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Assessing subsurface strata using geophysical and geotechnical methods for designing structures near ground cracks

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This paper presents a combined approach using both geophysical and geotechnical approaches to study and evaluate the subsurface strata near ground for sites suffering from faults and cracks. It demonstrates how both techniques can be utilized to gather useful information for design geotechnical engineers. The safe distance for construction close to a ground crack is mainly dependant on the subsurface stratification and the engineering properties of underlying soils or rocks. Other factors include the area geology and concepts of safety margins. This study is carried out for a site in Al-Qassim region, Saudi Arabia. This type of faults and cracks can normally occur due to a geological or physical event or due to the nature and properties of the subsurface material. The geotechnical works included advancing rotary boreholes to depths of 25m to 31m with sampling and testing. The geophysical method used included performing 2D electrical resistivity profiles. The results of geophysical and geotechnical works showed good and close agreement. The use of 2D electrical resistivity was found useful to establish the layer thicknesses of shale and highly plastic clay. This cannot be determined without deep and expensive direct boring investigation. The results showed that a thick layer of expansive soil, which is considered a high-risk soil type containing large percentage of highly plastic clay materials, underlies the site. The volume changes due to humidity variations can result in either swelling or shrinking. These changes can have significant impact on engineering structures such as light buildings and roads. The logic of placing structures in close vicinity of the cracks is based on lateral stresses exerted on the crack face. The layer thickness is a detrimental factor to establish a safe design distance. Stress distribution analysis procedure is explained.