



International Conference on Seismic Resilient Infrastructure (ICSRI-2026)

13-15th March 2026

Program Booklet

Organized by

Department of Civil Engineering

Indian Institute of Technology (BHU) Varanasi

In Association with

Indian Society of Earthquake Technology, Varanasi Chapter



International Conference on Seismic Resilient Infrastructure (ICSRI)-2026

Technical Schedule

Venue: Annie Bessent Lecture Theaters (ABLT) , IIT (BHU) Varanasi, India

Dates: 13th- 15th March, 2026

Day#1 -13 th March 2026		
Time	Activity	Venue
08:00 AM-onward	Registration	ABLT Foyer
09:00-09:50	Inauguration Program	ABLT-4
09:50-10:00	Group Photo	ABLT front
10:00-10:30	High Tea	ABLT front
10:30-11:15	Inaugural Lecture Prof. Ramancharla Pradeep Kumar , CSIR-CBRI Roorkee	ABLT-4
11:15-12:00	Keynote Lecture Prof. B.K. Maheshwari , IIT Roorkee	ABLT-4
12:00-12:45	Keynote Lecture Prof. Rajesh Kumar , IIT(BHU)	ABLT-4
12:45-14:00	Lunch	ABLT front
14:00-14:45	Keynote Lecture Prof. M. R. Madhav , IIT Hyderabad, JNTU Hyderabad	ABLT-4

14:45-15:30	Corporate Talk by MIDAS	ABLT-4
15:30-16:00	Keynote Lecture Prof. Neelima Satyam D , IIT Indore	
16:00-16:15	Tea Break	
16:15-16:45	Parallel Invited Talk Mr. Ankala Saibaba , Chief Track Engineer (Southeast Central Railway)	ABLT-2
	Parallel Invited Talk Dr. Suresh R Dash , IIT Bhubaneswar	ABLT-4
	Parallel Invited Talk Dr. Snehal , MNIT Allahabad	ABLT-1
16:45-18:30	Parallel Technical Session#1	ABLT 1, 2,& 4
19:00 onward	Gala Dinner	ABLT Front
Day#2 - 14th March 2026		
9:00-09:45	Keynote Lecture Prof. Sarat Kumar Das , IIT (ISM) Dhanbad	ABLT-4
09:45-10:30	Keynote Lecture Prof. Pijush Samui , NIT Patna	ABLT-4
10:30-11:00	High Tea	ABLT Foyer
11:00-11:30	Parallel Invited Talk Dr. Santhoshkumar G , IIT Bhubneshwar	ABLT-1
	Parallel Invited Talk Dr. Chinmoy Kolay , IIT Kanpur	ABLT-4
	Parallel Invited Talk Dr. M.V. Ravi Kishore Reddy , K.S.R.M. College of Engineering	ABLT-2

11:30-13:00	Parallel Technical Session#2	ABLT 1, 2,& 4
13:00-14:00	Lunch	GTAC
14:00-14:30	Keynote Lecture Prof. Amirtham Rajagopal , IIT Hyderabad	ABLT-4
14:30-15:00	Keynote Lecture Prof. Samit Ray Chaudhuri , IIT Kanpur	ABLT-4
15:00-15:15	High Tea	ABLT 4
15:15-15:45	Parallel Invited Talk Dr. Nitin Kumar , IIT Patna	ABLT-1
	Parallel Invited Talk Dr. Sanket Nayak , IIT (ISM), Dhanbad	ABLT-4
	Parallel Invited Talk Dr. P. Pravin Kumar Venkat Rao , IIIT Hyderabad	ABLT-2
15:45-16:15	Parallel Invited Talk Dr. Mousumi Mukherjee , IIT Mandi	ABLT-1
	Parallel Invited Talk Dr. Sukanta Das , Port and Airport Research Institute (PARI), Japan	ABLT-2
16:15 onward	Local Excursion	Ghat Darshan

Day#3 - 15 th March 2026		
9:00-09:45	Keynote Lecture Dr. Lopamudra Bhaumik , Geotechnical Engineer at Jacobs, Hillsboro, Oregon, United States	ABLT-4
09:45-11:30	Parallel Technical Session#3	ABLT 1, 2,& 4
11:30-12:00	Parallel Technical Session#3	
11:30-12:00	High Tea	ABLT 1, 2,& 4
12:00-12:45	Keynote Lecture Prof. Nihar Ranjan Patra , IIT Kanpur	ABLT-4
12:45-13:30	Valedictory Function	ABLT 4
13:30 –14:30	Lunch	GTAC

Parallel Technical Sessions

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Seismic vulnerability, risk, and resilience assessment Venue ABLT #4					
13/03/2026	16:45-17:00	8	NITISH KUMAR	Indian Institute of Technology Patna	Reliability-Based External Stability Evaluation of Gravity Retaining Walls under Seismic Conditions Using LHC-MCS
	17:00-17:15	9	RAMANDEEP MALHOTRA	Indian Institute of Technology Patna	Reliability-Aided Soft Computing Approach for Evaluating External Stability of Reinforced Soil Retaining Walls Under Static and Seismic Conditions
	17:15-17:30	19	Shrijit Banerjee	Jadavpur University, Kolkata	Influence of Perforated Interlayers on Wave Transmission Characteristics in Multi-Layer Structures
	17:30-17:45	25	Mahir Alam	Amritsar Group of College	An experimental Study on Evolution of Correspondence between California Bearing Ratio (CBR) and Dynamic Cone Penetrometer (DCP) Test
	17:45-18:00	38	Aftab Alam	Jadavpur University, Kolkata	Assessment of Time and Frequency Domains of Toggle-Brace Dampers for Seismic Loading on Multi-Storey Steel Structures
	18:00:18:15	41	Mayank Gangwar	Indian Institute of Technology Mandi	Life-Cycle Seismic Resilience Assessment of Riverine Bridges Under Multi-Hazard Scenario Incorporating Long-Term Climatic
	18:15-18:30	72	Debanjali Hazra	NITTTR Kolkata	Seismic Performance Evaluation of a Building using Optimum Tune Mass Damper Interter (TMDI)

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Dynamic properties of soil and ground response & Tunnels and rock mechanics Venue ABLT #1					
13/03/2026	16:45-17:00	27	Aman Pandey	Indian Institute of Technology (BHU) Varanasi	Experimental investigation of static and dynamic characterization of stabilized soil
	17:00-17:15	37	Nandkishor Sinha	National Institute of Technology Raipur	Influence of Geometry and Material Properties on Ground motion Amplification of Hill Slopes
	17:15-17:30	63	AAKASH SRIVASTAVA	Indian Institute of Technology (BHU) Varanasi	Effect of Water Table on the Seismic Response Performance of Municipal Solid Waste (MSW) Fines Deposit
	17:30-17:45	68	AANCHAL KUMARI	UPES Deharadun	Assessing the Influence of Soil Moisture Uncertainty on GRACE-Derived Groundwater Storage over India
	17:45-18:00	49	Annapurna Sakhardande	Goa College of Engineering, Goa	Evaluation of Alternative Fill Materials to Mitigate Lateritic Cavities
	18:00:18:15	55	R Dubey	Indian Institute of Technology (ISM) Dhanbad	Seismic Response of Discontinuities on Geotechnical Characterization of Rock Masses: - An example from Upper Vinhyyan Sandstone of Son Valley, Central India
	18:15-18:30	71	RISHI KUMAR GUPTA	Indian Institute of Technology (BHU) Varanasi	One-dimensional Ground response analysis of black cotton soil stabilized with fly-ash

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Application of machine learning and deep learning in seismic resilience Venue ABLT #2					
13/03/2026	16:45-17:00	4	Ayush Mishra	Veer Sundra Sai University of Technology, Gurla, India	A Study on Seismic Risk Analysis using Machine Learning
	17:00-17:15	14	PRATIMA KUMARI	National Institute of Technology Patna	System reliability assessment of geotextile retaining wall using artificial neural network
	17:15-17:30	26	Dinesh Kumar	National Institute of Technology Patna	Machine Learning Based Assessment of Charnockite Rock Strength for Structural Engineering via Non-Destructive Evalua-
	17:30-17:45	122	Sarthak Kundu	Indian Institute of Technology (BHU) Varanasi	Robust SVR Modelling of CFST Cyclic Lateral Response Using Data Augmentation
	17:45-18:00	73	Satyam Roy	NITTTR Kolkata	ML-Based Seismic Response Prediction of RC Buildings Using Indian Ground Motions
	18:00:18:15	89	Lakshmi Latha	Indian Institute of Technology Kanpur	Noise-Resilient Feature-Based Structural Health Monitoring Using Gradient Boosting: A Machine Learning Approach
	18:15-18:30	91	Vignesh Kumar N	Mizoram University, Tanhril, Aizol	Resilient Retrofit Design: Physics-Informed Machine Learning for Shear Strength Prediction of FRP-Strengthened RC Members under Seismic Vulnerability

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Seismic vulnerability, risk, and resilience assessment Venue ABLT #4					
14/03/2026	11:30-11:45	07	Prof. KasiViswanadh Prakhya	IIT(BHU) & DRDO	Interaction of longitudinal and transverse, and vertical bending and axial forces in seismic design of deep drill and blast concrete tunnel linings
	11:30-11:45	35	Rudra Prasad Sengupta	Jadavpur University, Kolkata	A Numerical Study On Seismic Response Mitigation Of Structures Using Tuned Mass Dampers
	11:45-12:00	78	Vijay Kumar	Indian Institute of Technology (BHU) Varanasi	Role of Vertical and Horizontal Bands in Seismic Performance of Confined Masonry Walls with Openings
	12:00-12:15	87	Deepesh Khandelwal	Indian Institute of Technology Kanpur	Multi-level Data Fusion Framework for Damage Assessment under Unknown Input Conditions
	12:15-12:30	104	AKILA KUMAR	K.S.R.M. University, Kadapa	Enhancing Playground Soil Permeability: A Review of Practical Economical Ground Improvement Methods
	12:30-12:45	106	kaushlendra parihar	Indian Institute of Technology Kanpur	From Collision Physics to Seismic Safety: Modeling and Efficiency of Impact Damper
	12:45-13:00	113	Jinesh Kasliwal	Visvesvaraya National Institute of Technology Nagpur	Seismic Assessment and Strengthening of an Existing Non-Code Compliant RC Building

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Earthquake disaster mitigation and management Venue ABLT #2					
14/03/2026	11:30-11:45	28	Tiyas Chakraborty	Jadavpur Univetsity, Kolkata	Enhancing Seismic Safety of Structures Using Base Isolation Technology
	11:30-11:45	54	SATISH KUMAR	Indian Institute of Technology (ISM) Dhanbad	Instability evaluation of road-cut slopes in a seismic Himalayan region: A case study of slopes along National Highway (NH)-7 between Rudraprayag and Joshimath, Uttarakhand, India
	11:45-12:00	61	Abinash kundu	Indian Institute of Technology (ISM) Dhanbad	Impact of repetitive vibrations and water flow on geotechnical attributes of road-cut Upper Kaimur Sandstone strata in and around Markundi Ghat, Sonbhadra, India.
	12:00-12:15	77	Surendran Murugesan	CSIR, SERC Chennai	Prediction of Ultra Low Cycle Fatigue life (ULCF) in IS:2062 grade steel under asymmetric cyclic loading based on a cyclic void growth Model
	12:15-12:30	86	Lakshmi Latha	Indian Institute of Technology Kanpur	Variability in Modal Data due to Uncertainty in Measured Acceleration Responses under Ambient Vibration Survey
	12:30-12:45	88	Akshay Baheti	Indian Institute of Technology Kanpur	Greedy Optimization of MR Damper Placement in MDOF Building for Seismic Risk Mitigation
	12:45-13:00	114	Agamoni Das	Hilti India	Optimized and realistic design methods of Post-Installed Anchors against high seismic shear loads

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Seismic soil-structure interaction & Seismic safety of pipelines, underground & buried structures Venue ABLT #1					
14/03/2026	11:30-11:45	11	Sattwik Ghosh	Jadavpur Univetsity, Kolkata	Vibration based Monitoring of Steel Pile considering Soil Nonlinearity
	11:30-11:45	12	Sreeja Das	Jadavpur Univetsity, Kolkata	Effect of Nonlinear Soil Behaviour on Pile Integrity Test
	11:45-12:00	29	AJEET PRAJAPATI	Indian Institute of Technology (BHU) Varanasi	Performance evaluation of buried pipe on slope subjected to vehicular loading
	12:00-12:15	33	SHRUTI RAUT	Indian Institute of Technology Delhi	Comparative Response of Connected and Disconnected Piled Raft Foundations in Sand under Pseudo-Static Seismic Loading
	12:15-12:30	103	Himaja Kancherla	K.S.R.M. University, Kadapa	Cost Effective Liquefaction Mitigation in Layered Soils : Comparative FEM Study of Ground Improvement Methods
	12:30-12:45	69	DEEPAK KUMAR	U.I.E.T. M. D. Rohtak	Prediction of Breach parameters for Overtopped Embankments by Regression Technique Impact
	12:45-13:00	116	Saptarshi Das	NITTTR Kolkata	of IS875 (Part 3):2015 Revisions on Wind Load Estimation for High Rise Structures in Kolkata

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Preparedness, public awareness and their participation Venue ABLT #1					
15/03/2026	9:45:00-10:00	105	HEMANTH KUMAR	K.S.R.M. University, Kadapa	Towards Resilient Campuses: A Review of Integrated Rainwater Harvesting, Greywater Recycling
	10:00-10:15	110	Vemareddy Kasthuri	K.S.R.M. University, Kadapa	MAPPING GROUNDWATER POSSIBILITY AREAS USING REMOTE SENSING AND GIS FOR CHEYYERU RIVER BASIN OF AN-DHRA PRADESH, INDIA
	10:15-10:30	118	Nilesh Bhopale	College of Engineering and Technology Akola Maharastra	Finite Element Analysis of Two Way Reinforced Concrete Slab
	10:30-10:45	117	Akanksha Jaiswal	Indian Institute of Technology (BHU) Varanasi	Seismic Vulnerability Assessment of Built Infrastructure in Varanasi District using a Multi Criterion Decision Analysis
	10:45-11:00	121	Nilesh Mishra	Amity University, Noida	SEISMIC RESPONSE OF STEEL BUILDINGS IN HILLY AREA
	11:00-11:15	123	Danish Dubey	Indian Institute of Technology (BHU) Varanasi	Synthetic Data Augmentation and Robust Preprocessing for Predicting Cyclic Response of CFST Columns
	11:15-11:30	124	Arush Moghe	Indian Institute of Technology (BHU) Varanasi	Robust Linear Regression of Augmented CFST Cyclic Lateral Response Data
	11:30-11:45	48	Vaibhav Kashyap	Yashoda Technical Campus Faulty of Engnieering, Satara Maharastra	Environmental Risk-Informed Assessment of Urban Road Infrastructure Expansion Using Advanced GIS and Remote Sensing: Implications for Seismic-Resilient Planning in Karad, Maharashtra

Date	Time	Abstract ID	Presenter's Name	Institute	Title
Theme : Miscellaneous Venue ABLT #2					
15/03/2026	9:45:00-10:00	16	Saurabh Jaiswal	Dr. Ram Manohar Lohia Awadh University Ayodhya	Use of Waste Tire Rubber Chips as a Partial Replacement to The Coarse Aggregates in Concrete
	10:00-10:15	17	BIRAJA MISHRA	CV Raman Global University Bhubneshwar, Orisa	A NURBS-Augmented Finite Element Approach for Flexural Vibration of Orthotropic Plates
	10:15-10:30	51	SHER BAHADUR SINGH	Indian Institute of Technology (BHU) Varanasi	FEM analysis of Euler beam considering material and geometric nonlinearity
	10:30-10:45	60	Kaushal Kumar	Jaypee University of Information Technology Waknaghat, Himachal Pradesh	Numerical Investigation of Structural Response under Blast Loading Using SAP2000 and AUTODYN
	10:45-11:00	70	Aravind Yadav	Indian Institute of Technology (BHU) Varanasi	Numerical investigation of Liquefaction of Sandy Soil using Standard Penetration Sounding of Dusharapara Site
	11:00-11:15	1	NAVNIT KUMAR	NATIONAL INSTITUTE OF TECHNOLOGY PATNA	Effects of stress-strain behavior on both pressurized and non-pressurized buried steel pipelines subjected to strike-slip fault movement
	11:15-11:30	43	Smita Kaloni	National Institute of Technology Uttarkhand	Machine Learning–Based Prediction of the Fundamental Period of Vertically Irregular Buildings

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Abstracts

Plenary & Keynote Lectures

Earthquake Safety Assessment of Buildings For Increasing Infrastructure Resilience

Prof. Ramancharla Pradeep Kumar^{1,*}

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

A significant portion of India's built environment remains highly vulnerable to earthquake-induced damage. This vulnerability stems from self-styled construction practices, lack of adherence to earthquake-resistant design standards, and the widespread presence of moderate to severe seismic zones across the country. With over 300 million buildings constructed without proper engineering oversight, the urgency to assess and retrofit these structures is critical to enhancing infrastructure resilience.

This paper will explore methodologies for evaluating the earthquake safety of existing buildings, emphasising scalable assessment techniques suitable for large-scale implementation. Additionally, emerging technologies, such as drone-based identification of structural features, will be discussed as innovative tools for rapid and efficient structural assessment.

Recent Advances in Seismic Soil-Structure Interaction

Prof. B.K Maheshwari^{1,*}

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THEME: Seismic Soil-Structure Interaction

ABSTRACT

Soil-Structure Interaction (SSI) is one of the design issues, which cannot be ignored for the structures founded on the weak soils particularly when these are subjected to strong excitation. During strong shaking, the behavior of soil is highly nonlinear; further if it is saturated loose sand, the liquefaction may occur. To deal effectively with such complex scenario, numerical modeling provides the best solution. For Soil-Structure Interaction considering earthquake loads, there are a number of important issues which need to be dealt rationally for a reasonably accurate analysis. First issue is modeling of unbounded soil media to satisfy the radiation conditions. Second, for dynamic loading, behavior of soil is frequency dependent and it needs to be taken care. Third is modeling material nonlinearity of soil. Fourth is modeling of liquefaction. To deal with boundary, both simplified and rigorous methods are available. To capture the frequency dependent behavior of soil, complex dynamic stiffness and unit impulse response function are discussed. To model the material nonlinearity of soil, equivalent linear, cyclic nonlinear and advanced plasticity models have been deliberated. To deal with liquefaction in numerical modeling, appropriate constitutive models are discussed. Some of the new upcoming nuclear power plants (NPP) in India are proposed to be founded on the soft soil i.e. alluvium in active seismic zone, necessitating to consider SSI for analysis. Some of these will be founded on Combined Piled-Raft Foundation (CPRF). So far, no study has been reported considering nonlinearity of soil for the NPP structures founded on CPRF considering earthquake loads. The speaker and his research group examined the dynamic responses of raft, pile group and CPRF of a NPP simulating the nonlinear finite element model. The effect of nonlinearity is examined. The study indicated the importance of CPRF over the raft foundation and pile group foundation for the design of nuclear power plants. The same will be discussed in this lecture.

GeoSutras – Principles for Modern Geopractice

Prof. M. R. Madhav^{1,*}

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THEME: Dynamic properties of soil and ground response

ABSTRACT

Geotechnical Engineering as a subdiscipline of Civil Engineering is hundred years old from the time enunciated his effective stress principle. The practice of geotechnical engineering has been following many of the tenets, e.g., linear stress – strain behavior, etc., rigid plastic (incompressible) material, homogeneous ground, etc. Recent developments have occurred over a variety of topics that reveal the true behavior of soils and the ground. GeoSutras highlight some of these new insights which have significant bearing on GeoPractice. The new approaches cover the influence of non-linear behavior on consolidation, effect of compressibility of the soil, consequence of ignoring over consolidation, non-uniqueness of deformation modulus, etc. The new paradigm Ground versus Soil will be presented.

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Seismic hazard and geotechnical vulnerability of Kashmir Valley

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THEME: Dynamic properties of soil and ground response

ABSTRACT

The Kashmir Nappe Zone forms an asymmetrical synclinorium bounded by the Panjal Thrust and Zaskar Thrust. Its oldest basement comprises the Precambrian Salkhala Series and Dogra Slates (Wadia, 1931), overlain by Panjal Volcanics and Triassic limestones. The Kashmir Valley basin is primarily filled with Plio-Pleistocene Karewa deposits and Holocene alluvium. These formations create a unique geomorphological setting where elevated Karewa terraces coexist with low-lying alluvial floodplains. The surrounding mountains, wetlands, reclaimed swamps, and river systems further contribute to high spatial variability in soil conditions.

According to the seismic design provisions of Bureau of Indian Standards in IS 1893 (2016), the Kashmir Valley lies in seismic Zones IV and V, indicating very high earthquake hazard. The region has experienced several damaging earthquakes, including the Mw 7.6 2005 Kashmir earthquake, which caused landslides, ground fissures, flooding, structural damage, and significant loss of life. Liquefaction has also been reported in several parts of Jammu and Kashmir during past seismic events.

This study aims to evaluate the geotechnical and seismic behaviour of soil deposits in the Kashmir region and to develop simplified guidelines for selecting suitable foundation depths and ground improvement strategies for future development. A comprehensive geotechnical database from approximately 700 investigation sites across the valley was compiled to characterize soil properties and their spatial variability, particularly within Karewa highlands and alluvial floodplains. These data were integrated with geological information to develop basin-scale cross sections.

Seismic hazard assessment was conducted using deterministic and probabilistic approaches. An earthquake catalogue was prepared, and seismicity parameters were estimated to generate peak ground acceleration (PGA) and spectral acceleration maps at bedrock. Based on PGA distribution, the region was divided into five seismic hazard zones with mean PGA values ranging from 0.175 g to 0.514 g for a 2475-year return period.

Geophysical investigations at approximately 192 locations included Multichannel Analysis of Surface Waves (MASW) and microtremor measurements to estimate shear wave velocity and site frequency characteristics. VS30 values vary from 150–200 m/s in alluvial plains to 350

–500 m/s in Karewa deposits and up to 900 m/s in hilly terrains. Joint inversion analyses indicate deep sedimentary deposits reaching depths of 900–1300 m.

Nonlinear ground response analyses reveal that these deep deposits amplify long-period seismic waves while attenuating short-period motions, which may significantly affect tall structures. Detailed liquefaction and bearing capacity assessments conducted for the Greater Srinagar region indicate that young alluvial deposits in the Jhelum floodplains are highly susceptible to liquefaction and possess low bearing capacity, necessitating deep foundations and ground improvement. In contrast, Karewa highlands show lower liquefaction potential but may experience seismic bearing capacity reduction. Integrated hazard assessment resulted in four vulnerability zones, providing guidance for foundation design and urban planning in the Kashmir Valley.

Enhancing building ductility, stiffness and strength for earthquake resistance

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

Enhancing ductility, stiffness, and strength is essential for improving a building's earthquake resistance. Each property contributes differently to how a structure responds to seismic forces. The present work focuses on different methodologies available for improvement in ductility, stiffness and strength in structural systems. Ductility allows a structure to deform significantly without sudden failure, enabling it to dissipate earthquake energy. Strength ensures the building can withstand the seismic forces without structural failure. Stiffness reduces excessive lateral displacement and inter-story drift during earthquakes. The focus will be on discussing these aspects together with advanced protection techniques like base isolation.

AI/ML-based methods for liquefaction susceptibility of soil due to seismic excitation: Present Developments and Future challenges

Satyam Tiwari¹ and Prof. Sarat Kumar Das^{1,*}

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THEME: Dynamic properties of soil and ground response

ABSTRACT

Earthquake-induced soil liquefaction is a major geotechnical hazard that not only affects the existing infrastructure but also causes danger to lifeline. With massive construction of waste containment impoundment to store the industrial wastes has further necessitated the accurate and real-time monitoring of the soil liquefaction. The use of artificial intelligence and machine learning (AI/ML) techniques to predict the liquefaction susceptibility of soil. These data-driven AI/ML-based methods have been proved to be very efficient in handling large datasets to capture the non-linear relationship involved in liquefaction phenomenon.

This study comprehensively presents a review on the recent advancements in the application of AI/ML-based methods for earthquake-induced soil liquefaction for deterministic and probabilistic methods. The study discusses the AI/ML-based methods in context of field and laboratory tests including Standard Penetration Test (SPT), Cone Penetration Test (CPT) and shear wave velocity (Vs) data. The key challenges and limitations that restrict the widespread adoption of AI/ML models in liquefaction analysis is highlighted. The issues related to availability of high-quality data, interpretability of the models and their generalization capabilities, and their practical applicability. Furthermore, the study directs towards future research to improve the physical interpretability, model transparency and reliability of data-driven AI/ML-based techniques with physics-informed neural network (PINN) and deep neural networks are discussed. Finally the integration of physical space with virtual reality through data connectivity in the framework of digital Twin (DT) for earthquake-induced liquefaction susceptibility assessment is presented.

Future prospect of Artificial Intelligence (AI) in Seismic Resilient Infrastructure

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THEME: Application of machine learning and deep learning in seismic resilience

ABSTRACT

The development of seismic resilient infrastructure is key task in civil engineering. Traditional models have made various assumptions for designing seismic resilient infrastructure. However, Artificial Intelligence(AI) does not make any assumption. It uses only dataset for the development of model. In this article, various AI techniques {Deep Learning (DL), Random Forest (RF), Recurrent Neural Network (RNN), K Nearest Neighbour(KNN), Decision Tree(DT), Classification and Regression Trees(CART), Logistic Regression(LR), Histogram-based Gradient Boosting(HGB) and Naive Bayes(NB)} have been employed in the various fields of earthquake engineering such as liquefaction, ground motion, etc. Various examples will be given to show the working procedures of AI models in different problems of earthquake engineering. The use of MATLAB for development of different AI techniques will be also described in this article. The practical application of various AI will be discussed in the field of earthquake engineering. This article also gives the advantages & disadvantages of various AI techniques.

Significance of Nonstructural Systems and Components as Key Drivers of Operational Continuity in Seismic and Multi-Hazard Environments

Prof. Samit Ray Chaudhuri^{1,*}

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

Over the past few decades, research on the seismic performance of nonstructural systems and components (NSCs) has significantly advanced in life-safety objectives, and operational continuity. It is now desired that future seismic design not only takes care of collapse prevention but also ensures rapid recovery of critical systems and facilities such hospitals, data centers, water supply network, power generation & distribution systems, and various industrial facilities. This aspect specifically requires performance metrics that explicitly quantify downtime, recovery trajectories, and system-level functionality rather than isolated component fragility, which has been the focus of much of the research carried out till date. However, any attempt in this direction must integrate multi-hazard exposure (seismic combined with wind, flood, or environmental degradation) for deterioration-informed fragility and resilience models. This presentation will focus on these aspects toward a unified, probabilistic and multi-hazard framework for seismic resilience of nonstructural systems and components.

Geotechnical Seismic Hazard Evaluation and Mitigation in Engineering Practice

Dr. Lopamudra Bhaumik^{1,*}

PhD, PE Geotechnical Engineer | NW Geotechnical Group Lead Jacobs Portland, Oregon President, ASCE Oregon Geotechnical Group

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THEME: Dynamic properties of soil and ground response

ABSTRACT

Several dams in the Pacific Northwest were constructed prior to the 1990s. Seismic performance of these dams was not considered in the original design. This is typical of most projects constructed before that time as the seismic hazard in the region was thought to be minimal at the time. However, the current understanding of the seismic hazard in the area indicates significant seismic hazard from both crustal and Cascadia subduction zone sources. Therefore, owners and agencies are identifying which of these dams are high hazard and require mitigation from seismic hazard in the next decade. This presentation will focus on procedures used for screening level geotechnical seismic evaluation of these dams that are currently used in engineering practice, using case studies. Evaluation of the potential for slope instability, settlement, and lateral movement; and identification of other potential seismic hazards that are associated with design earthquake(s) will be discussed. Mitigation measures to limit the potential for seismically induced ground displacement are discussed.

Seismic Performance Assessment of Framed Building with Base Isolators of Special Configurations

Prof. Rajesh Kumar^{1,*}

¹ Indian Institute of Technology (BHU) Varanasi

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

This study offers a comprehensive assessment of various seismic isolators, affirming the effectiveness of High Damping Rubber Bearings (HDRBs) and Lead Rubber Bearings (LRBs) in mitigating seismic impacts and enhancing structural ability. The numerical and experimental analyses underline the advantages of base isolation, while sliding isolation system with spring combinations present promising avenues for further optimization. Future research could focus on investigating the long-term performance and durability of HDRB, LRB, and sliding bearing hybrid isolators, exploring real life larger structures and varying seismic intensities, and developing advanced computational models to simulate complex interactions in hybrid isolation systems.

Sustainable Construction Techniques for Tunnels and Deep excavations

Ankala Saibaba

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ABSTRACT

Recently there has been a marked increase in the construction of major highway and railway tunnels and deep excavations due to increase in Infrastructure growth in transportation sector. Present practice of construction mostly relies heavily on traditional techniques and conventional materials, leading to increase in pollution levels, CO2 emissions and global warming Tunneling projects and the associated deep excavations involve consumption of high levels of energy and conventional material with little or no significant concern about the environment or ecological systems. To counter this trend, new techniques of construction are emerging in tunnel infrastructure sector which ensure infrastructure development duly safeguarding sustainability requirements of environmental protection, resource efficiency and social responsibility. This study examines the principles, challenges, and emerging practices of sustainable tunnel construction and sustainable material with emphasis on minimizing environmental impact while ensuring safety, durability, and economic viability. Key aspects discussed include optimized design of tunnel alignment and approaches, cross-section of tunnel to reduce excavation volumes, adoption of energy-efficient methods such as mechanized tunneling, design blasting and use of sustainable material that involve low-carbon emissions in tunnel linings, shotcrete, support systems and the protection measures of deep excavations. Advanced ground investigation, real-time instrumentation, and digital technologies such as Building Information Modeling (BIM) and digital twins are highlighted for their role in improving design accuracy, reducing uncertainties, and minimizing construction risks and rework. Sustainable management of excavated material, groundwater control, ventilation, and waste is also addressed, along with measures to protect biodiversity and nearby communities. A case study of the author in NF Railway is also discussed where surplus soil from deep excavations was converted to usable soil-cement blocks, thereby effecting considerable saving on cost as per life-cycle costing and reduction in CO2 levels as per life cycle analysis, providing employment to locals and enhancing the aesthetic appeal to ensure sustainability of tunnels and high cuttings. The study concludes that sustainable tunnel construction is achievable through a holistic approach combining engineering excellence, and policy support, making it a cornerstone for resilient and future-ready transport infrastructure worldwide.

Self-Centering Precast Post-Tensioned Shear Walls in Seismic Areas

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

Self-centring precast post-tensioned (PT) shear walls represent an innovative seismic-resistant structural system aimed at minimising damage and residual deformation during strong earthquakes. Unlike conventional reinforced concrete shear walls that dissipate seismic energy through yielding and cracking, PT shear walls are designed to rock at the base, with post-tensioning tendons providing restoring forces that enable re-centering after seismic events. This presentation discusses numerical and experimental studies evaluating the seismic performance of PT shear walls in comparison with conventional shear wall systems. Key response parameters such as strength, stiffness degradation, hysteretic behavior, energy dissipation, and residual drift are examined. The inherently low energy dissipation of pure self-centering systems is addressed through the incorporation of external energy dissipating devices, such as replaceable steel fuses. Results demonstrate that hybrid PT shear wall systems achieve an effective balance between self-centering capability and energy dissipation, offering a resilient, repairable, and performance-based alternative for construction in high seismic regions.

Nano-Silica Modified Cement Composites for Resilient Infrastructure

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THEME: Dynamic properties of soil and ground response

ABSTRACT

Material performance is fundamental to achieving seismic-resilient infrastructure. This invited talk presents the development of nano-silica modified multi-blended cementitious composites designed to enhance strength, durability, and microstructural stability under demanding service conditions.

Colloidal nano-silica (0.5-3.5%) was incorporated into binary, ternary, and quaternary blended systems containing fly ash (FA) and ultrafine fly ash (UFFA). An optimum dosage of 3% nano-silica was identified based on compressive strength performance. Advanced characterization techniques (TGA, XRD, SEM-EDX) revealed that nano-silica significantly accelerates hydration kinetics, enhances pozzolanic reactivity, and refines pore structure, leading to a denser and mechanically robust matrix.

The synergistic incorporation of FA, UFFA, and nano-silica, guided by particle packing principles, resulted in improved early-age strength development, enhanced durability characteristics, and reduced microstructural defects. The quaternary blended system demonstrated superior performance compared to conventional mixes, indicating its suitability for high-performance structural applications.

The findings highlight that optimized nano-silica based multi-blended cementitious composites offer a sustainable and high-strength material solution for seismic-resilient infrastructure in hazard-prone regions.

Plasticity-Based Stress Characteristics Approach for Geotechnical Stability

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THEME: Dynamic properties of soil and ground response

ABSTRACT

Accurate evaluation of earth pressures and stability of geotechnical structures under static and seismic loading remains challenging due to the presumption of failure surfaces in many conventional theories. Plasticity-based formulations provide a rigorous alternative by allowing failure mechanisms to develop naturally from stress equilibrium and yield conditions. This invited talk presents a semi-analytical stress characteristics framework based on the theory of plasticity, in which the governing hyperbolic stress equations are solved using a stress characteristics and finite difference scheme. The approach enables direct computation of stress fields and emergent failure surfaces without predefined geometry, offering high accuracy with computational efficiency. The proposed methodology is semi-analytical in nature and is capable of addressing a wide range of geotechnical problems, including earth pressure calculation and stability analysis of retaining structures and foundations under static and seismic conditions.

Hybrid Simulation: Theory and Applications

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

Hybrid simulation (HS) is an accurate and cost-effective method of simulating the seismic response of structural systems. In this simulation, a complete system is discretized into coupled domains of numerical and physical substructures, and the dynamic response of the system is determined by solving the equations of motion using a direct integration algorithm. The method integrates the benefits of computational simulation and physical testing. Real-time hybrid simulation (RTHS), i.e., HS conducted in real time, is particularly useful for the performance assessment of structures with rate-dependent devices. This talk will begin with the theory of HS and RTHS and their implementation in the Pseudo-Dynamic Testing Facility (PDTF) at IIT Kanpur. Key challenges in large-scale RTHS of complex structural systems, along with means to overcome them, will be highlighted. Several examples of completed and ongoing HS and RTHS involving not only earthquakes, but also other hazards will be presented.

Re-Engineering Earth Block Construction for Seismic-Resilient Low-Rise Housing in India: Development of Ultra-Compressed Masonry Systems

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

Masonry is the dominant residential construction system in India, with nearly 70–80% of buildings constructed using load-bearing masonry walls, as reported in the Government of India Housing Census. A significant portion of this construction is non-engineered, primarily driven by affordability constraints. Such construction typically relies on locally produced, non-standardized masonry units such as fired clay bricks, concrete blocks, or sun-dried bricks. These conventional masonry units require energy-intensive manufacturing processes that contribute significantly to carbon emissions and demand considerable production time and storage space. Fired clay bricks involve high-temperature kiln firing and require time for both firing and cooling. Concrete blocks require cement (which is energy- and carbon-intensive) and require curing time before they can be used in construction.

In this presentation, the development of ultra-compressed stabilized earth block (UCSEB) masonry for seismic-resilient housing in India is presented. Ultra-compaction improves the mechanical and physical properties of the blocks and provides sufficient green strength to allow their use in masonry construction immediately after fabrication. The long-term properties of the blocks demonstrate that masonry built with such blocks can achieve sufficient performance for seismic-resilient low-rise buildings. The UCSEB masonry system provides a practical alternative for low-rise housing that is affordable, environmentally responsible, and suitable for rapid construction.

Micromechanical insights on the flow-liquefaction phenomena of granular soil: Effect of particle morphology, loading rate and its direction

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THEME: Dynamic properties of soil and ground response

ABSTRACT

Undrained shearing response of saturated loose granular soil usually depicts a sudden loss in shear strength marking the emergence of flow-liquefaction type undrained or solid-fluid instability. For real field cases, such solid-fluid instability leads to catastrophic failure of geotechnical structures resulting in loss of life and property. In case of earthquake induced liquefaction, the loading is generally displacement/strain controlled with existence of a generalized strain state. Consequently, consideration of various strain paths becomes crucial while analysing the mechanical response of saturated loose sand subjected to undrained shearing. Additionally, loading rate can also significantly affect the mechanical behavior and undrained instability response of such soils, even for other geotechnical applications like pile driving, dynamic compaction and underground blasting involving loading of medium to high strain-rate range. For such cases, the interplay between drainage scenarios and loading rate will critically govern the generation of excess pore-water pressure and its subsequent dissipation process. The inherent material rate-sensitivity may further add complexities to it. This presentation delves into the micro-mechanics associated with flow-liquefaction phenomena in granular soil with a particular focus on particle morphology, loading rate and its direction. In this regard, 3D Discrete Element Method (DEM) based simulations of constant volume true-triaxial test have been carried out for loose granular soils at different strain rates and along various strain paths by controlling the intermediate strain ratio. A rolling resistance type contact model has been employed to indirectly cater the particle shape effects within the numerical framework. With increasing strain rate, significant reduction in the generation of pore-water pressure has been observed owing to the underlying suppressed particle rearrangement at higher rates. This leads to a delayed onset of complete liquefaction for the specimen in conjunction with enhanced peak deviatoric stress. Further, such a rate-sensitive response has been observed to be more significant for granular assembly of higher rolling resistance mimicking more irregular shaped particles. Additionally, a reduction in liquefaction susceptibility becomes evident with increasing intermediate strain ratio, which is attributed to enhanced particle contacts in the major and intermediate principal stress direction, leading to an increased mean confinement.

Sustainable Performance Enhancement of Masonry Walls with Textile- and Wire-Reinforced Mortar Composites

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

An experimental overview is presented on the sustainable performance enhancement of unreinforced masonry (URM) walls using textile-reinforced mortar (TRM) and wire-reinforced mortar (WRM) composite systems. Masonry specimens strengthened with externally bonded composite layers are evaluated under out-of-plane bending conditions to examine the effectiveness of these retrofitting interventions. The lecture will discuss the role of reinforcement configuration, material compatibility, and reinforcement ratio in improving the structural response of masonry walls. Particular emphasis will be placed on strength enhancement, stiffness improvement, crack control, ductility, and energy absorption capacity. The session will further highlight the potential of textile- and wire-reinforced mortar composites as sustainable, cost-effective, and compatible strengthening solutions for both existing and heritage masonry structures.

Seismic Safety Strategy of Masonry Structures: Challenges and Way Forward

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

Poor seismic performance of masonry (most preferred housing of common people in most of the developing countries and the prime constituents of ancient/heritage structures) is well documented in literature. The brittle failure of such structures during earthquake events (even in moderate earthquakes) lead to huge casualties, loss of economy and potential damage to ancient/heritage structures. Wide variations of material characteristics (brick/stone and mortar) and presence of bond between the materials (head joint and bed joint), makes the behaviour of masonry a complex phenomenon. Predominant nature of failure includes; shear, tension, diagonal and junction. Most of the strengthening strategy are focussed on application of composite materials. However, its availability and cost makes it far beyond the reach of common people. A few sustainable, cost-effective, easily applicable and straight forward strategy are also applied towards the seismic safety of masonry successfully. However, most of these are limited to the laboratory application. It's the need of the hour to popularize the same among the users and technical community for extending the applicability from lab to land. Effort may be made towards its standardization and availability of design guidelines. The policy makers and the technical community may have to play crucial role with the researchers for successful transformation of the strategy from lab to land, which may lead to sustainable infrastructure.

Smart Rainwater Utilization and Drone-Enabled Monitoring for Seismic-Resilient Educational and Public Infrastructure

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THEME: Seismic vulnerability, risk, and resilience assessment

ABSTRACT

Urban educational institutions and public buildings are increasingly vulnerable to both water scarcity and seismic disruptions. Conventional centralised municipal water supply systems are highly susceptible to earthquake-induced failures, leading to functional paralysis of critical infrastructure such as sanitation systems, fire safety reserves, and emergency utilities. This lecture proposes a decentralized, smart rainwater utilization framework integrated with UAV (drone)-based inspection and monitoring systems to enhance sustainability and seismic resilience in institutional infrastructure.

This lecture emphasizes rooftop rainwater harvesting (RWH) systems designed specifically for non-potable applications, including toilet flushing, landscape irrigation, cleaning operations, and emergency water reserves.

To enhance operational efficiency and post-disaster rapid assessment, the system integrates drone-enabled technologies for roof catchment inspection, blockage detection, crack identification in overhead tanks, thermal leak detection, and GIS-based campus drainage mapping. UAV-supported inspections reduce manual risk exposure and allow rapid condition assessment immediately following earthquakes, thus accelerating recovery timelines.

The proposed integrated system contributes to seismic functional resilience, water security, climate adaptation, and sustainable infrastructure development. The framework aligns with SDG 6 (Clean Water), SDG 11 (Sustainable Cities), and SDG 13 (Climate Action). This interdisciplinary approach bridges water resource engineering, structural resilience, smart infrastructure, and UAV-based monitoring technologies, offering a scalable model for campuses, hospitals, and public facilities in seismic-prone regions.

Seismic Stability of Slopes Subjected to Foundation Loads: Threshold Load Behavior and Failure Mechanisms - A Case Study

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THEME: Dynamic properties of soil and ground response

ABSTRACT

The construction of buildings on sloping ground significantly alters slope stability, particularly under seismic excitation. Conventional slope stability analyses typically consider free slopes; however, the presence of foundation loads acting as surcharge can fundamentally modify failure mechanisms and available safety margins. This study presents a detailed case study investigating the seismic stability of a natural hill slope subjected to foundation loads. Finite Element Limit Analysis (FELA), in conjunction with the Strength Reduction Method, is employed to evaluate the variation of Factor of Safety (FOS) with increasing footing load under pseudo-static seismic conditions. The results reveal a characteristic response: the FOS remains nearly constant at low loading intensity, followed by a sudden reduction beyond a critical value defined as the threshold load. This transition corresponds to a shift in failure mechanism from global slope instability to localized failure beneath the footing. The study further demonstrates the influence of slope angle, seismic coefficient, footing width, and edge distance on both the threshold load and overall seismic stability. Design charts and empirical relationships developed from the investigation are applied to the selected site to estimate allowable foundation loads and associated seismic safety margins. The findings emphasize that neglecting foundation surcharge in seismic slope analysis may lead to unconservative assessments. The proposed framework provides a rational and mechanics-based approach for evaluating the stability of slopes supporting structural loads in earthquake-prone regions.

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