The condition of infrastructure earthworks can deteriorate over time due to seasonal pore pressure cycles. To gain insights into the potential development of progressive failure mechanisms, gradual changes must be detected and quantified. Soil moisture variations are a good indicator and this can be observed using non-invasive electrical resistivity tomography (ERT). However, ERT is influenced by among others, material type, water content, pore fluid chemistry, density and temperature. The challenge is to understand how each factor contributes to resistivity measurements before changes in soil moisture content can be reliably quantified.

EARTHWORK CONDITION APPRAISAL IN THE UK

The condition of UK infrastructure earthworks is generally evaluated through a risk assessment involving the geometry, material history and visual inspection of the site. This is subjective and concentrates on the superficial changes in the structure. The use of a geotechnical method such as ERT to assess the health of an embankment through non-invasive methods is beneficial as it evaluates the assessment of the internal structure of the embankment without disturbing it.

Large infrastructure embankments of significant lengths were constructed in the UK during the period 1820 to 1900 for the expansion of the railway system. Embankments were also constructed in the 1950s and 1960s for motorway construction (Scott et al., 2007). The soils used to construct the embankments were often locally sourced from cuttings or tunnel spoil (Donald, 2005). Even though the materials used are similar, embankments constructed during these two periods presently have different physical properties due to the different construction methods employed, reflecting the difference in knowledge available at the time.

Railway embankments were generally constructed using an end setting method. The soil was carried by either horse drawn or steam driven carts to the end of the constructed section of embankment and the cart was emptied to the structure. The soil was not compacted as part of a controlled way. This method was employed as it was the most cost effective at the time. Storage of soil from nearby cuttings and tunnels was expensive and therefore the material had to be placed in the embankment at the same rate at which it was being won (Skempton, 1965). More recent motorway embankments were constructed using soils that were compacted in layers of known thickness to achieve the required density and strength available for the material (as specified by appropriate standards). A summary of the differences in present embankment 'quality’ is illustrated in Figure 2.

The term failure is commonly used but not always clearly defined, and it can mean many things. In the context of earthworks, failure is typically defined as a sudden and complete loss of strength. The term progressive failure describes the loss of integrity of a structure that has been caused by a combination of factors, such as time, load, and environmental conditions. This is a much more gradual process than a sudden failure, and it may not be immediately obvious that a structure is failing.

The effect on electrical resistivity of different soil parameters, as illustrated in Table 1.