Report 2020-Overseas activity of Fudo Tetra Corporation

January 2021
International Department/ Fudo Tetra Corporation

1. Our overseas activities

We specialize in the soft ground improvement work such as **Deep Soil Mixing (DSM)**, **Sand/Gravel Compaction Pile (SCP), Sand Drain method and MVT (Mammoth Vibro-Tamper for shallow densification)**, which is our best field of construction since 1950's, and we have resource who has capability of construction management, making design, analysis and other engineering works.

We have performed both public and private works as a subcontractor in overseas. Ground improvement works that consist of eleven projects (Deep Soil Mixing) in Vietnam, twelve projects (Sand Compaction Pile; SCP, Deep Soil Mixing and shallow compaction; MVT) in the U.S.A., one project (Offshore SCP) in South Korea, three projects (Offshore Deep Soil Mixing) in Hong Kong, one project (SCP) in Bangladesh, one project (Offshore Deep Soil Mixing) in Indonesia and one project (SCP) in Philippine have been completed so far until the end of 2020.

In this year, due to the impact of COVID-19, a lot of expected projects were postponed and suspended. Therefore, unfortunately our activity was lower than usual.

(1) U.S.A.

Fudo Tetra Corporation has established its U.S. subsidiary "Fudo Construction Inc. (FCI)" (URL:http://www.fudo-const.com) in San Mateo, California in 2005. FCI has performed some liquefaction mitigation works using the Sand Compaction Pile (SCP) and non-vibratory sand compaction pile method (called as SAVE-Compozer) for foundations of urban facilities in CA and WA states.

In addition, FCI has conducted the huge amount of Deep Soil Mixing work for New Orleans Levee improvement in Louisiana at 2009-2011, and MVT (Shallow densification) at Fort Lauderdale Airport runway at 2012-2014.

In 2017, we have conducted single column deep soil mixing work (CI-CMC) in Portland, Oregon for the foundation of huge sized Amazon warehouse. We have kept sufficient quality and consistent production rate through the project.

In the US, we are looking at the energy field, e-commerce projects and repairing/rebuild projects for old structures.

(2) Asia

(a) Indonesia

We have opened the representative office in Jakarta, Indonesia in 2015 and have been completed the subcontract work of ground improvement for 'Patimban Port Development Project (1) Package 1(Terminal construction)' in 2019. Off-shore CDM (Cement deep mixing method) was our scope of work and 2-CDM barges were operated with successful and dedicated efforts. This project was first off-shore CDM application in Indonesia.

As same as the Hong-Kong airport project case, CDM barges has been designed by our engineering team with using local flat barge (Indonesian flag with length 90m) and then the 2-CDM barges were mobilized at local shipyard (in Batam). These CDM barges are equipped with 6-Axes (2-Axes x 3-Masts) mixing rods. Off-shore CDM method was designed to prevent sliding quay wall and settlement on the 'Car and container terminal'.

Wick drain rigs

Meeting in the site

From 2019 to 2020, we have been ordered the engineering work from Chiyoda Corporation for the large size ground improvement work (wick drain) in Surabaya. The scope of our work was to visit the site and manage the quality control for the job performing by the local company.

(b) Bangladesh

We have completed the Sand Compaction Pile installation job in Dhaka for Japan's ODA railway project to protect the liquefaction damage at seismic event in 2017. After the sufficient quality control for compaction of the loose sandy ground, we could have good reputation from general contractor, consultant and client (DMTC: Dhaka Mass Transit Company). Please see the reference paper (Imai, et al, 2019). We are looking at the subsequent ODA projects in Dhaka and South Bangladesh area in the near future.

(c) Philippine

In Philippine, the liquefaction mitigation has been considered in the design of the railway depot and levee projects in recent years. We have been engaged in the SCP (Sand Compaction Pile) work for the new railway depot near Manila in 2019. Two SCP rigs are deployed and performed 800mm diameter SCP columns. In addition, we have started the liquefaction mitigation project by using our SAVE-COMPOZER system which uses our non-vibrated SCP rig for the new levee project in Mindanao in 2019. It is planned for the protection of newly developed river dike against the river flood issue and the liquefaction mitigation work will be completed in 2021.

SCP project near Manila

Presentation of Liquefaction mitigation work in DPWH in Manila

SAVE COMPOSER rigs in Mindanao

2. Technical paper published regarding our technology

(Sand Compaction Pile, SCP)

Mitsu Okamura, Masanori Ishihara and Takeshi Oshita, Liquefaction resistance of sand deposit improved with Sand Compaction Piles, Soils and Foundations, Vol.43, No.5, pp.175-187, **2003**

Kinoshita, H., Harada, K., Nozu, M. and Ohbayashi, J., Sand Compaction Pile Technology and its Performance in both Sandy and Clayey Grounds, TC 211 International Symposium on Ground Improvement, IS-GI Brussels **2012**.

Imai, Y., Kuriki, M., Okuda, M. and Muhammed, S., Observation on consolidation settlement of ground improved by Sand compaction pile and Prefabricated vertical drain applied to Dhaka MRT Line 6, Geotechnics for Sustainable Infrastructure Development - Geotec Hanoi **2019**, Phung (edt). ISBN 978-604-82-0013-8

(Non-Vibration SCP)

Nozu, M. Ohbayashi,J. and Matsunaga, Y, Application of the static sand compaction pile method to loose sandy soil, Proc.of the International Symposium on Problematic Soils (IS-TOHOKU 98), pp.751-755, **1998**.

(Deep Cement Mixing)

Nozu, M*:* MANUAL FOR DESIGN AND CONSTRUCTION OF CEMENT COLUMN METHOD, International cooperation and technology transfer in the field of soft ground were executed in the framework of JAPAN (JICA and Public Works Research Institute (Ministry of Construction)) - THAILAND (Department of Highway) Joint Study on Soft Clay Foundation, **1998**

Bertero, A., Leoni, F, Filtz, G, Nozu, M., Drus, D., Bench-Scale Testing and Quality Control/Quality Assurance Testing for Deep Mixing at Levee LPV 111. ICOG2012 (4th International Conference on Grouting and Deep Mixing), **2012**.

Nozu, M., Ngo Tuan Anh, Shinkawa, N and Matsushita K, Remedy of Deep Soil Mixing Quality for Montmorillonite Clay Deposited in the Mekong and Mississippi Deltas, TC 211 International Symposium on Ground Improvement, IS-GI Brussels **2012**.

Takano, M., Suzuki, K., and Shinkawa, N., Cement Deep mixing in Lack Huyen Port Infrastructure Construction Project in Northern Vietnam, 2015 DFI Deep Mixing Conference, San Francisco, **2015**.

Nozu, M., Masaru Sakakibara, and Ngo Tuan Anh, Securing of in-situ cement mixing quality for the expansive soil with the 'Montmorillonite' inclusion, 2015 DFI Deep Mixing Conference, San Francisco, **2015**.

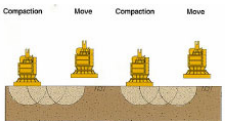
Nozu, M and Imai, Y, Some Engineering topics for Deep Soil Mixing (DM), 2021 DFI Deep Mixing On-line Conference, **2021**

(MVT: Shallow Densification)

Nozu, M., Sakakibara, M., and Matsushita, K, Application of Mammoth Vibro-Tamper (MVT) for the shallow compaction at airport runway expansion project in Florida, Asia Regional Conference (ARC), ISSMGE, **2015**.

Nozu, M., Vespi, F., Matsushita, K. and Walder, E: APPLICATION OF MAMMOTH VIBRO-TAMPER (MVT) FOR THE SHALLOW COMPACTION AT AIRPORT RUNWAY EXPANSION PROJECT ON FLORIDA LIMESTONE GROUND, DFI annual conference, **2018**

3. Ground Improvement method for oversea project

Method	Features	Machine
Deep Mixing	Soil-cement mixing column with 1,000-1,800mm in diameter is installed by mixing blades. This method was developed in 1970's in Japan. Both laboratory mixing test and check boring are required to keep its quality. Recently, special design technique called ALiCC method which realizes low DM improvement ratio (12-20%) has been developed so that we can achieve more economical design. In the US, at Levee raising-up projects in Louisiana, we have performed huge amount of DM (CI-CMC method) with large diameter of 1,600mm. Since 2009, we have completed offshore Deep Soil mixing projects in Vietnam, Hong Kong and Indonesia by renting the local flat barge.	
Power Blender (PB) for	Power Blender machine has been developed and widely spread in Japan by PB association since 1990. Up to 32ft=10m depth, good quality soil mixing can be done by special trencher system and excavator. Up to 2017, accumulated quantity has reached to 50Mm3.	
Sand/Gravel Compaction Pile (SCP,GCP)	Very dense sand/gravel pile with 700-900mm in diameter is installed in both clayey and sandy ground. This method is effective for increasing stability of clayey ground and mitigating liquefaction of loose sandy ground (In Bangladesh and Philippine, we have performed this SCP work for mitigation liquefaction). Recently, no-vibration (static) sand compaction pile machine has been introduced to the U.S. for mitigation of liquefaction in urban area.	
Off-shore Sand Compaction Pile	Large diameter sand pile (1600-2000mm) is installed by special barge. It is useful for foundation improvement at many harbor structures such as breakwater and various types of quay-wall. Construction speed is much faster than the other methods.	
MVT	Crawler crane and attachments are used to suspend the heavy vibrator and vibrating plate. This method has higher energy, higher productivity yet lower noise/vibration than conventional Dynamic Compaction.	

Contact Address;

FUDO TETRA CORPORATION
International Department
7-2 Nihonbashi-Koami-cho, Chuo-ku, Tokyo, JAPAN, 103-0016
Tel.:+81-3-5644-8535, Fax:+81-3-5644-8537
E-mail:webmaster@fudotetra.co.jp, URL:http://www.fudotetra.co.jp

FUDO Construction Inc. (USA)
1720 South Amphlett Boulevard, Suite 225, San Mateo, CA 94402, USA
Tel:+1-650-350-1120
URL: http://www.fudo-const.com

FUDO Representative Office in Jakarta, Indonesia
Bakrie Tower 3rd Floor, JL.HR.Rasuna Said, Kuningan, South Jakarta 12940, Indonesia
Tel:+62-21-2991-2499