

Shrinking and swelling soils in the UK

Assessing clays for the planning process

by Lee Jones, *Keyworth*

Many UK towns, cities, transport routes, and buildings are founded on clay-rich soils and rocks. The clays within these materials may be a significant hazard to engineering construction due to their ability to shrink or swell with seasonal changes in moisture content, local changes such as leakage from water supply pipes or drains, or following the planting, removal or severe pruning of trees.

The effects of shrinkage and swelling were first recognised by geotechnical specialists following the dry summer of 1947. The cost of damage resulting from the shrinking and swelling of clay soils in the UK has risen dramatically since then. After the drought of 1975–76 insurance claims came to over £50 million. In 1991, after the preceding drought, claims peaked at over £500 million. Current estimates put the cost at over £300 million a year, but if the UK were to suffer another severe drought costs would again rise significantly.

Swelling soils contain clay minerals that attract and absorb water, the more of this clay a soil contains, the higher its swell potential and the more water it can absorb. As a result, these materials increase in volume when they get wet and shrink when they dry. The effects of allowing soils with a high shrinking and swelling potential to



Structural failure caused by 'end lift'.

become either too wet or too dry can be severe when they are supporting buildings and other manmade structures.

Damage to a structure is possible when as little as three per cent volume expansion takes place. Failure results when the volume changes are unevenly

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distributed beneath the foundation. For example, water content changes in the soil around the edge of a building can cause swelling pressure beneath the perimeter of the structure, while the water content of the soil beneath the centre remains constant. This results in a failure known as 'end lift' (*above*). The opposite of this is 'centre lift', where swelling is focused beneath the centre of the structure or where shrinkage takes place under the edges (*left*).

If expansive soils can be recognised before construction takes place, special designs and construction methods can be used to lower the likelihood of later



Structural damage caused by 'centre lift'.

structural damage. These may reduce the swelling potential of the soil, concentrate the load of the structure on to pads or piers making the structure flexible, or reduce water infiltration into the ground around the foundation. Prevention is better and cheaper than repair, which can prove very costly.

The amount of shrinkage and swelling is dependent on the type of soil, and therefore the geological formation, on which the structure is founded. To make a proper evaluation of the soil, the engineer requires borehole and laboratory information, to provide the geological and geotechnical data required, and an accurate classification system.

Project teams at the BGS can draw on extensive research into ground movement caused by shrink/swell clays in the UK. Combining this expertise

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and experience with data from the UK rocks and soils geotechnical database, they can create maps which identify the

areas covered by shrink/swell clays. An indication of the relative volume change potential of the clay concerned can also be incorporated into the map.

This type of integrated approach provides the engineer or planner with an early warning of the likely occurrence and severity of any problems associated with the shrink/swell clay. Appropriate design and construction measures can then be used to mitigate the problem.

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Map showing areas of shrink/swell clays associated with outcrops of the Gault Clay and Mercia Mudstone. The relative volume change potential at specific sites is indicated.