ABSTRACT

In the last couple of decades, the bridge stock in Uganda has witnessed frequent incidences of failure. The bridge failures have resulted in increased bridge repair and maintenance costs, and sometimes replacement of structures. The lack of a one-stop centre where historical, technical, inspection and monitoring data can be found makes strategic planning problematic. As a result predictions on bridge failures, priority maintenance and vulnerability to factors, such as extreme weather conditions are seldom done. The purpose of this study has been to investigate the causes of accelerated deterioration and subsequent failure of bridges in Uganda. The focus has been to assess the condition states, potential risks and management strategies of highway bridges. The study is guided by five specific objectives: to establish the status and the need to improve bridge management; to determine the state condition of highways bridges; to identify causal factors of bridge failures; to recommend ways to mitigate bridges against potential risks of severe environmental conditions, and to develop an appropriate management strategy to aid decision-making for the maintenance of bridge stock. The findings of this report are based on literature and documents, interviews with the management of highway bridges, case studies, experiments and historical river flow and precipitation data series. Results show that the observed and potential damages on highway bridges are mainly attributed to inappropriate or/and irregular maintenance, age, overload, and environmental conditions, such as, extreme weather incidences. The observed flaws on highway bridges mainly constitute cracks, delamination, and spalls, abrasion and erosion of river banks, heavy silting of river channels. These flaws become a big problem if not attended to appropriately and in time. An evaluation of the in-situ concrete strength has been presented. Results of analysis of rebound hammer tests and the absence of rust stains in most study sites show that the old bridges (40-60 years) had good quality of concrete, an indication that bridges could have been built to high standard specifications. A knowledge-based multi-criteria model structure system that can be used for maintenance planning of bridges has been presented. The model is intended to aid decision-making process on the urgency of maintenance of bridges over others. An analysis of flood risk to highway bridges using long-term river flow series is also presented. Following the fitting of the Gumbel distribution to the annual maximum discharge values, return levels of maximum floods are predicted based on stationary and non-stationary settings. Result show a trend towards future higher discharge levels in three out of four rivers in a non-stationary setting. The future flood risk calls for a change in strategies of highway bridge management. The results can be used as a basis for decisions when new infrastructure is designed and when future needs for maintenance are planned. From the study, there is a need for a formal computerised Bridge Management System. To develop a robust Bridge Management System, the correct state of bridges must be determined. Because financial and other resources are always limited, priority studies must be done for the purpose of harmonizing maintenance, repair and rehabilitation with the available resources. Bridge-specific and network risk assessment studies should be done to come up with the possible consequences of bridge failures. The research has contributed to knowledge through two journal publications and two peer-reviewed conference papers in which the research has been shared with professionals and researchers in related fields.