CENTRUM PÆLE A/S

Test Site, DK-Hedensted – Exhumation P5, 19 August 2024

Observation Report

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Revision History

Revision	Date	Prepared	Checked	Description
1	2024-09-23	PG	-	Draft version issued for the Client's review

Contents

1 Introduction

CENTRUM PÆLE A/S (the Client) has requested Grud Interim Project Support ApS to prepare an observation report from a test pile exhumation at the CPSP test field located in DK-Hedensted.

1.1 Background

The test pile, P5, a Ø377/487 mm precast displacement pile type CPSP was installed during an installation test in June 2023 and did subsequently undergo an instrumented static load test in July 2023.

In subsequent communications with consultants, the question was raised whether the installation method by "screwing" the pile through the topsoil and into the bearing strata would impede the integrity of the threads along the pile perimeter.

1.2 Objective of the Exhumation

The objective of the exhumation was to document the post-installation condition of the threads.

1.3 Document Content

This document is an *Observation Report* with a summary of the background for the test pile exhumation, a description and justification of the applied methodology, adaptions made in the process, an analysis summary of the recorded images showing the CPSP thread condition and a conclusion.

2 Methodology

For the contemplated stepwise approach, refer Table 2-1.

Table 2-1: Planned Exhumation and Documentation Approach

Step	Activity	Planning Considerations
1	Excavation around the pile to enable pile extraction from the surrounding soil.	Sufficiently sized excavator. The pile tip is approx. 5.5 m BGL.
2	Lifting of the pile from the excavated pit and transport to the examination location	The weight of the pile is approx. 1900 kg. Additional dynamic load to be expected during lifting attempts and transport.
3	Cleaning of the pile threads for observation purposes	Preferable paved surface (due to jet cleaning). Availability of tools/equipment for mechanical- and jet cleaning of the pile thread crest, -flanks and pile shaft.
4	Recording of observations made during the stepwise cleaning of the threads	Availability of suitable photo-/video recording equipment and voice recorder/ notebook for recording observations between the cleaning steps.
5	Documentation of observations	Preparation of an observation report in PDF-format.

2.1 Photo Documentation

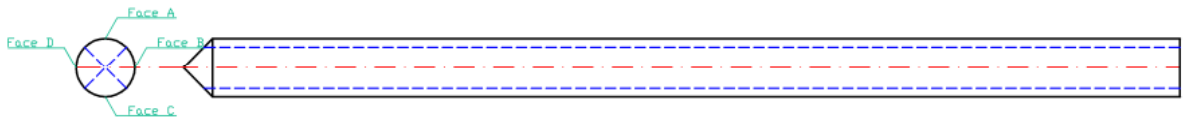
2.1.1 Equipment

The main recording tool for the observations was a Pentax dSLR camera, K-30 body with 16.3 MP APS-C sensor fitted with a Pentax 18-135mm F3.5-5.6 zoom lens.

2.1.2 Definition of Pile Surface Segments

The pile surface would be divided into four “strips” (Face A, -B, -C, and -D) each representing a 90° sector of the pile circumference, refer Figure 2-1.

Figure 2-1: Definition of Pile Surfaces



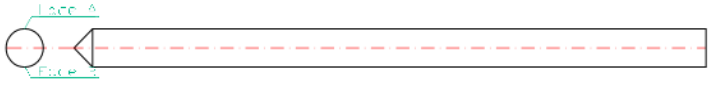
3 Observations

For the high-level observations made during the stepwise excavation and thread cleaning process as well as adaptions of the contemplated approach, refer Table 3-1.

Table 3-1: Realized Exhumation and Documentation Approach

Step	Activity	High-level Observations
1	Excavation around the pile to enable pile extraction from the surrounding soil.	The excavation caved in due to the GWL being above the pile tip elevation. It was not possible to fully excavate the pile prior to lifting it from its position. 
2	Lifting of the pile from the excavated pit and transport to the examination location	The pile was “wiggled” by means of the excavator arm via an attached lifting strap until it was possible to pull it out of the remaining approx. 2.5 m embedment.

3	Cleaning of the pile threads for observation purposes	The pile was partly covered in soil after being transported to the examination location. Less in the upper part, where parts of the thread crest, -flank and pile shaft where visible while more in the lower part where even the threads crests were covered.  The cleaning was done in steps: 1. Mechanical cleaning of the thread crests for a first impression of the thread condition. 

		2. Mechanical cleaning between the thread flanks and pile shaft for investigating the thread condition further.  3. Jet cleaning of the pile surface for a final investigation of the thread condition. 
4	Recording of observations made during the stepwise cleaning of the threads	With the setup on the examination location, it turned out be impracticable to position Face A, -B, -C, and -D upward for photo documentation between the cleaning steps. Instead, the four surfaces were reduced to two, Face A and -B each representing a 180° sector of the pile circumference. 

		To facilitate referencing of observed anomalies relative to the pile longitudinal axis, a measurement tape was put on the upward pointing pile surface with 0 (zero) at the welded steel pile tip and full pile length ~6.4 m at the pile head. The applied camera settings were: • Focal length, 24 mm • Aperture, F4.5-7 (depending on the specific lighting conditions) • Shutter speed, 1/250 sec • ISO 200. Exposure settings were checked with a "grey card" placed on the pile surface prior to recording a set of photos. The white balance was adjusted during post processing of the photos by means of the "Color Checker" WB neutral patch for outdoor recordings.  Despite the above-mentioned efforts to obtain "true colors" these may still be influenced by individual monitor and/or printer settings.

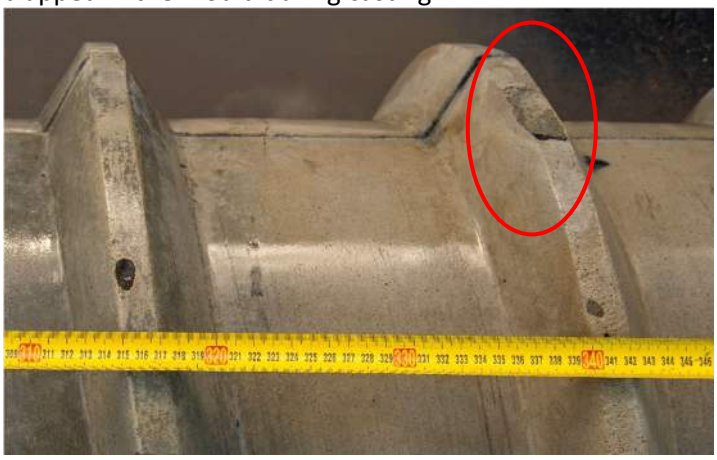
4 Analysis

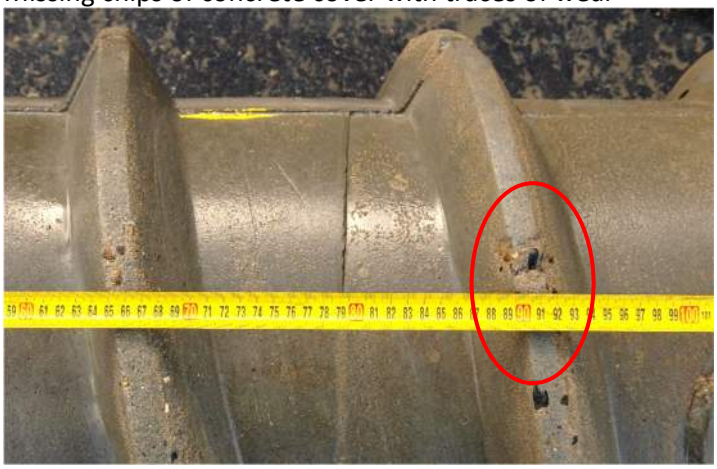
The analysis was prepared as a detailed review of each of the recorded photos, for each of the cleaning steps (1, 2, 3) and pile surfaces (Face A and -B).

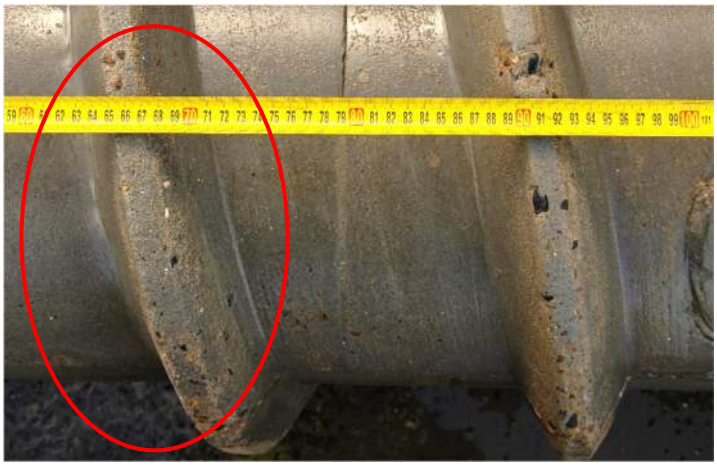
4.1 Coding of the Photo Documentation

A anomalies observed from the photo documentation were recorded with the distance from the pile tip as reference (in 10 cm increments as parallax effects do not justify shorter increments) and coded by assignment of a category abbreviation, refer Table 4-2.

Table 4-1: Anomaly Category Abbreviations for Coding

Abbreviation	Category	Description with Sample Pictures
Ab	Abrasion	The smooth concrete surface of the thread appears to have been roughened by the soil contact during installation. 
AP	Air Pocket	Idents in the surface of the thread interpreted as air pockets trapped in the mould during casting. 
Sc	Scaling	Chips of concrete cover missing at the thread crest and/or flanks. 

Sc-W	Scaling with wear	Missing chips of concrete cover with traces of wear 
Sc-R	Scaling, recent	Missing chips of concrete cover with a blueish tint interpreted as recent and caused by the excavation and/or mechanical cleaning of the pile. 
Wr	Wear	The concrete surface and aggregates appear to have been worn by the soil contact during installation. 

4.2 Summary of Observation Recordings

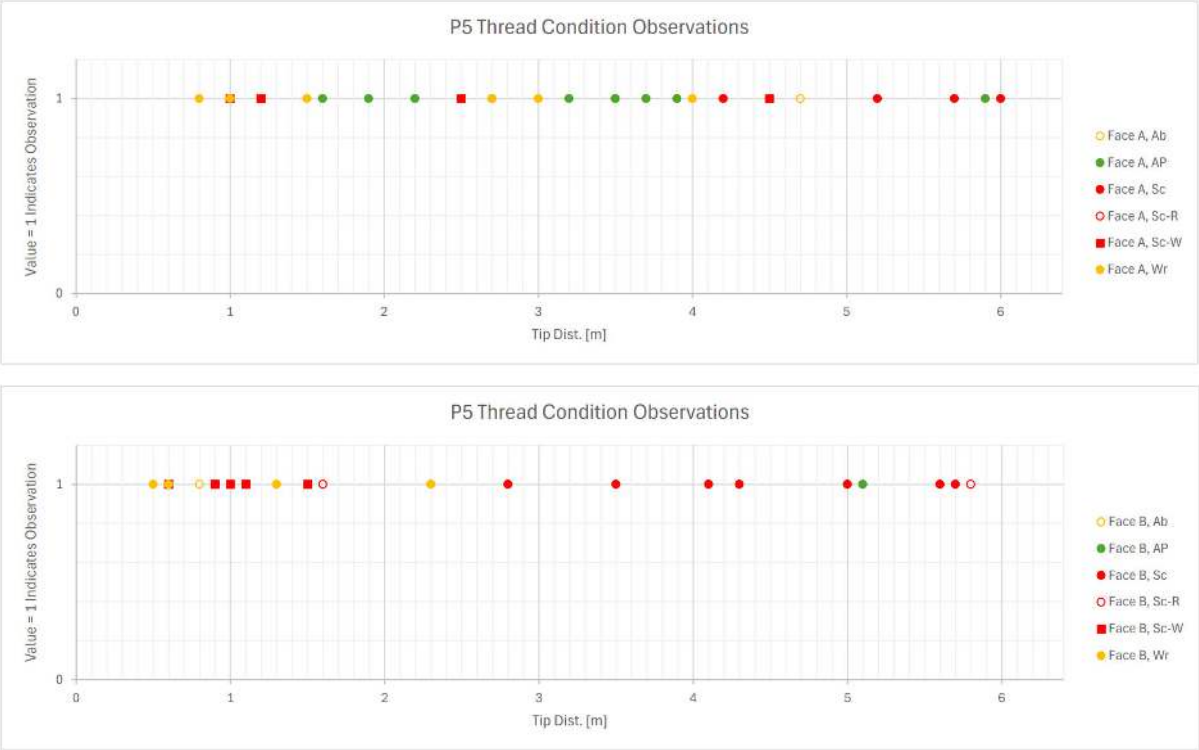
For the recorded observations by category, refer Table 4-2 and Figure 4-1.

Table 4-2: Photo Documentation Analysis Summary, Table Format

Clean. Step	Pile Face	Ab	AP	Sc	Sc-R	Sc-W	Wr
1	A		3			2	
2	A		4			2	
3	A	6	10	4		4	6
1	B				1		1
2	B				2		1
3	B	1	3	7	2	5	4

The recordings for cleaning steps 1 and 2 are shown in grey font as their values for detailed scrutiny of anomalies on the pile surfaces are of limited use. For details of the distance from the pile tip reference, refer Figure 4-1.

Figure 4-1: Photo Documentation Analysis Summary, Diagram Format



Only the observations for cleaning step 3 are shown in Figure 4-1.

4.3 Comments on the Observed Anomalies

The observed anomalies on the CPSP threads (categories Ab, AP, Sc, Sc-R, Sc-W, and Wr) are mostly scattered along the pile longitudinal axis, however with some exceptions:

- Significant wear is found at the leading edge of the thread just above the steel pile tip. Less significant wear is found on thread crest where the mould elements have not been completely aligned i.e. the part of the thread protruding farthest into the surrounding soil exhibits the most wear.
- Air pockets are with one exception found at Face A, which implies it was facing upwards in the mould.
- The scaling with wear is found at the lower part of the pile which implies that the scaling was present prior to or occurred during the early stages of installation.

The steel pile tip exhibits light wear on the tip and the helix plates, refer Figure 4-2.

Figure 4-2: Steel Pile Tip

5 Conclusion

On the whole, the exhumation of P5 and subsequent scrutiny for anomalies did not find evidence of damage to the CPSP threads which could be clearly attributed to the installation process. The wear at the leading edge of the thread just above the steel pile tip is regarded an unavoidable side effect of the installation method however, it is not seen to have a detrimental effect of the pile integrity nor the pile load bearing capacity.