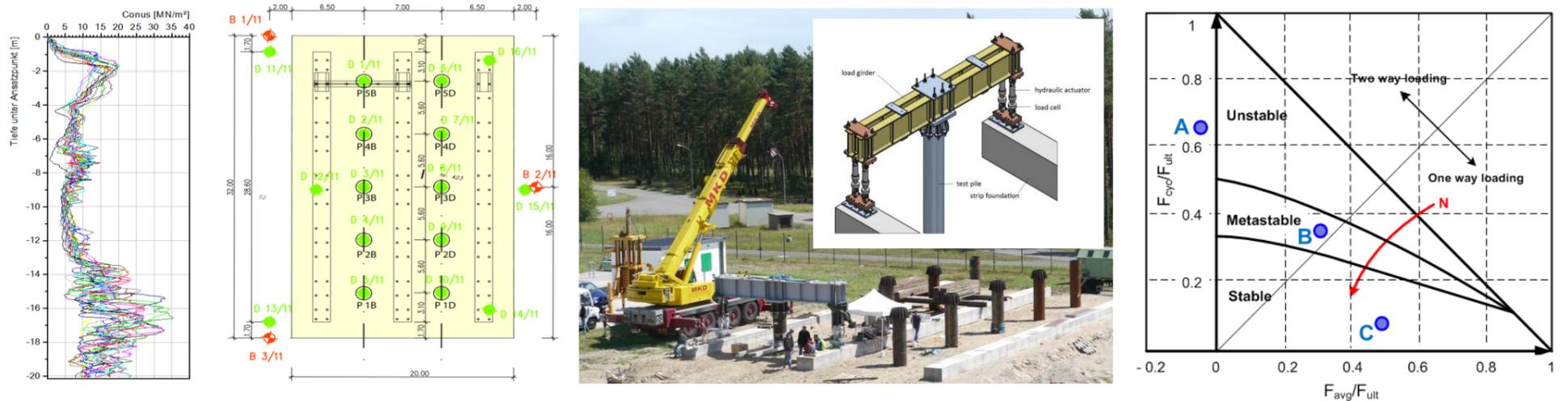


# Large scale cyclic loading tests at driven steel piles

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## Abstract

Offshore piles have to withstand predominantly cyclic axial loads when they are installed in multi-pile configurations, as in jacket foundations. Concerning the pile capacity, repeated cyclic loading is supposed to affect the load capacity of the pile and increased deformations have to be checked for serviceability. A large scale testing facility has been constructed at the BAM TTS site. In this open-air facility, large driven pipe piles can be loaded cyclically in tension and compression,



From left to right: CPT-results ; test site layout; Test site cyclic large scale testing device; General scheme interaction diagram with tested piles A, B and C marked.

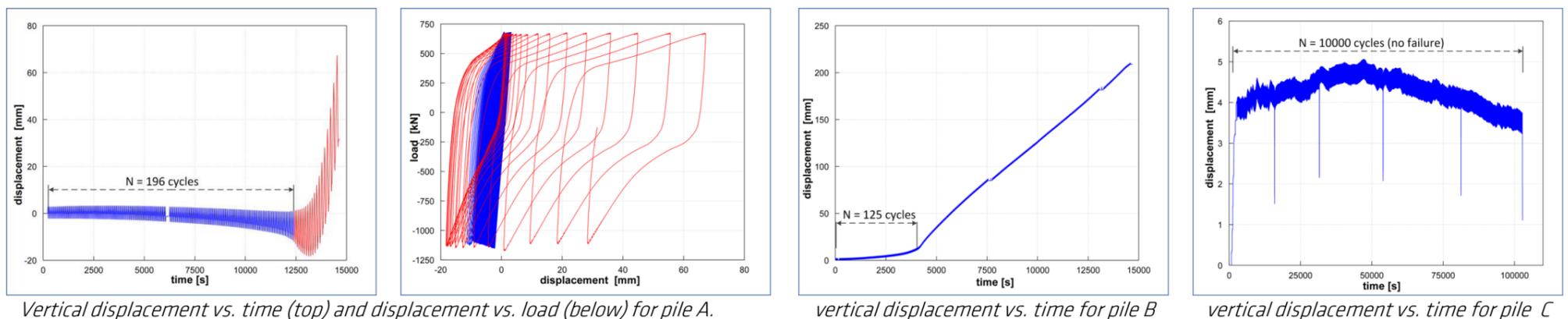
## Test Setup for Piles

In the large scale testing facility, large driven pipe piles can be loaded cyclically in both tension and compression. The layout of the test site is arranged around ten tubular steel piles with a diameter of 711 mm and an embedding length of 17.7 m.

## Cyclic Tests

A set of tests with cyclic axial loading have been done one year after installation for various amplitudes at eight of the test site piles. For a characterisation of the cyclic loading an interaction diagram has been used as introduced in Tsuha et al. 3 specific load cases A, B and C are shown:

- Pile A:** High level two way loading. Failure occurs after ~196 cycles. Increasingly large increments of permanent deformation after failure.
- Pile B:** High level one way loading. Regime change after 125 cycles. Metastable. Accumulation of permanent displacements with small increments.
- Pile C:** One way loading with small amplitude. Stable. No failure for 10.000 cycles between 750 and 1100 kN. No accumulation of displacements. Capacity after 10.000 cycles is min. 1820 kN compared to originally 1400 kN the year before.



## Findings

- Pile capacity with cyclic axial loading is governed by amplitude and cycles. Two-way loading is generally more severe than one way loading. One way loading with small amplitude with high average load can be endured for several thousand load cycles.
- Most of the cyclically loaded test piles do not fail suddenly with a sharp drop in capacity. Predominantly, the bearing behaviour shows an accumulation of displacements which are eventually acceptable for few load cycles.
- Compared to other test data the results at Horstwalde show comparatively many cycles until failure occurs

## Acknowledgement

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## References

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