INSTALLATION OF PU STEEL SHEET PILES

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2. Example of a guiding block
1 SUBJECT

This method statement describes in general the installation of an ArcelorMittal PU Steel Sheet Pile Wall.

2 EQUIPMENT AND MATERIAL

2.1 EQUIPMENT

The following equipment may be used:

- Driving Guide (robust, rigid and stable, horizontal two-level guiding frame (see Detail 3.1 and 3.2 and Picture 1))
- Driving Equipment (Vibrohammer, hydraulic, free-fall, diesel or steam hammer, driving cap, driving plate and clamp)
- Handling Shackle (See Drawing 2)
- Crane (Required characteristics: weight of template, min. height = max. pile length + height of template + hook length)
- Supports for the driving guide
3 Execution

For the installation of the PU sheet piles see the following steps:

- Positioning the 2-level horizontal guiding frame (see pictures in annexes).
- Ensuring correct alignment and horizontal stable position
- Driving PU piles if possible by vibratory hammer
- Checking pile verticality during pile penetration process
- If required drive PU piles by using Impact driving to final PDO (Pile Driving Objective)
- Check pile driving tolerances during installation (Tolerance indications in Chapter 4)
- Removing driving guide if piles found in correct, vertical position and rechecking pile driving tolerances
- Report pile-driving protocol for later evaluation

3.1 POSITIONING THE HORIZONTAL TWO-LEVEL GUIDING FRAME

3.1.1 Site Preparation

The site shall be prepared in such a way that operations can be carried out safely and efficiently.

3.1.2 Guiding frame installation

Ensuring correct alignment and horizontal stable position, when positioning the supports for the guiding frame. The supports need to be levelled and positioned correctly in both directions before the guiding frame is set up, according to the wall axis. The guiding frame should be firmly fixed and secured against any shifting. The frame, resp. the lower frame for the 2-level guiding frame, should be mounted as low as possible, preferable on the ground. The guide length should cover at least 6 pile pairs, the existing wall (previously driven) being covered along some 1.5 m additional to the 6 pairs.

When driving PU sheet piles in water, the frame, resp. the lower tier of the 2-level guiding frame can be applied above or below water for temporary bearing of piles.
3.2 Driving PU Piles by Vibratory Hammer

The PU piles, in general driven by vibratory hammer, can be installed following three methods “Pitch and Drive”, “Panel driving” or “Staggered driving”, described in the European Installation of Steel Sheet Piles Handbook (see Chapter 11.2.1 to 11.2.3). Double clamps are used for the driving of AZ sheet piles. To prevent pile twist within the frame, the free flange of PU sheet pile should be secured by a guide block during driving (see Picture 2 in the annexes).

If required, the PU piles may be driven by Impact driving to final PDO.

3.2.1 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 can only be practised for loose soils and short piles. The free leading interlock is constantly in danger of deviation. For dense sand and stiff cohesive soils or in the case of possible obstructions, panel driving is recommended.
3.2.2 Panel Driving

Sheet piles should be installed using the panel-driving technique in order to ensure that good verticality and alignment is achieved and to minimise the risk of driving difficulties or de-clutching problems. This technique also enables greater control to be maintained on the nominal wall length.

If a whole panel of piles has been pitched there is no need to drive all piles to full piles to maintain piling operations; if obstructions are encountered, individual piles can be left without fear of disruption to the overall efficiency.

**Detail 3.4: 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 thru' bolting to last driven pair.
7. 1st panel driven to final level in stages. Last pair of 2nd panel plumbed & driven accurately.
8. 1st panel completed
   2nd panel part driven
   3rd panel pitched
   Last pair of 2nd panel become 1st pair of 3rd panel.

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

![Diagram of Staggered Driving](image)

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

*Detail 3.5: Staggered Driving*
3.3 **CHECKING PILE VERTICALITY DURING PILE PENETRATION PROCESS AND CHECKING PILE DRIVING TOLERANCES INSIDE TEMPLATE POSITION**

The verticality in both directions is to be checked before, while and after driving the AZ sheet piles. If the verticality is correct, the guiding frame can be removed. If not, the unsuitable driven pile should be removed and re-driven again within the defined tolerances.

3.4 **REMOVING GUIDING FRAME IF PILES FOUND IN CORRECT POSITION AND VERTICAL AND RECHECKING PILE DRIVING TOLERANCES**

After removing the guiding frame, the pile driving tolerances (verticality, position and distance) of every pile are to be rechecked. If the tolerances of every pile have been approved, the driving can continue in the given direction.

3.5 **GENERAL REMARKS**

- Starting point of driving should be fixed. For installation on water, a fix-point on the land-side is required.
- After the first driving sequence has been achieved, the driving direction according to the driving drawing should in any case be respected.
- It is advisable to choose a vibrator with sufficient power reserve. This helps guard against the danger of interlock damage through overheating and early refusal.
- Impact hammers should also be sufficiently powerful so as to avoid, for example, local deformation of the piles. Hammers with variable impact energy are preferable.
- Pile heads can be protected for damage by impact driving by using a driving cap.
- It should be verified, either by tests or analysis, that the selected driving method does not cause damage to adjacent buildings and installations.
- Damaged sheet piles should not be driven as they might provoke interlock declutching.
3.6 **Handling, Storage and Lifting of Steel Sheet Piles**

Handling and storage of the sheet piles on the site shall be carried out in such a way that significant damage to the straightness of the sheet piles, to the interlocks and to the coatings does not occur.

Sheet piles should be stored (see Drawings 4 and 5 for storage of coated and uncoated PU sheet piles) in such a way that they can be lifted easily in sequence of use. Drawings 6 and 7 show the procedure to lift PU sheet piles from a nested stack and using a threader. Spacers shall be inserted between the individual sheet piles in a stack, when storing precoated steel sheet piles. The PU piles should be stored and supported on wood or a similar soft material placed between the elements in order to avoid permanent distortion of the profiles. The profiles should be handled using non-metallic straps or slings to prevent damage to the coating and to the connectors fixed to these elements.

Special devices for lifting and positioning the sheet piles should be used, such as shackles (see Drawing 2 in the Annexes), welded lifting hooks and similar, in order to avoid damage to the sheet piles and in particular to the interlocks. Friction grip devices can release unexpectedly and therefore shall not be used for the handling of the sheet piles.
4 Driving Tolerances for PU steel sheet piles

Usual driving tolerances as by the European Installation of steel sheet Piles Handbook, see therefore Detail 4.1 below.

![Image]

Position and orientation of the sheet piles are indicated in the driving plan. Deviations from this theoretical layout may occur due to rolling tolerances, soil conditions and driving procedure.

General tolerances for a straight and plumb sheet pile wall should be in accordance with the following figures:

a) deviation normal to the wall line at the top of the pile . . . . . . . . . . . . . ± 50 mm

b) finished level deviation from nominal level of top of pile . . . . . . . . . . . ± 20 mm

of toe of pile . . . . . . . . . . . . . ± 120 mm

c) deviation of verticality normal to line of piles as per cent of driving depth . . . . . ± 1% for pitch and drive method ± 1% for panel drive method

d) deviation of verticality along line of piles as a per cent of driving depth . . ± 1% ± 0,5%

In some cases and for certain constructions, tighter tolerances may be specified, as in the case for king piles of combined walls, where accuracy is especially important.

*Detail 4.1: Extract of the European Handbook “Installation of Steel Sheet Piles” p.71*

5 References

- ArcelorMittal Steel Sheet Piling – General Catalogue, Edition 2009
- European Standard, EN 12063, February 1999
- Installation of Steel Sheet Piles, ArcelorMittal, Reprint 2008
Drawing 1: Detail of PU driving cap

Drawing 2: Shackle for lifting a sheet pile from a stack to vertical position (Quick release)

Drawing 3: Driving clamp for vibratory hammer

Single clamp for single or double piles:

Double clamp setup for AU double piles:
**Drawing 4: Storage of PU sheet piles**

- Single piles
- Double piles

Legend:
- a support packing

**Drawing 5: Handling of sheet piles**

Legend:
- a support packing
- b spacers
- c protectors

**Drawing 6: Lifting sheet piles**

Legend: a lifting hook

**Figure 6.1:** Lifting sheet piles without a lifting beam

**Figure 6.2:** Lifting sheet piles with a lifting beam
Drawing 7: Example of using a threader

Legend:
b assembling process

Pictures

Picture 1: Example of a guiding frame  Picture 2: Example of a guiding block