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News Letter

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Inside This Issue

Editorial Board

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Messages
From the New Director

Alexis A. Acacio

Professor
Institute of Civil Engineering, University of the Philippines

Last year, the IPA, through Prof Osamu Kusakabe contacted the University of the Philippines with the possibility of conducting a seminar on pile foundations at our university. Through the efforts of the IPA, the Philippine Society of Soil Mechanics and Geotechnical Engineering and the University of the Philippines Institute of Civil Engineering, the seminar was held on May 2018. The seminar was jointly organized by the IPA, the Philippine Society for Soil Mechanics and Geotechnical Engineering and the UP ICE. It was sponsored by GIKEN LTD., Nippon Steel & Sumikin Bussan Corporation with the local support of AMH Philippines.

Practitioners, academicians and constructors from the various sectors attended the seminar and since then, better awareness of pile design and installation techniques using state of the art technology has sparked a renewed concern in the environmental effects of installation.

As the Philippines is undergoing a massive infrastructure development, press in piling installation is becoming very popular in the Philippines as the availability of land suitable for urban development is becoming difficult. Many areas of the country are on soft ground that would require the use of deep foundations. As the cost of driven piles are lower than that of cast in place piles, driven piles are still the more cost effective choice. Due to noise and other environmental concerns, the press-in pile proves to be a practical choice.

I look forward to serving as a board member of the IPA . With my dual role as a faculty member of the University of the Philippines and as the current president of the PSSMGE, I will do my best to ensure that the best knowledge and technologies regarding deep foundations become more accessible and available to the Philippine academic and professional communities.

◆ A brief CV of Prof. Alexis A. Acacio

Alexis A. Acacio is a professor of civil engineering at the University of the Philippines. His research interest involves the dynamic and seismic response analysis of shallow and deep foundations. He is also involved in various civil infrastructure projects throughout the entire Philippines and serves as the current president of the Philippine Society of Soil Mechanics and Geotechnical Engineering. Dr Acacio has been involved in the assessment, analysis and geotechnical design of various civil infrastructures in the Philippines and continues to deliver lectures to various professional societies and research institutions.

Messages
From the New Director

Mounir Bouassida
Professor
Department of Civil Engineering, University of Tunis El Manar – Tunisia

It is my great pleasure to write a message for this IPA Newsletter. My first involvement with IPA begun in 2017 when Prof. O. Kusakabe (President of IPA) invited me to review the first French-translated version of the Press-in Handbook. This invitation enabled me to go through detailed description of Press-in Technologies, which are yet to be practiced in Africa. In December 2018, Prof. Kusakabe sent me an e-mail informing me that all IPA board members agreed to his proposal to welcome me as a new IPA Director. This invitation, to join International Press-in Association, is honourable for me since I am the first representing African geotechnical investigators. Indeed, such an involvement will keep me updated, from the source, about innovative technologies regarding retaining structures and foundations I have found very efficient and non-time consuming in geotechnical applications.

In July 2019, I attended my first IPA board members meeting, in Tokyo during which I agreed to serve within the research committee. Several issues have been discussed. Essentially, how to obtain grants to support research development actions of IPA? I do hope my interaction with all IPA directors would enable me to find out viable alternatives in making research actions feasible and successful as well.

In addition, I had a meeting, with three engineers from GIKEN LTD. in charge of the two first running projects in Africa (Senegal and Egypt) in presence of Prof. Kusakabe. Because Press-in Technologies are not yet adopted in Africa, the discussion focused on the support and recommendations to be provided for GIKEN engineers to enter the African market by making Press-In Technologies competitive in comparison to classical retaining structures techniques. Dissemination of Press-in Technologies associated to specific advertisement might be programmed in the near future inside Africa by organizing an international seminar and/or international conference in 2021. Being aware that Africa comprises more than fifty countries speaking four official languages: Arabic, English, French and Portuguese, certainly an immense effort should be made to make possible the translation of IPA books and booklets for the best dissemination of Press-in Technologies. It will be my pleasure to contribute in such a task.

◆ A brief CV of Associate Prof. Mounir Bouassida

M. Bouassida is a professor of civil engineering at the National Engineering School of Tunis (ENIT), of the University of Tunis El Manar. Prof. Bouassida is the director of the Research Laboratory in Geotechnical Engineering and geo-risks. He launched a Tunisian consulting office in geotechnical engineering, SIMPRO. He is a co-developer of the software Columns 1.01 used for designing column-reinforced foundations. Prof. Bouassida held the office of the vice president of ISSMGE for Africa (from 2005 until 2009). In quality of appointed board member of ISSMGE, presently, he is managing the webinars activity within the newly established program of ISSMGE virtual university.

IPA News Letter

Volume 4, Issue 4 December 2019

Special Contribution

Technology Developments in Japanese Construction Industry

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ABSTRACT: The major Japanese construction companies have their own research and development (R&D) institutes as well as the design and engineering divisions, which is very different from the construction contractors outside Japan and one of the unique characteristics of the construction business in Japan. Such in-house research capability allows them to meet a wide variety of technical, social demands, and customer requirements in the world. It is also very important for their research institutes to develop new technologies in view of future trends in the business markets in the world. This report will introduce the recent activities of technology developments in such research institutes of one of Japanese contractors, i.e., Taisei Corporation which the author belongs to, with much focus on the technologies using recent ICT & AI technologies.

Key Words: Construction industry, Technology Development, Research Institute, Robot, ICT

1. INTRODUCTION

Major Japanese construction contractors have their own research institutes to enhance and expand their business markets. The topics of their research fields are significantly varied to cover the social and technical demands raised by our social lives and business activities of clients, as well as global trends. Selections and prioritizations of research and development topics are one of the major important duties of the author.

Major topics of research and development currently are

i) Technologies to cope with major future earthquakes and other natural disasters,
ii) Renovation and replacement of old existing infrastructures and buildings, especially in urban areas such as Tokyo,
iii) Environment-friendly construction to meet corporate social responsibility,
iv) Application of advanced technology such as use of ICT and AI to enhance productivity,
and
v) New construction technologies required for major projects in Japan.

Sustainable Development Goals (SDGs) which was proposed by the United Nations in 2015 are also important issues which we surely need to follow as the current and future global trends. Among the topics of the above, the recent advanced technologies which use ICT are introduced in this report after the brief introduction of the recent trends in Japanese construction industry.

2. RECENT TRENDS IN JAPANESE CONSTRUCTION INDUSTRY

It is necessary to first give an outline of overall trends in the Japanese construction industry. The Japan Federation of Construction Contractors (JFCC) publishes an annual handbook giving the latest data on the Japanese construction industry (JFCC, 2019). The author combines the data by referring the past issues of the handbooks.

Fig. 1 shows the overall trend in Japanese Gross Domestic Product (GDP) alongside investment in the construction market. It is revealed that GDP has remained almost unchanged for the past twenty years, with a slight increase up to about JPY 550 trillion (equivalent to USD 5.1 trillion at the latest exchange rate of 108 JPY/USD). At the same time, despite the unchanged trends in Japanese GDP, the investment in construction had halved by 2010 from a peak value of JPY 84 trillion in 1992 after the collapse of the Japanese bubble economy in 1989. After the investment hit the bottom value, the investment in construction has crept upward by 1.5 times to about JPY

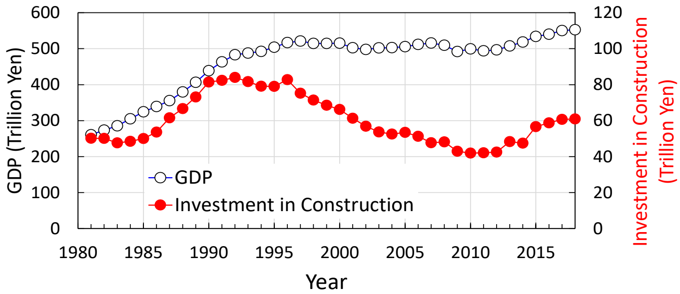

Fig. 1. Investment in construction in Japan
(Data from JFCC handbook)

60 trillion in 2018, which increase is thought to be attributed to rehabilitation and reconstruction work following the 2011 Tohoku Earthquake and a construction boom related to the upcoming 2020 Tokyo Olympic and Paralympic Games, and other big projects in Japan.

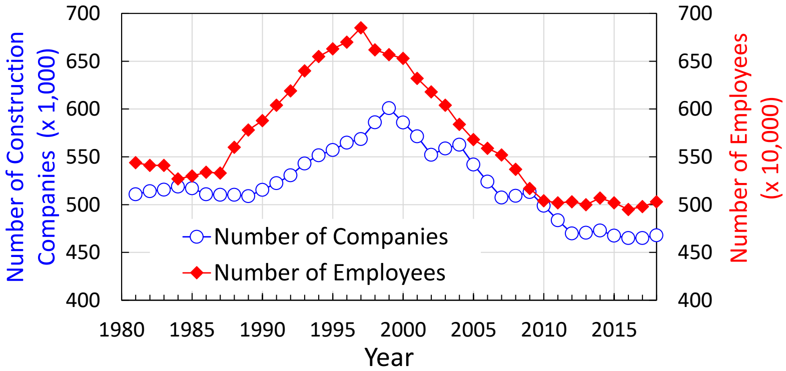

Fig. 2. Number of construction companies & employees in construction industry

Fig. 2 shows the overall trend in the number of construction companies operating in Japan and employees in the industry. The number of construction companies has decreased by 22% from the peak of 601,000 in 1999, while employment has fallen by 25% from the 1997 peak of 6.85 million. Although the investment has increased by about 1.5 times in the last five years, the number of construction companies as well as the number of employees have not increased at all, which means that a significant lack of labor in the construction industry has been experienced. Fig.2 clearly shows that once left the industry, it is not easy to return. Owing to the lack of labor, the construction workers have been busier and busier, which leads to the work of the construction industry less attractive for young engineers.

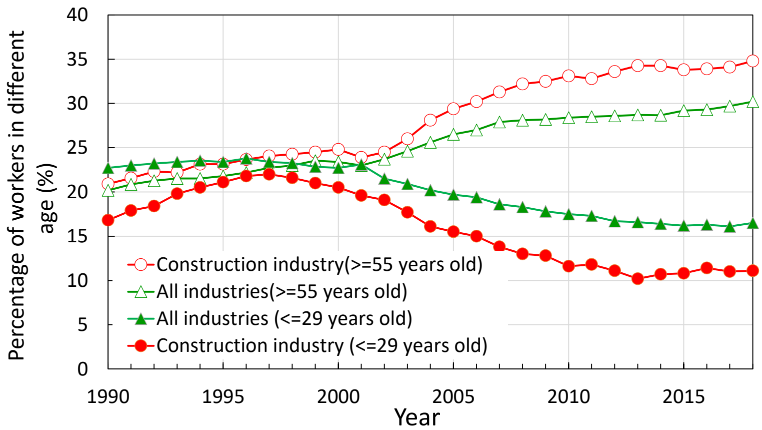

Fig. 3. Percentage of workers in different age in construction industry compared with that for all industries

Fig. 3 shows the percentage of workers in different age in the construction industry compared with that for all industries in Japan. It shows the significance of rapid aging in the construction industry compared with other industries in Japan. At present, more than one third of employees in the industry exceed 55 years old, with only about 10% being less than 29 years old. Attracting young engineers to the construction industry is a very urgent issue.

Considering the above situations in the construction industry, it is very important for us to develop new technologies to cope with the shortage of labor and skilled workers in construction, as well as more advanced technologies using ICT and AI which are attractive to young engineers, and which will change the negative image of '3D' in the industry, i.e., Difficult, Dangerous, and Dirty. Improving productivity in the industry will surely be one of the solutions.

3. IMPROVING PRODUCTIVITY IN CONSTRUCTION INDUSTRY

Unmanned construction system

In 1991 one of Japan's most active volcanoes erupted and generated an enormous pyroclastic flow that killed 43 people (Fig. 4). The site at Mt. Unzen remained in dangerous conditions, but the disaster recovery efforts had to go on, so the government decided to use unmanned construction systems for the work. Following the successful application of unmanned construction system at the Mt. Unzen site, the technology has been improved and used for many other natural disasters. These include the sites of landslides resulting from earthquakes, heavy rains and other natural occurrences. It is worth noting, also, that unmanned construction systems played an important role when the Fukushima nuclear power plant was severely damaged in the 2011 Tohoku Earthquake (Fig. 5). The unmanned machines removed rubble and debris immediately after the accident to allow rapid and problem-free commencement of other recovery work. Initially, the unmanned machines were controlled from a site house located at the nearest safe place for the work. Remote control of construction machinery requires particular skills that differ from those needed to operate the machines directly. Work was carried out step by step under manual control, using many monitors set up in the site house to observe the operation.

Fig. 4. Pyroclastic flow occurred at Mt. Unzen in 1991 (https://en.wikipedia.org/wiki/Mount_Unzen)

Fig. 5. Unmanned construction systems at Fukushima nuclear power plant https://www.nikkei.com/article/DGXNASFK11034_R11C13A2000000/

More than 25 years have passed since the first application of unmanned construction. Advanced technologies related to real-time positioning systems, monitoring systems, highly accurate sensor systems, communications, and other recent ICT and AI techniques ensure more accurate work with more automatic and autonomous control. Unmanned construction technology also contributes to reduce demand for workers. Two autonomous unmanned construction machines have been developed, a vibration roller system and a breaker system (Katayama and Ishii, 2016, Katayama et al., 2015). These machines can complete an assigned task without further human control once the initial conditions and target results are entered.

Fig. 6 shows the autonomous unmanned vibration roller named as 'T-iROBO Roller'. It is fitted with a number of sensors needed for autonomous operations. Fig. 7 shows the machine undergoing verification tests. After an operator enters data specifying the area requiring compaction, the machine completes the work, autonomously keeping track of the number of compactions. Since the machine accurately tracks its own position, construction work can continue even in poor visibility, such as with fog, and at night. Operational data can be linked with data from Building Information Modeling (BIM) or Construction Information Modeling (CIM) systems and linked to quality control data. An autonomous unmanned breaker machine (Fig. 8) named as 'T-iROBO Breaker' is able to detect a target object, such as a mass of rock, from a distance, approach the target, and break the up target while determining the best breaking position.

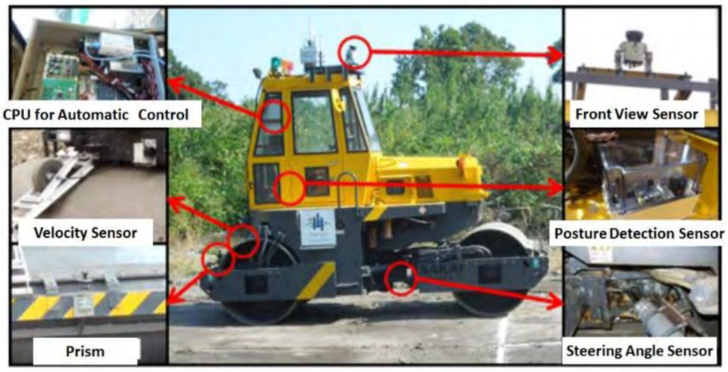

Fig. 6. Autonomous unmanned vibration roller

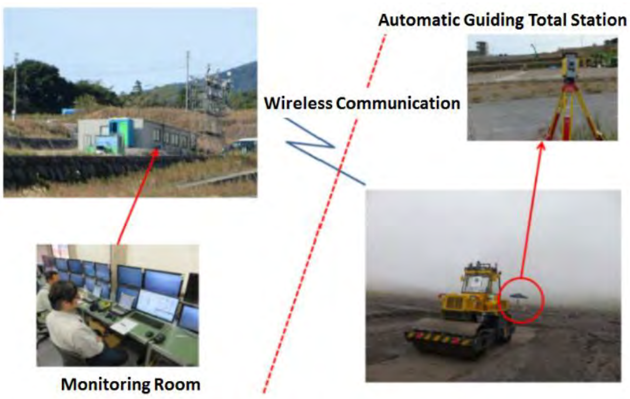

Fig. 7. Verification test of autonomous unmanned vibration roller

Fig. 8. Autonomous unmanned breaker

Automatic concrete slab finisher and cleaner

Manual slab finishing just after casting is hard work for a construction worker as shown in Fig. 9. It is slow work in a difficult posture that places a heavy burden on the body. An automatic finishing machine was then developed for concrete floors. An attempt was made to improve work conditions and efficiency in this concrete finishing work by developing a light-weight construction robot named as ‘T-iROBO Slab Finisher’ (Nakamura, 2016), as shown in Fig. 10. The machine does the work of three construction workers. Operation is done by a single worker with a controller like the one used for computer games, leading to a reduced workforce and easier work. The machine is battery-operated and weighs 90kg, of which 25kg is a battery weight. Continuous operation for 3.5 hours is possible. Battery performance and weight still leave room for improvement. In addition to the types of automatic machine described above, an automatic cleaning machine for construction sites has been developed (Kato, 2016) named as ‘T-iROBO Cleaner‘ as shown in Fig. 11. It can recognize safety cones and barriers marking off-limits areas.

Fig. 9. Finishing cast concrete is hard & time-consuming work

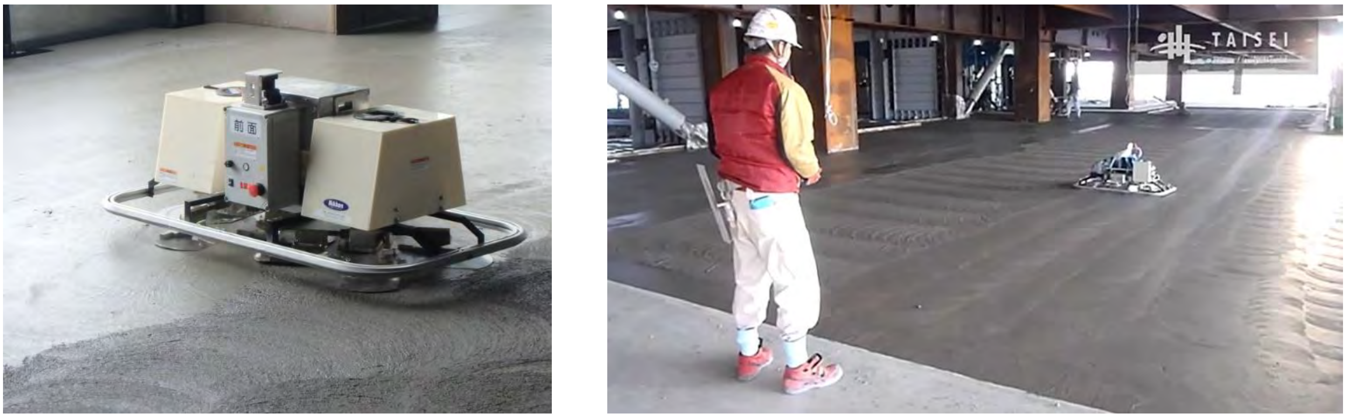

Fig. 10. Automatic concrete slab finisher

Fig. 11. Automatic cleaner for construction sites

Advanced positioning system for pile installation

Work of accurately marking the specified locations for piles generally requires at least two people, one stationed by the measuring system (total station theodolite) and the other moving around into the exact pile positions. An advanced positioning method named ‘T-Mark Navi’ that can be operated by just one person has been developed (Tanaka and Sueda, 2016). The operator wears a pair of wearable (smart) glasses that include a display system. Fig. 12 compares the operation of the system with the conventional method. A specially designed measurement device is used instead of the conventional total station theodolite. The operator carries a smart phone that communicates with the measurement device via wireless LAN and uses voice control technology to determine precise pile positions. Positioning data is visible on the display of the smart glasses, as shown in Fig. 13. This system reduces the number of workers required for pile positioning by half.

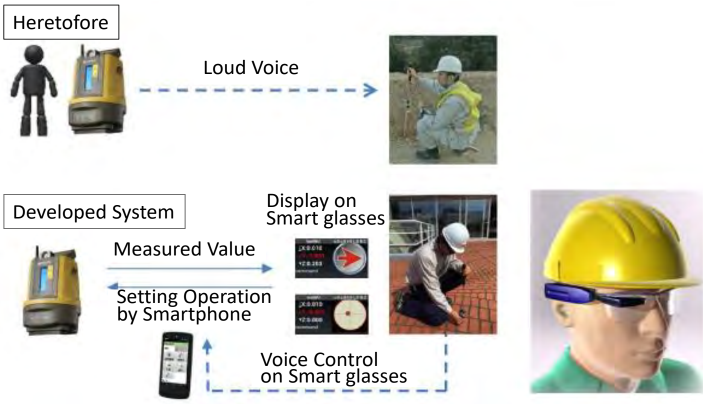

Fig. 12. Precise positioning system operated by only one person

Fig. 13. Display of positioning data via smart glasses

Systems developed for safer tunnel construction

Tunneling in complicated geotechnical conditions is one of the difficult constructions. Safe and secure tunneling is always desired. A technology used projecting mapping was developed for tunnel construction (Fig. 14) (Tani et al., 2019, Nikkei Construction, 2019). Once drilling was finished at the tunnel face, the face is covered with shotcrete quickly for safety and protection. Therefore, it is important to share the information on the face with all workers and operators. The system projects the necessary information directly on the runnel face so that all workers and operators can share the technical information easily. Examples of the projected information are shown in Fig. 15.

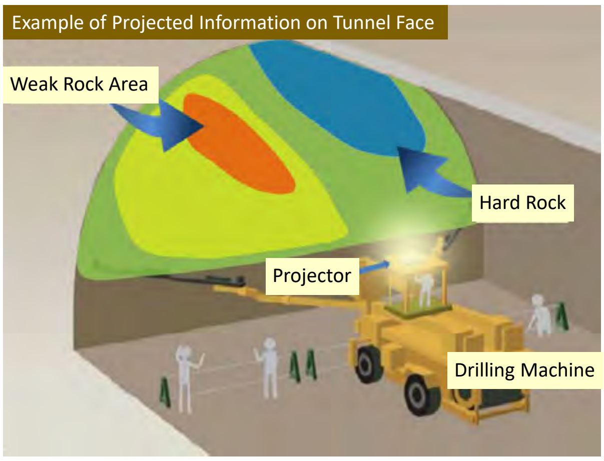

Fig. 14. Projection mapping system on tunnel face

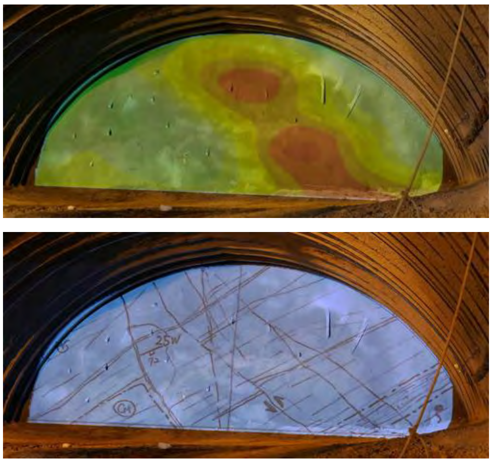

Fig. 15. Examples of the projections

4. SUMMARY

Some of the research and development activities at Taisei Advanced Center of Technology (TAC.T) was briefly introduced with focus on technologies to cope with the shortage of labor and skilled workers in the construction industry. Most technologies use advanced ICTs, and more AI technologies in the future. Implementation of ICT and AI in construction technologies will enhance the productivity of the construction industry as well as attract more young engineers to the industry. Please note that the contents described in this report are only a small part of the results. Further information can be available on the website of Taisei Corporation, and Report of Taisei Advanced Center of Technology, or please contact the author.

'Open innovation' has become a major keyword in the recent research and development activities. Collaborative work on a global scale with a wide variety of fields beyond the scope of construction is more necessary for further development of the construction industry in near future.

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◆ A brief CV of Dr. Kenichi Horikoshi

Kenichi Horikoshi is the general manager at Taisei Advanced Center of Technology, Taisei Corporation, Japan. After completing the Master's degree from Kyoto University in 1987, he joined Taisei Corporation. In 1996, he received PhD degree from the University of Western Australia for the thesis of 'Optimum Design of Piled Raft Foundations'. Since then he has engaged in a number of research projects and consulting works on a wide variety of geotechnical engineering fields. Currently, he is responsible for technology development strategy in Taisei Corporation. He is also the Secretary General of Asian Civil Engineering Coordinating Council (ACECC), as well as the vice president of Japanese Geotechnical Society.

IPA News Letter Volume 4, Issue 4 December 2019

Special Contribution

Gross National Safety Index for Natural Disasters (GNS)

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2 Associate Professor, Institute of Urban Innovation, Yokohama National University
3 Associate Professor, Faculty of Societal Safety Sciences, Kansai University

1. Introduction

Japan is one of the countries prone to various natural disasters such as earthquakes, floods, sediment disasters, and volcanos. In recent years, damage due to natural disasters is becoming more and more serious. It has suffered from the devastating damage caused by not only earthquakes but also a succession of localized torrential rains. However, current city's flood protection systems are not enough since the budget and personnel used for disaster prevention and mitigation measures are limited.

Needless to say, establishment of comprehensive disaster prevention and mitigation system is urgent and essential, which is an effective combination of hardware measures such as infrastructure and reinforcement of structures, and software measures such as hazard map development/disclosure and disaster prevention education.

Immediately after the Great East Japan Earthquake, Prof. Kusakabe advocated to create an index of nation-wide safety index, together with Gross Domestic Product (GDP) and Gross National Happiness (GNH), to steadily transform Japan to resilient land and coined GNS. GNS is an abbreviation of Gross National Safety for natural disasters, which is an index expressing quantitative risks for natural disasters. Roger Pulver (2012) showed his keen interest in GNS and stated in his article, "Japan's disaster must prompt a radical rethink of citizen's quality of life", that "Here's my point: The aftermath of the triple calamity in Tohoku has shown that Japan's government and industry have been neglecting the safety and the integrity of the people and the land. A paradigm of growth for the 21st century must consider the kind of scientific methods advocated by Kusakabe.", "The creation of investment security and the husbanding of the land can bring about a merger of the three Gs: GDP, GNS and GNH. Any country or region striving for this would be a magnet for investment and a beacon of hope for the world." Fig. 1 shows the article issued in the Japan Times on March 11, 2012.


The Japan Times

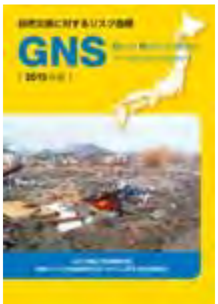
COUNTERPOINT

Japan's disasters must prompt a radical rethink of citizens' quality of life

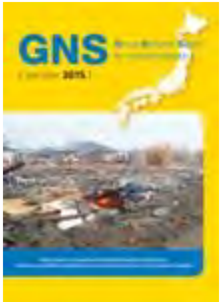
Fig. 1. Japan Times on March 11, 2012

In 2012, we have formed a research committee in Japanese Geotechnical Society(JGS) Kanto branch, with an aim of developing a safety index system for natural disasters for policy and decision makers to prioritize prevention and mitigation measures to be implemented. As a result, we published leaflets of GNS2015 and GNS2017 which were presented the concept of the GNS index and the way to calculate the year of 2015 and 2017 version GNS, together with the calculated results of GNS in the prefectural scale. Fig. 2 shows the leaflets of GNS2015 and GNS2017. These leaflets can be downloaded as PDF files from following URL;

GNS2015 (Japanese Version): http://www.jgskantou.sakura.ne.jp/group/pdf/GNS2015.pdf
GNS2015 (English Version): http://www.jgskantou.sakura.ne.jp/group/pdf/GNS2015English.pdf
GNS2017 (Japanese Version): http://www.jgskantou.sakura.ne.jp/group/pdf/GNS2017.pdf



GNS2015
Japanese Ver.



GNS2015
English Ver.

GNS2017
Japanese Ver.

Fig. 2. Leaflets of GNS

In GNS2015 and GNS2017, five natural events were considered including earthquake, tsunami, storm surge, sediment related to disaster events, and volcanic activity. While flood disaster, one of the most serious natural disasters in Japan, was not considered in GNS2015 and GNS2017 because the river basin level is usually needed for the calculation so that it is difficult to consider it in the prefectural scale using statistics data. Moreover, hardware and software measures for disaster prevention and mitigation are usually planned and carried out on various administrative units such as nation, prefecture, and/or municipality. Therefore, the disaster risks also should be evaluated in multi-scale (from national to municipal scales) to increase the effectiveness of investment for disaster prevention and it is also necessary to increase resolution of the damage estimation maps and use consistent statistical data to evaluate natural disaster risks in municipal scale as well.

Furthermore, in Japan, Basic Act on the Advancement of Public and Private Sector Data Utilization was established in 2016, and statistical and geographic information are becoming accessible for free. Statistics and GIS could make it possible not only to provide damage prediction depending on each flood basin but also to consider the most adequate countermeasures by municipality.

In this study, the new calculation methodology using GIS (Geographic Information System) was introduced to evaluate "exposure" of natural disasters more precisely in municipal scale. The newly extended GNS was applied to evaluate natural disaster risks of each municipality in East Japan. Additionally, the "exposure" of flood disasters can be evaluated by superposing damage estimation maps and population distribution using GIS (Mukai et al., 2018).

2. GNS Concept

2.1 Definition of GNS

The natural disaster risk, R can be expressed as the function of hazard H, exposure E, vulnerability V and resilience Re, by the following equation:

$$R = f(H, E, V, \mathrm{Re}) \qquad (1)$$

Here, H×E means "exposure" in a broad sense, which is determined by population distribution, geology and topography in a particular region. Also, V x Re is a value expressing the relation between society and natural disasters. In GNS2015, vulnerability can be expressed by V = V (V, Re). Thus, the natural disaster risk R can be expressed as follows;

$$R = f(H, E, V) \qquad (2).$$

The Eq (2) is a form of function adopted in the GNS calculation. One of the simplest forms may be

$$R = H \times E \times V \qquad (3)$$

The Eq (3) is the actually used equation for GNS2015 and 2017. One of the features of the Eq (3) is that R becomes null

when one of the three parameters are null. Namely, in the cases where no physical event causing hazard occurs (H=0), nor no people lives in the affected area caused by hazard (E=0), society is resilient enough against natural disasters, R

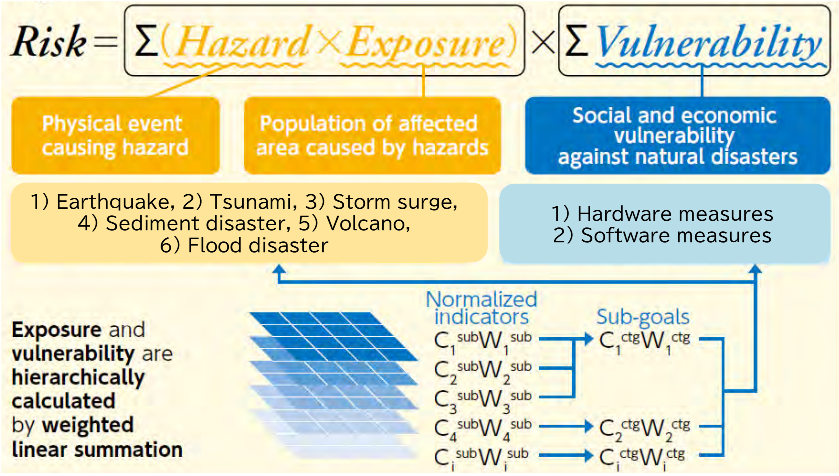


Fig. 3. Concept of GNS

becomes null. In the course of development of GNS2015, the following points are taken into consideration in such a way that the decision and policy maker responsible for budget plan can easily access; 1) Data to be used should be free access for the purpose of continuous updating, 2) Data to be used should be available at the prefectural level to compare one prefecture to another, 3) Prioritizing the items affecting for improving natural disaster measures and the items with higher propriety should be selected and 4) The values of hazard, exposure and vulnerability should be hierarchically calculated by weighted linear summation as shown in Fig. 3.

2.2 Exposure

As for “exposure”, the following 6 natural disasters are considered; (a) earthquake, (b) tsunami, (c) high tide (storm surge), (d) sediment disaster, (e) volcanic disaster, and (f) newly added flood disaster. In this study, in order to precisely evaluate the “exposure” of natural disasters except for earthquake and volcanic disaster in municipal scale, the population distribution exposed by each natural disaster was calculated using GIS software (by superimposing population data in municipal scale and estimation of damage caused by each disaster) (Mukai et al., 2018). While, the “exposure” of earthquake and volcanic disaster was evaluated in the prefectural scale due to the difference in the time scale and the frequency of occurrence. The frequency coefficient, which varies from 0 to 1, was defined by the following equation,

$$F_i = 1 - \exp(-N_i / \bar{N}) \qquad (4)$$

The Eq (4) is used and this frequency coefficient is expressed as H in Eq (3). In Eq (4), Ni is the cumulative number of disaster occurrences in each prefecture, and $\bar{N}$ is the average number of occurrences in 47 prefectures in Japan.

For the earthquakes, a further grouping is required. There are two types of earthquake; inter-plate earthquakes and earthquakes located directly above the focus. In GNS2015 and 2017, the data were normalized by different methods for each type of earthquake. Exposure Sub-goals are determined by 6 Normalized indictors based on 10 different Original data bases (Abe, 2006; Active faults research group, 1991; Arakawa et al., 1961; Cabinet Office, Government of Japan, 2015a; Geospatial Information Authority of Japan, 2015; Japan Meteorological Agency, 2015; Jiban-net, 2015; Ministry of Internal Affairs and Communications, 2015c; Miyazaki, 1956; Nakata and Imaizumi, 2002; Japan Meteorological Agency and Volcanological Society of Japan, 2003; National Research Institute for Earth Science and Disaster Prevention, 2015; National Land Information Division, National Spatial Planning and Regional Policy Bureau, MLIT, 2015; Statistical Information Institute Consulting and Analysis, 2015; The Headquarters for Earthquake Research Promotion, 2015).

For the inter-plate earthquakes, J-SHIS (Japan Seismic Hazard Information Station) Map prepared by National Research Institute for Earth Science and Disaster Prevention (2015) is utilized. The Map provides the distribution of population (population seismically exposed; PSE) in the areas, of which seismic intensity exceeds a certain value, for a given focus and a given magnitude of earthquake. In GNS2015 and GNS2017 calculations, equal or over the seismic intensity of 6 caused by the above 13 earthquakes was taken as “Exposure” for the inter-plate earthquakes. For the earthquakes located directly above the focus, extended lengths of active faults are used, and the extended lengths are divided by the total area of the prefecture, which is equivalent to a density of active faults. Since a clear separation of exposure calculated due to these two types of earthquake is not straightforward, the average value of the two exposures is used in the calculation.

For tsunami, “Tsunami Inundation Prediction” map provided by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is used to evaluate the population in the affected areas. For storm surges (high tide), the area 3 meters below the sea level is considered as the affected area and population in the affected area is calculated.

For sediment disasters, “sediment disaster hazard points” in the national land numerical information download service provided by MLIT are used to calculate the population in the affected area.

For volcanic disasters, the data are used in the chronological table of volcanic disaster from the year of 1600 onwards published by the Meteorological Agency (2003). The exposure of volcanic disasters is multiplying the percentage of people living in the volcanic areas and the frequency coefficient.

For flood, which is newly introduced, “Inundation Prediction” map provided by MLIT is used to evaluate and the population in the affected area with over 2 meters in inundation depth is considered. For each natural disaster, the exposure (E) can be calculated accurately by superimposing the above-mentioned affected area by natural disasters and the population distribution obtained from the portal site of Japanese Government Statistics (so-called e-Stat) provide by Statistics Bureau of Japan by using GIS. The national census is taken every five years and the population distribution data are also updated every five years.

2.3 Vulnerability

For vulnerability assessment, available data are categorized into two; hardware measures and software measures as an ordinary accepted classification. Hardware measures means physical disaster prevention methods such as aseismic methods of structures and upgrading methods of aged infrastructures to mitigate against natural disasters. Hardware measures indicators are classified into a group of sub-indicators named a sub-category. Four sub-categories are selected:(1) house, public facilities, (2) utility lines such as gas, water, sewage network (3) infrastructures (4) information, telecommunication. In the process of calculation of hardware measures indictors, sub-categories are calculated from 14 different data bases and then sub-categories are multiplied by weighted coefficients, leading to the values of these subcategories.

Software measures means measures other than hardware measures, including a social system of conducting frequent disaster education, stocking food for emergency and preparing manuals at the time of disasters. Four sub-categories are selected. (1) relief goods, food stock, (2) medical services, (3) economy and population structure, (4) insurance, (5) regulations/autonomy. Similar to that in the calculation process of hardware measures index, sub-indicators are obtained from a cluster of 22 database, and subcategories are multiplied by weighted coefficients. Finally, both hardware and software measures indicators are obtained by multiplying the weighted coefficient (see Table 1).

Table 1 Source data, normalized indicators, sub-goals, and weighting coefficients for the calculation of GNS

Original data	Normalized indicators	Weight Wi	Sub-goals	Weight wi	Sub-goals	Weight wi	Risk compo	Risk index
J-SHIS Map (Disaster affected people)	Inter-plate earthquake	1/2	Earthquake	1/6	-	-	Exposure	GNS
Total length of active faults [km]	Epicentral earthquake	1/2						
Tsunami inundation supposition	Tsunami	1.0	Tsunami	1/6				
Tsunami area population rate of altitude less than 3m [%]								
Number of storm surge [times]	Storm surge	1.0	Storm surge	1/6				
Population rate of altitude less than 3m [%]								
Sediment disaster hazard points	Sediment disaster	1.0	Sediment disaster	1/6				
Sediment disaster area population rate [%]								
Number of volcanic disasters	Volcano disaster	1.0	Volcano disaster	1/6				
Population rate in volcanic area [%]								
flood assumption area	Flood disaster	1.0	Flood disaster	1/6				
flood area population rate of altitude less than 2m [%]								
Rate of earthquake resistant private building [%]	Rate of earthquake resistance of buildings	1/3	Buildings	1/4	Hardware	1/2	Vulnerability	
Rate of earthquake resistant public building [%]								
Rate of non-fireproof wooden houses [%]	Rate of non-fireproof houses	1/3						
Rate of damaged buildings [%]	Rate of damaged buildings	1/3						
Rate of earthquake resistant main pipelines [%]	Rate of earthquake resistance of water supply and drainage facilities	1/2	Lifelines	1/4				
Rate of earthquake resistant purification plants [%]								
Rate of earthquake resistant service reservoirs [%]								
Rate of decrepit pipeline (over 40 years) [%]	Percentage of decrepit pipeline	1/2						
Total length of road [km]	Road density index	1/2	Infrastructures	1/4				
Repair rate of bridges [%]	Repair rate of bridges	1/2						
Rate of development of broadcast communication equipment system [%]	Rate of development of radio communication facilities for disaster prevention	1/2	Information, networks	1/4				
Rate of development of portable broadcast communication system [%]								
Rate of development of J-Alert system [%]	Rate of development of J-Alert system	1/2						
Rate of development of J-Alert automatic system [%]								
Number of stockpiling hardtacks [meals]	Stockpiling foods	1/5	Emergency stockpile	0.225	Software	1/2		
Number of stockpiling instant noodles								
Amount of stockpiling rice [kg]								
Number of stockpiling canned staple foods								
Number of stockpiling side dishes								
Amount of stockpiling water [l]	Stockpiling water	1/5						
Number of stockpiling blankets	Stockpiling blankets	1/5						
Number of supermarket store	Supermarket store index	1/5						
Number of convenience store	Convenience store index	1/5						
Number of physicians	Number of Physicians per 100,000 population	1/2	Medical services	0.225				
Number of hospital beds	Number of Hospital beds per 100,000 population	1/2						
Financial capability index	Financial capability index	1/4	Economy and population	0.225				
Gini coefficient	Gini coefficient	1/4						
Old-age index [%]	Old-age index	1/4						
Rate of persons who received public aid [%]	Rate of persons who received public aid	1/4						
Rate of participation in earthquake insurance [%]	Rate of participation in earthquake insurance	1	Insurance	0.10				
Number of dangerous sites subject to sediment disaster	Rate of specification of sediment disaster prone areas	1/3	Regulations and governance	0.225				
Number of sediment disaster prone areas								
Number of municipals publishing hazard maps for tsunami disaster	Rate of publication of hazard maps	1/3						
Number of municipals publishing hazard maps for floods disaster								
Number of municipals publishing hazard maps for sediment disaster								
Rate of households covered by voluntary disaster prevention organization [%]	Coverage rate for the voluntary disaster prevention organization	1/3						

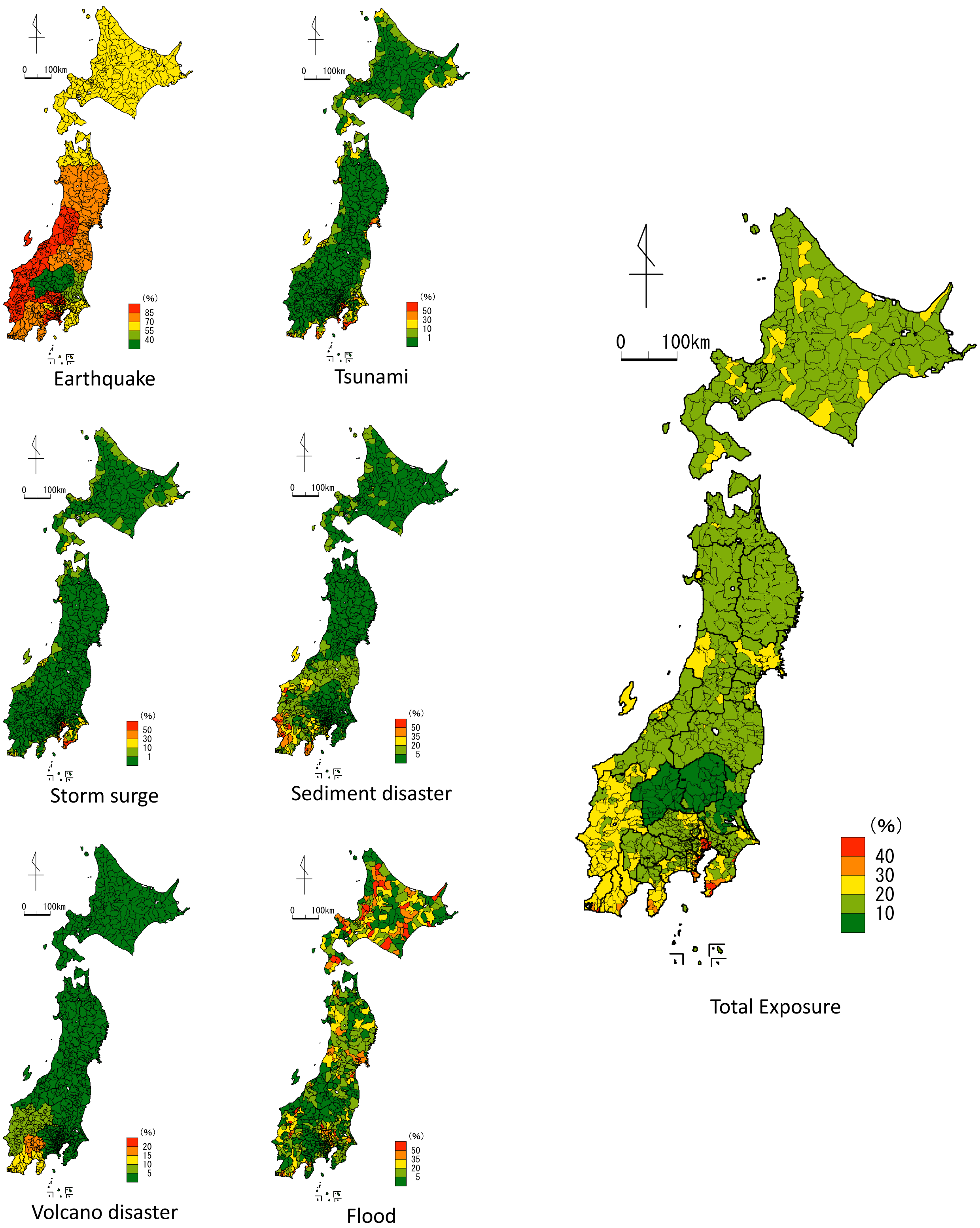


Fig. 4. Exposure

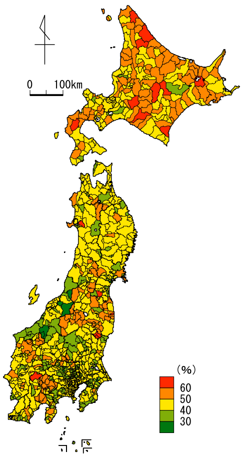
3. Natural disaster risks at East Japan area evaluated by GNS

3.1 Exposure

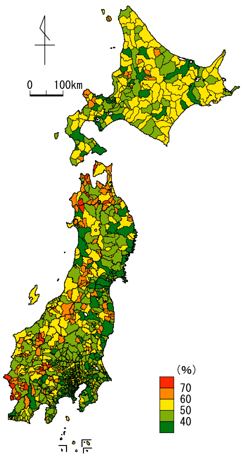
Fig. 4 shows the exposures of natural disasters in municipal scale in East Japan. The exposures of tsunami and storm surge are larger in the coast coastal areas of Chiba, Tokyo, Kanagawa, Shizuoka and Miyagi prefectures. The exposure of sediment disaster is larger near in mountainous areas of Kanagawa, Shizuoka, Nagano, and Niigata prefectures. As for flood, there are some municipalities with large flood exposure along first-class rivers in Saitama, Tokyo, Shizuoka, Nagano, Miyagi, and Hokkaido prefectures. The final summary of exposures is shown below. The three prefectures of Gunma, Tochigi, and Ibaraki have low exposures, and the exposures in coastal areas such as Tokyo, Chiba, Kanagawa, and Shizuoka tend to be high.

3.2 Vulnerability

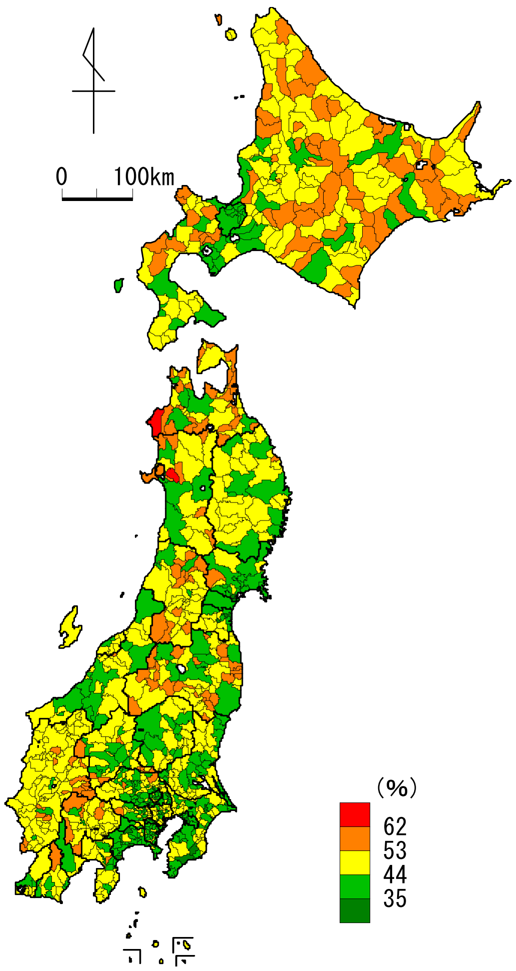
Fig. 5 shows the vulnerability obtained from the sum of hardware and software measures. Both vulnerabilities of hardware and software are not different in the prefectural scale but some differences are seen depending on municipalities, which are expressed with mosaic patterns.



Vulnerability related to hardware measures



Vulnerability related to software measures



Total vulnerability

Fig. 5. Vulnerability

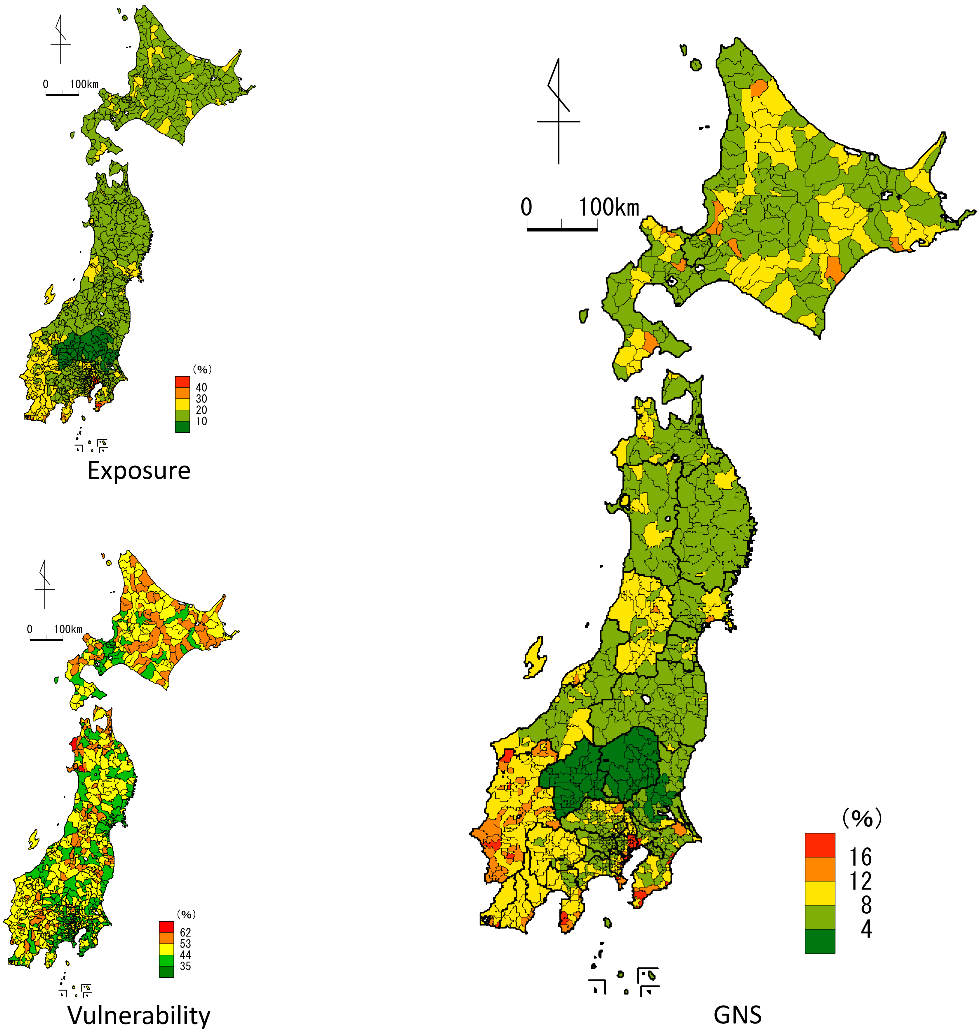


Fig. 6. GNS

3.3 GNS

Fig. 6 shows exposure, vulnerability, and GNS. The trend of GNS shows a tendency similar to that of exposure, which means that exposure has a great influence on GNS. GNS can indicate natural disaster hotspots in municipal scale.

4. Conclusions

In this study, the new calculation methodology using GIS (Geographic Information System) was introduced to evaluate exposure of natural disasters more precisely in municipal scale. The newly extended GNS was applied to evaluate natural disaster risks of each municipality in East Japan. Additionally, the exposure of flood disaster can be evaluated by superposing damage estimation maps and population distribution using GIS.

5. Acknowledgements

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◆ A brief CV of Dr. Kazuya Itoh

Kazuya Itoh graduated from Musashi Institute of Technology with Bachelor and Master degrees in the field of Civil Engineering in 1998 and 2000, respectively. He obtained his Ph. D degree from Tokyo Institute of Technology in the field of Civil Engineering in 2003. After his Ph. D, he worked in National Institute of Occupational Safety and Health, Japan (JNIOSH) then move to Tokyo City University from April, 2015. He is currently Associate Professor in Tokyo City University. His research field is physical modelling in geotechnical engineering, and he involves many civil engineering projects such as prevention and mitigation of geo-disasters, labour accident caused by geotechnical field etc.

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Series Report: Reports from USA (Part 4)

Applications of the Press-in Piling Method to Emergency Bridge Foundation Repair

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INTRODUCTION

Increasingly frequent and severe flooding damages foundations of bridge piers and abutments all over the world. Repair of compromised bridge foundations often requires steel cofferdams to be constructed under low lying bridge girders in the face of hard soil without generating a high level of vibrations. The Press-in Piling Method can easily satisfy these project needs because of the way the method works. This article highlights the advantages of the method with two case studies of emergency bridge foundation repair; one in the United States and the other in Japan.

CSX BRIDGE PIER REPAIR WORK IN COLUMBUS, OHIO, UNITED STATES OF AMERICA

CSX Transportation is one of a few freight railroad companies based in the United States, which has more than 30,000 km of route track in the eastern parts of the U.S. and Canada. One of its rail bridge piers in Columbus, Ohio was heavily scoured around its foundation, needing emergency repair work in 2015 (Fig. 1). The original pier foundation was on timber piles with a concrete footing. The repair work was to drive micropiles around the original footing first with a larger concrete encasement footing to be constructed after a sheet pile cofferdam was built. See Figs. 2 and 3 for the structural details.

Fig. 1. Bridge Pier with Damaged Foundation

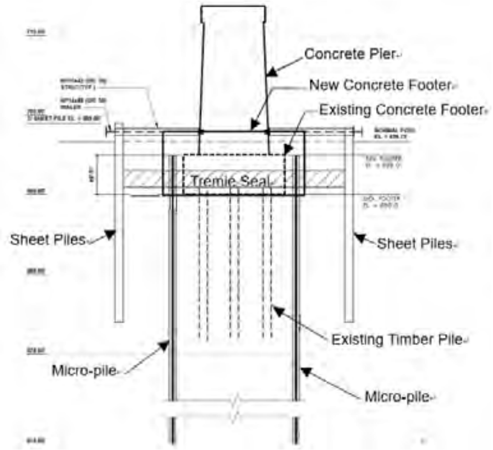

Fig. 3. Cross-section of Cofferdam and Pier Foundation (Source: Richard Goettle Inc.)

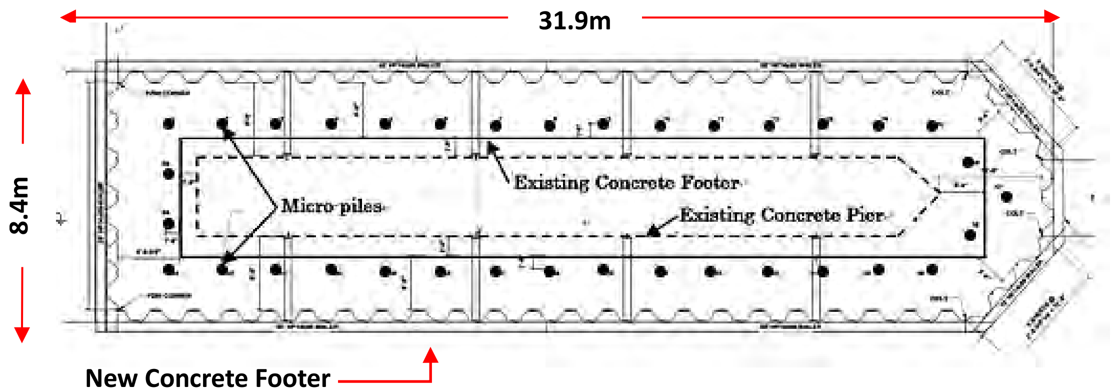

Fig. 2. Plan View of Cofferdam (Source: Richard Goettle Inc.)

The sheet pile cofferdam was to create dry working space around the damaged foundation to place tremie seal at the bottom and to construct a new larger reinforced concrete footing inside it. The construction of the cofferdam required careful planning because of the limited overhead clearance under the bridge girder (5.1 m) and proximity to the damaged foundation without generating a high level of vibration (White et al., 2002). For these reasons, the foundation subcontractor chose to press-in sheet piles for the cofferdam. Fig. 4 shows the soil conditions at the pier with N-values and the vertical location of the 7.5m long sheet piles. As can be seen, the soil was not very hard for the entire penetration except sand and silt mixed with stone fragments found between 3.6 to 4.5 m below the GL. A water jetting or auger attachment was not needed.

In order to work under the bridge girder, short sheet pile sections were brought over to the press-in piling machine by a small track loader with a special arm to hold the short sheet piles in position after their lower sections had been pressed in (Fig. 5). Each new section was then spliced by welding to the lower section in place. With the sheets spliced together, the press-in piling work continued. Approximately 9 sets of welded sheets were pressed-in per 10-hour shift. Fig. 6 shows the concrete pier with the existing concrete footing, lines of new micropiles, and steel bar reinforcement placed inside the sheet pile cofferdam.

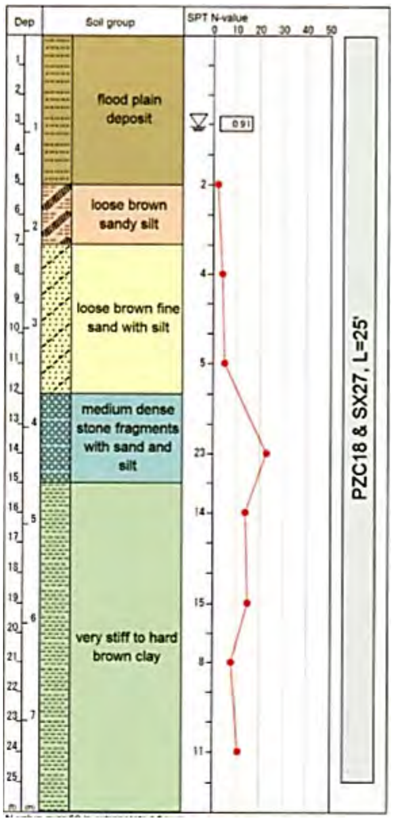

Fig. 4. Soil Conditions and Sheet Pile Location

Fig. 5. A Short Section Being Placed on Top of the Lower Section for Splicing Under the Rail Girder

Fig. 6. Sheet Pile Cofferdam and Micropiles for Larger Encasement Footing

The cofferdam construction was finished within a short period of time without affecting the weakened pier foundation or the rail girder above it. Although this project did not encounter very hard soil, emergency bridge foundation repair often faces gravel, cobbles, and boulders brought over by flooding. The auger attachment becomes essential for safe and efficient installation of sheet piles in these cases (Takuma et al., 2018). Additionally, sheet piles have been pressed in an extremely low headroom (1.0m) situation in fast running water on a different project (Takuma et al., 2015).

UTO BRIDGE ABUTMENT EMERGENCY REPAIR IN KAGOSHIMA, JAPAN

The Kyushu region of Japan experienced very heavy and continuous rain in a short period of time on June 20, 2016 and the following couple of days. More than 250 mm of precipitation was recorded during a 24-hour period in the City of Kagoshima where the Uto Bridge was located. The bridge section was immediately closed when deep erosion of the slope just in front of its abutment was reported. See Fig. 7 for the degree of erosion nearly exposing the abutment's foundation at the beginning of the project.

The highway agency in charge determined that a pressed-in pipe pile retaining wall would be the only safe and reliable solution to expediently protect the abutment because of the very steep and unstable slope created by the flooding right underneath it in addition to extremely difficult construction access.

Fig. 8 shows the concept of Giken's proprietary GRB System involving a Gyropress piling machine with its power unit, a Clamp Crane, and a Pile Runner; all working and moving on top of already installed piles while using the line of installed piles as a construction staging area as well as an access road. The Pile Runner hauls piles from a faraway access point by travelling on the piles to the Clamp Crane which then picks up one of the piles and brings it to the Gyropress piling machine. Once these pile sections are fully unloaded, the Pile Runner goes back to the access point for the next batch of piles. This system enables pile installation on projects even where construction access is impossible or extremely difficult to secure such as this project.

Fig. 7. Severe Erosion in Front of the Abutment

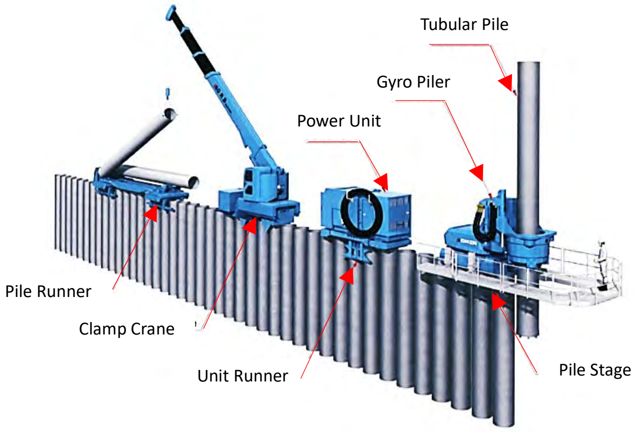

Fig. 8. Concept of GRB (Giken Reaction Base) System

Uto Bridge has a slightly curved 42-meter-long single span with a two-lane highway supported by its concrete girder. Fig. 9 shows the plan view of this emergency repair work to prevent further erosion around the foundation. 15 of 1,500mm diameter pipe piles were pressed in to form a very solid earth retaining structure. The pile's length varied from 15.5 to 24.5 meters with the wall thickness from 15 to 21 mm. Each pile was spliced once, twice, or three times depending on the pile's location and its overall length. The pile driving was planned to start from the downstream side because of easier access compared to the other side. The soil condition was from weathered to fresh sandstone covered with a thin surface clay layer spared from the storm water. The sandstone was expected to have an average equivalent N-value of 275. See Fig. 10 for the cutting shoe of the pile that enabled the pile installation into the sandstone. The Gyropress piling machine rotated and simultaneously pressed pipe piles into the ground (Takuma et al., 2013). Fig. 11 shows the installation of one of the piles in the

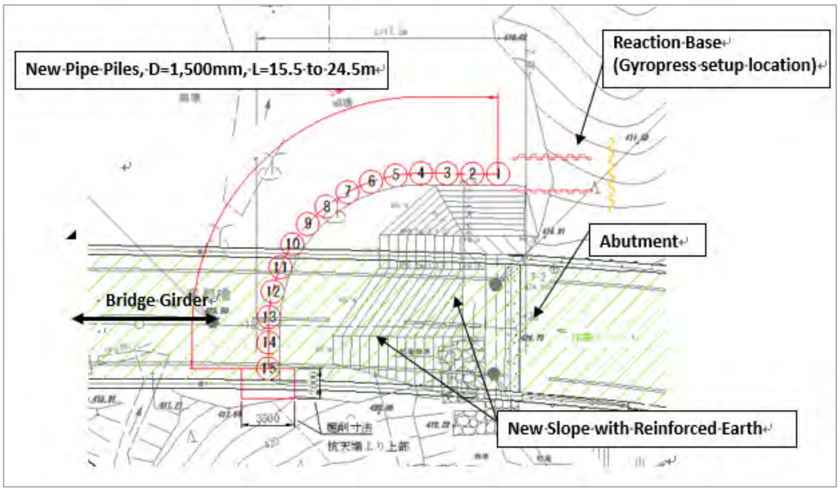

Fig. 9. Project Plan View

middle of the heavily eroded and unstable slope.

Fig. 10. Cutting Shoe of Pipe Pile (Sacrificial)

Fig. 11. Pile Installation on Heavily Eroded

The highest self-standing height of these piles was as much as 12 meters. Since there were no other practical ways to bring the piles to the Gyropress piling machine for the piling locations under the girder, a Clamp Crane was mobilized to supply the sections to those locations. The crane was equipped with a Y-shaped boom end, allowing it to lift and hold one end of pipe section in the minimal overhead clearance as shown in Fig. 12. The heaviest section lifted by the crane on this project was slightly more than 5.0 metric tons.

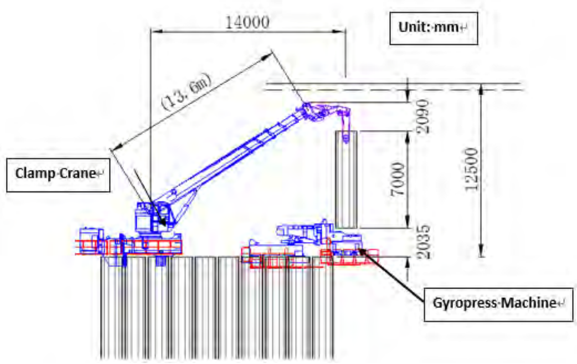

Fig. 12. Pipe Section Supplied by Clamp Crane

Fig. 13 shows installation of the last pile under the girder with the pile supplied by the Clamp Crane. Once the pile installation was completed, both the Clamp Crane and the Gyropress machine were walked backward to the reaction stand next to the side of the abutment and dissembled there for demobilization. Fig. 14 shows the completed pipe pile wall after the equipment was removed off the piles. 200 mm wide steel strips were welded onto both sides of each pile to fill the 80 mm wide gaps between piles as designed.

Fig. 13. Last Pile Supported by Clamp Crane during Splicing

The press-in force and torque were closely monitored real time for smooth installation with minimal vibration. Thanks to the combination of the rotating cutting shoes and the press-in force simultaneously exerted on the piles, the necessary press-in force for installation was relatively small, considering that the piles were installed deep into fresh sandstone. The piles were not for carrying vertical load so the vertical loading capacity was not calculated or tested.

Fig. 14. Pile Installation Completed

Finally, a reinforced earth embankment was placed against the abutment inside the retaining wall for its stability. The pressed-in pipe pile wall provided a highly reliable earth retaining structure to secure the once threatened abutment.

CONCLUSIONS

Press-in piling can provide very safe and highly reliable bridge foundation repair solutions even in the face of extremely difficult site conditions, such as low headroom, steep and unstable slopes, and very hard soil. A watertight cofferdam can be built quickly with pressed-in sheet piles even in running water.

ACKNOWLEDGMENTS

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Event Report

IPA Press-in Engineering Seminar in Tokyo 2019

Yuki Hirose

IPA Secretariat

Traditionally, IPA Press-in Engineering Seminar has been held in Kochi, birth place of Silent Piler, over last ten years. This time, the 11th IPA Press-in Engineering Seminar was held outside Kochi, at a conference room of the Japanese Geotechnical Society (JGS) in Tokyo on 18th September 2019. The theme of the seminar was selected as the State-of-the-Art technology for estimation of subsurface information by utilizing data obtained during press-in piling called the "Press-in Data Monitoring System". Over 70 participants attended this Seminar (Photo 1).

Photo 1. Overview of Seminar

After the opening address by Prof. Yoshiaki Kikuchi of Tokyo University of Science (Chair of Research Committee, IPA Director), four lectures were presented as follows:

Lecture 1 Title: Recommendations by JGS against the problems on foundation Pile by Dr. Hiroshi Furuya (Former Vice President of JGS, Senior Chief Engineer, Obayashi Corporation)

Lecture 2 Title: Estimation of subsurface information from data obtained during press-in piling by Mr. Hiroyuki Ishihara (Manager, GIKEN LTD.)

Lecture 3 Title: Improvements of Practical application of estimation method of ground information using Press-in data by Mr. Koichi Okada (Chief, GIKEN LTD.) and Ms. Nanase Ogawa (Assistant Manager, GIKEN LTD.)

Lecture 4 Title: Application of Press-in Data Monitoring System by Mr. Tomohisa Ozawa (President, Ozawa Civil Engineering and Construction Co. Ltd.)

Photo 2. Q&A Session

Many questions were raised by the audience in each Q&A session (Photo 2)

Prof. Osamu Kusakabe, President of IPA, gave the closing address, stating that the "Press-in Data Monitoring System" has a potential to enable designers and contractors to communicate and understand each other, and change the conventional processes of constructing structures better by sharing their feedback.

Prof. Kikuchi commented after the seminar that he was pleased to have more than 70 audiences in this seminar. Seminar topics were mostly focused on collecting subsurface Information during construction. These topics will be interested in not only practical engineers but also research engineers. Such a piece of Subsurface Information is important for practical engineers. He pointed out that the relation between the measured construction data during piling and soil properties are interesting to research engineers as well. The research committee of IPA plans to hold coming seminars in other places than Tokyo or Kochi, by which IPA hopes to improve the awareness of geotechnical engineers on the recent Press-in Technology.

Reports

11th IPA Press-in Engineering Seminar in Tokyo 2019 (Continued)

(1) Recommendations by JGS against the problems on foundation Pile

Naoki Suzuki
IPA Secretariat

Dr. Hiroshi Furuya gave a lecture on the JGS activity related to "Tilting Yokohama condo case" and introduced some recommendations on foundation pile made by a JGS special committee. "Tilting Yokohama condo case" was a controversial case of piling foundation, where several residents found a tilt between the two buildings, and they pointed out that "A handrail part of the corridor connecting the West Building and the Central Building was out of alignment by 20 mm". Subsequent investigations revealed that 8 piles did not reach the bearing layer, 2 piles did not have enough pile length, and data of other 45 piles were falsified. as is schematically illustrated in Fig.1. This scandal was taken up extensively by mass media such as newspapers and television, and widely spread to the public.

Dr. Furuya pointed out the following four issues from the investigative activity;

1) Chronic problems in the contract work: Construction sequence of pile foundations typically follows as geotechnical investigation, design, building confirmation, and selection of contractors. Generally, engineers in charge do not want to alter the initial design to meet the deadline of the pre-determined schedule, which might cause some delay. This problem often results that enough soil investigation is not carried out.
2) Lack of sharing topographical and geological information: Presently a data base of geological information covering most urban region in Japan is readily available to engineers for free. The ground under the tilting Yokohama building has a complex topography with uneven baring layer. If the existing data available were properly referred to, the initial design of pile foundations could have been made with higher accuracy.
3) Lack of knowledge on guideline concept: Guidelines or/and manuals for piling design and construction are aimed, in principle, to be written in such a way that everyone could reach the same results. However, for simplicity, these guidelines and manual sometimes omit the details such as preconditions and leave a room for engineers to interpret. Some practical engineers are lack of proper knowledge on soil investigation methods and interpretation of the results.
4) Lack of geotechnical engineers: A site supervisor familiar with the geotechnical engineering does not always manage constructions.

Various topics were presented through this lecture. The author has a comment on the use of construction data which will make it easier to check uncertainties during and after construction due to complex terrain. , and also the author feels that engineers will have to keep in mind that new technologies are likely to be a black box, thus causing data falsification more easily. It will become more necessary for us to keep up with new technologies and understand their ideas than ever before.

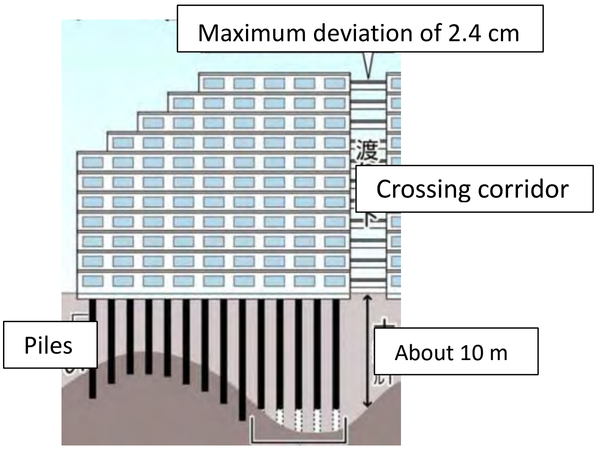


Fig.1. Illustration of "Tilting Yokohama condo case" (https://www.sankei.com/)

Photo 1. Dr. Furuya was giving a lecture

Reports

11th IPA Press-in Engineering Seminar in Tokyo 2019 (Continued)

(2) Use of press-in piling data for estimating subsurface information: IPA-TC2 technical material

Yukihiro Ishihara

Manager, Scientific Research Section, GIKEN LTD. / Director, IPA

IPA-TC2 (Chaired by Dr. Osamu Kusakabe, President of IPA) finalized a Japanese technical material on the use of press-in piling data for estimating subsurface information in 2017, titled as 'Technical Material on the Use of Piling Data in the Press-in Method, I. Estimation of Subsurface Information'. This technical material was published by IPA and is accessible on IPA Website. This report overviews the research activities on the use of press-in piling data, which were presented in IPA Press-in Engineering Seminar in Tokyo.

1. Background

The design and construction of structures with piles are usually based on the subsurface information that are obtained by interpolating the results of the site investigation results carried out separately from each other with the distance of several dozens of meters or about one hundred meters. On the other hand, local variations are often found in the actual ground conditions, such as the inhomogeneity of the soil layers and the existence of weak soils or hard cobbles in the ground. The difference between the prior information and the actual conditions arising from the inhomogeneity of the ground is one of the major factors that deteriorate the rationality of design and construction of structures with piles. Besides the well-known features of the Press-in Method (low noise, low vibration, spatial efficiency etc.), a feature of an automatic acquisition of piling data for each single pile has been focused on by Giken research team, in the expectation of rationalizing the design and construction of piles.

2. Estimation methods

So far, methods of estimating subsurface information from piling data have been developed for three different installation techniques in the Press-in Method: Standard Press-in (without any installation assistance), Press-in with Augering (Crushpiling) and Rotary Cutting Press-in (Gyropiling). These estimation methods do not require any instrumentation with piles, but assume several conditions as listed in Table 1.

Table 1 Assumed conditions in the estimation methods

Installation techniques	Assumed conditions
Standard Press-in	1) Without interlock connection 2) With repeated penetration and extraction 3) Relatively small penetration rate
Press-in with Augering (Crushpiling)	1) Piling data during pre-augering process 2) Requirement in size and shape of auger head
Rotary Cutting Press-in (Gyropiling)	1) Measurement of the length of soil inside the pile

In Standard Press-in, the penetration of a pile is similar to that of a cone in CPT. This similarity is taken into account in the estimation method. The estimation process can be divided into four, as shown in Fig. 1 (Ishihara *et al.*, 2015a). Firstly, the vertical jacking force applied to a pile by a press-in machine is decomposed into a base resistance (Q_b) and a shaft resistance (Q_s). Q_b is obtained as the difference between the jacking forces measured when the pile base passes a certain depth for the first time and for the second time in each cycle of the repeated penetration and extraction (Ogawa *et al.*, 2012). Secondly, a unit base resistance (q_b) and a unit shaft resistance (q_s) are obtained from Q_b and Q_s, by considering the area on which Q_b and Q_s are acting. The plugging conditions are taken into account to define the effective base area by introducing *IFR* (Incremental Filling Ratio) for tubular piles (Lehane & Gavin, 2001; Ishihara *et al.*, 2018), and this is extended to sheet piles considering the shape effect (Taenaka, 2013). Thirdly, the obtained q_b and q_s are converted into CPT q_c and f_s, by considering the scale effect on the plunging values of q_b (White & Bolton, 2005) and the rate effect based on the Finnie factor (Finnie *et al.*, 1994; White *et al.*, 2010; Bolton *et al.*, 2013). Finally, the soil type and SPT *N* are estimated from q_c and f_s, based on the methods developed by Robertson (1990) and Jefferies & Davies (1993) respectively.

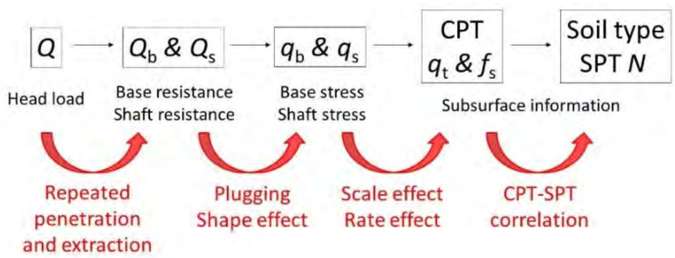


Fig. 1. Estimation process in Standard Press-in

In Press-in with Augering, two estimation methods were proposed (Ishihara *et al.*, 2015a), based on the knowledge acquired in the field of rock drilling. The first one is to estimate SPT N from a torque on the auger head (T_b), a penetration rate (v_d) and a rotation number (n) as shown in Eq. (1), with A and γ being constants. This is based on the knowledge that the parameter $T_b/(d_c)^\gamma$, where d_c is the depth of cut (= v_d/n), is proportional to the unconfined compressive strength of a rock (Nishimatsu, 1972; Fukui, 1996; Fujimoto, 2005) and the assumption that the unconfined compressive strength and SPT N are in proportional relationship. The second one is the method known as MWD (Measurement While Drilling) (JGS, 2004), in which SPT N is estimated from T_b, v_d, n and a base resistance on the auger head (Q_b) as shown in Eq. (2), with C_n the constant.

$$N = A\frac{T_b}{(v_d/n)^\gamma} \qquad (1)$$

$$N = C_n\left(Q_b + 2\pi\frac{T_b}{v_d/n}\right) \qquad (2)$$

The estimation process in Rotary Cutting Press-in is divided into three, as shown in Fig. 2. Firstly, a vertical and a rotational jacking forces applied to a pile by a press-in machine (Q, T) are decomposed into base and shaft components (Q_b, Q_s, T_b and T_s), by introducing Eqs. (3) - (6) where δ_{sp}, D_o and v_r are the frictional angle at the soil-pile interface, the outside diameter of the pile and the rotational rate of the pile shaft, respectively (Ishihara *et al.*, 2015b).

$$Q = Q_b + Q_s \qquad (3)$$

$$T = T_b + T_s \qquad (4)$$

$$\frac{T_b}{Q_b} = \frac{\tan\delta_{sp}}{3}D_o \qquad (5)$$

$$\frac{T_s}{Q_s} = \frac{v_r/v_d}{2}D_o \qquad (6)$$

Of these, Eq. (5) is based on the assumption that both Q_b and T_b are expressed by a unit base resistance (q_b), while Eq (6) is obtained by assuming that a frictional stress on the pile is shared by Q_s and T_s according to the ratio of v_d to v_r. The validity of the latter assumption is discussed by Bond (2011). Secondly, the incremental energy (δE) required for deforming a soil below the pile base by a volume of δV is calculated from Q_b and T_b. $\delta E/\delta V$ is an index called Specific Energy, which is widely used to represent the performance of machines for rock drilling (Teale, 1965; Hughes, 1972). According to Hughes (1972), Li & Itakura (2012) and others, there is a linear correlation between the Specific Energy in rock drilling and the unconfined compressive strength of the rock. By extending it, the Specific Energy required for penetrating something into a ground may be assumed as being in proportion to the unconfined compressive strength of the ground. By considering the proportional relationship between the Specific Energy required for Rotary Cutting Press-in and that for the penetration of an SPT sampler, SPT N value is obtained.

3. Case studies

Fig. 3 is the comparison between the subsurface information obtained by SPT and that estimated from the piling data in Standard Press-in, where a closed-ended tubular pile with D_o = 318.5mm and a sheet pile with the width of 600mm were pressed-in at v_d = 20mm/s and 30mm/s respectively. The peak values of N

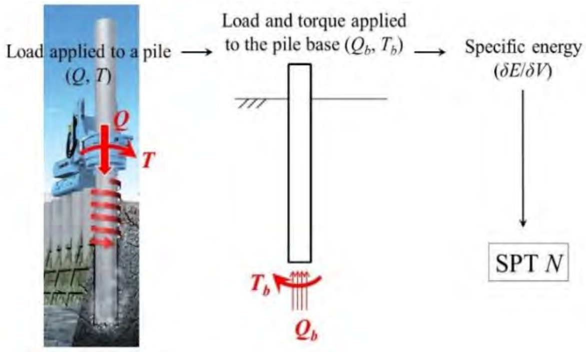
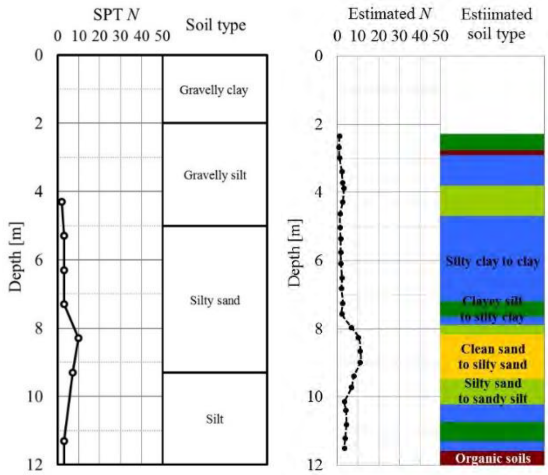
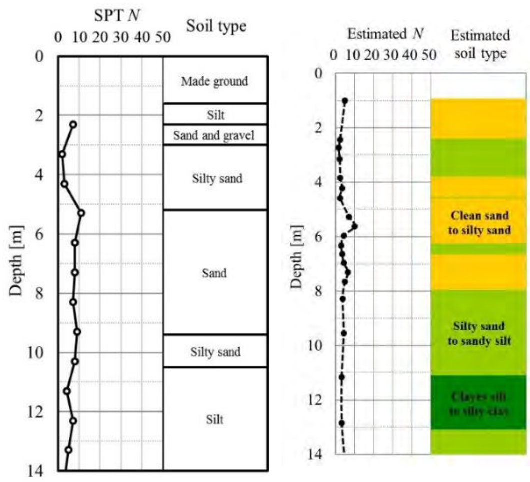


Fig. 2. Estimation process in Rotary Cutting Press-in



(a) Closed-ended, D_o = 318.5mm, v_d = 20mm/s (C11-05)



(b) Sheet pile, 600mm wide, v_d = 30mm/s (J0617-05)

Fig. 3. Comparison of SPT & boring (left) and estimation (right) (Standard Press-in)

and the soil type are well estimated, while the values of *N* (other than the peak values) are underestimated. The previous case studies including these two have revealed that the effect of plugging condition on the estimated results is significant while the effect of penetration rate is not. Fig. 4 is the comparison between the subsurface information obtained by SPT and that estimated from the piling data in the pre-augering process in Press-in with Augering, using an auger head with the number of wings of three and the outside diameter of 450mm. The trend of the variation of *N* with depth is well estimated, while big differences are found at some depths. Through the case studies including this, these differences are believed to be associated with the existence of large gravels or stones, judging from the records in SPT. Fig. 5 is the comparison between the subsurface information obtained by SPT and that estimated from the piling data in Rotary Cutting Press-in. The trend of the variation of *N* with depth is well estimated in this case, where the plugging condition were confirmed as almost constant with depth. Another other case study, on the other hand, has clarified that the effect of the plugging condition on the estimated results is significant. If the plugging condition varies with depth, it is recommended to measure the length of the soil column inside the pile with a sufficient frequency of data sampling so that *IFR* can be estimated continuously with depth.

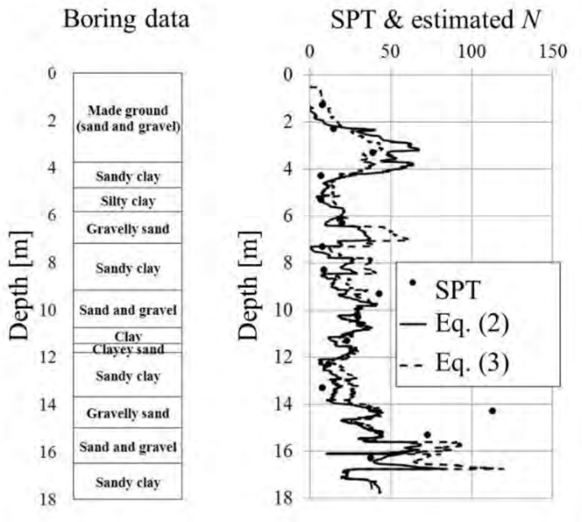


Fig. 4. Comparison of boring (left), SPT and estimation (right) (Press-in with Augering)

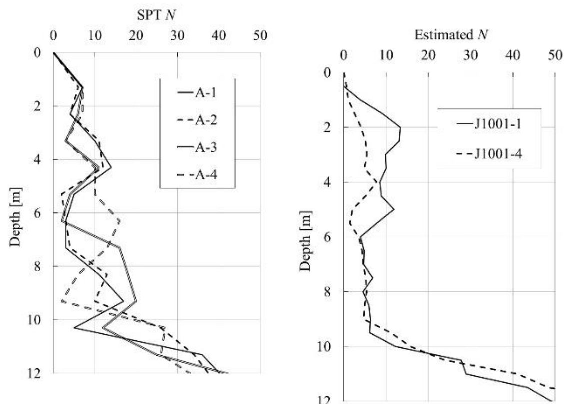


Fig. 5. Comparison of boring & SPT (left) and estimation (right)

4. Practical use of the estimated results

Based on the discussion through case studies, the technical material recommends that the estimated results should be limitedly used as reference information in termination control of piling work (e.g. confirmation of the bearing stratum), judgement of alteration of installation techniques, and so on, at the moment. Three examples are mentioned as follows. 1) Contractors grasp the trend of variation of the estimated *N* with depth and confirm the bearing stratum. They propose an alteration of the embedment depth, if significant variation in the depth of bearing stratum. 2) Contractors alter the press-in conditions (to operate press-in machines) based on the estimated information and improve the efficiency of piling work. 3) Contractors summarize the estimated information and propose an alteration in construction plan (e.g. re-selection of installation assistance) when unexpected ground conditions are encountered.

It is also recommended in the technical material that additional subsurface investigations should be conducted if the validity of the estimated results is dubious due to a significant difference from the existing subsurface information. In such a case, however, the limitation in the applicability of SPT to a hard ground (Mitsuhashi, 1995; Ogawa *et al.*, 2013) have to be considered. Other options could be a trial digging or a large-diameter core tube sampling (Watanabe *et al.*, 2006). A ground-penetrating radar (Kimura *et al.*, 2000) or a surface-wave method may also be the options if their present technical limitations (difficulty in classifying cobbles and cavities in the former and low dissolution in the latter) are overcome.

5. Future challenges

The author expects the estimation techniques to be practically used in actual construction projects. At the same time, continuous efforts are necessary on (1) updating the values of parameters by accumulating estimation results, (2) removing some of the restrictions in table 1 or developing new estimation methods, (3) direct estimation of pile performance, (4) developing better measurement techniques, and so on, to further sophisticate these techniques. Due to the uncertainties related with the ground, the concept of Observational Method addressed by Terzaghi (Peck, 1969) is still effective in the present construction projects; design calculations are still a sort of assumption that requires confirmation or modification during the construction phase (Kusakabe, 2017). The author expects that the estimation techniques assure a firm step forward for the press-in piling industry in this context. An English version of the IPA-TC2 technical material are to be prepared in the near future.

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Reports

11th IPA Press-in Engineering Seminar in Tokyo 2019 (Continued)

(3) Improvements of Practical application of estimation method of ground information using Press-in data

i) Expansion of the usage of estimation of ground information during press-in with augering

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GIKEN LTD.

“Silent Piler” pushes a pile into the ground by static loading, and the press-in force and penetration depth can be recorded during press-in. We call these measurement data “Press-in data”. These data have been often used by piler operators for checking piling work and by Client for managing quality of piling. Moreover, “Press-in data” contains valuable information such as ground information.

Fig.1 illustrates the “Press-in Data Monitoring System” using Press-in data. This system features two new technologies: First is automatic piling to optimize piling work. This system can optimize the piling work automatically by using Press-in data for estimating ground conditions. Second is estimation of ground information such as N value or soil classification by using Press-in data. In the actual ground. If we use this system, it will become easier to confirm the bearing stratum or check the construction plan because we can obtain the data from all the piles.

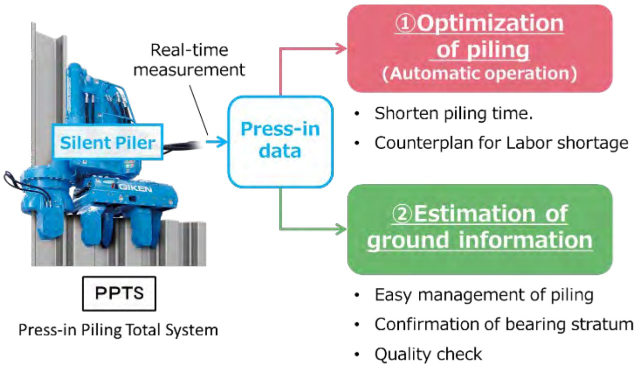

Fig.1. Press-in Data Monitoring System

We have been using Press-in Data Monitoring System since 2013. Although current Press-in Data Monitoring System has some limitations on scope of application (Table.1), it was confirmed that automatic operation by Press-in Data Monitoring System saved the piling time up to 30%. Laborsaving and productivity improvement were confirmed in some construction sites. Estimation of ground information by Press-in Data Monitoring System is gradually used for reference of changing construction method.

	Standard Press-in	Press-in with augering	Press-in with rotary cutting
①Optimization of piling	–	✔	–
②Estimation of ground information	✔	✔	✔

Table.1. Scope of application of Press-in Data Monitoring System

In Japan, Ministry of Land, Infrastructure and Transport promotes “i-Construction” for laborsaving and productivity improvement. Press-in Data Monitoring System can be selected to one of the possible solutions for these movements. For example, it is possible to achieve uniformity in operation speed in foreign countries where there are few experts who could operate the silent piler.

In the estimation method of ground information, N value can be estimated in press-in with augering (Fig.2) (IPA,2017). However, there is a limitation that this estimation method can only be used in a specific shape of auger. This is a problem because other shapes of auger are often used in construction sites. We devised the method that can estimate N value with any shapes of auger by using correction coefficients for each auger shape (Okada et al., 2018).

Fig.2. Press-in with augering

Auger shape is very complicated, so we simply modeled Auger shapes by diameter and number of wings (Fig.3). For the torque T generated on this modeled, the auger shape can be expressed eq.1,

$$T = N_w * q_b * tan\delta * \frac{1}{2}R^2L \cdots (\text{eq.}1)$$

Here, N_w: number of wing, q_b: unit base resistance, δ: wall friction angle, R: diameter of auger, L:width of wing. According to this equation, it is possible to use same estimation method by correcting torque generated from other auger shapes into that is generated by a specific shape of auger.

In order to check the validity of this correction, a field test was conducted with many types of auger shape in the same site and N values were estimated from press-in data (Fig.4). These graphs show that estimated N values without correction vary greatly. On the contrary the estimated N values with correction do not vary largely and are similar to N values in this site. It means that the correction is considered to work as assumed. In the future, we will work for practical use of estimation method by conducting validation of this correction in different types of ground.

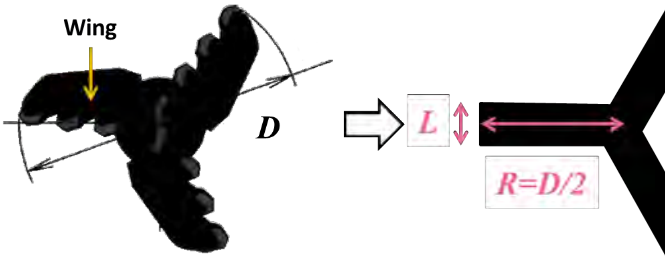

Fig.3. Model of Auger head shape

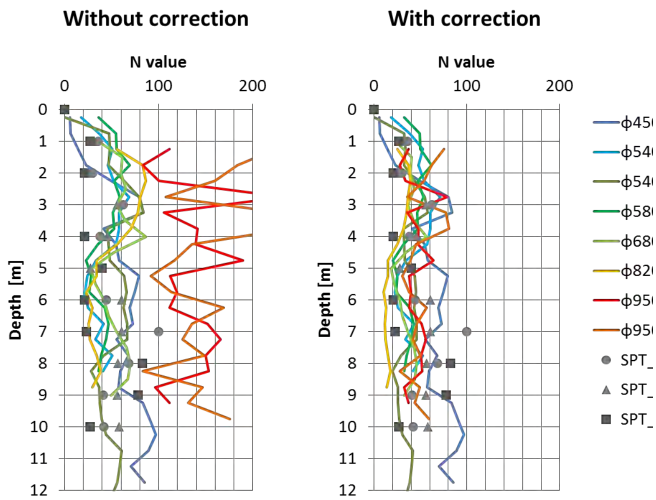

Fig.4. Comparison of Estimated N values

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ii) Expansion of the usage of estimation of ground information during press-in with Standard Press-in Method

Nanase Ogawa

GIKEN LTD.

1. Estimation of subsurface information and issues in the standard press-in Method

In standard press-in, a pile is installed by a static jacking force in soft ground with *N*-value of 25 or less. This technique has used a series of down and up movement with hydraulic cylinders to install a pile/sheet pile. The mechanism to install a pile/sheet pile is similar to that of a Cone Penetration Test (CPT), so cone resistance (q_c) and shaft resistance are estimated from the press-in force, and the estimation method of N-value and soil classification has been established[1).]

In the case where the standard Press-in method is used to estimate subsurface information, the condition needs the Press-in data acquired in the state which the interlocks disconnected. Under this condition, after estimating data in without interlock, it is necessary to pull out the steel sheet pile, and reconstruction in with interlock, which will increase the time required compared to normal construction. It is an important issue to remove the condition without interlocks in order to reduce the time and to increase the number of working examples.

2. Verification for solving problems

In cases where the steel sheet pile constructed with interlock, the evaluation of the interlock resistance becomes a problem. The interlock resistance refers to the resistance generated along the interlocking part between a reaction pile and an installation pile. Fig. 1 illustrates an image of installation and extraction operations with interlock. Fig. 1-(1) shows the initial installation, the pile head load (Q_1) at the time consists of tip resistance (Q_b), shaft resistance (Q_s) and joint interlock resistance (Q_i). After installation in the predetermined length, it immediately turns into extraction operation, and extracted the predetermined length, and then it turns to installation motion again. Fig. 1-(4) presents the situation during reinstallation, where the pile head load (Q_2) consists of the shaft resistance (Q_s) and the joint interlock resistance (Q_i) at early depth. Therefore, the tip resistance (Q_b) during installation can be estimated from the difference between Q_1 and Q_2.

Fig. 2 presents the field date, showing that the pile head loads are plotted with depth for the cases with and without interlocks. Obviously, the head load with interlock is larger than without one. The difference is considered to be the value of resistance between interlock. Fig. 3 shows the results of CPT index which are the measured value, and estimated results from Press-in data. The estimation results are similar to the measured one that the change with depth can be estimated, like the value are larger in sandy layer at 4-6m depth than other depths. However, all the peak values are evaluated small. The estimated *N*-value shows the similar tendency as the estimated CPT index. Fig. 4 is the estimation results of subsurface soil profile information. In cases of without interlock, the soil classification of sandy and cohesive soil is generally consistent with the CPT results. On the other hand, in the case of with interlock, the whole layers have judged to be sandy soil.

3. Summary

The CPT index, *N*-value and the soil classification were estimated using the Press-in data with interlock. In all cases, the trend of change with depth could be grasped. In addition, the peak value of the cone index and *N*-value were underestimated, as for the soil classification, the particle size was evaluated to be larger. In the future, we will continue to accumulate the Press-in data in order to improve the practicability of estimation method.

4. Reference

1) International Press-in Association (IPA), 2017. Technical material on the use of piling data in the Press-in Method Ⅰ. Estimation of subsurface information, pp. 7-32. (in Japanese).

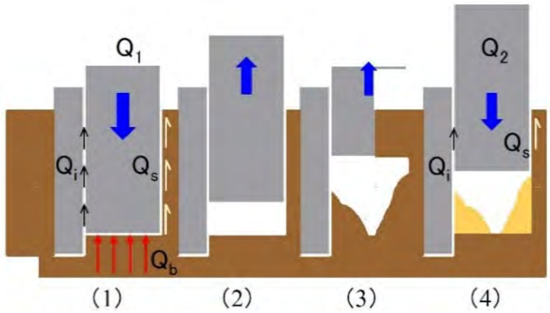

Fig. 1. Resistances and sheet pile base

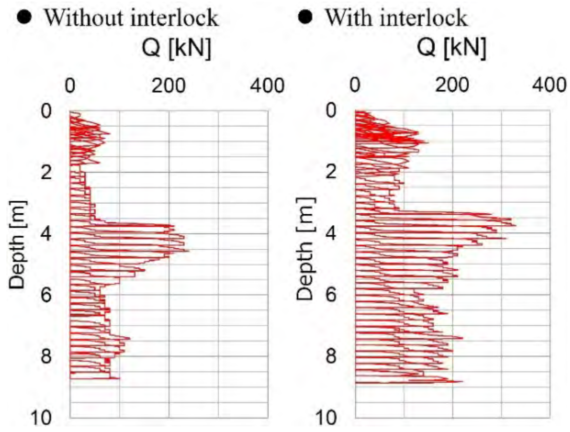

Fig. 2. Press-in force

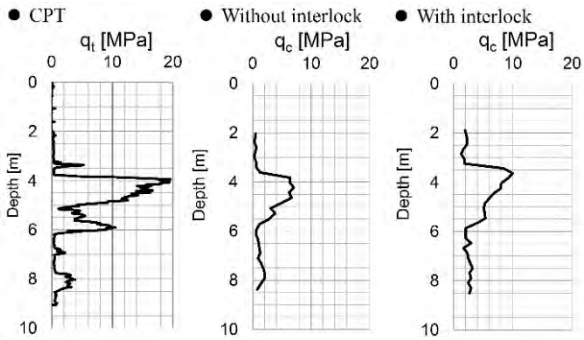

Fig. 3. Cone resistance

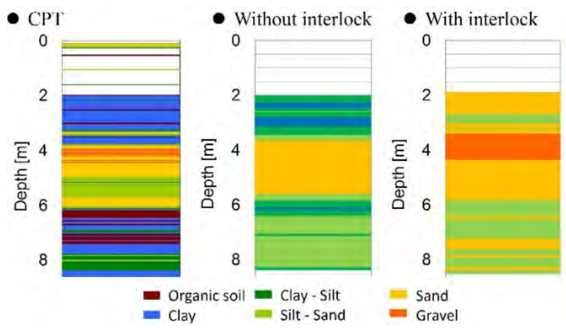

Fig. 4. Results of the estimation

Reports

11th IPA Press-in Engineering Seminar in Tokyo 2019 (Continued)

(4) Application of the Press-in Data Monitoring system

Masafumi Yamaguchi
IPA Secretariat

The fourth lecturer was Mr Tomohisa Ozawa, President of Ozawa Civil Engineering and Construction Co. Ltd. which is one of the leading piling contractors in Japan. He presented an application example of the Press-in Data Monitoring system, where a piling method was changed from a vibrator hammer assisted by water jetting to press-in assisted by augering due to unexpected ground conditions. The purpose of the piling work in the project was to construct six temporary earth retaining walls of rectangular shape. Each earth retaining consisted of 14.0-15.5m steel sheet piles which had to be installed into hard shale whose SPT *N* value is over 50. At the stage of the tender, a vibratory hammer assisted by water jetting was specified by the client, which was unlikely to succeed due to the ground conditions.

Photo 1. Mr. Ozawa was giving a lecture

"We encountered some difficulties in changing the piling methodology" Mr Ozawa said. "First of all, the test piling had to be conducted by the vibratory hammer for all steel sheet piles, even though we expected it would not be a success. This was at the direction of the client. It was a waste of time and cost. Secondly, all bore hole logs had to be re-collected at each temporary retaining wall as proof of the methodology change, which also extended the construction duration and increased the cost. Thirdly, the client did not have the cost estimate standard[1)] of the pressing-in assisted by the augering". Solving the second issue, the Pile Penetration Total (Hereinafter referred to Press-in Data Monitoring) system was utilized by Ozawa Civil Engineering and Construction Co. Ltd. The Press-in Data Monitoring system is the latest technology to estimate and record ground condition during pre-boring. By utilizing this system, the client accepted that there was no need for any additional borehole logs. Furthermore, the client also approved one or two piling tests by vibratory hammer at each retaining wall instead of all the steel sheet piles after several meetings and a cost estimate standard[2)] issued by Japanese Press-in Association to estimate the piling cost.

In conclusion, Mr Ozawa said "Press-in Data Monitoring system was useful, of course. Additionally, the technical material[3)] based on the science was important to prove that the latest technology is valid. For the estimation, the cost estimate standard made by past applications was helpful. They enabled us to logically and smartly discuss with the client and the main contractor based on science, technology and applications." I think that every participant understood their opinion and saw massive potential in the system.

1)In Japan, public clients (i.e. Ministry of Land, Infrastructure, Transport and Tourism) use the cost estimate standard to estimate a piling cost published by themselves or some associations. This client was a private one.
2) Japanese Press-in Association (JPA), 2017. The cost estimation standard of the Hard Ground Press-in Method.
3) International Press-in Association (IPA), 2017, Technical material on the use of piling data in the Press-in Method Ⅰ. Estimation of subsurface information (in Japanese).

Photo 2. Press-in assisted by augering

Photo 3. The technical book

Reports

From IPA Singapore Regional Office

Tomotaka Hirose

Chief, Construction Solution Department
GIKEN SEISAKUSHO ASIA PTE., LTD.

I am pleased to write this article regarding the IPA Singapore Regional Office. I have worked for GIKEN Seisakusho Asia, which is a subsidiary of GIKEN LTD., since 2018 and I have been involved with the IPA regional office as a corresponding member. The IPA regional office was established in March 2019 by IPA headquarters. According to their visions, the role of corresponding members is to strengthen the relationship between the general members and the vice president in the region through region-specific activities such as supporting the vice president, organizing seminars, and improving IPA activities. Photo 1 illustrates the IPA seminar that was held in Thailand in 2018, where I made a presentation about E-site visits as one of the speakers. In addition to the Thailand seminar, seminars were also held in Vietnam and the Philippines in 2018. The IPA is now preparing to hold seminars in Indonesia and Taiwan as well. Thus far, Mr. Yamaguchi, the IPA secretariat, has discussed how we could have a significant influence on the Indonesian construction market with the Indonesian Society for Geotechnical Engineering (HATTI) and the Indonesia Society of Civil and Structure Engineering (HAKI). Moreover, the IPA secretariat has said that the Indonesia seminar in Jakarta will be convened as early as next March.

Since the IPA has started providing seminars in Southeast Asia, GIKEN Seisakusho Asia has consistently supported the IPA, cooperating with Prof. Leung who is a professor at National University of Singapore and IPA's vice President (Photo 2). Beginning with the IPA seminar on press-in technology in Singapore in 2017, seminars have been held at several venues throughout Southeast Asia. With the press-in being an advanced construction system, we need to further justify the press-in method to clients and engineers alike from an academic point of view using validated documents. Thanks to IPA activities, the press-in piling method has spread to Asia including Singapore, Thailand, Taiwan, and Vietnam. For these countries and others in Southeast Asia, the press-in piling method offers significant advantages in addressing problems that arise due to vibration issues, narrow construction sites, traffic congestion during a construction project, and the accessibility of technology. Consequently, we are confident that the IPA will play an extremely important role in spreading engineering knowledge regarding the press-in method.

On a different note, the Technical Committee (TC3) on steel sheet piles was organized by IPA and has been researching the Partially Floating Sheet Pile (PFS) Method since 2017 (Fig. 1). The PFS method uses sheet piles reaching bearing stratum in conjunction with floating piles to protect river embankments from lateral displacement and has become a popular technique in Kyushu, located in western Japan. This unique method installed by press-in machines can significantly reduce material cost and construction duration. I have joined TC3 as an overseas committee member and Prof. Otani, a professor at Kumamoto University and the president of the Japanese Geotechnical Society, is serving as chair of TC3. We recently held the TC3 symposium that explained applications of the sheet pile and PFS methods to Thai civil engineers in Bangkok, Thailand on 31 October 2019. The aim of TC3 currently is to expand the scope of applications of the PFS design method. In short, the IPA has been, and will continue to be, significantly involved in advancing construction technology and methodology throughout Southeast Asia to improve construction projects in several nations.

Photo 1. IPA Seminar in Thailand (2018)

Photo 2. Attendance of the Taiwan exhibition (a picture taken with Prof. Leung, Vice President of IPA)

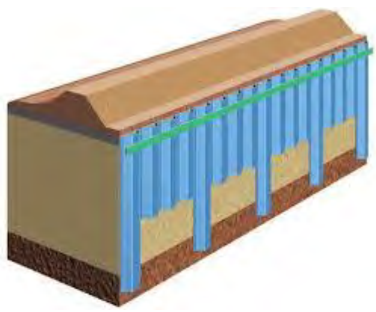

Fig. 1. Partially Floating Sheet Pile Method

Reports

Typhoon Hagibis: Japan suffers deadly floods in October, 2019

Yasumasa Kimura

Operating Officer, GIKEN LTD.

Catastrophe caused by Typhoon Hagibis

Typhoon Hagibis hit eastern Japan on 12th of October 2019, and brought immense damage arising from heavy rain and flood over a large area. 88 people were killed and 7 people were reported missing nationwide (as of 31st of October). Also, a total of 140 levees at 71 rivers were failed, and total 281 rivers overflowed their levees due to the disaster. According to the report from the Fire and Disaster Management Agency (FDMA), 84,383 residences in total were flooded or damaged by the disaster. Photo 1 shows a view of flooding at Chikuma River.

Photo 1 Torrential rain has caused rivers to flood along Chikuma River.

Site Investigation and Restoration Work

GIKEN LTD. conducted a site investigation regarding the disaster, specifically putting emphasis on the place where the damage was severe such as Nagano and Kanagawa Prefectures. While investigating, GIKEN LTD. visited the persons in charge of the management of the levees. This is a brief report on the circumstances of one of the disaster areas along Chikuma River and a restoration work performed in the construction site as is shown in Photo 2.

A levee constructed in Chikuma River was failed over the length of 70 meter, therefore a temporary levee was constructed by filling soils to prevent further damage. However, Nagano city office considered that the temporary levee is not enough. Therefore, another temporary levee work by installing sheet piles was performed. 2 Silent Pilers and 2 vibratory hammers were operated for the second temporary levee construction from evening of 16th of October and competed the construction work on 30th of October. Total 1,700 sheet piles (L=16m, W=40cm) were installed to construct the temporary levee with a height of 5.5m and horizontal length of 320m. Upon the completion of the construction, Nagano city canceled evacuation order of the area. Photo 3 illustrates the plan of recovery work, and Photo 4 presents a view of recovery work using Silent Piler.

Photo2 Overview of Construction Site

Sources of Photo 2 and Photo 3:
Ministry of Land, Infrastructure, Transport and Tourism Hokuriku Regional Development Bureau
(http://www.hrr.mlit.go.jp/press/2019/10/191028press2.pdf)

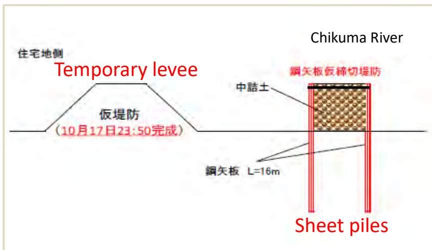

Photo 3 Cross-Section of Construction

Photo 4 Construction of sheet pile wall by Silent Piler

Reference:
Daily construction industry newspaper blog
(http://nikkankensetsukogyo2.blogspot.com/2019/10/blog-post_13.html)

Reports

Promotion of Handbook –Chinese Version–

Hongjuan He

IPA Secretariat

The Chinese Version of the “Press-in retaining structures: a handbook” was officially published in China in October 2019. The handbook is edited by IPA and published by China Architecture and Building Press (CABP) as announced in Volume, 4, Issue 3 of IPA Newsletter. In order to further promote the Press-in Technology through this Handbook, IPA presented some lectures in two occasions: “The 4th International Forum on Urban Flood Control and Drainage Capacity (IFUC 2019)” jointly organized by China Civil Engineering Society, China Water Conservancy Society and other units, with IPA as one of the co-organizers, and “19th Waterproof and Drainages Technology Forum” organized by China Civil Engineering Society Tunnel and underground Engineering Branch.

IFUFC 2019 was held in Guangzhou, China from November 14 to 15, 2019. Nearly 500 experts from Britain, Germany, Canada, Japan, Denmark and other countries participated. The president of IPA, Dr. Kusakabe delivered an opening greeting at the opening ceremony and made a speech entitled "Countermeasures against Urban Flooding -Japanese Experiences- “at the main forum on the morning of the 14th. Through introducing the cases of urban flood in Japan, Dr. Kusakabe pointed out the difficulty in constructing flood control structures in urban areas such as problems of limited construction space, noise and vibration environment in solving urban flooding. It is explained that the Press-in Technology can effectively construct in narrow construction space or under various complex geological conditions, as well as the characteristics of low noise and low vibration during construction. Mr. Guozhu Chen, presentative of Shanghai Office of GIKN LTD. also delivered a lecture entitled “Applications and case studies of Press-in Technology in urban flooding “at this forum.

19th Waterproof and Drainages Technology Forum was held in Nanning City, China from November 21 to 22, 2019. About 160 experts attended the forum. At this forum, Prof. Xiaoduo Ou, president of Guangxi Ruiyu Construction Technology Co., Ltd (IPA’s corporate member) delivered a lecture entitled “A new method of groundwater control in urban foundation”. Mr. Chen also presented a lecture entitled “Applications and case studies of Press-in method in the underground waterproof and drainage”. Both lecturers introduced and publicized IPA and Handbook to promote the Press-in Technology in China.

The author visited Guangzhou Lantian Shouhui Ltd (Design and construction company), Hongxin Ltd (steel sheet piles lease company), Tongji University and some other organizations during this Chinese business trip. Through communication with them, the author realized that Press-in Technology encountering three major difficulties in China right now. The first is that there are no Press-in Method guidelines in line with Chinese design or policy. The second is that there is no standard of quota. The third is the training of operators. IPA will consider establishing the China Branch, a technical committee in China, and providing the know-how and information which IPA holds to deal with these difficulties. The author believes that through the cooperation of IPA, companies and universities in China, Press-in Technology will develop better in China.

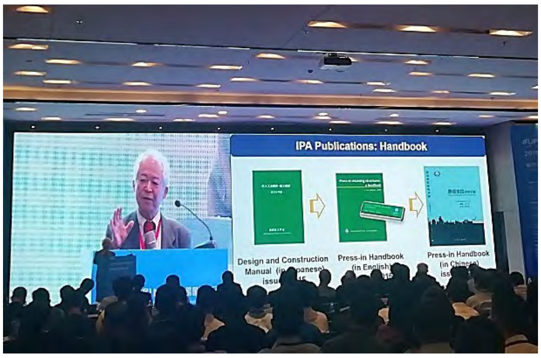

Photo 1. Dr. Kusakabe introduced the Chinese Version of Handbook in IFUFC

Photo 2. Mr. Chen made a lecture in IFUFC

Photo 3. Prof. Ou made a lecture in Nanning Forum

Young Members Column

Vijayakanthan Kunasegaram

Tokyo institute of Technology

I am Vijayakanthan Kunasegaram, a SriLankan and a final year PhD student at Tokyo institute of Technology (TIT). I received my bachelor degree in civil engineering at University of Peradeniya, Sri Lanka and Masters at TIT. I was first entered in IPA as a young researcher, to present the centrifuge model study about "self-standing steel pipe retaining wall" in a seminar held in Kochi, 2015. As part of the seminar, the field visit organized by IPA was a great opportunity for me to experience the real field constructions, advanced construction techniques and machineries related to the physical models in my PhD research. I was really impressed by the Press-in mechanism and the history behind the invention of "Silent Piler" by the IPA Honorary President Mr. Akio Kitamura, such a novel concept to overcome the miseries confronted on the company, back in 1970s. Today the "Silent Piler" with the advanced penetration techniques plays a major role in many construction projects around the world by removing the barriers, including noise and vibration.

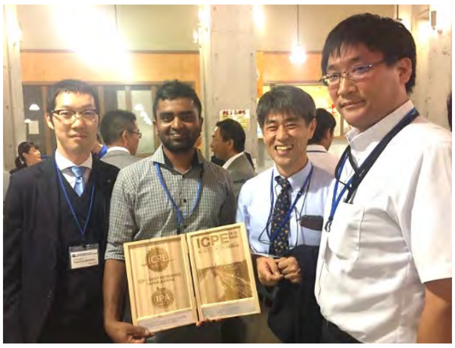

Photo 1. Mr. Kunasegaram (the 2nd from left) got the best paper in ICPE 2018

As a developing country, the landscape of SriLanka continues to be enhanced by several mega projects including airports, highways, railways and urban developments with the aid of multilateral agencies along with the Japan International Cooperation Agency (JICA) and the Asian Development Bank (ADB). While urging to develop the nation, it is also facing many challenges regarding to natural disasters (landslides and flooding), traffic congestion, aging and limited number of skilled workers and labor shortages, especially in the construction industry. I strongly believe that the innovative technologies and the indelible experiences of IPA with the contribution of civil engineering expertise could conquer the challenges in future Sri Lanka.

Announcement

The Second International Conference on Press-in Engineering (ICPE) 2021, Kochi: Call for Abstracts

IPA Secretariat

ICPE 2021 will be held on 19 (Sat) & 20 (Sun) June 2021 in Kochi, Japan organized by ICPE2021 Organizing Committee and International Press-in Association (IPA). ICPE Organizing Committee are calling for abstracts as follows.

■ Submission of abstracts/full papers

IMPORTANT DATES

1. Call for Abstracts	01 Nov 2020
2. Submission of Abstract	26 Apr 2020
3. Notice of acceptance of abstract	31 May 2020
4. Submission of full paper	30 Sep 2020
5. Submission of revised final paper	15 Jan 2021

Approximately 400 words, mailed to Assoc. Prof. Katsutoshi Ueno
E-mail: icpe2021@gmail.com

Submitted papers shall be peer-reviewed, and one registration is required for each paper.
Note: The registration fee will be anounced on the ICPE2021 / IPA website shortly.

Event Diary

Title	Date	Venue
■ IPA Events https://www.press-in.org/en/event		
IPA Seminar on Press-in Technology in Taiwan	March 17, 2019	Taoyuan City, Taiwan
IPA Seminar on Press-in Technology in Indonesia	March 26, 2019	TBD
International Society for Soil Mechanics and Geotechnical Engineering http://www.issmge.org/events		
2nd International Symposium on Seismic Performance and Design of Slopes	January 18-22, 2020	Edinburgh, United Kingdom
4th International Conference on Geotechnical Engineering	March 9 -11, 2020	Hammamet, Tunisia
First International Symposium on Construction Resources for Environmentally Sustainable Technologies (CREST2020)	March 10-12, 2020	Fukuoka, Japan
GEOAMERICA 2020 (4th PAN AMERICAN CONFERENCE ON GEOSYNTHETICS)	April 26-29, 2020	Rio de Janeiro, Brazil
■ Deep Foundations Institute http://www.dfi.org/dfievents.asp		
Piling & Ground Improvement Conference 2020	March 23-25, 2020	Sydney, Australia
SuperPile '20	June 3-5, 2020	Missouri, USA
■ Construction Machinery Events		
Construction Technology and Innovation Conference https://constructiontechcon.com/	February 12, 2020	Grand Rapids, USA
International Conference on Modern Construction Equipments and Practices https://waset.org/modern-construction-equipments-and-practices-conference-in-february-2020-in-bangkok	February 03-04, 2020	Bangkok, Thailand
2nd International Conference on Infrastructure and Construction https://www.scientificfederation.com/infrastructure-construction-2020/	October 15-16, 2020	Lisbon, Portugal
■ International Geosynthetics Society http://www.geosyntheticssociety.org/calendar/		
10th Chinese National Conference on Geosynthetics	May 27-31, 2020	Chengdu, China
■ Others		
8th Japan-China Geotechnical Symposium	March 14-15, 2020	Kyoto, Japan

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Editorial Remarks

IPA Newsletter Volume 4, Issue 4 showcases the value of research and development and information gathering in the field of engineering. Prof. Mounir Bouassida and I shared in our respective messages how IPA is being introduced to Africa and the Philippines. Together with IPA, new technologies and practices are brought to the awareness of professionals. These will equip them with new ways to tackle geotechnical and environmental challenges in the future.

The Special Contributions are presented by Dr. Kenechi Horikoshi, Dr. Kazuya Itoh, Dr. Mamoru Kikumoto, and Dr. Tomofumi Koyama. Dr. Horikoshi discussed "Technology Developments in Japanese Construction Industry" where he showed the status of investments in the construction industry in Japan, demographics of young professionals, and ways to cope up with the lacking labor force due to the rapid aging of the construction industry. Dr. Itoh, Dr. Kikumoto, and Dr. Koyama authored the "Gross National Safety Index for Natural Disasters (GNS)" where they quantified the components of natural disaster risk to develop a GNS map of Japan.

This issue's Series Report is dedicated to the "Applications of the Press-in Piling Method to Emergency Bridge Foundation Repair" provided by Giken America Corp. (Mr. Takefumi Takuma). This report shows that Press-in Technology is a reliable solution in the face of difficult site conditions.

11th IPA Press-in Engineering Seminar held in Tokyo is the main feature in this issue's event report. The presentations revolved around the acquisition of subsurface information and the use of construction data. IPA seminars and use of press-in pile systems have been more noticeable in Southeast Asia, according to the report by the Singapore Regional Office. The restoration operations of failed levees in Japan after Typhoon Hagibis struck Japan is also included in the reports. To end the reports, the Chinese version of "Press-in retaining structures: a handbook" was published and how it will further promote the Press-in Technology in China.

Young Members Column features Mr. Vijayakanthan Kunasegaram. He shared his experiences with the IPA and insights on the development of Sri Lanka. This latest issue of the IPA newsletter ends with an announcement: The Second International Conference on Press-in Engineering (ICPE) 2021, Kochi: Call for Abstracts.

At last, the Editorial board wants to thank you for your support throughout this year and hopes that you can continue to pay attention to our Newsletter in the coming year.

Alexis Philip Acacio

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