ENGINEERING CONSIDERATIONS

Sheet Piling Installation Options for Deep Toe Penetration

Installing any sheet piling material (steel, PVC, FRP or otherwise) to significant depths is a challenging task. Successful results require a skilled and experienced installation team as well as specific equipment suited for achieving the desired engineered depth of penetration. Knowledge of the characteristics of the sheet piling is not enough to ensure good results. Only after a thorough evaluation of the soil conditions at a site can the driving results have a chance of being accurately predicted. Over the past 25 years, many engineers have chosen to specify synthetic sheet piling (PVC, FRP) in various applications due to the inherent advantages of corrosion resistance, low carbon footprint and cost as compared to steel. Engineers have chosen to use synthetic sheets in place of slurry walls for the same reasons. Synthetic sheets also provide superior permeability performance and a higher degree of quality control. Moreover, while slurry walls are relatively brittle and do not perform well over time when exposed to load fluctuations and ground movements, the ductile nature of PVC sheets allow them to absorb earth pressures well. As a general rule synthetic sheets are installed with the same pile driving equipment that drives conventional sheet piling. However, given the material differences between synthetic and steel sheet piling and the wide variety of site conditions that can be encountered, when specifying synthetic sheet piling it is important to note that the following options are available:

Steel Sheet Piling	Using steel sheet piling with the necessary thickness and rigidness for conventional pile driving methods.
Advantage	Ability to withstand the heaviest impact hammers
Disadvantage	Sheet piling thickness must account for long-term corrosion of steel, high cost, very large carbon footprint
Steel Spuds	Steel spuds and similar devices can be driven along the installation line prior to and as a separate “driving episode” from driving the sheet piling
Advantage	driving the spud may potentially break up obstructions impeding the progress to the required penetration.
Disadvantage	increased installation time and logistics, monitoring spud type and size, possibility of creating excessive or unknown soil voids.
Water Jetting	Water Jetting is the direct injection of water, commonly at high pressure and volume, at the toe of the sheet piling with the purpose of displacing and saturating soil to encourage penetration of the sheet piling.
Advantage	saturated soils tend to substantially increase the effectiveness of both impact and vibratory installation equipment.
Disadvantage	saturating the soils in levees and other seepage barriers is generally discouraged, water volume and pressure is hard to monitor and/or regulate at jobsite.
Augering	Augering or drilling is a method that usually involves a helical screw blade which is driven into the ground and displaces soil in the area where it is being driven.
Advantage	the ability to loosen soil, can minimize the likelihood of obstructions.
Disadvantage	increased installation time and logistics, challenge of regulating the size of the auger, excessive displacement and alteration of soil conditions.
Trench and Fill	completely excavating the soil in order to “drop” sheets in the trench.
Advantage	diminishes need for any driving of the sheets.
Disadvantage	excessive disturbance of in situ soils, loss of compaction, voids, challenging to keep trench open in non-cohesive soils, lack of quality control at the jobsite.
PileClaw™	PileClaw™ is steel mandrel installation technology incorporating patented features to increase the likelihood of driving synthetic sheet piling to desired depths.
Advantage	track record of successful installations, specifically engineered and fabricated to match the characteristics of the sheet piling, designed to minimize excessive soil disturbance and optimize drivability, water gallery provides lubrication while regulating volume and pressure, no direct injection of water at the toe of the sheet, design features assist in the protection of the interlocks.
Disadvantage	new technology requires a “learning curve” for many installers, can be effectively used with a wide variety of cranes and crane mounted vibratory hammers, but for some site conditions encountered the most favorable equipment will be less common piling rigs similar to ABI mobileram units which utilize a hammer mounted to a vertical mast.

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When Specifying Steel Mandrel Installation Equipment

As noted, there are multiple options available for sheet piling installation (synthetic or otherwise). However, if specifying synthetic sheet piling and if selecting the steel mandrel installation option, then PileClaw™ will be the equipment utilized. PileClaw™ is proprietary, patent protected steel mandrel technology designed and fabricated to match specific synthetic sheet piling characteristics including thickness, depth, interlock size and web geometry. *No sheet piling driving equipment can ensure the successful installation of sheets to desired depths.* However, when used in accordance with the PileClaw™ User Guide, generally accepted pile driving practices and by qualified contractors, it offers multiple advantages in driving synthetic sheet piling.

Sample Specification:

Steel mandrel installation equipment shall be PileClaw™ as manufactured by CMI. PileClaw™ should be used in accordance with the PileClaw™ User Guide.

PileClaw™ Incorporates the Following Patented Technology:

- PileClaw™ driving guide designed increase speed, accuracy and overall productivity of driving operations.
- PileClaw™ lifting bridle promotes effiecient proper placement of the sheet piling on the steel mandrel.
- PileClaw™ holster, flippers and side clamps work in conjunction to keep the sheet piling in a stable position.
- PileClaw™ water gallery is an alternative to water jetting and does not directly inject water at the toe of the sheet. It optimizes the use of water to lubricate the sheets during insertion and facilitates the extraction of the steel mandrel after reaching desired toe penetration. It also helps activate hydrophilic sealants and relax soils to promote closure of voids.
- PileClaw™ male plow is designed to offer protection to the lead male lock during driving episodes.
- PileClaw™ re-driver assists the driven piles to remain in position during the extraction of the steel mandrel.
- PileClaw™ driving head is specially fabricated to maximize stiffness of the steel mandrel for optimum drivability and is compatible with most conventional vibratory hammer jaws.

The equipment used in conjunction with PileClaw™ is typically the same equipment that is used to drive steel sheet piling. A free hanging crane mounted vibratory hammer is the most common operation. Even more effective are piling rigs (see ABI Mobilram or Liebherr models) which utilize a vertical mast fixed to a track mounted carrier. These units can use a combination of pressing and vibration for driving and are capable of manipulating and controlling the sheet piling to a higher degree than is typically possible with a crane. These units are also capable of utilizing high-frequency hammers which tend to minimize damage to surrounding soils and structures. The use of PileClaw™ with excavator mounted vibratory hammers are limited to projects using relatively short sheet piles due to the maximum height extension of the excavator arm as well as the difficultly of maintaining vertical alignment of the piles.