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In situ Determination of Load Bearing Capacity of Soils on the Airfields

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Abstract

The article presents the results of the earth structures' bearing capacity evaluation and objectification for airfields by means of CBR (California Bearing Ratio) parameter. In order to quantify actual terrain conditions, in situ testing methods are advancing against laboratory testing. However, the optimal solution is to combine precise laboratory testing with in situ measurements. A correlation between CBR values and moisture content values of the backfilling soil of runway strips from earth structure of Žilina Airport was made within the frame of author's research activities. The CBR tests were performed on the clayey gravel specimens, which were prepared in the test cylinders used for a Proctor modified test. It has been found that the correlation allows determining of the moisture level to meet requirements of the RWY recommended by Aerodrome Design Manual [1]. The newest results of CBR in situ measurements on the aerodrome earth structures are also presented. CBR in situ values were objectified by the CLEGG device WS 32830. This device quantifies the value of rate of compaction from in situ tests based on CIV values (Clegg Impact Value) [2].

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Keywords: earth structures; airfields; in situ CBR; Clegg impact value; compaction.

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1. Introduction

The Earth structures should be designed, built and maintained at a reasonable cost, within a reasonable quality, while taking into account relevant user requirements and principles of sustainable development throughout their entire life cycle [3]. The Aerodrome Design Manual, Part 1 [1] is the relevant document for quality control of the earth structures of the airfield areas. A runway (RWY) shoulder should be prepared or constructed to be capable of supporting the airplane without inducing structural damage to the airplane in the event of an airplane taking off the runway, and capable of supporting ground vehicles, which may operate on the shoulder. In the part "Strength of runway strips", the portion of a strip containing a non-instrument runway is within a distance of at least:

- 75 m where the code number is 3 or 4,
- 40 m where the code number is 2,
- 30 m where the code number is 1,

from the center line of the runway and its extended center line should be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to airplanes which the runway is intended to serve in the event of an airplane taking off the runway. The value of CBR between 15 and 20 % are recommended.

2. Control methods for the bearing capacity of earth structures

Testing methods that are typically used to detect the degree of compaction parameters are listed in Table 1.

Table 1 Testing methods to detect degree of compaction used in Slovak republic.

Method	Type of material	Methodology
Direct methods: determination of bulk density (cutting-ring, the hole method, determination from the calculated volume of the pit) and humidity, calculation of *D* parameters.	Si, Sa , Gr, BoCo according to the applicable methodology	STN 72 1010 STN 72 1012
Indirect methods: radiometric methods	Si, Sa , BoCo	Annex E
static load tests	Si, Sa , Gr, BoCo	Annex F
dynamic load tests	Si, Sa , Gr, BoCo	Annex G
geodetic compaction control (levelling)	Gr, BoCo	Annex H
dynamic method of compaction control Sa , Gr, BoCo	Annex I	
penetration tests (static, dynamic) Si, Sa , Gr, BoCo		
Legend: F fine-grain soil, S sandy soil, G gravelly soil, B rocky and boulder backfill		

2.1. Determination of bulk density in situ

The 'hole' method is one of direct methods of determining the quality of soil. In this case, a degree of compaction is evaluated by determining of bulk density. A small hole of dimensions approximately 15 x 15 cm is excavated into the tested soil. Removed soil is then weighed in a natural condition and dried to determine the moisture content of soil. Volume of the hole is determined by filling it with sand. Specific mass of the removed soil is then divided by the volume of sand required to fill the hole. This determines the volumetric mass density of compacted soil. Afterwards, the results can be compared with the standard Proctor test.

Fig. 1 A view on excavated hole and a filling with sand.

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