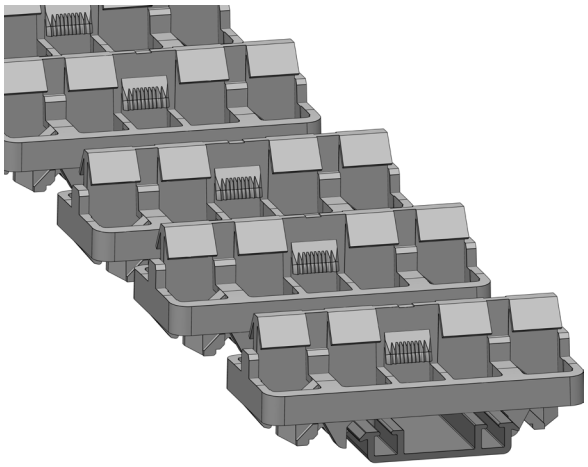
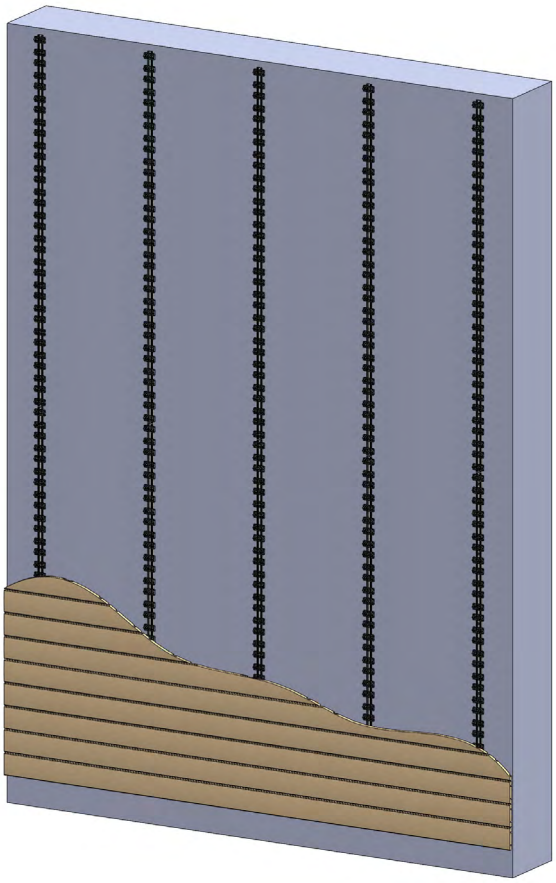
MINI RAIL - CLADDING

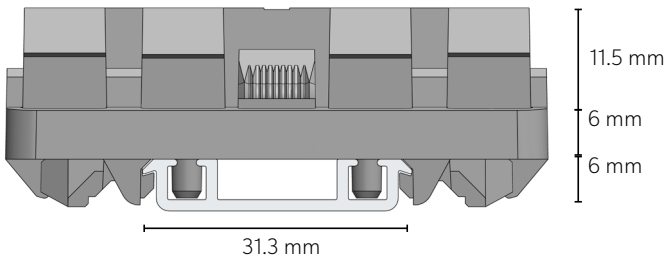
Utilisation : To fasten cladding

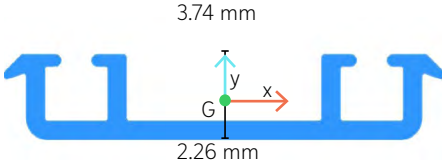


MINI RAIL



DIMENSIONS OF MINI RAIL WITH CLIPS





Centre of Gravity(G)

MOMENTS OF INERTIA :
Ixx = 260 mm^4
Iyy = 6341 mm^4
Ixx/v = 69,5 mm^3

© GRAD - REPRODUCTION PROHIBITED - V01

SUMMARY

1	Technical characteristics	p 3
2	Wind forces	p 4
3	Pull-out forces	p 8
4	Installing the rails directly to a wall	p 9
5	Fixation spans between rails	p 10
6	Installing the rails on a system of cross beams	p 12
7	Installing the rails on a curved wall	p 13

CALCULATION ASSUMPTIONS

The scope of application of the approach used is that defined in NF DTU 41.2 (French norms):

- Maximum pressures on the building envelope (generally depression in the corners of the structure) calculated with the following pressure coefficients:
  - Cpe = -1.4
  - Cpi = 0
- Building heights limited to 10 m and 28 m,
- All wind zones,
- All categories of site roughness (protected, normal and exposed),
- Flat terrain (average slope ≤ 5%, orography coefficient Co = 1).

FCBA study dated 30/05/2023

The fastening methods shown in this document are valid for cladding and soffit applications.

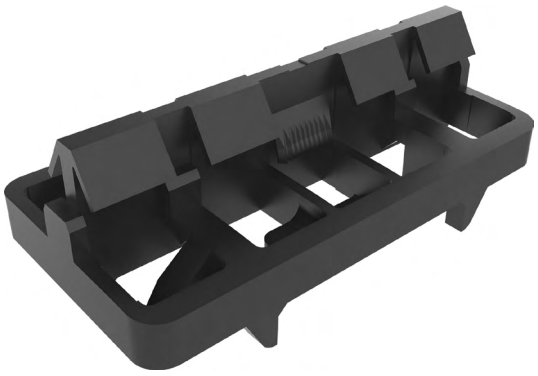
© GRAD - REPRODUCTION PROHIBITED - V01

RAIL ALUMINIUM

Material	Aluminium EN AW-6060
Mass per meter of rail without clips	0.183 kg
Colour	Black
Thermal Treatment	T6
Tensile strength (MPa)	190
Tensile stress at yield (MPa)	150
Minimal elongation (%)	6
Tensile modulus (MPa)	70000
Coefficient of linear expansion (10^{-6}/K)	24
Fusion Temperature (°C)	585-655
Thermal conductivity (W/mK)	160

CLIP GRAD

Material	Polyoxymethylene
Density (kg/m³)	1410
Colour	Noir
Tensile stress at yield (MPa)	64
Fusion temperature (°C)	190-220
Tensile modulus (MPa)	2850
Coefficient of linear expansion (10^{-6}/K)	110

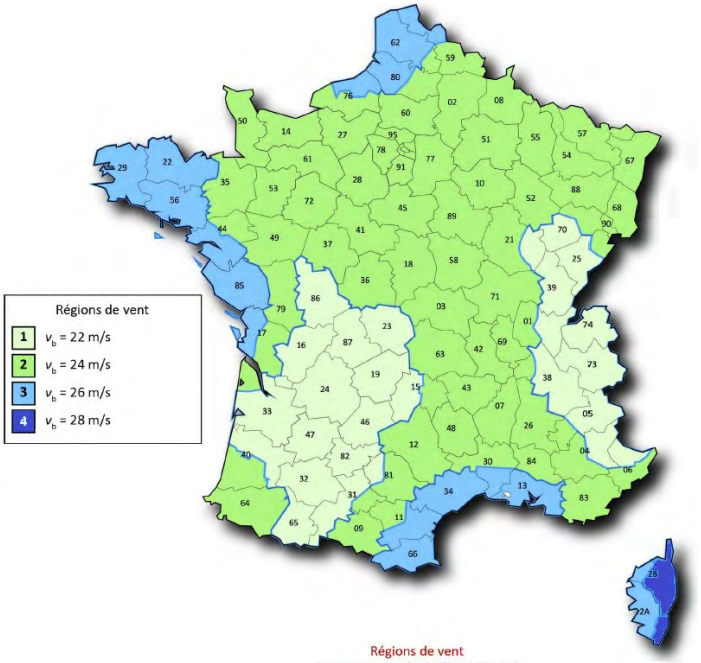


© GRAD - REPRODUCTION PROHIBITED - V01

WIND ACTION IN FRANCE

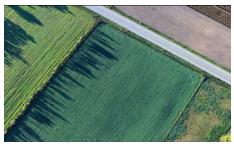
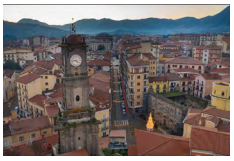
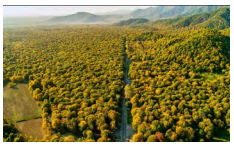
In the Eurocode rules, the average wind speed and the categories of wind roughness must be taken into account.

Here we have provided examples using French wind roughness.
All projects must follow local regulations concerning wind loads.



Régions de vent
Annexe Nationale de l'EN 1991-1-4

WIND ROUGHNESS CATEGORIES

0	II	IIIa	IIIb	IV
Sea or coastal area exposed to the sea.	- Airport - Flat countryside, with or without isolated obstacles (trees, buildings, etc.) separated from each other by more than 40 times their height	Countryside with hedgerows; vineyards, groves, scattered settlements.	Urbanized or industrial areas; dense groves, orchards.	Urban areas, 15% of which are covered with buildings averaging 15 m in height, dense forest.
	  		 	 

Orography: The orography coefficient takes into account an acceleration in wind speed on the structure due to specific orography. If the terrain has an average slope <5% then Co=1, if the value obtained is >5% then Co=1.15. An orography study is required to validate the coefficient.

- Support spacing: 650 mm (maximum spacing in accordance with NF DTU 41.2 [French Norms]);

Properties of aluminium used for Grad rails grade: EN AW-6060 T6 :
- Modulus of elasticity: E = 70,000 MPa ;
- Strength at 0.2%: f0= 150 MPa ;
- Ultimate tensile strength: fu = 190 MPa ;
- Partial safety factors: γ1= 1.1 ;
- Factor of safety (cladding board on 3 supports): k = 1.25 ;

© GRAD - REPRODUCTION PROHIBITED - V01

WIND FORCE : VALUE OF DEPRESSIONS IN (kN/M²)

BUILDING HEIGHT: 10 M

Flat Terrain (Co = 1), H = 10 m

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	1.20	1.01	0.75	0.58	0.54
2	1.43	1.21	0.90	0.70	0.64
3	1.67	1.41	1.05	0.82	0.75
4	1.94	1.64	1.22	0.95	0.87
Guadeloupe	3.21	2.71	2.02	1.57	1.44
Guyane	0.72	0.60	0.45	0.35	0.32
Martinique	2.53	2.14	1.60	1.24	1.14
Réunion	2.86	2.42	1.80	1.40	1.28
Mayotte	2.24	1.81	1.42	1.09	1.00

Table 1: Depression forces at 10 m height (kN/m²) flat terrain

Orography max (Co = 1.15), H = 10 m

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	1.59	1.34	0.99	0.77	0.71
2	1.89	1.60	1.19	0.93	0.85
3	2.21	1.86	1.39	1.08	0.99
4	2.57	2.17	1.61	1.26	1.15
Guadeloupe	4.25	3.58	2.67	2.08	1.90
Guyane	0.95	0.79	0.60	0.46	0.42
Martinique	3.35	2.83	2.12	1.64	1.51
Réunion	3.78	3.20	2.38	1.85	1.69
Mayotte	2.96	2.39	1.88	1.44	1.32

Table 2: Depression forces at 10 m height (kN/m²) Maximum orography

BUILDING HEIGHT: 28 M

Flat Terrain (Co = 1), H = 28 m

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	1.49	1.28	1.07	0.90	0.73
2	1.77	1.53	1.28	1.07	0.86
3	2.08	1.79	1.50	1.25	1.01
4	2.41	2.08	1.74	1.45	1.18
Guadeloupe	3.99	3.43	2.88	2.40	1.94
Guyane	0.89	0.77	0.64	0.54	0.43
Martinique	3.15	2.71	2.27	1.90	1.54
Réunion	3.56	3.06	2.57	2.14	1.73
Mayotte	2.72	2.34	1.96	1.62	1.31

Table 3: Depression forces at 28 m height (kN/m²) flat terrain

Orography max (Co = 1.15), H = 28 m

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	1.97	1.69	1.42	1.19	0.97
2	2.34	2.02	1.69	1.42	1.14
3	2.75	2.37	1.98	1.65	1.34
4	3.19	2.75	2.30	1.92	1.56
Guadeloupe	5.28	4.54	3.81	3.17	2.57
Guyane	1.18	1.02	0.85	0.71	0.57
Martinique	4.17	3.58	3.00	2.51	2.04
Réunion	4.71	4.05	3.40	2.83	2.29
Mayotte	3.60	3.09	2.59	2.14	1.73

Table 4: Depression forces at 28 m height (kN/m²) Maximum orography

© GRAD - REPRODUCTION PROHIBITED - V01

MAXIMUM DESIGN PULL-OUT FORCE PER FASTENER FOR FAÇADE APPLICATION

BUILDING HEIGHT: 10 M

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	321	286	235	198	189
2	361	323	265	224	211
3	400	358	294	249	235
4	442	395	325	275	259
Guadeloupe	563	528	454	384	363
Guyane	228	202	167	141	133
Martinique	493	472	389	328	310
Réunion	530	495	421	356	335
Mayotte	480	422	359	301	284

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

All Orography (Co = 1.15)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	387	345	283	238	227
2	435	389	319	270	254
3	482	431	354	300	283
4	533	477	391	331	312
Guadeloupe	662	594	495	425	437
Guyane	275	244	201	170	160
Martinique	587	552	454	384	374
Réunion	627	562	464	397	404
Mayotte	578	490	433	363	343

Maximum design pull-out force - Building height 10 m for façade installation only

BUILDING HEIGHT: 28 M

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	371	335	298	265	231
2	416	378	335	298	257
3	446	419	373	330	286
4	470	446	411	364	318
Guadeloupe	622	569	562	510	442
Guyane	263	239	211	189	162
Martinique	553	502	491	436	379
Réunion	590	537	534	472	410
Mayotte	504	479	445	392	340

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

All Orography (Co = 1.15)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	447	404	358	319	278
2	479	455	404	358	310
3	536	485	449	398	345
4	559	536	471	439	383
Guadeloupe	720	663	631	557	500
Guyane	317	288	254	227	195
Martinique	650	594	556	490	457
Réunion	689	631	596	524	468
Mayotte	596	543	505	473	410

Max. design pull-out force - Building height 28 m for façade installation only

© GRAD - REPRODUCTION PROHIBITED - V01

MAXIMUM DESIGN PULL-OUT FORCE PER FASTENER FOR SOFFIT APPLICATION

BUILDING HEIGHT: 10 M

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	361	328	281	247	239
2	399	363	309	271	259
3	436	395	335	294	281
4	477	432	364	318	303
Guadeloupe	570	545	461	421	400
Guyane	275	251	220	198	191
Martinique	511	485	425	368	351
Réunion	542	517	456	394	374
Mayotte	506	457	397	342	326

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

All Orography (Co = 1.15)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	423	383	325	284	274
2	469	426	359	313	299
3	515	466	392	341	325
4	545	510	413	370	353
Guadeloupe	698	632	509	450	458
Guyane	318	289	250	223	214
Martinique	628	567	457	401	411
Réunion	665	602	484	426	440
Mayotte	591	512	452	391	381

Maximum design pull-out force - Building height 10 m for soffit installation only

BUILDING HEIGHT: 28 M

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	408	374	339	309	277
2	429	415	374	339	301
3	473	433	410	369	328
4	489	473	447	402	358
Guadeloupe	617	571	576	542	477
Guyane	307	284	259	239	216
Martinique	560	516	524	471	416
Réunion	591	545	546	506	445
Mayotte	518	501	480	429	379

MAX CALCULATED PULL-OUT FORCE (ULS-STR VALUE) IN N

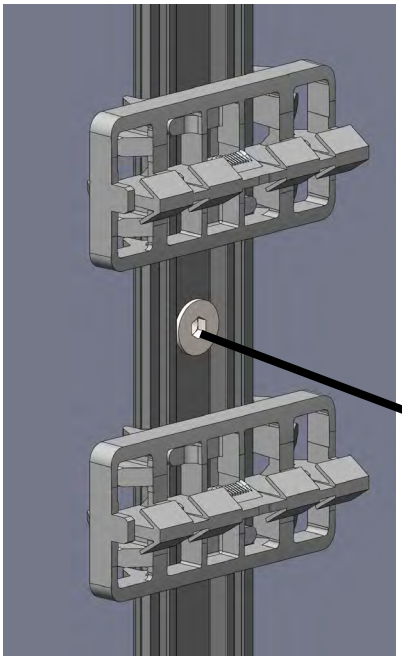
All Orography (Co = 1.15)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	451	440	396	359	320
2	501	461	440	396	350
3	552	506	453	434	383
4	566	552	494	473	419
Guadeloupe	752	697	630	564	518
Guyane	357	330	299	274	245
Martinique	643	595	567	535	464
Réunion	674	667	601	537	491
Mayotte	597	583	523	486	446

Maximum design pull-out force - Building height 28 m for soffit installation only

© GRAD - REPRODUCTION PROHIBITED - V01

PULL-OUT FORCE



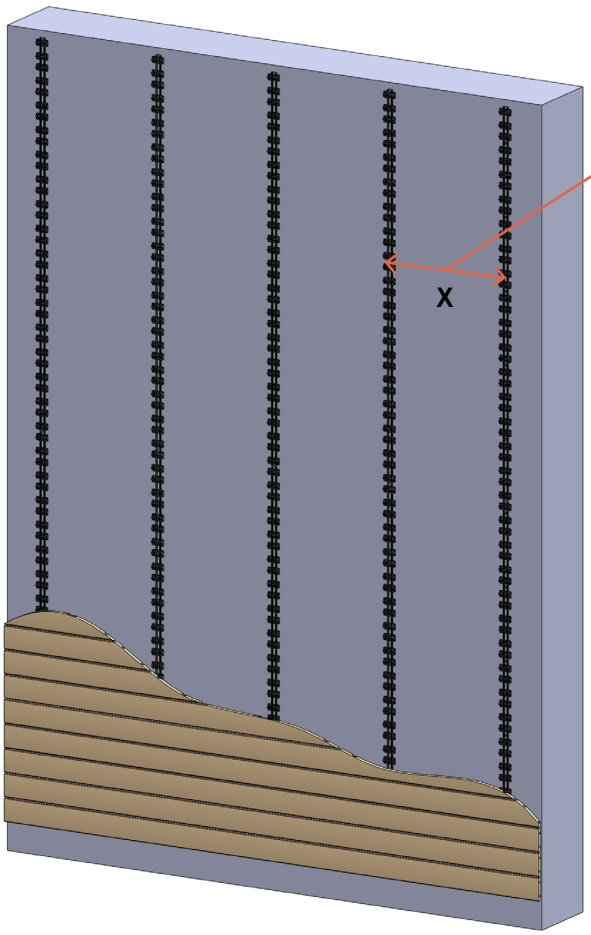
The pull-out force is an essential value for sizing fasteners.

A calculation note is also available to help with fastener sizing.

Pull-out forces
Ftens,k

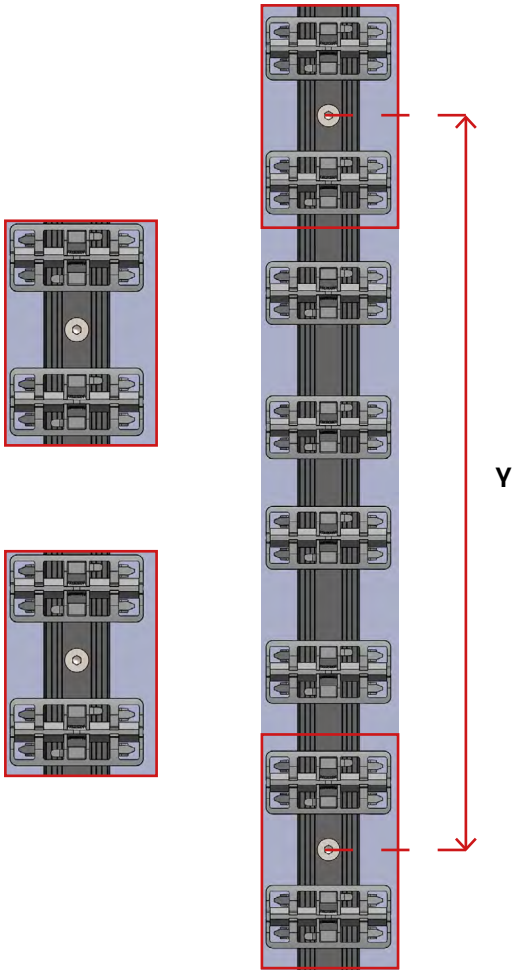
© GRAD - REPRODUCTION PROHIBITED - V01

FASTENING RAILS DIRECTLY TO THE WALL



Maximum rail spacing is 650 mm.

Maximum fastener spacing is 430 mm; this value may vary according to geographical area (see table p.10).



© GRAD - REPRODUCTION PROHIBITED - V01

MAXIMUM DISTANCE BETWEEN FASTENERS FOR FAÇADE APPLICATIONS

Calculations made by the Serviceability Limit State

BUILDING HEIGHT: 10 M

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.27	0.29	0.32	0.35	0.36
2	0.26	0.27	0.3	0.33	0.34
3	0.25	0.26	0.29	0.31	0.32
4	0.23	0.25	0.27	0.3	0.31
Guadeloupe	0.18	0.2	0.23	0.25	0.26
Guyane	0.33	0.35	0.38	0.41	0.43
Martinique	0.2	0.23	0.25	0.27	0.28
Réunion	0.19	0.21	0.24	0.26	0.27
Mayotte	0.22	0.24	0.26	0.28	0.29

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

All Orography (Co = 1.15)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.25	0.26	0.29	0.32	0.33
2	0.24	0.25	0.28	0.3	0.31
3	0.22	0.24	0.26	0.28	0.29
4	0.21	0.23	0.25	0.27	0.28
Guadeloupe	0.16	0.17	0.19	0.21	0.24
Guyane	0.3	0.32	0.35	0.38	0.39
Martinique	0.18	0.2	0.22	0.24	0.25
Réunion	0.17	0.18	0.2	0.22	0.24
Mayotte	0.2	0.21	0.24	0.26	0.27

Max. fixing distance to justify L/167 minimum - Building height 10 m for façade installation only

BUILDING HEIGHT: 28 M

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.26	0.27	0.29	0.3	0.32
2	0.24	0.25	0.27	0.29	0.31
3	0.22	0.24	0.25	0.27	0.29
4	0.2	0.22	0.24	0.26	0.28
Guadeloupe	0.16	0.17	0.2	0.22	0.23
Guyane	0.3	0.32	0.34	0.36	0.39
Martinique	0.18	0.19	0.22	0.24	0.25
Réunion	0.17	0.18	0.21	0.23	0.24
Mayotte	0.19	0.21	0.23	0.25	0.27

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

All Orography (Co = 1.15)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.23	0.24	0.26	0.28	0.3
2	0.21	0.23	0.24	0.26	0.28
3	0.2	0.21	0.23	0.25	0.26
4	0.18	0.2	0.21	0.23	0.25
Guadeloupe	0.14	0.15	0.17	0.18	0.2
Guyane	0.28	0.29	0.31	0.33	0.35
Martinique	0.16	0.17	0.19	0.2	0.23
Réunion	0.15	0.16	0.18	0.19	0.21
Mayotte	0.17	0.18	0.2	0.23	0.24

Max. fixing distance to justify L/167 minimum - Building height 28 m for façade installation only

© GRAD - REPRODUCTION PROHIBITED - V01

MAXIMUM DISTANCE BETWEEN FASTENERS FOR SOFFIT APPLICATION

Calculations made by the Serviceability Limit State

BUILDING HEIGHT: 10 M

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.26	0.27	0.29	0.31	0.32
2	0.25	0.26	0.28	0.30	0.31
3	0.24	0.25	0.27	0.29	0.29
4	0.23	0.24	0.26	0.28	0.28
Guadeloupe	0.17	0.19	0.21	0.24	0.25
Guyane	0.30	0.31	0.33	0.35	0.36
Martinique	0.19	0.21	0.24	0.26	0.26
Réunion	0.18	0.20	0.23	0.25	0.25
Mayotte	0.21	0.23	0.25	0.27	0.27

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

All Orography (Co = 1.15)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.24	0.25	0.27	0.29	0.30
2	0.23	0.24	0.26	0.28	0.28
3	0.22	0.23	0.25	0.27	0.27
4	0.20	0.22	0.23	0.26	0.26
Guadeloupe	0.16	0.17	0.18	0.20	0.22
Guyane	0.28	0.29	0.31	0.33	0.34
Martinique	0.18	0.19	0.20	0.22	0.24
Réunion	0.17	0.18	0.19	0.21	0.23
Mayotte	0.19	0.20	0.22	0.24	0.25

Max. fixing center distance to justify L/167 minimum - Building height 10 m for soffit installation only

BUILDING HEIGHT: 28 M

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

Flat Terrain (Co = 1)

	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.24	0.25	0.27	0.28	0.30
2	0.22	0.24	0.25	0.27	0.28
3	0.21	0.22	0.24	0.26	0.27
4	0.19	0.21	0.23	0.25	0.26
Guadeloupe	0.15	0.16	0.19	0.21	0.23
Guyane	0.28	0.29	0.31	0.32	0.34
Martinique	0.17	0.18	0.21	0.23	0.24
Réunion	0.16	0.17	0.20	0.22	0.23
Mayotte	0.18	0.20	0.22	0.24	0.25

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

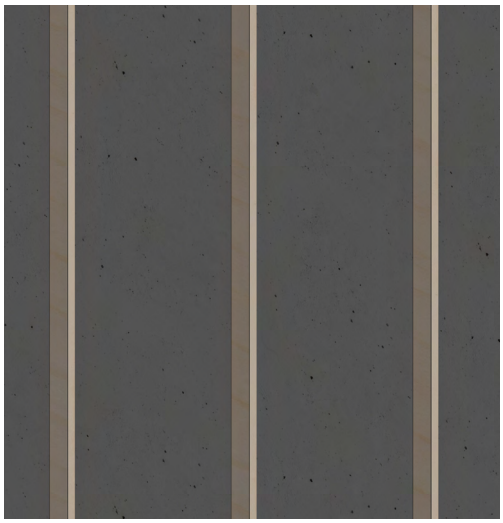
All Orography (Co = 1.15)

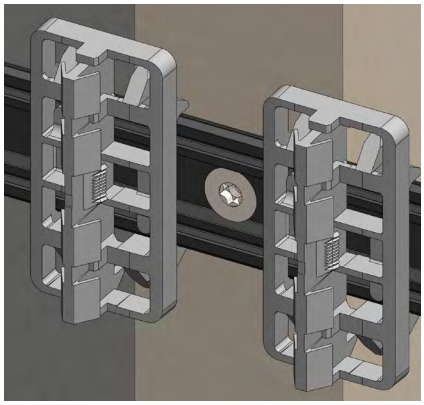
	WIND ROUGHNESS				
ZONE	**0**	**II**	**IIIa**	**IIIb**	**IV**
1	0.21	0.23	0.25	0.26	0.2
2	0.20	0.21	0.23	0.25	0.26
3	0.19	0.20	0.21	0.24	0.25
4	0.17	0.19	0.20	0.23	0.24
Guadeloupe	0.14	0.15	0.16	0.17	0.19
Guyane	0.26	0.27	0.28	0.30	0.31
Martinique	0.15	0.16	0.18	0.20	0.21
Réunion	0.14	0.16	0.17	0.18	0.20
Mayotte	0.16	0.18	0.19	0.21	0.23

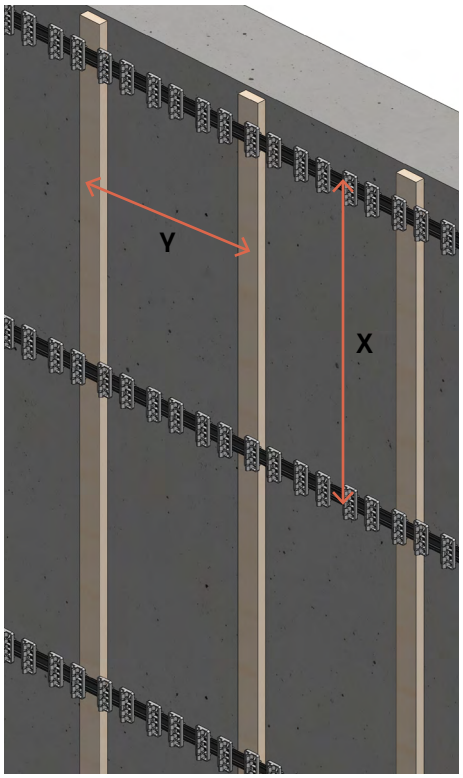
Max. fixing center distance to justify L/167 minimum - Building height 28 m for soffit installation only

© GRAD - REPRODUCTION PROHIBITED - V01

FASTENING RAILS TO FURRING STRIPS



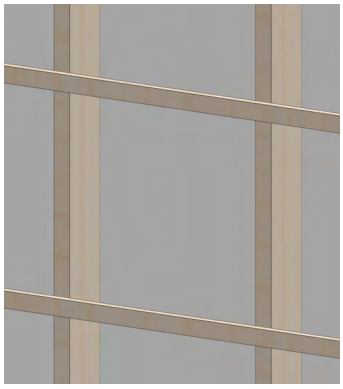


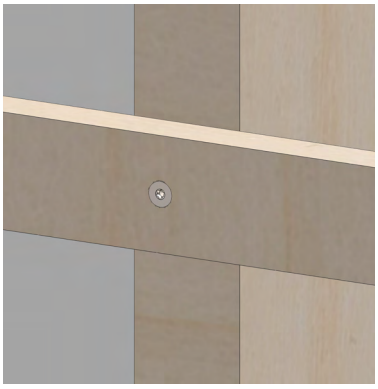


If the rails are fastened to a timber structure with existing furring, it is important to ensure that the furring strip spacing is **similar to or less than the maximum rail fastening spacing of 430 mm.**

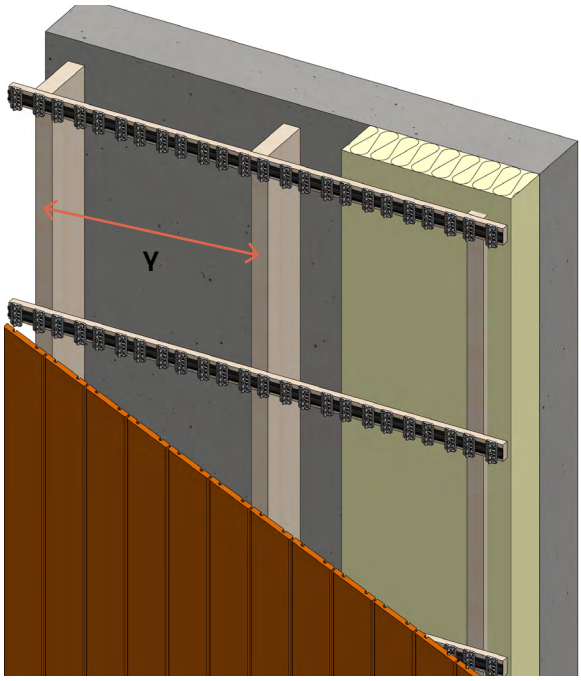
Rails should also be fastened with fasteners suitable for this type of structure.

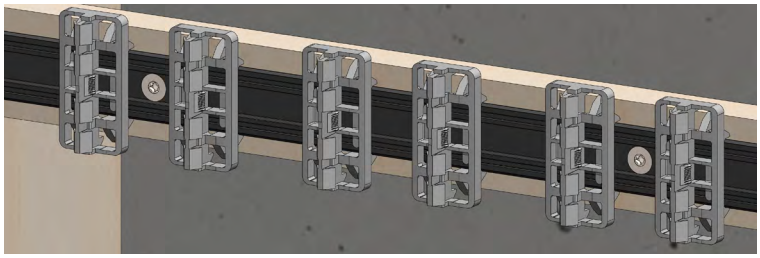
When the center-to-center distance of the existing wood structure is greater than the maximum rail fastening center-to-center distance (430 mm), the structure must be adapted with a double furring system.





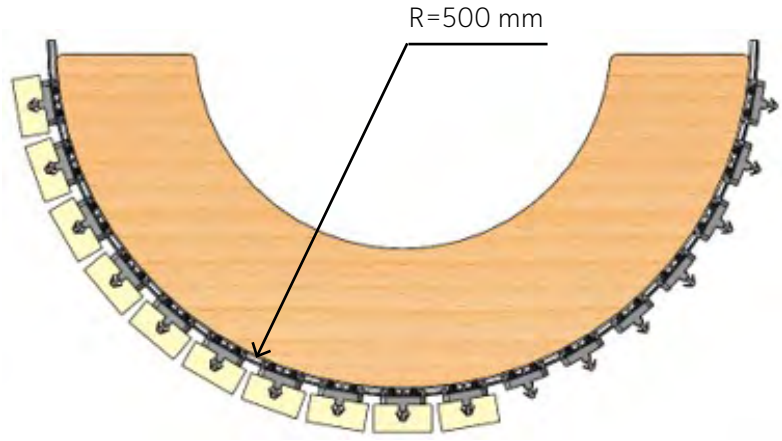
The furring strips are fastened to the other furring using countersunk screws, so that the screw head can be flush and does not interfere with the installation of the rail on the furring strips.



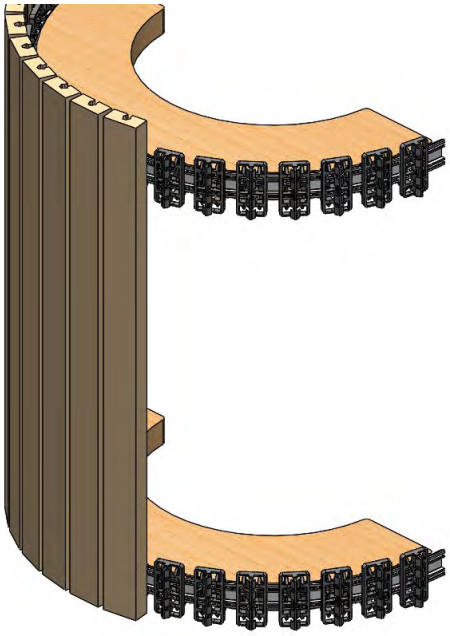


© GRAD - REPRODUCTION PROHIBITED - V01

INSTALLING THE RAILS ON A CURVED WALL

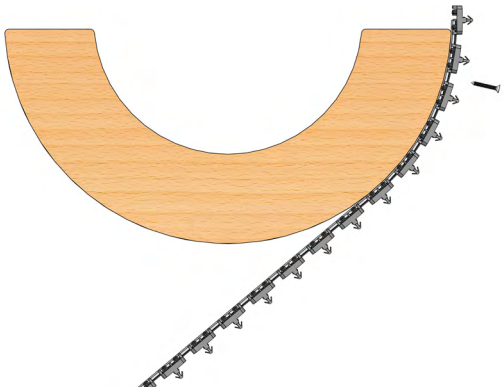


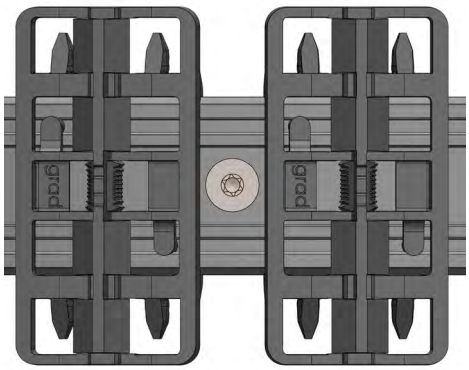
The Mini Rail enables manual bending up to a radius of 500 mm.

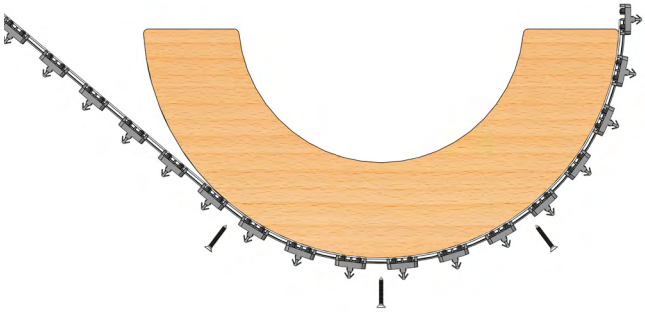


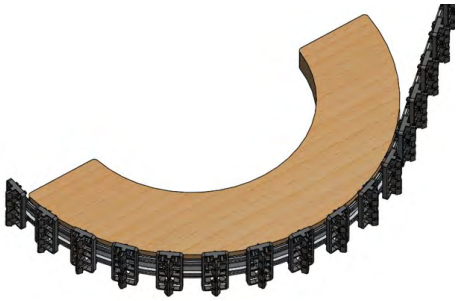
INSTALLATION

Start fastening the miniature rail at one end using suitable fasteners.
The spacing between fasteners must allow the miniature rail to be completely flush with the wall.









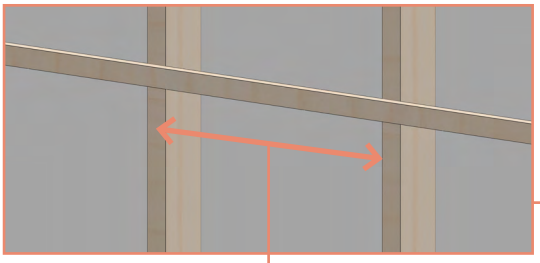
Adjust the screw spacing according to the radius of curvature, to ensure that the rail is held securely on the support.
Note: The mini-rail can be fastened with a nail gun.

© GRAD - REPRODUCTION PROHIBITED - V01

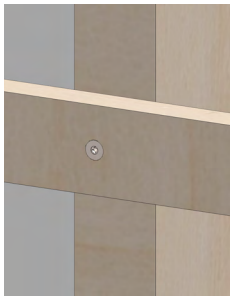
RAIL FASTENING ON A DOUBLE FURRING SYSTEM

VERTICAL CLADDING

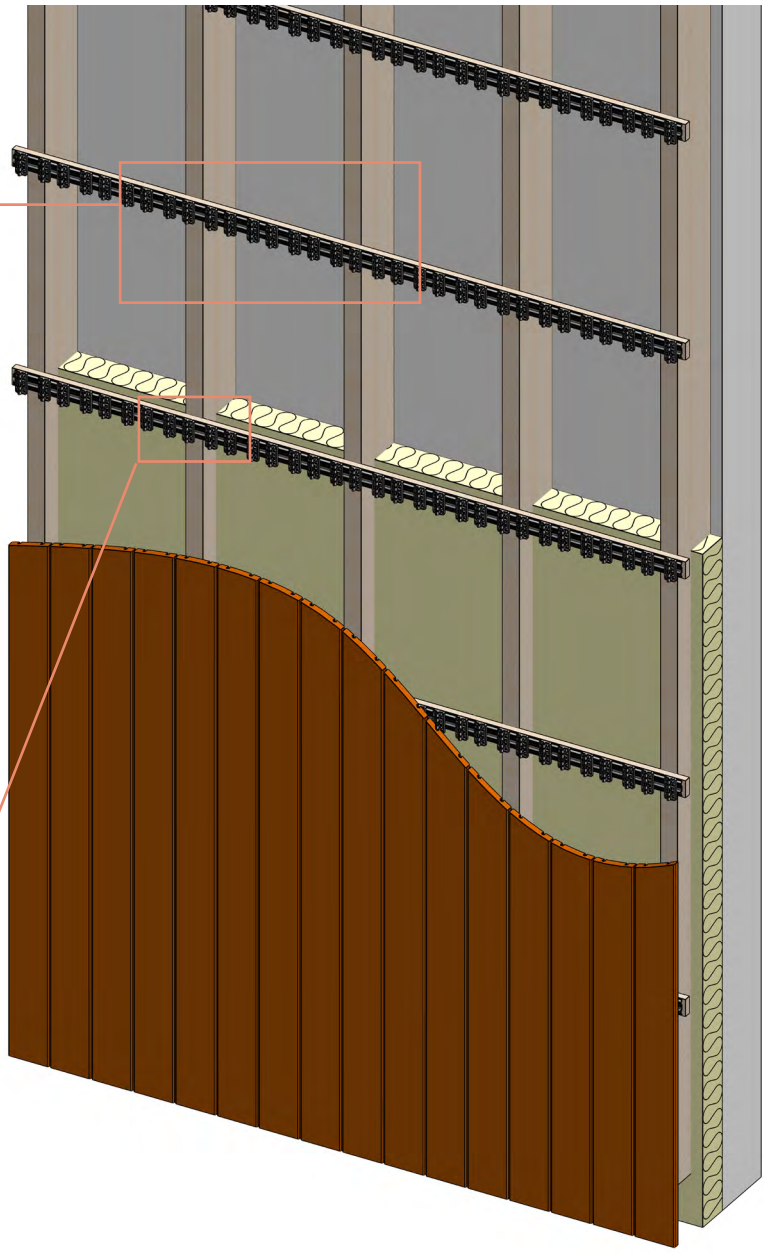
Horizontal cladding uses the same fastening principle, only the structure undergoes a few modifications



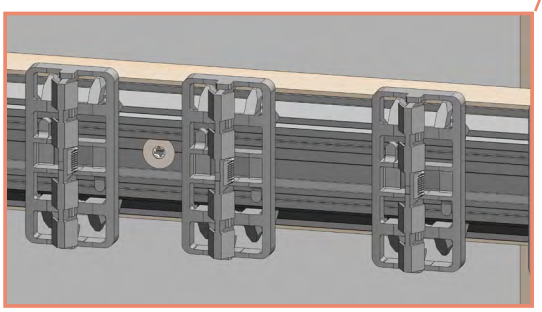
In cases where the spacing of the furring strips is greater than the maximum spacing for fastening the Mini Rail, a double-furring structure must be created and the rails fastened to these furring strips.

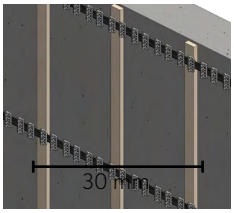


The horizontal furring strips are fastened to the existing furring strips using countersunk screws, so that the screw head can be embedded in the furring without interfering with the installation of the Mini Rail on the furring strip.



The rails are fastened to the horizontal furring with a screw suitable for this type of structure.





Minimum furring strip width is 30 mm

© GRAD - REPRODUCTION PROHIBITED - V01