

**Mastercourse 7LY4M0
2025 / 2026**

Part: Fire Safety Engineering (FSE)

COURSE INFORMATION FSE

Code	7LY4M0	
Lecturer FSE	Ir. Ruud van Herpen FIFireE.	
Coursename	<i>Nederlands:</i> Gebouwinstallaties en brandveiligheid	<i>English:</i> Building services and fire safety
Course coordinator	Dr. Zoltan Nagy	

Essential information

Goals, in operational terms
<ul style="list-style-type: none"> a) How to realize fire safe buildings, based on public objectives: <ul style="list-style-type: none"> - Personal safety of building occupants in case of fire; - Safety of third party properties (adjacent plots) in case of fire; b) Using active fire and smoke control installations; c) In a consistent fire safety concept, that is sufficient robust for a sustainable and resilient building. The robustness of the safety concept can be quantified by a sensitivity analysis.

Summary

The lectures focus on natural fires, instead of standard fires (standard fire curve). Natural fires depend on fuel characteristics and building characteristics. Therefore, natural fires are project-specific, different in every building. Natural fires are the basis for a performance based approach: *fire safety engineering* ! A performance based approach gives insight in the real fire risks of a building, instead of a rule based approach to ensure code compliance. Fire risks, related to energy transition, are not addressed in the building code and can only be found in a performance based approach. The link between sustainability/durability and fire protection is a hot topic:

<https://youtu.be/CHXvsehbnqc>

The thermal load of a natural fire is not comparable to the thermal load of a standard fire. With a natural fire it is possible to calculate more accurate the thermal load and response of building elements, heat detectors, sprinkler heads, etc. Also the optical density of the smoke, caused by a natural fire is important. The optical density of the smoke decreases the visibility for the building occupants. Smoke detectors are often used to alarm building occupants in case of a decreasing visibility in escape routes.

With thermal or optical detection it is possible to activate both active fire control systems (e.g. sprinkler) and active smoke control systems (e.g. overpressure systems or smoke and heat extraction ventilaton). The influence of active fire and smoke control systems can be taken into account in the natural fire concept. In many cases this results in a decreasing thermal load and an increasing available evacuation time.

Safety of the building occupants by evacuation in acceptable conditions inside the building is the main objective in fire safety engineering. However, sustainable buildings need to be fire resilient. In that case the safety of other risk subsystems is important too: the reliability in case of fire of building structure and fire resistant separation constructions. With a high reliability a fire resilient building is possible. In a fire resilient building evacuation of building occupants is not always necessary, a stay-in-place concept for building occupants might be a safer option.

Simulation results, based on the natural fire concept, depend on boundary conditions. Since most boundary conditions are stochastic, a sensitivity analysis is needed to determine the reliability or robustness of the safety concept. With zone modelling a sensitivity analysis is possible.

Topics and schedule

Week	Lectures FSE	Date	Topics
1	Lecture 1	22 April	<p>Introduction Fire Safety Engineering</p> <hr/> <p><u>Performance based vs prescriptive based:</u> Building, Fuel, Fire and Building occupants Objectives of public safety</p>
2	Lecture 2 and exercises	29 April	<p><u>Physiological aspects:</u> Personal safety of building occupants <i>Exercise:</i> Safety of bedridden building occupants</p> <hr/> <p><u>Natural Fires:</u> Stoichiometric combustion Non stoichiometric combustion Diffusion flames and premixed flames <i>Exercise:</i> Conservation of mass and energy in a fire compartment</p>
3	Lecture 3 and exercise	6 May	<p><u>Natural fire concept:</u> Building, fuel and fire characteristics Natural fires and zone modelling</p> <hr/> <p><i>Exercise:</i> Ozone simulation model Sensitivity analysis on boundary conditions (Q&A FSE-assignment)</p>
4	Lecture 4 and guest lecture	13 May	<p><u>Risk subsystems and Lines of Defence:</u> Stochastic boundary conditions</p> <hr/> <p><i>Guest lecture:</i> <u>Risk subsystem load bearing structure</u> (Geert Ravenshorst – TU Delft, Civil Engineering)</p>
5	Lecture 5 and exercise	20 May	<p><u>Risk subsystem compartmentation:</u> AST-RST analysis Assessment criteria for compartmentation</p> <hr/> <p><i>Exercise:</i> Natural fires, AST-RST analysis compartmentation, Equivalent fire duration</p>
6	Lecture 6 and exercise	27 May	<p><u>Risk subsystem safe evacuation:</u> ASET-RSET analysis large compartment Assessment criteria for human safety</p> <hr/> <p><i>Exercise:</i> AST-RST probabilistic approach, large compartment (Q&A FSE-assignment)</p>

7	Lecture 7 and guest lecture	3 June	<p><u>Heat transfer in case of fire:</u> Steady state and non-steady state boundary conditions Conduction, convection and radiation</p> <hr/> <p><i>Guest lecture:</i> Steel structures and fire resilience (Ralph Hamerlinck – Bouwen met staal)</p>
8	Lecture 8 and exercise	10 June	<p><u>Localized fires:</u> Detection, automatic suppression and smoke and heat extraction (SHEV)</p> <hr/> <p><i>Exercise:</i> Detection, sprinkler and SHEV (Q&A FSE-assignment)</p>
9	Lecture 9, menti-quiz and guest lecture	17 June	<p><u>Fire risks of energy transition:</u> Biobased materials, CLT, BIPV systems, Home batteries Menti-quiz: failure probability of facades</p> <hr/> <p><i>Guest lecture:</i> Fire in renovated single-family homes (Arnhem 2023) (Joost Ebus – NIPV Fire Service Academy)</p>
10	No Lecture	24 June	<p>International Fire Safety & Science Conference Dutch Fire Service Academy – Arnhem 24 and 25 June</p> <p>Free admission for TUE students! (not mandatory)</p>

Assignment

The assignment concerns a fire compartment with different levels of fire protection:

- Passive fire and smoke control (buffering of energy and smoke in the compartment volume)
- Active fire control (sprinkler)
- Active smoke control (smoke and heat extraction ventilation)

The assignment has to be finished in a small report, containing a comparison of the different levels of fire protection provisions for the subsystems:

- Safe compartmentation (building resilience)
- Safe escape routes (safety of building occupants)
- Safe attack routes (safety of fire service and assistance)

Literature

- R.A.P. van Herpen – *Fire Safety Engineering, course reader 7LY4M0* – 2026, TU Eindhoven, NL (available in pdf)
- R.R. Hagen, L. Witloks (modification R.A.P. van Herpen) – *The basis for fire safety (part A)* – 2014, IFV, Arnhem, NL (available in pdf)
- IFEG - *International fire engineering guidelines* - 2005, ICC, USA (available in pdf)
- Eurocode 1 – *Boundary conditions for natural fires* – 2019, NEN Delft, NL (available in pdf)