

CASE STUDY

Structural Integrity Diagnostics and Maintenance Governance for Uganda's Aging Infrastructure

A Case Study

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ABSTRACT

The structural integrity of critical infrastructure in many developing nations is a pressing concern due to ageing, material degradation, and insufficient maintenance regimes. This presents significant risks to public safety and economic development. This case study aims to diagnose the condition of selected ageing bridges and public buildings, evaluate current maintenance governance frameworks, and propose a data-informed strategy for prioritising interventions. A multi-stage diagnostic protocol was employed, combining visual inspections, non-destructive testing (including Schmidt hammer and ultrasonic pulse velocity), and structural modelling. Governance was analysed through document review and stakeholder interviews. A proportional hazards model, $h(t|X) = h_0(t) \exp(\beta_1 X_1 + \beta_2 X_2)$, was used to assess factors influencing time-to-intervention, with robust standard errors to account for heteroscedasticity. Approximately 40% of the inspected structures exhibited advanced corrosion or concrete spalling, directly linked to inadequate drainage detailing. The statistical model indicated that structure type and recorded maintenance history were significant predictors of deterioration state ($p < 0.05$). Governance analysis revealed fragmented responsibility and reactive, rather than planned, maintenance cultures. The study confirms a systemic issue of accelerated deterioration driven by both physical defects and institutional weaknesses. A condition-based maintenance approach is urgently required. Implement a centralised digital asset register with mandatory periodic inspections. Establish clear funding mechanisms for preventative maintenance based on risk-based prioritisation. Develop local capacity for advanced structural health monitoring. structural integrity, condition assessment, maintenance management, infrastructure governance, non-destructive testing, asset management This study provides a novel integrated framework linking technical diagnostics with institutional analysis for infrastructure management in a resource-constrained context, yielding a unique dataset for benchmarking.

Keywords: *Structural integrity assessment, Maintenance governance, Material degradation, Sub-Saharan Africa, Infrastructure management, Condition monitoring, Life-cycle analysis*

Article Highlights

- Multi-stage diagnostics reveal systemic corrosion and spalling in 40% of sampled structures.

Methodological Approach

Combined visual inspection, non-destructive testing (Schmidt hammer, ultrasonic pulse velocity), structural

- Statistical modelling identifies structure type and maintenance history as key deterioration predictors.
- Governance analysis uncovers fragmented responsibility and reactive maintenance cultures.
- Proposed framework integrates technical diagnostics with institutional reform for asset management.

modelling, and stakeholder interviews with proportional hazards statistical analysis.

This study links material degradation directly to institutional governance gaps.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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