



VERROTEC

Prüf-, Überwachungs- und
Zertifizierungsstelle (RPF14)

Content: **Test Report**

Project: VetroMount Top and VetroMount Side

Project number: VT 17-0682

Report: VT 17-0682 - 06

Contract: Static line load tests according to BS 6180:2011

Client: Bohle AG
Dieselstraße 10
D-42781 Haan

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Quelle: Bohle AG

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1. Motivation

The company VERROTEC GmbH located in Mainz (Germany) was assigned by the company Bohle AG located in D-42781 Haan to verify the guardrail effect of the balustrade system VetroMount Top and VetroMount Side by load testing to allow the balustrade system to be classified for use in accordance with BS 6180:2011 Barriers in and about buildings.

In this test report the relevant glass formats with their direct glazing of the substructure are evaluated under horizontal line loading.

Subject of this report is the resistance of the balustrade system under static line loads.

A transfer of the results of this test report is not permitted, unless within the scope of this report.

2. General Information

- Material compatibilities are to be verified when using different plastic materials (silicon, PVB, etc.).
- Corrosion of metallic materials has to be prevented by suitable means (e.g. different alloy choice, coating, prevention of contact corrosion, constructive means, etc.)
- Due to material and production related nickel sulphide inclusion, tempered glass is susceptible to spontaneous breakage of glass. We recommend the general use of tempered glass with Heat Soak Test. Due to the additional Heat Soak Test the risk of glass breakage due to nickel sulphide inclusion is considerably minimized.
- A constraint-free bearing of the glass is to be ensured.
- Contact between metal and glass or glass and glass have to be avoided permanently.
- In case of glass breakage the concerned areas are to be secured, the broken glass panes are to be replaced immediately.
- This document is only valid for the tested glazing system. The results of this document are only valid, if the boundary conditions defined in this document are provided on-site. This is to be verified on-site.
- This document is to be published unabridged; partial publication requires the permission of Verrotec GmbH.
- A transfer of the results on other positions and/or systems is not allowed unless described within this document.
- The company VERROTEC GmbH in Mainz, Germany, takes responsibility only for the appraised construction parts under the described preconditions. If there are any changes or discrepancies, we demand notification.



3. Standards and technical rules

- [1] BS 6180:2011 Barriers in and about buildings – Code of practice

4. Current Plans

The following current plans are the basis of this document:

- [2] Profile: Pattern of drilling Topmount / Pattern of drilling Sidemount - dwg.no.: 0003953 from 22.05.2018 (3 sheets) Index 00-D.
- [3] Handrail: BO_5215248 from 17.09.2018.
- [4] Edge protection: BO_5215257 from 17.09.2018.
- [5] Installation drawing VetroMount.



5. Description of the construction

5.1 General description

The glass for the guardrail system Vetromount Top and Vetromount Side consists either of monolithic thermally toughened safety glass (TSG) or of a laminated glass consisting of thermally toughened safety glass with at least 0.76 mm of polyvinyl butyral interlayer. The glass is clamped into a supporting profile made of aluminium (EN AW 6063 T66).

5.2 Substructure

The profile can be executed in two different configurations. Image 1 shows Vetromount Top for on-floor mounting. Image 2 shows Vetromount Side for front-mounting. Both profiles are available with different covers that are shown in Image 1 and Image 2.

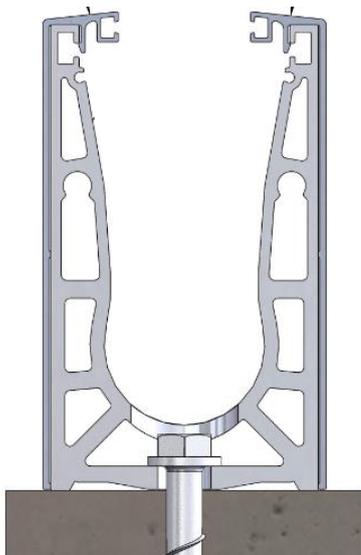
Both types of profiles have holes to be fixed to the substructure with a distance of 200 mm according to static requirements (e.g. Hilti HUS-3 H10).

Handrails can be chosen in different variations (see Image 10) taking into account the glass assemblies and the glass width. The connection of the handrail with the general supporting construction can be executed either as load-bearing or non-load-bearing connection. The specifications in section 5.4 has to be respected.

When necessary two or more profile sections can be connected with coiled spring pins.

Side Cover

Side Cover



Full Cover

Top Cover

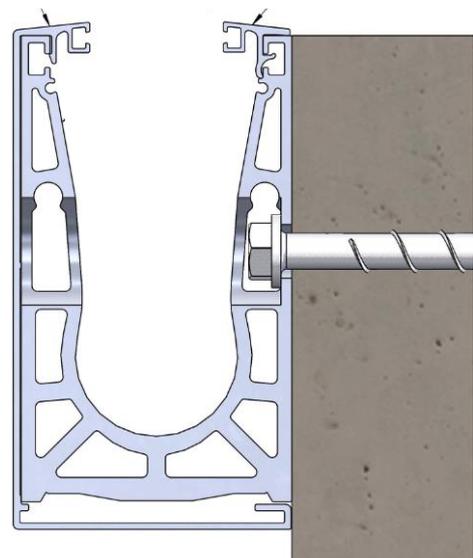


Image 1

Vetromount Top with Side Cover

Image 2

Vetromount Side with Full & Top cover

5.3 Glazing

The designation of the glass dimension are specified in Image 3. The maximum height of the glass is $h_G=1305$ mm. The glass panes are standing in the profile over a height of $h_c = 103$ bzw. 105 mm in the substructure. That leaves a glass height h_B varying between min. 900 mm and max. 1200 mm.

The clamping is secured with the glass pane bearings at least every 200 mm. The glass pane bearing consists of a blind bearing with two oppositely situated cross-wedges and pressure wedges Image 5. The glass pane bearings have different attachments for each glass assembly Table 1.

The glass for the guardrail system VetroMount Top and VetroMount Side consists either of monolithic thermally toughened safety glass (TSG) or of a laminated glass pane out of thermally toughened safety glass with at least 0.76 mm of polyvinyl butyral interlayer (according to Table 2).

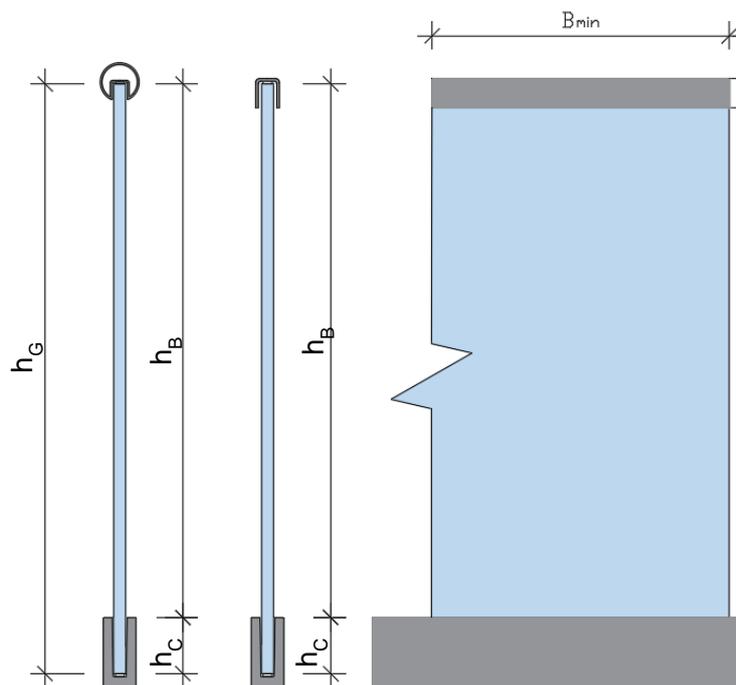


Image 3 Designation of the glass dimension

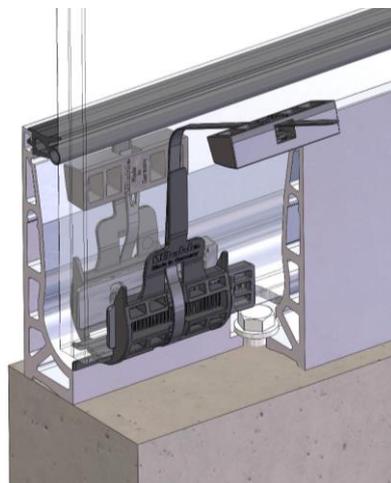


Image 4 Isometry of the glass pane bearing of the profile VetroMount

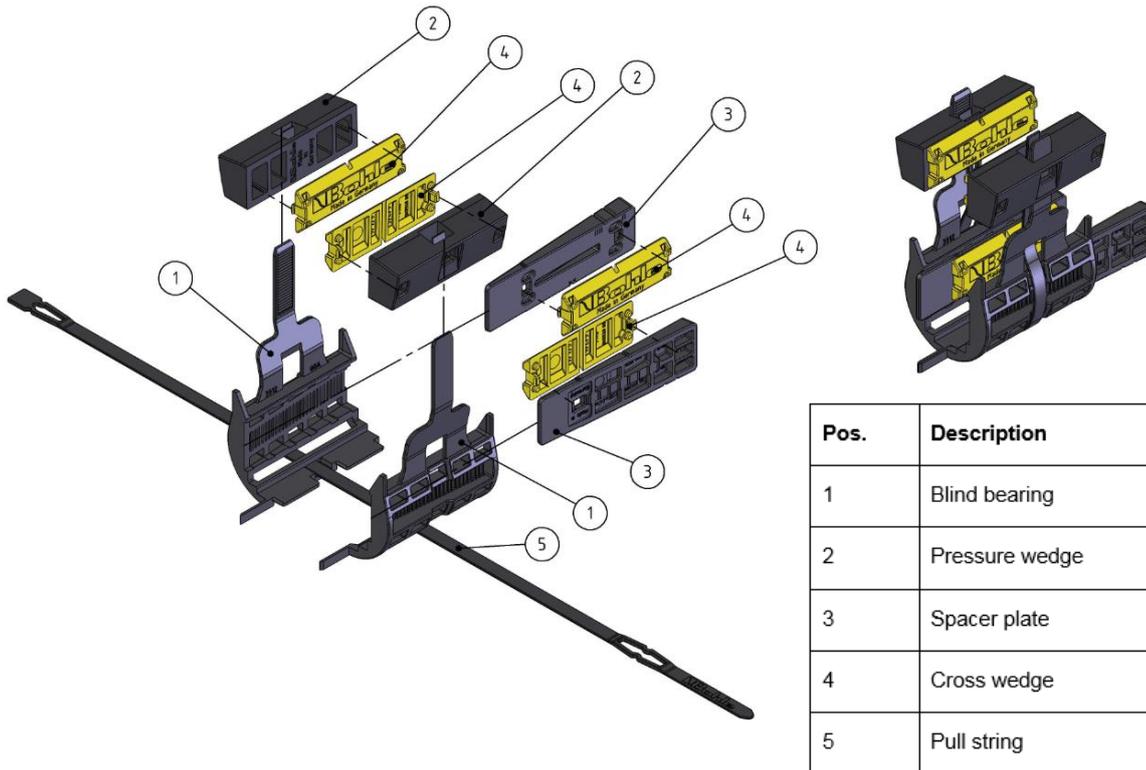


Image 5 Exploded drawing of the glass bearing

Table 1 Profile section of VetroMount depending on the glass assembly

Glass assembly	12,76 mm-13,52 mm	16,76 mm - 17,52 mm	20,76 mm – 21,52 mm
Profile section			

Table 2 Product standards of the glass

Product	Product standard	Compliance certificate
Thermally toughened soda lime silicate safety glass	DIN EN 12150-2	DCM (declaration of conformity by manufacturer)
Laminated safety glass	DIN EN 14449	DCM (declaration of conformity by manufacturer)

5.4 Edge Protection/ Handrail

A stainless steel or aluminium handrail shall be fitted to the upper edge of the pane in accordance with Annex A. Three versions of the handrail are possible:

- The glass panes are not connected to the neighbouring glasspanes by the attached handrail (design variant α , Image 6).
- The glasspanes are connected to the neighbouring glasspanes by a continuous handrail (design variant β , Image 7)
- The glasspanes are connected to the neighbouring glasspanes by a continuous handrail and connected by a post-corner connection (design variant γ , Image 8)

Possible edge protections are shown in Image 9, possible handrail profiles for the design variant β and γ are shown in Image 10.

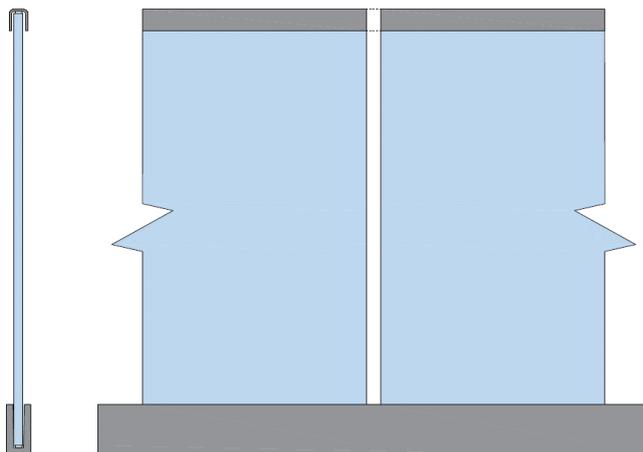


Image 6 System α : Version with attached handrail without connection between the panes

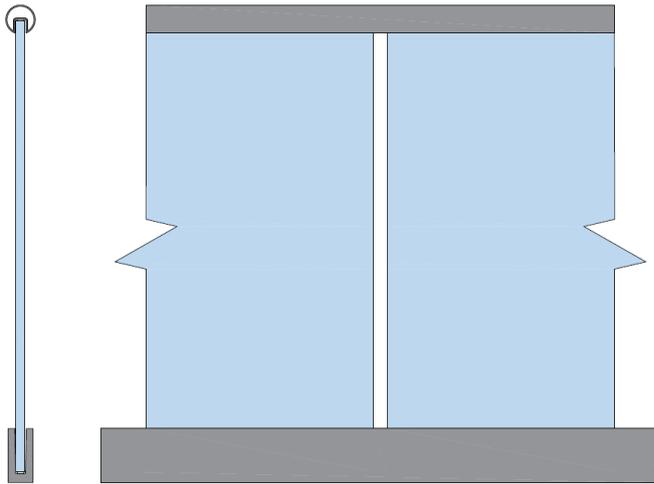


Image 7 System β : Version with continuous handrail without lateral end connection of the handrail

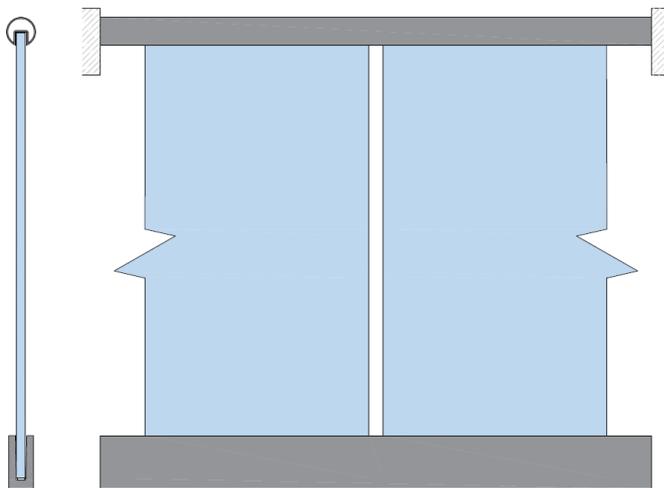


Image 8 System γ : Version with continuous handrail and lateral end connection of the handrail

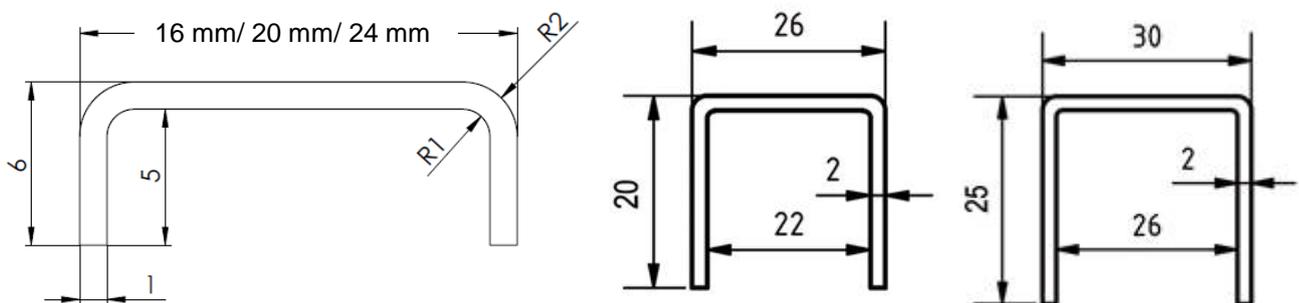


Image 9 Edge protection

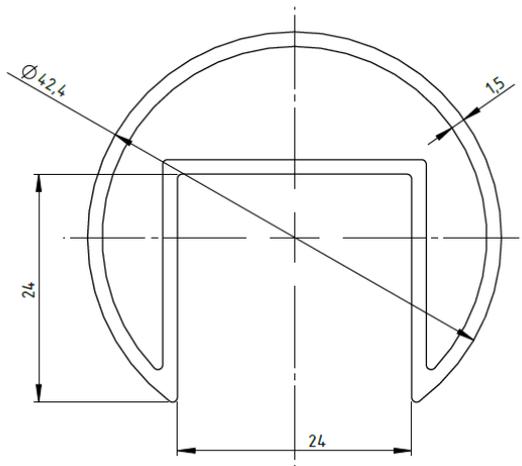


Image 10 Handrail

6. Horizontal Line Load Test

6.1 General

The guardrail function of the system is verified taking into account the regulation for load testing of BS 1680 [1].

6.2 Test setup

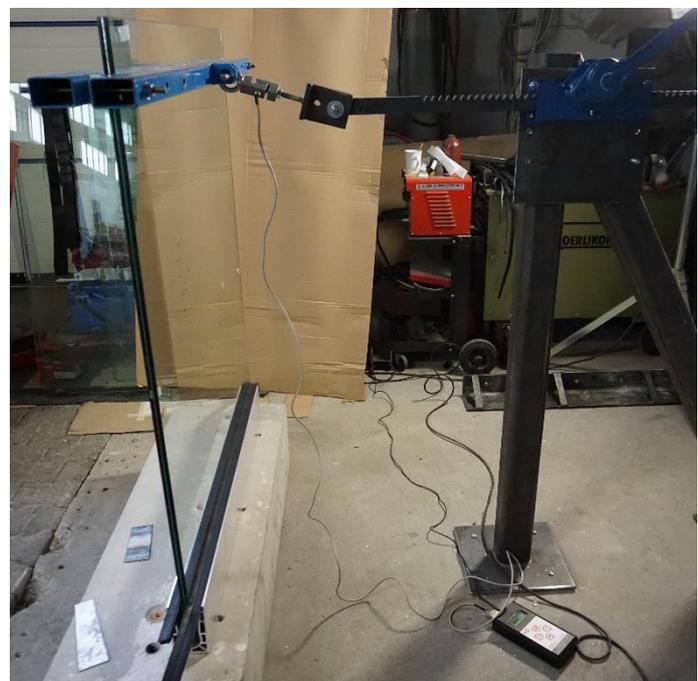
The system VetroMount Top and VetroMount Side were tested with two different glass width: 500 mm and 1000 mm. For the system VetroMount Top the profile was bolted to the top of a concrete block and for the system VetroMount Side the profile was bolted on the side of a concrete block, nominally 0.3 m x 0.3 m x 1.2 m which was fixed to the floor of the test facility. The glass panel was clamped with the glass pane bearings at least every 200 mm (Table 3) into the profile. The complete setup is shown in Image 11 and Image 12 for VetroMount Top and VetroMount Side.

Table 3 Amount of glass pane bearings

Glass pane width	Glass pane bearing
More than 500 mm	Maximum distance 200 mm, a smaller distance is allowed.



Image 11 Test setup VetroMount Top



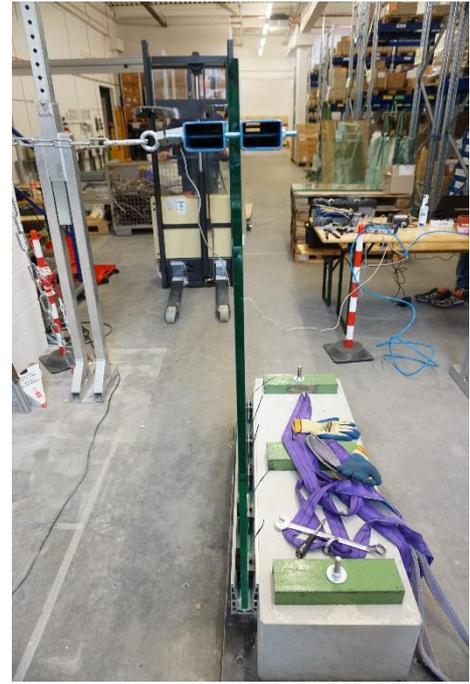


Image 12 Test setup VetroMount Side

6.3 Test procedure

A horizontal imposed line load was applied to the glass at different heights according to Table 4 and Table 5 above the datum level of the floor. The direction of the line load doesn't matter for the system VetroMount Top because it is symmetrical. The direction of the line load for the system VetroMount Side is in direction of crash and against direction of crash. An overview of the line load for VetroMount Side and VetroMount Top gives Image 13. The load was applied either via a hydraulic ram or a rack and pinion jack, the deflection was measured using a digital electronic displacement transducer (see Image 11).

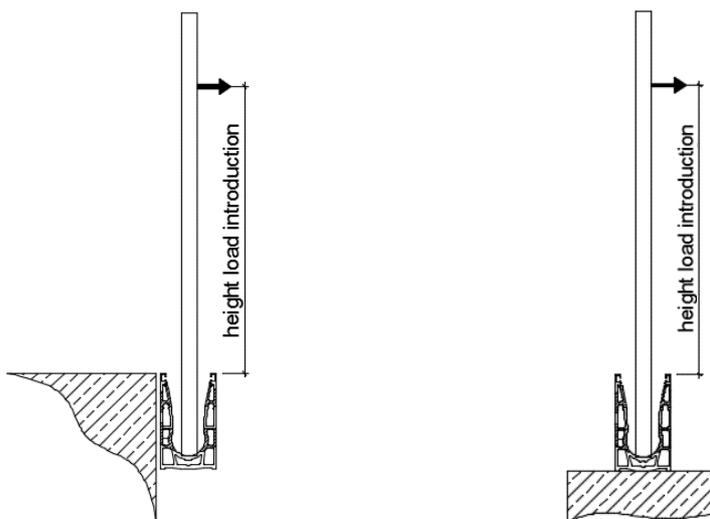


Image 13 Direction of line load for VetroMount Side system and VetroMount Top system

6.4 Results

Table 4 Summary of the results of VetroMount Top balustrade system tested under horizontal imposed line load

Profile	Glass assembly	Test specimen	Glass width [mm]	Height of applied load [mm]	Working line load for system [kN/m]	Deflection at working line load for system [mm]	Imposed line load at 25 mm deflection [kN/m]
VetroMount Top	88.2 LSG* out of TSG*)	PK11	500	1000	0.74	24.9	0.76
		PK9	1000	1000	0.36	15.2	0.57
	1010.2 LSG* out of TSG*	PK10	500	1000	0.74	14.8	0.98
		PK8	1000	1000	0.74	20.0	0.84
	15 mm (TSG*)	PK17	1000	1100	0.36	13,39	0,67
	19 mm (TSG*)	PK18	1000	1100	0,74	20,27	0.91

*LSG = Laminated safety glass

*TSG = Thermally toughened safety glass

Table 5 Summary of the results of VetroMount Side balustrade system tested under horizontal imposed line load

Profile	Glass assembly	Test specimen	Glass width [mm]	Height of applied load [mm]	Working line load for system [kN/m]	Deflection at working line load for system [mm]	Imposed line load at 25 mm deflection [kN/m]
VetroMount Side	88.2 LSG* out of TSG*	PK13	500	1000	0.36	12.9	0.60
		PK15	1000	1000	0.36	14	0.60
	1010.2 LSG* out of TSG*	PK12	500	1000	0.74	16.0	1.02
		PK14	1000	1000	0.74	20.5	0.85
	15 mm TSG*	PK17	1000	1100	0.36	16.1	0.55
	19 mm (TSG*)	PK18	1000	1100	0.74	24.9	0.75

*LSG = Laminated safety glass

*TSG = Thermally toughened safety glass



7. Conclusion

The company VERROTEC GmbH located in Mainz (Germany) was assigned by the company Bohle AG located in D-42781 Haan to verify the guardrail effect of the balustrade system VetroMount Top and VetroMount Side by load testing to allow the balustrade system to be classified for use in accordance with BS 6180:2011 Barriers in and about buildings.

The following Table 6 and Table 7 show an overview of the possible installation situations.



Table 6 Summary of Suitability of the balustrade system VetroMount Top and VetroMount Side out of laminated glass pane out of thermally toughened safety glass in accordance with Table 2 of BS 6180:2011[1]

Type of occupancy for part of the building	Examples of specific use	Horizontal uniformly distributed line load [kN/m]	VetroMount Top [T]/ VetroMount Side [S]								
			88.2 (B=500)		88.2 (B=1000)		1010.2 (B=500)		1010.2 (B=1000)		
			T	S	T	S	T	S	T	S	
Domestic and residential activities	(i)	0.36	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(ii)	0.74	✓				✓	✓	✓	✓	✓
Offices and work areas not included elsewhere, including storage areas	(iii)	0.22	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(iv)	0.36	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(v)	0.74	✓				✓	✓	✓	✓	✓
Areas where people might congregate	(vi)	1.50									
Areas with tables or fixed seating	(vii)	1.50									
Areas without obstacles for moving people and not susceptible to overcrowding	(viii)	0.36	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(ix)	0.74	✓				✓	✓	✓	✓	✓
Areas susceptible to overcrowding	(x)	1.50									
	(xi)	3.00									
	(xii)	(Note 1)									
Retail areas	(xiii)	1.50									
Vehicular	(xiv)	1.50 (Note 2)									
	(xv)	(Note 2)									

- (i) All areas within or serving exclusively one single family dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs
- (ii) Other residential, i.e. houses of multiple occupancy and balconies, including Juliette balconies and edges of roofs in single family dwellings
- (iii) Light access stairs and gangways not more than 600 mm wide
- (iv) Light pedestrian traffic routes in industrial and storage buildings except designated escape routes
- (v) Areas not susceptible to overcrowding in office and institutional buildings, also industrial and storage buildings except as given above
- (vi) Areas having fixed seating within 530 mm of barrier, balustrade or parapet
- (vii) Restaurants and bars
- (viii) Stairs, landings corridors ramps
- (ix) External balconies including Juliette balconies and edges of roofs; footways and pavements within building cartilage adjacent to basement/sunken areas
- (x) Footways or pavements less than 3 m wide adjacent to sunken areas
- (xi) Theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studio. Footways or pavements greater than 3 m wide adjacent to sunken areas.
- (xii) Grandstands and stadia
- (xiii) All retail areas including public areas of banks/building societies or betting shops
- (xiv) Pedestrian areas in car parks, including stairs, landings, ramps, edges or internal floors, footways, edges of roofs
- (xv) Horizontal loads imposed by vehicles

Note 1: See requirements of the appropriate certifying authority

Note 2: See Annex A



Table 7 Summary of Suitability of the balustrade system VetroMount Top and VetroMount Side out of monolithic thermally toughened safety glass (TSG) in accordance with Table 2 of BS 6180:2011[1]

Type of occupancy for part of the building	Examples of specific use	Horizontal uniformly distributed line load [kN/m]	VetroMount Top		VetroMount Side	
			15mm TSG (B=1000)	19mm TSG (B=1000)	15mm TSG (B=1000)	19mm TSG (B=1000)
Domestic and residential activities	(i)	0.36	✓	✓	✓	✓
	(ii)	0.74		✓		✓
Offices and work areas not included elsewhere, including storage areas	(iii)	0.22	✓	✓	✓	✓
	(iv)	0.36	✓	✓	✓	✓
	(v)	0.74		✓		✓
Areas where people might congregate	(vi)	1.50				
Areas with tables or fixed seating	(vii)	1.50				
Areas without obstacles for moving people and not susceptible to overcrowding	(viii)	0.36	✓	✓	✓	✓
	(ix)	0.74		✓		✓
Areas susceptible to overcrowding	(x)	1.50				
	(xi)	3.00				
	(xii)	(Note 1)				
Retail areas	(xiii)	1.50				
Vehicular	(xiv)	1.50 (Note 2)				
	(xv)	(Note 2)				

- (i) All areas within or serving exclusively one single family dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs
- (ii) Other residential, i.e. houses of multiple occupancy and balconies, including Juliette balconies and edges of roofs in single family dwellings
- (iii) Light access stairs and gangways not more than 600 mm wide
- (iv) Light pedestrian traffic routes in industrial and storage buildings except designated escape routes
- (v) Areas not susceptible to overcrowding in office and institutional buildings, also industrial and storage buildings except as given above
- (vi) Areas having fixed seating within 530 mm of barrier, balustrade or parapet
- (vii) Restaurants and bars
- (viii) Stairs, landings corridors ramps
- (ix) External balconies including Juliette balconies and edges of roofs; footways and pavements within building cartilage adjacent to basement/sunken areas
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- (xii) Grandstands and stadia
- (xiii) All retail areas including public areas of banks/building societies or betting shops
- (xiv) Pedestrian areas in car parks, including stairs, landings, ramps, edges or internal floors, footways, edges of roofs
- (xv) Horizontal loads imposed by vehicles

Note 1: See requirements of the appropriate certifying authority

Note 2: See Annex A

