GROUP MECHANICS OF VIBRATED STONE COLUMN FOUNDATIONS

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Introduction
The research project is a fundamental investigation into group mechanics and interaction phenomena of vibrated stone column foundations. Vibrated stone columns are frequently adopted to artificially improve the mechanical properties of soft cohesive soils and mixed fills. Their primary functions are to improve bearing capacity and reduce total/differential settlements so that more economic shallow foundation systems can be implemented. In recent years the vibrated stone column technique has witnessed widening participation by the construction industry as it is considered a flexible, cost effective and sustainable remediation technique. Despite advances in the technique, the interaction mechanics that influence and control group behaviour are still not fully appreciated or understood. Previous investigations have tended to concentrate on evaluating isolated column behaviour and neglected interaction effects associated with column groups. The important role of soil-structure interactions in controlling their performance is only now being fully appreciated and requires investigation.

Previous research has indicated that significant column distortions arise due to (i) column-soil, (ii) column-column and (iii) column-structure interactions which compromise the overall foundation performance. The degree of interaction is highly dependant on design criteria such as column spacing, column geometry and group configuration, none of which are catered for in current design protocol for bearing capacity or settlement. The proposed research seeks to address these limitations by evaluating the role and impact of these interactions on controlling foundation performance and accounting for them in revised design criteria.
**Methodology**
The research proposes a novel experimental technique of non-intrusive modelling using transparent synthetic soil in conjunction with laser technology. A laser in conjunction with a scanning beam box produces a light sheet that illuminates a vertical plane of the model. Seeding particles are added to give texture to the transparent soil. During foundation loading the displacement of the seeded particles in the transparent soil will be captured at suitable intervals with a digital camera. Using digital image correlation and Particle Image Velocimetry (PIV) the displacement fields at all stages of loading will be derived and subsequently the strain fields in the vertical plane. The investigative technique proposed will provide significant new insight into understanding the interaction mechanics involved within the context of vibrated stone column foundations.

![Figure 1. Schematic of experiment setup (Not to scale) (a) Plan view, (b) Foundation overview, (c) Cross section](image-url)
In addition to evaluating interaction phenomena within the context of vibrated stone column foundations, the proposed investigation presents an excellent opportunity to develop innovative non-intrusive modelling technologies using transparent synthetic soils for analysing various other forms of interactions in geotechnical problems (i.e. piling, retaining structures etc.). This will be of significant interest to the wider geotechnical modelling community and will represent a major breakthrough in modelling capabilities.

**Additional Information**

Those with an interest in the development of this new approach are encouraged to contact me. You may:

- wish to seek registration as a PhD student;
- wish to stay in touch with developments;
- have completed some work which sheds light on the matter;
- hope to collaborate, or visit.

**Project Contact**

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