



Wet Speed-Mixing

WSM - Soil Mixing Procedure
in Twinmix Design



Method description

WSM-procedure

Twinmix

WSM - a fast alternative for shoring applications

What is WSM?

WSM stands for **Wet Speed-Mixing**, a fast soil mixing procedure. The WSM is an alternative to conventional shoring and foundation methods such as king pile wall, steel sheet pile walls or the Jet Grouting walls.

The ABI MOBILRAM-System gets equipped with Twinmix auger drive TMBA and suitable mixing tools. These auger drives are built without gear mechanism so that typical negative effects like noise, wear, high maintenance and relatively low revolutions are avoided.

The WSM method is often combined with conventional methods like in combined walls, where the primary piles are processed with the WSM process. The secondary piles can be installed e.g. as cast in situ concrete piles.



The advantages

- **Vibration-free** - enables working in high density areas and surrounding properties.
- **Low noise** - due to its design noise emissions are reduced to a minimum.
- **Productive** - the high revolutions provide surpassing daily performances.
- **Economically** - reduced costs due to low cement and aggregate consumption and to the not existing soil excavation.
- **Environmentally friendly** - aggregates and the soil excavation do not have to be transported to or from the building site. Contaminated soils do not have to be disposed nor treated.

The soils

Preferably in soils with equal consistence and sufficient void volume.

The typical applications

- retaining walls
- shoring
- ground consolidation/stabilisation
- cut-off walls
- soil treatment

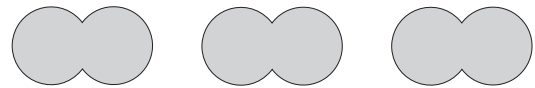


Shoring variations

The limited building area as well as the stability of an excavation often represent a problem. The sides of the excavation are normally vertical and the loads must be intercepted. The selection of the applied method is depending on whether the installation is set only temporarily or for a permanent usage.

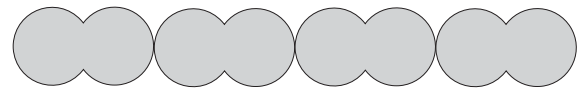
Contiguous pile wall

Contiguous pile wall is installed by positioning the pile elements next to each other, whereby the distance depends on the ground conditions. In firm cohesive soils the distance can be increased. As additional safety measure anchors between the pile gaps can be added.



The contiguous pile wall is an alternative to the secant or diaphragm wall. This type of wall can be used in different soils most often where dewatering is not necessary.

A special form of the contiguous pile wall is the tangential pile wall. In this variant the piles tangent each other, water tightness is not given.



The mixing sequence for a contiguous pile wall is depending on the distances between the pile elements. With sufficient distances the pile elements can be mixed successively. By smaller distances and tangential pile walls first the pile elements 1 – 3 – 5 – 7 etc. are installed and about two hours later the pile elements 2 – 4 – 6 – 8 etc.

Secant pile wall

The secant pile wall comprises piles, which have positive overlapping with each other. In the first step the primary pile elements are mixed in place. In the second step the secondary pile elements are mixed between the primary elements. The distance between the primary pile elements depends on the pile diameter and the desired overlapping. A typical overlapping amounts approx. 100 mm. These is already possible two or four hours after the primary pile elements were mixed. In order to reach a higher bearing capacity and bending moment, the elements can be strengthened with reinforcement such as I-beam.

The use of ABI MOBILRAM-System with automatic leader mast alignment provides a high degree on vertical control and good positioning of the piles. The system is also ideal for irregular wall patterns. The secant pile wall can also be used as cut-off wall.

The mixing sequences can vary from the mentioned data, depending on sites conditions.



Primary pile elements

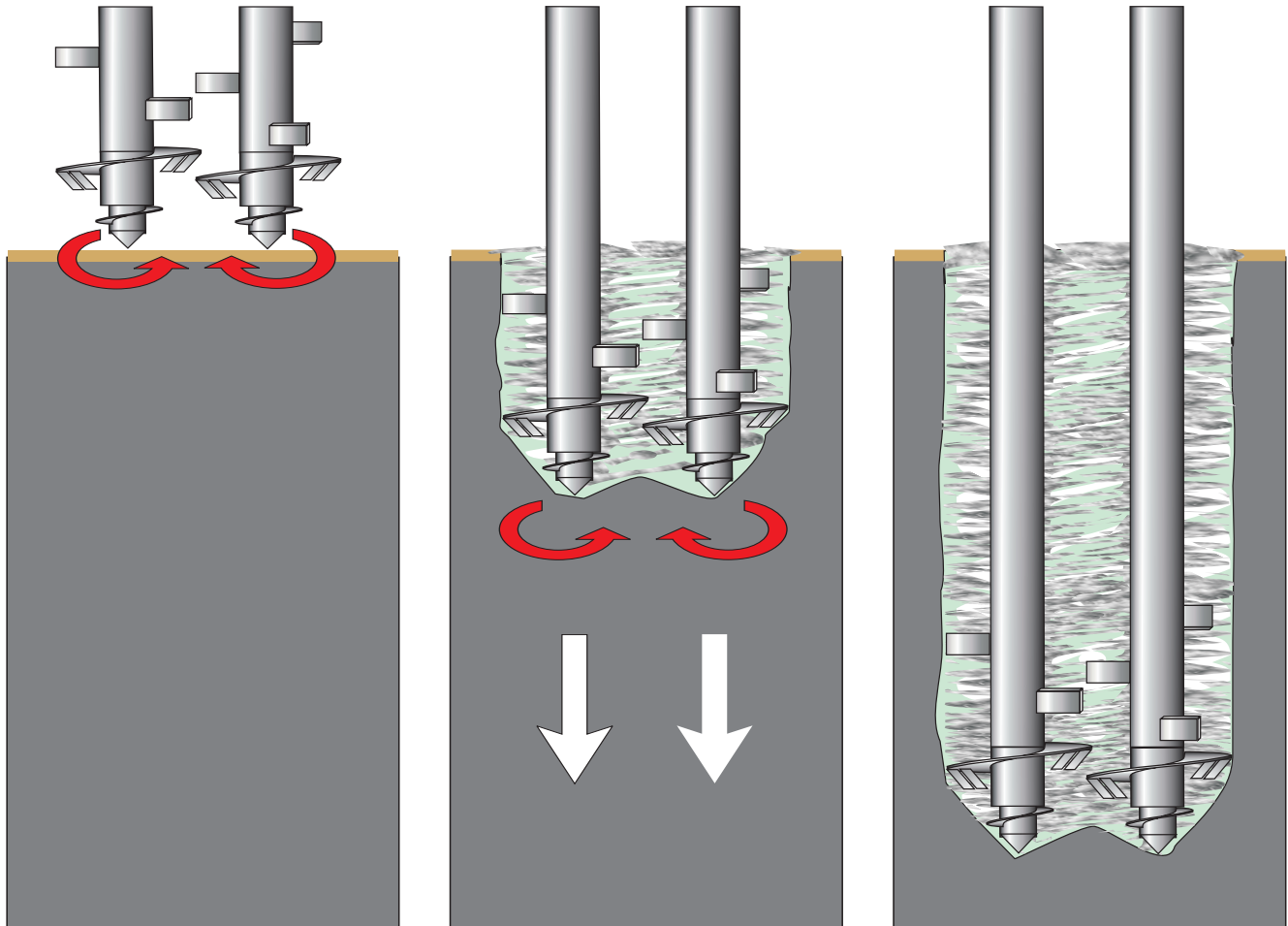


Secondary pile elements with reinforcement

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The principle

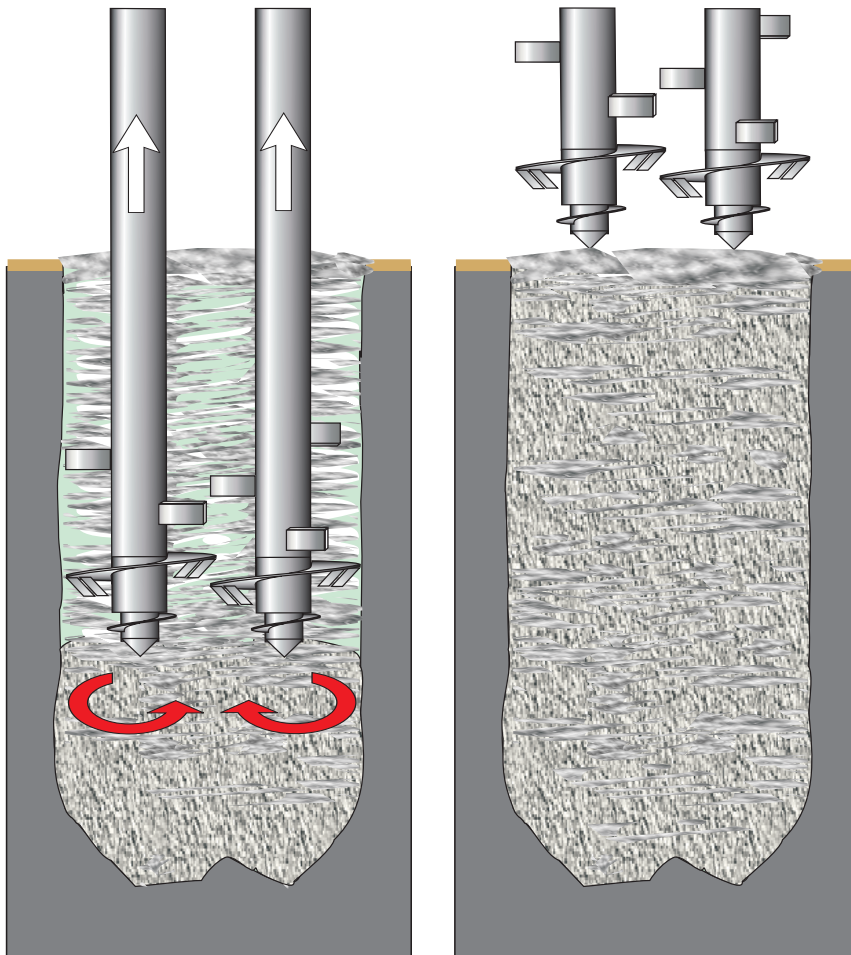


Positioning of the tooling. The mixing tools are mounted on a high revolutions TMBA auger drive while the suspension supply is hooked up. (suspension= water cement mixture in various ratios)

Lowering the mixing tool into the soil. A substantial amount of soil gets mixed with under pressure injected suspension.

Suspension is constantly pumped to the mixing tool while lowering to the required depth.





The actual tools are the two mixing heads. They are constructed to a definite diameter and designed depending on the geology. The connection with the ABI auger drive TMBA is made by extension rods. The soil at the location is mixed with suspension. An injecting pump delivers the suspension directly through a flushing swivel of the auger drive to the hollow stem of the mixing head.

Since mixing is actually achieved during lowering and withdrawing of the tooling, one speaks of a two step method. The load-bearing capacity and firmness of the pile element are determined by the amount of injected cement suspension and consistent stirring.

Depending on geology, engine power of the carrier, usable length of the mast and performance of the auger drive with the WSM procedure pile elements with a length up to 2500 mm, width up to 1300 mm and depth of max. 25 m can be installed. Single piles, secant pile walls, block patterns or any other required patterns can be carried out.

The developed mixture from soil and suspension gets mixed again during withdrawal and suspension is continuously pumped.

The completed wet mixed twin-pile, ready to cure.



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Site examples

Abstract of the ABI News 1/2004

Soil mixing in cooperation with our customer in the USA improved

ABI rigs have been used for soil mixing in the past, but a new development has occurred on the request of Condon Johnson, a contractor based in California, USA. The new requirement was to mix two columns at the same time, with drill centre lines 650 mm apart and have overlapping 100 mm mixing paddles. In addition the distance between the paddles should be adjustable to up to 1200 mm for future jobs. Drill depth on this job is 11 m.

The contractor has 3 ABI rigs in his fleet and the rig chosen was an ABI MOBILRAM TM 18/22. To get the necessary 45 RPM desired, given the horse power and hydraulic flow of the TM 18/22, two MDBA 3500 ABI rotary heads were selected, one from the contractor's fleet and one from the ABI rental fleet. A new sled was designed to fit two rotary heads, but is still able to connect with the existing ABI quick coupling system.

A major concern was to get the soil mix heads to travel straight. Traditionally a large thick wall pipe has been used, however with 2 heads and drill strings, weight would be an issue, so a thinner, lighter, but rigid dual wall pipe was used. To ensure that the 2 mixing heads do not collide below, a robust, adjustable auger guide was built and a wishbone connector attached just above the drill heads, which will travel down with the mixing heads in the soils.

The soil mix grout can be pumped up to 400 bar, so the rod couplings and flushing heads had to withstand the pressure as well. Since the mixing heads rotate in opposite directions it was decided to use hexagonal connections on the outer wall tube, so that all rods, adapter and drill heads could be swapped around or added together for future applications.

The smaller diameter, inner wall tubes have jet grout couplers, which have to seal the high pressures that are being used for this application.

The entire soil mixing process had to be electronically monitored. A display was mounted in the cab so the operator can observe the process and record the data. Flow meters and pressure transducers were mounted on the rig and connected to the monitor to record grout volume and pressure. In addition other sensors will monitor and record pile depth, mast inclination, RPM and torque of the drill head. All data recorded is stored on a removable data storage card, which is taken back to HQ and downloaded on a regular office PC and then printed on a report.



Abstract of the ABI News 1/2006

CVR buys its 4th machine for soil mixing

The company CVR nv, a medium-size special civil engineering enterprise from Beringen (Belgium), bought its fourth ABI machine. The new machine, an ABI MOBIL-RAM TM18/22 B, is particularly equipped for soil mixing procedures. Apart from soil mixing jobs it will be also used for other foundation methods like soldier beam walls, drilled piles with casing, secant pile walls, vibro piles and sheet pile walls.

CVR has continuously developed the soil mixing procedures in co-operation with ABI. The CVR C-MIX® and the CVR TWINMIX® technology is an alternative for the classical secant pile wall, which is used in Belgium since the year 1992. CVR has significantly contributed to the prevalence of this procedure and realized as a first special civil engineering company secant pile walls with small diameters. In the year 2002 CVR manufactured the first combined wall, the primary piles were mixed, the secondary piles were classical drilled piles with casing.

Due to the promising results CVR has decided to push forward the development of this procedure, to be able to mix also the secondary piles. Thus the CVR C-MIX® pile wall with the secondary piles mixed with overlapping in cured primary piles was born.

Higher performance is achieved with the CVR TWINMIX® procedure. For this version the twinmix auger drive TMBA designed by ABI is used, mixing two overlapped piles simultaneously.

CVR was awarded for the development of the CVR TWINMIX® pile wall with the innovation price 2006 of the Belgian Building Awards. During the evaluation of the procedure above all the numerous advantages of the mixed wall compared to the classical secant pile wall were in the centre of attention.

Beside the high performance the procedure offers further advantages. Through the utilization of the existing soil material no excavation occurs, which has to be removed. The on site production of the suspension saves also the concrete transports and the associated waiting times. Thereby the impact on the environment and surroundings is reduced in a high degree.

The mixing procedures as well as the in Europe patented mixing tools are meanwhile so far developed that CVR can apply the soil mixing method in nearly all soil types. Only in soils with large obstacles or in rock can not be mixed.

With the CVR C-MIX® and CVR TWINMIX® method not only excavation are build. The procedures are also very well suitable for the following applications:

- use as nearly waterproof shield
- treatment of contaminated soils
- increase of the load bearing capacity
- avoidance of soil settings





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