For Earth, For Life
Kubota

Laqnican Joint

Mechanical Joints for Steel Pipe Piles and Steel Pipe Sheet Piles

KUBOTA Corporation

The Concept of Laqnican Joint

In the construction of steel pipe piles and steel pipe sheet piles, the common practice for joining these piles has been the on-site weld-joining of the piles carried onto the construction site.

In weld-joining operations, however, careful construction managements are required such as the confirmation of the skill of welding operators, securement of appropriate operating conditions and weld quality confirmation inspections by means of Radiographic Test (RT) and Ultrasonic Test (UT).

Further, because the application of steel pipe piles with larger outside dimeters and heavier wall thickness tends to increase, and as a result the ratio of welding operations to total pile construction time also tends to increase, there has been a need for the development of a highly reliable, simple, low-cost pile joining system that replaces conventional weld-joining.

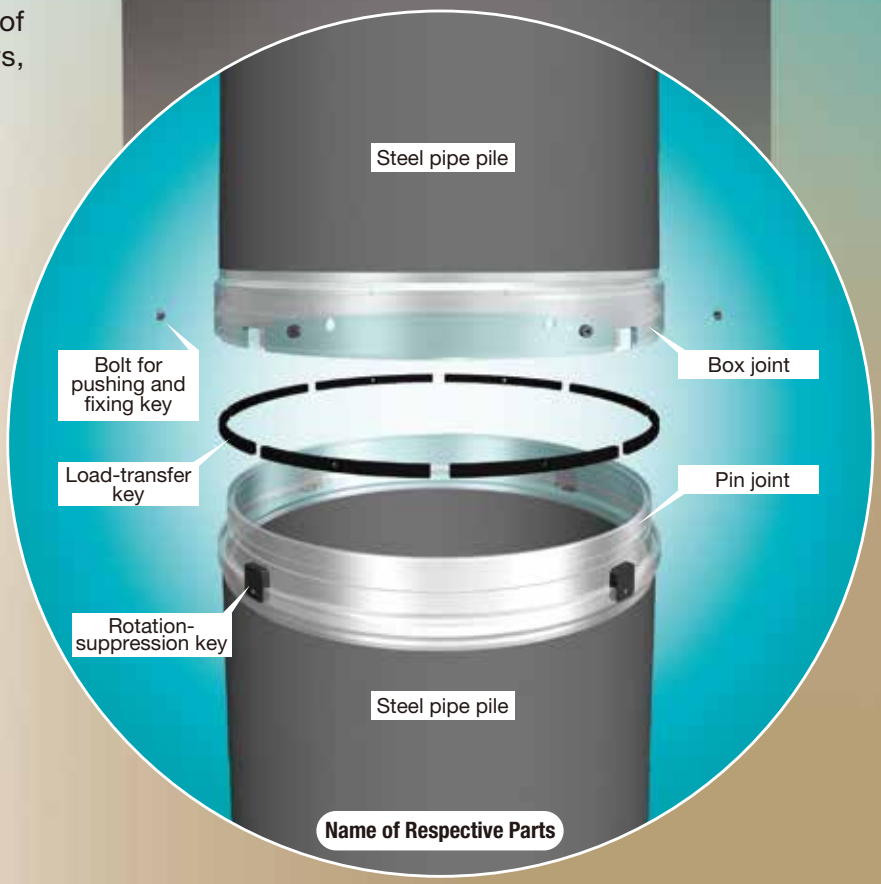
Laqnican joint are mechanical joints developed as a pile joining system that replaces the on-site weld-joining of steel pipe piles and steel pipe sheet piles. The trade name Laqnican comes from the Japanese word “laqni” (easily) and “can” (fitting together). The application of Laqnican joint in the on-site joining of piles offers many advantages such as securing stable quality, reducing pile construction times and mitigating joining load, which will contribute to cutting down construction costs.

Laqnican joint demonstrate a rich record of applications in the field of highways, railways, ports and harbors, rivers and electric utilities.

Achievement of easy pile construction management with stable quality and without worries about weather conditions

Possible to easily confirm the joining quality of every pile and junction

On-site joining time: About 5 minutes
Quality control time: About 3 minutes
Completion of joining



Name of Respective Parts

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Features of Laqnican Joint

1 Higher strength than steel pipes

Joining with higher strength is available regardless of weather conditions and operator skills.
(Steel pipes with Laqnican joint possess strength and deformation capacity equal or superior to those of steel pipes with no joints.)

…… **Contribution toward higher quality of on-site joints**

2 Faster Joining of Steel Pipes even with Larger Outside Diameters and Heavy Wall Thickness

Faster joining is achieved regardless of steel pipe sizes.
Steel pipes with different wall thicknesses can be joined at the construction site.

…… **Contribution toward the reduction of construction term**

3 Simple Joining Procedures

Joining is achieved by just inserting joints and fastening bolt for pushing and fixing key.
No special skills or qualifications are required.

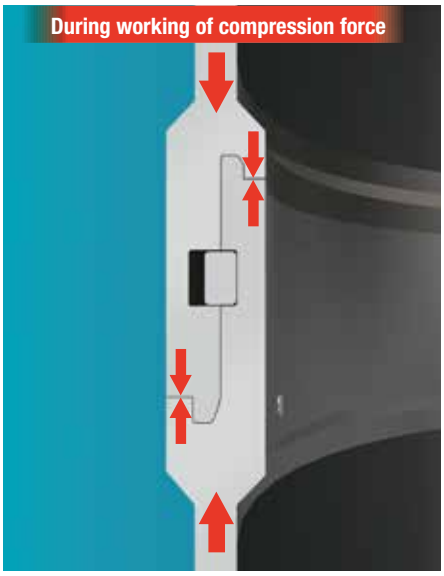
…… **Anyone can easily join pipes**

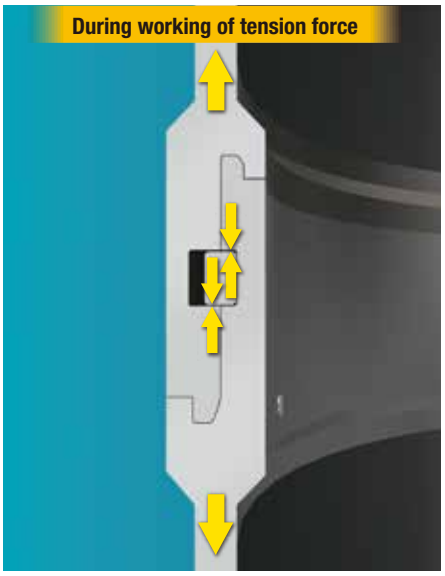
4 Simple Pile construction management

Construction management is achieved by only confirming fastening depth of bolt for pushing and fixing key using a depth gauge.
No particular inspection devices are required for joining confirmation and construction management.

…… **Inspection of every joint section**

Load-transfer Mechanism of Laqnican Joint



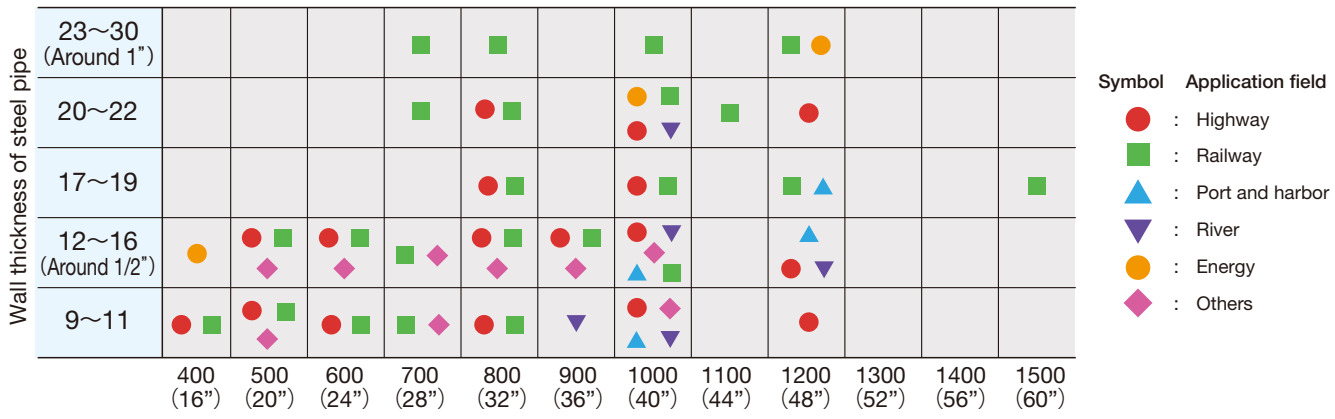


Compression force is transferred by the use of contact surface (metal touch section) perpendicular to the axial direction of box joint and pin joint.

Tension force is transferred from the joint key channel to the other joint via the load-transfer key.

(Reference) A List of Steel Pipe Sizes Employing Laqnican Joint in Past Construction Projects

mm (inch)



Structure of Laqnican Joint

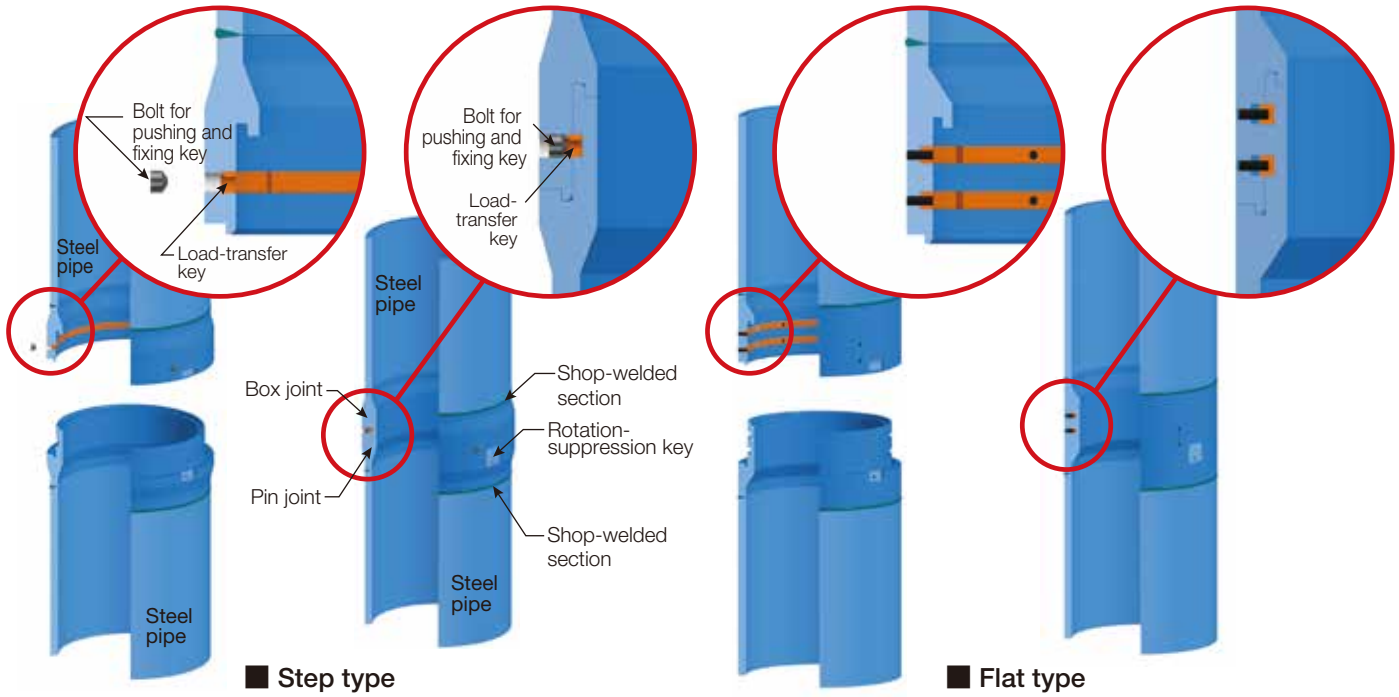
Laqnican Joint are composed of a box joint, pin joint, load-transfer key, bolt for pushing and fixing key and rotation-suppression key.

The box joint has a structure in which multiple arc-shaped plates (divided in the circumferential direction) called the load-transfer key are housed in circumferential channels inside the joint, and the load-transfer key can be pushed out to the pipe center direction by rotating the bolt for pushing and fixing keys. The pin joint has a structure in which peripheral circumferential channels are cut in a position relative to the box joint channel.

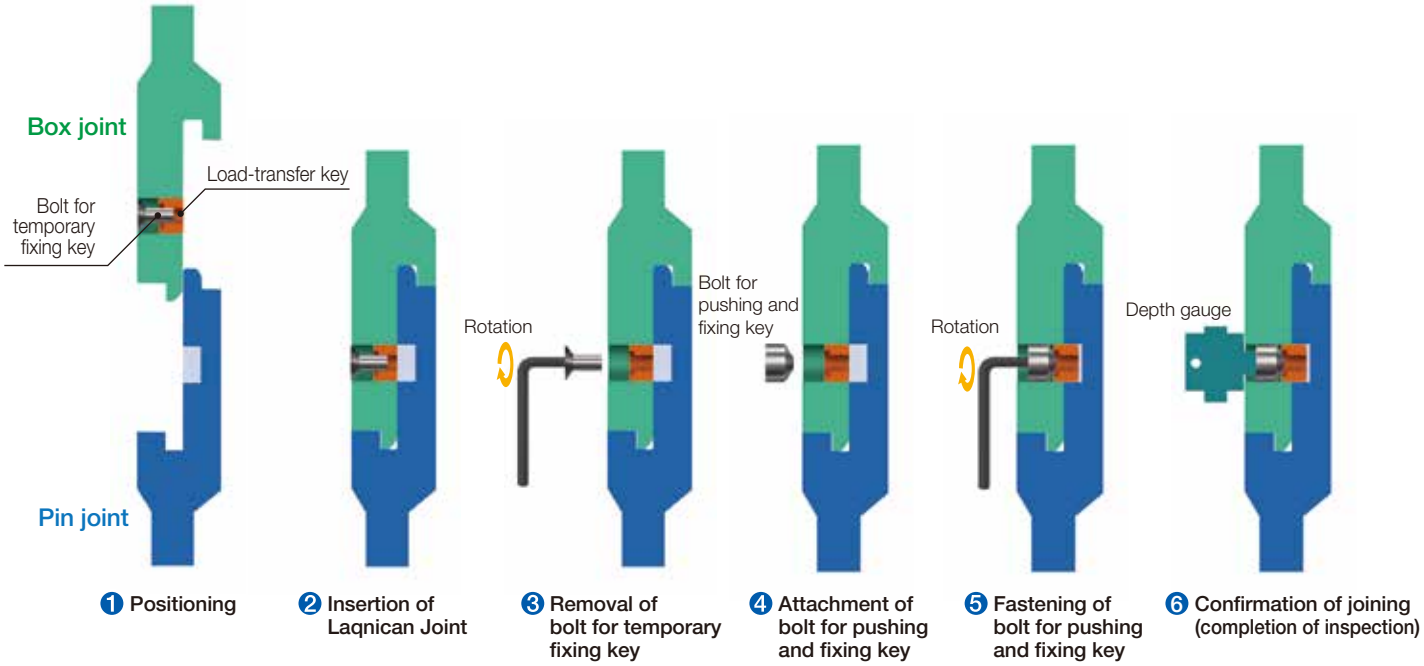
Joining steel pipes with Laqnican joint is completed in the following sequence: Insert a box joint which is shop-welded with the upper steel pipe pile is inserted into a pin joint which is shop-welded with the lower steel pipe pile; Then rotate the bolt for pushing and fixing key to push out the load-transfer key housed in the box joint in order to make the load-transfer key enter into the channel of the pin joint; Finally integrate the joining members to join the pipes. Every piece of completed junctions employing Laqnican joint can easily be inspected by confirming the fastening depth of bolt for pushing and fixing key.

Further, rotation torque occurring during the pile construction can be transferred by arranging the rotation-suppression key outside the surface of the Laqnican joining members. Meanwhile, in the case of adopting Laqnican joint in Pile driving Method and Vibro-hammer Method, measures (stop ring, etc.) are provided that prevent from loosening of bolt for pushing and fixing key.

■ Conceptual Drawing of Laqnican Joint Structure



■ Basic Flow of Joining Processes Employing Laqnican Joint



Product Specifications of Laqnican Joint

1. Material Quality of Base Steel Pipe

The material quality of base steel pipe shall apply or conform to JIS A 5525 (steel pipe pile) and JIS A 5530 (steel pipe sheet pile).

2. Material Quality of Laqnican Joint

The material quality of box joint and pin joint conforms to SFCM880R (chromium-molybdenum steel forged product) or POSTEN80 (high-strength steel plate).
The material quality of load-transfer key conforms to SFCM980S (chromium-molybdenum steel forged product).

■ Chemical Composition(%) SFCM880R, SFCM980S

C	Si	Mn	P	S	Cr	Mo
≦0.48	0.15 ~0.35	0.30 ~0.85	≦0.030	≦0.030	0.90 ~1.50	0.15 ~0.30

■ Chemical Composition(%) POSTEN80

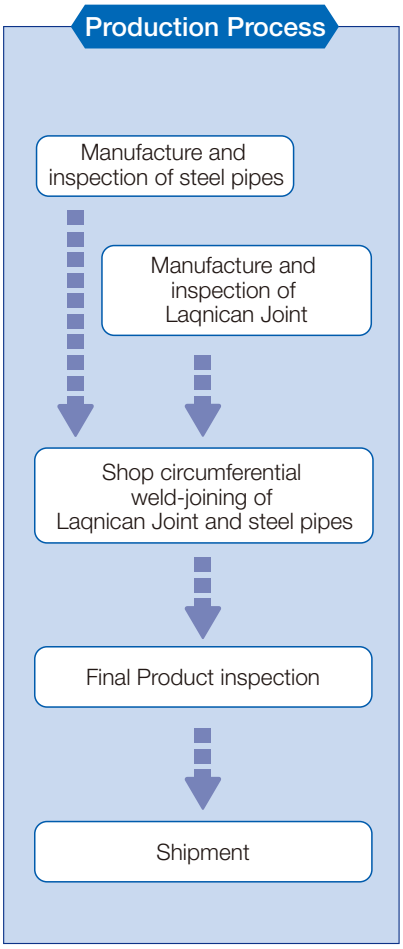
C	Si	Mn	P	S	Cr	Mo
≦0.16	0.10 ~0.40	≦1.50	≦0.030	≦0.030	0.40 ~0.80	—

■ Mechanical Properties

Ex.

Member	Yield point	Tensile strength	Elongation
Pin joint Box joint	≧705MPa (≒102 ksi)	880~1030MPa (≒128~149 ksi)	≧13%
Load-transfer key	≧755MPa (≒109 ksi)	980~1130MPa (≒142~164 ksi)	≧11%

Production Process



Available Size of Laqnican Joint

Laqnican Joint can be applied as the joints for steel pipes with sizes shown in the table below.

■ Step Type

Ex.

Material quality applied		OD 400~600 mm	OD 700~1500 mm
EN10025	S235 JR	~ t25 mm	~ t33 mm
	S275 JR	~ t19 mm	~ t25 mm
	S355 JR	~ t16 mm※	~ t19 mm※

Material quality applied		OD 16"~24"	OD 25"~60"
ASTM A252	Grade 1	~ t0.98"	~ t1.29"
	Grade 2	~ t0.74"	~ t0.98"
	Grade 3	~ t0.74"	~ t0.98"

※ Please inquire

■ Flat Type

OD : ϕ400mm ~ 1500mm / around 16"~ 60"
Wall Thickness : t9mm ~ t30mm / t0.35"~ t1.18"

For pipe diameters, pipe thicknesses, and other specifications not listed above, please contact us.

Joining Procedures for Laqnican Joint

1 Suspending upper pile

2 Positioning

3 Joining of Laqnican Joint

4 Removal of Bolt for temporary fixing key

5 Attachment and fastening of bolt for pushing and fixing key

6 Completion of attachment of all joining members

7 Inspection employing depth gauge

8 Completion of inspection of joining employing Laqnican Joint

Effects of Laqnican Joint on Joining Time Reduction

In the recent design of foundation pile structures, the application of steel pipe piles with large outside diameters and heavy wall thicknesses tends to increase. Due to the application of these piles, the ratio of welding time to total pile consturction time is increasing. Because the time required for the on-site joining of steel pipe piles with Laqnican Joint is about 5 minutes per junction regardless of the outside diameter and wall thickness of the steel pipe, steel pile joining times can be reduced using Laqnican Joint, and as a result Laqnican Joint can contribute to construction cost reduction due to reduced construction term.

The table below shows examples of comparison between the Laqnican Joint method and the weld-joining method conventionally applied. In the table, the joining time using Laqnican Joint is set as the time required from attaching bolt for pushing and fixing keys to their fastening. The joining time using weld joining is as shown in the Estimation Standard for Construction Contracts of Port/Harbor Civil Works (2015).

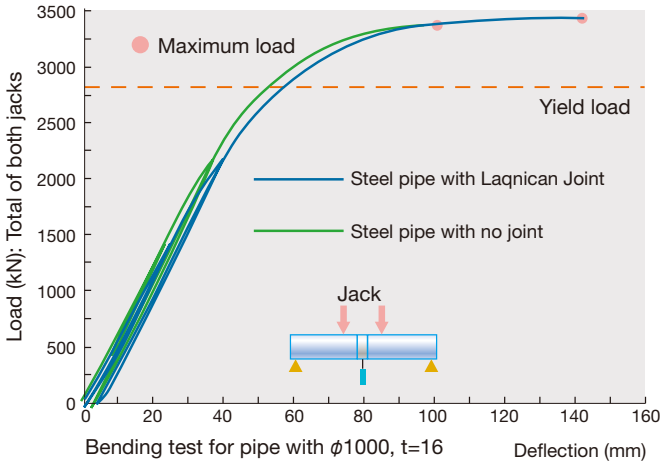
■ Comparison between Laqnican Joint and Weld Joint

Item		Laqnican Joint	Weld joint
Influence of weather condition		Joining can be undertaken regardless of weather conditions.	Impossible to conduct welding during rainfall and snowfall Shutting-out device required in the case of wind velocity of 10 m/s or higher
Main tools applied		Hexagonal wrench	Welding machine, generator
Joining time	Pile diameter × Wall thickness	Joining time	Joining time
Site A	ϕ1000×t22	5 minutes	105 minutes
	ϕ1000×t15	5 minutes	57 minutes
Site B	ϕ600×t16	5 minutes	61 minutes
	ϕ600×t10	5 minutes	24 minutes
Level of difficulty in joining operation		No requirement for expert skill	Requirement for expert skill (skill test, qualification)
Quality control method		Control of fastening depth of bolt for pushing and fixing key by the use of depth gauge	RT inspection • UT inspection • PT inspection • Visual inspection
Time required for quality control		3 to 5 minutes	Time required for joining pipe of ϕ1000 mm × t12 mm RT: 88 minutes (entire welding line); UT: 35 minutes (entire welding line); PT: 22 minutes (entire welding line) About 30 minutes additionally required until lowering of welding heat

*Welding: Operating time by two welders; Laqnican Joint: Operating time by one worker

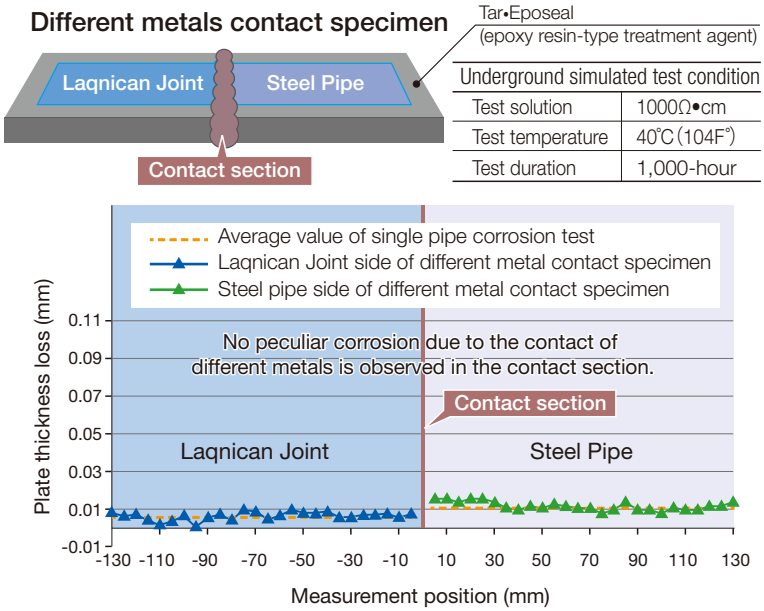
Load-carrying Capacity and Corrosion Resistance of Laqnican Joint

■ Load-carrying Capacity of Steel Pipes with Laqnican Joint



The tensile, compression, bending and shear strengths and deformation capacity of steel pipes with Laqnican Joint are equal or superior to those of steel pipes with no joints.

■ Corrosion Resistance of Steel Pipes with Laqnican Joint



*Laqnican Joint possess the corrosion resistance equal to that of steel pipe.

Examples of Piling Methods Employing Laqnican Joint

Pile driving Method

Vibro-hammer Method

Composit pile Method of Steel pipe pile and soil cement

Rotation pressing-in pile Method

Screwed pile Method

Press-in Method

Center Bored pile Method

Hydraulic rotation Center Bored pile Method

Application Examples of Laqnican Joint

Application to port construction

*Example using a pile driving barge

Application to railway construction

*Example of night time construction during railway tracks closing

Application to steel pipe sheet pile foundation

*Cutoff performance of Laqnican Joints can be improved by the use of cutoff materials.

Application to temporary working platform column

*Example of application to platform columns

Application to highway construction

*Example of construction under the condition in which an overhead clearance is restricted.

Various Optional Functions of Laqnican Joint

Construction instruments (example: protection of pin joints)

*Example of application in Gantetsu piling method (soil cement method)

Rotation-Suppression key for preventing from loosening

*Number of rotation-suppression keys changes depending on piling methods and construction machinery.

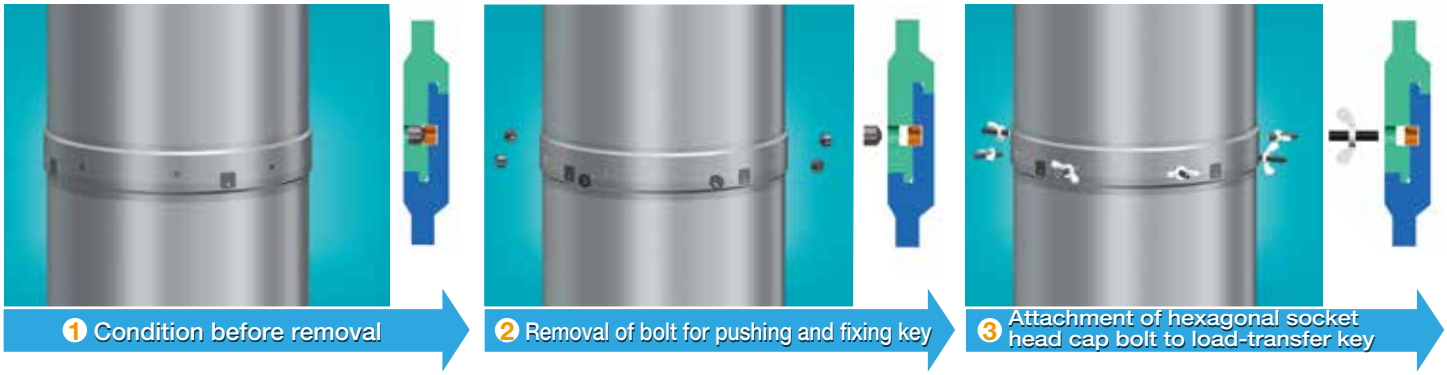
Nut for preventing from loosening

*Applied to prevent from loosening of rotation-suppression key

Stop ring

*Applied to prevent from loosening of bolt for pushing and fixing keys

Removal Procedures for Laqnican Joint



*(Note) Confirm that the load-transfer key is housed at the box side

*(Note) There is a case in which Laqnican Joint cannot be removed depending on construction conditions.

Evaluation Reports（Public Works Research Center）

Certification organization: Public Works Research Center
Certification date: January 11, 2002（Renewal: January 11, 2022）
Certification No.: No. 0115
Name of technology: Laqnican Joint Mechanical Joints for Steel Pipe Piles and Steel Pipe Sheet Piles
Dimensional range: Pipe outside diameter=φ400〜φ1600 mm; Pipe wall thickness= t9~t30 mm
Applicable pile Method: Vibro-Hammer Method, Pile driving Method, Bored precast pile Method（Center Bored pile Method, Composit pile Method of Steel pipe pile and soil cementt, etc）, Screwed pile Method, Press-in Method

Evaluation Reports (Coastal Development Institute of Technology)

Evaluation organization: Coastal Development Institute of Technology
Evaluation date: April 28, 2004（Renewal: March 31, 2019）
Evaluation No.: No. 08002
Name of technology: Laqnican Joint Mechanical Joints for Steel Pipe Piles and Steel Pipe Sheet Piles
Dimensional range: Pipe outside diameter=φ400~φ1600 mm; Pipe wall thickness=t9~t30 mm
Applicable pile Method: Vibro-Hammer Method, Pile driving Method, Bored precast pile Method (Center Bored pile Method, Composit pile Method of Steel pipe pile and soil cement, etc), Screwed pile Method, Press-in Method

Evaluation organization: Coastal Development Institute of Technology
Evaluation date: November 29, 2012（Partial renewal: March 31, 2021）
Evaluation No.: No. 20001
Name of technology: Laqnican Joint（Step Type）Mechanical Joints for Steel Pipe Piles and Steel Pipe Sheet Piles
Dimensional range: Pipe outside diameter=φ400~φ1500 mm; Pipe wall thickness= t9~t25 mm（SKK490）
Applicable pile Method: Vibro-Hammer Method, Pile driving Method, Bored precast pile Method（Center Bored pile Method, Composit pile Method of Steel pipe pile and soil cement, etc）, Screwed pile Method, Press-in Method

Laqnican Joint Website

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