LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Simulering av rumsbränder
Simulation of Fires in Enclosures

VBRN16, 5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED BI/RH
Date of Decision: 2023-04-12

General Information

Main field: Fire Safety Technology.
Compulsory for: MFST1
Language of instruction: The course will be given in English

Aim

The course is designed to provide basic knowledge of how the spread of fire and combustion gases is simulated using ”Computational Fluid Dynamics” (CFD), in fire safety design and fire investigations. It also provides an understanding of the limitations of the numerical and physical models used and an awareness of the most common sources of error.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to describe the physical models used for conservation of mass, material, energy, and momentum.
- be able to describe in depth models for combustion, radiation and turbulence (RANS, LES).
- be able to describe various numerical methods for solving the equation sets.
- be able to identify the limitations and most common sources of error of the model components used.

Competences and skills
For a passing grade the student must

- be able to calculate the spread of combustion gases in various enclosure configurations using CFD programs.
- be able to assess calculated results against experimental data.
- be able to decide on how the uncertainty in a simulation can be estimated on the basis of assumptions included in the physical and numerical models used.
- be able to understand and use professional terminology within the field of fire evolution simulation using CFD.
- be able to report on, both orally and in writing, and discuss the implications of the executed simulation of the spread of combustion gases in association with fire safety design and fire investigations.
- be able to make use of material published in technical references and user manuals for advanced simulation programs for combustion gas spreading.

Judgement and approach
For a passing grade the student must

- demonstrate insight into the possibilities and limitations of fire safety simulation methods, as well as their role in advanced building technical project planning and in human responsibility for their use.
- demonstrate the ability to analyse and evaluate individually the results of CFD calculations.
- demonstrate capability for identifying his/her own needs for further knowledge and for on-going improvement of his/her own competence in fire safety simulation.

Contents

- Introduction to CFD
- Time and length-scales in fires
- Turbulence models
- Numerical methods
- Large eddy simulation (LES)
- Combustion models
- Radiation models
- Soot models
- Heat transfer models
- Creation and processing of CFD models
- Common errors and troubleshooting in CFD modelling

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written individual examination and approved individual assignments.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Admission requirements:

- VBRF05 Fire Dynamics or VBRF10 Fire Dynamics

Assumed prior knowledge: VBR022 Fire Chemistry and Explosions.
The number of participants is limited to: No
The course overlaps following course/s: VBR200, VBRN15

Reading list

- Lecture notes.
- Manuals to the computer code FDS.
- Cox, G. and Kumar, S.: SFPE Handbook of Fire Protection Engineering, Chapter 3:8 ”Modelling Enclosure Fires Using CFD”. NFPA, Quincy, Massachusetts.
- Carlsson, J.: Computational strategies in flame-spread modelling involving wooden surfaces. Brandteknik, Report 1028 , 2003. Licentiat thesis. Chapter 4-6.
- Versteeg, H. K. and Malalasekera, W: An Introduction to Computational Fluid Dynamics, The Finite Volume Method (2nd Ed.). Harlow, Pearson Education Limited, 2007.
- Guan Heng Yeoh and Kwok Kit Yuen: Computational fluid dynamics in fire engineering,, Theory, modelling and practice. Butterworth-Heinemann, 2009. Also available as E-book.

Contact and other information

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