LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Branddynamik
Fire Dynamics

VBRF10, 15 credits, G2 (First Cycle)

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

General Information

Compulsory for: BI2
Language of instruction: The course will be given in Swedish

Aim

The overriding aim of the course is that, after taking the course, the students will understand the various stages that a fire in a building goes through. Furthermore, the course is aimed at providing the students with a knowledge base concerning the different methods and techniques applied in the analysis of a fire sequence, as well as developing their ability to critically examine those methods in terms of practical application. The course is also aimed at increasing the engineering-related ability to construct and analyse models.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to explain the effect of the enclosure on a fire sequence.
- be able to describe the assumptions in the most widely used models.
- be able to explain the range of application of the models (computational and computer) and the applicable constraints for fire safety engineering computations.
- be able to characterise the various stages of a fire sequence based on various variables.
- have knowledge of present research and developments within the area of fire science.

Competences and skills
For a passing grade the student must

- be able to apply various manual computation models and computer models for calculating various variables in a fire sequence.
- be able to calculate the value of various physical variables associated with a fire sequence.
- be able to analyse and interpret results from fire safety engineering experiments.
- be able to judge the reasonableness of calculated results obtained from various computational models.
- be able to estimate data values for input into computational and computer models where these are lacking in the problem statement.
- be able to design fire safety engineering systems for control and handling of combustion gases.
- be able to calculate the conditions in a building during a fire.
- be able to defend, orally and in writing, his/her choice of models and assumptions in the analysis of fire sequences in private and public operations.
- be able to present results from fire safety engineering experiments in a clear and scientific manner.
- be able to search for and apply information concerning fire evolution inside buildings in scientific journals and manuals.
- be able to plan and carry out fire safety engineering experiments.

Judgement and approach
For a passing grade the student must

- demonstrate a capacity to make judgements on the applicability of various models to various types of problems.
- demonstrate insight into the responsibilities of a fire engineer in choosing and reporting parameters in such a way that the models are used properly.
- demonstrate ability to identify the need for more knowledge concerning fire development in buildings.

Contents

- Qualitative description of a fire sequence. Ignition, flame spreading. Various ways of categorising a fire. The effect of the building on the fire.
- Heat release rate. Mass burning rate and time-dependency of the heat release rate, the order of magnitude of the heat release rate, the strengths and weaknesses of various test methods, growth of alfa-t2, the effect of the enclosure on the heat release rate, extraction of a power curve.
- Fire plumes and flames. Froude number, mean flame height, flame-height correlations, various profiles in a plume, ideal plumes, strong and weak plumes, plume correlations, ceiling jets, special issues to be considered in the design process, quasi-stationary conditions, selecting a plume model.
- Pressure profiles. Background on air-flow in buildings. Bernoulli's equation. Various forms of pressure. Computing pressure, rate and mass air-flow through openings.
- Gas temperatures. Energy balance, rate of heat transfer, correlations for computing gas temperatures. Fully-developed fires, ISO 834, temperature calculation.
- Smoke filling. Pressure build-up in the fire enclosure. Transient smoke filling models. Stationary models for control of combustion gases. Various fire safety engineering systems for handling and control of combustion gases. Continuity equations. Correlations.
- The influence of the enclosure on the formation of combustion products.
- Fire dynamics in tunnels.
- Computer modelling. Sub-models for computer models. Model constraints.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: The final certificate is based on a written examination (individual work), home assignments (individual work), and laboratory work reports (group work), and requires active participation in compulsory seminars.

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.

Parts
Code: 0112. **Name:** Fire Dynamics.
Credits: 8. **Grading scale:** TH. **Assessment:** Written examination. **Contents:** The course is based on lectures and written exercises
Code: 0212. **Name:** Laboratory Work and Homework.
Credits: 7. **Grading scale:** UG. **Assessment:** Home assignments (individual work), and laboratory work reports (group work), and participation in compulsory seminars is also required. **Contents:** This part of the course contains seminars and home assignments (individual work) and four laboratories (group work). **Further information:** Group assignments require active participation. Each group member must individually be able to account for the content of the assignment. If a group member does not fulfill the demands of the group or ignores hers/his commitment, she/he can be reassigned to another group or get a fail result.

Admission

Assumed prior knowledge: FMAA05 Calculus in One Variable or FMAB65 Calculus in One Variable B1 together with FMAB70 Calculus in One Variable B2 ,MMVA01 Thermodynamics and Fluid Mechanics, Basic Course.
The number of participants is limited to: No
The course overlaps following course/s: VBR032, VBR033, VBRF05, VBRN05

Reading list

- Karlsson, B, Quintiere, J G: Enclosure Fire Dynamics. CRC Press, 2022, ISBN: 978-1-138-05866-8. 2nd edition.
- Leif Staffansson: Selecting design fires. Lund: Department of Fire Safety Engineering, 2010, ISBN: 978-1-4939-2198-0. Report 7032.
- Haukur Ingason: Fire Dynamics in Tunnels. Springer, 2015. Selected chapters will be provided to the students.
- Additional litteratur will be provided to the students.

Contact and other information

Course coordinator: Nils Johansson, nils.johansson@brand.lth.se
Further information: Some of the teaching is given in English.