

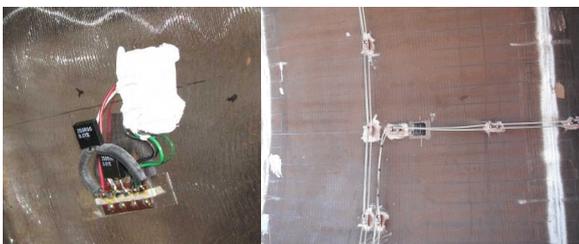
Overview

RES have supported several structural monitoring campaigns: designing systems, writing scopes of work, managing installations contractors and analysing the raw data to give a real understanding of the structural response. The analysis has been invaluable to the client with:

- Proving new designs
- Defining O&M activities
- Prolonging service life

RES has the experience to deliver the client's needs to develop a monitoring system suitable for their application. We work closely with installation contractors to develop an optimised system that can be efficiently installed.

Data can either be stored and collected intermittently or sent using the existing communication network, dependant on client needs.

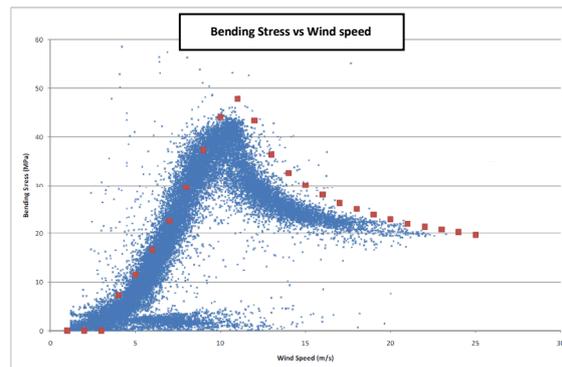


Strain Gauge

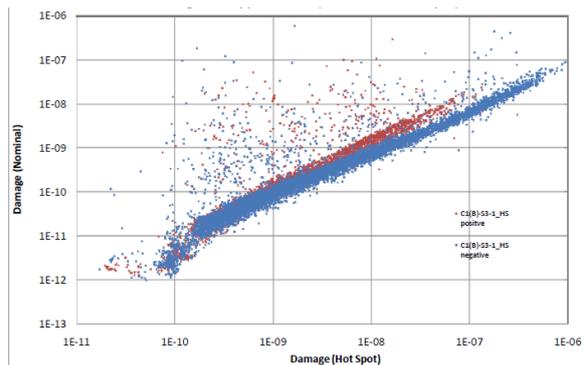
Strain Gauging of Monopile

The data is then post-processed to derive the required stress, displacements and accelerations.

Further analysis using Fast Fourier Transform and Rainflow counting enables detailed calculations to determine natural frequencies, stress concentration factors and fatigue model verification. Combining such analysis with the data gathered by a SCADA system provides highly valuable real-time information about the structural health of the structure, which can be used to verify designs are compliant with contracts and to assist in long-term asset management.



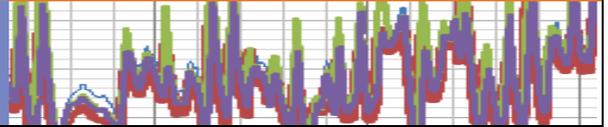
Comparison of actual load with design predictions



Stress Concentration Factor assessment

Project management of the design and installation include the following skills and activities:

KEY ACTIVITIES
Specification of the monitoring requirement
Design of monitoring system: instrumentation, logging and communications
Management of Installation Contractor
Site support onshore & offshore
Quality checking and Post processing of data
Interpretation of data into structural health information
Health & Safety management

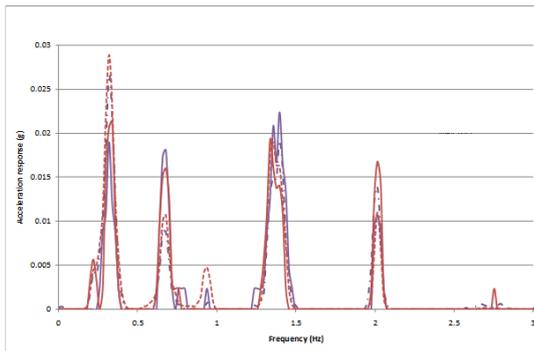


1. Jacket Structure

RES designed and commissioned a monitoring system at the substructure – foundation interfaces for a Wind Farm in the Irish Sea. Linear displacement transducers, strain gauges and accelerometers were installed in different locations to monitor the integrity of the grouted connection and global response of the structure. The system included a bespoke fibre communication and data logging system, and was installed in the fabrication yard shortly prior to load-out of the jackets.

2. Monopiles (MP)

RES has experience in designing and managing commission of monitoring systems designed to measure accelerations of MP foundations, J-tubes, turbine tower and nacelles.

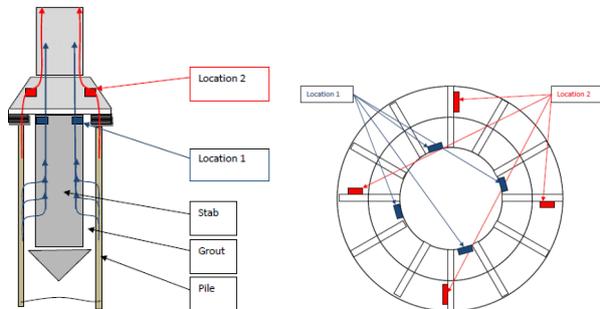


Analysis of the data can be conducted in the time and frequency domain.

3. Transition Pieces (TP)

RES designed and commissioned a monitoring system that is currently monitoring the grouted connection of an offshore wind farm in UK waters. The rate of settlement of the TP relative to the MP is measured by analyzing data gathered by displacement transducers and processed to produce transient settlement plots for comparison with the foundation designer's expectations.

This structural health monitoring of the grouted connection is a key factor in maintaining investor satisfaction regarding the asset integrity of the wind farm.



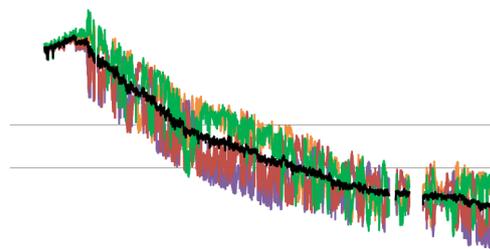
Schematic of instrumentation layout at jacket - pile joint



Accelerometer



Strain Gauge



Sample settlement of a TP