

MODELLING EXPLOSIVE COMPACTION FOR SOIL IMPROVEMENT

MSc. Graduation Project – Mechanical Engineering / Civil Engineering

Objective

The main objective of the assignment is to investigate the explosive compaction technology to optimize soil strengthening, with the aid of a pilot scale experiment and/or particle-scale numerical simulations.

The problem and the opportunity

In the last years, projects related to soil stabilization and improvement of inadequate soils have expanded enormously. In the vast panorama of available techniques, Explosive Compaction (EC) technology is very attractive because of low cost and ease of treating large and deep areas. EC involves placing a charge at depth in a borehole in loose soil (generally sands or gravels), and then detonating the charge, with minimal costs for transport, operation and waste. The explosion induces compaction with water expulsion and, in turn increases ground stiffness and strength.

Despite the many advantages, the approach has still not gained widespread acceptance. Like many other geotechnical processes, explosive compaction has been designed largely on experience rather than theory. It is common to carry out a trial before starting full-scale treatment. This empirical design basis appears to be an obstacle: owner's review boards are often reticent in approving proposals, contractors are unsure of risk factors when bidding work, and consulting geotechnical engineers lack familiarity with the method [1].

It is important to deepen the knowledge about EC and perform systematic studies to guide the stakeholders in their choices. Possible approaches involve pilot scale experiments in controlled conditions and advanced Discrete Element Method (DEM) [2], able to track the response of soil particles to explosions.

Research objectives

Studying the technique of explosive compaction, perform a pilot scale experiments to investigate the effect of blasting on different soils and conditions, and reproduce the same experiment with DEM simulations to look at the effect of blasting on the soil structure. The final goal is to establish a link between the procedure (e.g. arrangement, intensity, sequence of explosions) and the type and condition of the soil, to support the contractors in the design.

Student Profile

For this assignment we are looking for students who are proactive, analytical and out-of-the-box thinker. She/he has to analyse, explore and find interesting gaps in the research field. A special interest for numerical methods is required.

Supervision

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[1] W.B Gohj, M.G: Jefferies, J.A: Howie and D. Diggle, Explosive compaction: design, implementation and effectiveness, *Géotechnique*, 50(6), 2000.

[2] P. Cundall & O.D.L. Strack, Discrete Numerical Model for Granular Assemblies. *Géotechnique*, 29, 1979.

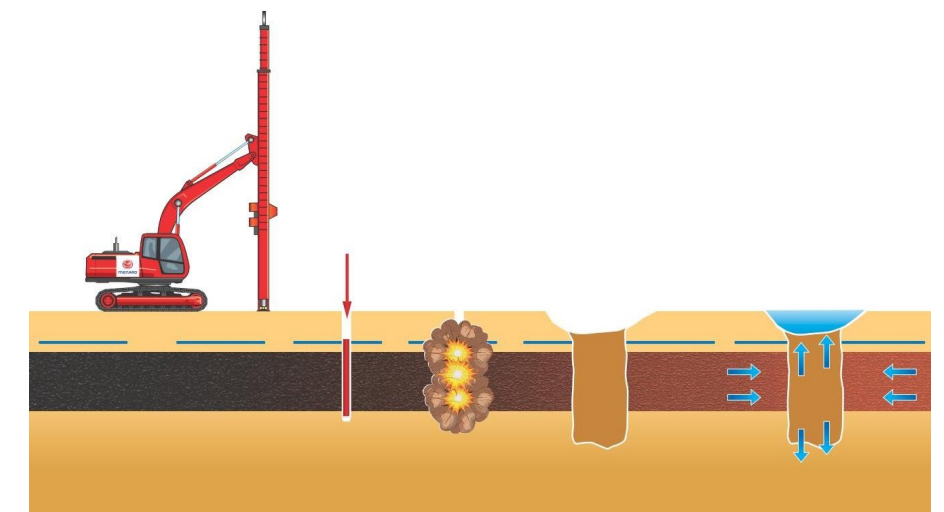


Fig 1: (Top) schematic of the explosive compaction, courtesy of [Menard](#);
(Bottom) soil spreading and water rise after blast explosions.