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Family of Density Curves of Queensland Soils from Compaction Tests, on a 3D Z-Plane Function of Moisture Content, Saturation, and Air-Void Ratio

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Abstract : Soil density depends on the volume of the voids and the proportion of the water and air in the voids. However, there is a limit to the contraction of the voids at any given compaction energy, whereby additional water is used to reduce the void volume further by lubricating the particles' frictional contacts. Hence, at an optimum moisture content and specific compaction energy, the density of unsaturated soil can be maximized where the void volume is minimum. However, when considering a full compaction curve and permutations and variations of all these components (soil, air, water, and energy), laboratory soil compaction tests can become expensive, time-consuming, and exhausting. Therefore, analytical methods constructed on a few test data can be developed and used to reduce such unnecessary efforts significantly. Concentrating on the compaction testing results, this study discusses the analytical modelling method developed for some fine-grained and coarse-grained soils of Queensland. Soil properties and characteristics, such as full functional compaction curves under various compaction energy conditions, were studied and developed for a few soil types. Using MATLAB, several generic analytical codes were created for this study, covering all possible compaction parameters and results as they occur in a soil mechanics lab. These MATLAB codes produce a family of curves to determine the relationships between the density, moisture content, void ratio, saturation, and compaction energy.

Keywords : analytical, MATLAB, modelling, compaction curve, void ratio, saturation, moisture content
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