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Messages
From the New Director

Kenichi Horikoshi
President & Representative Director
Seiwa Consultants Co., Ltd.

First of all, I am greatly honored to serve as a director of the International Press-in Association (IPA), which stands as one of the most promising organizations in the field of geotechnical engineering. I will contribute to the continued growth and development of the association.

Before joining Seiwa Consultants, I spent more than 30 years at a research institute in Taisei Corporation, a major contractor in Japan. During my tenure, I was deeply involved in projects primarily related to pile foundations and ground improvements. I also engaged in the management of technology developments, including strategy makings, budget controls, and intellectual property managements. I am confident that my extensive experience in these areas will greatly benefit the association's development.

Furthermore, I had the privilege of serving as the Secretary General for the Asian Civil Engineering Coordinating Council (ACECC) from 2013 to 2020. ACECC now consists of 17 civil engineering societies/institutions from around the world. ACECC has sponsored the International Conference on Press-in Engineering (ICPE) in 2018, 2021, and will sponsor ICPA 2024. With ACECC's extensive world-wide network, I am enthusiastic about leveraging these connections to further the goals of IPA.

The ongoing process of urbanization has made infrastructure construction increasingly complex and constrained. Despite densely packed infrastructure and buildings, it is imperative to minimize the adverse impacts of construction on neighboring structures and the environment while also reducing construction costs and periods. Given the pressing issues of global warming, climate change, and the looming threat of significant earthquakes, disaster mitigation measures are urgently required in many countries. Press-in technologies offer vital solutions to address these challenges.

To foster the continued advancement of press-in technologies, it is essential to invite more members from divers organizations of academia, industry and government by raising awareness of IPA's activities. It will also very important to invite young people who will make future developments. I hope I can strongly support to the expansion of IPA members from these aspects.

◆ A brief CV of Dr. Kenichi Horikoshi

Dr. Kenichi Horikoshi has held the position of President & Representative Director at Seiwa Consultants Co., Ltd since 2021. Prior to this role, he worked at Taisei Corporation as a geotechnical research engineer. He obtained Ph.D. in 1996 from the University of Western Australia after completing his Master's course at Kyoto University in 1987. Dr. Horikoshi served as the Secretary General of ACECC. He also held the position of Vice President at the Japanese Geotechnical Society.

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Special Contribution

Enhancing Bored Pile Integrity Evaluation and Anomaly Issues with Disturbed Fibre Optic Sensor Technology: A Case Study

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Abstract

The integrity of cast-in-place foundation piles is a major concern in geotechnical engineering. This study outlines a method for identifying common defects in bored cast-in-situ piles during instrumented load tests using Distributed Optical Fibre Strain Sensing (DOFSS) technology. DOFSS technology relies on Brillouin Optical Time Domain Analysis (BOTDA), which offers the advantage of recording continuous recording strain profiles, in contrast to traditional discrete sensors like Vibrating Wire strain gauges. In the context of pile instrumentation, obtaining a distributed strain profile is crucial for analysing a pile's load transfer and shaft friction while detecting irregularities in the strain pattern. Defects such as necking of the pile shaft, concrete disruptions, foreign material intrusion, and improper toe formation due to soil particle contamination at the base can potentially lead to pile failure. This study introduces a novel approach to detecting such defects using DOFSS technology, which may serve as a valuable addition to existing non-destructive testing (NDT) methods. Additionally, the paper includes discussions on the performance of instrumented piles based on maintained load tests.

Keywords: Pile, Fibre Optic Sensor, Integrity testing

1. Introduction

Pile foundations have a rich history spanning thousands of years, but the last five decades have witnessed a significant increase in the usage of concrete piles. As we've embraced larger diameter and longer piles, concerns about the quality and integrity of cast-in-place foundation piles have grown. This concern is exacerbated by the inherent challenges in inspecting these piles, given their substantial depth, limited accessibility, and the potential instability of the shafts. Furthermore, repairing pile foundations can be a complex and expensive endeavour, especially when addressing significant defects. As a result, there is a substantial demand for effective testing techniques to assess the integrity of bored piles. Traditional methods for evaluating pile integrity include cross-hole sonic logging (CSL), sonic echo (SE) testing, radiation-based gamma-gamma logging (GGL), and, more recently, thermal integrity testing methods like thermal integrity profiling.

In civil engineering, the use of Distributed Fibre Optic Strain Sensing Systems (DFOS) has only gained traction in the past decade. Initially, universities and research institutions were the primary adopters of DFOS for academic investigations (Iten, 2012). Over time, this technology has started to garner interest from the industry, gradually shifting from a purely research-oriented tool to one with practical applications. Notable references include the works of Feng et al. (2013), Gao et al. (2015), Glisic and Inaudi (2012), Hoult et al. (2014), Leung et al. (2015), and Zeni et al. (2015). The increasing recognition of DFOS in the domain of structural health monitoring can be attributed to its numerous benefits, which include a dense collection of spatial data, straightforward installation, and dependable performance.

Instrumented test piles are vital in validating pile performance and assessing geotechnical capacity. One major disadvantage of using conventional instruments such as strain gauges in instrumented pile load tests is that each sensor requires an individual cable for measurement. It ends up with complicated cable management required during the measurement process. To enhance the efficacy of instrumented test piles and achieve more precise geotechnical parameter determination through load-transfer analysis, there is a need for a more comprehensive and dependable system. This research introduces a novel approach by utilising DFOS with Brillouin Optical Time Domain Analysis (BOTDA) technology to enhance the functionality of instrumented test piles. BOTDA is an advanced technique for measuring continuous strains, with inherent distinct advantages over conventional point-wise sensors (Mohamad and Tee, 2015). This paper presents a case study of an instrumented load test carried out on top loaded bored pile using a DFOS technique. This innovation improves accuracy in load transfer analysis for piles and complements the existing pile integrity testing methods.

2. Principle Measurement and Pile Instrumentation

2.1. Brillouin Optical Time Domain Analysis (BOTDA)

In this research, a commercially available BOTDA from OZ Optic Ltd. was employed to assess the distribution of loads along the pile shaft. The BOTDA sensor operates by utilising two distinct light sources launched from opposite ends of an optical circuit. The system relies on the principle of backwards stimulated Brillouin scattering (SBS), where a pumping pulse light is launched from one end of the optical fibre and travels within the fibre, while a continuous wave (CW) light is launched from the opposite end and propagates in the opposite direction (as illustrated in **Fig. 1**). In this setup, the pump pulse generates backward Brillouin gain while the CW light interacts and amplifies the pump pulse light, creating stimulated Brillouin scattering. The Brillouin frequency shift within the single-mode fibre is directly proportional to changes in strain or temperature at that specific scattering location. A complete strain profile can be subsequently determined by precisely measuring these frequency shifts and propagation times. One notable advantage of BOTDA, compared to other distributed strain sensing systems like BOTDR (Brillouin Optical Time Domain Reflectometry), is its capacity to obtain data with greater precision.

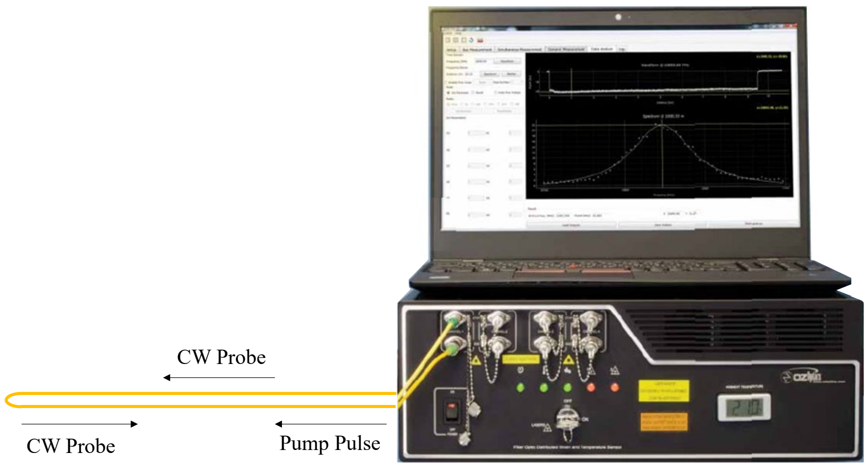

Fig. 1. Principle measurement of the BOTDA system

2.2. Distributed Fiber Optic Strain (DFOS) Sensing Cable

A 5.0 mm diameter optical cable that was designed to be embedded inside cast-in-situ concrete piles is shown in **Fig.2**. Six strands of steel wire reinforce the single-core, single-mode optical fibre in this cable, and it is covered in a polyethylene cable jacket. To make sure that any external strain caused by the concrete is ultimately transferred from the exterior coating to the inner core, the inner glass core and the outer plastic sheath are securely linked (Mohamad et al., 2011).

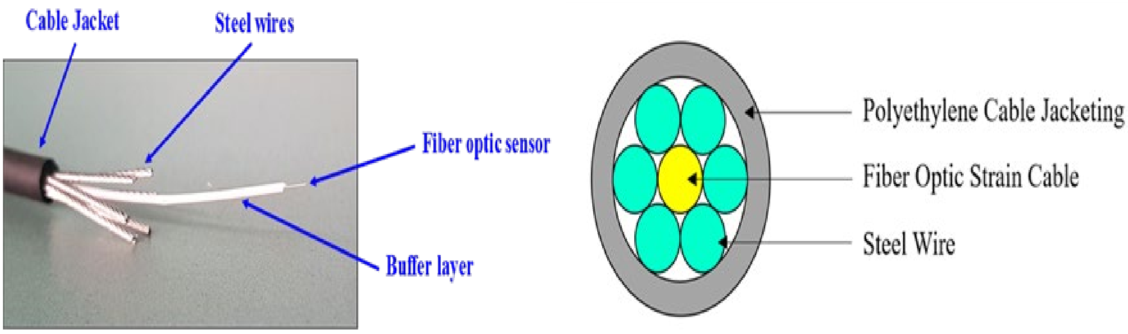

Fig. 2. Fiber optic strain sensing cable

3. Installation and Procedure

This study aims to develop a method of instrumented test pile on the cast in-situ bored pile by using a distributed fibre optic sensor via BOTDA. Two study areas, Bangi (TL1) and Kuala Lumpur Town Centre (TL2), have been chosen to test the pile.

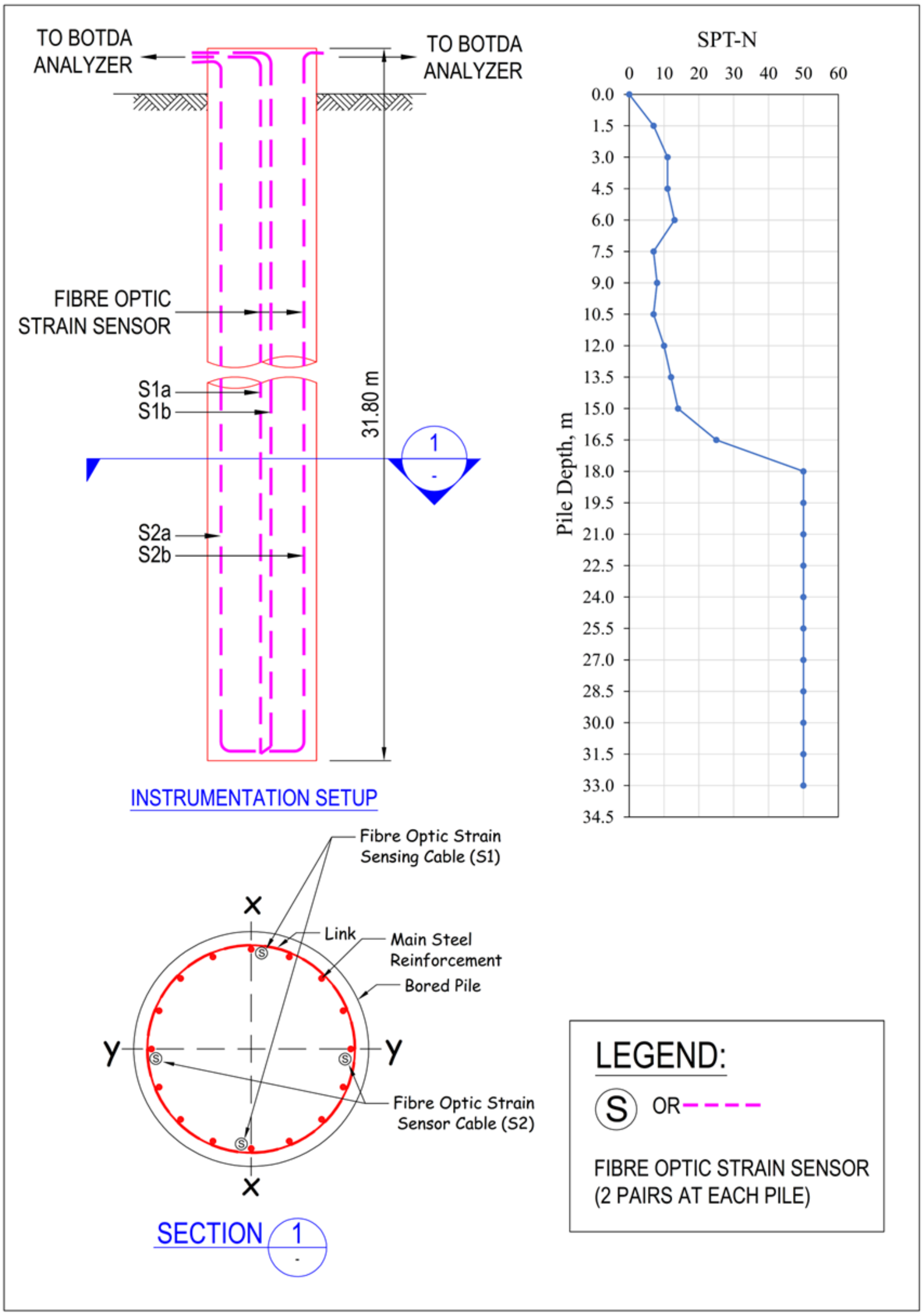

Fig. 3. Instrumentation setup in test pile (TL1)

3.1. Top Loaded Static Load Test on Cast-in-situ Bored Pile for TL1

The TL1 was equipped with DFOS. Concrete coring and an unconfined compression test validated the pile's integrity and anomalous. The diameter of the pile was 1200 mm. The details of the test pile are presented in **Table 1**. This test pile has a length of 31.8 m. According to the soil investigation report, the first 15.0 m of the soil was not hard, with SPT-N values ranging from 20 to 30. Beyond 18.0 m of depth, there was a hard layer with SPT-N > 50. The test pile was constructed using grade 30 concrete and a 12T25 primary reinforcing cage. Polymer was the stabilising fluid that was utilised to drill the hole. This test pile was installed with the DFOS to measure the strain along the pile during the loading stages. The optical cables were brought to the top of the pile with all the cables tied to the steel cage. From the top to the bottom of the pile, two pairs of distributed fibre optic strain sensing cables (S1a-S1b & S2a-S2b) were fixed to the major reinforcing bars (see **Fig. 3**). The continuous strain profile provided by these two pairs of distributed fibre optic sensors along the pile can be used to calculate the continuous shortening profile of the pile.

Table 1. Detail of instrumented test pile (bored pile – TL1)

Type of Test Pile	Bored Pile (TL1)
Pile Diameter	1200 mm
Working Load	7200 kN
Test Load	14400 kN
Types of Instrumentation	Fibre Optic Strain Cable
Test Equipment	Linear Voltage Displacement Transducers (LVDTs) Load cells Hydraulic jacks
Location	Bangi, Selangor
Pile length	31.8 m

3.1.1. TL1 Testing Procedure

This test used two hydraulic jacks to deliver axial loads to the pile's top. Two load cells were placed between the pile top and the hydraulic jacks to quantify the actual force imposed on the pile. Linear Variable Differential Transformers (LVDTs) were also used to measure the settlement of the pile's top.

The methods used to carry out the static load test were following ASTM D 1143/D 1143/M - 20 (2020). A predetermined load cycle and program were followed throughout the static load test. Two loading cycles totalling 14400 kN, or a maximum load of two times the Working Load (WL), or 7200 kN, were applied to the test pile. With five incremental load steps, the first cycle's maximum test load was set at 1 WL. The maximum test load was doubled to 2 WL in the second cycle, with 10 load increment steps.

The spatial resolution of the BOTDA analyser was set to 5 nanoseconds, which corresponds to a gauge length of 50 cm. It should be noted that readings could be taken at 5 cm intervals along the cable's length. At each loading stage, measurements were taken. The data collected from numerous instruments was evaluated to find any problems or anomalies with pile integrity. Additionally, the pile's integrity and any anomalies were cross-validated using test methods such as concrete coring and unconfined compression testing.

3.2. Top Loaded Static Load Test on Cast-in-situ Bored Pile for TL2

The TL2 was outfitted with DFOS. The integrity and anomaly of the pile were checked by exposing the pile structure for visual inspection. The pile had a diameter of 900 mm. **Table 2** contains information about the test pile.

This test pile has a length of 43.3 m. According to the soil investigation report, the first 31.5 meters of the foundation were not hard, with SPT-N values in the 20s. Beyond 31.5 m depth, there was a hard layer with SPT-N > 50. The test pile was built with grade 40 concrete and a 14T16 primary reinforcing cage. The polymer was employed as a stabilising fluid during the hole-drilling process.

The DFOS was installed with this test pile to measure the strain along the pile during the loading stages. **Fig. 4** depicts the instrumentation setup. All optical cables were carried to the top of the pile and fastened to the steel cage. Two pairs of distributed fibre optic strain sensing cables were attached to the major reinforcing bars from pile top to pile toe. These two distributed fibre optic sensing cables offer a continuous strain profile along the pile, which was utilised to calculate the pile's continual shortening profile and detect any pile integrity issues or anomalies. At each loading and unloading stage, LVDT readings were taken.

Table 2. Detail of instrumented test pile (bored pile – TL2)

Type of Test Pile	Bored Pile (TL2)
Pile Diameter	900 mm
Working Load	5500 kN
Test Load	11000 kN
Types of Instrumentation	Fiber Optic Strain Cable
Test Equipment	Linear Voltage Displacement Transducers (LVDTs) Load cells Hydraulic jacks
Location	Kuala Lumpur Town Centre
Pile length	43.3 m

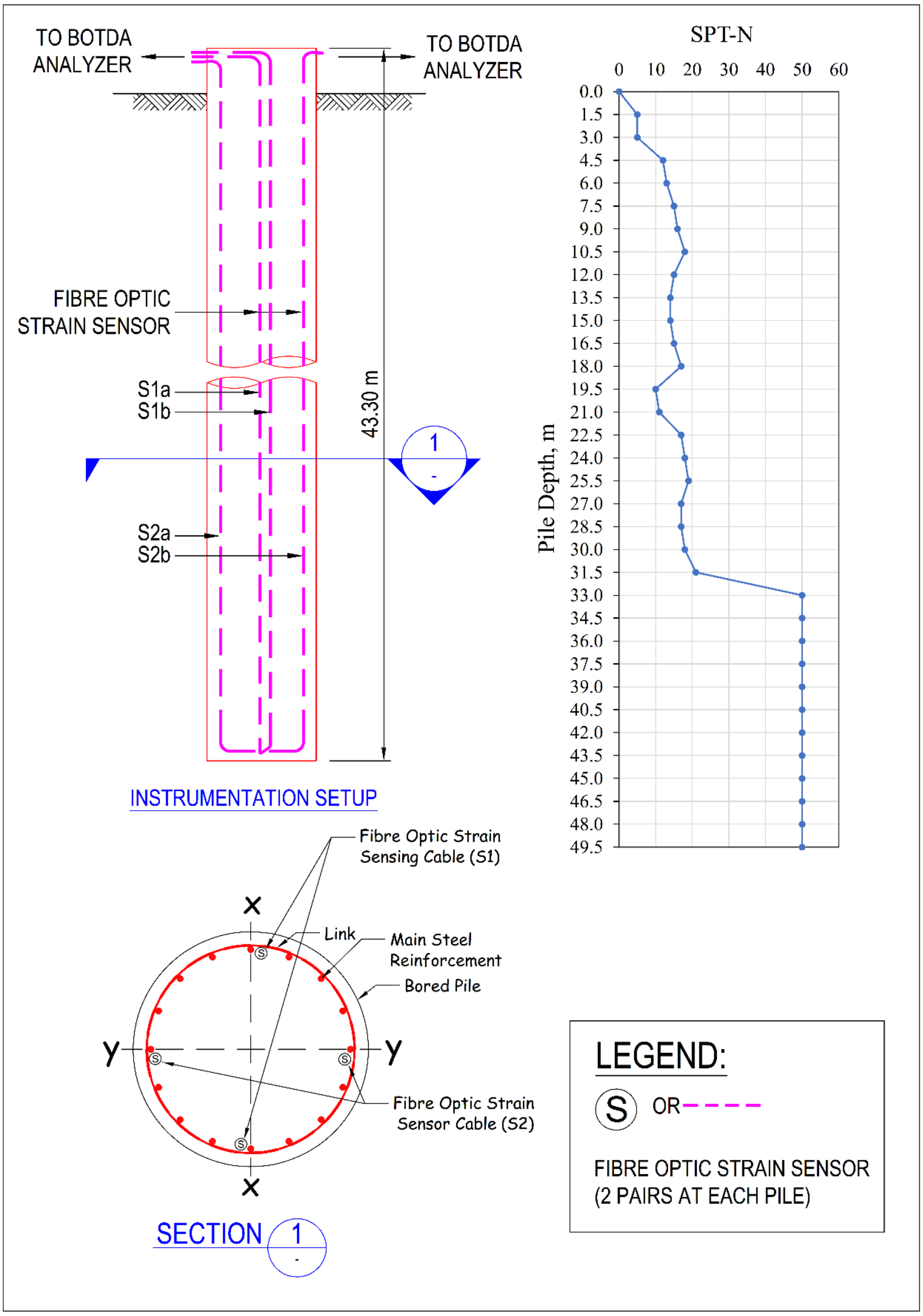

Fig. 4. Instrumentation setup in test pile (TL2)

3.2.1. TL2 Testing Procedure

In this experiment, two hydraulic jacks were utilised to apply axial loads at the top of the pile. Two load cells were positioned between the pile's top and the hydraulic jacks to measure the actual load applied to the pile accurately. LVDTs (Linear Variable Differential Transformers) were employed to monitor the settlement of the pile's top.

The static load test procedures followed the guidelines outlined in ASTM D 1143/D 1143/M – 20 (2020). The static load test was carried out according to the prescribed load cycle and program. The test pile was subjected to a maximum load of 2 times the Working Load (WL), equal to 5500 kN, or a total of 11100 kN distributed over two loading cycles. The maximum test load was set at 1 × WL in the first cycle, with four incremental load steps. In the second cycle, the maximum test load was increased to 2 × WL, with eight load increment steps.

The BOTDA analysers were configured with a spatial resolution of 5 nanoseconds, which corresponds to a gauge length of 50 cm. Notably, readings could be recorded at 5 cm intervals along the cable's length. Measurements were taken at each loading step. The data from various instruments were analysed to identify any issues related to pile integrity or anomalies. Furthermore, the pile's integrity and any anomalies were confirmed by visually inspecting the pile structure.

4. Measurement Results

4.1. Top Loaded Static Load Test on Cast-in-situ Bored Pile -TL1

With the continuous strain profile, DFOS is able to detect anomaly measurements in some of the test piles and subsequently increase the reliability of pile performance interpretation. For TL1, a DFOS sensor was installed in the test pile. Anomalies measurement was detected near the pile head. A coring test was carried out on the test piles to verify the problem physically. The mentioned test pile diameter is 1200 mm in diameter and 32 m in length. The whole length of the pile is constructed in soil strata with the top 10m in a soft layer with SPT N value ≈ 10. As shown in **Fig. 5**, the continuous strain profile was measured during the load test.

With the low SPT N value near the pile top, the pile top was not expected to have high soil friction. The strain profile near the pile top was expected to be nearly vertical with a gentle gradient. As the anomalies were near the pile head, a core test can be carried out to verify the concrete quality relatively easily. A 3 m length of the concrete sample had been cored out from the pile at the pile head, and the photo of the core sample is shown in **Fig. 6**. The core length shows that the concrete quality near the pile top is bad, and some of the length is empty. The core samples were tested with the unconfined compressive strength test. Some core samples could only achieve 10.4 MPa instead of the designated strength of the pile, which should be 35 MPa.

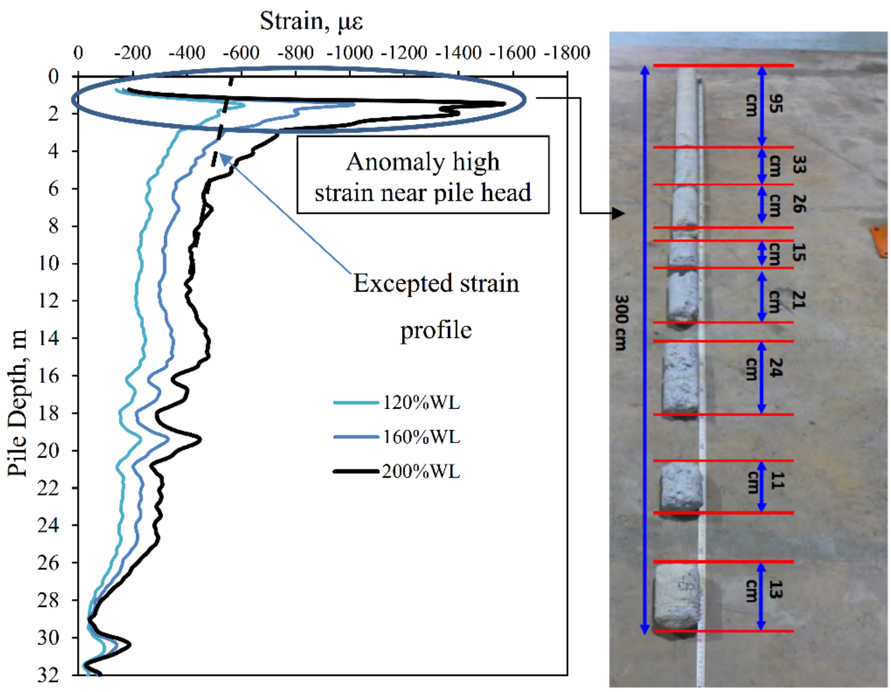

Fig. 5. Anomalies high strain measured near pile head

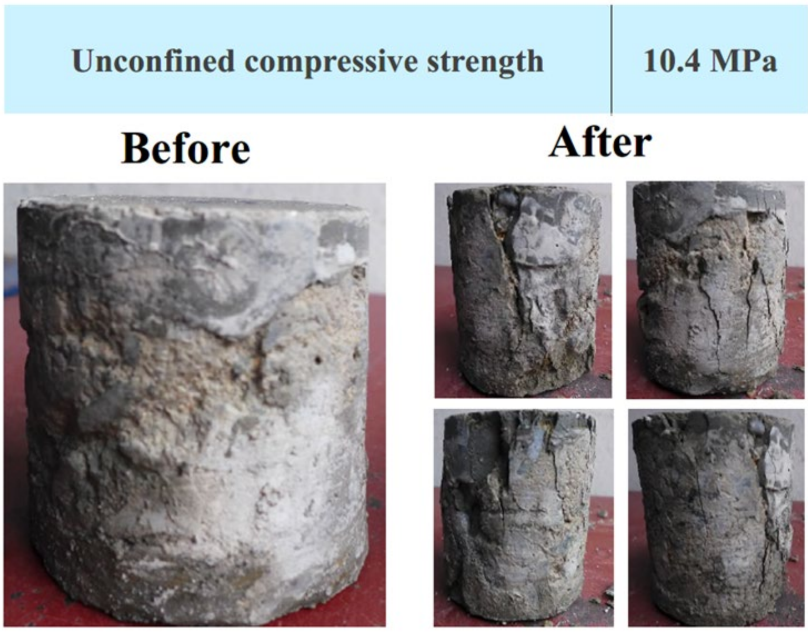

Fig. 6. Unconfined Compressive Strength of core sample

4.2. Top Loaded Static Load Test on Cast-in-situ Bored Pile- TL2

DFOS sensors were also installed in the test pile in another load test. Anomalies measurements were detected near the pile head. The anomaly measurement Kanwas detected at about 5 m depth from the pile head. The pile diameter was 1200 mm and 12 m in length with grade 40 N/mm2 concrete. The top 5.5 m length of the pile was in soft soil, and the friction was negligible. The pile was constructed with a 4.5 m length permanent steel casing. With the 4.5 m length steel casing and negligible soil friction near the pile top, the vertical straight line strain profile was expected to be recorded up to 5 m depth (**Fig. 7**). The pile was tested up to 220%WL. In the progress of increasing the test load to 230%WL, the sound of strong concrete crushing can be heard at the site, and the pile head settlement increased drastically from 20 mm to 53 mm. The DFOS sensing cable is broken, and the measurement is not able to continue at 230%WL. The pile was excavated to the suspected broken level to verify the test result. The test pile was confirmed broken at approximately 5 m depth just below the permanent steel casing, as shown in **Fig. 7**.

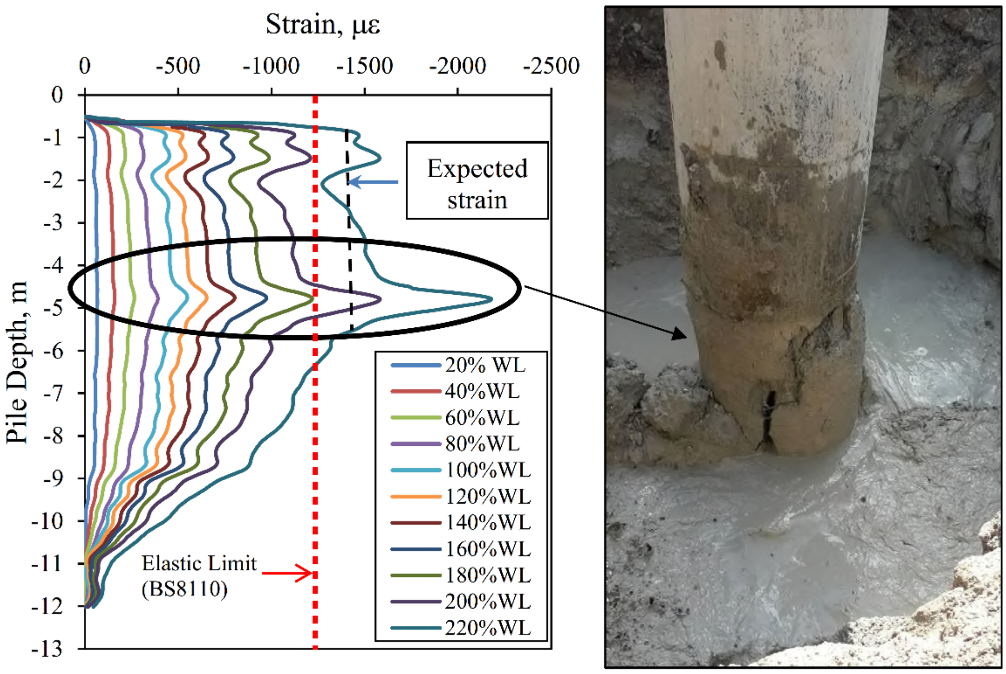

Fig. 7. Anomaly measurement of strain profile and visual validation

5. Discussion

The primary advantage of employing a Distributed Fiber Optic Sensing (DFOS) system for measurements lies in its ability to easily capture the complete strain profile rather than discrete data points obtained from traditional strain gauges. This continuous strain profile provides a more accurate understanding of overall pile performance and facilitates the detection of any abnormal pile behaviour. Such insights were previously challenging or uneconomical to obtain using conventional measurement systems.

BS8110-1:1997 (2007) has proposed a stress-strain curve for concrete, as depicted in **Fig. 8**, for adoption in reinforced concrete design. According to this suggested stress-strain curve, concrete with characteristic strength (fcu) values of 35 N/mm2 and 40 N/mm2 should reach their elastic limits at strain values of 1159 με and 1239 με, respectively, considering a material safety factor (γm) of 1.5. An important assumption in interpreting the results of instrumented test piles is that the concrete remains within its elastic range. The pile load transfer analysis uses the concrete's Young's modulus (Ec). If the concrete exceeds its elastic limit while still using Young's modulus for elastic concrete, it can introduce uncertainty and errors into the pile load transfer analysis.

DFOS enables the effective identification of pile sections with abnormally high strain. These high-strain sections often comprise subpar-quality concrete, as **Fig. 6** and **7** illustrate. Pile sections with inferior concrete quality have reduced structural stiffness and deform more than other sections with good-quality concrete. They tend to reach or exceed the elastic limit earlier, as shown in **Fig. 5** and **6**. Inferior concrete quality contributes to a lower and more uncertain Ec value. To obtain reliable results regarding pile performance, pile sections with poor-quality concrete should be excluded from the pile load transfer analysis.

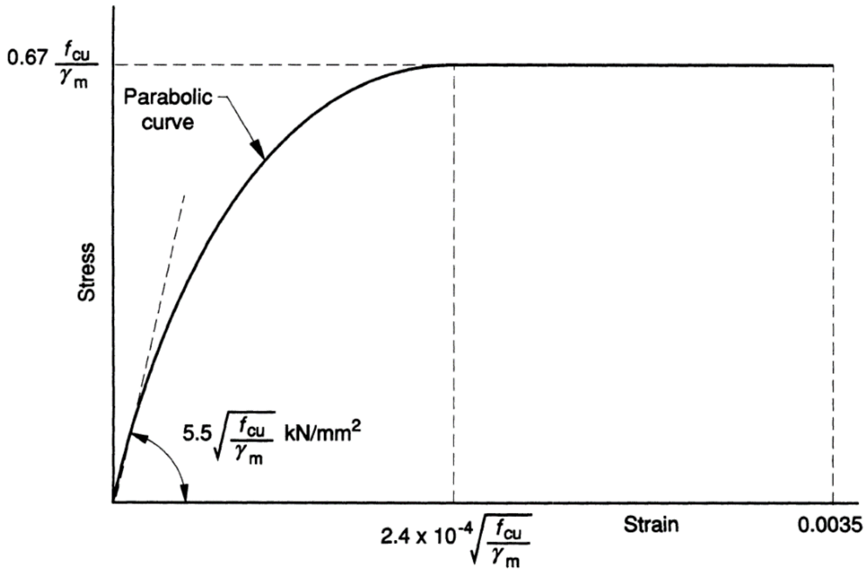

Fig. 8. Design Stress-Strain Curve for Normal Weight Concrete (adopted from BS8110: Part 1:1997)

6. Conclusion

It has been successfully executed to use a novel approach for instrumenting bored piles with distributed optical fibre strain sensors. The findings of field tests have generally shown that there is excellent agreement between fibre optic (FO) sensors and conventional sensors. When compared to the discrete data produced from conventional strain gauges, the main benefit of adopting dispersed measurements is the simplicity with which the entire strain profile can be easily captured. Traditional strain gauges frequently require data extrapolation between a few sensing locations, require time-consuming installation, and are prone to data problems caused by localised measurement inaccuracies.

When assessing a pile's load transfer and shaft friction and locating any anomalies in the strain pattern, having access to a comprehensive, continuous strain profile is crucial. In the case studies, this innovative approach successfully located characteristics of concrete contamination in problematic piles. Existing non-destructive testing (NDT) techniques may benefit from the Distributed Fiber Optic Strain Sensing (DFOS) technology. Until recently, conventional measurement devices were unable to provide such comprehensive information.

Credit authorship contribution statement

Bun Pin Tee: Conceptualization, Methodology, Writing – original draft, Preparation, Validation, Formal analysis, Investigation, Writing – review & editing, Visualisation. **Rini Asnida Abdullah**: Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualisation. **Hisham Muhammad**: Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualisation. **Ahmad Safuan A Rashid**: Writing – review & editing, Validation, Project administration, Methodology, Investigation, Formal analysis, Conceptualisation. **Afiqah binti Ismail**: Writing – review & editing, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualisation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgement

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Directors' research and development activities

The Application of Partial Floating End Bearing Sheet Piles to Mitigate Liquefaction-Induced Foundation Settlements

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Introduction

Liquefaction-induced tilting and settling of buildings founded on top of saturated sandy soils has been a major contributor to damage in many past earthquakes. These included the 2011 Tohoku Earthquake in Japan, the 2010-2011 earthquakes in New Zealand, the 2015 Nepal earthquake, and the most recent 2023 Turkey earthquakes. Geotechnical engineers have recommended the installation of sheet piles near foundations as an effective strategy to mitigate settlement induced by liquefaction as illustrated in Fig. 1. However, the cost associated with full-length sheet piles can be reduced by implementing partial floating sheet piles (PFS).

Initially, the PFS approach was conceived as a solution to counteract subsidence caused by the load of a river embankment constructed on soft clay ground within residential areas. This method involved the combination of partially floating sheet piles and end-bearing sheet piles. The partially floating sheet piles were situated in the liquefiable layer, while the end-bearing sheet piles were supported by a stable layer. Consequently, the utilization of the PFS technique allowed for a reduction in the weight of sheet piles used, cutting it approximately in half.

However, previous research investigated that sheet piles with gaps or half-lengths in liquefiable soils did not effectively mitigate liquefaction-induced shallow foundation settlements. To achieve improved performance in reducing liquefaction-induced foundation settlements, it is necessary to use full-length sheet piles that cover the entire liquefiable layer. As a result, our study involved only changing the configuration of the end-bearing portion of sheet piles to prepare the PFS.

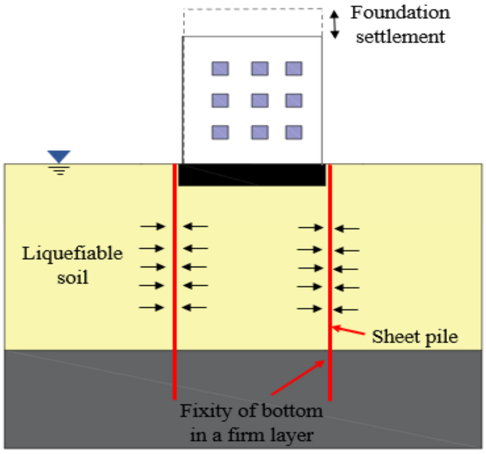


Fig. 1. Application of the sheet pile to mitigate the liquefaction-induced foundation settlement.

Experimental Program

In this study, the model ground properties were scaled down according to the similitude law, which was obtained based on a large-scale shake table test. The scaled model comprised three distinct soil layers with different relative densities: a 50% relative density top crust layer, a 30% relative density middle liquefiable layer, and an 85% relative density bottom dense layer. A shallow foundation was placed atop the crust layer, followed by the insertion of sheet piles (both full-length and PFS) at 0.625 times the foundation width from the center, utilizing the press-in technique as shown in Fig. 2(i). This study included five 1g shaking table tests. Test 1 had no mitigation measures (NM). Test 2 used full-length sheet piles (FL), while Tests 3 to 5 employed partial floating end-bearing sheet piles. For instance, "5-cut" indicates that 5 cm of the end-bearing sheet pile was removed to prepare 5 cm of PFS, as depicted in Fig. 2-ii(b).

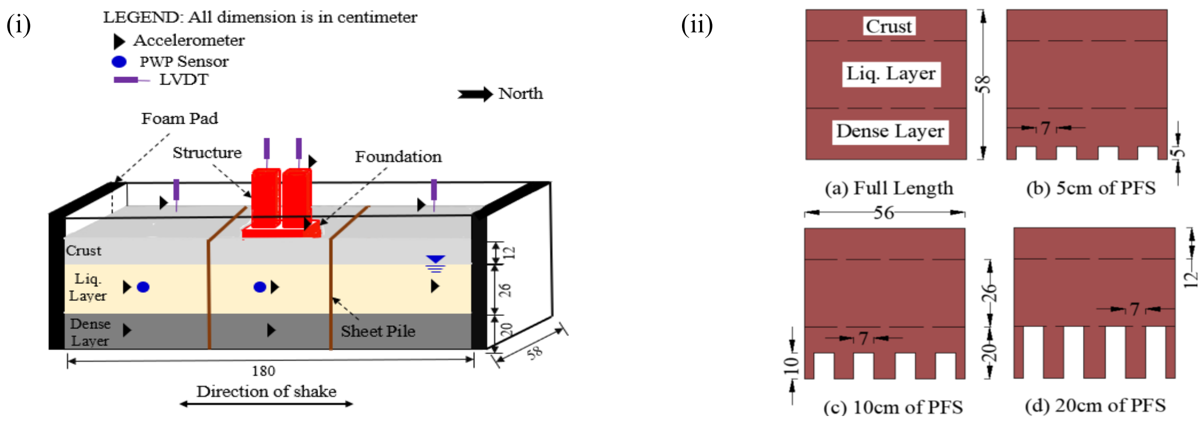


Fig. 2. (i) Schematic view of the model ground, sheet pile, foundation, and structure, (ii) Sheet pile types utilized in this study

Performance of PFS against Liquefaction-Induced Foundation Settlements

In this study, the settlement of the shallow foundation is represented in the form of settlement time histories as depicted in Fig. 3a. The maximum foundation settlement was determined from the recorded settlement-time histories in Fig. 3a and then plotted against the corresponding experiment number in Fig. 3b. In Fig. 3b, the installation of sheet piles resulted in a decrease in foundation settlement. For 'FL', '5-cut', and '10-cut' of PFS configurations, the sheet pile achieved sufficient fixity of bottom into the dense layer when compared to the '20-cut' of PFS. As a result, an increase in PFS led to a higher maximum foundation settlement.

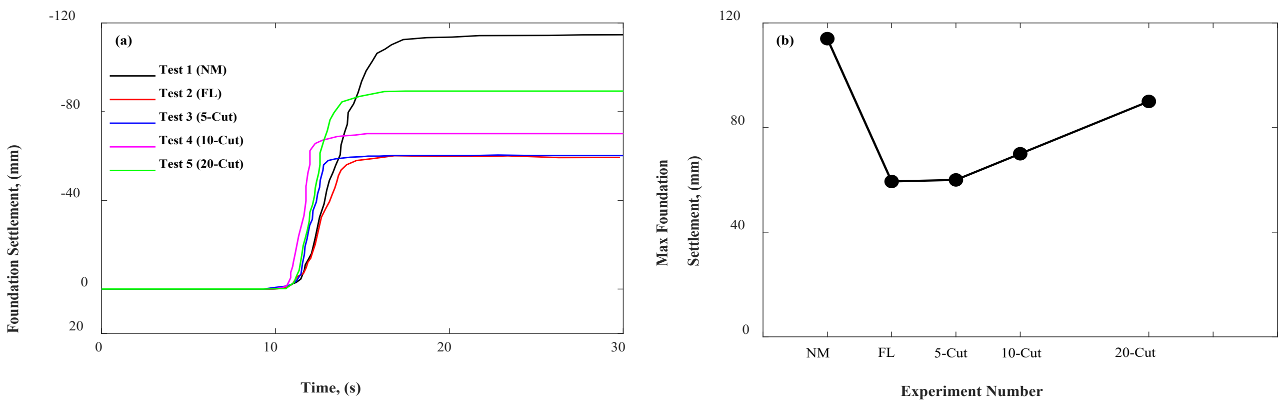


Fig. 3. (a) Foundation settlement-time histories, (b) The variation of maximum foundation settlement with the experimental number.

Conclusions

The objective of this investigation was a comparative analysis of partial floating end-bearing sheet piles within a model ground, aiming to mitigate liquefaction-induced foundation settlement using a series of scaled 1-g shaking table tests. The experimental outcomes demonstrated that the foundation settlement measured by installing 25% (5-cut) and 50% (10-cut) of PFS closely approximated the settlement observed with full-length sheet piles. please note our comprehensive research paper will be presented at the Third International Conference on Press-in Engineering in 2024, hosted in Singapore.

IPA News Letter Volume 8, Issue 4 December 2023

Serial Report

"RED HILL 1967™" Press-in Technology Dissemination Hub -Part 1-

Tsunenobu Nozaki

General Manager
IPA Secretariat

Foreword

GIKEN LTD. has inaugurated "RED HILL 1967" as the hub for disseminating the information about the superiority of press-in piling technology in Akaoka-cho, Konan City, Kochi, Japan. The facility is open to the public and tour reservations started being accepted from May 10 2023.

RED HILL 1967 comprises four distinct areas as shown in Fig.1; (1) "Sozokan (The Museum of Piling Machines)", which features piling equipment from around the world and successive press-in piling machines, (2) "Research Building", housing a research facility, a theater hall and an exhibition space dedicated to press-in piling technology, (3) the world's first "demonstration exhibition hall" that showcases actual structures created through the "Implant™ Method", utilizing the cutting-edge pile press-in/extraction machine "SILENT PILER™", and (4) "Kochi Factory 3", the GIKEN's largest factory in Japan.

Fig. 1 Facility's Full View

<u>Facility Outline</u>
Location : 246-3, Daito, Akaoka-cho, Konan-city, Kochi, Japan, 781-5310
Site Area: 36,000m^2
Capital: 1,637 million yen (excluding Kochi Factory 3)
Hours: 9:00 a.m. - 4:00 p.m. （Last admission at 15:00）
Closed: Weekends & National Holidays (As per the company holidays)
Admission: Free (Advance booking is necessary)

Message from the founder of GIKEN (Mr. Akio Kitamura, Executive Chairman of GIKEN LTD.)

"Seeing is believing" is a phrase that means if you see something yourself, you will believe it to exist or be true. It is difficult to explain a “machine structure” or “construction method” with unique processes that one has never seen before in words to a person in a precedent-based industry. It is also challenging for the listener to understand the true meaning of what is being explained. In addition, there are language barriers overseas, and it is a challenge to explain through an interpreter. However, once you see it, you can accelerate your understanding by using the knowledge, experience, and imagination in your brain. RED HILL 1967 is an “actual” exhibition and demonstration facility to realize a method based on this principle.

The Press-in Method is an innovative method with an exceptional advantage of the Press-in Principle, based on the “Five Construction Principles,” and scientifically supported. However, the truth of the method is still not known to the public. As a common occurrence, it is said that where there are advantages, there are disadvantages. Except, Press-in Principle has no drawbacks. Although, it had its weaknesses. The CRUSH PILER™ and GYRO PILER™ overcame the weak point, which was the installation of piles into hard ground. Meaning, the Press-in Principle overcame its weak point and entered the realm of perfection. The “RED HILL 1967” is a facility where visitors can immediately understand such domain. That is, a place that embodies “seeing is believing,” a base to distribute the true facts of the Press-in method, and meets the following conditions.

Introduction of the facility: Sozokan (The Museum of Piling Machines), Approx. 2,400m^2

This warehouse facility represents an expansion of the pre-existing "Museum of Piling Machines" formerly located at GIKEN’s Kochi Head Office. Here, an impressive array of 50 actual machines is showcased, including the inaugural SILENT PILER, a certified mechanical heritage. This collection, which we are proud of, encompasses GIKEN’s continuous lineage of inventions and advancements, as well as pile drivers utilizing diverse principles from around the globe.

Visitors will gain insight into the historical progression of press-in piling machines and the differences in construction principles through informative panels and videos.

The facility building is a completely new structure that breaks with conventional building standards, using steel sheet piles as the main structural members and confined ground seismic dampers* for the foundation (See Fig. 2, Fig. 3 and Fig. 4).

Fig. 2 Overview of The Museum of Piling Machines

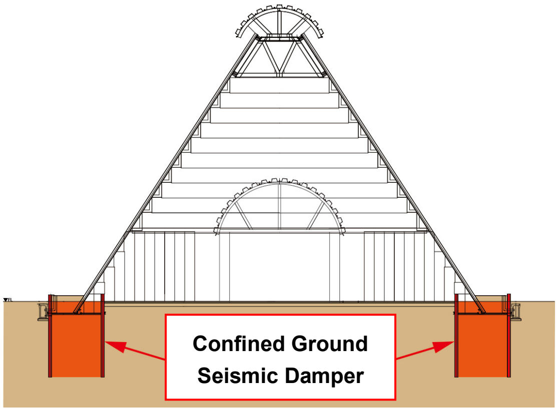


Fig.3 Confined Ground Seismic Damper*

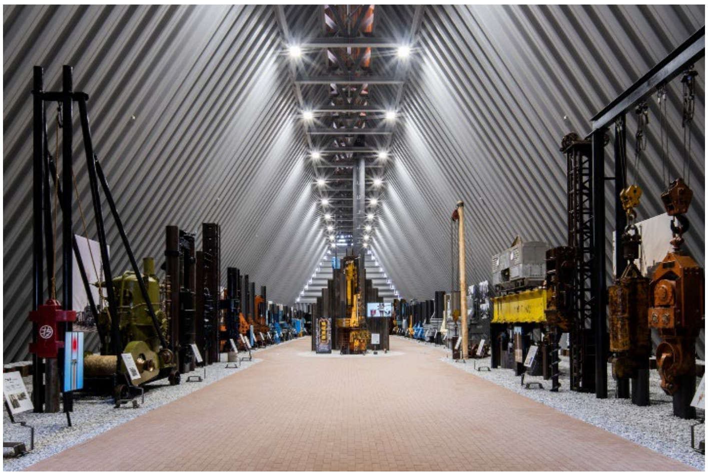


Fig. 4 Facility Interior

*Confined Ground Seismic Damper
A technology that suppresses lateral spreading due to soft ground or liquefaction and absorbs seismic motion while suppressing subsidence of the building by enclosing and tightening the ground that forms the foundation of the building through continuous steel sheet pile walls.

Introduction of the facility: Research Building, Approx. 900m^2

In addition to establishing laboratories for various demonstration tests, GIKEN has also created a theater and an exhibition space. This space offers visitors an accessible platform to grasp the evolution of press-in principles and technology, spanning the past, present, and future.

This structure stands as the inaugural architectural structure that leverages a continuous wall formed by pressing-in steel sheet piles, seamlessly integrating the functions of pile foundations, columns, and walls, shown in Fig. 5 and Fig. 6. The encompassing nature of this wall imparts a confined ground seismic damper structure. Notably, the elevator shaft, which is the path of the elevator, employs a large steel tubular pile measuring 2 meters in diameter as the world's first trial (Fig. 7).

While sharing the same steel sheet piles as the Sozokan, this curved building is distinct in its design approach.

Fig. 5 Overview of the Research Building

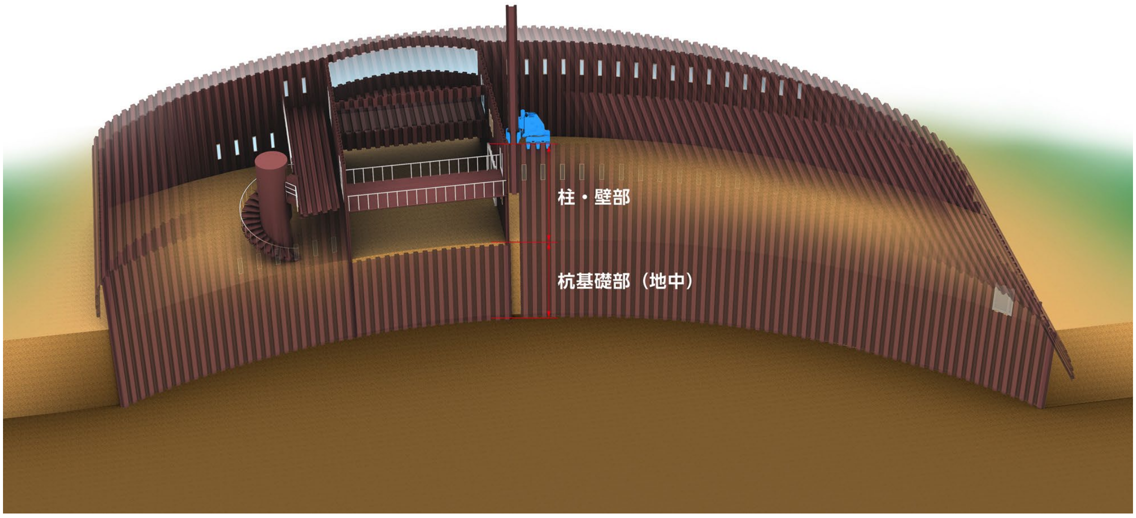


Fig. 6 perspective View of the Research Building

Fig. 7 Elevator Shaft used a Steel Tubular Pile

Fig. 8 Theater Room

In the theater room, a concept video of the press-in piling technology will be shown to visitors as the starting point here in this theater room. The theater room will also be used for seminars and lectures (Fig. 8).

The essentials, history and future prospects of the press-in piling technology are displayed using panels and videos at the Exhibition Space (Fig. 9), across from the Theater Room.

Fig. 9 Exhibition Space

Part 2 to be continued in the next issue of the Newsletter (March 2024).

Event Report

21st Southeast Asian Geotechnical Conference and 4th AGSSEA Conference, Bangkok, Thailand, 25-27 October 2023

Mark Albert H. Zarco

Professor, Institute of Civil Engineering
University of Philippines Diliman, Quezon City

The 21st Southeast Asian Geotechnical Conference and 4th Association of Geotechnical Societies in Southeast Asia (AGSSEA) was held on 25-27 October, 2023, at the Centara Grand and Bangkok Convention Center at Central World, Bangkok, Thailand (Photo 1 and 2). The conference was organized by the South East Asian Geotechnical Society (SEAGS), Engineering Institute of Thailand under H. M. The King's Patronage, and the Thai Geotechnical Society (TGS), and under the auspices of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

The conference was attended by more than 240 experts from 19 countries with the main theme "Innovative geotechnology to meet new challenges in the region and beyond". The technical program consisted of five keynote lectures as well as parallel session covering topics on seismic geotechnics, admixture in geotechnics, foundations, ground improvement, numerical analysis, sustainability in geotechnics, construction & excavation, slope stability, geosynthetics, and ground investigation.

During the 11th AGSSEA Council Meeting held on October 26, 2023, Prof. Kuo-Chieh Chao of the Asian Institute of Technology was elected as the next president of the SEA Geotechnical Society, while Prof. Suttisak Soralump of Kasetsart University would assume the chairmanship of the AGSSEA. It was also decided that the 22nd Southeast Asian Geotechnical Conference and 5th Association of Geotechnical Societies in Southeast Asia (AGSSEA) would be held in 2026 in Manila, Philippines. In attendance at the conference were Dr. Pastsakorn Kitiyodom and Prof. Mark Zarco, with Prof. Anh-Tuan Vu attending the council meeting online.

Photo 1. Opening ceremony by with ISSMGE Vice President for Asia Prof. Keh-Jian Shou, SEAGS and Thai Geotechnical Society President Prof. Suttisak Soralump, and Prof. Warakorn Mairang, Chairperson, 21st SEAGC & 4th AGGSE Conference Organizing Committee.

Photo 2. Group picture by members of the AGSSEA Council.

Event Report

17th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering

Mark Albert H. Zarco

Professor, University of the Philippines, Diliman

The 17th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering was held on 14 – 17 August, 2023, at the Hilton Astana Hotel, Astana, Kazakhstan (Photo 1). The conference was organized under the auspices of ISSMGE (International Society for Soil Mechanics and Geotechnical Engineering), the Kazakhstan Geotechnical Society (KGS), Akimat of Astana, the Eurasian National University, and “Geotechnical Center” Ltd. (Saint Petersburg, Russia).

The conference was attended by more than 600 experts from 90 countries with the main theme “Smart Geotechnics for Smart Societies”. The technical program consisted of eight keynote lectures, six special lectures, six invited lectures, six thematic lectures, and three Bright Spark lectures. One of the invited lectures entitled “Creep after Surcharge Unloading” was given by IPA President Prof. Leung Chun Fai (Photo 2).

Topics covered during the conference included: soil characteristics and properties; underground spaces and deep excavations; tunneling; slope debris flows and embankments; dams; shallow and deep foundations; soil dynamics and geotechnical earthquake engineering; soil improvement; Geoenvironmental engineering; geosynthetics and geoproducts; engineering geology and rock engineering; offshore and harbor geotechnics; Geotechnical training and education; in-situ testing and monitoring; GeoEnergy; case histories; investigations of foundations of historical structures, buildings and monuments; numerical analysis of soil-structure interaction; geotechnical infrastructures; marine geotechnics; mining and geotechnics; design and modelling; transportation geotechnics, engineering, and technology, pile foundations, technologies, and testing; trenchless technology in underground constructions; pipelines on problematic geotechnical conditions; frost geotechnics; BIM technology and geotechnical engineering; and Megaprojects and Megastructures in difficult geotechnical conditions.

During the ISSMGE Council Meeting held on August 13, 2023, IPA Director Dr. Andrew McNamara assumed the position of ISSMGE Secretary General from Prof. Neil Taylor (Photo 3). During the Asian Council Meeting held on August 15, 2023, it was decided that the next Asian Regional Conference on Soil Mechanics and Geotechnical Engineering would be held in 2027 in Bangkok, Thailand. It was also decided that the 1st Geotech Asia Conference will be held in Mumbai, India in 2025.

Photo 1. Group picture at the closing of the 17th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering

Photo 2. IPA President Prof. Leung Chun Fai delivering an invited lecture entitled "Creep after Surcharge Unloading"

Photo 3. IPA Director Dr. Andrew McNamara assuming the position of ISSMGE Secretary General during the ISSMGE Council Meeting held on 13 August, 2023.

Young Members Column

Investigation on offshore pile foundation subjected to coupled marine environmental factors

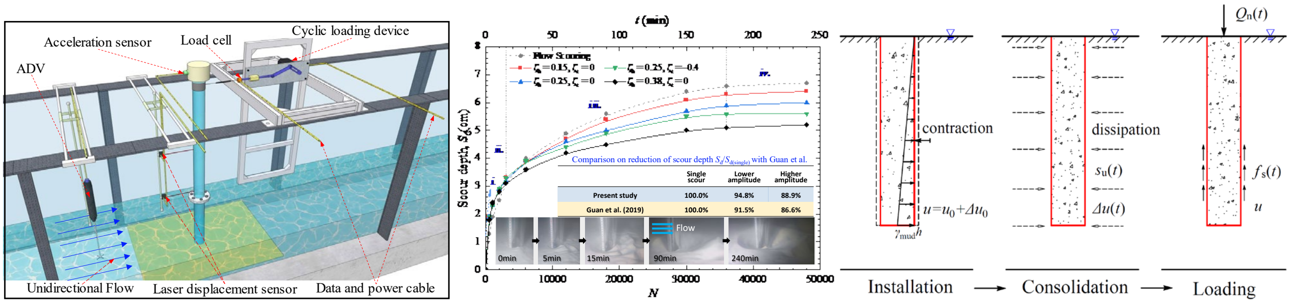
Hanbo Zheng

Ph.D. student, Tongji University

I obtained my bachelor's degree in mining engineering from Central South University in 2019 and became to a postgraduate student by recommendation. I applied a successive postgraduate and doctoral program in 2021 and and I am currently a third-year Ph.D. student at Tongji University, Department of Geotechnical Engineering. The institute is mainly oriented to solving problems encountered in civil engineering practice, such as the mechanical behavior of pile foundations for offshore wind turbines, scour phenomenon around hydraulic structures, and seismic response of pile foundation. I have gained much experience in the field for the past three years since I joined this institute at Tongji University. I have also learned how to critically analyze experimental data and convert it into abstract physical laws that can be applied in engineering practice. I joined the International Press-in Association (IPA) on Nov 28, 2019, as a young researcher.

With an increase in the demand for renewable energy and the maturity of offshore construction technology, offshore wind farms have been rapidly constructed and have flourished worldwide over the past decade. As one of the most popular supporting structures used for offshore wind turbines (OWTs), monopile foundations accounted for 81% of the installed OWT substructures in Europe. My current research work focuses on the long-term cyclic response and bearing capacity of offshore wind turbines foundation considering local scour effect. Monopile-supported OWTs are subjected to a complex combination of environmental loadings when deployed in extreme marine environments, including extreme wind and wave loads due to typhoons and storm surges as well as the removal of soil due to scour, which necessitates formidable requirements for the ultimate bearing capacity of the monopile foundations. I interested in the mechanical response of OWT system under the combined effect of cyclic loading and scour, such as the cumulative rotation evolution, natural frequency migration, ultimate bearing capacity reduction. The main research methods interest me including the flume model tests and the numerical investigation through advanced constitutive models

In addition, I have some previous works focused on theoretical analysis during the installation process of pile foundations, such as a spherical cavity drained expansion solution for overconsolidated soils, and a theoretical method on the time-varying capacity of a cast-in-place pile based on cavity contraction theory. I interested in the application of advanced soil constitutive models in above studies. I understand that the International Press-in Association (IPA) serves as an exceptional platform, fostering collaboration among engineers and researchers hailing from diverse organizations and institutions. Through this remarkable platform, they can exchange invaluable experiences and share groundbreaking findings, ultimately contributing to the development of innovative technologies that aim to enhance and uplift society as a whole. By facilitating this exchange of knowledge and expertise, the IPA plays a pivotal role in driving progress and fostering a brighter future for our global community.



✓ *Zhang, H., **Zheng, H. B.**, Wang, C., & Liang, F. (2022). Coupled effects of long-term cyclic loading and scour on the mechanical responses of monopile-supported offshore wind turbines. **Ocean Engineering**, 265, 112556.*

✓ *Liang, F., Zheng, H. B., & Zhang, H. (2021). Theoretical Analysis of Postconstruction Load-Carrying Capacity of a Cast-in-Place Pile Installed in K0-Consolidated Anisotropic Clayey Soil. International Journal of Geomechanics, 21(9), 04021166.*

Event Dairy

Title	Date	Venue
IPA Events https://www.press-in.org/en/event		
The Third International Conference on Press-in Engineering (ICPE 2024)	3-5 July 2024	Singapore
International Society for Soil Mechanics and Geotechnical Engineering http://www.issmge.org/events		
16th International Conference on Structural and Geotechnical Engineering	27-28 December 2023	New Cairo, Egypt
14th Austrian Geotechnical Conference - Vienna Terzaghi Lecture	1-2 February 2024	Vienna, Austria
Geo-Congress 2024	25-28 February 2024	Vancouver, Canada
7th International Conference series on Geotechnics, Civil Engineering and Structures (CIGOS)	4-5 April 2024	Ho Chi Minh City, Vietnam
International Conference on Geotechnical Engineering (ICGE'24)	25-27 April 2024	Hammamet, Tunisia
8TH INTERNATIONAL CONFERENCE ON EARTHQUAKE GEOTECHNICAL ENGINEERING (8 ICEGE)	7-10 May 2024	Osaka, Japan
Deep Foundations Institute https://www.dfi.org/events/		
Conference on Foundation Decarbonization and Re-use	28-30 May 2024	Amsterdam, Netherlands
SuperPile 2024	12-14 June 2024	San Francisco, California
Others		
EIT Tea Talk Seminar on Press-in Method	20 December 2023	Bangkok, Thailand

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Editorial Remarks from persons in charge

How time flies! We are pleased to publish the December issue. This issue will guide readers to explore the 'RED HILL 1967' architecture in Akaoka-cho, Japan, and introduce various research and development activities, including Enhancing Bored Pile Integrity Evaluation and research on settlement caused by liquefaction leading to Floating End Bearing Sheet Piles. In addition, the conference in Thailand and in Kazakhstan will be reported.

Confronted with the escalating challenges of climate change and its worldwide consequences, the adoption of sustainable construction practices is crucial, particularly within nearshore pile foundation projects. Coastal regions, susceptible to rising sea levels and extreme weather events, demand resilient infrastructure. A pioneering development in this field is the incorporation of press-in techniques, surpassing traditional approaches. This progressive strategy not only elevates engineering efficiency but also constitutes a strategic initiative to attain carbon neutrality and address environmental issues. Through the implementation of press-in techniques, nearshore pile engineering emerges as an essential solution to fortify infrastructure against the impacts of climate change, ensuring both longevity and environmental sustainability. The International Press-in Association would like to share information, build relationships, and deepen the discussion with researchers in the related areas.

Again, the 3rd International Press-in Conference is coming and will be held next year on 3-5 July 2024. As reported and noted in our previous issues, the theme of this international conference is 'Superiority of press-in piling towards sustainable construction in tackling climate change for infrastructure development' The deadline for submission of abstracts has been extended to 31 October 2023 (https://2024.icpe-ipa.org/abstracts). We look forward to your attendance at this international conference.

On behalf of the editorial board, we wish you all the best for the coming new year!

Chen Wang

Ramin Motamed

Nor Azizi Bin Yusoff