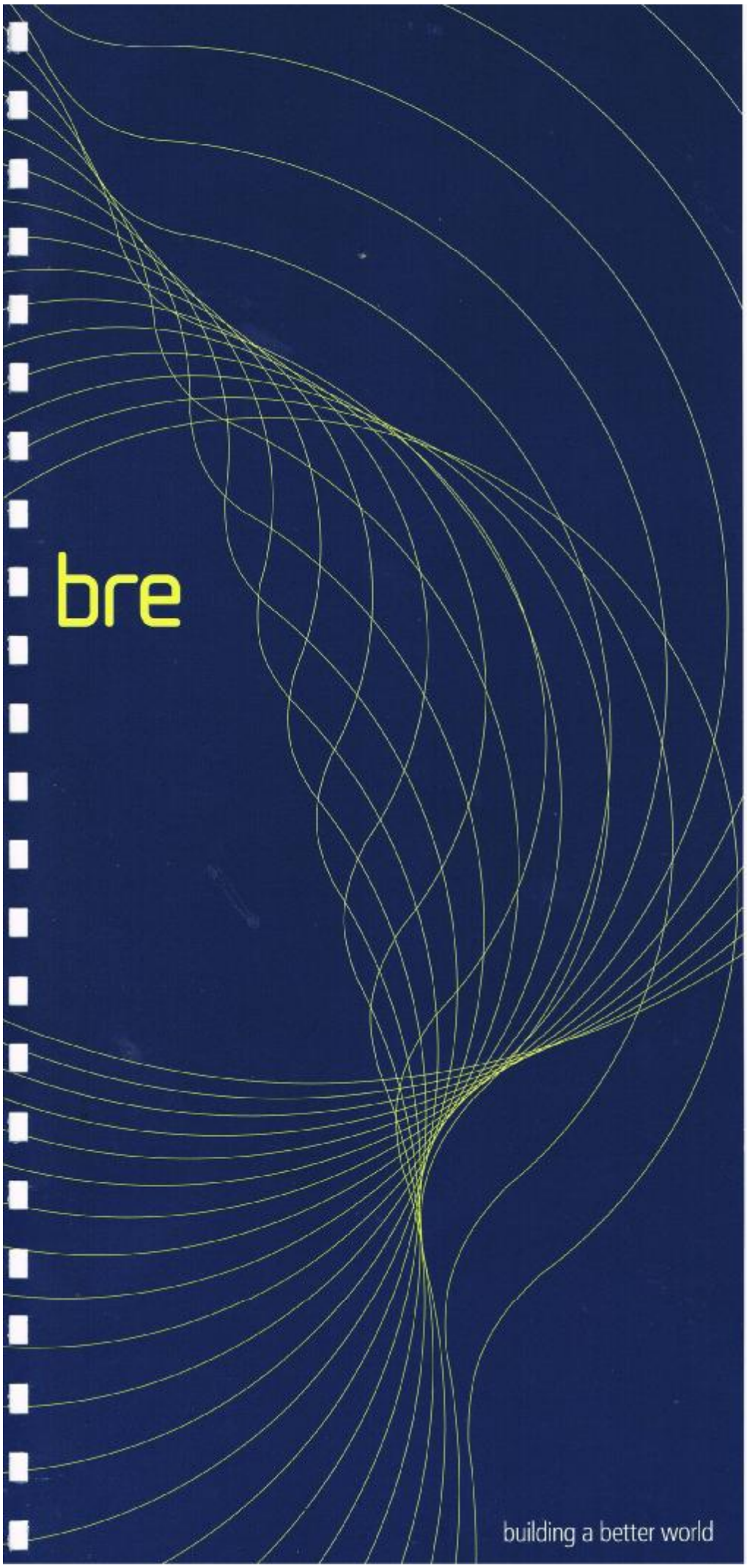
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ACR(M)001: 2000 Test for fragility on 6 metre long panels of 25 mm thick Safelock roof light specimens from Naturalight Systems Ltd

Prepared for: Mr. Chris Paine
Sales Director; Naturalight Systems Ltd

23 July 2005

Test report number 224 357b

Prepared on behalf of BRE by

Name	Malcolm Pound
Position	Senior Consultant and Laboratory Manager
Date	23 July 2005
Signature	M.C.Pound

Approved on behalf of BRE

Name	Dr. P. A. Blackmore
Position	Associate Director for Centre for Structural and Geotechnical Engineering
Date	27/7/05
Signature	P Blackmore

BRE
Garston
WD25 9XX
T + 44 (0) 1923 664000
F + 44 (0) 1923 664010
E enquiries@bre.co.uk
www.bre.co.uk

1 Introduction

At the request of Mr Chris Paine, Sales Director of Naturalight Systems Ltd, Accessory House, Barrington Industrial Estate, Barrington, Northumberland, NE22 7DQ, BRE issued Proposal Number 114 763k, dated 29 June 2005. The client accepted the proposal on 05 July and BRE tested specimen roof lights on 18 July 2005.

The tests assess the fragility of the specimen roof light assemblies when subjected to impacts by a heavy soft body as in the second edition of the standard ACR(M)001:2000[1].

This report describes the results of the fragility tests on 18 July 2005 on the 6 metre long specimen roof lights when they were tested with the details described herein on un-braced sigma section Multi-beam metal purlins.

The tests were carried out under the BRE Standard Terms and Conditions of Business by M. C. Pound as part of job number 224 357 on project number CV0452 and witnessed by:

Mr. Chris Paine Naturalight Systems Ltd

2 Details of the tests carried out

The tests were performed on specimens of roof light assemblies to the second edition of ACR (M) 001: 2000 Test for fragility of roofing assemblies. The scope of this edition of the standard describes it as applicable to any product that will form a roof or part of a roof assembly. The test is designed to simulate accidental impacts that can occur when humans stumble and fall onto the top surface of roof products. It provides information about the degree of resistance to the subsequent impacts and classifies the assemblies tested accordingly.

The tests use a 300 mm diameter, 45 kg cylindrical shaped impactor canvas bag filled with compacted sand. The test rig, impactor, drop height, number of drops and time of retention after impact are according to ACR (M) 001: 2000. Other conditioning as described in Clause 2.3.2 Note 1of the ACR standard was not performed.

The impactor bag described above was dropped vertically onto the outdoor surface of the specimen roof light assemblies. Depending on the results from the first impact a second identical impact may be performed at the same position on the same test specimen. When all impacts are completed at one position (including repeat tests) then the next position is tested usually using all new components. The height of 1.2 m above the specimen, specified in the ACR standard, from which the impactor was released, gave theoretical impact energies of 530 J (Joules). The impact energy in Nm (Newton metres) is calculated by multiplying the force of the impactor in Newtons by the drop height in metres. A Newton metre is equivalent to a Joule. For example: 441.5 N x 1.2 m = 529.8 Nm (J).

Impacts are performed at three positions to match those specified in the ACR standard and at other positions to attempt to establish the 'worst' position to impact the specimen in this manner. The specified positions are:

i. Within 150 mm of the centre of the test sample
ii. Within 300 mm of a support point, at least 150 mm away from the support
iii. Within 150 mm of the edge of the sheet, adjacent to the underlap with the other sheet, at a position chosen by the 'competent' person.

The quality control tests in Clause 1 of the ACR standard were not carried out because it is believed that the materials forming the roof light assembly comply with recognised current standards (as defined in Clause 1.1.2 of the ACR standard).

3 Performance criteria, classifications and definitions

ACR (M) 001: 2000 Test for fragility of roofing assemblies (2nd edition)

First impact at a point. On impact, if the impactor falls through the test assembly and hits the ground, the test assembly is classified as *fragile*.

If the impactor is retained on the test assembly the assembly must retain the load for at least 5 minutes. This time period may be shortened or extended if justified by the 'competent' person (see definition below).

If the test assembly retains the load for the 5 minutes after the impact then it will be classified *Class C. Non-fragile assembly*.

Second impact to same point as the first. The impactor is removed and a second impact similar to the first is made to the same point. If the impactor is retained on the test assembly after the second impact it must be retained for 5 minutes. If the impactor is not retained after the second impact the test assembly will be classified *Class C. Non-fragile assembly*. If, however, the test assembly retains the impactor after the second impact it will be classified *Class B. Non-fragile assembly*.

To attain a higher grade than Class B a person competent to do so closely examines the roofing assembly. If this examination shows no sign of damage to sheet or assembly likely to affect the long term strength and weatherability then the test assembly shall be upgraded to *Class A Non-fragile assembly*.

Any tearing at fixings, any fracture points, delamination within the product or damage to the surface protection that could accelerate the degradation process should be regarded as sufficient not to give a Class A rating.

ACR (M) 001: 2000 definitions:

Clause 0.1 Competent person – A person who can demonstrate that he/they has/have: a) sufficient knowledge of the mechanical and physical properties of the material and assembly under test. b) practical experience of installation of the product, usage and behaviour and failure in service. In these tests the 'competent person' described here was represented by **Mr Chris Paine, Sales Director of Naturalight Systems Ltd.**

Clause 4 (vi) Competent person – 'the name and signature of the competent person responsible for the tests and the date'. In these tests the 'competent person' described here was Mr M C Pound, BRE.

4 Roof light test specimen

Naturalight Systems Ltd supplied the new roof lights and components and assembled and fixed the test specimens onto the test rig at BRE. Figures 1 and 2 show the general test set up of the roof light test specimen mounted on BRE's ACR test rig.

Type: A polycarbonate roof light with aluminium glazing and end bars (some interlocking). Reference: Naturalight Systems Ltd Safelock system roof light; 6 metre long continuous panels. Drawing Number FL16.06.

Roof light: The 'glazing' is 25 mm (overall thickness) Bayer Makrolon Multi UV 3X/25 - 25 clear polycarbonate weighing 3.5 kg/m². It has diagonal, horizontal and vertical internal walls between upper and lower outer skins of about 0.9 mm thick.

The Safelock system consists of the polycarbonate glazing (described above) fitted into primary and secondary glazing bars with end bars at the top and bottom of the roof light sheets. Secondary bars interlock into the full length of the primary bars. The overall sizes of the glazing bars are: Primary bars 80 mm wide x 43 mm high, Secondary bars 51 mm wide x 33 mm high; in this instance all are 6 metres long. The glazing engagement into the bars was about 25 mm. Four 7.5 mm diameter threaded steel bars per roof light run through each panel with screws (with female threads) at each end outside the end bars. For the tests on 18 July the four threaded bars were at 80 mm from each edge then at 275 mm centres from those bars.

Fixings:. The roof light was fixed to the purlins with self-drilling and tapping screws, 35 mm long x 5 mm diameter through the glazing bars, at each corner of the starter panel and two corners of the interlocking panels (corners furthest away from the interlock) as well as at the intervening purlins.

Weatherseals: The top edge of the glazing in the bars has a silicone sealant seal.

Purlins: The purlins are specified in the ACR standard as part of the test rig. They are Sigma section Ward Building Components Ltd Multibeam metal purlins, 175 mm deep x 60 mm wide x 1.6 mm gauge and for this test rig about 3.2 m long. These purlins are referred to as 'C' section in the ACR standard. The 6.0 m long roof light test specimens spanned across five purlins at 1500 mm centres.

Dimensions: The overall size of the three panel test roof light assembly was 6.0 m long x 3.15 m wide.

5 Test set-up

The test rig is that specified in the second edition of ACR (M) 001: 2000 and consists of a steel frame with metal purlins, supported on steel legs. The horizontal specimen mounting surface height is about 900 mm above the concrete floor in the test laboratory.

The roof light test specimens were mounted horizontally on the test rig. In practice installation would be with an inclination of at least 10 degrees above horizontal. The purlins are fixed to cleats that in turn fix onto the test rig frame and the specimen is fixed to the purlins as described in Section 4 of this report and shown in Figure 1.

The heavy, soft body impactor was suspended vertically above the roof light assembly test specimen at 1.2 m drop height (a calibrated drop height gauge is used) and released from an electronic release mechanism with a remote trigger.

6 Results for the 6 metre long test specimens

The weight of the impactor bag was checked immediately prior to the day's testing and confirmed to be within the prescribed limits at 45.45 kg. The length of the drop height gauge was also checked and confirmed to be 1.2 m. Laboratory conditions were within 20°C ± 3°C at on average 52%RH at 21°C on the test date.
The soft body impact test results are given in full below and in photographs of some tests. The results are grouped to show repeat tests together at the same position on the roof light.

Results with four threaded bars per panel at 80 mm in from each long edge and at 275 mm centres from those:

Impact position and test number	Drop No.	Notes
Test 1. At a point midway along the long edge of a panel, close to a glazing bar	1	The impactor was retained on the specimen for 5 minutes close to the point of impact*. The glazing disengaged from the side glazing bar closest to the impact.
	2	The impactor was retained on the specimen for 5 minutes close to the point of impact*. Amounts of disengagement of the glazing increased leaving a gap of 30 mm** under the bar with the impactor in place.
Test 2. Repeat at same position as above at another bay between purlins	1	The impactor was retained on the specimen for 5 minutes close to the point of impact*. The glazing disengaged from the side glazing bar closest to the impact.
	2	The impactor was retained on the specimen for 5 minutes close to the point of impact*. Amounts of disengagement of the glazing increased leaving a gap of 30 mm** under the bar with the impactor in place.
Test 3. Repeat at same position as above at an end bay between purlins	1	The impactor was retained on the specimen for 5 minutes close to the point of impact*. The glazing disengaged from the side glazing bar closest to the impact.
	2	The impactor was retained on the specimen for 5 minutes close to the point of impact*. Amounts of disengagement of the glazing increased leaving a gap of 40 mm** under the bar with the impactor in place.

* With no further deterioration of the specimen occurring in that 5 minute period.
** Gaps generated by impacts were measured at their largest point at or near the point of impact

Table 1. Test results on 6 metre long specimens of 25 mm thick Safelock roof light when impacted at a point midway along the long edge of the panels between the purlins, close to a glazing bar

Impact position and test number	Drop No.	Notes
Test 1. At a corner of the panel near the side and end glazing bars	1	The impactor was retained on the specimen for 5 minutes close to the point of impact*. The glazing was disengaged from the glazing bars local to the point of impact
	2	The impactor was retained on the specimen for 5 minutes*. Disengagement of the glazing increased.
Test 2. Repeat at position above on 2nd panel	1	The impactor was retained on the specimen for 5 minutes close to the point of impact*. The glazing was disengaged from the glazing bars local to the point of impact
	2	The impactor was retained on the specimen for 5 minutes*. Disengagement of the glazing increased.
Test 3. Repeat at position above on the 1st panel (opposite corner)	1	The impactor was retained on the specimen for 5 minutes close to the point of impact*. The glazing was disengaged from the glazing bars local to the point of impact
	2	The impactor was retained on the specimen for 5 minutes*. Disengagement of the glazing increased.

* With no further deterioration of the specimen occurring in that 5 minute period.

Table 2. Test results on 6 metre long specimens of 25 mm thick Safelock roof light when impacted at the corners of the panels

Impact position and test number	Drop No.	Notes
Test 1. At the centre of a panel between purlins	1	The impactor was retained on the specimen for 5 minutes*. Glazing disengaged partly at one long edge.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing disengagement increased.
Test 2. Repeat at position above on another panel	1	The impactor was retained on the specimen for 5 minutes*. Glazing disengaged partly at one long edge.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing disengagement increased.
Test 3. Repeat at position above on other panel	1	The impactor was retained on the specimen for 5 minutes*. Glazing disengaged partly at one long edge.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing disengagement increased.

* With no further deterioration of the specimen occurring in that 5 minute period.

Table 3. Test results on 6 metre long specimens of 25 mm thick Safelock roof light when impacted at the centre span of the panels between purlins

Impact position and test number	Drop No.	Notes
Test 1. At the mid-point of the ends of the panels	1	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars and end nuts intact.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars and end nuts intact.
Test 2. Repeat at position above on another panel	1	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars and end nuts intact.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars and end nuts intact.
Test 3. Repeat at position above on other panel	1	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars and end nuts intact.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars and end nuts intact.

* With no further deterioration of the specimen occurring in that 5 minute period.

Table 4. Test results on 6 metre long specimens of 25 mm thick Safelock roof light when impacted at the mid-point of the ends of the panels

Impact position and test number	Drop No.	Notes
Test 1. At the point where two, three metre long lengths of threaded bar are joined (coincides with a purlin)	1	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars intact.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars intact.
Test 2. Repeat at position above on another panel	1	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars intact.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars intact
Test 3. Repeat at position above on other panel	1	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars intact.
	2	The impactor was retained on the specimen for 5 minutes*. Glazing remained engaged and the threaded bars intact

* With no further deterioration of the specimen occurring in that 5 minute period.

Table 5. Test results on 6 metre long specimens of 25 mm thick Safelock roof light when impacted over the point where two, three metre long lengths of threaded bar are joined (coincides with a purlin)

7 Conclusions and classifications

The impact tests reported here have been carried out to assess the fragility of 6 metre long specimens of Naturalight Systems Ltd 25 mm thick Safelock roof lights when spanning between five purlins. The results apply only to the new roof lights as configured, detailed, mounted and fixed as described herein.

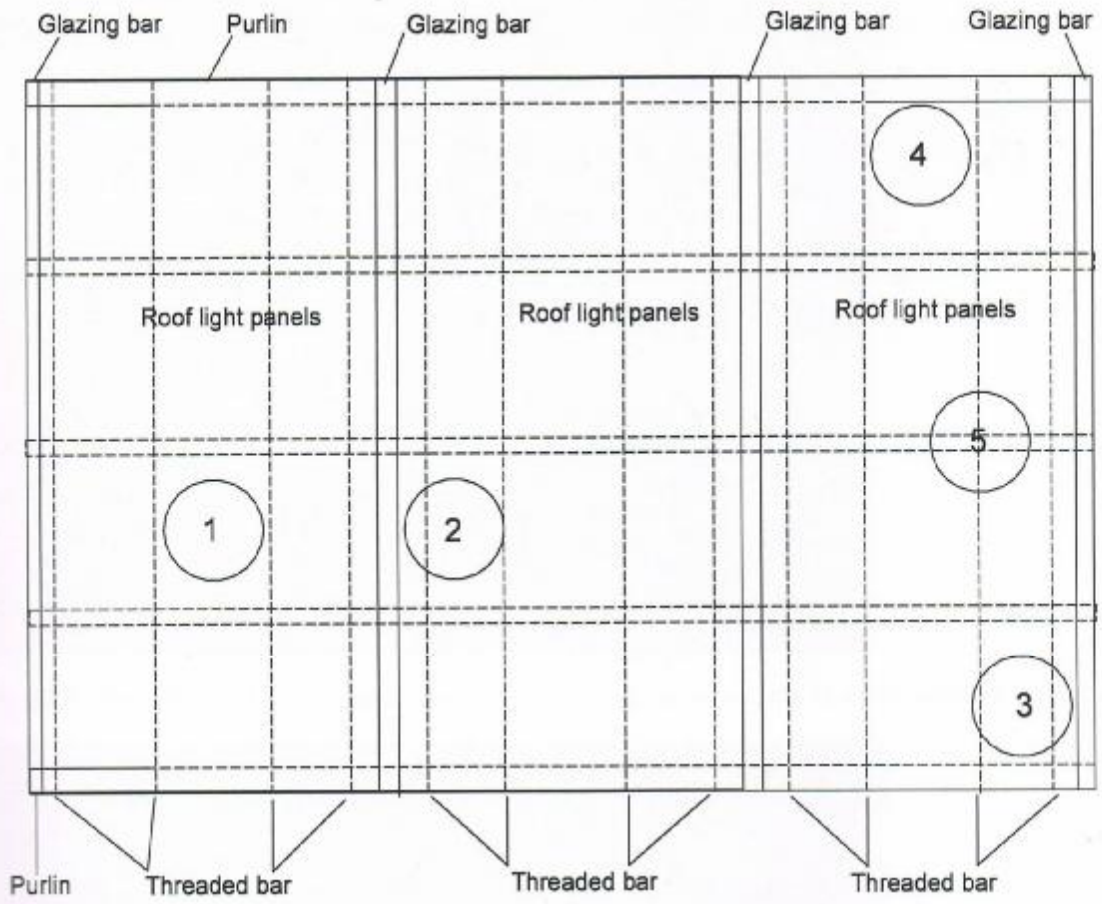
The impacts were performed according to methods in ACR(M)001:2000, 2nd edition, and results interpreted with regard to the classifications in it.

The testing found that the 'worst' position to impact this type of roof light set up in the manner described herein was at centre span between purlins, midway along a panel's long edge near a glazing bar. This point showed the greatest degree of damage after impacts. At all the positions tested there was no further deterioration of the specimens in the 5 minute period immediately after each impact. Repeat tests were performed at all the positions impacted on the roof light.

This 6 metre long size of Naturalight Systems Ltd Safelock roof light configured, detailed, mounted and fixed as described herein achieves 'Class B non-fragile assembly'. Class B is for assemblies that sustain two impacts at the 'worst' position for example and retains the impactor on the assembly for at least 5 minutes after each impact.

8 References

1. ACR (M) 001:2000. (second edition) Test for the fragility of roofing assemblies. Advisory committee for roofwork. Materials Standard.



1 = examples of positions of impacts

1 = Centre of span between purlins
2 = Centre of span between purlins ; close to long edge
3 = Corner of panel close to purlin
4 = end of panel, mid width
5 = Over the junction between two lengths of threaded bar

End of panel glazing bars not shown

Figure 1. Sketch of the general layout of the roof light test specimen showing impact positions

Figure 2. After the first drop at a point centre span between purlins close to a long edge of the panel

Figure 3. After the third repeat test to the centre of a roof light panel between purlins

Figure 4. Third repeat test to a corner of a roof light panel

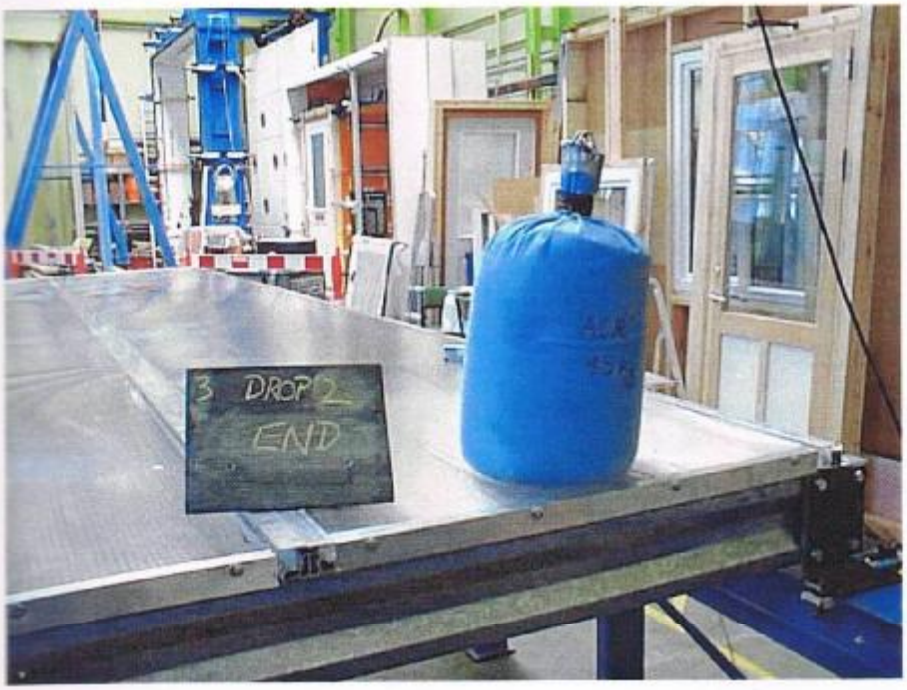
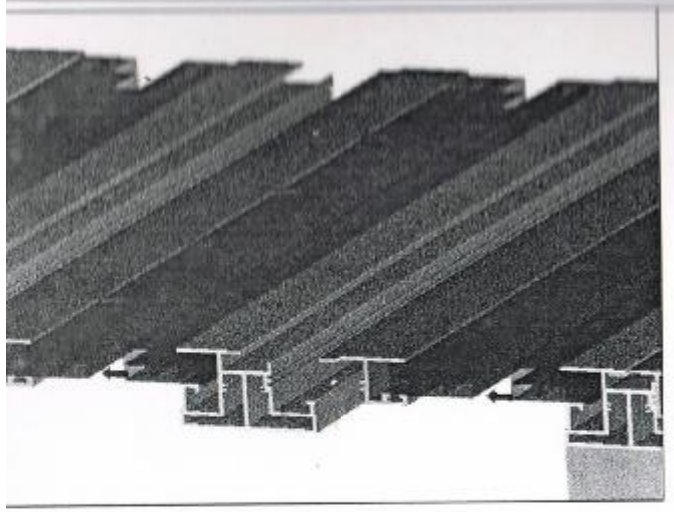
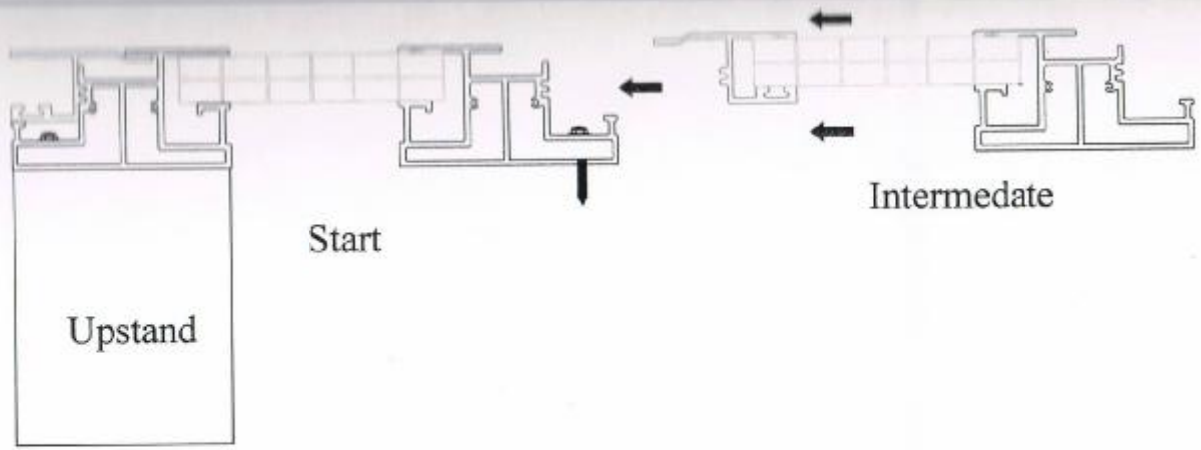


Figure 5. After the third repeat test to a point mid width at the end of the panels

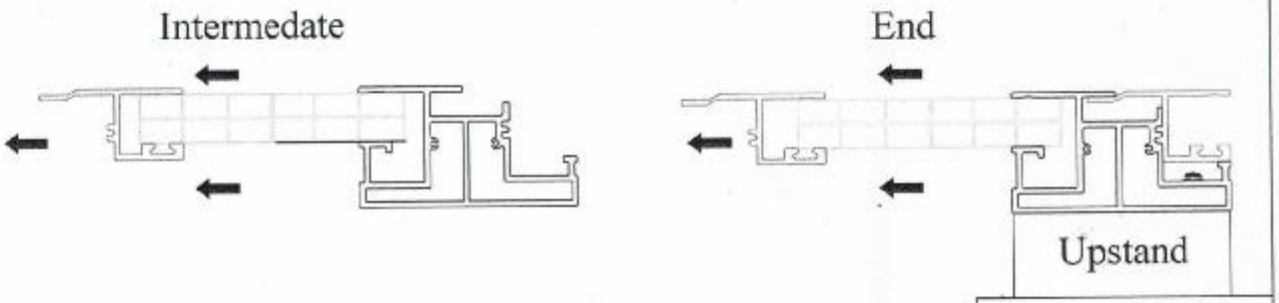
Figure 6. At a point over a joint in the threaded bar within the panels.



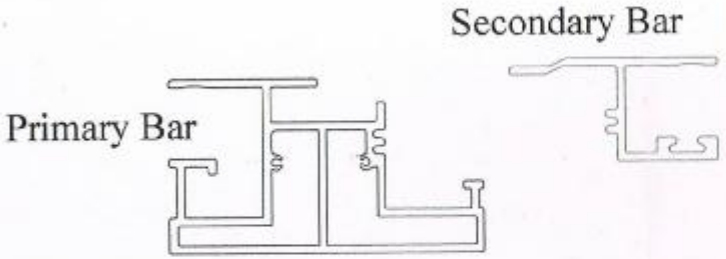


Installation Procedure

1. Lay First panel which has two primary bars onto upstand.
2. Check that Panel is level and square.
3. Fix Bar to upstand using apporpriate fixings to ensure adquate fix.
4. Insert intermedate panel into starter panel, making sure that the secondary bar is fully home to the primary bar. (These have a secondary bar and a primary bar on opposite sides)
5. Fix the panel by fixing through the channel on the primary bar.
6. Continue to fix the remaning panels using the above steps.
7. Once the final panel has been fixed insert the secondary bar into the final primary bar.
8. Fix the flashings to the perimeter edges of the fastlock panels, using the supplied fixings.



Fixing



Structured Polycarbonate

Naturalight Systems Limited

Naturalight Systems LTD
Accessory House,
Barrington Industrial Estate,
Bedlington,
Northumberland.
NE22 7DQ

Tel: (01670) 530355
Fax: (01670) 824540

Title: Fastlock Instalation Diagram	
Description: Exploded View	
Drawn By: A. Lee	Date: 16-11-2004
Scale: Not to Scale	Checked By: .
File Name: FL16.06	Job Number: N/A

For further information about BRE

BRE
Garston
Watford
WD25 9XX
T +44 (0)1923 664000
F +44 (0)1923 664010
E enquiries@bre.co.uk

BRE Scotland
Scottish Enterprise Technology Park
East Kilbride
Glasgow
G75 0RZ
T +44 (0)1355 576200
F +44 (0)1355 576210
E enquiries@bre.co.uk

www.bre.co.uk

bre