# Multi-scale Studies of Desiccation Cracking in Engineered Clay Fills – Numerical, Laboratory and Field Approaches

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## ABSTRACT

Desiccation cracking is common in clay soils subject to drying/wetting cycles. The phenomenon has potentially severe implications for infrastructure constructed from clay fills (e.g. railway embankments) as cracks can lead to rapid water infiltration and increased pore pressures at depth that can ultimately destabilise such structures. This issue may become more prevalent for UK infrastructure as climate projections predict warmer, drier summers and shorter but more intense periods of rainfall.

However, the mechanisms controlling crack evolution under cyclic drying/wetting conditions remain poorly understood with complex interactions between soil, atmosphere and vegetation to be considered.

The work presented here summaries several years of research combining numerical, laboratory and field studies in a holistic approach to the investigation of cracking in engineered soils. Laboratory work under controlled conditions, using a combination of simple shrinkage tests, an instrumented environmental chamber and microscopy, provides validation for a coupled hygro-mechanical model and is used to investigate the effect of environmental conditions measured in the field. Numerical experiments are then employed to investigate the key processes at work in laboratory tests, particularly where parameters are difficult to assess experimentally. Field work carried out at an extensively instrumented embankment site includes real-time monitoring of crack evolution in conjunction with depth dependent moisture content measurement and environmental data such as rainfall, evapotranspiration and runoff.

Key findings are that strong correlations between rainfall, soil moisture content at depth and suctions can be demonstrated in the field and that these can be related to crack opening. Recent geophysical studies show that cracking has a strong influence on rewetting and infiltration. Numerical and laboratory work has demonstrated material degradation effects related to cracking occurring at different scales and at different times during a drying event. This is exacerbated by cyclic drying/wetting although material properties (stiffness, tensile strength, density) also have influence.