar watershed

Dr. Neeta Kumari

Background of the work:

- Synergistic effect of various natural and human induced hydrogeochemical processes deteriorate the soil and water quality of a watershed threatening the survival, development and socio-economic sustainability of the residing inhabitants
- Hence, there is a need for intensive study of the various influencing parameters, their sources and extent of their impact on land and water quality of the watershed.
- In order to find the remedial and prevention techniques that could be applied for ecological and socio-economic improvement of the watershed.

Objectives:

- To monitor the hydro geochemistry of the study area on seasonal basis.
- To do statistical analysis of collected data
- To do LULC analysis of the area using GIS
- To develop WQI and analyze pollution based on HPI, Igeo.
- To improve soil quality by suitable amendments to improve socio-economic status of the area
- To develop a machine learning ANN model based on the obtained results

Methodology

Sampling area and locations are to be fixed using field survey and GPS equidistantly throughout the watershed

Soil and water samples are to be collected from fixed sampling points seasonally and the hydrogeochemical parameters are to be analyzed in laboratory based on APHA and IS codes.

Identification and study of the impact of point and non-point source pollution on environmental component are to be done on a seasonal basis using laboratory analysis and GIS

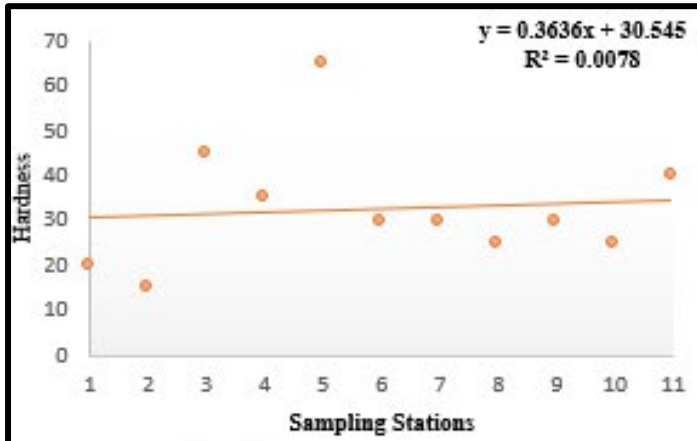
Index for area specific water quality and pollution monitoring is to be developed for future utility based on the laboratory results using statistics and neural network models.

Then the geospatial analysis of spectral indices and LULC changes are to be done to validate the ground results obtained and prepare a ANN model for overall watershed monitoring and planning

Based on the results the remediation techniques are to be obtained for improving ecological and socio-economic productivity .

Work done so far

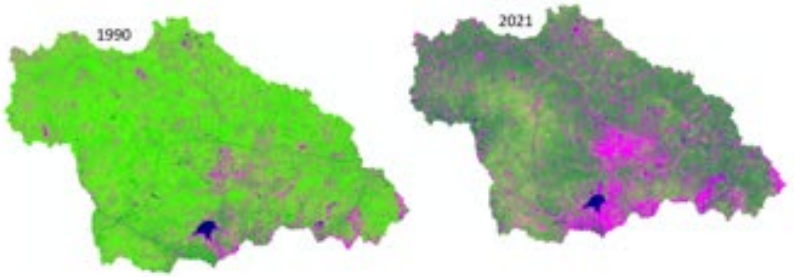
- Site investigation has been done
- Seasonal sampling and laboratory analysis has been done for year 2021 and still continuing.
- LULC changes and vegetation spectral indices have been studied for decadal period
- Future urban growth prediction has been done based on CA-ANN .
- Application of industrial and organic waste to enhance the quality of soil and water resource is being studied.



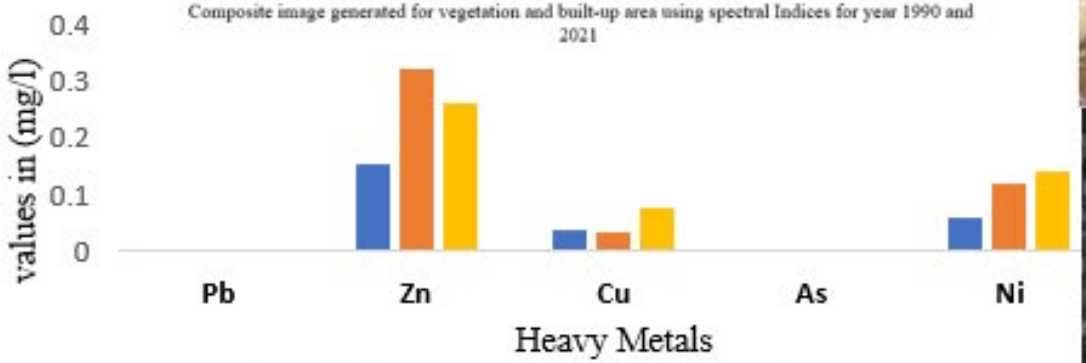
Monsoon 2021

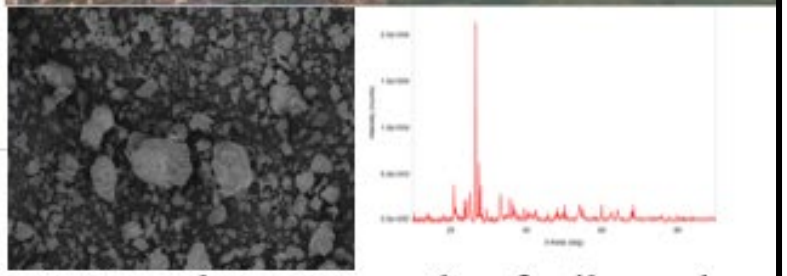
Component	Initial Eigenvalues		Extraction sums of squared loadings			
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.737	43.422	43.422	1.737	43.422	43.422
2	1.45	36.249	79.671	1.45	36.249	79.671
3	0.71	17.751	97.423			
4	0.103	2.577	100			

Extraction method: principal component analysis

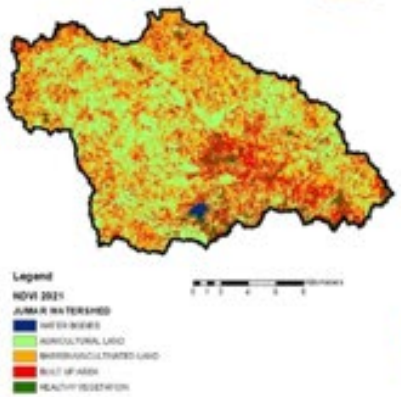


Composite image generated for vegetation and built-up area using spectral Indices for year 1990 and 2021

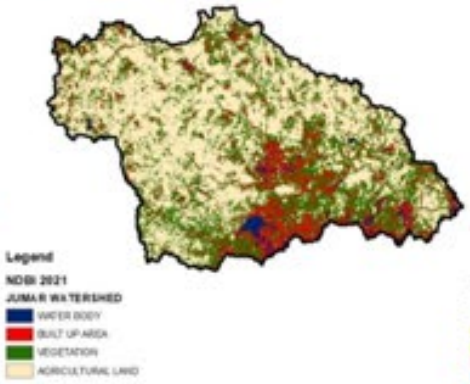




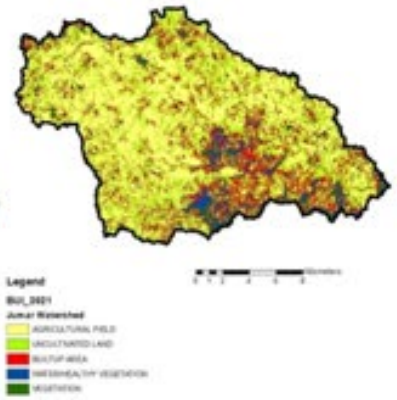
XRD and FESEM results of soil samples



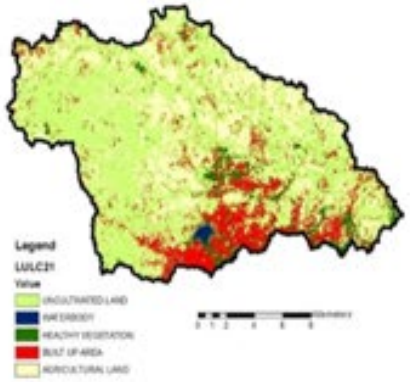
NDVI MAP OF JUMAR WATERSHED 2021



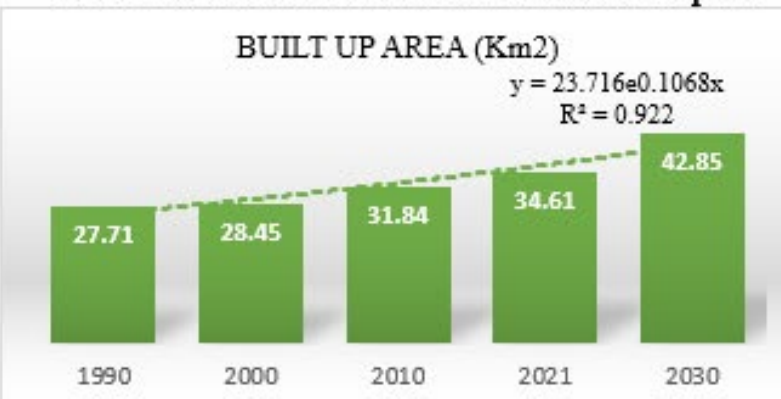
NDBI MAP OF JUMAR WATERSHED 2021



BUI MAP OF JUMAR WATERSHED 2021



LULC MAP OF JUMAR WATERSHED 2021



Outcome

- Based on the results obtained from on going research, it was found that the watershed suffer from degradation in soil and water quality. The LULC change show the significant loss of water resources and agriculture land both, while a slow increase in urban built up.

Publication

Pandey, S., **Kumari, N**. and Prasad, S.P., **2021**. Soil quality and pollution assessment around Jumar watershed of Jharkhand, India. ***Arabian Journal of Geosciences***, *14*(24), pp.1-20. (**SCI with IF 1.8)**

Book chapter

Kumari, N. and Pandey, S., 2022. Sustainability Assessment of Jumar River in Ranchi District of Jharkhand using River Sustainability Bayesian Network (RSBN) model Approach. In ***Ecological Significance of River Ecosystems*** **(pp. 407-428).** Elsevier.

Future Plan

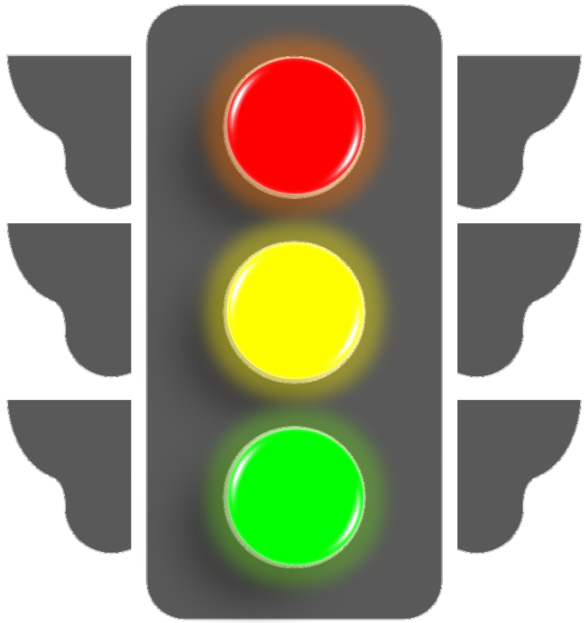
- Plan of effective water and soil management strategies
- Socio-economic impact assessment
- Look for probable opportunities for project funding

Capacity Analysis of Unsignalized Intersection

Dr. Ashish K. Patnaik

Background of the work:

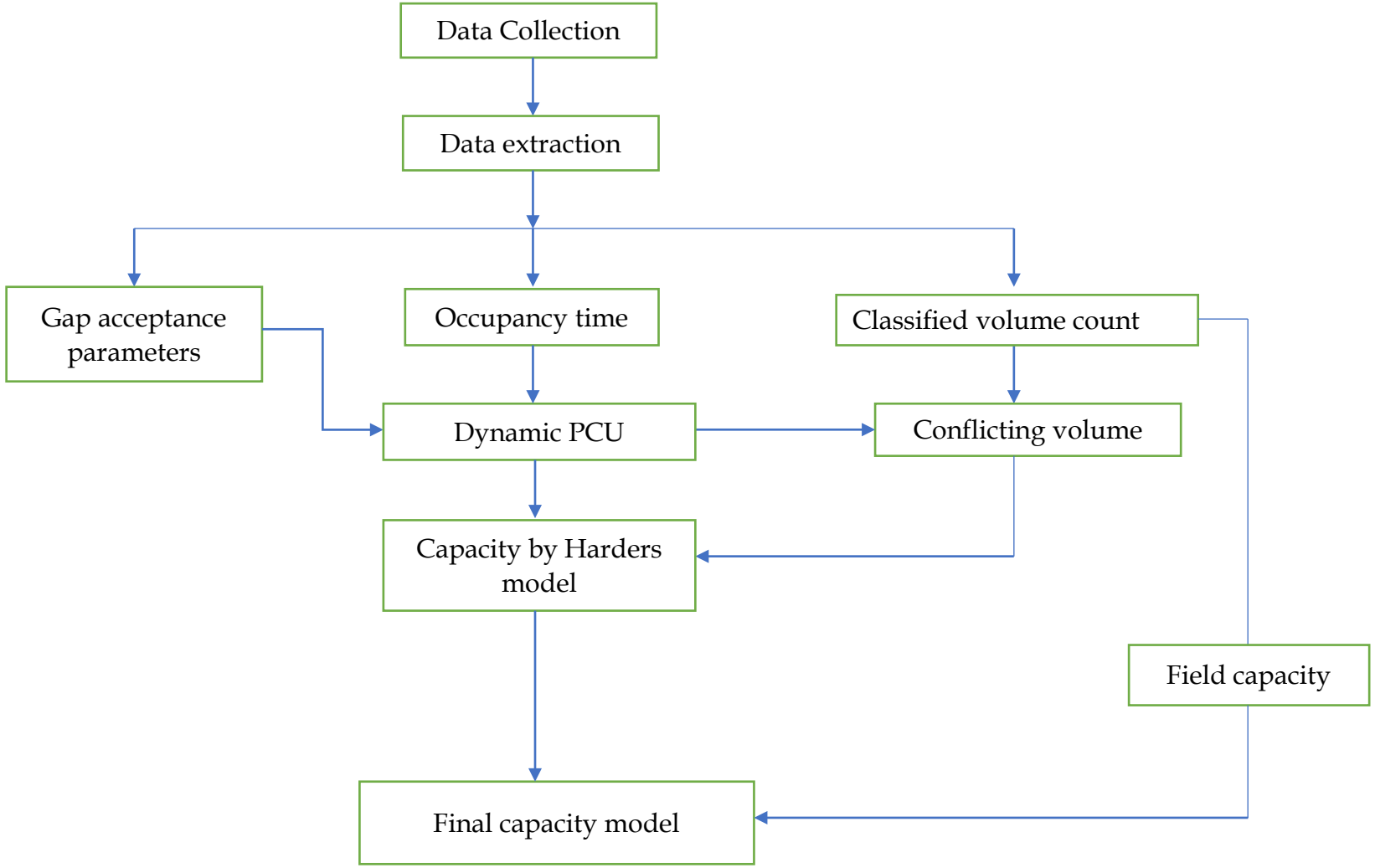
- The unsignalized intersection, is defined as any at-grade junction of two or more regular roads where the right-of-way for vehicles, bicycles, and pedestrians is not regulated by a highway traffic signal.
- The intersection generally comprises not just the roadway area, but also the surrounding walkways of pedestrian infrastructure.
- Gap acceptance is the minimum gap required to finish lane changing safely such as minor stream vehicle accepts an available gap to maneuver.
- Traffic Capacity is expressed as the maximum number of vehicles in a lane or a road that can pass a given point in unit time, usually an hour such as vehicles per hour per lane or roadway.



Objectives

- Investigate the traffic performance at unsignalized intersections under mixed traffic conditions such as speed, flow and intersection occupancy.
- Investigate the contributing parameters that can be used to describe maximum flow (capacity).
- To develop new procedures of capacity estimation at unsignalized intersections based on conflict streams.
- Development of capacity modelling of unsignalized intersection under mixed traffic flow conditions.

Methodology



Findings so far

Key findings of the study

- To develop a method for estimating a critical gap under mixed traffic flow conditions.
- To estimate the passenger car equivalents in the current traffic scenario.
- To develop different capacity models for the estimation of unsignalized intersection capacity.

Implication on environment/ society

- To identify the jam conditions and operational conditions in the unsignalized intersections which helps to reduce the accident rate.
- Reduces the fuel consumption and environmental pollution by estimating the capacity of any particular intersection.

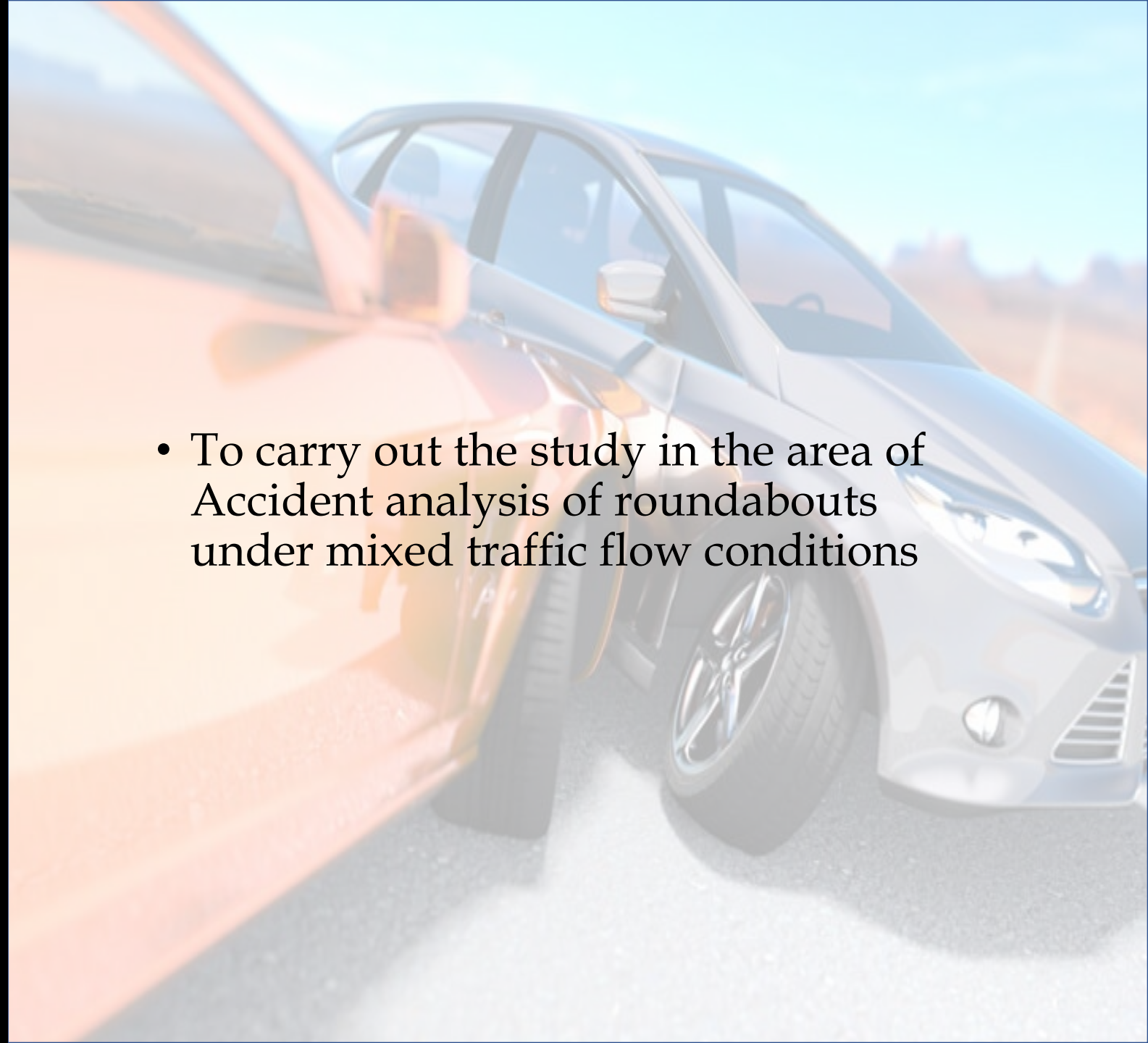
Outcomes (International Journals)

1. Patnaik, A.K., Agarwal, A., Panda, M., Bhuyan, P.K. (2018) "Entry capacity modelling of signalized roundabouts under heterogeneous traffic conditions" *Transportation Letters: The International Journal of Transportation Research,Taylor & Francis,* Vol. 12 (2), pp. 100-112, https://doi.org/10.1080/19427867.2018.1533160.**(SCI Indexed)**
2. Patnaik, A.K.,Chaulia, S., Bhuyan, P.K. (2018) "Roundabout entry capacity models: Genetic programming approach", *Proceedings of the Institution of Civil Engineers-Transport, ICE Publishing,https://doi.org/10.1680/jtran.17.00089.***(SCI Indexed)**
3. Patnaik, A.K., Ranjan, A.R., Bhuyan, P.K. (2018) "Investigating Entry Capacity Models of Roundabouts Under Heterogeneous Traffic Conditions", Transportation Research Record: Journal of the Transportation Research Board, Vol. 2672(15), pp. 35–43.DOI: 10.1177/0361198118777603. **(SCI Indexed)**
4. Patnaik, A.K., Krishna, Y., Rao, S. and Bhuyan, P.K. (2017) "Development of Roundabout Entry Capacity Model Using INAGA Method for Heterogeneous Traffic Flow Conditions", *Arabian Journal for Science and Engineering, Springer Publication*, Vol. 42(9), pp. 4181–4199, DOI 10.1007/s13369-017-2677-x. **(SCI Indexed)**
5. Patnaik, A.K., Rao, S., Krishna, Y.,Bhuyan, P.K. (2017) "Empirical Capacity Model for Roundabouts under Heterogeneous Traffic Flow Conditions". *Transportation Letters: The International Journal of Transportation Research,Taylor & Francis,* Vol.9(3), pp. 152-165.http://dx.doi.org/10.1080/19427867.2016.1203583. **(SCI Indexed)**
6. Patnaik, A.K. and Bhuyan, P.K. (2016) "Application of Genetic Programming Clustering in Defining LOS Criteria of Urban Street in Indian Context", *Travel Behavior and Society*, Elsevier Publication, Vol. 3, pp. 38-50,https://doi.org/10.1016/j.tbs.2015.08.003.**(SCI Indexed)**
7. Patnaik, A.K., Bhuyan, P.K. (2016) "Defining level of Service criteria of urban streets using divisive analysis (DIANA) of hierarchical clustering and GPS data in Indian context. *Alexandria Engineering Journal, Elsevier,* Vol. 55(1), pp. 407-418, https://doi.org/10.1016/j.aej.2015.11.003. **(SCI Indexed)**
8. Patnaik, A.K., Patra, R., Bhuyan, P.K. (2019) "Comparison of Artificial Intelligence Based Roundabout Entry Capacity Models", *International Journal of Intelligent Transportation System Research, Springer,* https://doi.org/10.1007/s13177-019-00207-z. **(Scopus Indexed)**
9. Patnaik, A.K., Kumar, D.P., Panda, M., Bhuyan, P.K. (2020) "Entry Capacity Quantifying Model through Drivers' Behavior at Roundabouts" Transportation Research Procedia, Elsevier, Vol. 48, pp. 707-718, https://doi.org/10.1016/j.trpro.2020.08.073. **(Scopus Indexed)**

Outcomes (Conferences)

1. Patnaik, A.K., Patra, R., Bhuyan, P.K. (2019) "Comparison among Entry Capacity Models for Roundabouts: Artificial Intelligence Techniques", 15th World Conference on Transport Research - WCTR 2019, 26-31 May, IIT Mumbai, India. (Accepted for journal publication)
2. Patnaik, A.K., Kumar, D.P., Panda, M., Bhuyan, P.K. (2019) "Entry Capacity Quantifying Model through Drivers' Behavior at Roundabouts", 15th World Conference on Transport Research - WCTR 2019, 26-31 May, IIT Mumbai, India. (Accepted for conference proceedings)
3. Patnaik, A.K., Ranjan, A.R., Bhuyan, P.K. (2018) "Investigating Entry Capacity Models of Roundabouts Under Heterogeneous Traffic Conditions", 97th Annual Meeting of the Transportation Research Board, Washington, D.C. January 7-11, 2018.
4. Patnaik, A.K., Agarwal, A., Bhuyan, P.K., Kumar, D.P. (2017) "Delay models for Roundabouts under mixed Traffic flow Conditions in Developing Countries" 4th Conference of Transportation Research Group of India, 17-20 December, Mumbai, India (International Conference).
5. Patnaik, A.K., Krishna, Y., Bhuyan, P.K. (2017) "Modelling Capacity of Roundabouts under Mixed Traffic Flow using Gap Acceptance Concept", International conference on Communication, Control, Instrumentation & Computational Technologies IC31CT-2015, Bangalore, India. (International Conference).
6. Patnaik, A.K., Bhuyan, P.K. (2017) "Defining Speed Ranges Of Urban Streets by Using Expectation-Maximization Algorithm". National seminar on SMTBF, Institution of Engineers, 11-12 November, Rourkela local centre, India.
7. Patnaik, A.K., Sahani, R., Sahoo, K., Bhuyan, P.K. (2016) "Modelling Entry Capacity Reduction Factor of Roundabouts under the Influence of Pedestrians in Developing Countries" 12th TPMDC, Transportation Planning and Implementation Methodologies for Developing Countries,19-21 December, Mumbai, India (International Conference).
8. Patnaik, A.K., Mishra, N.B., Bhuyan, P.K. (2020) "Modelling of Critical gap of Roundabouts under Heterogeneous Traffic Flow Conditions", 2nd ASCE Conference on CRSIDE, Challenges of Resilient and Sustainable Infrastructure Development in Emerging Economics, 02-04 March, Kolkata, India (International Conference).
9. Patnaik, A.K., Mishra, N.B., Bhuyan, P.K. (2020), Comparative study of Critical gap at Roundabouts: Heterogeneous Traffic Condition", 13th TPMDC, Transportation Planning and Implementation Methodologies for Developing Countries,10-11 December, Mumbai, India (International Conference).

Future plans



- To carry out the study in the area of Accident analysis of roundabouts under mixed traffic flow conditions

Mechanical and Structural Behavior of Hybrid Fiber Reinforced Concrete and Partially Replacement of Cement with Fly Ash

Prof. Birendra Kumar Singh

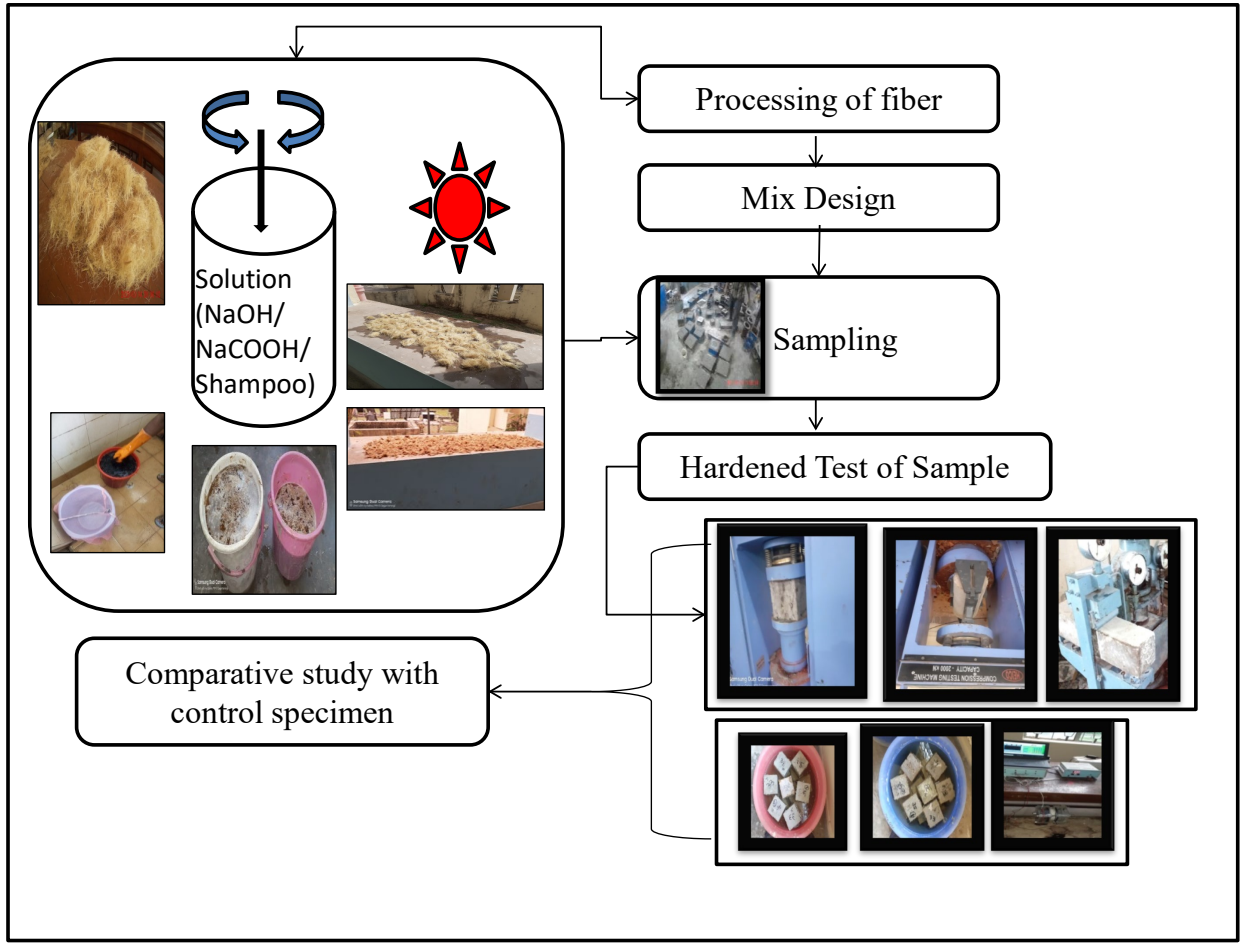
Background of the work:

Concrete is weaker in tension and brittle in nature which developed micro cracks due to drying and plastic shrinkage. Addition of reinforcing agent to create a bridge in interfacial transition zone within the composite to make the concrete ductile.

Objectives:

- Hybridization of natural fiber in a single matrix
- Hybridization of natural fiber with synthetic fiber in a single matrix
- Partially replacement of cement with fly ash in hybrid reinforced concrete
- Adoption of treated grey water from a colony in mixing of hybrid concrete
- Study the feasibility of Housing for Lower Income Groups above reclaimed back filled quarry dump for rehabilitation and resettlement purpose

Methodology



Findings so far

Discrete and randomly oriented both natural and textile fiber mixed with concrete composite enhanced mechanical properties of concrete matrix.

Fiber concentration play vital role in mechanical properties of the composite material

Agricultural and industrial waste material can be used as a reinforcing agent in concrete composite.

Outcome

- S Sarangi & B K Singh, "*Influence of textile fiber in the mechanical characteristic of Hybrid Fiber Reinforced Concrete*", Journal of Natural Fibers, SCIE, Q1, IF-5.32 DOI: https://doi.org/10.1080/15440478.2021.2002754
- S Sarangi & B K Singh, "*Influence of natural fiber in the mechanical and durability characteristic of Hybrid Fiber Reinforced Concrete*" Journal of Natural Fibers, SCIE, Q1, IF-5.323 Status: **Accepted on 19.10.2021 Online on 16.11.2021**
- S Sarangi, A Golder, M Mohan, I Roy, B K Singh, *"Housing for Lower Income Groups on shovel dumper over-burden (OB) dump-An approach towards re-habitation"*, presented in 3rd International Conference on Sustainable Environment, Energy and Construction (ICSEEC-2021), organised by Hindustan Institute of Technology & Science, Chennai, India from 16th & 17th December, 2021.nstitute of

Alternative Supplementary cementitious material (SCM’s)

Mr. Mani Mohan

Background of the work:

A common problem encountered in developing countries is the lack of availability of SCM's to prescribed pozzolanic standards, and this brings about a scarcity of standard supplementary materials to be blended with cement clinker in these countries. Low-cost housing possibilities are feasible if a considerable amount of local waste is utilized to make mortar and concrete in the building. Blending cement with locally available construction waste materials possessing adequate pozzolanicity is reasonable to reduce cement cost and environmental pollution

Objectives:

pozzolanic potential of locally obtained under-burnt crushed waste brick from kilns as a mineral admixture.

Methodology

Fig. I (a): Underburnt bricks as obtained from the kiln

Fig. I (b): Concrete Pulveriser

Fig. I (c): Bricks crushed in crusher and pulveriser

Fig. I (d): Different fractions of CBP

Fig. I (e): Dry constituents of mortar mix

Fig. I (f): Mortars cured in an accelerated curing tank at a constant temperature of 27°

Fig. II (a): Plastic vessels used to prepare cement paste

Fig. II (b): Cement paste cured inside plastic vessel sealed with Parafilm

Fig. IV :Testing

Fig. III (a): Cement paste after crushing

Fig. III (b): Powder being sieved through 63µ sieve

Fig. III (c): Powder immersed in isopropanol for hydration stoppage (TGA, XRD)

Fig. III (d): Powder filtered through filter paper (TGA, XRD)

Fig. III (e): Filtered powder washed with diethyl ether (TGA)

Fig. III (f): Final sample stored in airtight bags after drying at 40°C in oven

Findings

- Early appearance of monosulfoaluminate, early disappearance of ettringite, and additional AFm phases like strätlingite and katoite indicate the volume of hydrates produced in blended samples higher as compared to that of the OPC sample. This may be responsible for pore refinement of the structure, leading to higher compressive strength observed at 90 days.
- Low volume CBP replacement up to 15% can be done for attainment of long-term mechanical strength and secondary construction works like plastering of walls. For a mix design of M25 grade concrete, a high volume CBP replacement of 45% gives concrete grade M20**; thus, this grade of concrete can be satisfactorily used as a low-cost construction material for affordable housing.**
- CBP should be carefully selected as the pozzolanicity depends on the geology of clay deposits, which vary from place to place and the manufacturing process of bricks.

What Next?

- Compare the pozzolanic index of waste crushed brick powder found in Chotanagpur Plateau (Ranchi) and Gangetic Alluvial Plain (Patna)
- Enhance the pozzolanic reaction and maintain the integrity of concrete.
- Durability Study.

Production of Sustainable Geopolymer Concrete using Construction & Demolition Waste by Adapting Equivalent Mortar Volume Method

Dr. Puja Rajhans

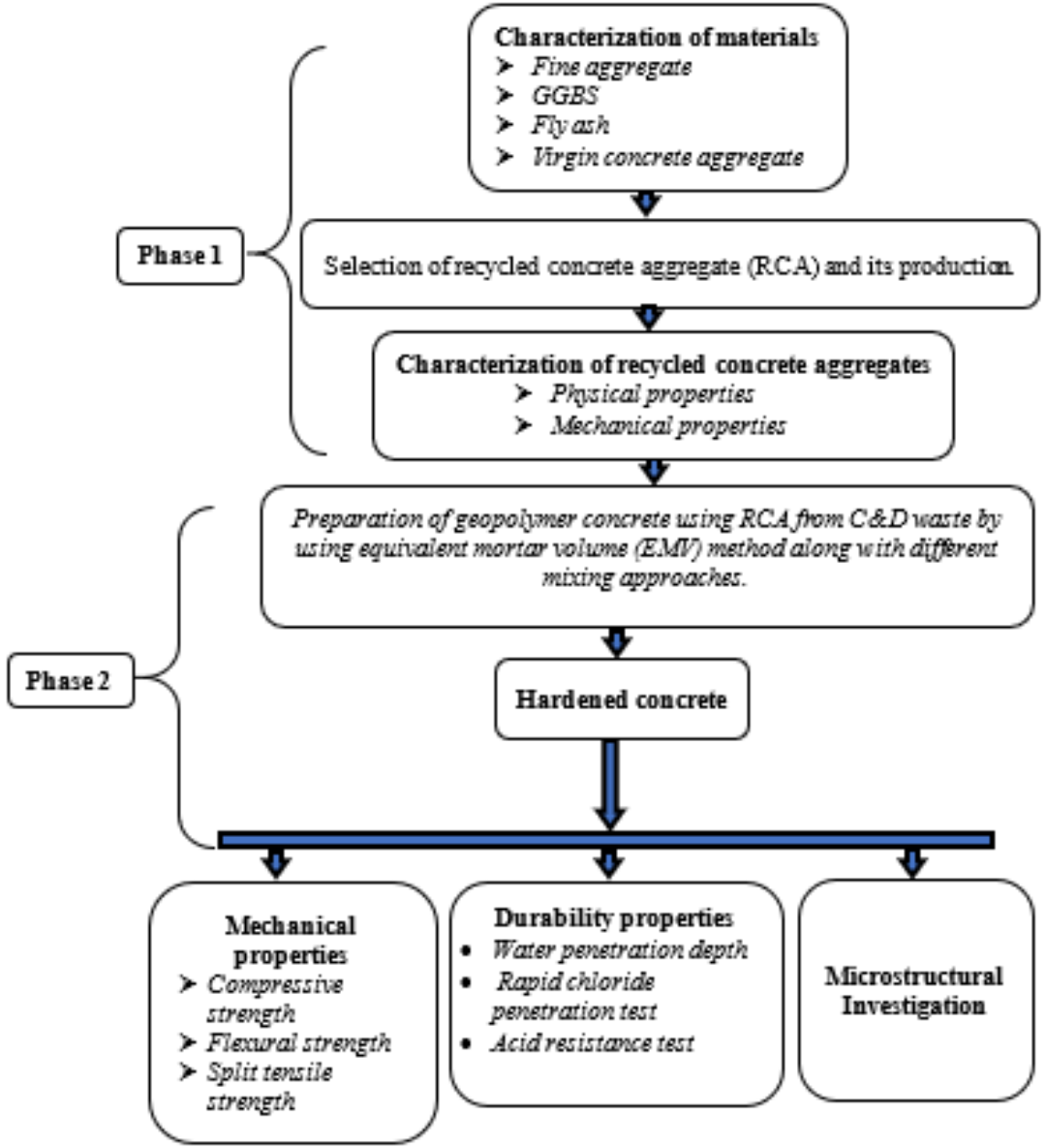
Background of the work:

To construct new structure, the old buildings are being demolished. Due to the demolishing of old buildings, many debris are generated, which leads to various environmental pollutions. To overcome from the current problem on the environment one of the best solutions for the above problem is using Construction & Demolition (C&D) waste as an aggregate in preparation of new concrete. Recycling of C&D waste has enormous potential and it has been the interesting subject of investigation for a decade. Using C&D waste as an aggregate reduces the use of virgin concrete aggregate (VCA).

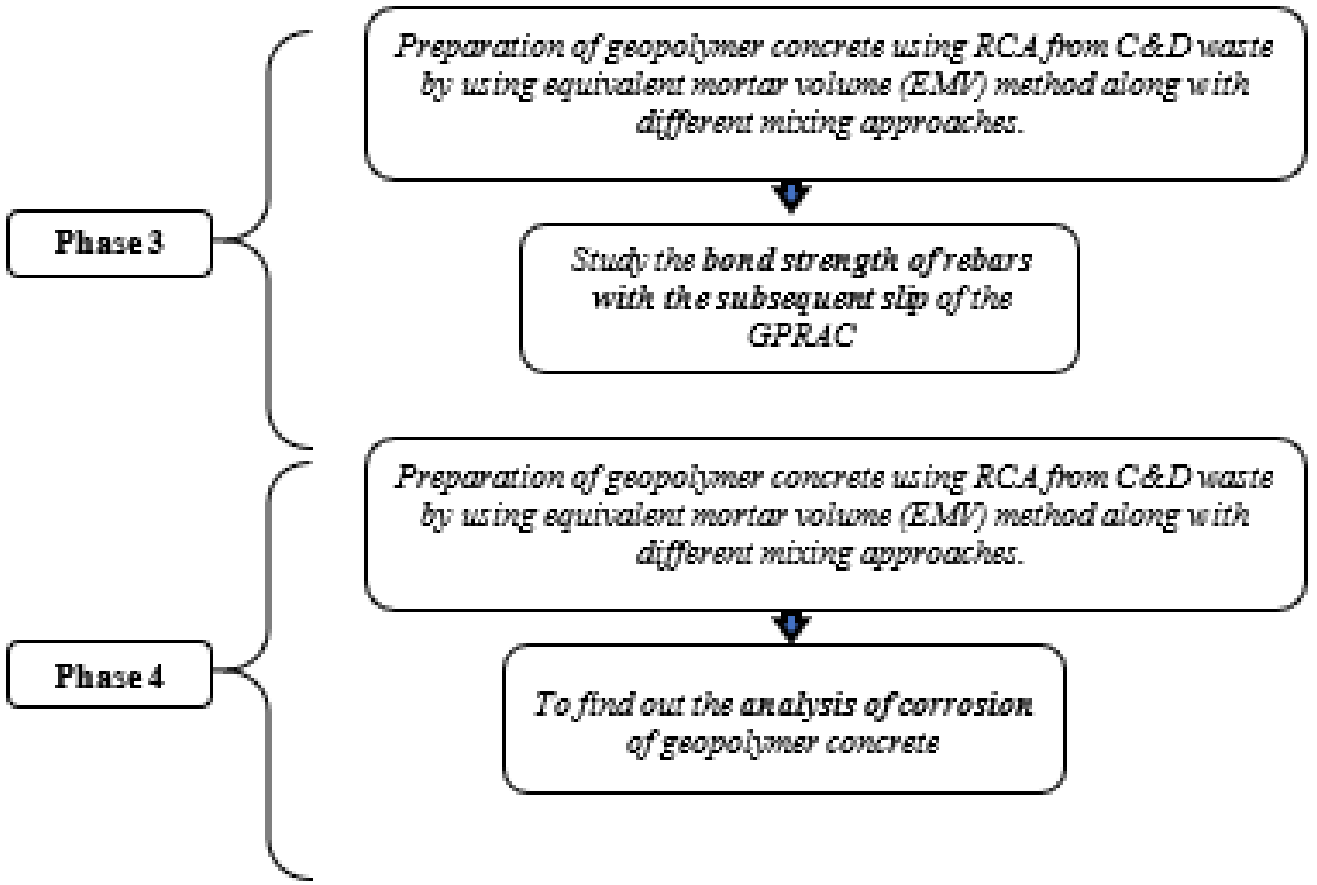
Objectives:

- To investigate the mechanical and durability properties of the geopolymer concrete containing recycled concrete aggregates (RCA) along with different mixing approach by using EMV method.
- To study the bond strength of rebars with the subsequent slip of the geopolymer concrete prepared by using recycled concrete aggregates (RCA) along with different mixing approach by using EMV method and the justification of improvement is checked through microstructural investigation.
- To find out the analysis of corrosion of geopolymer concrete prepared having recycled concrete aggregates

Methodology



Methodology



Findings so far

- It is observed that Construction & Demolition waste are used to produce sustainable geopolymer concrete after adding some admixtures. Along with admixtures, some different mixing approaches are also useful to achieve the desired strength and makes concrete more durable. Geopolymer concrete produced by using C&D waste possess good bond strength as well as shows better microstructural behavior.

Implication on environment/ society

- It has been observed that there is an increase of substantial growth of construction industry with the increase in population, requirements of urbanisation and the necessity of infrastructural development. This increase of construction industry precedes the requirement of making new structures. Moreover, to make new structure, the old buildings are being demolished. Due to the demolishing of old buildings, many debris are generated, which leads to various environmental pollutions. Nowadays, due to the massive impact due to increased construction industry, environment is experiencing practices resulting emission of CO_2 in the atmosphere, Reduction of natural resources, generation of large amount of waste materials and difficulties in finding the disposal land.
- To overcome from the current problem on the environment one of the best solutions for the above problem is using C&D waste as an C&D waste can be used as aggregate in the preparation new concrete like VCA. As a fact, aggregate occupies about 70 to 75 % of the concrete volume and hence use of crushed C&D waste as aggregate may solve many environmental problems. For the preparation of aggregates, the C&D wastes are mechanically broken down into small pieces. The small pieces are further crushed into small sized pieces through jaw crushers. After crushing, different sized pieces are screened by using sieving which can be called as recycled concrete aggregate (RCA).

Outcome

1. **Rajhans, P.,** Panda, S. K., and Nayak, S. (2018). Sustainable self compacting concrete from C&D waste by improving the microstructures of concrete ITZ. ***Construction and Building Materials (Elsevier)*, *163*, 557-570.**
2. **Rajhans, P.,** Panda, S. K., and Nayak, S. (2018). Sustainability on durability of self compacting concrete from C&D waste by improving porosity and hydrated compounds: a microstructural investigation. ***Construction and Building Materials (Elsevier)*, *174*, 559-575**
3. **Rajhans, P.,** Gupta, P. K., Kumar, R. R., Panda, S. K., and Nayak, S. (2019). EMV mix design method for preparing sustainable self compacting recycled aggregate concrete subjected to chloride environment. ***Construction and Building Materials (Elsevier)*, *199*, 705-716.**
4. **Rajhans, P.,** Chand, G., Kisku, N., Panda, S. K., and Nayak, S. (2019). Proposed mix design method for producing sustainable self compacting heat cured recycled aggregate concrete and its microstructural investigation. ***Construction and Building Materials (Elsevier), 218*, 568-581**
5. **Rajhans, P.,** Kisku, N., Nayak, S., and Panda, S. K. (2020). Sustainable self compacting acid and sulphate resistance RAC by two stage mixing approaches. ***Advances in Concrete Construction (Techno press), 9(1),* 55**.
6. Gupta, P. K., **Rajhans, P.,** Panda, S. K., Nayak, S., and Das, S. K. (2020). Mix design method for self-compacting recycled aggregate concrete and its microstructural investigation by considering adhered mortar in aggregate. ***Journal of Materials in Civil Engineering (ASCE)*, *32*(3), *04019371.***
7. Kisku, N., **Rajhans, P.**, Panda, S. K., Pandey, V., and Nayak, S. (2020, April). Microstructural investigation of recycled aggregate concrete produced by adopting equal mortar volume method along with two stage mixing approach. ***Structures (Elsevier), 24, 742-753***.
8. Kisku, N., **Rajhans, P.,** Panda, S. K., Nayak, S., and Pandey, V. (2020). Development of durable concrete from C&D waste by adopting identical mortar volume method in conjunction with two-stage mixing procedure. ***Construction and Building Materials*, *256*, 119361.**

Future Plans

- To observe the structural performance of geopolymer concrete prepared with C&D waste.
- To study the flexural behavior of reinforced geopolymer concrete prepared with C&D waste
- To determine the long-term curing affect of the geopolymer concrete prepared with C&D waste

On the Possibility of Using Ramie - A Natural Material in Cost Effective Low Threat Body Armours

Dr. Subhajit Sen

Background of the work:

Ramie (Boehmeria nivea) is one of the strongest natural cellulose fibres and comes with good physical and mechanical properties holding a great promise to be an alternative for protective vest subjected to low threat level. Even a partial replacement of Kevlar may reduce the cost substantially since Ramie can be procured locally and at a very nominal cost.

Objectives:

- explore the potential of Ramie, a natural fibre, to be used in body armours designed for relatively lesser threat (compared to military operations) encountered in low intensity conflict areas

Methodology

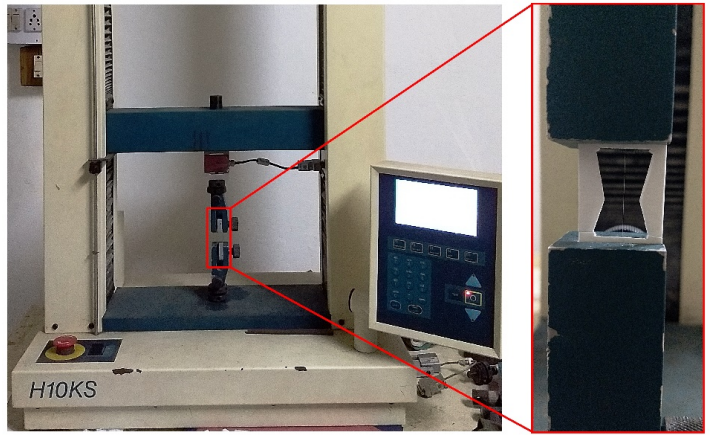
❖Material Characterization

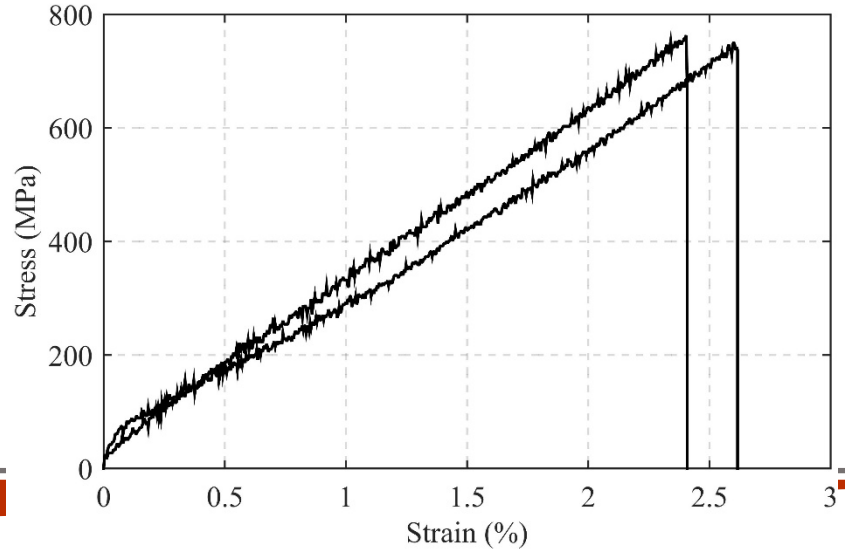
- **Tensile test** → stress strain behaviour
- **Direct shear test** → Inter yarn friction
- **Pull out test** →pull-out force and inter yarn interaction
- **Optical microscopy** → geometric dimension

❖Numerical simulation for impact response

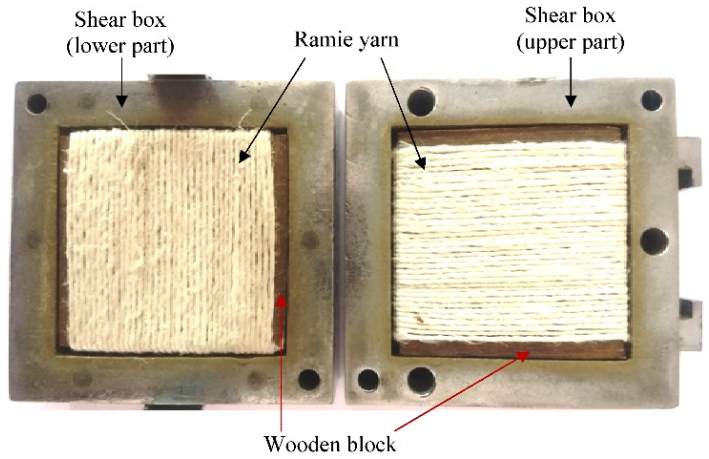
Material Characterization

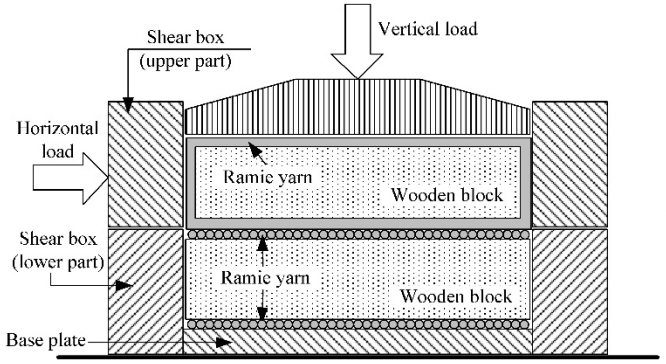
- Tensile Test

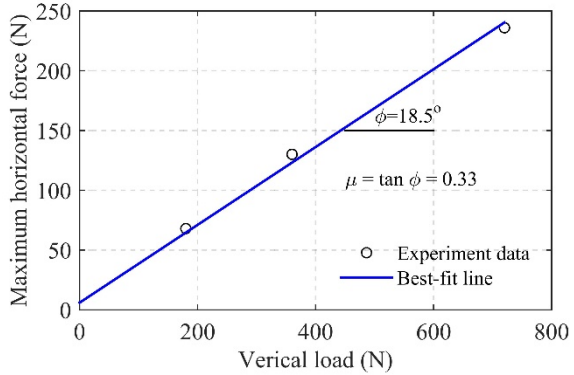




- Direct Shear Test

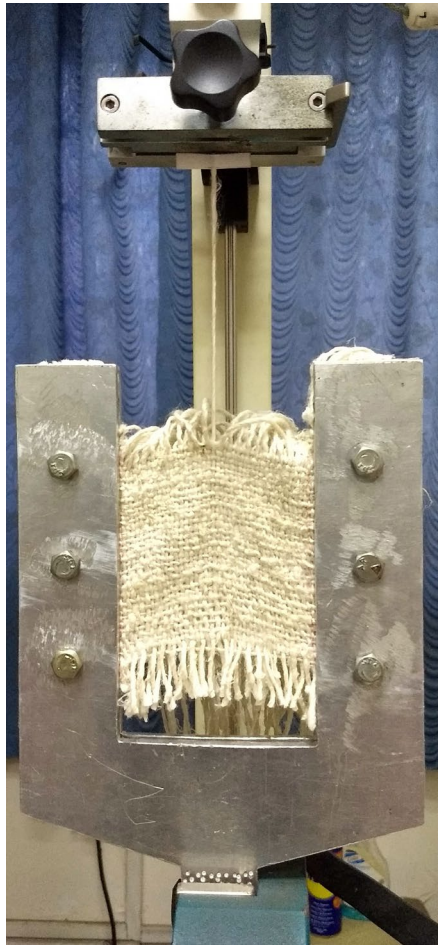


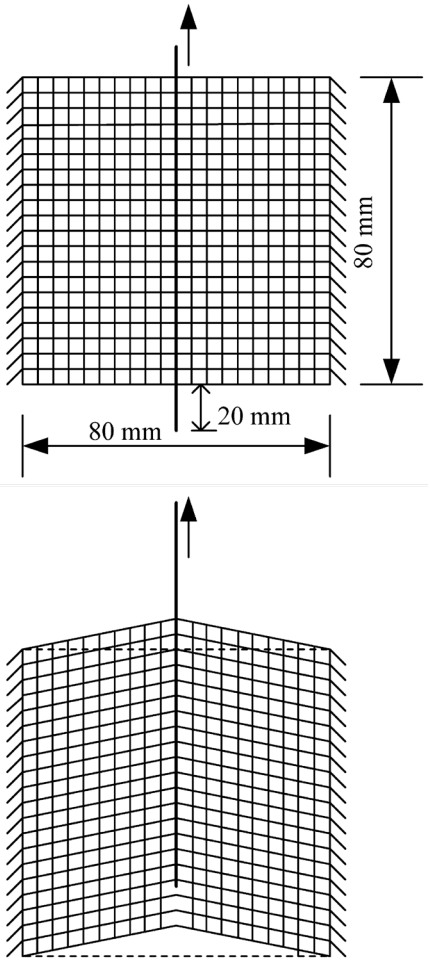


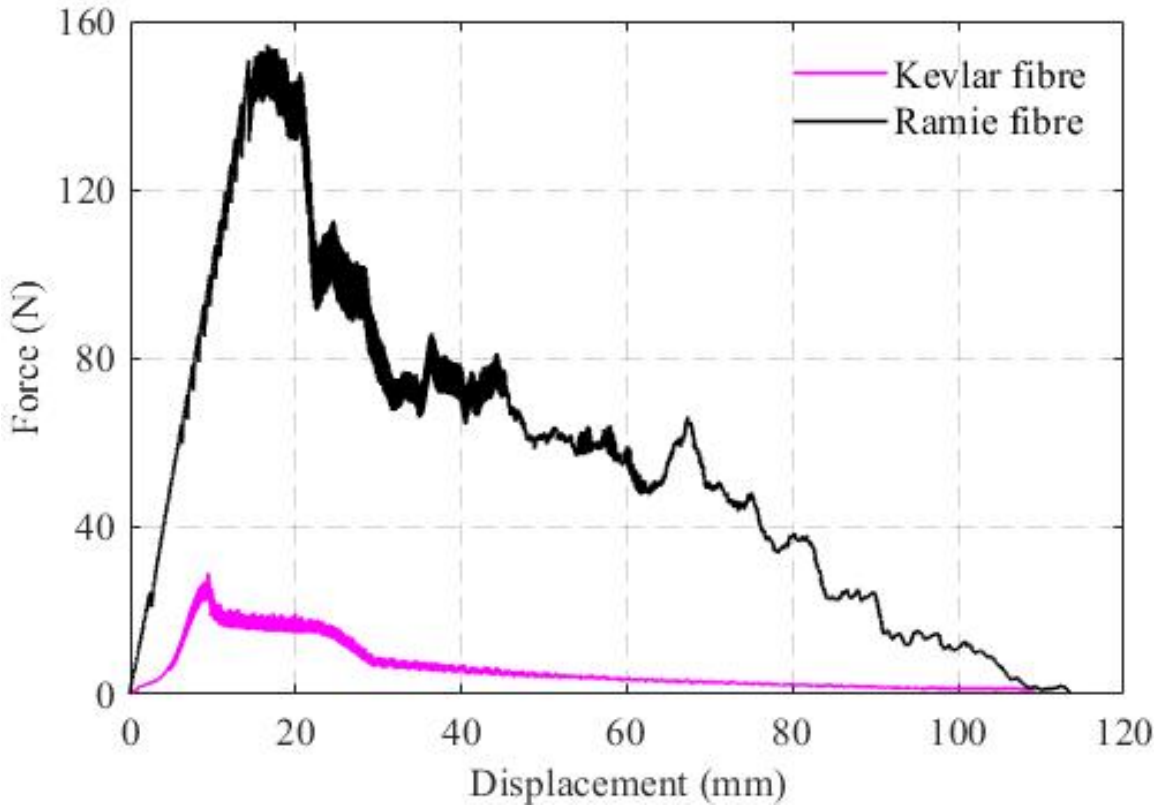


Material Characterization

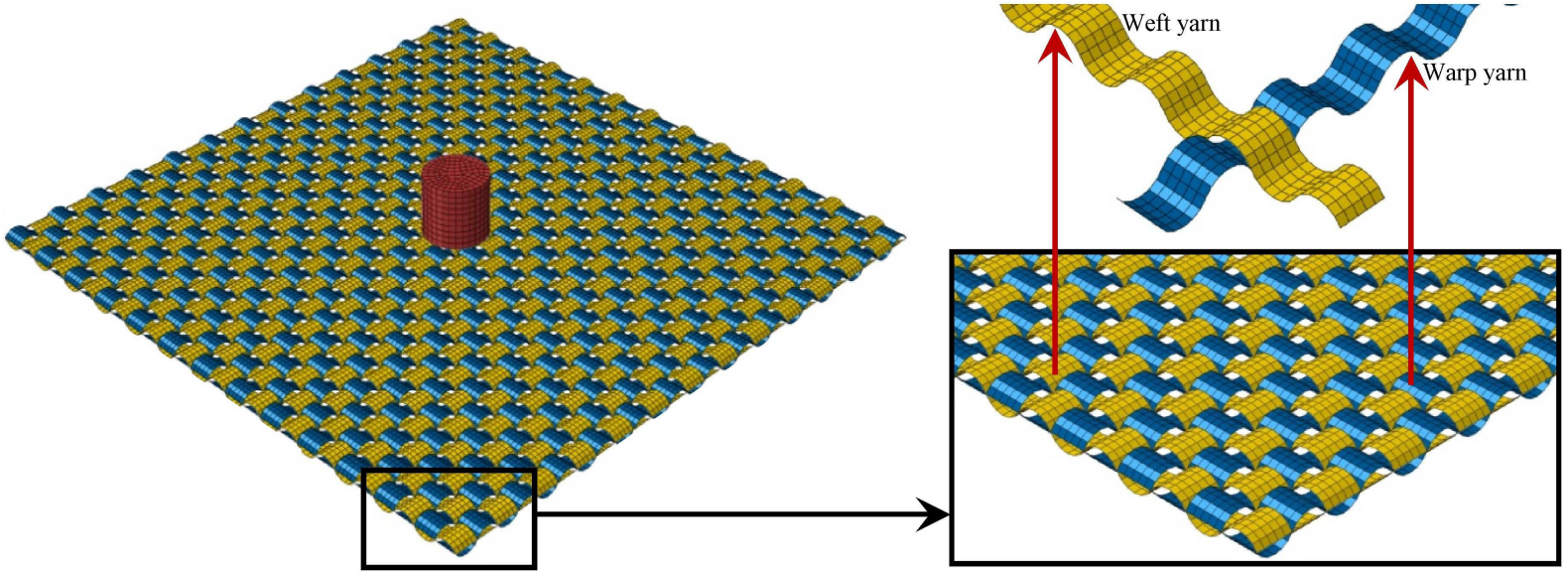
- Pull-out Test

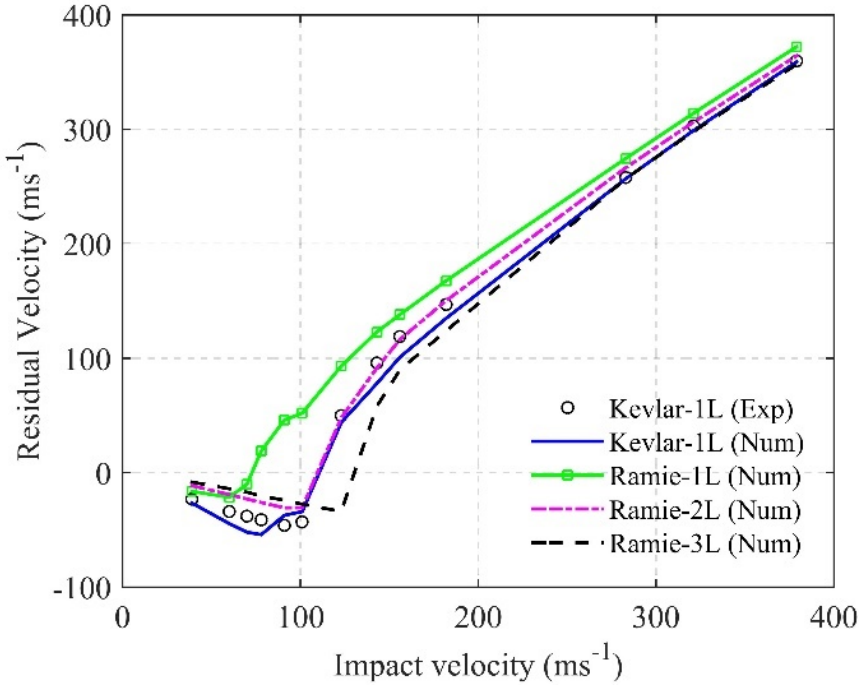






Numerical Simulations





3 Layer ramie produces similar ballistic response of single layer Kevlar

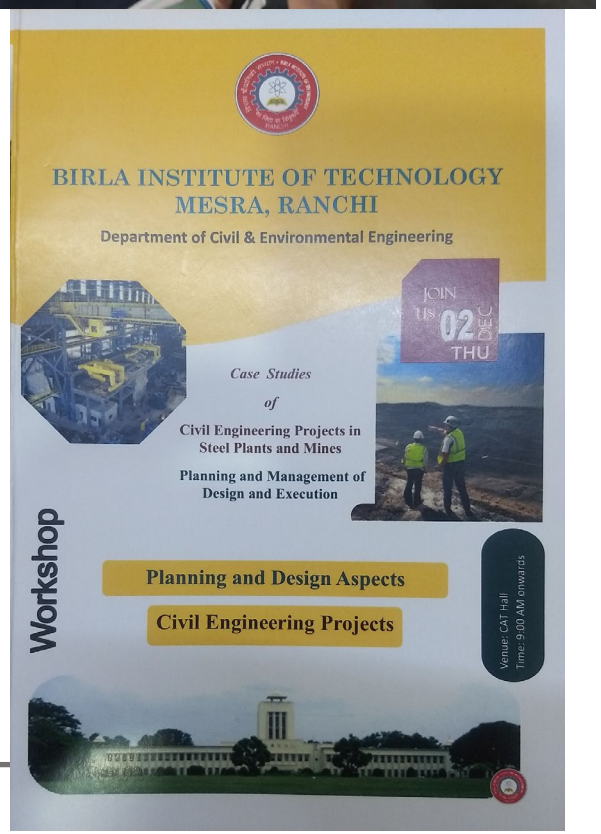
Sen *et al.* (2022), ***Journal of Industrial Textile*** (Accepted)

Departmental Achievements

Department Level

- Signed MoU with some recognized organisation viz. **NHAI**, **NCAP** etc.
- **STA** in **PMGSY** (Eastern Region)
- Organised several Workshops and Invited Lectures by Eminent Industry Personnel
- Distinguished Persons from Industry/ Academia/Research organizations visited our Department

Name of the Institution	Nature of Activity	Starting date	End date
National Highway Authority of India (NHAI). India	Student internship and field visits by departmental faculties	29-07-2020	28-07-2025
Jharkhand State Pollution Control Board (JSPC) and Ranchi Municipal Corporation (RMC), Jharkhand, India	As an institute of repute (IOR) of National Clean Air Programme	19-03-2021	18-03-2022
Jharkhand State Pollution Control Board (JSPC) and Jamshedpur notified Area Committee (JNAC), Jamshedpur, Jharkhand, India	As an institute of repute (IOR) of National Clean Air Programme	19-03-2021	18-03-2022



Faculty Level

Details	Number
Award/Recognition received	7
Sponsored Research/Consultancy Project	45
Publication in Journals	63
Publication as Book Chapter	25
Conferences/ Seminars/ Workshops/ Staff Development Programs attended by Faculty Members	56

Dr. Indrajit Roy delivering lecture at Pennsylvania State University

Notable Mentions

Dr. Siddhartha Sengupta

Best Paper Award in *International Conference on Recent Development in Sustainable Infrastructures: Research and Practices*

Dr. Sukalyan Chakraborty

Recipient of Fulbright Specialist Program Grant

Dr. Kirti Avishek

Member-State Environmental Appraisal Committee

Indo Global Excellence Award in Environmental Science

Notable Mentions

Dr. Indrajit Roy

- Selected to give intern to a German student in Mine Slope Stability.
- Invited lecture at Office of Surface Mining and Reclamation, USA on Mine Slope Stability.
- Invited lecture at University of Missouri Rolla, USA on Mine Slope Stability
- Invited lecture at Kyoto University, Japan.
- Invited lecture at Pennsylvania State University, USA.
- On behalf of CEE Dept., BIT Mesra, A request had been sent to CMD, SECL in 2017 for stopping the mining operations (three days) at World bank funded Mine (Kusmunda, Chattisgarh) which saved the life of atleast ten mine workers.

Ongoing Research Projects

- National Carbonaceous Aerosol Programme (NCAP) Working Group III- Modeling Carbonaceous Aerosol Source Influence and Atmospheric Effects, MoEFCC, Rs. 106.07 lakh + Rs. 53.47 lakh (Additional Grant), R. Naresh Kumar, Jawed Iqbal.
- Development of guidelines for design of all tiers of shovel- dumper dump above dragline dump and also delineation of phreatic surface within dragline dump throughout the year and its impact on stability with validation on two dragline mines of coal India, Coal India Limited R&D, Ministry of Coal, Rs. 75,30,000, Indrajit Roy, Anand Kumar Sinha, Bindhu Lal, Sudeshna Chakravarty
- Mobility, Bio-accessibility and Source Apportionment Study of Toxic Heavy Metals in Indoor and Outdoor Dust Environment: An Isotope Fingerprinting Approach, SERB-DST, Rs. 41,90,700, Tanushree Bhattacharya
- Prediction of Particulate Matter and Gaseous Pollutant Concentration Through ANN, PNN and CART Models and Comparison with Calpuff and Aermod in Singrauli Coal mines, Coal India, Rs. 85.25 Lakhs, Tanushree Bhattacharya, Bindhu Lal
- Effect of blasting in open cast mine dump and development of relationship between blast induced vibration and dump design, Coal India, 33 lakh, Indrajit Roy, Siddhartha Sengupta, Ashish Kumar Patnaik

Consultancy Works

Sl. No	Faculty name	Type of Work	Amount (in Lakhs)
1	Prof. Birendra Kr. Singh	Vetting	4.36600
2	Dr. Indrajit Roy	Mine slope-stability analysis	12.38400
3	Prof. Ananad Kr. Sinha Prof. Bindhu Lal	Scrutiny of DPRs under PMGSY	16.91196
4	Mr. Mani Mohan Dr. Siddhartha Sengupta along with Laboratory Assistant and Staff	Miscellaneous	5.38375

Future Directions

Thrust Areas

- Monitoring, assessment and remediation of conventional and emerging pollutant
- Environmental modelling and climate change
- Sustainable concrete
- Application of soft computing techniques and remote sensing in Civil Engineering
- Soil Stabilization
- Traffic Engineering and Transportation planning
- Geotechnical Earthquake Engineering

CENTRE FOR WATER RESEARCH

VISION

- To be a leading hub for knowledge and solutions to various issues on water science and technology

MISSION

- To research on challenging issues on water quality monitoring and water treatment
- To produce trained human resource in water science and technology through UG, PG and Ph.D. degree programs in engineering and science, research projects, and training programs

THRUST ACTIVITIES

- Monitor the impact of urbanization and industrialization on freshwater aquatic systems
- Develop environment friendly and cost-effective water treatment solutions for removal of conventional water pollutants
- Explore technologies for removal of new age water pollutants through combination of physico-chemical and biological processes

Major Facilities (to be developed):

2 Laboratories (STEP Building)

- **Environmental Chemistry**:

  HPLC, TOC analyser, stereo microscope with camera, ozone generator, oxygen concentrator

- **Unit Operations and Unit Processes**:

  Peristaltic pumps, magnetic stirrers, overhead stirrers

- **Sensors and database**:

  Water quality sensors, server for database

Initiatives Planned

- We will try to develop research collaboration with all the premier institutes/organizations of the country like IISc, IITs, NITs, IIEST, JU, Univ. of Calcutta, JNU, ISAR, TERI New Delhi etc.
- We intend to apply for upgradation of labs to various funding schemes like DST-FIST, AICTE-MODROBS, DST-PURSE.


Thank you