PhD-FSTC-2013-11
The Faculty of Sciences, Technology and Communication

DISSERTATION

Presented on 08/05/2013 in Luxembourg

to obtain the degree of

DOCTEUR DE L'UNIVERSITÉ DU LUXEMBOURG

EN SCIENCES DE L'INGÉNIEUR

by

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EVALUATION OF DYNAMIC DAMAGE INDICATORS ON REAL-LIFE CIVIL ENGINEERING STRUCTURES: MEASUREMENT UNCERTAINTY AND ENVIRONMENTAL INFLUENCES CONSIDERED

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Shaker Verlag
Aachen 2014

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Zugl.: University of Luxembourg, Diss., 2013

Printed in Germany.

ISBN 978-3-8440-2673-3
ISSN 0945-067X

Shaker Verlag GmbH • P.O. BOX 101818 • D-52018 Aachen
Phone: 0049/2407/9596-0 • Telefax: 0049/2407/9596-9
Internet: www.shaker.de • e-mail: info@shaker.de

PREFACE

This thesis is the result of my four years' work (June 2009 - May 2013) at the University of Luxembourg in the Faculty of Science, Technology and Communication, in the Research Unit of Engineering Science and under the supervision of Prof. Dr. Stefan Maas. The project *Dynamic Evaluation of Civil Engineering Structures* is financed by the University of Luxembourg in cooperation with the *Administration des Ponts et Chaussées Luxembourg*. The overall aim is to use non-destructive testing methods for condition control of civil engineering structures, and particularly of bridges. During this work, I have learned a lot in the field of vibration analysis, signal processing and conducting different projects. A large part of the work consisted in organising and conducting extensive test programmes for large bridges with artificial damage such as the Champangshiehl bridge which was tested during three weeks and demolished afterwards due to new urban planning. In this instance, one year was spent on the planning and evaluation from the ex ante calculation of the cracks to the organisation of the test series. This project required lot of discussions and organisational meetings as restrictions were imposed for safety and handling reasons. During this major project part, I gained a lot of experience in managing and scientifically approaching a project of this kind, as the opportunity to use an in situ structure for test procedures was unique for such a small country and University of Luxembourg.

Furthermore, as a research worker with a background in physics (specialisation in biophysics), it was initially a challenge to get into the field of engineering science. However, over the years and with the experience in teaching the exercises in mechanics, I acquired the knowledge in the field of engineering science, which was needed to accomplish the project. In addition, it was of high importance during the project to be familiar with using different software for signal processing and finite-element modelling. My background in physics

proved to be especially helpful to solve various problems encountered during the research. I can only affirm the common stereotype of physicists being able to handle any kind of problems. Even without a basic in engineering science I have always endeavoured to give my best input in this field of research and hope the gained results can be of interest for future work at the University of Luxembourg and abroad.

First of all, I would like to thank Prof. Dr. Stefan Maas giving me the opportunity to do this type of research at the University of Luxembourg without the usual profile. I remember well when I was sitting in his office for the first interview, and he was already convinced that a physicist, without any knowledge in neither mechanics nor finite-element modelling could handle this project. Secondly, I also want to thank him for several discussions about various problems, which I encountered during my work. In addition, he gave me the possibility to publish at different conferences and journals, which is an asset since nowadays a greater emphasis is given to listed publications and speeches.

I also want to thank my co-workers, especially Frank Scherbaum who was also involved in the project of the Champangshiehl bridge and my predecessors Prof. Dr. Ing Markus Waltering and Dr. Ing. Volker Bungard, from whom I gained my basics in vibration analysis, and who initiated me in the topic. Furthermore, I would like to thank the technical assistants without whom any experimental data, essential for this work, would be missing. Therefore, many thanks are due to Ed Weyer, Marc Seil, Vicente Reis Adonis, Claude Colle, Ken Adam, Cédric Bruyère, Ralph Reiter, Raphael Hinger and Gilbert Klein. I am also very grateful to André Stemper and Lionel Arend for fruitful discussions on signal processing, and Simone Drees for the administrative work. Moreover, another thank you goes to the students, whose Bachelor Theses or Master and Bachelor projects were also a part of this project: Ba Mamadou Aliou, Tom Wagner, Jeff Waldbillig, Pierre Reitz, Mike Scholtes, Philippe Ries, Jeremy Silva Vieira, Andy Tibolt, Thomas Ostrihon, Tom Schmit, Romain Steffen, Nuno Pereira and Patrick Ficerai. I am also thankful to the interims students whose algorithm or evaluation of the results helped a lot on the project: Christian Grosch, Shubham Sirothia and Patrick Lamberty. Further, another thank you goes to Michèle Noblet and Viet Ha Nguyen for the proofreading of the thesis.

Moreover, I would also like to thank the members of the dissertation defence committee: Prof. Dr. Guido De Roeck form the KU Leuven and Prof. Dr. Jean-Claude Golinval from the Université de Liège for fruitful discussions and corrections, and Ass.-Prof. Dr. Danièle

Waldmann-Diederich from the University of Luxembourg and Prof. Dr. Arno Zürbes from the Fachhoschule Bingen for their input during regular meetings over the four-year period of my research at the University of Luxembourg.

I am also ingratiated to the cooperation partners, without whom the experimental part would have been impossible: Gilles Didier and all his staff of the *division d'ouvrages d'art* and regional divisions of the *Administration des Ponts et Chaussées Luxembourg* for giving me the opportunity to measure the bridges in situ and for the transportation of the force exciters; Joseph Lippis, Dino and David at Construction Baatz for the help and organisation on the Champangshiehl bridge; the *Fonds Kirchberg*, whose donation on the test series on the Champangshiehl bridge was most welcome; Marc Buchler and Max Friob at ArcelorMittal for providing the beam blanks as an experimental mass to load the Champangshiehl bridge and Claude Schmit at Arcoop, project manager at the construction site of the porte de l'europe, for being in charge of the time management at the Champangshiehl bridge.

Last but not least, I am very grateful to my family, Marie-Paule and my friends for their endless patience, interest and support.

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