# In-Situ Strain Measurement of Concrete Micro-Piles under Loading using Distributed Fiber Optic Sensing Systems

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## ABSTRACT

We present experimental results on the measurement, in-situ and in real time, of the internal strain distribution along the height of a set of six separate micropiles with different configurations (Simple, with Expander Body and with Bidirectional Cell) using three separate fiber optic sensing techniques—two of them based on distributed Brillouin and Rayleigh scattering, and the third one based on the use of discrete fiber Bragg grating (FBG) strain sensors. The distributed techniques relied on the use of embedded fiber optic strain-sensing cables, while the FBG technique used discrete strain sensors packaged for concrete embedment.

Single-point and distributed strain measurements were made during the concrete pouring and curing process, as well as post-cure under compression loading. Results showed that it is practical and possible to obtain high spatial resolution strain profiles during the diverse construction phases of the micro-piles. There was good agreement among all 3 methods in terms of the overall strain accuracy. The best results were achieved using the Raleigh scattering system (called Odisi), which allowed for millimeter resolution strain profiles, that allowed to discern the interaction between the concrete pile surface and the surrounding soil.