HARD GROUND PRESS-IN METHOD

The Silent Piler for Hard Ground
Super Crush Piler
SCU-400M
SCU-600M
Technical Brochure
The Press-in Method has variety of superiorities, but had one weakness. It was to press-in at hard ground conditions. It has been a long time pending issue in the Press-in Industry. By the standard press-in method and the press-in with water jetting method cannot enable to install sheet piles into hard ground stratum such as sandy gravel layer with boulders and rock layer.

Super Crush Piler was designed for the solutions such issue. By the realisation of a GIKEN’s unique concept, ‘the Coring Theory’, which is press-in with simultaneous augering, made sheet piling work possible at hard ground conditions. It dramatically expands the sheet piling range without vitiating the superiorities of the Press-in Method.

Even though Super Crush Piler has an augering device, the press-in machine main body is so light and compact that its physical appearance does not give negative power of impression that typical massive augering machines have. The lightness and compactness of Super Crush Piler makes sheet piling work possible at limited working spaces and slopes. In addition, because Super Crush Piler firmly grips reaction piles, it hardly overturns during operations. This mechanism provides ultimately high safety performance.

The environmentally friendly designs are strictly applied in Super Crush Piler. The Power Unit has the world highest level of engine in smoke emissions and fuel consumption. Biodegradable hydraulic oil and grease are applied as its standard specifications. They can prevent fatal contamination in water and soil, if they are accidentally spilled over, because natural bacteria degrade them in a short period of time.

The introduction of Super Crush Piler expands the applicable ground range of press-in work. We believe not only that it improves the superiorities of the Press-in Method but also that it creates new chapter in the history of piling work. This brochure will give you detailed information about the features and superb functions of Super Crush Piler for your new recognitions.
When sheet piling work is carried out at hard ground condition, such as sandy gravel layers with boulders and rock, massive augering and piling machines are generally used. They are time consuming and not economical. They are even not environmentally friendly and not a safe piling method, neither. GIKEN has developed “the Hard Ground Press-in Method” to overcome those negative aspects. Noise and vibration generated from piling work can be minimised by pressing-in sheet piles with simultaneous augering. This Silent Piler, so called the Crush Piler, is so compact and light that it can eliminate negative psychological impact that massive conventional piling machines give to neighbours. Moreover, if piling alignment is located on slope or on the water, conventional piling machines require large temporary platform. Because such temporary facility is not necessary in the Hard Ground Press-in Method, environmental burden of the piling work is greatly reduced.


“Any construction work should be fair and appropriate for citizen. GIKEN defines what construction works are supposed to be by “the Five Construction Principles” which consists of Environmental Protection, Safety, Speed, Economy and Aesthetics. They are GIKEN’s fundamental of machine developments and construction method developments.

Overview

Superiorities of Press-in Method
- No vibration and no noise
- No machine overturning
- Compact and light machine
- Press-in load can be monitored during installation
- High piling quality

The Coring Theory
(Press-in with Simultaneous Augering)

Various Advantages
- Can install sheet piles at hard ground such as boulder, gravel and rock.
- No risk of machine over-turning and no negative psychological impact that massive conventional machines give.
- Compact and light machine makes piling work possible at limited working area and on slope.
- The augering section area is minimised just for sheet pile installation, so the amount of discharged soil can be minimised. It provides proper stability on the sheet pile wall.
- An environmentally friendly piling method with GIKEN’s original system technologies.

Features

The Five Construction Principles

Environmental Protection
- Construction work should be environmentally friendly and free from pollution.
- Static load is applied to press-in sheet piles, so there is no construction pollution like noise and vibration.
- Silent Piler is so light and compact that its extent of the piling activities can be minimised.
- GIKEN’s system technologies don’t require temporary platforms so that environment burden of construction work is minimised.
- The augering section area is minimised just for sheet pile installation, so the amount of discharged soil can be minimised. It gives no negative impact to surroundings.

Safety
- Construction work has to be carried out in safety and comfort with a method implementing the highest safety criteria.
- The compact Silent Piler doesn’t have risk of overturning, because the no gross reaction piles firmly.
- The Pile Auger and sheet pile being pressed-in are locked by high safety functions.
- The Crush Piler can be controlled by wireless control system, so the operator can control the Crush Piler at a safe spot.

Speed
- Construction work should be completed in the shortest possible period of time.
- Construction duration can be greatly shortened, because highly efficient piling work can be carried out with systemised packages of machineries and apparatuses.
- Multiple sets of compact machines and apparatuses can be used at the same time to greatly shorten construction period.
- Speedy piling progress is available, because there are least limits in working hours even at highly restricted areas and night works.

Economy
- Construction work must be done rationally with an inventive mind to overcome all constraints at the lowest cost.
- GIKEN’s system technologies don’t require temporary platforms so that construction cost is greatly reduced.
- This systemised package of machines and apparatuses can minimise number of work force so that labour cost is greatly reduced.
- All machines are so compact that it is not necessary to completely close active traffics.

Aesthetics
- Construction work must proceed smoothly and the finished product should portray cultural and artistic flavour.
- Smooth piling works are available by selecting the most effective package of machineries and apparatuses for individual project conditions.
- Artistic looking structure is available by installing decoration panels on sheet pile walls.
- With superiorities of the Press-in Method, highly accurate and high quality sheet pile walls are available.
Monitor

It is possible to check important operating information, such as Press-in Force and the Auger Torque, on the digital monitor in real time.

Maximum Extrapolated SPT N Value

Maximum Gravel-Boulder Size

Gravel-Boulder Proportion

Uniaxial Compressive Strength (N/mm²)

(Note)

1. Various numerical values that distinguish the nature of soil must be referred from the value indicated in borehole data.
2. The maximum values in borehole data must be applied to determine the applicability.

* GIKEN has many experiences at area where defined “Need individual consultation”. Please contact the nearest GIKEN office for detailed information. (Project achievements P25-P32)


Various Auger Heads

The type of auger heads shall be selected based on ground conditions.

For press-in 2 Wings
For cobble 2 Wings
For rock 3 Wings

* GIKEN keeps developing original auger heads for further improvements in terms of body designs and materials.
**Super Crush SCU-400M Specifications**

- **Pile Auger**
  - At transportation: 1470
  - Overall Length (mm): 3465

- **Hose Reel**
  - At transportation: 3215
  - Overall Length (mm): 3900

- **Press-in Machine Main Body**
  - Press-in Force: 800 kN
  - Extraction Force: 900 kN
  - Stroke: 1,000 mm
  - Mass: 10,600 kg (including Hose Reel)

- **Applicable Sheet Piles**: Sheet piles Type I, II, and III

- **Control System**: Radio control

- **Overall Length (mm) at transportation**: 3900 (for 21 m)

**Total mass 20,200 kg (21.0 m)**

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**Super Crush SCU-600M Specifications**

- **Pile Auger**
  - At transportation: 1470
  - Overall Length (mm): 3465

- **Hose Reel**
  - At transportation: 3215
  - Overall Length (mm): 3900

- **Press-in Machine Main Body**
  - Press-in Force: 800 kN
  - Extraction Force: 900 kN
  - Stroke: 1,000 mm
  - Mass: 13,400 kg (including Hose Reel)

- **Applicable Sheet Piles**: Sheet piles Type ᶘ, ᶙ, and ᶔ

- **Control System**: Radio control

- **Overall Length (mm) at transportation**: 3900 (for 30 m)

**Total mass 27,800 kg (30.0 m)**

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**Power Unit EU300F3 Specifications**

- **Power Unit**
  - **Power Source**: Diesel Engine
  - **Rated Output**: 230 kW (313 ps) / 1,800 min⁻¹

- **Fuel Tank Capacity**: 500 L

- **Hydraulic Oil Tank Capacity**: Piker Eco Oil 630 L

- **Driving Speed**: 1.4 km/h

- **Vibration Regulations**: Fulfils Official Regulation Requirement

- **Exhaust Emission Regulations**: Fulfils Off-road Regulation Requirement

- **Mass**: 7,980 kg

**Washing Apparatus**

- **Mass**: 320 kg

**Total mass 8,300 kg**

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**Reaction Stand for SCU-400M Size**

- **Mass**: 8,300 kg

**Reaction Stand for SCU-600M Size**

- **Mass**: 2,000 kg

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*The above specifications are subject to alternation without a prior notice.*
Mechanism of Press-in

Coring Press-in (Press-in at Sand Gravel & Boulder Strata)
Under “the Coring Theory”, a GIKEN's original technology, the Pile Auger penetrates into hard stratum by augering the minimum area to create a coreless zone underground. While the Pile Auger is being extracted, sheet pile is being pressed-in simultaneously. In this manner, augering is applied just for a driving assistance purpose. It does not decrease baring capacity of driven piles, because the least volume of soil is discharged and ground disturbance is minimised.

Press-in with Pre-augering (Press-in at Boulder & Rock Strata)
If sheet piles are installed into rock strata by conventional method, usually large area of rock are crushed and then replaced by sand prior to sheet piling. With this piling method, it takes more cost and time. The Super Crush Piler can solve such problems. The Pile Auger equipped on Super Crush Piler pre-auges prior to pressing-in sheet pile just necessary area of rock and then sheet pile is installed. The Super Crush Piler can handle the both pre-augering work and sheet pile installation work by the one unit. It makes sheet piling work at hard ground significantly efficient. In addition, the Pile Auger can pre-auger with high level of accuracy, because it is fixed with a guide attachment which is connected to the leading interlock of previously installed sheet pile.
Comparison Table (SCU-400M)

<table>
<thead>
<tr>
<th>Features</th>
<th>Budget</th>
<th>Environmental Burden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Ground Press-in Method</td>
<td>65 days (100 %)</td>
<td>145 t (191 %)</td>
</tr>
<tr>
<td>Excavation &amp; Sand replacement</td>
<td>Sheet pile press-in = JPY 41 million Total = JPY 41 million</td>
<td>(Add 130 t for temporary work platform work.)</td>
</tr>
<tr>
<td>Sheet pile jack-in = JPY 5.5 million Total = JPY 56.5 million</td>
<td>(138 %)</td>
<td></td>
</tr>
<tr>
<td>Excavation &amp; Piling Method</td>
<td>93 days (143 %)</td>
<td>147 t (194 %)</td>
</tr>
<tr>
<td>Sheet pile press-in = JPY 41 million Total = JPY 41 million</td>
<td>(100 %)</td>
<td></td>
</tr>
<tr>
<td>Sheet pile jack-in = JPY 72 million Total = JPY 77.5 million</td>
<td>(189 %)</td>
<td></td>
</tr>
</tbody>
</table>

Comparison Conditions

1. Installation budget only.
2. Excluding sheet piles.

Comparison Table (SCU-600M)

<table>
<thead>
<tr>
<th>Features</th>
<th>Budget</th>
<th>Environmental Burden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Ground Press-in Method</td>
<td>48 days (100 %)</td>
<td>76 t (100 %)</td>
</tr>
<tr>
<td>Excavation &amp; Sand replacement</td>
<td>Sheet pile press-in = JPY 36 million Total = JPY 36 million</td>
<td>(Add 130 t for temporary work platform work.)</td>
</tr>
<tr>
<td>Sheet pile jack-in = JPY 2.2 million Total = JPY 2.2 million</td>
<td>(149 %)</td>
<td></td>
</tr>
<tr>
<td>Excavation &amp; Piling Method</td>
<td>86 days (179 %)</td>
<td>145 t (191 %)</td>
</tr>
<tr>
<td>Sheet pile press-in = JPY 36 million Total = JPY 36 million</td>
<td>(100 %)</td>
<td></td>
</tr>
<tr>
<td>Sheet pile jack-in = JPY 51 million Total = JPY 72 million</td>
<td>(187 %)</td>
<td></td>
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</table>

Comparison Conditions

1. Installation budget only.
2. Excluding sheet piles.

Cross Section

- A casing with cemented carbide tips on the edge is driven by gyration jack-in, and the soil inside the casing is excavated. There are 2 work procedures required prior to sheet piling work:
  1. Casing with gyration, excavation, backfilling
  2. Sheet pile installation by a jack-in piling rig equipped with auger.

- There are 2 work procedures required prior to sheet piling work:
  1. Excavation & Piling Method

- There are 2 work procedures required prior to sheet piling work:
  1. Excavation & Sand replacement

- The penetration capacity into boulder is lower than "All Casing Sand Replacement Piling Method".

- The piling rig hardly overturns, because it clamps previously installed piles so that the rig is fixed with those reaction piles.

- The piling rig is so compact that it can be used at narrow site conditions and on slope.

- The penetration capacity into boulder is lower than "All Casing Sand Replacement Piling Method".

- This method requires less work procedures than other methods, because it doesn’t require sand replacement work.

- This method doesn’t cause construction pollutions such as noise and vibration, because sheet piles are installed by static load.

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- This method requires a large working area, because it requires massive construction equipments such as casing gyration jack-in machine, crawler crane and excavator.

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Superiorities of the Hard Ground Press-in Method (under physical restrictions at site)

- **On Slope:** No temporary working platform is required. It can shorten construction duration and reduce construction cost.

- **On The Water:** No temporary working platform is required. It can shorten construction duration and reduce construction cost.

- **Adjacent to Structure:** There is no working time restriction, because it is such a safe method that there is no risk of the machine overturning.

Machine Layout

- **Plan for Standard Assembling Work for Initial Piling**

- **Plan for Standard Press-in Work**

*A 80 ton crane is required for SCU-600M when sheet pile length is more than 15m.*
**Crush Piler with GRB System**

The GRB System makes press-in work possible on the water, on slopes, and at narrow space without work platforms.

**Press-in Procedures**

1. Pitch the sheet pile (1) into Chuck and grip it by Chuck.
2. After checking the alignment and verticality, start pressing-in the sheet pile (1).
3. Set the Reaction Stand on the Datum line horizontally, then set up the Crush Piler and counter weights on the Reaction Stand. The Pile Auger is then assembled with the Crush Piler.
4. Press-in the sheet pile (1) until Datum level. Press-in the sheet pile (2), until a depth where the Pile Auger gets enough resistance to support the weight of Crush Piler. Then self-move the Crush Piler forward.
5. Press-in the sheet pile (2) until Datum level.
6. Repeat the procedures 3 to 5 for several sheet piles, then remove the Reaction Stand to complete initial piling.
**Simultaneous Press-in Procedures**

1. Pitch the sheet pile into Chuck and grip it by Chuck.
2. Penetrate the auger head into the ground.
3. While extracting the auger head, sheet pile is being pressed-in.
4. Repeat the procedures 2 to 3 until a depth where the Pile Auger gets enough resistance to support the weight of Crush Piler. Then self-move the Crush Piler forward.
5. Press-in the sheet pile until Datum level.
6. Extract the Pile Auger, then continue the procedures 1 to 6 press-in work in that order.

**Press-in Procedures under Limited Headroom**

Under limited headroom, it is possible to press-in sheet piles by jointing the casing augers and welding sheet piles.

1. Although headroom clearance is more than 11m, piling work may not be possible due to the winding limit of the service crane to be used.
2. In the case the headroom clearance is less than 11m, please contact the nearest GIKEN office for individual consultation.

* Regular crane can be used, if the clearance is more than 11m.

**Overhead limit**

1. Pitch lower pile into Chuck.
3. Disconnect the motor part.
4. Connect the motor part and the middle casing auger. (Joint with bolts)
5. Connect the set of the motor part and the middle part to the lower part of casing auger.
6. Pitch the middle pile into Chuck and joint the sheet piles by welding.
7. Press-in work Repeat the procedures 3 to 7 until completion.
**Corner, Curve & Slope Piling**

- **Corner Piling**
  - Pattern 1
  - Pattern 2
  - Pattern 3

- **Curve Piling**

- **Slope Piling**
  - Up Slope
  - Down Slope

Minimum Radius of Alignment 
*R=8,000mm (recommended)*

*If you need to consider the radius of alignment less than 8,000mm, please contact to the nearest Giken office.*

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**Environmental Measures**

Silent Piler is designed with strict concept for environmentally-friendly machine. It meet with the Ultra Low Noise Standard and latest emission restrictions which are established by MLIT. By applying biodegradable oil (the Piler Eco Oil and the Piler Eco Grease), if hydraulic oil or grease is spilled to soil or water in any possibility, those are degraded by bacteria in natural environment so that they will be no risk of contamination.

* A Japanese act for Emissions from Non-Road Special Motor Vehicles

**Reduction of Vibration and Noise**

The Power Unit meets the “Ultra-low noise standard” established by the MLIT.

<table>
<thead>
<tr>
<th>Noise Level Measurement Result</th>
<th>Night Time</th>
<th>Daytime</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAeq</td>
<td>54(50)</td>
<td>48</td>
</tr>
<tr>
<td>L50</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>L90</td>
<td>56</td>
<td>56</td>
</tr>
</tbody>
</table>

* Distances from the measuring locations to Silent Pillers differ from 15 to 80m according to construction progress.

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**Vibration & Noise Measuring Sample**

- **Sheet Piling in Progress**
- **Measurement Location**

**Project Summary**

- **Project Name**: Kochi airport runway extension project
- **Location**: Nankoku City, Kochi Prefecture
- **Employer**: Kochi Aviation & Port Project Office, Shikoku Local Regeneration Authority of The Ministry of Land, Infrastructure and Transport
- **Main Contractor**: Shimizu - Sato JV.
- **Piling Contractor**: Giken Seko Co., Ltd.
- **Duration**: H12.5 - H12.9
- **Silent Piler**: Super Crush SCU-400M, 7 units
- **Pile Section / Length**: Type III, L = 15.5 - 16.5m, n = 2,000 pieces

**Noise Level Measurement Result (night time)**

<table>
<thead>
<tr>
<th>Location</th>
<th>LAeq</th>
<th>L50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Conversation</td>
<td>54(50)</td>
<td>43</td>
</tr>
<tr>
<td>Normal Driveway</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Normal Driveway</td>
<td>56</td>
<td>56</td>
</tr>
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<td>56</td>
<td>56</td>
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**Noise Level Measurement Result (daytime)**

<table>
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<td>43</td>
</tr>
<tr>
<td>Normal Driveway</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Normal Driveway</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Normal Driveway</td>
<td>54</td>
<td>54</td>
</tr>
</tbody>
</table>

The top value L10 in vibration level 80% range was less than 30dB.
Exhaust Emission

- Exhaust Emission Regulations
  - SCU-400M (since No.45) and SCU-600M (since No.14)
    The new generation environmentally-friendly engine conforms to the emission levels of the off-road act.
    (it meets with the 3rd standard of emissions from construction equipment by MLIT)
  - SCU-400M (No.1-No.44) and SCU-600M (No.4-No.13)
    It conforms 2nd standards in abroad for exhaust emissions that past engines could not conform.

- GIKEN’s Standard
  - Setting more strict original standards from the viewpoint of citizens.
    Highly energy-efficient utilisation → High combustion efficiency
    Elimination of other environmental burden → White smoke and dark smoke

Large reduction of white smoke: When the engine starts (warming-up time)
The Power Unit of the Super Crush Piler  A Past Power Unit

The engine with the electronic controlled fuel injection system reduces white smoke.

Large reduction of dark smoke: When the engine load is applied
The Power Unit of the Super Crush Piler  A Past Power Unit

The dark smoke emission are reduced by GIKEN's original designs on hydraulic control and fuel injection control.

Environment-Friendly Biodegradable Oil (the Piler Eco Oil and the Piler Eco Grease)

- Design Concept
  - Environmentally friendly concept has been adapted as the primary design concept.
  - A biodegradable oil has been developed by GIKEN with a hydraulic oil manufacturer.

- Standard Application of Biodegradable Oil
  - The label of Piler Eco Oil & Piler Eco Grease is affixed on Silent Piler.

Biodegradable oil is applied to Silent Piler, so if hydraulic oil or grease is spilled to soil or water in any possibility, those are degraded by bacteria in natural environment in short term.

- Their biodegradability has been certified by biodegradability test.

- Avirulence is certified by Fish Toxicity Test.

Biodegradability test: OECD*1 301C
Activated sludge was used as microorganism source. Biochemical oxygen consumption (BOD) of specimen material (Piler Eco Oil & Piler Eco Grease 100mg/L) was continuously assayed by automatic assay system to evaluate biodegradability (percentage of volume of degrade into carbon dioxide and water) after 28 days.

- After 28 days (Required more than 60% degraded.)
  - Eventually 100% will degraded. Time differs from conditions for 100% degrade.

Acute Toxicity Test: JIS*2 K 0102
This test is carried out to investigate the survival rate of 10 killifishes within 4 days in the water contains specimen material 100mg/L.

- After 4 days (Survival rate needs to be more than 50%)
  - Piler Eco Oil 100% alive → Meet the standard
  - Piler Eco Grease 100% alive → Meet the standard

*1: The Organization for Economic Co-operation and Development Standards.
*2: Japan Industrial Standards.

Piler Eco Oil
- 100% alive → Meet the standard

Piler Eco Grease
- 100% alive → Meet the standard
AUXILIARY EQUIPMENT for improvement of safety and work efficiency under various site conditions

Generally speaking, many sheet pile works are carried out where work platform is necessary, such as on water, at slope and at high pile head from ground surface. Under such working conditions, GIKEN’s Piler Stage and Auger Head Replacing Attachment make piling work safe and efficient. In addition, many auxiliary equipment are lined up to improve environmental and safety aspects.

Piler Stage

- Piler Stage is an easy handling platform.
- Junctions on the Crush Piler are easy insert type as well as junctions of each pieces. You can set the stage on the only one side.
- Adjustable handrails make flexible entry and exiting.
- Maximum loadable mass
  - Attaching both side: 350 kg
  - Attaching one side: 200 kg
  - Middle Stage: 150 kg
- Mass: 530 kg

Junctions on the Crush Piler are easy insert type as well as junctions of each pieces. You can set the stage on the only one side. Adjustable handrails make flexible entry and exiting.

Auger Head Replacing Attachment

It is necessary to use more than 2 types of Auger Head according to soil condition. Auger heads are so heavy that it takes time and needs hard work for the replacement. But Auger Head Replacing Attachment makes such replacement work much faster and safer.

If sheet pile alignment is close to any structure, or if site condition is too narrow to set the Piler Stage, or when corner piling is required, you can use the Adjustable Arm Type Attachment.

Hose Roller

- Mass: 8 kg
- Operation time: More than 50 hours with size D battery
- Applicable sheet pile sections: U Sheet Pile (400, 500, 600 mm)

Hose Roller can protect hydraulic hose damages by avoiding lugging hydraulic hoses on the ground, and make the hose handlings much easier.

Pile Laser

- Mass: 1.5 kg
- Operation time: More than 50 hours with size D battery
- Applicable sheet pile sections: U Sheet Pile (400, 500, 600 mm)

Sheet pile alignment is quickly and accurately set by palm-size laser diode pointer.

Pile Roller

- Mass: 9 kg
- Locking & Release Operation: Radio Control
- Maximum lifting load: 2,000 kg

Pile Roller eliminates noise and friction between piles while sheet pile is being pitched up. It makes crane work smoother and safer.

Hose Roller

- Mass: 11 kg for U Sheet Pile
- Mass: 13 kg for Hat Sheet Pile 900mm
- Applicable sheet pile sections: U Sheet Pile (400, 500, 600 mm)

* Type IV is not applicable.

Pile Laser

- Mass: 11 kg
- Operation time: More than 50 hours with size D battery
- Applicable sheet pile sections: U Sheet Pile (400, 500, 600 mm)

Pile Laser can protect hydraulic hose damages by avoiding lugging hydraulic hoses on the ground, and make the hose handlings much easier.

Radio Control Safety Shackle

- Mass: 9 kg
- Locking & Release Operation: Radio Control
- Maximum lifting load: 2,000 kg

The pitching shackle can lock and released the sheet pile by radio control. The latest model has improved in the safety function.

* This accessory is available only in Japan at this moment. (February, 2010)
GIKEN IT SYSTEM

GIKEN IT System can exchange various real-time information such as Press-in Management Information, Maintenance Information, and location information between piling site and GIKEN Total Support Centre. For instance, information of Press-in Monitoring System can be utilized for advice to improve piling productivity, and Maintenance Information can be utilized for advice to prevent machine trouble and to reduce repair time.

Press-in Monitoring System

Press-in Monitoring Data for each single pile, such as press-in force, auger torque and press-in time, is available for scientific analysis. Such data can be linked to borehole data to optimize operation settings for each ground condition. Proper advice can be given for any change in soil strata and presence of any underground obstacle.

Highly reliable sheet piling operations are available with Press-in Monitoring Data as a scientific evidence which can be passed to employers and engineers.

* This service is available only in Japan at this moment. (February, 2010)
Project Achievements

U Sheet Pile

**Construction of East Tsim Sha Tsui Station and pedestrian subway**
Kowloon, Hong Kong

Borehole Data

Uniaxial Compressive Strength
40 N/mm² - 130 N/mm²

**New Metro Rail Track Construction**
Perth, Australia

Borehole Data

**Construction of New Water Intake Pumping Station**
Kandy, Sri Lanka

Borehole Data

Uniaxial Compressive Strength: 100 MPa

**Fukuoka Ring Utility Conduit**
Fukuoka, Japan

Borehole Data

SPT value over 50 is extrapolated.
Shands Hospital, Subterranean pathway
Gainesville, Florida, U.S.A.

Palm Beach
Palm Beach, Florida, U.S.A.

Blackheath-Hill
London, U.K.

St. Johns Working
St. Johnes, Working, U.K.
**THE FIVE CONSTRUCTION PRINCIPLES**

If we analyse all the parties involved in any construction work, we can categorise them into three main groups: the client, the contractor and the general public. The ideal situation is when all three parties are in agreement and satisfied with the successful outcome of the construction work. Problems arise when one of the parties becomes a victim of imbalance in this relationship. The conventional construction methods based upon principles that "more is paid for less efficient work" are no longer appropriate to present-day society. Universally acceptable construction methods must embody the Five Construction Principles.

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
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<tbody>
<tr>
<td>Environmental Protection</td>
<td>Construction work should be environmentally friendly and free from pollution.</td>
</tr>
<tr>
<td>Safety</td>
<td>Construction work has to be carried out in safety and comfort with a method implementing the highest safety criteria.</td>
</tr>
<tr>
<td>Speed</td>
<td>Construction work should be completed in the shortest possible period of time.</td>
</tr>
<tr>
<td>Economy</td>
<td>Construction work must be done rationally with an inventive mind to overcome all constraints at the lowest cost.</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>Construction work must proceed smoothly and the finished product should portray cultural and artistic flavour.</td>
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</tbody>
</table>