

## TEST REPORT

**Lucideon Reference:** UK211035 (QT-62816/2/JB)/Ref. 1B

**Project Title:** Testing of Stand-Off Adapters - Free Standing Glass Protective Barrier System to BS 6180

**Client:** FH Brundle  
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Birmingham  
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**For the Attention of:** Mr Danny Hull

**Author(s):** Mr Michael Espley

**Report Date:** 25 May, 2021

**Purchase Order No.:** 749044

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**Work Location:** Lucideon UK

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## 1 INTRODUCTION

FH Brundle design and manufacture balustrades and barrier components to be used as architectural features in new and existing buildings. As part of their product development they required an extensive programme of testing to determine their product's performance in accordance with British and other European Standards.

## 2 SAMPLES AND TESTING

A range of free standing glass protective barriers were tested in accordance with BS 6180:2011 - Barriers In and About Buildings – Code of Practice. At the request of FH Brundle, the opportunity was taken to determine the deflections at a datum height of 1200 mm from the finished floor level. This was additional data and not required by the Standard.

An additional Standard used for testing was the Italian Standard UNI 10806:1999 Railings, Balustrades or Prefabricated Parapets - Determination of Mechanical Resistance to Distributed Static Loads.

**Table 1** - List of Samples and Associated Test Numbers

Reference	Test	Sample	Standard
B	1	Stand-Off Adapters - Type 1806460 – 15 mm Toughened Glass	BS 6180
	2	Stand-Off Adapters - Type 1806460 - 21.5 mm PVB Toughened Laminated Glass	BS 6180
	3	Stand-Off Adapters - Type 1806456 - 21.5 mm PVB Toughened Laminated Glass	BS 6180
	3a	Stand-Off Adapters - Type 1806456 - 21.5 mm PVB Toughened Laminated Glass	UNI 10806

## 3 TEST ARRANGEMENT

A concrete block of dimensions 2300 mm (L) x 900 mm (W) x 500 mm (H) was fastened to the laboratory strong-floor. The concrete was C35 with glass fibres and aggregate size of 20 mm.

Representatives from FH Brundle fitted the systems under test to the concrete block, ready for testing. Lucideon fitted the test equipment in place and conducted the testing.

Stand-Off Adapters were fitted to the side surface of the concrete block. The Stand-Off Adapters were spaced between 800 mm centres horizontally and 150 mm centres vertically. For Tests 1 and 2, the adapters (part number 1806460) were fitted with a concrete screw. For Tests 3 and 3a, the adapters (part number 1806456) were fitted using resin and screw.

Each different type and thickness of glass to be tested was fixed, in turn, into the Stand-Off Adapters.

#### 4 TEST METHOD

A hardwood spreader beam was placed at a distance of 1100 mm from the finished floor height to simulate a uniformly distributed line-load.

A reaction frame consisting of 2 No. steel stanchions and a steel cross-member was fastened to the laboratory strong-floor such that a ram could be clamped to the steel cross-member at the same height as the hardwood spreader.

A 5 kN calibrated load cell was attached to the hydraulic ram by way of a steel cage, to measure the load during testing.

A calibrated Linear Voltage Displacement Transducer (LVDT), to measure the deflection, was attached to the opposite side of the glass panel as the load was applied in the centre width of the panel at 1100 mm from the finished floor height. The LVDT's were positioned at 1100 mm from the finished floor height.

For BS 6180 a load was steadily applied up to each loading increment or until a deflection of 25 mm was reached as highlighted within BS 6180. The load at the last increment was then recorded.

For the UNI 10806 (Italian) tests, the line load was increased to a value as directed by a representative of FH Brundle. This test involves applying the load to the desired value (typically  $2 \text{ kNm}^{-1}$ ), followed by a dwell period of 15 minutes. The load is then removed, followed by a dwell period of 5 minutes. Deflection measurements are maintained throughout testing.

It should be noted that the result values in Table 3 and Table 4 are expressed as kN/m. All glass barrier lengths were 1000 mm, therefore the kN reading from the load cell is correct for kN/m. Refer to the Client's Drawings TR05-003, TR05-004, Charts 1–2 and Plates 1-4.

## 5 RESULTS

**Table 2 – BS 6180 Results – Refer to Parts List in Table 5**

Type of Occupancy for Part of the Building	Examples of Specific Use	Horizontal Uniformly Distributed Line Load (kN/m)	Stand-Off Adapter 1806460		Stand-Off Adapter 1806456
			15 mm Toughened Glass	21.5 mm PVB Toughened Laminate Glass	21.5 mm PVB Toughened Laminate Glass
Domestic and residential activities	(i) all areas within or serving exclusively one single family dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs	0.36	✓	✓	✓
	(ii) other residential, i.e. houses of multiple occupancy and balconies, including Juliette balconies and edges of roofs in single family dwellings	0.74	✓	✓	✓
Offices and work areas not included elsewhere, including storage areas	(iii) light access stairs and gangways not more than 600 mm wide	0.22	✓	✓	✓
	(iv) light pedestrian traffic routes in industrial and storage buildings except designated escape routes	0.36	✓	✓	✓
	(v) areas not susceptible to overcrowding in office and institutional buildings, also industrial and storage buildings except as given above	0.74	✓	✓	✓
Areas where people might congregate	(vi) areas having fixed seating within 530 mm of the barrier, balustrade or parapet	1.50	X	X	X
Areas with tables or fixed seating	(vii) restaurants and bars	1.50	X	X	X
	(viii) stairs, landings corridors ramps	0.74	✓	✓	✓

Type of Occupancy for Part of the Building	Examples of Specific Use	Horizontal Uniformly Distributed Line Load (kN/m)	Stand-Off Adapter 1806460		Stand-Off Adapter 1806456
			15 mm Toughened Glass	21.5 mm PVB Toughened Laminate Glass	21.5 mm PVB Toughened Laminate Glass
Areas without obstacles for moving people and not susceptible to overcrowding	(ix) external balconies including Juliette balconies and edges of roofs; footways and pavements within building cartilage adjacent to basement/sunken areas	0.74	✓	✓	✓
Areas susceptible to overcrowding	(x) footways or pavements less than 3 m wide adjacent to sunken areas	1.50	X	X	X
	(xi) theatres, cinemas, discotheques, bars, auditoria, shopping malls, assembly areas, studios; footways or pavements greater than 3 m wide adjacent to sunken areas	3.00	X	X	X
	(xii) grandstands and stadia	(Note A)	-	-	-
Retail areas	(xiii) all retail areas including public areas of banks/building societies or betting shops	1.50	X	X	X
Vehicular	(xiv) pedestrian areas in car parks, including stairs, landings, ramps, edges of internal floors, footways, edges of roofs	1.50	X	X	X
	(xv) horizontal loads imposed by vehicles	(Note B)	-	-	-

Note A) See requirements of the appropriate certifying authority.

Note B) See Annex A. (BS 6180:2011)

**Table 3** – Results - Horizontal Line Load Applied at 1100 mm from the Finished Floor Height BS 6180

Test	1	2	3
Glass Type	15 mm Toughened Glass	21.5 mm PVB Toughened Laminated Glass	21.5 mm PVB Toughened Laminated Glass
Adapter Type	1806460	1806460	1806456
Size of Glass (mm)	1000 (L) x 1434 (H)	1000 (L) x 1434 (H)	1000 (L) x 1434 (H)
Deflection at 0.36 kN/m (mm)	11.89	5.82	5.68
Deflection at 0.74 kN/m (mm)	25.00	16.56	15.22
Load at 25 mm deflection (kN/m)	0.74	1.06	1.20

**Table 4** - Results - Horizontal Line Load Applied at 1100 mm from the Finished Floor Height – UNI 10806

Test	Glass Type	Load (kN/m)	Deflection (mm)	Residual Deflection (mm)
3a	21.5 mm PVB Toughened Laminated Glass	1.52	34.17	2.22

**Table 5** – Parts List

Test	Item	FH Brundle Part Number	Quantity (per test)
1 & 2	Stand-Off Adapters	1806460	4
	M10 x 100 mm Concrete Screws	5002SCS10100	4
	15 mm Toughened Glass (1000x1434)	N/A	1
	21.5 mm PVB Toughened Laminated Glass (1000 x 1434)	N/A	1
3 & 3a	Stand-Off Adapters	1806456	4
	R KER II Hybrid Resin	50RKER300	1
	21.5 mm PVB Toughened Laminated Glass (1000 x 1434)	N/A	1

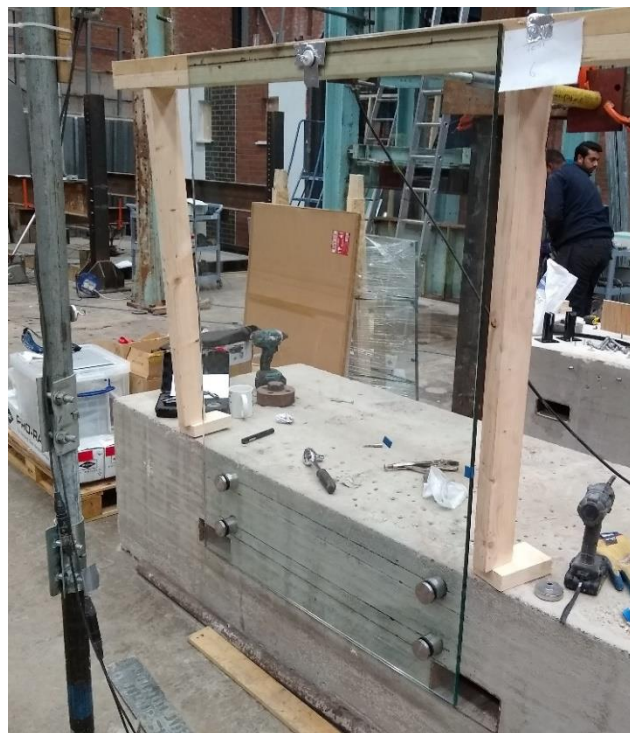
**NOTE:** The results given in this report apply only to the samples that have been tested.

**END OF REPORT**

## PLATES



**Plate 1** – Test 1 – 15 mm Toughened Glass – Load Application Side



**Plate 2** – Test 1 – 15 mm Toughened Glass – Deflection Measurement Side





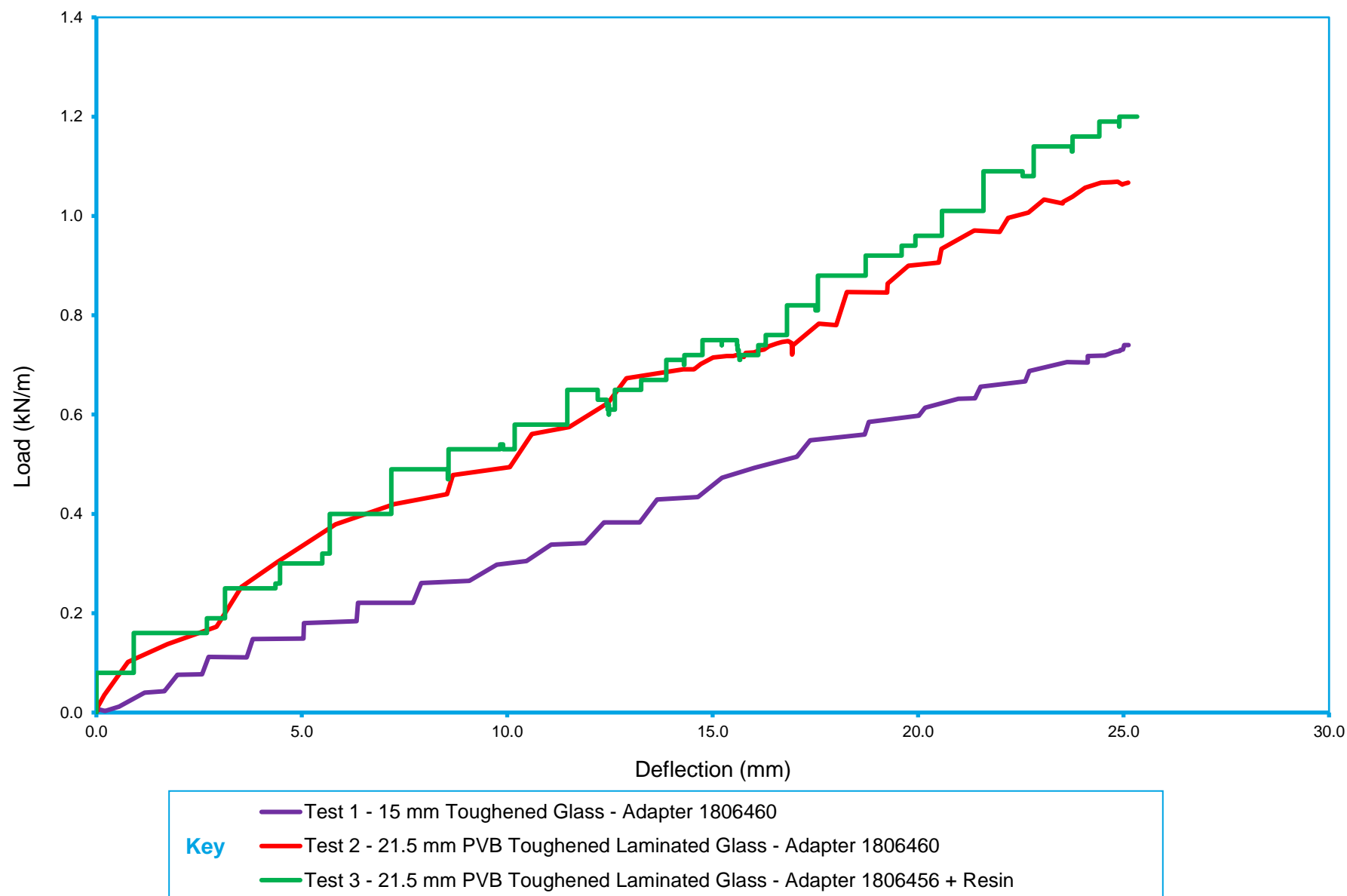
**Plate 3 – Test 1 – Stand-Off Adapters**



**Plate 4 – Test 3a – 21.5 mm PVB Toughened Laminated Glass – UNI 10806 Test**

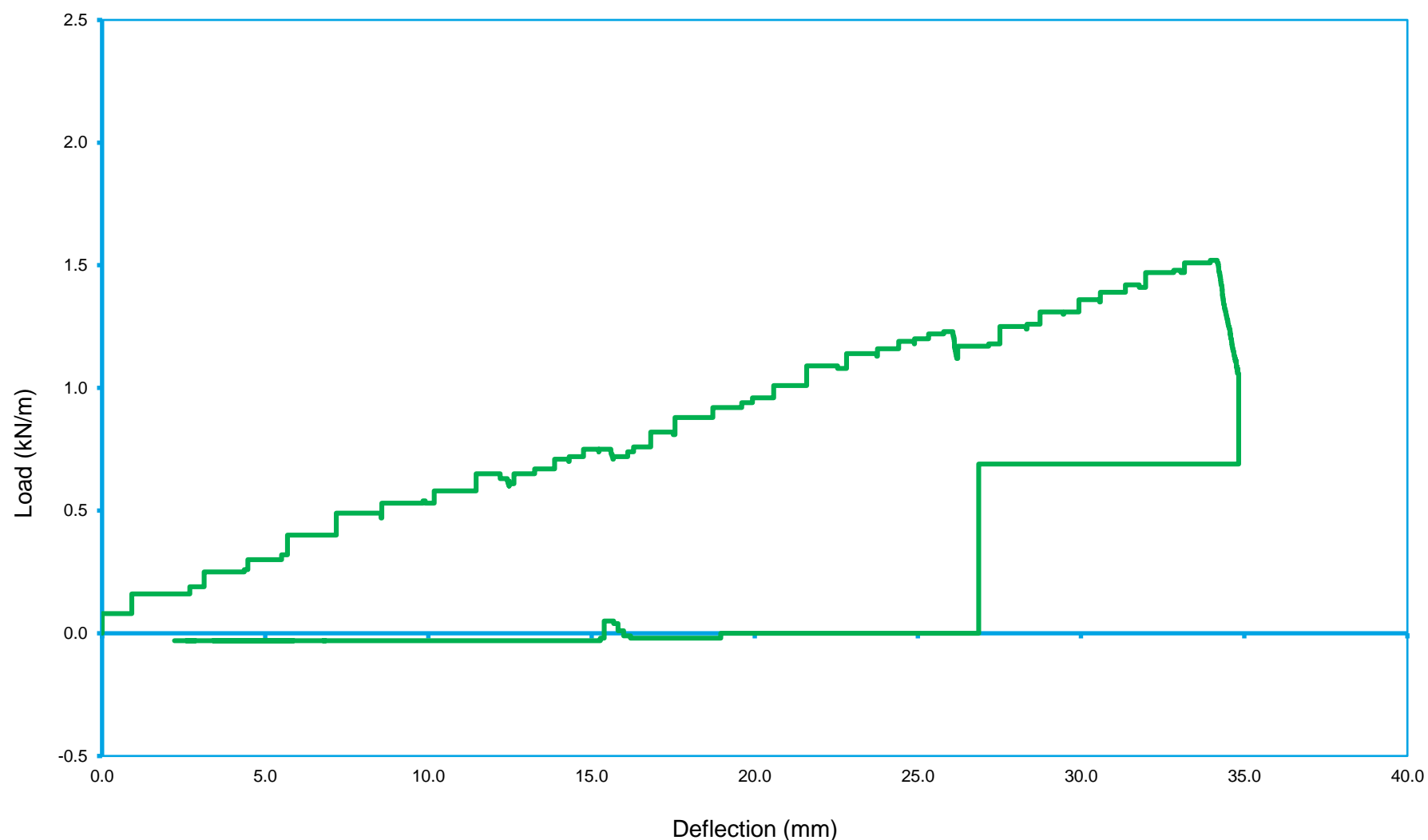
**Chart 1 - Ref. 1B - Tests 1 ,2 & 3 - Stand-Off Adapters - Horizontal Line Load at 1100 mm Height**  
 - Deflection at 1100 mm Height - BS 6180

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**Chart 2** - Ref. 1B - Test 3a - Stand-Off Adapters - Horizontal Line Load at 1100 mm Height  
- Deflection at 1100 mm Height - UNI 10806

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**Key** — Test 3a - 21.5 mm PVB Toughened Laminated Glass - Adapter 1806456 + Resin

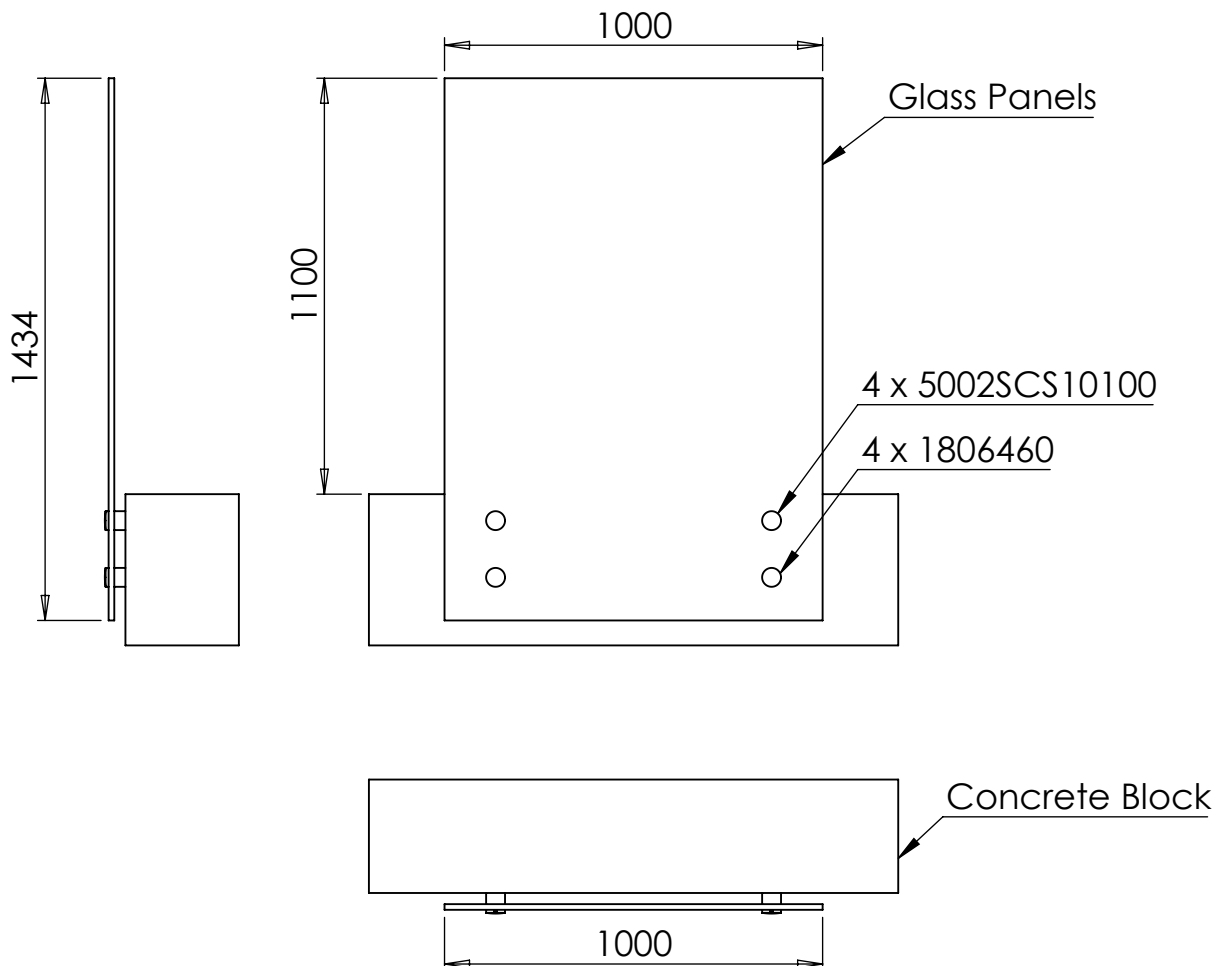
**PRO RAILING - STAND-OFF ADAPTERS**

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 ALL DIMENSIONS ARE IN MILLIMETERS



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## Load Testing of Stand-off Adapters, With A Range of Glass Panels 1000mm Wide to BS 6180:1999

For typical balustrade installations with a horizontal uniformly distributed line load of 1.5 kN/mm, displacement point loadings of 1.5 kN are also required. According to BS 6180:1999 the displacement of any point of the barrier should not exceed 25mm.

Carry out load testing in accordance with BS 6180:2011 Barriers in and about buildings.

These tests will allow FH Brundle Adjustable Stand-off for Glass to be classified for use within a balustrade design as outlined in BS 6180:2011 Barriers in and about buildings - Code of practice

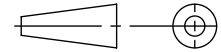
Test In Accordance	Parts Required	Foundation Material	Glass Size & Type	Fixings
BS 6180:1999	1 x 1806460	C35 with glass fibres, aggregate size 20mm slump 100	1000 x 1434mm 15mm Toughened	M10 x 100mm Concrete Screws
BS 6180:1999	1 x 1806460	C35 with glass fibres, aggregate size 20mm slump 100	1000 x 1434mm 21.5mm PVB Toughened	M10 x 100mm Concrete Screws

TEST REPORT NUMBER - TR05-004

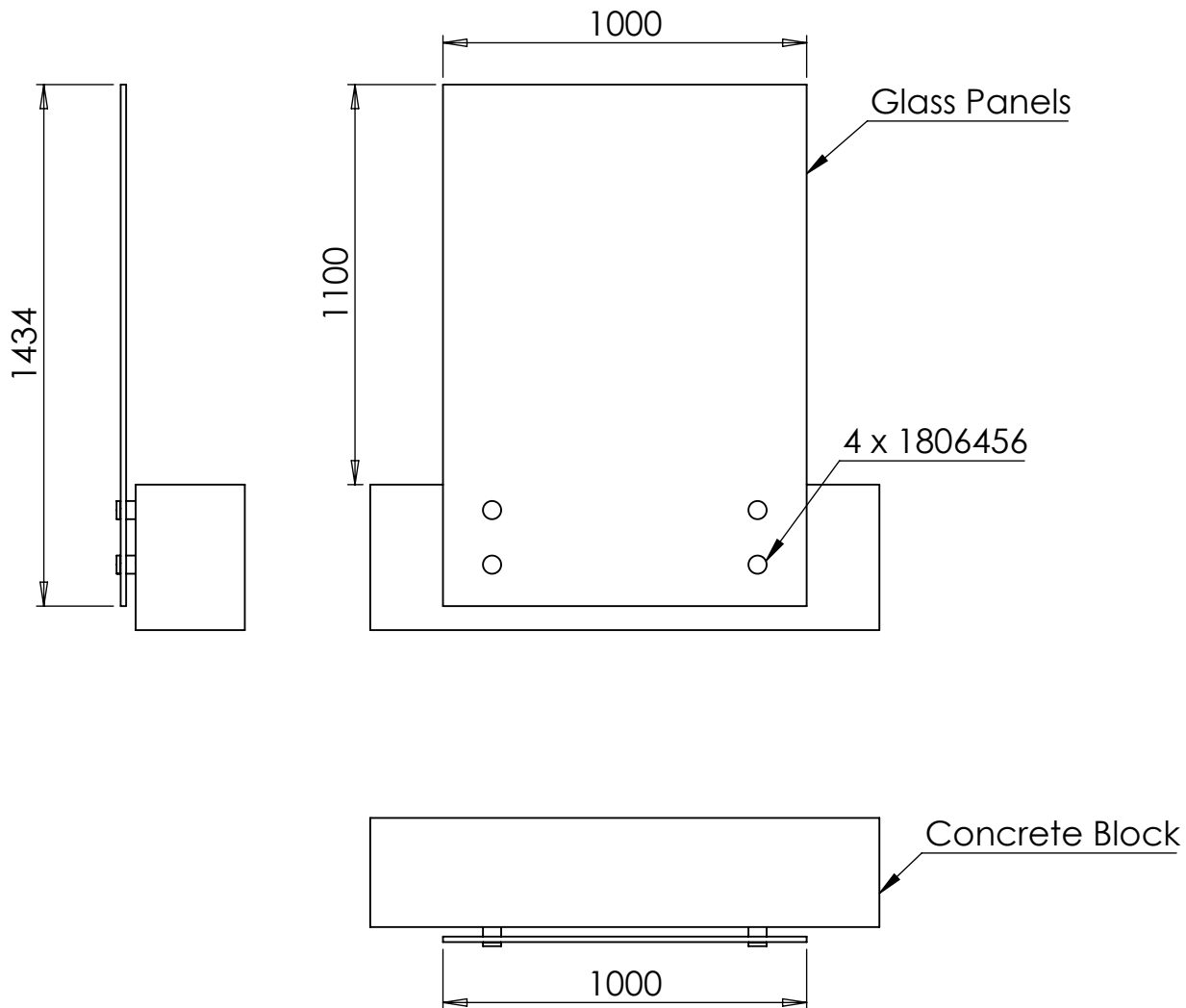
PRO RAILING - STAND-OFF ADAPTERS

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## Load Testing of Stand-off Adapters, With A Range of Glass Panels 1000mm Wide to BS 6180:2011

For typical balustrade installations with a horizontal uniformly distributed line load of 1.5 kN/mm, displacement point loadings of 1.5 kN are also required. According to BS 6180:2011 the displacement of any point of the barrier should not exceed 25mm.

Carry out load testing in accordance with BS 6180:2011 Barriers in and about buildings.

These tests will allow FH Brundle Adjustable Stand-off for Glass to be classified for use within a balustrade design as outlined in BS 6180:2011 Barriers in and about buildings - Code of practice

Test In Accordance	Parts Required	Foundation Material	Glass Size & Type	Fixings
BS 6180:2011	1 x 1806456	C35 with glass fibres, aggregate size 20mm slump 100	1000 x 1434mm 21.5mm PVB Toughened	50RKER300