ESC SHEET PILE CATALOG

INSTALLATION PROCEDURES

ESC STEEL LLC

2024 EDITION

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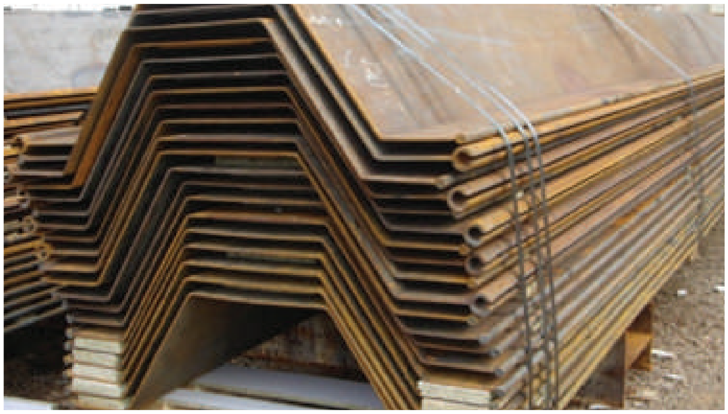
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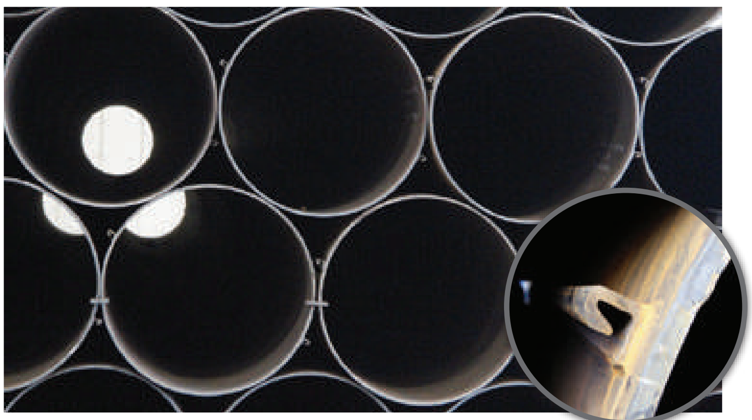
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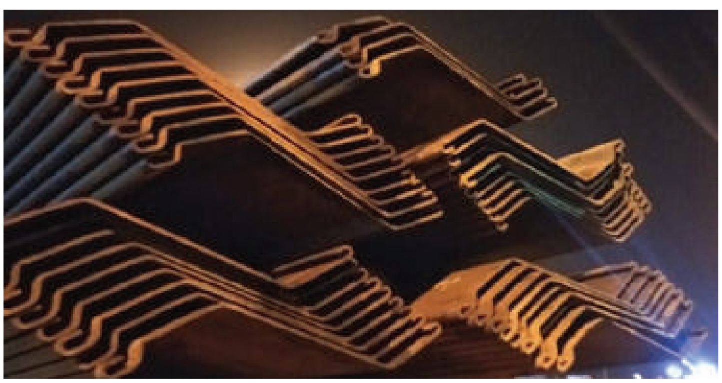
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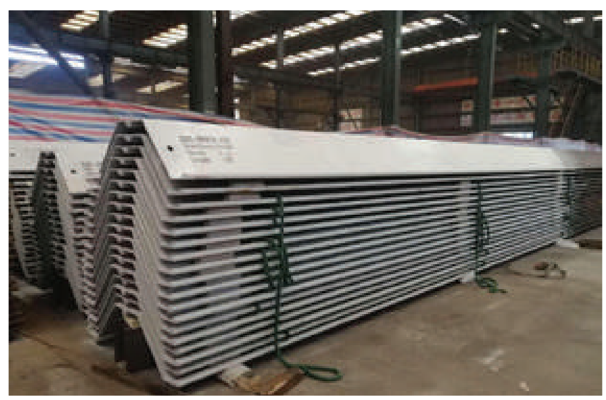

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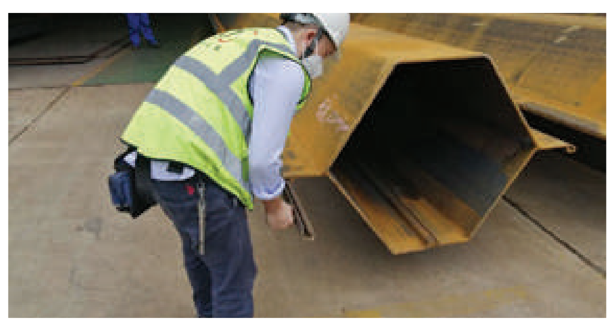


ESC SHEET PILE PRODUCTS

02 GENERAL

The following document provides an introduction to the methods of installing the ESC sheet piles. It is intended as a guide to an experienced sheet piling contractor. It should not be used as a reference for anybody unfamiliar with sheet piling operations as much of the information below assumes a level of knowledge about piling in general that would only be available to an experienced contractor. This manual is specific to the installation of ESC piles that are supplied globally.

The information presented here has been obtained through a combination of theoretical research and practical experience in driving ESC piles. Every piling operation is unique however, and the information in this manual may only be used as a guide to assist the installation contractor. Ultimately, the final decisions about the installation methods will come down to a combination of the site conditions, the information provided within this text, and the installation contractor's knowledge and experience.

Prior to any decisions being made regarding the equipment or technique for the pile installation, detailed information is required about the soil conditions and the site conditions where the sheet pile is to be installed.

3.1 SITE CONDITIONS

The site conditions must be considered mainly to ascertain the problems of obtaining access to the driving area, and the consequences that the driving operations will have on other areas of the site, or on neighbouring facilities such as buildings, roads, services etc. Some of the factors that need to be considered are listed below;

- Local laws and bylaws.
- Construction standards and contract requirements.
- Safety, particularly when hoisting the pile in close proximity to the public.
- Effects of ground vibrations on existing facilities
- Noise pollution
- Working area and platform stability
- Existing services within the working area that may be affected

This list is by no means complete, and every site will have aspects that will affect the selection of piles and piling equipment, each of which must be identified and addressed.

3.2 SOIL CONDITIONS

Soil conditions may be separated into three broad categories for the purposes of piling;

Granular Soil

Consisting mainly of sands and sandy silts, granular soils resist pile penetration mainly as a point resistance at the toe of the pile, friction along the length of the pile contributing little to the overall resistance. The density of the soils being penetrated therefore governs the required driving force.

Cohesive Soil

Consisting of clays and clayey silts, cohesive soils resist pile penetration primarily from adhesion between the soil and the body of the pile, with virtually no point resistance at the toe of the

pile. The required driving force is therefore a function of the undrained shear strength of the soil and the surface area of the embedded pile.

Rock

Rock may be in boulder form floating in soils or as a continuous layer underlaying soil layers. The presence of any rock should be identified and its nature carefully categorised to determine if it is universally present or a local phenomenon likely to only affect a few piles. Sheet piles cannot be driven continuously through rock using conventional means, however, it is sometimes possible to key a pile of short way (<1.0m) into highly weathered or soft rock varieties such as sandstone. Beyond this special installation techniques are required, which will remove the rock from in front of the pile.

Considerations of all of the above factors are vital to the selection of the correct sheet pile and the necessary installation equipment. In several cases, the maximum structural properties of a sheet pile are selected not by the requirements of its final function, but by the stresses of the installation process. This is particularly true for granular soils. Frequently however, a site consists of combination of granular and cohesive soils within separate layers, so driving stresses on the sheet pile must always be considered.

4.1 PILE INSTALLATION

ESC offers a large varied c ollection of sheet piles and piles.

We will start here discussing the unique ESC "wide" piles.

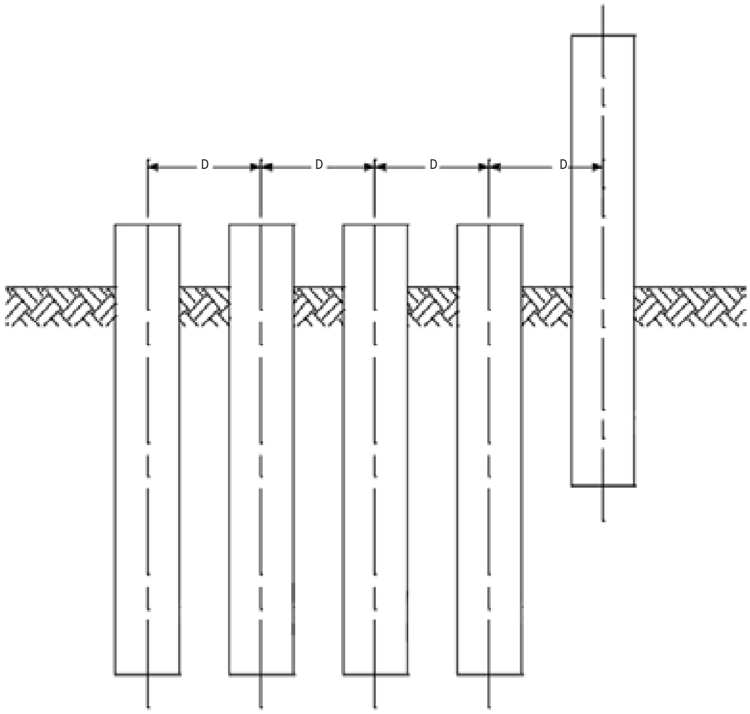
ESC "wide" piles should be driven using the staggered method, where every second pile is driven and then the intermediate pile slotted into the resulting gap. The pile is driven first and the infill piles slotted in. Figure 1 illustrates the staggered driving method.

The unit width on the drawings will be different for each pile series. All "wide" piles should have a tolerance of ±20mm that the pile can flex during set up spacing.

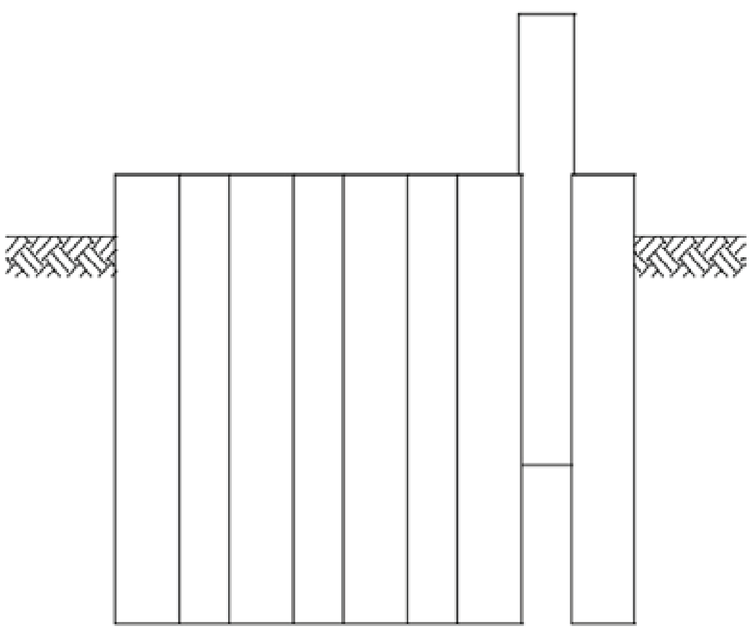
The staggered driving method is used as it offers the following advantages;

- Improved pile alignment. As each second pile is driven as an individual piles, the inherent problem of cumulative lean that always occurs during sheet pile driving is eliminated. If there is a slight misalignment between two adjacent initial piles, the infill pile has sufficient flexibility to accommodate variations in the resulting gap without the danger of detracking.

- Quicker installation. Careful alignment control is required when installing the initial pile, however as the infill pile can only follow the tracks of its adjacent initial piles, the time spent on alignment is minimal. The overall effect is an increase in piling speed.



STAGE 1 : Installation of Initial Pile



STAGE 2 : Installation of of the infill piles and completion of panel

FIGURE 1 : Staggered Driving Technique for ESC Piles

INSTALLATION TECHNIQUE

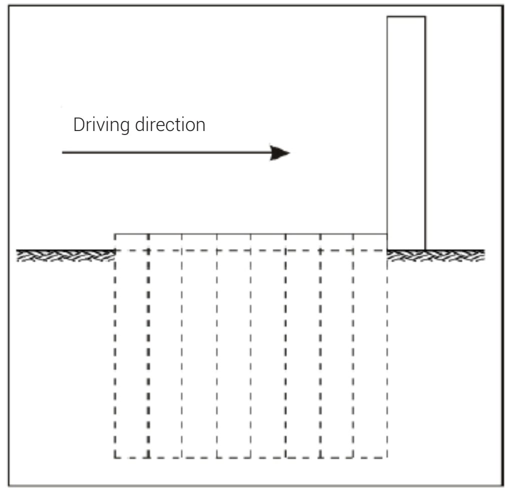
The ESC HRZ or HRU Pile has a different method of installation. The drivability of each pile section is a function of its cross-section properties, length, steel grade used, load applied and duration of its application and the method employed for installation. The cross-section properties of a pile are based upon the thickness of steel, depth and width of section and its designed shape.

Under most circumstances the greater the surface area of the piling profile, the greater the driving force required.

Whilst it is recognised that, in common with most civil engineering projects, a measure of flexibility is desirable to meet site conditions, every precaution must be taken to maintain the necessary standards of safety whilst giving the required alignment and verticality of the installed piles.

The first sheet pile must be installed with great care and attention to ensure it is vertical both planes of the wall.

It is essential that the following piles are interlocked sufficiently to the preceding pile before being released and the hammer applied. This can be achieved by a preliminary dug-out trench in the wall line which automatically reduces the driving length.



4.2 PITCH AND DRIVE

This method, where each sheet pile is driven to full depth before pitching the next one, is the simplest way of driving but is encouraged only for loose soils and short piles. The free leading interlock is constantly in danger of deviation. For dense sands and stiff cohesive soils or in the case of possible obstructions, panel driving is recommended.

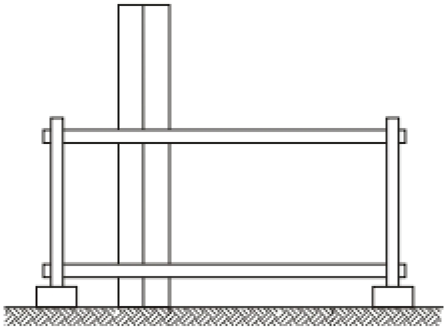
4.3 PANEL DRIVING

Sheet piles often are best installed using the panel-driving technique in order to ensure that good verticality and alignment is achieved and to minimize the risk of driving difficulties or de-clutching problems.

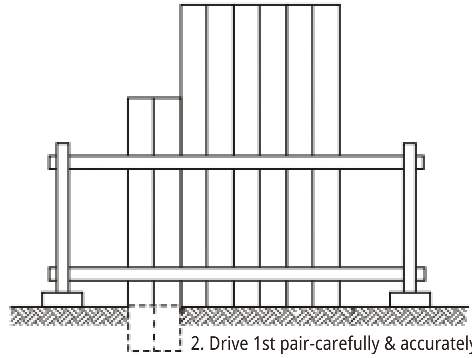
This technique also enables greater control to be maintained on the nominal wall length. Because a whole panel of piles has been pitched there is no need to drive all piles fully to maintain piling operations; if obstructions are encountered, individual piles can be left high without fear of disruption to the overall efficiency.

INSTALLATION TECHNIQUE

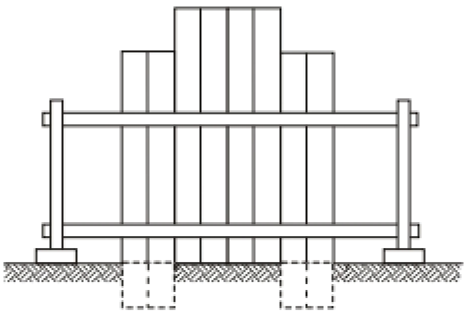
Panel Driving



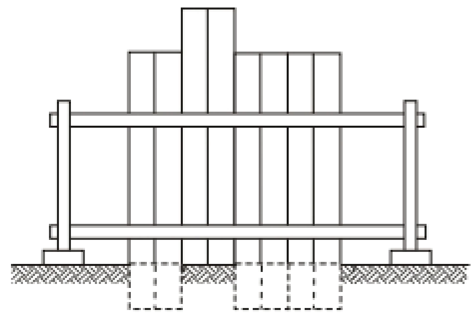
1. Pitch, align & plumb 1st pair



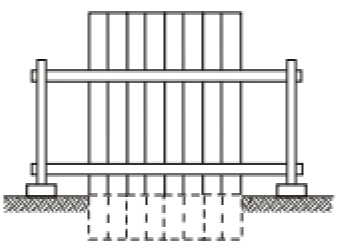
2. Drive 1st pair-carefully & accurately pitch remainder of panel



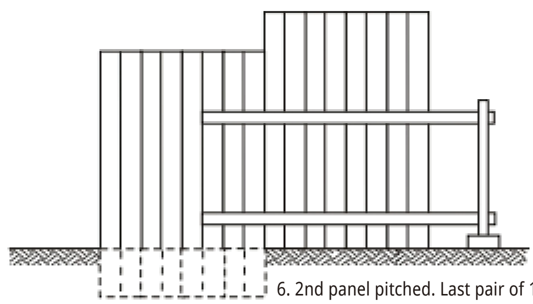
3. Ensure last pair are accurately positioned & plumbed, drive last pair



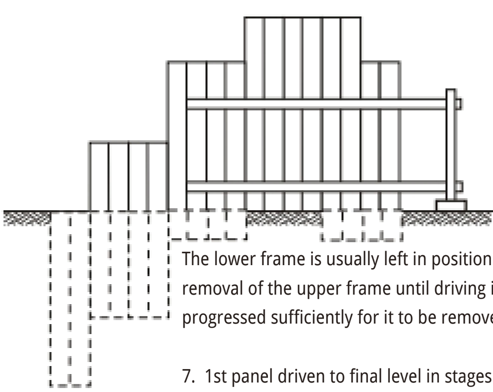
4. Drive remainder of panel-working backwards towards 1st pair



5. 1st panel part driven



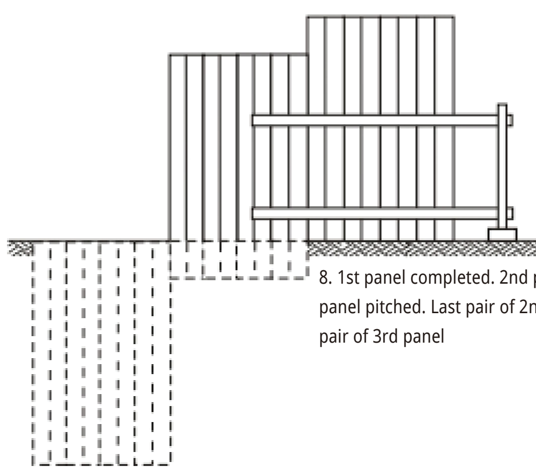
6. 2nd panel pitched. Last pair of 1st panel become 1st pair of 2nd panel, gates supported by through bolting to last driven pair



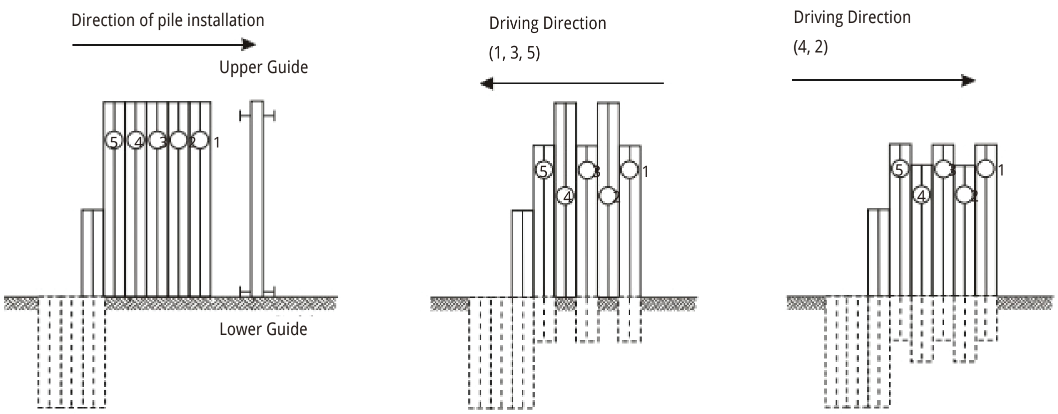
The lower frame is usually left in position after removal of the upper frame until driving is progressed sufficiently for it to be removed

7. 1st panel driven to final level in stages. Last pair of 2nd panel plumbed and driven accurately

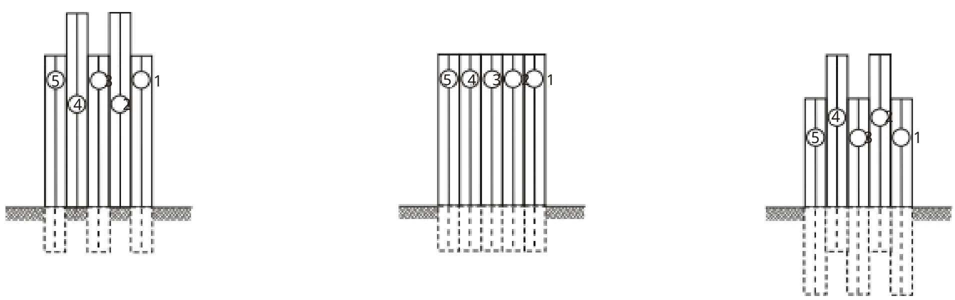
Note: The same concept is used for single piles.



8. 1st panel completed. 2nd panel part driven. 3rd panel pitched. Last pair of 2nd panel become 1st pair of 3rd panel



Only the reinforced elements 1, 3, 5 are pre-driven: the other 2, 4 ... follow



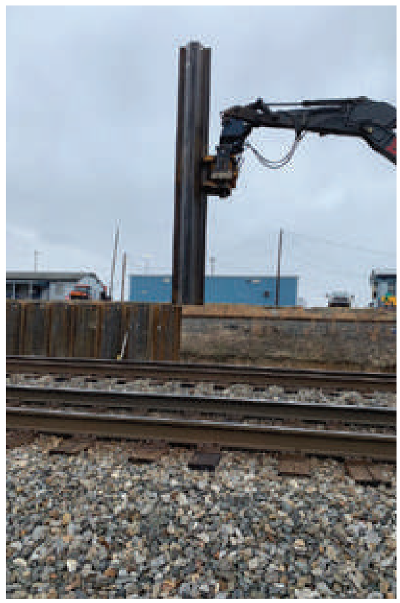
4.4 STAGGERED DRIVING

In difficult soil conditions panel installation combined with staggered driving is recommended.

The piles are installed between guide frames and then driven in short steps as follows: piles 1, 3 and 5 first; then piles 2 and 4.

If the soil is very dense sand, gravel or rock, piles 1, 3 and 5 can be reinforced at the toe. In this case, these piles are always driven first and piles 2 and 4 in the second stage.

EXCAVATOR MOUNTED HAMMER



ELECTRIC VIBROHAMMER

4.5 EQUIPMENT

Vibratory hammers are the recommended equipment for the installation of ESC piles. Experience has shown that the ESC piles will penetrate all soil types when installed using the correct selection of hammers.

Refer to the section 'Selection of Driving Equipment' for details on the correct selection of hammers.

4.6 PILING GUIDES

Piling guides should always be used in the installation of ESC piles, regardless of the installation technique or the equipment used to drive the piles.

If a leader is used, with the vibro mounted on a piling rig (ABI/Bauer etc.) slide on the mast, then only a bottom guide will be required to ensure correct positioning of the piles.

If a free hanging vibro is used with a crane, then an upper and lower guide will be required.

The selection and design of the piling guide will be mainly determined by the driving technique and the size of the pile, but will also be affected by a number of secondary considerations, including access, site conditions, and budget.

It is the responsibility of the piling engineer to use his knowledge of the site, as well as his piling experience to select a suitable piling guide design.

SELECTION OF DRIVING EQUIPMENT

Here we will review the most common options available. Some methods may not be covered & installers are encouraged to review separately if not covered here.

5.1 VIBRATORY HAMMER

ESC recommend that all piling operations are performed using a vibratory hammer. Vibratory hammers have long been proved the most efficient and common method of pile installation, and for this reason the selection guidelines contained here focus only on this type of equipment.

Selection of the correct hammer is essential to obtain maximum driving efficiency and obtain the correct penetrations for the pile. The details below are only to be used as a guideline as every brand of vibratory hammer performs differently. It is recommended that prior to the final selection of any equipment, the equipment manufacturer should be contacted and precise specifications for the equipment obtained. Hammers are defined by three major parameters;

Frequency - The frequency of the vibrations of the hammer, and subsequently the pile, are critical in determining the extent the friction between the pile and the soil will be broken, allowing the pile to penetrate. Generally, high frequencies enable the soil to liquefy better and the pile will penetrate more easily. Frequency is also critical if vibrating near existing structures. High frequency vibrations will not travel far in soil compared to low frequency vibrations, and will therefore have less chance of damaging neighbouring structures. For these reasons, ESC always specify high frequency hammers in their own contracting work.

Centrifugal Force - Centrifugal force is the magnitude of the blow that the hammer delivers to the pile and is critical for overcoming side resistance and tip resistance. Figure 3 below relates pile length to centrifugal force as a guideline to hammer selection.

The Centrifugal Force diagram takes into account the structural condition of the soil. Higher structural density requires a greater centrifugal force. Table 2 should be used in conjunction with the selection diagram.

Curve	Type of Soil	
	Granular	Cohesive
A	Loose	Soft
B	Medium	Firm
C	Dense	Hard
D	Very Dense	Very Hard

Soil Conditions for Centrifugal Force Selection

Amplitude - Amplitude is the magnitude of movement the pile experiences during vibration. A large amplitude or stroke will result in a greater impact force at the toe of the pile. In cohesive soils, a large amplitude is sometimes necessary to break the elastic bond between

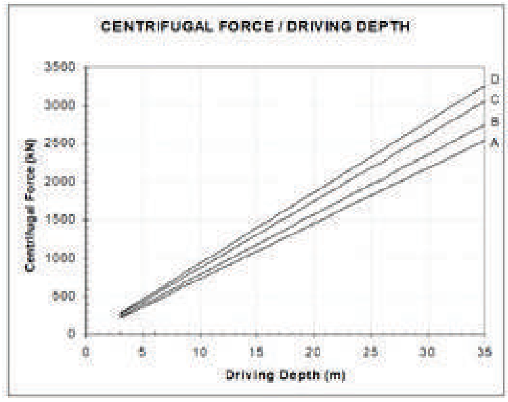


Figure 3. Required Centrifugal Force

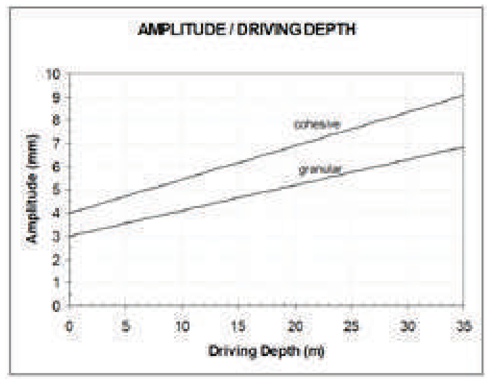


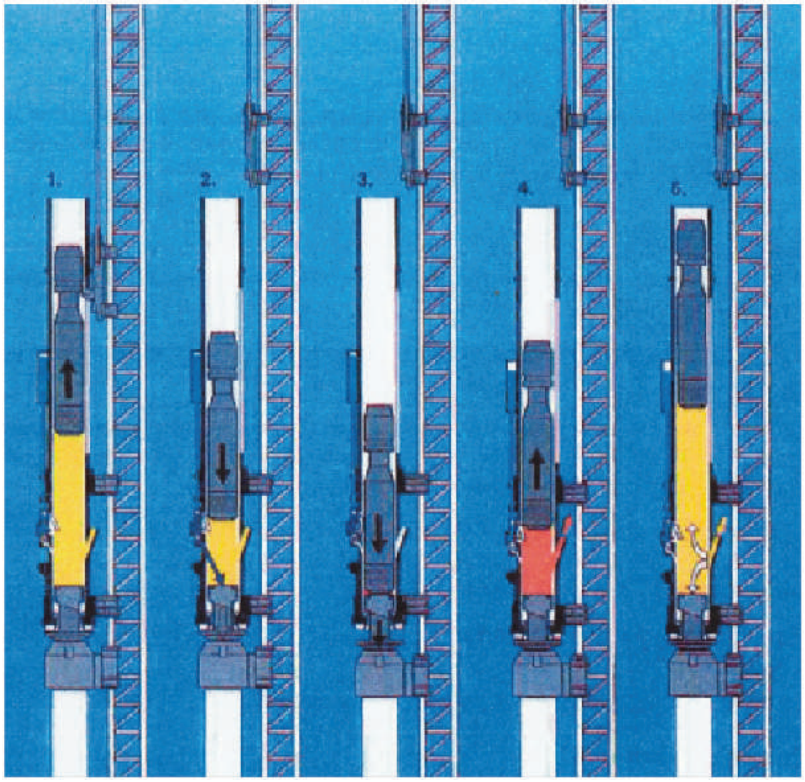
Figure 4. Required Amplitude

the soil and the pile surface. Higher amplitudes are usually achieved at the expense of frequency in some machines however, so care should be exercised when selecting high amplitude machines. Figure 4 below provides a selection chart for amplitude vs. pile length. The figures given for amplitude in this chart are the vibration amplitude, not the full pile oscillation which is double the amplitude (up and down vibration). Caution should be used when reading an equipment specification, to determine if the values given are amplitude or oscillation values.

HYDRAULIC VIBROHAMMER

HYDRAULIC DROP HAMMER

DIESEL PILE HAMMER



5.2 DIESEL HAMMERS

A diesel hammer consists principally of a cylinder, a piston (ram) and an impact block at the bottom of the cylinder.

In single acting hammers the top end of the cylinder is open, but with double acting types it is closed. This double acting effect can also be achieved by using a vacuum chamber.

To start the single acting hammer, the piston is lifted to a pre-set height and automatically released. The falling piston compresses the air in the compression chamber and activates the fuel pump to spray fuel on top of the impact block. The impact block atomizes the diesel fuel, which ignites in the highly compressed air. This explosive energy throws the piston upward thus driving the pile downwards and re-starting the hammer cycle.

Diesel hammers perform especially well in cohesive or very dense soil layers. Under normal site it is usual to select a ratio of ram weight to weight of pile plus cap of 1:2 to 1.5:1. Driving caps of flat anvil blocks are necessary to protect the pile heads during driving.

A penetration of 25 mm per 10 blows should be considered as the limit for the use of diesel hammer in accordance with the hammer manufacturer's recommendations.

Under circumstances a penetration of 1 mm per blow could be allowed for a short period of time. Longer periods of time at this blow rate would cause damage to the hammer and equipment.

Diesel pile hammers operate as follows:

1. Raising of Piston
For starting the diesel pile hammer, the ram weight (piston) is raised by means of a tripping device and automatically released at a given height.

2. Injection of Diesel Fuel and Compression
While dropping, the piston will actuate the pump lever, so that a given quantity of diesel fuel is sprayed on top of impact block. After passing the exhaust ports, the piston will start compressing the air in the cylinder chamber.

3. Impact and Explosion
The impact of the prison on the impact block will atomize the diesel fuel in the combustion chamber. The atomized fuel will ignite in the highly compressed air. The resulting explosive energy will force up the piston.

4. Exhaust
While moving upwards, the piston will expose the exhaust ports. Exhaust gases will escape and the pressure in the cylinder will equalize.

5. Scavenging
The piston keeps jumping upwards and will draw fresh air through the exhaust ports for scavenging the cylinder, while also releasing the pump lever. The pump lever returns to its starting position, so that the pump will again be charged with fuel.

5.3 DROP HAMMERS

General

This hammer is easily adapted to drive any of the pile sections for all ground conditions eg. above and below the water table, and also adopts the same ram weight ratio and driving sets as described for Diesel hammers.

Ram weights up to 11 tonnes are available with a variable drop height of up to 1.2 metres. At maximum ram weight and stroke height a blow rate of 40 blows/minute can be obtained when used in automatic sequence.

It is always preferable to use a heavy ram, with short stroke to minimize pile head damage and noise emission levels.

The hammer controls are precise and used correctly this hammer can achieve 75-80% of rated output energy. Data recording units simultaneously store the relevant driving information.

There are three main types of drop hammer:

Cable Operated Drop Hammers

These consist of a machine lifted weight which is then allowed to free fall to drive the pile.
The falling height can be regulated by the cable winch.

Steam Drop Hammers

For these special drop hammers the cylinder represents the falling weight which is lifted by steam pressure.

A valve system interrupts the pressure and causes the cylinder to fall. The height can be adjusted to the given conditions.

Hydraulic Drop Hammers

This type of hammer consists of a segmental ram guided by two external supports; the ram is lifted by hydraulic pressure to a preset height and allowed to free-fall on to the anvil or driving cap.

5.4 DOUBLE-ACTING HYDRAULIC HAMMERS (HYDROHAMMER)

This type of hammer consists of an enclosed ram that is lifted by hydraulic pressure. On thee downward stroke, additional energy is delivered to the ram, producing an acceleration of 2 g. The maximum stroke of 1 metre thus corresponds to a free fall drop of 2 metre.

These hammers range from a maximum energy/blow of 35 kNm to 3000 kNm with a blow rate of 50/60 blows per minute. The electronic control system ensure optimum control of the piling process and the design enables a range of safety, monitoring and indicating devices to incorporated. The net energy supplied to the pile, which is measured during every blow, and shown on the control panel can be continuously regulated from maximum to less then 5%.

The hydro-hammer can operate at any angles, above and below water level and is suitable both for driving and extracting piles. Under normal site conditions it is usual to select a ram weight that

is in the ratio 1 : 1 to 1 : 2 with the weight of the pile plus driving cap. A heavy hammer with short drop is always preferable to minimise pile head damage and noise level emissions.

Up to the present time only hydro-hammers from 36 kNm to 90 kNm energy per blow have been known to be used for sheet piling; hammers larger in capacity than these are considered to be too heavy.

5.5 SHEET PILE PRESSES

The elimination of the noise of sheet driving, which had for years been accepted as a nuisance to be tolerated, was the original purpose of the development of sheet pile presses as an alternative to the classical methods.

Originally developed to drive piles silently, the machines are also widely recognised for their vibration-free operation.

The machines, which are especially suited for the use in cohesive soils, are hydraulically operated and take most of their reaction force from the friction of the previously driven piles. In the standard system, the engine consists of a cross-head containing hydraulic rams and the hydraulic power pack mounted on the cross-head.

Sheet piles are installed in a panel and the machine is set on the panel by means of a crane (Type 1).

The rams (hydraulic cylinders) are connected to the piles and by pressurising two rams, whilst the others are locked, enables the piles to be pushed into the ground, two at a time, to the full extent of the rams. When all the rams have been extended, they are all retracted simultaneously causing the cross-head and power pack to be lowered and the cycle is then repeated to completion.

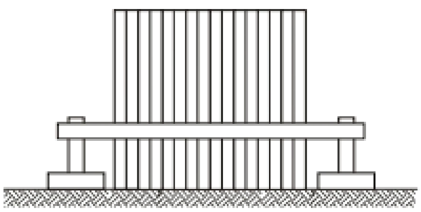
DRIVING USING ESC GUIDE

DRIVING USING MOBILE CRANE

SELECTION OF DRIVING EQUIPMENT

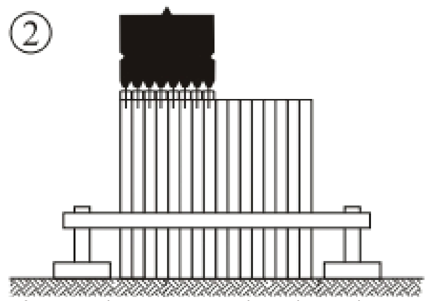
Type 1 : Machine Operation

①



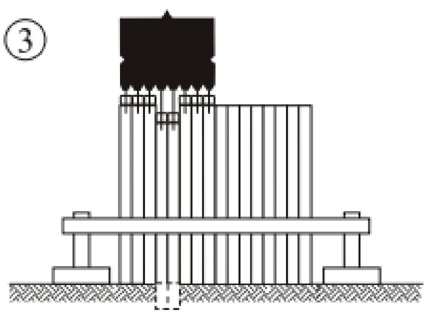
Pitch panel of sheet piles into guide beams supported on stable trestles

②



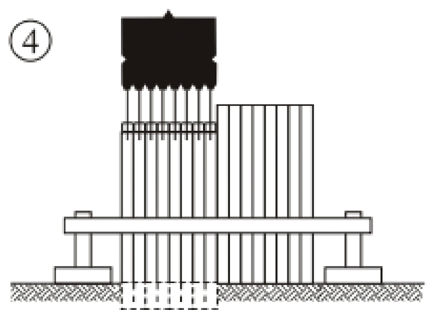
Lift press and connect onto 8 piles in the panel

③



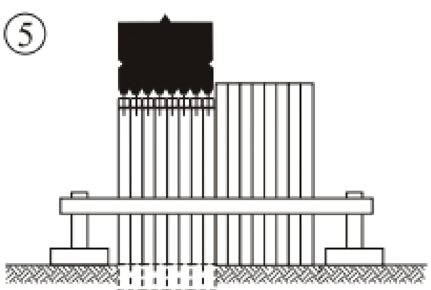
Extend rams 4 and 5 pushing each pile a distance of 750mm into the ground

④



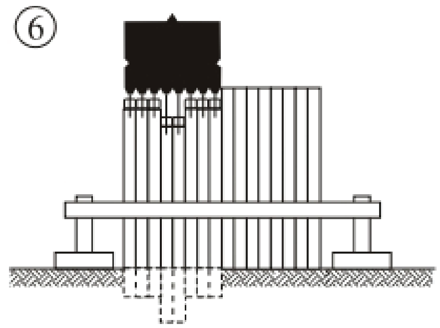
Extend all other rams in pairs working symmetrically from the centre out

⑤



React all rams lowering the machine

⑥



React all rams lowering the machine

Note: Piles are extracted using the reverse operation of the above sequence

These presses can develop forces of up to 300 tonnes.

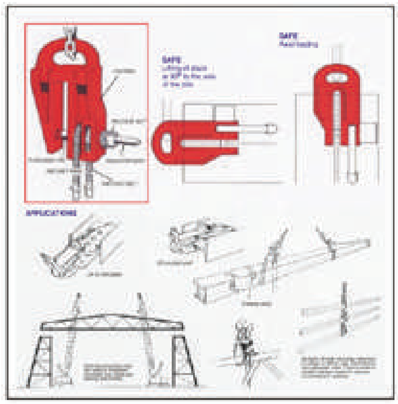
Another type of machine with similar features uses a moveable frame to hold the installed panel and to move from panel to panel, giving complete independence from a crane. In this system, pre-drilling loosens the soil during the press operation (Type 2)

A chain pull connected to a fixed point or to piles that have already been driven can provide supplementary press force.

Other kinds of presses jack one pile after another to the complete depth while walking on the previously set piles. These machines work completely independently from crane, and also use the reaction force of the piles already set to operate. These machines can accommodate limited circular construction if required (Type 3).

TYPE 2 : SHEET PILE PRESS
(Taken from TESPA Reprint 2001)

TYPE 3 : HYDRAULIC PRESS
(Taken from TESPA Reprint 2001)



(Brochure courtesy of Dawson Engineering Pte. Ltd)

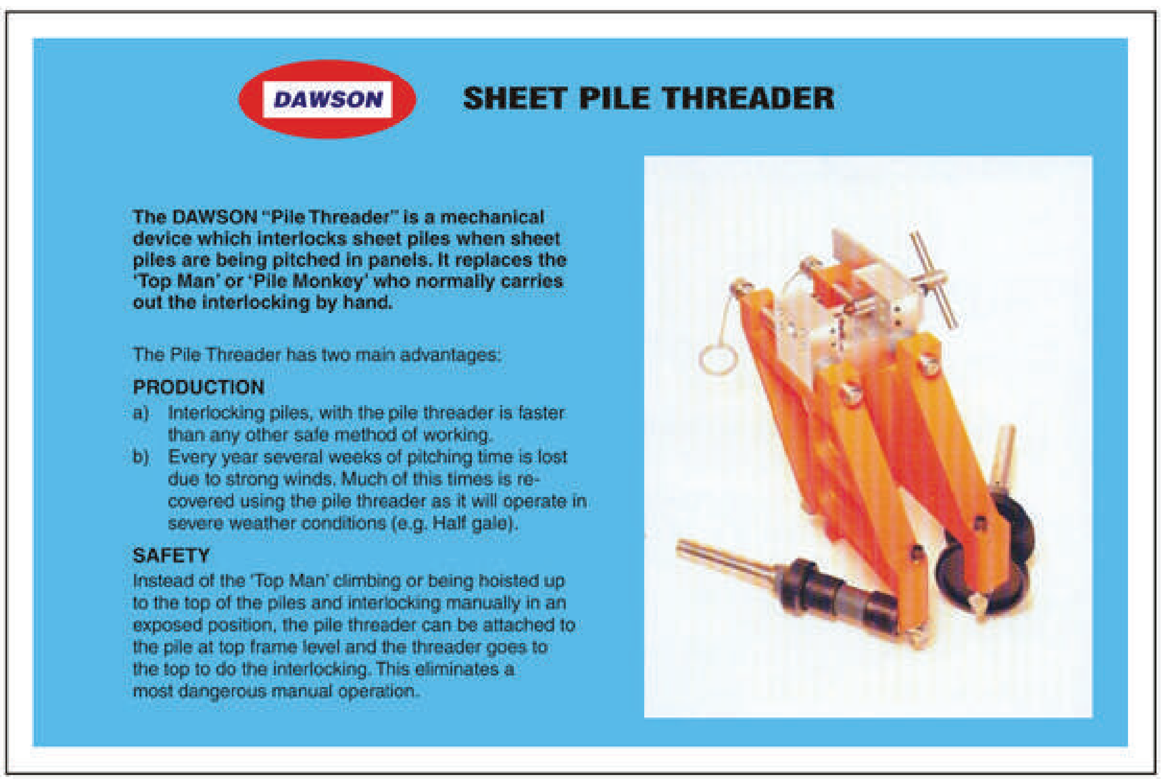
5.6 SHACKLES

Besides the standard shackles widely used, a variety of ground –release and ratchet-release shackles are available. These enable the crane connection to the pile top to be released, when required, from ground level or walkway waling level. This is fast, efficient and safe. The shackle uses a lifting hole in the head pile through which shear pin passes. Friction grip methods of lifting should never be used as they can accidently release in a number of different circumstances.

Method of operation for shackles when used in conjunction with pile threader (see Threaders, section 5.8)

5.7 THREADERS

As a consequence of panel driving, there is a need to interlock piles and release their crane connection, at high level, with efficiency and safety. The sheet pile threader designed to interlock any steel sheet pile accommodating the different profiles, handling and interlock types without the need for a man to be employed at the pile top. Work on pitching piles can also continue in windy conditions which would stop manual interlocking, making the work more efficient as well as safe.



(Brochure courtesy of Dawson Engineering Pte. Ltd)

5.8 REINFORCING SHOES

Having taken all precautions to guide the piles accurately during installation, pile design efficiency may still make the pile vulnerable to damage from artificial or natural obstruction such as cobbles, boulders, concrete and old timber piles.

Reinforced shoes can be provided to give strength to the leading edge of the sheet pile and to help maintain its shape when passing through difficult ground.

5.9 STEEL HANDLING SHOES

These are simple cast-steel shoes designed to slide between each pile in a stack to enable easy separation and handling.

5.10 DRIVING CAPS

General

Driving caps with a dolly may be required when using hammers in order to transmit the blow directly to the pile and to protect the hammers and the pile heads.

Guiding grooves for the pile are formed on the lower surface of the driving cap.

A suitable connection between the leader and the driving cap can be obtained by a spacer insert to give the required clearance.

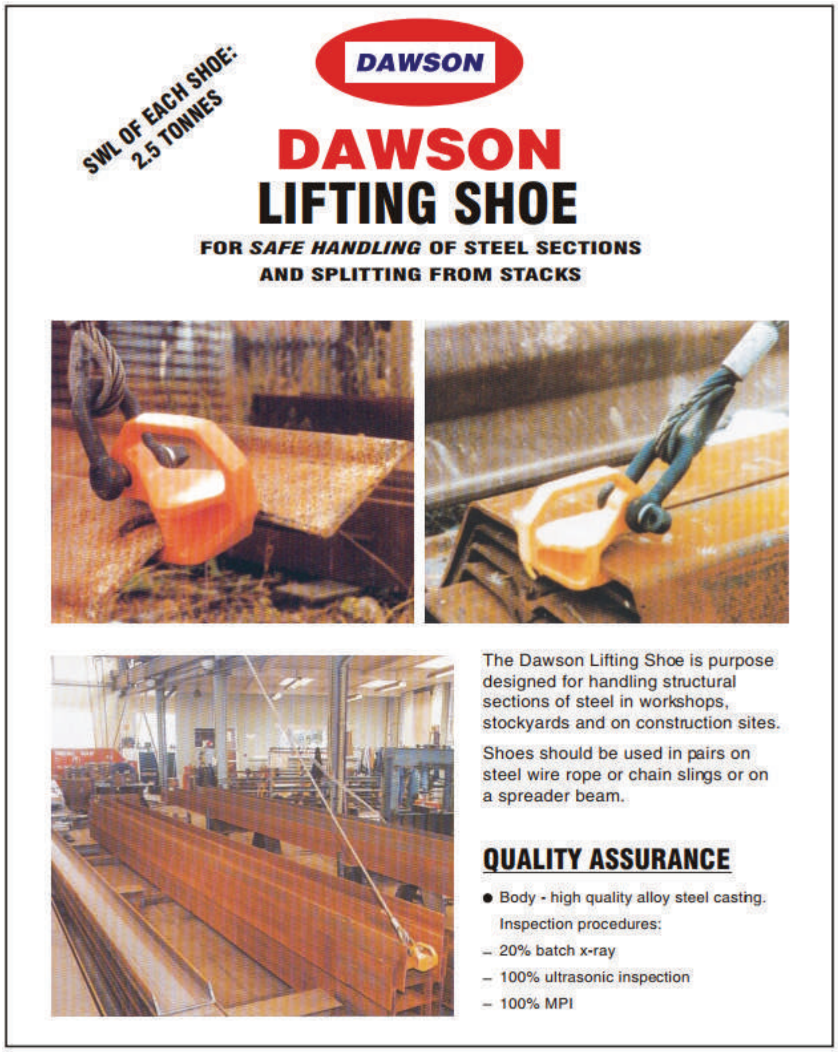
The insert must have a sliding connection on the cap and on the leader.

5.11 DOLLY

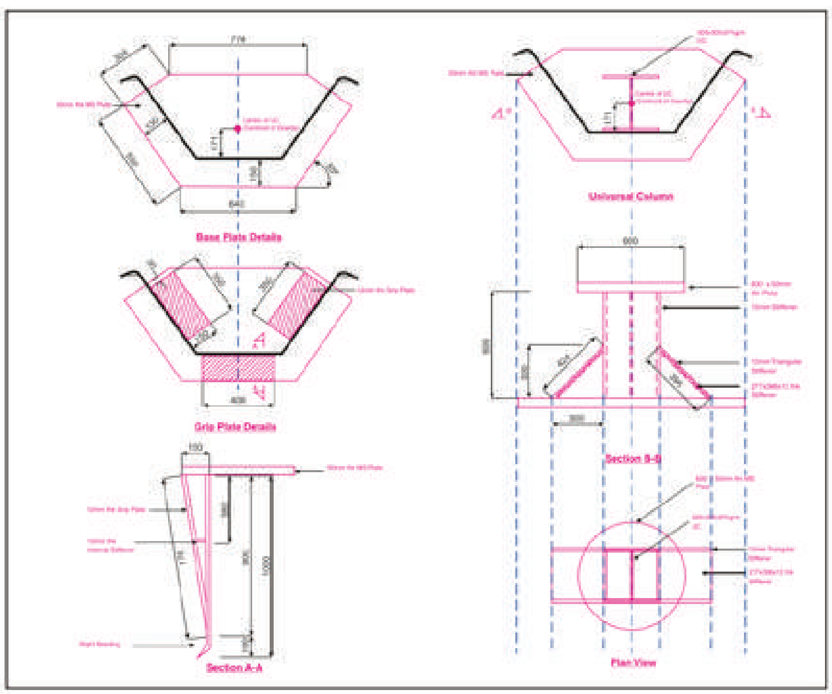
The dolly is fitted into a recess on the upper surface of the driving cap. The dolly cushions the blow from the hammer and thus prevents damage to the hammer and the cap.

Dollies are normally built of plastic or wooden components, with a combination of steel cables and steel plates which give a reasonable life expectancy and also quickly dissipate the heat generated.

When hard driving is experienced the dolly has to be replaced more frequently than under normal requirements.



(Brochure courtesy of Dawson Engineering Pte. Ltd)



Special Driving Cap & Dolly for ESC Wide Profile Sheet Piles

In some circumstances, the force of the vibratory hammer alone may be insufficient to achieve the desired penetration. This may be due to obstructions or hard ground conditions. In this situation, the piling engineer has a range of options available to further the penetration of the pile.

6.1 JETTING

The objective of jetting is to locate a pressure source at the toe of the pile, which during the vibration process will loosen and remove the material under the pile. Using jetting, dense to very dense soils can be penetrated by the sheet pile.

Three techniques of jetting are commonly available;

- Air pressure
- Low water pressure
- High water pressure

All systems use a similar technique of using pipes to transfer the pressure source to the toe of the pile. Two to four pipes are welded to the back of the pile and connected to the pressure source via flexible hoses. The pressure source is usually located at ground level. Table 5 shows a summary of the parameters for each of the jetting systems.

When using the jetting technique, care must be taken that the large volumes of water do not create any side effect problems. If there is a risk of settlement, high pressure jetting is preferred to low pressure due to the reduced amount of water being used.

Using low pressure jetting, the soil characteristics are only slightly modified, although special care must be taken if the piles have to carry vertical load. Using high pressure jetting, soil mechanical characteristics are not affected.

TABLE 5 : JETTING PARAMETERS

Jetting Technique	Pipe Diameter (mm)	Nozzle Diameter (mm)	Supply Pressure (bar)	Supply Volume	Recommended Soils
Air Pressure	25	5 - 10	5 - 10	4.5 - 6 m^3/min	Cohesive
Low Water Pressure	20 - 40	5 - 10	10 - 20	200 - 500 l/min	Dense granular
High Water Pressure	30	1.2 - 3.0	250 - 500	20 - 60 l/min	V. Dense granular

6.2 PRE-DRILLING

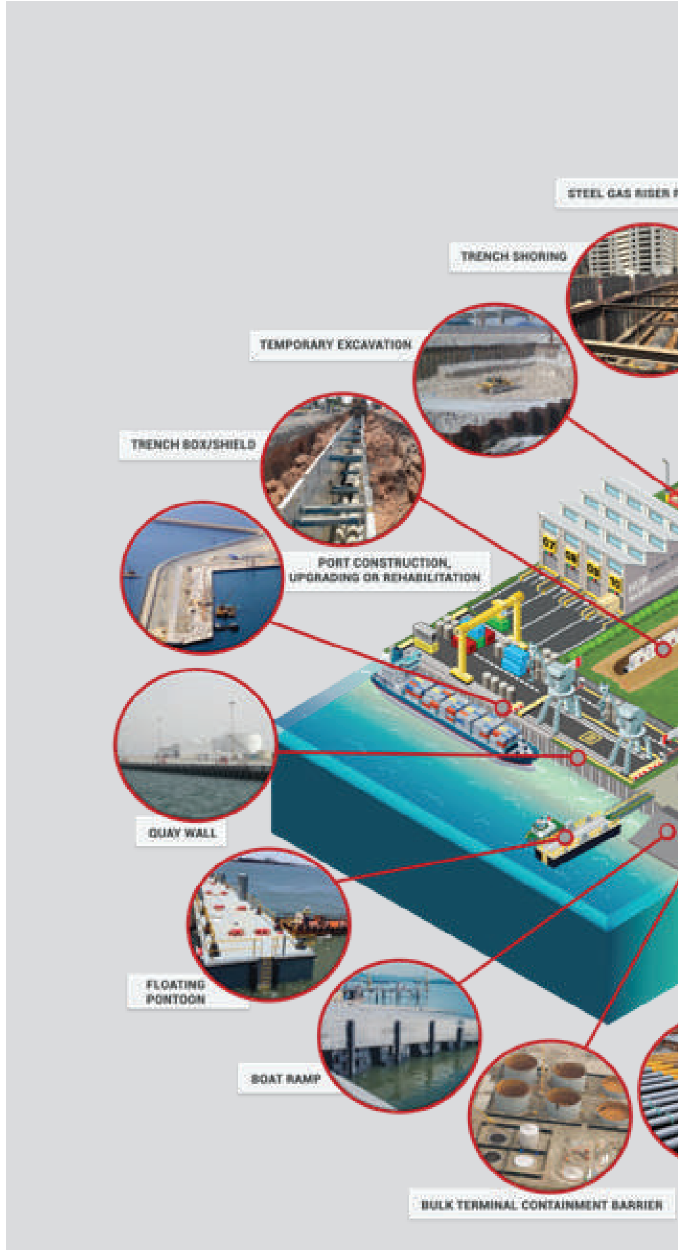
The ESC pile ranges vary significantly and can include a large clutching system, which offers advantages in certain areas but has the effect of increasing driving resistance. Toe resistance of the sheet pile can be reduced by the provision of pre-drilled holes in the ground, which coincide with the positions of the clutches. The pre-drilled holes are ideally 100 – 150mm diameter and are drilled deep enough to accommodate the entire embedded pile.

In certain circumstances, this technique is not feasible, such as;

- There may be a layer of loose or soft material overlying the hard material that needs to be drilled. Pre-drilled holes would be unable to stay open in the soft material and would collapse.
- The piles may be installed in a body of water, with the hard material that requires drilling below the sea / lake / river bed.

Using this method, very hard soils, including soils with hard rock layers, may be penetrated with a degree of confidence. The method is particularly effective for installing sheet piles into marine conditions where there may be little or no soil covering the bed rock and it is necessary for the piles to penetrate sufficiently to obtain a toe support.

ESC EXPERTISE & FIELD OF APPL



6.3 BLASTING

This process is reserved for soil conditions that are impossible to penetrate using any of the methods covered above. Two techniques are used;

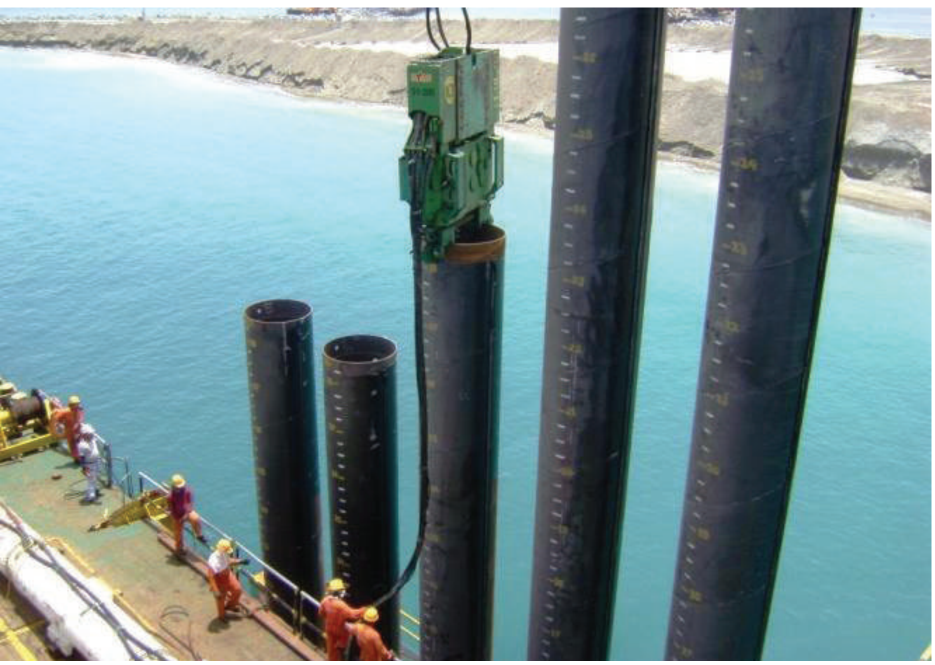
Normal Blasting
Explosives are lowered into drilled holes and covered with soil before detonation. This creates a V-Shaped trench along the proposed line of the wall. Driving conditions in the loosened area are still very difficult and toe reinforcement of the piles is recommended.

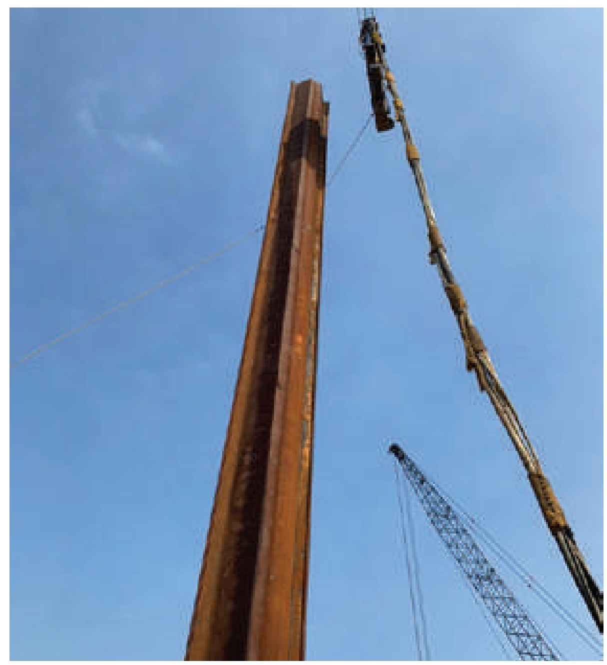
Shock Blasting
Low powered explosives are used to reduce the solid rock to a very fine granular material without displacing it, rather than blasting a cavity in the rock. The width of granulated rock zone is only slightly wider than the sheet pile wall and to the exact depth of the required pile penetration. The rock immediately adjacent to this zone remains totally intact. The sheet piles should be driven into this granulated zone as soon as possible after blasting to obtain maximum benefit from the process. The act of driving the sheet piles into this zone compacts the soil ensuring adequate support for the embedded piles.

DRIVING ASSISTANCE

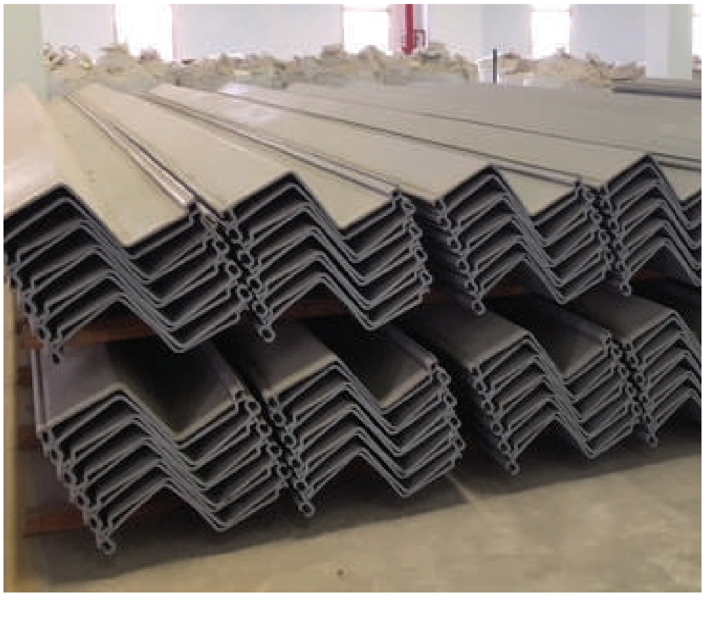
If any specialised installation techniques are to be employed to supplement driving into hard soil conditions, ESC should be notified at the time of ordering the piles. This will allow ESC time to make recommendations and suggest any modifications to the pile that may be required. For particularly hard driving, the top and toe of the sheet piles should always be reinforced, and ESC will provide this service if given notification.

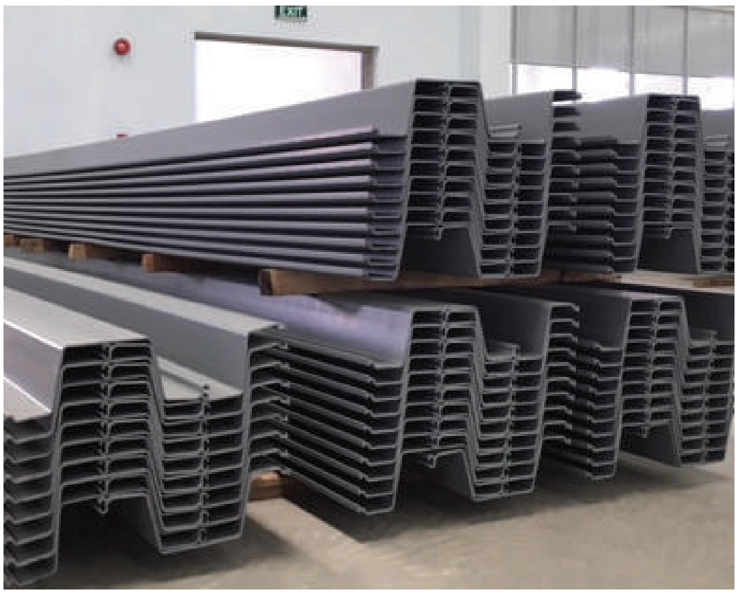
PUMP STATIONS, WATER TREATMENT AND SEWERAGE TREATMENT PLANTS • DRY CONSTRUCTION COFFERDAMS IN OPEN WALER SITUATIONS • POLLUTION AND GROUNDWATER CONTAMINATION CONTROL • DEEP DRAIN IN URBAN AREAS & LOW FLOW CHANNEL • PERMANENT LOAD BEARING BRIDGE ABUTMENTS • RIVERS, CANALS AND STORM WATER DRAINS • BASEMENT & BELOW GROUND CONSTRUCTIONS • COFFERDAMS FOR BRIDGE FOUNDATIONS • EROSION CONTROL WORKS & SILT TRAP • WHARVES, DOCKS, PIER AND JETTIES • OPEN CAST TUNNELS & PIPELINES • BRIDGE & CULVERT UPGRADING • GROUND WATER CUT-OFF WALLS • SLOPE STABILISATION WORKS • FLOOD CONTROL SYSTEMS • GROUND RECLAMATION • TRENCHING WORKS • WEIRS AND DAMS • RETAINING WALLS





“WE TAKE THE PRESSURE, SO YOU DON’T HAVE TO”




EXIT

10 VINYL SHEET PILE PRODUCTS

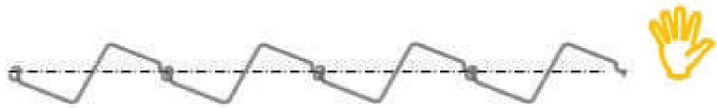
ESC Vinyl Sheet Piles also known as PVC Sheet Piles are a modern alternative for your project. They offer a lower cost than steel, wood or concrete alternatives. The ESC Vinyl Sheet Pile is a strong, light-weight, UV and impact resistant product. The product is inert does not rust, corrode or crack. The ESC Vinyl Sheet Pile retains its structural integrity for decades.

ESC recommends that the installation of its vinyl sheet piles to be completed in compliance with the engineer's plan, drawings and project documentation. This guide is intended to be a general guide to the main aspects of vinyl sheet piling installation. The selection of the best profile by ESC should be completed by a competent structural engineer or designer familiar with both the piling materials, site conditions and project requirements. While there are a lot of parallels to be drawn with the installation of steel sheet piles, the installer should also be aware of the subtle differences involved.

10

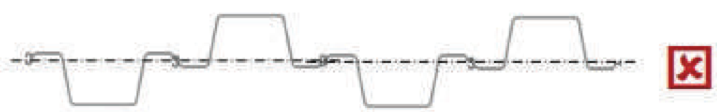
11.1 SHEET PILE ORIENTATION

This is the correct orientation, for Z piles the piles should be driven with the female interlock leading. A driving guide should be used to ensure the Z remains straight especially if they are driven in singles.

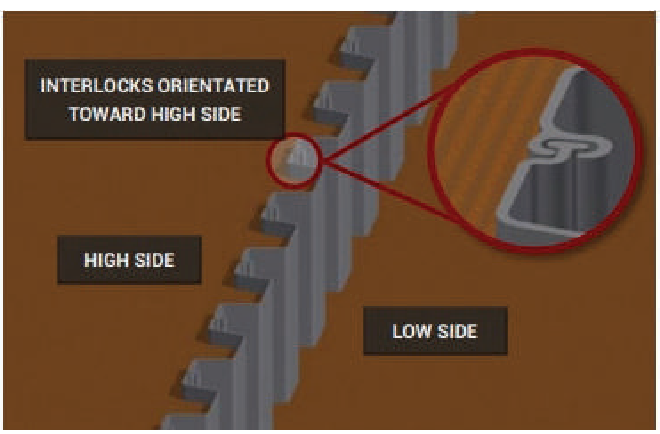


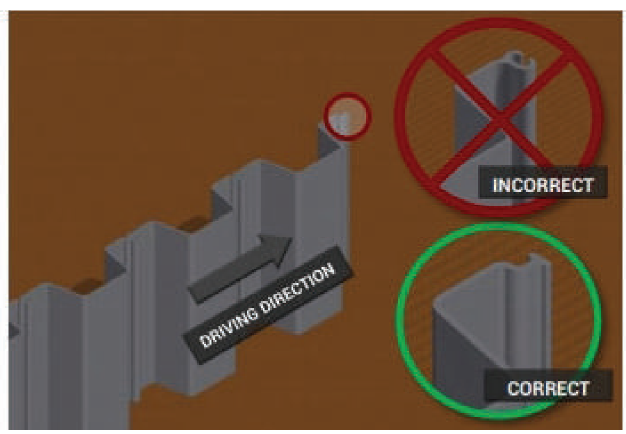
Unless incorporated in the engineers' design, the 'Jagged' Z Pile orientation should not be used. This provides up to 20% wider unit width on the sheet pile and a shallower depth of wall, but the bending capacity decreases drastically.

This is the correct orientation, for Z piles the piles should be driven with the female interlock leading. A driving guide should be used to ensure the Z remains straight especially if they are driven in singles.



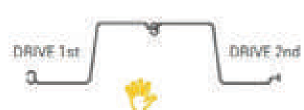
While this configuration theoretically increases the combined bending strength of the wall, this is not recommended as the flanges of the sheet pile do not align hence there may be localised bending of the interlock.





11.2 DRIVING IN SINGLES OR PAIRS

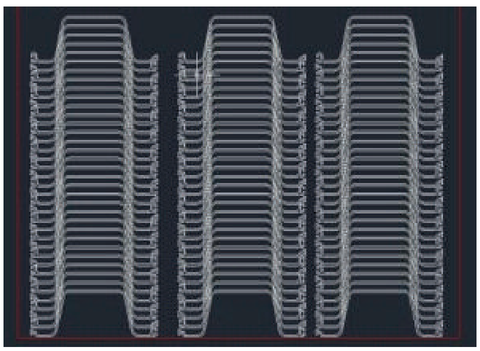
It is generally recommended that Omega Type Piles are driven in singles, whilst Z type piles are driven in pairs. Pairs are preferable from an alignment perspective and are less confusing but they can also be driven in singles to increase the applied driving load capacity per pile.



11.3 LOADING & UNLOADING

Vinyl sheet piles should be properly handled to avoid unnecessary damage prior to and during installation. Sheet piles can be effectively stacked to minimize storage and logistical volume thus saving handling costs whilst keeping the piles orderly.

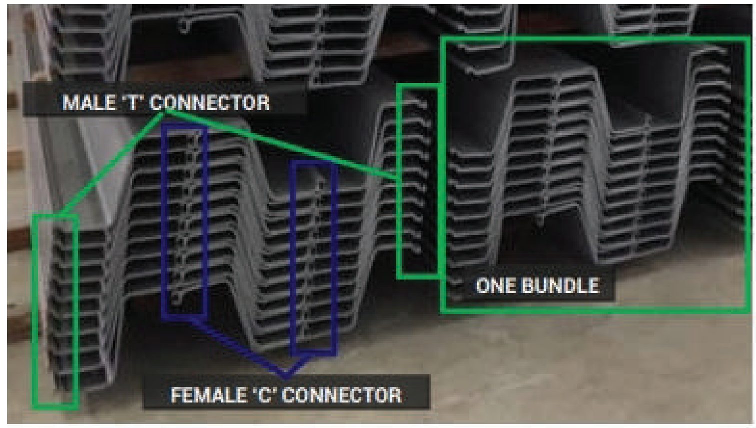
For ESC-VU25 & ESC-VU40 Omega Piles as shown on the left, the most effective stacking configuration is shown, where 2 columns of sheet piles are stacked together. The Female 'C' Connectors are kept on the inside and the Male 'T' Connectors are orientated to the outside. For other Omega Piles, the stacking should be as shown below:

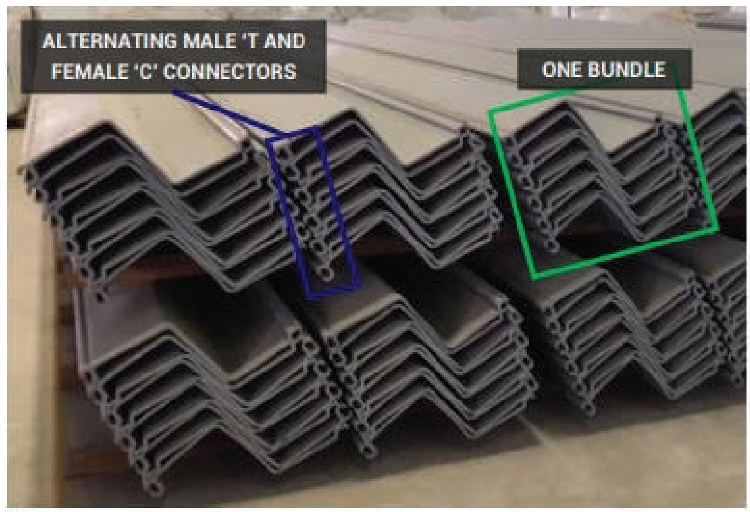


For Z shape sheet piles, the piles are typically stacked diagonally, with alternating connectors. This also makes driving more straightforward as the piles are progressively picked up from one side and are in the correct orientation.

Wooden supports are recommended evenly spaced out in 1-2 metre intervals to prevent unnecessary sagging and potential deformation during storage. This is especially important for the thinner section piles.

Soft webbing slings should also be used over chain slings to prevent pile damage during lifting and handling. Where possible a minimum of two webbing slings should be used to safely lift a bundle of vinyl sheet piles. Unnecessary exposure to sunlight for long periods of time during storage should also be avoided where possible. While ESC's vinyl sheet piles contain additives to increase UV resistance, it is still recommended to minimise UV exposure when possible during storage.





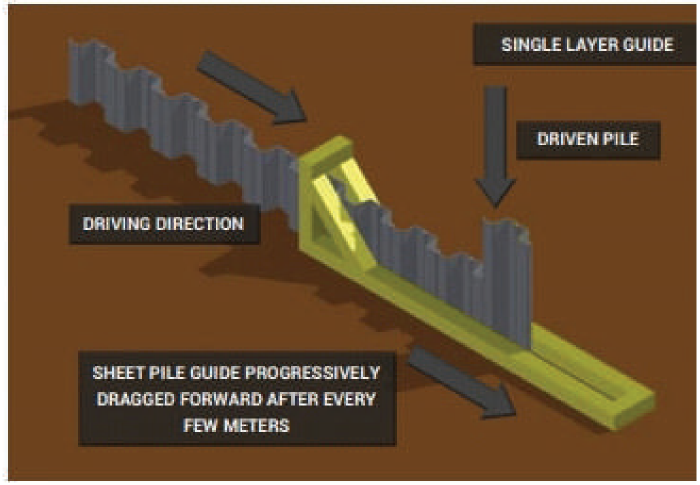
SHEET PILE INSTALLATION PROCEDURES

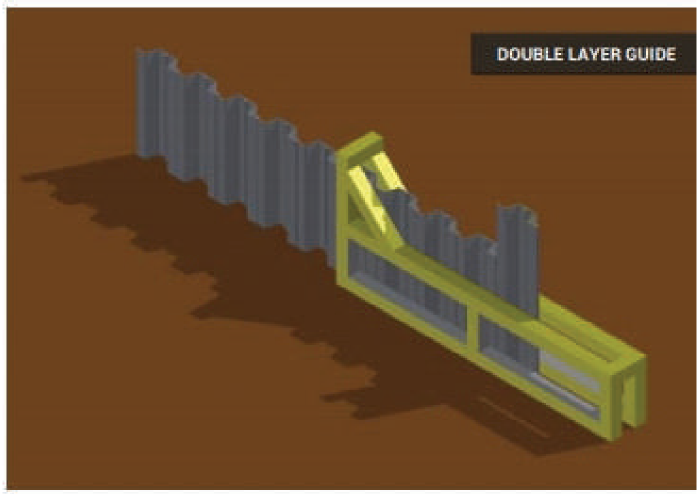
11.4 DRIVING GUIDES

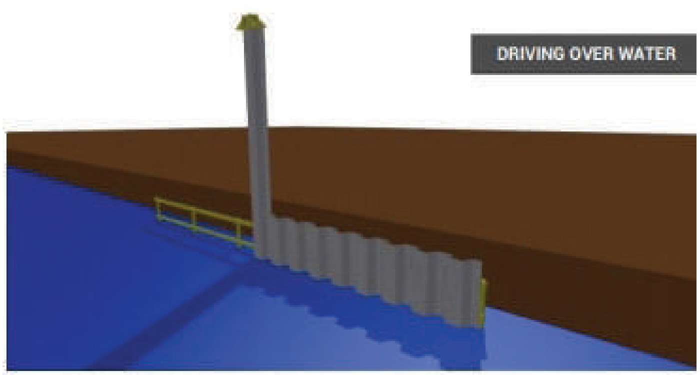
ESC recommends driving guides in general as they improve the appearance of the driven line of sheet piles. Typically the driving guides are constructed of either steel sections (channels or beams) welded together with a spacing slightly wider than the depth of the sheet pile profile being driven. Driving guides should typically be able to align with at least 8 pairs of Z piles or 8 U piles for maximum efficiency whilst using the previously driven piles to help maintain alignment. Shown on the right are typical driving guides which may be dragged progressively along. A single layer driving guide is generally recommended for piles with less than 1 meter of exposed length and double layer for greater than 1 meter exposed height. The driving guide can further be reinforced from movement by driving small steel beams to stop it shifting laterally. Spirit level should also be checked on the guide to ensure it is sufficiently flat. Wood or steel chocks can be used to adjust levelling as well, but these may sink if the ground is too soft or the chocks are too small.

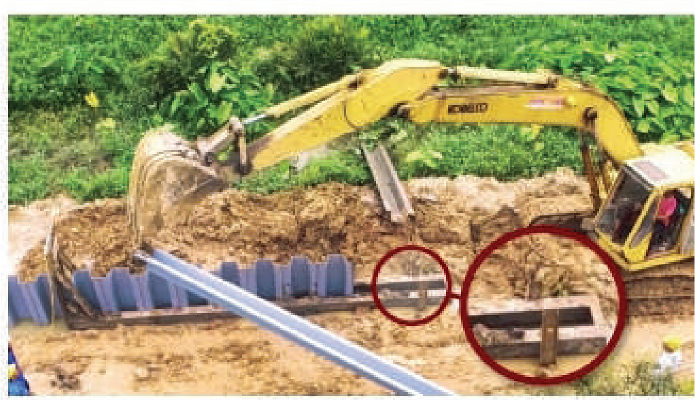
When constructing over water, vertical steel or wood beams can be driven on the land side of the sheet pile wall with horizontal beams spot welded or wooden planks nailed onto the vertical members. For optimal straightness over water, this can also be repeated over the water side, but the installer must be careful not to have enough of a gap for the sheet piles to be driven through. The vertical guide beams should also be checked for verticality in both planes prior to installing the horizontal members.

A similar driving guide for marine installation to the land based guides, but must be properly pitched to ensure verticality.









11.5 INSTALLATION METHOD

EXCAVATOR COMPRESSION

In some cases of soft soil, utilising just the backhoe of an excavator pressing and hammering against the vinyl sheet pile is sufficient to drive it to design depth. A steel pile head is typically used to protect the pile top and also distribute the excavator pressing load.

EXCAVATOR MOUNTED VIBROHAMMER

Suitable vibrohammers for the installation of vinyl sheet piles are typically in the small to medium range. Excavator mounted vibrohammers are an excellent option because of their versatility and the fact that generally the excavator is utilised in other activities prior to and/or after the sheet pile installation such as excavation or soil compaction. The operator has to be mindful of verticality during driving, since unlike the crane, the vibrohammer has to follow the hinge trajectory of the excavator. For tougher soil conditions a mandrel can be used in conjunction with this system—see “Mandrels” section of this installation guide.

CRANE MOUNTED VIBROHAMMER

Crane mounted vibrohammer is advantageous over excavator mounted vibrohammer installation as it can effectively handle much longer pile lengths. Also the vibrohammer can effectively rest its weight and force directly on top of the clamped sheet pile which results in better verticality. However, the cost for driving is typically higher than the excavator options due to the extra mobilisation cost of a crane.

DROP HAMMER

A drop hammer is a mechanically simple driving method for driving vinyl sheet piles by lifting and releasing a falling drop hammer weight at low frequency.

WATER JETTING

Water jetting may be used in conjunction with other installation methods where the soil is very compacted or cohesive. A high pressure jet of water (or sometimes air) is expelled from the base of the sheet pile loosening the soil as the sheet pile is driven through.

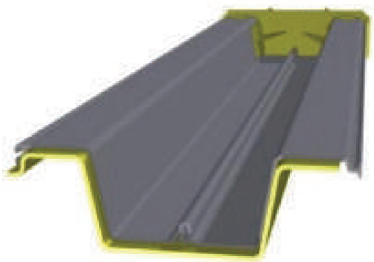
MANUAL INSTALLATION

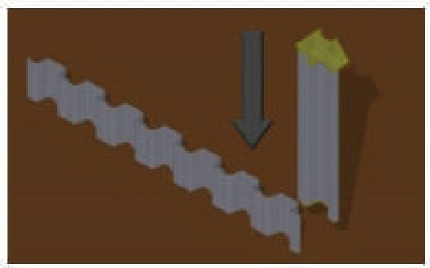
For extremely soft soils and low driving depths, simple manual tooling can be used to pitch and hammer down the sheet piles with just a few labourers.

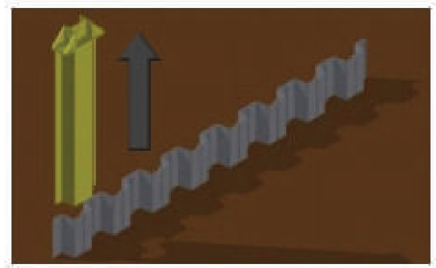
11.6 INSTALLATION MANDRELS

SLEEVE MANDREL

Description	A steel sleeve welded to a steel pile head that fits over the Z pile pair or single Omega pile. The sheet pile is typically horizontally slid onto the sleeve and clamped on by screw. Then it is lifted over and driven down. Once the design depth is reached or further penetration is refused, the steel mandrel is withdrawn leaving the vinyl sheet pile in place.
Equipment Required	Vibrohammer (excavator or crane mounted), Crane or Excavator.
Suitable for	Slightly more difficult soil conditions where driving the vinyl sheet pile directly is not possible. Also suitable for longer sheet piles with thinner profiles.
Advantages	Can penetrate more difficult soils without potentially damaging the vinyl sheet pile
Disadvantages	During withdrawal, vinyl sheet pile can potentially pull up with steel mandrel

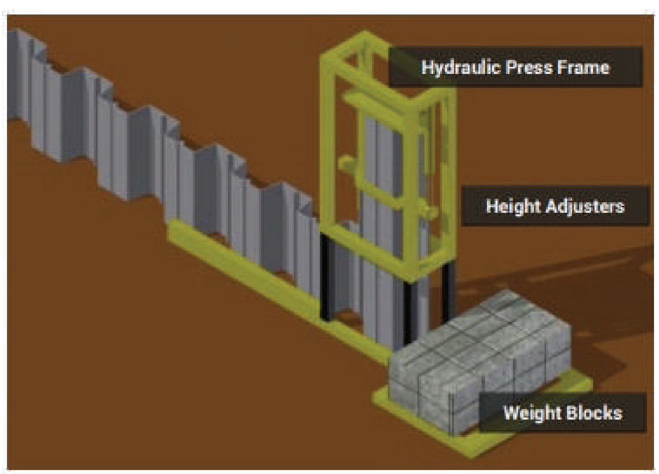






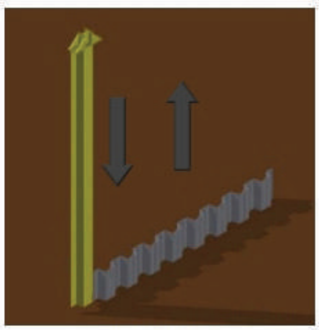
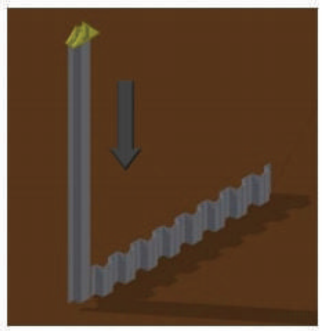
HYDRAULIC PRESS FRAME

Description	The frame consists of a hydraulic cylinder which can be connected to a pile head sleeve. The cylinder has a stroke of typically 1 metre or less, so the frame must be progressively lowered in stages as the pile is pressed down. The height adjuster is used to lower the hydraulic press frame. A counterweight is also used to prop the frame down to react against the downward pressing force.
Equipment Required	Crane, Hydraulic Press Frame, Counterweights & Hydraulic Powerpack
Suitable for	Shorter pile lengths and where an excavator and/or vibrohammer is not freely available or economical.
Advantages	Fast for shorter piles and only requires a crane to move the frame and sheet piles.
Disadvantages	Limited stroke per cylinder means that for each pile, the cylinder is retracted and the frame is lowered multiple times, which can slow down the installation process especially for longer piles.



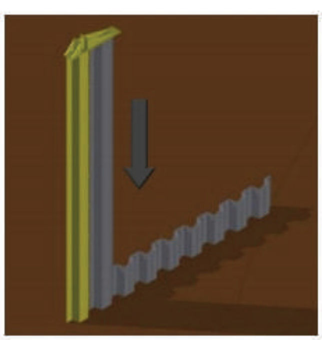
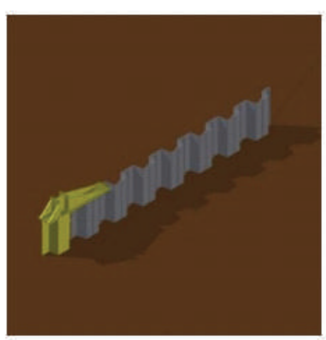
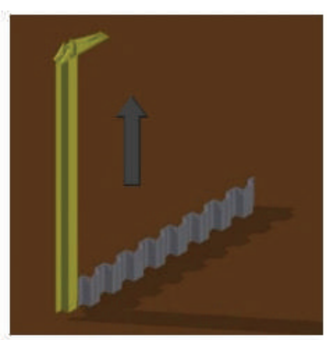
CUTTING MANDREL

Description	The steel mandrel which follows the profile of the sheet pile is used to cut and loosen the soil. Following withdrawal of the steel mandrel, the vinyl sheet pile is driven in its place. This steel mandrel can be a simple bent sheet metal following the profile of the steel mandrel. This sheet can directly be clamped onto the vibrohammer.
Equipment Required	Vibrohammer (excavator or crane mounted)
Suitable for	Cohesive soils and if the installer wants a simple to fabricate mandrel.
Advantages	Can penetrate more difficult soils without potentially damaging the vinyl sheet pile. Also it is a simply fabricated steel sheet.
Disadvantages	Potentially slower that sleeve mandrel because the mandrel is withdrawn and changed out with the sheet pile


SIDE MANDREL

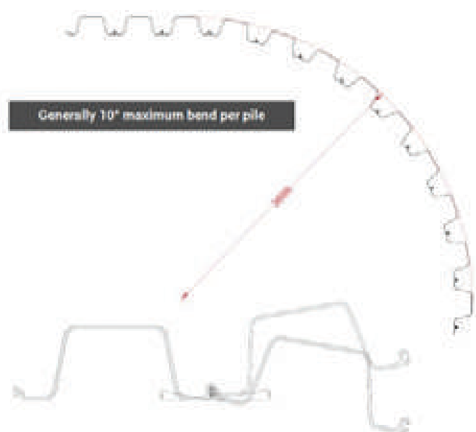
Description	Mandrel consists of a leading steel mandrel the same length as the sheet pile with a sleeve template for a preceding vinyl sheet pile. When the mandrel is driven to depth, a cut for the next sheet pile is made in the soil, whilst the adjacent sheet pile is driven. Upon extraction of the mandrel, the vinyl sheet pile remains in place.
Equipment Required	Vibrohammer (excavator or crane mounted)
Suitable for	Large installations that justify the cost of this type of mandrel. Also typically the fasted installation mandrel because of its dual purpose (cuts and drives at the same time).
Advantages	Efficient as the leading steel mandrel cuts the soil for the next pile whilst driving the vinyl sheet pile in the previously cut soil area.
Disadvantages	Driving direction has to follow mandrel. Sometimes the vinyl sheet pile may pull up as the mandrel is being withdrawn.

VINYL SHEET PILING ACCESSORIES

12.1 CORNERS & BENDS

Corners and bends in the driving line of ESC vinyl sheet piles can easily be accommodated via the use of special corner pieces or connectors or just varying the angle gradually between each standard pile. If a gradual bend is used, typically the minimum bend radius is 6x the pile width (so for example the ESC-VU610-9.0 has a bend radius of approximately 3.6m). It is highly recommended to consult with ESC for the recommended corner configuration.



12.2 SUPPLY OF INSTALLATION GUIDES & EQUIPMENT

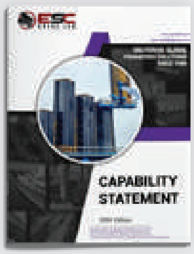
ESC is a professional supplier of the following generic and specially designed systems for effective vinyl sheet pile installations:

- Installation Mandrels - side, cutting, sleeve
- Hydraulic Press Frame Sets
- Driving Guides
- Pile Heads
- Bumper Fenders
- Geotextiles

PROJECT PHOTOS 13

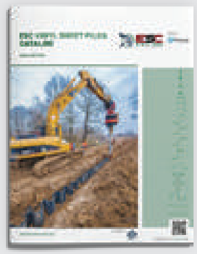
ESC Product Catalogs

You may download all our product catalogs on this https://www.escsteel.com/construction-product-catalogs or request via email: info@escsteel.com. If you are viewing online, you may click on the image below to download.



ESC Capability Statement


Marine & Foundation Piling Catalog


Vinyl Sheet Pile Catalog

Vinyl Sheet Pile Installation Guide

Trench Shoring Catalog

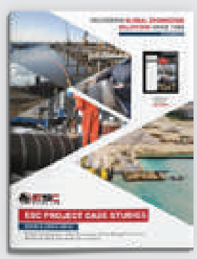

Steel Structures Brochure


Marine Mooring Bollards Catalog

Port & Offshore Structures Capability Statement

Marine Fender Catalog

Project Case Study - Book I



Project Case Study - Book II

Project Case Study - Book III

Combination Walls Project Case Study


Steel Pipes Projects Case Study

ESC CAPABILITY STATEMENT

MARINE & FOUNDATION PILING CATALOG

VINYL SHEET PILE CATALOG

VINYL SHEET PILE INSTALLATION GUIDE

VINYL SHEET PILE INSTALLATION GUIDE

STEEL STRUCTURES CAPABILITIES

MOORING BOLLARDS CATALOG

MARINE FENDERS CATALOG

PORTS & OFFSHORE STRUCTURES

ESC PROJECT CASE STUDIES

COMBINATION WALL PROJECTS

STEEL PIPE PILING PROJECTS

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