1. STEELWORK PROTECTION

until R 240

Fire Resistance of Structural Members

Steel structures are a construction system used worldwide.

One of the main advantages is that they have great resistance per weight unit, which provides them with tremendous versatility and the possibility of creating complex yet light structures.

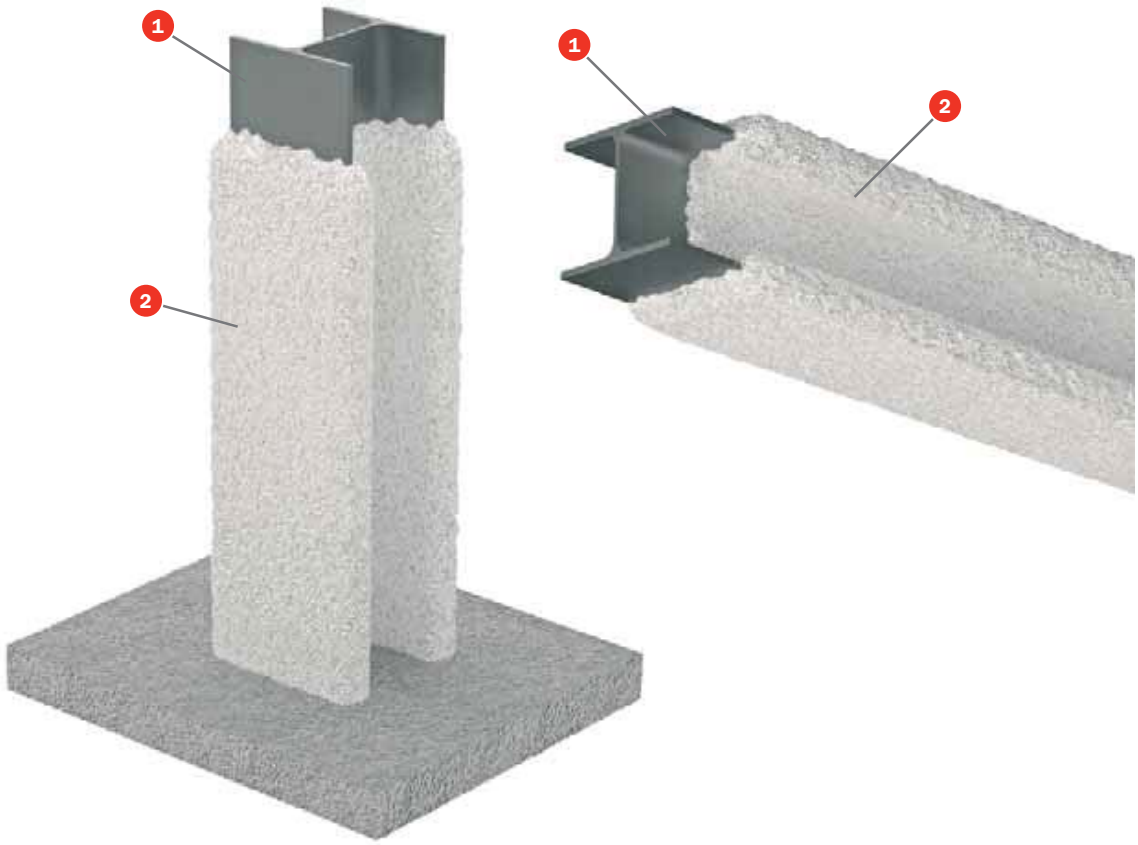
By contrast, one of the drawbacks of steel is its high thermal conductivity. Therefore, in the event of a fire, the progressive increase in temperature plus steel high heat transmission result in a reduction of the structure's bearing capacity and mechanical resistance. The resistance and elastic limit are modified after 250 °C, and after approximately 500 °C the drop in resistance is significant enough so as not to support its design capacity.

To avoid this, **mercor tecresa®** introduces **Tecwool® F** mortar, tested pursuant to standard UNE ENV 13381-4 to determine the mortar fire protection properties when applied to steel structural elements: beams, pillars or tension members.

Tecwool® F has been designed and tested to cover a great variety of steel profiles characterised by their section factors. Likewise, it is tested for several design temperatures specified in the standard.

COLUMN

BEAM



TESTS

Standard: UNE ENV 13381-4

Laboratory: APPLUS
Test No: 08/32302469

Laboratory: FIRES

Test No: FR-082-09

SOLUTION

1. Steel Profile.
2. **Tecwool® F** (thickness according to the profile's section factor and fire resistance time required).

APPLICATION

Tecwool® F is spread with a pneumatic machine pursuant to the following technical specifications:

The surface to be protected requires no prior primer, mesh or any other type of support for the mortar adherence.

The surface to be protected should be free from dust, oil, waste, poorly attached particles, paint leftover, etc.

It is recommended to use water with the application hose to wash dirt away from the faces. This will also help achieve a thermal balance between the mortar and the applied surface.

Tecwool® F can provide different finishings: rugged, smooth, painted, etc., according to different aesthetic requirements. Once the spread is completed and in order to obtain a smooth finishing, a roller should be used and pressed slightly over the wet mortar until the desired finishing is obtained. It is possible to paint the mortar with elastic acrylic coatings to form a steam barrier. Before painting the mortar should be completely dry (28 days).

Once spread, mortar should be water sprayed superficially to ensure optimum settling of the cement.

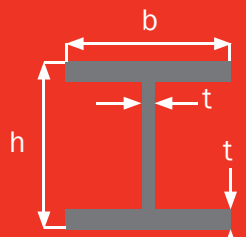


Fig. I

Fig. II - **4 SIDED**
P = 4b + 2h -2t

Fig. III - **3 SIDED**
P = 3b + 2h -2t

Fig. IV - **2 SIDED**
P = 2b + h - t

Fig. V - **1 SIDED**
P = b

SECTION FACTOR CALCULATION

Tecwool® F application on a metal structure is performed covering the entire surface of the profile that could be attacked by fire.

We define the profile section factor (profiled) or mass factor as: the relation between the section of the exposed external perimeter of the structural element itself per unit of length and its volumetric section per unit of length.

To simplify the calculation, the following expression is used:

$$Mass = \frac{P}{A} \ (m^{-1})$$

where:

P = Profile's protected straight section perimeter (m)

A = Profile's straight section area (m^2)

MASS CALCULATION EXAMPLES FOR HEB - 180

HEB - 180 profile measures

h = 180 mm / b = 180 mm / t = 8.5 mm

4 sided "profiled" protection example (See Fig. II)

1.- Perimeter exposed to fire calculation:

P = 4 x b + 2 x h - 2 x t = 4 x 180 + 2 x 180 - 2 x 8,5 = 1063 mm = 1,063 m

2.- Profile section:

$$A = 65{,}3 \ cm^2 = 0{,}00653 \ m^2$$

3.- Section factor:

$$\frac{1{,}063}{0{,}00653} = 162{,}8 \ (m^{-1})$$

2 sided "profiled" protection example (See Fig. IV)

1.- Perimeter exposed to fire calculation:

P = 2b + h - t = 2 x 180 + 180 - 8,5 = 531,5 mm = 0,5315 m

2.- Profile section:

$$A = 65.3 \ cm^2 = 0{,}00653 \ m^2$$

3.- Section factor:

$$\frac{0{,}5315}{0{,}00653} = 81{,}4 \ \ (m^{-1})$$

Once the profile's form factor is known, we should look at the mortar thickness specification chart and find the **Tecwool®** mortar to be applied for that thick mass so as to comply with the required fire resistance.

MORTAR THICKNESS SPECIFICATION CHART ACCORDING TO THE REQUIRED FIRE RESISTANCE AND THE PROFILE'S SECTION FACTOR

The information in this chart appears in the characteristics report under file 08/32302469.

Valid chart for 500 ºC design temperature on steel pursuant to UNE ENV 13381-4.

Masividad (m^{-1})	R 15 min	R 30 min	R 45 min	R 60 min	R 90 min	R 120 min	R 180 min	R 240 min	R 300 min
63	[15]	[15]	[15]	[15]	[17]	[23]	[35]	[47]	[59]
70	[15]	[15]	[15]	[15]	18	24	36	49	61
80	[15]	[15]	[15]	[15]	20	26	38	51	[64]
90	[15]	[15]	[15]	[15]	21	27	40	53	---
100	[15]	[15]	[15]	[15]	22	28	42	55	---
110	[15]	[15]	[15]	16	23	29	43	56	---
120	[15]	[15]	[15]	17	24	30	44	57	---
130	[15]	[15]	[15]	17	24	31	45	58	---
140	[15]	[15]	[15]	18	25	32	45	59	---
150	[15]	[15]	[15]	18	25	32	46	60	---
160	[15]	[15]	[15]	19	26	33	47	61	---
170	[15]	[15]	[15]	19	26	33	47	62	---
180	[15]	[15]	16	19	26	34	48	62	---
190	[15]	[15]	16	20	27	34	48	[63]	---
200	[15]	[15]	16	20	27	34	49	[63]	---
210	[15]	[15]	17	20	27	35	49	[64]	---
220	[15]	[15]	17	20	28	35	49	[64]	---
230	[15]	[15]	17	21	28	35	50	[64]	---
240	[15]	[15]	17	21	28	35	50	[65]	---
250	[15]	[15]	17	21	28	36	50	[65]	---
260	[15]	[15]	17	21	28	36	51	[65]	---
270	[15]	[15]	18	21	29	36	51	---	---
280	[15]	[15]	18	21	29	36	51	---	---
290	[15]	[15]	18	22	29	36	51	---	---
300	[15]	[15]	18	22	29	37	51	---	---
310	[15]	[15]	18	22	29	37	52	---	---
320	[15]	[15]	[18]	[22]	[29]	[37]	[52]	---	---
330	[15]	[15]	[18]	[22]	[29]	[37]	[52]	---	---
340	[15]	[15]	[18]	[22]	[30]	[37]	[52]	---	---