FIXINOX

STAINLESS STEEL CONNECTORS

ADJUSTABLE FIXING SYSTEMS FOR NATURAL STONE

www.fixinox.com

CONTENTS

FIXINOX
STAINLESS STEEL CONNECTORS

FIXINOX
STAINLESS STEEL CONNECTORS

1. GENERAL DESCRIPTION

The mechanical anchors allow the fixing of natural stones in facing, of low thickness or massive, on a concrete or block masonry support. Each stone is held at 4 fixing points, either load bearing or retaining.

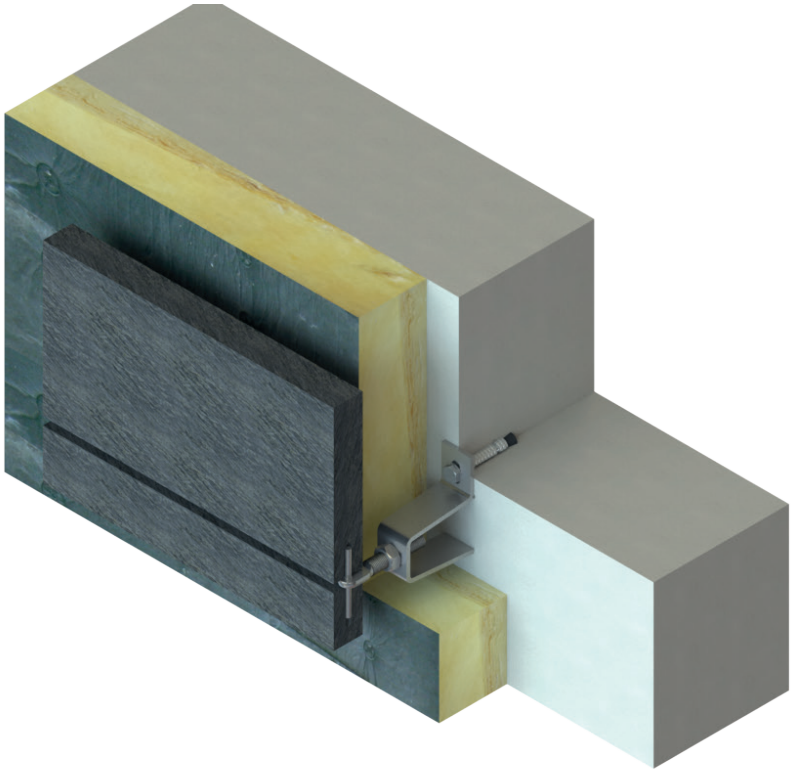
The method avoids the need for a top and bottom support beam. This stone attachment system allows for almost continuous external thermal insulation. This type of fastening contributes to reducing energy consumption costs and to preserving the environment by reducing greenhouse gas emissions.

The stones are supported by stainless steel fasteners placed in the vertical or horizontal joints of the stones. horizontal joints of the stones. These fasteners allow for adjustment during installation with a tolerance of 10 to 15 mm in all three dimensions.

Our in-house design office will propose the layout of the fixings for your project and provide you with a complete file showing the types of stone fixings, their quantity and their position on the façade.

The Fixinox range of stone fixings includes three different systems

- individual mechanical stone ties
- chemically anchored stone ties
- the intermediate frame structure with rail



2. BENEFITS

Natural stone anchors have certain essential characteristics which, in combination, allow both :

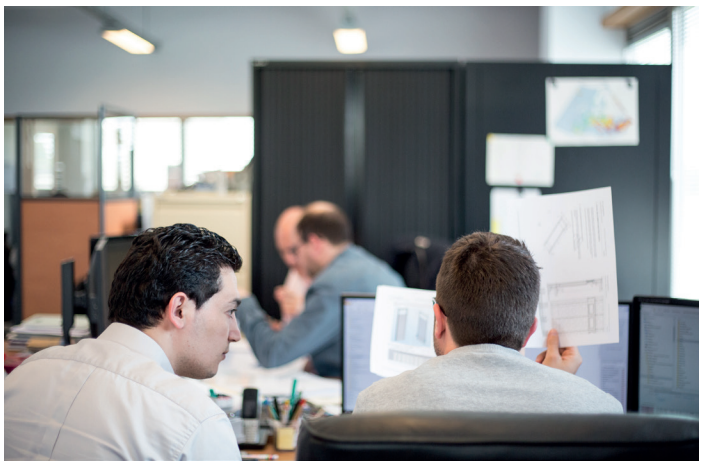
- Fixing the façade stone invisibly with load-bearing and retaining fasteners
- Ensure good continuity of the building's insulation
- Drastically reduce their impact on the energy performance of the building
- Contribute to the protection of the building against the degradation of time
- Guarantee a long-lasting quality through the use of stainless steel
- Adapt to the configuration of the site by manufacturing standard or customised parts.

All our stone ties are adjustable in 3 directions (vertically, horizontally and in depth)
All our stone ties are adjustable in 3 directions (vertically, horizontally and in depth), whether they are mechanical or chemically anchored; this is to facilitate the work of the stone laying teams.

The non-accessibility of the stone ties after installation justifies the choice of A2 (304 L) or A4 (316 L) stainless steel which does not require inspection or maintenance.

All our stone ties are designed by our design office and manufactured in our workshops.

Our design office offers to draw up an anchoring plan for your project, including an inventory of the stone ties and a complete technical file containing the calculation notes justifying the types of ties proposed.



Fixinox engineering office

Manufacturing workshop

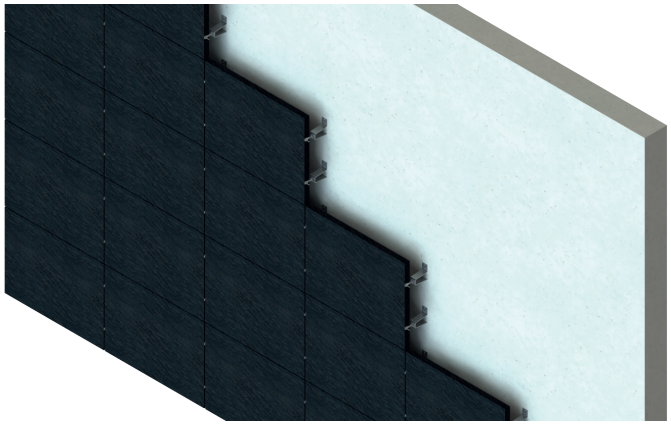
3. METHOD OF CALCULATION

Each stone tie takes a vertical and/or horizontal load. For this reason, we have divided them into two categories: load-bearing and restraining clips. Only load-bearing ties are able to take all or part of the weight of the stone in addition to a wind load. Restraining clips only take up a wind load (tension/compression).

All stone ties have a pin with a boss. This pin is inserted into a hole previously made in the thickness of the stone and ensures its anchorage while
This pin is inserted into a hole in the stone thickness and ensures that it is anchored, while at the same time guaranteeing that the stone can expand freely as a result of temperature and humidity variations.

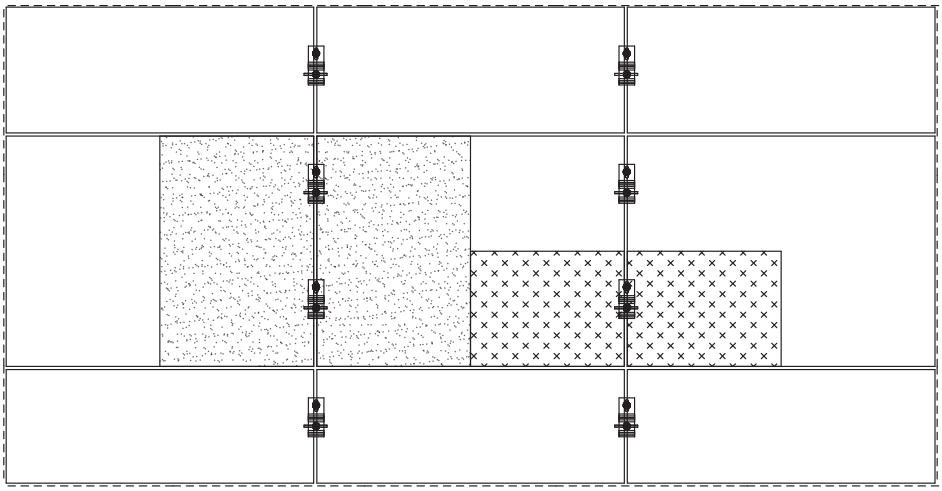
Depending on the configuration of the façade, the ties are placed in the vertical or horizontal joints of the stones.
horizontal joints of the stones.

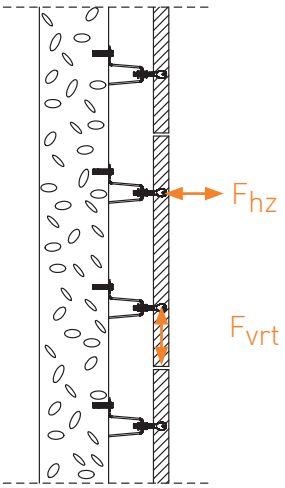
This difference is important for the calculation of the load-bearing capacity.



Fasteners in vertical joints

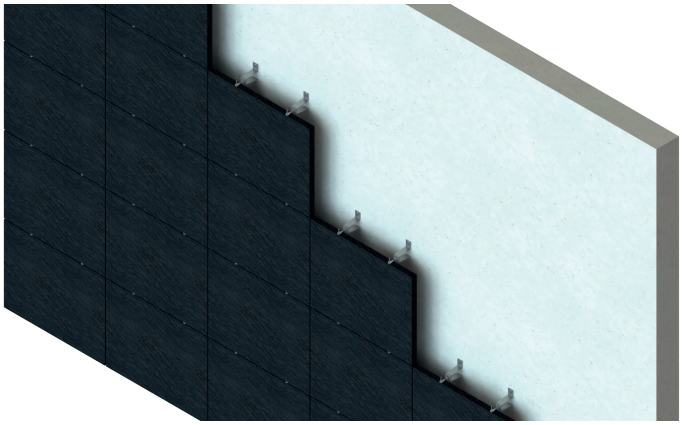
Wind forces: Case of fixings in vertical joints





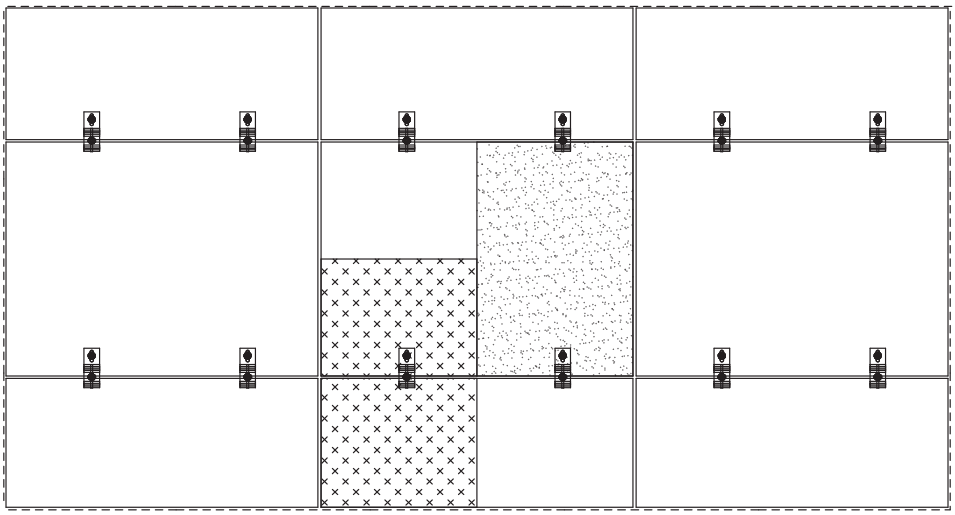
F_{hz} = 1/2 stone

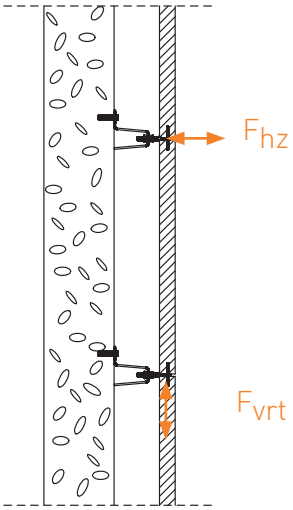
F_{vrt} = 1/2 stone



Fasteners in horizontal joints

Wind forces: Case of fixings in horizontal joints





F_{hz} = 1/2 stone

F_{vrt} = 1/2 stone

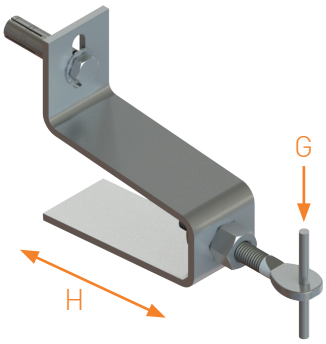
All stone ties are designed by our engineering department and are all subject to a calculation note based on the characteristics of the stone and the Eurocodes.

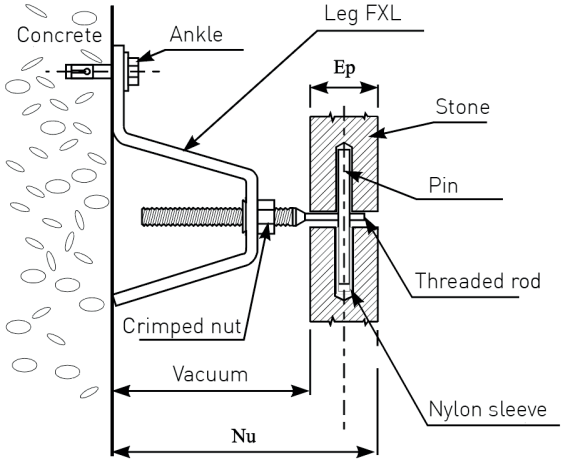
Despite all the care taken in writing this catalogue, it is not exhaustive. Not all possible fixing situations could be
not all possible fixing situations could be represented and the design office can find a solution for each case of a construction site.

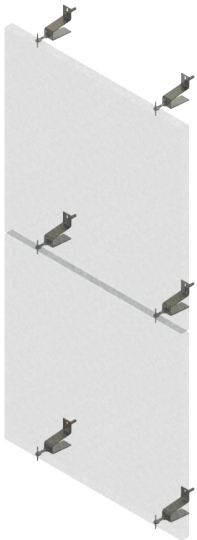
4. MECHANICAL FASTENERS

A. LOAD-BEARING MECHANICAL FASTENERS

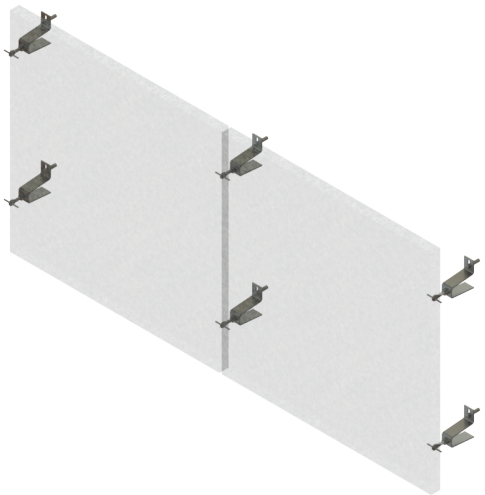
FXL FX with two loose nuts







Horizontal joints

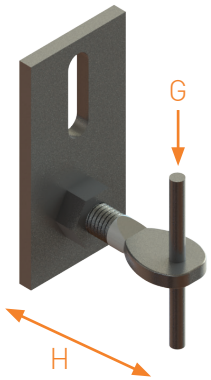


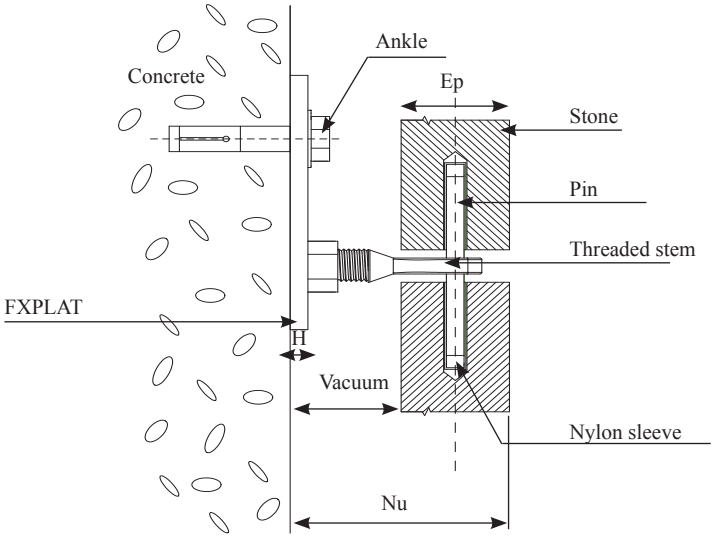
Vertical joints

Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 FXL bracket, 1 threaded rod (see TF), 2 nuts, 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: FXL H / G (daN) / Type
Example: FXL 80 / 60 / 1

DIMENSIONAL CHARACTERISTICS AND LOADS			
NAME	**THEORETICAL VOID (MM) Tolerance +/- 10 mm**	**LOAD CAPACITY G (daN)**	**METRIC THREADED ROD**
FXL 40	70	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 70	100	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 90	120	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 110	140	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 130	160	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 150	180	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 170	200	30	M10
		45	M12
		60	M12
		75	M14
		90	M14

FXPLAT FX with a welded nut

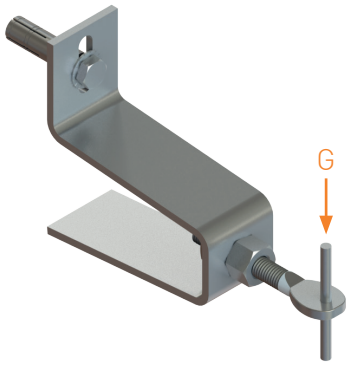


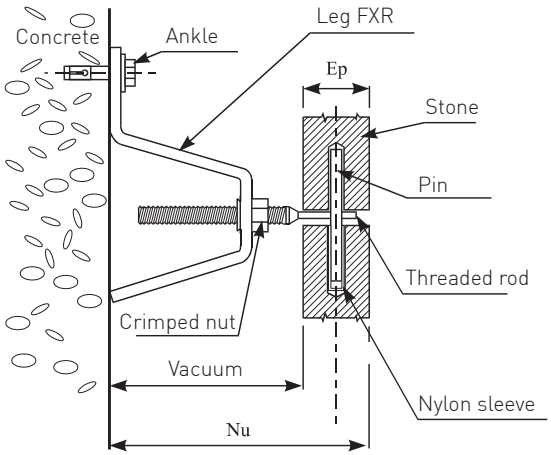


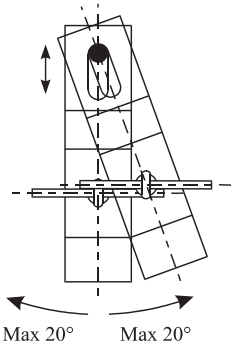
Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 FXPLAT bracket, 1 threaded rod (see TF), 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half welded pin
Type 3 = half pin free
Designation: FXPLAT H / G (daN) / Type
Example: FXPLAT 40 / 30 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS				
NAME	**H (mm)**	**THEORETICAL VOID (MM) Tolerance +/- 10 mm**	**LOAD CAPACITY G (daN)**	**METRIC THREADED ROD**
FXPLAT O	4 + 8 mm nut	30	30	M10
FXPLAT O	4 + 10 mm nut	30	60	M12

FXR FX with a crimped nut



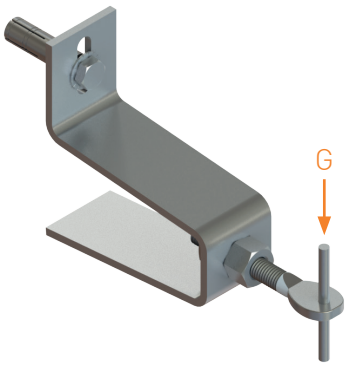


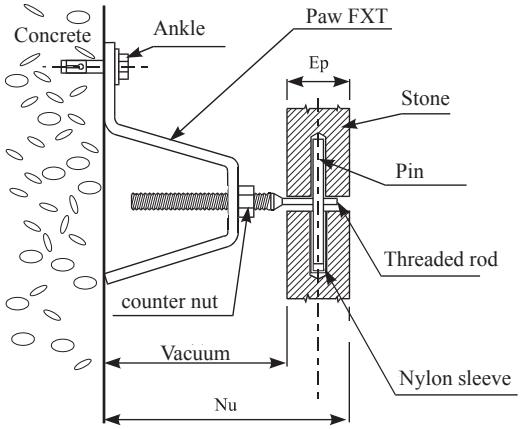


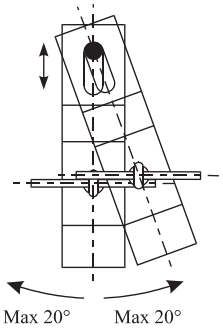
Material: This type of fastener is available in stainless steel A2 and stainless steel A4.
Composition: 1 FXR bracket, 1 threaded rod (see TF), 1 pin and 1 dowel.
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: FXR H / G (daN) / Type
Example: FXR 40 / 30 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS			
NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	PERMISSIBLE LOAD G (daN)	METRIC THREADED ROD
FXR 20	50	30	M10
FXR 40	70	30	M10
FXR 60	90	30	M10
FXR 80	110	30	M10

FXT FX tapped with a locknut





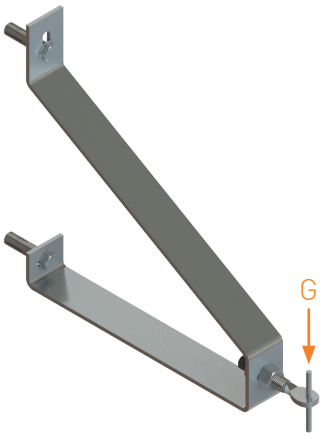


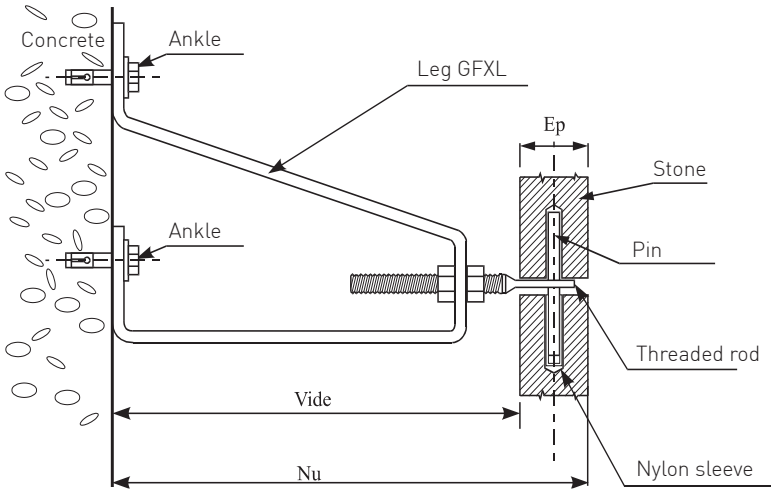
Material: This type of fastener is available in A2 stainless steel and A4 stainless steel
Composition: 1 FXT bracket, 1 threaded rod (see TF), 1 nut, 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: FXT H / G (daN) / Type
Example: FXT 40 / 60 / 1
Example: FXT 40 / 30 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS			
NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	METRIC THREADED ROD
FXT 20	50	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXT 40	70	30	M10
		45	M12
		60	M12
		90	M14
		75	M14
FXT 60	90	30	M10
		45	M12
		60	M12
		75	M14
		90	M14

NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	METRIC THREADED ROD
FXT 80	110	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXT 100	130	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXT 120	150	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXT 140	170	30	M10
		45	M12
		60	M12
		75	M14
		90	M14

GFXL FX for high vacuum



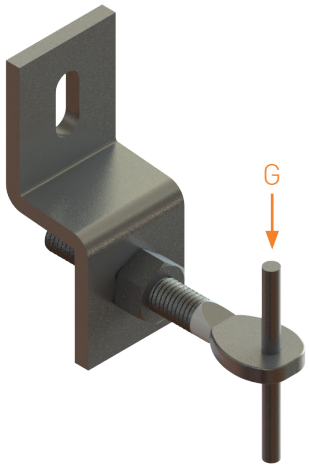


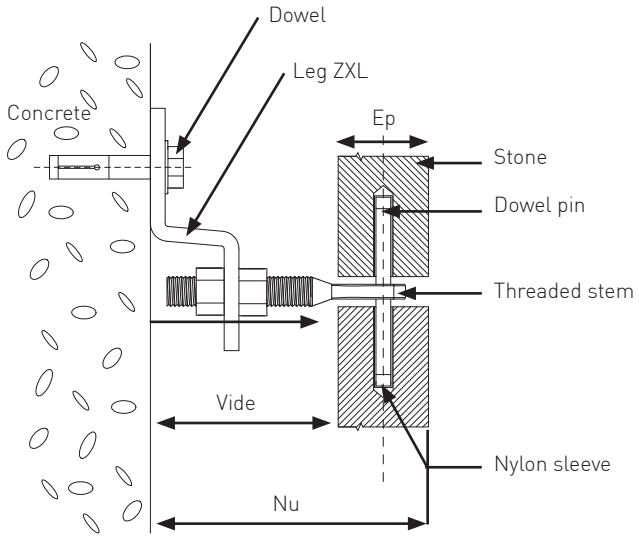
Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 GFXL bracket, 1 threaded rod (see TF), 2 nuts, 1 pin and 1 or 2 dowels
Type: Type 1 = full pin
Type 2 = half welded pin
Type 3 = half pin free
Designation: GFXL H / G (daN) / Type
Example: GFXL 280 / 60 / 3

DIMENSIONAL CHARACTERISTICS AND LOADS				
NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	METRIC THREADED ROD	NUMBER OF PEGS
GFXL 180	210	30	M10	1
		45	M12	1
		60	M12	1
		75	M14	1
		90	M14	1
GFXL 210	240	30	M10	1
		45	M12	1
		60	M12	1
		75	M14	1
		90	M14	1
GFXL 240	270	30	M10	1
		45	M12	1
		60	M12	1
		75	M14	1
		90	M14	1
GFXL 270	300	30	M10	1
		45	M12	1
		60	M12	1
		75	M14	1
		90	M14	1
GFXL 300	330	30	M10	2
		45	M12	2
		60	M12	2
		75	M14	2
		90	M14	2
GFXL 330	360	30	M10	2
		45	M12	2
		60	M12	2
		75	M14	2
		90	M14	2
GFXL 360	390	30	M10	2
		45	M12	2
		60	M12	2
		75	M14	2
		90	M14	2
GFXL 390	420	30	M10	2
		45	M12	2
		60	M12	2
		75	M14	2
		90	M14	2
GFXL 420	450	30	M10	2
		45	M12	2
		60	M12	2
		75	M14	2
		90	M14	2

NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	METRIC THREADED ROD	NUMBER OF PEGS
GFXL 450	480	30	M10	2
		45	M12	2
		60	M12	2
		75	M14	2
		90	M14	2

ZXL Z-shaped leg

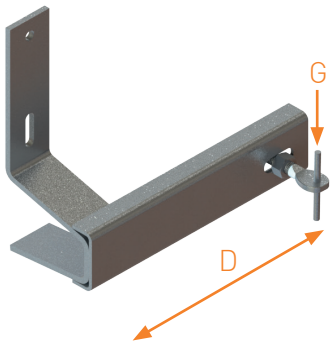


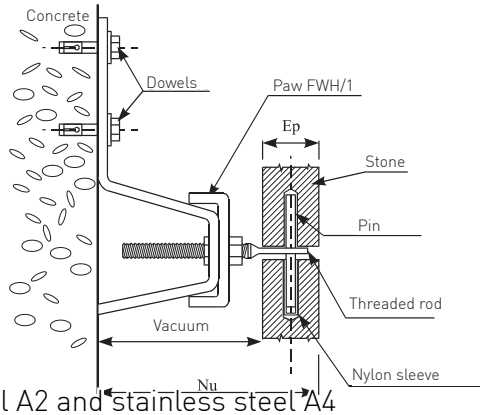


Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 ZXL bracket, 1 threaded rod, 2 nuts, 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: ZXL H / G (daN) / Type
Example: ZXL 45 / 30 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS			
NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	METRIC THREADED ROD
ZXL 25	55	30	M10
		45	M12
		60	M12
ZXL 35	65	30	M10
		45	M12
		60	M12
ZXL 45	75	30	M10
		45	M12
		60	M12

FXH/1 FX horizontally offset with a threaded rod





Material: This type of fastener is available in stainless steel A2 and stainless steel A4

Delivery comprises: 1 FXH/1 bracket, 1 threaded rod (see TF), 2 nuts, 1 pin and 2 dowels

Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free

Designation: FXH/1 H / D / G (daN) / Type / Cantilever side (R for Right or L for Left)

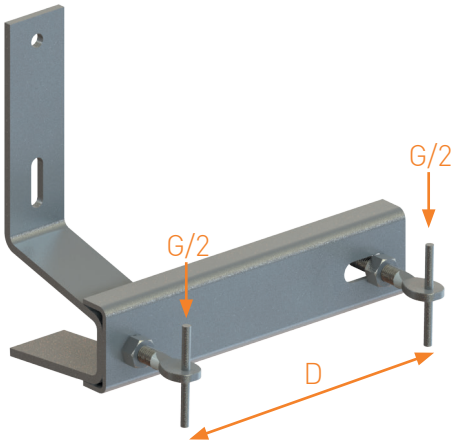
Example: FXH/1 80 / 150 / 60 / 2 / L

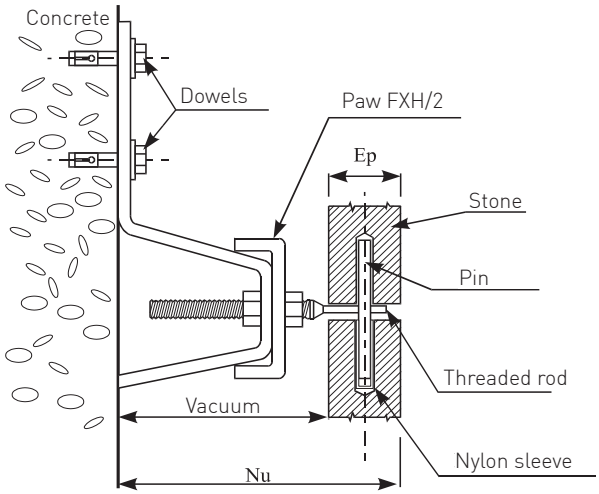
DIMENSIONAL CHARACTERISTICS AND LOADS

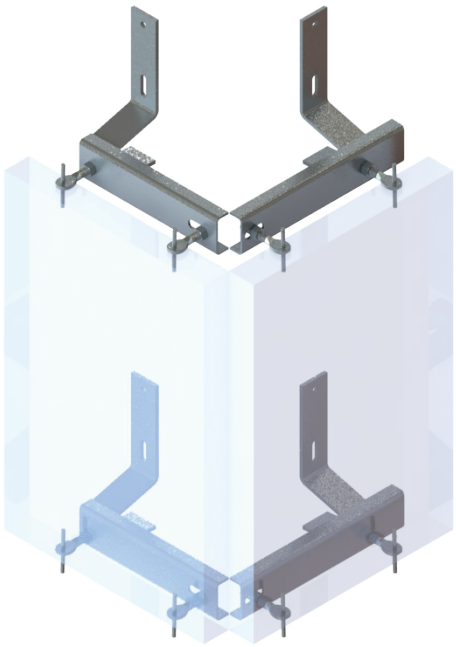
NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	D (mm)	METRIC THREADED ROD
FXH/1 40	70	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/1 60	90	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/1 80	110	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	

NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	D (mm)	METRIC THREADED ROD
FXH/1 100	130	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/1 120	150	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/1 140	170	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/1 160	190	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/1 180	210	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	

FXH/2 FX horizontally offset with two threaded rods





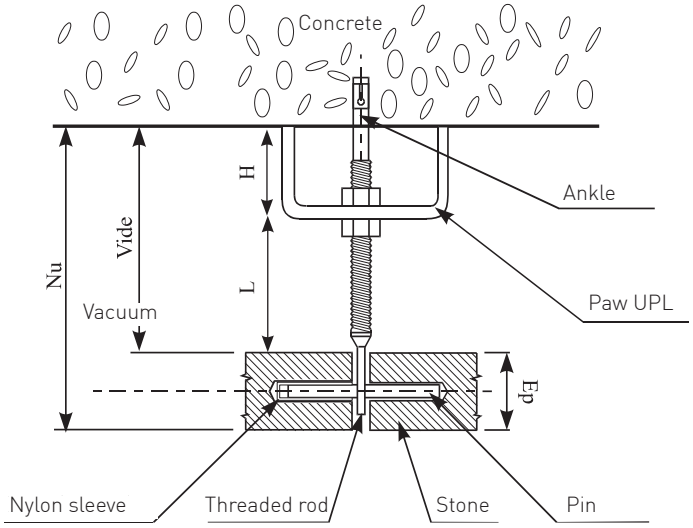


Material:	This type of fastener is available in stainless steel A2 and stainless steel A4
Delivery comprises:	1 FXH/2 bracket, 2 threaded rods (see TF), 4 nuts, 2 pins and 2 dowels
Type:	Type 1 = full pin
	Type 2 = half welded pin
	Type 3 = half free pin
Designation:	FXH/2 H / D / G (daN) / Type / Cantilever side (R for Right or L for Left)
Example:	FXH/2 80 / 150 / 60 / 1 / R

DIMENSIONAL CHARACTERISTICS AND LOADS				
NAME	**THEORETICAL VOID (MM) Tolerance +/- 10 mm**	**LOAD CAPACITY G (daN)**	**D (mm)**	**METRIC THREADED ROD**
FXH/2 40	70	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/2 60	90	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/2 80	110	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/2 100	130	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/2 120	150	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	

NAME	THEORETICAL VOID (MM) Tolerance +/- 10 mm	LOAD CAPACITY G (daN)	D (mm)	METRIC THREADED ROD
FXH/2 140	170	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/2 160	190	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	
FXH/2 180	210	30	100	M10
			150	
			200	
		45	100	M12
			150	
			200	
		60	100	M12
			150	
			200	

UPL U-profile in ceiling



Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 UPL bracket, 1 threaded rod, 2 nuts, 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: UPL H / L / G (daN) / Type
Example: UPL 45 / 90 / 30 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS

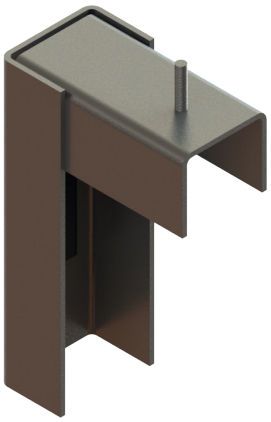
NAME	H (mm)	L ± 20 mm	AXIAL LOAD CAPACITY G (daN)	METRIC THREADED ROD
UPL 25	25	20	100	M10
			100	
			100	
		35	100	
			100	
			100	
UPL 35	35	40	100	M10
			100	
			100	
		50	100	
			100	
			100	
UPL 45	45	45	100	M10
			100	
			100	
		65	100	
			100	
			100	
		85	100	
			100	
			100	
		105	100	
			100	
			100	

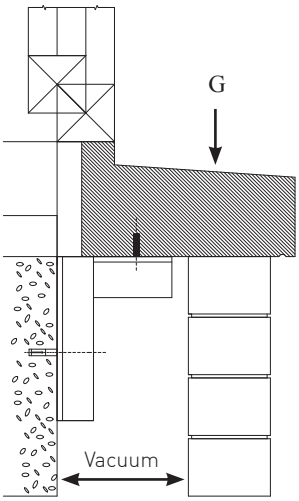
B. THRESHOLD SUPPORTS

As a result of the desire to increase the energy performance of the building and to avoid thermal bridges, the sills of the windows or French windows are detached from the load-bearing masonry on which they were supported and rest on sill angles.
on which they were supported and rest on sill brackets. The type of sill bracket depends on the weight of the sill and its overhang. The dimensioning and layout of these brackets is carried out by our internal design office. These parts are made to measure in our workshops.

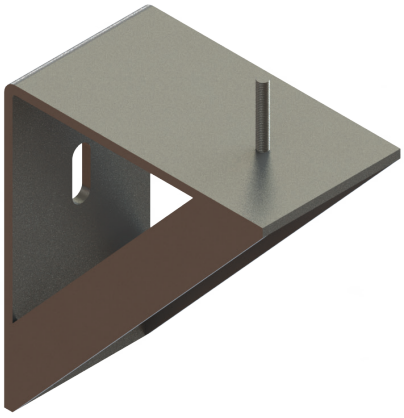
Here are 2 examples of these sill brackets:

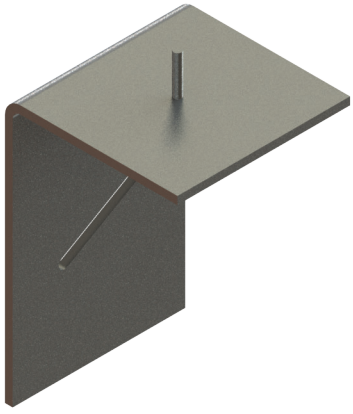
DUS Double U for Threshold





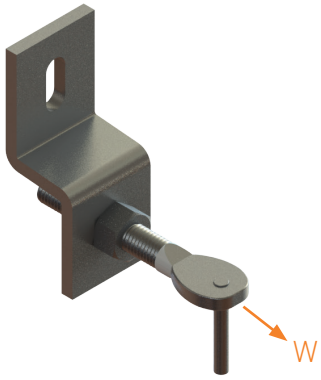
EQS Square for Threshold

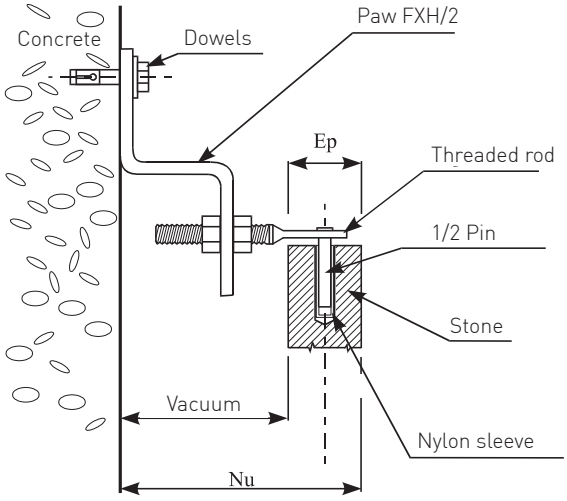




C. MECHANICAL RESTRAINTS

ZWL Z-shaped leg

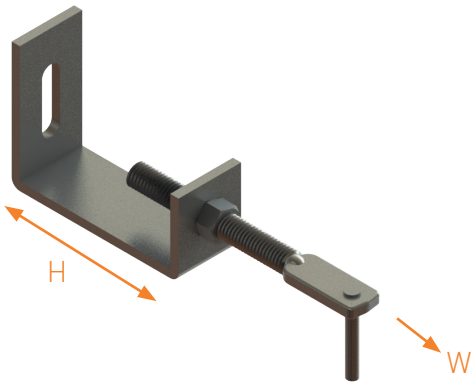


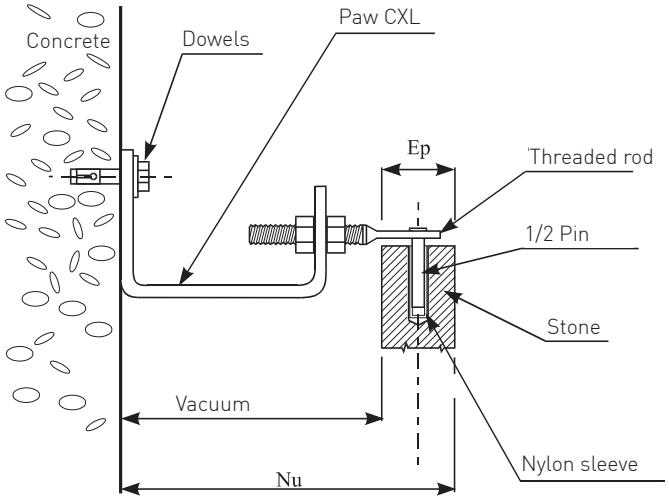


Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Content: 1 ZWL bracket, 1 threaded rod, 2 nuts, 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: ZWL H / L / W (daN) / Type
Example: ZWL 45 / 60 / 30 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS				
NAME	**THEORETICAL VOID (MM) Tolerance +/- 10 MM**	**L ± 10 mm**	**PERMISSIBLE HORIZONTAL LOAD W (daN)**	**METRIC THREADED ROD**
ZWL 25	55	30	30	M8
			45	
			60	
		30	30	
			45	
			60	
ZWL 35	65	40	30	M8
			45	
			60	
		50	30	
			45	
			60	
ZWL 45	75	45	30	M8
			45	
			60	
		60	30	
			45	
			60	

CXL C-shaped tab



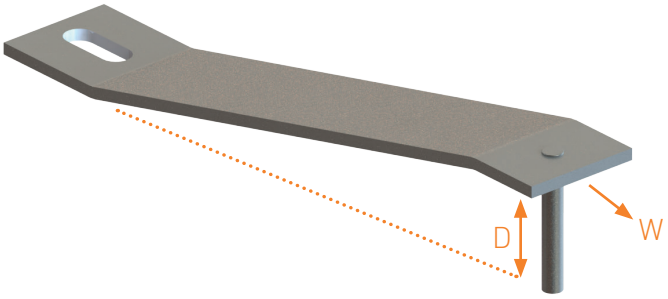


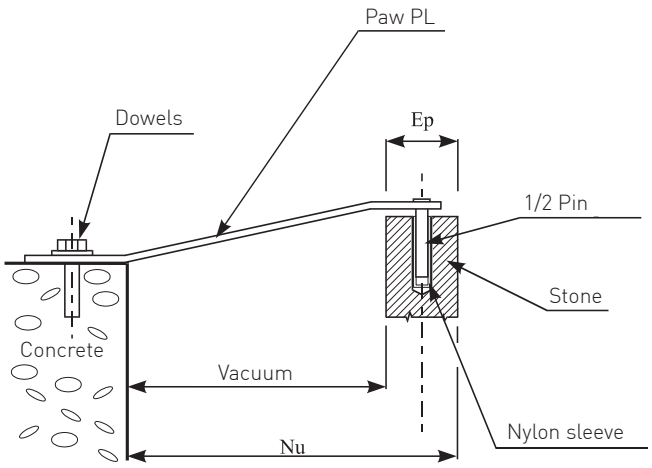
Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 CXL bracket, 1 threaded rod, 2 nuts, 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half free pin
Designation: CXL H / L / W (daN) / Type
Example: CXL 60 / 150 / 30 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS

NAME	H (mm)	L ± 10 mm	PERMISSIBLE HORIZONTAL LOAD W (daN)	METRIC THREADED ROD
CXL 60	60	45	30	M8
			45	
			60	
		60	30	
			45	
			60	
		90	30	
			45	
			60	
		150	30	
			45	
			60	
CXL 80	80	45	30	M8
			45	
			60	
		60	30	
			45	
			60	
		90	30	
			45	
			60	
		150	30	
			45	
			60	

PL Retaining plate at the head of the wall





Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 PL bracket, 1 pin and 1 dowel
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: PL Empty / D - W (daN) / Type
Example: PL 160 / 30 - 45 / 3

DIMENSIONAL CHARACTERISTICS AND LOADS

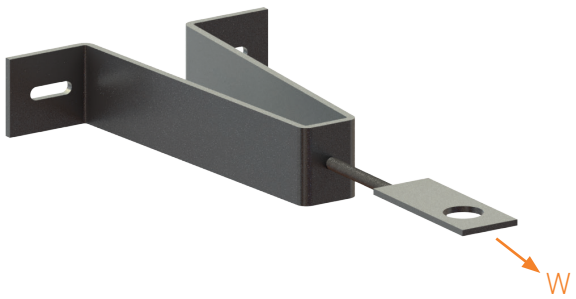
NAME	THEORETICAL VOID (MM) Tolerance +/- 10 MM	VACUUM (mm)	D (mm)	PERMISSIBLE HORIZONTAL LOAD W (daN)
PL 140	50	140	0	30
				45
				60
			30	30
				45
				60
PL 160	70	160	0	30
				45
				60
			30	30
				45
				60
PL 180	90	180	0	30
				45
				60
			30	30
				45
				60
PL 200	110	200	30	30
				45
				60
			60	30
				45
				60

NAME	THEORETICAL VOID (MM) Tolerance +/- 10 MM	VACUUM (mm)	D (mm)	PERMISSIBLE HORIZONTAL LOAD W (daN)
PL 220	130	220	30	30
				45
				60
			60	30
				45
				60
PL 240	150	240	30	30
				45
				60
			60	30
				45
				60

FXEC FX Scaffolding Bracket

Scaffolding is necessary for the installation of a stone façade. We have therefore developed a stainless steel anchor that fulfils three essential functions:

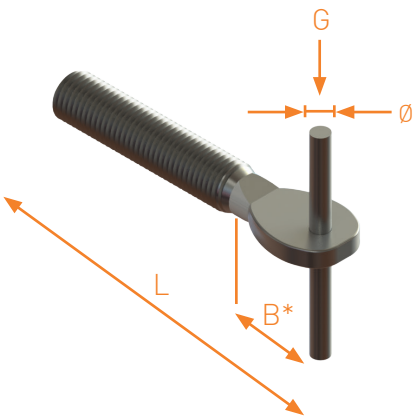
1. To secure the scaffolding and therefore the people on it
2. To make this anchor invisible after the scaffolding has been dismantled
3. To be able to reuse these anchors during a later intervention on the façade

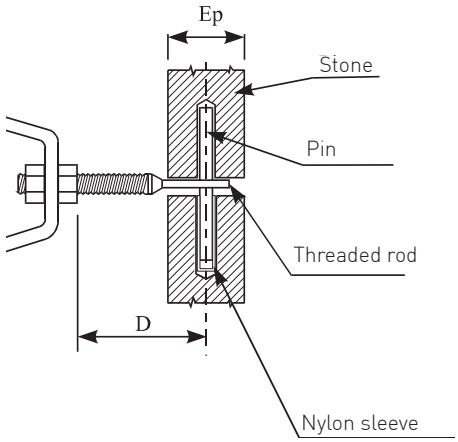


Permissible load in tension and compression = 250 daN

D. ACCESSORIES FOR ADJUSTABLE LEGS TYPE FX, U, ZX AND CX

TF Threaded rod





B depends on the thickness of the stone (3, 4 or 5 cm)

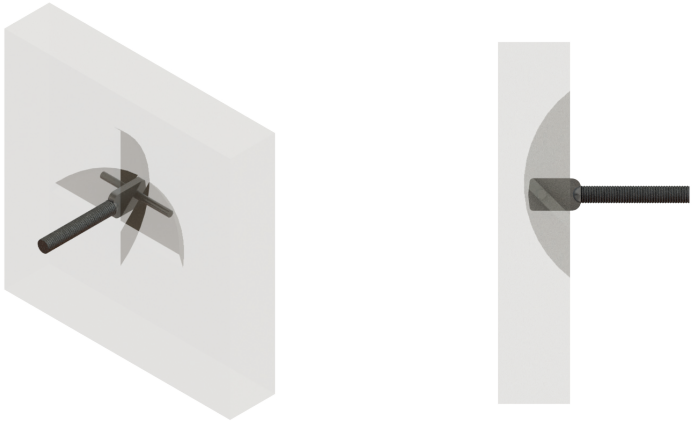
Material: This type of fastener is available in A2 stainless steel and A4 stainless steel
Composition: 1 TF and 1 pin
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: TF Metric x L / B diameter Ø / Type
Example: TF M10x80/25 Ø 5 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS						
NAME	METRIC	L (mm)	B (mm)	Diameter D Ø (mm)	LEVER ARM D (mm)	LOAD CAPACITY G (daN)
TF M10x	10	60	25/30	5-6	30	62
		70			40	47
		80			50	37
		90			60	31
		100			70	27
		120			90	21
		150			120	15
TF M12x	12	70	25/30	5-6	40	71
		80			50	72
		90			60	59
		100			70	50
		120			90	38
		150			120	28
TF M14x	14	80	30/30	5-6	50	120
		90			60	99
		100			70	83
		120			90	63
		150			120	47

DOR Dorsal

The back stone clamp is used in cases where it is not possible to fit a standard stone clamp in the field of the stone.

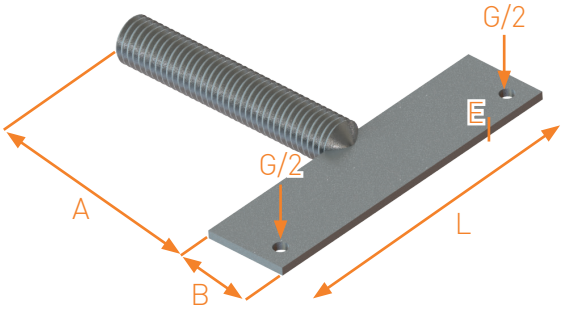
The back stone clamp is identical to a standard stone clamp with a solid pin (type 1). The only difference is the installation of this fastener.

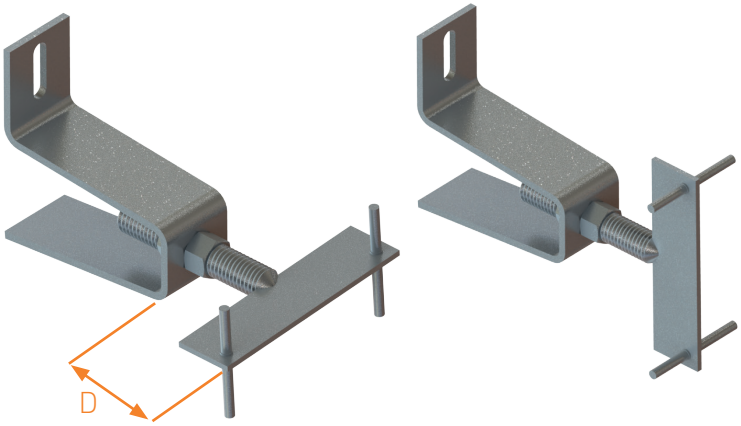


The installation of this back brace consists of :

1. Making a vertical bleed at the location where the back brace is to be implanted
2. In the middle of this vertical kerf, make a horizontal kerf oriented at 45° upwards in the thick ness of the stone.upwards in the thickness of the stone
3. Fill both kerfs with a chemical product compatible with the stone to be laying
4. Place and adjust the back clamp so that the flat of the threaded rod enters the vertical groove and the pin enters the horizontal groove. vertical groove and that the pin enters the horizontal groove

AVT Centred aircraft tab

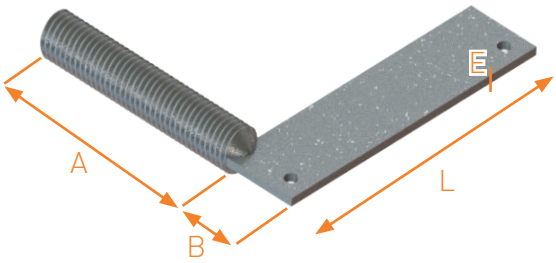


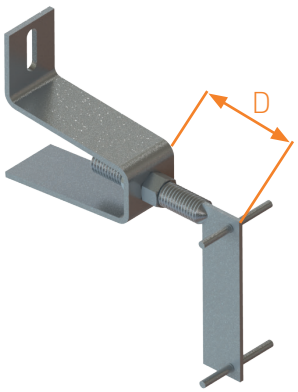


Material: This type of fastener is available in A2 stainless steel and A4 stainless steel
Composition: 1 AVT bracket and 2 pins
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: AVT Metric x A / L x B x E / 1
Example: AVT M10x60 / 165x30x3 / 1

DIMENSIONAL CHARACTERISTICS AND LOADS						
NAME	METRIC	A (mm)	L (mm)	B X E (mm X mm)	LEVER ARM D(mm)	LOAD CAPACITY G (daN)
AVT	M10	50	65	30 x 3	50	37
			75			
			95			
			115			
			165			
		60	65		60	31
			75			
			95			
			115			
			165			
		70	65		70	27
			75			
			95			
			115			
			165			
AVT	M12	50	75	30 x 4	50	72
			95			
			115			
			165			
			215			
		60	75		60	59
			95			
			115			
			165			
			215			
		70	75		70	50
			95			
			115			
			165			
			215			

AVL On-board aircraft leg



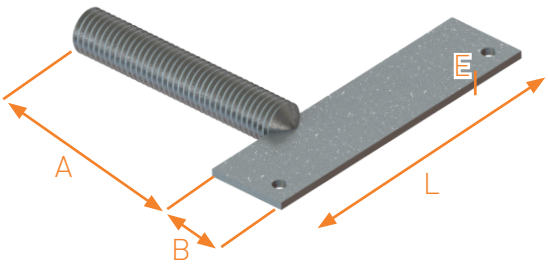


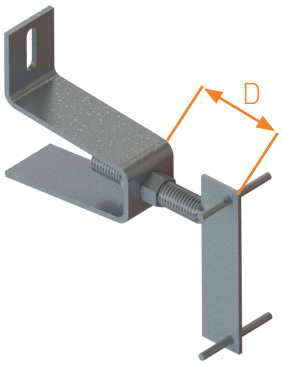
Material: This type of fastener is available in A2 stainless steel and A4 stainless steel
Delivery comprises: 1 AVL bracket and 2 pins
Designation: AVL Metric x A / L x B x E
Example: AVL M10x60 / 165x30x3

DIMENSIONAL CHARACTERISTICS AND LOADS						
NAME	METRIC	A (mm)	L (mm)	B X E (mm X mm)	LEVER ARM D(mm)	LOAD CAPACITY G (daN)
AVL	M10	50	65	30 x 3	50	25
			75			
			95			
			115			
			165			
		60	65		60	20
			75			
			95			
			115			
			165			
		70	65		70	17
			75			
			95			
			115			
			165			

NAME	METRIC	A (mm)	L (mm)	B X E (mm X mm)	LEVER ARM D (mm)	LOAD CAPACITY G (daN)
AVL	M12	50	75	30 x 4	50	52
			95			
			115			
			165			
			215			
		60	75		60	42
			95			
			115			
			165			
			215			
		70	75		70	37
			95			
			115			
			165			
			215			

AV Off-centre aircraft tab

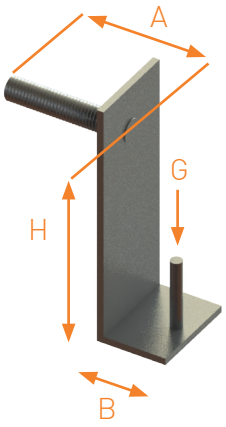


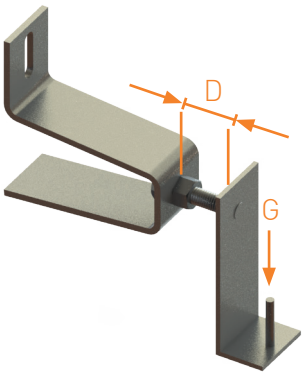


Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 AV bracket and 2 pins
Designation: AV Metric x A / L x B x E - L1 / L2
Example: AV M10x60 / 165x30x3 - 115/50

DIMENSIONAL CHARACTERISTICS AND LOADS						
NAME	**METRIC**	**A (mm)**	**L (mm)**	**B X E (mm X mm)**	**LEVER ARM D (mm)**	**LOAD CAPACITY G (daN)**
AV	M10	50	65	30 x 3	50	25
			75			
			95			
			115			
			165			
		60	65		60	20
			75			
			95			
			115			
			165			
		70	65		70	17
			75			
			95			
			115			
			165			
AV	M12	50	75	30 x 4	50	52
			95			
			115			
			165			
			215			
		60	75		60	42
			95			
			115			
			165			
			215			
		70	75		70	35
			95			
			115			
			165			
			215			

TQR Threaded rod + 1 bracket + ½ welded pin





Material: This type of fastener is available in A2 stainless steel and A4 stainless steel
Delivery comprises: 1 TQR/1 bracket
Designation: TQR/1 Metric x A / B / H Ø
Example: TQR/1 M10 x 60 / 30 / 85 Ø 5

DIMENSIONAL CHARACTERISTICS AND LOADS							
NAME	METRIC	A (mm)	B (mm)	H (mm)	Diameter Ø (mm)	LEVER ARM D (mm)	LOAD CAPACITY G (daN)
TQR/1	M10	50	30	85	5	50	35
		60				60	29
		70				70	25
		50		135		50	35
		60				60	29
		70				70	25
TQR/1	M12	50	30	85	5	50	61
		60				60	51
		70				70	44
		50		135		50	61
		60				60	51
		70				70	44
TQR/1	M14	50	35	85	5	50	99
		60				60	82
		70				70	70
		50		135		50	99
		60				60	82
		70				70	70

TRI Return triangle

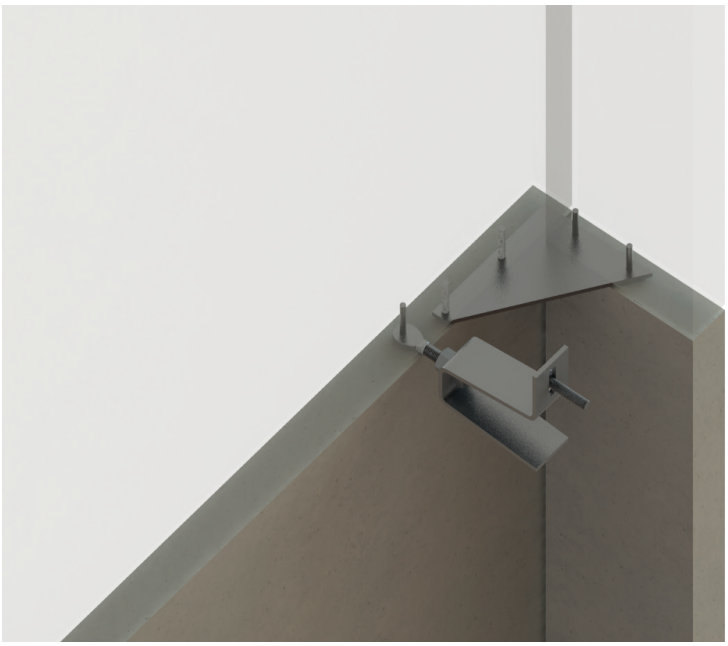
Return stones in the transom or in the arch can be fixed in some cases by corner or lintel triangles. This stone attachment consists of a rectangular triangle placed in the joint between the stones. This return triangle transfers the load from the return stone to the main stone to which it is attached. It must be ensured that the anchors of the main stone, to which these triangles are attached, can take the weight of the main stone and the weight of the return stone(s).

There are two possible scenarios:

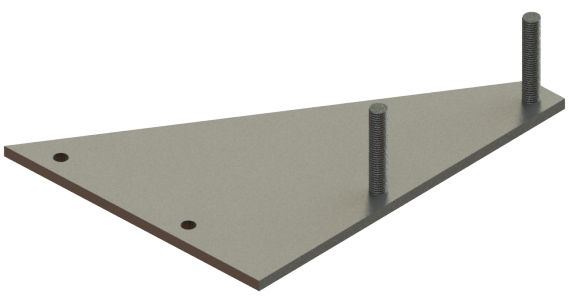
TRIC Corner triangle

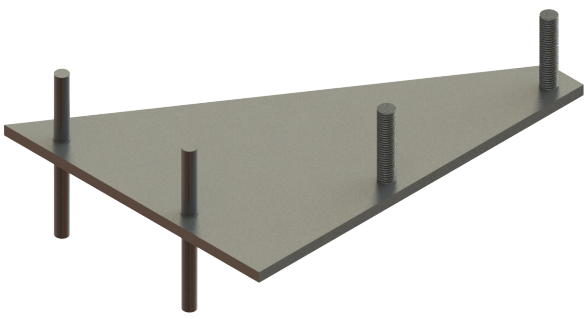
This triangle is used to transfer the weight of the stones in the panel to the main façade stone.
façade stone.
It consists of a triangle with 2 holes and 2 welded threaded rods.
The installation of this corner triangle consists of :

1. Place the triangle in the horizontal joint between the two stones
2. Drill holes in the main stone at the the threaded rods and the return stone at the the holes in the triangle
3. Chemically anchor the threaded rods into the main stone
4. Place two pins through the two holes in the return stone



Material: This type of fastener is available in stainless steel A2 and stainless steel A4
Composition: 1 triangle with 2 welded threaded rods, 2 pins
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: TRIC / Type
Example: TRIC / 2



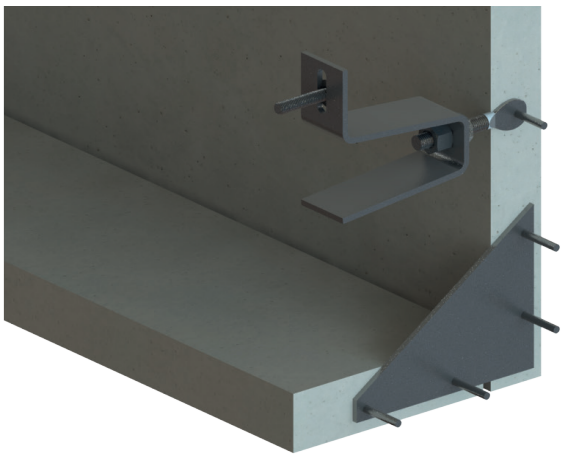


TRIL Lintel triangle

This triangle is used to transfer the weight of the arch stone to the front stone.

The installation of this lintel triangle consists of :

1. Place the triangle (which has 4 holes) in the vertical vertical joint
2. Drill the main stone and the voussoir stone at the holes in the triangle
3. Place the 4 pins through the holes of the triangle



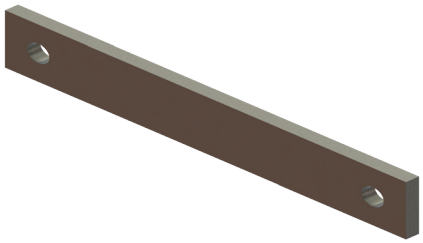
Material: This type of fastener is available in A2 stainless steel and A4 stainless steel
Composition: 1 triangle with 4 holes and 4 pins
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: TRIL / Type
Example: TRIL / 1

CAV Rider

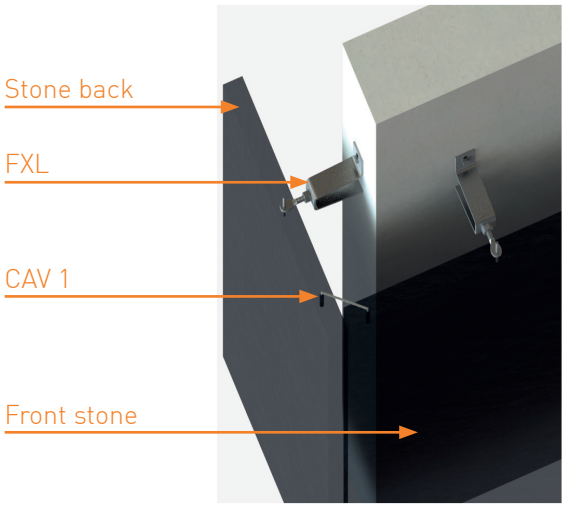
The rider mechanically reinforces and secures the callus of the main facade stone or connects two independently anchored stones. The rider consists of either a wire bent into a U-shape (CAV 1) or a flat and two pins (CAV 2).

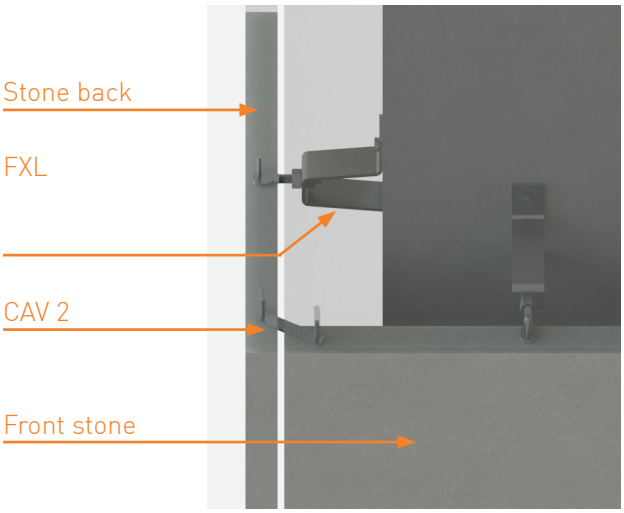
The flat rider is placed in the joint between two adjacent stones. The U-shaped rider is placed in the field of an isolated stone. In both cases, the rider is never used to transfer weight or wind loads.

CAV 1

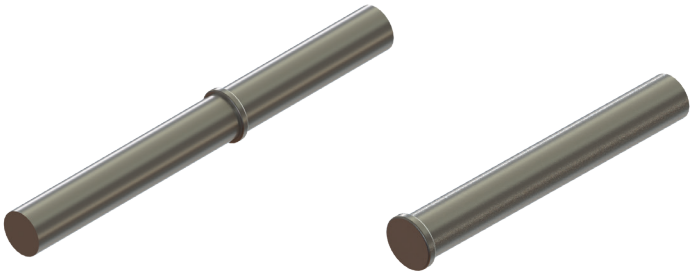


CAV 2



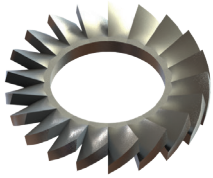


GOU Pin



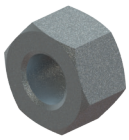
G 5x60 + B: Pin diam 5, 60 mm long, Boss
G 6x60 + B: Pin diam 6, 60 mm long, Boss
G 5x35 + B: Half pin diam 5, 35 mm long, Boss
G 6x35 + B: Half pin diam 6, 35 mm long, Boss

REV Fan washer



EV-M8
EV-M10
EV-M12

DIN 934 Nut



DIN 934 -M8
DIN 934 - M10
DIN 934 - M12
DIN 934 -M14
DIN 934 - M16
DIN 934 - M20

CHE1 Hammer dowel for non-cracked concrete

CHE1-M8

CHE2 Expansion dowel for concrete blocks and sand-lime blocks

CHE2-M8

CHE3 Expansion dowel

The FAZ are intended for use in cracked concrete

ARTICLE FISHER	DESIGNATION ITEM NO. CUSTOMER
F507555	Stainless steel dowel FBN II 8/10 A4-50/bte
F507558	Stainless steel dowel FBN II 10/10 A4-50/bte
F507563	Stainless steel dowel FBN II 12/10 A4-20/bte
F501396	Stainless steel dowel FAZ II 8/10 A4-50/bte
F501403	Stainless steel dowel FAZ II 10/10 A4-50/bte
F501413	Stainless steel dowel FAZ II 12/10 A4-20/bte

E. CHEMICAL SEAL

FIXOCHIM Styrene-free vinylester resin

Use:

- Sealing of threaded rod M8 to M30 electrogalvanised and stainless steel A2-70 OR A4-70
- Sealing of reinforcing bars Ø8 to 32mm

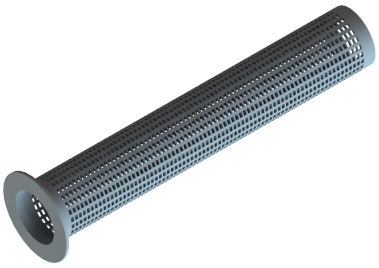
Advantages:

- 2 ATE: Threaded rod (M8 to M30) in cracked/non-cracked concrete
  Reinforcing bars (Ø8 to 25mm)
- Fire resistance (F120)
- Can be used under seismic action (category C1 performance) for sealing threaded rods (>M12 and (>M12) and reinforcing bars (> Ø12)

Pistol

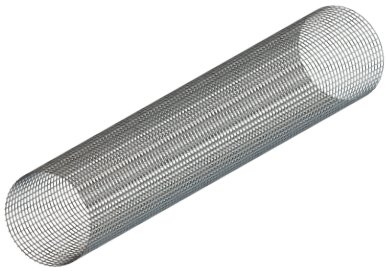
Nozzle / Mixer

Plastic sieves



Screen DIJ/85 Plastic
Screen D15/130 Plastic

Galva sieve



Screen D20/1000 Galva
Screen D22/1000 Galva

F. FX MOUNTING INSTRUCTIONS

1. Place and adjust the anchor in its ideal position in relation to the hole in the stone to be fixed.
2. Point out the location of the anchor on the concrete substrate. (*)
3. Place the anchor according to the manufacturer's instructions.
4. Place the anchor in its ideal position on the anchor.
5. Insert the pin and its nylon sleeve into the hole in the stone.
6. Adjust the anchor in all three dimensions.
7. Complete the fixing of the anchor to the dowel according to the manufacturer's instructions.

Additional instructions

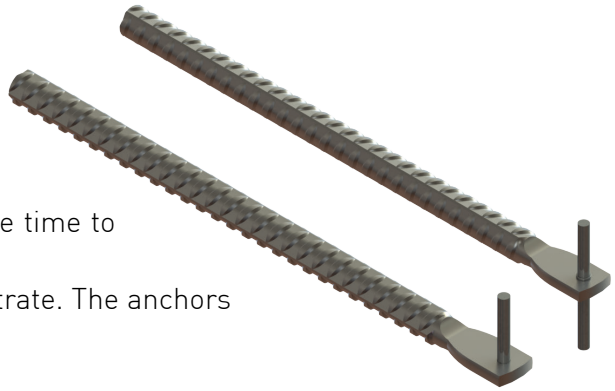
1. Ensure that the bottom of the anchor is in contact with the concrete.
2. Allow the threaded rod to extend at least one turn of the thread behind the nut.
3. The gap between the flattened part of the threaded rod and the bottom stone must be at least 2 mm.
4. Make sure that the pin does not touch the bottom of the hole in the bottom stone so that a movement of 5mm between the stone and the pin is possible.
5. The hole in the upper stone must be well filled with marble adhesive.
6. Make sure that this glue does not get caught between the flattened part of the threaded rod and the lower stone.

(*) If the substrate is not concrete, the type of dowel must be adapted to the actual substrate.

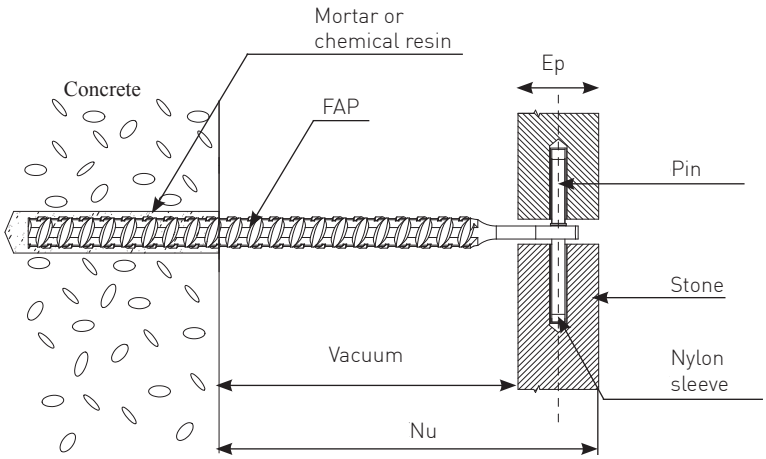
5. MORTAR/CHEMICAL FIXINGS

A. LOAD-BEARING CHEMICAL FASTENERS

FAP Anchoring of concrete bars



This fixing allows the stone to be supported and at the same time to withstand the forces of the wind.
The adjustment is made through the hole drilled in the substrate. The anchors are sealed with sealing resin or quick-setting mortar.



Material: This type of fastener is available in stainless steel A2, A4 and Duplex 1.4362
Composition: 1 FAP bar and 1 pin
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: FAP Ø / L / Type
Example: F AP 10 / 110 / 2

DIMENSIONAL CHARACTERISTICS AND LOADS							
NAME	DIAMETER Ø (mm)	LENGTH (mm)	ANCHORING DEPTH t ≥ (mm)	OVERHANG K (mm)	LOAD CAPACITY daN G (kg)	Ø DRILLING Ø (mm)	PIN DIAMETER Ø (mm)
FAP 10 /110	10	110	85	25	106	14	5
FAP 10 /120		120		35	86		
FAP 10 /130		130		45	72		
FAP 10 /140		140		55	62		
FAP 10 /150		150		65	54		
FAP 10 /160		160		75	48		
FAP 10 /180		180		95	40		
FAP 10 /190		190		105	36		
FAP 10 /200		200		115	34		
FAP 10 /210		210		125	31		
FAP 10 /220		220		135	29		

NAME	DIAMETER Ø (mm)	LENGTH (mm)	ANCHORING DEPTH t ≥ (mm)	OVERHANG K (mm)	LOAD CAPACITY daN G (kg)	Ø DRILLING Ø (mm)	PIN DIAMETER Ø (mm)
FAP 10 /230	10	230	85	145	27	14	5
FAP 10 /240		240		155	26		
FAP 10 /250		250		165	24		
FAP 10 /260		260		175	23		
FAP 10 /270		270		185	22		
FAP 10 /280		280		195	21		
FAP 10 /290		290		205	20		
FAP 10 /300		300		215	19		
FAP 10 /310		310		225	18		
FAP 10 /320		320		235	17		
FAP 10 /330		330		245	17		
FAP 10 /340		340		255	16		
FAP 10 /350		350		265	15		
FAP 10 /360		360		275	15		
FAP 10 /370		370		285	14		

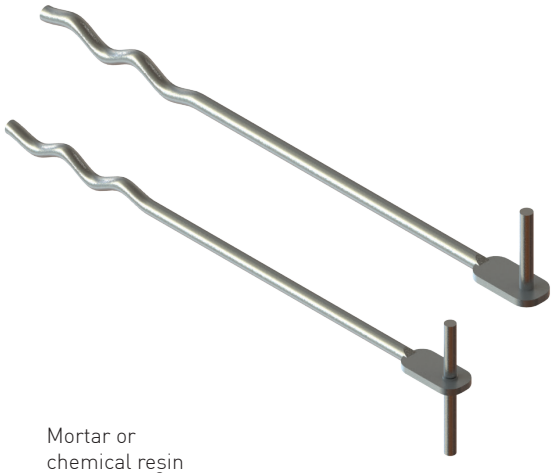
DIMENSIONAL CHARACTERISTICS AND LOADS

NAME	DIAMETER Ø (mm)	LENGTH (mm)	ANCHORING DEPTH t ≥ (mm)	OVERHANG K (mm)	LOAD CAPACITY daN G (kg)	Ø DRILLING Ø (mm)	PIN DIAMETER Ø (mm)
FAP 12 /110	12	110	85	25	181	16	5
FAP 12 /120		120		35	147		
FAP 12 /130		130		45	124		
FAP 12 /140		140		55	107		
FAP 12 /150		150		65	94		
FAP 12 /160		160		75	83		
FAP 12 /180		180		95	69		
FAP 12 /190		190		105	63		
FAP 12 /200		200		115	58		
FAP 12 /210		210		125	54		
FAP 12 /220		220		135	50		
FAP 12 /230		230		145	47		
FAP 12 /240		240		155	45		
FAP 12 /250	12	250	85	165	42	16	5
FAP 12 /260		260		175	40		
FAP 12 /270		270		185	38		
FAP 12 /280		280		195	36		
FAP 12 /290		290		205	34		
FAP 12 /300		300		215	33		
FAP 12 /310		310		225	32		
FAP 12 /320		320		235	30		
FAP 12 /330		330		245	29		
FAP 12 /340		340		255	28		
FAP 12 /350		350		265	27		
FAP 12 /360		360		275	26		
FAP 12 /370		370		285	25		

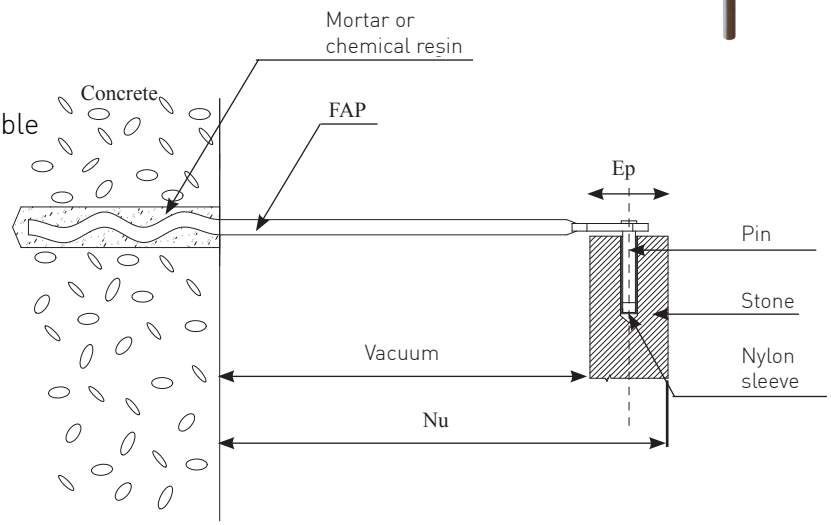
DIMENSIONAL CHARACTERISTICS AND LOADS							
NAME	DIAMETER Ø (mm)	LENGTH (mm)	ANCHORING DEPTH t ≥ (mm)	OVERHANG K (mm)	LOAD CAPACITY daN G (kg)	Ø DRILLING Ø (mm)	PIN DIAMETER Ø (mm)
FAP 16 /110	16	110	85	25	221	20	5
FAP 16 /120		120		35	221		
FAP 16 /130		130		45	221		
FAP 16 /140		140		55	221		
FAP 16 /150		150		65	220		
FAP 16 /160		160		75	197		
FAP 16 /180		180		95	162		
FAP 16 /190		190		105	149		
FAP 16 /200		200		115	138		
FAP 16 /210		210		125	128		
FAP 16 /220		220		135	120		
FAP 16 /230		230		145	112		
FAP 16 /240		240		155	106		
FAP 16 /250	16	250	85	165	100	20	5
FAP 16 /260		260		175	95		
FAP 16 /270		270		185	90		
FAP 16 /280		280		195	86		
FAP 16 /290		290		205	82		
FAP 16 /300		300		215	78		
FAP 16 /310		310		225	75		
FAP 16 /320		320		235	72		
FAP 16 /330		330		245	69		
FAP 16 /340		340		255	67		
FAP 16 /350		350		265	65		
FAP 16 /360		360		275	62		
FAP 16 /370		370		285	60		

B. CHEMICAL RESTRAINT FIXINGS

FAV Anchoring with retaining wire



The adjustment is made through the hole drilled in the substrate. The anchors are sealed with chemical resin or quick-setting mortar.



Material: This type of fastener is available in stainless steel A2, A4 and Duplex 1.4362
Composition: 1 FAV wire and 1 pin
Type: Type 1 = full pin
Type 2 = half pin welded
Type 3 = half pin free
Designation: FAV Ø / L / Type
Example: FAV 6 / 140 / 1

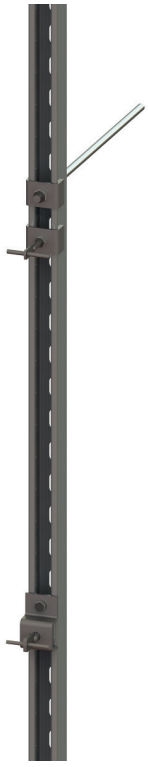
DIMENSIONAL CHARACTERISTICS AND LOADS						
NAME	WIRE DIAMETER Ø (MM)	LENGTH (mm)	ANCHORING DEPTH	VACUUM (mm)	Ø DRILLING Ø (mm)	PIN DIAMETER Ø5 (mm) G (kg)
FAV/06/110	6	110	75	25	14	55
FAV/06/120	6	120	75	35	14	55
FAV/06/130	6	130	75	45	14	55
FAV/06/140	6	140	75	55	14	55
FAV/06/150	6	150	75	65	14	55
FAV/06/160	6	160	75	75	14	55
FAV/06/170	6	170	75	85	14	55
FAV/06/180	6	180	75	95	14	55
FAV/06/190	6	190	75	105	14	55
FAV/06/200	6	200	75	115	14	55
FAV/06/210	6	210	75	125	14	55
FAV/06/220	6	220	75	135	14	55
FAV/06/230	6	230	75	145	14	55
FAV/06/240	6	240	75	155	14	55
FAV/06/250	6	250	75	165	14	55
FAV/06/260	6	260	75	175	14	55
FAV/06/270	6	270	75	185	14	55
FAV/06/280	6	280	75	195	14	55

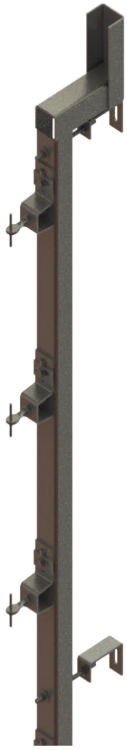
6. FRAMING FIXINGS

A. INTRODUCTION

Frame fixings can be a good alternative to point stone fixings. In some cases, it is economically or technically advantageous to use this type of fastening system, for example, when :

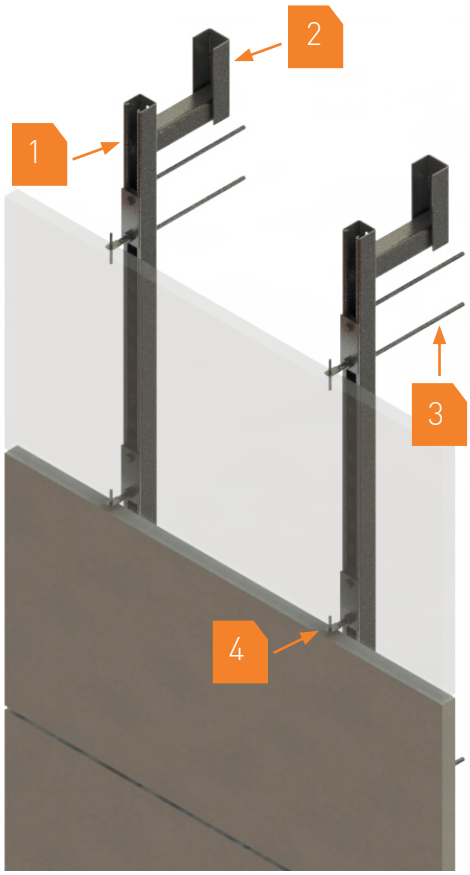
1. It is not possible to attach directly to the building structure with point fixings due to the lack of support in the necessary places.
2. The distance between the stone and the structure of the building is too great.
3. The number of anchors in the building must be reduced in order to reduce heat loss or to achieve op timum air or water tightness.
4. The project includes a large number of small stones.
5. It is difficult to penetrate the insulation (for ex. foamglass) with point stone ties.





B. FRAMES WITH NOTCHED RAILS

This framework is composed as follows:



1. Mounting rail

Standard notched rails with a size of 41 x 41 mm or 41 x 21 mm and a maximum length of 3 metres are placed vertically at regular intervals according to the layout of the façade stones. These rails allow for continuous vertical adjustment of the stone ties attached to them.

2. Console

The entire weight of the stones, the rail and its accessories is taken up by the supporting bracket. This bracket is either composed of :

1. of a 'U' shaped piece welded to a bracket that is fixed to the to the building structure. On request, an inter mediate piece between the rail and the bracket can allow continuous depth adjustment

2. a hanger with a double plate which is fixed to the back of the on the back of the rail to be suspended

3. Wind anchor

The wind anchors are fixed at regular intervals along the rail and allow the horizontal wind loads to be taken up while keeping the frame at a fixed distance from the building.

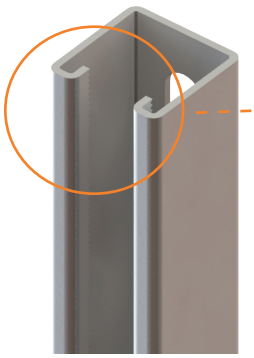
4. Stone ties

These brackets are fixed to the rail by means of a toothed nut and carry the weight of the stones and transmit it to the framework. A lateral inclination (limited to 20°) of these brackets allows continuous lateral adjustment.

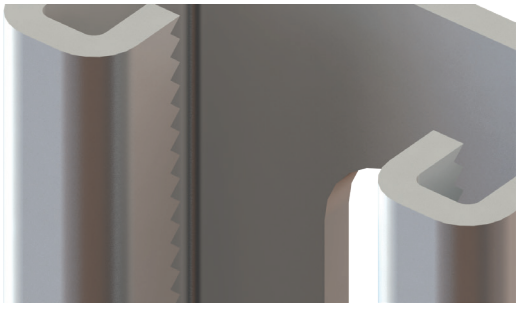
Mounting rails:

There are two types of rails, 41x21x2.5 and 41x41x2.5. Both types are notched and are available in stainless steel grades A2 and A4 and in galvanised steel.

Rail 41x21



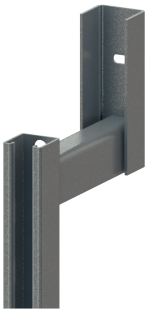
Rail 41x41



Grooving improves slip resistance

DIMENSIONAL CHARACTERISTICS AND LOADS							
REF.	SIZE			PERFORATION	INERTIA MODULE		MOMENT OF INERTIA	
	thickness	length	height	diam/axe	Wx (cm3)	Wy (cm3)	Ix (cm4)	Iz (cm4)
C -21	2,5	41	21	Oblong 12x28/65mm	0,89	2,55	0,99	5,27
C-41	2,5	41	41	Oblong 12x28/55mm	2,84	4,43	6,07	9,16

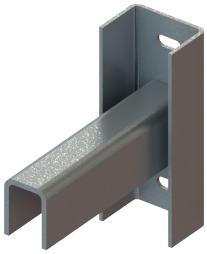
Different examples of consoles:



Bracket welded to the rail

Console with additional depth adjustment

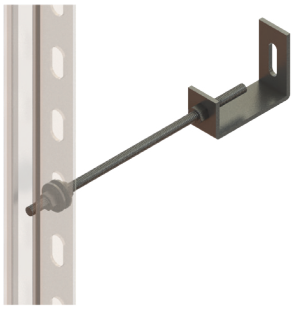
Double hanger for supporting rail support



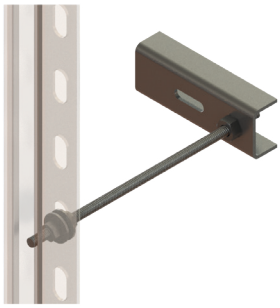
Double dowelled console pegged

another example

Various wind anchors:



Mechanical anchor type CXL



Mechanical anchor type UPL

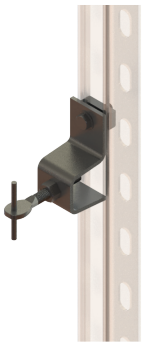
Anchor Sealed

The load-bearing stone attachments for these rails are:

1. FXP

DIMENSIONAL CHARACTERISTICS AND LOADS				
NAME	**H (mm)**	**THEORETICAL VOID (MM) Tolerance +/- 10 mm**	**LOAD CAPACITY G (daN)**	**METRIC THREADED ROD**
FXR O	4 + 8 mm d'écrou	40	30	M10

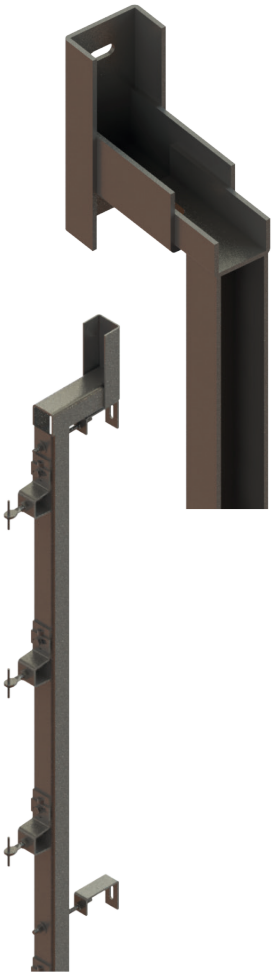
2. FXL 40



DIMENSIONAL CHARACTERISTICS AND LOADS			
NAME	**THEORETICAL VOID (MM) Tolerance +/- 10 mm**	**LOAD CAPACITY G (daN)**	**METRIC THREADED ROD**
FXL 40	70	30	M10
		45	M12
		60	M12
		75	M14
		90	M14

C. FRAMES FOR SPECIAL APPLICATIONS

In cases where it is not possible to use notched rails (cavity too small, inertia of standard rails too low...) we use rails manufactured and dimensioned on demand.



The framework is composed as follows:

1. Mounting rail

The mounting rails, with a maximum length of 3 metres, are placed vertically at regular intervals according to the layout of the façade stones. They are U-shaped and their dimensions are determined according to the loads to be supported. Holes are drilled in the bottom of this profile where the stone clips are to be attached.

2. Console

The entire weight of the stones, the rail and its accessories is taken up by the supporting bracket. This bracket is either composed of :

1. a "U" shaped part welded to a bracket that is fixed to the building structure. On request, an intermediate piece between the rail and the bracket can be used for continuous depth adjustment
2. a hanger with a double strap which is fixed to the back of the rail to be suspended

3. Wind anchor

The wind anchors are fixed at regular intervals along the rail and allow the horizontal wind loads to be taken up while keeping the frame at a fixed distance from the building.

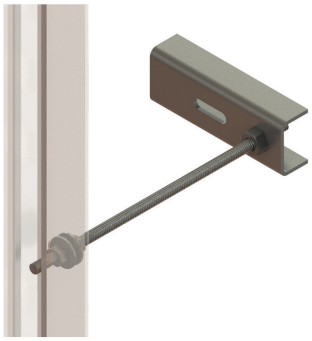
4. Stone ties

These clips are fixed to the rail and carry the weight of the stones and transmit it to the framework.
A groove or boss on the stone clamp leg prevents vertical slippage. A lateral inclination (limited to 20°) of these brackets allows continuous lateral adjustment.

The "rails" are U-shaped and are dimensioned on request, according to the exact problems of the building site: complex support, large stones, horizontal posts, etc.

The various brackets are of the same type as the brackets for mounting rails, and the U shape is welded either directly to the bracket or to an intermediate horizontal U shape for additional depth adjustment.

The various wind anchors are of the same type as the mounting rail brackets:



Mechanical anchor
type CXL

Mechanical anchor
type UPL

Anchor Sealed

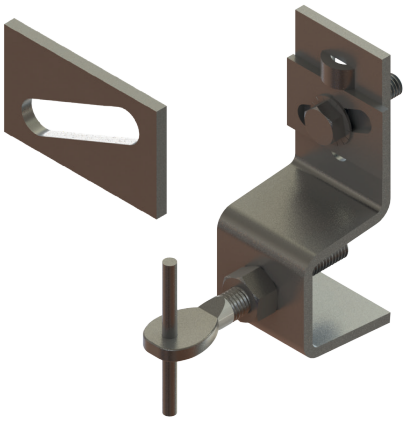
The load-bearing stone attachments for these rails are :

1. FXP + boss

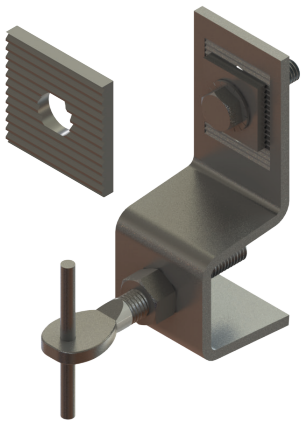
DIMENSIONAL CHARACTERISTICS AND LOADS				
NAME	**H (mm)**	**THEORETICAL VOID (MM) Tolerance +/- 10 mm**	**LOAD CAPACITY G (daN)**	**METRIC THREADED ROD**
FXR 0	4 + 8 mm d'écrou	40	30	M10

2. FXL + boss

In order to prevent the stones from slipping in the slot, a pair of bosses/anti-slip plates or a pair of ridges/ ribbed squares is provided

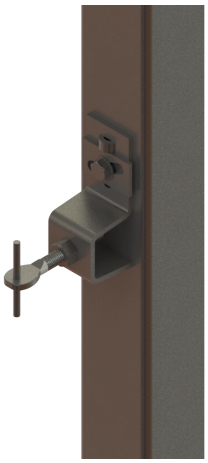


FXL with boss
+ anti-slip plate



FXL with stripe
+ grooved square

Also, depending on the cases encountered and the economic/technical/thermal choices, it is possible to fix the FXL either inside or outside the U



FXL outside the U

FXL inside the U

DIMENSIONAL CHARACTERISTICS AND LOADS			
NAME	**THEORETICAL VOID (MM) Tolerance +/- 10 mm**	**LOAD CAPACITY G (daN)**	**METRIC THREADED ROD**
FXL 40	70	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 70	100	30	M10
		45	M12
		60	M12
		75	M14
		90	M14
FXL 90	120	30	M10
		45	M12
		60	M12
		75	M14
		90	M14

D. INSTALLATION INSTRUCTIONS

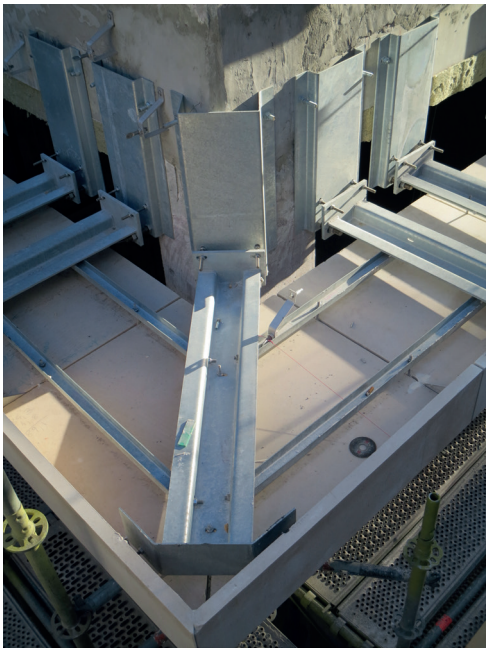
This frame fixing system is installed in two phases:

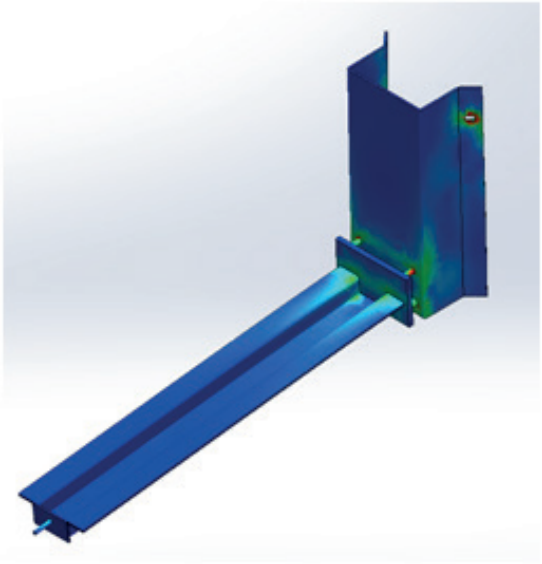
1. Installation of the support bracket, which is custom-made according to the distance between the stones and the building and the loads to be
building and the loads to be supported, vertical rail and/or wind anchors

2. Assembly of the load-bearing and retaining stone brackets: refer to the "calculation method" chapter to determine the loads applied to each stone bracket (vertical or horizontal joint) and to the entire structure.

E. SUBSTRUCTURE AND CUSTOM-MADE PARTS

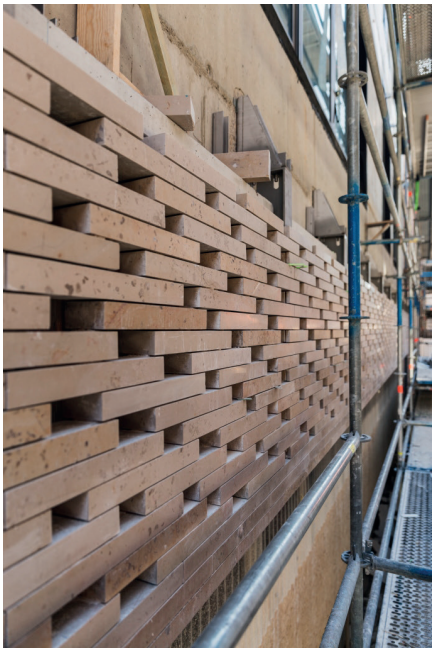
For some projects, it is not possible to anchor directly to the building structure.
In this case, it will be necessary to provide an intermediate metal structure that will be fixed to the structure of the building. This assembly is designed and dimensioned by our design office. The parts are then manufactured according to the engineer's plan. The following pages contain some solutions for specific cases on site.





Fixing of a stone fascia
Site Belliard 65 in Brussels

Intermediate framework for stone wall between balconies
Building site l'Alliance in Braine l'Alleud



Moucharabieh in natural stone "bricks"
CERA construction site in Leuven

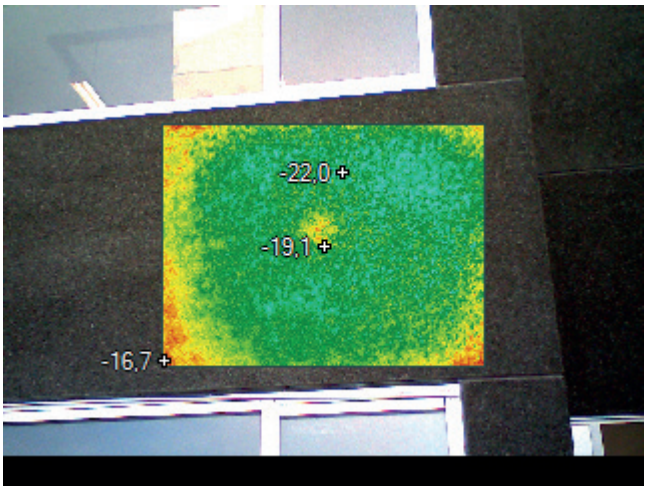
Attachment structure for stone fixing
Job site city 2 in Charleroi

7. CALCULATION OF THERMAL BRIDGES

A. INTRODUCTION

Since 2012, Fixinox has been a pioneer in the accurate calculation of thermal bridges caused by fasteners passing through insulation. Based on simple observations, we claim to have some of the best solutions on the market in terms of thermal bridges due to the presence of fixings.

Without even going into the details of the calculations by digital simulation, three common sense recommendations should be followed:



- Have the lowest number of thermal bridges and and therefore the number of fasteners passing through the insulation

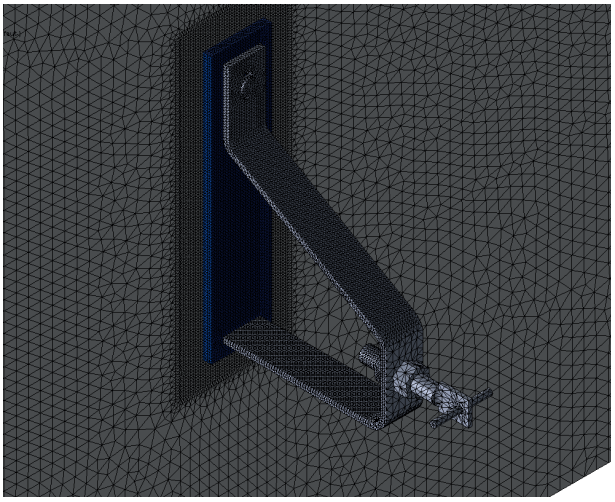
- Have the smallest possible fastener sections, for example, by favouring materials with the best mechanical characteristics

- Finally, look for materials with the lowest possible lowest possible thermal conductivity

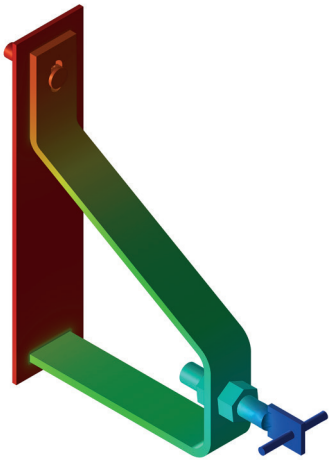
Stainless steel successfully fulfils all three of these requirements. Even though there are less conductive materials such as wood or fibreglass/resin composites, stainless steel offers the best possible fire resistance of the various materials used today as a facade fastening system as well as greater durability.

MATERIAL	CURRENT THERMAL CONDUCTIVITY AT 23°C
Aluminium	200 W m-1 K-1
Steel	50 W m-1 K-1
Stainless steel	15 W m-1 K-1

B. CALCULATION OF THERMAL BRIDGES BY NUMERICAL SIMULATION



Numerical Simulation / Meshing



Numerical Simulation / Results

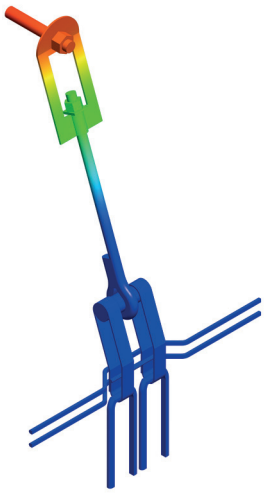
The exact calculation of thermal bridges is done by digital simulation. We carry them out in accordance with the standards:

- EN ISO 10211: «Thermal bridges in buildings -- Heat flows and surface temperatures temperatures -- Detailed calculations»,

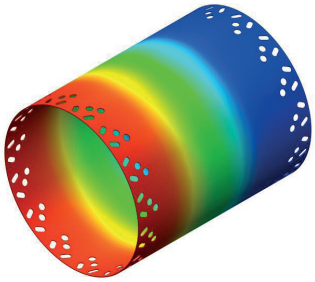
- EN ISO 6946: «Building components and walls -- Thermal resistance and thermal transmittance thermal transmittance -- Methods of calculation»,

- EN ISO 10456: «Materials and products for building -- Hygrothermal properties -- Tabulated useful values and procedures for determining declared and useful thermal values».

Our know-how has been confirmed by two successful collaborations with the Ubatc (Belgian Union for Technical Approval of Construction) and the CSTB (Centre Scientifique et Technique du Bâtiment, France) for two separate technical opinions. The Fixi 3D system of fixings for suspended panels on the one hand and our anchors for sandwich panels on the other. Both of them mention the thermal bridges generated by the Both mention the thermal bridges generated by the fixings, so that these values can be included in the PEB or RT2020 studies.



ATG 15/2630



Technical Notice 3/16-872

C. IMPACTS ON THE FAÇADE (U_{PAROI})

nce the thermal bridges related to the fixings have been calculated, the overall U value including all the elements (the wall plus the anchors).

This is done using the following formula:

$$U_c = U_{p0} + \Delta U$$

With:

$$U_{p0} = \frac{1}{\frac{1}{h_{ext}} + \frac{d_{pierre}}{\lambda_{pierre}} + \frac{d_{air}}{\lambda_{air}} + \frac{d_{isolant}}{\lambda_{isolant}} + \frac{d_{support}}{\lambda_{support}} + \frac{1}{h_{int}}}$$

Or: $d_{material}$ is the thickness of the material (in m)
$\lambda_{material}$ is the thermal conductivity of the material (in W/(K.m)
h_{int} and h_{ext} are the convective heat transfer coefficients at both surfaces (in W/(m².K))
and such that $h_i = \frac{1}{R_{si}}$

And

$$\Delta U = \frac{\sum N_i * \chi_i}{A_{façade}} \quad \text{or} \quad \Delta U = \sum n_i * \chi_i$$

Où: N_i : the number of anchors of type i
n_i : the areal density of type i fixings
χ_i : is the point thermal transmittance of fasteners of type i
$A_{façade}$: is the surface area of the stone façade under consideration

D. THREE LEVELS OF ANALYSIS

When using these results to optimise thermal bridges by seeking to reduce them as much as possible, one should always look at three distinct levels of analysis.

The fastener (1) is a constituent element of the opaque wall (2). The opaque walls (2) are only one of elements (windows, ventilation systems, heating systems, etc.) in the EPB or RT 2020 study of a complete building (3).

At Fixinox, we stop the analysis at the first two levels, as only thermal engineering offices have the transverse thermal competence for all the elements that can make up a building.

At the fastening level alone, the reference value is the fastening thermal bridge x, calculated as described above. It is interesting to compare different options to measure the various impacts.

- selected materials
- the performance of the insulating block
- the cross-sections of the fasteners
- the positioning of the fixing in relation to the insulation
- possible thermal "shims" that should be placed

When arriving at the second level of analysis, that of the U_{Paroi}, other fundamental elements are integrated to complete the analysis grid, in particular the surfaces considered and the density (number of fixings per m^2) of thermal bridges present on the opaque wall.

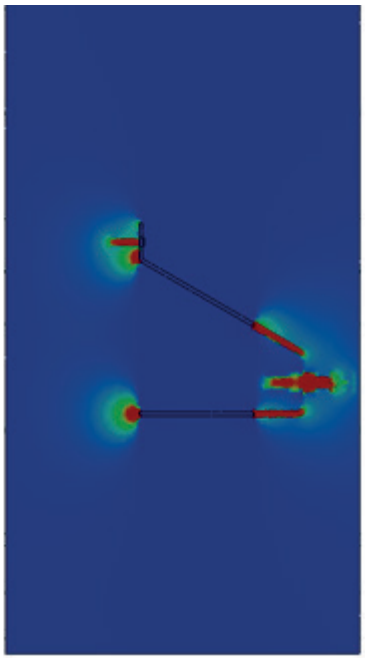
E. CASE STUDIES

Applied to natural stone fixings, Fixinox has already collaborated on leading projects for which a precise study and a calculation note were requested by the site's EPB manager being responsible for the K value of the building and the future consumption of the finished building:

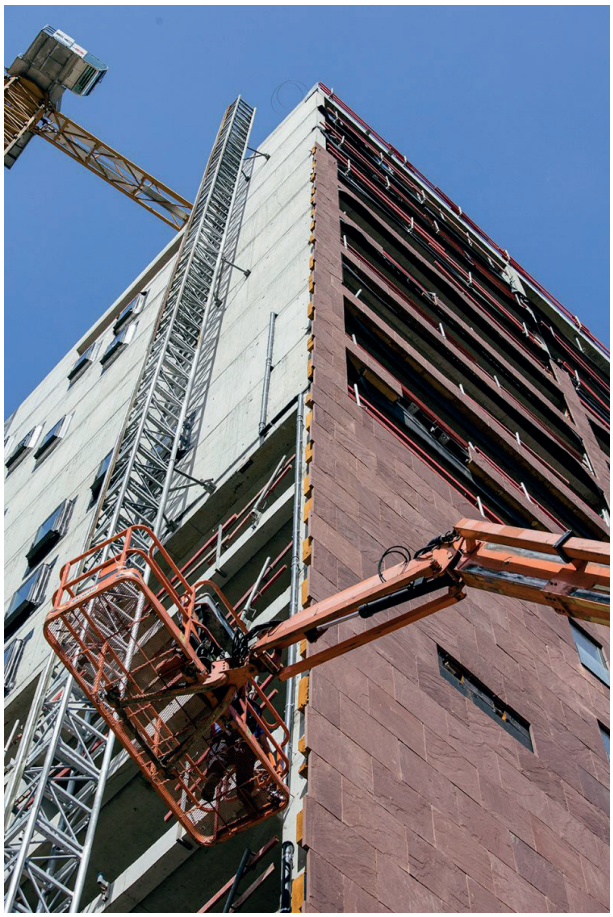
The Attradius headquarters in Namur (Belgium)

Architect : DDS & Partners
Certification BREEAM : « Very good »

Calculated anchoring:

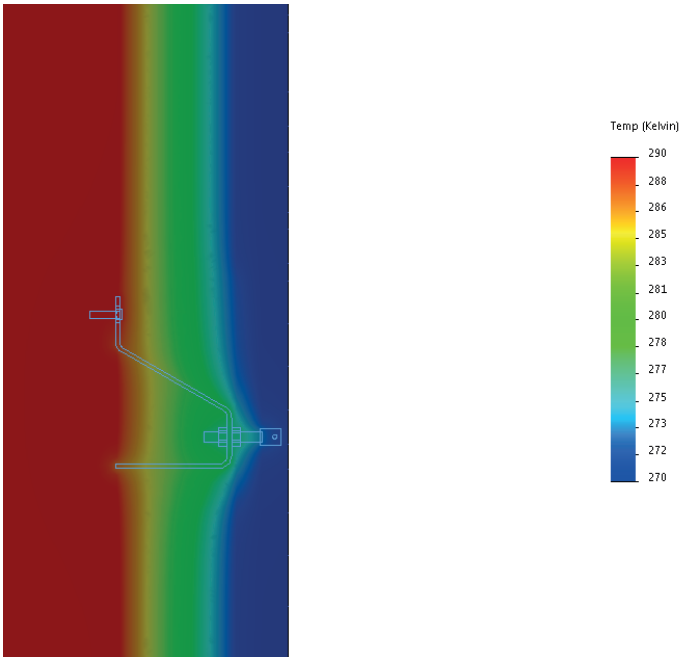


Twist Tower, Leuven - Belgium



Architect : Stéphane Beel Architecten
Certification BREEAM « Outstanding »

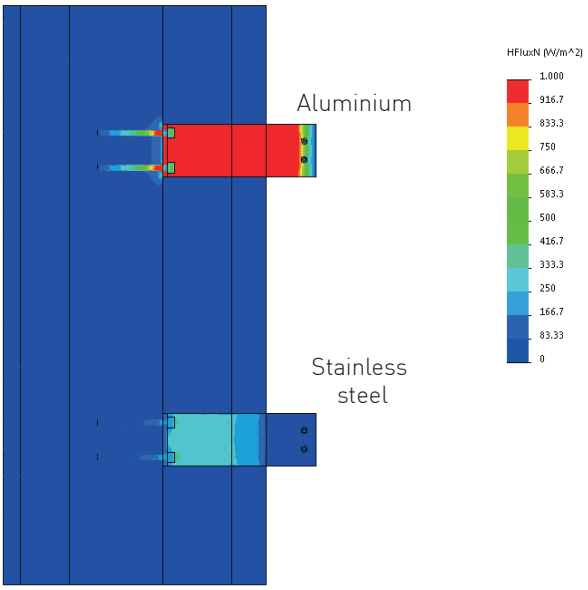
Calculated anchoring:



The K, in Lyon - France

Architect : Atelier Véra & Barrand Architects

Calculated anchoring:

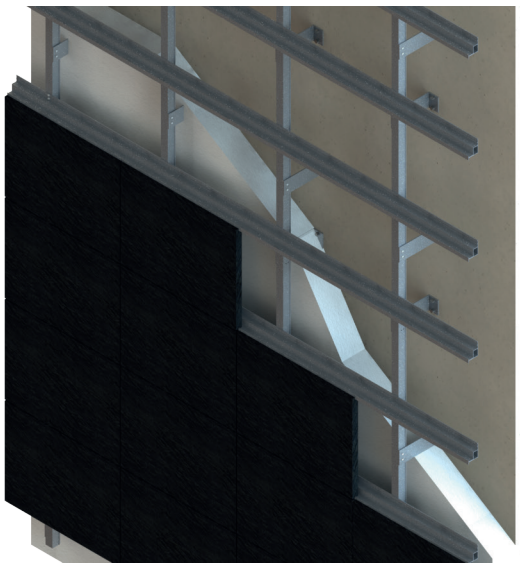


F. CASE OF ALUMINIUM FRAMES / THERMAL ANALYSIS

Comparison of aluminium brackets and stainless steel brackets.

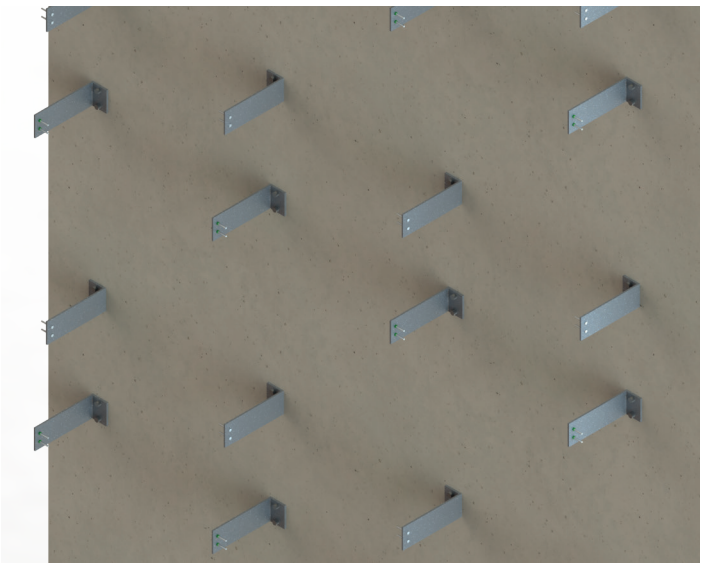
In Lyon, Fixinox is approached more and more frequently not only as a manufacturer but also for the calculation of thermal bridges related to the fixings.

The competing system to the stapled brackets described in this brochure is a double aluminium rail system, with aluminium brackets as point fixings, responsible for thermal losses as shown in the image below.
as shown in the image below:



This system undermines the three simple principles for dealing with thermal bridges.Indeed :

- The number of brackets is consequent, and therefore the number of thermal bridges
- The use of aluminium as a load-bearing material material increases the cross-section al strength.
  For the same loads, the stainless steel section is smaller
- Finally, aluminium is on average more than 10 times more heat-conductive than steel
  Stainless steel



The last point is the most critical; the use of aluminium in general as a fixing material for facades is totally at odds with the treatment of thermal bridges.

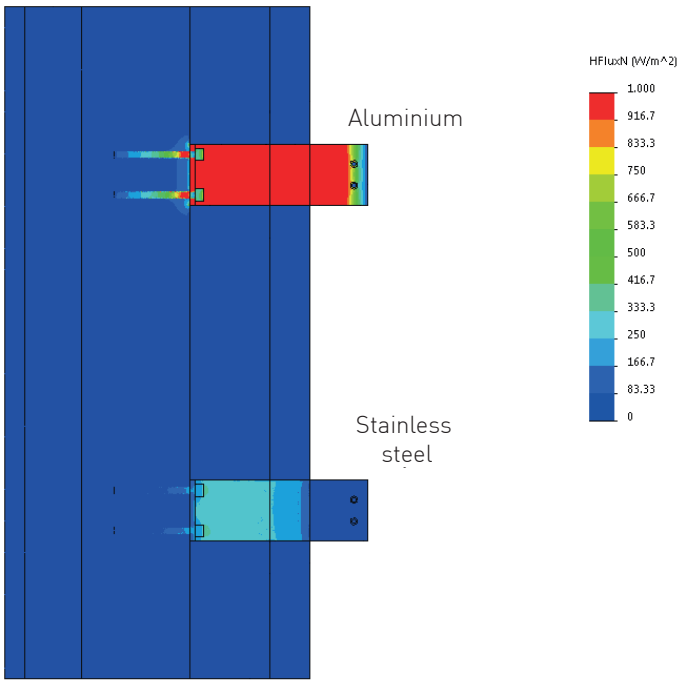
Aluminium is by nature an excellent conductor of heat and electricity. This is demonstrated by its successful use in the following applications:

- radiators, cooking stoves
- heat exchangers
- the rear panels of premium smartphones dissipating the heat emitted by the battery and electronic components

In this case, Fixinox is able to offer an alternative by replacing these aluminium brackets, which greatly degrade the insulation, with brackets with smaller sections made of stainless steel. This change makes it possible to reduce the value of the thermal bridge caused by the fixing by a factor of 4 to 5.

To better understand this difference with an illustration, a representation of the heat flow for a calculation of two brackets can be found below, with :

- the two different materials
- the same dimensions
- an identical thermal environment
- identical dowels (stainless steel)



The heat flow out of the two fasteners can be seen. For aluminium, the value is at saturation (red colour) in the chosen scale, while this heat flux is much lower (colours close to Blue) for the stainless steel fastener.

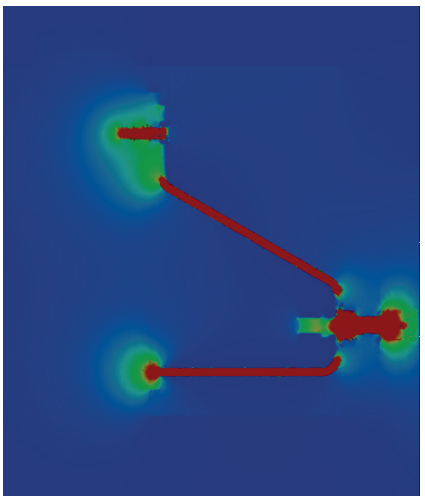
G. IMPACT OF THERMAL "SHIMS" ON THE THERMAL BRIDGE

This is one of the cases where the double analysis grid is very useful to measure the exact beneficial impact of the application of thermal shims. This allows us to put precise figures on a recurrent request from architects and design offices.

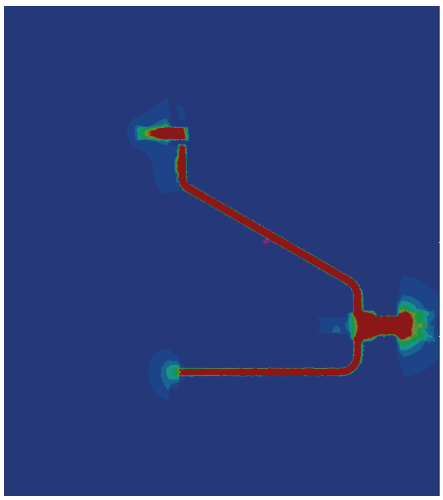
On the one hand, shims do indeed reduce the thermal bridge. If we look at the thermal bridge x: compared to the thermal bridge of the fixing alone, the gain per fixing, by
the application of "plastic" shims varies from 15 to 20% for 3 mm shims and from 25 to 30% for 7 mm shims (depending on the material).

When looking at the degradation of the U-wall, the application of 3 mm thermal shims improves the
When looking at the degradation of the U-wall, the application of 3 mm thermal shims improves the "performance of the opaque wall" by about 5 %, 7 mm shims improve the U-wall by 6 %.

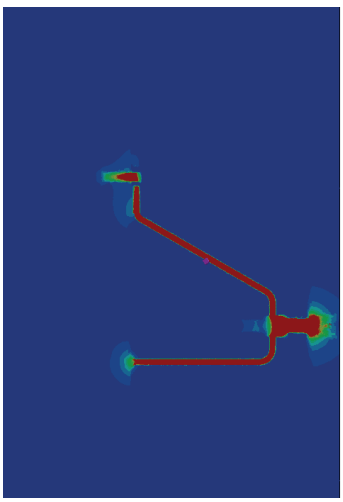
Many thermal problems such as actual building consumption >> theoretical consumption could be avoided by systematically calculating the various thermal bridges integrated. We have been campaigning for many years to have them taken into account. We believe that the use of stainless steel for the attachment of cladding is highly recommendable in this respect.



Without wedge



3 mm spacer



7 mm spacer

8. NOTES

FIXINOX

STAINLESS STEEL CONNECTORS

1

FIXINOX BELGIQUE

Head office

Z.I. de Jumet - Première rue, 8 - 6040 Jumet (Charleroi)

Tél. : +32 71 81 05 26 - Fax : +32 71 81 05 29 - info@fixinox.be

Antwerp Head Office

4c IZ De Zwaan-Jagersdreef, 2900 Schoten

Tél. : +32 3 227 57 00 - Fax : +32 3 227 57 02 - info.antwerpen@fixinox.be

2

FIXINOX FRANCE

21 rue Jean-Pierre Timbaud- 75011 Paris

3

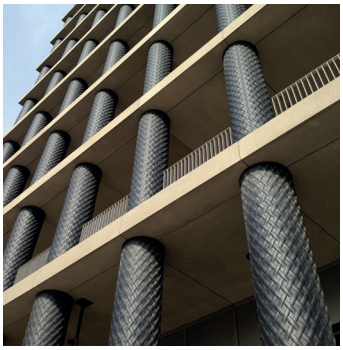
INTERNATIONAL

info@fixinox.be

FIXINOX PRESENT ON THE MAJOR EXCEPTION SITES

Police Station
Charleroi, BE

The Intercontinental Londre 02
Londres, AN



One Pancras Square
Londres, AN

Fitzroy Place
Londres, AN