# HARD GROUND PRESS-IN METHOD



#### Introduction

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.

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### **Overview**

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.



#### The Five Construction Principles

#### The Hard Ground Press-in Method is a piling method that fulfils "The five construction principles" in a well-balanced manner.



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.

# **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 rig grips 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 w

# 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.









Under construction

After completion

## Applicable Ground Condition

#### Table for Applicability



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)

For the further information about applicable ground conditions, please refer "Standard Estimation Guide Book of Hard Ground Press-in Method" issued by Japan Press-in Piling Association.

#### Various Auger Heads

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



\* GIKEN keeps developing original auger heads for further improvements in terms of body designs and materials.

# **Silent Piler**

Super Crush Piler (Component Names)



#### Super Crush SCU-400M Specifications





Press-in Machine Main Body				
Press-in Force	800 kN (82 ton)			
Extraction Force	900 kN (92 ton)			
Stroke	1,000 mm			
Mass	10,600 kg (Including Hose Reel)			
Applicable Sheet Piles	Sheet piles Type ${\rm I\!I}, {\rm I\!I},$ and ${\rm I\!V}$			
Control System Radio control				
*For other sheet pile sections, please contact the nearest GIKEN office				
Pile Auger				

Pile Auger				
Mass	9,600 kg (for 21.0 m)			

Total mass 20,200 kg (21.0 m)

# Super Crush SCU-600M Specifications





Press-in Machine Main Body				
Press-in Force	800 kN (82 ton)			
Extraction Force	900 kN (92 ton)			
Stroke	1,000 mm			
Mass	13,400 kg (Including Hose Reel)			
Angliashia Ohast Dilas	Sheet piles Type $V \mbox{L}$ and $V \mbox{I} \mbox{L}$			
Applicable Sheet Files	Sheet piles Type IIw, IIIw, and $I\!Vw$			
Control System Radio control				
*For other sheet pile sections, please contact the nearest GIKEN office				
Pile Auger				

Mass 14,400 kg (for 30.0 m)

Total mass 27,800 kg (30.0 m)

#### Power Unit EU300F3 Specifications



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Power Unit					
Power Sou	rce	Diesel Engine			
Potod Output	Power Mode	230 kW(313 ps) / 1,800 min-1			
	Eco Mode	204 kW(277 ps) / 1,600 min-1			
Fuel Tank (	Capacity	500 L			
Hydraulic Oil	Tank Capacity	Piler Eco Oil 630 L			
Driving Speed		1.4 km/h			
Vibration Regulations		Approved by MLIT (Ministry of Land, Infrastructure, Transport and Tourism) as an Ultra-low noise standard equipment			
Exhaust Emission Regulations		Fulfils Off-road Regulation Requirement			
Mass		7,980 kg			
*Includes 20m hydraulic pressure hoses, the volume of rating capacity of hydraulic oil and full fuel.					
		-			

Washing Apparatus		
Mass	320 kg	

#### Total mass 8,300 kg

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

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







Total mass 1,250 kg

\* 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-augers 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.



Pre-augering Area

Press-in with the Pile Auger (with press-in auger head)

Replace the pre-auger head to the press-in auger head

After completion of installation, while the Pile Auger is being extracted, the soil inside the Pile Auger are removed for backfilling.

Backfilling after completion of sheet pile installation



Layout of press-in augering area

#### Comparison Table (SCU-400M)



12 - 15m: Soft rock (uniaxial compressive strength 15 N/mm<sup>2</sup>)

#### Comparison Table (SCU-600M)



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.



#### Plan for Standard Assembling Work for Initial Piling



\*A 80 ton crane is required for SCU-600M when sheet pile length is more than 15m.

#### Plan for Standard Press-in Work



\*A 80 ton crane is required for SCU-600M when sheet pile length is more than 15m.

#### Side View for Standard Press-in Work

#### Standard Trench Excavation





#### 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**

#### Initial Press-in Procedures



1. 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.

- 2. Pitch the sheet pile (1) into Chuck and grip it by Chuck.
- 3. After checking the alignment and verticality, start pressing-in the sheet pile (1).



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 2 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.





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



# **Corner, Curve & Slope Piling**

#### Corner Piling





\* Applicability of slope piling depends on ground condition, the sheet pile lengths above ground and installation depth, etc. Please contact to the nearest GIKEN office for individual consultation.



## **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 with the "Ultra-low noise standard" established by the MLIT.



#### Vibration & Noise Measuring Sample

Sheet Piling in Progress

#### ▼ 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

#### Sheet piling alignment

Measurement Location

St.1 St.1

St.2





▼ Noise Level Measurement Result (night time)

St 3

Location	S	t.1	S	t.2	St	t.3	St	.4	St	.5
Time	LAeq	L50	LAeq	L50	LAeq	L50	LAeq	L50	LAeq	L50
Back ground noise	54(50)	45(41)	48	43	45	43	-	-	-	-
May	43	41	51	47	44	43	-	-	-	-
August	52	50	56	53	48	46	-	-	-	-
September	56	54	54	51	51	48	-	-	-	-
January	-	-	52	49	58	55	48	46	44	43
February	-	-	48	45	46	43	48	45	48	45
Environmental standard	50dB									

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

Noise Level Measurement Result 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 the emission level to 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 PilerA Past Power Unit

Large reduction of dark smoke : When the engine load is applied





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

# The Power Unit of the Super Crush Piler

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) GIKEN's Original Product

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.

- 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.



No need to worry about contamination when working at river, canal and ocean.

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



Result

→ Meet the standard

Meet the standard

Piler Eco Oil

Degraded 77.2%

**Piler Eco Grease** 

Degraded 66.2%

Their biodegradability has been certified by biodegradability 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 valuate 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.

#### • Avirulence is certified by Fish Toxicity Test.



\*1: The Organization for Economic Co-operation and Development Standards.

\*2: Japan Industrial Standards.

## Improvement of Safety and Work Efficiency at Site

# **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.



Attaching both side	350	kg
Attaching one side	200	kg
Middle Stage	150	kg
• Mass	530	kg

#### 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.



# GIKEN'S ORIGINAL ACCESSORIES for improvement of work efficiency (Seek better environmental protection and safety work)

#### Radio Control Safety Shackle



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

- Mass.....9 kg
- Locking & Release Operation......Radio Control
- Maximum lifting load......2,000 kg
  - \* This accessory is available only in Japan at this moment. (February, 2010)

#### Pile Roller



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

#### Mass

for U Sheet Pile	11kg
for Hat Sheet Pile 900mm	13kg
• Applicable sheet pile sections	U Sheet Pile
	(400, 500, 600 mm)
	*Type IV <sub>A</sub> is not applicable.
	Hat Sheet Pile 900 mm
	14 00

Applicable sheet pile length......Max. 20 m

#### Hose Roller



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

- Applicable sheet pile sections ..... U Sheet Pile (400, 500, 600 mm)

(400, 500, 600 mm) Hat Sheet Pile 900 mm

#### Pile Laser



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

- Mass..... 1.5 kg
- Operation time...... More than 50 hours with size D battery.

# **Informatised Piling**

# **IMPROVEMENT** of piling efficiency by connecting GIKEN Total Support Centre and piling site

#### 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 utilize for advices to improve piling productivity, and Maintenance Information can be utilized for advices to prevent machine trouble and to reduce repair time.



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

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

#### 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 optimise operation settings for each ground condition. Proper advice can be given for any change in soil strata and presence of any underground obstacle.



Ľ,

GPS Satellite

# **Project Achievements**

#### U Sheet Pile



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





Uniaxial Compressive Strength 40N/mm<sup>2</sup> - 130N/mm<sup>2</sup>

\* \*

New Metro Rail Track Construction Perth, Australia



2\_ 3\_ 4\_ 5\_ 6\_ Filling (angular COBBLE of concrete) Filling (silty SAND with fine gravel of granite and some 200 700mm cobble) 7\_\_\_\_\_8\_\_\_ 200 Filling (silty SAND with fine gravel of granite) 9 boor SPIV L = 29.0 m 10 11\_ 12 silty SAND with shell fragment 13\_ 14\_ 15\_ silty SAND with fine gravel 0 U Sheet Pile 16 17 18\_ 19\_ ++0 silty SAND with fine 20 grained granite 21 22 23 very strong medium grained GRNITE 24 silty SAND with medium 25 rained granite 26 27 very strong medium grained GRNITE 28 29

Filling (silty SAND with fine gravel)

**Borehole Data** 



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





**Fukuoka Ring Utility Conduit** Fukuoka, Japan



SPT value over 50 is extrapo



Shands Hospital, Subterranean pathway Gainesville, Florida, U.S.A.



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



SPT value over 50 is extrapola







St. Johns Working St. Johnes, Working, U.K.



#### Other Pile Sections



I-495 Washington Capital Beltway Maryland, U.S.A.



Hochwasserschutz Koeln-Rodenkirchen Uferstrasse Koeln, Germany





#### Reconstruction Work for Tohoku Main Line Yadamae Aomori, Japan





#### SJ51 Phase 2 Street Retaining Wall Construction Work Tokyo, Japan



SPT value over 50 is extrapol



# Canary Wharf Isle Of Dogs Station Canary Wharf, London, U.K.









West Toronto Diamond Rail to Rail Grade Separation Toronto, Canada



Woodhill Apartment Complex Orlando, Florida, U.S.A.





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