News Letters

Volume 6, Issue 3 September 2021

【Special Issue for ICPE 2021】

The Second International Conference on Press-in Engineering (ICPE) 2021, Kochi, Japan

ONLINE 19-20 June 2021

ICPE2021

Contents

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Visual ICPE 2021

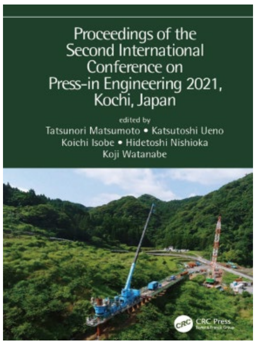
Participants: 430 from 19 countries and regions

Australia	Brazil	Canada	China	France	Germany	Hong Kong
Japan	Korea	Malaysia	Netherlands	Singapore	Sri Lanka	Thailand
Tunisia	Ukraine	United Kingdom	United States	Viet Nam		

Full Papers: 65 from 12 countries and regions

Australia	China	Germany	Japan	Malaysia	Singapore
Sri Lanka	Thailand	Ukraine	United Kingdom	United States	Viet Nam

Proceedings



Program:

Welcome & Opening

Tatsunori Matsumoto
Chair of ICPE 2021


Leung Chun Fai
President of IPA

Charles Ng
President of ISSMGE

Seiji Hamada
Governor of Kochi Prefecture

Mamoru Mimura
President of Japanese Geotechnical Society

Katsutoshi Ueno
Chair of Scientific Working Group

Award Ceremony


Andrew McNamara
Chair of IPA Award Committee

Keynote Lectures

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Yukihiro Ishihara

Yozo Fujino
Josai University

Chair:
Kenichi Horikoshi

Mark Randolph
University of West Australia

State-of-the-Art Reports

Chair:
Stuart Haigh

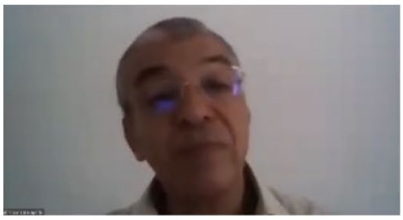
Jiro Takemura
Tokyo Institute of Technology

Yukihiro Ishihara
GIKEN LTD.

Jun Otani
Kumamoto University

General Sessions (*P7—20*)

Closing Ceremony



Mounir Bouassida
University of Tunis El Manar

Yoshihisa Fujisaki
Chair of Administrative Working Group

Best Presentation Award

Kojiro Okabayashi
Vice-Chair of Scientific Working Group

Remarks of ICPE 2021

Tatsunori Matsumoto

Chair, ICPE 2021 Organizing Committee
Vice President, IPA

The organizing committee and IPA first scheduled to hold the Second International Conference on Press-in Engineering (ICPE 2021) on site in Kochi, the birthplace of the Press-in technology, following the 1st conference (ICPE 2018). However, to prevent the expansion of the coronavirus infection (COVID-19), after discussion among the persons concerned including the IPA Directors, we decided to hold ICPE 2021 on-line and on-demand styles. In spite of it, the name of the conference was kept as ICPE 2021, Kochi, and many institutes in Kochi Prefecture as well as other places supported ICPE 2021. The year of 2021 is the 15th year from the founding of IPA in 2007 with the founding President, Dr. Malcom Bolton. IPA has been distributing the Press-in technology over the world, and Press-in machines are used in 41 countries at present. In order to mature the Press-in community as well as the Press-in technology, integration of geotechnical engineering, foundation engineering, mechanical engineering, information technology, environmental engineering and measuring engineering etc. is inevitable. ICPE 2021 aimed to promote the academic field of "Press-in engineering", where experts of various academic fields interact with a focus on the Press-in method. The conference offered opportunities for academics and practitioners to intercommunicate with one another, and for students and young experts to present their achievements.

In response to our call for papers, the organizing committee had received over 70 abstracts, and after rigorous peer review process 65 papers from 12 countries have been selected for publication in the conference. The organizing committee was deeply moved by that the number of participants (registrants) was 430 from 19 countries, which exceeded those in the 1st conference (426 participants from 17 countries in ICPE 2018), even though ICPE 2021 was held in the difficult time. These facts clearly indicate that interest in the Press-in technology and its demand are increasing in construction industry over a wide area of the world.

This conference was supported by 27 institutes, and funding was committed from two organizations, THE KAJIMA FOUNDATION and THE MAEDA ENGINEERING FOUNDATION. IPA has had a great privilege to have very distinguished members in the international advisory board, including the current President and Secretary General of International Society of Soil Mechanics and Geotechnical Engineering, the past Chair and Secretary General of Asian Civil Engineering Coordinating Council, and the current President of Japanese Geotechnical Society and two past Presidents. This would demonstrate an increasing recognition and high credibility of IPA in construction industry over the world.

We selected the main theme in this conference as "Evolution and Social Contribution of Press-in Engineering for Infrastructure Development, and Disaster Prevention and Mitigation". The background of this theme was as follows. There is a growing need for the maintenance and renovation of obsolete infrastructures in developed countries, developing countries face compelling challenges of constructing adequate infrastructures in response to rapid urbanization, and we are witnessing greater threats of earthquakes, typhoons, and other natural disasters, which forces us to recognize and acknowledge the unexpected vulnerability of infrastructures. We were extremely delighted to have two distinguished keynote speakers Dr. Yozo Fujino and Dr. Mark Randolph. Dr Fujino is currently the President of Josai University. At the same time, he is the Distinguished Professor in Yokohama National University, the Distinguished Chair Professor in Hong Kong Polytechnic University, and the Professor Emeritus in the University of Tokyo. He has been engaged in many big projects of bridges and other structures, both in and outside of Japan. Dr. Randolph is Emeritus Professor, The University of Western Australia, and Technical Authority, Fugro. IPA is proud of that his keynote lecture in ICPE 2021 is also IPA 15th Anniversary Commemorative Lecture. I believe that the keynote lectures gave us clear ideas for roles and necessary development of Press-in technology in the near future.

Researches of the technical committees (TCs) in IPA have been very active. Five TCs have been established so far. The State-of-the-Art Report lectures were delivered from TC1 (Application of cantilever type steel tubular pile wall embedded to stiff ground), TC2 (Estimation of Subsurface Information from Data Obtained during Press-in Piling) and TC3 (Expansion of Applicability and Assessment of Seismic Performance of PFS (Partial Floating Sheet pile) Method. The SOA lectures suggested new design concepts for foundation structures constructed using Press-in technology.

As the Chair of the Organizing Committee, I would like to take this opportunity to express my appreciation to all the members of the International Advisory Board, the Organizing Committee, the Scientific Working Group, the Administrative Working Group, and paper reviewers for their dedicated efforts to make this event a great success.

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Keynote Lecture 1

Research and Development for Infrastructure, Renovation, and Management

Alexis Philip Acacio

Professor, Institute of Civil Engineering
University of the Philippines

The keynote lecture of Prof. Yozo Fujino started by citing the late Prof. David Billington's three (3) "E" requirements on towers and bridge – efficient, economical, and elegant. Being efficient and economical are typical criteria that almost all engineers use and thus, needs no further explanation. However, the elegant criterion is quite unusual and thus, he defined it as *"ones which we would like to paint."* From this he pointed out that painting bridges is an effective way to know and learn bridge structures, primarily due to the immense time one would need in observing the subject in order to produce the painting. Fig. 1 shows the painting album of Prof. Fujino. Prof. Fujino studied dynamic action of long-span bridges under wind loading through wind tunnel experiments. However, real world bridge actions (vibrations) are much more *"exciting"* and different from the laboratory simulated actions. Live loads from moving vehicles, pedestrians and earthquakes produce behaviors that are more complicated. Due to the vital role that civil infrastructures play in our society, it is important to study the actual performance of the infrastructures under real loads.

Without proper maintenance, infrastructures deteriorate and will inevitably collapse. This often results to damage in properties and even loss of life. Damage in infrastructures (e.g., bridges, tunnels, etc.) is often not visible, making visual inspection not always effective in assessing the condition of infrastructures. In December of 2012, concrete roof panels of over 130 meter in length in a tunnel in Japan suddenly collapsed, resulting to the first human-loss accident related to maintenance that occurred in the country. This became a wake-up call for Japan, which in turn lead to having safety of infrastructure as one priority in research and development. The following year (2013), Council of Science, Technology and Innovation (CSTI) proposed Strategic Innovation Program (SIP). The SIP projects include research to implement advanced technologies in society through collaboration among ministries, government institutions, universities, and industry.

This is where SIP projects come into the maintenance of infrastructures (Fig. 2). Advanced technology needs to be incorporated in assessing the condition of the infrastructures to properly identify the damage that cannot be determined through visual inspection alone and to avoid labor-intensive programs. Multiple disciplines (e.g., Information, robotics, and material technology, etc.), on top of civil engineering, is necessary to come up with an efficient and cost-effective civil infrastructure management system. From the research under the SIP, multiple inspection systems using advanced technology (e.g., drones, robotics, etc.) were developed and implemented on actual assessment of infrastructures. Aside from the decrease in manpower needed to carry out the assessment, the use of advance technology also allowed inspections to be done without causing significant disturbance to the infrastructure users (i.e., vehicles in a bridge / tunnel). Prediction models in estimating the residual fatigue life of reinforced concrete bridge slab was also developed using the information gathered from the advanced inspection methods.

With the productive output that the SIP produced with the interplay of multiple disciplines and having civil engineering as the bridge / center of these disciplines, Prof. Fujino highlighted that civil engineer are capable in producing innovative outputs by widening their horizon according to one's interest and the needs of the society.

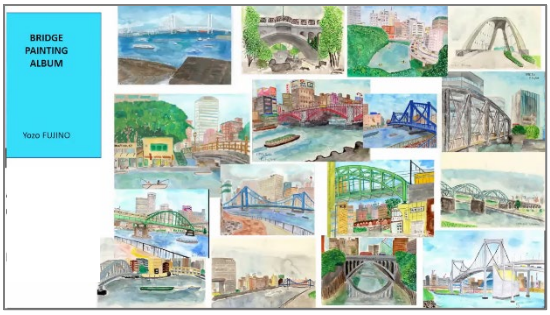

Fig. 1. Bridge painting album of Prof. Fujino

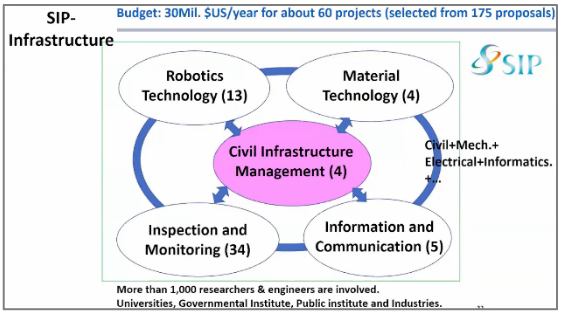

Fig. 2. SIP Infrastructure

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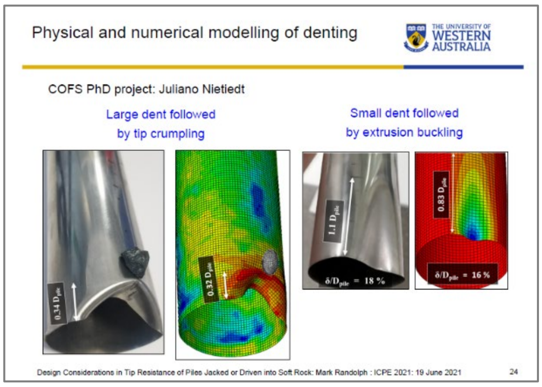
Keynote Lecture 2 (IPA 15th Anniversary Special Keynote Lecture)

Design Considerations in Tip Resistance of Piles Jacked or Driven into Strong Soil or Weak Rock

Adnan Anwar Malik

Assistant Professor, Department of Civil and Environmental Engineering
Saitama University



Prof. Mark Randolph gave the IPA 15th year keynote lecture in ICPE2021. He is an Emeritus Professor in Centre of Offshore Foundation Systems, Ocean Graduate School, The University of Western Australia. The contents of the lecture are the characterization of weak rock (in terms of strength and its mass properties), extraction of rock parameters for the estimation of cast-in-situ and driven piles capacity, and pile tip damage during pile installation. Mostly correlations with unconfined compressive strength (UCS, q_{ucs}) are used to estimate the end-bearing and limiting shaft resistance. But the available UCS data is typically scattered and sparse. However, in certain weak rocks, the penetrometer data can be helpful to improve the profiling. The lecture also highlighted the importance to further exploring the discontinuity while moving from soft rocks to strong soils whose strengths are based on undrained shear strength (S_u) or cone resistance (q_c). Based on UCS and CAU test data on soft rocks like partially weathered mudstone, limestone, chalk, a correlation can be made between cone resistance (q_c) and cone factor (N_k) to estimate the shear strength of rock. According to this correlation, the strength of the material increases exponentially with the increase in N_k factor. The appropriate N_k values for the pile design in strong soil can be considered between 12-15, whereas N_k values in soft rock can be considered between 50-60. In the Hoek-Brown model, the involved parameters are strongly correlated with the geologic strength index (GSI), which is a subjective measurement that includes observation of discontinuities and the general intactness of the sample. The rock unconfined strength ratio (q_{ucs}/σ_{ci}, intact rock strength σ_{ci}) and rock global mass strength ratio (q_{cm}/σ_{ci}) decreases with the decrease in geologic strength index (GSI) or quality of rock. However, the difference between the decreasing trend of rock unconfined strength ratio and rock global mass strength ratio against GSI become larger as GSI value decreases below 50-60%. So, it should be kept in mind when interpreting the UCS data for design, especially for weak rock or GSI less than 60%.

Prof. Mark Randolph also commented on the effective construction of jacked or driven piles and cast-in-situ piles during the lecture. The jacked or driven piles are less commonly used in soft rock unless it is penetrated through the soft stratum to reach hard stratum to utilize end-bearing. It is also difficult to estimate the shaft resistance for driven or jacked piles, and the chances of pile tip damage are high. Cast-in-situ pile shaft friction can be enhanced through an expandable grooving tool (used in NW Shelf of Australia) to obtain a rough surface for better interlocking, and base resistance can be enhanced through base grouting, expander body, and Bi-directional jacking. For axial pile design for end-bearing capacity, it is better to use the hyperbolic relationship between UCS and end-bearing resistance with limiting the end-bearing capacity as 2 times the UCS at high UCS values of the material (greater than 15 MPa) and 5 times the UCS at lower UCS values of the material (less than 0.2 MPa). The interface roughness considerably affects the shaft resistance. Intermediate rock strength gives a very rough shaft (higher interlocking), whereas strong rock and strong soil give a smooth shaft (lower interlocking). Moreover, the normalized shaft friction (τ_s/S_u) varies with shaft diameter, i.e. a small diameter shaft has higher shaft friction (Seidel and Haberfield 1995). The normalized shaft friction has a linear relationship with the square root of the normalized shear strength for strong soils and soft rocks. However, the parameter Ψ is 0.5 for hard soils and 2.0 for soft rock, and this difference is due to the interlocking function (Kulhawy and Phoon 1993).

The new installation piling techniques like vibratory installation, small groups of rings of piles, and silent piling (screw pile, push-in technology) can overcome the issues related to monopile installation, such as environmentally damaging effect on marine life and pile tip damage. Based on previous and ongoing studies, it stated that the pile with a larger pile diameter to wall thickness ratio (D/t) is more vulnerable to pile tip damage, and its phenomenon can be explored through physical (centrifuge) and numerical modelling (more challenging). A better design approach is to separate and analyze the pile tip damage reasons such as dent initiation and extrusion buckling. Comparing the pile strength with boulder resistance will establish whether the dent will develop or not. Later, in order to sense the extrusion buckling, the lateral soil forces with structural force should be compared.

State-of-the-Art Session

Yoshiaki Kikuchi

Chair, IPA Research Committee
Professor, Tokyo University of Science

The State-of-the-Art Session was held in the morning of Day two. In the session there were three reports. These reports were related to the topics conducted by IPA technical committees which worked and finished until 2020. The report 1, 2 and 3 were related to TC1, TC2, and TC3, respectively.

(1) State-of-the-Art Report 1

The report was titled 'Application of cantilever type steel tubular pile wall embedded to stiff grounds' and reported by Associate Professor Jiro Takemura who was the chair of TC1. By the Press-in method, cantilever type steel tubular pile wall can be constructed even in stiff ground. When expanding the road width in a valley-like place, upright wall can be easily constructed to the slope by this method and by the wall, the road expansion will be easily finished. But according to traditional design method, the wall requires deep embedment length, because of less experience of stiff steel pile walls in stiff ground condition. Centrifugal experiments and numerical analysis were conducted to propose new design method for cantilever type steel pile walls. The main conclusion of the research was that embedment length of the pile wall should be determined by the allowable deflection of the wall top and maximum bending moment of the pile.

(2) State-of-the-Art Report 2

The report was titled 'Use of press-in piling data for estimating subsurface information' and reported by Mr. Yukihiro Ishihara who was the secretary of TC2. The Japanese version of the final report was published covered TC work in 2016 and 2017. A machine used for press-in method has sensors to monitor the pile installing conditions such as penetration rate, torque, and axial load acting on the pile. From the piling data, embodiment of visualization of underground was conducted. If monitor information was collected from the construction site, the information would support the performance condition of the installed piles. Furthermore, when realizing the ground conditions of the site with construction data collected during installation and unexpected conditions occurred, the alternation of the construction plan could be done. The research results shows that the estimation of the ground conditions can be satisfied for the practical aims with the data collected during construction. Continuous efforts for improving the use of construction data are required in future work.

(3) State-of-the-Art Report 3

The report was titled 'State of the art report on steel sheet pile method in geotechnical engineering -development of PFS method-' and reported by Professor Jun Otani who was the chair of TC3. Fig. 1 shows the image of PFS structure, Partial Floating Sheet pile structure. PFS was proposed for the countermeasure of the ground settlement. When constructing embankment on soft ground, settlement of the ground surface in surrounding wide area is inevitable. In such cases, by using PFS, PFS works as a separator of the ground settlement and settlement area is restricted only in embankment area. This structure was already proposed as a tentative structure and the research of TC3 aimed to expand the application of this structure as the permanent structure. To use PFS to permanent structure, realization of the behavior during the seismic ground motion and of the effect of settlement reduction after the earthquake is required. In the research, filed investigation of the existing PFS after Kumamoto earthquake in 2016, laboratory experiment against earthquake, numerical analysis, and development of the design method for the countermeasure of the seismic motion were conducted. Oversea seminars were held three times by the TC3 for the transfer the technique to Southeast Asia countries.

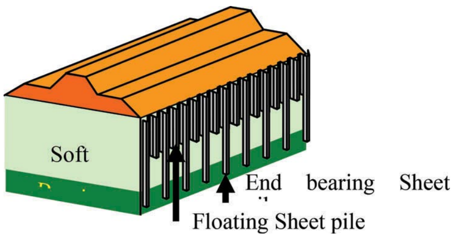


Fig. 1. Image of PFS. Some long sheet piles work as end bearing piles and other short piles separate inner and outside ground.

Session A-1
Pile Performance (Vertical Performance)

Chair: Hidetoshi Nishioka

Professor, Department of Civil and Environmental Engineering
Chuo University

The following five presentations were made. These are one numerical approach (A01), two laboratory model tests on dry sand (A04 & A06), and actual pile loading tests in the field (A03 & A05). The three cases, A04 to A06, dealt with the plugging phenomenon of open-ended steel pipe piles.

No.	Paper Titles	Presenters and Organizations
A01	Size effect of footing in ultimate bearing capacity of intermediate soil	T. Iqbal (Nagaoka University of Technology)
A03	Feedback on static axial pile load tests for better planning and analysis	T. Sanagawa (Railway Technical Research Institute)
A04	Study of bearing capacity of tubular piles with diaphragm under pressing loads	M.P. Doubrovsky (Odessa National Maritime University)
A05	Results of static vertical load tests on tubular piles installed by Standard Press-in and Rotary Cutting Press-in	K. Okada(GIKEN LTD.)
A06	The inner friction resistance and the resistance of an actual part of open-ended piles by the double-pipe model pile experiment	H. Yamazaki (Nippon Steel Corporation)

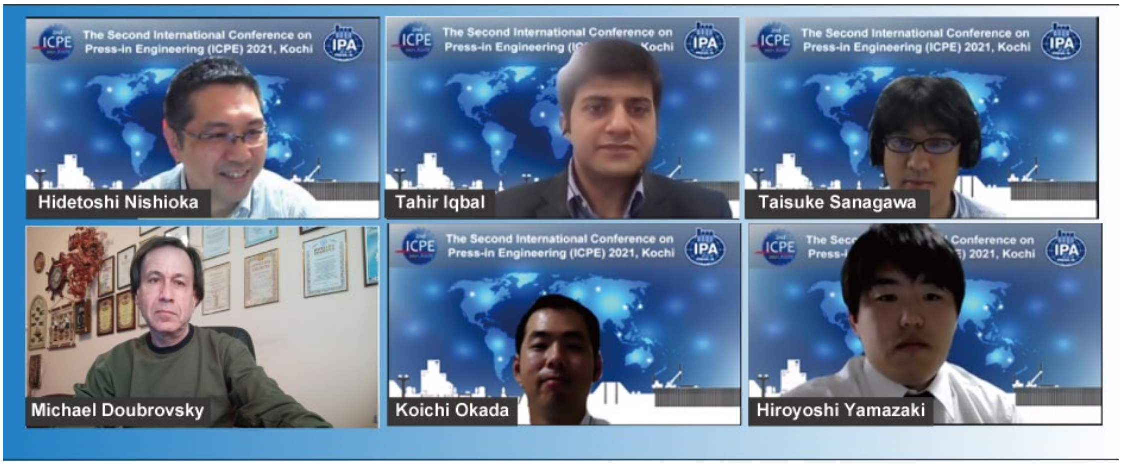
A01 proposed the rigid-plastic finite element method (RPFEM) to study the size effect of the bearing capacity of shallow foundations. The results showed that although the RPFEM using the Terzaghi equation and the standard Drucker-Prager yield criterion were in good agreement, none of them could represent the actual size effect. On the other hand, the proposed RPFEM with higher-order Drucker-Prager yield criterion evaluated the size effect.

A03 was a case study on pile loading tests, especially the points to be considered when planning the tests, mainly in Japan and France. Specific examples were presented, such as cases where the creep limit load was difficult to evaluate because the load holding time and load increment were not constant.

A04 proposed a method of installing a diaphragm inside the pile to ensure that a plug is created. It was reported that even if the diaphragm was located much higher than the pile tip (e.g., 9 times the pile diameter), the improvement effect could be expected. The plugging phenomenon occurs at two locations (just below the diaphragm and at the pile end), which is expected to shorten the rooting depth into the bearing layer.

A05 was a valuable case report that compares the rotary effect during press-in in the same ground. However, in the case of without rotary installed pile, the pile was shorter with no installed strain gauges. So, the comparison was made by empirically estimating the skin friction. The disturbance effect of the inner surface ground of the steel pipe by the rotation of the protective parts of the strain gauge and the validity of the empirical estimation of skin friction were discussed.

A06 was on a model pile experiment in which the resistance at the end plug is directly measured using a double-pipe. It was clearly shown that even if a plugging phenomenon occurred, the resistance might be reduced by further increasing the displacement. Since this was an unusual test, the test method was mainly discussed.



Group photo of Session A-1

Session A-2
Pile Performance (Vertical Performance)

Chair: Stuart Haigh

Director, IPA
Reader, The University of Cambridge

Session A2 contained 6 interesting papers detailing predominantly experimental work on the vertical performance of pressed in piles with papers from the UK, Vietnam, and Japan. The papers generally focused on the adequacy of existing design guidelines in predicting the performance of these piles, with suggestions being made improving the existing design equations to reflect observed behaviour better. Some brief details of the contents of the papers are given below.

A07 The vertical and horizontal performance of pressed-in sheet piles
This paper by Timo Zheng and co-authors from both Cambridge University and GIKEN covered observations of the behaviour of sheet piles under both vertical and horizontal loading from field tests carried out with GIKEN as part of the Cambridge-GIKEN summer testing programme in 2019. The testing demonstrated that sheet piles have a substantial capacity in both vertical and horizontal directions with a considerable contribution being generated as base capacity due to plugging of the sheet pile pan. The installation process was shown to substantially affect vertical capacity, with increased surging reducing installation load but also vertical stiffness and capacity. A modified p-y analysis was proposed to predict the behaviour of these piles under horizontal loading.

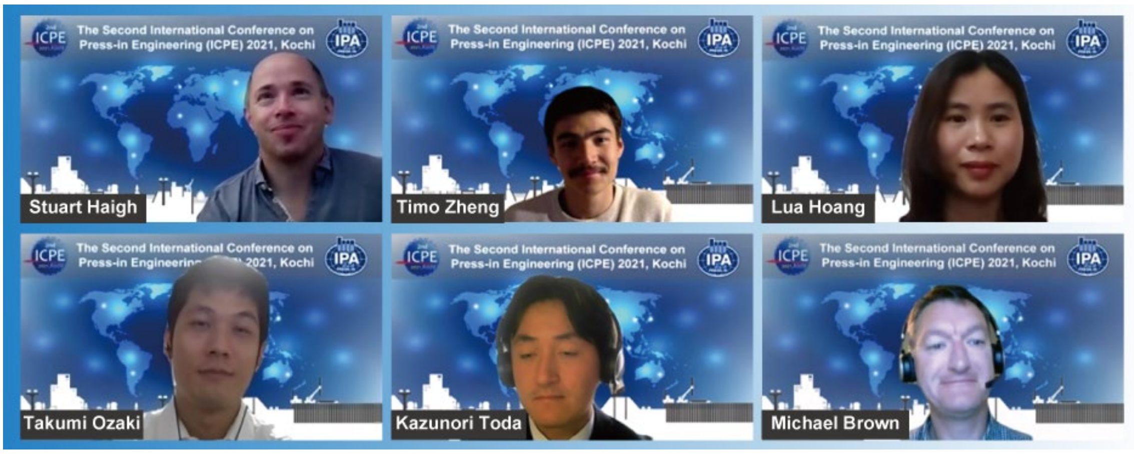
A08 Performance of pressed-in piles in saturated clayey ground: Experimental and numerical investigations
This paper by Lua Hoang from Vietnam and co-authors from Kanazawa University investigated set-up effects on the capacity of piles in saturated clay. The authors installed model piles and performed static load tests both immediately after installation and after 24 hours. The experimental work was complemented by numerical analysis using a cavity expansion method to model installation. It was seen that the pile capacity increased substantially after 24 hours due to dissipation of excess pore pressures, and this could be well replicated with the numerical analysis used.

A09 Proposal of vertical design bearing capacity estimation formula of Gyropress method based on Japanese railway standard
This paper by Takumi Ozaki and co-authors from both the RTRI and JPA utilized a database of field measurements of Gyropress pile performance to propose a new formula for pile capacity within the Japanese Railway Design Code. Allowable deformations were defined for a series of limit states, and statistical analysis on the available data was carried out to determine the expected capacity under each state. While the database used was quite small, this method, when applied to a larger pile database, has great potential to define both the expected capacity of piles and the uncertainty on this value.

A10 Comparison of SPT-based design methods for vertical capacity of piles installed by rotary cutting press-in
A11 An investigation into vertical capacity of steel sheet piles installed by the standard press-in method

This pair of papers by Kazunori Toda and co-authors from GIKEN describes the latest data and analysis of pile test behaviour and its linkages with site-investigation data for both Gyropress and standard press-in technologies based on case-history analysis of GIKEN's database of field pile installations. It was shown that existing design formulae underestimate the base capacity developed by Gyropress piles when embedded deeply into a stiff bearing stratum and that using the newly developed method this embedment may be safely reduced, increasing the efficiency of the Gyropress process. For pressed-in piles, in agreement with paper A07, it was noted that plugging of sheet piles substantially increases the base resistance from what might be expected, leading to an enhanced capacity not reflected in previous design calculations.

A12 Predicting the capacity of push and rotate piles using offshore design techniques and CPT tests
This paper by Mike Brown from the University of Dundee and Yukihiro Ishihara from GIKEN describes the analysis of Gyropress piles data utilizing CPT-based design methods from offshore engineering practice. It was shown that these methods show great promise compared to standard SPT-based methods in predicting the performance of these piles. Preliminary work utilizing DEM (Discrete Element Modelling) to study soil flow around a rotating pile also showed great promise in better understanding Gyropress piles behaviour.



Group Photo of Session A-2

Session A-3
Pile Performance (Horizontal Resistance)

Chair: Koji Watanabe

Associate Professor,Department of Civil Engineering
Aichi Institute of Technology

The underlined authors presented the following six papers in session A-3. This session focused on the horizontal resistance of the pile. All the presentations provided the outcomes of the fundamental and practical researches to contribute in the development and enhancement of press-in technology for various civil engineering problems.

Paper A13: Behaviour of three types of model pile foundations under vertical and horizontal loading, <u>W.T. Guo (Kanazawa University)</u>, Y. Honda, X. Xiong, T. Matsumoto and Y. Ishihara.

The authors conducted a series of model experiments at 1G acceleration field to investigate the load transfer behaviours of model foundations supported by three different types of piles subjected to vertical and horizontal loading. According to experiment results, PPF (Plate Pile Foundation) can carry almost the same loads with OPF (Open-ended pipe pile foundation) and larger loads than those of BPF (Box pile foundation) under both vertical and horizontal conditions. The authors concluded that sheet pile foundation would be a promising alternative to conventional round pipe pile foundation, especially in high seismic areas where foundations experience both vertical and horizontal loading.

Paper A14: Experimental study on the pile group effect in the horizontal resistance of spiral piles, <u>N. Ohnishi (Chuo University)</u> and H. Nishioka.

This study examined the horizontal resistance and the pile group effect on spiral and cylindrical piles by conducting the model horizontal load tests in dry sand condition. The experiments were carried out in five cases by changing the center-to-center spacing of the piles from 1.5 times to 8 times the pile diameter. The results revealed that the tendency of the pile group effect for the spiral pile varied vastly depending on the evaluated load level. The authors suggested that the spiral piles were more affected by the pile group effect than ordinary cylindrical piles at the initial loading stage. The authors also mentioned that experiments to reduce construction disturbances will be conducted.

Paper A15: Experimental observation on the ultimate lateral capacity of vertical-batter screw pile under monotonic loading in cohesionless soil, A. Jugdernamjil (Kyushu University), N. Yasufuku, Y. Tani, T. Kurokawa and M. Nagata.

1g model experimental studies were performed in the laboratory to evaluate the lateral performance of a screw pile in dense sand and comparing it with conventional model pile types such as a flat bar and a pipe by the authors. Totally 26 experimental cases were performed, which included vertical-batter combinations. The authors examined that the load-displacement characteristic was nonlinear under lateral loading. The authors also implied that the case of 45 degree batter screw pile demonstrated higher ultimate lateral resistance.

Paper A16: Experimental evaluation of the lateral capacity of large jacked-in piles and comparison to existing design standards, A. Dobrisan (Cambridge University), S.K. Haigh and Y. Ishihara.

The devastation caused by the 2011 Tohoku earthquake and subsequent tsunami revealed the need to rethink of seawall design. This paper presents the results of a full-scale lateral test on a pile identical to those used in the new seawalls. Additionally, this research proposed a novel data analysis method to retrieve accurate p−y curves from experimental data. Results show good agreement with design p−y relationships at shallow depths, while below 3m depth, the design curves significantly over-predict soil stiffness. The paper highlighted the need for new appropriate design specifications to account for large stiff piles and obtain better assessment of their lateral capacity.

Paper A17: A Study on analysis of horizontal resistance of screw coupled foundation with vertical and battered piles in cohesionless soil, T. Kurokawa (HINODE, Ltd.), Y. Tani, M. Nagata, A. Jugdernamjil and N. Yasufuku.

This study examined the horizontal resistance of screw coupled piles, which are expected to improve, through model tests in the sand tank. The authors carried out a static nonlinear analysis to rationalize the structural design. A bilinear soil reaction spring is considered for the ground and a beam model for the pile in the analytical model. The authors mentioned that this analysis allowed to reproduce the initial rigidity and the maximum load of the screw coupled pile structure, and an example of the optimization of the structure for vertical and battered piles was identified.

Paper A18: Influence of horizontal loading height on subgrade reaction behavior acting on a pile, A. Mohri (Tokyo University of Science), Y. Kikuchi, S. Noda, K. Sakimoto, Y. Sakoda, M. Okada, S. Moriyasu and S. Oikawa.

The authors proposed installing a row of piles behind the caisson and filling the space in between with rubble as a reinforcement method tsunamis. It is necessary to understand the load conditions acting on a pile and determine the cross-section and embedment length of the pile used in the structure. Model experiments were conducted based on the bending moment distribution to estimate the external force acting as a distributed load on the offshore side of the pile. This study examined that the behavior of the subgrade reaction on the horizontal resistance characteristics of a pile depends on its deformation mode.

Group Photo of Session A-3

Session A-4
Piling Process

Chair: Xi Xiong

Assistant Professor, Faculty of Geoscience and Civil Engineering
Kanazawa University

Session A-4 covers the topic of pile performance / piling process, and as scheduled by the program, six papers were presented at the session. Five papers presented experimental studies, whilst one introduced a numerical method to simulate the silent piling group installation process. Highlights of the proceedings of the session are presented as follows.

Dr. Moriyasu, from Nippon Steel Corporation, presented the results of laboratory experiments in paper A19 “Influence of different pile installation methods on vertical and horizontal resistances”. In this study, a model pile was installed using four types of pile installation methods: monotonic push-in, surging (repetitive push-in and pull-out), vibratory pile driving, and bored pile installation in dense dry sand ground. The authors concluded that the cyclic shearing of surging or vibratory pile driving prevented soil dilation and decreased pile penetration resistance while increasing vertical resistance.

Dr. Taenaka, from Nippon Steel Corporation, introduced the results of laboratory experiments in paper A20 “Stress changes in adjacent soils of tapered piles during installation into sand”. The radial and vertical pressure in adjacent soils between a straight pile and a tapered pile during installation into sand at 1g were investigated. The test results suggest that the profiles of pressure changes around the piles are quite different, leading to differences in the radial stress distribution between tapered and straight piles.

Mr. Ishihara, from GIKEN LTD., reported a series of large-scale model tests in paper A21 “Comparison of penetration resistance and vertical capacity of short piles installed by standard press-in in loose sand”. In this study, a closed-ended pile or an open-ended pile was installed with or without surging in loose sand to around 6 m. Phenomena of pile set-up or set-down were observed in some cases. The cause of the set-down was concluded to be mainly due to the pile installation being terminated at a depth where the soil strength decreased with depth and to a lesser extent because negative pore water pressure was generated during installation.

Mr. Saleem, from Saitama University, presented the results of laboratory experiments in paper A22 “Performance comparison of closed-ended pressed-in pipe piles with helical pile in dense sand: An experimental study”. The authors conducted model tests of closed-ended steel pipe piles and single helix piles having similar tip diameters under dense ground conditions. Test results showed that steel pipe piles require higher installation force than helical piles having equivalent tip diameters, while helical piles exhibit less ultimate bearing capacity than steel pipe piles having equivalent tip diameters.

Dr. Cerfontaine, from the University of Southampton, presented the results of a numerical study in paper A23 “Discrete element modelling of silent piling group installation for offshore wind turbine foundations”. Numerical simulations of the installation of a novel silent piling concept were conducted using Discrete Element Method (DEM). This concept uses a cluster of four closely spaced piles that are jacked asynchronously. The authors found that a cluster of piles can be jacked ‘silently’ and indicated that a capacity equal to six times the tool weight necessary for installation.

Ms. Panchal, from Keltbray Piling, and Dr. McNamara, from City, University London, introduced a potential removal method for existing bored concrete cast in-situ piles in paper A24 “Rehabilitation of brownfield sites using the Gyro Piler to remove existing bored cast in-situ concrete piles”. The authors explored the use of the Giken Gyropiler to overcore and removed concrete piles in their entirety. This technique, combined with more sustainable foundations, could rehabilitate sites that have been polluted with piles and has the potential to improve the value of brownfield sites.

Group photo of Session A-4

Session B-1
Infrastructure Development (Pile Walls)

Chair: Jiro Takemura

Associate Professor, Department of Civil and Environmental Engineering
Tokyo Institute of Technology

In this session, the six papers listed below were presented by the underlined authors. They are all outcomes of the research activities of IPA Technical Committee TC1 “Application of cantilever type steel tubular pile (CSTP) wall embedded to stiff grounds”. Various approaches were employed in their researches.

B01 “Numerical simulation for centrifuge model tests on cantilever type steel tubular pile retaining wall by rigid plastic FEM”, K. Mochizuki, H.H. Tamboura, K. Isobe (Hokkaido University), J. Takemura & K. Toda;

B02 “Reliability analysis on cantilever retaining walls embedded into stiff ground (Part 1: contribution of major uncertainties in the elasto-plastic subgrade reaction method)”, N. Suzuki (GIKEN LTD.), K. Nagai & T. Sanagawa;

B03 “Reliability analysis on cantilever retaining walls embedded into stiff ground (Part 2: construction management with piling data)”, N. Suzuki (GIKEN LTD.), Y. Ishihara & K. Nagai;

B04 “Dynamic behavior of cantilever tubular steel pile retaining wall socketed in soft rock”, S M Shafi (Tokyo Institute of Technology), J. Takemura, V. Kunasegarm, Y. Ishihama, K. Toda & Y. Ishihara;

B05 “A centrifuge model study on laterally loaded large diameter steel tubular piles socketed in soft rock” V. Kunasegaram (South Eastern University of Sri Lanka), J. Takemura, Y. Ishihama & Y. Ishihara;

B06 “Discussion about design method for embedded length of self-standing steel tubular pile walls pressed into stiff ground”, T. Sanagawa (Railway Technical Research Institute).

In **B01**, to examine the effects of embedment length of the wall into the stiff layer on the safety factor of wall, 2D rigid plastic FE analyses were conducted. The loading and ground conditions that were studied are the seismic intensity and the thickness of sand layer overlying the stiff layer respectively, both of which critically affect the stability of the wall.

In **B02**, a reliability analysis was performed for CSTP walls embedded in two-layers ground with relatively soft upper soil and stiff sandstone, treating the soil/rock properties, surcharge on the retained soil, rock surface depth and yielding strength of steel as variables. Three ultimate limit states (i.e., wall deflection, flexural and rotational failures) were considered. The analysis suggested that the depth of rock surface significantly affects the three limit states in the order of the rotational, deflection and flexural failure and the reliable estimation with less uncertainty on the rock depth is of critical condition for safe and economic design of the wall.

B03 is the sister paper of B02, conducting reliability and cost analyses to examine the effective use of piling data over the uncertainty discussed in B02. It concluded that the construction management with the piling data has significant advantages especially for the wall with relatively short embedment and the ground with high uncertainty of the rock depth.

B04 reported the results of centrifuge model test on the dynamic stability of CSTP (pile dia Φ=2.0m) wall embedded in soft rock with two relatively small embedment depths (d_e) less than the minimum requirement ($d_e \geqq 3/\beta$, here β is characteristic value), namely, d_e = 3.0 m [1.2/β] and 2.5 m [1.0/β]. From the test results, it was revealed that the elastic resilience of the cantilever wall fixed to the rigid ground has crucial effects on the dynamic wall behavior and residual displacement and wall pressure after the dynamic earthquake loading. Furthermore, it was shown that the performance of the wall are considerably improved by the increase of the rock socketing depth by 0.5 m.

In **B05**, from a series of centrifuge tests on laterally loaded single steel pile (Φ=2.0m) embedded in two types of ground (i.e., a single soft rock layer and a soft rock layer with overlying sand), the influence of rock socket depths on the deformation, and failure mechanism of rock socketed piles was investigated for a constant eccentricity of 6.5 m from the ground surface. Two different failure modes that were observed are ground failure and pile structural failure, of which occurrence depends on the embedment depth and the ground conditions.

B06 first showed the overview of the design methods of embedded cantilever wall employed for various design codes in Japan and later on discussed the optimum method by comparing the embedment depth calculated for different design conditions by different codes.

The common messages from the six papers are the advantages of CSTP wall embedded in stiff grounds and the significance of rational determination of the wall embedment length in it.

Group photo of Session B-1

Session B-2
Infrastructure Development (Sheet pile walls)

Chair: Kentaro Nakai

Associate Professor, Department of Civil Engineering
Nagoya University

In total, 6 excellent papers related to soil - steel sheet pile interaction problems were presented in this session. In recent years, steel sheet pile has been increasingly used not only as temporary structures but also as permanent structures. Research activities by both numerical and experimental approaches were presented for the use of sheet piles as ground reinforcement method and retaining wall. Furthermore, the latest attempt to visualize the internal condition of the ground using X-ray CT technology was also included. All presentations contained new and interesting findings, and discussions with the audience were also very meaningful.

1st presentation was "3D FEM analysis of partial floating steel sheet piling method on two-layered ground" by K. Kasama et al. The paper presents the result of 3D soil-water coupled finite element analyses to evaluate the effectiveness of the partial floating steel sheet piling method (PFS method) for the stability of embankment on two-layered soft ground. Authors found that the settlement and lateral displacement of soft ground largely depends on the thickness ratio of the sand and clay layers, and deformation of the ground are greatly reduced due to the existence of the sand layer. The analysis results expanded the applicability of the PFS method to the actual ground.

2nd presentation was "Experimental study for liquefied soil in a gap between underground walls" by K. Fujiwara et al. The paper describes the result of shaking table test for the purpose of observing the lateral ground deformation of the ground during liquefaction. Through the experiment assuming reinforced ground with steel sheet piles, it was confirmed that the ground deformation becomes three-dimensionally complicated behavior when there is a gap between the piles such as the PFS method.

3rd presentation was "Model test on double sheet-pile method for excavation works using X-ray CT" by H. Sugimoto et al. This paper tries to clarify the soil behavior between two sheet-piles and the mechanism of its effectiveness of the structure using X-ray CT. From the X-ray CT scan image, multiple slip lines were found in the soil between two sheet piles and the position of the slip lines was considered to be essential for the effectiveness of this construction method. It is expected that more efficient construction will be studied in the future, such as the increase in soil density between the piles and the effect of the fixation of the pile heads.

4th presentation was "A study on the effect an earth-retaining wall's rigidity and embedded depth on its behavior" by N. Matsumoto et al. Model experiment of a cantilever-type earth-retaining wall using an aluminum-layered ground that could easily simulate ground failure was conducted. The authors focused on the flexural rigidity and the embedded depth (wall length) of the retaining wall and found that the safety against collapse might be improved by increasing the embedding length. A series of studies by the authors are expected to contribute to more reasonable and simple design method with an appropriate safety margin in a different way from current design condition.

5th presentation was "Physical and numerical modeling of self-supporting retaining structure using double sheet pile walls" by A. Nasu et al. Model experiments and FE analysis were conducted for the purpose of understanding the mechanical behavior of double sheet pile walls. The effectiveness of the double sheet pile walls was experimentally shown, and the behavior of the double sheet piles was well demonstrated by the FE analysis. The authors concluded that the shear resistance of the inner soil might take an important role in resisting the earth pressure. Further research is expected to develop a cost-effective and self-supporting retaining structure by double sheet pile walls for urban construction.

6th presentation was "Study on liquefaction countermeasure method of river embankment using wood and sheet pile" by G. Hashimura et al. Centrifuge model test and FE analysis was conducted using wooden piles and steel sheet piles as a countermeasure against liquefaction of river embankments. Authors described that the construction method using steel sheet piles was effective in suppressing deformation, and the combined use of wooden piles was more effective in suppressing liquefaction by narrowing the pile spacing rather than increasing the penetration depth. Seismic countermeasure of river embankments is an important issue specially for low land areas, and as in this study, the development of effective and low-cost strengthening technology is considered to be an important issue in the future.

At the first time when I heard that the conference will be held online, I was worried whether the discussion could be held properly. However, smooth and active discussions were possible by utilizing on-demand videos and accepting questions using *Slido Application*. I would like to thank to the organizing committee of the conference. I also felt lot of merits unique to online, such as easy viewing of slides, easy listening to voices, and easy participation in conferences. Of course, I expect to have intimate face-to-face exchanges, but it was also a conference where I felt the possibility of new style academic conference in the future.

Group Photo of Session B-2

Session C-1
Disaster Prevention and Mitigation

Chair: Koichi Isobe

Associate Professor, Division of Civil Engineering
Hokkaido University

The session C-1, whose topic is Disaster prevention and mitigation, was held as the last session of the Second International Conference on Press-in Engineering. 6 presenters including students, young and senior researchers have talks about various kind of topics. They were interesting and novel, respectively. They gave us hope for further application development and future potential of the press-fitting method.

The first speaker, Dr. Chen Wang from Tongji University, gave us talk about the challenging and novel simulation method to simulate and estimate the procedure of the erosion and scoring of the riverbed, especially around the existing bridge foundation. In Japan as well, this type of disaster is increasing due to the increase in heavy rainfall caused by climate change. The press-in method will provide some effective solution against such a kind of disasters. We would like to hope the further development of their research.

The second speaker, Mr. Kohei Kasahara from Railway Technical Research Institute, had a presentation on design calculation method for sheet pile reinforcement method in liquefiable ground. According to the model tests, the great effect of this reinforcement method for an existing pile foundation in liquefiable ground was confirmed. The simulation method they proposed had a good agreement with the model test results by considering the displacement level dependency and the reduction of the effective stress caused by the excessive pore water pressure. We cannot help but expect that their achievements will facilitate reinforcement for existing foundations.

The third speaker, Mr. Masafumi Oka from Yokohama National University, gave us talk about the novel anti-corrosive effect by inserting sheet piles or utilizing existing steel plate. According to their experiment, the suppressing polarization effect with sheet piles against corrosion was confirmed. These results will lead to extend the opportunity to use the press-in method. And also, Mr. Oka won the best presentation and paper award. Congratulations!

The fourth speaker, Ms. Fuyuki Kawatake from National Institute of Technology, Kochi College, had a presentation on a countermeasure construction method using a glass crushing material called Sandwave G, which is a recycled material in order to reduce the damage induced liquefaction by the huge Nankai Trough earthquake, which is expected to occur in the future. The fifth speaker, Prof. Kojiro Okabayashi, who is a supervisor of the fourth speaker, gave us a talk about a countermeasure method against liquefaction of fishing ports. Their experiments and simulation let us know that sandbags and permeable steel sheet piles provide great effect for the disaster mitigation.

The last speaker of this session, Mr. Kazunori Toda from GIKEN LTD., had a presentation about the experimental study on tsunami mitigation effect of pile-type porous tide barrier. The newly proposed method using tubular piles, sheet piles and porous sheets made of fabric materials will be a good solution for the tsunami mitigation in the future. I'm looking forward to seeing new results on the field tests applied in site.

Finally, I deeply appreciate the cooperation from all of the presenters and participants for discussion. I hope your success and development on their research in the future.

Group photo of Session C-1

Session D-1
Case Histories (1)

Chair: Vu Anh Tuan

Geotechnical Engineering Laboratory
Le Quy Don Technical University, Hanoi

Session D-1: Case histories-1 of the conference contained six excellent papers presenting about Press-in piling and applications in practice, as follows:

D01 “Press-in piling application: Permanent stabilization of an active-landslide-slope” by M. Yamaguchi, Y. Kimura, T. Nozaki and M. Okada. The paper reviewed the applicability of Press-in piling technology to the pile installation on an active-landslide-slope by reporting the outlines of the disaster rehabilitation work, design of permanent measures, and the construction plan and implementation. It was demonstrated that the combined use of tubular piles, rotary Press-in piling, and the Non-staging System was capable of constructing a continuous wall composed of tubular piles on an active-landslide-slope while allowing one-way alternating traffic on the road adjacent to the site. Also, the construction cost and duration were reduced by using Press-in piling technology.

D02 “Press-in technology: Advantage of Gyropress Method for renovation of the third wharf of Dakar Port in Senegal” by Y. Ndoye, Y. Kitano and T. Funahara. This paper presented the application of the Gyropress method (Rotary cutting Press-in method) for repairing a 350m long wharf of Dakar Port in Senegal. A comparison between Gyropress Method and All Casing Method was shown in the paper. After considering many factors, the initial design was changed from gravity wharf type into wharf on piles type, thus, the Gyropress method was selected over the All-Casing method. That showed the effectiveness of the Gyropress method for a difficult construction site. During all construction periods, the port operation was able to proceed without any major changes.

D03 “Construction of retaining wall for river disaster restoration by Gyropress Method” by K. Matsuzawa, T. Hayashi and K. Shirasaki. The paper presented a repair work of the Ezure water discharge channel using a steel tubular pile wall as a main structure of the retaining wall of the sluiceway. Twenty-five tubular piles were installed at the location where the discharged water flows into the Kinugawa River. The Gyro Piler was set at the pile top level, 3.0m higher than the current bank crest, using a reaction base and reaction sheet piles. It is concluded that Press-in technology has been able to contribute widely to the countermeasure project and helped improve the safety of the surrounding residents and their lives.

D04 “Steel tubular piling by the Gyropress Method in proximity to obstructive existing H-shaped piles” by N. Yamazaki. In this paper, a construction project for reinforcing the seismic resistance of an existing river dike was presented. In this project, 42 steel tubular piles were installed, in which 11 piles were installed by Press-in piling with a GRB System, and 31 piles were installed by a normal Press-in piling. There were existing H-shaped piles in the northern end river section where four new piles were to be installed, and these H-shaped piles were planned to be removed beforehand. An attempt to pull out and remove the existing piles using a vibratory hammer failed because the piles were broken at a depth of about 3m from the riverbed. Therefore, steel tubular piles were installed at deviated locations by rotary-pressing with a Reaction Stand in proximity to the existing H-shaped piles. The success of the project showed that it was possible to install piles in proximity to obstructive existing H piles.

D05 “Case study of oval shaped foundation using the Gyropress Method under overhead restrictions” by K. Takeda. This paper described the Press-in piling method of steel pipe piles to form steel pipe foundations for the expansion of bridge piers to widen an existing bridge on the expressway. In this project, it was necessary to install steel pipes under girders/beams of a road bridge while keeping the bridge in service. It was also necessary to embed the piles in a gravel layer having a maximum extrapolated SPT N-value of more than 70. The Gyropress Method using a type of machine capable of low headroom operation was adopted. By welding short segmental piles together in vertical position under overhead restrictions, it was possible to press in steel pipe piles until reaching the supporting layer.

D06 “Construction of anchor piles for mooring bank by Skip Lock Method” by Y. Tada, M. Kitamura, S. Kamimura and Y. Sawada. This paper showed the application of Gyropress Method and the Skip Lock Method to install anchor piles for a steel tubular pile quay wall. From the comparison between the Gyropress Method with the Skip Lock Method and the vibro hammer method using water jets after the removal of rubble mound, the Gyropress method was adopted because it can keep a good balance of the “five construction principals” which consists of environment protection, safety, speed, economy, and aesthetics. In addition, this project is the first application of using a modified Gyro Piler for the Skip Lock Method in which pile pitches were about 2 to 3 times the diameter of the pile.

Group Photo of Session D-1

Session D-2
Case Histories (2)

Chair: Nor Azizi bin Yusoff

Head, Research Centre for Soft Soil (RECESS)
Universiti Tun Hussein Onn Malaysia

The session started slightly after lunchtime on day 1. Even though all six presented papers had been carried out through an online environment, it successfully highlighted a remarkable case history of Press-in technology in many parts of the world.

Mr. Yamaguchi presented the first paper on the disaster of rehabilitation work in Japan by implying the breast wall concept. The construction had been conducted in a narrow space and minimum noise and vibrations were permitted during construction in order not to impact the adjacent buildings and existing piers. The construction successfully implemented the rotary press-in piling, Combi-Gyro Method, and Non-staging System. The next paper entitles Press-in piling applications: Seawall pile foundation work. This paper reported a success story for Press-in piling implementation for a reconstruction project on the damage to Kamaishi's fishing port. It was recognized that the dismantling and removal of existing structures and the construction of a new seawall were very challenging due to limited space and minimum vibration disturbance allowed for this project.

Later, Mr. Takuma and Mr. Nagano shared the Giken America Corp. experience in America on the construction at The East Garden Grove in California and Jacksonville, Florida. Interestingly, the Press-in piling with the GRB System achieves pile installation in a very narrow and long work zone as exemplified with the case study projects. In addition, some local government agencies in the U.S. have been specifying press-in piling as well as that in combination with the GRB System for their levee projects.

The 4th paper by Ms. Nagarajan and Mr. Vaz from Giken America Corp. demonstrated a flood-damaged New York subway station repair with pressed-in sheet piles. Sheet pile walls were constructed in a busy and relatively narrow street in the densely populated district. The sheet piles were pressed day and night to expedite construction without disturbing the area's residents or business owners, achieving substantial cost saving compared to the originally designed earth retaining with secant pile walls.

Mr. Geppert presented their case study by implementing Press-in technology for river dykes construction in Germany. Based on this project, it can be said that dyke reinforcement utilizing sheet piling is an established part of flood protection measures in Germany. The reasons for this are, among others, the flexible applicability, the reduction of environmental impacts, the constant high quality, reliable and proven technology.

The last paper was presented by Dr. Kitiyodom. He shared his experience on the application of Silent Piler in the Bangkok MRT Orange Line Project. Recently, the MRT Orange line is considered one of Bangkok's most difficult projects because the tunnel alignment passes through the congested urban areas in the city. Many underpinning works are required along the route. The low-headroom, limited working space and vibration have become concerned issues to be considered during construction. Silent Piler was successfully implemented in those constraint areas.

In summary, all the presented papers highlighted the global achievements of the Press-in technology especially for constraint conditions such as low headroom, limited working area and nearby operating transportation. Finally, I hope that the case studies will serve as a reference for similar construction projects in all parts of the world.

Group Photo of Session D-2

Session E-1
Other Topics

Chair: Pastsakorn Kitiyodom

Deputy Managing Director
Geotechnical & Foundation Engineering Co., Ltd.

This session "Other Topics" started from 15:30 on the second day of conference. On this session, as it was scheduled by the program, six papers were presented. The brief summary and discussion of each presentation are as follows.

E01. "Vertical and diagonal pull-out experiments of flip-type ground anchors embedded in dry sand in plane-strain condition" by S. Yoshida, X. Xiong, T. Matsumoto & M. Yoshida
The results of vertical and diagonal pull-out experiments of flip anchors were described. Effects of main experimental parameters which are embedment depth, breadth of the anchor, pull out angle and embedment angle of anchor plate were presented. The two-dimensional ground failure model for shallow anchors was proposed. The maximum pull-out force calculated from the proposed model qualitatively agreed well with the measured value.

E02. "Preliminary results of questionnaire survey on field performance of press-in machine" by T. Takeuchi, S. Sato, T. Takehira, M. Kitamura & H. Murashima and presented by N. Ogawa
A questionnaire survey was conducted on the field performance of press-in piling machine, with the special attention to Gyro Piler. The survey concludes that operator's experience and skill play an important role for effective press-in piling with a minimum risk for damaging the machine.

E03. "2D/3D FEM Embedded Beam Models for Soil-Nail reinforced Slope Analysis" XC, Lin
This paper demonstrates the use of 2D Embedded Beam Row element for soil-nail group modelling in PLAXIS 2D, comparison of response is drawn against that of 3D Embedded Beam element in PLAXIS 3D, as well as the field data. It has affirmed that, the 2D Embedded Beam Row model can effectively handle groups of soil nails in the plane strain condition and produce both quantitative and qualitative predictions of deformation and structural response.

E04. "Development of small-sized splice plates applied to steel sheet pile longitudinal joints" H. Nakayama & T. Momiyama
The splice plates are welded to fill a section shortage of the interlock where welding can't be applied. The splice plates tend to be larger and heavier according to the increase of size of sheet piles, and hence welding work becomes laborious. To reduce such burden, a small-sized splice plate that can keep the original splice plate in a like diamond shape was developed. The validity and effectiveness of the newly developed splice plated was confirmed through experiments and construction practices on site.

E05. "Summary of case histories of retaining wall installed by rotary cutting press-in method" N. Suzuki & Y. Kimura
Japanese case histories of retaining walls of the rotary cutting press-in piles were presented in terms of the application, pile materials, project scale, spatial restrictions for working, and ground conditions. About 70% if the projects had one of the spatial restrictions. Besides, over 60% of the projects have problems of hard ground (N>75) and obstacles.

E06. "A Decade of R&D in Press-in Technology: Bridging the Gap Between Academia-Industry in Malaysia" N. A., Yusoff, T. N., Tuan Chik, M. K., Chani & K. W., Chung

A decade of joint activities between UTHM and several industrial stake holders in adapting Press-in Technology in Malaysia was presented. The activities allow dissemination of latest Press-in technology to both academia-industry by establishing R&D collaborations with local and international stakeholders in the Malaysia construction industry.

Group Photo of Session E-1

Award Ceremony Report

Andrew McNamara

Chair, IPA Award Committee
Senior Lecturer, City, University London

It is with great pleasure that I write to report on the recent Award Ceremony that was held during the International Conference on Press-in Engineering in June 2021. The IPA has a total of five award categories with awards presented for the years 2019 and 2021. The award categories are:

- ICPE Best Paper Award
- Life-long Contribution Award
- Outstanding Project Award
- Innovative Technology Award
- Distinguished Research Award

The purpose of these awards is to foster excellence in research and innovation relevant to press-in engineering and to recognize the dedication and achievements of those operating in this challenging field.

➢ **ICPE 2021 Best Paper Awards**

The ICPE 2021 Best Paper Award Committee comprised Prof. Tatsunori Matsumoto, Associate Prof. Katsutoshi Ueno and Mr. Yukihiro Ishihara and they were responsible for assessing all the papers that had been highly rated. A total of 47 research papers were submitted to ICPE2021 and these were subjected to a rigorous peer-review process. The papers were rated by the reviewers in terms of five significant aspects that are all key qualities: (1) Reliability, (2) Practicality, (3) Novelty/Originality, (4) Impact on development and promotion of press-in technology, (5) Quality of text, perfection.

The Committee considered 10 papers that had been highly rated and selected the three Best Research Papers as follows:

- L. T. Hoang, X. Xiong and T. Matsumoto "Performance of pressed-in piles in saturated clayey ground: experimental and numerical investigations"
- S. Moriyasu, M. Ikeda, T. Matsumoto, S. Kobayashi and S. Shimono "Influence of different pile installation methods on vertical and horizontal resistances"
- B. Cerfontaine, M. Brown, M. Ciantia, M. Huisman and M. Ottolini "Discrete Element Modelling of silent piling group installation for offshore wind turbine foundations"

A total of 13 project papers were submitted to ICPE2021 and these were subjected to the same rigorous peer-review process. All papers were rated by the reviewers in terms of five significant aspects important to projects: (1) Innovation in the project, (2) Difficulty of the project, (3) Economic advantages offered to the project, (4) Impact on development and promotion of press-in technology, (5) Quality of text, perfection and readability.

The Committee considered seven papers that had been highly rated, and selected two Best Project Papers as follows.

- M. Yamaguchi, Y. Kimura, T. Nozaki and M. Okada “Press-in piling applications: Permanent stabilization of an active-landslide-slope”
- T. Takuma, S. Kambe, and M. Nagano “Upgrading earthen levees with press-in piling and the GRB System”

IPA Life-long Contribution Award

Life-long Contribution Award recognizes and honors individuals who have made great contributions to the advancement of the press-in engineering over an extended period of time. The Award Committee of the IPA sought nominations for a worthy recipient of a Life-long Contribution Award. The selection process involved consultation with the Special Committee of the IPA in order that a suitable recommendation could be made to the Steering Committee for their approval. The award recognizes the many contributions of **Dr. Masaaki Terashi** a well-known expert world-wide in the field of ground improvement. Dr Terashi graduated from Tokyo Institute of Technology and worked for the Port and Harbor Research Institute for many years, engaging in research on development in deep mixing and centrifuge modeling. He worked for Nikken Sekkei, one of the largest consultants in Japan, for several years before he joined Giken as an advisor. Upon its establishment in 2007 he joined the IPA and played a major role in the series of IPA workshops under the first IPA president, Professor Malcolm Bolton. When Dr. Osamu Kusakabe became the second IPA president in 2016, he worked closely with him and drafted the revised constitution and bylaws. He also served as the founding chair of Award Committee for four years and successfully moderated the awards ceremony at the first ICPE in 2018. Based on his unrivalled experience as a code writer in the port and harbor field in Japan, and as a consultant in Japan and overseas, he played a central role in writing and editing “Design and Construction Guidelines for Press-in Piling” in Japanese in 2015 and 2020, as well as “Press-in retaining wall: a handbook”, in 2016 and 2021. Without his contributions, these publications would have not materialized.

IPA Awards 2019

Three categories of award were made covering Outstanding Project, Innovative Technology and Distinguished Research.

- **Outstanding Project Award**
  Construction project of retaining wall adjacent to railway in Kyushu, Japan
  Kyushu Railway Company, SANKIKENSETSU INC., Tonichi Consultant, Kyushu Sales Office and Kansai Sales Office, GIKEN SEKO LTD.
- **Innovative Technology Award**
  Headroom restriction Clear Piler for ultra-low overhead clearance” and “steel sheet pile mechanical joint”
  Japan Water Agency, East Japan Railway Company, TOTETSU KOGYO CO. and GIKEN LTD.
- **Distinguished Research Award**
  Recent research into the behaviour of jacked foundation piles
  D.J. White and A.D. Deeks

IPA Awards 2021

Three categories of award were made covering Outstanding Project, Innovative Technology and Distinguished Research.

- **Outstanding Project Award**
  Emergency bridge abutment repair with pressed-in pipe piles
  T. Takuma, H. Nishimura and M. Nagano
- **Innovative Technology Award**
  Effective Utilization of Underground Space in Urban Area
  T. Takeuchi and Y. Kimura
- **Distinguished Research Award**
  Estimation of N value and soil type from ppt data in standard press-in and press-in with augering
  Y. Ishihara, N. Ogawa, M. Lei, K. Okada, M. Nishigawa and A. Kitamura

For more information of IPA Awards, please access IPA Website: https://www.press-in.org/en/page/award.

ICPE 2021 Best Presentation Award

ICPE 2021 Scientific Group

The Best Presentation Award was presented to students and young researchers who are under 40 years old as well as delivered the best presentation at each session of ICPE 2021. The marks given by the sessions chairs and all participants determined the recipients. There were 59 presentations in 2-days sessions and the following presenters were awarded.

- Session A-1: Pile Performance (Vertical Performance)

A06 : Mr. Hiroyoshi Yamazaki
"The inner friction resistance and the resistance of an actual part of open-ended piles by the double-pipe model pile experiment"

- Session A-2: Pile Performance (Vertical Performance)

A11 : Mr. Kazunori Toda
"An investigation into vertical capacity of steel sheet piles installed by the standard press-in method"

- Session A-3: Pile Performance (Horizontal Performance)

A16: Mr. Andrei Dobrisan
"Experimental evaluation of the lateral capacity of large jacked-in piles and comparison to existing design standards"

- Session A-4: Piling Process

A19: Dr. Shunsuke Moriyasu
"Influence of different pile installation methods on vertical and horizontal resistances"

- Session B-1: Infrastructure Development (Pile Walls)

B04: Mr. S M Shafi
"Dynamic behavior of cantilever tubular steel pile retaining wall socketed in soft rock"

- Session B-2: Infrastructure Development (Sheet Pile Walls)

B09: Mr. Hideharu Sugimoto
"Model test on double sheet-pile method for excavation works using X-ray CT"

- Session C-1: Disaster Prevention and Mitigation

C03: Mr. Masafumi Oka
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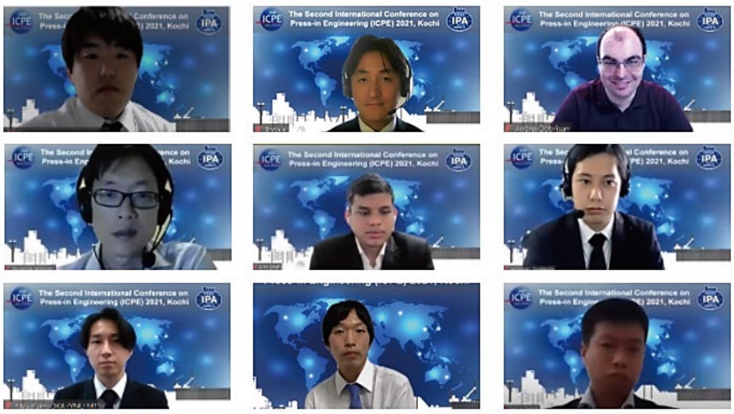

Special Contribution
Comments on Analysis of a Static Loading Test

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1. INTRODUCTION

The foundation industry and the engineering practice embrace an undesirable disparity of procedures and schedules of performing a static pile loading test. While the maximum applied load, number of load increments, means of providing reaction load, total test duration, extent of instrumentation, etc. will naturally vary depending on the specific circumstances and objectives, there are explicit rules for what to do and what not to do. Regrettably, the rules are more often than not broken. The following illustrates a few by way of presenting and analyzing actual results from an instrumented test.

2. SOIL PROFILE, INSTRUMENTATION, LOADING SCHEDULE, AND BASIC RESULTS

The test pile was a 400-mm diameter, square, precast concrete pile driven to 18 m embedment at a site in Singapore. According to borehole information, summarized in Fig. 1 the profile comprised an upper 5 m thick layer of sandy silt, a hydraulic fill placed on 6 m of soft marine clay followed by sandy silt at 11 m depth and designated as Kallang and Jurong formations, respectively. The SPT N-indices indicated the fill as compact, the clay as very soft to soft, and the sandy silt dense to very dense. The borehole may not have been drilled close to the test pile; as the analysis will suggest, the first 3 m of the profile designated as sandy silt is probably more likely the soft layer, i.e., the Kallang-Jurong boundary could be at 14 m and not at 11 m depth.

The pile instrumentation consisted of a special telltale system called Glostrext (Hanifah and Lee 2006), a system employing Vibrating Wire (VW) extensometers to measure strain between a series of anchor points. Seven anchor points (see Fig. 1A) were installed at 2, 8, 11, 14, 16, 17, and 18 m depths in the test pile and referenced to the pile head a 0.0 m depth; no stick-up. The strain measurements gave compression between the anchor levels and accumulated compressions gave anchor movements to subtract from the pile head movement to provide the movement of the anchor levels and, eventually, of the pile toe. The strain measurement was obtained as a difference between two VW readings and it will, therefore, never quite have the same accuracy as a single VW record. However, it is independent of bending moment, which a VW pair cannot ensure. In effect, the Glostrext system provides strain values at par with the more conventional system of embedded VW gages. The strain value is the average over the anchor length (distance between anchor levels). Usually, the strain value is assumed to be representative for the midpoint of an anchor length. Theoretically, in a uniform soil showing linearly increasing shaft resistance and no toe resistance, the average axial force in the pile converted from the strain readings between the pile head and an anchor level some distance above the pile toe, is the force at 0.7 (= $1/\sqrt{2}$) times the anchor length down from the pile head. However, for anchor lengths further down the pile, the location gets closer to the mid-point of the anchor length (Fellenius 2021). All here used force-averages calculated from strain measured between the anchor levels are plotted at anchor-length mid-point. Note also that the measurement of movement, provided by the Glostrext system is a "companion" measurement of great value for the analysis.

The maximum applied load was 2,500 kN; 2.5 times the intend working load. The test schedule comprised three phases of loading followed by unloading. Phase 1 comprised four approximately equal increments applied about every hour followed by an about 6-hour load-holding before complete unloading. Phase 2 comprised 2 increments of about 8 and 18 minutes load-holding duration, respectively, the second load level being about three times the first, and the load was maintained for about 6 hours. (The twice larger second load increment was, presumably, due to an accidental overshooting of the load increase). The third load increment, about equal to the first, was held for about one hour and the fourth, slightly smaller, was held for 10 hours before unloading. Phase 3 comprised 10 about equal load increments. The first 5 were held for 10 minutes, each of the following 3 were held for about 1 hour, and the 9th was held for about 4 hours. The 10th was held for about 2 hours. The duration of the test from start to finish was 3 days. Fig. 1B shows the graph of the load vs. time test schedule. Obviously, the crew had some difficulty maintaining the pressure in the jack.

Fig. 1C shows the main test response, the pile-head load-movement and the compression of the pile. At the 2,500-kN maximum applied load, the pile head moved about 50+ mm and the compression of the pile was 10 mm. Thus, the pile toe moved 40 mm. Note that each unloading caused the next phase, Phases 2 and 3, to start not from zero as for Phase 1, but from the strain and movement remaining from the preceding test phase.

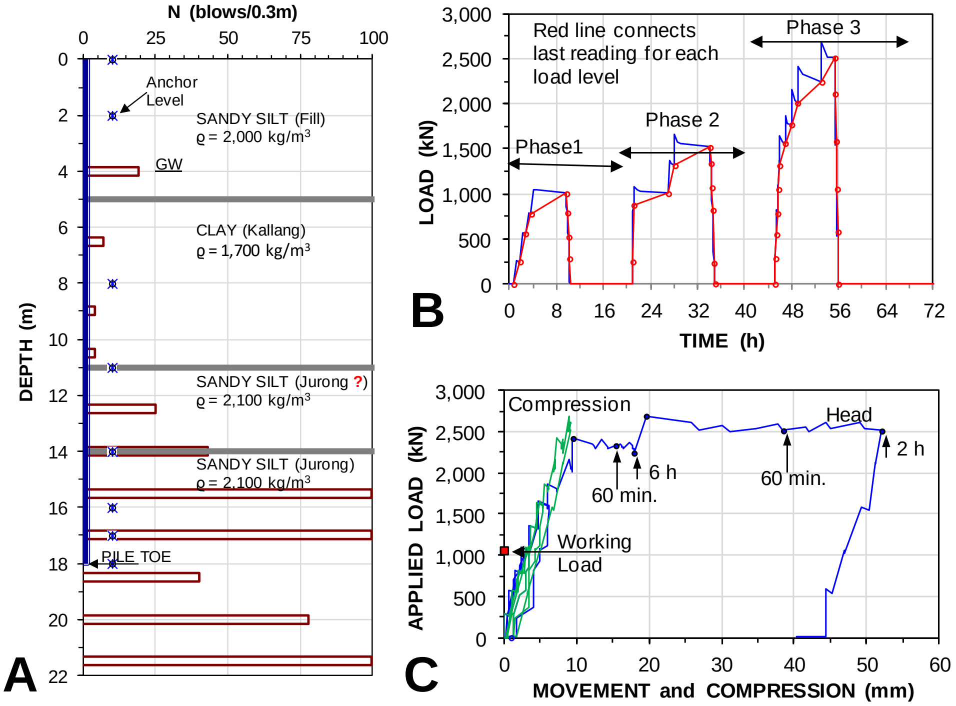

Fig. 1. Soil profile, Anchor levels, Load-time schedule, and Load-movement

Figure 2 shows the strain in the pile remaining at the end of Phase 1 and additional strain remaining at the end of Phases 2 and 3 as well as the total strain induced by the three phases. Such strain is commonly referred to as "residual strain" and the corresponding force is "residual force". It is likely that had an additional phase been introduced after Phase 2 and before the last phase, additional residual strain would have been added to the records. Or, on the other hand, if Phases 1 and 2 had not been part of the schedule, Phase 3, now being the first phase, would have had no such added strain incorporated. Of course, some strain was likely induced during the driving and by set-up following the driving.

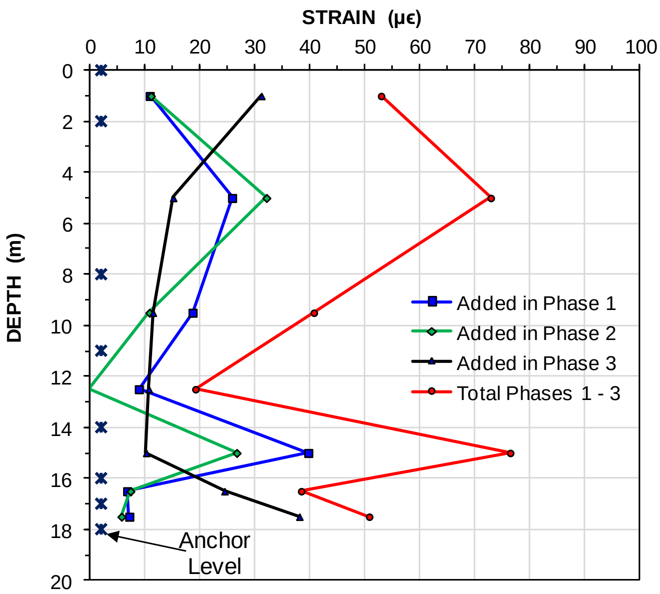

Fig. 2. Strain remaining in the pile after unloading the applied load

In contrast to the subject test, most test schedules are a bit more consistent than the current test in regard to load-holding durations and load levels. Moreover, the applied load levels on actual tests are usually better maintained. However, the main principle is often the same: the tests include a few to several unloading-reloading events or phases—

"cycles" they are not. For years, I have asked colleagues to tell me their rational for specifying a schedule of unloading/reloading and their including uneven load increments, as opposed to scheduling a series of equal increments each held for an equal length of time. The former schedule means spending a not inconsiderable extra amount of money—a client's money or a tax payers' money—a rational for what the extra spending buys or if the spending is warranted is never declared. To date, nobody advocating the former schedule has been able to tell me what is gained by the former over the latter. Of course, when pressured for a reply, many will say that the Code requires it, which to me is the same as the of-old excuse: "the Devil made me do it"! The following analysis will show what unloading-reloading and uneven load-holdings will do to a test interpretation. On a positive note, it will also illustrate how the load-movement results of the Glostrext gages can be used to analyze the response of a pile to applied loads.

3. DATA ANALYSIS

The first analysis step after compiling and organizing the test data is to convert measured strain, ϵ, to axial force, Q. This requires knowing the pile material secant modulus, E_s and the pile cross sectional area, A; $Q = E_s A\epsilon$. However, for a concrete pile, such as the subject test pile, the E_s-modulus can range from a value ≈25 GPa through ≈35 GPa, depending on concrete quality and amount of reinforcement in the pile. Moreover, for the subject pile, the nominal area has to be corrected for the central void. Thus, neither E nor A is known with acceptable accuracy. However, the secant stiffness, E_sA, can be determined directly from the measurements by, for each record, plotting a graph of the load divided by the strain versus strain. The secant method requires that (1) the zero-force reference of the first reading is accurate, (2) the measured strain is unaffected by locked-in strain, and (3) no or only a minimal amount of shaft resistance develops between the load application and the strain measurement location. This limits the method to a record from a gage located close to the location of applying the load; the pile head for the subject case.

The stiffness of the pile at gage levels away from the load application can alternatively be determined by the tangent stiffness method, which employs plotting the change of applied load (Q) divided by change of strain ($\Delta Q/\Delta\epsilon$) against strain (ϵ) to determine the tangent stiffness, E_tA,. There is a simple mathematical relation between the tangent stiffness, E_tA, and the secant stiffness, E_sA. The tangent method is independent of zero shift and residual force. However, it is a differentiation approach and it is therefore very sensitive to data error or inadequate accuracy. The latter means that the applied load, the load that caused the strain at the gage level and the force that caused the change of strain must be kept very stable, because, otherwise, the delay before a load change at the load application point (pile head, usually) is registered as a force change at the gage level would impact the veracity of the interpretation. The tangent method requires that shaft resistance response is plastic, i.e., constant (after an initial movement). If, in contrast, the soil response is strain-hardening, i.e., continues to increase with increasing force, the evaluated stiffness (modulus) increases with strain. If strain-softening, the tendency is instead to decrease with increasing strain. Moreover, the commonly appearing downward slope of the stiffness line (by linear regression), indicating reducing modulus for increasing strain, will be considerably exaggerated by no-plastic shaft resistance. For details, see Fellenius (1989; 2021).

Note, the strict definition of stiffness is a spring constant and it is really E_sA/L and, therefore, "E_sA" should perhaps be called something else, say "stiffness number", which, however, could be confusing. The term "rigidity number" has been used, but "rigidity" is associated with resistance to bending and the context here is axial force, so, I prefer to stay with the term "stiffness".

Fig. 3 shows the secant and tangent stiffness graphs for the subject case records. The secant stiffness method was applied to the strain measured between the pile head and the anchor level at 2 m below the pile head. Linear regression analysis for the values showed that only in Phase 3 was the maximum applied load carried to a load level that would present a secant stiffness development in Phase 3. If maintaining the readings immediately before the start of Phase 1 as the zero reference to Phase 3 records, a secant stiffness, E_sA, of 4.14 GN was obtained. The total strains remaining after each unloading of Phases 2 and 3, were 7 and 13 $\mu\epsilon$, respectively, for the gage length between the pile head and 2.0 m depth. The graph shows the secant modulus calculated after subtracting those values. The Phase 3 linear regression then showed E_sA to be 4.50 GN, instead, which is an about 8 % larger value. N.B., the subtraction of the strains is an uncertain action as the data also include the effect of hysteresis.

The bottom graph shows the tangent stiffness plot for the Phase 3 (Phase 1 and 2 did not engage the pile sufficiently). Note that the values from the last two load levels are affected by the erratic loads applied in the test (c.f. Fig. 2). The pile has a uniform cross section and therefore, the secant method stiffness obtained for the uppermost gage level is representative for all the strain records. Thus, applying the tangent method (bottom graph) to the measured strains would seem to be redundant. However, the plot is still worthwhile because it adds reference to the representativeness of the records. The tangent method applied to the records indicated that the stiffness is 4.5 GN, which is the same as that shown by the secant method after correcting for zero level. As mentioned, the tangent method is independent of the zero-strain reference uncertainty. Therefore, the tangent method result confirms that, for this test, the residual strain at the start of the test should be subtracted from the records before calculating and plotting the secant values. Moreover, no significant strain-hardening appears to be present.

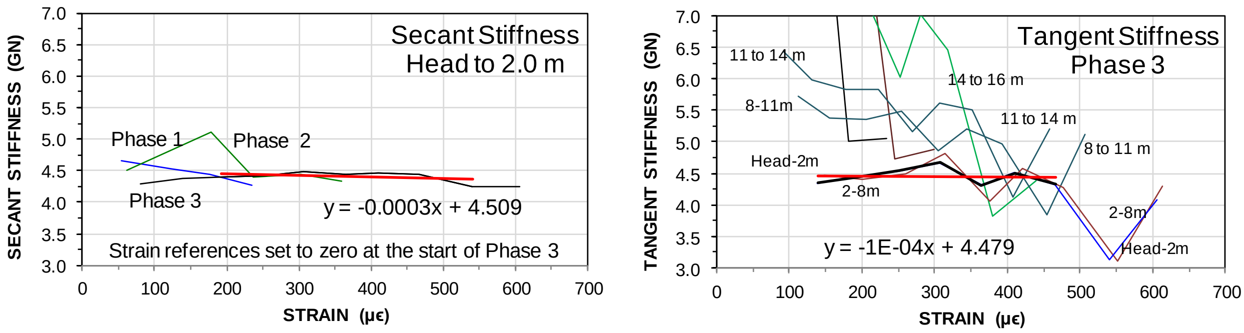

Fig. 3. Secant and tangent stiffness versus strain

The so-established secant stiffness, E_sA = 4.5 GN, was applied to convert the measured strains to axial force in the in the pile. Fig. 4 shows the force distributions (blue line) converted from the about 60-minute measurement of each of the 10 load levels of Phase 3, L3-1 through L3-10, and for the maximum load applied in Phases 1 and 2, L2-4 and L2-5. Values from the anchor length between 2 and 8 m depths appeared to be erratic and were not plotted. My next step was to choose the L3-7 distribution as a suitable target for a back-calculation of distribution of axial force that gave a fit to measured and calculated values. The fit is indicated using red circles connected with a red line. The analysis presents the distribution of mobilized unit shaft resistance. It is convenient to express this in relation to an effective stress distribution, employing the soil profile parameters. This determines a distribution of a ratio, called ß-coefficient, between the effective stress and force reduction from the pile head to the pile toe and the ß-coefficients that gave the fit are listed to the right. N.B., the calculation represents the shaft resistance mobilized for the Target Load and it is not intended to represent an ultimate shaft resistance.

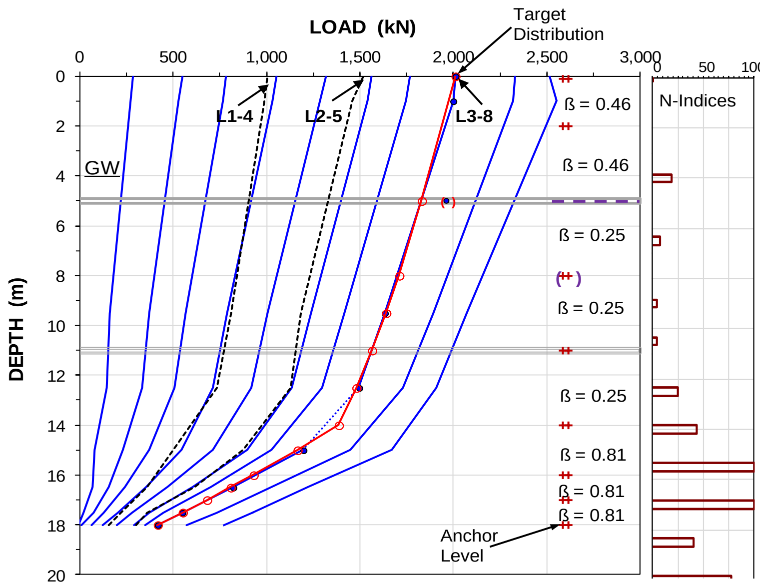

Fig. 4. The strain records converted to force and plotted at the mid-point of each anchor length

The figure includes the N-index diagram as reference to the soil profile and the back-calculation suggests that the softer middle zone extends about 3 m deeper than given in the borehole log. From the load levels L3-5 (1,316 kN) through L3-8 (2,010 kN), the curves are parallel, which indicates plastic shaft resistance. The last two curves are slightly less steep, which would indicate strain hardening, but it is more likely due to the erratic load-holding for the load levels.

For comparison, the analysis of the Phase 3 records was also carried out without adjusting for the strain induced by the two preceding phases. With regard to the ß-coefficients, the difference between the results were slight, as indicated in Table 1, but for the middle portion of the pile. The more noticeable difference was with the toe resistance obtained by linear extrapolation of the curve over the lowest 3 m length of the pile. The adjusted toe resistance for the target distribution was 416 kN, whereas the toe resistance for the unadjusted records was 480 kN. The unadjusted analysis overestimated the target toe force by 15 %.

Table 1. Distribution of ß-coefficients with and without correction of strain from preceding test phases

Depth (m)	0.0 - 5.0	5.0 - 14.0	14.0 - 18.0		
Corrected	0.46	0.25	0.81		
Depth (m)	0.0 - 5.0	5.0 - 11.0	11.0 - 15.0	15.0 - 15.0	16.0 - 18.0
Not corrected	0.50	0.26	0.24	1.10	0.80

The next step was to fit calculated and measured force-movement curves as indicated in Fig. 5. The circles show the measured force-movements and the curves show the simulated and fitted curves. The simulations employed t-z functions for the shaft resistance and a q-z function for the toe resistance. The t-z function was separated on the lower soil layer, "Jurong formation" and a layer combining the "Kallang formation" and fill, thus, employing two t-z functions and the toe resistance q-z function for the analysis as shown in Fig. 6. The fit is good for the first eight load levels, while it is much less good for the last two, which is considered due to the erratic load holding for these last two steps of the test. Of course, a fit to the large-movement records could have been forced, but it would have resulted in a poor fit for the beginning of the test. A similarly good fit for the unadjusted test records could also be produced, but it required a series of different t-z functions and the solutions are therefore less credible. The q-z function was obtained with a function coefficient, θ, of 0.30, which is a very low value indicative of presence of a residual toe force. A function coefficient in the range of 0.6 through 0.8 is more common for virgin conditions. (The simulation calculations and fits were made with the UniPile software; Goudreault and Fellenius 2014).

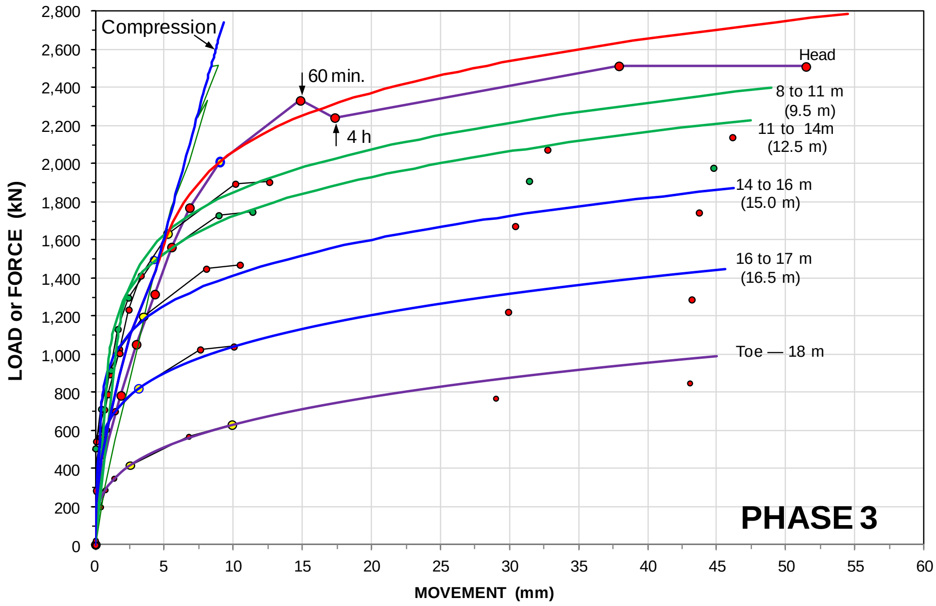

Fig. 5. Load-movement curves for the pile-head and gage levels

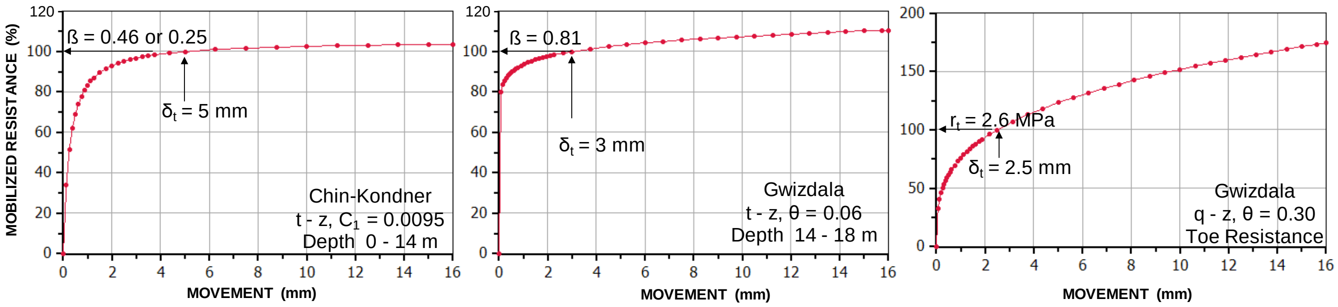

Fig. 6. The t-z and q-z functions that gave the fit

Having established the load-movement response of the pile would seem to provide all information needed for use in the piled foundation design as described in my previous newsletter item. However, there is still the issue of the locked-in force in the pile affecting the test. Residual force may or may not have been introduced due to driving and set-up, though some certainly would have. Moreover, the attempt to remove the effect of the Phases 1 and 2 may not have been sufficient to change the "before-test" conditions for Phase 3 to those for Phase 1. Regardless, it is very likely that the Phase 3 test was affected by presence of residual force developed from the pile head down along most of the pile length.

An analysis (N.B., for the Target Distribution of axial force in the pile) to establish the probable amount of residual force and its distribution relies on the assumption that the negative direction of shear force is equal to the positive direction, that is, the shear resistance unaffected by residual force is represented by a ß-coefficient distribution not smaller than half that back-calculated from the test records. However, unless measured directly, it is not known how far down this condition is valid, that is, at what depth does the negative direction change to positive direction of shear and what is the length of this transition. Also not known is the magnitude of unit shaft resistance along the pile below the transition zone and the magnitude of the final toe resistance. The boundary conditions for the distribution are (1) that the depth to the start of the transition is at the pile toe, which also optimizes the final toe resistance, (2) the final toe resistance cannot be smaller than that determined in the test, (3) that for whatever toe resistance chosen as the "correct" final toe resistance, the slope of the positive shaft resistance rising from that value cannot be steeper than the slope evaluated from the test condition, and (4) the length of the transition zone is unknown; it depends on the relative movement between the pile and the soil in developing the residual conditions—it is usually several pile diameters in length. The actual distribution will be somewhere within the boundaries and establishing it requires applying suitable judgment. Fig. 7 compares a probable distribution after correcting the measured Phase 3 distribution for residual force likely resulting from the driving and set-up following the driving combined with additional residual force due to Phases 1 and 2 not accounted for by re-zeroing the strain and movement records. The analysis suggests that the residual pile-toe force was about 200 kN and the true toe resistance mobilized by the 2,000 Target Load was about 600 kN. Separating out and knowing resistance contribution from the pile toe is always complex. When knowing the pile toe force is important, as for the subject test, performing a bidirectional test is always preferable—the axial force in the pile established in a bidirectional test is true and unaffected by residual force.

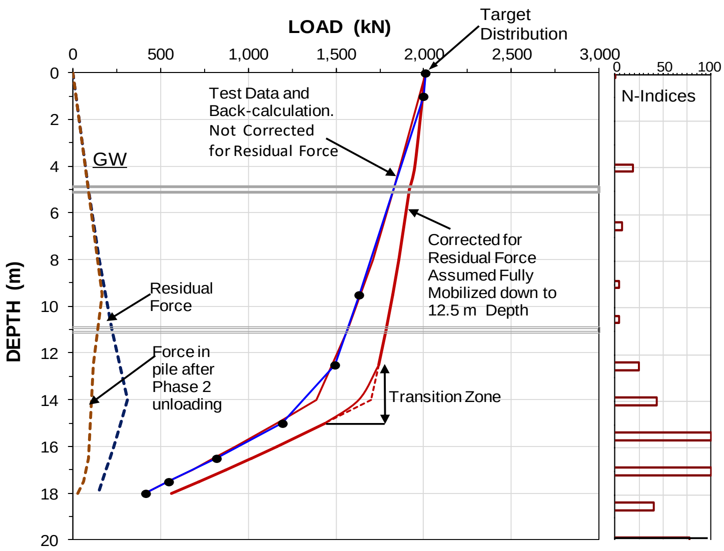

Fig. 7. Distribution of target force before and after correction of potential residual force

The back-calculation of the measured distribution of axial force gave the distribution of shaft resistance along the pile expressed in values of unit shaft resistance, r_s, as well as correlated to effective stress, σ'_z, by a ß-coefficient ($ß = \sigma'_z/r_s$). The relation Fig. 8 shows these distributions for the uncorrected and corrected conditions of residual force. The unit shaft resistance is a function of effective stress, usually considered a proportionally relation, and, therefore, it increases with depth. However, conventionally, the unit shaft resistance is treated as a constant, stress-independent number, which is false. In contrast, the ß-coefficient-is usually constant within a uniform soil and it is therefore a much simpler parameter to use in an analysis. As long as the effective stress is brought into the analysis, the two approaches are identical. Note, the linear distributions shown in the figure are based on assuming an immediate transition from negative to positive direction of residual shaft shear, disregarding that it actually occurs over a transition length.

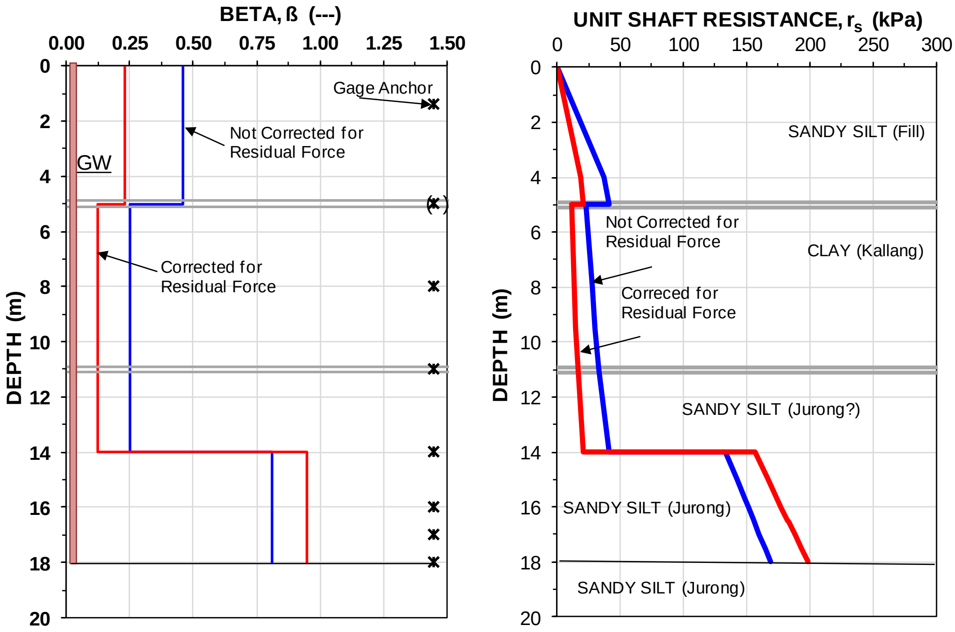

Fig. 8. Distribution of ß-coefficient and unit shaft resistance before and after correction for residual force

The presence of residual force will not have had any significant effect on the shaft resistance response in terms of force-movement, i.e., the t-z functions for the virgin conditions would be approximately unchanged from those determined for the test conditions. However, the virgin toe resistance will show a considerable softer initial response—the residual toe force will appear as a prestressing force and the initial part of the force-movement curve will then be in reloading, appreciably stiffer than in virgin loading. A re-analysis of the load-movement response of the pile under assumption of shaft and resistances equal to those determined from the corrected force distribution, applying the same t-z functions as used for the simulations shown in Fig. 5, but with the t-z function changed to θ = 0.60 and toe resistance (developed at the 2,000-kN Target Load) of 400 kN, results in the pile-head load-movement and a pile-toe force-movement curves shown in Fig. 9. Of course, the calculated response depends on the assumptions made in regard to the residual force present in the pile at the static test and the calculated test curves for the assumed virgin test could either be closer to and more deviating from the measured. However, even with a more optimistic set of assumptions, the difference between the pile-head response as determined in the static loading test and that corrected for the assumed presence of residual force is substantial and will affect the results of using the results for design decisions. In assuming a very conservative distribution of residual force, a similarly corrected analysis can be used for a load-movement and settlement analysis that aims to decide if the design for a piled foundation supported on piles similar to the test pile is suitable.

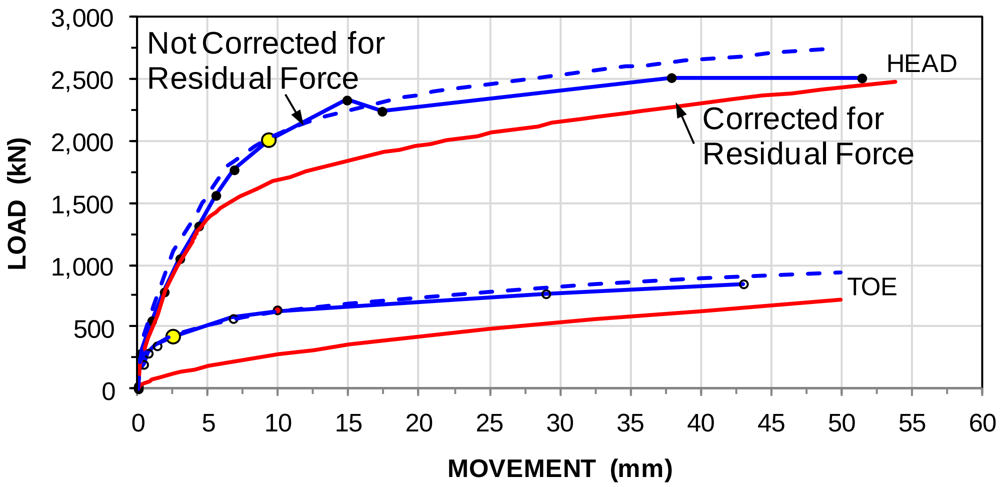

Fig. 9. Measured and corrected pile-head load-movement and pile-toe force-movement curves

4. CONCLUSIONS

Several observations result from the study of the records and analysis of the of the records of the static loading test on the instrumented precast concrete pile.

1. The soil exploration was intermittent and very limited. It would have been useful to see samples from sampling made at closer separations as well as seeing information from laboratory tests, in particular, compressibility variation, e.g., from the oedometer tests on Shelby tubes. The results from a CPTU sounding or two would have been very supporting to the analysis.
2. The primary problem with obtaining an accurate analysis lies with the testing schedule incorporating unloading and reloading events, which adversely affected the analysis of the main test, Phase 3.
3. Because of a delay before a change of applied load fully affects the strain measured down the pile, the demonstrated difficulty in holding the applied load constant affected the ability to correlate measured strain to axial force.
4. The fact that the testing schedule comprised uneven magnitudes of load increments and varying load holding durations introduced additional imprecision for the test analysis. My attempt to correct for this by subtracting the strain remaining in the pile before starting the main test phase is only partially effective as the loading and unloading were active at different levels of residual strain in the pile.
5. It is likely that residual force resulted from the driving and set up after the driving. However, the imposition of the two unloading and reloading events before the main test made it difficult to entirely assess the amount of residual force and its distribution.
6. For additional comments on aspects that can affect the interpretation of the results of a static loading test, see Fellenius and Nguyen (2019).
7. A several-day test duration infers considerable costs that instead of adding value to a test reduces it. Performing instead a test with a series of equal load increments (say about 20±) applied at equal times, (rarely longer than 15 minutes) and with each load level well maintained and held for equal duration would add values and save costs. The savings could be used to pay for the extra soil sampling and analysis and a cone penetrometer test for "free" enhancement of the test value.
8. Notwithstanding the problems due to the unloading-reloading and load-holding variations imposed by the project designers, the analysis of the test results provided insight in the pile response that can be extrapolated to use of piles of different size and length and/or site conditions, e.g., effect of fills and excavations, for foundations on single piles and pile groups contained in the project.
9. The Glostrext telltale-type instrumentation proved to function very well, adding significant value to the loading test.

5. ACKNOWLEDGEMENT

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Editorial Remarks from persons in charge

Prof. Alexis Philip Acacio
(Professor, University of the Philippines)

This issue is the special edition for ICPE 2021 which was held on 19th and 20th of June through an online platform due to the current pandemic. Despite the challenges brought by the COVID-19 situation, the 2nd ICPE follows the success of the first ICPE, which was held in 2018. We received 430 applications from experts of different fields from 19 countries. The live streaming of the two-day conference consisted of the two keynote lectures, state-of-the-art sessions, and five group sessions where 59 numbers of research papers were presented. The recording of each presentation is available on-demand by logging in the ICPE2021 Participant Site.

By summarizing the contents of the conference through the articles in this issue, we hope that the important information of ICPE would be delivered to IPA members who could not attend.

Dr. Pastsakorn Kitiyodom
(Deputy Managing Director, Geotechnical & Foundation Engineering Co., Ltd.)

The Editorial Board is pleased to publish Volume 6, Issue 3 on schedule. This issue is the special issue for 2nd International Conference on Press-in Engineering (ICPE) 2021. To prevent the expansion of the coronavirus infection (COVID-19), the ICPE 2021 was held on-line and on-demand styles during 19-20 June 2021. The main theme in this conference was selected as "Evolution and Social Contribution of Press-in Engineering for Infrastructure Development, and Disaster Prevention and Mitigation". This issue summarized all the topics presented and discussed at the conference.

Dr. Adnan Anwar Malik
(Assistant Professor, Saitama University)

It's been more than one year and nine months since the start of COVID-19, and things are not yet fully normalized. However, advancements in information technology have greatly helped society to continue its activities. One example of the benefits of information technology is the second international conference on press-in engineering 2021 (ICPE2021), which was held online. This newsletter includes an overview of the topics presented at the conference (ICPE2021), such as pile performance, piling process, infrastructure development, disaster prevention and mitigation, case histories, and others. In addition, it also presents the special contribution of Dr. Bengt H. Fellenius on the topic "Comments on analysis of a static loading test". Overall, this newsletter covers the latest research, advancement in technology, and practical application of deep foundations (especially related to press-in engineering), which will benefit the related community.