

INTRODUCTION MITS CMS-COLUMN TECHNOLOGY

MITS = Middle Pressure Injection Total System

CMS = Combination Mixing Slurry System

The Combination Mixing Slurry (CMS) system , which is one of the MITS construction method, is a ground improvement method that uses two agitation systems, slurry medium pressure injection and a special agitation blade, on an improvement machine with a backhoe as a base machine.

The CMS system has been widely used for more than 12 years since its development.

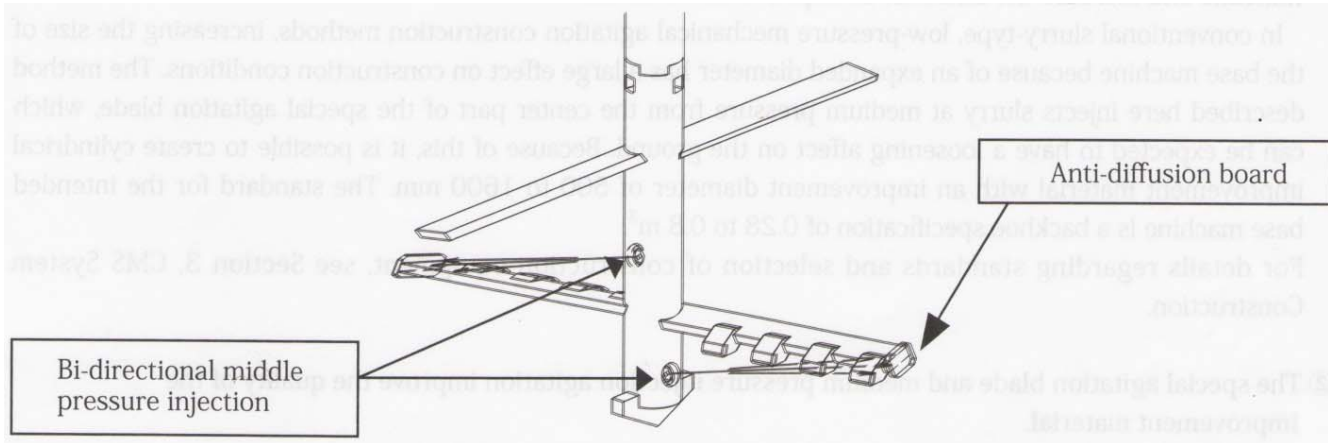
CMS method is difference with TENO-Column method a little.

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1. Principles of CMS system



1) With mechanical agitation methods, cement-type stabilization material is added to soft ground as slurry. Next, the stabilization material and soft ground are mechanically agitated and mixed in-situ to solidify the soft ground mechanically.

2) With high pressure injection jet grouting methods, the ground structure is broken down by powerful energy generated by high water pressure, and then cement-type solidifiers are packed underground.



1. Principles of CMS system

Ground Condition:

Cohesive Soil $N < 11$

Sandy Soil $N < 15$

(Standard Construction)

Diameter:

$\Phi 500\text{mm} \sim 1600\text{mm}$

Depth of Improvement:

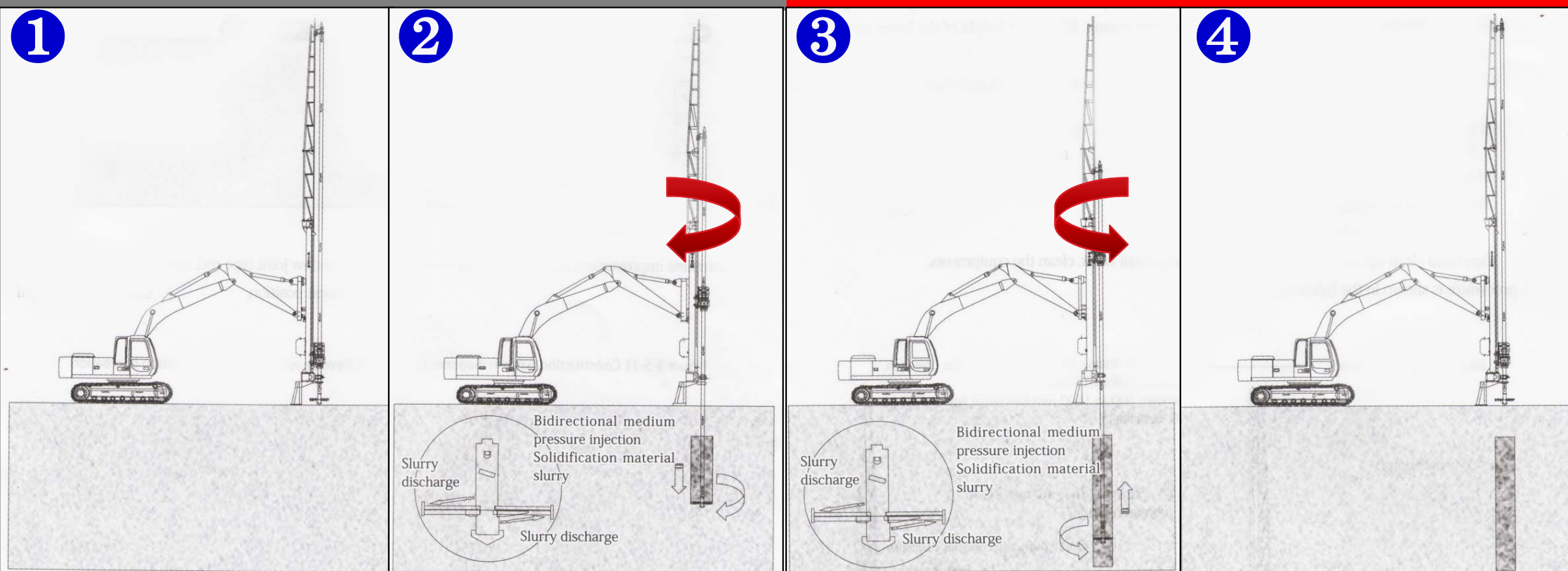
0.5m \sim 15m

(23m of Maximum on Experience)



2. Construction process and Equipment

2.1 Construction process



1
Install the base machine.
Perform drilling, injection and agitation

2
Bidirectional medium pressure injection.
Solidification material slurry.

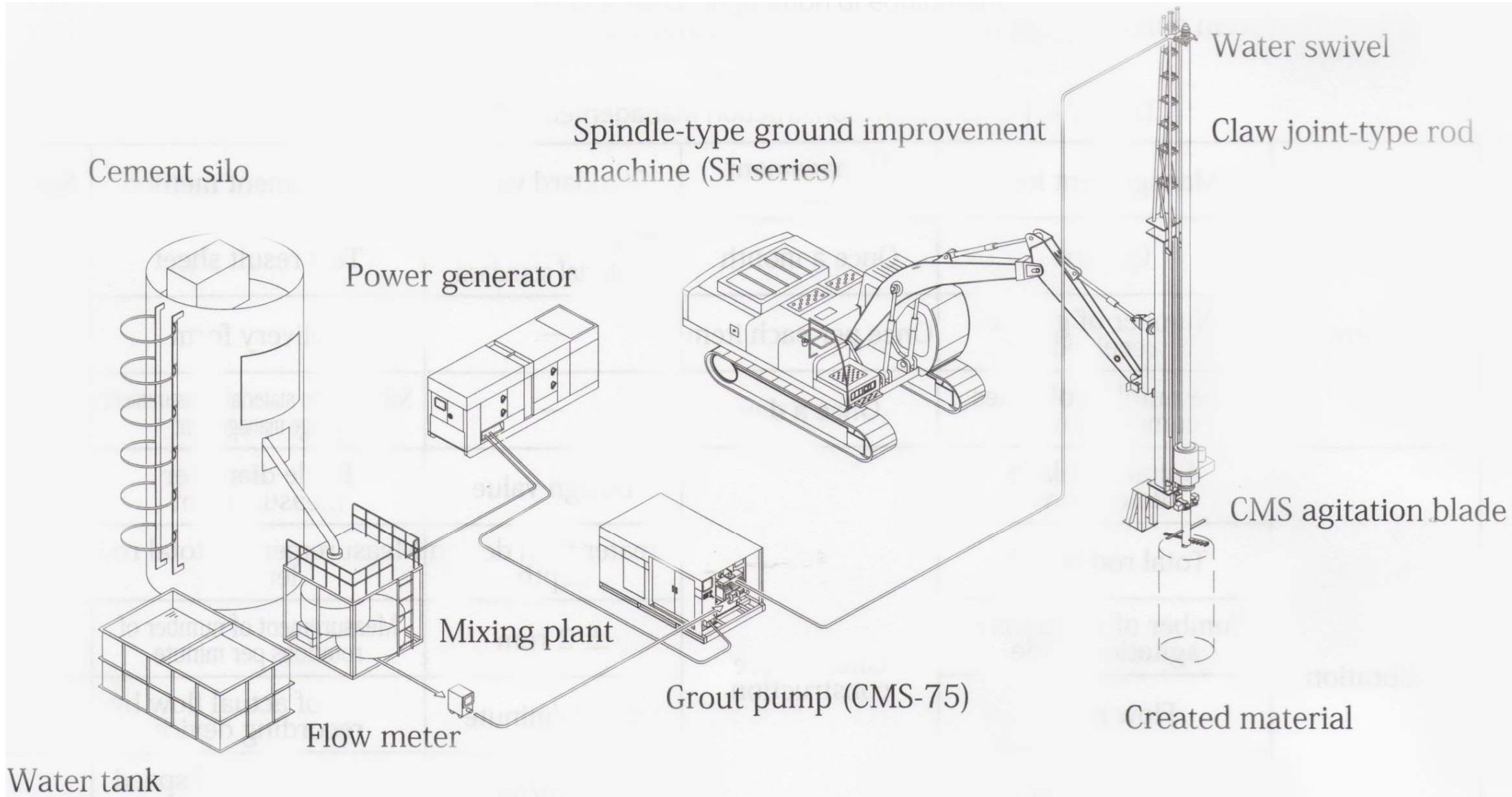
3
Pull up with reverse rotation with injection and agitation.

4
Completion of drilling.
Pull up the claw joint-type rod, then move and set up a next position

2. Construction process and Equipment

2.2 Equipment (1)

CMS-Column machine setup



2. Construction process and Equipment

2.2 Equipment (2)

CMS-Column machine

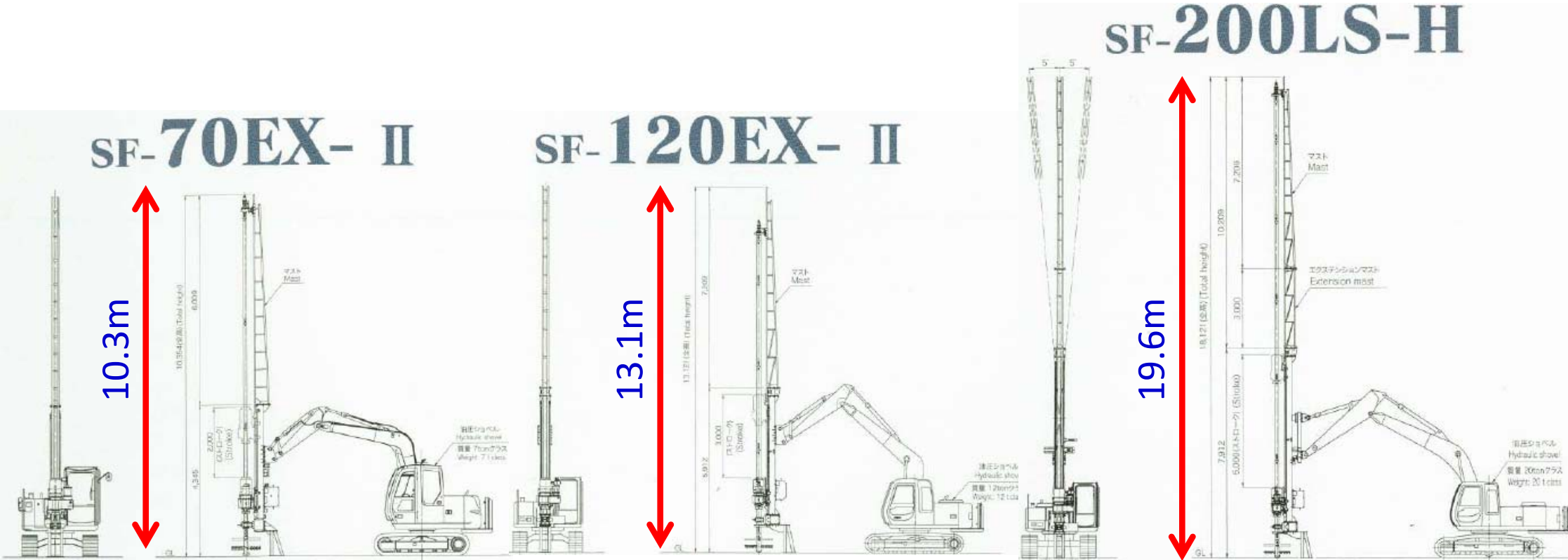


SF series machines

2. Construction process and Equipment

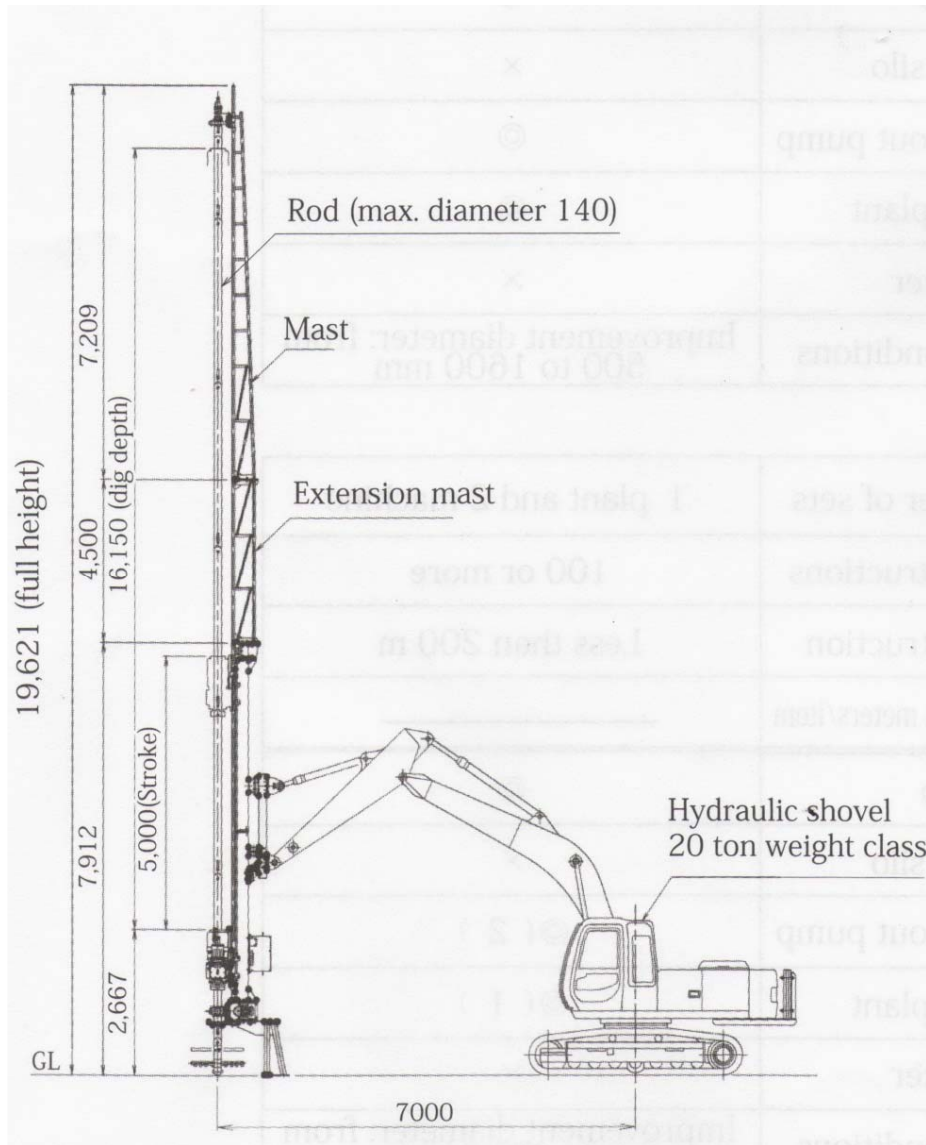
2.2 Equipment (3)

CMS-Column machine



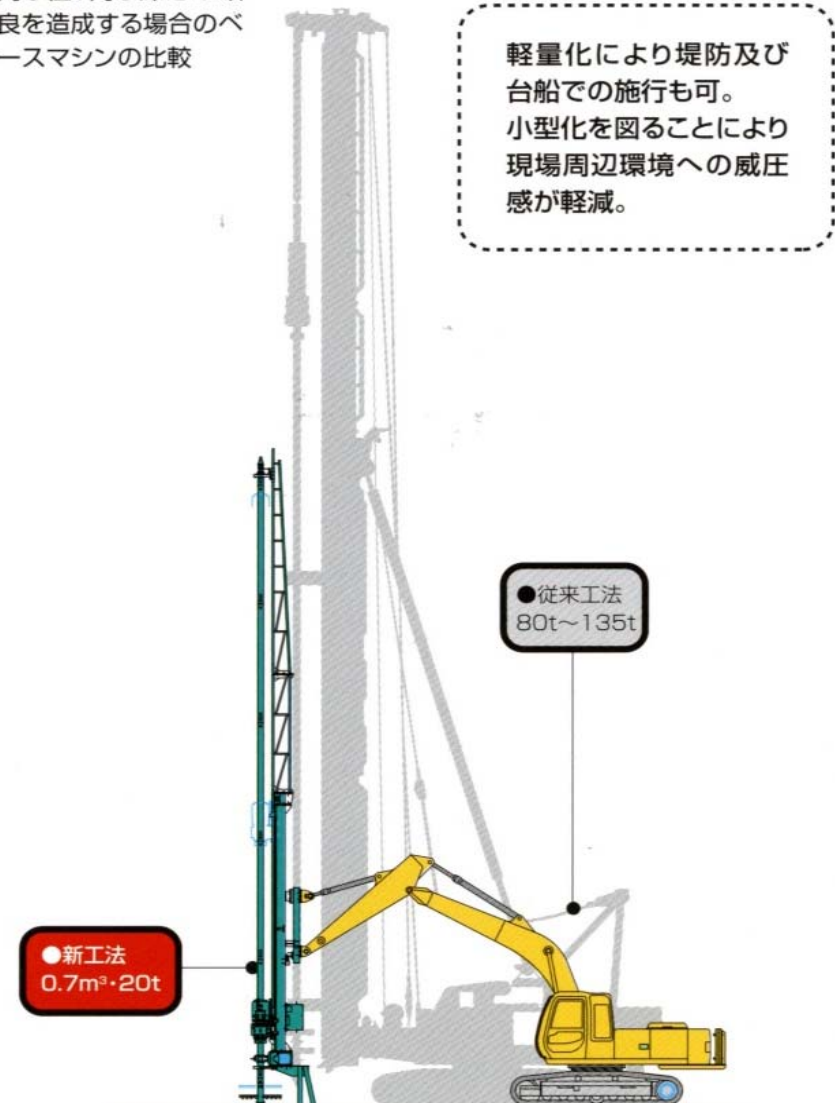
2. Construction process and Equipment

2.2 Equipment (4)



SF-200 LS-H standard diagram

同じ径、同じ深さの改良を造成する場合のベースマシンの比較



軽量化により堤防及び台船での施行も可。小型化を図ることにより現場周辺環境への威圧感が軽減。

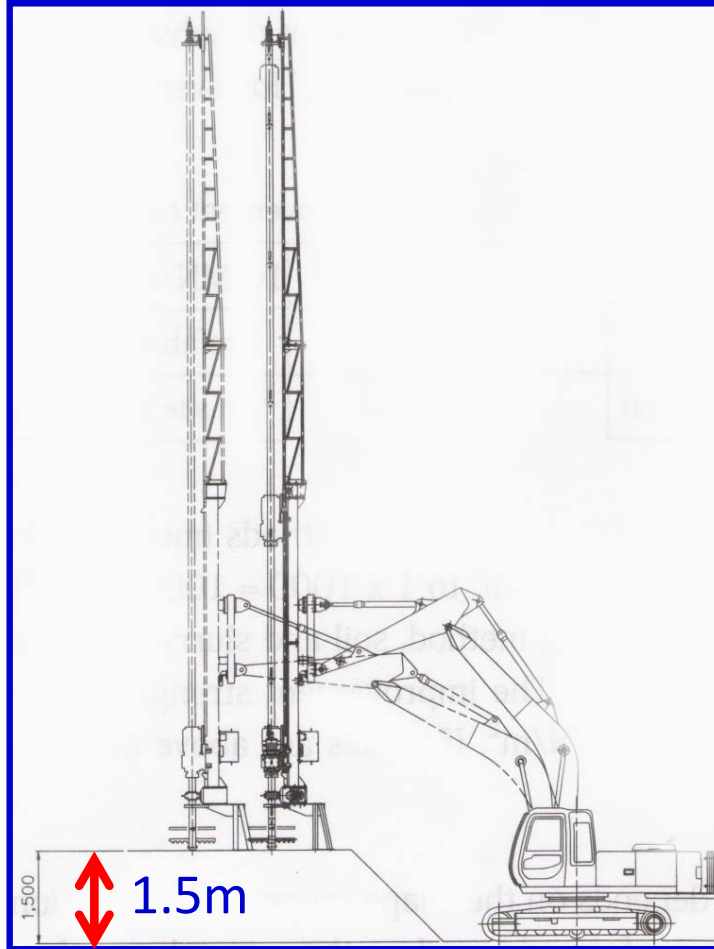
Comparison CMS machine with Conventional machine

2. Construction process and Equipment

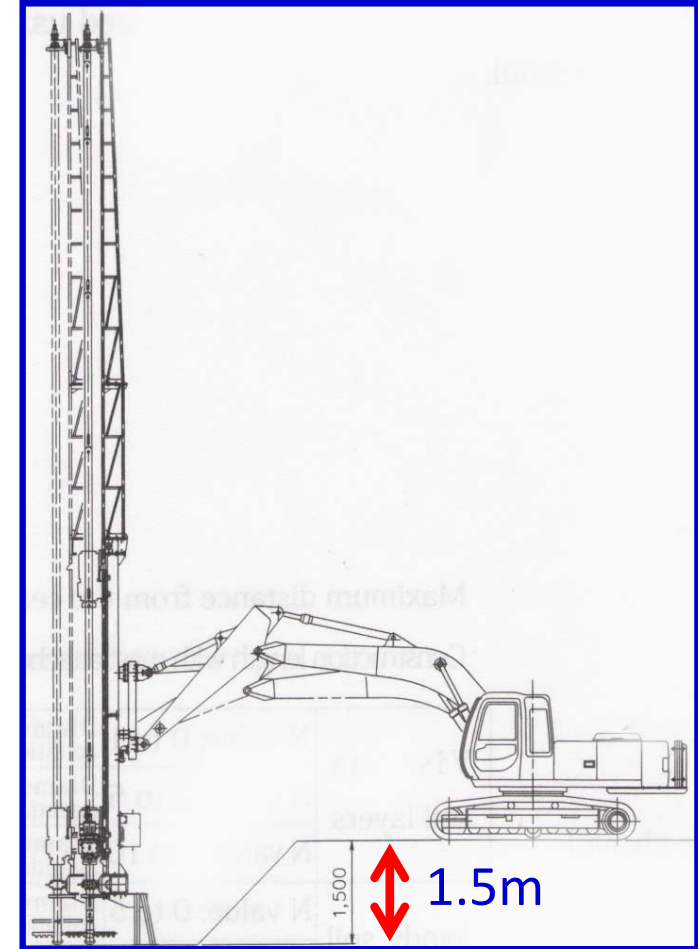
2.2 Equipment (5)



SF-200 LS-H machine



**Top part
Construction**



**Bottom part
construction**

2. Construction process and Equipment

2.2 Equipment (6)

Column's diameter in according to Injection pressure

Improvement diameter (mm)	Injection pressure (MPa)
500	5 to 10
600	5 to 10
800	5 to 10
1000	10 to 15
1200	10 to 15
1400	15 to 20
1600	15 to 20

2. Construction process and Equipment

2.2 Equipment (7)

CMS-Column machine's capacity

Machines	Column length per 12h working (m)
SF-70 EX-II	175
SF-120 EX-II	
SF-200 LS-H	

3. Features of CMS-Column

Beside features as TENO-Column, CMS-Column has more some advantaged:

- 1) The special agitation blade and medium pressure injection make it possible to decrease the size of the base machine and increase the diameter of improvement material.
- 2) The special agitation blade and medium pressure injection agitation improve the quality of improvement material.
- 3) Displacement of the surrounding ground can be reduced.
- 4) Can be adapted to mid-depth improvement creation flexibly and a low burden on the environment.

4. Soil condition

Soil condition apply for SF-200 LS-H machine

Blade diameter \ Viscous soil	N value	N value	N value	Wing diameter \ Sandy soil	N value	N value	N value
	0 to 1	2 to 5	6 to 10		5 or less	6 to 10	11 to 15
$\phi = 500$ mm	◎	◎	◎	$\phi = 500$ mm	◎	◎	◎
$\phi = 600$ mm	◎	◎	◎	$\phi = 600$ mm	◎	◎	◎
$\phi = 800$ mm	◎	◎	○	$\phi = 800$ mm	◎	◎	○
$\phi = 1000$ mm	◎	○	○	$\phi = 1000$ mm	◎	◎	○
$\phi = 1200$ mm	◎	○	△	$\phi = 1200$ mm	◎	○	△
$\phi = 1400$ mm	◎	○	△	$\phi = 1400$ mm	○	△	△
$\phi = 1600$ mm	◎	△	※	$\phi = 1600$ mm	○	※	※

◎ : Optimal, ○ : Satisfactory and compliant with conditions, △ : Not necessarily incompatible but inspection is required

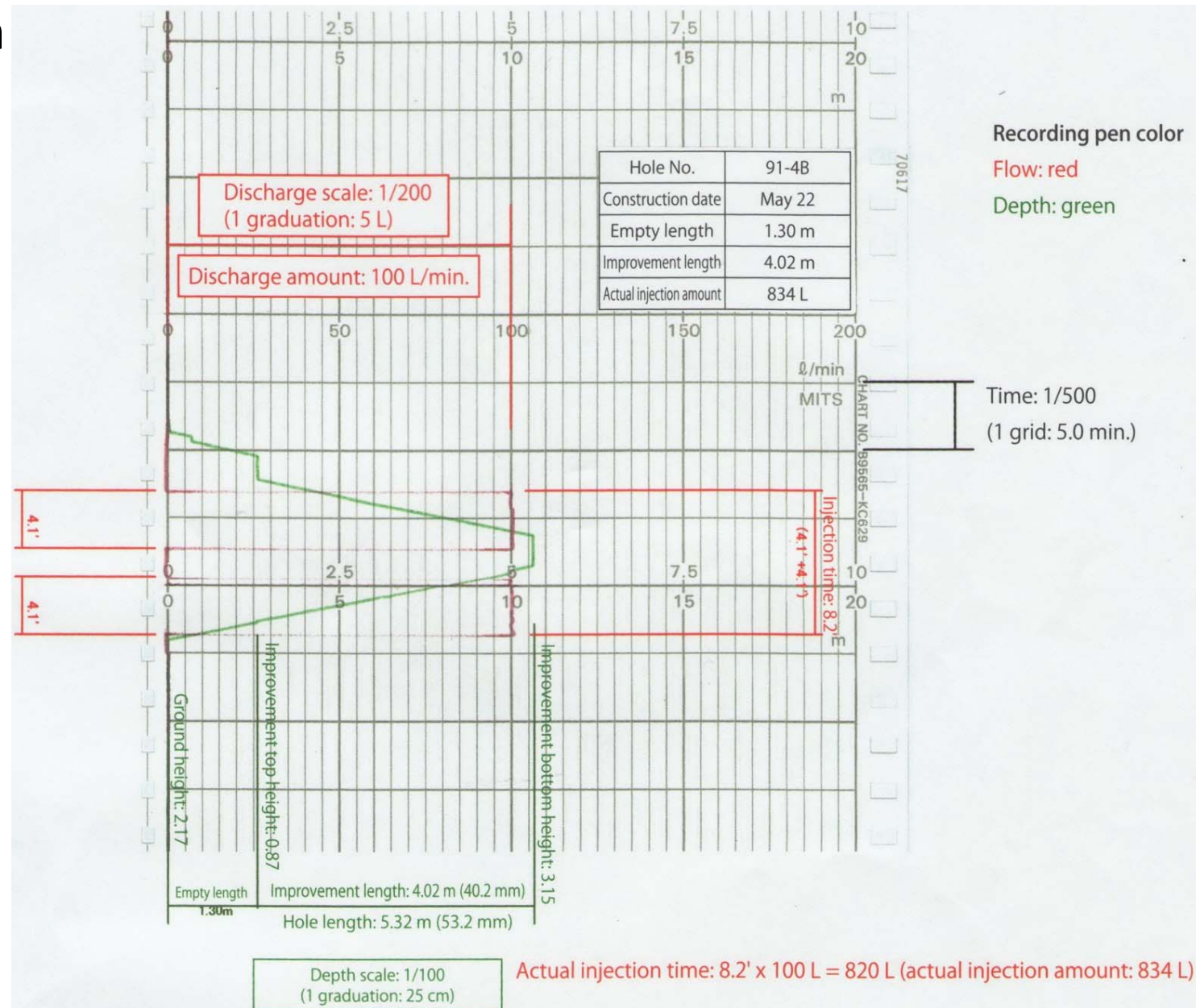
Note that for ○ and △ , inspection is required if construction is possible because of the moisture content.

The ※mark indicates that the application scope depends on soil characteristics and is an area that requires confirmation by test construction.

5. Control, monitoring and record construction works

The flow and construction depth are managed using dedicated construction management equipment installed on the specially modified base machine.

All data of drilling will be recorded and print out.



6. Project history (1)



Subway Construction, Strengthen for soft ground
Diameter Φ 1400mm, Depth=16.0m

6. Project history (2)



Levee of River, Prevention for Sliding
Diameter $\Phi 1000\text{mm}$, Depth=7.6m

6. Project history (3)



Retaining wall and Foundation for Concrete Culvert
Diameter $\Phi 1600\text{mm}$, Depth=8.0m

6. Project history (4)



Foundation for Concrete Culvert
Diameter $\Phi 1600\text{mm}$, Depth=2.4m

6. Project history (5)



Increase stable for river bank
Diameter $\Phi 1000\text{mm}$, Depth=17m