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Report

Soft body impact test

Hard body impact test

Facade system QC25-10

Order no.: 08-G-0123 Ref.: GWV/GZ

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Project	:	Soft and hard body impact tests – facade system QC25-10
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1. Photographic report
2. Schematic details, facade system QC25-10

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1 Assignment

1.1 Introduction

On 13 June 2008, Mr P. Selles issued a verbal assignment, on behalf of Hunter Douglas Construction Elements B.V., to carry out soft and hard body impact tests on facade system QC25-10.

This assignment was confirmed in writing by BDA Geveladvies B.V. on 29 August 2008.

1.2 Objective of the assignment

The objective of the assignment is to determine the performance of facade system QC25-10 during soft and hard body impact tests.

1.3 Method

The tests were conducted by *ing.* G.W. Verheij and Mr P. Golverdingen of BDA Geveladvies B.V. on 10 July 2008. The weather was rainy with dense cloud cover during the soft impact tests. The average outdoor temperature was approximately 17 °C. Mr P. Selles and employees of Hunter Douglas were present during the tests.

The soft body impact tests were performed outdoors, on the Hunter Douglas property in Leek. The hard body impact tests were performed in the Hunter Douglas laboratory in Leek. At the request of the principal, the soft and hard body impact tests were conducted in conformance with EOTA TR 001 (February 2003).

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2 Conclusion

2.1 Expression of test results

The results of the impact tests were checked against § 2.5 'Expression of test results' EOTA TR 001 (February 2003) and § 4.3 'Expression of test results' of this report.

2.2 Soft body impact tests, external walls

Safety in use

There was no collapse, no penetration and no projection of facade system QC25-10 during performance of the soft body impact tests.

Serviceability

There was no penetration and no degradation of facade system QC25-10 during performance of the soft body impact tests.

Facade system QC25-10 therefore meets the most stringent requirements of the EOTA TR 001 (February 2003).

2.3 Hard body impact tests, external walls and roofs

Safety in use

There was no collapse, no penetration and no projection of the attachment hardware and aluminium panels of facade system QC25-10 during performance of the hard body impact tests.

Serviceability

There was no penetration and no degradation of the attachment hardware and aluminium panels of facade system QC25-10 during performance of the hard body impact tests.

Facade system QC25-10 therefore meets the most stringent requirements of the EOTA TR 001 (February 2003).

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3 Details

3.1 General

Facade system QC25-10

The aluminium facade construction is composed of vertical aluminium uprights that are mounted in aluminium anchors attached to the bearing construction of the building facade. The facade panels are secured to the uprights with aluminium attachment brackets. The panels of the facade system consist of a sandwich construction. The aluminium facade panels are constructed from extruded aluminium sections, finished with aluminium sheeting on the inside and outside. The thickness of the outer sheet is 0.9 mm and the thickness of the inner sheet is 0.5 mm. An aluminium honeycomb core is glued between the sheets. See appendix 2 for the technical specifications and detail drawings of the facade system. The test must be performed on panels with a maximum dimension of 4500 mm × 1500 mm (w × h). The thickness of the panels is 25 mm.

Soft body impact tests

The soft body impact tests were conducted on panels mounted as a facade, type QC25-10. The facade system was designed and manufactured by Hunter Douglas Construction Elements B.V. of Leek, The Netherlands. The aluminium facade system to be tested was mounted on a vertical, fixed steel main bearing construction. The steel main bearing construction for the test facades is located outdoors, on the Hunter Douglas property in Leek.

Hard body impact tests

The hard body impact tests were conducted on aluminium facade panels of the facade system QC25-10, laying flat on the ground. See appendix 2 for the technical specifications and detail drawings of the panels.
The facade panels were attached to system-specific rails using system-specific fixing plates. The uprights and panels were laid flat on the tiled laboratory floor.

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3.2 External walls

The following impact tests were performed on facade system QC25-10, in conformance with EOTA TR 001 (February 2003).

Table 1 – Safety in use

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	1	900	no collapse, no penetration and no projection
Hard body impact	1	1	10	

Table 2 – Serviceability

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact	50	3	400	no penetration and no degradation
Hard body impact	0.5	3	6	

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3.3 Roofs

The following impact tests were performed on facade system QC25-10, in conformance with EOTA TR 001 (February 2003).

Table 3 – Safety in use

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact (not performed)	-	-	-	no collapse, no penetration and no projection
Hard body impact	1	1	10	

Table 4 – Serviceability

Test	Impactor (kg)	No. of impacts	Energy (Nm)	Criteria
Soft body impact (not performed)	-	-	-	no penetration and no degradation
Hard body impact	0.5	1	10	

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4 Requirements

4.1 Soft body impact tests

In EOTA TR 001 (February 2003) requirements are laid down for the safety in use and serviceability of facade and roofing systems. The soft body impact test simulates the impact load generated by a person who accidentally falls against a facade panel and/or on a roof panel.

The impact load for roofs is equivalent to the fall load caused by a soft body impactor having the same characteristics as that used for facades, provided that the test specimen is mounted horizontally, in conformance with § 2.4 'Test procedure', Figure 3 – 'Vertical impact on horizontal assembly' in EOTA TR 001 (February 2003). This soft body impact test was not performed.

The impact load for facades is equivalent to the load caused by swinging into it with a soft body impactor. The test facade must be mounted vertically, in conformance with § 2.4 'Test procedure', Figure 2 – 'Impact on vertical assembly' in EOTA TR 001 (February 2003). The soft body impactor has the following characteristics:

For safety in use and for serviceability

- A leather bag filled with glass beads with a total mass of 50 ± 0.5 kg, in conformance with § 2.2 'Test apparatus' in EOTA TR 001 (February 2003).
- The distance measured vertically between the suspension point and contact point must be determined in conformance with § 2.4 'Test procedure' in EOTA TR 001 (February 2003).

4.2 Hard body impact tests

In EOTA TR 001 (February 2003) requirements are laid down for the safety in use and serviceability of facade and roofing systems. The hard body impact test simulates the impact load generated by a falling object that accidentally falls on a facade panel and/or roof panel. The hard object falls on the panel from a predetermined height (see figure 2).

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The fall load is equivalent to the load caused by dropping a hard steel ball with the following characteristics:

- ***For safety in use***

  Steel ball with a diameter of 63.5 ± 1 mm and a total mass of 1030 g (± 40), (1 kg steel ball), in conformance with § 3.2 'Test apparatus' in EOTA TR 001 (February 2003).

- ***For serviceability***

  Steel ball with a diameter of 50 ± 0.5 mm and a total mass of 514 g (± 19), (0.5 kg steel ball), in conformance with § 3.2 'Test apparatus' in EOTA TR 001 (February 2003).

4.3 Expression of the results

The test result is pass/fail, according EOTA TR 001 (February 2003), depending on whether the panel assemblies meet the following combined criteria:

For safety in use

- no collapse: the test result is favourable when, after the test, the panel of assembly maintains its mechanical integrity and is still capable of carrying its own weight in the tested position;
- no penetration: the test result is favourable when, after the test, the impactor has not passed the test specimen;
- no projection: the test result is favourable when, after the test, the impactor has not created parts of the panel (e.g. core, face, reinforcement) to project from the face of the panel, on the other side of the specimen then the impact side, creating sharp cutting edges of surfaces likely to cause injury by contact.

For serviceability

- no projection: the test result is favourable when, after the test, the impactor has not penetrated the face of the test specimen on the impact side of the specimen;
- no degradation: the test result is favourable when, after the test, there are no visible (to the naked eye) cracks, depressions, protuberances or any other defects in the materials, which may influence the fitness for use of the panel or assembly. Deformations, which only affect the appearance, are allowed, but should be mentioned in the test report.

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5 Test procedure

5.1 Soft body impact test

The test method consists of assessing the effect of the impact load caused by a soft body impactor.

The soft body impactor must have the following dimensions:
- the total mass of the impact body must be 50 ± 0.5 kg;
- the bag is filled with glass beads with a diameter of 3 ± 0.5 mm;
- the impact body must be hung in such a manner that it does not make contact with the construction.

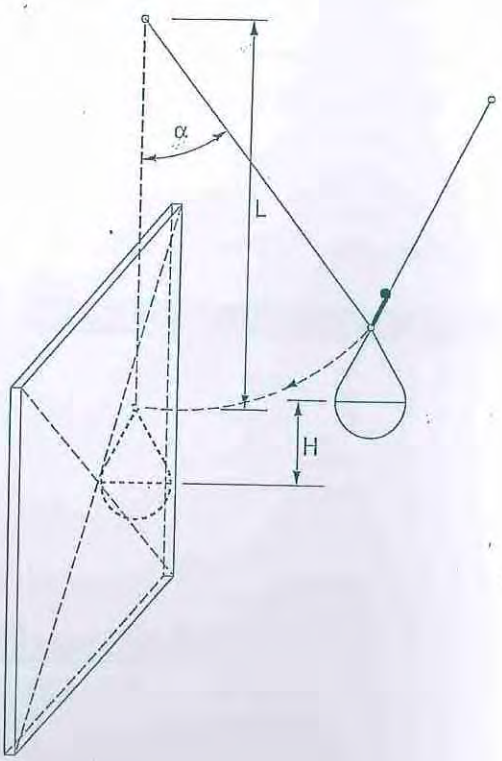
The soft body impact test must be performed in conformance with § 2.4 'Test procedure', Figure 2 – 'Impact on vertical assembly' in EOTA TR 001 (February 2003). Since the facade panel must be able to withstand an impact load at any point, the weakest point must be sought and the impact body must be hung in such a manner that it will impact that point.

The soft body impactor with mass (m) is dropped from a height (h), so that the total impact energy ($E = g \times h \times m$, in which g = 9.81 m/s) corresponds with one of the following energies E in Nm.
- for safety in use: 900 Nm;
- for serviceability: 400 Nm.

The height (h) is measured between the designated point of impact and the height of release of the soft body impactor. For tests conducted on wall assemblies the angle α must always be smaller or equal to 65° (see Figure 1). The bag is held vertically when released (not horizontally).

The soft body impactor is then lifted upwards to a point above the release position (see figure 1). The impact object must be released suddenly from this position (removal of the attachment hook). After the test, the state of the building structure and the attachments must be determined through inspection. It is particularly important to note any signs of rupturing (crack formation or breakage), penetration, detachment and degradation.

Figure 1 – Assembly for the soft body impact test



5.2 Hard body impact test

In this test, the hard body impactor with mass (m) is dropped from a height (h) so that the total impact energy ($E = g \times h \times m$, in which $g = 9.81$ m/s) corresponds with one of:

- hard body impact test (1 kg steel ball): 3 Nm or 10 Nm;
- hard body impact test (0.5 kg steel ball): 1.3 Nm; 2.5 Nm; 3.75 Nm or 6 Nm.

The height (h) is measured between the designated point of impact and the height of release of the hard body impactor.

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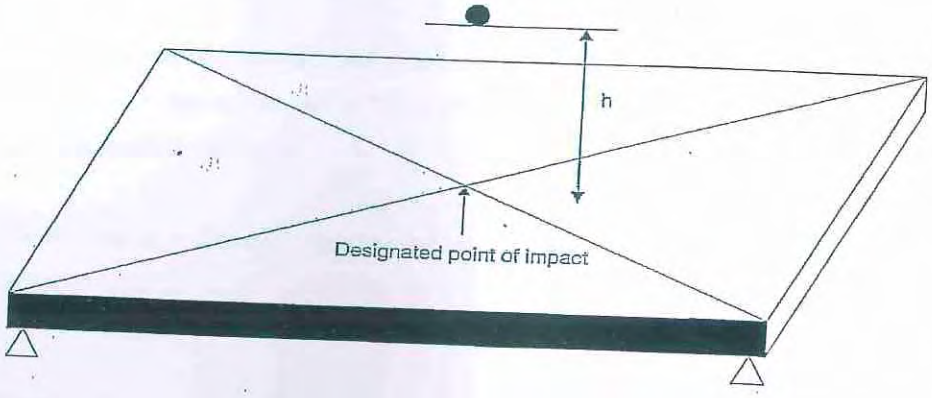
Figure 2 – Assembly for the hard body impact test



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6 Observations

After the impact tests specified below, the panels show slight, acceptable deformation (indentation). The deformation was measured with a calibrated steel straight edge and a calibrated digital caliper gauge after each impact test.

For the degree of indentation, see the tables below and photos 1 through 8 of the photographic report (appendix 1).

6.1 External walls

Safety in use

There was no collapse, no penetration and no projection of facade system QC25-10 during performance of the soft body and hard body impact tests.

Table 5 – Safety in use

Test	Impactor (kg)	Impact test No.	Energy (Nm)	Indent panel (mm)
Soft body impact	50	1	900	Indent-depth = 5.4
Hard body impact	1	1	10	Indent-depth = 3.7

Serviceability

There was no penetration and no degradation of facade system QC25-10 during performance of the soft body and hard body impact tests.

After the impact tests specified below, the panels exhibited slight, acceptable deformation (indentation). For the degree of indentation, see the tables below.

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Table 6 – Serviceability (external walls)

Test	Impactor (kg)	Impact test No.	Energy (Nm)	Indent panel (mm)
Soft body impact	50	1	400	Indent-depth = 0.18
Soft body impact	50	2	400	Indent-depth = 0.22
Soft body impact	50	3	400	Indent-depth = 0.26
Hard body impact	0.5	1	6	Indent-depth = 4.4
Hard body impact	0.5	2	6	Indent-depth = 4.4
Hard body impact	0.5	3	6	Indent-depth = 4.4

6.2 Roofs

Safety in use

There was no collapse, no penetration and no projection of the attachment hardware and aluminium panels of facade system QC25-10 during performance of the hard body impact tests. The aluminium panels were not subjected to soft body impact tests.

Table 7 – Safety in use (roofs)

Test	Impactor (kg)	Impact test No.	Energy (Nm)	Indent panel (mm)
Soft body impact (not performed)	-	-	-	-
Hard body impact	1	1	10	Indent-depth = 4.0

Serviceability

There was no penetration and no degradation of the attachment hardware and aluminium panels of facade system QC25-10 during performance of the hard body impact tests.

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Table 8 – Serviceability (roofs)

Test	Impactor (kg)	Impact test No.	Energy (Nm)	Indent panel (mm)
Soft body impact (not performed)	-	-	-	-
Hard body impact	0.5	1	10	Indent-depth = 3.8

Gorinchem, 2008.12.03

Author of report

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BDA Geveladvies B.V.

Prof. *ir.* N.A. Hendriks

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APPENDIX 1

Photographic report

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Photo 1
Test arrangement for soft body impact test.

Photo 2
An indicative measurement of the indentation was made using a calibrated steel straight edge and a calibrated digital caliper gauge.

Photo 3
No damage to the panels or the panel fasteners was ascertained.

Photo 4
Test arrangement for hard body impact test.

Photo 5
Test arrangement for hard body impact test.

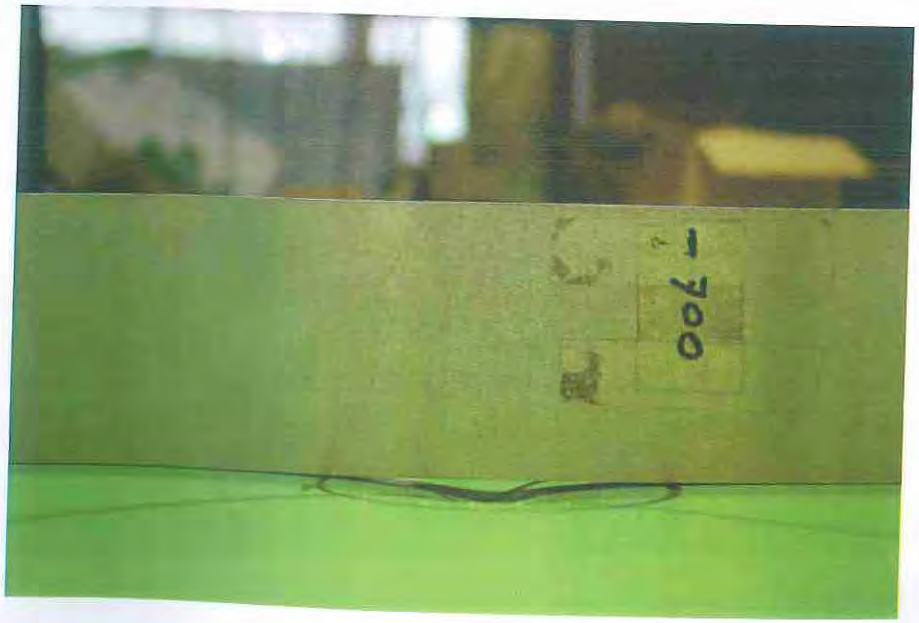

Photo 6
The indentation of the panel was measured using a calibrated steel straight edge.

Photo 7
The indentation of the panel was measured using a calibrated digital caliper gauge.

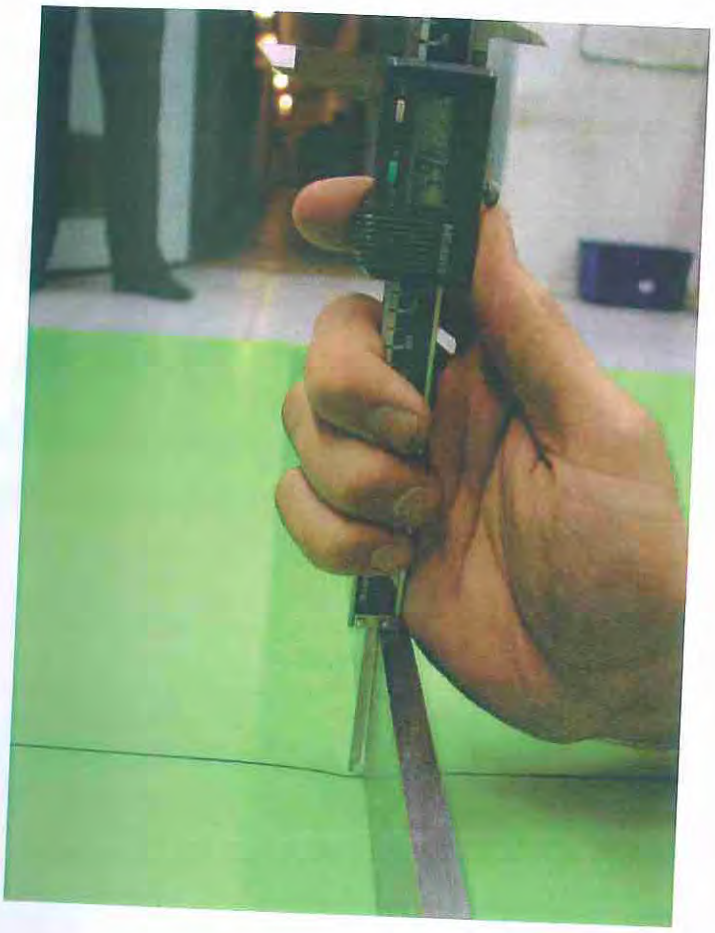

Photo 8
The steel ball has fallen in the middle of the panel.

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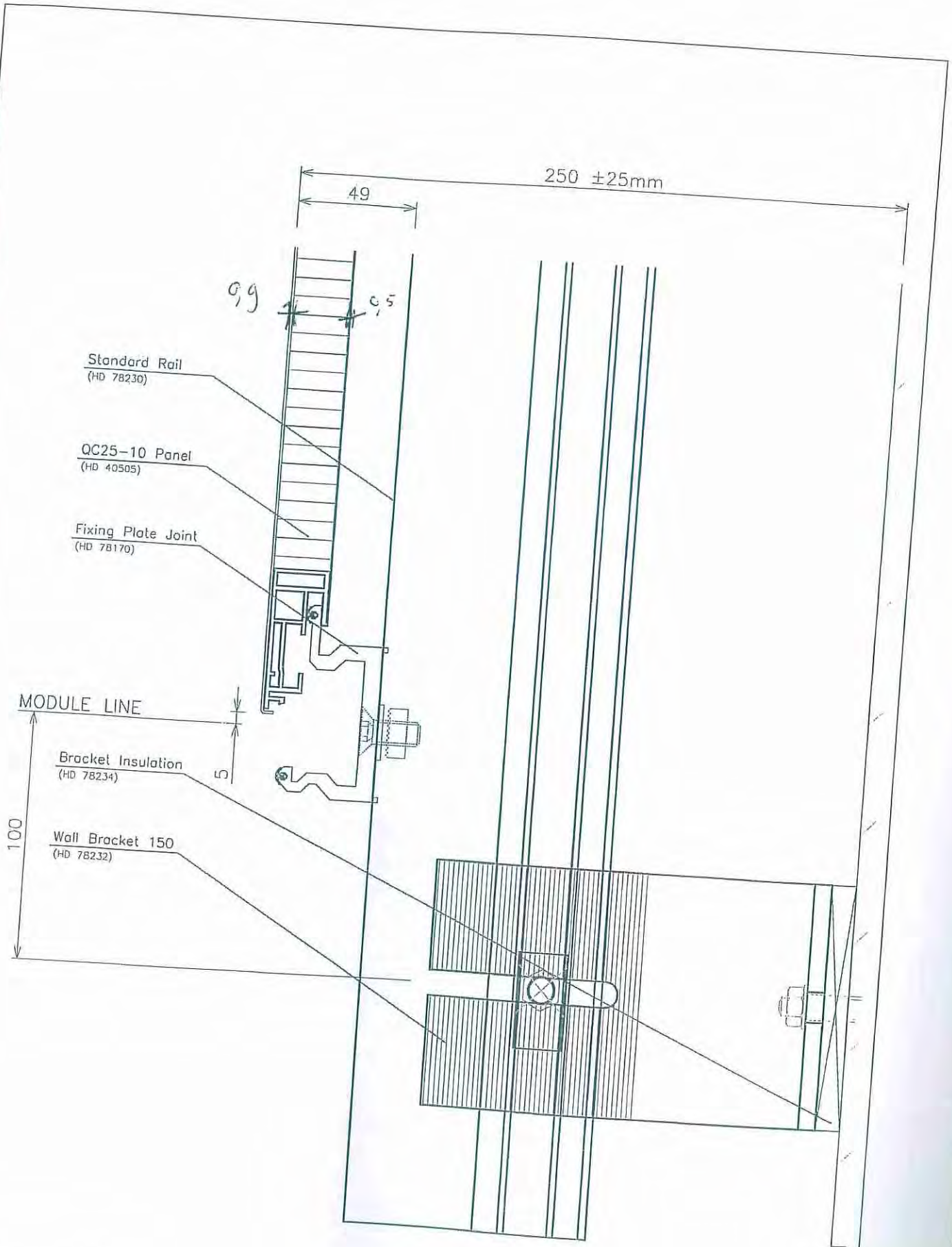
APPENDIX 2

Schematic details

Facade system QC25-10



REVISIONS

NO.	DATE	DESCRIPTION	DRAWN	CHECKED

DEFINITE

Secundaire steelwork to be engineered and calculated by the building engineer.

All aluminium materials fixed to steel support must be separated by plastic shims or equivalent to prevent galvanic corrosion.

PROJECT NAME
QC25-10 TEST
R&D
PMS 031.25.00xxx

TITLE
BOTTOM DETAIL
QuadroClad 25-10
DETAIL 1.2

CHECKED	DATE	DRAWN	SCALE	SIZE
PS	12.02.08	SH	1:2	A4
DWG		SHEET		STATUS
001		d1.2		C

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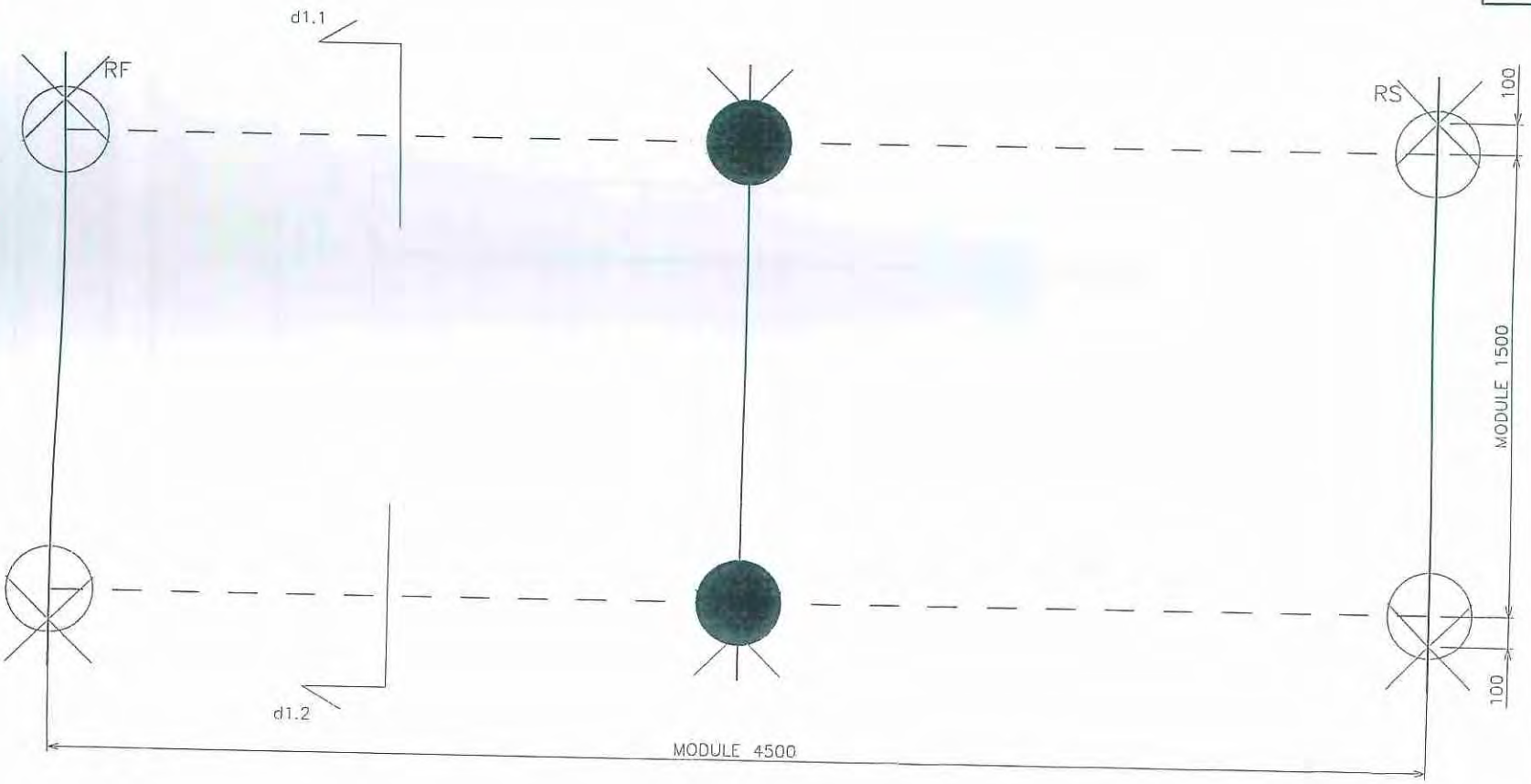

○	78170 Fixing Plate Joint
●	78171 Fixing Plate Mid
RF	78172 Retainer Fixed
RS	78173 Retainer Sliding
×	78232 Wall Bracket 150

DEFINITE

Secundaire steelwerk to be engineered and calculated by the building engineer.

All aluminium materials fixed to steel support must be separated by plastic shims or equivalent to prevent galvanic corrosion.

REVISIONS

REV.	DATE	DESCRIPTION	DRAWN	CHECKED

PROJECT NAME

QC25-10 TEST
R&D
PMS 031.25.00xxx

TITLE

VOORAANZICHT
QC25-10 System
VIEW 1.1

CHECKED	DATE	DRAWN	SCALE	SIZE
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DWG	SHEET	STATUS
001	d1.1	C

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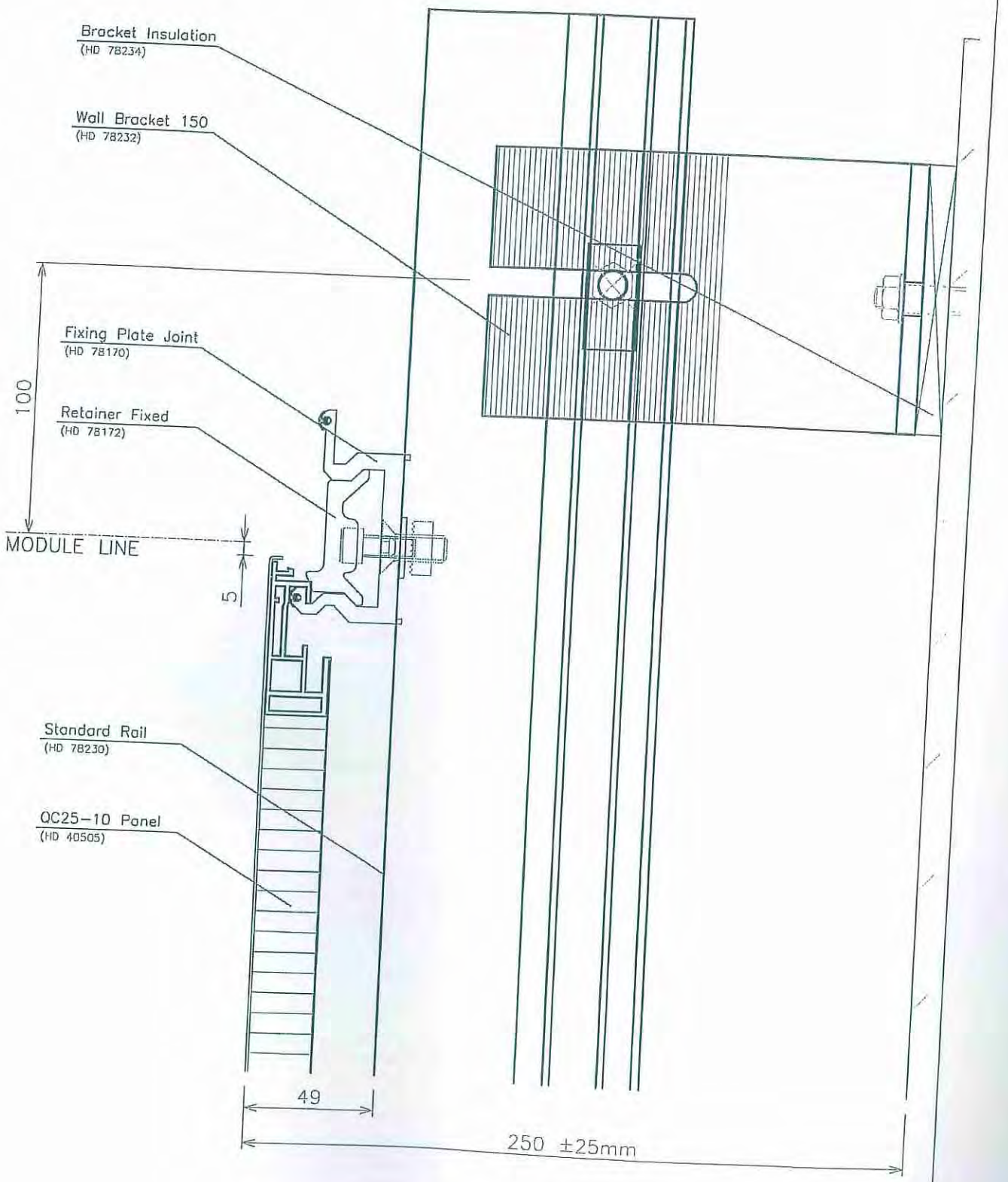

REVISIONS				
REV.	DATE	DESCRIPTION	DRAWN	CHECKED

DEFINITE

Secundaire steelwork to be engineered and calculated by the building engineer.

All aluminium materials fixed to steel support must be separated by plastic shims or equivalent to prevent galvanic corrosion.

PROJECT NAME
QC25-10 TEST
R&D
PMS 031.25.00xxx

TITLE
TOP DETAIL
QuadroClad 25-10
DETAIL 1.1

CHECKED	DATE	DRAWN	SCALE	SIZE
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DWG		SHEET		STATUS
001		d1.1		C

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