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Procedia Engineering 195 (2017) 252 – 258

Procedia Engineering

www.elsevier.com/locate/procedia

18th International Conference on Rehabilitation and Reconstruction of Buildings 2016, CRRB 2016

Modification of Soils for Excavation Work and Underlayer

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Abstract

The paper describes the possibility of soil liquefaction, which would be further used in the form of self-compaction grout. These grouts would be used as a basis for utility lines at lower cost and without unnecessary waste. A prerequisite is that the soil is stabilized by a suitable stabilizer, which should increase the strength of the composite. The composite will be necessary liquefy by using water and a suitable plasticizer additives. Self-compacting grouts can be used as a underlayer for floors. Modification of the underlying layer is performed by using appropriate kinds of binders.

Peer-review under responsibility of the organizing committee of the 18th International Conference on Rehabilitation and Reconstruction of Buildings 2016

Keywords: soil; stabilization; lime; cement, plasticizing additives

1. Introduction

During the implementation of utility lines is produced a large amounts of soil. These soils have a different composition or fraction, containing organic substances etc. In current practice are such soils landfilled. This way of management with soil, is however inefficient. Therefore, there is an effort to find the possibility of modifying soils for their re-use.

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Peer-review under responsibility of the organizing committee of the 18th International Conference on Rehabilitation and Reconstruction of Buildings 2016
doi:10.1016/j.proeng.2017.04.551

The modification of excavated soils has according to [1] a long history and is performed mainly with the purpose of improving their usability in construction. Nowadays are unsuitable soil stabilized by hydraulic binders which are selected in relation to the type of soil. The stabilisation can improve mainly the strength of the soils and their resistance to softening. [1]

The idea is that by using appropriate plasticizers, which are mixed with the excavated soil, could be created the stabilized and liquid composite, which could by their properties replace sand backfill. Thus treated soil could be more effectively utilize and apply back in the process of construction of utility lines. [2] The formed composite should also gradually raise strength and thus should provide additional protection of utilities.

The technology of reusing soils as fluidised suspensions is not yet well known around the world. Some experience with the use of fluidised soils can be found in literature published e.g. in Germany, Switzerland, France, Italy, the United Kingdom, the USA and Japan. [2]

In the first phase it is necessary to excavated soil perform appropriate tests, through which we discover the chemical composition of the soil. Important too is to know the grading curve of the earth. With these parameters it is possible to determine the appropriate hydraulic binder, which should ensure the increases of strength. Soil composition also outlines whether it would be preferable to use a plasticizer or other liquefying additives. Anticipated benefits of liquefied soils based self-compacting grouts are lower economic cost, consumption of secondary raw materials (in the form of excavated soil), with which it is normally treated as waste and increased protection of utility lines before the breach. Therefore, this paper aims to investigate the possibility of reusing soils as self-compacting grouts.

2. Materials and methods

The experiments were performed with F6 Cl (low-plasticity clay) and F3 MS (sandy loam) soil. Both soils originated from the Czech Republic. For use the soil as foundation is required of its specification. In the Czech Republic is the classification of rocks as a foundation soils carried out according to ČSN 1997-1 [3]. If the soil does not meet standards, it is necessary to do its treatment. Soils, whose treatment are not possible or would be costly, are taken to a landfill. Before using soil it is necessary to do laboratory tests, which lay down how the soil will be treating. Table 1 shows the properties of the used soils. The most important parameter is liquid limit and modulus of deformation. Based on the liquid limit are soil divided into plastic, low plastic and medium or highly plastic. Both of used soils are low plasticity. The most important technical characteristics, in mechanics of soil, belongs plastic properties because they determine the compression of soil (subsidence), ie. soil deformation. Modulus deformation is 12.00 MPa (F6 Cl) and 5.00 MPa (F3 MS). Modulus of deformation shows that the soil is able to transmit certain load. To increase its carrying capacity is suitable for its stabilization by binders and additives. According to other parameters are the soils stiff consistencies, not/less and conditionally suitable to backfilling, with effective angle of internal friction 19° (F6 Cl) and 24-29° (F3MS). Effective angle of internal friction of soils classified soils as coherent. Based on the results it is necessary to do a treatment of soil by suitable binders and optionally other additives.

Table 1. The results of F6 Cl and F3 MS soil analysis.

Parameter	Unit	F6 Cl	F3 MS
Water content	[%]	11.60	13.20
Liquid limit	[%]	37.80	28.10
Plastic limit	[%]	23.20	23.25
Plasticity index		14.60	6.20
Class per ČSN EN 1997-13		F6 CI	F3 MS
Backfilling suitability		not suitable/less suitable	conditionally suitable
Effective angle of internal friction	[°]	19	24 - 29
Total angle of internal friction	[°]	0	8
Modulus of deformation	[MPa]	12.00	5.00