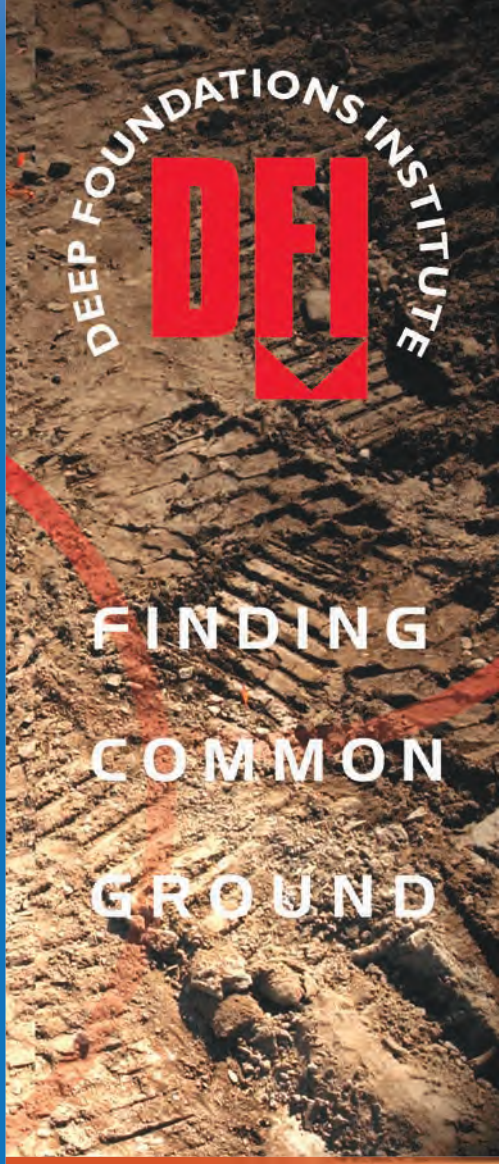
DFI INDIA 2026



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15th Annual Conference
DFI India 2026 on

Deep Foundation Technologies for Infrastructure Development in India

Guwahati, Assam, 24 -26 September 2026

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15th Annual Conference on

Deep Foundation Technologies for Infrastructure Development in India

IIT Guwahati, Assam, 24-26 September 2026

Souvenir

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DFI of India Technical Committees
Conference Schedule
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Deep Foundations Institute, DFI of India
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About the Organizers

Deep Foundations Institute (DFI) and DFI of India

The Deep Foundations Institute is a non-profit organization that brings together professionals such as engineers, contractors, manufacturers, and equipment suppliers for deep foundations and deep excavations. Following the success of the international conference held in Hyderabad in 2011, and the inaugural conference on Deep Foundation Technologies for Infrastructure Development in India held at IIT Madras in Chennai in 2012, DFI of India was officially established in 2013. It was registered with the Ministry of Company Affairs as a non-profit organization under an affiliation agreement with DFI USA.

Following the success of these conferences, DFI of India decided to hold annual conferences on the central theme 'Deep Foundation Technologies for Infrastructure Development in India' in different cities. Highly successful conferences were held in Mumbai (2013), New Delhi (2014), Bangalore (2015), Kolkata (2016), Chennai (2017), Gandhinagar (2018), Hyderabad (2019), virtual conferences in 2020 and 2021 followed by conferences in Tirupati (2022), Vadodara (2023), Goa (2024) and most recently, the 14th conference in Surat (2025). DFI of India has organized a series of seminars and workshops across the country, all of which have been very successful.

We aim to raise professional standards in the foundation industry and encourage the use of modern, innovative technologies to support India's rapid development on a continuous and sustained basis. Through seminars, workshops, and training courses, the chapter aims to provide a strong platform for ongoing interaction among all stakeholders in the Indian foundation industry, including international agencies.

DFI of India has several programs for students, women in deep foundation, geotechnical investigation professionals and technicians, apart from the entire workforce in the deep foundation construction industry.

Visit www.dfi-india.org for more information about DFI of India.

Indian Geotechnical Society (IGS), Guwahati Chapter

The Indian Geotechnical Society (IGS) Guwahati Chapter (NE) is a premier regional hub dedicated to advancing geotechnical engineering across Northeast India. Established in 2005, the chapter bridges the gap between academic research and practical engineering solutions, addressing the region's unique geological and structural challenges. The chapter brings together a diverse community of professionals, including top academicians, research scientists, design consultants, construction engineers, and students. By hosting national-level conferences, technical seminars, and specialised workshops, it fosters continuous learning and collaboration. Dr Sasanka Borah, Assistant Professor, Assam Engineering College, is the current Chair, and Dr Vivek Padmanabha, Assistant Professor, IIT Guwahati, is the Honorary Secretary.

Website: https://www.igs.org.in/local-chapter/guwahati-assam

Indian Institute of Technology Guwahati

IIT Guwahati, the sixth member of the IIT fraternity, was established in 1994. In a short time, IIT Guwahati has built world-class infrastructure for advanced research and has been equipped with state-of-the-art scientific and engineering instruments. Beyond its laurels in teaching and research, IIT Guwahati has greatly fulfilled the aspirations of people in the northeast region since its inception.

Indian Institute of Technology Guwahati's campus sits on a sprawling 285-hectare plot on the north bank of the river Brahmaputra, around 20 km from the heart of the city. With the majestic Brahmaputra on one side, and with hills and vast open spaces on the other, the campus provides an ideal setting for learning.

Website: https://www.iitg.ac.in/

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Preface

The DFI of India Annual Conference has become a premier forum for professionals, academics, and students in deep foundations and geotechnical engineering. Its distinctive strength lies in bringing together practical experience, research, innovative technologies, and real-life case studies, thereby fostering knowledge exchange and collaboration across the foundation industry.

The 15th DFI of India Annual Conference, to be held at IIT Guwahati from 24–26 September 2026, is particularly significant as we bring the conference to the North-East region of India for the first time. Organised in collaboration with IIT Guwahati and the IGS Guwahati Chapter, the conference aims not only to provide a platform for technical exchange but also to raise awareness and encourage the adoption of modern geotechnical and foundation technologies in this rapidly developing region.

As you flip through this Souvenir, you will find the keynote abstracts, details of the special sessions, accepted technical papers from Indian and international contributors, and information about our valued sponsors and exhibitors. This Souvenir is intended not merely as a record of the conference, but as a useful technical reference for delegates and professionals beyond the event.

The conference brings together five eminent national and international keynote speakers, along with a rich selection of technical papers, case studies and knowledge-sharing sessions. A special highlight is the dedicated session on “Hillslope Stability & Landslide Mitigation”, a subject of immense relevance to the fragile terrain of the North-East and the Himalayan region. The session will bring together leading experts for a panel discussion focused on practical solutions and the way forward to address these challenging and increasingly important issues. Sustainability in deep foundation construction is another important thrust area of this conference. The panel discussion on “Sustainability in Construction – Opportunities & Challenges” will deliberate on our responsibilities, practices and opportunities as we move towards more sustainable construction practices.

We are privileged to honour Dr. S. R. Gandhi, former professor at IIT Madras and currently a visiting professor at IIT Gandhinagar, with the DFI of India Lifetime Contribution Award 2026. His outstanding contributions to advancing deep foundation technology and practice in India have left a lasting imprint on our profession, and we are delighted to recognise his remarkable legacy.

We are honoured to have Er. Ashish Bansal, GM (Construction), Northeast Frontier Railway, as our Chief Guest, and Prof. Dhirendra Nath Buragohain, former Director, IIT Guwahati, as Guest of Honour. Further, the presence of Prof. Devendra Jalihal, Director, IIT Guwahati, greatly enhances this august gathering during the inauguration of this conference.

We are deeply honoured to welcome Ms. Theresa Engler, Executive Director, DFI USA, to the DFI-India 2026 Conference in person. Her presence, travelling all the way from the United States to join us in Guwahati, is a tremendous gesture of support and encouragement for DFI of India. Her participation reflects the strong bond between DFI USA and DFI of India and motivates us to continue strengthening the foundation engineering community in India and beyond.

The conference also continues the valued Women in Deep Foundations (WIDF) initiative, celebrating and highlighting the growing and significant contributions of women to our industry. Further, the DFI-India Awards for the best technical papers at the conference, and for students in the M.Tech and Ph.d. categories, augment our tradition of recognising excellence, innovation and contributions that advance foundation technology and practice.

We express our sincere appreciation to all our sponsors and exhibitors, whose generous support has contributed greatly to the success of this conference. We also acknowledge with gratitude the efforts of the conference chair, Prof. Arindam Dey, and the Advisory, Organising and Technical committees, whose collective commitment has made this event possible. We reserve a word of appreciation for DFI USA, spearheaded by James Johnson and his board, Theresa Engler and Matthew Glisson, for enabling a bigger vision for India’s foundation growth. We express our pride in acknowledging the efforts of the DFI office team – Jaime Cettina, Jessica Zellat and Mathias Burpee from the USA office; Pranav Jha, T.S. Mahendran and Aswin V Hari from the India office – hats off to their herculean efforts for the success of this mega event.

Finally, we warmly welcome all students and young professionals attending the conference. Your curiosity, energy and fresh perspectives are essential to the future of our profession. We are confident that the interactions, discussions and experiences at this conference will inspire new ideas, strengthen professional relationships and contribute to the continued advancement of deep foundation and geotechnical engineering in India. We look forward to welcoming you all to Guwahati for three days of learning, interaction, innovation, and professional camaraderie.

Dr. Sunil S. Basarkar
Chairman, DFI of India

Er Ravikiran Vaidya
Vice-Chairman, DFI of India

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Message from President, DFI

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As my term as President of the Deep Foundations Institute (DFI) comes to an end this year, I am deeply impressed by the progress DFI of India (DFII) has made and the impact it continues to have. Through education and collaboration, DFII brings together India's deep foundation professionals to advance productivity, safety, sustainability, and quality across the industry. Each time DFII reports its activities to the DFI Board of Trustees, I am struck by its continued success in connecting international knowledge with local expertise.

DFII's annual collaboration with local Indian Institutes of Technology (IITs) and chapters of the Indian Geotechnical Society reflects DFI's broader goal of bringing together the geotechnical design and construction community to support the development of vital infrastructure. One of the principal ways DFII advances this goal is through its annual conference on deep foundation technologies for infrastructure development. This year is no exception: the 15th Annual Conference offers timely technical sessions and discussions focused on the challenges facing the industry and the solutions needed to address them.

I am grateful to the DFII Executive Committee, led by Dr. Sunil Basarkar; the DFII staff, led by Pranav Jha; and the Conference Organizing Committee, led by Conference Chair Dr. Arindam Dey of IIT Guwahati, in partnership with the Indian Geotechnical Society Guwahati Chapter. Their efforts have produced a three-day program rich in both technical content and networking opportunities.

I am also pleased that DFI Executive Director Theresa Engler can attend this year's conference, representing DFI's broader leadership and contributing to the event's success. The keynote speakers are exceptional, and the entire program reflects our shared values of safety, quality, innovation, sustainability, and resilience while advancing geotechnical design and construction. I encourage every attendee to participate fully, exchange ideas, and help shape the future of India's infrastructure.

As DFII presents its 15th Annual Conference, DFI is also preparing for its 51st Annual Conference, to be held November 2–5, 2026, in Orlando, Florida, USA. The program will explore the impacts of sea-level change and bring together knowledgeable experts from around the world to share solutions to this global concern. We hope many of you attending the conference in India will consider joining us in Orlando later this year.

My wish is that you find inspiration throughout the coming three days and leave with valuable knowledge and ideas to share with others. Thank you to all the speakers, sponsors, attendees, and exhibitors whose participation makes this 15th Annual Conference possible. On behalf of DFI's leadership, I wish you an insightful, productive, and memorable experience.

Warm Regards,

James Johnson
James Johnson
DFI President

Message from Executive Director, DFI

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It is amazing to see how far DFI of India (DFII) has come regarding its activities and to be holding its 15th annual conference. Once again, there is an impressive lineup of keynote speakers from across the globe and outstanding technical presentations and sessions, reflecting the depth of expertise and collaboration that define our industry.

I'm especially pleased to be attending the conference this year which will be my third time visiting India and meeting with the DFII members in attendance. In partnership with the Indian Geotechnical Society Guwahati Chapter and the Indian Institute of Technology Guwahati, the DFII 15th annual conference organizing committee, and DFII staff have curated a must-attend three-day agenda featuring high-quality papers and vibrant discussions. The conference proceedings will once again be published by Springer Nature, extending the reach of this valuable technical content worldwide.

I'm delighted another DFII Women in Deep Foundations dedicated session that celebrates diversity and inclusion in our field. Also, I anticipate the session on hillslope stability and landslide mitigation will be of great interest since slope stability, erosion control and landslide mitigation are specifically challenging in the Northeastern region of the nation.

Additionally, I expect a lively discussion during the panel discussion on concerns and policy interventions regarding Northeast hill infrastructure.

I hope to speak to many attendees about the strategic initiatives DFI is focused on overall and the progress we have made with each:

Industry Awareness and Advancement: Encouraging new talent to join the industry to support our member companies in filling essential roles. Our main outreach this year was to hold an Equipment Rodeo, providing 16–19-year-olds with an opportunity to experience firsthand what it's like to drive construction equipment and provide encouragement of their pursuit of careers in our industry.

Corporate Membership Growth: Enhancing member value and expanding our network by connecting with related industries and associations. 2026 has seen an increase in membership and active involvement in our committees and other technical activities.

Conference Vision and Planning: Choosing high-interest specialty themes for our North American annual conferences with a goal of bringing not only DFI members together, but also public policymakers, financers, insurance providers and risk modelers, to discuss this year the pressing worldwide concern of sea level impacts. I hope you will join us in Orlando this November.

Special thanks to Conference Chair Dr. Arindam Dey, the organizing, advisory, technical, and core conference committee members; DFII staff—T.S. Mahendran and Aswin V. Hari, led by Pranav Jha; and our DFI U.S. office team—Mathew Glisson, Jaime Cettina, Rebecca Gallery, Jessica Zellat, and Mathias Burpee. I also want to recognize and thank the conference sponsors and exhibitors for their invaluable support.

I encourage everyone, authors, speakers, panelists, and participants to engage deeply in the sessions, explore new ideas, and connect with fellow attendees.With warm regards,

Theresa Engler
DFI Executive Director

Message from Chief Guest

Shri Ashish Bansal
General Manager
Northeast Frontier Railway (Construction), Maligaon

I extend my warm greetings to the 15th Annual Conference of the Deep Foundations Institute of India (DFI-India 2026), being organized by the Deep Foundations Institute of India in association with IIT Guwahati and the Indian Geotechnical Society, Guwahati Chapter. The conference provides an excellent opportunity for professionals, researchers, academicians, and practitioners from across the country to come together and share their knowledge, experience, and perspectives on the development of deep foundation technologies.

The theme of this year's conference, "Deep Foundation Technologies for Infrastructure Development in India," is particularly relevant as the country witnesses significant growth in transportation, urban infrastructure, industrial development, and other major infrastructure projects. As projects become increasingly complex, the need for sound geotechnical investigation, appropriate foundation systems, improved construction practices, and innovative engineering solutions becomes ever more important. Platforms such as DFI-India provide an opportunity to discuss these challenges and learn from both research and practical field experience.

Northeast Frontier Railway (Construction) has a significant role in the development and connectivity of the Northeastern region, linking remote areas with major economic centres and supporting the movement of people and goods. Railway infrastructure in this region often involves difficult terrain, steep slopes, challenging ground conditions, heavy rainfall, and landslide-prone areas. These conditions demand careful geotechnical assessment, robust foundation systems, and innovative construction approaches to ensure the safety, reliability, and long-term performance of railway infrastructure.

This conference brings together experts to discuss a wide range of topics, including deep foundations, hillslope stability and landslide mitigation, marine and coastal infrastructure, sustainability, and the application of emerging technologies in geotechnical engineering. The exchange of ideas among experienced practitioners, young professionals, researchers, and students can play an important role in addressing the evolving challenges faced by the infrastructure sector.

I am confident that the technical sessions, discussions, and interactions during DFI-India 2026 will generate valuable insights and encourage greater collaboration between industry and academia. Such collaboration is essential to translate innovative ideas and research into practical solutions that contribute to safer, more resilient, and sustainable infrastructure.

I extend my sincere best wishes to the organisers, speakers, delegates, sponsors, and participants for a successful and enriching conference. I hope DFI-India 2026 will serve as a meaningful forum for knowledge sharing, professional interaction, and advancing deep foundation and geotechnical practices in India, with particular relevance to the continued development of the Northeast.

Shri Ashish Bansal
General Manager
Northeast Frontier Railway (Construction), Maligaon

Message from Guest of Honour

Prof. Dhirendra Nath Buragohain
Former Director, IIT Guwahati

The development of infrastructure is, at its core, a reflection of a nation's aspirations and its ability to translate knowledge into lasting public value. In this context, the 15th Annual Conference of the Deep Foundations Institute of India (DFI-India 2026) comes at a pivotal moment for India's infrastructure sector. I am pleased to be associated with this conference and to see experts from academia, industry, research institutions, and the professional community coming together at IIT Guwahati to deliberate on the evolving challenges of foundation engineering.

Deep foundation engineering occupies a critical place in modern infrastructure development. As projects extend into increasingly complex ground conditions and demanding environments, conventional approaches must be complemented by improved investigation methods, analytical tools, construction technologies, and a deeper understanding of soil–structure interaction. Equally important is the ability to learn from field experience and convert that knowledge into better engineering practice.

The North-eastern region offers a particularly valuable setting for such discussions. Its varied geological conditions, mountainous terrain, seismicity ordeals, intense rainfall, and susceptibility to landslides create challenges that require careful engineering judgement and context-specific solutions. Infrastructure development in the region therefore presents not only difficulties but also significant opportunities for innovation in geotechnical and foundation engineering.

Having had the privilege of serving IIT Guwahati, I am especially pleased to see the Institute continuing to provide a platform for meaningful interaction between knowledge creators and practitioners. An institution's strength lies not only in the research it produces, but also in its ability to connect that knowledge with the needs of society and industry. Conferences such as DFI-India 2026 contribute to this process by encouraging dialogue across disciplines and bringing practical engineering challenges into academic and research discussions.

I am also encouraged by the conference's attention to areas such as hillslope stability and landslide mitigation, sustainability, emerging technologies, and innovative approaches to foundation construction. These are issues that will increasingly shape the future of infrastructure engineering. At the same time, involving young researchers, students, and professionals is essential to ensure that the knowledge and experience of the present generation are carried forward and further developed.

I congratulate the Deep Foundations Institute of India, IIT Guwahati, the IGS Guwahati Chapter, and the organising committee for bringing together this distinguished gathering. I hope the conference will generate thoughtful technical discussions, encourage new collaborations, and contribute to engineering solutions that are safe, sustainable, and responsive to India's diverse infrastructure needs.

I wish all participants a stimulating and fruitful DFI-India 2026, and I look forward to the exchange of ideas and experiences that this gathering will undoubtedly bring.

Prof. Dhirendra Nath Buragohain
Former Director, IIT Guwahati

Message from Chair, DFI of India

DEEP FOUNDATIONS INSTITUTE OF INDIA
Non-profit company Registered under Ministry of Company Affairs, Government of India
(Regn. No. U91900TN2013NPL091176)
Regd. Address:
44/17 'BHASKARA', 19 Usha Street, Dr. Seethapathy Nagar, Velachery, Chennai 600042,
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Dear Delegates, Guests, Fellow Professionals and Friends,

It gives me immense pleasure to welcome you to the 15th Annual Conference of the Deep Foundations Institute of India (DFI-India), being held from 24–26 September 2026 at IIT Guwahati, Assam. This year's conference, is particularly special to me as it is the first annual conference of DFI-India during my tenure as Chairman.

This year's conference brings together a vibrant community of professionals, academicians, researchers, students and industry leaders, with a rich programme of keynote addresses, technical sessions, panel discussions and industry exhibitions.

The decision to hold this year's conference in North-East India is deliberate and significant. The region is witnessing rapid infrastructure development, while its distinctive geological, terrain and climatic conditions present unique challenges to foundation engineering. We hope to disseminate the latest knowledge and good practices among all stakeholders in this region, and strengthen their interaction with the wider national and international deep foundations community. I am particularly confident that this conference will initiate stronger and continuing engagement between DFI-India, the professional and academic community of the North-East.

This conference continues to take forward the legacy of well thought initiatives reflecting DFI-India's commitment to knowledge, innovation, inclusiveness, recognition of excellence and nurturing the future of deep foundation engineering. The Women in Deep Foundations (WiDF) initiative celebrates the yeoman contribution of women professionals and promotes greater participation, leadership and mentorship in our industry. The Lifetime Contribution Award honours distinguished professionals whose contributions have enriched our discipline, while the Student Awards recognise and encourage the next generation of deep foundation professionals.

The North-Eastern region is characterised by extensive hills and mountainous terrain, where landslides, slope failures and erosion-related problems are recurring challenges. Recognising this pressing regional need, DFI-India has planned a special half-day technical session on Hillslope Stability and Landslide Mitigation on 24th September 2026. The session will bring together experts to discuss challenging case histories and state-of-the-art approaches for slope protection, erosion control and landslide risk reduction, followed by an interactive panel discussion.

I sincerely acknowledge the support of the DFI-India Board, the Executive Committee, IIT Guwahati, IGS Guwahati Chapter, organizing & technical committee members, advisors, speakers, authors, sponsors, exhibitors, participating students and volunteers who have contributed a lot for the success of this conference.

I extend a warm welcome to all our delegates and am confident that the coming three days at IIT Guwahati will provide with valuable technical learning, meaningful professional interactions and new opportunities for collaboration.

Let us use this conference to share knowledge, embrace innovation and collectively advance the practice of deep foundation engineering in India.

I wish you all a technically enriching, productive and memorable DFI-India 2026 Conference.

With warm regards,Warm Regards,

Dr. Sunil S Basarkar
Chairman, DFI of India

Message from Director, IIT Guwahati

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प्रो. देवेन्द्र जालिहाल
Prof. Devendra Jalihal
निदेशक
Director

It is a matter of great satisfaction for IIT Guwahati to host the 15"· Annual Conference of the Deep Foundations Institute of India (DFI-India 2026). The Institute is pleased to welcome distinguished professionals. Academicians, researchers, and industry leaders. and young engineers from across the country for this important forum dedicated to advances in deep foundation and geotechnical engineering.

As Director of IIT Guwahati, I am proud that we are actively hosting this national-level conference focused on one of the most critical domains in infrastructure engineering. The conference theme, "Deep Foundation Technologies for Infrastructure Development in India," reflects a growing area of importance as India continues to undertake ambitious infrastructure projects across diverse geographical and geological conditions. The performance and reliability of any major infrastructure project are closely linked to the quality of its foundation systems. Addressing the challenges associated with complex ground conditions therefore requires a combination of sound engineering principles, innovative technologies, field experience, and continued research.

Located in the north-eastern part of the country, IIT Guwahati is especially relevant to discussions on infrastructure development in challenging terrain. The region presents a wide range of geotechnical conditions, including hilly terrain, difficult soil profiles, high rainfall, seismic activity, and landslide susceptibility. Over the years, the Institute has contributed to education, research, and technological development in areas relevant to these challenges. Its location and academic environment provide a natural platform for bringing together scientific research and practical engineering experience.

I believe that conferences of this nature are important not only for presenting technical developments but also for creating lasting professional connections and encouraging the next generation of engineers and researchers. Interaction among experienced practitioners, faculty members, researchers, and students can inspire new ideas and help address the increasingly complex demands of infrastructure development.

I appreciate the organising team and all collaborators for their hard work and commitment in bringing this prestigious conference to a grand success.

On behalf of IIT Guwahati, I extend my best wishes to DFl-India 2026, the IGS Guwahati Chapter, the organising team, speakers, sponsors, and all delegates for a successful and rewarding conference. I hope DFl-India 2026 will lead to valuable discussions, stronger industry-academia collaboration, and continued progress in deep foundation and geotechnical engineering in India.

Devendra Jalihal

(Devendra Jalihal)
निदेशक
भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
गुवाहाटी-७८१०३९
Director
Indian Institute of Technology Guwahati
Guwahati-781039

Message from IGS President

INDIAN GEOTECHNICAL SOCIETY
Registered under Societies Act vide Regn. No. S/18957 dated 16.05.1988)
(Affiliated to INTERNATIONAL SOCIETY FOR SOIL MECHANICS AND GEOTECHNICAL ENGINEERING)

Dear Colleagues and Esteemed Guests,

It gives me immense pleasure to extend my warm greetings to all participants of the 15th DFI-India Annual Conference 2026, being held at the prestigious Indian Institute of Technology Guwahati, in collaboration with the DFI of India, IIT Guwahati, and the Indian Geotechnical Society (IGS) Guwahati Chapter.

Deep foundations are where engineering meets the ground and where the aspirations of infrastructure take root. As India advances its ambitious infrastructure development, innovative, reliable and sustainable deep foundation technologies are increasingly vital. The theme of this conference, "Deep Foundation Technologies for Infrastructure Development in India," is therefore both timely and significant.

The DFI-India Annual Conference provides an important platform to connect research, design, construction, and technology, fostering knowledge exchange and innovative solutions for safer and more resilient infrastructure. I sincerely appreciate the efforts of the DFI of India, IIT Guwahati, and the IGS Guwahati Chapter, along with all speakers, sponsors, delegates, and volunteers. May this conference inspire meaningful collaboration and set new benchmarks in deep foundation engineering.

On behalf of the Indian Geotechnical Society, I wish the 15th DFI-India Annual Conference 2026 every success. Let us innovate beneath the ground to build higher, safer, and stronger above it.

With my best wishes for a stimulating, productive, and memorable conference.

Yours sincerely,

Dr. Anil Joseph
President, Indian Geotechnical Society

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Message from IGS Guwahati Chapter

It gives us immense pleasure to welcome the geotechnical and foundation engineering community to DFI-India 2026: 15th Annual Conference on Deep Foundation Technologies for Infrastructure Development in India, to be held during 24–26 September 2026 at Indian Institute of Technology Guwahati. The conference marks an important occasion for the geotechnical community, as one of India's leading forums on deep foundation engineering comes to the North Eastern Region.

The North-eastern region of India is entering an important phase of infrastructure development. Major investments in road and highway connectivity, bridges, railways, tunnels, hydropower, urban infrastructure and other strategic projects are creating new opportunities as well as demanding geotechnical conditions. Foundation engineering in this region often requires solutions that account for difficult terrain, variable subsurface conditions, seismic effects, heavy rainfall, erosion and riverine environments. Addressing these challenges effectively requires not only sound engineering fundamentals but also access to advanced technologies, specialized expertise and experience from comparable projects.

DFI can play a pivotal role in this regard. We look forward to DFI-India 2026 serving as a platform for facilitating the exposition of the region's distinctive geotechnical challenges, project experiences and research, while providing opportunities for interaction with experts, practitioners, researchers, consultants, contractors and technology providers from across India and abroad. Through technical presentations, case studies, industry interactions, exhibitions and professional networking, we look forward to fostering knowledge exchange, capacity building, industry–academia collaboration and greater exposure to contemporary foundation technologies and practices. We also hope that the conference will enable young engineers and researchers from the Northeast to showcase their work, build professional networks and contribute to the wider geotechnical community, thereby creating opportunities for sustained collaboration and future initiatives in the region.

The IGS Guwahati Chapter is proud to join hands with DFI of India and IIT Guwahati in organizing this significant event. We gratefully acknowledge the efforts of the DFI-India team, IIT Guwahati, technical and advisory committees, sponsors, exhibitors and volunteers.

On behalf of IGS Guwahati Chapter, we extend our warm welcome to all participants and wish DFI-India 2026 a highly successful and memorable conference.

With best regards,
Dr. Sasanka Borah - Chairman
Dr. Vivek Padmanabha – Honorary Secretary
Dr. Chiranjb Prasad Sarma – Jt. Secretary
Dr. Malaya Chetia – Treasurer
IGS Guwahati Chapter, Guwahati, Assam

Message from Conference Chair

Dr. Arindam Dey
Department of Civil Engineering, IIT Guwahati

It is a great pleasure and privilege to welcome you all to the DFI-India 2026: The 15th Annual Conference, hosted at the prestigious Indian Institute of Technology Guwahati. This milestone edition brings together the deep foundation and geotechnical engineering community at a time when India is witnessing an extraordinary transformation in its infrastructure landscape. The event is jointly organized by the Deep Foundations Institute of India (DFI of India), the Indian Geotechnical Society Guwahati Chapter, and the Indian Institute of Technology Guwahati (IIT Guwahati).

The theme of this year's conference, "Deep Foundation Technologies for Infrastructure Development in India," addresses a subject that is both timely and fundamental. As the country advances towards larger, more ambitious, and more complex infrastructure systems, the role of foundations extends far beyond simply supporting structures. Foundations must respond to challenging ground conditions, demanding performance requirements, environmental considerations, construction constraints, and the need for greater efficiency and resilience. Addressing these challenges requires not only sound engineering principles but also continuous innovation, collaboration, and a willingness to learn from both successes and failures.

Over the years, DFI-India conferences have evolved into an important platform for connecting professionals, researchers, academicians, consultants, contractors, manufacturers, students, and other stakeholders engaged in deep foundation engineering. The 15th Annual Conference reflects that journey and offers an opportunity to look ahead. It provides a space where ideas developed in research laboratories can meet lessons learned in the field, where established practices can be questioned and improved, and where emerging technologies can be explored for their potential to transform the way we design and construct foundations.

Hosting this conference at IIT Guwahati is particularly meaningful. Situated in the Northeast, a region marked by diverse geological, geotechnical, geographical, climatic, and infrastructural challenges, the institute provides an inspiring setting for conversations on the future of foundation engineering and offers revered industry participants a chance to experience campus life once more. As one of the premier technical institutions in the country, IIT Guwahati has consistently contributed to the advancement of civil and geotechnical engineering through cutting-edge research, industry collaboration, and the nurturing of young talent. The collaboration among DFI of India, IGS Guwahati Chapter, and IIT Guwahati reflects a shared commitment to fostering interdisciplinary discussion, knowledge sharing, and innovation in foundation engineering. The region itself reminds us that engineering solutions cannot always follow a single template. They must be responsive to local ground conditions, environmental realities, construction practices, and the needs of the communities they serve.

The conference will bring together a wide spectrum of technical knowledge and practical experience. Through keynote sessions, special sessions, panel discussions, technical presentations, case studies, research contributions, and interactions with industry, participants will have the opportunity to explore contemporary developments in deep foundation and geotechnical engineering. Equally important will be the informal conversations that take place beyond the technical sessions, conversations that often lead to new collaborations, new questions, and new possibilities.

I am especially pleased to see the continued emphasis on students and young professionals. The future of our profession depends on how effectively we inspire, guide, and empower the next generation of engineers and

researchers. A conference is not only a place to present what we already know; it should also foster curiosity, critical thinking, and the confidence to ask how things can be done better. I hope young participants will use this opportunity to interact with experienced professionals, share their ideas, discover new areas of interest, and build lasting professional connections.

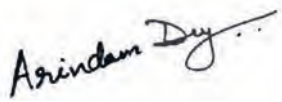
At the same time, the challenges before us demand a broader perspective. Sustainability, digitalisation, advanced numerical modelling, data-driven engineering, automation, artificial intelligence, innovative construction technologies, and improved monitoring and performance assessment are increasingly shaping our profession. The opportunity before us is not simply to adopt new technologies, but to apply them thoughtfully, combining technological progress with engineering judgement, practical experience, safety, and responsibility.

A strong conference is ultimately built by its community. I therefore extend my sincere appreciation to the DFI of India, IIT Guwahati, the IGS Guwahati Chapter, the advisory committee, the organising and technical committees, the speakers, authors, sponsors, exhibitors, volunteers, and all who have contributed their time and expertise to make this event possible. Their collective effort transforms a conference from a programme of sessions into a meaningful platform for knowledge and collaboration.

I sincerely thank all professionals, organisations, institutions and students from across India and beyond who are actively participating in this significant gathering. Your involvement as a speaker, delegate, sponsor, exhibitor or volunteer will contribute to the dissemination of knowledge and the collaborative spirit central to the success of this event. Together, let us shape the future of geotechnical and deep foundation engineering in India and create sustainable solutions that serve our society for generations to come.

I warmly invite you all to join us in Guwahati to exchange ideas, inspire one another, and help build deeper, smarter, and more sustainable foundations for the future. We at IIT Guwahati eagerly look forward to welcoming you and making DFI-India 2026 a memorable and enriching experience for all.

Warm regards,



Dr. Arindam Dey
Associate Professor
Department of Civil Engineering
Indian Institute of Technology Guwahati

DFI of India Lifetime Contribution Award 2026

Profile of Prof. Shailesh. R. Gandhi

Professor Shailesh Rajnikant Gandhi (Prof. S. R. Gandhi) made IIT Madras, his alma mater where he did his masters and research, his abode for more than forty years. He started as a scientific officer in the Department of Ocean Engineering and became a professor in Civil Engineering. Prior to this he obtained his BE in civil engineering from LE college Morbi in Gujarat. Prof. Gandhi moved to SVNIT Surat in 2016 and served as director until end of his tenure in October 2021. Professor Gandhi is currently a visiting professor in IIT Gandhinagar.

During his tenure at IIT Madras, Prof. S. R. Gandhi secured research projects on the Design of Circular Rafts, Reinforced Earth Embankments, wave energy systems, Densification of Fly Ash at various thermal plants, and Negative Drag on pile foundations.

He actively associated with a large number of Governmental and Non-Governmental organisations as a foundation consultant. His major clients include various Ports, Fertiliser industries, Thermal/Nuclear power plants, Construction Industries, etc., where he reviewed subsoil investigation reports, designed alternative foundation systems, recommended foundation types and bearing capacity, and monitored foundation performance (occasionally with special instrumentation). The Professor actively reviewed earthquake damage to various structures at Kandla Port, assessed earthquake damage to various lighthouses, and assessed Tsunami damage to port structures in the Andaman and Nicobar Islands.

Prof. Gandhi used his academic and practical expertise to optimise the foundation systems of various mega projects, such as the fertiliser berth at Paradip port, the foundation for a Fertiliser Plant at Kakinada, IFFCO expansion works at Aonla, UP, the ESSAR steel plant at Vizag, and the eighth cargo berth at Kandla, to name a few. These projects had special foundations and foundation elements such as diaphragm walls, precast driven piles, ground improvement using stone columns, and ground improvement using vertical drains and preloading. He disseminated these experiences in technical papers published in journals, conferences, and seminars.

Prof. S. R. Gandhi extended his support to various prestigious design and construction houses, including Larsen & Toubro Ltd, Engineering Construction Company (ECC); Fichtner Consulting Engineers, Chennai; M. N. Dastur and Co, Chennai; and Keller (GmbH), Singapore; Keller (India), Chennai; NTPC; BHEL; MRPL;, BPCL; IFFCO Fertilisers; ONGC; and NALCO. The government, quasi-governmental, and private organisations listed above benefited from their association with Prof. Gandhi in their projects across various parts of India.

He served as an arbitrator in many disputes and advised on many projects of national importance. He is a member of professional bodies like the Indian Geotechnical Society, Deep Foundations Institute, Institution of Engineers (India), Indian Road Congress, and Indian Society for Rock Mechanics and Tunnelling. He has served in these bodies in various capacities. Prof. Gandhi was the editor of the Indian Geotechnical Journal for three years.

Prof. S. R. Gandhi delivered the IGS annual lecture ‘Observations on Pile Design and Construction Practices in India’ in 2015.

He guided several researchers and graduate students during his academic career at IIT Madras and is currently a visiting professor at IIT Gandhinagar. Several research papers on various topics in foundation engineering, especially in ground improvement and deep foundation, are in his credit. He continues to offer his advise on foundation systems for various projects.

Prof. Gandhi received awards such as IGS-AIMIL Gold Medal and IGS-AFCONS best paper award for his technical writings in the journals and conference proceedings. He was part of the organizing team of very successful conferences namely IGC 1996, IGC 2006, and DFI India 2013 held at Anna University and IIT Madras.

Prof. Shailesh Rajnikant Gandhi

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Keynote Presentation Abstracts and Bio

CONSTRUCTIBILITY - DRIVEN FOUNDATION SELECTION FOR MARINE AND NEARSHORE INFRASTRUCTURE: LESSONS FROM STEEL DRIVEN AND CAST IN-SITU PILE SYSTEMS

Colin Smith
Head-Marine, Keller Ground Engineering India

About the speaker: Colin Smith is Head – Marine at Keller Ground Engineering India, where he establishes and leads Keller's marine business across India. With more than 28 years of international experience, he has delivered complex marine infrastructure, deep foundation, offshore engineering, and heavy civil construction projects across Africa, the Middle East, Europe, Asia, and North America.

Starting his career in foundation engineering before moving into senior leadership roles in marine construction and offshore renewables, Colin has developed extensive expertise in planning and executing ports, jetties, quay walls, coastal infrastructure, marine terminals, offshore wind developments, and subsea cable installation projects. His experience spans the full project lifecycle, from early-stage feasibility, constructability reviews, and engineering strategy through to procurement, commercial management, and successful project execution under both EPCI and traditional contracting models. Colin has developed a strong interest in constructability-driven engineering, recognising that successful delivery of marine infrastructure depends on effectively integrating geotechnical design, foundation selection, installation methodology, temporary works, marine logistics, and execution planning.

About the Presentation: Marine and nearshore infrastructure projects are increasingly being executed in challenging coastal and offshore environments where construction methodology, marine operability, and installation constraints can govern project feasibility as much as structural and geotechnical design requirements. In India, foundation solutions for jetties, berths, quay walls, coastal terminals, marine bridges, and nearshore infrastructure have traditionally relied heavily on bored cast in-situ (BCIS) piling systems supported by temporary access structures and land-based construction methodologies adapted for marine environments. Internationally, however, there has been increasing adoption of driven steel tubular pile systems and installation-led foundation design approaches aimed at improving constructability, reducing offshore exposure, minimising temporary works, and increasing construction efficiency.

This presentation will examine the practical differences between steel driven and cast in-situ pile systems through the lens of marine and nearshore constructability, using examples from projects executed in India together with broader international marine and offshore construction experience. The presentation will focus on how foundation system selection influences installation methodology, marine spread requirements, temporary works, construction sequencing, productivity, quality control, and long-term durability.

Key technical aspects to be discussed include pile drivability in varying coastal soil conditions, installation tolerances in marine environments, pile fatigue considerations, hammer and rig selection, nearshore, coastal, and offshore logistics, marine operability limitations, monsoon and weather impacts, temporary works interaction, and quality assurance challenges associated with marine concreting and pile installation. The presentation will also compare how differing foundation systems influence nearshore, coastal, and offshore exposure duration, construction risk, programme certainty, and lifecycle maintenance requirements.

Selected case studies from marine and nearshore infrastructure projects will be presented to demonstrate where conventional marine piling methodologies encountered execution challenges and where alternative installation-led approaches improved safety, constructability, and project efficiency. The presentation aims to encourage greater integration between geotechnical interpretation, foundation design, marine construction planning, and installation methodology selection in order to improve productivity, quality, and execution certainty for future marine infrastructure developments.

Keynote Presentation Abstracts and Bio

DESIGN AND CONSTRUCTION OF FOUNDATIONS IN KARSTIC GEOLOGY

Suresh Gutta, Ph.D., P.E.
Senior Geotechnical Engineer, A.G.E.S., Inc., USA

About the speaker: Dr. Suresh Gutta, Ph.D., P.E., is a Senior Geotechnical Engineer at A.G.E.S., Inc., Pittsburgh, USA, with over 20 years of experience in geotechnical engineering for transportation infrastructure projects. He has led and supported complex projects with a combined construction value exceeding $1 billion, providing expertise in technical design, construction, and risk management. His areas of specialization include landslide stabilization, deep foundations in complex geological formations, rock slope engineering and rockfall mitigation, ground improvement techniques, and geotechnical instrumentation and monitoring. Dr. Gutta holds a Ph.D. in Civil and Environmental Engineering (Geotechnical) from the University of Delaware and a Master's degree from IIT Delhi. He has authored numerous publications in international journals and conference proceedings and actively contributes to the profession through his involvement in the DFI Anchored Earth Retention Technical Committee and the ASCE Geo-Institute Deep Foundations Committee.

About the Presentation: The presentation will focus on the challenges of geotechnical design in karstic geology, where highly variable subsurface conditions such as solution activity, rock elevation changes, voids, soft clay seams, and sinkholes create significant uncertainty in foundation selection and design. It will highlight the importance of comprehensive site investigations, geological expertise, and geophysical methods in characterizing karst conditions, and will review foundation solutions including micropiles, end-bearing driven piles, and compaction grouting-supported mat foundations. Drawing on projects in Central and Eastern Pennsylvania, the presentation will also discuss design approaches, construction techniques, load testing, and key lessons learned for successful foundation performance in karst terrain.

ADVANCING DEEP FOUNDATION DESIGN ON DUBAI SEDIMENTARY ROCK: INSIGHTS FROM FIELD PERFORMANCE AND GEOTECHNICAL NUMERICAL MODELLING

Dr. Marwan Alzaylaie
Senior Manager, Dubai Development Authority

About the speaker: Dr. Marwan Alzaylaie has been working at Dubai Development Authority-Government of Dubai (DDA) as Senior Manager-Geotechnical Engineering since 2006. His responsibilities include reviewing geotechnical design works, such as geotechnical investigation reports, shoring & retaining system design, piling & deep foundation design, soil stability for open excavation, groundwater control (dewatering), and ground improvement. He also supervises and monitors geotechnical works and construction sites within DDA jurisdictions. He worked for Sharjah Municipality from 2002 to 2006 as a Civil Engineer, where his main duties included monitoring, controlling, and inspecting construction projects at different phases for buildings.

Since 2015, Dr. Alzaylaie has been teaching as a part-time lecturer at Heriot-Watt University Dubai. He teaches geotechnical engineering courses and supervises research by postgraduate and undergraduate students. In 2021, he began teaching in the Civil Engineering Department at Abu Dhabi University College of Engineering as Adjunct Faculty.

Dr. Alzaylaie obtained his PhD in civil and geotechnical engineering from Technische Universität Darmstadt (TU Darmstadt) in Germany. His PhD thesis was titled "Stiffness and Strength of Dubai Sedimentary Rock". In 2002, he graduated with a B.Sc. in civil engineering from the University of Sharjah (UoS). He also obtained his M.Sc. in civil engineering from Uos in 2008. His master's research was titled "Modification of the Swelling and Phosphorus Retention Characteristics of Bentonite Clay Using Alum".

Dr. Alzaylaie has published several papers and has served as a member of the organising committees for numerous international conferences. Furthermore, he is a founder member and secretary & treasurer of the Deep Foundation Institute Middle East (DFI Middle East), a founder member of the Geotechnical & Material Engineering Committee in the Society of Engineers-UAE, and a former member of the ISSMGE Technical Committee TC 217 - Land Reclamation.

About the Presentation: Dubai has experienced unprecedented urban development over the past two decades, characterized by the rapid construction of high-rise towers and landmark skyscrapers founded on complex subsurface

conditions consisting of loose to dense sands overlying weak sedimentary rock formations. The safe, economical, and sustainable design of deep foundation systems in such geological conditions requires a reliable assessment of soil and rock stiffness parameters, pile behaviour, and soil–structure interaction mechanisms. However, conventional geotechnical practice in Dubai has generally adopted highly conservative values for the mechanical properties of Dubai sedimentary rock, often resulting in overdesigned foundation systems with increased construction costs, material consumption, and execution time.

This research investigates the stiffness and strength characteristics of Dubai sedimentary rock through an extensive geotechnical study that integrates field investigations, laboratory testing, full-scale static pile load testing, and advanced numerical modelling using the Finite Element Method (FEM). The study is based on a comprehensive database comprising 195 boreholes, 116 static pile load tests, and geotechnical data collected from more than 45 high-rise towers in the Business Bay and Downtown Dubai developments.

A detailed numerical modelling methodology was developed using PLAXIS FEM analysis to calibrate the modulus of elasticity of Dubai sedimentary rock against measured pile settlement behaviour from instrumented static load tests. Comparative analyses were conducted among conventional empirical approaches, analytical methods, FEM simulations, and actual field performance. The results consistently showed that the in-situ stiffness and load-bearing behaviour of Dubai sedimentary rock are significantly higher than the conservative values commonly adopted in design practice.

The research further presents a representative high-rise development case study in Business Bay, Dubai, to evaluate the behaviour of deep pile foundations under high structural loads. The study included a detailed assessment of pile settlement response, shaft resistance mobilisation, stiffness characterisation, and rock–pile interaction mechanisms, derived from field-monitored performance and advanced numerical modelling. The findings confirmed that optimised foundation solutions can be achieved through calibrated geotechnical modelling and performance-based design methodologies without compromising safety or serviceability.

The outcomes of this research contribute to the development of more economical, sustainable, and technically optimised foundation design approaches for high-rise buildings constructed on Dubai's sedimentary rock. Furthermore, the study provides practical guidance for improving geotechnical design methodologies, enhancing soil–structure interaction assessment, and supporting green construction practices in Dubai and similar weak rock environments worldwide.

INTEGRATED GEOPHYSICS FOR ROCK-SOCKETED PILES AND DEEP FOUNDATIONS: FIELD APPLICATIONS FOR CONTINUOUS ROCK PROFILING AND CONSTRUCTION RISK REDUCTION

Dr. Sanjay Rana
Managing Director, PARSAN Overseas Pvt. Ltd.

About the speaker: Dr. Sanjay Rana, a Professional Engineer (PE), certified geophysicist, and gold medalist from IIT Roorkee, is a pioneering figure in engineering and applied geophysics with over 35 years of experience. As the Managing Director of PARSAN Overseas Pvt. Ltd., he has successfully led more than 2,000 projects across India and several international locations, providing expertise in engineering, environmental, mining, and groundwater geophysics. Widely recognized for introducing innovative technologies such as Ground Penetrating Radar (GPR), Dam Geophysics, Passive Seismic Tomography, and Subsurface Utility Engineering (SUE) to the Indian subcontinent, Dr. Rana has played a transformative role in advancing geophysical practices. He has authored key national guideline documents for geophysical investigations published by leading institutions, including IRC, BIS, IndSTT, and the Tunneling Association of India, and actively contributes to the development of industry standards and codes of practice. A dedicated environmentalist and educator, he founded the Aqua Foundation in 1998 and continues to mentor young professionals while advocating for technology-driven, non-invasive geophysical solutions that support infrastructure, environmental sustainability, and national development.

About the Presentation: This keynote presentation will explore the practical application of integrated geophysical techniques in the planning, design, and construction of rock-socketed piles and deep foundation systems. Emphasizing real-world field implementation, the presentation will demonstrate how geophysical methods can complement conventional borehole investigations to provide continuous subsurface characterization, reduce uncertainty, and support informed engineering decision-making.

The keynote will highlight the limitations of relying solely on borehole data, particularly in heterogeneous geological conditions where localized weathered zones, irregular rockhead profiles, and subsurface anomalies can significantly

Keynote Presentation Abstracts and Bio

influence foundation performance. It will showcase the role of advanced geophysical techniques such as Seismic Refraction Tomography, Multichannel Analysis of Surface Waves (MASW), and Electrical Resistivity Tomography (ERT) in identifying critical subsurface features and improving confidence in foundation design.

Drawing on two significant field case studies, the presentation will illustrate how integrated geophysical investigations have been successfully used to characterize variable rockhead conditions along urban infrastructure corridors and to assess weak and saturated zones within dam foundation environments. These examples will demonstrate the value of continuous subsurface profiling in optimizing borehole locations, refining rock socket lengths, reducing construction risks, and improving foundation execution strategies.

The keynote will also discuss practical lessons learned from field implementation, including the advantages and limitations of various geophysical methods, challenges in data interpretation, and the importance of integrating geophysical findings with traditional geotechnical investigations. Finally, it will examine emerging opportunities in the field, including 3D geophysical imaging, digital geotechnics, Building Information Modelling (BIM) integration, and AI-assisted interpretation, highlighting the growing role of geophysics in risk-informed foundation engineering.

THE EUROPEAN APPROACH TO STANDARDIZATION OF GEOTECHNICAL WORKS - WITH REFERENCE TO THE EXECUTION OF DIAPHRAGM WALLS AND BORED PILES

Dr. Karsten Beckhaus
BAUER Spezialtiefbau GmbH

About the speaker: Dr. Karsten Beckhaus is the Technical Director of BAUER Spezialtiefbau GmbH; he has been active in the specialized civil engineering sector for 23 years and in the broader field of civil engineering for over 30 years. Karsten Beckhaus completed both his diploma studies in civil engineering and his subsequent doctoral studies at the Technical University of Munich. Today, he heads Bauer's "Technical Services" division, which supports projects worldwide with specialized civil engineering tasks. His responsibilities include quality management, innovation, and sustainability.

Furthermore, Karsten Beckhaus is actively involved in standardization and serves as a member of various working groups; he is currently leading the revision of the European execution standards EN 1536 for bored piles and EN 1538 for diaphragm walls. Additionally, he acts as the Liaison Officer for the European standardization organization between Technical Committee TC 288 on specialized geotechnical works and Technical Committee TC 104 on concrete and related products.

About the Presentation: In Europe, the design, execution, and testing of geotechnical structures such as deep foundations are standardized through a combination of European Standards (EN). These are processed and adopted by the European Committee for Standardization (CEN) following a systematic and formal procedure that ensures broad consensus among all stakeholders in the respective field of construction.

Guidelines, specific technical contract conditions, or other regulations issued by individual parties, such as the recommendations of the German Geotechnical Society (DGGT) on piled foundations, can supplement these general standards. They often contain more detailed information, reflect individual or local experience, or offer additional technical support. The EFFC and DFI organizations also make a valuable contribution with their guide to tremie concrete for deep foundations (3rd edition, 2024).

The structural and geotechnical design of piled foundations or retaining walls is standardized in EN 1992 and EN 1997, also known as Eurocodes EC2 and EC7. A series of EN standards covers the relevant aspects of execution, differentiated according to the working methods used, such as jet grouting or in-situ soil mixing. These are divided into a total of 13 standards, plus a 14th standard for ground freezing (a new EN currently under development).

The corresponding standards for bored piles and diaphragm walls are EN 1536 and EN 1538. They are currently being revised, and the author of this article is leading the relevant working group, and final drafts are due for public enquiry (CEN ENQ) in summer 2026. All execution standards follow a uniform structure: Starting with a clearly defined scope (1), the relevant normative references (2), and the definitions relevant to the respective standard (3), the following chapters address the information required for the execution of the works (4), the geotechnical investigation (5), and materials and products (6). Chapter 7 explains specific design considerations that are considered essential for the design of bored piles (including piles forming a wall) or diaphragm walls (including barrettes) and that extend the general design rules according to EC2 and EC7. New aspects include, for example, a classification of the required watertightness of a

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diaphragm wall, as well as a harmonization of rules for concrete cover and reinforcement spacing to ensure complete backfilling of the excavation and full embedding of all reinforcing bars in the concrete. Execution obviously forms the core of the execution standards. Chapter 8 addresses specific aspects such as tolerances and fundamental requirements, focusing on the construction site – from the work platforms through excavation and cleaning, reinforcement placement and concreting, plus basic requirements on post-grouting and trimming in case of applications.

The concluding chapters deal with supervision, inspection, testing, monitoring and maintenance related to execution, records and special requirements regarding health, safety and environment, emissions and sustainability in general. The key points of the future execution standards for piles and diaphragm walls are presented and explained in the context of the fundamental need for perfectly harmonized and interconnected standards. If the combined requirements defined in the European standards and in supplementary (e.g. DFI) guidelines are met and implemented in practice, sufficient quality and integrity of the geotechnical work can be assumed. Reference is made from individual clauses to practical use cases, showing their relevance e.g. to: -

a) avoid misjudgment of ground resistance or properties influencing wear & tear or clogging with a considerable impact on costs,
b) provide contractual agreement in case of the necessity for watertightness of D-Walls or decant pile walls by classes to be specified,
c) set clear requirements for clear distance between reinforcement bars and align concrete cover requirements for the benefit of concrete flow versus durability requirements etc. from structural codes,
d) regulate nominal geometrical tolerances to be considered for geotechnical and structural design, and
e) the need for recording of requested information, regarding deviations from expected or specified parameters, that have proven to potentially allow for major consequences if not even for collapses like the Cologne Archive Collapse, where a 0.6m wide void in a D-Wall led to Germany's costliest construction failure.

Special Technical Session
Hillslope Stability and Landslide Mitigation
24 September 2026 2:00pm to 5:35pm

Session Moderators

Annapoorni Iyer
Engosym Consultants

Dola Roychowdhury
G-Cube Consulting Engineers LLP

This session will focus on critical challenges faced across India's North-Eastern region, particularly in slope stability, erosion control, and landslide mitigation. The session will bring together experts to share challenging case histories and state-of-the-art solutions, followed by a moderated panel discussion offering an interactive platform for knowledge exchange among project owners, consultants, contractors, researchers, and technology providers.

DIFFERENT APPROACH FOR LANDSLIDE MITIGATION IN HIMALAYAN REGION

Ratnakar R. Mahajan,
Director, Technical Excellence, Maccaferri India

About the Speaker: Dr. Ratnakar R. Mahajan serves as Director - Technical Excellence at Maccaferri India and also oversees activities across the Southeast Asia and Pacific (SEAP) region. A Civil Engineer with 20+ years of experience in geotechnical engineering, he has extensive experience in slope stability, geosynthetic soil reinforcement, geotechnical centrifuge modelling, instrumentation, pseudo-static earthquake analysis, ground improvement, river training, and geohazard protection / mitigation.

Over the years, he has been associated with prestigious infrastructure projects in India and abroad.

He has contributed to codes and guidelines for the Bureau of Indian Standards (BIS) and the Indian Roads Congress (IRC). He is an active member of BIS TXD 30, IGS, IRC, Int. Geosynthetics Society and ISSMGE TC-218.

He has helped students while he worked as adjunct faculty and BOS member of various institutes.

About the Presentation: Landslides are becoming increasingly common worldwide, and India is no exception. Globally, more than 430 major landslides were recorded between 2000 and 2019. Approximately 3,700 landslides were recorded in India between 2015 and 2022, according to the Geological Survey of India (GSI). The number of fatalities is increasing due to extreme weather events such as heavy rainfall, floods, cloudbursts, and landslides.

This paper presents the successful treatment of several landslides in the state of Uttarakhand, India. The highway from Rishikesh to the Chhota Char Dham region experiences heavy traffic during the yatra season. Every year, pilgrims face road closures due to landslides. The Ministry of Road Transport and Highways (MoRTH) identified seven landslide-prone locations as part of a rehabilitation programme following the 2013 tragedy.

Near Badrinath Dham, a chronic landslide near Lambgarh village required road widening and rockfall protection measures. Traditionally, landslides are mitigated by disposing of debris on the valley side and excavating the hillside for road construction or widening. However, this approach often further destabilises slopes that are already vulnerable to failure.

A different approach was adopted for treating the seven landslides, involving detailed studies of natural drainage channels, geological assessments, geotechnical investigations, and valley-side construction. The treatment measures included diverting and draining both surface and subsurface water flows. Solutions varied for each landslide and included hillside rock stabilization using anchors. The installation of steel mesh systems enhanced the safety of road users.

Valley-side soil retention was achieved using flexible structures such as reinforced soil walls, reinforced soil slopes, and mass gravity walls. At the Lambgarh site, the primary challenge was retaining soil at heights exceeding 40 m and protecting the retaining structures from flash floods in the Alaknanda River.

The adoption of this innovative landslide mitigation approach yielded encouraging results, ensuring the safety of road users while requiring minimal maintenance from the authorities.

Keywords: Slope stability, Landslide, Geosynthetics, Safety

Special Technical Session on Hillslope Stability and Landslide Mitigation

REHABILITATION AND LANDSLIDE MITIGATION USING THE WORLD'S TALLEST REINFORCED EARTH® STRUCTURE AT TINDHARIA (NH-55) AND SLOPE STABILIZATION AT Z-MORH TUNNEL, INDIA

Atanu Adhikari
Chief Development Officer, Geoquest India

About the Speaker: Atanu Adhikari is a Civil Engineer and Geotechnical Specialist with close to 30 years of experience. He heads the Engineering and Commercial Services Group at Geoquest India Pvt. Ltd. as Chief Development Officer and serves as the Principal Expert and Segment Leader within the Geoquest International Group, where he leads R&D and provides expertise in geotechnics, geosynthetics, hydraulics, soil reinforcement, and precast solutions.

His work spans reinforced soil structures, slope stabilisation, landslide and geohazard mitigation, river training, and advanced precast systems. He has played a key role in developing multiple patented technologies that are now in commercial use across the industry. He is actively involved in several codal committees, including IRC, BIS, and IGS, where he contributes significantly to the development of national guidelines and standards. Atanu has also authored 15+ technical papers presented at various national and international forums.

About the Presentation: The objective of this keynote address is to present successful case studies addressing challenging landslide mitigation measures in India. The discussion focuses on two major infrastructure projects where complex geotechnical conditions required innovative and sustainable engineering solutions.

The first case study concerns a landslide rehabilitation project on National Highway 55 (Siliguri–Darjeeling Road) in West Bengal. This stretch comprises three major landslide zones: S1 (35 m), S2 (101.3 m), and S3 (34.3 m). The stabilisation strategy combined advanced techniques, including in-situ grouted soil nailing, pre-stressed ground anchors for slope stabilisation, and a hybrid Reinforced Earth® structure (TerraLink® system) to widen the existing roadway. Comprehensive drainage measures were also implemented to mitigate hydrostatic pressure buildup within the slope. Notably, the S2 location features one of the tallest Reinforced Earth® structures in the world, standing at 101.3 m.

The second case study is situated along the Srinagar–Sonamarg Highway near the Z-Morh Tunnel in Jammu and Kashmir, another geotechnically challenging and landslide-prone region. Similar to the first project, a combination of innovative stabilization methods was employed to ensure long-term slope stability and safety.

Geoquest India developed and implemented permanent, sustainable solutions for both projects. Each site presented unique technical challenges, requiring a tailored approach that integrated multiple engineering techniques. This presentation will highlight the design philosophy, construction methodologies, quality control measures, and testing protocols adopted across both projects. It will also emphasise how high standards of engineering practice can deliver durable and sustainable solutions for complex landslide mitigation problems.

GEOHAZARD MITIGATION MEASURES OVER VULNERABLE HILL SLOPES: A FRAMEWORK FOR QUALITY CONTROL AND MONITORING IN COMPLIANCE WITH MORTH CIRCULAR 305.15

Mr. Ankur Saxena
Business Advisor, TechFab India

About the Speaker: Mr. Ankur Saxena business advisor brings with him more than a decade of experience in the geohazard mitigation and infrastructure protection industry, with extensive exposure to some of the most challenging engineering environments across India. His professional journey has involved working closely with geotechnical, infrastructure and highway stakeholders, with a particular focus on slope stabilization, rockfall mitigation, geosynthetics and resilient infrastructure solutions.

Over the years, Mr. Saxena has developed a strong understanding of the practical challenges associated with managing geotechnical hazards where engineering solutions must not only be technically sound, but also reliable, constructible and suited to difficult terrain and demanding site conditions.

His experience extends beyond business development into the technical and application aspects of geohazard mitigation. He has been actively involved in knowledge-sharing initiatives and technical forums, including discussions around improving quality and quantity control in slope protection and rockfall mitigation works for national highway projects.

Today, as infrastructure development continues to expand into increasingly challenging terrains, the need for scientifically designed, quality-controlled and sustainable geohazard mitigation solutions has never been more important.

Special Technical Session on Hillslope Stability and Landslide Mitigation

We are therefore delighted to have Mr. Saxena with us today at DFI, IIT Guwahati, where he will share his experience and insights on, Geohazard Mitigation measures over Vulnerable Hill Slopes, Quality Control and monitoring measures, bringing together industry experience, field realities and practical engineering perspectives.

About the Presentation: India's expanding highway and hydropower corridors through the Himalayan and hill terrains of Uttarakhand, Himachal Pradesh, and the North East continue to face escalating geohazard risks rockfall, debris flow, and slope instability driven by seismic activity, monsoon intensity, and anthropogenic slope-cutting for infrastructure development. This paper presents an integrated approach to geohazard mitigation on vulnerable hill slopes, covering hazard assessment, protection-system selection, and post-installation quality control and monitoring.

The study outlines a hierarchy of mitigation measures, including rockfall barriers, drapery and pinned mesh systems, SDA (soil dowel/nail) anchoring, geocell-based slope reinforcement, 3D mat geo-mattresses, and hydroseeding matched to slope geometry, rockfall energy classification, and site-specific failure mechanisms. Particular emphasis is placed on rockfall barrier design per ETA certification under EAD 340059-00-0106, energy absorption classes (3000 kJ–5000 kJ), and net/mesh specification considerations relevant to Indian highway and railway corridor conditions.

A significant portion of the paper addresses the regulatory shift introduced by MoRTH Circular Code 305.15 (dated 1 July 2026), which mandates ETA/CE certification, Mandatory Quality Control Certificate (MQCC) compliance, QR-based product tagging, and NABL-accredited third-party testing for geosynthetic and slope protection products. The paper discusses implications for contractors, executing departments (PWD, NHAI, BRO, NHIDCL), and design consultants, and proposes a practical quality-assurance workflow from material traceability and batch testing to field installation verification and long-term performance monitoring to align project execution with the new compliance regime.

Drawing on field experience from active slope protection works on Himalayan highway projects (including SDA anchoring, geocell, 3D mat geo, and rockfall mesh installations across multiple chainages), the paper concludes with recommendations for standardizing QC checklists, monitoring protocols (including low-cost field instrumentation for displacement tracking), and documentation practices to improve long-term slope stability outcomes and regulatory compliance across India's hill-road network.

Keywords: Rockfall mitigation, slope stabilization, MoRTH 305.15, ETA/CE certification, geosynthetics, hill road infrastructure, quality control, monitoring systems

PANEL DISCUSSION

Topic: North-East Hill Infrastructure: Concerns and Policy Interventions

PANELISTS

Prof. Anjan Dutta

Professor, IIT Guwahati

About the Panelist: Anjan Dutta obtained his Bachelor's degree in Civil Engineering from REC Silchar (now NIT Silchar). He completed his master's in Structural Engineering from IIT Madras and a Ph.d. from IIT Delhi (Department of Applied Mechanics). He joined IIT Guwahati in 1999 and is currently a Professor in the Department of Civil Engineering. He served as Head, Department of Civil Engineering (2006-9), and Dean, Institute Works(April 2009-June 2014 and March 2025-August 26). He has published more than 125 research papers in journals and conferences. He has guided several Ph.d. students and is a member of many committees. His research areas include Finite Element Analysis, Bridge Engineering, Retrofitting of structures, Seismic control, and System Identification techniques for assessment of damage in structures. He is involved in a large number of consultancy projects of national importance.

Er. Sai Baba Ankala, ME, MBA, IRSE

Tunnel Expert for NHIDCL, Govt of India
Ex. Chief Engineer/HAG, Indian Railways (Govt. of India)

About the Panelist: Sai Baba Ankala, is a former Chief Engineer/HAG of Indian Railways, Government of India, and currently serves as a Tunnel Expert for NHIDCL, Government of India, while also working as a freelance consultant in bridges and tunnels.

He obtained his B.Tech. in Civil Engineering from SVU College of Engineering, Tirupati, M.E. in Structural Engineering from the Indian Institute of Science, Bangalore, and MBA in Information Technology from JNTU, Hyderabad. He is currently pursuing his Ph.D. in

Special Technical Session on Hillslope Stability and Landslide Mitigation

Infrastructure Management at IIT Guwahati. He has also achieved top ranks in national competitive examinations including GATE, IES and IRSE.

With over 36 years of experience, he has contributed to major infrastructure projects involving Railways, Highways, Ports and Metro Rail, with extensive expertise in bridges and tunnels. His notable projects include the design and construction of the world's tallest railway bridge in Northeast India, India's first 1.2 km long double-decker integral PSC flyover in Kerala, 66 km of railway tunnels in Northeast India, four Metro Rail projects in Bangalore, Hyderabad, Trivandrum and Surat, and 124 Road Over Bridges across National Highways, State Highways and Expressways. He has also been involved in the safety audit of major tunnels and cable-stayed bridges, as well as the design and safety audit of large-scale highway tunnel projects in Odisha, Shimla and Maharashtra.

He has contributed to international railway projects in Malaysia-Singapore, Gabon, Bangladesh and the Middle East. He is a Fellow of professional bodies including IEI, IPWE, ICI and ACCE.

His distinguished achievements include the Prime Minister's Award for Innovation in Integrated Logistic Parks, Railway Minister's Gold Medal for Excellence in Railway Service, YII International Award for the design of the world's tallest bridge, and Engineer of the Year Awards from various professional institutions. He has also received the ICI Lifetime Achievement Award for his contribution to the student community through nearly 800 lectures and mentoring initiatives.

Dr. Atop Lego

Retd.Chief Engineer, PWD Arunachal Pradesh

About the Panelist: Dr. Atop Lego obtained his B.E. in Civil Engineering from Shivaji University, Kolhapur, Maharashtra, in 1984. He completed his M.Tech. in Structural Engineering from IIT Guwahati in 2004 and Ph.D. from IIT Guwahati in 2018.

He has over 37 years of professional experience in civil engineering and public infrastructure. He began his career with the Arunachal Pradesh PWD as an Assistant Engineer in 1984 and subsequently served as Executive Engineer, Superintending Engineer, and Chief Engineer (Survey, Investigation, Design and Planning). He also served as Director of Urban Development and Housing, Urban Development Department, Government of Arunachal Pradesh. From May 2013 to October 2021, he served as Chief Engineer in Arunachal Pradesh PWD. Since November 2022, he has been serving as Director of Seismic and Structural Consultant Private Limited.

He is a Life Member of the Indian Road Congress, Indian Society of Earthquake Technology, Indian Concrete Institute, and Institution of Public Health Engineers, and is also a member of the Institution of Engineers (India) and the American Society of Civil Engineers. He currently serves as a Corresponding Member of the B5 Committee of the IRC Specification Committee, dealing with IRC:24 Specification for Design of Steel Bridge and IRC:22 Design of Steel Composite Bridge.

During his distinguished public service career, he received the Gold Medal under the Chief Minister's Award for Excellence in Public Administration for the year 2018–19 from the Government of Arunachal Pradesh.

Women in Deep Foundations (WiDF) India Group

Special Session 2:50pm to 3:30pm - 25 September 2026

DFI of India (DFII) formally launched a WiDF group during its 2018 conference at IIT Gandhinagar. The group actively works to empower women in the industry by educating and encouraging young professionals about different prospects and opportunities, connecting academia and industry, etc.

Since 2019, WiDF India group has maintained a WhatsApp group where they discuss a wide range of topics, including the technical and non-technical sides of the industry, make plans, coordinate activities, etc. The group's members also support each other and share their experiences, whether in the field or in the office.

WiDF conducted several programs for the benefit of women in engineering and the student community over the last six years. DFI-India annual conferences hold a special session for women, which used to be very interactive and live.

Srishti Bafna

Executive Engineer, NHIDCL

Mrs Srishti Bafna is a civil engineering graduate from BIT Durg and has an M.Tech in Construction Technology & Management from IIT Delhi. In February 2022, she joined the Ministry of Road Transport and Highways through the UPSC Engg. Services Examination. She is now an Executive Engineer in MoRTH, currently on deputation to NHIDCL & posted as DGM in the Regional Office, NHIDCL, Assam.

Sanjita Bodo
Executive Engineer, PWRD

Mrs. Sanjita Bodo is a Civil Engineer and Executive Engineer with the Public Works Roads Department (PWRD), Government of Assam. She is currently associated with the Project Management Unit (PMU) of the Assam Resilient Rural Bridges Programme (ARRBP), a World Bank-funded initiative to improve rural bridge connectivity and resilience in Assam. She has extensive experience in implementing and administering World Bank-funded infrastructure projects, including the Assam State Road Project (ASRP), Assam Bridge Project-I (ABP-I), Assam Bridge Project-II (ABP-II), and ARRBP. Her expertise includes project administration and management, procurement and contract management, coordination with the World Bank, project consultants, field divisions, and contractors, and monitoring physical and financial progress. She actively facilitates the implementation of bridge infrastructure projects in Assam.

Session Supported by

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DFI Membership Overview

Overview

DFI is an international association of contractors, engineers, suppliers, academics and owners in the deep foundations industry. For more than 50 years, we have brought together professionals for networking, education, communication and collaboration. As a member, you help create a consensus voice and a common vision for continual advancement in the planning, design and construction of deep foundations and excavations.

Find Common Ground. Become a Member of DFI

- Network with thousands of members and industry professionals worldwide
- Get involved locally through DFI's active presence in Europe, India and the Middle East
- Strengthen your knowledge base and obtain practical information at seminars, short courses, workshops and conferences
- Collaborate with colleagues by joining one of 15 active Technical Committees, Regional Chapters or a DFI group
- Stay informed through the flagship Deep Foundations magazine and the peer-reviewed DFI Journal
- Gain visibility with a corporate member listing on the DFI website, which has 20,000 views each month
- Connect and communicate with industry peers through social media such as DFI's Linkedin Groups
- Access OneMine.org and download up to 100,000 articles, technical papers & books from DFI & organizations all over the world - at no cost

Deep Foundations Magazine

Deep Foundations, the publication of the DFI, is created by the industry for the industry. The magazine has one goal - to keep members informed about the industry they themselves are shaping. Every issue informs you of state-of-the-art projects; new techniques, products and technology; news on leading corporations and individuals; committee activities and upcoming events. The magazine also publishes guest editorials and regular columns from DFI's President and Executive Director.

The full-color magazine is published six times a year and is distributed to DFI members worldwide, as well as engineering libraries at several universities and colleges. Digital editions of each issue are available on the DFI website. Advertising in the magazine is a privilege of corporate membership.

DFI of India Technical Committees

DFI of India operates through six specialized committees, each focusing on critical aspects of foundation engineering. These committees work collaboratively to enhance industry standards, promote innovation, and enable convergence of research and practical applications in deep foundation systems. These committees are structured to address key challenges and advancements in deep foundation industry. These includes,

DFI of India Committee for Geotechnical Characterization for Foundations

Committee Chair: Dr. C Parthasarathy

The Committee was established in 2018 to enhance geotechnical investigation and reporting practices across the country. It focuses on promoting proper subsurface exploration, innovative technologies, and effective procurement methods. The committee developed a 5-day training program for geotechnical lab technicians to enhance their understanding of the standard procedures and practices. Till now, more than 60 technicians across India are trained under this program. As part of promoting good work practices, the group also organizes expert-led webinar series titled *"Practices for Efficient Subsurface Characterization."*

DFI of India Training Committee on Foundation Technologies

Committee Chair: Ravikiran Vaidya

The DFI of India Training Committee on Foundation Technologies is established in 2022, to enhance various aspects of foundation construction based on demand from the industry. The Committee organizes specialized training programmes and workshops based on the evolving needs of the industry. Key topics include *Support Fluids, Tremie Concrete, Ground Improvement, Pile Top Drilling using RCD Technology,* and *Design and Construction of Diaphragm Walls*. Recently, the Committee conducted a workshop on *Deep Excavation Support Systems* in Ahmedabad, covering important aspects of design and construction. Future programmes will address emerging areas such as *geotechnical software applications*, *working platforms*, etc. Through these initiatives, the Committee promotes professional development, knowledge sharing, and improved practices in foundation engineering across India.

DFI of India Sustainability Committee

Committee Chair: Dr. Venu Raju

DFI of India has established a dedicated Sustainability Committee to promote sustainable practices in India's deep foundations and geotechnical industry. The Committee focuses on raising industry awareness, training engineers in carbon footprint assessment using the EFFC/DFI Carbon Calculator, supporting carbon reduction initiatives, and adapting international sustainability guidance to the Indian context. The Committee has conducted an online *Carbon Calculator Training Session* and organized a full-day workshop on *Sustainability and Carbon Footprint Assessment in Deep Foundations*. As part of its ongoing initiatives, the committee is also organizing a Poster Competition during DFI-India 2026 to encourage innovative ideas and sustainable solutions. The committee is also organizing a panel discussion program focused on Sustainability in India Foundation Industry at DFI-India 2026.

DFI of India Support Committee Working Group

The Support Committee Working Group is comprised of DFI members with a special interest in providing support and guidance to the DFII regional chapter. The members assist DFII leadership and staff with worldwide resources including presentations and articles as well as oversight over project initiatives such as CFA Pile implementation and alliances with various Indian public agencies. The working group is led by cochairs Satyajit Vaidya, P.E. and Lucky Nagarajan.

DFI of India Support Committee Co-chairs

Satyajit A. Vaidya, P.E.
Principal, LANGAN

Lucky Nagarajan, ASCE G-I BoG /
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DFI of India Students Outreach - Groundwork Committee

Committee Chair: Prof. B. Umashankar

The committee was formed in 2020 for the benefit of students across India with interest in geotechnical and foundation engineering. Its mission is to cultivate a strong pipeline of skilled and passionate young engineers who can contribute to the advancement of foundation engineering in the country. To achieve this, the committee organizes webinars on various aspects of deep foundations and ground improvement, fostering knowledge sharing and industry exposure. As part of its annual initiatives, The committee successfully conducted two in-person Groundwork Series sessions in 2026. The first session was held in collaboration with Anna University, Chennai, and the second with Sardar Patel College of Engineering, Mumbai. It also confers student awards to encourage and recognize excellence among graduate students and researchers in geotechnical and foundation engineering.

DFI of India Helical Screw Pile Task Committee

Committee Chair: Mohan Ramanathan

The DFII Helical Screw Pile Task Committee was reconstituted with renewed vigour in March 2026 to kick-start its initiatives. The committee is actively working to build technical knowledge, develop guidance, and promote the adoption of helical screw piling technology in India. The committee is preparing to undertake its first trial helical screw pile installation, which will serve as an important milestone in evaluating the technology under Indian conditions.

DFI of India Working Committee for Bored Cast-in-Situ Pile Construction Quality Control

Coordinators: Anirudhan I V and Aswin V Hari

Formed in 2025, DFI of India is initiating the development of a document titled: "A Practical Guide to Mitigate Under-performance of Bored Cast-in-Situ Piles." This document aims to serve as a practical reference to identify recurring issues contributing to the poor performance of bored cast-in-situ piles and recommending must do quality control measures to enhance construction quality.

DFI of India has representation in CED 43 of Bureau of Indian Standards (BIS)

Represented by - Dr. Sunil S Basarkar, DFI of India Chair
Alternate 1 - Anirudhan I V, Board Member, DFI of India
Alternate 2 - Smt. Sangeen Desai, DFI Member

For more details on these committees, visit dfi-india.org

If you have expertise, you can join any of the committees. Conditions apply.
Please contact Pranav Jha at activities@dfi-india.org

DFI of India Activities

Annual Conferences

Technical Workshops

Technical Training Programs

Geotechnical Laboratory Technician Training

Student Outreach Programs

Women in Deep Foundation India Group activities

Sustainable Foundations

Helical Pile Technology Implementation

Quarterly Newsletter

DFI of India Headquarters

No 44/17, Bhaskara, 19, Usha Street
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Chennai – 600 042, Tamil Nadu, India

SPECIAL PANEL DISCUSSION
Topic: Sustainability In Construction – Opportunities & Challenges

Session Moderator

Dr. Venu Raju
Senior Advisor, Sustainability, Keller Group plc

PANELISTS

Mr. Mohan Ramanathan
Founder & Director, Advanced Construction Technologies, Chennai

Mr. Mohan Ramanathan is the Immediate Past Chair of DFI of India and Founder, Director of ACT Group of Companies. He has over 40 years of experience in varied fields such as Pile Foundations, Heavy Earthmoving Equipment, Demolition and Concrete Flooring. He is also an active member in several professional societies like DFI of India, IGS, Institution of Engineers, ACCE, ICI and IDA. He is constantly involved in the transfer of technologies into India from developed countries.

Dr. Eng. Shilton RICA
Head of Project Development, ArcelorMittal SSP Luxembourg

Dr. Eng. Shilton Rica is the Head of Project Development at ArcelorMittal Europe – Long Products, focusing on techno-marketing of sheet pile solutions in collaboration with clients and production mills. With a PhD from the University of Luxembourg on foundation pile design, he has over a decade of experience in geotechnical engineering, structural analysis, and project development across Europe and Latin America. Since 2019, he has also served as an external lecturer at the University of Luxembourg, teaching both bachelor's and master's level geotechnical courses. His professional journey includes roles as Technical Sales Manager, Senior Design Engineer, and external collaborator with institutions like BAM Berlin and Deltares Netherlands. He is an active member of several professional bodies, including AGS, DFI, and BGGG, and has published extensively in international conferences and journals.

Ms. Shrikarpagam Dhandapani
Doctoral Researcher
Indian Institute of Technology Madras

Shrikarpagam Dhandapani is a doctoral researcher in the Department of Civil Engineering at the Indian Institute of Technology Madras. She holds an M.S. by Research in Ocean Engineering from IIT Madras and a B.E. in Civil Engineering from Government College of Technology, Coimbatore. Her doctoral research focuses on material sustainability in construction, with particular emphasis on sustainable business model configurations and the institutional changes required to support the construction sector's sustainability transition. She has presented her research at international conferences, including EPOC 2024, EPOC 2025, CI-CRC Joint Conference 2026, and EPOC 2026. Her areas of expertise include system dynamics modelling, offshore structural analysis, and Python programming. She has also contributed to studies on sustainable building materials and green construction practices.

About DFI India 2026, Overview and Themes

The 15th Annual Conference on Deep Foundation Technologies for Infrastructure Development in India, will be held during September 24-26, 2026, at IIT Guwahati, Assam, India.

Organised by the Deep Foundations Institute (DFI) of India in collaboration with the Indian Geotechnical Society (IGS) Guwahati Chapter and the Indian Institute of Technology (IIT) Guwahati, the event will bring together the geotechnical professionals in the industry and academia to exchange ideas, discuss challenges, and present the latest technologies in geotechnical design and construction for major infrastructure projects. The conference will also offer excellent networking opportunities and a showcase of innovative products and services.

The conference will open with an inaugural session, followed by two keynote addresses. The second session will focus on a special theme and feature presentations by distinguished experts. In addition to corporate presentations, sessions three to five will include keynote lectures, contributory paper presentations, and the Women in Deep Foundations (WiDF) session. Parallel technical sessions will further highlight a wide range of topics through paper presentations. The conference will conclude on the third day with an awards presentation and valedictory session. Delegates will also receive the conference proceedings, offering valuable insights into best practices and cost-effective project execution.

An exhibition featuring over 30 booths from leading stakeholders in the industry will further enhance the overall conference experience.

The conference will focus on the following topics:

- Design and Construction of Deep Foundations and Deep Excavation Techniques
- Hillslope Stability and Landslide Mitigation
- Ground Improvement Techniques as Foundations and Stabilisation for Deep Excavation and Tunnelling
- Deep Foundations Failures: Insights, Learnings and Improved Practices
- Design and Construction of Deep Foundations for Marine, Coastal and Near-Shore Structures
- Sustainable, Cost-Effective and Smart Approaches in Deep Foundations, including Reuse of Existing Foundations
- Geotechnical Site Characterisation, Instrumentation, Performance Monitoring, Digital Data Management and Automation/AI/ML Applications in Deep Foundations
- Research, Experimental and Numerical Methods in Deep Foundations, Deep Excavations and Ground Improvement Technologies
- Field Applications and Case Studies of Deep Foundations for Seismic Risk Mitigation

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Suresh Gutta, PhD , P E , American Geotechnical & Environmental Services, Inc, Canonsburg

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Himanshu Saurav, Indian Institute of Technology, Delhi; Sumeet Kuma Sinha, Indian Institute of Technology, Delhi

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Filippo Mira-Catto, Bauer Foundations Canada; Piero Roberti, DRB Geoconsult GmbH

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Ahmad Mamdouh Sabbah, Jawaharlal Nehru Technological University Hyderabad; Darga Kumar Nandyala, Jawaharlal Nehru Technological University Hyderabad

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Leila Novalic, ArcelorMittal Sheet Piling; Shilton Rica, ArcelorMittal Sheet Piling,

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Bony Sharma, SVNIT Surat; Shashank Singh, SVNIT Surat; Dr.Shr uti J.Shuk la, SVNIT Surat; Dr.C handresh H.Sol anki, SVNIT Surat

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Chiranjib P.Sar ma, Assam Skill University

Abstracts of Contributory Papers

DESIGN AND CONSTRUCTION OF THE SCALE PIT BRACED EXCAVATION

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ABSTRACT: Scale pit in steel melting shop is an integral part of process where filtered and cooled water is recirculated in the system. The execution of deep underground structure of scale pit presented significant construction challenges at AMNS project at Hazira. A robust execution strategy was developed for constructing scale pit in a 22 m deep excavation, within soil strata comprising essentially of silty fine to medium sand. The deep excavation work was located close to the Arabian Sea, exposing the site to huge tidal variations. During the excavation phase, the project faced a substantial groundwater ingress which represented a major hydrogeological challenge. To make things even more critical, a heavily loaded silo building and an electrical building stood on two adjacent sides of the pit. Both facilities remained fully operational throughout execution, meaning the structural stability of these buildings had to be preserved throughout execution. Furthermore, on the other two sides of the pit, new construction work for the SMS building had to progress simultaneously. This paper focuses on construction and risk mitigation strategy adopted, how various execution challenges were overcome and how advanced geotechnical and structural engineering was used to successfully deliver the foundation for this vital infrastructure.

Keywords: scale pit, steel plant, contiguous piles, deep excavation, shotcrete, Plaxis, Staad, wellpoint dewatering, grout pile, deep well dewatering, instrumentation, waling and strutting system

NUMERICAL STUDY ON PILED RAFT FOUNDATION RESPONSE SUBJECTED TO GROUNDWATER TABLE DRAWDOWN

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ABSTRACT: Three-dimensional numerical analyses have been performed to examine the response of a large prototype-sized piled raft foundation (PRF) experiencing a continuous groundwater table (GWT) drawdown. The soil within the stressed zone can be categorized into three distinct layers: a saturated layer located beneath the phreatic surface, a capillary-saturated layer above it, and a partially saturated layer extending towards the ground surface. Results indicate that GWT lowering leads to higher suction and a lower degree of saturation in the unsaturated zone of the PRF compared to the corresponding unpiled raft. At low loading levels, due to drawdown, both sagging differential settlement and average settlement increase. At higher loads, sagging differential settlement decreases, but average settlement increases. As GWT lowers, a reduction in pile frictional resistance, and negative frictional resistance develops first in corner piles, followed by edge and then center piles. Following complete groundwater drawdown, at lower loading levels, the axial load on the center pile decreases, for the edge pile it remains nearly unchanged, and for the corner pile it increases compared with pre-drawdown conditions. At higher loading levels, however, the axial loads on the center, edge, and corner piles all decrease relative to pre-drawdown values.

Keywords: Piled raft foundation, groundwater drawdown, numerical modeling, unsaturated soil

A COMPARITIVE BACK ANALYSIS STUDY BETWEEN TWO MATERIAL CONSTITUTIVE MODELS WITH SITE I & M DATA FOR DEEP EXCAVATION RETAINING SYSTEMS IN CHENNAI GEOLOGICAL PROFILE.

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ABSTRACT: A numerical case study using PLAXIS 2D was performed between two material constitutive models like conventional Mohr – Coulomb (MC) and Hardening Soil (HS) to examine its performance, reliability and applicability in capturing the diaphragm wall behavior during multi staged excavations in Chennai geological profiles. This study is basically from an ongoing Underground Metro Project of having deep earth retaining system using diaphragm wall of depth 37m; calibrated with enhanced Instrumentation and Monitoring system with well captured monitoring frequency during the stages of excavations. The objective of the study is to establish an empirical formula derived based on the various soil investigations done across CHENNAI using available lab tests and in-situ test results and Geotechnical Instruments data taken during construction stages from site - from which Geotechnical Engineering Parameters were determined by calculating the back analysis. Our case study with calibrated model represents these Engineering Parameters as shown in Table (1) and (2) using SPT correlation between Young's modulus and Undrained Cohesion values for cohesive layers as best fit which is developed based on the back analysis.

For clay layers E50/cu as 500. For sand layers, it was estimated from E'/N relationship given by Burland and Burbidge (1985) and further the best fit is developed based on the back analysis as 2.0 for Chennai Geological Profiles. The behavior of predicted wall movements and ground settlements as per the Engineering Parameters are compared with the actual behavior of the diaphragm wall using Inclinometer (Geotechnical Instruments) and thereby suggesting the Best Fit Constitutive model with Engineering Parameters for its future recommendations / applications at deep excavation analysis in Chennai geological profile.

COMBINED PILED RAFT FOUNDATION SYSTEM WITH DIAPHRAGM WALL IN CLAYEY SOIL: A CASE STUDY AND FEM ANALYSIS FOR PEERLESS TRAYAM, KOLKATA

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ABSTRACT: As cities continue to expand, the demand for taller structures continues to grow. This has driven a paradigm shift from selecting a site with ideal ground conditions to a forced choice of construction on most complex ground conditions. The challenge before geotechnical engineers is to innovate the design of foundation systems capable of delivering safe and reliable structural performance. This study highlights the design innovation and implementation of a combined piled raft foundation system for a mixed-use development project (2B+G+14) in Kolkata for Peerless Trayam. The project has a diaphragm wall as retention system for excavation of basement area. The construction site is characterized of clayey silt followed by Silty Clay at founding level. A 3D finite element model of was developed using PLAXIS 3D, to simulate staged construction and soil-structure interaction. As the D-wall is structurally connected to the piled raft foundation, the behavior of whole system was evaluated, thereby simulating the actual conditions during construction and service. The foundation system comprises of 303 piles of 900mm and 600mm diameter pile with raft thickness varying from1.4 to 0.8m. From the PLAXIS 3D analysis a total settlement of 80.4 mm is estimated, with an average raft contact pressure of 109 kPa and maximum axial forces of 3523 kN and 1423 kN were obtained for the 900 mm and 600 mm diameter piles, respectively. Further a sensitivity analysis with a 25% variation in soil parameters was performed to assess the impact of geotechnical uncertainties on the performance of foundation system. The results showed only marginal increases compared to the original model, with the foundation performance remaining within the code-specified limits.

Keywords: Combined Piled Raft Foundation, Soil-Structure interaction, PLAXIS 3D, Diaphragm Wall

DESIGN ADEQUACY ASSESSMENT OF DIAPHRAGM WALL FOR ENLARGED LAUNCHING SHAFT OPENING USING FEM AND REAL-TIME FIELD MONITORING

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ABSTRACT: Design modifications during urban tunnelling often require rapid verification of structural safety. This study evaluates the adequacy of diaphragm walls for an enlarged launching shaft opening in Chennai Metro Phase II using finite element modelling (FEM) validated by real-time field monitoring. The roof slab opening was enlarged from 12 m × 8 m to 16.48 m × 8 m. To incorporate the effect of this modification in the numerical model, the slab stiffness was reduced, representing the loss of lateral restraint provided by the slab. PLAXIS 2D analyses predicted maximum wall deformations of 22–23 mm, while inclinometer I-10 recorded 15 mm. Although FEM overpredicted deformation by approximately 47–53%, it accurately captured the deformation profile and trends. The measured deformation remained within acceptable serviceability limits. The results confirm that FEM provides conservative predictions while demonstrating that the diaphragm wall system remains structurally adequate after modification.

Keywords: Diaphragm wall, launching shaft, PLAXIS 2D, real-time monitoring, slab stiffness, urban tunnelling

DESIGN AND CONSTRUCTION OF FOUNDATIONS IN KARSTIC GEOLOGY

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ABSTRACT: Karstic geology is one of the most challenging subsurface conditions encountered in geotechnical engineering. Non-homogeneous solution activity, high variability in top of rock elevations, soft clay seams and voids in limestone bedrock, and sinkholes pose significant uncertainty in characterizing subsurface conditions and selecting appropriate foundation types. Because these features are highly variable and site-specific, applying uniform design methodologies often leads to overly conservative solutions or, alternatively, foundations that are unsafe or impractical to construct.

Effective geotechnical design in karst geology requires a comprehensive subsurface investigation program that integrates detailed geologic research, thorough site reconnaissance surveys, well-planned drilling and laboratory testing, and appropriate use of geophysical methods. Local geology expertise is essential for interpreting karst processes, assessing the severity of solution activity, and understanding environmental and hydrogeologic factors that influence foundation performance. These insights guide the development of foundation alternatives tailored to the specific risks present at each site.

Deep foundations including micropiles, lower capacity end-bearing driven piles, and mat foundations supported on ground improved by compaction grouting are some of the well-known foundation options in karstic geology. Central and Eastern Pennsylvania State in the United States is underlain by diverse karstic geologic formations. This paper presents a state-of-the-art review of geotechnical design approaches, construction techniques, and extensive load testing of deep foundations in karstic geology. Lessons learned from these projects highlight the importance of adaptable design frameworks, rigorous subsurface characterization, and construction practices tailored to the unique challenges of karst geology.

Keywords: Karst, Subsidence, Micropiles, and Grouting

CHALLENGES IN UNDERGROUND METRO CONSTRUCTION AND MITIGATION THROUGH ALTERNATIVE DESIGN

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ABSTRACT: This study mainly focuses on to overcome the challenges in underground metro construction with suitable alternative design. In underground metro construction in dense urban environmental is highly challenging task including (1) geological conditions, (2) Uncertain Hydrology conditions, (3) managing existing utilities and Infrastructures, and (4) Ensuring safety during construction.

Keywords: metro design, underground station, construction techniques, diaphragm wall, shear Pin

RATIONAL N-VALUE SELECTION FOR ROCK SOCKETED PILES IN WEAK WEATHERED BASALTIC ROCK

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ABSTRACT: The axial load carrying capacity of piles founded in weak, fragmented intermediate rock is determined using Method 2 of IRC:78 (Part 1)-2024. This method needs an equivalent SPT N-value, linked to shear strength through the correlation established by Cole and Stroud (1977). This correlation uses N-values extrapolated from refusal conditions in weak weathered rock. In practice, SPT is usually discontinued at the soil-rock interface, or after initial runs in rock. The equivalent N-value is then assigned based on general assumptions and past experience. This can lead to overestimation or underestimation of pile capacity, depending on the judgement applied. This study evaluates three approaches for assigning the equivalent N-value from Core Recovery (CR) and Rock Quality Designation (RQD): one based on CR alone, one based on the average of CR and RQD, and one based on RQD alone, with separate criteria for side friction and end bearing. These approaches are applied to two boreholes in weak weathered basaltic rock of the Mumbai region. The results are compared against pile load test results at the same two locations. The RQD-based approach matched the field results most closely at both locations. The average-based approach consistently overestimated capacity, and is shown to be unsuitable for design.

Keywords: Rock socketed piles, Weak weathered basaltic rock, Equivalent N-value, Core Recovery, Rock Quality Designation, IRC:78, Pile load test

OPEN CAISSONS FOR UNDERGROUND AND LAND BUILDINGS

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ABSTRACT: Open Caissons, popularly known as Well Foundation, are commonly used as Deep Foundation in River Bridge construction, Ports, Harbours and Dam related structures in our country.
However, this Deep Foundation Technique has been used for Underground and Land Buildings elsewhere in the World, though rarely. Open Caisson Technique and Method become inescapable in some situations of Land and Underground Building where alternate Techniques are not feasible. This Technical paper is based on Author's experience, expertise gained and understanding of this Technique used in our Country. One of the Caisson was of size 12.4 m wide 29.55 m long and 16.7 m deep, housing multiple floors below ground. The Open Caisson also supported 8.5 m high RCC framed Building above ground. Illustrative real example is discussed. The Paper covers Methodology, Soil Exploration, Shape and Size of Caisson. Engineering and Design aspects are discussed and

deliberated. Design Criteria, Skin Friction, Adhesion, Bearing Capacity and Analysis are deliberated in particular. Construction, Sinking and challenges of adverse conditions and situations are discussed. Specific recommendations and suggestions for planning, investigations, design and construction are covered.
Keywords: Caisson, underground, land building, design, sinking, shift, tilt, complex alignment, tunnel, recommendation.

COMPARATIVE ASSESSMENT OF PILE FOUNDATION CAPACITIES USING ANALYTICAL APPROACHES AND NUMERICAL MODELING: A CASE STUDY

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ABSTRACT: Design of pile foundations in routine practice commonly relies on analytical approaches enumerated in national and institutional standards. These methods provide practical and conservative estimates of pile capacity. In parallel, advances in numerical modelling allow a more realistic representation of soil–pile interaction, particularly in complex and mixed soil profiles.

This paper presents a case study from Northen part of Indian Peninsula, wherein pile capacities for bored cast in-situ piles were compared for analytical methods in accordance with IRC provisions with that of simulated using numerical modelling. The subsurface conditions at the project sites consist of mixed soil strata such as layers of silty sand, clayey sand and silty clay. This necessitated the careful assessment of shaft and end-bearing contributions. For this purpose, the pile capacities were first derived using code-based analytical approaches considering the relevant soil parameters obtained from site investigations. Further, the same pile–soil systems were then modelled using a finite element-based software MIDAS-GTS-NX. For this purpose, soil layers were simulated using Mohr-Coulomb model replicating in-situ stratification, whereas the loading conditions and boundary conditions were simulated to reflect the in-situ behavior of sub-surface profile and Ground water conditions.

The study aims to compare the performance of piles subjected to vertical loads using both approaches Code based analytical methods and numerical models and subsequently delve deeper to investigate the factors contributing to the same. Furthermore, the comparison is intended to identify the level of conservatism in code-based approaches and assess the potential of numerical modelling as a supplementary tool for optimizing pile design in infrastructure projects. The findings are expected to provide practical insights into the combined use of analytical and numerical methods for foundation design in mixed soil conditions.

Keywords: Pile Foundation; Shaft Resistance; End Bearing; Analytical Approach; Numerical model

OPTIMIZING ROCK SLOPE DESIGN WITH LIMITED GROUND DATA: IMPLICIT VS. EXPLICIT JOINT MODELING IN RS2

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ABSTRACT: This paper evaluates the geotechnical design of a substantial mountain excavation necessitated for the establishment of an 11,000 m^2 expansion platform for an industrial facility in a complex geological setting. The excavation involves steep igneous rock slopes, predominantly composed of Harzburgite and Dunite, located immediately adjacent to the operational industrial area, imposing stringent stability and risk management requirements.
A primary challenge for the design was a significant vertical data gap arising from topographical constraints. While the slope crest reaches elevation (EL) +62m Mean Sea Level (MSL), subsurface investigation was restricted to boreholes collared at EL +32m MSL. This left the critical upper 30 meters of the rock mass uncharacterized, necessitating a design strategy heavily reliant on surface mapping from 111 surface investigation points.
To address the geological uncertainty and optimize the support system, a comprehensive 2D finite element analysis was conducted using Rocscience RS2 (Version 11.026) based on the Shear Strength Reduction (SSR) method. The study details a comparative analysis of three material modeling approaches: (i) Implicit Continuum: Generalized

Hoek-Brown (GHB) varying the Geological Strength Index (GSI); (ii) Implicit Jointed Continuum: Jointed Generalized Hoek-Brown (JGHB) incorporating ubiquitous joint sets; and (iii) Explicit Discontinuum: A discrete fracture network approach utilizing GHB for the rock matrix and the Barton-Bandis criterion for three critical joint sets derived from surface data.
Results indicated a significant divergence in calculated stability. The Implicit Continuum GHB yielded the highest Strength Reduction Factors (SRF), effectively acting as an upper bound by homogenization of the rock mass. Conversely, the Implicit Jointed Continuum JGHB produced conservatively low SRF values, driven by its inherent assumption of infinite joint persistence which forces failure along continuous weak planes. The Explicit modeling approach provided the critical intermediate solution governed by the mobilization of intact rock bridges between non-persistent joints. Based on these findings, the explicit modelling approach was selected to define the final support system, comprising grouted anchors and shotcrete. The study provides practical guidance for engineers on selecting suitable rock slope modelling strategies and offers a framework for balancing safety and constructability in complex rock slope excavation.
Keywords: RS2, Finite Element Analysis, Shear Strength Reduction (SSR), Explicit Modeling, Implicit Modeling, Data Limitation/Gap.

HYBRID SLOPE STABILIZATION OF MINE OVERBURDEN DUMP USING MICROPILES AND GEOSYNTHETIC REINFORCEMENT: A CASE STUDY FROM ODISHA

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ABSTRACT: This paper presents a comprehensive case study on the remediation of a rainfall-induced slope failure within the backfilled overburden dump of an open-cast Chromite Mine in Kaliapani, Odisha. The failure, occurring over a strike length of 130m, was triggered by heavy monsoon rains causing saturation and significant softening due to pore water pressure buildup in the underlying weathered serpentinite sludge layer.

The remediation strategy adopted a hybrid geotechnical approach combining deep foundation elements with reinforced soil techniques. The design solution incorporated two rows of 200-250mm diameter micropiles arranged in a staggered manner at the toe to arrest basal movement and provide deep anchorage into the stable strata. The failed slope was reconstructed as a Reinforced Soil Slope (RSS) utilizing high-strength uniaxial geogrids (150 kN/m) with a Composite Green Facia & flexible Gabion fascia system and Geogrid reinforcement to ensure surficial stability and erosion control. Additionally, a robust drainage network comprising geo-composite drains and lined channels was implemented to prevent water percolation into the critical sludge layer.

Numerical analysis using the Limit Equilibrium Method (Bishop's simplified) demonstrated that the intervention significantly improved the global stability, increasing the Factor of Safety (FOS) from a critical 1.22 to a stable 1.55. This case study highlights the efficacy of combining micropiles with geosynthetics in stabilizing complex mine dump failures under heavy rainfall conditions, offering a sustainable model for similar infrastructure challenges.

Keywords: Slope Stabilization, Micropiles, Reinforced Soil Slope (RSS), Mine Dump Failure, Geosynthetics.

STABILITY ANALYSIS OF TUNNEL PORTAL SLOPES UNDER VARYING GROUND CONDITIONS

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ABSTRACT: Tunnel portal stability is a critical concern in underground storage projects, especially under complex geological and groundwater conditions. This study investigates the effectiveness of different slope stabilization measures through a comparative analysis for a planned slope section navigating through compressible black organic clay layer interbedded with sandy soils under intense monsoon rainfall conditions. Detailed geotechnical investigations were carried out to assess insitu ground conditions and adopt design modifications for stabilizing portal ramp slope sections. Stability assessment of portal ramp slopes up to 20m height were analysed using strength reduction factor technique for different conditions of slopes without support, with support and support with

drainage hole combinations. Numerical analysis carried out for given slope conditions reflected relative impact of providing long continues drainage holes along the slope height in improving strength reduction factor of slope sections. Continuous geotechnical monitoring during excavation guaranteed safety and performance.

Keywords: Tunnel portal; Slope stability; Weak soils; Groundwater; Geotechnical monitoring

A CRITICAL REVIEW OF LANDSLIDE RISK ASSESSMENT: INTEGRATING GEOTECHNICAL PARAMETERS WITH ADVANCED ML ARCHITECTURES

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ABSTRACT: Landslide risk assessment has transitioned from traditional deterministic and stochastic methods toward sophisticated data-driven frameworks powered by machine learning and geospatial intelligence. This research provides a review of the current state of landslide susceptibility modeling, focusing on the integration of geotechnical parameters, geospatial conditioning factors, and advanced algorithmic architectures. Traditional models often lack the scalability and objectivity required for large-scale assessments, whereas machine learning techniques such as Random Forest, Support Vector Machines, and Extreme Gradient Boosting effectively manage the high-dimensional, non-linear relationships inherent in environmental data. The inclusion of geotechnical indices alongside geomorphological and hydrological variables significantly enhances the physical reliability of these predictive models.The emergence of Explainable Artificial Intelligence (XAI) addresses the transparency concerns of models, allowing for a deeper understanding of the causal triggers of slope failure. By incorporating high-resolution satellite imagery, Interferometric Synthetic Aperture Radar, and real-time IoT sensor data, modern frameworks can now assess not only hazard susceptibility but also the exposure and potential economic loss of physical assets and infrastructure. This review synthesizes findings from recent literature, underscoring the necessity for methodological standardization and the development of cross-regional datasets to improve global disaster resilience and land-use planning.
Keywords: Landslide Susceptibility Modeling, Machine Learning, Explainable AI (XAI)

SLOPE STABILITY ASSESSMENT AND MITIGATION OF HILL SLOPE INSTABILITY AFFECTING A BURIED PIPELINE IN A HIGH-RAINFALL REGION-A CASE STUDY

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ABSTRACT: Slope instability in hilly terrain poses significant risks to linear infrastructure, particularly strategically important pipelines crossing steep, high-rainfall regions. This study presents the stability assessment and mitigation measures adopted for an exposed 42-inch crude oil pipeline near Bala Village, Mangaluru, India. The pipeline is a critical asset, and its uninterrupted operation is of vital importance. The pipeline traverses several hill slopes in the Mangaluru region, where prolonged monsoon rainfall led to progressive slope failure, exposing approximately 100 m length of the pipeline. The site comprises steep slopes (about 1V:1.5H) in lateritic soil deposits exhibiting high sensitivity to moisture variations. Additional destabilizing factors include roadway loading and excavation disturbances near the pipeline ROU (Right of Use). Such pipelines with restricted ROU conditions create several challenges in implementing stabilization measures. A detailed geotechnical investigation, including boreholes, laboratory testing, and drone-based topographic surveys, was conducted to establish subsurface stratigraphy and groundwater conditions. Comprehensive stability analyses were performed using finite element (PLAXIS 3D) and limit equilibrium (GEO-5) methods under static and pseudo-static seismic conditions. Considering the strategic importance of the pipeline, a slope rectification scheme was implemented to ensure uninterrupted operations during construction. The rectification scheme included self-drilling anchors at the crest, contiguous pile walls with anchors near the pipeline, toe stabilization using deep piles, and horizontal subsurface drainage to control pore water pressures. The adopted rectification measures significantly improved slope stability, achieving

acceptable factors of safety under both static and seismic conditions. This study highlights the importance of robust stabilization techniques for safeguarding strategically important pipeline infrastructure in lateritic hill slopes subjected to extreme rainfall.
Keywords: Slope Stability, High Rainfall Region, Lateritic Soil, Slope Stabilization, Finite Element Analysis

PERFORMANCE STUDY ON SAND REINFORCED WITH JUTE GEOCELL AND SYNTHETIC CARPET GEOCELL

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ABSTRACT: Geocellular confinement systems represent an effective geosynthetic solution for improving the stability and load-bearing performance of granular foundations in erosion-prone or weak ground conditions. Laboratory model tests were carried out to evaluate the comparative bearing capacity of Natural Jute Geocell (JG) and Nonwoven Synthetic Carpet Geocell (CG) systems within a sand foundation. Geocells were fabricated to optimal geometric ratios of pocket size (a/B) = 0.5, height (H/B) = 0.7, and width (W/B) = 5. The reinforcement layer was placed at a depth (u/B) of 0.1 below the footing, B being footing width. To assess the influence of reinforcement height, the testing program included both full-height (H/B=0.7) and half-height (H/B=0.35) geocell systems. The results indicate significant improvements in bearing capacity and settlement behavior for both reinforced systems compared with the unreinforced sand bed. The CG system consistently outperformed the JG system, exhibiting improvement factors approximately 30–100% higher across the investigated settlement range. The percentage reduction in settlement increased with unreinforced settlement, up to about 15–25%, after which it decreased gradually. Peak settlement reductions of approximately 75–80% were observed for CG, while JG systems achieved reductions in the range of 45–65%, depending on reinforcement height. Overall, geocell material type and height were found to be key parameters governing settlement mitigation, with full-height CG configuration providing the most effective performance.

Keywords: natural jute geocell, nonwoven synthetic carpet geocell, flexural rigidity, bearing capacity

GEOGRID REINFORCED ASH BUND - NUMERICAL INVESTIGATIONS ADDRESSING S EISMIC RISKS & SUSTAINABILITY

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ABSTRACT: An appropriate dumping and management of fly ash produced from thermal power plants remains a serious challenge for certifying environmental sustainability and geotechnical fortification. Ash bunds, which considered to be a containment structures for slurry form of fly ash, are predominantly vulnerable to the seepage failures and overall stability due to the heterogeneous features of fly ash deposits. Since stored material in bund is more prone to failure particularly in the slurry form, due to its saturated self-weight and increased pore water pressures. The study represents a comprehensive stability analysis of an ash bund which located in Chhattisgarh, India. where obstinate seepage at the toe drain was observed, results in contamination of neighbouring water sources, which may concern about potential adversative effects on public health.

A numerical modelling approach using GeoStudio was implemented to assess the overall performance of the ash bund under both static and seismic loading conditions. Stability analyses for slopes were did using the SLOPE/W module and Bishop's Simplified Method was used to determine the factor of safety for gravity loading. SEEP/W was used to know the seepage behaviour and marking phreatic surface development, by allowing calculation of pore-water pressure distribution within the bund. Considering Stress–deformation features, including lateral displacement and settlement behaviour due self-weight of fly ash during the staged construction of bund, were analysed using SIGMA/W. Since the seismic performance was examined through QUAKE/W in accordance with the IS 1893, the complete analysis considering post-earthquake stability analysis was carried out by the Newmark sliding block method was used for the estimation of permanent displacements.

To improve stability and mitigate outflow, geogrid reinforcement was combined within the proposed third-stage

raising of the bund at several embedment depths and lengths. The overall performance of present unreinforced and reinforced configurations was compared based on factors of safety, pattern of seepage, variation in pore-water pressure, deformation features, and seismic-induced dislodgments. The results validate that geogrid reinforcement efficiently intercepts critical slip surfaces, control seepage, decrease deformations, and significantly enhance the static and seismic stability of the ash bund.

The studied ash bund denotes a finite slope system, where the geometry and boundary situations of the containment structure in largely affects the stability. Natural slopes are commonly encountered in steep mountainous terrains which are infinite slopes, where failure mechanisms are mostly controlled by near-surface soil situations and groundwater variations. Since, progressive numerical tools such as GeoStudio, with SEEP/W, SLOPE/W, SIGMA/W, and QUAKE/W, offer a versatile framework for evaluating both finite and infinite slope difficulties through seepage, deformation, and stability calculations.

Although the current study emphases on the stability of an ash bund at Chhattisgarh, its findings have noteworthy implications for the North-Eastern region of India, where several thermal power plants are situated, the area which falls in moderate-to-high seismicity. In line with the objective of Government of India to attaining 100% fly ash utilization, the development and safe process of ash ponds are becoming progressively important. The methodology and stability measures projected in this study can be effectively propose to similar ash dumping facilities in the North-East, to promote safe and sustainable fly ash management considering seismic safety concerns.

Keywords: Fly ash, Ash bund, seepage failure, pore water pressure, Slope stability, **reinforced geo-material etc.**

SLOPE STABILITY ANALYSIS AND GEOTECHNICAL APPROACHES TO LANDSLIDE MITIGATION OF OKSRT ROAD, ARUNACHAL PRADESH: A CASE STUDY

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ABSTRACT: Landslides pose a severe threat to India's hilly terrains, particularly along critical corridors like the Orang-Kalaktang-Shergaon-Rupa-Tenga (OKSRT) road in Arunachal Pradesh. Traditional mechanistic models often fail to account for the chronic uncertainties of these highly heterogeneous, tropically weathered slopes. This study addresses this gap by presenting a site-specific evaluation of the OKSRT road, integrating landscape-scale hydrological conditions with localized geotechnical parameters. Moving beyond reactive stabilization, we evaluate advanced, proactive measures—including geosynthetics, eco-engineering (bio-bioengineering), and hybrid soil-nailing systems. Performance metrics, evaluated via the Factor of Safety (FoS), demonstrate that these integrated, sustainable approaches significantly outperform conventional methods in both long-term slope resilience and ecological restoration. By synthesizing regional data with global best practices, this paper delivers a scalable, cost-effective engineering framework uniquely tailored to the fragile, monsoon-dominated ecosystem of Arunachal Pradesh, establishing a vital blueprint for resilient infrastructure in the region.

Keywords: landslide mitigation, root reinforcement, geotechnical parameters, slope stability, hydrological conditions

GROUND IMPROVEMENT BY MEANS OF CONTROLLED MODULUS COLUMNS IN SOFT CLAY- A CASE STUDY

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ABSTRACT: Ground improvement techniques play a crucial role in enabling safe and economical foundation solutions on weak or highly compressible soils. The Controlled Modulus Column (CMC) method, commonly referred to as rigid inclusion, is widely adopted for enhancing bearing capacity and controlling settlement in challenging geotechnical conditions. Unlike conventional piles, CMCs act as rigid inclusions in combination with a Load Transfer Platform (LTP), forming a composite ground system that redistributes stress between inclusions and surrounding soil. CMC installation may be carried out using displacement or non-displacement techniques, depending on site and subsurface conditions. Load sharing is governed by deformation compatibility, with differential settlements progressively reducing until equilibrium is reached at the neutral plane, beyond which shaft friction and toe resistance contribute to overall stability.

This paper presents a case study from the west coast of India near Mumbai Port, involving treatment of soft marine clay underlain by weathered rock for industrial infrastructure. The study covers design methodology, installation approach, and quality control, along with practical considerations. Field performance demonstrates that CMC installation reduced total settlements to within 25–40 mm, meeting serviceability criteria, with load test results confirming acceptable behavior. These findings highlight CMCs as a reliable and efficient ground improvement solution for projects requiring strict settlement control.

Keyword: Soft Clay, Rigid Inclusion, Controlled Modulus, Load Transfer Platform.

GEOTECHNICAL MAPPING OF MUMBAI SUB-SOIL FOR EFFECTIVE DESIGN & CONSTRUCTION OF LARGE DIAMETER CIRCULAR ROADWAY TUNNEL USING TUNNEL BORING MACHINE

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ABSTRACT: Mumbai's rapid urbanization and severe geometric constraints have necessitated large-diameter subterranean roadway networks. Mechanized tunneling through the coastal volcanic complex of the Deccan Trap presents extreme engineering challenges, characterized by hyper-heterogeneous mixed-face profiles (ranging from soft estuarine clays to high-strength intact basalts exceeding 112 MPa), variable rock mass weathering grades, and dynamic tidal-induced hydrogeological regimes. This paper outlines a generalized geotechnical mapping and structural optimization framework developed for large-diameter mechanized tunneling across coastal urban centers characterized by severe mixed-face geology. The underlying geological profile represents typical regional sequences where thick layers of anthropogenically reclaimed fill and soft marine clays (c = 62 kPa, E = 22 MPa) overlie highly variable weathering profiles of hard, fractured volcanic rock complexes (UCS 6.21-112.53 MPa). The occurrence of a dual soil-rock interface across single, large-diameter tunnel sections necessitates the operation of high-confinement slurry-shield Tunnel Boring Machines (TBMs) within a stable envelope of 6 to 7 bar. Traditional empirical models are advanced by integrating the German Tunnelling Committee (DAUB) wedge stability framework with real-time empirical correlations between Rock Mass Quality (RQD/GSI) and dynamic slurry face pressure calibration under macro-tidal fluctuations.

Keywords: Slurry shield; coastal geology; mixed face; DAUB model; segmental liner; volcanic rock mass; ground equilibrium.

NUMERICAL ANALYSIS FOR AXIAL PULLOUT CAPACITY OF INCLINED PILES

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ABSTRACT: The inclined pile provides an economical method for stabilizing slopes and retaining wall systems, providing buoyancy control of pipelines, and providing anchor support for transmission towers. These piles are designed to withstand the tensile forces developed from the external pullout load or overturning moment caused by these structures. The maximum uplift capacity of these piles is governed by the pile geometry, inclination, embedment ratio (L/D), and soil characteristics (such as soil type, density, and soil-pile interface). This paper presents a parametric finite element investigation using ABAQUS on the axial pullout capacity of inclined piles in granular soils. Pile inclination (0°–50°, in 10° increments), embedment ratio, soil density, friction angle, and pile–soil interface friction ratio are systematically varied to assess their individual and combined effects on pullout response. The results reveal that the pullout capacity ratio (PCR) peaks at inclinations of 35°–40°, with the optimal inclination shifting to lower angles as the interface-to-soil friction ratio (δ/ϕ) decreases. Soil density, embedment ratio, and interface friction angle are found to critically govern the uplift response of inclined piles. The findings provide a parametric basis for optimizing inclined pile design in granular soils, contributing to more efficient and reliable foundation systems for uplift-critical applications in geotechnical engineering.

Keywords: Inclined Pile, Axial Pullout Capacity, Numerical Analysis, ABAQUS, FEM

ENHANCEMENT OF GROUTING PERFORMANCE USING STABLE GROUT

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ABSTRACT: Water leakage under high hydrostatic pressure poses significant challenges in deep excavations and water storage dam foundations, often occurring through excavation bodies or founding strata. Grouting is a widely adopted method to mitigate such seepage, requiring careful selection of materials and procedures based on site-specific geology. In this study, groutability tests were conducted at two locations with varied geological formations, including weathered shale, quartzite, conglomerate, and different grades of granite, up to a depth of 40m. Grout mixes were optimized by varying the water–cement ratio, and the performance of stable grout (with microfine cement) was compared with unstable grout (ordinary cement) through field application at separate locations. Descending stage grouting was adopted, with a tube-à-manchette system used in collapse-prone strata to ensure controlled injection. A triangular hole pattern with primary, secondary, and tertiary stages was implemented, followed by permeability assessment through a central master hole. Results showed a significant reduction in permeability with stable grout, along with improved particle binding in highly weathered granite. The study highlights the importance of grout mix design and systematic groutability testing for effective seepage control in complex geological conditions.

Keywords: Groutability, Deep excavations, Microfine cement, Geological variability, Tube- à-manchette (TAM) and Seepage control.

MITIGATION OF GROUTING INDUCED TUNNEL DISTORTION AND SUCCESSFUL IMPLEMENTATION OF GROUND IMPROVEMENT FOR CROSS PASSAGE CONSTRUCTION: A CASE STUDY

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ABSTRACT: In an underground metro project, a cross passage (CP) was required to be constructed in a layer of fine silty sand with relatively thin clay lenses. Average crown depth of the tunnels was 15 m. Groutability assessment indicated that cement grouting is possible in silty sand layer. but ineffective in the silty clay because of its very low permeability. Numerical analysis further showed that formation of a grout block around the CP would be beneficial in reducing the ground deformation during CP construction activity. Grouting had to be done from the tunnel itself due to some site constraints. However, during application of grouting, slight ground heaving and distortion in the adjacent tunnel was noticed leading to suspension of the grouting works. A revised grouting strategy comprising reduced injection pressure, temporary tunnel bracing, enhanced instrumentation and monitoring, and structural adequacy verification enabled safe completion of the remaining grouting works. Post grouting soil samples were also collected to verify and confirm the efficacy of grouting activities. The study demonstrates that successful grouting in heterogeneous ground requires an observational approach integrating groutability assessment, numerical modelling, adaptive construction control and real-time monitoring to manage unforeseen field conditions.
Keywords: grouting, cross passage, ground improvement, tunnel

RESPONSE OF BUILDING DUE TO STRENGTHENING OF CIRCULAR TUNNEL LINER BY BONDING STEEL PLATE

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ABSTRACT: Tunnels may show signs of deformation or distresses which are cracks, leakages and ovalisation, due to ageing effect or redistribution of ground stresses due to unforeseen imposition of overburdens. This may happen within the service life of the tunnel, necessitating the requirement of strengthening the tunnel liners. Various researchers have developed the strengthening mechanism of tunnel liners but the effect of such tunnel deformation on the buildings on ground surface, within the influence zone, has not been analyzed. Thus, it has become extremely important to assess the damage of buildings over tunnel alignment so that mitigation measures can be taken up accordingly. Present study focuses on the analyses of the impact of tunnel deformation on the above ground buildings and compares the outcome with the benefit of retrofitting of tunnel by additional steel liners on those buildings. Deformation of tunnels has been analyzed by Murir Wood method as well as by numerical analysis following which the deformation of the ground surface has been computed by Peck's formula. The impact on a building has been assessed by Burland's method. It has been found that the impact on the building gets substantially reduced and thus buildings on ground surface can be prevented from damages, if the tunnel lining is strengthened with steel plate as soon as deformation or distresses, beyond stipulated limits, are noticed in the tunnel lining.

Keywords: Service life, Deformation, Crack, Retrofitting, Mitigation

SEEPAGE CONTROL IN HYDROPOWER INFRASTRUCTURE

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ABSTRACT: In the development of large-scale hydropower projects, the design and execution of temporary river diversion structures, specifically cofferdams, present significant geotechnical challenges. Maintaining dry excavation conditions is critical for foundation preparation and powerhouse construction. Execution of permeation grouting in conditions like high ground water flow velocity, heterogeneity of ground strata, space constraints etc., remains challenging. This paper presents a case study comprehensively covering permeation grouting as a primary seepage barrier solution for cofferdams founded on unconsolidated, pervious alluvial strata executed in challenging ground conditions.

Keywords: seepage control, permeation grouting, TAM, cofferdam

COMPARATIVE STUDY ON LIQUEFACTION POTENTIAL AND GROUND IMPROVEMENT ASSESSMENT AS PER IS 1893:2016 AND IS 1893:2025

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ABSTRACT: Ground improvement for foundations is often required to address potential liquefaction hazards. IS 1893:2025 (though withdrawn, is expected in future) introduces revisions to seismic zoning and zone factors compared to IS 1893:2016, including the addition of a new seismic zone. The revised zoning framework results in upgrading by one or two zones in some regions, no change in others, and downgrading in certain areas. In addition, the adoption of return-period–based zone factors may lead to either an increase or a reduction in seismic demand

for a particular site. IS 1893:2025 also revises the liquefaction assessment methodology, modifying the evaluation of cyclic stress ratio (CSR), cyclic resistance ratio (CRR), and the factor of safety (FOS) required to mitigate liquefaction. These revisions directly influence liquefaction assessment and ground improvement requirement shall be decided based on the new demand. This paper compares liquefaction assessment evaluation as per IS 1893:2016 and IS 1893:2025, focusing on how changes in seismic zoning, return period-based factors, and updated CSR-CRR procedures effect on ground improvement evaluation.

Keywords: ground improvement, liquefaction, IS 1893, seismic zone, CSR, CRR, factor of safety

DEEP GROUND IMPROVEMENT USING JET GROUTING

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ABSTRACT: Deep ground improvement is needed for the construction of TBM Safe Haven Block in Toronto. Due to the high depth (40m below grade) and the very challenging soil conditions, the Jet-Grouting technique has been used to realize a maintenance block for TBM. The paper will describe the performance of jet-grouting during the trials, the modification of the jet-grouting parameters increasing the erosion energy in order to meet the project specifications, and the results of the intensive in-situ and laboratory testing campaign.

SEISMIC BEHAVIOR OF AN UNDERGROUND BOX TUNNEL STRUCTURE AT SHALLOW DEPTH

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ABSTRACT: Shallow underground box structures are widely used for metro corridors, subways, and underground parking facilities in congested urban areas. Because such structures are constrained by the surrounding ground, their seismic response is governed largely by soil deformation and soil–structure interaction rather than by inertial response alone. This study presents a parametric assessment of a 10.0 m wide × 6.0 m high cut-and-cover box tunnel subjected to different overburden, ground, and seismic conditions. Backfill heights of 6, 8, and 10 m were considered together with three non-cohesive ground conditions: loose-to-medium silty fine sand, medium-dense silty sand, and very dense sand. The seismic cases included peak ground accelerations (PGA) of 0.24 and 0.36, corresponding approximately to amplified design conditions for Seismic Zones III and IV, while non-seismic cases were also examined for bending-moment comparison. Two-dimensional space-frame models in STAAD.Pro and finite-element models in MIDAS GTS NX were used to evaluate free-field or racking deformation and critical bending moments at the roof–wall, base–wall, and wall–roof junctions. The results of the study reveal that free-field deflection (racking deformation) and bending moment reduces by 14-21% and 6-15% respectively, when compactness of subsoil surrounding the structure changes from loose to medium and further to dense under same seismic conditions. Racking deformation also reduces by 4 to 7% due to increase in tunnel depth from 6m to 8m and then to 10m. On the other hand, deformation becomes almost double when seismic zone changes even for same soil condition. The findings provide comparative design guidance for preliminary seismic assessment of shallow cut-and-cover box tunnels.

Keywords: underground box structure, shallow depth, seismic behavior, racking deformation.

FORENSIC GEOTECHNICAL INVESTIGATION OF DIAPHRAGM WALL FAILURE SUPPORTING DEEP EXCAVATION: INSIGHTS FROM FIELD EVIDENCE, NUMERICAL MODELING, AND LITERATURE REVIEW

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BSTRACT: The paper investigates the distress and subsequent failure observed at an under-construction site during the August 2025 monsoon season, where a D-wall with anchorage was employed to support 18.5-meter-deep vertical excavation for a proposed nine-story building. A comprehensive forensic geotechnical investigation was conducted, incorporating field reconnaissance, detailed site observations, and advanced numerical analysis to identify the probable causes of failure. The study reveals that the failure resulted from a combination of factors, such as (i) inadequate anchorage capacity, (ii) positioning of a temporary PCC wall over the reinforced D-wall, (iii) ineffective surface and subsurface drainage facilities, and (iv) surcharge loading caused by dumping of excavated material behind the wall from the adjacent site. The findings were also corroborated through a critical review of the published literature study, where similar cases of failure were reported. Based on the forensic assessment, both short-term and long-term remedial measures were suggested for improving the design, construction, and performance of D-walls in future projects. The outcome of the study provides valuable insight and practical guidance to practicing engineers and contractors to mitigate the risk in future developments.

Keywords: Diaphragm Wall, Deep excavation support, Finite Element Numerical Analysis, Forensic Geotechnical Engineering, Factor of safety, Strength Reduction Technique

A DETAILED ROOT CAUSE ANALYSIS OF LARGE-SCALE PILE FAILURE IN A PROJECT AND THE SALIENT LESSONS LEARNED

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ABSTRACT: In last few decades the piling technology especially for bored pile construction has undergone a vast change. Earlier methods like percussive boring, direct mud circulation and in some cases reverse mud circulation technique of pile boring have, in many cases for large value projects, been replaced by hydraulic boring machines. In many major urban projects, ready mix concrete from qualified suppliers is used. In spite of these advancements, pile failures are found to be common in many projects. In one such large project, foundation system was planned and designed with bored cast in-situ piles. Anticipating defects, static load test and non-destructive tests in the form of pile integrity test and high strain dynamic test (HSDT) were carried out by a qualified agency. A major part of constructed piles were found defective and unable to carry designed loads. Detailed studies and analysis were performed using the available records to find the root cause of the major pile failure. In this paper the analysis procedure adopted and the final findings including conclusion are presented. All the piles were abandoned and a different foundation system on raft foundation, as agreed upon by both the owner and designer, were designed and constructed. The basic cause of failure as obtained from this study can be considered as a lesson for the practice of bored piling work.

Keywords: Ready Mix concrete (RMC); Pile Integrity Test (PIT); High Strain Dynamic Test (HSDT); Toe Defects/ Soft toe; Rock socketing depth

CONSTRUCTIONAL CHALLENGES AND SOLUTIONS OF LARGE-DIAMETER PILING IN SOIL AND ROCK IN MARINE AND TIDAL CONDITIONS: A COMPARATIVE STUDY OF INDIA AND BANGLADESH PROJECTS

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ABSTRACT: Engineering and construction of large-diameter bored cast-in-situ piles in marine and tidal environments involve complex challenges arising from varying geological conditions. This paper presents a qualitative analysis of piling practices in the Indian coastal region and Bangladeshi riverine projects, focusing on the engineering and functional suitability of rotary drilling rigs and Reverse Circulation Drilling (RCD) systems. Key issues addressed include: drivability analysis of single and double-stage liners; operational and financial feasibility of flat barges, spud barges, and self-elevating jack-up platforms; quality assurance in maintaining pile verticality within tolerable inclination; sealing of fissure cracks in soft rocks; support fluid selection and management; cage lowering cycle optimization; concrete mix proportions for optimized rheology, strength, and durability; and optimized concreting duration to avoid cold joints. The paper also elaborates on how soil stratigraphy influences scour depth and pile bearing capacity. End stabilization and improvement through base grouting, with performance validation by bi-directional and O-cell load testing, is discussed with reference to published findings (Bhattacharya and Maiti 2024).

Keywords: RCD, large-diameter bored cast-in-situ pile, jack-up, drivability analysis, base grouting, operational excellence, tremie concreting, O-cell load test, reverse circulation drilling, marine piling

FINITE ELEMENT ANALYSIS OF PILE GROUP RESPONSE TO STAGED BRACED DEEP EXCAVATION IN COHESIVE AND COHESIONLESS SOIL

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ABSTRACT: Urban cities require deep excavations for developments near existing buildings, affecting pile foundations. This research employs finite element analysis with PLAXIS 3D and the Hardening Soil model to examine the impact of staged excavations on adjacent pile foundations. The study analyzes a 16-pile group to understand progressive displacements and moments, simulating cohesionless and cohesive soil conditions. The focus is on how excavation depth and proximity to structures dictate displacement patterns and potential failure modes. Displacements, moments, and stress changes during each excavation phase are analyzed. The analysis shows that in cohesionless soil, displacements and moments are greater than in cohesive soil. The simulation results show that at 24 m excavation depth, there is a significant increase in horizontal and vertical displacements, moments, and stress as compared to 4 m and 12 m excavation depths in soil, pile cap, and piles. This research studies the effect of settlement and strain on piles, providing a clear understanding of soil-pile interactions. The findings support better design practices and the development of targeted measures to mitigate the risks associated with staged braced excavation adjacent to pile-supported structures.

Keywords: braced excavation, pile foundation, PLAXIS 3D

ESTIMATION AND FIELD ESTABLISHMENT OF VERTICAL LOAD CAPACITY OF LARGE DIAMETER BORED PILE THROUGH STATIC AND DYNAMIC TESTS - CASE STUDY OF MAJOR RIVER BRIDGE IN WEST BENGAL, INDIA

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ABSTRACT: The large diameter long Reinforced Cement Concrete (RCC) Bored Cast-in-situ pile foundation is popular in use for the long span bridge structure over major river. The groups of 2000 mm large diameter and 63 m long RCC Bored Pile are adopted to support the 120 m long cable-stayed span of the major bridge structure crossing

over the river Ganga nearby Kalyani city along the 6-lane wide Kalyani Expressway in West Bengal. At design stage the detailed geotechnical investigations works comprising of field exploration, in-situ testing and laboratory tests were undertaken for the engineering characterization of subsurface soil layers at every pylon i.e. substructure location of the bridge. Based on the investigation data, the geotechnical vertical load carrying capacity of single large diameter bored pile shaft in soil was calculated by following the available Indian standards. The vertical load carrying capacity of single bored pile as estimated by following the various guidelines were also compared with each other. The establishment of estimated vertical load carrying capacity of RCC Bored pile shaft was done by conducting the top-down static anchor vertical pile load test (compression) corresponding to the routine load test over the working pile. Later another working pile of identical geometry and concrete grade adjoining to the earlier tested working pile was also tested for verification of its load carrying capacity including the overall shaft integrity through high strain dynamic vertical load test as per the available ASTM and IRC guidelines. The static load-deflection behavior of the said similar working piles under same pile group as interpreted from the results of static and dynamic load tests are compared with each other. This paper presents the project case study of major river bridge structure covering the geotechnical design estimation of vertical load carrying capacity and then its field verification through static and high strain dynamic load tests for the large diameter long RCC Bored Pile Shaft.

Keywords: Geotechnical Investigation, RCC Bored Cast-in-situ Pile Foundation, Vertical Load Carrying Capacity, Static Anchored Pile Load Test,

FULL-SCALE EXPERIMENT ON THE RESILIENCE OF EMBANKMENT REINFORCED BY S HEET PILE WALLS TO OVERFLOW AND EROSION

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ABSTRACT: The embankment, which has been widely used along coasts, rivers, roads and railways, is vulnerable to erosion when it is overflowed by water. Embankment reinforced by a double sheet pile wall is expected to be effective among several possible countermeasures against such failure. This paper reports the results of a full-scale experiment to investigate the resilience of an embankment reinforced by a double sheet pile wall at its shoulders to overflow failure. The experiment was performed on a trapezoidal earth-fill embankment enclosed between a double sheet pile wall and two partition walls. The sheet pile walls were built of hat shaped sheet piles installed by Press-in with Auger (PA) method. The land side of the embankment was excavated in four steps to simulate the erosion caused by overflowing. The ground surface elevation during embankment construction and excavation were monitored with a total station and an auto level. The inner (land side) sheet pile wall was allowed to deform freely under lateral stress. The pile head lateral displacement was measured using a stroke sensor and a total station. The embankment remained structurally stable after excavation; although there were occurrences of a fissure and crest subsidence. A lateral pile-head displacement equal to 0.8% of the retaining wall height was observed which is within the tolerable limit based on serviceability criteria. The results implied that a double sheet pile wall connected by partition walls ensures the post-erosion structural integrity of the embankment; provided that the embedment depth is determined by considering the possible depth of erosion, thereby maintaining its resilience against overflow failure.

Keywords: Full-scale experiment, overflow, erosion, sheet pile wall, reinforced embankment, Press-in with Auger.

COMPARISON OF UNIT SKIN FRICTION FROM BI-DIRECTION STATIC LOAD TEST (BDSLT) WITH THEORETICAL FOR A MARINE STRUCTURE IN GUJARAT

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ABSTRACT: Capacity of any kind of pile is derived from skin friction developed between the pile surface and surrounding soil and also from the end bearing offered at pile toe. There are various approaches given in different standards like IS 2911, IRC 78, CIRIA 143 to calculate the skin friction component and end bearing component for different types of soil. In one of the marine projects executed in Gujarat State near Arabian Sea, the pile capacity for 1500mm diameter & 1800mm diameter BCIS pile was calculated as per IS 2911 approach. In pile capacity calculation the skin friction up to dredge level from existing seabed level is neglected as the structure located offshore, the dredging activities will happen before the commissioning of the project at the actual structure location. The free length of pile is 19.6m above the dredge level. Instrumented initial pile load test using Bi-Directional Static Load Test (BDSLT) method was carried out under marine condition, near to the offshore structure location to confirm the design capacity of the pile. This paper describes the method adopted for design of the pile, method of load test adopted using double casing to avoid skin friction above the dredge level and comparison of the unit skin friction obtained from the load test results with the theoretical value. The unit skin friction obtained from the instrumented Bi-Directional load test is higher than the theoretical skin friction calculated as per IS 2911 approach by 1.8 to 2.6 times.

Keywords: BCIS pile, pile capacity, BDSLT, load test, skin friction, end bearing.

NUMERICAL ANALYSIS ON PULLOUT CAPACITY OF TORPEDO ANCHOR

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ABSTRACT: The torpedo anchor is an innovative tool for deep-water mooring applications, used in anchoring systems where conventional anchors are unsuitable. This paper presents a numerical analysis of the pullout capacity of the torpedo anchor embedded in soft clay. The effects of fin configuration, loading inclination, pad-eye location, and embedment depth on the pullout resistance of the torpedo anchor were examined via Plaxis 3D. The anchors were examined at 90°, 70°, 30°, 10°, and 0°. The finding reveals that the 4-fin at a 10° angle offers higher capacity resistance than the other anchors; however, the 10° inclination is practically ineffective. The anchor with 4 fins pulled out at 30° offers optimal resistance compared to the other anchors. Further, the pull-out resistance of the torpedo pile is significantly increased with an increase in embedment depth. The response of the pull-out capacity of the torpedo anchor yielded maximum with the pad-eye location at (2/3) of the anchor length. The results contribute to improving the understanding of the pull-out behaviour of torpedo anchors and provide optimal guidelines for offshore environments.

Keywords: Torpedo Anchor, pullout, fin, pad-eye, clay

OPTIMUM FOUNDATIONS FOR AN ELEVATED EXPRESSWAY – A COST-EFFECTIVE AND SUSTAINABLE SOLUTION

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ABSTRACT: Infrastructure is the very basis for the survival of urban areas. Expressways are being built commonly in all major cities to combat traffic issues. The major challenges are managing the traffic and minimising the difficulties to commuters. The elevated expressway under presentation is 10 km long. As per tender specifications,

1.5 m diameter bored cast in-situ (BCIS) piles with 1 D (Diameter) socketing into hard rock is to be adopted. Soil strata was top silty clay, followed by soft disintegrated rock (SDR) and then hard rock. The layer thickness varies from location to location. Based on our recommendations, for the design pile capacity, pile diameter was reduced from 1.5 m to 1.2 m. The pile termination levels were also decided on the thickness of strata i.e., in weathered rock / soft disintegrated rock, if the thickness was large and in hard rock with 0.3 Diameter socketing. The safe design capacities were confirmed through large number of pile load tests. The adopted pile diameter and lengths resulted in savings of materials, cost and time (sustainability). The expressway was available for public use within the scheduled time.

Keywords: Infrastructure, Bored cast in-situ piles, rock socketing, sustainability

SUSTAINABLE DEEP FOUNDATION DESIGN THROUGH CPTu AND PILE LOAD TESTING: A CASE STUDY

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ABSTRACT: This paper presents a comparative evaluation of pile capacity predictions using conventional borehole-based methods (IS:2911) and advanced CPT-based approaches, validated against pile load test results for an industrial project in Gujarat. The geotechnical investigation comprised boreholes and CPTu soundings, enabling detailed characterization of subsurface conditions. Pile capacities for a 900-mm-diameter bored cast in-situ pile were estimated using IS:2911(Part-1/Section-2)-2010, the LCPC method, and the Doan and Lehane method. Results show that, while all methods provide comparable predictions for shallow depths (≤ 15 m), significant differences arise for deeper foundations, where the IS:2911 approach underestimates the shaft and base resistances. The average safe compressive pile capacity predicted by the CPT-based methods is 8% less than that interpreted from the load test, whereas IS:2911 underestimates the capacity by 62%. Adoption of CPT-based design results in a 60% reduction in the number of piles, leading to project cost savings of about ₹900 crores. In addition, the optimized design reduces material consumption, corresponding to an estimated reduction of 228,600 tonnes of CO_2 emissions. The study demonstrates that CPT-based methods provide a reliable, economical, and sustainable approach to pile foundation design.

Keywords: site characterization, cone penetration test, deep foundation, pile load test, cost optimization, sustainability

BUILDING SUSTAINABLE AND LOW ENVIRONMENTAL IMPACT RETAINING STRUCTURES USING STEEL SHEET PILES

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ABSTRACT: Construction materials such as steel and cement account for an estimated 5-12% of global greenhouse gas (GHG) emissions. Enhancing material efficiency therefore represents a significant opportunity to reduce emissions within the construction sector. Steel sheet piles, widely used in maritime structures among other applications, are essential structural elements. Their alignment with circular economy principles is crucial for supporting long-term climate goals and mitigating future anthropogenic climate risks. Circular economy strategies rely on regenerative, cradle-to-cradle concepts, and steel sheet piles can be integrated into these principles across their entire life cycle, from production and design to end-of-life management. When manufactured using Electric Arc Furnace (EAF) technology, sheet piles are produced from recycled steel, resulting in a comparatively low initial carbon footprint. Relative to alternative retaining wall systems, such as secant pile or diaphragm walls, steel sheet piles demonstrate substantially lower environmental impacts. During the design phase, additional carbon reductions can be achieved through optimized selection of pile width and steel grade. Such design optimizations have been shown to significantly decrease the embodied emissions associated with construction projects. At the end of their service life, steel sheet piles can be reused multiple times, often up to ten cycles of reuse, before being fully recycled, effectively closing the material loop. Reuse also delivers further benefits, including immediate product availability and the avoidance of emissions linked to new production. Consequently, steel sheet piles represent a

highly efficient and sustainable construction solution, ideally positioned to promote material circularity and reduce environmental impacts within the built environment.

Keywords: steel sheet piles, sustainable construction, material efficiency, circular economy, carbon footprint

SUSTAINABLE FOUNDATION SOLUTIONS FOR STORAGE TANKS IN THE HYDROCARBON INDUSTRY

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ABSTRACT: Hydrocarbon storage tanks are critical infrastructure, and their structural performance is highly sensitive to foundation-induced total and differential settlements. Conventional reinforced cement concrete (RCC) pile foundations are widely adopted in soft, loose, or organic soils to control settlements; however, they involve high construction costs and significant carbon emissions, which conflict with sustainability and net-zero carbon objectives. This study investigates sustainable and techno-economically viable foundation solutions for storage tanks using ground improvement techniques capable of accommodating considerable settlements without compromising serviceability. Two techniques, vibro stone columns and dynamic compaction, are evaluated through full-scale project case studies. Stone columns of 900 mm diameter at spacings of 1.8 m were installed beneath fixed roof tanks with diameters of 45 m and heights of 19.5 m, founded on organic soil and silty sand over medium to stiff clay. Dynamic compaction was adopted beneath 57 m diameter, 14.8 m high floating roof tanks founded predominantly on silty sand. Hydro-test results indicated maximum total settlements ranged from 112 mm to 250 mm for stone columns improved ground, with corresponding maximum angular distortions between 1 in 459 and 1 in 315. For dynamically compacted ground, the recorded maximum total settlement ranged from 18 mm to 39 mm, with corresponding maximum angular distortions between 1 in 995 and 1 in 710. Performance evaluations considering uniform settlement, planar tilt, and out-of-plane deformation confirmed compliance with serviceability requirements. Compared to conventional RCC pile foundations, the proposed solutions achieved substantial reduction in embodied carbon of approximately 87.2% for stone columns and 96.5% for dynamic compaction. The results demonstrate that vibro stone columns and dynamic compaction can effectively replace conventional RCC pile foundations for hydrocarbon storage tanks by satisfying serviceability requirements while substantially reducing construction costs and carbon emissions in marginal subsoil conditions.
Keywords: sustainability, ground improvement, settlement, RCC pile foundation, stone columns, dynamic compaction, organic soil, UN SDG 9: industry, innovation and infrastructure

BS 8002:2015 AND THE EVOLVING DESIGN OF EARTH RETAINING STRUCTURES: SERVICEABILITY, SUSTAINABILITY AND STEEL SHEET PILE SYSTEMS

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ABSTRACT: The design of earth retaining structures is increasingly driven by serviceability performance, constructability constraints, and risk-informed decision-making rather than by ultimate limit state checks alone. BS 8002:2015 – Code of Practice for Earth Retaining Structures reflects this shift by promoting a design framework that emphasizes realistic soil-structure interaction, deformation control, and consideration of staged construction effects. This paper reviews the underlying design philosophy and principal recommendations of BS 8002:2015 and evaluates its relevance to modern retaining wall and green sheet pile applications.

The study identifies limitations in the explicit integration of advanced numerical analysis, construction-stage monitoring, model calibration, and sustainability considerations within the existing framework. To address these

gaps, an integrated design framework is proposed, providing a structured approach for selecting appropriate analytical or numerical methods, incorporating observational monitoring and calibration, and evaluating lifecycle environmental performance alongside conventional safety and serviceability requirements. The framework is further discussed in the context of steel sheet pile systems, highlighting the potential benefits of reuse, recycling, and reduced embodied carbon.

The proposed approach demonstrates how BS 8002:2015 can be supplemented by numerical analysis, monitoring-based feedback, and lifecycle assessment while retaining its practical and performance-oriented design philosophy.

Key words: Limit state design, steel sheet piles, modern design techniques**.**

ROLE OF INTEGRATED GEOPHYSICAL TECHNIQUES IN GEOTECHNICAL SITE CHARACTERIZATION FOR DEEP FOUNDATIONS

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ABSTRACT: Reliable geotechnical site characterization is fundamental to the safe and economical design of deep foundations, particularly in projects involving complex and heterogeneous subsurface conditions. Conventional investigations based on boreholes and in-situ testing provide valuable point data but often fail to capture lateral variability, concealed weak zones, groundwater conditions, and subsurface anomalies influencing foundation performance. Near-surface geophysical techniques offer a powerful, non-invasive means to complement traditional investigations and enhance subsurface understanding at the project scale. This paper presents the application of integrated geophysical methods, including seismic refraction, multi-channel analysis of surface waves (MASW), electrical resistivity tomography (ERT), and borehole seismic techniques, for comprehensive site characterization. Seismic methods provide insights into stratigraphy, depth to competent strata, and stiffness parameters, while MASW enables evaluation of shear-wave velocity profiles relevant to dynamic response. ERT assists in delineating groundwater regimes, weathered zones, and potential weak zones. Case-based insights demonstrate that integrated surveys enable continuous subsurface profiling, optimize borehole placement, and improve confidence in foundation design. In the case examples presented, seismic refraction tomography delineated a localized rockhead depression of approximately 8–10 m that governed pile-length zoning. In another example MASW shear-wave velocities of 120–200 m/s and ERT resistivities below 20–30 ohm-m identified weak, saturated zones. These geophysical interpretations were subsequently validated against confirmatory boreholes and laboratory index data. The study concludes that geophysical integration significantly reduces uncertainty and enhances the reliability and efficiency of deep foundation design.

Keywords: deep foundations, geotechnical site characterization, seismic refraction, MASW, electrical resistivity tomography, borehole geophysics

APPLICATION OF THE SUPERLET TRANSFORM TO LOW-STRAIN PILE INTEGRITY TESTING

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ABSTRACT: Low-strain impact integrity testing of deep foundations (sonic echo method) is widely used for quality control of concrete piles due to its simplicity and minimal preparation requirements. However, for long piles and in the presence of significant noise, toe reflections and reflections from cross-sectional changes can be weak and difficult to identify in the time-domain record, reducing confidence in the interpretation. This study proposes superlet-based time–frequency analysis as an additional interpretation tool. The approach provides a joint time–frequency representation of the signal, allowing separation of overlapping components that cannot be resolved in the time domain. Power, phase, and the real and imaginary components of the complex representation are all analysed, providing complementary information. The approach was evaluated using a clear field record with added synthetic noise and field data from a 30 m bored pile. In both cases, toe reflections were identified as localised features in the time–frequency domain, and the interpreted pile lengths agreed with the design values. The approach extends the standard data analysis workflow and is implemented in the open-source Python package echopile.

Keywords: pile integrity testing, low-strain integrity testing, sonic-echo, superlets

AI - ASSISTED GEOTECHNICAL REPORT SUMMARIZATION FOR PROJECTS

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ABSTRACT: Construction projects are associated with huge volume of geotechnical data such as field and laboratory test results. Reviewing the sub-stratum conditions based on various test results and converting into actionable summaries take considerable time. Latest advancements in Artificial Intelligence (AI) field created a scope in reviewing large volumes of data in less time. AI has ability to convert the huge data into simple summaries, graphs and tabular outputs. This eases the Engineers workflows and reduces the review time on geotechnical reports. This paper presents the applications of AI-assisted tools for geotechnical report summarizations. AI helps in quick summarizing of the sub-stratum conditions based on AI prompting. It is used in enhanced data interpretation, understanding the trends in boreholes, creating the 2D and 3D sub-stratum models. Geotechnical risk identification and parametric comparison across project sites can be achieved through AI techniques. AI memorizes the historical data to create a database and enhances presentation of geotechnical data to project stakeholders. Practical use cases are presented to illustrate how AI workflows assist Engineers in various geotechnical review aspects. Though AI tools can function as geotechnical report review support tool, the final interpretations and recommendations remain the responsibility of the geotechnical engineer.

Keywords: AI prompting, data interpretation, parametric comparison, AI workflows, sub-stratum models, data base, review support tool.

RATE EFFECTS ON PARTICLE BREAKAGE IN PLANE STRAIN PILE SAND INTERACTION

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ABSTRACT: The rate of penetration plays a significant role in governing the behaviour of piles installed in crushable granular soils, although the underlying mechanisms are not yet fully understood. This study aims to investigate the influence of quasi-static penetration rates on the mechanical response of crushable sand using a rate-dependent constitutive modelling framework. A two-dimensional finite element approach is employed to simulate pile–soil interaction under controlled penetration velocities, incorporating viscoelastic behaviour along with particle breakage mechanics. The coupled response of stress/deformation/breakage has been studied utilizing calibrated model parameters derived from existing experimental data. Results show that higher penetration rates decrease the amount of fragmentation during penetration while producing a stiffer soil response; on the other hand, lower penetration rates will increase the amount of grain crushing and increase the compressibility of the soil. The stress and breakage distributions proved to be highly non-linear, exhibiting a concentration of stresses and breakages at the vicinity of the pile tip edges. The results of this research indicate that crushing can cause a reorganization of the particles and significantly affect how the pile and the soil are in contact with each other (i.e., alter the stress distributions and deformation patterns). These findings emphasise the importance of considering both rate effects and grain breakage mechanisms to better understand the complex multi-scale response of crushable soils during pile penetration.

Keywords: FEM, Crushing, granular soils, Shear Rates and Pile -Penetrations

ASSESSMENT OF LATERAL LOAD RESPONSE IN PILE FOUNDATIONS: A COMPARATIVE FINITE ELEMENT APPROACH

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ABSTRACT: In civil engineering projects, pile foundations are commonly used to support structures subjected to lateral and vertical loads. Pile foundations subjected to lateral loading are commonly analysed using simplified p-y curve methods, which may not fully capture pile–soil–pile interaction effects in group foundations. This study evaluates the lateral response of single piles and pile groups using two numerical approaches: FB-MultiPier based on the p-y method and three-dimensional finite element analysis using PLAXIS 3D. Analyses were performed for a single pile, a 3×3 pile group with spacing varying from 1.5D to 3D, and a large pile-supported water intake structure. Results from the study revealed that the p–y method predicted lateral displacements up to 35% higher than the 3D finite element model. The results indicate that increasing pile spacing reduces lateral displacement and bending moments due to reduced interaction effects within the pile group. Comparisons between the two numerical approaches showed that the p-y method predicted higher lateral displacements than the 3D finite element model for the cases considered. The study highlights the influence of modelling approach, pile spacing, and structural connectivity on the predicted lateral performance of pile foundations subjected to lateral loads.

Keywords: Pile Foundation, Lateral behaviour, Group Interaction Effects, Finite Element Analysis, p-y method

LOAD SETTLEMENT AND LOAD SHARING RESPONSE OF FLEXIBLE PILED RAFTS WITH VARYING PILE LENGTH

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ABSTRACT: Piled raft foundations have been widely recognized as an economical and efficient geotechnical foundation solution, wherein the applied structural loads are transferred through a combined mechanism involving both pile resistance and raft–soil contact pressure. The reliable prediction of optimized pile length is of paramount importance for the mitigation of differential settlement in the design of flexible piled raft foundations. In the present study, instrumented 1-g model tests have been conducted to investigate the behavior of the flexible piled raft foundations in cohesionless soil. Pile load-sharing percentage has been obtained with the help of strain gauges attached to the piles. The load-total settlement, load-differential settlement, and load-sharing response of the piled raft foundation subjected to vertical loading have been presented in this paper. Further, a numerical model has been developed using finite element analysis and validated based on the findings of the model tests. Subsequently, a parametric study has been conducted at prototype scale to compare the real-field performance of the piled raft foundation with uniform and non-uniform pile lengths, attributing varying pile spacing and raft-soil stiffness parameter. Incorporating optimized pile lengths into the foundation design enables the development of an economical and structurally resilient foundation system.

Keywords: flexible piled raft, differential settlement, load sharing, finite element analysis, optimized pile length

BACK ANALYSIS OF A DEEP EXCAVATION: A CASE STUDY OF TANGENT PILE WALL COLLAPSE IN KOCHI

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ABSTRACT: Many case histories of deep excavation failure have been studied over the past years. It is essential to properly investigate these failures and identify technical solutions to reduce their risk of occurrence. This paper presents a case study on the failure of a shoring system for deep excavation of a commercial building at Kaloor, Kochi. The excavation was 9.5 m deep and the retaining wall adopted was tangent piles with a single-strut propping system. The failure resulted in significant ground settlement, damaging the adjacent road and disrupting critical public utilities including traffic, electricity, telecommunications, and water supply. A back analysis using the finite element software PLAXIS 3D has been conducted to investigate the failure. The problem is also analysed using classical earth pressure theories and semi-empirical approaches, and the results from finite element analysis are compared with those obtained from theoretical methods. The study concludes with key lessons learned from the failure and proposes corresponding remedial measures.

Keywords: Deep Excavation, Tangent Piles, Strut, Finite Element Analysis, PLAXIS 3D, Theoretical methods.

A CASE STUDY ON DESIGN OF PILE-RAFT FOUNDATION SYSTEM FOR HIGH RISE BUILDING

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ABSTRACT: The increasing demand for high-rise buildings in urban areas necessitates efficient foundation systems capable of bearing of heavy load while optimizing construction cost. The design of foundation systems for high-rise buildings requires careful considerations. The foundation system should be safe in shear failure as well as settlement. The differential settlement/angular distortion should also be within allowable limit. Raft is one of the possible foundation solutions for high rise buildings and generally found to be safe for high rise buildings. However, sometime, settlement/angular distortion of raft foundation may exceed if soil strata is poor and foundation load is heavy. Piled raft foundations offer an efficient alternative to conventional pile foundation systems by utilizing the combined action of piles and raft and thus reducing settlement/angular distortion. This paper presents a three-dimensional numerical study of a piled raft foundation system supporting a 52-storey reinforced concrete building with three basement levels. The analysis is performed using FEM software PLAXIS 3D to evaluate the behavior of the foundation under complex soil–structure interaction conditions. An instrumentation and monitoring for measuring settlement on site are also planned. A direct numerical comparison between the current field readings and the PLAXIS ultimate settlement is therefore not appropriate at this stage. The measured settlement till date (7months) by settlement markers is found to be within limit. Thus, it can be concluded that introduction of piled raft can be used to limit settlement/angular distortion.

Keywords: Combined Pile-Raft Foundation, Soil-Structure Interaction, PLAXIS 3D, Settlement Monitoring, Instrumentation

HYDRO-MECHANICAL ANALYSIS OF ANCHORED DIAPHRAGM WALL UNDER RAINFALL CONDITIONS

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ABSTRACT: Rapid urban expansion has increased the need for underground facilities such as metro rail infrastructure, utility tunnels and other underpasses, which depend largely on deep excavation & Earth retaining structures. Earth-retaining structures laterally supporting such deep excavations are highly sensitive to groundwater and environmental conditions, in addition to the actual loading conditions and are particularly vulnerable to changes in the subsurface hydraulic behaviour as rainfall infiltration changes the pore pressure in the soil mass. Also, prolonged rainfall duration and low permeability of soils further aggravate these impacts. A hydro-mechanical analysis of an anchored diaphragm wall under rainfall conditions is presented in this paper. A numerical modelling approach using Plaxis 2D, a finite element-based software, was adopted to simulate the rainfall infiltration conditions in the soil mass. The analysis considers rainfall intensity, soil hydraulic property and groundwater table conditions to evaluate their influence on the wall deflection, ground settlement, bending moment and pore water pressure. The results illustrate that rainfall infiltration causes a significant increase in the pore-water pressure within the excavation zone, an increase in lateral displacement, bending moment of the wall, ground settlement behind the anchored diaphragm wall and pore water pressure in the soil. The study highlights the importance of incorporating rainfall-induced hydro-mechanical behaviour in the design and construction of Earth-retaining structures in deep excavations.

Keywords: Deep excavation, Anchored diaphragm wall, Hydro-mechanical analysis, Plaxis 2D.

PARAMETRIC STUDY ON SETTLEMENT BEHAVIOUR OF LARGE PILED RAFT FOUNDATIONS

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ABSTRACT: Piled raft foundations are widely adopted as a cost-effective solution for supporting heavily loaded structures, especially in poor ground conditions. In such systems, load is transferred through the interaction between raft and piles, which helps control both total and differential settlements. However, evaluating settlement behaviour remains challenging because of the complex interactions among soil, raft and piles, particularly in large foundations. A 3D finite element approach is used to evaluate the settlement behaviour of piled raft foundations constructed on sandy soil. The numerical model is developed and validated to ensure reliable prediction of foundation response. The Hardening Soil model is adopted to simulate the sandy soil, allowing a realistic representation of its behaviour under loading. A vertical load is applied to the raft and the settlement result is examined. The study conducts a parametric investigation to assess the influence of key design parameters on piled raft foundation. These parameters include pile slenderness ratio, relative stiffness of pile and soil, raft stiffness, pile spacing ratio and raft aspect ratio. The findings provide a better understanding of load transfer mechanisms and settlement behaviour of piled raft foundation, contributing to more efficient foundation design.

Keywords: Pile raft foundation, settlement analysis, soil structure interaction

EXPERIMENTAL INVESTIGATION OF SKIRTED FOOTING OVER STONE COLUMN EMBEDDED CLAYEY SOIL

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ABSTRACT: Foundations built on soft to medium clayey soils often encounter challenges in design and construction due to low bearing capacity and excessive settlement. This study aims to investigate the capacity of skirted footing rested on stone column improved clayey soil. To achieve the objectives, a steel test tank of dimension 1mx1mx1m was filled with remoulded clay of soft to medium consistency. A vertical compressive load test was conducted on a shallow footing of size 150mm×150mm×50mm rested on clay soil to determine its capacity. Then, a series of experiment was performed on skirted footing of same size placed over a single stone column of diameter (*D*) 50 mm and length 400 mm (8*D*), constructed at the middle of the clay bed. Steel skirts of varying depths, such as, 0*D*, 1*D*, 2*D*, 3*D* and 4*D* were connected along the sides of the shallow footing of size 150mm×150mm (3*D*x3*D*). Load–settlement curves were obtained for each test and the load corresponding to a settlement of 20% of the footing size were considered as ultimate load capacity. The increase in the load carrying capacity of skirted footing rested on stone column improved clayey soil were observed to be 22.7%, 28.3%, 43.4%, 76.1% and 101.3% respectively, for skirt depths of 0*D*, 1*D*, 2*D*, 3*D* and 4*D* compared to the shallow footing rested on clay soil. The load improvement ratio corresponding to different settlements and settlement reduction factor at different loads were evaluated. Load-sharing behavior of skirted footing and stone columns was also studied.

Keywords: Clayey soil, Skirted footing, Stone column, Composite foundation, Load-settlement

EXPERIMENTAL INVESTIGATION OF FLY-ASH+LIME+CLAY COLUMN EMBEDDED IN COHESIVE SOIL

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ABSTRACT: Deep-seated medium-soft cohesive soil possess major difficulties in geotechnical engineering because of weak shear-resistance, low-bearing capacity, high compressibility, and tendency to undergo excessive settlement. This study aims to investigate the load-bearing capacity of shallow-foundation (*SF*) rested on Fly-ash+Lime+Clay column (*FLCC*) embedded cohesive soil. To achieve the desired mix of *FLCC*, clayey soil was blended with varying percentages of fly-ash and lime, followed by unconfined compressive strength (UCS) test at curing periods of 7, 14, and 28 days. The mix with 47% Fly-ash, 3% Lime, and 50% Clay (*F47L3C50*) was observed to be the best composition. A test-tank of dimension 1m^3 was prepared with medium-soft cohesive soil up to a depth of 0.9m, and vertical load test was performed on a shallow-foundation (*SF*) of size 0.3m×0.3m×0.05m. Two *FLCC* configurations, single (1) and square group (4) with 3*D* spacing were constructed in cohesive soil bed, each with a uniform diameter (*D*) of 0.05 m and with varying *L/D* ratios of 6, 8, and 10. Vertical load tests were performed on shallow-foundation (*SF*) of same size rested over *FLCC* improved clayey soil. The ultimate load obtained from load-settlement graphs demonstrated improvement of capacity as 1.34times, 1.49times, 1.79times, 2.32times, 2.49times and 2.82times respectively for the *L/D* ratios of 6, 8 and 10, for single (1) and group (4) column. The load-improvement factor was evaluated for settlements of 5–50 mm and the settlement reduction factor was determined for applied loads of 0.2–0.8 kN. Load-sharing behaviour between shallow-foundation (*SF*) and *FLCC* was also evaluated.

Keywords: FLCC, L/D, SF, cohesive soil, load test

COMPARATIVE EXPERIMENTAL STUDY ON LOAD CAPACITY AND LOAD DISTRIBUTION OF CONNECTED AND DISCONNECTED PILED RAFT SYSTEMS ON SAND

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ABSTRACT: This study presents an experimental investigation of the load-transfer and load-sharing behaviour of three foundation systems: an unpiled raft (UR), a Connected Piled Raft (CPR), and a Disconnected Piled Raft (DPR). To enable direct comparison, all geometric parameters of the raft and piles were maintained identical across the test configurations. Strain-controlled static vertical load tests were conducted to evaluate settlement response, load transfer, and structural response of piles. The direct structural connection between the raft and the piles increased the CPR's load-carrying capacity by 54% compared to UR. The DPR's load-carrying capacity was only 3.4% lower than the CPR capacity, confirming load transfer through the cushion layer. The DPR piles carried 6% less load than the CPR piles due to the raft-pile disconnection. The maximum axial load in the CPR foundations was observed at the pile head, and in DPR foundations, the maximum axial load was observed below the pile head with the development of negative skin friction in the upper portion of the pile. The results highlighted fundamental differences in load distribution between CPR and DPR systems.

Keywords: CPR, DPR, load sharing ratio, Load Improvement factor, Settlement efficiency

EFFECTS OF SLOPE GRADIENT ON THE SEISMIC PERFORMANCE OF PILE GROUPS

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ABSTRACT: Pile-supported structures located on or adjacent to hill-slopes in seismically active regions are subjected to considerable lateral dynamic forces during earthquakes due to the combined effects of inertial loads from the superstructure and kinematic interaction with the surrounding soil mass. The present study numerically investigated the influence of slope geometry on the dynamic behavior of a 2 × 2 pile group installed at the slope crest. A shaking table experiment involving a 2 × 2 model pile group installed at the crest of a model cohesionless soil slope was modeled and validated using PLAXIS 3D. Following validation, the numerical model was used to investigate the effects of slope geometry on the dynamic performance of the pile group. The dynamic performance of the pile group was evaluated using various response parameters, including pile cap displacement and pile cap acceleration. The results indicated that both the peak pile cap acceleration and the peak pile cap displacement increased with increasing slope gradient. The study highlights the significant effects of slope gradient on pile behavior during seismic loading, emphasizing the need to incorporate slope geometry in the design and analysis of pile foundations in hilly terrain.

Keywords: pile foundation, slopes, shaking table, finite element analysis

UPLIFT RESPONSE OF HELICAL PILE WITH SINGLE AND DOUBLE HELIX CONFIGURATIONS IN DRY SAND

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ABSTRACT: Helical piles have gained increasing attention as efficient foundation systems for resisting uplift forces, owing to their installation advantages and enhanced load-carrying capacity afforded by the helical geometry. Accordingly, this study investigates the uplift resistance of a single helical pile embedded in the cohesionless soil through a series of laboratory-scale model tests. The experimental results for different helical configurations are examined to evaluate their load-bearing resistance, failure mechanism, and load-settlement response. The influence

of key parameters, including the number of helices, the embedment depth for single-helix configurations, and the inter-helix spacing for double-helix configurations, is systematically analysed. The outcomes of the present analysis demonstrate that uplift resistance increases significantly with increasing helix number and embedment depth of the helix-bearing plate. However, the failure mechanism is strongly influenced by helix spacing in double-helix piles. To validate the reliability of these observed trends, the present experimental findings are corroborated by a three-dimensional (3D) finite element analysis performed in ABAQUS. Thus, this study is expected to provide valuable insights into optimal helical pile design for applications in transmission towers, renewable energy platforms, and structures in sandy soil deposits subjected to uplift loading.

Keywords: failure mechanism, finite element analysis, helical piles, helix configurations, soil-structure interaction, uplift resistance.

LOAD CAPACITY ASSESSMENT OF FIELD SCALE JACKED PILES INCORPORATING INSTALLATION EFFECTS

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ABSTRACT: Jacked piles are one of the commonly used displacement piles, opted as foundation support to heavy infrastructures, owing to its controlled installation process involving very little noise and vibrations. However, even such controlled penetration process alters the stress-strain states of the surrounding soil leading to generation of post-installation residual stresses, which significantly influence the load capacity of these piles. Conventional design approaches usually idealize jacked piles as a wished-in-pile with either some ad hoc enhancement in its estimated load capacity or assigning empirically estimated post-penetration residual stress field for subsequent pile load determination through numerical simulation. As a result, the penetration induced installation effects on both the stress and strain fields in conjunction with developed residual stresses are often neglected, resulting inaccurate load capacity estimation in jacked piles. Additionally, CPT inferred shaft and end resistance predictions are also popular for design of such jacked piles; however, appropriateness of extrapolating such small-sized cone predictions for load capacity estimation of large-sized jacked piles are yet to be analyzed systematically. In this regard, the present study employs an Arbitrary Lagrangian-Eulerian (ALE) based finite element approach in conjunction with critical-state based soil model to mimic the pile penetration process followed by the loading phase. The numerical framework for the jacking process has been first validated against a lab-scale study. Next a field-scale pile jacking has been simulated to explore the possible scale effects in both the penetration and pile load test phases. The results reveal pronounced scale effects in the load transfer mechanisms, with lab-scale piles exhibiting end resistance dominance in contrast to the shaft resistance dominated field-scale pile response. Despite having higher absolute capacity, the normalized resistances remain lower in case of field-scale piles due to greater confinement effects. These findings emphasize the importance of incorporating installation effects and scale dependency for the field-scale capacity prediction of jacked piles.

Keywords: jacked pile, installation effects, scale effect, Arbitrary Lagrangian-Eulerian FEM, load capacity

PERFORMANCE INDICES FOR HELICAL ANCHORED DIAPHRAGM WALLS UNDER SURCHARGE LOADING

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ABSTRACT: Design of diaphragm walls for deep excavations in urban environments requires reliable performance indicators that account for surcharge loading, excavation stages, and anchorage efficiency. This study presents a plane-strain experimental investigation to develop normalized performance indices for diaphragm walls supported

by helical anchors in sandy soil. Scaled model tests were conducted on unanchored, single-row anchored, and double-row anchored walls subjected to staged excavation and surcharge loading at different offset distances. Lateral earth pressures measured along the wall depth were used to derive bending moment distributions, which were expressed in normalized form for consistent comparison among configurations. The results indicate that normalized bending moment, wall displacement, and excavation depth ratios provide effective measures for evaluating wall performance. Double-row helical anchors reduced the maximum normalized bending moment by approximately 45% compared with the unanchored wall and permitted deeper excavation with lower bending demand than the single-row system. An anchor inclination of 15° produced the most favorable response. The proposed normalized indices provide practical benchmarks for design assessment and support the calibration of numerical models for deep excavation analysis.
Keywords: diaphragm wall; helical anchors; deep excavation; normalized response; physical modeling

MACHINE LEARNING AIDED SURROGATE MODELLING FOR THE BEHAVIOURAL PREDICTION OF LARGE PILED RAFT FOUNDATIONS

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ABSTRACT: The behaviour of Large Piled Raft Foundations (LPRFs) is governed by complex soil structure interactions, making accurate prediction of settlements, load capacity, and bending moments is essential for safe and economical design. In this study, a machine-learning-based framework was developed to predict key performance parameters of LPRFs using Extreme Gradient Boosting (XGBoost) models. A comprehensive dataset consisting of 26 input features including LPRF geometric characteristics and stratified soil properties was generated from detailed numerical simulations. Five critical output parameters were considered: average settlement, differential settlement, load carrying capacity, maximum raft bending moment, and piled-raft coefficient. XGBoost models were extensively tuned using systematic hyperparameter optimization, achieving outstanding prediction accuracy with R^2 values exceeding 0.99 for all outputs. Comparative analysis revealed that XGBoost significantly outperformed Artificial Neural Network (ANN) in accuracy, stability, and reproducibility, primarily due to its deterministic gradient-boosting structure, while ANN exhibited minor variations across repeated runs due to random weight initialization. SHAP-based interpretability showed that geometric parameters of the LPRF dominated prediction behaviour, whereas soil properties appeared uninfluential due to the absence of variability in the dataset. The findings demonstrate that XGBoost serves as a robust surrogate model capable of rapidly and reliably predicting LPRF performance. Future work will include generating datasets with varied soil stratifications and pile configurations to generalize the model and enable more realistic assessment of soil influence. The study establishes a strong foundation for integrating machine learning into geotechnical design of piled raft foundations in complex soil environments.
Keywords: Piled Raft Foundation, Machine Learning, Surrogate Modelling, XGBoost, Foundation for Highrise Buildings

DYNAMIC RESPONSE OF A SINGLE PILE IN LIQUEFIED SOIL

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ABSTRACT: Pile foundations are widely used to transfer structural loads to deeper competent strata, particularly in alluvial regions such as the Brahmaputra valley, where near-surface soils predominantly comprise loose, saturated sands and silts. These cohesionless deposits are highly susceptible to liquefaction under seismic excitation, significantly altering the interaction between piles and surrounding soil. Under such conditions, the dynamic interaction between soil and pile is significantly altered, often leading to increased deformation demand

and structural distress. This study investigates the dynamic response of a single pile embedded in liquefiable soil using three-dimensional finite element analysis in OpenSeesPL. The liquefiable sand layers are modelled using a pressure-dependent multi-yield constitutive formulation capable of simulating cyclic mobility and pore pressure buildup, while cohesive layers are represented using a pressure-independent multi-yield model. Two idealized ground conditions are considered: a sand-dominated liquefiable profile and a layered profile comprising alternating liquefiable and non-liquefiable strata, along with variations in pile head boundary conditions. Seismic excitation is applied using the Kobe earthquake record. The results demonstrate that liquefiable soil conditions lead to significant stiffness degradation, increased pore pressure generation, and amplified lateral displacement of the pile. In contrast, the presence of cohesive layers reduces deformation demand but induces higher internal forces due to stiffness contrast. The study highlights the critical influence of soil stratification and boundary conditions on pile response and emphasizes the necessity of incorporating liquefaction effects in seismic design of pile foundations.

Keywords: Soil–pile interaction; Liquefaction; Dynamic analysis; OpenSeesPL

DFI India 2026 Conference Chair and Technical Editors

Dr. Arindam Dey

Conference Chair and Springer Volume Editor

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Dr. Arindam Dey is currently an Associate Professor at Civil Engineering Department of IIT Guwahati. He is also an Associate Faculty in the School of Interdisciplinary Studies and Sustainability (SiSAS) for Disaster Management and Research, IIT Guwahati. He obtained his B.E. from Jadavpur University Kolkata, followed by M.Tech. and Ph.D. from IIT Kanpur. Before joining IIT Guwahati in 2011, he has been a Post-Doctoral Fellow at the StreGa Laboratory, University of Molise, Campobasso, Italy. He is an active researcher in several streams of geotechnical and foundation engineering including disaster management, geotechnical earthquake engineering, transportation geotechnics, soil-structure interaction, geophysical investigation, geosynthetics engineering, landslide geotechnology and computational geotechnics. He has supervised more than 70 Masters and PhD students. His strong research group has contributed more than 380 technical contributions of national/international repute. He is a member of several professional bodies including ISET, ISSMGE, IGS, DFI, TRG India and several others. He has been involved in research projects funded by DST-NRDMS, DST-NMHSE, JSPS and JST LOTUS fellowships from Japan. He is an active research consultant and has done several public or private funded flagship projects. He has received prestigious national awards in the fields of geophysical investigations and geotechnical earthquake engineering.

Er. Anirudhan I V

Conference Technical Chair and Springer Volume Editor

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Anirudhan IV is a geotechnical consultant based in Chennai, India. His career as an independent consultant began in 1987, after seven years with a leading consultancy firm. His major areas of expertise are Deep Foundations, Ground Improvement, and Geotechnical Characterisation. His organisation, Geotechnical Solutions, executed more than 2000 small and medium-sized geotechnical investigations and provided foundation recommendations. Sr. Geotechnical Expert, Kellog Brown & Root Engineering & Construction India Private Limited, & KBR International since 2023

He graduated in Civil Engineering with a specialisation in Geotechnical Engineering from IIT Kanpur, India, in 1981, after obtaining a B.Sc. Engg. (Hons) in Civil Engineering from the University of Calicut in 1979.

He is actively involved with the Indian Geotechnical Society and the Deep Foundations Institute of India, and has conducted several conferences, workshops and seminars. He was a member of TC-302 of ISSMGE on Forensic Engineering and TC-301 of ISSMGE on Historic Sites, and the convener of TC-04 of the Indian Geotechnical Society on Geotechnical Investigation. He has authored and published several technical papers and guideline manuals, including the guideline manual on Lateritic Soils, the guideline manual on Geotechnical Investigation, and the design manual for Continuous Flight Augered Piles. He is currently the chairman of the Deep Foundations Institute of India and has also served as the chairman and honorary secretary of the Chennai Chapter of the IGS.

Anirudhan is presently on the editorial board of the Indian Geotechnical Journal and was a member of the editorial board from 2008 to 2012.

DFI India 2026 Conference Chairs and Technical Editors

Dr. Sreedeep Sekharan

Springer Volume Editor

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Dr. Sreedeep has been a Professor in the Geotechnical Engineering Division, Department of Civil Engineering, Indian Institute of Technology Guwahati, since 2017. He obtained his doctoral and master's degrees from the Indian Institute of Technology Bombay and a bachelor's degree from Calicut University, Kerala, India. He has been engaged in teaching and research since joining the Department of Civil Engineering, Indian Institute of Technology Guwahati, in 2006. His core research interests include geotechnical and geoenvironmental engineering, with a specific focus on the behaviour of unsaturated geomaterials; climate change impacts on soils; biogeotechnics (biochar, biopolymers as soil amendments, soil-plant-admixture-atmosphere interactions, soil-bioplastic interactions); reuse and recycling of industrial and agricultural wastes; and hazardous waste management. He has published more than 150 technical papers in international journals and more than 100 conference articles. He received the Shamsher Prakash Research Award for Geotechnical Engineering in 2014. He is a member of the American Society of Civil Engineers, the American Society for Testing and Materials, the International Association for Computer Methods and Advances in Geomechanics, the Indian Geotechnical Society, TC 106 of the International Society for Soil Mechanics and Geotechnical Engineering, and the International Society for Environmental Geotechnics. He is an associate editor for the Environmental Geotechnics Journal and the Indian Geotechnical Journal.

DFI India 2026 Research Award Winner

Anandha Raj L
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FINITE ELEMENT ANALYSIS OF RAILWAY EMBANKMENT RESTING ON SOFT GROUND REINFORCED WITH GRANULAR COLUMNS

Abstract: This thesis presents the work carried out to address a few research gaps identified through a detailed literature review on railway embankments constructed on soft soil reinforced with granular columns. The work begins with developing an axisymmetric FE model to analyse the behaviour of a railway embankment during the construction, post-construction, and operational (train loading) stages. The developed FE model is validated using field data from the trial embankment at the National Field-Testing Facility (NFTF) site in Ballina, New South Wales, Australia. The model is then used to investigate the influence of different column arrangements, the effect of geosynthetic encapsulation, and various centre-to-centre spacings on the load-bearing capacity throughout the sequential construction stages. An equivalent moving train load is applied at the crest of the embankment with axle loads of 25 and 35 T and train speeds ranging from 40 to 160 km/hr to evaluate the response of the improved soft ground after the post-construction stage. The equivalent dynamic load is calculated using a dynamic amplification factor (DAF) derived from field experiments.

The study also examines the influence of partial encasement lengths on granular columns and compares their performance with OGC and EGC cases. Similar to the previous stage, an equivalent dynamic loading approach is first applied to represent the train loading. Subsequently, a moving train load analysis is performed using the axle loads and geometry of the Alfa Pendular train to evaluate the undrained response of the improved soft ground. The key findings from these analyses are then presented and discussed. Further, a 3D strip FE model is developed to simulate an embankment resting on field-representative soft ground reinforced with granular columns. The developed model is validated using field data from the NFTF site. A parametric study examines encasement stiffness, encasement length, and encased floating columns with penetration depths ranging from 20% to full column length. The study evaluates long-term performance based on embankment settlement, load transfer between the column and the surrounding soft soil, column bulging, excess pore water pressure, and lateral displacement at the embankment toe. The results indicate that partial encasement of about 60% of column length and floating columns with penetration depths of 60 to 80% of the column length can achieve performance comparable to fully encased columns while reducing material usage by approximately 20 to 40%.

At the final stage of the study, an uncertainty analysis is carried out, and predictive equations are developed using the MARS model. This analysis considers the material properties of estuarine clay in the soft soil model. Based on the Latin Hypercube Sampling method, 200 sample sets are generated, and FE analyses are performed to obtain the embankment responses. Among these, 150 datasets are used for training, and 50 for testing the model. The model performance is evaluated using statistical methods, and predictive equations are developed for embankment settlement, stress, excess pore water pressure, and lateral bulging of columns. Overall, this thesis provides practical insights into the safe yet economical design of transport embankments on soft ground.

Keywords: Railway embankment; Sequential construction; Soft ground; Granular columns; Train loading; FE modelling; Long-term performance; Partial encasement; Consolidation; MARS model; Latin Hypercube Sampling (LHS) technique.

DFI India 2026 Research Award Winner

Kiruthika P
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PERFORMANCE OF GRANULAR COLUMNS IN STRATIFIED SOILS UNDER STATIC AND DYNAMIC LOADING

Abstract: Among various ground improvement methods, granular/stone columns are extensively used as a ground treatment technique to strengthen poor bearing soils, minimise settlement, and improve liquefaction resistance. However, most existing studies and design approaches of granular columns focus on idealized uniform soil conditions, typically considering clay under static loading and sand under dynamic loading. The effectiveness of granular columns is strongly controlled by characteristics of the surrounding soil, particularly the type and thickness. In reality, natural soil deposits are rarely homogeneous; they are stratified, with different soil types and thicknesses at different locations. However, current practice still inadequately understands and addresses the performance assessment of granular columns in layered soil deposits. Therefore, a systematic investigation into the behaviour of granular column-reinforced ground under multilayer soil conditions is essential to improve the reliability of design approaches and to better represent realistic field conditions. This study aims to investigate the performance of granular columns installed in stratified soil profiles necessary to enable a realistic and reliable understanding under both static and dynamic loading conditions through experimental and numerical simulations.

The study considers two representative geomaterials: liquefiable soil (L)/sand with a relative density of 40% and non-liquefiable (NL)/clay soils with an undrained shear strength of 10 kPa. In addition to material variation, the study examines the effects of layer thickness and location under static and dynamic loading. To achieve these objectives, the study adopts an integrated framework combining laboratory element testing, physical model testing, and advanced numerical simulations. Element-level investigations include consolidation, static triaxial, and cyclic triaxial tests under unit-cell conditions. Physical model tests under static loading were conducted in a rigid tank (0.55 m × 0.55 m × 0.50 m) to examine the response of group columns. Dynamic model tests were carried out in a laminar shear box (1.5 m × 1.0 m × 0.8 m) using Bhuj earthquake motion as the input excitation. The tests evaluated radial consolidation characteristics, stress-strain response, stress concentration factor under static loading, and excess pore pressure (EPP) response, vertical settlement, horizontal acceleration, and liquefaction susceptibility under dynamic loading. In addition, we performed finite element analyses using PLAXIS 3D. The Hardening Soil model was adopted for static analyses, whereas the HSsmall and UBC3D-PLM models were employed for dynamic analyses to represent the non-liquefiable soil and liquefiable soil/granular column materials, respectively. The numerical models were calibrated and validated against experimental results and extended to realistic field-scale stratified soil profiles for parametric analyses.

The consolidation test results indicate that stratification primarily influences the consolidation rate, while its effect on ultimate settlement is relatively limited when layer thicknesses are equal. Granular columns improved the drainage response, particularly when the clay layer was located near the loading surface. Under static triaxial and static physical model tests, the effectiveness of the treatment is strongly governed by the presence and position of the clay/NL layer, with the clay layer near the loading surface being effective in mobilization of stress, reaching stress improvement to 378%-312%. The enhanced performance is attributed to effective stress transfer from the surrounding soil to the stiffer granular columns, quantified through stress concentration ratios. Notably, stress mobilization was found to be considerably higher in NL/clay layers (reaching 4 to 5) compared to sand layers due to better lateral confinement. An important observation is that lateral bulging, typically assumed to occur at shallow depths, also developed prominently within clay layers and continued throughout the clay layer in stratified systems. Therefore, attention must be paid to any soft clay layers that are present along the column length while determining the load-carrying capacity of the granular column.

Under dynamic loading, untreated stratified profiles exhibited a distinct pore pressure response compared with homogeneous liquefiable deposits. The presence of NL layer impeded the upward migration of excess pore

pressure, resulting in accumulation below the non-liquefiable layer interface. In treated profiles, granular columns facilitated partial drainage and promoted excess pore pressure dissipation during shaking; however, delayed dissipation was observed beneath the NL layer interface. Additionally, the treated profile with a thicker NL layer showed the greatest settlement reduction. The horizontal surface acceleration was amplified in the presence of granular columns, with the highest amplitude observed when the liquefiable layer was located at the surface. The findings emphasise that the thickness and location of the NL layer in stratified soil profiles significantly influence the effectiveness of granular columns in EPP dissipation, vertical settlements, and acceleration response.

Overall, this study shows that soil stratification strongly controls the performance of granular column-treated ground, particularly the location and thickness of non-liquefiable layers. Under static loading, stratification governs stress transfer, column mobilisation, and bulging behaviour, with greater column mobilisation and stress transfer observed within the clay/NL layers. Under dynamic loading, NL interlayers alter EPP migration, vertical settlement response, and cyclic shear stress distribution, thereby modifying the liquefaction susceptibility of the treated stratified ground. The findings highlight the critical role of stratification in governing the static and seismic performance of granular column-reinforced soil systems.

Keywords: Stratified soils, granular column, element tests, static model tests, shake table tests, FE modelling, liquefaction mitigation.

DFI of India 2026 Research Award Finalists

Other Research Students in the Final Round

Aman Srivastava, Indian Institute Technology Roorkee
‘Seismic Performance Evaluation of Bridge Abutments and Wells Supporting Piers in Flat and Hilly Terrains’

Bony Sharma, Sardar Vallabhbhai National Institute of Technology Surat
‘Behavioral Study of Large Piled Raft Foundations in Stratified Soil Using Machine Learning Techniques’

DFI India 2026 Masters Award Winner

Ameena M K
Post Graduate student,
Indian Institute of Technology Madras
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INTEGRATED HYDRODYNAMIC–GEOTECHNICAL ASSESSMENT OF SCOUR AND SCOUR PROTECTION EFFECTS ON THE BEHAVIOUR OF OFFSHORE MONOPILES

Abstract: Offshore wind energy has emerged as one of the most promising renewable energy resources for achieving sustainable and low-carbon power generation. Among foundation systems, monopiles are widely adopted for offshore wind turbines due to their structural simplicity, ease of installation, and cost-effectiveness in shallow to intermediate water depths. Despite these advantages, monopiles are highly vulnerable to seabed scour induced by currents and waves. Scour alters seabed morphology, reduces effective embedment depth, and significantly modifies soil-structure interaction. These changes influence lateral stiffness, bending moment distribution, stress transfer mechanisms, and dynamic stability, thereby affecting the long-term safety and performance of offshore wind turbine foundations.

This study investigates the coupled hydrodynamic-geotechnical behaviour of offshore monopiles subjected to current-induced scour and scour protection measures using an integrated Computational Fluid Dynamics (CFD) and finite element modelling framework. The CFD solver REEF3D was combined with the geotechnical software PLAXIS 3D to establish a comprehensive methodology for assessing scour development, monopile lateral response, bending moment behaviour, stress redistribution, and dynamic performance under varying seabed conditions. The overall modelling workflow and integration of CFD with geotechnical analysis are illustrated in Figure 1, which provides a schematic summary of the study framework.

A numerical framework was developed in REEF3D to simulate scour formation around monopiles under steady currents. The Reynolds Averaged Navier-Stokes (RANS) equations were solved using the k-ω turbulence model to capture near-bed turbulence, horseshoe vortex formation, wake turbulence, and flow separation. Sediment transport and bed evolution were modelled using established bed-load transport equations. A mesh convergence study confirmed mesh independence at 0.025 m, with further refinement producing only marginal variation (~4.6%). Model validation against published experiments showed good agreement, with predicted equilibrium scour depth (130.89 mm) deviating by ~8.15% from the experimental value (142.5 mm).

A parametric study examined the influence of pile diameter, current velocity, sediment grain size, and seabed porosity on scour development. Larger monopiles generated stronger flow disturbances and intensified vortex systems, leading to deeper scour holes. At prototype scale, equilibrium scour depth increased from ~1.015 m to 1.22 m as diameter grew from 1.6 m to 2.0 m, with intermediate values for 1.8 m monopiles. Sediment grain size exhibited an inverse relationship with scour depth: finer grains (D_{50} = 0.075 mm) produced deeper scour (~1.20 m), while coarser grains (D_{50} = 0.35 mm) reduced scour (~0.90 m). Current velocity was a dominant factor, with scour depth rising from ~0.91 m at 0.38 m/s to ~1.208 m at 0.42 m/s, driven by enhanced bed shear stress and sediment transport. Seabed porosity also played a critical role with loose sand conditions yielded scour depths up to ~1.6 m, whereas dense sand limited scour to ~0.85 m due to greater inter particle confinement and shear resistance.

The CFD-derived scour profiles were integrated into PLAXIS 3D to evaluate monopile geotechnical response under lateral loading. Idealized scour geometries, including narrow and wide profiles with varying slope angles, were analysed for loose, medium dense, and dense sand under scenarios without scour, with scour, and with scour protection. Results showed that scour substantially reduces lateral capacity by removing near-surface soil support and decreasing effective embedment depth. Loose sand showed the highest sensitivity, while dense sand remained comparatively stable. Wide scour geometries caused greater capacity reduction than narrow ones. Figure 2 shows representative outcomes from these parametric analyses, highlighting key trends in scour depth variation and monopile response.

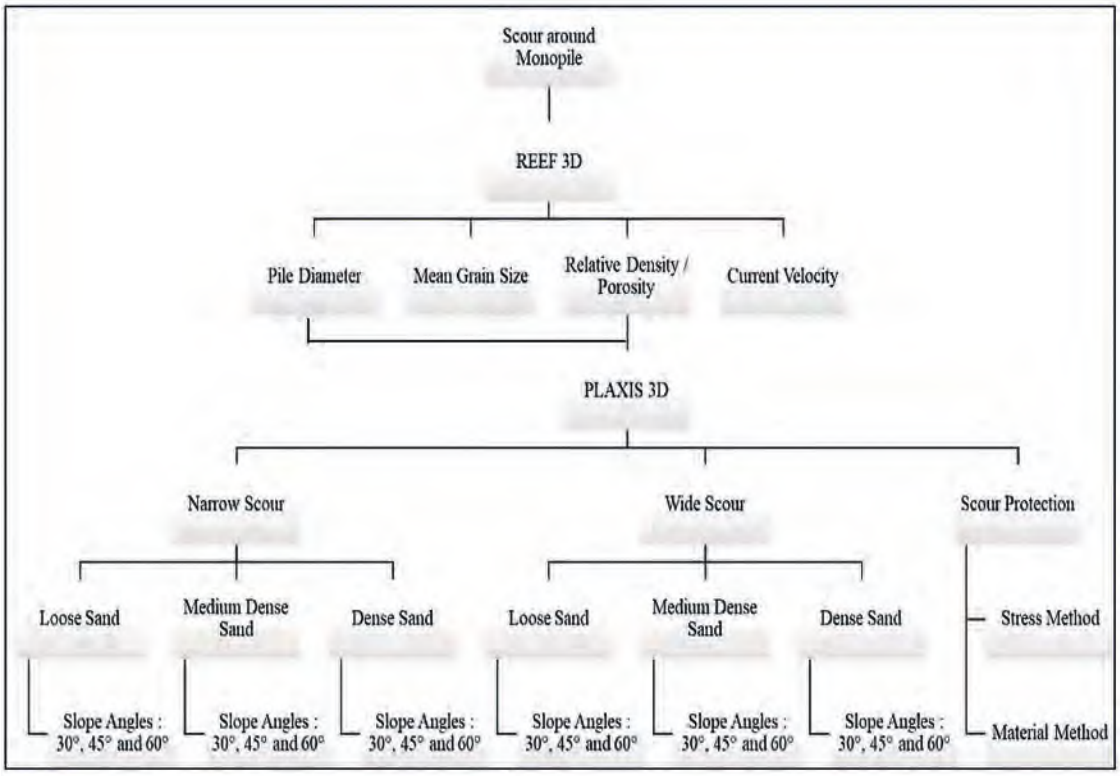

Figure 1. Summary of overall work

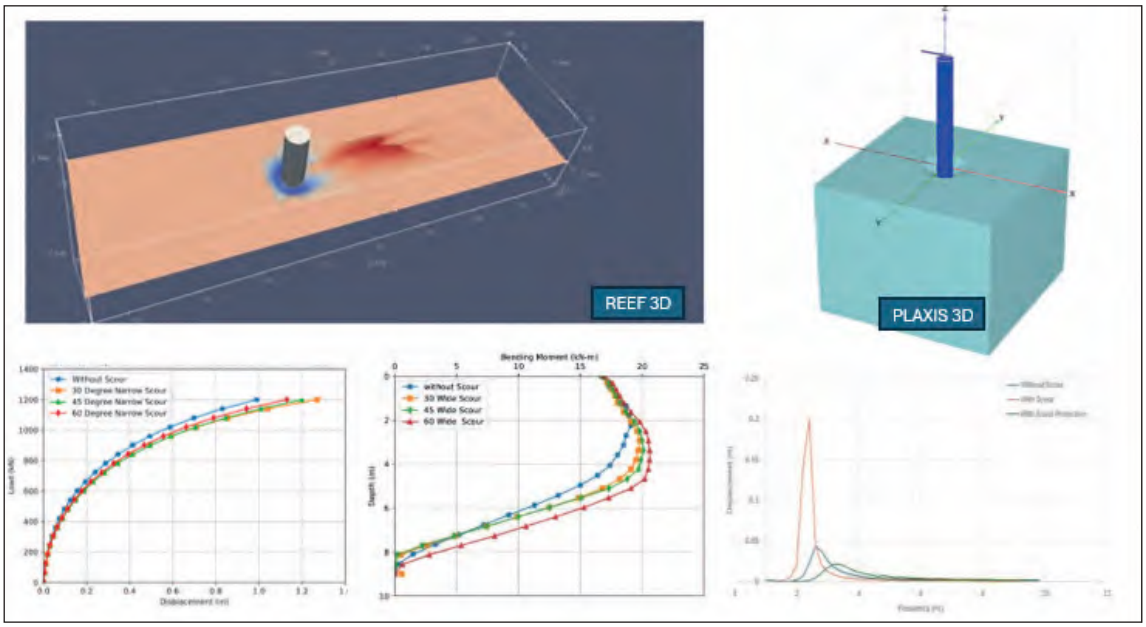

Figure 2. A few results from the thesis work

The CFD-derived scour profiles were integrated into PLAXIS 3D to evaluate monopile geotechnical response under lateral loading. Idealized scour geometries, including narrow and wide profiles with varying slope angles, were analysed for loose, medium dense, and dense sand under scenarios without scour, with scour, and with scour protection. Results showed that scour substantially reduces lateral capacity by removing near-surface soil support and decreasing effective embedment depth. Loose sand showed the highest sensitivity, while dense sand remained comparatively stable. Wide scour geometries caused greater capacity reduction than narrow ones. Figure 2 shows representative outcomes from these parametric analyses, highlighting key trends in scour depth variation and monopile response.

Bending moment analyses revealed that scour increases demand and shifts the critical bending moment location downward, redistributing load transfer to deeper soil layers. Scour modifies soil-pile interaction by shifting passive resistance mobilisation below the scour base, creating localized stress concentration zones. Scour protection improved lateral capacity and soil stiffness but also increased bending moment demand due to enhanced restraint near the pile head. The effectiveness of scour protection was evaluated using both material-based and stress-based improvement approaches.

We assessed dynamic behaviour through frequency response analysis. Scour reduced system stiffness and lowered dominant frequencies, increasing susceptibility to resonance. For example, in loose sand, frequency decreased from ~2.6 Hz (without scour) to ~2.4 Hz (with scour), while scour protection raised it to ~3.4 Hz. Medium-dense sand exhibited dominant frequencies of ~3.8 Hz, ~3.4 Hz, and ~4.0 Hz under the three respective conditions. Dense sand showed the highest natural frequencies, ranging from ~4.2 Hz (with scour) to ~4.8 Hz (with protection). These findings highlight that scour weakens dynamic stability, whereas protection restores confinement and enhances stiffness.

Overall, this study establishes a strong hydrodynamic-geotechnical coupling between scour development, soil stiffness degradation, stress redistribution, structural response, and dynamic behaviour of offshore monopiles. The integrated CFD-geotechnical framework provides a practical methodology for incorporating realistic scour characteristics into offshore foundation analysis, contributing to safer and more reliable design strategies for wind turbine monopiles under coupled loading conditions.

Keywords: CFD, Monopile, Scour, Scour Protection, Soil-Structure Interaction

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WiDF India Student Development Grants 2026 – Winners

Namrata Bhattacharjee
IIT Delhi

Namrata Bhattacharjee is a doctoral researcher at the Indian Institute of Technology Delhi (IIT Delhi), specialising in geotechnical engineering. She completed her bachelor's degree in 2018 and master's degree in 2021 from the Indian Institute of Engineering Science and Technology (IIEST), Shibpur. She joined IIT Delhi in August 2021 to pursue her doctoral research and is currently in the final stage of her PhD. Her research focuses on the measurement, characterisation, and assessment of railway-induced ground vibrations, with particular emphasis on real-time field measurements, vibration propagation through soil, and soil–structure interaction. Her doctoral work involves comprehensive field investigations and analysis of train-induced ground vibrations near railway and metro infrastructure. Moving forward, her research interests include developing improved approaches for vibration prediction and mitigation, understanding soil–structure interaction under dynamic loading, and exploring sustainable and resilient geotechnical solutions for transportation infrastructure. She aims to contribute to the development of safer, more reliable, and performance-oriented geotechnical infrastructure through field-based research and data-driven approaches.

Nikita Chauhan
Academy of Scientific and Innovative Research (AcSIR), CSIR-Central Building Research Institute, Roorkee

Nikita Chauhan is a Ph.D. researcher in Geotechnical Engineering at the Academy of Scientific and Innovative Research (AcSIR), and also serves as a Senior Project Associate at CSIR-Central Building Research Institute, Roorkee. She holds an M.Tech. in Geotechnical Engineering from NIT Kurukshetra. Her doctoral research focuses on the scaled-down model testing and advanced numerical modelling of piled raft foundations, with particular emphasis on their optimization utilizing non-uniform pile lengths, different pile arrangements and spatially varying rafts. Her technical expertise includes PLAXIS 3D, deep foundations, skirted foundations and soil–structure interaction. Her research has been disseminated through papers in highly esteemed journals including ocean engineering (Impact factor = 6.3). She has gained practical exposure to site-specific engineering challenges being involved in projects such as distress investigation of Raft foundation at Rajiv Gandhi Thermal Power Plant, Hisar. She is currently involved in foundation designing of Sri Viswaroopa Murugan Statue at Ratnagiri Arulmigu Balamurugan Temple at Vellore, Chennai.

DFI India 2026 Conference Inauguration Invitation

Deep Foundations Institute of India
Indian Geotechnical Society Guwahati Chapter
Indian Institute of Technology (IIT) Guwahati

Cordially invite you to the

Inauguration

of 15th Annual Conference on

Deep Foundation Technologies for
Infrastructure Development in India
DFI-India 2026

(24 - 26 September 2026)

Shri Ashish Bansal

General Manager (Construction), Northeast Frontier Railway, Maligaon
is the Chief Guest
and will inaugurate the Conference and release the conference souvenir

Prof. Dhirendra Nath Buragohain

Former Director, IIT Guwahati
is the Guest of Honour

Prof. Shailesh R Gandhi

Former Director, SVNIT Surat
will receive the Ninth DFI India Lifetime Contribution Award 2026

Dr. Sunil S Basarkar

DFI of India Chair
will preside over the session

Dr. Arindam Dey

Conference Chair
will welcome the gathering

Venue : Dr. Bhupen Hazarika Auditorium, IIT Guwahati
Date: 24 September 2026 Thursday
Time: 9:30 AM to 10:30 AM

Programme overleaf

DFI India 2026 Conference Inauguration Schedule

PROGRAMME

9:30 hrs to 10:30 hrs

National Anthem:

Welcome Address:
Dr. Arindam Dey
Conference Chair, DFI-India 2026, IIT Guwahati

Presidential Address:
Dr. Sunil S Basarkar
Chairman, DFI of India

About IGS and IGS Surat Chapter:
Dr. Anil Joseph
President, Indian Geotechnical Society, New Delhi

About IIT Guwahati:
Prof. Devendra Jalihal
Director, IIT Guwahati

About DFI and its Activities:
Ms. Theresa Engler
Executive Director, DFI

Guest of Honour Address by:
Prof. Dhirendra Nath Buragohain
Former Director, IIT Guwahati

DFI India Lifetime Contribution Award 2026:
Recipient Prof. Shailesh R Gandhi, Former Director, SVNIT Surat
Citation by Er. Ravikiran Vaidya
Award and Felicitation by Dr. Sunil S Basarkar
Reply by Prof. Shailesh R Gandhi

Inaugural Address and Conference Souvenir Release by the Chief Guest:
Er. Ashish Bansal
General Manager (Construction), Northeast Frontier Railway, Maligaon

Vote of Thanks:
Dr. Sasanka Borah
Chairman, IGS Guwahati Chapter

Inauguration of Exhibition (during networking break):
Prof. Dhirendra Nath Buragohain
Former Director, IIT Guwahati

DFI India 2026 Conference Schedule Day 1

DFI-India 2026 Conference at Guwahati - 24 -26 September 2026 - Conference Schedule			
Thursday 24 September 2026 - Day 1			
Start	End	hrs	Description
8:30 AM	9:30 AM	1:00	Registration and Networking
9:30 AM	10:30 AM	1:00	Inauguration
10:30 AM	**11:15 AM**	**0:45**	**Networking, Refreshment & Exhibition Inauguration**
Day 1 Session 1 Sponsored by Bauer Engineering India, Platinum Sponsor			
Plenary Session: Dr. Bhupen Hazarika Auditorium			
11:15 AM	11:55 AM	0:40	**Keynote:** Constructability - Driven Foundation Selection for Marine and Nearshore Infrastructure: Lessons from Steel Driven and Cast In-Situ Pile Systems - **Mr. Colin Smith**, *Head - Marine, Keller Ground Engineering India*
11:55 AM	12:05 AM	0:10	Corporate Presentation - **Bauer Engineering India**
12:05 AM	12:45 PM	0:40	**Keynote:** Design and Construction of Foundations in Karstic Geology - **Dr. Suresh Gutta**, *Senior Geotechnical Engineer, American Geotechnical & Environmental Services, Inc*
12:45PM	12:50 PM	0:05	Corporate Presentation - **Cemindia Projects**
01:00 PM	**02:00 PM**	**1:00**	**Lunch, Exhibition & Networking**
Day 1 Session 2			
Plenary Session: Dr. Bhupen Hazarika Auditorium			
Special Technical Session on 'Hillslope Stability and Landslide Mitigation'			
02:00 PM	02:05 PM	0:05	**Introduction** by Session Moderator
02:05 PM	02:35 PM	0:30	**Invited Presentation:** Different approach for landslide mitigation in Himalayan region - **Dr. Ratnakar R. Mahajan**, *Director Technical Excellence, Maccaferri India*
02:35 PM	02:40 PM	0:05	Corporate Presentation - **Freyssinet Menard India**
02:40 PM	03:10 PM	0:30	**Invited Presentation:** Rehabilitation and Landslide Mitigation Using the World's Tallest Reinforced Earth® Structure at Tindharia (NH-55) and Slope Stabilization at Z-Morh Tunnel, India - **Mr. Atanu Adhikari,** *Chief Development Officer, Geoquest India*
03:10 PM	03:15 PM	0:05	Corporate Presentation - **Modern Hiring Services**
03:15 PM	03:45 PM	0:30	**Invited Presentation:** Geohazard Mitigation Measures Over Vulnerable Hill Slopes: A Framework for Quality Control and Monitoring in Compliance with Morth Circular 305.15 - **Mr. Ankur Saxena**, *Business Advisor, TechFab India Industries Ltd.*
03:45 PM	**04:30 PM**	**0:45**	**Networking, Refreshment & Exhibition Break**
04:30 PM	05:30 PM	1:00	**Special Session Panel Discussion:** North-East Hill Infrastructure: Concerns and Policy Interventions **Panelists:** **Dr. Atop Lego**, *Former.Chief Engineer, PWD Arunachal Pradesh* **Mr. Ankala Saibaba**, *Former Chief Engineer, Northeast Frontier Railway* **Prof. Anjan Datta**, *Professor, IIT Guwahati* **Moderator:** **Annapoorni Iyer**, *Engosym Consultants*
05:30 PM	05:35 PM	0:05	**Closing Remarks** by Session Moderator

DFI India 2026 Conference Schedule Day 2 Morning

DFI-India 2026 Conference at Guwahati - 24-26 September 2026 - Conference Schedule			
Friday 25 September 2026 - Day 2			
Start	**End**	**hrs**	**Description**
8:30 AM	9:00 AM	0.30	**Registration, Networking**
Day 2 Session 1			
Plenary Session, Hall: Dr. Bhupen Hazarika Auditorium			
9:00 AM	9:10 AM	0.10	Welcome
9:10 AM	9:20 AM	0.10	DFI of India Overview - **Dr. Sunil S Basarkar**, DFI of India Chair
9:20 AM	9:25 AM	0.05	Corporate Presentation - **Giken Ltd**
9:25 AM	10:05 AM	0.40	**Keynote:** Advancing Deep Foundation Design on Dubai Sedimentary Rock: Insights from Field Performance and Geotechnical Numerical Modelling **Dr. Marwan Alzaylaie,** *Senior Manager, Dubai Development Authority*
10:05 AM	10:10 AM	0.05	Corporate Presentation - **Sany Heavy Industry India Pvt Ltd**
10:10 AM	10:15 AM	0.05	Corporate Presentation - **Keller Ground Engineering India Pvt Ltd**
10:15 AM	10:25 AM	0.10	Corporate Presentation - **UCON Structures LLP**
10:30 AM	**11:15 AM**	**0.45**	**Networking, Refreshment & Exhibition Break**
Parallel Session 1-1 Hall 1, Conference Center			
Theme: Deep Foundations and Deep Excavation Techniques			
11:15 AM	11:30 AM	0.15	DFII268: Design And ConstD18:D29on of the Scale Pit Braced Excavation *Paramartha Som, L&T Construction*
11:30 AM	11:45 AM	0.15	DFII2616: Numerical Study on Piled Raft Foundation Response Subjected to Groundwater Table Drawdown *Rajib Modak, IIT Guwahati*
11:45 AM	12:00 PM	0.15	DFII2633: A Comparitive Back Analysis Study Between Two Material Constitutive Models with Site I &M Data for Deep Excavation Retaining Systems in Chennai Geological Profile. *Anandharaj N, Cemindia Projects Ltd.*
12:00 PM	12:15 PM	0.15	DFII26108: Open Caissons for Underground and Land Buildings *Abhay Kumar, Principal Consultant*
12:15 PM	12:30 PM	0.15	DFII2636: Design Adequacy Assessment of Diaphragm Wall for Enlarged Launching Shaft Opening Using Fem and Real-Time Field Monitoring *Dharma R.B, L&T Construction*
12:30 PM	12:45 PM	0.15	DFII2674: Challenges In Underground Metro Construction and Mitigation Through Alternative Design *Murugesan Muthu, URC Technology Services Pvt. Ltd.*
01:00 PM	**02:00 PM**	**1.00**	**Lunch, Exhibition & Networking**
Parallel Session 1-2 Hall 2, Conference Center			
Theme: Hillslope Stability and Landslide Mitigation			
11:15 AM	11:30 AM	0.15	DFII2624: Optimizing Rock Slope Design with Limited Ground Data: Implicit VS. Explicit Joint Modeling in RS2 *Priyanka Bhartiya, COWI India*
11:30 AM	11:45 AM	0.15	DFII2667: Stability Analysis of Tunnel Portal Slopes Under Varying Ground Conditions *Anjali J, Engineers India Ltd.*
11:45 AM	12:00 PM	0.15	DFII2663: Hybrid Slope Stabilization of Mine Overburden Dump Using Micropiles and Geosynthetic Reinforcement: A Case Study from Odisha *Dola Roychowdhury, G-CUBE Consulting Engineers LLP*

DFI India 2026 Conference Schedule Day 2 Morning

12:00 PM	12:15 PM	0.15	DFII2689: Performance Study on Sand Reinforced with Jute Geocell and Synthetic Carpet Geocell *Diksha Dutta, The Assam Royal Global University*
12:15 PM	12:30 PM	0.15	DFII26109: Slope Stability Analysis and Geotechnical Approaches to Landslide Mitigation of OKSRT Road, Arunachal Pradesh: A Case Study *Rishabh Chaurasia, Pioneer Foundation Engineers Pvt. Ltd.*
12:30 PM	12:45 PM	0.15	DFII2677: Slope Stability Assessment and Mitigation of Hill Slope Instability Affecting a Buried Pipeline in a High-Rainfall Region-A Case Study *Aman Shrivastava, Engineers India Ltd.*
01:00 PM	**02:00 PM**	**1.00**	**Lunch, Exhibition & Networking**
Parallel Session 1-3		**Hall 3, Conference Center**	
Theme: Ground Improvement Techniques			
11:15 AM	11:30 AM	0.15	DFII2610: Ground Improvement by Means of Controlled Modulus Columns in Soft Clay - A Case Study *Sandip Bhutale, Menard India*
11:30 AM	11:45 AM	0.15	DFII2614: Geotechnical Mapping of Mumbai Sub-Soil for Effective Design & Construction of Large Diameter Circular Roadway Tunnel Using Tunnel Boring Machine *Biswanath Dewanjee, Tata Consulting Engineers*
11:45 AM	12:00 PM	0.15	DFII2627: Numerical Analysis for Axial Pullout Capacity of Inclined Piles *Himanshu Saurav, IIT Delhi*
12:00 PM	12:15 PM	0.15	DFII26138: Deep Ground Improvement using Jet Grouting *Vidyaranya Bandi, Bauer Engineering India Pvt Ltd*
12:15 PM	12:30 PM	0.15	DFII2649: Mitigation Of Grouting Induced Tunnel Distortion and Successful Implementation of Ground Improvement for Cross Passage Construction: A Case Study *Tanumaya Mitra, Cemindia Projects Ltd.*
12:30 PM	12:45 PM	0.15	DFII26113: Response of Building due to Strengthening of Circular Tunnel Liner by Bonding Steel Plate *Debjyoti Kar, IIEST Shibpur*
01:00 PM	**02:00 PM**	**1.00**	**Lunch, Exhibition & Networking**
Parallel Session 1-4		**Hall 4, Conference Center**	
Theme: Research, Experimental and Numerical Methods			
11:15 AM	11:30 AM	0.15	DFII2620: Rate Effects on Particle Breakage in Plane Strain Pile Sand Interaction *Udathala Hanumanthu, NIT Rourkela*
11:30 AM	11:45 AM	0.15	DFII2625: Assessment of Lateral Load Response in Pile Foundations: A Comparative Finite Element Approach *Krishnendu S A, L&T Construction*
11:45 AM	12:00 PM	0.15	DFII2628: Load Settlement and Load Sharing Performance of Flexible Piled Raft Foundation with Varying Pile Lengths *Nikita Chauhan, Academy of Scientific and Innovative Research (AcSIR), CSIR-Central Building Research Institute, Roorkee*
12:00 PM	12:15 PM	0.15	DFII2630: Back Analysis of a Deep Excavation: A Case Study of Tangent Pile Wall Collapse in Kochi *Riswana Iqbal, School of Engineering, CUSAT*
12:15 PM	12:30 PM	0.15	DFII2631: A Case Study on Design of Pile-Raft Foundation System for High Rise Building *Sanjay Bharati, Kalpataru Projects International Limited*
12:30 PM	12:45 PM	0.15	DFII2644: Hydro-Mechanical Analysis of Anchored Diaphragm Wall Under Rainfall Conditions *Anjali Arunachalam, IIT Tirupati*
01:00 PM	**02:00 PM**	**1.00**	**Lunch, Exhibition & Networking**

DFI India 2026 Conference Schedule Day 2 Post Lunch

Day 2 Session 2 Afternoon			
Plenary Session		**Hall: Dr. Bhupen Hazarika Auditorium**	
02:00 PM	02:40 PM	0.40	**Keynote:** Integrated Geophysics for Rock-Socketed Piles and Deep Foundations: Field Applications for Continuous Rock Profiling and Construction Risk Reduction **Dr. Sanjay Rana,** *Managing Director, PARSAN Overseas Pvt. Ltd.*
02:40 PM	02:50 PM	0.10	Corporate Presentation: **CEG Test House and Research Centre Pvt Ltd**
02:50 PM	03:30 PM	0.40	**Women in Deep Foundations (WiDF) India Session** - Srishti Bafna, NHIDCL & Sanjita Bodo, PWD Assam
03:30 PM	**04:15 PM**	**0.45**	**Networking, Refreshment & Exhibition Break**
Parallel Session 2-1		**Hall 1, Conference Center**	
Theme: Deep Foundations for Marine, Coastal and Near-Shore Structures			
04:15 PM	04:30 PM	0.15	DFII2645: Estimation And Field Establishment of Vertical Load Capacity of Large Diameter Bored Pile Through Static and Dynamic Tests - Case Study of Major River Bridge in West Bengal, India *Avik Kumar Mandal, LEA Associates South Asia Pvt. Ltd.*
04:30 PM	04:45 PM	0.15	DFII2655: Full-Scale Experiment on the Resilience of Embankment Reinforced by Sheet Pile Walls to Overflow and Erosion *Rupali Sarmah, Giken Ltd.*
04:45 PM	05:00 PM	0.15	DFII26114: Comparison of Unit Skin Friction from Bi-Direction Static Load Test (BDSLT) with Theoretical for a Marine Structure in Gujarat *Thomas John, L&T GeoStructure*
05:00 PM	05:15 PM	0.15	DFII26120: Numerical Analysis on Pullout Capacity of Torpedo Anchor *Ahmad Mamdouh Sabbah, JNTU Hyderabad*
05:15 PM	05:30 PM	0.15	
05:30 PM	**07:00 PM**	**1.30**	**Break and Networking**
07:00 PM	08:00 PM	1.00	Cultural program at Dr. Bhupen Hazarika Auditorium
08:00 PM	010:00 PM	2.00	Banquet Dinner
Parallel Session 2-2		**Hall 2, Conference Center**	
Theme: Sustainable, Cost-Effective and Smart Approaches in Deep Foundations			
04:15 PM	04:30 PM	0.15	DFII26115: BS 8002:2015 And the Evolving Design of Earth Retaining Structures: Serviceability, Sustainability and Steel Sheet Pile Systems *Venkatesh Karumuri, Meever India*
04:30 PM	04:45 PM	0.15	DFII2623: Optimum Foundations for an Elevated Expressway – A Cost-Effective and Sustainable Solution *C.R. Balaji, Prof V.S. Raju Consultants*
04:45 PM	05:00 PM	0.15	DFII2661: Sustainable Deep Foundation Design Through CPTu and Pile Load Testing: A Case Study *Sorabh Gupta, Cengrs Geotechnica Pvt. Ltd.*
05:00 PM	05:15 PM	0.15	DFII2690: Building Sustainable and Low Environmental Impact Retaining Structures Using Steel Sheet Piles *Shilton Rica, ArcelorMittal Sheet Piling*
05:15 PM	05:30 PM	0.15	DFII2694: Sustainable Foundation Solutions for Storage Tanks in the Hydrocarbon Industry *Sampat Raj, Engineers India Limited*
05:30 PM	**07:00 PM**	**1.30**	**Break and Networking**
07:00 PM	08:00 PM	1.00	Cultural program at Dr. Bhupen Hazarika Auditorium
08:00 PM	010:00 PM	2.00	Banquet Dinner

DFI India 2026 Conference Schedule Day 2 Post Lunch

Parallel Session 2-3 Hall 3, Conference Center			
Theme: Ground Improvement Techniques			
04:15 PM	04:30 PM	0.15	DFII26133: Seepage Control in Hydropower Infrastructure *Amal Jose, Bauer Engineering India Pvt. Ltd*
04:30 PM	04:45 PM	0.15	DFII26141: Seismic Behavior of an Underground Box Tunnel Structure at Shallow Depth *Chiranjib Sarkar, Jadavpur University*
04:45 PM	05:00 PM	0.15	DFII2642: Enhancement of Grouting Performance Using Stable Grout *Shaik Meheruddin, Cemindia Projects Ltd.*
05:00 PM	05:15 PM	0.15	DFII26134: Comparative Study on Liquefaction Potential and Ground Improvement Assessment as Per Is 1893:2016 And Is 1893:2025 *Anjima C S, Bauer Engineering India Pvt Ltd*
05:15 PM	05:30 PM	0.15	DFII26106: Geogrid Reinforced Ash Bund - Numerical Investigations Addressing Seismic Risks & Sustainability *Vaishali Rajurkar, Ramdeobaba University*
05:30 PM	**07:00 PM**	**1.30**	**Break and Networking**
07:00 PM	08:00 PM	1.00	Cultural program at Dr. Bhupen Hazarika Auditorium
08:00 PM	010:00 PM	2.00	Banquet Dinner
Parallel Session 2-4 Hall 4, Conference Center			
Theme: Research, Experimental and Numerical Methods			
04:15 PM	04:30 PM	0.15	DFII2651: Parametric Study on Settlement Behaviour of Large Piled Raft Foundations *Vishalkumar Thakarya, SVNIT Surat*
04:30 PM	04:45 PM	0.15	DFII2657: Experimental Investigation of Skirted Footing Over Stone Column Embedded Clayey Soil *Nisha Das, NIT Silchar*
04:45 PM	05:00 PM	0.15	DFII2679: Comparative Experimental Study on Load Capacity and Load Distribution of Connected and Disconnected Piled Raft Systems on Sand *Shilpa Mary Sam, NIT Calicut*
05:00 PM	05:15 PM	0.15	DFII2669: A Critical Review of Landslide Risk Assessment: Integrating Geotechnical Parameters with Advanced ML Architectures *Radha Rao, Goa College of Engineering*
05:15 PM	05:30 PM	0.15	DFII2659: Experimental Investigation of Fly-Ash+Lime+Clay Column Embedded in Cohesive Soil *Jubilee Baruah, NIT Silchar*
05:30 PM	**07:00 PM**	**1.30**	**Break and Networking**
07:00 PM	08:00 PM	1.00	Cultural program at Dr. Bhupen Hazarika Auditorium
08:00 PM	010:00 PM	2.00	Banquet Dinner

DFI India 2026 Conference Schedule Day 3

DFI-India 2026 Conference at Guwahati - 24-26 September 2026 - Conference Schedule			
Friday 26 September 2026 - Day 3			
Start	**End**	**hrs**	**Description**
8:30 AM	9:00 AM	0.30	**Registration, Networking**
Day 3 Session 1			
Plenary Session		**Hall: Dr. Bhupen Hazarika Auditorium**	
9:00 AM	9:05 AM	0.05	Welcome
9:05 AM	9:35 AM	0.30	**Panel Discussion:** Sustainability in Construction – Opportunities & Challenges **Panelists:** *1.* **Dr. Shilton Rica**, *ArcelorMittal Sheet Piling* *2.* **Er. Mohan Ramanathan**, *Advanced Construction Technologies* *3.* **Shrikarpagam Dhandapani**, *IIT Madras* **Moderator:** **Dr. Venu Raju**, *Keller*
9:35 AM	9:40AM	0.10	Corporate Presentation - **Veda Pile Tech India Pvt Ltd**
9:40 AM	9:45 AM	0.10	Transition Time to Start the Parallel Sessions
Parallel Session 3-1		**Hall 1, Conference Center**	
Theme: Deep Foundations and Deep Excavation Techniques			
9:45 AM	10:00 AM	0.15	DFII26100: Rational N-Value Selection for Rock Socketed Piles in Weak Weathered Basaltic Rock *Anupam Pande, Structcon Designs Pvt Ltd*
10:00 AM	10:15 AM	0.15	DFII2635: Combined Piled Raft Foundation System with Diaphragm Wall in Clayey Soil: A Case Study and Fem Analysis for Peerless Trayam, Kolkata *Jnanendra Vijay Kumar Chorapalli, L&T Construction*
10:15 AM	10:30 AM	0.15	DFII26117: Comparative Assessment of Pile Foundation Capacities Using Analytical Approaches and Numerical Modeling: A Case Study *Rishabh Saran, CEG Test House and Research Centre Pvt. Ltd.*
10:30 AM	**11:15 AM**	**0.45**	**Networking, Refreshment & Exhibition Break**
Parallel Session 3-2		**Hall 2, Conference Center**	
Theme: Deep Foundations Failures: Insights, Learnings and Improved Practices			
9:45 AM	10:00 AM	0.15	DFII265: Forensic Geotechnical Investigation of Diaphragm Wall Failure Supporting Deep Excavation: Insights from Field Evidence, Numerical Modeling, and Literature Review *Khushboo Uniyal, Graphic Era (Deemed to be University)*
10:00 AM	10:15 AM	0.15	DFII2632: A Detailed Root Cause Analysis of Large Scale Pile Failure in a Project and the Salient Lessons Learned *Parthasarathi Sengupta, Consultant*
10:15 AM	10:30 AM	0.15	DFII2671: Finite Element Analysis of Pile Group Response to Staged Braced Deep Excavation in Cohesive and Cohesionless Soil *Sumitra S. Kandolkar, Goa College of Engineering*
10:30 AM	**11:15 AM**	**0.45**	**Networking, Refreshment & Exhibition Break**

DFI India 2026 Conference Schedule Day 3

Parallel Session 3-3 Hall 3, Conference Center			
Theme: Site Characterization, Instrumentation, Performance Monitoring			
9:45 AM	10:00 AM	0.15	DFII2639: Application of the Superlet Transform to Low-Strain Pile Integrity Testing *Ilya Lozovsky, Geoelectromagnetic Research Centre*
10:00 AM	10:15 AM	0.15	DFII2643: AI - Assisted Geotechnical Report Summarization for Projects *Tharunkumar Kalluru, Nextpower*
10:15 AM	10:30 AM	0.15	DFII2640: Dynamic Response of a Single Pile in Liquefied Soil *Chiranjib P. Sarma, Assam Skill University*
10:30 AM	**11:15 AM**	**0.45**	**Networking, Refreshment & Exhibition Break**
Parallel Session 3-4 Hall 4, Conference Center			
Theme: Research, Experimental and Numerical Methods			
9:45 AM	10:00 AM	0.15	DFII2695: Uplift Response of Helical Pile with Single and Double Helix Configurations in Dry Sand *Bijesh Paul, IIT Kanpur*
10:00 AM	10:15 AM	0.15	DFII26118: Load Capacity Assessment of Field Scale Jacked Piles Incorporating Installation Effects *Mohammad Sameer Dar, IIT Mandi*
10:15 AM	10:30 AM	0.15	
10:30 AM	**11:15 AM**	**0.45**	**Networking, Refreshment & Exhibition Break**
Plenary Session Hall: Dr. Bhupen Hazarika Auditorium			
11:15 AM	11:55 AM	0.40	Keynote: The European Approach to Standardization of Geotechnical Works - with Reference to the Execution of Diaphragm Walls and Bored Piles - **Dr. Karsten Beckhaus,** *Technical Director, BAUER Spezialtiefbau GmbH*
11:55 AM	12:05 PM	0.10	Transition Time to Start the Valedictory Session
12:05 PM	12:25 PM	0.20	**DFII Awards:** Best Paper Awards, Student Awards, Photo Awards, Sustainability Awards
12:25 PM	**01:15 PM**	**0.50**	**Valedictory /Closing**
01:15 PM	**02:15 PM**	**1.00**	**Closing Lunch**

DFI India 2026 Conference Print Only Papers

DFI-India 2026 Conference Print Only Papers
DFII2641: Constructional Challenges and Solutions of Large-Diameter Piling in Soil and Rock in Marine and Tidal Conditions: A Comparative Study Of India And Bangladesh Projects *Amal Bhattacharya, Afcons Infrastructure Ltd.; Ayanesh Maiti, Transrail Lighting Limited*
DFII26123: Performance Indices for Helical Anchored Diaphragm Walls Under Surcharge Loading *Ragini Vishwakarma, Indian Institute of Technology Roorkee; Satyendra Mittal, University of Patanjali; Vishwas A. Sawant, Indian Institute of Technology Roorkee*
DFII2680: Effects of Slope Gradient on the Seismic Performance of Pile Groups *Sinjan Debnath, Indian Institute of Technology Kharagpur; Prof. Aniruddha Sengupta, Indian Institute of Technology Kharagpur*
DFII26137: Machine Learning Aided Surrogate Modelling for The Behavioural Prediction of Large Piled Raft Foundations *Bony Sharma, SVNIT Surat; Shashank Singh, SVNIT Surat; Dr. Shruti J. Shukla, SVNIT Surat; Dr. Chandresh H. Solanki, SVNIT Surat*

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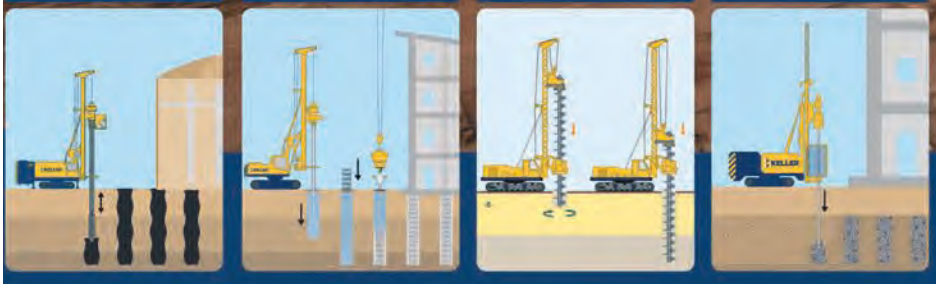

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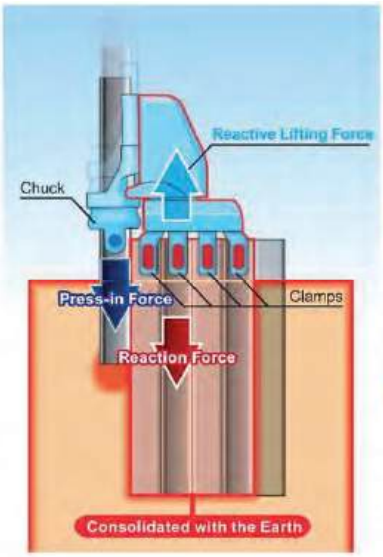

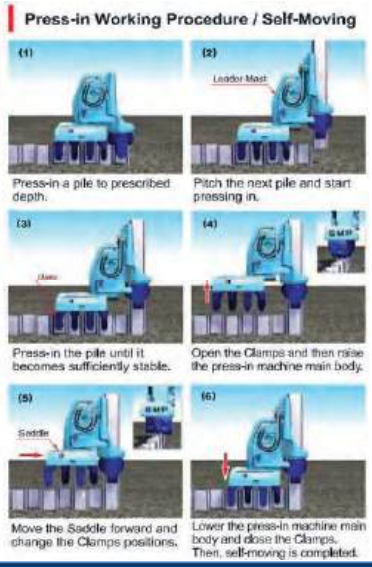

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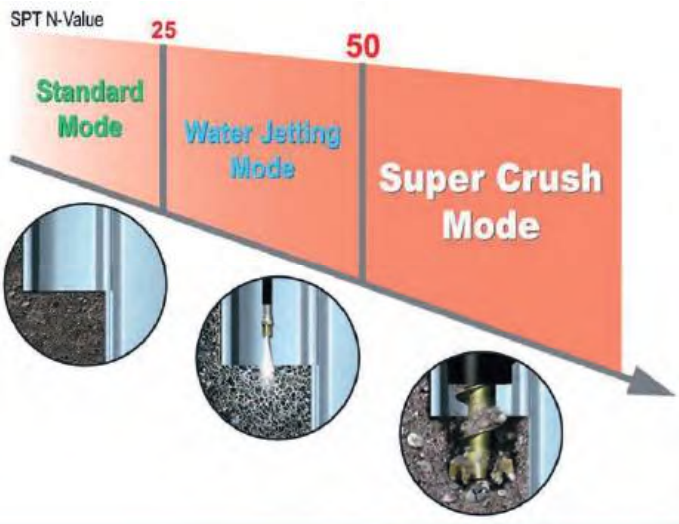

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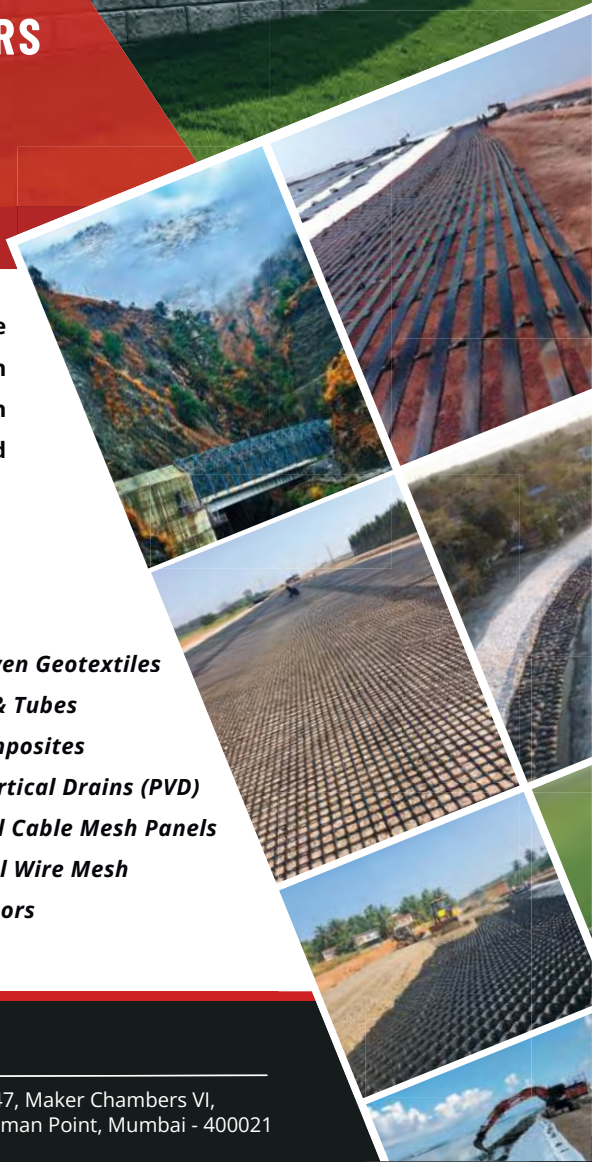

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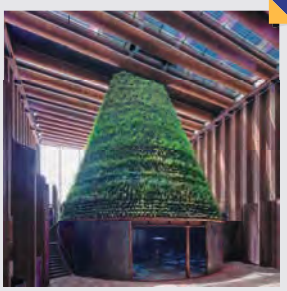

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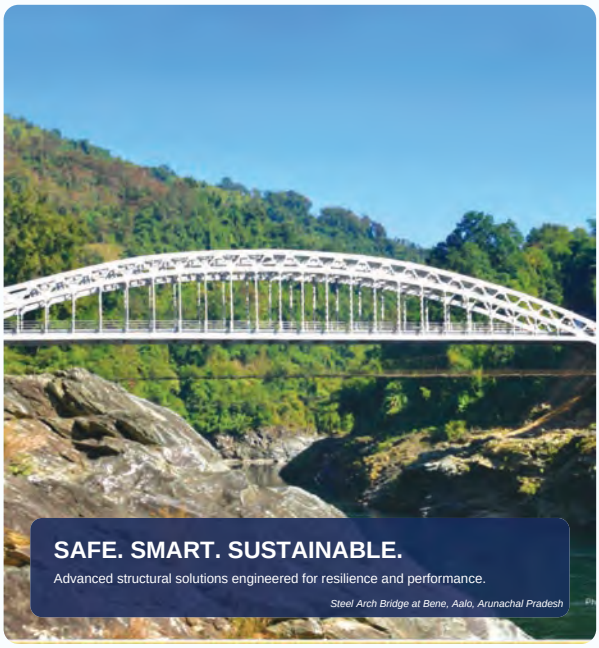

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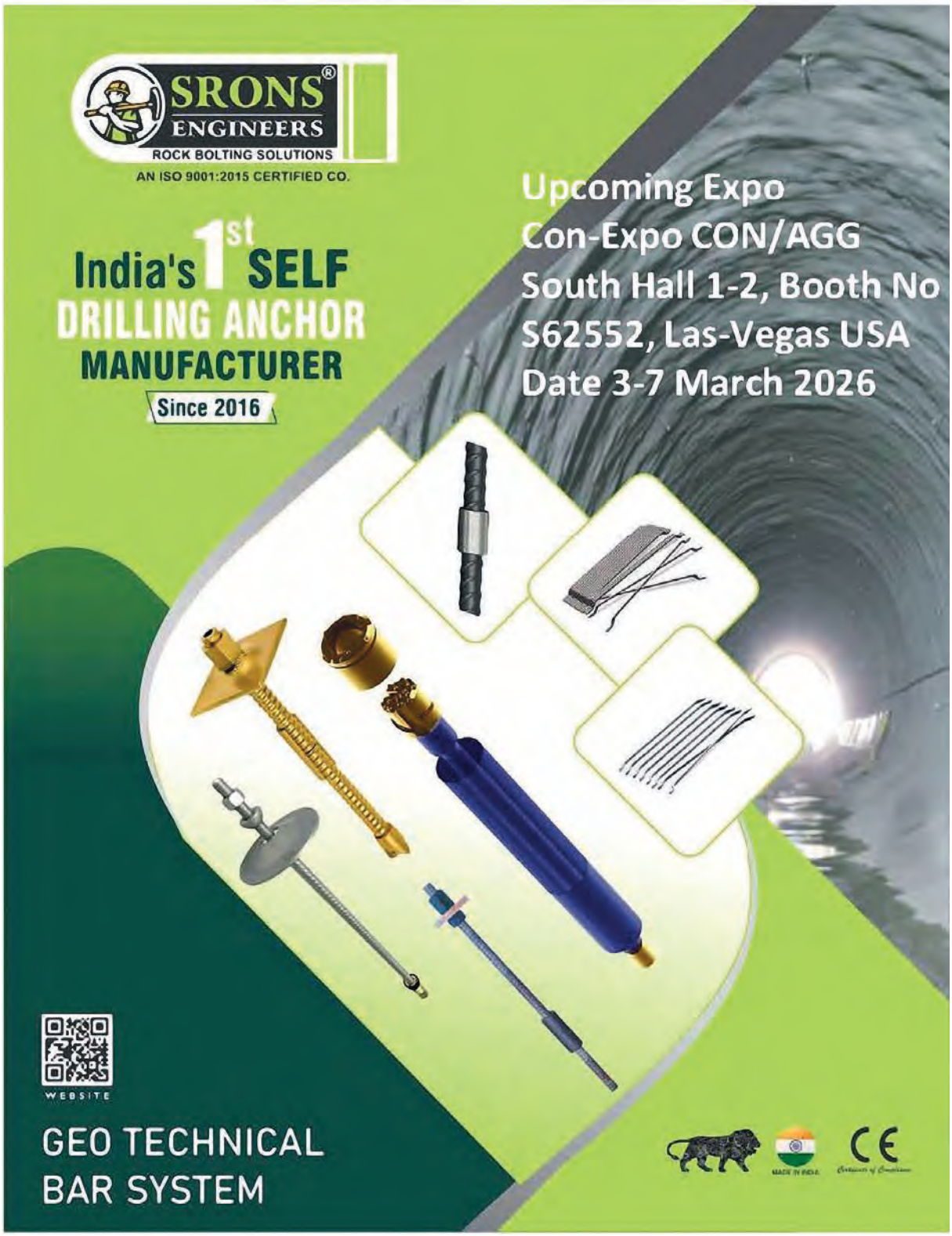

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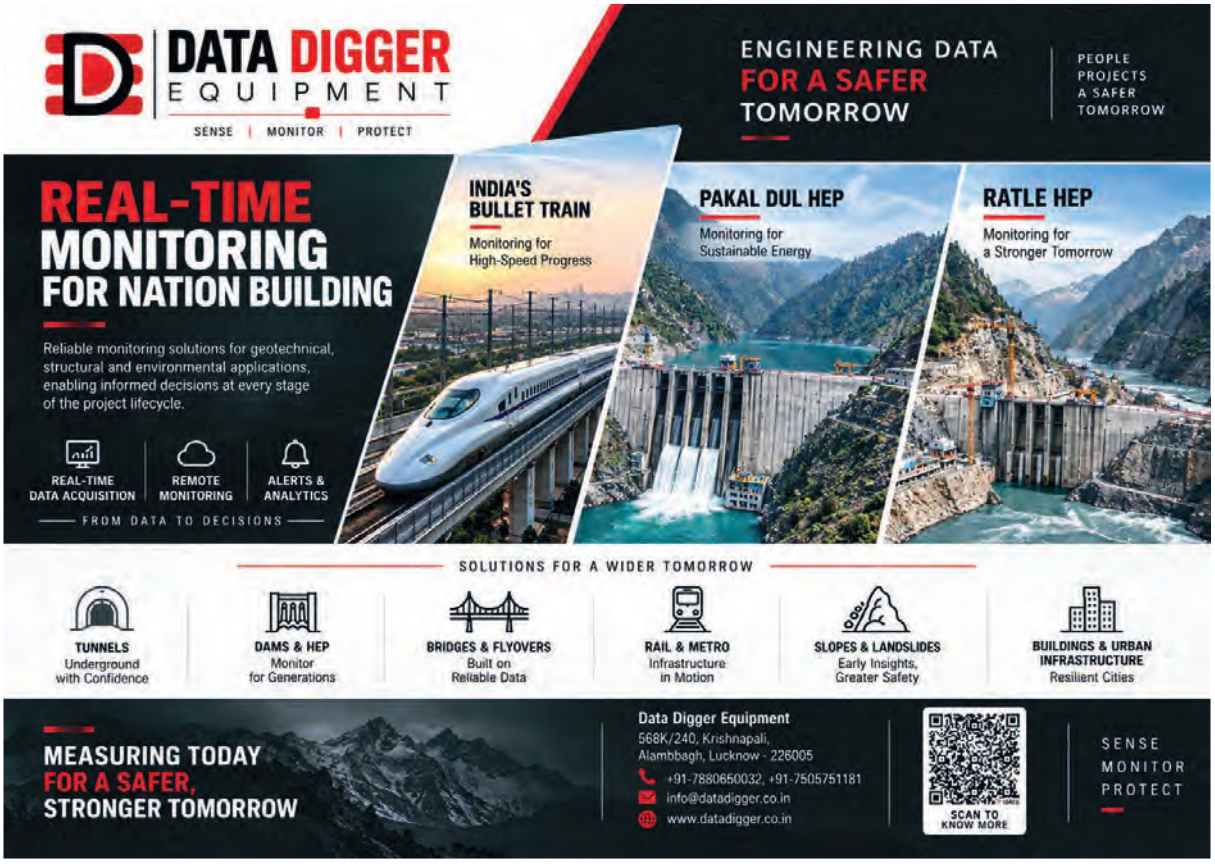

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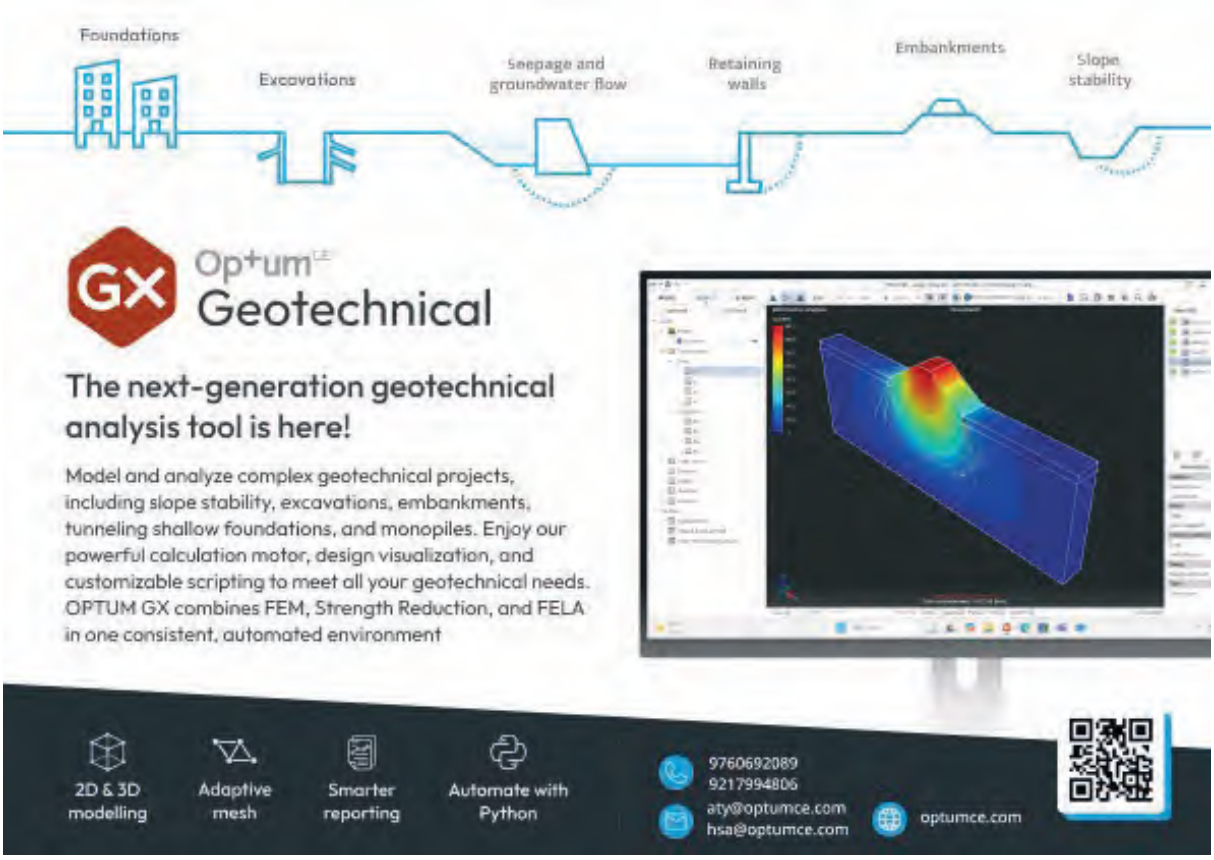

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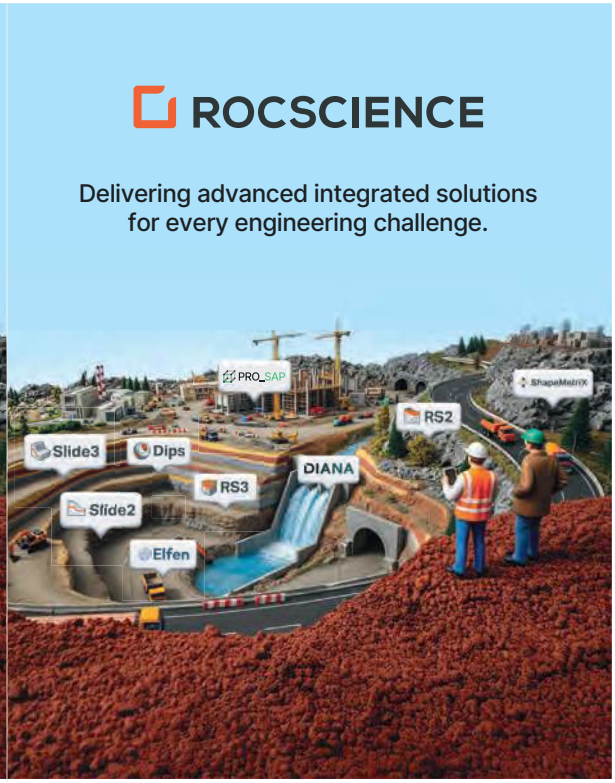

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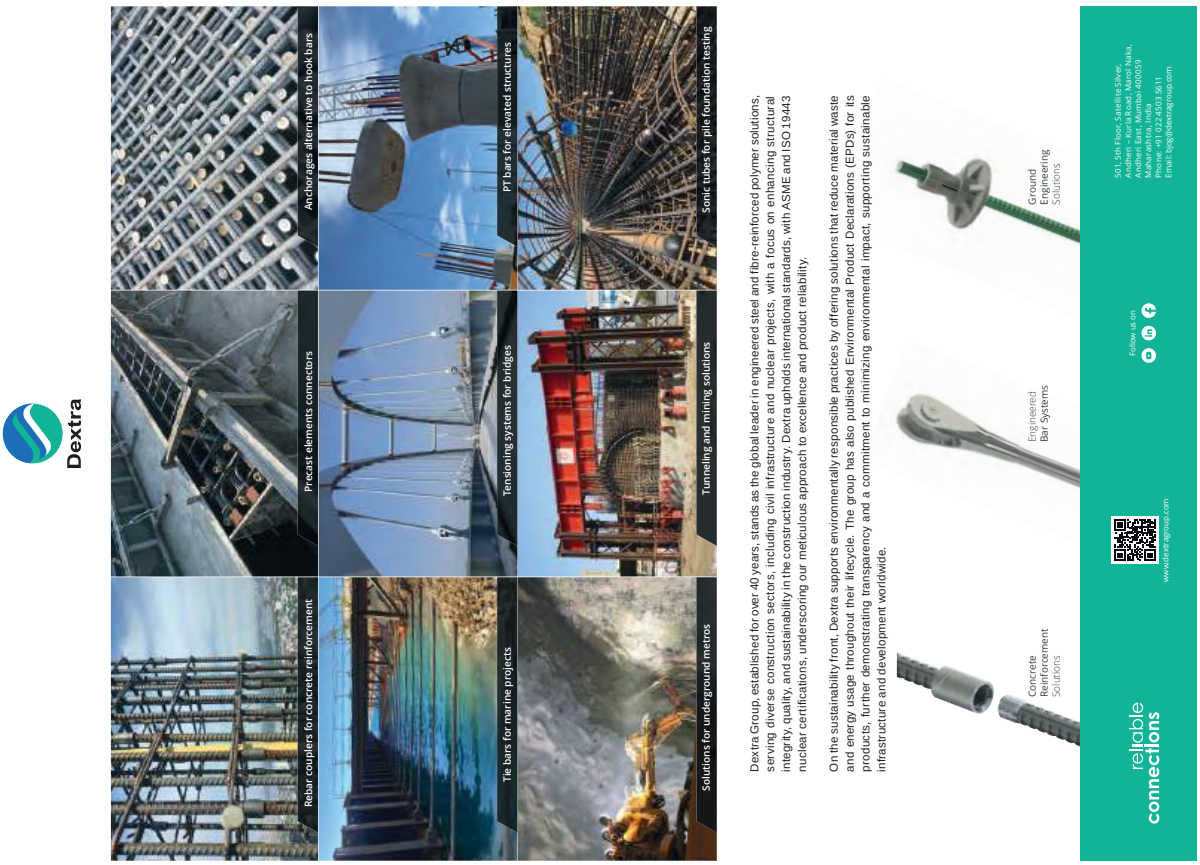
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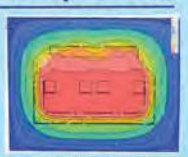

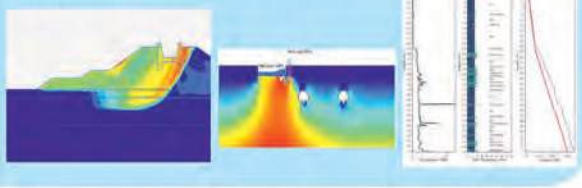

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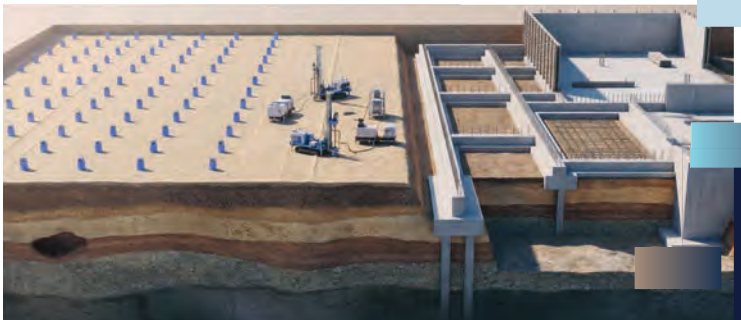

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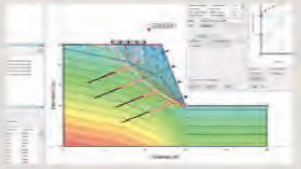

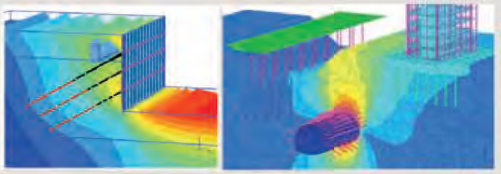

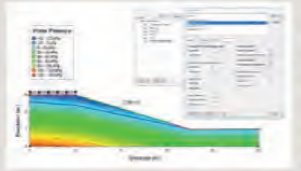

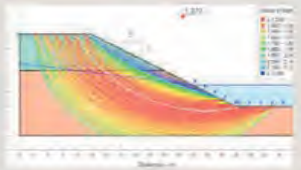

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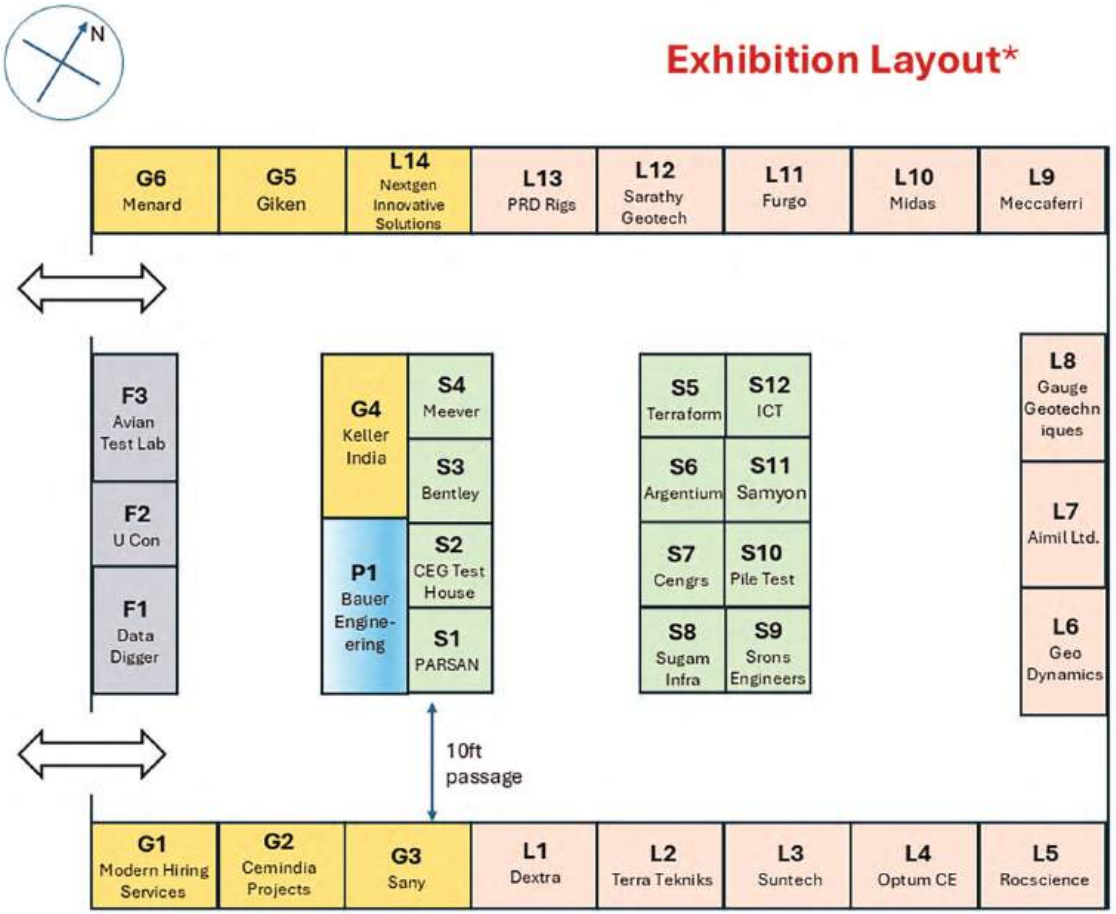
EXHIBITION LAYOUT

Exhibition Layout*



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