PASSIVE FIRE PROTECTION OF INSTALLATIONS CERTIFICATIONS & TESTS SEISMIC BEHAVIOR

Fire Safety Academy

3 Giugno 2019
Milano

AGENDA

1 Passive Fire Protection - Compartmentation

2 Passive Fire Protection – Firestopping, Testing & Approvals

3 Behavior under seismic conditions

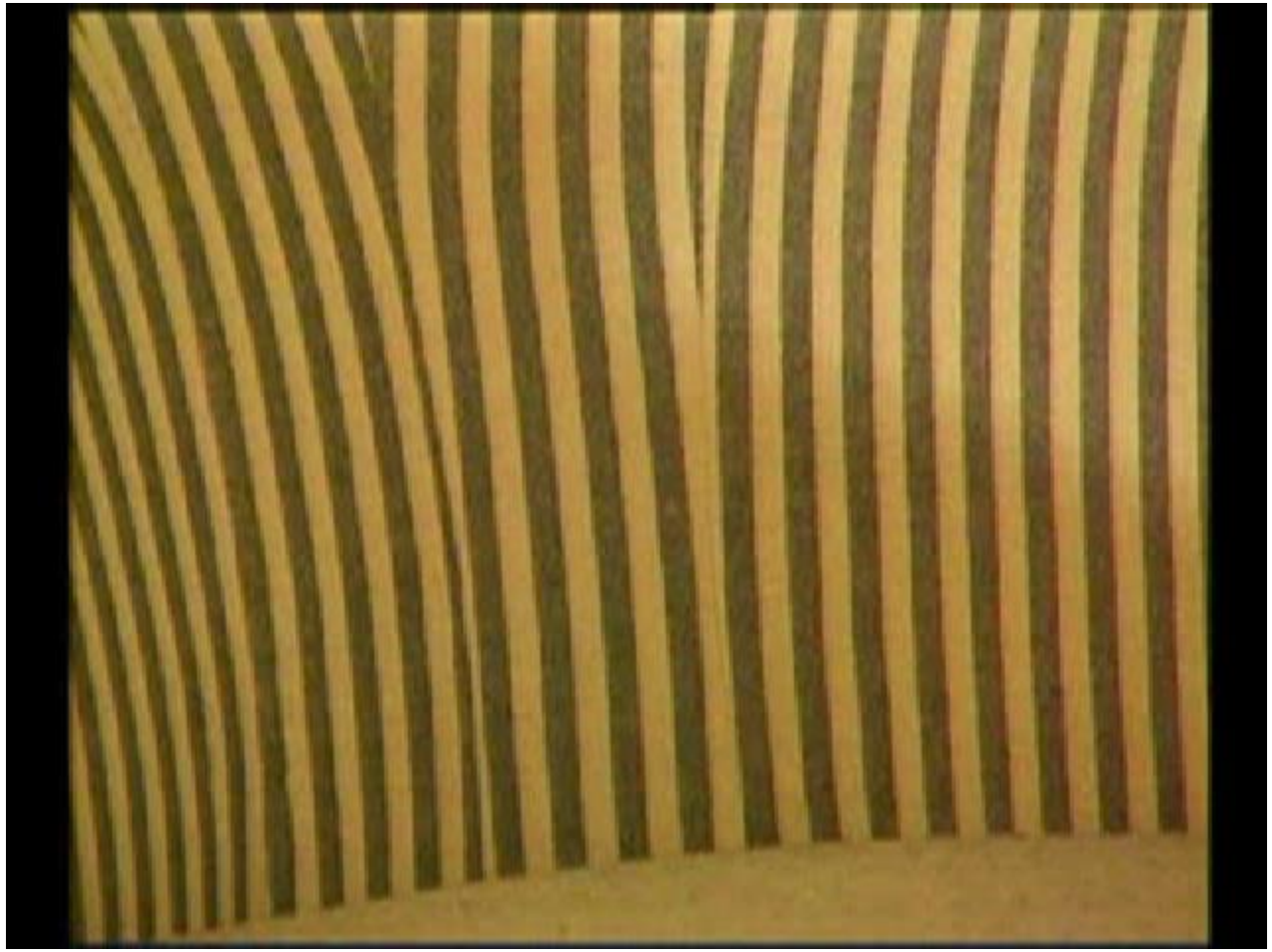
AGENDA

1 Passive Fire Protection - Compartmentation

2 Passive Fire Protection – Firestopping, Testing & Approvals

3 Behavior under seismic conditions

WHY FIRE PROTECTION ?



PASSIVE FIRE PROTECTION

Passive Fire Protection is one of the three key components besides active Fire Protection and education for fire protection in buildings

Passive Fire protection is a range of measures designed to prevent, contain or slow the spread of fire from the area of origin to other areas in the building to minimize damage and give occupants enough time to evacuate

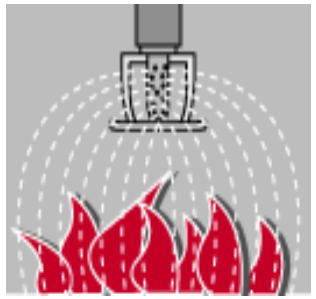
KEY ELEMENTS OF FIRE PROTECTION

Active

Detection & Alarm

Automatic / manual fire suppression are activated
i.g. automatic doors, notification fire department
i.g. occupants have time to move outside the building

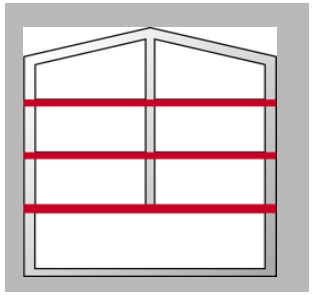
Automatic Suppression



Sprinkler / extinguishing systems

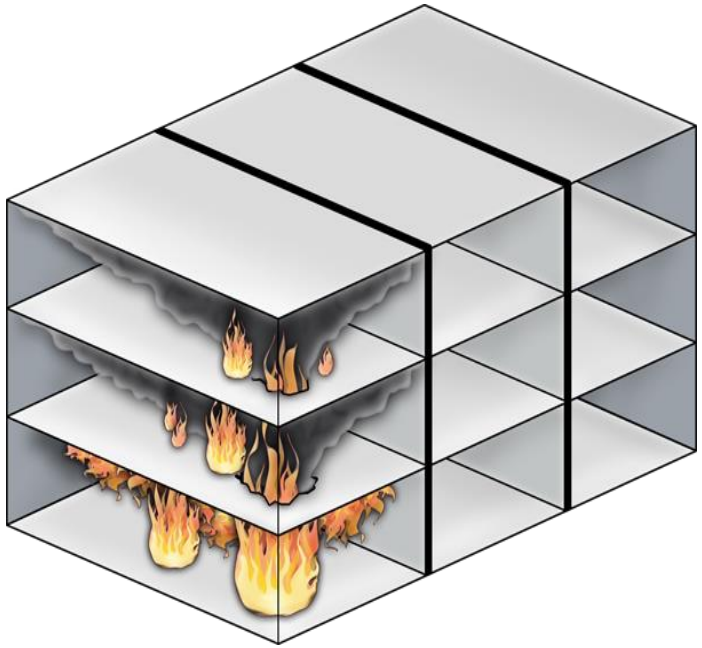
Passive

Compart-mentation



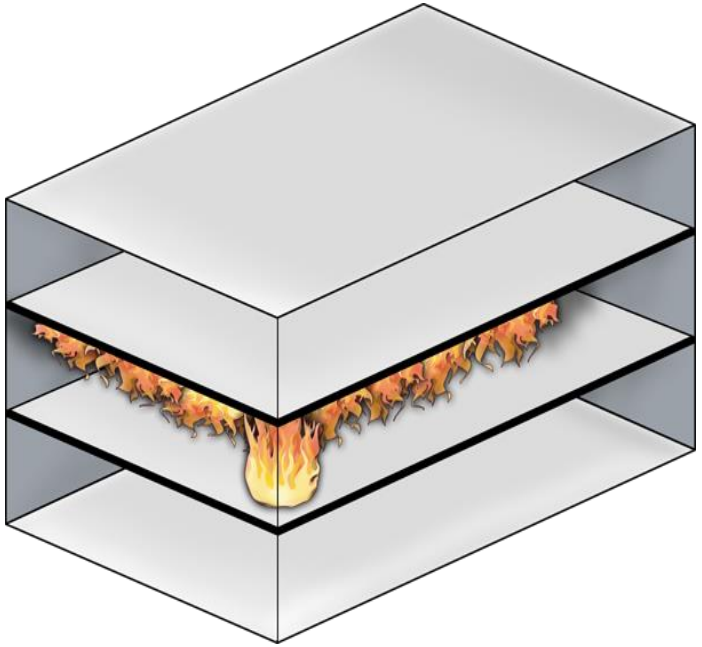
Barriers such as walls, partitions and floors to delay or prevent fire or smoke from propagating from one space to another.

VERTICAL AND HORIZONTAL COMPARTMENTATION



Vertical compartmentation *by use of fire-resisting* ***walls****:*

Fire can spread vertically via openings in floors

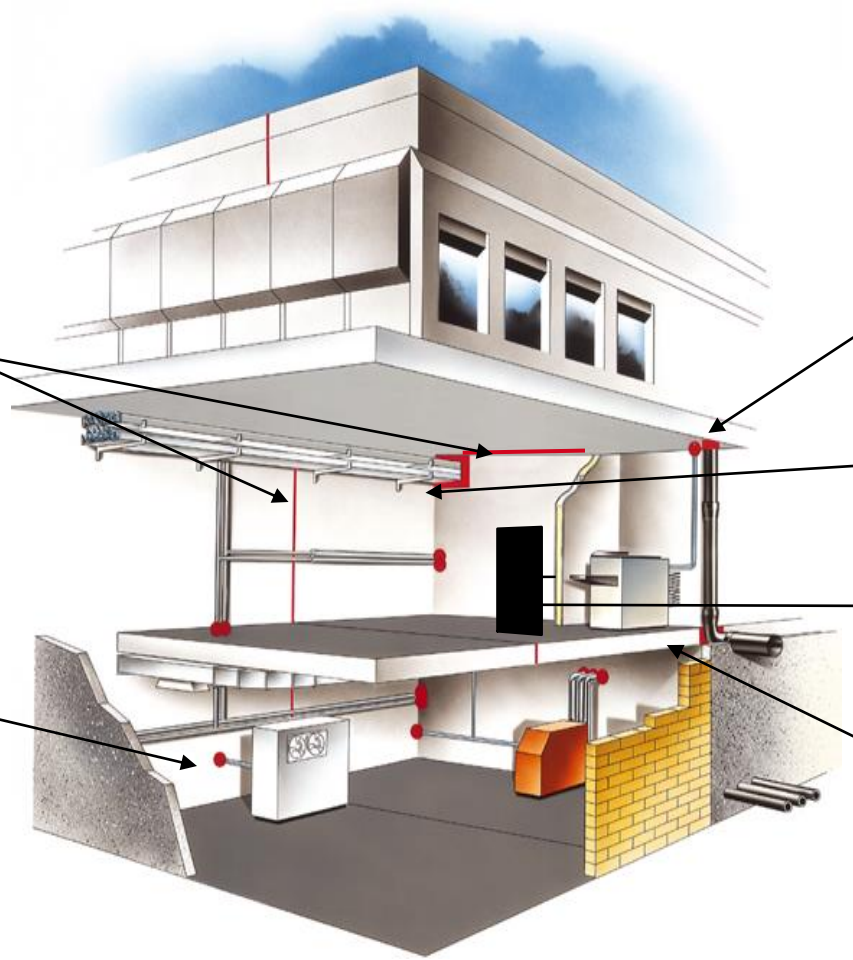


Horizontal compartmentation *by use of fire-resisting* ***floors****:*

Fire can spread horizontally via openings in walls

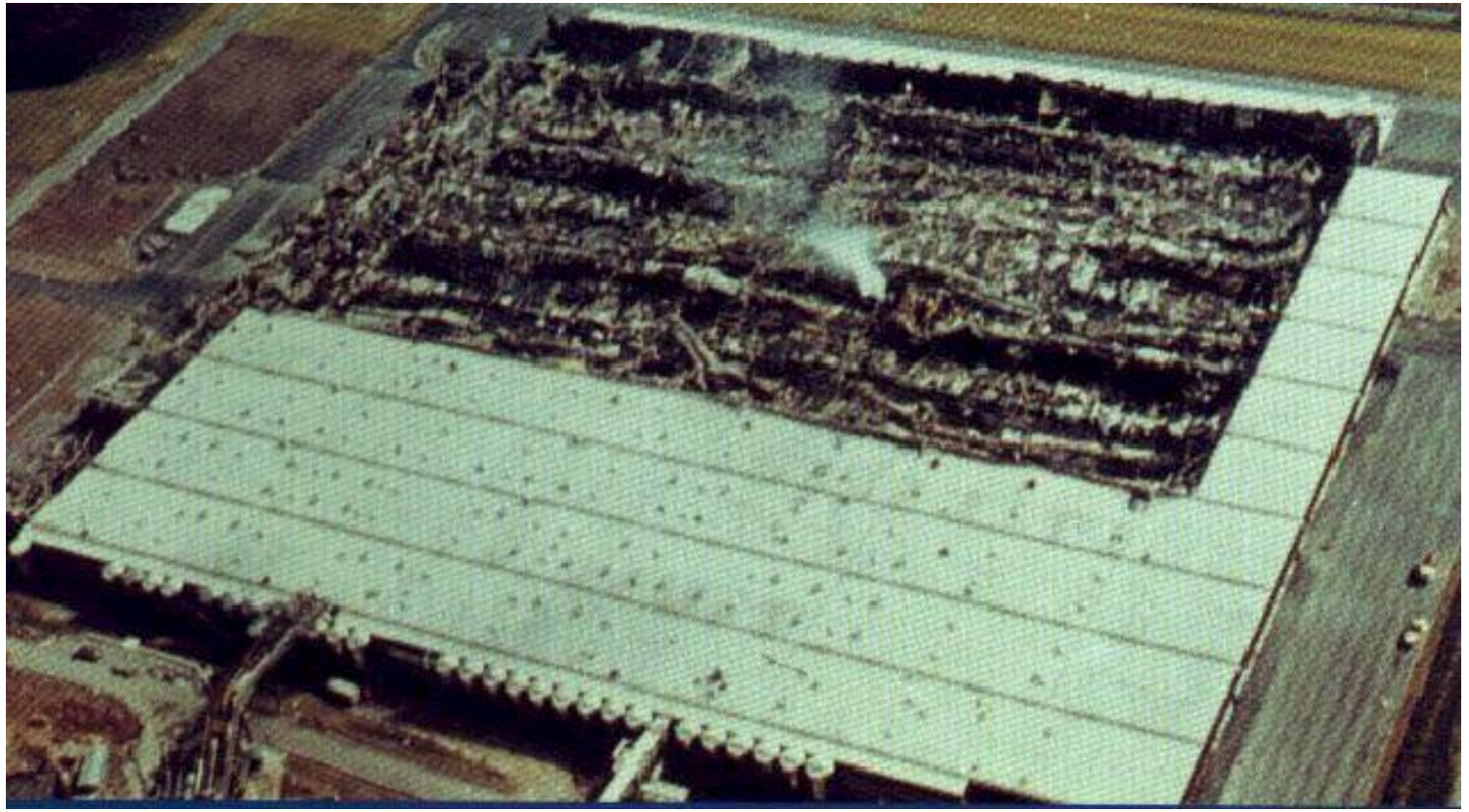
Madrid Feb 2005 Windsor-Building

AREAS THAT CAN ALLOW FOR FIRE/SMOKE SPREAD



COMPARTMENTATION

SUCCESSFUL COMPARTMENTATION



AGENDA

1 Passive Fire Protection - Compartmentation

2 Passive Fire Protection – Firestopping, Testing & Approvals

3 Behavior under seismic conditions

WHAT IS FIRESTOP ?

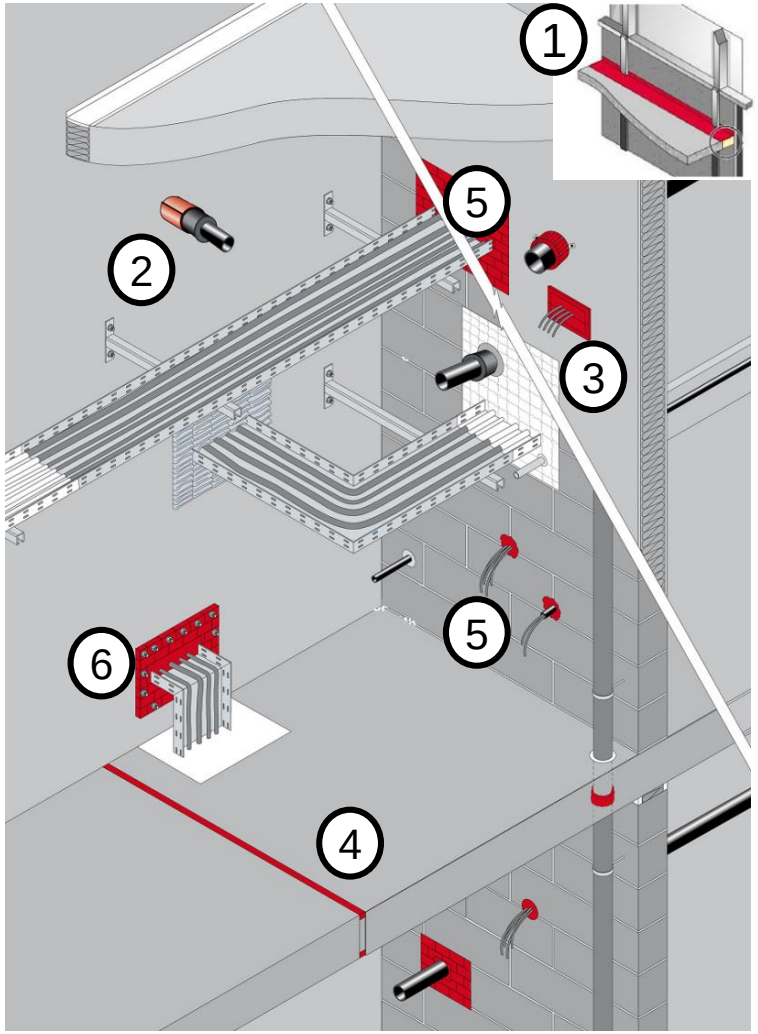
Firestop systems, if installed correctly, will help to maintain the fire resistance of a floor or wall as it is penetrated by an object or joint and resist the spread of smoke and fire.

It is part of the life safety plan in structures

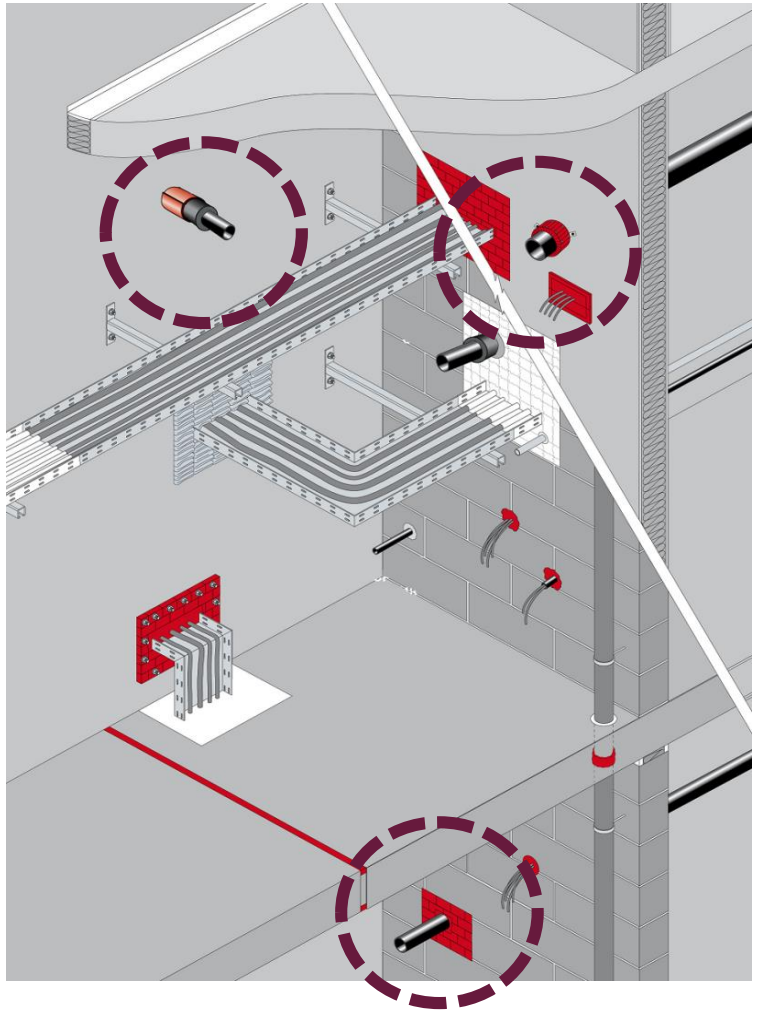
APPLICATION FOCUS INSTEAD OF PRODUCT FOCUS: OPENINGS IN BUILDINGS

All openings in fire rated walls and floors must be protected by systems with adequate fire resistance.

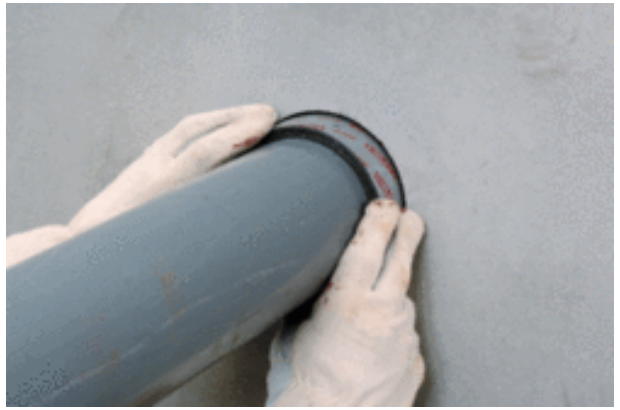
1. Curtain wall Joints
2. Penetrations of combustible and non-combustible pipes
3. Mixed penetrations (cables and pipes in one seal)
4. Linear Joints
5. Cable penetrations



PIPE PENETRATIONS

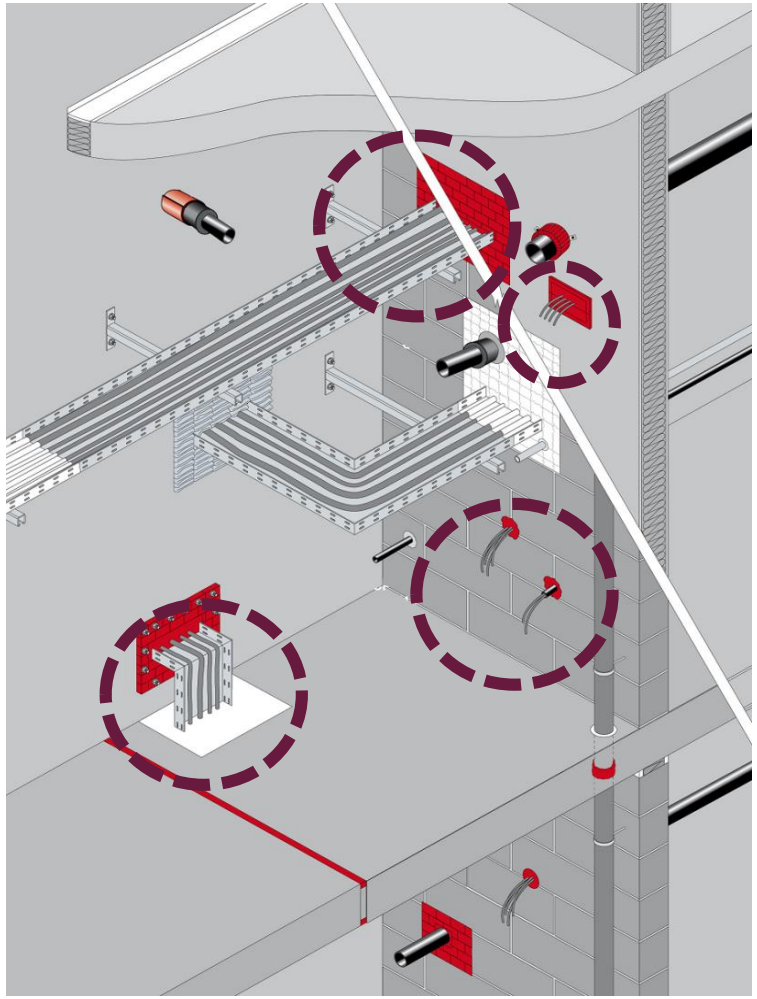


Combustible Pipes



Non-Combustible Pipes

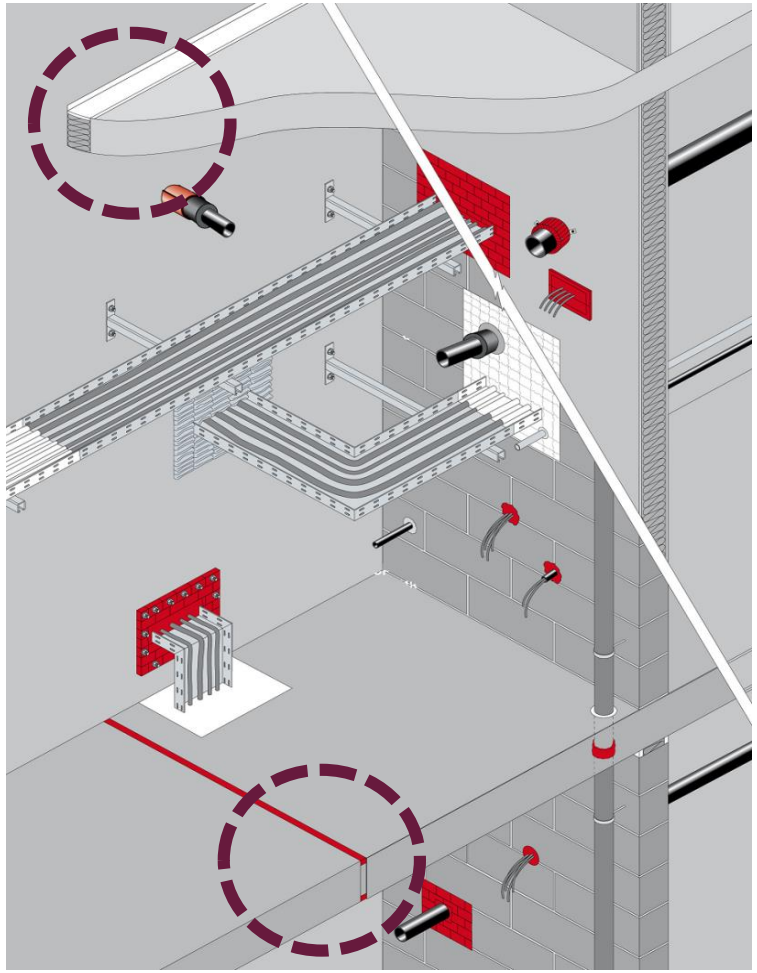
CABLE PENETRATIONS



Cable Trays

Single Cables / Bundles

LINEAR JOINT SEALS AND CURTAIN WALL JOINT SEALS

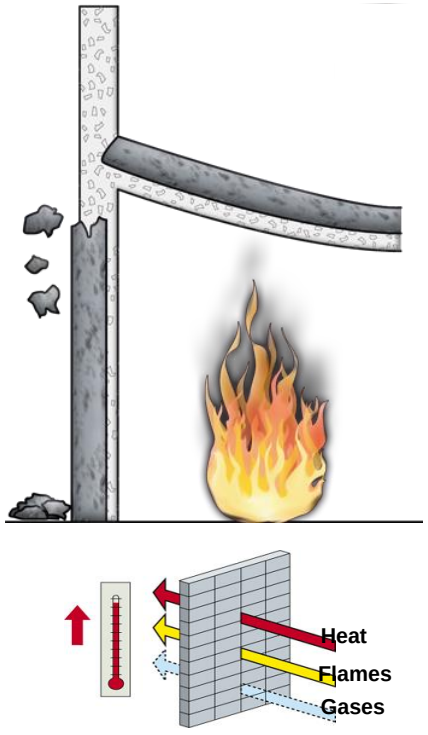


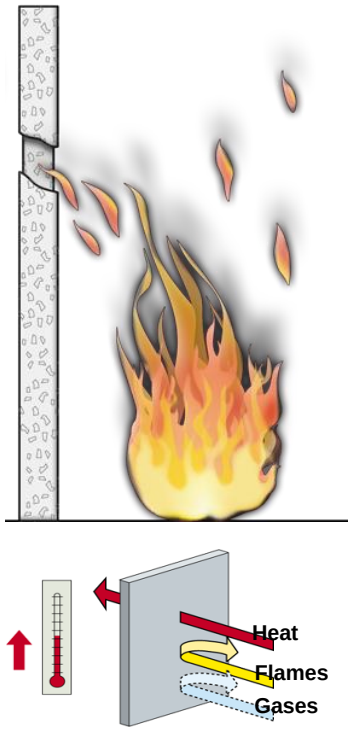
Linear Joint Seals

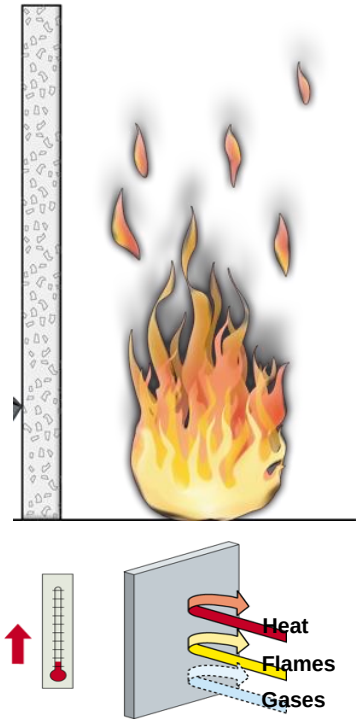
Curtain Wall Seals

HOW IS THE FIRE RESISTANCE PERFORMANCE TESTED AND CLASSIFIED IS CLASSIFIED IN RATINGS (EN)

Load Bearing Capacity	Integrity	Insulation
R - Rating	E - Rating	EI - Rating

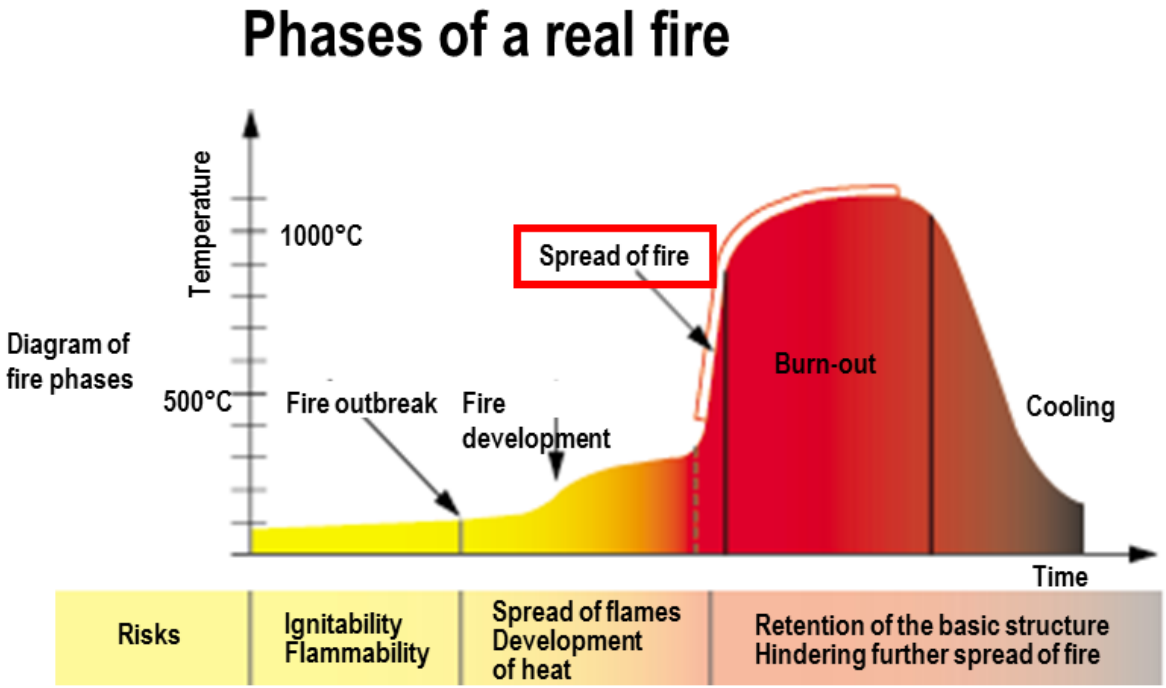


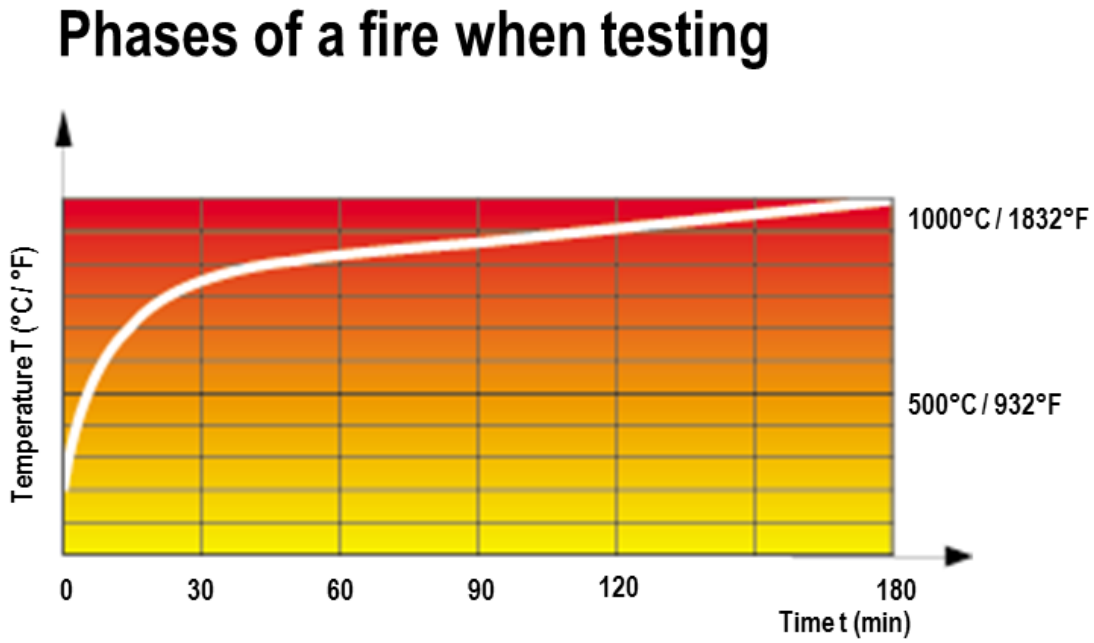




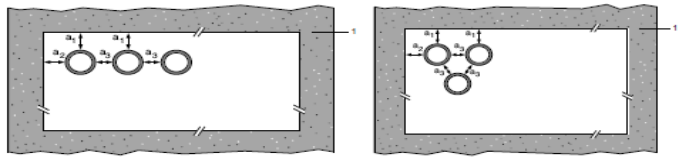
All criteria are measured in hours and minutes

REAL FIRE DEVELOPMENT IS THE BASE FOR FIRE TESTING

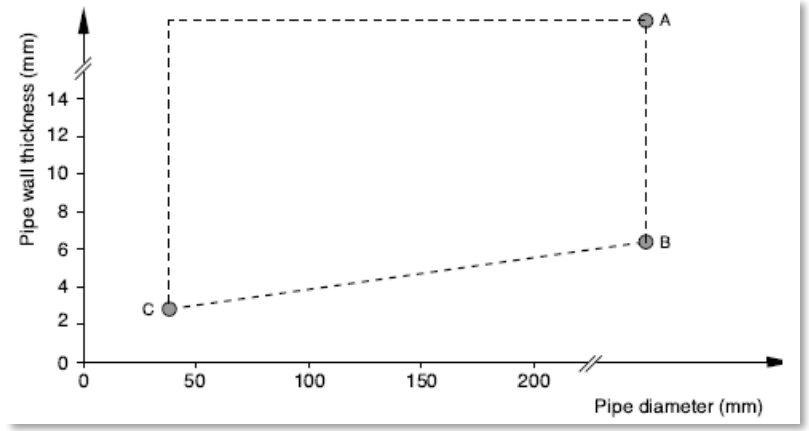




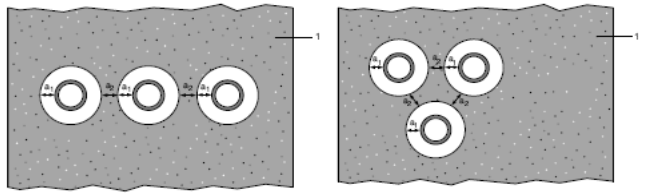
IN EUROPE EN TESTING IS ESTABLISHED AS THE HIGHEST TEST STANDARD - EXAMPLE PIPE PENETRATIONS



Standard configuration for multiple pipe penetrations



Schematic illustration for field of application rules



Standard configuration for multiple pipe penetrations

Pre-defined configurations and rules for the field of application are given in EN 1366-3 for pipe testing.

The field of application will be defined based on the rules in the test standard.
→ Standard configurations or otherwise only the tested configuration will be covered

PIPE PENETRATIONS

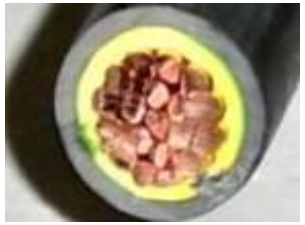
During fire test

After fire exposure & hose stream

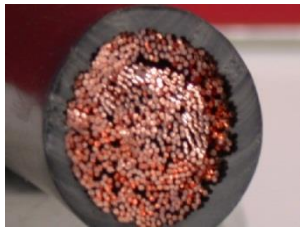
PIPE PENETRATIONS

EN TESTING – CABLE PENETRATIONS

The selection of cables for the standard configuration considers all known influencing parameters and is thought to be representative for all cables used in buildings in Europe.



S = Sheathed



W = Wire

T = Telecommuni-
cation cable

Des.	Type	Size	Material *)	Ø
A1	S			14
A2	S	5 x 1,5	EPR / PO	14
A3	S	5 x 1,5	XLPE / EVA	14
B	S	1 x 95	PVC / PVC	21
C1	S	4 x 95	PVC / PVC	47
C2	S			61
C3	S	4 x 95	XLPE / EVA	46
E	S	1 x 185	PVC/PVC	27
D1	S	4 x 185	PVC/PVC	52
D2	S			80
D3	S	4 x 185	XLPE / EVA	63
F				18
G1	W	1 x 95	PVC / -	17
G2	W	1 x 185	PVC / -	23

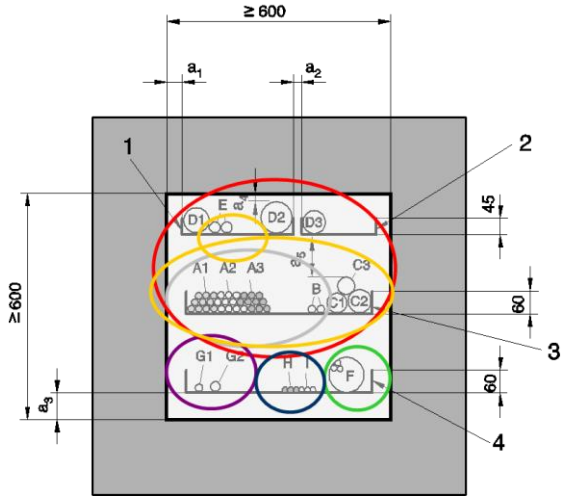
Small Sheathed

Medium Sheathed

Large Sheathed

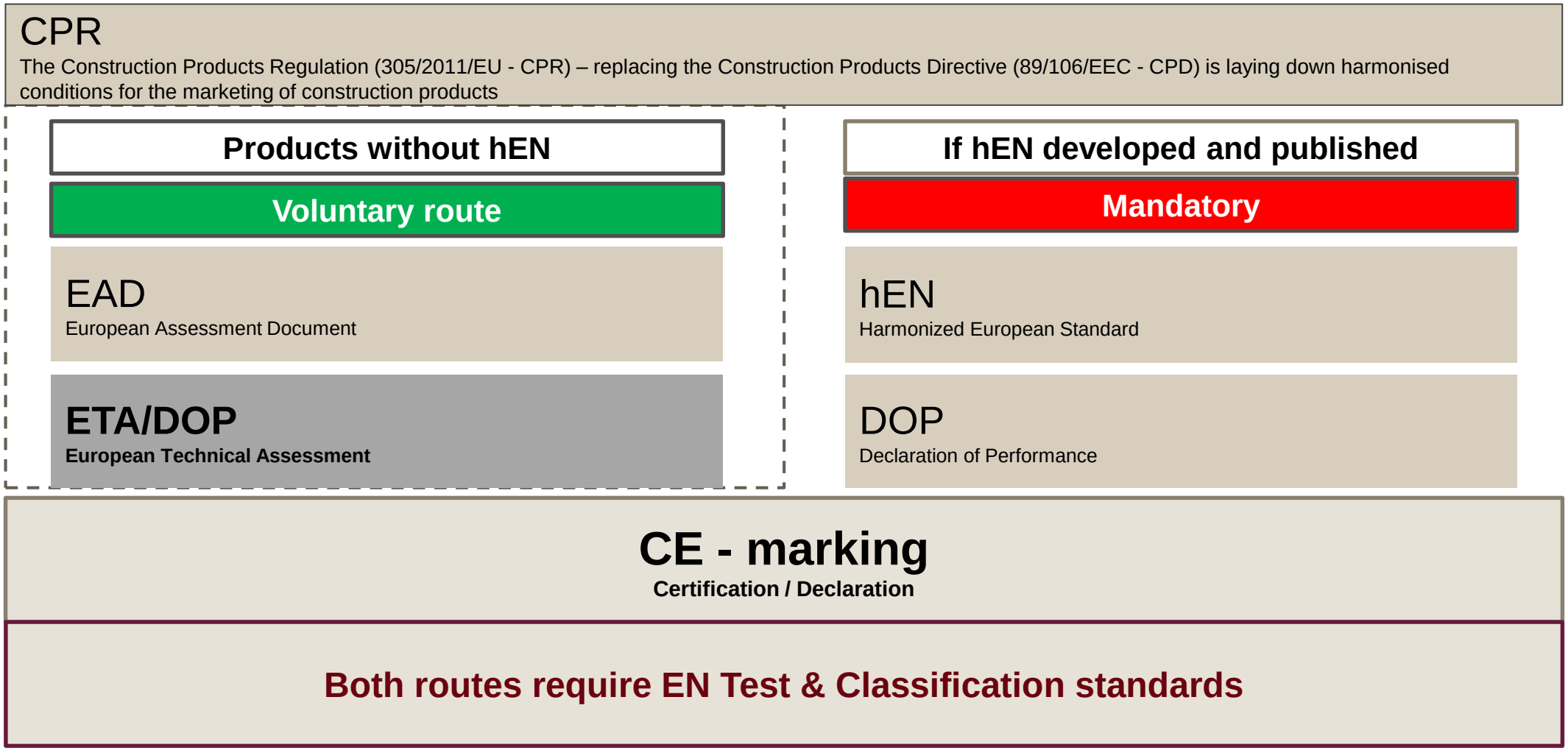
Telecommunication Cable

Wires

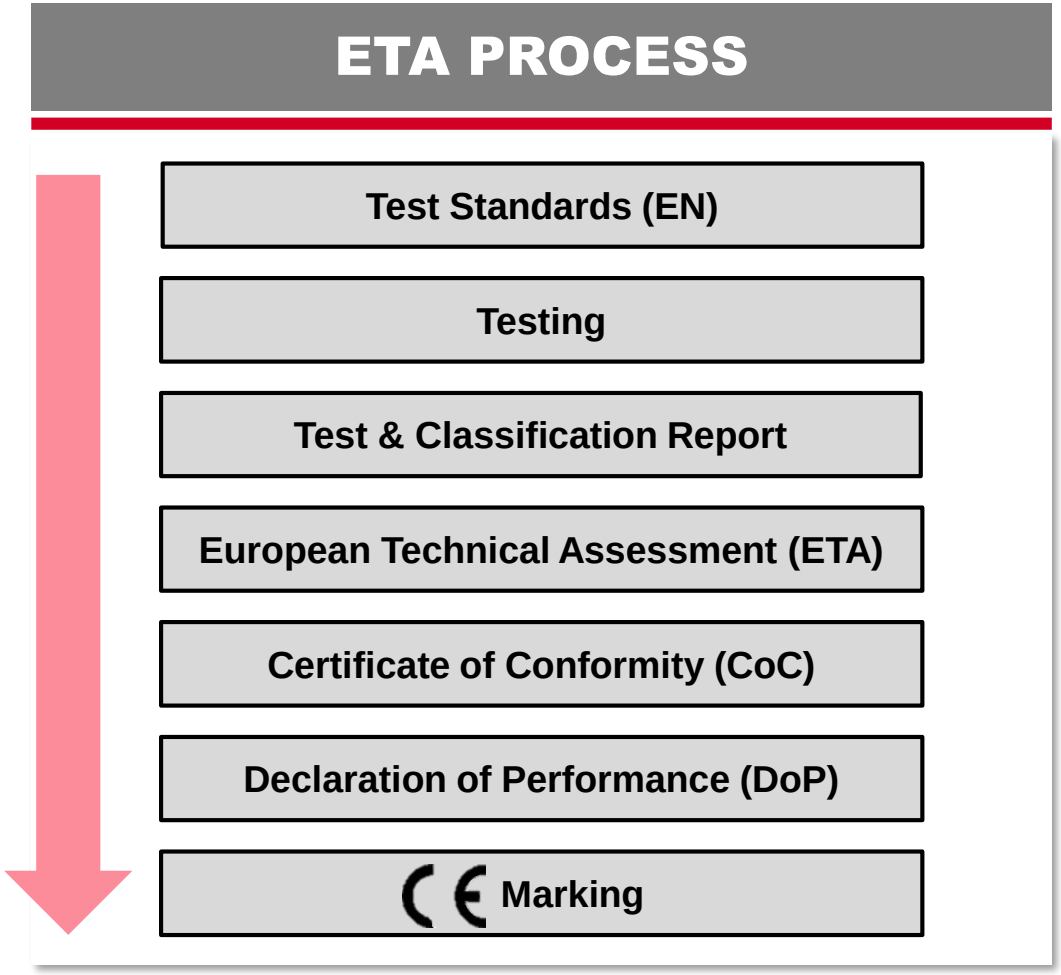


Pre-defined configurations and rules for the field of application are given in EN 1366-3 for cable testing.

CERTIFICATION - EUROPEAN CONSTRUCTION **PRODUCT** REGULATION & CE-MARKING



EUROPEAN TECHNICAL ASSESSMENT



- **ETA & DoP** should be checked for **field of application** and performance results

- **CE Marking** means that a product was tested according to standardized European norms but it says nothing about its performance and field of application.

AGENDA

1 Passive Fire Protection - Compartmentation

2 Passive Fire Protection – Firestopping, Testing & Approvals

3 Behavior under seismic conditions

FIRE IS THE MOST COMMON POST EARTHQUAKE RISK

Multiple simultaneous ignitions: **50-75%** of the fires start **immediately after** the event

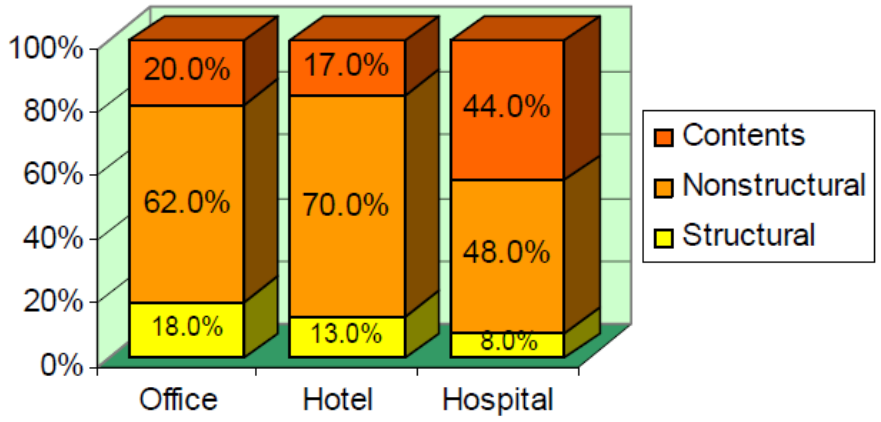
About 50% of the fires reported in the data occurred more than several hours (and up to several days) after the earthquake events

For example, after the earthquake of Northridge in 1994, there were a total of 466 fires reported after the earthquake, some of them were due because of the rupture of natural gas valves.

Sources: (1)A Method for Evaluating Fire After Earthquake Scenarios for Single Buildings. Elizabeth J. Kelly and Raymond N. Tell
(2) After the Shaking Stops: A Communitywide Approach to Managing Post-Quake Fires. Insurance Institute for Business & Home Safety
(3) Hospital Seismic Safety. California healthcare foundation January 2009

DAMAGES TO NONSTRUCTURAL COMPONENTS CAN RESULT IN MAJOR ECONOMIC LOSS AND A THREAT TO LIFE SAFETY

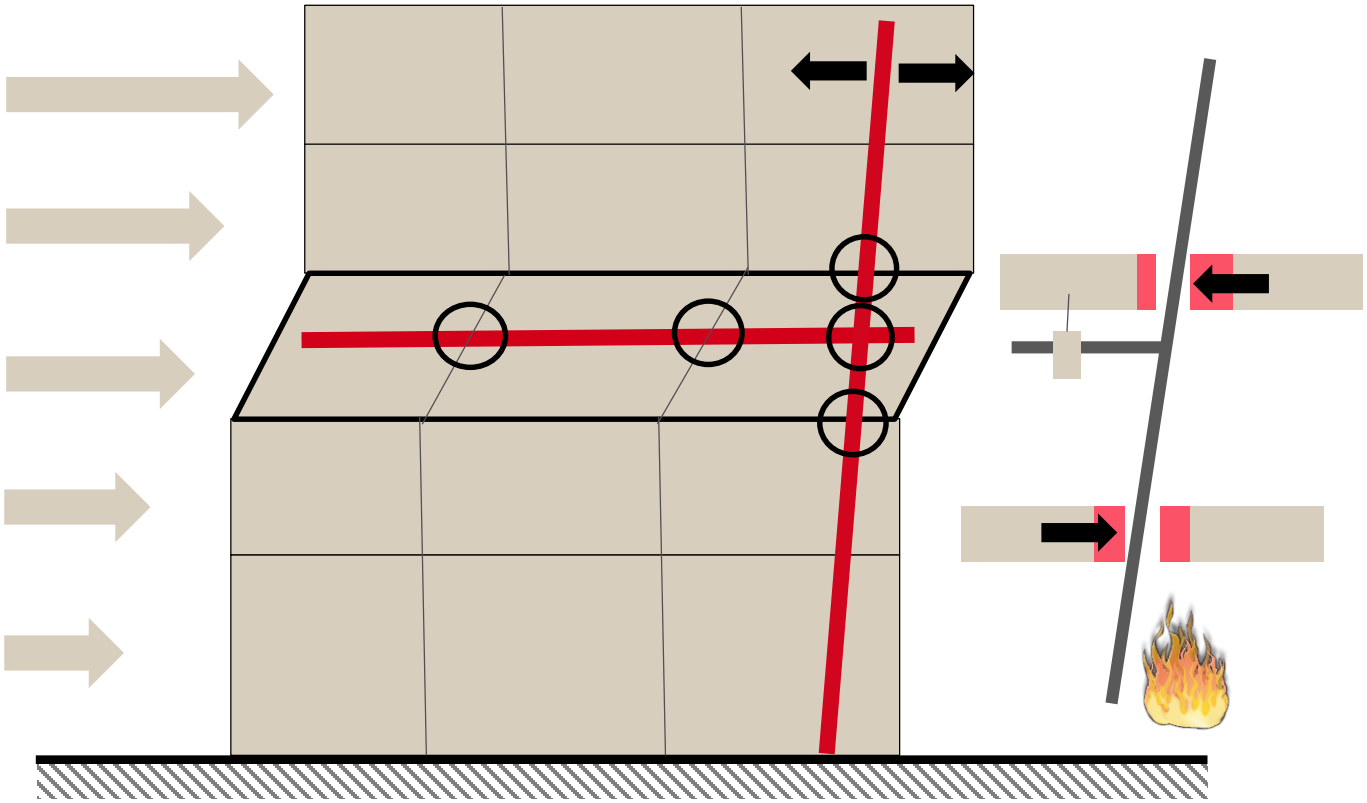
In most buildings, the **non-structural** components account for **60 to 80 percent** of the value of the building. Mostly these non structural components are fragile, easily damaged and costly to repair or replace.



Typical investments in building construction (after E. Miranda)

Source: Earthquake effects on buildings. Christopher Arnold. FEMA Library, www.sponse.eu, www.italymagazine.com

BUILDING MOVEMENT THROUGH EARTHQUAKES



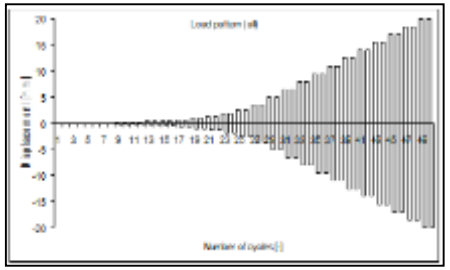
Example: Movement of wall / floor

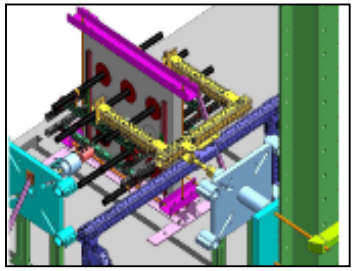
- Pipes and cables are fixed to the ceiling or the wall. During an earthquake the penetrants can move in a different direction than the walls or the floors
- All crossing points in the walls and floors are critical
- Undefined movement of pipes/cables within firestop penetrations is very likely
- Movement of pipes/cables will damage stiff firestop products like sealants or coated boards
- Risk of toxic smoke or fire to pass through the opening

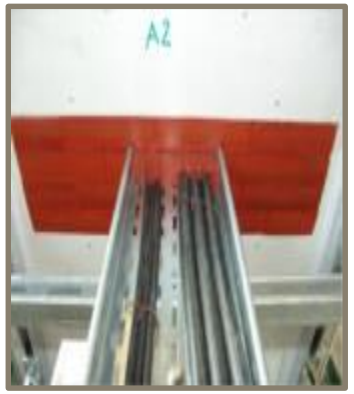
Different product types for each application available: Cables, cable trays and pipes

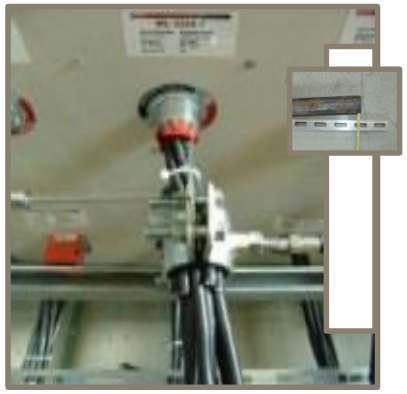
SEISMIC TESTS OF PENETRATION SEALS

- Test results show big differences in the behaviour, appearance and failure modes of different Firestop product systems. These results were verified in a large scale seismic shake table test at the University of California, San Diego.
- Quasi- static cyclic loads according to FEMA* 461 protocol applied directly on one single penetrant, whereas the wall was fixed.
- The use of stiff and unflexible materials with low elasticity (e.g. mortars and grouts, board systems, semi-plastic sealants) may be critical especially in connection with pipes or cable trays where displacement forces are high.
- Metal pipes may be deformed, plastic pipes may be bent during movement.
- Low flexibility of the Firestop system will not be able to make up for the penetrant movement.
- Penetrants or walls might break or even be destroyed.









Flexible or pre engineered systems with high safety level.

SUMMARY

- Active & Passive Fireprotection together with Education are the key elements for Fire Safety, Compartmentation is essential for saving lives
- High Test Standards and a clearly defined Field of applicaitons together with s strong Codes/Regualations are essential to use the right systems
- With the right design and Product Selection, Compartmentation also will work after a seismic event

GRAZIE

Markus Schneider
Hilti AG
Global Head of Codes & Regulations
Business Unit Fire Protection