FIRE-SAFE LOG BUILDING

HIRSITALOTEOLLISUUS
FINNISH MASS TIMBER HOUSE INDUSTRY

Tero Lahtela
Mikko Löf
Seppo Romppainen

FIRE-SAFE LOG BUILDING

The *Fire-safe log building guide* is based on the Finnish Ministry of the Environment's Decrees 848/2017 and 927/2020 on the fire safety of buildings. The purpose of this publication is to provide practical instructions for designing a fire-safe log building and shed light on regulations related to the use of wood.

This guide covers log-frame buildings from the perspective of tabular design in fire regulations, but also provides instructions for functional fire design. Functional fire design is an equal method alongside the tabular design laid down in fire regulations and can be used to implement fire safety solutions that deviate from the tabular design.

It is recommended to read this guide in conjunction with the regulations on fire safety in buildings. It is also recommended to examine the explanatory memorandums related to the regulations that have been prepared by the Finnish Ministry of the Environment.

The manuscript for this publication was written by Construction Engineer Tero Lahtela. The preparation of the work was guided by a steering group composed of representatives of the Finnish Mass Timber House Industry Association.

In Helsinki on 30 October 2025

Seppo Romppainen
Managing Director
Finnish Mass Timber House Industry Association

Publisher	Hirsitaloteollisuus ry, Perttulantie 11, 88610 Vuokatti tel +358 50 376 5901, www.hirsikoti.fi
Manuscript and drawings	Insinööritoimisto Lahtela Oy
Layout	PunaMusta Oy
Cover photo	Nilonkangas School. Image Kontiotuote Oy.

The publication is available for download on the websites of www.hirsikoti.fi and www.puuinfo.fi.

TABLE OF CONTENTS

1.0 CLASSIFICATION AND SURFACE CLASS OF CONSTRUCTION PRODUCTS

1.1 EUROPEAN CONSTRUCTION PRODUCT CLASSIFICATION

Construction products are divided into categories based on how they contribute to a fire. The classification examines the material's flammability, fire propagation properties, and the generation of smoke and combustible droplets. The European construction product class designation consists of the factors indicated in Tables 1 and 2. Figures 1 and 2 show an indicative breakdown of construction products into categories.

1.2 CONSTRUCTION PRODUCT CLASS

Class A1 construction products are single-component, non-combustible products. Products in the A2-s1, d0 class usually consist of several components, but requirements have also been set for the components in this class. Construction products belonging to other classes may be single-component or multi-component, but in these categories the properties of the components are generally not stated in the products' declaration of performance, for example.

The classification of construction products is based on the behaviour of the material at the onset of a fire. Only classes A1 and A2-s1, d0 can be considered ones that describe the fire behaviour of a construction product, because as non-combustible products, these behave in the same way at the beginning of a fire and in a later stage. Construction products belonging to other categories may, for example, be coated products, the surface of which is active at the beginning of a fire, but at a later stage of the fire the core of the product may also be involved. For this reason, the current decree on fire safety in buildings also lays down class requirements for the core of construction product (e.g. thermal insulation) in some cases. In this case, a construction product classified solely based on its surface does not meet the class requirements.

The class of a construction product is determined by means fire tests based on standards. In classes A2…D, smoke formation and the formation of burning droplets are also examined. The class of a construction product should always be found out from the manufacturer (declaration of performance).

Table 1. The formation of a construction product´s class indication in general.

Involvement in fire		**Smoke formation**		**Production of burning droplets and parts**	
Description	**Marking**	**Description**	**Marking**	**Description**	**Marking**
Not involved in fire	A1	Very minor	s1	Does not occur	d0
Extremely limited involvement	A2	Minor	s2	Those that are extinguished quickly occur	d1
Very limited involvement	B	Other than s1 or s2	s3	Other than d0 or d1	d2
Limited involvement	C				
Involvement acceptable	D				
Behaviour acceptable	E				
Behaviour not defined	F				

Table 2. The formation of a flooring´s class indication in general.

Involvement in fire		**Smoke formation**	
Description	**Marking**	**Description**	**Marking**
Not involved in fire	$A1_{FL}$	Limited	s1
Extremely limited involvement	$A2_{FL}$	Other than s1	s2
Very limited involvement	B_{FL}		
Limited involvement	C_{FL}		
Involvement acceptable	D_{FL}		
Behaviour acceptable	E_{FL}		
Behaviour not defined	F_{FL}		

CLASSIFICATION AND SURFACE CLASS OF CONSTRUCTION PRODUCTS

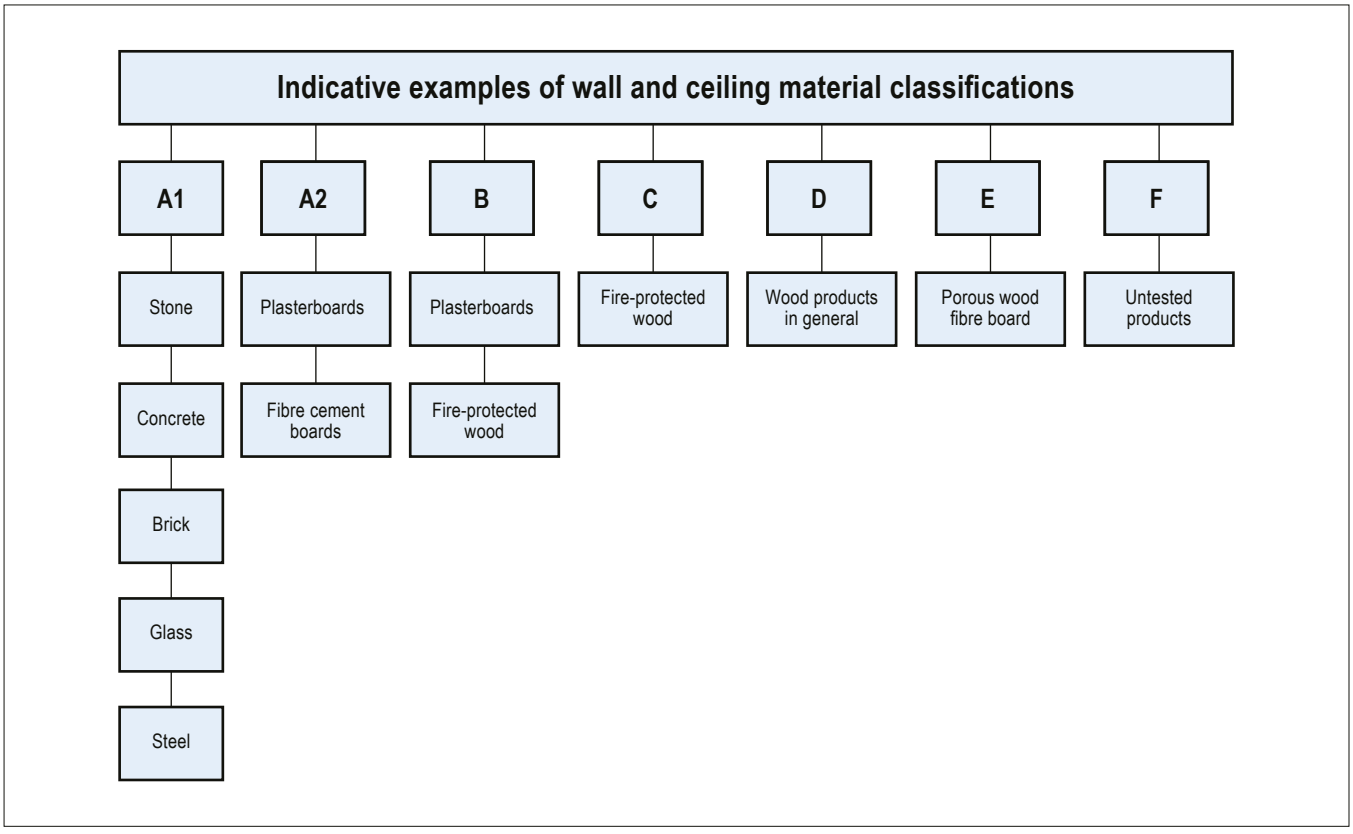


Figure 1. Division of wall and ceiling materials into classes.

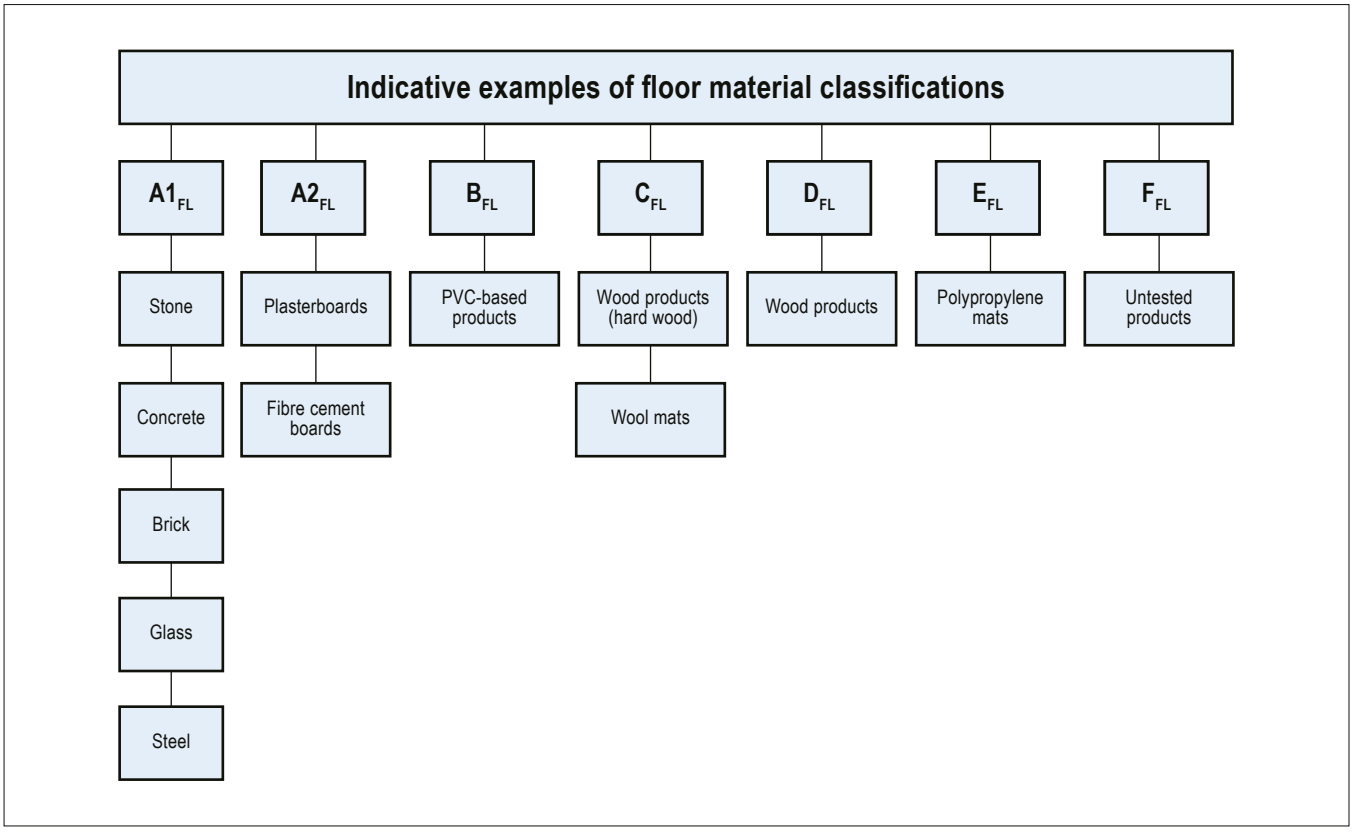


Figure 2. Division of floor materials into classes.

1.3 SURFACE CLASS

Class requirements have been set for the interior and exterior surfaces of the building. The surface class has a significant impact on the propagation of a fire, heat generation, the time of flashover, and the formation of smoke and droplets.

Wood-based products that form a uniform surface usually achieve surface class D-s2, d0 or D-s2, d2. However, it should be noted that in the case of wood-based products, the installation method, the density and thickness of the product, and the base structure have a great impact on the surface class achieved with the construction product. As such, when using wood-based products, the surface class achieved by the products should always be determined from the manufacturer's documents (declaration of performance).

Particular attention should be paid to the surface classes achievable with wooden grates. The challenge with wooden grates is that they do not form a uniform surface and the grate burns from all sides at the same time. This means that the fire spreads rapidly across the grate surfaces.

1.4 LOG STRUCTURE PRODUCT CLASS AND SURFACE CLASS

Logs are a single-material building material, so they behave in the same way at the beginning and later stages of a fire. Solid logs generally fall within the construction product class D-s2, d0 and the surface class D-s2, d0. Therefore, the fire behaviour of a log structure is predictable and known. These factors contribute to the fire safety of the building.

1.5 UPGRADING THE SURFACE CLASS OF A LOG STRUCTURE TO A HIGHER CLASS

The surface class of a structure can be raised to a higher class by coating the structure with a sheet-like product that achieves a higher surface class or by treating the surfaces of the structure with a fire retardant. In log structures, fire retardants are normally used so that the log structure can be left as a visible surface. When using fire retardants on a wooden surface, a maximum surface class of B-s1, d0 can be achieved.

Fire retardants must be tested according to standards. The test results are only valid for those building elements and installation methods of building elements that have been included in the testing. For example, a fire retardant that has only been tested on a wall surface cannot be used on a ceiling surface.

Any other surface treatments applied over the fire retardant surface treatment are only possible if the fire retardant's documents allow this and state what materials the surface treatments can be applied with. Therefore, not just any surface treatment can be applied over the fire retardant surface treatment. This may result in, for example, a chemical reaction that prevents the fire retardant from working or causes surface treatments to peel off from the wood surface.

1.6 IMPLEMENTATION OF FIRE RETARDANT SURFACE TREATMENTS

Fire retardant surface treatments can be carried out at the factory (recommended) or on site. During implementation, attention should be paid to the following things, among others:

- Sufficient time is allocated for the work (drying times, number of applications).
- The person applying the surface treatment must be a professional (companies offering fire retardant treatments).
- The surface treatment equipment is suitable for the purpose (professional-grade equipment).
- The conditions correspond to the instructions of the fire retardant supplier (e.g. +15…50°C, RH 40…65%).
- The moisture content of the wooden structure corresponds to the instructions of the fire retardant supplier (e.g. 14…18% by weight).
- The wooden surfaces to be treated are clean (no stains, no dust).
- The fire retardant is absorbed into different types of wood differently (it may take several treatments to achieve the required film thickness).
- Quality control and documentation are carried out carefully.
- Protection of treated surfaces from dirt, bumps, etc.

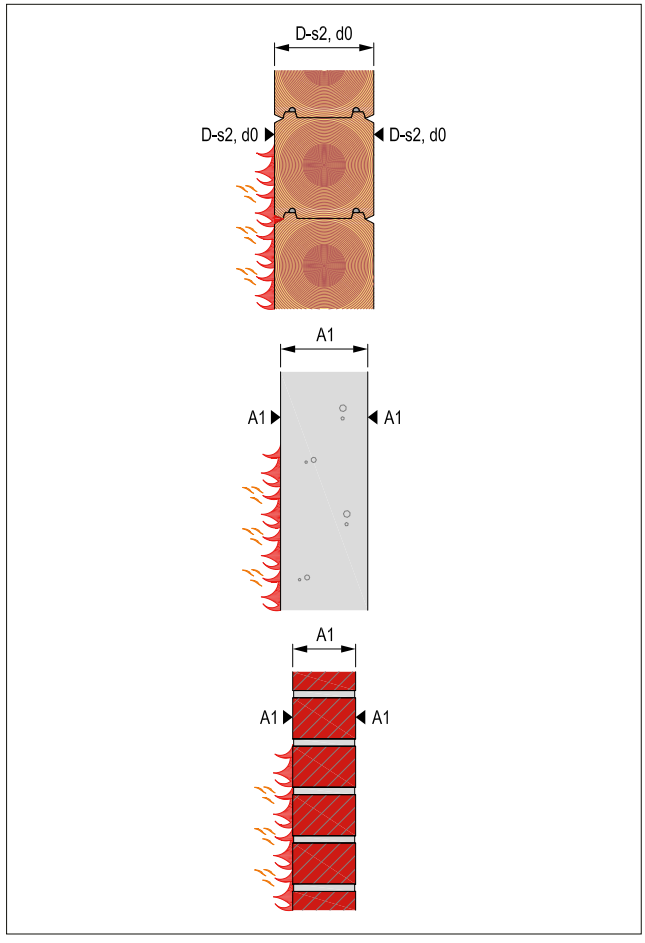


Figure 3. Single-component construction products.

2.0 FIRE DESIGN OF A LOG STRUCTURE

2.1 WOOD CHARRING

Wood is a combustible material with well-known fire behaviour. When wood is heated, it softens before it ignites, and when the wood reaches a temperature of 100°C, chemically unbound water begins to evaporate. The thermal softening of dry wood begins when the wood temperature is 180°C and reaches its maximum when the wood temperature is 320…380°C. At this point, the bonds of lignin, cellulose and hemicellulose in the wood begin to break down. If the wood is very moist, its thermal softening begins when the wood temperature is around 100°C.

Wood ignites when its temperature is 250…350°C. A typical criterion value for ignition and the start of charring in fire safety design is 300°C. The ignition temperature is affected by how long the wood is exposed to heat. The size of the piece of wood and the power of the ignition source also affect the ignition of the wood. For example, a solid piece of wood cannot be ignited with a match because it is not possible to produce enough heat to raise the temperature of the solid piece to the ignition point. On the other hand, in the context of incidents such as flat fires with the temperature reaching around 1,000°C very quickly, even a solid wooden structure will catch fire very quickly. When wood burns, a layer of carbon forms on its surface, which slows down the heating of the wood interior and, at the same time, decelerates the burning.

The charring of a glued wood product depends on the type of glue used in the product. In this context, a glued wood product means a solid wood product assembled from, for example, wooden lamellas by gluing them together. Some glue types are not fire resistant, which may result in the lamellas coming apart (delamination). As the lamellae come off, so does the carbon layer that protects the wood, accelerating the progress of charring.

For the fire safety design of wooden structures, it is important that the charring rate of the wood in different cases is known accurately. Different wood products each have a different charring rate. The charring rate of a wood product should be checked from industry manuals or the product manufacturer's documents. Charring is also affected by the type of glue used in the product and the possible fire protection type of the wooden structure.

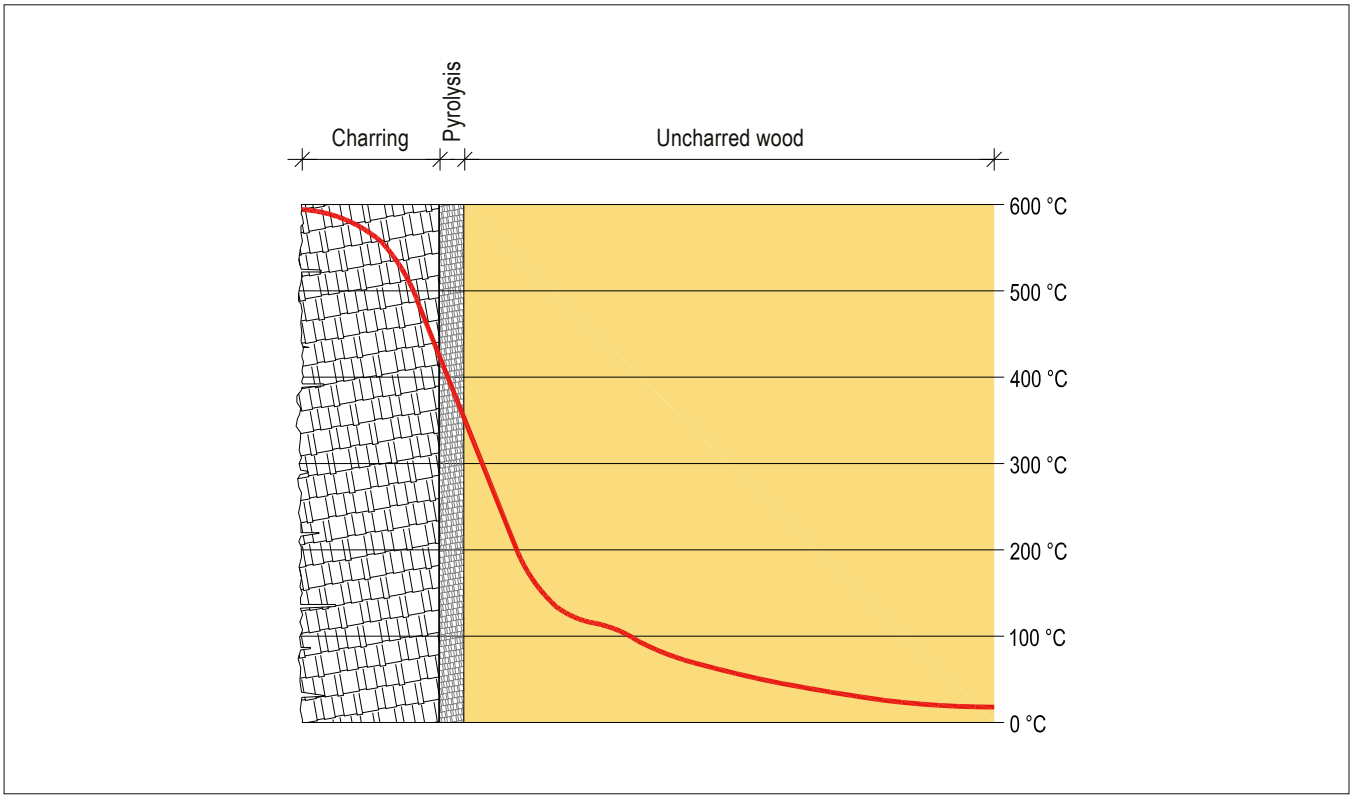


Figure 4. When wood burns, a layer of carbon forms on its surface, which slows down the heating of the wood interior and, at the same time, decelerates the burning.

2.2 FIRE DESIGN OF A NON-FIREPROOFED LOG WALL

Log walls are usually not fireproofed because they are not usually covered with fireproofing, such as plasterboard. This means that the log wall chars from the start of the fire and a protective layer of carbon forms on the wall surfaces exposed to the fire. As a result of charring, the dimensions of the log wall change because material burns away from the wall surfaces exposed to fire.

The fire design of a solid log wall is simple. The log wall chars at its characteristic charring rate on one or both sides, and at the end of the fire resistance period, the effective cross-section of the log wall remains, which is dimensioned for the stresses in a fire. Manufacturers of log products have ready-made design tables that show the load-bearing capacity of the effective cross-section of a log wall in various cases. It is particularly important to check that the dowels in overlapping logs function in a fire situation and transfer forces between the overlapping logs.

Log walls are usually so massive that they achieve sufficient load-bearing capacity in a fire situation, even if the fire resistance period is 60…90 minutes. If necessary, the thickness of the log wall can be increased in case of a fire. In this way, the effective cross-section of the wall will be larger at the end of the fire resistance period and, as a result, the load-bearing capacity will be better.

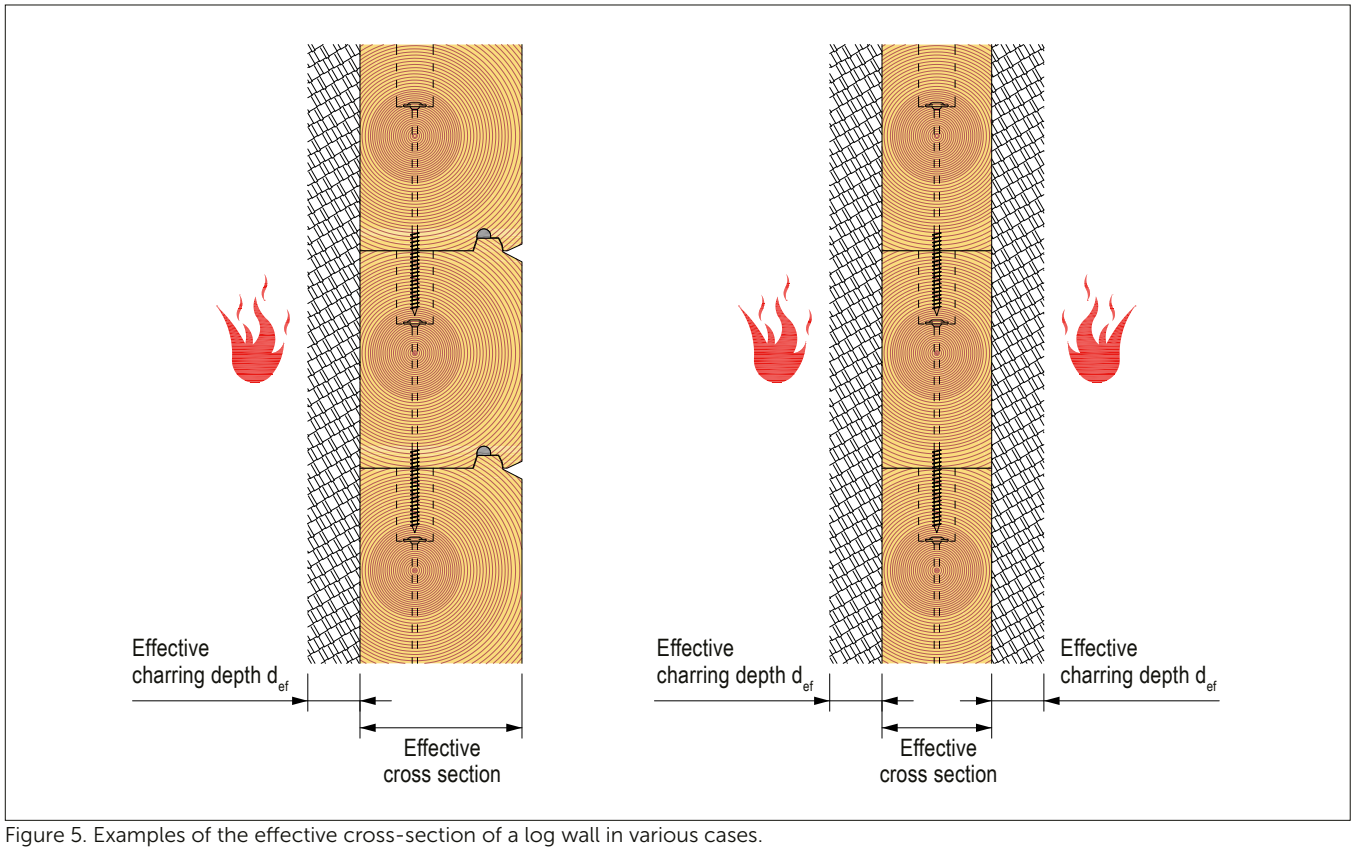


Figure 5. Examples of the effective cross-section of a log wall in various cases.

3.0 A BUILDING'S FIRE CLASS

3.1 A BUILDING'S FIRE CLASS AND ESSENTIAL REQUIREMENTS

Buildings are divided into four fire classes P0, P1, P2 and P3 (Table 3). Fire classes P1, P2 and P3 are used when a building is designed according to the fire classes and numerical values of the fire regulations (tabular design). Fire class P0 is used when a building is designed partly or entirely based on assumed fire development that covers the fire situations likely to occur in the building in question (functional fire design). Functional fire design is described in more detail in Chapter 8.

A building belongs to fire class P0, for example, when evacuation safety or the fire resistance of structures is based on functional fire design. A building does not belong to the P0 fire category when, from the perspective of the whole, a minor deviation from the categories and numerical values of the tabular design is justified by functional fire design. Different parts of a building can belong to different fire classes if the spread of fire from one part to another is prevented by a fire wall.

The essential requirements for the fire safety of a building are presented in Table 4. The essential requirements are considered to be met whenever a building is designed using the fire regulations table dimensions. When using functional fire design, compliance with the essential requirements is demonstrated on a case-by-case basis, taking into account the characteristics and use of the building. The most important factors in the fire safety design of a building's frame are the fire resistance of the load-bearing frame and the compartmenting building elements. These two factors largely determine what types of structures and connection details can and should be used in a building.

Table 3. Building fire classes.

Fire class	Description	Typical construction projects
P0	• According to functional fire design (number of people and fire load information must be provided)	• Residential building over 28 m high • Workplace building over 28 m high
P1	• The load-bearing structures of the building are assumed to withstand the fire and the cooling phase without the fire being extinguished (usually in buildings with more than 2 storeys) • There is no limit to the size of the building and the number of people	• Buildings not permitted in fire classes P2 and P3
P2	• The requirements for the load-bearing structures of a building may be less stringent than fire class P1. • A sufficient level of safety is achieved by setting requirements particularly for the properties of surface parts and devices that improve fire safety. • The size of the building and the number of people are limited depending on the intended use.	• Residential building with a maximum of 8 floors and a height of 28 m • Care facility (excluding a closed penal institution) with a maximum of 8 floors and a height of 28 m • An accommodation building with a maximum of 8 floors and a height of 28 m • Workplace building with a maximum of 8 floors and a height of 28 m • Conference and commercial building with a maximum of 4 floors and a height 14 m • Production and storage building with 1 floor [1)]
P3	• The load-bearing structures of the building are generally not required to be fire-resistant, with some exceptions (for example, for compartmenting structures the R requirement also applies) • A sufficient level of safety is achieved by limiting the size of the building and the number of people depending on the intended use	• Residential building with a maximum of 2 floors and a height of 9 m (floors of the same fire compartment) • Care facility with a maximum of 1 floor and a height of 9 m • An accommodation building with a maximum of 2 floors and a height of 9 m • Workplace building with a maximum of 2 floors and a height of 9 m • Conference and commercial building with a maximum of 2 floors and a height 9 m • Production and storage building with 1 floor and height of 14 m [1)]

[1)] In a predominantly 1-storey building, a maximum of 200 m² of compartmentalized and 50 m² of non-compartmented premises that are essentially related to the operation of the building may be located on the second floor.

Table 4. Essential requirements in fire safety design.

Essential requirement	Main factors in fire safety design	
Load-bearing structures must have the required fire resistance	• Building fire class • Fire load group • Load capacity of building elements R	
The development and spread of fire and smoke must be limited	• Building fire class • Fire compartment size • Compartmentation of building elements NO • Class of internal surfaces	• Facade and balcony surface class • Cladding class • Protective cladding • Sprinkling
The spreading of fire to adjacent buildings must be limited	• Safety distance to adjacent buildings • Facade and balcony surface class • Cladding class	• Fire wall • Compartmentation of outer shell NO • Sprinkling
In the event of a fire, people must be able to leave the building or be rescued with the help of others	• Building fire class • Number of people in the building • Building area • Building height • Load capacity of exit route building elements R • Compartmentation of exit route building elements NO • Number of exit routes	• Emergency exit • Exit route dimensions • Class of exit route surfaces • Exit route indications and lighting • Fire alarms • Smoke detectors • Smoke ventilation • Door opening directions • Sprinkling
The safety of rescue personnel must be taken into account	• Building fire class • Load capacity of building elements R • Compartmentation of building elements NO • Emergency access roads	• Extinguishing routes • Smoke ventilation • Sprinkling

3.2 THE IMPACT OF FIRE CLASS ON THE USE OF LOG STRUCTURES

Log structures can be used in all fire classes of buildings. Based on the tabular design, the main fire classes of log buildings are P3 and P2, but log structures can also be used in fire class P1. Based on the tabular design, log structures in fire class P1 can be used as load-bearing structures in buildings with a maximum of 2 floors.

Non-load-bearing exterior walls can be constructed with a log frame in a P1 fire class building with more than 2 floors. However, it should be noted that the surfaces on the outside of the exterior wall have higher surface class requirements and the log surface cannot be used as is (see Table 5).

When using log-structured exterior walls in a P1 fire class building, special attention must be paid to the following requirements:

- Requirements for exterior wall construction materials

  (see the Finnish Ministry of the Environment Decree 927/2020, Section 25).
- Surface class requirements for the outer surface of the exterior wall

  (see Table 13).

Table 5. Requirements for the facade surfaces of a non-load-bearing log exterior wall in a P1 fire class building with more than 2 floors.

Building height and purpose of use	Log frame	Log facade**
3...8 floors ≤ 28 m high residential and workplace building	D-s2, d2	B-s2, d0
3...8 floors ≤ 28 m building in general	D-s2, d2	B-s1, d0

**) Solid log exterior wall without thermal insulation and facade ventilation gap.

4.0 LOAD-BEARING CAPACITY AND COMPARTMENTATION OF A BUILDING ELEMENT

4.1 DEMONSTRATING THE LOAD-BEARING CAPACITY AND COMPARTMENTATION OF A BUILDING ELEMENT

Load-bearing and compartmenting building elements must be designed to comply with REI class requirements (Figure 7) using the fire situation presented by the standard fire curve. The construction material of the load-bearing frame of the building does not affect the basic fire requirements from the perspective of load-bearing capacity and compartmentation. For example, in a 3-8-storey residential block of flats, the fire resistance requirements for load-bearing and compartmenting building elements are the same in both a wood- and concrete-framed building.

The fire resistance of a building element can be demonstrated through calculations using the calculation methods presented in Eurocode 5. Eurocode 5 contains methods for examining non-fire-protected and fire-protected building elements. Alternatively, the fire load capacity can be demonstrated with a standard fire test. This method is recommended if the building element is a standard one that is mass-produced or if it is a complex assembly consisting of several parts. A fire test usually provides a more accurate result and, by extension, also a more economical overall result. An acceptable method of demonstrating load-bearing capacity is also the final result obtained by combining fire test results and calculated results.

4.2 LOAD-BEARING AND COMPARTMENTING LOG WALL

A solid log wall is a building element that is easy to manage in terms of fire safety. As a single-component material, the log wall chars in a controlled manner, leaving an effective cross-section that is designed to provide load-bearing capacity and compartmentation in a fire situation.

The connections of compartmenting log walls to other building elements must be designed to be tight in terms of fire safety so that fire gases do not reach the other side of the compartmenting wall. Table 6 presents sealing options for log walls. The effect of possible settlement of the log wall on the tightness of the connections must be taken into account in the design.

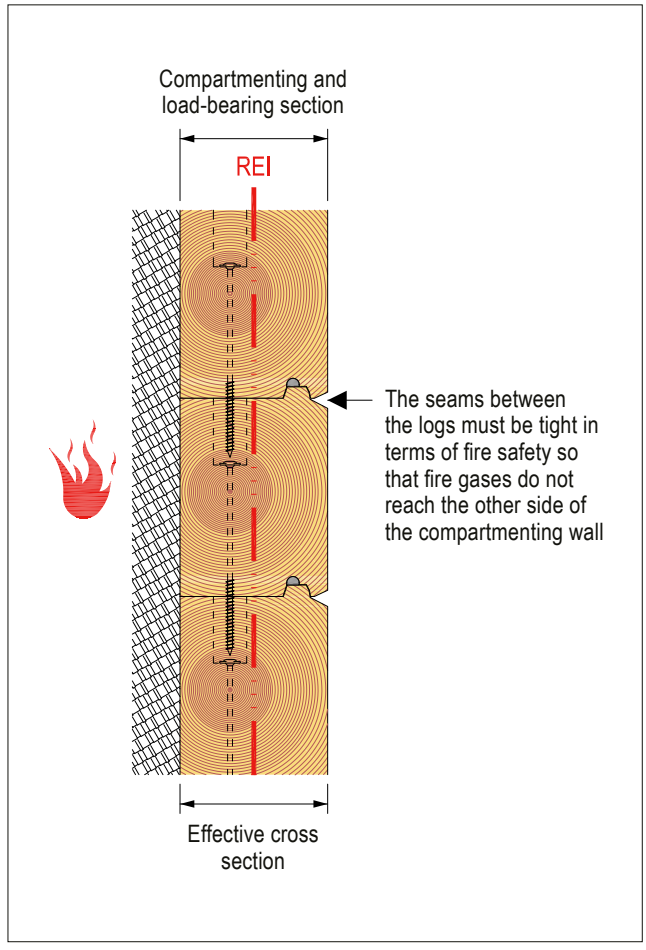
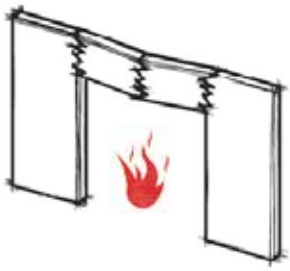


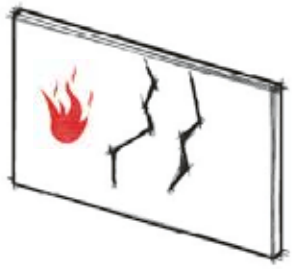
Figure 6. Load-bearing and compartmenting log wall.



Load-bearing capacity

R

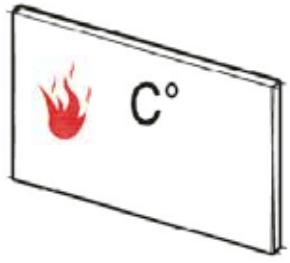
The building element must maintain its load-bearing capacity for the required fire resistance period.
(also applies to non-load-bearing compartmenting building elements)



Tightness

E

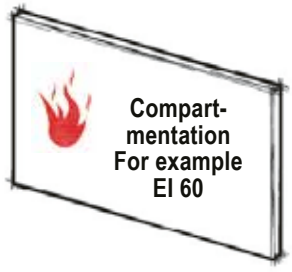
The building element must maintain its flue gas and thermal radiation tightness for the required fire resistance period



Insulation

I

The building element must maintain its heat insulation capacity for the required fire resistance period.



A building component that fully or partially meets the requirements only for tightness E may also be accepted as a compartmenting building element. In this case, the evacuation of people must not be compromised and the fire must not spread to another fire compartment within the required fire resistance period. An example of such a compartmenting building element is a class E glass fire door, which has a sufficient safety distance to the exit route, flammable structures and movables.

Figure 7. Basic requirements for fire resistance of load-bearing and compartmenting building elements.

LOAD-BEARING CAPACITY AND COMPARTMENTATION OF A BUILDING ELEMENT

Table 6. Sealing options for fire-rated load-bearing log walls.

Log type	Sealant for the joint between logs	Sealant for cross and dovetail joints	Vertical seam sealant for mitre joints
Planed log Laminated log (lamellas parallel) Non-sag laminated log (lamellas crossed)	**Glass wool** • width = width between tongues • thickness at least 2 mm higher than the tongue and groove **Polyethylene tape (LD-PE)** • closed cell • 2 pcs seam tapes • diameter ≥ 10 mm **Polypropylene felt** • width = width between tongues • thickness at least 2 mm higher than the tongue and groove **Polyurethane foam tape** • open cell • 2 pcs seam tapes • width ≥ 10 mm • height ≥ 10 mm • overlap in extensions ≥ 50 mm **Thermoplastic elastomer (TPE) profile tape** • at tongues • height of the seam tape hollow profile ≥ 9 mm	**Glass wool** • width = width of the joint • thickness ≥ 15 mm **Polypropylene felt** • width = width of the joint • thickness ≥ 15 mm **Polyurethane foam tape** • open cell • 2 pcs seam tapes • width ≥ 40 mm • height ≥ 10 mm or • width = width of the joint • thickness ≥ 8 mm	**Polyurethane foam tape** • open cell • 2 pcs seam tapes • width ≥ 15 mm • height ≥ 15 mm **Thermoplastic elastomer (TPE) profile tape** • 2 pcs seam tapes • 2-cavity profile • height of the seam tape hollow profiles ≥ 7 mm
Round log	**Polyurethane foam tape** • open cell • width = width of the seam • thickness ≥ 5 mm **Polypropylene felt** • width = width of the seam • thickness ≥ 8 mm	**Glass wool** • width = width of the joint • thickness ≥ 15 mm **Polyurethane foam tape** • open cell • width = width of the seam • thickness ≥ 8 mm	----

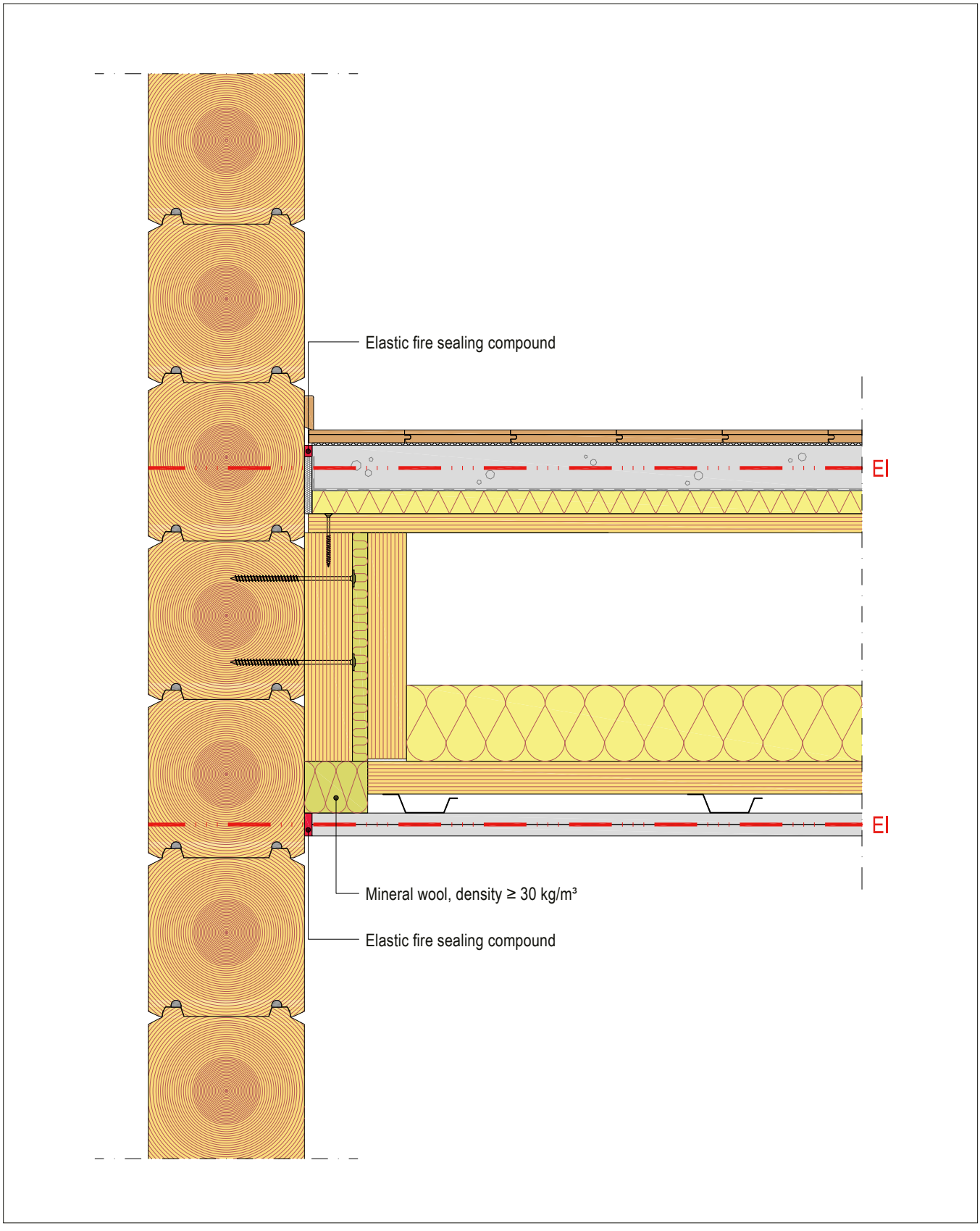


Figure 8. The principle of the connection between a partitioned intermediate floor and a log wall.

LOAD-BEARING CAPACITY AND COMPARTMENTATION OF A BUILDING ELEMENT

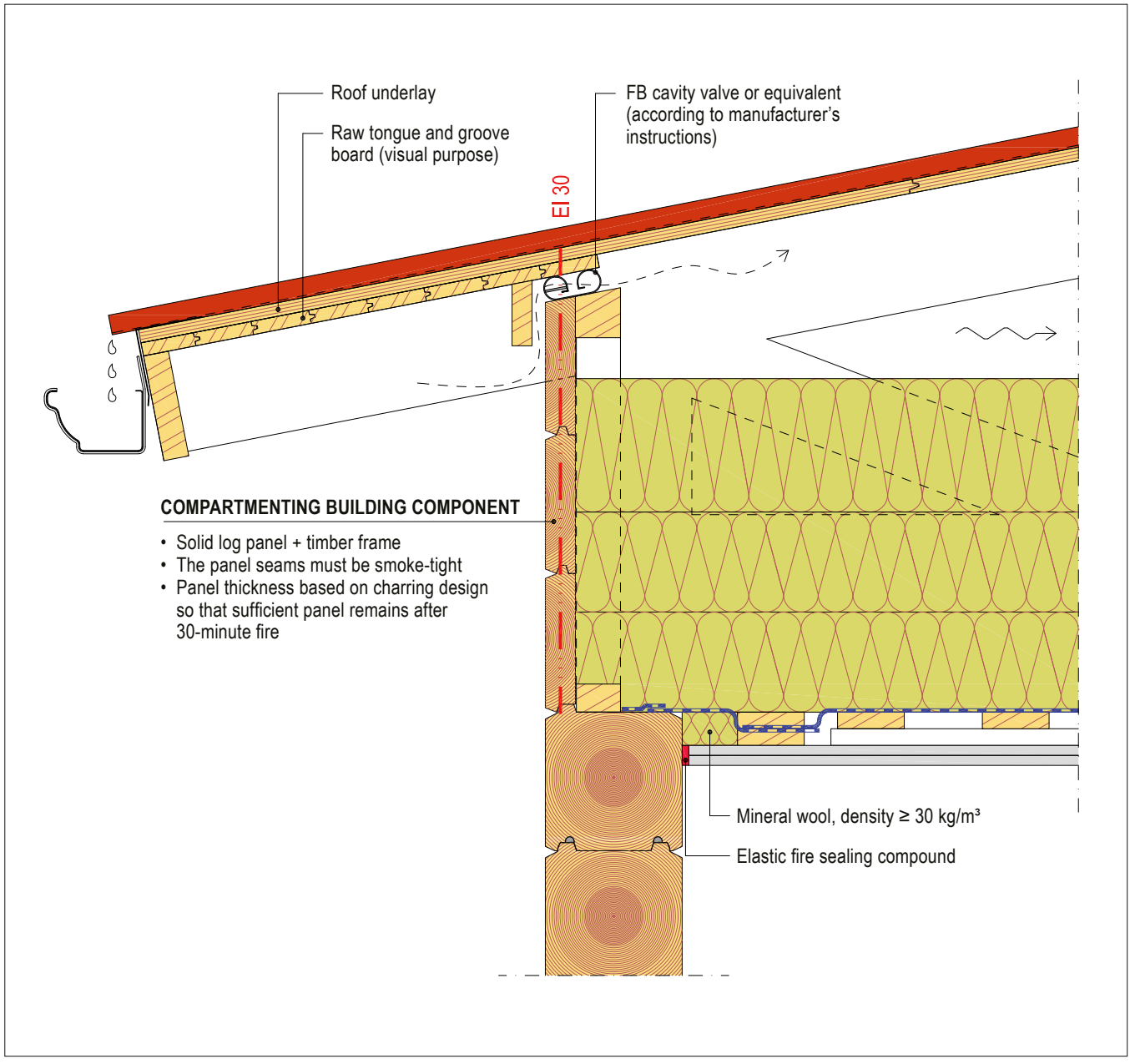


Figure 9. The principle of a compartmenting eave structure.

5.0 PROTECTIVE CLADDING

5.1 PROTECTIVE CLADDING PROPERTIES

Protective cladding refers to a construction product or an assembly of construction products that, for a specified period of time, protects the building component behind the cladding from ignition, charring or other damage caused by fire. The European protective cladding classes are K_1 10, K_2 10, K_2 30 and K_2 60. In Finland, the protective cladding classes K_2 10 (protection time 10 min) and K_2 30 (protection time 30 min) are used in design according to the tabular design of the fire regulations. In the class designation, the subscript refers to the substrate behind the protective cladding. Subindex 2 means that the protective cladding in question can be used on all bases, regardless of the type and density. In addition to the protective cladding class, requirements are set for the class of building materials used in the protective cladding.

The temperature rise behind the protective cladding is limited as shown in Figure 10. During the protective cladding period, there must be no damage (cracks, etc.) in the protective cladding that could allow fire to damage the building element being protected. In practice, the building element to be protected must not be damaged in any way during the protective cladding period. There is no calculation method for dimensioning the protective cladding, so the protective cladding class of a construction product used as protective cladding must be determined by testing in accordance with the standard.

5.2 PROTECTIVE CLADDING REQUIREMENTS IN A P2 FIRE CLASS BUILDING

Protective cladding is required in a P2 fire class building. In buildings with a maximum of 2 floors, protective cladding can be left out under certain conditions. In buildings with more than 2 floors, the protective cladding requirements are stricter and foregoing the protective cladding is also more challenging, but not impossible. The protective cladding requirements for a P2 fire class building are presented in Tables 7…9. A log-built exterior wall usually does not have a separate facade, so there is no ventilation gap in the exterior wall. In this case, there is no need for external protective cladding in the log-structured exterior wall.

5.3 LEAVING OUT PROTECTIVE CLADDING IN A LOG BUILDING

In practice, the protective cladding is implemented with A2-s1, d0 class plasterboard, which is placed over the building element to be protected. However, in a log building, it is usually not desirable to cover the log walls with protective cladding, at least not fully, so exceptional conditions must be used. Protective claddings can be left out in the ways shown in Figures 11 and 12 (see Tables 7...9).

Figure 12 shows methods for reducing/eliminating protective cladding on wall and ceiling surfaces in a 3…8-storey P2 fire class building. The method based on the REI classification determines the total area of the wall and ceiling surfaces (including window and door openings) that define the fire compartment, including the surfaces of the internal load-bearing partitions of the fire compartment. From this total area, the maximum area that can be left unprotected is determined by a percentage tied to the REI classification. The maximum unscreened area can be freely placed on the wall and ceiling surfaces of the fire compartment. In this case, it is also possible to cover the entire roof with protective cladding, so that the maximum area without protective cladding is available for the log walls as a whole. In addition to the above, internal non-load-bearing partitions in the fire compartment may be left without protective cladding.

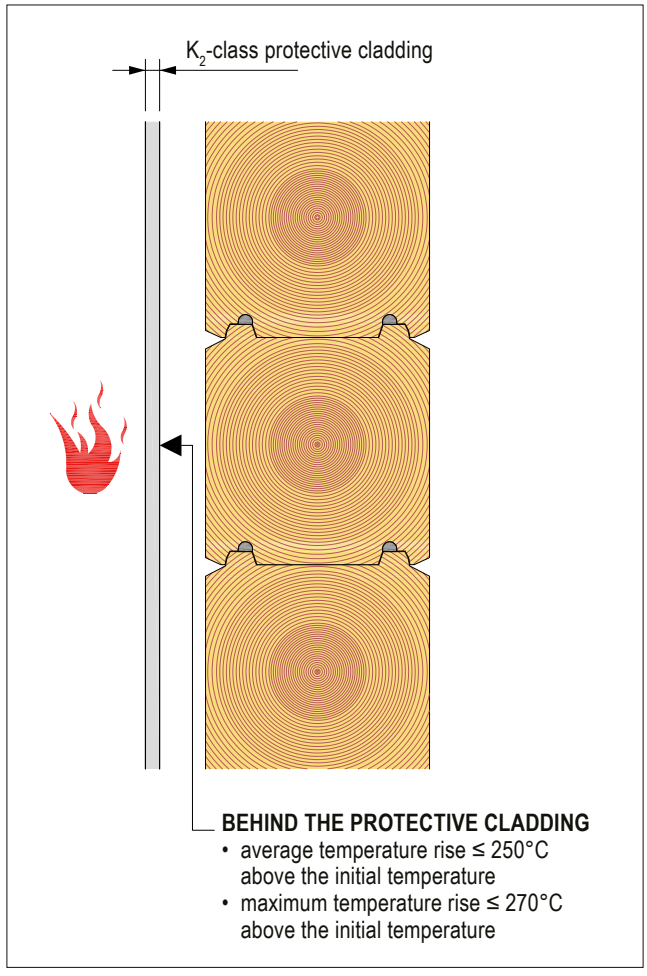


Figure 10. Permissible temperature rise behind K2 class protective cladding.

PROTECTIVE CLADDING

Table 7. 5.2 Protective cladding requirements in a P2 fire class building			
Building with 1...2 floors, maximum height 9 m			
Designation (purpose of use)	**Building element**	**Protective cladding**	**No protective cladding needed**
Day care centre [1] (assembly space) School (assembly space) Restaurant (assembly space) Shop (commercial space) Library (assembly space) Office (workplace)	Wall surfaces	K_2 10, B-s1, d0	• in a building element with thermal insulation on the insulating part of at least class B-s1, d0 and other accessories at least class D-s2, d2 • in a D-s2, d2 class solid wood wall with a density of at least 350 kg/m^3 • in a wall with an inner surface of at least class B-s1, d0 and the wall as a building element of at least class EI 15 • in columns and beams that meet the class requirements R 30 and D-s2, d2
	Ceiling surfaces	K_2 10, B-s1, d0	
	Exterior wall frame exterior surfaces (interior surface of ventilation gap)	No requirement	No requirement
Small house (housing unit) Terraced house (housing unit) Residential block of flats (housing unit)	Wall surfaces	K_2 10, B-s1, d0	• in a building element with thermal insulation on the insulating part of at least class B-s1, d0 and other accessories at least class D-s2, d2 • in a D-s2, d2 class solid wood wall with a density of at least 350 kg/m^3 • on housing unit surfaces with thermal insulation on the insulating part of at least class B-s1, d0 and other accessories of at least class D-s2, d2 • in columns and beams that meet the class requirements R 30 and D-s2, d2
	Ceiling surfaces	K_2 10, B-s1, d0	
	Exterior wall frame exterior surfaces (interior surface of ventilation gap)	No requirement	No requirement
Hotel (accommodation space) Residential care home (care facility)	Wall surfaces	K_2 10, B-s1, d0	• in a building element with thermal insulation on the insulating part of at least class B-s1, d0 and other accessories at least class D-s2, d2 • in a D-s2, d2 class solid wood wall with a density of at least 350 kg/m^3 • in columns and beams that meet the class requirements R 30 and D-s2, d2
	Ceiling surfaces	K_2 10, B-s1, d0	
	Exterior wall frame exterior surfaces (interior surface of ventilation gap)	No requirement	No requirement
Exit route	Wall surfaces	K_2 10, B-s1, d0	
	Ceiling surfaces	K_2 10, B-s1, d0	

[1] In daytime use.

Table 8. 5.2 Protective cladding requirements in a P2 fire class building			
Building with 3...4 floors, maximum height 14 m			
Designation (purpose of use)	**Building element**	**Protective cladding**	**The fire compartment may feature unprotected wall and ceiling surfaces**
Day care centre [1] (assembly space) School (assembly space) Restaurant (assembly space) Shop (commercial space) LIbrary (assembly space)	Wall surfaces	K_2 30, A2-s1, d0	• non-load-bearing partition walls • ≤ 20%, without special requirements • > 20% ... ≤ 80% if building elements R 90 and EI 90 • > 80% if building elements R 120 and EI 120
	Ceiling surfaces	K_2 30, A2-s1, d0	
	Floor surfaces	K_2 30, A2-s1, d0	
	Exterior wall frame exterior surfaces (interior surface of ventilation gap)	K_2 10, A2-s1, d0	
Small house (housing unit) Terraced house (housing unit)	Wall surfaces [2]	K_2 10, A2-s1, d0	
	Ceiling surfaces [2]	K_2 10, A2-s1, d0	
	Ceiling surfaces [2]	K_2 10, A2-s1, d0	
	Exterior wall frame exterior surfaces (interior surface of ventilation gap)	-	
Residential block of flats (housing unit)	Wall surfaces [2]	K_2 10, A2-s1, d0	
	Ceiling surfaces [2]	K_2 10, A2-s1, d0	
	Ceiling surfaces [2]	K_2 10, A2-s1, d0	
	Exterior wall frame exterior surfaces (interior surface of ventilation gap)	K_2 10, A2-s1, d0	
Exit route	Wall surfaces	K_2 10, A2-s1, d0	
	Ceiling surfaces	K_2 10, A2-s1, d0	
	Floor surfaces	K_2 10, A2-s1, d0	

[1] In daytime use.
[2] Alternatively, K2 30, A2-s1, d0 class protective cladding can be used in accordance with Table 9, in which case unprotected wall and ceiling surfaces are permitted.

Table 9. 5.2 Protective cladding requirements in a P2 fire class building			
Building with 3...8 floors, maximum height 28 m			
Designation (purpose of use)	**Building element**	**Protective cladding**	**The fire compartment may feature unprotected wall and ceiling surfaces**
Residential block of flats (housing unit) Office (workplace space) Hotel (accommodation space) Residential care home (care facility)	Wall surfaces	K_2 30, A2-s1, d0	• non-load-bearing partition walls • ≤ 20%, without special requirements • > 20% ... ≤ 80% if building elements R 90 and EI 90 • > 80% if building elements R 120 and EI 120
	Ceiling surfaces	K_2 30, A2-s1, d0	
	Floor surfaces	K_2 30, A2-s1, d0	
	Exterior wall frame exterior surfaces (interior surface of ventilation gap)	K_2 10, A2-s1, d0	
Exit route	Wall surfaces	K_2 10, A2-s1, d0	
	Ceiling surfaces	K_2 10, A2-s1, d0	
	Floor surfaces	K_2 10, A2-s1, d0	

PROTECTIVE CLADDING

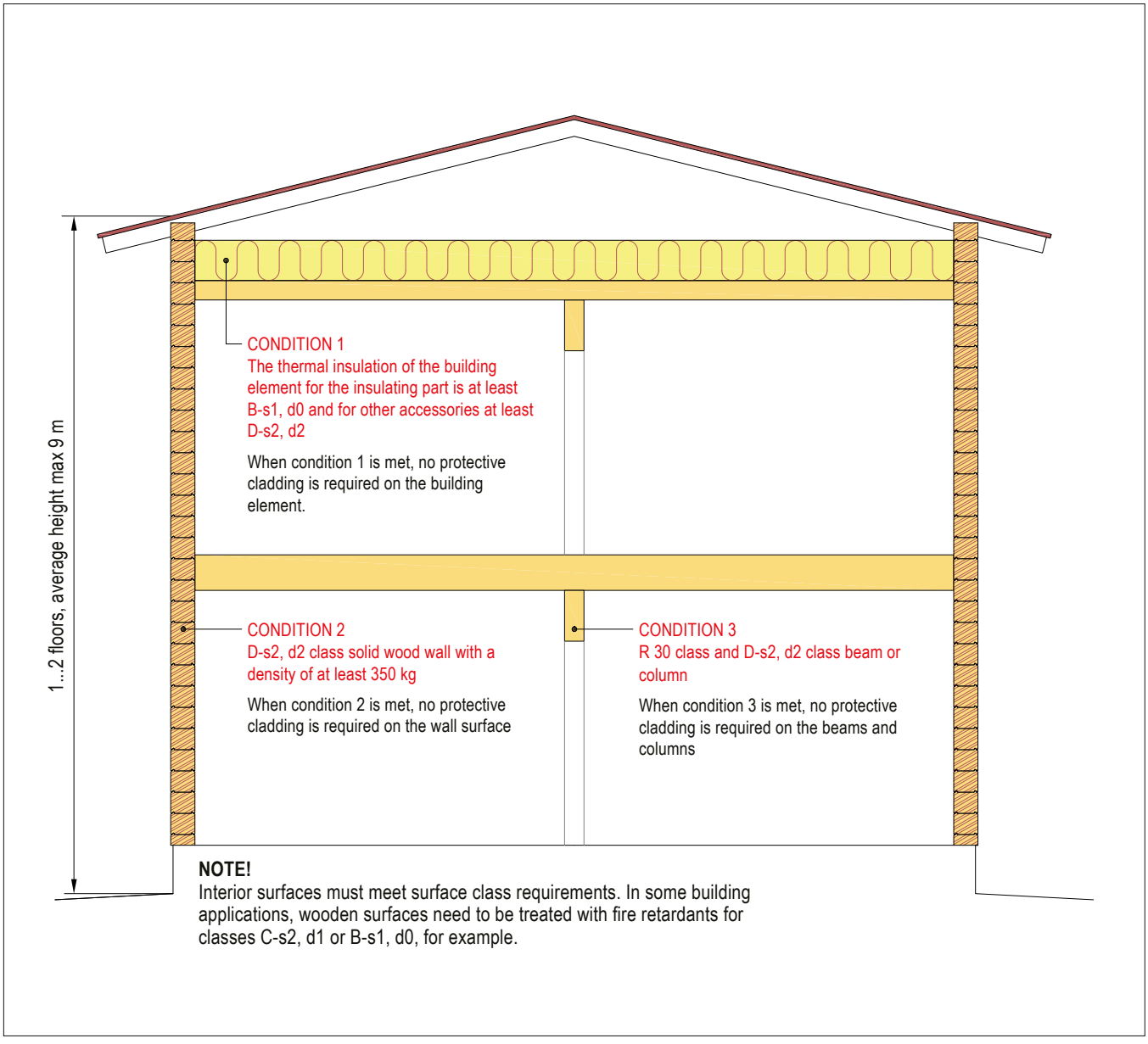


Figure 11. Conditions under which internal protective cladding can be left out in a 1...2-floor P2 fire class log building.

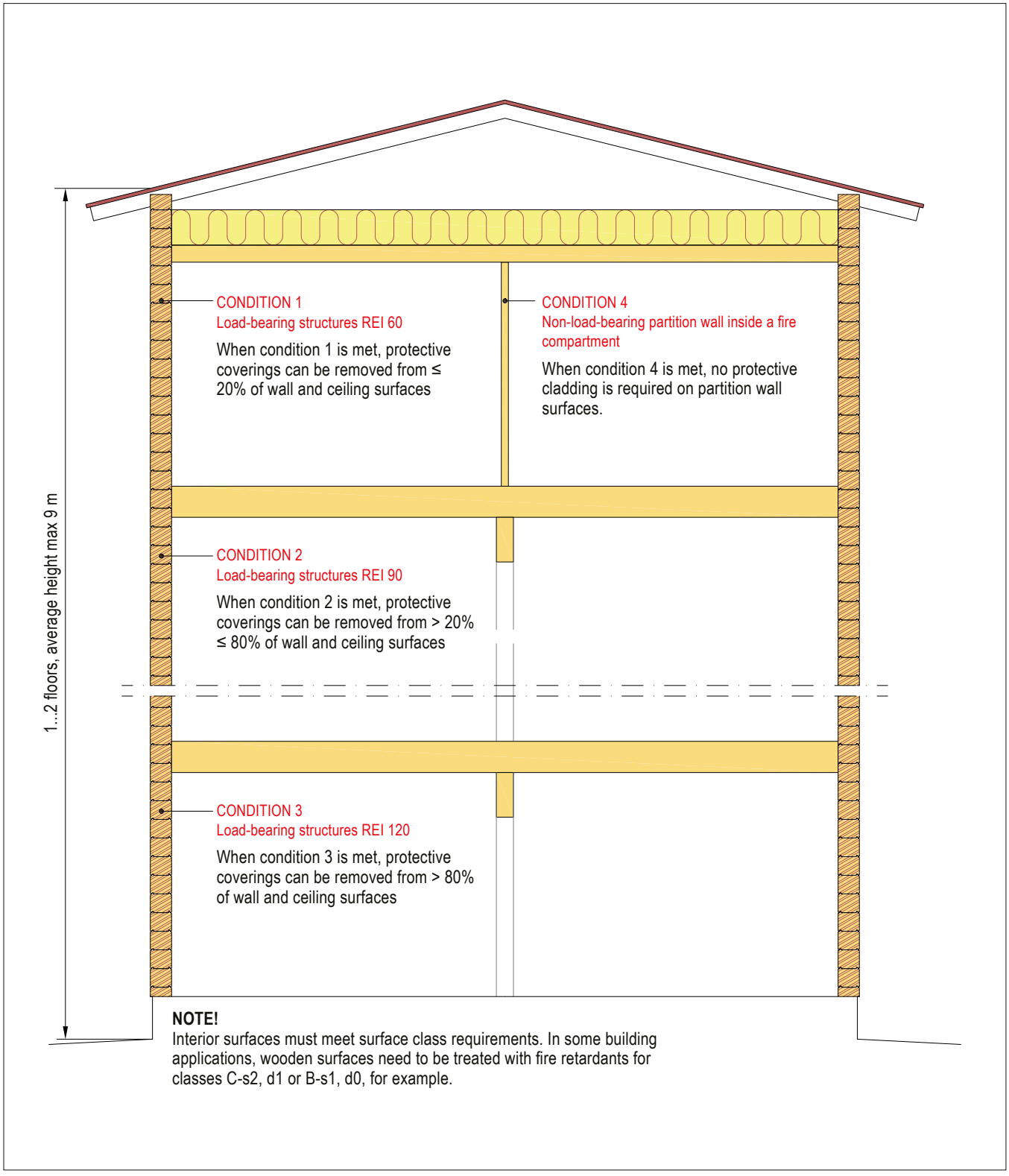


Figure 12. Conditions under which internal protective cladding can be left out in a 3...8-floor P2 fire class log building.

6.0 FIRE REGULATIONS BY BUILDING TYPE

6.1 BUILDING SIZE AND NUMBER OF PEOPLE

Tables 10…12 present requirements related to the size of the building and the number of people based on the tabular design of the fire regulations. Deviations from the table design requirements can be made by designing the building to fire class P0 (functional fire design).

Table 10. Fire safety requirements for typical log-framed buildings in P1 fire class as regards the log frame.

P1	Designation	Usage	Fire load group	Sprinkling [1]	Fire compartment [m²]	Floor [qty]	Frame [2]
	Day care centre (daytime use) School Restaurant	Assembly space	less than 600 MJ/m²	-	≤ 2,400	1…2	R 60
				required	≤ 24000	1	R 60
				required	≤ 12000	2	R 60
	Shop	Commercial space	less than 600 MJ/m²	-	≤ 300	1…2	R 60
			600–1,200 MJ/m²	-	≤ 2,400	1…2	R 90
			600–1,200 MJ/m²	required	≤ 24000	1	R 60
			600–1,200 MJ/m²	required	≤ 12000	2	R 60
	Library	Assembly space	600–1,200 MJ/m²	-	≤ 2,400	1…2	R 90
				required	≤ 24000	1	R 60
				required	≤ 12000	2	R 60
	Office	Workplace space	less than 600 MJ/m²	-	≤ 2,400	1…2	R 60
				required	≤ 24000	1	R 60
				required	≤ 12000	2	R 60

[1] Through a safety assessment, sprinklers can always become mandatory in buildings intended for people whose escape options are worse than usual due to reduced functional capacity (e.g. care facility, accommodation, housing unit).

[2] Load-bearing frame class requirement. The frame of the compartmenting building elements must meet at least the same fire resistance time requirement as is required for the compartmentation.

Table 12. Fire safety requirements for typical log-framed buildings in the P3 fire class as regards the log frame.

P3	Designation	Usage	Sprinkling [5]	Floor area [m²]	Fire compartment [m²]	Height [m]	Floor [qty]	Person [6] [qty]	Frame [7]
	Day care centre (daytime use) School Restaurant	Assembly space	-	≤ 2,400	≤ 400	≤ 9	1	≤ 500	-
			required	≤ 4800	≤ 1200	≤ 9	1	≤ 1000	-
			-	≤ 1600	≤ 400	≤ 9	2	≤ 50	-
			required	≤ 2,400	≤ 600	≤ 9	2	≤ 50	-
	Shop	Commercial space	-	≤ 2,400	≤ 400	≤ 9	1	≤ 500	-
			required	≤ 4800	≤ 1200	≤ 9	1	≤ 1000	-
			-	≤ 1600	≤ 400	≤ 9	2	≤ 50	-
			required	≤ 2,400	≤ 600	≤ 9	2	≤ 50	-
	Library	Assembly space	-	≤ 2,400	≤ 400	≤ 9	1	≤ 500	-
			required	≤ 4800	≤ 1200	≤ 9	1	≤ 1000	-
			-	≤ 1600	≤ 400	≤ 9	2	≤ 50	-
			required	≤ 2,400	≤ 600	≤ 9	2	≤ 50	-
	Small residential building [1]	Housing unit	-	≤ 2,400	by housing unit	≤ 9	1	≤ 250	-
			-	≤ 1600	by housing unit	≤ 9	2	≤ 150	-
	Terraced house [2]	Housing unit	-	≤ 2,400	by housing unit	≤ 9	1	≤ 250	-
			required	≤ 4800	by housing unit	≤ 9	1	≤ 500	-
			-	≤ 1600	by housing unit	≤ 9	2	≤ 150	-
			required	≤ 2,400	by housing unit	≤ 9	2	≤ 250	-
	Residential block of flats [3]	Housing unit	Not possible						
	Office	Workplace space	-	≤ 2,400	≤ 400	≤ 9	1	≤ 250	-
			required	≤ 4800	≤ 1200	≤ 9	1	≤ 500	-
			-	≤ 1600	≤ 400	≤ 9	2	≤ 150	-
			required	≤ 2,400	≤ 600	≤ 9	2	≤ 150	-
	Hotel [4]	Accommodation space	-	≤ 2,400	≤ 400 overnight accommodation ≤ 400 other spaces	≤ 9	1	≤ 50	-
			required	≤ 4800	≤ 600 overnight accommodation ≤ 1,200 other spaces	≤ 9	1	≤ 100	-
			-	≤ 1600	≤ 400 overnight accommodation ≤ 400 other spaces	≤ 9	2	≤ 10	-
			required	≤ 2,400	≤ 600 overnight accommodation ≤ 1,200 other spaces	≤ 9	2	≤ 10	-
	Residential care home [4]	Care facility	-	≤ 2,400	≤ 400 overnight accommodation ≤ 400 other spaces	≤ 9	1	≤ 10	-
			required	≤ 2,400	≤ 600 overnight accommodation ≤ 1,200 other spaces	≤ 9	1	≤ 25	-

[1] This is a 1...2-floor residential building, in which adjacent and stacked spaces belong to the same housing unit.
[1] This is a 1...2-floor residential building, in which adjacent housing units belong to different fire compartments and stacked spaces belong to the same housing unit.
[1] This is a 1...2-floor residential building, in which adjacent and overlapping spaces belong to different fire compartments.
[4] The fire compartment must be divided into sections according to accommodation rooms.
[5] Through a safety assessment, sprinklers can always become mandatory in buildings intended for people whose evacuation options are worse than usual due to reduced functional capacity (e.g. care facility, accommodation, housing unit).
[6] Number of places in the accommodation and care facility; in other cases the number of people staying in the building.
[7] Load-bearing frame class requirement. The frame of the compartmenting building elements must meet at least the same fire resistance time requirement as is required for the compartmentation.

FIRE REGULATIONS BY BUILDING TYPE

Table 11. Fire safety requirements for typical log-framed buildings in the P2 fire class as regards the log frame.

	Designation	Usage	Sprinkling [5]	Floor area [m²]	Fire compartment [m²]	Height [m]	Floor [qty]	Person [6] [qty]	Frame [7]
P2	Day care centre (daytime use) School Restaurant	Assembly space	-	no limitation	≤ 2,400	≤ 9	1	no limitation	R 30
			required	no limitation	≤ 9600	≤ 9	1	no limitation	R 30
			-	no limitation	≤ 2,400	≤ 9	2	≤ 250	R 30
			required	no limitation	≤ 4800	≤ 9	2	≤ 500	R 30
			required	≤ 12000	≤ 1200	≤ 14	3...4	≤ 1000	R 60
	Shop	Commercial space	-	no limitation	≤ 2,400	≤ 9	1	no limitation	R 30
			required	no limitation	≤ 9600	≤ 9	1	no limitation	R 30
			-	no limitation	≤ 2,400	≤ 9	2	≤ 250	R 30
			required	no limitation	≤ 4800	≤ 9	2	≤ 500	R 30
			required	≤ 12000	≤ 300 [8]	≤ 14	3...4	≤ 1000	R 60
	Library	Assembly space	-	no limitation	≤ 2,400	≤ 9	1	no limitation	R 30
			required	no limitation	≤ 9600	≤ 9	1	no limitation	R 30
			-	no limitation	≤ 2,400	≤ 9	2	≤ 250	R 30
			required	no limitation	≤ 4800	≤ 9	2	≤ 500	R 30
			required	≤ 12000	≤ 1200	≤ 14	3...4	≤ 1000	R 60
	Small residential building [1]	Housing unit	-	-	by housing unit	≤ 9	1...2	no limitation	R 30
			-	≤ 12000	by housing unit	≤ 14	3...4	≤ 1000	R 45
			required	≤ 12000	by housing unit	≤ 14	3...4	≤ 1000	R 30
	Terraced house [2]	Housing unit	-	no limitation	by housing unit	≤ 9	1...2	no limitation	R 30
			-	≤ 12000	by housing unit	≤ 14	3...4	≤ 1000	R 45
			required	≤ 12000	by housing unit	≤ 14	3...4	≤ 1000	R 30
	Residential block of flats [3]	Housing unit	-	no limitation	by housing unit	≤ 9	2	no limitation	R 30
			required	≤ 12000	by housing unit	≤ 28	3...8	≤ 1000	R 60
	Office	Workplace space	-	no limitation	≤ 2,400	≤ 9	1	no limitation	R 30
			required	no limitation	≤ 9600	≤ 9	1	no limitation	R 30
			-	no limitation	≤ 2,400	≤ 9	2	no limitation	R 30
			required	no limitation	≤ 4800	≤ 9	2	no limitation	R 30
			required	≤ 12000	≤ 2,400	≤ 28	3...8	≤ 1000	R 60
	Hotel [4]	Accommo-dation space	-	no limitation	≤ 800 overnight accommodation ≤ 1600 other spaces	≤ 9	1	≤ 150	R 30
			required	no limitation	≤ 1,200 overnight accommodation ≤ 2400 other spaces	≤ 9	1	≤ 300	R 30
			-	no limitation	≤ 800 overnight accommodation ≤ 1600 other spaces	≤ 9	2	≤ 50	R 30
			required	no limitation	≤ 1,200 overnight accommodation ≤ 2400 other spaces	≤ 9	2	≤ 100	R 30
			required	≤ 12000	≤ 800 overnight accommodation ≤ 1,200 other spaces	≤ 28	3...8	≤ 500	R 60
	Residential care home [4]	Care facility	-	no limitation	≤ 800 overnight accommodation ≤ 1600 other spaces	≤ 9	1	≤ 100	R 30
			required	no limitation	≤ 1,200 overnight accommodation ≤ 2400 other spaces	≤ 9	1	≤ 200	R 30
			-	no limitation	≤ 800 overnight accommodation ≤ 1600 other spaces	≤ 9	2	≤ 25	R 30
			required	no limitation	≤ 1,200 overnight accommodation ≤ 2400 other spaces	≤ 9	2	≤ 50	R 30
			required	≤ 12000	≤ 800 overnight accommodation ≤ 1,200 other spaces	≤ 28	3...8	≤ 150	R 60

[1] This is a 1...4-floor residential building, in which adjacent and stacked spaces belong to the same housing unit.
[1] This is a 1...4-floor residential building, in which adjacent housing units belong to different fire compartments and stacked spaces belong to the same housing unit.
[1] This is an at least 2-floor residential building, in which adjacent and overlapping spaces belong to different fire compartments.
[4] The fire compartment must be divided into sections according to accommodation rooms.
[5] Through a s afety assessment, sprinklers can always become mandatory in buildings intended for people whose evacuation options are worse than usual due to reduced functional capacity (e.g. care facility, accommodation, housing unit).
[6] Number of places in the accommodation and care facility; in other cases the number of people staying in the building.
[7] Load-bearing frame class requirement. The frame of the compartmenting building elements must meet at least the same fire resistance time requirement as is required for the compartmentation.
[8] 1,200 m², if the space is on the first floor of the building and the load-bearing and compartmenting building elements of the space meet the requirements of class A2-s1, d0.

6.2 SURFACE CLASS REQUIREMENTS

Tables 13...15 present the interior surface class requirements of the building and the surface class requirements of the facade based on the tabular design of the fire regulations. Deviations from the table design requirements can be made by designing the building to fire class P0 (functional fire design).

Table 13. Surface class requirements in a P1 fire class building (building with a maximum of 2 floors).

P1	Designation	Usage	Spaces according to intended use			Exit route			Log facade**
			Walls	Ceilings	Floors	Walls	Ceilings	Floors	
	Day care centre (daytime use) School Restaurant	Assembly space	D-s2, d2 [a] C-s2, d1 [b] D-s2, d2 * [b]	D-s2, d2 [a] C-s2, d1 [b] D-s2, d2 * [b]	- -	A2-s1, d0 [4]	A2-s1, d0 [4]	D_{FL}-s1	D-s2, d2 [8] [9]
	Shop	Commercial space	D-s2, d2 [a] B-s1, d0 [b] C-s2, d1 * [b]	D-s2, d2 [a] B-s1, d0 [b] C-s2, d1 * [b]	- D_{FL}-s1 D_{FL}-s1	A2-s1, d0 [4]	A2-s1, d0 [4]	D_{FL}-s1	D-s2, d2 [8] [9]
	Library	Assembly space	B-s1, d0 [b] C-s2, d1 * [b]	B-s1, d0 [b] C-s2, d1 * [b]	D_{FL}-s1 D_{FL}-s1	A2-s1, d0 [4]	A2-s1, d0 [4]	D_{FL}-s1	D-s2, d2 [8] [9]
	Office	Workplace space	D-s2, d2 [1]	D-s2, d2 [1]	-	A2-s1, d0 [4]	A2-s1, d0 [4]	D_{FL}-s1	D-s2, d2 [e] [7]

[1] Small parts of the surfaces may be covered with materials that do not meet the requirement.
[4] Class requirement for minor surfaces B-s1, d0.
[7] Surfaces of the first floor and above and below emergency exits B-s2, d0, fire eave EI 30.
[8] Fire eave EI 30, the falling of large parts of the facade structure must be limited.
[9] External wall with windows and other openings E 30 or sprinkling in a fire compartment bordering the external wall or a fire alarm connected to the emergency response centre.
[a] Fire compartment with a maximum size of 300 m².
[a] Fire compartment larger than 300 m².
[e] Up to 14 m high
[*] Sprinkling in the building.
[**] Solid log exterior wall without thermal insulation and facade ventilation gap.

Table 14. Surface class requirements in a P2 fire class building.

P3	Designation	Usage	52.511			Exit route			Log facade**
			Walls	Ceilings	Floors	Walls	Ceilings	Floors	
	Day care centre (daytime use) School Restaurant	Assembly space	D-s2, d2 [a] D-s2, d2 [b]	D-s2, d2 [a] D-s2, d2 [b]	- -	B-s1, d0	B-s1, d0	D_{FL}-s1	D-s2, d2
	Shop	Commercial space	D-s2, d2 [a] B-s1, d0 [b] C-s2, d1 * [b]	D-s2, d2 [a] B-s1, d0 [b] C-s2, d1 * [b]	- - -	B-s1, d0	B-s1, d0	D_{FL}-s1	D-s2, d2
	Library	Assembly space	B-s1, d0 [b] C-s2, d1 * [b]	B-s1, d0 [b] C-s2, d1 * [b]	- -	B-s1, d0	B-s1, d0	D_{FL}-s1	D-s2, d2
	Residential block of flats	Housing unit	D-s2, d2 [1]	D-s2, d2 [1]	-	B-s1, d0	B-s1, d0	D_{FL}-s1	D-s2, d2
	Office	Workplace space	D-s2, d2 [1]	D-s2, d2 [1]	-	B-s1, d0	B-s1, d0	D_{FL}-s1	D-s2, d2
	Hotel	Accommo-dation space	D-s2, d2	D-s2, d2	-	B-s1, d0	B-s1, d0	D_{FL}-s1	D-s2, d2
	Residential care home	Care facility	D-s2, d2	D-s2, d2	-	B-s1, d0	B-s1, d0	D_{FL}-s1	D-s2, d2
	Small residential building	Housing unit	D-s2, d2 [1]	D-s2, d2 [1]	-	Usually no exit route			D-s2, d2
	Terraced house	Housing unit	D-s2, d2 [1]	D-s2, d2 [1]	-	Usually no exit route			D-s2, d2

[1] Small parts of the surfaces may be covered with materials that do not meet the requirement.
[a] Fire compartment with a maximum size of 300 m².
[a] Fire compartment larger than 300 m².
[*] Sprinkling in the building.
[**] Solid log exterior wall without thermal insulation and facade ventilation gap.

FIRE REGULATIONS BY BUILDING TYPE

Table 15. Surface class requirements in a P2 fire class building.

P2	Designation	Usage	Spaces according to intended use			Exit route			Log facade**
			Walls	Ceilings	Floors	Walls	Ceilings	Floors	
	Day care centre (daytime use) School Restaurant	Assembly space	D-s2, d2 [a) 2)] C-s2, d1 [b) 2)] D-s2, d2 * [b) 2)]	D-s2, d2 [a) 2)] C-s2, d1 [b) 2)] D-s2, d2 * [b) 2)]	- -	A2-s1, d0 [4)]	A2-s1, d0 [4)]	D_{FL}-s1	D-s2, d2 [c)] B-s2, d0 * [d)] D-s2, d2 * [d) 5)]
	Shop	Commercial space	D-s2, d2 [a) 2)] B-s1, d0 [b) 2)] C-s2, d1 * [b) 2)]	D-s2, d2 [a) 2)] B-s1, d0 [b) 2)] C-s2, d1 * [b) 2)]	- D_{FL}-s1 D_{FL}-s1	A2-s1, d0 [4)]	A2-s1, d0 [4)]	D_{FL}-s1	D-s2, d2 [c)] B-s2, d0 * [d)] D-s2, d2 * [d) 5)]
	Library	Assembly space	B-s1, d0 [b) 2)] C-s2, d1 * [b) 2)]	B-s1, d0 [b) 2)] C-s2, d1 * [b) 2)]	D_{FL}-s1 D_{FL}-s1	A2-s1, d0 [4)]	A2-s1, d0 [4)]	D_{FL}-s1	D-s2, d2 [c)] B-s2, d0 * [d)] D-s2, d2 * [d) 5)]
	Residential block of flats	Housing unit	D-s2, d2 [2)]	D-s2, d2 [2)]	-	A2-s1, d0 [4)]	A2-s1, d0 [4)]	D_{FL}-s1	D-s2, d2 [c)] B-s2, d0 * [d)] D-s2, d2 * [d) 5)]
	Office	Workplace space	B-s1, d0 [2) 3)] D-s2, d2 * [2)]	B-s1, d0 [2) 3)] D-s2, d2 * [2)]	-	A2-s1, d0 [4)]	A2-s1, d0 [4)]	D_{FL}-s1	D-s2, d2 [c)] B-s2, d0 * [d)] D-s2, d2 * [d) 5)]
	Hotel	Accommodation space	B-s1, d0 [2) 3)] C-s2, d1 * [2) 3)]	B-s1, d0 [2) 3)] C-s2, d1 * [2) 3)]	-	A2-s1, d0 [4)]	A2-s1, d0 [4)]	D_{FL}-s1	D-s2, d2 [c)] B-s2, d0 * [d)] D-s2, d2 * [d) 5)]
	Residential care home	Care facility	B-s1, d0 [2)]	B-s1, d0 [2)]	D_{FL}-s1	A2-s1, d0 [4)]	A2-s1, d0 [4)]	D_{FL}-s1	B-s2, d0 [c)] D-s2, d2 * [c)]
	Small residential building	Housing unit	D-s2, d2 [2)]	D-s2, d2 [2)]	-	Usually no exit route			D-s2, d2 [c)] D-s2, d2 [e) 6)]
	Terraced house	Housing unit	D-s2, d2 [2)]	D-s2, d2 [2)]	-	Usually no exit route			D-s2, d2 [c)] D-s2, d2 [e) 6)]

[2)] When the surface has protective cladding, the surface class is determined by the material class of the protective cladding.
[3)] Minor parts of wall surfaces D-s2, d2. Also applies to walls with protective cladding.
[4)] Class requirement for minor surfaces B-s1, d0.
[5)] Surfaces of the first floor and above and below emergency exits B-s2, d0, fire eave EI 30, the falling of large parts of the facade structure must be limited.
[6)] Surfaces of the first floor and above and below emergency exits B-s2, d0.
[a)] Fire compartment with a maximum size of 300 m^2.
[a)] Fire compartment larger than 300 m^2.
[c)] Building with up to 2 floors.
[d)] Building with more than 2 floors, maximum height of 28 m.
[e)] A residential building with a maximum height of 14 m, in which the basement and floors belong to the same housing unit.
[*)] Sprinkling in the building.
[**)] Solid log exterior wall without thermal insulation and facade ventilation gap.

7.0 WOOD-STRUCTURED ADDITIONAL FLOOR

A maximum of one wood-structured additional floor can be built into a P1 fire class residential building without sprinklers. A maximum of two additional wooden floors can be built on top of each other. In this case, the two additional floors in question and the top concrete layer must have sprinkling. The maximum height of the building, including additional floors, is 28 meters. The structures and stairs of the additional floor stairwell must be made of A2-s1, d0 class building materials. Concrete structures, brick structures and steel structures are applicable in this case. In particular, non-load-bearing stairwell structures are recommended to be implemented as a sheet metal frame structure clad with plasterboard. Such structures can be elemented in the same way as wooden structures, and they meet the A2-s1, d0 class building material requirement.

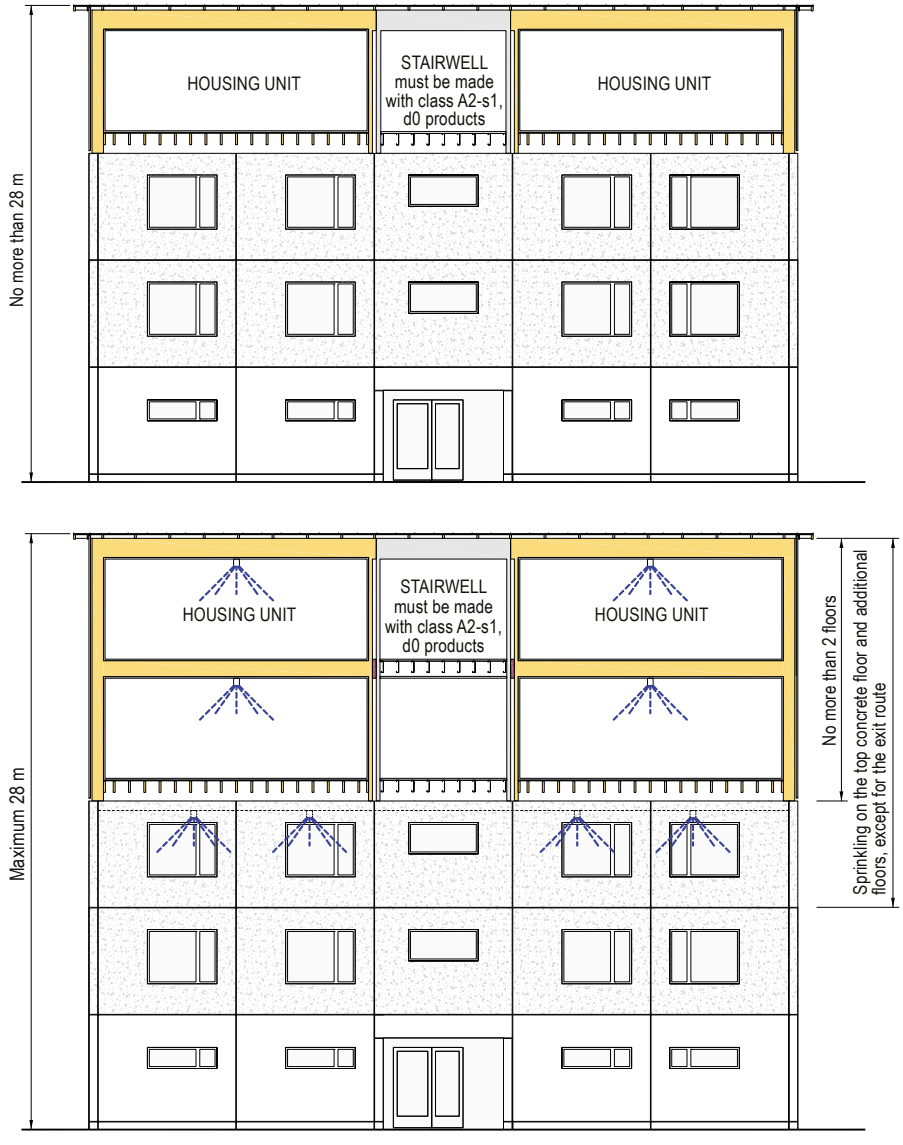


Figure 13. Principles of sprinkling for a wood-structure additional floor in a P1 fire class residential building.

WOOD-STRUCTURED ADDITIONAL FLOOR

Table 16. Fire regulations for an additional wooden floor when there is one additional floor.

Fire class	Designation	Purpose of use	Number of floors
P1	**Wood-structured additional floor**	**Housing unit**	**7 + 1**
Things to note **Fire load group less than 600 MJ/m²**			

Active protection	**Requirement**	**Things to note**
Sprinkling	-	
Mains-connected fire alarm	In housing unit	
Fire alarm	-	
Fire alarm connected to the emergency response centre	-	
Scope	**Requirement**	**Things to note**
Number of additional floors	1 pc	
Building height including additional floor	≤ 28 m	
Floor area	Not limited	
Number of people	Not limited	
Fire compartment size on floors	By housing unit	
Fire compartment size in the attic	≤ 1,600 m²	
Floor fire compartment division	-	
Division of the attic/roof ceiling joist cavity's fire compartment into sections	Section size ≤ 400 m²	
Building element classes	**Requirement**	**Things to note**
Thermal insulation and other fillings in the exterior wall	B-s1, d0 (for the insulating part), however, at least D-s2, d2 (for the insulating part)	If the requirement B-s1, d0 is not met, the thermal insulation and other fillings must be protected with a separating building element or protective cladding.
Thermal insulation and other fillings in the roof ceiling joist		
Thermal insulation and other fillings in other building elements	D-s2, d2 (for the insulating part)	
Load-bearing and stiffening building elements on floors	R 60	
Compartmenting building elements on floors	EI 60 (also R 60)	
Dividing building elements on floors	-	
Load-bearing and stiffening building elements on floors	R 60	Construction products at least A2-s1, d0
Compartmenting building elements in the exit route	EI 60	Construction products at least A2-s1, d0
Stair landings and flights	R 30	Construction products at least A2-s1, d0
Compartmenting building elements in the attic	EI 30 (also R 30)	
Dividing building elements in the attic/roof ceiling joist cavity	EI 15 (also R 15)	
Compartmenting building element between the attic/roof ceiling joist cavity and the floor	EI 60 (also R 60)	
Surface classes [1)]	**Requirement**	**Things to note**
Wall and ceiling surfaces on the floor	D-s2, d2	Small parts of the surfaces may be covered with materials that do not meet the requirement
Wall and ceiling surfaces in the sauna and bathroom	D-s2, d2	
Wall and ceiling surfaces in the exit route	A2-s1, d0	Surface class for minor surfaces B-s1, d0
Floor surfaces on floors	-	
Floor surfaces in the sauna and bathroom	-	
Stair landings and flights in the exit route (must be made with class A2-s1, d0 products)	A2-s1, d0	Surface class for minor surfaces B-s1, d0
The tops of the stair steps in the exit route	D_{FL}-s1	
The tops of the stair landings in the exit route	D_{FL}-s1	
The fronts of the stair steps in the exit route	B-s1, d0	
The fronts of the stair landings in the exit route	B-s1, d0	
Outer surface of the exterior cladding	B-s2, d0	D-s2, d2, when the fire eave is EI 30
Back surface of ventilated exterior cladding	B-s2, d0	D-s2, d2, when the fire eave is EI 30
Exterior cladding fixing studs	D-s2, d2	See Figure 46
Outer surface of exterior wall windbreak/thermal insulation	A2-s1, d0	
Attic/roof ceiling joist cavity surfaces when compartmented from the space below	D-s2, d2 (class E underlay is possible)	
Roof outer surface	B_{ROOF}(t2)	
Protective cladding of a wooden frame	**Requirement**	**Things to note**
Internal wall and ceiling surfaces on floors Floor surfaces on floors	K_2 30, A2-s1, d0	Does not apply to non-load-bearing partition walls inside the fire compartment

[1)] Does not apply to the following, for example: door, window, mounting surface, handrail, moulding

Table 17. Fire regulations for an additional wooden floor when there are two additional floors.

Fire class	Designation	Purpose of use	Number of floors
P1	**Wood-structured additional floor**	**Housing unit**	**6 + 2**
Things to note **Fire load group less than 600 MJ/m²**			

Active protection	**Requirement**	**Things to note**
Sprinkling	3 top floors	Does not apply to the exit route
Mains-connected fire alarm	In housing unit	
Fire alarm	-	
Fire alarm connected to the emergency response centre	-	
Scope	**Requirement**	**Things to note**
Number of additional floors	Maximum of 2	
Building height including additional floor	≤ 28 m	
Floor area	Not limited	
Number of people	Not limited	
Fire compartment size on floors	By housing unit	
Fire compartment size in the attic	≤ 1,600 m²	
Floor fire compartment division	-	
Division of the attic/roof ceiling joist cavity's fire compartment into sections	Section size ≤ 400 m²	
Building element classes	**Requirement**	**Things to note**
Thermal insulation and other fillings in the exterior wall	A2-s1, d0 (for the insulating part)	
Thermal insulation and other fillings in the roof ceiling joist		
Thermal insulation and other fillings in other building elements	A2-s1, d0 (for the insulating part)	
Load-bearing and stiffening building elements on floors	R 60	
Compartmenting building elements on floors	EI 60 (also R 60)	
Dividing building elements on floors	-	
Load-bearing and stiffening building elements on floors	R 60	Construction products at least A2-s1, d0
Compartmenting building elements in the exit route	EI 60	Construction products at least A2-s1, d0
Stair landings and flights	R 30	Construction products at least A2-s1, d0
Compartmenting building elements in the attic	EI 30 (also R 30)	
Dividing building elements in the attic/roof ceiling joist cavity	EI 15 (also R 15)	
Compartmenting building element between the attic/roof ceiling joist cavity and the floor	EI 60 (also R 60)	
Surface classes [1)]	**Requirement**	**Things to note**
Wall and ceiling surfaces on the floor	D-s2, d2	Small parts of the surfaces may be covered with materials that do not meet the requirement
Wall and ceiling surfaces in the sauna and bathroom	D-s2, d2	
Wall and ceiling surfaces in the exit route	A2-s1, d0	Surface class for minor surfaces B-s1, d0
Floor surfaces on floors	-	
Floor surfaces in the sauna and bathroom	-	
Stair landings and flights in the exit route (must be made with class A2-s1, d0 products)	A2-s1, d0	Surface class for minor surfaces B-s1, d0
The tops of the stair steps in the exit route	D_{FL}-s1	
The tops of the stair landings in the exit route	D_{FL}-s1	
The fronts of the stair steps in the exit route	B-s1, d0	
The fronts of the stair landings in the exit route	B-s1, d0	
Outer surface of the exterior cladding	B-s2, d0	D-s2, d2, when the fire eave is EI 30
Back surface of ventilated exterior cladding	B-s2, d0	D-s2, d2, when the fire eave is EI 30
Exterior cladding fixing studs	D-s2, d2	See Figure 46
Outer surface of exterior wall windbreak/thermal insulation	A2-s1, d0	
Attic/roof ceiling joist cavity surfaces when compartmented from the space below	D-s2, d2 (class E underlay is possible)	
Roof outer surface	B_{ROOF}(t2)	
Protective cladding of a wooden frame	**Requirement**	**Things to note**
Internal wall and ceiling surfaces on floors Floor surfaces on floors	K_2 30, A2-s1, d0	Does not apply to non-load-bearing partition walls inside the fire compartment

[1)] Does not apply to the following, for example: door, window, mounting surface, handrail, moulding

8.0 FUNCTIONAL FIRE DESIGN

8.1 REQUIREMENTS

Functional fire design is an equal method alongside the tabular design of fire regulations. The fire safety requirements of a building are considered to be met if the building is designed based on assumed fire development that covers the situations likely to occur in the building in question. Compliance with the requirements is verified on a case-by-case basis, taking into account the characteristics and use of the building.

Functional fire design uses methods the validity of which has been demonstrated. Test and calculation methods according to European (EN) and international (ISO) standards can be assumed to meet the qualification requirements if the application is within the scope of the method in question. The design criteria, design models used and results obtained must be presented in connection with the building permit procedure.

Functional fire design documents include, among other things

- a description of the building and the fire safety equipment in it
- assumptions made about the use of the building throughout its life cycle
- assumptions made about the rescue department's operational capabilities
- grounds for the fire situations selected for examination
- failure analyses to the necessary extent with justifications
- maintenance and upkeep required during the use of the building
- a description of the methods used, including the applicability of the calculation and test methods with their limitations, as well as the initial data and assumptions made with justifications
- the results obtained, including sensitivity analyses (will a small change in the assumptions made cause a significant change in fire safety)
- acceptance criteria and comparison of the results obtained with them
- Identification and delimitation of application areas, if both tabular design and functional design have been used in the design process.

Functional fire design documentation is required

- for building permit processing
- for other designers and engineers
- for the developer
- for the contractor
- for the owner/occupant of the building.

8.2 FUNCTIONAL FIRE DESIGN PROCESS

Functional fire design is a team effort, in which the fire engineering office is an essential actor. The functional fire design process includes the following factors:

- The building owner's/occupant's/user's objectives regarding functional fire design.
- Boundary conditions for architecture and structural design.
- Boundary conditions for fire design.
- Agreeing on the official process.
- Boundary conditions issued by the building control authority.
- Role of the rescue department.
- The need and role of third-party verification.
- Accepting assumptions and acceptance criteria.
- Conducting functional analyses and collaborating with other design disciplines.
- Presentation of analyses and conclusions to authorities.
- Conducting possible additional analyses.
- Final analysis reports and key points of the results for the fire safety plan.

8.3 DIVISION OF TASKS IN THE DESIGN PROCESS

The fire safety designer is supported by the building's other designers, the developer and the authorities. The division of tasks is broadly as presented below:

- The developer and principal designer
- set a goal for the design process
- make the final decisions in the context of choices.

The architect, structural engineer, fire safety engineer and other designers present

- practical solutions in cooperation
- initial assumptions of the functional fire design, acceptance criteria, analyses and their conclusions.

The tasks of the building control authority, the rescue department and any third party are as follows:

- The rescue department provides comments.
- The third party provides in various process phases and issues a statement.
- The building control authority approves the arrangement.

8.4 REGULATORY APPROVALS

The challenge of functional fire design is defining acceptance criteria. Demonstrating fire safety through calculations produces different results in all different buildings. This is because, in functional fire design, fire safety is examined by simulating a real fire event. In this case, there are many variables between different buildings, as the buildings differ in terms of architecture, structure and fire load, among other things. Defining acceptance criteria is challenging in this case, because there is no single acceptance criterion for different kinds of buildings.

The comparison principle is normally used when accepting the results of functional fire design. The design results obtained in practice are compared with a building of similar use, the fire safety of which has been designed using the tabular design in the National Building Code. The method is described in the publication INSTA TS 950: Fire Safety Engineering — Comparative method to verify fire safety design in buildings (2014). It is a good idea to agree on acceptance criteria with the authorities at the beginning of the functional fire design process.

However, the acceptance criteria for the results of functional fire design are always derived from the following essential requirements:

- Load-bearing structures must have the required fire resistance.
- The development and spread of fire and smoke must be limited.
- The spreading of fire to adjacent buildings must be limited.
- In the event of a fire, people must be able to leave the building or be rescued with the help of others.
- The safety of rescue personnel must be taken into account.

8.5 WHEN TO USE FUNCTIONAL FIRE DESIGN

Functional fire design can be used to create solutions that deviate from the tabular design of fire regulations. Functional analysis can also be focused on individual structural units, so some of the building can be designed using tabular design and some using functional fire design.

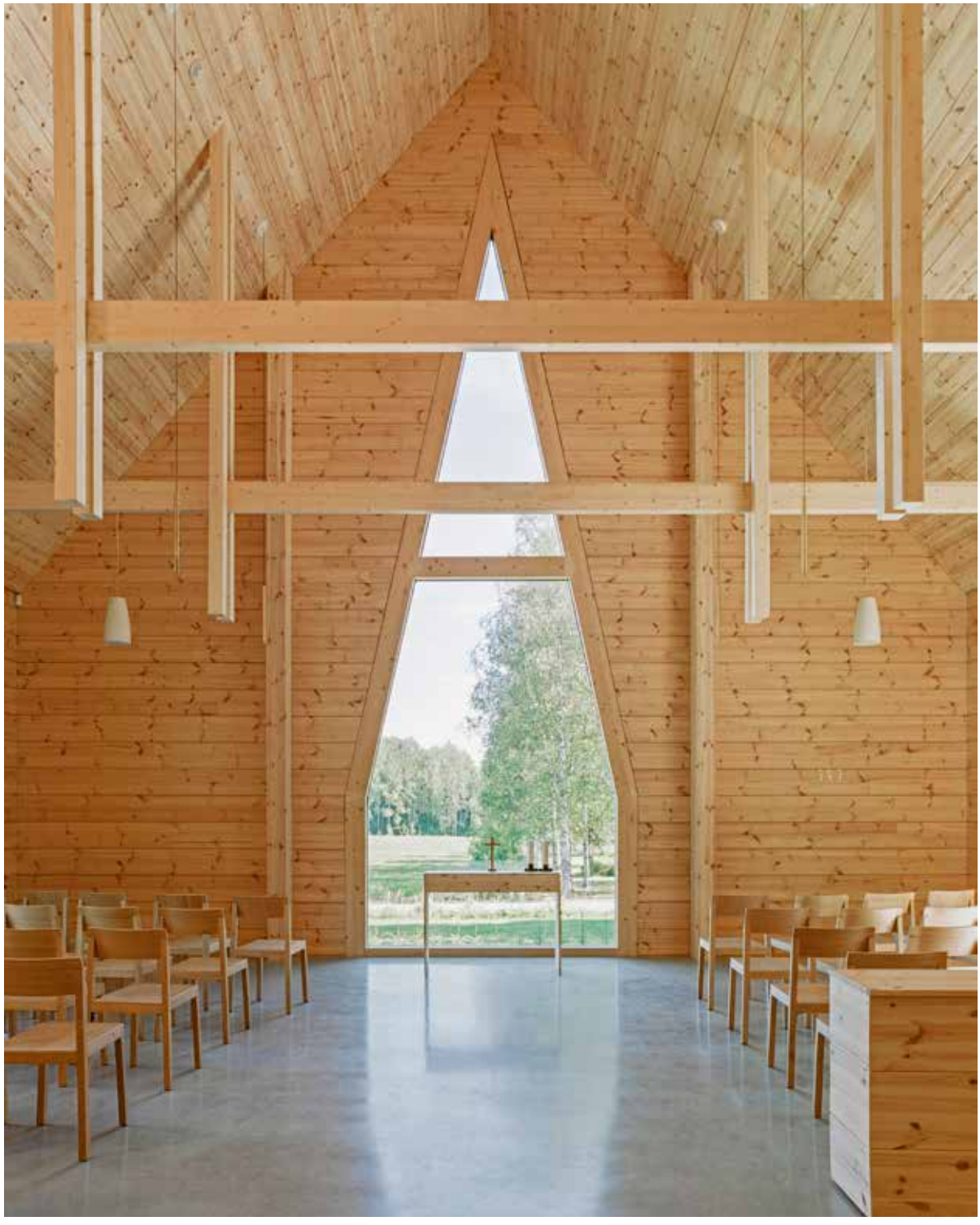
Functional fire design is normally used when
- the intention is to optimise structural solutions (cost savings)
- the intention is to construct a building or structural whole that cannot be implemented using the tabular dimensions of the fire regulations.

Functional fire design is typically utilised in the following cases, among others:

- High wooden buildings.
- Large hall-like buildings.
- Methods of use not permitted in the tabular design.
- Assembly spaces, hotels, care facilities.
- When the intention is to avoid protective cladding on some building elements.
- When the intention is implement a deviation from the surface class requirement.
- When the intention is to implement a deviation from the minimum distance between buildings.

Figure 14. In Cultural Centre Monio, it has been possible to leave a lot of the log surfaces visible thanks to functional fire design. Image Kontiotuote Oy.

9.0 REFERENCES



Vihti chapel Photo Honkarakenne Oyj.

Vihti chapel. Photo Honkarakenne Oyj.

Karstula School Photo Honkarakenne Oyj.

REFERENCES

Naava Chalets. Photo Honkatalot / Hans Koistinen.

Inkoonranta small block of flats. Photo Honkatalot / Hans Koistinen.

Log block of flats Kuusamo. Photo Kuusamo Hirsitalot Oy / Jakke Murtovaara.

Log block of flats Kuusamo. Photo Kuusamo Hirsitalot Oy / Jakke Murtovaara.

REFERENCES

Hotel Iso-Syöte. Image Kontiotuote Oy.

Cultural Centre Monio. Image Kontiotuote Oy.