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COGEAR: COupled seismogenic GEohazards in Alpine Regions

COGEAR

MODULE 3

Geotechnical measurements in the Visp Area

Preliminary Subsoil Investigation Using the Weight Sounding Test

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Von Moos Weight Sounding Test Report

General task

As part of the COGEAR project, prior to the drilling of the additional planned boreholes in the Industrial Area of the Lonza factory in Visp, a preliminary soil investigation was performed. The main purpose of this investigation was to confirm the relevance of drilling new boreholes and instrumenting them, from the non-linear soil behavior perspective, by means of pre-determining some mechanical parameters of the subsoil in the project area. Considering that the drilling campaign will involve a more precise determination of soil parameters, using in-situ and laboratory methods, the scope of this preliminary investigation was reached using the very simple and fast method of “von Moos” Weight Sounding Test.

Investigation description

The “von Moos” Weight Sounding Test is a fast method of investigating the geological layers, having as result the approximation of geotechnical parameters like compaction, stiffness modulus or friction angle. The test itself consists basically in pushing into the soil a pyramidal tip of an area of 10cm^2 by means of a falling weight which freely slides along a shaft. The mass of the falling weight is 30kg and the falling height is 20cm. The pyramidal tip is attached to the end of a 22mm thick steel bar which basically connects the tip to the falling weight system. As the tip is driven down into the ground additional bars will be installed one after another.

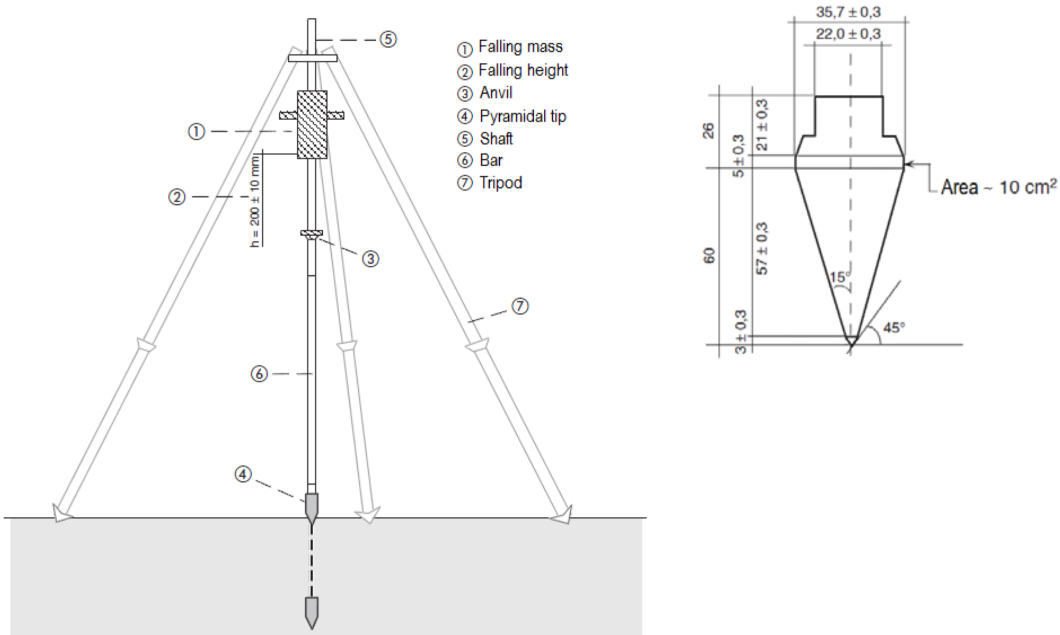

Figure 1 – Von Moss Sounding System

The measurement procedure involves counting the number of hits required to reach a penetration of the tip in the soil of 0.2m (N_{M20}). The number of counts is introduced in the protocol along with the corresponding reached penetration depth. The test stops as soon as the number of hits exceeds 100 for a 0.2m depth segment.

Starting for the number of required hits, by means of correlation and dependence functions presented by the actual codes of practice, the approximated values for various soil parameters (cone resistance, compaction, stiffness modulus or friction angle) can be obtained.

Results of the investigation

The performed measurements were summarized in several depth plots. The initial raw data, representing the number of hits against the reached depth is represented in the picture below (Figure 2). Even after a first look, it seems obvious that in the range of 7 – 8m there is a major change in the structure of the subsoil.

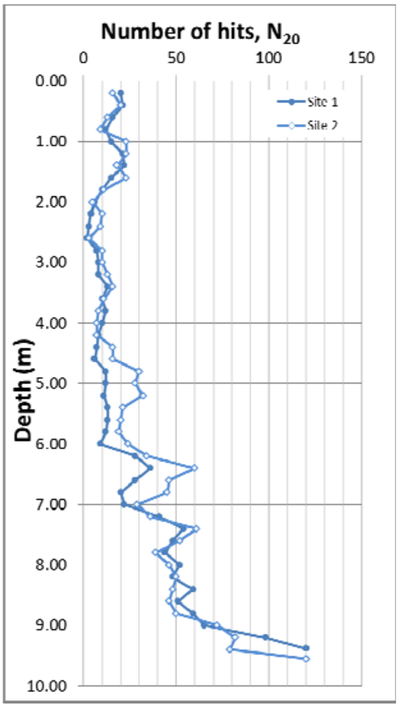

Figure 2 – Number of hits

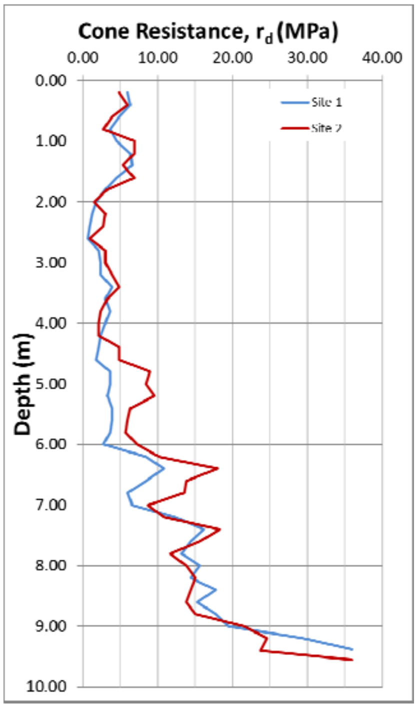

Figure 3 – Cone resistance

According to SN 670 314 – Rammsondierung "von Moos", paragraph 10, there is a linear relation between the average penetration depth for one hit and the cone resistance. The depth plot of the cone resistance is shown in Figure 3. Consistent with the variation of the required number of hits along the depth, the cone resistance stays in the range of 0 – 10MPa for the first 7m and afterwards there is a transition zone followed by a jump to the value of approx. 35MPa, measured on a penetration segment of only 18cm.

The variation of compactness with the depth was obtained by means of the dependence relations presented in the Annex 1 of the DIN 4094 Norm at paragraph 4.10b. The considered input data was the cone resistance obtained in the previous step and the output data is presented in the picture below (Figure 4). Some threshold values between different states of compactness (von Soos, 2006) are shown on the same plot in order to get a better view on the in situ situation.

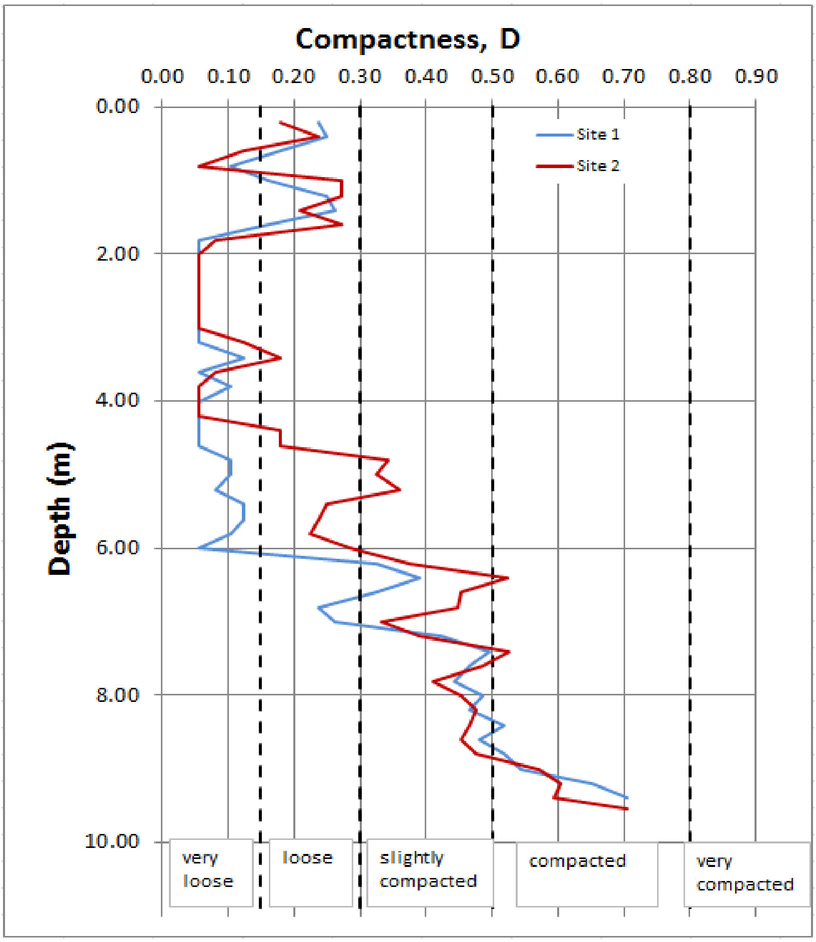

Figure 2 – Compactness

According to this plot, the initial assumptions made with respect to the subsoil of the investigated site are proven to be right. On the first 6 to 8m there are mostly loose to slightly-compacted alluvial material layers.

The last parameters of the investigated soil that could also be determined by means of empirical relations according to DIN 4094, Annex 1, are the friction angle (Figure 3) and the stress dependent stiffness modulus E_s (Figure 4), which gives an idea about the compressibility of the material. The presence of the uniform linear segments in the stiffness modulus depth plot and of the constant ones form the friction angle plot is caused actually be the limited validity range of input data for the different empirical relations used. For example, considering the cone resistance, r_d, as input data for determining the friction angle, the dependence relation $\varphi = 13.5 \cdot \lg r_d + 23$ is valid only for $5 \le r_d \le 28$ (DIN 4094, Annex 1, 4.16). In the situations in which the input data was out of range, the minimum or the maximum range limit was used to generate the depth plot points, in order to create a continuous curve.

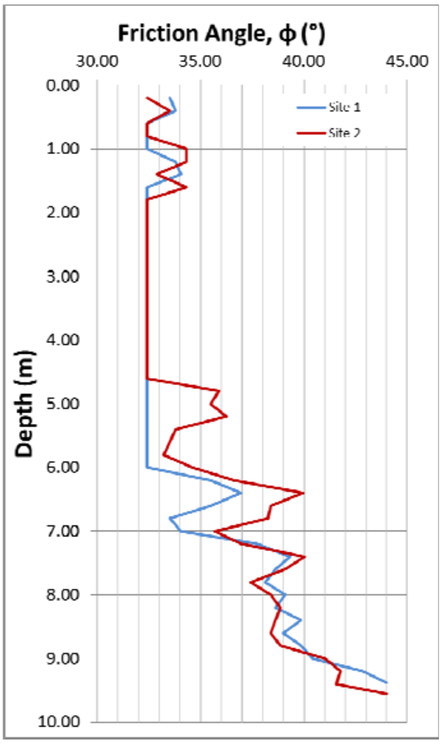

Figure 4 – Friction Angle

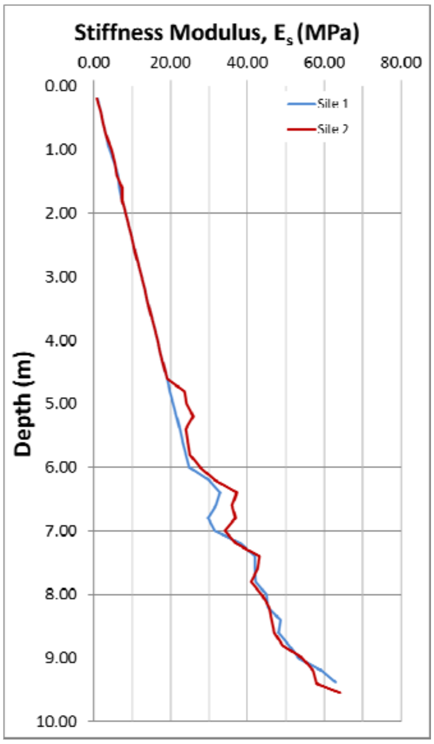

Figure 3 – Stiffness Modulus

References:

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Schweizerischer Verband der Strassen- und Verkehrsfachleute (2006). SN 670 314 (Umnummerierung der inhaltlich unveränderten SN 670 417) – Rammsondierung «von Moos».

Von Soos, P. (2006). Eigenschaften von Boden und Fels – ihre Ermittlung im Labor. In: Smoltczyk (ed.) Grundbau-Taschenbuch – Teil 1: Geotechnische Grundlagen. Ernst & Sohn, Berlin, 6. Auflage.