IMPLANT LEVEE
Highly Resilient Disaster Prevention Levee

Levee Upgrading Work in Japan
Implant Levee

Twin Steel Sheet Pile Wall System
Steel sheet piles are installed into the embankment to a depth determined for proper stability and/or cut-off of flow. Also, liquefaction of the levee can be prevented by enclosing it with twin sheet pile walls. Thus, the levee can withstand large external loading and the levee crest can remain in place, even in catastrophic events.

Advantages of Implant Levee

- **Flood, Storm Surge and Tsunami Protection**
- Functions of the levee can be maintained by increasing its stability.

Giken Reaction Base (GRB) System
The press-in machine utilises reaction force from previously installed piles and performs piling work on top of the piles. With further development based on the principle of "reaction based mechanism", "the GRB System" was developed as a press-in system which performs all piling procedures such as; pile transportation, pile pitching and press-in work, on top of installed piles. The GRB System consists of a Silent Piler in the front, a Power Unit as a power source, a Clamp Crane to pitch piles and a Pile Runner to convey piles from storage site.

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Gyropress Method
Gyropress Method installs tubular piles with cutting bits attached on pile toe by rotary jack-in system, and travels on top of piles which are completely installed (completed piles).

- **Press-in Force**
- Gyration Force
- Gyropress Force

Contiguous Tubular Pile Wall
Steel tubular pile wall is a vertical barrier and can be installed in locations where space is scarce, such as urban environments or where the construction of a wide levee is not feasible. The piles are installed into the embankment to a depth determined for proper stability to withstand large dynamic and hydraulic loading.

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Comparison of Implant Levee to conventional levees  
(Risk Analysis)

Failure of levees potentially results in devastating consequences, in both life and economic losses, around the failure. Therefore, risk analysis and evaluation is a key issue for levee operation and management.

<table>
<thead>
<tr>
<th>Failure/ Deterioration Mode/ Risk Elements</th>
<th>Process</th>
<th>Implant Levee</th>
<th>Conventional Levee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instability</td>
<td>Water entering the embankment through surface cracks or animal burrows could reduce the soil strength of the levee. This may compromise the stability of the embankment and, in turn, reduce the ability of the levee to perform as designed during high water events.</td>
<td>Negligible</td>
<td>Moderate - High</td>
</tr>
<tr>
<td>Internal Erosion</td>
<td>The hydrostatic pressure against a levee slope increases significantly and can force water into the levee embankment and its foundation. This seepage will generally follow paths of least resistance. Depending on the geotechnical properties of the soil, internal erosion may then happen.</td>
<td>Negligible</td>
<td>Moderate - High</td>
</tr>
<tr>
<td>Settlement</td>
<td>Large seismic accelerations cause settlement and loss of effective shear strength in water-saturated, unconsolidated sediment, leading to loss of bearing pressures and lateral spreading of levee.</td>
<td>Negligible - Low</td>
<td>High</td>
</tr>
<tr>
<td>Breach</td>
<td>Levees can breach before overflow/ overtopping if there are structural issues with the levee making it unstable under a hydraulic load.</td>
<td>Negligible</td>
<td>Moderate - High</td>
</tr>
<tr>
<td>Collapse (Widespread Devastation)</td>
<td>Large external cyclic loading due to these catastrophic events may lead to large parts of the levee collapsing or significant deformations. The levee failure occurs when the weakness of the levee reaches an unsustainable ultimate state.</td>
<td>Negligible - Low</td>
<td>High</td>
</tr>
</tbody>
</table>
Costal Levee Upgrading Work, Japan

Twin Sheet Pile Walls installed with Press-in with Simultaneous Augering
2,399no. U Sheet Piles /w L=15.0m - 16.5m (700Lm)

Sheet Pile Installation

Tie Rod Installation

Completion

Silent Piler (Crush Mode)

Cross Section

Land Side

Sea Side

Twin Sheet Pile Walls

Tie Rods

Road

Boulders

500mm-800mm

5000mm ~ 6000mm

Potentially Liquefiable Soil Layer

Scour Protection

U Sheet Piles /w
L=15.0m ~ 15.5 m

Sheet Piles (Land Side)

Sheet Piles (Sea Side)
**Seawall Upgrading Work, Japan**

**West Area**

Contiguous Tubular Pile Wall installed with Gyropress Method (Rotary Jack-in Method)
564no. Tubular Piles Ø1,000mm L=19.5m (670Lm)

New Seawall

[Cross Section]

Sea Side

Land Side

Existing Seawall

Road

Tubular Piles Ø1,000mm L=19.5m

Pile Installation without disturbing adjacent traffic (Gyropress Method)

Post Pile Installation

**East Area**

Twin Sheet Pile Walls installed with Press-in with Simultaneous Augering
1,800no. U Sheet Piles III L=19.5m - 23.0m (577Lm)

New Seawall

[Cross Section]

Sea Side

Land Side

Existing Seawall

Concrete Liner Wall

Tie Rods

Road

Tubular Piles Ø1,000mm L=19.5m

650mm

U Sheet Piles III L=19.5 - 23.0m

Rapid Construction by Systematic Method
Other Examples

Seawall Upgrading Work, Japan (Gyropress Method)

- Tubular Pile Installation
- Post Pile Installation

Riverine Levee Upgrading Work, Japan

- Sheet Pile Installation
- U Sheet Pile Installation
- Scour Protection

Levee Upgrading Work, Japan

- Tie Rods
- Potentially Liquefiable Soil Layer
- Anti-liquefaction Ground

Seawall Improvement Work, Japan

- Tubular Piles
- L = 13.5 m
- L = 20.5 m