Plaster and Façade Systems

P914_TB.de

Technical Brochure 2024-05

MP 75 Fire

Fire Protection Gypsum Plaster

Planing Guide

NEW

■ New formulation with fibre-reinforced plaster

Contents

MP 75 Fire

Fire Protection Gypsum Plaster

Product description

MP 75 Fire has been developed specially for fire protection of buildings in interiors. Its task is to protect the load bearing coated construction elements in the event of a fire so that their function is maintained until the fire has been extinguished or building evacuated.

MP 75 Fire consists of gypsum as a binder in combination with a special mix of lightweight aggregates, additives and fibres to ensure good machine application. MP 75 Fire has been granted the European Technical Approval ETA-21/0727.

Field of application

- Concrete ceilings and walls acc. to DIN EN 1992-1-2
- Concrete beams and supports acc. to DIN EN 1992-1-2
- Steel columns and beams acc. to DIN EN 1993-1-2
- Special constructions acc. to DIN 4102-4

Properties and added value

- Easy machine application
- Gypsum based
- Fibre reinforced
- Colour white

Technical data

Description	Standard	Unit	MP 75 Fire
Reaction to fire	EN 13501-1	–	A1
Compressive strength	EN 13279-2	N/mm²	≥ 2.3
Tensile bond strength ▪ On concrete ▪ On steel	EN 1015-2	 N/mm² N/mm²	 ≥ 0.2 ≥ 0.15
Water vapour diffusion resistance	EN 12086	–	7
pH value	–	–	12 – 13
Initial setting time	–	min	approx. 90 – 170
Final setting time	–	min	approx. 180 – 300
Bulk density	–	kg/m³	500 – 600
Dry density	EN 1015-10	kg/m³	approx. 750
Bending tensile strength	EN 13279-2	N/mm²	1.0
Thermal conductivity $\lambda_{10,\,dry}$	EN 1745	W/m·K	0.20
Wet mortar weight	–	kg/mm/m²	approx. 1.3
Dry plaster weight	–	kg/mm/m²	approx. 0.8

The stated technical data were evaluated acc. to the respective test standards. Deviations under site conditions are possible.

Material requirement and efficiency

Application	Consumption approx.	Yield approx.	
	kg/m²	m²/bag	m²/t
10 mm application thickness	6.2	3.2	161.0

All stated figures are approximate values and may deviate depending on the substrate conditions. The exact consumption can only be determined on the individual object.

Notes on fire resistance

The application options and the fire protection properties of the MP 75 Fire stated here are based on the data of the European Technical Approval ETA -21/0727 and the test reports on which it is based. All specifications marked with plus offer the user additional application options, which are not directly included in the European Certificate of Usability, but which have been technically assessed on the basis of the Experts Opinions BB-23-325-1 & -2 by IBB Hauswaldt.

The basis for the Experts Opinions BB-23-325-1 & -2 are, in addition to the DIN 4102-4 (Fire behaviour of building materials and building components) and the DIN EN 133813 /-4 (Test methods for determining the contribution to the fire resistance of structural members), the test reports of the MFPA Leipzig on which the ETA-21/0727 is based.

Knauf wishes to point out that before the fire protection enhancement with MP 75 Fire, the construction and implementation including all those in the planning aid marked with plus should in every case be coordinated and authorised in advance in consultation between the persons responsible for fire resistance and/or the relevant authorities. Technical Brochure P914_TB provides an overview of all areas of application classified as feasible from a fire resistance perspective. The application thicknesses specified here are compliant with ETA-21/0727 or were calculated in accordance with the specifications of the DIN EN 1992-1-2 (Eurocode 2: Design of concrete structures - Part 1 – 2: General rules – Structural fire design). All application thicknesses are valid exclusively when the stated specifications are complied with in detail.

The layer thicknesses specified are minimum thicknesses that must be observed. It is not permissible to apply a second layer after the fire protection plaster has hardened. For this reason, we recommend application of a layer thickness that is always 10 to 20 % more than the minimum to avoid the risk of layer thicknesses that are too thin.

Concrete constructions

Fire resistance coating of concrete components

Field of application

1-sided exposed concrete walls and slabs

- For a concrete density in a range of 1955 kg/m^3 to 2725 kg/m^3.
- Concrete strength class at least C30/37 up to and including C50/60.
- Fire resistance classes 30 to 180 minutes

plus

- Concrete density of 800 kg/m^3 to 1954 kg/m^3
- Concrete classes < C30/37

The rating of the application thickness of MP 75 Fire required for fire resistance purposes on concrete components is in accordance with the tables on the following pages and depends on

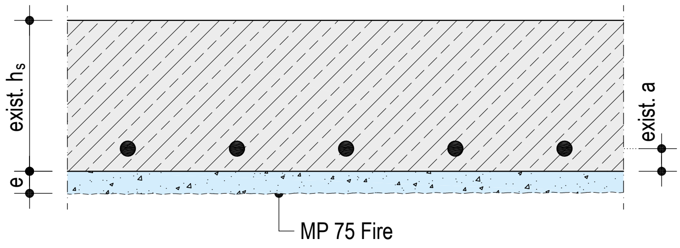
- Constructional component and loading
- Required fire resistance class according to building authority requirements
- Demands on the concrete thickness acc. to DIN EN 1992-1-2, section 5 for the necessary fire resistance class
- Existing concrete thickness
- Equivalent thickness of concrete of the ETA-21/0727

Procedure

1. Observe the fields of application.
2. Determine the required thicknesses of concrete (req. a and req. h_s) acc to DIN EN 1992-1-2, section 5.
3. Determine the existing concrete thickness (exist. a and exist. h_s) and derive the decisive (maximum) missing concrete thickness.
4. Read off the minimum plaster layer thickness e for MP 75 Fire in accordance with the missing concrete thickness from the tables on the following pages.

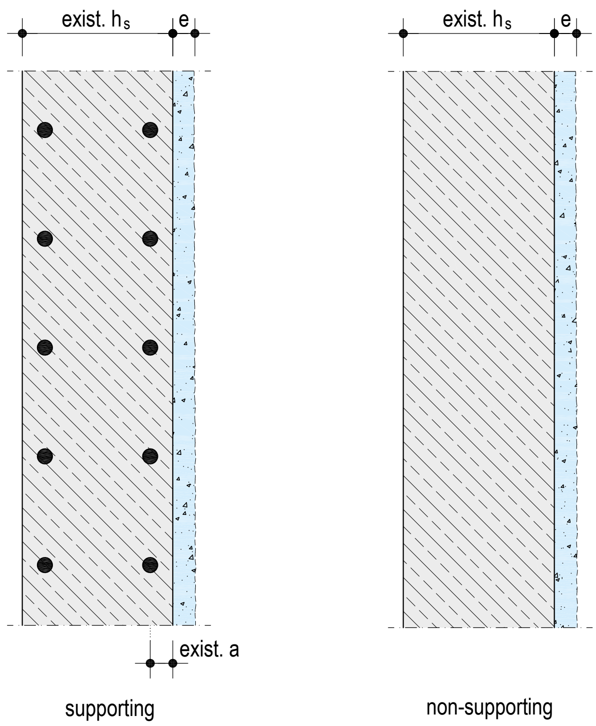
For rating examples see "Rating example" on page 11.

Concrete covers



exist. a = *existing axial spacing*
exist. h_s = *existing slab thickness*
e = *thickness MP 75 Fire*

Concrete walls



exist. a = *existing axial spacing with supporting walls*
exist. h_s = *existing wall thickness*
e = *thickness MP 75 Fire*

plus

Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2

- Prior consultation is recommended acc. to note on page 5

Minimum application layer thickness e

In dependence on the fire resistance class and missing concrete thickness

Diagram 1

Minimum application layer thickness MP 75 Fire in mm	REI 30									
21										≤ 50
20									≤ 49	
19								≤ 47		
18							≤ 46			
17						≤ 45				
16					≤ 43					
15				≤ 42						
14			≤ 40							
13		≤ 39								
12	≤ 38									
	38	39	40	42	43	45	46	47	49	50
	Missing concrete thickness in mm									

Diagram 2

Minimum application layer thickness MP 75 Fire in mm	REI 60									
21										≤ 67
20									≤ 64	
19								≤ 62		
18							≤ 60			
17						≤ 58				
16					≤ 56					
15				≤ 54						
14			≤ 52							
13		≤ 50								
12	≤ 48									
	48	50	52	54	56	58	60	62	64	67
	Missing concrete thickness in mm									

Minimum application layer thickness e (continuation)

In dependence on the fire resistance class and missing concrete thickness

Diagram 3

REI 90										
Minimum application layer thickness MP 75 Fire in mm / Missing concrete thickness in mm	52	55	57	60	62	65	67	70	72	75
21										≤ 75
20									≤ 72	
19								≤ 70		
18							≤ 67			
17						≤ 65				
16					≤ 62					
15				≤ 60						
14			≤ 57							
13		≤ 55								
12	≤ 52									

Diagram 4

REI 120										
Minimum application layer thickness MP 75 Fire in mm / Missing concrete thickness in mm	52	55	58	62	65	68	71	75	78	81
21										≤ 81
20									≤ 78	
19								≤ 75		
18							≤ 71			
17						≤ 68				
16					≤ 65					
15				≤ 62						
14			≤ 58							
13		≤ 55								
12	≤ 52									

Minimum application layer thickness e (continuation)

In dependence on the fire resistance class and missing concrete thickness

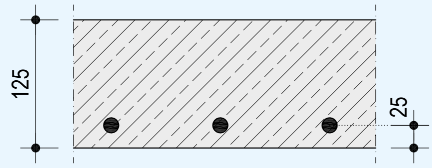
Diagram 5

Minimum application layer thickness MP 75 Fire in mm	REI 180									
21										≤ 73
20									≤ 70	
19								≤ 67		
18							≤ 65			
17						≤ 62				
16					≤ 59					
15				≤ 57						
14			≤ 54							
13		≤ 51								
12	≤ 48									
	48	51	54	57	59	62	65	67	70	73
	Missing concrete thickness in mm									

Rating example

Structurally determined supported, twin-axis stressed reinforced concrete ceiling with side ratio 1.5 < l_y/l_x ≤ 2.0 and supported on all 4 edges acc. to DIN EN 1992-1-2, section 5, table 5.8, columns 2 and 5

Required fire resistance class:	**REI 180**
Concrete density:	**2100 kg/m³**
Concrete strength class	**C25/30**
Slab dimensions:	
l_x:	**5 m**
l_y:	**10 m**
Slab thickness exist. h_s:	**125 mm**
Axial spacing exist. a:	**25 mm**
Thickness e:	**?? mm**



Step 1

Checking of the prerequisites acc. to ETA-21/0727
- Concrete density = 2100 kg/m³ ranges between 1955 kg/m³ to 2725 kg/m³
- Concrete strength class C25/30 is at least C25/30

Step 2

Requirements in the minimum axial spacing acc. to DIN EN 1992-1-2, section 5, table 5.8, columns 2 and 5
- req. a = 40 mm

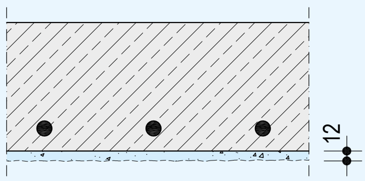
Step 3

Deriving the missing concrete thickness
- req. h_s - exist. h_s = 150 mm - 125 mm = **25 mm**
- req. a - exist. a = 40 mm - 25 mm = **15 mm**

Decisive missing concrete thickness = 25 mm

Step 4

Deriving the min. layer thickness for MP 75 Fire
- Diagram 5 (see page 10): **e = 12 mm**



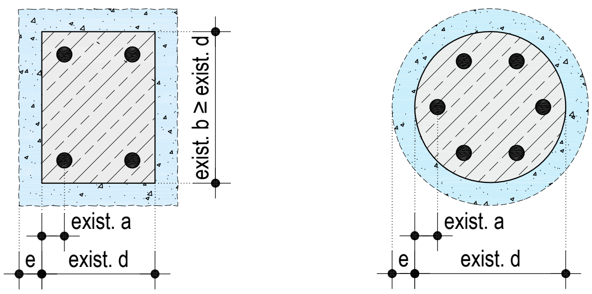
Field of application

3-sided or 4-sided exposed concrete beams and columns

- For a concrete density in a range of 1955 kg/m³ to 2725 kg/m³
- Column / beam width of at least 150 mm
- Beam height of at least 450 mm
  Lower heights are possible if the cross-sectional area is not reduced.
- Concrete strength class C30/37 up to and including C50/60.
- Fire resistance classes 30 to 180 minutes

plus

- 1-sided or 2-sided exposed concrete beams and columns
- Concrete density of 800 to 1954 kg/m³
- Concrete classes < C30/37
- Column / beam width of 80 – 149 mm
- Applications acc. to DIN 4102-4



exist. a *= existing axial spacing*
exist. b *= larger existing column width*
exist. d *= smaller existing column width or diameter*
e *= thickness MP 75 Fire*

Concrete columns

The rating of the application thickness of MP 75 Fire required for fire resistance purposes on concrete components is in accordance with the tables on the following pages and depends on

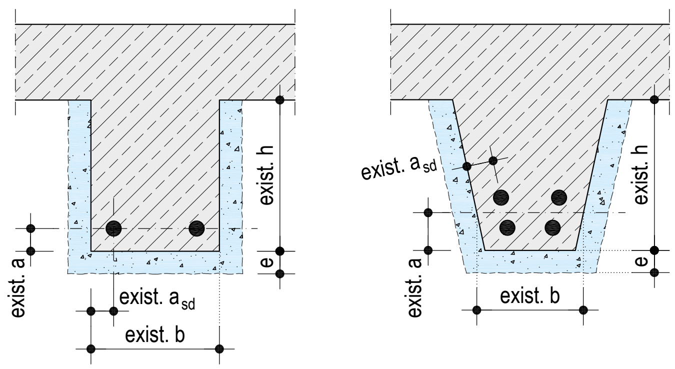
- Constructional component and loading
- Required fire resistance class according to building authority requirements
- Demands on the concrete thickness acc. to DIN EN 1992-1-2, section 5 for the necessary fire resistance class
- Existing concrete thickness
- Equivalent thickness of concrete of the ETA-21/0727

Procedure

1. Observe the fields of application.
2. Determine the required concrete thickness (req. a and req. b or req. d) acc to DIN EN 1992-1-2, section 5.
3. Determine the existing concrete thickness (exist. a and exist. b or exist. d) and derive the decisive (maximum) missing concrete thickness.
4. Read off the minimum plaster layer thickness e for MP 75 Fire in accordance with the missing concrete thickness from the tables on the following pages.

For rating examples see page 15.

Concrete beams



exist. a *= existing axial spacing*
exist. a_{sd} *= existing lateral axial spacing*
exist. b *=existing beam width in the height of the center of gravity of the tensile area reinforcement*
exist. h *= existing beam height*
e *= thickness MP 75 Fire*

plus

Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2

- Prior consultation is recommended acc. to note on page 5

Minimum application layer thickness e

In dependence on the fire resistance class and missing concrete thickness

Diagram 6

R 30

Minimum application layer thickness MP 75 Fire in mm \ Missing concrete thickness in mm	43	44	45	46	48	49	50	52	53	54	56	57
22												≤ 57
21											≤ 56	
20										≤ 54		
19									≤ 53			
18								≤ 52				
17							≤ 50					
16						≤ 49						
15					≤ 48							
14				≤ 46								
13			≤ 45									
12		≤ 44										
11	≤ 43											

Diagram 7

R 60

Minimum application layer thickness MP 75 Fire in mm \ Missing concrete thickness in mm	49	51	54	57	59	62	65	68	70	73	76	78
22												≤ 78
21											≤ 76	
20										≤ 73		
19									≤ 70			
18								≤ 68				
17							≤ 65					
16						≤ 62						
15					≤ 59							
14				≤ 57								
13			≤ 54									
12		≤ 51										
11	≤ 49											

Minimum application layer thickness e (continuation)

In dependence on the fire resistance class and missing concrete thickness

Diagram 8

R 90												
Minimum application layer thickness MP 75 Fire in mm												
22												≤ 82
21											≤ 79	
20										≤ 76		
19									≤ 73			
18								≤ 70				
17							≤ 67					
16						≤ 64						
15					≤ 61							
14				≤ 58								
13			≤ 55									
12		≤ 52										
11	≤ 49											
	49	52	55	58	61	64	67	70	73	76	79	82
	Missing concrete thickness in mm											

Diagram 9

R 120												
Minimum application layer thickness MP 75 Fire in mm												
22												≤ 82
21											≤ 79	
20										≤ 76		
19									≤ 73			
18								≤ 69				
17							≤ 66					
16						≤ 63						
15					≤ 60							
14				≤ 56								
13			≤ 53									
12		≤ 50										
11	≤ 47											
	47	50	53	56	60	63	66	69	73	76	79	82
	Missing concrete thickness in mm											

Diagram 10

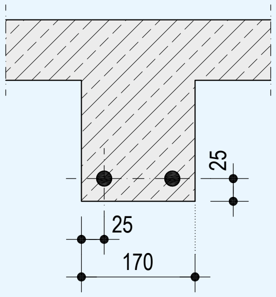
R 180								
Min. appli. layer thick. MP 75 Fire in mm								
22	≤ 77							
21								
20								
19								
	45	50	55	60	65	70	75	77
	Missing concrete thickness in mm							

Rating examples

Concrete beams

Structurally determined supported concrete beams with simple reinforcement layer acc. to DIN EN 1992-1-2, section 5, table 5.5

Required fire resistance class:	**R 120**
Concrete density:	**2100 kg/m³**
Concrete strength class:	**C30/37**
Beam width exist. b:	**170 mm**
Axial spacing exist. a:	**25 mm**
Lateral axial spacing exist. a_{sd}:	**25 mm**
Thickness e:	**?? mm**



Step 1

Checking of the prerequisites acc. to ETA-21/0727

- Beam width exist. b = 170 mm > 150 mm
- Concrete density = 2100 kg/m³ in range between 1955 kg/m³ to 2725 kg/m³
- Concrete strength class = C30/37 < C50/60

Step 2

Demands on beam width and min. axial spacing acc. to DIN EN 1992-1-2, section 5, table 5.5, column 3

- req. b = 240 mm
- req. a = 60 mm
- req. a_{sd} = 60 mm + 10 mm = 70 mm

Step 3

Deriving the missing concrete thickness

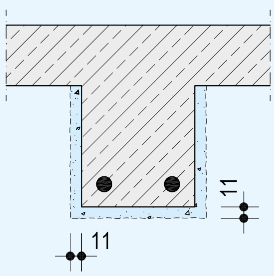
- req. b - exist. b = 240 mm - 170 mm = 70 mm (corresponds to **2 x 35 mm**)
- req. a - exist. a = 60 mm - 25 mm = **35 mm**
- req. a_{sd} - exist. a_{sd} = 70 mm - 25 mm = **45 mm**

Decisive missing concrete thickness = 45 mm

Step 4

Deriving the min. layer thickness for MP 75 Fire

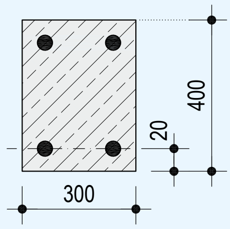
- Diagram 9 (see page 14): **e = 11 mm**



Rectangular concrete column

Utilisation factor μ_{fi} = 0.7, stressed from all sides, not pre-stressed acc. to DIN EN 1992-1-2, section 5, table 5.2a

Required fire resistance class:	**R 90**
Concrete density:	**2010 kg/m³**
Concrete strength class:	**C25/30**
Column cross-section:	**300 × 400 mm**
Smaller column width exist. d:	**300 mm**
Axial spacing exist. a:	**20 mm**
Thickness e:	**?? mm**



Step 1

plus Checking of the prerequisites acc. to Expert Report BB-23-325-1 & -2

- Column width exist. d = 300 mm > 80 mm
- Concrete density = 2010 kg/m³ in range between 1955 kg/m³ to 2725 kg/m³
- Concrete strength class = C25/30 < C30/37 Does not correspond to ETA-21/0727

Step 2

Demands on column width and min. axial spacing acc. to DIN EN 1992-1-2, section 5, table 5.2a, column 4

- req. d = 350 mm
- req. a = 53 mm

Step 3

Deriving the missing concrete thickness

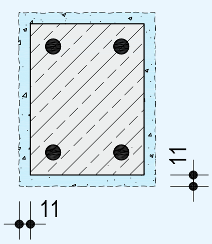
- req. d - exist. d = 350 mm - 300 mm = 50 mm (corresponds to **2 x 25 mm**)
- req. a - exist. a = 53 mm - 20 mm = **33 mm**

Decisive missing concrete thickness = 33 mm

Step 4

Deriving the min. layer thickness for MP 75 Fire

- Diagram 8 (see page 14): **e = 11 mm**



Steel structures

Fire resistant coating of steel columns and beams

Field of application

3-sided or 4-sided exposed steel beams and columns

MP 75 Fire can be used as a fire resistant coating with the following profiles and exposure to fire.

Profiles

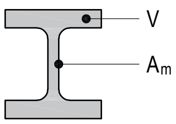
- I profiles
- H profiles
- L profiles
- T profiles
- U profiles
- Hollow sections
- Steel plates

plus

- 1-sided or 2-sided exposed steel beams and columns
- Applications acc. to DIN 4102-4

The rating of the application thickness of MP 75 Fire required for fire resistance purposes on steel columns and beams is in accordance with table 3 to 6 on the pages 22 to 25 and depends on the following 3 parameters:

1. Ratio of the surface on which the heat acts (circumference) A_m to the profile cross-section area V of the steel cross-section to be protected the so-called A_m/V value; it is determined in accordance with page 18 taking the installation conditions into consideration.



   A_m = Circumference of the steel profile exposed to fire (cm)
   V = Profile cross-section (cm^2)
   For common profile cross-sections the A_m/V values from table 2 on pages 19 to 21 can be read off.

2. The required fire resistance class R (retention of the stability) according to building authority requirements.

3. Critical steel temperature, used when dimensioning acc. to DIN EN 1993-1-2 (determined by the structural design engineer)

Protective treatment of the steel components based on alkyd resin, epoxy resin, polyurethane, zinc-dust epoxy resin or zinc-dust silicate is required.

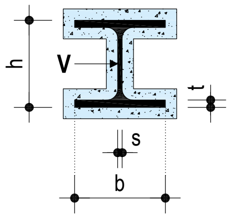
The ratio value used A_m/V (profile factor) corresponds to the ratio value U/A in the DIN 4102-4 in case the cross-section remains constant over the length.

Round up the results when calculating the A_m/V values.

The maximum permissible A_m/V factors are 429 m^{-1} for 3-sided exposure to flame and 495 m^{-1} for 4-sided exposure to flame.

The maximum web height of the steel beams is 639 mm and the maximum profile height for columns is 1000 mm.

For hollow steel sections, the minimum application thickness e must be multiplied by a factor of 1.25.



b *= profile width*
d *= hollow profile exterior diameter*
h *= profile height*
s *= web thickness*
t *= flange thickness or hollow profile thickness*

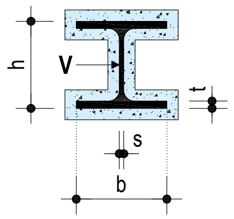
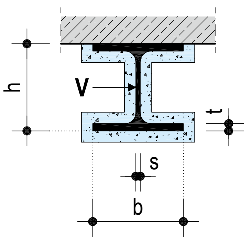
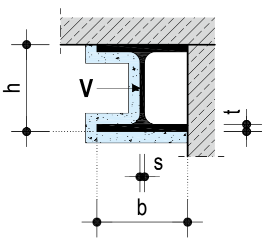
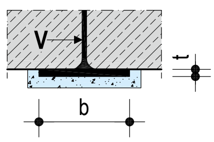
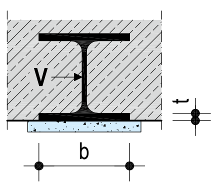
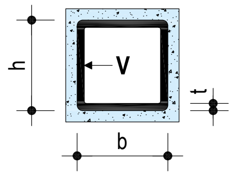
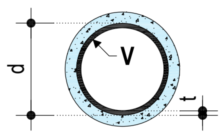
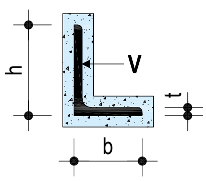
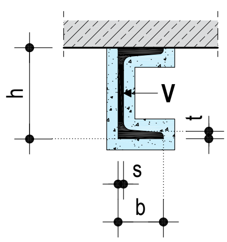
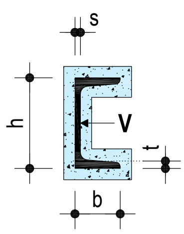
plus

Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2

- Prior consultation is recommended acc. to note on page 5

Calculation of A_m/V values

Table 1: Determine individual A_m/V value from profile individual dimensions

Construction features b, h, s and t in cm; area V in cm²	Exposure to fire	A_m/V in m^{-1}
Beam or column		
	All-sided	$\frac{4b + 2h - 2s}{2bt + (h - 2t)\,s} \cdot 100$
Beam or column		
	3-sided	$\frac{3b + 2h - 2s}{2bt + (h - 2t)\,s} \cdot 100$
Beam or column		
	3-sided Corner	$\frac{2b + h - s}{2bt + (h - 2t)\,s} \cdot 100$
Beam or column		
	3-sided flange	$\frac{b + 2t}{bt} \cdot 100$
Flange		
	1-side flange	Calculate complete flange thickness $\frac{b}{bt} \cdot 100$
Hollow section, corner		
	All-sided	$\frac{2b + 2h}{(2b + 2h - 4t)\,t} \cdot 100$
Hollow section, round		
	All-sided	$\frac{\pi d}{\pi\, t\,(d - t)} \cdot 100$
L profile		
	All-sided	$\frac{2b + 2h}{bt + ht - tt} \cdot 100$
U profile		
	3-sided	$\frac{3b + 2h - 2s}{2bt + (h - 2t)\,s} \cdot 100$
U profile		
	All-sided	$\frac{4b + 2h - 2s}{2bt + (h - 2t)\,s} \cdot 100$

Note	The curves on the profile cross-sections are ignored in order to simplify calculation.

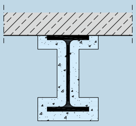
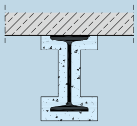
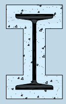
Overview A_m/V values

Table 2: A_m/V values acc. to DIN EN 1993-1-2

A_m/V value in m^{-1} for profile								
Standard DIN 1025-3	**A_m/V in m^{-1} 3-sided**	**A_m/V in m^{-1} 4-sided**	**Standard DIN 1025-2**	**A_m/V in m^{-1} 3-sided**	**A_m/V in m^{-1} 4-sided**	**Standard DIN 1025-4**	**A_m/V in m^{-1} 3-sided**	**A_m/V in m^{-1} 4-sided**
HEA 100	217.5	264.6	HEB 100	179.6	218.1	HEM 100	96.4	116.4
HEA 120	220.2	267.6	HEB 120	166.5	201.8	HEM 120	92.2	111.1
HEA 140	208.3	252.9	HEB 140	154.7	187.2	HEM 140	88.2	106.3
HEA 160	192.3	233.5	HEB 160	139.6	169.1	HEM 160	82.8	99.9
HEA 180	185.4	225.2	HEB 180	131.7	159.3	HEM 180	80.0	96.5
HEA 200	174.7	211.9	HEB 200	121.6	147.2	HEM 200	75.9	91.6
HEA 220	161.7	196.0	HEB 220	115.4	139.6	HEM 220	73.4	88.6
HEA 240	147.1	178.4	HEB 240	107.5	130.2	HEM 240	60.6	73.0
HEA 260	140.6	170.5	HEB 260	105.1	127.1	HEM 260	59.2	71.4
HEA 280	135.7	164.4	HEB 280	102.3	123.7	HEM 280	58.4	70.4
HEA 300	126.8	153.6	HEB 300	96.0	116.1	HEM 300	50.2	60.4
HEA 320	117.7	141.9	HEB 320	91.3	109.8	HEM 320/305	65.6	79.1
HEA 340	112.0	134.6	HEB 340	88.3	105.8	HEM 320	50.0	59.9
HEA 360	107.0	128.0	HEB 360	85.6	102.2	HEM 340	50.3	60.1
HEA 400	101.3	120.1	HEB 400	82.3	97.5	HEM 360	50.8	60.5
HEA 450	96.1	112.9	HEB 450	79.4	93.1	HEM 400	51.9	61.3
HEA 500	91.4	106.9	HEB 500	76.2	88.7	HEM 450	53.5	62.7
HEA 550	90.1	104.2	HEB 550	75.6	87.4	HEM 500	54.5	63.4
HEA 600	88.9	102.2	HEB 600	74.8	85.9	HEM 550	55.8	64.4
HEA 650	87.2	99.6	HEB 650	74.1	84.6	HEM 600	56.7	65.1
HEA 700	84.6	96.2	HEB 700	72.5	82.4	HEM 650	57.9	66.0
HEA 800	83.9	94.4	HEB 800	72.2	81.1	HEM 700	58.9	66.8
HEA 900	81.3	90.6	HEB 900	70.4	78.4	HEM 800	60.6	68.1
HEA 1000	80.7	89.3	HEB 1000	70.3	77.8	HEM 900	62.0	69.1
						HEM 1000	63.7	70.5

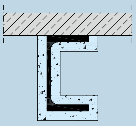
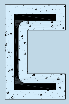
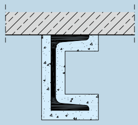
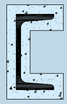
Overview A_m/V values (continuation)

Table 2: A_m/V values acc. to DIN EN 1993-1-2 (continuation)

A_m/V value in m^{-1} for profile					
Standard DIN 1025-5	A_m/V in m^{-1} 3-sided 	A_m/V in m^{-1} 4-sided 	Standard DIN 1025-1	A_m/V in m^{-1} 3-sided 	A_m/V in m^{-1} 4-sided 
IPE 80	369.1	429.3	IPN 80	346.1	401.6
IPE 100	335.0	388.3	IPN 100	301.9	349.1
IPE 120	311.4	359.8	IPN 120	268.3	309.2
IPE 140	291.5	336.0	IPN 140	239.6	275.8
IPE 160	269.2	310.0	IPN 160	219.7	252.2
IPE 180	254.0	292.1	IPN 180	200.0	229.4
IPE 200	234.4	269.5	IPN 200	185.3	212.3
IPE 220	221.0	253.9	IPN 220	171.4	196.2
IPE 240	205.1	235.8	IPN 240	160.1	183.1
IPE 270	197.2	226.6	IPN 260	148.8	170.0
IPE 300	187.7	215.6	IPN 280	138.9	158.4
IPE 330	174.1	199.7	IPN 300	131.2	149.3
IPE 360	162.3	185.7	IPN 320	123.4	140.3
IPE 400	152.7	174.0	IPN 340	116.8	132.6
IPE 450	143.7	163.0	IPN 360	110.0	124.7
IPE 500	132.8	150.0	IPN 380	104.8	118.7
IPE 550	124.6	140.3	IPN 400	99.6	112.7
IPE 600	114.7	128.8	IPN 450	89.1	100.7
			IPN 500	80.7	91.1
			IPN 550	75.5	84.9

Overview A_m/V values (continuation)

Table 2: A_m/V values acc. to DIN EN 1993-1-2 (continuation)

A_m/V value in m^{-1} for profile					
Standard DIN 1026-2	A_m/V in m^{-1} 3-sided 	A_m/V in m^{-1} 4-sided 	Standard DIN 1026-1	A_m/V in m^{-1} 3-sided 	A_m/V in m^{-1} 4-sided 
UPE 80	290.1	339.6	U 30 x 15	398.2	466.1
UPE 100	277.6	321.6	U 30	259.2	319.9
UPE 120	259.7	298.7	U 40 x 20	333.3	388.0
UPE 140	247.3	282.6	U 40	264.1	320.5
UPE 160	234.6	266.8	U 50 x 25	317.1	367.9
UPE 180	224.7	254.6	U 50	272.5	325.8
UPE 200	212.8	240.3	U 60	286.4	332.8
UPE 220	197.9	223.0	U 65	255.8	302.3
UPE 240	187.8	211.2	U 80	242.7	283.6
UPE 270	177.9	199.1	U 100	238.5	275.6
UPE 300	153.4	171.0	U 120	222.9	255.3
UPE 330	138.3	153.8	U 140	210.3	239.7
UPE 360	129.8	143.9	U 160	200.4	227.5
UPE 400	120.0	132.5	U 180	193.2	218.2
			U 200	182.0	205.3
			U 220	170.6	192.0
			U 240	163.1	183.2
			U 260	154.0	172.7
			U 280	149.2	167.0
			U 300	145.8	163.0
			U 320	116.4	129.6
			U 350	122.9	135.8
			U 380	125.4	138.1
			U 400	116.9	129.0

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Minimum application layer thickness e

In dependence on the A_m/V value, on the critical steel temperature and on the required **Fire resistance class R30**

Table 3:

A_m/V in m^{-1}	R30					Critical steel temperature in °C					
495	–	–	–	750	700	600	550	500	450	350	300
340	–	–	–	700	650	600	500	450	400	350	300
330	–	–	750	700	650	550	500	450	400	350	300
320	–	–	750	700	650	550	500	450	400	350	300
310	–	–	750	700	600	550	500	450	400	350	300
300	–	–	750	700	600	550	500	450	400	300	–
290	–	–	750	650	600	550	500	450	350	300	–
280	–	–	750	650	600	550	500	450	350	300	–
270	–	–	700	650	600	550	500	400	350	300	–
260	–	–	700	650	600	500	450	400	350	300	–
250	–	750	700	650	600	500	450	400	350	300	–
240	–	750	700	650	550	500	450	400	350	300	–
230	–	750	700	600	550	500	450	400	350	300	–
220	–	750	650	600	550	500	450	400	350	300	–
210	750	700	650	600	550	500	450	400	350	300	–
200	750	700	650	600	500	–	450	350	300	–	–
190	750	700	650	600	500	450	400	350	300	–	–
180	700	650	600	550	500	450	400	350	300	–	–
170	700	650	600	550	500	450	400	350	300	–	–
160	700	650	600	500	–	450	400	350	300	–	–
150	650	600	550	500	450	400	350	300	–	–	–
140	650	600	500	–	450	400	350	300	–	–	–
130	600	550	500	450	–	400	350	300	–	–	–
120	600	500	–	450	400	350	300	–	–	–	–
110	550	500	450	–	400	350	300	–	–	–	–
100	500	–	450	400	350	300	–	–	–	–	–
90	500	450	400	350	–	300	–	–	–	–	–
80	450	400	350	–	300	–	–	–	–	–	–
< 80	400	–	350	300	–	–	–	–	–	–	–
	10	11	12	13	14	15	16	17	18	19	20
						Minimum application layer thickness e in mm					

Caution	Should the determined steel temperature not be in the table, the next lower critical temperature must always be assumed.

Minimum application layer thickness e (continuation)

In dependence on the A_m/V value, on the critical steel temperature and on the required **Fire resistance class R60**

Table 4:

A_m/V in m^{-1}	R60								Critical steel temperature in °C									
495	–	–	–	–	–	–	–	–	–	–	750	700	650	550	500	450	400	350	300
340	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	400	350	300	–
330	–	–	–	–	–	–	–	–	–	750	700	650	600	550	450	400	350	300	–
320	–	–	–	–	–	–	–	–	–	750	700	650	600	500	450	400	350	300	–
310	–	–	–	–	–	–	–	–	–	750	700	650	600	500	450	400	350	300	–
300	–	–	–	–	–	–	–	–	–	750	700	650	550	500	450	400	350	300	–
290	–	–	–	–	–	–	–	–	–	750	700	600	550	500	450	400	350	300	–
280	–	–	–	–	–	–	–	–	–	750	700	600	550	500	450	400	350	300	–
270	–	–	–	–	–	–	–	–	–	750	650	600	550	500	450	400	350	300	–
260	–	–	–	–	–	–	–	–	–	700	650	600	550	500	450	400	350	300	–
250	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
240	–	–	–	–	–	–	–	–	750	700	650	600	550	450	–	400	350	300	–
230	–	–	–	–	–	–	–	–	750	700	650	600	550	450	–	400	300	–	–
220	–	–	–	–	–	–	–	–	750	700	650	600	500	450	400	350	300	–	–
210	–	–	–	–	–	–	–	–	750	700	600	550	500	450	400	350	300	–	–
200	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
190	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
180	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
170	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
160	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–	–
150	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–	–
140	–	–	–	–	–	750	700	650	600	–	550	500	450	400	350	300	–	–	–
130	–	–	–	–	–	750	700	650	600	550	500	450	400	350	–	300	–	–	–
120	–	–	–	–	750	700	650	600	–	550	500	450	400	350	300	–	–	–	–
110	–	–	–	750	700	650	–	600	550	500	450	400	–	350	300	–	–	–	–
100	–	–	750	700	650	–	600	550	500	–	450	400	350	300	–	–	–	–	–
90	750	–	700	650	–	600	550	500	–	450	400	350	300	–	–	–	–	–	–
80	700	–	650	600	–	550	500	–	450	400	350	–	300	–	–	–	–	–	–
< 80	650	–	–	600	550	500	–	450	400	–	350	300	–	–	–	–	–	–	–
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
									Minimum application layer thickness e in mm									

Caution	Should the determined steel temperature not be in the table, the next lower critical temperature must always be assumed.

Minimum application layer thickness e (continuation)

In dependence on the A_m/V value, on the critical steel temperature and on the required **Fire resistance class R90**

Table 5:

A_m/V in m^{-1}	R90 Critical steel temperature in °C																			
495	–	–	–	–	–	–	–	–	–	–	–	750	700	650	550	500	450	400	350	300
340	–	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
330	–	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
320	–	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
310	–	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
300	–	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
290	–	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
280	–	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
270	–	–	–	–	–	–	–	–	–	–	750	700	650	550	500	450	400	350	300	–
260	–	–	–	–	–	–	–	–	–	–	750	700	600	550	500	450	400	350	300	–
250	–	–	–	–	–	–	–	–	–	–	700	650	600	550	500	450	400	350	300	–
240	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
230	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
220	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
210	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
200	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
190	–	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
180	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
170	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
160	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
150	–	–	–	–	–	–	–	750	700	–	650	600	550	500	450	400	350	300	–	–
140	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	–	300	–	–
130	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–	–
120	–	–	–	–	–	–	750	700	650	600	550	–	500	450	400	350	300	–	–	–
110	–	–	–	–	–	750	700	–	650	600	550	500	450	400	350	300	–	–	–	–
100	–	–	–	–	750	–	700	650	600	550	500	–	450	400	350	300	–	–	–	–
90	–	–	–	750	700	650	650	600	550	–	500	450	400	350	300	–	–	–	–	–
80	–	750	–	700	650	–	600	550	–	500	450	400	350	300	–	–	–	–	–	–
< 80	750	–	700	650	–	600	550	–	500	450	400	–	350	300	–	–	–	–	–	–
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
	Minimum application layer thickness e in mm																			

Caution	Should the determined steel temperature not be in the table, the next lower critical temperature must always be assumed.

Minimum application layer thickness e (continuation)

In dependence on the A_m/V value, on the critical steel temperature and on the required **Fire resistance class R120**

Table 6:

A_m/V in m^{-1}	R120 Critical steel temperature in °C																	
495	–	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300
340	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	–	300
330	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
320	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
310	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
300	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
290	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
280	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
270	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
260	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
250	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
240	–	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–
230	–	–	–	–	–	–	750	700	650	600	550	–	500	450	400	350	300	–
220	–	–	–	–	–	–	750	700	650	600	550	500	450	–	400	350	300	–
210	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	–	300	–
200	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
190	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
180	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
170	–	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–
160	–	–	–	–	–	750	700	650	600	550	–	500	450	400	350	300	–	–
150	–	–	–	–	–	750	700	650	600	550	500	450	400	350	–	300	–	–
140	–	–	–	–	–	750	700	650	600	550	500	450	400	350	300	–	–	–
130	–	–	–	–	750	–	700	650	600	550	500	450	400	350	300	–	–	–
120	–	–	–	–	750	700	650	600	550	500	450	–	400	350	300	–	–	–
110	–	–	–	750	–	700	650	600	550	500	450	400	350	300	–	–	–	–
100	–	–	–	750	700	650	600	550	500	–	450	400	350	300	–	–	–	–
90	–	–	750	700	650	–	600	550	500	450	400	350	300	–	–	–	–	–
80	–	750	700	650	–	600	550	500	450	400	350	300	–	–	–	–	–	–
< 80	750	700	650	–	600	550	500	450	–	400	350	300	–	–	–	–	–	–
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
	Minimum application layer thickness e in mm																	

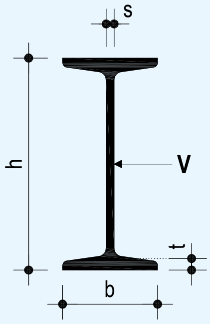
Caution	Should the determined steel temperature not be in the table, the next lower critical temperature must always be assumed.

Rating examples

I profile

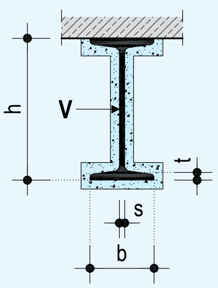
Profile: **I 200**
Critical steel temperature: **500° C**
Cross-sectional dimensions
- h: **20 cm**
- b: **9 cm**
- s: **0.75 cm**
- t: **1.13 cm**

Required fire resistance class: **R 90**
Fire exposure: **3-sided**
Thickness e: **?? mm**



Step 1

Determination of A_m/ V values for steel columns and beams



3-sided

$$A_m/V = \frac{3b + 2h - 2s}{2bt + (h - 2t)\,s} \cdot 100$$

$$A_m/V = \frac{3 \cdot 9 + 2 \cdot 20 - 2 \cdot 0.75}{2 \cdot 9 \cdot 1.13 + (20 - 2 \cdot 1.13) \cdot 0.75} \cdot 100$$

$$A_m/V = \frac{65.50}{33.645} \cdot 100$$

$$\mathbf{A_m/V = 194.68\ m^{-1}}$$

Condition for use of table 5 on page 24 fulfilled:
A_m/V value: $194.68\ m^{-1} \leq 429\ m^{-1}$

Step 2

Minimum application layer thickness e

A_m/V value in m^{-1}	R 90 Critical steel temperature in °C				
230	600	550	500	450	400
220	600	550	500	450	400
210	600	550	500	450	400
200	600	550	**500**	450	400
190	600	550	500	450	400
180	550	500	450	400	350
170	550	500	450	400	350
	28	29	**30**	31	32
	Minimum application layer thickness e in mm				

For the A_m/V value the same or next higher value from table 5 on page 24 must be determined.

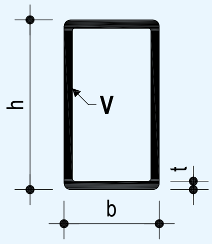
Result

Minimum application thickness MP 75 Fire: ≥ 30 mm

Hollow profile

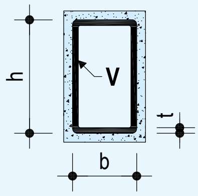
Profile: **160 × 90 × 8 mm**
Critical steel temperature: **750° C**
Cross-sectional dimensions
- h: **16 cm**
- b: **9 cm**
- t: **0.8 cm**

Required fire resistance class: **R 120**
Fire exposure: **All-sided**
Thickness e: **?? mm**



Step 1

Determination of A_m/ V values for steel columns and beams



4-sided

$$A_m/V = \frac{2b + 2h}{(2b + 2h - 4t)\,t} \cdot 100$$

$$A_m/V = \frac{2 \cdot 9 + 2 \cdot 16}{(2 \cdot 9 + 2 \cdot 16 - 4 \cdot 0.8) \cdot 0.8} \cdot 100$$

$$A_m/V = \frac{50}{37.44} \cdot 100$$

$$\mathbf{A_m/V = 133.55\ m^{-1}}$$

Condition for use of table 6 on page 25 fulfilled:
A_m/V value: $133.55\ m^{-1} \leq 495\ m^{-1}$

Step 2

Minimum application layer thickness e

A_m/V value in m^{-1}	R 120 Critical steel temperature in °C				
170	–	–	–	750	700
160	–	–	750	700	650
150	–	–	750	700	650
140	–	–	**750**	700	650
130	–	750	–	700	650
120	–	750	700	650	600
110	750	–	700	650	600
	29	30	**31**	32	33
	Minimum application layer thickness e in mm				

For the A_m/V value the same or next higher value from table 6 on page 25 must be determined.

**Result × 1.25
(25 % safety margin)**

Minimum application thickness MP 75 Fire: 1.25 × 31 mm ≥ 39 mm

Special constructions

Fire resistance coating of

Ribbed ceilings without intermediate components

Ribbed ceilings with intermediate components

Reinforced concrete hollow ceilings

Brick and brick/steel ceilings

Vaulted ceilings

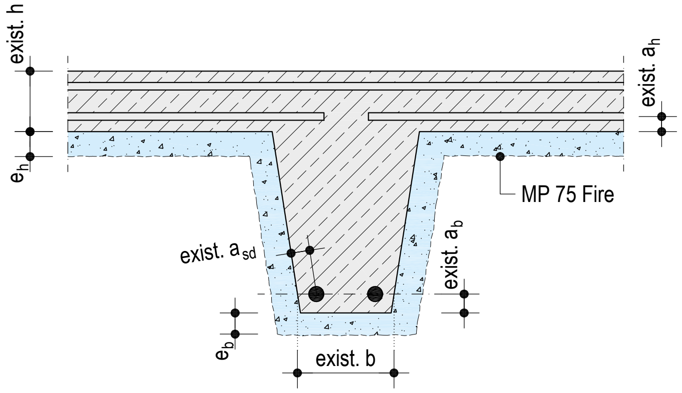
Hollow clay element ceiling

Concrete ceilings with embedded steel beams (coves)

Field of application

1-sided exposed concrete ceilings and
3-sided or 4-sided exposed concrete beams and columns

- For a concrete density in a range of 1955 kg/m³ to 2725 kg/m³
- Beam width of at least 150 mm
- Beam height of at least 450 mm
- Concrete strength class C30/37 up to and including C50/60



exist. a_b = *existing axial spacing in the downstand beam*
exist. a_h = *existing axial spacing in the cover*
exist. a_{sd} = *existing axial spacing in the downstand beams*
exist. b = *existing rib width in the height of the centre of gravity of the tensile area reinforcement*
exist. h = *available cover thickness*
e_b = *thickness MP 75 Fire on the downstand beams*
e_h = *thickness MP 75 Fire in flat section*

plus

- Beam width of 80 – 149 mm
- Concrete density in a range of 800 kg/m³ to 1954 kg/m³
- Concrete classes < C30/37
- Applications acc. to DIN 4102-4
- Fire resistance classes 30 to 180 minutes

The rating of the application thickness of MP 75 Fire required for fire resistance purposes on concrete components is in accordance with the tables on pages 8 to 10 and depends on

- Constructional component and loading
- Required fire resistance class according to building authority requirements
- Demands on the concrete thickness acc. to DIN EN 1992-1-2, section 5 for the necessary fire resistance class
- Existing concrete thickness
- Equivalent thickness of concrete of the ETA-21/0727

Procedure

1. Observe the fields of application.
2. Determine the required thicknesses, width and minimum spacings of concrete acc to DIN EN 1992-1-2, section 5.
3. Determine existing concrete thickness, width and minimum spacings and derive the decisive (maximum) missing concrete thickness.
4. Read off the minimum plaster layer thickness e for MP 75 Fire in accordance with the missing concrete thickness from the tables on pages 8 to 10.

For rating examples see the following page.

Downstand beams

The downstand beams of ribbed ceilings can be fire resistance upgraded with MP 75 L Fire in acc. with the indicated equivalent concrete thicknesses for concrete beams and supports in ETA-21/0727.
The application thicknesses from diagrams 6 to 10 on pages 13 and 14 apply.

Slab area

The slab area of the ribbed ceiling is considered separately and fire resistance upgraded in acc. with the equivalent concrete thickness for concrete covers.
The application thicknesses from diagrams 1 to 5 on pages 8 to 10 apply.

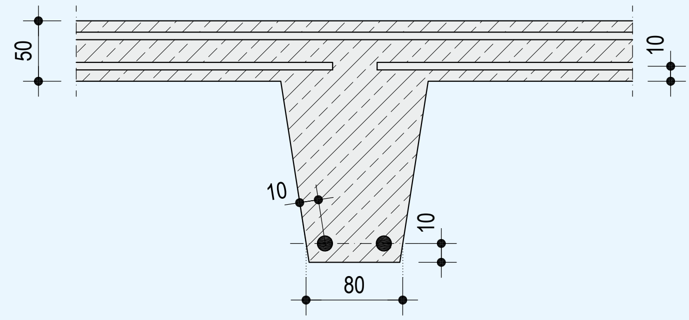
plus **Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2**

- Prior consultation is recommended acc. to note on page 5

Rating example

Twin-axis stressed structurally determined supported reinforced concrete ribbed ceiling with simple reinforcement layer acc. to DIN EN 1992-1-2, section 5, table 5.10

Required fire resistance class:	**REI 90**
Concrete density:	**2010 kg/m³**
Concrete strength class:	**C30/37**
Existing cover thickness exist. h:	**50 mm**
Existing axial spacing concrete cover exist. a_h:	**10 mm**
Existing rib width exist. b:	**80 mm**
Existing rib axial spacing exist. a_b:	**10 mm**
Existing rib lateral axial spacing exist. a_{sd}:	**10 mm**
Thickness e_b and e_h:	**?? mm**



Step 1

Checking of the prerequisites acc. to Expert Opinion BB-23-325-2

- Rib width exist. b = 80 mm ≥ 80 mm
- Concrete density = 2010 kg/m³ corresponds to normal-weight concrete acc. to DIN EN 206-1 / DIN 1045-2
- Concrete strength class = C30/37 corresponds with ETA-21/0727

Step 2

Downstand beam with simple reinforcement layer

Demands on rib width and minimum spacings acc. to DIN EN 1992-1-2, section 5, table 5.10, column 3

- req. b = 160 mm
- req. a_b = 40 mm
- req. a_{sd} = 40 mm + 10 mm = 50 mm

Step 3

Deriving the missing concrete thickness

- req. b - req. b = 160 mm - 80 mm = 80 mm (corresponds to **2 x 40 mm**)
- req. a_b - exist. a_b = 40 mm - 10 mm = **30 mm**
- req. a_{sd} - exist. a_{sd} = 50 mm - 10 mm = **40 mm**

Decisive missing concrete thickness = 40 mm

Step 4

Reading off the min. application thickness e_b for MP 75 Fire

- Diagram 8 (see page 14): **e_b = 11 mm**

Step 2

Board area

Demands on board thickness and minimum spacings acc. to DIN EN 1992-1-2, section 5, table 5.10, column 5

- req. h = 100 mm
- req. a_h = 15 mm

Step 3

Deriving the missing concrete thickness

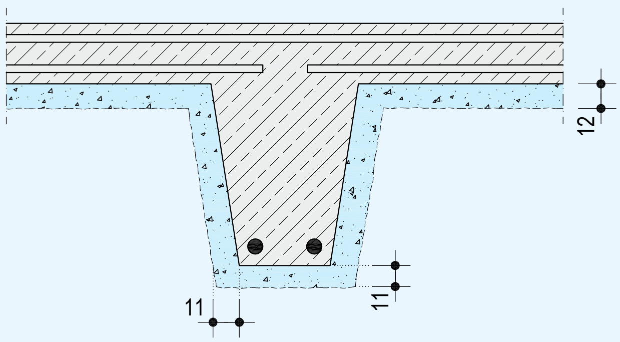
- req. h - exist. h = 100 mm - 50 mm = **50 mm**
- req. a_h - exist. a_h = 15 mm - 10 mm = **5 mm**

Decisive missing concrete thickness = 50 mm

Step 4

Read off min. layer thickness e_h for MP 75 Fire

- Diagram 3 (see page 9): **e_h = 12 mm**



Field of application

Figure 1: Intermediate component acc. to DIN EN 15037-3, type SR

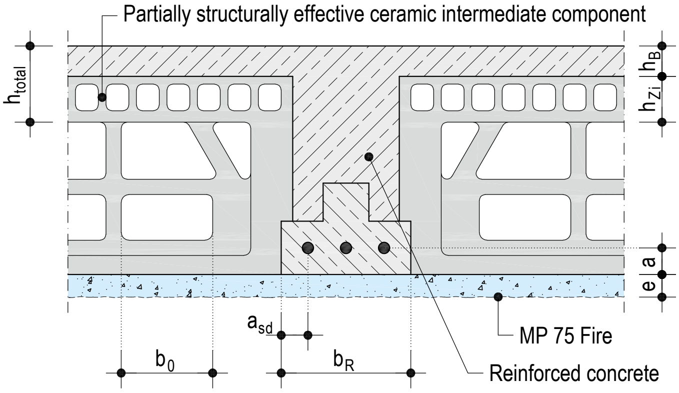


Figure 3: Intermediate component acc. to DIN EN 15037-2 with level bottom

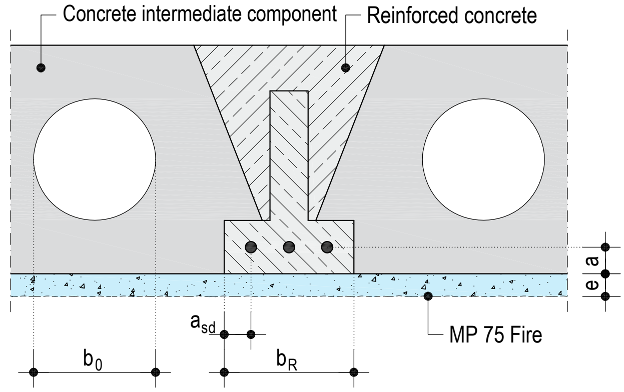


Figure 2: Intermediate component acc. to DIN EN 15037-3, type RR

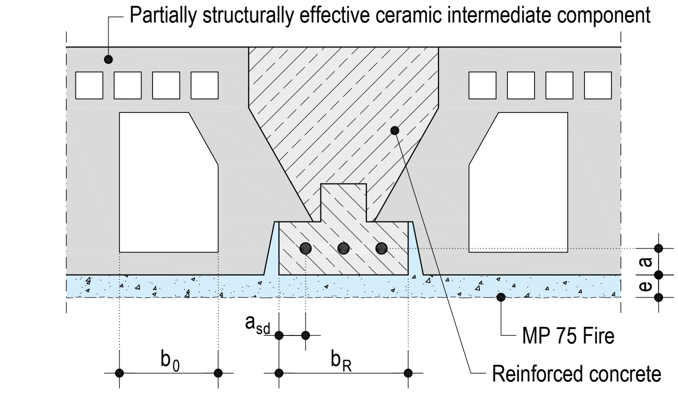
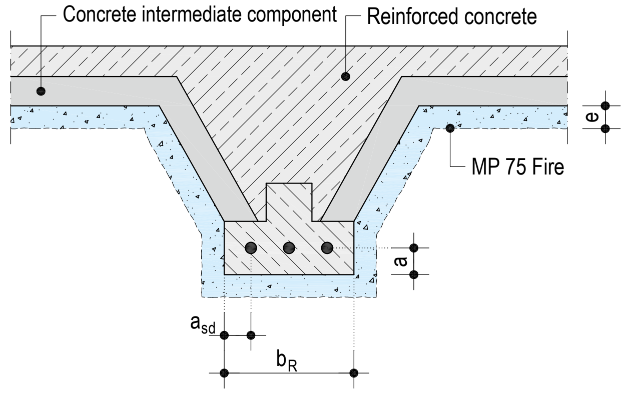


Figure 4: Intermediate component acc. to DIN EN 15037-2 with non-level bottom



A_{Net} = *net cross-section area of the intermediate components*
a = *vertical axial spacing*
a_{sd} = *lateral axial spacing*
b_R = *rib width*
b_0 = *spacings of intermediate component internal webs*
h_B = *thickness of applied concrete*
h_{total} = *effective fire protection cover thickness*
h_{Int} = *creditable height of brick lay-in ceiling*
e = *thickness MP 75 Fire*

MP 75 Fire in accordance with the specifications of the Expert Opinion BB-23-325-2 or. DIN 4102-4:2016-05 can be applied on intermediate components made of concrete or ceramic intermediate components (acc. to DIN EN 15037-2 and 3).

Initially, the suitability of the existing cover must be certified for the required fire resistance class to the requirements in the DIN 4102-4:2016-05.

Case 1: Level bottom (Figure 1 – 3)
The reinforced concrete ribs can be reinforced with MP 75 Fire n accordance with the equivalent concrete thicknesses specified for concrete ceilings and walls (diagram 1 to 5 from page 8 ff.).

Preconditions:
- $h = A_{Net}/b$
- $b_0 \leq 60$ mm (for type RR)
- Further requirements: see DIN 4102-4:2016-05, section 5.7

Case 2: Non-level bottom (Figure 4)
The reinforced concrete ribs can be reinforced with MP 75 Fire in accordance with the equivalent concrete thicknesses specified for concrete beams and columns (diagram 6 to 10 from page 13 ff.).

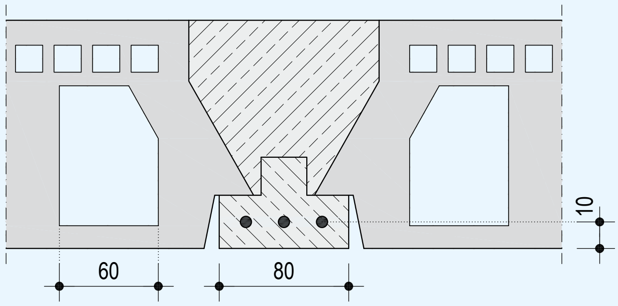
Preconditions:
- $w \geq 80$ mm
- Further requirements: see DIN 4102-4:2016-05, section 5.7

plus **Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2**
- Prior consultation is recommended acc. to note on page 5

Rating example

Reinforced concrete ribbed ceiling with intermediate component of type RR – DIN 4102-4:2016-05, Tab.5.14, lines 1.1.2, 2 and 3.1

Required fire resistance class:	**REI 90**
Concrete density:	**2010 kg/m³**
Effective ceiling thickness h_{total}:	**80 mm**
Existing rib width w_R:	**80 mm**
Spacing of intermediate component web b_0:	**60 mm**
Existing axial spacing a:	**10 mm**
Thickness e:	**?? mm**



Step 1

Checking of the prerequisites

- exist. lap width w_0: = 60 mm ≤ 60 mm
- Calculation of h_{total} from h_{zi}, h_B and A_{Net} acc. to DIN 4102-4, section 5.7.2
- Concrete density = 2010 kg/m³ corresponds to normal-weight concrete acc. to DIN EN 206-1 / DIN 1045-2
- Concrete strength class C25/30 < C50/60

Step 2

Requirements on the total thickness (ribs intermediate components)

Definition of the minimum requirements on the ceiling height h_{total}, rib width b_R and min. axial spacing a acc. to DIN 4102-4:2016-05, table 5.14, lines 1.1.2, 2 and 3.1 or acc. to DIN EN 1992-1-2:2010-12, table 5.8, columns 2 and 3

- req. h_{total} = 100 mm
- req. b_R = no requirement
- req. a = 30 mm

Step 3

Deriving the missing concrete thickness

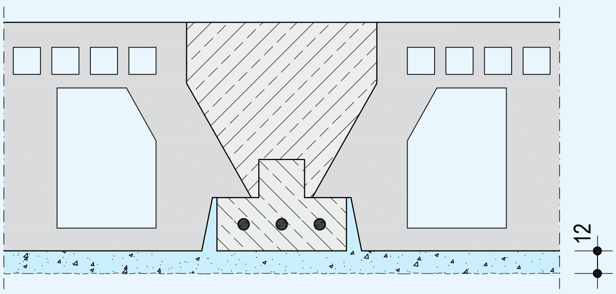
- req. h_{total} - exist. h_{total} = 100 mm - 80 mm = **20 mm**
- req. w_R: **Must not be considered**
- req. a - exist. a = 30 mm - 10 mm = **20 mm**

Decisive missing concrete cover = 20 mm

Step 4

Deriving the min. layer thickness for MP 75 Fire

- Diagram 3 (see page 9): **e = 12 mm**

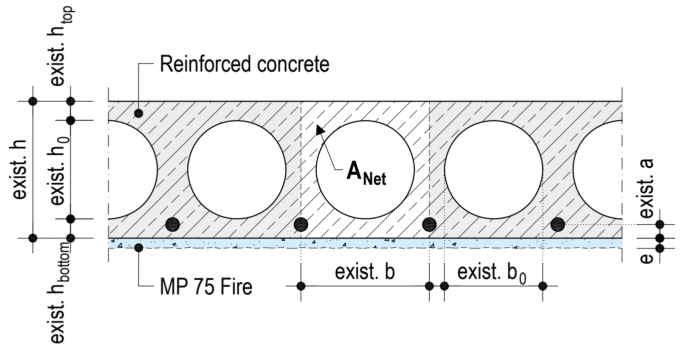


Field of application

Reinforced concrete slabs with cavities can be upgraded acc. to the Experts Opinion BB-23-325-2 and the specifications acc. to DIN 4102-4:2016-05. For fire resistance upgrading with MP 75 Fire, the equivalent concrete thicknesses from chapter "Ceilings and walls" (diagrams 1 to 5 from page 8 ff.) must be considered.

Preconditions acc. to Experts Opinion BB-23-325-2 and/or DIN 4102-4:2016-05

- **For reinforced concrete slabs with plemums ($w_0/h_0 > 1$) see DIN 4102-4:2016-05, section 5.4:**
  - $A_{Net}/w \geq h$
  - exist. $h_{bottom} \geq 50$ mm
- **For reinforced concrete hollow slabs with plemums ($w_0/h_0 > 1$) see DIN 4102-4:2016-05, section 5.5:**
  - exist. a ≥ 10 mm
  - exist. h ≥ 80 mm



A_{Net}	*= net cross-section area*
exist. a	*= existing axial spacing*
exist. b	*= existing cross-section width*
exist. b_0	*= existing plenum width*
exist. h	*= existing slab thickness*
exist. h_{top}	*= existing concrete thickness above plenum*
exist. h_{bottom}	*= existing concrete thickness below plenum*
exist. h_0	*= existing plenum height*
e	*= thickness MP 75 Fire*

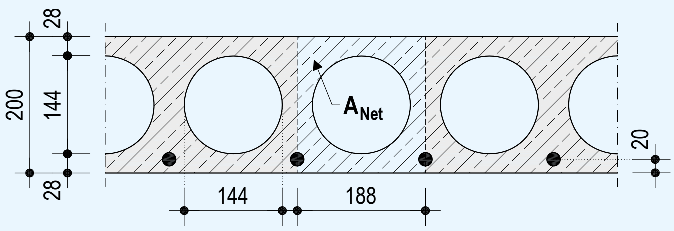
plus **Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2**

- Prior consultation is recommended acc. to note on page 5

Rating example

Rating example – Raw reinforced concrete hollow core slabs made of normal concrete $b_0/h_0 \leq 1$, regardless of the arrangement of a screed with the same bar diameters in accordance with DIN 4102-4:2016-05, tables 5.7 line 4 (or 1.1) and 5.8 line 2 (or 1.1)

Required fire resistance class:	**REI 90**
Concrete density:	**2010 kg/m³**
Concrete strength class:	**C45/55**
Existing ceiling thickness exist. h:	**200 mm**
Plenum height h_0:	**144 mm**
Plenum width b_0:	**144 mm**
Axial spacing exist. a:	**20 mm**
Thickness e:	**?? mm**



Step 1

Checking of the prerequisites

- w_0 / h_0 = 144 mm / 144 mm ≤ 1
- exist. h = 200 mm > 80 mm
- exist. a = 20 mm > 10 mm
- Concrete density = 2010 kg/m³ corresponds to normal-weight concrete acc. to DIN EN 206-1 / DIN 1045-2
- Concrete strength class C45/55 < C50/60

Step 2

Demands on cover thickness and minimum spacing acc. to DIN 4102-4:2016-05, tables 5.7 and 5.8

- req. h = 120 mm
- req. a = 35 mm

Step 3

Deriving the missing concrete thickness

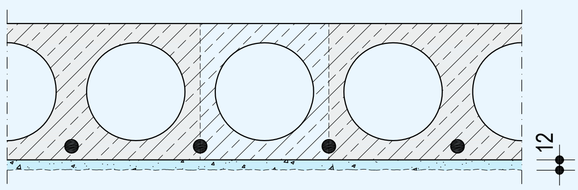
- req. h - exist. h = 120 mm - 200 mm = **- 80 mm**
- req. a - exist. a = 35 mm - 20 mm = **15 mm**

Decisive missing concrete cover = 15 mm

Step 4

Deriving the min. layer thickness for MP 75 Fire

- Diagram 3 (see page 9): **e = 12 mm**

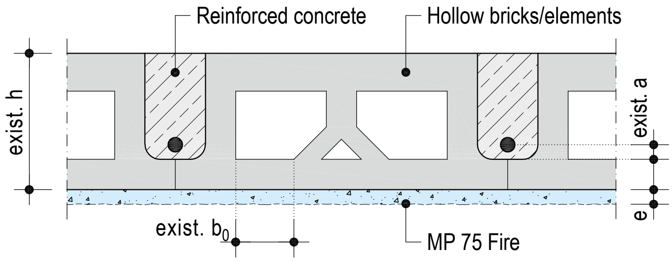


Field of application

MP 75 Fire can be used in accordance with the specifications of the Expert Opinion BB-23-325-2 or. DIN 4102-4:2016-05 on brick ceilings acc. to DIN EN 1045-2-100). The brick ceilings (brick/steel ceilings) can be reinforced with MP 75 Fire in accordance with the equivalent concrete thicknesses specified for concrete ceilings and walls (diagram 1 to 5 from page 8 ff.).

Requirements:

- For REI ≥ 60 only floor bricks acc. to DIN 4159 maybe used, where the clearances b_0 of the vertical or inclined internal webs $b_0 \leq 60$ mm.
- For the minimum thickness h of the brick ceiling DIN 4102-4:2016-05, table. 5.15, line 1.1, must be consulted.
- The minimum spacing a is assessed differently depending on the mounting and column width in accordance with DIN 4102-4:2016-05, table. 5.15, lines 2.1 to 2.2.3.



exist. a *= existing axial spacing*
exist. b_0 *= existing spacings of the brick internal webs*
exist. h *= existing slab thickness*
e *= thickness MP 75 Fire*

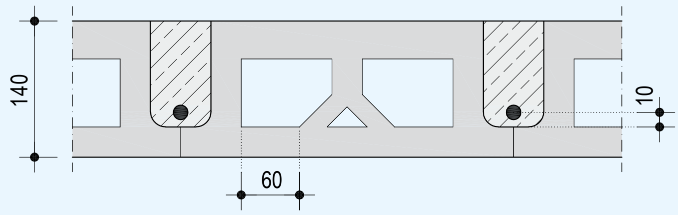
plus **Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2**

- Prior consultation is recommended acc. to note on page 5

Rating example

Brick ceiling acc. to DIN 1045-100 – structurally determined, wit consideration of a screed

Required fire resistance class:	**REI 90**
Existing ceiling thickness h:	**140 mm**
Existing lap spacings w_0:	**60 mm**
Existing axial spacing a:	**10 mm**
Thickness e:	**?? mm**



Step 1

Checking of the prerequisites

- exist. lap width w_0: = 60 mm ≤ 60 mm

Step 2

Rating of the brick ceiling

Definition of the minimum requirements on the ceiling height h and minimum axial spacing a acc. to DIN 4102-4:2016-05, table 5.15, lines 1.1 and 2.1

- req. h = 165 mm
- req. a = 20 mm

Step 3

Deriving the missing concrete thickness

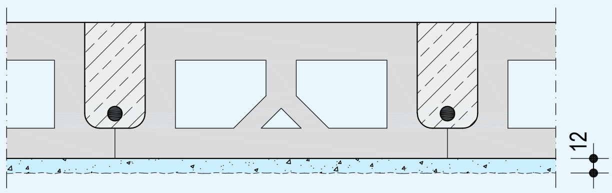
- req. h - exist. h = 165 mm - 140 mm = **25 mm**
- req. a - exist. a = 20 mm - 10 mm = **10 mm**

Decisive missing concrete cover = 25 mm

Step 4

Deriving the min. layer thickness for MP 75 Fire

- Diagram 3 (see page 9): **e = 12 mm**



Field of application

MP 75 Fire can be used directly on vaulted ceilings and without plaster bases. The plaster can be applied fully or only partially in the area of the underflange.
The specifications of the Expert Opinion BB-23-325-2 or DIN 4102-4:1994-03, section 3.11.3 apply.

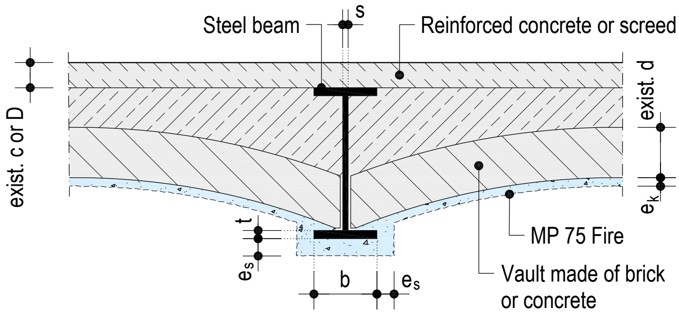
Rating of the application thickness on steel

- Determination of the A_m/V value of the steel beam section to be protected:
  - Steel area exposed to flame (V) = cross-section of the lower flange
  - Circumference (A_m) = circumference of the actual (generally 4-sided) exposed to flame, freely-exposed flange section (see example on the following page)
- Read off the application thickness from the tables (tables 3 to 6) from page 22

Rating of the application thickness above the ceiling sections (vaults)

- The specifications of the minimum thicknesses D and c acc. to DIN 4102-4:1994-03, table 29, lines 1.2 and 1.3, must be observed.
- Determination of the required vault thickness d acc. to DIN 4102-4:1994-03, table 29, line 1.1.
- Rating of the missing vault thickness: $d_{req} - d_{exist}$
- Reinforcement with MP 75 Fire in accordance with the equivalent concrete thicknesses specified for concrete slabs and walls (diagram 1 to 5 from page 8 ff.).

Caution	The steel beam must be covered on 3 sides with the determined application thickness and the transition between steel and vaulted ceiling must be filled out.



b = *beam width*
exist. c = *existing concrete cover over the steel beam*
exist. D = *existing screed thickness*
exist. d = *existing vault thickness*
s = *web thickness*
t = *flange thickness*
e_k = *application thickness MP 75 Fire over the vault*
e_s = *application thickness MP 75 Fire over the steel*

plus

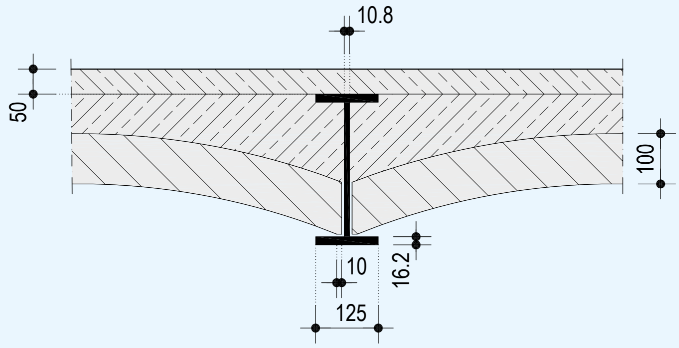
Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2

- Prior consultation is recommended acc. to note on page 5

Rating example

Prussian vaulted ceiling with I 300 beam, brick masonry and concrete layer

Required fire resistance class:	**REI 120**
Critical steel temperature:	**500 °C**
Beam width b:	**125 mm**
Web thickness s:	**10.8 mm**
Flange thickness t:	**16.2 mm**
Exposed steel top (flange)	**10 mm**
Vault thickness d:	**100 mm**
Concrete layer c:	**50 mm**
Thickness e_s:	**?? mm**
Thickness e_k:	**?? mm**



Step 1

Checking of the prerequisites acc. to DIN 4102-4:1994-03, table 29, lines 1.2 and 1.3

- No screed required, as exist. c = 50 mm ≥ 45 mm

Step 2

Calculation of the application thickness above the ceiling sections (vaults)

- Determination of the required vault thickness d acc. to DIN 4102-4:1994-03, table 29, line 1.1 d_{req} = 120 mm
- Determination of the missing vault thickness: $d_{req} - d_{exist}$ = 120 mm - 100 mm = 20 mm
- Determination of the required application thickness (see diagram 4 on page 9) **e_k = 12 mm**

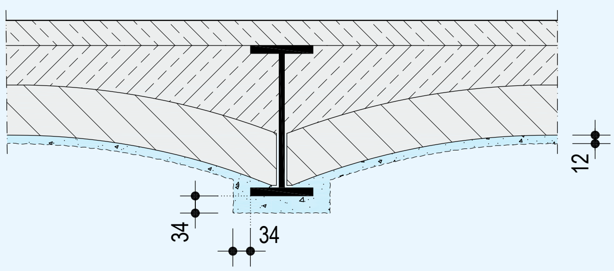
Step 3

Calculation of the application thickness above the steel beam sections

- A_m/V value calculation
  - $A_m = b + 2t + 2 \cdot 10$ = 125 mm + 2 · 16.2 mm + 2 · 10 mm = 177.4 mm = 17.74 cm
  - $V = b \cdot t$ = 125 mm · 16.2 mm = 2025 mm² = 20.25 cm²
  - A_m/V = (17.74 cm / 20.25 cm²) · 100 ~ 90 m⁻¹
- Determination of application thickness at R120, 500 °C (see table 6 on page 25) **e_s = 34 mm**

Step 4

Definition of application thickness execution



Field of application

MP 75 Fire can be used directly on hollow clay element ceilings and without plaster bases. The plaster can be applied fully or only partially in the area of the underflange.
The specifications of the Expert Opinion BB-23-325-2 or DIN 4102-4:1994-03, section 3.11.3 apply.

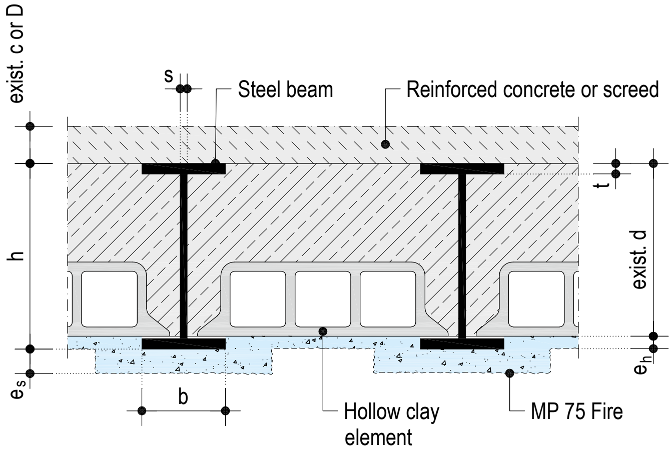
Rating of the application thickness on steel

- Determination of the A_m/V value of the steel beam section to be protected:
  - Steel area exposed to flame (V) = cross-section of the lower flange
  - Circumference (A_m) = circumference of the actual (generally 3-sided) exposed to flame, freely-exposed flange section (see example on the following page)
- Read off the application thickness from the tables (tables 3 to 6) from page 22

Rating of the application thickness above the ceiling sections (hollow clay elements)

- The specifications of the minimum thicknesses D and c acc. to DIN 4102-4:1994-03, table 29, lines 1.2 and 1.3, must be observed.
- Calculation of the effective fire protection cover thickness t: $t = A_{Net}/b$
- Determination of the required min. thickness d acc. to DIN 4102-4:1994-03, table 29, line 1.1.
- Rating of the missing vault thickness: $d_{req} - d_{exist}$
- Reinforcement with MP 75 Fire in accordance with the equivalent concrete thicknesses specified for concrete slabs and walls (diagram 1 to 5 from page 8 ff.).

Caution	The steel beam must have a lateral overlap of at least 50 mm covered by the determined application thickness.



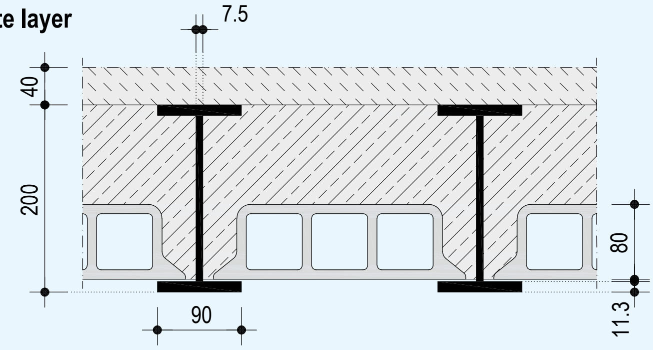
A_{Net}	*= net cross-section area*
b	*= beam width*
exist. c	*= existing concrete cover over the steel beam*
exist. D	*= existing screed thickness*
exist. d	*= existing fire protection cover thickness*
h	*= beam height*
s	*= web thickness*
t	*= flange thickness*
e_s	*= application thickness MP 75 Fire over the steel*
e_h	*= application thickness MP 75 Fire over the hollow clay element*

plus **Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2**
- Prior consultation is recommended acc. to note on page 5

Rating example

Hollow clay element normal ceiling with I-300 beams with concrete layer

Required fire resistance class:	**R 90**
Critical steel temperature:	**500 °C**
Beam height h:	**200 mm**
Beam width b:	**90 mm**
Web thickness s:	**7.5 mm**
Flange thickness t:	**11.3 mm**
Concrete cover c:	**40 mm**
Cover thickness d:	**80 mm**
Total profile cross-section V:	**33.4 cm²**
Thickness e_s:	**?? mm**
Thickness e_h:	**?? mm**



Step 1

Checking of the prerequisites acc. to DIN 4102-4:1994-03, table 29, lines 1.2 and 1.3

- No screed required, as exist. c = 40 mm ≥ 35 mm

Step 2

Determination of the application thickness above the ceiling sections (hollow clay elements)

- Comparison of the effective fire protection cover thickness t: (= A_{Net}/b) with the specifications acc. to DIN 4102-4:1994-03, table 29, line 1.1.
  - t_{req} = 100 mm
  - t_{exist} = 80 mm
  - t_{req} - t_{exist} = 100 mm - 80 mm = 20 mm
- Determination of the required application thickness (see diagram 3 on page 9) **e_h = 12 mm**

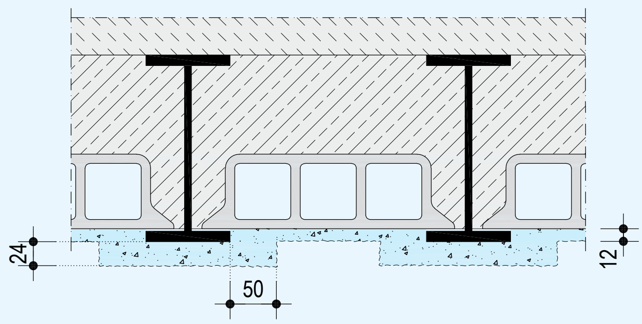
Step 3

Calculation of the application thickness above the steel beam sections

- A_m/V value calculation
  - A_m = b + 2t = 90 mm + 2 · 11.3 mm = 112.6 mm = 11.3 cm
  - V = 33.4 cm²
  - A_m/V = (11.3 cm / 33.4 cm²) · 100 = 33.8 m⁻¹ ≤ 80.0 m⁻¹
- Determination of application thickness at R 90, 500 °C (see table 5 on page 24) **e_s = 24 mm**

Step 4

Definition of application thickness execution



Field of application

MP 75 Fire can be used on arched ceilings or similar concrete ceilings with embedded steel beams.
The specifications of the Expert Opinion BB-23-325-2 or DIN 4102-4:1994-03, section 3.11.2 apply.

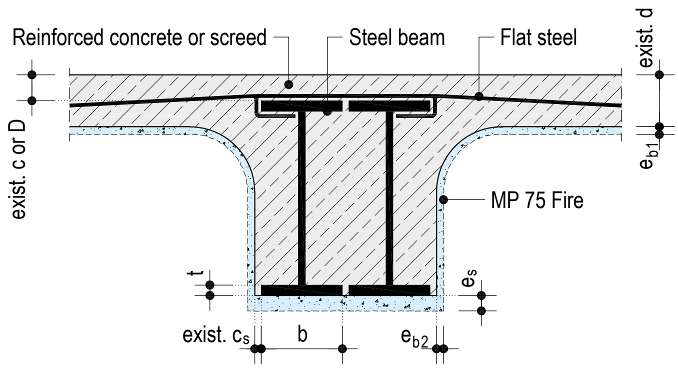
Rating of the application thickness on steel

- Determination of the A_m/V value of the steel beam section to be protected:
  - Steel area exposed to flame (A_m) = cross-section of the lower flange
  - Profile cross-section (V) = circumference of the actual freely-exposed flange section (see example on the following page)
- Read off the application thickness from the tables (tables 3 to 6) from page 22

Rating of the application thickness on concrete

- The specifications of the minimum thicknesses D and c acc. to DIN 4102-4:1994-03, table 29, lines 1.2 and 1.3, must be observed.
- Determination of the required min. thickness d acc. to DIN 4102-4:1994-03, table 29, line 1.1.
- Rating of the missing minimum thickness for the ceiling area: $d_{req} - d_{exist}$
- Reinforcement with MP 75 Fire (e_{b1}) in accordance with the equivalent concrete thicknesses specified for concrete slabs and walls (diagram 1 to 5 from page 8 ff.).
- Determination of the required min. concrete thickness c_s acc. to DIN 4102-4:1994-03, table 29, line 2.1.1.1 or 2.1.2.1.
- Rating of the missing concrete cover laterally on the beam: req. c_s - exist. c_s
- Reinforcement with MP 75 Fire (e_{b2}) in accordance with the equivalent concrete thicknesses specified for concrete supports and beams (diagram 6 to 10 from page 13 ff.).

Caution	Different and diverse requirements and ratings apply for the exposed steel, the concrete cover thickness and the lateral concrete cover of the downstand beams.



b	*= beam width*
exist. c	*= existing concrete cover over the steel beam*
exist. c_s	*= lateral concrete cover over the steel beam*
exist. D	*= screed thickness*
exist. d	*= cover thickness (outside the beam area)*
t	*= flange thickness*
e_{b1}	*= application thickness MP 75 Fire over the concrete*
e_{b2}	*= application thickness MP 75 Fire laterally from the downstand beam*
e_s	*= application thickness MP 75 Fire over the steel*

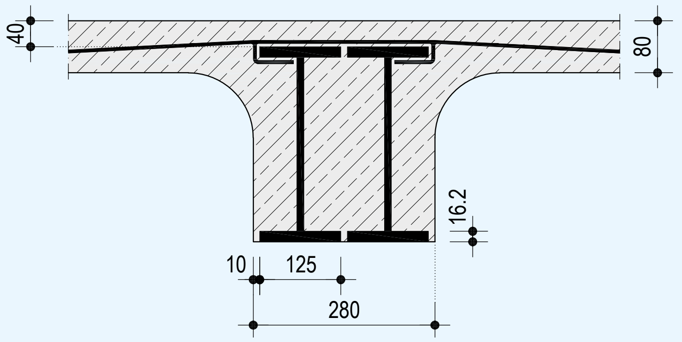
plus **Technical fire resistance assessed acc. to Experts Opinion BB-23-325-1 & -2**

- Prior consultation is recommended acc. to note on page 5

Rating example

Half-dome arched ceiling with I-300 beams

Required fire resistance class:	**REI 90**
Critical steel temperature:	**500 °C**
Beam width b:	**125 mm**
Flange thickness t:	**16.2 mm**
Concrete cover c:	**40 mm**
Cover thickness d:	**80 mm**
Lateral concrete cover on the steel beam c_s:	**10 mm**
Thickness e_s:	**?? mm**
Thickness e_{b1}:	**?? mm**
Thickness e_{b2}:	**?? mm**



Step 1

Checking of the prerequisites acc. to DIN 4102-4:1994-03, table 29, lines 1.2 and 1.3

- No screed required, as exist. c = 40 mm ≥ 35 mm

Step 2

Calculation of the application thickness on the concrete cover

- Comparison of the cover thickness d with the specifications acc. to DIN 4102-4:1994-03, table 29, line 1.1.:
  - t_{req} = 100 mm
  - t_{exist} = 80 mm
  - $t_{req} - t_{exist}$ = 100 mm - 80 mm = 20 mm
- Determination of the required application thickness (see diagram 3 on page 9) **e_{b1} = 12 mm**

Step 3

Determination of the application thickness laterally from the downstand beam

- Comparison of the lateral concrete cover with the specifications acc. to DIN 4102-4:1994-03, table 29, line 2.1.2.1:
  - $c_{s,\,req}$ = 35 mm
  - $c_{s,\,exist}$ = 10 mm
  - $c_{s,\,req} - c_{s,\,exist}$ = 35 mm - 10 mm = 25 mm
- Determination of the required application thickness (see diagram 8 on page 14) **e_{b2} = 11 mm**

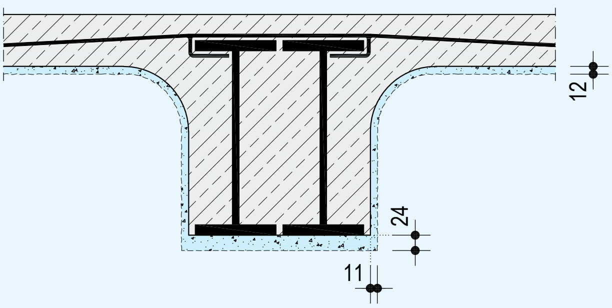
Step 4

Calculation of the application thickness above the steel beam sections

- A_m/V value calculation
  - $A_m = b + 2t = 125\ mm + 2 \cdot 16.2\ mm = 157.4\ mm = 15.74\ cm$
  - $V = b \cdot t = 125\ mm \cdot 16.2\ mm = 2025\ mm^2 = 20.25\ cm^2$
  - $A_m/V = (15.74\ cm / 20.25\ cm^2) \cdot 100 \sim 80\ m^{-1}$
- Determination of application thickness at REI 90, 500 °C (see table 6 on page 25) **e_s = 24 mm**

Step 5

Definition of application thickness execution



Notes on the document

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References to other documents

Product data sheets

- MP 75 Fire P9101_DSP.de

Technical brochures

- Knauf Plaster Competence P10.de

Intended use of Knauf Systems

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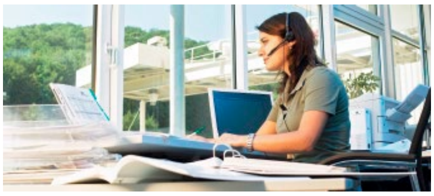

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