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Abstract

Objectives/Scope: It is widely understood that most construction risk lies in the ground, so to avoid cost and schedule overrun, major capital works projects such as industrial and civil infrastructure, constructed onshore, offshore or on islands, require an understanding of subsurface conditions. Epistemic uncertainty of the subsurface is the principal cause of ground risk and must be reduced to effectively manage risk. As with major existing assets, unforeseen conditions including geological hazards such as karst, can pose a major issue for the stability, serviceability, and sustainability of infrastructures from the relatively short construction phase and, critically, throughout the more extensive operational life. Traditionally pre-construction ground investigations at the design stage are conducted over relatively large areas based on limited or incomplete localized information, largely provided by a conventional drill-sample-test approach. This provides discrete ground information with relatively poor spatial sampling. For projects where asset construction is complete or already operating, the presence of subsurface hazards resulting from poor or incomplete site characterization can result in unforeseen and unwanted outcomes for the asset, generating unexpected costs and even failures to asset serviceability. Engineering geophysical screening methods when integrated with other geo-data, can made a significant contribution to reducing epistemic uncertainty, to a better understanding of the subsurface and to manage ground-related risks for infrastructure development and operation.

Methods, Procedures, Process: Engineering geophysics can provide spatial imaging of the subsurface leading to detection of adverse subsurface conditions such as karst (cavities, solution features) that forms a common geohazard across the middle east region. Shallow seismic surveys comprising of Tomographic Imaging of Surface waves (TomoSW), Multichannel Analysis of Surface Waves (MASW) and Cross-hole Tomography were performed at the surface and between existing boreholes to assess the presence of karst during construction activities and in areas with challenging access.

Results, Observations, Conclusions: The geophysical results were displayed in the form of two-dimensional anomaly strength maps and three-dimensional shear wave velocity models to map the extension of hazardous zones generated by karstic dissolution within the subsurface stratigraphy. This approach helped to geographically focus and implement practical remediation measures to prevent future damage to existing assets caused by settlement, subsidence, and other types of ground failure. Geophysical results were used to determine the success of remedial activities comprising pre-grouting and post-grouting assessment of the subsurface.

Novel/Additive Information: The purpose of this paper is to demonstrate using different case studies, how geophysics can be used to better manage karstic related ground risk when compared to a conventional approach.