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Interim report on ACR(M)001: 2000 Test for fragility on 25 mm thick Fastlock roof light specimens from Naturalight Systems Ltd

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

23 June 2005

Test report number 223 837

Prepared on behalf of BRE by

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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 763g, dated 03 June 2005. The client accepted the proposal on 08 June and BRE tested specimen roof lights on 16 and 21 June 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 interim report describes the results of the tests on 16 and 21 June from fragility tests on the 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 223 837 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 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 weathertightness 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, 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 Fastlock system roof light. 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 skins of about 0.9 mm thick.

The Fastlock system consists of the polycarbonate glazing 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 primary bars. The overall sizes of the glazing bars is: Primary bars 80 mm wide x 43 mm high, Secondary bars 51 mm wide x 33 mm high. The glazing engagement into the bars was about 25 mm. Two 7.5 mm diameter threaded bars per roof light run through each roof light panel with screws (with female threads) at each end outside the end bars. These threaded bars are at about 310 mm centres at 335 mm in from the edge of the glazing.

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 interlocking panels (corners furthest away from the interlock).

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 roof light test specimens spanned across two purlins at 2.0 m centres.

Dimensions: The overall size of the test roof light assembly was 2.0 m long x 2.0 m wide for two panel specimens and 3 m long x 2.0 m wide for three panel specimens.

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 test specimens

The weight of the impactor bag was checked 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, 22°C on both test dates. 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.

Impact position	Drop No.	Notes
At the centre of one roof light sheet	1	The impactor was retained on the specimen for 5 minutes close to the point of impact. The side glazing and threaded bars were bent by the effect of the impact. Some minor creases in the surface close to the point of impact. Glazing remained engaged to the bars.
	2	The impactor was retained on the specimen for 5 minutes close to the point of impact. Amounts of bending and creasing increased. Glazing remained engaged to the bars.
Repeat at same position as above on 2nd panel	1	The impactor was retained on the specimen for 5 minutes close to the point of impact. The side glazing and threaded bars were bent by the effect of the impact. Some minor creases in the surface close to the point of impact. Glazing remained engaged to the bars.
	2	The impactor was retained on the specimen for 5 minutes close to the point of impact. Amounts of bending and creasing increased. Glazing remained engaged to the bars.
		Actions: Replaced one panel with new .
Repeat on new panel at position above	1	The impactor was retained on the specimen for 5 minutes close to the point of impact. The side glazing and threaded bars were bent by the effect of the impact. Some minor creases in the surface close to the point of impact. Glazing remained engaged to the bars.
	2	The impactor was retained on the specimen for 5 minutes close to the point of impact. Amounts of bending and creasing increased. Glazing remained engaged to the bars.

Table 1. Test results on specimens of 25 mm thick Fastlock roof light when impacted at the centre of panels

Impact position	Drop No.	Notes
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 became 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
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 moved but not disengaged.
	2	The impactor was retained on the specimen for 5 minutes. The glazing moved more but not disengaged again.
		Actions: Removed roof light and replaced with new and changed all surround sheets for new. New fixings used
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 moved but not disengaged.
	2	The impactor was retained on the specimen for 5 minutes. The glazing moved more but not disengaged again
		Actions: Replaced starter panel with new and new fixings
4th repeat at position above; on the starter panel	1	The impactor was retained on the specimen for 5 minutes close to the point of impact. The glazing moved but not disengaged.
	2	The impactor was retained on the specimen for 5 minutes with some disengagement of glazing close to the point of impact.

Table 2. Test results on specimens of 25 mm thick Fastlock roof light when impacted at the corners of the panels

Impact position	Drop No.	Notes
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. The glazing bar buckled close to the impact point. Glazing remained engaged.
	2	The impactor was retained on the specimen for 5 minutes. Glazing disengaged at the edge local to the impact point.
Repeat at position above on other panel	1	The impactor was retained on the specimen for 5 minutes. Glazing disengaged at the edge local to the impact point.
	2	The impactor was retained on the specimen for 5 minutes. Glazing disengaged more leaving a gap under the glazing bar of 170 mm
		Actions: Replaced one panel with new and continued tests on 2nd panel
Repeat at position above on other panel	1	The impactor was retained on the specimen for 5 minutes. Glazing disengaged at the edge local to the impact point leaving a gap under the glazing bar of 130 mm.
	2	The impactor was retained on the specimen for 5 minutes. Glazing disengaged more leaving a gap under the glazing bar of 340 mm. Glazing bar bent. Impactor jammed in gap
		Actions: Removed all panels and performed one drop on a single panel
Repeat at position above on single panel	1	Glazing bar bent on impact and impactor bounced off onto floor. Glazing remained engaged

Table 3. Test results on specimens of 25 mm thick Fastlock roof light when impacted at a point midway along the long edge of a panel, close to a glazing bar

7 Conclusions and classifications

The impact tests reported here have been carried out to assess the fragility of specimens of Naturalight Systems Ltd 25 mm thick Fastlock roof lights. The interim results apply only to the new roof lights as configured, mounted and fixed as described herein.

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

Components were changed after each pair of impacts at each position. The testing found that the 'worst' position to impact this type of roof light set up in the manner described herein was midway along a panel's long edge near a glazing bar. Repeat tests were performed at all the positions impacted on the roof light.

The results from some repeat tests were not consistent with those preceding. At one position the roof light while technically achieving a class B (bag retained after the second impact) had damage that was sufficient to either allow the impactor through or partly through the roof light . This may have been because testing was carried out on specimens damaged and weakened by previous impacts. The results thus far warrant further testing with new components on modified 25 mm thick Fastlock system roof lights. The new tests will also double check the results at all the other positions tested.

8 References

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

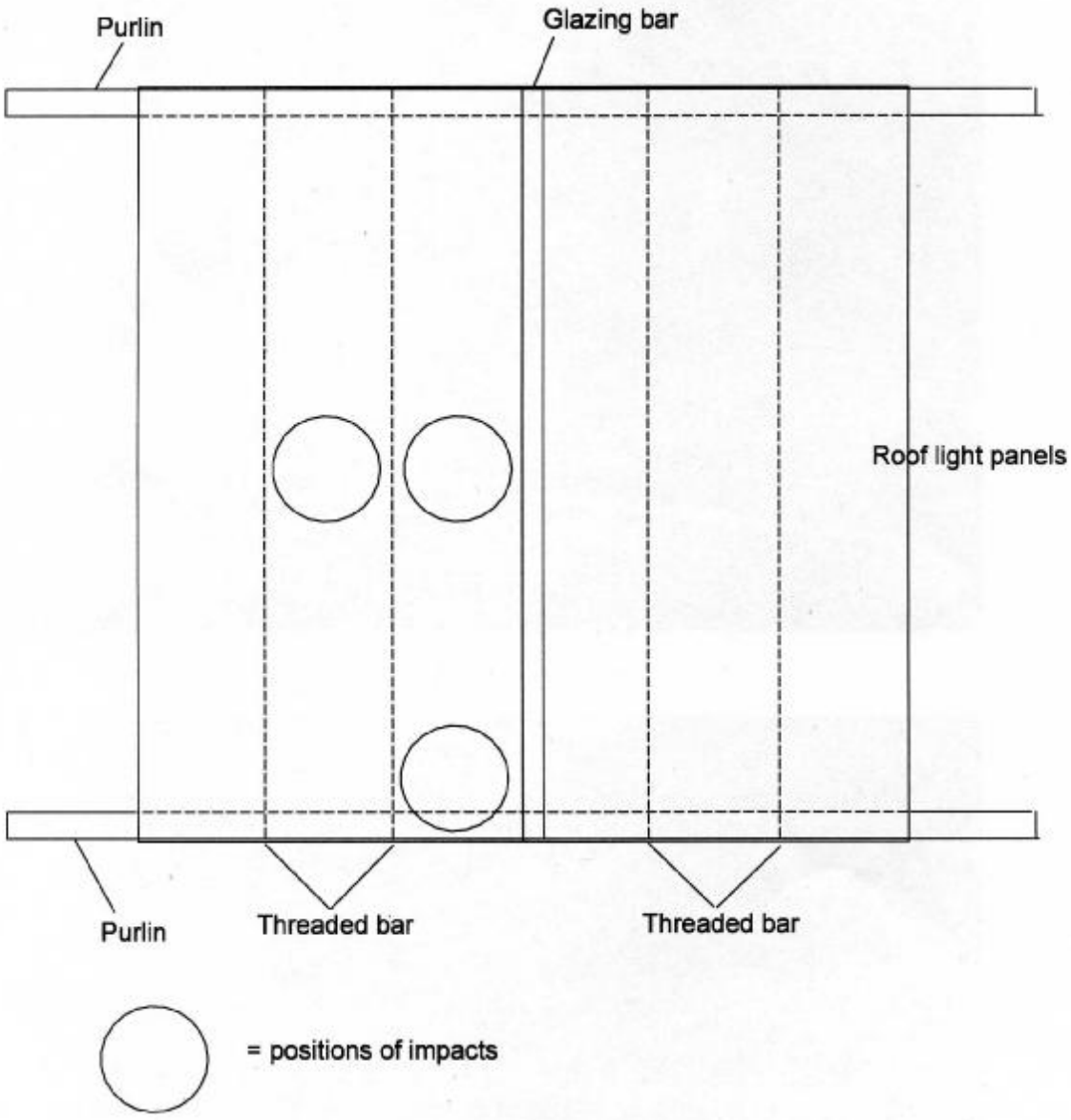

Figure 1. Sketch of the general layout of the roof light test specimen showing impact positions

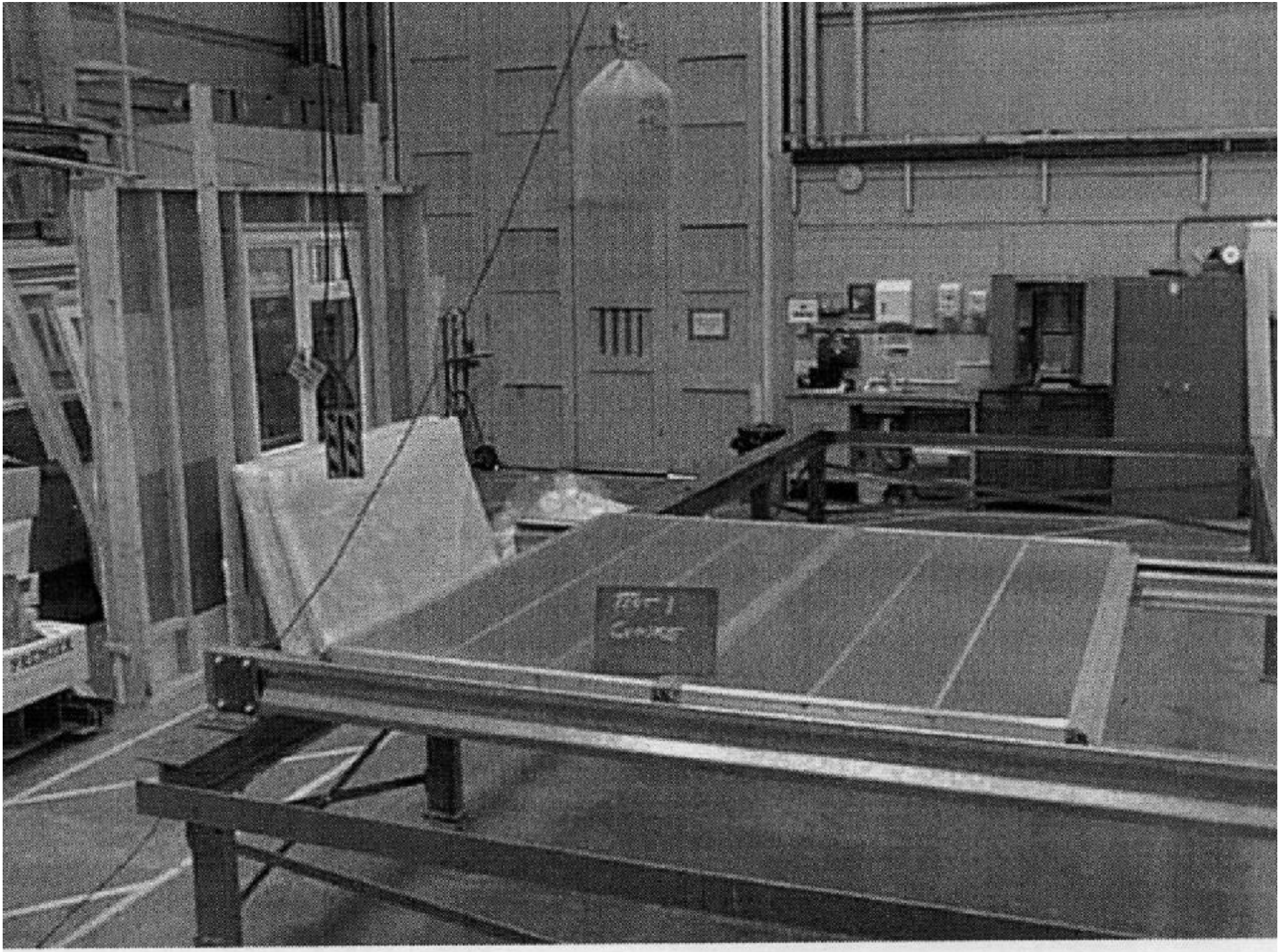

Figure 2. The test set up prior to the first impact