



International Press-in Association
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Volume 6, Issue 1 March 2021

Messages

IPA enters its 15th year in existence

Chun Fai Leung

President, IPA

Osamu Kusakabe

Immediate President and Executive Director, IPA

IPA was inaugurated on 16th February 2007 in Cambridge with Prof Malcolm Bolton of Cambridge University as its Founding President and Mr. Akio Kitamura of GIKEN LTD. as its Honorary President (Photo 1). IPA has now entered its 15th year in existence. It has organized many events, seminars and research activities related to press-in engineering in the past many years in various parts of the world. The notably key event is the inaugural International Conference in Press-in Engineering held in Kochi, Japan, in September 2018 which attracted a large number of participants globally. The inaugural event was opened by the International Society for Soil Mechanics and Geotechnical Engineering President Prof Charles Ng and Secretary General Prof Neil Taylor. The conference facilitated many fruitful exchanges and interaction among researchers and practitioners (Photo 2).



Photo 1 The Members of IPA Establishment



Photo 2 ICPE2018, Kochi

IPA has planned a good number of events to commensurate the IPA 15th year in existence. With the Covid-19 still affecting vast majority of countries globally, on-line communication remains the key communication channel among IPA members. With the Newsletter serving a major role, IPA has lined up a series of articles starting with this article in the March 2021 issue to kick off its celebration. The highlight of this year is certainly the 2021 International Conference on Press-in Engineering (ICPE) to be held online on 19-20 June. There will be a named IPA 15th year keynote lecture at the conference. In conjunction with the above, certain issues of the Newsletter will cover a special article on the IPA 15th Year Keynote Lecture as well as a special report on ICPE 2021. If feasible, the 15th Year Keynote Lecture will be made available online for the benefit of IPA community.

There will be a special article on 'History of IPA' in the December 2021 issue and the March 2022 Newsletter will be specially dedicated to the 15th Anniversary of IPA with articles highlighting the contributions and achievements of IPA on press-in piling.

To fulfil its mission of forming and developing the international network and contributing to the society on development on research and practice in press-in piling, IPA will continue to organize international seminars (Photo 3) and events online. Meetings by the IPA technical committees will continue to be held online (Photo 4). As soon as the Covid-19 situation is under control and face-to-face international meetings are feasible, IPA plans to reinstate its seminars and events face-to-face in various parts of the world. IPA's wish is that some events can be taken face-to-face during the present important year of IPA 15th year in existence. Examples include the IPA International Seminars in Taipei and Jakarta that were postponed in 2020.



Photo 3 Seminar on Press-in Technology in Singapore



Photo 4 Technical Committee Meeting

IPA is now equipped with four wheels to move forward towards the next 15 years: International Conference on Press-in Engineering, Newsletter, Handbook of Press-in Retaining Structure and Technical committee. On the 15th year of IPA foundation, IPA will concentrate its effort on multilingualization of the Handbook. Up to the present time, there exist Japanese, English and Chinese versions (Photo 5). Since revised English version will be published soon, a large project of multilingualization of the Handbook will be commenced in 2021 by translating the revised English version into French, Russian, Portuguese, Thai and Vietnamese. Once this project is completed, IPA community has the Handbook with eight different languages, which would certainly cover a major part of global needs for technological information of Press-in Piling (Photo 6).

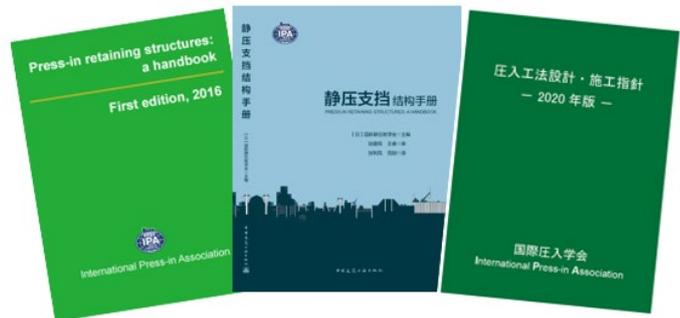


Photo 5 Handbook (English, Chinese and Japanese version)



Photo 6 Press-in Technology applied in 42 countries / areas

Research activities are of essence for future developments of Press-in Engineering and Press-in piling machine. IPA will make every effort to form more Technical committees on the occasion of the 15th year anniversary. Rapid development of AI technology enables us to make construction machinery automated. It is reasonably anticipated that piling is to be carried out by an automated piling machine in the next 15 years. One of the IPA technical committees will gather and compile know-hows that experienced operators gain through actual operation on site to provide a valuable data-base for deep learning, in connection with the development of automated press-in piling machine.

Messages From the Director

Andrew McNamara

Senior Lecturer, City, University of London

I have been very fortunate to have been involved with the International Press-in Association since the Inaugural Workshop at the University of Cambridge in 2007. However, I became aware of the huge potential of silent piling much earlier when I saw sheet piles being effortlessly embedded into sand and gravel on a project in Staines, UK in 1997. I remember being astonished at the sound of gravel crushing as the sheets penetrated with ease whilst the press-in machine itself purred, it was effectively silent with any noise being drowned by nearby road traffic.

I was excited therefore when, as a recipient of an IPA Research Grant, I was given an opportunity to undertake research that would contribute towards the activities of the IPA. And I knew that I would be working with other like-minded individuals; keen to change the way we build. Key attributes of anyone working with the IPA must be a genuine desire to improve the construction process; with special consideration for improving environmental and safety aspects; whilst maintaining efficiency. The need for such change has never been more important and press-in piling has the ability to make major contributions to sustainable, cost efficient construction.

Much of my research in recent years has been focused on bearing piles to carry load in poor ground conditions; traditionally bored cast in place concrete. These piles, which are often very large diameter, are extremely wasteful of concrete; which in any form is a pollutant that uses disproportionately large amounts of cement. Once in the ground they are difficult and expensive to remove; and they usually remain in place creating deep obstructions to future users of the site. This means that bored cast in-situ concrete piled foundations cannot be regarded as sustainable and alternatives are therefore needed.

The concept of hybrid foundations based on groups of sheet piles has only occasionally been used; until now. However, such a form of construction could offer sustainable development opportunities whereby pressed-in sheet piles installed in square or circular formations are capped with a shallow concrete slab. Preliminary centrifuge model test results have shown that this method of construction could offer good bearing capacity with installation of potentially high capacity foundations in an incremental manner. But importantly, this configuration will provide the opportunity to remove the foundations in their entirety when it is required to redevelop the site creating a potentially carbon free foundation.

The prospect of continued collaboration with IPA friends from around the world focusing on applications for press in piling is exciting and I look forward to many more opportunities for meeting and discussion of research projects and outcomes in the future.

◆ A brief CV of Dr. Andrew McNamara



Andrew McNamara is Chief Engineer at Skanska Building and a Senior Lecturer in Civil Engineering at City, University of London. His dual position in academia and industry follows 18 years predominantly working for contractors prior to undertaking doctoral research in 1998. He is recognised by the community for both research and his professional contribution to civil engineering. Recent construction projects have included landmark developments Battersea Power Station, The Gherkin, Heron Tower and The Scalpel whilst research has focussed on developments in deep foundations. He leads the Centre of Excellence in Temporary Works and Construction Method Engineering at City, University of London where he established a unique MSc degree programme this specialist area. He is a former chair of ISSMGE technical committee TC104 on Physical Modelling in Geotechnics.

Case-History

Usa Coast Seawall Upgrade Project, Kochi, Japan - Disaster Mitigation Projects at Coastlines in Kochi, Japan -

Ryo Kamioka

Manager, Construction Methodology Promotion Section
GIKEN LTD.

INTRODUCTION

Every 100-150 years, Nankaido in Southwest Japan is periodically struck by a large earthquake which is known as the “Nankai Earthquake”. Its most recent occurrence was on the 21st of December 1946, known as the “Showa Nankai Earthquake”. The earthquake measured between 8.1 and 8.4 on the moment magnitude scale and resulted in at least 1362 dead, 2600 injured and 100 missing. During the earthquake, serious damage to levee embankments occurred in Kochi Prefecture (Fig. 1) due to the tremors, liquefaction and tsunamis, resulting in widespread inundation in the region.



Fig. 1. The epicenter of the Earthquake (Depth of 30km)



Fig. 2. Pacific Ring of Fire

Japan is located on what is called the Ring of Fire (Fig. 2). This is a giant circle around the Pacific Ocean where edges of tectonic plates are slowly moving. This can result in sudden displacement of the ocean floor, which causes earthquakes and tsunamis. Beneath the Pacific Ocean along the Southwest coast of Japan, the Philippine Sea Plate is slowly being pushed under the Eurasian Plate. It is said that within the next 30 years, there is a 70% chance of the next Nankai mega earthquake (Fig. 3).

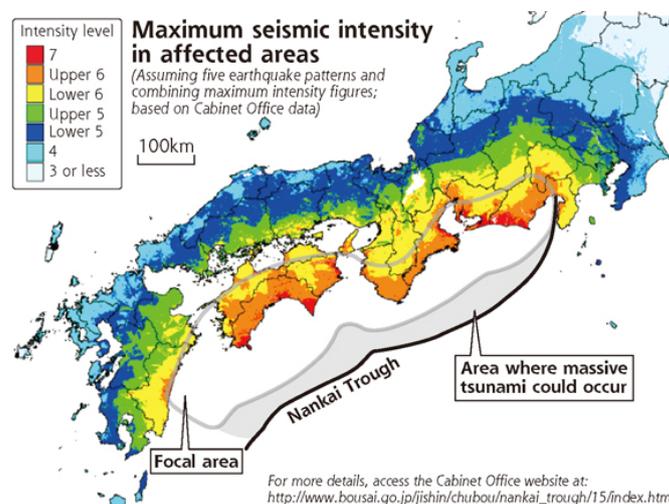


Fig. 3. Distribution of Maximum Seismic Intensity (Shindo) in the event of maximum possible Nankai Mega Earthquake

PROJECT'S SCOPE OF WORK AND SELECTION OF PRESSED-IN PILE WALLS

The Usa area is located approximately 10km west of Kochi city and at the mouth of the 12km deep Uranouchi Bay, which is surrounded by the mainland of Shikoku Island and the Yokonami Peninsula. The Usa area is blessed with warm climate, a ria coast and the Kuroshio Current. It is a thriving distribution hub and is rich in fisheries resources. Nowadays, the area is famous for fish farming, leisure fishing and marine sports and recreation. Due to its calm water, the area is also used as an important refuge harbor. In the narrow hinterland of the Usa coast, there is an emergency transportation route and there are approximately 600 households with a population of approximately 4,000. The area was one of the hardest hit by the previous "Showa Nankai Earthquake" in 1946. Therefore, in order to minimize damage, it is preparing itself for the next Nankai mega earthquake.

PROJECT'S SCOPE OF WORK AND SELECTION OF PRESSED-IN PILE WALLS

In order to protect the coastlines from the Nankai mega earthquake, coastal infrastructures are being upgraded with high resiliency. This is in line with the National Resilience Plan, which is one of Japan's national policies. In the Usa area, coastal protection projects and levee reinforcement projects were carried out to increase resiliency against earthquakes, tsunamis and storm surges. This document specifically features these coastal and levee seismic reinforcement projects, which utilize Implant Structures.

*Implant Structure™: Embedded piled foundation installed by the press-in piling method.

The Usa coast seawall upgrade project stretches approximately 5,800m (Fig. 4). The following seismic design criteria were applied on the project.



出典：国土交通省 四国地方整備局 高知河川国道事務所「直轄高知海岸南国工区海防対策・液状化対策事業」、水産庁「平成24年度公共事業の事前評価書」

Fig. 4. Coastal Protection Scheme in Kochi Prefecture

1. Seismic movement level
 - 1) Level 1 earthquake ground motions
 - Moment magnitude scale of earthquake: 8.6
 - Acceleration of earthquake: 250gal
 - Horizontal seismic coefficient: $K_h=0.19$
 - *Level 1 earthquake ground motions: Earthquake ground motions which have a high possibility of occurrence, during the service life of proposed structures (every tens or hundreds of years).
 - 2) Level 2 earthquake ground motions
 - Acceleration of earthquake: 400gal
 - Horizontal seismic coefficient: K_h =Not specified (Analyzed by utilizing a deformation dynamic analysis software)
 - *Level 2 earthquake ground motions: Earthquake ground motions which have an intensity of the maximum scale, among those expected to occur on proposed structures. Although it has an extremely low possibility

- of occurrence, it would have a cause catastrophic impact on the area.
- 2. Required aseismatic performance of seawalls
 - 1) As for Level 1 earthquake ground motions
Structures maintain their serviceability during and after earthquakes.
 - 2) As for Level 2 earthquake ground motions
Structure damage caused by earthquakes is not critical, but minor and local, and can be repaired in a short period of time without additional reinforcement works.
- 3. Wave impact (Impact of tsunamis)
130kN/m (Impact load by floating objects is not considered.)
- 4. Required height of seawalls
2.2-2.4m above the existing seawalls
- 5. Service life of proposed structures
50 years

The proposed seawalls were installed right in front of the existing seawalls. Behind the proposed seawalls, there was a road and dense residential area. In addition to this, there was only a restricted narrow working space available alongside the proposed seawalls. Therefore, the Implant Structure (embedded steel tubular pile wall installed by the press-in piling method) was chosen for the seawall upgrade work, to satisfy the following criteria.

- 1) High resiliency and toughness of seawalls against earthquakes and tsunamis, with the above mentioned aseismatic performance
- 2) Minimum footprint of proposed seawalls
- 3) No interference to the adjacent road traffic and daily activities in the community during construction
- 4) Construction works within a restricted working space
- 5) Low noise and vibration
- 6) Economy
- 7) Minimize construction time

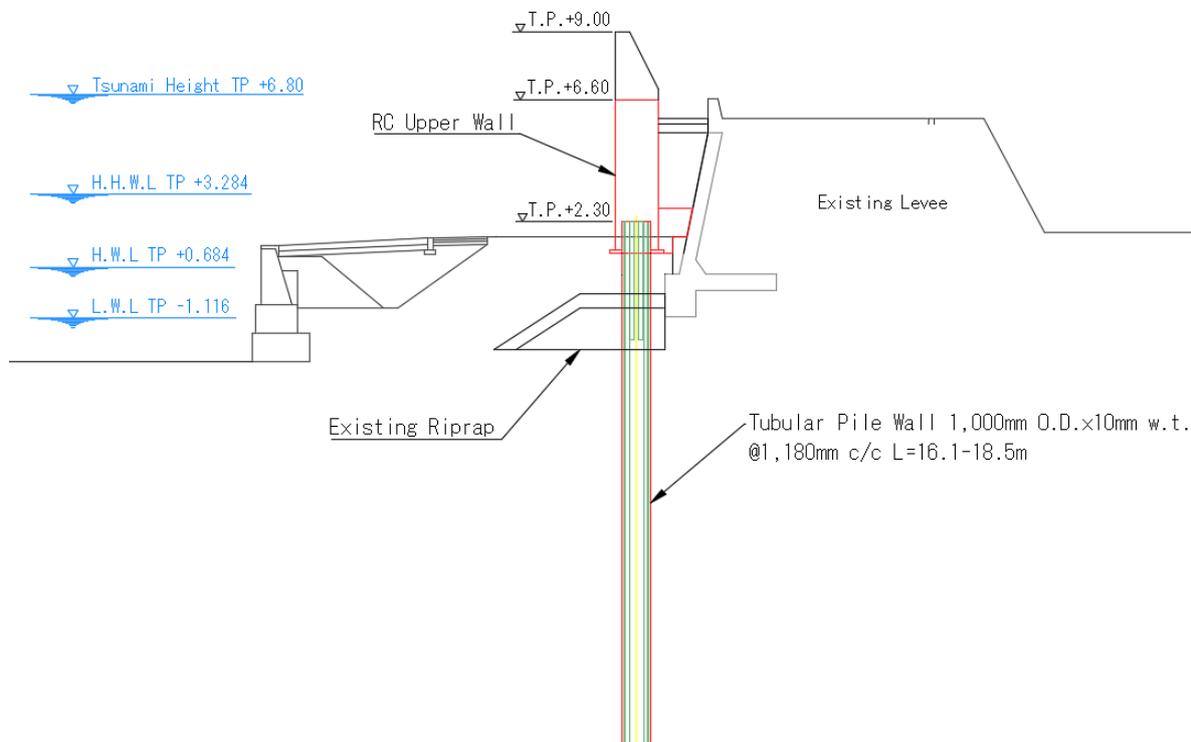


Fig. 5. Typical Cross Section of Proposed Seawall

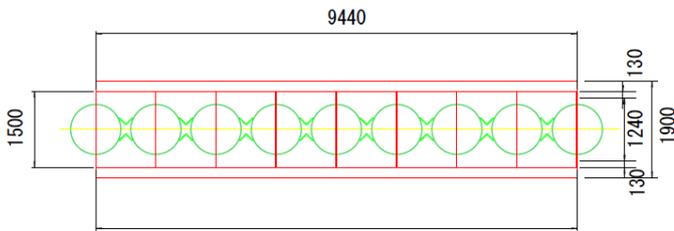


Fig. 6. Detail of Seawall (Plan)

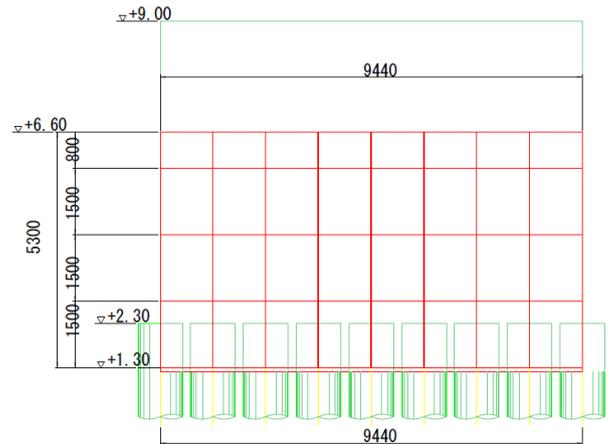


Fig. 7. Detail of Seawall (Longitudinal Section)

GROUND CONDITION

In the project areas, there are liquefiable soil layers (loose sand and silty sand layers) beneath the existing levees, which are broadly located. 1,000mm diameter steel tubular piles were installed into the non-liquefiable soil layer (silt layer) underlying the liquefiable layer, to minimize the horizontal deflection of the levee in the event of earthquakes (Fig. 8).

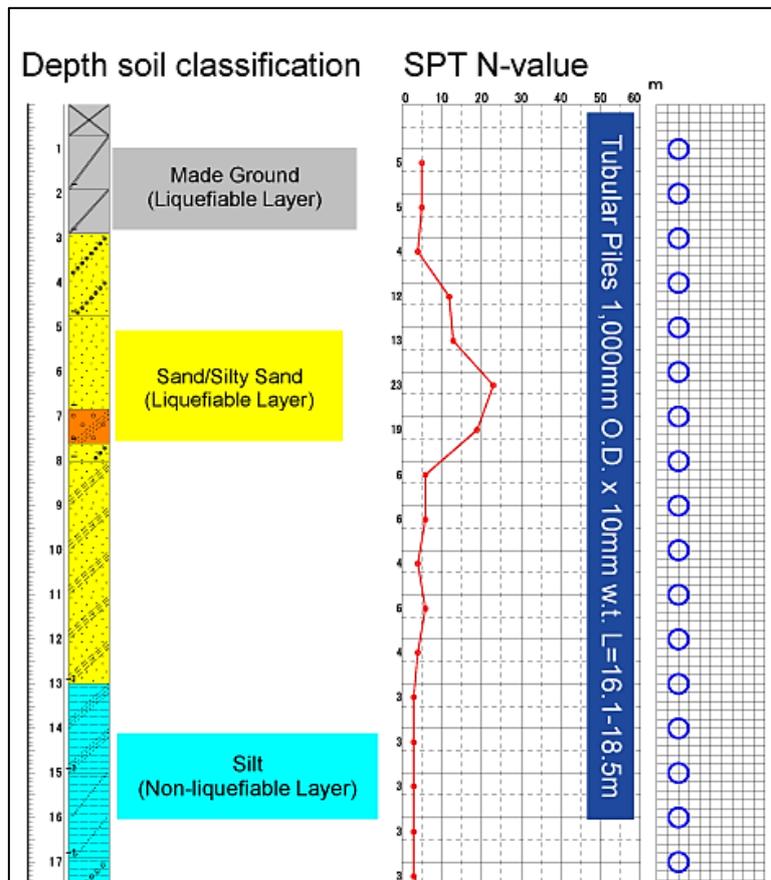


Fig. 8. Soil boring log

CONSTRUCTION METHOD

The Gyropress Method™ (rotary press-in piling method) was utilized to install tubular piles efficiently in the restricted working space, with less noise and vibration. In order to overcome local rock and unforeseen obstructions, sacrificial drilling bits were attached on the pile tip. When encountering major obstacles, a core barrel (reusable steel tubular pies with larger number of non-sacrificial drilling bits) was utilized to penetrate through the obstacles prior to the pile installation.

Where there is enough access available for a normal service crane, the standard Gyropress Method was utilized to install tubular piles (Photo 1). In contrast, in some areas of the project site, the access for construction machines in front of the existing sea walls was only a few meters wide. In order to overcome the extremely difficult working conditions, the Gyropress method with the GRB™ Non-staging system was utilized (Photo 2).

*GRB Non-staging System: A footprint-free pile installation method, which comprises 1) Silent Piler, 2) Clamp Crane and 3) Pile Runner. With the GRB Non-staging System, all the steps including transportation, pitching and installing the piles, are completed on the piles since each mechanical device travels on top of previously installed piles.



Photo 1. Pile Installation (Standard Gyropress Method)



Photo 2. Pile Installation (Gyropress Method) with GRB Non-staging System)

CONCLUSION

The Implant Structures comprises high modulus pile materials and they are firmly installed into the ground using the press-in piling method. Being embedded into the ground, the structure is extremely resilient despite its narrow footprint. When liquefaction is a concern, in the case of earthquakes, Implant Structures do not normally require solidifying surrounding ground. On the other hand, gravity structures normally require ground improvement, when being constructed above a liquefiable soil layer. Also, Implant Structures can be constructed within restricted working space, since the press-in piling method enables prefabricated piles to be installed using a minimum working space.

Coastal infrastructures are critical in the protection of human life and as defenses for other infrastructures in their hinterland. Urban coastlines are a priority in the importance of protection works. In such places, generally only narrow spaces are available for construction works. Therefore, gravity structures are not often considered on urban coastlines due to their need for considerable space. In contrast, the combination of narrow and resilient Implant Structures and the press-in piling method is a perfect fit for construction on or the rehabilitation of coastlines. Implant Structures can also be installed rapidly and economically. Therefore, construction costs and time are less compared to large gravity structures.

Case-History

Rapidly Increasing Press-in Piling Projects in New York Metropolitan Area (Part 1)

Takefumi Takuma

GIKEN LTD., c/o Giken America Corporation

Masashi Nagano

Giken America Corporation

INTRODUCTION

The Giken America Corporation is a U.S. subsidiary of GIKEN LTD. that was established in Orlando, Florida back in 1999. It had undertaken numerous sheet and pipe pile installation work as a speciality piling contractor using GIKEN's machines to showcase the advantages of the press-in piling method in North America. In 2010, it started to focus more on promoting its press-in piling technology to project owners and consultants while making GIKEN's press-in piling machines available for rental and sales for contractors. In March 2019, it opened a New York City office as its new headquarters in the Americas, intending to focus on the most populous region of North America. It also started collaboration with Mueser Rutledge Consulting Engineers (MRCE), a famed New York City-based geotechnical consultant, and Heavy Metal Rentals (HMR), a well-established construction equipment rental company based in Long Island, New York. Three press-in piling projects with their approximate locations shown in Fig. 1 will be discussed as part of GIKEN's achievements in the New York Metro region.

Earth Retaining Walls for Long Island Expressway/Cross Island Parkway Widening

When the Perini Corporation, then a New York-based heavy civil contractor, undertook an expressway widening and bridge replacement project in Long Island in New York in 2000. They submitted value engineering (VE) change proposals to the project owner, the New York State Department of Transportation, to build 10.5m (35ft) high self-standing pressed-in pipe pile walls for earth retaining at two different locations on the project in lieu of very large H-section soldier piles with precast concrete panels. The tall self-standing earth retaining walls were necessary because of space and environmental requirements. Giken America assisted Perini's preparation of the VE packages and later conducted the pipe pile installation. The piles were 914mm (36 inches) in diameter and 15.3 to 24.4m (50 to 80ft) in length with P-T interlocks. Water jetting and an auger attachment were utilized to facilitate pile installation into dense sand with gravel mixed in at some depths with SPT values varying from 20 to an equivalent above 100. See Fig. 2 for pipe pile installation work conducted next to the expressway. Pressed-in pipe piles benefitted both the project owner and the contractor with substantial cost savings. The piling work was conducted at two different times in 2001 and 2002.



Fig.1. Project Locations (Base map from Wikipedia on "Boroughs of New York City")



Fig.2. Tubular Pile Installation for Widening of Long Island Expressway

New York Metro Canarsie Tunnel Rehabilitation and Core Capacity Improvement

The New York subway's BMT Canarsie Line connects the boroughs of Brooklyn on the east and Manhattan on the west via a tunnel under the East River. In 2012, the historical Hurricane Sandy inundated and severely damaged the tunnel and related subway facilities. The tunnel's permanent repair is currently ongoing near the 1st Avenue Station in Manhattan. During the earlier part of the repair work, pressed-in sheet pile walls were installed for earth retaining with lower cost and lower noise/vibration than the original design of secant pile walls combined with soldier pile and lagging walls. This alternate shoring design with pressed-in sheet piles was proposed by MRCE with Giken America's assistance. The project location was in a busy and relatively narrow street sandwiched with high-rise apartment buildings on one side and popular stores in low-rise buildings on the other. Fill and fine sand were underlain with glacial till with SPT N-values ranging from less than 10 to way above 50. 14m (46ft) long Z-shaped sheet piles were chosen as earth retaining members. Some sections required a day-and-night piling operation to expedite the process without disturbing the area's residents or businesses. Giken America rented a Silent Piler F401-Z1400 model with its auger attachment to the Judlau/TC Electric Joint Venture. The duration of sheet pile installation was from December 2017 through April 2018. See Fig. 3 for piling work being safely conducted just next to an open sidewalk.

83-89 Columbia Street Building #3 New Boiler Plant and Site Work

Masaryk Towers Corporation, the manager of a high-rise apartment complex in the Lower East Side of Manhattan, built a new underground boiler room with pressed-in sheet pile walls that were installed for earth retaining. The original shoring design had been to retain 7.7m high soil to create 22.5m x 27.5m of underground space with a combination of soil-mixing and sheet pile walls. When contacted by the piling contractor for the project (Peterson Geotechnical Construction LLC) for a different type of piling equipment, HMR suggested the use of pressed-in sheet piles for the entire earth retention, which achieved a cost reduction, a shorter construction period, and minimum noise and vibration during piling. 15.2m (50ft) long Z-shaped sheet piles were pressed into sand and silt laminated layers with SPT N-values between 10 and 30. Giken America rented a Silent Piler F401-Z1400 model to the piling contractor for a couple of months in the summer of 2019. Fig. 4 shows sheet piles being installed just next to the high-rise apartment building.



Fig.3. Press-in Piling Next to Sidewalk 83-89 Columbia Street Building #3 New Boiler Plant and Site Work



Fig.4. Sheet Pile Installation next to a High-rise Apartment Complex Site

CONCLUSIONS

More and more New York area projects are enjoying the benefits that the press-in piling method provides. It has been solving difficulties associated with earth retaining and pile installation within the densely built metropolis and other crowded cities around the world. Collaboration with established local engineering consultants, equipment rental companies, and progressive engineering contractors appears to enhance the sphere of press-in piling technology.

ACKNOWLEDGMENTS

The authors appreciate the support provided by Hiroyuki Nishimura of Giken Ltd. and Ian Vaz of Giken America Corp.

Serial Report

Development History of SILENT PILER (Part 3): Development of PPTS

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1. Outline of PPTS

In the Press-in Method, the installation process can be observed by monitoring the static load required for pressing-in the piles into the ground. This feature has been paid attention to since shortly after the launch of the first press-in machine (SILENT PILER) in 1975 (Kitamura, 2017), in an expectation that the monitored information can be used for verifying the performance of every single pile. To turn this expectation into reality, efforts have been made both from academic and practical points of views. Academically, a joint research with the University of Cambridge was commenced in 1994, based on the awareness of Mr. Akio Kitamura (Executive Chairman of GIKEN LTD.), and has been continued up to present (Ishihara & Haigh, 2018), providing the accumulation of the reliable experimental data and the understanding on the soil-pile interaction mechanism during press-in piling. Practically, we started to develop the technique of utilizing the data monitored and recorded during piling (piling data) in 2007, and have continued collecting the piling data in actual piling sites as well as in our test fields or experimental facilities.

The practical use of the piling data was conceptualized in the illustration shown in Fig. 1 in 2008 (Ishihara et al., 2008). The examples of the press-in piling data are the vertical jacking force, rotational jacking force (or torque), penetration depth, time, rotation number and so on. The piling data can be obtained automatically by a system equipped in a press-in machine. The obtained piling data are supposed to be utilized mainly in three ways; selecting piling conditions, estimating subsurface information and estimating the performance of piles.

The selection of piling conditions refers to the selection of an adequate penetration technique (Standard Press-in, Press-in with Water Jetting, Press-in with Augering or Rotary Cutting Press-in) and the selection of adequate values for press-in conditions such as the rate of penetration or extraction, rotation number, displacement of penetration or extraction and so on. An automatic operation of the press-in machine is a typical example of this application.

The estimation of subsurface information refers to the estimation of information related with the ground at the base of a pile which is being pressed-in. It is expected to improve the reliability of the termination control of the press-in piling work and to provide an objective material for judging the necessity of adopting another penetration technique or modifying the embedment depth of piles.

In the estimation of the performance of piles, it is expected that a capacity or a stiffness of a pile in a vertical or a horizontal direction is estimated from the piling data. This will make it possible to assure the quality of each pile while mitigating the impact of additional time and cost required for confirming the performance of piles based on the conventional load testing methods.

In the early stage of the development of this technique, the focus was mainly on the estimation of subsurface information,

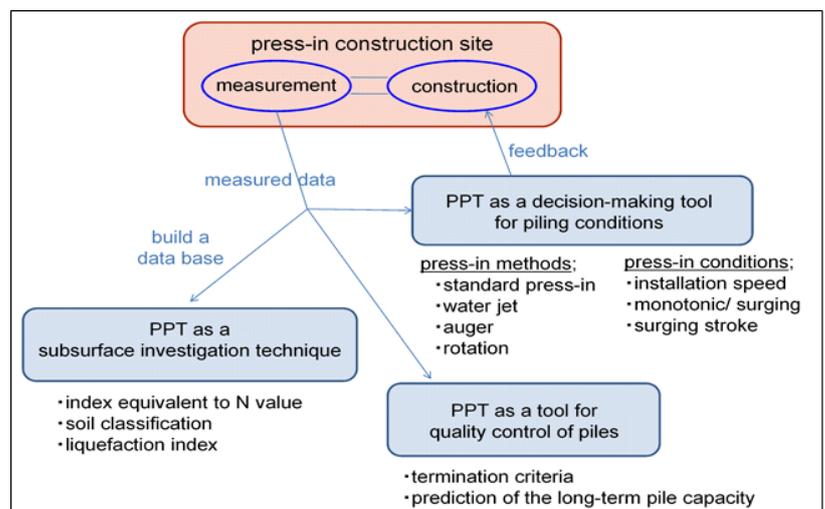


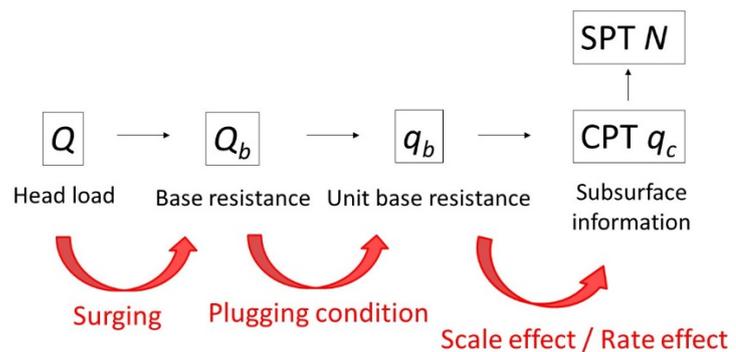
Fig. 1. Concept of the use of press-in piling data

and this technique was called as PPT (Pile Penetration Test), in analogy with the technical terms of CPT (Cone Penetration Test) and SPT (Standard Penetration Test) that refer to the subsurface investigation techniques. After that, as the expansion of the focus into the automatic operation of the piling machine, it was renamed as PPT (Press-in Piling Total) System and was registered with NETIS (New Technology Information System) (MLIT, 2014) as No. SK-170006-A in 2017. The methods of estimating subsurface information from the press-in piling data were assessed by IPA-TC2 and summarized into a technical material in Japanese in 2017 (IPA, 2017). At present, the automatic operation technique of PPTS is equipped in the latest machines of Press-in with Augering, while the subsurface estimation techniques of PPTS are equipped in the latest machines of Standard Press-in, Press-in with Augering and Rotary Cutting Press-in.

2. Estimation of subsurface information

In Standard Press-in, a pile is installed with a static jacking force without the use of any installation assistance (such as water jetting or augering). It follows that the process of the penetration of a pile is similar to that of a cone in CPT. Taking advantage of this similarity, Ishihara et al. (2009a, 2009b) demonstrated that the base resistance Q_b , measured by the load cell in the base of the closed-ended pile, and the shaft resistance Q_s , obtained by subtracting Q_b from the head load Q , can be converted into CPT cone resistance (q_c) and sleeve friction (f_s) by considering the scale effect (White & Bolton, 2005) and the rate effect (Finnie et al., 1994; White et al., 2010; Bolton et al., 2013) on Q_b . Subsequently, the soil type and SPT N can be estimated based on the methods developed by Robertson (1990) and Jefferies & Davies (1993) respectively. The instrumentation on piles for measuring the base resistance became no longer necessary when Ogawa et al. (2012) confirmed that the base resistance can be obtained as the difference between the two values of the jacking force recorded when the pile base passes a certain depth for the first time and for the second time in one cycle of surging.

Regarding Press-in with Augering, two methods to estimate SPT N values were proposed by Ishihara et al. (2013), based on the knowledge in the field of rock drilling. The first one uses the proportional correlation between the parameter $T_b/(d_c)^\gamma$ and the unconfined compressive strength of a rock (Nishimatsu, 1972; Fukui, 1996; Fujimoto, 2005), where T_b is the torque on the auger head, d_c is the depth of cut (ratio of downward to rotational velocity) and γ is a constant. The second method adjusts the parameters used in the technique of MWD (Measurement While Drilling) (JGS, 2004) to link the resistance on the auger head with SPT N values.



In Rotary Cutting Press-in, SPT N values are estimated by assuming a proportional correlation between the SPT N values and the energy (δE) required for deforming a soil below the pile base by a volume of δV (Ishihara et al., 2015). This assumption is based on the knowledge of the linear correlation between the Specific Energy (= $\delta E / \delta V$) in rock drilling and the unconfined compressive strength of the rock (Hughes, 1972; Li & Itakura, 2012). The calculation of the Specific Energy requires the information of the resistance on the pile base, not on the pile head. Ishihara et al. (2015) proposed a method of decomposing the load and torque applied to the pile head (Q, T) into base and shaft components (Q_b, Q_s, T_b and T_s), based on the assumptions that both Q_b and T_b are expressed by the base stress (q_b) and that the frictional stress on the pile shaft is shared by Q_s and T_s in proportion to the ratio of vertical to rotational velocity (Bond, 2011).

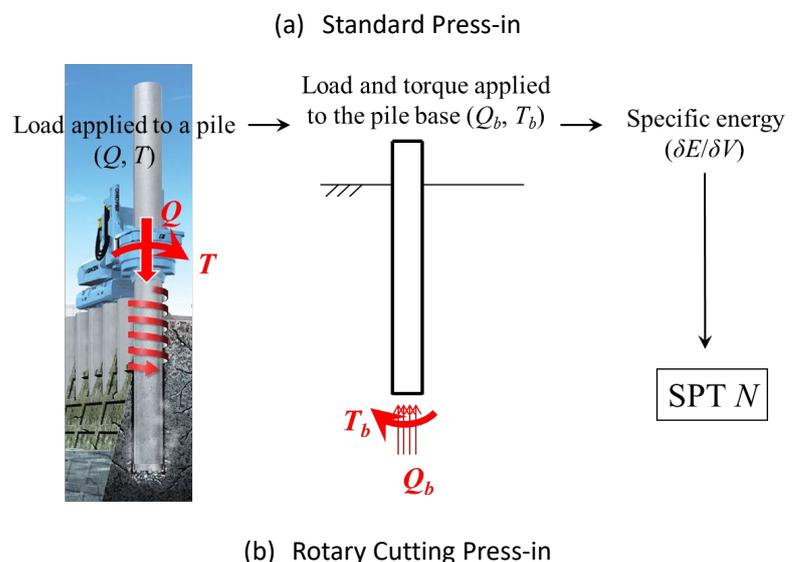


Fig. 2. Processes of estimating subsurface information from piling data

The processes of estimating SPT N from the piling data in Standard Press-in and Rotary Cutting Press-in are summarized in Fig. 2.

3. Automatic operation of the press-in machine

When operating a press-in machine, the values of the press-in parameters such as the rate of penetration and extraction, the displacement of penetration and extraction, the flowrate of the water jet, the rotation number of the auger head and so on are controlled so that the piling operation is progressed smoothly while the resistance acting on the pile being pressed-in is maintained to be sufficiently smaller than the sum of the reaction forces. In the older versions of the automatic operation system of the press-in machine, the values of all the press-in parameters were determined by the operators themselves, and the press-in machine functioned “automatically” as specified by the operator. Expecting that the process of determining and specifying the values of the press-in parameters can also be automated by utilizing the information estimated from the press-in piling data, the collection of the piling data at construction sites were started in 2007, and much effort has been made to develop a program for this new automatic operation. The program for Press-in with Augering has been put into practical use since 2013.

The comparison of the existing automatic operation and the new (PPTS) automatic operation is shown in Fig. 3 (Ishihara, 2018). In the new automatic operation, press-in piling data such as the penetration depth, the vertical and rotational jacking force and the inclination of the press-in machine are utilized to estimate the piling state (the state of interlocking with the previously installed pile, the extent of plugging inside a casing of the augering device, and so on) and the ground condition at the pile base (SPT N for soils or the unconfined compressive strength for rocks). Based on the estimated information, adequate values for the press-in parameters are determined and fed back to the press-in machine. As a result, the efficiency of the piling work can be improved while the accuracy of the piling work is secured. With the use of the PPTS automatic operation, a trend has been confirmed that the more the ground condition varies with depth, to a greater extent the duration for the pile installation is reduced. Several case studies have shown that the reduction of the pile installation in Press-in with Augering was around 30% on average in the actual piling sites that have typical ground conditions containing gravels or varying with depth (Ishihara, 2018; JPA, 2020).

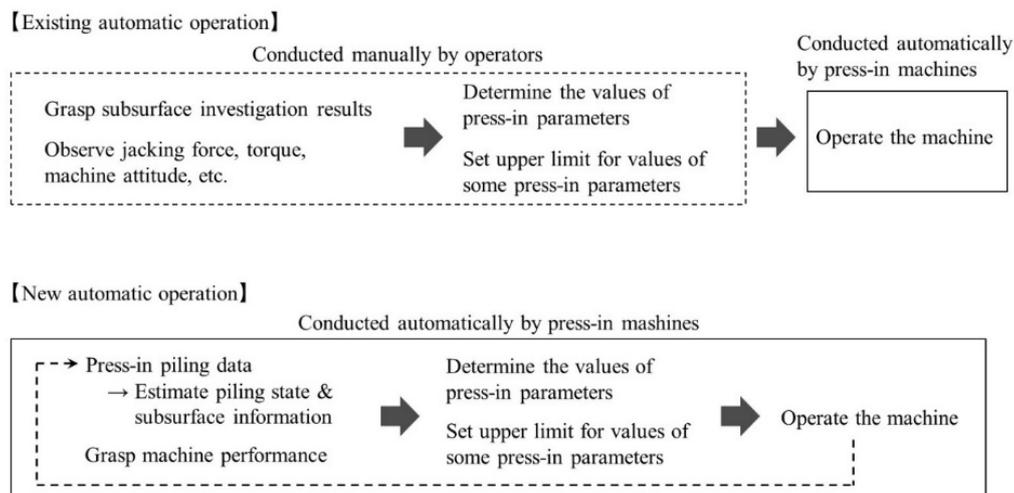


Fig. 3. Comparison of existing and new (PPTS) automatic operation system for press-in machines

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Report

12th IPA Press-in Engineering Seminar in Tokyo 2020

(1) TC1 “Application of Cantilever Type Steel Tubular Pile Wall embedded to Stiff Grounds”

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IPA-Technical Committee (TC)1 (Chaired by Dr. Jiro Takemura, the author) was set up in 2017 to figure out the issues for further application of cantilever type steel tubular pile wall embedded to stiff grounds and establish a rational design procedure of embedded cantilever steel tubular pile wall as the final goal. This report overviews the research activities done by TC1, i.e., case study, physical modeling, numerical analyses, parametrical study by design models, which were presented in the seminar.

1. Background and objectives

Thanks to the innovative pile installation method, like rotary cutting press-in method (e.g., Gyropress), the applicability of steel tubular pile walls (STPW) retaining systems has increased significantly for various structures (road, harbor, railway) and objectives, not only ordinary retaining structures (Miyanohara et al., 2018, Suzuki and Kimura, 2021), but also restoration, rehabilitation and reconstruction of disaster areas (Takada, 2016, He, 2018). The installation ability of large steel tubular pile (STP) into very stiff grounds is a critical advantage of the rotary cutting press-in method. The combination of large diameter and high rigidity STP, and the stiff embedded ground enables to construct cantilever type walls with large retained height (Fig. 1). By the combination, the wall top displacement caused by the wall bending deflection and the wall rotation in the embedment can be controlled below the required displacement. However, the current design method of embedded cantilever wall has been developed for the relatively flexible steel sheet pile wall into soft grounds for small retained height (e.g. less than 4m, JRA (1999)). Therefore, simple application of the current design method to the cantilever type STPW embedded in stiff grounds (Fig. 2) may require unnecessary embedment depth, or increase a risk of failure caused by the unexpected performance of the wall. Several concerns can be pointed out such as,

1) The minimum embedment depth (d_0) requirement using characteristic value (β), such as $d_0 \geq 3/\beta$ (ASP, 2009; IPA, 2014&2016) should be verified, as it is based on long flexible wall behavior in an infinite uniform elastic media, which conflicting the rigid nature of large diameter pile;

2) As the pile diameter (Φ) increases, the relative embedment depth (d_e/Φ) and wall thickness and diameter ratio (t/Φ) tend to decrease. Furthermore, near the surface of stiff ground, especially rock, the stress concentration could occur on the front side of tubular pile. These particular conditions could enhance local and 3D behavior, which is not taken into account in the conventional 2D analytical/numerical models;

3) High confinement or fixity of the piles by the stiff ground could generate the large resilience of pile, which affects the wall-soil interaction, the wall pressure from the retained soil, and the residual wall displacement after the temporal loading event, e.g., earthquake.



Fig. 1. Application of STPW (H=13m, lp=23m) for road widening projects. (Miyanohara et al.2018)

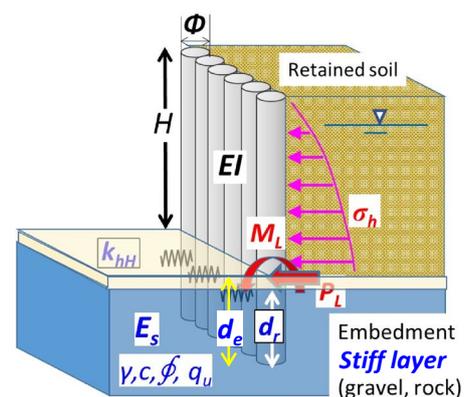


Fig. 2. Cantilever STPW embedded in stiff ground and conditions used in the design.

To answer the above-mentioned concerns and establish a rational design procedure, four working groups were created

in TC1 with several tasks as shown below. *Note: some findings related to the tasks underlined were presented in the seminar.*

- WG1 on design method:
 - Task 1: to analyze present design methods, and identify the issues such as embedment depth, soil characteristics, seismic design.
 - Task 2: to analyze the design procedure of existing large diameter tubular steel pipe walls.
 - Task 3: to propose a new rational design method of large diameter tubular steel pipe wall including seismic design.
- WG2 on centrifuge model tests:
 - Task 1: to clarify mechanical behavior of large diameter tubular steel pipe wall in stiff ground under static loads.
 - Task 2: to analyze influences of critical conditions such as embedment depth, ground stiffness and strength on the wall behavior.
 - Task 3: to discuss difference between the behavior of actual structures and that predicted by the simplified design model.
 - Task 4: to simulate the deformation and failure behavior under earthquake loading.
- WG3 on numerical analyses:
 - Task 1: to verify and calibrate 3D FEM method by centrifuge modeling.
 - Task 2: to analyze the detail and local behavior of wall and ground, which cannot be observed in the centrifuge model tests.
 - Task 3: to analyze the influence of parameters on behavior of large diameter tubular steel pipe wall using simple flame analysis and 2D FEM.
- WG4 on case study of construction:
 - Task 1: to collect construction cases with design details as many as possible.
 - Task 2: to collect the data observed during and after construction, if available, with the collaboration of TC2.
 - Task 3: to identify the concerns in the actual construction, in particular on the cost and time.

2. Case study

Since the Gyropress method was developed by Nippon Steel and GIKEN LTD and first applied in 2004, it has been applied more than 400 projects till 2019 (Hirata & Matsui, 2016; IPA, 2019; Suzuki & Kimura, 2021). Fig. 3 shows some summary of the case records, giving the number of projects in terms of pile diameter, pile length with the joint number and maximum converted SPT N-values with the site ground type. As for the pile diameter, 1m piles have been most commonly used about 40%, but the large diameter piles over 1m have been used more than 30% with 2.0m maximum. The project shown in Fig. 1 is an example of the 2.0m pile wall. While for the pile length, the most frequently used length is about 18m and very long piles over 30m were constructed. The number of welding joint depends on the site condition, such as upper space clearance, and the required pile length. The most of piles have been embedded in the ground with maximum N value over 50. About 20 % of recorded cases, the walls were constructed in gravel or rock ground with the converted N-value of 300 or higher. The application of large diameter pile in the stiff grounds for large height retaining walls is an increasing trend especially for the site with severe conditions, such as spatial restriction, low noise and vibration requirements, and short construction period.

Among the records of which design procedure were confirmed, the minimum embedment depth ($d_0 \geq 3/\beta$) were adopted especially for the road construction projects. Although the number of applications has increased significantly, very limited record is available on the monitored behavior of the wall during and after the construction. The data related to serviceability limit state (SLS) and the ultimate limit state (ULS), and the wall performance from SLS and ULS under various actions, e.g., static and seismic loadings are critically important to rationalize the design procedure.

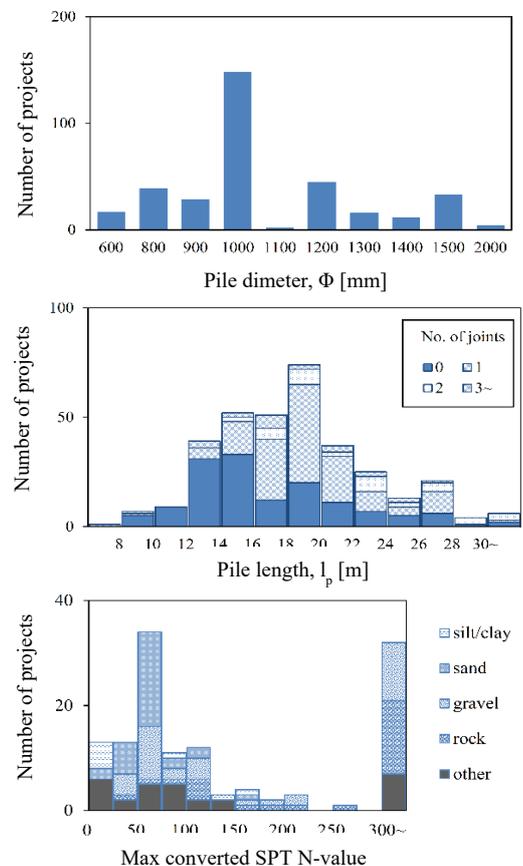


Fig. 3. Summary of case records of STPW installed by rotary cutting press-in method. (Suzuki & Kimura, 2021)

3. Behavior of large diameter STPW investigated by physical models and numerical models

To fill the gap or limitation of field records and investigate the critical behavior of large diameter STPW embedded in stiff grounds, several series of centrifuge model tests and numerical analyses have been carried out to discuss the effects of critical conditions, such as embedment depth, and ground conditions, 3D effect of tubular pile wall, and static and dynamic loading.

(1) Centrifuge model study

Three series of centrifuge model tests were conducted, 1) Simulation of excavation and loading using cantilever plate wall embedded in soft rock (Kunasegaram et al., 2018 and Kunasegaram & Takemura, 2019), 2) Horizontal loading tests to single STP pile and STP wall socketed in a soft rock with and without overlying sand, and 3) Dynamic loading tests to STPW in a soft rock. The main parameter studied is the socket depth to the stiff layer (d_r). For the uniform soft rock ground, the wall embedment depth (d_e) is equal to d_r , while for the two-layers ground d_e is the sum of the top layer depth and d_r (Fig. 2). To generalize the embedment or socket depth, normalized embedment depth ($d_e\beta$ or $d_r\beta$) were estimated. The d_e and d_r adopted in the centrifuge tests were all far below the minimum embedment depth ($d_0=3/\beta$).

a) Series I model: 2D retaining wall

Model test setup shown in Fig. 4 can simulate an excavation process and an extreme loading for a cantilever type retaining wall in a geotechnical centrifuge. In other words, it can model the high stiffness wall behavior with large retaining height from the serviceability limit state (SLS) to the ultimate limit state (ULS). In this series, several centrifuge model tests were conducted on plate walls with per width flexural rigidity (EI) equivalent to STPW with $\Phi=2.5\text{m}$ and 1.0m , embedded in soft rocks and sand (Kunasegaram et al., 2018; Kunasegaram & Takemura, 2019). Observed wall top displacements and rotations of 12m high rigid walls ($\Phi_{eq}=2.5\text{M}$) with $d_e=2.5\text{m}$ ($d_e\beta=0.86$) and 3.0m ($d_e\beta=1.05$) are compared in Fig. 5. As a unified loading index in the two processes, the moment load applied at the excavation bottom is used in the horizontal axis. Though $d_e\beta$ s are much smaller than the minimum requirement ($d_0\beta=3$), the wall displacements by the excavation were well controlled below the target allowable displacement ($\delta_t=50\text{mm}$, 0.4% wall height). Assuming ULS at $\delta_t=5\%H$, the safety margin at SLS against the failure are about threefold in terms of the moment load. Backward slip failure was confirmed for $d_e=2.5\text{m}$ wall after the test, but for $d_e=3.0\text{m}$ wall, the embedment portion was securely fixed by the soft rock, preventing the catastrophic failure. A half meter increment of the embedment for this case can significantly increase the safety of the wall.

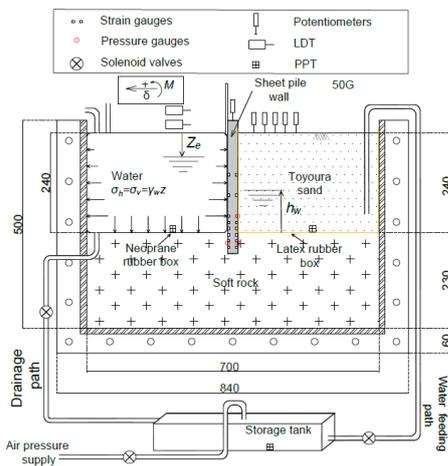


Fig. 4. Centrifuge model test setup on rigid plate wall (Kunasegaram & Takemura, 2019).

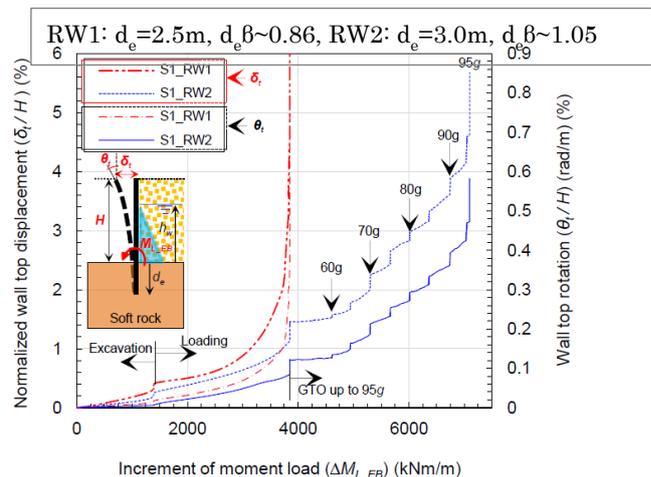


Fig. 5. Effect of embedment depth observed in Series I centrifuge tests (Kunasegaram & Takemura, 2019).

b) Series II model: parametric study on rock sock depth and ground conditions

To investigate the effect of embedment depth under clear loading conditions, lateral loading tests were performed for $\Phi=2.0\text{m}$ single STP (SP) and STP wall (RPW) socketed in the soft rock with and without overlying sand. The load – displacement curves are compared in Fig. 6. Details of the tests are given in Kunasegaram et al. (2019), but the test conditions, e.g., ground conditions and socket depth with normalized depth [d_r , $d_r\beta$] are shown in the figure. From Series II tests, several findings are derived. 1) Lateral resistances of wall and single pile increase with d_r , but the trend of the increase depends on imposed displacement, ground condition, and types of failure (ground failure or pile failure, Fig. 7). 2) Optimum socket depth, over which the effect of d_r is insignificant is much smaller than $3/\beta$. 3) As shallow rock part mainly resists to the horizontal load in the early stage of loading, the effect of socket depth may not be so apparent.

However, once the rock initiates yielding at the shallow depth, the influence of socket depth becomes eminent. 4) The single piles have higher lateral resistance per unit width than the walls both for the initial subgrade reaction and the ultimate resistance. 5) The effect of socket depth and the difference between the pile and the wall are more significant for the single soft rock layer than the sand/soft rock layers. 6) In the two layers, the complicated interaction between pile/wall and soil determines the residual displacement and lateral stiffness of wall. The above findings are all critically concerned to the issues for the rational design procedures, such as, critical embedment depth, non-linearity of p-y curves, and accumulation of residual displacement of the wall subjected to various loading history.

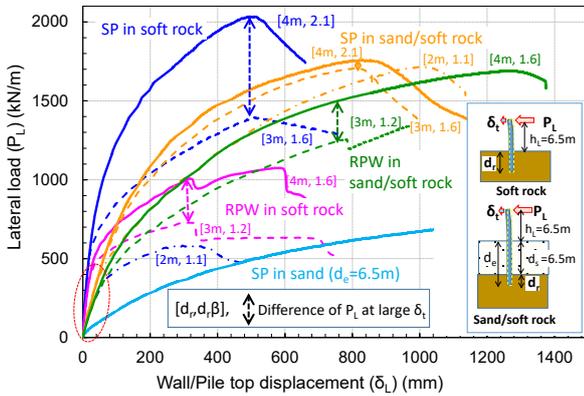


Fig. 6. Effect of embedment depth observed in Series II centrifuge tests (Kunasegaram et al., 2019).

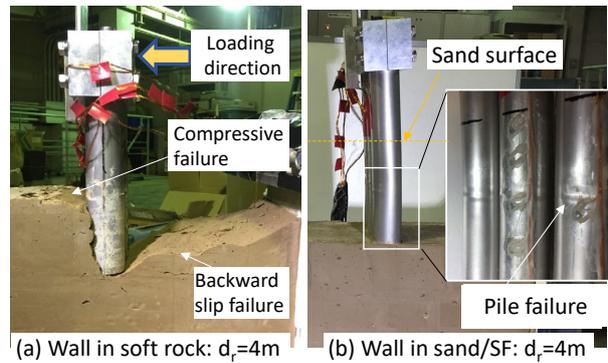


Fig. 7. Failure mode observed in wall loading in Series II centrifuge tests (Kunasegaram et al., 2019).

c) Series III model: Dynamic loading on STP retaining wall embedded in soft rock

A 12m high cantilever walls embedded in the soft rock with backfill sand, which is similar to the model in Series I, were made using the same STP wall in Series II. Several dynamic loadings were applied to the models with different embedment depths (Shafi et al., 2021). In the loading sequence, water was fed in the backfill to rise the water level. The accumulated wall displacements observed were plotted against the cumulative Arias intensity for the wall with $d_e=2.5\text{m}$ ($d_r\beta=1.2$) and 3.0m ($d_r\beta=1.6$) in Fig. 8. Similar to Series I, the dynamic stability of the wall is significantly increased by a half meter increase of the embedment into the soft rock. It was also found that high confinement or fixity of the piles by the stiff ground could generate the large resilience of pile, which resulted in the increase of wall earth pressure after shaking. This pressure should be considered as an action to examine the structural safety of the pile and wall residual displacement after the earthquake.

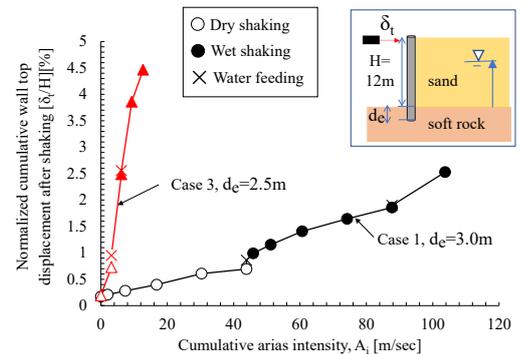


Fig. 8. Effect of embedment depth under dynamic loading Series III centrifuge tests (Shafi et al., 2021).

(2) Numerical and analytical studies

Though the centrifuge model tests could provide valuable results on the mechanical behavior of the cantilever type STPW embedded in stiff grounds, there are still many remaining concerns which might affect the wall behavior or be critical in the rational and safe design procedure, such as plugging of rock in the socket part, local 3D effect of deformation of thin wall tubular pile. In particular, the pile structural failure with local buckling (Fig. 7) could be a common ULS for the wall relatively large d_e , even $d_e\beta$ are well below the minimum requirement ($d_0\beta=3$). Using 3D FEM, Ishihama et al. (2019) investigated the plugging effect, the local stresses at the pile tip, and pile deformation at the pile tip and the rock surface, and found that the plugging effect and 3D effects could not significantly affect the overall behavior of laterally loaded STPW in soft rock. TC1_WG3 further conducted 3D and 2D FEM analyses for the wall model embedded in the soft with $d_r=4.0\text{m}$ (Centrifuge test Series II). In the 3D analysis, the actual tubular pile was modeled by solid element, while in the 2D analysis, the pile was modeled by a beam element with equivalent EI of the actual STP wall. The load – displacement curves

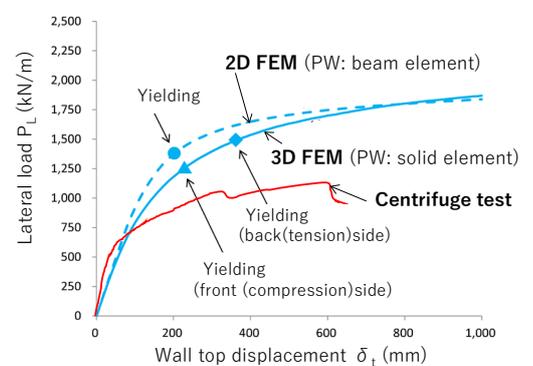


Fig. 9. 2D and 3D FEM results of laterally loaded STPW embedded in soft rock with centrifuge model result: $d_r=4\text{m}$.

obtained by the 3D and 2D analyses were compared with the centrifuge test result in Fig. 9. At the relatively small displacement less than 50mm, which corresponds to allowable value or SLS, no significant difference can be seen in the 3D and 2D models. Over this SLS, the resistance of 2D model becomes larger than that of the 3D model. This can be attributed to local yielding of the ground and pile due to stress concentration at the front toe near the rock surface and back toe near the pile bottom. The analyses overestimate the ultimate resistance, as the FEM cannot simulate the crack formation and back slip failure (Fig. 7). However, from Fig. 9 it can be said that the 2D model can be applied without specific consideration of 3D effects of STPW for the displacement prediction till the SLS.

The top wall displacements analyzed by subgrade reaction method using bi-linear p-y relation is plotted against to the relative embedment depth to the minimum requirement ($d_e\beta/3$) in Fig. 10. This is the common analytical model for the design of retaining wall called “elasto-plastic analysis” in Japan (JRA, 1999). The wall and ground conditions modeled in the centrifuge test Series I were assumed in the analyses, which are indicated in the figure with the centrifuge experiment results. The elasto-plastic analysis could predict the wall deflection with reasonable accuracy. From the figure the critical embedment depth, over which the displacement markedly increases can be confirmed. For the soft rock cases, the critical depths are much smaller than the minimum required depth ($3/\beta$), 20 to 30%, especially for the large diameter and high retaining wall. While for sand case the critical depth is about 60% of $3/\beta$. These trends of the d_e effect were also confirmed by rigid-plastic FEM (Mochizuki et al., 2019).

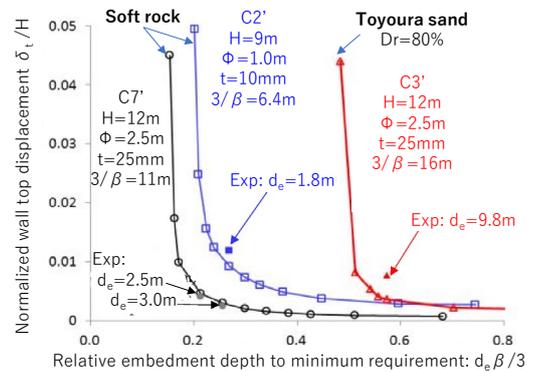


Fig. 10. Result of subgrade reaction methods using bi-linear p-y relation (Ishihama et al., 2018).

4. Toward rational design procedure and practice

Current design practice for the embedded cantilever wall using the minimum embedment depth ($d_0=3/\beta$) adopted in the simple design method (ASP, 2009; IPA, 2014&2016) is based on the assumption of infinite beam on the uniform linear elastic subgrade. But the subgrade reaction of the pile and wall are very non-linear and change with depth. As its simplicity, this simple method could be beneficial for the small height flexible sheet pile wall. However, in the application of STPW in stiff grounds this minimum embedment depth requirement tends to be over conservative and not economical, and even inconsistent with limit states design concept, especially for the high retaining height and large diameter STP wall. Structural pile failure becomes dominant ultimate limit state over a certain embedment depth (d_e). This can be considered as a critical depth, over which no significant contribution of the d_e increase can be expected for ULS, and this critical depth might be much less than the minimum required embedment depth. The common practice using minimum embedment depth in the simple method should be considered as an option, not requirement and the required performances of the limit states, e.g., SLS and ULS should be examined by reasonable methods, considering the non-linearity of soil – structure interaction.

Combination of elasto-plastic analysis and limit equilibrium method should be a common design practice for the large diameter STPW in stiff ground. However, in the application of the non-linear subgrade reaction method, there are several issues remained for the further research. For examples, modeling of p-y relation, including the evaluation of the parameters used in the p-y curves. The estimation of modulus and strength of soil/rock is key issues for the very stiff ground with very large STP-N values. The variability of ground conditions are also major uncertainties in the design and construction of the wall. Especially as the depth of stiff layer could significantly control deformation as shown in Fig. 6. The data recorded in the press-in process of the pile could contribute to the reduction of the effect of uncertainty and economical and safe construction (Suzuki et al., 2021a and 2021b). To establish the more reliable methods, accumulating field data is of critical importance, as reliable database on site ground conditions, wall specifications, and wall behavior during and after the construction should be the sources for identifying the critical issues and for updating the design method.

As for the earthquake loading, two issues can be pointed out, one is dynamic earth pressure and the other the residual earth pressure after the loading. Even for the large flexural rigidity of the wall with secured fixity by the stiff ground, a relatively large dynamic wall deflection could be generated in the cantilever wall, which might cause the seismic earth pressure different from the one on the rigid wall and increase the residual earth pressure. They are closely related to the wall stress and residual displacement. To have answers on these issues, the further researches should be performed by the physical and numerical studies and field study of the wall after the strong earthquake.

The outcome derived from the TC1 activity will be summarized and reported as a form of final report soon.

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Reports

IPA Press-in Seminar in Tokyo 2020

(2) TC3 “Expansion of Applicability and Assessment of Seismic Performance of PFS Method”

Jun Otani

Professor, Kumamoto University
Director, IPA / Chair, TC3

1. Introduction

Annual IPA Press-in Seminar was held on November 30, 2020 and because of the COVID-19, this time of seminar was organized by online presentations. TC3 which is the title of “Technical Committee on Expansion of Application Conditions and Evaluation of Seismic Behavior of PFS (Partial Floating Sheet pile) Method” was asked to organize one of the technical sessions in this seminar. The basic idea of TC3 session was the presentations of all WG (Working Group) and those are WG1: Field investigation, WG2: Laboratory test, WG3: Numerical analysis, WG4: Design and WG5: Overseas. At the beginning of this session, the contents of this session were introduced by the chair of TC3 in which the PFS method as shown in Fig. 1 which is one of the main topics was also introduced. And then, the presentations by the head of each WG were followed. In this report, those contents are summarized including the final conclusions although the activities of WG5 was briefly introduced in the presentation by the chair at the beginning of the session.

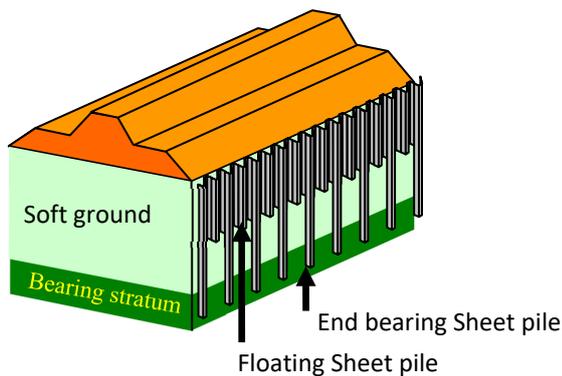


Fig. 1. PFS method

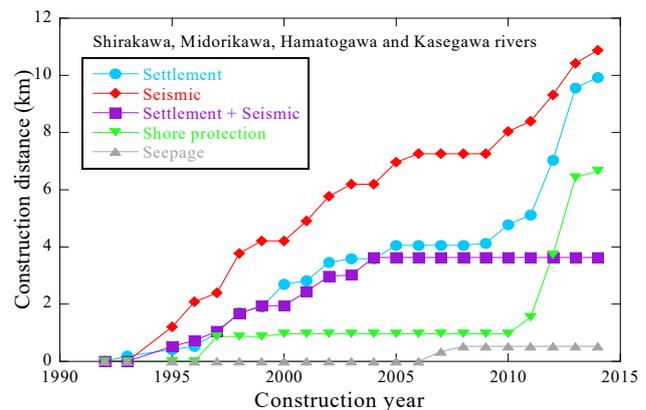


Fig. 2. Purpose of countermeasures

2. The contents of the presentations

(1) Field investigation WG (WG1) by Prof. Kasama of Tokyo Institute of Technology

In order to evaluate the effect of various steel sheet pile construction methods on the suppression of deformation during earthquakes, the settlement behavior of river embankments reinforced by steel sheet pile methods under the 2016 Kumamoto earthquake was summarized focusing on the type of steel sheet pile method, shape, location of countermeasures (inside and outside of the embankment), and combination of each method. In addition, quantitative analysis of the settlement of river embankments was carried out focusing on the liquefaction of the embankment and its foundation soil. Fig.2 shows total number of annual changes on the steel sheet pile methods in Kumamoto with the purposes of the countermeasures.

(2) Laboratory test WG (WG2) by Prof. Tobita of Kansai University

In order to investigate the seismic performance of PFS method, model shaking tests were conducted at a centrifuge. Target ground conditions were 1). clayey ground and 2). two layers of loosely packed saturated sand (upper part) and clay (lower part). Followings are the summary of those two cases:

1) Clayey soil: Although PFS sheet piles are less effective in preventing lateral flow than full-bottomed sheet piles because of their lower bending rigidity, they are as effective as full-bottomed sheet piles in reducing the settlement of the top of the embankment during excitation.

2) Two-layer ground: The lateral displacement of the sheet pile was reduced by about 30% by rooting the lower end of the floating part of the sheet pile into the clay layer.

(3) Numerical analysis WG (WG3) by Prof. Nakai of Nagoya University

Here, 2-D or 3-D finite element methods were used and the following points were verified numerically:

- 1) Verification of the effectiveness of the countermeasure for controlling lateral flow during embankment construction
- 2) Seismic performance verification at the time of an earthquake

Fig. 3 shows the shear strain distribution 10 years after the occurrence of the earthquake (enlarged display around the embankment) along with the amount of subsidence and horizontal displacement at the top of the embankment.

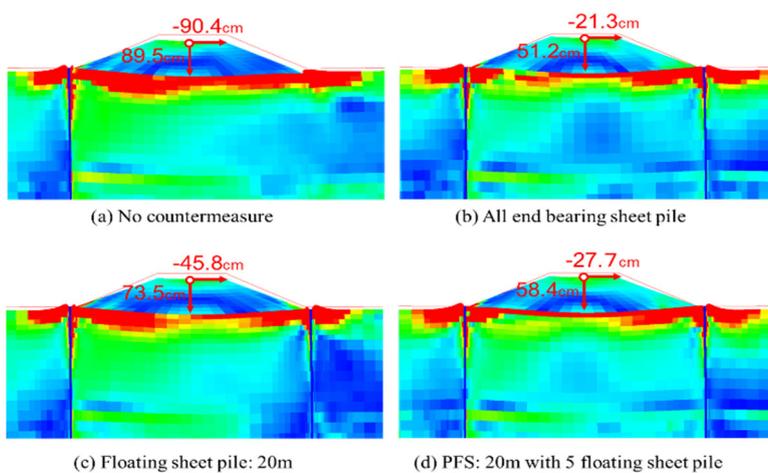


Fig. 3. Comparison of embankment deformation

(4) Design WG (WG4) by Prof. Nishioka of Chuo University

The PFS method is a close construction countermeasure method to suppress settlement of the surrounding ground where consolidation settlement is more dominant than horizontal displacement due to the presence of sandy ground on the surface layer in response to increased load. In the case that the sandy ground on the surface layer may liquefy, the countermeasure is necessary. As for the seismic reinforcement method using steel sheet piles for embankments on liquefied ground, design methods and development policies have been developed to some extent in each field under the condition that it is not PFS method (e.g. Soil Mechanics Laboratory Manual for river embankments). The mission of the WG4 was to revise the design manual so that it can be easily used for practical design of seismic reinforcement and construction in close proximity. In this presentation, the basic idea and flow chart of the revised design method was introduced. Table 1 shows the proposed design manual for the sheet pile method under earthquake.

Table 1. Table of contents for design manual

1. General remarks
1.1 Objectives
1.2 Positioning of the construction method
1.3 Scope of application
1.4 About this manual
1.5 Related standards
1.6 Basic concept of PFS method
1.7 Investigation, design, and construction procedures
2. Site investigation
2.1 Objectives
2.2 Contents and items
2.3 Planning
3. Design
3.1 Basic concept
3.2 Determination of applicability
3.3 Setting basic specifications
3.4 Consideration of earthquake
3.5 Consideration of countermeasures for surrounding ground
3.6 Sheet pile head treatment
4. Construction
4.1 Installation of sheet pile
4.2 Construction procedure
4.3 Points to note for the use of water jet

(5) Conclusions by Dr. Taenaka of Nippon Steel Corporation

At the end of session, the activities by TC3 were concluded and the contents of all the presentations were summarized. The summaries of all presentations were listed as follows:

- 1) WG1: a) Survey on the actual situation of river bank reinforcement (regions and project results), b) Survey of bank subsidence after the Kumamoto Earthquake

2) WG2: a) Evaluation of seismic behavior of PFS method in clayey ground, b) Evaluation of seismic behavior of PFS method in liquefied layer ground

3) WG3: a) Investigation of the effect of lateral displacement during raising and its range of application, b) Proposal of 2D analysis model by comparison with 3D analysis, c) Confirmation of the seismic effect of the PFS method by comparing the methods of no countermeasures, floating, PFS, and end bearing.

4) WG4: a) Introduction of seismic design (liquefaction design) (*Ensure consistency with the 2016 Guide to Liquefaction Countermeasures for River Embankments), b) Provide information that contributes to technical judgment on the scope of application.

3. Conclusions

Steel sheet pile method had been used more temporarily works but recently, the use as a permanent structure has been considered. At the same time, PFS method which was originally developed for the countermeasures of ground subsidence due to river embankment constructions. In addition to those, the effective installation method which is “Press-in technique” makes it enhanced. Those were the motivation of TC3. We hope that more wide variety of the use of steel sheet pile including the countermeasure on earthquake are increased from now on.

Reports

Technical assessment on the design and construction method for rotary press-in pile by Japan Society of Civil Engineers

Mitsuhiro Okada

Engineer, Japan Press-in Association (JPA)

JPA has received a technical assessment for the rotary press-in piling method by the Japan Society of Civil Engineers (Japanese version in 2020, and English translated version in 2021).

The assessment was conducted by the Technical Evaluation Committee consisting of six experts, specializing in earthquakes, ports, roads, railroads, and piles (chair: Prof. M. Hamada). In this assessment, it was confirmed that the formula for calculating the bearing capacity of rotary press-in piles is on the safe side with respect to the results of the vertical and horizontal loading tests.

The rotary press-in piling method has been used in more than 400 projects in Japan, most of which were for building earth retaining walls. In the future, we would like to propose and expand the application of the piling method to construction projects that require vertical bearing capacity, such as foundations for roads and bridges. Please contact us by e-mail for more information.

international@giken.com



Certificate by JSCE

Young Members Column

Press-in Technology Promotional Platform by Adapting Augmented Reality (AR)

Azizul Hakim bin Azizuddin

Final Year Undergraduate Student, Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia (UTHM)



I'm Azizul Hakim Bin Azizuddin, a final year student at Universiti Tun Hussein Onn Malaysia (UTHM). In pursuing my final year project, Dr. Nor Azizi Yusoff acted as my project supervisor and introduced to me the Press-in Technology. I was given a task to create a platform promoting silent piling technology using augmented reality (AR). Due to the Covid-19 pandemic situation, one of the challenges faced by the International Press-in Association (IPA) is the restriction of face-to-face meetings among Board of Directors and technical committee members. This research was conducted in order to recognize an alternative way in delivering the information to related people in the absence of face-to-face meeting. Nowadays, smartphones are the common gadget used by every people in this world. Therefore, one of the possible, fastest, and safest ways to deliver information or data regarding silent piling technology is by using a mobile application that is available in every type of smartphone.

One of the up-to-date technologies is the Augmented Reality (AR). AR is a combination of virtual world and the real world. It allows a level of immersion that no virtual equipment can provide. This study focused on applying AR as a platform to promote silent piling technology. The developed application is a reasonable option to be used for construction industry and education sectors. This mobile application may lead the digital revolution in any university. It also contains powerful features, including cloud-based authoring system which can transform the education institution using these tools and enhance the learning programs. General knowledge associated with press-in technology are also available on this platform. Therefore, it is potentially applicable as a tool to train workers on site in a safe environment with minimum risks. In summary, augmented reality may be one of the potential ways of communication during this pandemic situation. Further applications could be developed for other civil engineering applications.

I'm happy to be involved in this interesting journey. Please visit my video presentation related to this project at <https://youtu.be/pncHWXcZHj4>. Thank you.



Fig. 1. Scanning the augmented reality using zapcode on site, the concept



Fig. 2. Augmented reality platform for press-in technology

Announcement

The Second International Conference on Press-in Engineering 2021, Kochi (ICPE2021) 19-20, June, ONLINE

ICPE2021 offers opportunities for academics and technicians to intercommunicate with one another and for students and young experts to present their achievements. It also provides forums for introducing Japanese efforts for building national resilience as well as study reports of IPA Technical Committees.

- **Date:** 19 (Sat) & 20 (Sun) June 2021
- **Venue:** Online
- **Organized by:** ICPE2021 Organizing Committee and International Press-in Association (IPA)
- **Keynote lectures:**
 - ◆ Lecture 1
Theme: R&D for Infrastructure Maintenance, Renovation and Management
Speaker: Prof. Yozo Fujino (President, Josai University)
 - ◆ Lecture 2
Theme: Design Considerations in the Tip Resistance of Piles Jacked or Driven into Strong Soil or Weak Rock
Speaker: Prof. Mark Randolph (University of Western Australia)
- **ICPE2021 Website:** <https://icpe-ipa.org/>
- **How to apply:** <https://www.press-in.org/en/event>
*Please refer to "The Second International Conference on Press-in Engineering 2021, Kochi"

The IPA would be grateful to welcome your participation. We would also appreciate your help in disseminating information of this event to your colleagues. We look forward to seeing you at the conference and finding common ground with you.

New Members (December 2020 – February 2021)

Members who joined IPA from December 2020 to February 2021.

■ New Individual Members (2)

HyungHoon Lee Kenichi Horikoshi

■ New Student Members (14)

HAKIM AZIZUL	OROZI SOUGUI OUMAR	Kazuki Kondou
Amiera Binti Zamrie Izzatul	Muhammad Haiqal Bin Husain Haiqal	A/L Gunasagar Pavahlan
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Yugo Tsutsui	INTAN SOLEHA NOOR INTAN SOLEHA BINTI RAMLI	
NUR AQILAH FATINI BINTI CHE AYOB		

■ Numbers of Members as 28th February 2021

Individual Members: 684 Student Members: 43 Corporate Members: 54

Event Dairy

Title	Date	Venue
■ IPA Events https://www.press-in.org/en/event		
The Second International Conference on Press-in Engineering, Kochi (ICPE 2021)	June 19-20, 2021	Online
International Society for Soil Mechanics and Geotechnical Engineering http://www.issmge.org/events		
2 nd International Conference on Geotechnical Engineering – Iraq 2021	April 5-6, 2021	Duhok, Iraq
16 th International Conference of the International Association for Computer Methods and Advances in Geomechanics – IACMAG	May 5-8, 2021	Torino, Italy
4 th International Conference on Transportation Geotechnics (4 th ICTG)	May 24-27, 2021	Online
XXV Argentine Congress of Geotechnical Engineering - CAMSIG	May 26-28, 2021	Posadas, Argentina
5 th International Conference on New Developments in Soil Mechanics and Geotechnical Engineering	May 27-29, 2021	Nicosia, North Cyprus
Mediterranean Symposium on Landslides	June 7-9, 2021	Naples, Italy
6 th International Conference on Geotechnical Research and Engineering (ICGRE 2021)	June 21-23, 2021	Online
7 th International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics	July 12-15, 2021	Online
3 rd Pan-American Conference on Unsaturated Soils	July 25-28, 2021	Rio de Janeiro, Brazil
■ Deep Foundations Institute http://www.dfi.org/dfievents.asp		
International Foundations Congress and Equipment Exposition	May 10-14, 2021	Dallas, Texas
SuperPile 2021	June 23-25, 2021	Philadelphia, Pennsylvania
■ International Geosynthetics Society http://www.geosyntheticssociety.org/calendar/		
EUROENGE0 3 rd European Regional Conference of IAEG	April 8-12, 2021	Athens, Greece
■ Others		
ASCE Engineering Mechanics Institute International Conference 2021 https://sites.durham.ac.uk/emi2020-ic/	March 22-24, 2021	Online
Structures Virtual 2021 https://www.structuresvirtual.org/	June 2-4, 2021	Online

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Editorial Remarks



The world is still fighting against the COVID-19 pandemic, which was first identified in December 2019 and severely affected human life in all respects across the globe. The situation is getting better as the vaccination against COVID-19 has been rolled out in many countries. However, we should still act cautiously, wear masks, keep distancing, and avoid crowded places. Carefully conformed to the precautions mentioned above, International Press-in Association (IPA) continued its activities worldwide and published its 1st issue of the newsletter for 2021.

As IPA enters its 15th year, Prof. Chun Fai Leung (IPA President) and Prof. Osamu Kusakabe (IPA immediate President & Executive Director) presented IPA's activities and future action plan for the next 15 years in the form of an article in this issue of the newsletter. Moreover, Dr. Andrew McNamara (IPA Director) highlighted the effectiveness of press-in piling and pointed out the performance of hybrid foundations under the Messages section.

The March 2021 issue includes case histories from the USA and Japan regions. Mr. Takefumi Takuma and Mr. Masashi Nagano (Giken America Corporation) presented the press-in piling projects in New York Metropolitan area where pipe piles and sheet piles were preferred over other piling techniques, resulted in substantial cost savings. Moreover, Mr. Ryo Kamioka (Manager, Construction Methodology Promotion section Giken Ltd.) presented the Gyropress Method for installing tubular piles at the usa coast seawall upgrade project, Kochi, Japan, to protect coastlines from the Nankai mega-earthquake.

Mr. Yukihiro Ishihara provides a final part of the development of Silent Piler which introduces PPTS. The newsletter also includes two reports written by Assoc. Prof. Jiro Takemura (IPA Director) and Prof. Jun Otani (IPA Director) from the 12th IPA Press-in Engineering Seminar in Tokyo 2020 (online). In addition, a report on the safety assessment of bearing capacity formula for rotary press-in piles is included in the reports section.

The young member's column addresses Augmented Reality (AR) benefits in silent piling technology. The newsletter's remaining sections provide information about new IPA members, upcoming events, and corporate members.

The editorial board believes that this issue provides state-of-the-art knowledge about press-in technology, which will assist professionals and researchers in their future tasks.

Adnan Anwar Malik

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