ROCK-SOCKETED CAISSON PILES IN THE BIG APPLE

Drilled rock-socketed caisson piles are widely used in New York City for high-rise building foundations due to their high load-carrying capacity and low-vibration installation. This article reviews their historical development, construction practices and code-based design approach. It also explores the potential for adopting similar systems in Indian cities like Mumbai. Emphasis is placed on the need for rock characterization and design correlations to ensure reliable application. Read more on **page 3.**

Volume 11 Book 3, July 2025

DFI of INDIA News

Quarterly Newsletter from
Deep Foundations Institute of India
www.dfi-india.org

Volume 11 Book 3, July 2025

DFI of INDIA News

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ROCK-SOCKETED CAISSON PILES IN THE BIG APPLE

Cover Story

Satyajit A. Vaidya, P.E., Principal, Langan International, USA, svaidya@langan.com

Background

New York City (NYC) is famous for its high-rise buildings, many of which are supported on deep foundations. These buildings are typically characterized by their relatively small footprint and high slenderness ratios, which results in significantly high compression, uplift and lateral loads on the foundations. One of the unique deep foundation types often utilized to support these buildings in NYC is a drilled rock-socketed caisson. These foundations offer unique benefits in NYC by simultaneously providing relatively high compression and uplift capacities without the need for static load testing. Caisson piles consist of a permanent steel casing drilled into top of rock, a rock socket drilled into competent rock below the casing tip, full-length steel reinforcement and full-length grout or concrete fill. A schematic longitudinal section of a caisson pile is shown in Figure 1. Typical as-built conditions of small and relatively larger diameter caisson piles are shown in Figure 2.

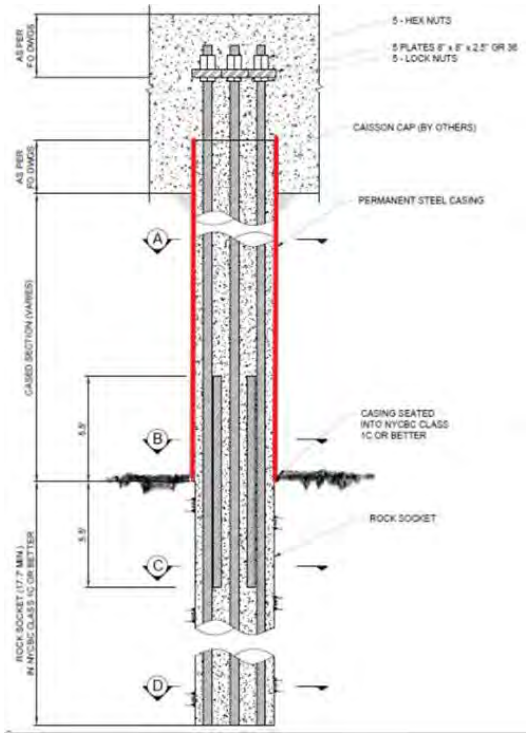

Fig. 1: Schematic Longitudinal Section of a Caisson Pile

Fig. 2: Typical Caisson Pile Conditions at Pile Cut-off

Historical Perspective

The first documented rock-socketed caisson pile was reportedly installed and tested in NYC in 1936 according to a 1943 Building Department bulletin. The pile was 300 mm in diameter, was tested to an uplift test load of 370 kN and experienced only about 2 mm of deflection. The contractor petitioned the Building Department to allow the use of this new type of pile foundation to carry compression and uplift loads. The details of discussions and usage case histories that followed are not well documented, but the 1968 NYC Building Code subsequently formalized the requirements for design and construction of rock-socketed caisson piles. Most importantly, the Code stipulated that as long as the caisson pile rock sockets were constructed in NYC Building Code Class 3-65 or better quality rock and the socket rock quality was visually confirmed, the caisson piles could be designed using an allowable bond stress value up to 1.38 MPa without the need for static load testing. Class 3-65 rock was defined in the 1968 Code as generally strong crystalline rock with a Rock Core Recovery (REC) of at

Continued

least 35%. These basic Code provisions are still in place, although modifications have been made in subsequent Code revisions to the allowable stress design factors and some other design requirements, such as minimum pile dimensions. The latest Code also requires caisson sockets to extend into rock with minimum Rock Quality Designation value (instead of REC) of 35%.

State of Practice

In typical practice, caisson piles have diameters ranging from about 200 mm to about 900 mm. Typical caisson pile compression capacities of the order of 1,300 to 26,000 kN are fairly common, although in very special circumstances larger diameter, ultra-high-capacity, specialty elements with a compression capacity of up to 400,000 kN have ben installed. Individual uplift capacities of caisson piles typically range between 1/3 and 1/2 of their individual compression capacities. Lateral capacities typically range from as low as 10 kN to as high as 900 kN per pile, depending on the cross sectional and material properties of the caisson pile and the soil conditions within about the upper 10 diameters of the pile.

Fig. 3: Typical Caisson Pile Rigs

The following installation sequence is typically used:

1. The pile rig is centered over the caisson pile location and the permanent steel casing is drilled into the ground to top of rock. The casing is fitted with carbide cutting teeth or a specialty cutting shoe with diamond studs. The casings are cleaned out either during casing installation using duplex drilling method, or after casing installation to a certain depth followed by additional casing advancement. Duplex drilling is the preferred method for casing installation, because it is typically more efficient. For small diameter piles, the casing is advanced using a liquid fluid (water and hole stabilizer additive) flush. Handling, circulation and disposal of large quantities of fluid becomes challenging for large-diameter piles and therefore air is used as a drilling fluid or bucket augers are used to bring soil cuttings up to the ground surface. In any case, it is advisable to always use internal flush techniques to clean the casing as opposed to allowing external flush, which can result in soil loss and adverse impacts to adjacent infrastructure.

Fig. 4: Small and Large Diameter Down-the-hole Air Hammers

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DFI of India New Executive Committee Member Interview

- Mr. Ramadas Veluri V.S.

What areas/technologies of the foundation industry do you believe have the most potential for growth or innovation in next decade?

Mr. Ramadas Veluri V.S.,
Director, India – South and East
Keller India

With rapid urbanisation and the growing focus on transportation and the development of Tier 2 and Tier 3 cities, there will be significant potential in the design and execution of earth retention systems, deep excavations and infrastructure projects such as metro works in the coming years. In addition, conventional foundation systems—as well as innovations in their design and execution—will continue to hold relevance and deserve focused attention from the foundation engineering community. Emerging sectors like renewable energy, green hydrogen and related infrastructure are also gaining momentum. These developments call for sector-specific, reliable foundation solutions that ensure smooth and timely project execution, while accounting for local soil and geotechnical conditions. The foundation industry must proactively adapt to these evolving needs to support India's infrastructure growth sustainably and efficiently.

In your view, what are the key challenges currently facing the foundation industry in India?

In my view, the foundation industry in India is currently facing several key challenges. Firstly, as the success of any infrastructure project heavily depends on the timely completion of foundation works, there is a pressing need for a performance-based evaluation system for foundation contractors and practitioners. This should consider factors such as safety, quality and adherence to timelines, helping to reduce delays in major projects. Secondly, there is a noticeable shortage of skilled manpower for the execution and supervision of foundation works at project sites. Addressing this gap through proper training and capacity building is crucial for ensuring consistent quality and efficiency. Lastly, due to significant variations in soil conditions and the inconsistency in the type and quality of foundation equipment and methods used on-site, designers often remain conservative in their approach. There is a need to build

Continued

The executive committee members of DFI of India represent the key stakeholders across 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.

industry-wide confidence in adopting advanced or optimized designs by improving data reliability, encouraging innovation and fostering trust among all stakeholders—from investors to end users.

How can DFI of India help the foundation industry to overcome these challenges?

DFI of India should continue to play its pivotal role in uniting the foundation industry and bridging the gaps between academia, contractors and equipment manufacturers. It must also facilitate the engagement of international experts to introduce advanced foundation techniques and design methodologies suited to India's evolving infrastructure landscape. Additionally, DFI of India has the potential to serve as a strong platform for inspiring and guiding young engineers to pursue foundation engineering as a rewarding and impactful career path.

What is the importance of collaboration and knowledge-sharing among professionals to drive industry advancement?

Collaboration and knowledge-sharing will enable the adoption of newer techniques, facilitate the introduction of advanced equipment from developed countries and enhance our existing design methods and philosophies.

What message would you like to share with the DFI of India community?

It is the need of the hour to promote DFI of India and its initiatives more actively across all sectors of the foundation industry. Every DFI member can play a significant role in this effort by sharing their work at conferences, highlighting successful implementation of innovative foundation techniques or designs and inspiring the wider community. Active engagement is crucial and greater participation from professionals across the foundation industry will further strengthen DFI of India's impact and outreach. This collective effort can help in building a strong and informed foundation engineering community in India, fostering innovation and collaboration. It will also create greater awareness about the challenges and opportunities within the sector, paving the way for knowledge-sharing, technical advancement and long-term capacity building. The more we contribute, the more we empower the next generation of engineers to carry the torch forward.

DFI-India 2025: 14th Annual Conference

The DFI of India is set to host the much-anticipated DFI-India 2025: 14th Annual Conference, a premier event dedicated to advancing the field of deep foundations. The event promises to be a pivotal event for professionals in the deep foundations industry. With a focus on sharing the latest advancements, practices and challenges in subsoil characterization in foundation engineering. The conference offers a unique platform for industry leaders, researchers and practitioners to collaborate and exchange knowledge.

Key Highlights of DFI-India 2025

Keynote Lectures: The Keynote Lectures at the DFI of India Annual Conference serves as a highlight of the event, featuring distinguished national and international experts from the deep foundations community. At the 2025 event, we are honored to feature keynote addresses by eminent experts including **Dr. Stuart Hardy,** *Associate Director Arup, who will speak on "Reinvigorating the Observation Method: The Role of Real Time Back Analysis";* **Dr. Makarand Khare,** *Terranova Consultants will cover the topic "Geotechnical Instrumentation in Civil Infrastructure Projects – Case Studies from India";* **Dr. Eric W L Chong,** *Engineering Manager, Keller Pty, will give insights on "Pushing the Boundaries with Deep CFA Piling – Design and Construction Perspectives ";* and **Mr. Abhishek Basu,** *Head of Civil Engineering, Adani Infra India, will share his views on "A Case Study of Geotechnical Challenges in Treating Soft Soil through Vacuum Consolidation in Dhamra Port Expansion".*


Dr. Stuart Hardy


Dr. Makarand Khare


Dr. Eric W L Chong


Mr. Abhishek Basu

Special session: A special half-day session on 'Innovations in Deep Foundation and Testing Equipment' will be conducted during the second half of the first day of the Conference. This session is poised to be a highlight of the event, offering valuable insights into the complexities and innovations in deep foundation engineering and testing equipment.

It will address the unique challenges associated with modern foundation design, advanced construction methodologies and the use of advanced testing equipment. The session will bring together some of the leading experts from industry pioneers, including experts from Giken, ArcelorMittal and other global leaders in the field.

Technical Presentations: Attendees will gain insights from technical sessions and peer-reviewed papers covering emerging trends, research and innovations in deep foundation engineering. Topics will include design

Continued

challenges, construction techniques and case studies. These sessions also offer opportunities for interaction with experts and knowledge sharing.



Technical Paper Presentations at DFI-India 2024, Goa

Networking Opportunities: DFI-India 2025 offers a vibrant environment for meaningful networking among professionals in the deep foundation and geotechnical engineering industry. Attendees will have the chance to connect with industry leaders, decision-makers, contractors, consultants and suppliers from across India and abroad.



Glimpses of DFI-India 2024, Goa

Sponsorship & Exhibition Booths: Organizations will display their latest products, technologies and services through dedicated booths strategically placed within the event venue. This allows direct engagement with key decision-makers, project managers and procurement professionals from the deep foundations and infrastructure sectors. The exhibition space offers high visibility and fosters meaningful business interactions and leads.

Awards and Recognitions: Recognition of exceptional achievements in the field through various awards like the Student Awards and Best Paper Awards, that highlight innovation and excellence.

Glimpses of the Awards Ceremony at DFI-India 2024, Goa

Women in Deep Foundations (WIDF) India Session: The WiDF session has been a significant highlight of DFI–India conferences. The upcoming session features **Ms. Vidya Basarkod**, Managing Director, COWI, scheduled on September 9, 2025.

Ms. Vidya Basarkod


Glimpses of WiDF Session at DFI-India 2024, Goa

DFI of India, in collaboration with IGS Surat Chapter and SVNIT Surat, is all set to host the DFI-India 2025: 14th Annual Conference in Surat from September 8–10, 2025. We welcome you all to attend this landmark event which will bring together leading minds, innovators and industry experts to explore groundbreaking advancements in deep foundations and infrastructure development.

Continued

Official Venue Partner: Avadh Utopia, Surat

Set in the heart of Surat, Avadh Utopia is a world-class venue known for its unparalleled blend of elegance, luxury, state-of-the-art facilities and seamless event experience. With its world-class amenities and exceptional hospitality, this venue sets the perfect stage for insightful discussions, networking and innovation

Location: https://maps.app.goo.gl/ht5Hbo5mKWVy9FQD7

Why Attend?

DFI-India 2025 serves as a crucial platform for exchanging knowledge, fostering innovation and building partnerships within the geotechnical and deep foundations industry. With India witnessing rapid urbanization and infrastructure expansion, this conference will highlight sustainable solutions, technological advancements and regulatory updates shaping the future of the sector.

DFI-India 2025 offers an unparalleled opportunity to engage with experts from leading organizations, government bodies and research institutions, making it a must-attend event for professionals committed to advancing deep foundation practices in India.

Join us at DFI-India 2025 to connect with industry pioneers, explore groundbreaking ideas and contribute to the advancement of deep foundations in India.

For more details, visit dfi-events.org/india25/.

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*Confirmed list as on 04 August 2025

Technical photo features of relevance are invited from the readers. Each feature shall preferably illustrate a modern technology or testing procedure. Please prepare your feature with six to eight good quality pictures with brief description.

New Committee Update - DFI of India Sustainability Committee

Dr. Venu Raju

We are pleased to announce the formation of the DFI of India Sustainability Committee, chaired by **Dr. Venu Raju,** Senior Advisor – Sustainability, Keller Group. The committee brings together experienced professionals committed to advancing sustainable practices in deep foundations. Members of the committee include: Mr. I.V. Anirudhan, Geotechnical Solutions; Ms. Sujatha Manoj, Beca; Prof. Purnanand Savoikar, Goa Engineering College; Ms. Geethanjali K., Engineers India; and Mr. Sai Kumar S., Keller.

The **main purpose** of the committee is to guide the deep foundations industry on its sustainability journey as it looks to achieve the sustainability goals of India and the planet.

Key committee activities:

- **Create awareness** in the industry, for both clients and member organizations, about the importance and relevance of sustainability in the geotechnical sector.
- **Train** foundation industry engineers on carbon footprint calculations, using the EFFC/DFI Carbon Calculator.
- Provide an **industry overview** for setting **carbon reduction targets** with metrics on measurement of progress.
- Develop and extend the EFFC/DFI **guidance documents** on carbon reduction and circular economy to make them relevant, practical and actionable in India.

We look forward to the valuable contributions of this committee in driving positive environmental impact and fostering a culture of sustainability within the geotechnical & foundations community.

DFII & DFI Upcoming Events

Event	Date	Venue
Rigid Inclusion Summit	Sept 4, 2025	Lenexa, Kansas
DFI-India 2025	Sept 11-13, 2025	Surat, Gujarat
DFI50	Oct 20-23, 2025	Nashville, Tennessee
7th Int. Symposium on Deep Foundations and Soil Improv.	Nov 6-7, 2025	Mexico City, Mexico
Shotcrete Short Course	Nov 12-13, 2025	Georgetown, Kentucky
Conference on Foundation Decarbonization and Re-use	Mar 24-26, 2026	Amsterdam, the Netherlands
DFI-PFSF Piling & Ground Improvement Conference	May 18-20, 2026	Sydney, Australia

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DFI of India Workshop on "Design and Construction of Diaphragm Walls"

The DFI of India, through its Training Committee on Foundation Technologies, successfully organized a two-day workshop on "Design and Construction of Diaphragm Walls" on July 11–12, 2025, at Hotel Holiday Inn, Chennai. The program brought together a wide range of professionals, researchers and industry experts, with participation both in person and online.

The workshop was inaugurated by **Mr. Devarajan Chinnusamy**, Managing Director of URC Construction, who served as the Chief Guest and emphasized the growing need for advanced deep foundation technologies in India's infrastructure landscape.

The event featured highly engaging and technically rich sessions led by a distinguished panel of speakers, including **Mr. A. Vetriiselvan**, Bauer Engineering India; **Dr. Makarand Khare**, Terranova Consultants; **Mr. Franz-Werner Gerressen**, Bauer Germany (online); **Mr. Madan Kumar Annam**, Keller Asia; **Mr. Manish Kumar**, ITD Cementation India; **Mr. Anirudhan I.V.**, Geotechnical Solutions; **Mr. Thomas Domanski**, TDA Geotech Services (online); **Mr. Jeyson Samuel**, Sam Geo Consultants & Constructions; **Dr. Jaykumar Shukla**, Geo Dynamics Engineers; **Mr. Madheswaran D.P.**, UCON Group of Companies; **Mr. Sivaramakrishnan S.**, L&T Geostructure and **Mr. Gianfranco Di Cicco**, GDConsulting (online).

DFI of India extends sincere gratitude to its Premier Sponsors-UCON Group of Companies, Grimtech Projects India and Suntech Infra Solutions-as well as Radiance Realty, Heritage Infraspace India and Geocon Consultancy Services for their generous support. The workshop is attended by 94 in-person and 74 online delegates. It received excellent feedback and was appreciated for its depth, content and expert-led discussions.

*All photographs shown above were captured during the workshop

DFI-India 2025 Conference Chair Message

- Prof. Chandresh Solanki

Dr. Chandresh H. Solanki
Professor,
SVNIT Surat

It is with great enthusiasm that I welcome you all to the **DFI-India 2025: 14th Annual Conference**, jointly organized by the **Deep Foundations Institute of India (DFI of India)**, the **Indian Geotechnical Society Surat Chapter** and **Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat**. This landmark event will be held from **September 8-10, 2025**, at the prestigious **Avadh Utopia**, Surat, a city renowned for its dynamic blend of industrial growth, academic excellence and infrastructural development. The event promises to bring together an exciting and diverse community of professionals, researchers, consultants, academicians and young engineers from across India and abroad, all united by a shared interest in advancing the science and practice of deep foundation technologies.

The theme of this year's conference **"Deep Foundation Technologies for Infrastructure Development in India"** is both appropriate and critical, considering the scale and complexity of infrastructure projects being undertaken across the country. As India accelerates its transformation through investments in metro systems, high-speed rail corridors, expressways, smart cities and coastal infrastructure, the demand for robust, sustainable and cost-effective foundation systems has never been greater. In this context, deep foundation technologies play a pivotal role, providing solutions to challenging ground conditions, supporting tall and heavy structures and enabling safe and efficient load transfer mechanisms essential for long-term infrastructure performance.

As one of the premier technical institutions in the country, SVNIT Surat has consistently contributed to the advancement of civil and geotechnical engineering through front-line research, industry collaboration and the nurturing of young talent. The collaboration between **DFI of India, IGS (Surat Chapter)** and **SVNIT Surat** reflects a shared commitment to nurturing interdisciplinary discussion, knowledge distribution and innovation in foundation engineering. This conference represents a platform where knowledge converges with practice, where field challenges stimulate academic inquiry and where academia and industry jointly explore opportunities to develop transformative solutions.

DFI-India 2025 is set to offer a rich and well-curated technical program that provides to a wide range of interests and specialties within the deep foundations domain. The conference will feature keynote addresses by well-known global and national experts, focused theme sessions, invited technical talks, peer-reviewed contributory paper presentations and interactive expert panel discussions. A special highlight of the event will be the dedicated **Women in Deep Foundations (WiDF)** session, recognizing and encouraging

Continued

the contributions of women professionals in geotechnical and foundation engineering.

The scope of the technical program is expansive and relevant to current industry needs. Topics will include ground improvement techniques; deep excavations and their support systems; piled raft foundations; foundations for marine and near-shore structures; instrumentation and monitoring; performance evaluation; seismic analysis and design; numerical modelling and simulation; data-driven decision making; AI and machine learning applications in geotechnical design; and case studies of foundation failures and corrective measures. These discussions will not only deepen understanding but also promote the adoption of international best practices suited for Indian conditions.

This year's conference is particularly dedicated to nurture the next generation of geotechnical engineers and researchers. We are proud to encourage **student involvement** through a well-structured volunteer program, **complimentary registrations** and interaction with senior professionals and exhibitors. These engagements provide invaluable exposure to real-world engineering practices, career insights and mentoring. As a faculty member and Chair of the IGS Surat Chapter, I personally believe in empowering students and early-career professionals and this platform is designed to fulfill that very purpose.

Alongside the technical sessions, the conference will also host an expansive **exhibition**, featuring over **30 booths** representing leading geotechnical service providers, equipment manufacturers, software developers, consultants and research organizations. This exhibition will offer delegates an opportunity to explore the latest technologies, tools, products and services that are shaping the future of foundation engineering. Furthermore, sponsors and exhibitors will benefit from exceptional visibility and engagement with a highly focused audience of decision-makers, influencers and future collaborators.

DFI-India 2025 is more than just a conference, it is a convergence of intellect, innovation and intent. It is an opportunity to strengthen our collective resolve to solve pressing infrastructure challenges through cooperation, scientific consistency and technical excellence. Whether you are a researcher presenting novel findings, a practitioner sharing field experience, an industry leader offering solutions or a student seeking to learn and connect, this event offers something meaningful for everyone.

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

In conclusion, I extend my heartfelt appreciation to the **DFI of India organizing committee**, the **members of IGS Surat Chapter**, the **faculty and students of SVNIT Surat** and all collaborating partners for their persistent efforts and enthusiasm in bringing this conference to life. I look forward to welcoming you to **Surat,** a city that symbolizes innovation, enterprise and completeness for what promises to be a transformative and memorable experience for the entire geotechnical community.

Let us come together to exchange ideas, inspire one another and build deeper, smarter and stronger foundations for the future.

DFII Technical Committee News & Reports

DFII Committee for Geotechnical Characterisation for Foundations

The committee is currently working on recruiting experts for the webinar series "Practices for Efficient Subsurface Characterization." The committee is also planning to conduct a 5-day workshop on geotechnical lab testing at different parts of the country.

DFII Training Committee on Foundation Technologies

The Committee has conducted six training programs to date with four online programs and the last two being hybrid events in 2024 and 2025. These events have seen increasing interest from the industry and academia with participants from different parts of the country.

The Committee successfully conducted the workshop on "Design & Construction of Diaphragm Walls," July 11–12, 2025, at Hotel Holiday Inn, Chennai inviting participants both in-person and online. Overall 12 experts, both in-person and online presented during the workshop on various aspects of Diaphragm Walls. More information about the workshop is detailed on Page 11.

DFII Student Outreach Committee-Groundwork

The Committee is planning to conduct in-person and online Groundwork webinars for the year 2025. More details will be shared soon. The Committee successfully conducted the DFI of India Student Awards 2025. In the Best Ph.D. Thesis category, Ms. Rima Das from NIT Tiruchirappalli was selected for her work on *'Mitigation of Earthquake Induced Soil Liquefaction Risk by Induced Partial Saturation (IPS) '*, while Mr. Gaurav Tripathi from IIT Tirupati was chosen for the Best Master's Project for his work on *'Comprehensive Analysis of Deep Excavation in Metro Rail Infrastructure under Static and Seismic Loading: A Numerical Modelling Approach.'* The winners will be awarded during the DFI-India 2025: 14th Annual Conference to be held in Surat.

CFA Pile Technology Implementation Committee

The committee is playing a pivotal role in Panel 20 sub-committee under CED 43, which is drafting the BIS code for CFA Guidelines. The guidelines document is currently under review and is expected to be out in 2025. They are alo planning a knowledge dissemination program on CFA technology in November 2025. More details will be out soon.

Women in Deep Foundations India

The group is currently working on developing a WiDF event at DFI-India 2025. The session features Ms. Vidya Basarkod, Managing Director, COWI scheduled on September 9, 2025. More details will be shared soon.

DFII Sustainability Committee

DFI of India has established a dedicated Committee on Sustainability under the leadership of Dr. Venu Raju, Senior Advisor, Sustainability, Keller Group. Please refer to page 10 to read more about committee's key activities.

Continued from page 4

2. After casing installation and cleaning, a down-the-hole air-hammer is used to drill a rock socket of appropriate diameter extending to the required design depth.

Fig.5: Down-hole Camera Equipment and Rock Socket Views

3. The casing and rock socket are then completely cleaned out and the rock socket is inspected using a down-hole, underwater video camera. Soda ash or similar coagulant is added to the water if necessary to settle out rock dust particles, so a clear view of rock socket is available for inspection.

Fig. 6: Flushing of Casing and Rock Socket and Tremie-Grout/Concrete placement

4. The required full-length steel reinforcement is then placed in the casing and rock socket and the entire shaft is completely filled with grout or concrete using tremie method.

Benefits and Opportunities in India

Caisson piles, when properly installed in suitable ground conditions, offer significant benefits over other pile types. These benefits include low vibration levels during installation, relatively high load-carrying capacities, simultaneous compression and uplift resistance and significant time and cost savings if load testing can be avoided based on Code provisions.

Drilled caisson pile technology works well in the New York City market because rock underlying the city, although sometimes deep, is typically of good quality that generally improves with depth. Also, the minimum strength characteristics of the rock formation can be reliably defined based on rock REC and RQD data obtained during subsurface investigation. Space is limited in the city and labor costs are usually very high and therefore, constructing efficient foundation elements that can provide high individual load-carrying capacities becomes commercially attractive. Down-the-hole hammer equipment and the required air compressors are readily available with typical foundation contractors. Also, the simple and robust allowable stress design procedure in the Building Code makes foundation design relatively easy.

So, could a similar approach be developed and used elsewhere? The high-rise building demand in Indian cities has been steadily growing. Some of the cities like Mumbai are underlain by relatively strong rock formations. It will be beneficial if engineering properties of these rock formations are systematically studied based on subsurface investigations and using full-scale pile load test data. Perhaps such an approach can enable establishment of useful correlations between typical rock types, REC and RQD values and allowable side shear resistance for rock-socketed piles, so that high-capacity rock-socketed piles can be designed and constructed reliably and cost-effectively.

This article is based on an invited lecture presented during special session on 'Foundations for Tall Buildings' from the DFI-India 2024: 13th Annual Conference, Goa.

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 50 years, we have brought together professionals for networking, education, communication and collaboration. As a member, you help create a consensus voice and a common vision for continual advancement in the planning, design and construction of deep foundations and excavations.

Find Common Ground. Become a Member of DFI

- Network with thousands of members and industry professionals worldwide
- Get involved locally through DFI's active presence in Europe, India and the Middle East
- Strengthen your knowledge base and obtain practical information at seminars, short courses, workshops and conferences
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