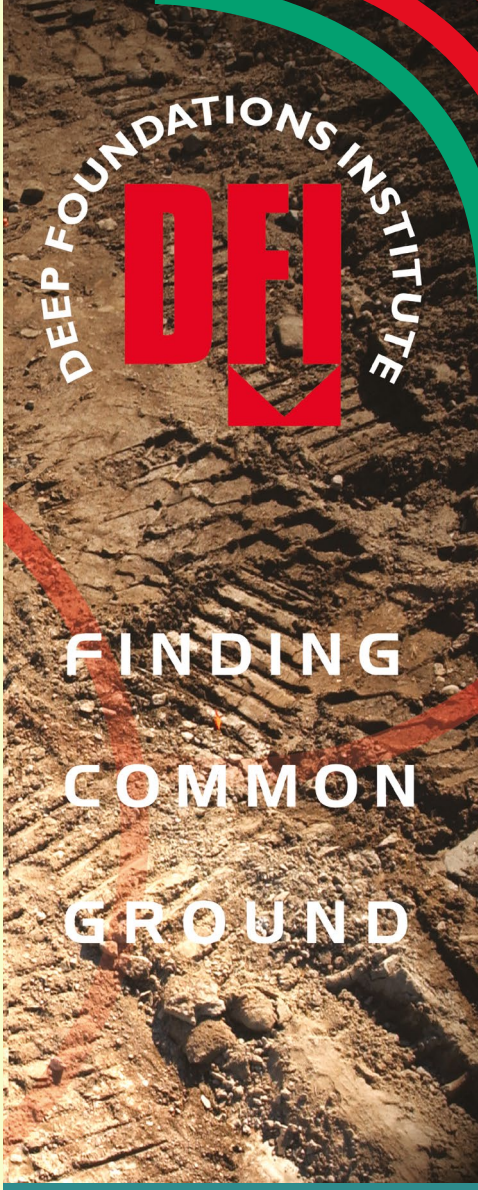
DFI INDIA 2021



Souvenir

With extended abstracts
Sponsor / Exhibitor catalogue

www.dfi-india.org

Deep Foundations Institute USA, DFI of India
India Institute of Technology Madras, Chennai
Indian Geotechnical Society Chennai Chapter

10th Anniversary Conference
DFI India 2021 on

Deep Foundation Technologies for Infrastructure Development in India

X-CD Platform, 12-20 November 2021

Deep Foundations Institute of India

Advanced foundation technologies
Good contracting and work practices
Skill development
Design, construction, and safety manuals
Professionalism in Geotechnical Investigation
Student outreach 'GroundWork'
Women in deep foundations

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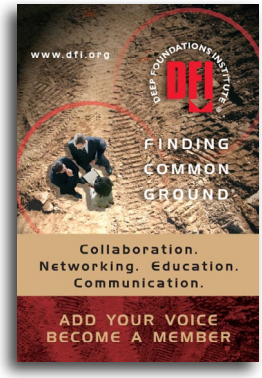

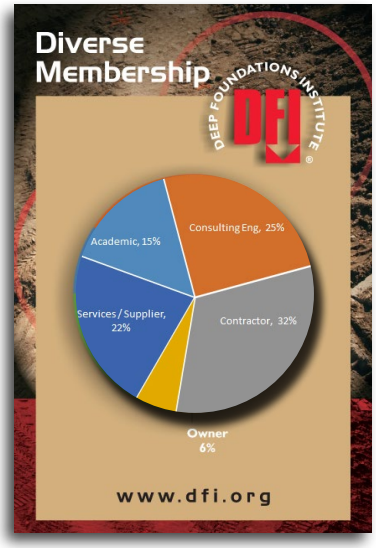

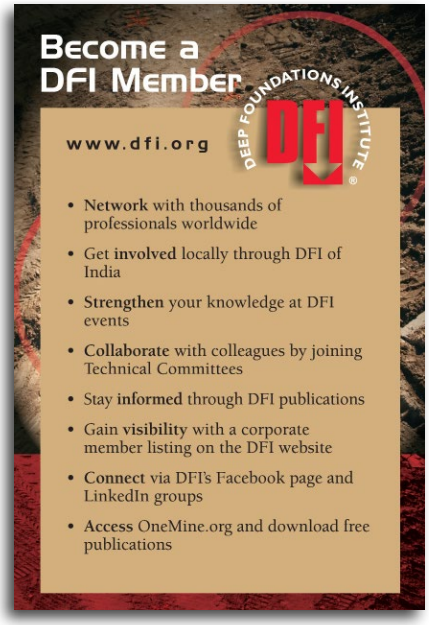

DFI India 2021

10th Anniversary Conference on

Deep Foundation Technologies for Infrastructure Development in India

Virtual, 12-20 November 2021

Souvenir

With Extended Abstracts
Important Updates
Conference Schedule
Delegate List
Sponsor, Exhibitor and Advertiser Catalogue

Deep Foundations Institute, DFI of India
India Institute of Technology Madras, Chennai
Indian Geotechnical Society Chennai Chapter

www.dfi-india.org

About the Organizers

Deep Foundations Institute (DFI) and DFI of India

DFI is an international non-profit association of engineers, contractors, manufacturers, equipment suppliers in the deep foundations and excavations.

DFI of India was registered at Chennai with the Ministry of Company Affairs as a non-profit organization in 2013, following its second event in Hyderabad in 2011 and the inaugural Deep Foundation Technologies for Infrastructure Development in India conference held in Chennai in 2012. These events were followed by highly successful conferences in Mumbai (2013), in New Delhi (2014), in Bangalore (2015), in Kolkata (2016), in Chennai (2017), in Gandhinagar (2018), in Hyderabad (2019) and virtual conference in 2020. Several seminars and workshops were organized in different cities in India.

The chapter's mission is to help the Indian foundation industry on a continuous and sustained basis in measurable steps, become professional, and embrace new technologies for faster development of India. The chapter looks to provide a platform for constant interaction for all stakeholders of the Indian foundation industry, including international agencies via seminars, workshops and training courses. Visit www.dfi-india.org for more information about DFI of India.

Indian Institute of Technology Madras

INDIAN INSTITUTE OF TECHNOLOGY MADRAS (www.iitm.ac.in), one among the foremost institutes of national importance in higher technological education, basic and applied research, was established in 1959. IIT Madras is a residential institute with nearly 550 faculty, 8000 students and 1250 administrative and supporting staff and is a self-contained campus located in a beautiful wooded land of about 250 hectares. It has established itself as a premier centre for teaching, research and industrial consultancy in the country. Visit www.iitm.ac.in for more information about IIT Madras.

Indian Geotechnical Society (IGS), Chennai Chapter

INDIAN GEOTECHNICAL SOCIETY, IGS, was established in 1948 to advance and disseminate knowledge in different fields of geotechnical engineering. The Madras Chapter of IGS was established in 1987 and later named as Chennai Chapter. Chennai Chapter (www.igschennai.in) has more than 900 life members, including about 120 members of the parent body. The Chapter has been organising seminars and symposiums every year with an emphasis on field practices. The National Conference IGC-1983 was held at IIT Madras. The Chennai Chapter conducted IGC-1996 at Anna University, IGC 2006 at IIT Madras and IGC-2016 at IIT Madras. The Chapter also organised the 4th Indian Young Geotechnical Engineers Conference (4IYGEC) on May 17-18, 2013, at IIT Madras and later in 2021, the 8th IYGEC virtually in October 2021. The Sixth International Symposium, 6IGS-Chennai 2015, on Disaster Mitigation in Special Geoenvironmental Conditions was organised by the Chapter and Indian Institute of Technology Madras during January 21-23, 2015, with the support of the Asian Technical Committee on Geotechnology for Natural Hazards (ATC-3) of ISSMGE. IGS Bangalore Chapter and IGS Kochi Chapter were the co-organisers of the symposium. The IGS Chennai Chapter received the best chapter award twice during 2012 and 2013. Visit www.igschennai.in for more information about the Chapter.

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Er. Mohan Ramanathan
Managing Director, Advanced Construction Technologies (P) Ltd., Chennai

Technical Chair

Prof. A Boominathan
IIT Madras

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Ms Theresa Engler, Executive Director, DFI USA

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Ms Aastritha Vatchala, DFI of India

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Ms Mary Ellen Large, Director Technical Activities, DFI USA
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Mr PVSR Prasad, Keller Ground Engineering India Pvt Ltd.
Ms Jaime Cettina, DFI USA

Preface

The pre-cursor to the 10th Anniversary DFI India conference on 'Deep Foundation Technologies for Infrastructure Development of India' was held during 19-20 November 2020. There were three pre-conference webinars during the months of July, August and September 2020. The expectation and excitement was that the 10th Anniversary Conference could be an in-person event at IIT Madras. In April 2021, the second wave of the pandemic shattered all the hopes for a grand conference at IIT Madras and we took the painful decision to go for virtual again. The challenge was accommodating all the contributory paper presentations of a decent duration during a two-day conference. We also wanted to provide a good platform for the sponsors and the exhibitors where the delegates can virtually interact with them. Even though virtual interaction is a well-accepted norm, engaging the delegates in a networking mode is a real challenge. With this in mind, the conference is now spread over seven days from 12 to 20 November 2021. There will be eight technical sessions in the afternoons of 12, 13, 19 and 20 November 2021, during which six insightful keynote presentations and eighteen contributory presentations are offered. Four evenings on 15-18 November 2021 are dedicated to networking with the exhibitors. Eight technical networking sessions on important advanced topics of deep foundation engineering and one on Women in Deep Foundations (WiDF) are also scheduled to make these evenings more useful to the professionals and academia.

We scheduled a panel discussion on an important topic, 'Harnessing Foundation & Geo-Technologies for Accelerated Construction of Infrastructure Projects' proudly associating with ITD Cementation, one of the foundation industry giant representing the constructors, India Construction Equipment Rental Association CERA, and Indian Construction Equipment Manufacturers Association ICEMA. Dr K S Rama Krishna, the Principal founder of DFI of India, will lead the discussion. DFI of India is extending its support to the students through its outreach programme, GroundWork. The conference will have a brief session based on the students' competition held in October 2021. The presence and contributions of women in the foundation industry is increasing day by day, and DFI of India has a strong team acknowledging the contribution of women engineers to the industry. There will be a 90-minute session by the DFI India WiDF team during the conference.

DFI of India acknowledges the immense contribution to geotechnical engineering by several veterans in the field and academia. We are proud to honour one of them during every annual conference with our Life Time Contribution Award, and are pleased to present the 2021 award to Shri Murli Iyengar.

Support to DFI India 2021 from the industry was overwhelming despite several constraints. More than 20 sponsors and exhibitors are supporting the conference. MHWirth and Heritage Infrastructure are our platinum sponsors, while Keller Ground Engineering and ITD Cementation are the diamond Sponsors.

DFI USA provided us free of cost a very versatile conference platform powered by Zoom and X-CD Technologies for the conduct of this conference. DFI USA extended their support on all fronts, including the paper review portals, paper publications and drawing keynote presenters for the conference.

We gratefully acknowledge all the generous support and inspirational participation of the sponsors. We also express our sincere gratitude to the conference chairs, advisory committee, organising committee, and technical committee for their time and expertise. The enthusiastic support in the form of guidance, close coordination, and follow up by Ms Theresa Engler, DFI Executive Director, Ms Mary Ellen Large, DFI Director of Technical Activities, and the staff of DFI is gratefully acknowledged. The efforts from Mr G V Prasad, Director-operations at DFI of India, Mr T.S. Mahendran, Mr Pranav Jha, and Ms Astritha, all at DFI of India, are highly appreciated.

We have received support through messages from DFI President and Executive Director, Conference Chair and Technical Chair, IGS President, Chair and Honorary Secretary of the IGS Chennai Chapter.

Special thanks are due to all the presenters who spent valuable time preparing the presentations and joining the rehearsal sessions in order to make the conference management smoother. We express our gratitude.

Publishing a conference souvenir is our way of appreciating the supporters and contributors of this prestigious event. This conference souvenir in digital form will provide the abstracts of the presentations, details and the commercials of the sponsors and the exhibitors, a brief account of DFI India activities and the attendee details. This souvenir will serve as a future record of the conference proceedings.

I V Anirudhan
Chairman, DFI of India

Mohan Ramanathan
Vice-Chairman, DFI of India

Deep Foundations Institute of India and DFI USA

Deep Foundations Institute of India

Chairman

Anirudhan IV, Geotechnical Solutions, Chennai

Vice Chairman

Mohan Ramanathan, Advanced Construction Technologies (P) Ltd, Chennai

Immediate Past Chairman

Dr. K S Rama Krishna, Geotechnical & Project Consultant, Chennai

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Pranav Jha

Manager - Accounts & Admin

Mahendran T.S.

Assistant Engineer - Operations

Velpula Aastritha Vatchala

Deep Foundations Institute USA

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Gianfranco Di Cicco, Bauer Foundation Corp., Odessa, FL

Immediate Past President

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Executive Director

Theresa Engler

Director, Technical Activities

Mary Ellen (Bruce) Large, P.E., D.GE

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www.dfi-india.org – Email dfiindiaoffice@gmail.com

Deep Foundation Technologies for Infrastructure Development in India - DFI India 2021
Virtual, 12-20 November 2021

Message from President, DFI

Deep Foundations Institute
326 Lafayette Avenue
Hawthorne, NJ 07506 USA
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staff@dfi.org | www.dfi.org

November 1, 2021

It is my pleasure to express, on behalf of Deep Foundations Institute and its membership, hearty congratulations to DFI of India's leadership on their excellent efforts to create another informative and substantive annual conference which focuses on deep foundation technologies for infrastructure development in India yet is relevant to geoprofessionals across the globe. Holding this year's conference once again in an online format, while not the original plan for its anniversary event, makes the content accessible to anyone, anywhere. I, for one, am pleased to see the continued progress of our Indian chapter, the vision of former DFI Trustee and Distinguished Service Award winner, Dr. K. S. Rama Krishna and now ably led by chair IV Anirudhan with support of the executive committee. The chapter's activities continue to expand DFI's mission of bringing together multi-disciplined individuals and organizations to find common ground and create a shared vision and consensus voice for continual advancement in the deep foundations industry. This is accomplished well by the offering of this annual conference as well as other initiatives - introduction of new technologies, skills training programs, and forging alliances with major Indian organizations.

I am pleased to see such high-quality technical papers in the 2021 conference proceedings and the interesting speakers on the program schedule combined with the GroundWork student program and Women in Deep Foundations session. Of specific interest and importance is the panel discussion on "Harnessing Foundation and Geo-Technologies for Accelerated Construction of Infrastructure Projects. This session embodies DFI's multidisciplinary forum with perspectives from contractors, engineers and equipment manufacturers/suppliers. I also want to thank the dedicated DFI of India staff led by G. Venkata Prasad, director of operations along with Pranav Jha, assistant manager of operations and TS Mahednran, accountant and administrator. I am also pleased that we can continue to offer guidance from DFI headquarters in the USA from Theresa Engler, executive director and other staff plus the support committee led by Srilakshmi (Lucky) Nagarajan and Satyajit (Seth) Vaidya.

At DFI we believe the dissemination of high calibre expertise and experience through conferences and publications, such as this one, are key to the continual technologies advancements in our industry and we thank all speakers, panellists and authors for contributing. We also thank the supporting sponsoring companies who see the value of DFI of India's ongoing efforts and I look forward to the four exhibition days between technical sessions to learn more about the advancements of CFA piles, helical screw piles, instrumentation, testing and analysis, soil investigation, mass stabilization, reverse circulation drilling and more. We encourage and count on all in attendance to support the chapter's efforts through membership and involvement.

Best wishes to all delegates, speakers, students and sponsors for an informative conference week!

Michael H. Wysockey, Ph.D., P.E.
DFI President

Message from Executive Director, DFI

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November 1, 2021

It is with pride that I send my best wishes for a successful conference to our DFI of India Chapter and thank all who are involved in creating another event that informs and advances the deep foundations industry in India.

This would not be possible if not for the input of many! I thank the authors who willingly share their knowledge through submission of quality technical papers and presentations, the sponsors/exhibitors who support the event financially and through the sharing of their latest technologies, the delegates who contribute to the conversation and discussions, and the DFI of India executive committee, led by Chair, I V Anirudhan. It is my pleasure to have been part of the planning from our headquarters in the United States along with our director of technical activities, Mary Ellen Bruce Large, P.E., our director of IT and marketing, Ashley Gordon and our professional development coordinator, Jaime Cettina. I greatly appreciate the hard work of the DFI of India staff – G V Prasad, Pranav Jha and T S Mahendran – who tirelessly coordinate the many parts of this conference and the other ongoing initiatives of the chapter.

The week-long program celebrating 10 years of DFI of India conferences being presented online allows many more to participate from across the globe. Congratulations to the conference organizing and technical committees for seeing the success of their efforts come to fruition. And heartfelt thanks to all delegates. We appreciate your support and look forward to your continued membership and participation in all DFI of India activities moving forward!

Theresa Engler,
DFI Executive Director

Message from Chairman, DFI of India

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Tamilnadu, INDIA

November 3, 2021

My association with DFI and DFI of India started with the DFI conference held in Hyderabad in 2021. I acknowledge the untiring efforts Dr K S Rama Krishna put into making the Indian foundation industry understand the value of an institute like this. The idea of an annual conference on the theme 'Deep Foundation Technologies for Infrastructure Development in India' was mooted by him in 2012. Starting with the annual conference, DFI India 2012, at IIT Madras, finally culminating in establishing the India Chapter of DFI USA, the annual conferences held in the subsequent years brought many industry partners into the fold of DFI of India. The industry giants like Larsen & Tubro, ITD Cementation, Keller Ground Engineering India, Tata Projects, and IRB, to mention a few, found value in associating with DFI. The owners like Nuclear Power Corporation of India Limited (NPCIL) and Chennai Metro Rail Limited (CMRL) are very much on the growth path of DFI of India.

It is my pleasure to wish success for the DFI India 2021 conference being held virtually while being part of the organising team. The virtual conference spread over eight days between 12-20 November 2021 is packed with insightful technical and networking sessions. DFI-India conferences primarily focus on bridging the gap between theory and practice. I am sure that the conference proceedings will help the delegates greatly.

The annual conferences, webinars, seminars and workshops are only part of DFI of India activities. The students' outreach programs, Women in Deep Foundation programs, lab technicians training programs, advanced technology transfer programs like the continuous flight auger pile installation and testing and knowledge sharing webinars like steel webinars are aimed to help the Indian foundation construction industry to achieve world-class standards.

I wish the virtual conference a great success.

Anirudhan I V
Chairman, DFI of India

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)

President: Prof. N.K. Samadhiya
Hon. Secy. Prof. J.T. Shahu

November 2, 2021

Dear distinguished colleagues,

On behalf of the Indian Geotechnical Society (IGS), I wish to congratulate DFI India on the eve of organising the 10th Anniversary Conference on 'Deep Foundation Technologies for Infrastructure in India'. It is also nice to know that several industry stakeholders are supporting this event held virtually during November 12-20, 2021.

DFI India has been quite active in India in the recent years in bringing a number of experts and practitioners in foundation technologies and ground improvement together to address the critical needs in technology and knowledge sharing in the geotechnical aspects of design and construction of foundations of civil infrastructure.

The technical program is excellent and has participation of many experts and professionals from industry and academia. I am sure that the deliberations in the workshop and conference present an opportunity for the professionals to arrive at new/innovative, rational methods of design and construction that enable fast track construction and also ensure safety and sustainability in geotechnical constructions in the country.

I wish the conference a great success.

Best wishes and regards

Samadhiya

Prof. Narendra k Samadhiya
President, Indian Geotechnical Society
New Delhi

Prof. Narendra K Samadhiya
Prof. in Civil Engineering
Indian Institute of Technology, Roorkee
Roorkee-247667 Distt: Haridwar, Uttarakhand, INDIA

Message from Conference Chair

Mr. Mohan Ramanathan
Managing Director
Advanced Construction Technologies (P) Ltd., Chennai
Executive Committee, DFI of India

November 1, 2021

Dear Attendees and Delegates,

This is a momentous conference in many ways. DFII celebrates this as its 10th Annual conference event. In the past,each event has been a milestone in the history of DFII .We have all been attending these events to greet each other,exchange pleasantries, renew contacts and learn new technologies. But this year, due to COVID-19 pandemic,we are going to learn in another way. We have never depended on the internet more than now, for all our ways to live and survive. In the same spirit, DFII has organised this 10th Conference as a virtual event and celebrate of its glorious its journey. As the theme of the conference,"Deep Foundation Technologies for Infrastructure Development in India" suggests,India is on the verge of unleashing the biggest budget ever in Infrastructure spending after Independence and this conference will add knowledge and experience of eminent experts from across the world.

I wish the organisers my best wishes and to the delegates good connectivity and rich learning experience.

Jai Hind.

Mohan Ramanathan
Conference Chair

Message from Conference Technical Chair

Prof. A Boominathan
Professor (Retired), Geotechnical Engineering Division
Department of Civil Engineering
Indian Institute of Technology (IIT) Madras, Chennai
Executive Committee, DFI of India

November 2, 2021

Dear Colleagues

I am delighted to inform you of the 10th-anniversary conference on Deep Foundation Technologies for Infrastructure Development in India that the DFI India Regional Chapter is organising during November 12-20, 2021. DFI India has successfully brought together industry and academic professionals through several conferences conducted in different parts of India. The 10th-anniversary event would have been a great gala event in Chennai if not for the challenging circumstances. We have now planned for a virtual event with an exciting assortment of events spanning nine days.

The DFII 2021 comprises six technical sessions with an assortment of 6 keynote lectures and 18 contributing papers by renowned international and national experts. I also look forward to the panel discussion on 'Harnessing Foundation & Geo Technologies for Accelerated Construction of Infrastructure Projects' coordinated by Dr. K.S. Rama Krishna brings together three eminent experts from three leading Indian organisations. The DFI India conference will see networking sessions on nine topics covering wider areas of deep foundation technologies coordinated by national and international experts for the first time. A session is also organised by the DFI's Women in Deep Foundations (WiDF) Committee.

The activities of DFI India have grown significantly over the years, with active engagement in the development and promotion of promising new technologies. Recently the DFI India had successfully implemented CFA pile installation in one of the project sites in the Northern part of India and has also developed guidelines for analysis, design and construction methodology for CFA piles in India. Before this conference, DFI India had organised several webinars on Steel Retaining Structures and Foundations, and these webinars were well attended and appreciated by participants from more than 40 countries.

The DFI of India had announced its student outreach program "Groundwork" during the DFII2020 Annual Conference last November. This program was aimed to enhance the professional and interpersonal skills of students in the geotechnical field. This year, a series of webinars consisting of technical and professional development seminars were arranged for civil engineering students and particularly those with geotechnical engineering interests. The inaugural webinar was delivered by eminent deep foundation expert Prof. Harry G. Polous, Senior Consultant, Coffey International Ltd, Sydney. All the webinars saw good participation by the student community. This year DFII continued the 'Groundwork' outreach program with a Level-2 Problem Solving Competition.

I am sure that participants will find this conference fruitful and beneficial. I wish all success for the DFI India 2021 virtual conference.

Prof. A Boominathan
Conference Technival Chair

Message from Director Operations, DFI of India

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October 29, 2021

It is a pleasure for me to write a message for DFII 2021 conference souvenir and reach out to all participants of this year's program. On behalf of DFII, we express our immense gratitude to sponsors, exhibitors, keynote speakers, other speakers, panellists, delegates, DFI leadership, technical and organizing committee members for their contribution to the conference's success.

I take this opportunity to highlight the important programs of this year's conference.

This year, we succeeded in roping in the strengths of the Construction Equipment Rental Association (CERA India) and Indian Construction Equipment Manufacturers Association (ICEMA) organizations, which will help us roll out skill training programs catering to foundation equipment operators. This collaboration will benefit the Indian construction industry substantially. We have planned interesting panel discussions as a part of this year's conference program to discuss the opportunities of implementing more new foundation technologies popular the world over and skill training programs speedily by having the participation of the leadership of these two organizations.

Apart from this, DFII 2021 conference will provide an enriching experience to all participants from other interesting deliverables from key speakers & Women in Deep Foundation (WiDF) team, student programs, dedicated time slots provided to exhibitors between 15th to 18th Nov'21, deliberations planned during this period by many Indian experts on prospects of India for new foundation technologies.

As a routine matter, delegates will be kept abreast of the progress of current initiatives being pursued by DFII, including plans that will benefit different stakeholders of India in enhancing the performance of foundation construction.

I wish the DFII 2021 conference great success. We look forward to having the charm of the in-person conference event next year.

Mr. G Venkata Prasad
Director-Operations
DFI of India

Message from IGS Chennai Chapter

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Chairman
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Dr. V B Maji
Honorary Secretary
094454 22073 (M), vbmaji@gmail.com

November 1, 2021

Dear Friends,

It gives us immense pleasure to write a message for the 10th Anniversary Conference on Deep Foundation Technologies for Infrastructure Development in India to be held from 12-20 November 2021. Due to extended pandemic restrictions on large gatherings, this DFI India 2021 conference is beautifully planned as a virtual event. The event is offering a great line of keynotes from internationally acclaimed experts and many technical sessions with very rich content. This virtual event offers a wonderful platform for academicians and professionals to present and discuss many crucial aspects of the issues and latest technologies in the area of Deep Foundation.

DFI India is very active since its inception and has successfully conducted many seminars/conferences earlier. We are sure that this virtual conference also will be successfully organized. The success of this conference is due to the dedication and efforts of the DFI team working on the preparations for a long time to make this become a reality. We congratulate the team DFI and express our sincere thanks and appreciation. On behalf of the Indian Geotechnical Society (IGS) Chennai Chapter, we wish the DFI India 2021 conference a grand success.

Prof. M Muttharam
Chairman, IGS Chennai Chapter

Dr. V B Maji
Honorary Secretary, IGS Chennai Chapter

Prof. M Muttharam
Prof. in Civil Engineering
Division of Soil Mechanics and Foundation Engineering
CEG, Anna University, Chennai

Dr. V B Maji
Associate Prof. in Civil Engineering
Division of Geotechnical Engineering
IIT Madras, Chennai

DFI of India Lifetime Contribution Award 2021

Shri Murli Iyengar

After obtaining M.Tech. degree in Geotechnical Engineering from IIT- Bombay, Shri Murli Iyengar took up an assignment with The Cementation Company Limited (now known as ITD Cementation) in 1964 at their Kolkatta office. He worked for 6 yrs there as Geotechnical Engineer for various projects in India, Nepal & Sri Lanka.

In 1970, Shri Iyengar joined Engineers India Limited, a prestigious consultancy firm as Sr. Geotechnical Engineer and worked for various Projects in India and abroad. He was on a Middle East (Iraq) assignment for about three years from 1975. Since 1986, he diversified his experience in Project Engineering. During 1992-1995 he worked as Project Engineering Manager for Tabriz Petro Chemical project, reviewing the works by European and Korean contractors.

Shri Murli Iyengar worked in Engineers India Limited as General Manager (In Chennai) and Executive Director (EIL- New Delhi). He was responsible for the functioning of the Engineering Division concerning quality and timeliness, working in close coordination with other Divisions.

After retiring from EIL in September 2001, he took up Geotechnical engineering Consultancy for various Organisations such as Munsell Harris, Howe India etc., providing Geotechnical support, primarily for Marine Projects. Parallelly also took up an assignment for the Consultancy for Gangavaram Port project, a grass-root Port, 20 km south of Vishakapatnam, which involved major Ground Improvement works. He also provided Geotechnical support to GMR for their CORR Project in Chennai.

Presently Shri Iyengar is associated with Afcons Infrastructure Limited to provide Geotechnical engineering support for their various Infrastructure Projects in India and abroad.

Shri Murli Iyengar made several presentations and published papers on deep excavation, ground improvement for stockyards. He is a member of the Indian Geotechnical Society IGS and the Indian Society of Earthquake Technology ISET. He had been the convener for the BIS committee for IS 2911 (pile foundations) and a member of Various Codal Panels of BIS in Geotechnical Engineering.

He had regular interactions with IIT- Delhi, CBRI – Roorkee, Department of Earthquake Engineering Roorkee, IIT Madras, and National Institute of Ocean Technology during his professional career. He was also Member of Research Council SERC – Chennai.

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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 30 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.

KEYNOTE PRESENTATION

MAKING THE MOST OF YOUR SITE CHARACTERIZATION PROGRAMS: BRING YOUR A-GAME!

Benjamin (Ben) Rivers,
Senior Geotechnical Engineer, Federal Highway, Administration (FHWA)., Email: Maurice.Bottiau@ffgb.be

Benjamin (Ben) Rivers is a senior geotechnical engineer with the Federal Highway Administration (FHWA). Ben received both his bachelor's and master's degrees from North Carolina State University. Ben has worked for the Federal Highway Administration's Resource Center for the last 20 years. Before joining the FHWA, he worked in the private sector for 6 years in Asheville, NC. With FHWA, he is currently focused in program areas related to subsurface investigations, earthwork, geohazards, geotechnical asset management and performance, geotechnical data transfer, and post-grouted drilled shafts. He is also leading the current EDC5 initiative on Advanced Geotechnical Methods in Exploration (The A-GaME).

ABOUT THE PRESENTATION: Solving geotechnical problems fundamentally begin with recognizing the information and parameters that are most relevant for the design, construction and performance of our facilities, and characterizing geotechnical project site conditions with that in mind. Site characterization is a rational process that starts with developing a conceptual site model based on expectations informed from existing sources, and our experience and general knowledge of regional geology, geohydrology, landforms and previous land use. The conceptual site model is continuously refined as the information from a well-executed geotechnical site investigation improves the understanding of site conditions to meet specific project investigation objectives by targeting that most relevant information. That is being strategic and discerning with site characterization efforts: That is bringing your A-GaME!

In 2018, the Federal Highway Administration, in partnership with industry organizations, began an Every Day Counts (EDC) initiative focused on improving site characterization efforts by strategically incorporating the effective use of underutilized geotechnical exploration methods into geotechnical practice with the intent to minimize risks in project delivery and improve design and constructibility decisions within transportation and the geotechnical industry. This effort is known as Advanced Geotechnical Methods in Exploration - or simply as the A-GaME. The A-GaME recognizes the value of methods beyond the rudimentary Standard Penetration Test (SPT) – such as exploration geophysics, optical and acoustic televiewers, measurement-while-drilling (MWD), cone-penetration testings (CPT) and other innovative methods and technologies that enhance our understanding of site conditions and variability during geotechnical site characterization efforts. This presentation will explore the practical implications of embracing a strategic approach to geotechnical site characterization and will highlight tools and techniques and how they can be introduced and routinely incorporated within our investigation programs to improve decisions and reduce risks on our geotechnical projects.

KEYNOTE PRESENTATION

OBSERVATIONAL METHODS IN DEEP FOUNDATIONS

Duncan Nicholson, BSc MSc DIC CEng MICE,
Retired Director – Ove Arup and Partners and Arup Fellow Ove Arup and Partners Ltd

Mr. Nicholson has extensive international experience of geotechnical design for major projects involving foundations, deep basements, retaining walls, tunnels and earthworks. He started his Civil Engineering career with George Wimpey and Co Ltd and then gained an MSc in Soil Mechanics at Imperial College in 1977. He then joined the geotechnical section of Ove Arup and Partners Limited, becoming a Director in 2000 and retired in 2017. He was made an Arup Fellow in 2014 and still works part time for Arup. He has a strong interest in improving design guidance and particularly in the use of the Observational Method.

• In 1994 he coordinated the Geotechnique Symposium in Print on the Observational Method which was published in 1996.

• In 1999 he was the lead author of the Ciria Report 185, (1999) - Observational Method in Ground Engineering.

• He contributed to the New Ciria Guide C760 (2017) Guidance on Embedded Retaining Wall Design. Section 7.4 develops recent thinking on the Observational Method.

• He is the current Chairman of ISSMGE TC206 on the Observational Method.

foundations and ground improvement. The presentation will include a discussion of various techniques, devices, and/or approaches and practical applications, installation details, and select test results and observations. Smart Cell (post grouting device), Expander Body (grouted foundation element), Super Cell (bi-directional static load testing device) and EQ-drains (in situ vertical drains) will be discussed.

ABOUT THE PRESENTATION: Bored piles and record – the Use of preliminary and contract pile tests to develop the design. Using rig data to control processes - eg CFA records for example – key issue is controlling ground loss. Driven piles and pile driving monitoring to get to final set. Each pile has its own design as you go to get to a set. On polymers - About the loss of fluid level in the pile. As a check on infiltration into surrounding soil. On D-walls - Rig monitoring systems - verticality control and steering. Filter cake formation control. On ground treatment – About vibro-compaction, grouting. This is the use of field data to control the compaction process. Also construction dewatering.

KEYNOTE PRESENTATION

DEEP EXCAVATIONS – AN HISTORICAL REVIEW

Prof. John Endicott,
AECOM Fellow and Executive Director at AECOM Asia Co Ltd, Hong Kong

Prof. John Endicott is AECOM Fellow and Executive Director at AECOM Asia Co Ltd, Hong Kong with responsibility for ground engineering throughout the Asia and Pacific Region. John started to work for Maunsell, a legacy company of AECOM in 1970 and he has worked in ground engineering, tunnels, slopes, foundations reclamation and deep basements at Maunsell, in United Kingdom and in Hong Kong since 1975, and Dames and Moore 1982 to 1990. Notable is his work on design of underground structures including pioneering numerical analysis of soil/ structure interaction that has included involvement with over 100 underground railway stations and as many tunnels for many purposes. He has recently authored a book on deep excavations in soil. ohn received a first class degree in Engineering in 1967 followed by a PhD in 1971 at Cambridge University. He is Registered as a Geotechnical Engineer and as a Structural Engineer. He is an Adjunct Professor at University of Hong Kong and at Hong Kong University of Science and Technology. His professional interests are widely spread in all aspects of ground engineering. He has published over 50 papers in Journals and at Conferences. He was a Member of the International Panel of Experts for the Urban Renewal Authority of Singapore advising on underground development and has been a Member of the Town Planning Board in Hong Kong. John was recently honored as a Fellow Commoner at St Catharine's College Cambridge..

ABOUT THE PRESENTATION:

Many engineering projects, require deep excavations for underground structures. Typically for underground railways excavations of the order of 18 to 30 metres are adopted. In new cities or in zones of urban renewal in older cities, there is a demand for more space which results in deep basements as much as six storeys and more. Fifty years ago basements were less common and basements deeper than two storeys were quite unusual. Computers were uncommon and most engineers estimated by using slide rules and performed detailed calculations by hand. Within a few years computers came onto the market and they were followed by software which was simple at first and has been progressively updated and become quite user-friendly. Modern design makes use of powerful analytical programs, large data bases, information management, programming, monitoring and reporting.

Reflecting on fifty years of design and construction of deep excavations the talk will outline the rudiments of early design and construction which gives insight as to how modern computer-based ground engineering has developed where it is today.

KEYNOTE PRESENTATION

RECOMMENDED PRACTICES IN GROUND CHARACTERIZATION FOR COMPLEX PROJECTS- AN OWNERS PERSPECTIVE

Dr. R P Singh,
Senior DGM (Civil), National High Speed Rail, Corporation Limited, Mumbai

Dr. R. P. Singh is currently serving as a Deputy General Manager in National High Speed Rail Corporation Limited and is a part of a team responsible for executing India's First Bullet Train Project i.e. Mumbai-Ahmedabad High Speed Rail Project. He is currently associated with geotechnical investigation and ground strength assessment through pile load test and plate load tests. He is also associated with planning and construction of 21 km long suburban undersea tunnel of MAHSR in Mumbai. He obtained his Master and PhD degree from IIT Bombay and is a recipient of a Doctoral Research Award of during IACMAG 2019 conference and many best paper award for his publications related with railway research. His research on track geomechanics has been complemented by Ministry of Railways (GoI) and Managing Director of NHSRCL. Dr Singh has over 19 years of experience of working in Indian Railways at various capacities and also served as Assistant Professor (Track) in Indian Railways Institute of Civil Engineering in Pune which train officers of Indian Railways. He was instrumental in developing a world class geotechnical laboratory at IRICEN, Pune which was complemented by Niti Aayog. He has undergone for various training programs related with conventional railway and high-speed rail and working with JICA with high-speed railway technology transfer from Japan..

ABOUT THE PRESENTATION: Completion of infrastructural projects in time is imperative requirement of sustainable growth of the country. One of the reason for the delay of the project is challenges in foundation construction which have several aspects such as correct ground characterization, foundation design and verification of design parameters through various load tests. Ground characterization based on field and laboratory testing practices are very old which needs updation as per international codal requirements. Lack of skilled manpower, instruments and motivation among the existing "expert agency for implementing the updates are some of the hurdles in ground characterization. The foundation design approaches also need an overhaul in respect of quality design parameters and verification of design philosophy through various load tests. The client requirement to build confidence for better foundation in light of the above challenges and recommendations for improvement are discussed in this presentation.

KEYNOTE PRESENTATION

HOW THE CHOICE OF FOUNDATION CAN ALTER THE FATE OF A BRIDGE PROJECT – 3 CASE STUDIES

Alok Bhowmick,
Managing Director, B&S Engineering Consultants Pvt Ltd

Mr. Bhowmick is the Manging Director of a leading firm "B&S Engineering Consultants Pvt Ltd" and holds a post-graduation degree in structural engineering from IIT, Delhi. He has more than 40 years of Design Consultancy experience in transportation infrastructure. He has accreditation of International Professional Engineer from Institution of Engineers (India). He is a Fellow of Indian National Academy of Engineering, India. He has received several awards and citations in his professional career. In 2018, he was awarded with 24th S B Joshi Memorial Award for Excellence in Bridge & Structural Engineering. He is an active member of several professional bodies (e,g. IEI, CEAI, IABSE, IAStructE, ECI) and code making bodies (e,g. IRC, BIS). He is the immediate past President of Indian Association of Structural Engineers (IAStructE) and currently Chairman of the Professional Development & Technical Events Committee of IAStructE. He is also holding the position of Vice Chairman of ING-IABSE and Chairman, Editorial Board of the quarterly journal "BRIDGE & STRUCTURAL ENGINEER" published by ING-IABSE.

ABOUT THE PRESENTATION: The most uncertain and challenging part of a bridge design and construction is the 'Choice of foundation'. During the planning and conceptual design stage, it is extremely important to choose the right type of foundation. Wrong choice can lead to disaster for the project. This paper will present three interesting case studies of past bridge projects, to demonstrate how correct choice of foundation can help to meet the project commitments while the wrong choice of foundations can led to huge delay in project completion, leading to time and cost overrun.

Several key lessons can be learnt from the delayed execution of this iconic project. It highlights the need to carry out the geotechnical and geological investigation to the fullest at the inception of the project before even the project is tendered for execution. Right choice of foundation is a prerequisite for timely completion of such projects.

KEYNOTE PRESENTATION

REVERSE CIRCULATION DRILLING (RCD) TECHNOLOGY FOR LARGE DIAMETER PILES

Nikolas Schmitz,
Head of Global BD and Sales, MHWirth, Germany

Nikolas Schmitz joined MHWirth in 2006 and has been working for 15 years in several positions in the engineering and sales department where he gained profound experience in the foundation, subsea and onshore mining industry. With this background and his in-depth knowledge of the technical and the economic challenges of drilling projects worldwide, he advances the development of MHWirth's pile top drilling solutions in various applications globally. He holds a degree in industrial engineering from the Münster University, Germany.

ABOUT THE PRESENTATION: For today's construction industry, large-diameter piles are common practice, as they are more competitive than drilling a larger number of smaller piles. More and more piles are installed by drilling rigs, replacing the installation by hammer, vibrators or caisson. Equipment capabilities and techniques with rotary drill rigs are highly developed, but very costly and time-consuming when it comes to rock drilling, large diameters and deep foundations. Pile top drill rigs (PBA), based on reverse circulation drilling (RCD) technology, overcome these challenges and are an efficient solution for large diameter drilling (0.6 m to 8.0 m/19.7 ft to 26.3 ft) and drilling depths of up to 500 m (1,640 ft.)in various geological conditions onshore and offshore. The paper will explain benefits of RCD technology and prove this with figures from the Mumbai Trans Harbour Link project.

PANEL DISCUSSION

HARNESSING FOUNDATION & GEO-TECHNOLOGIES FOR ACCELERATED CONSTRUCTION OF INFRASTRUCTURE PROJECTS

BACKGROUND: To tap GDP growth potential and in triggering the economy, the government of India is giving thrust to implement many major infrastructure projects in India. There is substantial scope for implementing new technologies, good work practices, skill programs to address the current challenges/constraints involved in the speedy execution of the deep foundation scope of many construction projects.

DFII has been striving to achieve this goal through its various programs and collaborative basis support of multiple stakeholders of the industry. To continue the efforts, the DFII team and Construction Equipment Rental Association (CERA India) leadership have agreed to collaborate. CERA India members own around 60 per cent of foundation equipment in India the collective efforts can make a big impact in the foundation industry.

DFII leadership is also in touch with the Indian Construction Equipment Manufacturers Association (ICEMA) and Infrastructure Equipment Skill Council (IESC) to leverage their strengths to serve mutual interests. DFII also has been engaging many owner companies to appraise them best deep foundation practices at the global level by getting international expertise at their doorstep. This is to seek their support in advancing the Indian deep foundation industry.

An interesting panel discussion is being organized as a part of DFI India 2021 conference involving a leadership team from the above-mentioned organizations covering the following topics.

Moderator

Dr. K S Rama Krishna
Director, DFI of India

Highlighting the goals of panel discussion program, and for matured foundation technologies, constraints and remedies to implement new technologies, need of enhancing skill levels of professionals/foundation equipment operators, he will moderate the panel discussions program.

Dr. K.S. Rama Krishna is Director (immediate past chair) and an Executive Committee member of DFI of India. He served as Chairman of DFI of India from its inception in 2013 to 2020, and is a member of the DFI Board of Trustees. He is recipient of DFI 2020 Distinguished Service Award. As an independent consultant he provides geotechnical engineering services in the area of foundation engineering and project implementation, for land, coastal projects and offshore oil and gas projects.

As head of foundation engineering at Larsen & Toubro Limited (L&T) between 2005 and 2013, he provided technical expertise to several projects and companies within L&T. He was instrumental in identifying and implementing the latest foundation technologies, equipment and in building techniques in the special foundations industry. He retired from L&T as chief engineer–technologies in 2013.

In 2017, Dr. Rama Krishna was named one of four winners of the DFI President's Award, and was recognized for his efforts in creating DFI of India, organizing annual conferences and quarterly workshops, introducing CFA technology to India, and creating a permanent DFI of India office.

Panellist:

Manish Kumar
Executive Vice President & Chief Technical Officer, ITDCEM

Mr Manish Kumar will provide contractor's perspective, including scope for improvement in current tender practices comparable to global next practices that will aid in raising the bar of geotechnical and foundation contractors.

Manish Kumar is Executive Vice President and Chief Technical officer with ITD Cementation India Ltd., Mumbai, India. He holds B.Tech and M.S. degrees in Civil Engineering from IIT Bombay and Auburn University, Alabama, USA, respectively. He is author of more than 19 technical papers in National and International forums. He is a Life member of Indian Geotechnical Society and a member of BIS Committee on Foundations.

Till very recently, Manish Kumar was heading the Specialist Engineering Division covering Geotechnical activities such as Piling, Diaphragm Walling, Ground Improvement, Anchors and other Grouting applications. In his career, he has been involved with major construction projects such as Elevated and Underground Metros, Airports, Industrial projects, High-rise Buildings, Dam Rehabilitation Works and other Infrastructural Projects.

As Chief Technical Officer, he is the Chief for many other functions in his Organization including Quality, Design and EHS functions. He has more than 34 years of experience in design and construction of Pile Foundations, Diaphragm Walls, Geotechnical Investigations, Ground Improvement, and other Geotechnical Designs in India and in USA.

Panellist:

Satin Sachdeva,
Secretary-General, CERA India

Mr Satin Sachadeva will present construction equipment rental market (current and future), foundation equipment status, cost vis a vis other equipment, challenges in recovering the capital cost, foundation contractors' challenges, Covid challenge and adapting to new normal, skills scarcity, suggested way forward in partnering with DFII to serve mutual interests.

Satin Sachdeva: As a man thinketh in his heart so is he. If you can think different, so will be you. That's what describes Satin Sachdeva in one line.

The founder of CERA (Construction Equipment Rental Association) and also its current Secretary General, India's largest equipment rental association and a dynamic entrepreneur, who has set the industry ablaze with his modern ideas, dynamism, keen foresight, impeccable leadership skills, intellect and futuristic outlook, is celebrating 25 years of successful journey in the industry, rendering excellent services to the nation in building infrastructure and generating employment. Satin Sachdeva leads by example and believes that the ability to learn and transform is very important in the fast -changing world.

He is the pioneer of seeding the thought of organizing the equipment rental industry and the one who has realized the contribution of construction equipment rental industry towards India's infrastructure progress. With a vision of creating and sustaining a conducive environment for the growth of the industry, he has mooted the strong relationship between the construction equipment rental industry, manufacturers, financers and construction companies not within India but globally.

He is also the Managing Director & CEO of the company he founded – Equipment Planet, a premier construction equipment rental company which also buys and sells construction equipments. His group's other company E-value is a valuation & inspection, surveyor & loss assessor organization.

Panellist:

Dimitrov Krishnan,
MD, Volvo CE; President ICEMA

Will share the potential for construction equipment market, the success of ICEMA, collaboration opportunities between DFII/ICEMA/IESC for advancing foundation technologies and promotion of skill programs related to foundation equipment.

Dimitrov Krishnan is Managing Director of Volvo CE India Pvt Ltd, and president of the Indian Construction Equipment Manufacturers Association (ICEMA).

Krishnan, who served as vice-president of ICEMA from 2019 to 2021, has been on the ICEMA governing council for more than five years. A part of the Construction & Mining Equipment Industry in India and Asia Pacific region for 27 years, he spent the first 13 years of his career working in India. From 2006 to 2014, he held senior management roles at Asia Pacific region based out of Singapore. In October 2014, he returned to India to head Volvo Construction Equipment in India.

CHALLENGES OF EARTHEN COFFERDAM IN DEEP EXCAVATIONS FOR WATERFRONT STRUCTURES, A CASE STUDY

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ABSTRACT: This paper is a case study of an earthen Cofferdam, constructed for a deep excavation at Intake location in river Aaundha, Maharashtra, India. A 12 m (39 ft) deep excavation was made to construct the Intake well. The natural soil profile at this location is clay followed by rock. An earthen Cofferdam of maximum height 7 m (23 ft) was made around the periphery of the excavation. Cofferdam embankment and excavation slopes were analyzed using the finite element software PLAXIS-2D. Clayey sand was proposed as filling material during design, but clayey soil was used for the embankment formation during execution. The embankment was built up to 5m height in July 2017 and completely submerged due to monsoon. In February 2018 embankment height raised to 7m (23 ft) by filling the soil over the existing submerged embankment. After a few days of completion of the Cofferdam construction, the inside slope of the embankment had started sliding due to continuous dewatering. The design and execution of deep excavation with earthen Cofferdam for waterfront structures are challenging. The selection of filling material for embankment formation and dewatering techniques plays a vital role in the safety and stability of the embankments. Although all the safety measures were taken during the design, execution challenges are unpredictable.

Keywords: Deep excavation, Embankment, Cofferdam, Slope stability, PLAXIS, Dewatering, and sudden drawdown.

CONFINED SPACE AND INNER-CITY PROJECTS – FUTURE CHALLENGE AND OPPORTUNITY FOR DIAPHRAGM WALLING

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ABSTRACT: Diaphragm walls are known as underground structural elements commonly used as retention systems for excavation pits and shafts and permanent foundation walls or elements. One can anticipate that global urbanization and increasing demands on environmental considerations will need to be accommodated in underground space in the future. These trends show an increasing requirement for diaphragm walling in even more complex conditions, especially in inner-city applications with limited space. Complex conditions in terms of space limitations, especially for inner city job sites, require specifically adapted solutions for slurry, spoil, reinforcement and concrete handling and the related logistics to ensure smooth production. Furthermore, one focus will be given to the QA/QC topics of the production process. Real time installation control, data transfer and reporting systems become more and more important. Therefore, the paper will describe the construction method and the sequence of activities required for the construction of diaphragm wall systems. It will describe also the main equipment that will be needed to execute these works under various conditions. In addition to the general description of the system and the required equipment, the paper will show some site examples for infrastructure projects with their specific solutions when working under space restrictions.

Keywords: Diaphragm wall, Trench Cutter

EFFECTS OF CHANGE IN THE SUPPORT SYSTEM ON TEMPORARY SECANT PILE WALL

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ABSTRACT: Deep excavation with support system is required to construct various part of underground structures like shafts, stations and entry structures etc. These structures have to be constructed using permanent or temporary embedded retaining walls with support system. The selection of a suitable type of retaining wall will depend upon the geological condition present in the particular location, time, cost and available equipment etc. In Bangalore Metro Rail Project, secant pile wall is adopted as the temporary earth retaining system and depth of excavation is about 20 m. It is designed initially based on bottom up construction methodology with 3 level of struts and 3 level of anchors but at later stage due to time and other construction related issues, it is decided to change the configuration to 6 levels of strut. Generally, in deep excavations, all the underground structures should be designed and checked for the critical forces from both permanent stage and construction stages. Since, secant piles are used as temporary retaining wall, only construction stage analysis is carried out to get the governing forces and deformation. In construction stage analysis, soil layers are defined with boundary conditions and the surcharge during construction and surcharge from actual building near the secant pile are considered. This paper discusses the effect of change in the support system from anchors to struts and how these changes in the support system affect the behavior of secant pile and subsequently adjacent buildings present in the influence zone of the excavation. As a result, in changing from anchors to struts, the wall displacement, strut forces and ground movement on the adjacent ground and buildings increases. The increase in deflection, ground movements and strut forces occurs during backfilling sequence of the underground station excavation. During backfilling, struts has to be removed and this imparts higher magnitude in deflection, strut forces and ground movements.

Keywords: Support system, Anchors, Struts, Ground movement, Settlement

IMPACT ASSESSMENT OF EXCAVATION INDUCED SETTLEMENTS: A STUDY OF CHENNAI METRO PHASE II

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ABSTRACT: The Phase 2 of Chennai Metro is being introduced in the city to ease the dependence on the existing transportation systems. Phase 2 is a combination of underground and elevated metro stretches comprising of three corridors. The current study focusses on the underground stretch of Corridor 3 which has a total of 29 underground stations. Construction of the underground cut and cover stations results in ground movements, which in turn impact the structures adjacent to the excavations. The greenfield ground settlement can be evaluated with the help of empirical approach or an approach requiring finite element modelling (FEM). The paper compares empirical and FEM approaches with regards to ground conditions in Chennai. Further, with the predicted ground settlements,

building damage assessment is performed. The damage category of a building is defined based on the estimated tensile strains. This paper also compares the building damage assessment with empirical method and finite element modelling.

Keywords: cut and cover excavations, settlement trough, building damage assessment

OVERVIEW OF ENABLING WORKS FOR WATERFRONT STRUCTURES – DESIGN & CONSTRUCTION

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ABSTRACT: Major bridges crossing mighty rivers must be constructed in flowing water. Constructing the sub-structure in water has been a challenging job for contractor. Special construction techniques with marine fleets to be adopted for waterfront construction. Enabling works like temporary piling platform and cofferdam used for pile and pile cap construction. Apart from this, enabling works like load out jetty to transport the materials from land to water; temporary walkway for access of workman to work location; temporary access bridge for construction vehicles movement; temporary liners for tower crane foundation; Concrete block to act as dead man anchor for barge movements were all required by the contractor for smooth functioning of site as per construction schedule. Investment in enabling works by contractor plays a significant role on profit margin of the project and of course with utmost safety. Design of enabling works for waterfront structures involves hydrological data like afflux, bathymetry survey, current force, scour depth and wave force to be taken cautiously for safe and economic design. Type of foundation and pile/well cap top level corresponding to water levels shall influence the construction scheme. Usage of geotechnical software like Wallap and Plaxis required for enabling work design to enhance the safety of the structure. Bathymetry and soil condition play a critical role in design and construction of enabling works. Water Discharge quantity in river along with water levels like low water level, high flood level, seasonal fluctuation of water levels has a great impact on design of enabling works. Establishing enabling works for waterfront construction near to an existing bridge is an additional challenge for the contractor. Along with design, constructing the enabling works in water requires special construction methodology and sequence of work. This paper shall provide insights on overview of design and construction of enabling works for waterfront construction.

Keywords: Afflux, Bathymetry, Cofferdam, Enabling works, Scour depth, Sheet pile, Software, Temporary Platform, Waterfront construction.

REALISTIC ESTIMATION OF WATER TABLE DEPTH FOR DESIGN OPTIMIZATION OF BORED TUNNEL AND CUT & COVER TUNNEL STRUCTURES FOR UNDERGROUND METRO

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ABSTRACT: With the rapid expansion of urban transportation systems, tunnels and cut & cover structures are considered as the only solution in improving the urban space congestion problem in mass rapid transit system. Therefore, it is necessary to accurately design underground structures with realistic assumptions and considerations of design parameters like site geotechnical data, water table, surcharge load etc. Over conservative approach provides not only uneconomical design but sometimes it also causes overdesign of the concerned structures. Water table depth has a significant role in some design aspects of underground structures like floatation check, lateral and uplift pressure on the buried structure, etc. In current practice of tunnel and cut & cover structure design, water table is assumed to coincide with the ground level. Most of the Design Basis Reports & Outline Design Specifications directly mention consideration of water table at ground level for floatation check and load calculations, etc. However, the actual scenario is different in most of the cities specially in northern, central, western and eastern regions of India except the coastal cities.

In the present study an attempt has been made to carry out a parametric study on the effect of water table depth in the design of a typical 6.3m outer diameter circular tunnel with 6m backfill. In this study, it is also attempted to establish an analytical method of calculating the most realistic consideration of water table depth instead of the present hypothetical assumption of considering water table to coincide with the ground level. The findings of the current study may be helpful to the researchers and practising engineers in design of tunnel and cut & cover structure for subways and metros.

Keywords: Underground Structure, Water Table, Floatation.

"SPECIAL APPLICATION OF MICRO-PILES" FOR THE CONSTRUCTION OF A BRIDGE WELL FOUNDATION

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ABSTRACT: Pavai-and TeampT JV started working on the project T49A, Sumbar J & K State as part of slope and earth stabilization for ongoing Banihal - Katra Railway Connection Project. This project has several tunnels and bridges with slopes that are protected with various types of protection system such rock bolting, rock anchors, and micro piles. For the main two bridges Bring number 2 and 3 at T49 A location Pavai - TeampT JV has to design and execute the circular group of micro piles (Fig.1) for deep excavation of earth for the purpose of construction of well foundations (CAISSON FOUNDATIONS) for both bridge 2 and 3 piers. In this paper we discuss about the purpose, basic design, detailed design approaches and actual work implementation of micro pile with composite rock bolt applications and permanent rock anchors for slope stabilization works in this project.

Keywords – Active and Passive Earth Pressures, Micro Piles, Capping Beam, SDA Bar, Waler.

ADVANCED GEOTECHNICAL INVESTIGATION AND DATA INTERPRETATION FOR COMPLEX UNDERGROUND STRUCTURES

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ABSTRACT: In recent times, development of underground space for variety of purposes is becoming more viable alternative to surface facilities with an ultimate aim of conserving surface space for various reasons and for strategic purposes. However, construction of underground structures continues to be expensive, with project cost rising rapidly and often significantly exceeding the preconstruction estimate. One of the most desirable and optimistic ways to improve the economic feasibility of underground construction is adopting a proper and systematic geotechnical investigation process. As variation in geology plays a dominant role in cost, feasibility, safety and behaviour of underground structure, serious consideration has to be given for geotechnical investigation. As soon as the investigation data is obtained, it should be properly interpreted and evaluated to get a meaningful outcome for greater savings in cost and time through optimum design. The basic objective of this paper is to recommend guidelines for planning and executing an effective multiphase geotechnical investigation programme with advanced methods depending on the complexity of project and timely interpretation of the investigation data. This paper highly emphasizes on deriving the stratigraphy, structural features, presence of water pockets, insitu stress condition and strength parameters through field and laboratory investigations. From this study, Geotechnical Engineers are expected to achieve a great extent of understanding in interpretation of investigation data and collaborating inter related geotechnical information to derive the aforementioned key inputs. As a result, this will help in designing adequate support system for the underground structures, eradicating the possibilities of overdesign.

Keywords: Geotechnical investigation, guidelines, field testing, geotechnical parameters, underground structure

ANALYZING THE DYNAMIC PILE LOAD TEST MEASUREMENT WITH AN AID OF STRESS WAVE THEORY

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ABSTRACT: A traditional static pile load test is considered to be a reliable, but time consuming and expensive way to determine the pile load-settlement behavior/bearing capacity. The imminent risks of personal injuries/site damage increases when heavy kentledge structures are used as counterweight and then collapse or when support elements fail. Static Load Testing (SLT) is nowadays often replaced by less time consuming and more economic methods, such as the High Strain Dynamic Testing (HSDT, commonly known as Dynamic Load Testing or DLT) and Rapid Load Testing (RLT). But these quick methods also have their own limitations and disadvantages. This paper focusses on the advantages/disadvantages of DLT, which is performed by dropping a reaction mass on the

pile head. This introduces an impact load on the pile top and as a result stress waves will propagate in the pile from the pile top to the pile toe, where they will reflect. The stress waves also generate reflections when changes in pile cross section (necking's, bulbs, pile toe), changes in pile material properties and friction along the pile shaft are encountered. The waves travelling from the top (downward waves) and waves travelling to the top (upward waves) contain information, and these waves can be separated to derive this information by performing measurements of strain and acceleration near the pile head. The mobilized pile capacity can be established by performing signal matching on the upward wave information, using wave equation software like AllWave-DLT or Capwap. This paper discusses the importance of understanding the principles of stress wave theory in combination with DLT and for the proper elaboration, interpretation and understanding of test results. Most important factors for setting up and performing a good field test, as well as for establishing mobilized capacity from the test results are also discussed in the paper.

Keywords: DLT, Dynamic Load Testing, High Strain Dynamic Test, HSDT, Signal Matching, drop weight, bored piles

NONDESTRUCTIVE LENGTH ESTIMATION OF PILE FOUNDATION

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ABSTRACT: A new method called Effective Dispersion Analysis of Reflections (EDAR) was recently developed to effectively analyze the waves generated from lateral impact to piles. Lateral impact leads to transverse waves which are dispersive and thus time domain processing based on peak picking fail to produce accurate results. EDAR provides a new visualization method for analyzing wave reflections by examining the phase difference of a pair of recorded response in the frequency domain by explicitly incorporating the dispersion characteristics of the waves. EDAR can also provide an alternate method to easily visualize the reflection for top impact scenarios, reducing the subjectivity of time domain peak picking. EDAR also incorporates the effects of radiation damping due to the surrounding soil resulting in more accurate length estimates in field conditions. Pile length estimates obtained were within 10% error margins in field conditions after careful analysis accounting for the soil effects.

PERFORMANCE OF STONE COLUMNS IN SOFT CLAY - A COMPARATIVE STUDY OF BEARING CAPACITY OF SOIL ESTIMATED USING IS CODE METHOD, ACTUAL FIELD LOAD TESTS AND OBSERVATIONS FROM NUMERICAL MODEL –A CASE STUDY

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ABSTRACT: Assam cancer care foundation (ACCF) proposed the construction of hospitals and related facilities across 18 locations in the state of Assam-India. In this paper, study on Performance of stone columns in soft clayey soils at Jorhat site, one among the 18 locations is discussed. At this site, Ground improvement by Vibro-stone columns of 900mm diameter were installed at spacing of 2.0m C/C in square pattern up to a depth of 9m below founding level by Dry-bottom feed vibro-displacement method to improve the safe bearing capacity of in situ soil from 70 Kpa to 140 Kpa to support hospital building, LINAC block and service building, by method of reinforcing the ground as they provide increased bearing capacity and reduce the foundation settlements. Stone columns were designed based on guidelines given in IS-15284(Part-I)-2013. The reliability of any method can be justified based on their ability to predict safe bearing capacities. Design is validated by two initial field load tests (single & group

column test) and three routine load tests (single column test) as per guidelines given in IS code. Results showed 20 % higher than estimated safe bearing capacities. Numerical modeling was also performed using PLAXIS -2D program. Deformations & stability checked using software and results were compared with actual settlements estimated empirically along with the field load tests. Comparison of Results shows theoretical, field load test results holds good with Numerical Analysis Results

Keywords: Vibro Stone column, Single column & Group column load tests, Silty clayey, Dry bottom feed vibro displacement method

RAPID LOAD TESTING: THE QUICK MAINTAINED QUASI-STATIC LOAD TEST

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ABSTRACT: Until the mid 1980s the only alternative to Static Load Testing (SLT) of Deep Foundation Elements was High Strain Dynamic Testing (HSDT), generally referred to as Dynamic Load Testing (DLT). While DLT offers advantages over SLT (such as the short test duration), it also has clear disadvantages (especially for cast-in-situ elements) that are well documented. In the mid 1980s an alternative was developed, which is now known as the Rapid Load Test (RLT). This testing method incorporates the advantages of both SLT and DLT by applying a quasi-static load to the foundation element and soil. As more experience was gained with RLT (through the various systems that are commercially available), the confidence in this testing method increased, resulting in a Japanese, Australian and ASTM standard for this testing method that was first published in 2008 and a Eurocode that was issued in 2016. This paper will describe the various RLT devices that are available, the techniques for obtaining the quasi static pile/soil behavior from the test results, the RLT prediction and analysis methods, as well as the equipment required to monitor the test itself. All this will be illustrated by a description of RLT tests that were performed as test program for optimization of the foundation design and for quality control of the design and construction of working piles.

Keywords: Rapid Load Testing, StatRapid, pile load testing,

UNCERTAINTIES IN PILE CAPACITIES DUE TO THE PRESENCE OF DECAYED WOOD LAYERS – A CASE STUDY

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ABSTRACT: In coastal or marine areas, deep pile foundations are facing a common issue of encountering decayed wood layers at greater depths. In many cases, the depth of piles are prefixed and piles are likely to be terminated at this decayed wood layer. The decayed wood layer is highly compressible and have

very low shear strength. This leads to reduced load carrying capacity which affects the stability of foundation. Hence suitable care has to be taken in choosing the geotechnical design parameters for this type of ground condition.

Based on the data from a major project site, this paper is an attempt to highlight the uncertainties in the estimation of pile capacities due to the variations in the thickness of the decayed wood layers in the vicinity of a particular bore hole. Attempt was also made to predict the capacity and settlement of pile groups, if terminated in these decayed wood layers.

Keywords: Pile capacity, Decayed wood layers, Pile group settlement

USE OF RELIABILITY BASED APPROACH TO DETERMINE GEOTECHNICAL PARAMETERS OF SOIL SITE

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ABSTRACT: Proper Geotechnical investigation plays an important role in suitably addressing the geotechnical challenges faced during construction stages. However, improper investigations lead to shocking results both financially and technically. Some of the most important geotechnical investigation tests like Standard Penetration Test (SPT), Pressure Meter Test (PMT), etc. which are very much important in determining the foundation parameters, require too much manual intervention. These factors govern the workmanship of geotechnical investigation and the results we obtain from them. This leads to uncertainty in the results of these investigations.

Generally, numbers of tests are conducted below a particular structure and their average results are used for the design of foundation or other underground utilities. In the backdrop of the fact that there are no stringent guidelines on the extent of geotechnical investigations to be carried out below critical structures like Defense facilities, Nuclear facilities, etc., this method of averaging may lead to obnoxious results. The greatest drawback of this approach is that we are not using sufficient data to characterize the soil profile of any particular area. In case some more investigations are done in that area, the results may change drastically. In this paper reliability-based approach is used to estimate the parameters obtained from SPT & PMT. The probabilistic approach is used to estimate the 95 percentile values of parameters that become input for the design of underground structures or utilities. As the uncertainty exists in the evaluation of these parameters due to improper investigations, it is appropriate to evaluate these parameters based on the probabilistic approach using the best fit probabilistic distribution curve. This approach helps in the conservative estimation of geotechnical parameters below any structure with minimal failure probability.

Keywords: Standard Penetration Test, Pressure Meter Test, 95 percentile values.

DESIGN AND PERFORMANCE EVALUATION OF A GROUTING PROGRAM IN WEAK ROCK MASSES

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ABSTRACT: Grouting is performed in rock masses in order to increase its strength properties and also to reduce the seepage. In the design of underground structures such as tunnels or caverns located in weak rock masses, grouting plays an essential role. Grouting is a complex process demanding high degree of skill and knowledge in understanding of grout flow and requirements for certain geological conditions. This paper discusses the design process for grouting in rock masses adopted for a cavern project and the practical difficulties faced during the execution at site. The design parameters of grouting includes the injection pressure, grout material properties and stopping criteria. The paper also discusses the various tests performed at site to evaluate the efficacy of the grouting process which was initially defined based on the design and previous experiences. The final grouting scheme suiting to the present geological condition is arrived based on the test results. The practical difficulties faced during the execution and the measures taken to overcome these are discussed in detail. This work shows the importance of state of art in the development of a grouting process based on geological and hydrogeological conditions prevailing at site and can be helpful in grouting design for weak rock masses.

Keywords: Grouting, Weak Rockmasses, Efficacy, Design

DEVELOPMENT OF DESIGN CHARTS FOR SAND COMPACTION PILE METHOD OF IMPROVEMENT FOR LOOSE TO MEDIUM DENSE SANDS

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ABSTRACT: The improvement of soft clay deposits using stone columns is a well-established ground improvement technique in the western world. This technique has been well documented and has proper design codes for precise execution in the field. The sand compaction pile (SCP) method is a contemporary technique to stone columns and has limited literature related to the strength characteristics of the loose to medium dense sand deposits treated with SCP. The available studies on the SCPs installed in cohesionless deposits focused on the improvement by indirectly assessing the SPT-N values pre- and post-installation of the SCPs. The widespread implementation of the SCP technique in recent years has increased the need for a more direct evaluation of the improvement. Earlier studies in this regard have revealed that the available design solutions are based on the type of installation equipment, their working efficiency, and accumulated field data. However, it is found that there are no generic design codes for the direct estimation of the ultimate bearing capacity of the SCP improved cohesionless deposits. To meet the design requirement for the SCP treated ground, a series of experimental and numerical investigations are performed in the present study to arrive at a direct framework in the form of design charts based on the pressure-settlement response of the treated ground. The developed design charts give the ultimate bearing capacity (UBC) of the treated sand deposit for the known initial relative density (RD) of the deposit, spacing and diameter of the SCPs, size of the footing, and for the specified target unit weight required for the intended application. It is concluded that the design charts will be of preliminary use to the design engineers to directly evaluate the UBC of the SCP improved loose

to medium dense cohesionless deposits as part of the SCP method of ground improvement. It is expected to have more field-scale experiments and in-depth analysis before implementing these charts for actual field execution.

Keywords: sand compaction pile method, design chart, ultimate bearing capacity, bearing capacity factor, single column, multiple columns.

GROUND IMPROVEMENT USING STONE COLUMNS TO MITIGATE LIQUEFACTION POTENTIAL OF FINE SAND BY WET TOP FEED VIBRO REPLACEMENT METHOD – A CASE STUDY

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ABSTRACT: This is a case study on ground improvement using Stone columns at Kokrajhar in Assam which comes under seismic Zone V as per IS: 1893. The strata at site comprised of mostly fine sands with low SPT- N values, fine content less than 10% and ground water table (GWT) at shallow depth. As ground water table subjected to seasonal variation, water table is considered at ground level for designing purpose. The geotechnical profile of the boreholes was analysed on the guidelines of IS 1893 (Part 1) -2016 and it was observed that the liquefaction potential of the soil layers is prominent and ground improvement is inevitable up to a depth of 9.5 m below existing ground level. In order to mitigate the liquefaction of soil layer, Stone columns were proposed. The in-situ soil is densified using wet top feed vibro- replacement method with an area replacement ratio of 16%, so that the relative density of the soil can be enhanced to prevent liquefaction risk. Correlation between relative density, fines content and increment of SPT N –value given by Tokimatsu and Yoshimi (1983) was used for designing purpose. Field tests such as SPTs were carried out at site to validate the extent of SPT (N) improvement. Detail comparison of pre and post density, SPT N values and CRR values were discussed in this paper.

Keywords: Liquefaction, Stone column, SPT, CPT, Wet top feed vibro replacement method, Relative density, Replacement ratio, Cyclic resistance ratio (CRR)

IN-SITU STUDY ON IMPROVEMENT OF SOFT GROUND USING STONE COLUMNS FOR RAILWAY EMBANKMENT

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ABSTRACT: The authors through this paper intend to introduce the non-vibro technique of ground improvement by stone column, being used for the first time in India under the Western Dedicated freight Corridor in Mumbai area. New 2x25 KV double line dedicated freight corridor tracks, capable of carrying 32.5-ton axle load are proposed to be built on this stretch. Non-Vibro Displacement Stone Columns of 900 mm diameter were installed to improve the safe bearing capacity of the soft ground to take the loading of Dedicated Freight Corridor Railway embankment.

Vertical footing load tests on single and three column groups were conducted to assess the improvement in the sub-surface condition after installation of stone columns. This paper describes load tests conducted on stone columns and analysis of the obtained results. The observed load settlement behaviour of the improved ground has also been presented. Behaviour of single and group of stone columns have been compared and criteria adopted for arriving at desired factor of safety based on the settlement observed, has also been discussed.

KEYWORDS: Stone Columns, Soft Soils, Ground Improvement, Consolidation, Pre-loading

MARINE CLAY STABILISATION USING AN ENCASED STONE COLUMN WITH TYRE CHIPS AS AGGREGATES

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ABSTRACT: A stone column is one of the most commonly employed methods of ground improvement techniques. This method used to increase the strength, decrease the compressibility of loose granular and fine-grained soils. Also, it accelerates the consolidation in clays and reduces the liquefaction potential of sands and silt soils. In general, the stone column contains 15 to 75mm stone aggregates. In reality, it is not easy to avail the natural stone aggregates due to unavailability in locally nearby places. Present work aims to replace the stones partially or entirely by scrap tyre chips as an alternative material. The utilisation of recycled tyre chips in ground improvement is an environmentally friendly solution and avoid the disposal of tyre chip waste in large pits. Model tests conducted on marine clay with encased end bearing stone columns (ESC) constructed with a mixture of stone aggregate and tyre chips with sizes 4.75 to 10mm. The column diameter is 75 mm, L/d ratio maintained to 5.3. Non-woven geotextile wrapped encased stone column has introduced in the soft marine clay model. Encasement prevents the lateral squeezing of aggregates into the surrounding clay and protects the drainage function of the stone column. A set of load-settlement tests were conducted on both the clay model and clay model treated with the stones-tyre chips column. The model was loaded by the tri-axial loading frame. Shear strength parameters of stones and tyre chips were determined by large size direct shear tests. Model test results are concluding that the load-carrying capacity of the clay is improved significantly after installing the stone column in it. The encasement increases the load-carrying capacity and stiffness of the ordinary stone column. It is also proved that the stone aggregate could be replaced partially by tyre chips up to 60% without a significant reduction in its performance.

Keywords: Stones, tyre chips, marine clay, model test

BEHAVIOUR OF PILED RAFT- IMPORTANCE OF OBSERVATIONAL STUDY

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ABSTRACT: Piled raft foundation system is an intelligent geotechnical concept, developed towards reducing the settlement of the raft and the footings by providing pile elements below the raft or footings, as the case maybe. Although a large volume of works has been done on the behaviour of piled rafts by observational studies, the effect of construction methodologies such as deep excavations, the installation methodologies used for piling etc appear to have not been covered adequately. This paper discusses the effect of deep excavations, pile installation techniques and the effect of adding structural elements, based on the data available from published literatures. Based on this study, the performance of the piled raft monitored by the author has been revisited and the results of

such a study are discussed.

KEYWORDS: Piled raft, ANSYS, Compressible layer

A STUDY ON THE EVALUATION OF PILE BEARING CAPACITY FACTOR AND ADHESION FACTOR IN IS 2911

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ABSTRACT: Bearing capacity factor (Nq) and Adhesion factor (α) are the key parameters for analyzing the load carrying capacity of pile foundations embedded in cohesionless and cohesive soils respectively. Numerous models are available in the form of charts or equations for the computation of these parameters and hence, have been adopted by most of the International and National standards. Indian Standard for the Design and Construction of Concrete Pile Foundations, IS 2911–Part 1 (2010), also makes use of charts detailed in its Annexure B. However, the sources of these charts have not been specified clearly, making it difficult to back-refer to the actual models to assess their basis for resolving any critical scenarios encountered during design. The present study aims at acquiring a distinct understanding of the development of these charts in order to bring more clarity to the design process of pile foundations. The given charts have been compared with various models specified in existing literature and international standards for the calculation of Nq and α for both driven and bored piles and hence, the basis of Indian Standard charts has been identified. Moreover, it is evident that the use of these charts complicates the process of automation of analysis and design of pile foundations as well as the associated optimization studies. Additionally, the manual entry of data especially, from the logarithmic graph of Nq, escalates the chances of error thus, making it a critical concern for design offices. Therefore, this paper also presents a non-linear regression model for Nq and α, developed using NCSS software for both driven and bored piles. Through multiple iterations, the value of coefficient of determination for Nq and α has been found to reach greater than 0.995. The developed equations can be simplistically used for both manual and automated analysis of pile foundations.

Keywords: adhesion factor, bearing capacity factor, pile foundation, regression equations

DETERMINATION OF PILE SPRING IN STRATIFIED LAYERS

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ABSTRACT: Spring stiffness of soil and rock at different depth is often required for a pile structural model. If the pile is rested in multiple layers of soil, then it is rather more complex to simulate the soil in a structural model. The spring stiffness will vary based on density of soil strata over the depth. When a pile is socketed in weathered rock followed by a soil layer, a sudden change in subgrade modulus can influence the pile deflection drastically. Determination of soil spring and simulation of the pile in this condition required correct interpretation of subgrade

modulus. The conventional approach of pile spring calculation underestimates the spring stiffness by ignoring underlaying stiffer layers. A finite difference method (FDM) of analysis can reasonably estimate the p-y of soil / rock based on subgrade modulus of each layer. However, the transition between the layers can be better simulated as per the deflection pattern of the pile. The lateral deflection of the pile is mainly dependent on the stiffness of soil layer surrounded by the pile. Generally, the lateral influence of a pile varies from 4D to 6D depending on the soil type. Therefore, soil spring stiffness around the pile would require special attention of a Geotechnical engineer to avoid uncertainty in the prediction of pile behaviour.

In this paper, emphasis has been given to develop an approach for pile spring stiffness design. A standard software program LPile has been used to develop p-y curves of soil and rock layers at different depths and then converted to soil/ rock springs over the depth. Modulus of Subgrade Reaction as given in IS 2911 (Part2) was also used to correlate the spring value for different type of soil. Obtained analytical results were compared with full scale field trial for lateral deflection of pile. A good agreement between these two approaches has been established.

The effect of soil structure interaction in the structural model shall be simulated by assigning an equivalent vertical and horizontal soil spring, which is developed by Winkler's soil spring approach. A simplified design principle for calculating the pile spring is discussed in this paper. This approach has been extensively used in Mumbai metro elevated line pile design.

Keywords: Pile spring, stiffness, Modulus of Subgrade Reaction, p-y curves

FOUNDATIONS OF SELF DRILLING MICROPILES IN 4G AND 5G NETWORK TELECOM MASTS IN INDIA

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ABSTRACT: Micropiles transfer tension or compression forces as well as cyclic loads into the ground via skin friction. The Self Drilling Micropiles (SDM) can be utilized for permanent applications. The hollow bar simultaneously acts, as drilling rod, injection tube and reinforcement for the micropile. The SDM system can be used in any type of soil, including unstable soils, without the need for temporary casing. Injecting a cement grout through the hollow steel tendon ensures that the borehole is filled from the bottom to the top. The system is fast, simple, and flexible. The installation minimises noise, vibration, and spoil. There are many potential applications, including foundations, underpinning, resisting uplift, dynamic/cyclic load applications and geothermal installations.

The SDM technology were introduced to India first time in the Indian history and utilised in the 4G and 5G network projects. The SDM challenge the traditional cast-in-situ piles in the 4G project and raft foundations in the 5G project. Utilisations of the tensile and the compressive strength capacity of SDM with smart solutions results in noticeably big costs, 17-38 % depending on the soil conditions and time savings. The cost of the SDM solutions was about 40% less than the cast-in-situ piles and raft foundations in an ongoing 5G project. The SDM were used successfully in the liquefiable soil types as well.

Keywords: self-drilling micropiles, telecom mast foundation, power transmission tower foundation

HOW CHOICE OF FOUNDATION CAN ALTER THE FATE OF A BRIDGE PROJECT – 3 CASE STUDIES

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ABSTRACT: The most uncertain and challenging part of a bridge design and construction is the 'Choice of foundation'. During the planning and conceptual design stage, it is extremely important to choose the right type of foundation. Wrong choice can lead to disaster for the project. This paper will present three interesting case studies of past bridge projects, to demonstrate how correct choice of foundation can help to meet the project commitments while the wrong choice of foundations can led to huge delay in project completion, leading to time and cost overrun.

Keywords: Pile Foundation, Well Foundation, Prestressed rock anchors, Vibro-hammer, jacketing.

LINER PILES USED AS SUPPORT TO KENTLEDGE FOR INITIAL COMPRESSION LOAD TEST

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ABSTRACT: The initial pile load tests are conducted to ensure the geotechnical capacity of the pile in a particular site condition. Normally kentledge method is adopted for the compression pile load tests. In this method the entire kentledge load is loaded above secondary beams which are supported by concrete blocks above the Natural Ground Level. So, it is important to ensure the SBC (for shear and settlement) of the natural ground. In one of our projects initially it was decided to go with kentledge system for initial compression load test on 56m long 1200mm diameter BCIS pile. The test load and total kentledge load were 2160t and 2700t, respectively. The soil strata mainly consisted of clay with low SPT N value and water table almost at ground level. It was suggested to replace top soil using Granular Sub-base (GSB) with good compaction in order to avoid excessive settlement of concrete blocks placed to support the kentledge weight. When the kentledge loading started, even before reaching 10% of total kentledge load, excessive settlement on the GSB layer was observed. This paper describes the problems faced during normal kentledge method and how it was overcome using the liner pile system for initial compression load tests in this particular site condition for higher test load.

Keywords: Geotechnical capacity, kentledge, liner piles, load test, settlement.

NUMERICAL STUDY ON UPLIFT CAPACITY OF HELICAL PILE EMBEDDED IN CLAY

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ABSTRACT: Helical piles foundation systems have been extensively used in engineering application. It is commonly adopted to resist the compression, uplift force, overturning moment and lateral forces. Helical pile system is extensively used in many structures such as Transmission towers, Wind farms and other offshore structure because it is easy and quick to install. Realizing the importance of helical pile, an attempt is made in the present investigation to bring out the effect of spacing between the helix, blade thickness, and shaft thickness through numerical analysis. To validate the finite element model experimental investigation was carried out. In this investigation model steel piles with dual helical plate embedded in clay bed with the consistency of 0.4 was tested to study the effect of uplift loading on the behaviour of piles in tensions. Model helical pile with 12.5 mm diameter circular shaft and helix diameter of 25 mm. The model pile embedded in clay bed for a depth of 400 mm. Parametric analysis of helical pile by varying blade thickness, shaft thickness, and the spacing of helix was carried out by using Finite Element tool Plaxis 3D. From this analysis, an increase in thickness from 4 mm to 10mm increase the uplift load. Similarly, an increase in spacing of helices from 0.5 m to 1.5m increase the uplift capacity beyond that it decreases the uplift capacity. By keeping the contact area of the helix as constant as the number of a helix and helical spacing was varied, the critical number of the helix was found as 2 and the critical spacing of helix was found as 1.5 m for this study.

Keywords: Critical spacing, Finite element method, Helical pile, Uplift capacity.

PERFORMANCE OF STORAGE TANKS SUPPORTED BY SHALLOW & DEEP FOUNDATIONS

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ABSTRACT: Storage tanks are heavily loaded thin-shelled structures that exert large loads on and require large foundations to support them. They are generally very sensitive to foundation settlements as it may hinder the performance of tanks resulting in significant commercial or social impacts. Selection of their foundation is dependent on availability of suitable ground and limitations imposed by design specifications. Design of the tank foundations is generally based on theoretical methods and validation by representative field tests. This paper reviews settlement criteria for storage tanks as per national and international standards, case studies of large to medium diameter tanks supported on deep foundation i.e., bored cast-in-situ piles and shallow foundations on improved ground and their performance during load tests & hydro-tests is discussed. Paper concludes that storage tanks can also be supported on shallow foundations resting on improved ground reducing the settlement, time and cost significantly depending on the sub-soil.

Keywords: piles, ground improvement, storage tanks, hydrotest

RECTIFICATION MEASURES AND RESTORATION OF DISTRESSED PUMP FOUNDATIONS

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ABSTRACT: At a Fertilizer plant located in the southern part of India, 74 numbers of pump foundations have shown non-uniform settlements causing the tilting of pump foundations under self-weight primarily due to the presence of varying thickness of the heterogeneous subsoil beneath the pump foundations and soil erosion because of water seepage through deeper excavations in the close vicinity. Various corrective measures have been explored and taking due cognizance of the prevailing subsoil conditions, site constraints, and constructability aspects, micropiling has been adopted.

This paper presents the site problem and details of remedial measures adopted for rehabilitation of the distressed pump foundations. The main objective of this paper is to provide guidelines for designer during design and detail engineering stage to avoid similar nature of problems and also to provide a solution concept to tackle similar nature of problem(s) if encountered at site.

Keywords: pump foundation, settlement, micropile

REVERSE CIRCULATION DRILLING (RCD) TECHNOLOGY FOR LARGE-DIAMETER PILES

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ABSTRACT: For today's construction industry, large-diameter piles are common practice, as they are more competitive than drilling a larger number of smaller piles. More and more piles are installed by drilling rigs, replacing the installation by hammer, vibrators or caisson. Equipment capabilities and technics with rotary drill rigs are highly developed, but very costly and time-consuming when it comes to rock drilling, large diameters and deep foundations. Pile top drill rigs (PBA), based on reverse circulation drilling (RCD) technology, overcome these challenges and are an efficient solution for large diameter drilling (0.6 m to 8.0 m/19.7 ft to 26.3 ft) and drilling depths of up to 500 m (1,640 ft.)in various geological conditions onshore and offshore. The paper will explain benefits of RCD technology and prove this with figures from the Mumbai Trans Harbour Link project.

Keywords: deep foundations, reverse circulation drilling (RCD), large diameter drilling, hard rock drilling, onshore/offshore drilling

SOIL-STRUCTURE INTERACTION FOR A TENSION PILE PULLED WITH STRAND

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ABSTRACT: A unique tension pile where the pull is at a point a certain distance below the top of the pile. The pull is transferred by a cable consisting of high tensile strands. The HDPE duct of the cable prevents bond between the strands and pile concrete in upper portion. While soil friction on the pile will act downwards on the whole length, there is tension in the bottom portion of pile, there will be compression at the top portion.

Keywords: Tension, compression, annular space, high tensile strands, side friction

VSM AND OFD® TECHNOLOGY: MECHANIZED SOLUTIONS FOR ON- AND OFFSHORE DEEP FOUNDATIONS

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ABSTRACT: Due to the worldwide population growth, the development of sustainable infrastructure and the exploration of renewable energies plays a key role to handle the rising megacity trends and to limit carbon footprint.

Herrenknecht AG is a leading manufacturer of Tunnel Boring machines and has constantly endeavored through its extensive Research and Development programs to address limitations faced by the civil engineering industry as regards to construction equipment capabilities. New mechanized technologies, mainly coming from the tunnelling industry, have been developed by Herrenknecht AG as an efficient alternative to conventional civil engineering, where tailor-made concepts are required to comply with restricted conditions onsite.

Very often this innovation led technology capability has meant making construction processes safer due to minimal human intervention and also far more productive due to higher performance as compared to other latest or conventional methods of construction. The rising need for even higher building structures and large-capacity bridges involve the development of innovative deep foundation technologies for on- and offshore operation. Conventional methods like bore piles reach their technical and economic limits under certain conditions.

For building shafts and foundations, the mechanized Vertical Shaft Sinking Machine technology (VSM) from Herrenknecht AG is a proven innovation and has now been used in various onshore infrastructure projects worldwide to construct a total of 94 circular shafts in depths of up to 115 meters. It operates below the groundwater level, completely remote-controlled from the surface in a diameter range from 4.5 to 18 meters.

Subsequently Herrenknecht noted that Offshore foundations, especially in non-drivable ground conditions such as soft and hard rock (e.g. limestone, sandstone, mudstone, granite etc. or soft soil with high density) and shallow continental shelf (water depth approx. 20-60m), presented construction challenges and equally an opportunity for building high performance equipment. The latter construction conditions usually requires drilled installation methods for applications such as harbor enlargements, bridge foundations and foundations for offshore wind turbines. The Offshore Foundation Drilling technology (OFD®) is Herrenknecht's latest innovation, incorporating our learnings from the VSM and full-face Tunnel Boring machines, and the OFD® enables a rapid and economical offshore installation in such variable ground and rock conditions.

This paper will discuss the technology behind the new mechanized technology of VSM and Herrenknecht's latest innovation of the OFD® along with their respective application fields in foundations construction. The paper will further present in details, their range of benefits to the construction industry.

Keywords: drilling, under water, rock drilling, high availability, performance drilling, offshoredrilling, Mechanized foundation drilling, monopile, shaft construction

ANALYSIS OF SOIL - CEMENT MIXTURE FOR GROUND IMPROVEMENT

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ABSTRACT: The main principle of any ground improvement technique is to improve the engineering properties of soil, enhance its stability and amplify its bearing capacity. Soil-cement columns by deep soil mixing for enhancing the properties of low relative density soil, is one such ground improvement technique. In the present study, load carrying capacities of soil cement column were analysed. Two different soils with low relative density from Dahisar River Mumbai and Tapi River, Gujarat were mixed with OPC 53 grade cement. Soil cube samples were prepared by varying water cement ratio and cement content. Cement dosages of 275Kg/m3; 325Kg/m3; 375Kg/m3; 425Kg/m3 were taken at varying water cement ratio of 0.2, 0.3, and 0.4. After curing, the soil cement cube samples were tested at 7 days and 28 days unconfined compressive strength. The results showed that the compressive strength of both the soil samples improved with cement content. An optimum compressive strength was achieved at water cement ratio 0.4% and cement dosage of 425Kg/m3.

COMPARISON OF GROUND MOVEMENT NEAR BUILDINGS DUE TO UNDERGROUND STATION EXCAVATION WITH ANALYTICAL AND NUMERICAL METHODS

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ABSTRACT: In urban areas, construction of underground stations and basements is always a challenging task due to the presence of dense sensitive buildings in the vicinity. The main objective of this paper is to predict the ground movements associated with construction phase of launching shaft excavation in Bangalore Metro project analytically. Also, the comparison of these predicted values with numerical values, and subsequently with actual measurements is presented. These values will help to assess the potential damage, both architecturally and structurally, to the existing building in the influence zone due to ground movements. The principles given by Bowles (1990) and Clough & O'Rourke (1990) depending on the type of soil shall be used to compute ground movements of buildings present in the influence zone. Based on several case histories, Clough and O'Rourke (1990) suggested that the settlement profile is triangular for an excavation in sandy soil or stiff clay. The maximum ground surface settlement will occur just behind the wall. The influence zone of the corresponding settlement will extend about twice to thrice of the influence depth (He) for sandy soil and stiff to very hard clays, respectively. This paper compares ground movement of building predicted by above analytical method and numerical analysis carried out using PLAXIS 2D finite element software. The buildings that are in the influence zone of excavation are considered. On comparing the results obtained from numerical, analytical and actual settlement values, it is observed that wall deflection from numerical values is about 33% higher than actual value. In addition, the

maximum ground settlement obtained from numerical analysis is comparable with the settlement obtained from analytical approach. However, the observed settlements at the building locations are significantly smaller than predicted. This might be due to support provided by the secant pile walls in the opposite side as the stress around the retaining wall will be in three-dimensional direction. Also the deep ground water table during the excavation could have helped in reducing the wall movement and the ground settlement.

Keywords: Ground movement, Influence zone, Instrumentation, PLAXIS 2D

THEORETICAL STUDY ON OPTIMUM DEPTH OF GROUND IMPROVEMENT FOR LATERALLY LOADED PILES IN CLAYEY DEPOSIT

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ABSTRACT: Pile foundation is generally used to transfer the vertical load of the superstructure through weak soil to competent bearing stratum. However, in some cases lateral load needs to be transmitted along with axial load, e.g., offshore piles subjected to wind and wave induced load, pile foundation under seismic motion etc. In case of pile embedded in soft to medium stiff clayey deposit, lateral pile deflection may not be in the allowable deflection range under the applied lateral load. Hence, ground improvement may be carried out to increase the lateral pile capacity. Knowledge of the required depth of ground improvement is very much essential in this aspect. In this present study, Beam on Nonlinear Winkler Foundation (BNWF) approach has been used to get a preliminary estimation of optimum depth of ground improvement required to enhance the lateral load carrying capacity of pile. Optimum depth of ground improvement can be defined as the depth from ground surface up to which any increase in soil stiffness will increase the lateral capacity of pile. Further improvement of soil properties beyond this optimum depth will have very little impact on lateral pile capacity. Fourth order governing differential equation of pile deflection has been solved. Element stiffness matrix has been derived and presented in a compact form. A computer code has been written in MATLAB and investigation has been carried out on piles of different slenderness ratios (L/D) of different pile stiffness factors (Ep/Es) to determine the optimum depth of ground improvement.

KEYWORDS: BNWF, Pile, Ground Improvement, Lateral capacity

CASE STUDY ON EFFECT OF VIBRATION FROM PILE DRIVING ON NEARBY BUILDINGS

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ABSTRACT: Vizhinjam International Seaport is a port under construction in Arabian Sea at Thiruvananthapuram, the capital city of Kerala, India. Pile foundation (DMC type bored cast in situ pile) has been recommended to support the harbour structures. Pile load test (Test pile) was conducted as per BI Specifications on the reclaimed sea shore before the piling operations. The fishermen community in the nearby area complained that cracks were

developed in their houses due to the test pile works. They demanded suspension of the piling work or adequate measures to protect their houses adjacent to the project site. An expert committee was formulated by the authorities to investigate the issue and to suggest remedial measures. A detailed field study was conducted to monitor the vibration levels produced by pile construction and also its distance of influence. The study was conducted during the driving of steel casing and boring operations near the test pile already finished under similar working conditions. The vibration levels were measured using accelerometers in the surrounding ground and adjacent buildings within a radial distance of 500 m. The measured acceleration levels were used to predict the vibration levels in future due to piling operations in the harbour area. Nature and extent of damages in buildings as claimed by the occupants due to the test pile were measured. The buildings in the study area are very old and of poor quality construction. The maximum level of vibration observed at the site was 1.5 mm/s. The measured vibration levels were compared with permissible vibration limits and safe distance between the pile and buildings was determined.

Keywords: Pile driving; vibration level; acceleration

CASE STUDY FOR REMOVAL OF REDUNDANT STEEL JOIST PILES UNDER BASE SLAB OF AN OPERATIONAL METRO STATION BY NATM PILOT TUNNEL FOR CLEARING THE ALIGNMENT FOR EAST WEST METRO LINE TUNNELS IN KOLKATA, INDIA

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ABSTRACT: Kolkata East West Metro is a predominantly underground corridor traversing the most congested part of the city. The twin tunnels pass below an existing North-South Metro underground Station at a depth of 8.593 m from base slab. It was discovered that there was a temporary steel decking for maintaining vehicular traffic during construction of the underground station and parts of some huge redundant steel joist piles were still remaining under the base-slab of existing station which would obstruct the alignment of twin tunnels of new Metro line being bored with EPB tunnel boring machines. Those machines were not capable to cut such steel joists and it was obligatory to remove those joist piles before tunneling. As the steel joist are existing below base slab of an operational metro station, there was no scope for physical extraction of those piles from surface. Proper methodology was devised for removal of those piles by construction of pilot tunnel by New Austrian Tunneling Method [NATM] which was a unique challenge in soft alluvial geology of Kolkata. The pilot tunnel was subsequently suitably filled up for boring of main tunnels. Due to sensitive location of the work, proper measures for minimizing ground settlement was adopted to avert any distress to the structure of the existing metro station as well as metro tracks. Elaborate instrumentation schemes for monitoring ground movement parameters were undertaken during NATM pilot tunnel as well as subsequent work of main tunnels. The geotechnical parameters and design issues associated with this soft ground NATM pilot tunnel and subsequent passage of main tunnels and measures adopted to restrict ground movement are discussed in this case study. The instrumentation schemes for ground movement are also elaborated and the field results are compared with predicted values.

Keywords: Kolkata Metro , Geotechnical investigation, Tunneling, ground movement, NATM

CONFERENCE CHAIR AND TECHNICAL CHAIR

Conference Chair and Session Chair

Mr. Mohan Ramanathan
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Mr.Mohan Ramanathan is the 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 a B.Tech in Civil Engineering from IIT, Madras in India and Masters from UIUC,USA. He is also an active member in several professional societies like DFII, IGS, Inst of Engineers,ACCE, ICI and IDA.He is constantly involved in the transfer of technologies into India from developed countries. Presently,his firm Advanced Construction Technologies (ACT) represents several giants in the Infrastructure sector. He is an active member in the Executive Committee of DFII and also heading the initiative in the introduction of Helical Screw Piles in India.

Conference Technical Chair

Prof. A Boominathan
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Dr. A. Boominathan is a Professor of Geotechnical Engineering Division of IIT Madras. He obtained his Ph.D. in Geotechnical Engineering from Moscow Civil Engineering Institute in 1986. He worked as a CSIR Scientific Pool Officer at the Ocean Engineering Centre, IIT Madras in 1987. Since 1988, he has been a faculty member of IIT Madras. Prof. Boominathan has geotechnical, geophysical and earthquake engineering background through teaching, research and consulting. He has guided 13 Ph.D, 11 MS (by Research) and several M.Tech theses. He has authored over 190 scientific papers including 58 papers in referred journals and serves as an editorial board member of Journal of Earthquake & Tsunami. He received IGS-Shri M.S. Jain biennial prize in 2004 and IGS-Prof. C.S. Desai Biannual Prize in 2012 from the Indian Geotechnical Society. He was chairman of IGS Chennai Chapter during 2012-17 and conducted 6 IGS2015 and IGC 2016. He is IGS National Executive committee member during 2014-17 and 2020-21.

TECHNICAL SESSION CHAIRS

Sunil S. Basarkar, Ph.D,
General Manager, Afcons Infrastructure Limited

Dr. Basarkar is working as General Manager in Afcons Infrastructure Limited, Mumbai and is Head of a specialized Geotechnical engineering design group engaged in geotechnical investigations, pile constructions, deep retaining structures, ground improvements, drilling, grouting and variety of geotechnical and tunnel engineering involved in Land, Marine and infrastructural EPC projects. He had been profusely involved in Elevated as well Underground metro works at Kolkata, Delhi, Jaipur, Nagpur, Ahmedabad, Kanpur, Bangalore, Chennai and many cities in India.

He is a graduate in Civil Engineering from NIT Rourkela, post-graduate in Geotechnical Engineering from Pune University and PhD in Pile foundations from IIT Bombay.

He has field experience of 16 years in areas of geotechnical engineering with infrastructural organizations in addition to Academic and Research experience of 16 years.

Published 54 papers in Journals and Conference proceedings: 54.

He is Fellow of several professional organizations like The Institution of Engineers (India), Indian Geotechnical Society, and Indian Institute of Bridge Engineer

He is National Executive Committee Member, Deep Foundations Institute of India, and Present Co-Editor, Deep Foundations Institute Journal (USA).

Annapoorni Iyer,
Engosym Consultants

Annapoorni Iyer is a first-generation entrepreneur and has been in the civil engineering Industry from the year 2001. She has more than 19 years of experience and deeply believes in 'Knowledge is Power'. Annapoorni graduated in civil engineering in the year 2001 from Mumbai University. Without much wait she was employed with Maccaferri group, a pioneer group in providing engineering solutions to various geotechnical problems with flexible structures. She was given the opportunity to handle various critical slope stability issues encountered in various prestigious projects like

- Mumbai-Pune Expressway,
- Konkan Railway,
- Ahmedabad-Vadodara Expressway,
- Pakyong Airport at Sikkim (Tallest reinforced structure in the world) and many more.

With her strong belief and more than 15+ years of experience in the technical field and exposure to commercial and execution aspects, she ventured into entrepreneurship by establishing her consultancy firm in the year 2017, 'Engosym Consultants'. She has number of National and International papers published to her credit. Her objectives include spreading industrial and corporate experience to student community for the benefit of construction industry. She is passionate about giving back to the society through joy of engineering.

Annapoorni has been active in various forums and always looks ways and means to give back the knowledge and experience gained to the student community. She is an active contributor to the IGS Pune Chapter.

She is also an active member of DFI community and is a part of WiDFI. In the Annual DFI conference held at Hyderabad in the year 2019, she was an invited for a panel discussion on Women in Civil engineering field.

Annapoorni Iyer has been appointed as Council member, Maharashtra Social Media Council of WICCI. WICCI and she looks forward to support more and more women in the industry in their future endeavors.

Prof. K. Ilamparuthi
(Retd. Anna University)

Prof Kanni Ilamparuthi retired as Senior Professor from College of Engineering Guindy, Anna University after more than 30 years teaching. He has total 35 years research experience including a fellowship from Commonwealth form October 1999 to November 2000, University of Liverpool, UK.

Prof Ilamparuthi obtained his PhD from IIT Madras in 1991, while he completed his civil engineering studies from College of Engineering, Guindy, Madras University and post graduation from the same institute in 1982.

He has guided 11 PhDs and 152 ME thesis. He has more than 200 international and national journal and conference publications. He is Co-editor of the book "Geotechnical Design and Practice-Selected Topics", Development in Geotechnical Engineering ,Springer Nature Singapore Pte. Ltd. 2019.

Prof Ilamparuthi is a member DFI, Life Member at ISTE and Life Fellow of IGS.

Awards received by Prof Ilamparuthi:

- IGS – YGE Best Paper Biennial Award – 2019 for the Paper entitled "Laboratory Study on Response of Single Pile Adjacent to Supported Cut" by R.K.Madhumathi and K.lamparuthi published in Journal of Geotechnical and Geological Engineering, (2018),Vol. 36 Issue 5, pp. 3111-3133", under the section"Deep Excavations and Underground Structures".
- Active Consultant Award for the year 2015, Anna University.
- Commonwealth fellow (Geotechnical Engineering) University of Liverpool, UK .
- IGS & AIMIL Best paper Award on Instrumentation for the paper – "Performance Monitoring and Numerical Simulation of Piled Raft Foundations of a 12 storey Building" published in Indian Geotechnical Journal (2008).
- IGS & Z.Tech (P) Ltd., Award on Geotextiles Application for the paper – "Role of Geotextile in dewatering with High water content wastes" published in IGC 2004 .
- IGS & AFCONS Award for Case Histories for the paper – "Field study on piled raft foundation on twelve storied building in Chennai" Published in IGC-2003.
- IGS & Shri.B.N. Gupta Award for New Approaches & Techniques for analysis and Design of foundation for the paper- "Analyses of raft foundation" published in IGC 2001.

Prof Ilamparuthi is adjudicator/jury member of many technical committees of Government of Tamilnadu

Govind Raj,
Geotechnical Manager, Keller Ground Engineering

Govind Raj is practicing Geotechnical Engineer having 19 years of experience in analysis, design and execution of foundations for infrastructure projects. He had worked for Multinational Organizations such as Swiss boring (Trevy Group), Zublin Ground Engineering (Ed Zublin/Strabag) and Six Construct at various levels. He had Master's in Structural Engineering from National Institute of Technology, Calicut in 2002.

Presently, he is working with Keller Ground Engineering (I) Pvt Ltd since 2019 as the Geotechnical Manager. His area of interest includes construction of Heavy Foundations esp. "Bored Piles, Diaphragm Walls and Deep Excavations".

Dr. C R Parthasarathy

Founder, Chairman and Managing Director, Sarathy Geotech and Engineering Services Pvt Ltd., https://sarathygeotech.com//

He started his career as a Geotechnical Engineer in 1993 and involved in numerous large scale site investigation/engineering studies for both Offshore and Onland projects viz., multi-storeyed complexes, refineries, embankments, bridges, water-retaining structures, offshore platforms, pipelines, Jackup rigs etc. He has rich experience in Site Characterisation & Deep Foundation testing. He is the user of PDI products for over two decades.

Dr CR Parthasarathy is the founder director of Sarathy Geotech & Engineering Services Pvt ltd, the company with its registered office at Bangalore, India, was established in 2007 to provide geotechnical and testing services for both offshore and on land constructions in India and abroad.

As a technical partner of Pile Dynamics USA, he is instrumental in promoting quality testing of deep foundations in India and authorised trainer for high strain dynamic pile testing.

He is the life fellow of Indian Geotechnical Society (IGS), Elected National Executive Member of IGS for three consecutive terms and currently Chairman, IGS-Bengaluru Chapter.

M. Jeevan Reddy

B.Tech, M.Tech, Associate - Geotechnical, AECOM

M. Jeevan Reddy is currently working in AECOM as Associate with 13 years of experience in wide range of civil engineering projects like bridges and metros, Ports & Marine structures, Reclamation and Ground Improvement for both offshore & onshore terminals.

My experience as a Geotechnical Engineer includes preparing interpretation of ground strategy reports, foundation designs, technical specifications for Highways & railway bridge structures, stability analyses for embankment and excavation, Reclamation and Ground improvement design, Spun pile design, Design of excavation support systems, provide recommendations for foundations (deep and shallow), design of stone columns, Vibro compaction & PVD for ground improvement.

Ravi Sundaram

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Mr. Ravi Sundaram is founder Director of Cengrs Geotechnica Pvt. Ltd. and directs the company's geotechnical consultancy services and geotechnical construction activities.

His expertise includes geotechnical investigations, geophysical surveys, ground improvement and groundwater studies. He has published over 70 papers reflecting his experience in geotechnical practice. He strives to integrate field experience with academic research in order to be responsive to complex geotechnical challenges facing India.

- Received IGS-Prof. Dinesh Mohan Memorial Award [2017-18] for Excellence in Professional Practice.
- Delivered the prestigious 6th MADHAV LECTURE (in honor of Prof. Madhav, former Vice-President –Asia, ISSMGE) in 2017 on "Geotechnical Investigations in Difficult Soil Conditions – Indian Experiences".
- Received the IGS Delhi Chapter Lifetime Achievement Award in 2012.
- Co-edited a book titled "Geotechnics for Transportation Infrastructure" published by Springer Nature, Singapore (2019)

He obtained his B. Tech in Civil Engg in 1978, M.Tech in Soil Mech & Found. Engg in 1980, from IIT Delhi.

Subhadeep Banerjee

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Subhadeep Banerjee is currently serving as the Professor of the Department of Civil Engineering at Indian Institute of Technology, Madras, India. He received his PhD in Civil Engineering from National University of Singapore in 2010. His research interests include seismic soil-foundation interactions, cyclic behaviour of geomaterials and finite element analysis of complex dynamic problems. Besides, he is also an expert in constitutive modelling of soils special emphasis to the transient dynamic behaviour. At IIT Madras, he has formed three research groups to study the following attributes, (i) Cyclic characterization of various types natural soils, improved ground, landfills etc., (ii) Development of constitutive models of soils emphasizing on their performance under seismic loadings, and (iii) Application of fundamentals of dynamics to various complex soil-structure problems such as, tunneling, base isolation techniques, plate anchors, retaining walls etc

PVSR Prasad
Geotechnical Manager for Keller India (South)

P.V.S.R. Prasad graduated with a Master of Technology in Geotechnical Engineering from Indian Institute of Technology in Delhi, India. Prasad has been working with Keller since 2006, and he is presently Geotechnical Manager for Keller India (South). He served almost 15 years in Keller Malaysia & Keller India as a design manager and he handled complex geotechnical engineering challenges during his career. His professional interests include heavy foundations especially bored cast in-situ piles, deep excavations, ground improvement works in soft soils, soil retention system using deep soil mixing, jet grouting and various grouting works in soil & rock for different applications like highways, commercial buildings, storage tanks, dams and metro stations.

Ravikiran Vaidya,
Principal Engineer of Geo Dynamics

Mr. Ravikiran Vaidya, Principal Engineer of Geo Dynamics has been instrumental in popularizing the concept of Deep Foundation Testing in India. He has created a deep foundation testing industry and today Geo Dynamics is India's biggest and well acclaimed company in this field.

He is the recipient of the prestigious Dinesh Mohan Award for Excellence in Professional Practice for the year 2018-2019 by the IGS

He is one the national executive committee member of IGS, DFI and on the IRC and BIS sub-committee and is well acclaimed both in academia and industry.

Sangeen Desai, Deputy Manager Business Development at Keller Ground Engineering (I) Pvt Ltd

Sangeen is a Deputy Manager Business Development at Keller Ground Engineering (I) Pvt Ltd. She has vast experience of 10 years in field of Geotechnical Engineering with specialization in ground improvement techniques to support oil storage tanks, process units, treatment plants, highways, slope stabilization, buildings. She hold's a bachelor's in Civil engineering from Maharaja SayajiRao University Baroda of and master's of Geotechnical engineering from Indian Institute of Technology Roorkee.

Dr. K. Muthukkumaran
Professor, NIT Trichy

Dr. K. Muthukkumaran is currently Professor in Civil Engineering at National Institute of Technology, Tiruchirappalli, India. He obtained Ph.D. in Soil-Structure Interaction and Marine Geotechnical Engineering from Indian Institute Technology Madras. He has published more than 120 papers in international and national journals and conferences. He has completed 5 R & D (including ISRO - Chandrayaan- 2 Mission project) & 60 major consultancy projects in Geotechnical Engineering and published two patent including "Moon Soil" (A Method for Manufacture of Highland Lunar Soil Simulant). He has guided 8 PhD, 5 MS (by research) and more than 40 M.Tech. students in Geotechnical and allied research areas. He is the Founder Chairman of Indian Geotechnical Society (IGS-Trichy) Trichy Chapter. He is a member of Technical Committee (TC-301 on "Preservation of Historic Sites") of International Society for Soil Mechanics and Geotechnical Engineering. He has been elected as member of IGS National Executive Committee for 2017-18. He is an International Advisory Member of Soil Structure Interaction Group, Egypt. He is an Associate Editor of Journal of Innovative Infrastructure Solutions and peer reviewer of various journals of ASCE, Elsevier, Springer and Taylor & Francis. Prof. Muthukkumaran area of research is in geotechnical engineering, which includes pile foundation, soil-structure interaction, marine geotechnics & foundations, field instrumentation, geotechnical physical modeling, ground improvement and forensic geotechnical engineering. He has received DST Young Scientist Award, IGS- Smt. Indra Joshi Biennial Award and Keynote Paper Award – GEOMATE Conference 2015 at Osaka, Japan. Prof. Muthukkumaran has significant administrative contribution as Estate Officer, Associate Dean (Planning and Development), Member of Buildings and Works Committee and member of Board of Governors (BoG) of National Institute of Technology, Tiruchirappalli and Member of Buildings and Works Committee, IIM Trichy. He has received NIT Trichy Achiever Awards for research publications, research projects, maximum citation and consultancy projects. He is a recipient of Bharat Vikas Award -2018.

Dr. B. Umashankar
Professor, Indian Institute of Technology Hyderabad. https://civil.iith.ac.in/dr-b-umashankar/

Balunaini Umashankar is Professor in the Department of Civil Engineering, IIT Hyderabad. He has been with IIT Hyderabad since 2009 after completing his PhD from Purdue University. He specializes in geotechnical engineering with research focus on foundation engineering, geosynthetics in pavements, reinforced earth structures, recyclable materials in geotechnics, and soil-structure interaction.

He has been involved with several research projects funded by National Highway Authority of India (NHAI), Ministry of Road Transport & Highways (MoRTH), Neyveli Lignite Co. Ltd. (NLC), Department of Science and Technology (DST), etc. He advises Irrigation & CAD Department, Government of Telangana, in many projects including the recently concluded prestigious project in the State- 'The Kaleshwaram Lift Irrigation Scherme'.

Kondapalli Bairagi
Geotechnical Engineering Head, L&T Wet Division

Kondapalli Bairagi completed his Master's degree (M. Tech) in Geotechnical Engineering from NIT Warangal in 1997. He joined in L&T –ECC as a Post graduate engineer in 1997. He is an Expert in geotechnical engineering designs, detailing and execution guidance. Handled all kinds of Geotechnical designs for Power plants, Steel plants, Water treatment projects & Infra structure projects with his technical management of geotechnical engineering efforts, widely recognized as an experienced geotechnical engineer in the field of onshore construction projects. His expertise in the field and personalized approach to design, resulted in significant project savings in L&T Construction during last 20 years.

Presently he is heading the Geotechnical Engineering design team to provide the conceptual designs, comprehensive recommendations, detailed engineering and economic alternatives pertaining to the foundations for various structures in Water supply projects, Sewage treatment projects, Industrial projects & Irrigation Projects for L&T Construction.

He published a few technical papers in the field of geotechnical engineering in National wide conferences.

DFI INDIA OFFICE TEAM

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Theme Network Sessions 15-18 November 2021

CFA Pile Technology - 15 Nov 2021 -5:00 pm to 6:00pm

Dr Sunl Basarkar, Afcons Infrastructure
Mr. Thomas Domanski, TDA Geotech.
Mr. V K Panwar, Engineers India Limited
Dr. K V Babu, L&T Hydrocarbon
Mr. Sanjoy Chakraborti, Soilmec India
Dr Kumar Pitchumani, Aecom

Foundations for Offshore Structures & Monopiles -15th Nov 6PM-7PM

Prof Subhamoy Bhattacharya Univ of Surrey UK
Dr. Rajesh Katyal, NIWE
Mr Rajamanickam Ramanathan, AFCONS
Dr. Madhuri Murali FUGRO

Deep Foundation Instrumentation Testing and Analysis (Design and Performance) - 16 Nov 2021 -5:00 pm to 6:00pm

Mr Ravikiran Vaidya, Geo Dynamics
Mr Akhleshkumar Laharia, Nuclear Power Corporation Ltd
Mr Sheshmani Sonkar, SMEC International Pty Ltd
Dr Makarand Khare, Terranova Consultants
Mr Pradeep Ahirkar, National High Speed Rail Corp Ltd
Mr Prashant Joshi, Jkumar Infra Projects Limited

Helical Screw Piles -16th Nov 6PM-7PM

Mr Mohan Ramanathan, Advanced Technology
Prof Amit Prashant, IIT Gandhinagar
Prof Sumanta Haldar, IIT Bhubaneswar
Mr Manish Kumar, ITD Cementation

Advanced Testing Procedures for Gotechnical Investigation -17 Nov 2021 -5:00 pm to 6:00pm

Dr Parthasarathy CR, Sarathy Geotech & Engg Services Pvt ltd.
Dr Sanjay Rana, Parson Overseas (P) Ltd.
Mr Kandarp Bhatt, National Manager, Aimil Ltd
Dr Brent Robinson, Pile Dynamics Inc USA
Mr Shivakumar GC Bangalore Metro Corporation Ltd. (BMRCL)
Mr Ramzy M, TMG Manufacturers Inc. USA
Mr Ramakrishna Raju N, Tata Projects Ltd

Excavator based Foundation Techniques -17th Nov 5PM-6PM

Mr Mohan Ramanathan, Advanced Construction Technologies
Mr Ramarajan, VOLVO CE
Mr Shyam Chengalpath, PANASIA
Mr Ashutosh Dhar Worldcon Technologies

Reverse circulation drilling -18 Nov 2021 -5:00 pm to 6:00pm

Dr KS Rama Krishna, DFI India
Mr Theodore Paul, GM, ITD Cementation India Ltd
Dr Jaykumatr Shukla, Geo Dynamics
Mr Nikolas Schmitz, MHWirth Germany

Women in Deep Foundation -18 Nov 2021 -6:00 pm to 7:00pm

Ms Yogini Deshpande, Renuka Consultants
Ms Lucky Nagarajan, General Manager Engineering and Business Development, Giken America Corp
Ms Dola Roy Choudhury, VP Founder Director G-Cube Ltd Consulting Engineers LLP
Ms Sangeen Desai, Deputy Manager Business Development Keller Ground Engineering (India) Pvt Ltd.
Ms Annapoorni Iyer, Founder-Engosym Consultants Council Member - WICCI
Ms Anupama Choudhury, Senior Engineer Contracts of AFCONS Infrastructure Ltd
Dr Jaymohan, Principal LBS Institute of Technology for Women
Ms Akhila Manne, Unirac
Ms Aarti Bhargava, AIMIL Limited
Ms Anjana Kadni, Aecom

DFI INDIA INITIATIVES – PROGRESS UPDATE

Report by Mr.G Venkata Prasad
Director Operations, DFI of India

DFII completed eight successful years since it was incorporated, and close to 4 years since full time office was set up. It is pleasure for us to update the readers of this article that its various initiatives achieved further progress during last one year which is covered below. This is expected to leave an imprint in related areas of Indian geotechnical & deep foundation industry in the long run.

But for the sustained efforts of around 80 experts representing various DFII committees drawn from various organizations, good number of organizations sponsoring these programs, support from DFI USA, this would not have been a reality. DFII leadership offers their immense gratitude to all of them.

Progress update of DFII programs

DFII CFA Pile Technology Implementation Committee

After completing 6 trial piles installation and load testing, sharing relevant documents to major players of Indian deep foundation industry, CFA pile guideline document developed by the expert members of the committee is referred to Bureau of Indian Standards to approve this as IS Code and this is being followed up.

- Few of the prospective projects are being pursued to implement CFA pile technology with the support of few like-minded consultants/contractors/owners, and we are hoping to see this reality during 2021-22.
- To know other interesting developments of this program, follow the link on DFII website https://india.dfi.org/cfa-pile-india-/
- DFII Committee for Geotechnical Characterization of Foundations (DCGCF)
- CGCF team is ready to launch 5-day short term training and certification program covering existing soil lab technicians of different geotechnical investigation agencies.
- A four-hour trainer's workshop was held on 11th Sept'21. And, first pilot program is scheduled to be conducted at Nagpur to cover the local soil lab technicians during Dec'21. Learnings of this will be made use to fine-tune the program to conduct in different parts of India in future.
- National Academy of Construction, Hyderabad, DFII's training partner is setting up a full-fledged soil laboratory and expected to be in place by Nov'21. NABL accreditation process is expected to be completed by March'21 and thereafter regular DFII developed training programs will be conducted.
- More programs from the DCGCF are on agenda for enhancing work practices and follow the link to know about this https://india.dfi.org/geotechnical-characterization-for-foundations-india/

DFI Groundwork

DFI US put in place a global platform for the student community to provide mentorship programs to groom future generation geotechnical professionals and DFII teamed up with them to avail of this opportunity in India. Following programs were held during this year and further activities will be resumed commencing from Jan'22.

DFII leadership/Ground work committee are initiating necessary efforts to set up a platform for providing intern ship program to serve student community pursuing geotechnical courses.

Further, Students' competition 2021 has been initiated as part of DFI India 2021 conference. 41 students representing 12 teams Participated. Also, 30 minutes session with presentations by award winning students is scheduled during DFI India 2021 conference event.

Women in Deep Foundation Committee (WiDF)

Date	Technical	Professional Development
19 01 2021	Foundation Design Challenges for Tall Buildings by Emeritus Professor Harry G Poulos at University of Sidney & Senior Consultant with Coffey	Body Language by Mary Ellen, Technical Director, DFI
16 02 2021	Sustainable Foundations of High-Rise Building in Soft Soil – Requirements & Recommendations for Technical Solutions by Prof. Rolf Katzenbach, Technical University of Darmstadt, Germany & Founder of Katzenbach Engineers	Abstract Writing by Prof. Anne Lemnitzer
16 03 2021	An Introduction to ground anchor technology by Dr. Devon Mothersille, Managing Director Geoserve Global Ltd.	The Art of Negotiation by Ms. Jewel Stover
20 04 2021	Underground Infrastructures and Metros by Dr. William Cheang, Principal Consultant (Geotechnics) Engineering Simulations, Design Integration Analysis, Bentley Systems.	
18 05 2021	Ground Improvement for Railway embankments on soft marine clay and expansive soils - case studies by Mr. N Rama Krishna Raju, VicePresident & Head (Engineering). Tata Projects Limited, Hyderabad.	Mentorship with Intention and Purpose by Ms. Srilakshmi Nagarajan, General Manager, Engineering and Business Development, Giken America

Set up with the support of the DFI US team, its goal is to foster greater success and interest of professional women in the industry by promoting networking events, endorsing outreach, and building mentoring relationships.

Under "Civil Engineering Careers – Connect & Grow" series following 3 webinars were organized for the benefit of students and young professionals in India.

- 1st Webinar titled "Bridging Academia and Practise" conducted on 22nd Dec'21 – Panellists: Dr. N Kumar Pitchumani, Regional Director, AECOM, & Dola Roy Chowdhury.
- 2nd webinar titled "Education Beyond Classroom" conducted on 24th Feb'21 – Panellists: Dr. Akanksha Tyagi, IITR & Dr. R Chitra, CSMRS
- 3rd Webinar titled "Foundations for Future" held on 8th April 2021 - Panelists: Dr. Sunil S Basarkar, General Manager, Afcons Infrastructure Ltd. Mumbai Sridhar Valluri, DGM, Business Development Keller Ground Engineering Mumbai.

Further activities will be resumed commencing from Jan'22.

There will be a 60 minutes session by WiDF India team during DFI India 2021 conference on 20 November 2021. Technical presentations by women professional and videos of successful woman professionals planned.

DFI CMRL International Geotechnical Engineering, Contractual, Construction Working Group

Its goal is to provide value-based solutions to Chennai Metro second phase project. Its activities will pick up commencing from next year once COVID 19 pandemic situation eases.

Training Programs

There is good demand from the industry for training programs meant for field engineers for promoting

good work practices. DFII leadership is looking forward to put in place a strong platform consisting of experts (retired & working professionals) in different domains from the industry to focus on this area in future.

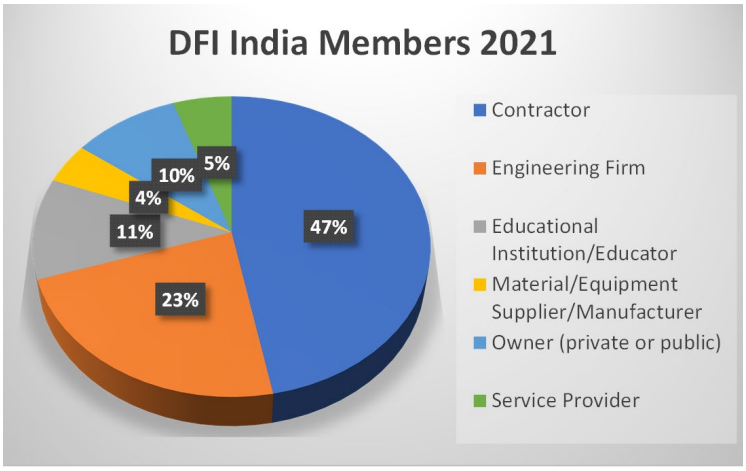
This year following two programs are planned to be implemented during the last quarter of FY 2021-22.

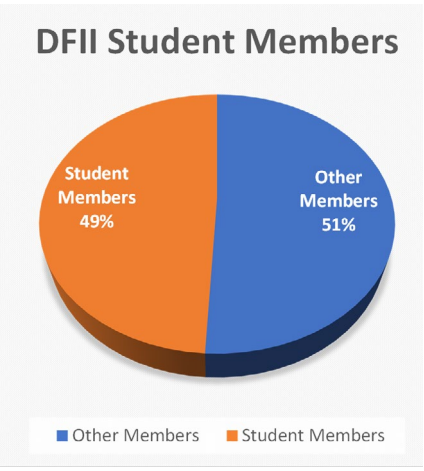
Current Programs (Planned during Dec'21 – Jan'22)

One 3-hour workshop program planned on the topic "Enhancing the Performance of Pile Construction" comprising the presentations from 3 experts from the industry, i.e., Dr K S Ramakrishna, past Chairman DFII, Mr Rajith Kumar from L&T and Dr Jaykumar Shukla from Geodynamics.

Workshop on RCD technology – Speakers inclued Mr Bob Schock, Mr Nicolas Schmitz, Head, Global Business & Sales, MHWirth, Mr Umesh, MhWirth India, Mr Vetriselvan, Technical Head, L&T Geostructures, Dr Jaykumar Shukla, Geodynamics

DFII Membership





We are thankful to all well wishers of DFII, its membership is growing steadily with more interest from students. Currently total membership stands at 452 with following composition from different stakeholders. We are hoping to improve this for the year 2022.

Plan for FY 2022-23

While continuing efforts to progress with current programs, DFII is envisaging to take up a few activities in the future ahead connected with a) helical piles b) piling rig operator training program. DFII members will have an update on the same once we are ready to initiate this.

Appeal to Well-Wishers of DFII

We request all well-wishers to come forward to become members of DFII, volunteer their time for the progress of different committee activities to serve mutual interests and to avail the following benefits.

Benefits of Associating with DFII

Visit to know more about DFII Programs www.dfi-india.org

Many major projects in India are impacted by means of time/cost overruns due to serious challenges in execution of geotechnical and foundation scope

DFI of India Platform is Available to address all such issues through Implementation of

- **New Technologies**
- **Skill Development Programs**
- **Good Work Practices**

Continuous Basis Learning & Training is required to address Foundation Industry Challenges

Knowledge Platforms

- **Conference/Workshops/Seminar Programs**
- **DFI Journals/Publications**
- **Educational Series Programs**
- **Other Training Programs**

Be Part of Various Committees for Enhancing Professional Competencies

DFII can help to develop TRAINING CALENDAR for different companies by offering customized programs

Help Yourself by Becoming Part of DFII Family

Conference /Workshops/ Webinars/Seminars

Professional Development

- Networking with International Experts
- Paper Presentation
- Gaining Knowledge about Advancements in Geo Foundation Industry
- Solutions to Constructions Challenges
- Products Knowledge

Showcasing the Products & Services

- Sponsorship
- Exhibitor

Be Part of Various Committee

Executive Committee

- Key Decision-Making Body on DFII Programs Comprising of Experts Representing Multiple Stakeholders

Technical Committees

- Be a Change Agent to Implement New Technologies, Skill Programs, Good Work Practices, Student Programs that Enhance Performance of Individuals, Companies and Industry

Conference Committees

- Technical & Organization Committees
- Conference & Session Chairs
- Paper Reviewer

Editorial Committee

- Newsletter and Other Publications

DFI India 2021 Virtual Conference Invitation

INVITATION
INAUGURAL SESSION

Deep Foundations Institute of India
in association with
Indian Institute of Technology Madras and
Indian Geotechnical Society Chennai Chapter
cordially invites you to join the 4-day virtual
10th Anniversary Conference on
'Deep Foundation Technologies for Infrastructure Development in India'

Dates
12-20 November 2021

Time
2:30 pm IST to 7:30 pm IST on 12, 13, 19 & 20 Nov '21 and
Network Sessions and Exhibition from 5:00 pm IST to 7:30 pm IST on 15,16,17 & 18 Nov '21

Venue
X-CD Platform

Inauguration and DFI India 2021 Lifetime Contribution Award
between 2:30 and 2:55 pm IST on 12 Nov '21

Mr. Murli Iyengar
Executive Director (Retd) of Engineers India Limited
will receive the DFI India Lifetime Contribution Award and
inaugurate the conference

Mr. Mohan Ramanathan
Managing Director of ACT Chennai and
Conference Chair
will chair the Inauguration Session

and

Prof. A Boominathan
Professor at IIT Madras and
Conference Technical Chair
will release the conference souvenir and proceedings

Details in the next sheet

DFI India 2021 Virtual Conference Schedule

DFI-India 2021 Conference Program*						
From (IST)	**To (IST)**	**Duration**	**Event**	**Speaker/Keynote**	**Organisation**	**Topic/Title**
Friday, November 12, 2021						
Day 1 Session 1: Chairs: 1. Dr. Sunil S Basarkar, Afcons Infrastructure Ltd. 2. Annapoorni Iyer, Engosym						
14:00	14:30	0:30	Conference Site Guide	Pranav	DFI India	
14:30	14:55	0:25	Inauguration			
14:55	15:45	0:50	**Keynote 1**	**Dr. R P Singh**	**NHSRCL, Mumbai**	**Recommended Practices in Ground Characterization for Complex Projects - An Owner's Perspective**
15:45	15:55	0:10	Sponsor Videos and Slides			
15:55	16:15	0:20	Paper: PID1251458	Bokka Kishor Kumar	TATA Projects	In-Situ Study on Improvement of Soft Ground using Stone Columns for Railway Embankment
16:15	16:35	0:20	TBD	TBD	TBD	TBD
16:35	17:05	0:30	Networking/Exhibition Break			
Day 1 Session 2: Chairs: 1. Prof. K Ilamparuthi, Anna University, 2. Govind Raj, Keller India						
17:05	17:25	0:20	Paper: PID1250588	Anjana Kadni	AECOM	Impact Assessment of Excavation Induced Settlements: A Study of Chennai Metro Phase II
17:25	17:45	0:20	Paper: PID1249664	Velugu Suresh Kumar	L&T Construction	Ground Improvement Using Stone Columns To Mitigate Liquefaction, Reduce Settlements and to Increase Bearing Capacity of In situ Soils – A Case Study
17:45	18:05	0:20	Paper: PID1250570	Chiranjib Sarkar	AECOM	Realistic Estimation of Water Table for Design Optimization of Bored Tunnel and Cut & Cover Tunnel Structures for Underground Metro
18:05	18:15	0:10	Platinum Sponsor Corporate Presentation - MHWirth - Mr. Anoop Menon			
18:15	18:25	0:10	Sponsor Videos and Slides			
18:25	19:15	0:50	**Keynote 2**	**Mr. Ben Rivers**	**Federal Highway Administration, USA**	**Making the Most of Your Site Characterization Programs: Bring Your A-GaME!**
19:15	19:20	0:05	Close	Session Chair		
Total (h:mm)		**4:50**				

DFI-India 2021 Conference Program*						
Saturday, November 13, 2021						
Day 2 Session 1: Chairs: 1. Dr. C R Parthasarathy, Sarathy Geotech, 2. Jeevan Reddy, AECOM						
14:30	14:35	0:05	Recap	Session Chair		
14:35	15:25	0:50	**Keynote 3**	**Mr. Alok Bhowmick**	**B&S Engineering Consultants, Noida**	**How the Choice of Foundation Can Alter the Fate of a Bridge Project – 3 Case Studies**
15:25	15:35	0:10	Sponsor Videos and Slides			
15:35	15:55	0:20	Paper: PID1250600	Gurpreet Singh Bhatia	NPCIL	Use of reliability based approach to determine geotechnical parameters of soil site
15:55	16:15	0:20	Paper: PID1250580	Sampat Raj	EIL	Rectification Measures and Restoration of Distressed Pump Foundations
16:15	16:25	0:10	Platinum Sponsor Corporate Presentation - Heritage Infraspace India - Mr. Pranil Chakraborty			
16:25	16:55	0:30	Networking/Exhibitation Break			
Day 2 Session 2: Chair: Dr. Ravi Sundaram, Cengrs Geotechnica						
16:55	18:25	1:30	**Panel Discussion - Harnessing Foundation & Geo Technologies for Accelerated Construction of Infrastructure Projects**			
18:25	18:35	0:10	Sponsor Videos and Slides			
18:35	18:55	0:20	Paper: PID1250946	Thomas John	L&T Geostructure	Liner Piles used as Support to Kentledge for Initial Compression Load Test
18:55	19:15	0:20	Paper: PID1250262	Dr. Chandramohan P	Navayuga Engg. Company	Soil Structure Interaction for a Tension Pile Pulled with Strand
19:15	19:20	0:05	Close	Session Chair		
Total (h:mm)		**4:50**				

* Conference Program subject to change

Conference & Registration Website: https://www.dfi-india.org/DFII2021/index.html

DFI India 2021 Virtual Conference Schedule

DFI-India 2021 Conference Program*			
Monday, November 15, 2021			
17:00	19:00	2:00	**1. CFA pile technology, 2. Helical screw piles**
17:30	19:30	2:00	Exhibition
Total (h:mm)		**2:30**	
Tuesday, November 16, 2021			
17:00	19:00	2:00	**1. Deep foundation instrumentation, testing and analysis (Design and performance), 2. Foundation for offshore structures and monopiles**
17:30	19:30	2:00	Exhibition
Total (h:mm)		**2:30**	
Wednesday, November 17, 2021			
17:00	19:00	2:00	**1. Advanced testing procedures for geotechnical investigation, 2. Mass stabilization for soils, 3. Excavator based foundation techniques**
17:30	19:30	2:00	Exhibition
Total (h:mm)		**2:30**	
Thursday, November 18, 2021			
17:00	19:00	2:00	**1. Reverse Circulation Drilling, 2. Women in Deep Foundation**
17:30	19:30	2:00	Exhibition
Total (h:mm)		**2:30**	

* Conference Program subject to change
Conference & Registration Website: https://www.dfi-india.org/DFII2021/index.html

DFI-India 2021 Conference Program*						
Friday, November 19, 2021						
Day 3 Session 1: Chairs: 1. Prof Subhadeep Banerjee, IITM, 2. PVSR Prasad, Keller India						
14:30	14:35	0:05	Recap	Session chair		
14:35	15:25	0:50	**Keynote 4**	**Mr Nikolas Schmitz**	**MHWirth, Germany**	**Reverse Circulation Drilling (RCD) Technology for Large Diameter Piles**
15:25	15:35	0:10	Sponsor Videos and Slides			
15:35	15:55	0:20	Paper: PID1250444	Dr. Lutfi Ay	AyCrete Ltd	Foundations of Self Drilling Micro Piles in 4G and 5G Network Telecom Masts in India
15:55	16:15	0:20	Paper: PID1250582	Dr. Marc Peters	Herrenknecht AG	VSM and OFD® TECHNOLOGY: Mechanised Solutions for Deep On- and Offshore foundations
16:15	16:35	0:20	Paper: PID1251102	Marcel Bielefeld	Allnamics Geo-technical & Pile Testing Experts	Rapid Load Testing: The Quick Maintained Quasi-Static Load Test
16:35	16:40	0:05	Diamond Sponsor Corporate Presentation - Keller Ground Engineering India			
16:40	17:10	0:30	Networking/Exhibition Break			
Day 3 Session 2: Chairs: 1. Ravikiran Vaidya, Geo Dynamics, 2. Sangeen Desai, Keller India						
17:10	17:30	0:20	Paper 14: PID1250566	Sandeep Pattnaik	Geoconsult	Determination of Pile Spring in Stratified Layers
17:30	17:50	0:20	Paper 15: PID1250894	Dr. V Balakumar	Simplex Infrastructure Ltd	Behaviour of Pile Raft - Importance of Observational Study
17:50	18:10	0:20	Paper 16: PID1251120	Vivek Samu	North Carolina State University	Nondestructive Length Estimation of Existing Pile Foundations through Effective Dispersion Analysis of Reflections
18:10	18:15	0:05	Diamond Sponsor Corporate Presentation - ITD Cementation			
18:15	18:25	0:10	Sponsor Videos and Slides			
18:25	19:15	0:50	**Keynote 5**	**Mr. Duncan Nicholson**	**Arup, London**	**Observational Methods in Deep Foundations**
19:15	19:20	0:05	Close	Session Chair		
Total (h:mm)		**4:50**				

* Conference Program subject to change
Conference & Registration Website: https://www.dfi-india.org/DFII2021/index.html

DFI India 2021 Virtual Conference Schedule

DFI-India 2021 Conference Program*						
From (IST)	**To (IST)**	**Duration**	**Event**	**Speaker/Keynote**	**Organisation**	**Topic/Title**
Saturday, November 20, 2021						
Day 4 Session 1: Chairs: 1. Dr. K Muthukkumaran, NIT Trichy, 2. Prof. B Umashankar, IIT Hyderabad						
14:30	14:35	0:05	Recap	Session Chair		
14:35	14:50	0:15	DFII Overview	Mr. G V Prasad	DFI India	Overview of DFI India Activities
14:50	14:55	0:05	Diamond Sponsor Corporate Presentation			
14:55	15:25	0:30	**GroundWork**			DFI India Student Program - GroundWork
15:25	15:35	0:10	Sponsor Videos and Slides			
15:35	15:55	0:20	Paper: PID1250564	Dr. N Aarthi	IIT Madras	Development of Design Charts for Sand Compaction Pile Method of Improvement for Loose to Medium Dense Sands
15:55	16:15	0:20	Paper: PID1250442	Raja Rajan Kalidoss	L&T	Overview of Enabling works for Waterfront Structures - Design & Construction
16:15	16:35	0:20	Paper: PID1250446	George Moses	L&T	Design and Performance Evaluation of a Grouting Program in Weak Rock Masses
16:35	17:05	0:30	Networking/Exhibition Break			
Day 4 Session 2: Chair: K Bairagi, L&T ECC						
17:05	17:55	0:50	**Keynote 6**	**Prof. John Endicott**	**AECOM, Hong Kong**	**Deep Excavations – An Historical Review**
17:55	18:05	0:10	Sponsor Videos and Slides			
18:05	19:05	1:00	**WiDF India**			**Success stories within us**
19:05	19:20	0:15	Valedictory session			
Total (h:mm)		**4:50**				

* Conference Program subject to change
Conference & Registration Website: https://www.dfi-india.org/DFII2021/index.html

DFI-India 2021 Conference Program*				
Paper Publication				
Delegates can read these technical papers anytime during the conference.	**Paper ID**	**Author**	**Organisation**	**Title**
	Paper: PID1250560	Nagaraj Kumar B V	Pavai Infra Geotech	Special Applications of Micro Piles for Construction of a Bridge Well Foundation
	Paper: PID1251084	Ashirbad Satapathy	BITS Pilani	A Study on The Evaluation of Pile Bearing Capacity Factor and Adhesion Factor in IS 2911
	Paper: PID1250526	Kalaiselvi M	L&T construction	Advanced Geotechnical Investigation and Data Interpretation for Complex Underground Structures
	Paper: PID1251072	Anburaj C	L&T Construction	Effects of Change in the Support System on Temporary Secant Pile Wall
	Paper: PID1251074	Srinivas Alagesan	L&T Construction	Comparison of Ground Movement near Buildings due to Underground Station Excavation with Analytical and Numerical
	Paper: PID1251080	Dileep Kumar	CUSAT	Uncertainties in Pile Capacities due to the Presence of Decayed Wood Layers - A Case Study
	Paper: PID1251068	Rashmi Patel	SVKM's NMIMS MPSTME	Analysis of Soil-Cement Mixture for Ground Improvement

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DFI India 2020 Virtual Conference Schedule

DFI-India 2021 Conference Program*				
Recorded Video Paper Presentation				
Delegates can watch these Video Presentations anytime during the conference under 'On Demand' section	**Paper ID**	**Speaker**	**Organisation**	**Title**
	Paper: PID1249912	Franz-Werner Gerressen	BAUER Maschinen GmbH	Diaphragm walls using trench cutter in confined space
	Paper: PID1250902	Biswanath Dewanjee	Kolkata Metro Rail Corporation	Case Study for Removal of Redundant Steel Joist Piles under Base Slab of an Operational Metro Station by NATM Pilot Tunnel for Clearing the Alignment for East West Metro Line Tunnels in Kolkata, India
	Paper: PID1251062	PVSR Prasad	Keller Ground Engineering India Pvt Ltd	Performance of Storage Tanks Supported by Shallow & Deep Foundations
	Paper: PID1251100	Marcel Bielefeld	Allnamics Geotechnical & Pile Testing Experts	Analyzing the dynamic pile load test measurement with an aid of stress wave theory
	Paper: PID1251256	Pamu Ramana	L& T Construction	Case Study: Challenges of Earthen Cofferdam in Deep Excavations for Waterfront Structures
	Paper: PID1250574	Tanumaya Mitra	IIEST, Shibpur	Theoretical Study on Optimum Depth of Ground Improvement for Laterally Loaded Piles Embedded in Clayey Deposit
	Paper: PID1250516	Jaya V	College of Engineering Trivandrum	A Case Study on Effect of Vibration from Pile Driving on Nearby Buildings
	Paper: PID1250484	Yeddala Krishnaiah	LNTECC	Performance of Stone Columns in Soft Clay - A Comparative Study of Bearing Capacity of Soil Estimated using IS Code Method, Actual Field Load Tests and Observations from Numerical Model – A Case Study
	Paper: PID1250496	Parameshwaran V S	L&T	Ground Improvement using Stone Columns to Mitigate Liquefaction Potential of Fine Sand by Wet Top Feed Vibro Replacement Method – A Case Study
	Paper: PID1250530	Naga Sivaji Bolisetti	NIT Calicut	Marine Clay Stabilisation using an Encased Stone Column Filled With Tyre Chips as Aggregates
	Paper: PID1250510	Karthick Kumar Viswanadhan	CEG, Anna University	Numerical Study on Uplift Capacity of Helical Pile Embedded in Clay

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Developing, manufacturing and marketing of deep foundations quality assurance NDT equipment for pile testing 40 years ago Dr. Joram Amir, the founder of Piletest, began using NDT (Non Destructive Testing) to perform quality assurance for deep foundations. Back then, at the late 1970's, there were no pile testing specific devices and he used an equipment which was cumbersome and required two people connected by a 100m long data cable. These field experiences, quickly led him to harness state-of-the-art technologies and develop a compact, lightweight and outdoor capable pile testing solutions - the PET (Pile Echo Tester).

18 Fouracres Walk, Hemel Hempstead, Herts HP3 9LB,
Contact: Gadi Lahat , Email: gadi@piletest.com

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Tsentralnaya st. 1M , Penza, Russia - 440004; +7 (8412) 99 91 89, export@npp-geotek.com

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MODEN; Get high-definition imaging of your boreholes to ensure contractor quality and consistency at all your projects. OJACK360: Evolution of the conventional OJACK System. Prevent the soft layer and pile load failure with a system that stops particle sedimentation around the jack. TremieMATE: Evolution of the conventional Tremie Mate System. Prevent a soft layer and pile load failure with a system that stops particle sedimentation at the pile bottom. TWAVE: Evolution of the conventional ultra sonic test. Get higher accuracy integrity of your pile to ensure foundation quality. Compact, lightweight and outdoor capable pile testing solutions - the PET (Pile Echo Tester).s.

20, Jalan PP 11/5, Alam Perdana Industrial Park, 47130 Puchong, Selangor, Malaysia - 47130, Contact: , Email: info.mrgeotech@gmail.com, Phone: +60 16-608 8129

HEICO

Hydraulic & Engineering Instruments popularly known as HEICO was established by Late Sardar Resham Singh Matharu in the year 1972. Right from its inception, the company has been serving the customers with quality control instruments for material testing mainly for soil, concrete, rock, bitumen, rubber, steel and many others. The company follows the standard quality management system as mandated for its registration with ISO 9001:2015 certificate.

B-59/4 , Naraina Industrial Area, Phase-2, New Delhi-110028, Contact: RAUNAQ Singh, Email: RAUNAQSINGH@HEICOIN.COM, Mobile: 9811046105

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Pile Top Drill Rigs(PBA)

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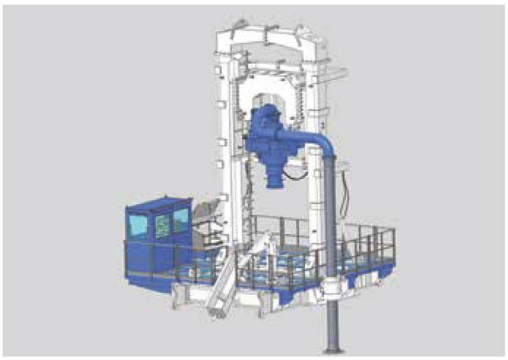
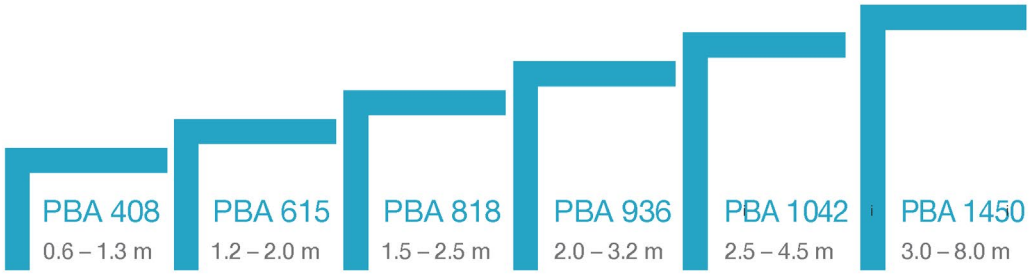
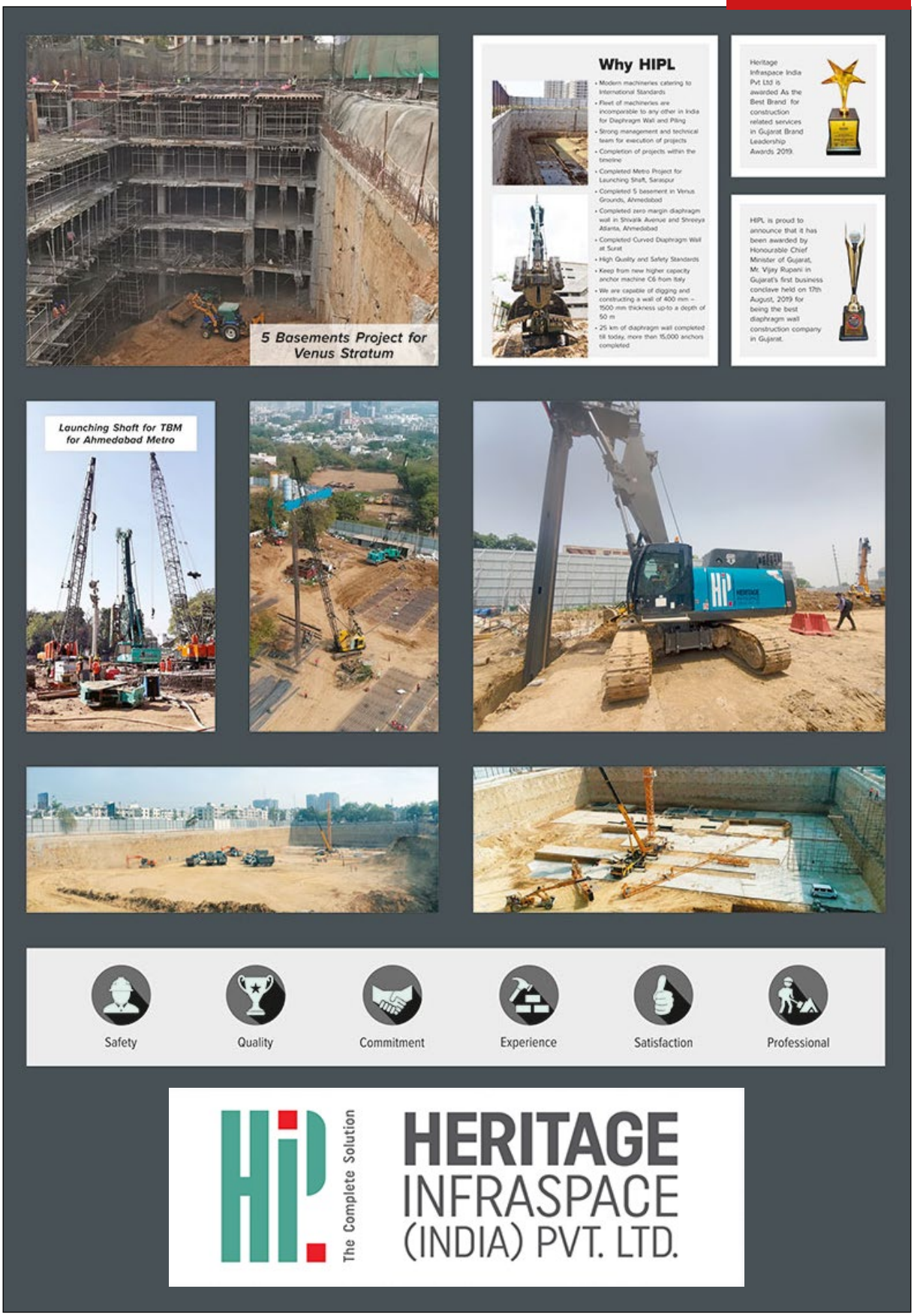
Six different machine models cover the diameter range from 0.6 to 8.0 m. All rigs meet the HSE standards and are designed according to the latest European standards.





Pile top drill rig	408/1300/200	615/2000/300	818/2500/300	936/3200/300	1042/3200/330	1450/6000/330
Maximum power swivel torque	81 kNm (59 700 ft·lb)	150 kNm (111000 ft·lb)	180 kNm (132500 ft·lb)	360 kNm (269000 ft·lb)	420 kNm (310 000 ft·lb)	500 kNm (368500 ft·lb)
Maximum drilling speed infinitely variable	38 rpm	23 rpm	30 rpm	20 rpm	21 rpm	20 rpm
Maximum thrust force	400 kN (90000 lb)	650 kN (145000 lb)	800 kN (180000 lb)	1000 kN (225000 lb)	1 100 kN (247 000 lb)	1450 kN (320000 lb)
Maximum pull back	600 kN (135000 lb)	725 kN (162000 lb)	1100 kN (247000 lb)	1700 kN (380000 lb)	2 000 kN (450 000 lb)	3000 kN (675000 lb)
Unit weight drill rig	17000 kg (18.4 short tons)	19000 kg (20.9 short tons)	27000 kg (29.8 short tons)	32000 kg (35.3 short tons)	34 500 kg (38.0 short tons)	64000 kg (70.5 short tons)
Unit weight hydraulic clamping device	3000 kg (3.3 short tons)	5000 kg (5.5 short tons)	6000 kg (7.2 short tons)	9000 kg (9.9 short tons)	9 000 kg (9.9 short tons)	Dependent on diameter
Hydraulic power pack type	HP II	HP IVa	HP IVa	HP Va / HP Va-s	HP VI / HP VI-s	HP VI / HP VI-s
Air compressor delivered air volume	10–15 m^3/min (353–529 ft^3/min)	10–25 m^3/min (353–882 ft^3/min)	20–25 m^3/min (705–882 ft^3/min)	20–25 m^3/min 705–882 ft^3/min	2 x 25 m^3/min 2 x 882 ft^3/min	2 x 25 m^3/min 2 x 882 ft^3/min
Air compressor operating pressure	13 bar (188 psi)	13 bar (188 psi)	17 bar (246 psi)	20 bar (290 psi)	20 bar (290 psi)	20 bar (290 psi)
Back filling pump delivery volume	800 m^3/h (470 ft^3/min)	800/1200 m^3/h (470/706 ft^3/min)	1200 m^3/h (706 ft^3/min)	1400 m^3/h (824 ft^3/min)	> 2500 m^3/h (> 1470 ft^3/min)	> 2500 m^3/h (> 1470 ft^3/min)
Back filling pump pressure at delivery head, approximately	5 bar (72 psi)	5 bar (72 psi)	5 bar (72 psi)	5 bar (72 psi)	5 bar (72 psi)	5 bar (72 psi)

PLATINUM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• Keep from new higher capacity anchor machine C6 from Italy
• We are capable of digging and constructing a wall of 400 mm – 1500 mm thickness up-to a depth of 50 m
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Heritage Infraspace India Pvt Ltd is awarded As the Best Brand for construction related services in Gujarat Brand Leadership Awards 2019.
HIPL is proud to announce that it has been awarded by Honourable Chief Minister of Gujarat, Mr. Vijay Rupani in Gujarat's first business conclave held on 17th August, 2019 for being the best diaphragm wall construction company in Gujarat.
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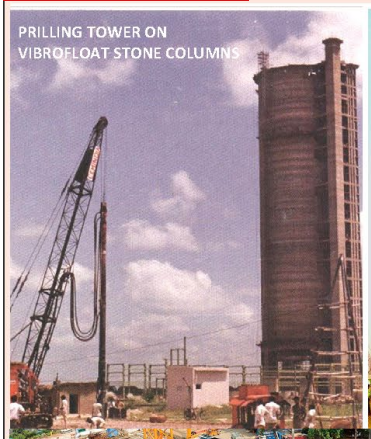

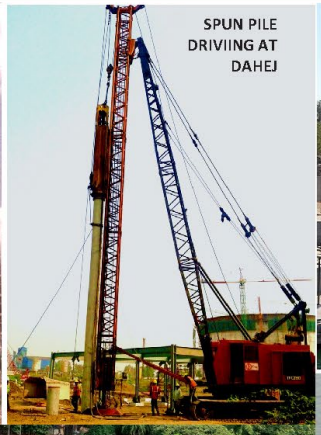

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WHO WE ARE

- **ITD Cementation India Limited(ITD Cem)** is a pioneer company in the Piling, Diaphragm Walling & Ground Improvement Space.
- **ISO 9001-2015 certified company** - an associate company of **ITD Group** based in Bangkok, Thailand
- Turnover of **INR 2718 Crore** company
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- Excellent reputation in the Industry with its Esteemed Clientele for **Timely Delivery** and **Quality Construction** with the **High Safety Standards**

WHAT WE DO

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- Bored Cast-in-Situ Piling
- Driven Cast-in-Situ Piling
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- Driven Precast Piling
- Spun Concrete Piling
- Micro Piling
- Secant Piling

DIAPHRAGM WALL

- 600, 800, 1000, 1200 mm Thk RCC Dwalls
- Barrette Piles
- Cement Bentonite Slurry Walls
- T, L, + Panels
- Cut Off Walls

GROUND IMPROVEMENT

- Vibro Floatation Stone Columns
- Band Drains
- Vibro Compaction
- Sand Piles
- Soil Mixing
- Geo Textile
- Instrumentation

REHABILITATION

- Drilling & Grouting
- Dam Rehabilitation
- Soil/Rock Anchors
- Shotcreting
- Rehab of RCC Structures
- Gabion Walls
- Slope Stabilization
- Rock Bolting

ITD Cementation India Limited

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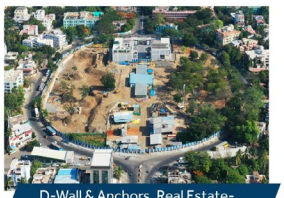

D-Wall & Anchors, Real Estate-Commercial

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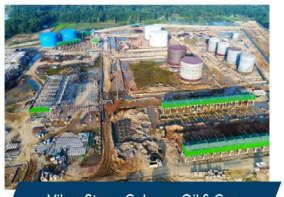
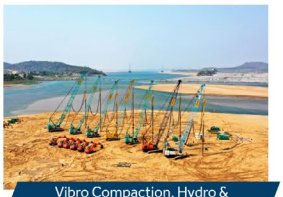
Keller is proud to have contributed towards the strongest and safest foundations to India's infrastructure growth story since the time of our establishment. With technical expertise of providing a vast range of geotechnical solutions to different projects, Keller holds a steadfast record of being on scope, on time and on budget for every project. The Keller team is thoroughly experienced in understanding the role of stakeholders and those aspects of project management that ensure the success and quality delivery of projects. Offering the best suited geotechnical engineering solution within the specified time limit and building the safest foundations is our area of specialty.



Vibro Stone Column, Oil & Gas

Secant Piling, Transportation-Metro



Vibro Compaction, Hydro & Irrigation

Marine Piling, Ports & Harbour

Uniting "Global strength" & "Local focus" Keller has been providing Geotechnical solutions with required combination of techniques.

HEAVY FOUNDATIONS/ EARTH RETENTION & SHORING

- Bored Piles
- Precast Driven Piles
- Diaphragm Walls
- Contiguous Piles
- Barrettes
- Driven Cast-in-situ Piles

GROUND IMPROVEMENT

- Vibro Stone Columns
- Vibro Compaction
- Vibro Sand Columns
- Deep Soil Mixing

GROUTING

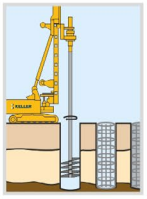
- Jet Grouting
- Permeation Grouting
- Compaction Grouting

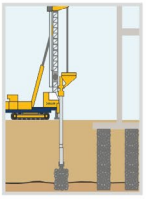
SMALL DIAMETER DRILLING

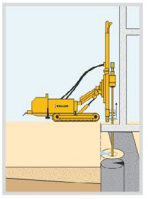
- Soil Anchors
- Rock Anchors
- Uplift Anchors
- Micropiles

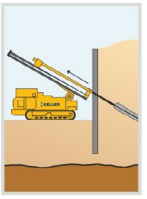
NEAR SHORE MARINE

- Marine Jetty
- Wharf Structure
- Tubular Piling
- Subsea Soil Improvement









Keller is a provider of One Stop Solutions to solve a wide range of geotechnical challenges across the entire construction sector by using individually or combination of various Techniques and Foundation Interface Works

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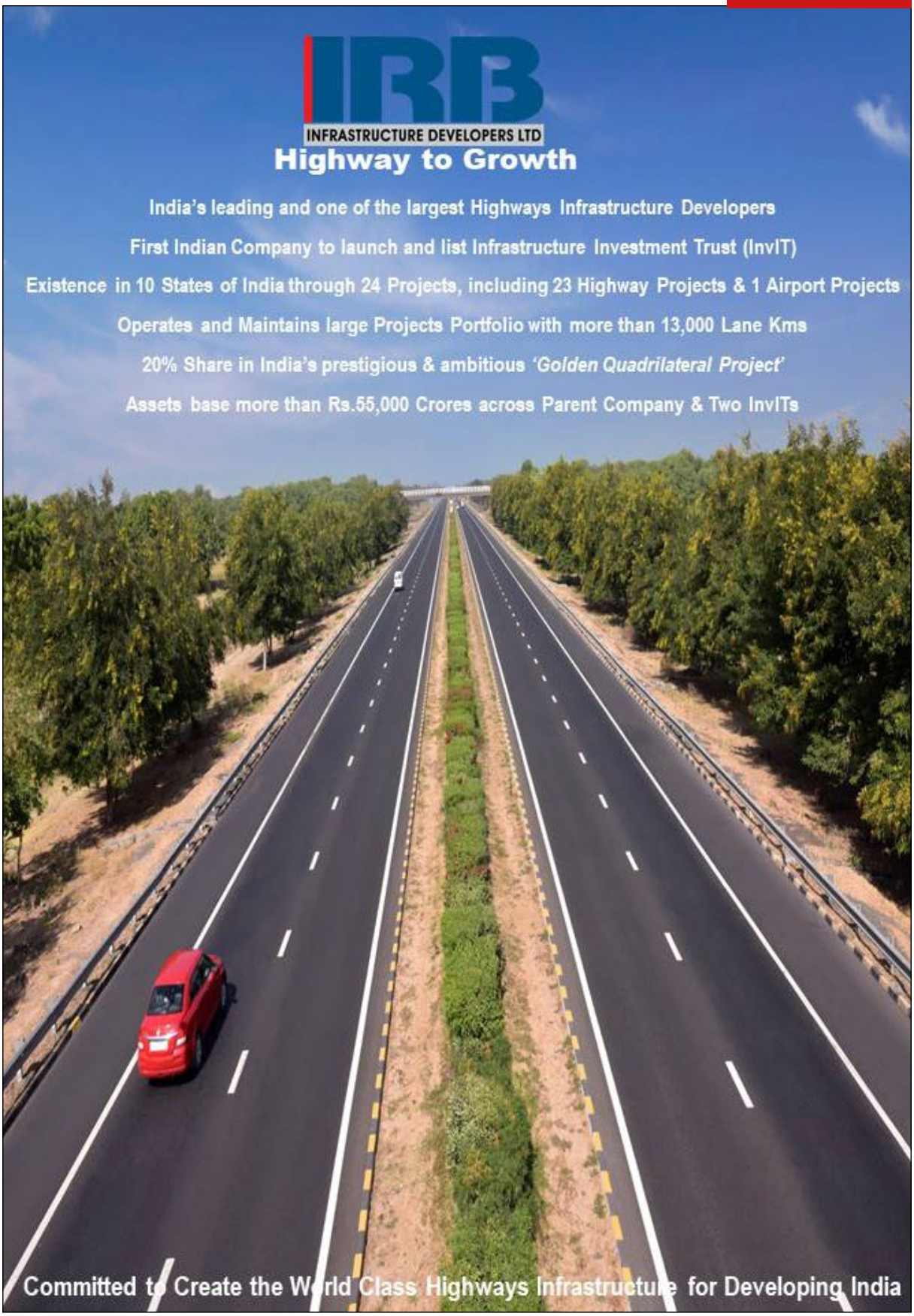
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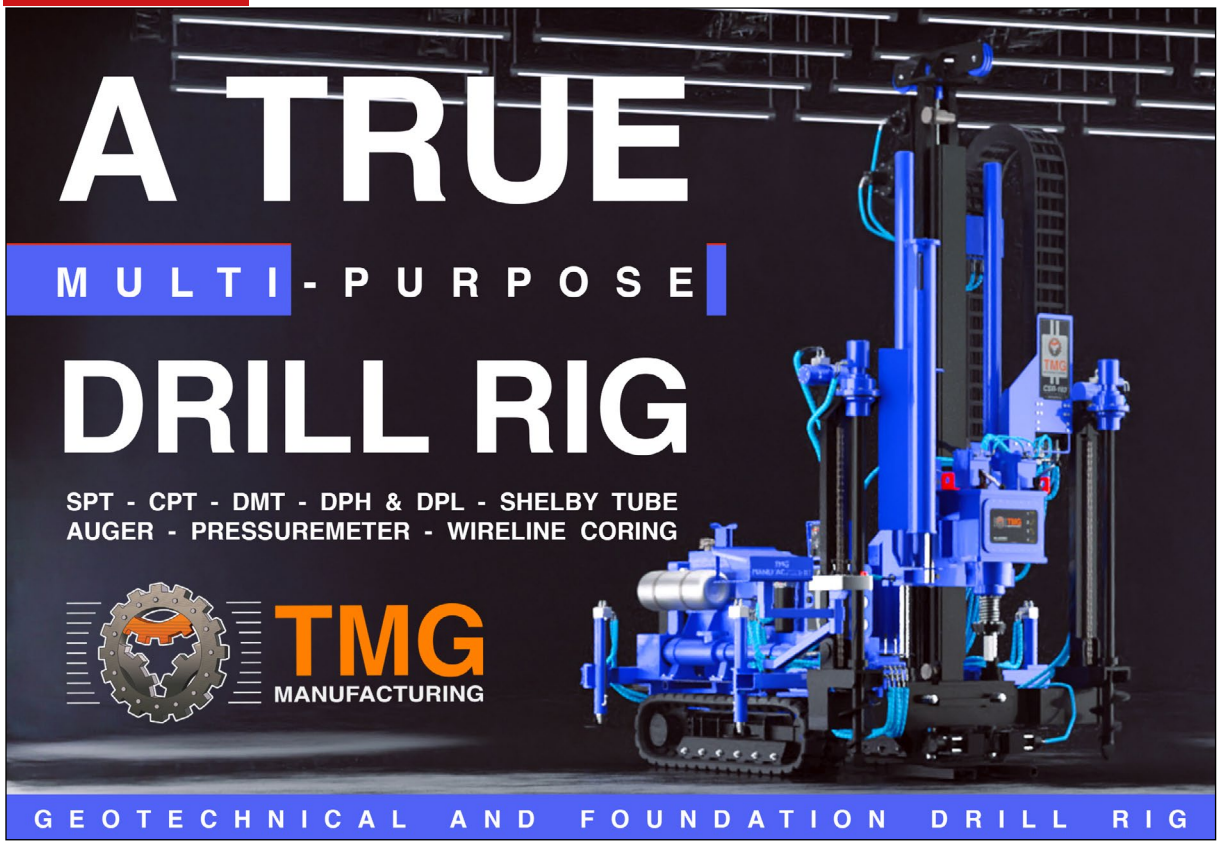

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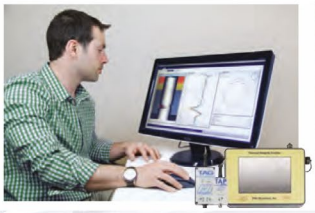
Instrumentation & Technology
Quality Assurance for Deep Foundation Projects

Pile Driving Analyzer® (PDA)



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All accepted papers will be published in the Conference Proceedings and select papers will be presented orally by the author during the technical sessions. Proposals for panel sessions are welcomed and encouraged. Please describe the panel topic and list the proposed speakers in the abstract. Paper format guidelines are available at www.dfi.org/annual2022. Abstracts are accepted on the following topics:
New ways of doing things – changes/developments/adaptations from the past two years – technology, business change/growth, workplace practices, flexibility, coordination of a remote workforce
Infrastructure, policy, and legislation (upcoming transportation projects and trends, collaboration, logistics, financing, teaming, contract vehicles, changed conditions, influence of the infrastructure bill investment on the foundation industry, response to climate influence, sustainability, resiliency)
Load testing, Smart Monitoring, and Data Management (planning and execution, sensors and instrumentation, integrity testing methods, noise and vibrations, project information and data management systems)
Adapting deep foundation techniques for innovative urban and waterfront construction solutions (ground improvement, excavation support, drilled and driven piling, dewatering, tunneling)
The business of the business (business issues, ethics, safety, project management, deep foundations education, entrepreneurism, mentoring, negotiation skills, risk management, insurance)
High value subsurface characterization processes (investigation in complicated geology, program optimization, innovation, visualization)
Designing for complex and local geology (Piedmont) and project constraints (geotechnical and geological challenges, existing structures, access, schedule, code requirements)
Challenges to working within state and national codes and the impact of existing codes on technical innovations.
Groundbreaking, mega, and local projects (historical, current projects, case histories, regional challenges)
Local and national/international case histories with lessons learned
"The kitchen sink" – Any other interesting papers on your favorite deep foundation topics
Conference Chair: Sebastian Lobo-Guerrero, Ph.D., P.E., American Geotechnical and Environmental Services, Inc., sebastianl@agesinc.com
Program Co-Chairs: Hannah Iezzoni, P.E., Keller North America, hannah.iezzoni@keller-na.com and Chris Woods, P.E., G.E., D.GE., LEEDAP BD+C, Densification, Inc., chris@densification.com
For inquiries, please contact: techactivities@dfi.org
IMPORTANT DATES
Abstracts Due: Fri., Jan. 14, 2022
Notification of Abstract Decision: Fri., Jan. 21, 2022
Draft Papers Due: Fri., Apr. 8, 2022
Notification of Presentation Decision: Fri., July 1, 2022
Revised Papers Due: Fri., July 29, 2022
Final PowerPoint Due: Wed., Sept. 7, 2022

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