MULTI-SEISMIC AND GPR APPROACH FOR SLOPE STABILITY ASSESSMENT, MCGALLS BAY, BERMUDA

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Some projects pose the challenge of establishing geophysical survey geometries within constrained areas while still obtaining sufficient spatial distribution of data points containing information to the desired depths.

This paper presents a multi-method survey approach within a small constrained area that was used to assess shallow and deep geological parameters possibly affecting slope stability and erosion potential of waterfront property in Bermuda.

Multiple-frequency GPR antennas were used to gather information ranging from high-resolution shallow imaging of voids to deep imaging of geologic structures. Seismic survey geometries were constructed to allow for multiple analyses from one data set. The primary seismic survey included multichannel analysis of surface wave (MASW) methods, from which shear wave velocity (Vs) depth profiles were derived. Other seismic information was obtained by refraction, reflection, and common-offset analyses.

Results of shallow GPR and seismic investigations include the mapping of soil layers, measurement of soil density (stiffness), and delineation of voids within a depth of 15 to 20 feet. GPR and MASW mapping results revealed distinct layers of soil.

Deep subsurface imaging was accomplished with high-powered low-frequency

(LF) GPR surveys and common mid-point (CMP) and common offset (CO) seismic reflection processing. LF GPR imaging was effective from depths of approximately 25 to 160 feet. Seismic models for this area are considered effective from approximately 50 to several hundred feet, depending on signal quality. Deep air-filled layered and vertical void structures were identified in all survey areas.

The survey results included:

- stiff and competent layers were identified and evaluated for foundations and slope anchors
- candidate areas were identified for grouting in the presence of extensive void structures and evidence of soil subsidence
- soft and loose soil areas may need stabilization before being exposed to heavy equipment
- shallow soil layers dip toward the ocean and may represent failure surfaces creating slope failure hazards