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Time Capsule

# Survey of slope condition on motorway earthworks in England and Wales (RR199)

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## Introduction

The research described in this publication is the culmination of 8 years of motorway earthworks condition research, led by John Perry. The research involved data gathering using new survey methodologies and covered 570km of motorway and identified 17km of embankment slope failure and 5.5km of cutting slope failure. It was published in 1989. It was the first time an in-depth and national assessment had been made of the condition of highway earthworks. The research was a milestone in asset management and provided a springboard for many years of research and application which continues on a national scale to this day

## The research

When the research was commissioned, it was within a context of growing awareness that earthworks problems, predominantly slope failures, were being seen by maintenance authorities on an increasingly regular basis on what was then on average a 10–20-year-old network. At the time, no formal asset data were collected, and the level of geotechnical awareness was limited. To undertake the data collection for the research, a new methodology was developed measuring slope characteristics and condition. Motorway lengths were chosen based on their geology over a statistically significant length. Geologies which were unlikely to have problems were also included as a benchmark. Once collected, the data revealed relationships between slope failure and material, slope angle, slope height, drainage and orientation. The extent of the slope failure problem on the motorway network was ascertained and the causes of failure revealed in detail, although the mechanism was not fully understood. Slope failures were shallow in depth. Most research at the time had been in deep or first-time and residual failures, with very little being known in practice about the theory of low stress environments and the impact of vegetation.

## The importance of the work

This is a seminal piece of work which is both a milestone and a springboard. The research revealed there was a problem with the earthwork network. It quantified the problem and provided data for remedial works. It revealed that fill slopes in particular (as against cutting slopes) were being constructed too steeply in overconsolidated clays. It was common practice to construct these embankments with a slope of 1(v):2(h) and were shown to be failing. This increased awareness of slope condition, and general earthwork condition eg settlement, led to new methodologies for slope inspection, analysis and competence requirements. This is now known as Geotechnical Asset Management, a profession which this research spawned. The original survey was undertaken on foot, a method still undertaken today but improved technologies eg LIDAR and InSAR have greatly improved the amount, accessibility and timeliness of data collection, especially given that the network is busier than when the research was undertaken.

In new build, shallower slope angles could be recommended for a variety of materials and this change has led to flatter slopes in modern practice. This major change in approach to new construction has influenced design analysis and cost benefit assessments. Flatter

slopes require more land and this needed to be balanced against maintenance costs of steeper slopes. In some cases where failures are infrequent in a material at a steep angle it may be better to use the steep angle and spend more on maintenance and less on land.

The mechanism of shallow failures became an active area of research as a result of RR199. Research into the strength characteristics and pore water pressures (Crabb and Atkinson, 1991) and the growing awareness of earthworks performance instigated by the TRL research has led to a continuing interest as evidenced by the current Achilles project: assessment, costing and enhancement of long-life, long-linear assets (eg Briggs, Dijkstra and Glendinning, 2019).

There is no doubt RR199 was a milestone in the performance of geotechnical assets and future design. It was also a springboard to future major research commissions, as it highlighted a problem that needed addressing, and began the new area of practice of geotechnical asset management.

## References

Briggs K.M., Dijkstra T.A. and Glendinning S (2019). *Evaluating the deterioration of geotechnical infrastructure assets using performance curves*. In International conference on smart infrastructure and construction 2019 (ICSIC) Driving data-informed decision-making. Institution of Civil Engineers Publishing, UK. pp. 429-435.

Crabb G.I. and Atkinson J.H. (1991). *Determination of soil strength parameters for the analysis of highway slope failures*. In Slope stability engineering: developments and applications (ed. R. Chandler). London: Thomas Telford, UK. pp. 13-18

Perry J. (1989). *A survey of slope condition on motorway earthworks in England and Wales*. Research Report 199. Transport Research Laboratory, Crowthorne, Berkshire, UK.