NIPPON STEEL

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Screwed Steel Pile
NS ECO-PILE

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NS ECO-PILE™
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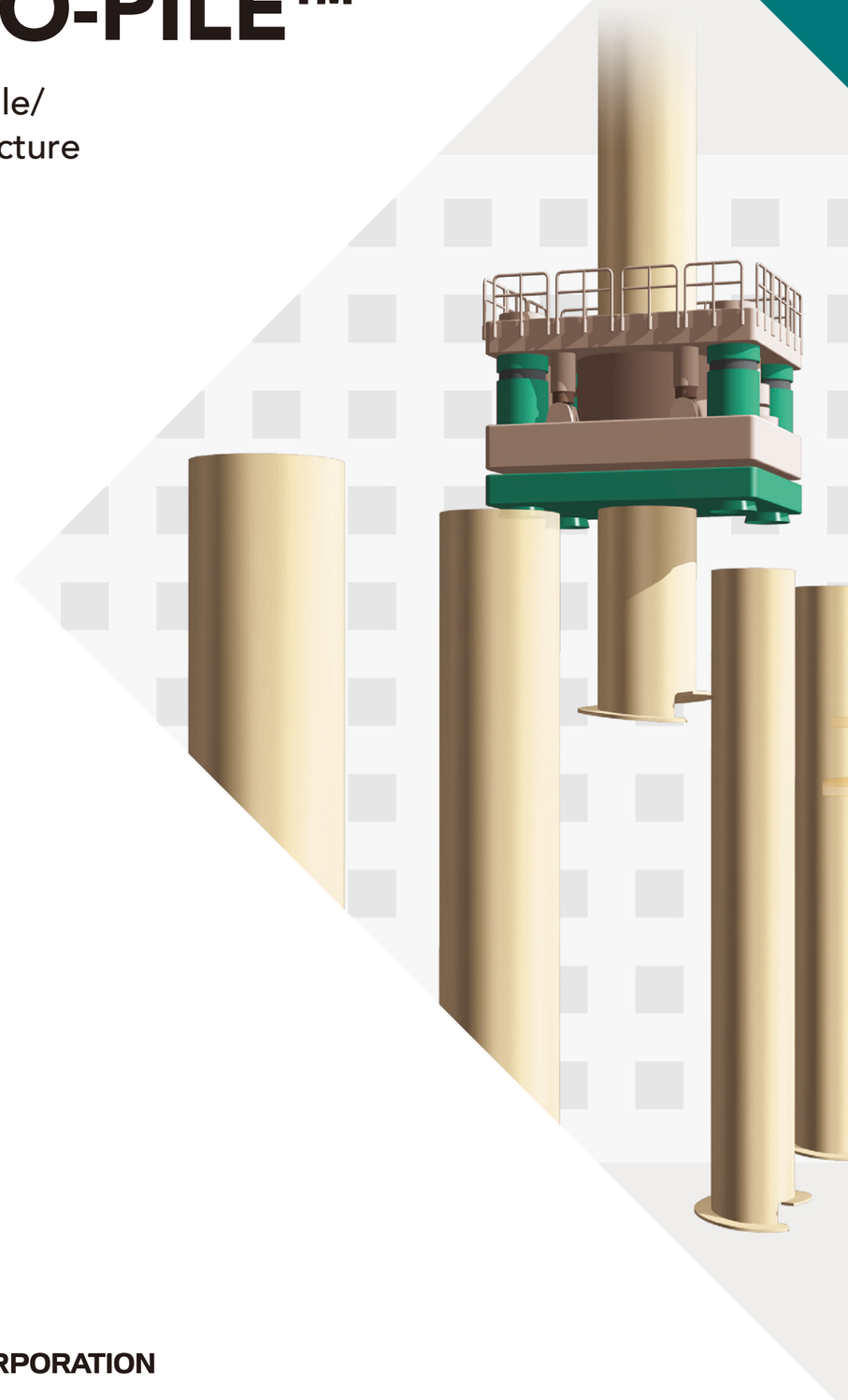
NS ECO-PILE™

Construction Product

Screwed steel pile/
Foundation Structure



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Characteristics

1 Overview of NS ECO-PILE

What is NS ECO-PILE?

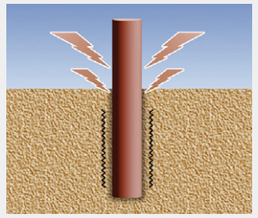
Most of the major cities in Japan are built on alluvial plains at the lower reaches of the rivers. Since alluvium is typically soft ground, structures such as high-rise buildings or expressways need to be supported by piles long enough to reach the hard ground base. Industrial waste such as waste soil or slurry as well as noise and vibration arising during the conventional pile construction method create environmental and social problems. NIPPON STEEL's NS ECO-PILE solves all these problems and realizes high bearing capacity, excellent earthquake resistance, cost effectiveness and shorter construction period. This is the piling method of the future.

Structure of NS ECO-PILE

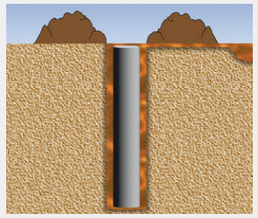
NS ECO-PILE is a steel pile with a helical blade welded to the edge. During construction, a pile driver or casing rotator, for example, rotates the pile, and the blade on the edge performs the digging that drives the pile into the ground like a wood-screw.

Construction compared with conventional pile method

Conventional pile



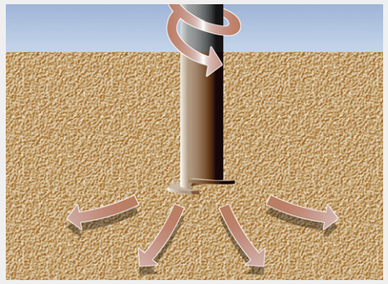
Driven pile:
noise and vibration problems



Cast-in-place pile:
Disposal of slurry and waste soil; sludge; and possible collapse of the bored hole wall

Bored pile:
Disposal of slurry and waste soil; or reduction in the bearing capacity at the bottom due to loosening of the ground

Conceptual illustration of screw piling



Many Advantages

＜Structural Performance＞

1 Large bearing capacity

A large vertical bearing capacity is generated by the consolidation effect of the ground as the pile is screw-driven into the ground and the base enlarging effect of the blade as the blade rotates to drill the ground.

2 Large pulling resistance capacity

A large pulling resistance capacity is maintained as the passive soil resistance, which acts on the blade part as propulsive force as the pile penetrates into the ground, is wholly turned into pulling resistance.

3 Excellent earthquake resistance

The steel pile foundation is highly resistant to deformation and earthquakes.

4 High quality

At the final embedment stage, the bearing layer can be confirmed by the torque, thus constructing a pile foundation of excellent quality and reliability.

＜Environmental friendly＞

1 Low noise and low vibration

The screw piling method with a pile driver or casing rotator causes no impact when driving a pile into the ground, minimizing noise and vibration during construction.

2 No waste Soil

By screw-driving the pile without excavating the ground, no waste soil is produced.

3 Congestion reduction

Construction vehicles such as dump trucks, concrete mixer trucks etc. are not required. Therefore, it is possible to reduce the occurrence of traffic congestion due to construction vehicles.

4 Recycling

To remove a pile, it is rotated in the direction opposite to that when driven, allowing easy recycling of used pile. NS ECO-PILE can thus also be used as temporary piles.

＜Applicability on various conditions＞

1 Batter piles

Unlike cast-in-place piling, the method drives piles without excavating the ground and so there is no risk of collapse of the bored hole wall. In the field of structural design, batter piles can reduce the number of piles more economically than vertically straight piles.

2 Proximity work

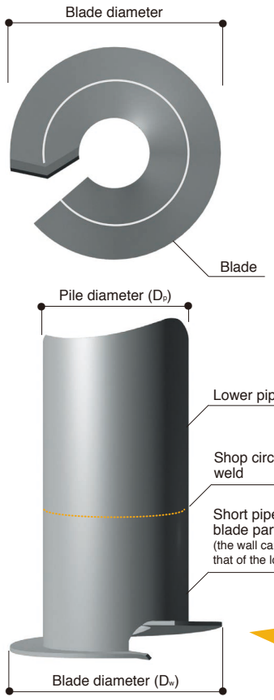
As the method drives piles without excavating the ground, the subterranean soil around the piles is not loosened. Therefore, pile-driving can be performed without affecting the foundation or buried pipes of an existing structure nearby.

3 Small area or under height restrictions

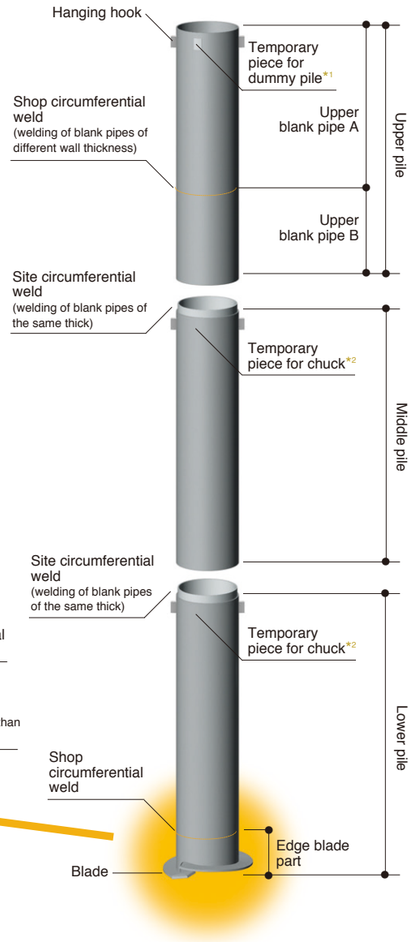
The equipment for pile driving is small and so the method can be used in small area such as sites adjacent to existing structures. For example, piles can be driven by a casing rotator at a site with limited overhead clearance such as under an elevated bridge or aerial wires.

NS ECO-PILE is good for environmental conservation and contributes to save overall construction cost and term under working restrictions.

2 Structure of NS ECO-PILE



Rd=$\frac{Dw}{Dp}$ is called the blade diameter ratio.



Note

The maximum difference in wall thickness between connecting blank pipes should be 7 mm or less.
When blank pipes of different thickness are connected, a thick wall part should be considered to mitigate stress concentration. The taper grinding length of the part inside the blank pipe shall be not less than 4(t1-t2). When (t1-t2) is not more than 2 mm, or when (t1-t2) is not more than 3 mm in the case of both-side welding of the shop circumferential weld, the taper grinding may be omitted.
When the site circumferential weld of a pile is connected to another pile, the wall thickness of the piles should be the same.

*1 Temporary pieces for dummy piles may be installed inside the steel pipe.
*2 Temporary pieces for chucks are used when pile driving penetrating with a compact size pile driver.

3 Construction Machinery

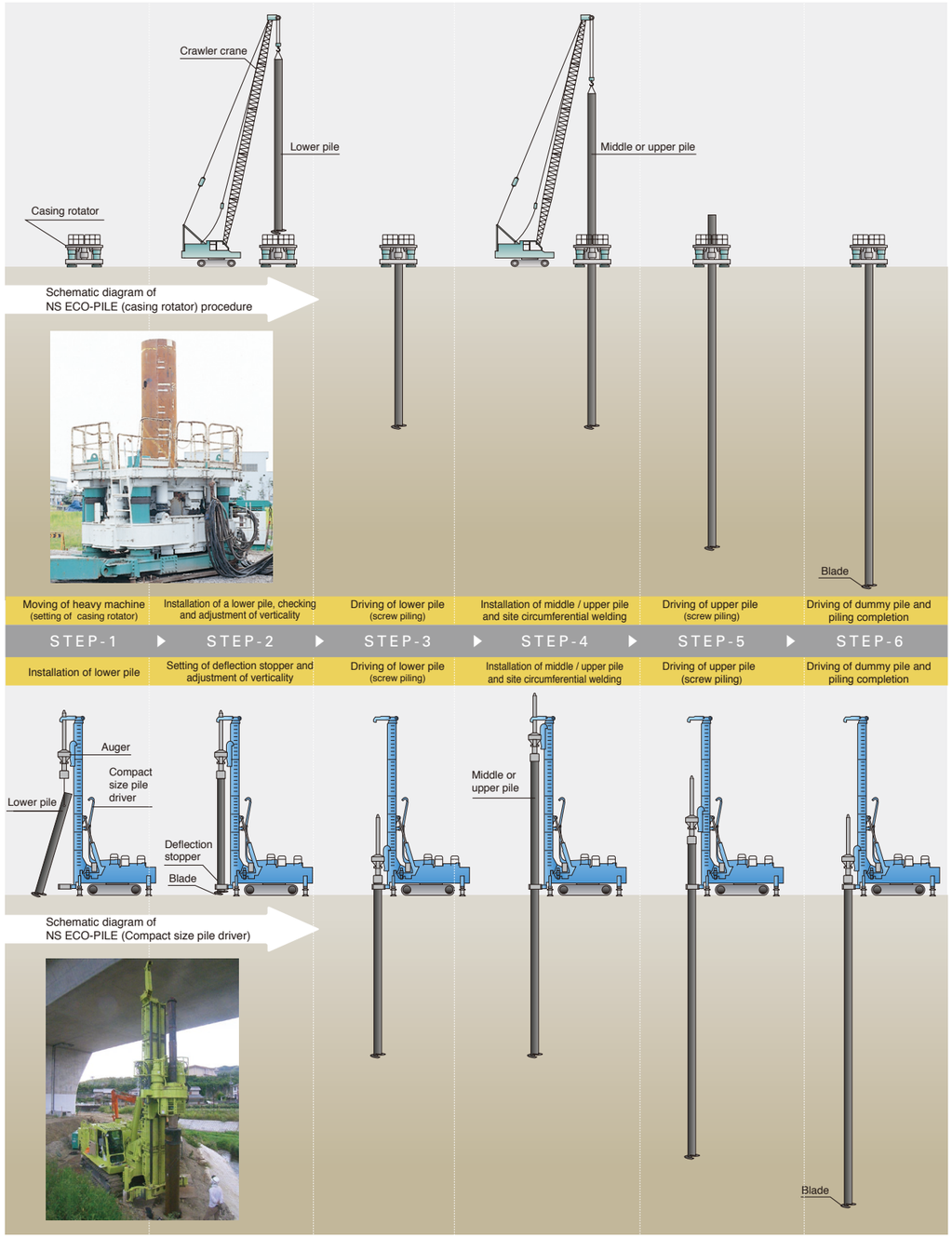
Major construction machines used with NS ECO-PILE Method

Type	Machine	Specifications, standard, etc	Remark
Construction machine 1	Casing rotator, 1500 class	Maximum torque: 1150 kN・m (117 t・m)	φ500 to φ600 mm in dia. (standard outside pile diameter)
	Casing rotator, 2000 class	Maximum torque: 2070 kN・m (211 t・m)	φ700 to φ1200 mm in dia. (standard outside pile diameter)
	Casing rotator, 2600 class	Maximum torque: 5100 kN・m (520 t・m)	φ1300 to φ1600 mm in dia. (standard outside pile diameter)
Construction machine 2	Compact size pile driver DHJ25	Maximum torque: 276 kN・m (28.1 t・m)	φ400 or less in dia. (standard outside pile diameter)
	Compact size pile driver DHJ45	Maximum torque: 548 kN・m (55.9 t・m)	φ600 or less in dia. (standard outside pile diameter)
Type of crane	Crawler crane	Capacity selectable as required	Used for pile installation or heavy machinery relocation
Backhoe			Used for backfilling a vacant hole (after removing the temporary pile)

Construction

1 Construction Procedure

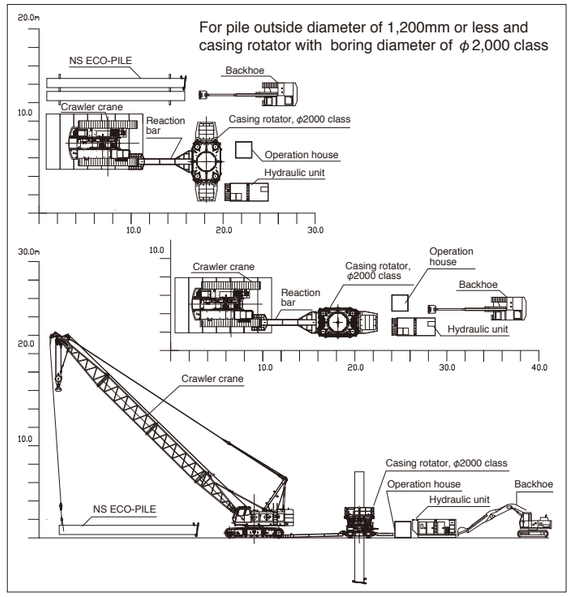
NS ECO-PILE procedures



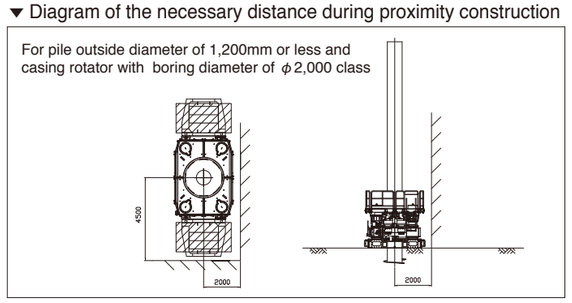
Note : If it is difficult to penetrate the pile due to hard intermediate layer, the soil inside the pile may be excavated with a hammer grab etc. as an auxiliary method.

2 Example of Machine Layout

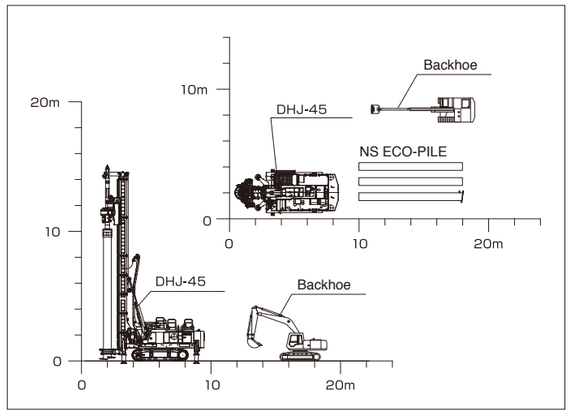
▼ Example of layout when casing rotator is used



▼ Diagram of the necessary distance during proximity construction



▼ Example of layout when Compact size pile driver (DH45) is used



3 Special Jigs for NS ECO-PILE

For driving NS ECO-PILE, the following jigs are used in addition to the major machines:

Spiral collar
(for casing rotator)

This is used to insert an NS ECO-PILE from above the machinery (patent no. 3484653)

Dummy pile

A dummy pile is used when the pile head is lower than the working ground level.

Temporary pieces for dummy pile

Protrusion on the pile head on which to apply torque to NS ECO-PILE

Construction

4 Flow of Construction Management

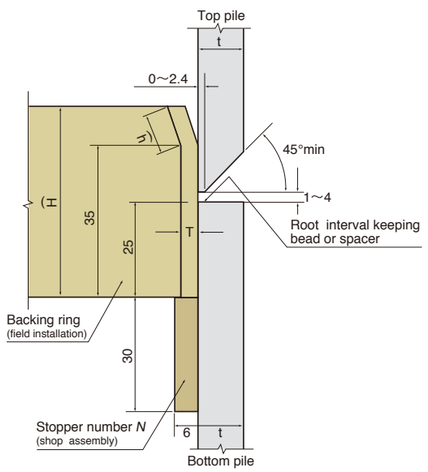
Fluctuation of working torque is used for all piles to check whether a pile has reached the bearing layer. A test pile is driven at each site to determine the management method to confirm arrival at the bearing layer, and the basic criterion for completion of piling is when the pile is embedded into the bearing layer to a depth equivalent to the pile diameter (1 Dp) or more.

Ⓐ : Driving of test pile

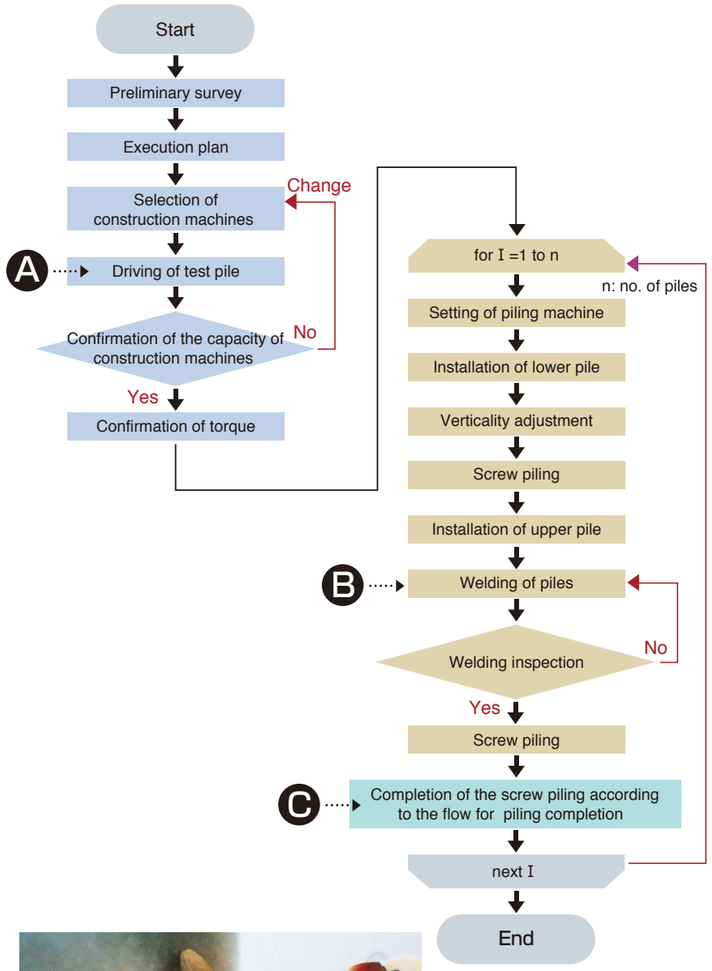
Test piles are driven to confirm the degree of workability of the actual ground condition at the work site, adequacy of machines selected, and the status of torque generation. By comparing the status of torque generation and the results of boring data, the torque fluctuation which confirms arrival at the bearing layer is determined.
The number and location of test piles are determined to suit the position of the boring exploration point and the scale of the number of piles. Some initial permanent piles may be used as test piles in the vicinity of the boring exploration point.

Ⓑ : Site circumferential weld

Piles are generally connected with welded joints. The backing ring should be that of a standard joint specified by the Japanese Industrial Standard (JIS A 5525).



Example of shape and dimensions of backing ring and stopper



Welding work

Ⓒ : Management of the piling completion flow for piling completion

In the standard procedure, a pile is screwed to the design depth and piling is completed when the pile is embedded into the bearing layer to a depth of 1 Dp or more. But when there is a difference between the depth of the bearing layer determined by a fluctuation of working torque and the depth of the bearing layer determined at the time of design or when the bearing layer is a very hard stratum, the piling can be completed at a depth shallower or greater than the design depth.

The bearing layer is generally confirmed by the fluctuation of working torque for judging the bearing layer determined by the test pile, but if the bearing layer is shallower than expected, it may be difficult to penetrate the pile to the design depth. In such cases, piling is sometimes completed at a depth shallower than the design depth if it can be confirmed that the pile has penetrated the bearing layer to a sufficient depth (1 Dp or more) and that torque has been generated.

If the bearing layer is too hard to drive a pile to a depth of 1 Dp or more, piling can be completed at an embedment depth of less than 1 Dp providing it can be confirmed that torque has been generated.