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# Application of CETRIS<sup>®</sup> Boards in Fire Protection

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## 8.1 Fire Protection of Building Constructions

### 8.1.1 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. This standard is 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)

### 8.1.2 Fire-Related Properties of Building Materials – Flame Spread

ČSN 73 0863 – “Determination of flame propagation along the surface of building materials” is used for specification of the flame spread index “is”, characteristics expressing the speed of flame spread in time under exactly defined test conditions.

The Flame spread index “is” has been specified for CETRIS® cement-bonded particleboard with surface treatment (Finish, Lasur, Dekor) – always with the result  $i_s = 0$ .

### 8.1.3 Classification of Building Products into Euro Classes according to Reaction to Fire

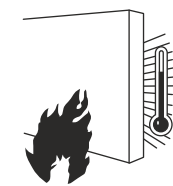
Based on these tests, the CETRIS® cement bonded particleboard is classified as A2. Its complementary classification of smoke generation is s1, its classification of flaming drops (particles) is d0, which means that the final classification is A2-s1,d0. This result applies to classification of the board behaviour in fire conditions, except for flooring.

This classification applies to all types of CETRIS® boards except for DEKOR. Due to its surface treatment (marmolite plaster), the CETRIS® DEKOR cement bonded particleboard is classified into class B. Its complementary classification of smoke generation is s1, its classification of flaming drops (particles) is d0, which means that the final classification is B-s1,d0.

### 8.1.4 Fire Resistance of Building Constructions

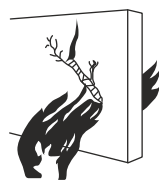
Fire resistance is a specific and decisive property of building constructions. Fire resistance is expressed in time (minutes) for which the assessed construction is able to resist effects of the so called standard fire, i.e. fire progressing under exactly specified conditions. As these parameters are specific for individual building constructions and differ according to the action of the stress on the specific construction, multiple test methodologies and standards for evaluation of these properties also exist.

Fire resistance is specified by test or calculation, extrapolation and comparison to test standards and regulations. Fire resistance classification is done either on the basis of a test, including the conditions for direct application, or methods for expansion of the application (calculations, extrapolations, etc.) by an authorised body, which issues the fire resistance classification certificate. Fire resistance is specified in minutes on the basic scale: 15, 30, 45, 60, 90, 120 and 180 minutes. The fire resistance values for the individual limit conditions are marked as follows



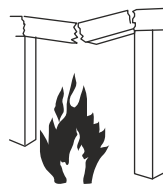
Insulation ability

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 according to them, for instance:

- 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) only the 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.
- for the wall and ceiling cladding of wooden buildings, the fire resistance of the cladding must be K.

## 8.2 Vertical Wall Constructions

### 8.2.1 Scope of Application

According to the background information provided here, the CETRIS® boards can be applied in the following types of vertical wall constructions:

- Non-load-bearing walls and partitions up to a height of 9.50 metres and a fire resistance in the range EI 15 - EI 180 minutes, with and without mineral filling (with an air gap).
- Shaft or separate advanced wall – with one-sided cladding of a wall construction with a fire resistance of EI 15 – EI 45.
- Wall on a wooden framework – as a load-bearing wall with a maximum height of 3 metres, and as non-load-bearing (filling) walls with a maximum height of 4 metres.

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 preparation of the samples. 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 this variant solutions are recommended for applications and elements which cannot be tested because of the methodologies used or the spatial arrangement of the kilns. These solutions have also been professionally assessed and tested by expert assessments of PAVUS Praha or Fires Batizovce.

*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 this reason, the axial distances and types of CW profiles / wooden pillars, which comply with the tests are stated. It is however necessary to consider them as the absolute minimum limit values. It is necessary to emphatically draw attention to the fact that when dimensioning the firewalls, the structural static requirements must also be assessed according to the real stress.*

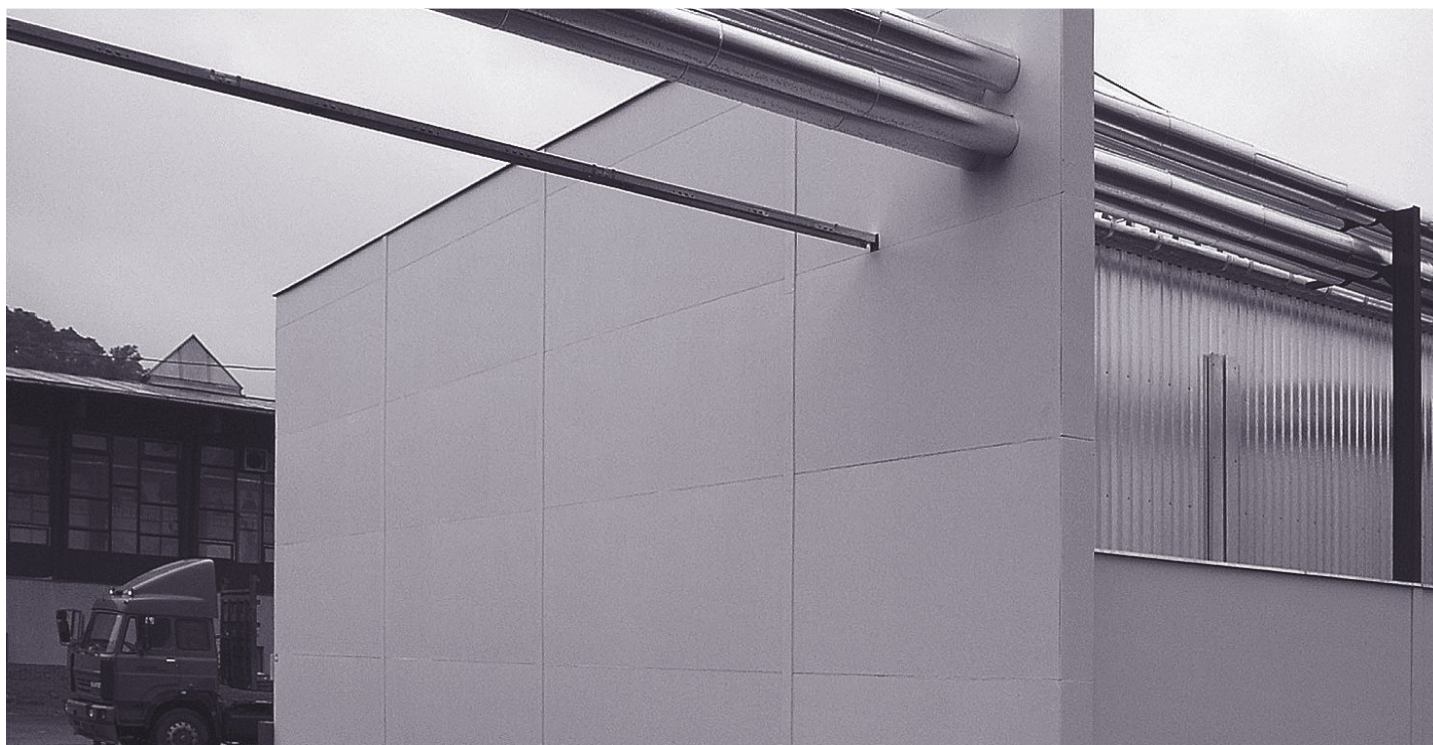
Assembly of fire constructions may only be carried out by trained staff – see Chap. 8.8. Training of assembly companies for CETRIS® board applications.

Description of the construction

The vertical fire partitions – walls and partition walls – with CETRIS® cement-bonded particleboard cladding 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.

### Survey of wall constructions

See table on the next page.

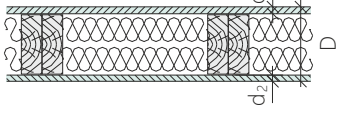

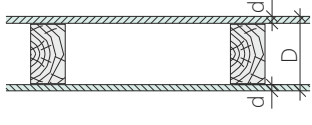
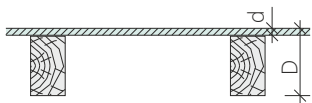


Type / Marking	Scheme	Size			Weight (kg/m <sup>2</sup> )	Max. wall height (m)	Mineral wool		Fire Resistance	Thermal resistance (m <sup>2</sup> K/W)	Weighted sound transmission loss (dB)
		a (mm)	d (mm)	D (mm)			Thickness (mm)	Density (kg/m <sup>3</sup> )			
WS 01		75	16	107	45	4,50			EI 30	0,15	44
WS 02		75	12	99	38	3,60	60	50	EI 45	1,61	52
		100		124		4,00			EI 45		
		2x75		174		7,80			EI 15		
WS 03		75	10+10	115	56	4,00			EI 45	0,19	-
WS 04		75	16	107	49	3,60	60	75	EI 60	1,65	
		100		132		4,00			EI 60		
WS 05		75	12+12	123	67	4,00			EI 60	0,23	50
						5,50			EI 45		
						7,30			EI 30		
WS 06		75	12+12	123	72	4,00	60	75	EI 90	1,73	56
WS 07		75	16+18	143	95	4,00			EI 90	0,32	
WS 08		75	16+18	143	95	4,00	60	75	EI 120	1,80	
WS 09		2x75	18+12+12	234	118	4,00			EI 120	0,40	
WS 10		2x75	18+12+12	234	122	4,90	60	75	EI 180	1,90	61
						6,40			EI 120		
						9,50			EI 90		
WS 11		75	16	91	22	4,00			EI 15 <sup>3</sup> )	0,08	
WS 12		75	12+12	99	34	4,00			EI 30 <sup>3</sup> )	0,11	
WS 13		75	16+16	107	48	4,00	60	50	EI 45 <sup>3</sup> )	1,67	

Supplementary classification according to ČSN 73 0810: 2010 – all walls with steel load-bearing structures with DP 1 classification.



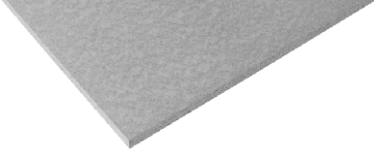
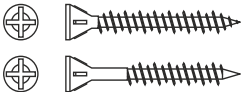
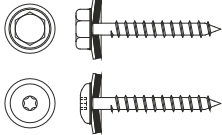
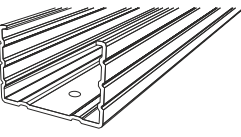
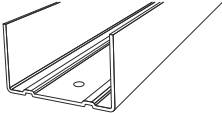



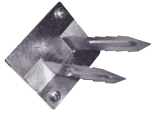
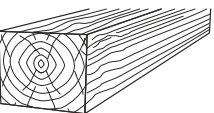

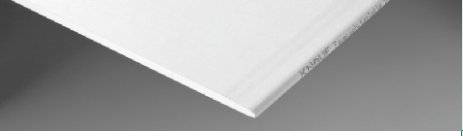




Type / Marking	Scheme	Size			Weight (kg/m <sup>2</sup> )	Max. wall height (m)	Mineral wool		Fire Resistance	Thermal resistance (m <sup>2</sup> K/W <sup>1</sup> )	Weighted sound transmission loss (dB)
		Supporting structure	d (mm)	D (mm)			Thickness (mm)	Density (kg/m <sup>3</sup> )			
WW 01		wooden lath 120x100 mm axially 625 mm	d <sub>1</sub> =14 CETRIS® BASIC d <sub>2</sub> =12,5 Knauf RED	146,5	43	3,00	120	40	REI / REW 60 DP3	0,08	
						3,00			REI / REW 15 DP2		
						4,00			EI 60 DP3		
WW 02			12+12	148	74	3,00			REI 60 DP3	0,32	
						3,00			REI 45 DP2		
						4,00			EI 60 DP3		
WW 03		wooden lath 100x60 mm axially 625 mm	14	128	45	3,00			REI 30 DP3	0,15	
						3,00			REI 15 DP2		
						4,00			EI 30 DP3		
WW 04			14	114	27	3,00			REI 15 DP2	0,08	
						4,00			EI 15 DP2		

Notes to the table:

- 1) Informative thermal resistance value
- 2) Fire resistance value for exposition to fire on the CETRIS® board (full cladding) side as well as on the profile (hollow) side
- 3) The fire resistance value applies only to the fire stress on the CETRIS® boards

## Materials for assembly of the firewall constructions – specifications

Description	Visualisation	Note
CETRIS® BASIC board Cement bonded particleboard, smooth surface, cement grey. Basic format 1,250x3,350 mm. Volume mass 1320±70 kgm <sup>-3</sup>		Thickness according to the fire resistance requirements
Screw 4.2x25, 35, 45, 55 mm Counter-sunk, self-tapping screws		Screw type according to the thickness of cladding and type of load-bearing construction. Anchoring in the interior, or exterior under the warm cladding system (ETICS)
Screw 4.2 – 4.8 x 38, 45, 55 mm Stainless steel or galvanised screws with half-round or hex head with thrust water-tight washer		Screw type according to the thickness of the cladding and type of load-bearing construction. Anchoring on the exterior – it is necessary to pre-drill the board (hole diameter 8(10) mm)
CW profile 75, 100 (vertical) Galvanised sheet metal profile 75x50x0.6 mm 100x50x0.6 mm		Dimensions according to the fire resistance and wall height requirements. Alternatively, it is possible to use steel profiles with a cross-section area that minimally equivalent to the CW profiles.
UW profile 75, 100 (horizontal) Galvanised sheet metal profile 75x40x0.6 mm 100x40x0.6 mm		
Steel dowels For profile anchoring to masonry (concrete) walls)		Dimensions (diameter and length) by weight of structure, type of substrate and anchored material
Fireproof sealant White matter for filling the joints and looping the screw heads		DEXAFLAMM-R putty (manufactured by Tora Spytihněv), or fire-resistant DenBraven (acrylic, silicone) putty
Heat-insulation Mineral or rock wool (Isover, Rock wool, Knauf Insulation ...)		It is necessary to keep the thickness and volume mass according to the specification in the composition. Reaction to fire class A1
Adhesive pins		For stabilisation of position of the insulation boards in the frame construction.
Wooden post Spruce timber of minimum class SII, max. Humidity 18%.		Alternatively glued timber may be used; cross-section according to the specifications in the composition
FIBERFRAX Durafelt Aluminium-silicon fibre mats/paper		For profile lining on the bottom side, interruption of thermal bridges, as insulation for temperatures up to 1,260° C
KNAUF GKF / RED board KNAUF plasterboard of 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 Praha spol. s r.o.
KNAUF Uniflott Plasterboard joint filler.		Cannot be used for CETRIS® board joint filling!!!
Screw TN 35 Quick screw (4.0 × 35 mm) for plasterboard anchoring		Cannot be used for CETRIS® board anchoring!!!

## 8.2.2 Fire Partitions, Shaft Wall on Steel Framework

### 8.2.2.1 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  $h_s$  and thickness  $d$  should always be lower than 40. The  $h_s/d > 40$  ratio represents slenderness ratio  $L/i$  circa 140.

The peripheral profiles are anchored into the frame (masonry) with steel dowels with a spacing of 625 mm, the joint between the profiles and the masonry is filled with fire-resistant filler. The axial distance of the vertical interior profiles does not exceed 625 mm.

### 8.2.2.2 Construction Composition

The construction is symmetrically or asymmetrically cladded on one or both sides with one or more layers of CETRIS® cement bonded 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). The horizontal displacement of the boards is min. 400 mm.

For multi-layer cladding, the gaps between the boards mutually overlap – in the vertical direction by the profile (625 mm), in the horizontal direction min. 400 mm.

For CETRIS® board anchoring to the sheet metal profiles self-tapping screws with sunken heads are used; the screw heads are equipped with blades for countersinking in the board and 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). In the exterior (the boards form a visible cladding) anchoring must be done via the pre-drilled holes using the screws with a visible head and water-tight washer. Gaps of minimum width 5 mm are left between the boards. The joint fill, the wall perimeter filling and coverage of the screw heads is done using fire-resistant filler.

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/rock wool basis)



Fire Resistance	Structure of the double-sided cladding made of CETRIS® boards						
	with an air gap			with thermal insulation (mineral or rock wool with resistance to fire class A1)			
	Cladding	Min. air gap thickness	Cladding	Cladding	Insulation thickness	Density	Cladding
EI 30	16	50	16	-	-	-	-
EI 45	10+10	50	10+10	12	60	50	12
EI 60	12+12	50	12+12	16	60	75	16
EI 90	18+16	50	18+16	12+12	60	75	12+12
EI 120	18+12+12	50	18+12+12	16+16	60	75	16+16
EI 180	-	-	-	18+12+12	60	75	18+12+12

## Sizes of partition walls taller than 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/rock wool basis)

Fire resistance <sup>1)</sup>	Structure of the double-sided cladding made of CETRIS® boards				Maximum height (m)
	Cladding	Insulation thickness <sup>3)</sup>	Density	Cladding	
EI 15	12	60	50	12	7,8
EI 30 <sup>2)4)5)</sup>	16	-	-	16	4,5
EI 30 <sup>2)4)</sup>	12+12	-	-	12+12	7,3
EI 45 <sup>2)4)</sup>	12+12	-	-	12+12	5,5
EI 90	18+12+12	60	75	18+12+12	9,5
EI 120					6,4
EI 180					4,9

Supplementary classification according to ČSN 73 0810: 2010 – all walls with steel load-bearing structures with DP 1 classification.

Notes to the table:

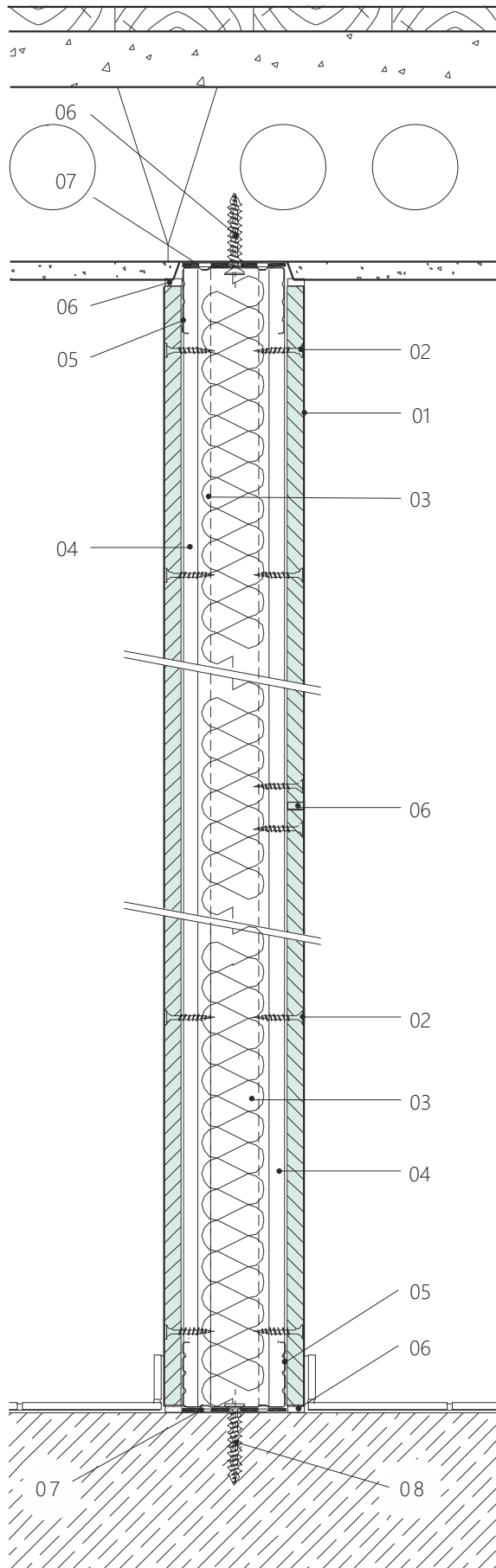
- 1) Classification of limit conditions of fire resistance is performed pursuant to EOTA TR 35
- 2) The air gap width is 75 mm
- 3) Mineral or rock wool insulation (e.g. Isover, Rock wool Knauf Insulation ...) with a prescribed density and thickness, reaction to fire class of min. A2. If we are not filling the entire joint, it is necessary to secure the position of the insulation – e.g. with adhesive pins.

- 4) For partitions with a height above 4 m, it is necessary to consider a higher weight of the construction and the higher the stress in the steel cross-section, which causes a drop in the critical temperature of the steel. For this reason, 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.
- 5) The upper base U profile must have a minimum height of 100 mm at the point of the CW post.



## 8.2.2.3 Model Construction Designs – Partition Walls – Details of a Wall with Single-layer Cladding

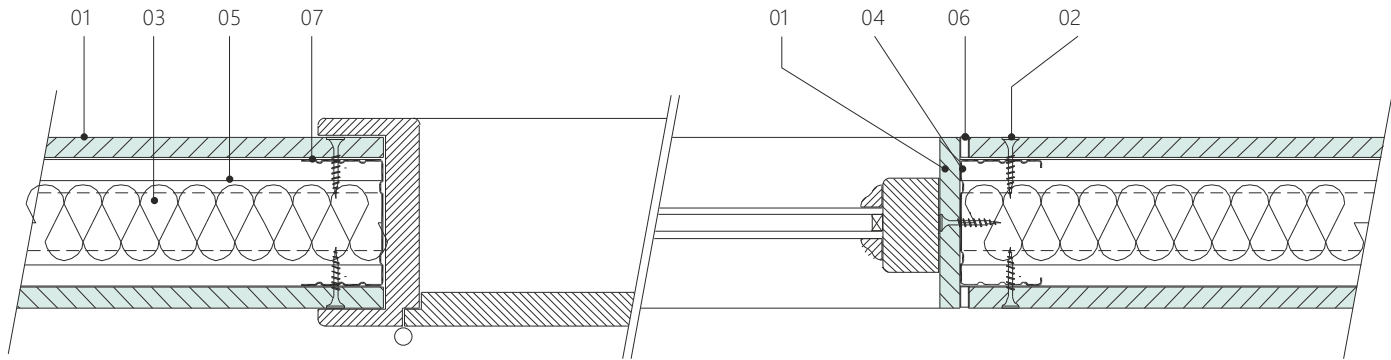
### Vertical section



- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 DEXAFLAMM-R filler
- 07 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 08 dowel

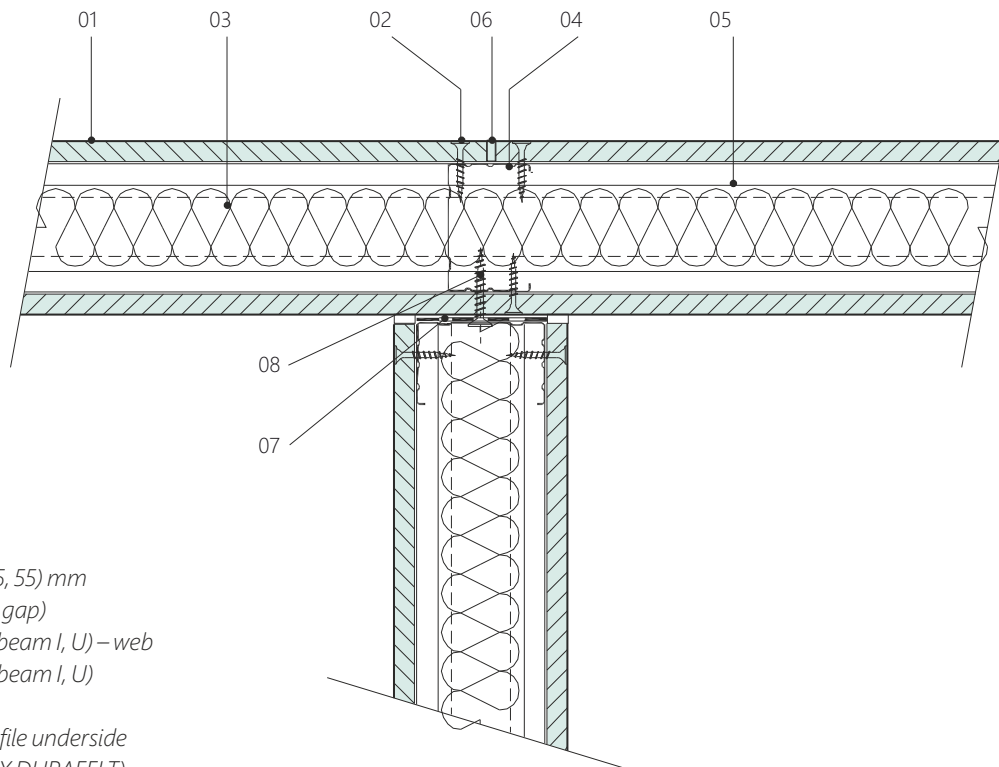


## Hole in the wall - Horizontal section



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

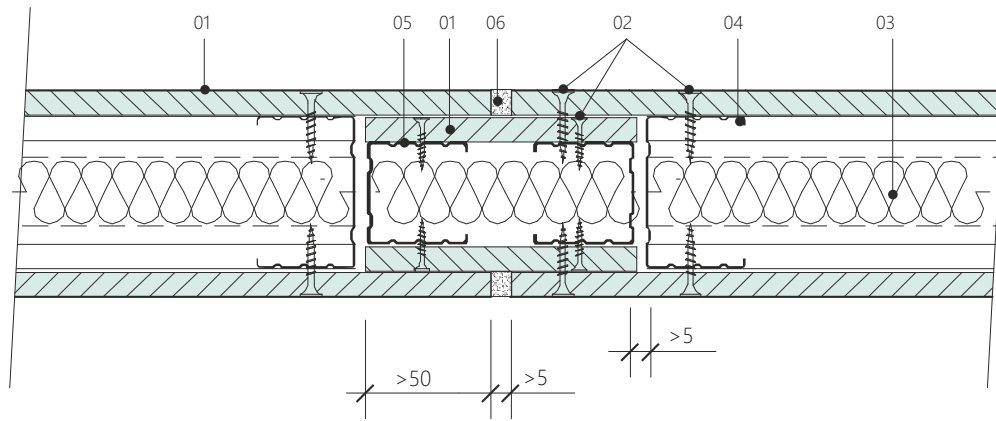
## T-joint - Horizontal section



- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing of the profile underside  
(paper FIBERFRAX DURAFELT)
- 08 dowel

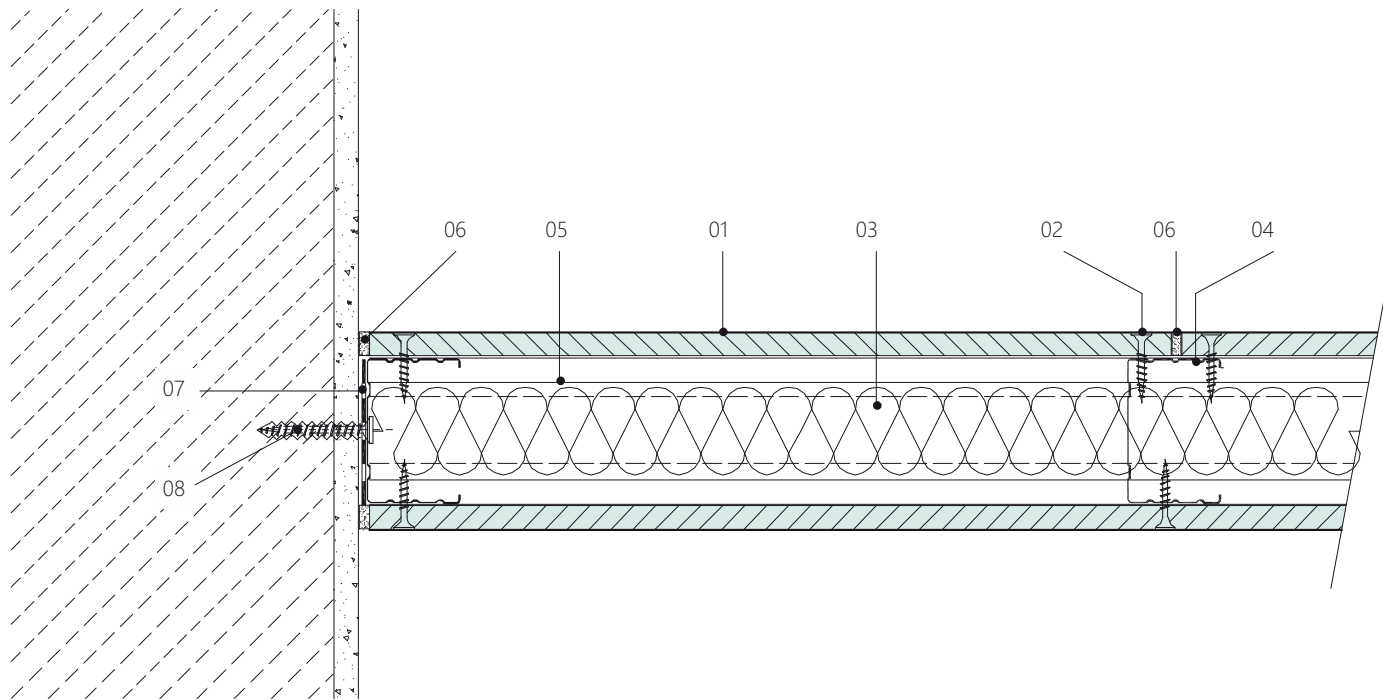


Joint detail – EI > 60 min - Horizontal section



- 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 fire resistant filler.

Connection at the wall - Horizontal section

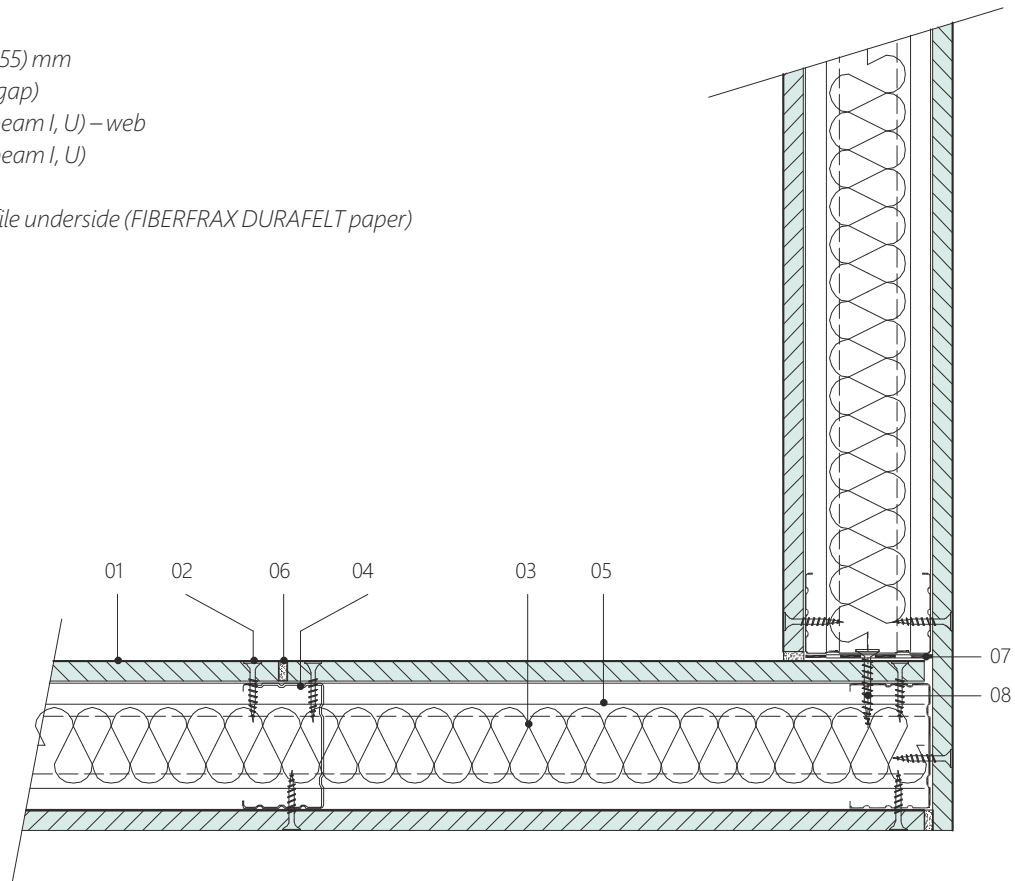


- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 08 dowel



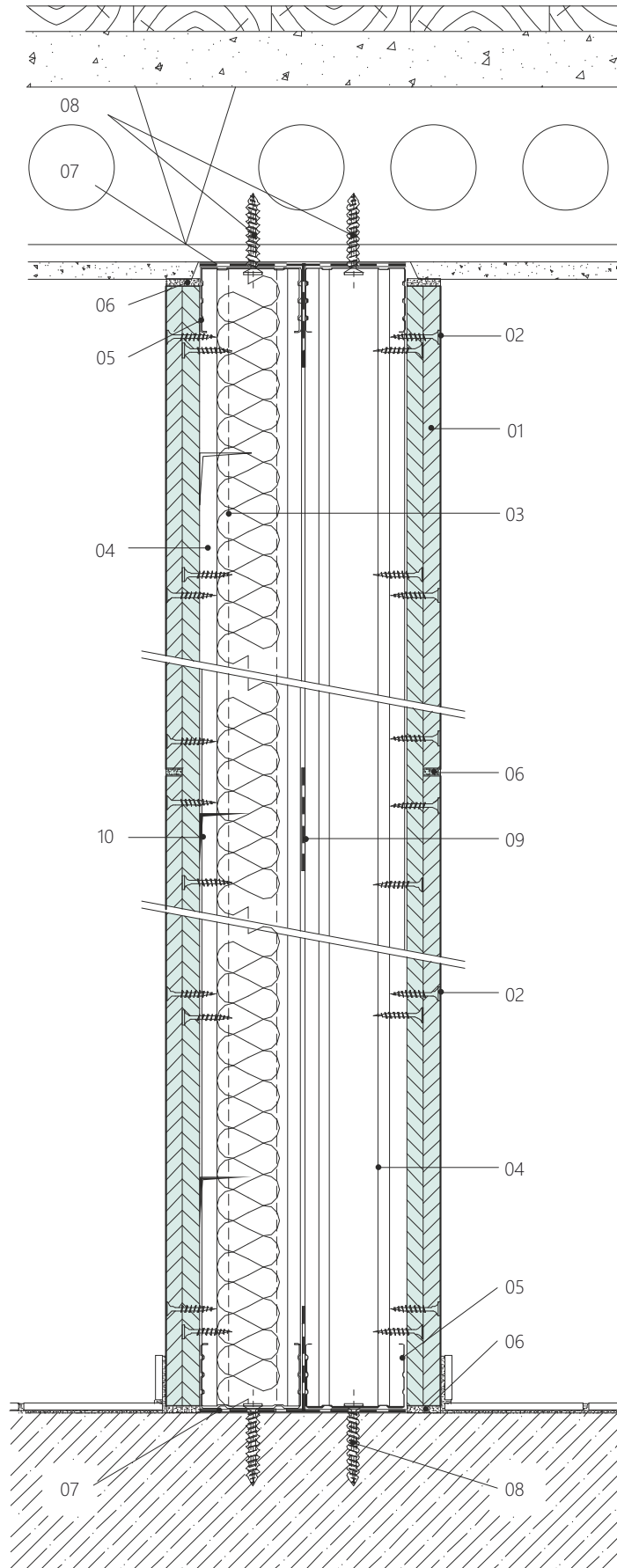
## L-joint - Horizontal section

- 01 CETRIS® board
- 02 screw 4.2×35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 08 dowel



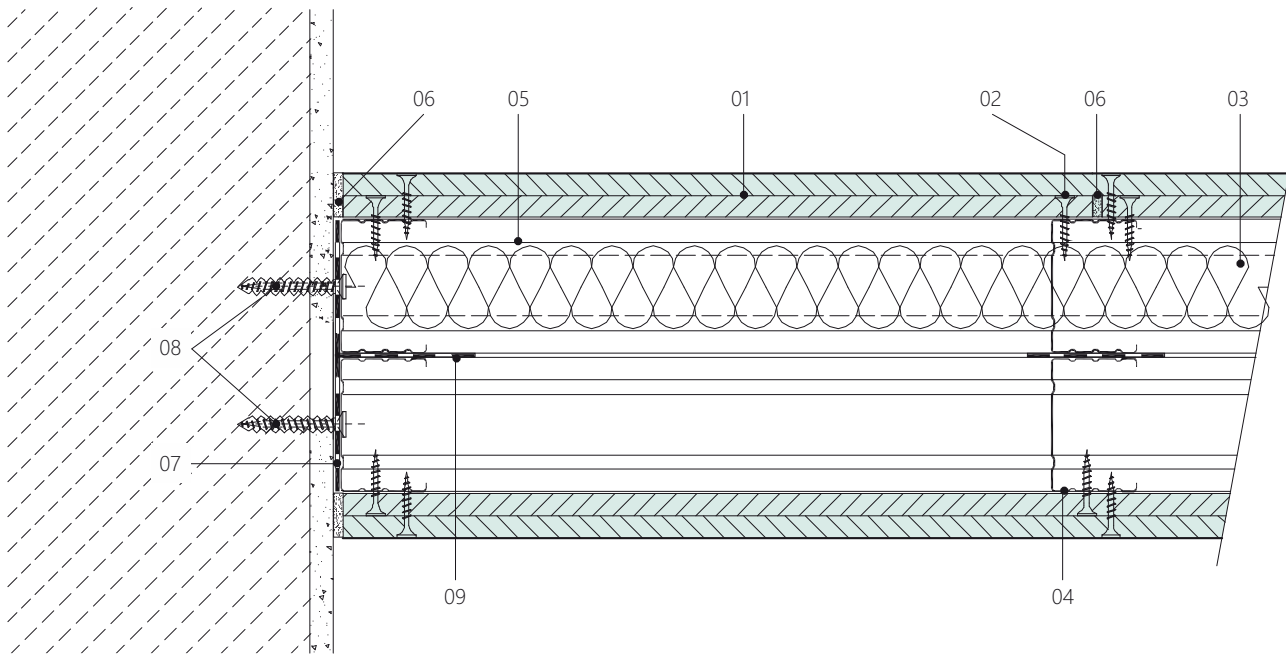
## 8.2.2.4 Model Construction Designs – Partition Walls – Details of a Wall with Multi-layer Cladding

### Vertical section



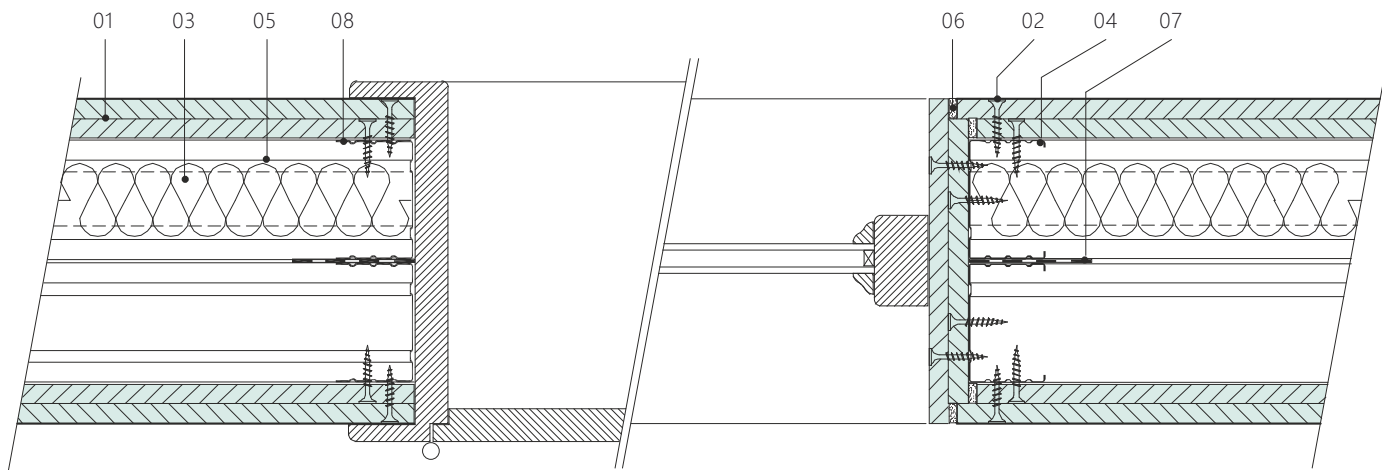
- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 08 dowel
- 09 sealing tape
- 10 adhesive pins

## Connection at the wall Horizontal section



- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 08 dowel
- 09 sealing tape

## Hole in the wall Horizontal section

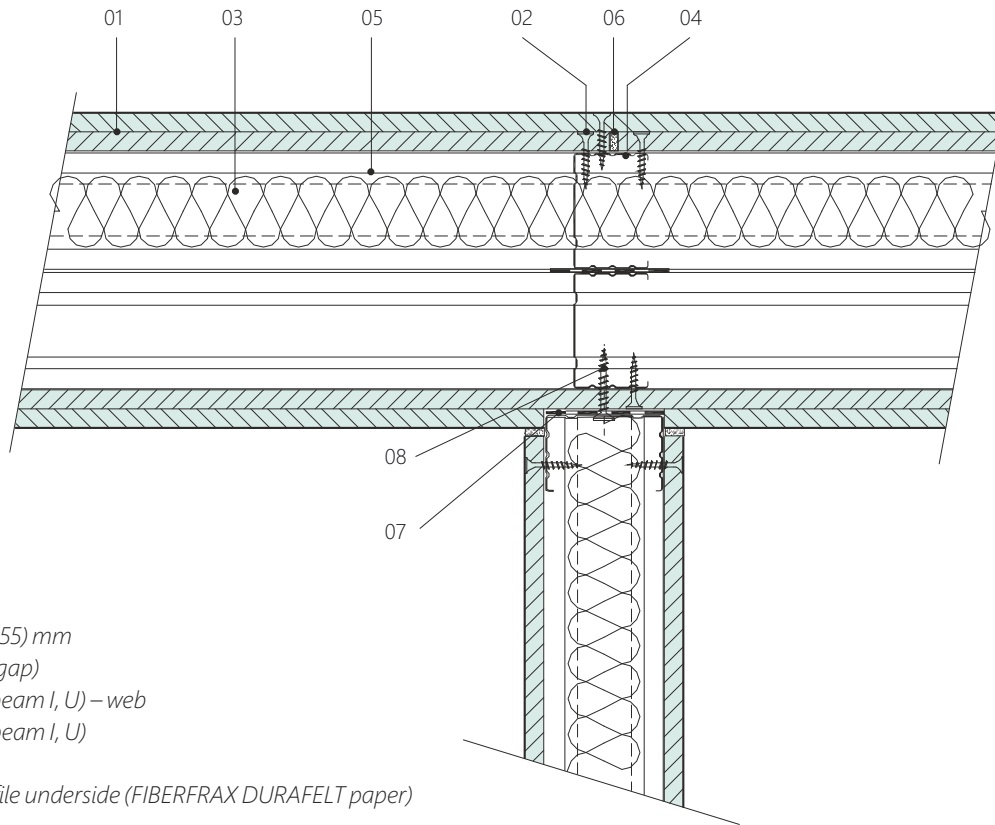


- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing tape
- 08 UA profile (opening jamb)





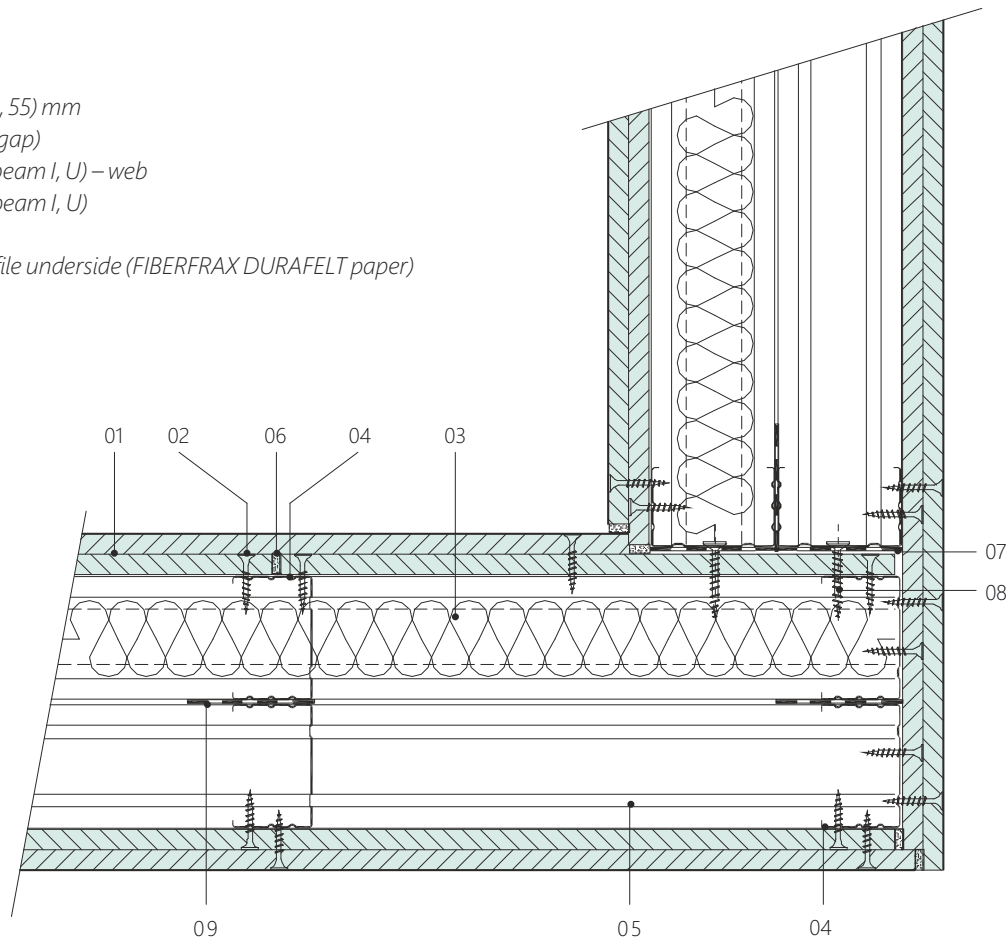
### T-joint - Horizontal section



- 01 CETRIS® board
- 02 screw 4.2×35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 08 dowel

### L-joint - Horizontal section

- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 mineral wool (air gap)
- 04 CW profile (steel beam I, U) – web
- 05 UW profile (steel beam I, U)
- 06 fire resistant filler
- 07 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 08 dowel
- 09 sealing tape



## 8.2.3 Shaft (Advanced) Firewalls

Shaft (advanced) firewalls are wall constructions clad only with single-layer CETRIS® cement-bonded particleboards, which ensure the stipulated fire resistance.

They can be used as separate shaft walls as well as advanced walls - to increase the fire resistance of the existing constructions. In this case, it is not required for the existing constructions to exhibit any fire resistance. The maximum separate height of these constructions is 4 m. In the case of cladding of lift shafts in multi-storey buildings, use at a higher height is conditional:

- the load-bearing constructions of the cladding are anchored to the load-bearing wall of the building, or other load-bearing constructions with a maximum spacing of 4,000 mm using steel dowels,
- the load-bearing construction to which the shaft wall is fixed must have a fire resistance that is higher than that of the shaft wall itself,
- all the joints (also between the lift shaft and the load-bearing construction) must be filled fire-resistant filler.

The mechanical requirements of the lift shaft cladding are described in ČSN EN 81-20 Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – Part 20: Passenger and goods lifts. For safe operation of the lift, the shaft wall must have such a mechanical strength that withstands the action of 1,000 N (100 kg) perpendicular to the wall from one or the other side at an arbitrary point, proportionately to the circular or square area of 300 x 300 mm:

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

This parameter was verified by the Strojírenský a zkušební ústav Brno. The CETRIS® cement bonded particleboard of thickness 12 mm in one layer anchored to the frame construction was chosen.

During the repeated test, neither permanent deformation occurred nor was the prescribed elastic deformation limit exceeded.

### Overview of shaft (advanced) firewalls

Fire resistance	One-sided cladding with CETRIS® boards	Insulation thickness	Density	Fire stress
EI 15	16	-	-	only on the cladding side – CETRIS® boards
EI 30	12+12	-	-	on the cladding side – CETRIS® boards also on the side of the gap (profiles)
EI 45	16+16	60	50	only on the cladding side – CETRIS® boards

Supplementary classification according to ČSN 73 0810: 2010 – DP1.

### 8.2.3.1 Load-bearing Construction of Advanced Walls

The load-bearing construction is a frame consisting of steel zinc-coated CW profiles CW 75 × 50 × 0.6 mm. The peripheral profiles are anchored into the existing masonry construction with steel dowels with a spacing of 625 mm, the joint between the profiles and the masonry is filled with fire-resistant filler. The axial distance of the vertical profiles does not exceed 625 mm.

### 8.2.3.2 Construction Composition

The shaft (advanced) wall has one-sided cladding with one or more layers of CETRIS® cement bonded particleboards with the option to insert thermal insulation between the vertical profiles. The horizontal overlap of the boards is min. 400 mm. For multi-layer cladding, the gaps between the boards mutually overlap – in the vertical direction by the profile (625 mm), in the horizontal direction min. 400 mm. In the case of the composition with a fire resistance of EI 45 (cladding with two layers of CETRIS® cement bonded particleboards of thickness 16 mm), it is necessary:

- mineral wool (of thickness 60 mm, minimum weight 50 kg/m<sup>3</sup>) and secure it against failure of the UW steel profiles of approximate

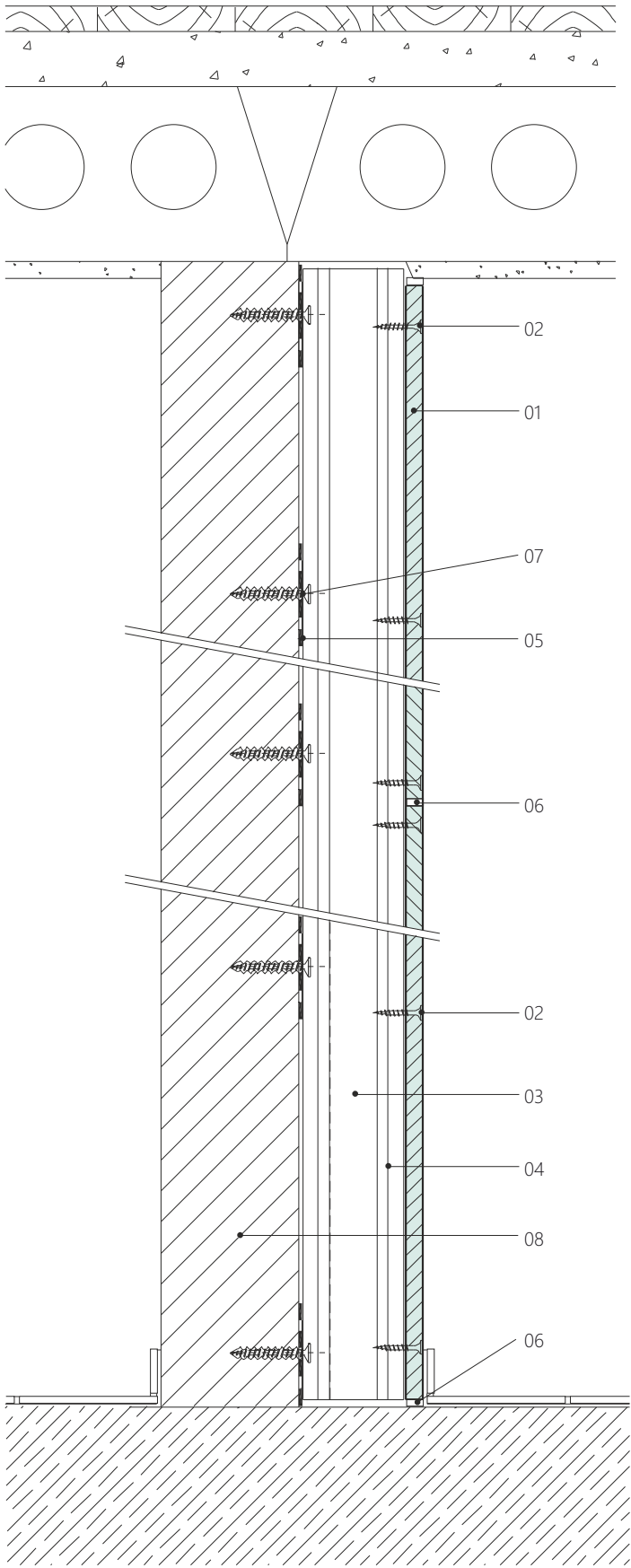
length 100 mm. These profiles are located at the point of the vertical joints of the mineral wool boards (inserted insulation) and are fixed to the vertical CW post.

- apply fire-resistant filler to the contact surface of the CW steel posts with the CETRIS® boards, e.g. DEXAFLAMM-R, Den Braven acrylic fire-resistant filler.



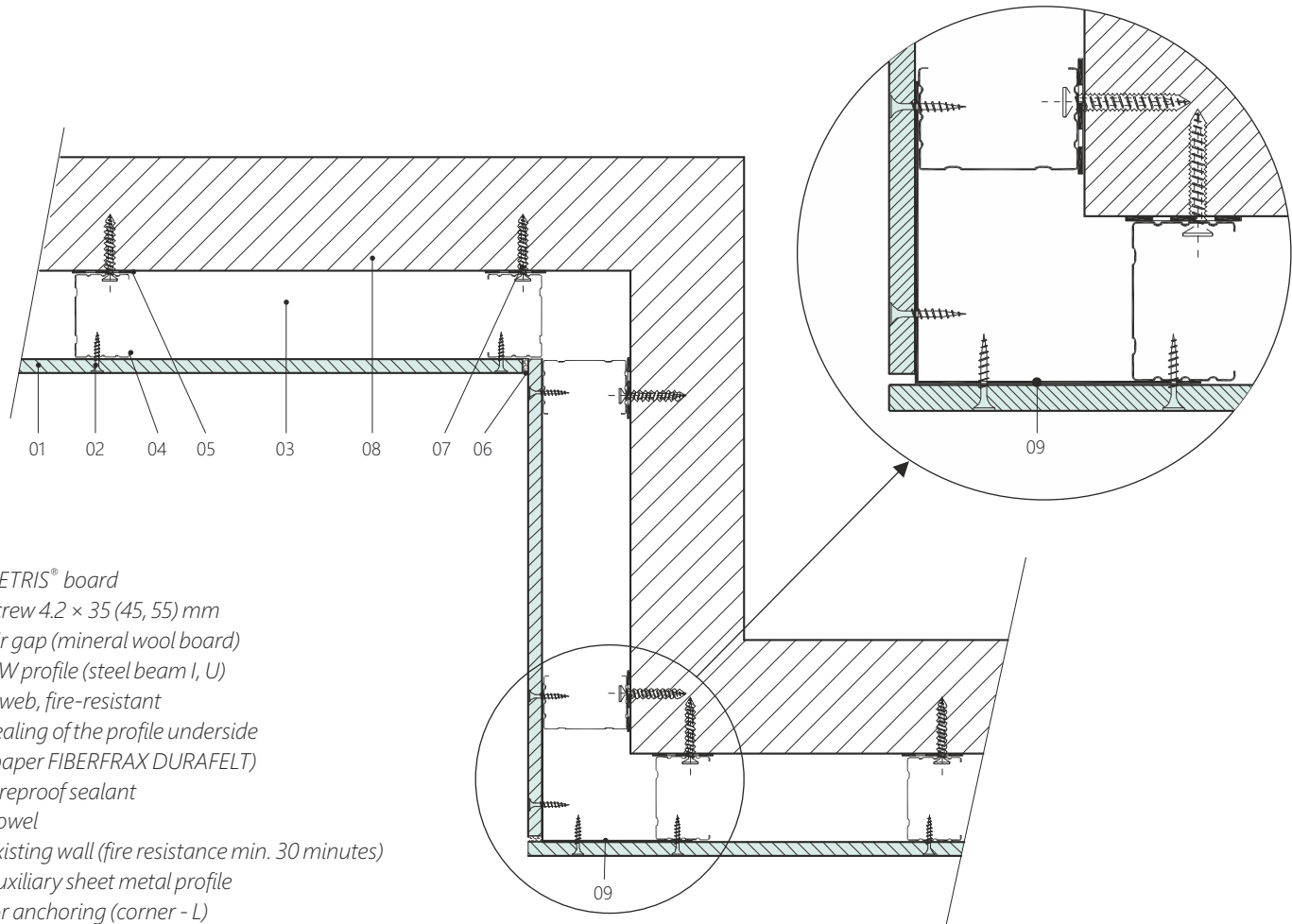
### 8.2.3.3 Model Construction Solutions – Details of Advanced Walls

#### Vertical section



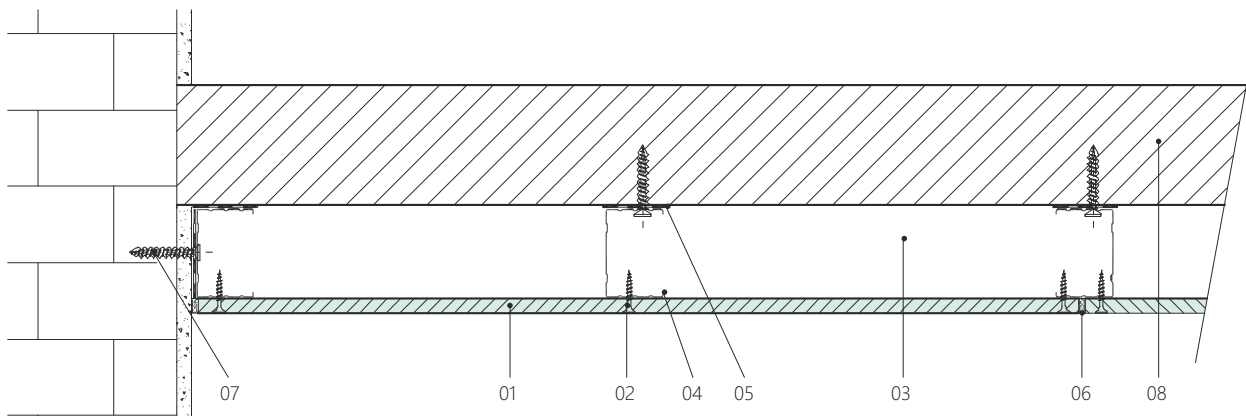
- 01 CETRIS® board
- 02 screw 4.2 × 35 (45, 55) mm
- 03 air gap (mineral wool board)
- 04 CW profile (steel beam I, U) – web
- 05 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 06 fire resistant filler
- 07 dowel
- 08 existing wall

### Inner corner, outer corner 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)  
– web, fire-resistant
- 05 sealing of the profile underside  
(paper FIBERFRAX DURAFELT)
- 06 Fireproof sealant
- 07 dowel
- 08 existing wall (fire resistance min. 30 minutes)
- 09 auxiliary sheet metal profile  
for anchoring (corner - L)

### Connection at the wall 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) – web
- 05 sealing of the profile underside (FIBERFRAX DURAFELT paper)
- 06 fire resistant filler
- 07 dowel
- 08 existing wall



### 8.2.3.5 General Principles of Assembly of Fire Walls on a Steel Frame

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 must 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 cladding 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 pre-drilled holes (8 or 10 mm) and screws with visible heads and sealing washers (see chapter 7.1.6.2).
- 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 wall cladding.
- 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 shorter than the room height. For walls with a height greater than 4 m, the CW profile must be shorter by 20 mm – the dilatation in the lower and upper mounting of the base (U) profile must be min. 10 mm. In case of wall height > 4 mm, it is necessary to observe the principles given in the table on page 146 + points 4 and 5.
- Dilation joints and all contacts with the wall and the corner joints must be filled with fire resistant filler (e.g. DEXAFLAMM-R, Den Braven acrylic fire resistant filler). The filler must be driven in to a minimum depth of 5 mm.
- The surfaces of the CW or UW profiles adjacent to the floor and the ceiling or wall must be covered with fire resistant filler; if the fire resistance of the wall is greater than 60 minutes, we recommend lining with FIBERFRAX DURAFELT paper. This paper is also suitable for partial insulation of potential thermal bridges in the construction.
- The boards of multilayer cladding 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. 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 153.
- For fire resistances of constructions above 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 felt.
- The position of mineral wool in an air gap of higher thickness than the thickness of the mineral wool strip should be fixed with adhesive pins.
- All openings in CETRIS® fire partitions must be sealed with inserts or in other ways pursuant to the project specifications. Installations inside the partition walls (water distribution lines, electrical wiring, etc.) must be protected against fire with mineral wool, otherwise the fire resistance of the wall could be reduced.
- 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.
- Surface treatment and filling of CETRIS® boards can be done only after acclimatization of boards in installed condition

### 8.2.3.6 Assembly Procedure

- Measure the locations of the UW profiles in the horizontal planes and apply fire resistant filler to the floor and ceiling, or underline it as necessary with FIBERFRAX DURAFELT paper.
- 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 as 625 mm.
- Install the CW profiles in the construction with the spacing as per the structural assessment and board thickness, but with a max. spacing of 625 mm. The length of the CW profiles must be about 15 mm shorter than the height of the room.
- Insert cut mineral felt between the profiles if required.
- 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.
- In the case of double or multilayer cladding 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.*
- 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 cladding the spacing can be increased in the first layer up to a maximum of 400 mm.



## 8.2.4 Fire Walls with a Wooden Supporting Structure Clad with a CETRIS® Cement Bonded Particleboard

Based on the new fire resistance tests of wall constructions, we have significantly extended the offer of wall compositions with wooden supporting structure clad with CETRIS® cement bonded particleboards. The list of structures includes compositions of bearing walls (wall height up to 3 m) and non-load-bearing walls (height up to 4 m) is given in table 6. fire resistance is determined according to EN 13 501-2 with sorting of construction components (DP2/ D. P3) in accordance with ČSN 73 0810, article 3.2.

### 8.2.4.1 Load-bearing Construction

The load-bearing construction consists of a frame of wooden vertical and horizontal beams mutually connected with screws.

The cross-section of the vertical wooden beams depends on the composition of the construction – it is necessary to keep the cross section mentioned in the table with a list of compositions. The beams can be made of dry spruce lumber (moisture content 18 % compactness class min. S II), alternatively glued lumber can be used.

The wooden prisms are anchored into the frame (masonry) with steel dowels with a spacing of 625 mm, the joint between the profiles and the masonry is filled with fire-resistant filler (e.g. DEXAFLAMM-R, Den Braven acrylic fire resistant filler). The axial distance of the vertical internal wooden posts must not exceed 625 mm.

### 8.2.4.2 General Principles of Assembly of Fire Walls on a Wooden Frame

The following principles apply to the implementation of the load-bearing wooden frame and for anchoring of CETRIS® boards.

- Maximum spacing of the screws anchoring the CETRIS® boards to the wooden posts must not exceed 200 mm (screws by the edges), or 400 mm (across the surface) and the distance from the board vertical edges must not be less than 25 mm in the case of fire walls.
- When installing CETRIS® boards it is necessary to keep joints with a minimum width of 5 mm, the joints must be filled with filler (DEXAFLAMM-R, Den Braven acrylic fire resistant filler).
- In case of two layers of CETRIS® boards, it is necessary to overlay the joints – in horizontal direction by 625 mm of the post distance, in the vertical direction by min. 400 mm. The joints must be filled with fire resistant filler.
- A horizontal joint created when cladding CETRIS® boards on a wall must be supported with wooden beam of minimum width 60 mm.
- Maximum spacing of dowels for anchoring the wooden beams must not exceed 625 mm.
- The maximum spacing of the dowels for anchoring the wooden posts should not be more than 625 mm.
- Dilation joints and all contact surfaces with the wall and the corner joints must be filled with fire resistant filler. The filler must be driven in to a minimum depth of 5 mm.
- The surfaces of the wooden prisms in contact with the floor and the ceiling or masonry must be treated with fire resistant filler.
- The position of cut mineral felt in an air gap of higher thickness than the thickness of the cut mineral felt must be fixed with adhesive pins.
- If there is an underlay tape prescribed on the wooden posts in the composition, it is necessary to use a minimum board width 200 mm. The underlay tape is fixed to the wooden posts with screws with countersunk head and the screw spacing is max. 300 mm.

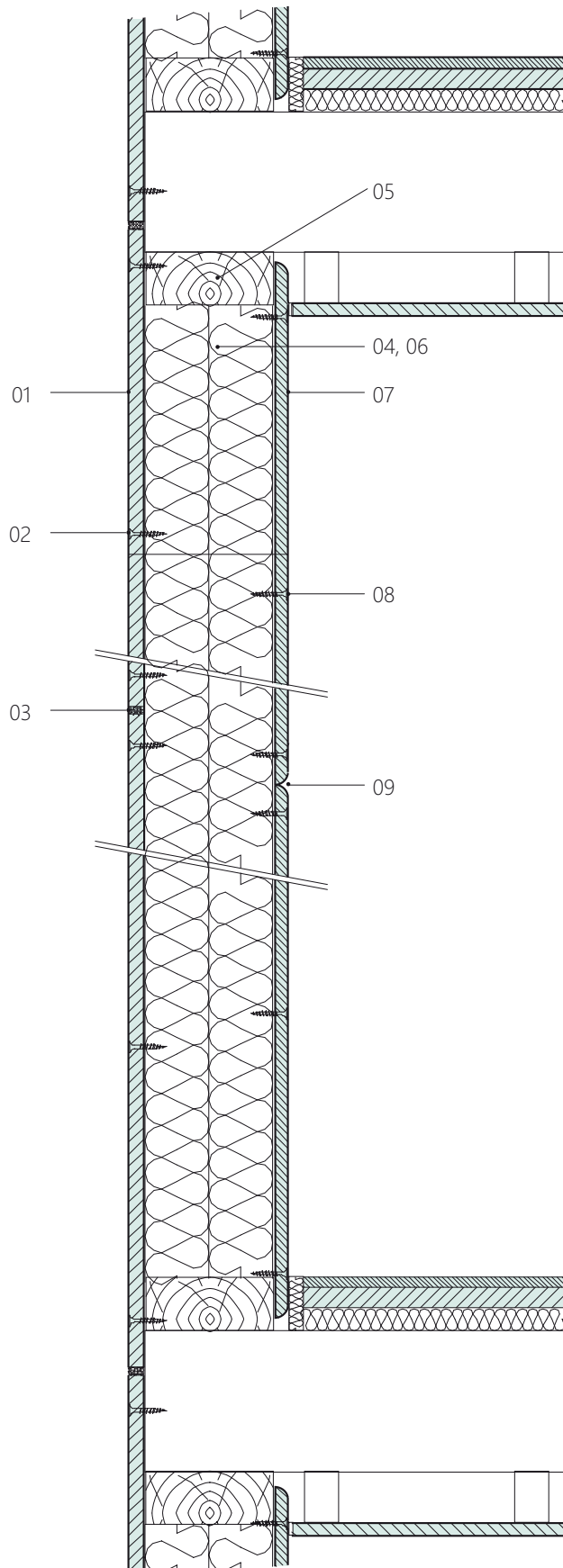
Fire resistance	Composition of CETRIS® board double-sided cladding				Maximum height (m)
	Exterior cladding	Insulation thickness	Density	Interior cladding	
EI 15 DP2	14	-	-	-	3
REI 15 DP2					4
REI 30 DP3	14	-	-	14	3
REI 15 DP2					3
EI 30 DP3					4
REI 60 DP3	12+12	-	-	12+12	3
REI 45 DP2					3
EI 60 DP3					4
REI/REW 60 DP3	12	120	40	Knauf plaster-board GKF 12,5	3
REI/REW 15 DP2					3
EI 60 DP3					4

- All openings in the peripheral firewall must be sealed with fire packing or in some other way according to the project specifications. Installations inside the partition walls (water distribution lines, electrical wiring, etc.) must be protected against fire with cut mineral felt otherwise the fire resistance of the wall could be reduced.

*Note: Anchoring of KNAUF Red boards, joint filling and surface finish must be done in compliance with the manufacturer's recommendations.*

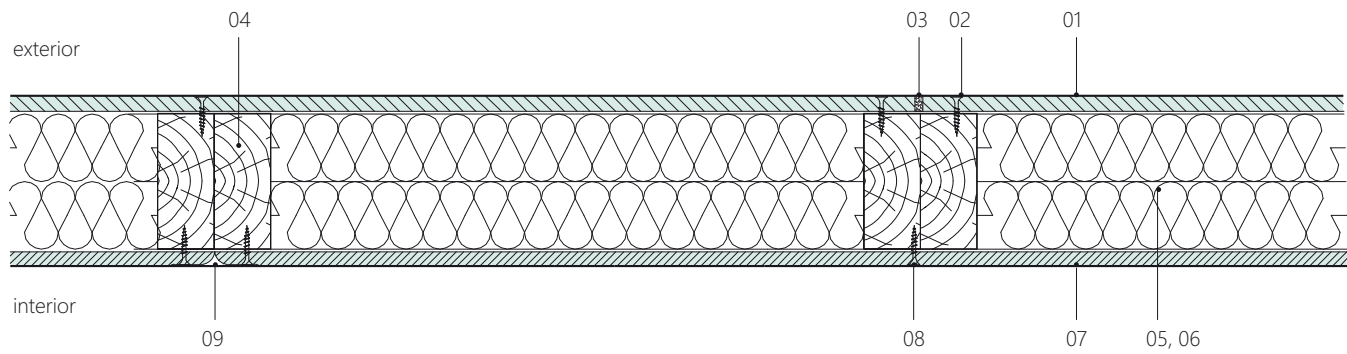


Vertical cross-section



- 01 CETRIS® board of thickness 14 mm
- 02 screw 4.2×35 mm
- 03 fire resistant filler
- 04 vertical wooden pillar (axial spacing max. 625 mm)
- 05 wooden prism
- 06 cut mineral felt (Orsil Uni) - 2× thickness 60 mm
- 07 Knauf GKF board - thickness 12.5 mm
- 08 screw TN 3.5×35 mm
- 09 gap filler – Knauf Uniflott

## Horizontal cross-section



- 01 CETRIS® board of thickness 14 mm
- 02 screw 4.2 × 35mm
- 03 fire resistant filler
- 04 vertical wooden pillar (axial spacing max. 625 mm)
- 05 wooden prism
- 06 mineral wool (Orsil Uni) - 2× thickness 60 mm
- 07 Knauf GKF board - thickness 12.5 mm
- 08 screw TN3.5×35mm
- 09 joint filler – Knauf Uniflott

## 8.3 Horizontal Constructions – Suspended Ceilings (Fire from Below)

### 8.3.1 Scope of Application

Based on the test results provided here, the CETRIS® boards can be applied in the following types of fire resistant horizontal wall constructions:

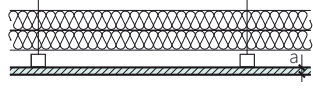


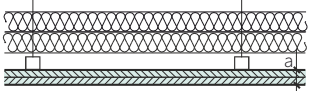
- Separate fire ceiling panel, heat (fire) exposure from underneath. In this case, the fire resistance is specified directly by the result of the fire resistance test.
- horizontal protective membrane (ceiling) sub-floor (roof) constructions, exposure to heat (fire) from below. The fire resistance is for the entire assembled construction.

As stated in the protocols it is also necessary to comply with the technology of the ceiling assembly and all assembly procedures used and tested in the context of preparation of the samples. The ceiling constructions may be of any size on the condition that the spacing between the suspensions will not increase and that the dilatation measures will be adequately implemented. The test results apply to cavities of any height. In the final analysis, 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.

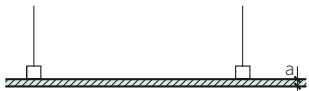
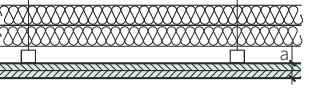
*Important notice:*

- *All the data applies to the conditions and stress of horizontal constructions during fire pursuant to the valid text of ČSN EN 1364-2 and ČSN 13 381-1. The results of fire resistance tests and implementation principles from them only assess the issue of the technical properties of the constructions in relation to their resistance to actual fire. For this reason, the axial distances and types of CD profiles and other elements, which comply with the tests are stated. These, however, must be considered the minimum limits that must not be exceeded. It is necessary to note that when dimensioning fire ceiling panels, it is also necessary to consider the structural requirements for the construction and modify it according to real stress in relation to the weight of the CETRIS® boards.*
- *Assembly of fire constructions may only be carried out by trained staff – see Chap. 8.8. Training of assembly companies in applications with CTD CETRIS® boards.*

Overview of horizontal constructions - separate ceilings (tested according to ČSN EN 1364 - 2)

Type / Marking	Diagram	Cladding of the ceiling	Weight (kg/m <sup>2</sup> )	Mineral wool					Fire Resistance	Thermal resistance (m <sup>2</sup> K/W <sup>1</sup> )	Weighted sound transmission loss (dB)	
				Thickness (mm)	Density (kg/m <sup>3</sup> )	Description	Assembly support spacing (mm)	Load-bearing support spacing (mm)				Hanger spacing (mm)
C 01		1x12	21,60	2x40	60	CD profiles	420	1000	420	EI 15	2,06	43
C 02		2x12	36,5	-	-	CD profiles				EI 30	0,10	-
C 03		2x12	37,5	-	-	Wooden laths 60x40				EI 30	0,10	-
C 04		2x12	41,60	2x40	100	CD profiles				EI 45	2,12	

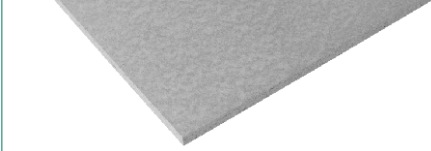
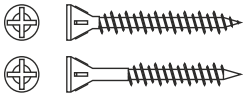
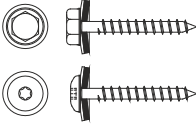
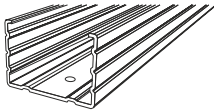
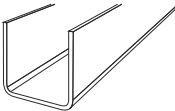





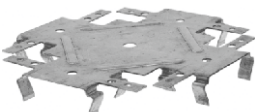


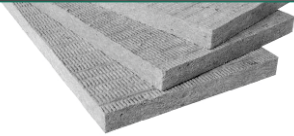
Overview of horizontal protective membranes (tested according to ČSN EN 13 381 -1)

Diagram	Cladding of the ceiling	Weight (kg/m <sup>2</sup> )	Mineral wool					Classification of protected horizontal element (ceiling/roof)	
			Thickness (mm)	Density (kg/m <sup>3</sup> )	Description	Assembly support spacing (mm)	Load-bearing support spacing (mm)		Hanger spacing (mm)
	1x12	17,5			CD profiles	420	1000	420	R 20
	2x12	37,6	2x40	50	CD profiles				R 45

Note: other instances of application of compositions of protective membranes are given on pages 163 - 166.



## Materials for assembly of horizontal constructions – specifications

Description	Visualisation	Note
CETRIS® BASIC board Cement bonded particleboard, smooth surface, cement grey. Basic format 1,250x3,350 mm, density 1320±70 kgm <sup>-3</sup>		Thickness according to the fire resistance requirements
Screw 4.2x25, 35, 45, 55 mm Counter-sunk, self-tapping screws		Screw type according to the thickness of the lining and type of load-bearing construction. Anchoring in the interior, or exterior under the thermal insulation system (ETICS)
Screw 4.2 – 4.8 x 38, 45, 55 mm Stainless steel or galvanised screws with half-round or hex head with thrust water-tight washer		Screw type according to the thickness of the cladding and type of load-bearing construction. Anchoring in the exterior – it is necessary to pre-drill the board (hole diameter 8(10) mm)
CW profile 75, 100 (vertical) Galvanised sheet metal profile 75x50x0.6 mm 100x50x0.6 mm		Creation of load-bearing grid for installation of the ceilings. They are fixed using a straight or Nonius hanger on the floor (roof) construction.
UD profile Galvanised open sheet-metal profile of dimensions 28 x 27 x 0.6 mm, length 3.00 m.		It is used to anchor the ceiling to the walls, masonry with steel dowels
Connection for CD profile		For mechanical connection of CD profiles.
Direct hanger of thickness 1 mm, length 125 mm, load capacity 40 kg		Used to hang the metallic CD profile grid on the wooden beams of the roof ceiling constructions.
Nonius hanger of load capacity 40 kg. Three-part system used for fixing the CD profile grating to the load-bearing construction of the suspended floor		It allows setting of various cavity heights the ceiling and load-bearing construction.
Cross-coupling		Used for mechanical mutual connection of crossing CD profiles lying one above the other.
Wooden lath Section 60 x 40 mm.		It forms a wooden base construction (assembly and load-bearing profile). Dry impregnated timber class S10 (strength class C24)
NIVEAU plane cross-coupling		Used for mechanical mutual connection of crossing CD profiles lying in one plane.
DEXAFLAMM-R filler White tixotropic filler for joints and sealing of screw caps.		Alternatively, it is possible to use a fire resistant single-component (acrylic, silicone) permanently elastic filler (Sika firesil, Den Braven Pyrocyl)
FIBERFRAX DURAFELT paper Aluminium-silicon fibre mats of thickness 13 mm.		For profile lining on the bottom side, interruption of thermal bridges, as insulation for temperatures up to 1,260° C
ISOVER Mineral board of thickness 60 mm, density 60, or 100 kg/m <sup>3</sup> . Max. density 100 kgm <sup>3</sup> .		Alternatively, it is possible to use a mineral board with the same density, combustibility max. B according to ČSN 730862, the assumed reaction to fire class is A2 (according to EN 13501)



Apart from the compositions of separately hanged products, it is possible to achieve a fire resistance of the horizontal ceiling and roof constructions by using membranes – ceiling with CETRIS® cement bonded particleboard cladding. These ceilings were tested pursuant to ČSN EN 13381-1 Test methods for determining the contribution to the fire resistance of structural members - Part 1: Horizontal protective membranes in compositions, see the table on page 161 - Overview of horizontal protective membranes.

Basic conditions:

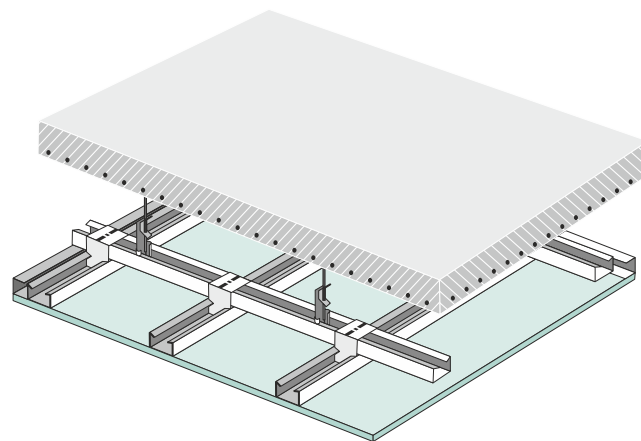
- The height of the cavity between the face of the ceiling board and the upper face of the membrane (ceiling) is min. 300 mm (composition CETRIS® Basic board 12 mm), or 420 mm (composition CETRIS® Basic 2x12 mm + 2x40 mm mineral wool)

- No flammable material may be inserted into the cavity
- The incline of the ceiling or roof construction is 0 - 25° from the horizontal plane

In this case, the ceiling including the ceiling construction is exposed to the effects of a standard fire. A standard composition of the ceiling construction was used - steel beams covered with reinforced lightweight concrete slabs. Within the scope of broader classification based on Euro code calculations, the test results can subsequently be used also under other types of ceiling constructions, see information below.

### Suspended reinforced concrete floor slab protected on the underside by a horizontal membrane (with soffit)

Protected concrete floor slab Total thickness of suspended floor slab / reinforcement cover of at least	Ceiling CETRIS® BASIC 12 mm resistance to fire class	Ceiling CETRIS® BASIC 2 x 12 mm 2x40 mm mineral wool insulation resistance to fire class
60/15 mm	REI 45	REI 60
80/20 mm	REI 60	REI 90
100/30 mm	REI 90	REI 120

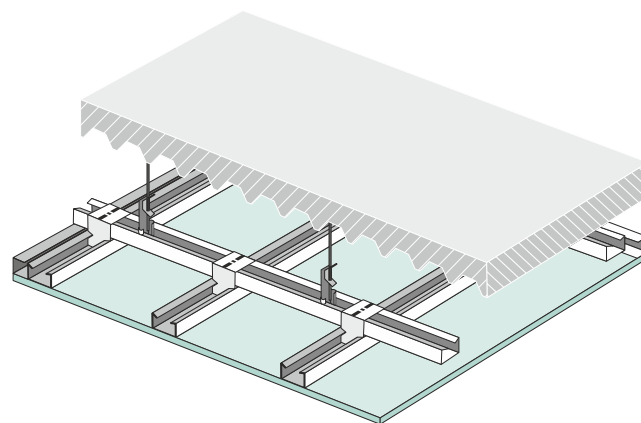


#### Usage conditions:

Type of suspended floor slab	Applies to suspended floor slabs made of concrete with steel reinforcements designed according to EN 1992 on the basis of the critical temperature of the steel reinforcements; the maximum temperature for the steel reinforcements is 500°C.
Concrete density	The classification applies to concrete with a minimum density of 2,300 kg/m <sup>3</sup> at 20 °C

### Composite suspended reinforced concrete floor slab (trapezoidal sheet metal + concrete) protected on the underside by a horizontal membrane (soffit)

Composite suspended floor slab protected by a horizontal membrane – ceiling CETRIS® BASIC 12 mm	Composite suspended floor slab protected by a horizontal membrane – ceiling CETRIS® BASIC 2 x 12 mm + 2x40 mm, mineral wool insulation
REI 30 (R30, I45)	REI 60 (R60, I60)



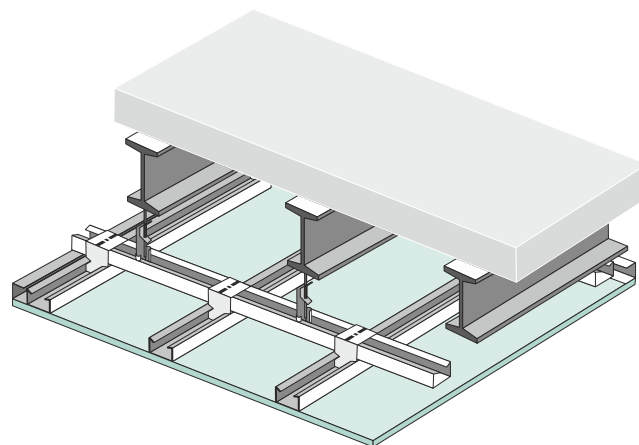
### Usage conditions:

Type of corrugated sheet metal	Classification applies to steel corrugated sheet with cavity (not filled with concrete), which broadens from top downwards, for steel corrugated sheeting with cavity (not filled with concrete), which narrows from top downwards (herringbone shaped cavity). The minimum height of the corrugated sheet wave is 50 mm and the minimum thickness of the sheeting is 0.75 mm; steel class S according to EN 10025-1 excluding class S185
Concrete density	The classification applies to concrete with a minimum density of 2,300 kg/m <sup>3</sup> at 20 °C
Thickness of the suspended floor slab concrete	Minimum thickness of composite suspended floor slab at the thinnest point (above the corrugated sheeting wave) is 40 mm;

### Ceiling construction of steel beams protected on the underside by a horizontal membrane (with soffit)

### Usage conditions:

Types of profiles	Classification applies to steel beams made of open profiles type I, H, U, T, L and closed square cross-section profiles;
Steel class	All construction class steels in class S according to EN 10025-1 excluding class S185



### Fire resistance of the ceiling construction protected by a horizontal membrane – hanging ceiling of composition CETRIS® BASIC 12 mm:

Cross-section coefficient of the steel beam $A_m/V$ [m <sup>3</sup> ]	Resistance to fire class depending on design temperature							
	350 °C	400 °C	450 °C	500 °C	550 °C	600 °C	650 °C	700 °C
≤ 160	R 20	R 20	R 20	R 20	R 20	R 20	R 30	R 30
≤ 250	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20
≤ 300	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20
≤ 390	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20

### Fire resistance of the ceiling construction protected by a horizontal membrane – hanging ceiling of composition CETRIS® BASIC 2x12 mm + 2x40 mm, mineral wool insulation

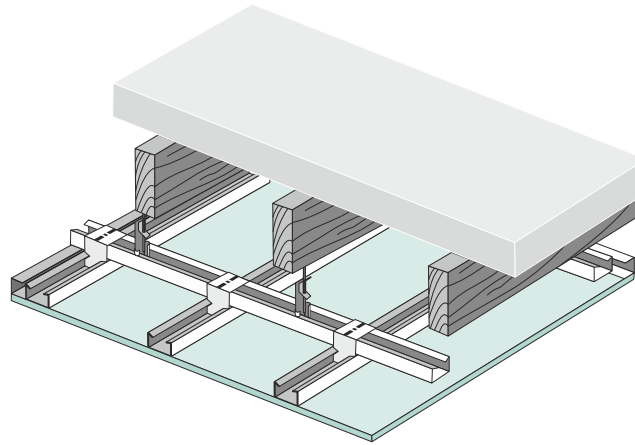
Cross-section coefficient of the steel beam $A_m/V$ [m <sup>3</sup> ]	Resistance to fire class depending on design temperature							
	350 °C	400 °C	450 °C	500 °C	550 °C	600 °C	650 °C	700 °C
≤ 160	R 45	R 45	R 45	R 45	R 45	R 60	R 60	R 60
≤ 250	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 60
≤ 300	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45
≤ 390	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45

*A* - steel profile perimeter exposed to fire

*V* - Cross-section area of steel profile



Ceiling construction of wooden ceiling beams protected on the underside by a horizontal membrane (hanging ceiling)



**Fire resistance of the ceiling construction protected by a horizontal membrane – ceiling of composition CETRIS® BASIC 12 mm, thermal stress on 3 sides, degree of utilisation of the cross-section 100%:**

Stress on 3 sides, usage level 100%		Cross-section height of the wooden beam (mm)											
		80	100	120	140	160	180	200	220	240	260	280	300
Cross-section width of the wooden beam (mm)	60	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20
	80	R 20	R 20	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30
	100	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30
	120	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30
	140	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 45	R 45	R 45	R 45	R 45
	160	R 30	R 30	R 30	R 30	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45
	180	R 30	R 30	R 30	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 60
	200	R 30	R 30	R 30	R 45	R 45	R 45	R 45	R 45	R 60	R 60	R 60	R 60

**Fire resistance of the ceiling construction protected by a horizontal membrane – ceiling of composition CETRIS® BASIC 12 mm, thermal stress on 4 sides, degree of utilisation of the cross-section 100%:**

Stress on 4 sides, usage level 100%		Cross-section height of the wooden beam (mm)											
		80	100	120	140	160	180	200	220	240	260	280	300
Cross-section width of the wooden beam (mm)	60	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 20
	80	R 20	R 20	R 20	R 20	R 20	R 20	R 20	R 30	R 30	R 30	R 30	R 30
	100	R 20	R 20	R 20	R 20	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30
	120	R 20	R 20	R 20	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30
	140	R 20	R 20	R 20	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30
	160	R 20	R 20	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30
	180	R 20	R 20	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 45	R 45
	200	R 20	R 20	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 45	R 45	R 45

**Fire resistance of the ceiling construction protected by a horizontal membrane – hanging ceiling of composition CETRIS® BASIC  
2x12 mm + 2x40 mm mineral wool, thermal stress on 3 sides, degree of utilisation of the cross-section 100%:**

Stress on 3 sides, usage level 100%		Cross-section height of the wooden beam (mm)											
		80	100	120	140	160	180	200	220	240	260	280	300
Cross-section width of the wooden beam (mm)	60	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 60
	80	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	100	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	120	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	140	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	160	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	180	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 90	R 90
	200	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 90	R 90	R 90	R 90

**Fire resistance of the ceiling construction protected by a horizontal membrane – hanging ceiling of composition CETRIS® BASIC  
2x12 mm + 2x40 mm mineral wool, thermal stress on 4 sides, degree of utilisation of the cross-section 100%:**

Stress on 4 sides, usage level 100%		Cross-section height of the wooden beam (mm)											
		80	100	120	140	160	180	200	220	240	260	280	300
Cross-section width of the wooden beam (mm)	60	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45	R 45
	80	R 45	R 45	R 45	R 45	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	100	R 45	R 45	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	120	R 45	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	140	R 45	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	160	R 45	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	180	R 45	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60
	200	R 45	R 45	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60	R 60

**Usage conditions:**

Cross-section, number of stressed sides	Classification applies to beams with a four-square section of minimum 60 x 80 mm, maximally 200 x 300 mm. The beam is exposed to thermal stress from three sides in a case where the ceiling construction (cladding) provides protection during the fire resistance of the wooden beam itself. In the rest of the cases, the beam is considered as thermally protected from 4 sides;
Fire resistance of ceiling construction	Fire resistance of ceiling construction on wooden beams must be proved separately;
Degree of utilisation of the cross-section	Degree of utilisation of the cross-section must be determined during design of the wooden beams according to EN 1995-1-1 and related standards. If the degree of utilisation is not defined, the table for 100% utilisation level shall be applied. The table for a certain level of cross-section utilisation automatically also covers all the lower cross-section utilisation levels. The dimensioning table containing the utilisation levels of 70 – 80 -90 % should be requested from the manufacturer.
Wood type	Beams from solid wood or glued beams with density $\geq 290 \text{ kg/m}^3$ , wood carbonisation rate $\leq 0.8 \text{ mm/min}$ , without specification of the type of wood.



## 8.3.2 Principles of Design and Assembly

### 8.3.2.1 Load-bearing Construction – CD Profiles

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 suspended floor (roof) construction by a system of hangers. The crosswise and lengthwise spacing of the profiles, the spacing and the type of suspensions depend on the cladding type (weight of the ceiling panel).

The grid can hold the heat insulation according to the soffit composition. The bearing grid can be complemented by UD profile in case of wall structures, it is used for anchoring of the soffit to the vertical structures. Anchoring is done by means of steel dowels.

### 8.3.2.2 Load-bearing Construction – Wooden Laths

The supporting structure consists of unidirectionally oriented wooden laths of cross-section 60 × 40 mm, with a maximum axial distance of 420 mm. The wooden laths can be attached to the ceiling beams or to roof beams (max. length 1,000 mm) or to the supporting structure by hinges.

### 8.3.2.3 Construction Composition

The composition of ceiling is clad on the bottom side with one or two layers of CETRIS® th. 12 mm. The boards mutually overlap – by at least 400 mm to prevent the creation of a cross-joint. For multi-layer cladding, the gaps between the boards mutually overlap – always by the profile (420 mm).

For anchoring of CETRIS® boards on CD profiles are used self-drilling self-tapping screws 4.2 × 25 mm with countersunk head, and with milling for recessing into the board. The screw length must be at least 10 mm longer than the thickness of the anchored board. In case of multi-layer cladding is necessary to use a screw at least 35 mm long for anchoring of the second CETRIS® layer.

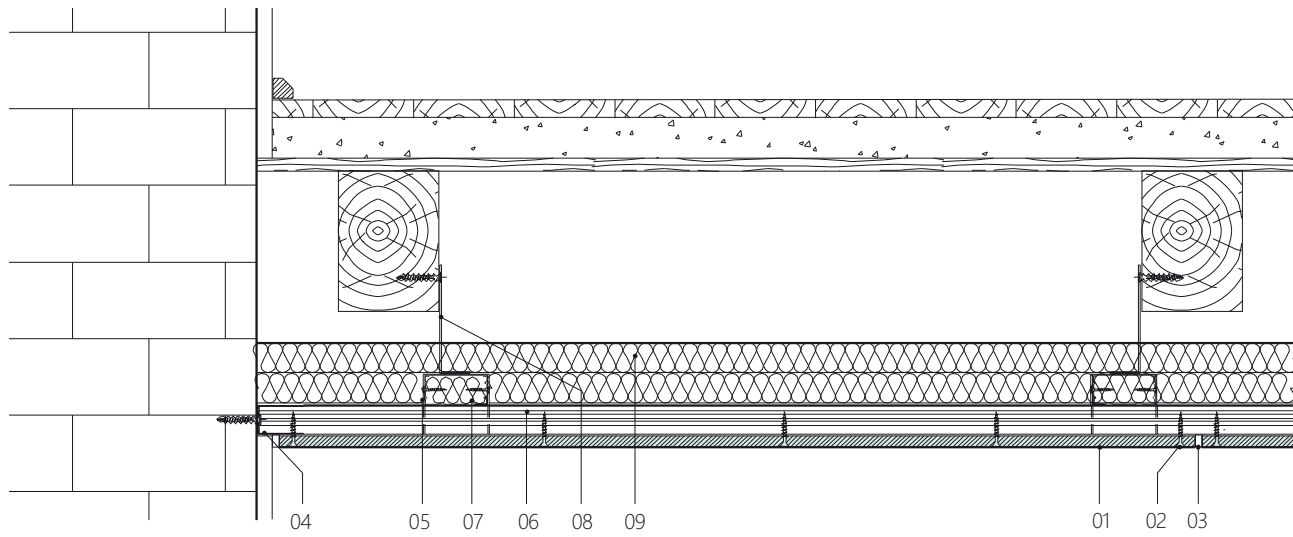
For anchoring of CETRIS® boards on wooden laths are used self-drilling, self-tapping screws 4.2 × 35 mm with countersunk head, and with milling for recessing into the board. For anchoring into the second layer of CETRIS® boards it is necessary to use a screw of minimum length 55 mm. When applied in the exterior, where the CETRIS® board is visible, the last layer of the CETRIS® boards must be anchored as applies to the façade cladding – i.e. using screws inserted into the pre-drilled holes with visible heads and sealing washers.

Joints of minimum width 5 mm are left between the boards. The joint fill, the wall perimeter filling is done using fire-resistant filler.



## 8.3.2.4 Sample Design Solutions - DETAILS

### Longitudinal and transverse cross-section

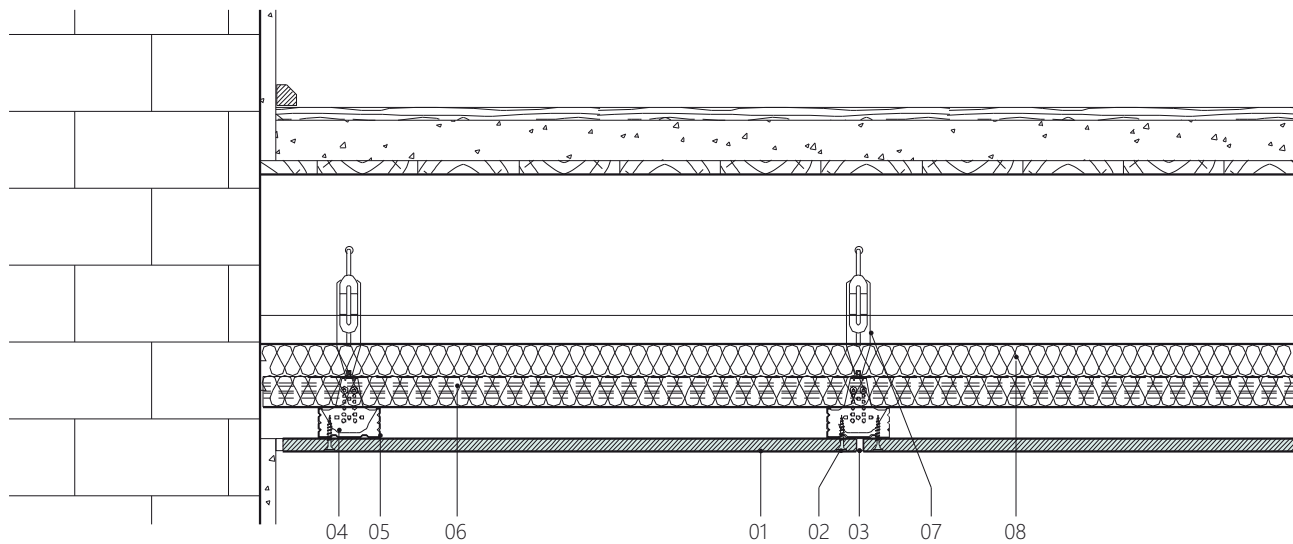


- |                               |                            |
|-------------------------------|----------------------------|
| 01 CETRIS® board              | 06 CD installation profile |
| 02 screw 4.2 × 25 (35, 45) mm | 07 CD support profile      |
| 03 fire resistant filler      | 08 hanger                  |
| 04 UD profile                 | 09 mineral wool            |
| 05 cross-connector            |                            |

UD profile 

Cross-connector 

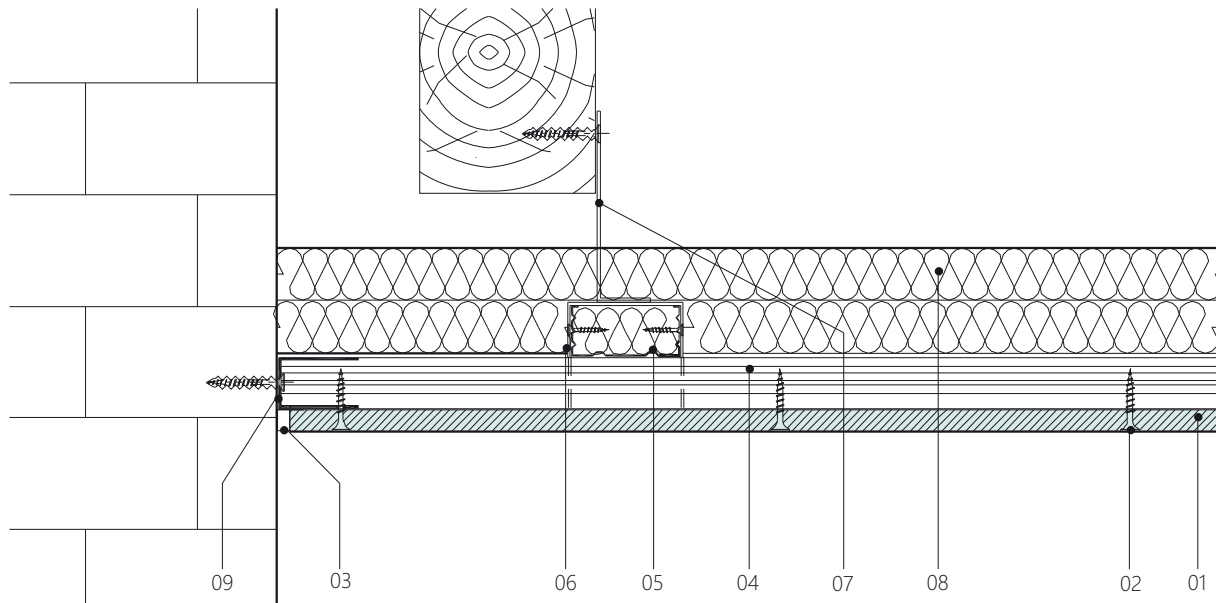
CD profile 



- |                               |                            |
|-------------------------------|----------------------------|
| 01 CETRIS® board              | 05 CD installation profile |
| 02 screw 4.2 × 25 (35, 45) mm | 06 CD support profile      |
| 03 fire resistant filler      | 07 hanger                  |
| 04 cross-connector            | 08 mineral wool            |

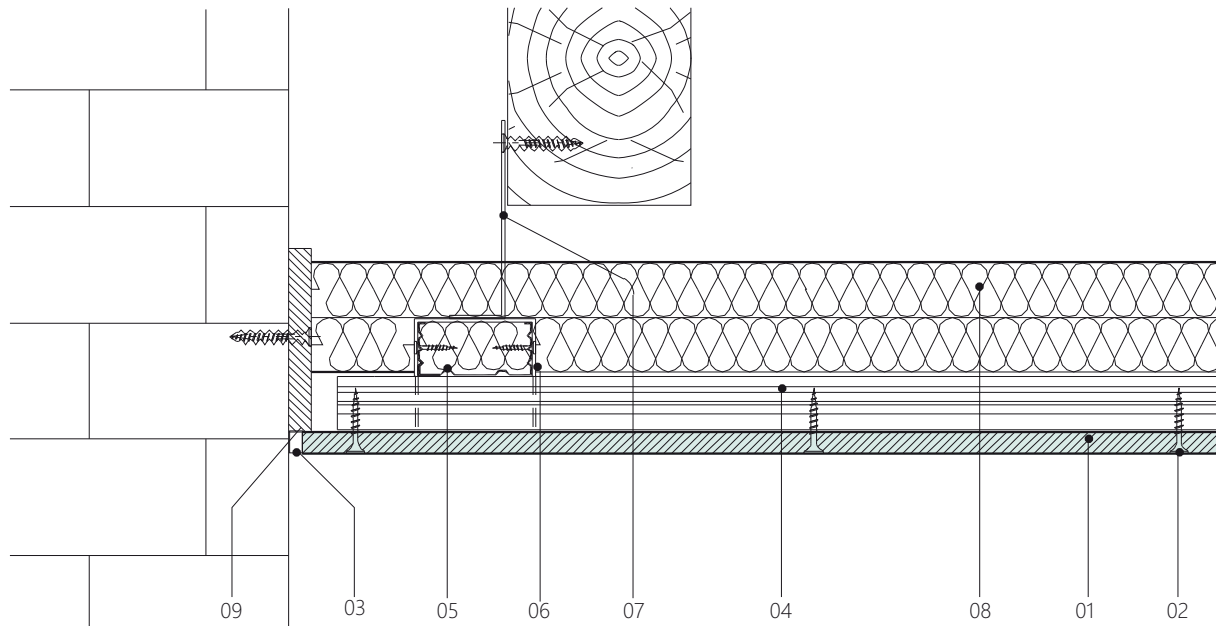


**Connection with joint filled with filler (supported with a profile)**



- |                               |                     |
|-------------------------------|---------------------|
| 01 CETRIS® board              | 06 cross-connector  |
| 02 screw 4.2 × 25 (35, 45) mm | 07 hanger           |
| 03 fire resistant filler      | 08 cut mineral felt |
| 04 CD installation profile    | 09 UD profile       |
| 05 CD support profile         |                     |

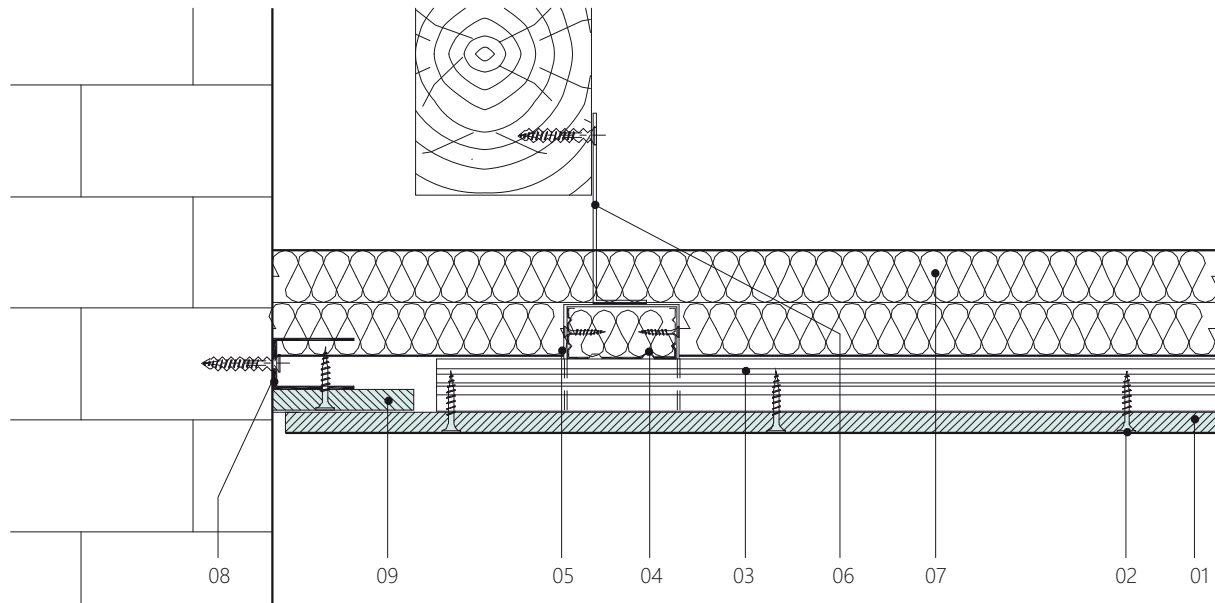
**Connection with joint filled with filler (supported with a strip)**



- |                               |                     |
|-------------------------------|---------------------|
| 01 CETRIS® board              | 06 cross-connector  |
| 02 screw 4.2 × 25 (35, 45) mm | 07 hanger           |
| 03 fire resistant filler      | 08 cut mineral felt |
| 04 CD installation profile    | 09 CETRIS® tape     |
| 05 CD support profile         |                     |

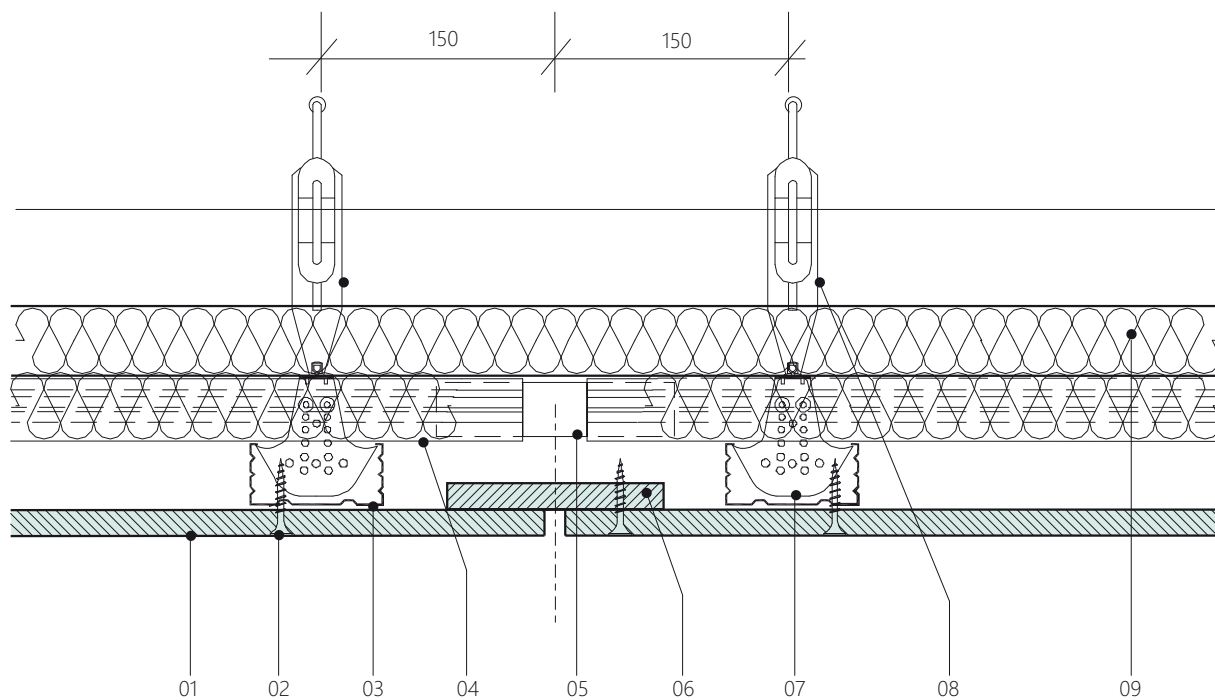


## Connection with supported joint (supported with a strip and profile)



- |                               |                     |
|-------------------------------|---------------------|
| 01 CETRIS® board              | 06 hanger           |
| 02 screw 4.2 × 25 (35, 45) mm | 07 cut mineral felt |
| 03 CD installation profile    | 08 UD profile       |
| 04 CD support profile         | 09 CETRIS® tape     |
| 05 cross-connector            |                     |

## Dilatation joint in the ceiling

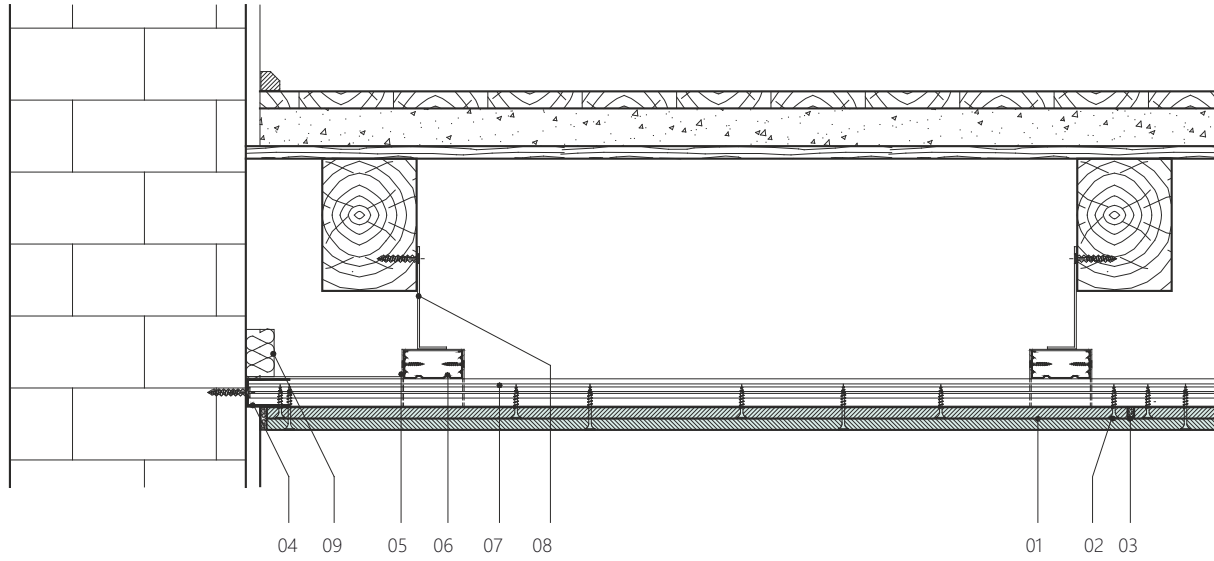


- |                               |                     |
|-------------------------------|---------------------|
| 01 CETRIS® board              | 06 CETRIS® tape     |
| 02 screw 4.2 × 25 (35, 45) mm | 07 cross-connector  |
| 03 CD installation profile    | 08 hanger           |
| 04 CD support profile         | 09 cut mineral felt |
| 05 CD connection              |                     |



## Fire-resistant ceiling

Longitudinal section



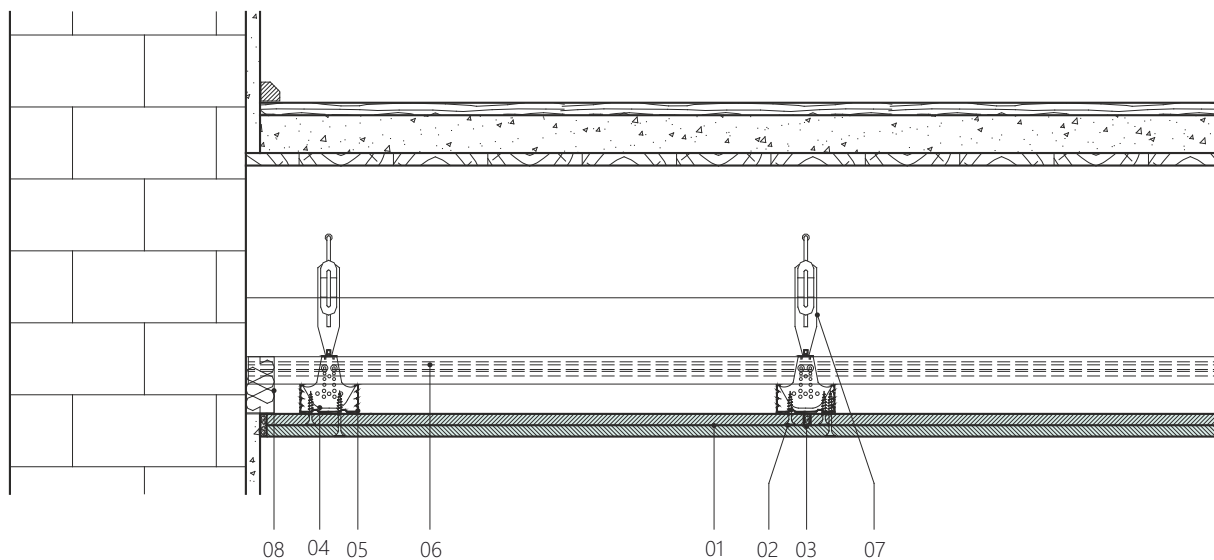
- |                           |   |
|---------------------------|---|
| 01 CETRIS® board          | 06 CD installation profile  |
| 02 screw 4.2 × 25 (45) mm | 07 CD support profile   |
| 03 fire resistant filler  | 08 hanger   |
| 04 UD profile             | 09 mineral insulation – sealing along the walls<br>(min. thickness 30 mm, height 50 mm) |
| 05 cross-connector        |   |

UD profile 

Cross-connector 

CD profile 

Transverse section

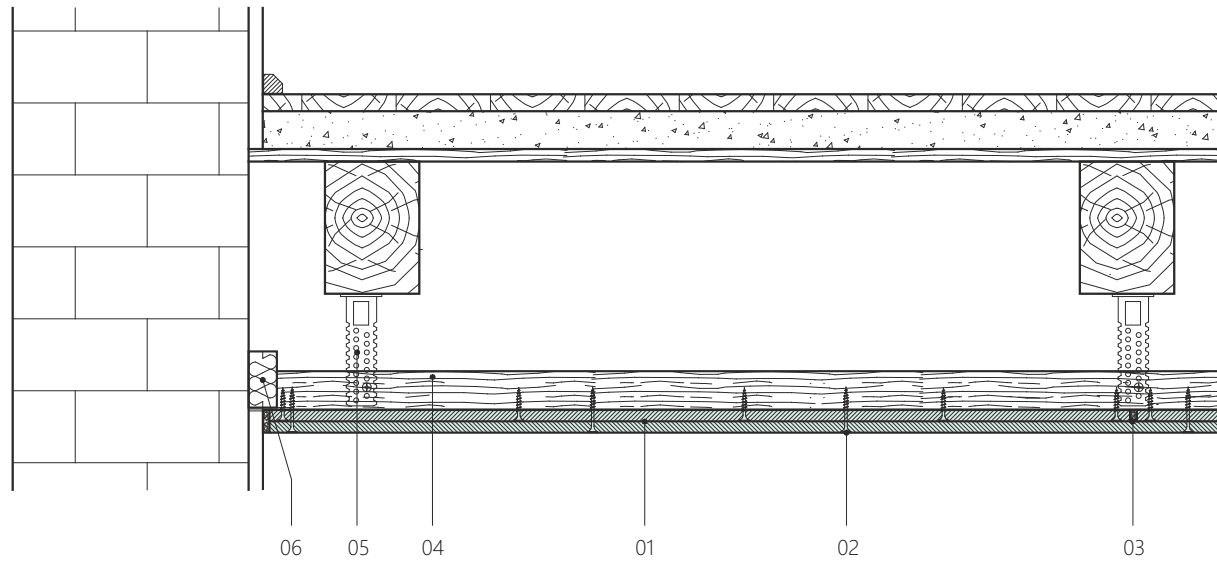


- |                           |   |
|---------------------------|---|
| 01 CETRIS® board          | 06 CD support profile   |
| 02 screw 4.2 × 25 (45) mm | 07 hanger   |
| 03 fire resistant filler  | 08 mineral insulation – sealing along the walls<br>(min. thickness 30 mm, height 50 mm) |
| 04 UD profile             |   |
| 05 cross-connector        |   |



## Fire-resistant ceiling

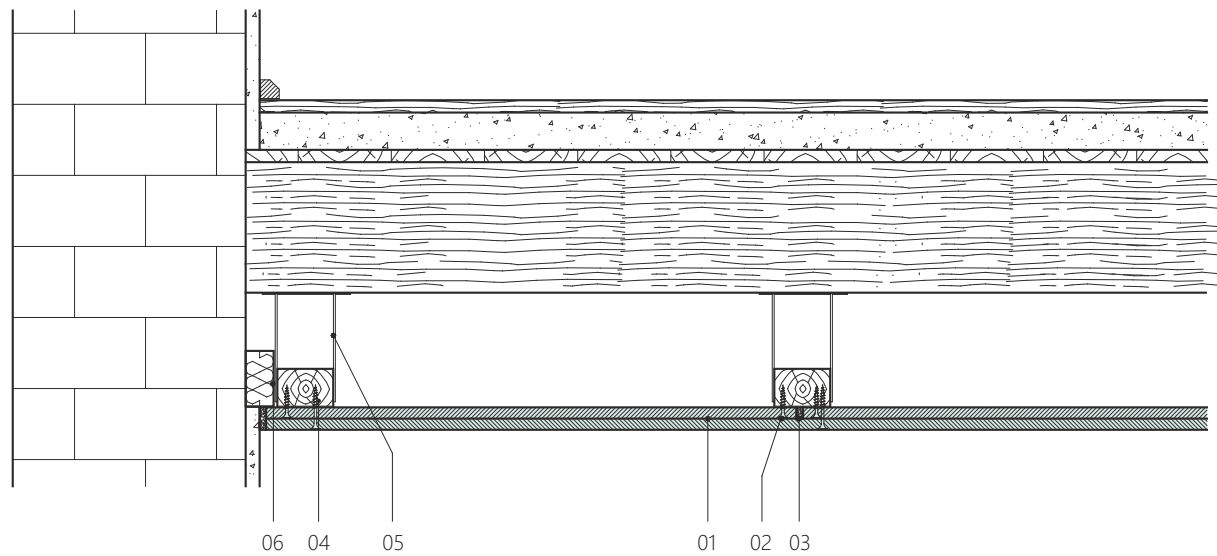
Longitudinal section



01 CETRIS® board  
02 screw 4.2 × 35 (55) mm  
03 fire resistant filler

04 wooden lath  
05 direct hanger  
06 mineral insulation – sealing along the walls 60 × 40 mm  
(min. thickness 30 mm, height 50 mm)

Transverse section



01 CETRIS® board  
02 screw 4.2 × 35 (55) mm  
03 fire resistant filler

04 wooden lath  
05 direct hanger  
06 mineral insulation – sealing along the walls 60 × 40 mm  
(min. thickness 30 mm, height 50 mm)



### 8.3.2.5 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 must 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 is not 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 CD profiles (the spacing of the laths for fire ceilings 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.
- Screws used for anchoring the boards to CD and UD profiles must be at least 10 mm longer than the thickness of the anchored board. For installation of the boards on a wooden lath, the screw must be 30 mm longer than the thickness of the fixed board.
- If the CETRIS® board is used as visible cladding of an exterior fire construction it must be anchored as façade cladding – i.e. with pre-drilled holes (8 or 10 mm) and screws with visible heads and sealing washers (see chapter 7.1.6.2).
- CETRIS® assembly inserts or strips must always have a minimum thickness of 12 mm.
- Maximum spacing of dowels for anchoring the UD profiles must not exceed 625 mm.
- The CETRIS® strip to cover the joints between the CETRIS® boards must overlap on both sides by at least 10 mm, unless otherwise specified in the detail drawing.
- 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 fire resistant filler (DEXAFLAMM-R, Den Braven acrylic fire resistant filler). The filler must be driven in to a minimum depth of 5 mm.
- The surface of CD or UD profiles, adjacent to the wall, should be sealed with fire resistant sealant as necessary and underlaid with FIBREFRAX DURAFELT paper.
- NIVEAU connectors from KNAUF for CD profiles 60 × 27 will be applied for types of suspended ceilings with two layers of CETRIS® boards. The shims of such connectors must be bent and screwed into the supporting profile with LN3.5 × 9 mm screws.

#### Axial distance of assembly CD profiles, load-bearing CD profiles and suspensions

Ceiling panel composition	Spacing of assembly profiles a (mm)	Spacing of loadbearing profiles b (mm)	Spacing of suspensions c (mm)	Note
1 × 12 mm	< 420	< 1000	< 420	picture 1
2 × 12 mm	< 420	< 900	< 420	picture 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 the load-bearing construction of the ceiling for cladding with CETRIS® cement bonded particleboard (thickness 12 mm)**

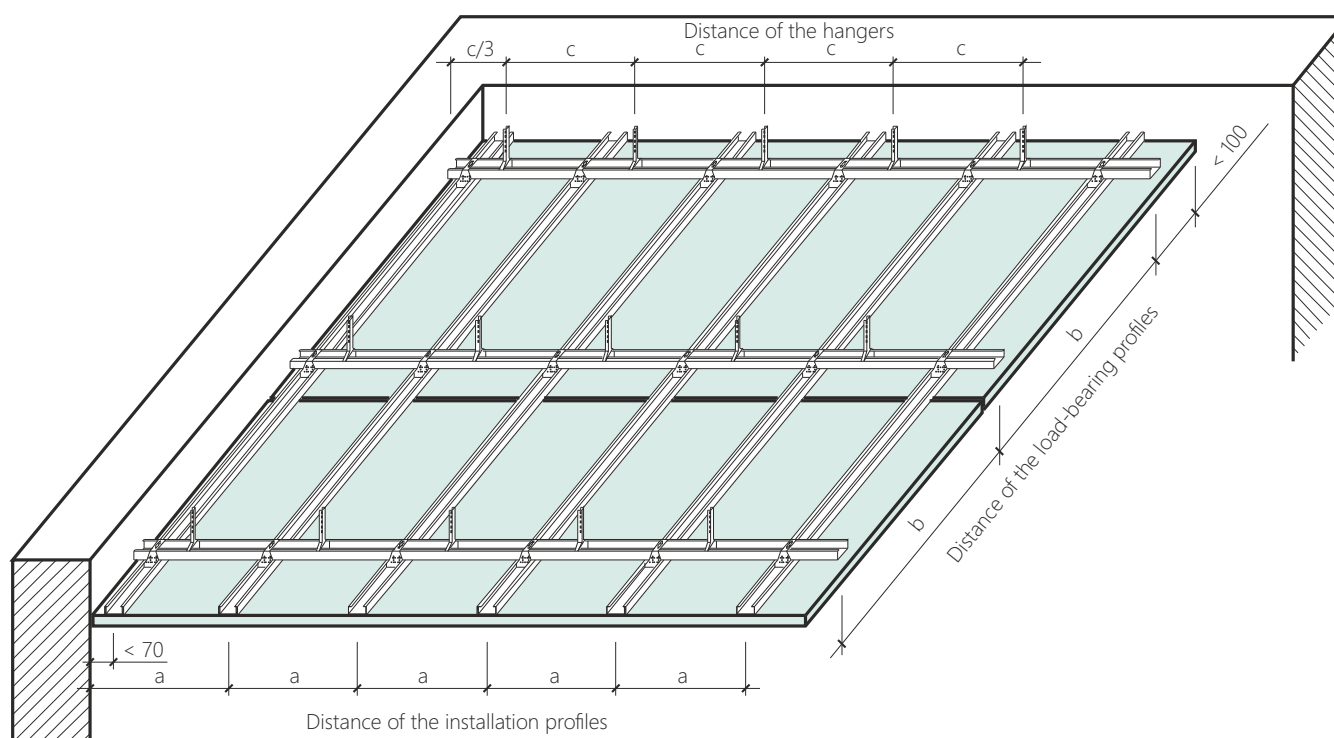
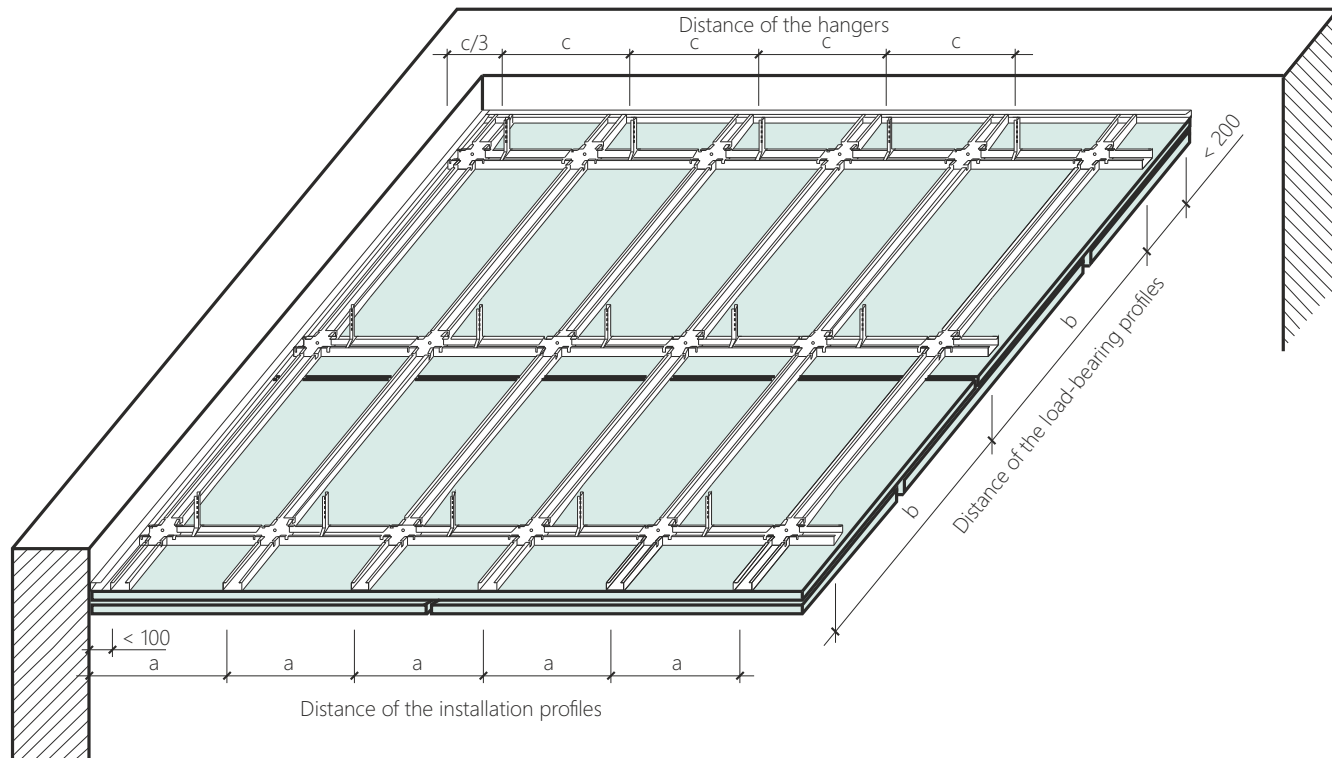


Fig. 2) Schematic drawing of the load-bearing construction of the ceiling for cladding with CETRIS® cement bonded particleboard (thickness 2 × 12 mm)



- NIVEAU cross-connectors from KNAUF for CD profiles 60 × 27 will be applied for types of suspended ceilings with 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® tapes. In exposed cases – in the case of higher demand for fire

resistance of both ways, all 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.

- In the case of suspended ceiling composition without inserted mineral wool, it is necessary to insert a strip of mineral wool with a minimum thickness of 30 mm and a height of at least 50 mm over the circumference (along the walls) of the CETRIS® board cladding.

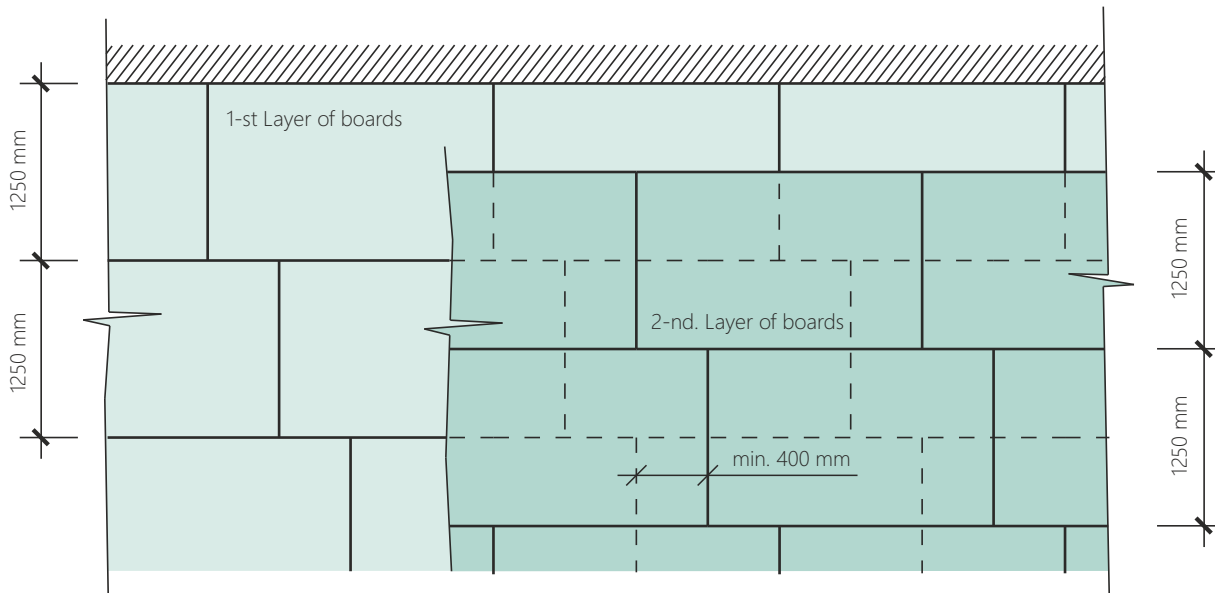
### 8.3.2.6 Notes to Assembly

The CETRIS® ceiling system is fixed to a metal grid of CD profiles or to wooden laths. 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 FIBERFRAX DURAFELT paper or mineral wool and fire resistant 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 passage.

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 lath 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, it must always be pressed tightly to the load-bearing CD profiles, pre-drilling of the board is recommended
- In the case of cladding of large ceiling 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.

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



## 8.4 Horizontal Constructions - Ceilings and Floors (Fire from Above)

### 8.4.1 Introduction

Horizontal constructions (ceiling, roof, floor constructions) are most often afflicted by fire stress from below. The required fire resistance is most often achieved in these cases by use of ceilings (solution described in Chapter 7.3 Horizontal constructions – ceilings).

Using CETRIS® cement bonded particleboards it is also possible to achieve the fire resistance of horizontal constructions to fire stress from above. This fire load is characteristic especially for ceiling and floor constructions that form horizontal divisions between storeys.

#### The ceiling/floor construction (steel load-bearing construction) – with fire stress from above

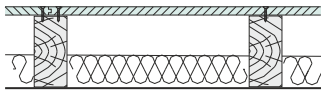
Schematic drawing of the construction	Cladding thickness CETRIS® d (mm)	Axial distance of load- bearing profiles <sup>1</sup> (mm)	Mineral wool		Ceiling type	Fire resistance <sup>2</sup>
			Thickness (mm)	Density (kg/m <sup>3</sup> )		
	22	625	80	25	Galvanised sheet metal 0,55 mm	REI 45 / RE 60
	22	625	80	25	Particleboard 10 mm	
	22	625	80	25	Cardboard 12,5 mm	
	18	420	80	25	Galvanised sheet metal 0,55 mm	

Notes to the 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/m<sup>2</sup>.

## The ceiling/floor construction (wooden load-bearing construction) – with fire stress from above

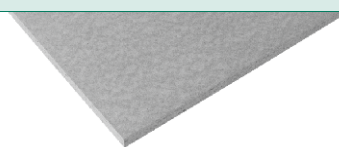
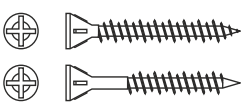

Schematic drawing of the construction	Cladding thickness CETRIS® d (mm)	Axial distance of load-bearing profiles <sup>1</sup> (mm)	Mineral wool		Ceiling type	Fire resistance <sup>2</sup>
			Thickness (mm)	Density (kg/m <sup>3</sup> )		
	22	625	80	25	Wooden laths 50x30 mm for fixture of any ceiling	REI 45 / RE 30
	2x12	625	80	25		

Notes to the 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/m<sup>2</sup>.

### Materials for execution of fire structures

Description	Visualisation	Note
CETRIS® BASIC, or PD (PDB) board Cement bonded particleboard, smooth surface, cement grey. Basic format 1,250x3,350 mm. Density 1320±70 kgm <sup>-3</sup>		Thickness according to the fire resistance requirements
crew 4.2x45, 55 mm Counter-sunk, self-tapping screws		For anchoring CETRIS® boards to the load-bearing construction.
Heat-insulation Mineral or rock wool (Isover Orstop of thickness 80 mm, density 25 kg/m <sup>3</sup> )		It is necessary to observe the thickness and volume mass according to the specification in the composition. Reaction to fire class A1.

## 8.4.2 General assembly principles

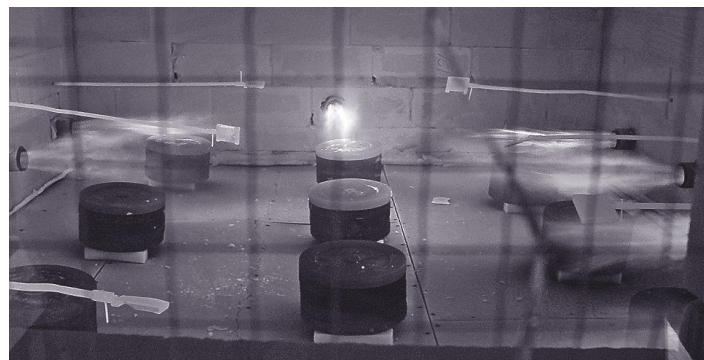
For complete principles for floor construction assembly, see Chapter 6 Floor Systems.

Main principles stressed in this context:

- Maximum spacing of screws anchoring CETRIS® boards to beams must not exceed 300 mm. The minimum distance from the edge is 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® tape of the same thickness. The minimum width of the tape 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 the finally cut board is

250 mm. CETRIS® boards are always laid with the longer edge perpendicular to the beams. The ceiling cavity filling – 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.





# 8.5 Steel Construction Cladding with CETRIS® Cement Bonded Particleboards

## 8.5.1 Introduction

Steel is an inorganic material and therefore may be classified as a non-flammable substance without special testing. Upon 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.

The CETRIS® cement bonded particleboard cladding ensures that the steel reaches the critical temperatures only after the defined period. 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:

- Time of required protection – fire resistance in minutes
- Design temperature
- Cross-sectional coefficient  $A_m/V$

The time of the required protection (fire resistance) is required in the following intervals: 15, 30, 45, 60, 90 minutes.

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

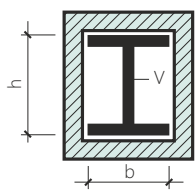
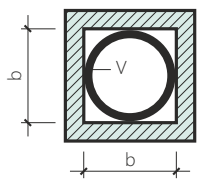
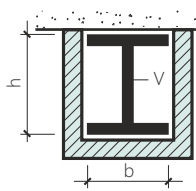
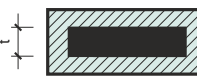
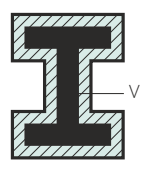
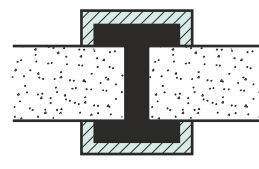
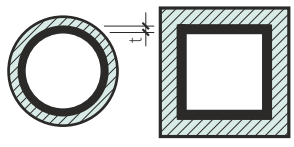
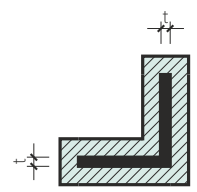
For details on determination of the coefficient of utilisation of the cross section see the ČSN EN 1993-1-2 standard, Euro code 3: Design of steel structures - Part 1 - 2: General rules – Structural fire design, chapter 4.2.4. A significant factor defining the shape of the cross section is the ratio  $A_p/V$  – cross-sectional coefficient of protected steel profile. The elements of the  $A_m/V$  ratio include:

$A_m$  perimeter of the protected steel profile in mm.  
 $V$  area of crosswise section of the steel profile in mm<sup>2</sup>.

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.

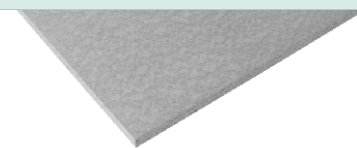
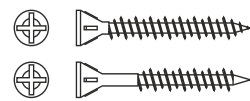
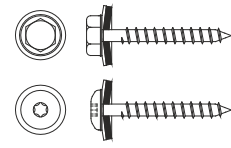
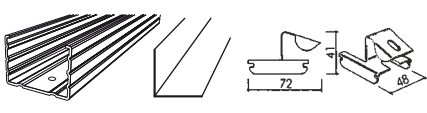

The effect of this factor is significant – subtle profiles (cross sections with high  $A_m/V$  ratios) approach the critical temperature more quickly, and therefore need to be protected with thicker cladding.

## 8.5.2 Calculation of $A_p/V$

Shape of cross-section	Exposure to fire	$A_p/V(m^{-1})$	Shape of cross-section	Exposure to fire	$A_p/V(m^{-1})$
	From four sides	$1000 \frac{2b + 2h}{V}$		From four sides	$1000 \frac{4b}{V}$
	From four sides	$1000 \frac{2h + b}{V}$		From four sides	$\frac{2000}{t}$
	From four sides	$1000 \frac{O}{V}$		From four sides	$\frac{1000}{t}$
	From four sides	$\frac{1000}{t}$		From four sides	$\frac{2000}{t}$

Cross-section dimensions  $b, h, t$  are in mm, cross-section area  $V$  in  $mm^2$

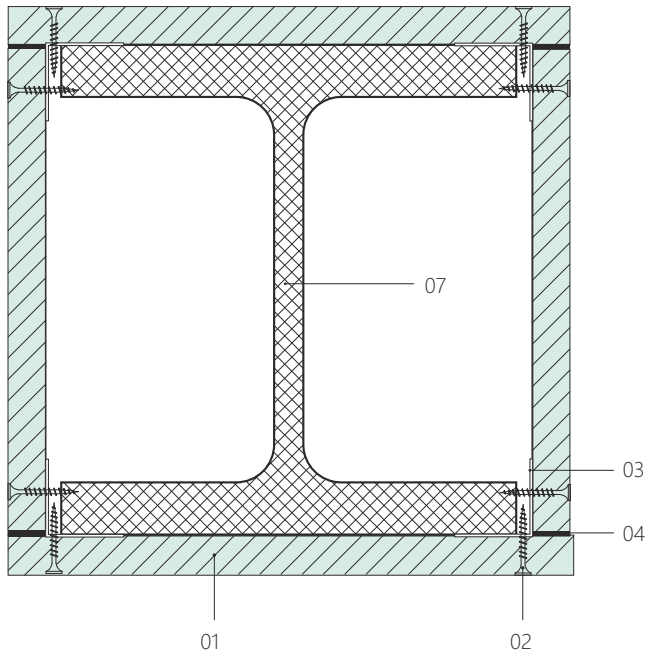
### Materials for execution of fire structures

Description	Visualisation	Note
CETRIS® BASIC board Cement bonded particleboard, smooth surface, cement grey. Basic format 1,250x3,350 mm, volume mass $1320 \pm 70 \text{ kgm}^{-3}$		Thickness according to the fire resistance requirements
Screw 4.2x25, 35.4 mm Counter-sunk, self-tapping screws		Screw type according to the thickness of the cladding. Anchoring in the interior, or exterior under the thermal insulation system (ETICS)
Screw 4.2 – 4.8 x 38, 45 mm Stainless steel or galvanised screws with half-round or hex head with thrust water-tight washer		Screw type according to the thickness of the cladding and type of load-bearing construction. Anchoring on the exterior – it is necessary to pre-drill the board (hole diameter 8 (10) mm)
Auxiliary structures Galvanised sheet metal profiles CD 60x27x0.6 mm, L 50x50x0.6 mm, Clamp to flanges of "I" beams		Dimensions according to fire resistance requirements and wall height. Alternatively, it is possible to use steel profiles with a cross-section area that minimally equivalent to the CW profiles.
Fire resistant filler White material for joint filling and screw head covering.		DEXAFLAMM-R filler (manufactured by Tora Spytihněv), or fire-resistant DenBraven (acrylic, silicone) filler

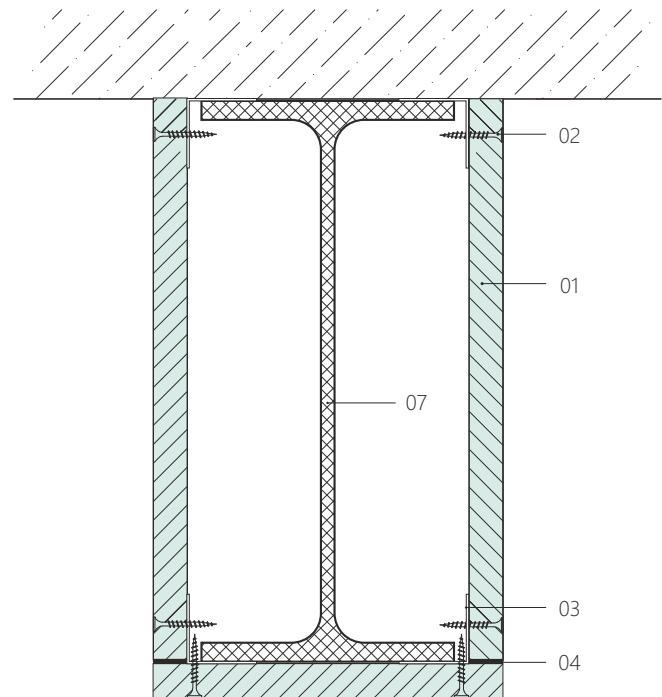
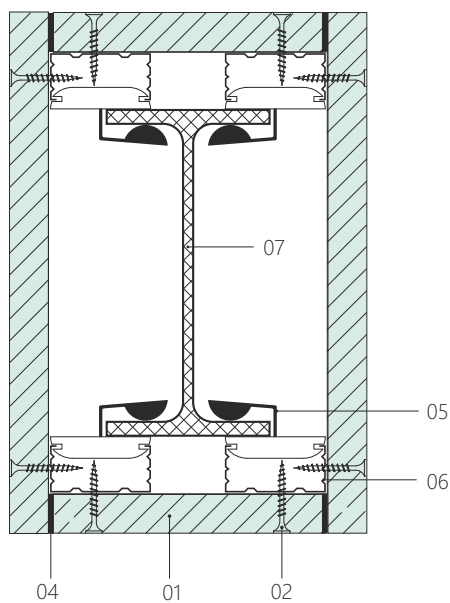
### 8.5.3 Methods of Cladding (Directly, or on Auxiliary Construction)

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 fire resistant filler
- 05 clamp to flanges of "I" beam
- 06 CD profile 60 × 27 × 0.6 mm
- 07 protected steel cross-section



## 8.5.4 Dimension Tables

Resistance to fire classification R 15									
Design temperature (°C)	350	400	450	500	550	600	650	700	750
Am / V (1/m)	Thickness of CETRIS cement bonded particleboard to keep the temperature below the design temperature (mm)								
45	10	10	10	10	10	10	10	10	10
60	10	10	10	10	10	10	10	10	10
80	10	10	10	10	10	10	10	10	10
100	10	10	10	10	10	10	10	10	10
120	10	10	10	10	10	10	10	10	10
140	10	10	10	10	10	10	10	10	10
160	10	10	10	10	10	10	10	10	10
180	10	10	10	10	10	10	10	10	10
200	10	10	10	10	10	10	10	10	10
220	10	10	10	10	10	10	10	10	10
240	10	10	10	10	10	10	10	10	10
260	10	10	10	10	10	10	10	10	10
280	10	10	10	10	10	10	10	10	10
300	10	10	10	10	10	10	10	10	10
320	10	10	10	10	10	10	10	10	10
340	10	10	10	10	10	10	10	10	10
360	10	10	10	10	10	10	10	10	10
380	10	10	10	10	10	10	10	10	10
402	10	10	10	10	10	10	10	10	10
Resistance to fire classification R 30									
45	10	10	10	10	10	10	10	10	10
60	12	10	10	10	10	10	10	10	10
80	14	12	10	10	10	10	10	10	10
100	14	12	12	10	10	10	10	10	10
120	14	14	12	10	10	10	10	10	10
140	16	14	12	10	10	10	10	10	10
160	16	14	14	12	10	10	10	10	10
180	16	14	14	12	12	10	10	10	10
200	16	14	14	12	12	10	10	10	10
220	16	16	14	12	12	10	10	10	10
240	16	16	14	14	12	12	10	10	10
260	16	16	14	14	12	12	10	10	10
280	16	16	14	14	12	12	10	10	10
300	16	16	14	14	12	12	10	10	10
320	16	16	14	14	12	12	10	10	10
340	16	16	14	14	12	12	10	10	10
360	16	16	14	14	12	12	10	10	10
380	18	16	16	14	12	12	10	10	10
402	18	16	16	14	14	12	10	10	10



Resistance to fire classification R 45									
Design temperature (°C)	350	400	450	500	550	600	650	700	750
Am / V (1/m)	Thickness of CETRIS cement bonded particleboard to keep the temperature below the design temperature (mm)								
45	16	14	12	10	10	10	10	10	10
60	18	16	14	12	12	10	10	10	10
80	20	18	16	14	14	12	12	10	10
100	20	18	18	16	14	14	12	12	10
120	22	20	18	16	16	14	14	12	12
140	22	20	18	18	16	16	14	12	12
160	22	20	20	18	16	16	14	14	12
180	22	22	20	18	18	16	16	14	12
200	22	22	20	20	18	16	16	14	14
220	22	22	20	20	18	18	18	14	14
240	22	22	20	20	18	18	18	16	14
260	22	22	20	20	18	18	18	16	14
280	22	22	22	20	18	18	18	16	14
300	24	22	22	20	20	18	18	16	14
320	24	22	22	20	20	18	18	16	16
340	24	22	22	20	20	18	18	16	16
360	24	22	22	20	20	18	18	16	16
380	24	22	22	20	20	18	18	16	16
402	24	22	22	20	20	18	18	16	16
Resistance to fire classification R 60									
45	22	20	18	16	14	12	12	10	10
60	24	22	20	18	16	14	14	12	12
80		24	22	20	18	18	16	14	14
100			24	22	20	18	18	16	16
120			24	22	22	20	18	18	16
140				24	22	20	20	18	18
160				24	24	22	20	20	18
180				24	24	22	22	20	18
200					24	22	22	20	20
220					24	24	22	22	20
240					24	24	22	22	20
260						24	24	22	20
280						24	24	22	22
300						24	24	22	22
320						24	24	22	22
340							24	24	22
360							24	24	22
380							24	24	22
402							24	24	22

Resistance to fire classification R 90									
Design temperature (°C)	350	400	450	500	550	600	650	700	750
Am / V (1/m)	Thickness of CETRIS cement bonded particleboard to keep the temperature below the design temperature (mm)								
45				24	22	20	18	18	16
60						24	22	20	18
80								24	22
100									24

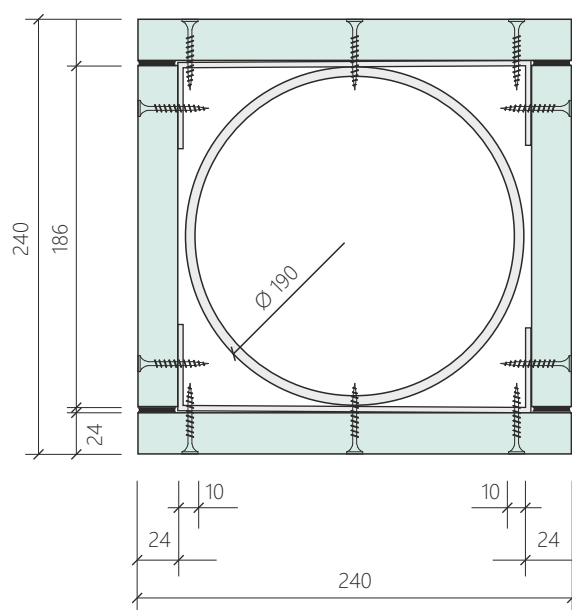
Notes to the table:

- The values apply to pillars (with fire load from 4 sides) with a cross-sectional coefficient of 45-402 m<sup>-1</sup> and beams (with fire load from 3 or 4 sides) with a cross-sectional coefficient of 50-402 m<sup>-1</sup>
- The CETRIS® board cladding can be used for right angle, circular, closed and open steel profiles. The maximum height of the web of the steel profile is 600 mm.
- the dimension tables apply to all steel classes excluding S 185 and all types of steels marked E (according to EN 10 025 or EN 10 113).
- Types of profiles:
  - open cross-section profiles (type I, H, T, U)
  - for rolled or welded profiles

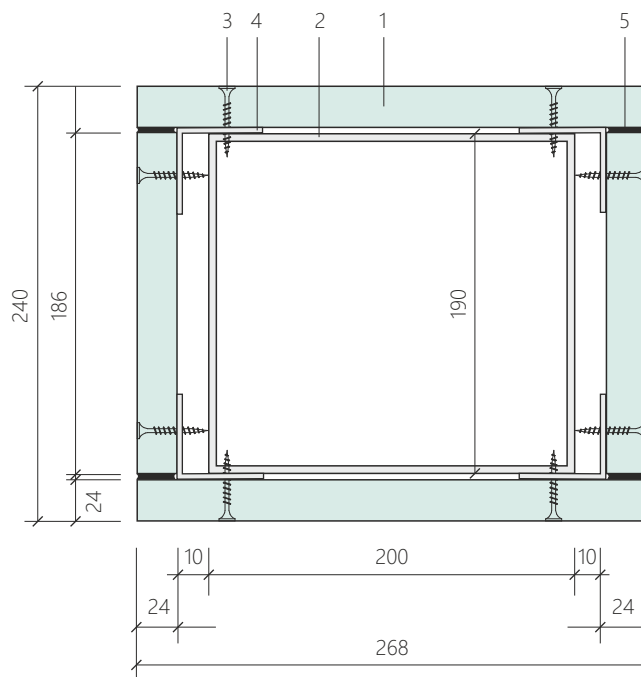
## 8.5.5 General Principles of Cladding Assembly

- The minimum CETRIS® board thickness is 10 mm and the maximum thickness is 24 mm.
- The 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 from the edge is 25 mm. The screw must be at least 10 mm longer than the thickness of the fixed board.
- A sunken head screws may be used for interior anchoring. 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 pre-drilled (min. hole diameter. 8 mm) and the pre-drilled holes must be filled with fire resistant filler (DEXAFLAMM-R, Den Braven fire resistant filler).
- All joints between CETRIS® boards of 3 – 10 mm width, wall and corner contacts must be filled with fire resistant filler.
- When laying a cladding of circular closed profiles, it is necessary to create an auxiliary structure for the CETRIS® boards, e.g. from L profiles. The L profiles must overlap at least at two points and mechanically joined with the circular profile – see Figure (a)
- When cladding of square closed profiles with metal profiles, it is necessary on 2 sides of the cross-sections to mechanically join the CETRIS® board cladding with the steel cross-section, see Figure (b)

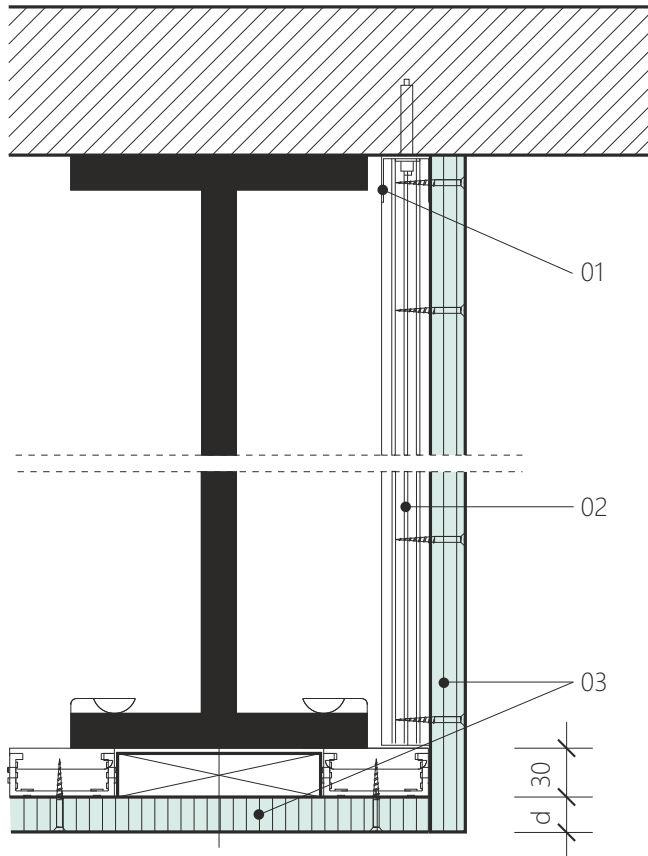
a) cladding of round closed profiles



b) cladding of square closed profiles

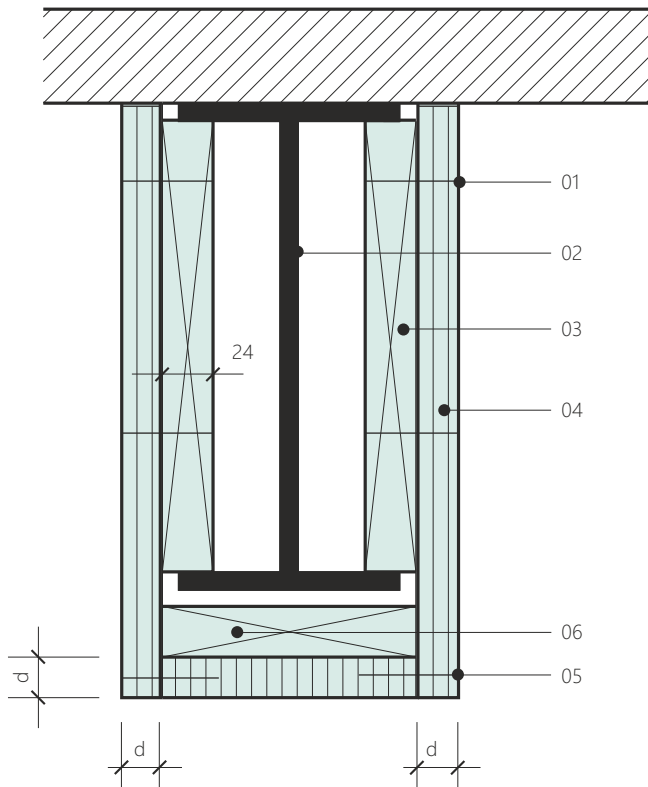


Transverse section



- 01 UD profile 28 x 27 x 0.6 mm
- 02 CD profile 60 x 27 x 0.6 mm, span 400 to 600 mm, according to the height of the beam and under the joints
- 03 CETRIS® cement bonded particleboards

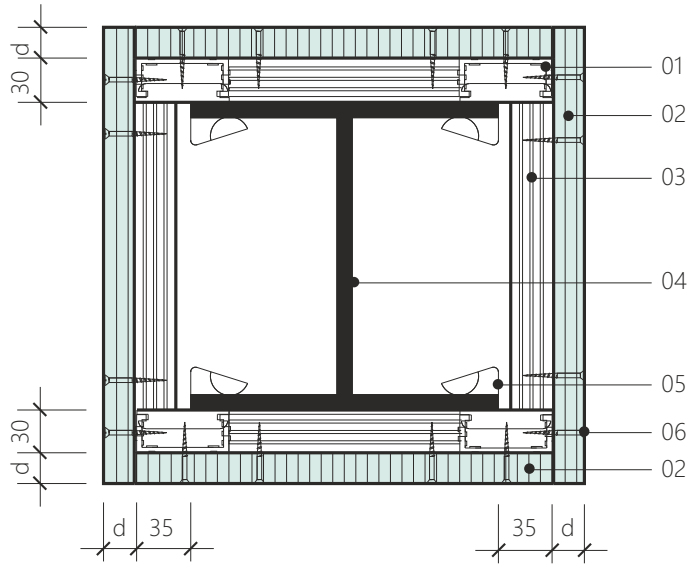
Transverse section



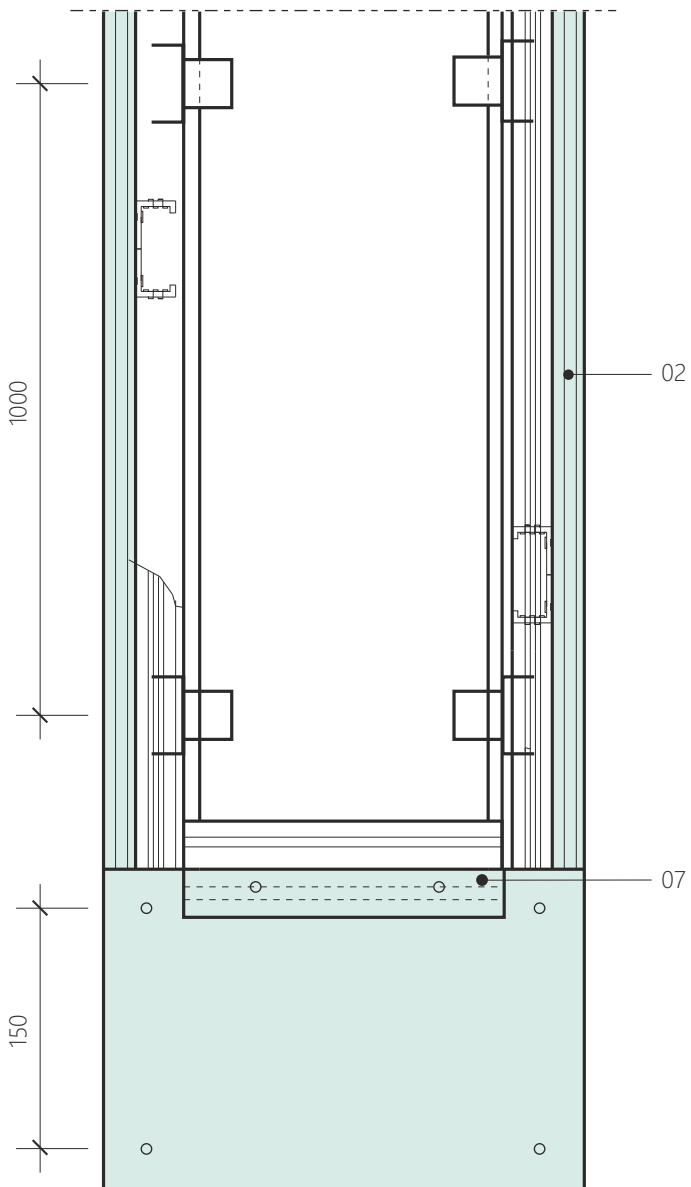
- 01 screws
- 02 steel beam
- 03 assembly insert of CETRIS® cement bonded particleboard
- 04 CETRIS® cement bonded particleboard
- 05 screws
- 06 CETRIS® board in the case of single-layer cladding for joint coverage



### Horizontal section



### Vertical section



- 01 CD profile 60x27x0.6 mm
- 02 CETRIS® cement bonded particleboard
- 03 CD profile 60x27x0.6 mm (under the gaps)
- 04 steel column
- 05 Knauf clamps
- 06 screws
- 07 CD profile 60x27x0.6 mm (under the gaps)



## 8.6 Wall and Ceiling Cladding with Fire Protection Effect

The CETRIS® cement bonded particleboard can be used 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) and the purpose of this type of cladding is to protect flammable material against ignition. Cladding of K class protects flammable material against fire for a specified period of time, including carbonisation and other damage, and also prevents the protected elements from catching fire on both sides at the same time. Apart from this, the requirements for reaction to fire may be applied to the cladding products.

### 8.6.1 Test Procedure for Fire Protective Cladding

The test procedure for determination of the capability of the cladding to protect the flammable materials under it from ignition during specified exposure to fire is defined in EN 14 135 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 (flammable) materials covered by the cladding with a density of at least 300 kg/m<sup>3</sup> are represented in the tests by 19 mm thick chipboard not treated with any flame retarder (not impregnated) whose density is at least 680 kg/m<sup>3</sup>.

The tested cladding is applied to a standard horizontal construction – with top wooden prisms 45 x 95 mm (spacing 600 mm) and chipboard with a thickness of 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 temperature increase on the bottom side of the flammable base is

recorded. The cladding is monitored and time to damage is recorded. After the test, the damage to the cladding and defects of the flammable base are recorded. 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 average temperature measured on the bottom side of the chipboard and average 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. Melting and shrinkage are considered as damage while discolouration is not.

### 8.6.2 Cladding with CETRIS® Cement Bonded Particleboard with Fire Protection Effects

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

Cladding schematic drawing	Cladding composition	Cavity	Auxiliary structure	Fire resistance	Classification
	CETRIS® 10 mm	10 mm	Wooden laths 70x10 mm	10 minutes	K <sub>1</sub> 10 / K <sub>2</sub> 10
	CETRIS® 2x12 mm	cavity not required (air gap)	not required	30 minutes	K <sub>2</sub> 30

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

- the CETRIS® board fire cladding can be used as cladding for vertical and horizontal constructions
- CETRIS® boards must be laid without cross joints
- CETRIS® boards are laid with a minimum joint width of 4-5 mm, which is filled with fire resistant filler. In the case of multilayer cladding, the inner joints of the bottom CETRIS® board layers must also be filled with filler
- The maximum spacing of the screws used to anchor the CETRIS® board of thickness 10, or 12 mm must not exceed 200 mm (at the edges), or 400 mm (in the middle)
- for cladding of fire resistance K<sub>1</sub>10 / K<sub>2</sub>10, all the contact joints between the CETRIS® boards must be supported with a wooden lath. Maximum distance of support wooden laths is 625 mm, the minimum lath width is 70 mm and the minimum cavity height is 10 mm.
- when using multi-layer CETRIS® board cladding, it is necessary to lay the boards in the next layer in such a manner that they are displaced in relation to the preceding layer by at least 400 mm

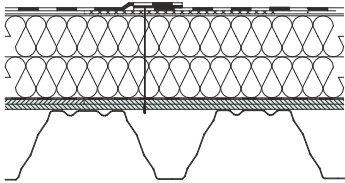
## 8.7 Light Composed Roofing

### 8.7.1 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 elasticised 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 load-bearing elements – Part 2: 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 also pursuant to the updated ČSN 73 0810: 2009 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.

### 8.7.2 Fire Characteristics

Construction drawing	Description of the construction	Fire resistance
	<p>Hydro insulating foil Amouplan SM 120 – 180 (thickness 1.2 – 1.8 mm)</p> <p>Separation textile (non-woven glass fibre textile)</p> <p>Insulating boards EPS 100S - 2 layers, thickness 60 mm</p> <p>PE vapour barrier</p> <p>CETRIS® cement bonded particleboards Basic – 2 layers, thickness 10 mm</p> <p>Load-bearing trapeze sheet metal TR 150/280/0.75 (or other pursuant to structural assessment)</p>	REI 30

### 8.7.3 General Assembly Principles

- Trapeze sheet metal must be anchored in supports in every bottom wave with two screws with a 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-tapping screws 4.8 × 20 mm with the maximum spacing of 500 mm.

The limit conditions for use of other types of trapeze sheet metals are:

- 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 bending tension above support 99.8 MPa

These values apply to trapeze sheet metal of steel class S 320 GD, yield limit  $f_y = 320$  MPa.

Technical and professional services for design of suitable trapeze sheet metal are provided by Kovové profily s.r.o.

- The CETRIS® cement bonded particleboards are laid tightly in both layers, without gaps; when laying the second layer, the joint overlap must be minimum 625 mm. The CETRIS® boards are anchored with screws IR2-4.8 × 50 mm or SC3/35- PH2-4.8 × 45 mm. Both screws were tested and the supplier guarantees the minimum calculated value of 400 N for one element (safety factor 2.5). The maximum spacing of the screws in the longitudinal and transverse direction is 600 mm. The CETRIS® BASIC board are always laid tightly in one dilatation field (max. 6.70 × 6.70 m).

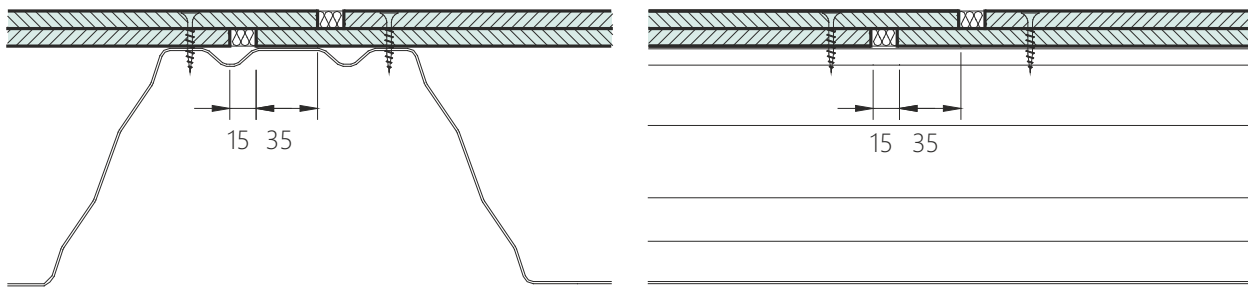
The width of the individual dilatation joints must be 15 mm that shall be filled with mineral wool tape. If there is no requirement for fire resistance, a single layer of CETRIS® boards of minimum thickness 16 mm will suffice – even in this case the minimum rated value of load-bearing capacity 400 N is guaranteed (shearing of the screw).

- A vapour barrier must be laid pursuant to the instructions of the supplier with an overlap of about 150 mm.
- Polystyrene foam insulation boards 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 have an overlap of min. 250 mm.
- Separation layer – unwoven glass fibre textile 200 gr/m<sup>2</sup>. Folding with an overlap of about 150 mm.
- Hydro insulation foil type Armourplan SM 120 (thickness 1.2 mm) to Armourplan SM 180 (thickness 1.8 mm). The foil overlap is about 150 mm, and in the overlays the foil is anchored mechanically – telescope R45 × 105 and screw IG-C-6 × 60 mm (supplied by SFS intec spol. s r.o.). The anchor spacing is 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., a.s. 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	Visualisation	Note
CETRIS® BASIC board Cement bonded particleboard, smooth surface, cement grey. Basic format 1,250x3,350 mm, density 1320±70 kgm <sup>-3</sup>		Thickness and number of layers according to the fire resistance requirements. One layer of minimum thickness 16 mm will suffice where no fire resistance is required.
IR2-4.8x50 or SC3/35-PH2-4.8x45 mm screws (supplied by SFS intec spol. s r.o.). Counter-sunk, self-tapping screws		The load capacity of the screws was tested – the guaranteed min. calculated capacity is 400 N.
Membrane – PE foil (supplied by Coleman S.I., a.s.).		Can be replaced by a different type, if the thickness ≤ 2 mm and heating capacity H ≤ 15 MJ/m <sup>2</sup> . Permissible I Al foil with a thickness of up to 1 mm.
Insulation boards – foam polystyrene EPS 100S, th. 60 mm (supplied by Rigips s.r.o.).		Insulation boards used must show compressive strength of min. 100kPa, declared coefficient of thermal conductivity λ = 0.036 W/mK, fire reaction class E, max. bulk density 30 kg/m <sup>3</sup> .)
Separation glass fibre textile – 200 gr/m <sup>2</sup> (supplied by Coleman S.I., a.s.).		
Hydro insulating foil type Armourplan SM 120 (thickness 1.2 mm) to Armourplan SM 180 (thickness 1.8 mm) (EUROTEC Praha a.s.)		In the composition with classification DP1 it is necessary to use hydro insulation in combination with EPS for class BROOF <sub>(t3)</sub> .
Isofast IG and telescope R45 fasteners		

# 8.8 Training of Assembly Companies for CETRIS® Board Applications

## 8.8.1 Assembly Certification

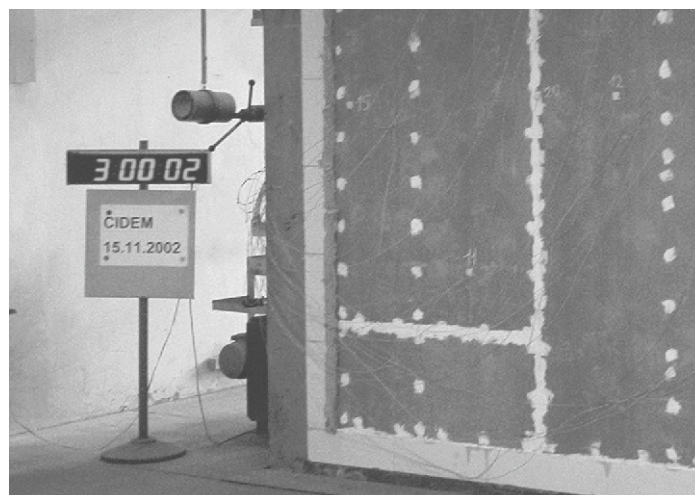
CIDEM Hranice, a.s., CETRIS® Division in cooperation with the training centres at secondary and vocational schools trains assembly companies in the application of CETRIS® Cement Bonded Particleboards. Training is always evaluated and ends in a certificate "On Assembly Qualification". It is intended mainly for companies that build fire resistant constructions and is in this respect directly required by the competent institutions (Fire Rescue Service, Building Authorities...).

Objective of training: Obtain a certificate in assembly of CETRIS® cement bonded particleboards (walls, ceilings, floors, façades, etc.) with emphasis on fire resistance and where proof of assembly qualifications is required (Fire Rescue Service, Building Authorities).

Content: Basic properties of CETRIS® cement bonded particleboards, general principles for assembly of CTD CETRIS® constructions. CETRIS® board floor and façade systems. Fire protection of building constructions. Fire partitions and walls. Advanced walls and fire-resistant wall cladding. Ceilings and soffits.

Intended for: Qualified building workers, dry building construction assembly workers experienced in their assembly.

Training document: Certificate of the training centre or the manufacturer CIDEM Hranice, a.s.



The list of trained companies and training centres is available at the website [www.cetris.cz](http://www.cetris.cz).

