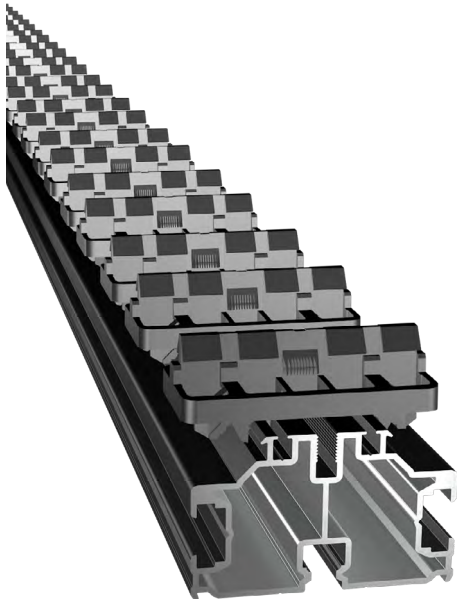


PR39 - CLADDING

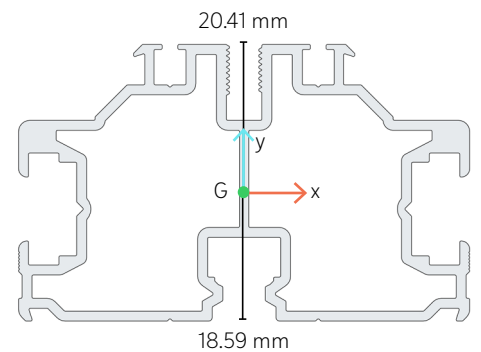
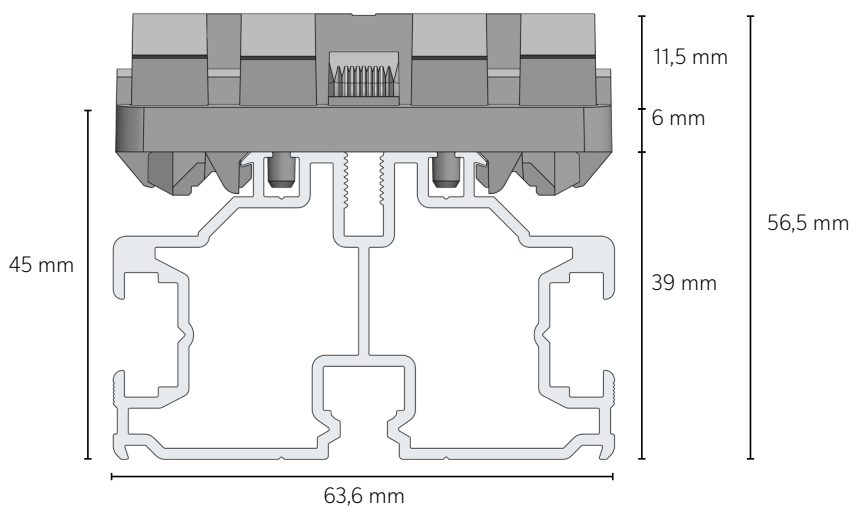
Utilisation : Structure for fastening cladding boards



RAIL PR39



DIMENSIONS OF PR39 RAIL WITH CLIPS



Position of center of gravity (G)

MOMENTS OF INERTIA:

$$I_{xx} = 75341 \text{ mm}^4$$

$$I_{yy} = 178425 \text{ mm}^4$$

$$I_{xx/v} = 3691 \text{ mm}^3$$

SUMMARY

1	Technical Characteristics	p 3
2	Wind forces	p 4
3	Pull-out forces	p 8
4	Rail installation directly on the wall	p 9
5	Rail installation on L Brackets	p 15

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:
 - $C_{pe} = -1.4$
 - $C_{pi} = 0$
- 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 $\leq 5\%$, orography coefficient $C_o = 1$).

FCBA study dated 30/05/2023

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

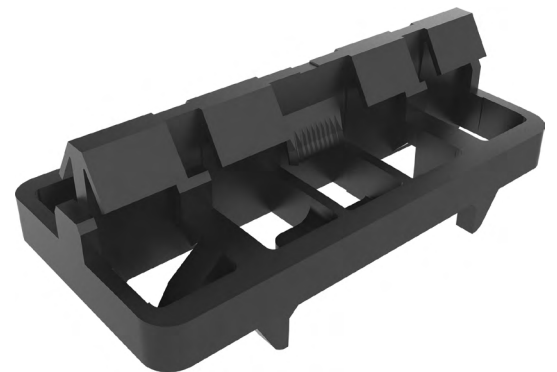
ALUMINIUM RAIL

Material	Aluminium EN AW-6060
Mass per meter of rail without clips	1,242 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



GRAD CLIP

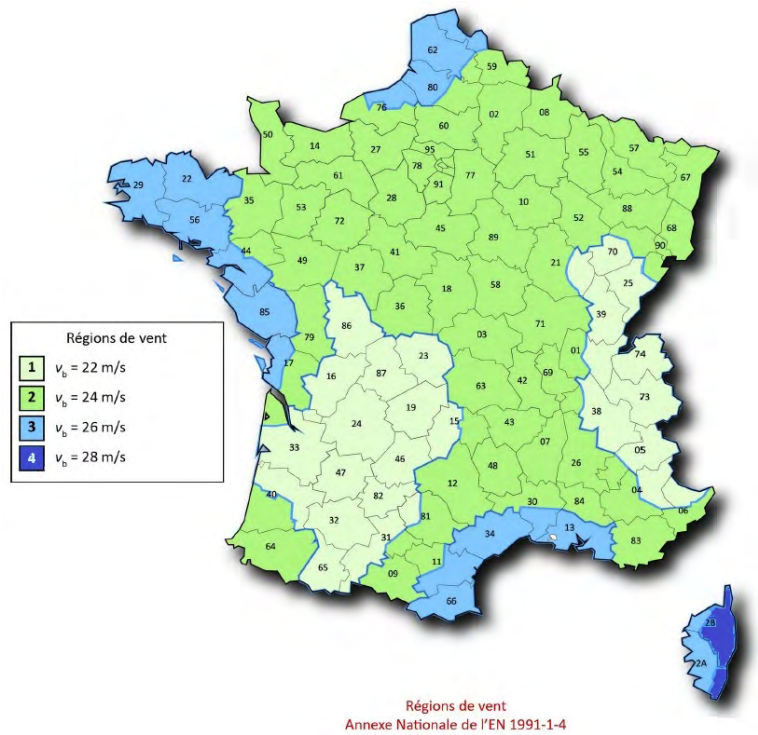
Material	Polyoxymethylene
Density (kg/m³)	1410
Colour	Black
Tensile stress at yield (MPa)	64
Fusion temperature (°C)	190-220
Tensile modulus (MPa)	2850
Coefficient of linear expansion (10⁻⁶/K)	110



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.



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 20 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 $C_o = 1$, if the value obtained is $> 5\%$ then $C_o = 1.15$. 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: $E = 70,000 \text{ MPa}$;
- Strength at 0.2%: $f_0 = 150 \text{ MPa}$;
- Ultimate tensile strength: $f_u = 190 \text{ MPa}$;
- Partial safety factors: $\gamma_1 = 1.1$;
- Factor of safety (cladding board on 3 supports): $k = 1.25$;

WIND FORCE : DEPRESSION VALUES IN (KN/M²)

BUILDING HEIGHT: 10 M

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

ZONE	WIND ROUGHNESS				
	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
Guyana	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

Max orography (Co = 1,15), H = 10 m

ZONE	WIND ROUGHNESS				
	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
Guyana	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

ZONE	WIND ROUGHNESS				
	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
Guyana	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

Max orography (Co = 1,15), H = 28 m

ZONE	WIND ROUGHNESS				
	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
Guyana	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

MAXIMUM DESIGN PULL-OUT FORCE PER FASTENER FOR FAÇADE APPLICATION

BUILDING HEIGHT: 10 M

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

Flat terrain (Co = 1)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	1580	1329	987	763	711
2	1882	1593	1185	921	842
3	2198	1856	1382	1079	987
4	2554	2159	1606	1250	1145
Guadeloupe	4095	3567	2659	2067	1895
Guyana	948	790	592	461	421
Martinique	3330	2817	2106	1632	1501
Réunion	3764	3185	2369	1843	1685
Mayotte	2948	2382	1869	1435	1316

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

All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	2089	1758	1306	1010	940
2	2489	2106	1567	1219	1114
3	2907	2454	1828	1427	1306
4	3377	2855	2124	1654	1514
Guadeloupe	4934	4407	3516	2733	2507
Guyana	1253	1044	783	609	557
Martinique	4210	3725	2785	2159	1984
Réunion	4568	4087	3133	2437	2228
Mayotte	3882	3151	2472	1897	1741

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

BUILDING HEIGHT: 28 M

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

Flat terrain (Co = 1)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	1961	1685	1408	1185	961
2	2330	2014	1685	1408	1132
3	2738	2356	1974	1645	1329
4	3172	2738	2290	1909	1553
Guadeloupe	4552	4247	3791	3159	2554
Guyana	1171	1014	842	711	566
Martinique	4044	3567	2988	2501	2027
Réunion	4304	3966	3383	2817	2277
Mayotte	3580	3080	2580	2132	1724

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

All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	2594	2228	1863	1567	1271
2	3081	2663	2228	1863	1497
3	3621	3116	2611	2176	1758
4	4076	3621	3029	2524	2054
Guadeloupe	5351	4998	4590	4064	3377
Guyana	1549	1340	1114	940	749
Martinique	4793	4407	3916	3307	2681
Réunion	5095	4735	4254	3725	3011
Mayotte	4418	3996	3412	2820	2280

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

MAXIMUM DESIGN PULL-OUT FORCE PER FASTENER FOR SOFFIT APPLICATION

BUILDING HEIGHT: 10 M

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

Flat terrain (Co = 1)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	1882	1632	1290	1066	1014
2	2185	1895	1487	1224	1145
3	2501	2159	1685	1382	1290
4	2856	2461	1909	1553	1448
Guadeloupe	4288	3862	2962	2369	2198
Guyana	1250	1092	895	763	724
Martinique	3633	3120	2409	1935	1803
Réunion	3992	3488	2672	2145	1988
Mayotte	3251	2685	2172	1737	1619

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

All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	2392	2061	1608	1312	1243
2	2792	2409	1869	1521	1417
3	3210	2757	2131	1730	1608
4	3680	3158	2426	1956	1817
Guadeloupe	5111	4594	3819	3036	2809
Guyana	1556	1347	1086	912	860
Martinique	4401	3967	3088	2461	2287
Réunion	4752	4280	3436	2740	2531
Mayotte	4080	3453	2775	2200	2043

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

BUILDING HEIGHT: 28 M

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

Flat terrain (Co = 1)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	2264	1988	1711	1487	1264
2	2633	2317	1988	1711	1435
3	3041	2659	2277	1948	1632
4	3475	3041	2593	2211	1856
Guadeloupe	4691	4389	4010	3462	2856
Guyana	1474	1316	1145	1014	869
Martinique	4185	3862	3291	2804	2330
Réunion	4434	4163	3686	3120	2580
Mayotte	3871	3383	2883	2435	2027

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

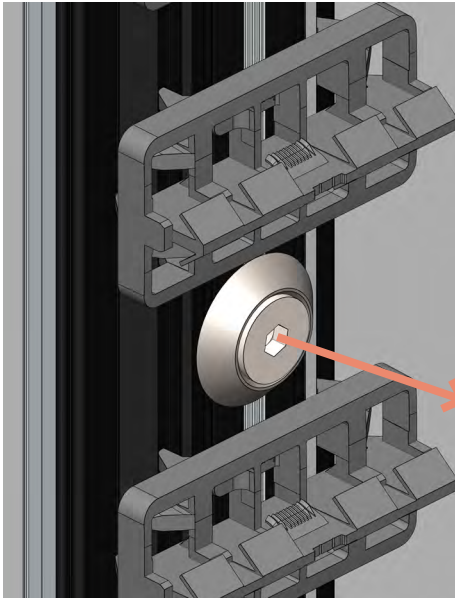
All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	2896	2531	2165	1869	1573
2	3384	2966	2531	2165	1800
3	3898	3419	2914	2479	2061
4	4269	3898	3332	2827	2357
Guadeloupe	5476	5112	4725	4258	3680
Guyana	1852	1643	1417	1243	1051
Martinique	4929	4594	4114	3610	2983
Réunion	5200	4879	4444	3967	3314
Mayotte	4604	4192	3715	3123	2583

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

PULL-OUT FORCE

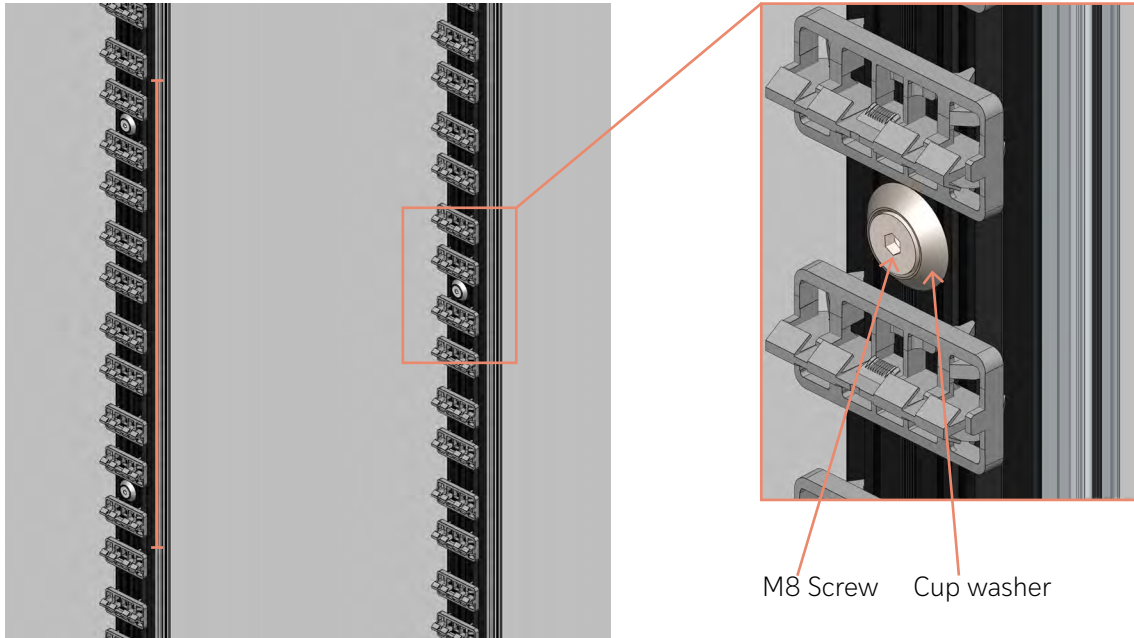


The pull-out force is an essential value for sizing fasteners.

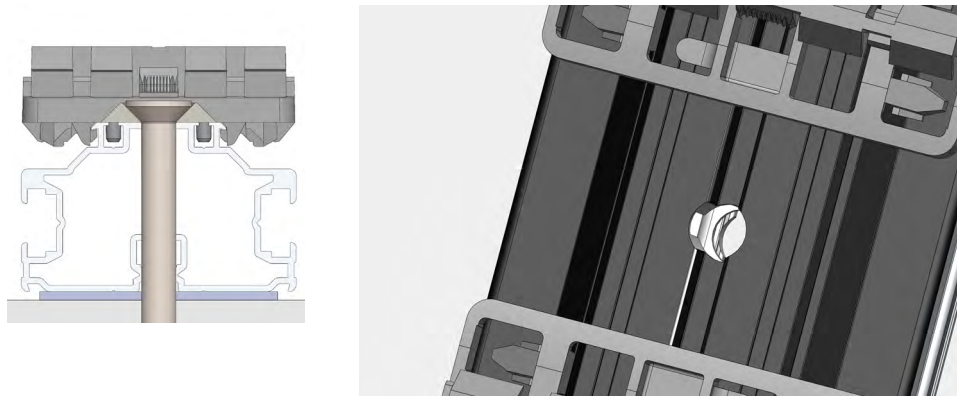
A calculation note is also available to help with fastener sizing.

Pull-out force:
 $F_{tens,k}$

RAIL FASTENING DIRECTLY TO THE WALL USING THROUGH-BOLTS HORIZONTAL CLADDING

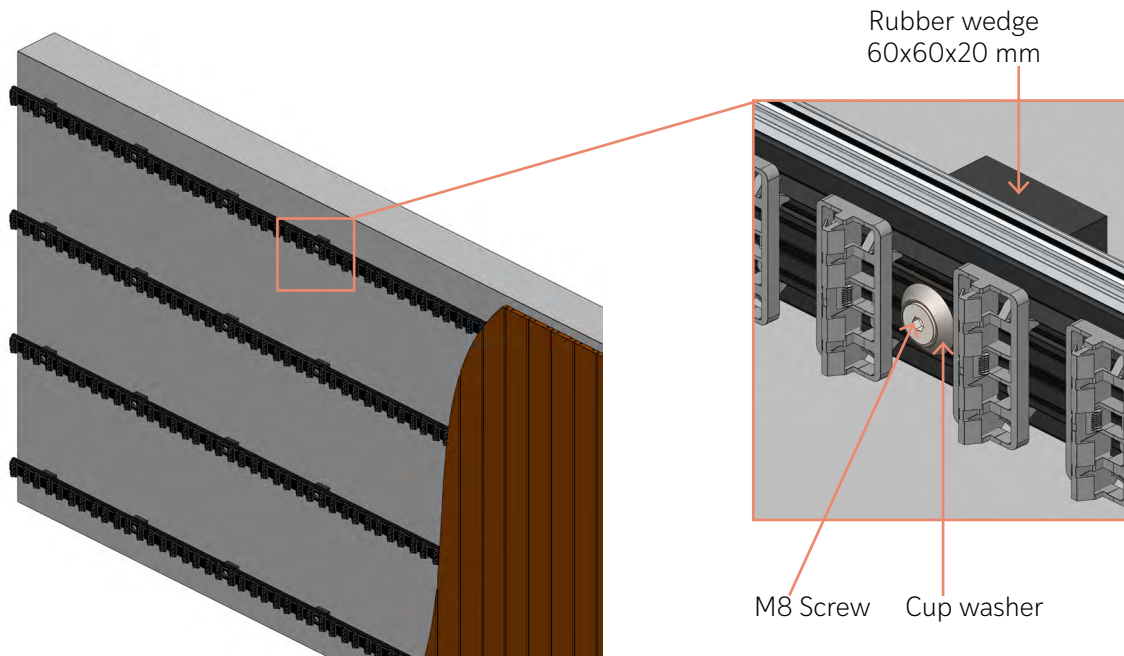


Max. distance between fasteners: **1350 mm**
(depending on geographical area - refer to tables on
pages 13 and 14)

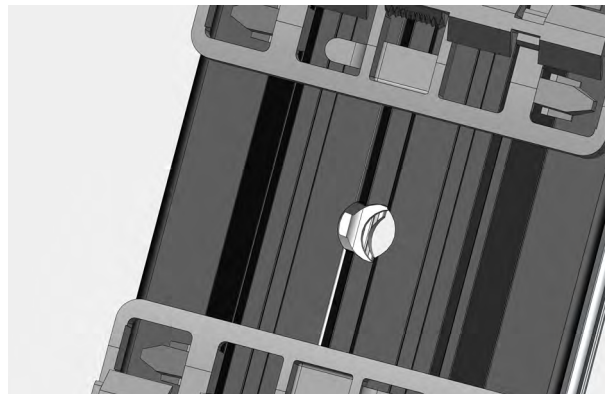
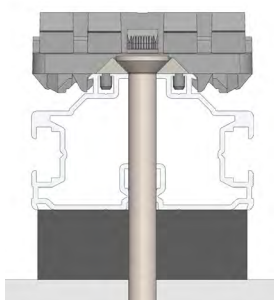


PR39 rails can be fastened using M8 countersunk screws.
A cup washer must be fitted between the screw head and the rail.

RAIL FASTENING DIRECTLY TO THE WALL USING THROUGH-BOLTS VERTICAL CLADDING

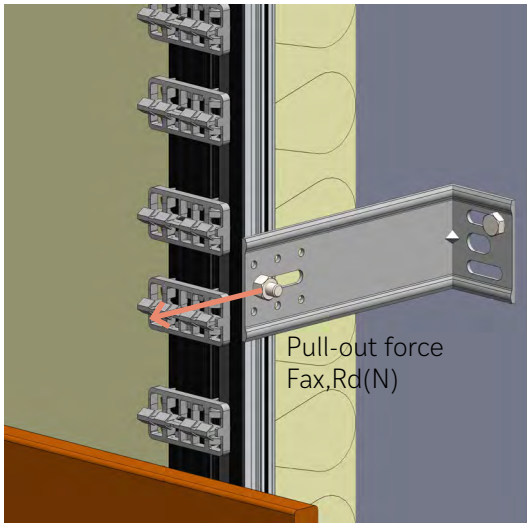


Max. distance between fasteners: **1350 mm**
(depending on geographical area - refer to tables on
pages 13 and 14)



PR39 rails can be fastened using M8 countersunk screws. A cup washer must be fitted between the screw head and the rail.

SIZING RAIL FASTENERS FOR CLADDING

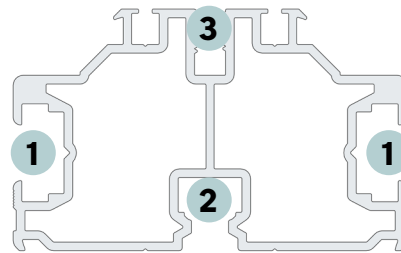
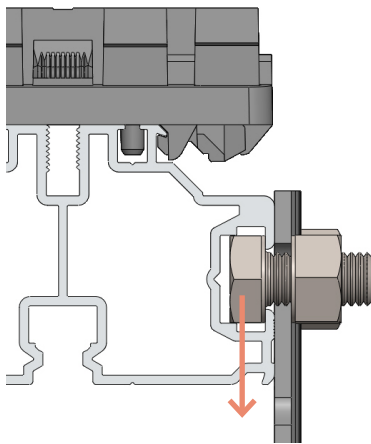


Performance of bolt retention in the rail

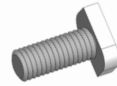
Values	F
Average	4563
Deviation	173.7
CV	3.8%
Fax,Rk	4229 N

After applying the reduction coefficient, we obtain the following value : **Fax,Rd = 3383 N**

COMPATIBLE SCREWS FOR ANCHORING VIA RAIL GROOVES



1



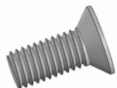
M8 hexagonal or hammerhead screw or nut

2



M6 hex head screw or nut

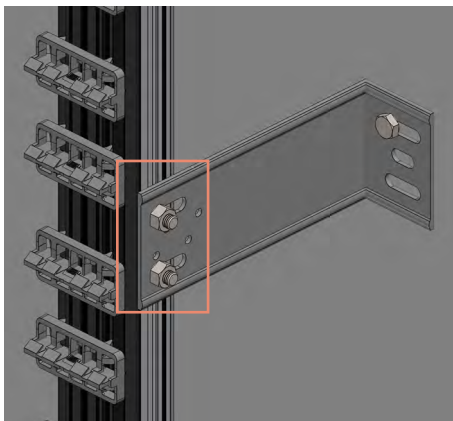
3



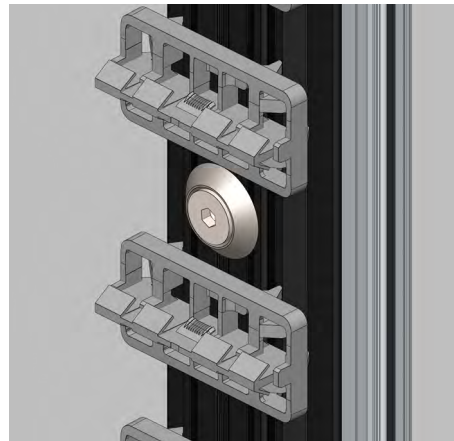
M5 countersunk screw

If the pull-out force is greater than 3383N (see table p 13 and 14), the fastener must be reinforced or the centre-to-centre distance reduced.

2 solutions are available to meet this requirement.



Lateral reinforcement by adding a second bolt in the rail and bracket



Reinforced central fixing with M8 screw and cup washer.

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	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,35	1,35	1,35	1,35	1,35
4	1,35	1,35	1,35	1,35	1,35
Guadeloupe	1,31	1,35	1,35	1,35	1,35
	1,08	1,28			
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,35	1,35	1,35	1,35	1,35
Réunion	1,35	1,35	1,35	1,35	1,35
	1,21				
Mayotte	1,35	1,35	1,35	1,35	1,35

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,35	1,35	1,35	1,35	1,35
4	1,35	1,35	1,35	1,35	1,35
Guadeloupe	1,19	1,26	1,35	1,35	1,35
	0,82	0,97	1,30		
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,29	1,35	1,35	1,35	1,35
	1,04	1,23			
Réunion	1,24	1,31	1,35	1,35	1,35
	0,92	1,08			
Mayotte	1,34	1,35	1,35	1,35	1,35
	1,17				

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	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,35	1,35	1,35	1,35	1,35
4	1,35	1,35	1,35	1,35	1,35
Guadeloupe	1,17	1,27	1,35	1,35	1,35
	0,87	1,01	1,2		
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,32	1,35	1,35	1,35	1,35
	1,10	1,28			
Réunion	1,24	1,33	1,35	1,35	1,35
	0,97	1,13			
Mayotte	1,35	1,35	1,35	1,35	1,35
	1,28				

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,35	1,35	1,35	1,35	1,35
	1,26				
4	1,31	1,35	1,35	1,35	1,35
	1,09	1,26			
Guadeloupe	1,04	1,13	1,24	1,31	1,35
	0,66	0,76	0,91	1,09	
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,18	1,26	1,34	1,35	1,35
	0,83	0,97	1,16		
Réunion	1,11	1,2	1,28	1,35	1,35
	0,74	0,86	1,02	1,23	
Mayotte	1,26	1,32	1,35	1,35	1,35
	0,96	1,12	1,34		

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

Cells with this colour indicate a reduction in the distance between rail fasteners, unless the fastening system is to be reinforced. Details of fastener reinforcement are given on page 16.

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	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,35	1,35	1,35	1,35	1,35
4	1,35	1,35	1,35	1,35	1,35
Guadeloupe	1,28 1,03	1,35 1,21	1,35	1,35	1,35
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,35 1,29	1,35	1,35	1,35	1,35
Réunion	1,33 1,15	1,35	1,35	1,35	1,35
Mayotte	1,35	1,35	1,35	1,35	1,35

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,35	1,35	1,35	1,35	1,35
4	1,35 1,28	1,35	1,35	1,35	1,35
Guadeloupe	1,17 0,79	1,24 0,93	1,35 1,23	1,35	1,35
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,26 0,99	1,33 1,16	1,35	1,35	1,35
Réunion	1,21 0,88	1,28 1,03	1,35	1,35	1,35
Mayotte	1,31 1,11	1,35	1,35	1,35	1,35

Max. fixing centre 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	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,35	1,35	1,35	1,35	1,35
4	1,35	1,35	1,35	1,35	1,35
Guadeloupe	1,14 0,84	1,23 0,97	1,32 1,14	1,35	1,35
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,27 1,05	1,35 1,21	1,35	1,35	1,35
Réunion	1,2 0,93	1,3 1,08	1,35 1,27	1,35	1,35
Mayotte	1,35 1,21	1,35	1,35	1,35	1,35

MAX DISTANCE BETWEEN FASTENERS TO JUSTIFY L/167 IN M

All orography (Co = 1,15)

WIND ROUGHNESS

ZONE	0	II	IIIa	IIIb	IV
1	1,35	1,35	1,35	1,35	1,35
2	1,35	1,35	1,35	1,35	1,35
3	1,34 1,19	1,35	1,35	1,35	1,35
4	1,28 1,04	1,34 1,19	1,34	1,35	1,35
Guadeloupe	1,02 0,64	1,1 0,74	1,2 0,88	1,28 1,04	1,35 1,28
Guyana	1,35	1,35	1,35	1,35	1,35
Martinique	1,15 0,80	1,24 0,93	1,31 1,10	1,35 1,30	1,35
Réunion	1,08 0,71	1,17 0,83	1,26 0,98	1,33 1,16	1,35
Mayotte	1,23 0,93	1,29 1,07	1,35 1,26	1,35	1,35

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

Cells with this colour indicate a reduction in the distance between rail fasteners, unless the fastening system is to be reinforced. Details of fastener reinforcement are given on page 16.

FASTENING RAILS WITH AN L BRACKET SYSTEM



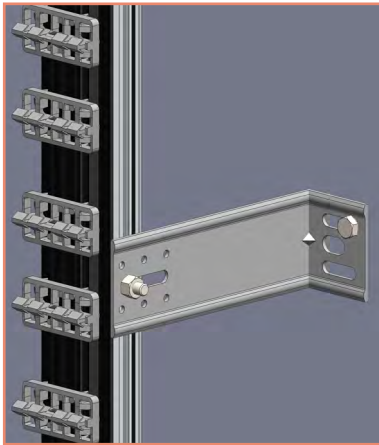
Max distance between brackets
1350 mm

*(depending on geographical zone -
refer to the tables on pages 13 and 14)*



FASTENING RAILS WITH AN L BRACKET SYSTEM

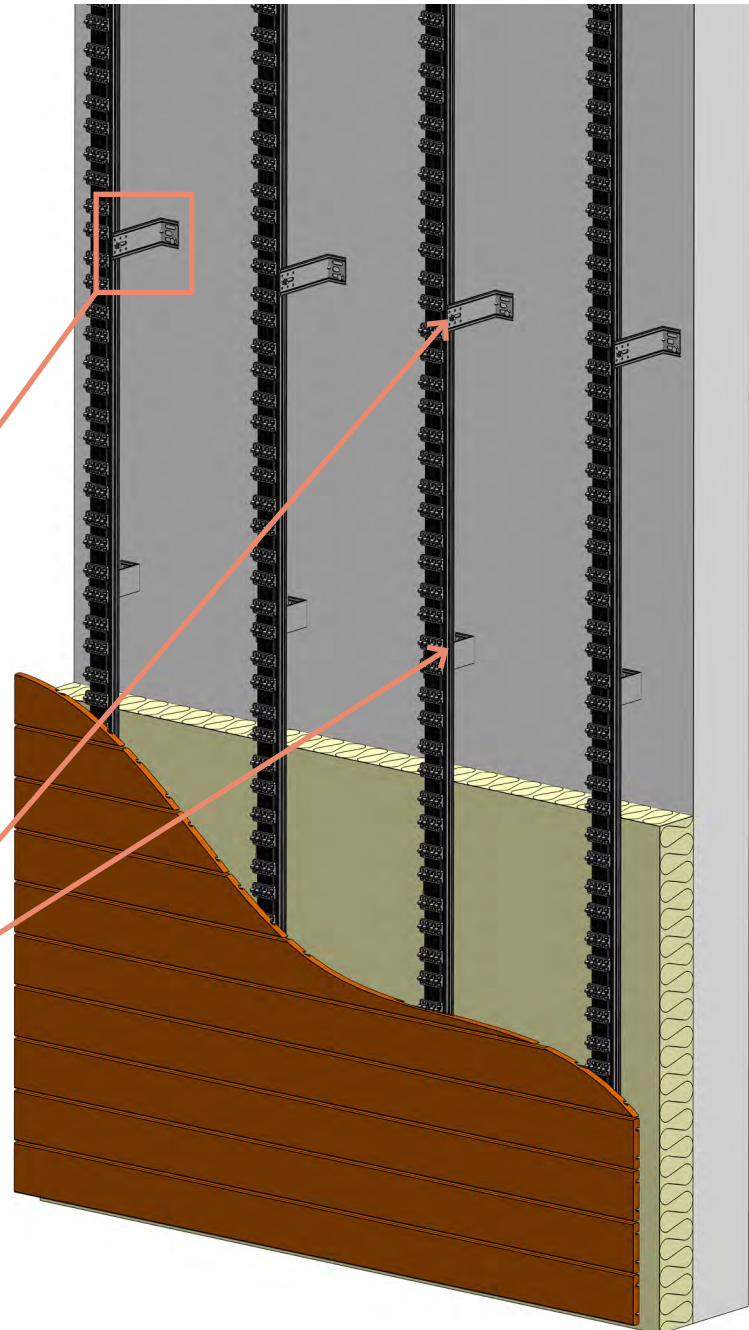
HORIZONTAL CLADDING



The rails are fastened to the bracket with an M8 bolt.

The cladding brackets can be fixed to the wall using suitable lag bolts.

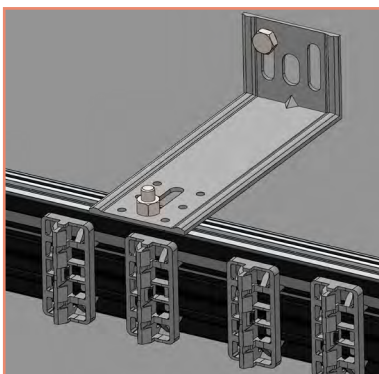
The brackets must be fastened alternately on both sides of the rail.



FASTENING RAILS WITH AN L BRACKET SYSTEM

VERTICAL CLADDING

Vertical cladding uses the same holding and fastening principles as horizontal cladding.



The rails are fastened to the bracket with an M8 bolt.

The cladding brackets can be fixed to the wall using suitable lag bolts.

