

**INVESTIGATION OF SPECIFIC SITES AND MATERIALS IN BULGARIA
ACCORDING THE STANDARD БДС EN 16907-1**

Irena Sulay¹

University of Architecture, Civil Engineering and Geodesy - Sofia

***Abstract:** This paper aims to present informative specific site and material investigations in Bulgaria according the new standard БДС EN 16907-1, that became effective on 16.05.2019. This standard gives basic principles and general rules for the planning, design and specification of earthworks as a main engineering process.*

***Keywords:** earthworks, principles, general rules, standard, material, investigation*

1. INTRODUCTION

In the field of transport infrastructure in Bulgaria the main emphasis is placed on the pavement design, the components of road pavements, the reducing of the environmental impact of the road construction, the use of recycled materials in the road pavements and others [1][2][3].

Earthworks, however, are a main engineering process and require very accurate planning, design, construction and maintenance [4]. CEN/TC 396 prepared a set of European earthworks standards and divided them into seven distinct parts. Each separate part corresponds to a different stage of the planning, execution and control of earthworks.

The European standard EN 16907-1:2018 is the first one of the set earthworks standards and has the status of a Bulgarian standard БДС EN 16907-1: 2019 from 16.05.2019. The Eurocode 7 (EN 1997, Part 1 and Part 2) and the earthworks standards (EN 16907, from Part 2 to Part 6) are referred to in the text of the standard and some or all of their content constitutes requirements of it.

The standard [5] provides overview of the specific site and material investigations for earthworks.

2. INVESTIGATION OF SPECIFIC SITES AND MATERIALS

Very important issue is the information needed for soils, rocks and other fill materials (description, identification, classification and characterization).

The description of materials for earthworks should contain: type of material and geological conditions; presence of pollutants, organic matter and evolving or reactive minerals; information about material classification; information about material compaction properties and etc.

In addition to material description, the groundwater conditions and other types of hydrologic information are also important in order to carry out an effective design process.

The requirements of Eurocode 7, Part 2 (EN 1997-2) specific to a ground investigations should be satisfied.

¹ Irena Sulay, Assist. Prof. Dr. Eng., Dept. "Road construction and transport facilities", UACEG, 1 H. Smirnenki Blvd., Sofia 1046, e-mail: irenasulay@abv.bg

The standard [5] considers only the ground properties, which are of considerable importance for the execution of earthworks.

The geotechnical investigation should incorporate a desk study and a preliminary investigation to characterize the site in general terms. In case of need, subsequent investigation should provide detailed information for specific elements.

Old waste disposal sites, pollutions and others should be take into account.

2.1. Site investigations, specific ground investigations and geotechnical report

The cuttings and the fills are the main two types of earth structures. They should be designed according to Eurocode 7, Part 1 (EN 1997-1), which consider stability, deformations and durability of the structure. Eurocode 7, Part 2 (EN 1997-2) identifies the need to plan the investigations to provide sufficient information for the different stages of design [5].

Geotechnical measurements may be necessary for the purposes of monitoring stability, testing calculation assumptions concerning the ground stability, for the purposes of observing the structural behavior and for preserving evidence on adjacent structural works.

The design of earthworks needs information on soils, rocks and other materials, which will be excavated, treated, transported, stockpiled, compacted etc. Three are the relevant aspects, which should be take into consideration - nature, state, geometry and volumes of the materials (soils, rocks etc.). The specific ground investigations should cover all zones affected by earthworks. In most cases are applied geological analysis, testing of samples taken from borings, pits or stockpiles, observations of the ground, laboratory or *in situ* measurements of soil and rock properties etc.

The location and spacing between investigation points and investigation depth shall consider the guidance within Eurocode 7, Part 2 (EN 1997-2). Investigations should include chemical tests of the environmentally-relevant parameters. The investigations regarding earthworks and other structures should ensure that the required information will be obtained for the different elements of the project.

The geotechnical report must be prepared according to Eurocode 7. These include the preparation of reports at different phases in the ground investigation, design and construction process.

2.2. Classification systems of the materials

The classification of the materials (classes/groups, describing in accordance with standard descriptive systems), used for earth structures, is of great importance for the planning and specifying construction procedures and for the choice of the quality control methods.

The classified materials should ensure all requirements for earth-structures to achieve the required design criteria of bearing capacity, serviceability and durability. The standard EN 16907-2 gives rules for the description and classification of soils, rocks and other materials used for earthworks. The classification should cover three stages: description based on observation, classification by parameters of “intrinsic properties” (material properties that cannot readily be changed and are properties independent from the state conditions during execution) and classification based on parameters of “state properties” (material properties that are readily changed by earthworks processes,

Design of earthworks is based either on experience or on preliminary full-scale tests.

There are two possibilities of experience use [5]:

- for simple works, identification of the nature of ground may be considered as sufficient to apply popular techniques for earthworks;

- for more complex works, testing and use of a more elaborated classification system is necessary in order to determine the best construction process.

Preliminary full-scale trials are employed for assessing materials of unknown behavior, or the use of new equipment or procedures. A list of commonly used test standards for identification and classification of fill materials is given in EN 16907-2.

CONCLUSIONS

This paper aims to present informative specific site and material investigations in Bulgaria according the new standard БДС EN 16907-1, that became effective on 16.05.2019. This standard gives important basic principles and general rules for the planning, design and specification of earthworks as a main engineering process.

REFERENCES

- [1] Donchev, M.; Mihaylov, N.; Blab, R.: Izsledvane na validnostta na uplatnenieto po metoda „Valtsuvashst segment“ pri tsimento-stabilizirani smesi s frezovan asfalt, Godishnik na Universiteta po arhitektura, stroitelstvo i geodezia Sofia, tom 52, broy 2, 2019, 555 – 566 [Donchev, M.; Mihaylov, N.; Blab, R.: Examining the validity of the “roller sector” compaction method on cement-treated mixtures with milled asphalt]
- [2] Donchev, M.; Mihaylov, N.; Blab, R.: Izsledvane razvitieto na yakostta vav vremeto pri hidravlichno-svarzanite smesi s 50% retsikliran asfalt, Sbornik s dokladi na XVII Mezhdunarodna nauchna konferentsia VSU‘2017, 8 - 9 yuni 2017, Sofia, Bulgaria, tom 2
- [3] Donchev, M.; Mihaylov, N.: Izsledvane na vliyanieto na nano-podobriteli i fayalit v tsimento-pyasachni raztvori, Godishnik na Universiteta po arhitektura, stroitelstvo i geodezia Sofia, tom 49, broy 4, 2016, 101 – 106 [Donchev, M.; Mihaylov, N.: Study on the influence of nano-additives and fayalite in cement-sand mixes]
- [4] Mihaylov, N.: Rakovodstvo za sistema ot znaniya za izgrazhdane na bezопасni patishta - chast I: Zemni raboti, Institut po transportno stroitelstvo i infrastruktura OOD, 2020
- [5] BDS EN 16907-1: 2019 Zemni raboti. Chast 1: Printsipi i obshti pravila