



# Fluid Mechanics Aspects of Fire and Smoke Dynamics in Enclosures

By Bart Merci, Tarek Beji



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This book aims at fulfilling the need for a handbook at undergraduate and starting researcher level on fire and smoke dynamics in enclosures, giving fluid mechanics aspects a central role. Fluid mechanics are essential at the level of combustion, heat transfer and fire suppression, but they are described only cursorily in most of the existing fire safety science literature, including handbooks.

The scope of this handbook ranges from the discussion of the basic equations for turbulent flows with combustion, through a discussion on the structure of flames, to fire and smoke plumes and their interaction with enclosure boundaries. Using this knowledge, the fire dynamics and smoke and heat control in enclosures are discussed. Subsequently, a chapter is devoted to the effect of water and the related fluid mechanics aspects. The book concludes with a chapter on CFD (Computational Fluid Dynamics), the increasingly popular calculation method in the field of fire safety science.

The authors have attempted to write a book where the theory is illustrated by worked-out examples and the reader is challenged to complete additional clarifying exercises. The book is intended primarily for teaching purposes, but at the same time should prove a useful tool for starting researchers in the field of fire safety science, providing in-depth insight into fluid mechanics in relation to fire phenomena.

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### Editorial Review

#### Review

Using this book people can learn to understand how fires developed and how they can be controlled. The book transfers knowledge from general fluid dynamics and combustion science to the area of fire safety science. Using this approach the accuracy of the prediction of fire will be higher than in traditional approaches more based on empirical correlations. The approach taken in the book is forward looking. The book will be relevant for a long time.

*Professor D.J.E.M. Roekaerts, Delft University of Technology, Department Process and Energy, section Fluid Mechanics, Delft, The Netherlands*

#### About the Author

**Prof. Bart Merci** obtained his PhD, entitled 'Numerical Simulation and Modelling of Turbulent Combustion', at the Faculty of Engineering at Ghent University in the year 2000. As postdoctoral fellow of the Fund for Scientific Research – Flanders (FWO Vlaanderen), he specialized in numerical simulations of turbulent non-premixed combustion, with focus on turbulence – chemistry interaction and turbulence – radiation interaction. He reoriented his research towards fire safety science, taking the fluid mechanics aspects as central research topic. He became lecturer at Ghent University in 2004 and Full Professor in 2012. He is the head of the research unit 'Combustion, Fire and Fire Safety' in the Department of Flow, Heat and Combustion Mechanics. Since 2009, Bart Merci coordinates the 'International Master of Science in Fire Safety Engineering', with Lund University and The University of Edinburgh as partners. He has been the President of The Belgian Section of The Combustion Institute since 2009 and Associate Editor of Fire Safety Journal since 2010. He is member of the Executive Committee of the International Association for Fire Safety Science. He is author of more than 100 journal papers.

**Dr. Tarek Beji** obtained his PhD, entitled "Theoretical and Experimental Investigation on Soot and Radiation in Fires", at the University of Ulster in 2009. He joined Ghent University in 2011 as a post-doctoral researcher in the department of Flow, Heat and Combustion Mechanics and worked on the novel topic of fire forecasting. Since 2012 he has been very active in a large international collaborative research program called PRISME, focusing on mechanical ventilation and fire dynamics in nuclear facilities. Since he joined Ghent University he participated actively in the 'International Master of Science in Fire Safety Engineering' as lecturer and member of the program steering committee.

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