

INTEGRASI DATA GEOTEKNIK DAN PEMODELAN 3D UNTUK ANALISIS STRATIGRAFI DI AREA BREAKWATER

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ABSTRACT

The construction of marine infrastructure, such as breakwaters, is susceptible to geotechnical risks arising from uncertainties regarding subsurface stratigraphic conditions. This study aims to integrate geotechnical data obtained from hand-boring with three-dimensional (3D) modeling to analyze soil stratigraphy at the proposed breakwater site at Beach, Bengkalis Regency, Riau. Data were collected from nine hand-boring locations, comprising spatial coordinates, depth, soil layer descriptions, and physical soil parameters (soil classification). Stratigraphic analysis was conducted by correlating data across boreholes to identify soil layer types, thicknesses, and continuity. A 3D model was developed using spatial interpolation methods to comprehensively visualize the vertical and lateral distribution of soil layers. Cross-validation was performed by comparing model results with actual field data. The findings demonstrate that integrating geotechnical data with 3D modeling yields a more accurate stratigraphic representation than conventional two-dimensional approaches. The resulting 3D model illustrates layer geometry and thickness variations while identifying potential geohazard zones—such as soft soil layers—that impact breakwater stability. This research contributes to the advancement of geotechnical investigation methods in data-limited coastal areas and provides a scientific basis for safer, more sustainable coastal infrastructure planning.

Keywords: geotechnical data integration, 3D modeling, stratigraphy, hand-boring, breakwater, Papal Beach