



Event: 2nd K-FORCE Symposium

Place: Tirana University

Date: 10-09-2019

Knowledge FOR Resilient soCiEty

FSE Education and Research at DTU-BYG

Technical University of Denmark (DTU)

Department of Civil Engineering (DTU-BYG)

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DTU Civil Engineering
Department of Civil Engineering

Co-funded by the
Erasmus+ Programme
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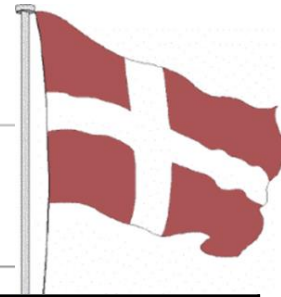
EDUCATION: FSE courses in the MSc and MiB program



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GENERAL COMPETENCES

min 30 ECTS

TECHNICAL SPECIALIZATION

min 30 ECTS

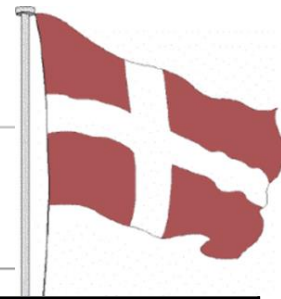
ELECTIVE COURSES

max 30 ECTS

THESIS PROJECT

30-35 ECTS





GENERAL COMPETENCES in FSE

- 11080 Advanced building design (1/6 subjects)*

10 ECTS

TECHNICAL SPECIALIZATION in FSE

- 11020 Fire dynamics
- 11022 Building fire safety
- 11023 *Structural Fire Safety***

3 x 5 ECTS

ELECTIVE COURSES in FSE

- 11124 Computational Fluid Dynamics for Buildings*

5 ECTS

THESIS PROJECT

30-35 ECTS

**only few students in the class*

***mandatory*





MiB (Master in Fire) programs at DTU-BYG

- Target: engineers working in the field of FSE industry or in the public section
- Requirement: BSc or BEng in building engineering + min 2 year relevant work experience
- Work load: half than a full time master (half-time working day assumed)
- Duration: min 2 years (3 semesters of courses plus 1 last semester for final project)
can be extended to 4 years upon agreement with the head of study
- Frequency: every 2 years
- Started: 1999 (20 years ago, 10 times the program runs)
- Schedule: 3 weeks of lectures at DTU (one every 1 ½ month approx.) + remote learning
(3 courses per week, each having 1 ½ day lecturing)
- ECTS: 60 ECTS in total – *equivalent to 1 year MSc Education*
(5 ECTS per course, 3 course per semester, final project of 15 ECTS)
- Certification: The program allows to apply as certified fire consulant (brandrådgiver)





MiB (Master in Fire) programs at DTU-BYG

	Spring semester (Jan – May)	Autumn semester (Aug. – Dec.)
1st year (2019)	<i>15 ECTS</i>	<i>15 ECTS</i>
2nd year (2020)	<i>15 ECTS</i>	<i>15 ECTS</i>



MiB (Master in Fire) programs at DTU-BYG

	Spring semester (Jan – May)	Autumn semester (Aug. – Dec.)
<i>Pre-course (2018)</i>		<ul style="list-style-type: none">• <i>11E16 Engineering-applied Mathematics and Physics</i> <p><u><i>ONLY FOR Beng GRADUATES</i></u></p>
1st year (2019)	<ul style="list-style-type: none">• 11B04 Fire Chemistry• 11B24 Building fire safety• 11B25 Fire Dynamics	<ul style="list-style-type: none">• 11B01 Structural fire safety• 11B02 Industrial fires• 11B12 Fire modeling
2nd year (2020)	<ul style="list-style-type: none">• 11B05 Fire risk management• 11B13 Fire dimensioning• 11B27 Complex buildings	<ul style="list-style-type: none">• 11MIB Fire safety project

Recent student projects on FSE

METHOD PROJECTS	STRUCT. LAB	FIRE LAB	CFD	FEM	OTHER
Fire protection of bridge cables		LUGI			
PEF resist. of fire insulated steel frames				LUGI	
Strength of tempered glass in fire	LUGI	LUGI			
Optimization of insulated steel car parks					LUGI
Water mist system as active fire barrier			LSSO		LSSO
Overpressure and ventilation systems			LSSO		LSSO
Sprinkler systems in high-rise buildings					LSSO
Reliability of smoke detectors exposed to					FRAM

Recent student projects on FSE

METHOD	STRUCT. LAB	FIRE LAB	CFD	FEM	RISK
PROJECTS					
Experimental investigation of fire properties for CLT with fire retardant		FRAM			
Fire risk scenarios in pharmaceutical production applying single-use technology					FRAM
Determining fire brigade intervention size					FRAM
Fire risks of batteries charged by solar cells installed in residential buildings					FRAM
Dynamic risk assessment for estimation of evacuation safety in a complex building					FRAM
Non-fossil fuel vehicles and fire impact on environment and emergency services					FRAM



- *EDUCATION: FSE courses in the MSc and MiB program*
- *RESEARCH: main field of expertise, lab facilities and current projects*



Fire Group

Kristian Hertz
Professor

Fire Safety, Concrete Structures



Lars Schiøtt Sørensen
Assoc. Professor, MiB Leader

Fire dynamics, fire safety, risk

Luisa Giuliani
Assoc. Professor

Structural fire safety



Frank Makert
Assoc. Professor

Fire risk, fire chemistry, & dynamics, industrial fires

Anne Dederichs
SP - DTU part-time Assoc. Prof.

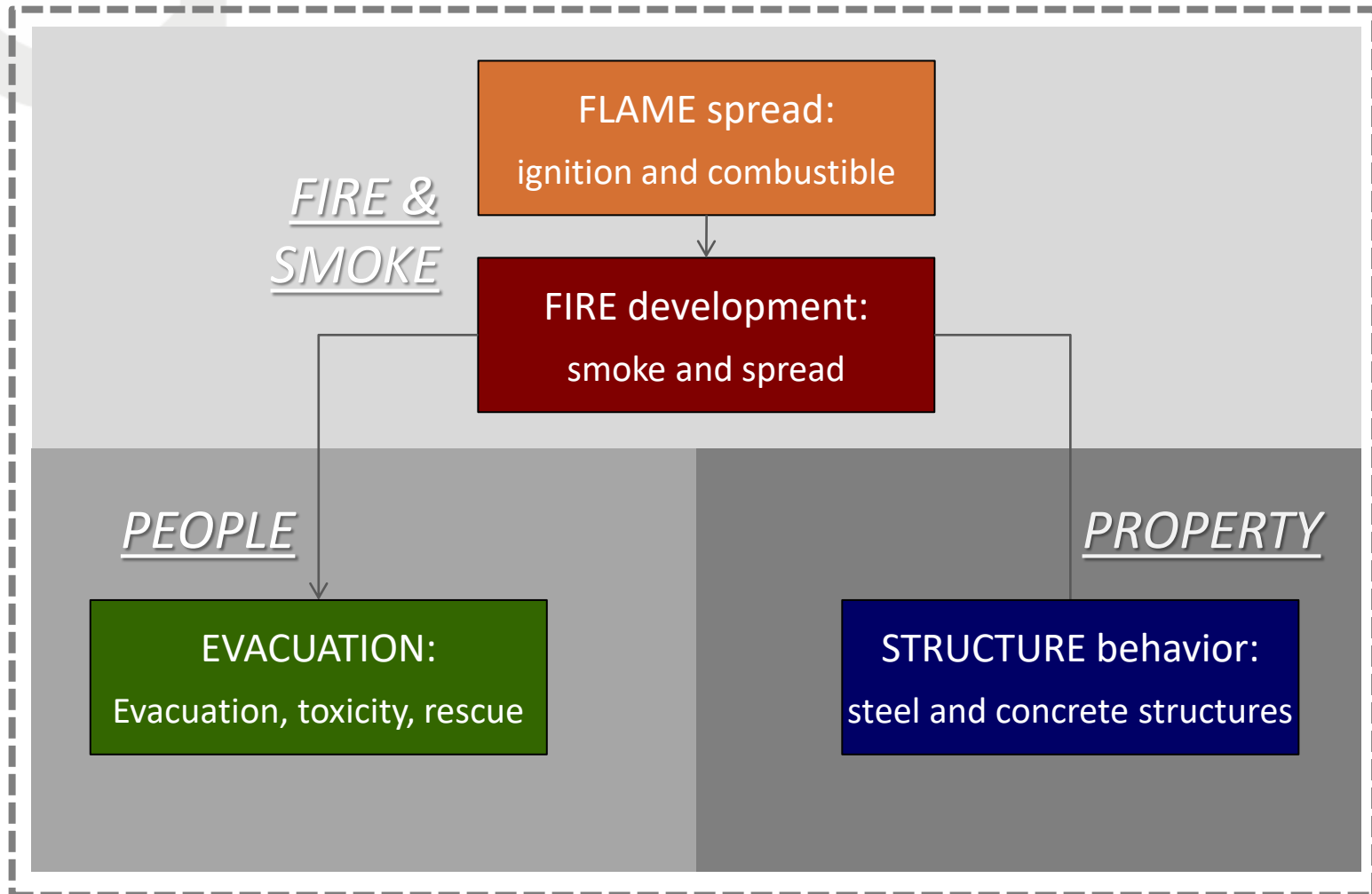
Evacuation, toxicity























Aline Møller
MiB study secretary

Research areas in fire safety

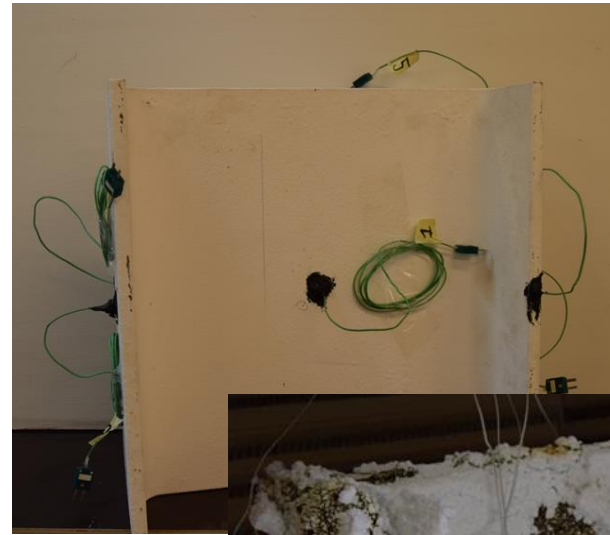
FIRE RISK



Group competences

MAIN RESEARCH AREAS	 KHZ	 LSS	 FRAM	 LUGI	 AND
FLAME					
FIRE					
STRUCTURE					
EVACUATION					
RISK					

Fire Lab at DTU-BYG



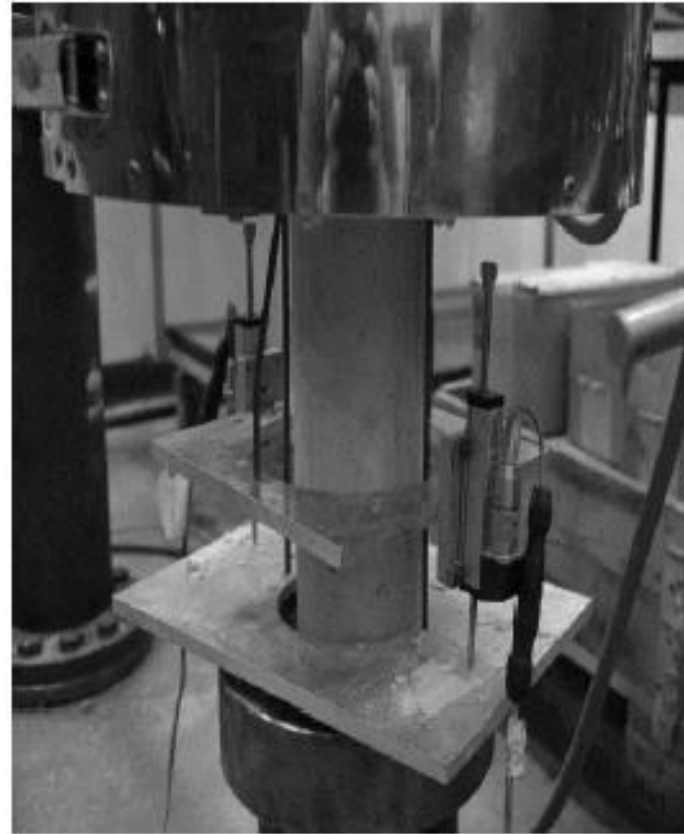
Fire Lab at DBI

(Danish Institute of Fire and Security Technology)



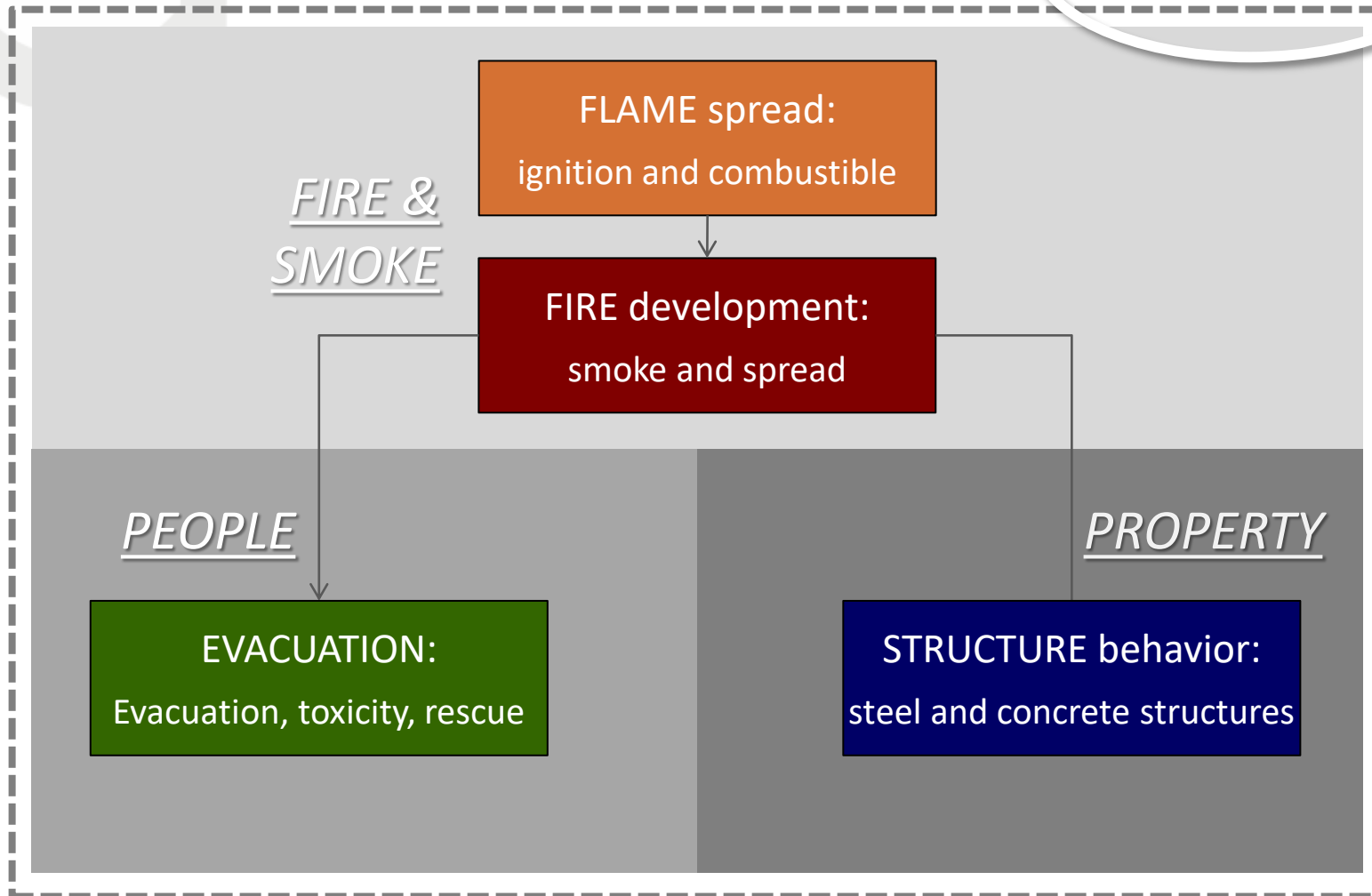
Fire test of superlight floor deck

Structural and concrete Lab at DTU-BYG



Research areas in fire safety

FIRE RISK

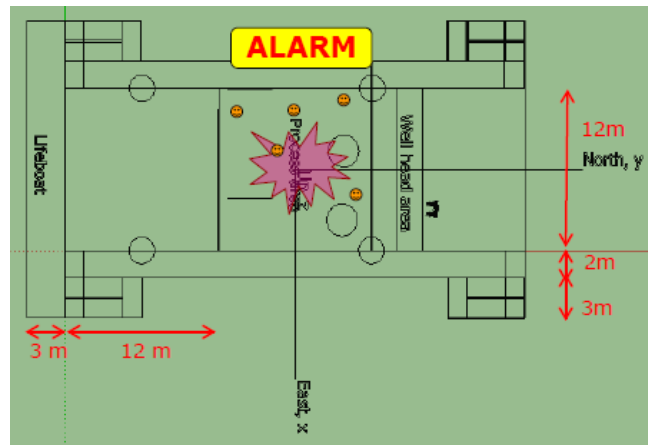




Fire safety and risk dynamic modelling

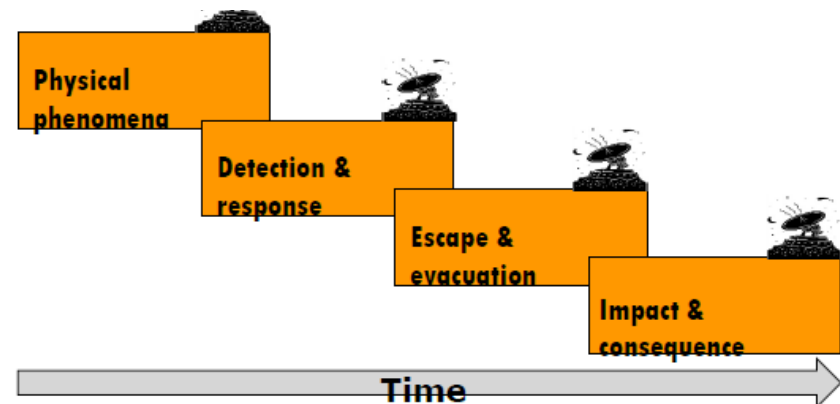
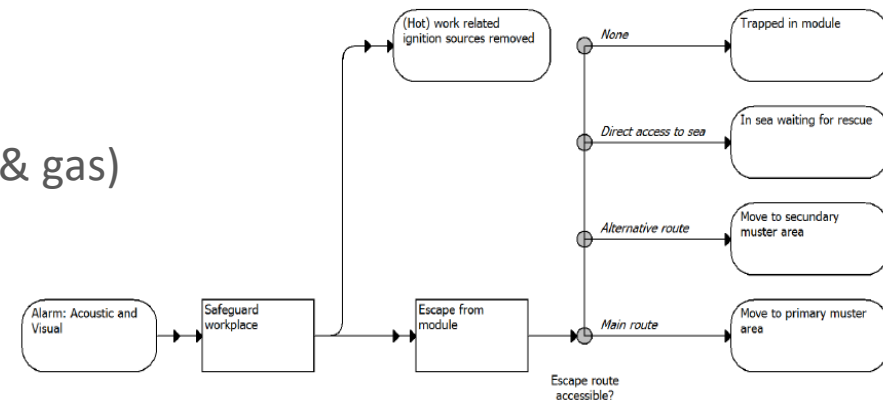
Frank Markert, Assc. Prof.

- Fire risk assessment & management
- Dynamic modelling of Fault & Event trees
- Prediction of ASET / RSET
- Safe energy infrastructures (hydrogen, oil & gas)
- Offshore fire safety
- Fire safety of installations & components
- ATEX and SEVESO



Critical scenario in an oil platform

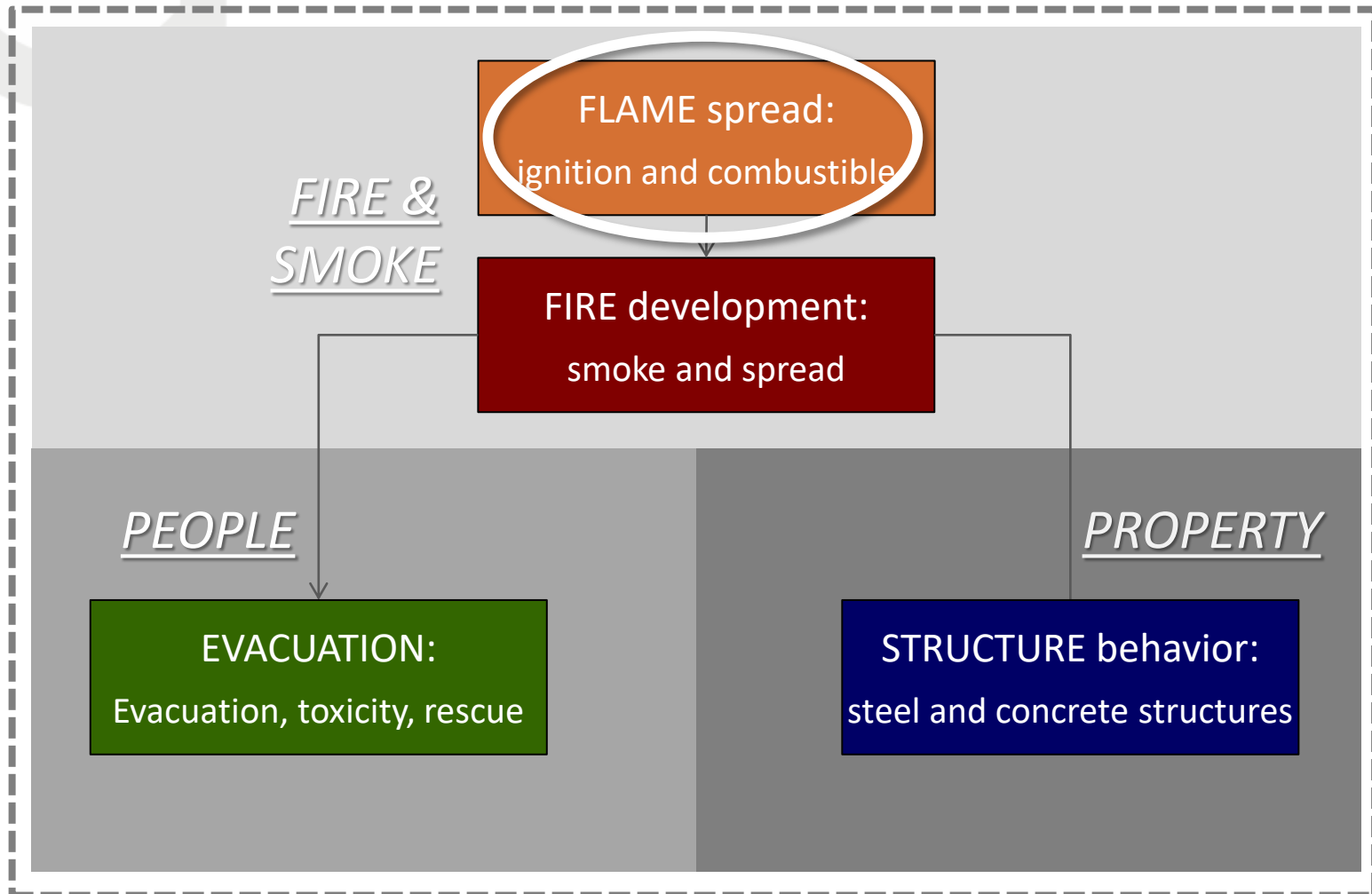
Evacuation event tree



Assesment of an accident

Research areas in fire safety

FIRE RISK

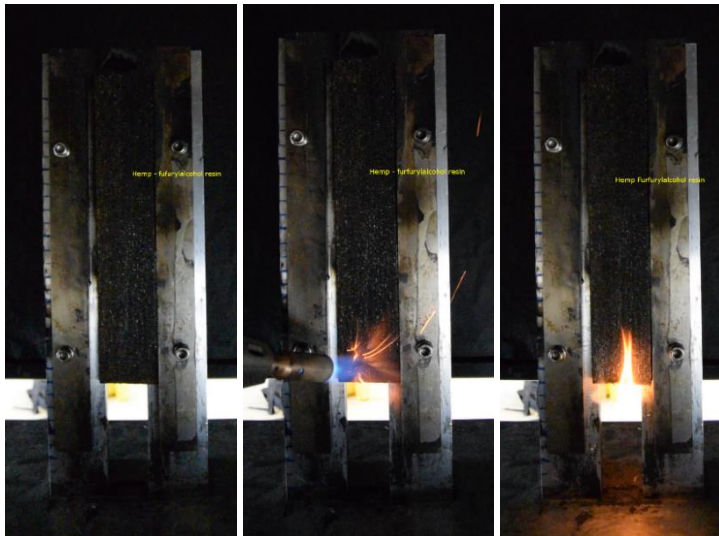




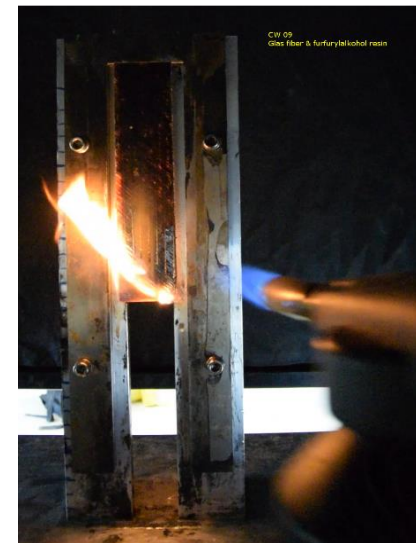
Ignition testing of bio-materials and composites

Frank Markert, Assc. Prof.

- Fire chemistry & toxic fire emissions
- Fire dynamics
- Fire lab testing
- Reaction to fire
- Performance-based codes



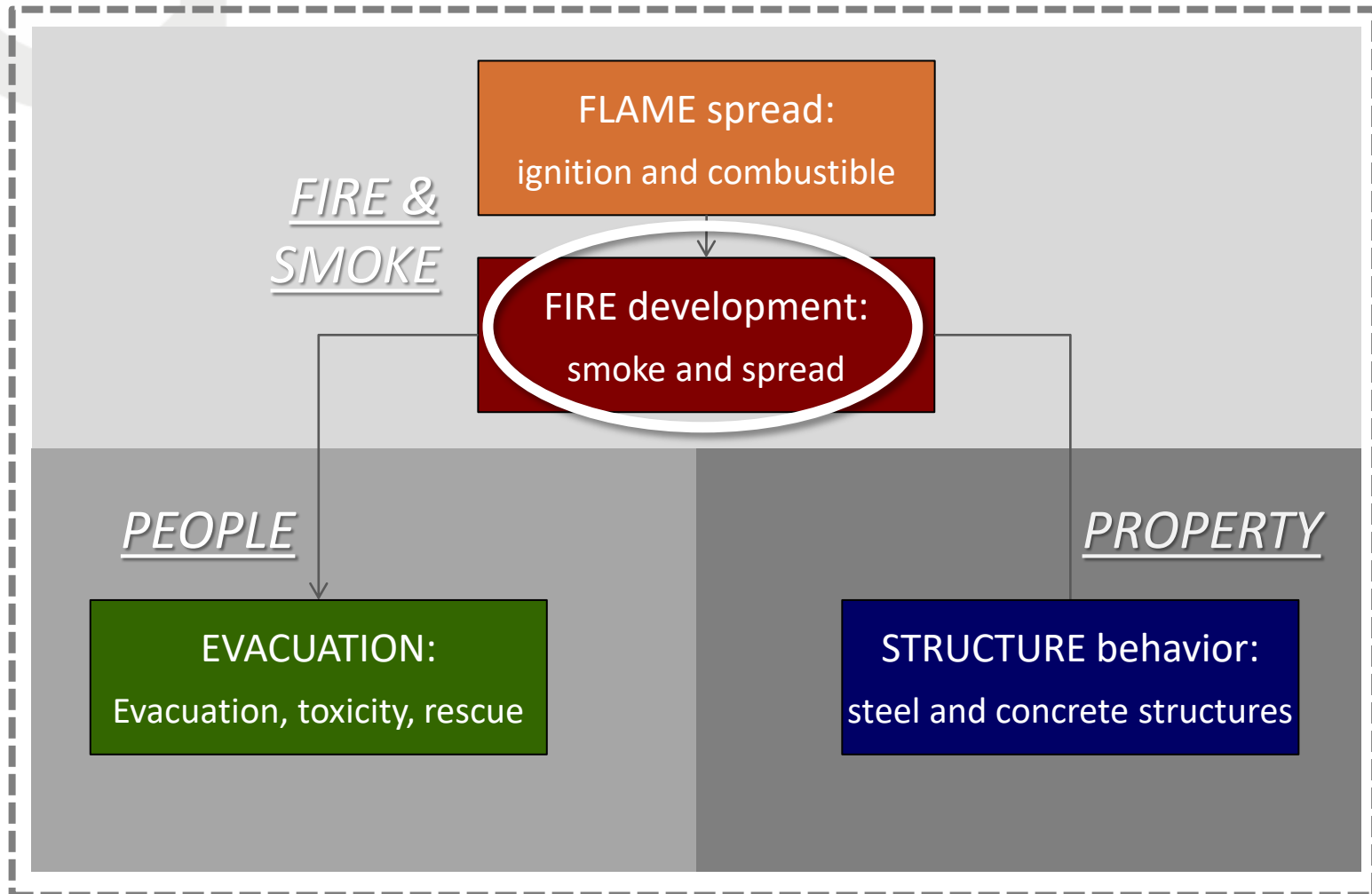
Hemp - furan



Glas fiber - furan

Research areas in fire safety

FIRE RISK

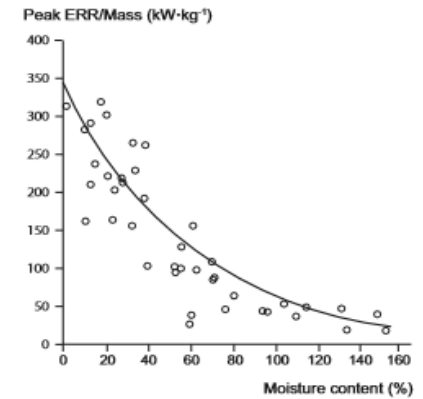
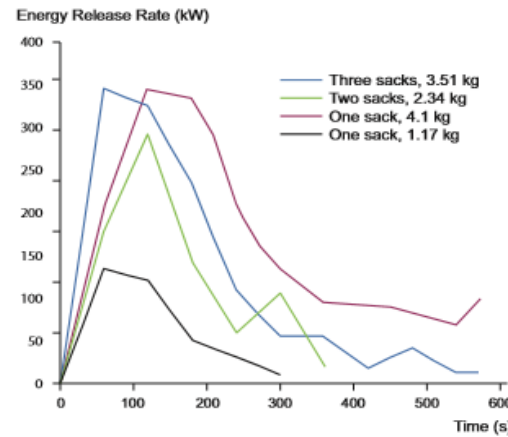
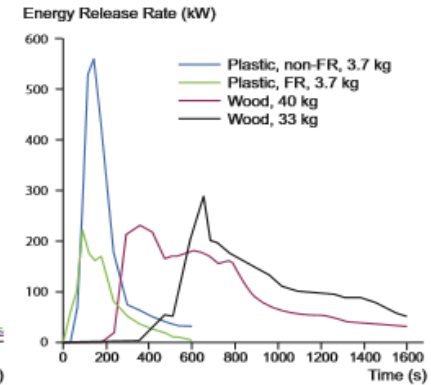
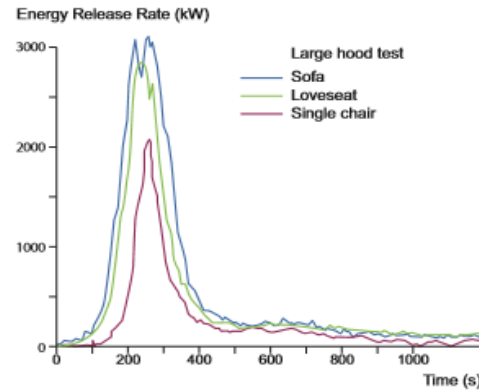
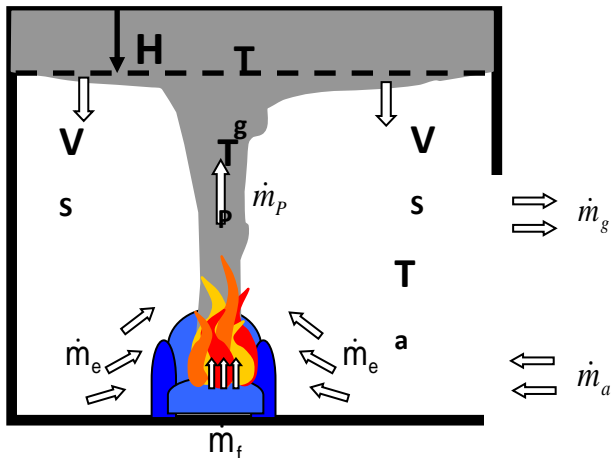




FSE and PBD

Lars Schjøtt Sørensen, Assc. Prof., MiB Leader

- Fire-safety Engineering (FSE)
- Performance-based design (PBD)
- Fire physics
- Fire dynamics
- Fire chemistry (some parts)



TEST: oxygen consumption calorimetry

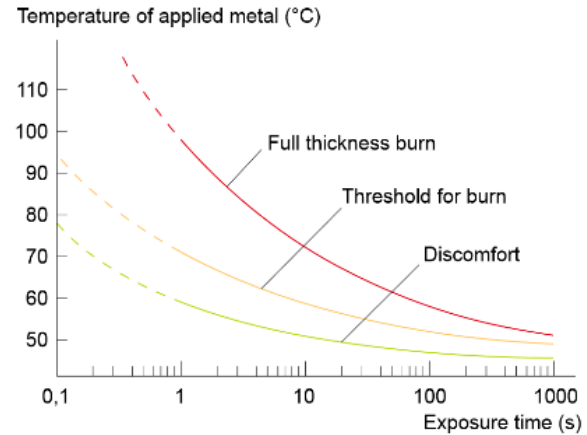




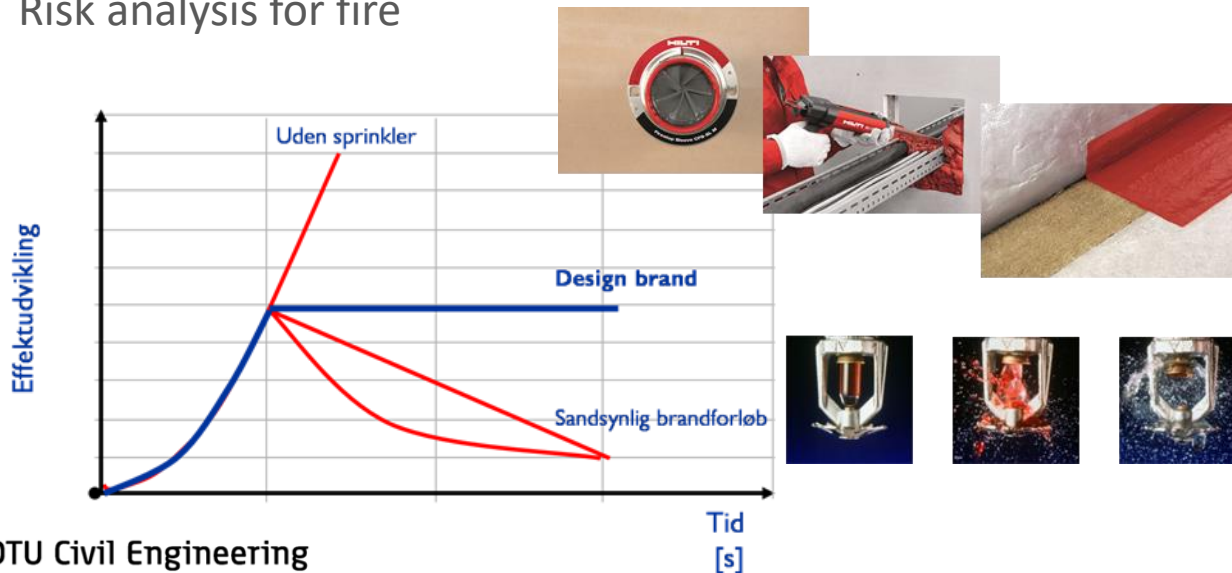
Building Fire Safety

Lars Schjøtt Sørensen, Assc. Prof., MiB Leader

- Building fire safety
- Active and passive fire safety
- Combustible properties of materials
- Health hazard (flame retardants, toxicity, skin burn)
- Offshore fire safety
- Large scale fire tests
- Risk analysis for fire



Health hazard
TEST: flame retardants
PICTURE: burn

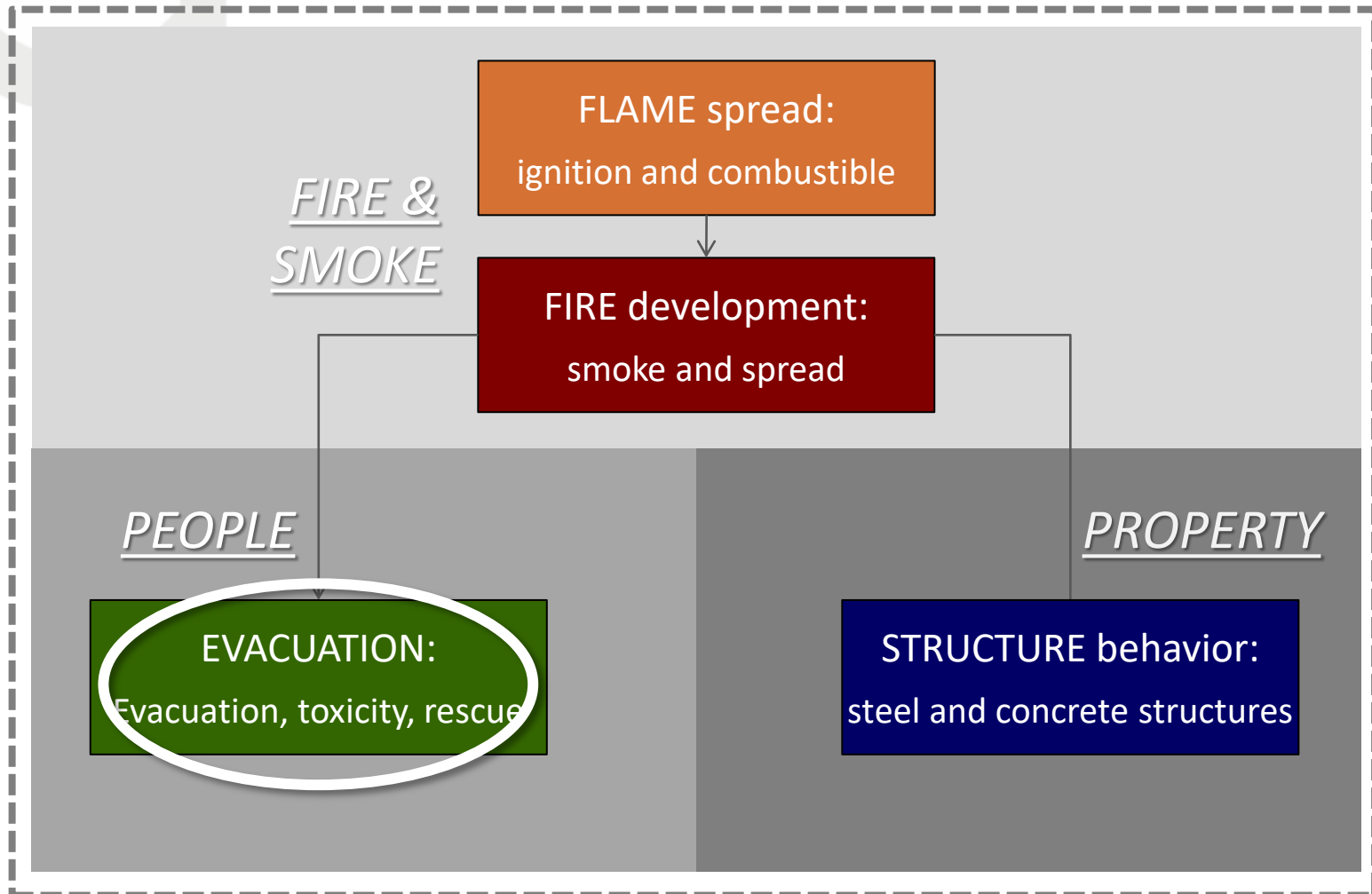


TEST on sprinkler and water mist



Research areas in fire safety

FIRE RISK





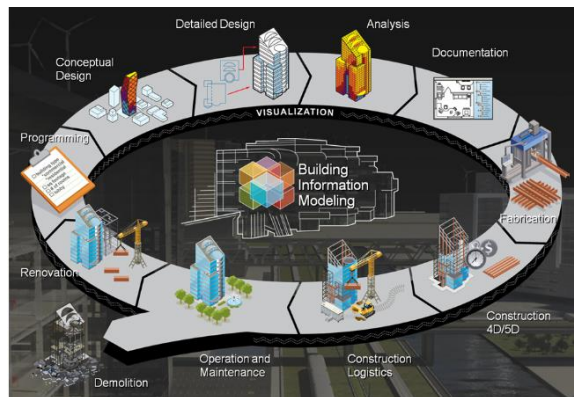
Evacuation

Anne Dederichs, Assc. Prof.



Evacuation and fire brigade intervention

BIM-fire

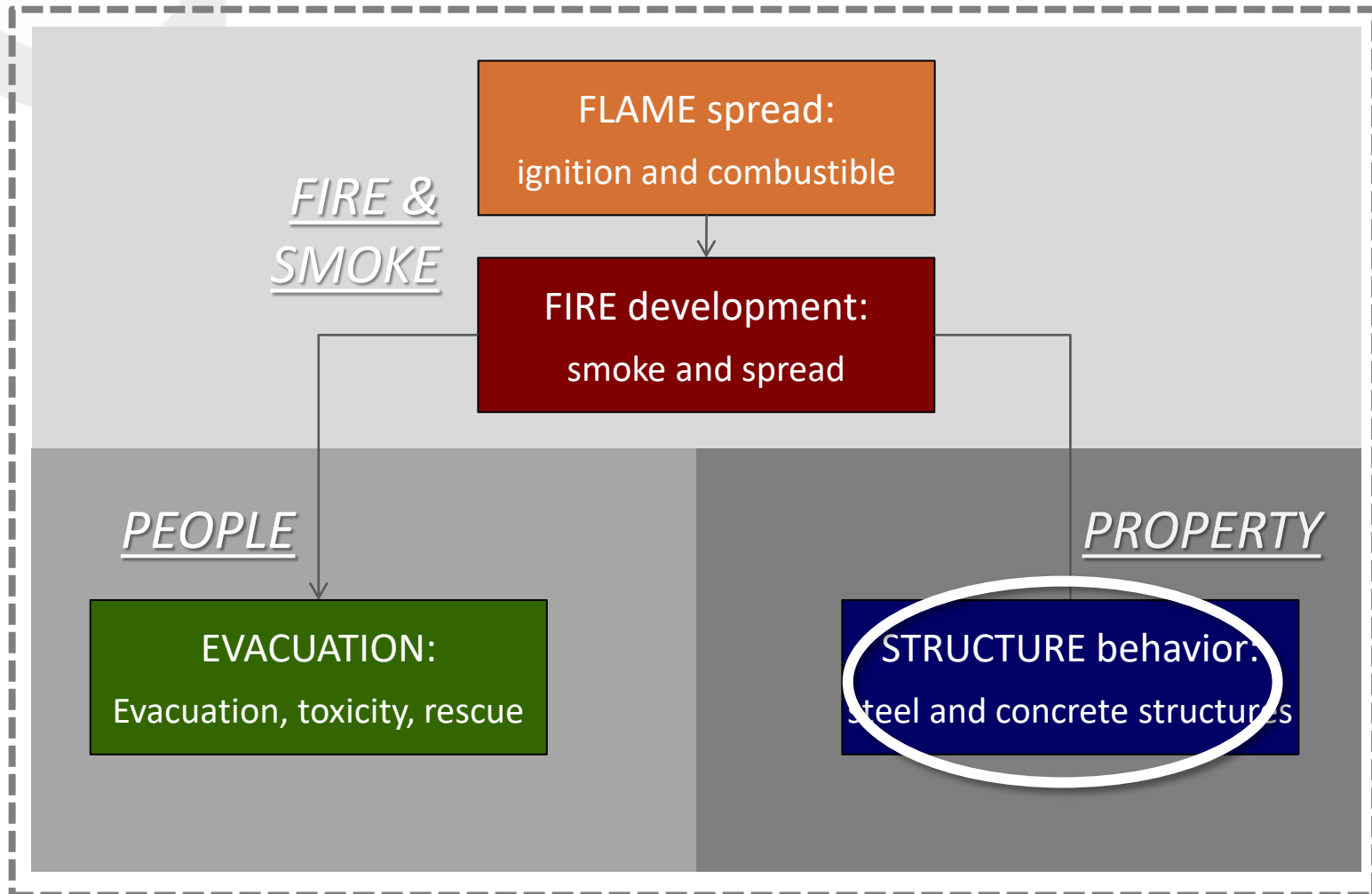


Windturbine-fire



Research areas in fire safety

FIRE RISK



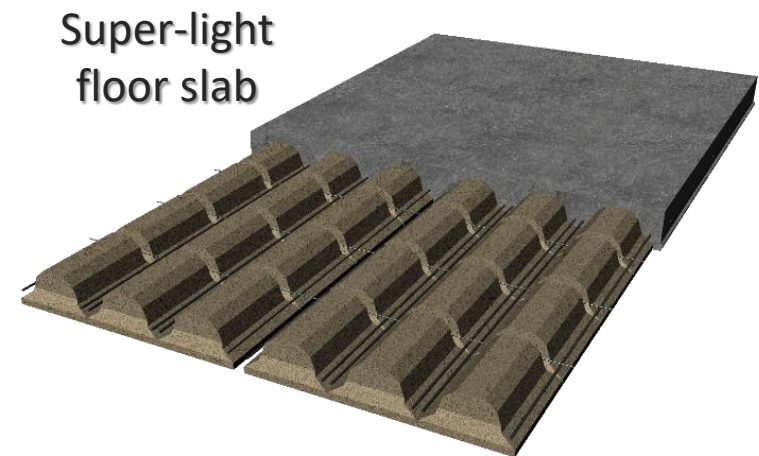


Fire resistant concrete structures

Kristian Hertz, Full Professor

Structural fire safety design

- High temperature properties of concrete and reinforcement.
- Fully developed design fires. Modelling of concrete structures
- Zone method in EN1992-1-2.
- New fire safe super-light structures.





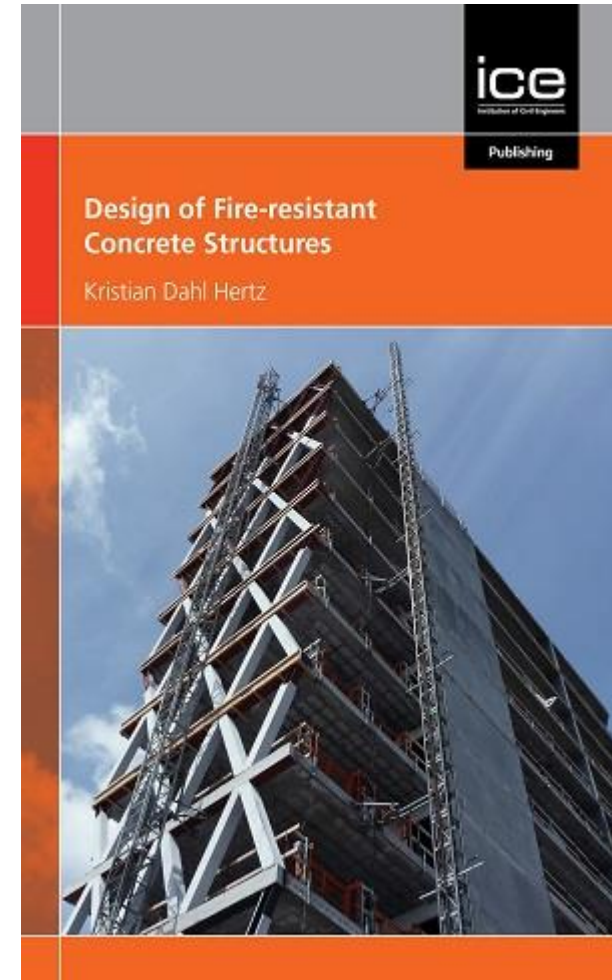
Fire-resistant concrete structures

Kristian Hertz, Full Professor

*DTU oven for
loaded materials*



Concrete Wall in a DTU
fire test at DBI



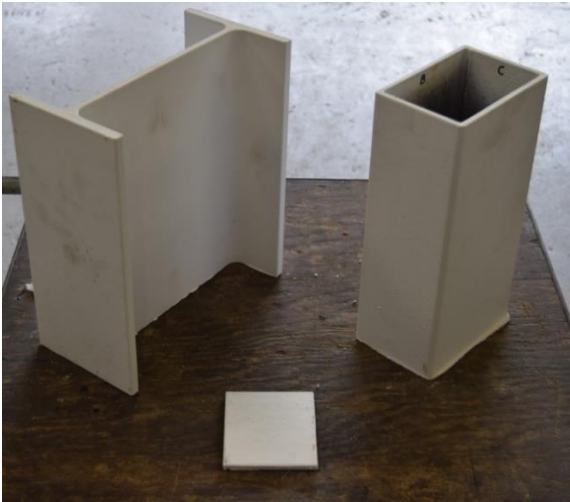


Steel structures in fire

Luisa Giuliani, Assc. Professor

Testing of intumescent paint

- Fire protection of bridge cables with epoxy coating
- Mechanical resistance of intumescent and epoxy paint
- Effect of heating rate on thermal resistance of intum. paint





Steel structures in fire

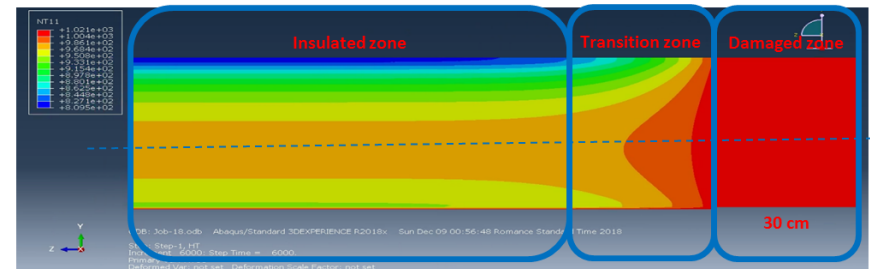
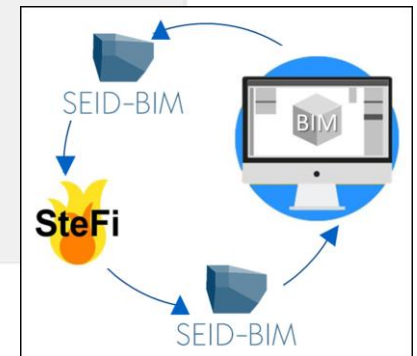
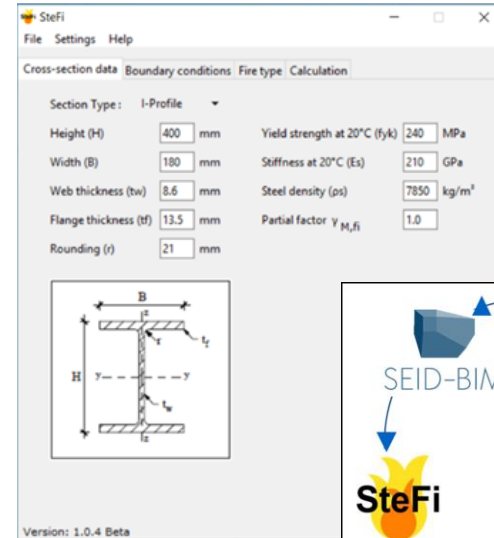
Luisa Giuliani, Assc. Professor

Design methods

- Optimization of steel structures in fire
- BIM-Integrated fire design of steel elements

Numerical model of fire-induced collapses

- Effects of restrained thermal expansions in steel buildings
- Post-earthquake fire (PEF) resistance of steel buildings



Temperature distribution after 10 minutes of heating





Co-funded by the
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Thank you for your attention

Luisa Giuliani, Frank Markert, Lars S. Sørensen*

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