



**SPIT injection systems for post-  
installed rebar connections under fire  
conditions**

**Ramset ChemSet™ Reo 502 Xtrem™**

**Ramset ChemSet™ Epcon G5 Xtrem™**

**Fire Evaluation Report  
No. FR25-00057371-39**

05/03/2026 – CSTB/SMP/GABS Alexandre

# **EVALUATION REPORT No. FR25-00057371-39**

on SPIT injection systems  
for post-installed rebar connections under fire conditions

Ramset ChemSet™ Reo 502 Xtrem™  
Ramset ChemSet™ Epcon G5 Xtrem™

according to EAD 330087-02-0601

REQUESTED BY:

**SPIT SAS**

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## 1. Topic

When subjected to fire conditions, construction elements performances are reduced by the effect of the temperature increase. Following the SPIT company request, CSTB has performed a study aiming at evaluating of the fire behaviour of the Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™ injection systems used in conjunction with concrete reinforcing bars ( $\Phi 10$  to  $\Phi 40$  mm). These adhesives are currently covered by the European Technical Assessment ETA-25/0647 dated 2026/02/24.

The present study is aiming at supplying data for the design of the injection anchoring system when exposed to fire. This report presents values of bond capacities and load capacities respectively for an overlap joint application and for an anchorage application using the Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™ adhesives.

### WARNING

This report does not deal with the mechanical design at ambient temperature; neither does it deal with the design according to other accidental solicitations. Design at ambient temperature shall be carried out before fire design.

## 2. References

### 2.1. Laboratories referred to in the Evaluation report

Main Institutes and laboratories referred to in this report:

**CSTB (Centre Scientifique et Technique du Bâtiment)**

84 avenue Jean Jaurès, Champs sur Marne, 77 447 Marne la Vallée, Cedex 2, France

**Politecnico di Milano Laboratory of Material Testing**

Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milano

**SIGGMA SRL**

Via Settala 6, 20124 Milano, Italy

### 2.2. Literature

- [1] **EOTA** – EAD 330087-02-0601, Systems for post-installed rebar connections with mortar, May 2022.
- [2] **EOTA** – European Technical Assessment ETA-25/0647 of 2026/02/24
- [3] **CEN** – EN 1991-1-2. Eurocode 1, Part 1-2: Actions on structures: general actions – actions on the structures exposed to fire. 2002.
- [4] **CEN** – EN 1992-1-1. Eurocode 2, Part 1-1: Design of concrete structures - General rules and rules for buildings. 2005.
- [5] **CEN** – EN 1992-1-2. Eurocode 2, Part 1-2: Design of concrete structures – General rules and structural fire design. 2005.
- [6] **Politecnico di Milano Laboratory of Material Testing** – Test Report No. 2025/2488 Tensile load tests on post-installed rebar connection with resin EPCON C8 subjected to high temperature exposure according to EAD 330087-01-0601, 23/07/2025
- [7] **SIGGMA** – Expert Report 283-2025-R01 for the assessment of Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™

## 3. Author

Marne-la-Vallée, France.

On March 6, 2026,

**Studies and Assessment Engineer, Alexandre GABS**

## 4. Background

### 4.1. Fire design method

Fire design is performed following the three steps detailed below:

- 1) First, an experimental program of pull-out tests at high temperatures (test series 18 according to EAD 330087-02-0601 [1]) is carried out to determine the relationship between bond strength and temperature [2]. This relationship is then expressed by a temperature reduction factor  $0 < k_{fi}(\theta) < 1$  which describes the decrease of resistance of the bond system (see Section 5).
- 2) Secondly, a thermal calculation using the method described in EN 1991-1-2, Section 3 [3] is performed to determine the temperature distribution along the post-installed rebar for each fire duration and for a given structural configuration.

Finally, at each time during the exposure to fire conditions, the values of bond strength are determined along the post-installed rebar. For the anchor application, the bond resistance is calculated by integrating the bond resistances along the embedded depth.

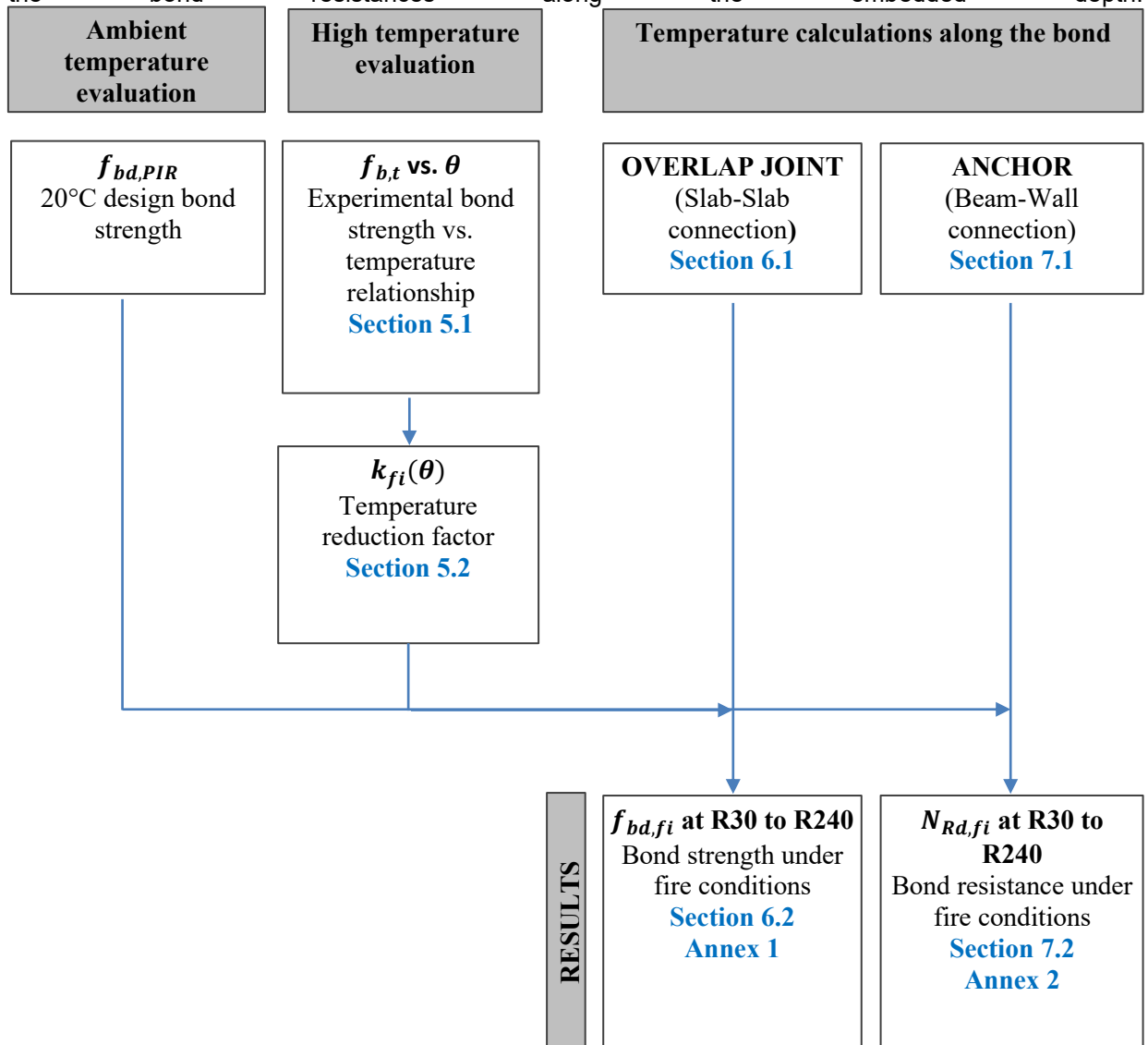


Figure 1 presents the steps of the fire design method and the corresponding sections of the report.

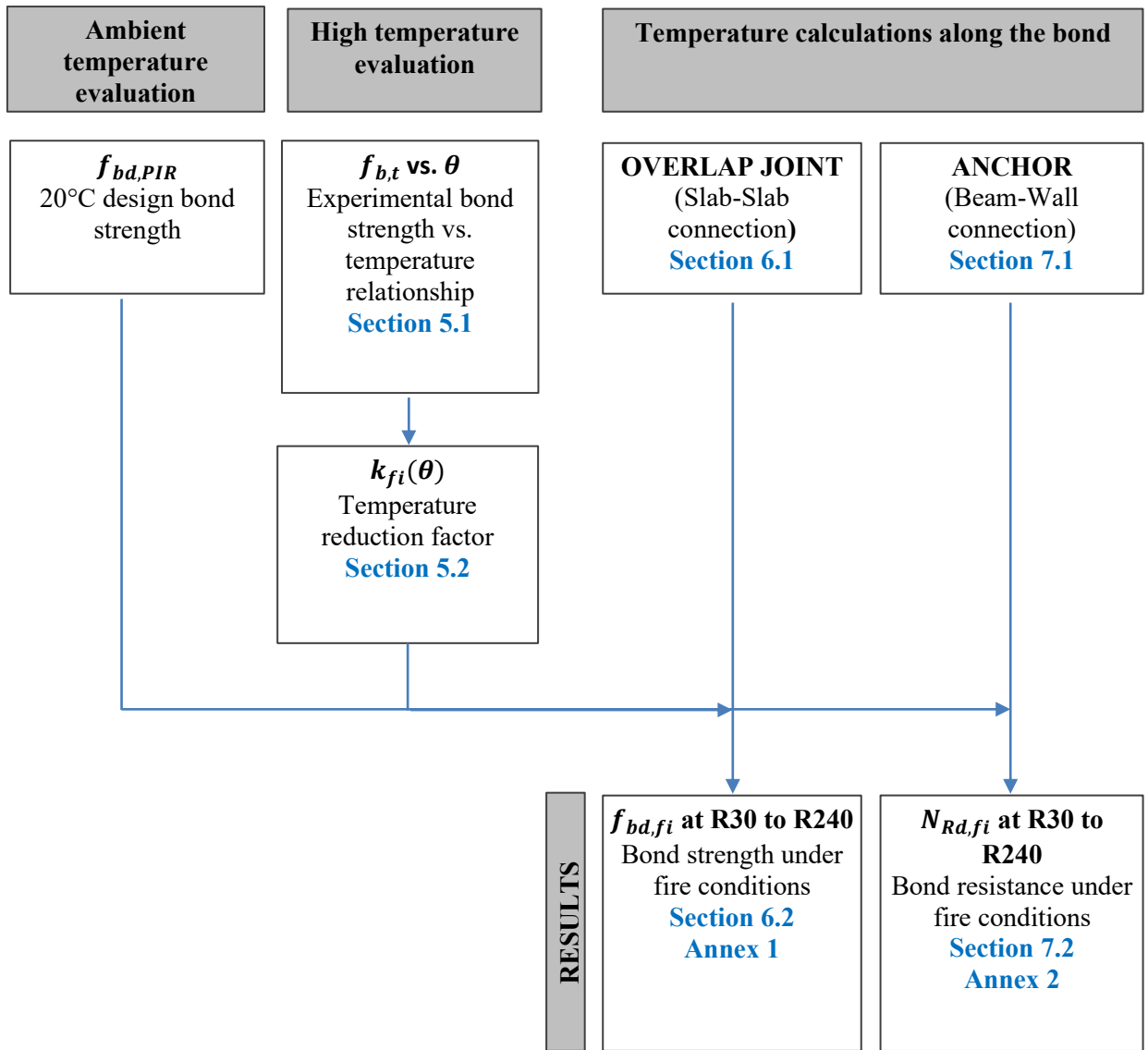
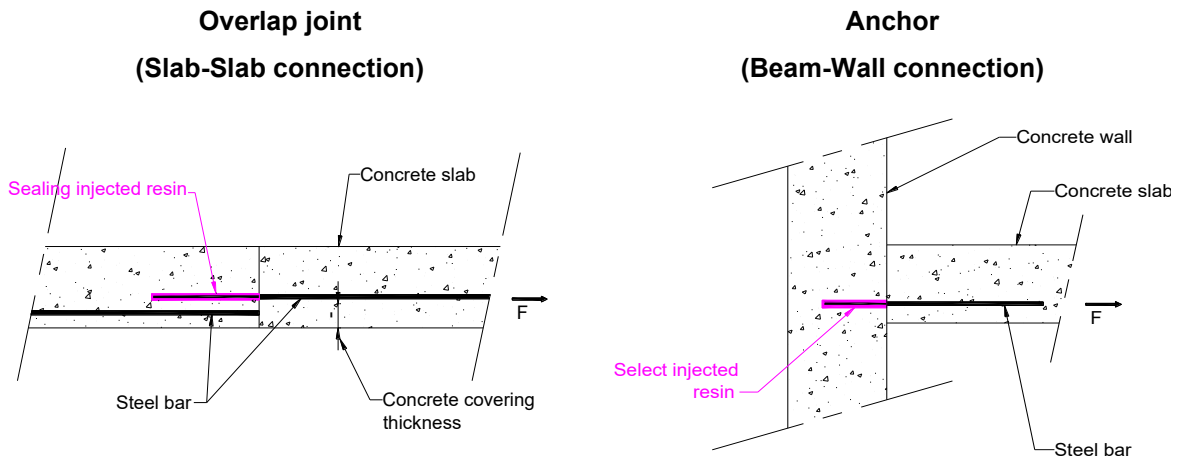


Figure 1: Used method for fire design of post-installed rebars

The design covers two structural uses of post-installed rebars in concrete (Figure 2): i) the overlap joint application and ii) the anchor application.

- i. In the overlap joint application for a slab-slab configuration where the lower surface is exposed to fire conditions, the temperature is uniform. The bond resistance is uniform along the embedment depth and depends on the concrete cover and the duration of the fire (Section 6.2).
- ii. In the anchor application for a beam-wall configuration where at least one side of the wall is exposed to fire, the temperature along the embedment depth (inside the wall) is not uniform. This leads to different bond strength values and the bond resistance of the connection is calculated by integration of the bond resistances along the segments of the rebar (Section 7.2).



**Figure 2: Sketches of a Slab-Slab connection (left) and of a Beam-Wall connection (right)**

## 4.2. Scope of application

The values of bond strength and bond resistance presented in this report are applicable for given parameters: Concrete class, structural configuration, fire duration, bar diameter, bond length, concrete cover and maximum temperatures. The result tables are provided in annexes 1 and 2.

### i. Concrete class

The fire evaluation is applicable for C20/25 concrete. According to the EAD [1], the design bond strength for a cast-in rebar in C20/25 concrete is  $f_{bd,PIR} = 2,30 \text{ N/mm}^2$  for bar diameters between  $\Phi 10$  to  $\Phi 40$  mm.

### ii. Structural configuration

Fire design covers slab-slab and beam-wall configurations for beams with a width higher than 40 cm. The bond strength of the slab-slab configuration **SHALL NOT** be applied to a beam-beam configuration.

### iii. Fire duration

The bond strength and bond resistance values are provided for 30, 60, 90, 120, 180 and 240 min of exposure to standard ISO 834-1 fire conditions. The thermal loading is calculated using the method described in EN 1991-1-2, Section 3 [3].

### iv. Bar diameter

The fire design covers steel rebars with diameters of 10, 12, 16, 20, 25, 28, 32 and 40 mm with a yield strength of  $f_y = 500 \text{ N/mm}^2$ .

### v. Anchorage length

For the slab-slab configuration, the bond strength values are provided. The calculation of the anchorage length shall be carried out in accordance with EN 1992-1-1, Section 8 [4].

For the beam-wall connection, the load capacities are calculated for lengths between the minimum length  $l_{b,min}$  and the maximum anchorage length conditioned by the yielding of steel. The minimum anchorage length  $l_{b,min}$  is calculated in accordance with EN 1992-1-1, Section 8 [4] (see equation below).

$$l_{fi,min} = l_{b,min} = \max(0,3 \cdot l_{b,rqd}; 10 \cdot d; 100 \text{ mm})$$

Where:

$l_{b,rqd}$  is the basic required anchorage length

$$l_{b,rqd} = \frac{d}{4} \cdot \frac{\sigma_{sd}}{f_{bd,PIR}} = \frac{d}{4} \cdot \frac{f_{yk}}{\gamma_s \cdot f_{bd,PIR}}$$

Where:

$f_{yk}$  = 500 N/mm<sup>2</sup> is the characteristic steel yield strength of the rebar

$\gamma_s$  = 1,15 is the partial safety factor for steel

$f_{bd,PIR}$  = 4,3 N/mm<sup>2</sup> is the design bond strength in C50/60 concrete

$d$  = the diameter of the rebar

$$N_{sd} = \frac{f_{yk}}{\gamma_s} \cdot \pi \cdot \left(\frac{d}{2}\right)^2$$

Where:

$f_{yk}$  = 500 N/mm<sup>2</sup> is the characteristic steel yield strength of the rebar

$N_{sd}$  = the design steel strength of the rebar

$\gamma_s$  = 1,15 is the partial safety factor for steel

$d$  = the diameter of the rebar

Table 4-1 presents the minimum anchorage length and steel yield strength values.

Rebar diameter [mm]	10	12	16	20	25	28	32	40
Basic required anchorage length $l_{b,rqd}$ [mm]	253	303	404	506	632	708	809	1011
Minimum anchorage length $l_{b,min}$ [mm]	100	120	160	200	250	280	320	400
Design yield strength of the steel rebar [kN]	34,1	49,2	87,4	136,6	213,4	267,7	349,7	546,4

**Table 4-1: Minimum anchorage length and steel strength**

vi. Concrete cover

Choice of the concrete cover shall be carried out in accordance with EN 1992-1-1, Section 4 [4]. In this evaluation, concrete cover is only considered for the thermal protection it brings to the rebar.

For the slab-slab configuration, bond strength values are provided for different concrete covers starting at 40 mm.

For the beam-wall connection, the concrete cover in the beam influences the temperature distribution along the rebar in the thickness of the wall. The bond resistance values are provided for concrete covers inside the beam of 20, 30 and 40 mm. Results are only provided for concrete covers larger than the diameter of the bar in accordance with EN 1992-1-1, Section 4 [4].

vii. Maximum temperatures

In accordance with EN 1992-1-2, Section 5 [5], steel resistance remains constant between 20°C and 350°C for bar laminated at high temperature. Therefore, resistances are only considered along the parts of the bond below 350°C. Furthermore, the resistance is considered equal to zero above the temperature  $\theta_{max}$  (described in Section 5.1) linked to the adhesive behavior.

## 5. Bond strength vs. temperature relationship

### 5.1. Experimental bond strength

A pull-out test campaign was carried out at high temperature on a minimum of 20 samples using rebars with a diameter of 12 mm and an embedment depth of 120 mm (test series 18 according to EAD 330087-01-0601 [1]). The test procedure and results of this campaign are described in the test report [6].

For the Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™ injection systems, the  $a$ ,  $b$  and  $\theta_{max}$  parameters are presented in Evaluation Report [7] and reported in the Table below:

Trend curve	Equation	$a$	$b$
Power trend	$f_{bm}(\theta) = a \cdot \theta^{-b}$	1813,936	-1,34963

**Table 5-1: Power trend curve parameters**

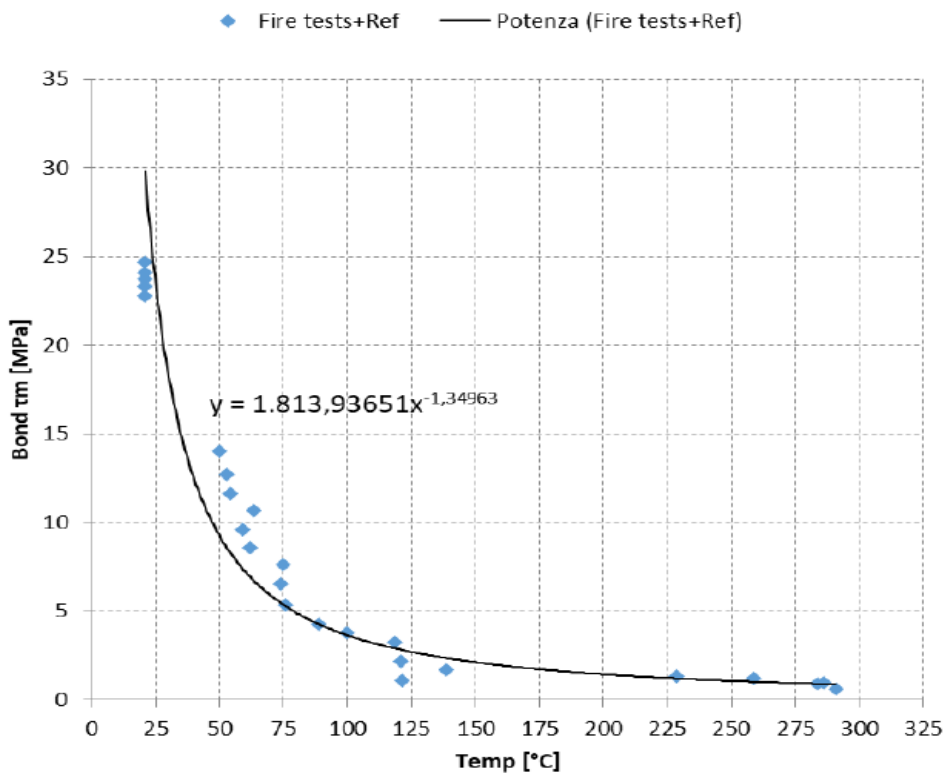
Where:

$f_{bm}(\theta)$  is the mean bond strength at the temperature  $\theta$  (in N/mm<sup>2</sup>)

$\theta$  is the temperature of the bond

$a$  and  $b$  are the fitting function constants

The maximum temperature reached during the tests is identified as  $\theta_{max}$ .



**Figure 3: Bond strength vs. temperature relationship [7]**

For the Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™ **Erreur ! Source du renvoi introuvable.** injection systems, the  $a$ ,  $b$  and  $\theta_{max}$  parameters are presented in the following Table 5.3.

$f_{bm}(\theta)$ parameters	
$a$	1813,936
$b$	-1,34963
$\theta_{max}$	250,6°C

**Table 5-2: Parameters of the mean bond strength vs. temperature curve**

## 5.2. Temperature reduction factor

The temperature reduction factor  $k_{fi}(\theta)$  is determined from the fitted curve  $f_{bm}(\theta)$  to describe the variation of bond strength with temperature. It is calculated using the following equations.

$$k_{fi}(\theta) = \frac{f_{bm}(\theta)}{f_{bm,rqd}} \leq 1 \text{ for } 20^\circ\text{C} \leq \theta \leq \theta_{max}$$

$$k_{fi}(\theta) = 0 \text{ for } \theta > \theta_{max}$$

Where:

$k_{fi}(\theta)$  = temperature reduction factor

$f_{bm}(\theta)$  = the mean bond strength at the temperature  $\theta$

$f_{bm,rqd}$  =  $\min\{10 \text{ N/mm}^2; f_{bm}(\theta)\}$  is the required bond strength at normal ambient temperature

$\theta$  = the temperature of the bond

$\theta_{max}$  = maximum temperature measured during the tests

Figure 4 presents the variation of the temperature reduction factor vs. temperature for the Ramset ChemSet™ Reo 502 Xtrem™ and Ramset ChemSet™ Epcon G5 Xtrem™ **Erreur ! Source du renvoi introuvable.** injection systems taken from European Technical Assessment ETA-25/0647 of 2026/02/24.

No extrapolation beyond test temperatures is allowed. For temperatures higher than the maximum measured temperature during the tests ( $\theta_{max}$ ), the reduction factor  $k_{fi}(\theta)$  is equal to zero.

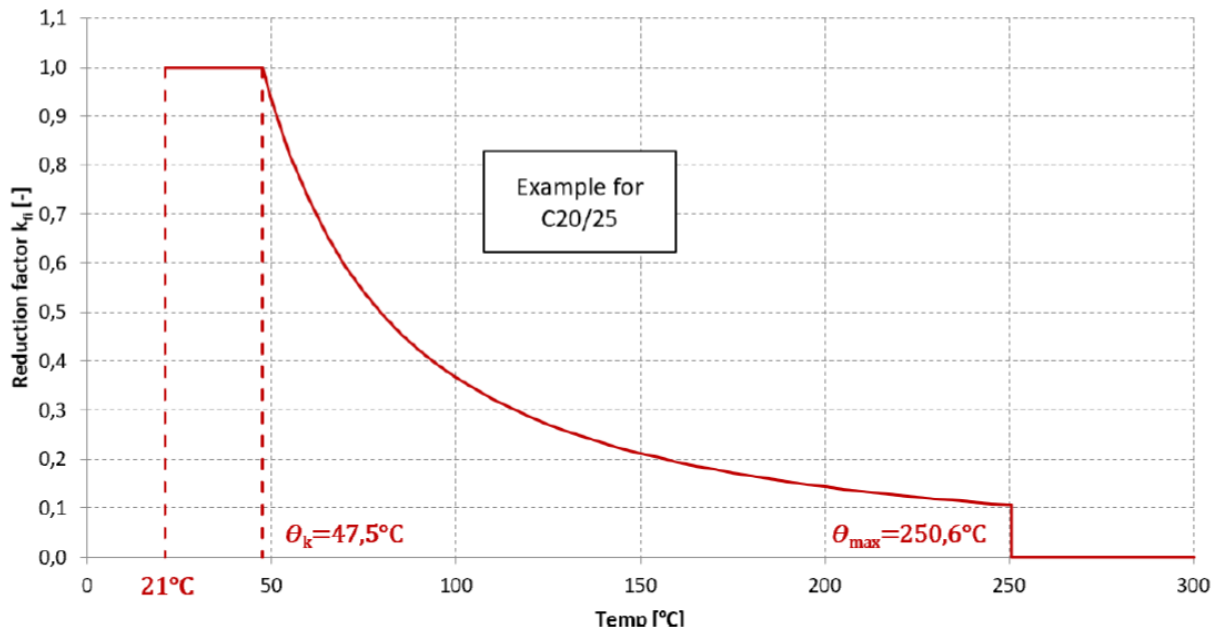


Figure 4: Temperature reduction factor  $k_{fi}(\theta)$  vs. temperature  $\theta$  [2]

## 6. Overlap joint application

### 6.1. Temperature fields

The knowledge of the fire behaviour of traditional concrete structures to assess the temperature distribution for every fire duration by modeling the thermal exchanges inside concrete elements. The temperature profile depends on the configuration of the connection: slab-slab or beam-wall. These temperatures are calculated using the finite element method in accordance with EN 1991-1-2, Section 3 [3] with the CAST3M software.

At the initial time ( $t=0$ ) every element temperature is supposed equal to 20°C.

The fire is modeled by a heat flux on the boundaries of the structure. The standard temperature-time curve is used for the temperature analysis at the fire exposed surfaces (EN 1991-1-2, Section 3 [3]).

$$\theta_g = 20 + 345 \log_{10}(8t + 1)$$

Where:

$\theta_g$  is the gas temperature in the fire compartment  
 $t$  is the time (min)

On the boundaries, the net heat flux  $\dot{h}_{net}$  should be determined by considering heat transfer by convection and radiation as:

$$\dot{h}_{net} = \dot{h}_{net,c} + \dot{h}_{net,r} \quad (\text{W/m}^2),$$

Where:

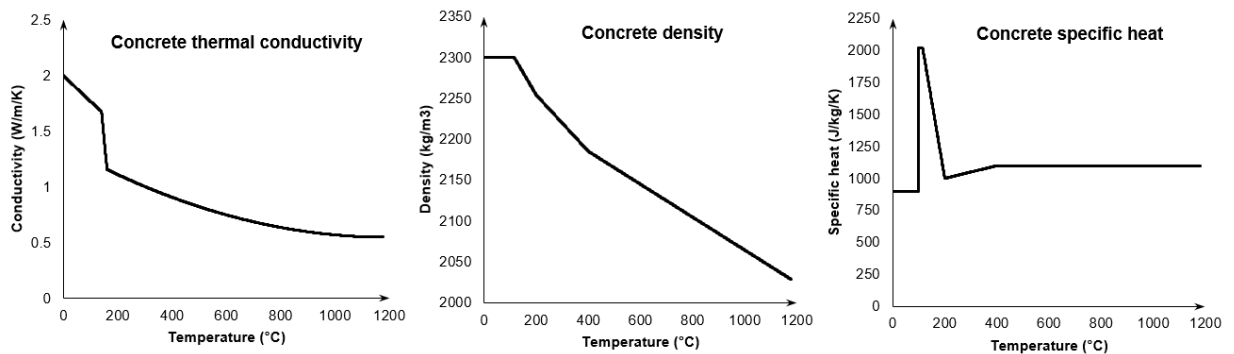
$$\text{convective heat flux: } \dot{h}_{net,c} = \alpha_c \cdot (\theta_g - \theta_m) \quad (\text{W/m}^2),$$

$$\text{radiative heat flux: } \dot{h}_{net,r} = \phi \cdot \varepsilon_m \cdot \varepsilon_f \cdot \sigma \cdot (\theta_r^4 - \theta_m^4) \quad (\text{W/m}^2).$$

Where:

$\phi$  is the configuration factor (= 1,0)  
 $\varepsilon_m$  is the emissivity of the concrete member (= 0,7)  
 $\varepsilon_f$  is the emissivity of the fire (= 1,0)  
 $\sigma$  is the Stefan Boltzmann constant (=  $5,67 \cdot 10^{-8} \text{ W/m}^2\text{K}^4$ )  
 $\theta_s$  is the surface temperature of the member (°C)  
 $\theta_r$  is the effective radiation temperature of the fire (°C)  
 $\alpha_c$  is the coefficient of heat transfer by convection (= 25 W/m<sup>2</sup>K for the fire exposed surfaces; = 4 for the unexposed surfaces)

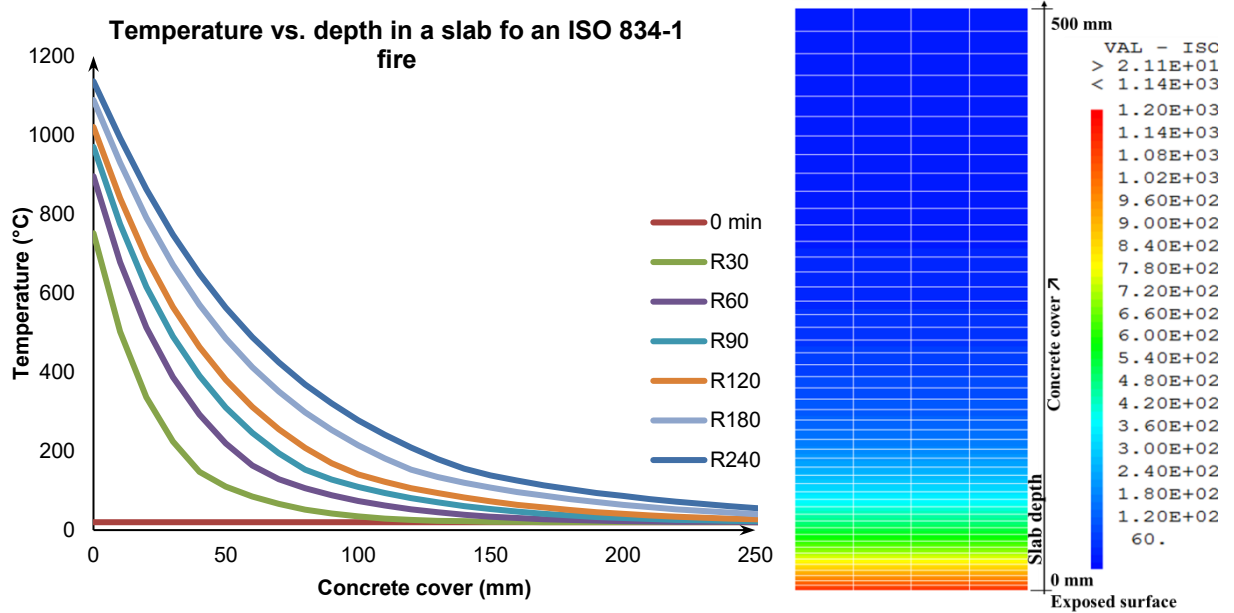
In this study, only concrete is considered in the thermal calculation (EN 1992-1-2, Section 4 [5]). The concrete thermal properties are provided by EN 1992-1-2, Section 3 [5]. The variations of thermal conductivity, mass density and specific heat are represented in Figure 5. The peak of the specific heat corresponds to a concrete having a water percentage of 1,5% in accordance with EN 1992-1-2, Annex A [5].



**Figure 5: Variations of thermal conductivity, density and specific heat of concrete according to EN 1992-1-2 [5]**

For a slab-slab connection (Figure 2), the thermal calculation is carried out on a two-dimensional mesh by applying the fire heat flux as boundary condition on the lower surface. No boundary condition at 20°C is applied on the upper surface to be conservative.

The isotherms are horizontal implying that the temperature is uniform along the bonding interface and equal to the temperature in a slab at a depth equivalent to the concrete cover. Figure 6 presents the temperature versus concrete cover at 0, 30, 60, 90, 120, 180 and 240 min during an ISO 834-1 fire. The same temperature curves are provided in EN 1992-1-2, Annex A [5].



**Figure 6: Temperature vs. concrete cover temperature at 0, 30, 60, 90, 120, 180 and 240 min during an ISO 834-1 fire**

## 6.2. Design bond strength

From the temperature curves (Section 6.1, Figure 6) and the temperature reduction factor  $k_{fi}(\theta)$  (Section 5.2), the values of the design bond strength  $f_{bd,fi}$  are determined using the following equation.

$$f_{bd,fi}(\theta) = k_{fi}(\theta) \cdot f_{bd,PIR} \cdot \gamma_c / \gamma_{M,fi}$$

Where:

$f_{bd,fi}(\theta)$	is the design bond strength that depends on temperature
$f_{bd,PIR}$	= 2,3 for C20/25 concrete is the design bond strength at 20°C
$\gamma_{M,fi}$	= 1,0 is the partial safety factor for concrete in fire design
$\gamma_c$	= 1,5 is the partial safety factor for concrete at ultimate state for persistent & transient design situations
$k_{fi}(\theta)$	is the temperature reduction factor

Annex 1 presents values of the design bond strength for different concrete covers at 30, 60, 90, 120, 180 and 240 min during an ISO 834-1 fire.

The partial safety factor for concrete in fire design is equal to 1.0 according to EN 1992-1-2, Section 2 [5], while the partial safety factor for concrete at ultimate state for persistent & transient design situations is equal to 1.5. This leads to obtaining higher values of bond resistances at the beginning of a fire in fire design in comparison to ambient temperature design for the same rebar geometry. Design at ambient temperature shall be carried out before fire design.

## 7. Anchor application (beam-wall connection)

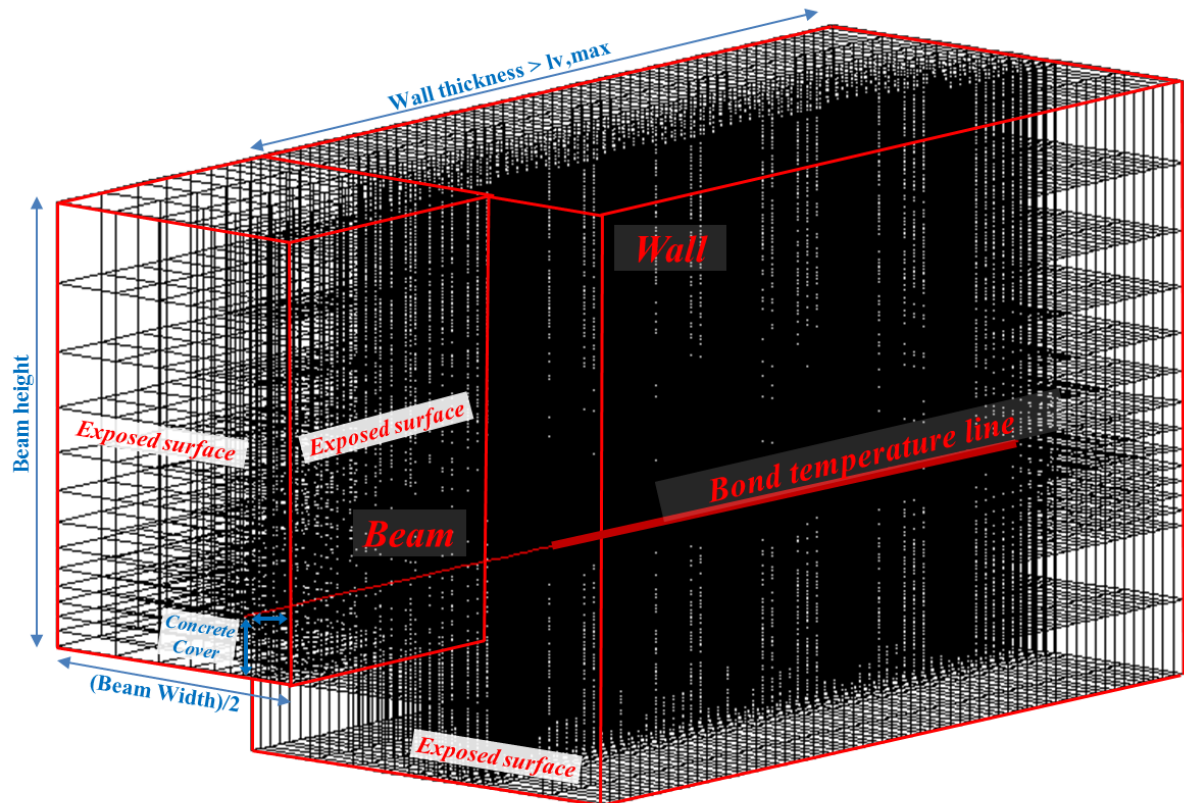
### 7.1. Temperature fields

For a beam-wall connection (Figure 2) where the post-installed rebar is installed inside the wall, where temperature gradient exists along the thickness of the wall. The temperature along the embedment depth is not uniform and depends on the fire duration. Therefore, the temperature profiles along the embedment depth are determined for each fire duration, for each embedment length and for the concrete cover inside the beam of 10, 20, 30 and 40 mm.

A three-dimensional mesh was used. Due to symmetry considerations only half of the structure is meshed (Figure 7). The same calculation parameters (material thermal and physical properties, standard temperature-time curve, convective and radiative heat fluxes) as the ones described in Section 6.1 are applied.

The boundary conditions are:

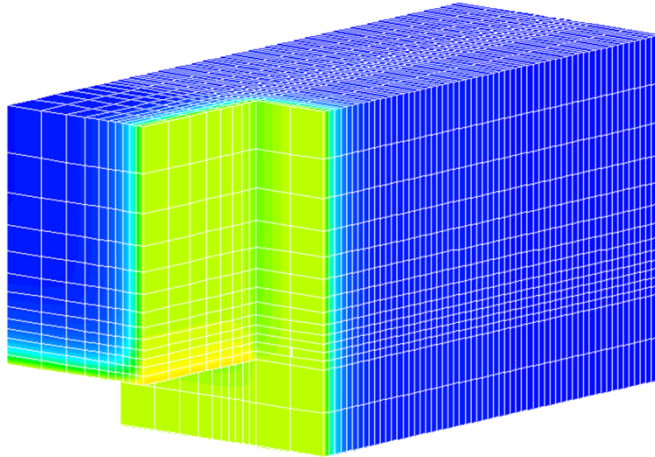
- On the lower and lateral sides of the beam: convection and radiation of the ISO 834-1 fire are applied to the elements.
- On the side of the wall where the beam is connected: convection and radiation of the ISO 834-1 fire are applied to the elements.
- No heat exchange condition is applied on the other sides (adiabatic surfaces).



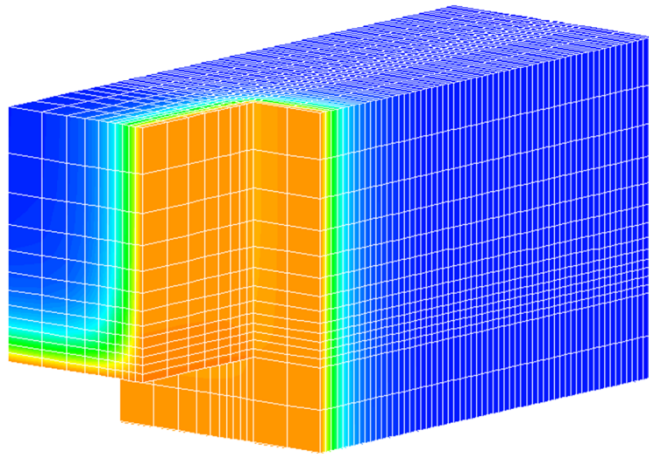
**Figure 7: Used mesh for thermal calculations for the beam-wall connection**

Figure 8 presents the calculated thermal fields at 30, 90 and 240 min. The geometry of the mesh of the beam used for calculations is taken large enough so that the isotherms at 240 min of heating are parallel to the concrete surfaces (Figure 8). This implies that the same temperature profiles along the embedment depth of the post-installed rebar would be obtained for larger and higher beams. The beam height was equal to 300 mm and the beam width was equal to 400 mm.

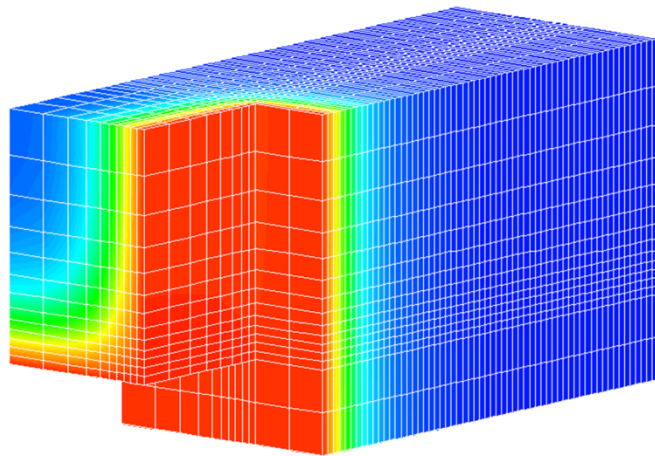
**30 min**



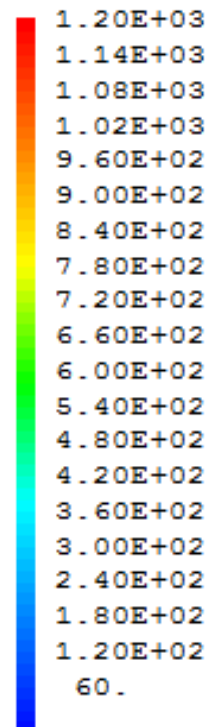
**90 min**



**240 min**



**Temperature scale**



**Figure 8: Temperature fields at 30, 90 and 240 min during an ISO 834-1 fire for the beam-wall connection**

## 7.2. Design bond resistances

From the calculated temperature profiles and from the temperature reduction factor  $k_{fi}(\theta)$  (Section 5.2), the values of design load capacities  $N_{Rd,fire}$  are determined by integration of the design bond resistances.

$$N_{Rd,fi} = \pi \cdot d \cdot \int_0^{l_v} f_{bd,fi}(\theta(x)) \cdot dx = \pi \cdot d \cdot f_{bd,PIR} \cdot \frac{\gamma_c}{\gamma_{M,fi}} \cdot \int_0^{l_v} k_{fi}(\theta(x)) \cdot dx$$

Where:

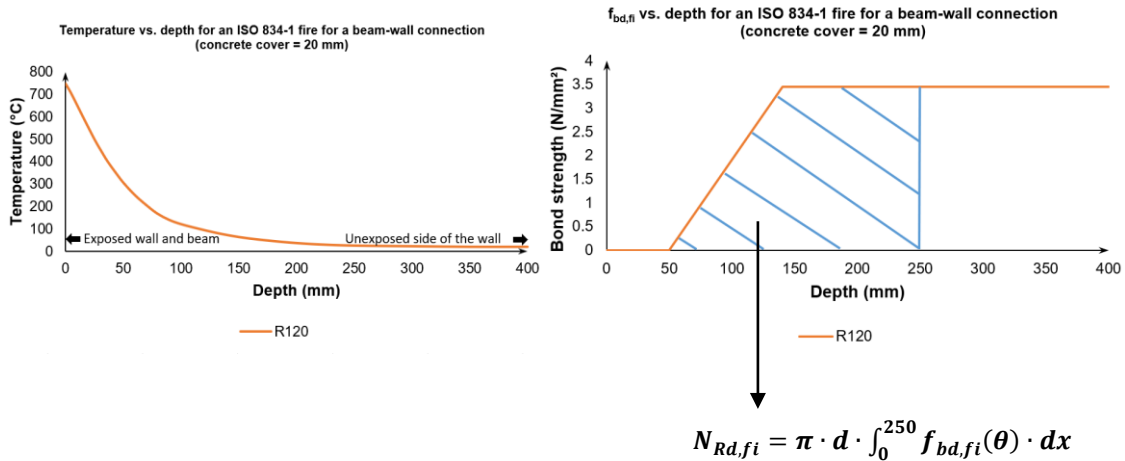
$N_{Rd,fi}$	is the design bond resistance at a given time during the fire
$f_{bd,PIR}$	= 2,3 for C20/25 concrete is the design bond strength at 20°C
$\gamma_{M,fi}$	= 1,0 is the partial safety factor for concrete in fire design
$\gamma_c$	= 1,5 is the partial safety factor for concrete at ultimate state for persistent & transient design situations
$k_{fi}(\theta)$	is the temperature reduction factor
$l_v$	is the embedment depth of the post-installed rebar

The integration is performed by finite differences using the following equation.

$$N_{Rd,fi} \approx \pi \cdot d \cdot f_{bd,PIR} \cdot \frac{\gamma_c}{\gamma_{M,fi}} \cdot \sum_0^{l_v} k_{fi}(\theta_i) \cdot \Delta x$$

For the calculation, the value of  $\Delta x$  was taken equal to 10 mm and the maximum temperature reduction factor  $k_{fi}(\theta_i)$  on the length of  $\Delta x$  was taken into account.

Figure 9 presents a general example of the calculation of the design bond resistance by integration of  $f_{bd,fi}(\theta)$  on a bond length of 250 mm by using the temperature profile along the bond at 120 min during an ISO 834-1 fire with a concrete cover of 20 mm in the beam.



**Figure 9: General example of the calculation of the design bond resistance by integration of  $f_{bd,fi}$**

Annexes 2.1, 2.2, 2.3 and 2.4 present the values of  $N_{Rd,fi}$  at different fire durations for different bond lengths respectively for concrete covers of 20 mm, 30 mm and 40 mm. The minimal and maximum values of bond lengths are in accordance with Section 4.2.

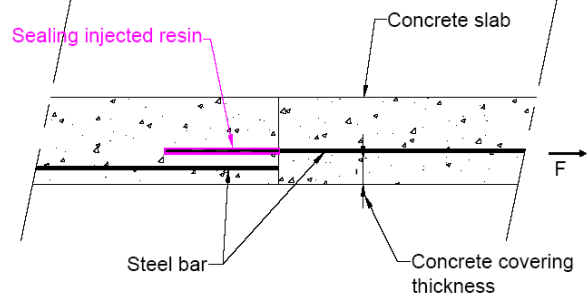
## 8. List of annexes

- Annex 1:** Design bond strength for an overlap joint application (slab-slab connection)
- Annex 2.1:** Design bond resistances for an anchoring application (beam-wall connection) with a concrete cover of 20 mm for diameters 10, 12, 16 and 20 mm
- Annex 2.2:** Design bond resistances for an anchoring application (beam-wall connection) with a concrete cover of 30 mm for diameters 25 and 28 mm
- Annex 2.3:** Design bond resistances for an anchoring application (beam-wall connection) with a concrete cover of 40 mm for diameters 10, 12, 16, 20, 25, 28, 32 and 40 mm

## Annex 1: Maximum applicable bond strength for an overlap joint application

The table presents design bond strength ( $f_{bd}$ ) for a **Slab-Slab connection** using **C20/25 concrete** and rebars with a yield strength  $f_y = 500 \text{ N/mm}^2$  in an **ISO 834-1 fire** (at 30, 60, 90, 120, 180 and 240 min) for concrete covers between 30 and 280 mm.

The bond strength values shall not be applied for beam-beam connections. Post-installed rebars shall be designed in ambient temperature conditions before being designed in fire conditions.



Fire Design Bond Strength $f_{bd,fi}$ (N/mm <sup>2</sup> )						
Concrete Cover (mm)	R30	R60	R90	R120	R180	R240
20						
30	0,43					
40	0,75					
50	1,11	0,44				
60	1,58	0,65	0,37			
70	2,22	0,90	0,51			
80	3,06	1,17	0,71	0,47		
90	3,45 <sup>1)</sup>	1,49	0,90	0,62		
100		1,90	1,12	0,80	0,45	
110		2,40	1,37	0,97	0,57	0,39
120		3,01	1,67	1,16	0,71	0,47
130		3,45 <sup>1)</sup>	2,04	1,38	0,85	0,57
140			2,46	1,64	0,99	0,70
150			2,96	1,94	1,15	0,81
160			3,45 <sup>1)</sup>	2,29	1,33	0,93
170				2,70	1,53	1,07
180				3,15	1,75	1,21
190				3,45 <sup>1)</sup>	2,01	1,37
200					2,30	1,54
210					2,63	1,74
220					2,99	1,96
230					3,38	2,21
240					3,45 <sup>1)</sup>	2,48
250						2,78
260						3,10
270						3,45
280						3,45 <sup>1)</sup>

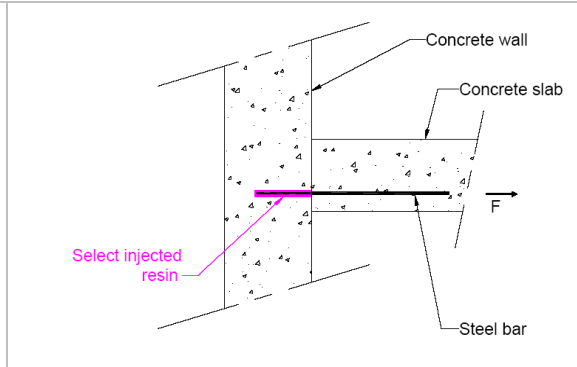
<sup>1)</sup>  $f_{bd,fire}$  remains constant at this value for larger concrete covers

The present table aims to supply data for fire design of the post-installed rebar product. This study does not deal with design at normal ambient temperature, neither does it deal with design according to other accidental actions.

**Annex 2.1: Maximum applicable loads for an anchoring application (beam-wall connection) with a concrete cover of 20 mm for diameters 10, 12, 16 and 20 mm**

The table presents design bond resistances ( $N_{Rd,fi}$ ) for a **Beam-Wall connection** using **C20/25 concrete** and rebars with a yield strength  $f_y = 500 \text{ N/mm}^2$  in an **ISO 834-1 fire** (at 30, 60, 90, 120, 180 and 240 min) for a **concrete cover of 20 mm** and for rebar diameters 10, 12, 16 and 20 mm.

The design load values may be used safely for a slab-wall connection. Post-installed rebars shall be designed in ambient temperature conditions before being designed in fire conditions.



Concrete Cover = 20 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_p$ (mm)	R30	R60	R90	R120	R180	R240
10	100	6,0	2,8	1,6	0,9	0,5	0,1
	110	7,11	3,70	2,10	1,28	0,68	0,28
	120	8,20	4,78	2,74	1,72	0,96	0,47
	130	9,28	5,86	3,51	2,24	1,28	0,71
	140	10,37	6,95	4,44	2,86	1,65	0,97
	150	11,45	8,03	5,52	3,59	2,08	1,28
	160	12,53	9,12	6,61	4,44	2,57	1,63
	170	13,62	10,20	7,69	5,44	3,14	2,03
	180	14,70	11,28	8,78	6,53	3,79	2,47
	190	15,79	12,37	9,86	7,61	4,54	2,98
	200	16,87	13,45	10,94	8,70	5,38	3,55
	210	17,95	14,53	12,03	9,78	6,35	4,20
	220	19,04	15,62	13,11	10,86	7,43	4,92
	230	20,12	16,70	14,19	11,95	8,52	5,74
	240	21,20	17,79	15,28	13,03	9,60	6,65
	250	22,29	18,87	16,36	14,12	10,69	7,66
	260	23,37	19,95	17,45	15,20	11,77	8,75
	270	24,46	21,04	18,53	16,28	12,85	9,83
	280	25,54	22,12	19,61	17,37	13,94	10,91
	290	26,62	23,21	20,70	18,45	15,02	12,00
	300	27,71	24,29	21,78	19,53	16,11	13,08
	310	28,79	25,37	22,87	20,62	17,19	14,16
	320	29,88	26,46	23,95	21,70	18,27	15,25
	330	30,96	27,54	25,03	22,79	19,36	16,33
	340	32,04	28,62	26,12	23,87	20,44	17,42
	350	33,13	29,71	27,20	24,95	21,52	18,50
	360	34,15 <sup>1)</sup>	30,79	28,28	26,04	22,61	19,58
	370		31,88	29,37	27,12	23,69	20,67
	380		32,96	30,45	28,21	24,78	21,75
	390		34,04	31,54	29,29	25,86	22,84
400		34,15 <sup>1)</sup>	32,62	30,37	26,94	23,92	
410			33,70	31,46	28,03	25,00	
420			34,15 <sup>1)</sup>	32,54	29,11	26,09	
430				33,62	30,20	27,17	
440				34,15 <sup>1)</sup>	31,28	28,25	
450					32,36	29,34	
460					33,45	30,42	
470					34,15 <sup>1)</sup>	31,51	
480						32,59	
490						33,67	
500						34,15 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this length  $l_p$ .

The table continues on the next page.

Concrete Cover = 20 mm		Fire Design Bond Resistance $N_{Rd,ft}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
12	120	9,84	5,74	3,29	2,07	1,15	0,57
	130	11,14	7,04	4,22	2,69	1,53	0,85
	140	12,44	8,34	5,33	3,43	1,98	1,17
	150	13,74	9,64	6,63	4,31	2,50	1,53
	160	15,04	10,94	7,93	5,33	3,09	1,95
	170	16,34	12,24	9,23	6,53	3,77	2,43
	180	17,64	13,54	10,53	7,83	4,55	2,97
	190	18,94	14,84	11,83	9,13	5,44	3,58
	200	20,24	16,14	13,13	10,43	6,46	4,26
	210	21,54	17,44	14,43	11,74	7,62	5,04
	220	22,84	18,74	15,73	13,04	8,92	5,91
	230	24,14	20,04	17,03	14,34	10,22	6,88
	240	25,45	21,34	18,33	15,64	11,52	7,98
	250	26,75	22,64	19,64	16,94	12,82	9,19
	260	28,05	23,94	20,94	18,24	14,12	10,49
	270	29,35	25,25	22,24	19,54	15,42	11,80
	280	30,65	26,55	23,54	20,84	16,72	13,10
	290	31,95	27,85	24,84	22,14	18,03	14,40
	300	33,25	29,15	26,14	23,44	19,33	15,70
	310	34,55	30,45	27,44	24,74	20,63	17,00
	320	35,85	31,75	28,74	26,04	21,93	18,30
	330	37,15	33,05	30,04	27,34	23,23	19,60
	340	38,45	34,35	31,34	28,64	24,53	20,90
	350	39,75	35,65	32,64	29,94	25,83	22,20
	360	41,05	36,95	33,94	31,24	27,13	23,50
	370	42,35	38,25	35,24	32,55	28,43	24,80
	380	43,65	39,55	36,54	33,85	29,73	26,10
	390	44,95	40,85	37,84	35,15	31,03	27,40
	400	46,26	42,15	39,14	36,45	32,33	28,70
	410	47,56	43,45	40,44	37,75	33,63	30,00
	420	48,86	44,75	41,75	39,05	34,93	31,30
	430	49,17 <sup>1)</sup>	46,06	43,05	40,35	36,23	32,61
440		47,36	44,35	41,65	37,53	33,91	
450		48,66	45,65	42,95	38,84	35,21	
460		49,17 <sup>1)</sup>	46,95	44,25	40,14	36,51	
470			48,25	45,55	41,44	37,81	
480			49,17 <sup>1)</sup>	46,85	42,74	39,11	
490				48,15	44,04	40,41	
500				49,17 <sup>1)</sup>	45,34	41,71	
510					46,64	43,01	
520					47,94	44,31	
530					49,17 <sup>1)</sup>	45,61	
540						46,91	
550						48,21	
560						49,17 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,ft}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 20 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
16	160	20,05	14,58	10,57	7,11	4,12	2,61
	170	21,79	16,32	12,31	8,71	5,02	3,24
	180	23,52	18,05	14,04	10,44	6,06	3,96
	190	25,26	19,79	15,78	12,18	7,26	4,77
	200	26,99	21,52	17,51	13,91	8,62	5,68
	210	28,72	23,26	19,24	15,65	10,16	6,72
	220	30,46	24,99	20,98	17,38	11,90	7,88
	230	32,19	26,72	22,71	19,12	13,63	9,18
	240	33,93	28,46	24,45	20,85	15,36	10,63
	250	35,66	30,19	26,18	22,58	17,10	12,26
	260	37,40	31,93	27,91	24,32	18,83	13,99
	270	39,13	33,66	29,65	26,05	20,57	15,73
	280	40,86	35,39	31,38	27,79	22,30	17,46
	290	42,60	37,13	33,12	29,52	24,03	19,20
	300	44,33	38,86	34,85	31,25	25,77	20,93
	310	46,07	40,60	36,58	32,99	27,50	22,66
	320	47,80	42,33	38,32	34,72	29,24	24,40
	330	49,53	44,07	40,05	36,46	30,97	26,13
	340	51,27	45,80	41,79	38,19	32,70	27,87
	350	53,00	47,53	43,52	39,93	34,44	29,60
	360	54,74	49,27	45,26	41,66	36,17	31,33
	370	56,47	51,00	46,99	43,39	37,91	33,07
	380	58,21	52,74	48,72	45,13	39,64	34,80
	390	59,94	54,47	50,46	46,86	41,38	36,54
	400	61,67	56,20	52,19	48,60	43,11	38,27
	410	63,41	57,94	53,93	50,33	44,84	40,01
	420	65,14	59,67	55,66	52,06	46,58	41,74
	430	66,88	61,41	57,39	53,80	48,31	43,47
	440	68,61	63,14	59,13	55,53	50,05	45,21
	450	70,34	64,88	60,86	57,27	51,78	46,94
	460	72,08	66,61	62,60	59,00	53,51	48,68
	470	73,81	68,34	64,33	60,74	55,25	50,41
	480	75,55	70,08	66,07	62,47	56,98	52,14
	490	77,28	71,81	67,80	64,20	58,72	53,88
	500	79,02	73,55	69,53	65,94	60,45	55,61
	510	80,75	75,28	71,27	67,67	62,19	57,35
	520	82,48	77,01	73,00	69,41	63,92	59,08
	530	84,22	78,75	74,74	71,14	65,65	60,82
	540	85,95	80,48	76,47	72,87	67,39	62,55
	550	87,42 <sup>1)</sup>	82,22	78,20	74,61	69,12	64,28
560		83,95	79,94	76,34	70,86	66,02	
570		85,69	81,67	78,08	72,59	67,75	
580		87,42 <sup>1)</sup>	83,41	79,81	74,32	69,49	
590			85,14	81,55	76,06	71,22	
600			86,88	83,28	77,79	72,95	
610			87,42 <sup>1)</sup>	85,01	79,53	74,69	
620				86,75	81,26	76,42	
630				87,42 <sup>1)</sup>	83,00	78,16	
640					84,73	79,89	
650					86,46	81,63	
660					87,42 <sup>1)</sup>	83,36	
670						85,09	
680						86,83	
690						87,42 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_v$ .

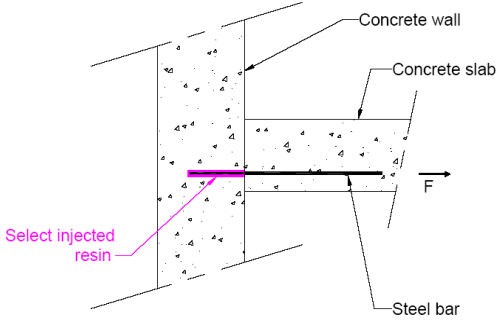
The table continues on the next page.

Concrete Cover = 20 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
20	200	33,74	26,90	21,89	17,39	10,77	7,10
	210	35,91	29,07	24,05	19,56	12,70	8,39
	220	38,07	31,24	26,22	21,73	14,87	9,84
	230	40,24	33,40	28,39	23,89	17,04	11,47
	240	42,41	35,57	30,56	26,06	19,20	13,29
	250	44,58	37,74	32,73	28,23	21,37	15,32
	260	46,74	39,91	34,89	30,40	23,54	17,49
	270	48,91	42,08	37,06	32,57	25,71	19,66
	280	51,08	44,24	39,23	34,73	27,87	21,83
	290	53,25	46,41	41,40	36,90	30,04	23,99
	290	53,25	46,41	41,40	36,90	30,04	23,99
	300	55,42	48,58	43,56	39,07	32,21	26,16
	310	57,58	50,75	45,73	41,24	34,38	28,33
	320	59,75	52,91	47,90	43,40	36,55	30,50
	330	61,92	55,08	50,07	45,57	38,71	32,67
	340	64,09	57,25	52,23	47,74	40,88	34,83
	350	66,25	59,42	54,40	49,91	43,05	37,00
	360	68,42	61,59	56,57	52,07	45,22	39,17
	370	70,59	63,75	58,74	54,24	47,38	41,34
	380	72,76	65,92	60,91	56,41	49,55	43,50
	390	74,92	68,09	63,07	58,58	51,72	45,67
	400	77,09	70,26	65,24	60,75	53,89	47,84
	410	79,26	72,42	67,41	62,91	56,06	50,01
	420	81,43	74,59	69,58	65,08	58,22	52,17
	430	83,60	76,76	71,74	67,25	60,39	54,34
	440	85,76	78,93	73,91	69,42	62,56	56,51
	450	87,93	81,09	76,08	71,58	64,73	58,68
	460	90,10	83,26	78,25	73,75	66,89	60,85
	470	92,27	85,43	80,41	75,92	69,06	63,01
	480	94,43	87,60	82,58	78,09	71,23	65,18
	490	96,60	89,77	84,75	80,25	73,40	67,35
	500	98,77	91,93	86,92	82,42	75,56	69,52
	510	100,94	94,10	89,09	84,59	77,73	71,68
	520	103,10	96,27	91,25	86,76	79,90	73,85
	530	105,27	98,44	93,42	88,93	82,07	76,02
	540	107,44	100,60	95,59	91,09	84,24	78,19
	550	109,61	102,77	97,76	93,26	86,40	80,35
	560	111,78	104,94	99,92	95,43	88,57	82,52
	570	113,94	107,11	102,09	97,60	90,74	84,69
	580	116,11	109,27	104,26	99,76	92,91	86,86
590	118,28	111,44	106,43	101,93	95,07	89,03	
600	120,45	113,61	108,59	104,10	97,24	91,19	
610	122,61	115,78	110,76	106,27	99,41	93,36	
620	124,78	117,95	112,93	108,43	101,58	95,53	
630	126,95	120,11	115,10	110,60	103,74	97,70	
640	129,12	122,28	117,27	112,77	105,91	99,86	
650	131,28	124,45	119,43	114,94	108,08	102,03	
660	133,45	126,62	121,60	117,11	110,25	104,20	
670	135,62	128,78	123,77	119,27	112,42	106,37	
680	136,59 <sup>1)</sup>	130,95	125,94	121,44	114,58	108,53	
690		133,12	128,10	123,61	116,75	110,70	
700		135,29	130,27	125,78	118,92	112,87	
710		136,59 <sup>1)</sup>	132,44	127,94	121,09	115,04	
720			134,61	130,11	123,25	117,21	
730			136,59 <sup>1)</sup>	132,28	125,42	119,37	
740				134,45	127,59	121,54	
750				136,59 <sup>1)</sup>	129,76	123,71	
760					131,92	125,88	
770					134,09	128,04	
780					136,26	130,21	
790					136,59 <sup>1)</sup>	132,38	
800						134,55	
810						136,59 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_v$ .

The present table aims to supply data for fire design of the post-installed rebar product. This study does not deal with design at normal ambient temperature, neither does it deal with design according to other accidental actions.

**Annex 2.2: Maximum applicable loads for an anchoring application (beam-wall connection) with a concrete cover of 30 mm for diameters 25 and 28 mm**

<p>The table presents design bond resistances (<math>N_{Rd,fi}</math>) for a <b>Beam-Wall connection</b> using <b>C20/25 concrete</b> and rebars with a yield strength <math>f_y = 500 \text{ N/mm}^2</math> in an <b>ISO 834-1 fire</b> (at 30, 60, 90, 120, 180 and 240 min) for a <b>concrete cover of 30 mm</b> and for diameters 25 and 28 mm</p> <p>The design load values may be used safely for a slab-wall connection. Post-installed rebars shall be designed in ambient temperature conditions before being designed in fire conditions.</p>	 <p>The diagram illustrates a cross-section of a beam-wall connection. A vertical concrete wall is on the left, and a horizontal concrete slab is on the right. A steel bar is embedded in the wall and extends into the slab. A pink arrow points to the bar in the wall with the label 'Select injected resin'. A horizontal force 'F' is applied to the right end of the slab. Labels with arrows identify 'Concrete wall', 'Concrete slab', and 'Steel bar'.</p>
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Concrete Cover = 30 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
25	250	57,33	48,32	41,64	36,28	27,31	19,70
	260	60,04	51,03	44,35	38,99	30,02	22,41
	270	62,75	53,74	47,06	41,70	32,73	25,12
	280	65,46	56,45	49,77	44,41	35,44	27,83
	290	68,17	59,16	52,48	47,12	38,15	30,54
	300	70,88	61,87	55,19	49,83	40,85	33,25
	310	73,59	64,58	57,90	52,54	43,56	35,96
	320	76,30	67,29	60,61	55,25	46,27	38,67
	330	79,01	70,00	63,32	57,96	48,98	41,38
	340	81,72	72,71	66,03	60,67	51,69	44,09
	350	84,43	75,42	68,74	63,38	54,40	46,80
	360	87,14	78,13	71,45	66,09	57,11	49,51
	370	89,85	80,84	74,16	68,80	59,82	52,22
	380	92,56	83,55	76,87	71,51	62,53	54,92
	390	95,27	86,26	79,58	74,22	65,24	57,63
	400	97,98	88,97	82,29	76,93	67,95	60,34
	410	100,69	91,68	85,00	79,64	70,66	63,05
	420	103,40	94,39	87,70	82,35	73,37	65,76
	430	106,11	97,10	90,41	85,06	76,08	68,47
	440	108,82	99,81	93,12	87,77	78,79	71,18
	450	111,53	102,52	95,83	90,48	81,50	73,89
	460	114,24	105,23	98,54	93,19	84,21	76,60
	470	116,94	107,94	101,25	95,90	86,92	79,31
	480	119,65	110,64	103,96	98,61	89,63	82,02
	490	122,36	113,35	106,67	101,32	92,34	84,73
	500	125,07	116,06	109,38	104,03	95,05	87,44
	510	127,78	118,77	112,09	106,73	97,76	90,15
	520	130,49	121,48	114,80	109,44	100,47	92,86
	530	133,20	124,19	117,51	112,15	103,18	95,57
	540	135,91	126,90	120,22	114,86	105,89	98,28
	550	138,62	129,61	122,93	117,57	108,60	100,99
	560	141,33	132,32	125,64	120,28	111,31	103,70
	570	144,04	135,03	128,35	122,99	114,02	106,41
	580	146,75	137,74	131,06	125,70	116,72	109,12
	590	149,46	140,45	133,77	128,41	119,43	111,83
	600	152,17	143,16	136,48	131,12	122,14	114,54
	610	154,88	145,87	139,19	133,83	124,85	117,25
	620	157,59	148,58	141,90	136,54	127,56	119,96
	630	160,30	151,29	144,61	139,25	130,27	122,67
	640	163,01	154,00	147,32	141,96	132,98	125,38
	650	165,72	156,71	150,03	144,67	135,69	128,08
	660	168,43	159,42	152,74	147,38	138,40	130,79
	670	171,14	162,13	155,45	150,09	141,11	133,50
	680	173,85	164,84	158,16	152,80	143,82	136,21
	690	176,56	167,55	160,86	155,51	146,53	138,92
	700	179,27	170,26	163,57	158,22	149,24	141,63
	710	181,98	172,97	166,28	160,93	151,95	144,34
720	184,69	175,68	168,99	163,64	154,66	147,05	
730	187,39	178,39	171,70	166,35	157,37	149,76	
740	190,10	181,09	174,41	169,06	160,08	152,47	
750	192,81	183,80	177,12	171,77	162,79	155,18	
760	195,52	186,51	179,83	174,48	165,50	157,89	
770	198,23	189,22	182,54	177,18	168,21	160,60	
780	200,94	191,93	185,25	179,89	170,92	163,31	
790	203,65	194,64	187,96	182,60	173,63	166,02	
800	206,36	197,35	190,67	185,31	176,34	168,73	
810	209,07	200,06	193,38	188,02	179,05	171,44	
820	211,78	202,77	196,09	190,73	181,76	174,15	
830	213,42 <sup>1)</sup>	205,48	198,80	193,44	184,46	176,86	
840		208,19	201,51	196,15	187,17	179,57	
850		210,90	204,22	198,86	189,88	182,28	
860		213,42 <sup>1)</sup>	206,93	201,57	192,59	184,99	
870			209,64	204,28	195,30	187,70	
880			212,35	206,99	198,01	190,41	
890			213,42 <sup>1)</sup>	209,70	200,72	193,12	
900				212,41	203,43	195,83	
910				213,42 <sup>1)</sup>	206,14	198,53	
920					208,85	201,24	
930					211,56	203,95	
940					213,42 <sup>1)</sup>	206,66	
950						209,37	
960						212,08	
970						213,42 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 30 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_b$ (mm)	R30	R60	R90	R120	R180	R240
28	280	73,32	63,23	55,74	49,74	39,69	31,17
	290	76,35	66,26	58,78	52,78	42,72	34,20
	300	79,39	69,30	61,81	55,81	45,76	37,24
	310	82,42	72,33	64,85	58,85	48,79	40,27
	320	85,46	75,37	67,88	61,88	51,83	43,31
	330	88,49	78,40	70,92	64,92	54,86	46,34
	340	91,53	81,44	73,95	67,95	57,90	49,38
	350	94,56	84,47	76,99	70,99	60,93	52,41
	360	97,60	87,50	80,02	74,02	63,97	55,45
	370	100,63	90,54	83,06	77,06	67,00	58,48
	380	103,67	93,57	86,09	80,09	70,04	61,52
	390	106,70	96,61	89,13	83,13	73,07	64,55
	400	109,73	99,64	92,16	86,16	76,11	67,59
	410	112,77	102,68	95,19	89,20	79,14	70,62
	420	115,80	105,71	98,23	92,23	82,17	73,66
	430	118,84	108,75	101,26	95,26	85,21	76,69
	440	121,87	111,78	104,30	98,30	88,24	79,72
	450	124,91	114,82	107,33	101,33	91,28	82,76
	460	127,94	117,85	110,37	104,37	94,31	85,79
	470	130,98	120,89	113,40	107,40	97,35	88,83
	480	134,01	123,92	116,44	110,44	100,38	91,86
	490	137,05	126,96	119,47	113,47	103,42	94,90
	500	140,08	129,99	122,51	116,51	106,45	97,93
	510	143,12	133,03	125,54	119,54	109,49	100,97
	520	146,15	136,06	128,58	122,58	112,52	104,00
	530	149,19	139,10	131,61	125,61	115,56	107,04
	540	152,22	142,13	134,65	128,65	118,59	110,07
	550	155,26	145,17	137,68	131,68	121,63	113,11
	560	158,29	148,20	140,72	134,72	124,66	116,14
	570	161,33	151,24	143,75	137,75	127,70	119,18
	580	164,36	154,27	146,79	140,79	130,73	122,21
	590	167,40	157,30	149,82	143,82	133,77	125,25
	600	170,43	160,34	152,86	146,86	136,80	128,28
	610	173,47	163,37	155,89	149,89	139,84	131,32
	620	176,50	166,41	158,92	152,93	142,87	134,35
	630	179,53	169,44	161,96	155,96	145,91	137,39
	640	182,57	172,48	164,99	158,99	148,94	140,42
	650	185,60	175,51	168,03	162,03	151,97	143,45
	660	188,64	178,55	171,06	165,06	155,01	146,49
	670	191,67	181,58	174,10	168,10	158,04	149,52
680	194,71	184,62	177,13	171,13	161,08	152,56	
690	197,74	187,65	180,17	174,17	164,11	155,59	
700	200,78	190,69	183,20	177,20	167,15	158,63	
710	203,81	193,72	186,24	180,24	170,18	161,66	
720	206,85	196,76	189,27	183,27	173,22	164,70	
730	209,88	199,79	192,31	186,31	176,25	167,73	
740	212,92	202,83	195,34	189,34	179,29	170,77	
750	215,95	205,86	198,38	192,38	182,32	173,80	
760	218,99	208,90	201,41	195,41	185,36	176,84	
770	222,02	211,93	204,45	198,45	188,39	179,87	
780	225,06	214,97	207,48	201,48	191,43	182,91	
790	228,09	218,00	210,52	204,52	194,46	185,94	
800	231,13	221,03	213,55	207,55	197,50	188,98	
810	234,16	224,07	216,59	210,59	200,53	192,01	
820	237,20	227,10	219,62	213,62	203,57	195,05	
830	240,23	230,14	222,66	216,66	206,60	198,08	
840	243,26	233,17	225,69	219,69	209,64	201,12	
850	246,30	236,21	228,72	222,73	212,67	204,15	
860	249,33	239,24	231,76	225,76	215,71	207,19	
870	252,37	242,28	234,79	228,79	218,74	210,22	
880	255,40	245,31	237,83	231,83	221,77	213,25	
890	258,44	248,35	240,86	234,86	224,81	216,29	
900	261,47	251,38	243,90	237,90	227,84	219,32	
910	264,51	254,42	246,93	240,93	230,88	222,36	
920	267,54	257,45	249,97	243,97	233,91	225,39	
930	267,72 <sup>1)</sup>	260,49	253,00	247,00	236,95	228,43	
940		263,52	256,04	250,04	239,98	231,46	
950		266,56	259,07	253,07	243,02	234,50	
960		267,72 <sup>1)</sup>	262,11	256,11	246,05	237,53	
970			265,14	259,14	249,09	240,57	
980			267,72 <sup>1)</sup>	262,18	252,12	243,60	
990				265,21	255,16	246,64	
1000				267,72 <sup>1)</sup>	258,19	249,67	

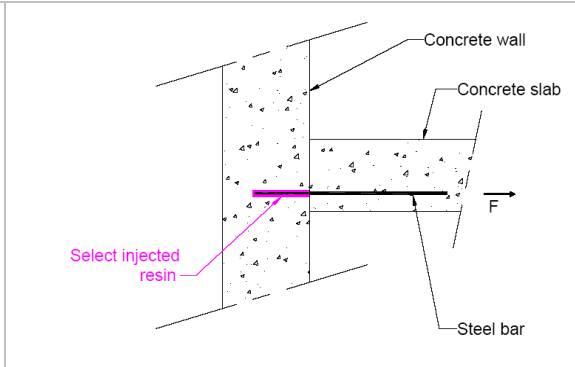
<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_b$ .

The present table aims to supply data for fire design of the post-installed rebar product. This study does not deal with design at normal ambient temperature, neither does it deal with design according to other accidental actions.

**Annex 2.3: Maximum applicable loads for an anchoring application (beam-wall connection) with a concrete cover of 40 mm for diameters 10, 12, 16, 20, 25, 28, 32 and 40 mm**

The table presents design bond resistances ( $N_{Rd,fi}$ ) for a **Beam-Wall connection** using **C20/25 concrete** and rebars with a yield strength  $f_y = 500 \text{ N/mm}^2$  in an **ISO 834-1 fire** (at 30, 60, 90, 120, 180 and 240 min) for a **concrete cover of 40 mm** and for diameters 10, 12, 16, 20, 25, 28, 32 and 40 mm

The design load values may be used safely for a slab-wall connection. Post-installed rebars shall be designed in ambient temperature conditions before being designed in fire conditions.



Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
10	100	7,55	3,69	2,03	1,22	0,53	0,27
	110	8,63	4,75	2,62	1,64	0,79	0,45
	120	9,72	5,84	3,34	2,13	1,10	0,66
	130	10,80	6,92	4,20	2,71	1,45	0,91
	140	11,88	8,01	5,23	3,38	1,85	1,20
	150	12,97	9,09	6,31	4,18	2,31	1,53
	160	14,05	10,17	7,40	5,11	2,85	1,91
	170	15,14	11,26	8,48	6,19	3,46	2,33
	180	16,22	12,34	9,56	7,27	4,15	2,81
	190	17,30	13,43	10,65	8,36	4,94	3,34
	200	18,39	14,51	11,73	9,44	5,85	3,95
	210	19,47	15,59	12,82	10,53	6,87	4,63
	220	20,55	16,68	13,90	11,61	7,95	5,39
	230	21,64	17,76	14,98	12,69	9,04	6,24
	240	22,72	18,84	16,07	13,78	10,12	7,19
	250	23,81	19,93	17,15	14,86	11,20	8,25
	260	24,89	21,01	18,24	15,95	12,29	9,34
	270	25,97	22,10	19,32	17,03	13,37	10,42
	280	27,06	23,18	20,40	18,11	14,46	11,51
	290	28,14	24,26	21,49	19,20	15,54	12,59
	300	29,23	25,35	22,57	20,28	16,62	13,67
	310	30,31	26,43	23,65	21,36	17,71	14,76
	320	31,39	27,52	24,74	22,45	18,79	15,84
	330	32,48	28,60	25,82	23,53	19,87	16,93
	340	33,56	29,68	26,91	24,62	20,96	18,01
	350	34,15 <sup>1)</sup>	30,77	27,99	25,70	22,04	19,09
	360		31,85	29,07	26,78	23,13	20,18
	370		32,93	30,16	27,87	24,21	21,26
	380		34,02	31,24	28,95	25,29	22,34
	390		34,15 <sup>1)</sup>	32,33	30,04	26,38	23,43
400			33,41	31,12	27,46	24,51	
410			34,15 <sup>1)</sup>	32,20	28,55	25,60	
420				33,29	29,63	26,68	
430				34,15 <sup>1)</sup>	30,71	27,76	
440					31,80	28,85	
450					32,88	29,93	
460					33,96	31,02	
470					34,15 <sup>1)</sup>	32,10	
480						33,18	
490						34,15 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
12	120	11,66	7,01	4,01	2,55	1,32	0,79
	130	12,96	8,31	5,05	3,25	1,74	1,10
	140	14,26	9,61	6,28	4,06	2,22	1,44
	150	15,56	10,91	7,58	5,02	2,78	1,84
	160	16,86	12,21	8,88	6,13	3,42	2,29
	170	18,16	13,51	10,18	7,43	4,15	2,80
	180	19,46	14,81	11,48	8,73	4,98	3,37
	190	20,76	16,11	12,78	10,03	5,93	4,01
	200	22,06	17,41	14,08	11,33	7,02	4,74
	210	23,37	18,71	15,38	12,63	8,24	5,55
	220	24,67	20,01	16,68	13,93	9,54	6,47
	230	25,97	21,31	17,98	15,23	10,84	7,49
	240	27,27	22,61	19,28	16,53	12,14	8,63
	250	28,57	23,91	20,58	17,83	13,44	9,91
	260	29,87	25,21	21,88	19,13	14,75	11,21
	270	31,17	26,52	23,18	20,44	16,05	12,51
	280	32,47	27,82	24,48	21,74	17,35	13,81
	290	33,77	29,12	25,78	23,04	18,65	15,11
	300	35,07	30,42	27,09	24,34	19,95	16,41
	310	36,37	31,72	28,39	25,64	21,25	17,71
	320	37,67	33,02	29,69	26,94	22,55	19,01
	330	38,97	34,32	30,99	28,24	23,85	20,31
	340	40,27	35,62	32,29	29,54	25,15	21,61
	350	41,57	36,92	33,59	30,84	26,45	22,91
	360	42,87	38,22	34,89	32,14	27,75	24,21
	370	44,17	39,52	36,19	33,44	29,05	25,51
	380	45,48	40,82	37,49	34,74	30,35	26,81
	390	46,78	42,12	38,79	36,04	31,65	28,11
	400	48,08	43,42	40,09	37,34	32,95	29,41
	410	49,17 <sup>1)</sup>	44,72	41,39	38,64	34,25	30,72
	420		46,02	42,69	39,94	35,56	32,02
	430		47,33	43,99	41,25	36,86	33,32
440		48,63	45,29	42,55	38,16	34,62	
450		49,17 <sup>1)</sup>	46,59	43,85	39,46	35,92	
460			47,90	45,15	40,76	37,22	
470			49,17 <sup>1)</sup>	46,45	42,06	38,52	
480				47,75	43,36	39,82	
490				49,05	44,66	41,12	
500				49,17 <sup>1)</sup>	45,96	42,42	
510					47,26	43,72	
520					48,56	45,02	
530					49,17 <sup>1)</sup>	46,32	
540						47,62	
550						48,92	
560						49,17 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
16	160	22,48	16,28	11,84	8,18	4,55	3,05
	170	24,22	18,01	13,57	9,91	5,53	3,73
	180	25,95	19,75	15,30	11,64	6,64	4,49
	190	27,69	21,48	17,04	13,37	7,91	5,35
	200	29,42	23,21	18,77	15,11	9,36	6,32
	210	31,15	24,95	20,51	16,84	10,99	7,40
	220	32,89	26,68	22,24	18,58	12,72	8,62
	230	34,62	28,42	23,97	20,31	14,46	9,99
	240	36,36	30,15	25,71	22,04	16,19	11,51
	250	38,09	31,89	27,44	23,78	17,93	13,21
	260	39,82	33,62	29,18	25,51	19,66	14,94
	270	41,56	35,35	30,91	27,25	21,39	16,68
	280	43,29	37,09	32,65	28,98	23,13	18,41
	290	45,03	38,82	34,38	30,72	24,86	20,14
	300	46,76	40,56	36,11	32,45	26,60	21,88
	310	48,49	42,29	37,85	34,18	28,33	23,61
	320	50,23	44,02	39,58	35,92	30,07	25,35
	330	51,96	45,76	41,32	37,65	31,80	27,08
	340	53,70	47,49	43,05	39,39	33,53	28,81
	350	55,43	49,23	44,78	41,12	35,27	30,55
	360	57,17	50,96	46,52	42,85	37,00	32,28
	370	58,90	52,70	48,25	44,59	38,74	34,02
	380	60,63	54,43	49,99	46,32	40,47	35,75
	390	62,37	56,16	51,72	48,06	42,20	37,49
	400	64,10	57,90	53,46	49,79	43,94	39,22
	410	65,84	59,63	55,19	51,53	45,67	40,95
	420	67,57	61,37	56,92	53,26	47,41	42,69
	430	69,30	63,10	58,66	54,99	49,14	44,42
	440	71,04	64,83	60,39	56,73	50,88	46,16
	450	72,77	66,57	62,13	58,46	52,61	47,89
	460	74,51	68,30	63,86	60,20	54,34	49,62
	470	76,24	70,04	65,59	61,93	56,08	51,36
	480	77,98	71,77	67,33	63,66	57,81	53,09
	490	79,71	73,51	69,06	65,40	59,55	54,83
	500	81,44	75,24	70,80	67,13	61,28	56,56
	510	83,18	76,97	72,53	68,87	63,01	58,30
	520	84,91	78,71	74,27	70,60	64,75	60,03
	530	86,65	80,44	76,00	72,34	66,48	61,76
	540	87,42 <sup>1)</sup>	82,18	77,73	74,07	68,22	63,50
	550		83,91	79,47	75,80	69,95	65,23
560		85,64	81,20	77,54	71,69	66,97	
570		87,38	82,94	79,27	73,42	68,70	
580		87,42 <sup>1)</sup>	84,67	81,01	75,15	70,43	
590			86,40	82,74	76,89	72,17	
600			87,42 <sup>1)</sup>	84,47	78,62	73,90	
610				86,21	80,36	75,64	
620				87,42 <sup>1)</sup>	82,09	77,37	
630					83,82	79,11	
640					85,56	80,84	
650					87,29	82,57	
660					87,42 <sup>1)</sup>	84,31	
670						86,04	
680						87,42 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{rd,fi}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
20	200	36,77	29,02	23,46	18,89	11,69	7,90
	210	38,94	31,19	25,63	21,05	13,74	9,25
	220	41,11	33,35	27,80	23,22	15,91	10,78
	230	43,28	35,52	29,97	25,39	18,07	12,48
	240	45,44	37,69	32,14	27,56	20,24	14,39
	250	47,61	39,86	34,30	29,72	22,41	16,51
	260	49,78	42,02	36,47	31,89	24,58	18,68
	270	51,95	44,19	38,64	34,06	26,74	20,84
	280	54,12	46,36	40,81	36,23	28,91	23,01
	290	56,28	48,53	42,97	38,39	31,08	25,18
	300	58,45	50,70	45,14	40,56	33,25	27,35
	310	60,62	52,86	47,31	42,73	35,41	29,51
	320	62,79	55,03	49,48	44,90	37,58	31,68
	330	64,95	57,20	51,65	47,07	39,75	33,85
	340	67,12	59,37	53,81	49,23	41,92	36,02
	350	69,29	61,53	55,98	51,40	44,09	38,19
	360	71,46	63,70	58,15	53,57	46,25	40,35
	370	73,62	65,87	60,32	55,74	48,42	42,52
	380	75,79	68,04	62,48	57,90	50,59	44,69
	390	77,96	70,20	64,65	60,07	52,76	46,86
	400	80,13	72,37	66,82	62,24	54,92	49,02
	410	82,30	74,54	68,99	64,41	57,09	51,19
	420	84,46	76,71	71,15	66,57	59,26	53,36
	430	86,63	78,88	73,32	68,74	61,43	55,53
	440	88,80	81,04	75,49	70,91	63,59	57,70
	450	90,97	83,21	77,66	73,08	65,76	59,86
	460	93,13	85,38	79,83	75,25	67,93	62,03
	470	95,30	87,55	81,99	77,41	70,10	64,20
	480	97,47	89,71	84,16	79,58	72,27	66,37
	490	99,64	91,88	86,33	81,75	74,43	68,53
	500	101,80	94,05	88,50	83,92	76,60	70,70
	510	103,97	96,22	90,66	86,08	78,77	72,87
	520	106,14	98,39	92,83	88,25	80,94	75,04
	530	108,31	100,55	95,00	90,42	83,10	77,20
	540	110,48	102,72	97,17	92,59	85,27	79,37
	550	112,64	104,89	99,33	94,75	87,44	81,54
	560	114,81	107,06	101,50	96,92	89,61	83,71
	570	116,98	109,22	103,67	99,09	91,77	85,88
	580	119,15	111,39	105,84	101,26	93,94	88,04
	590	121,31	113,56	108,01	103,43	96,11	90,21
600	123,48	115,73	110,17	105,59	98,28	92,38	
610	125,65	117,89	112,34	107,76	100,45	94,55	
620	127,82	120,06	114,51	109,93	102,61	96,71	
630	129,99	122,23	116,68	112,10	104,78	98,88	
640	132,15	124,40	118,84	114,26	106,95	101,05	
650	134,32	126,57	121,01	116,43	109,12	103,22	
660	136,49	128,73	123,18	118,60	111,28	105,38	
670	136,59 <sup>1)</sup>	130,90	125,35	120,77	113,45	107,55	
680		133,07	127,51	122,93	115,62	109,72	
690		135,24	129,68	125,10	117,79	111,89	
700		136,59 <sup>1)</sup>	131,85	127,27	119,95	114,06	
710			134,02	129,44	122,12	116,22	
720			136,19	131,61	124,29	118,39	
730			136,59 <sup>1)</sup>	133,77	126,46	120,56	
740				135,94	128,63	122,73	
750				136,59 <sup>1)</sup>	130,79	124,89	
760					132,96	127,06	
770					135,13	129,23	
780					136,59 <sup>1)</sup>	131,40	
790						133,56	
800						135,73	
810						136,59 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{rd,fi}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
25	250	59,52	49,82	42,88	37,15	28,01	20,64
	260	62,23	52,53	45,59	39,86	30,72	23,35
	270	64,93	55,24	48,30	42,57	33,43	26,06
	280	67,64	57,95	51,01	45,28	36,14	28,76
	290	70,35	60,66	53,72	47,99	38,85	31,47
	300	73,06	63,37	56,43	50,70	41,56	34,18
	310	75,77	66,08	59,14	53,41	44,27	36,89
	320	78,48	68,79	61,85	56,12	46,98	39,60
	330	81,19	71,50	64,56	58,83	49,69	42,31
	340	83,90	74,21	67,27	61,54	52,40	45,02
	350	86,61	76,92	69,98	64,25	55,11	47,73
	360	89,32	79,63	72,69	66,96	57,82	50,44
	370	92,03	82,34	75,39	69,67	60,53	53,15
	380	94,74	85,05	78,10	72,38	63,24	55,86
	390	97,45	87,76	80,81	75,09	65,95	58,57
	400	100,16	90,47	83,52	77,80	68,66	61,28
	410	102,87	93,18	86,23	80,51	71,36	63,99
	420	105,58	95,89	88,94	83,22	74,07	66,70
	430	108,29	98,59	91,65	85,93	76,78	69,41
	440	111,00	101,30	94,36	88,64	79,49	72,12
	450	113,71	104,01	97,07	91,35	82,20	74,83
	460	116,42	106,72	99,78	94,06	84,91	77,54
	470	119,13	109,43	102,49	96,77	87,62	80,25
	480	121,84	112,14	105,20	99,48	90,33	82,96
	490	124,55	114,85	107,91	102,19	93,04	85,67
	500	127,26	117,56	110,62	104,90	95,75	88,38
	510	129,97	120,27	113,33	107,60	98,46	91,09
	520	132,68	122,98	116,04	110,31	101,17	93,80
	530	135,39	125,69	118,75	113,02	103,88	96,51
	540	138,09	128,40	121,46	115,73	106,59	99,22
	550	140,80	131,11	124,17	118,44	109,30	101,92
	560	143,51	133,82	126,88	121,15	112,01	104,63
	570	146,22	136,53	129,59	123,86	114,72	107,34
	580	148,93	139,24	132,30	126,57	117,43	110,05
	590	151,64	141,95	135,01	129,28	120,14	112,76
	600	154,35	144,66	137,72	131,99	122,85	115,47
	610	157,06	147,37	140,43	134,70	125,56	118,18
	620	159,77	150,08	143,14	137,41	128,27	120,89
	630	162,48	152,79	145,84	140,12	130,98	123,60
	640	165,19	155,50	148,55	142,83	133,69	126,31
	650	167,90	158,21	151,26	145,54	136,40	129,02
	660	170,61	160,92	153,97	148,25	139,10	131,73
	670	173,32	163,63	156,68	150,96	141,81	134,44
	680	176,03	166,34	159,39	153,67	144,52	137,15
	690	178,74	169,04	162,10	156,38	147,23	139,86
	700	181,45	171,75	164,81	159,09	149,94	142,57
	710	184,16	174,46	167,52	161,80	152,65	145,28
720	186,87	177,17	170,23	164,51	155,36	147,99	
730	189,58	179,88	172,94	167,22	158,07	150,70	
740	192,29	182,59	175,65	169,93	160,78	153,41	
750	195,00	185,30	178,36	172,64	163,49	156,12	
760	197,71	188,01	181,07	175,35	166,20	158,83	
770	200,42	190,72	183,78	178,06	168,91	161,54	
780	203,13	193,43	186,49	180,76	171,62	164,25	
790	205,84	196,14	189,20	183,47	174,33	166,96	
800	208,54	198,85	191,91	186,18	177,04	169,67	
810	211,25	201,56	194,62	188,89	179,75	172,37	
820	213,42 <sup>1)</sup>	204,27	197,33	191,60	182,46	175,08	
830		206,98	200,04	194,31	185,17	177,79	
840		209,69	202,75	197,02	187,88	180,50	
850		212,40	205,46	199,73	190,59	183,21	
860		213,42 <sup>1)</sup>	208,17	202,44	193,30	185,92	
870			210,88	205,15	196,01	188,63	
880			213,42 <sup>1)</sup>	207,86	198,72	191,34	
890				210,57	201,43	194,05	
900				213,28	204,14	196,76	
910				213,42 <sup>1)</sup>	206,85	199,47	
920					209,56	202,18	
930					212,26	204,89	
940					213,42 <sup>1)</sup>	207,60	
950						210,31	
960						213,02	
970						213,42 <sup>1)</sup>	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{Rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
28	280	75,76	64,90	57,13	50,72	40,48	32,22
	290	78,80	67,94	60,16	53,75	43,51	35,25
	300	81,83	70,97	63,20	56,79	46,55	38,29
	310	84,87	74,01	66,23	59,82	49,58	41,32
	320	87,90	77,04	69,27	62,86	52,62	44,36
	330	90,94	80,08	72,30	65,89	55,65	47,39
	340	93,97	83,11	75,34	68,93	58,68	50,43
	350	97,01	86,15	78,37	71,96	61,72	53,46
	360	100,04	89,18	81,41	75,00	64,75	56,49
	370	103,07	92,22	84,44	78,03	67,79	59,53
	380	106,11	95,25	87,48	81,07	70,82	62,56
	390	109,14	98,29	90,51	84,10	73,86	65,60
	400	112,18	101,32	93,55	87,13	76,89	68,63
	410	115,21	104,36	96,58	90,17	79,93	71,67
	420	118,25	107,39	99,62	93,20	82,96	74,70
	430	121,28	110,43	102,65	96,24	86,00	77,74
	440	124,32	113,46	105,69	99,27	89,03	80,77
	450	127,35	116,50	108,72	102,31	92,07	83,81
	460	130,39	119,53	111,76	105,34	95,10	86,84
	470	133,42	122,57	114,79	108,38	98,14	89,88
	480	136,46	125,60	117,82	111,41	101,17	92,91
	490	139,49	128,63	120,86	114,45	104,21	95,95
	500	142,53	131,67	123,89	117,48	107,24	98,98
	510	145,56	134,70	126,93	120,52	110,28	102,02
	520	148,60	137,74	129,96	123,55	113,31	105,05
	530	151,63	140,77	133,00	126,59	116,35	108,09
	540	154,67	143,81	136,03	129,62	119,38	111,12
	550	157,70	146,84	139,07	132,66	122,41	114,16
	560	160,74	149,88	142,10	135,69	125,45	117,19
	570	163,77	152,91	145,14	138,73	128,48	120,23
	580	166,81	155,95	148,17	141,76	131,52	123,26
	590	169,84	158,98	151,21	144,80	134,55	126,29
	600	172,87	162,02	154,24	147,83	137,59	129,33
	610	175,91	165,05	157,28	150,87	140,62	132,36
	620	178,94	168,09	160,31	153,90	143,66	135,40
	630	181,98	171,12	163,35	156,93	146,69	138,43
	640	185,01	174,16	166,38	159,97	149,73	141,47
	650	188,05	177,19	169,42	163,00	152,76	144,50
	660	191,08	180,23	172,45	166,04	155,80	147,54
	670	194,12	183,26	175,49	169,07	158,83	150,57
680	197,15	186,30	178,52	172,11	161,87	153,61	
690	200,19	189,33	181,56	175,14	164,90	156,64	
700	203,22	192,37	184,59	178,18	167,94	159,68	
710	206,26	195,40	187,62	181,21	170,97	162,71	
720	209,29	198,43	190,66	184,25	174,01	165,75	
730	212,33	201,47	193,69	187,28	177,04	168,78	
740	215,36	204,50	196,73	190,32	180,08	171,82	
750	218,40	207,54	199,76	193,35	183,11	174,85	
760	221,43	210,57	202,80	196,39	186,15	177,89	
770	224,47	213,61	205,83	199,42	189,18	180,92	
780	227,50	216,64	208,87	202,46	192,21	183,96	
790	230,54	219,68	211,90	205,49	195,25	186,99	
800	233,57	222,71	214,94	208,53	198,28	190,03	
810	236,61	225,75	217,97	211,56	201,32	193,06	
820	239,64	228,78	221,01	214,60	204,35	196,09	
830	242,67	231,82	224,04	217,63	207,39	199,13	
840	245,71	234,85	227,08	220,67	210,42	202,16	
850	248,74	237,89	230,11	223,70	213,46	205,20	
860	251,78	240,92	233,15	226,73	216,49	208,23	
870	254,81	243,96	236,18	229,77	219,53	211,27	
880	257,85	246,99	239,22	232,80	222,56	214,30	
890	260,88	250,03	242,25	235,84	225,60	217,34	
900	263,92	253,06	245,29	238,87	228,63	220,37	
910	266,95	256,10	248,32	241,91	231,67	223,41	
920	267,72 <sup>1)</sup>	259,13	251,35	244,94	234,70	226,44	
930		262,17	254,39	247,98	237,74	229,48	
940		265,20	257,42	251,01	240,77	232,51	
950		267,72 <sup>1)</sup>	260,46	254,05	243,81	235,55	
960			263,49	257,08	246,84	238,58	
970			266,53	260,12	249,88	241,62	
980			267,72 <sup>1)</sup>	263,15	252,91	244,65	
990				266,19	255,95	247,69	
1000				267,72 <sup>1)</sup>	258,98	250,72	

<sup>1)</sup> Bond resistance to ensure steel yield  $N_{Rd,fi}$  is achieved starting from this from this length  $l_v$ .

The table continues on the next page.

Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
32	320	100,46	88,05	79,16	71,84	60,13	50,69
	330	103,93	91,52	82,63	75,30	63,60	54,16
	340	107,39	94,99	86,10	78,77	67,07	57,63
	350	110,86	98,45	89,57	82,24	70,54	61,10
	360	114,33	101,92	93,04	85,71	74,00	64,57
	370	117,80	105,39	96,51	89,18	77,47	68,03
	380	121,27	108,86	99,97	92,65	80,94	71,50
	390	124,74	112,33	103,44	96,11	84,41	74,97
	400	128,20	115,80	106,91	99,58	87,88	78,44
	410	131,67	119,26	110,38	103,05	91,35	81,91
	420	135,14	122,73	113,85	106,52	94,81	85,38
	430	138,61	126,20	117,32	109,99	98,28	88,84
	440	142,08	129,67	120,78	113,46	101,75	92,31
	450	145,55	133,14	124,25	116,92	105,22	95,78
	460	149,01	136,61	127,72	120,39	108,69	99,25
	470	152,48	140,07	131,19	123,86	112,16	102,72
	480	155,95	143,54	134,66	127,33	115,62	106,19
	490	159,42	147,01	138,13	130,80	119,09	109,65
	500	162,89	150,48	141,59	134,27	122,56	113,12
	510	166,36	153,95	145,06	137,73	126,03	116,59
	520	169,82	157,42	148,53	141,20	129,50	120,06
	530	173,29	160,88	152,00	144,67	132,97	123,53
	540	176,76	164,35	155,47	148,14	136,43	127,00
	550	180,23	167,82	158,94	151,61	139,90	130,46
	560	183,70	171,29	162,40	155,08	143,37	133,93
	570	187,17	174,76	165,87	158,54	146,84	137,40
	580	190,63	178,23	169,34	162,01	150,31	140,87
	590	194,10	181,69	172,81	165,48	153,78	144,34
	600	197,57	185,16	176,28	168,95	157,24	147,81
	610	201,04	188,63	179,74	172,42	160,71	151,27
	620	204,51	192,10	183,21	175,89	164,18	154,74
	630	207,98	195,57	186,68	179,35	167,65	158,21
	640	211,44	199,04	190,15	182,82	171,12	161,68
	650	214,91	202,50	193,62	186,29	174,59	165,15
	660	218,38	205,97	197,09	189,76	178,05	168,62
	670	221,85	209,44	200,55	193,23	181,52	172,08
	680	225,32	212,91	204,02	196,70	184,99	175,55
	690	228,79	216,38	207,49	200,16	188,46	179,02
	700	232,25	219,85	210,96	203,63	191,93	182,49
	710	235,72	223,31	214,43	207,10	195,40	185,96
720	239,19	226,78	217,90	210,57	198,86	189,43	
730	242,66	230,25	221,36	214,04	202,33	192,89	
740	246,13	233,72	224,83	217,51	205,80	196,36	
750	249,60	237,19	228,30	220,97	209,27	199,83	
760	253,06	240,66	231,77	224,44	212,74	203,30	
770	256,53	244,12	235,24	227,91	216,21	206,77	
780	260,00	247,59	238,71	231,38	219,67	210,23	
790	263,47	251,06	242,17	234,85	223,14	213,70	
800	266,94	254,53	245,64	238,32	226,61	217,17	
810	270,41	258,00	249,11	241,78	230,08	220,64	
820	273,87	261,47	252,58	245,25	233,55	224,11	
830	277,34	264,93	256,05	248,72	237,02	227,58	
840	280,81	268,40	259,52	252,19	240,48	231,04	
850	284,28	271,87	262,98	255,66	243,95	234,51	
860	287,75	275,34	266,45	259,13	247,42	237,98	
870	291,22	278,81	269,92	262,59	250,89	241,45	
880	294,68	282,28	273,39	266,06	254,36	244,92	
890	298,15	285,74	276,86	269,53	257,83	248,39	
900	301,62	289,21	280,33	273,00	261,29	251,85	
910	305,09	292,68	283,79	276,47	264,76	255,32	
920	308,56	296,15	287,26	279,94	268,23	258,79	
930	312,03	299,62	290,73	283,40	271,70	262,26	
940	315,49	303,09	294,20	286,87	275,17	265,73	
950	318,96	306,55	297,67	290,34	278,64	269,20	
960	322,43	310,02	301,14	293,81	282,10	272,66	
970	325,90	313,49	304,60	297,28	285,57	276,13	
980	329,37	316,96	308,07	300,75	289,04	279,60	
990	332,84	320,43	311,54	304,21	292,51	283,07	
1000	336,30	323,90	315,01	307,68	295,98	286,54	

The table continues on the next page.

Concrete Cover = 40 mm		Fire Design Bond Resistance $N_{rd,fi}$ (kN)					
Diameter (mm)	Length $l_v$ (mm)	R30	R60	R90	R120	R180	R240
40	400	160,26	144,75	133,64	124,48	109,85	98,05
	410	164,59	149,08	137,97	128,81	114,18	102,38
	420	168,93	153,42	142,31	133,15	118,52	106,72
	430	173,26	157,75	146,64	137,48	122,85	111,05
	440	177,60	162,09	150,98	141,82	127,19	115,39
	450	181,93	166,42	155,31	146,16	131,52	119,73
	460	186,27	170,76	159,65	150,49	135,86	124,06
	470	190,60	175,09	163,99	154,83	140,20	128,40
	480	194,94	179,43	168,32	159,16	144,53	132,73
	490	199,27	183,76	172,66	163,50	148,87	137,07
	500	203,61	188,10	176,99	167,83	153,20	141,40
	510	207,95	192,43	181,33	172,17	157,54	145,74
	520	212,28	196,77	185,66	176,50	161,87	150,07
	530	216,62	201,11	190,00	180,84	166,21	154,41
	540	220,95	205,44	194,33	185,17	170,54	158,74
	550	225,29	209,78	198,67	189,51	174,88	163,08
	560	229,62	214,11	203,00	193,84	179,21	167,41
	570	233,96	218,45	207,34	198,18	183,55	171,75
	580	238,29	222,78	211,67	202,52	187,88	176,09
	590	242,63	227,12	216,01	206,85	192,22	180,42
	600	246,96	231,45	220,35	211,19	196,56	184,76
	610	251,30	235,79	224,68	215,52	200,89	189,09
	620	255,63	240,12	229,02	219,86	205,23	193,43
	630	259,97	244,46	233,35	224,19	209,56	197,76
	640	264,31	248,79	237,69	228,53	213,90	202,10
	650	268,64	253,13	242,02	232,86	218,23	206,43
	660	272,98	257,47	246,36	237,20	222,57	210,77
	670	277,31	261,80	250,69	241,53	226,90	215,10
	680	281,65	266,14	255,03	245,87	231,24	219,44
	690	285,98	270,47	259,36	250,20	235,57	223,78
	700	290,32	274,81	263,70	254,54	239,91	228,11
	710	294,65	279,14	268,04	258,88	244,24	232,45
	720	298,99	283,48	272,37	263,21	248,58	236,78
	730	303,32	287,81	276,71	267,55	252,92	241,12
	740	307,66	292,15	281,04	271,88	257,25	245,45
	750	311,99	296,48	285,38	276,22	261,59	249,79
	760	316,33	300,82	289,71	280,55	265,92	254,12
	770	320,67	305,16	294,05	284,89	270,26	258,46
	780	325,00	309,49	298,38	289,22	274,59	262,79
	790	329,34	313,83	302,72	293,56	278,93	267,13
800	333,67	318,16	307,05	297,89	283,26	271,46	
810	338,01	322,50	311,39	302,23	287,60	275,80	
820	342,34	326,83	315,72	306,57	291,93	280,14	
830	346,68	331,17	320,06	310,90	296,27	284,47	
840	351,01	335,50	324,40	315,24	300,61	288,81	
850	355,35	339,84	328,73	319,57	304,94	293,14	
860	359,68	344,17	333,07	323,91	309,28	297,48	
870	364,02	348,51	337,40	328,24	313,61	301,81	
880	368,36	352,84	341,74	332,58	317,95	306,15	
890	372,69	357,18	346,07	336,91	322,28	310,48	
900	377,03	361,52	350,41	341,25	326,62	314,82	
910	381,36	365,85	354,74	345,58	330,95	319,15	
920	385,70	370,19	359,08	349,92	335,29	323,49	
930	390,03	374,52	363,41	354,25	339,62	327,82	
940	394,37	378,86	367,75	358,59	343,96	332,16	
950	398,70	383,19	372,08	362,93	348,29	336,50	
960	403,04	387,53	376,42	367,26	352,63	340,83	
970	407,37	391,86	380,76	371,60	356,97	345,17	
980	411,71	396,20	385,09	375,93	361,30	349,50	
990	416,04	400,53	389,43	380,27	365,64	353,84	
1000	420,38	404,87	393,76	384,60	369,97	358,17	

The present table aims to supply data for fire design of the post-installed rebar product. This study does not deal with design at normal ambient temperature, neither does it deal with design according to other accidental actions.

END OF REPORT



## Le futur en construction

Établissement public au service de l'innovation dans le bâtiment, le CSTB, Centre Scientifique et Technique du Bâtiment, exerce quatre activités clés : la recherche et expertise, l'évaluation, la certification et la diffusion des connaissances, organisées pour répondre aux enjeux de la transition énergétique dans le monde de la construction. Son champ de compétence couvre les produits de construction, les bâtiments et leur intégration dans les quartiers et les villes.

Avec plus de 900 collaborateurs, ses filiales et ses réseaux de partenaires nationaux, européens et internationaux, le groupe CSTB est au service de l'ensemble des parties prenantes de la construction pour faire progresser la qualité et la sécurité des bâtiments.