

Penetration Experiments under Reduced Gravity

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Abstract

Penetration experiments will find several applications in exploration missions in the near future.

Penetrators are common tools for the investigation of physical surface properties. The techniques and theories are widely applied under 1g condition on Earth and the results are used by engineers and scientists.

The main contribution to the bearing resistance of a soil is combined of shaft and base resistance [1]. The theories show, that the resistance scales with gravity. Penetration experiments during a parabolic flight campaign have been performed for evaluating this gravity scaling of the bearing resistance in different materials during a parabolic flight campaign in December 2012.

The main part of the experiment is composed of a steel rod penetrating into a sample cell. Depth and penetration force are recorded during this process. A sieving mechanism provided the ability of sample preparation during flight. Different compaction regimes of the sample material could be created with a ruttler mounted underneath the sample cell.

The parabolic flight campaign consisted of 4 flight days. On each day 13 parabolas with Martian gravity, 12 parabolas with lunar

gravity and 6 microgravity parabolas could be performed. Three different sample materials have been examined within the 4 flight days: glass spheres, glass corn and Mojave sand. The glass spheres and glass corn samples were made of the same material, but with different shape. The Mojave sand is a natural soil from the Mojave desert in California (US).

The experimental description and the first results will be presented.

Acknowledgements

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[1] Craig R.F.: Craig's Soil Mechanics, Spon Press, London and New York, first published 1977