



Integrated Fire Engineering and Response

COST action network number [TU0904](#) in domain Transport and Urban Development

Training School on 12-15 March 2013

Buro Happold

# Winter Training School Lulea, Sweden “The Scenario”

Florian Block

# The Idea of the Training School

## The Past

- In **Malta** and **Naples** the training schools were very much **theory** and **research**.
- The **first purpose** was to give the students a chance to listen to **experience, advice** and **ideas** of some of the **leading figures** in fire engineering (and me) to get a flavour for **what else** is important a outside of the their own PhD research.
- The **second purpose** was for the students to **share** their respective **research** with their **peers** and the **scholars**.

## The Idea

- After **two successful** training school following the **same model** with different students we wanted to try something **new**.
- The **idea** was to give the students some **hands-one experiences** with the practical application of **advanced fire engineering** methods on a (somewhat) realistic scenario.

### Fully Performance-based Fire Engineered Solutions

- The focus is on achieving **life safety** for occupancy and the **emergency services**.
- Involves
  - the prediction of the **fire and smoke** development,
  - the escape of the **people** and
  - the response of the **structure**.
- Used to design
  - **smoke management** systems and active fire fighting measures,
  - internal layouts and number and **size of stairs** and
  - design and **fire protection** of the structure.
- Only done to the full extent for a small number of **complex buildings**.
- Often the **ASET – RSET** Method is used to demonstrate life safety.

## ASET - RSET

### Available Safe Escape Time - ASET

- This is the time during which **tenable conditions** are maintained within the escape routes of the building. This means
  - acceptably **low** concentration of **toxic gases**,
  - acceptably **low temperatures**,
  - sufficient **visibility** and
  - sufficient structural **stability**.
- The ASET can be calculated with a wide range of methods of varying degree of complexity. Starting from simple **hand calculations** over complex computational fluid dynamics and combustion **modelling** (CFD) and non-linear finite element analysis (FEA) to full-scale **experiments**.

## ASET - RSET

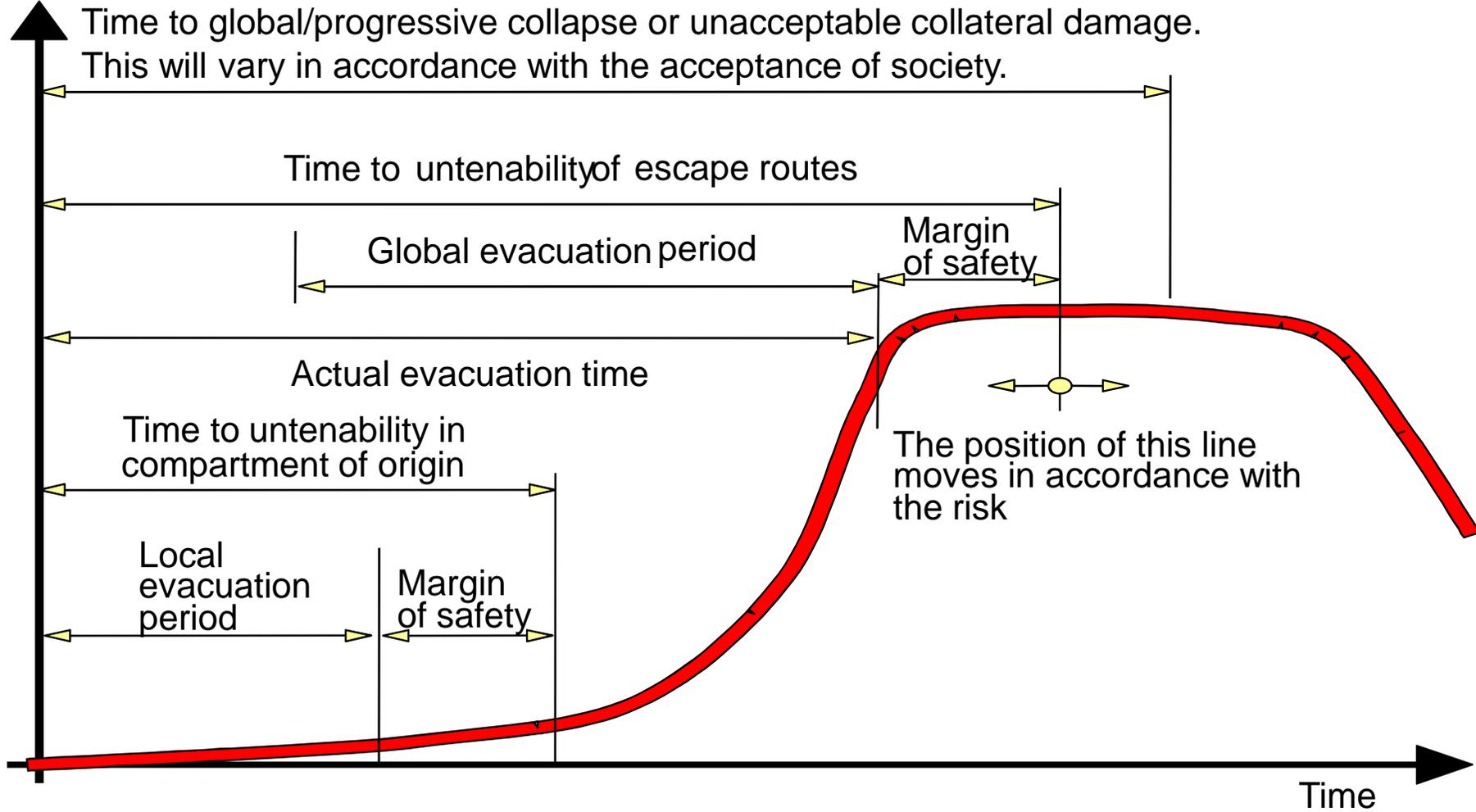
### Required Safe Escape Time - RSET

- This is the time which is needed for the **occupants** of the building to **leave the building** and to allow search and rescue missions of the **emergency services**.
- The RSET can be calculated with a wide range of methods of varying degree of complexity. Starting from static people flow **hand calculations** over full agent-based numerical people flow **simulations** to full-scale **experiments**.
- **Consultation** with the **fire brigade** is essential to allow for their time requirements.

**The ASET needs always to be larger than the RSET**

# Time as Measure

Temperature



## The Task - 1

### What will you do?

- Perform a **concept ASET – RSET** assessment of a (sort of) realistic atrium building.
- To do so you will first split into **9 groups of 3-4 people** by picking group numbers from a hat/bowl/bucket.
- Each group will be a **fire engineering consultancy** and you will have to give your group a **name**.
- During the rest of the morning you will get an introduction to
  - Smoke and fire modelling with **FDS**,
  - People flow modelling with **SMARTMOVE** and
  - Structural modelling with **LSDYNA**

## The Task - 2

### What will you do?

- Starting from tonight each group will have **3.5 hours of guided tutorial** to perform the required analyses to enable you to conduct an ASET-RSET assessment.
- Each group will be given different **predefined input parameters** to ensure a variety of solutions.
- Given the very **short time** available and time intensive numerical calculations the analyses will have to be **relatively crude** but should give you an idea what the likely outcome will be if a more detailed assessment is conducted.
- **Not all** combinations of **scenarios** will lead to a **safe design** and there will not be enough time to rerun the models until every group has a safely working design.
- It is therefore required that you use **engineering judgement** to suggest what changes are required to make the design work.

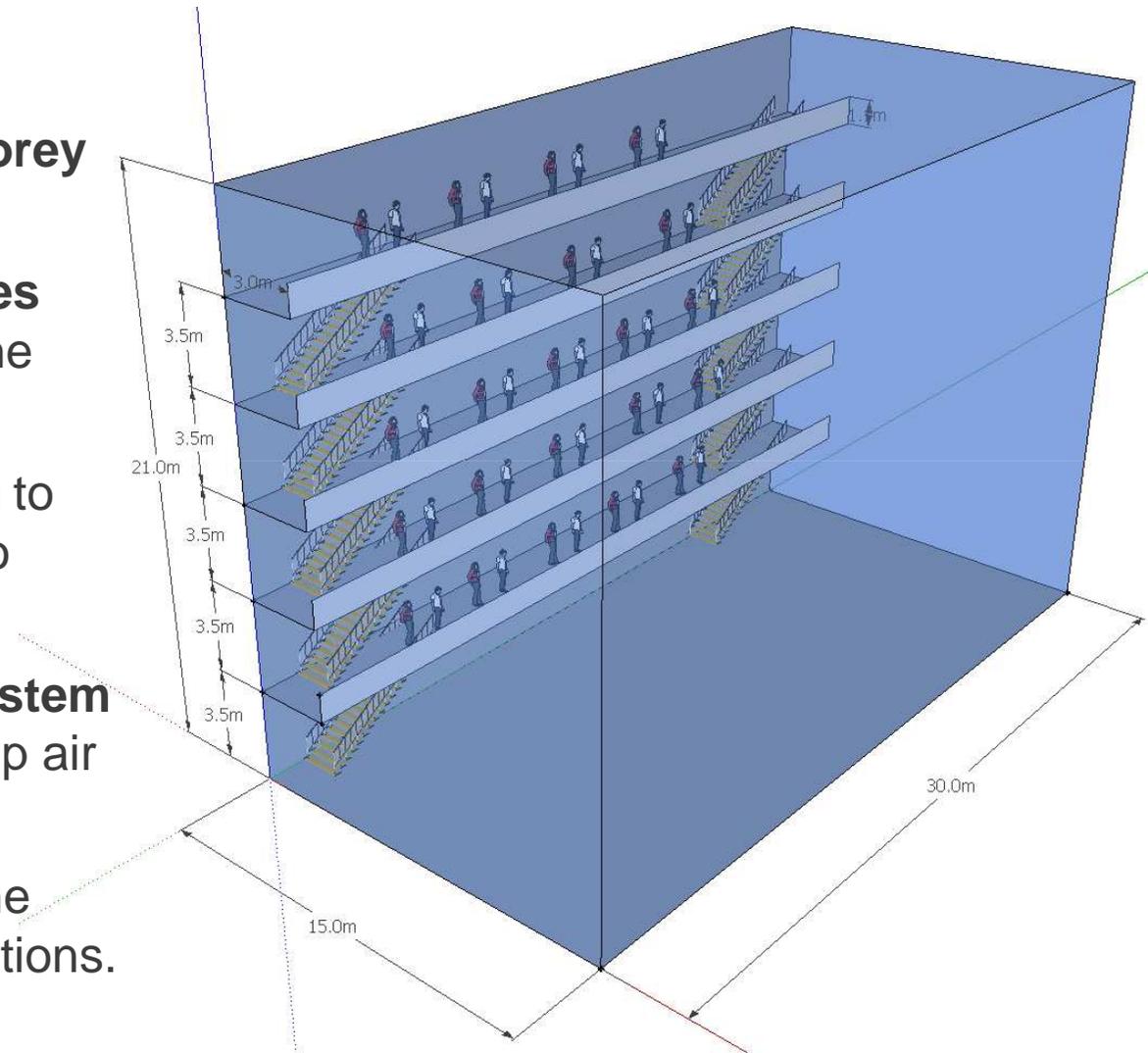
## The Task - 3

### What will you do?

- On the last day you will have time in the morning to **combine the results** and to prepare a short **10 minutes presentation** in which you will show
  - your **input** scenarios,
  - your modelling **results**,
  - your **interpretation** of the results as an **ASET-REST** assessment and
  - any suggestion to make the design **more efficient** or **safer**.
- A panel of judges might ask questions and will award **prices** to the best consultancy firms.

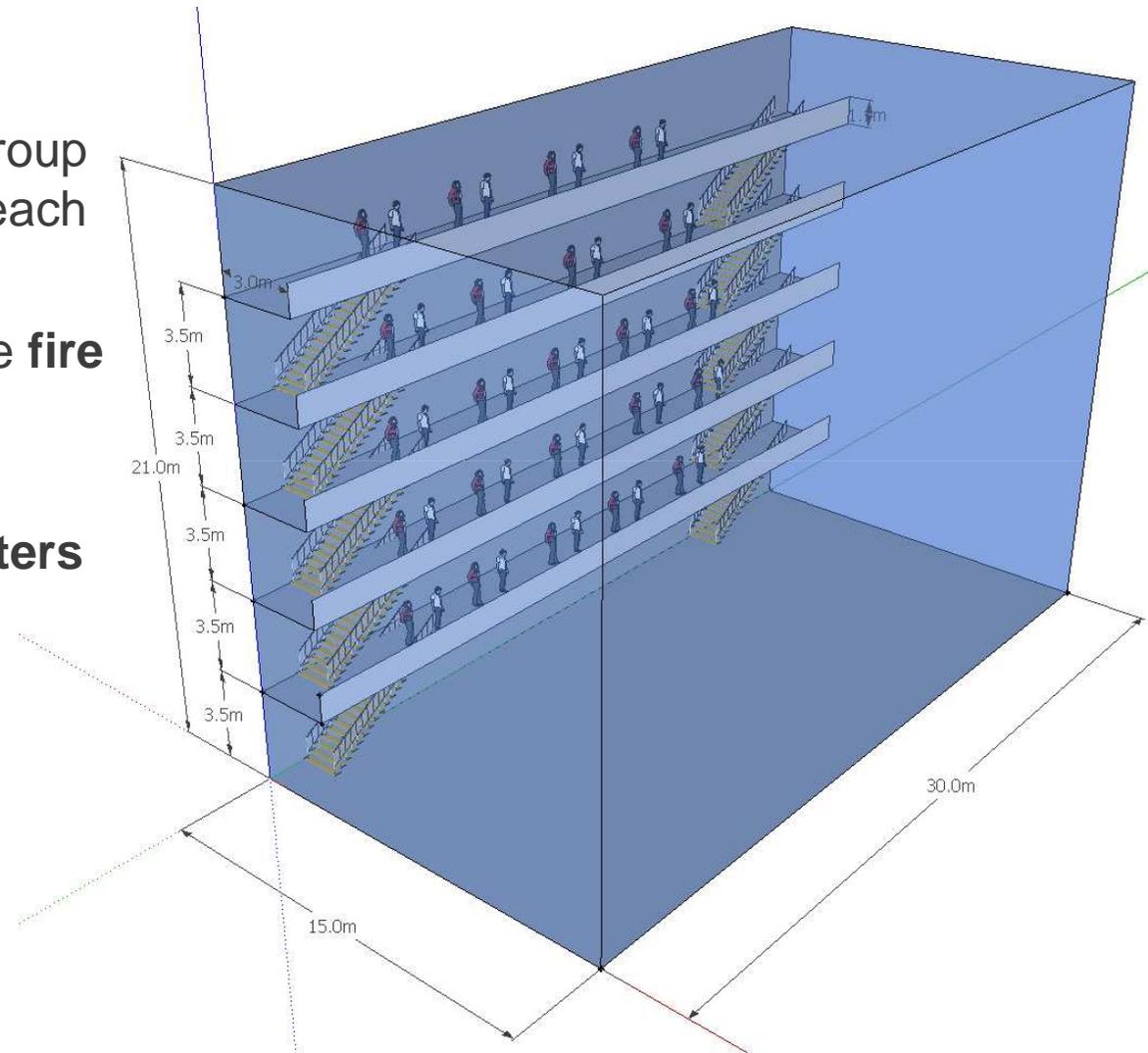
## The Scenario

- The scenario will be a 21m **six storey** high atrium.
- It will have **open escape balconies** which lead to rooms adjacent to the atrium (not to be modelled).
- There will be **1 or 2 stairs** leading to the ground floor allowing people to escape from the balconies.
- There will be a **smoke control system** with extract at the top and make-up air at the bottom.
- There will be a **localised fire** at the base of the atrium in different locations.



## The Scenario

- The **input parameters** for each group will be given at the **beginning** of each hand-on **tutorial** session
- Please allow for **30** minutes for the **fire brigade** to arrive and conduct the search and rescue mission.
- You can assume that the **fire fighters** wear a **breathing apparatus**.



## Hands-on Session

<b>Time</b>	<b>FDS – F441</b>	<b>SMARTMOVE – F445</b>	<b>LS-DYNA – E531</b>
13.03: 18:30 – 22:00	G1	G2	G3
14.03: 8:30 – 12:30	G2	G3	G1
14.03: 13:30 – 17:30	G3	G1	G2

## Hands-on Session

Group	FDS	SMARTMOVE	LS-DYNA
G1.1	A	A	A
G1.2	B	B	B
G1.3	C	C	C

## Hands-on Session

Group	FDS	SMARTMOVE	LS-DYNA
G2.1	A	B	A
G2.2	B	C	B
G2.3	C	A	C

## Hands-on Session

Group	FDS	SMARTMOVE	LS-DYNA
G3.1	A	B	C
G3.2	B	C	A
G3.3	C	A	B

## Hands-on Session - FDS

Scenario	Fire location	Fire growth rate	Max. HRR	Type of smoke extract	Extract rate / area	Inlet rate / area
A	GF - centre of atrium	medium	2 MW	natural		
B	GF - underneath the balcony	medium	2 MW	natural		
C	GF - underneath the balcony	medium	2 MW	mechanical		

## Hands-on Session - SMARTMOVE

Scenario	Number of stairs	Stair width	Location of stair	Number of people per level
A	1	2m	at one end only	
B	1	3m	at one end only	
C	2	2m	at both ends	

## Hands-on Session – LS-DYNA

Scenario	Type of Fire	Position of fire exposure	Structural loading
A	ISO	Top and bottom	100%
B	ISO	Bottom only	100%
C	ISO	Bottom only	150%

## The Scenario

# Good Luck!

