Resilience Engineering *for* Urban Tunneling

Edited by

Michael Beer, Dr.-Ing.
Hongwei Huang, Ph.D.
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Preface

This report addresses the area of resilience engineering with specific emphasis on urban tunnels and their embedding into civil infrastructure systems. It provides bases for developing a comprehensive overall approach to resilience of urban tunnels. The contributions in this report cover the state of the art from various relevant perspectives, as well as conclusions made for perspective developments. As such, this report provides a source for students and researchers interested in resilience of urban tunnel and infrastructure to get a quick impression on the state of development. It may also serve as a resource for practitioners to adopt recent developments for current and future engineering projects to address and increase resilience. Eventually, the report will increase awareness of the significant importance of resilience among authorities to implement requirements to ensure sustained societal and economic benefits.

The state of the art is represented in seven invited papers. The paper by Zhang and Ayyub describes pathways for using integrated structural health monitoring to enhance the resilience of civil infrastructure. Meschke, Cao, and Freitag report on recent developments for controlling mechanized tunneling using real-time predictions for ensuring structural reliability. An advanced technology for real-time monitoring of tunnels is presented by Huang and Zhang, where non-intrusive inspections are used to ensure tunnel resilience. These three contributions demonstrate the current level of achievement in the area using advanced engineering models and technologies. In addition, they provide a perspective for further developments expanding from this platform. The remaining papers address selected specific challenges and ideas for solution that seek their synergetic marriage with the broad powerful platform to form a comprehensive overall framework to address resilience of urban tunnels at large. Behrensdorf, Broggi, and Beer explore a numerical concept for assessing the reliability of complex interconnected systems. Klemt-Albert, Hartung, and Bahlau discuss the criticality of neuralgic points in traffic networks in view of enhancing resilience. Zuev and Beer highlight issues and potential solutions when assessing reliability of networks of critical infrastructure. Eventually, Einstein documents the importance of decision aids in tunneling with respect to risk and resilience.

The second part of this report is built on the discussions from the First International Workshop on Resiliency of Urban Tunnels (Reston, Virginia, USA, September 1, 2016) and the conclusions drawn for perspective developments. This part is structured in conclusions from three breakout session reports, and three structured research recommendations on the key topics are identified. The first breakout session report concerns the monitoring for resiliency of urban tunnels. The second report refers to robust design of tunnels. Third, the modeling and

management of uncertainties is considered. The reports in these three topic areas summarize synergetic findings and advice from expert discussions as a guide for future developments. They were used as a basis to develop three structured research recommendations, which were rolled out after the breakout session reports. The first recommendation is focused on developments on monitoring for resiliency of urban tunnels. The second concerns robust monitoring and maintenance for durability. The third is devoted to resilience engineering at a system scale. These recommendations are intended to be developed into large-scale research programs.

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Attendees and Affiliations

Last	*First*	*Affiliation*
Amare	Tekeste	Maryland Transportation Authority
Ariaratnam	Samuel	Arizona State University
Atamturktur	Sez	Clemson University
Ayyub	Bilal	University of Maryland
Beer	Michael	Leibniz Universität Hannover
Bergeson	Bill	Federal Highway Administration
Broggi	Matteo	Leibniz Universität Hannover
Butry	David	National Institute of Standards and Technology (NIST)
Einstein	Herbert	Massachusetts Institute of Technology (MIT)
Galisson	Loic	Soldata Northern America
Gong	Wenping	Clemson University
Huang	Hongwei	Tongji University
Irias	Xavier	East Bay Municipal Utility District
Juang	Hsein	Clemson University
Klemt-Albert	Katharina	Leibniz Universität Hannover
McLeod	Marshall	East Bay Municipal Utility District
McPherson	David	HDR, Inc.
Meschke	Günther	Ruhr University Bochum
Nie	Xingyao	Tongji University
Ning	Zhangwei	Soldata Northern America
Phillips	Brian	University of Maryland
Saadat	Yalda	University of Maryland
Sansavini	Giovanni	ETH Zurich
Shou	Kehjian (Albert)	National Chung-Hsing University
Topa Gomes	António	University of Porto
Wu	Jingzhe	University of Maryland
Xie	Xiongyao	Tongji University
Xiong	Haocheng	Virginia Tech
Zhang	Dongming	Tongji University
Zhang	Jie	Clemson University
Zhang	Yunfeng	University of Maryland
Zhang	Yinning	Virginia Tech
Zhou	Biao	Tongji University
Zuev	Konstantin	California Institute of Technology