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Engineering Geology and Geophysical Investigations of Rock Masses at the Foundation Level of New El- Fayium City

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ABSTRACT

New El-Fayium City is one of the most modern urban settlements established in 2000 like New Cairo and New Assuit. The proposed site of the study area is located southeast of El-Fayium City, between latitudes $29^{\circ}12'$ and $29^{\circ}14'$ N and longitudes $30^{\circ}52'$ and $30^{\circ}54'$ E. The city covers an area of about $1,700 \text{ km}^2$ and it is considered as a wadi plain with a gentle relief in the northeastern direction and at the southwestern of the city, the elevation is more than 70 m where Naalun Mountain is located but at the northern part the elevation is less than 40 m.

The foundation layers at New El-Fayium City consist mainly of impure calcareous sandy silt, calcareous clayey silt, sandy silt, calcareous silty clay which have high swelling characteristics and calcareous sand conglomerate. In the study area, as a result of inadequate studies of the geological formations and nature of the soil and their impact on buildings, several cases of structural imperfections or cracks in concrete members were observed in the city.

It was observed that expansive soils in the study area are considered among the difficult foundation materials and expand upon wetting due to water leakage from agricultural areas. Expansive soils are considered problematic soils for architectural and civil engineers when used as foundation materials or a foundation level to support various types of civil engineering structures. This type of soils may cause minor to major structural damages to pavements and buildings. Clay soils in the study area are mainly containing a considerable amount of montmorillonite (smectite), in addition to kaolinite and illite. Such a mineral (montmorillonite) has high potentiality for swelling or shrinking, due to changes in its moisture content. Moreover, direct and indirect methods are used to evaluate the swelling potentiality of the soils.

This thesis is concerned about carrying out laboratory tests for geological samples as well as shallow seismic field measurements for estimation the engineering-geological characteristics.

These engineering-geological characteristics were measured for both soil and rock samples using physical, geotechnical properties for soil samples and physical and mechanical properties for rock samples.

The physical properties of soil samples include moisture content, density, specific gravity, insoluble residue and grain size analysis, while the geotechnical properties include Atterberg limits, consistency indices and swelling potentiality by direct and indirect methods.

The physical and mechanical of the sedimentary rock samples were achieved by determining the moisture content, density, specific gravity, porosity, insoluble residue, grain size analysis and unconfined compressive strength.

Also, ten shallow seismic refraction profiles were acquired in the study area for depth and velocity calculations. Four layers were detected in the area reaching a maximum depth of 50 m. The seismic tomography is one of the most advanced and accurate methods which are used to imagine the subsurface models and produce smoothed and layered models. Multi-analysis of surface wave (MASW) method is applied to obtain 1D shear waves velocity of these ten seismic profiles.

Several thin clay layers intercalated with sand and gypsum pockets were found in the study area. These layers were observed in boreholes but not detected in the seismic sections. The thickness of these clay layers is sometimes below the vertical seismic resolution, so it cannot be detected and other times above it and can be resolved. Therefore, the vertical seismic resolution has been determined to detect the thickness of thin clay layers that may cause soil swelling which in turn, severely damages the foundation and crack the building structures.

Finally, by calculating the compressional and shear wave velocities from shallow seismic refraction profiles, it is easy to estimate the engineering parameters and classify the soil depend on referenced ranges Tables.

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