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Physical Tests on Localized Fluidization in Offshore Suction Bucket Foundations

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Abstract : Suction buckets are promising innovative foundations for offshore wind turbines. They generally feature the shape of an inverted bucket and rely on a suction system as a driving agent for their installation into the seabed. Water is pumped out of the buckets that are initially placed to rest on the seabed, creating a net pressure difference across the lid that generates a seepage flow, lowers the soil resistance below the foundation skirt, and drives them effectively into the seabed. The stability of the suction mechanism as well as the possibility of a piping failure (i.e., localized fluidization within the internal soil plug) during their installation are some of the key questions that remain open. The present work deals with an experimental study of localized fluidization by suction within a fixed bucket partially embedded into a submerged artificial soil made of spherical beads. The transient process, from the onset of granular motion until reaching a stationary regime for the fluidization at the embedded bucket wall, is recorded using the combined optical techniques of planar laser-induced fluorescence and refractive index matching. To conduct a systematic study of the piping threshold for the seepage flow, we vary the beads size, the suction pressure, and the initial depth for the bucket. This experimental modelling, by dealing with erosion-related phenomena from a micromechanical perspective, shall provide qualitative scenarios for the local processes at work which are missing in the offshore practice so far.

Keywords : fluidization, micromechanical approach, offshore foundations, suction bucket
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