Serial Report

"RED HILL 1967™" Press-in Technology Dissemination Hub -Part 2-

Tsunenobu Nozaki

General Manager
IPA Secretariat

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Introduction of the facility: Demonstration Area, Approx. 4,600m^2

This facility showcases new structures constructed using the "Implant™ Method," employing the "SILENT PILER™" and "GRB™ System." These innovative techniques enable construction without the need for temporary works.

GRB System

The "GRB System" stands out as one of the pioneering innovations within our extensive lineage of inventions. This system is designed to encompass all piling processes, such as pile transportation, pile pitching, and press-in operations, directly on the already installed piles. Through the operation of all mechanical components on the piles themselves, it achieves "temporary-work-less construction," which eliminates the need for temporary construction work.

The "GRB System" comprises the following five integral functions, sequenced from the front in the direction of press-in piling operation:

(1) The "SILENT PILER," responsible for installing piles into the ground.
(2) The "Power Unit," serving as the hydraulic power source.
(3) The "UNIT RUNNER™," carrying the Power Unit.
(4) The "CLAMP CRANE™," used for pitching piles.
(5) The "PILE RUNNER™," engaged in transporting piles from the laydown area.

Conventional construction methodologies necessitate the installation of temporary working platform or berms on water or sloped construction sites to accommodate machinery. In contrast, the GRB System streamlines all procedures directly onto the piles themselves, negating the requirement for temporary platforms. This approach optimizes efficiency, enabling the primary construction works to be executed seamlessly.

Eliminating temporary construction not only shortens the construction period and significantly reduces construction costs, but also eliminates the burden on the environment caused by the installation and dismantling of temporary structures. The GRB System, which reduces wasteful CO2 emission from temporary construction, can be said to be a technology that contributes to a decarbonized society.

Fig. 1 Overview of GRB System

Gyropress Method™

The Gyropress Method, designed for the installation of tubular piles into hard ground, exhibits two distinct characteristics.

The first distinctive feature involves affixing drill bits called "ring bit" to the toe of the tubular pile, which serves to cut through the ground. The second involves the installation of the tubular pile while simultaneously rotating it. Through the rotation of the tubular pile equipped with a ring bit, the method effectively cores through hard ground and promptly constructs the Implant Structure. Notably, this technique can penetrate obstacles such as existing structures, enabling press-in operations without necessitating obstacle removal.

When installing steel tubular piles into hard ground, the conventional construction process involved a two-step construction process, such as

Fig. 2 Overview of Gyropress Method

soil replacement method by utilizing a separate machine, prior to the pile installation. In contrast, the Gyropress Method streamlines this process, eliminating the need for such intricate steps and allowing the entire construction process to be executed using a single unit.
For instance, when addressing rehabilitation of river bulkheads and road retaining walls, the Gyropress Method enables the direct press-in of tubular piles into existing concrete structures, thereby upgrading and reinstating their functionalities without necessitating removal. This approach has gained substantial recognition globally, as seen through its adoption by the Republic of Senegal and Amsterdam in the Netherlands, earning praise not only in Japan but across the international stage.

Combi-Gyro Method™

The Combi-Gyro Method involves a synergistic approach that combines Hat-shaped steel sheet piles and steel tubular piles, both of which are installed and combined to establish cut-off walls and earth retaining walls.
Cut-off walls and earth retaining walls require a certain level of stiffness. However, depending on the site conditions, there are cases where construction with steel sheet piles alone is not strong enough, and construction with steel tubular piles alone could lead to overstrength, increasing costs. The Combi-Gyro Method combines highly economical Hat-shaped steel sheet piles and highly rigid steel tubular piles to construct stiff walls at the optimal cost.
In alternative construction approaches, distinct machines would be necessary for installing steel sheet piles and tubular piles individually to create such a wall. However, the Combi-Gyro Method enables steel sheet piles and tubular piles to be installed by the same press-in piling machine.

Fig. 3 Overview of Combi-Gyro Method

Overhead Clearance Method

The Overhead Clearance Method is a construction technique specifically developed for sites with "limited overhead clearance," where obstacles like bridges and high-voltage cables are present above. Utilizing the specialized Silent Piler known as the "CLEAR PILER™," piles can be installed without necessitating the removal or relocation of overhead obstructions.
Traditional piling equipment is generally large in size and require a relatively large working space. Consequently, executing construction at locations with overhead obstacles has proven challenging. For instance, when operating beneath a bridge, conventional approaches necessitated the removal of the overhead bridge girder or the construction of a temporary bypass road.
In contrast, SILENT PILER boast a notably compact design. Moreover, the CLEAR PILER and the GRB System are particularly developed for operation in "low headroom" environments, enabling construction in challenging settings marked by overhead impediments. This breakthrough capability facilitates the revitalization and reinforcement of aging road bridges without disrupting existing urban functionality.
For example, the machine for tubular piles needs the minimum headroom of 2.5m, the machine next to it for steel sheet piles needs the minimum headroom of 1.7m (Fig. 4), and the special machine for ultra-low headroom needs the minimum headroom of only 1m (Fig. 5).

Fig. 4 CLEAR PILERs for Tubular Piles (left) and Sheet Piles (right)

Fig. 5 CLEAR PILER for ultra-low headroom

Dead Space Utilization Method/Rail Safe Method

The Dead Space Utilization Method is a construction technique that involves constructing a retaining wall with piles along the embankment surrounding railways and highways. This approach effectively generates new usable space.

Embankments are commonly employed for railways and highways; however, the slope embankments often lack utility and remain unutilized spaces.

Particularly, in urban areas where effective use of land is required, this construction method, which can make use of slope space, demonstrates its true value.

The construction procedure unfolds as follows: commencing with the installation of a retaining wall through pile pressing into the slope, the subsequent steps involve excavating soil at the passive side to form a level area, while simultaneously filling soil at the retained side. Following this, the wall is reinforced. The sequence is remarkably straightforward. The upshot is the creation of new roads along railways and the capacity to introduce supplementary tracks as needed.

In traditional construction methods, working in proximity to railways presents challenges due to the potential risk of machinery overturning. However, the SILENT PILER eliminates this concern by securely gripping the previously installed piles, ensuring stability and eliminating the risk of tipping over. This makes it feasible to conduct construction even during railway operational hours. Moreover, harnessing the capabilities of the GRB System permits construction on slopes without the necessity for temporary works.

Fig. 6 Overview of Rail Safe Method

Implant Lock Levee™

The "Implant Lock Levee" refers to a levee that robustly withstands a variety of destabilizing factors. This is achieved by constructing self-supporting walls using steel sheet piles within an earth levee. Within the embankment, two rows of steel sheet piles are installed, and these are connected by a " confining wall" as shown in Fig. 7. This innovative configuration enhances the levee's stability against potential failure.

The primary catalyst behind the frequent floods occurred in various places each year is the "riverbank failures." Most of river embankments are constructed as "earth embankments," comprising soil that is filled and compacted. Consequently, when these embankments absorb water, they become vulnerable and prone to fracturing. It can be asserted that earth levees, due to their lack of water compatibility, possess a structural weakness that renders them unable to endure rupture-inducing elements brought about by heavy rainfall, including overtopping, seepage, and erosion.

Implant Lock Levees, on the contrary, avert collapse by maintaining self-supporting steel sheet pile walls even if the embankment is eroded due to rising water or flooding. Furthermore, in the event of an earthquake, the encircling steel sheet piles confine the movement of the underground liquefaction layer, mitigating ground subsidence. This phenomenon is referred to as the "confined ground seismic damper." The greatest feature of this embankment is that it does not break even in the event of a major earthquake, as well as overtopping and seepage.

Fig. 7 Overview of Implant Lock Levee

Implant Barrier™

The Implant Barrier stands as an innovative coastal defense structure that employs pressed-in piles as structural elements, integrating wall components crafted from diverse materials like fiber, steel, and concrete, strategically engineered to mitigate the impact of tsunamis and minimize damage. Here, from the right, we are exhibiting implant barrier wall materials made of fiber, steel, and concrete materials. In particular, the Implant Barrier made of fiber material not only functions in an emergency, but also contributes to maintaining the landscape by storing it in normal times.

Fig. 8 Various Types of Implant Barriers

General Concrete Retaining Wall and Implant Structure Concrete Retaining Wall

A retaining wall is designed and constructed to prevent a slope from collapsing when there is a need to establish varying elevations on the ground. Presented below are three different types of concrete retaining walls.

The retaining wall seen in on the left is a conventional concrete block retaining wall. This type of wall counters the lateral pressure of the earth through a combination of block weight and base resistance.

The retaining wall in the middle employs an Implant Structure, featuring concrete sheet piles that have been installed into the ground.

The retaining wall on the right is an Implant Structure design incorporating a PC pile wall that has been installed. A PC pile wall, comprising concrete piles containing internal PC steel wire, is recognized for its capacity to effectively withstand substantial lateral earth pressure. Due to the firm embedment into the ground, the Implant Structure retaining wall robustly withstands external forces, ensuring its persistence and functionality over time.

Fig. 9 Comparison of Concrete Retaining Walls

Implant Structure Steel Sheet Pile Retaining Wall (Preloaded Retaining Wall)

The retaining wall in the front is a typical sheet pile retaining wall constructed by installing steel sheet piles vertically. One in the back is the "Preloaded Retaining Wall," which is constructed by pressing steel sheet piles at an angle. A Preloaded Retaining Wall is a wall that is stiffer than a vertical retaining wall by applying lateral loads to the upper parts of the wall toward the passive side. A bent wall tries to return to its original straight shape. This force is used to hold down the embankment on the back more firmly.

Through the collaborative research between GIKEN and the University of Cambridge, it has been substantiated that the lateral deflection in the wall structure when a load is imposed on the embankment is only within the range of 1 to 4%. This variance is notably minimal in comparison to the deformation observed in a conventional vertical retaining wall.

Fig. 10 Comparison of Preload Retaining Wall and Traditional Embedded Retaining Wall

Implant Bell Cap Bridge™

The Implant Bell Cap Bridge is a temporary-work-less bridge that can be constructed in a small space and in a short construction period.

The bridge piers are steel tubular piles with bell cap-shaped members attached and pressed-in, and beams and bridge girders are installed on top of them. This bell cap has the function of increasing the ground contact area and increasing the bearing capacity by broadly compacting the ground. This minimizes the required embedded depth of piles.

When constructing a bridge using conventional construction methods, a foundation is built on the ground to support the bridge, and the piers are installed on top of that. This traditional process necessitates substantial construction works, demanding a significant workspace and extended construction duration.

On the other hand, with the Implant Bell Cap Bridge approach, steel tubular piles with bell caps serve as foundations and piers, so the work process can be minimized. In addition, since the work can be completed on the bridge girder installed on the piles, there is no need for temporary construction or a large working space. It is expected to be applied in various places such as for new construction in a restricted working space such as urban areas and emergency transportation roads in the event of a natural disaster.

Fig. 11 Overview of Implant Bell Cap Bridge

Introduction of the facility: Kochi Factory 3, Approx. 3,500m²

GIKEN established this facility as the largest plant in Japan in order to accelerate their product development in pursuit of its global expansion. It serves as a hub for the advancement, prototyping, and validation of large-scale products, which have become our primary emphasis in recent times. For the first time in Japan, GIKEN adopted the Gyropress Method for the rotary cutting and press-in installation of steel tubular piles for the building's foundation work, and successfully achieved the installation of 54 steel tubular piles, with pile lengths ranging from 15 to 15.8 meters.

Kochi Factory 3 with Steel Tubular Pile Foundation

Future Prospects of RED HILL 1967

Much like GIKEN group, there are people all over the world who feel frustrated with the irrationalities in the construction industry and are passionately pursuing machinery, methodologies, and structures based on the latest scientific principles. GIKEN hopes that such like-minded individuals will visit RED HILL 1967, resonate with the advantages of the press-in principle, and feel connected to its history. GIKEN looks forward to exploring the future of construction together with those who share the vision.

GIKEN recognizes that comprehending the theoretical advantages of the press-in principle and their distinctive methods might not suffice to foster complete conviction. For this reason, they extend a cordial invitation to those individuals, encouraging them to witness firsthand the tangible impact of GIKEN's efforts. By doing so, visitors can ascertain the validity of GIKEN's endeavors and cultivate unwavering confidence in their pursuits.