

# 1. STEELWORK PROTECTION

## 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**<sup>®</sup> introduces **Tecwool**<sup>®</sup> 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**<sup>®</sup> 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.

TECWOOL<sup>®</sup> F MORTAR

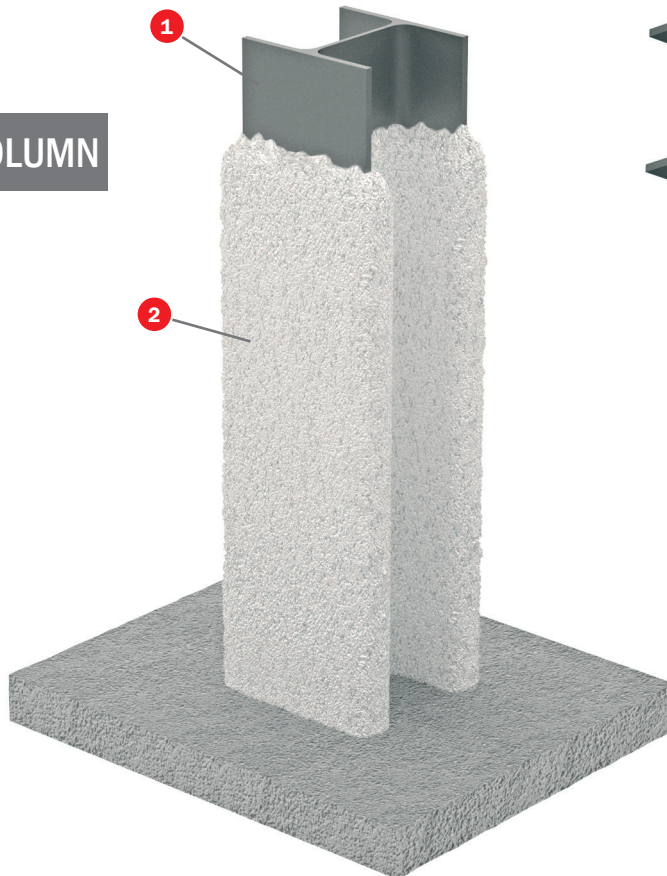
# CONSTRUCTIVE SOLUTIONS

# TECWOOL® F MORTAR

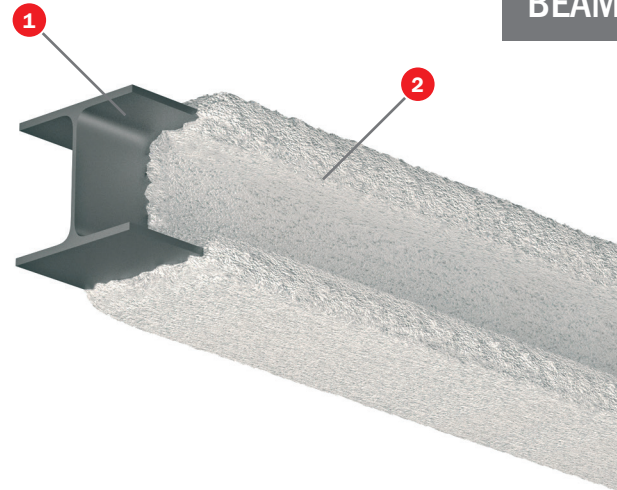
## STEELWORK PROTECTION

### TECWOOL® F MORTAR

COLUMN



BEAM



#### TEST

**Standard:** UNE EN 13381-4

**Laboratory:** TECNALIA

**Test No:** 069497-001

#### 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 finishes: 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 finish 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.

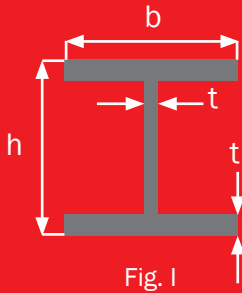


Fig. I

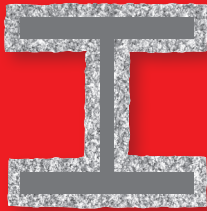


Fig. II - 4 SIDED  
 $P = 4b + 2h - 2t$



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



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

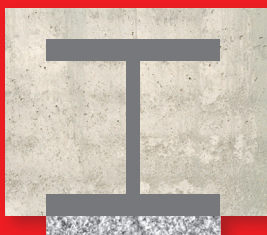


Fig. V - 1 SIDED  
 $P = b$

## 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 or length.

To simplify the calculation, the following expression is used:

$$\text{Masividad} = \frac{P}{A} \quad (m^{-1})$$

where:

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

A = Profile's straight section area (m<sup>2</sup>).

## MASS CALCULATION EXAMPLES FOR HEB - 180

### HEB - 180 profile measures

$$h = 180 \text{ mm} / b = 180 \text{ mm} / t = 8.5 \text{ mm}$$

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

1.- Perimeter exposed to fire calculation:

$$P = 4 \times b + 2 \times h - 2 \times t = 4 \times 180 + 2 \times 180 - 2 \times 8,5 = 1063 \text{ mm} = 1,063 \text{ m}$$

2.- Profile section:

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

3.- Section factor:

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

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

1.- Perimeter exposed to fire calculation:

$$P = 2b + h - t = 2 \times 180 + 180 - 8,5 = 531,5 \text{ mm} = 0,5315 \text{ m}$$

2.- Profile section:

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

3.- Section factor:

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

Once the profile's form factor is known, we should look at the mortar thickness specification chart and find the **Tecwool® F** 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

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

OPEN SECTION BEAMS AND PILARS					CLOSED SECTION BEAMS AND PILARS				
TEST RESULTS UNDER THE EN 13381-4 STANDARD AND CLASSIFICACION UNDER THE EN 13501-2 STANDARD					TEST RESULTS UNDER THE EN 13381-4 STANDARD AND CLASSIFICACION UNDER THE EN 13501-2 STANDARD				
Mass (m <sup>-1</sup> )	R30 min	R60 min	R90 min	R120 min	R 90 min	R30 min	R60 min	R90 min	R120 min
58	10	10	11	21	58	10	10	12	22
70	10	10	16	25	70	10	10	19	27
80	10	10	18	27	80	10	10	20	30
90	10	11	20	29	90	10	12	22	32
100	10	12	22	31	100	10	13	24	34
110	10	14	23	32	110	11	15	25	36
120	10	15	24	33	120	11	16	27	37
130	10	16	25	34	130	11	18	28	39
140	10	16	26	35	140	11	19	29	40
150	10	17	26	36	150	11	20	30	41
160	10	18	27	36	160	11	20	31	42
170	10	18	28	37	170	11	21	32	43
180	10	19	28	37	180	11	22	33	44
190	10	19	28	38	190	11	23	34	45
200	10	19	29	38	200	12	23	35	46
210	10	20	29	39	210	13	24	35	47
220	11	20	29	39	220	13	24	36	47
230	11	20	30	39	230	13	25	37	48
240	11	21	30	39	240	14	26	37	49
250	11	21	30	40	240	14	26	37	49
260	12	21	30	40	260	15	26	38	50
270	12	21	31	40	270	15	27	38	50
280	12	21	31	40	280	15	27	39	50
290	12	22	31	40	290	15	27	39	50
300	12	22	31	41	300	15	27	39	51
310	13	22	31	41	310	16	27	39	51
320	13	22	31	41	320	16	28	39	51
330	13	22	32	41	330	16	28	40	51
340	13	22	32	41	340	16	28	40	51
350	13	22	32	41	350	16	28	40	52
360	13	23	32	41	360	16	28	40	52
370	13	23	32	41	370	17	28	40	52
380	13	23	32	42	380	17	28	40	52
390	13	23	32	42	390	17	29	40	52
400	14	23	32	42	400	17	29	40	52
410	14	23	33	42	410	17	29	41	52
420	14	23	33	42	420	17	29	41	52
430	14	23	33	42	430	17	29	41	52
440	14	23	33	42	440	17	29	41	52
505	14	24	33	43	505	18	30	41	52

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