

Collapsing loess soils

An under-appreciated hazard

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What do Buckingham Palace, the Nissan Primera and hydrocollapse have in common? The answer is loess. Loess covers approximately 10% of the world's surface. It is a silty soil, usually light brownish-yellow in colour, deposited by the wind, and has the potential to collapse when wetted and loaded. As a consequence it is a major hazard in geotechnical engineering. In Britain the distribution of this material, although minor, still commands the interest of geo-engineers.

When the BGS first mapped southern Britain at the end of the 19th century, the limited deposits of superficial loess encountered were generally considered as materials of little scientific interest masking more interesting rocks. However, near-surface availability and the inherent nature of the material enabled it to be used for brickmaking and the term brickearth was coined for these deposits. In southern Britain, by and large, brickearth means

loess — but a terminological confusion had been introduced. Buckingham Palace is built from bricks made from the loess of northern Kent, as was much of suburban Victorian London. More recent applications have included the use of Essex loess in mud-splash tests conducted on the Nissan Primera at the manufacturer's test track in Sunderland.

By the mid 20th century, when the Soil Survey began to map areas of the southern UK, the extent of loess material began to be appreciated, with the most well-known location being at Pegwell Bay in Kent. However, even now the extent and nature of loess in Britain is not fully appreciated.

Described as a macroporous, metastable, collapsing soil, geo-engineers consider loess to be a major global geohazard. The silt particles comprising these soils accumulate by air-fall and a very open soil structure is formed, which can be maintained following post-depositional

processes. When loaded and wetted the soil structure may collapse rapidly (a process called hydroconsolidation) resulting in ground subsidence and distress to overlying structures. In many cases, major subsidence can occur with buildings being severely damaged or destroyed. This is a continuing problem in many parts of the world from China to Eastern Europe where large tracts of thick loess deposits coincide with concentrations of people and industry. For example, in one small district of Lanzhou, China over 100 of 168 buildings have been damaged or destroyed as a result of loess collapse in the last ten years. Loess has even been mooted as a possible host for low level radioactive waste disposal. It is a less significant problem in England, but in recent years has still caused a number of houses to be abandoned due to severe subsidence damage.

In the mid 1970s the BGS completed an extensive survey in south-east Essex which included an area designated for major urban development to accompany the proposed construction of a third London Airport at Maplin Sands. The survey investigations revealed the presence of collapsing loess soils up to eight metres in thickness in the study area. The airport and accompanying urban development plans were dropped, but there is no doubt that had they gone ahead there would have been some interesting subsidence problems to solve. The BGS is currently preparing a major study of the UK loess, in association with the Geohazards Research Group at Nottingham Trent University, and it is hoped that this definitive national study will give our loess the status that it enjoys in many other countries.

Main photo: *Pegwell Bay, Kent the best-known loess site in the UK. Cliff section shows 3 m of brown loess overlying the Chalk.*

Inset photo: *A scanning electron micrograph showing the typical macroporous structure of loess from Pegwell Bay, Kent. The view shows silt-sized quartz particles coated with clay minerals which 'bond' the particles together making a metastable structure. The hair-like 'cobweb' features represent the early stages of cementation by calcite. The clay and calcite bonds break down when the sample is loaded and wetted causing collapse of the soil structure into void spaces.*

