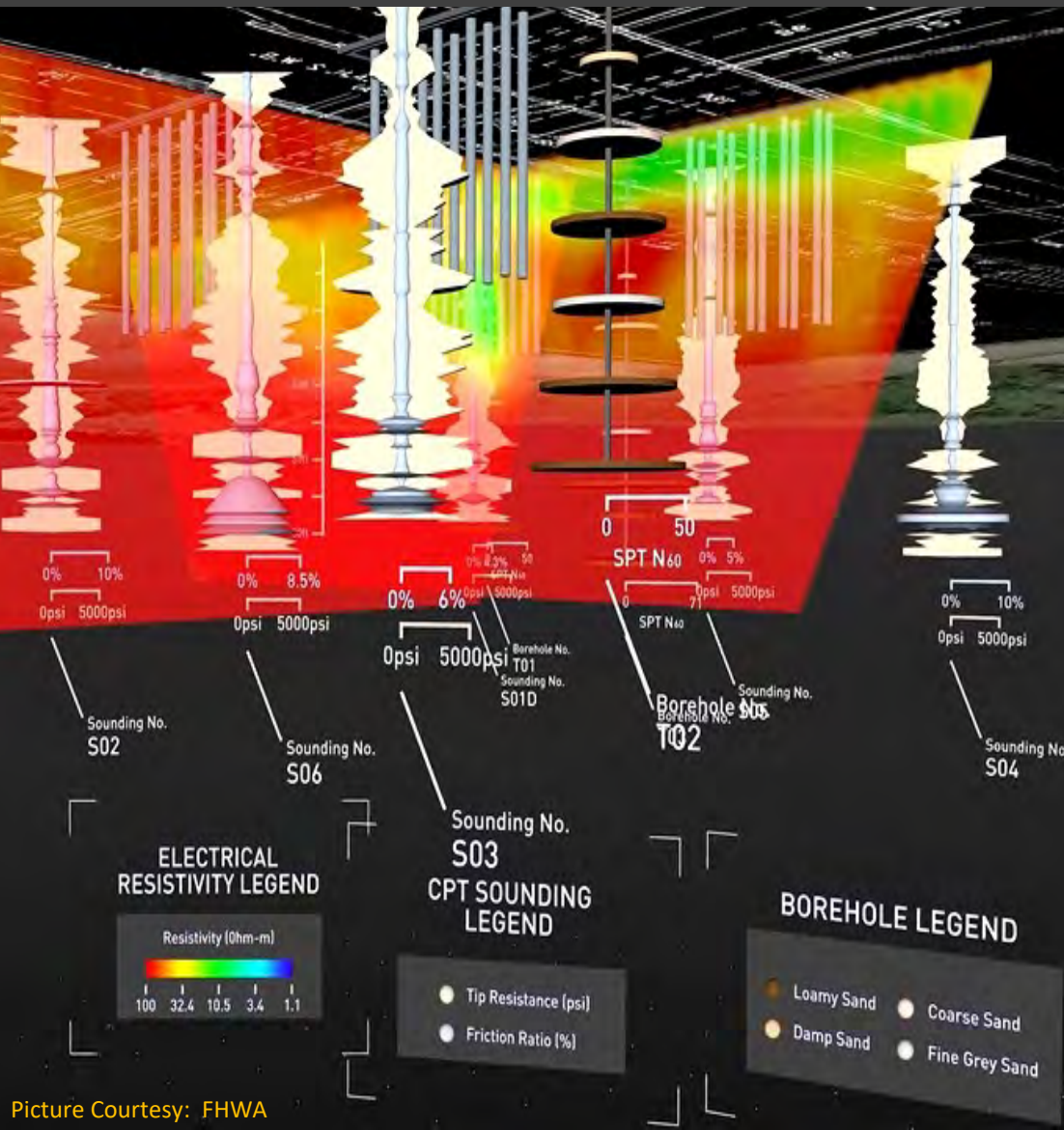


Bring your A-GaME!

“...Further progress depends chiefly on the improvement of our methods for measurement in the field, on the scope and quality of the field observations and on the adaption of our methods of subsoil exploration to practical requirements.”

- Karl Terzaghi



Picture Courtesy: FHWA



Volume 8 Book 1, Jan 2022

DFI of INDIA

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Quarterly Newsletter from
Deep Foundations Institute of India

www.dfi-india.org

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Making Most of Your Site Characterization Programs: Bring your A-GaME!

- Extract from *Mr. Ben Rivers* Keynote Presentation during DFII 2021 Conference

Cover Story

The A-GaME

Nearly 50% of the problems experienced in construction are indirectly or directly related to how well we characterize our subsurface conditions and relate it to the design and construction. In United States typically in transportation owners spend about 1 to 3% of project cost on investigation and there is an argument for doing some upfront risk reduction to reduce the uncertainties before we get to construction, and that's what A-GaME is about. We can use that 1 to 3% of project costs wisely by adopting a rational site characterization approach and appropriate underutilized proven methods for design and construction needs to reduce the uncertainties, schedule delays, and project cost escalations.

Mainstream Effective Underutilized Methods

- CPT - Cone Penetration Test
- SCPT - Seismic Cone Penetration Test
- ER - Electrical Resistivity
- IP - Induced Polarization
- SP - Self Potential
- MWD - Measurement While Drilling
- Seismic: Refraction
- Seismic: Reflection
- Seismic: FWI - Full Waveform Inversion
- Seismic: SASW - Spectral Analysis of Surface Waves
- Seismic: Tomography
- Seismic: Downhole
- Seismic: Crosshole
- Seismic: P-S Suspension Logging
- TDEM - Time-Domain Electromagnetic
- FDEM - Frequency-Domain Electromagnetic
- VLFEM - Very Low Frequency Electromagnetic
- OTV - Optical Televiewers
- ACT - Acoustic Televiewers
- GPR - Ground Penetrating Radar
- MicroGravity
- PMT - Pressuremeter Test
- DMT - Flat Plate Dilatometer Test
- VST - Vane-Shear Test
- Rock Discontinuities from Photogrammetry
- Pore-water pressure from Field Piezometers



DFI of India News

1. Cone penetration testing (CPTu/SCPTu) - It has been around for decades, electrical cones now-a-days are more reliable than the conventional SPT. It is 3-10 times faster than the conventional drilling. It has more reliable parameters than conventional SPT. Small strata changes can easily be discernible. Shear wave measurements with SCPTu is possible, also pore-water pressure can be measured.

2. Electrical Methods (ER, IP, SP) - Electrical resistivity imaging or tomography can discern contrasting material and groundwater conditions over large areas. we can distinguish clays that are typically conductive, rock and airfield voids are very resistant. It is quite helpful to understand that the variations within our profiles.

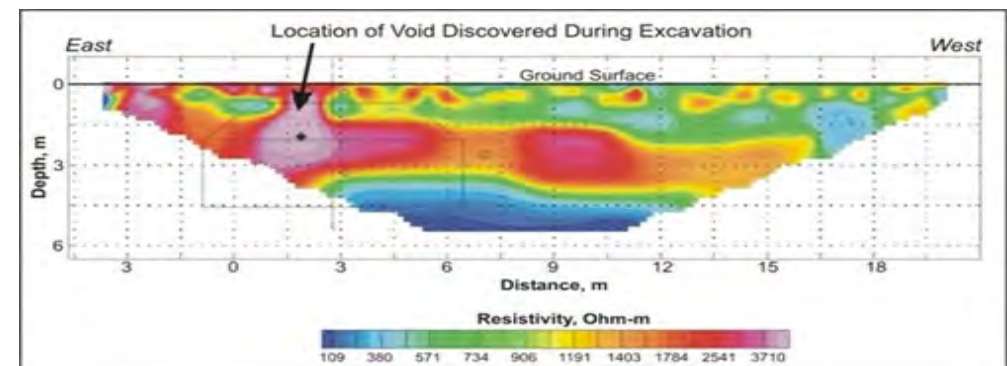


Fig 1: Locating void in Electrical resistivity imaging

3. Measurement While Drilling (MWD) - It is probably the youngest at least in the United states for geotechnical characterization. It is recently standardized in Europe as ISO 22476-15. Common drilling parameters

Contd.

Cover story in each issue of the newsletter showcases a technology/work practise that is not very popular in India, but has tremendous potential for India's infrastructure development. Readers may contribute to the cover story.

measured are Penetration rate (u), Rotation speed (N), Flow rate (Q), Torque (T), Fluid pressure (PI), and Net down-thrust or crowd (F). These parameters can be used to normalise to discern strata changes and variability in partially weather rock, rock, and dense or hard materials where we cannot push a CPT cone. Florida has made great correlations to skin-friction resistance in drilled shaft drilling – within 10% of load-tested results in their Florida limestone, and are now in the process of relating measures taken during subsurface investigation to those relationships.

4. Seismic Methods (Surface Waves, Refraction, FWI, Downhole, Reflection) – This method indicates stratigraphic changes and boundaries over large areas. We can also get load-displacement behaviour as we are measuring elastic properties. These measurements can help us for engineering purposes including seismic hazard susceptibility. Refer Fig. 2.

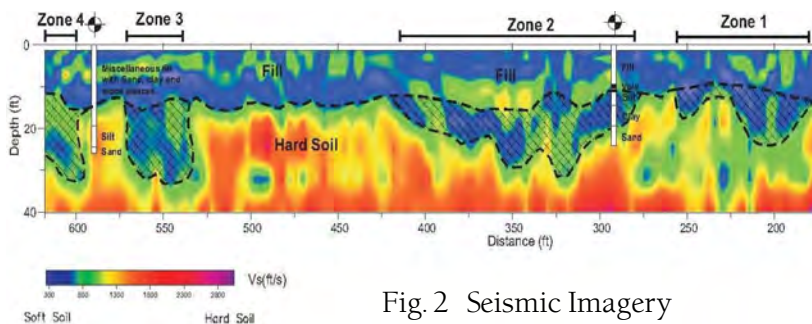


Fig. 2 Seismic Imagery

5. Televiewers - Optical and Acoustic (OTV/ATV) – It is a revolutionary technology for rock structure. Through this method, we get high-resolution 360 degrees spatially oriented continuous data. Instead of guessing discontinuities or fracture zones, we can see it in the sidewall

(refer Fig. 3). It eliminates difficult oriented coring and is independent of core quality.

Influence of Measurements on Reliability

The reliability of geotechnical design/construction parameters directly depends on the type, quantity and quality of measurements used to establish values for the parameters.

Type of measurements: We have direct measurements where samples from field is taken to laboratory test to determine shear strength and permeability, etc and we can also do testing in the field that is direct. But often we're using indirect methods and we're using transformations or correlations to get these parameters that we need for both design and construction.

Indirect measurements are often less reliable because of the uncertainty associated with the transformation. Indirect measurements can be used to produce more reliable estimates than direct measurements when reliable direct measurements are difficult to obtain (e.g. undisturbed laboratory measurements for clean coarse-grained soils), or sample disturbance and unrepresentative samples are of concern. Large numbers of indirect measurements can be acquired cost-effectively.

Quantity of measurement: If the site is uniform we do not need as much information to converge to a point where we get the coefficient of variation (COV) and reduce the unexplained error.

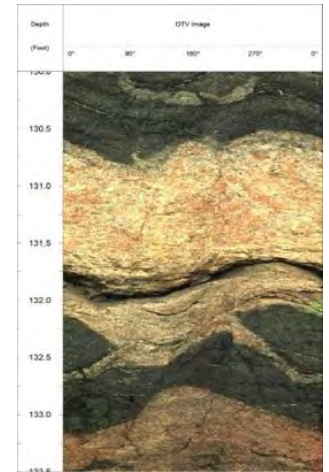


Fig. 3 Televiewer imagery

Contd. on Page 14

Director of Operations Message



Mr. G Venkata Prasad in impressively conducting the virtual conference program. Industry pundits endorsed this as the most successful program of the various other virtual events attended by them regularly in terms of rich content, many interesting case studies presented, topics chosen covering all stakeholders of the foundation industry, flawless management of all sessions in a timebound manner.

Every year conference involves stupendous efforts right from January month including finalization of theme & sessions, dates, venue, key speakers, session chairs, paper reviewers, issuing notification for call for abstracts, review of the same to approve the abstracts that satisfy the guidelines, follow up for detailed papers, PPTs, identifying panel discussions program befitting with critical demands of deep foundation industry, development of sponsors/ delegates brochures, follow up for sponsors/exhibitors, reaching out to different companies for nominating delegates, making all-conference arrangements, conducting rehearsals for all speakers/panelists, the list goes exhaustive. DFII leadership is thankful to all technical and organizing

committee members, key speakers, and other paper presenters, panelists, sponsors/exhibitors for their support for the success of the conference. We offer our special thanks to Mrs. Theresa Engler, Executive Director, Mrs. Mary Ellen, Past Technical Director of DFI USA, and their office staff for providing us wonderful virtual conference platform, extending possible support at every stage for the success of the conference program.

DFII is evolving and it is one of its kind organizations involved in multiple programs that will benefit the foundation industry directly. It is every day learning experience for the DFII office team to promote DFII as a concept and in garnering the support of more volunteers for contributing to its multiple programs. At this point, we are putting necessary efforts into finalizing the 2022 program, for agreeing with the CFA pile committee, DFII committee for geotechnical characterization for foundation, Groundwork committee, DFII training committee the activities to be carried out during FY 2022-23. As an outcome of the DFII 2021 panel discussions' program, we planned for the FY 2022-23 to organize webinar programs for Construction Equipment Rental Association (CERA) members to let them know ways and means to achieve optimization of foundation equipment performance in India, enter an agreement with Infrastructure Equipment Skill Council (IESC) for promotion of skill training programs covering foundation equipment operators.

We have a plan to reach out to design/structural consultants forums to impress upon the need of providing due space for

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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.

geotechnical engineers' design of foundations to avert potential execution issues and also to implement possible advanced foundation construction solutions. Mr. Alok Bhowmick the Managing Director of a leading firm "B&S Engineering Consultants Pvt Ltd" in his keynote presentation on the topic "How the choice of foundation can alter the fate of a bridge project - 3 case studies" while mentioning the foundation related issues that caused serious delays in case of 3 major bridge projects, asserted that structural engineers mostly dominate in development of foundation design and emphasized the need of changing the scenario in India through collective efforts.

We have also planned to enhance our efforts to connect industry leaders with the students' community in meeting the demand for internship programs, organize site visits in the major projects in the vicinity of different colleges and other interesting programs to the possible extent that will benefit students directly and in building a successful career.

It is our goal to expand the visibility of DFII with every passing year through its multiple programs that will serve the interests of multiple stakeholders and in achieving the DFII mission. We thank all DFII partners and well-wishers for their support in this interesting journey.

HAVE YOU RENEWED YOUR DFI MEMBERSHIP FOR 2022 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://india.dfi.org/members/>



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be taking
advantage of
one of DFI's
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Unearth More than 140,000 Technical Papers – At No Cost

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DFI members have free, unlimited access to more than 140,000 technical papers at OneMine.org the Global Digital Research Library for the mining, tunneling and deep foundations construction communities.

- Download DFI's archived documents including conference proceedings, technical manuals, reference documents, magazine articles and journal papers
- Download documents from related industry organizations
- Search by keyword, title, author or participating society
- Sign in as a DFI member at www.dfi.org and be automatically logged in to OneMine.org

Many publications of DFI are available from OneMine.org, a web-based document library containing over 1,40,000 articles, technical papers and books from organizations all over the world. DFI Members can access OneMine at no additional cost, while non-members can purchase and download documents for \$25 per download.

DFI of India acknowledges the immense contribution to geotechnical engineering by veterans in field and academia. DFII honors one of the veterans during every annual conference with the Lifetime Contribution Award. The Lifetime Contribution Award for 2021 was awarded to **Shri Murli Iyengar**, who is a well-known Geotechnical consultant and spent several years in the prestigious Engineers India Limited, Delhi.

DFI India Life Time Contribution Award 2021

Thank you DFI for this award I'm greatly honored and I highly cherished. During my professional career I had great benefits from interaction with several eminent engineers & scientists and organizations who helped me to achieve my goals. My thanks to all of them. I thank Prof R K Kati for the development of the basics in the subject during my academic years at IIT Bombay, Mr. Ghosh Rasidhar of cementation who gave me insight into the practical aspects and application of geotechnical engineering. I thank EIL for providing me with an opportunity to work on key onshore and offshore projects. After retirement, I took up Geotechnical consultancy assignments. My major interaction has been with Afcons in marine projects, metro rail Chennai and Kolkata, highways, bridges, etc. I highly cherish interaction with Mr. Giridhar Rajugopal, Deputy Managing Director and Mr. Avinash Patil, Executive Vice President, Design Department of Afcons, and others were always been open and receptive to innovative ideas. I also would like to express my thanks to GMR, Gangavaram Port, and others for my involvement in their major projects. I'm grateful for the support and help always readily available from IIT Madras Geotechnical Department, and Mr. I V Anirudhan for giving innovative solutions to many of my projects. My family members always have been very supportive and I acknowledge and thank them.

- **Murli Iyengar**



DFI of India Lifetime Contribution Award 2021

Awarded to

Shri Murli Iyengar

Formerly Executive Director, Engineers India Limited
Geotechnical Consultant



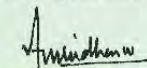
It is a matter of great satisfaction and pleasure for us in Deep Foundations Institute of India to recognise the invaluable services rendered by you to the geotechnical engineering and deep foundations construction industry in India and the great contributions you made to large-scale projects management.

As a token of sincere appreciation for several decades of dedicated professional service to the Indian deep foundation industry, we would like to take this opportunity to honour you with the "DFI of India Lifetime Contribution Award 2021" during the DFI-India 2021 virtual Conference during 12-20 November 2021.

We are sure that the delegates attending the DFI-India 2021 conference will have the opportunity to know your great contributions to the Civil Engineering field in India in the areas of engineering, project management and construction. We also like to place on record our gratefulness to you for your continuous guidance and advice to DFI of India right from its inception to date.

We are wishing you good health, strength and many more years of active professional life.

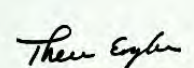
Wishing you the best,



Anirudhan IV
Chairman, DFI of India



Mohan Ramanathan
Vice-Chairman, DFI of India



Theresa Engler
Executive Director, DFI USA

Pile Length Determination through Lateral Hammer Impact

- Vivek Samu, Postdoctoral Research Scholar, North Carolina State University (vsamu@ncsu.edu)

Introduction

Pile length is a critical information especially when dealing with scenarios such as scour, reuse, or rehabilitation of structures. Several methods have been developed to estimate embedded pile depth which are broadly classified as borehole-based methods and surface-based methods [1]. Borehole methods, as the name suggests, such as parallel seismic require installation of a borehole near the pile foundation and often provide the most reliable results. Unfortunately, borehole installation is expensive and time consuming and thus cannot be used in all the situations. Surface-based methods rely on recording stress wave propagation in the piles often generated from hammer impacts. Surface-based methods are cheaper and faster compared to borehole methods, but analysis of the recorded response can be complicated and subjective.

Surface methods such as sonic echo, impulse response rely on generating longitudinal wave by impacting the pile top. Although, the procedure is straightforward in theory, for bridges in-service pile tops are not accessible. Existence of pile cap and superstructures have a significant influence on the waves recorded further complicating the peak picking process. The pile sides are often more easily accessible but impacting the pile sides generated bending/flexural waves that are dispersive in nature. Dispersive waves distort as they travel along the pile and thus identification of peaks in the time domain is not feasible.

Newly Developed EDAR Methodology

A simple theoretical model pile shown in Figure 1 is used to demonstrate the methodology. Impact 1 resembles sonic echo/ ultraseismic type of testing and results in longitudinal waves that are nondispersive in nature. Initial and reflected wave arrivals are clearly evident in this case using which the total pile length is calculated as 15.6 m which is within 1% of the actual length of 15.5 m (Figure 1 (a)). In contrast, impact 2 produces bending wave that are dispersive in nature evident from the time domain signal (Figure 1 (b)). The reflection peaks are not identifiable in time domain and thus a similar approach cannot be used to calculate the length estimate. The newly developed 'effective dispersion analysis of reflections' (EDAR) is capable of analyzing both these scenarios to accurately estimate the pile length. The signals are processed in the frequency domain to obtain a specialized plot called the EDAR plot with patterns named cycle period (K1) and wiggle period (KR) that correspond to the initial and reflected wave arrivals and length estimate is obtained by explicit incorporation of the dispersion relation of the waves generated [2]. The phase difference between the signals at two sensor locations in the frequency domain is the abscissa of the EDAR plot. *The key to length estimation is to choose the ordinate of the EDAR plot using the dispersion relation of the waves generated.* The ordinate for the longitudinal waves is chosen as frequency since wavenumber and frequency have a linear relationship for longitudinal

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waves. In case of bending waves, the Timoshenko wavenumber is directly used, which makes the cycle and wiggle periods uniform.

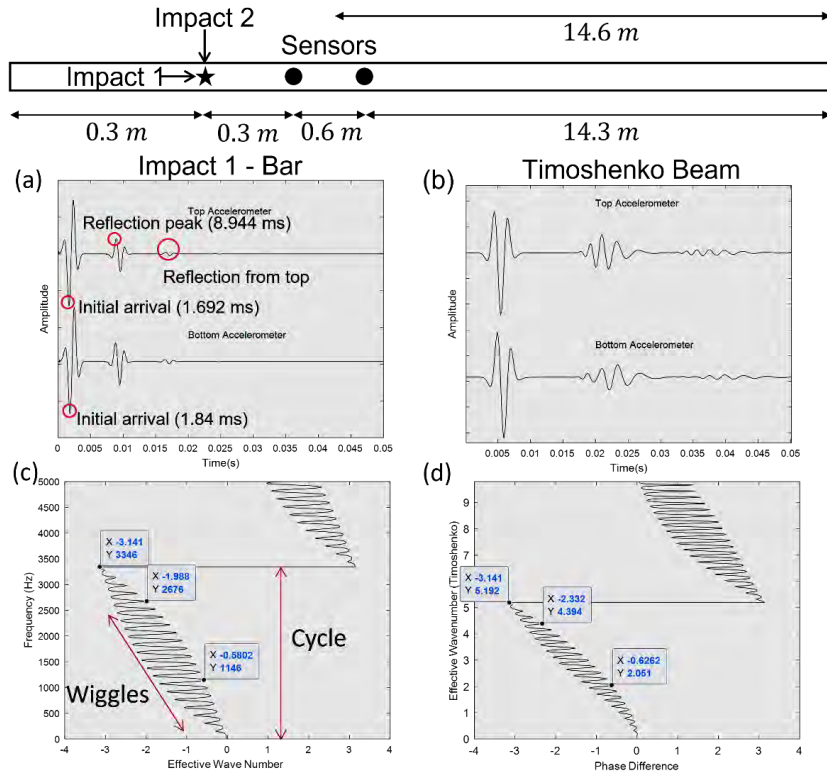


Fig1: Model pile (a) and (b) are the time domain signals for impacts 1 and 2 respectively. (c) and (d) are the EDAR plots for impacts 1 and 2 respectively

EDAR method requires the calculation of the cycle period (K_1) and wiggle period (K_R) from the EDAR plot (as shown in Figure 1 (c) and (d)) and with the known sensors spacing (ΔL) the distance from the pile tip to

the midpoint (L_e) of the sensors can be calculated using the simple relationship:

$$L_e = \frac{K_I * \Delta L}{K_R}$$

The total length of the pile is calculated by adding the distance from the midpoint of the sensors to the pile top to the estimate obtained from equation resulting in an accurate estimate of 15.5 m in both the cases. Although EDAR can be linked to time domain processing, frequency-domain analysis not only simplifies the length estimation process but also eliminates the subjectivity of the peak picking process in the time domain, which can be complicated in real data. The real power of EDAR is its ability to handle with ease, more complex situations such as side impacts.

The above examples were applied to idealized bar and beam without any embedment but in reality, the soil surrounding the pile can have a significant effect on the wave propagation. Most importantly the waves generated on impact radiate into the soil leading to attenuation. While it is known that the side impact can produce secondary longitudinal waves in addition to transverse waves, their amplitude is low compared to the transverse waves for a freestanding pile. The soil surrounding the pile leads to faster decay of the transverse waves compared to longitudinal waves. We discovered that the reflected waves in field settings are dominated by the secondary longitudinal waves [3] due to this differential attenuation of waves. Thus, to incorporate this phenomenon, a two-step EDAR method in which the analysis of the cycle and wiggle period are separated is used to estimate the pile length as detailed in the following section.

Field Testing Results

Prestressed concrete pile with a 0.4064 m square cross section shown in

Contd.

Figure 2 was tested using the EDAR methodology. The accelerometers were installed with a spacing of 0.2, 0.15 and 0.25 m.



Fig 2: Prestressed concrete piles in North Carolina, USA (a) Site (b) Instrumented pile

Total pile length (from bottom of pile cap to pile tip) was calculated from the pile markings as 15.55 m of which 14.1 m was embedded. Firstly, the average cycle period is calculated from multiple impact repetitions as 1407 Hz (Figure 3 (b)) using the EDAR plot from the farthest spaced two sensor responses for each impact. Assuming values for the density (2400 Kg/m^3) and Poisson's ratio (0.15), the modulus of elasticity of concrete is computed as 45.78 GPa by matching the experimentally average cycle period value with the cycle period obtained from a synthetic model of an infinite Timoshenko beam. The wave velocity is calculated based on the modulus and density as 4284 m/s. Careful examination of the EDAR plots from multiple impacts revealed some good data containing fainter but recognizable and repeatable wiggles (Figure 3 (c) and (d)) in the frequency range between 800 Hz and 3000 Hz. The wiggle period is averaged over all the

observed wiggles and is calculated as 157.21 Hz. EDAR analysis resulted in a length estimate of 15.08 m, which is within 5% of the actual length of 15.55 m.

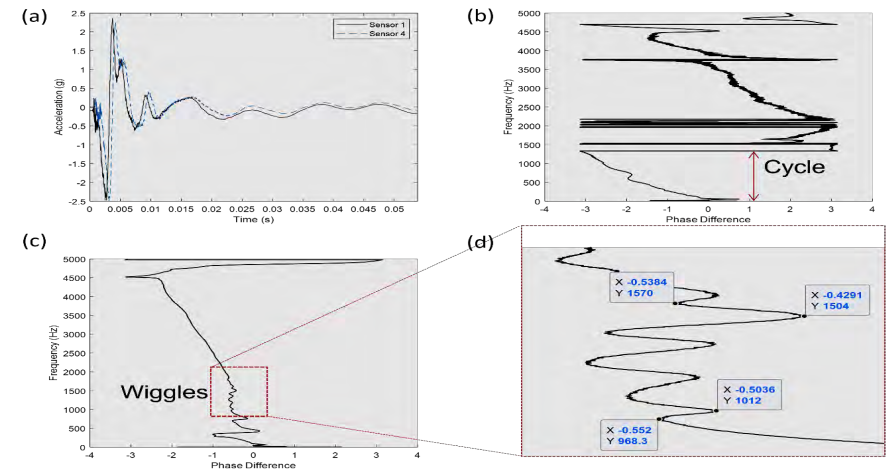


Fig 3: EDAR analysis of field data (a) representative time signal (b) representative cycle period (c) wiggle identification (d) average wiggle period estimation

Conclusion

The newly developed EDAR methodology facilitates the analysis of dispersive waves generated from side impact through explicit incorporation of dispersion relation in the frequency domain to obtain the pile length estimate. The resulting length estimate was within 5% error margin for the prestressed concrete pile tested. Future work will involve further testing and validation of EDAR for different pile types and scenarios and to extend the applicability of EDAR for pile integrity.

DFI GROUNDWORK

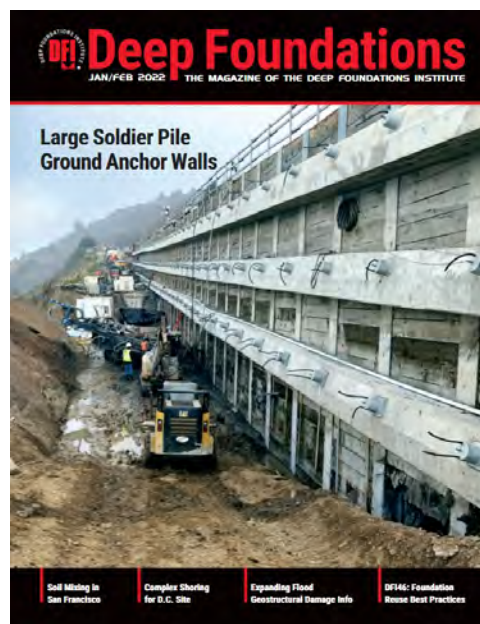
Laying the Foundation for the Next Generation of Foundation Practitioners

DFI of India is back with its popular Groundwork webinar series 2022. Groundwork is DFI India's Student Outreach program. 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.

Schedule of monthly webinars : Webinar 1 - 18 Jan'22; Webinar 2 - 15 Feb'22; Webinar 3 - 15 Feb'22; Webinar 4 - 19 April'22.

Registration is free and applicable for all the webinars in this series. Working professionals from industry can also join the program. For details of webinars and to register, visit: <https://bit.ly/3Ks6N13>

For Sponsorship Opportunities: Contact, Pranav Jha, Email: activities@dfi-india.org



Read latest DFI Magazine Jan-Feb'22 issue here: <https://dfi.org/publications/dfi-magazine-deep-foundations/>

DFII & DFI Upcoming Events



DFII has launch its first training program on Reverse Circulation Drilling (RCD) technology based on demand from the industry. This technology is now being increasingly used in India and there is a phenomenal scope for piling applications to infrastructure projects such as: bridges, offshore oil and gas platforms, windfarms, marine and coastal structures like harbors, jetties, loading platforms, mooring and berthing dolphins, dry docks, outfall and intake structures, onshore super structures, high-rise building, metro rail projects, etc.

This program is scheduled for two days on 25th and 26th Feb'22 between 15:00 to 18:00 pm IST.

For more details and registration, visit: <https://dfi.org/india-rcd-training>

Event	DFI India Training Program	SuperPile 2022	S3 2022	DFI-India 2022	DFI47	DFI-PFSF Piling & Ground
Date	Feb 25-26, 2022	June 15-17, 2022	July 26-28, 2022	Sept 15-17, 2022	October 4-7, 2022	November 16-18, 2022
Venue	Online	St. Louis,	Nashville,	TBD	National Harbor,	Sydney, Australia

Deep Foundations Institute of India is regularly conducting workshops and conferences in association with other organizations with similar interests

DFII Technical Committee News & Reports

DFI India Student Outreach program 'Groundwork'

DFI India conducted Student Problem Solving Competition -2 as a part of DFII2021 conference. 40 students in 12 teams from 8 different colleges participated in the competition, and top 5 teams won different prizes from DFI of India. Springer Nature publication gifted e-book vouchers worth 100 Euros to top two teams.

DFII Groundwork team second installment of its launched its highly popular webinar series - Groundwork 2022. These monthly webinars will be conducted between Jan'22 to May'22, one each month.

Registration for this series is free. For more details, and to register, visit: <https://bit.ly/3Ks6N13>.

DFI India Training Programs

DFI India started working on providing training programs and workshops on topics of importance to field and design engineers. DFI india recently conducted a training program with L&T Hydrocarbon engineering IC on 'Enhancing the Performance of Pile Construction in India'. The program was well received and appreciated.

DFI india is working on one more training program on 'Reverse Circulation Drilling Technology' with international experts. This training program will aid to the understanding of field engineers on efficient use of RCD technology. The program will be launched in Feb-Mar'22. For more details, contact activities@dfi-india.org.

Recap - DFI India 10th anniversary conference

DFI India's much anticipated 10th Anniversary Conference on Deep Foundation Technologies for Infrastructure Development in India was held between 12th Nov'21 to 20th Nov'21 in virtual mode. The event was organised by DFI of India in collaboration with IGS Chennai Chapter.

The conference started on 12 Nov '21 with the inauguration by conference chair Mr. Mohan Ramanathan, followed by the release of the souvenir by Prof. A. Boominathan, DFI India 2021 Technical Chair. Life Time Contribution Award 2021 which was awarded to Shir. Murli Iyengar and the citation was read by DFI of India chair Mr. IV Anirudhan. Prof. M Muttharam, Chair - IGS Chennai gave her message, and the inauguration session was concluded by vote of thanks from Mr. G V Prasad, Director of Operations, DFI of India.

The conference was divided into three parts: first being technical programs on 12th & 13th Nov'21, followed by the second part that was networking and exhibition sessions between 15th - 18th Nov'21, and finally the third part which was again technical sessions on 19th & 20th Nov'21.

The first session on 12th Nov'21 was kick started by Dr. R P Singh of National High-Speed Rail Corporation, Mumbai who delivered an amazing Keynote Presentation on "Recommended Practices in Ground Characterization for Complex Projects - An Owner's Perspective". It was followed by a paper presentation. The session was Chaired by Dr. Sunil S Basarkar, Afcons Infrastructure Ltd., and Annapoorni Iyer, Engosym. The second session of the day was chaired by Prof. K Ilamparuthi, Anna University, and Govind Raj,

Contd.

Keller India. The highlight of this session was Mr. Ben Rivers; Federal Highway Administration, USA delivering a keynote presentation on “Making the Most of Your Site Characterization Programs: Bring You're A-Game”.

Second day, 13 Nov'21, had a very interesting Keynote Presentation by Mr. Alok Bhowmik; B&S Engineering Consultants, Noida; on “How the Choice of Foundation Can Alter the Fate of a Bridge Project – 3 Case Studies”. This session was chaired by Dr. C R Parthasarathy, Sarathy Geotech & Jeevan Reddy, AECOM. Another highlight of the day was the panel discussion program during the second session of the day on “Harnessing Foundation & Geo Technologies for Accelerated Construction of Infrastructure Projects” moderated by Dr. K S Rama Krishna. Panelists were Manish Kumar, Executive VP, ITD Cementation; Satin Sachdeva, Secretary-General, CERA; and Dimitrov Krishnan, President, ICEMA. It focused on the geotechnical specialty equipment, and its market. It had contractor's & manufacturer's viewpoint and the challenges faced by them. It also included points on India's equipment rental market. The panel discussion thought provoking and received extremely positive review from all. Dr. Ravi Sundaram, Cengrs Geotechnical chaired the session.

15th to 18th Nov'21 was meant for Networking and exhibition. New concept of virtual Networking lounge was introduced where experts of different subject matter interacted with each other and presented their viewpoints on their area of interest. Anyone from audience had to option to join the conversation and add their views.

On 19th Nov'21, a Keynote Presentation was delivered by Mr. Nikolas Schmitz, MHWirth, Germany on “Reverse Circulation

Drilling (RCD) Technology for Large Diameter Piles”, the session was chaired by Prof Subhadeep Banerjee, IITM & PVSR Prasad, Keller India. Second session of the day saw Mr. Duncan Nicholson; Arup, London; delivering an informative Keynote Presentation on “Observational Methods in Deep Foundations”. This session was chaired by Ravikiran Vaidya, Geo Dynamics, and Sangeen Desai, Keller India

20th Nov'21 was the last day of the conference, where DFII Groundwork Student problem solving competition's winners were announced and an interactive discussion was conducted with Mr. Sorabh Gupta, Cengrs Geotechnica. This session was chaired by Dr. K Muthukkumaran, NIT Trichy Prof. B Umahankar, IIT Hyderabad

The last session of the conference was graced by Prof. John Endicott AECOM, who delivered a Keynote Presentation on Deep Excavations – An Historical Review. The last program in session was WiDF India program titled ‘Success Stories within us’. This session was moderated by Dr. N. Kumar Pitchumani; Regional Director, AECOM India.

The conference closed with a Valedictory session where conference chair Mr. Mohan Ramanathan, Conference Technical Chair Prof. A Boominathan, and DFI of India's Director of Operations Mr. G V Prasad extended their thanks to all the speakers, participants, sponsors, and everyone involved. They also summarised the key takeaways from the conference. The conference ended by playing Indian National Anthem.

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Cover Story - Continued from Page no. 4

In variable site it takes more numbers of measurements. In addition to affecting estimates of the mean value for a design parameter, the number of available measurements also influences the accuracy of estimates for variability and uncertainty (refer below Fig 4).

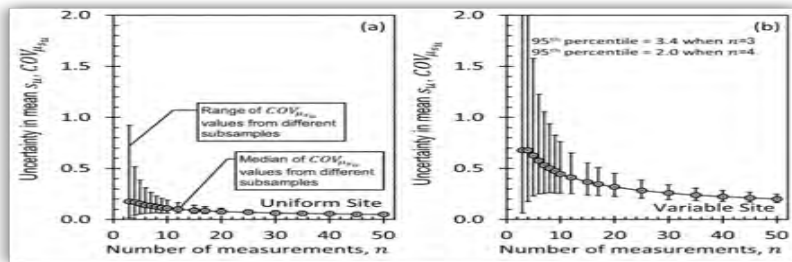


Fig. 4 The coefficient of variation (COV) shows the extent of variability in relation to the mean of the population.

Improving Site Characterization for Constructability

Looking at constructability reducing risks and uncertainties for the contractors and to avoid any bad surprises during construction is important.

Improve site characterisation for:

1. Excavation/Blasting, depth of rock, condition of rock:

- Measurement While Drilling (MWH) is a mature technology for drilling and blasting operations, they have correlations in software to get rock condition, hardness, fracture-frequency, etc.
- Downhole logging gives option to look at the structure. Televue (optical and acoustic) gives orientations and condition of discontinuities (joints, bedding, fractures, infilling)

- Seismic Refraction give us an idea of the stiffness through compression wave velocities.

2. Dewatering and Groundwater Management:

- CPTu (Soil) for Pore Pressure Measurements, and dissipation.
- MWD for measuring Fluid Pressure, In-Flow and Out-Flow Rates.
- In-Situ Permeameter (Soil) for Mean Permeability.
- Piezometer for Pore Pressure Measurements Over Time
- Borehole Logging (Rock) by Flowmeter Logs, Temperature Logs, Electromagnetic-Induction Logs. Televue can be used for obtaining condition of discontinuities.
- Borehole Testing by Pump/Drawdown Testing, Constant Head Testing, Packer Testing for Flowrates, and Slug Testing.
- Surface Electrical Imaging (ER, IP, SP) to determine conductive zones within contrasting resistive zones, and to get Flow Direction.

3. Problematic conditions/Bad actors, Site Variability, and Ground Improvement:

- CPTu/SCPTu (Soil) to discern soft, compressible, weak materials, including thin lenses (soil), pre/post ground improvement – changes in tip/sleeve resistance, permeability, shear-wave velocity.
- MWD (Soil and Rock) to ascertain variations in strata and lithology, Karst features, Grouting operations, Core quality control/verification
- Televue (Rock) to know in-place rock-mass condition,

Contd.

variation, clay infilling within joints, etc

- d) Surface Seismic Imaging (Soil and Rock) gives variations in seismic velocities across site, and changes in velocity measures pre/post improvement.
- e) Surface Electrical Imaging (Soil and Rock) to know variations of materials confirmed/correlated with other testing across site, and apparent extent of improvement if correlation to measured change in resistivity.

4. Visualization and Bidding:

Improved spatial understanding of subsurface conditions with modern visualization methods using all methods and data, collectively. Digital exchange of geotechnical data (eg. DIGGS) - Transmit Geotechnical Data to Bidders. These digital data are readily usable.

A Look to the Future

Improved Processes: One of the great benefit of A-GaME technology is that they are digitally acquired making it easy to take data from all the methods used collectively and interpret it, which can be shared with the contractors and stakeholders in visual forms which are easy to understand. DIGGS (Fig. 5) can be a game changer in this aspect.

Improved Communication: The data are easy to share and understand. For example these data can be easily visualized through holograms



Fig. 5 DIGGS

which makes it easy to understand even for a non-technical person

Improved Data Management and Leveraged Data Accessibility: DIGGS Will Aid Geotechnical data management, geotechnical asset management, communication of geotechnical data, data-fusion and machine learning, reliability-based design calibration, and integration of geotechnical and geo-construction data elements into other platforms.

Takeaways

Standardized digital data exchange (e.g. DIGGS) will transform computer-driven processes in our field and industry.

The type, quality, and quantity of measurements have a significant influence in the reliability of parameters used for design and construction.

Bring your A-GaME! - Use the rational process to develop an understanding of conditions influencing design and constructability considerations. Target that information using effective tools from your A-GaME toolbox.

Advanced Geotechnical Methods in Exploration (The A-GaME)

Improve Geotechnical Site Characterization by using rational (not prescriptive) site characterization approach, and appropriate underutilized proven methods for design and construction needs.

It will result in reduced uncertainties, schedule delays, and project cost escalations; explained/Characterized site variability; and improved reliability for design and construction.

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



DFI-India 2022 Annual Conference on Deep Foundation Technologies for Infrastructure Development in India

September 15th - 17th, 2022

DFI of India (DFII) is organizing its 11th annual conference in September 2022. Abstracts for original technical papers relevant to the conference theme are invited for DFI-India 2022 Annual Conference on Deep Foundation Technologies for Infrastructure Development in India. The conference will be held on 15-17 September 2022. The banner of the conference is Collaborate, Learn, and Educate

Call for abstract is Open.

For more information, visit <https://dfi.org/India2022>

This e-newsletter of DFI of India is available at <https://india.dfi.org/dfi-of-india-newsletters/>

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