

## Introduction

Soil arching is a natural phenomenon that occurs in all granular soils as a result of a redistribution of stresses. It causes a redistribution of the embankment load at the base of the embankment. Quantifying the amount of soil arching that occurs is a vital part of the design process for piled embankments used in the construction of roads and railways on poor soils such as peat or soft clay. The piles are driven through the unsuitable foundation soil to a firm-bearing stratum and three-dimensional soil arches develop which span the soft soil and distribute the embankment loads to the rigid piles and then the firm-bearing stratum. A geosynthetic layer is often installed over the pile caps at the base of the embankment, as illustrated in Figure 1(b). This further reduces the load acting on the soft foundation soil. To date none of the current design methods<sup>1, 2, 3</sup> truly grasp the key characteristics of piled embankments<sup>4</sup>.

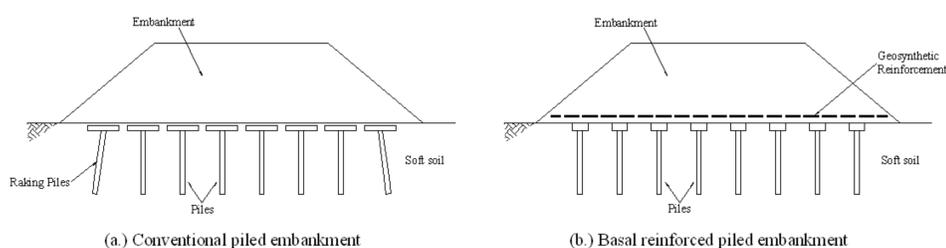
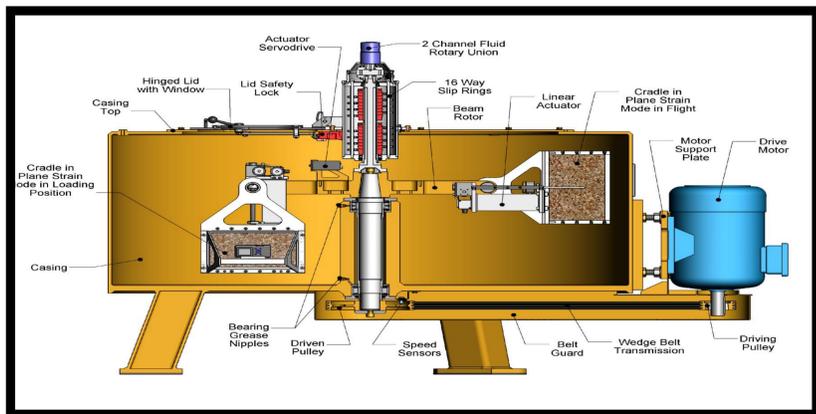


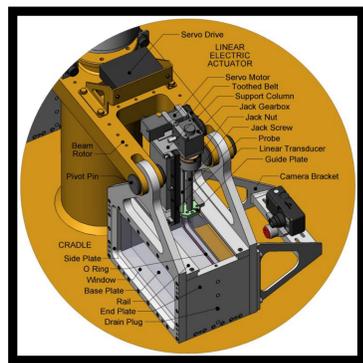
Figure 1: Pile supported embankments



(a)



(b)



(c)

Figure 2: (a) Geotechnical centrifuge general arrangement; (b) Geotechnical centrifuge at IT Sligo; (c) Centrifuge strongbox general arrangement

## Aims

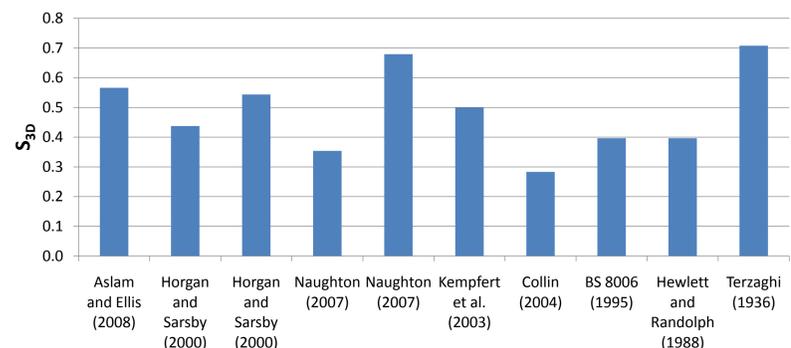
This study aims to identify the mechanism of action in soil arching and to define and quantify the characteristics and properties of soil that influence it. Model testing in the IT Sligo Geotechnical Centrifuge, Figure 2, will be conducted to investigate the arching mechanism and to develop a numerical model that can accurately represent the arching mechanism in piled embankment problems.

## Methodology

The selected soils that are to undergo testing will be characterised in accordance with the British Standards<sup>5</sup>. A novel model will be designed and constructed for testing in the IT Sligo Geotechnical Centrifuge. The development of a three-dimensional numerical model of the piled embankment problem will be achieved and validated against the experimental program.

## Progress to date

The study commenced in September 2010. Preliminary investigation of the various piled embankment design methods highlighted the fact that there is no definitive method to follow. Each method produced different estimations of the quantity of arching occurring, as illustrated in Figure 3.



[Note:  $S_{3D}$  is the stress reduction ratio (= average vertical stress carried by reinforcement/ average vertical stress due to embankment fill)]

Figure 3: Comparison of piled embankment design methods in terms of Stress Reduction Ratio<sup>6</sup>

## Future Work

The results from the experimental model and the numerical modelling will be analysed in detail and a comparative study will be conducted to conclude which of the design methods is the most accurate.

## References

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