

Offshore Wind Structures - Gambling With Grout: Worth the Risk?

In the early days of the offshore wind industry in Europe, an injection grouting technique was adopted as a supposed quicker and cheaper method of allowing wind turbine support towers to be placed close to vertical on non-vertically installed ($\sim 1^\circ$) steel large diameter (> 4 m) "monopiles", in effect impact driven thin walled steel tubular shells. The technique was sold as a quick, cost effective and apparently problem-free solution. The design guideline in use at the time mistakenly permitted this to be done without the use of reinforcing shear keys on the monopile and transition piece walls.

However, in the UK and elsewhere, towards the end of 2009 these grouted connection joints, between the monopiles and connecting steel transition pieces were observed to be failing by slipping downwards and cracking at the top and bottom near the grout seals.

On closer inspection, this appeared to be due to the very high strength extremely brittle grout cracking as a result of tensile stresses being present as a result of repeated tower bending. More worrying still, this was not an isolated incident and over 70% of offshore wind turbines were found to be affected, leading to subsequent costly repairs, consisting of cement filling, installation of elastomeric spring support bearings above the failed or at risk connections as well as a number of claims and legal disputes. There is now a clear move towards direct non-grouted bolted flange connections, although some developers are persisting with the use of inclined non shear keyed monopile grout connections.

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