Geoelectrical and geotechnical characterization of shallow subsurface soil from the campus of University of Peshawar, Khyber Pakhtunkhwa

Ihtisham Islam[1,2] and Waqas Ahmed[1]
[1]National Centre of Excellence in Geology, University of Peshawar, Pakistan
[2]Department of Geology, Shaheed Benazir Bhutto University Sheringal Dir Upper, Pakistan
ihtisham.islam2463@gmail.com

Abstract

The stability of engineered and natural structures like roads, buildings, tunnels, bridges, dams, and slopes is the most important aspect of geotechnical engineering. A proper design and successful construction of any infrastructure needs precise determination of the geotechnical properties of soil. These properties are conventionally obtained by geotechnical laboratory investigations performed on soil samples collected from construction site.Sampling from these traditional techniques is generally expensive and time consuming. Furthermore, soil properties are subjected to wide temporal and spatial variations and therefore accurate evaluation of soil properties require high density sampling.Recently, rapid, cost effective and non-destructive geophysical techniques i.e. electric resistivity, seismic refraction, ground penetrating radar etc. have got much attention and are commonly practiced in engineering site analysis. Among all these techniques, geo-electric survey is an attractive tool used for evaluating subsurface properties without any soil disturbance.

The study area, campus of the University of Peshawar is located in Peshawar District. It is comprised of the western part of the Peshawar Basin and lies about 10km of Peshawar city on the main Grand Trunk road, KhyberPakhtunkhwa. It is situated at latitude 34°02' and longitude 71°28' and about 1177ft above mean sea level. Construction of residential flats and research laboratories is proposed by the National Centre of Excellence in Geologyand the University of Agriculture, Khyber Pakhtunkhwa. Geo-electrical resistivity survey was conducted to obtain data in the study area and undisturbed soil samples from drilled boreholes were collected for the geotechnical analysis.

The results of resistivity data and geotechnical analysis were correlated in order to develop a relationship between moisture content and soil resistivity. The results shows good correlation with R2=0.716. Graphically,electrical resistivity readings are increase with a decreasing moisture content, reason being for a low soil moisture content there is less ionic mobility of electrons and hence higher the resistance. Another correlation is established between soil strength parameters i,e cohesion (c) and Angle of internal friction (ϕ), and electrical resistivity data. Angle of internal friction shows good correlation with R2=0.8441 indicating with increasing (ϕ), resistivity also increases.Weak correlation has been observed between cohesion and electrical resistivity with R2=0.4272. Correlation between SPT (N) and electrical resistivity is also observed which shows a good correlation with R2=0.80. These results concluded that resistivity of soil increases with increasing SPT (N) and angle of internal friction while it decreases with increasing moisture content and cohesion.