

Geotechnical Design and Performance of Foundations on Expansive Soils in Mozambique

A Sudanese Methodology for African Arid Climates

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ABSTRACT

{ "background": "Expansive soils present a significant geotechnical challenge for foundation design across many arid and semi-arid regions of Africa, leading to structural damage and economic loss. Current design practices often rely on imported methodologies that may not adequately account for local climatic and soil behavioural patterns.", "purpose and objectives": "This working paper aims to adapt and evaluate a foundation design methodology, originally developed for Sudanese arid climates, for application on expansive soils in a representative arid region of Mozambique. The objective is to assess its technical suitability and performance for mitigating swell-shrink risks.", "methodology": "The study employs a comparative analytical framework. Site investigation data from a case study location, including soil suction profiles and swell pressure tests, were used as inputs. The core analytical model is a modified volumetric strain prediction: $\epsilon_{sv} = \gamma_h (\log \psi_f - \log \psi_i) + \beta$, where γ_h and β are soil-specific parameters derived from oedometer tests, and ψ represents soil suction. Foundation performance was simulated under projected moisture change scenarios.", "findings": "The adapted methodology indicated that deep, stiffened raft foundations, as per the Sudanese approach, could reduce differential settlement by an estimated 60-75% compared to conventional strip footings for the studied soil profile. Parameter uncertainty analysis showed that the swell pressure coefficient was the most sensitive variable, with a 95% confidence interval for predicted heave spanning $\pm 18\text{mm}$.", "conclusion": "The Sudanese methodology provides a technically viable framework for foundation design on expansive soils in analogous African arid climates, such as found in parts of Mozambique. Its success hinges on accurate, site-specific characterisation of soil suction parameters.", "recommendations": "Geotechnical investigations in target regions should prioritise the measurement of soil suction and swell pressure. Further validation through long-term monitoring of instrumented structures is essential. Design codes should consider incorporating climate-based suction models.", "key words": "expansive

Keywords: *Expansive soils, Foundation design, Geotechnical engineering, Southern Africa, Soil-structure interaction, Arid climates, Sudanese methodology*

Article Highlights

- Deep, stiffened raft foundations may reduce differential settlement by 60-75% versus strip footings.
- Swell pressure coefficient is the most sensitive variable in the predictive model.
- Methodological success depends on accurate, site-specific soil suction parameters.
- Provides a framework for foundation design in analogous African arid climates.

Core Analytical Model

The study employs a modified volumetric strain prediction: $\epsilon_{sv} = \gamma_h (\log \psi_f - \log \psi_i) + \beta$, where parameters are derived from site-specific oedometer and suction tests.

This adaptation highlights the critical need for localized geotechnical data in arid region foundation design.

ABSTRACT-ONLY PUBLICATION

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