

Exploring potential benefits of bridge condition assessment in highway operations

Wen-Jun CAO

PhD researcher

Singapore-ETH Centre/National
University of Singapore

Singapore
wenjun.cao@arch.ethz.ch

W.J. Cao is a PhD candidate working on computational and probabilistic engineering with Profs Koh and Smith

Wang-Sheng Liu

Dr.

Nanyang Technological University

Singapore
LIUW0036@e.ntu.edu.sg

W.S. Liu is a researcher working on optimal design of stochastic complex systems

Chan Ghee Koh

Prof

National University of Singapore

Singapore
cqkoh@nus.edu.sg

C.G. Koh is a full professor from Department of Civil & Environmental Engineering, National university of

I.F.C. Smith

Prof

Swiss Federal Institute of
Technology (EPFL)/ Singapore-ETH
Centre

Switzerland
ian.smith@epfl.ch

I.F.C. Smith is a full professor and Head of the Applied Computing and Mechanics Laboratory, Swiss Federal Institute of Technology, Lausanne

Contact: wenjun.cao@arch.ethz.ch

1 Abstract

In recent years, an increasing number of private firms are involved in public works using the funding strategy of public-private partnerships (PPPs), especially for civil infrastructure projects such as highways and bridges. In this paper, a framework is proposed to quantify the potential benefits of condition assessment in the operation phase. The updated safety condition of highway bridges is introduced as a constraint of the profit optimization problem. The framework includes the following three steps. First, structural identification is carried out to identify parameter values of the bridge involved in the highway project. Then the reserve capacity under the relevant limit state is calculated based on the requirements of bridge design codes. The last step is to investigate the effects of reserve capacity on the optimal operating profit. This framework is applied to a highway flyover project in Singapore. The optimal operating profit based on quantified reserve capacity increases relative to the case without information of reserve capacity. This significant potential economic benefit associated with bridge condition assessment in the operation phase of toll highways.

Keywords: Build-operate-transfer, model updating, reserve capacity, multidisciplinary optimization