

Case-History

Potential Use of Gyro Piler in ASEAN Countries

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The Gyropress Method uses a newly developed press-in piling machine, so called “Gyro Piler” where rotary function is incorporated to allow tubular piles with cutting bits attached on pile toe to be inserted into a ground vertically or at varying lateral angle at both sides. In Japan where the press-in piling method is originated, the Gyropress Method has been widely applied for disaster prevention and infrastructure construction in urban area. Though the Gyropress Method has yet to be adopted in ASEAN Countries, the potential of this advanced technology to be adopted in the local construction market has been the talking point for geotechnical engineers.

1. Seawall Construction for Road Development at Marina Coastal Expressway, Singapore

Marina Coastal Expressway (MCE) connects Kallang-Paya Lebar Expressway (KPE) and East Coast Parkway (ECP) in the east to the Ayer Rajah Expressway (AYE) in the west, with direct connections to Marina South and Straits View areas (Fig. 1). With the development of Marina Bay Financial Centre and Gardens by the Bay, MCE caters for the expected increase in traffic volume around the Marina Bay area. The dual five-lane, 5km long expressway will support the large number of commuters who travel to offices, homes and attractions in the Marina Bay area.



Fig. 1. C481 of Marina Coastal Expressway [S'pore]



Fig. 2. Proposed Seawall & Future Reclamation

Contract 481 involves the construction of about 0.5km seawall to allow reclamation to take place in marine condition at Marina Wharf (Fig. 2 & Fig. 3). Gravity Cofferdam Seawall consisting of box type tubular sheet piles wall (Fig. 4) socketed into firm ground has been proposed for construction before the portion of sea is reclaimed with sand fill.



Fig. 3. Marina Coastal Expressway after Reclamation



Fig. 4. Tubular Sheet Piles installed by Giken Kokan Piler

The seabed varies with water depth ranging from 8m to 18m. Furthermore, the site is located in difficult soil conditions where there exists a thick soft marine clay deposit (Kallang Formation) under the seabed. The concept of having “implant” seawall derives from similar concept of “implant” tooth has been adopted. Gravity box tubular sheet piles wall socketed into Old Alluvium (OA) layer has been constructed to provide the robustness to the overall seawall structure (Fig. 5).

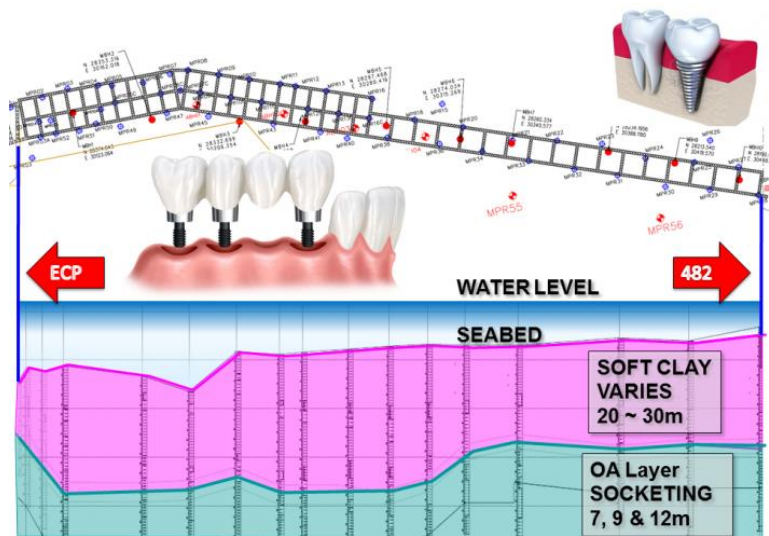


Fig. 5. Implant Seawall on thick Marine Clay Deposit

Under the site condition above water, it would have been normal to construct temporary staging at much effort, far and above that is necessary for the required construction works. This is unavoidable as the current conventional piling method has to rely on a flat working platform to sit their machineries.

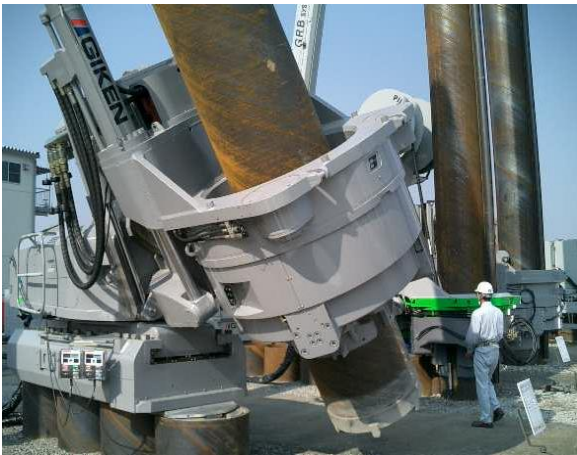
Therefore, the press-in piling technology has been effectively used in this project as it allows the machine to self-walk over previous installed tubular sheet piles during pile driving operation. 1169 nos. of 1200mm diameter tubular sheet piles have been installed successfully by using two Tubular Piler machines for duration of almost one year (Figs. 6).



Figs. 6. GIKEN Kokan Piler & Tubular Sheet Piles

2. How Gyropress Method can be adopted instead?

Gyro Piler has a lateral tilting function which enables to install batter piles and anchor piles at an inclined angle with a set of rotational cutting bit at the pile tip (Fig. 7). The press-in machine has been developed to allow the raker and strut-free piles to be installed from the same position, allowing the construction of a robust structure through hard layer or obstacles (Figs. 8).



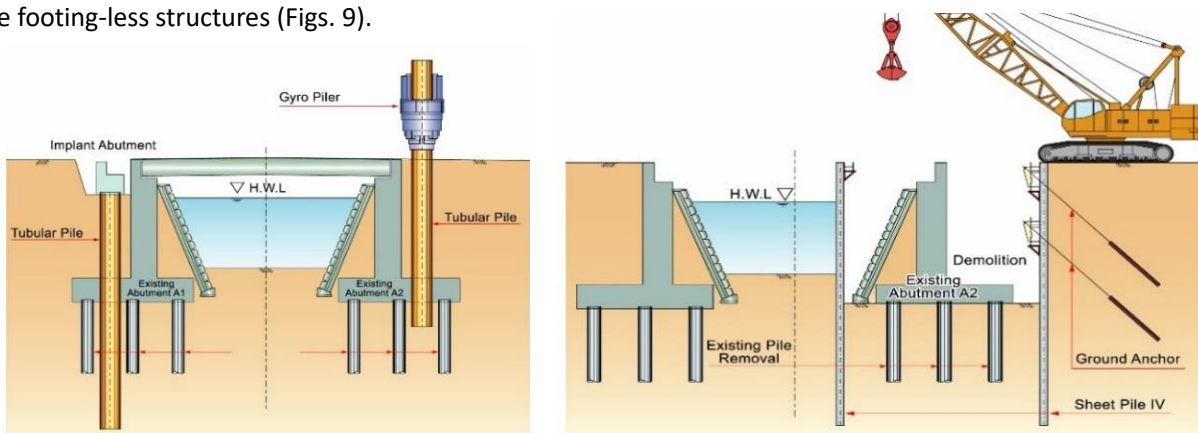
Figs. 7. Installation of Raker Pipe Pile with Rotational Cutting Bit using Gyro Piler



Figs. 8. Installation of Strut-free Piles for Construction of Robust Structure through Obstacles

3. Concept of Implant Structure

The Implant Structure is made of modular prefabricated structural elements and installed into the ground using the press-in piling method. It functions both as a foundation pile and act ultimately as the body of a structure. During construction, no extensive temporary work is necessary. It is a structural revolution which changes the current footing-based approach into the footing-less structures (Figs. 9).



Figs. 9. Comparison using Concept of Implant Structure versus Conventional Approach

4. Conclusions

This new concept of construction further adds engineering value to the overall construction. It reinforces the existing structures and minimizes the construction activities involved. The procedure of works is systematic and imposes less environmental problem to the surrounding. Even if any existing structures obstruct the construction of a new structure, it can still be solved by demolishing only a small affected part of the existing structure.



Figs. 10. The Gyropress Method

The Gyropress Method (Fig. 10) adopts the superiority of press-in piling technique with the following advantages:

- The Gyro Piler grips on reaction piles, rotating and pressing down a new pile into soil and allows the press-in machine to travel forward in the direction of wall construction and causes minimum disturbance (silent & less vibration) to the surrounding environment which makes the piling technique efficient to infiltrate into congested area .
- Even if the soil is hard or an obstacle (e.g. concrete structure) is encountered below ground, the Gyro Piler can still penetrated the obstacle by special cutting bits at the pile tip.
- The rotation and downward force are applied to the pipe pile to be pressed-in at ground surface, making it possible even when the overhead clearance is limited (e.g. under a bridge or viaduct).
- The Gyro Piler has a lateral tilting function which enables the installation of batter piles and anchor piles for a high modulus and robust retaining walls.

Acknowledgement

- Main Contractor of MCE481 Project - Hock Lian Seng Infrastructure Limited (Singapore)
- Geotechnical Consultant of MCE481 Project – AGS Consultants Pte. Ltd. (Singapore)
- Giken Seisakusho Asia Pte., Ltd. (Singapore)
- National University of Singapore (Singapore)

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◆ A brief CV of Dr. Teik Lim Goh



Teik Lim Goh has his early education in University of Malaya (KL, Malaysia). After graduation, he joined Ove-Arup (KL) as a consulting engineer. He came to National University Singapore to further his doctorate study, researching on a deep excavation topic in soft ground. He started practicing as a geotechnical engineer in SembCorp Engineers & Constructors, specializing in deep excavation work for the construction of cut-and-cover road tunnel in Singapore (Kallang & Paya Lebar Expressway | Contract 421). He has then joined Giken Seisakusho Asia as a Technical Manager, and soon thereafter has been promoted as General Manager, in-charge of Asia region in promoting the use of Silent Piler. In 2011, he established his own company, Atsunew Giken to specialize in sub-contracting of Silent Piler work. He is a registered professional engineer in Singapore & Malaysia.