„Even the best materials used in a perfect system do not by themselves guarantee absolute perfection of the construction. That is why it is very important for the site managers, assembly companies and especially the craftsmen themselves to take proper care to duly and consistently work in compliance with the prescribed technological procedures and contact us, the manufacturer of the CETRIS® cement bonded particleboards, with trust in the case of any doubt. All our colleagues are ready to provide any information that might help you resolve any particular problem.

We believe that mutual exchange of experience between the manufacturer of CETRIS® cement bonded particleboards and the customer will contribute to the successful implementation of the customer's construction work."

9 Applications of CETRIS® Boards in Fire Protection pursuant to EN Standards

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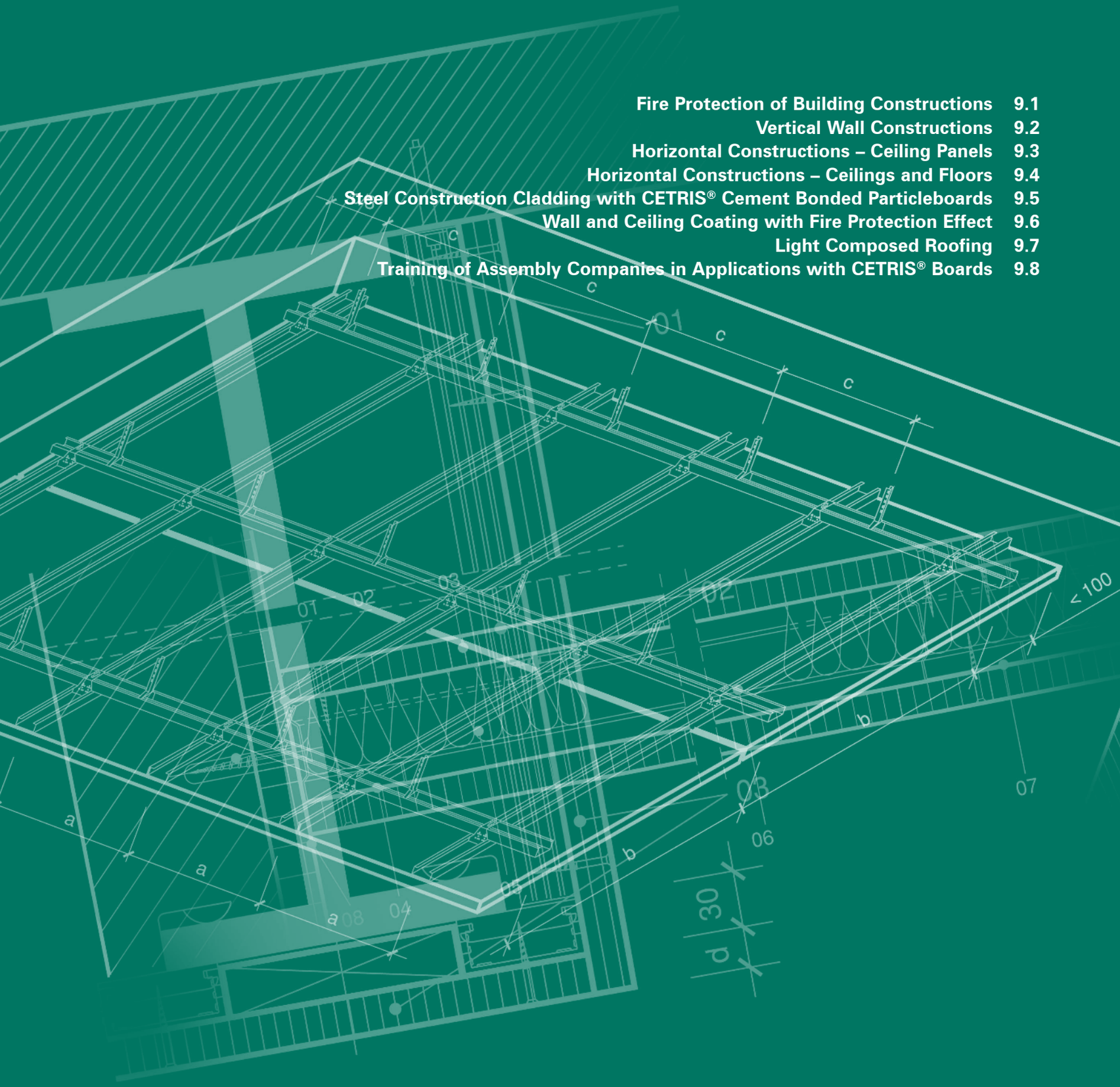
Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

9



CETRIS®

9.1 Fire Protection of Building Constructions

The purpose of this chapter is to inform the user about all of the protective technical options of building constructions against the effects of fire with the help of CETRIS® cement-bonded particleboard. This text has been prepared on the basis of fire resistance test results pursuant to European standards.

The knowledge summarised in this chapter results from theoretical-experimental solutions leading to tabular processing of dimensions of vertical and horizontal fire partitions pursuant to the effective European technical standards EN. This catalogue also newly includes texts concerning horizontal ceiling (floor) constructions and steel construction coating. All below mentioned construction data are based on the set of test protocols of PAVÚS – Veselí nad Lužnicí, (prepared by Ing. Bauma CSc. and Ing. Karpaš CSc.) and the tests made by the testing laboratory of FIRES spol. s r. o. Batizovce.

Particular references to the individual protocols and assessments are listed at the end of this chapter. The assembly instructions and model solutions have been prepared on the basis of conclusive tests of the individual applications specified in the test protocols and construction materials.

9.1.1 Requirements of Fire Safety of Building Constructions

The requirements for fire safety of building constructions and products built in them are stipulated by the Fire Standards Code. These guidelines are divided into four groups:

- Design standards (requirements for building design with regard to fire safety)
- Test standards (defining methods of testing and proving the required properties)
- Value standards (fire technical properties of selected constructions and materials)
- Subject standards (technical conditions of fire safety equipment)

9.1.2 Fire-Related Properties of Building Materials – Flame Spread, Classification Based on National Standards

Cement-bonded particleboard is also classified pursuant to the following national standards:

- DIN 4102 in class B1 – **schwer entflambar (hardly flammable)**
- PN-B-02874:1996 (Protocol NP- 595/02/JF) – classification **niezapalny (non-flammable)**

Flame Spread Index

ČSN 73 0863 standard – Specification of the Speed of Flame Spread along the Surface of Building Materials – is used for specification of the flame spread index $\mathbf{i_S}$, characteristics expressing the speed of flame spread in time under exactly defined test conditions. The Flame spread index $\mathbf{i_S}$ has been specified for CETRIS® cement-bonded particleboard with Denasil paint (Protocol 10474) and with façade plaster Bayosan (Test protocol № Z-7.04-94), with dispersion plaster Rudicolor (Test protocol № Z-7.03-94) – always with the result $\mathbf{i_S = 0}$.

9.1.3 Classification of Building Products in Euro Classes depending on the reaction to fire

At present the European Union intensely formulates harmonised technical standards of building fire safety as the basis for implementation of the basic requirements of the CPD directive.

The main objective of this directive is to harmonise the national legislation of EU countries with the aim to achieve exclusive use of products meeting the following basic requirements for fire safety in buildings:

- Preservation of load-bearing capacity and stability of the construction for a certain period of time
- Restriction of ignition and spread of fire and its products inside the building
- Restriction of flame spread outside the building
- Possibility of evacuation of persons and animals in the case of fire
- Facilitation of safe intervention of fire and rescue corps

An important part of the harmonised European standards is represented by a new classification system of building materials (products) based on their assumed reaction to fire class, the so called EURO CLASSES, and new related EN test standards.

The new classification system became legally binding after its publication in the Official Journal of the EU. The system has been completed and implemented as the EN 13 501-1 standard, adopted in the Czech Republic in 2003. The new standard eliminated the principal differences in the national systems of EU countries in this area, as a serious obstacle to common trade. Another advantage of the new system is a more accurate evaluation of building products. Pursuant to the new test standards, the system is getting closer to the results of large-scale tests, i.e. behaviour in real fire situations.

The test methods for the purpose of the classification, the classification criteria, the new EURO CLASSES and their identification are shown in Table 1. The tables give an idea of the procedure of classification of a building product into one of the seven classes: The acclimatised test sample is tested by the procedures described in the relevant test standards, the measured test results are entered in the test protocols, these are compared to the relevant classification criteria and the result is processed in the form of EURO CLASS Classification Protocol of Building Product.

For the purpose of classification of building products pursuant to their reaction to fire test results pursuant to the following European standards are used:

- **EN ISO 1182:2002 Non-Flammability Test**. This test distinguishes products that will not contribute or will only insignificantly contribute to fire, regardless their practical application. The test is used together with the test pursuant to EN ISO 1716 standard for classification of building products to classes A1, A2, $A1_{fl}$ and $A2_{fl}$.

- **EN IS01716:2002 Specification of Combustion Heat.** This test is used for specification of the maximum amount of heat released by a completely burnt product, regardless its practical application. The test is used together with the test pursuant to the EN ISO 1182 standard for classification of building products to classes A1, A2, $A1_{fl}$ and $A2_{fl}$.

- **EN 13823:2002 Test by single burning item (hereinafter SBI).** This test is used to classify the product contribution to fire progress if the product is exposed to the heat effects corresponding to a single burning item placed in the corner of the room close to the tested product. The test is used for classification to classes A2, B, C and D. Under specific conditions of the combination of components of a heterogeneous product, this test is also suitable for classification to class A1.

- **EN ISO 11925-2:2002 Test of Flammability by single Flame Source (hereinafter Flammability Test).** This test is used for specification of the flammability of the product by single flame. This test is used for classification to classes B, C and D, E, B_{fi}, C_{fi}, D_{fi} and E_{fi}.

- **EN ISO 9239-1: 2002 Determination of the burning behaviour using a radiant heat source** (hereinafter Radiant Panel Test). This test specifies the critical heat flow under which the flames no longer spread along horizontal surfaces. The test is used for classification to classes $A2_{fl}$, B_{fl}, C_{fl} and D_{fl}.

Non-flammability and burning heat are material characteristics and therefore do not depend on the practical application of the product.

Table 1: The following criteria are assessed for the purpose of classification of building products pursuant to their reaction to flame

CLASS	TEST METHOD	CLASSIFICATION CRITERIA	ADDITIONAL CLASSIFICATION
A1	EN ISO 1182:2002(1) *and*	T ≤ 30 °C; *and* m ≤ 50 %; *and* t_f = 0 (i.e. without stable burning)	
	EN ISO 1716:2002	PCS ≤2,0 MJ/kg (1) *and* PCS ≤2,0 MJ/kg (2a) *and* PCS ≤1,4 MJ/m² (3) *and* PCS ≤2,0 MJ/kg (4)	
A2	EN ISO 1182:2002(1) *and/or*	T ≤50 °C; and m ≤50 %; and tf ≤20 s	
	EN ISO 1716:2002 *and*	PCS ≤3,0 MJ/kg (1) *and* PCS ≤4,0 MJ/m² (2) *and* PCS ≤4,0 MJ/m² (3) *and* PCS ≤3,0 MJ/kg (4)	
	EN 13823:2002	FIGRA ≤120 W/s and LFS < sample edge *and* THR_{600s} ≤7,5 MJ	smoke production (5) and flaming drops/particles (6)
B	EN 13823:2002 *and*	FIGRA ≤120 W/s *and* LFS < sample edge *and* THR_{600s} ≤7,5 MJ	smoke production (5) and flaming drops/particles (6)
	EN ISO 11925-2:2002(8) *exposition time = 30 s*	Fs ≤ 150 mm za 60 s	
C	EN 13823:2002 *and*	FIGRA ≤250 W/s et LFS < sample edge *and* THR_{600s} ≤7,5 MJ	smoke production (5) and flaming drops/particles (6)
	EN ISO 11925-2:2002(8) *exposition time = 30 s*	Fs ≤150 mm za 60 s	
D	EN 13823:2002 *and*	FIGRA ≤750 W/s	smoke production (5) and flaming drops/particles (6)
	EN ISO 11925-2:2002(8) *exposition time = 30 s*	Fs ≤150 mm za 60 s	
E	EN ISO 11925-2:2002(8) *exposition time = 15 s*	Fs ≤150 mm za 20 s	flaming drops/particles (7)
F	**no requirements**		

Notes to Table 1

1) For homogeneous products and substantial components of heterogeneous products,
2) For any external non-substantial components of heterogeneous products
2a) Alternatively, any non-substantial component with PCS 2 MJ/m² on condition that the product complies with the criteria of EN 13 823: FIGRA 20 W/s, LFS for sample edge and THR_{600} s 4 MJ and s1 a d0,
3) For any internal non-substantial components of heterogeneous products
4) For the product as a whole
5) s1 = SMOGRA 30 m²/s² and TSP_{600} s 50 m², s2 = SMOGRA 180 m²/s² and TSP_{600} s 200 m², s3 = no s1 or s2,
6) d0 = non-flaming drops/particles in the course of 600 s (EN 13823), d1 = drops/particles not burning longer than 10 s in the course of 600 s of the test (EN 13 823), d2= no d0 or d1. Classification d2 means paper ignition (EN ISO 11 925-2),
7) Complies = paper does not ignite (unclassified), non-compliant = paper ignites (classification d2),
8) Under condition of flame acting on the surface and if suitable with regard to the final use of the product, its acting on the edge

The results of flammability tests, SBI and radiant panel tests depend on the practical application of the product. The conditions of practical application include:
- Product position,
- Product location in relation to other neighbouring products (substrate, connecting elements etc.).

Typical positions of the product include:
- Vertical, face side to open space (position of wall/façade),
- Vertical, face side to a cavity,
- Horizontal, exposed side down (ceiling position),
- Horizontal, exposed side up (floor position),
- Horizontal, inside cavity.

All products except for flooring must be tested in the vertical position for the purpose of the classification. Floorings must be tested with the exposed side up pursuant to EN ISO 9239-1 and in the vertical position pursuant to EN ISO 11925-2.

Typical locations in relation to other products include but are not limited to the following:
- Free standing: without any other products in front or behind the tested product. In this case the product is tested free standing with a suitable fixation,
- On the base: glued, mechanically fixed or touching the base. In this case the product is tested together with the base and fixation typical of its practical application,
- With a cavity between the product and the base. This is also how the product must be tested.

For classification of CETRIS® cement-bonded particleboard, pursuant to its reaction to fire test results the following European standards have been used:
- EN ISO 1182:2002 Non-flammability test
- EN ISO 1716:2002 Combustion heat specification
- EN 13823:2002 Test by single burning item (SBI)
- EN ISO 11925-2:2002 Test of flammability by single flame source (Flammability test)

On the basis of these tests performed by IBS – Institut für Brandschutztechnik und Sicherheitsforschung Linz (Austria) the CETRIS® cement-bonded particleboard is classified as **A2**. Its additional classification of smoke production is **s1**, flaming drops (particles) **d0**, i.e. total classification is **A2-s1,d0**. This result applies to classification of behaviour in fire except for flooring.

Use of the classification is governed by the following rules. The area of use of the classification results follows from the test conditions depending on the product application in practice. The product can be classified differently for different practical applications. Use of standard bases and fixation methods and their effect on the resulting classification has already been mentioned.
The possibility to extend the classification on products of the same composition but different thicknesses and densities will be specified in the relevant European standards for the respective products. The general rule applicable to these cases is that if a product of two different thicknesses or densities is to be classified, then the worse of the achieved classifications will apply to the thicknesses and densities between the two classified variants.

9.1.4 Fire Resistance of Building Constructions

Fire resistance is a specific and decisive property of building constructions. Fire resistance is expressed in time (minutes) for which the assessed construction is able to resist effects of the so called standard fire, i.e. fire progressing under exactly specified conditions. As these parameters are specific for individual building constructions and differ with the ways they are stressed, there are more test methodologies and standards for evaluation of these properties.
Fire resistance is specified by test or calculation, extrapolation and comparison to test standards and regulations by an authorised person who issues the fire resistance classification certificate.

Fire resistance is specified in minutes on basic scale: 15, 30, 45, 60, 90, 120 and 180 minutes.

The values of fire resistance for the individual limit conditions are marked as follows:

Insulation ability **I** | Integrity **E** | Load-bearing capacity and stability **R**

R ..... Load-bearing capacity and stability
E ..... Integrity
I ..... Insulation ability – limit temperature of the non-heated surface
W .... Limit density of heat flow from the non-heated side
S ..... Burning product penetration (... and others, less often used)

The decisive limit conditions are defined for every construction in compliance with the relevant project standard and suitable constructions are selected on the basis of these, such as:
- Constructions meeting the requirements of the three basic limit conditions, i.e. stability (R), integrity (E) and insulation ability (I) are classified with fire resistance **REI**. These requirements must be met by fire compartment partitions, i.e. walls and ceilings
- Non-load-bearing fire partitions (interior walls, partitions and ceiling panels) have their requirements for fire resistance defined on the basis of just two of the limit conditions, i.e. integrity (E) and insulation ability (I), i.e. **EI**
- For load-bearing bar elements (beams and pillars) just load-bearing capacity and stability are required – **R**
- Fire closures are required to show integrity (E) and insulation ability (I), those formerly marked as closures of PB type are now marked pursuant to ČSN 730810 as closures of EI type, and those formerly marked as PO, i.e. requiring integrity (E) and limit density of heat flow (radiation-W), are now marked as closures type **EW**

9.2 Vertical Wall Constructions

9.2.1 Applicability Range

On the basis of the present data CETRIS® boards may be used in the following types of vertical wall constructions:

- Non-load-bearing walls and partitions up to the height of 6 metres and fire resistance up to 180 minutes, with or without mineral fill (with air gap)
- Additional cladding of walls or advanced walls increasing fire resistance of the existing construction. The precondition is fire resistance of the construction before the cladding application for at least 30 minutes (EI)
- Lift shaft or separate advanced wall – single side coated wall construction
- Peripheral wall on wooden framework – as a load-bearing wall with 3 metres max. height, as a non-load-bearing (fill) wall with 4 metres max. height

As stated in the protocols it is also necessary to comply with the technology of the wall assembly and all assembly procedures used and tested in the context of the sample preparation. This means that the proposed connecting elements, their spacing and layout on the construction and other details are binding and must be complied with for the above attests to be applicable. In addition there are recommended variant solutions for applications and elements which cannot be tested because of the methodologies used or the spatial arrangement of the kilns. These solutions have nevertheless been professionally assessed by expert assessments of PAVUS Praha.

Important notice
All data apply to the conditions and loads of the wall constructions by fire in the sense of the effective wording of EN 1363-1, EN 1364-1, EN 1365-1.
The typical samples of the constructions have been tested and the tests have been documented by the state accredited testing laboratory PAVÚS – Veselí n. L. in different wall compositions, and on the basis of these tests the laboratory has issued fire resistance test protocols nos. Pr-02-02.089, Pr-02-02.090, Pr-03-02.066, and Pr-03-02.091. These reports, together with some other tests performed in recent years, have been used as the basis for PAVÚS a.s. Praha (Ing. Karpaš CSc, Ing. Bauma CSc), who then prepared extended applications and the needed dimensional tables generalising the results for the above application range in the context of the final expert assessment.

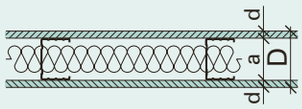
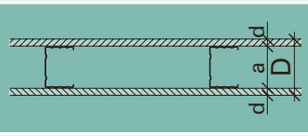
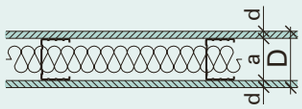
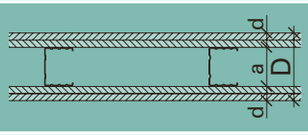
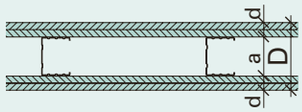
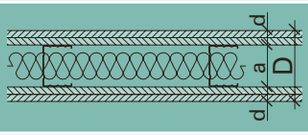
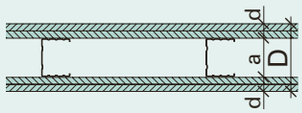
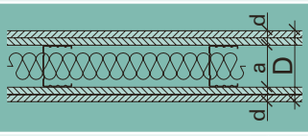
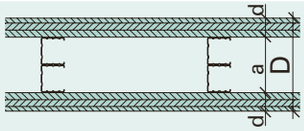
Important notice
The results of fire resistance tests and the tables following from them only assess the issue of the technical properties of the constructions in relation to their resistance to actual fire. For that reason axial distances and types of CW profiles found compliant by the tests are specified. These, however, must be considered the minimum limits that must not be exceeded. It needs to be noted that when dimensioning fire partitions what also always needs to be considered is structural requirement for the construction based on the actual loading.

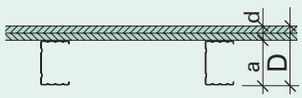
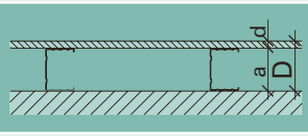
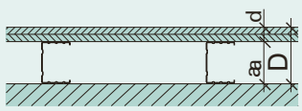
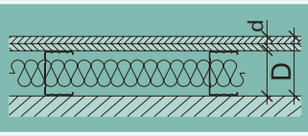
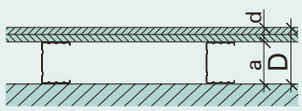
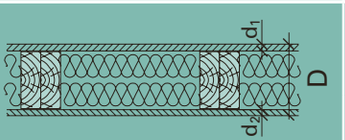
Assembly of fire constructions may only be carried out by trained staff – see Chapter 9.8 Training of Assembly Companies in Applications with CETRIS® Boards.

Description of Construction
The vertical fire partitions – walls and partition walls – coated with CETRIS® cement-bonded particleboard can be designed on the basis of the fire resistance tests and extended applications of their results through theoretical calculations in several basic variants with different values of fire resistance pursuant to the following Table 2.

Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

Table 2: Survey of wall constructions

TYPE	CONSTRUCTION SCHEME	CONSTRUCTION SIZE (mm)			WEIGHT (kg/m²)	MAXIMUM WALL HEIGHT (m)	MINERAL WOOL [1]		FIRE RESISTANCE	THERMAL RESISTANCE (m²K/W)	WEIGHED SOUND TRANSMISSION LOSS R_W (dB)	DESCRIPTION
		a (mm) (CW profile)	d (mm)	D (mm) (wall thickness)			Bulk density (kg/m²)	Insulation thickness (mm)				
Non-load-bearing partition wall on steel framework		75	12	99	38.10	3.60	75	60 (75) [9]	EI 45	1.61 [2]	52	Page 12
		100		124		4.40						
		2×75		174		6.00						
		75	16	107	44.80	4.00	-	-	EI 30	0.15 [2]	44	
		75	16	107	49.30	3.60	75	60 (75) [9]	EI 60	1.65 [2]	-	
		100		132		4.80						
		2×75		182		6.00						
		75	10+10	115	56.00	4.00	-	-	EI 45	0.19 [2]	-	
		100		140		5.00	-	-	EI 30 [9]			
		2×75		90		6.00						
		75	12+12	123	67.20	4.00	-	-	EI 60	0.23 [2]	50	
		100		148		5.00	-	-	EI 45 [9]			
		2×75		198		6.00						
		75	12+12	123	71.70	4.00	75	60 (75) [9]	EI 90	1.73 [2]	56	
		100		148		5.00						
		2×75		198		6.00						
		75	16+18	143	**95.20**	4.00	-	-	EI 90	0.32 [2]	-	
		100		168		4.90			EI 60 [9]			
		2×75		218		6.00						
		75	16+16	139	94.10	4.00	75	60 (75) [9]	EI 120	1.80 [2]	-	
		100		164		5.00						
		2×75		214		6.00						
		2×75	18+12+12	234	117.60	4.00	-	-	EI 120	0.40 [2]	-	
						6.00	-	-	EI 90 [9]			
		2×75	18+12+12	234	122.10	4.00	75	60 (75) [9]	EI 180	1.90 [2]	61	

TYPE	CONSTRUCTION SCHEME	CONSTRUCTION SIZE (mm)			WEIGHT (kg/m²)	MAXIMUM WALL HEIGHT (m)	MINERAL WOOL [1]		FIRE RESISTANCE	THERMAL RESISTANCE (m²K/W)	WEIGHED SOUND TRANSMISSION LOSS R_W (dB)	DESCRIPTION
		a (mm) (CW profile)	d (mm)	D (mm) (wall thick-ness)			Bulk density (kg/m²)	Insulation thickness (mm)				
Shaft wall		75	12+12	99	33.60	4.00	-	-	EI 30 [3]	0.11 [2]	-	Page 4
Advanced wall on steel construction		75	10	85	14.00	4.00	-	-	Ei (x) [4] + 15	0.05 [2]	-	Page 5
		75	18	93	25.20	4.00	-	-	Ei (x) [4] + 30	0.09 [2]	-	
		75	12+12	99	33.60	4.00	-	-	Ei (x) [4] + 45	0.11 [2]	-	
		75	16+16	107	44.80	4.00	-	-	Ei (x) [4] + 60	0.15 [2]	-	
		75	18+18	111	54.15	4.00	75	50	Ei (x) [4] + 90	1.67 [2]	-	
		75	12+12	99	33.60	4.00	-	-	Ei 30 [5]	0.11 [2]	-	
Direct wall cladding of CETRIS® boards			12	-	16.80	4.00	-	-	Ei (x) [4] + 15	0.06 [2]	-	Page 5
			10+10	-	28.00	4.00	-	-	Ei (x) [4] + 30	0.10 [2]	-	
			14+14	-	39.20	4.00	-	-	Ei (x) [4] + 45	0.13 [2]	-	
			18+18	-	50.40	4.00	-	-	Ei (x) [4] + 60	0.17 [2]	-	
Peripheral load-bearing wall	 Exterior coating CETRIS® BASIC Interior coating Knauf GFK	Wooden column 100 × 120 (axial max. 625 mm)	d1 = 14 CETRIS® BASIC	146.5	58.10	3.00 (4.00) [8]	40	120	REI 60 [6]	3.11 [3]	46	Page 6
			d2 = 12.5 Knauf GKF						REW 60 [7]			

Notes to the table:

1) Mineral fibre board of prescribed thickness and bulk density, A1 class of fire reaction pursuant to EN 13501-1).
2) Informative value of thermal resistance
3) Fire resistance value for exposition to fire on the CETRIS® board (full coat) side as well as on the profile (hollow) side
4) EI (x) is the original value of fire resistance of the additionally clad wall (minimum 30 minutes).
5) Fire resistance of the existing construction is not required
6) Value of fire resistance for exposition to external fire (fire on the exterior side)
7) Value of fire resistance for exposition to internal fire (fire on the interior side) – as closed fire compartment
8) Wall height over wooden construction may be extended to 4.0 m, unless exposed to load
9) Applies to wall higher than 4.0 m

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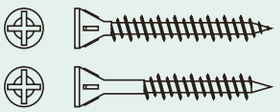
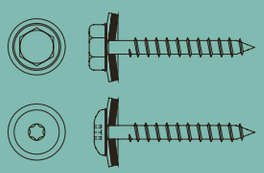
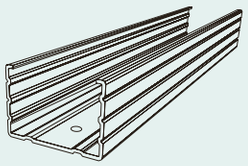
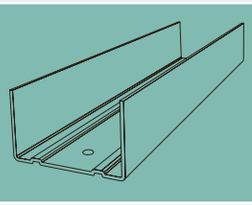
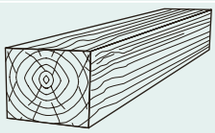
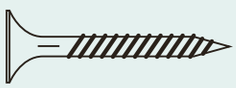
Table 3: Materials for assembly of fire wall constructions – specifications

DESCRIPTION	PICTURE	REMARKS	TYPE OF WALL CONSTRUCTION			
			PARTITION WALLS	ADVANCED WALLS	LOAD-BEARING WALLS	SHAFT WALLS
CETRIS® BASIC Cement-bonded particleboard, smooth surface, cement grey. Basic size 1,250 × 3,350 mm Bulk density 1,320 ±70 kgm^3		Thickness pursuant to fire resistance requirement.	X	X	X	X
CETRIS screw 4.2 × 25, 35, 45, 55 mm Screws for cement-bonded particleboard, self-cutting, self drilling with sunken heads		Screw type pursuant to cladding thickness and load-bearing construction type.	X	X	X	X
Screw 4.8 × 38, 45, 55 mm Stainless or galvanised screws with semi-circular or hexagonal heads with compressive water tight washer.		Screw type (length) pursuant to the cladding thickness. For anchoring of upper layer of CETRIS® boards in exteriors – where the board remains visible. **The board must be predrilled with a min. hole diameter of 8 (10) mm!**	X	X	X	X
CW profile 75, 100 (vertical) Zinc-coated sheet metal profile 75 × 50 × 0.6 mm 100 × 50 × 0.6 mm		Size pursuant to the requirement for the wall fire resistance and height. Steel profiles may be used as an alternative.	X	X	-	X
UW profile 75, 100 (horizontal) Zinc-coated sheet metal profile 75 × 40 × 0.6 mm 100 × 40 × 0.6 mm			X	X	-	X
Steel dowels For profile anchoring to masonry (concrete) walls		Size (diameter and length) pursuant to the construction weights, base types and anchored material.	X	X	X	X
Putty DEXAFLAMM-R White tixotrophic material for joint filling and screw head covering.		Alternatives include fire resistant single-component putties (acrylic, silicon) permanently elastic (Sika Firesil, Den Braven Pyrocryl).	X	X	X	X

DESCRIPTION	PICTURE	REMARKS	TYPE OF WALL CONSTRUCTION			
			PARTITION WALLS	ADVANCED WALLS	LOAD-BEARING WALLS	SHAFT WALLS
ORSIL (ISOVER) Mineral board thickness 60 mm, bulk density 75 kgm^{-3}.		Alternatives include mineral board of the same bulk density, flammability class max. B pursuant to ČSN 73 0862, assumed fire reaction class A2 (pursuant to EN 13501).	X	X	-	-
ORSIL (ISOVER) type UNI Mineral felt thickness 2 × 60 mm, bulk density 40 kgm^{-3}.			-	-	X	-
Adhesive pins		For stabilisation of position of insulation boards in frame construction.	X	X	X	-
Wooden post Spruce lumber min. class SII, max. humidity 18 %, size 120 × 100 mm.		Alternatively glued logs may be used (Euro Profile).	-	-	X	-
Paper SIBRAL Mats of aluminium-silicon fibre, th. 13 mm		For profile lining on the bottom side, interruption of thermal bridges, as insulation for temperatures up to 1,260° C.	X	X	X	X
KNAUF GKF Plasterboard KNAUF thickness 12.5 mm. Basic size 1,250 × 2,000 (2,500) mm.		Processing, anchoring, filler applications, surface finish of boards pursuant to the instructions of KNAUF company.	-	-	X	-
KNAUF Uniflott Filler for joint filling between plasterboards.		Cannot be used for CETRIS® board joint filling.	-	-	X	-
Screw TN 35 Quick screw (3.5 × 35 mm) for plasterboard anchoring.		Cannot be used for CETRIS® board anchoring.	-	-	X	-

9.2.2 Fire Partitions, Shaft Wall on Steel Framework

9.2.2.1 Load-Bearing Construction

The load-bearing construction is a frame consisting of steel zinc-coated profiles CW (vertical posts) and UW (horizontal profiles). For specification of the CW profile dimension in relation to the height and total thickness of the wall, the ratio of the wall height hs and thickness **d** should always be lower than **40**. The **hs/d > 40** ratio represents slenderness ratio **L/i** circa 140. The recommended profile sizes are shown in relation to the construction height in Table 5.

Peripheral profiles are anchored in the frame (wall) with steel dowels with the spacing of 625 mm, the joint between the profiles and the wall is filled with DEXAFLAMM-R filler. The axial distance of the vertical interior profiles does not exceed 625 mm.

9.2.2.2 Construction Composition

The construction is symmetrically or asymmetrically coated on one or both sides with one or more layers of cement-bonded CETRIS® particleboards. The thickness and the number of the CETRIS® boards, and the mineral wool insertion represent the decisive elements of fire resistance (see the dimension tables for the particular specified construction types). Horizontal overlap of the boards is min. 400 mm. In the case of multilayer coating the joints between the boards are overlapped – in the vertical direction by a profile width (625 mm), and in the horizontal direction by min. 400 mm. For CETRIS® board anchoring to the sheet metal profiles self-cutting screws with sunken heads are used. The screw heads are equipped with blades for countersinking in the board. The screw size is 4.2 × 25 or 35, 45, 55 mm. The screw length must always be at least 10 mm longer than the thickness of the screwed board (in the case of multilayer coating at least 10 mm longer than the total thickness of all anchored layers). Gaps are left between the boards with the minimum width of 5 mm. The joint fill, the wall perimeter filling and coverage of the screw heads is made with DEXAFLAMM-R filler.

Table 4: Dimensions of partition walls with heights up to 4 m (a steel framework of CW profiles, two-sided, clad with one- or a multi-layer coat of CETRIS® boards with or without interior heat insulation on mineral wool basis)

FIRE RESISTANCE [1]	THICKNESS OF TWO-SIDED COAT OF CETRIS® BOARDS (mm)					
	with air gap [2]			with mineral wool [3]		
	COAT	GAP	COAT	COAT	INSULATION	COAT
EI 30	16	-	16	Not applicable		
EI 45	10 + 10	-	10 + 10	12	60	12
EI 60	12 + 12	-	12 + 12	16	60	16
EI 90	18 + 16	-	18 + 16	12 + 12	60	12 + 12
EI 120	18 + 12 + 12	-	18 + 12 + 12	16 + 16	60	16 + 16
EI 180	To be assessed			18 + 12 + 12	60	18 + 12 + 12

Notes to Table 4:

1) Classification of min. value of limit conditions of fire resistance is performed pursuant to ČSN 73 0810, the constructions are tested pursuant to EN 1364-1
2) Air gap width 50 mm minimum
3) Mineral insulation Orsil (Isover) or another mineral fibre board with bulk density of at least 75 kg/m^3, max. flammability class B (not easy to catch fire) pursuant to ČSN 73 0862 (A2 fire reaction class EN 73501-1 assumed).

Table 5: Dimensions of partition walls with heights between 4 and 6 m (a steel framework of CW profiles, two-sided, clad with one- or a multi-layer coat of CETRIS® boards with or without interior heat insulation on mineral wool basis)

FIRE RESISTANCE [1]	THICKNESS OF TWO-SIDED COAT OF CETRIS® BOARDS (mm)					
	with air gap [2] with additional modification [4]			with mineral wool [3]		
	COAT	GAP	COAT	COAT	INSULATION	COAT
EI 30	10 + 10	-	10 + 10	Not applicable		
EI 45	12 + 12	-	12 + 12	12	75	12
EI 60	18 + 16	-	18 + 16	16	75	16
EI 90	18 + 12 + 12	-	18 + 12 + 12	12 + 12	75	12 + 12
EI 120	To be assessed			16 + 16	75	16 + 16

Note: In the case of wall heights above 6 m, fire resistance must be assessed individually on the basis of the actual conditions.

Notes to Table 5:

1) Classification of limit conditions of fire resistance is performed pursuant to ČSN 73 0810, the constructions are tested pursuant to EN 1364-1
2) Air gap width 75 mm
3) Mineral insulation Orsil (Isover) or another mineral fibre board with bulk density of at least 75 kg/m^3, max. flammability class B (not easy to catch fire) pursuant to ČSN 73 0862 (A2 fire reaction class EN 73501-1 assumed). If the insulation does not fill the whole gap then the insulation position must be secured – for example with adhesive pins.
4) In the case of partitions with the height of 4 – 6 m it is necessary to consider the higher weight of the construction resulting in increased tension in the steel profile, causing a drop of the critical temperature of steel. That is why in the case of higher partitions, the steel framework needs better protection – unless filled with mineral wool in the points of contact between the steel CW profiles and the boards, the coating needs to be padded with a strip of CETRIS® board with the minimum thickness of 12 mm for the strip to overlap the width of the CW profile at least by 60 mm on each side.

Table 6: Dimensions of manhole or separate advanced wall (a steel framework of CW profiles, one-sided, clad with two layers of CETRIS® boards without interior heat insulation)

FIRE RESISTANCE [1]	THICKNESS OF TWO-SIDED COAT OF CETRIS® BOARDS (mm)	FIRE EXPOSURE
EI 30	12 + 12	On the CETRIS® side
		On the profile (cavity) side

Notes to Table 6:

1) Classification of limit conditions of fire resistance is performed pursuant to ČSN 73 0810, the constructions are tested pursuant to EN 1364-1.

Note: The construction may be used also as an advanced wall – for increased fire resistance of the existing wall construction. Fire resistance of the existing construction is not required. Maximum height of this construction is 4.0 m.

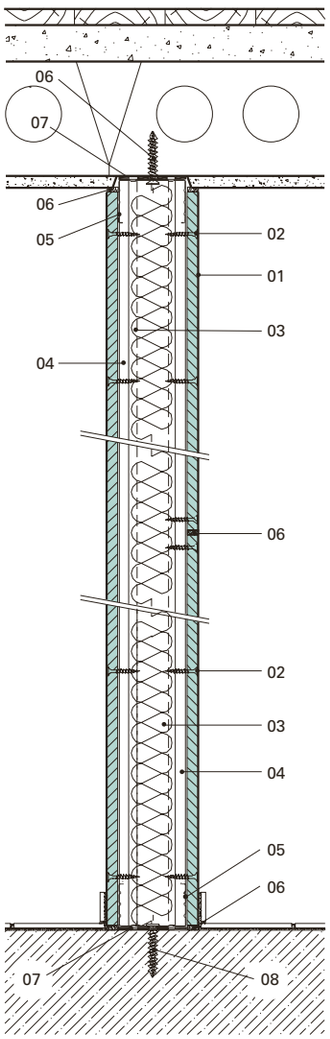
Note: Requirements for mechanical parameters of elevator shaft coating are specified in EN 81-1 Safety Regulations for Construction and Assembly of Elevators – Part 1: Electrical Elevators. For safe elevator operation the shaft walls must show mechanical compactness sufficient to resist 300 N force acting perpendicularly to the wall on one or the other side, in any place, evenly across a circular or square area of 5 cm²:

- without permanent deformation
- with flexible deformation up to 15 mm.

This parameter has been tested in the Technical Testing Laboratory in Prague, State Establishment, branch office Plzeň. The test was performed on CETRIS® cement-bonded particleboard, thickness 12 mm in one layer, anchored to a steel frame. The axial distance of the support profiles was 625 mm. None of the repeated tests resulted in any permanent deformation or exceeded the prescribed limit of flexible deformation.

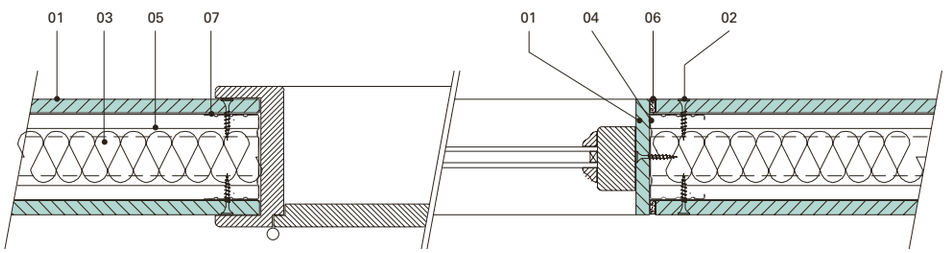
9.2.2.3 Model construction designs – partition walls – Details of a wall with single-layer coating

Vertical cross section



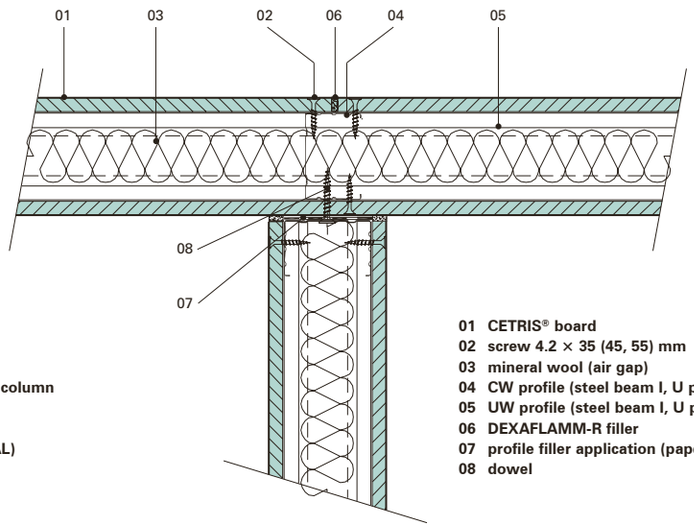
01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel

Wall opening
Horizontal cross-section



01 CETRIS® board
02 screw Cetris-Hobau 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 UA profile

T-joint
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel

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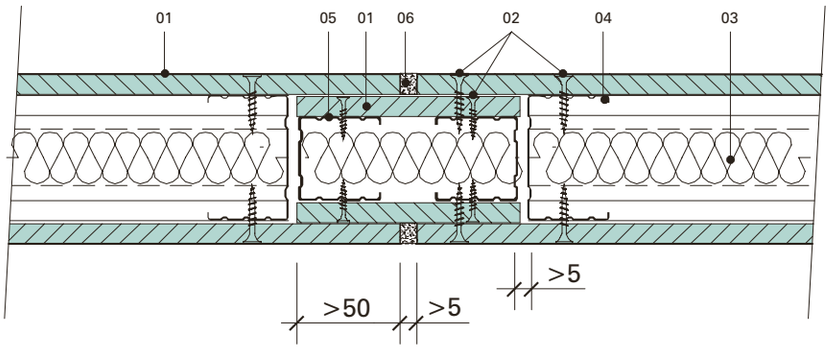
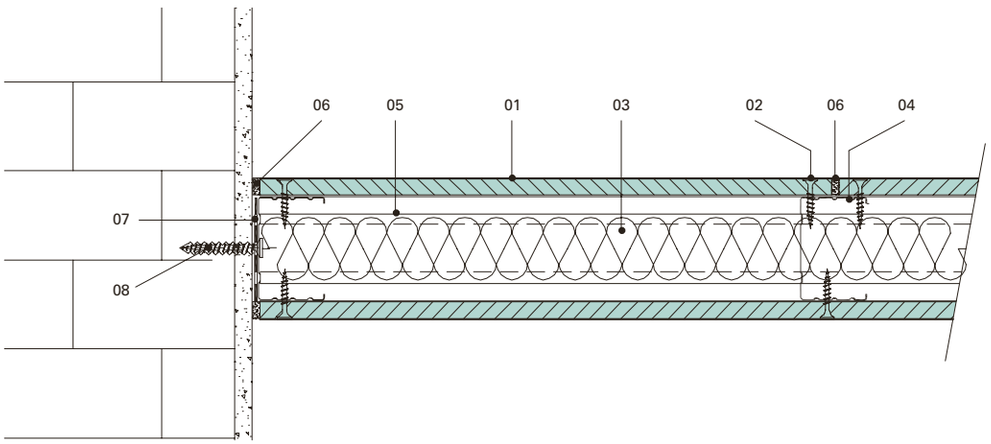
Joint detail – EI > 60 min
Horizontal cross-section



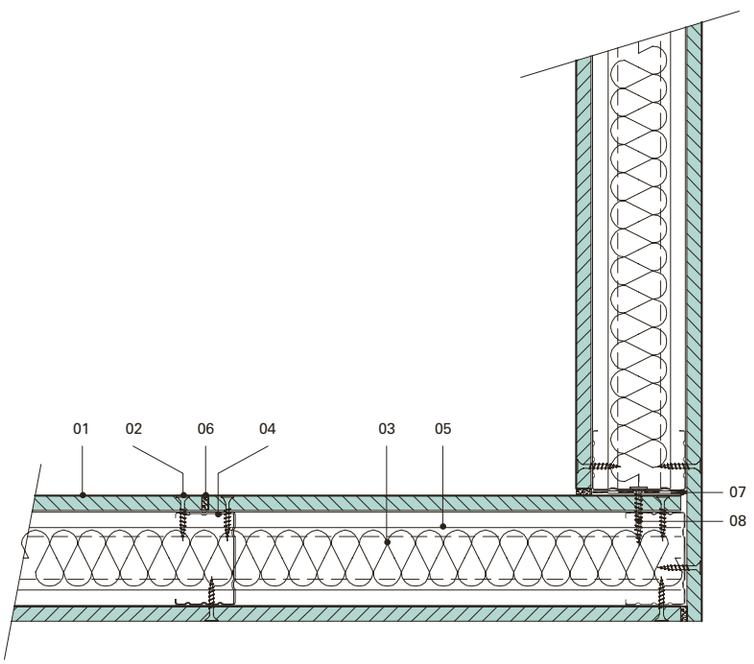
01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile 75
05 UW profile 50
06 DEXAFLAMM-R filler

Wall connection
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel

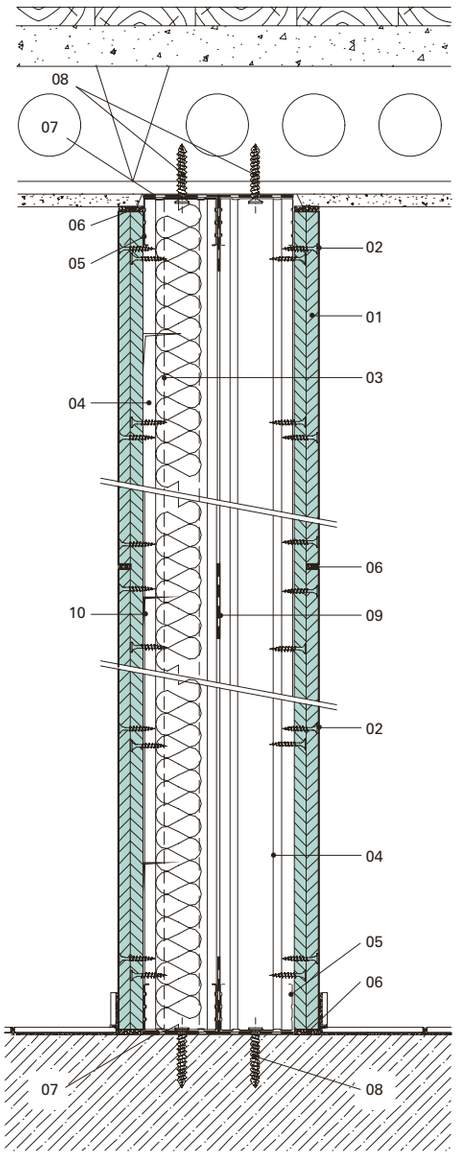
L joint
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel

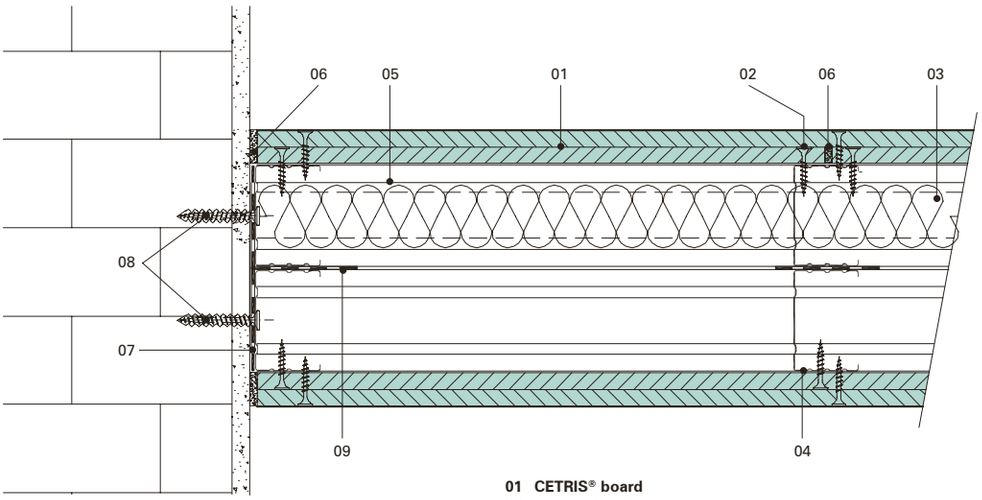
9.2.2.4 Model construction designs – partition walls – Details of a wall with multi-layer coating

Vertical cross-section



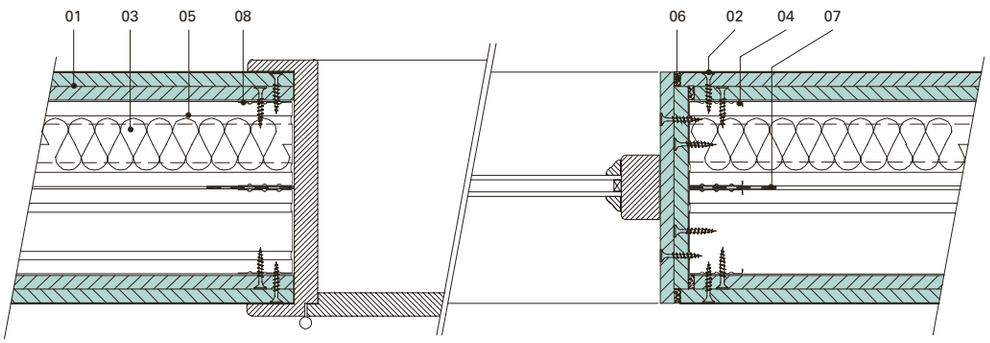
01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel
09 sealing tape
10 adhesive pin

Wall connection
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel
09 sealing tape

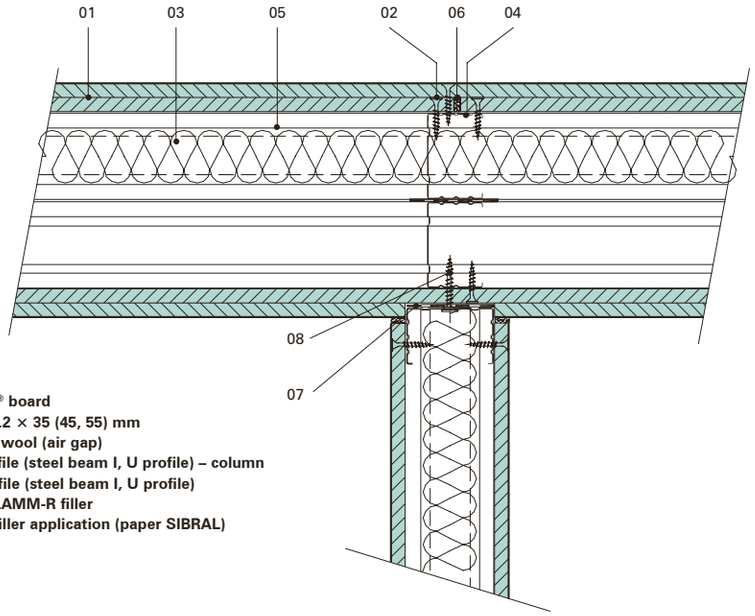
Wall opening
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 sealing tape
08 UA profile (opening jamb)

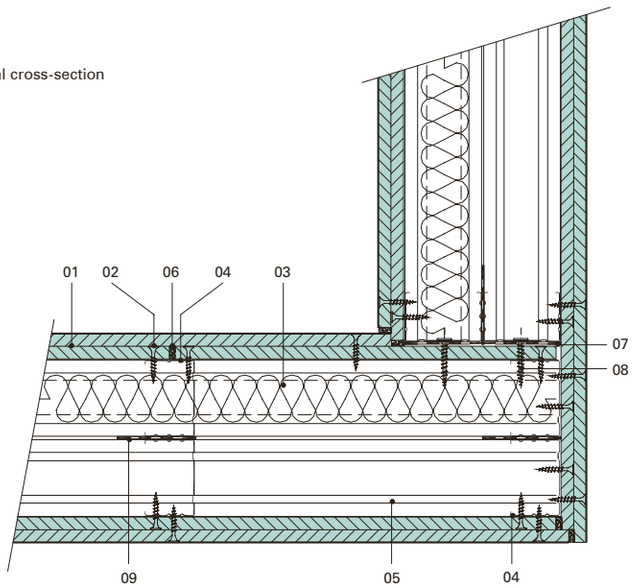
Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

T-joint
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel

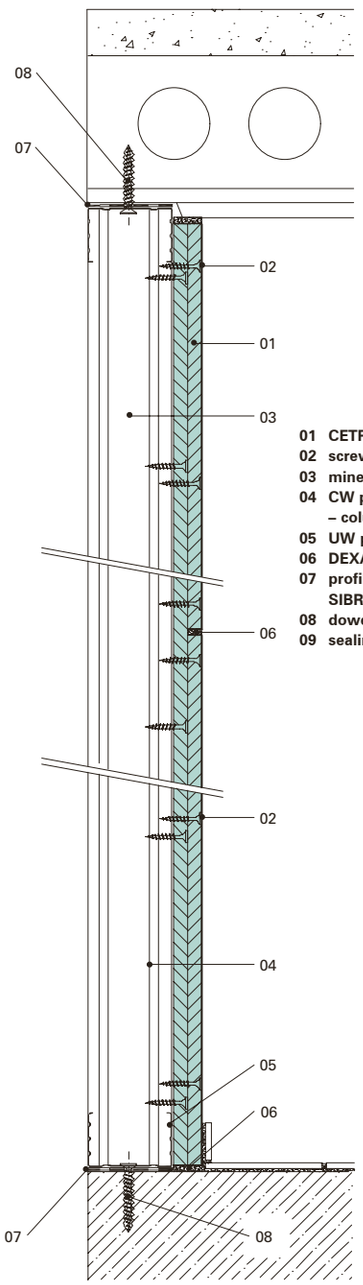
L joint
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel
09 sealing tape

9.2.2.5 Model construction designs – partition walls – Details of a shaft wall

Vertical cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 mineral wool (air gap)
04 CW profile (steel beam I, U profile) – column
05 UW profile (steel beam I, U profile)
06 DEXAFLAMM-R filler
07 profile filler application (paper SIBRAL)
08 dowel
09 sealing tape

9.2.3 Advanced Walls and Direct Fire Cladding of Walls

Cladding and advanced walls allow for increasing fire resistance of existing fire partitions of D1 or D2 type on condition that these constructions are already fire resistant for at least 30 minutes. Cladding and advanced walls do not increase fire resistance of partitions with zero fire resistance, regardless the material of which they are made (such as single-layer metal walls of corrugated sheet metal etc.).

Note: If the existing wall construction is not of type D1 or D2 or does not meet the required fire resistance of EI 30, the solution with a shaft (advanced) wall may still be used – see previous chapter.

9.2.3.1 Load-Bearing Construction of Advanced Walls

The load-bearing construction consists of a frame of steel zinc-coated profiles CW 75 × 50 × 0.6 mm. The profiles are anchored in the existing wall construction with steel dowels with the spacing of 625 mm, the joint between the profiles and the wall is filled with DEXAFLAMM-R filler. Axial distance of vertical profiles does not exceed 625 mm.

9.2.3.2 Construction Composition

The advanced wall is one-sided clad with one or more layers of CETRIS® cement bonded particleboards. The direct coating of CETRIS® boards is directly applied to the existing construction. Horizontal overlaps of the boards are at least 400 mm. In the case of multilayer cladding the joints between the boards are mutually overlapped – in the vertical direction by a profile width (625 mm), and in the horizontal direction at least 400 mm.

Table 7: Dimensions of advanced walls

Advanced walls of CETRIS® boards are one-sided clad constructions fixed to a grid of metal profiles anchored in the existing load-bearing construction with a certain offset – gap. The size of the gap and whether the gap is filled with mineral wool or not and the fire resistance of the CETRIS® board claddings are the decisive factor of the final fire resistance of the whole structure.

CETRIS® BOARD THICKNESS (mm)	TYPE OF INSULATION	GAP THICKNESS (mm)	FIRE RESISTANCE INCREASED BY… (min)	RESULTING FIRE RESISTANCE (min)
10	Air	50	15	EI (x) [1] +15
18	Air	50	30	EI (x) [1] +30
2 × 12	Air	50	45	EI (x) [1] +45
2 × 16	Air	50	60	EI (x) [1] +60
2 × 18	Mineral board [2]	50	90	EI (x) [1] +90

Notes to Table 7:

1) Original value of fire resistance of the additionally protected wall EI (x)
2) Mineral fibreboard Orsil (Isover) thickness 50 mm with bulk density of at least 75 kgm^{-3}, maximum flammability class B (not easy to catch fire) pursuant to ČSN 73 0862 (A2 fire reaction class pursuant to EN 13501-1 assumed)

Table 8: Dimensions of direct cladding

Regarding the higher weight of the cladding, the application must always also be assessed from the structural point of view. Direct cladding may only be applied to flat walls with the planarity tolerance not exceeding 5 mm for prevention of tension transfer into the construction.
Fixation to the brick or concrete is exclusively executed with steel dowels within a grid of 300 × 300 mm (this applies to thicknesses of 10 – 12 mm) or within a grid of 450 × 450 mm (this applies to thicknesses 14 mm and up). The thickness of CETRIS® boards and the number of layers depend on the required fire resistance value.

CETRIS® BOARD THICKNESS (mm)	FIRE RESISTANCE INCREASED BY… (min)	RESULTING FIRE RESISTANCE (min)
12	15	EI (x) [1] +15
2 × 10	30	EI (x) [1] +30
2 × 14	45	EI (x) [1] +45
2 × 18	60	EI (x) [1] +60

Notes to Table 8:

1) Original value of fire resistance of the additionally protected wall EI (x)

As follows from the tables, the cladding thickness mentioned in them can also increase the fire resistance of walls with a fire resistance value higher than 30 minutes by addition of the value by which the fire resistance increases to the original fire resistance value of the existing wall. Validity of this statement has been verified by calculation even for the extreme value of increase of the required resistance from 120 to 180 minutes. The increased fire resistance applies to all D1 and D2 type walls with a 30 minute minimum fire resistance of the original wall. These tables do not apply to walls of D3 type.
The cladding is not recommended for walls and partitions of plasterboard and gypsum fibre boards.

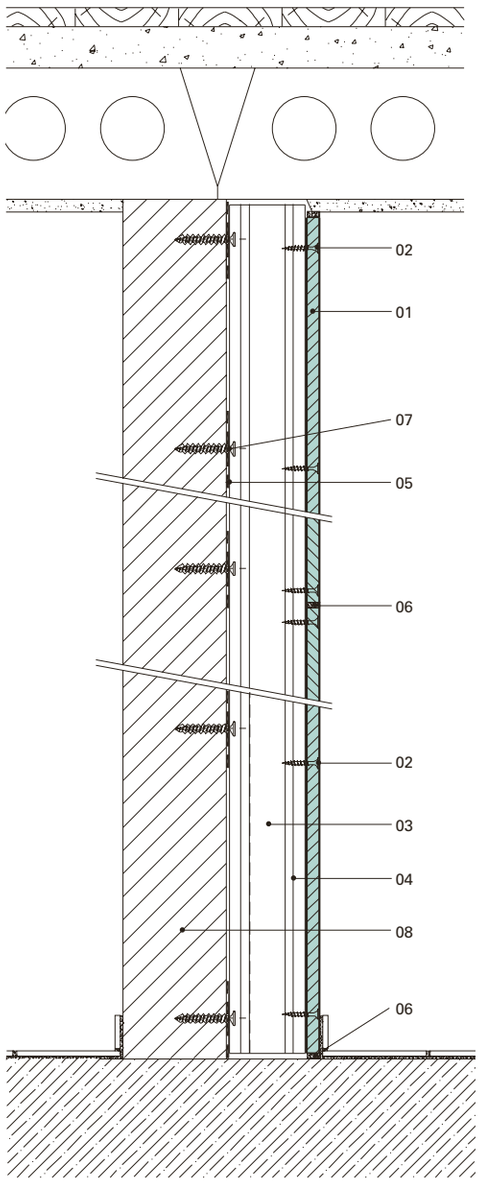
Note 1: Direct wall cladding is only recommended in absolutely necessary cases and over smaller areas, as in the point of the board fixation to the wall the concentrated tensions may cause wall cracking, in effect reducing the fire resistance of the cladding.

Note 2: The classification D1, D2 and D3 applies in the Czech Republic only.

Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

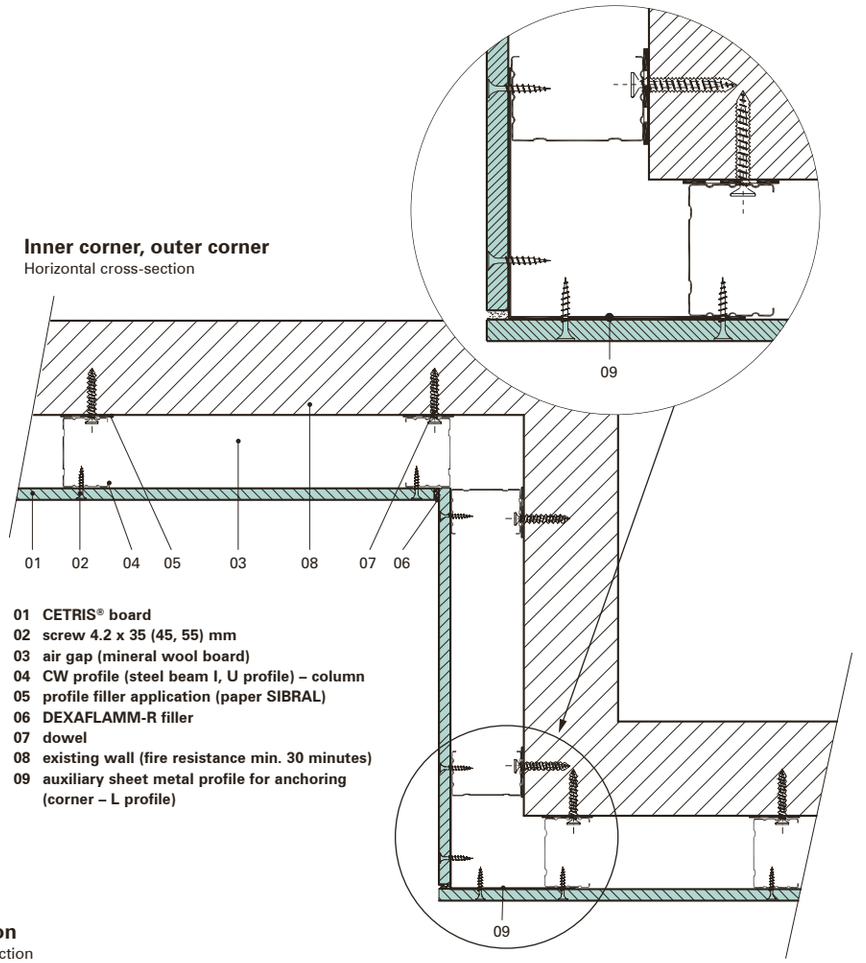
9.2.3.3 Model Construction Solutions – Details of Advanced Walls

Vertical cross-section



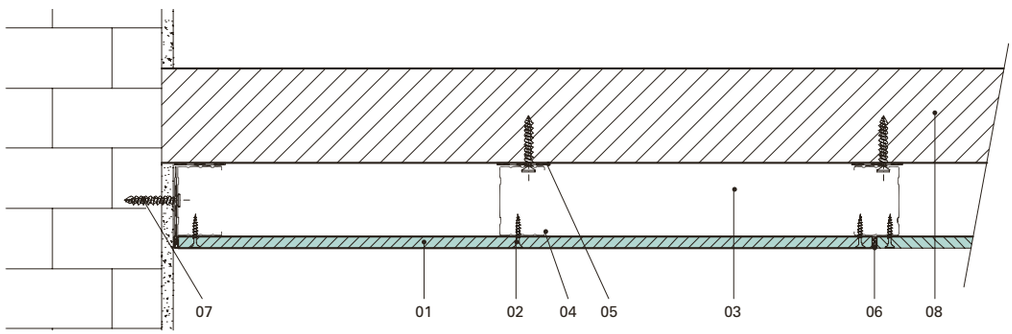
01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 air gap (mineral wool board)
04 CW profile (steel beam I, U profile) – column
05 profile filler application (paper SIBRAL)
06 DEXAFLAMM-R filler
07 dowel
08 existing wall (fire resistance min. 30 minutes)

Inner corner, outer corner
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 x 35 (45, 55) mm
03 air gap (mineral wool board)
04 CW profile (steel beam I, U profile) – column
05 profile filler application (paper SIBRAL)
06 DEXAFLAMM-R filler
07 dowel
08 existing wall (fire resistance min. 30 minutes)
09 auxiliary sheet metal profile for anchoring (corner – L profile)

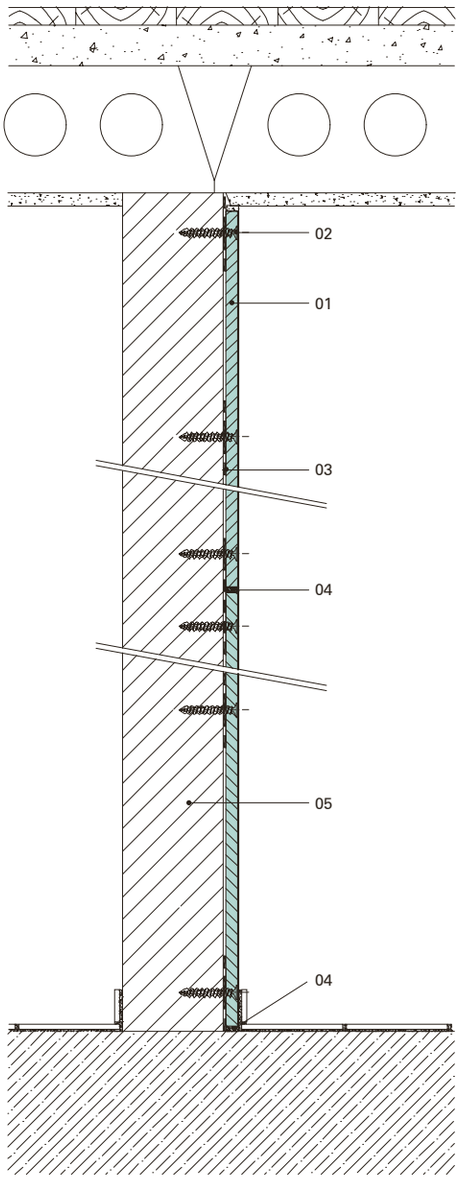
Wall connection
Horizontal cross-section



01 CETRIS® board
02 screw 4.2 × 35 (45, 55) mm
03 air gap (mineral wool board)
04 CW profile (steel beam I, U profile) – column
05 profile filler application (paper SIBRAL)
06 DEXAFLAMM-R filler
07 dowel
08 existing wall (fire resistance min. 30 minutes)

9.2.3.4 Model Construction Solutions – Details of Direct Wall Cladding

Vertical cross-section



01 CETRIS® board
02 dowel
03 profile filler application (paper SIBRAL)
04 DEXAFLAMM-R filler
05 existing wall (fire resistance min. 30 minutes)

9.2.3.5 General Principles of Assembly of Fire Walls on Steel Framework

All building constructions to which the non-load-bearing fire partitions and walls of CETRIS® boards are fixed in any manner, or by which they are supported and which might threaten their stability, must have at least the same fire resistance as the CETRIS® partition itself. If these constructions are structurally stressed then their potential deformations may not interfere with the integrity of the wall of CETRIS® boards. This requirement does not apply if the supporting and load-bearing construction cannot be exposed to thermal stress by fire even under the least favourable conditions for the period of the prescribed fire resistance.

- Maximum spacing of the screws anchoring the CETRIS® boards to the CW profiles must not exceed 200 mm (screws by the edges), or 400 mm (across the surface) and the distance from the board edges must not be less than 25 mm in the case of fire walls. In the case of multilayer coating the screw spacing may be doubled.
- Maximum spacing of screws on CETRIS® strips or assembly inserts must be 100 mm, or less.
- Screws used for anchoring CETRIS® boards to CW profiles must be at least 10 mm longer than the thickness of the anchored board.
- If the CETRIS® board is used as visible coating of an exterior fire construction it must be anchored as façade cladding – i.e. with predrilled holes (8 or 10 mm) and screws with visible heads and sealing washers (see chapter 8.7.7).
- Maximum spacing of dowels for anchoring CW and UW profiles must not exceed 625 mm.
- CETRIS® assembly inserts or strips must always be at least 12 mm thick and their thickness must be equal to the thickness of the coat board.
- The CETRIS® strip at the joints of the CETRIS® boards must overlap on both sides by at least 60 mm, unless otherwise specified in the detail drawing.
- Maximum spacing of CW assembly profiles must not exceed 625 mm, and at the same time must be based on the board thickness and the respective structural assessment. The length of CW profiles is about 15 mm less than the room height.
- Dilation joints and all contacts with the wall and the corner joints must be filled with fire resistant filler DEXAFLAMM-R. The filler must be applied to a minimum depth of 5 mm.
- Areas of CW or UW profiles adjacent to the floor and the ceiling or wall must be covered with fire resistant DEXAFLAMM-R filler. In the case of wall fire resistance more than 60 minutes SIBRAL paper is recommended to be placed under the profiles. The SIBRAL paper is also suitable for partial insulation of potential thermal bridges in the construction
- Boards of multilayer coats must be placed with an overlap of at least 400 mm and always without any cross joint
- Joints of single-layer coats must always be supported with a CW profile under the joint or (in the places where this is impossible for construction reasons) with a CETRIS® strip. In exposed cases – in the case of higher demand for fire resistance – both methods may be used. The boards must be laid tightly and their joints must be filled with filler. In the case of multilayer coating even the inside joints of the bottom layers must be filled with filler.
- All dilation joints in fire partitions with fire resistance above 60 minutes must always be supported with CETRIS® board strips under the joints of the same thickness as the thickness of the coat pursuant to the figure on page 26.
- For the purpose of fire resistances of constructions of more than 60 minutes it is recommended to insulate the insides of the CW and UW profiles adjacent to the load-bearing walls and ceilings with cut mineral wool.
- The position of mineral wool in an air gap of higher thickness than the thickness of the mineral wool strip is recommended to be fixed with adhesive pins.
- In the case of walls without mineral wool fills and with a height of 4 – 6 m it is necessary to underlay the contacts of the boards with the steel CW profiles with CETRIS® strips, thickness at least 12 mm, placed under the joints. The strip should exceed the width of the CW profile by at least 60 mm on each side.
- All openings in CETRIS® fire partitions must be sealed with inserts or in other ways pursuant to the project specifications. Installations inside the partitions (water pipes, electrical wiring etc.) must be wrapped in mineral wool for fire resistance, otherwise the fire resistance of the wall might be reduced by them.
- In the case of cladding of large wall constructions (longer or higher than 6 m) dilations in the load-bearing construction must be designed and made visible in the cladding of CETRIS® boards as well.

9.2.3.6 Assembly Procedure

a) Measure the locations of the UW profiles in the horizontal planes and apply DEXAFLAMM-R filler, or paper SIBRAL as needed, onto the places on the floor and on the ceiling where the profiles are to be laid.
b) Fix the profiles to the floor, ceiling or to the walls, as the case may be, with steel dowels. The maximum spacing of the dowels with regard to the weight of the boards has been specified to be 625 mm.
c) Install the CW profiles in the construction with the spacing as per the structural assessment and board thickness, max. 625 mm apart. The length of the CW profiles must be about 15 mm shorter than the height of the room.
d) Insert mineral wool between the profiles if required.
e) Screw in the CETRIS® boards on the prepared construction leaving a gap of at least 10 mm between the floor and the ceiling and the bottom and top edges of the boards. Fix the CETRIS® boards with the screws to the CW profiles only.
f) In the case of double or multilayer coats the boards are laid with an overlap of minimum 400 mm.

NOTE! In the case of three-layer coats the joints of the bottom and the top coat must not be in the same places.

g) The following applies to anchoring CETRIS® boards to the construction: The maximum axial distances of the screws from each other is 200 mm, only in the case of double or multilayer coating the spacing can be expanded in the first layer to 400 mm max.

9.2.4 Load-Bearing Peripheral Wall on Wooden Framework – (Alternatively: Non-Load-Bearing Peripheral Wall on Wooden Framework)

9.2.4.1 Load-Bearing Construction

The load-bearing construction is made of a frame of wooden vertical columns 120 × 100 mm and horizontal beams 120 × 50 mm, interconnected with screws. The prisms can be made of dried spruce lumber (humidity 18 %, compactness class min. S II), or glued lumber may be used. The wooden prisms are anchored in the frame (the wall) with steel dowels with the spacing of 625 mm.

The gap between the columns and the wall is filled with DEXAFLAMM-R filler. Axial distance of the vertical inside wooden posts must not exceed 625 mm.

9.2.4.2 Construction Composition

The construction is asymmetrically coated:

- On the outside with a single layer of cement-bonded particleboard CETRIS® 14 mm thick with horizontal overlap of 400 mm min. For anchoring of the CETRIS® boards self-cutting screws with sunken heads and blades for countersinking in the board are used, screw size 4.2 × 35 mm. The joints between the boards must be at least 5 mm wide. The joints, the wall perimeter and the screw heads are filled/covered with DEXAFLAMM-R filler.
- On the inside with a single layer of Knauf® GKF plasterboard 12.5 mm thick with horizontal overlap of 400 mm min. For anchoring of the Knauf® GKF boards self-cutting screws with sunken heads TN 4.2 × 35 mm are used. The joints between the boards must be minimised. The joints are filled and the screw heads are covered with Uniflott filler. The space between the frame posts must be filled with mineral wool, minimum thickness 120 mm.

Table 9: Fire characteristics of load-bearing peripheral wall on wooden framework, height up to 3 m

FIRE RESISTANCE [1]	CONSTRUCTION COMPOSITION			FIRE EXPOSURE
	Exterior coat	Mineral board [2]	Interior coat	
REI 60 D3	CETRIS® 14	120	Knauf® GKF 12.5	External fire (exposed CETRIS® board)
REW 60 D3 [3]				Internal fire (exposed KNAUF board)

Notes to Table 9:
1) Classification of limit fire resistance pursuant to ČSN 73 0810, construction tested pursuant to EN 1365-1
2) Mineral insulation Orsil (Isover) type Uni or another mineral fibre board with bulk density of at least 40 kgm^{-3}, flammability grade max. B (not easy to catch fire) pursuant to ČSN 73 0862 (A2 fire reaction class pursuant to EN 13501-1 assumed)
3) As fire compartment

9.2.4.3 General Principles of Assembly of Fire Walls on Wooden Framework

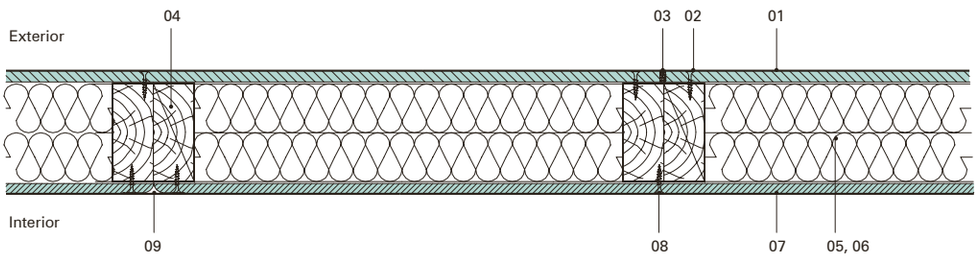
The below mentioned principles apply to implementation of the load-bearing wooden frame and for anchoring CETRIS® boards. Anchoring of Knauf boards, joint filling and surface finish must be implemented in compliance with the regulations of Knauf company.

- Maximum spacing of the screws anchoring CETRIS® boards to the wooden posts must not exceed 200 mm (screws at the edges), or 400 mm (across the surface) and the distance from the board edges must not be less than 25 mm in the case of fire walls.
- If the CETRIS® board is used as visible coating of an exterior fire construction it must be anchored as façade cladding – i.e. with predrilled holes (8 or 10 mm) and screws with visible heads and sealing washers (see chapter 8.7.7).
- Maximum spacing of dowels for anchoring wooden prisms must not exceed 625 mm.
- Maximum spacing of the vertical wooden posts must not exceed 625 mm, Profile 120 by 100 mm is the minimum size and needs structural assessment.
- Dilation joints, all contacts with the wall and the corner joints must be filled with refractory filler DEXAFLAMM-R. The filler must be applied to the minimum depth of 5 mm.
- Areas of wooden prisms adjacent to the floor and the ceiling or wall must be covered with fire resistant DEXAFLAMM-R filler.
- The position of mineral wool in an air gap of higher thickness than the thickness of the mineral wool must be fixed with adhesive pins.
- All openings in the fire wall must be sealed with fire inserts or in other ways pursuant to the project specifications. Installations inside the partitions (water pipes, electrical wiring etc.) must be wrapped in mineral wool for fire resistance, otherwise the fire resistance of the wall might be reduced by them.

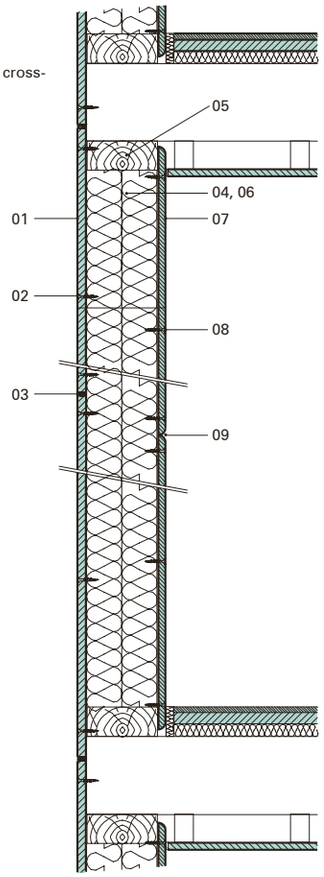
9.2.4.4 Model construction solutions – peripheral load-bearing wall on wooden construction – DETAILS

01 CETRIS® 14 mm board
02 screw 4.2 × 35 mm
03 DEXAFLAMM-R filler
04 vertical wooden post 120 × 100 mm (spacing 625 mm)
05 wooden prism 120 × 50 mm
06 mineral wool (Orsil Uni) – 2× thickness 60 mm
07 Knauf GKF 12.5 mm board
08 screw TN 3.5 × 35 mm
09 joint fill – Knauf Uniflott

Horizontal cross-section



Vertical cross-section



9.3 Horizontal Constructions – Ceiling Panels

9.3.1 Applicability Range

On the basis of the tests CETRIS® boards may be used in the following types of horizontal constructions:

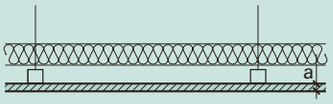
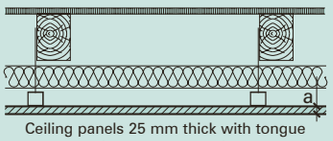
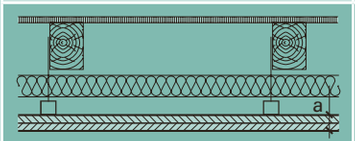
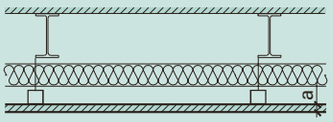
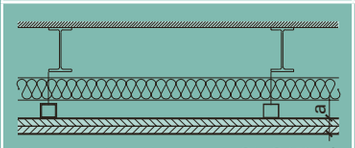
- Separate fire ceiling panel, heat (fire) exposition from underneath. In this case the fire resistance is specified directly by the result of the fire resistance test.
- Ceiling (roof) panel, heat (fire) exposition from underneath. In this case the fire resistance of the composed construction is specified as the sum of fire resistance of the ceiling (roof) construction and the protective panels of CETRIS® boards.

As stated in the protocols it is also necessary to comply with the technology of the ceiling panel assembly and all assembly procedures used and tested in the context of the sample preparation. The ceiling constructions may be of any size on condition that the spacing between the suspensions will not increase and that the expansion measures will be adequately adapted. The test results apply to cavities of any height. This in effect means that the designed joining elements, their spacing and layout and other details are binding and must be complied with for the belowmentioned attests to apply.
The typical samples of the constructions have been tested and the test have been documented by the state accredited testing laboratory PAVÚS – Veselí n. L. in different wall compositions and. On the basis of these tests the laboratory has issued fire resistance test protocols № Pr-03-02.088 and Pr-03-02.089. These reports, together with some other tests performed in recent years, have been used as the basis for PAVUS a.s. Praha (Ing. Karpaš CSc, Ing. Bauma CSc), who then prepared extended applications and the needed dimensional tables generalising the results for the above application range in the context of the final expert assessment.

Important notice:
All data apply to the conditions and exposures of horizontal constructions in the case of fire in the sense of the currently valid wording of EN 1364-2. The results of fire resistance tests and the tables following from them only assess the issues of technical properties of the constructions in relation to their resistance to actual fire. For that reason axial distances and types of CD profiles found compliant by the tests are specified. These, however, must be considered the minimum limits that must not be exceeded. It needs to be noted that when dimensioning fire ceiling panels, what also always needs to be considered is the structural demand for the construction. The the load-bearing construction must be adjusted with respect to the actual loading in relation to the weight of the CETRIS® boards.

Assembly of fire constructions may only be carried out by trained staff – see Chapter 9.4 Training of Assembly Companies in Applications with CETRIS® Boards.

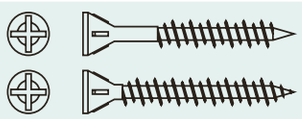
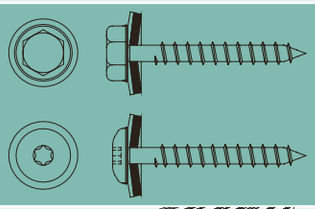
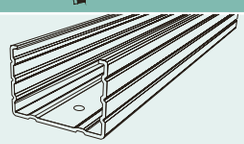
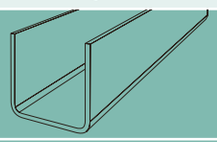
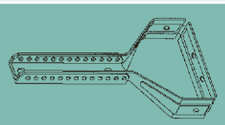
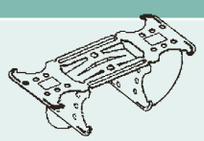
Table 10: Survey of horizontal constructions

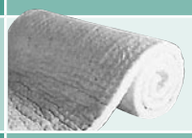
	FIRE RESISTANCE [1]	CEILING PANEL COATING a (mm)	MINERAL WOOL [1]		CEILING PANEL CONSTRUCTION WEIGHT (kg/m²)	LOAD-BEARING CONSTRUCTION				FIRE RESISTANCE	THERMAL RESISTANCE	DESCRIPTION, SOLUTION DETAILS
			BULK DENSITY (kg/m³)	THICKNESS (mm)		Description	Spacing of assembly profiles (mm)	Spacing of load-bearing profiles (mm)	Spacing of suspensions (mm)			
Separate ceiling panel		1 × 12	75	2 × 40	21.60	CD 60 × 27	420	1000	420	EI 15 [3]	2.06 [2]	Page 24
		2 × 12			41.60			900		EI 45 [3]	2.12 [2]	
Ceiling panel under joist ceiling	 Ceiling panels 25 mm thick with tongue and groove connections	1 × 12			21.60			1000		REI 30 [4]	2.06 [2]	Page 30
	 Ceiling panels 30 mm thick with tongue and groove connections	2 × 12			41.60			900		REI 60 [4]	2.12 [2]	
Ceiling panel under steel beam ceiling	 Unprotected steel beams ratio O/A S 300 m²	1 × 12			21.60			1000		REI 30 [4]	2.06 [2]	Page 31
	 Unprotected steel beams ratio O/A S 150 m²	2 × 12			41.60			900		REI 60 [4]	2.12 [2]	

Notes to Table 13:

1) Mineral fibre board of prescribed thickness and bulk density, flammability grade max. B (not easy to catch fire) pursuant to ČSN 73 0862 (A2 fire reaction class pursuant to EN 13501-1 assumed).
2) Informative value of thermal resistance of the ceiling panel construction itself.
3) Value of fire resistance of separate ceiling panel for fire exposure from underneath.
4) Value of fire resistance of composed construction for fire exposure from underneath. The resulting fire resistance of the whole composition equals to the sum of fire resistance of the ceiling (roof) construction and the protective ceiling panels of CETRIS® boards. For other variants of the ceiling (roof) construction see the principles specified in Chapter 9.3.3 Fire Ceiling Panels under Ceiling (Roof) Construction.

Table 11: Materials for assembly of horizontal constructions – specifications

DESCRIPTION	PICTURE	NOTE	TYPE OF CEILING PANEL	
			Separate ceiling panel	Ceiling panel under ceiling (roof) construction
CETRIS® BASIC Cement-bonded particleboard, smooth surface, cement grey. Basic size 1,250 × 3,350 mm Bulk density 1,320 ±70 kgm³		Thickness 12 mm, number of layers pursuant to fire resistance requirement.	X	X
CETRIS screw 4.2 × 25, 45 mm Self-cutting and self drilling screws with sunken heads.		Screws 4.2 by 25 – coating 1 × 12 mm Screws 4.2 by 45 – coating 2 × 12 mm	X	X
Screw 4.8 × 38, 45, 55 mm Stainless or galvanised screws with semi-circular or hexagonal heads with compressive water tight washer.		Screw type (length) pursuant to the cladding thickness. For anchoring of upper layer of CETRIS® board in exterior – where the board remains visible. The board must be predrilled with a hole diameter of 8 (10) mm!	X	X
CD profile Zinc-coated sheet metal open profile 27 × 60 × 0.6 mm, length 2.50 – 4.50 m.		Creates load-bearing grid for ceiling panel assembly. Fixed with straight or nonius suspension on ceiling (roof) construction.	X	X
UD profile Zinc-coated sheet metal open profile 28 × 27 × 0.6 mm, length 3.00 m.		For ceiling panel anchoring to masonry walls with steel dowels.	X	X
Connector for CD profile		For mechanical connections of CD profiles.	X	X
Straight suspension 1 mm thick, length 125 mm, load-bearing capacity 40 kg		For suspension of metal grid of CD profiles on wooden joists of ceiling construction.	X	X
Nonius suspension, load-bearing capacity 40 kg Three-part system for fixation of CD profile grid to load-bearing ceiling construction.		Allows for setting different heights of the cavity between the ceiling panel and the load-bearing construction.	X	X
Cross connector		For mechanical fixation of crossing CD profiles in vertical arrangement.	X	X

DESCRIPTION	PICTURE	NOTE	TYPE OF CEILING PANEL	
			Separate ceiling panel	Ceiling panel under ceiling (roof) construction
Planar cross joint NIVEAU		For mechanical fixation of crossing CD profiles in a single plane.	X	X
Steel dowels For profile anchoring to masonry (concrete) walls		Size (diameter and length) pursuant to the construction weights, base types and anchored material.	X	X
Filler DEXAFLAMM-R White tixotrophic material for joint filling and screw head covering		Alternatives include fire resistant single-component fillers (acrylic, silicon) permanently elastic (Sika Firesil, Den Braven Pyrocryl).	X	X
Paper SIBRAL Mats of aluminium-silicon fibre, thickness 13 mm		For profile lining on the bottom side, interruption of thermal bridges, as insulation for temperatures up to 1,260° C.	X	X
ORSIL (ISOVER) Mineral board thickness 2 × 40 mm, bulk density 75 kgm^{-3} (max. bulk density 100 kgm^{-3})		Alternatives include mineral board of the same bulk density, flammability class max. B pursuant to ČSN 73 0862, assumed fire reaction class A2 (pursuant to EN 13501).	X	X

9.3.2 Separate Fire Ceiling Panel

9.3.2.1 Load-Bearing Construction

The load-bearing construction consists of a grid of steel zinc-coated profiles CD 60 × 27 × 0.6 mm in lengthwise and crosswise directions. The lengthwise and the crosswise profiles may be assembled to a single plane (connected with flat cross joints) or to two planes (the crosswise grid is placed above the lengthwise grid and the two grids are connected with multilevel joints). The grid is fixed to the ceiling (roof) construction with a system of suspensions. The crosswise and lengthwise spacing of the profiles, the spacing and the type of suspensions depend on the coat type (weight of the ceiling panel).The grid holds heat insulation consisting of two layers of mineral fibreboard, thickness 40 mm.

The load-bearing grid may be complemented at the wall with a UD profile for the ceiling panel anchoring to vertical constructions. The anchors are made with steel dowels.

9.3.2.2 Construction Composition

The ceiling panel construction is coated on the bottom side with one or two layers of CETRIS® cement-bonded particleboards, thickness 12 mm. The boards are laid with mutual overlaps of at least 400 mm to prevent formation of cross joints. In the case of multilayer coating the joints between the boards are mutually overlapped – always at least by one profile width (420 mm).

CETRIS® boards are anchored to the steel profiles with self-cutting and self-drilling screws with sunken heads and blades for countersinking, size 4.2 × 25 mm. The screw must be at least 10 mm longer than the thickness of the fixed board. In the case of multilayer coating the second layer of CETRIS® boards must be screwed with screws with the minimum length of 35 mm. Gaps are left between the boards with the minimum width of 5 mm. The joints and wall perimeter are filled and screw heads are covered with DEXAFLAMM-R filler.

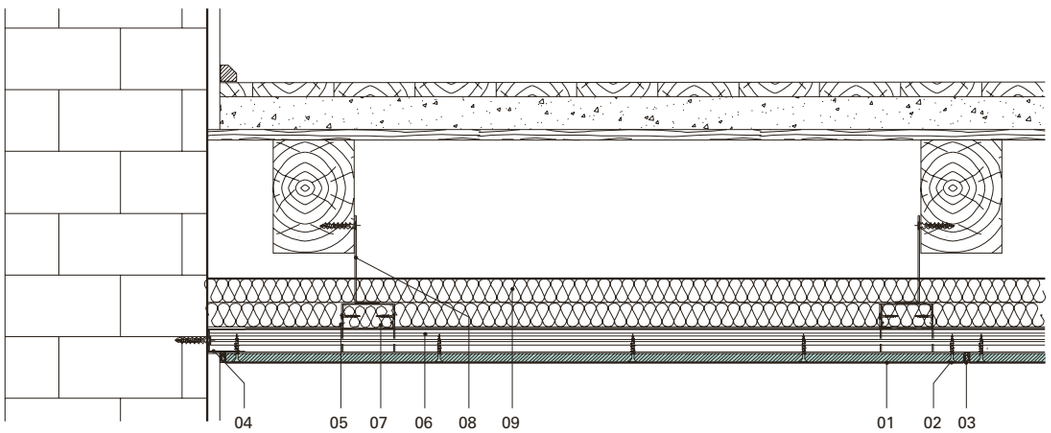
Table 12: Fire characteristics of separate ceiling panels coated with CETRIS® boards

FIRE RESISTANCE [1]	CONSTRUCTION COMPOSITION		FIRE EXPOSURE
	COATING	MINERAL FIBREBOARD [2]	
EI 15	CETRIS® 1 × 12 mm	2 × 40 mm	Heat exposition from underneath
EI 45	CETRIS® 2 × 12 mm	2 × 40 mm	Heat exposition from underneath

Notes to Table 15:
1) Classification of limit fire resistance pursuant to ČSN 73 0810, construction tested pursuant to EN 1365-1
2) Mineral insulation Orsil (Isover) type Uni or another mineral fibre board with bulk density of at least 40 kgm^{-3}, flammability grade max. B (not easy to catch fire) pursuant to ČSN 73 0862 (A2 fire reaction class pursuant to EN 13501-1 assumed)

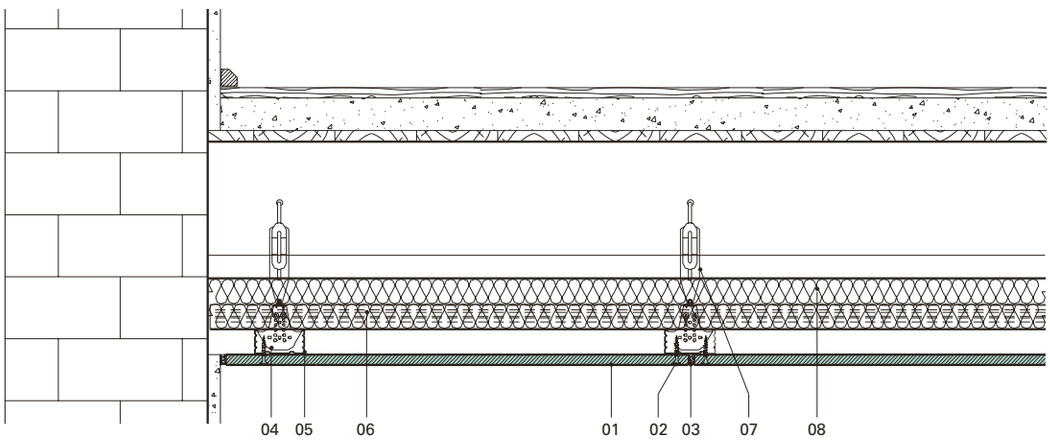
9.3.2.3 Model construction solutions – details

Lengthwise cross-section



01 CETRIS® board
02 screw 4.2 × 25 (35, 45) mm
03 DEXAFLAMM-R filler
04 UD profile
05 cross connector
06 CD profile – assembly
07 CD profile – load-bearing
08 suspension
09 mineral wool

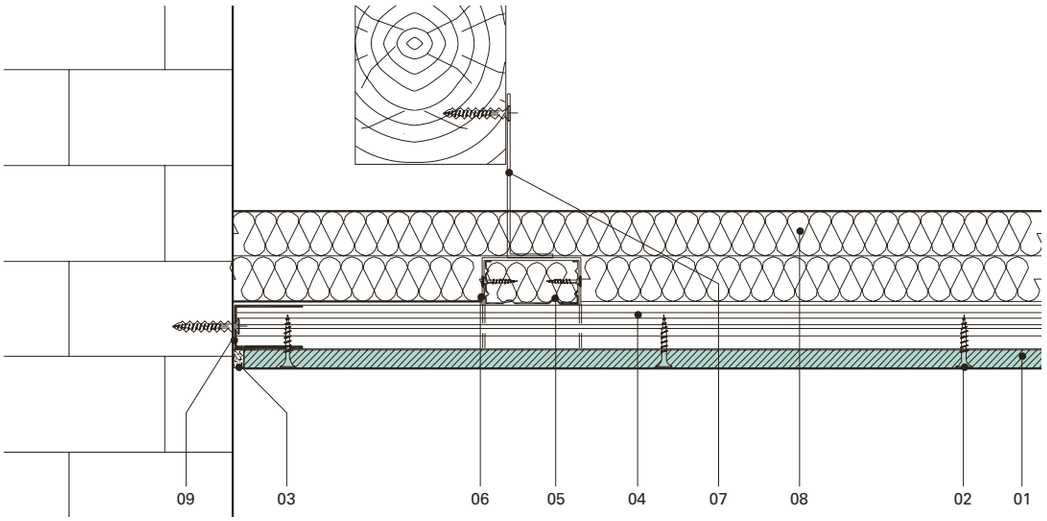
Crosswise cross-section



01 CETRIS® board
02 screw 4.2 × 25 (35, 45) mm
03 DEXAFLAMM-R filler
04 cross connector
05 CD profile – assembly
06 CD profile – load-bearing
07 suspension
08 mineral wool

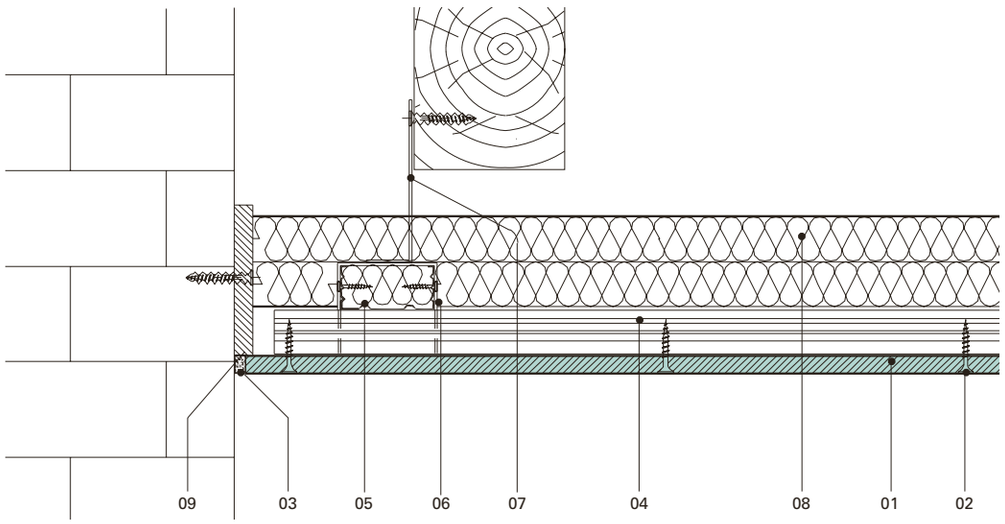
Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

Connection with joint filled with filler (sealed with a UD profile)



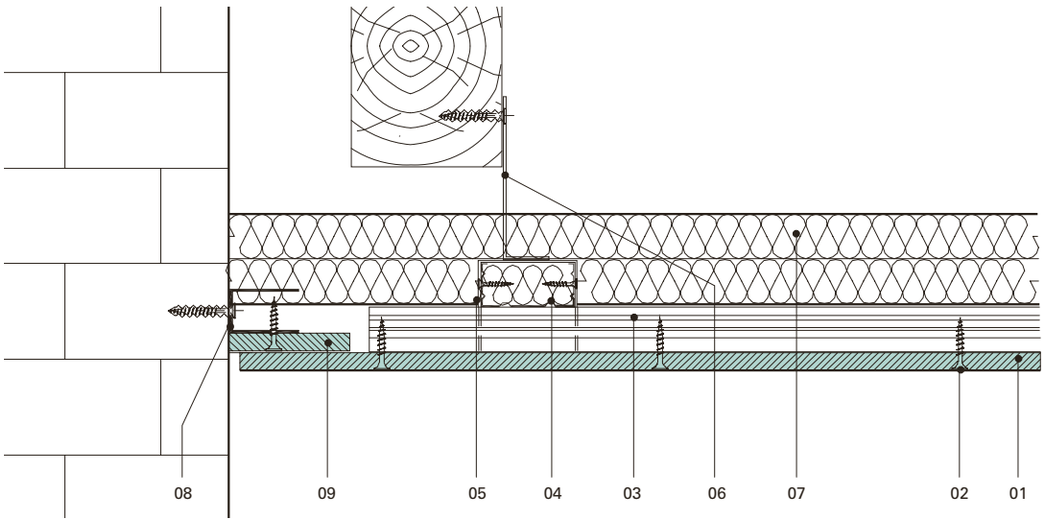
01 CETRIS® board
02 screw 4.2 × 25 (35, 45) mm
03 DEXAFLAMM-R filler
04 CD profile – assembly
05 CD profile – load-bearing
06 cross connector
07 suspension
08 mineral wool
09 UD profile

Connection with joint filled with filler (sealed with a CETRIS strip)



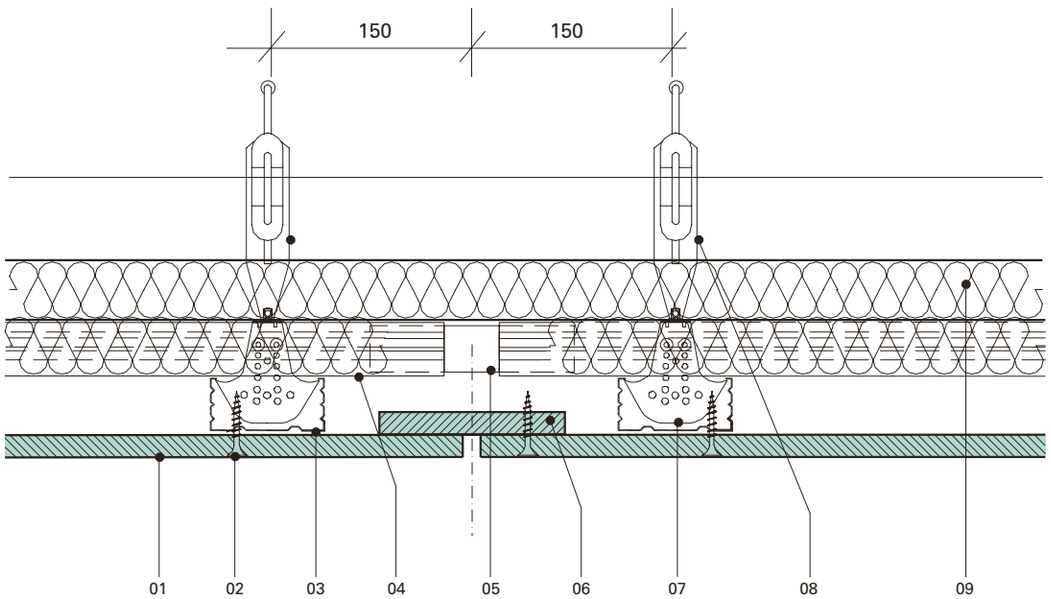
01 CETRIS® board
02 screw 4.2 × 25 (35, 45) mm
03 DEXAFLAMM-R filler
04 CD profile – assembly
05 CD profile – load-bearing
06 cross connector
07 suspension
08 mineral wool
09 CETRIS® strip

Connection with supported joint (sealed with a UD profile and CETRIS strip)



01 CETRIS® board
02 screw 4.2 × 25 (35, 45) mm
03 CD profile – assembly
04 CD profile – load-bearing
05 cross connector
06 suspension
07 mineral wool
08 UD profile
09 CETRIS® strip

Dilation joint in ceiling panels



01 CETRIS® board
02 screw 4.2 × 25 (35, 45) mm
03 CD profile – assembly
04 CD profile – load-bearing
05 CD joint
06 CETRIS® strip
07 cross connector
08 suspension
09 mineral wool

9.3.2.4 General Principles of Assembly of Fire Ceiling Panels

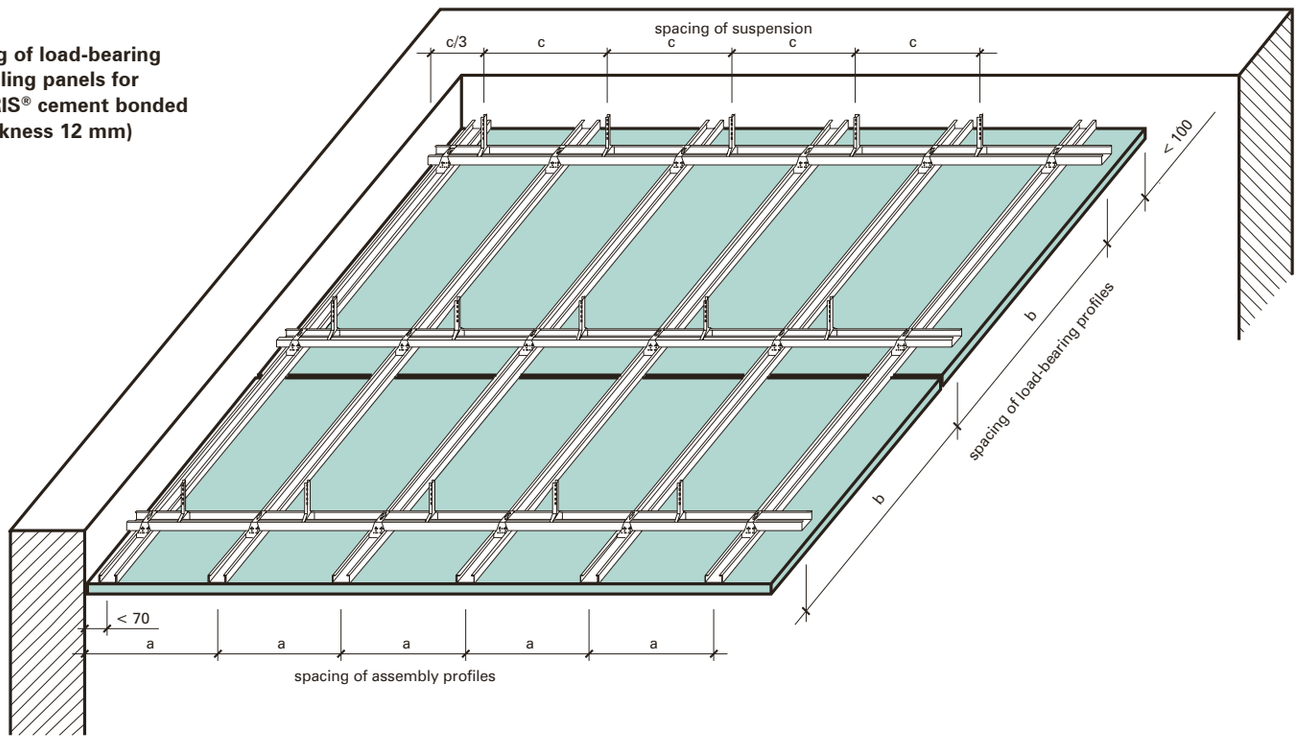
- All structurally independent load bearing building constructions, to which CETRIS® ceiling panels are fixed in any manner or related as boundaries of fire compartments which might threaten their stability if failing, must have at least the same fire resistance as the CETRIS® ceiling and panels themselves. If these constructions are structurally stressed then their potential deformations may not interfere with the integrity of the ceiling or panels of CETRIS® boards. This requirement does not apply if the supporting and load-bearing construction cannot be exposed to thermal stress by fire even under the least favourable conditions for the period of the prescribed fire resistance.
- Maximum spacing of the screws anchoring CETRIS® boards to the CD profiles must not exceed 200 mm (screws by the edges), or 400 mm (across the surface) and the distance from the board edges must not be less than 25 mm in the case of fire ceiling panels.
- Screws used for anchoring CETRIS® boards to CD profiles must be at least 10 mm longer than the thickness of the anchored board.
- If the CETRIS® board is used as visible coating of an exterior fire construction it must be anchored as façade cladding – i.e. with predrilled holes (8 or 10 mm) and screws with visible heads and sealing washers (see chapter 8.7.7).
- CETRIS® assembly inserts or strips must always be at least 12 mm thick.
- CETRIS® strip covering joints between CETRIS® boards must overlap on both sides by at least 10 mm, unless otherwise specified in the detail drawing.
- Maximum spacing of dowels for anchoring UD profiles must not exceed 625 mm.
- The bottom layer of insulation boards is laid over assembly CW profiles and fills the load-bearing CW profile.
- Dilation joints and all contacts with the wall and the corner joints must be filled with refractory filler DEXAFLAMM-R. The filler must be applied to the minimum depth of 5 mm.

Table 13: Axial distance of assembly CD profiles, load-bearing CD profiles and suspensions

CEILING PANEL COATING COMPOSITION	SPACING OF ASSEMBLY PROFILES **a** (mm)	SPACING OF LOAD-BEARING PROFILES **b** (mm)	SPACING OF SUSPENSIONS **c** (mm)	NOTE
1 × 12 mm	< 420	< 1,000	< 420	See Figure 1
1 × 12 mm	< 420	< 900	< 420	See Figure 2

The values apply to ceiling panels and constructions without additional loading (lighting, air conditioning etc.). The visible ceiling constructions in rooms where negative or excess pressure may be created by ventilation and air conditioning technology must be assessed individually.

Fig. 1)
Schematic drawing of load-bearing construction of ceiling panels for coating with CETRIS® cement bonded particleboard (thickness 12 mm)



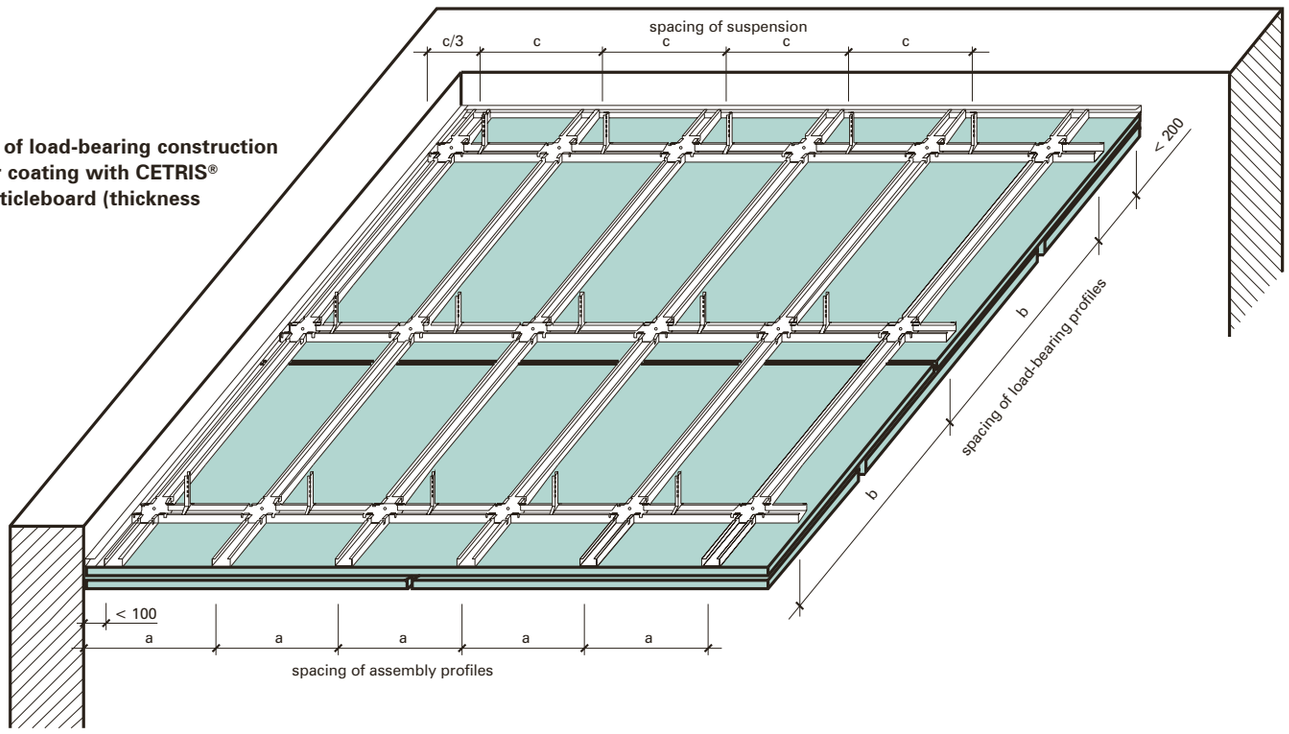


Fig. 2)
Schematic drawing of load-bearing construction of ceiling panels for coating with CETRIS® cement bonded particleboard (thickness 2 × 12 mm)

- Surfaces of CD or UD profiles adjacent to masonry walls must be covered with fire resistant filler DEXAFLAMM-R and sealed with a layer of SIBRAL paper as needed.
- NIVEAU connectors by KNAUF for profiles CD 60 × 27 will be used for ceiling panels of two layers of CETRIS® boards. Fishplates of these joins must be bent and screwed together with the load-bearing profile with screws LN 3.5 × 9 mm.
- KNAUF cross connectors for profiles CD 60 × 27 will be used for ceiling panels of one layer of CETRIS® boards. It is recommended to secure the cross connectors with screws of minimum size M6 × 40 with nuts and washers.
- Joints of multilayer coating must alternate with mutual overlaps of at least 100 mm and without any cross joint whatsoever.
- Joints of single-layer coats must always be supported with a CD profile, or (where impossible for construction reasons) with CETRIS® strips. In exposed cases – in the case of higher demand for fire resistance – both ways are recommended to be used simultaneously. All joints must be filled with filler. In the case of multilayer coats the joints of the bottom layers must be filled with filler too.

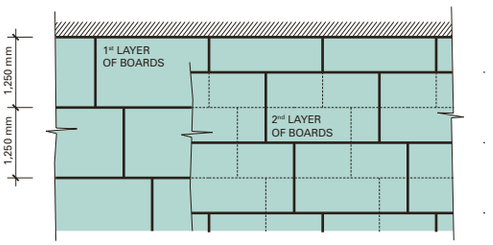
9.3.2.5 Notes to Assembly

The system of CETRIS® ceiling panels is fixed to the metal grid of CD profiles crossed either on a single level (cross connectors) or on two different levels (connectors). CETRIS® boards are then fixed to these profiles with screws in one or two layers.
No additional load (such as lighting) may be fixed to the CETRIS® board ceiling panels themselves and no other holes may be drilled in them without further treatment (for ventilation grids etc.). All these adaptations may only be performed by procedures proposed by the project. Lighting must be suspended under the ceiling panels on a separate load-bearing construction. The passages must be sealed with SIBRAL paper or mineral wool and DEXAFLAMM-R filler. Locations and types of lamps, potentially sunk in the panels, must be discussed with the fire protection designer in advance and the openings must be treated with fire protection means depending on the lamp and construction type. Ventilation grids for air conditioners must be provided with fire resistance identical with the fire resistance of the through pass.

The following assembly rules must be observed:

- CETRIS® boards must always be assembled with the longer edge perpendicular to the load-bearing profiles.
- All crosswise joints must be supported with a profile or an assembly insert with an overlap of at least 400 mm.
- Fixation must always start from the centre or corner of the board (for elimination of potential tensions).
- When screwing the board always press it tightly to the load-bearing CD profiles. Pre-drilling of the board is recommended.
- When coating large ceilings (longer or wider than 6 m) the dilations on the load-bearing construction must be carefully designed and made visible in the CETRIS® board coating too.

When applying a two-layer ceiling panel construction the second (external) layer must always be overlapped pursuant to the following scheme:



9.3.3 Fire Ceiling Panels under Ceiling (Roof) Construction

Fire ceiling panels described in the previous chapter may also be used under ceiling (roof) constructions if the relevant regulations are complied with.
Adding the value of fire resistance of the ceiling panel to the fire resistance value of the protected ceiling (roof) construction itself will result in the total fire resistance of the ceiling (roof) + ceiling panel system. The values apply to all types of ceiling (roof) constructions – concrete, steel, composite steel-concrete and wooden.

Assessment of fire resistance of ceiling (roof) constructions is based on dimension tables included in the following standards:

- **ČSN 73 0821** "Fire Safety of Buildings – Fire Resistance of Building Constructions"
- **ENV 1992-1-2** "Design of concrete structures. General rules. Part 1.2: Structural fire design"
- **ENV 1993-1-2** "Design of steel structures. General rules. Part 1.2: Structural fire design"
- **ENV 1994-1-2** "Design of composite steel and concrete structures. General rules. Part 1.2: Structural fire design"
- **ENV 1995-1-2** "Design of timber structures. General. Part 1.2: Structural fire design"

For easier orientation the frequent occurring cases, especially in the field of wooden and steel ceiling (roof) constructions, will be dealt with in the following chapters.

Specification of fire resistance of concrete ceiling (roof) constructions will not be dealt with here for the generally high fire resistance of such constructions (protection of concrete constructions against fire is required very rarely). If this value needs to be specified the following standards may be used: ČSN 73 0821, ENV 1992-1-2.

9.3.3.1 Fire Ceiling Panel under Wooden Construction

When assessing the fire resistance of **wooden** ceiling (roof) construction the whole composition of the construction should be assessed, including the layers above the cover (decks) such as insulation, backfill, flooring (roofing) which also contribute to the construction integrity.
To simplify this procedure the fire resistance of wooden ceilings (roofs) is calculated as the lower of the values of fire resistance of the load-bearing ceiling (roof) beam (ceiling joist) and of the cover of planks or boards.
Table 14 is used for specification of the fire resistance of wooden ceilings. **However, as the thickness of the ceiling planks is hardly ever very high, it is always the ceiling planks that decide the fire resistance of the whole ceiling (roof) construction.**
The important aspects also include the implementation of the ceiling (roofing) – the ceiling integrity is determined by the plank joints; assessment for the centres of the planks is only made in the case of a lath covering of all joints.
This material includes values of fire resistance for the most frequent cases (with minimum fire resistance of the ceiling – roof construction). All details of the issue can be found in ČSN 73 0821 and ENV 1995-1-2 standards.

Table 14: Fire resistance of wooden load-bearing elements (taken from ČSN 73 0821)

ELEMENT NAME, VARIANT	FIRE RESISTANCE IN MINUTES
Wooden beams (ceiling joints), bend stressed, unprotected on three sides	
a) Min. width 100 mm, min. height 140 mm	25
b) Min. width 120 mm, min. height 160 mm	30
c) Min. width 140 mm, min. height 200 mm	40
d) Min. width 180 mm, min. height 260 mm	50

Note to Table 14: Fire resistance of wooden beams is specified for beams of massive timber, use of soft timber (spruce, pine, fir) of class I-II is assumed.

Table 15: Fire resistance of wooden ceiling cover (pursuant to ENV 1995-1-2)

CEILING COVER THICKNESS (mm)	FIRE RESISTANCE (PLANK BREAKING) IN MINUTES BY IMPLEMENTATION			
	TIGHTLY PLACED PLANKS [1]	SEMI-GROOVE JOINT [1]	TONGUE AND GROOVE JOINT [1]	JOINT LATHING [2]
20	4.4	6.7	8.9	18.2
25	6.2	9.3	12.4	27.1
30	8.2	12.2	16.3	36.8
35	10.3	15.4	20.6	47.5
40	12.6	18.9	25.2	58.9

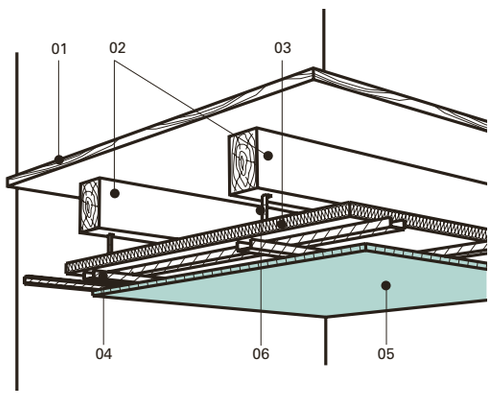
Notes to Table 15:
1) Fire resistance specified by the time to plank breaking in the places of joints
2) Fire resistance specified by the time to plank breaking in the places of full thickness

Example:
An existing joist ceiling includes beams with a diameter of 140 × 160 mm, the ceiling planks are tongue and groove connected and the plank thickness is 25 mm. The required fire resistance after application of ceiling panels is 30 minutes.

Procedure:
1. *Specify the fire resistance of the existing wooden ceiling from the tables as the lower of the following two values:*
   - *Fire resistance of the beam (ceiling joist) – 30 min.*
   - *Fire resistance of the ceiling planks 25 mm thick and tongue and groove connected – 12 min.*

Therefore the fire resistance of the existing ceiling is 12 min.

2. Design of ceiling panel construction
Required fire resistance of the ceiling panels = Required total fire resistance – Fire resistance of the existing ceiling construction, i.e. 30 – 12 = 18 minutes => The sufficient ceiling panel construction will be 1 layer of CETRIS® boards, thickness 12 mm, with fire resistance EI 21 D1



01 ceiling planks
02 wooden beam
03 mineral wool
04 CD profile
05 CETRIS® cement bonded particleboards
06 suspension

9.3.3.2 Fire Ceiling Panels under Steel (Steel-Concrete) Construction

Fire resistance of steel constructions – their effectiveness in fire protection and ability to resist fire – is determined by their shape, or the proportion of the circumference of the steel construction exposed to fire O (in mm) and the cross section area of the construction A (in mm²) and the method of protection of the load-bearing beams (unprotected vs. protected with cladding, paint etc.). This material includes values of fire resistance for the most frequently occurring cases (with minimum fire resistance of the ceiling – roof – construction). All details can be found in ČSN 73 0821, ENV 1993-1-2 standards.

The parameters of suspended ceiling panels clad with CETRIS® cement bonded particleboard were tested in 2007 in the context of certification pursuant to EN 13 964 Suspended Ceilings. The result of the tests is an EC Certificate of conformity for Suspended ceiling panels with the following declared values, including but not limited to:

- **Fire resistance** (variants EI 15 and EI 45 – see above)
- **Reaction to fire A2 s1,d0**
- **Susceptibility to breaking – impact resistance 1A.** A ceiling panel of one layer of CETRIS® boards, thickness 12 mm (assembled on a grid of CD profiles) was tested pursuant to EN 13 964 standard, annexe D, by 36 hits by a ball, 12 times vertical and 24 from various directions at an angle of 60°. The tests were based on the maximum impact speed (1A – nearly 60 km/hr), and the ball was shot to different places on the ceiling (board joints, between supports etc.). In the course of the test and after its completion the appearance of the ceiling panels was monitored continuously – the appearance was not damaged in any way, and no defect (crack) developed. Thus the compactness, function and safety of the ceiling panel were not compromised.
- **Sound transmission loss Rw = 43 dB** (applies to the variant with a single-layer CETRIS® coat of 12 mm).
- **Thermal resistance of ceiling panel 2.26 m²K/W**

Table 16: Fire resistance of ceilings of steel beams (unprotected) exposed to fire on three sides

DESCRIPTION OF CONSTRUCTION	FIRE RESISTANCE IN MINUTES AT PROPORTION O/A*10³ (m⁻¹)	
	>100 <150	>150 <300
Ceiling of steel beams, unprotected, exposed to fire on three sides	15	10

Fire resistance of construction of shaped unprotected sheet metal profiles cold drawn

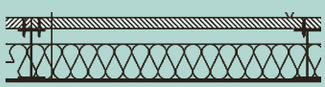
NAME OF ELEMENT, VARIANT	FIRE RESISTANCE IN MINUTES
Sheet metal filled with concrete class B20, min. thickness 40 mm, without additional reinforcement	20
Sheet metal filled with concrete class B20, min. thickness 40 mm, with additional reinforcement (area min. 15 % of sheet metal cross section area, coverage 30 mm)	45

9.4 Horizontal Constructions – Ceilings and Floors

9.4.1 Introduction

Horizontal constructions (ceiling, roof, floor constructions) are mostly exposed to fire on their bottom part. The required fire resistance is achieved in these cases by ceiling panels (for the solutions see Chapter 9.3 Horizontal Constructions – Ceiling Panels). CETRIS® cement bonded particleboards can also improve the fire resistance of horizontal constructions exposed to fire from the upper size. This fire load is characteristic mainly for ceiling and floor constructions forming horizontal partitions between the floors of a house.

Ceiling Construction (Steel Load-Bearing Construction) – Exposed to Fire from Upper Side

CONSTRUCTION SCHEMATIC	THICKNESS OF UPPER LAYER OF CETRIS® **d** (mm)	AXIAL DISTANCE OF LOAD-BEARING PROFILES [1] (mm)	MINERAL WOOL		CEILING PANEL TYPE	FIRE RESISTANCE [2]
			Thickness **a** (mm)	Bulk density (kgm⁻³)		
	22	625	80	25	Zinc-coated sheet metal 0.55 mm	REI 45 RE 60
	22	625	80	25	Particleboard thickness 10 mm	
	22	625	80	25	Plasterboard thickness 12.5 mm	
	18	420	80	25	Zinc-coated sheet metal 0.55 mm	

Notes to table:
1) The test was performed with steel I profiles 140 with the span of 4 m.
2) Classification of limit fire resistance pursuant to EN 13 501-2, constructions tested pursuant to EN 1365-1 and EN 1364-2 with reduced vertical load with the intensity of 100 kg/m².

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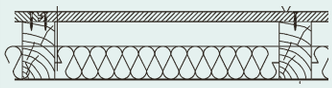
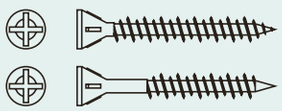
Ceiling construction[3] (wooden load-bearing construction) – exposed to fire from the upper side

CONSTRUCTION SCHEMATIC	THICKNESS OF UPPER LAYER OF CETRIS® **d** (mm)	AXIAL DISTANCE OF LOAD-BEARING PROFILES [1] (mm)	MINERAL WOOL		BOTTOM CEILING PANEL TYPE	FIRE RESISTANCE [2]
			Thickness **a** (mm)	Bulk density (kgm^{-3})		
	22	625	80	25	Wooden laths 50 by 30 mm (axial distance 500 mm) for anchoring of any panel.	REI 45 RE 30
	2 × 12	625	80	25		

Notes to table:
1) The test was performed with wooden prisms 80 by 140 mm (spruce logs) with the span of 4 m.
2) Classification of limit fire resistance pursuant to EN 13 501-2, constructions tested pursuant to EN 1365-1 and EN 1364-2 with reduced vertical load with the intensity of 100 kg/m².
3) Alternative use as floor construction.

Materials for fire construction implementation

DESCRIPTION	PICTURE	NOTE
CETRIS® BASIC, PD, PDB Cement-bonded particleboard, smooth surface, cement grey. Basic size 1,250 × 3,350 mm Bulk density 1,320 ±70 kgm³		Thickness pursuant to fire resistance requirement. Floor board CETRIS® PD, PDB, tongue and groove connections.
CETRIS screw 4.2 × 45, 55 mm Self-cutting and self-drilling screws with sunken heads.		For CENTRIS® board anchoring to load-bearing construction.
ORSIL (ISOVER) Mineral board thickness 80 mm, bulk density 25 kgm^{-3}		Alternatives include mineral board of the same bulk density, flammability class min. A2 (pursuant to EN 13501-1).

9.4.2 General Principles of Assembly

Complete principles for floor construction assembly see Chapter 7 Floor Systems.
Main principles to be stressed in this context:

- Maximum spacing of screws anchoring CETRIS® boards to beams must not exceed 300 mm.
- Maximum distance from the edge 25 mm. The screw must be at least 20 mm longer than the thickness of the fixed board (steel construction) or 30 mm (wooden construction). When laying two layers of CETRIS® boards each layer needs to be anchored separately.
- In the case of ceiling/floor constructions CETRIS® boards are laid tightly (without gaps). CETRIS® PD (or PDB) floor boards must be glued in their tongue and groove joints with a dispersion glue – such as Uzin MK 33, Henkel Ponal etc.
- When using CETRIS® boards without treated edges (tongue and groove) the joints off the supports must be supported with CETRIS® strips of the same thickness. The minimum width of the strip is 100 mm, maximum spacing of screws anchoring the strip 200 mm.
- The boards must be laid to avoid cross joints – with a minimum overlap of 625 mm. The minimum size of any cut board must be 250 mm. CETRIS® boards are always laid with the longer edge perpendicular to the beams.
- The ceiling cavity fill – mineral wool – must be laid across the ceiling area in the prescribed thickness of the layer.
- All joints – between the ceiling and the walls – must be sealed with mineral wool.

9.5 Steel Construction Cladding with CETRIS® Cement Bonded Particleboards

9.5.1 Introduction

Steel is an inorganic material and therefore may be classified as a non-flammable substance without special testing. Following direct exposure to fire, steel construction elements lose their load-bearing power due to exposure to high temperatures (increasing to up to 550° C as soon as after 5 minutes of burning) and the building construction stability is compromised. It is therefore necessary to protect all steel elements adequately where fire resistance is required.
CETRIS® cement bonded particleboard cladding assures that the critical temperature of steel disintegration is only achieved after elapse of the specified time. The cladding of CETRIS® boards may be applied directly on the steel profiles or through an auxiliary construction.

Selection of thickness of the CETRIS® cement bonded particleboard cladding in the case of protection of steel constructions depends primarily on the following three factors:

- Length of required protection – fire resistance in minutes
- Design temperature
- Cross-sectional coefficient Ap/V

The length of the required protection (fire resistance) is required in the following intervals: 15, 30, 45, 60, 90, 120, 180 and 240 minutes.

The design temperature depends on the intensity of the element loading (coefficient of utilisation of the cross section at normal temperature θ_D). Unless specified otherwise, the value of 500°C is used, corresponding to the coefficient range of 0.78 to 0.80.

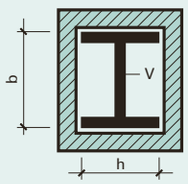
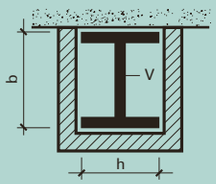
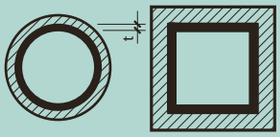
For details see EN 1993-1-2 standard, Euro code 3: Design of steel structures. General rules. Part 1.2: Structural fire design, Chapter 4.2.4.
A significant factor defining the shape of the cross section is the ratio Ap/V – **cross-sectional coefficient of protected steel profile** (in the past the ratio O/A was used).

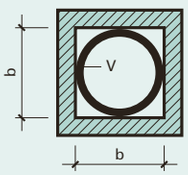
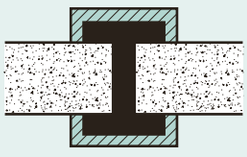
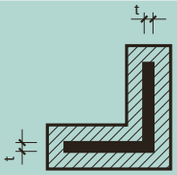
The elements of the Ap/V ratio include:
A_p .... **perimeter** of the protected steel profile in cm (originally marked O).
V ..... **area** of crosswise section of the steel profile in cm² (originally marked A).

When specifying the size of the heated perimeter it is necessary to always consider just the part of the steel construction exposed to flame in the course of fire (usually all sides of the column and three sides of the beam) – see table.

The effect of this factor is significant – subtle profiles (cross sections with high A_p/V ratios) approach the critical temperature more quickly, and therefore need to be protected with thicker cladding.

9.5.2 Calculation of Ap/V

SHAPE OF CROSS SECTION	EXPOSURE TO FIRE	A_p/V (m^{-1})
	From four sides	$1000\ \frac{2b + 2h}{V}$
	From three sides	$1000\ \frac{2b + h}{V}$
	From four sides	$1000\ \frac{O}{V}$
	From four sides	$\frac{1000}{t}$

SHAPE OF CROSS SECTION	EXPOSURE TO FIRE	A_p/V (m^{-1})
	From four sides	$1000\ \frac{4b}{V}$
	From four sides	$\frac{2000}{t}$
	From four sides	$\frac{1000}{t}$
	From four sides	$\frac{2000}{t}$

Cross-section dimensions **b**, **h**, **t** in mm, cross-section area **V** in mm².

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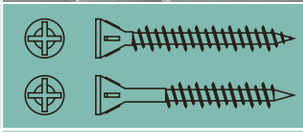
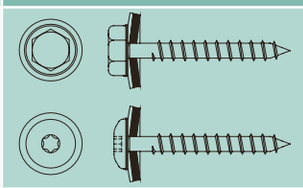
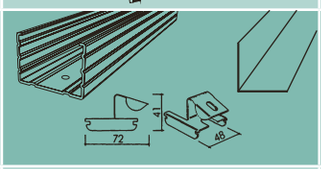
Materials for fire construction implementation

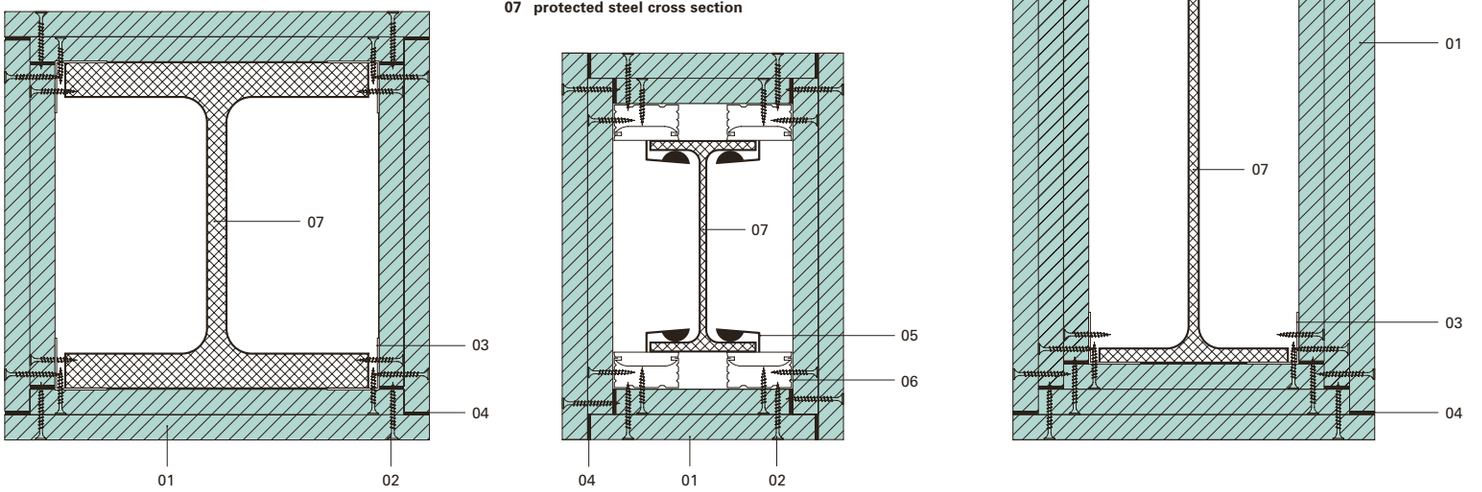
DESCRIPTION	PICTURE	NOTE
CETRIS® BASIC PD (PDB) Cement-bonded particleboard, smooth surface, cement grey. Basic size 1,250 × 3,350 mm Bulk density 1,320 ±70 kgm³		Thickness pursuant to fire resistance requirement, maximum 24 mm..
CETRIS screw 4.2 × 25, 35, 45, 55 mm Self-cutting and self-drilling screws with sunken heads.		Screw type (length) pursuant to the cladding thickness. Suitable for interiors and for anchoring bottom layers in exterior applications.
Screw 4.8 × 38, 45, 55 mm Stainless or galvanised screws with semi-circular or hexagonal heads with compressive water tight washer.		Screw type (length) pursuant to the cladding thickness. For anchoring of upper layer of CETRIS® board in exteriors – where the board remains visible. The board must be predrilled with holes of 8 (10) mm min. diameter!
Auxiliary construction Zinc-coated sheet metal profiles CD 60 × 27 × 0.6 mm L 50 × 50 × 0.6 mm Clamp to flanges of "I" beams		For creation of auxiliary construction for cladding assembly. Screws or rivets are used for anchoring of the profiles or clamps to the steel cross section.
Filler DEXAFLAMM-R White tixotrophic material for joint filling and screw head covering.		Alternatives include fire resistant single-component fillers (acrylic, silicon) permanently elastic (Den Braven Pyrocryl).

9.5.3 Methods of Cladding (directly, or on auxiliary construction)

Cladding of CETRIS® cement bonded particleboards can be applied directly on the steel profile – in this case it is recommended to use the easier way of anchoring the CETRIS® boards protecting the web with the auxiliary L profile 50 × 50 × 0.6 mm. This profile is laid directly on the flange with the offset of about 6 mm from the profile edge – the gap is for the screw anchoring the upper CETRIS® board (protecting the profile flange).

Alternatively the cladding of CETRIS® cement bonded particleboards may also be assembled to an auxiliary construction – for example on CD profiles clamped to flanges of the I beams or suspensions.

01 CETRIS® board cladding
02 screw 4.2 × 25 (35, 45, 55) mm
03 auxiliary "L" profile 50 × 50 × 0.6 mm
04 Dexaflamm R filler
05 clamp to flanges of "I" beam
06 CD profile 60 × 27 × 0.6 mm
07 protected steel cross section



9.5.4 Dimension Tables

Classification of fire resistance R 15

PROFILE TYPE	OPEN PROFILE (I, ⊔, L,…)									CLOSED PROFILE (□, ▭, ○…)								
Design temperature	350	400	450	500	550	600	650	700	750	350	400	450	500	550	600	650	700	750
A_p/V	Thickness of CETRIS® cement-bonded particleboard needed for keeping the steel temperature below the design temperature (mm)																	
44	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
80	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
120	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
160	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
200	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
240	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
280	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
320	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
360	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
400	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12
440	10	10	10	10	10	10	10	10	10	12	12	12	12	12	12	12	12	12

Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

Classification of fire resistance R 30

PROFILE TYPE	OPEN PROFILE (I, LJ, L,...)									CLOSED PROFILE (□, ▭, ○...)								
Design temperature	350	400	450	500	550	600	650	700	750	350	400	450	500	550	600	650	700	750
A_p/V	Thickness of CETRIS® cement-bonded particleboard needed for keeping the steel temperature below the design temperature (mm)																	
44	12	10	10	10	10	10	10	10	10	12	12	10	10	10	10	10	10	10
80	14	12	10	10	10	10	10	10	10	16	14	12	12	12	12	12	12	12
120	16	14	12	10	10	10	10	10	10	18	16	14	12	12	12	12	12	12
160	16	14	12	10	10	10	10	10	10	20	18	14	12	12	12	12	12	12
200	18	16	14	12	10	10	10	10	10	22	18	16	14	12	12	12	12	12
240	18	16	14	12	10	10	10	10	10	22	20	18	14	12	12	12	12	12
280	18	16	14	12	10	10	10	10	10	22	20	18	14	12	12	12	12	12
320	18	16	14	12	10	10	10	10	10	24	20	18	14	12	12	12	12	12
360	18	16	14	12	10	10	10	10	10	24	20	18	16	12	12	12	12	12
400	18	16	14	12	10	10	10	10	10	24	20	18	16	14	12	12	12	12
440	18	16	14	12	10	10	10	10	10	24	20	18	16	14	12	12	12	12

Classification of fire resistance R 45

PROFILE TYPE	OPEN PROFILE (I, LJ, L,...)									CLOSED PROFILE (□, ▭, ○...)								
Design temperature	350	400	450	500	550	600	650	700	750	350	400	450	500	550	600	650	700	750
A_p/V	Thickness of CETRIS® cement-bonded particleboard needed for keeping the steel temperature below the design temperature (mm)																	
44	16	16	14	12	10	10	10	10	10	18	16	14	14	12	10	10	10	10
80	22	20	18	16	14	12	10	10	10	24	22	20	18	16	14	12	12	12
120	24	22	20	18	16	14	12	10	10	26	24	22	20	18	16	14	12	12
160	26	24	22	20	18	16	14	12	10	30	28	26	24	20	18	16	14	12
200	26	24	22	20	18	16	14	12	10	32	30	28	24	22	20	18	16	12
240	28	24	22	20	18	16	14	12	10	34	30	28	26	24	20	18	16	14
280	28	26	24	22	20	18	16	12	12	34	32	30	28	24	22	20	16	14
320	28	26	24	22	20	18	16	14	12	36	34	30	28	24	22	20	18	14
360	28	26	24	22	20	18	16	14	12	36	34	30	28	24	22	20	18	14
400	28	26	24	22	20	18	16	14	12	36	34	30	28	26	22	20	18	14
440	30	26	24	22	20	18	16	14	12	38	34	30	28	26	24	20	18	14

Classification of fire resistance R 60

PROFILE TYPE	OPEN PROFILE (I, LJ, L,...)									CLOSED PROFILE (□, ▭, ○...)								
Design temperature	350	400	450	500	550	600	650	700	750	350	400	450	500	550	600	650	700	750
A_p/V	Thickness of CETRIS® cement-bonded particleboard needed for keeping the steel temperature below the design temperature (mm)																	
44	22	20	18	18	16	14	12	12	10	24	22	20	18	16	16	14	12	10
80	28	26	24	22	20	18	18	16	14	32	30	26	24	22	20	20	18	16
120	32	30	28	26	24	22	20	18	16	36	34	32	28	26	24	22	22	18
160	34	32	30	28	26	24	22	20	18	40	36	34	32	30	28	26	24	20
200	36	34	32	30	26	24	22	20	18	42	40	38	36	32	30	28	24	22
240	36	34	32	30	28	26	24	22	20	46	44	40	38	34	32	30	28	24
280	38	36	32	30	28	26	24	22	20	48	44	40	38	36	34	30	28	26
320	38	36	34	32	30	26	24	22	20	48	44	42	40	38	34	30	28	26
360	38	36	34	32	30	28	26	24	20	48	46	44	40	38	34	32	30	26
400	40	36	34	32	30	28	26	24	22	50	46	44	40	38	34	32	30	28
440	40	38	34	32	30	28	26	24	22	50	48	44	40	38	36	32	30	28

Classification of fire resistance R 90

PROFILE TYPE	OPEN PROFILE (I, LI, L,...)									CLOSED PROFILE (□, ▭, ○...)								
Design temperature	350	400	450	500	550	600	650	700	750	350	400	450	500	550	600	650	700	750
A_p/V	Thickness of CETRIS® cement-bonded particleboard needed for keeping the steel temperature below the design temperature (mm)																	
44	32	32	30	28	26	24	24	22	20	34	34	32	30	28	26	26	22	20
80	42	40	38	36	34	32	30	28	28	46	44	42	40	38	36	34	32	30
120	48	46	44	42	40	38	36	34	32	54	52	50	46	44	42	40	38	36
160	52	50	48	44	42	40	38	36	34	60	58	56	52	50	48	46	42	40
200	54	52	50	48	44	42	40	38	36	64	62	60	58	54	52	48	46	44
240	56	54	50	48	46	44	42	40	38	70	68	64	60	58	56	52	50	48
280	58	54	52	50	48	46	42	40	38	72	68	66	62	60	58	54	50	48
320	58	56	54	50	48	46	44	42	40	74	70	68	64	60	58	54	52	50
360	58	56	54	52	50	46	44	42	40	74	70	68	64	62	58	56	54	50
400	60	58	54	52	50	48	46	42	40	74	72	68	66	62	60	58	54	50
440	60	58	56	52	50	48	46	44	40	76	72	70	66	64	60	58	54	50

Classification of fire resistance R 120

PROFILE TYPE	OPEN PROFILE (I, LI, L,...)									CLOSED PROFILE (□, ▭, ○...)								
Design temperature	350	400	450	500	550	600	650	700	750	350	400	450	500	550	600	650	700	750
A_p/V	Thickness of CETRIS® cement-bonded particleboard needed for keeping the steel temperature below the design temperature (mm)																	
44	44	42	40	38	36	34	34	32	30	46	44	42	40	38	36	36	34	32
80	56	54	52	50	48	46	44	42	40	62	60	58	54	52	50	48	46	44
120	64	62	60	58	56	54	52	48	46	72	70	68	64	62	60	58	54	52
160	68	66	64	62	60	58	56	52	50	-	-	76	72	70	68	64	62	58
200	72	70	68	66	62	60	58	56	54	-	-	-	-	76	72	70	66	64
240	74	72	70	68	64	62	60	58	56	-	-	-	-	-	-	76	72	70
280	-	74	72	68	66	64	62	60	56	-	-	-	-	-	-	-	74	70
320	-	76	72	70	68	66	62	60	58	-	-	-	-	-	-	-	76	74
360	-	-	74	72	68	66	64	62	58	-	-	-	-	-	-	-	-	74
400	-	-	74	72	70	68	64	62	60	-	-	-	-	-	-	-	-	74
440	-	-	76	72	70	68	66	62	60	-	-	-	-	-	-	-	-	76

Classification of fire resistance R 180

PROFILE TYPE	OPEN PROFILE (I, LI, L,...)									CLOSED PROFILE (□, ▭, ○...)								
Design temperature	350	400	450	500	550	600	650	700	750	350	400	450	500	550	600	650	700	750
A_p/V	Thickness of CETRIS® cement-bonded particleboard needed for keeping the steel temperature below the design temperature (mm)																	
44	64	62	62	60	58	56	54	52	50	68	66	64	62	60	58	56	56	54
80	-	-	-	-	76	74	72	70	68	-	-	-	-	-	-	-	-	74

Notes to the table:
The values specified for the minimum cross section coefficient may also be used for profiles with a lower coefficient.
The dimension tables apply to all steel classes except for class S 185 and all steel types identified with E (pursuant to EN 10 025 or EN 10 113 standard).

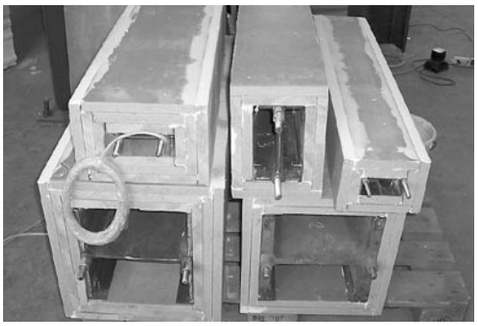
9.5.5 General Principles of Cladding Assembly

- The maximum thickness of a CETRIS® board is 24 mm, higher thickness requirements must be resolved with multilayer cladding of boards with a maximum layer thickness of 24 mm.

- Maximum spacing of anchoring screws must not exceed 400 mm, when using CETRIS® 14 mm boards or thinner the distance must be reduced to 200 mm. The minimum distance of the screws from the edge is 25 mm. The screws must be at least 10 mm longer than the thickness of the anchored board. In the case of multilayer cladding the screw length must be at least 5 mm longer than the thickness of the two connected layers.

- For interior anchoring and for anchoring of bottom layers of multilayer cladding of CETRIS® boards in the exterior, sunken head screws may be used. Upper layers of CETRIS® boards in exteriors must be anchored with screws with semi-circular or hexagonal heads and water tight compressive washers and the CETRIS® board must be predrilled (min. hole diameter 8 mm). The predrilled holes must be filled with fire resistant filler DEXAFLAMM-R.

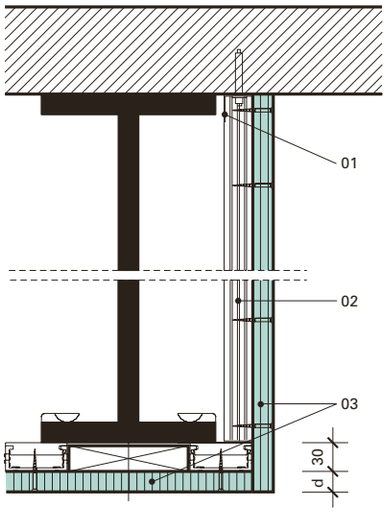
- Joints of multilayer cladding must be overlapped by a min. 400 mm and cross joints must be prevented.



- In the case of single-layer cladding the joints not laying on the steel profile flanges must be laid over a strip of CETRIS® board of the same thickness as the cladding. The minimum width of the strip is 100 mm, and the maximum spacing of the strip anchoring screws is 200 mm.

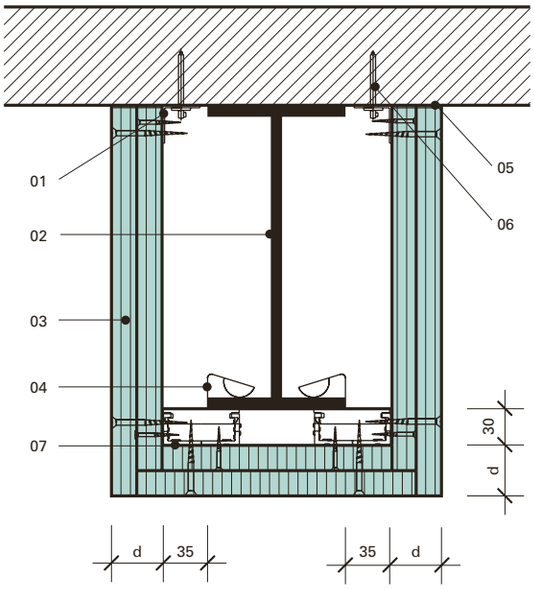
- All joints between CETRIS® boards of 3 – 10 mm width, wall and corner contacts must be filled with Dexaflamm-R filler.

Crosswise cross-section



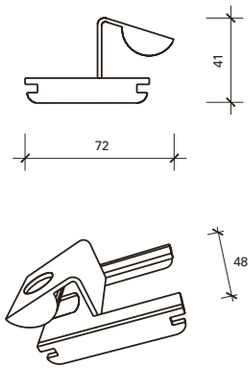
01 UD profile 28 × 27 × 0.6 mm
02 CD profile 60 × 27 × 0.6 mm, spacing 400 to 600 mm, depending on the beam height and under joints
03 CETRIS® cement bonded particleboards

Crosswise cross-section

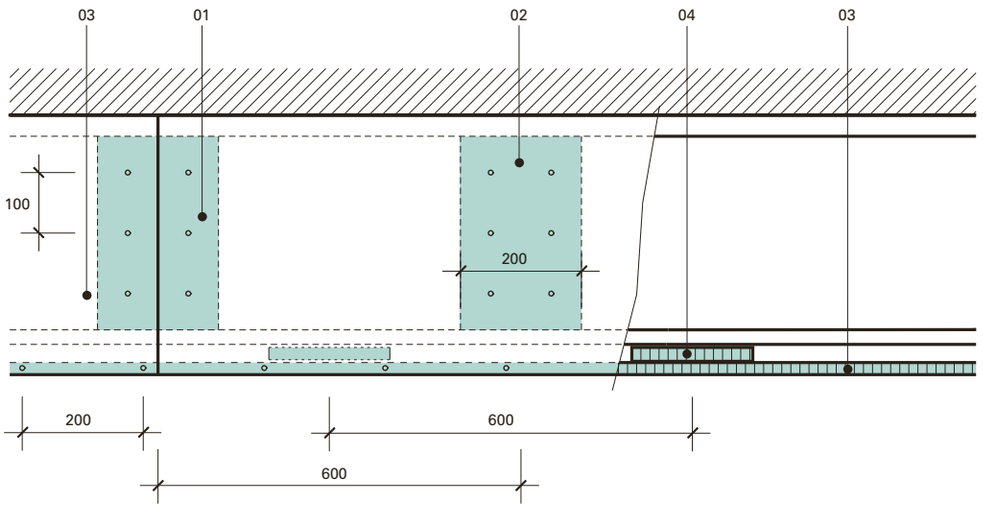


01 angle piece 50 × 50 × 0.6 mm
02 steel beam
03 CETRIS® cement bonded particleboards with overlapped joints
04 clamps Knauf®
05 filled with Dexaflamm R filler
06 steel dowel with screw
07 CD 60 × 27 × 0.6 mm

KNAUF clamp



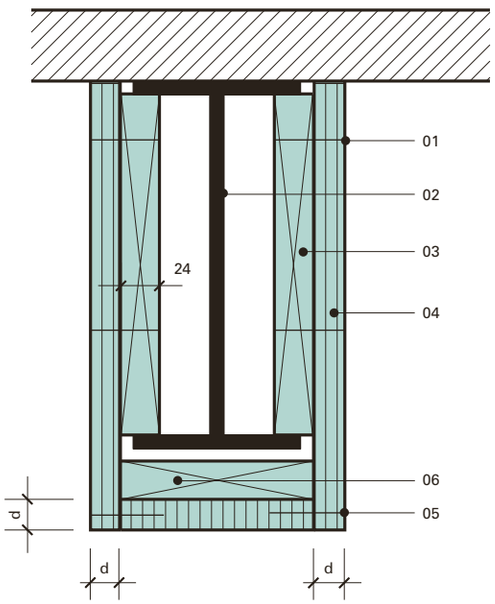
Longitudinal section



01 CETRIS® cement bonded particleboard strip under joint
02 assembly insert of CETRIS® cement bonded particleboard
03 CETRIS® cement bonded particleboard
04 CETRIS® cement bonded particleboard strip

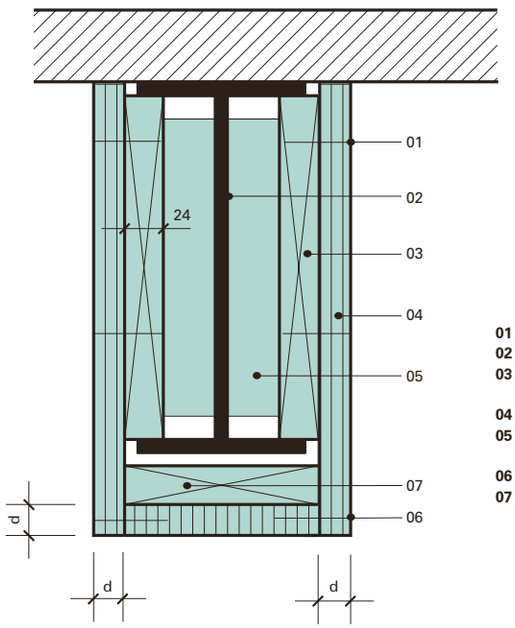
Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

Crosswise cross-section



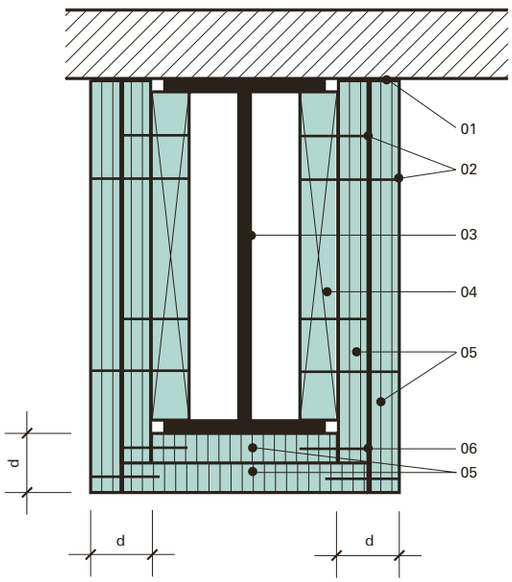
01 screws
02 steel beam
03 assembly insert of CETRIS® cement bonded particleboard
04 CETRIS® cement bonded particleboard
05 screws
06 CETRIS® board in the case of single-layer cladding for joint coverage

Crosswise cross-section



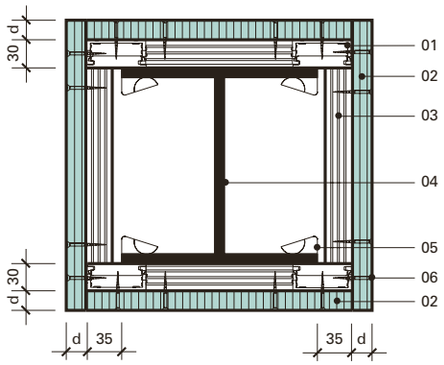
01 screws
02 steel beam
03 assembly insert of CETRIS® cement bonded particleboard
04 CETRIS® cement bonded particleboard
05 support of CETRIS® cement bonded particleboard
06 screws
07 CETRIS® in the case of single-layer cladding for joint coverage

Crosswise cross-section



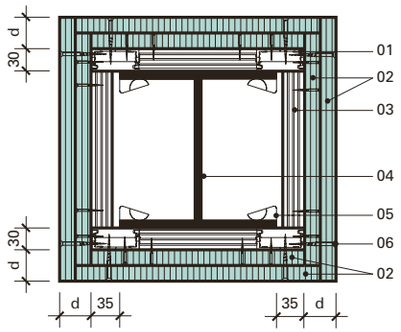
01 filled with Dexaflamm R filler
02 screws
03 steel beam
04 assembly insert of CETRIS® cement bonded particleboard
05 CETRIS® cement bonded particleboard (joint overlap min. 50 mm)
06 screws

Horizontal cross-section



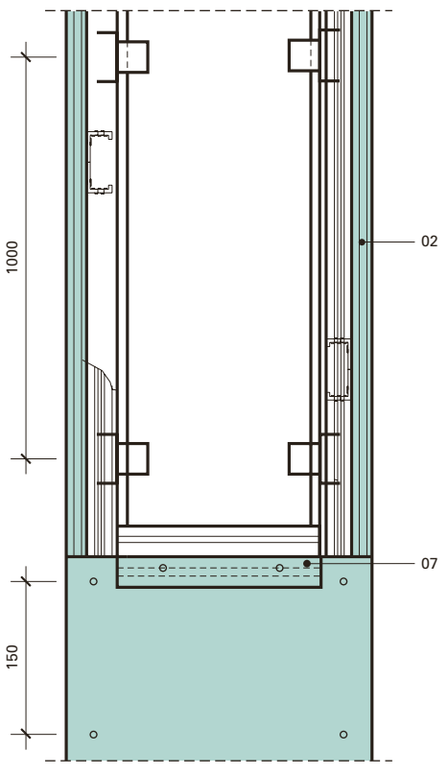
01 CD profile 60 × 27 × 0.6 mm
02 CETRIS® cement bonded particleboard
03 CD profile 60 × 27 × 0.6 mm (under joints)
04 steel column
05 Knauf clamps
06 screws
07 CD profile 60 × 27 × 0.6 mm (under joints)

Horizontal cross-section

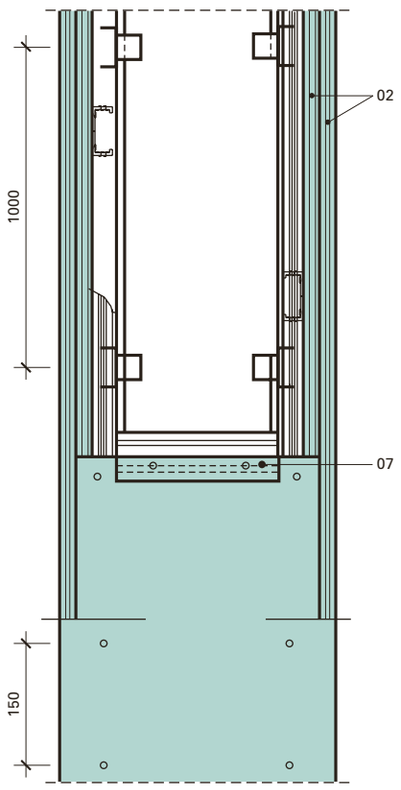


01 CD profile 60 × 27 × 0.6 mm
02 CETRIS® cement bonded particleboard (overlapped joints)
03 CD profile 60 × 27 × 0.6 mm (under joints)
04 steel column
05 Knauf clamps
06 screws
07 CD profile 60 × 27 × 0.6 mm (under joints)

Vertical cross-section



Vertical cross-section



All values in mm

9.6 Wall and Ceiling Coating with Fire Protection Effect

CETRIS® cement bonded particleboard is newly tested for its ability to protect flammable materials against ignition. In the testing and classification standards the application is described as wall and ceiling cladding with fire protection effect – cladding of flammable parts of buildings. This requirement mainly applies to timber constructions in Western Europe.

The cladding in this case means the outermost part of a vertical element (such as a wall, a partition, a peripheral wall) or the bottommost part of a horizontal or inclined element (such as a ceiling, a roof or a ceiling panel). The purpose of this type of cladding is to protect flammable material against ignition. Cladding of K class is cladding protecting flammable material against fire for a specified period of time, including carbonisation and other damage, and also preventing the protected elements from catching fire on both sides at the same time. In addition requirements for reaction to fire may be applied to the cladding products.

9.6.1 Test procedure for fire protective cladding

The test procedure for specification of the ability of the cladding materials covering flammable materials to protect these materials against ignition during pre-specified fire exposition is defined in EN 14 135 standard Coverings. Determination of fire protection ability.

The cladding is fixed to the bottom side of a horizontally oriented flammable base and exposed from the bottom to predefined standard thermal and pressure conditions in the kiln.

The clad (flammable) materials with a density of at least 300 kg/m³ are represented in the tests by chipboard 19 mm thick, not treated with any flame retarder (not impregnated) whose density is at least 680 kg/m³.

The tested cladding is applied to a standard horizontal construction – with top wooden prisms 45 × 95 mm (600 mm apart) and chipboard thickness 19 (±2 mm) – in the form of a plain ceiling panel. The cladding itself may be assembled directly on the chipboard (without cavity), or on auxiliary laths (with cavity).

The recorded values include temperature increase on the bottom side of the flammable base. The cladding is monitored and time to damage is recorded. The record of the condition after test includes both damage to the cladding and defects of the flammable base.

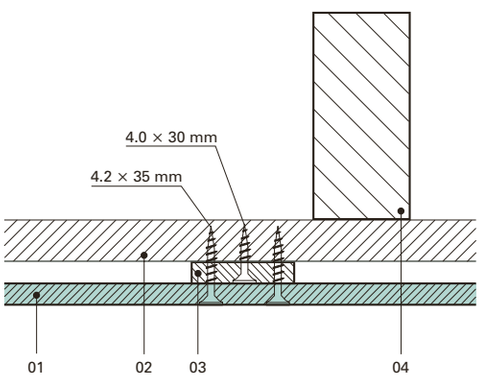
Cladding is expected to provide for fire protection of materials under them and prevent fire in cavities unless the cladding collapses in the course of the test pursuant to EN 14 135 within the given test time (for example 10 minutes, 30 minutes or 60 minutes) and unless the fire gets into any cavity in the cladding and the following requirements are fulfilled for the specified period of time:

- The mean temperature measured on the bottom side of the chipboard and mean temperature measured on the non-exposed side of the cladding must not exceed the baseline value by more than 250° C and the maximum temperature measured in any place on these elements must not exceed the initial temperature by more than 270° C
- No ignition or carbonisation of any part of the bottom side of the chipboard or non-exposed side of the cladding may occur. Thawing and shrinkage are considered damage while discoloration is not.

9.6.2 Cladding with CETRIS® Cement Bonded Particleboard with Fire Protection Effects

CETRIS® cement bonded particleboard is tested as cladding of flammable materials in the following composition:

CLADDING COMPOSITION	CAVITY	AUXILIARY CONSTRUCTION	FIRE RESISTANCE	CLASSIFICATION
CETRIS® 10 mm (tightly laid boards, no filler)	10 mm	wooden laths 70 × 10 mm	10 minutes	**K10**



01 CETRIS® cement bonded particleboard
02 chipboard 19 mm
03 wooden lath 10 × 70 mm
04 wooden beam 49 × 95 mm

9.6.3 General Principles of Assembly of Cladding of CETRIS® Cement Bonded Particleboard with Fire Protection Effects

- CETRIS® boards are laid without cross joints
- CETRIS® boards are laid tightly without gaps. A joint must be visible along the perimeter or in the case of an area larger than 6 × 6 m. The minimum width of the joint must be 15 mm and the joint must be supported with a strip of CETRIS® board of the same thickness as the cladding laid underneath (10 mm), with the minimum with of 150 mm
- Maximum spacing of the CETRIS® 10 mm anchoring screws must not exceed 200 mm (by the edges), or 400 mm (in the middle), and the screws must be at least 25 mm away from the board edge.
- Minimum length of screws for CETRIS® board anchoring must be 35 mm
- All points of contact between CETRIS® boards must be laid over wooden laths
- Maximum distances of support wooden laths is 625 mm, and the minimum lath width is 70 mm
- Minimum width of the cavity (lath thickness) is 10 mm.

9.7 Light Composed Roofing

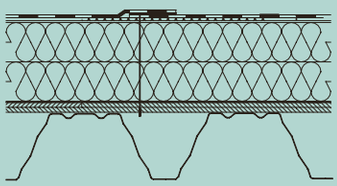
9.7.1 Introduction

Light composed roofing is a combination of materials with resulting high-standard parameters of use. The load-bearing construction is made by profiled trapeze sheet metal, fire resistance is provided by two layers of CETRIS® cement bonded particleboards, high thermal resistance is achieved by use of insulation boards of elastified foam polystyrene. The composition also includes vapour barrier and hydro insulating layers with high resistance to weather effects.

The test of fire resistance of this composition has been performed pursuant to EN 1365-2:2001 Fire resistance tests for loadbearing elements. Floors and roofs.
The assembled test sample (a beam with overlapped end) was loaded with increased load for the inside forces and tensions to correspond to the values of a continuous beam with two equal fields. Direct application allows use of this composition for inclined roofs with the slant range from 0° to 25°.

This roof construction meets the fire safety requirements pursuant to the updated ČSN 73 0810: 2009 Standard, Fire Safety of Buildings, Common Provisions.
Use of CETRIS® cement bonded particleboards assures high rigidity of the roofing. At the same time the boards form a firm flat base protecting the subsequently laid heat insulating and hydro insulating layers from damage – especially during assembly.

9.7.2 Fire Characteristics

CONSTRUCTION - SCHEMATIC	CONSTRUCTION DESCRIPTION	FIRE RESISTANCE
	• Hydro insulating foil MERX MK 15 thickness 1.5 mm • Separation textile (non-woven glass fibre textile) • Insulating boards EPS 100S - 2 layers, thickness 60 mm • Vapour barrier PE • CETRIS® cement bonded particleboards Basic – 2 layers, thickness 10 mm • Load-bearing trapeze sheet metal TR 150/280/0,75 (or other pursuant to structural assessment)	**REI 30** (pursuant to EN 13 501-2) **REI 15 DP1 *** (pursuant to ČSN 73 0810:2009)

*** Note:** Classification pursuant to ČSN 73 0810 applies to the part of the roofing consisting of the load-bearing and fire partitioning layers.

9.7.3 General Principles of Assembly

• **Trapeze sheet metal** must be anchored in supports in every bottom wave with two screws with the minimum diameter of 5.5 mm with washers. The edge supports (steel or concrete beams) must be sufficiently stiff in crosswise bend and twist for transfer of horizontal membrane forces. Lengthwise connection of trapeze sheet metal pieces must be secured with self-cutting screws 4.8 × 20 mm with the maximum spacing of 500 mm.
The limit conditions for use of other types of trapeze sheet metals include:

– Maximum bend momentum above the support 3,554 Nm
– Maximum bend momentum in the field 2,000 Nm
– Maximum transverse strength 3,703 N
– Maximum bend tension above support 99.8 MPa

These values apply to trapeze sheet metal of steel class S 320 GD, skid limit f_Y = 320 MPa.

Technical and professional design services for a suitable trapeze sheet metal is provided by the company Kovové profily s.r.o.

• **CETRIS® cement bonded particleboards** are laid tightly in both layers, without gaps. The second layer joint overlap must be min. 625 mm. CETRIS® boards are anchored after laying with screws IR2-4.8 × 50 mm or SC3/35-PH2-4.8 × 45 mm. Both screws were tested by the supplier for the guaranteed minimum rated value of 400 N per element (safety factor 2.5). The screw spacing in the lengthwise and the crosswise direction is max. 600 mm. CETRIS® BASIC boards are always laid tightly by dilation field (max. 6.70 × 6.70 m). Dilation joints must be implemented between the fields (15 mm) and filled with mineral wool strips.
In the case of no requirement for fire resistance, a single layer of CETRIS® boards of minimum thickness 16 mm will suffice – even in this case the minimum rated value of load-bearing capacity 400 N is guaranteed.

• **Vapour barrier** must be laid pursuant to the instructions of the supplier, with about 150 mm overlap.

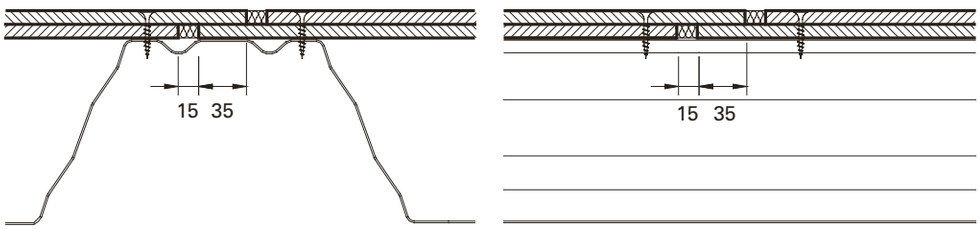
• **Insulation boards of foam polystyrene** must be laid in two layers, with the minimum thickness of each individual layer 60 mm. The joints of the upper layer of insulation boards must show min. 250 mm overlaps.

• **Separation layer** – unwoven glass fibre textile 200 gr/m^2. Overlap circa 150 mm.

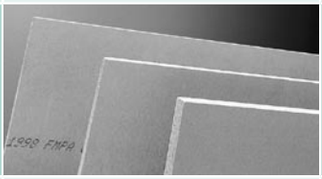
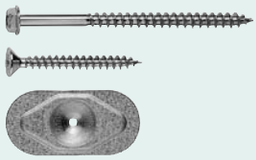
• **Hydro insulating foil Merx MK 15**. The foil overlap is about 150 mm, and in the overlays the foil is anchored mechanically – with IW-T Fastening of waterproof membranes and insulation (supplier SFS intec). Anchor spacing circa 400 mm. The screw supplier guarantees the minimum rated value of 400 N per element (safety factor 2.5). Mutual adhesion of the foils is provided by heating with a hot air gun and mechanical pressing together (with a roller).
Technical and professional design services for a suitable type of vapour barrier, separation foil and hydro insulation is provided by the company Coleman S.I.

Details by the through passes, roof gullies, skylight, attics etc. must be lined with mineral wool, thickness min. 40 mm, on the side across the full height of the heat insulation layer of EPS.

Implementation of dilation joint between CETRIS® boards



Materials for assembly of fire resistant roofing

DESCRIPTION	PICTURE	NOTE
Trapeze sheet metal TR 150/280/0.75 Profiled load-bearing sheet metal element, minimum thickness 0.75 mm (supplier Kovové profily).		On the basis of structural assessment another type may be used (on condition of compliance with the conditions specified in the classification protocol).
CETRIS® Basic Board. Cement bonded particleboard, cement grey smooth surface. Standard size 1,250 × 3,350 mm. Bulk density 1,320 ±70 kg/m³.		Thickness and number of layers pursuant to the fire resistance requirements. One layer of minimum thickness 16 mm will suffice where no fire resistance is required.
IW-T Fastening of waterproof membranes and insulation Supplier SFS intec		Screw load-bearing capacity tested – guaranteed minimum rated value of load-bearing capacity 400 N.
Vapour barrier – PE foil Supplier Coleman S.I.		May be substituted with another type if thickness ≤ 2 mm and heating capacity H ≤ 15 MJ/m².
Insulating boards Foam polystyrene EPS 100S, thickness 60 mm (supplier Rigips).		Insulation boards used must show compressive strength of a min. 100 kPa, declared coefficient of thermal conductivity λ = 0.036 W/mK, fire reaction class E, max. bulk density 30 kg/m³.
Separation glass fibre textile – 200 gr/m² (supplier Coleman S.I.).		
Hydro insulating foil MERX MK 12, thickness 1.2 mm (supplier Coleman S.I.).		Composition classified with DP1 must include hydro insulation included in the composition with EPS in class BROOF(t3).
Fixation element Isofast IG and telescope R45 For fixation of hydro insulation and heat insulation in CETRIS® boards (supplier SFS intec).		

Application of CETRIS® Boards in Fire Protection pursuant to EN Standards

Product certificate:
Fire ceiling panel constructions clad with CETRIS® boards

PAVUS, a. s.
AUTORIZOVANÁ OSOBA 216
Prosecká 412/74, 190 00 Praha 9 - Prosek
Rozhodnutí o autorizaci č. 37/2002 ze dne 13. 12. 2002

CERTIFIKÁT VÝROBKU
č. 0142/216/§5/2004
vydaný
pro výrobce:

CIDEM Hranice a.s.
Skalní 1088, 753 40 Hranice
IČ 14617081

stát původu výrobku:
Česká republika

Autorizovaná osoba 216 podle ustanovení § 5 odst. 2 nařízení vlády č. 163/2002 Sb., kterým se stanoví technické požadavky na vybrané stavební výrobky (dále jen nařízení vlády č. 163/2002 Sb.), na základě přezkoumání podkladů, předložených výrobcem, zkoušek vzorku (vzorků) výrobku a posouzení systému řízení výroby výrobcem, vydává tento certifikát výrobku

POŽÁRNÍ STĚNOVÉ KONSTRUKCE OPLÁŠTĚNÉ DESKAMI CETRIS

Tímto certifikátem výše uvedená autorizovaná osoba osvědčuje, že uvedený výrobek v rozsahu technických požadavků souvisejících se základními požadavky podle přílohy č. 1 nařízení vlády č. 163/2002 Sb., odpovídá stavebnímu technickému osvědčení č. S-0142/216/§5/2004 ze dne 17.5.2004 (dále jen STO) a že výrobcem je zajištěno řádné fungování systému řízení výroby.

Nedílnou součástí tohoto certifikátu je Protokol o certifikaci č. P-0142/216/§5/2003 ze dne 17.5.2004, kde je uvedena identifikace výrobku, závěry zjišťování, ověřování a výsledků zkoušek, provedené podle ustanovení § 5 odst. 3 nařízení vlády č. 163/2002 Sb.

Tento certifikát platí po dobu kladných výsledků vyhodnocení dohledu nad řádným fungováním systému řízení výroby u výrobce, prováděného autorizovanou osobou 216 podle § 5 odst. 4 nařízení vlády č. 163/2002 Sb., nejdéle však po dobu platnosti uvedeného STO.

Tento certifikát, jako doklad o shodě výrobku s technickými požadavky stanovenými v době vydání tohoto certifikátu nařízením vlády č. 163/2002 Sb. a o posouzení shody podle § 5 tohoto nařízení vlády, je vydán pro výrobce k využití pro účely vyplývající z § 13 zákona č. 22/1997 Sb., o technických požadavcích na výrobky a o změně a doplnění některých zákonů, ve znění pozdějších předpisů.

Upozornění:
Podle ustanovení § 11a odst. 3 zákona č. 22/1997 Sb., o technických požadavcích na výrobky a o změně a doplnění některých zákonů, ve znění pozdějších předpisů, je autorizovaná osoba 216 oprávněna zrušit nebo změnit vydaný certifikát, pokud se prokáže, že se změněly skutečnosti, za kterých byl vydán, zejména pokud se zjistí, že výrobky nesplňují požadavky technických předpisů, které se na ně vztahují.

V Praze dne 17. 5. 2004

Ing. Jaroslav Dufek
ředitel PAVUS, a.s. - AO 216

Product certificate:
Fire wall constructions clad with CETRIS® boards

PAVUS, a. s.
AUTORIZOVANÁ OSOBA 216
Prosecká 412/74, 190 00 Praha 9 - Prosek
Rozhodnutí o autorizaci č. 37/2002 ze dne 13. 12. 2002

CERTIFIKÁT VÝROBKU
č. 0143/216/§5/2004
vydaný
pro výrobce:

CIDEM Hranice a.s.
Skalní 1088, 753 40 Hranice
IČ 14617081

stát původu výrobku:
Česká republika

Autorizovaná osoba 216 podle ustanovení § 5 odst. 2 nařízení vlády č. 163/2002 Sb., kterým se stanoví technické požadavky na vybrané stavební výrobky (dále jen nařízení vlády č. 163/2002 Sb.), na základě přezkoumání podkladů, předložených výrobcem, zkoušek vzorku (vzorků) výrobku a posouzení systému řízení výroby výrobcem, vydává tento certifikát výrobku

POŽÁRNÍ PODHLEDOVÉ KONSTRUKCE OPLÁŠTĚNÉ DESKAMI CETRIS

Tímto certifikátem výše uvedená autorizovaná osoba osvědčuje, že uvedený výrobek v rozsahu technických požadavků souvisejících se základními požadavky podle přílohy č. 1 nařízení vlády č. 163/2002 Sb., odpovídá stavebnímu technickému osvědčení č. S-0143/216/§5/2004 ze dne 20.4.2004 (dále jen STO) a že výrobcem je zajištěno řádné fungování systému řízení výroby.

Nedílnou součástí tohoto certifikátu je Protokol o certifikaci č. P-0143/216/§5/2003 ze dne 20.4.2004, kde je uvedena identifikace výrobku, závěry zjišťování, ověřování a výsledků zkoušek, provedené podle ustanovení § 5 odst. 3 nařízení vlády č. 163/2002 Sb.

Tento certifikát platí po dobu kladných výsledků vyhodnocení dohledu nad řádným fungováním systému řízení výroby u výrobce, prováděného autorizovanou osobou 216 podle § 5 odst. 4 nařízení vlády č. 163/2002 Sb., nejdéle však po dobu platnosti uvedeného STO.

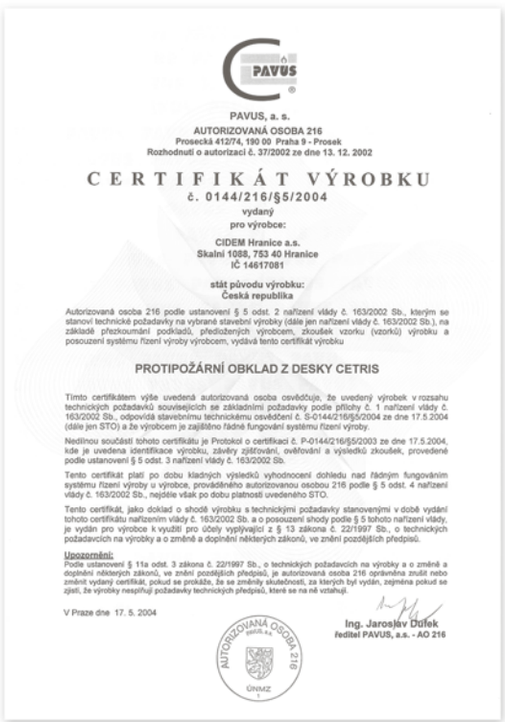
Tento certifikát, jako doklad o shodě výrobku s technickými požadavky stanovenými v době vydání tohoto certifikátu nařízením vlády č. 163/2002 Sb. a o posouzení shody podle § 5 tohoto nařízení vlády, je vydán pro výrobce k využití pro účely vyplývající z § 13 zákona č. 22/1997 Sb., o technických požadavcích na výrobky a o změně a doplnění některých zákonů, ve znění pozdějších předpisů.

Upozornění:
Podle ustanovení § 11a odst. 3 zákona č. 22/1997 Sb., o technických požadavcích na výrobky a o změně a doplnění některých zákonů, ve znění pozdějších předpisů, je autorizovaná osoba 216 oprávněna zrušit nebo změnit vydaný certifikát, pokud se prokáže, že se změněly skutečnosti, za kterých byl vydán, zejména pokud se zjistí, že výrobky nesplňují požadavky technických předpisů, které se na ně vztahují.

V Praze dne 20. 4. 2004

Ing. Jaroslav Dufek
ředitel PAVUS, a.s. - AO 216

Product certificate:
Fire cladding with CETRIS® boards



PAVUS, a. s.
AUTORIZOVANÁ OSOBA 216
Prosecká 412/74, 190 00 Praha 9 - Prosek
Rozhodnutí o autorizaci č. 37/2002 ze dne 13. 12. 2002

CERTIFIKÁT VÝROBKU
č. 0144/216/§5/2004
vydaný
pro výrobce:

CIDEM Hranice a.s.
Skalní 1088, 753 40 Hranice
IČ 14617081

stát původu výrobku:
Česká republika

Autorizovaná osoba 216 podle ustanovení § 5 odst. 2 nařízení vlády č. 163/2002 Sb., kterým se stanoví technické požadavky na vybrané stavební výrobky (dále jen nařízení vlády č. 163/2002 Sb.), na základě přezkoumání podkladů, předložených výrobcem, zkoušek vzorku (vzorků) výrobku a posouzení systému řízení výroby výrobcem, vydává tento certifikát výrobku

PROTIPOŽÁRNÍ OBKLAD Z DESKY CETRIS

Tímto certifikátem výše uvedená autorizovaná osoba osvědčuje, že uvedený výrobek v rozsahu technických požadavků souvisejících se základními požadavky podle přílohy č. 1 nařízení vlády č. 163/2002 Sb., odpovídá stavebnímu technickému osvědčení č. S-0144/216/§5/2004 ze dne 17.5.2004 (dále jen STO) a že výrobcem je zajištěno řádné fungování systému řízení výroby.

Nedílnou součástí tohoto certifikátu je Protokol o certifikaci č. P-0144/216/§5/2003 ze dne 17.5.2004, kde je uvedena identifikace výrobku, závěry zjišťování, ověřování a výsledků zkoušek, provedené podle ustanovení § 5 odst. 3 nařízení vlády č. 163/2002 Sb.

Tento certifikát platí po dobu kladných výsledků vyhodnocení dohledu nad řádným fungováním systému řízení výroby u výrobce, prováděného autorizovanou osobou 216 podle § 5 odst. 4 nařízení vlády č. 163/2002 Sb., nejdéle však po dobu platnosti uvedeného STO.

Tento certifikát, jako doklad o shodě výrobku s technickými požadavky stanovenými v době vydání tohoto certifikátu nařízením vlády č. 163/2002 Sb. a o posouzení shody podle § 5 tohoto nařízení vlády, je vydán pro výrobce k využití pro účely vyplývající z § 13 zákona č. 22/1997 Sb., o technických požadavcích na výrobky a o změně a doplnění některých zákonů, ve znění pozdějších předpisů.

Upozornění:
Podle ustanovení § 11a odst. 3 zákona č. 22/1997 Sb., o technických požadavcích na výrobky a o změně a doplnění některých zákonů, ve znění pozdějších předpisů, je autorizovaná osoba 216 oprávněna zrušit nebo změnit vydaný certifikát, pokud se prokáže, že se změněly skutečnosti, za kterých byl vydán, zejména pokud se zjistí, že výrobky nesplňují požadavky technických předpisů, které se na ně vztahují.

V Praze dne 17. 5. 2004

Ing. Jaroslav Dufek
ředitel PAVUS, a.s. - AO 216

Product certificate:
Fire cladding of steel constructions with CETRIS® boards

PAVUS, a.s.
Autorizovaná osoba AO 216, Notifikovaná osoba 1391
Prosecká 412/74, 190 00 Praha 9 - Prosek
Rozhodnutí o autorizaci č. 37/2002 ze dne 13.prosince 2002

CERTIFIKÁT VÝROBKU
č. 216/C5a/2006/0107
vydaný pro

výrobce:
CIDEM Hranice, a.s., Skalní 1088, 753 40 Hranice
místo výroby:
CIDEM Hranice, a.s., Skalní 1088, 753 40 Hranice
stát původu výrobku:
Česká republika

V souladu s ustanovením § 5a odst. 2 nařízení vlády č. 163/2002 Sb., kterým se stanoví technické požadavky na vybrané stavební výrobky, ve znění nařízení vlády č. 312/2005 Sb. (dále jen „nařízení vlády č. 163/2002 Sb."), Autorizovaná osoba AO 216 potvrzuje, že u stavebního výrobku:

Protipožární obklad ocelových konstrukcí cementotřískovými deskami CETRIS®

přezkoumala podklady předložené výrobcem, provedla počáteční zkoušku typu výrobku na vzorku a posoudila systém řízení výroby výrobcem a zjistila, že uvedený výrobek splňuje požadavky stanovené technickými předpisy, které souvisejí se základními požadavky uvedenými ve Stavebním technickém osvědčení č.S-216/C5a/2006/0107 ze dne 5.září 2006 (dále jen „STO").

Autorizovaná osoba AO 216 zjistila, že systém řízení výroby výrobků výrobcem odpovídá příslušné technické dokumentaci a zabezpečuje, aby výrobky uváděné na trh, sjišťovaly požadavky stanovené ve shora uvedeném stavebním technickém osvědčení a odpovídaly technické dokumentaci podle § 4 odst. 3.

Nedílnou součástí tohoto certifikátu je Protokol o certifikaci č. P-216/C5a/2006/0107 ze dne 15.září 2006, který obsahuje závěry zjišťování, ověřování, výsledky zkoušek a základní popis certifikovaného výrobku, nezbytný pro jeho identifikaci.

Tento certifikát zůstává v platnosti po dobu, po kterou se požadavky stanovené ve Stavebním technickém osvědčení, na které byl uveden odkaz, nebo výrobní podmínky v místě výroby a systém řízení výroby výrobků výrobcem, výrazně nezmění.

Autorizovaná osoba AO 216 provádí nejméně jedenkrát za 12 měsíců dohled nad řádným fungováním systému řízení výroby v místě výroby u výrobce podle § 5a nařízení vlády č. 163/2002 Sb.

Pokud Autorizovaná osoba AO 216 zjistí nedostatky, je oprávněna zrušit nebo změnit tento certifikát

V Praze dne 15.září 2006

Ing. Jaroslav Dufek
ředitel PAVUS, a.s. - AO 216

Posuzované vlastnosti certifikovaného výrobku jsou uvedeny na druhé straně tohoto certifikátu.

Notes

Notes