

# INSTA 950

Fire Safety Engineering – Comparative method to verify fire safety design in buildings

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- Working as a fire safety consultant for 7 years
  - Performance based design
  - Risk assessment – land use planning
  - Business development
  - Research

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# Why INSTA 950?

Teknisk specifikation

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**Fire Safety Engineering – Comparative method to verify fire safety design in buildings**

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# Why INSTA 950?

- Describing the *most common verification approach* for fire safety engineering
- Describe *how* to verify fire safety design when there is a lack of clearly defined acceptance criteria
- A **standardized process** - more consistent and uniform processes
- Increase the **Nordic collaboration**



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# Background

- Prepared by the Inter Nordic Standardization Cooperation
- Participants from all Nordic countries
  - Building authorities
  - Standardization and research organisations
  - Consultants
  - Industry
- Initiated by SP as a continuation on the project “Verifying Fire Safety Design in Sprinklered Buildings”

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# Absolute vs Comparative

- Defined values that defines the level of safety that should be fulfilled.

## ASET

Parameter	Criteria						
Visibility	Visibility no less than 3 m in the primary fire compartment at area of $\leq 100 \text{ m}^2$ . Visibility no less than 10 m at height of 2 m in escape routes and compartments of areas $> 100 \text{ m}^2$ . As an alternative to determine visibility, a smoke-free height of $1,6 \text{ m} + 0,1 \times H$ .						
Thermal <sup>a</sup>	Continuous radiation intensity of maximum $2.5 \text{ kW/m}^2$ and, a short-term radiation intensity of maximum $10 \text{ kW/m}^2$ if the maximum radiant dose is less than $60 \text{ kJ/m}^2$ .						
Temperature	Gas temperature not higher than $80 \text{ }^\circ\text{C}$ .						
Toxicity <sup>b</sup>	<table border="0"> <tr> <td>CO</td> <td>&lt; 2 000 ppm</td> </tr> <tr> <td>CO<sub>2</sub></td> <td>&lt; 5 %</td> </tr> <tr> <td>O<sub>2</sub></td> <td>&gt; 15 %</td> </tr> </table>	CO	< 2 000 ppm	CO <sub>2</sub>	< 5 %	O <sub>2</sub>	> 15 %
CO	< 2 000 ppm						
CO <sub>2</sub>	< 5 %						
O <sub>2</sub>	> 15 %						
<sup>a</sup> In addition to the energy from background radiation. <sup>b</sup> Toxicity does not need to be calculated when the visibility surpasses 5 m.							

- An alternative design is at least as safe as a design with pre-accepted solutions.
- Benchmarking against pre-accepted solutions.

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# Contents

- 1. Definitions**
- 2. The process of comparative approach**
- 3. Fire safety objectives**
- 4. Uncertainty and sensitivity management**
- 5. Documentation**
- 6. National determined parameters**

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## **3. Fire safety objectives**

- Evacuation – ASET/RSET
- Protection against generation and spread of fire and smoke
- Prevention of fire spread **within** the fire compartment
- Prevention of fire spread **between** fire compartments
- Stability and load-bearing capacity in case of fire
- Fire spread between buildings
- Safety for rescue service

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  - **Uncertainty and sensitivity analysis**
  - **Robustness analysis**
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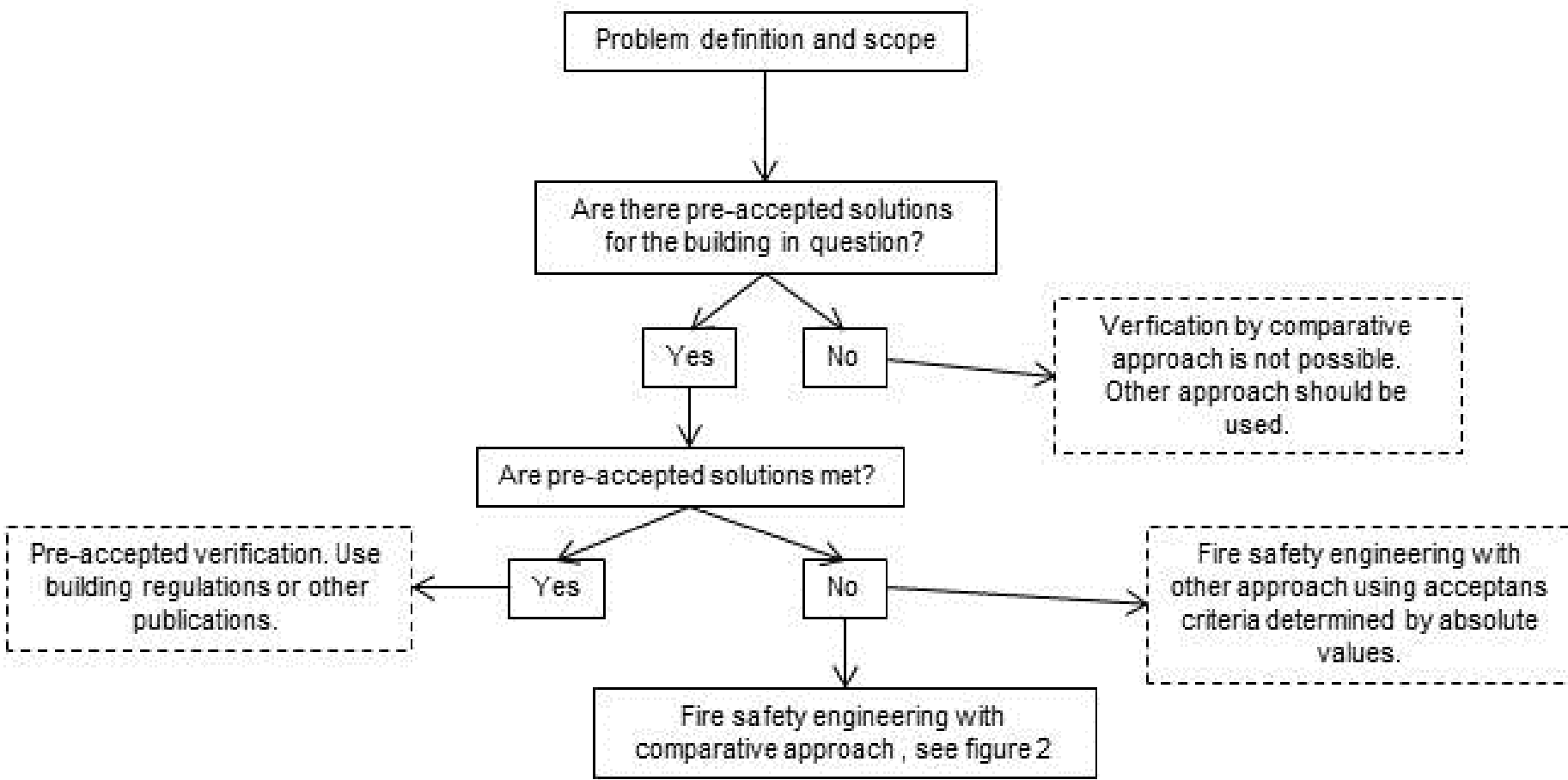
1. Definitions
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# When can you use it?

- 1. Allowance to use fire safety engineering methods**
2. Defined pre-accepted solutions for the problem and scope
3. Deviations from the pre-accepted solutions
4. Lack of absolute criteria to benchmark against

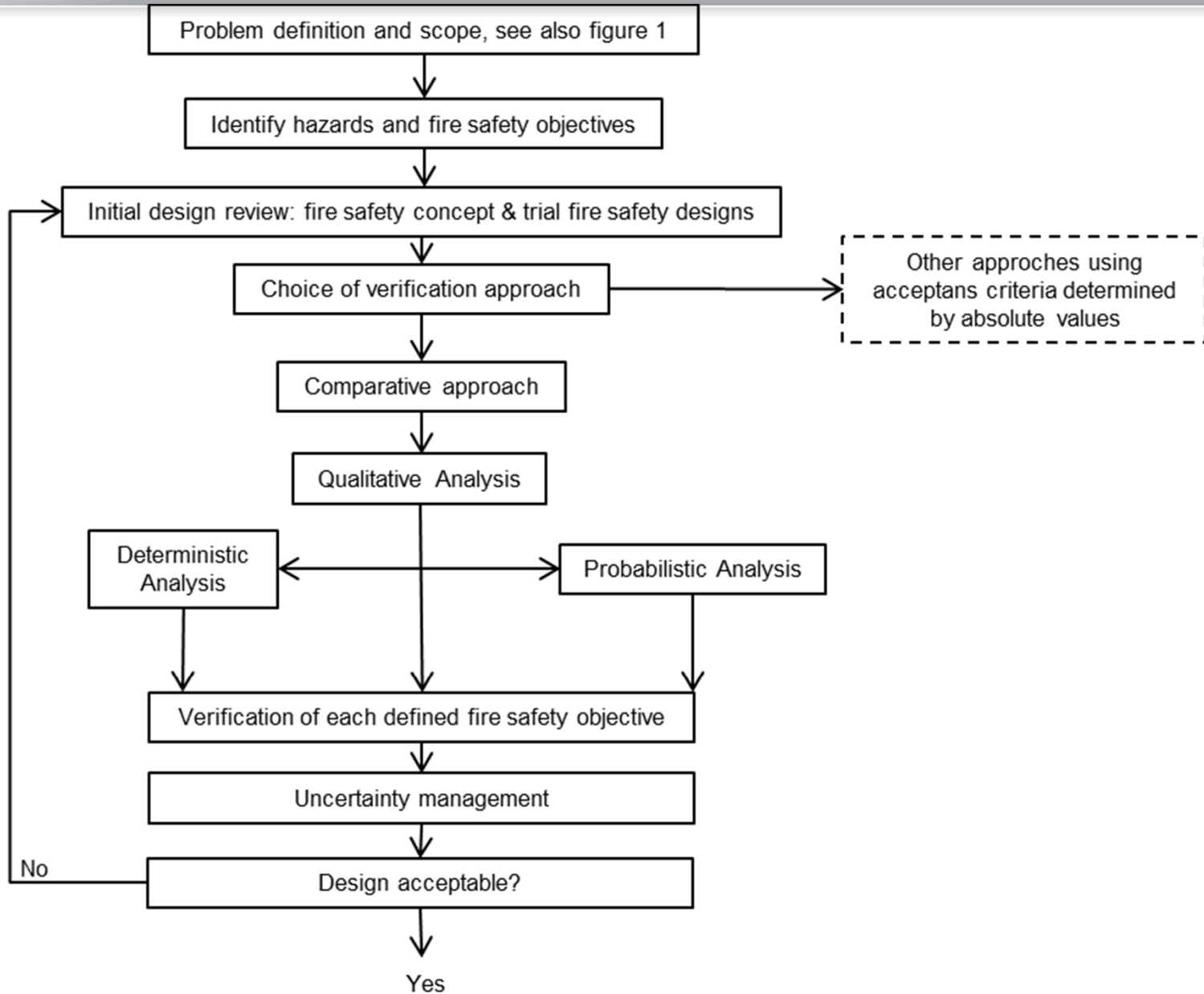
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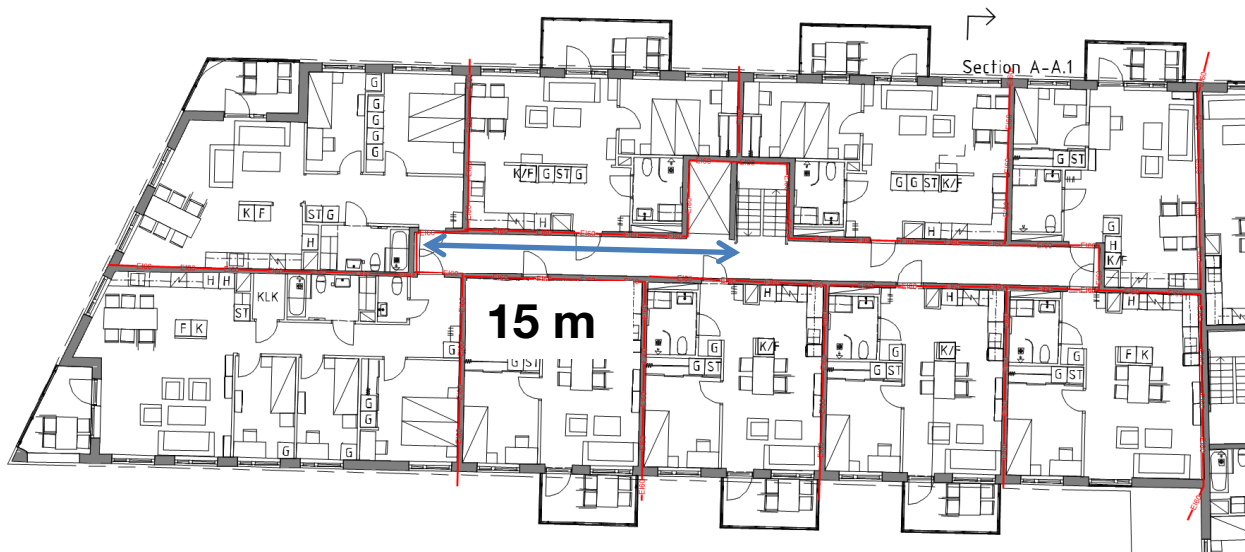
# The process of a comparative approach

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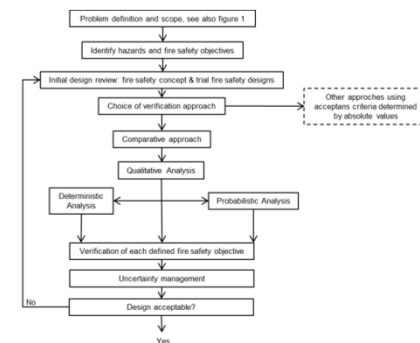


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# Define your problem



- Dead end in evacuation route
- Pre-accepted solution – 10 m
- Actual design - 15 m
- 9 apartments

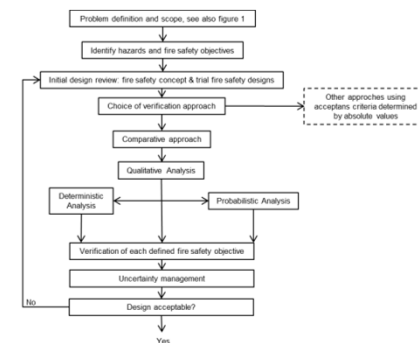


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# Define the scope

**Swedish regulations [BBR 5:332]:**

*“Evacuation routes shall be designed to limit the risk for persons to be trapped by fire and smoke.”*



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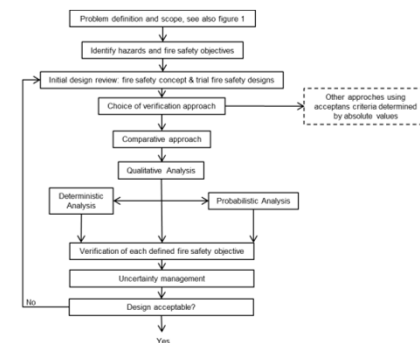
# Identify hazards

**Main deviation from fire safety objectives:**

- Increased risk of blocking the evacuation route

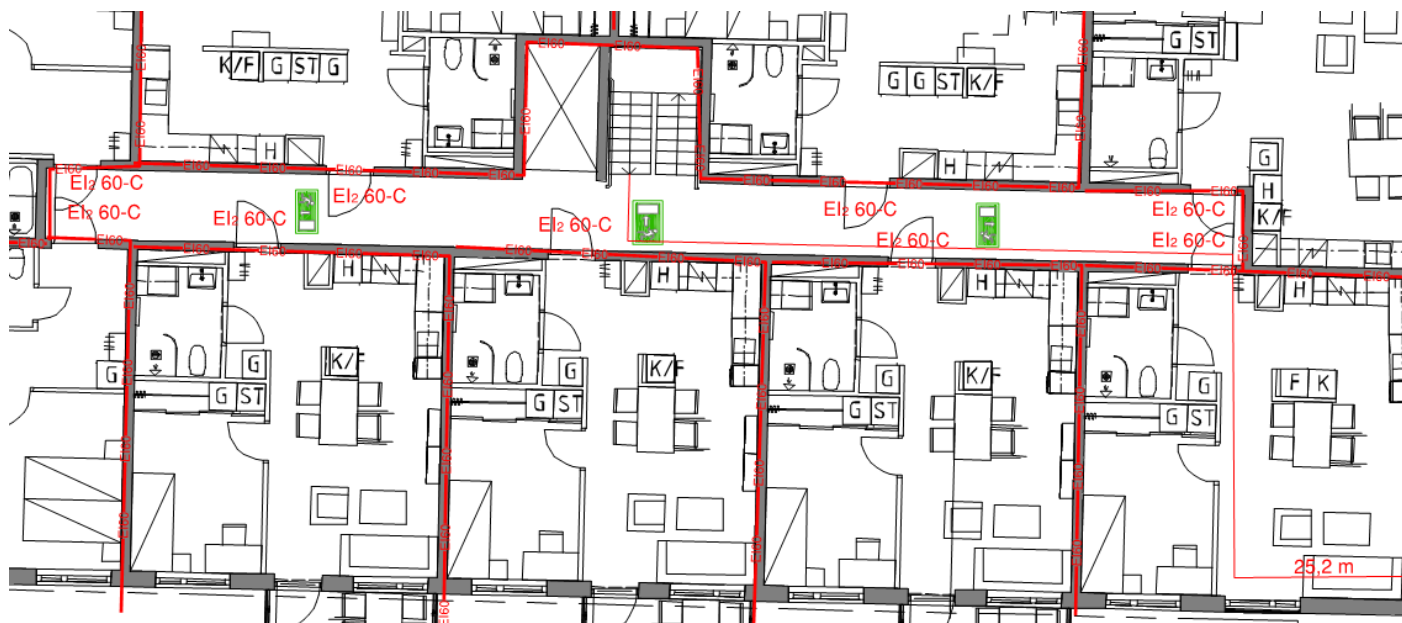
**But there are deviations concerning:**

- Mean of egress
- The safety of fire and rescue services



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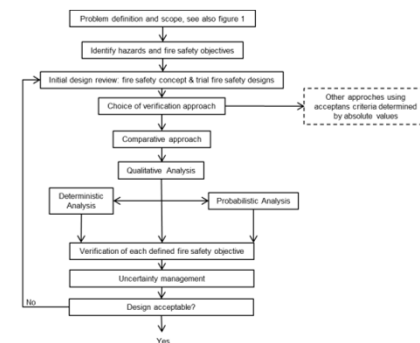
# Initial design review



**Maximum  
distance  
50 meter**

**Doors with fire resistance  
class EI 60 and door closers**

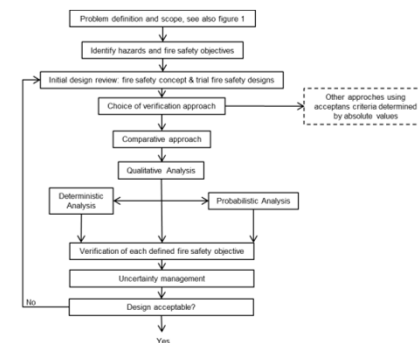
**Signs and emergency  
lightning in the corridors**



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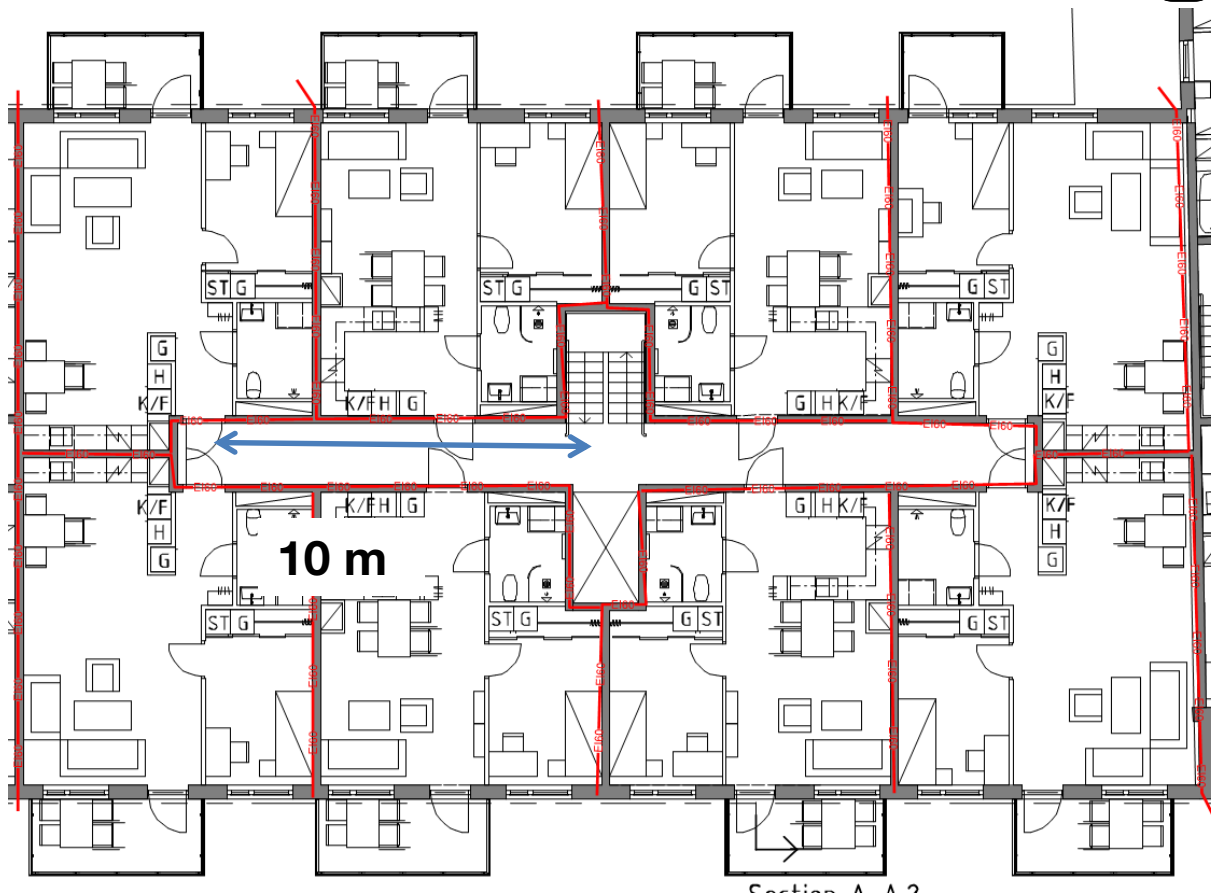
# The verification approach

- Comparison between the fire safety level of a trial fire safety design and an *equivalent* reference building
- Performed on different levels:
  - on individual objectives,
  - a set of objectives
  - a whole building

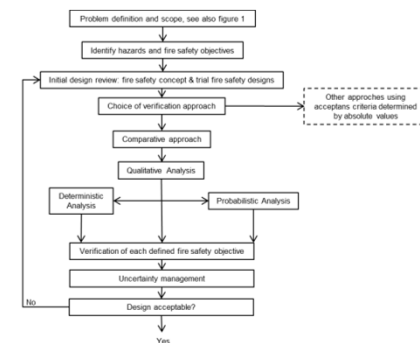


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# Reference building



- 8 apartments
- dead end – 10 m



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# Reference building Extreme?



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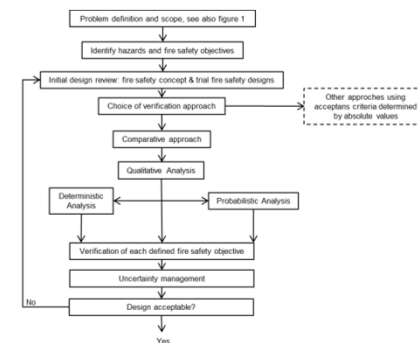
# Reference building Extreme?



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# Verify the safety level

- **Qualitative analysis** - logical reasoning
- **Deterministic analysis** – focusing on consequences
- **Probabilistic analysis** - likelihood of a particular unwanted event occurring

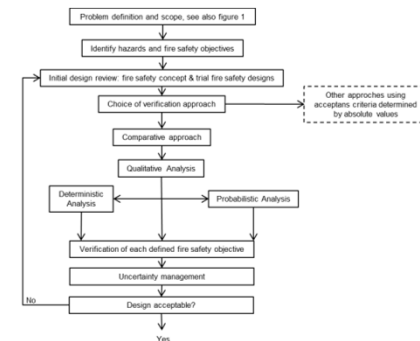
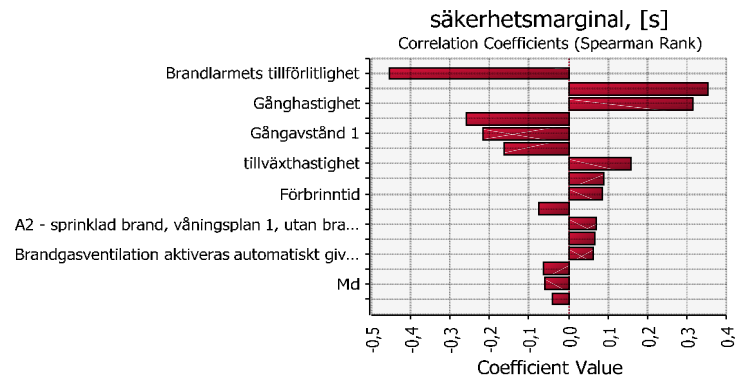




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# Uncertainty management

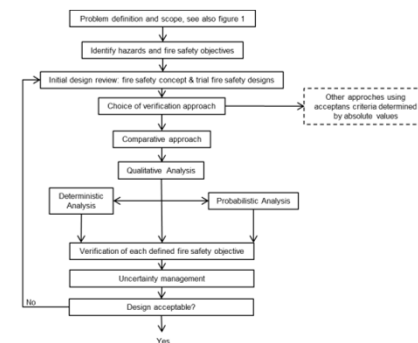
- Uncertainty analysis
- Sensitivity analysis
- Robustness analysis



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# Acceptable design?

- Is the level of safety at least at the same level as the reference building?
- **Yes** – OK!
- **No** – define a new initial design review and do the process all over.



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# Will it work? - Challenges

- Defining your reference building – how and how extreme?
- Lack of scientific support for the pre-accepted solutions
  - “Deem to satisfy solutions” – we don’t have the whole picture
- Lack of tools for analysing different Fire safety objectives
  - Main focus today - ASET/RSET – analysis
  - No useful methods for some of the fire safety objectives

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# The Future

- A new project is initiated in the Nordic collaboration

## ***”FSE for Innovative and Sustainable Building Solutions”***

- Create new verification methods from a **practical perspective**
- INSTA standard providing new methods
- INSTA standard providing guidance on the process of safe and innovative fire safety design

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# The Future

## **FSE for Innovative and Sustainable Building Solutions**

- 6 work packages
- Representatives from all Nordic Cloutiers
- Iceland is leading one work-packge concering

*“identification and analysis of the barriers to innovation and trade”*