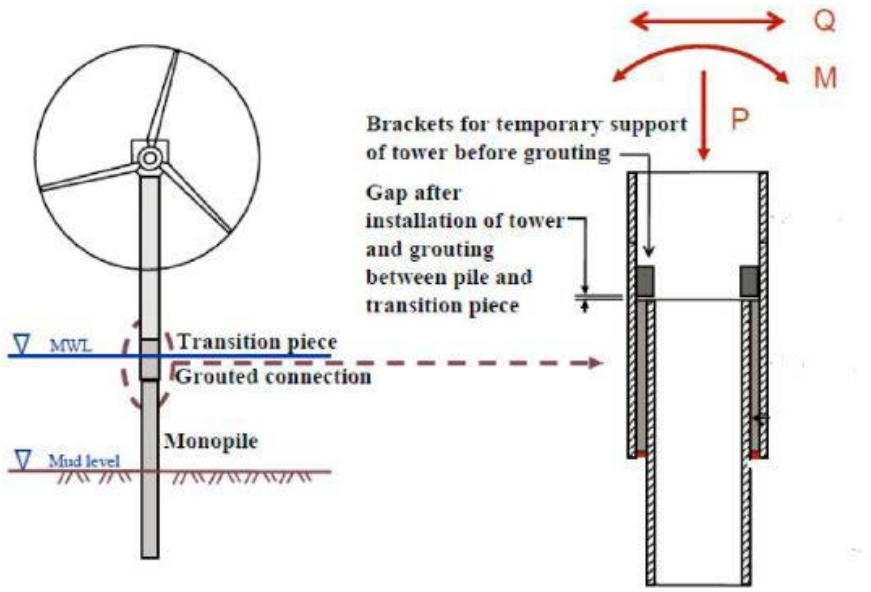
Offshore Wind Turbine Grouted Connections

MMI analysed offshore wind turbine structures to determine if changes in the natural frequency of the structures could be used as an early indicator of failure in grouted connections.

A commonly used design for the support structure of offshore wind turbines features a monopile capped by a transition piece, which supports the wind turbine tower. The transition piece has a larger internal diameter than that of the external diameter of the pile, over which it sits. The connection between the pile and the transition piece is formed by filling the annular space between the two with concrete grout.



Under certain circumstances, there is the potential for the grout to degrade, and for the integrity of the joint to be compromised. MMI was asked by a client to use Finite Element Analysis (FEA) to investigate how different connection failure modes would affect the overall dynamic response of the turbine structure. Five failure modes were considered; disbonding between the inner surface of the transition piece and the grout; disbonding between the external surface of the pile and the grout; horizontal cracking in the grout and loss of grout from the bottom of the connection; wear of the Grout; compressive failure of the grout.

MMI built a detailed FEA of the wind turbine structure, including soil stiffness and non-linear effects, including friction and inelastic connectors. The mesh used in the FE model allowed analysis of varying degrees of disbonding and grout degradation.

The second part of the work assessed the feasibility of using natural frequency response monitoring as a means of diagnosing degradation of the grouted connection.

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