Date: 27-06-2017

Place: Technical University of Denmark

Knowledge FOr Resilient soCiEty

Interdisciplinary teaching at DTU-BYG

Technical University of Denmark

Department of Civil Engineering

(DTU-BYG)

DTU Civil Engineering
Department of Civil Engineering

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- *Interdisciplinarity in Fire Design:*

  11B12: Brandmodellering (IT Fire)

- *Interdisciplinarity in Building Design:*

  1080 Advanced Building Design

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Interdisciplinarity in Fire Design:

11B12: Brandmodellering (IT Fire)

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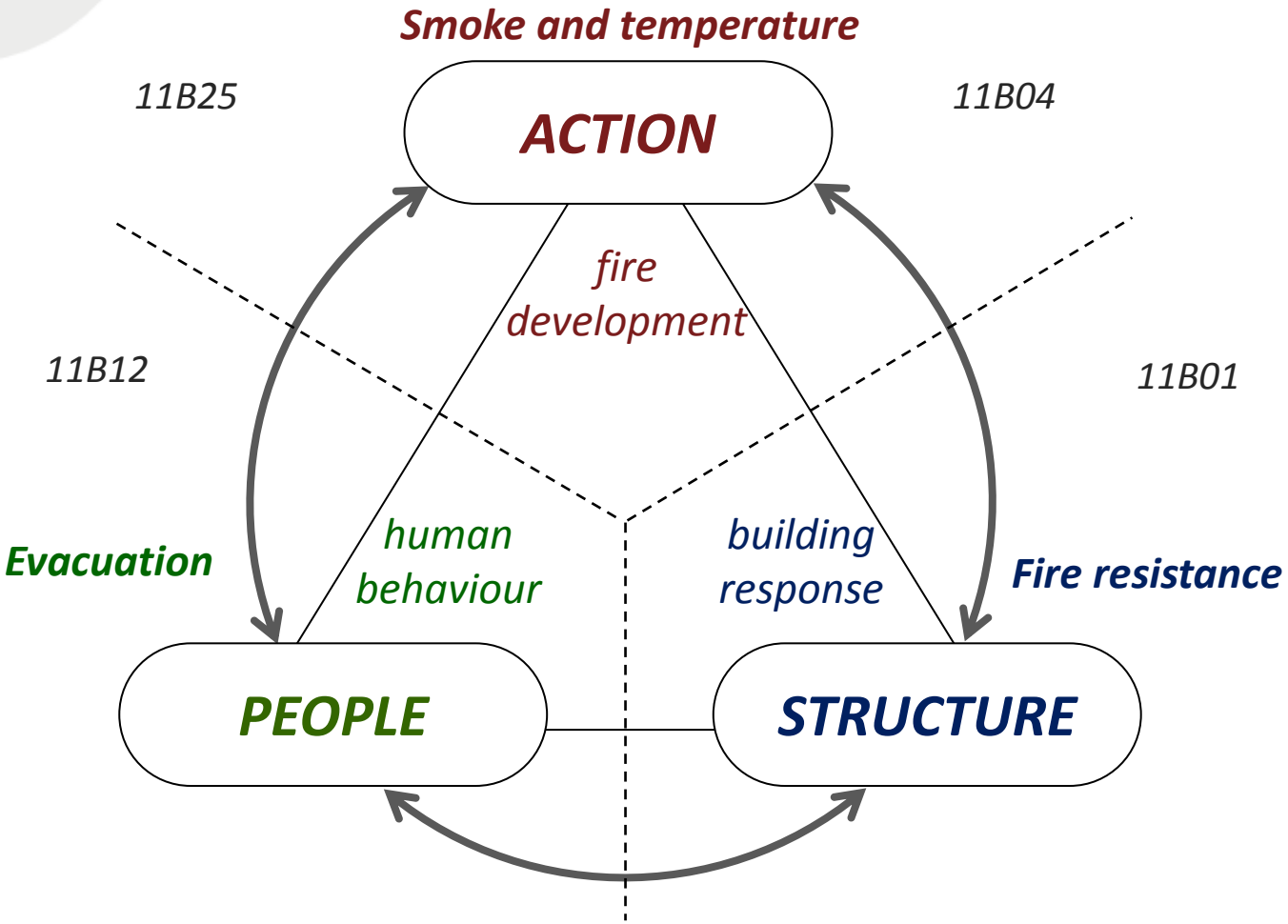
Interdisciplinarity in Fire Safety Design



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Fire Safety Design Strategies

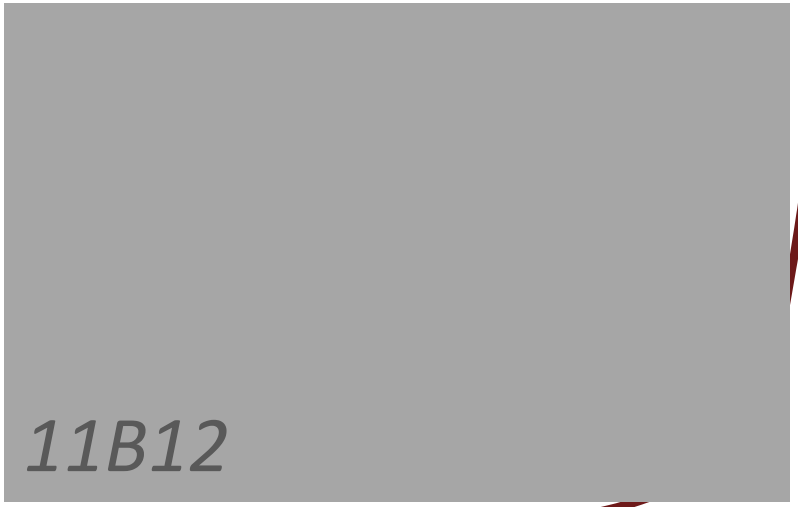
prevention

protection

robustness

active

passive



FLASHOVER

PEOPLE

STRUCTURE

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11B12 - Brandmodellering

Education: MIB (Master I Brandsikkerhed

ECTS points: 5

Work load: 280 hours

Lectures: 27 hours (3 modules of 1 ½ day each)

Duration: August - November + examination in January

Teachers: Luisa Giuliani (fire, course responsible) and Christian Kindler (evacuation)

Feedback: Report on fire spread (I module) + Report on Evacuation (II module)

Evaluation: Report on Final Assigment

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11B12 - Brandmodellering

	I MODULE		II MODULE		III MODULE	
9-10.30	INTRO FDS-INPUT	FDS-THEORY	EVACUATION BASICS	VALIDATION MODEL REF.	ASS.1 - SOLU RECAP	EVAC&STEPS ADVANCED
10.45-12	EX1-INPUT	ASS.1 – FIRE Q&A	EVACUATION MODELING	ASS.2 - EVAC Q&A	VALIDATION ADVANCED	FINAL ASS. Q&A. EVAL.
13-14.30	FDS-OUTPUT EX2-OUTPUT		STEPS - HANDS ON		FDS ADVANCED	
14.45-16	VALIDATION EX3-MESH		STEPS - STAIRS		ASS.2 - SOLU RECAP	

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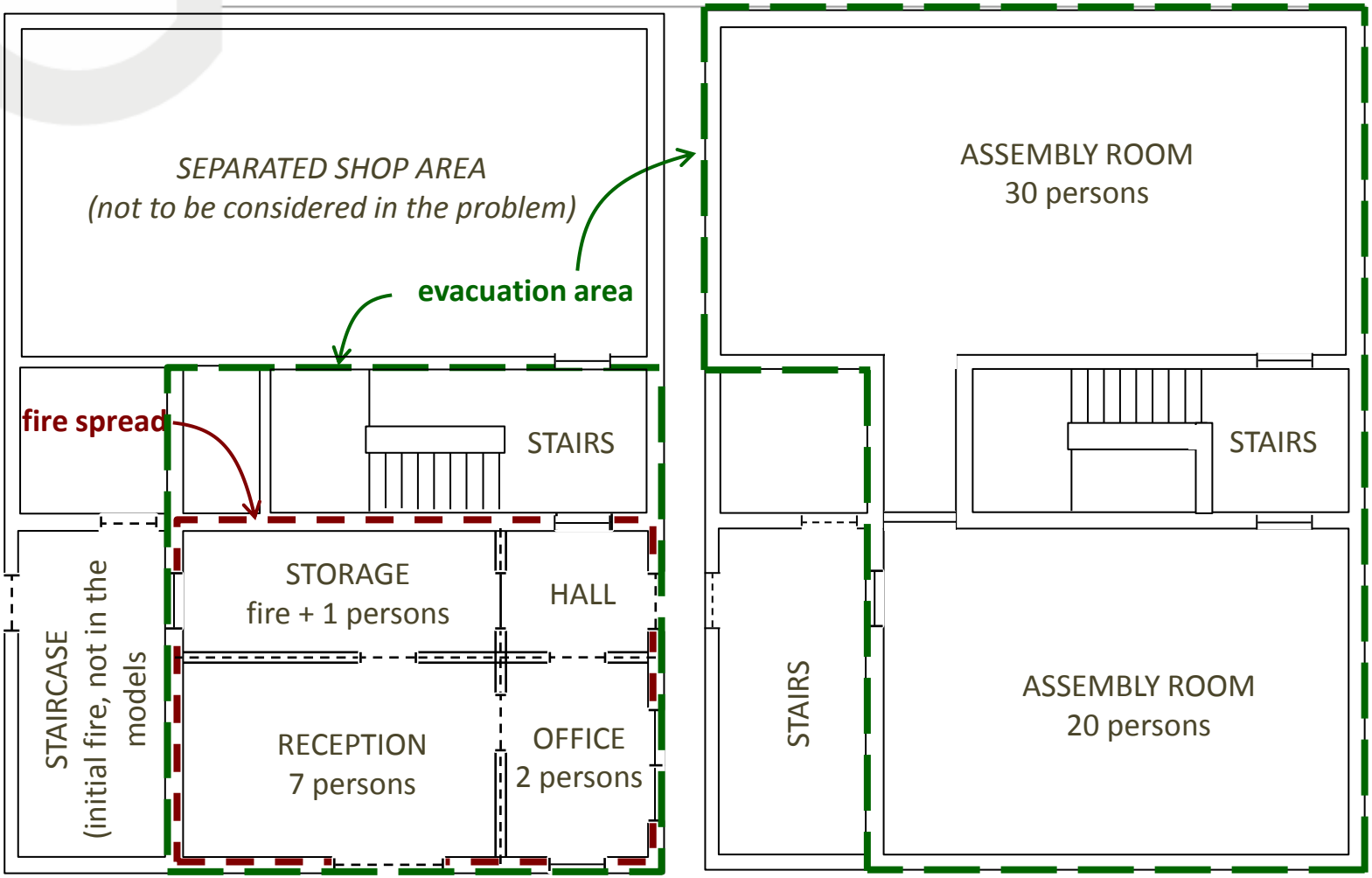
11B12 - Final assignment



GROUND FLOOR

FIRST FLOOR

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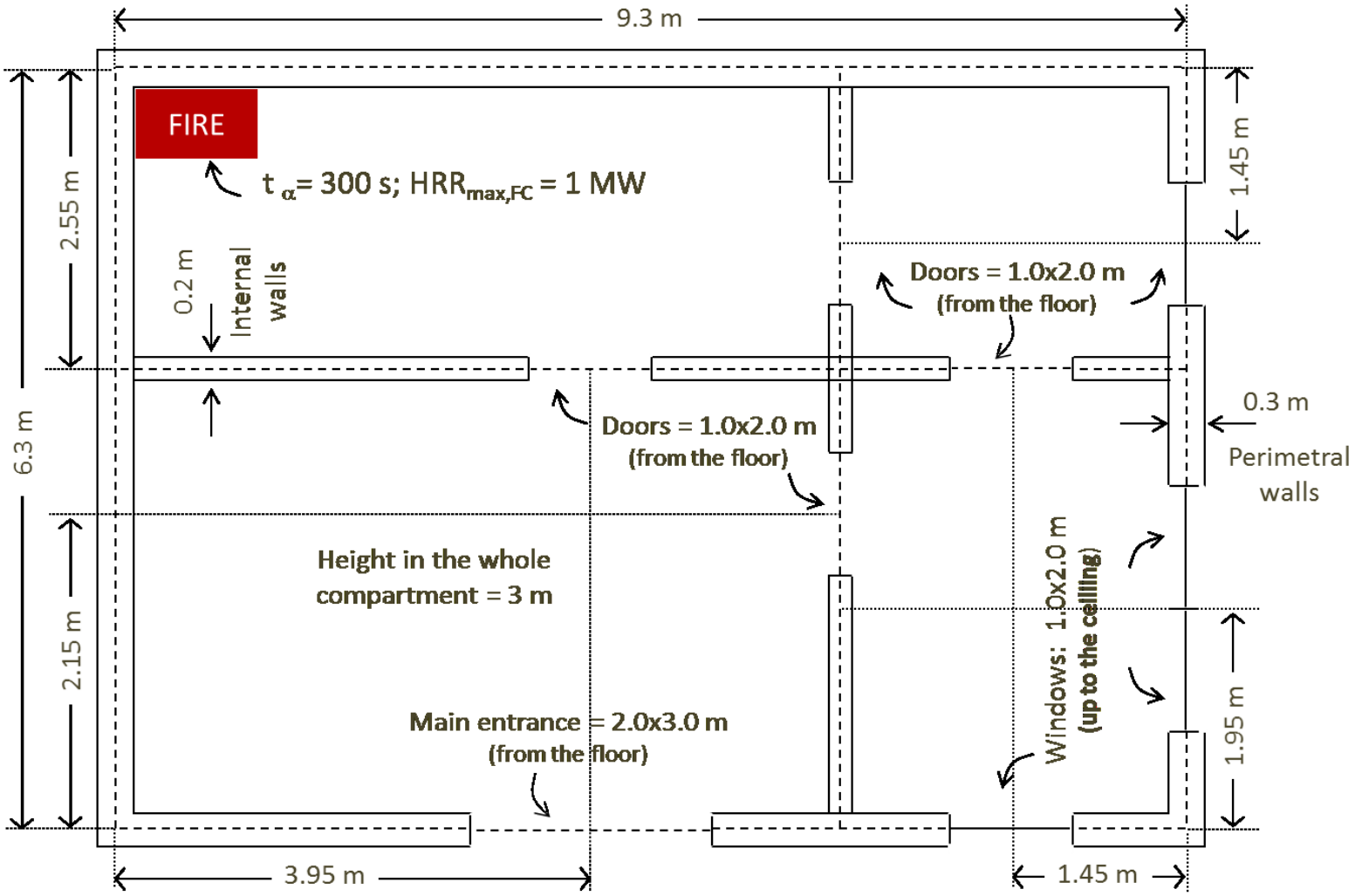
11B12 - Data for fire model



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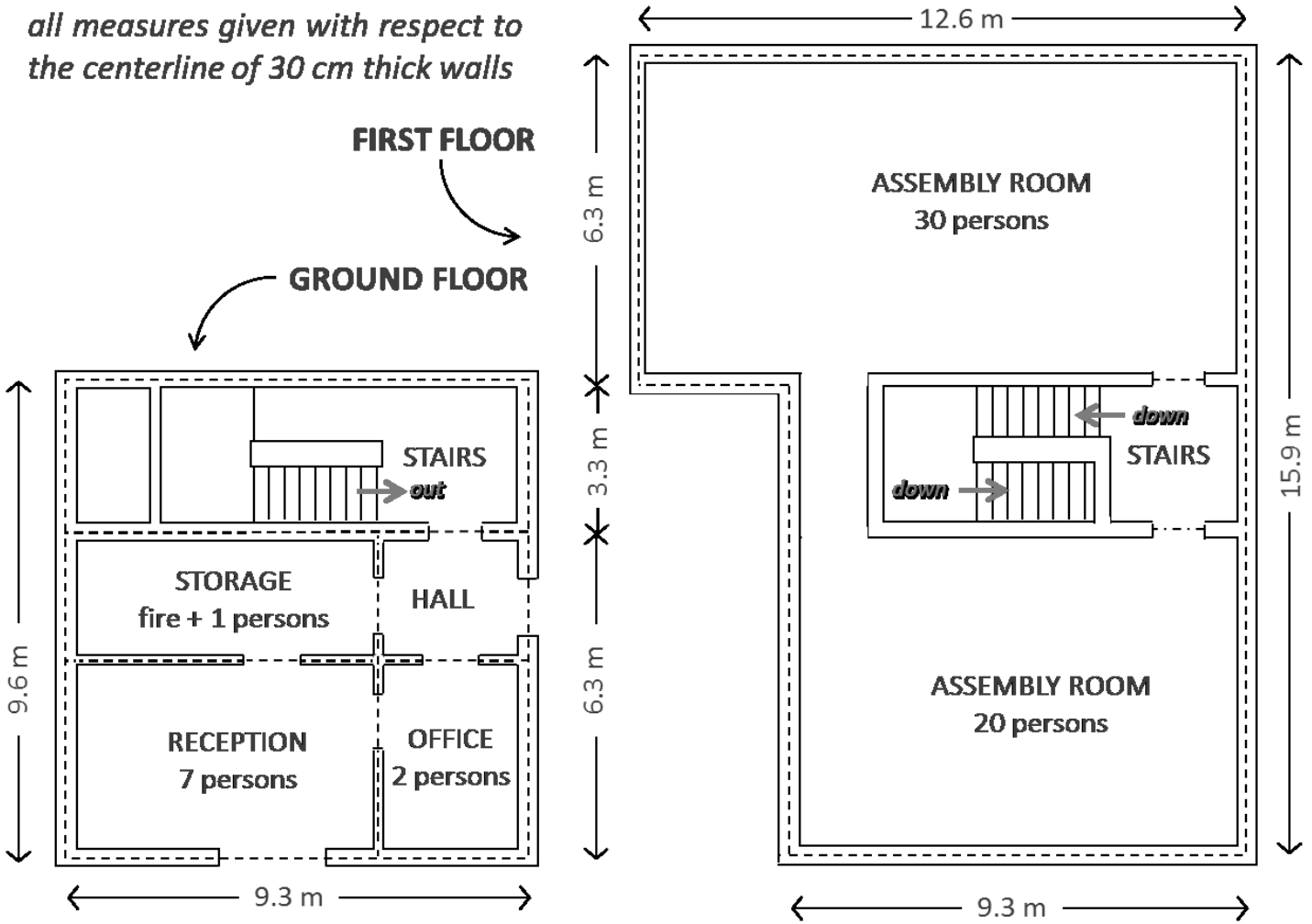
11B12 – Data for evacuation model

all measures given with respect to the centerline of 30 cm thick walls



- *Interdisciplinarity in Fire Design:*

  11B12: Brandmodellering (IT Fire)

- *Interdisciplinarity in Building Design:*

  1080 Advanced Building Design

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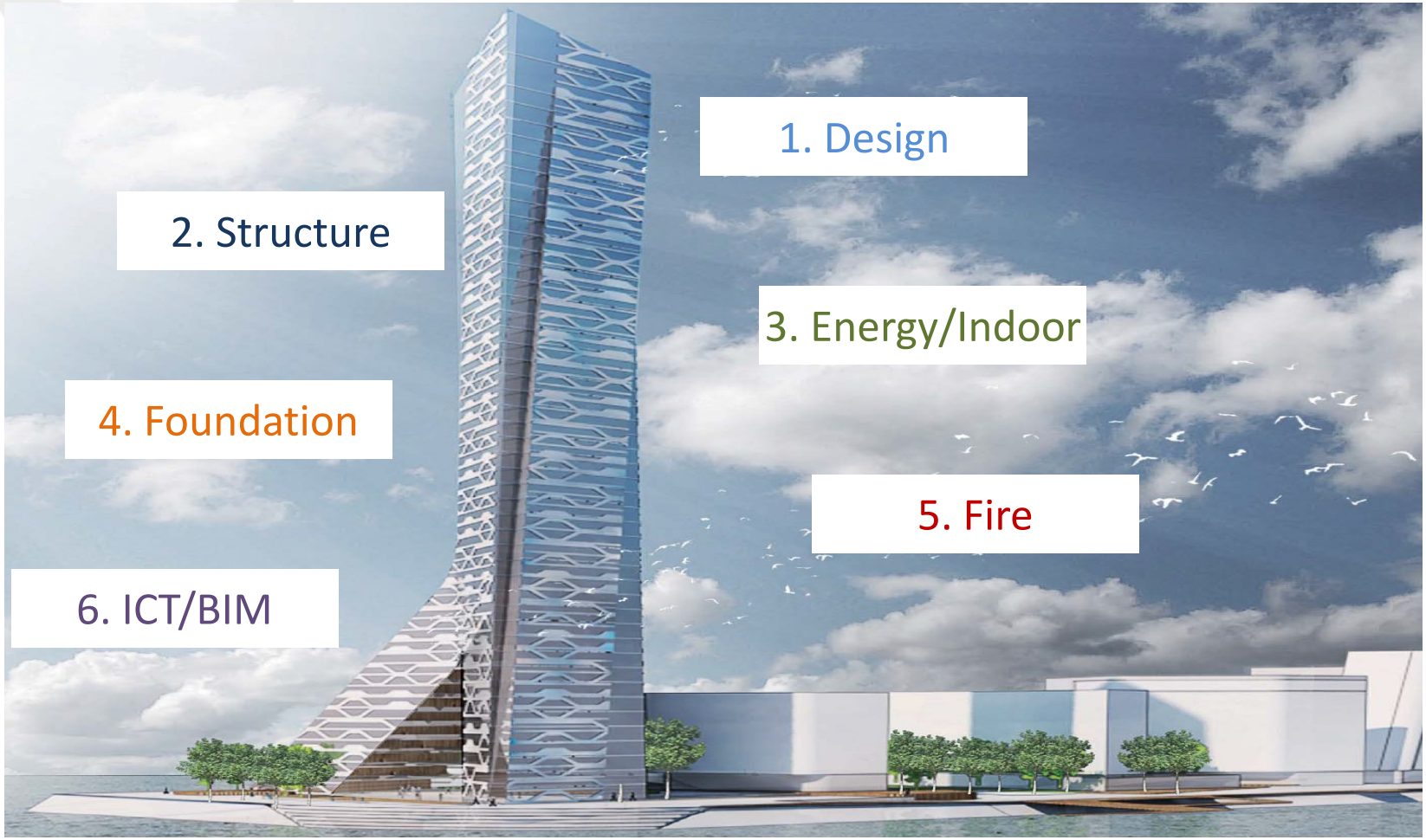
11080 - Advanced building design



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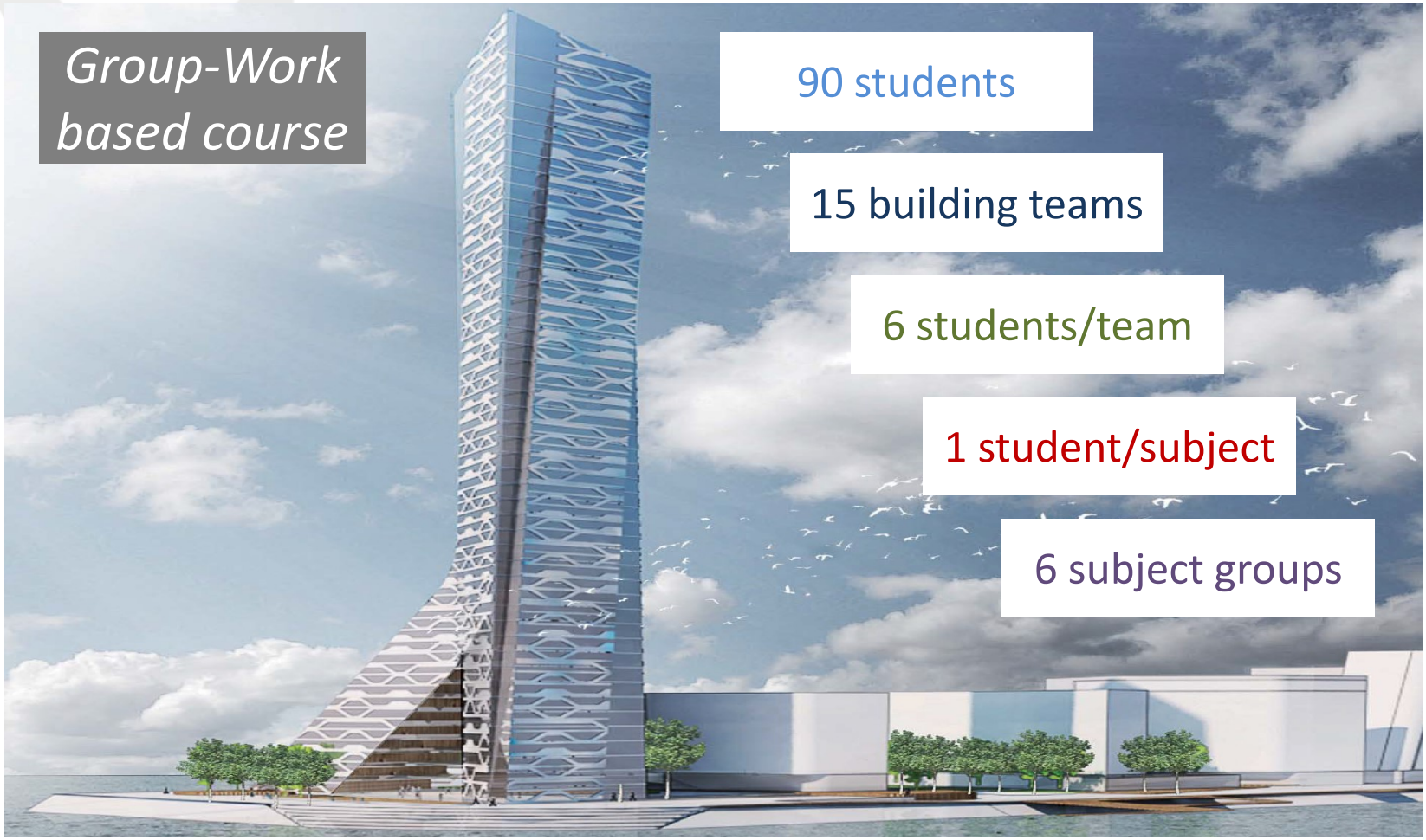
11080 - Advanced building design



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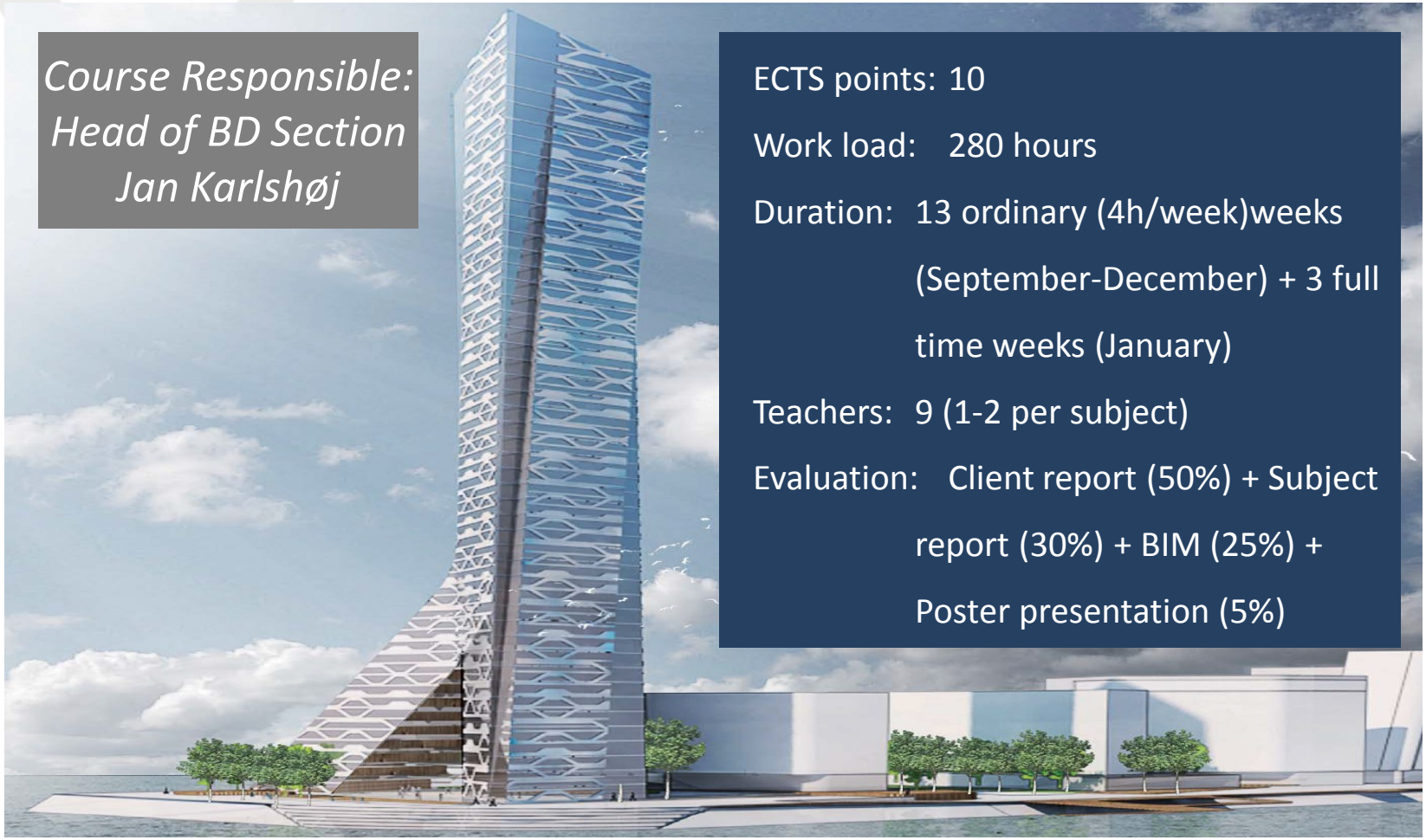
11080 - Advanced building design



Course Responsible:
Head of BD Section
Jan Karlshøj

ECTS points: 10

Work load: 280 hours

Duration: 13 ordinary (4h/week)weeks (September-December) + 3 full time weeks (January)

Teachers: 9 (1-2 per subject)

Evaluation: Client report (50%) + Subject report (30%) + BIM (25%) + Poster presentation (5%)

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11080 - General information

[The course aims at giving students] “an understanding of **integrated building design** and the way specialized competences can be used collaboratively within multidisciplinary project teams to create a **design that fulfils many functional requirements simultaneously**. Going beyond mere analysis of a given construction, students will apply their additional competences to construct **solutions to open-ended problems**. Students will work in groups to solve realistic design jobs that accurately reflect the demands of the construction industry. Students will also work with **digital building design methods**.”

6 design subjects and 1-2 teacher per subject:

Subject 1: Design (architecture)

Subject 2: Building structure

Subject 3: Building services

Subject 4: Geotechnical engineering

Subject 5: Fire Safety

Subject 6: Project Management and ICT Coordination

Group-work based course:

- 6 students in each group
- Each student is responsible for a subject
- All students are responsible for a good integration among subjects and for the final design (partly – see evaluation)

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11080 - Learning objectives

A student who has met the objectives of the course will be able to:

a. **Collaborate** with other specialists

b. Analyze a **client's requirements** inspired by System Engineering

c. Participate in developing a design management scheme to enable the project team to work together towards common goals and deadlines

d. Use **3D object-oriented building models** and associated IT tools to develop a detailed design solution

e. **Integrate various technical requirements into a functional building design** that satisfies the client brief

f. **Produce technical reports** documenting the fulfilment of specific functional requirements, such as indoor climate, energy performance, structural performance, fire and safety performance, acoustic performance and constructability

g. Justify and defend **design decisions**

h. Develop an outline design and project proposal

i. Present a final design to internal assessors

j. Recognize the need to develop **alternative solutions** and iterations in the design process in accordance to System Engineering

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11080 - Task and assignments

MAIN TASK

To replace a proposal for a hotel and residential building called ***Lighthouse Building T*** at the Aarhus waterfront with a project proposal for an **office** tower. The office tower must comply with the Building Class **2020** requirements according to Danish Building Code 2010.

SPECIFIC ASSIGNMENTS

2-week team contract:	team members and subject responsible
5-week memo:	main design strategies for each subject
7-week presentation:	initial project proposal and design choices - *FOR FEEDBACK*
13-week report:	Part 1: 1 client report + Part 2: 6 subject reports - *FOR FEEDBACK*
13-week BIM:	Building Information Models of the building - *FOR FEEDBACK*
13 week review:	each group review another group's 13-week report - *FOR FEEDBACK*
3-week report:	1 client report + 6 subject reports for each group - *FOR EVALUATION*
3-week BIM:	Builiding Information Models of the building - *FOR EVALUATION*
3-week poster:	Presentation of the final building design - *a kind of oral examination*

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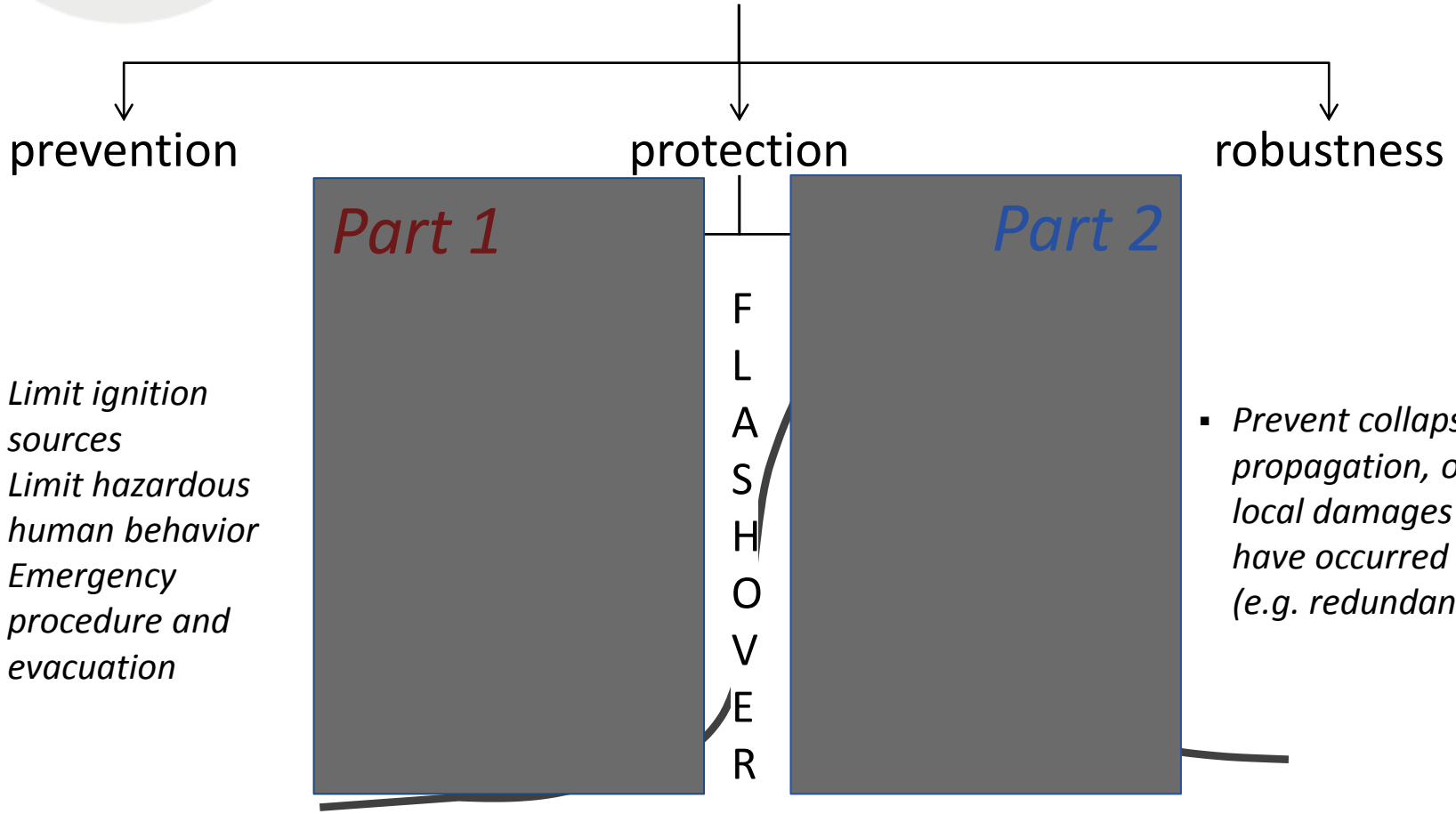
Fire Safety Strategies



- *Limit ignition sources*
- *Limit hazardous human behavior*
- *Emergency procedure and evacuation*

- *Prevent collapse propagation, once local damages have occurred (e.g. redundancy)*

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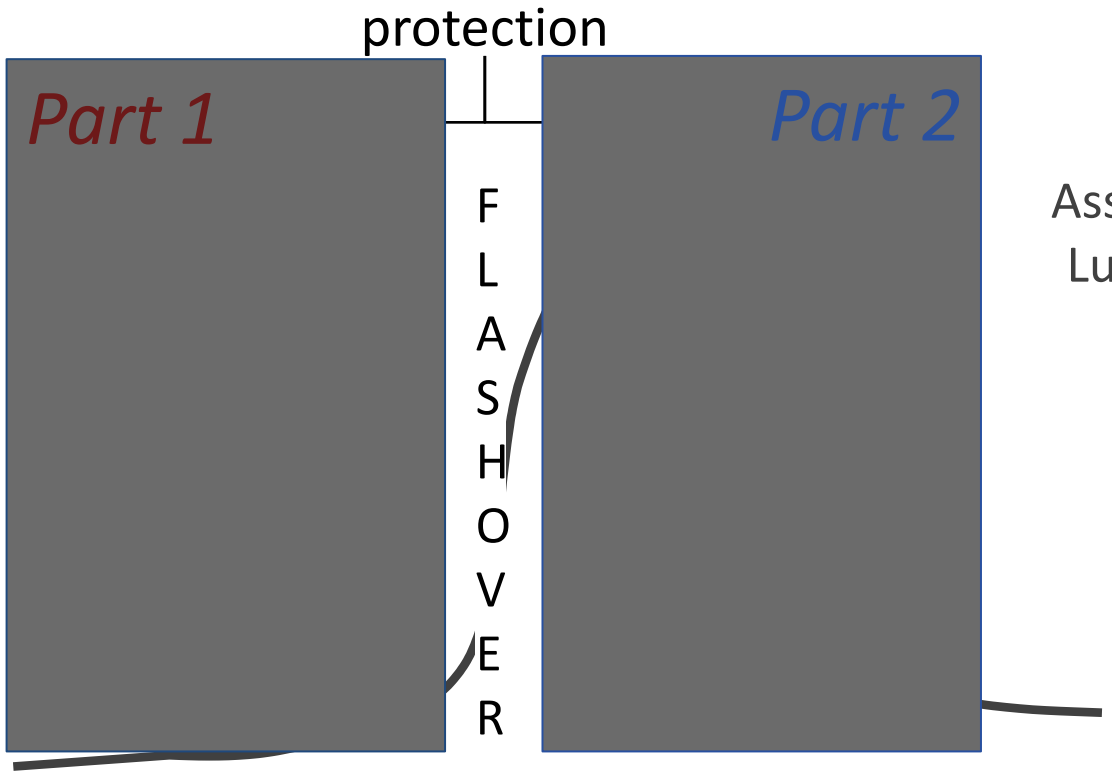
SMOKE MANAGEMENT AND EVACUATION

Teacher:
Associate Prof.
Anne Dederichs

STRUCTURAL FIRE SAFETY DESIGN

Teacher:
Associate Prof.
Luisa Giuliani



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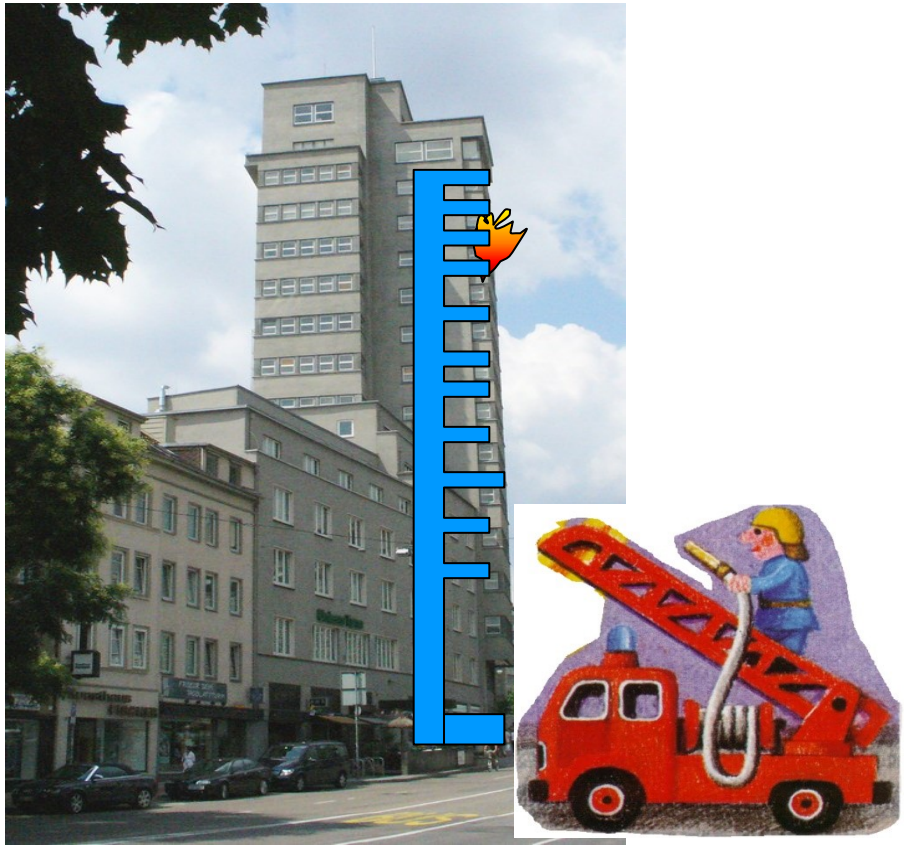
SMOKE MANAGEMENT AND EVACUATION

PRESCRIPTIVE

PERFORMANCE-BASED

Part 1



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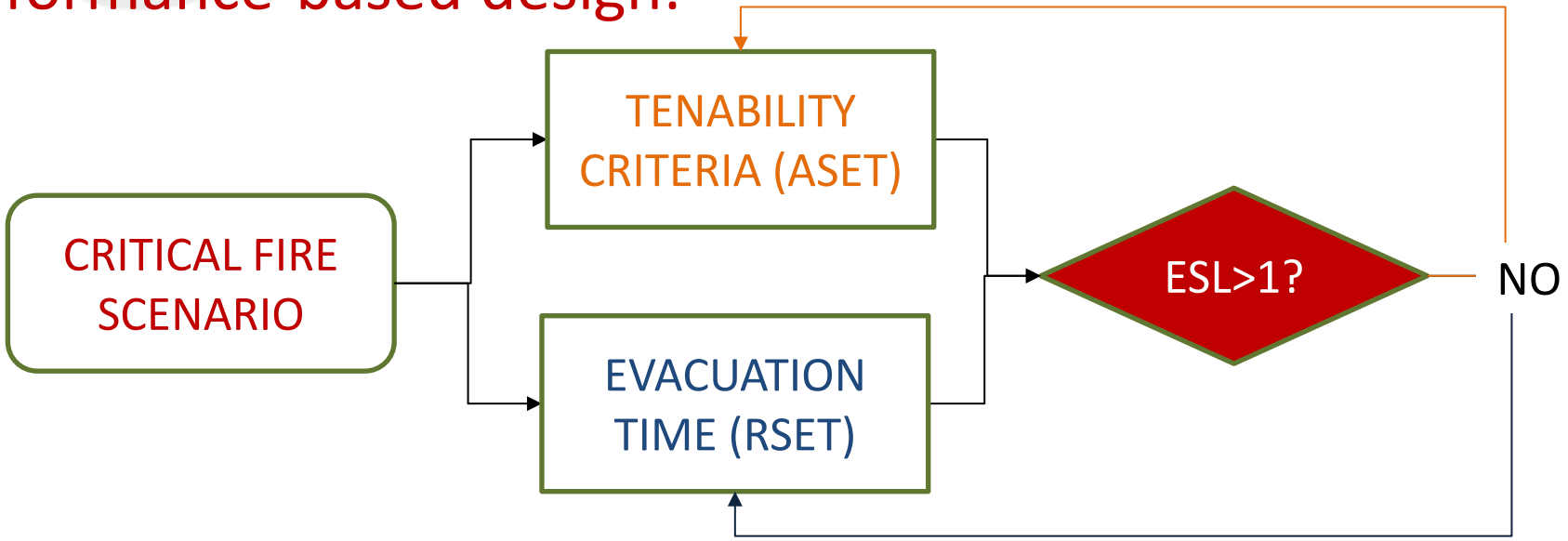
Ensure evacuation and access of the rescue service. Consider smoke spread, passive and active fire protection and operation and maintenance. In particular:

a. For traditional parts of the building you should apply the prescriptive (Eksempelsamling)
b. For untraditional parts, you need to proof that people can evacuate without being affected by critical conditions, by selecting relevant scenarios, calculating the ASET and RSET conditions and present an event tree for risk assessment

Performance-based design:



STRUCTURAL FIRE SAFETY DESIGN

ELEMENT DESIGN, STANDARD FIRE

ELEMENT DESIGN, PARAMETRIC FIRE

GLOBAL RESPONSE, FIRE SCENARIOS

Part 2

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Design structural elements to resist a fully developed fire in the compartment (Danish parametric curve).

1. Identify critical compartments (high fuel load, low thermal inertia, low ventilation, as well as large/high compartments)
2. Identify critical elements (utilization factor and maximum heating temperature) and at least:
   - 1 beam, 1 column, 1 floor slab, plus possible key elements for structural robustness
3. Design/verify the critical elements against fire
4. Suggest modification for improvements/optimization

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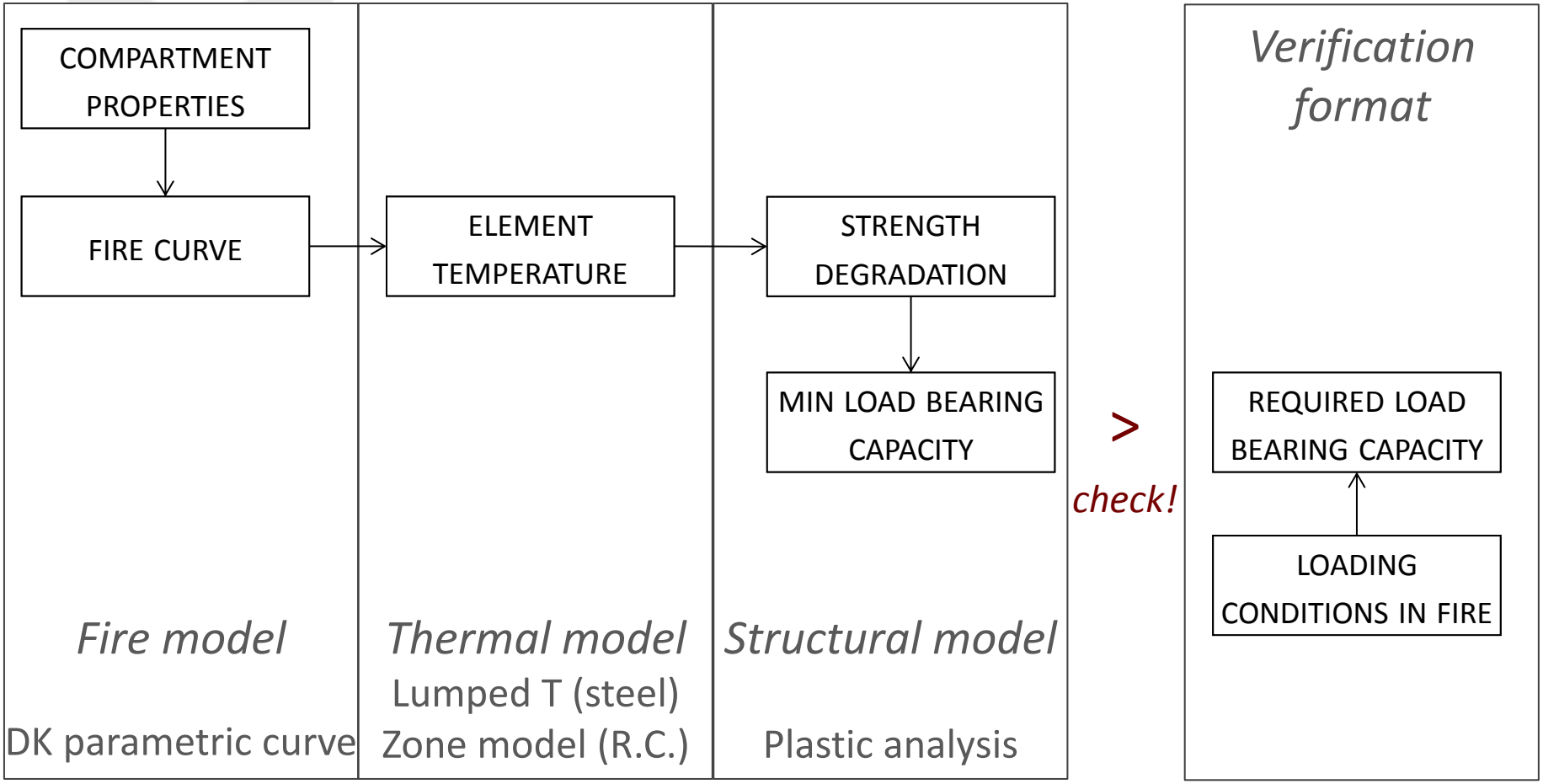

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Inter-relations between Subj.5 and other subjects

Subj. 1: Architectural design

- the design of staircases and rescue staircases influences the evacuation time;
- the distribution of spaces determines the choice and size of compartments;
- the intended destination of usage influences the loads and the resistance class;
- the presence of suspended ceiling influences the height of the smoke layer;
- type and amount of insulations may be incompatible with aesthetic or architectonic needs.

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Inter-relations between Subj.5 and other subjects

Sub. 2: Building structure

- Consistency with the structural and static scheme used in subj. 2 calculations!
- modifications on the element size or material required by fire verifications affect the weight and stiffness of the structure assumed in subj.2 and may therefore require to recalculate the structure for the final design.

3: Building Energy

- when designing the pipe system, pay attention fire compartments and possible escape of smoke and fire from holes and venting in the walls;
- consider installations for fire extinguishing and overpressure in staircases

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Inter-relations between Subj.5 and other subjects

Sub. 4: Geotechnical design

- Limitations of fire spread and evacuation from the underground parking lot (subj. 5.1);
- Boundary conditions of the bottom columns influences subj. 5.2 calculations.

Sub. 6: Management

- Evacuation strategy: cost for training staff and occupants, alarm maintenance
- Active measures: cost of installing and maintaining of the sprinkler system etc.
- Passive measures: cost of insulation and sustainability aspect (toxic paint etc.)

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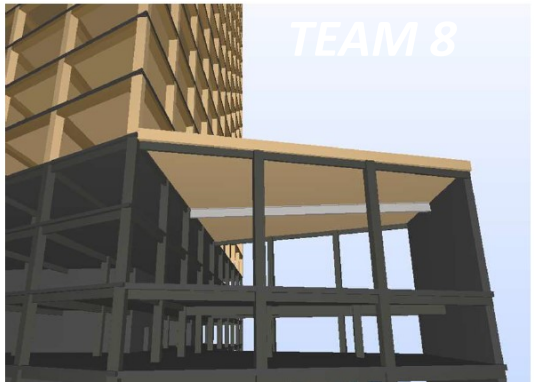
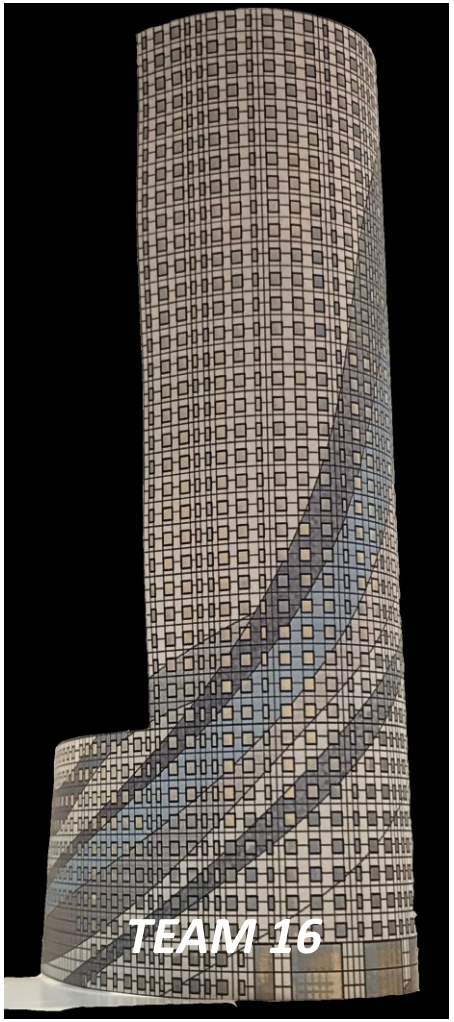
11080 - Some projects in autumn 2016





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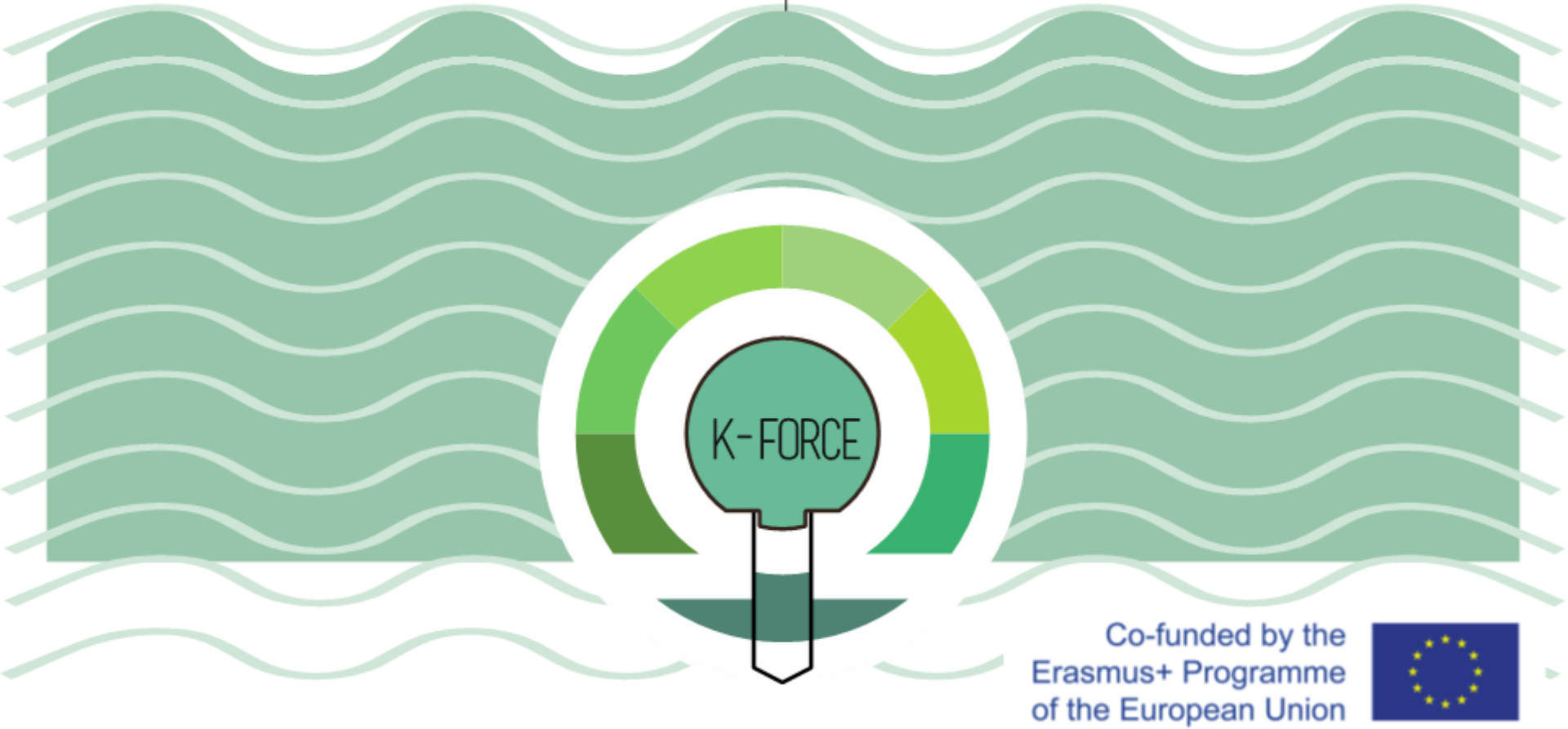

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Thank you for your attention

Luisa Giuliani, Ph.D., P.E. - lugi@byg.dtu.dk

Associate Prof. at DTU-BYG (Civil Engineering Department)

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