

CADFEM Consulting

Hydro-Acoustic Simulation of a Hydraulic Hammer

Transient Sound Emission Analysis During Offshore
Pile Driving of Monopiles

Your Contact Person:

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Task

In the swiftly growing offshore wind industry, sound emission especially under water is a growing concern. In order to determine the peak sound pressure at certain locations in advance a detailed numerical simulation of the transient driving impact and the related hydroacoustics is necessary.

As an example a large monopile with conical shape (total length 50m, diameters 3m – 4,75m, wall thickness 50mm) was investigated which was installed with the hydraulic MENCK hammer MHU 800S. The impact energy is 820kJ which generates an impact force of 85MN. The final penetration depth of the pile is 20m and the water depth is 22m.

Solution

Using the ANSYS® Workbench™ environment, a flexible dynamics model was set up to assess the underwater noise emission from hammer impact, through the pile and into the surrounding area.

FE model:

- Nonlinear contacts.
- ANSYS acoustic elements simulate water environment.
- Two-way algorithm (strong, matrix coupling) simultaneously calculates the interaction of Fluid & Structure (FSI) for structural displacement and sound pressure values.

Results:

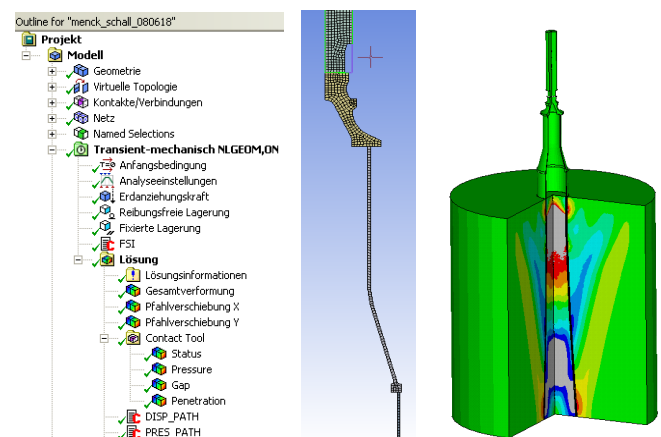
- Axial displacement produces radial bending vibration in the pile. Sound vibration within the pile is responsible for sound emission.
- A snapshot fixed point-in-time to show the sound pressure wave from hammer impact down through to seabed is shown at right.
- Also shown at right are the three simulated microphone signals.

Customer Benefit

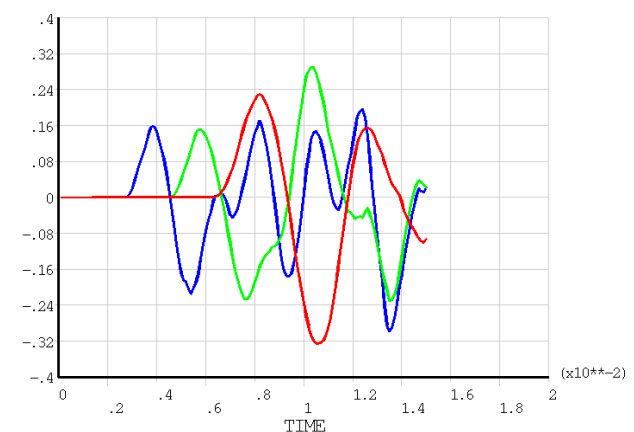
High noise levels are easily accessed through this simulation. Hence appropriate noise protection systems can be developed such enclosing the pile in a "bubble curtain" or an auxiliary pile with air cambers, treatment of the pile surface or other solutions.



Offshore pile driving by means of the hydraulic MENCK hammer.



ANSYS® Workbench™ Flexible Dynamics tree, 2D mesh of hammer equipment and hydro sound pressure.



Simulated microphone signals at 1m distance.

Figures by Courtesy of Menck GmbH