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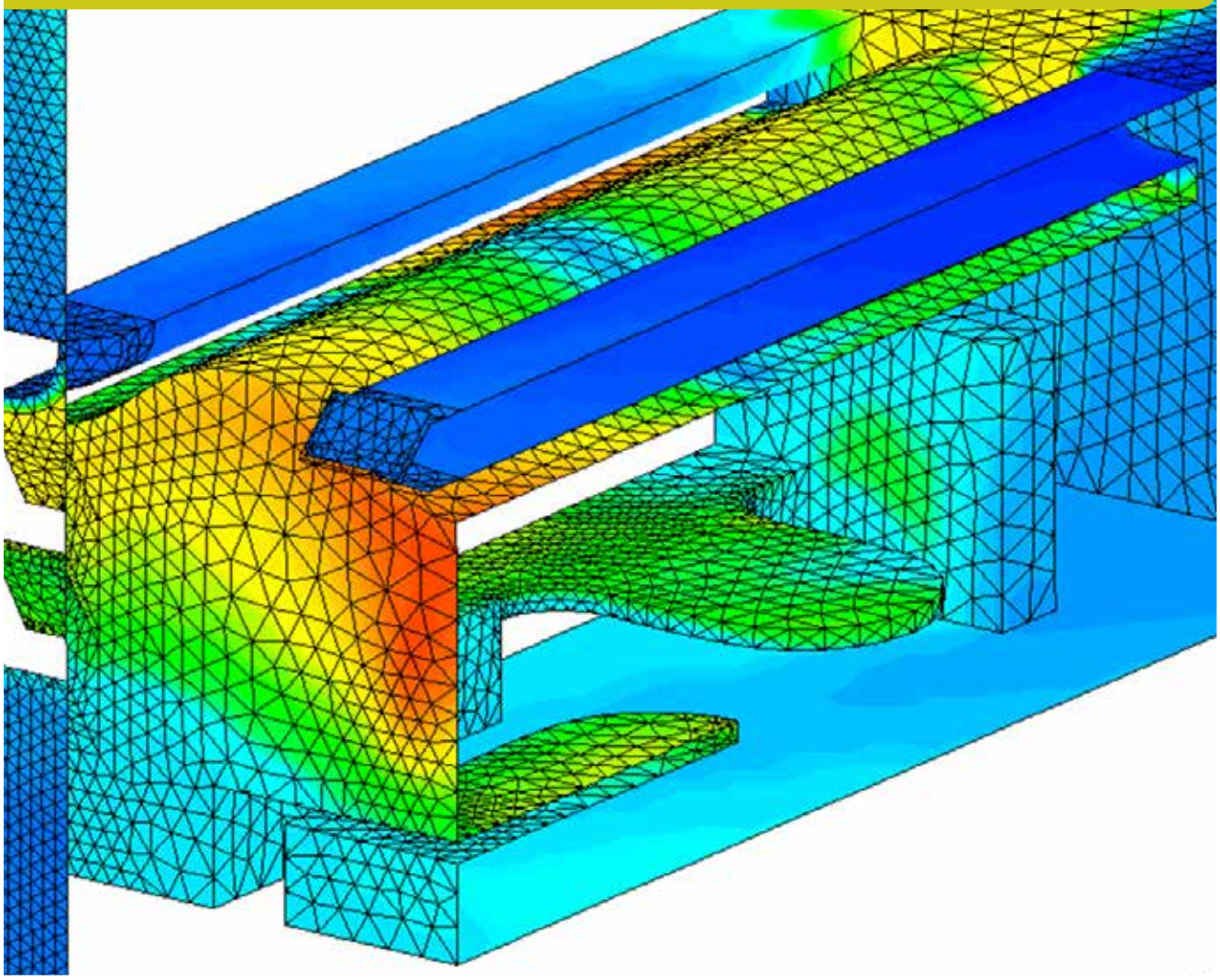
Computational fluid dynamics in building design

An introductory guide

Richard Chitty and Chunli Cao



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Contents

Abbreviations v

1 Introduction 1

2 Computational fluid dynamics explained 2

2.1 Grids 3
2.2 Sub-models 4
2.3 Other models 4

3 Computational fluid dynamics in use 5

3.1 Resources 5
3.2 Analysis of results 5

Building applications

4 Fire safety design 10

4.1 Data input 10
4.2 Data output 10
4.3 Post processing 11
4.4 Modelling assumptions 11
4.5 Fire investigation 12

5 Ventilation and thermal comfort 13

5.1 Defining indoor thermal comfort 13

6 Wind loading 15

6.1 Effect of turbulence models in wind loading calculations 15
6.2 Atmospheric boundary layer 16
6.3 Domain size 16

7 Microclimate around buildings 17

7.1 Identification of potential issues 17
7.2 Wind climate 17
7.3 Criteria for pedestrian comfort 18
7.4 Outdoor thermal comfort criteria 18

Cont'd . . .

Case studies

8 Case study 1: Fire simulation 20

8.1 The test scenario 20
8.2 Setting up the problem 20
8.3 Simulations 20
8.4 Summary 22

9 Case study 2: Natural ventilation 23

9.1 The building 23
9.2 The CFD model 23
9.3 The problem considered 24
9.4 Summary 25

10 References 26

1 Introduction

Computational fluid dynamics (CFD) modelling is a powerful tool that is routinely used in fire engineering and building design[1,2]. It can be used to simulate different aspects of a building's performance or its impact on the local environment.

This guide gives some of the background to the CFD methodology for non-experts such as Building Control and other regulatory authorities who have to approve or accept a design. They may be presented with the visualised results of CFD simulations in various graphical formats (including animations) that show the predicted performance. However, underlying assumptions, factors and limitations that impact on the quality of the predictions tend to be buried in detailed technical reports.

The process of reviewing CFD predictions is often dependent on the ability of the reviewer to be able to identify 'schoolboy' errors (eg supersonic wind velocities or fire temperatures of 5000 °C!) using simple sanity checks based on their experience of the real world rather than the mathematical limits of the simulation environment. Visualisation methods often mask the difference between:

- a *qualitative* simulation to demonstrate the feasibility of a concept
- a *quantitative* simulation required to prove functionality of different aspects of the design.

This guide discusses the current capabilities and limitations of CFD for building design and gives guidance on best practice, focusing on:

- fire safety
- ventilation
- thermal comfort
- wind movement around buildings.

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Computational fluid dynamics in building design

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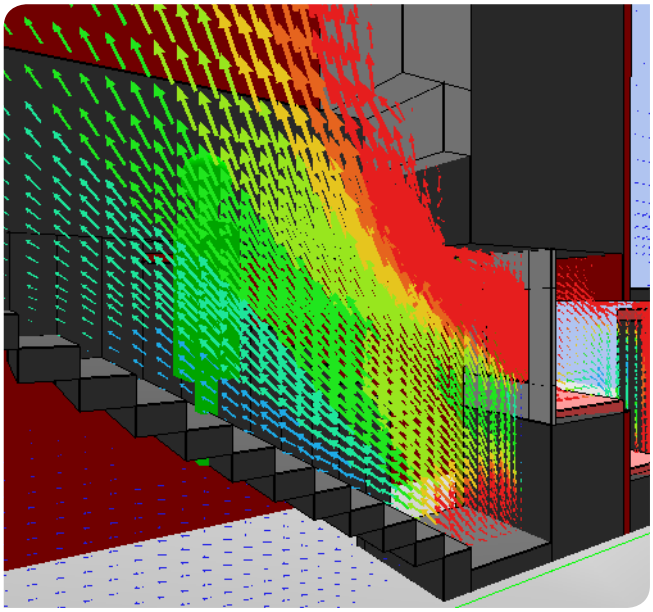

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