

USE OF HIGH STRAIN DYNAMIC LOAD TESTS AND INSTRUMENTED PILE LOAD TESTS IN THE OPTIMISATION OF SKIN FRICTION AND END BEARING CAPACITIES OF ROCK SOCKETED BORED PILES

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High-strain dynamic load tests (HSDLT) and instrumented pile load tests (IPLT) are modern techniques for evaluating the axial capacity of deep foundations. This study explores how these testing methods can be used to optimise the design of rock-socketed bored piles by improving the estimates of skin friction and end bearing capacity. Currently, pile designs often rely on conservative empirical formulas or limited site data, which can lead to over-engineered foundations or, conversely, under-designed piles with safety risks. The overall purpose of this research is to bridge the gap between conventional design predictions and actual pile performance by leveraging data from real pile load tests in Sri Lankan projects.

The research investigates three case studies involving rock-socketed cast-in-situ bored piles: (1) a high-rise building project ("Oceanfront" mixed development), (2) a transportation infrastructure project (KMTTDP), and (3) an elevated highway project (Port Access Road in Colombo). In each project, a series of HSDLTs and/or static IPLTs were conducted on selected test piles. The methods of analysis include field testing (using a drop-weight apparatus for HSDLT and a reaction frame with strain-gauged piles for IPLT), data interpretation with signal-matching analysis (CAPWAP for dynamic tests), and comparisons with predictions from analytical and empirical design methods. Key design methods considered are those based on intact rock strength and rock mass properties (e.g., empirical formulas using uniaxial compressive strength and Rock Mass Rating), as well as code-based criteria (such as the 10% pile diameter failure criterion in BS 8004 and a 25 mm settlement criterion in local guidelines). By comparing measured shaft friction mobilisation and end bearing with these predictions, the study identifies discrepancies and potential conservatism or non-conservatism in current design approaches.

Principal conclusions drawn from the study are that incorporating HSDLT and IPLT data can significantly improve the accuracy of rock-socketed pile capacity predictions. The data-driven insights allow for calibration of design parameters — for instance, confirming that the commonly assumed bond strength between rock and concrete can be safely increased for high quality rock sockets, or that the end bearing in moderately weathered rock may be lower than textbook values unless large settlements occur. The study's findings underscore the importance of performing at least one full-scale load test in major projects to optimise the pile design: using test-validated parameters, pile lengths or diameters could be reduced in some cases, leading to substantial cost savings without compromising safety. In summary, the use of high-strain dynamic and instrumented static pile load tests provides a more reliable basis for the design of bored piles in rock, enabling engineers to strike a better balance between safety and economy in foundation design.

Keywords: Axial capacity, Dynamic testing, Load transfer, Rock-socketed piles, Static load testing

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