

Promat



FIRE SAFETY SOLUTIONS FOR TIMBER BUILDINGS

INTRODUCTION

The construction of timber buildings, particularly those using Cross Laminated Timber (CLT), is on the rise due to their sustainability and aesthetic appeal. However, especially for the high rise and complex shaped buildings present unique challenges when it comes to fire safety. Understanding and addressing these issues is crucial for ensuring the safety of occupants, protecting buildings, assets and the environment.

Wood is an organic material that has been used as a **building material** throughout human history. Wood has many advantages, such as workability, excellent strength/density ratio, corrosion resistance, and an aesthetic appeal. However, it has two basic disadvantages: it needs constant maintenance, and it **burns**.

Promat, the global leader in passive fire protection, is committed to providing innovative solutions and technical advice to meet the fire safety needs of modern timber buildings. In this document, we will explore the main fire safety challenges of timber buildings and present Promat's comprehensive range of solutions designed to tackle these issues effectively.



01. FIRE SAFETY CHALLENGES IN TIMBER BUILDINGS

All over the world, fire safety strategies are usually based on the following principles:

- Slowing or preventing rapid fire growth
- Safe evacuation of the building and firefighting access
- Preserving structural stability
- Prevent the fire spread to other compartments

1.1 FIRE DYNAMICS

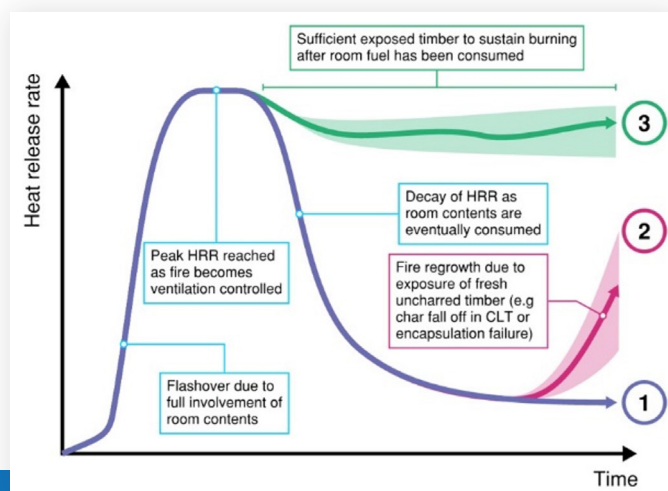
The inclusion of timber structural elements within a building adds fuel load to the fire compartment and often the timber is not adequately protected from ignition. Exposed mass timber, if available in sufficiently large quantities, can impact the room fire dynamics (fire growth rate, fire heat release rate (HRR), fire duration and temperature). For mass timber buildings, after the consumption of the building furnishing, there are three possible fire scenarios:

These fire safety goals can be achieved with a proper combination of fire safety measures and suitable building components, but it must be considered that timber's combustible nature opens new and unexplored fire safety challenges since most of the existing building codes and fire safety regulations were not written for combustible structural materials.

1. Decay of fire due to the limited amount of exposed timber and/or effective timber encapsulation
2. Re-growth due to charred lamellae fall off or encapsulation failure
3. Continued flaming due to the amount of timber exposed and ventilation

If the structure continues to burn beyond the consumption of the building furnishings, fire control becomes more difficult. Compartmentation and structural stability can be compromised in a manner not anticipated by conventional structural design approaches and performance assessment methods.

Fire dynamics in complex and high-rise timber buildings require specialized analysis to understand how the fire will evolve, considering internal and external fire spread, the amount of exposed timber, ventilation conditions, burn-out, self-extinction and potential re-ignition.



Promat solutions to control fire dynamics:

- Prevent timber ignition (encapsulation)
- Heat and smoke extraction ducts
- Compartmentation

1.2 SAFE EVACUATION OF THE BUILDING

A safe escape route is the most important aspect to save lives, making sure people have the time and the means to evacuate in case of fire to a place of total safety. The escape route must also facilitate a rapid and effective rescue by fire brigades who enter the building to extinguish the fire or to search for people still inside the building.

Since a person's ability to escape can be affected by both the smoke and the heat from a fire, timber's significant contribution to the quick development of fire and toxic smoke in a building (it is usually assigned to reaction to fire class D-s2,d0 to EN 13501-1) can make it difficult for occupants to evacuate safely, for

firefighters to operate within the building and can lead to extensive damage, especially when fire occurs in a high-rise building.

Promat solutions for a safe evacuation of the building:

- Prevent timber ignition (encapsulation)
- Improve timber reaction to fire
- Fire rated ventilation ducts (pressurized systems)
- Heat and smoke extraction ducts
- Compartmentation of the escape routes

1.3 PRESERVE STRUCTURAL STABILITY

The fire resistance of the loadbearing structure is the minimum requirement for fire safety of any building: only if the structure does not collapse the compartmentation can contain the fire, people can escape, the fire brigade can search the building for survivors and possibly fight the fire, and destruction of valuable assets is limited.

When a timber element is exposed to fire, the material starts to burn at the surface. Gradually a layer of char (burnt wood) is built up. Such a layer reduces the supply of oxygen and, thanks to its extremely low conductivity, prevents the increase of temperature of the inner layers, slowing down the burning process of the core of the wooden elements. Because of this characteristic, a structural timber element can resist fire

for a long time, generally much longer than steel, or even concrete, of the same dimensions can.

Over time, the layer of char becomes thicker and the remaining cross section of timber decreases until it is no longer able to carry the loads. Whenever an unprotected structure does not meet the required fire resistance rating, fire protection must be applied.

Promat solutions to preserve structural stability:

- Prevent timber ignition (encapsulation)
- Delay and slow the charring with protective materials

1.4 PREVENT FIRE SPREAD TO OTHER COMPARTMENTS

The role of compartmentation is to create boundaries to prevent fire, hot smoke and gases propagation through the building, leaving enough time for the occupants to escape safely. It also allows the fire brigades to enter the building, check if all the occupants have actually left or help those who can't get out on their own, and then fight the fire itself before it spreads to other compartments.

Historically, the approach of fire safety assumed that if compartmentation withstood the fire, then there is no fire spread beyond the compartment of origin. This implicitly means that fire and smoke damage will be limited to the compartment involved in the initial fire, while the rest of the building, and the property it contains, will remain safe.

In the case of timber buildings, the structure itself can become involved in the fire, adding an additional level of complexity wherein the role of compartmentation

might be to reduce the rate of fire spread across the entire building, but not always stop it. Furthermore, fire spread from above to below through the floors is a serious risk in timber buildings.

Finally, especially for high-rise timber buildings, the presence of exposed timber can result in increased external fire spread potential through the façade.

Promat options to prevent fire spread to other compartments:

- Horizontal compartmentation (Protection of timber floors and roofs)
- Vertical compartmentation (Timber frame walls and shaft walls)
- Fire rated façades
- Fire stopping and cavity barriers

02.PROMAT SOLUTIONS FOR COMPREHENSIVE FIRE PROTECTION

Promat offer a wide range of technologies and solutions for an all round fire protection of timber buildings.

- Encapsulation to prevent timber ignition (Mass timber walls and floors)
- Improve timber fire reaction (Escape routes)
- Structural protection (Beams and columns)
- Timber floor protection (Joists with fire above)
- Timber floor protection (Joists with fire below)
- Fire rated timber frame walls
- Façades
- Fire stopping
- Sealing of joints
- Ventilation and smoke extraction ducts

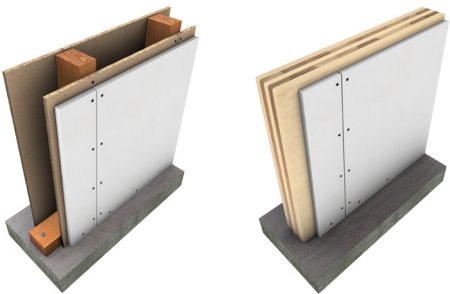
In the following paragraphs, we provide a high-level overview of possible Promat protective products for specific solutions depending on the required fire rating. As not all the products and solutions might be available in each country and for further details on the systems, we recommend to always refer to the local handbook and consult classification reports, local certificates or contact your local Promat representative.

2.1 ENCAPSULATION - PREVENTING TIMBER IGNITION

Fire protection ability “K” is the ability of a wall or ceiling covering to protect the material behind the covering against ignition, charring and other damage for a specified time. By encapsulating timber, the fire dynamics of the combustible construction is decoupled from the compartment fire dynamics. Covering products are tested to EN 14135 and classified to EN 13501-2 for fire resistance period up to 60 minutes. A covering is designated K₁ or K₂ if during a test in accordance with EN 14135 within the classification period:

- There is no collapse of the covering or parts of it
- The interface temperature increase does not exceed 250 °C on average and 270 °C at any point
- After the test there is no burnt material or charred material at any point of the substrate

Promat solutions are shown in the table below and are applicable to vertical, horizontal, or sloped elements.



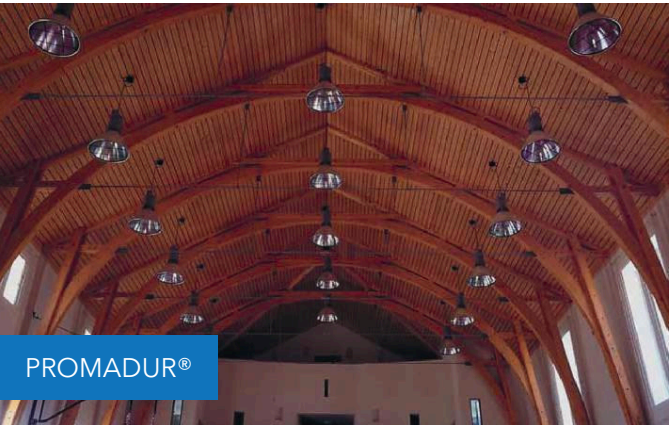
K ABILITY	COVERING MATERIAL
K ₁ 10 / K ₂ 10	PROMATECT®-100 - 10 mm
K ₂ 30	PROMATECT®-100 - 18 mm
K ₂ 60	PROMATECT®-XS - 2x15 mm
K ₂ 90*	PROMATECT®-100 - 2x20 mm

*Currently EN 13501-2 standard does not allow for classification of K₂ coverings beyond 60 minutes. The solution is supported by fire test executed to prEN 14135:2024 with an extended duration.

2.2 IMPROVE TIMBER REACTION TO FIRE

Timber is assigned to D-s2,d0 fire reaction class according to the EN 13501-1, which means it is highly combustible and able to significantly contribute to the development of a fire in a building. Thus, in order to reduce the risk associated with the outbreak and propagation of fire and limiting its spread onto other elements, in many occasions timber needs to be properly protected.

Promat’s solution is PROMADUR®, a high performing water based single component reactive paint which expands in the event of a fire, creating a protective insulating foam which protects the substrate from the contact with air (oxygen), decreasing the combustibility.



Solid timber, chipboard, and plywood (minimum thickness 12 mm) protected with only 300 g/m² of PROMADUR® conform to fire reaction class B-s1,d0 according to EN 13501-1, the highest possible fire protection class achievable for reactive coatings.

The natural beauty of timber is not obscured thanks to PROMADUR®’s extremely good transparency, keeping the aesthetical aspect many designers are looking to exploit. The limited VOC content and ease of application make it ideal for a wide range of buildings, such as hotels, restaurants, schools, public buildings, museum, library, offices and private houses.

Alternatively, depending on local regulations, K₁ 10, K₂ 10 or K₂ 30 covering with fire protective boards could fit for the purpose.

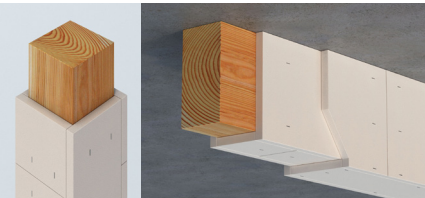
2.3 STRUCTURAL PROTECTION

The fire resistance of a timber structure, i.e. the time during which it keeps the load-bearing capacity when exposed to fire, can be determined by calculation according to the Eurocode EN 1995-1-2. When timber heats up during a fire, the material starts to burn at the surface, forming a layer of char. During the fire, the charred depth will gradually increase. The charred material has no strength left and the pyrolysis zone (between the char and the still unburned wood) has a very limited mechanical resistance. Therefore, the remaining cross-section of the timber element gradually reduces, at some point the load can no longer be carried and the element will collapse.

- Particularly in renovations, the cross-section of load-bearing timber is often not sufficient to provide the necessary fire resistance, meaning it’s necessary to apply fire protection. A fire protective material acts in two ways:
- Postponing the start of the charring process
 - Slowing the charring rate

Promat offers board and paint products that have been tested and assessed by independent institutes.

BOARDS SOLUTIONS



Beams and columns can be clad with PROMATECT®-100 boards to provide up to R 90 fire resistance (test to EN 1365-3 and EN 1365-4). Fire protective boards are directly stapled to the timber elements ensuring an easy and fast installation with a smooth surface.

ELEMENT	CROSS SECTION	FIRE RESIST	PROMATECT®-100
Column	> 120x120 mm	R 60	18 mm
Column	> 120x120 mm	R 90	2x18 mm
Beam	> 100x200 mm	R 90	2x18 mm



Timber beams, columns, ceilings and walls can be protected with PROMADUR® transparent intumescent paint + PROMADUR® Top coat finishing (80-100 g/m²)
The fire rating of protected timber element is a combination of the original fire resistance of the unprotected element and the contribution of the protective material. The latter is quantified through the values of $t_f \rightarrow t_{ch}$ (time of failure and start of charring) and k_β (ratio of carbonization speed) obtained from fire tests to EN 13381-7 as required by EN 1995-1-2.

PROMADUR®	$T_f \rightarrow T_{ch}$		K_β
	BEAMS & COLUMNS	CEILINGS & WALLS	
181 g/m ²	7 min	6 min	1,0
468 g/m ²	13 min	12 min	1,0
1120 g/m ²	17 min	-	0,71

Depending on the section, the shape, the different types of timber and the quantity of the protective coating applied, PROMADUR® might increase the fire rating of timber elements up to 120 minutes (R 120) and above. Contact your local Promat office for further details.

2.4 COMPARTMENTATION

Ensuring effective compartmentation in timber buildings is vital to prevent the spread of smoke and fire. Promat offers solutions for vertical and horizontal compartmentation, façades, fire stopping for service penetrations and joint sealants. Our products are tested to meet and often exceed the most demanding international fire safety standards, providing reliable protection.

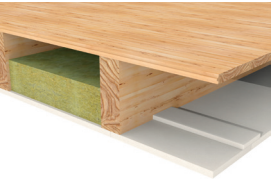
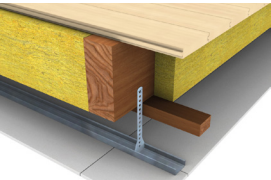


2.4.1 Timber floors

Timber floors must ensure both compartmentation and structural stability. Solutions are typically tested according to EN 1365-2 to prove REI criteria are met. These elements are particularly vulnerable to fire exposure from both below and above, necessitating effective fire protection. In practice, wooden floors vary widely in configuration: different decking types (e.g. OSB, Multiplex, Chipboard, Timber), joist size and spacing, as well as insulation type, if present.

Promat offers solutions up to REI 120 for both below and above fire exposure, adaptable to most market scenarios, with flexible installation options with boards, either direct to joists or with suspended ceilings, with or without insulation, or even with sprays. In the tables below, the products and corresponding thicknesses are listed according to the required fire resistance and the desired installation method.

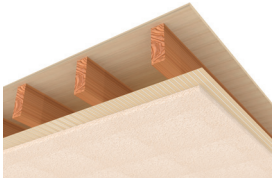

FIRE FROM BELOW – FIRE PROTECTIVE BOARDS SOLUTIONS

PROMATECT®-100					
		REI 30	REI 60	REI 90	REI 120
<div>Direct fixation</div>	No insulation	10 mm	15 mm	18 mm	2x15 mm
	With insulation	10 mm	15 mm	2x15 mm	2x15 mm
<div>Suspended</div>	No insulation	10 mm	15 mm	18 mm	2x15 mm
	With insulation	10 mm	15 mm	2x15 mm	2x15 mm

Please refer to local Promat handbook, classification reports, local certificates or contact your local Promat representative for further details on the solutions. Different thicknesses might apply for specific situations


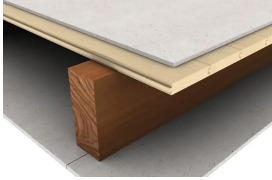


FIRE FROM BELOW – SPRAY SOLUTIONS

PROMASPRAY®-P300				
	REI 30	REI 60	REI 90	REI 120
Mesh directly fixed to joists				
	22 mm	24 mm	37 mm	46 mm
Suspended mesh				
	21mm	21 mm	33 mm	45 mm

Please refer to local Promat handbook, classification reports, local certificates or contact your local Promat representative for further details on the solutions. Different thicknesses might apply for specific situations

FIRE FROM ABOVE

		REI 30	REI 60	REI 90	REI 120
Only screed					
	PROMATECT®-H	10 mm	25 mm	2x20 mm	2x25 mm
Screed + underneath board					
	PROMATECT®-H screed	10 mm	25 mm	25 mm	2x20 mm
	PROMATECT®-100 underneath	15 mm	15 mm	15 mm	2x15 mm

Please refer to local Promat handbook, classification reports, local certificates or contact your local Promat representative for further details on the solutions. Different thicknesses might apply for specific situations

2.4.2 Timber roofs

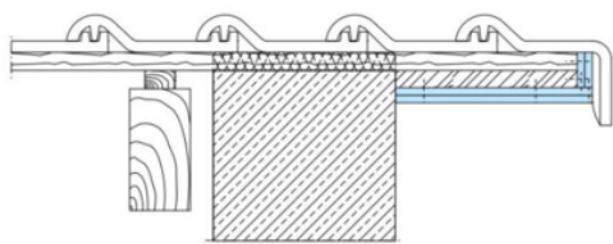
Timber roofs are also particularly vulnerable to fire exposure and often require to be protected from fire to preserve compartmentation and loadbearing capacity. Promat offers solutions up to REI 120 with PROMATECT®-100 fire protective boards fixed to steel profiles.

	PROMATECT®-100	
	REI 60	REI 120
	15 mm	2x20 mm

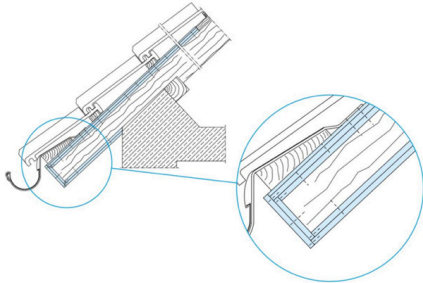
Please refer to local Promat handbook, classification reports, local certificates or contact your local Promat representative for further details on the solutions. Different thicknesses might apply for specific situations



Each project is unique and requires special consideration of the installation to prevent fire spread through weak points in the roof compartmentation. Some examples for roof eaves are shown below, solved with PROMATECT®-H moisture resistant fire protection board.



These design details are special situations which need to be evaluated on a case-by-case basis. Please contact your local Promat representative for further information.



2.4.3 Timber frame walls

In both new and existing buildings, it may be necessary to create compartmentation walls. Timber-framed walls can serve solely for compartmentation purposes (EI rating, tested according to EN 1364-1) or combine this with a load-bearing function (REI rating, tested according to EN 1365-1). Promat offers solutions for timber-framed walls with performance ratings up to EI / REI 120, as detailed in the tables.

Please refer to local Promat handbook, classification reports, local certificates or contact your local Promat representative for further details on the solutions. Different thicknesses might apply for specific situations

FIRE RATING		
	EI 60	- 10 mm PROMATECT®-100 - Timber studs + mineral wool - 10 mm PROMATECT®-100
	EI 120	- 18 mm PROMATECT®-100 - Timber studs + mineral wool - 18 mm PROMATECT®-100
	REI 90	- 15 mm PROMATECT®-100 - Timber studs + insulation (cellulose or mineral wool) - 15 mm OSB - 15 mm PROMATECT®-100
	REI 120	- 18 mm PROMATECT®-100 - Timber studs + insulation (cellulose or mineral wool) - 15 mm OSB - 18 mm PROMATECT®-100

2.4.4 Timber frame shaft walls

To close openings in fire resistant walls or service shafts the installation can usually be done from one side only. Promat offers timber-framed shaft walls with fire resistance up to EI 120, capable of withstanding fire exposure from both sides while having the fire protection boards only on one side, as detailed in the table.

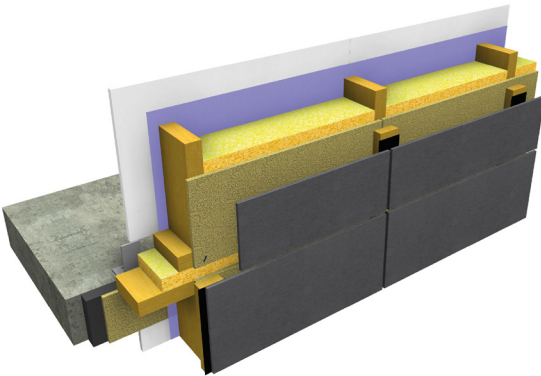
	EI 30	- Timber studs* - 2 x 10 mm PROMATECT®-100
	EI 60	- Timber studs* - 2 x 15 mm PROMATECT®-100
	EI 120	- Timber studs* - 2 x 25 mm PROMATECT®-100

Please refer to local Promat handbook, classification reports, local certificates or contact your local Promat representative for further details on the solutions. Different thicknesses might apply for specific situations

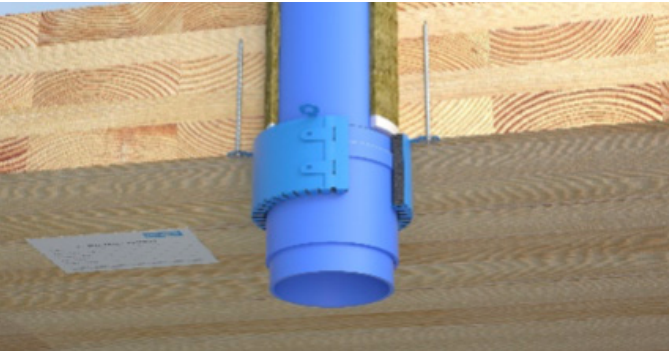
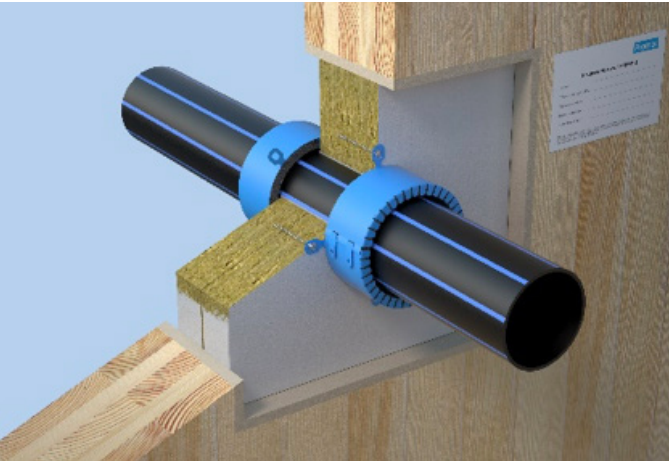
*In case of fire exposure from the frame side, timber studs shall be encased with PROMATECT®-100 boards.

2.4.5 Facades

There has been numerous facade fires worldwide in recent years highlighting how rapidly and dangerously fire can spread via this route. Timber buildings, are highly vulnerable. Promat offers tested solutions for facades and curtain walls and can develop custom solutions tailored to specific needs. Please contact your local Promat Representative for further information.



2.4.6 Fire stopping & cavity barriers



Inadequate sealing of service penetrations and joints can compromise the entire building's compartmentation. Special attention is required when selecting solutions for timber substrates, as the common ones tested on rigid or flexible supporting constructions are not applicable for instance to CLT floors and walls. Promat's range of solutions, tested according to EN 1366-3 and EN 1366-4, is continuously evolving to meet market demands. Try our selector (<https://selector.promat.com/>) or contact us to find the right solution to your needs.



2.5 VENTILATION AND SMOKE EXTRACTION DUCTS

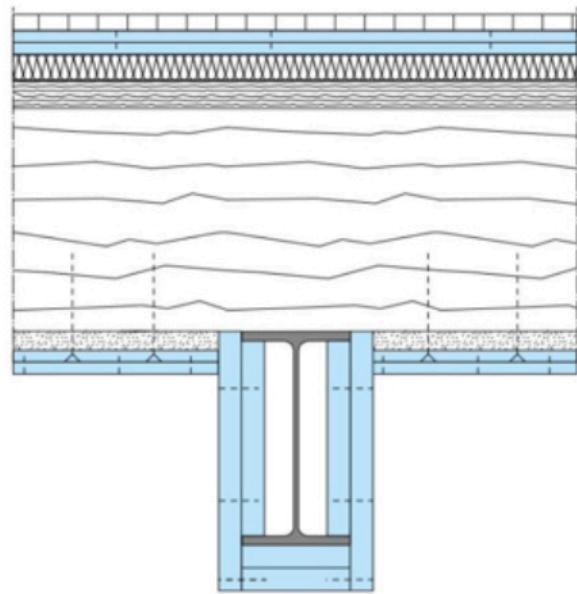
Smoke extraction is a crucial element in controlling fire and protecting people. Studies show that smoke is a main source for the spreading of fire through a building. In addition, toxic gasses can block the exits of the building. This is why smoke extraction is so crucial. Promat offers a unique and maintenance free solution for smoke extraction and ventilation. Please refer to Promat ducting handbook, or contact your local Promat representative for further details.



2.6 SPECIAL APPLICATIONS

The complexity and ongoing advancements in timber construction demand the continuous development of new solutions. Promat is dedicated to creating reliable solutions that align with market trends and specific project needs. Key areas of focus and development

include modular buildings, timber-steel hybrid constructions, CLT structures and preserving the beauty of timber while providing fire protection. Here below few examples are shown. Please contact us to explore possible solutions for any specific needs.



Combination of timber and steel

Often when changing the use of a building with timber floors, new traffic loads require additional supporting steel beams. Often new buildings that are utilising CLT floors, still require support from steel beams.



Historical timber floor protection

Often existing timber buildings contain historical ceilings which must be preserved in their original conditions. With a specific solution developed for installation from above we can fire protect the timber floor maintaining the original aesthetical aspect.



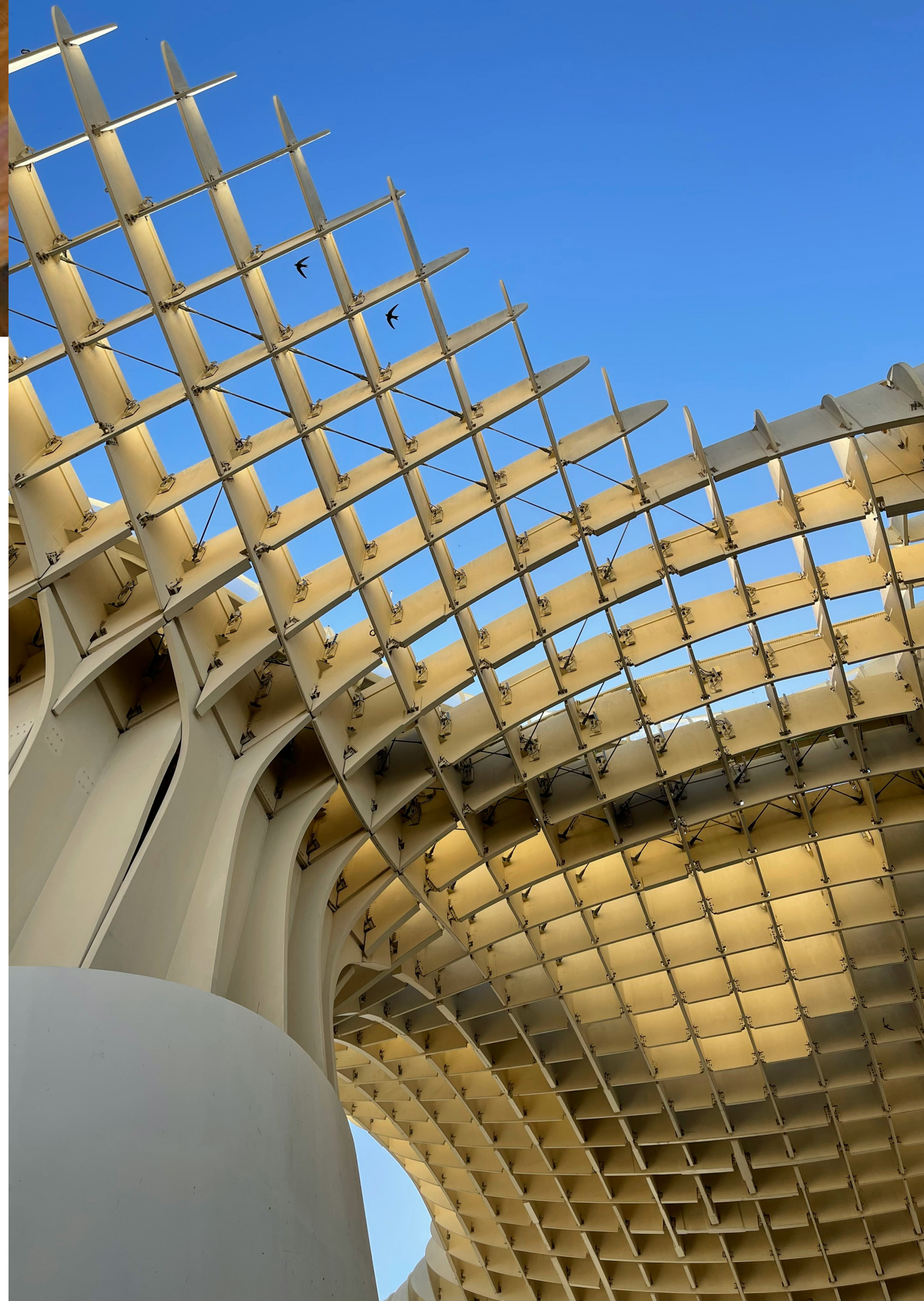
03. A SAFER AND MORE SUSTAINABLE FUTURE

At Promat, sustainability is at the heart of our mission to advance expertise and build a safe, sustainable world. Our ClearChange concept focuses on six key areas:

- **Product Design:** Creating products with reduced environmental impact and enhanced longevity.
- **Decarbonisation:** Lowering carbon emissions through innovative processes and renewable energy.
- **Delivery and Assembly:** Minimizing packaging waste and optimizing logistics.
- **Energy Saving:** Supporting energy-efficient buildings and operations.

- **Built to Last:** Developing durable products that facilitate repairs and retrofits.
- **Re-use and Recycling:** Promoting recycling and reusing materials to achieve zero landfill waste.

Timber buildings, known for their sustainability, align perfectly with our vision. Wood is a renewable resource, and its use in construction helps reduce the carbon footprint. Promat's fire protection solutions ensure that these sustainable buildings are also safe and compliant with fire safety regulations, enhancing their overall durability and environmental benefits.



04. YOUR TRUSTED PARTNER

In our modern world, the fire safety of Timber buildings is extremely challenging because of the uncertainties on the adequacy of the conventional approach and of the existing gap in regulations, shortage of expertise and available solutions. When designing ambitious and innovative buildings, trustworthy expert advice is essential to ensure reliable fire protection. Promat offers free expert support to help solve complex design challenges.

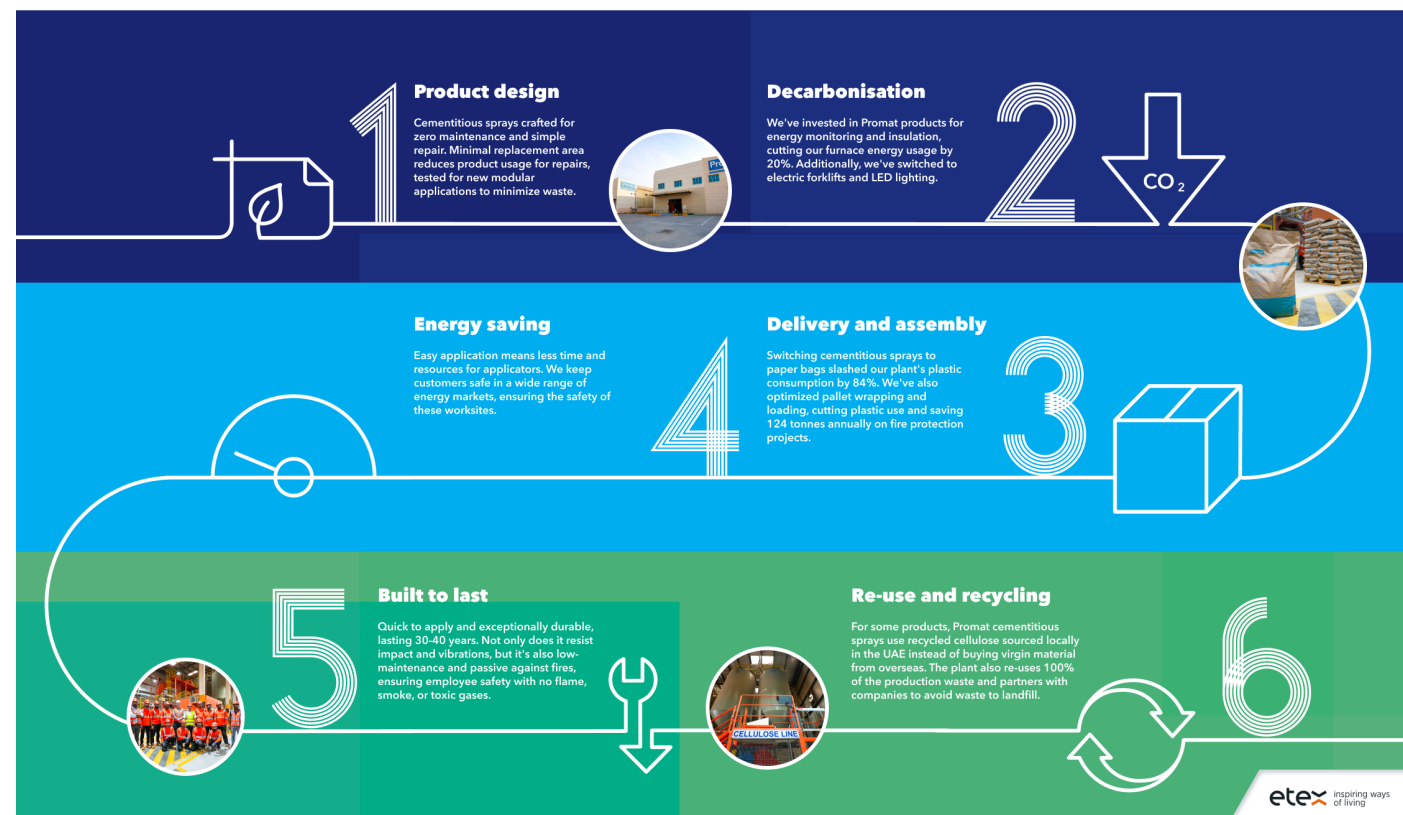
Up-to-date regulations: We monitor and contribute to fire regulation updates in many countries, guiding you through the most recent news and ensuring that our solutions are compliant with the most advanced standards.

The most appropriate solution: We help you choose the optimized solution through different product technologies, reports, and test standards.

Beyond regular solutions: With more than 60 years of experience, tests exceeding regulation requirements, dedicated simulation tools, worldwide network of engineers and in-house testing facilities, we provide tailored solutions for your unique building.

If you are concerned about the fire safety of a timber structure, whether it's refurbishing an old building, or a new construction challenge, our Technical Experts are well placed to support you.

Promat 6 STEPS TO CLEARCHANGE



05. CASE STUDY

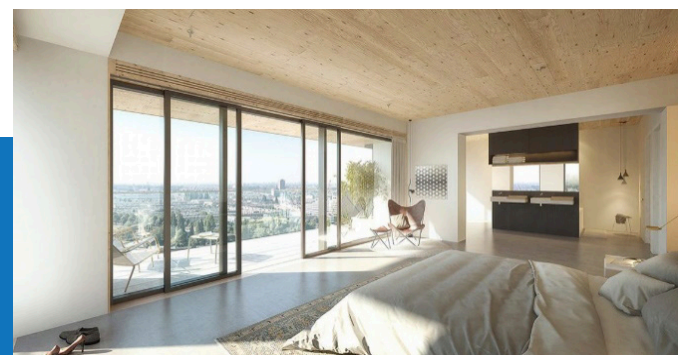
5.1 HAUT ON THE AMSTEL, AMSTERDAM, NETHERLANDS

HAUT is the highest wooden residential tower in the Netherlands with a "BREEAM Outstanding" sustainability certificate. To make this an example of sustainable innovation, Lingotto and the architects of Team V and engineers from Arup designed the building with load bearing CLT walls and CLT floors. The question was how to protect such a large-scale building and its inhabitants in case of fire.

Arup analysis resulted in a requirement for the CLT walls to not significantly contribute to the fire load in the fire compartment for at least 90 minutes. Although there are different ways to achieve this fire resistance, the best multidisciplinary solution for HAUT was to protect the CLT from charring for 90 minutes by covering it with a fire-resistant board.

When the design team and contractor looked for a partner to find feasible fire protection options that would comply with the design specifications for such an innovative project, the project managers also called upon the fire protection experts of Promat. Our fire safety engineers initially used a performance-based method to define a solution to ensure that timber walls would not exceed temperatures of 270°C for at least 90 minutes, then a fire test was carried out at the Promat Fire Lab to validate the proposal.

A CLT partition wall was tested for 90 minutes and was compared to a traditional plasterboard solution. When both panels were removed from the furnace, the difference in fire resistance was quite spectacular. While the plasterboard panel had burned away and the CLT wall was fully involved in flames, the PROMATECT®-100 panel was still in place and continued to protect the CLT wall from the fire without charring of the CLT.



"Promat has proactively used its product knowledge, experience and test facilities to provide innovative products and solutions for this spectacular building and demonstrated to meet the stringent Arup fire and acoustic requirements which can be built efficiently".

Pascal Steenbakkers, ARUP Engineering

5.2 KONINGSPLEIN, AMSTERDAM

In the heart of Amsterdam (Koningsplein), GBB Apeldoorn installed PROMATECT®-100 boards to protect the wooden floor construction 60 minutes (REI) in a large monumental building that recently was being renovated. PROMATECT® boards were also used to provide 60 minutes protection (R) to steel beams and columns.



"The tested and smart solutions with PROMATECT®-100 boards with a single sheet layer under wooden floors are ideal. It makes huge savings in transport movements and installation costs."

Robert Vreenegoor, GBB Apeldoorn Project Manager



Promat

Preserve the structure, protect the people.

In today's fast-changing construction environment, preserving and protecting structures is essential.

Our comprehensive solutions cover all types of projects, including Electric Vehicle car parks to modular and eco-friendly constructions. We offer a range of certified products from boards, paints, and sprays that surpass industry standards.



FIRE
STOPPING



VENTILATION &
SMOKE EXTRACTION



COMPARTMENTATION



STRUCTURAL FIRE
PROTECTION

etex inspiring ways
of living