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NFCA®
National Fireproofing
Contractors Association

Presented by: Dr Gabby Peck

OUR MISSION

EDUCATE

ADVOCATE

ADVANCE THE PASSIVE FIRE INDUSTRY GLOBALLY

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NFCA®
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WHERE YOU'LL SEE US...

UL Standards & Engagement

NFPA®

ICC INTERNATIONAL CODE COUNCIL®

ASTM INTERNATIONAL

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WHAT:

To educate & advocate for the passive fire industry

Speak, Write, Advocate & Promote

ICC
CSI
CSC, FFMIA, ON
BOA, ON FMIA
RAIC
NFPA
Centre for Campus Fire Safety
Fire Marshalls
Code officials

GET INVOLVED | JOIN A COMMITTEE | CONTRIBUTE IDEAS & NETWORK | ADVANCE YOUR PROFESSOINAL DEVELOPMENT

MAY 2026
gabby@fcia.org

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FREE RESOURCES & MATERIALS....

5

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FREE RESOURCES

Life Safety Digest – free to subscribe

& reach out if you have an interesting article you'd like to see, or write!

Subscribe at www.fcia.org

HAFK

•Complimentary PDF to Code Official, Fire Marshals, Authorities Having Jurisdiction, Specifiers and Architects with Design Firms, Governmental organizations, and select others.

Webinars Newsletter

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Elevate your fireproofing standards with NFCA's expert resources.

The National Fireproofing Contractors Association (NFCA) has crafted dynamic, industry-consensus Standard Practices and Quality Assurance Procedures to guide the precise application and quality assurance procedures of fireproofing products, such as SFRM and IFRM. These are the industry authority documents, designed to ensure compliance and excellence and uniform industry practices, provide clear, actionable guidelines for contractors and construction professionals to achieve consistent, high-quality installations that meet rigorous safety and performance standards.

Explore the NFCA Approved documents below, essential tools for enhancing building safety and project success.

- NFCA 100 Standard Practice for the Application of Sprayed Fire-Resistive Material
- NFCA 200 Field Quality Assurance Procedure for the Application of Sprayed Applied Fire-Resistive Material
- NFCA 300 Standard Practice for the Application of Intumescent Fire-Resistive Material
- NFCA 400 Field Quality Assurance Procedure for the Application of Intumescent Fire-Resistive Material

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2025

12/16/2025 - 'What the Structural Fireproofing Discipline Needs to Know about Firestopping Penetrations and Fire-Resistive Joints' with Bill McHugh (FCIA), Carl Fernald (PCI -Tampa), Gus Mancini (Gleeson Powers), and Rich Walke (CTI)
11/11/2025 - 'The Most Commonly Misunderstood Code Requirements for Structural Fire-Resistance: Part II' with Tony Crimi (AC Consulting Solutions), Bill McHugh (NFCA), and Rich Walke (CTI)
09/17/2025 - 'Fireproofing Fluted Metal Decks-to-Beam Connections' with Bill McHugh (NFCA), Carl Fernald (Performance Contracting, Inc.), and Rich Walke (CTI)
08/05/2025 - 'The Most Commonly Misunderstood Code Requirements for Structural Fire-Resistance' with Tony Crimi (A.C. Consulting Solutions), Bill Koffel (Koffel Associates), Bill McHugh (NFCA), and Rich Walke (CTI)
07/15/25 - Thermal & Ignition Barrier Requirements for Foamed Plastic with John Dalton (Saint-Gobain)
06/17/25 - Growing the Available Market While Unlocking Carbon Savings in Steel Buildings with Galen Burrell (Saint-Gobain)
04/14/25 - Excellence in Fireproofing Projects - The 2025 NFCA Award of Excellence Winning Projects
03/25/25 - Fireproofing Materials and Fire-Resistance
02/25/25 - Fireproofing Inspection with Bill McHugh (NFCA)
01/14/25 - The ASTM E119, UL 263, and CAN/ULC S101 Fire Test Standards with Rich Walke (CTI)

2024

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Fireproofing Products

Fireproofing protection products protect structural steel framed buildings and are categorized into Sprayed Fire-Resistive Material (SFRM), Intumescent Fire-Resistive Material (IFRM) and Rigid Board Fire Protection. The following information separates products into these several categories and is intended to provide general information about various types of fire protection products. Manufacturer's information can be easily accessed by clicking on the Manufacturers name in the Manufacturers Section of this web site. Product details are available at the manufacturers website.

- Sprayed Fire-Resistive Materials (SFRM)
- Intumescent Fire-Resistive Material (IFRM)
- Rigid Board Fire Protection

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GET ACCREDITED:

NFCA online exam registrations now open for August '26

IFRM Accredited Contractor
NFCA®
National Fireproofing Contractors Association
SAMPLE
Contractor Name
Location

NFCA IFRM & SFRM Contractor Accreditation Programs

NFCA's SFRM and IFRM Contractor Accreditation Programs prove contractor knowledge.

Additional programs:

UL CERTIFIED MANAGEMENT SYSTEM QUALIFIED SFRM CONTRACTOR

UL Solutions Qualified SFRM Contractor Program

UL Solutions' Qualified SFRM Contractor Program has a mandatory office and on-site management system audit to verify that policies and procedures are working at the company.

IAS INTERNATIONAL ACCREDITATION SERVICE®

IAS AC 291 Accreditation Program

Establish Inspector competence through passing an exam, and showing experience in the same type and complexity of materials and listings to be inspected.

MAY 2026
gabby@fcia.org

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NFCA

Presented by: Dr Gabby Peck

OUR EVENTS '26...

COMPLETED

02 PFP'CON DUBAI

DUBAI, Dubai World Trade Centre

JAN 12TH TO JAN 14TH

PFPCON '26 DUBAI
12-14 JANUARY 2026
DUBAI WORLD TRADE CENTRE
FCIA NFCA

COMPLETED

01 PFP CON

Las Vegas, NV

March 30th

to

April 3rd

PFPCON 2026

Bring on '27!

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TO OUR MEMBERS, FRIENDS, SPONSORS SUPPORTERS & BOARD

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NFCA®
National Fireproofing Contractors Association

Welcome to

TODAY'S SESSION

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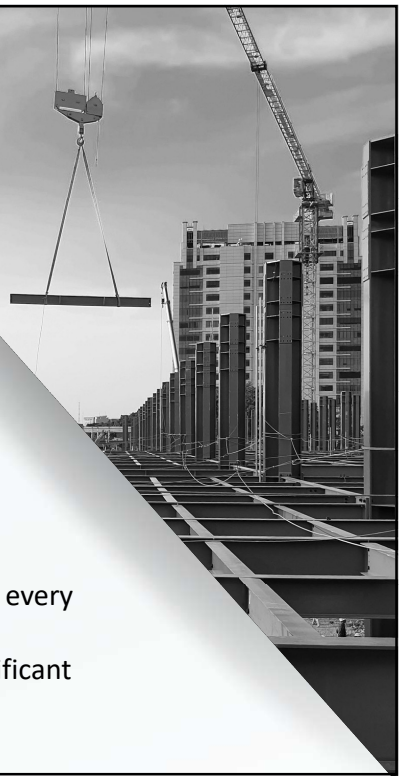
15

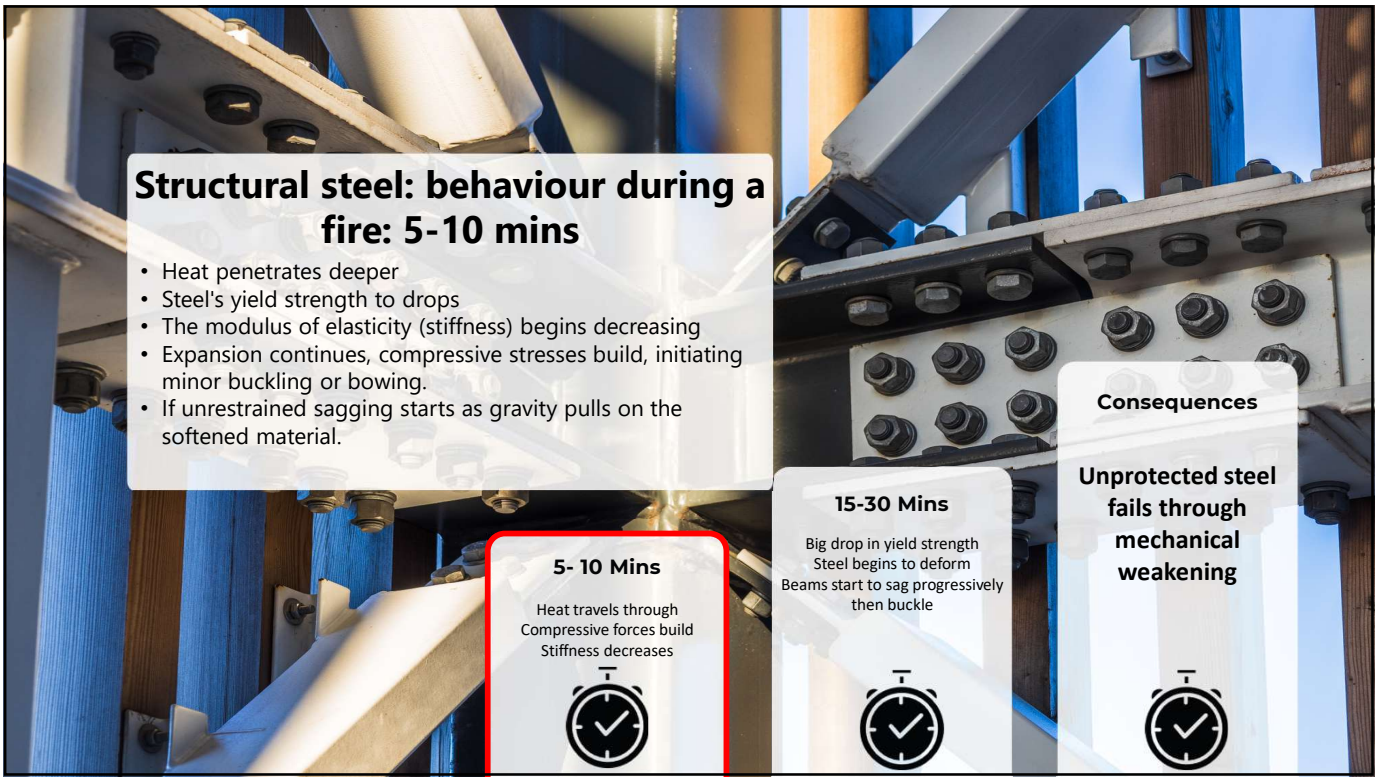
Structural steel: behaviour during a fire



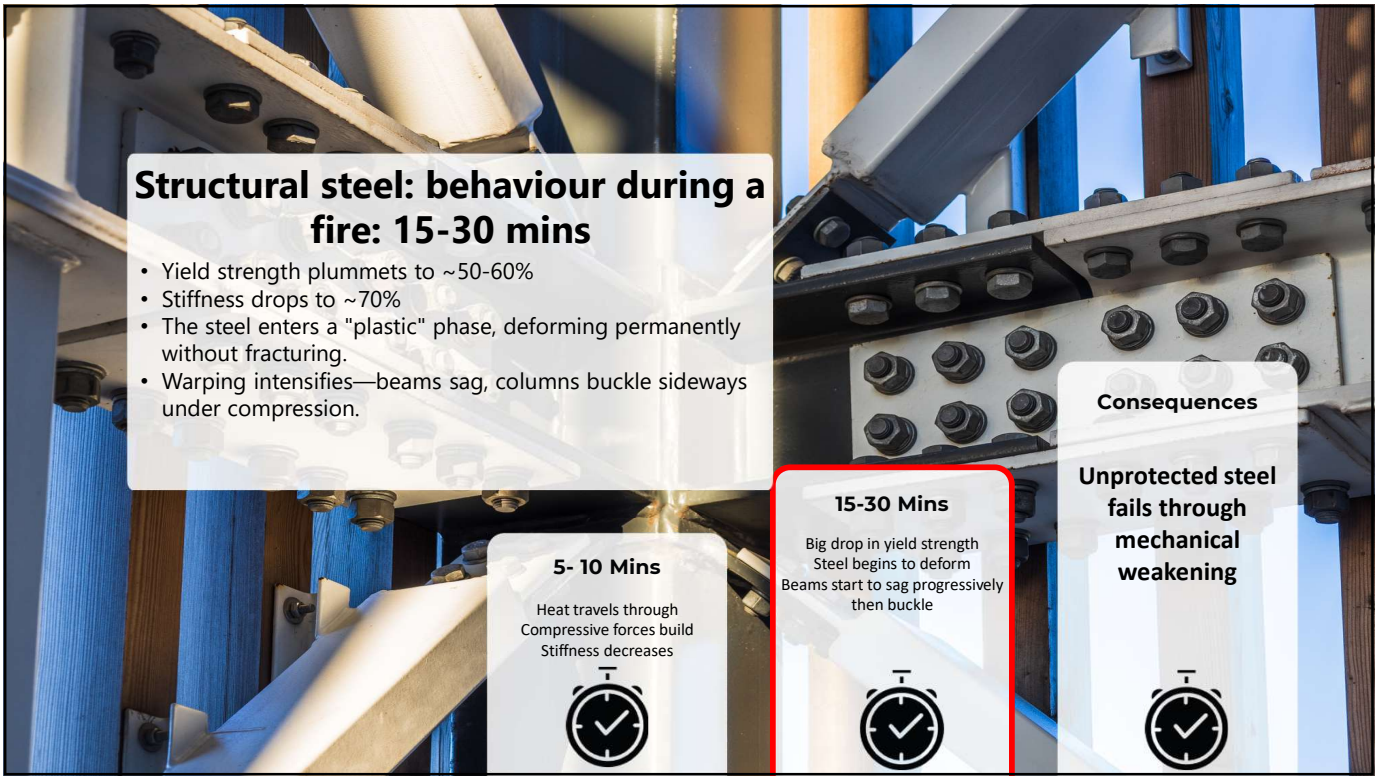
- Steel is an excellent conductor of heat
- Heat will spread fast through the steel

- Steel will expand appx 0.0012% per °C rise, or approximately 0.0000065 in/in/°F.
- A 30-foot beam will expand roughly 0.23 inches for every 100°F temperature increase.
- In restrained structures, this expansion creates significant internal compressive stresses.

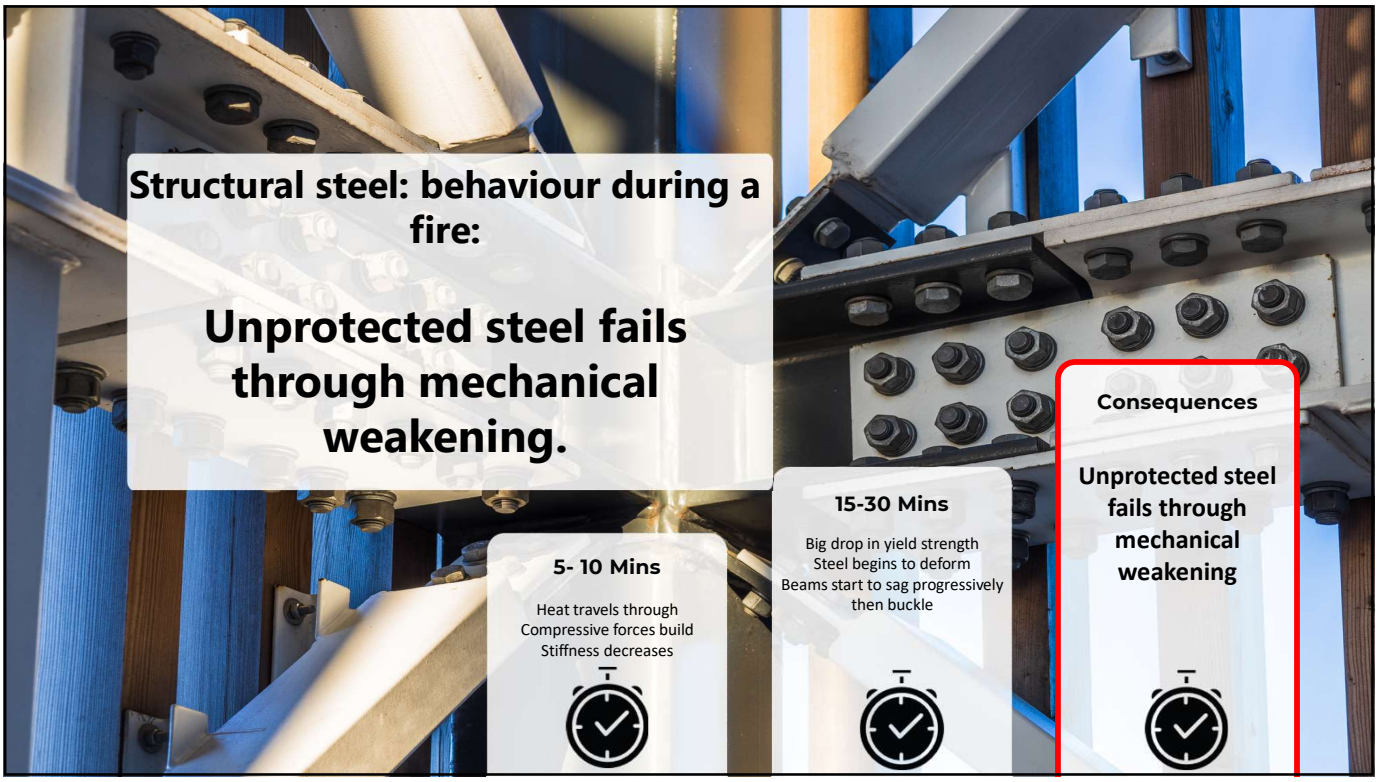
16


Structural steel: behaviour during a fire: 5-10 mins
• Heat penetrates deeper
• Steel's yield strength to drops
• The modulus of elasticity (stiffness) begins decreasing
• Expansion continues, compressive stresses build, initiating minor buckling or bowing.
• If unrestrained sagging starts as gravity pulls on the softened material.
5- 10 Mins
Heat travels through
Compressive forces build
Stiffness decreases
15-30 Mins
Big drop in yield strength
Steel begins to deform
Beams start to sag progressively
then buckle
Consequences
Unprotected steel fails through mechanical weakening

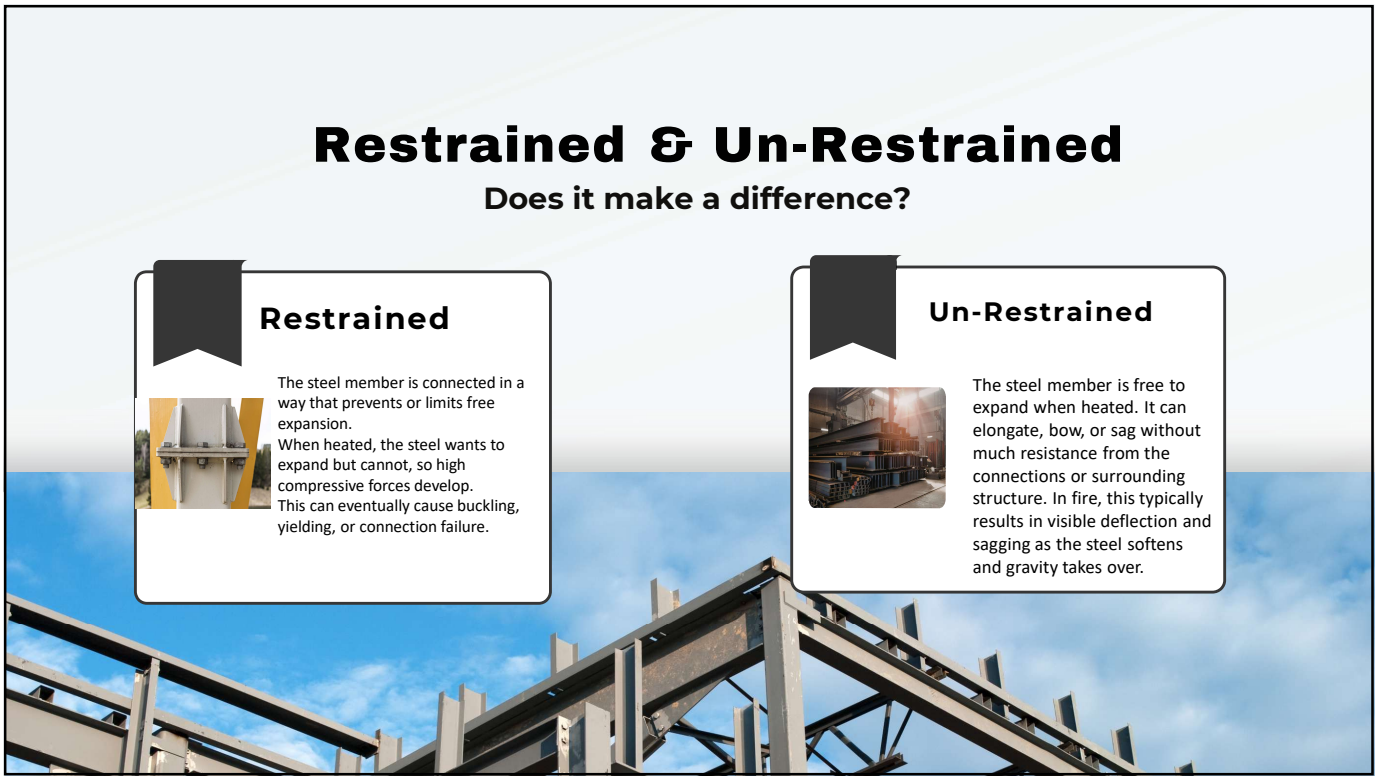
17


Structural steel: behaviour during a fire: 15-30 mins
• Yield strength plummets to ~50-60%
• Stiffness drops to ~70%
• The steel enters a "plastic" phase, deforming permanently without fracturing.
• Warping intensifies—beams sag, columns buckle sideways under compression.
5- 10 Mins
Heat travels through
Compressive forces build
Stiffness decreases
15-30 Mins
Big drop in yield strength
Steel begins to deform
Beams start to sag progressively
then buckle
Consequences
Unprotected steel fails through mechanical weakening

18


Structural steel: behaviour during a fire:
Unprotected steel fails through mechanical weakening.
5- 10 Mins
Heat travels through
Compressive forces build
Stiffness decreases
15-30 Mins
Big drop in yield strength
Steel begins to deform
Beams start to sag progressively
then buckle
Consequences
Unprotected steel fails through mechanical weakening

19


Restrained & Un-Restrained
Does it make a difference?
Restrained
The steel member is connected in a way that prevents or limits free expansion.
When heated, the steel wants to expand but cannot, so high compressive forces develop.
This can eventually cause buckling, yielding, or connection failure.
Un-Restrained
The steel member is free to expand when heated. It can elongate, bow, or sag without much resistance from the connections or surrounding structure. In fire, this typically results in visible deflection and sagging as the steel softens and gravity takes over.

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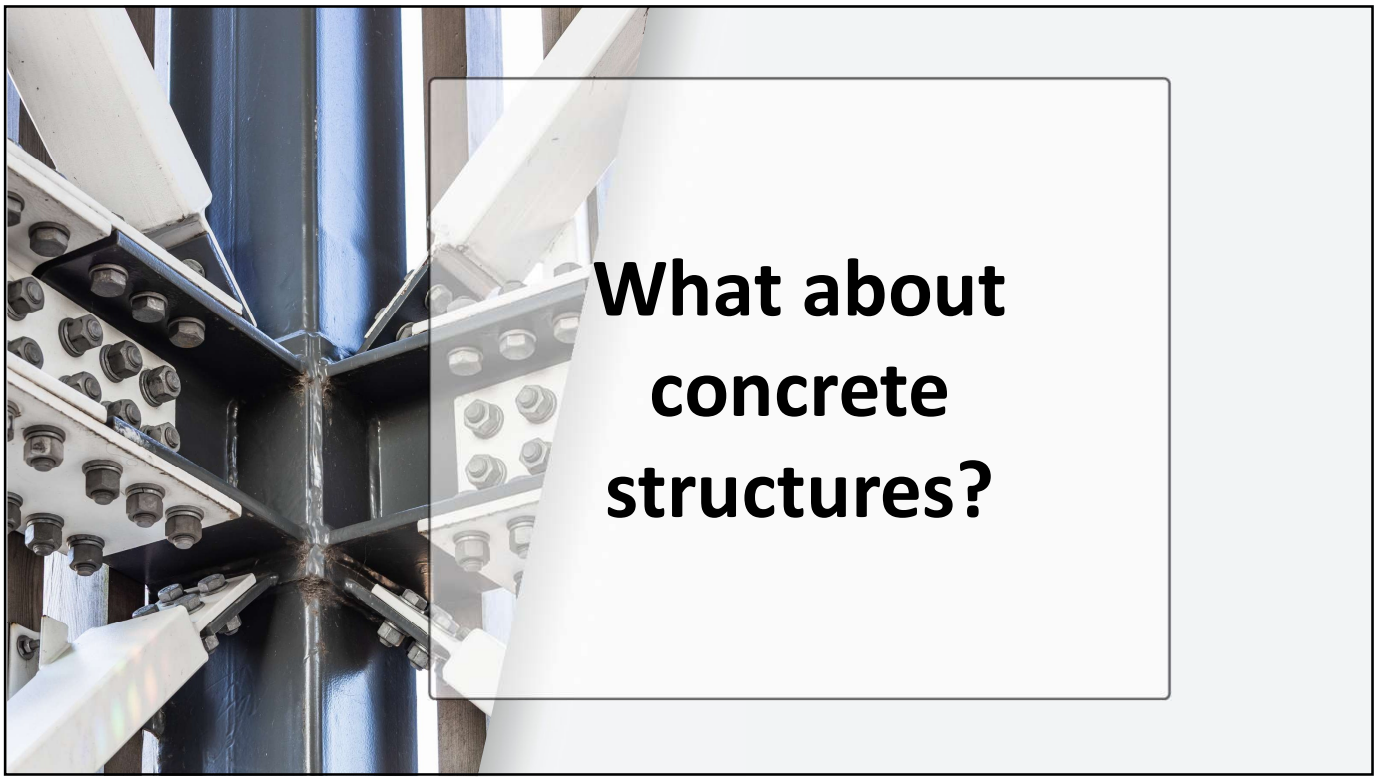
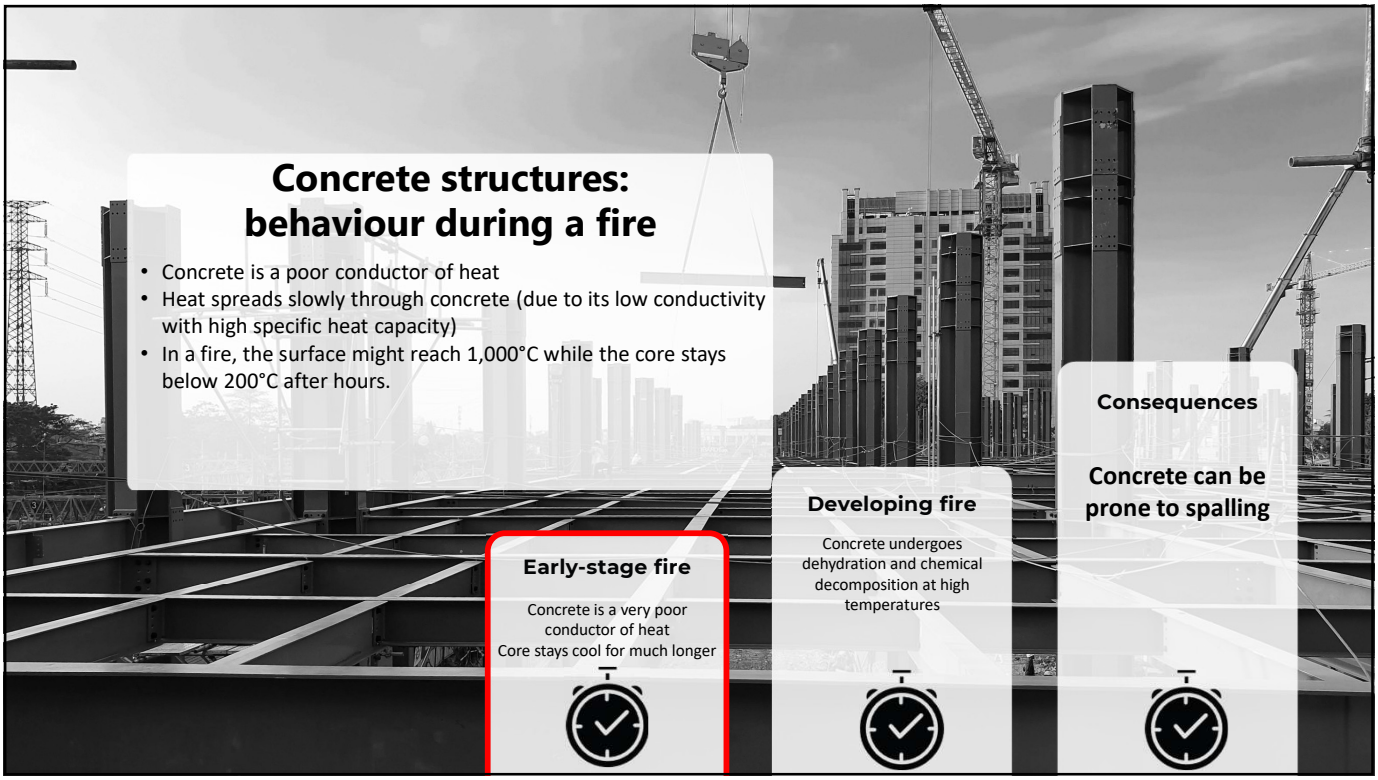
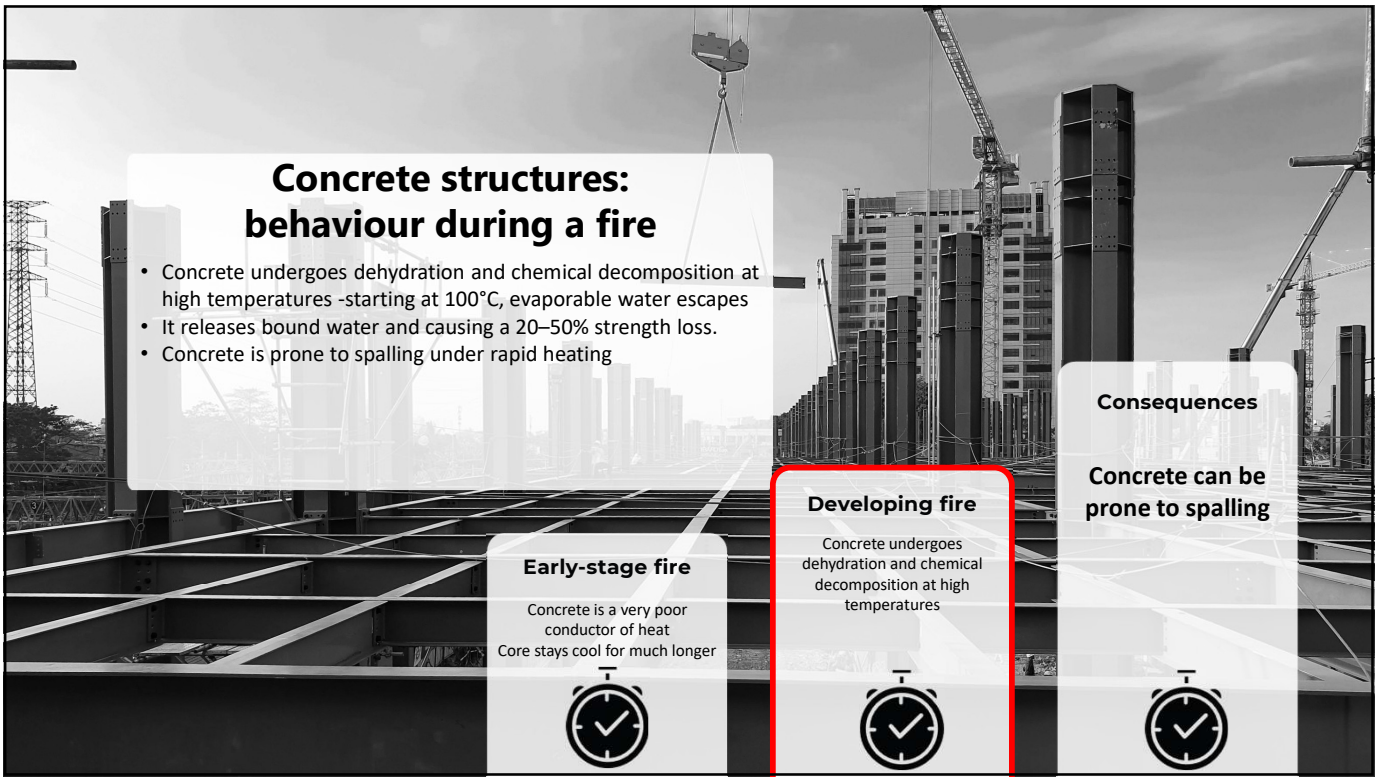

What about concrete structures?

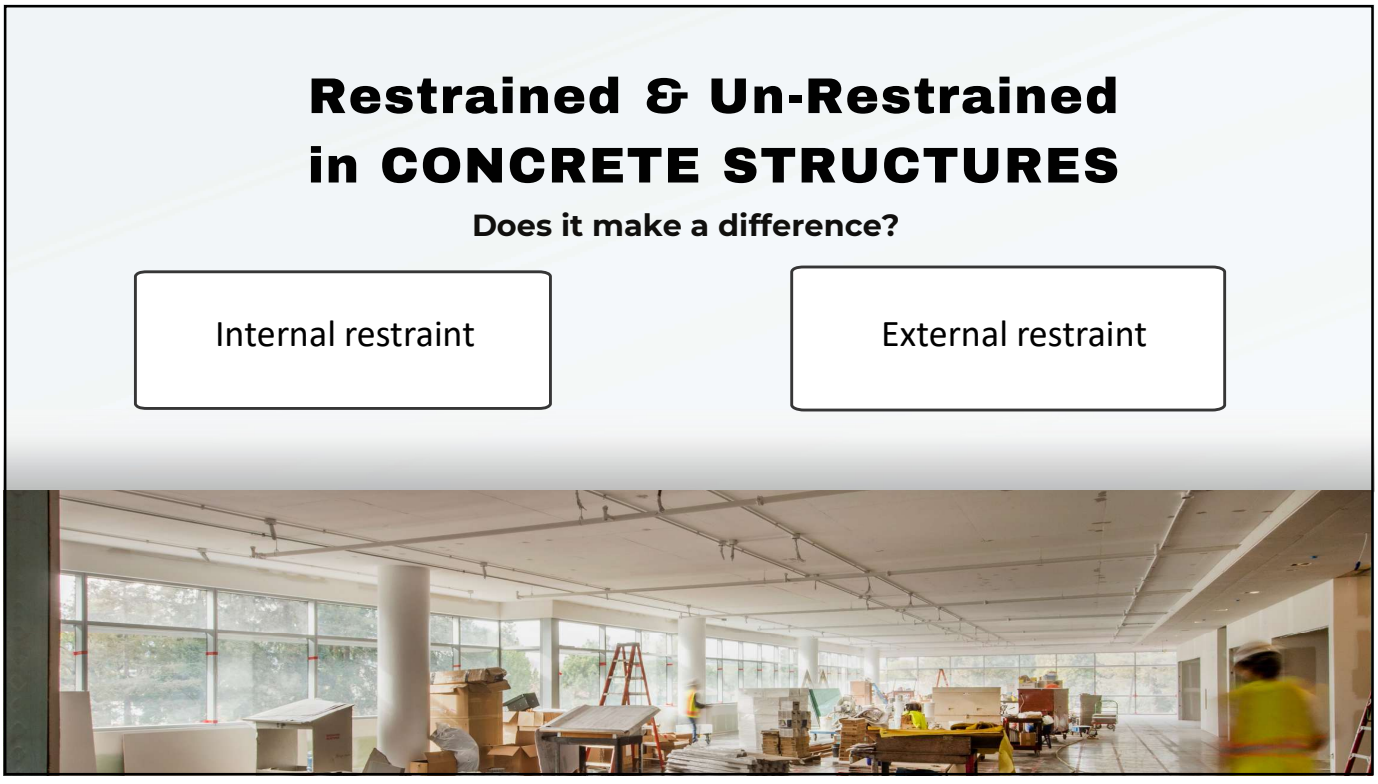
21


Concrete structures: behaviour during a fire
• Concrete is a poor conductor of heat
• Heat spreads slowly through concrete (due to its low conductivity with high specific heat capacity)
• In a fire, the surface might reach 1,000°C while the core stays below 200°C after hours.
Early-stage fire
Concrete is a very poor conductor of heat
Core stays cool for much longer
Developing fire
Concrete undergoes dehydration and chemical decomposition at high temperatures
Consequences
Concrete can be prone to spalling

22


Concrete structures:
behaviour during a fire
• Concrete undergoes dehydration and chemical decomposition at high temperatures -starting at 100°C, evaporable water escapes
• It releases bound water and causing a 20–50% strength loss.
• Concrete is prone to spalling under rapid heating
Early-stage fire
Concrete is a very poor conductor of heat
Core stays cool for much longer
Developing fire
Concrete undergoes dehydration and chemical decomposition at high temperatures
Consequences
Concrete can be prone to spalling

23


Restrained & Un-Restrained
in CONCRETE STRUCTURES
Does it make a difference?
Internal restraint
External restraint

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We rely on the structure remaining stable so that we can:

- Maintain safe egress
- Maintain safety of firefighters
- Maintain safety of the nearby area
- **Maintain continuity of the fire barriers in place**
- **Maintain compartmentation**

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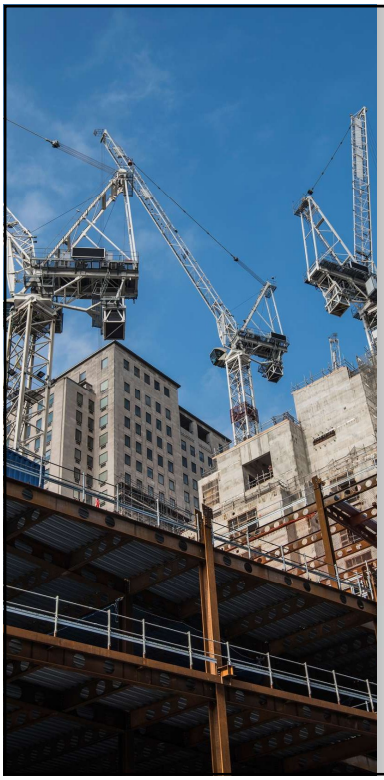
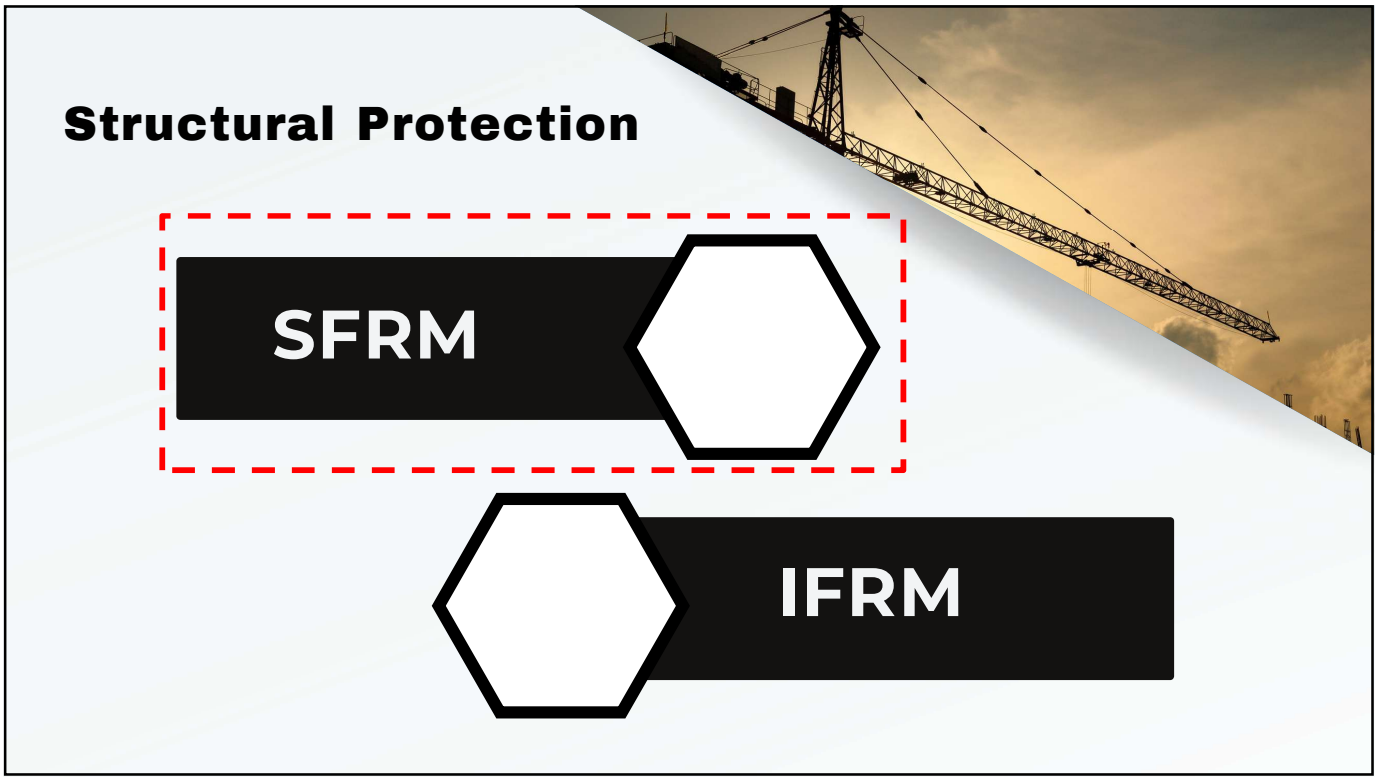
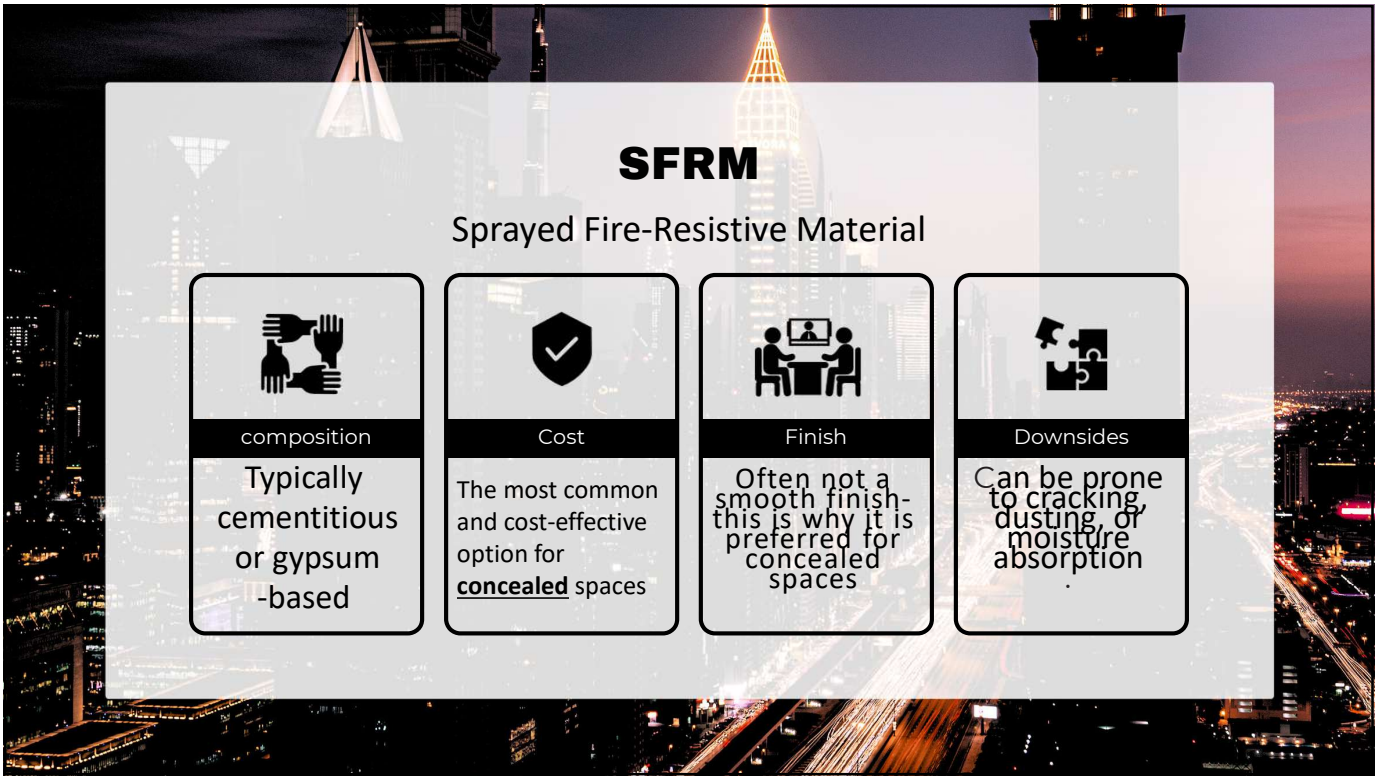


Goal:
Provide a thermal barrier to delay the failure point of the structure during a fire

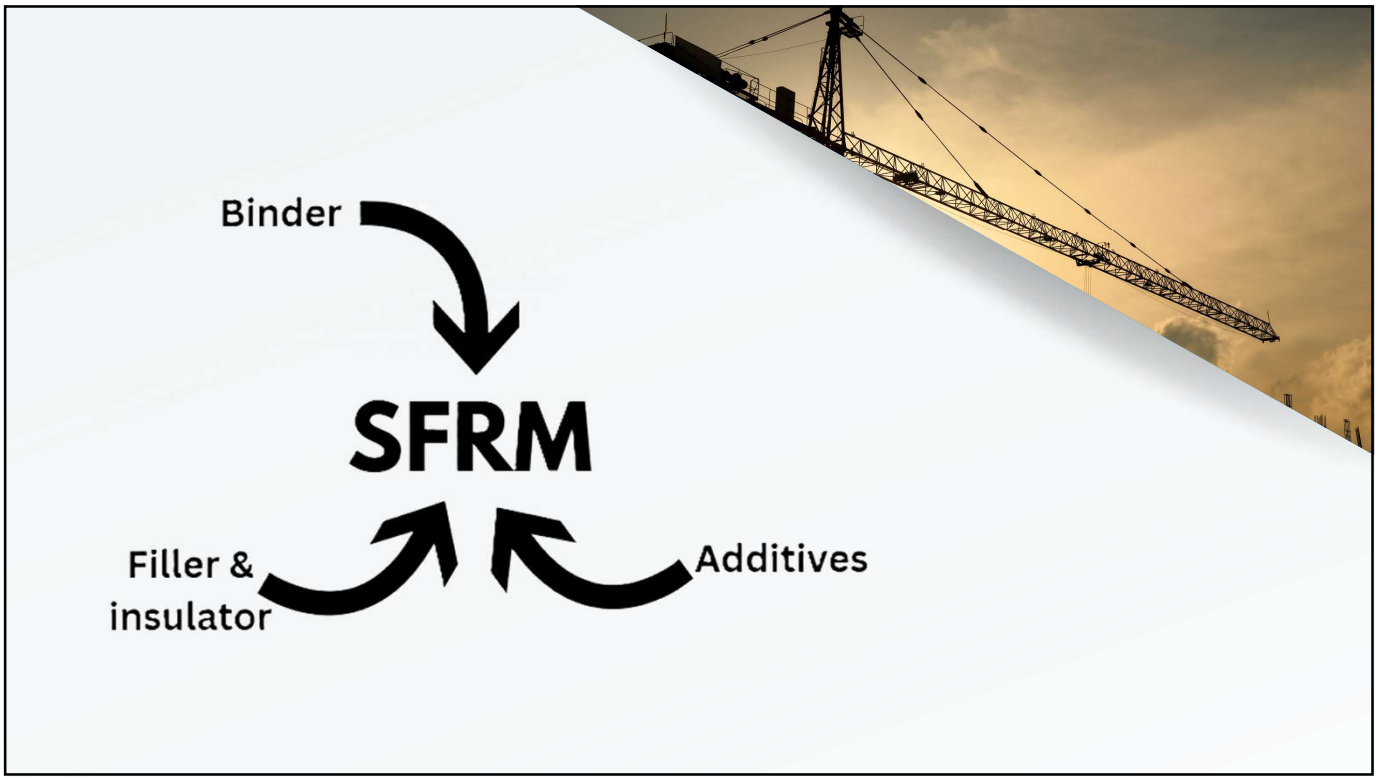
26


Structural Protection
SFRM
IFRM

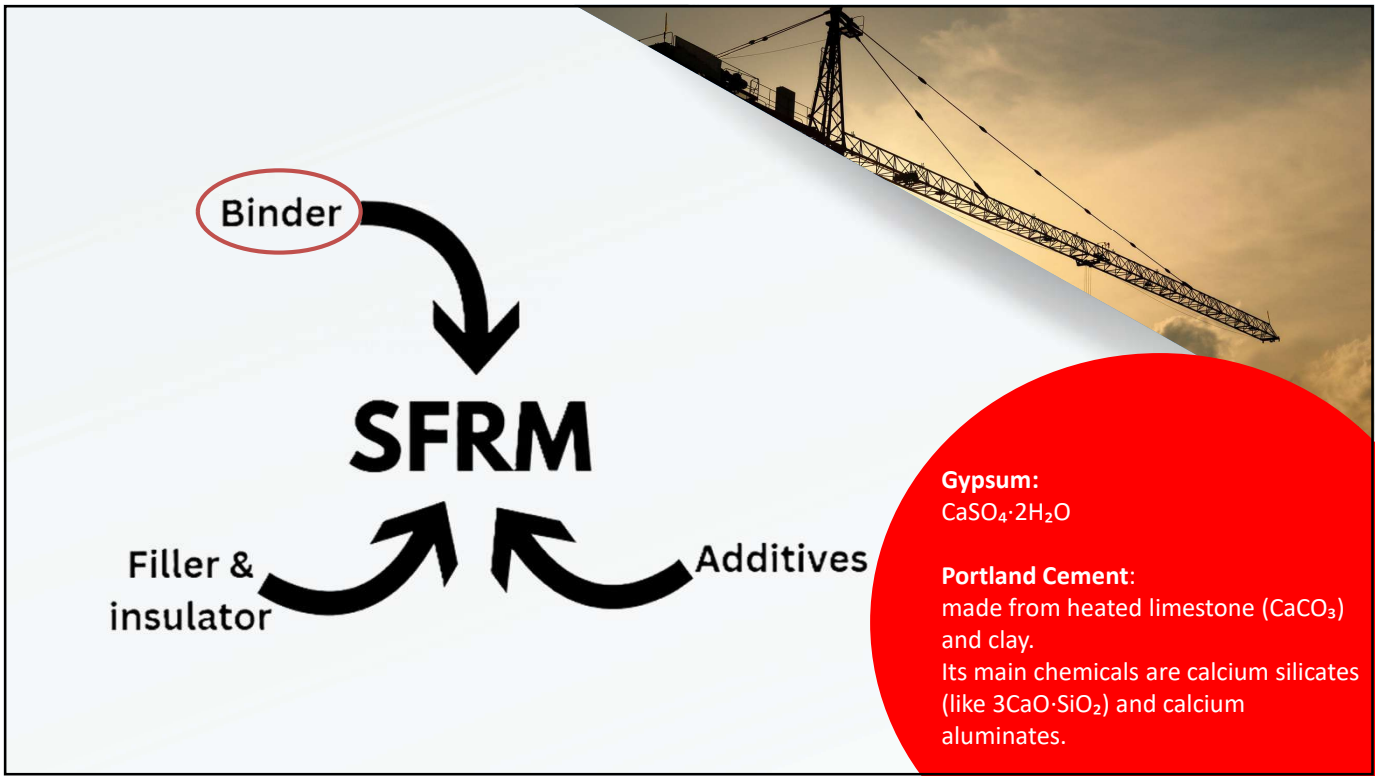
27


SFRM
Sprayed Fire-Resistive Material
composition
Typically cementitious or gypsum -based
Cost
The most common and cost-effective option for concealed spaces
Finish
Often not a smooth finish- this is why it is preferred for concealed spaces
Downsides
Can be prone to cracking, dusting, or moisture absorption

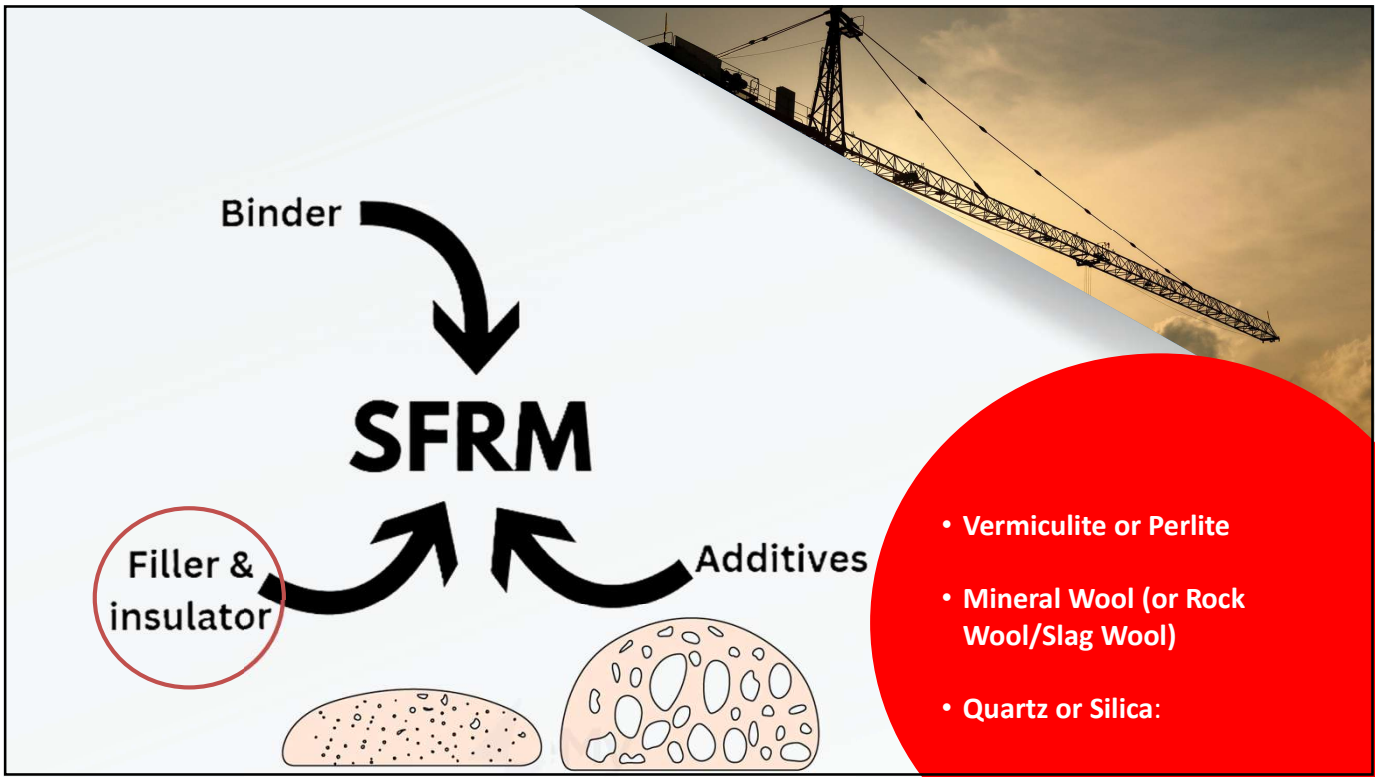
28


Binder
SFRM
Filler &
insulator
Additives

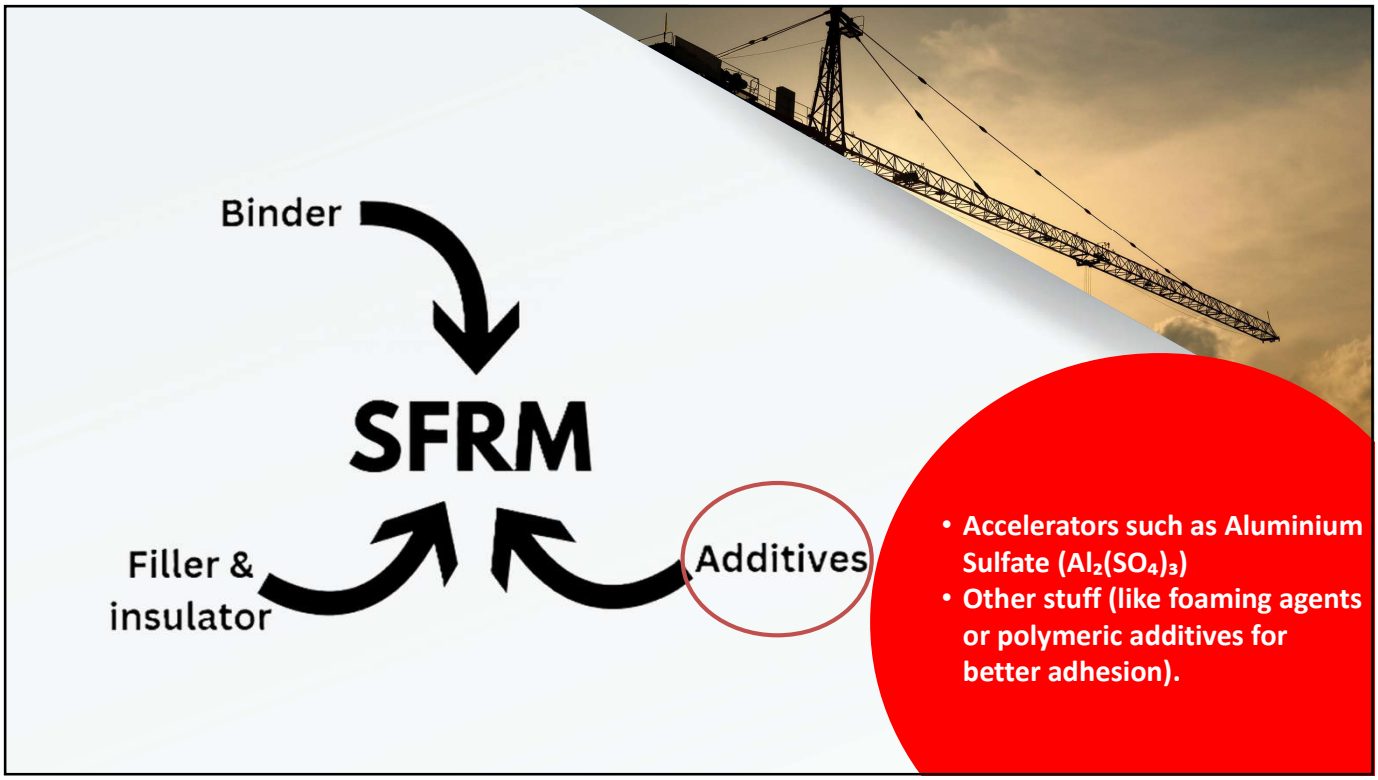
29


Binder
SFRM
Filler &
insulator
Additives
Gypsum:
CaSO4·2H2O
Portland Cement:
made from heated limestone (CaCO3) and clay.
Its main chemicals are calcium silicates (like 3CaO·SiO2) and calcium aluminates.

30


Binder
SFRM
Filler & insulator
Additives
• Vermiculite or Perlite
• Mineral Wool (or Rock Wool/Slag Wool)
• Quartz or Silica:

31


Binder
SFRM
Filler & insulator
Additives
• Accelerators such as Aluminium Sulfate ($Al_2(SO_4)_3$)
• Other stuff (like foaming agents or polymeric additives for better adhesion).

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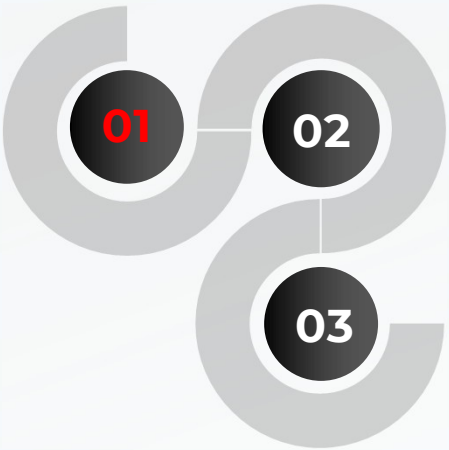
SFRM:
The 3 key methods of protection

33

SFRM: Methods of protection

Providing an insulating Layer

- SFRM is sprayed on thick (0.5-2 inches), creating a barrier full of air pockets (porosity).
- SFRM's low heat conductivity (due to porosity) means temperature changes propagate slowly.



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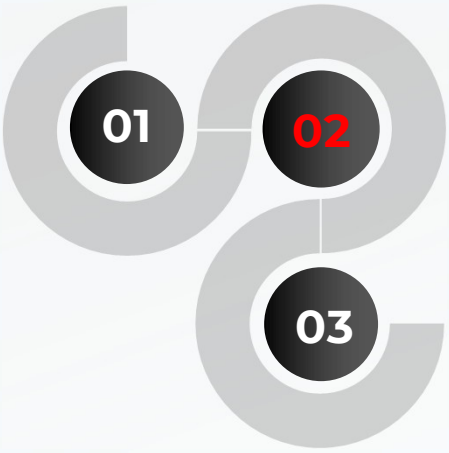
SFRM: Methods of protection

Endothermic cooling

- The dehydration reactions (e.g., $CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 + \mathbf{2H_2O}$) are endothermic
- The reactions aren't instant.

- At low heat, dehydration is slow; in a fire, it ramps up.
- This "temperature-dependent rate" ensures protection scales with fire intensity.



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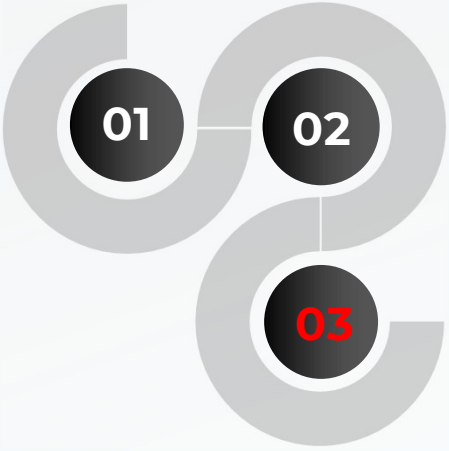
SFRM: Methods of protection

Expansion and charring

- some SFRMs, minerals like vermiculite expand (exfoliate) when heated, thickening the layer.

- The dehydrated remnants form a char-like residue—a dry, insulating crust that further blocks radiation (which bounces off or gets absorbed).



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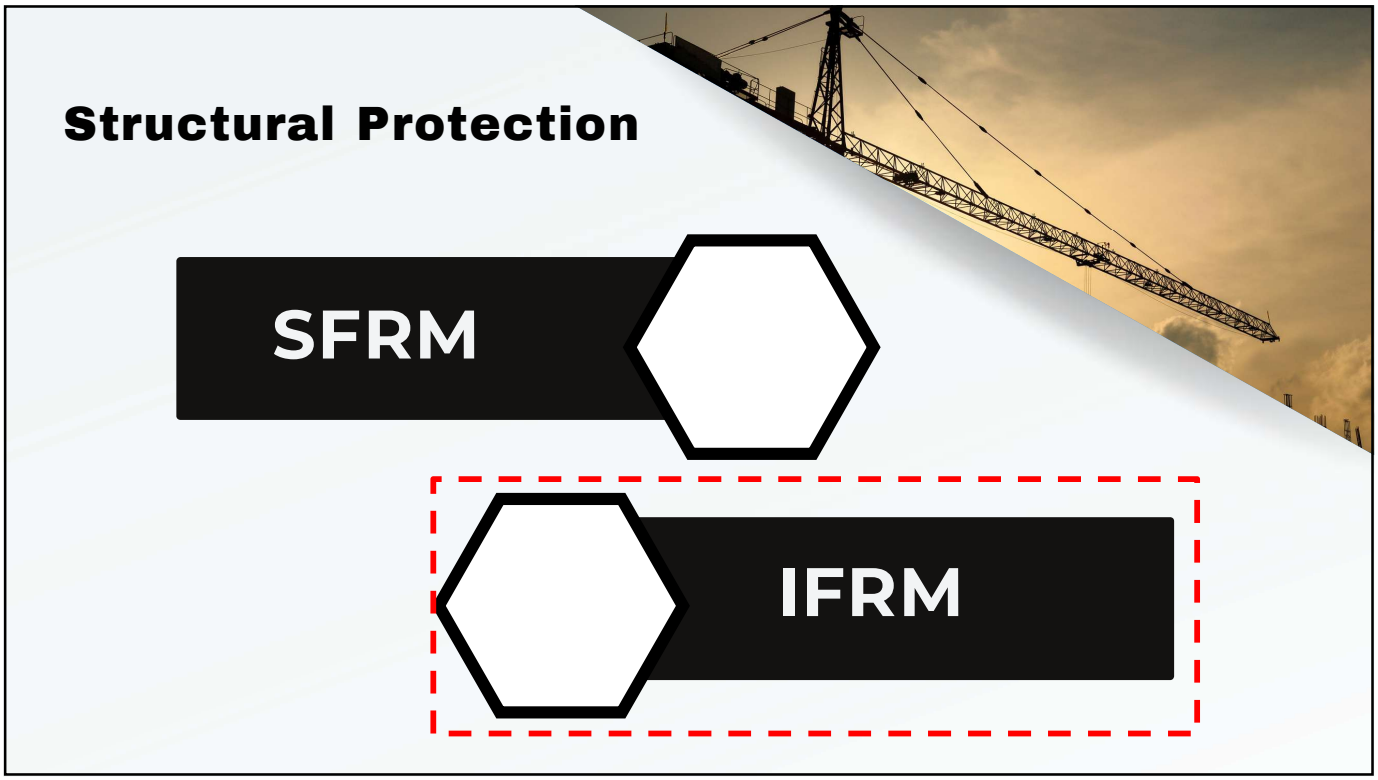
Structural Protection
SFRM
IFRM

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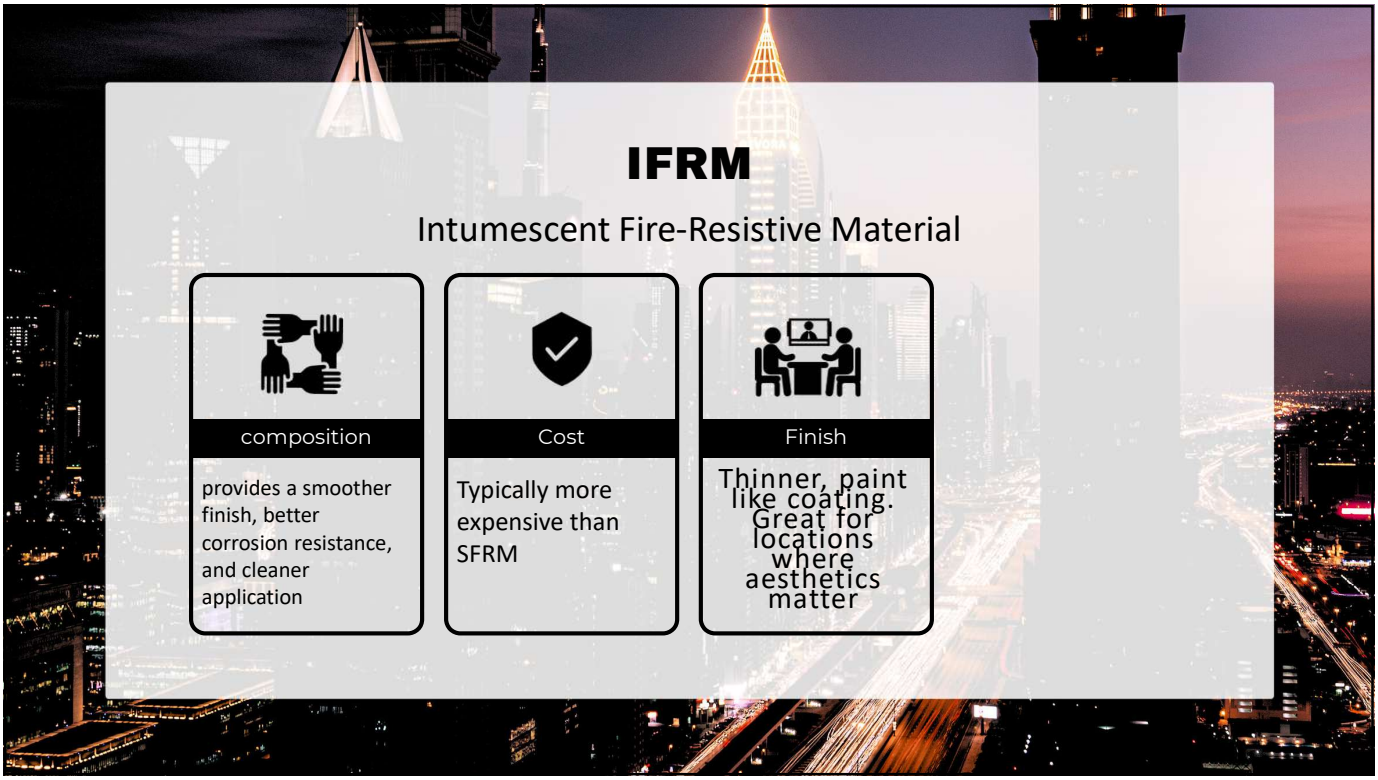
IFRM
Intumescent Fire-Resistive Material
composition
provides a smoother finish, better corrosion resistance, and cleaner application
Cost
Typically more expensive than SFRM
Finish
Thinner, paint like coating. Great for locations where aesthetics matter

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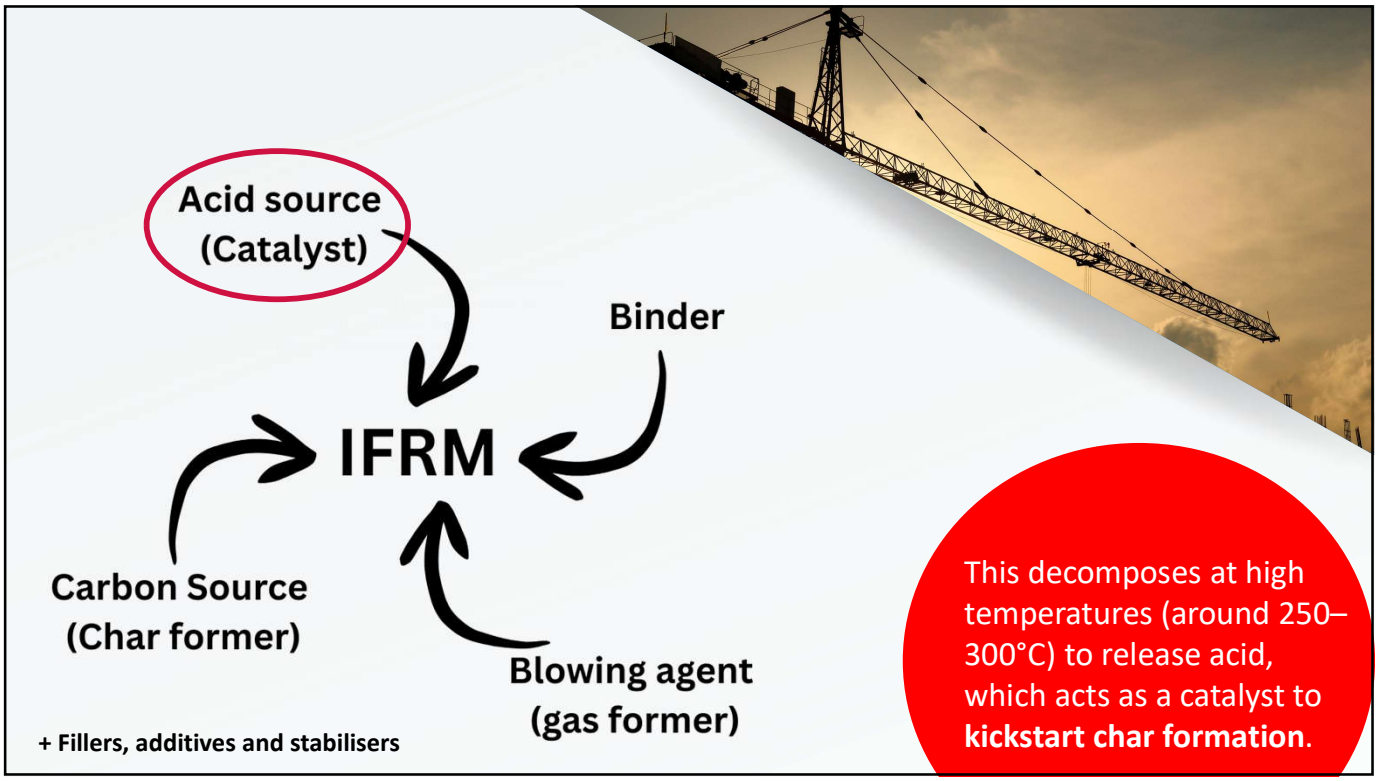
Acid source
(Catalyst)
Binder
IFRM
Carbon Source
(Char former)
Blowing agent
(gas former)
+ Fillers, additives and stabilisers
This decomposes at high temperatures (around 250–300°C) to release acid, which acts as a catalyst to **kickstart char formation**.

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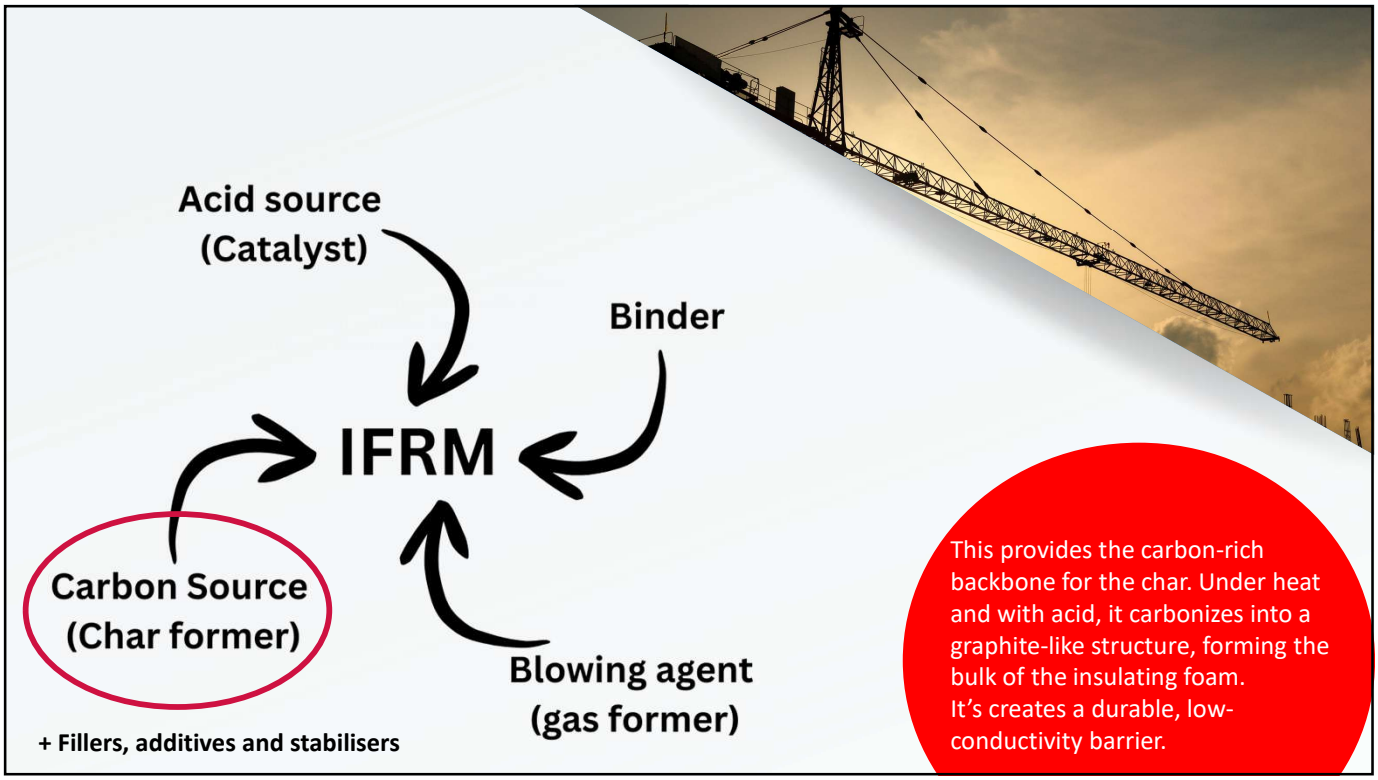
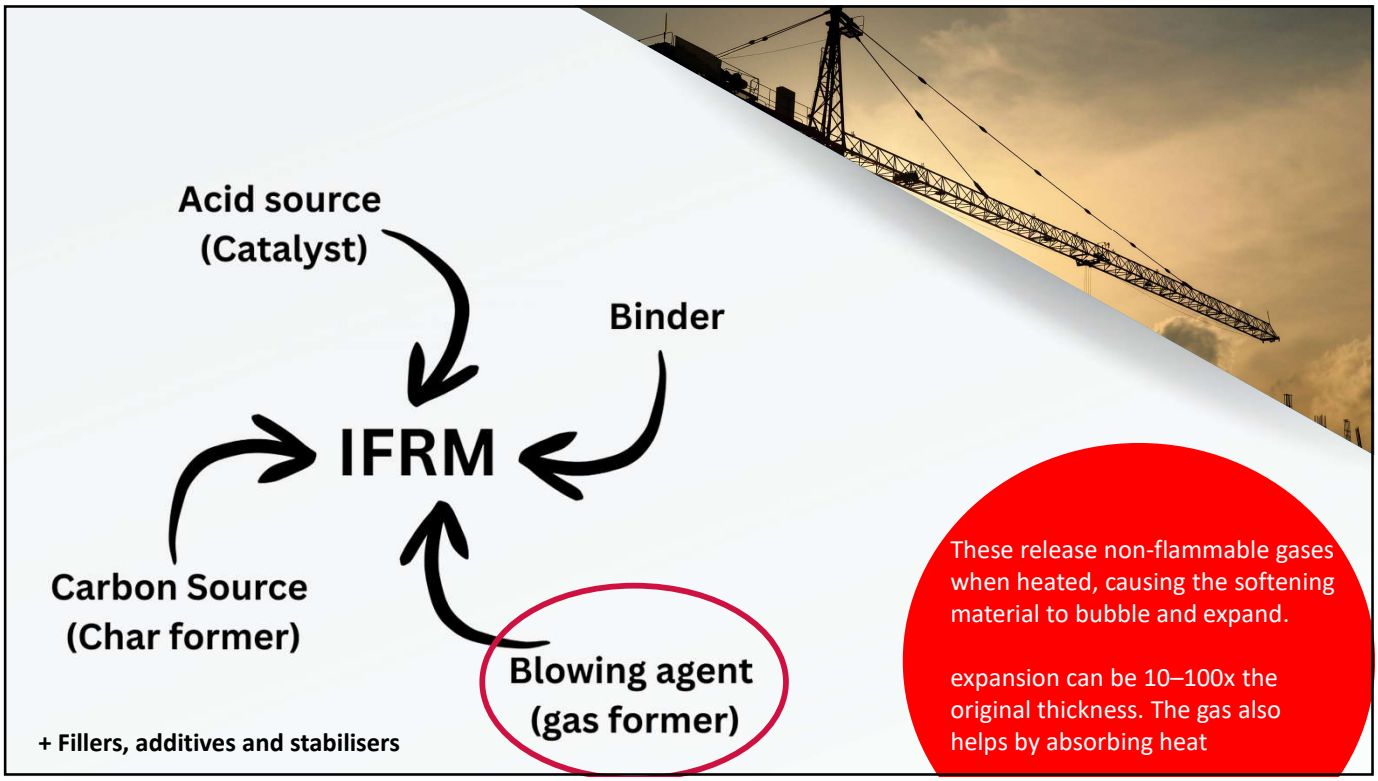

Acid source
(Catalyst)
Binder
IFRM
Carbon Source
(Char former)
Blowing agent
(gas former)
+ Fillers, additives and stabilisers
This provides the carbon-rich backbone for the char. Under heat and with acid, it carbonizes into a graphite-like structure, forming the bulk of the insulating foam.
It's creates a durable, low-conductivity barrier.

40


Acid source
(Catalyst)
Binder
IFRM
Carbon Source
(Char former)
Blowing agent
(gas former)
+ Fillers, additives and stabilisers
These release non-flammable gases when heated, causing the softening material to bubble and expand.
expansion can be 10–100x the original thickness. The gas also helps by absorbing heat

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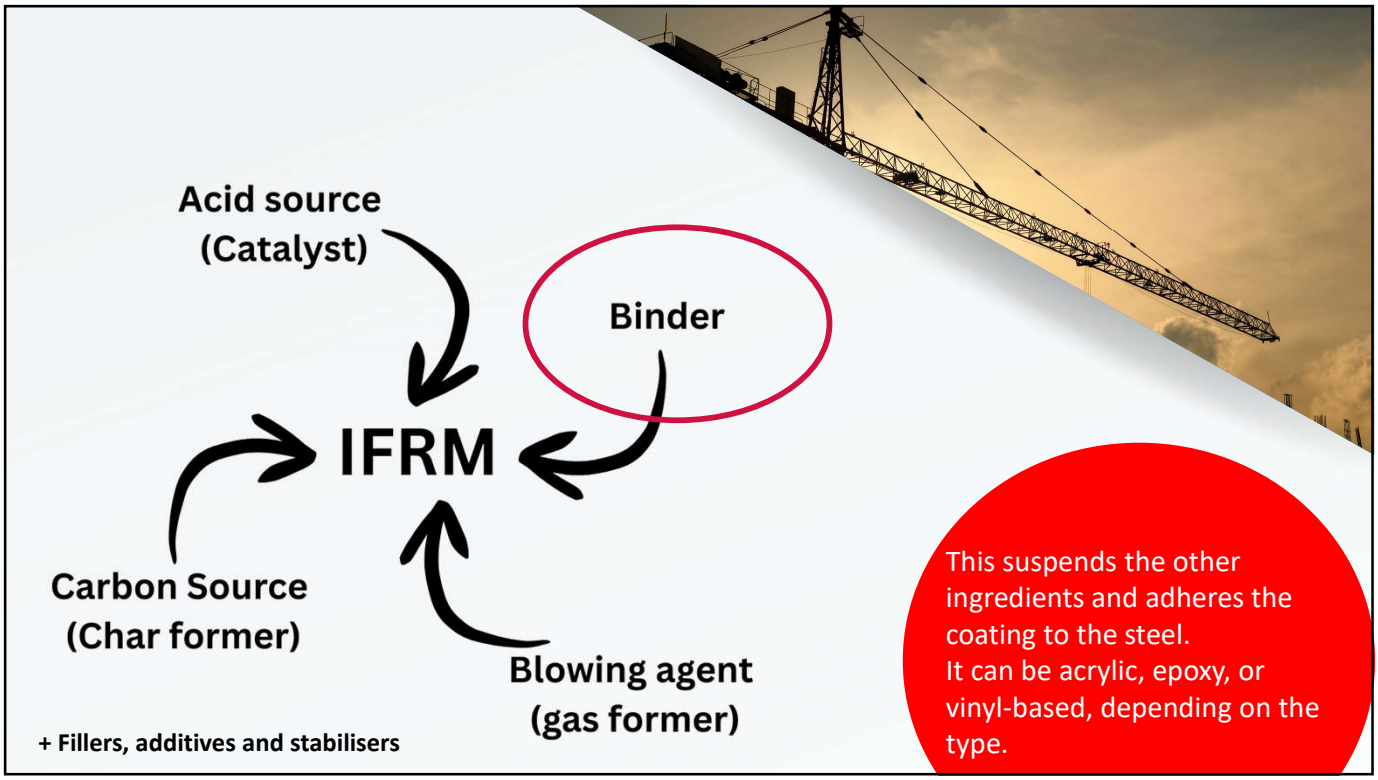
Acid source
(Catalyst)
Binder
IFRM
Carbon Source
(Char former)
Blowing agent
(gas former)
+ Fillers, additives and stabilisers
This suspends the other ingredients and adheres the coating to the steel.
It can be acrylic, epoxy, or vinyl-based, depending on the type.

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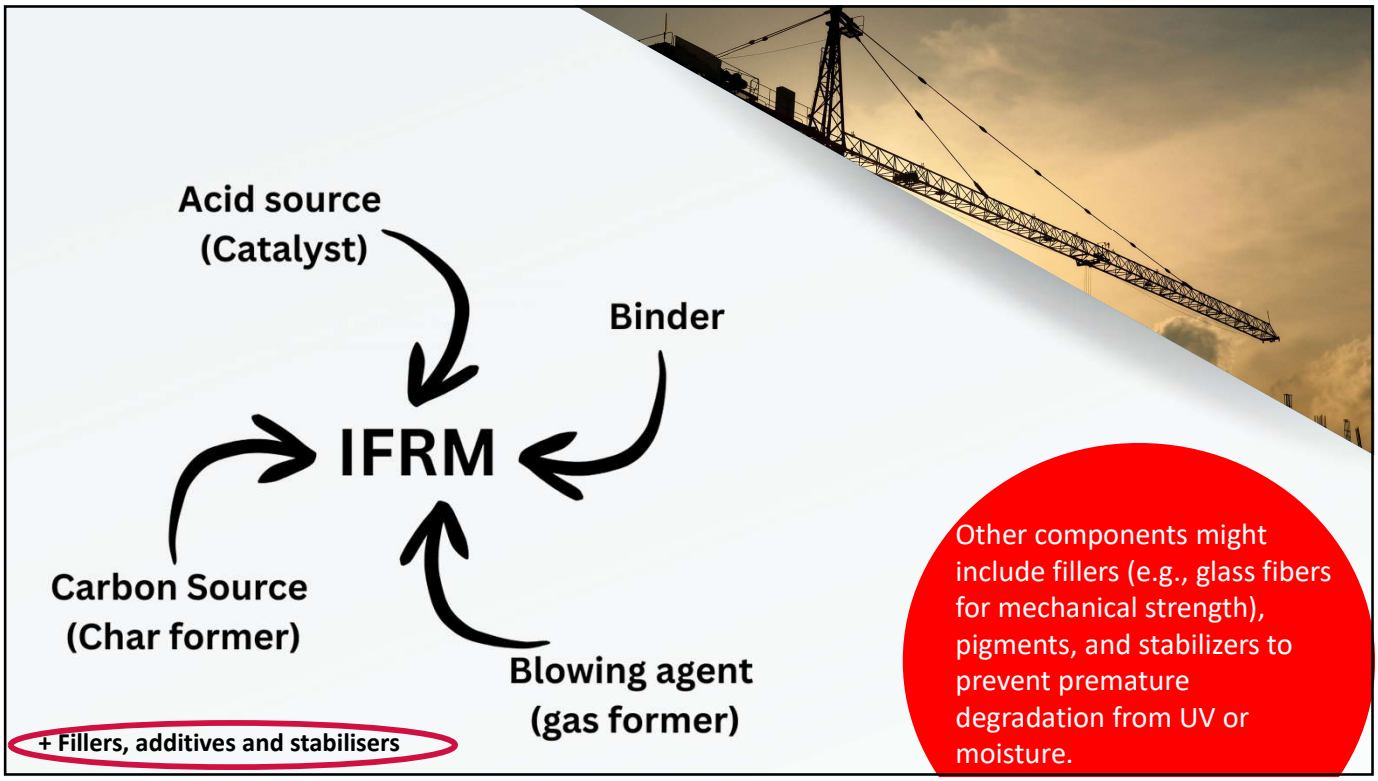
Acid source
(Catalyst)
Binder
IFRM
Carbon Source
(Char former)
Blowing agent
(gas former)
+ Fillers, additives and stabilisers
Other components might include fillers (e.g., glass fibers for mechanical strength), pigments, and stabilizers to prevent premature degradation from UV or moisture.

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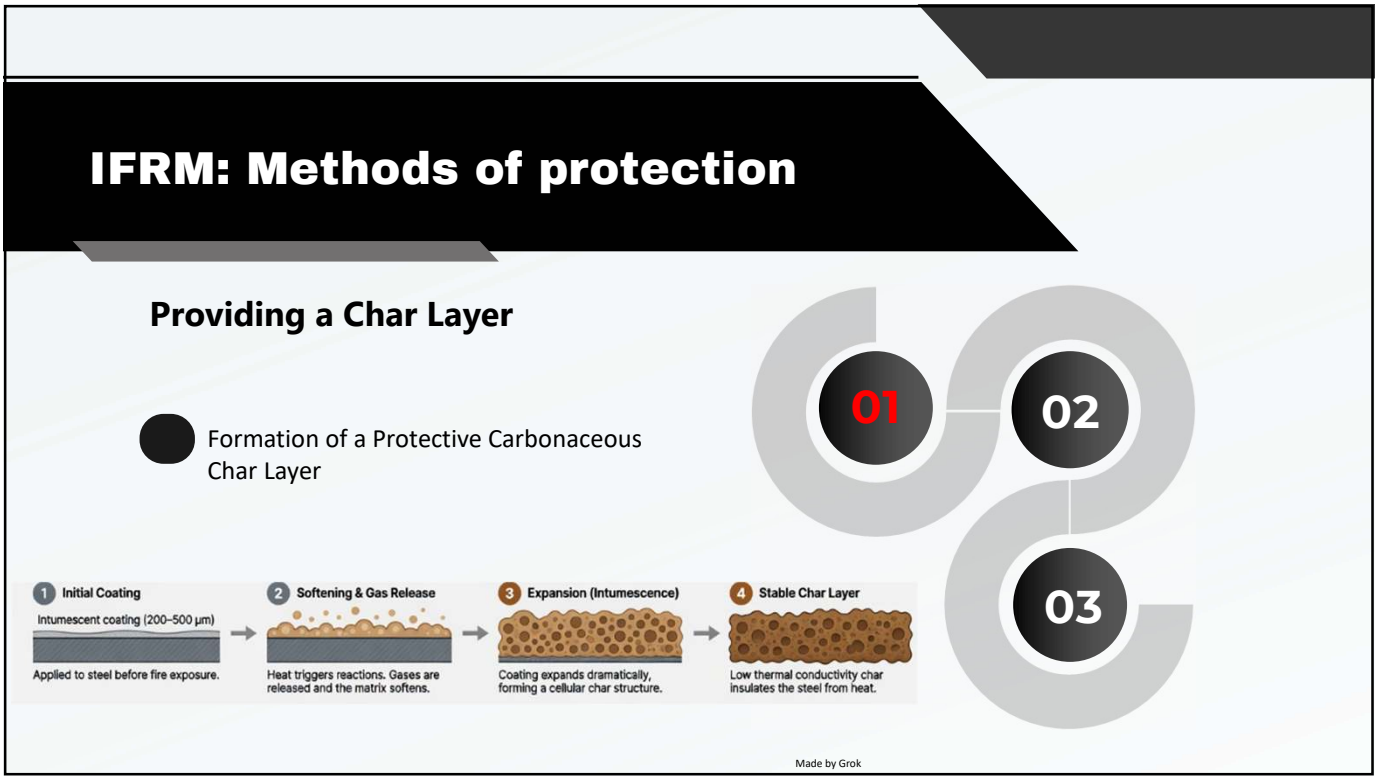
IFRM: Methods of protection
Providing a Char Layer
Formation of a Protective Carbonaceous Char Layer
01
02
03
1 Initial Coating
Intumescent coating (200–500 µm)
Applied to steel before fire exposure.
2 Softening & Gas Release
Heat triggers reactions. Gases are released and the matrix softens.
3 Expansion (Intumescence)
Coating expands dramatically, forming a cellular char structure.
4 Stable Char Layer
Low thermal conductivity char insulates the steel from heat.
Made by Grok

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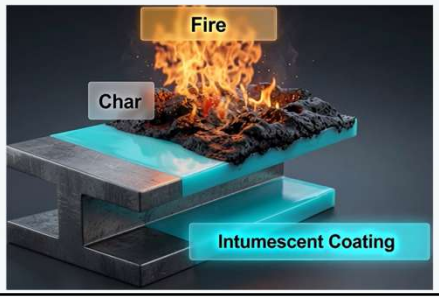
IFRM: Methods of protection

Thermal Barrier

- Intumescence and Creation of a Thermal Barrier.



Video made by Grok

01 02 03

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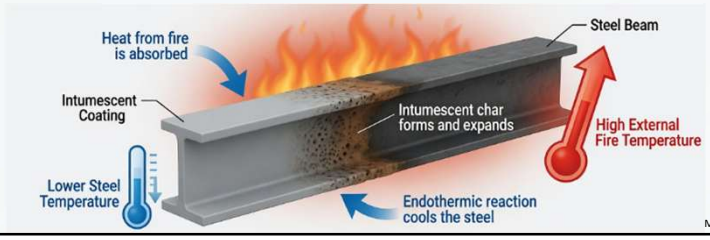
SFRM: Methods of protection

Endothermic heat absorption & cooling

- Dehydration, decomposition, and gas release are endothermic processes that absorb significant heat.
- This cools the coating surface and dilutes flammable gases near the steel.



Made by Grok

01 02 03

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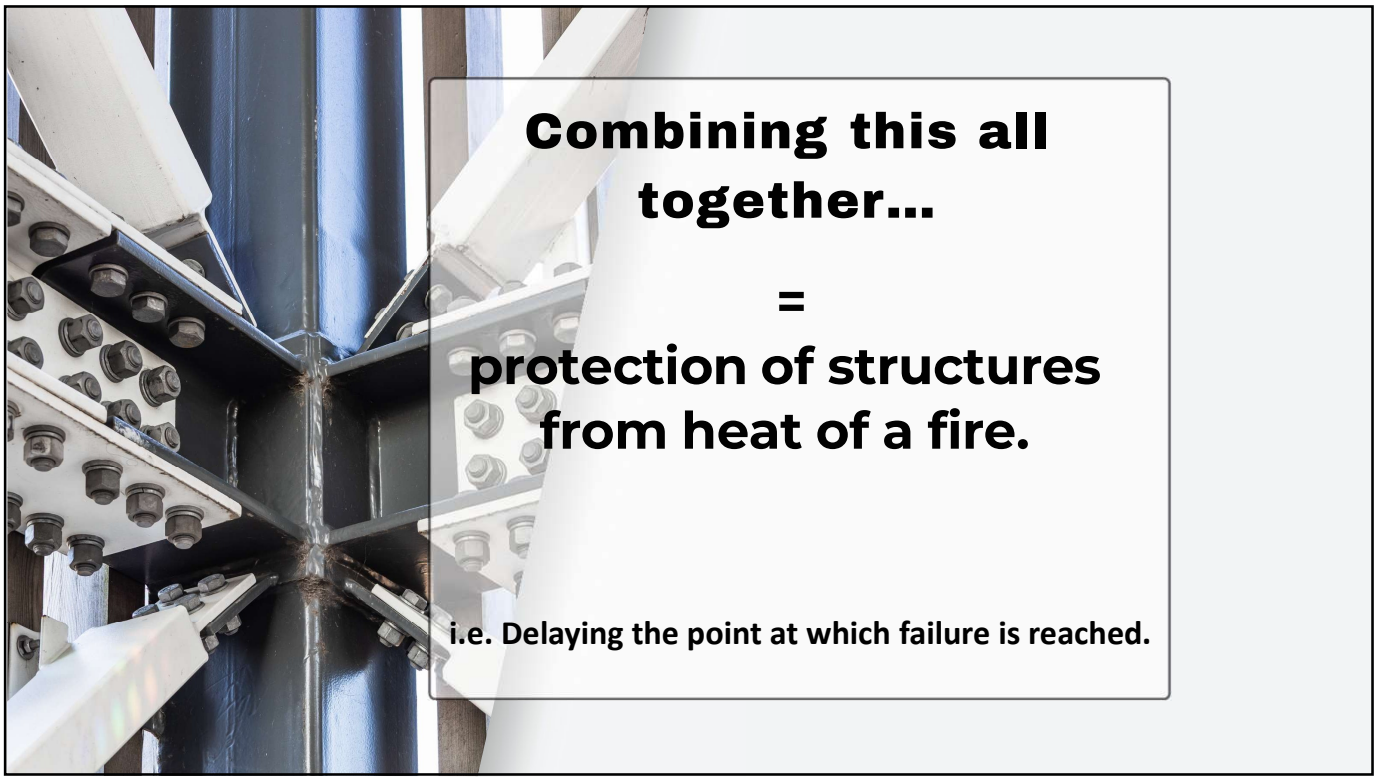
Combining this all together…
=
protection of structures from heat of a fire.
i.e. Delaying the point at which failure is reached.

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When SFRM or IFRM protection is used VS when it is not….

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Images sourced from official investigation reports (including Intemac forensic report NIT 2-05) and contemporary news coverage (EFE / press photographs). Used for educational purposes in fire protection engineering training.

Windsor tower, Madrid, Spain
12th Feb 2005

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Windsor tower, Spain 12th Feb 2005

- Fire started on the 21st floor (electrical fault)
- Fire grew rapidly in the open-plan office space filled.
- Within an hour, flames engulfed floors above
- Fire **spreading upward at 6-15 minutes per floor** via broken windows and external spill plumes (hot gases rising and igniting above).

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Windsor tower, Spain 12th Feb 2005

- Downward spread was slower (20-30 minutes per floor)
- fueled by falling debris
- Fueled by radiant heat through the façade
- Spread via internal paths like service voids and unsealed slab-cladding gaps

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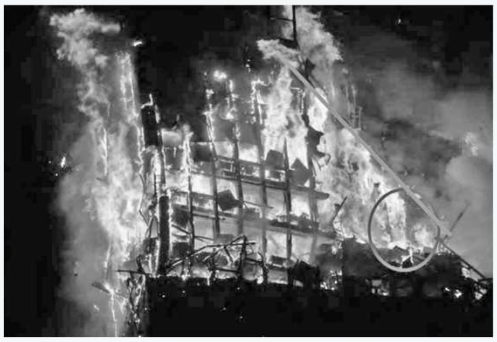
Windsor tower, Spain 12th Feb 2005

- Lacked operational sprinklers (retrofit)
- Had incomplete fire stopping → poor compartmentation.
- Blaze involved multiple floors simultaneously
- a "chimney effect" combined with very high fuel loading led to temperatures exceeding 1,000°C in spots.
- the **unprotected perimeter steel columns above the 17th floor heated exponentially buckling outward**



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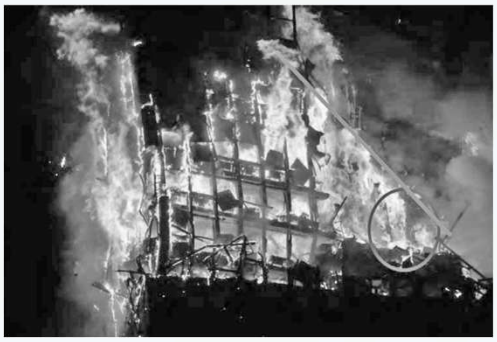
Windsor tower, Spain 12th Feb 2005

The building was under renovation relating to fire protection:

- New exterior emergency stairwells
- Updating existing utilities (compartmentation improvements to utilities, stairwells, floors and basement)
- Sprinkler retrofitting
- Full curtain wall replacement, including fireproofing of the perimeter steel columns.

This was only partially complete at the time of the fire.



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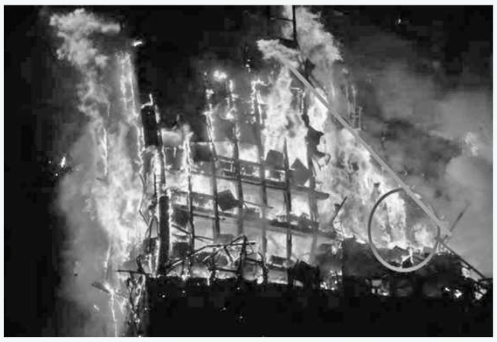
Windsor tower, Spain 12th Feb 2005

- This triggered progressive collapses.
- 1st east face of the 21st floor at 3hrs into the fire
- 2nd upper sections around floors 20-25 shortly after
- 3rd south mid-sections of 17-20 appx 1 hour after that
- Debris from these falls thought to have cracked the 17th-floor transfer slab, aiding downward fire spread.
- Aluminum used in the curtain wall melted, “fire drops” propelled downward spread



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Windsor tower, Spain
12th Feb 2005

- Below the 17th floor, **protected steel held**, but unprotected spots (e.g., 9th floor south/west sides) buckled
- The concrete core and internal columns redistributed loads, preventing further failure.

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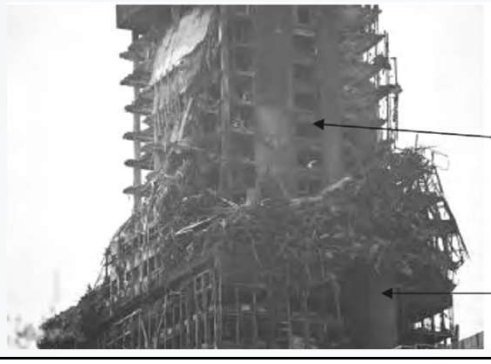
Windsor tower, Spain
12th Feb 2005

Upper floors

Lower floor damage



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Windsor tower, Spain
12th Feb 2005

Fire protection system	At time of construction (1970s Spanish code)	At time of fire (under refurbishment)
Compartmentation	**X**	Under construction, **but not fully compartmentalised**
Fire stopping between cladding & Structure	**X**	Under construction
Protection of steel	**X**	**17th floor + above: NO** 18th floor, part complete 4-15th floor: Complete (except 9 and 15)
Sprinkler system	**X**	Being retrofitted
Fire alarm system	YES	YES

Buckling at floor 9

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Other examples

An apartment block in St Petersburg, Russia (2002)
Reinforced concrete: FULL COLLAPSE

Gas explosion and partial collapse of a multi-story residential building, St. Petersburg, Russia.
Source: News coverage / official emergency response imagery. Used for educational purposes.

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Other examples

Delft University, Netherlands (2008):
Steel concrete hybrid: PARTIAL COLLAPSE

Faculty of Architecture building fire, TU Delft, Netherlands – 13 May 2008 During the fire (left) and post-fire structural damage (right) Source: Contemporary news coverage. Used for educational purposes

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Other examples

Wilton Paes Almeida Building in São Paulo, Brazil (2018): Concrete & steel building: COLLAPSE

Wilton Paes de Almeida Building fire & collapse, São Paulo, Brazil – 1 May 2018 Concrete & steel high-rise: rapid fire spread and structural collapse Source: Contemporary news coverage. Used for educational purposes

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The ones that didn't collapse

Deutsche Bank Building in lower Manhattan (2007)
NO STRUCTURAL COLAPSE

Mandarin Oriental Hotel/Beijing Television Cultural Centre in Beijing, China (2009): NO STRUCTURAL DAMAGE OR COLAPSE

Source: Contemporary news coverage. Used for educational purposes

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Apply this to higher risk scenarios…
High-rise buildings
Hospitals

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Apply this to higher risk scenarios…
High-rise buildings
Hospitals
Rely on defend in place
Specialist equipment & fuel loading is different
Hospitals are occupied 24/7
Occupants are unable to escape easily, unattended and sometimes, not at all

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Key points:

- Everything has limitations
- Occupancy and fuel loading helps determine risk & required protection
- Structural protection in hospitals is a necessity to protect vulnerable occupants

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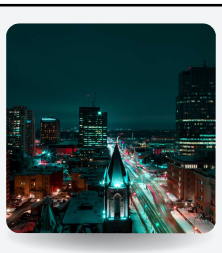


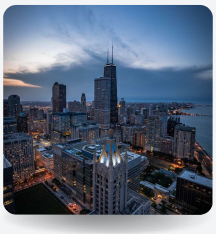


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