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A Geo-Physical Investigation into the Colombo Port Seabed using Sub Bottom Profiler

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Abstract: Traditionally, seabed layers were determined by using conventional mechanical methods like boreholing, which retrieved the strata at a single point at one time. Later it was developed to various acoustic remote sensing techniques which can determine layers robustly, with less cost. Sub Bottom Profiler (SBP) is an effective method used to identify and describe the layers of sediments under the seabottom. SBP is almost similar to an echo sounder, but portion of the sound pulse is penetrating beneath the seafloor and reflected off of the strata layers. These refracted acoustic signals will show any sort of density disturbance. Sub bottom systems have been used to detect and measure the thickness of sediment deposits, identify buried objects, and define the bedrock layer of a basin. Transducer frequency and pulse length are the key aspects on the SBP system performance. Absorption losses are proportional to the transmitting frequency. Long sound pulse lengths required more energy and resulting deeper penetration but decreasing the system resolution. The Stratabox HD is a pinger type SBP having the capability of detecting the soft sediment layers in high resolution. The objective of this study was to carry out a geo-physical investigation of the Colombo Port using the SBP. Data was collected at the Jaya Container Terminal (JCT) basin. Sub-bottom fence diagrams were generated with Hypack software and results were validated using the existing borehole samples. The initial sub bottom soft layers were closely matched with the borehole sample data.

Keywords: Sub Bottom Profiler, Sediments, Geo Physical Investigation, Coastal Engineering

Introduction

Sub bottom profiler (SBP) is a widely used geophysical technique, which is used to distinguish and depict different strata of sediment below the bed of water bodies. Sub bottom profiler is used in many fields such as under water terrain measuring, terrain mapping, buried object investigation and hidden status exploration have been the most common usages of the SBP. While, sedimentary materials cannot be identified from sub bottom profiler directly, different layers can be distinguished according to the penetration of acoustic impedance with respect to different layers (Gutowski et at, 2004; Wheeler, 1998) SBP is based on vertical reflection similer to seismic profiling (Figure 1). Basically SBP are used in shallow reflection seismic profiling. Usually SBP transmitted its echostic wave around a central frequency and their bandwidths varied from system to system. SBP used acoustic wave source and one or several receivers. Lower frequencies are used in SBP to penetrate bottom strata. They developed significantly during the past few decades with different capabilities.

The pinger type SBP is a shallow penetration profiling system designed to provide high resolution results up to 30m in soft materials. Shorter wavelengths allows for

fine details in the shallow subsurface (Uncles & Mitchell, 2017).

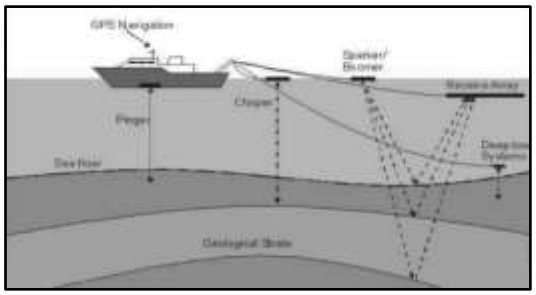


Figure 1. Various SBP techniques.

The main purpose of this study was to assess the performance of StrataboxHD SBP in bottom strata classification.

Methodology

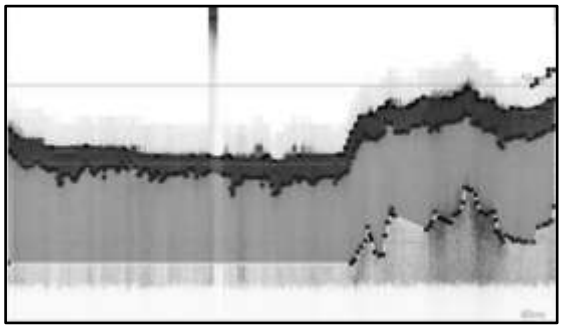
Sub-bottom data was collected at the Colombo Port using the Stratabox HD subbottom profiler. The frequency of the transducer was 10kHz. Data was collected & processed using Hypack software and results were compared with the third party borehole samples of the same area obtained from the Ports Authority. Further, collected grab sample data were also used to classify the first layer of the strata.

Figure 2. Collected SBP Data and Sample Locations.

Results

In Colombo Port, mainly two sub bottom layers were identified from the StrataboxHD SBP (Figure 3). Top layer was a soft silty clay layer varying from 1 to 3m deep and the second layer was a moderate clay layer ranging from 2-10m after the top layer. This was further verified by the existing borehole sample data (Figure 4). The average penetration depth was about 20m from the system.

Figure 3. Classified SBP layers Fence Diagram.



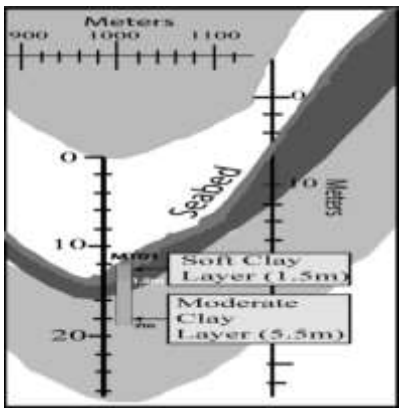


Figure 4. Comparision of SBP data with Borehole

Conclusion

StrataboxHD SBP is capable of successfully distingulish the soft bottom layers and they and closely matching with the existing borehole data in the vicinity. However, the bottom penetration depth is about 20m as we used the 10kHz transducer. For better penetration, it is recommended to use lower frequencies like 3 kHz. Further, this system is successfully be used in detection of burried objects like pipelines. But, the reception sensitivity must be correctly adjusted as the background noises is also playing an important role in obtaining better results.

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Author Biographies

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