



Measuring impact of heating and cooling on pile performance

The challenge

The foundation scheme for a new Sixth Form Studies Centre at Lambeth College included a ground-source heat-pump system, using foundation piles as in-ground radiator elements. Since there is limited information about the impact of heating and cooling on the performance of piled foundations, CSIC was asked to:

- perform a pile-loading test incorporating temperature cycles over an extended length of time
- investigate the concrete stresses generated by temperature change and whether these could exceed the limiting values imposed by design codes

The approach

About 900m of fibre optic cable were installed, with reinforced ribbon cable used for strain sensing and 8-core, single mode fibre, loose tube cable for temperature sensing. A Brillouin Optical Time Domain Reflectometry (BOTDR) analyser was used to continuously monitor the fibre optic sensors. Eighteen conventional Vibrating Wire Strain Gauges (VWSGs) were installed to provide a comparison with the continuous strain and temperature profiles generated by the fibre optic systems.

The benefits

The results from this maintained load/cyclic thermal test, the first to be successfully carried out on a test pile in the UK, revealed that:

- movements and strains of the pile during thermal cycling were small and within the design limits
- the concrete stresses generated by the mechanical and thermal loading were within the design limits
- the strain profile provided valuable information about the deformation mechanism of the pile. This observation was used as the basis for developing the Thermal Pile Standard guide published by the Ground Source Heat Pump Association

