Report 2017-Overseas activity of Fudo Tetra Corporation

January 2018
International Department/ Fudo Tetra Corporation

1. Our overseas activities

We specialize in the soft ground improvement work such as **Deep Soil Mixing**, **Sand/Gravel Compaction Pile, 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 received both public and private work as a subcontractor in overseas. Ground improvement works that consist of eleven projects (Deep Soil Mixing) in Vietnam, eleven projects (Sand Compaction Pile; SCP, Deep Soil Mixing and shallow compaction; MVT) in U.S.A., one project (Offshore SCP) in South Korea and three projects (Offshore Deep Soil Mixing) in Hong Kong have been completed so far until the end of 2017.

(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. There was no settlement/sand boiling in the improved area of UPS Cerritos project site where is so closed to the epicenter, during the earthquake on Mar. 29, 2014 in Los Angels.

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.

(2) Asia

(a) Hong Kong

We have completed the Hong Kong International Airport Contract, Deep Mixing 1st and 2nd Trial Works (by Single Rig) in 2011-2015 with using local flat barge and our mobilization technique. DCM is designed to support the reclaimed ground for new runway. Two DCM barges were mobilized at local shipyard. Then since 2016, we are working for Main production of Hong Kong International Third Runway Reclamation Project.

DCM barge in Hong Kong airport main production work

Reference: http://www.threerunwaysystem.com/en/overview/project-overview/

(b) Indonesia

We have opened the new representative office in Jakarta, Indonesia in 2015. So, hopefully we would like to look at the local ground improvement projects which are expected in near future.

In particular, off-shore deep soil mixing work is expecting for the coming new port project.

In addition, there is high potential seismic risk in Indonesia due to many subduction zones and faults (Rusnardi, R. P., et.al., Seismic hazard analysis for Indonesia, Journal of Natural Disaster Science, Vol. 33, Number 2, 2012). Therefore, liquefaction mitigation method like Sand Compaction Pile (SCP) is suitable and effective to protect the sandy ground.

(c) 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. 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).

2. Technical paper published regarding our technology

(Sand Compaction Pile, SCP)

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**.

(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**.

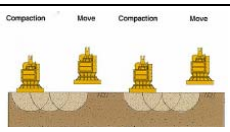
Nozu, M., Masaru Sakakibara, and Ngo Tuan Anh, Securing of in-situ cement mixing quality for the expansive soil with the 'Montmorillonite' inclusion, 2015 DFI Deep Mixing Conference, San Francisco, **2015**.

(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 1,000-1,600mm 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. This method does not need long curing/waiting time to obtain the strength. 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 the South, 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 and Hong Kong by using the local flat barge.	 
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. 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. Both gravel and sand are applicable as infilling materials; however, daily quantity of around 2,500m3 is required.	
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.	

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