

DESANDING OF SUPPORT FLUIDS

The quality of the completed foundation element is extremely dependent on the cleanliness of the support fluid prior to the placement of concrete. Thus the continuous removal of the contaminants during the drilling process is critical. Read more about it in the **Cover Story on Page 3**.



Picture Courtesy:



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DFI of INDIA

News

- 2 DFI of India Team 2023-24
- 3 Desanding of Support fluids
- 5 Director of Operations' Message
- 7 Leadership Change at DFI of India
- 8 Studies on the use of DCIS Piles for Mitigating Liquefaction of Soils
- 11 DFII & DFI Coming Events
- 12 DFII Interview
- 14 DFII Technical Committee News & Reports
- 16 What Can DFI Do for You?

Quarterly Newsletter from
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Desanding of Support fluids

- Extract from *Guide to Support Fluids for Deep Foundations* by the joint EFFC/DFI Support Fluids Task Group

Cover Story

The quality of the completed foundation element is extremely dependent on the cleanliness of the support fluid prior to the placement of concrete. Thus the continuous removal of the contaminants during the drilling process is equally important as the preparation of the support



Fig. 1 Desander Cyclone

fluid. Mineral fluids are cleaned using well-established mechanical means, possibly with the assistance of chemical additives. The generic terms of 'desanding' and 'desanders' are better referred to as 'solids separation' and 'solids separation plants'. The removal of fines can involve desilting hydrocyclones and centrifuges. Removal of sand is the easy part of the process, removing suspended fines is more laborious.

To restore the support fluid's properties, in the case of physical loading, mechanical equipment can help to remove the soil particles from the support fluid. The efficiency of all types of separation plant decreases significantly with increasing fluid density. It is, therefore important to characterise the material being excavated and estimate the type and



Fig. 2 Desander unit

quantity of material that will need to be removed from the support fluid in order to assess the separation equipment required.

Equipment for physical loading includes Primary Shaker Screens, Secondary Shaker Screens, Desander cyclones, Desilter cyclones, Centrifuges, and Filter Presses.

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Equipment Type	Typical D50 Cut Point	Typical Maximum Capacity
Primary Shaker Screens	<3mm	1000 m ³ /hr
Secondary Shaker Screens	0.2 mm to 0.4 mm	500 m ³ /hr
Desander cyclones	80 μm	250 m ³ /hr
Desilter cyclones	20 μm	150 m ³ /hr
Centrifuges	<5 μm	25 m ³ /hr
Filter Presses	<5 μm	25 m ³ /hr

Table 1. Typical D50 Cut Points for Separation Equipment

The desander should be placed prior to the desilters or mud cleaners, and after the shale shakers and degassers. A volume of mud is pumped into the wide upper section of the hydrocyclone at an angle roughly tangent to its circumference. As the mud flows around and gradually down the inside of the cone shape, solids are separated from the liquid by centrifugal forces. With reverse circulation methods, the separation plant may become the critical factor



*Fig. 3. Desanding plant
(Pic Courtesy: Bauer Engineering India)*

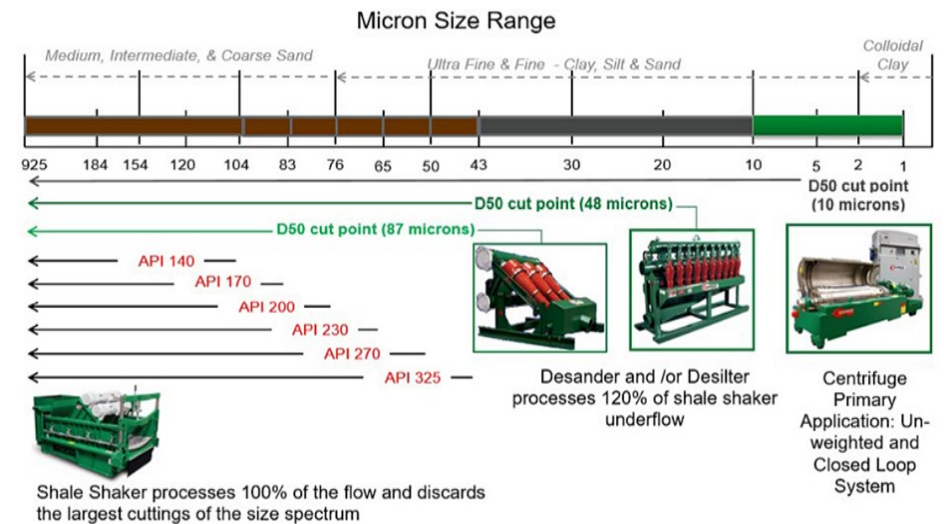


Fig. 4 Solid Control Equipment appropriate for each particle size

determining productivity, especially in weaker and/or finer strata. Hydromills must be limited to a rate of advance that does not overload the fluid. Under 20-30 μm, it is almost impossible to remove particles without degrading the support fluid. Centrifuges and filter presses are often used to treat fluid before disposal or to control fluid density when using hydromills.

For more information visit:

<https://www.dfi.org/communities/industry-alliances/effc-dfi-support-fluids-task-group/>

It is not in the stars to hold our destiny but in ourselves

- William Shakespeare



G Venkata Prasad

By welcoming the DFII community to the new year with bright prospects, I feel delighted to share good developments during 2022 that will enhance the visibility of DFII during the year 2023 further.

As a part of the DFII 2022 conference event, we organized a sideline meeting to discuss the way forward for launching the piling rig operators training program. We had representation from the Infrastructure Equipment Skill Council

(IESC), major foundation equipment manufacturers like Bauer Equipment, Sany India, Liebherr, and PRD rigs, four major contractors Like L&T, Bauer Engineering, Keller India and ITDCEM and National Academy of Construction (NAC). IESC which was set up with joint efforts of 40 plus equipment manufacturers covering 90% of infrastructure equipment has done a remarkable job since its inception in 2014. With the help of 60 training partners, IESC is implementing skill training programs covering 40 job roles covering the total gamut of construction equipment. DFII & IESC leadership team members are in touch with us to put joint efforts to promote operator training programs

Director of Operations' Message

related to foundation equipment. We are hopeful to make headway during the year 2023 in this regard.

We have taken on board Ms. Sai Sindhu who has completed her M Tech from IIT Tirupati and now she is part of the DFII office to support the technical activities of DFII. With newly acquired competencies, the DFII office team intends to pursue training programs in the future ahead by taking the support of the members of the training committee. We are gearing up to conduct the next training program on support fluids to serve the interests of design/planning/field engineers and to promote good work practices related to deep foundation execution.

During the third week of Dec'22, we conducted a third training program at the National Academy of Construction, Hyderabad meant for soil lab technicians, more are on agenda to be pursued in major cities like Mumbai, Delhi & Chennai. We covered two programs at Nagpur & Bangalore earlier. We are planning to launch webinar series covering educational programs relevant to good work practices for soil investigation jobs.

Conscious efforts are being made to organize site visits/internship programs for students pursuing geotechnical courses/interests by taking the help of major organizations that are part of the DFII community. This is to make them more industry fit for delivering better performance when they join the mainstream construction industry.

Contd.

The executive committee members of DFI of India represent all the stakeholders in the foundation research, design and construction. The members will express their views about the role of DFI and other similar organizations in the development and transfer of modern technology for infrastructure development of India.

CFA pile implementation in a couple of projects will be a reality soon as some proactive owner, foundation equipment & contractor organizations are putting necessary efforts in this direction. Thus, 2023 year will see more organizations opting for this technology and deriving its benefits.

We are investing necessary efforts to enhance the visibility of the DFII organization and its activities through social media platforms, by having a column dedicated in a popular magazine like New Building Materials & Construction World on regular basis.

We are thankful to the DFI leadership team led by Mrs. Theresa Engler, the DFII Board, Executive Committee members, and other well-wishers for their continuing support for the success of the DFII mission.



HAVE YOU RENEWED YOUR DFI MEMBERSHIP FOR 2023 YET?

Get it now if you have not already. DFI offers multiple benefits to its members for their technical as well as professional development. Learn, Network and Grow with DFI.

Check DFI membership categories, benefits, fee and renew here: <https://www.india.dfi.org/members/>

Dr. B. Umashankar to Chair DFII Groundwork Committee

Dr. Balunaini Umashankar became the chair of DFII Student Outreach Committee 'Groundwork' for 2023-24. He succeeded Prof. A Boominathan as the chair of this committee. Dr. 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 is an active member of DFI.



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Mr. Mohan Ramanathan, MD, Advanced Construction Technologies Pvt Ltd, Chennai took over as the Chair of DFI of India regional chapter in Jan 2023 for a term of two years. Mr. Ramanathan has over 40 years of experience in pile foundations, heavy earthmoving equipment, demolition and concrete flooring. He has been actively involved in identifying and transferring technologies relating to construction, ground engineering and mechanisation to India from developed countries. He is a member of several professional societies including DFII, IGS, Institution of Engineers (India), ACCE, ICI and IDA. As an active member in the DFII Executive Committee, he served as vice-chair of DFII during 2021-2022. He is also spearheading the new DFII technology initiative in the introduction of Helical Screw Piles in India.

Mohan Ramanathan has a bachelor's degree in civil engineering from IIT Madras and a master's degree from University of Illinois at Urbana-Champaign in the USA.

Under the leadership of **Mr. Anirudhan**, from Jan 2021 to Dec 2022, DFI of India has been elevated to top position, the same will be continued under new leadership of **Mr. Mohan Ramanathan**.



Leadership Change at DFI of India

Dr. Sunil Basarkar is nominated as the Vice-Chairman of DFI of India for 2023-2025. He is one of the core committee member of DFII and an active member of executive committee. 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.

Join us in welcoming the new chair and vice-chair of DFI of India and wishing them the best.



Studies on the use of DCIS Piles for Mitigating Liquefaction of Soils

-Dr. K V Babu, L& T Energy-Hydrocarbon, Vadodara, Gujarat, India, kv.babu@larsentoubro.com

-Prof. B.V.S. Viswanadham, Indian Institute of Technology Bombay, Mumbai, Maharashtra, India, viswam@civil.iitb.ac.in

INTRODUCTION

In the energy sector, critical structures which are sensitive to settlements are supported with pile foundations. Site which is prone to liquefaction experiences considerable loss of shear strength and imposes significant settlement also. Liquefiable sites require ground improvement to support the structures to meet the serviceability criteria. The driven displacement technique has been used to densify the loose to medium dense silty sand (Stuedlein and Allen 2018) and in loose, clean sands (Stuedlein et al. 2016). Unlike bored piles, DCIS driven cast-in-situ (DCIS) piles displaces the soil laterally while driving the empty steel tube thereby densifying the surrounding soil. DCIS piles provide higher capacities compared to bored piles because of such densification due to lateral displacement of surrounding soil. (Raju and Gandhi 1989).

SUBSURFACE INVESTIGATIONS AND SITE CHARACTERISATION

A liquefiable site is located north-eastern part of India with the geology constituting the highest alluvial plain in the domain of the Himalayan Rivers to the north of the Ganga, and it is part of the great Gangetic basin. Detailed soil investigations were carried out in this site earmarked for a large infrastructure project. The investigation consisted of bore logs of depths ranging from 15 m to 20 m; static cone penetration tests up to 15 m to 20 m, and laboratory tests on soil samples.

The boreholes were 150 mm in diameter and standard penetration tests (SPT) were carried at 1.5m intervals or change of strata, whichever occurs earlier as per IS2131-2002.

The static cone penetration tests were carried out as per IS 4968 (part-3)-2002 using cone area as 10 cm² with 20 ton jack capacity.

An electric cone attached with piezo cone was used for field measurement of cone and frictional resistance. The resistance was continuously monitored with depth. In this study, CPT data have been considered for assessment of the liquefaction potential of the site. In general, the site stratigraphy consists of top sand layer ranging from 1.5 m to 2.5 m thick, underlain by medium stiff clay 7.5 m to 10 m thick followed by medium dense to dense sand up to 30 m depth. Ground water depth was observed at depths ranging from 4.3 m to 9.2 m from natural ground level. The natural ground surface elevation approximately 48 m above mean sea level.

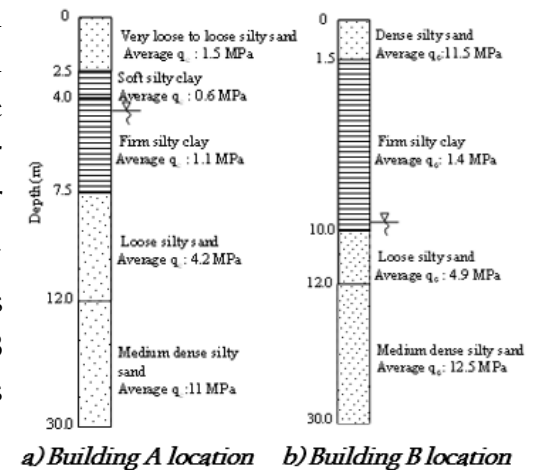


Fig. 1 Typical Soil Profiles

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SEISMIC DESIGN CONSIDERATIONS

Liquefaction triggering analyses were carried out as per the procedure outlined in IS1893 (Part-1)-2016. Liquefaction analyses show that site is prone to liquefaction at multiple layers. Earthquake magnitude is 6.5 and maximum ground acceleration is 0.24g. Liquefaction triggering analyses for silty clay layers have been performed using the Boulanger and Idriss (2007) procedure. In this study, liquefaction analyses were performed at two locations, namely building A and building B. Depth of liquefiable layer was found to be at 8 m to 14 m at Location A, whereas at Location B it is ranging from 10 m to 14 m.

GROUND IMPROVEMENT AND TEST LOCATIONS

DCIS piles were found appropriate here as a means to densify the loose liquifiable soil layers and then offering adequate capacity to support the structures. DCIS piles driven to 13.5m to 14.5m depth were designed. Static cone penetration tests, pre and post installation of DCIS piles, were conducted to study the improvement in the soil after constructing the DCIS piles. At building 'A', post-cone penetration test was conducted with ten piles group. For building 'B', post-cone CPT was done in five piles group. Spacing between the piles in building 'A' was 4D, and for building 'B' it was kept as 5D. The pile has a uniform diameter of 550 mm. To meet the design requirement, pile length below pile cut-off-level is 12 m for building A and 10 m for building B. Pile cut-off level is 2.5 m and 3.5 m for building 'A' and 'B' respectively.

IN-SITU TEST RESULTS

The evaluation of ground improvement post-installation of DCIS piles was assessed by conducting CPT.

For Building A

It can be noticed from Figure 2 that, significant increase in cone resistance is observed in the soil due to installation of DCIS piles at all depths. Major improvement is noticed in cohesionless strata which start from 8 m from natural ground level onwards compared to cohesive strata.

The change in cone resistance in the liquefiable depth of 8 m to 14 m

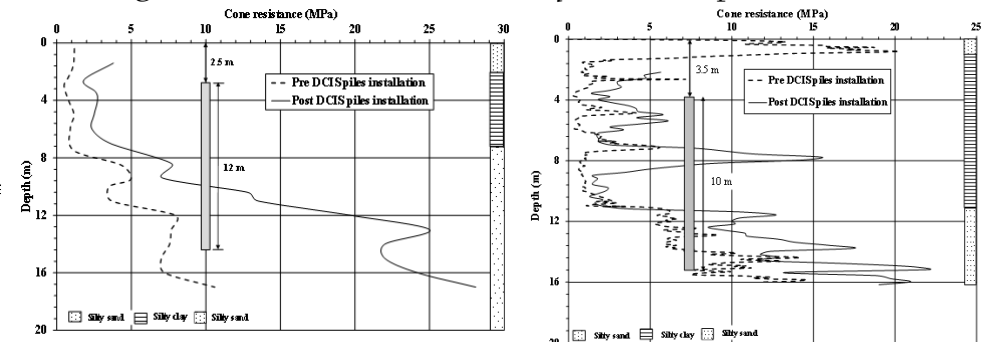


Fig. 2. Comparison of cone resistance pre and post-installation of piles with spacing of 4D at building 'A' location (left) and 5D at building 'B' location (right)

ranges from 7 MPa to 22 MPa. Further, it can be noticed that pile base has the ability to densify the soil up to 2.2 m (4D) below pile base and it is in good agreement with the results reported by Kishida (1967).

Contd.

For Building B

It can be noticed that significant increase in cone resistance was observed in silty sand layer after installation of DCIS piles. From this, it is evident that cohesionless strata is more effective in transmitting vibrations compared to cohesive strata. In the case of silty clay layers, due to remoulding, undrained shear strength reduces initially and gradually regains strength as time elapses. The change in cone resistance in the liquefiable depth of 11 m to 14 m ranges from 11 MPa to 22 MPa. It can be noticed from field CPT measurements, even the soil at deeper depths gets densified due to displacement piles.

COMPARISON OF LIQUEFACTION TRIGGER

Liquefaction trigger analyses for sandy silty layers were performed as per the guidelines outlined in BIS 1893(Part-1) 2016. In the case of silty

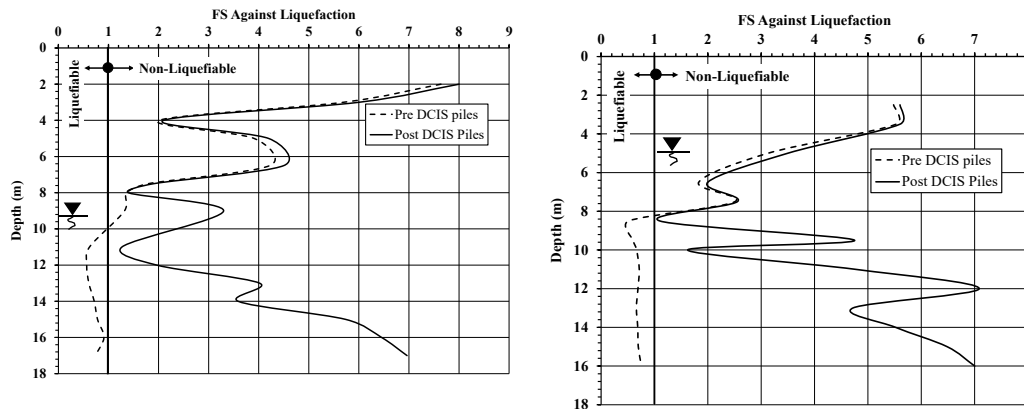


Fig. 3. Comparison of factor of safety against liquefaction for pre and post treatment conditions for Building A (left) and Building B (right)

clay, liquefaction trigger assessment was made as per Boulanger and Idriss (2006) procedure. If the factor of safety less than one, then the soil assumed to liquefy.

As predicted factor of safety in silty sand layer from 8 m to 16 m depth is significantly higher as compared to silty clay. The post treatment factor of safety against liquefaction ranging from 1.5 to 7 in silty sand layer. On the other hand, due to the remoulding clay layer while installation of DCIS piles, marginal increase in factor of safety was noticed.

CONCLUSIONS

Liquefaction analyses post installation of DCIS show that the loose to medium dense sand improved its cone resistance sufficient to mitigate the liquefaction trigger at site. In-situ measurements show that significant improvement in cone resistance post installation of DCIS piles with spacing of 4D and 5D. DCIS pile helps improving the relative density of loose to medium dense sand apart from supporting the structures there by is a unique foundation system that serves as ground improvement procedure and the foundation. Further studies are warranted in this direction to evaluate further on the use of DCIS piles in improving the ground.

The full paper is published in DFI -India 2022: 11th Annual Conference, Tirupati.



DFI of India (DFII) in collaboration with Indian Geotechnical Society (IGS) Baroda Chapter is organizing its 12th annual conference during 14-16 September 2023.

The call for abstracts for original technical papers on below mentioned themes are due on **27 Feb'23**.

Abstracts are being accepted on the following themes:

Theme 1: Deep Foundation and Deep Excavation Techniques (Renewable Energy Sector; Urban, Industrial, Transportation Infrastructure; Complex Soils, Coralline, Carbonate or Weak Rock).

Theme 2: Sustainability Practices in Deep Foundation Industry.

Theme 3 : Investigation and Reuse of Existing Deep Foundations for Economical Perspective and Sustainability.

Theme 4 : Innovative Techniques and Testing for Foundations and Geotechnical Investigations, Monitoring and Performance.

Theme 5: Construction and QA/QC of Deep Foundations Including Case Studies.

Theme 6: Ground Improvement Techniques.

Theme 7: Geotechnics for Marine, Near-shore and Coastal Construction.

Theme 8 : Innovations in Experimental and Numerical Methods in Deep Foundations and Ground Improvement.

Theme 9 : Futuristic Technologies in Deep Foundations - Large Diameter Piles, Helical Piles, Monopiles, Tiebacks, Driving Devices, etc; and Legal and Contractual Aspects of Deep Foundation Construction Projects.

Submit your abstract here: <https://www.india.dfi.org/india2023>

DFII & DFI Upcoming Events



GROUNDWORK

Laying the Foundation for the Next Generation of Foundation Practitioners

DFI of India Student Outreach Committee 'Groundwork' restarted its popular monthly webinar series from Feb'23 onwards.

These webinars are developed for student in civil engineering and particularly with geotechnical engineering interests. The program will focus on supplementing academic coursework with practical design, construction, and QC/QA topics, describe various types of careers and introduce companies in geotechnical and foundation industry, raise awareness of DFI and resources available.

Registration is free and applicable for all the upcoming webinars in this series. Working professionals from industry can also join the program.

For more details, visit: <https://www.india.dfi.org/events/upcoming-dfi-events/>

Event	SuperPile 2023	S3 2023	DFI-India 2023	DFI48
Date	June 7-9, 2023	Aug 8-10, 2023	Sept 14-16, 2023	Oct 31 - Nov 3, 2023
Venue	Atlanta, Georgia	Boston, Massachusetts	Vadodara, Gujarat	Seattle, Washington

Interview with Dr. Sujatha Manoj, Technical Director, Mott MacDonald, Sydney, Australia

Dr. Sujatha Manoj is a professional civil and geotechnical engineer with over 30 years' experience, with Master's and PhD degree from IIT Bombay. She is currently the Technical Director of Mott MacDonald in Sydney, Australia and also Discipline Lead on central tunnelling package of the 16 Billion Dollar Sydney Metro project, which is 66Km underground tunnel and 31 underground stations, the largest infrastructure project in Australia.



She was a keynote speaker in DFII 11th Annual Conference, 2022. Her overall experience of the conference and her professional career in her words....

How was your overall experience of attending DFI-India 2022 annual conference?

The DFI-India 2022 annual conference held in Tirupati, was such a great experience. A very well planned and well organised event which has left each and every participant, with some gain of knowledge, a good network of contacts and some great memories. The selection of location itself was very thoughtful, being the serene and holy city of Tirupati which itself was a great choice. Unlike many other conferences I attended, this one stood out owing to the great human touch and human experience, rather than just being a gathering of engineers sharing knowledge. There was a lot of personal connection. Personally, for me, this was a great opportunity to catch up with many of my old contacts whom I have



*DFI-India 2022 Conference,
Tirupati, India*

worked with few decades back. Overall, a beautiful experience at a great place, with some great people coming together.

Why do you think it's important for industry professionals to attend such conferences regularly?

It is indeed important for industry professionals to attend such conferences. Apart from being a great networking opportunity, it is also important to keep updated about the progress made in industry and new practices as well as progress in academy research. Such events give a great platform for Industry professionals from consulting and contracting environment, academicians and policy and decision makers from client organisations to come together, brainstorm and discuss issues of common interest and find common grounds where more collaboration can be possible. The academy and research have progressed quite a lot today and such conferences also provides an opportunity for the industry to gather more knowledge about the progress made in research and find possible opportunities where such research progress can be put to use to improve industry practices.

How did you find the WiDF India panel discussion session? And few words on the efforts made by WiDF India team in raising the awareness in the industry.

It was good to see the high energy and positive outlook of the participants in the WiDF panel discussion session. It is a fact that women in industry, especially in construction environment, do not always get a fair go. They have to prove themselves before being recognised, there are many barriers and the number of women in the engineering industry are very small even in this age. WiDF is doing a great job in raising awareness and such organised work providing support for women will go long way in encouraging youngsters to progress in their career. It was good to see several women entrepreneurs and others in top managerial roles in international organisations coming together and sharing their experiences and lessons learnt. Such organised efforts and group

Contd.

networking will really help and support women in engineering to find their way forward and go up in their career.

Tell us about your professional journey in construction industry.

I have been fortunate to start my career in a leading construction company in India in Mumbai and had the opportunity to work with and learn from some of the greatest civil engineering practitioners in India. In my career, there were many situations where I was the only lady engineer in the group, obviously due to the small percentage of ladies that is in the industry, even today. There have been several barriers, several constraints of being a woman, especially in the engineering and construction industry. It does take more time, for a woman to be taken seriously at work most of the times; many times, it also requires for one to have to prove themselves to be capable, before being given a major responsibility while their male counterparts with same level of qualifications and experience will be given the responsibility without them having to prove anything. It is taken for granted. Maintaining work life balance can be a huge challenge, but it was great fun and greatly rewarding, to struggle and overcome all such hurdles, and reach one's goal.



Australia AGS Debate night

As a woman working in top management of a reputed firm what will be your advice to young female engineers starting their career in construction/geotech industry.

There are indeed several hurdles and constraints, which makes the journey tough. It is, however, possible to overcome all this hurdles, by hard work, by consciously being upto date and do in the best possible way what you do. It is

possible and it is important to maintain work life balance and be focussed in what you do. The great feeling to drive on an expressway which you played a major role in constructing, or to see a building which you have had a huge role in building, is so fulfilling. It does take more efforts to establish yourself in an industry where women are a minority, but just by mere hard work and focussed efforts, it is possible to reach your goal and the reward of such hard work and dedication is always gratifying. That is my experience, having faced many such hurdles and having had to overcome them many times, in the many organisations and many countries that I have worked in the past 29 years of my career.



Abu Dhabi International airport

What do you think about DFI of India's role in bringing the different stakeholders of foundation industry on a common platform and its benefits to the industry?

DFI of India is playing a huge role in bringing together the engineers, contractors, client organisations and the academicians, providing a common platform where they can brainstorm over improving the industry practices and building a better and more sustainable future. There is many times a huge gap between academic research and industry practice. Even when research progresses are made in different fields of engineering, the industry lags behind in taking benefit of such good research. There are many useful innovations practiced by some sessions of the industry which the other may not be aware and DFI provides a good platform for sharing such knowledge and experience and building better, from the lessons learnt. Its also a great opportunity to establish a good network with major stakeholders and decision makers being present in such events like the DFI conference.

DFII Technical Committee News & Reports

DFII Committee for Geotechnical Characterisation for Foundations

DCGCF conducted its third 5-days training program for working Geotech lab technicians at National Academy of Construction Hyderabad during 19-23 Dec'22. The program was jointly organised by DFII and NAC, and was successfully conducted. More training programs are planned in different regions of India during 2023-24.



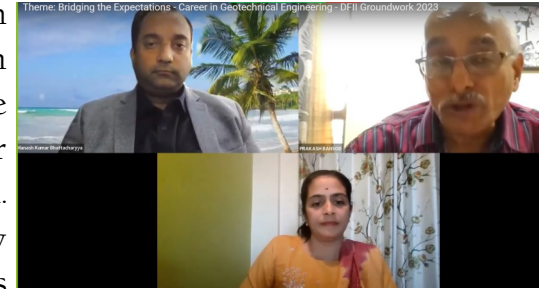
DFII Training Committee

DFII Training committee is developing a new training program on 'Support Fluids'. It will be the third training program overall and first in 2023. The program is scheduled to be conducted online during April 2023. More training programs are planned in 2023 on topics like Working Platform, Tool Management for Construction Equipment, Tremie Concrete, etc.

DFII Student Outreach Committee—Groundwork

DFII Groundwork committee started the popular Groundwork Webinar Series for the year 2023 with the first webinar conducted on 16 Feb'23. It was an interactive panel discussion program on the topic 'Bridging the Expectations - Career Prospects in Geotechnical Engineering Industry'.

Panelists included veteran geotechnical engineer Mr. Prakash Bansod, and human resource professional Mr. Manash Kumar Bhattacharyya from Keller India. The session was moderated by Mrs. Annapoorni Iyer, and was attended by more than 100 participants from all over the world. Monthly sessions are planned till May'23.



CFA Pile Technology Implementation Committee

The efforts of this committee in popularising CFA piling in India is bringing real time change in the industry with India witnessing CFA piling for the first time in projects across the country. The Committee is actively looking for projects where CFA Piling can be adopted in real-time project, and bring together different stakeholders for the same.

Following the request of DFII CFA committee, CED 43 Committee agreed to come up with a Guideline document for CFA Pile construction. Dr. Basarkar was chosen as co-convenor for this committee. The document is expected by mid 2023. DFII is hopeful that the BIS Guidelines will help consultants, contractors, and owners adopt the CFA piling technology in India.

WiDF India Group

After successfully organising the panel discussion program during DFI-India 2022 conference in Tirupati, WiDF India team planned to start quarterly programs in 2023. These programs includes online discussions, technical presentations, in-person interaction with college students, etc.



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At Keller, our aim is to provide world class and optimal geotechnical solutions for our customers. As a stand-alone or in combinations, our techniques solve a wide range of challenges across the entire construction sector -- infrastructure construction for oil and gas, dams, transportation, industrial, water treatment plants, and commercial projects.

Keller's ESG and sustainability agenda is not only about meeting legislative requirements or client demand, it is also about making our business environmentally sustainable -- a world that we want to operate in.

Global strength and local focus is what makes us unique. Our indepth know-how of local markets and ground conditions makes us well equipped to take up local engineering challenges. Our global knowledge base allows us to tap into our wealth of experiences and engage with the brightest minds in the industry -- to find the optimum solution.

HEAVY FOUNDATIONS/ EARTH RETENTION AND SHORING

- Bored piles
- Precast driven piles
- Driven cast-in-situ piles
- Diaphragm walls
- Barrettes
- Contiguous piles
- CFA piles (auger cast)

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 provides one stop solution 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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WHAT CAN DFI DO FOR YOU?

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
- 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 130,000 articles, technical papers & books from DFI & organizations all over the world - at no cost



48th Annual Conference on Deep Foundations

Oct 31st - Nov 3rd, 2023

Join us for DFI's 48th Annual Conference on Deep Foundations in Seattle and network with the largest gathering of international practitioners specializing in cutting-edge technologies and risk management for deep foundations, ground improvement, earth retention and excavation support. Attend special lectures featuring world-renowned keynote speakers, share experiences and lessons learned and discuss the advancements and innovations in the state-of-practice, research, materials and equipment.

Registration is open, register now.

For more information, visit <https://www.dfi.org/annual2023>

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