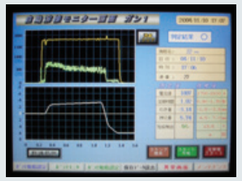
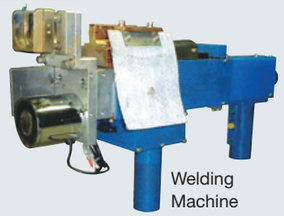
6. Example of Construction

Welding Control Device

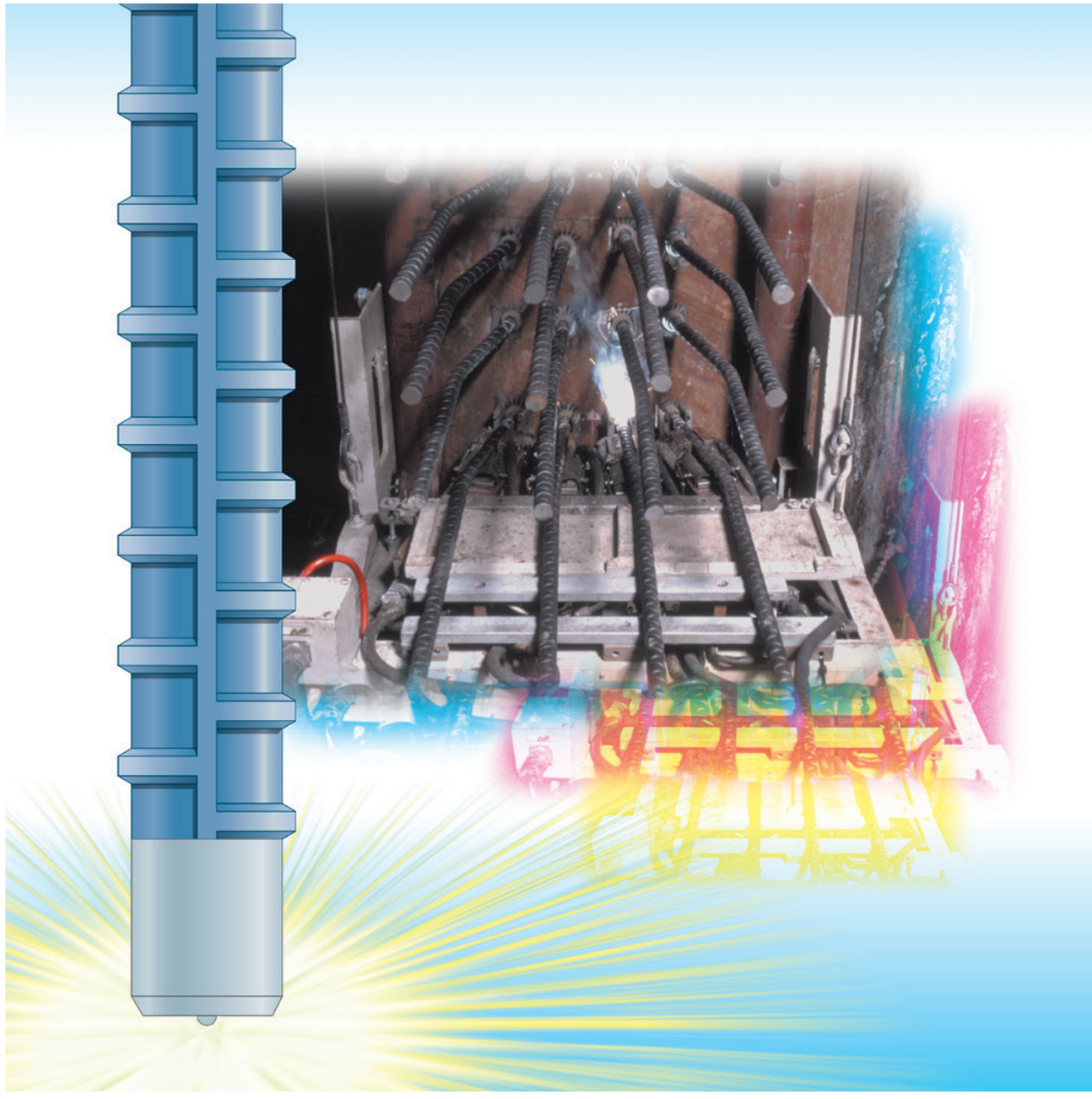


Monitoring Panel



Welding Machine

NS Stud Method



NS Stud Method Association

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NS Stud Method
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NS Stud Method Association

NS Stud Method

NS-Stud method is stud-welded long and large diameter deformed reinforcing bar to Steel Pipe Sheet Pile or Steel Plate directly. This method is also keep the quality by monitoring technology, and to shorten the construction period by high efficiency automatic 4th multiple welding guns.

Contents

1. NS Stud Method

NS-Stud method is sensational welding method which is full penetration stud welded long and large diameter deformed reinforcing bars to steel plate by stud machine. This method has below features, compared with Joint Bar method, Plate Bracket method, and Mechanical Joint method which are used for connection with re-bar and steel plate in the past.

※NS-Stud method is authorized as design of connection method with pile cap and steel pipe sheet pile in Specification for highway bridges in Japan Part IV – Sub structure ver. 2002.

Features

①Construction period shall be reduced by Automatic multi stud welding machine which has a rail guide frame. This method will omit welding or other work by manual.

②Automatic multi stud welding machine is carried out welding with kept high quality by a servo motor (Fig.1) and monitoring system (Fig.2) without non-destructive test. Servo motor is able to implement high responsiveness in various welding phenomena.

③Automatic welding method will make to reduce construction period with the improvement of work efficiency compared with conventional way of assemblage.

Fig.1

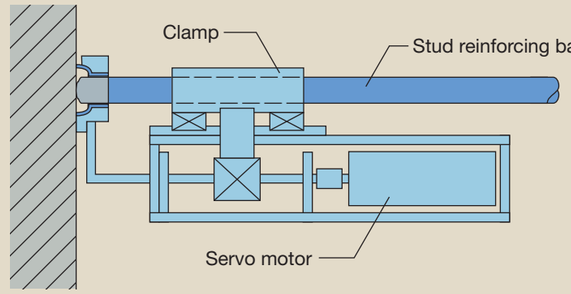
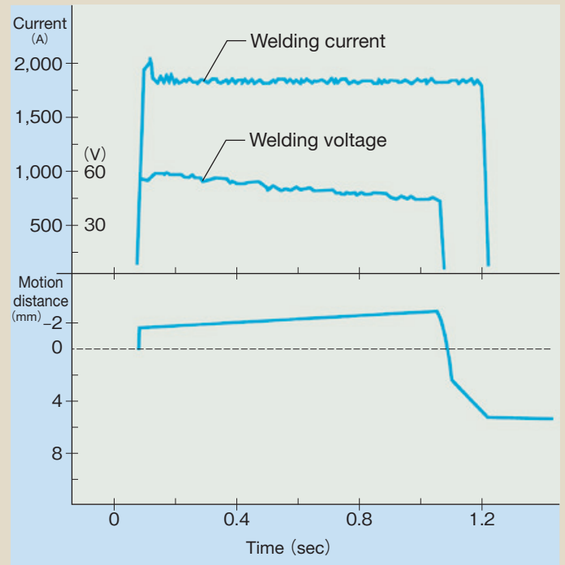
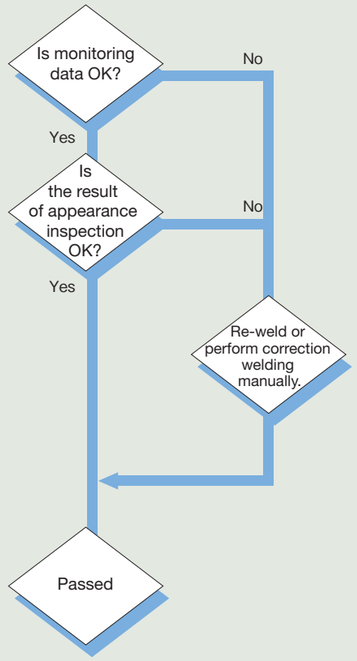


Fig.2

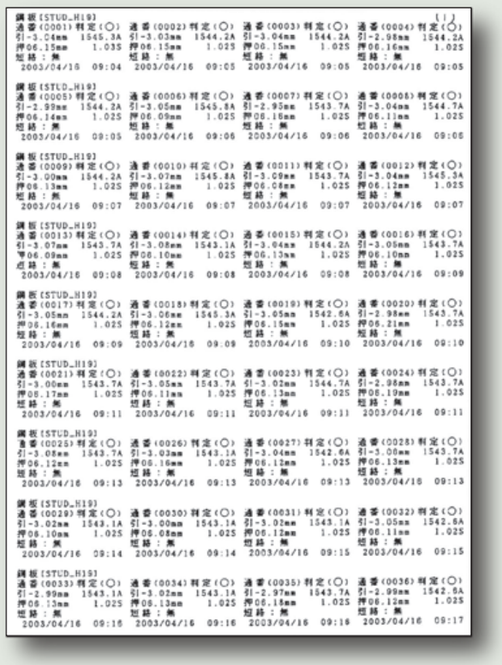


2. Quality Control

Joint judgment procedure

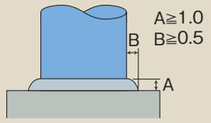


Monitoring data



Appearance inspection pass conditions

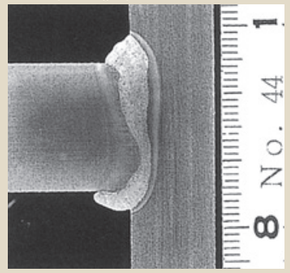
1) Weld-reinforcement shape.



2) Are there cracks or lodgment of slag?

3) Is there any undercutting?

Micro-photograph of stud weld.



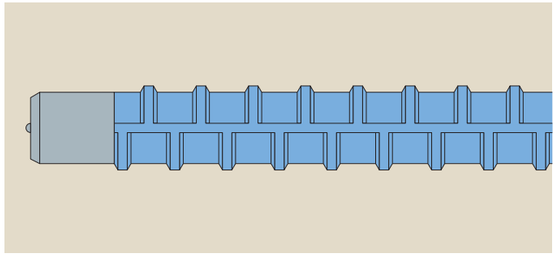
Monitor instrument

Monitoring data management value (Horizontal)

	D19	D22
Welding current (A)	1,400～1,900	1,700～2,100
Welding time (sec)	0.9～1.30	0.9～1.30
Stud pull-up distance (mm)	1.5～3.5	1.5～3.5
Stud pull-in distance (mm)	4.5～7.0	4.5～7.0
Short circuit	no	no

3. Standard Specifications

A deformed reinforcing bar stud is the same shape as a normal deformed reinforcing bar, and its chemical has been upgraded for improved weldability. It uses material that is equivalent to SM490A rolled steel for welded structures.
The shapes, dimensions, mechanical properties, and so on, of this material, which is called SM490A-SD, conforms to SD345 of JIS G 3112 (Steel Bars for Concrete Reinforcement), as shown in Steel Pipe Sheet Pile Foundation Design Guide and Commentary: Japan Road Association (December 1997).



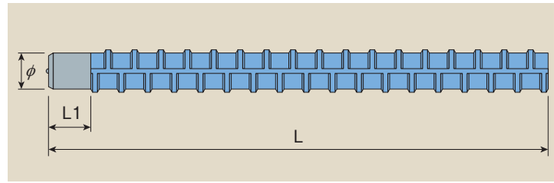
Merchanical properties of SM490A-SD

Standard name	Yield point N/mm²	Tensile strength N/mm²	Elongation %
SM490A-SD	345～440	490 min	18 min (Conforms to JIS No,2)
SD345	345～440	490 min	

Chemical composition of SM490A-SD

Standard name	%					
	C	Si	Mn	P	S	$C+\frac{Mn}{6}$
SM490A-SD	0.20 max	0.55 max	0.90 max	0.035 max	0.035 max	0.35 max
SD345	0.27 max	0.55 max	1.60 max	0.040 max	0.040 max	0.50 max

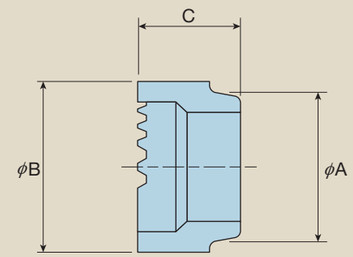
Deformed reinforcing bar stud



Shape and welding conditions of deformed reinforcing bar studs

	Name	D19	D22
Deformed reinforcing bar stud	Rib diameter ϕ (mm)	19	22
	Rib length L1 (mm)	25	30
	Dimension L (mm)	Optional	Optional
Welding conditions	Welding current (A)	1,550	1,900
	Welding time (sec)	1.0	1.0
	Stud pull-up distance (mm)	2.5	2.5
	Stud pull-in distance (mm)	6.0	6.0
	Welding posture	Perpendicular, Horizontal	Perpendicular, Horizontal

Arc shield (for horizontal welding)

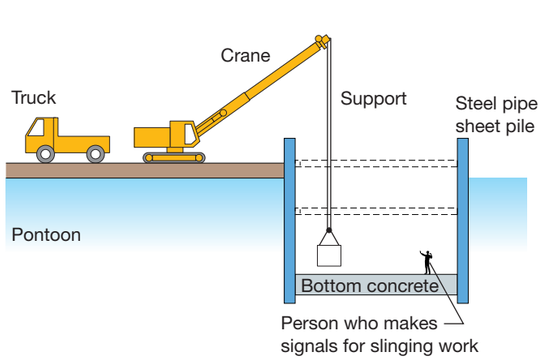


(mm)

	D19	D22
ϕA	26	31
ϕB	31	32
C	17	19

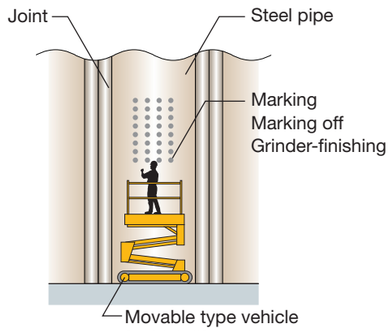
4. Work Flow Diagram

Lowering work materials and equipment into well.



Equipment used	Truck and crane
Safety precautions	● Use the specified equipments to go up/down work in the well. ● The truck for transportation of materials and equipments shall be properly guided by nominated and qualified guide. ● The truck shall be stopped with placing chocks beneath the tires to prevent moving. ● The person who makes signals to crane and the crane operator must communicate with each other using transceivers. ● When lowering work of materials and equipments in the well, it shall be used a rope for assistance with carefully. ● Be sure to adequately ventilate in well.

Centering marking-off



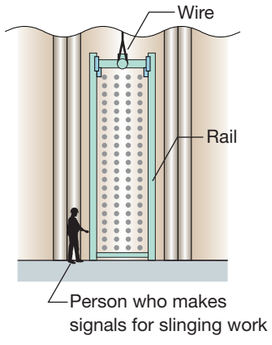
Equipment used	Movable type vehicle for high lift
Safety precautions	● The driving of high lift vehicle shall be paid careful attention to the surrounding area. ● The workers may not approach to the high lift vehicle during work. ● When carrying out marking-off or marking work, the workers must pay careful attention so as not to injure their hands. ● When setting a jig or carrying out grinding work, the workers must wear protective gears (goggles, mask).

Marking

Grinder – finishing

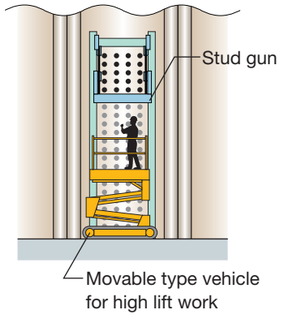
Welding rail jig

Setting rails



Equipment used	Crane
Safety precautions	● The person who makes signals to crane and the crane operator must communicate with each other using transceivers when setting rail. ● When unloading work of materials and equipments in the well, it shall be used a rope for assistance with carefully for prevention to hit with strut materials in well.

Setting stud guns



Equipment used	Stud gun (4-Gang) Movable type vehicle for high lift work
Safety precautions	● When setting stud gun, the workers must pay careful attention so as not to injure their hands.

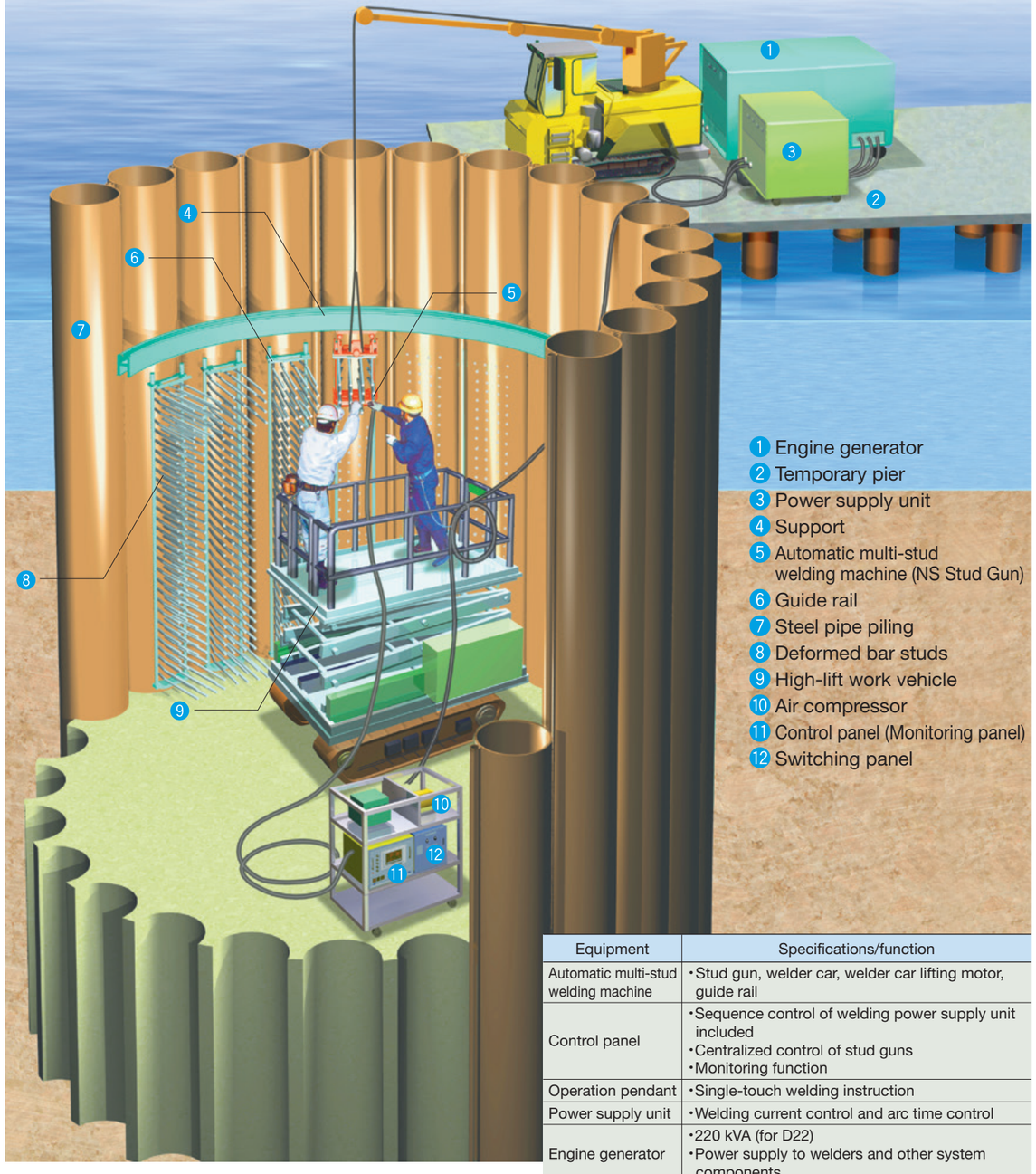
Welding the studs

End

5. Implementation Summary of NS Stud Construction Method

Example of pile cap connection work of pipe piling foundation

Item	Specifications
Pipe piling diameter	800 mm or larger, in principle
Number of stud guns	As required (usually 4)
Deformed bar studs	D19、D22
	Min. horizontal pitch: 100 mm (between centers) Min. vertical pitch: 100 mm (between centers)



Equipment	Specifications/function
Automatic multi-stud welding machine	・Stud gun, welder car, welder car lifting motor, guide rail
Control panel	・Sequence control of welding power supply unit included ・Centralized control of stud guns ・Monitoring function
Operation pendant	・Single-touch welding instruction
Power supply unit	・Welding current control and arc time control
Engine generator	・220 kVA (for D22) ・Power supply to welders and other system components
Air compressor	・Air supply for bar clamps