

Fire Performance Testing of an External Cladding System BS 8414-1:2015 + A1:2017

Test Report

Prepared for : Kingspan Insulation Ltd.
Project : System Development
Report No. : DLR1516 Rev.0
Sample : Vitracore G2 Composite Panel With 180mm Rockwool Duo Slab Insulation



4559

September 2018

Contents

1.	Introduction	4
1.1	Purpose of Testing	4
1.2	Terms and Definitions	5
2.	Test Summary	5
3.	Description of the Test Sample	6
4.	Test Apparatus	10
4.1	Test Rig	10
4.2	Heat Source	10
4.3	Thermocouples	10
5.	Test Procedures	14
5.1	Testing	14
5.2	Post-test Examination	14
6.	Test Data / Observations	15
6.1	Post-test Examination	19

Table Index

Table 1	Observations	5
Table 2	System Details	8
Table 3	Visual Observations During the Test	15
Table 4	Post-test Observations	19
Table 5	Document Status	38

Figure Index

Figure 1	Photo DLP C2753H/1593 External View of the Test Sample	7
Figure 2	Schematic View of the Test Rig	11
Figure 3	Thermocouple, Cavity Barrier Locations & Panel Numbering	12
Figure 4	Level 2 Section Drawing Showing the Thermocouple Locations	13
Figure 5	Thermocouple Readings on Level 1 - External	17
Figure 6	Thermocouple Readings on Level 2 – External	17
Figure 7	Thermocouple Readings on Level 2 – Internal (Cavity)	18
Figure 8	Thermocouple Readings on Level 2 – Internal (Mid-depth of 180mm Rockwool Duo Slab Insulation)	18
Figure 9	Area Map Showing the Condition of the ACM Panels After the Test	21

Appendices

Photographs

Drawings

1. Introduction

This report describes the fire performance test carried out at Al Futtaim Exova (AFE) laboratory in Dubai at the request of:

Kingspan Insulation Ltd.,
Pembroke, Leominster,
Herefordshire, England.

Contact email: highrisetechnical@kingspan.com

Contact number: +44 1544 387 382

AFE Job/Sample Number: PD 106193 / C2753H

The test sample consisted of an external wall cladding system (Vitracore G2 Composite Panel with 180mm Rockwool Duo Slab Insulation) installed by European Aluminium Systems on behalf of Kingspan Insulation Ltd.

This test report is personal to the client, confidential, non-assignable and shall not be reproduced, except in full, without prior written approval of AFE.

1.1 Purpose of Testing

The test was carried out on 2nd July 2018 and was to determine the fire performance of an aluminium composite metal wall cladding system fixed to the masonry face when exposed to external fire under controlled conditions. The test method was in accordance with AFE test method statement DMC2753H/MSrev0, which was in accordance with the following standards:

- ▶ BS 8414-1: 2015 + A1:2017

This test report relates only to the actual sample as tested and described herein.

The tests were witnessed wholly or in part by:

Adrian Brazier - Kingspan Insulation Ltd.

The test was supervised by Arun Kumar Murugan of Al Futtaim Exova.

1.2 Terms and Definitions

1.2.1 Level 1 Height

2500mm above the top of the combustion chamber opening on the test apparatus.

Refer to section 4 for details.

1.2.2 Level 2 Height

5000mm above the top of the combustion chamber opening on the test apparatus.

Refer to section 4 for details.

1.2.3 Start Temperature, T_s

Mean temperature of the thermocouples at Level 1, five minutes prior to ignition of the heat source.

1.2.4 Start Time, t_s

Time when the temperature recorded by any external thermocouple at Level 1 equals or exceeds 200°C above T_s and remains above this value for at least 30 seconds.

2. Test Summary

The cladding system was tested in accordance with BS 8414-1:2015 + A1:2017 without any early termination of the test.

Table 1 Observations

Parameters	Temperature data / observations
T_s , start temperature	28°C
t_s , start time	165 seconds after ignition of the crib (thermocouple 3)
Peak temperature & time at Level 2 (External)	728°C at 753 seconds from t_s (thermocouple 12)
Peak temperature & time at Level 2 (Mid-depth of cavity)	602°C at 891 seconds from t_s (thermocouple 20)
Peak temperature & time at Level 2 (Mid-depth of 180mm Rockwool Duo Slab Insulation)	498°C at 1569 seconds from t_s (thermocouple 28)

For full details refer to Section 6.

The above results are valid only for the conditions under which the tests were conducted.

3. Description of the Test Sample

The test specimen mainly comprised of:

- ❖ Vitracore G2 composite panel.
- ❖ 180mm Rockwool Duo Slab insulation.
- ❖ Siderise RH25G 90/30 horizontal open state cavity barrier.
- ❖ Siderise RSV-90/30 vertical open state cavity barrier.
- ❖ ECF-B-S-220 Helping Hand bracket.
- ❖ Aluminium 'T' rail and 'L' rail.

Main wall - 2580mm wide x 8508mm high.

Wing wall - 1260mm wide x 8508mm high.

The top termination of the cladding system was closed with 2mm thick aluminium sheet. The main wall and wing wall sides were left open. The interface between the cladding system and the combustion chamber was covered with 5mm thick aluminium sheet. The distance of the finished face of the wing wall to the side opening of the combustion chamber was 180mm.

Photo DLP C2753H/1593 shows an external view of the sample.

Figure 1 Photo DLP C2753H/1593 External View of the Test Sample



The system components are mentioned in Table 3. Refer to the drawings in Appendix B for sample construction details and dimensions.

Material information described in Table 3 below is as supplied by Kingspan Insulation Ltd.

Table 2 System Details

Component	Description	Installation Details
Bracket	ECF-B-S-220 Helping Hand Bracket and 100-HR25 Polypropylene Iso Pad. See photos DLP C2753H/1424 & DLP C2753H/1433 in Appendix A.	The brackets were fixed to the masonry with MFRFB-A4-10x80 concrete support anchors and nylon wall plugs. Polypropylene Iso Pad shims were placed between masonry wall and brackets.
Cavity barrier	Horizontal intumescent cavity barrier: Siderise RH25G-90/30, open state cavity barrier, 75mm thick. See photos DLP C2753H/1437 & DLP C2753H/1504 in Appendix A.	The horizontal cavity barriers were fixed to the masonry with RS350 brackets and MFRFB-A4-10x80 concrete support anchors and nylon wall plugs. 4 nos. of horizontal continuous cavity barriers were fixed to the main wall and wing wall, at 75mm, 2425mm, 4830mm and 6485mm above the combustion chamber opening.
	Vertical cavity barrier: Siderise RSV-90/30, open state cavity barrier, 75mm thick. See photos DLP C2753H/1433 & DLP C2753H/1504 in Appendix A.	3 nos. of continuous vertical cavity barriers were fixed to the masonry, two on the main wall and one on the wing wall with RS195 brackets and MFRFB-A4-10x80 concrete support anchors and nylon wall plugs.
Insulation	180mm Rockwool Duo Slab insulation. See photos DLP C2753H/1504 & DLP C2753H/1506 in Appendix A.	Insulation was fixed to the masonry wall with steel and plastic pins.
Railing	120x60x2mm Aluminium 'T' rail 60x40x2mm Aluminium 'L' rail See photos DLP C2753H/1504 & DLP C2753H/1506 in Appendix A.	Railings were fixed to the Helping Hand brackets with 5.5mm diameter TEK screws.
Panel	Vitracore G2 panel, 4mm thick. Top Skin – Aluminium Core – Aluminium Bottom Skin – Aluminium See photo DLP C2753H/1584 in Appendix A.	Aluminium composite panels were fixed to the railings with rivets. 20mm joints were provided between the panels.

AFE was not involved in the design, procurement, installation and specification of the materials or system.

Sample installation

AFE monitored the installation of the sample based on the drawings supplied by Kingspan Insulation Ltd, which are included in Appendix B of this report. Any deviation of the installation from these drawings were recorded and reported.

Date of installation: 24 to 29 June '18

Ambient temperature range: 28 - 38°C

4. Test Apparatus

4.1 Test Rig

The test specimen was installed on a purpose-built test rig constructed by AFE as per the BS 8414-1:2015 + A1:2017 standard.

The rig comprised of two mutually perpendicular walls (constructed from the masonry bricks of compressive strength: 7.3 N/mm², density: 730kg/m³ and thermal conductivity: 0.18W/mK), one referred to as the main wall with a width of 3275mm and the other as the wing wall with a width of 2685mm. The total height of the test rig was 9180mm.

A combustion chamber with an opening of 1999mm x 2010mm was positioned at the base of the main vertical wall.

Refer to Figure 2 below for a schematic diagram of the test rig.

4.2 Heat Source

A timber crib, 1500mm x 1000mm in plane and 1000mm in height, was constructed using Pinus Silvestris softwood sticks as described in BS 8414-1:2015 + A1:2017 with a first layer consisting of 10 long sticks of 1500mm. The next layer consisted of 15 short sticks was evenly distributed to cover an area of 1500mm x 1000mm.

The process was repeated to give a total of 20 layers of sticks, giving a nominal height of 1000mm. The crib was constructed on a solid steel platform positioned 400mm above the floor of the combustion chamber and placed centrally and displaced 100mm from the back wall of the chamber.

The crib was ignited using 16 strips of low density fibreboard, soaked for 5 minutes in 5 litres of white spirit.

4.3 Thermocouples

All thermocouples used conformed to BS EN 60584-1:2013, Type K (Chromel / Alumel). The thermocouples were mineral insulated and had a nominal 1.5mm diameter with insulated junctions. Data acquisition was performed at 3 second intervals.

The locations of the thermocouples on the specimen were as shown in Figure 3.

4.3.1 External thermocouples at Levels 1 and 2

Thermocouples were positioned in front of the main wall on the centre line and at 500mm & 1000mm each side of the centre line of the combustion chamber (five locations). Thermocouples were also positioned in front of the wing wall, at 150mm, 600mm & 1050mm from the finished face of the main wall (three locations).

4.3.2 Internal thermocouple locations at Level 2

Thermocouples were positioned within each layer of the main test wall face greater than 10mm on the centre line and at 500 mm and 1000 mm each side of the centre line of the combustion chamber (five locations). Thermocouples were also positioned within each layer of the wing test wall face greater than 10mm at 150 mm, 600 mm and 1050 mm from the finished face of the main test wall face (three locations).

Figure 2 Schematic View of the Test Rig

Note: All dimensions are in mm, the drawing is not to scale

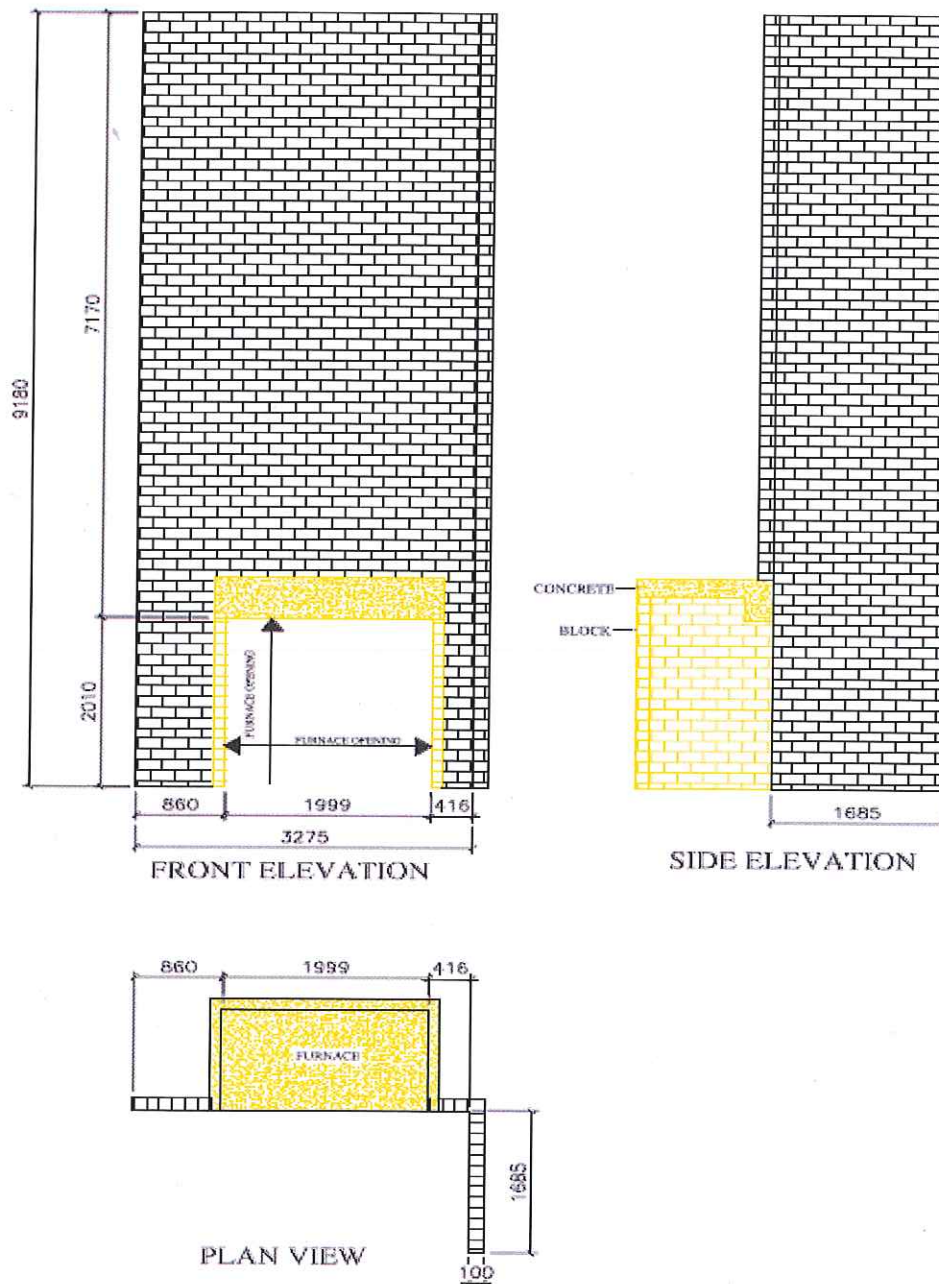


Figure 3 Thermocouple, Cavity Barrier Locations & Panel Numbering

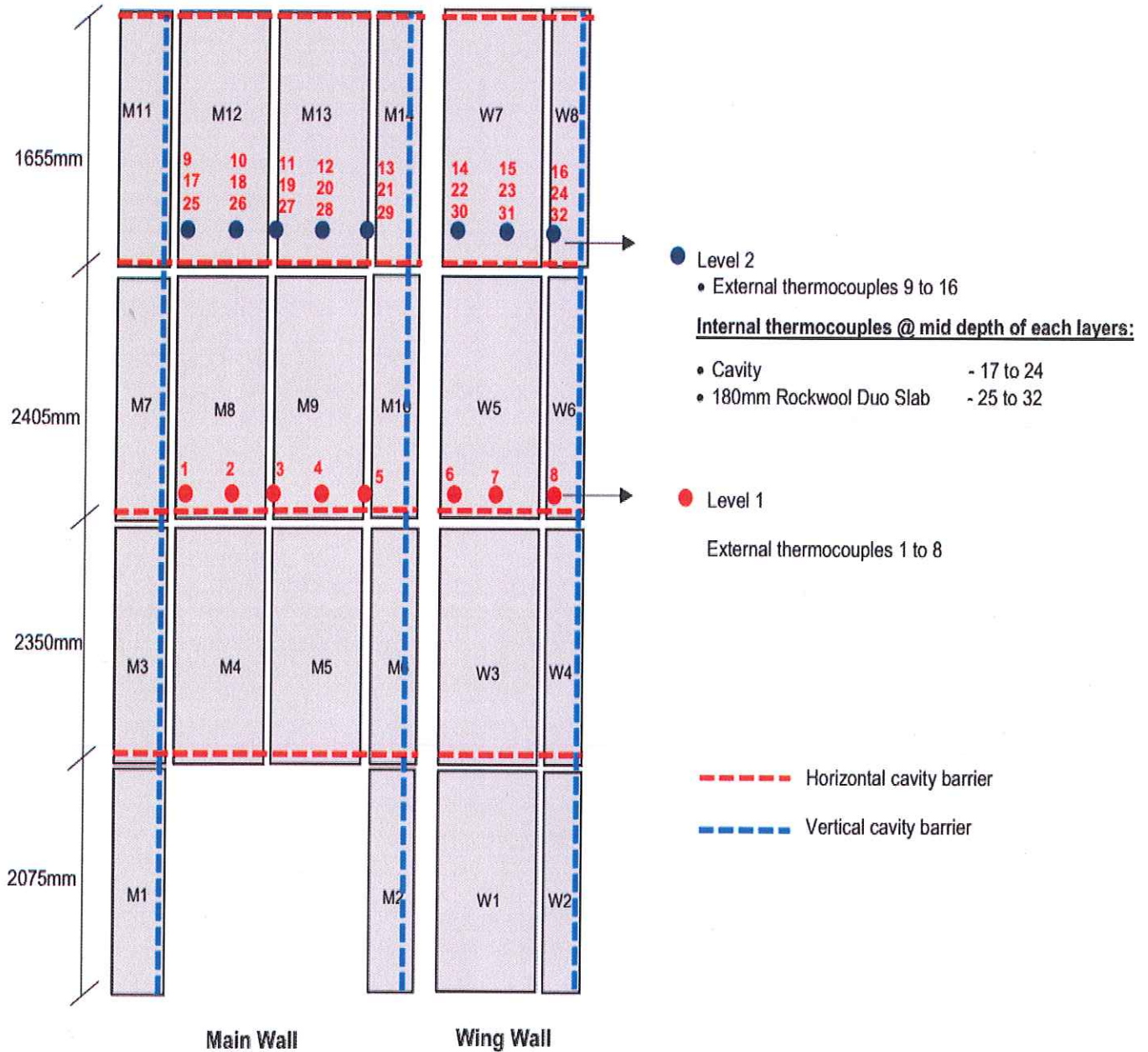
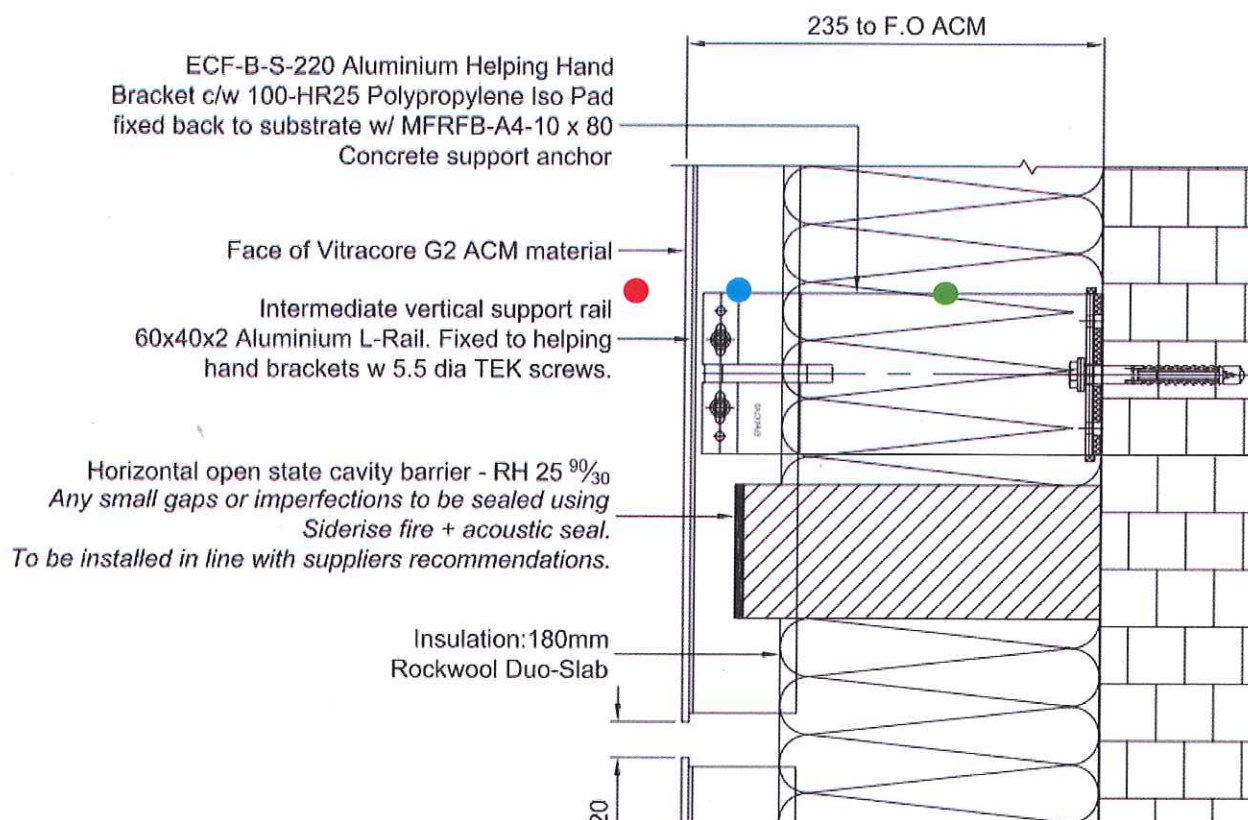


Figure 4 Level 2 Section Drawing Showing the Thermocouple Locations



- Level 2, External thermocouples 9 to 16
- Level 2, Internal thermocouples in cavity 17 to 24
- Level 2, Internal thermocouples in the insulation 25 to 32

5. Test Procedures

5.1 Testing

The environmental conditions were recorded.

The data acquisition and video recording was started 5 minutes prior to ignition of the fuel source. Then fuel source was ignited.

Significant events were recorded, including;

- changes in flaming conditions
- change in the mechanical behaviour of the cladding system
- the detachment of any part of the sample
- fire penetration through any fire stops in the cladding system

The heat source was extinguished 30 minutes after ignition. The data acquisition was continued to 60 minutes from ignition.

5.2 Post-test Examination

After the test was terminated, the sample was allowed to cool. The sample was then examined for damage, including the following.

- Spalling
- Melting
- Deformation
- Delamination
- The extent of flame spread over the surface of the cladding system
- The extent of flame spread and/or damage within intermediate layers
- An estimate of flame spread and/or damage within cavities
- The extent to which the external face of the cladding system has burnt away or become detached
- Details of any collapse or partial collapse

Smoke staining and discolouration were not considered damage in this context.

6. Test Data / Observations

Installation date: 24 to 29 June '18

Ambient temperature during installation: 28 - 38°C

Date of testing: 2 July '18.

Ambient temperature during testing: 30°C

Wind speed: 0.13 m/s

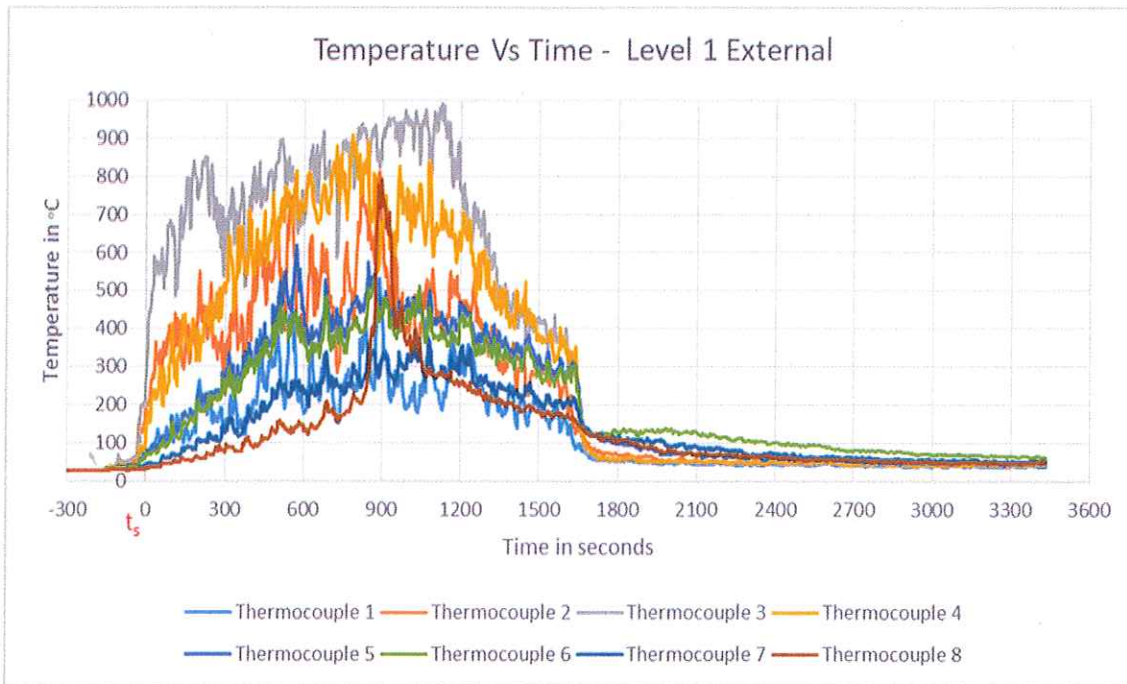
Table 3 below summarises the observations during the test.

Table 3 Visual Observations During the Test

Time	Seconds	Observation	Photo Reference
06:06:19	-	Ignition of crib	-
06:07:15	-	Flame tip reached above the combustion chamber.	-
06:09:04	00	Start time t_s , 225°C ($\geq T_s + 200^\circ\text{C}$) at thermocouple 3, Level 1 (main wall).	-
06:09:46	42	Coating of panels M4 and M5 started peeling off.	DLP C2753H/0001
06:10:40	96	Coating of panels M8 and M9 started peeling off.	-
06:11:56	172	Approximately 50% of coating of panels M4 & M5 burned.	-
06:12:46	222	Sustained flame on panels M8 and M9 vertical joint.	DLP C2753H/0002
06:13:48	284	Top aluminium skin of panels M4 and M5 melting.	-
06:14:21	317	Coating of panels W3 started peeling off	-
06:14:47	343	Panels M4 and M5 partially melted and insulation burning.	DLP C2753H/0003
06:15:48	404	Debris of panel M4 fell off.	-
06:16:08	424	Insulation behind the panel M9 burning.	DLP C2753H/0004
06:16:38	454	Approximately 40% of panels M4 & M5 melted.	-
06:16:41	457	Self-sustained flame on panels M3 and M4 vertical joint.	-
06:17:37	513	Flaming debris fell off the main wall.	-
06:18:56	592	Discolouration on panel W5.	-
06:19:46	642	Panel M9 partially melted and insulation burning.	-
06:21:12	728	Self-sustained flame on panels M12 and M13 vertical joint.	DLP C2753H/0005
06:21:25	741	Horizontal cavity barrier behind the panels M9 & M10 burning.	DLP C2753H/0006
06:22:12	788	Self-sustained flame on panels W3 and W4 vertical joint.	-

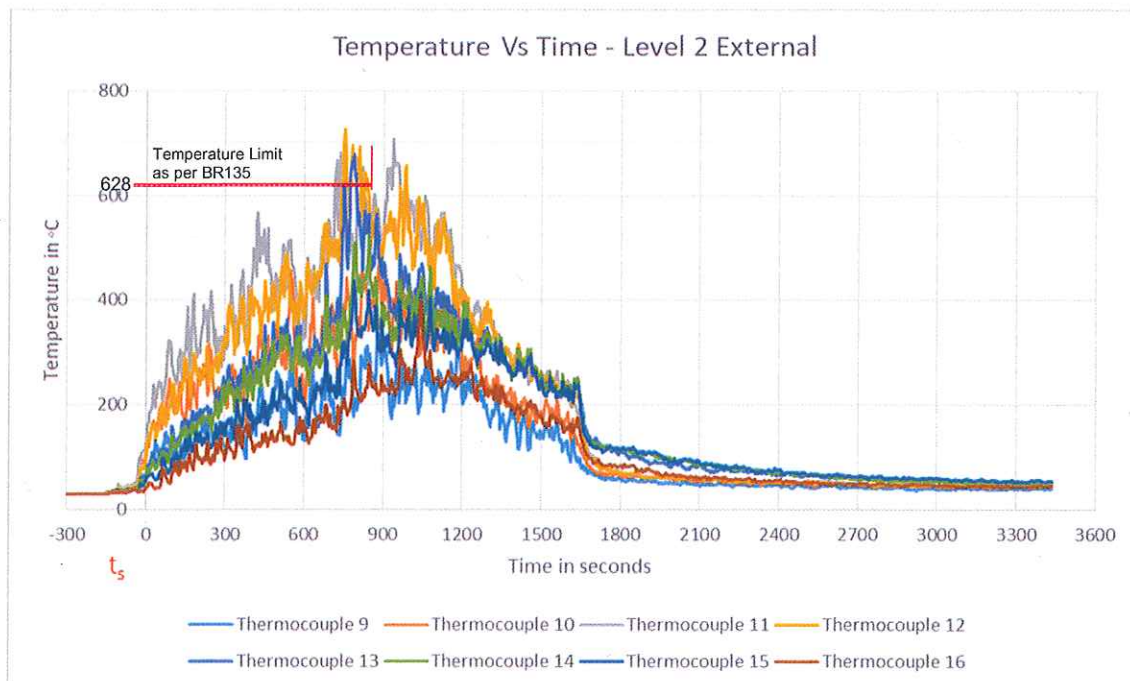
Time	Seconds	Observation	Photo Reference
06:23:03	839	Sporadic flame on panels M12, M13 and M14 vertical joints.	DLP C2753H/0007
06:23:14	850	High intensity sustained flames on panels W1, W2, W3 & W4 joints.	DLP C2753H/0008
06:24:36	932	Approximately 85% of panels M4 and M5 melted.	-
06:25:48	1004	Self-sustained flame on panels W5 and W6 vertical joint.	-
06:28:50	1186	Flame behind the panel W5.	-
06:36:19	1635	The heat source was extinguished, observation continued for another 30 minutes.	-
06:40:09	1865	All visible flames ceased. Temperature dropped.	-
07:06:19	3435	Test was terminated 60min after the ignition.	-

Figure 5 Thermocouple Readings on Level 1 - External



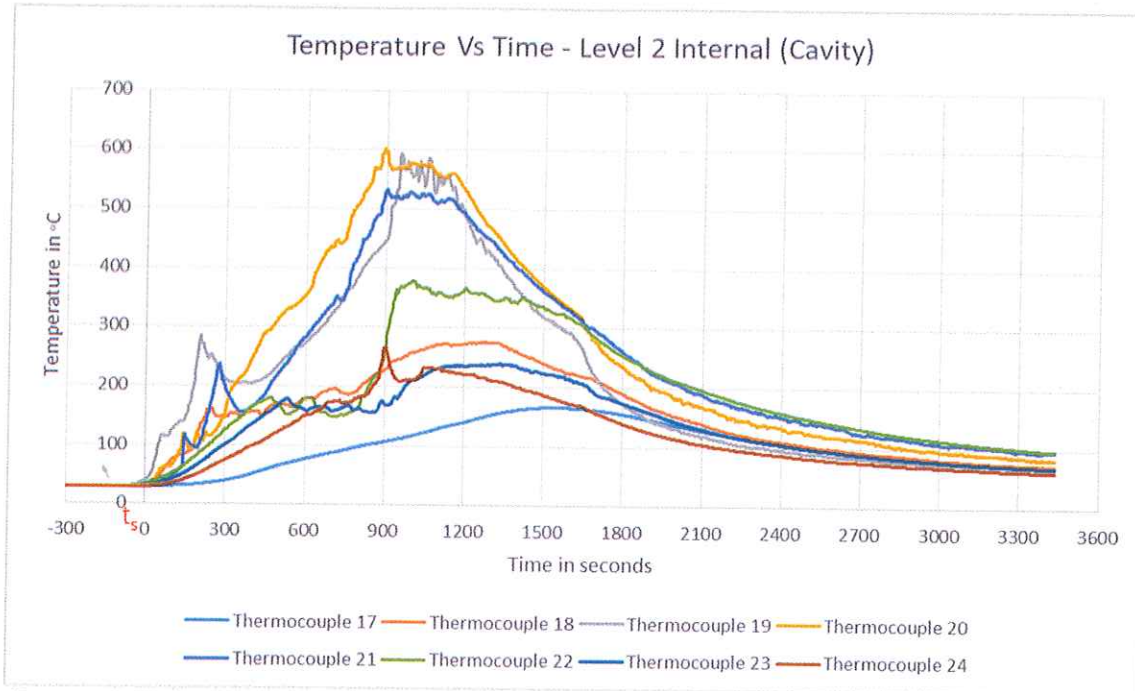
For thermocouple locations see Figure 3 & 4.

Figure 6 Thermocouple Readings on Level 2 – External



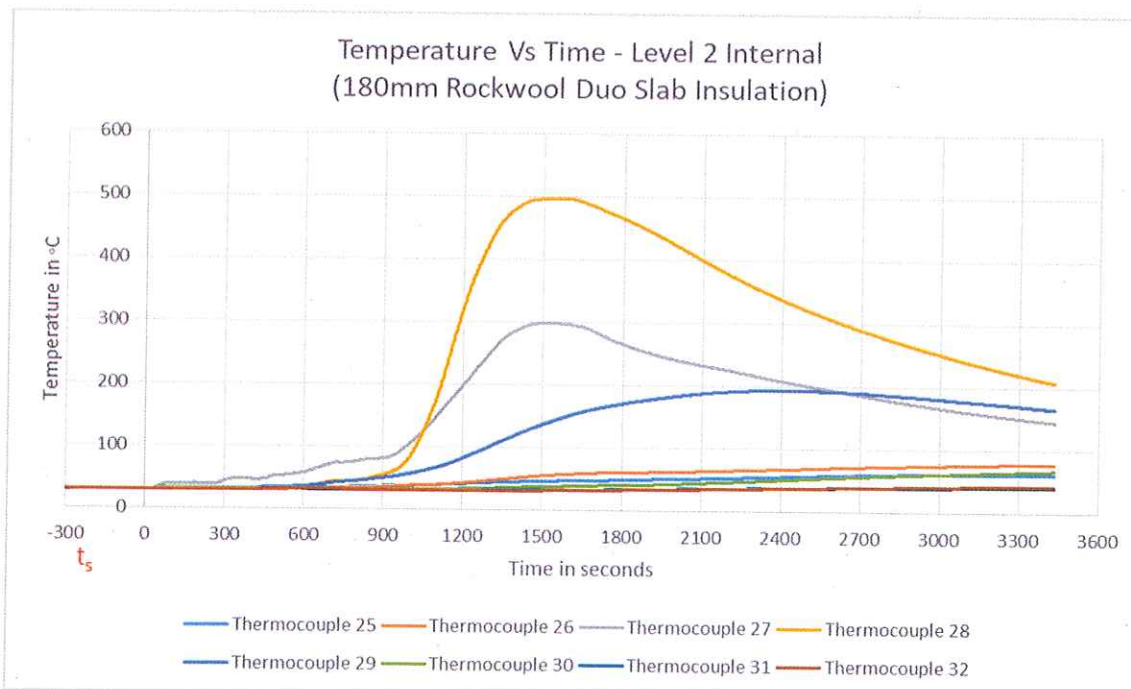
For thermocouple locations see Figure 3 & 4.

Figure 7 Thermocouple Readings on Level 2 – Internal (Cavity)



For thermocouple locations see Figure 3 & 4.

Figure 8 Thermocouple Readings on Level 2 – Internal (Mid-depth of 180mm Rockwool Duo Slab Insulation)



For thermocouple locations see Figure 3 & 4.

6.1 Post-test Examination

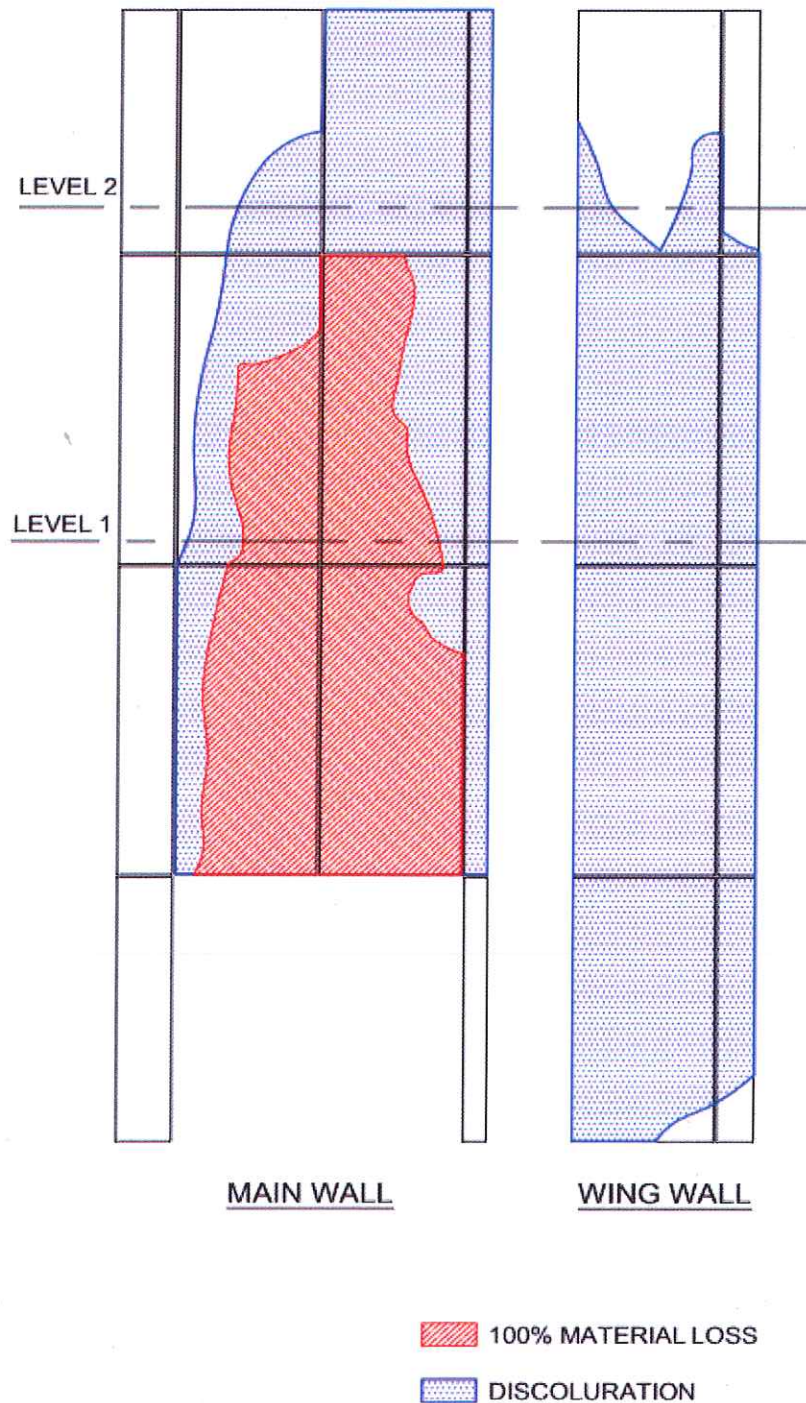
Table 5 below summarises the post-test observations.

Table 4 Post-test Observations

Sl. No.	Components	Observation	Photo Reference
1	Aluminium composite panels	<p>Panels M1 & M11–No significant changes to the panels.</p> <p>Panels M2, M6, M10 & M14– 100% discolouration of the panels.</p> <p>Panels M3 & M7 - Minor discolouration was observed at the edge. No other damage was observed</p> <p>Panels M4 & M5 – Approximately 90% of the panel was consumed and remaining area was discoloured and buckled.</p> <p>Panels M6, M10, M12 & M13 – No material loss on the panels. Discoloration was observed.</p> <p>Panels M8 & M9 - Approximately 50% of the panel was consumed and remaining area was discoloured and buckled.</p> <p>Panel M12 - Approximately 20% of the top coating of panel was burned. Discolouration observed on the remaining areas.</p> <p>Panel M13 - Approximately 80% of the top coating of panel was burned. Discolouration observed on the remaining areas.</p> <p>Panels W1, W2, W3, W4, W5 & W6 – 100% discolouration on the panels. Minor material loss observed.</p> <p>Panels W7 and W8- No material loss on the panels. Discoloration observed.</p>	<p>DLP C2753H/0009</p> <p>See Figure 9 in this section for the damaged areas.</p>
2	Cavity barrier	<p>Horizontal intumescent cavity barrier:</p> <p>Main wall:</p> <p>The 1st horizontal cavity barrier at 75mm above the combustion chamber was activated except the cavity behind M3. Material loss and damage was observed.</p> <p>The 2nd horizontal cavity barrier at 2425mm above the combustion chamber was activated except the cavity behind M7. Material loss and damage was observed.</p>	<p>DLP C2753H/0010, DLP C2753H/0012, DLP C2753H/0013, DLP C2753H/0014, & DLP C2753H/0015.</p>

Sl. No.	Components	Observation	Photo Reference
		<p>The 3rd horizontal cavity barrier at 4830mm above the combustion chamber was activated. Cavity barrier was intact and no material loss observed.</p> <p>The 4th horizontal cavity barrier at 6485mm above the combustion chamber was activated. Cavity barrier was intact and no material loss observed.</p> <p>Wing wall:</p> <p>The 1st horizontal cavity barrier at 2075mm above the ground level was activated. Minor material loss observed.</p> <p>The 2nd horizontal cavity barrier at 4425mm above the ground level was activated. Cavity barrier was intact and no material loss observed.</p> <p>The 3rd horizontal cavity barrier at 6830mm above the ground level was activated. Cavity barrier was intact and no material loss observed.</p> <p>The 4th horizontal cavity barrier at 8485mm above the ground level was activated. Cavity barrier was intact and no material loss observed.</p> <p>Vertical cavity barrier:</p> <p>Discolouration and buckling to the vertical cavity barriers on the main wall and wing wall was observed.</p>	
3	180mm Rockwool Duo Slab insulation	<p>All the insulation was in place.</p> <p>Discolouration and minor damage to the rock wool insulations on the main wall and wing wall was observed.</p>	DLP C2753H/0010, DLP C2753H/0011, & DLP C2753H/0015
4	Railing	<p>All railings behind panels M4, M5, M8 & M9 were melted off. Railings behind panels M2, M6, M10, M12, M13 & M14 were discoloured and buckled.</p> <p>All other railings were in place and no damage was observed.</p>	DLP C2753H/0014 & DLP C2753H/0015
5	Brackets	<p>All other brackets were intact. Minor damage and discolouration was observed.</p>	DLP C2753H/0011

Figure 9 Area Map Showing the Condition of the ACM Panels After the Test



- Approximately 6m² of the total external visible area was completely consumed.
- Approximately 14m² of the total external visible area was discoloured.

Appendix A

Photographs

Note: Any warp in the images is due to fish eye effect of the camera.

Pre-test Phase



DLP C2753H/1424

Helping hand brackets



DLP C2753H/1504

Cavity barriers, rock wool duo slab insulation and railings



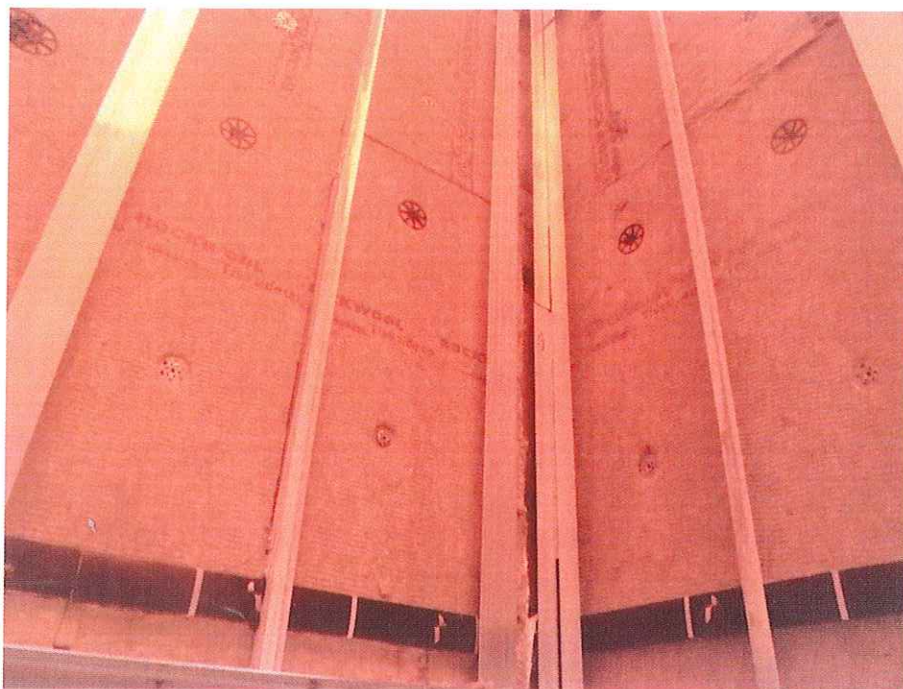
DLP C2753H/1433

Helping hand bracket and vertical cavity barrier

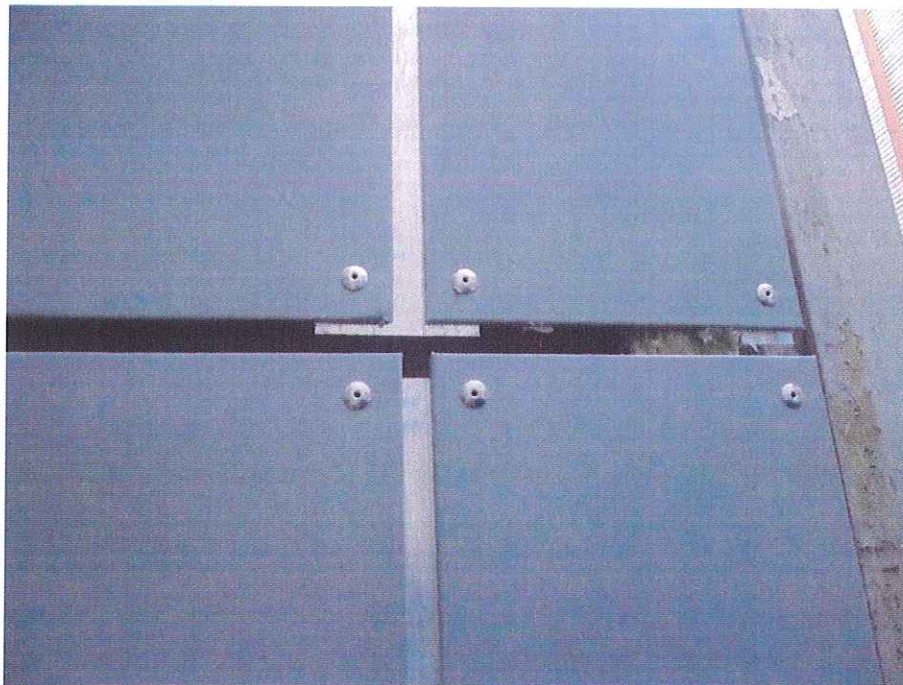


DLP C2753H/1437

Vertical and horizontal intumescent cavity barrier



DLP C2753H/1506 Rockwool Duo Slab Insulation and railings



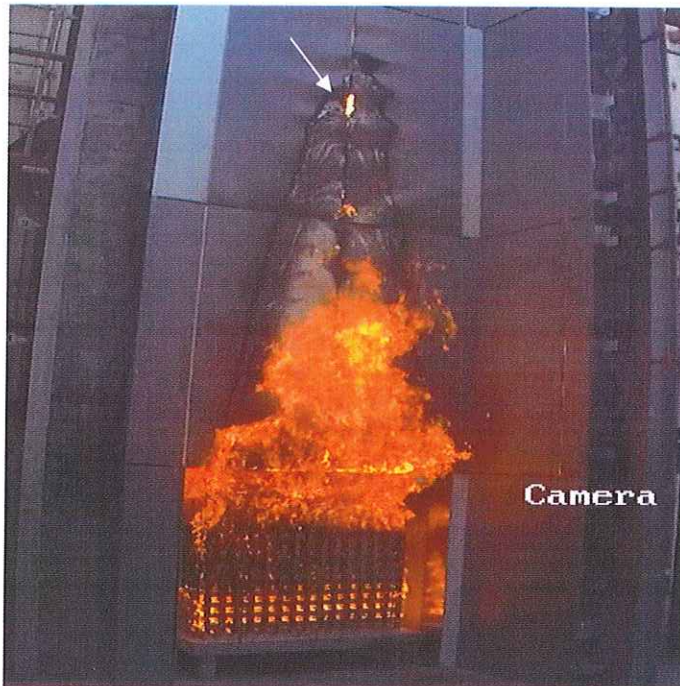
DLP C2753H/1584 Vitracore G2 composite panel fixing

Testing Phase



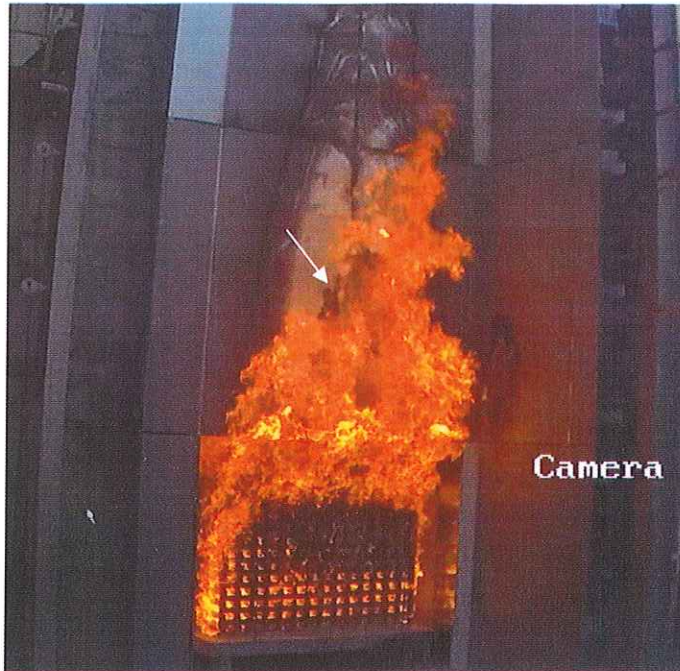
DLP C2753H/0001

Coating of panels M4 & M5 started peeling off.



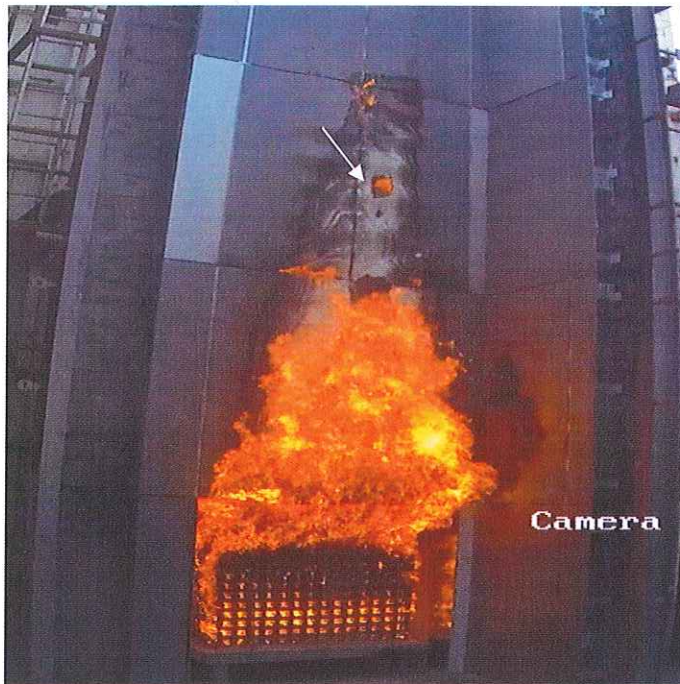
DLP C2753H/0002

Sustained flame on panels M8 & M9 vertical joint.



DLP C2753H/0003

Panels M4 & M5 partially melted and insulation burning.



DLP C2753H/0004

Insulation behind the panel M9 burning.



DLP C2753H/0005

Self-sustained flame on panels M12 & M13 vertical joint.



DLP C2753H/0006 Horizontal cavity barrier behind the panels M9 & M10 burning.



DLP C2753H/0007 Sporadic flame on panels M12, M13 & M14 vertical joints.



DLP C2753H/0008

High intensity sustained flames on panels W1, W2, W3 & W4 joints.

Post-Test Phase



DLP C2753H/0009

View of the sample after the test



DLP C2753H/0010

Cavity barrier, Rockwool Duo Slab insulation and railings



DLP C2753H/0011

Helping Hand brackets



DLP C2753H/0012 Cavity barrier at the top of combustion chamber



DLP C2753H/0013 Cavity barrier on wing wall



DLP C2753H/0014

Rockwool Duo Slab insulation and railings on main wall



DLP C2753H/0015

Rockwool Duo Slab insulation and railings on wing wall

Appendix B

Drawings

The following three un-paginated sheets are copies of Kingspan Insulation Ltd. drawings numbered:

- L8 Rev. 03
- DT8A Rev. 03
- DT8B Rev. 01

Important Notes Panels: 4mm THK Vitracore G2 System: BML400 All dimensions are theoretical and should be checked and verified prior to instruction to manufacture.
REFERENCE DRAWINGS
TEST NUMBER 8 Vitracore G2 Composite Panel with 180mm Rockwool Due-Slab Insulation.

SYSTEM: BOOTH MUIRE BML400 RIVET FIXED-20MM JOINT			
INSULATION: 180MM ROCKWOOL DUE-SLAB			
CAVITY BARRIER: SIDERISE RSV 90/30 & RH25G 90/30			
TEST	ACM	Classification - EN 13501	Finish/Colour
8	Vitracore G2 Composite Panel	A2, s1,d0	Silver Metallic

This Drawing to be read in conjunction with DT 8A + 8B.

Rev	Date	Alteration	Initial
03	20.08.18	Additional information added.	GI
02	12.07.18	Additional details added.	SC
01	05.07.18	Updated as per comments	GI
00	20.06.18	First Issue	GI

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Client:	KINGSPAN
Project:	KINGSPAN FIRE TEST DUBAI
Title:	Panel Elevations

Drawn By:	GI	Checked By:	Nick Jenkins
Scale:	1:1 @ A3	Date:	June 2018
Job No:	Test 8	Dwg No:	L8
CAD Ref:	Extn Dubai Testing	Rev:	03

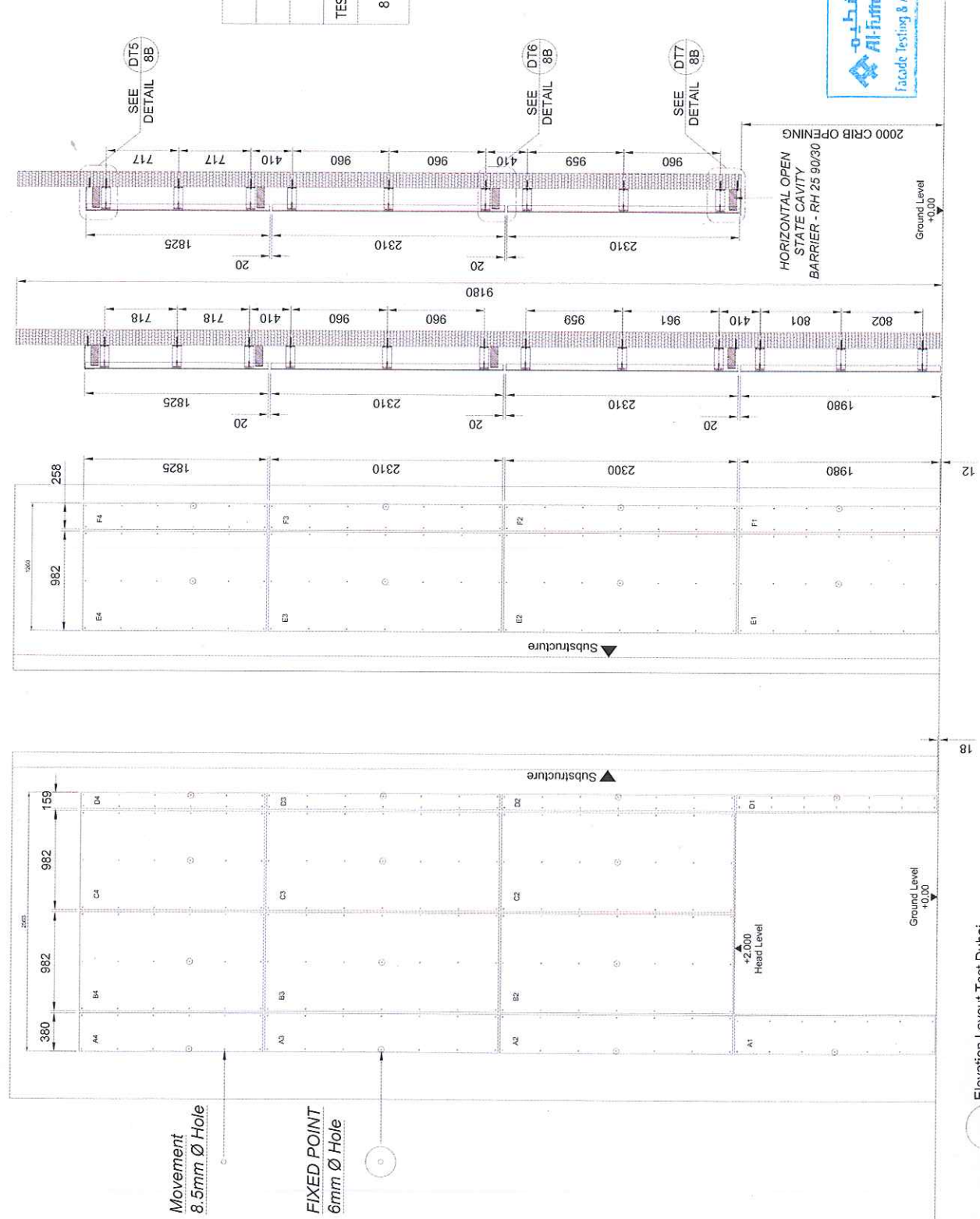
أسس الجالايل EXOVA
Al-Jalail EXOVA
Facade Testing & Advisory Services Division

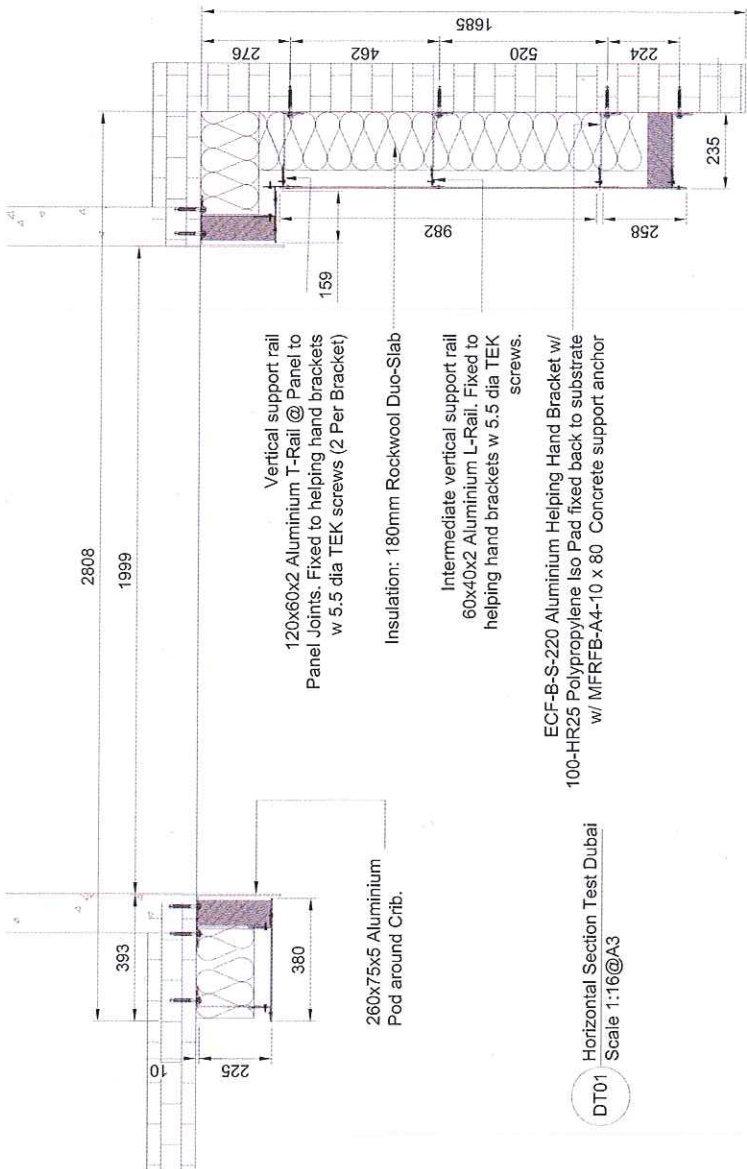
Section 2
insulation omitted
for Clarity

Section 1
insulation omitted
for Clarity

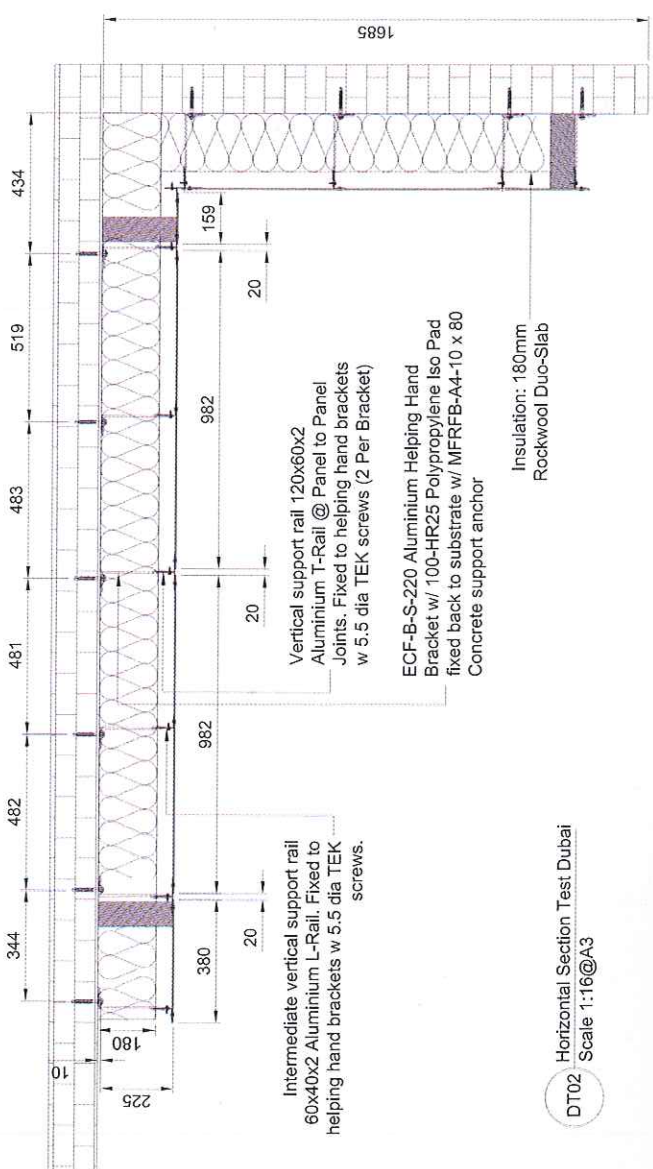
Side Elevation

Front Elevation Above Crib





DT01 Horizontal Section Test Dubai
Scale 1:16@A3



DT02 Horizontal Section Test Dubai
Scale 1:16@A3

TEST NUMBER 8

Vitracore G2 Composite Panel with 180mm Rockwool Duo-Slab Insulation.

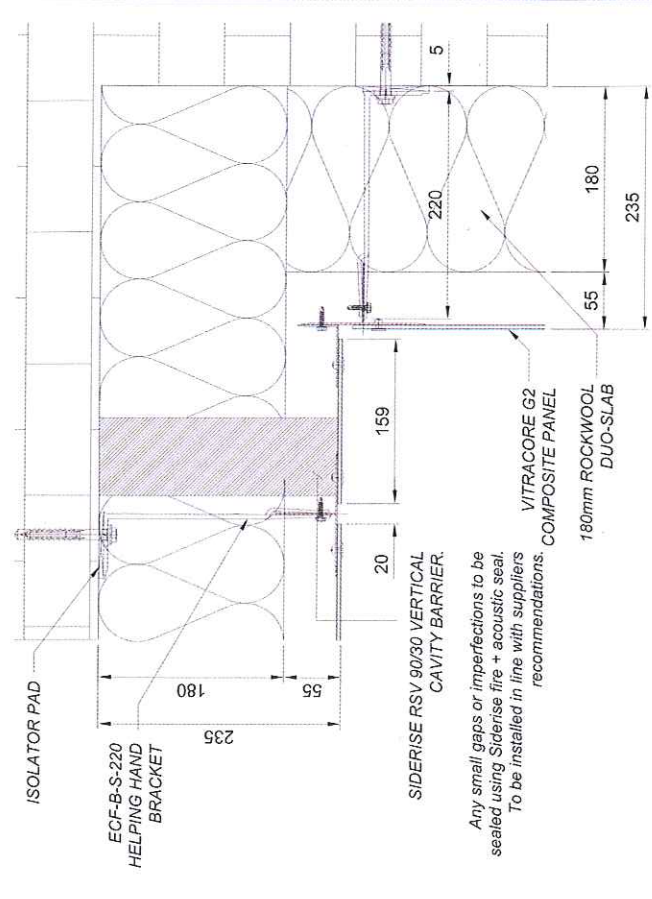
Important Notes

Panels: 4mm THK Vitracore G2 System: BML-400

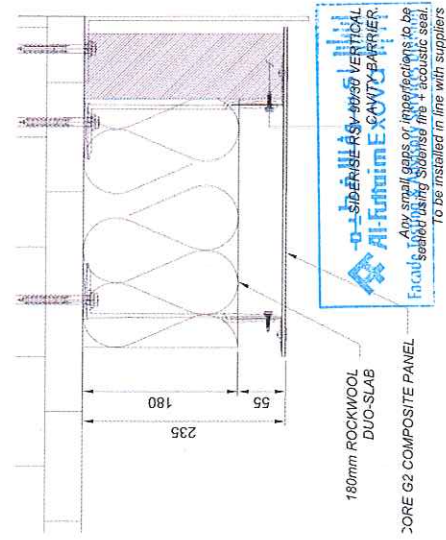
All dimensions are theoretical and should be checked and verified prior to instruction to manufacture.

REFERENCE DRAWINGS

DT03 Horizontal Section Internal Corner Test Dubai
Scale 1:5@A3



Any small gaps or imperfections to be sealed using Siderise fire + acoustic seal. To be installed in line with suppliers recommendations.



DT04 Enlarged Jamb Detail Test Dubai
Scale 1:6@A3

GI 20.09.18 Additional information added.

GI 02.05.07.18 Updated as per comments

GI 01.20.05.18 First Issue

boothmuir

Architectural Cladding Systems

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Rev Date Alteration Initial

A EUROCLAD COMPANY

Client: KINGSPAN

Project: KINGSPAN FIRE TEST DUBAI

Title: Detail A

Drawn By: GI

Checked By: Nick Jenkins

Scale: 1:6@A3 Date: June 2018

Job No: Test 8 Draw No: DT04 Rev: 03

CAD Ref: Extn Detail Test.dwg

END ADDENDUM A1

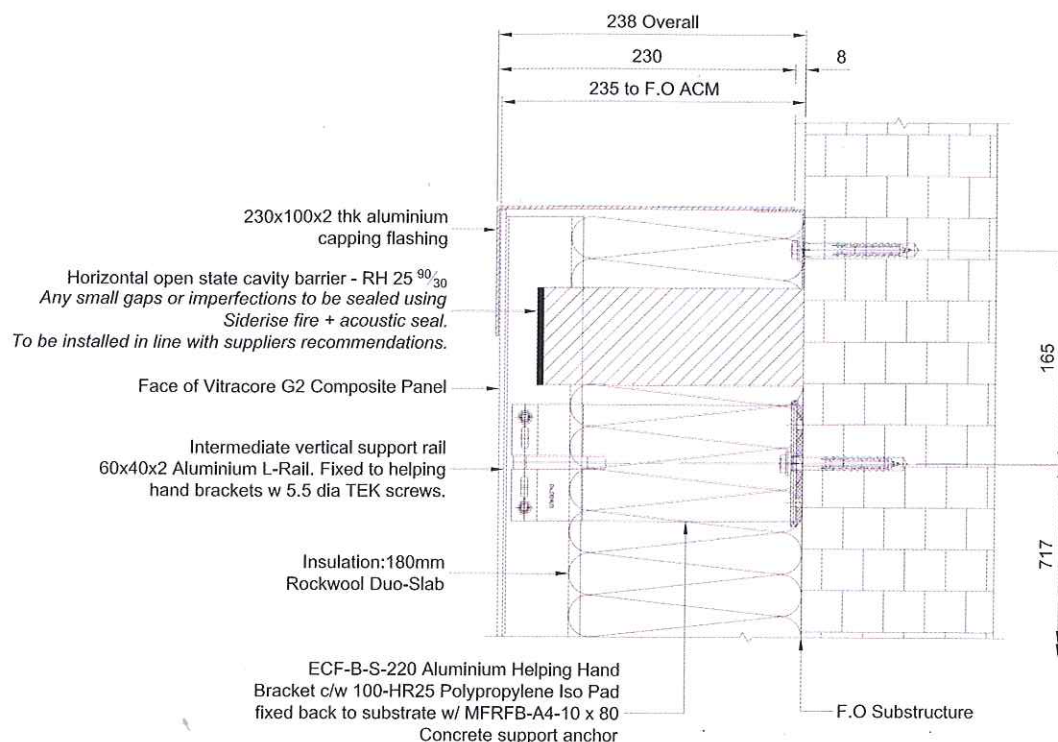
Panels: 4mm THK Vitracore G2
System: BML400

All dimensions are theoretical and should
be checked and verified prior to
instruction to manufacture.

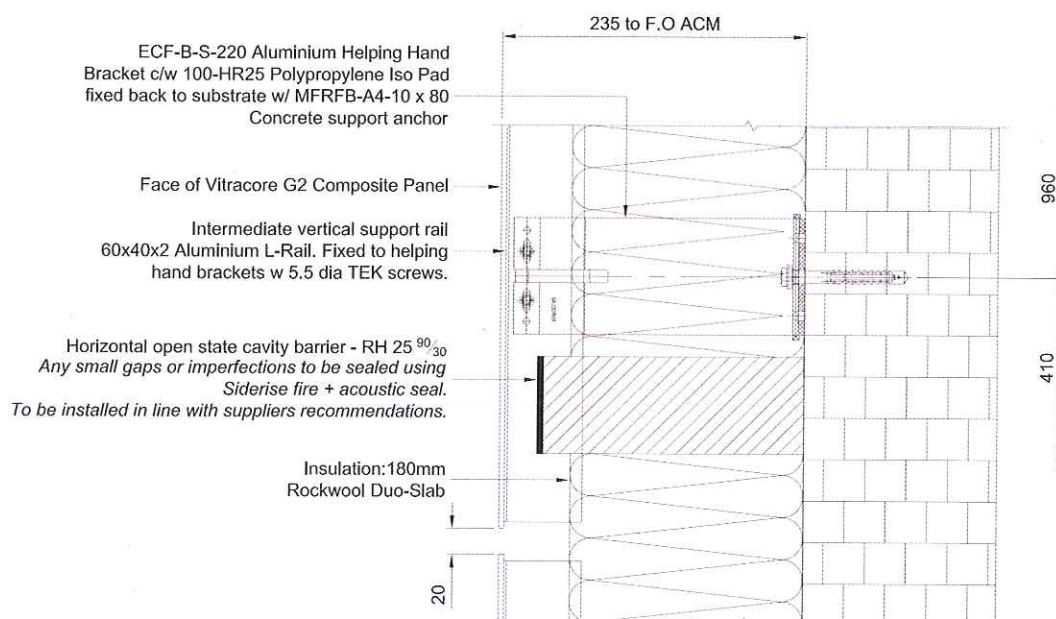
REFERENCE DRAWINGS

TEST NUMBER 8

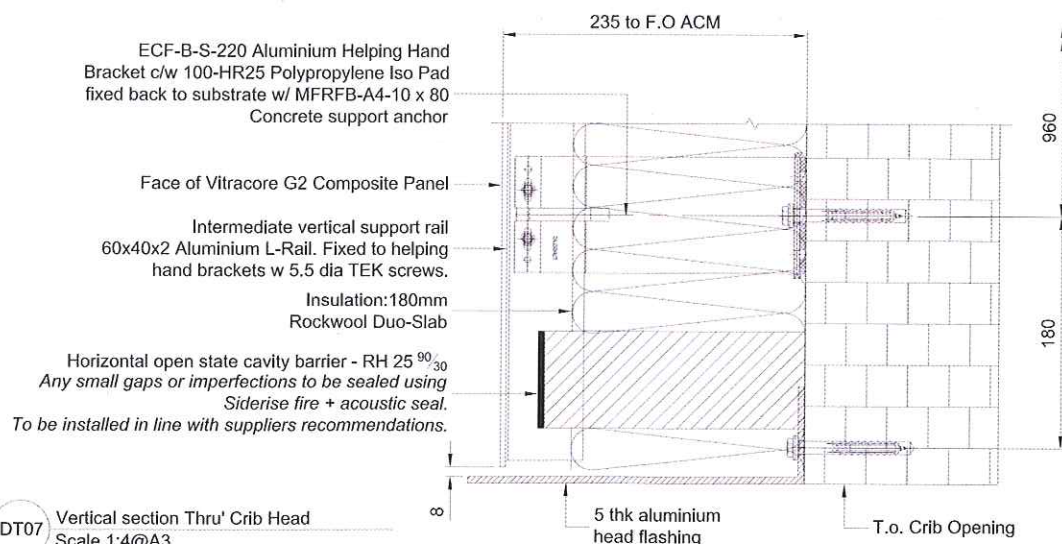
Vitracore G2 Composite Panel with
180mm Rockwool Duo-Slab Insulation.



DT05 Vertical section thru' capping
Scale 1:4@A3



DT06 Vertical section Thru' Panel to Panel Joint
Scale 1:4@A3



DT07 Vertical section Thru' Crib Head
Scale 1:4@A3

01	20.08.18	Additional Information added.	GI
00	12.07.18	First Issue	SC
Rev	Date	Alteration	Initial
boothmuirie Architectural Cladding Systems			
Calder House South Caldean Road, Coatbridge ML5 4EG T: 01236 345 500 F: 01236 345 515 W: www.boothmuirie.co.uk			
A EUROCLAD COMPANY			
Client: KINGSPAN			
Project: KINGSPAN FIRE TEST DUBAI			
Title: Details B			
Drawn By: SC		Checked By: Nick Jenkins	
Scale: See Dwg @ A3		Date: July 2018	
Job No: Test 8		Dwg No: DT8B Rev:01	
CAD Ref: Extra Dubai Test.dwg A3			
FOR APPROVAL			

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Table 5 Document Status

Rev No.	Author	Reviewed & Approved for Issue		
		Name	Signature	Date
0	Arun Kumar M	Manoj Kumar Lab. Manager		17/09/2018