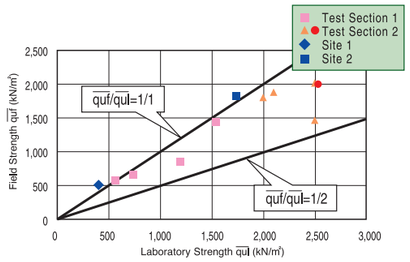
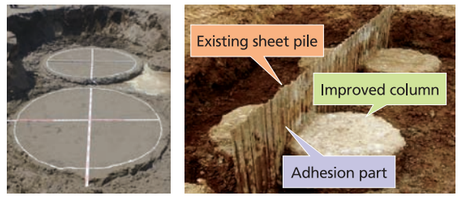
Effectiveness of Improvement (FTJ Method)

$\overline{quf}/\overline{qul}$=1/1~1/2 Extremely good strength development



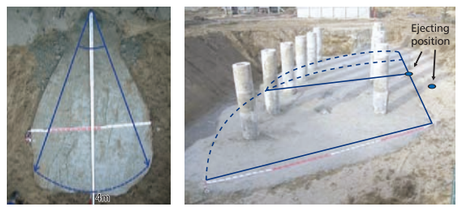
Adhesion to existing structures such as sheet piles

FTJ



Unified improved ground can be created behind existing columns (in case of sandy soil)

FTJ-FAN



Examples of Application

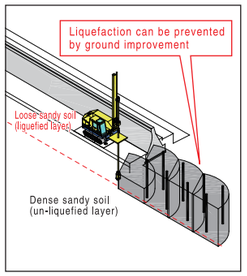
Name : Agano River, Matsuhama Area Non-soil Embankment Earthquake-Resistant Construction

Owner : MLIT, Hokuriku Regional Development Bureau

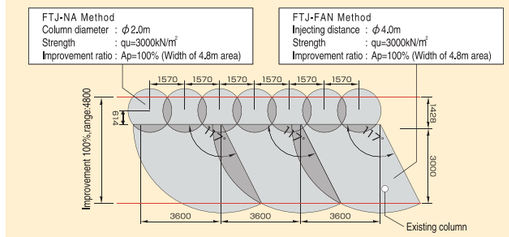
Location : Niigata Prefecture

Outline : Residential buildings are close to the mouth of Agano River. Ground improvement was executed directly under existing non-soil embankment (existing concrete walls) as a countermeasure against liquefaction

Name	Agano river, Matsuhama port (upper) earthquake-resistant construction	Agano river, Matsuhama port (middle) earthquake-resistant construction	Agano river, Matsuhama port (lower) earthquake-resistant construction
Specification	FTJ-FAN:Injecting distance 4.0m, FTJ-NA:ϕ2.0m, Improved length:3.4~7.6m		
Volume	Length : 173.5m FTJ-FAN : V=3878.5m³ FTJ-NA : V=1299.8m³	Length : 110m FTJ-FAN : V=2411.5m³ FTJ-NA : V=1061.2m³	Length : 141m FTJ-FAN : V=3824.4m³ FTJ-NA : V=1784.3m³



■Figures of improved ground arrangement pattern



Twin-flow Cement Slurry Jet Mixing Method

FTJ (F Twin Jet) Method

NETIS Registration Number:QS-040034-VE [2014 Utilization Promotion Technology]

Swing type Multi-flow Cement Slurry Jet Mixing Method

FTJ-FAN Method

NETIS Registration Number: HR-140015-A

Shortening of construction period and cost reduction are realized by using high pressure jet from multi-nozzles to expand the improvement dimensions and fasten the implementation.

In recent years, the renovation and seismic retrofit of old infrastructures have variegated the needs of High Pressure Jet Mixing Methods such as ground improvement in close proximity or directly under existing structures. Besides this, more efficient and economical methods are required.

FTJ Method can produce large section of improved ground at a double speed in comparison with conventional methods by ejecting large quantity of cement slurry from multi-nozzles on the tips of mixing blades with high pressure, which shortens construction period and reduces construction cost. Besides, simultaneous usage of air discharges disaggregated soil to the ground surface, which reduces the horizontal displacement of existing structures during execution.

FTJ-FAN Method controls the direction of cement slurry ejection to create fan-shaped or rectangle-shaped sections of improved ground. By creating flexible shapes of improved ground, the ground improvement directly under existing structures can be executed among determined areas more efficiently and economically.

FUDOTETRA

Fudo Tetra Corporation
Geo-Technical Division

ISO 9001
ISO14001
Authentication Registration

7-2 Nihonbashi-Koami-Chou Chuou-Ku Tokyo 103-0016 Japan
Tel:+81-3-5644-8534 Fax: +81-3-5644-8537
URL: http://www.fudotetra.co.jp
E-mail: geo@fudotetra.co.jp

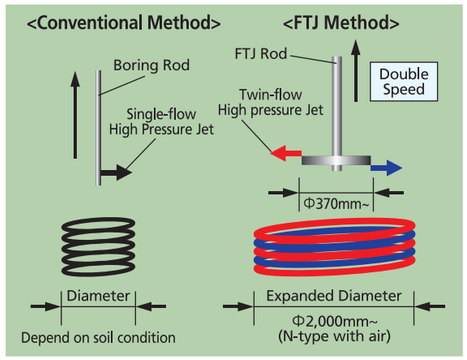
FTJ Method was selected as [2014 Utilization Promotion Technology] by New Technology Utilization Evaluation Conference <Kyushu Regional Development Bureau>

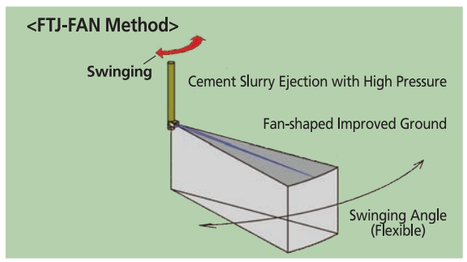
Contractors using FTJ Method have an advantage of [Additional Points for General Evaluation System] and [Additional Points for Construction Performance]

FUDOTETRA

2015 10-DAT-101

Characteristics





Large Diameter, High Speed

Twin-flow high pressure jet achieves larger diameter and higher productivity in comparison with conventional single-flow methods.

Reliable QA/QC System

Sophisticated QA/QC system is applied and depth-jetting flow rate are measured and recorded to create improvement columns precisely (N-type & L-type equipment). This QA/QC system has never been used in the past jet grouting method.

Wide Range of Applications

The method can be applied at loose sandy layer and soft clayey layer that are generally considered targets for the ground improvement. Besides, while conventional high pressure jet methods need auxiliary penetration for ground having underground obstacle such as hard rock or layers with N value more than 50, FTJ Method can penetrate by special construction method.

Highly Mobile Small-size Construction Machine

N-type is equipped with small-size construction machine having high mobility and construction efficiency.

Reduce Displacement of Ground during Execution

Simultaneous usage of air reduces displacement of existing structures during execution.

FTJ-FAN Method

Creating Flexible Shape of Improved Ground

Using swinging jet system creates fan-shaped or rectangle-shaped sections of improved ground.

More Effective Improved Column Arrangement

Eliminating waste improved areas makes more effective arrangement of improved columns.

Construction Specifications

Applicable Soil Range

Sandy Soil:N≦30　Clayey Soil: N≦3

※ by special construction method, N=50 sandy soil was also applicable in some past cases.

Strength of improved ground

FTJ Method:quck=0.2~1.0 MN/m²

FTJ Fan　Sandy Soil:3.0 MN/m²　Clayey Soil:1.0 MN/m²

Applicable Depth

●FTJ Method

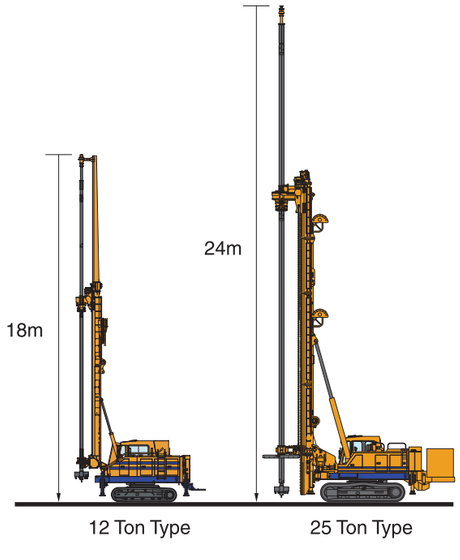
Construction Machine	#of Axes	Standard Depth	Maximum Depth (Extension Axes)
N-type Machine (12t type)	1	10 m	18 m
N-type Machine (25t type)	1	17 m	24 m
S-type Machine (Boring Machine)	1	20m (Maximum:35m)	
L-type Machine (110~130t type)	1~2	27 m	45 m

※ N-type: Maximum depth was 30m in some past cases

●FTJ-FAN Method

Construction Machine	#of Axes	Standard Depth	Maximum Depth (Extension Axes)
N-type Machine (12t type)	1	10 m	
N-type Machine (25t type)	1	17 m	20 m
S-type Machine (Boring Machine)	1	10 m	

N-type Construction Machine



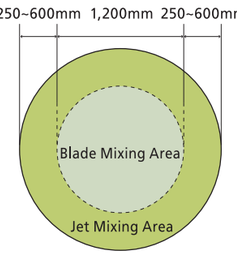
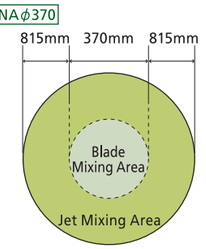
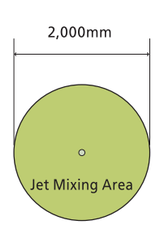
Standard Improvement Specifications

In FTJ Method, we can select the most appropriate equipment from the following three types of equipment depending on the conditions including soil and construction conditions, surrounding environment conditions, etc.

■ N-type and S-type can be used with or without air.　※ Without air, (-N,-S) type can be used in under water or filling constructions. With air, (-NA,-SA) type with air-lift effect can reduce the displacement of surrounding ground.

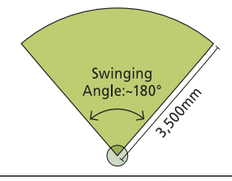
■ Mixing blades of N-type are changeable (Φ370,Φ600). ϕ370 is applicable in case of hard ground.

■ The dimensions shown below depend on ground conditions

Type	L-Type ※2 Axes can be applied	N-Type ※ With or without air, changeable mixing blade		S-Type ※ With or without air	
Dimensions (mm)※2					
Column Diameter (mm)	Without Air 1,700~2,400	Without Air	Sandy Soil 1,600 Clayey Soil 1,500	Without Air	Sandy Soil 900~1,200 Clayey Soil 900~1,400
		With Air	2,000~※2	With Air	2,000
Jetting Distance (mm)	Without Air 250~600	Without Air	Blade(ϕ370mm) 615 Blade(ϕ600mm) 565	Without Air	Sandy Soil 450~600 Clayey Soil 450~700
		With Air	Blade(ϕ370mm) 815 Blade(ϕ600mm) 700	With Air	945
Mixing Blade (mm)※1	1,200	370~600		110	
Standard Machine※1	L-Type	N-Type		S-Type	
Slurry Ejection	During Withdrawal	During Withdrawal		During Withdrawal	
Construction Speed※1	More than 2.0 min/m	More than 4.0 min/m		More than 4.0 min/m	

※1 Can be decided depending on shape of improved ground, mixing blades, combination of mixing blades and construction machine, construction speed, etc

※2 ϕ3,500mm in some past cases

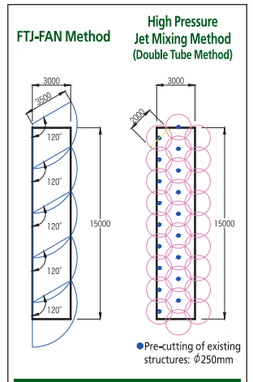
Type	FTJ-FAN (Swing type)
Dimensions	
Diameter (mm)	~3,500※1
Swinging Angle(°)	~180※2
Standard Machine	N-type Machine
Slurry Ejection	During Withdrawal
Construction Speed	More than 4.0 min/m (range of 10°)※3

※1 In sandy soil ϕ4,000mm was created in some past cases

※2 Swinging angle is changeable

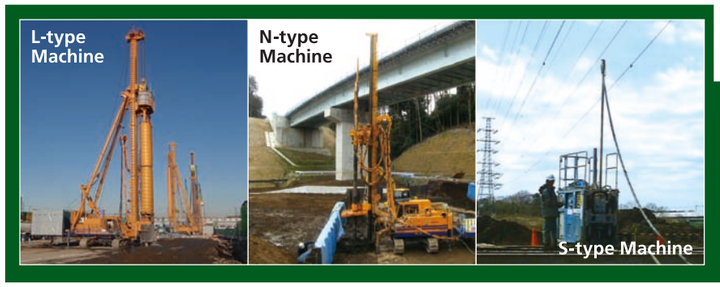
※3 Withdrawal time depends on soil conditions, swinging angles, etc

■ Comparison with Conventional Methods



Reducing the number of improved columns and construction cost

■ Variation of blades



On Construction Barge