Abstract

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Voids between the particles are often attributed to the arrangement of particles. Granular packing governs the performance of civil engineering materials, yet the independent effects of particle size distribution parameters—mean size and Coefficient of Variation (CV)—on void fraction remain underexplored. This study develops a controlled experimental framework using spherical steel balls to eliminate confounding effects of particle shape and texture, enabling precise evaluation of gradation influences.

Real world gradations were replicated through a hyperbolic base distribution derived from IRC:105-2019. A custom mould–piston assembly and tamping-based compaction ensured repeatability in void measurement. Systematic variation of mean particle size and standard deviation revealed that larger mean size of particles increased voids, while broader distributions reduced them by allowing smaller particles to fill interstitial spaces. Comparisons confirmed that well-graded mixes achieved lower voids than uniformly graded ones due to angularity and surface roughness.