Jet-Grouting Columns Performance of Foundation Improvement- A case study

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Received: 16 May 2016 Accepted: 13 Feb. 2017

Extended Abstract

(Paper pages 467-486)

Introduction

Jet-grouting is a soil improvement technique which was originated in Japan. Jet-grouting method consist of disaggregation of soil or weak rock and its mixing with, and partial replacement by, a cement agent; the disaggregation is achieved by means of a high energy jet of a fluid which can be the cement agent itself. Jet-grouting techniques can be grouped into three main systems, which are named single, double and triple fluid, depending on the number of fluids injected into the subsoil, namely, grout (usually water–cement mixture), air and grout, and water plus air and grout. In the beginning, jet grouting was mostly viewed as a means of improving the subsoil properties for the foundations of large structures. Nowadays, its application are diversified for use in foundations, excavations, tunneling, water barriers and underpinning. This paper studies foundation improvement by jet-grouting in one of Iran northern cities and seeks the optimum design parameters for jet-grout columns in saturated and unsaturated sand. Results of cement grouting as one-fluid jet-grouting method together with site geotechnical characteristics are presented. Diameters of jet-grouted columns, uni-axial strength of soil-cement cores and core recovery index are surveyed as the most important parameters for performance assessment of improved foundation and the primary design is modified and the project completed based on the results.

Material and methods

Design parameter of jet-grout columns were assumed according to guidelines and previous expertise as follows~~ed~~: single-fluid jet-grout method with 450 bar injection pressure and rod withdrawal speed of 0.5 cm/sec with a grout density of 1600 gr/cm^3. Monitor rotation speed was set to 30 rpm. Soil strata consists of a 5 meter sand with some gravels followed by a 7 meter clayey silt with the average SPT numbers of 30 and 7, respectively. To investigate the effectiveness of design parameters, jet-grout columns head were uncovered by excavating its nearby soil and columns diameter were measured. Several core samples were prepared from columns with a L/D ratio of 2 and an average diameter of 74 mm by means of a triple tube core barrel after 28 days of columns installation. The volume of core samples were calculated by multiplying its length to its average cross section (calculated from the average diameter of cores) and their unit weight were obtained by dividing its weight to its volume. Uniaxial compression test conducted in the deformation-control mode with the strain rate of 1 percent on all samples. Core samples were tested in different ages from 34 to 85 days and uniaxial compression strength (UCS) of samples were corrected by age correction factor according to soil type suggested by Sližytė et al.

Results and discussion

It is observed that the average diameter of columns that are constructed in unsaturated sand with design parameters mentioned in material and methods section, is one meter and the average diameter of columns that are constructed in saturated sand with the same density as unsaturated sand is 0.8 meter. This could be due to the dissipation of fluid jet energy under the water.

The modified obtained values from uniaxial compression test show that the strength of samples varies from 28 to 90 kg/cm^2. By omitting the lower, an upper 5 precent of the data as irrelevant data, the average UCS of the remaining part is equal to 57 kg/cm^2. By applying a geotechnical safety factor of 2.5 to the modified ~~a~~ filtered UCS values, a UCS of 40 kg/cm^2 is obtained as the structural strength of get-grout column.

Conclusion

-It is observed that utilizing one-fluid jet-grout method with 450 bar injection pressure in saturated silty sand with mean SPT number 30, rod withdrawal speed of 0.5 cm/sec and grout density of 1600 gr/cm^3 will result in 80 cm diameter jet-grout columns, while the same parameters will result in a 100 cm column in unsaturated sand which can be due to fluid jet energy dissipation under water.

-Considering the common design parameter for jet-grout columns in Iran, which are the same as the design parameters discussed in this paper, the UCS of get-grout columns in near shore silty sand with a safety factor of 2.5 is about 40 kg/cm^2.

Keywords: Soil improvement, jet grouting, performance assessment, unconfined compression strength

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