Experimental evidences of the effectiveness of some liquefaction mitigation measures

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Abstract

Earthquakes induced liquefaction is one of the most significant causes of damage to structures during an earthquake. Ground improvement is currently considered to be the most appropriate mitigation tecnique to prevent soil liquefaction. This work is aimed to compare different liquefaction mitigation techniques for protection of small-to-medium sized 'critical' infrastructures and low-rise buildings. The effectiveness of some techniques (densification, addition of fine contents, induced partial saturation and drainage systems) was verified via experimental evidences coming from laboratory testing, physical modelling and liquefaction field prototype tests. Starting from the calibration of advanced soil constitutive models, numerical modelling activities were extended to the back-analysis of centrifuge tests and field prototype tests, up to a parametric study with different geometrical layouts.

Keywords: soil liquefaction; mitigation techniques, laboratory tests, numerical modelling, centrifuge tests.

1. Introduction

Excessive deformation of ground surface caused by earthquakes are of great concern for civil engineering works, human lives an the environmental. Such ground deformations are often associated with soil liquefaction. Liquefaction is a phenomenon marked by a rapid loss of soil strength which can occur in loose, saturated soil deposits subjected to earthquake shaking or other forms of rapid loading. During liquefaction, when the effective stresses approach zero, soil behaviour switches from that of a solid to that of a fluid, causing serious damage to engineering structures. Ground improvement is currently considered to be the most appropriate approach to mitigate soil liquefaction. As part of the objective of the LIQUEFACT (WP4) project is to make an objective comparison of the different mitigation techniques. Not all the existing techniques can be applied in densely urbanized areas or sites with historic buildings to be preserved. In these cases, it becomes necessary to adopt less invasive mitigation techniques that combine the need to reduce the risk of liquefaction and the protection

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