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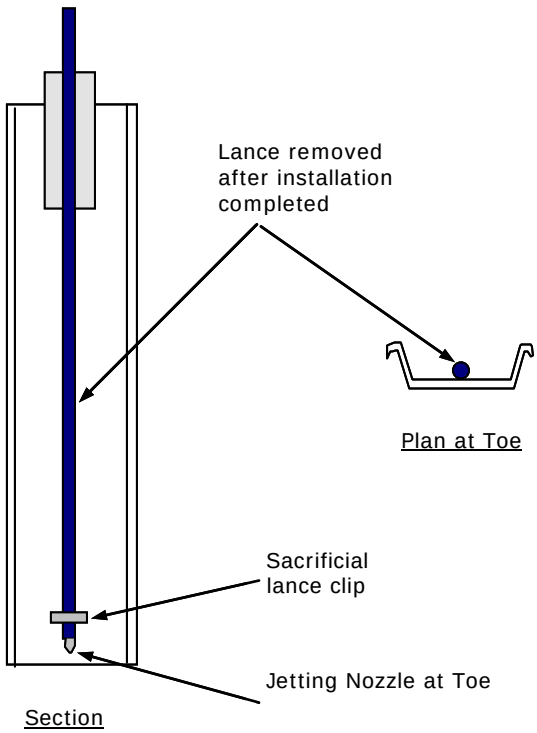
Tosa Still Worker WP150
Water Jetting

Water jetting is primarily used to enable piles to be pressed into ground conditions that otherwise would be unsuitable for the Tosa Still Worker Silent and Vibrationless Pile Press. This could be due to either density (cohesive or granular soils) or stiffness (cohesive soils).

In order to significantly improve the installation of sheet piles into the above difficult ground conditions water jetting can be utilised. Water jetting also optimises the sheet pile section required.

Water jetting is effected by means of either a high strength steel jetting pipe (lance) attached to the in pan of the sheet pile. The lance system is shown below.

Jetting Lance in the In Pan of a Sheet Pile



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The jet is operated at low pressures in the initial stages of the installation to prevent excessive washout of soil particles. As the installation progresses, the jet is operated continuously throughout the installation to maintain a clear jet nozzle. The water pressure is adjusted in response to the ground resistance to enable the optimum penetration of the pile to be achieved with a minimum disturbance to the structure of the ground.

The Effects of Water Jetting

The possible effects of the water jetting operation on the sub soil structure may be cause of concern for Structural Engineers. To address this concern, we offer below a basic explanation of the water jetting operation on the soil.

Granular Soils

When piles of any type are installed into granular soils, most of the resistance to the pile penetration results from the creation of a pressure bulb in the soil at pile toe level.

Significant resistance can also arise from clutch friction caused by the granular particles becoming packed in the leading clutch during installation. Water jetting applied close to the toe of the pile, during installation will reduce these effects. Sealant, applied to the lead clutch, is often used with the water jetting to reduce clutch bind.

In fine and medium granular soils, the main action of the water jet is to locally increase the pore water pressure such that the inter particle friction in the soil is virtually eliminated, thus reducing the internal shear strength of the soil immediately under the pile toe.

In coarse granular soils, the main action of the water jet is to oscillate the particles reducing the resistance to pile penetration.

The water jet has further actions as the water returns to ground level. These are flushing out the leading clutch, reducing clutch friction when installing the subsequent pile and reducing skin friction on the pile being installed as some of the water returns up the face of the pile hence lubricating the pile/soil interface.

The water jetting operation does not significantly displace soil and large voids are not created. In very fine soils (for example silts) some migration of the silt particles can occur towards the ground surface as the water returns or into the voids in more coarse granular soils.

However in the predominantly silty soils of Japan, where water jetting is utilised extensively, no serious problems have been caused by loss of soil volume arising from the use of this technique.

On completion of the pile installation the water jet is turned off. The residual excess pore water pressure dissipates and the pore water pressure returns to normal almost immediately thus restoring the internal shear strength of the soil to its original condition.

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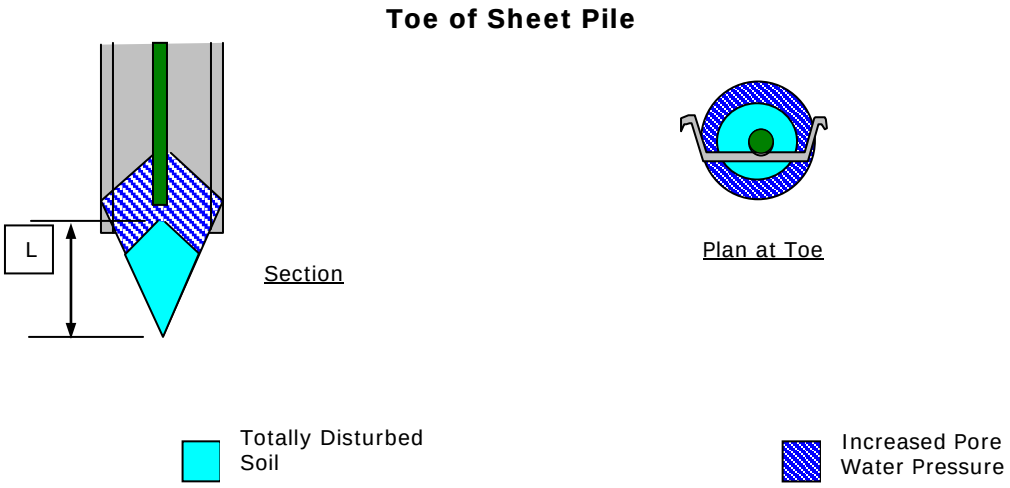
The localised nature of the water jetting effect is illustrated below.

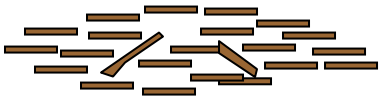


The depth of disturbance 'L' consists of a cone of very high pressure, roughly proportional to that of the jet pressure, within which, the soil structure is totally disturbed. This depth 'L' is a function of the density of the soil and the particle size distribution.

Outside of this primary cone there is an inverted cone where the pore water pressures are increased above the natural level, resulting in reduced soil strength. The volume of this cone is determined by the volume of jet flow rather than pressure and by the speed of penetration of the pile.

Cohesive Soils

When steel sheet piles are installed into cohesive soils most of the resistance to pile penetration results from shaft adhesion (skin friction) rather than end resistance. The closely fitting platelets in clay soils, as illustrated below, render the clay effectively impermeable therefore the action of the water jet cannot be to either oscillate the particles or to significantly affect the pore water pressure.



The impermeability ensures that the bulk of the water returns, to ground level or to the upper surface of the clay strata, up the shaft of the pile. The lubricating action of the returning water is clearly very efficient in reducing the amount of adhesion contributing to the pressing resistance whilst at the pile toe the water clearly has a localised softening/cutting effect which reduces the end resistance and eases the penetration of the pile.

The longer term effects of any localised softening of the clay affects the working of the sheet pile only in respect of movement and not in terms of overall stability as the full passive resistance will still be mobilised. However, the sheet pile wall will have to move slightly further than usual before the passive resistance is mobilised.

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