

Hugo Hens

Performance Based Building Design 1

From Below Grade Construction to Cavity Walls

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to Cavity Walls

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To my wife, children and grandchildren

*In remembrance of Professor A. de Grave
Who introduced building physics as a new discipline
at the University of Leuven (KULeuven), Belgium, in 1952*

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Preface

Overview

Just like building physics, performance based building design was hardly an issue before the energy crises of the nineteen seventies. Together with the need for more energy efficiency, the interest in overall building performance grew. The tome on applied building physics already discussed a performance rationale, and contained an in depth analysis of the heat, air, moisture performance requirements at the building and building enclosure level. This third tome builds on that rationale although also structural aspects, acoustics, fire safety, maintenance and buildability are considered now. The text reflects thirty eight years of teaching architectural, building and civil engineers, coupled to more than forty years of experience in research and consultancy. Where and when needed, input from over the world was used, reason why each chapter ends with a list of references and literature.

The book should be usable by undergraduates and graduates in architectural and building engineering, though also building engineers, who want to refresh their knowledge, may benefit. The level of discussion assumes the reader has a sound knowledge of building physics, along with a background in structural engineering, building materials and building construction.

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A book of this magnitude reflects the work of many, not only of the author. Therefore, first of all, we like to thank the thousands of students we had. They gave us the opportunity to test the content and helped in upgrading it.

The text should not been written the way it is, if not standing on the shoulders of those, who preceded. Although we started our carrier as a structural engineer, our predecessor, Professor Antoine de Grave, planted the seeds that slowly fed our interest in building physics, building services and performance based building design. The late Bob Vos of TNO, the Netherlands, and Helmut Künzle of the Fraunhofer Institut für Bauphysik, Germany, showed the importance of experimental work and field testing for understanding building performance, while Lars Erik Nevander of Lund University, Sweden, taught that application does not always ask extended modeling, mainly because reality in building construction is much more complex than any simulation can reflect.

During the four decennia at the Laboratory of Building Physics, several researchers and PhD-students got involved. I am very grateful to Gerrit Vermeir, Staf Roels Dirk Saelens and Hans Janssen who became colleagues at the university; to Jan Carmeliet, now professor at the ETH-Zürich; Piet Standaert, a principal at Physibel Engineering; Jan Lecompte, at Bekaert NV; Filip Descamps, a principal at Daidalos Engineering and part-time professor at the Free University Brussels (VUB); Arnold Janssens, associate professor at the University of Ghent (UG); Rongjin Zheng, associate professor at Zhejiang University, China, Bert Blocken, professor at the Technical University Eindhoven (TU/e) and Griet Verbeeck, professor at KHL, who all contributed by their work. The experiences gained by working as a structural engineer and building site supervisor at the start of my career, as building assessor over the years, as researcher and operating agent of four Annexes of the IEA, Executive Committee on Energy Conservation in Buildings and Community Systems forced me to rethink the engineering based performance approach every time again. The many ideas I exchanged and got in Canada and the USA from Kumar Kumaran, Paul Fazio, Bill Brown, William B. Rose, Joe Lstiburek and

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Finally, I thank my family, my wife Lieve, who managed living together with a busy engineering professor, my three children who had to live with that busy father and my many grandchildren who do not know their grandfather is still busy.

Leuven, February 2012

Hugo S. L. C. Hens