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Correlations between geotechnical and electrical data: A case study at Garchy in France

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Abstract

Geophysical (Electrical Resistivity Tomography, Ground Penetrating Radar profiles and seismic refraction) and geotechnical (dynamic penetrometer, in situ vane test) surveys were carried out at Garchy (Nièvre, France). The main objective of this study was to establish qualitative and quantitative correlations between electrical and geotechnical data from this site in a simple geological context.

Concerning qualitative correlations, geotechnical tests and Electrical Resistivity Tomography sections are consistent with a three-layers model: a fine soil with a significant clay fraction sandwiched between a low moisture sandy soil and oolitic limestones. Despite the usual difficulty to locate clearly interfaces in inverted ERT sections, both methods provide consistent depths of the substratum top. Moreover, this study confirms that correlations between reflectors of GPR profiles and vertical geotechnical property variations are mainly explained by vertical water content changes.

As far as quantitative correlations are concerned, no clear relationship between cone resistance and inverted resistivity extracted from ERT sections has been observed. Nevertheless, if we do not consider the upper sandy soil composed with gravels, the couple inverted resistivity–cone resistance would be a lithological discriminator. This lithological discrimination is enhanced when inverted resistivity values obtained from extracted 1D soundings are considered. This original result should be validated in other sites. Moreover, a satisfactory quantitative correlation between inverted resistivity values and measured water content values has been obtained; this correlation demonstrates once more that resistivity is a good indirect predictor of water content.

Keywords: Geotechnical tests; Electrical tomography; Ground Penetrating Radar; Water content

1. Introduction

Proper design and successful construction of any structure require an accurate determination of the engineering properties of the soils at the site. For this purpose, geotechnical field tests (cone penetration test, dynamic and static cone penetration test, in situ vane

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