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# News Letter

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## Inside This Issue



## Editorial Board



# *Messages*
## From the Director

Kiyoshi Minami

Managing Executive Officer, Muramoto Corporation

I have been a director of the International Press-in Association (IPA) since 2019. Before being the director, I helped with the publication of "Design and Construction Guideline for Press-in Piling 2015 (the Japanese version)" as an editorial member. I will continue to do my best to contribute toward IPA's activities.

I majored in civil engineering and have been mainly engaged in road construction and maintenance work. I am very interested in how to use construction machinery well and proceed with construction efficiently since utilization of construction machinery is indispensable for various construction works. In other words, I would like to investigate and research the ideal way of management in the wide field of civil engineering and construction mechanical engineering.

I am working for IPA Technical Committee 5 which is titled "Influence of operator skill and experience on field performance of Press-in Piling" as a co-chair. In order to carry out reliable and efficient Press-in Piling, following a given construction plan, it is a premise that an operator properly operates the press-in machine, so that the machine can function as the designer of the machine expects. It is often the case, however, that construction is not always so under ideal conditions in actual field sites. It is supposed that not only machine malfunction but also lack of experience and skill of operators are affecting quality of construction. This technical committee focuses on the aspects of machinery and operation, aiming to clarify the influence of the operators' experience and skill on workability in Press-in Piling. We hope that TC5's outcome will contribute to further improvement of efficiency and reliability of the Press-in Method and operator skill. We also believe that it will lead to basic knowledge for automation and robotization of the Press-in Method in the future.

### ◆ A brief CV of Mr. Kiyoshi Minami

Kiyoshi Minami joined the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Japan in 1978 and conducted surveys and research related to the design and construction of earth structure at the Public Works Research Institute. After that, he was mainly engaged in work related to road construction and management. Currently, he is working to provide guidance on various construction issues in Muramoto Corporation. In addition, he belongs to the Japan Society of Civil Engineers and is involved in research and research on measures for introducing ICT technology to improve productivity and measures for improving the construction management ability of engineers.

# *Messages*
# From New Director

Jignasha Panchal

Technical Manager
Keltbray Piling, UK

I am very privileged to be writing this short piece as a new director of the International Press-in Association (IPA). As Technical Manager of a UK-based piling contractor, my day-to-day work involves solving technical and practical problems associated with piling activities. I am also involved with driving innovation across the business unit to improve on current practices.

Whilst my current position focuses on reinforced concrete pile design and construction, I am passionate about sustainable foundations and recognize the value of exploring alternative solutions. This is demonstrated through my work in leading the research and development of a new piling product, the HIPER® Pile which was launched in the UK in May 2021. The HIPER® Pile has been designed to cut material, and therefore embodied carbon, and optimizes the design and construction of conventional rotary bored piles.

My first encounter with members of the International Press-in Association was during the First International Conference on Press-in Engineering in Kochi, Japan in 2018. I was excited to meet such a wide range of enthusiastic professionals and academics who had a shared passion for improving all aspects of the construction process. I was involved in a number of research projects during my doctoral studies, particularly relating to the use of sheet piles as load bearing foundation options, and presented this work at the ICPE conference in 2018.

GIKEN's "Five Construction Principles" were first published in 1994 and have proven to be well ahead of their time. It is encouraging to see that the rest of the world is beginning to acknowledge that the unit cost of a particular foundation is no longer the only assessment criteria, and that there is now an urgent need for a varied approach to the design and construction of deep foundations.

One particular aspect of the "Five Construction Principles" relates to Environmental Protection which is defined as being construction work that is "free from pollution". We are now realizing that anything left in the ground which no longer has a purpose is considered pollution and is therefore unacceptable. The beauty of pressed-in piles is that they can be removed as easily as they are installed, with minimal impact on the local and wider environment, and can be reused.

I am always keen to explore and develop new, sustainable solutions that reduce the impact on the environment and society, and look forward to serving as a director of the IPA to collaborate with like-minded individuals, and develop new and exciting technologies that can be deployed worldwide to improve construction practice.

## *A brief CV of Dr. Jignasha Panchal*

Jignasha Panchal is Technical Manager at Keltbray Piling, a UK based piling contractor, and an honorary research fellow at City, University of London, where she completed her PhD in 2018. Her research interests are focused on sustainability in construction, ground movements associated with deep excavations in soft soils, improving pile capacity and physical modelling. Jignasha is the Lead Project Manager on a highly innovative research and development project and delivered a new piling product, the HIPER® Pile, earlier this year. Her knowledge of industry practice, and understanding of academic research, have allowed her to close the gap between blue-sky novel ideas and bring them to market.

# *Messages*
# From the New Director

Gülin Yetginer

Leading Advisor
Offshore Geotechnics, Equinor AS

I have been fortunate to start my professional life working with Press-in piling in Kochi back in 2001, which was part of my Master's Thesis and part of a long-term collaboration initiative between GIKEN LTD. and University of Cambridge in the UK. The maintained pile load testing I was conducting in Kochi at that time has been fundamental in my subsequent career decisions in two distinct ways:

Firstly, it led me into offshore geotechnics. This was initially characterized by extensive periods offshore with assignments primarily in the North Sea but also internationally, followed by consultancy and design experience and eventually led me into joining a broad energy company, Equinor, with focus on offshore design and operations. In Equinor I have been working with both old (upstream) and new (offshore wind) projects and have represented Equinor's interests as their Technical Authority / Leading Advisor within offshore geotechnics.

Secondly, I was fortunate enough to publish the findings of the maintained load tests from Kochi in a conference of the British Geotechnical Association in 2003 and subsequently in Geotechnique in 2004. This strengthened my academic roots and ensured my continued focus on the importance of publication and collaboration within the geotechnical community. This experience also formed the basis for my involvement in international standardization work: I am currently leading the Technical Panel focusing on marine soil investigations and an active member of API GEO / ISO WG10 committees specializing on foundation design requirements, as well as ISO WG7 specializing in jack-up operations and site-specific assessments.

Some of the more recent research and project activities that I have been involved in are published as a keynote paper in the 4$^{th}$ International Symposium on Frontiers in Offshore Geotechnics in 2020, titled "Bridging Knowledge between Old and New Energy Projects", building on the experience I have acquired since joining Statoil / Equinor.

I would like to thank you very much for welcoming me onboard to IPA. This appointment very much feels like going back to my roots and I truly look forward to my involvement in the Association.

## *A brief CV of Ms. Gülin Yetginer*

Gülin Yetginer is a chartered civil engineer (CEng) with close to 20 years of experience within offshore geotechnics. She started her career working for a geotechnical drilling contractor, Fugro, where she gained extensive offshore experience internationally. She was then employed by RPS Energy, a consultancy firm in the UK, as a manager with full technical and commercial responsibility for their offshore geotechnics team.

After working 10 years in the UK, she joined Equinor (formerly Statoil) in 2012 and has since been supporting various projects within old and new energy.

*Special Contribution*

# Long-term response of piled foundations to sustained load

Bengt H. Fellenius, Dr.Tech. P.Eng.

Consulting Engineer, Sidney, B.C., Canada

## 1. INTRODUCTION

I am always glad to have an opportunity to present one of my favorite topics, i.e., piled foundations. Particularly now to the IPA readership because I have benefitted so much from Japanese research as presented in milestone case history papers such as by Endo et al. (1969), Inoue et al. (1977), Okabe (1977), Kakurai et al. (1987), Kusakabe et al. (1992), and Yamashita et al. (2011, 2012, 2013), emphasizing full-scale observations on response of actual foundations. Few other countries have given this topic as much thought and provided as much insight.

Piled foundations are usually employed to transfer load through a soft and compressible soil to a competent soil at some depth, combining shaft and toe resistances. When the design relies on shaft-bearing, the piles are invariably long. Whether the project comprises single piles or pile groups, the geotechnical design practice usually aims to ensure a safety against failure of the single pile (ULS design), employing a variety of definitions of what constitutes failure or "capacity". The potential for long-term settlement is rarely considered, however. It seems to be that if the safety factor (or resistance factor) is adequate, then, there is no settlement issue, which, while often true, can be very painful when not.

Normally, the soft soil surrounding the piles will compress over time and settle, developing downdrag that could result in an unacceptable increase the settlement of a piled foundation. Practice and many uninformed codes, attempt to resolve this issue by estimating the associated drag force that is then included as a load together with the sustained load from the structure—very costly approach and yet not always safe.

A pile group can be made up of many single piles, or bents of two or three piles spaced at large distances in terms of pile diameter, say, larger than 15 diameters. At that spacing, there will be minimal interaction between the piles. A group with a common raft supported on such widely spaced piles is rare.

Piled foundations can be supported on single piles and groups of piles, small (narrow) or wide. Single piles or small bent of a few piles can be considered to have no or minimal mutual interference, whereas piles in larger groups do interact. The response of narrow groups is dominated by the response of the perimeter piles, acting similarly to single piles. The response of wide groups is dominated by the interior piles and the raft rigidity. Both narrow and wide groups are also affected by the response of the soil below the pile toe level.

This article addresses the issues for single pile, narrow pile groups, and wide pile groups in terms of settlement. Due to limits of space, bearing issues are not included. However, bearing is the less important issue for a design, because if the settlement is adequate, bearing is usually also well at hand. The opposite is not always true, however.

## 2. FOUNDATIONS ON A SINGLE PILE

A settlement analysis of a piled foundation begins with determining the distribution of axial force in the pile after applying a load, the sustained (dead) load, making use of the available information on the piles, the soil, and, as is often needed, results of an instrumented static loading test. When the load from the supported structure is placed on the pile, the pile moves down a small distance, which movement generates positive shaft resistance and, eventually, also pile-toe resistance. Functions describing the shaft and toe resistances vs. movement are called t-z and q-z functions, respectively. Fig. 1 shows typical such functions. The functions can have display quite an array of force-movements, depending on soil type and soil response. In the figure, all curves have been normalized to show both movement and force to go through a common point, "Target Point". The principles of the functions is that a single function coefficient determines the shape of the selected function before and after the Target Point (Fellenius 2021).

The t-z functions can range from strain-softening to strain-hardening. Usually, the shaft resistance response is assumed to be elastic- plastic similar to the vander Veen function. Often the response is hyperbolic (Vijayvergiya; Chin-Kondner), i.e., initially steep and then gently increasing and sometimes, the shaft resistance reduces (softens) with increasing movement Hansen; Zhang). The q-z function, is almost always strain-hardening and most often best simulated as a

Gwizdala function. The pile toe is not engaged until all elements have mobilized significant shaft resistance. Once pile toe element is mobilized, all or most additionally applied load is conveyed to the pile toe.

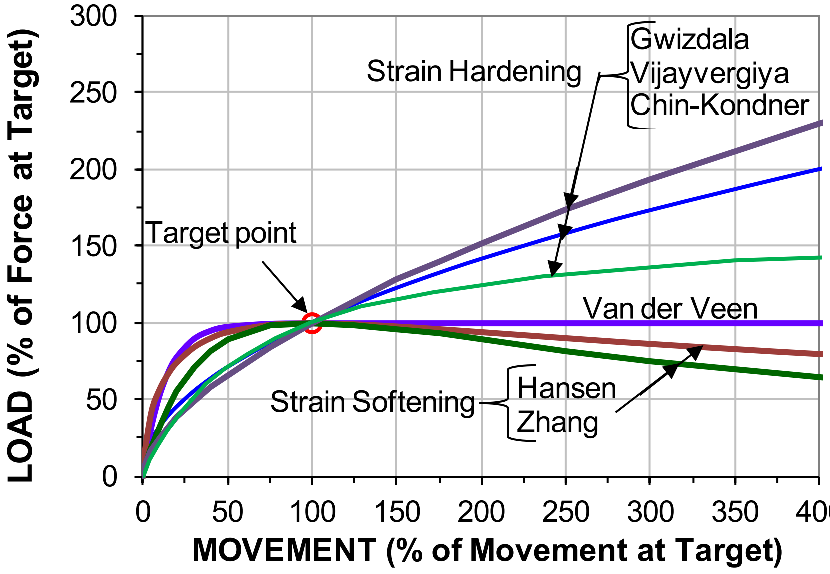


Fig. 1. Typical t-z and q-z function curves

Fig. 2A shows distributions of axial force for a series of applied loads to 30 m long pile installed in a two-layer soil deposit (Fellenius 2021). The portion of the applied load reaching the pile toe, i.e., the toe resistance ($R_t$), is indicated at the pile toe. The dotted force curve starting from an assumed sustained load, $Q_d$, indicates axial force that increases with depth due to accumulated negative skin friction. Each intersection of the latter curve with a force distribution curve is a potential force equilibrium—neutral plane (first observed in full-scale tests by Johannessen and Bjerrum 1965 and Endo et al. 1969). A horizontal line is drawn from each intersection.

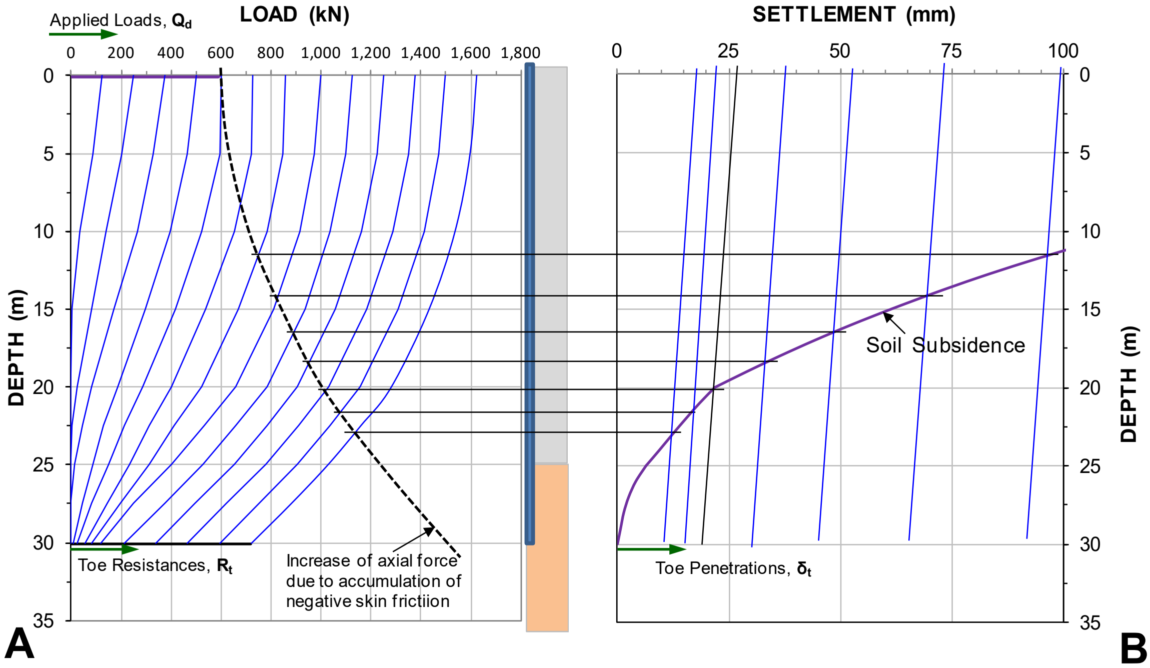


Fig. 2. Distributions of pile-force, pile-settlement, and soil subsidence

Fig. 2B shows the horizontal lines from the potential force equilibriums intersecting with the expected long-term settlement distribution ("soil subsidence") curve. Each such intersection indicates a potential settlement equilibrium, i.e., depth where the settlement of the pile is equal to the settlement of the soil, with the sloping straight line representing the pile compression and its value at the pile toe level and at the pile head level indicating the pile toe movement ($\delta_t$) and corresponding pile head settlement, respectively.

A force equilibrium can only occur where there is no movement between the pile and the soil, i.e., the settlement of the pile is equal to the settlement of the soil and it is, therefore, the settlement equilibrium. The figure shows an infinite number of force and settlement equilibriums. Only one of these equilibriums is true and it is that for which the toe force in Fig. 2A is the toe force that results in the pile-toe movement shown in Fig. 2B, that is, the q-z relation is satisfied. The depth for which this is satisfied is called the Neutral Plane.

Fig. 3 uses a graphical procedure to illustrate the principles of the unified design analysis according to Fellenius (1984; 1988; 2016; 2021). The method is easily computerized, e.g., UniPile by Goudreault and Fellenius (2014). The graphical process is to, first, in a diagram of force versus depth (Fig. 3A), draw a force distribution curve downward from the pile head, starting with the applied sustained load and increasing with the load due to negative skin friction accumulated along the entire length of the pile—the dotted curve. Second, a series of force distribution curve is drawn upward from a couple of potential pile toe forces, showing the axial force increasing with accumulated positive shaft resistance. Each intersection of the downward increasing force distribution curve and an upward increasing curve is a force equilibrium and a potential neutral plane. Third, the soil subsidence is plotted in a diagram of settlement versus depth (Fig. 3B). The condition for a potential neutral plane to be correct is that the "Loop" shown in Fig. 3, satisfies the q-z relation for the pile. The 'satisfying' "Loop" starts at a pile toe force, rises to intersect with the downward force distribution, proceeds horizontally to intersect with the subsidence curve, goes downward to the pile toe, indicating a pile toe penetration that matches the force per the q-z relation. The settlement indicated at the pile head is the downdrag for the pile under the loading conditions and the double-arrow indicates the associated drag force, $Q_d$. The drag force is of no concern for the response of the piled foundation and only of concern in regard to the structural strength of the pile. The transfer from negative skin friction to positive shaft resistance occurs gradually in a transition zone that reduces the magnitude of the drag force is not shown in the figure. N.B., the unified method required that all forces are unfactored.

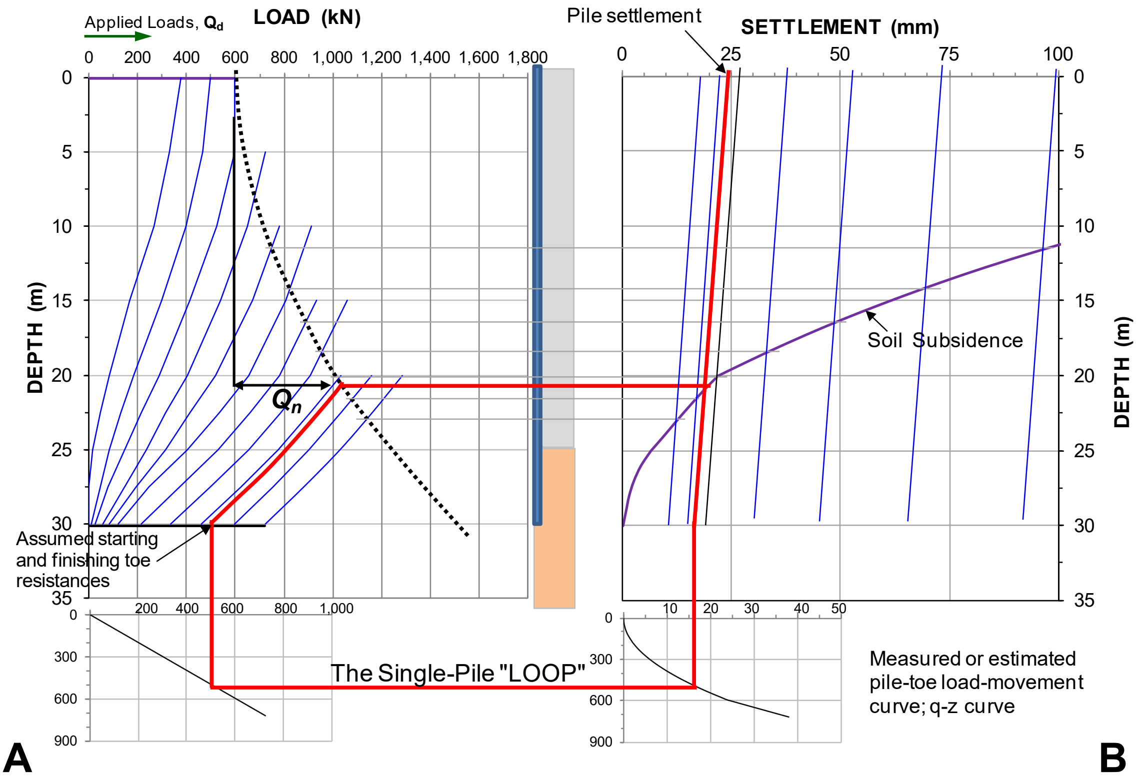


Fig. 3. Loop" determining the depth to the neutral plane and the downdrag

## 3. NARROW PILE GROUP

As load is applied to a piled foundation on a narrow pile group, settlement will first develop as the load is transferred to the soil. This "load-transfer movement" comprises pile axial compression and pile toe movement if a part of load reaches the pile toe. The pile toe movement is governed by the particular q-z relation for the soil at the pile toe level. Additional settlement will be caused by the soil compression (consolidation) due to the increased stress below the pile toe level. To calculate the settlement of a pile group, Terzaghi and Peck (1948; 1967) proposed that the load carried by a pile raft be assumed transferred to the soil through an equivalent raft of the same size as the raft, loaded by the same stress, and located at the lower third-point of the pile embedment depth. The settlement calculation for the equivalent raft would then be per conventional methods for settlement analysis. Actually, because the applied load starts to be distributed to the soil at the neutral plane, rather than being located at the lower third-point, the equivalent raft should be at the neutral plane. (In the long-term, a neutral plane will always develop). However, as originally proposed, the method disregards the fact that the piles enhance the compressibility of the soil between the equivalent footing and the pile toe level (the piles and soil act as a pier with a combined stiffness), which greatly reduces the settlement in this zone. Therefore, the design can just as well place the equivalent raft at the pile toe level.

The Terzaghi-Peck method usually results in settlement values that greatly overestimate the actual values. For pile groups comprising a small number of piles, no more than four rows, i.e., narrow groups, more realistic settlement values result from adjusting the equivalent raft to a larger width in recognition of the load shedding due to the shaft resistance between the neutral plane and the pile toe level. Fellenius (2021) proposed that the equivalent raft at the pile toe be widened by lines sloping 5(V):(1(H) from the neutral plane as indicated in Fig. 4.

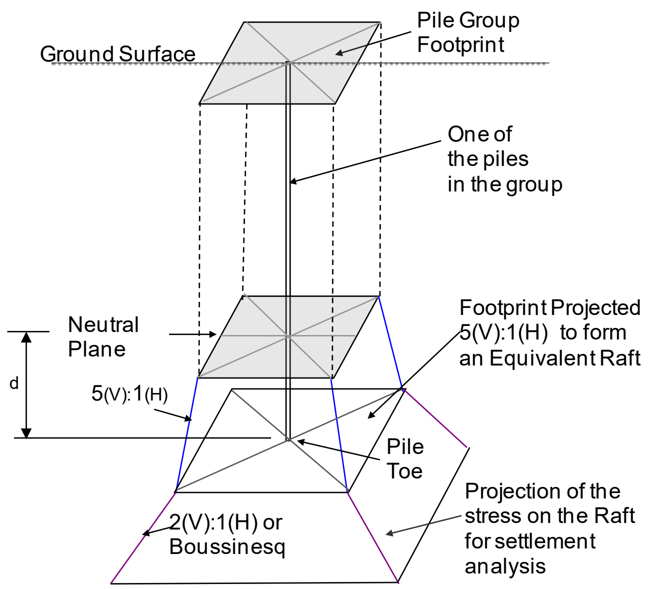


Fig. 4. Widening of the equivalent raft for a narrow group of piles

Note, that the compressibility (stiffness) of the pile-soil pier needs to be proportioned between the pile and soil E moduli and respective areas to that of an $AE_{pier}$. Moreover, the stress changes due to fill, adjacent foundations, and/or changes of pore pressure must be included in the settlement calculations.

## 4. WIDE PILED FOUNDATIONS

4.1 Contact Stress

It is common to design a pile group as equal to the same number of single piles with the average bearing reduced by an "efficiency coefficient", smaller than unity, defined as the ratio of the group bearing to the sum of the bearing of the individual piles. This approach originates in the fact that a group of piles will sometimes induce appreciable settlement in the soil below the pile toe level while single piles do not. Thus, at equal load per pile, the group will settle more than the singe pile. The "group efficiency" approach attempts to adjust to this fact. Yet, the bearing of a single pile within the group is about the same as that of a single pile outside the group. Moreover, the "group efficiency" approach only applies to small and narrow groups. For large and wide groups, a group bearing concept is not realistic. The response of a pile group to an applied load, be it small or large, narrow or wide, has to be analyzed in terms of settlement.

That the contact stress below a piled raft cast on the ground in-between the interior piles would contribute to the bearing of the raft is a widespread fallacy. However, just like the stress distribution between rebars and the concrete in a reinforced concrete column, the distribution of the raft load to the piles ("rebars") and to soil ("concrete"), respectively, is according the principle of strain compatibility per the E moduli of the piles and soil and the areas of pile and soil. That is, the force in the piles and in the soil will be according to each total area and E modulus, the strain, $\epsilon$, being equal for the soil and pile. Groups comprising closely spaced piles will have smaller total contact load as opposed to groups with widely spaced piles. This is because the free soil area, $A_{soil}$, is smaller where piles are closely spaced and the load $E_{soil} A_{soil} \epsilon$ will be large in relation to the total load carried by the piles, $E_{pile} A_{pile} \epsilon$ (Auxilia 2009, Yamashita 2011; 2012; 2013).

Moreover, while the E-modulus of the concrete does not change with depth, the E-modulus of the soil will likely differ between the various soil layers. Therefore, the contact stress (by definition immediately under the raft) can be large when the soil is here engineered backfill with an E-modulus much larger than the natural soil. If spacing is wide, the free soil area, $A_{soil}$, will be large, and, consequently, the contact load will be large. Down in a soft soil layer with a small $E_{soil}$, the force in the soil will be smaller and the axial force in the piles will be correspondingly larger than just below the pile head. This is independent on whether the total area of the piled foundation and the total area of the piles, the Footprint Ratio, is small or large.

4.2 Perimeter versus Interior Piles

Hansbo (1984; 1993) and Hansbo and Jendeby (1998) reported a case history of long-term response of two adjacent four-storey buildings in Göteborg, Sweden, supported on 300 mm diameter piles, driven to 28 m depth in a thick deposit of soft clay. One building was constructed on a grillage of beams (contact area was not reported) and the other on a raft. The nominal total average load over each building footprint corresponded to 66 kPa and 60 kPa, respectively—very similar values. The as-designed average axial working loads were 220 kN and 520 kN/pile, respectively—quite different values. The conservatively estimated pile "capacity" is stated to have been 330 kN. At the end of construction, measured pile loads were about 150 and 300 kN/pile, respectively, again, quite different values. As shown in Fig. 5, the measurements also showed that the buildings settled on average a very similar amount, about 40 mm, over a 13 year period. The equivalent-pier shortening was smaller for Building 1, reflecting its smaller average pile load (and, larger pier stiffness, EA/L), but because of its larger average stress across the footprint, this difference was compensated by the settlement below the pile toe level being larger.

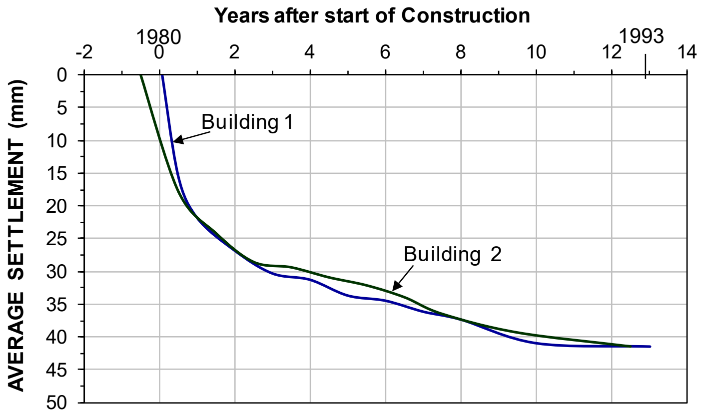


Fig. 5. Settlement measured for the two buildings over 13 years

The analogy between a pile group and a concrete column is only applicable to interior piles in a group, not to perimeter piles (side piles or corner piles) because the perimeter piles are surrounded by soil, whereas the concrete column is free standing. An interior pile is a pile having at least one row or column of piles between itself and the raft perimeter.

The strain compatibility principle, i.e., that the strain is the same in the pile and soil, means that the applied load causes no relative movement between the pile surface and the soil in the interior of a pile group. Thus, there is no shaft resistance along the interior piles and the latter piles will transfer their full share of the load to the pile toe. This is similar to absence of shear force between rebars and concrete due to the applied load in the reinforced concrete column. (The toe response is addressed below). In contrast, the perimeter piles will shed load due to shaft resistance. Obviously, the response of interior versus perimeter piles will be insignificant in a 3 by 3 group of piles: 8 perimeter piles versus 1 interior pile. Similarly, a 4 by 4 group will have 12 versus 4 piles and a 5 by 5 group will have 14 versus 9 piles. A design of a pile group, must therefore differ between narrow group (groups with four or fewer rows of piles) and wide groups (groups of five or more rows).

Thus, the response of a wide piled foundation, differs from that of a single pile or a narrow piled foundation. The response of a perimeter pile, i.e., the outermost row—sometimes, also the next row—is similar to that of a single pile or a pile in a narrow group. However, for interior piles, the response is quite different.

The mentioned difference was first observed by Okabe (1977) when measuring axial force distribution in interior and perimeter piles over 4.5 years and comparing the records to that of a single pile nearby (Fig. 6). The site was subjected to general subsidence due to water mining that developed negative skin friction and significant drag force in the single pile. Measurements of axial force in the perimeter pile showed it to have a drag force about equal to the single pile. However, the interior piles were neither affected by negative skin friction nor by positive shaft resistance.

As first stated by Franke (1991), when load is applied to a group of piles, the shaft resistance on interior piles is not mobilized the way it is in a single pile, from the head downward, but from the toe to upward. The statement means that for an interior pile, in contrast to a perimeter pile, the transfer of the load applied to the raft to the soil is unaffected by shaft resistance. For a flexible raft and uniformly distributed load, therefore, both the compression and pile toe penetration will be larger for an interior pile than for a perimeter pile. However, because perimeter piles are affected by shaft resistance starting at the ground surface, their response is stiffer than that of the interior piles; in case of a rigid raft, the perimeter piles will receive a larger portion of the sustained load as opposed to the interior piles. The following analysis illustrates the concept, which is independent of the bending rigidity of the raft, i.e., it applies to both flexible and rigid rafts.

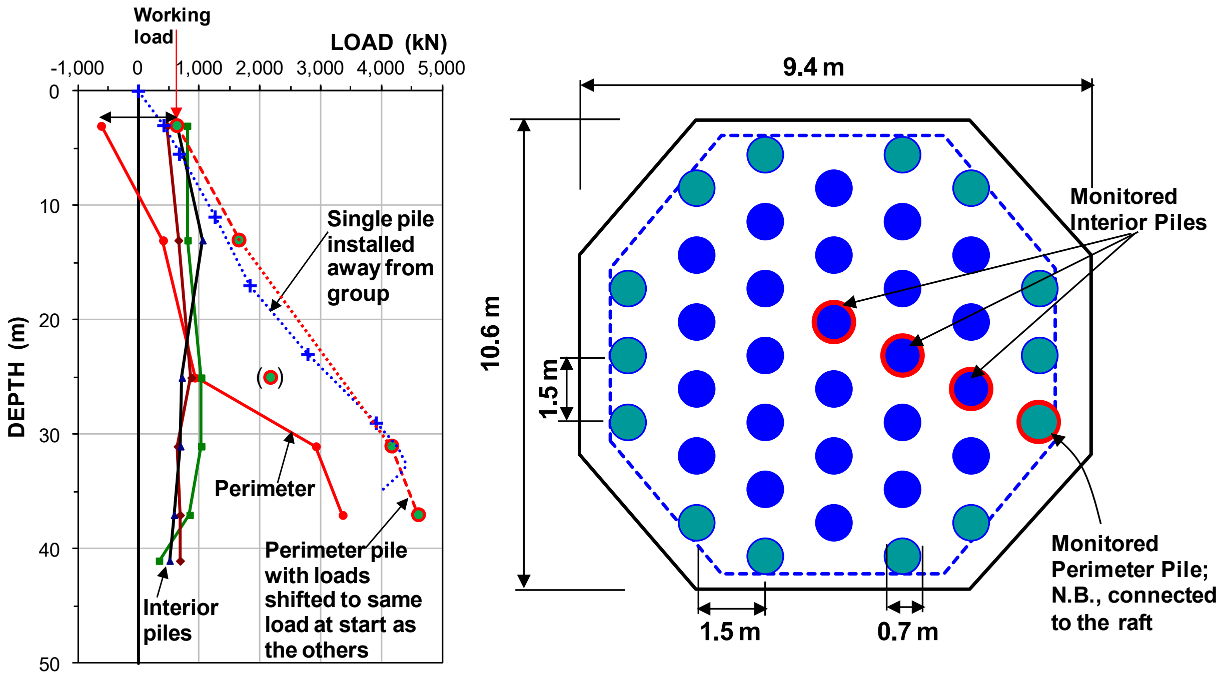


Fig. 6. Axial pile loads measured 4.5 years after construction (Okabe 1977)

As the load reaches the pile toe level, the pile toe moves down, which is the same mechanism as when pushing the soil upward starting at the pile toe level. The distance the pile toe moves into the soil is equal to a soil compression—largest at the pile toe level (equal to the pile toe penetration) and diminishing upward along the pile. The process generates shaft resistance in the zone immediately above the pile toe, which reduces the force reaching the pile toe. The pile toe response depends on the pile toe soil stiffness (load-penetration relations, i.e., the particular q-z function).

The foregoing is the "Franke principle": the response of an interior pile follows the requirement that the toe penetration and force resulting from an applied load is coupled to the particular q-z function for the toe condition and t-z function for the shaft resistance immediately above the pile toe. Moreover, the movement between the pile and the soil diminishes over a distance up from the pile toe to where there is no more relative movement. A shaft resistance will develop along this length of pile, but above this length, or zone, there is no more shaft resistance along the interior pile.

The principles are illustrated in the following hypothetical example comprising a wide piled-raft foundation supported on 355 mm diameter, round concrete piles at a three-diameter spacing in a square grid and constructed to 22 m depth in a soft soil transitioning to a dense sand at 20 m depth. A small fill placed across the area outside the foundation footprint will result in about 25 mm long-term subsidence at the site. The applied unfactored sustained load is 800 kN/pile. The live load is 200 kN/pile. Fig. 7A illustrates the analysis procedure for determining where the toe movement for the toe force is equal to the upward movement (compression) of the soil in-between the piles. According to the Franke principle, the so-determined shaft resistance is equal to the balance between the toe force and the applied load. The blue curve shows the pile toe resistance versus toe movement, the q-z curve, as determined in a test or by 'informed' analysis. The burgundy curve shows the applied load subtracted by the shaft resistance engaged upward from the pile toe plotted against the pile toe movement—this curve can be obtained in a bidirectional static loading test, real or simulated as shown in Fig. 7B with the bidirectional cell placed right at the pile toe (beyond about 500 kN, the downward curve is extrapolated).

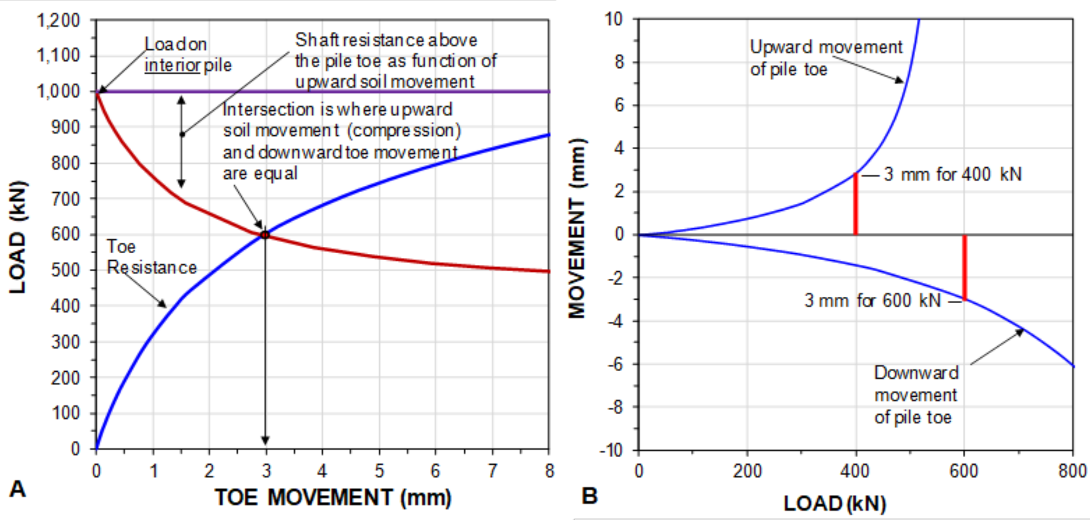


Fig. 7. The process for determining the load-transfer toe-movement and toe-force for interior piles

A raft can be either rigid or flexible (and anything in between). Fig. 8 shows load-movement response for a perimeter pile and an interior pile. For a certain total pile load applied to the raft, if the raft is rigid, the pile head movements are equal for all piles. Then, because the shaft resistance for a perimeter pile develops from the raft level, the response of the perimeter pile is stiffer than that of the interior piles and, therefore, the load at the head of the perimeter pile will be larger than that of the interior pile. If the raft is flexible, the loads will be equal, and, because of the response of the perimeter pile is stiffer, its movement will be smaller than that of the interior pile. (The movements do not include the effect of the settlement below the pile toe level). As a raft is never totally rigid or totally flexible, the actual load of any case will be somewhere in-between the extremes, as the red circles indicate in the figure.

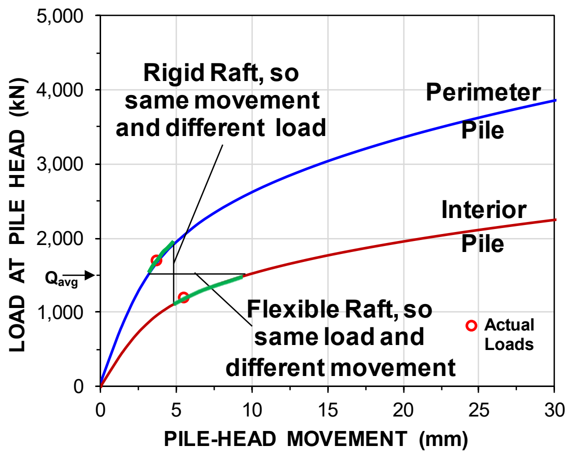


Fig. 8. Comparison of load distribution for a perimeter pile and an interior pile in a wide pile group.

Of the perimeter piles, the corner pile has the maximum exposure to the shaft resistance development. Therefore, it can be expected that the corner pile will, at first, take on larger load from the superstructure. Then, in the long-term, as the surrounding soil consolidates and settles, negative skin friction will reduce the shaft resistance and make the perimeter piles appear to become softer, thus, the load will be transferred to the interior pile develop Fig. 9 shows full-scale measurements by Mandolini et al. (2005) and Russo and Viggiani (1995) illustrating the latter development.

4.3 Settlement below the pile toe level

Be the spacing or the contact stress large or small, the response of the piled raft is compression of the pier system (piles and soil) plus settlement of the soil below the pile toe level. The compression of the pier system is determined by $E_{pier}$, the combined E-moduli ($E_{pile}$ and $E_{soil}$) in relation to the respective areas of piles and soil (Fellenius 2016; 2021). The settlement of the soil below the pile toe level can be calculated as that of an equivalent raft at the pile toe level loaded by the same stress as applied to the foundation raft, as shown in Fig. 10. Note, the analysis must include the influence of stress changes due to other foundations, fills, excavations, and changes of groundwater table.

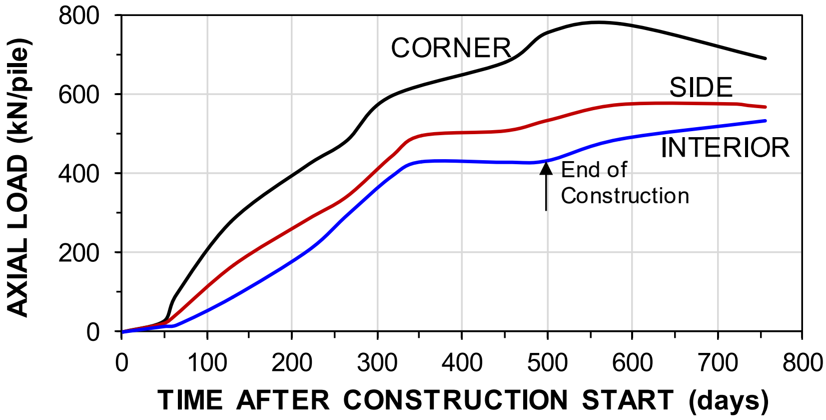


Fig. 9. Measured axial load during and after construction (data from Russo and Viggiani 1995)

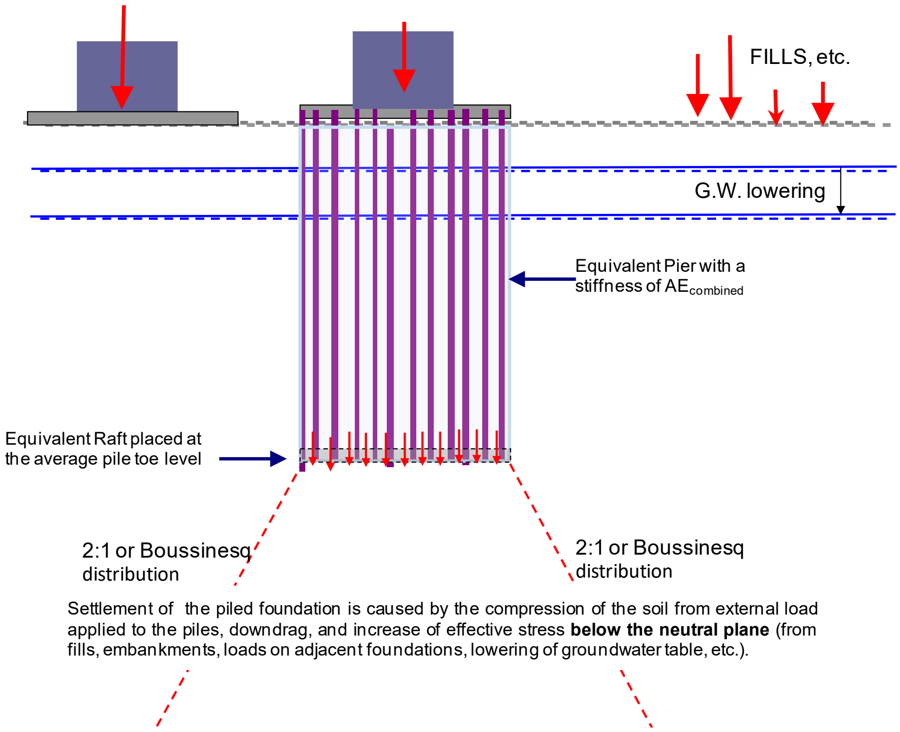


Fig. 10. The equivalent raft for calculation of settlement below the pile toe level

## 5. CLOSURE

Designing a piled foundation based on the concept of capacity is fraught with much uncertainty. The design should instead emphasize settlement. N.B., with due recognition of the difference in response between narrow and wide pile groups and between interior and perimeter piles. The settlement analysis is particularly important for piles in subsiding soil.

## 6. REFERENCES

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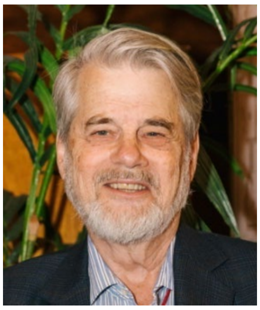
## ◆ A brief CV of Dr. Bengt H. Fellenius



Fellenius obtained his M.Sc. (1962) and a Doctor of Technology (1972) from the Royal Institute of Technology in Stockholm. He has nearly 60 years of consulting engineering experience with foundation design for industrial plants, highway projects, and marine structures as well as special investigations and instrumented field tests. He was Professor of Civil Engineering at the University of Ottawa 1980-2000, where he taught and carried out research centered on site-improvement methods and analysis of single piles and wide pile groups in subsiding soil. He is an internationally active foundation engineering consultant and the author of some 400 technical papers addressing piled foundations, soil improvement, foundation settlement, codes and standards, and in-situ sounding. Dr. Fellenius has given lectures and courses to several universities and international conferences throughout North and South America, Europe, and South-East Asia. He currently lives in Sidney, BC, Canada.

## *Directors' research and development activities*

# Smart Pile, Smart foundation and Smart infrastructure?

Kenichi Soga

Chancellor's Professor, Donald H. McLaughlin Chair in Mineral Engineering
University of California, Berkeley

One of the greatest challenges facing civil engineers in the 21st century is the stewardship of aging infrastructure along with the creation of new infrastructure that society demands. The existing infrastructure requires monitoring and remedial interventions when new infrastructure is created nearby, and the high cost of replacement often leads to a desire to extend the asset's life. Furthermore, existing infrastructure is placed under increased load and usage than they were originally designed. Another challenge is developing response strategies when a catastrophic event occurs (e.g., an earthquake). Infrastructure systems face a multitude of hazards that must be assessed, communicated, and managed appropriately. Future-proofing existing and new infrastructure has become a constant theme in government and industry discussions.

The critical deterioration of civil infrastructure has driven the search for new methods of rehabilitation and repair by incorporating sensors and developing remote systems that would allow monitoring and diagnosis of possible problems occurring. It is envisaged that structures will eventually be able to monitor themselves and inform owners of their state. These smart infrastructures have unusual abilities: they can sense a change in temperature, pressure, or strain; diagnose a problem; and initiate an appropriate action to preserve their integrity and continue to perform their intended functions. Sensors measure the state of the actual ambient conditions. If the sensor signals differ from the nominal conditions, rehabilitation action can be taken. Smart infrastructure, therefore, adapts to changing environments and demands. In geotechnical construction, the performance of geotechnical structures is monitored during construction due to uncertainty in soil-structure interaction. Although monitoring after construction has been limited up to now, the use of low-cost sensors allows us to make a new step toward the development of a 'smart foundation'.

There are several benefits to smart foundation technologies; the most obvious one is the increased safety levels they can provide to cope with adjacent new constructions and natural disasters such as climate change, flood warnings and earthquakes. Furthermore, the data can be used to reduce costs associated with end-of-life structures. The concept of smart foundations allows their performance to be monitored during their working lives. For example, the average working life of a building is about 25-40 years. In urban areas, possible locations for foundations are often constrained by the underground infrastructure. With the ground becoming more congested, there is a significant risk that there will come the point at which there is no room for new foundations, inhibiting new development and reducing economic sustainability. The solution is for a new development to reuse as much of the existing foundations as possible. Reuse also has a considerable environmental benefit as the new development will require fewer raw materials and less disposal of topsoil and have reduced energy consumption during construction. The additional economic benefits of reuse include time savings in the construction process. However, to exploit this technology, there is a need to know how load develops, how it is distributed and what factors need to be understood in unloading structures.

There has been a rapid development in the area of smart infrastructure over the last decade thanks to innovation in sensor/actuator design and fabrication, fiber optics, micro-electro-mechanical sensors (MEMS) and other electronic devices, signal processing and control, and wireless sensors and sensor networks (Soga and Schooling, 2016). For example, structural integration of fiber optic sensing systems represents a new branch of engineering which involves the unique marriage of: fiber optics, optoelectronics and composite material science. Optical fiber sensors have a number of advantages over their electrical counterparts. The transmission of light down an optical fiber is an established technique in optical communications for carrying information and is the primary candidate for resident sensing systems.

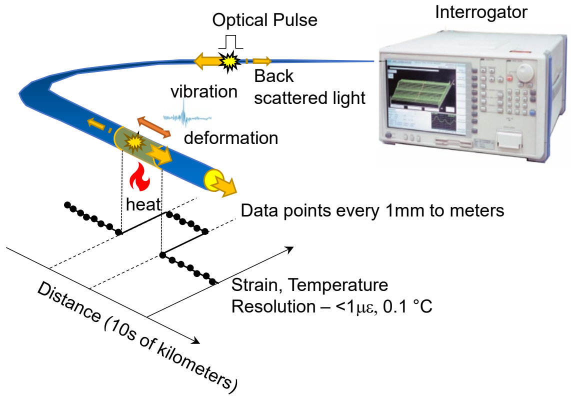
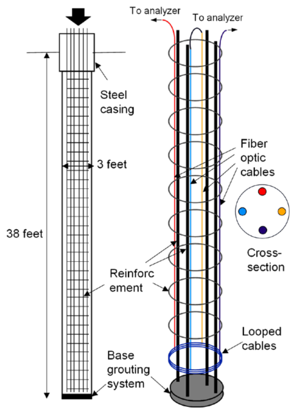



Fig. 1. Distributed fiber optic sensing technology that measures strain/temperature/vibration continuously along the fiber optic sensing cable.

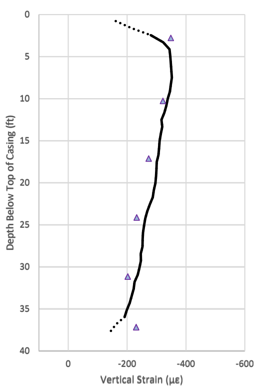
In the past 15 years, our research at the University of Cambridge and the University of California, Berkeley, has focused on investigating the feasibility of distributed fiber optic strain sensing technology in creating smart geotechnical structures. The novel aspect of this technology lies in the fact that tens of kilometers of fiber optic cable can be sensed at once for continuous distributed strain measurement, as shown in Fig. 1. The system utilizes standard low-cost fiber optic cables and the strain resolution can go down to 2 micro strains. The sensing material itself (silica) is relatively inert and can be ideal for long-term monitoring of many decades by embedding the fiber optic cable inside structures. The distributed measurement nature of this technology clearly differentiates it from the other discrete point-wise strain measurement technologies. Such features can potentially provide a relatively cheap but highly effective monitoring system for both the short and long term. Further details of the technology can be found in Kechavarzi et al. (2016) and Soga and Luo (2018).

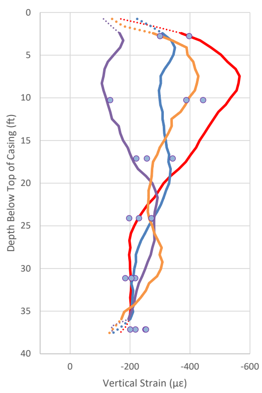
Fig. 2 shows an example of strain measurements made on a 38 feet (11.6 m) long concrete test pile. The diameter is 3 feet (0.9 m). The aim of the project was to examine the effect of different base grouting methods on pile performance and a series of pile loading tests was conducted for the investigation. The pile had conventional vibration wire strain gauges (VWSGs) at six levels, and each level had four strain gauges, providing a total of 24 strain datasets with 24 cables coming out from the instrumented pile. Four distributed fiber optic strain sensing (DFOS) cables were also installed longitudinally next to the strain gauges, as shown in Fig. 2(a). The DFOS analyzer provided strain data every 0.25 m along the cables, giving a total of 180 datasets from the four cables coming out of the pile. Fig. 2(c) shows the strain data recorded from the two measurement systems when a vertical load of 7.8MN was applied. The strain data at each level are the average value of the four strain values, and the two data sets match well, providing confidence in both datasets. Moreover, the 'almost' continuous strain data from the DFOS system gives a clear trend of a gradual decrease in strain with depth. And the gradient of the strain profile at each location is related to the shaft friction developing at that location. Instead of plotting the averaged data, Fig. 2(d) shows the actual strain data of 24 VWSGs and the 4 DFOS cables. At a given level, VWSG data are scattered. If only such data were to be provided, a data interpreter would start wondering whether some of the data are true or not. The DFOS data, on the other hand, show apparent variation in strain profile among different positions of the pile. There is a significant strain difference between the red and purple lines, indicating that the pile is actually bending. By examining the datasets carefully, one will note that the bending changes its direction from the upper section to the lower section. The DFOS data gives a clearer picture of the soil-pile interaction behavior and, in this case, a picture beyond what we conventionally think when designing a vertically loaded pile (i.e., no bending).




(a) Instrumented pile

(b) photo of pile installation

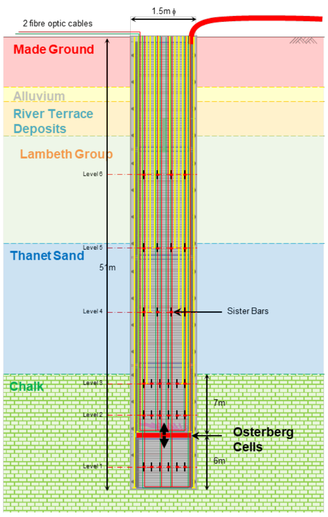



(d) Averaged data (triangles – VWSG, Line - DFOS) (c) Actual data sets (circles – VWSG, Lines- DFOS)

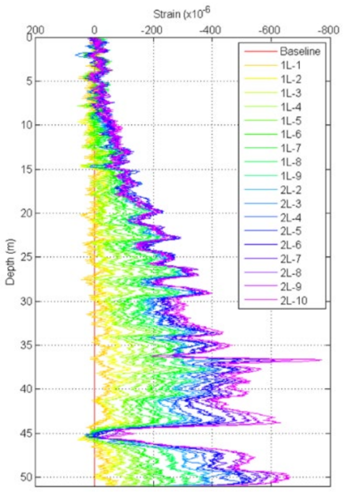
Fig. 2. Load testing of a base grouted pile

Fig. 3 shows another data set of a concrete pile loading test. The length of the pile is 51 m, whereas the diameter is 1.5 m. The loading was applied using a bi-directional Osterberg cell installed at 6 m above the pile bottom, as shown in Fig. 3(a). Again, four DFOS cables were installed in the longitudinal direction. Fig. 3(c) shows the variation in the averaged strain profile at different loads applied by the load cell. The strain is the largest at the load cell location and decreases to zero at the ground surface, indicating the development of shaft friction. As the applied load increases (yellow, green, blue and then to purple lines in the figure), the strain gradient increases, which in turn indicates mobilization of shaft friction with applied load. Pelecanos et al. (2017) analyzed this dataset and derived the t-z relations of different soil layers as shown in Fig. 3(d). Such field-derived soil-pipe interaction relations can be useful for future pile designs in similar ground conditions (Pelecanos et al., 2018). Compared to the smooth trend in strain data shown in Figs. 2(c) and (d), the strain profiles (data every 0.05 m and hence about 1000 data points per line) shown in Fig. 3(c) are very much fluctuating. When each DFOS data at a given load (25.7MN) are plotted, the locations of the variations are very similar among the four cable datasets, as shown in Fig. 3(e). This suggests that the variations recorded are real and not due to the errors of the measurement system. The instrumented pile also had DFOS temperature cables installed next to the strain cables and change in temperature was measured during the curing process of the concrete immediately after Tremie pour. Thermal integrity testing of the installed pile was conducted, and the temperature data was used to estimate the shape of the pile, as shown in Fig. 3(f) (Rui et al., 2016). The spatial variation in pile shape can be linked to the strain variation shown in Fig. 3(c) and the t-z curves shown in Fig. 3(d).

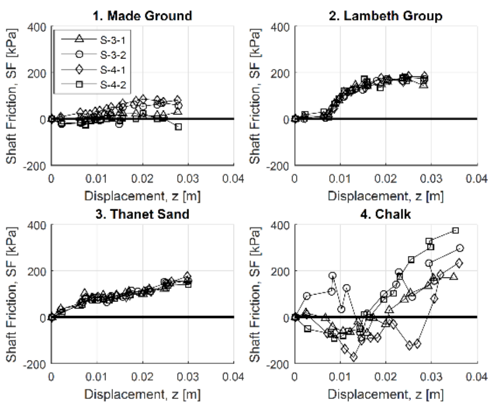



(a) DFOS Instrumented pile

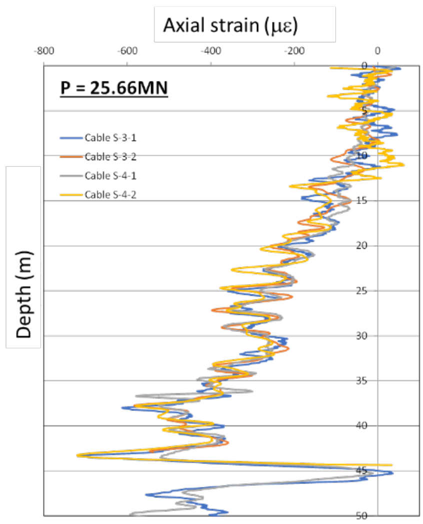
(b) Photo of pile installation



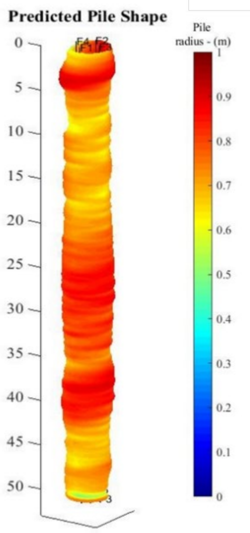

(c) DFOS strain profiles at different loads




(d) Derived t-z curves from DFOS data




(e) Strain profiles from four cables




(f) Estimated pile shape

Fig. 3. Load testing of a large diameter long pile

Design limits are frequently based on strain developing in the structure. Although strain measurement is well established, current practice has until recently been restricted to the measurement of point-wise strains by means of vibrating wire (VWSG) or metal foil strain gauges. When instrumenting building components such as columns or beams where the strain distribution is merely a function of the end conditions and applied loading, point sensors can be suitable to define the complete strain profile. However, where structures interact with soil, (e.g., underground infrastructure such as foundations, tunnels or pipelines) or indeed in the case of a soil structure (dam or embankments), the state of the structure is not fully understood unless the complete in situ strain regime is known. In the context of monitoring strain in piled foundations, capturing the continuous strain profile cab be invaluable to pinpoint localized problem areas such as joint rotations, deformations and non-uniformly distributed soil-structure interaction loads.

The case studies presented in this note show possible application of DFOS technology for smart piles (i) to conduct quality control/assessment of pile installation (e.g., a sensor embedded pile communicating with construction machine during installation), (ii) to measure the actual pile performance (axial and bending) during actual loading from a building or the surrounding soil and (iii) to future proof the pile against a future hazard such as earthquake or nearby construction. Such initiative can potentially lead to making a step-change in the civil engineering industry by providing innovative solutions to realize smart foundation systems that has 'intelligence for life'.

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## ◆ A brief CV of Prof. Kenichi Soga

Kenichi Soga is the Donald H. McLaughlin Professor and a Chancellor's Professor at the University of California, Berkeley. He is also a faculty scientist at Lawrence Berkeley National Laboratory. He obtained his BEng and MEng from Kyoto University in Japan and PhD from the University of California at Berkeley. He was Professor of Civil Engineering at the University of Cambridge before joining UC Berkeley in 2016. His current research activities are infrastructure sensing, performance based design and maintenance of infrastructure, energy geotechnics, and geomechanics. He is a Fellow of the UK Royal Academy of Engineering, the Institution of Civil Engineers (ICE) and American Society of Civil Engineers (ASCE). He is a Bakar Fellow of UC Berkeley, promoting commercialization of smart infrastructure technologies.

IPA News Letter Volume 6, Issue 2 June 2021

*Case-History*

# Rapidly Increasing Press-in Piling Projects in New York Metropolitan Area (Part 2)

Takefumi Takuma

GIKEN LTD., c/o Giken America Corporation

Masashi Nagano

Giken America Corporation

## INTRODUCTION

In March 2019, the Giken America Corporation, a U.S. subsidiary of GIKEN LTD., opened a New York City office as its new headquarters in the Americas with a goal to focus on the most populous region of North America. This article will be discussing the press-in piling projects along the Gowanus Canal in the Borough of Brooklyn as part of GIKEN's recent achievements in the New York Metro region.

## GOWANUS CANAL – EPA (ENVIRONMENTAL PROTECTION AGENCY) SUPERVISED CLEANUP SITE

The Gowanus Canal is a 2.9km long and 30m wide canal located in the industrial zone of Brooklyn which discharges into the New York Harbor. It was built in the mid-1800s for the purpose of industrial transportation. Since the mid-20$^{th}$ century, however, the cargo volume drastically decreased with the main mode of domestic cargo transportation taken over by trucking. Manufactured gas plants, paper mills, tanneries, and other chemical plants on the sides of the canal operated and discharged their waste water into it. That in combination with the overflow of surface water and untreated sewage made the canal one of the most contaminated water bodies in the United States. High levels of toxic chemical compounds, fecal coliforms, and heavy metals including mercury, lead, and copper were found. Due to its proximity to Manhattan and the high-end residential neighborhoods in Brooklyn, the area near the canal started to experience rapid gentrification, prompting the canal's environmental cleanup. The EPA listed it on the National Priority List of Superfund sites (Federally supervised priority environmental cleanup sites) in 2010 and the cleanup preparation work started in 2013. Fig. 1 shows the general location of the canal in the boroughs of New York City and Fig. 2 shows an aerial photograph of the canal and the surrounding urban areas.


Fig.1. Location of Gowanus Canal in Brooklyn, New York


Fig. 2. Aerial View of Gowanus Canal (Google Map)

The cleanup scope of work involves the dredging of approximately 450,000 cubic meters of highly contaminated sediment, placement of clean soil material and its capping, and construction of retention tanks to reduce the discharges from combined sewer outfalls. In addition, the deteriorated bulkheads facing the canal have to be reconstructed at many locations at the expenses of the landside property owners before dredging. The pilot work was started at the 4th Street Turning Basin in 2016.

## USE OF PRESS-IN PILING

In 2018, as part of the bulkhead reconstruction of the pilot work, press-in piling was added for testing after the use of a vibratory hammer had caused major ground settlement and resultant closure of the promenade of a high-end supermarket. The one-month-long press-in piling test for the total wall length of 273m exhibited much less noise, vibration, and settlement; satisfying most of the project requirements. Following the test result, the first full-scale segment of the Gowanus Canal remediation project at the Municipal Works Former MGP Site specified press-in piling for sheet pile installation. The soil conditions consisted of the top layer of contaminated soft soil and the underlying gravel layer with equivalent N-values reaching from 20 to 100. In addition, many debris including metal pieces was found to be in the canal floor and the pile line. The use of an auger attachment or water jetting was not allowed because of highly contaminated soil. Instead, predrilling was done by another method with excavated soil carefully and fully recovered and hauled away for treatment at a different location. Coated Z-shaped AZ46-700N sheet piles in lengths of 15.7m and 20.9m were installed. Fig. 3 shows a typical cross section of the new sheet pile bulkhead wall and Fig. 4 shows the line of installed sheet piles with the press-in piling machine (Giken F401-1400 model) in the distance. In order to verify the sheet pile wall's integrity against potential migration of contaminated water, sensors to detect complete engagement of the interlocks were welded at the bottom of each sheet pile pair as shown in Fig. 5. The total wall length of approximately 226m of this segment was completed with press-in piling in September 2020.

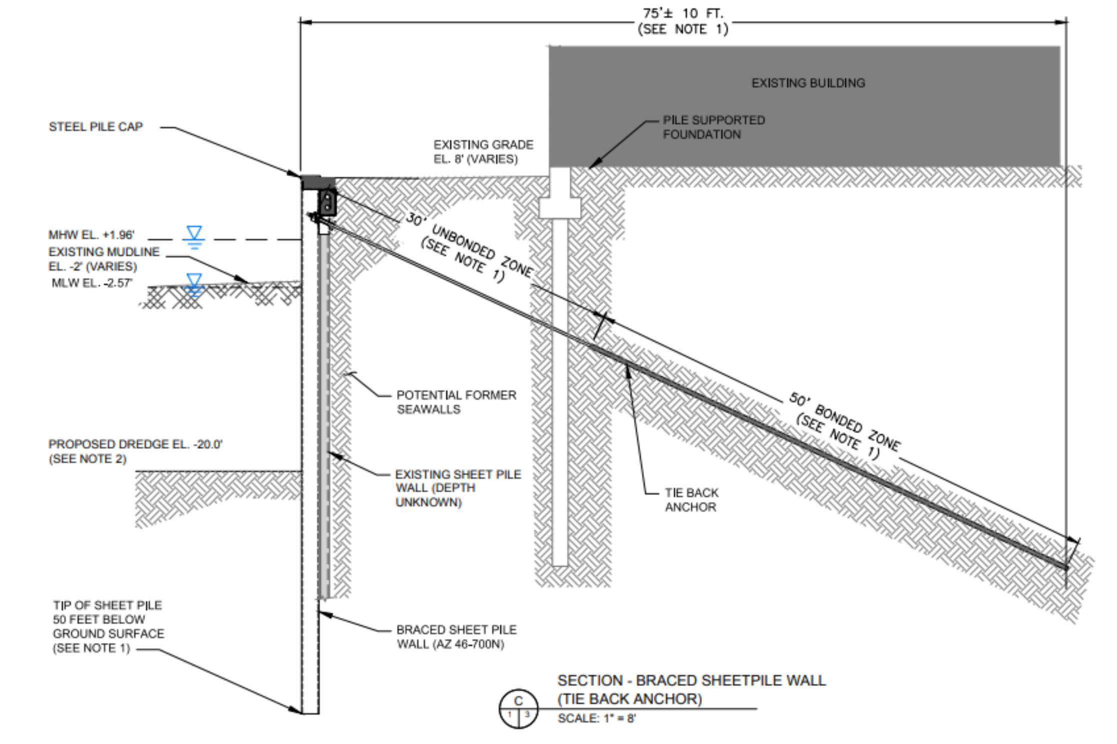


Fig. 3. Typical Cross Section of Existing and New Sheet Pile Walls with Tie Back Anchors

Fig. 4. Pressed-in Sheet Piles in the Gowanus Canal

Fig. 5. Non-declutching Sensor and Cable Conduit

## SUMMARY

The low-noise and low-vibration advantages of the press-in piling method fulfilled the project's need to minimize the settlement and displacement of the existing canal frontage and nearby buildings as part of environmental remediation of the highly contaminated Gowanus Canal in New York. Also, the press-in piling's ability to achieve very accurate installation contributed to the formation of fully interlocked sheet pile walls as verified with non-declutching sensors. Other future segments of the remediation work are likely to utilize pressed-in sheet piles.

## ACKNOWLEDGMENTS

The authors appreciate the support provided by Ian Vaz of Giken America Corp.

*Report*

# Ordinary General Assembly 2021

The IPA Ordinary General Assembly 2021 was held from 24 to 28 May, 2021. The total votes have achieved the quorum and all the presented Agendas were resolved in accordance with Article 22 of Constitution.

- Period: 24 May to 28 May 2021
- Meeting place: IPA Website（On-line voting through the Members Site）
- Agendas: https://www.press-in.org/en/page/general_assemblies
- Number of eligible members: 708（Individual Members:673, Corporate Members: 53）
- Quorum: 364 （a majority of members）
- Total votes: 388 ［achieved quorum］（Turnout 53%）

**Votes on each Agenda：**

| | Agendas | Affirmative votes | Dissenting votes | Results |
|---|---|---|---|---|
| Agenda 1 | Activity Plan for FY 2021 | 388 | 0 | Approved |
| Agenda 2 | Budget for FY 2021 | 387 | 1 | Approved |
| Agenda 3 | Election of Directors and Auditors for the term 2021–2022 | 388 | 0 | Approved |

The list below shows the incoming and outgoing members of IPA Directors and auditor. Thanks to the outgoing directors and auditors for their great contributions during the terms and very welcome the new directors.

**Incoming Directors and Auditor**

**Director**

**Dr. Jignasha Panchal**
Technical Manager
Keltbray Piling
The United Kingdom

**Director**

**Ms. Gulin Yetginer**
Leading Advisor
Offshore Geotechnics, Equinor AS
Turkey

**Auditor**

**Dr. Goh Teik Lim**
Director
Atsunew Giken Pte. Ltd.
Singapore

**Outgoing Directors and Auditors**

| Director | Director | Director | Auditor |
|---|---|---|---|
|  |  |  |  |
| Prof. Alexis Philip Acacio | Prof. Barry Michael Lehane | Prof. Hiroko Suzuki | Prof. Guixuan Wang |

*Event Report*

# 1st International Symposium on Construction Resources for Environmentally Sustainable Technologies (CREST 2020)

Hemanta Hazarika

Professor, Department of Civil Engineering
Kyushu University, Fukuoka, Japan

The 1st International Symposium on Construction Resources for Environmentally Sustainable Technologies (CREST 2020) was successfully held Online during March 9-11, 2021 with live broadcasting team based at Ito campus of Kyushu University. The main event was held on March 9 -10, and a special workshop called “The 2011 Great East Japan Disaster - Commemorating 10 Years from the Disaster - " was also organized Online on March 11. CREST 2020 was originally planned to be held during March 10-12, 2020. However, due to the global pandemic caused by COVID-19, the event was forced to postpone by one year, and finally, it had to be held completely Online due to the declaration of the state of emergency by the Japanese government.

The symposium was held under the auspices of Kyushu University, Fukuoka, Japan, in association with University of Cambridge, UK; Asian Technical Committee No. 1 (ATC 1) and Technical Committee No. 302 (TC 302) of International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE). The symposium was supported by Kyushu Regional Development Bureau of MLIT, Japan; Fukuoka Prefecture; Fukuoka City; Embassy of India in Japan; UN-Habitat, Fukuoka; International Press-in Association; Kyushu Branch of The Japanese Geotechnical Society; Global and Local Environment Co-creation Institute of Ibaraki University, Japan and Japan Federation of Construction Contractors.

In the opening ceremony of the symposium (Photo 1), Prof. Tatsuro Ishibashi (President, Kyushu University), Prof. Gopal Madabhushi (University of Cambridge and Co-chairman of CREST 2020), Prof. Charles W. Ng (President, ISSMGE), Prof. Kenji Ishihara (Former President, ISSMGE), Mr. Kazuya Murayama (Director General, Kyushu Regional Development Bureau), Prof. Osamu Kusakabe (Former President, IPA) and CREST 2020 organizing committee chairman Prof. Hemanta Hazarika (Kyushu University) delivered their greetings and graced the occasion. In the two-day symposium, a total of about 350 people from 28 countries (representing all the continents) participated Online. In the symposium, 2 Plenary lectures, 11 keynote lectures, and 15 special lectures were delivered by distinguished scholars from all over the world, in addition to 93 general presentations. CREST 2020 organizing committee is very proud to announce that, 3 out of the 15 special lectures were delivered by female researchers from different regions of Asia, Europe, and America. This reflects the diversities (both in gender and races) of CREST 2020. In addition, with the aim of fostering young researchers, 2 best paper awards and 17 best presentation awards were presented to general presenters under the age of 35. Furthermore, for the first time a digital exhibition of all the sponsors was experimented. The On demand technical booths were viewed by more than 100 participants. On March 11, which also marked the 10th year from the 2011 Great East Japan Earthquake, three parallel workshops were held as part of CREST 2020, under the umbrella of a special workshop with the theme "Sustainability and Resiliency". A total of about 360 participants took part in those three workshops.

In the closing ceremony of the symposium, Prof. Kazuya Yasuhara (Co-chairman of CREST 2020) and Prof. Ikuo Towhata, (former Vice President of ISSMGE) graced the occasion by delivering their closing remarks. The main symposium came to an end with the vote of thanks by Prof. Hemanta Hazarika.

Photo 1: A glimpse of the opening ceremony and guests of honor

## Young Members Column

Naoya Matsumoto

Student, CHUO UNIVERSITY

I have received my bachelor's degree from Chuo University and I am doing research activities as a second-year master student at the same university, in the laboratory of foundation and underground structures. In this laboratory, we are working on research themes that can contribute to solving problems in practice, such as design, construction, maintenance, management, and disaster prevention, focusing on foundation and underground structures. Before the pandemic, I always made many field trips because I believe that it is important to see and feel things with my own eyes. The photo was taken at the Seto Ohashi Bridge during a field trip under the aegis of the Japan Society of Civil Engineers. On the picture I am located at the far end.

My research is focused on the rigidity and embedded depth of the earth retaining wall. I have applied an aluminum bars to model a pile in the ground. By using this apparatus, we can easily observe the slip surface in the soil. Therefore, we can observe the behavior of the retaining wall when it collapses, which cannot be reproduced in reality. This research may enable us to determine the embedded depth of earth retaining walls more economically.

The first IPA event in which I participated was the "12th IPA Press-in Engineering Seminar in Tokyo 2020". The current design method for earth retaining walls has a tendency to overestimate the embedded depth when applied to rigid steel pipe piles and hard ground conditions. My own research focuses on the embedded depth and rigidity of earth retaining walls, so I was glad to be a member and participate in the conference because I was able to get knowledge about the latest findings. I would like to acquire a wide range of knowledge so that I can contribute to the world as a civil engineer during the rest of my student life.

Yuna Sasaki

Student, CHUO UNIVERSITY

I am Yuna Sasaki, and I am a first-year master student at Chuo university in Tokyo. I received my bachelor’s degree in civil engineering at the same university. When I was in third grade of bachelor, I have experienced to study in Denmark at University of Southern Denmark (SDU) for two semesters.

The motivation for studying abroad was to become an international civil engineer. Nowadays, a number of construction companies extend their project overseas. Being inspired by the engineers who work abroad, I decided to study in the environment of many international students.

In the city I lived in, construction works to build railroad tracks of trams and stations have been carried out. Then I began to be interested in underground structures and made up my mind to study in this field, and now I belong to the present laboratory, specific to foundations and underground structures.

Now I study bearing capacity of the scoured bridge foundation. In recent years, along with heavy rainfall disasters, the damage of foundations due to scour has been increasing. This study focuses on the damages of foundations such as settlement and inclination due to scour. The aim of the study is to clarify the bearing capacity of foundation after the scour. To elucidate its mechanism, I perform vertical loading tests of scoured foundations with aluminum rods. The reason for using these aluminum rods is that they behave mechanically like dense sand and can be easily reproduced manually in any scour condition. This study will help to obtain the information for future emergency disaster operations of damaged river bridges.

IPA is a good stage for me to have opportunities to know civil technologies and exchange opinions for the future development in this field. I look forward to sharing my study in IPA in the near future.

## *Announcement*

# The Revised Edition of the “Press-in retaining structures: a handbook”

The first edition of “Design and Construction Guideline for Press-in Piling 2015” was published in Japanese in June 2015. It was the first technical publication which systematized designing, planning and construction aspects of the press-in piling method. Having been met favorably by many readers in the Japanese geo-structural engineering industry, it was translated into English in December 2016 to be distributed across the global geo-structural engineering industry.

The handbook has been used as a practical guidebook, by academic researchers and professional engineers in many countries, since its first publication. The circulation of the handbook has increased concurrently with the popularity of the press-in piling method on the global market, which is utilized in 41 countries so far.

In order to satisfy the most recent trends of design and construction aspects of press-in structures, it has been updated in the second version. The contents address technical issues, related to the selection of appropriate retaining wall types and press-in systems based on the latest press-in piling technologies.

The handbook is published in both PDF and printed book, and is also available in June at the IPA webpage.

URL: https://www.press-in.org/en/publication/index/1

# Listing Proceedings of ICPE 2018 on academic search engines

Yoshiaki Kikuchi

Chair, IPA Research Committee

We are pleased to inform you that Proceedings of the first international conference on Press-in Engineering (ICPE 2018, Kochi) has been listed on external academic search engines, J-Stage which were developed by Japan Science and Technology Agency (JST). [https://www.jstage.jst.go.jp/browse/icpe/](https://www.jstage.jst.go.jp/browse/icpe/) (Fig. 1.)

J-Stage (Japan Science and Technology Information Aggregator, Electronic) is the e-journal platform which has formed networks with a range of external science and technology information and scholarly information services (Fig. 2).

We are going to add contents and improve the settings continuously cooperating with external services, so that people inside and outside IPA get access to valuable papers easily.

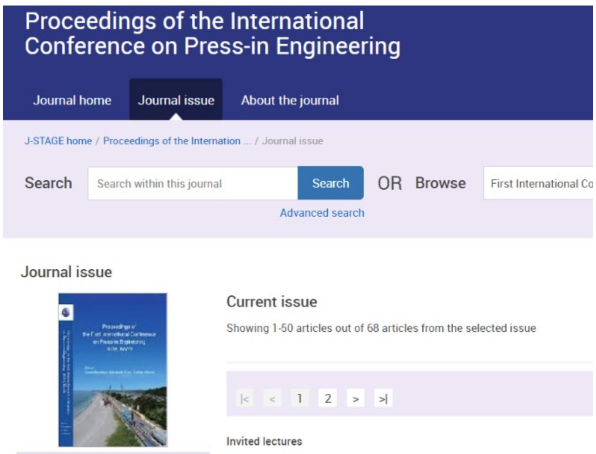


Fig. 1. Image of J-Stage’s web-site

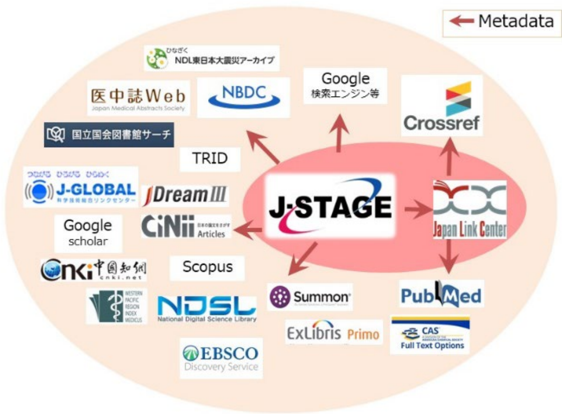


Fig. 2. Networks of J-Stage with external services

[https://www.jstage.jst.go.jp/static/pages/ForAuthors/-char/en](https://www.jstage.jst.go.jp/static/pages/ForAuthors/-char/en)

## New Members (December 2020 – February 2021)

Members who joined IPA from March 2021 to May 2021.

- New Individual Members (14)

| | | | |
|---|---|---|---|
| Kenichi Horikoshi | Xi Xiong | Yu Harada | Heng Li Ng |
| Yahya Ndoye | Jignasha Panchal | Shogo Umeki | Takanori Yasuda |
| Keiji Otsubo | Akito Tamaki | Mitsuhiro Okada | Atsuki Matsudaira |
| Takashi Unno | Shinichiro Imamura | | |

- New Student Members (22)

| | | | |
|---|---|---|---|
| Shota Yoshida | Yuna Sasaki | Fuyuki Kawatake | Koki Matsumoto |
| Moeka Hirano | Natsuki Yamamura | Yuki Arai | Takahiro Furukawa |
| Soki Kawada | Yuta Kinashi | Satoshi Makino | Fuga Nishino |
| Hiroki Yoshida | Yuki Isobe | Takatoshi Sagawa | Hideharu Sugimoto |
| Hayato Ono | Keiichiro Ono | Fumika Fukuda | Tatsuo Sega |
| MUHAMMAD AIMAN Aiman | | Filzah Atiqah Haris | |

- Numbers of Members as 31st May 2021

Individual Members: 673 Student Members: 65 Corporate Members: 53

## Obituary Notice

Tadahiko Okumura, civil engineer and former Secretary General of the IPA, died on Saturday, 8 May, 2021 at the age of 75.

Dr. Okumura graduated the University of Tokyo and he earned a doctorate in civil engineering at the University of Tokyo in 1984. After retiring from Shimizu Corporation, he served as Senior Director of the Geo-space Engineering Center of the Engineering Advancement Association of Japan.

Dr. Okumura contributed to the establishment of the IPA in February 2007 and he served as the Founding Secretary General of the IPA from its establishment to 2017. His major achievements as Secretary General include four international workshops in New Orleans, Shanghai, Singapore and Ho Chi Minh.

The IPA offered flowers and a condolence telegramme to his funeral in the name of the IPA President.

## 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 19-21, 2021 | Online |
| **International Society for Soil Mechanics and Geotechnical Engineering** http://www.issmge.org/events | | |
| 6th International Conference on Geotechnical Research and Engineering (ICGRE 2021) | June 21-23, 2021 | Online |
| 7th International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics | July 12-15. 2021 | Online |
| 3rd Pan-American Conference on Unsaturated Soils | July 25-28, 2021 | Rio de Janeiro, Brazil |
| 6th GeoChina International Conference 2021 | September 18-19, 2021 | NanChang, China |
| 10th International Conference on Scour and Erosion | October 18-21, 2021 | Arlington, USA |
| 3rd International Symposium on Coupled Phenomena in Environmental Geotechnics (CPEG2020) | October 20-22, 2021 | Kyoto, Japan |
| 5th World Landslide Forum | November 2-6, 2021 | Kyoto, Japan |
| **Deep Foundations Institute** http://www.dfi.org/dfievents.asp | | |
| SuperPile 2021 | June 23-25, 2021 | Philadelphia, Pennsylvania |
| **Others** | | |
| The 56th Annual Meeting of the Japan National Conference on Geotechnical Engineering | July 12-15, 2021 | Online |
| Japan Society of Civil Engineers 23rd International Summer Symposium in 2021 | September 8-9, 2021 | Online |

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## Editorial Remarks from persons in charge

Dr. Nor Azizi Bin Yusoff
(Senior Lecturer, Universiti Tun Hussein Onn Malaysia)

Welcome back to The IPA Newsletter, Volume 6 issue 2. Thank you for giving me an opportunity with Professor Leung Chun Fai in delivering the editorial remarks. While working from home and managing the Covid19 situation in all parts of the world, this edition may offer us the extension of learning. I can see many great sharing from prominent experts including Professor Bengt Fellenius, Professor Kenichi Soga, our IPA directors and many more may enrich ourselves with the evolution of geoengineering and technology. Let's enjoy and discover the beauty of Press-in engineering from this issue. Please enjoy your reading...

Prof. Chun Fai Leung
(Professor, National University of Singapore)

The IPA Newsletter, Volume 6 issue 2 comes together with a strong collaboration between the industrial experts, academia and younger students in understanding Press-in Engineering and other geotechnical practices. The case history in New York may provide an insight to the practitioners while other expert sharing offers some theoretical justifications and future dimensions to these interesting engineering discoveries. Thank you to other contributors who shared their event report, young member's column and other initiatives in spreading the Press-in Engineering. I would also like to welcome and thank you for our incoming and outgoing directors and auditors. Let's work together!