

21st EFA Roundtable
Nis, Serbia



Smoke!

July 11, 2019
René Hagen, professor of fire
safety

Themes

- ▶ The development of smoke



Themes

- ▶ The development of smoke
- ▶ Smoke spread in the object



Themes

- ▶ The development of smoke
- ▶ Smoke spread in the object
- ▶ Smoke spread in the building



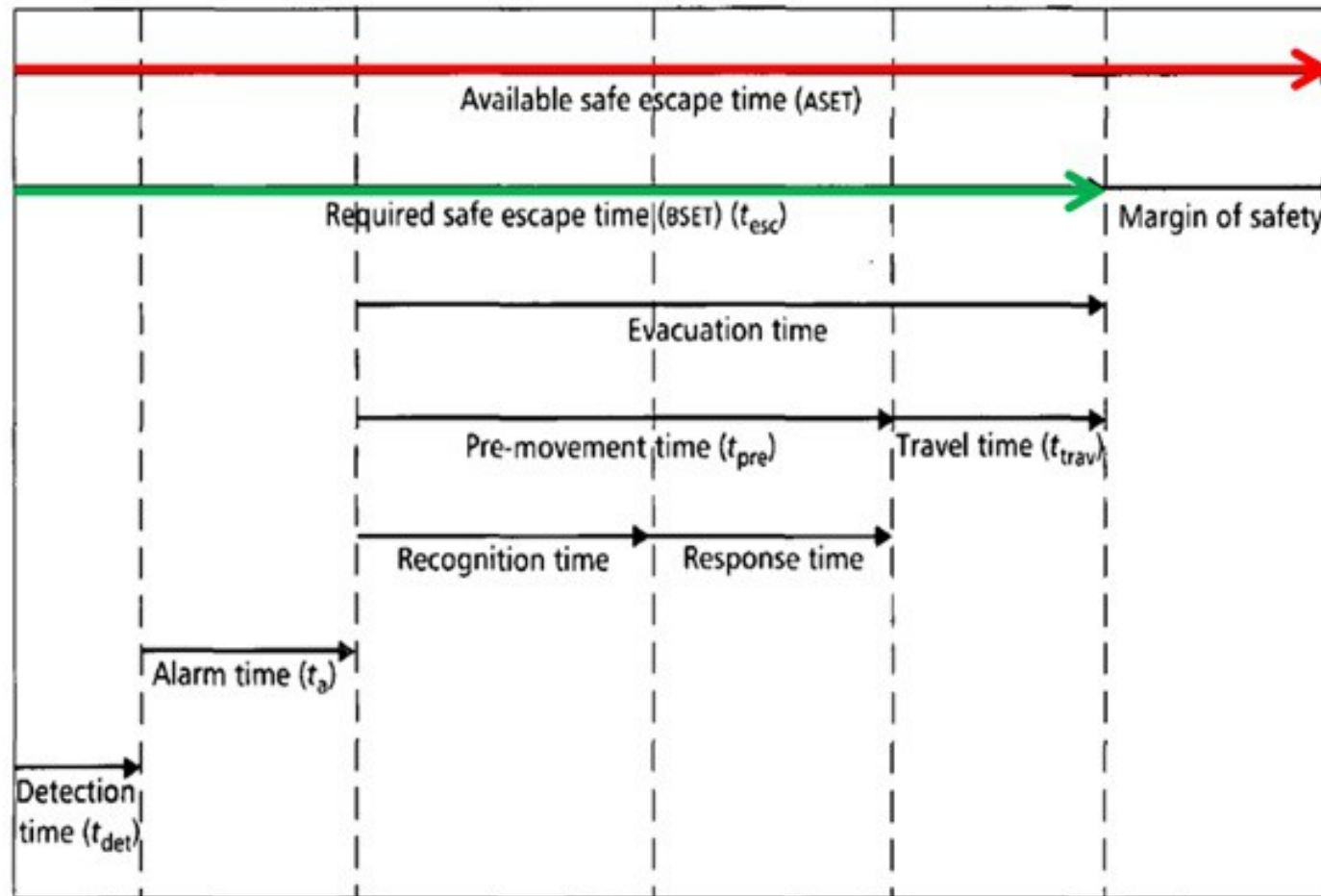
Themes

- ▶ The development of smoke
- ▶ Smoke spread in the object
- ▶ Smoke spread in the building
- ▶ Smoke spread to the surrounding of the building



The problem of smoke

Available (ASET) vs. required (RSET) escape time



Required escape time becomes longer



Available escape time becomes shorter



Smoke has an increasing impact on the fire

Veel rookoverlast door brand: nabijgelegen ziekenhuis stelt operaties uit



The development of smoke

Development of fire causes

- ▶ Discovery of cooking
 - discovery of fire
 - stone age
- ▶ Discovery of smoking
 - from America by Columbus
 - early 16th century
- ▶ Discovery of electricity
 - 19th century

Current causes of fire

- ▶ Discovery of cooking
 - discovery of fire
 - Stone age
- ▶ Discovery of smoking
 - from America by Columbus
 - early 16th century
- ▶ Discovery of electricity
 - 19th century



Brandoorzaken

1. Roken 26 % (meubilair in brand)
2. Koken 15 % (kleding in brand)
3. Elektrische apparatuur/installatie 15 %

Fires by smoking



Fires by smoking are relatively often fatal



Fires by cooking



Fires in electrical equipment



RTLnieuws

Steeds meer woningbranden door oververhitte telefoonopladers

Risc factors of fatal domestic fires

- ▶ 71% die in the room where the fire started
- ▶ 33% had a working smoke detector
- ▶ 60% die through a rapidly fire growth
- ▶ 74% die through a rapidly smoke spread

Smoke spread in the object

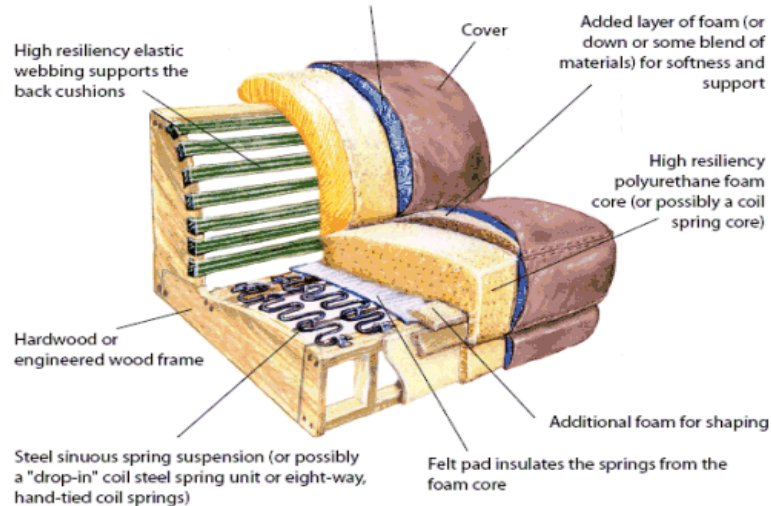
Sofas and mattresses; the biggest problem

- The cause of more than 25% of all fatalities and injuries by fire
- This is on EU level almost 1000 fatalities per year!

THE INSIDE STORY: UPHOLSTERY

Construction features vary depending on furniture design and price

Cushioning may be inserted in a polyester or cotton casing to separate cover fabric from core materials



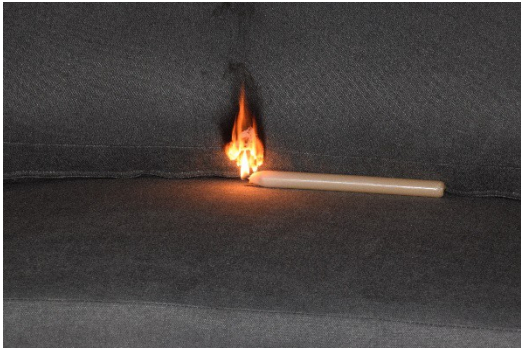
Source: American Furniture Manufacturers Association



Impression tests upholstered furniture and mattresses



Impression tests UF and mattresses



Brand in bankstel veroorzaakt enorm veel rook: brandweer moet mensen van de balkons halen in appartementsgebouw

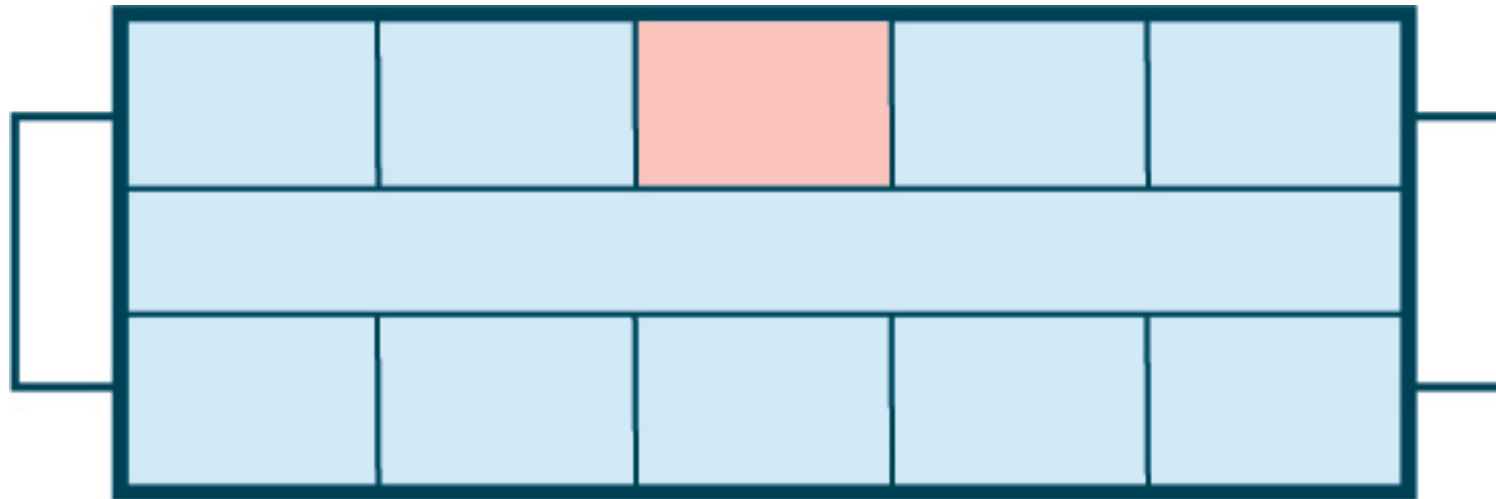
Eindhovens Dagblad Nieuws



Brandweer haalt mensen van balkon brandend complex

Smoke spread in the building

Fire compartments in residential buildings



Principle fire compartments

- ▶ Threatened area

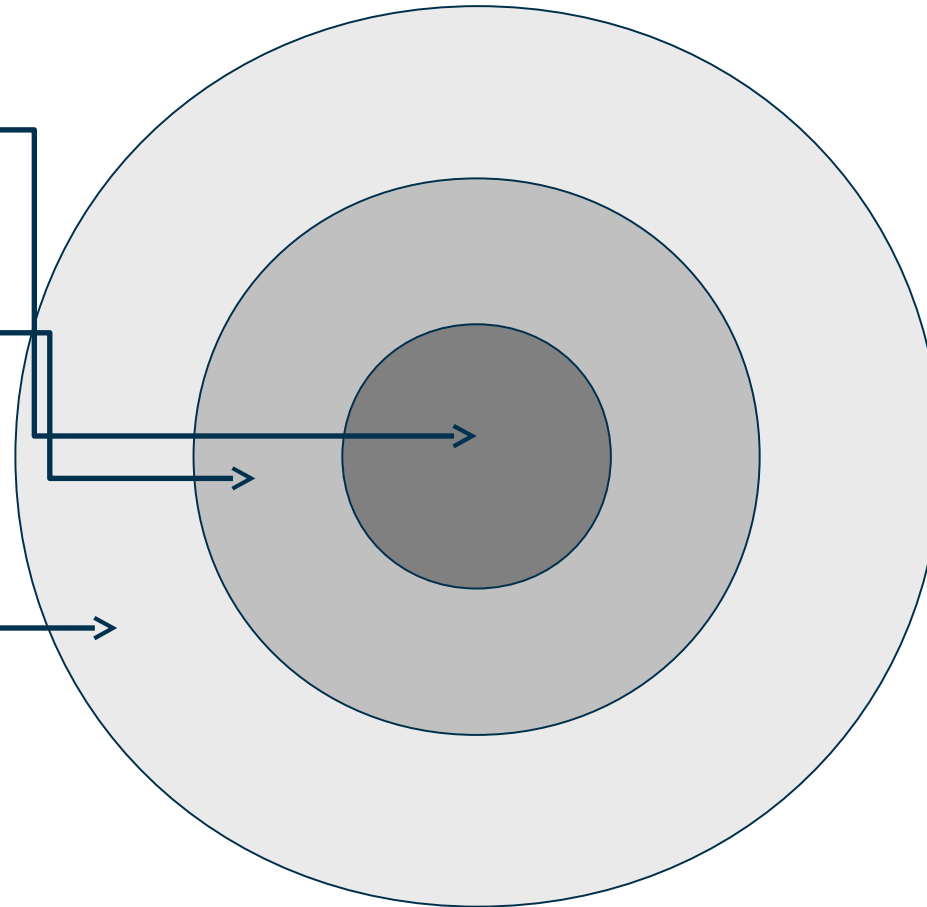
= rescue

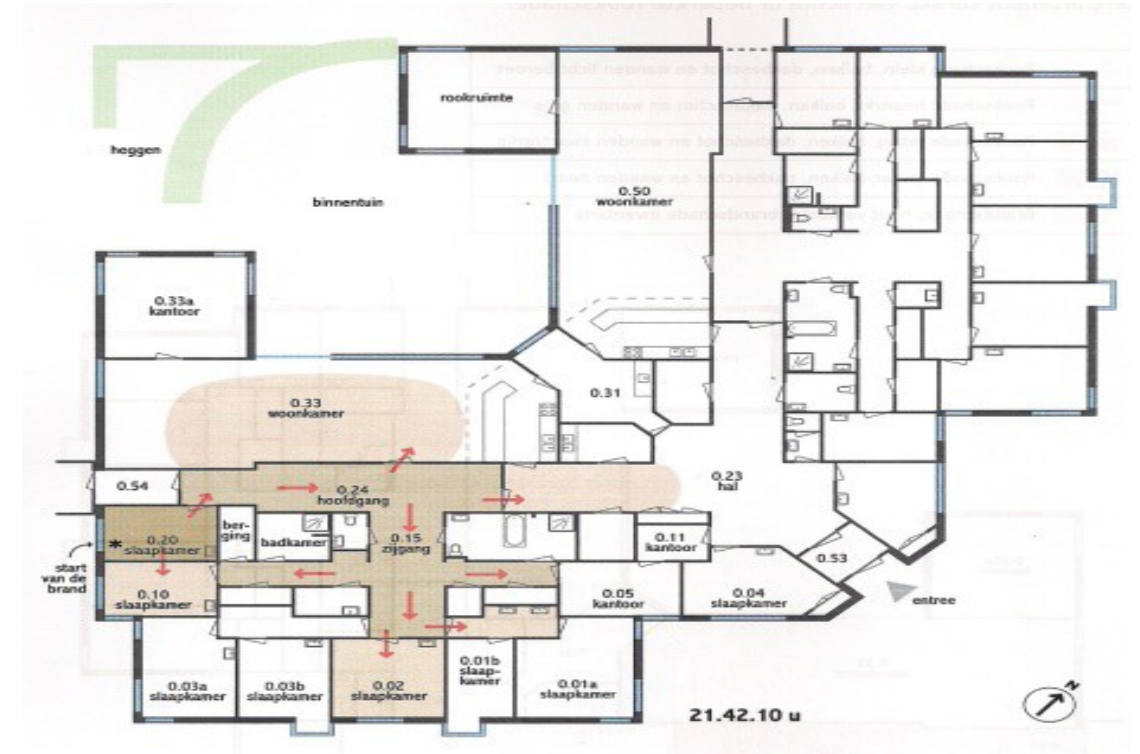
- ▶ Potential threatened area

= evacuate

- ▶ Not threatened area

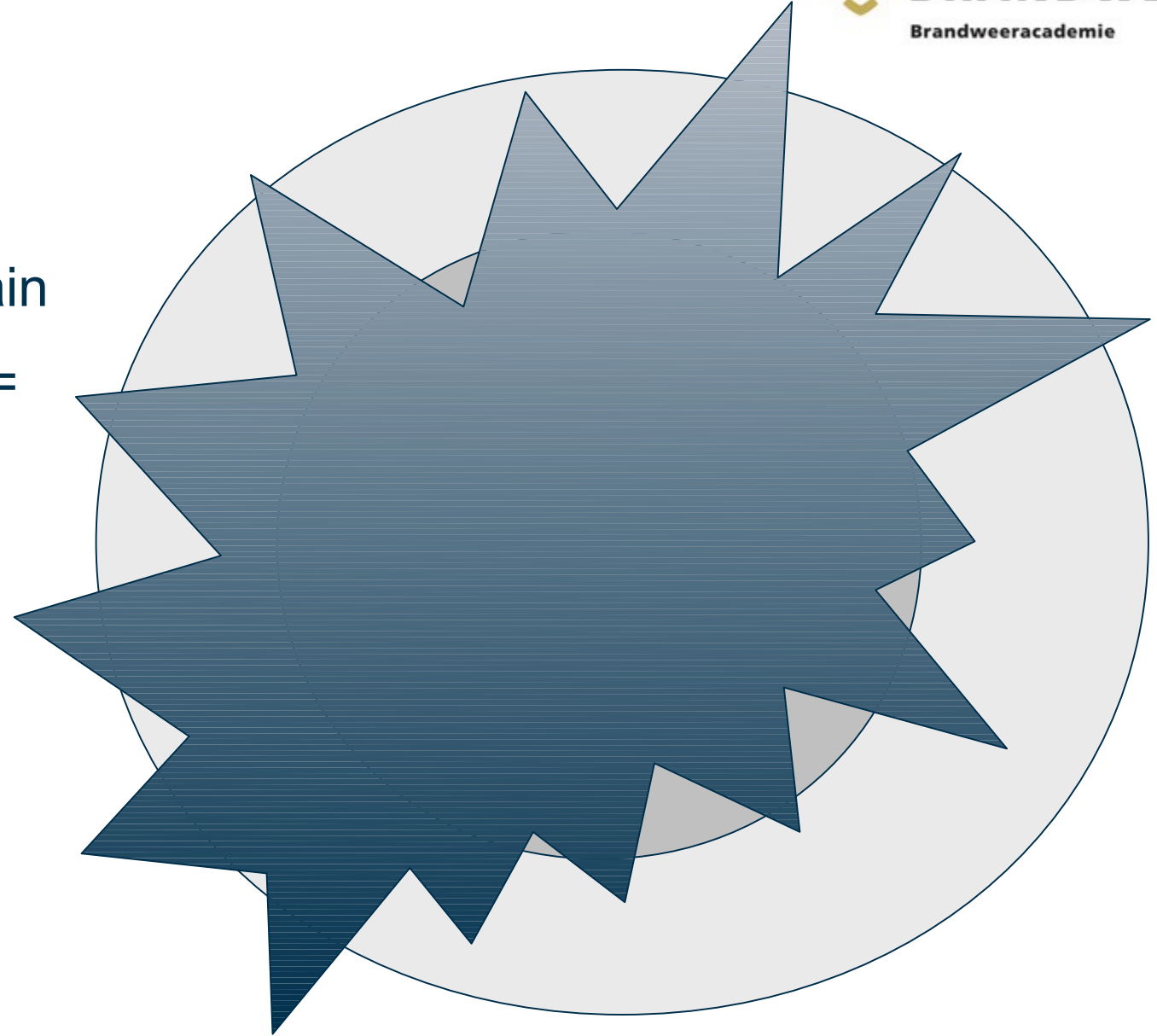
= not evacuate



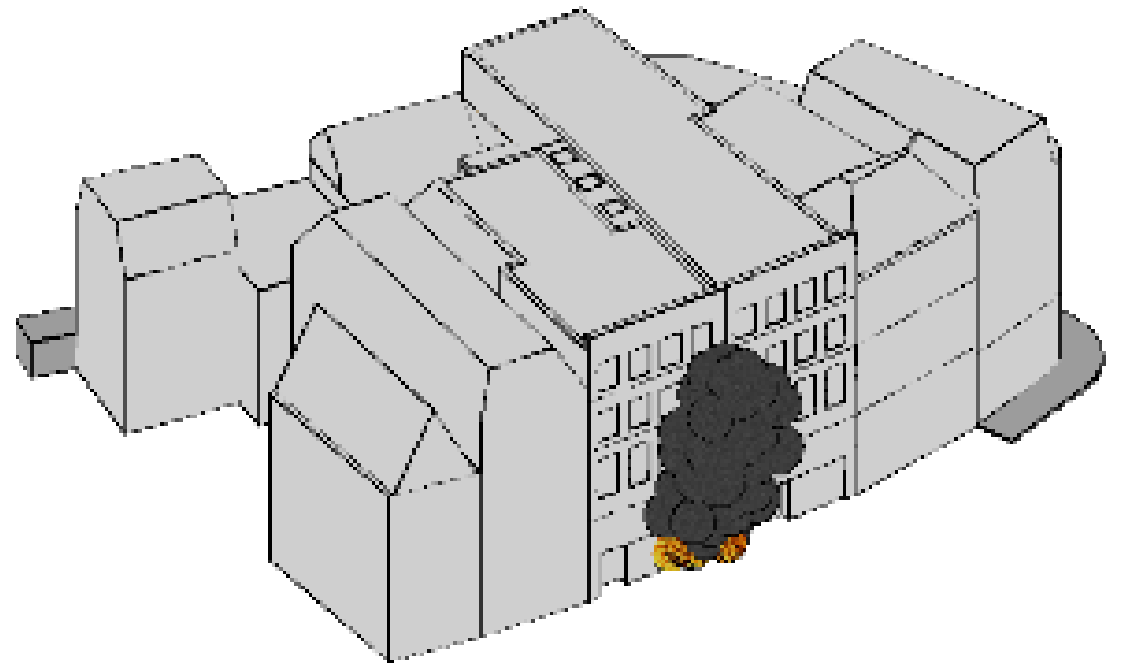


Practise

- ▶ Threatened area = uncertain
- ▶ Potential threatened area = uncertain
- ▶ Not threatened area = uncertain



De Kelders, Leeuwarden (2013)



Hof van Wageningen, Wageningen (2015)





De Notenhout, Nijmegen (2015)




Studentenflat, Diemen (2017)



16					
15					
14					
13					
12					
11					
10					
9					
8					
7					
6					
5					
4			X		
3			X		
2			X		
1			X		
BG		X			
	appartementen	gang	centrale trappenhuis	gang	appartementen

16					
15					
14			X		
13			X		
12			X		
11			X		
10			X		
9			X		
8		X	X		
7		X	X		
6		X	X		
5		X	X	X	
4		X	X	X	
3			X		
2		X	X	X	
1			X		
BG		X		X	
	appartementen	gang	centrale trappenhuis	gang	appartementen

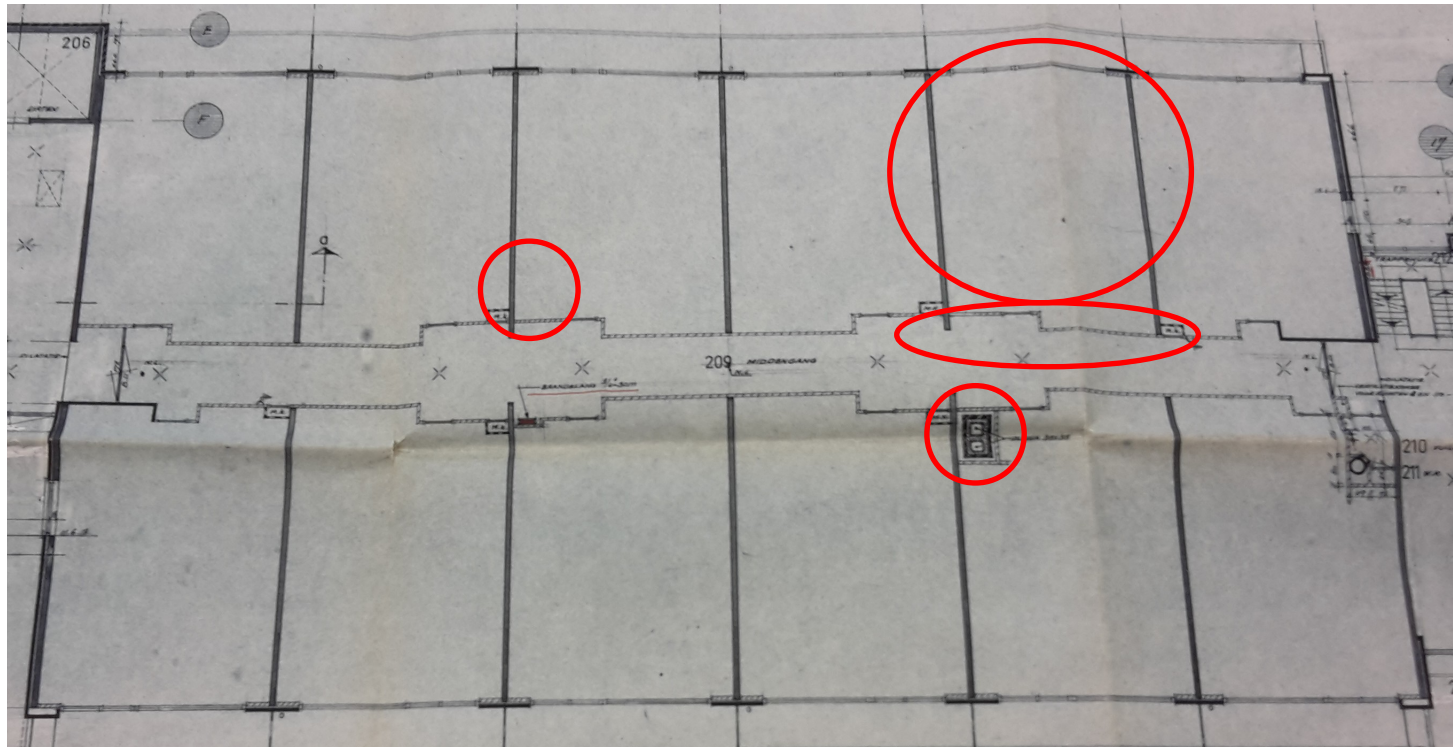
16		X			
15		X	X		
14		X	X		
13		X	X	X	
12		X	X	X	
11		X	X	X	
10		X	X	X	
9			X	X	
8		X	X	X	
7		X	X		
6		X	X	X	
5		X	X	X	
4		X	X	X	
3			X	X	
2		X	X	X	
1			X	X	
BG		X		X	
	appartementen	gang	centrale trappenhuis	gang	appartementen

Practise: scooter in the corridor



Source: VRR

The casus



Source: VRR

The analisis

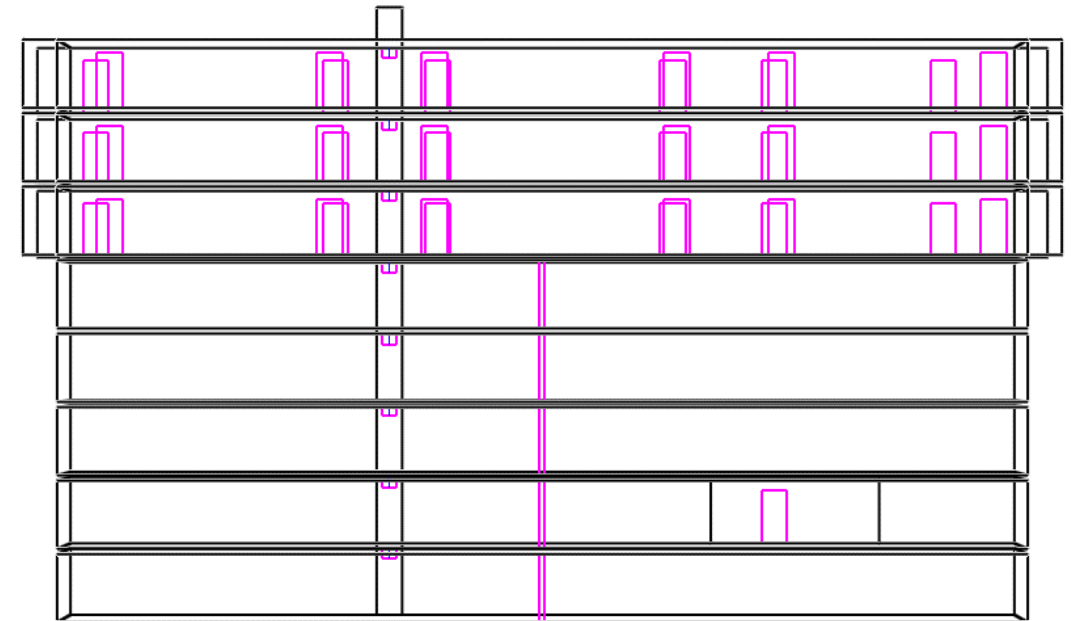
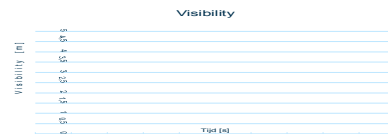
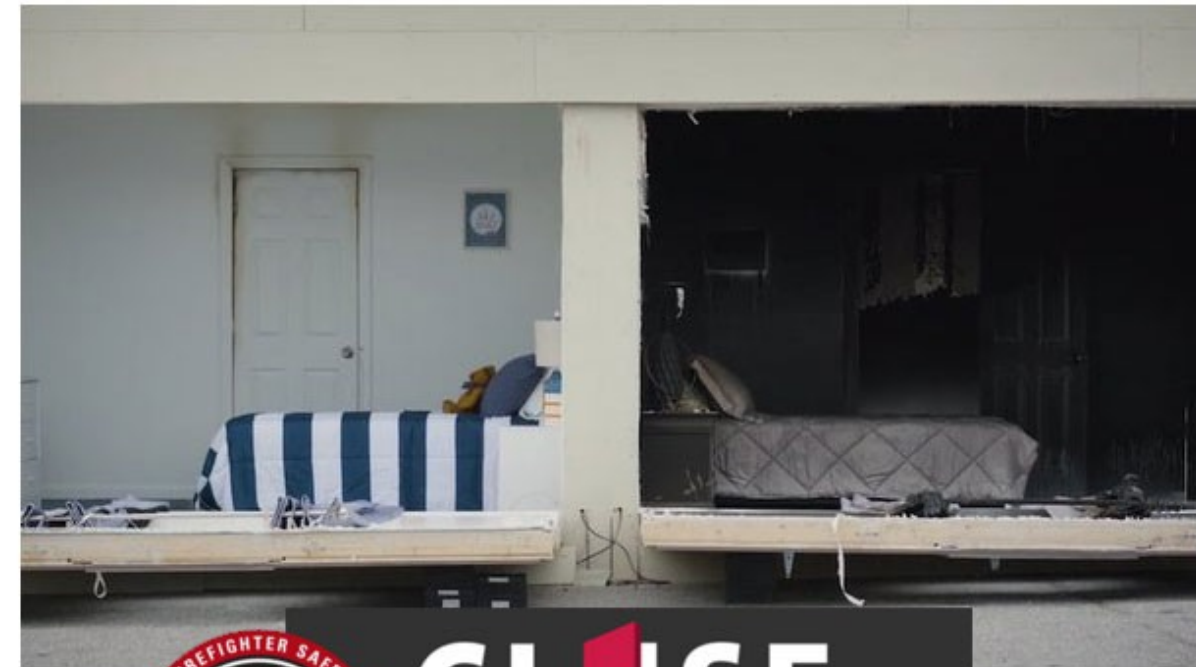
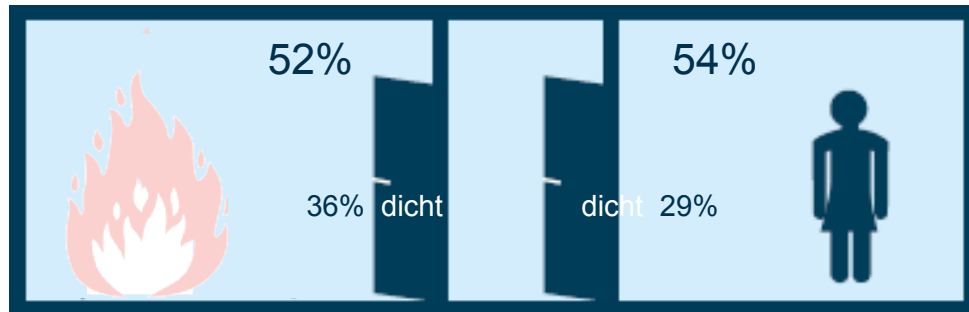


Chart and animation: Visibility and smoke spread

Source: BA

Closing doors turned out to be effective

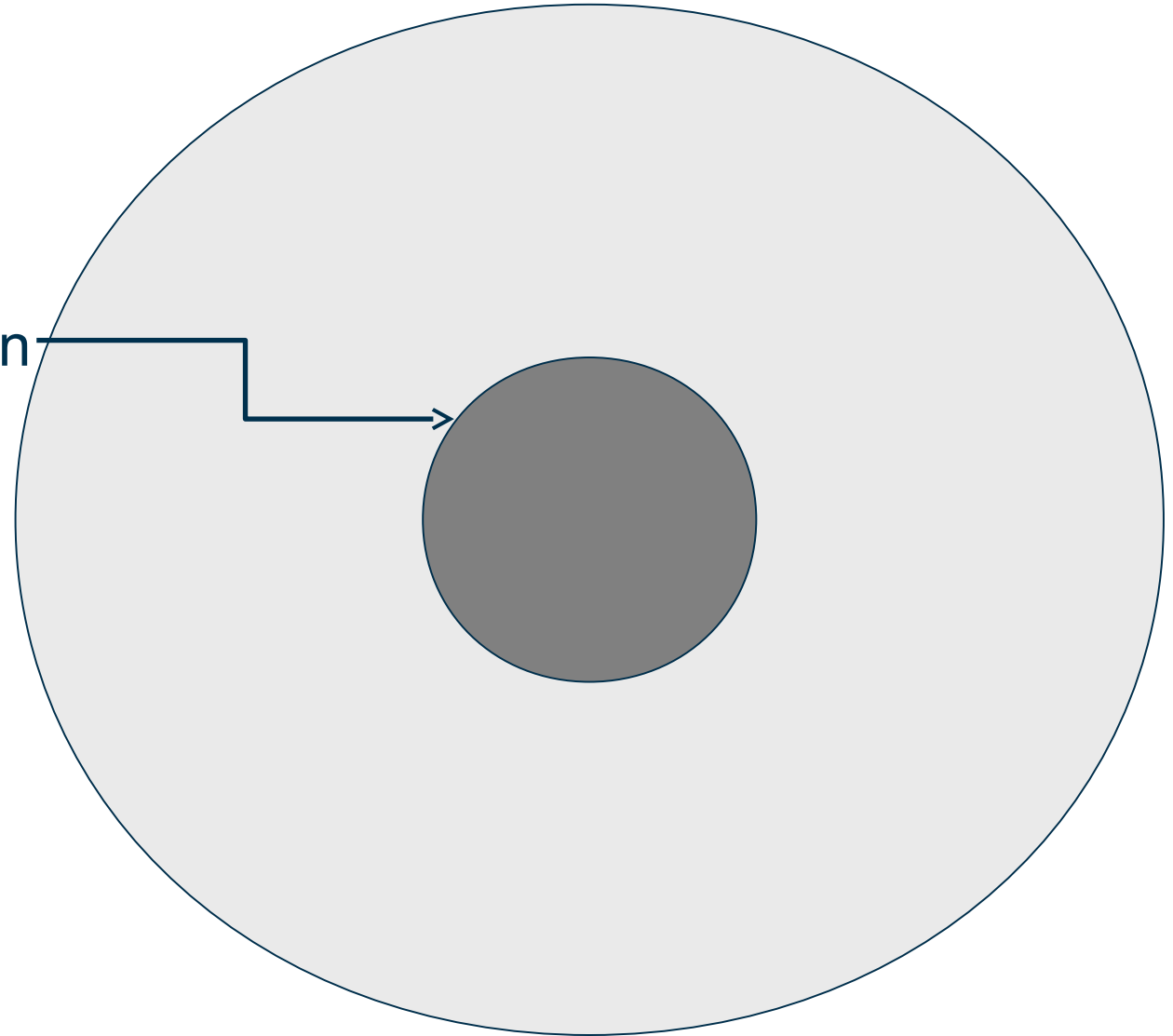


Closing doors is not stay-in-place!



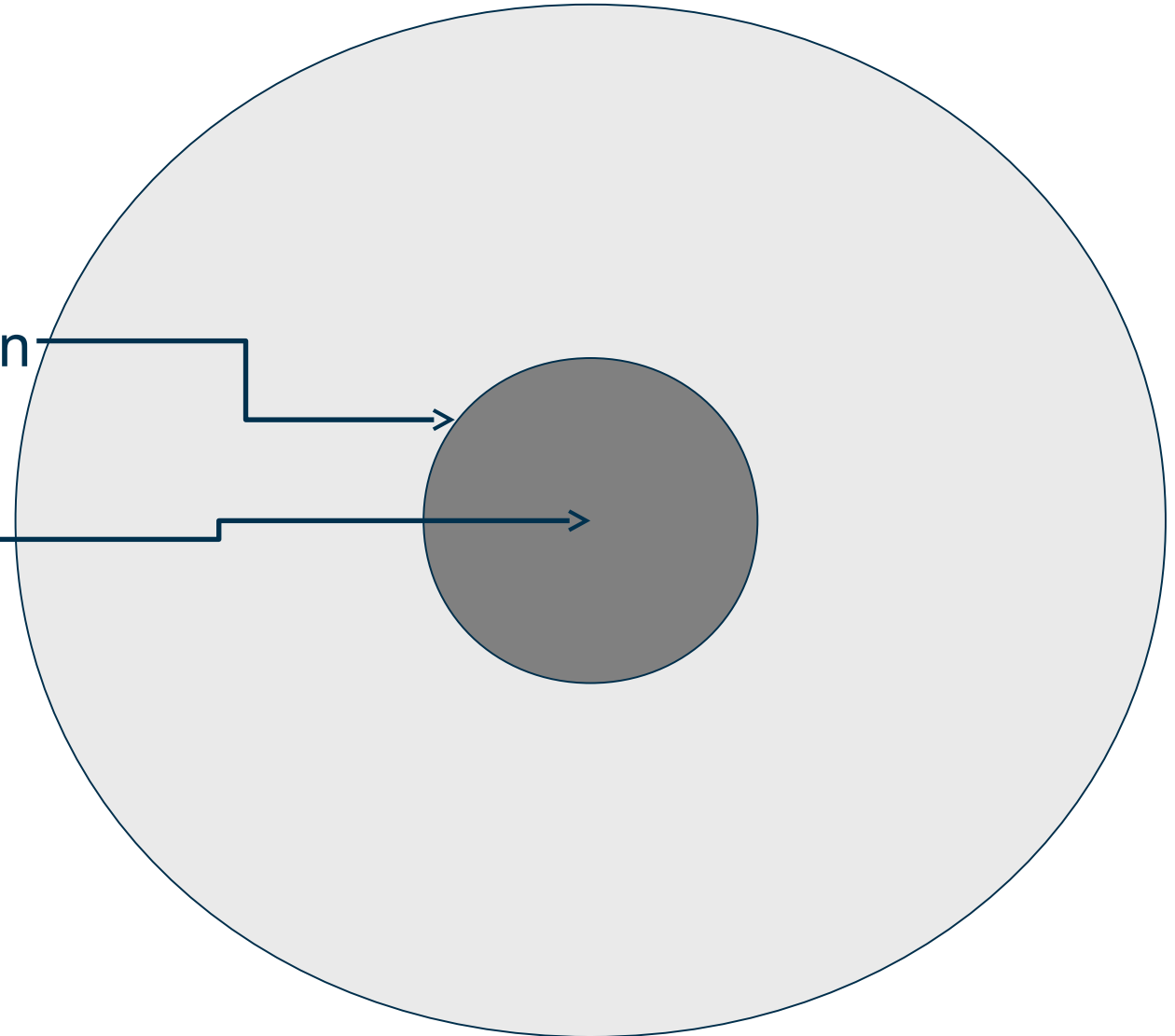
Stay-in-place

- ▶ Smoke tight compartmentation

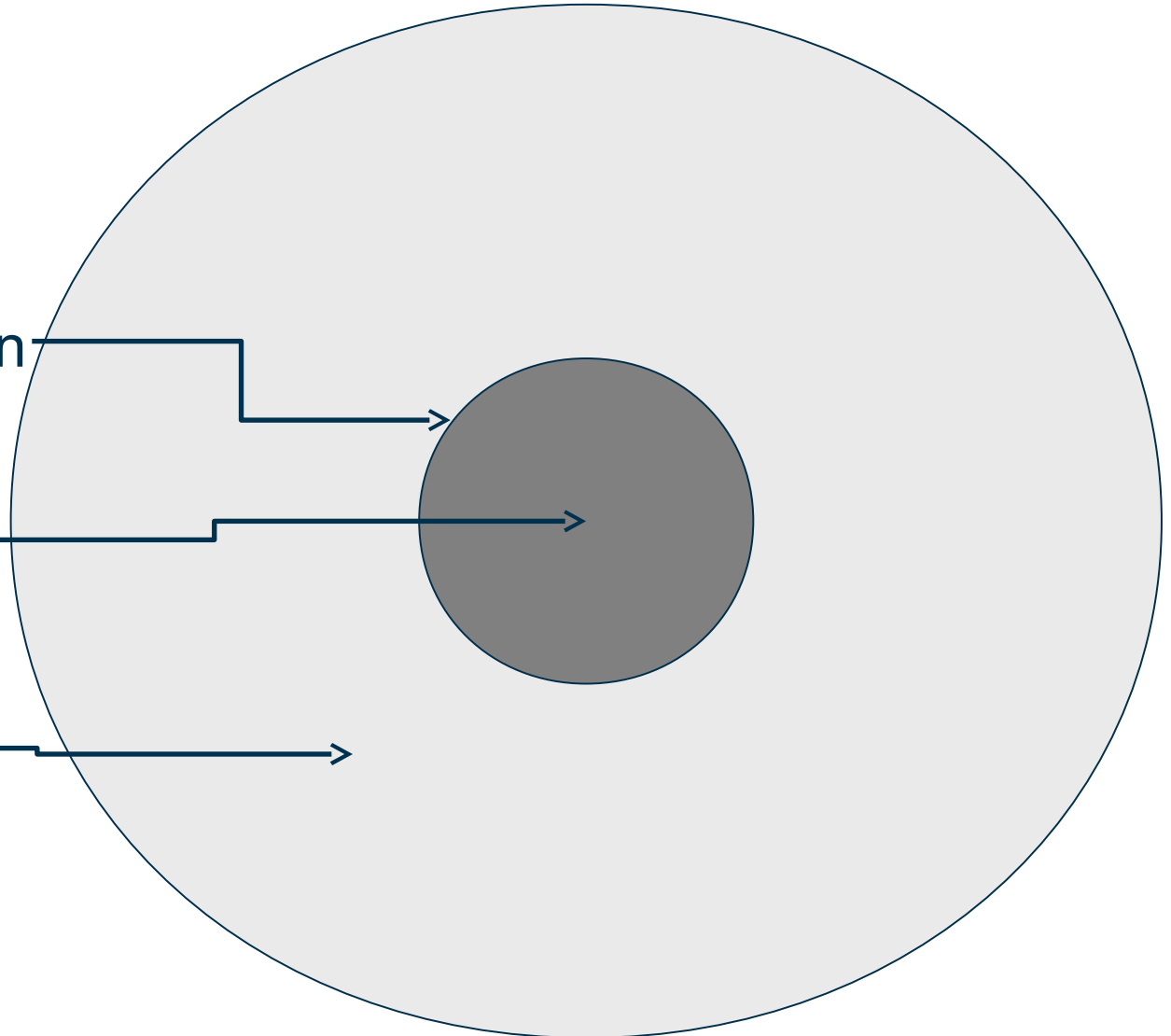


Stay-in-place

- ▶ Smoke tight compartmentation
- ▶ Automatic extinguishing



Stay-in-place

- ▶ Smoke tight compartmentation The diagram consists of a large light gray circle representing a room. Inside this circle is a smaller dark gray circle representing a fire compartment. Three arrows point from the text on the left to the diagram: the first points to the dark gray circle, the second points to the dark gray circle, and the third points to the light gray circle.
- ▶ Automatic extinguishing
- ▶ People should stay

More research is necessary

Practical experiments (1)



Dag	Doel testdag	Test	Effect preventieve maatregelen op rookverspreiding			Effect brandweerinzet op rookverspreiding
			Deur naar vluchtweg open/ dicht	Specifieke rookwerende scheiding	Sprinkler	Tactiek
1	Demodag voor media en VIPS	1	Open	Nee	Nee	
2	effect deur	2	Dicht	Nee	Nee	Offensief binnen
		3	Open	Nee	Nee	Defensief binnen
3	effect deur 2	4	Dicht	Nee	Nee	Defensief binnen
		5	Open	Nee	Nee	Offensief binnen
4	effect rookwerende scheiding	6	Dicht	Ja	Nee	Offensief binnen
		7	Dicht	Ja	Nee	Defensief binnen
5	effect sprinkler	8	Dicht	Nee	Ja	Offensief binnen
		9	Open	Nee	Ja	Defensief binnen
6	effect sprinkler 2	10	Dicht	Nee	Ja	Defensief binnen
		11	Open	Nee	Ja	Offensief binnen
7	Effect rookwerende scheiding + sprinkler	12	Dicht	Ja	Ja	Offensief binnen
		13	Dicht	Ja	Ja	Defensief binnen
8	Organische vuurlast®	14	Open	Nee	Nee	Offensief binnen
		15	Dicht	Nee	Nee	Defensief binnen
9	Maximale ventilatie	16	Open	Nee	Nee	Offensief binnen
		17	Open	Nee	Nee	Defensief binnen
10	Nulmeting en reserve	18	Open	Nee	Nee	Geen inzet (nulmeting)
		19				

Practical experiments (2)



Practical experiments (3)



Practical experiments (4)





Rescue, extinguish or evacuate? What first?



Smoke spread to the surrounding of the building

Research to the impact of fires



The impact of fires on society through the smoke spread

- ▶ Smoke nuisance for residents
- ▶ Economic damage
 - Traffic jams
 - Failure of third-party business operations
- ▶ Malfunction of (other) collective provisions
 - Schools
 - Hospitals
 - Utilities

Thank you for your attention!

