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Riverine Levee Improvements in Densely Populated Areas with Press-in Piling Method

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ABSTRACT

Levees are protecting people's lives and properties from flooding worldwide. However, they need to be improved according to the changes in their performance requirements and/or applicable design codes. Steel sheet piles are used for retrofitting many existing earthen levees for their speedy constructability, stable quality, high strength, and lasting durability. This paper will study two riverine levee improvement projects in densely populated areas that utilized pressed-in sheet piles in order to control noise and vibration associated with pile driving.

ADAVANTAGES OF THE PRESS-IN PILING METHOD

The most common press-in piling machines such as Giken's Silent Pilers use hydraulic force to press piles into the ground by holding onto a few previously installed piles. To summarize the advantages of the press-in piling of this type over other methods:

1. It generates very low noise and is practically vibration free (White et al., 2002).
2. The press-in piling machine is relatively small and its clamping points are much lower than those with other piling methods. The lower clamping points enable the equipment to work in physically tight working conditions, horizontally and vertically, such as an area under railway girders (Takuma et al., 2015) or right next to existing sensitive structures (Takuma et al., 2013).
3. With attachments, it can deal with hard soil conditions very effectively (Takuma et al., 2018).
4. It can achieve much more accurate pile installation due to a combination of the machine's better control of the piles and low clamping points.

A high pressure jetting or continuous flight auger attachment will be coupled with a press-in piling machine when installing piles in hard soil conditions. The water jet attachment is good for dense sand and silt layers, while the auger attachment facilitates pile installation into stiff clay, gravels, cobbles, boulders and soft rock. These attachments work simultaneously with pile driving, minimizing settlement of the surrounding ground.

In the case that access to a piling location is very limited, the Giken Reaction Base (or GRB) System may provide a solution with a Clamp Crane, which clamps onto and moves on previously driven piles; and Pile Runner, which travels also on the driven piles between the Clamp Crane and a faraway material supply point. The piling operation can be done without an access road with this system. See Fig. 1 for the concept of the GRB system in the case of a pipe pile application.

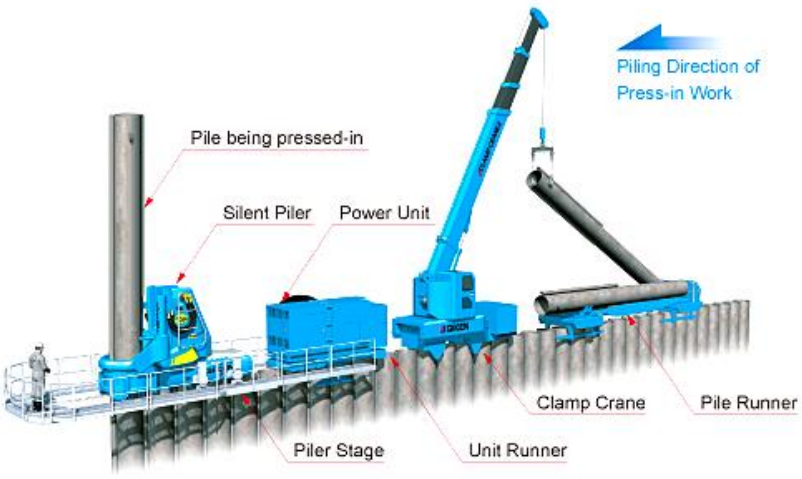

Fig. 1. GRB System Operation without an Access Road

GARDERE CANAL IMPROVEMENTS – PHASE 2 IN HARVEY, LOUISIANA

The Gardere Canal is located in the New Orleans southern suburb of Harvey in Jefferson Parish on the west bank of the Mississippi River while majority of the City of New Orleans is on the other side. This SELA-06 Gardere Canal Phase 2 project was part of the multi-year Southeast Louisiana Urban Flood Control Project (abbreviated as the SELA Project) by the US Army Corps of Engineers and the Sewerage and Water Board of New Orleans to enhance the flood control ability in New Orleans and its surrounding areas. The entire SELA project was authorized by the United States Congress in 1996, prompted by the May 1995 Louisiana Flood and worked on in segments and phases. The construction of this particular section started in March, 2007. Approximately 4,000 pairs of PZ35 sheet piles were installed to form a wider concrete-lined drainage channel for a higher discharge capability. See Fig. 2 for its typical cross section. The press-in piling was specified to minimize the noise and vibration levels of the sheet pile installation work since the canal ran through densely populated residential and commercial areas. As shown in the boring data (Fig. 3), the soil was mostly soft clay except a silty fine sand layer with the SPT value of about 30 between 5.5m and 7.0m below the GL.

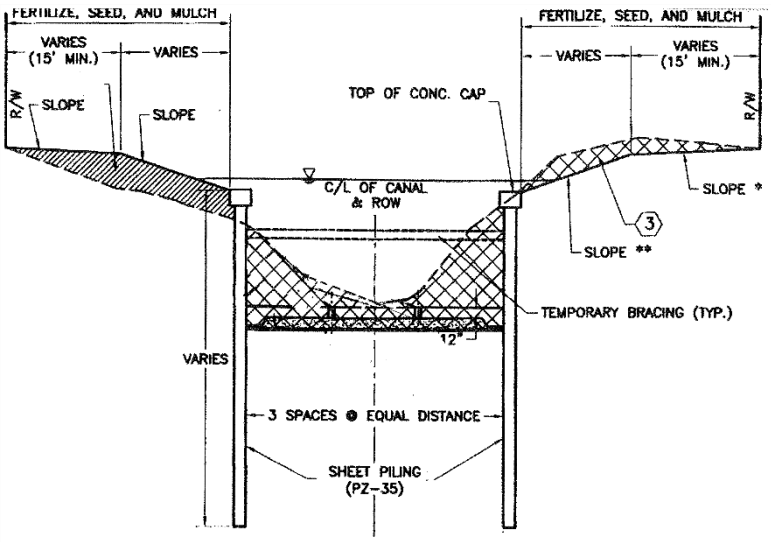

Fig. 2. Typical Cross Section

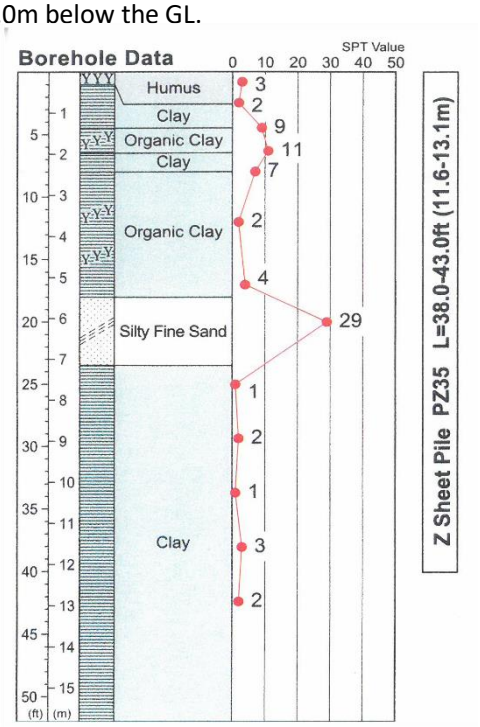

Fig. 3. Soil Conditions and Sheet Pile Location

Fig. 4 shows the canal's typical conditions prior to improvement. As can be noted, the levees on both sides were bordering with backyards of the area's houses. Two units of Silent Pilers were used to facilitate progress of the sheet pile installation. A small caterpillar-mounted service crane was hoisting the sheets to both equipment as shown in Fig. 5. The construction noise and vibration were successfully mitigated.

Fig. 4. Gardere Canal before Improvement

Fig. 5. Two Silent Pilers at Work

Giken America Corp. (Giken's U.S. subsidiary) and later Blue Iron Foundations and Shoring LLC took care of the press-in piling work under B&K Construction Company, Inc. of Mandeville, Louisiana. The press-in sheet pile installation was completed in the spring of 2010. Fig. 6 shows the completed levee improvement work. There have been an increased number of projects with the press-in piling specified in this region including other SELA projects since this one.

Fig. 6. Completed Gardere Canal Improvement

SANDALWOOD CANAL IMPROVEMENTS IN JACKSONVILLE, FLORIDA

Sandalwood Canal In-channel Improvements Project (Hodges Blvd. from Beach Blvd. to Atlantic Blvd., Project No. P-80-01) was to repair the damaged earthen levees by an earlier flooding as well as to increase the drainage capacity of an existing canal by widening/deepening with sheet piles installed in the levees located in a densely populated residential area of Jacksonville, Florida. Fig. 7 illustrates its typical cross section with the broken line showing the existing ground.

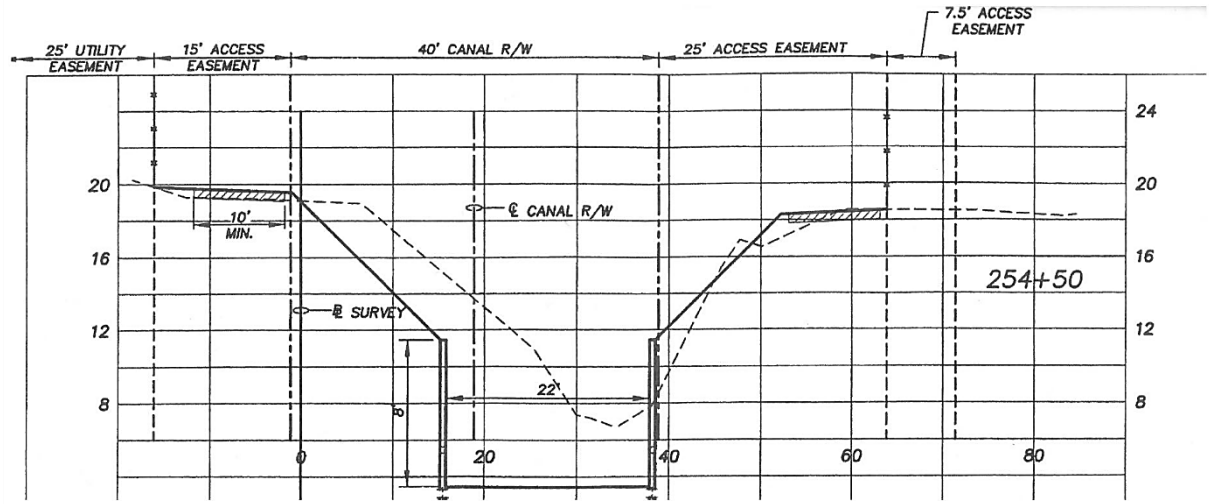

Fig. 7. Typical Cross Section

In order to minimize noise/vibration and also to reduce in-stream exposure time of piling equipment during construction, two units of Silent Pilers were used, so the work was to be done only during the dry season of winter. The soil conditions were primarily sandy with the SPT values of between 10 and 45 as shown in Fig. 8.

The noise and vibration levels during the sheet pile driving were limited by the project specifications that stated: "The hydraulic press-in equipment shall not produce more than 70dB of noise, at a distance of 25 feet from the equipment, while in operation. It shall not produce any measurable vibration at the ground surface, at a distance of 25 feet from the equipment, while in operation."

The project was started off with clearing of vegetation overgrown on the levees. Fig. 9 shows the conditions after the vegetation removal. As can be seen, the widths of the levee's shoulders were too narrow (approximately 3m on the wider side) for a truck crane to maneuver through. Therefore, a 10ton-capacity Clamp Crane was used with small flatbed trucks delivering sheet piles to the crane by driving on the levee's wider shoulder. A weir was first built with pressed-in sheet piles as shown in Fig. 10.

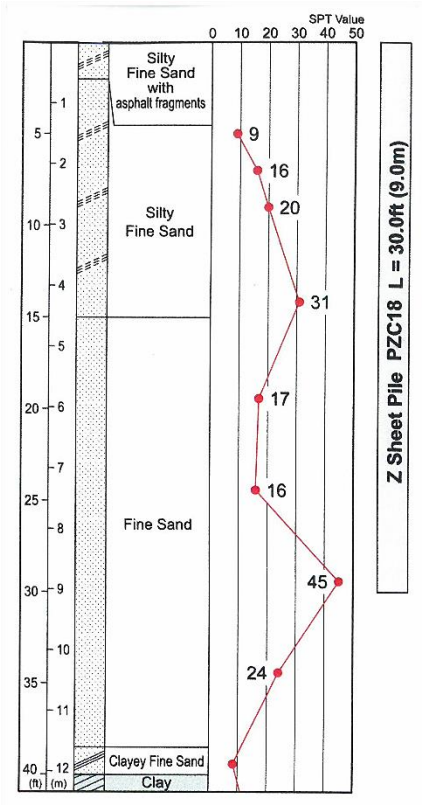

Fig. 8. Soil Conditions and Sheet Pile Location

Fig. 9. Sandalwood Canal after Removal of Vegetation

Fig. 10. Sheet Piles Installation for Weir

The Clamp Crane was hoisting sheet piles to both Silent Pilers (Fig. 11). Approximately 950 pairs of 7.0m to 9.0m-long PZC18 sheet piles were installed without causing damage to nearby homes. Fig. 12 shows the completed section of sheet pile walls. The project's owner was the City of Jacksonville with its design consultant being CDM's Jacksonville office. Giken America Corp. pressed in all the sheet piles under Felix Associates, LLC located at Stuart, Florida. The duration of sheet pile installation was between November 2007 and February 2008.

Fig. 11. Clamp Crane Pitching Sheet Piles to Silent Piler

Fig. 12. Completed Sheet Pile Installation

CONCLUSIONS

Sheet piles are commonly used for improvement work of existing levees. Noise and vibration associated with conventional sheet pile installation can be easily mitigated with the use of press-in piling as exemplified by the case study projects. The GRB system in combination with press-in piling enables sheet pile installation where supplying sheet piles to the piling location is otherwise extremely difficult due to lack of sufficient access. Many levee improvement projects in various parts of the U.S. have been and will be increasingly adopting pressed-in sheet piles next to residential/commercial properties and to other sensitive structures like underground utilities and bridge foundations.

REFERENCES

Takuma, T., Nishimura, H., and Kambe, S. (2013), Low Noise and Low Vibration Tube Pile Installation by the Press-In Piling Method, Proceedings of Deep Foundations Institute 2013 Annual Conference

Takuma, T., Nishimura, H., and Kambe, S., (2015), Development of Very Low Head Room Sheet Piler Press in Driver, Proceedings of 2015 International Foundations Congress and Equipment Expo

Takuma, T., DellAringa, C., and Nagano, M., Retrofitting Drainage Systems with Pressed-In Sheet Piles in Very Hard Soil in Southern California, (2018), Proceedings of Deep Foundations Institute 2018 Annual Conference

White, D., Finlay, T., Bolton, M. and Bearss, G. (2002), “Press-in Piling: Ground Vibration and Noise During Piling Installation”, Proceedings of the International Deep Foundation Congress, ASCE Special Publication 116