

## **REACTION TO FIRE TEST REPORT No EUI - 18 - FF – 000081A**

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**Test:** EUI-18-FF-000081A

**Performed on:** 25 January 2019

**Test Standard:** **BS 8414-2:2015+A1:2017** – Fire performance of external cladding systems  
Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame

**Product:** Façade system incorporating mineral wool insulation and air cavity  
Referenced: Dri-Design with K-Roc Rainscreen Slab

**Test sponsor :** KINGSPAN Limited  
Greenfield Business Park No. 2,  
Flintshire, Holywell,  
CH8 7GJ, UK



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## 1. INTRODUCTION

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The test was carried out in accordance with BS 8414-2:2015+A1:2017 which provides a method for determining the fire performance characteristics of non-loadbearing external cladding systems fixed to and supported by a structural steel frame when exposed to an external fire under controlled conditions. The fire exposure is representative of an external fire source or a fully-developed (post-flashover) fire in a room, venting through an opening such as a window aperture that exposes the cladding to the effects of external flames, or from an external fire source.

This test report relates only to the actual specimen as tested and described in this report.

### 1.1. DETAILS OF THE TEST

This report describes the reaction to fire test performed at Efectis UK/Ireland Ltd (EUI) fire laboratory located on Shore Road, Newtownabbey in Northern Ireland, UK

at the request of:

KINGSPAN Limited  
Greenfield Business Park No. 2,  
Flintshire, Holywell,  
CH8 7GJ, UK

EUI Job number: EUI-18-000081

Test date: 25 January 2019

Test method: in accordance with BS 8414-2:2015+A1:2017

Deviations:

- Thermocouples were installed to proposing locations according to BR 135:Fire performance of external thermal insulation for walls of multistorey buildings.

The test was witnessed by: Mr. Nick Jenkins, Mr. Darren McCaffrey of Kingspan Ltd.

## 2. DESCRIPTION OF THE TESTED PRODUCT

### 2.1. DESCRIPTION OF SUBSTRATE

The tested specimen was fixed to the external face of Efectis UK/Ireland Ltd large scale testing steel frame constructed in accordance with BS 8414-2:2015+A1: 2017.

### 2.2. DESCRIPTION OF PRODUCT TESTED

The cladding system prior to fire test is shown in Figure 4.9 of Appendix 4. Full details of the system have been provided by the client and are summarised in the following section. All materials used in detail are provided in section 2.6.

The tested cladding system build up is given in order from steel frame (Efectis testing frame) to the external face of the facade:

- Two layers of 15 mm Knauf Wallboard (GYPROC Saint-Gobain)
- Air and vapour control layer of Airguard control membrane (DuPont)
- Steel frame system of steel 'C' sections with 100 mm x 50 mm studs
- Earthwool Omni fit slab insulation (KNAUF) of 100 mm thickness fitted in between the studs
- Sheathing board Y-wall (RCM) of 12 mm thickness
- Breather membrane TYVEK FireCurb (DuPont)
- Two layers of Kingspan K-Roc Rainscreen slab insulation of 100 mm thickness
- Siderise RH25G 90/30 (Siderise) Horizontal open state cavity barrier (No.4)
- Siderise RV 90/30 (Siderise) Vertical open state cavity barrier (No.3)
- Air cavity 38 mm thick, measured between insulation and Omega profiles
- Dry-design aluminium cassette of 2 mm thickness, of PPC Dark copper colour as finishing on the outer face.

The top and sides of the specimen were closed using 2 mm aluminium cap flashings. Drawings of the system and photographs of system during construction can be seen in Appendix 1-2.

### 2.3. INSTALLATION OF SPECIMEN

All test materials were supplied and installed by the sponsor. Efectis UK/Ireland were not involved in the sample selection process and therefore cannot take any responsibility for the relationship between samples supplied for testing and product placed on the market.

Drawings in Appendix 1 were supplied by the test sponsor and checked by the EFECTIS UK/Ireland laboratory during the mounting and were found compliant with the tested product.

### 2.4. INSTALLATION SEQUENCE

#### 2.4.1. Frame

The steel frame was constructed using 'C' section channel stud reference C100060120 (STEEL FORMED SECTIONS). Studs of dimensions 100 mm x 50 mm x 1.2 mm were fixed to the head and the base track at 300 mm and 600 mm centres using screws reference CFC26 Tek Screws of Ø 5.5 mm x 25 mm dimensions. The head track and the base track were made using rails references U104067180 and U104055120 (STEEL FORMED SECTIONS) respectively. The steel frame was fixed using fixings reference Multi-Monti-S-7.5x75 of Ø 7.5 mm x 75 mm dimensions to the concrete slabs of the testing rig, with outer face of the steel frame being 20 mm far from the face of the concrete slabs.

#### 2.4.2. Insulation fitted within the frame

Within the steel stud frame earthwool insulation reference Omni Fit SLAB (KNAUF) of 100 mm thickness was fitted covering all areas between the stud frames.

### 2.4.3. Unexposed face of the facade

#### 2.4.3.1. Vapour barrier

A vapour and air control layer reference AirGuard (DuPont) and thickness 0.3 mm was installed on the unexposed face of the frame. All joints and overlaps were covered using a tape reference Tyvek Acrylic tape (DuPont).

#### 2.4.3.2. Plasterboard

Two layers of plasterboards reference WallBoard (KNAUF) dimensions 2400 mm x 1200 mm and thickness 12.5 mm were installed on top of the vapour barrier on the unexposed face of the frame. The plasterboards were fixed to the steel 'C' studs using fixings reference SXS/18-S16-5.5x41A4 of Ø 5.5 mm x 41 mm dimensions evenly spaced at approx. 150 mm centres. The two layers were installed with 600 mm overlaps.

### 2.4.4. Exposed face of the facade

#### 2.4.4.1. Sheathing boards

One layer of sheathing boards reference Y-wall (RCM) of dimensions 2400 mm x 1200 mm and thickness 12 mm were clad on the exposed face of the frame using fixings reference SXS/18-S16-5.5x41A4 of Ø 5.5 mm x 41 mm dimensions. Screws were evenly spaced and fixed at 500-600 mm centres. Additionally, a vapour control sealing tape reference Cortex 0750 (OBEX) was used on the joints of sheathing boards and slabs for sealing the interface of slab edges.

#### 2.4.4.2. Underlay membrane

An underlay membrane reference Tyvek FireCurb (DuPont) of thickness 0.175 mm was installed on top of the sheathing board layer. All joints and overlaps were covered using a tape reference Tyvek Acrylic tape (DuPont).

#### 2.4.4.3. Fire stop barrier

Horizontal and vertical fire stop barriers were installed on the underlay membrane. The fire barriers reference Siderise RH25G 90/30 (Siderise) thickness 75 mm and width 273 mm were compressed by 10 mm by the cladding. They were fixed using specific system brackets.

A set of no. 3 vertical fire barriers were installed also on the sheathing board layer. Two of them were placed next to combustion chamber opening vertical sides (65mm from chamber opening to C/L) and the third one on the wing face of the façade system (180mm to C/L from the angle).

A set of no. 4 horizontal fire barriers were installed on the entire width of the facade and it's wing at height of:

2240 mm; above the floor level  
2540 mm above the floor level in line with 1<sup>st</sup> concrete slab  
5540 mm above the floor level in line with 2<sup>nd</sup> concrete slab  
8605 mm above the floor level in line with 3<sup>rd</sup> concrete slab

#### 2.4.4.4. Brackets

Brackets reference KSF-B-S-220 Helping Hand brackets (KSF) were installed on the sheathing board layer using screws reference SX5/38-S16-5.5x61A4 of Ø 5.5 mm x 61 mm dimensions. Those brackets were combined with isolation pad sheets placed between the bracket and the sheathing board. On the main face the horizontal spacing between the brackets varied between 290 mm (up to combustion chamber full height level) and 600 mm (above combustion chamber level) and on the wing wall the spacing between the brackets was approximately 600 mm. The vertical spacing between the brackets varied between 100 mm (where the 1<sup>st</sup> horizontal barrier was installed on the main face) and 850 mm on the rest areas.

#### 2.4.4.5. Insulation

Insulation combining two layers of mineral wool reference K-Roc Rainscreen Slab and thickness 100 mm was fixed to the sheathing board layer, over the helping hand brackets, following pattern as specified by manufacturer's details.

#### 2.4.4.6. Outer face

On the helping hand brackets, aluminium rails of 'T' and 'L' shape profiles were fixed using screws reference SX5/8-S16-5.5x31A4 of Ø 5.5 mm x 31 mm dimensions.

For supporting the outer face panels, horizontal Omega profiles reference A-H12202520 of dimensions 122mm x 25mm x thickness 2mm and 'Z' profiles reference A-Z08102525 of dimensions 40 mm x 25 mm x 40 mm of thickness 5 mm were fixed on the aluminium 'T' and 'L' profile rails using screws reference SX5/8-S16-5.5x31A4 of Ø 5.5 mm x 31 mm dimensions.

Finally, the outer face cassettes reference Dri-Design cassettes (Kingspan) were clad on the Omega fixed to the Z profiles using rivets reference SSAL 4818 of Ø 4.8 mm x 18mm dimensions. The cassettes were made by aluminium having thickness of 2 mm. The colour of the cassettes was PPC Dark Copper as specified by the manufacturer. All cassettes were in dimensions as shown in Figure A1 of Appendix A according to sponsor's drawing.

#### 2.4.4.7. Air gap

A continuous air gap layer of 38 mm was managed between the insulation and the inside of the Omega rails. The air gap was blocked where the vertical fire barriers were installed and reduced to 25 mm in the location of the horizontal fire barriers.

#### 2.4.5. Flashings and closures

The side edges of the façade system were closed with 'L' shape aluminium closure flashing thickness 2 mm. The flashings were secured directly on the sheathing board layer using screws reference SX5/8-S16-5.5x31A4 of Ø 5.5 mm x 31 mm dimensions, running along the full height of both sides. The dimensions of the flashings were 263 mm x 50 mm.

The top edge of the façade system was closed using an aluminium top cap flashing of 'L' shape with dimensions 295 mm x 76 mm and thickness 2 mm. The top cap flashing was secured on the top concrete slab using 'L' shape channel and screws reference SX5/8-S16-5.5x31A4 of Ø 5.5 mm x 31 mm dimensions.

In line with the opening of the combustion chamber a frame made of double layer plasterboards reference WallBoard (KNAUF) thickness 15 mm was installed on the steel stud construction using screws reference SX5/18-S16-5.5X41A4 of Ø 5.5 mm x 41 mm dimensions. The plasterboards were extended along the thickness of the unexposed face and the steel frame, being flushed with the exposed face of the sheathing board layer.

A pre-fabricated aluminium pod frame of 'L' shape thickness 5 mm was fixed onto the sheathing board layer with screws reference SX5/18-S16-5.5X41A4 of Ø 5.5 mm x 41 mm dimensions. The dimensions of the pod frame were 305 mm x 75 mm.

#### 2.4.6. Joints

The cassette panels were installed so that there was a vertical joint central to the combustion chamber running the full height of the system. The width of the joint was 15 mm.

Horizontal joints of 14 mm width were resulted by the way the cassettes were clad, with one of them being at 2400 mm above the combustion chamber.

At each floor level, a movement/expansion joint was managed on the slab edges.

## 2.5. DIMENSIONS OF THE TEST SPECIMEN

In accordance with the requirements of the BS 8414-2:2015+A1: 2017, the cladding system measured:

Test requirement	Actual measurement
shall extend horizontally from the finished corner of the test sample, at least 2 400 mm on the main test face	2496 mm
shall extend horizontally from the finished corner of the test sample, at least 1 200 mm on the wing	1279 mm
shall extend from the base of the test apparatus to a height of at least 6 000 mm above the top of the combustion chamber opening on both faces	6615 mm
allow a distance of (260 ±100) mm from the side of the opening of the combustion chamber to the finished face of the test specimen	185 mm
Allow unobstructed the combustion chamber opening (Width x Height) of (2 000 ±100) x (2 000 ±100)	1900 mm x 2025 mm

## 2.6. SUMMARY OF MATERIALS USED

Based on the information provided by the test sponsor, the materials as used on the as-built façade system are given in the following table.

Material	Reference	Composition	Characteristics	Supplier
Steel Formed Sections - studs	Steel Formed Sections – Code: C100060120	gauge steel	100 mm x 50 mm x 1.2 mm thick	Steel Formed Sections
Steel Formed Sections – Head Track	Steel Formed Sections – Code: U104067180	gauge steel	104 mm x 50 mm x 2 mm thick	Steel Formed Sections
Steel Formed Sections –Base Track	Steel Formed Sections – Code: U104055120	gauge steel	104 mm x 50 mm x 1.2 mm thick	Steel Formed Sections
Insulation fitted within the steel frame	Omni Fit SLAB	Glass mineral wool	100 mm thick Reaction to fire: A1	KNAUF
Vapour/Air control barrier	AirGuard	PP with a Ethylene-Butylacrylate Copolymer coating	0.3 mm thickness Reaction to fire: E	DuPont
Tape for sealing joints of membranes	Tyvek Acrylic	made of durable Tyvek HDPE and acrylic adhesive	White colour	DuPont
Plasterboards of non-exposed face (no. 2 layer)	WallBoard	Gypsum board with ivory paper face	2400 mm x 1200 mm x 12.5 mm thick Reaction to fire: A2	KNAUF
Sheathing Board	Y-Wall	Calcium Silicate Board	2400 mm x 1200 mm x 12 mm thick	RCM
Vapour control tape	Cortex 0750	EPDM membrane	Thickness: 0.75 mm Reaction to fire: E	OBEX
Underlay membrane	Tyvek FireCurb	flash-spun-bond HDPE with transparent halogen-free flame retardant acrylic lacquer	0.175 mm thickness Reaction to fire: B-s1, d0	DuPont

Horizontal fire barriers	Siderise RH25G 90/30	Non-combustible stone-wool lamella core, with reinforced aluminium foil face c/w intumescent	75 mm x 273 mm Reaction to fire: A1	Siderise
Vertical fire barriers	Siderise RV 90/30	Non-combustible stone-wool lamella core, with reinforced aluminium foil face	75 mm x 273 mm Reaction to fire: A1	Siderise
Helping hand brackets c/w iso-pad sheets	KSF-B-S-220	Made of aluminium EN-AW 6060 T68	Bracket height 220 mm	KSF
Insulation of exposed face (no. 2 layer)	Kingspan K-Roc Rainscreen Slab	Soft and rigid stone mineral wool slab	100 mm thickness Reaction to fire: A1	Kingspan
Rails	a) 'T' and 'L' shape profiles b) Omega profiles c) Z profiles	Aluminium	-	-
External façade cladding	Benchmark Dri-Design cassettes	Aluminium	2 mm thickness Face colour: PPC Dark Copper Aluminium has Class 1 surface spread of flame to BS 476-7:1987, and are Class 0, as defined by building regulations	Kingspan
Flashings and closures	-	Aluminium	2-5 mm thickness	-
Screws used for installation of the frame	CFC26 Tek Screws	Stainless Steel	5.5 mm x 25 mm	-
Screws for fixing the frame on the concrete slabs	Multi-Monti-S-7.5x75	Galvanised screw	7.5 mm x 75 mm	-
Screws for fixing plasterboards on the frame	SXS/18-S16-5.5x41A4	-	5.5 mm x 41 mm at 150 mm centres	-
Screws for fixing sheathing boards on the frame	SXS/18-S16-5.5x41A4	-	5.5 mm x 41 mm at 150 mm centres	-
Screws for fixing the hand brackets on the sheathing boards	SX5/38-S16-5.5x61A4	-	5.5 mm x 61 mm	-
Screws for fixing the rail system	SX5/8-S16-5.5x31A4	-	5.5 mm x 31 mm	-
Rivets used for cladding the cassettes on the rail system	SSAL 4818	-	4.8 mm x 18 mm	-
Screws for fixing flashings	SX5/8-S16-5.5x31A4	-	5.5 mm x 31 mm	-
Screws for fixing closure and pod frame	SX5/18-S16-5.5x41A4	-	5.5 mm x 41 mm	-



### 3. TEST DETAILS

#### 3.1. CONDITIONING

In accordance with paragraph 7 of BS 8414-2:2015+A1: 2017 the hygrometric stability of the specimen was reached for the test as according to material and sponsor specifications no curing time needed.

Mounting : from 14 January 2019 to 24 January 2019  
Curing period : from 24 January 2019 to 25 January 2019  
Test : 25 January 2019

The specimen was installed, conditioned and tested indoors thus protected from adverse environmental conditions such as water, windload and ambient temperatures outside the range - 5 °C to +40 °C during the application, curing and test period.

#### 3.2. THERMAL PROGRAM

In accordance with annex A of the standard BS 8414-2:2015+A1: 2017, a wood crib acted as a fuel source. The crib comprised:

- 100 long sticks dimensions  $50 \pm 2 \times 50 \pm 2 \times 1\,500 \pm 5$  mm ;
- 150 short sticks dimensions  $50 \pm 2 \times 50 \pm 2 \times 1\,000 \pm 5$  mm ;
- 16 strips of low density fibreboard having nominal dimensions of  $25 \times 12 \times 1\,000$  mm.

Low density fibreboard was soaked inside a container filled with 5 litres of white spirit for at least 5 minutes prior to the test.

Sticks were cut from Scots pine (*Pinus sylvestris*) with the average density of  $460.6 \pm 32.6$  (dry basis). Wood was stored inside the lab prior to the test reaching average moisture content prior to the test of  $11.3 \pm 0.8$  %.

### 4. APPARATUS

Efectis UK.Ireland Ltd erected a large steel frame based on recommendations given in Annex B of BS 8414-2:2015+A1: 2017. Dimensions and layout of the steel frame are given below. Moreover, a combustion chamber was constructed for wood crib. Details are shown in Figures 1-3.

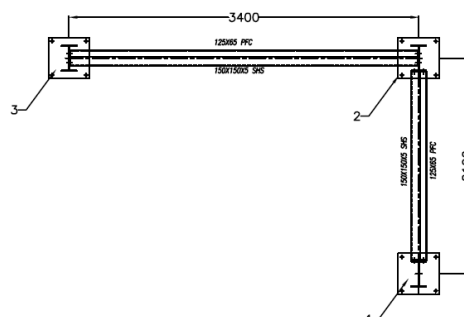


Figure 1. Top view of Efectis UK/Ireland test frame

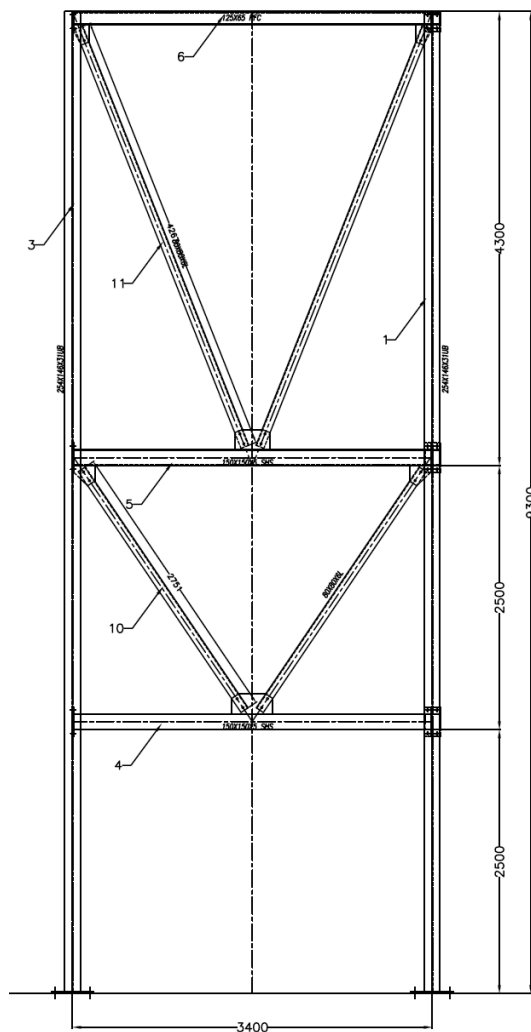


Figure 2. Front view of Efectis UK/Ireland test frame

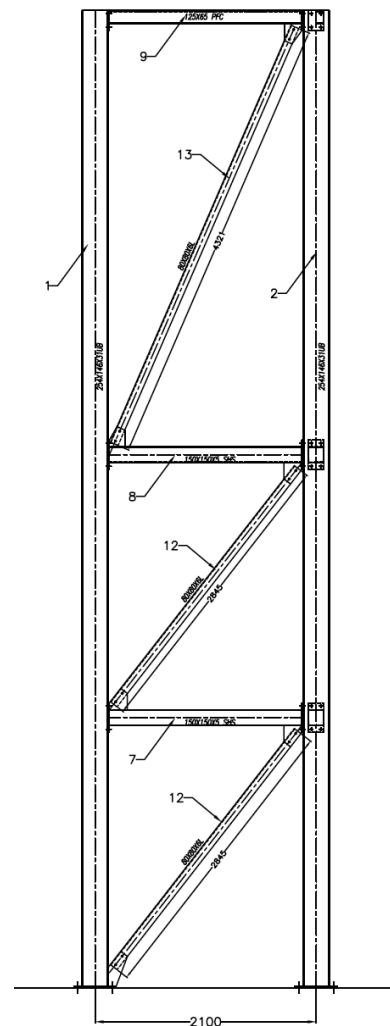


Figure 3. Side view of Efectis UK/Ireland test frame

## 5. INSTRUMENTATION

After the application of the system on the test frame the specimen was instrumented with Ø 1.5 mm calibrated mineral insulated thermocouples to monitor the specimen temperature. Their positions are shown in Appendix No 2. The thermocouples were attached to the test specimen by the staff of the test Laboratory EFFECTIS UK/Ireland.

The thermocouples were Type 'K' (nickel / chrome, nickel / aluminium) and were therefore suitable for continuous use at temperatures up to 1100°C. Each thermocouple was connected to the data logger, and the signal was recorded at intervals of 6 s.

The temperatures recorded are shown in Figure 3.1 to 3.7, in Appendix No 3.

Location	Markings
External thermocouples at level 1 (Main face)	Chan 1 to 5
External thermocouples at level 1 (Wing face)	Chan 6 to 8
External thermocouples at level 2 (Main face)	Chan 9 to 13
External thermocouples at level 2 (Wing face)	Chan 14 to 16
Internal thermocouples (Main face), midpoints inside the cavity, at level 2	Chan 17 to 21
Internal thermocouples (Wing face), midpoints inside the cavity, at level 2	Chan 22 to 24
Internal thermocouples (Main face), midpoints inside the K-Roc Rainscreen Slab insulation, at level 2	Chan 25 to 26
Internal thermocouples (Main face), midpoints inside the sheathing board layer, at level 2	Chan 27 to 28
Internal thermocouples (Main face), midpoints inside the Omni Fit SLAB insulation, at level 2	Chan 29 to 30
Internal thermocouples (Main face), midpoints inside the plasterboard WallBoard layer, at level 2	Chan 31 to 32

## 6. TEST RESULTS

### 6.1. TEST CONDITIONS

- Ambient temperature before the test: 13°C
- Ambient humidity before the test: 61%
- Wind speed: tested indoors, 0.2 m/s

### 6.2. TEMPERATURE PROFILES

Figures 3.1 to 3.7 in Appendix No.3 show temperature history during the test. Summary of the temperature data is shown in table below.

Parameter	Result
Start temperature – $T_s$	14.17°C
Start time - $t_s$	78 sec after ignition of the crib (10.1 min after datalogging started)
Peak temperature/time at Level 2, external	431.5°C at 18.3 min, TC at Chan11
Peak temperature/time at Level 2, internal	586.9°C at 26.3 min, TC at Chan19

### 6.3. VISUAL OBSERVATIONS DURING THE TEST

Height observation are given relative to the top of combustion chamber. For cladding face numbering refer to Figure 4.10a-4.10b in Appendix 4. If not mentioned otherwise, the heights reported below refer to centre line of the combustion chamber.

Time from ignition (min:sec)	$t_s$ (min:sec)	Observation
00:00		Ignition of crib
00:30		Black smoke visible
00:50		Flames from the chamber started to impinge on façade system
01:18	00:00	Start time ( $t_s$ ) threshold achieved. External temperature at level 1 (2.5 m above the top of combustion chamber) $\geq 213^\circ\text{C}$ ( $T_s+200^\circ\text{C}$ ) at thermocouple Chan 3 .
02:26	01:08	Flame tip reached Level 1
04:38	03:20	Flame tip reached A9-B9 height on the main face

		Minor discoloration of A1 to A5 and B1 to B5 panels
06:14	04:56	Major discoloration of A1 to A5 and B1 to B5 panels
07:00	05:42	Expansion of vertical joint between panels A1 to A3 and B1 to B3
07 :45	06:27	Hole opened on A2 panel-flames coming through
08 :15	06:57	Holes opened in B1 to B3. Panels started melting Discoloration of C1 panel
08 :32	07:14	Flames on the wing face of the façade – C1 panel on flames
08 :46	07:28	Holes opened in A3 to A5 and B1 to B4 panels
09 :00	07:42	Pod frame of combustion chamber bended Discoloration of C2 and C3 panels
09:22	08:04	Aluminium melting on panels A1 to A5 and B1 to B4 Flames passing over the two bottom fire barriers
09 :40	08:22	Discoloration of A6, A7, B6 and B7 panels
10:00	08:42	Parts of panels A1 to A4 and B1 to B4 fell down Flame observed on C2 panel
11:03	09:45	Horizontal joint between C1 and C2
13:20	12:02	Parts of bottom fire barrier fell down Panels A6 and B6 melted
16:00	14:42	Joint between panels C1 and C2 expanded
16:15	14:57	Flames reached A7-B7 panel height A7 and B7 panels melted
17:56	16:38	Part of bottom fire barrier behind panel B1 fell down
19 :00	17:42	Flames coming through panel A8 Discoloration of C4 Side flashing closure of wing face bended on height of C2-C3 panels
26:00	24:42	A part of the crib collapsed followed by subsequent elements of the crib falling
27:00	25:42	Another part of the crib fell out
30:00- 33:00	28:42- 31:42	Extinction of the heating source commenced
34:00	32:42	No flames observed on the façade cladding system after extinction of fire source
<b>60:00</b>	<b>58:42</b>	<b>Termination of the test.</b>

#### 6.4. POST-TEST EXAMINATION

##### 6.4.1. Summary

The cladding system was examined when cooled (within 24 h of the test). Examination compromised of external surface and internal layers.

##### 6.4.2. Outer face Dri-Design cassettes

On the main face of the cladding system, cassette panels A-3 to A0 and B-3 to B0 remained in place without any major damage. Only some discolouration was observed on B0 panel.

Major damage was observed on panels A1 to A8 and B1 to B8. Most of this area was melted and all the panels were severely damaged as described more extensively below:

Panels: A1, B1 were 80% destroyed  
Panels: A2, B2 were 70% destroyed  
Panels: A3, B3 were 55 - 60% destroyed  
Panels: A4, B4 were 45 - 50% destroyed  
Panels: A5, B5 were 40 - 45 % destroyed  
Panels: A6, B6 were 30 - 35% destroyed  
Panels: A7, B7 were 10 - 20% destroyed  
Panels: A8, B8 were up to 5% destroyed

The cassette panels A9 to A15 and B9 to B15 were discoloured but they remained in place.

On the wing face, major discolouration was observed on C-2 to C8. Partial damage visible on cassette panels C1 and C2 with some cracks on them. Panels C9 to C15 remained in place without further damage or discolouration.

#### 6.4.3. Helping hand Brackets and Railing system

The helping hand brackets of the main face, supporting the insulation and the railing system, were melted on the centreline above the combustion chamber up to the height of the 2<sup>nd</sup> fire barrier. Rest were intact and in place after removing the cassette panels and only some discolouration up to a height of 1.5 m above the combustion chamber. On the wing face all brackets were in place.

On the main face, the rail system supporting the cassette panels was completely damaged and melted on the area confined in between the vertical fire barriers and vertically from combustion chamber up to the 3<sup>rd</sup> horizontal fire barrier. The rest of the rails were in place after removing the cassette panel and only minor discolouration was observed on them just above the 3<sup>rd</sup> fire barrier and those close to the corner. On the wing face, all rails were in place with minor discolouration on those behind panels C-1 to C3.

#### 6.4.4. K-Roc Rainscreen Slab insulation

On the main face, the K-Roc Rainscreen slab insulation was mainly in place. Above the combustion chamber, contained between the vertical fire barriers and up to the 1<sup>st</sup> fire barrier height, parts of it fell down during test. Above the 1<sup>st</sup> fire barrier and up to height behind panels A3 and B3, major discolouration was observed. Up to level of A9-B9 panels, the insulation was slightly discoloured. Above this height, insulation remained without any damage or discolouration.

On the wing face, similar observations were made above the 3<sup>rd</sup> fire barrier, where the insulation was remained intact. On the area behind C-2 to C0 the slabs were discoloured slightly also. On the area between C1 and C8 there was major discolouration.

#### 6.4.5. Fire barriers

The bottom horizontal fire barrier placed just above the combustion chamber on the main face of façade system, was activated during testing. After the end of the test it was still in place but completely damaged. Same observation was made regarding the fire barrier of the same height on the wing face.

The 2<sup>nd</sup> horizontal fire barrier, which was placed in line with the bottom concrete slab, was activated during testing. After the end of the test it was still in place but completely damaged. Same observation was made regarding the fire barrier of the same height on the wing face.

The 3<sup>rd</sup> horizontal fire barrier, which was placed in line with the middle concrete slab, was not activated during testing. After the end of the test only some discoloration was visible on the underside of the barrier. Same observation was made regarding the fire barrier of the same height on the wing face.

The top horizontal fire barrier was intact and in place after test. Same was the fire barrier on the same height of the wing face of the system. Neither was activated during testing.

The vertical fire barriers remained intact, only discoloration was observed along the inside edges facing the centreline which was running across the full height above the combustion chamber. The fire damage on the main face of the façade system was contained within the bounds of the vertical cavity barriers running across the combustion chamber vertical edges. Same observation was made regarding the vertical fire barrier of the wing face.

#### 6.4.6. Sheathing board layer

All boards were intact and no damage was observed.

#### 6.4.7. Insulation within the frame

No damage was observed on the Omni Fit SLAB insulation which was fitted within the studs of the metal frame.

#### 6.4.8. Plasterboards

No damage was observed to plasterboard layer installed on the supporting metal frame made from C studs.

#### 6.4.9. Frame

No damage was observed on the metal frame of the façade system.

### 7. REFERENCE

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BS 8414-2:2015+A1: 2017 'Fire performance of external cladding systems - Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame', British Standards Institute, 2017.

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The attention is drawn on the fact that the results obtained with the sample being the subject of the present test report can not be generalized without justification of the representativeness of the samples and tests.

Belfast, on 18 April 2019

**SIGNED**



CHOTZOGLU Konstantinos  
Project Leader

**AUTHORIZED**



FLAMMIER Damien  
Lab Manager

## APPENDIX 1 – DRAWINGS OF THE SYSTEM (AS SUPPLIED BY SPONSOR)



Figure 1.1. Sketch of the tested facade.

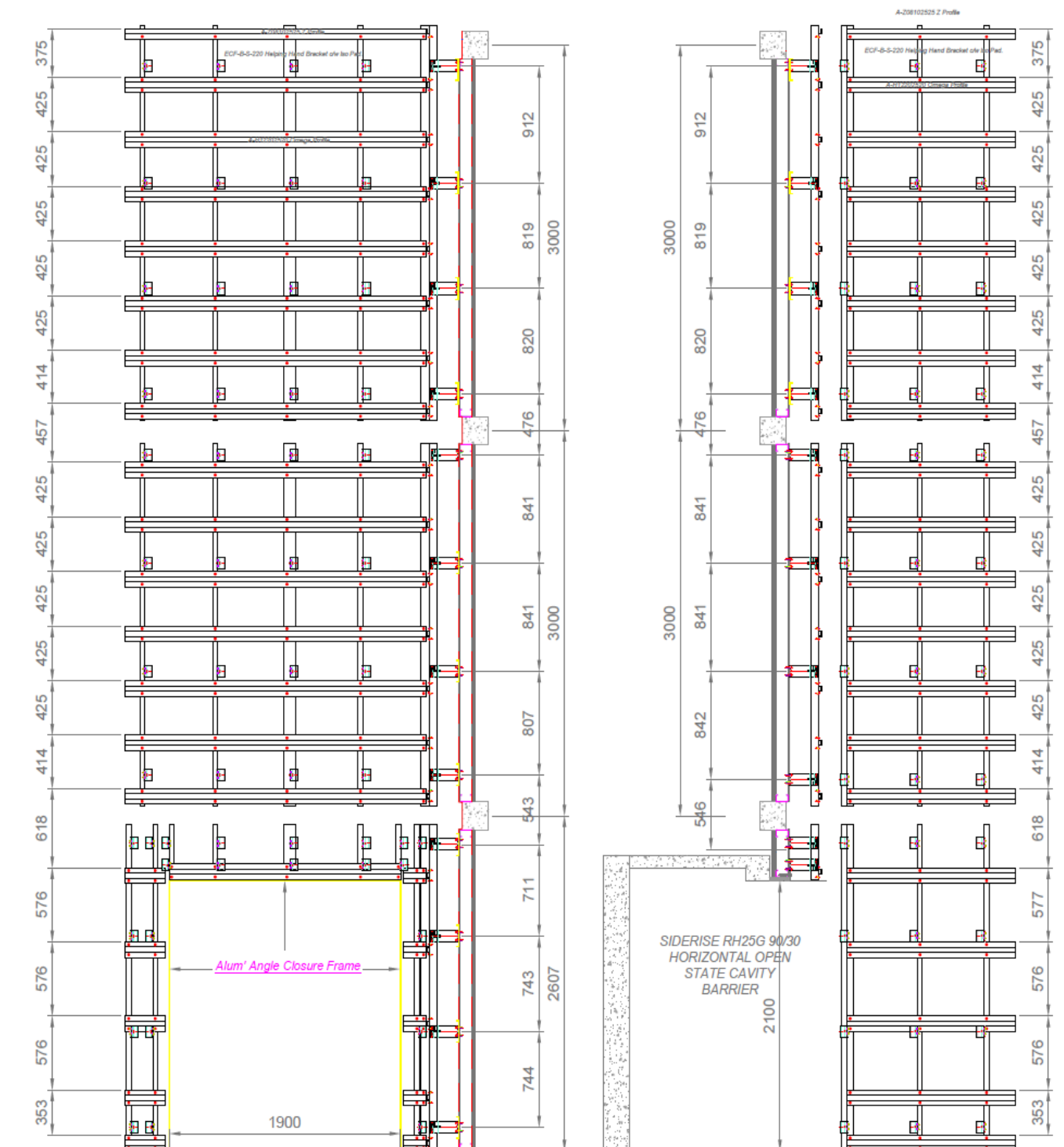


Figure 1.2. Sketch of the tested facade. Elevation layout of SFS sections.



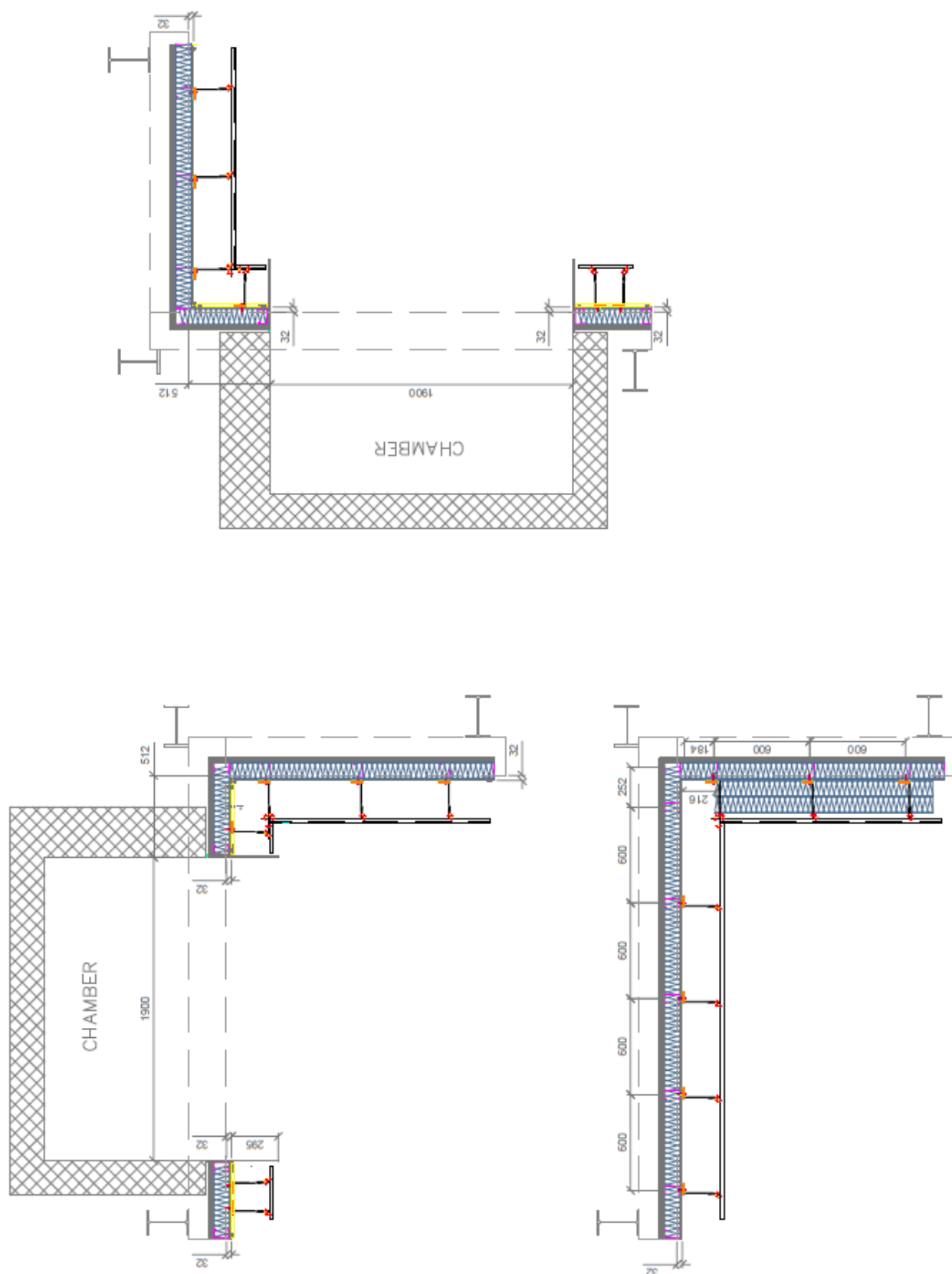


Figure 1.3. Sketch of façade system detail. Plan layout of SFS.

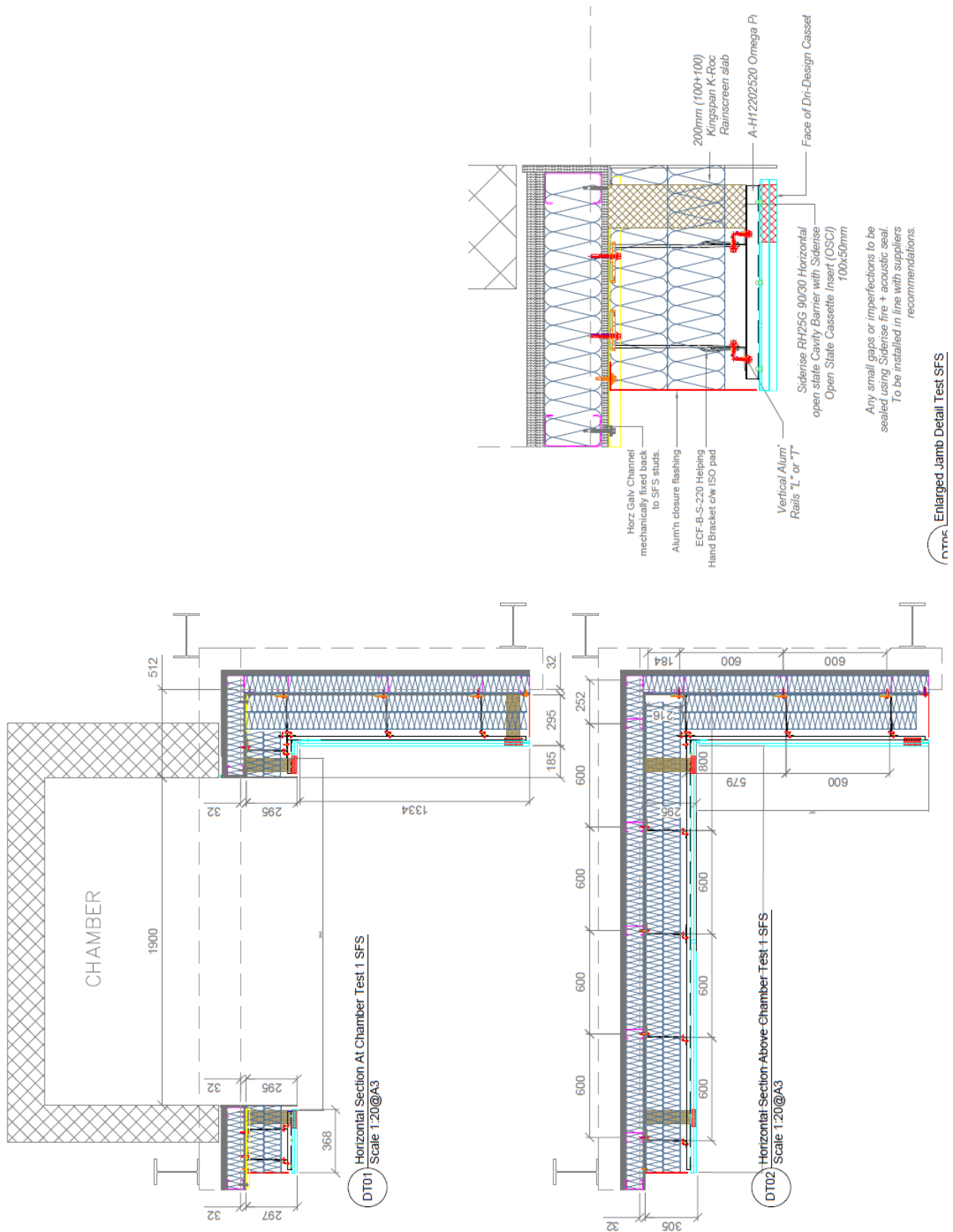


Figure 1.4. Sketch of façade system detail. Jamb detail.

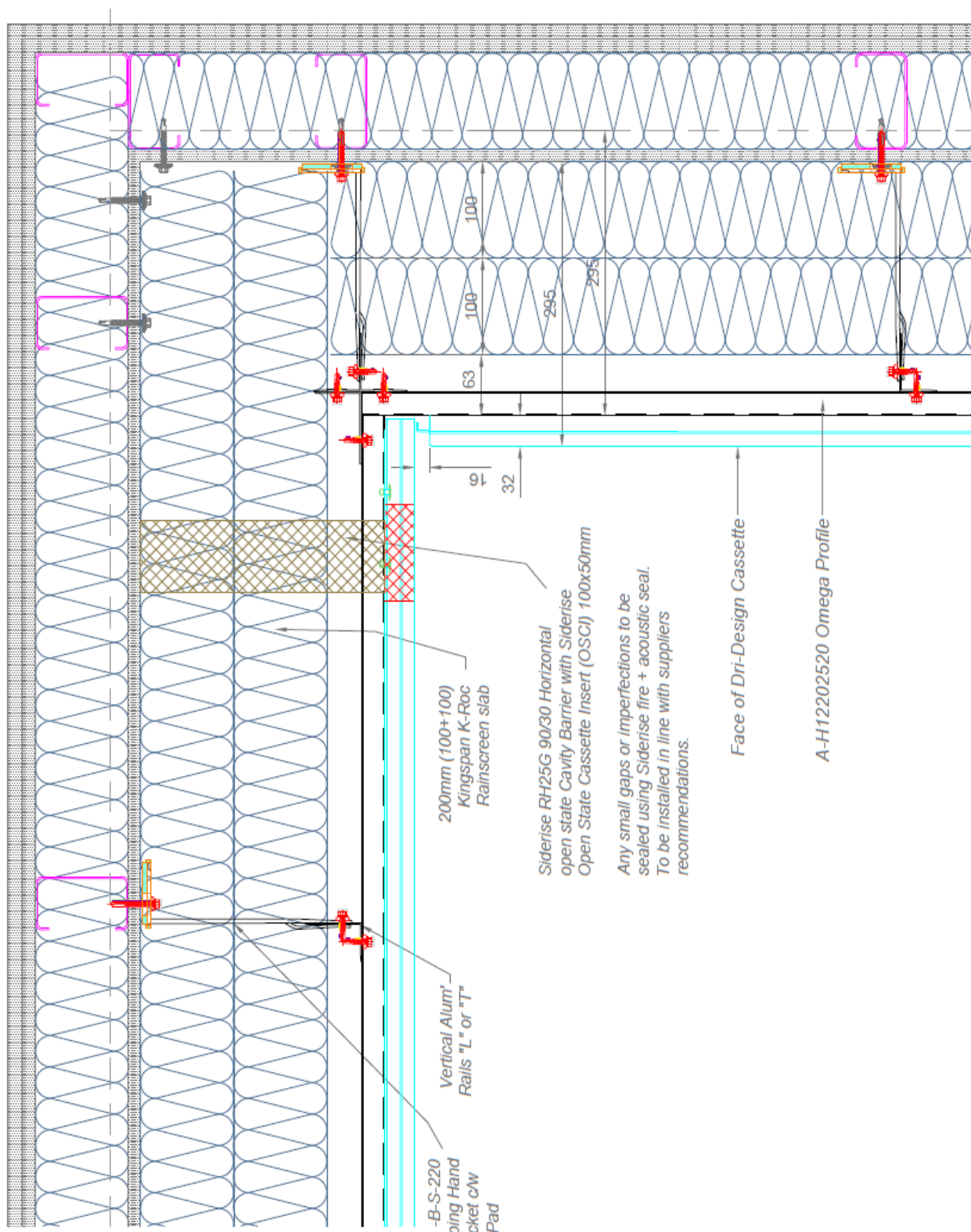


Figure 1.5. Sketch of façade system detail. Horizontal section – internal corner.

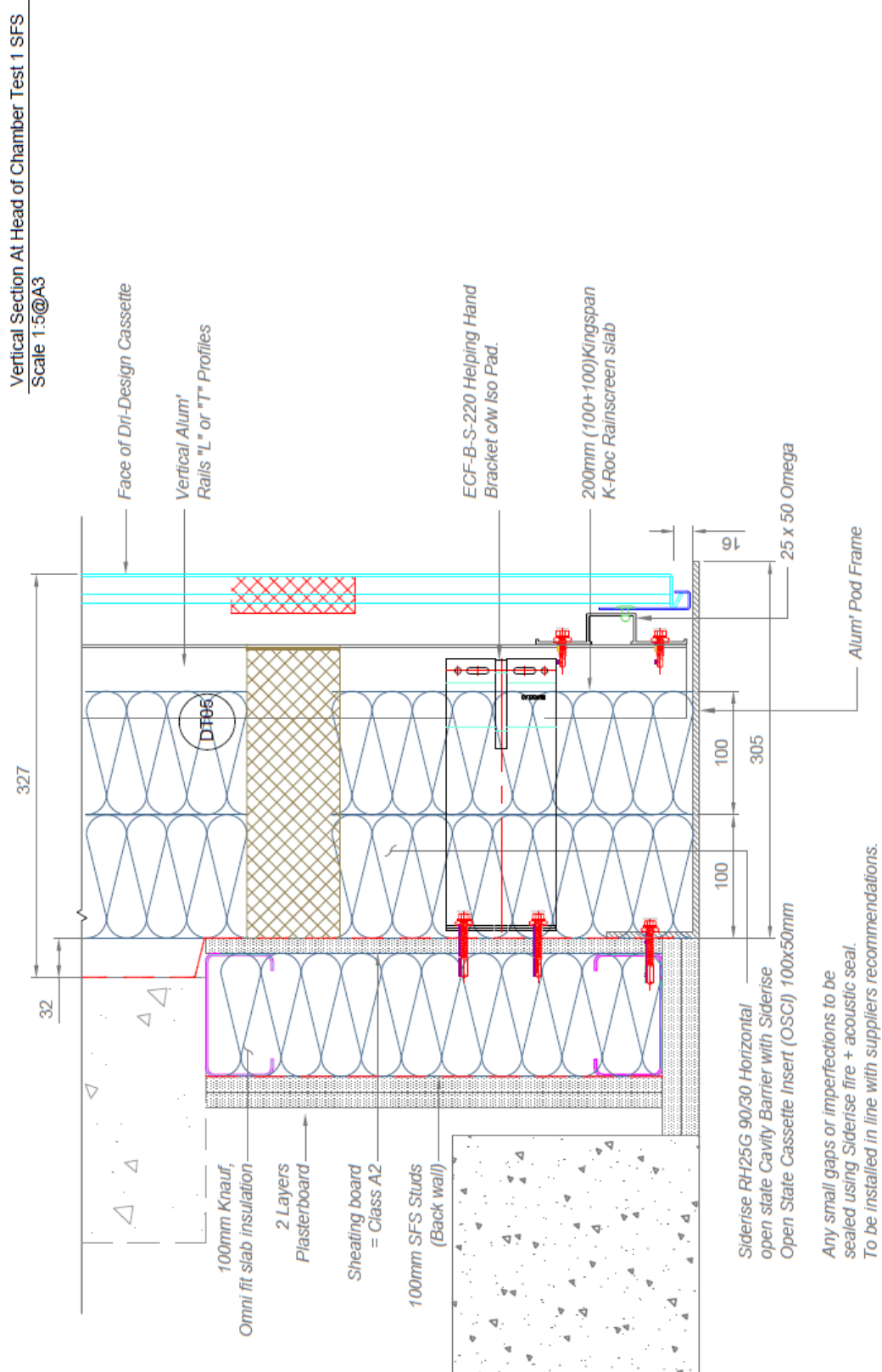


Figure 1.6. Sketch of façade system detail. Vertical section at head of chamber.

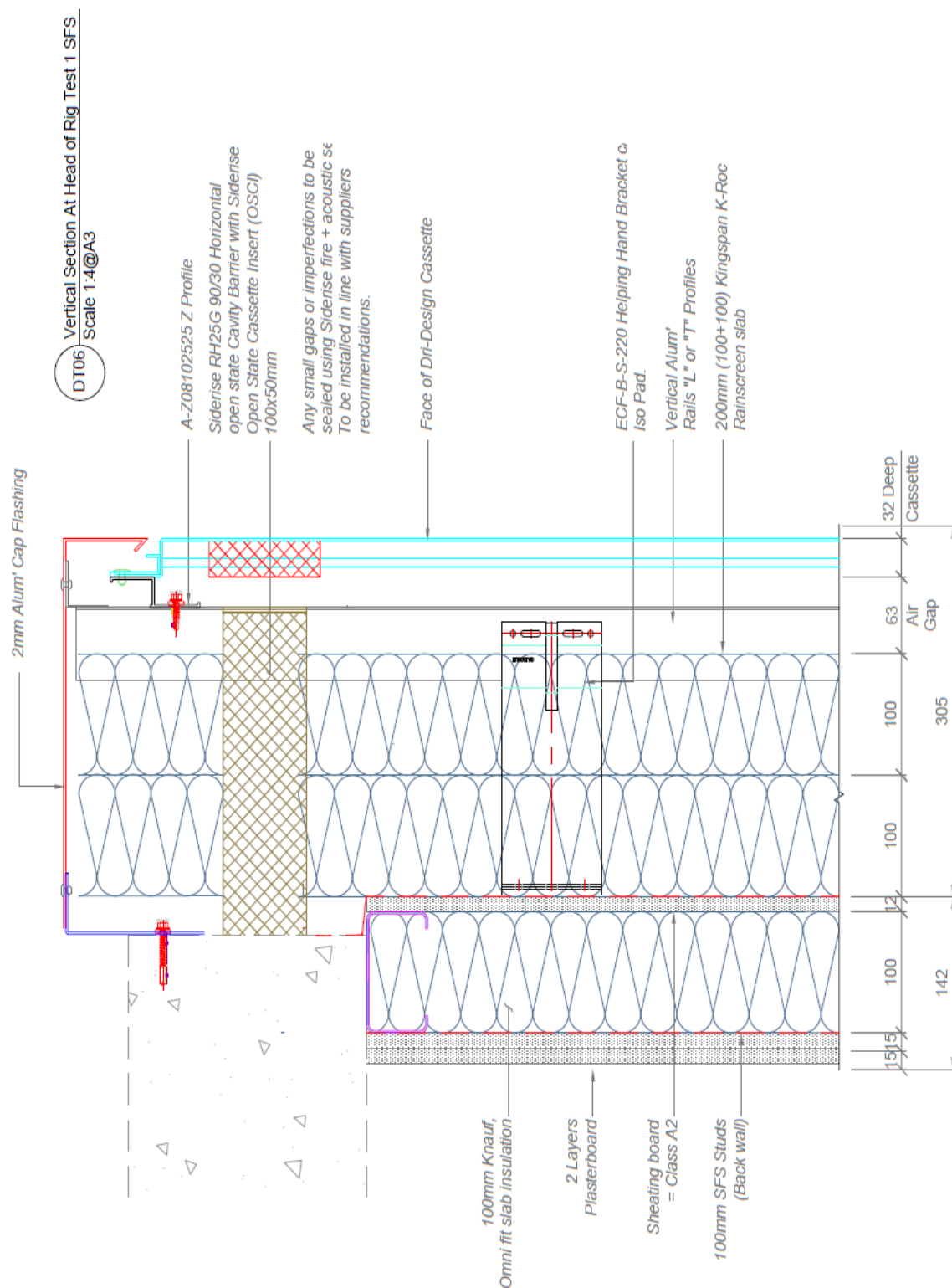


Figure 1.7. Sketch of façade system detail. Vertical section at head of rig.



## APPENDIX 2 – THERMOCOUPLES LOCATION

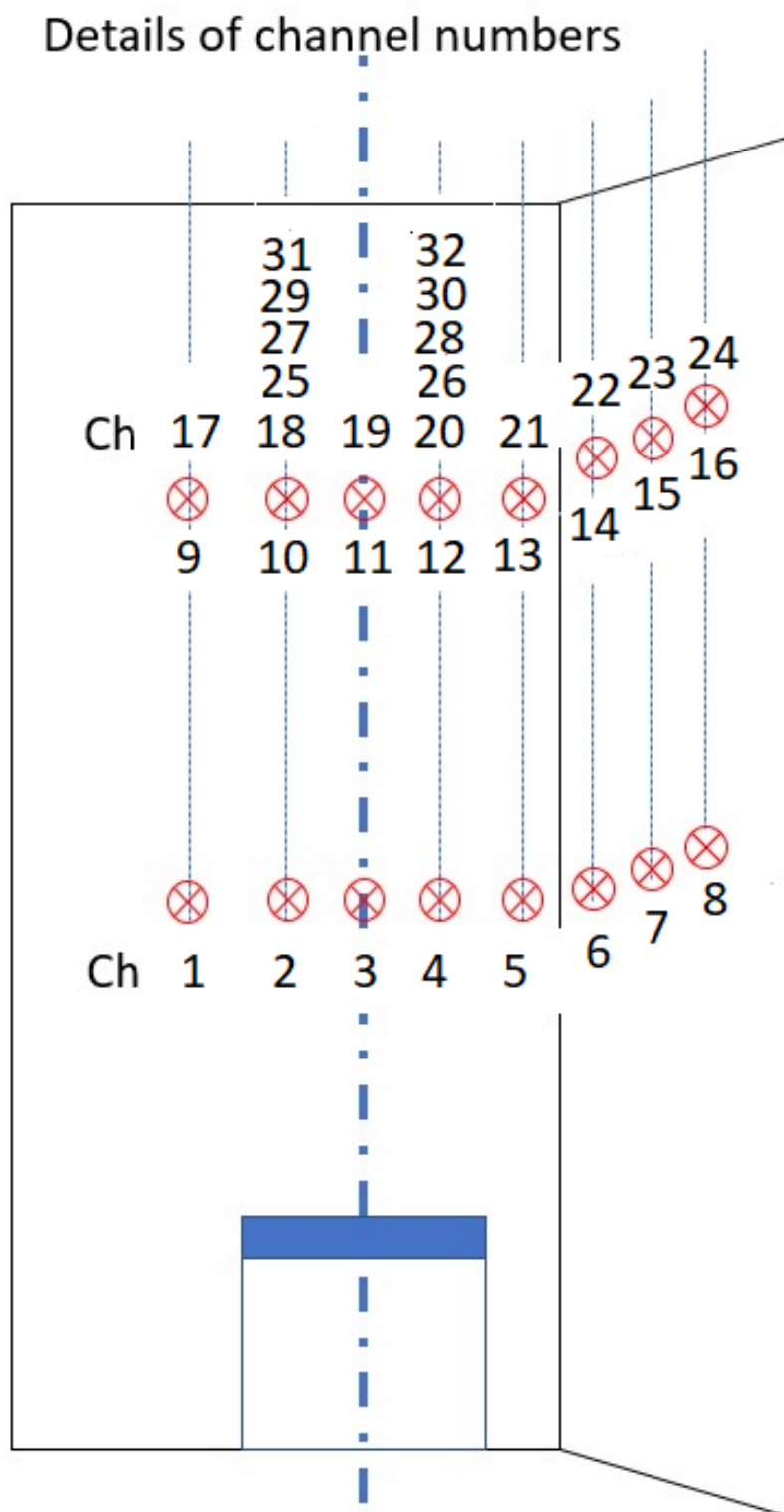


Figure 2.1. Thermocouple locations

### APPENDIX 3 – GRAPHS

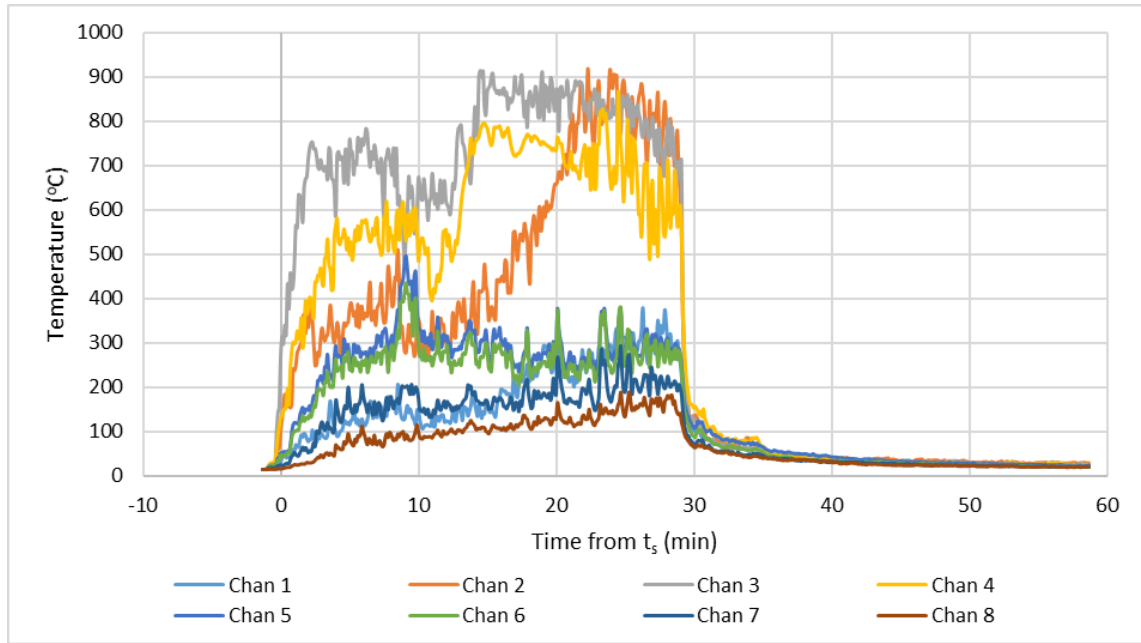


Figure 3.1. Level 1 external temperatures history recorded during the test

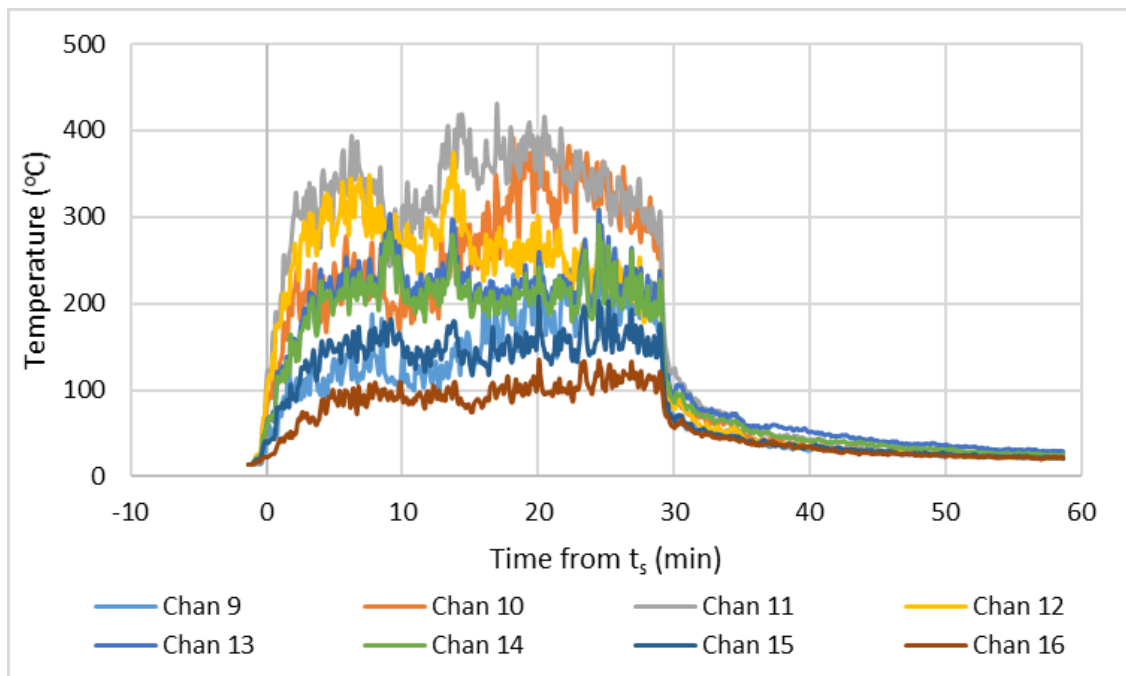


Figure 3.2. Level 2 external temperatures history recorded during the test

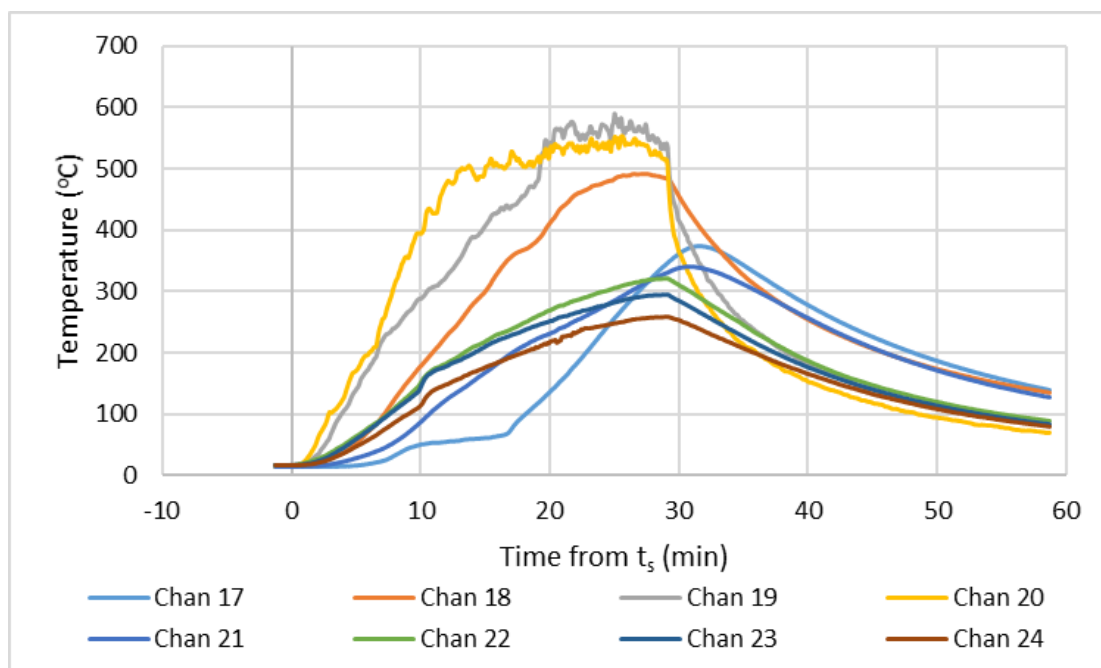


Figure 3.3. Level 2-cavity internal temperatures history recorded during the test

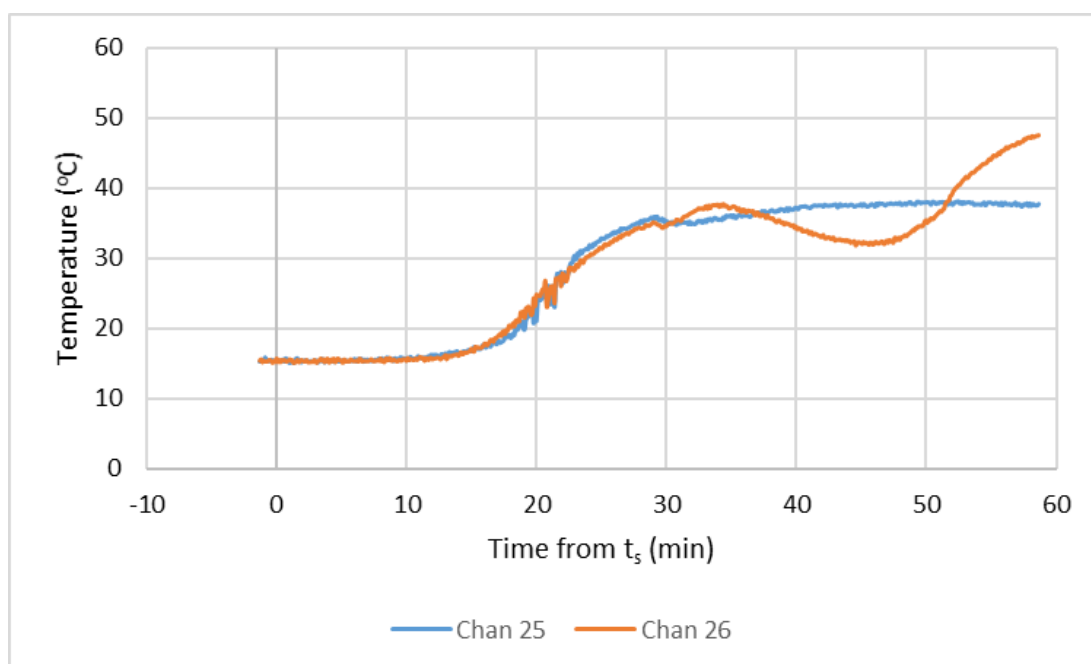


Figure 3.4. Level 2- K-Roc Rainscreen Slab insulation internal temperatures history recorded during the test



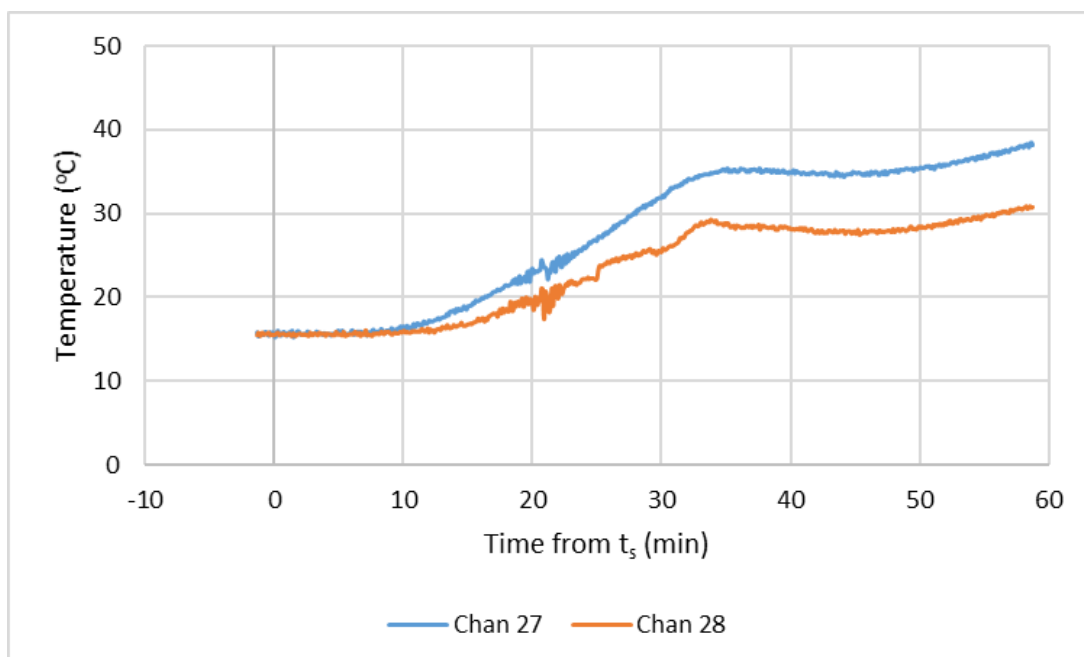


Figure 3.5. Level 2- sheathing board layer internal temperatures history recorded during the test

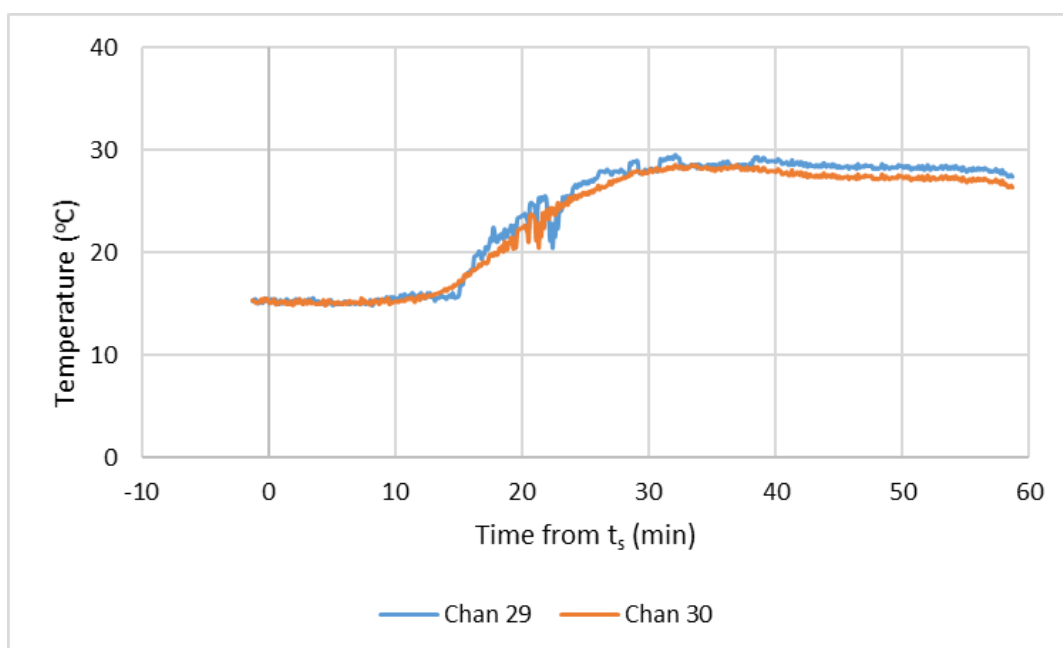


Figure 3.6. Level 2- Omni Fit SLAB insulation internal temperatures history recorded during the test

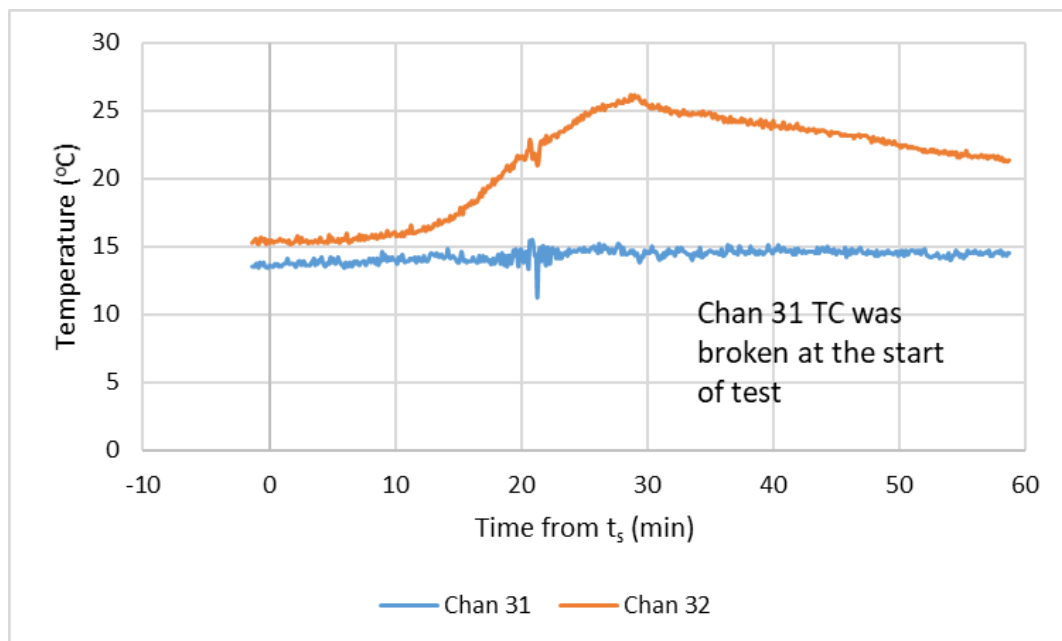


Figure 3.7. Level 2- Plasterboard WallBoard internal temperatures history recorded during the test

**APPENDIX 4 – PHOTOGRAPHS**

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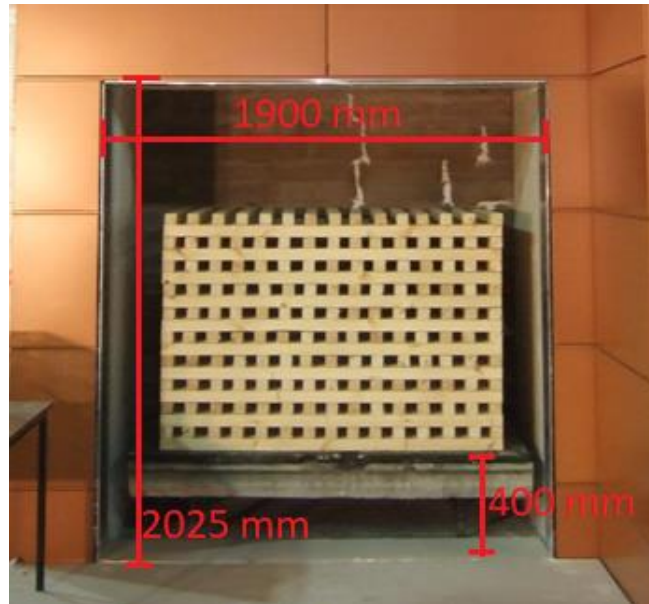


Figure 4.1. Wood crib used on the tested façade – dimensions of the opening are shown.



Figure 4.2. Omni Fit Slab insulation fitted within the steel frame during construction.



Figure 4.3. Sheathing board layer clad on the steel frame during construction.



Figure 4.4. Tyvek FireCurb layer installed on top of the sheathing board layer during construction.



Figure 4.5. Vertical fire barrier in place on the left hand side of the combustion chamber's opening and flashing closure installed on the side of the system, fixed on the sheathing board layer.



Figure 4.6. Installing k-Roc Rainscreen Slab insulation on the façade system using the brackets for holding in place.





Figure 4.7. Railings installed on the brackets during construction.

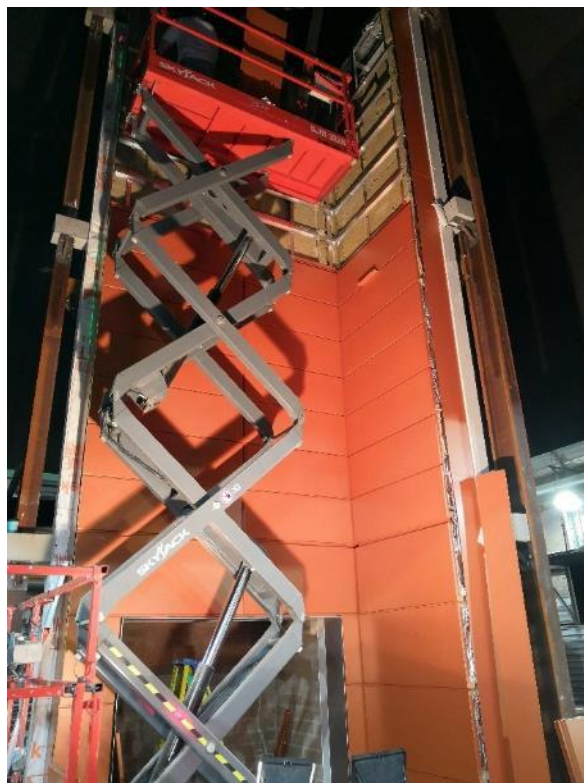


Figure 4.8. Dri-Design cassettes installation on the railing support system.



Figure 4.9. Cladding system before the test.

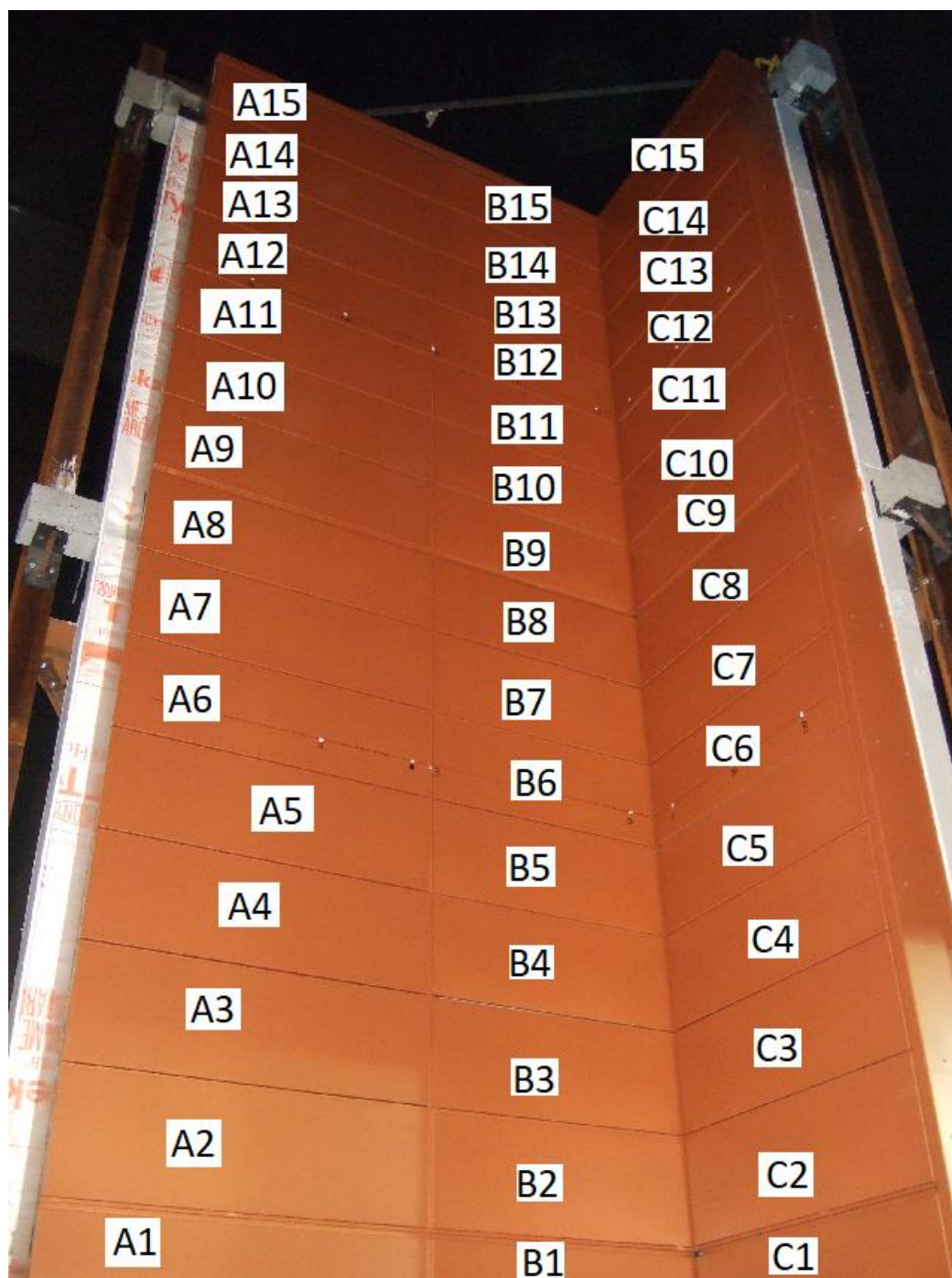


Figure 4.10a. Cladding system facing parts identification for referencing (above combustion chamber opening)



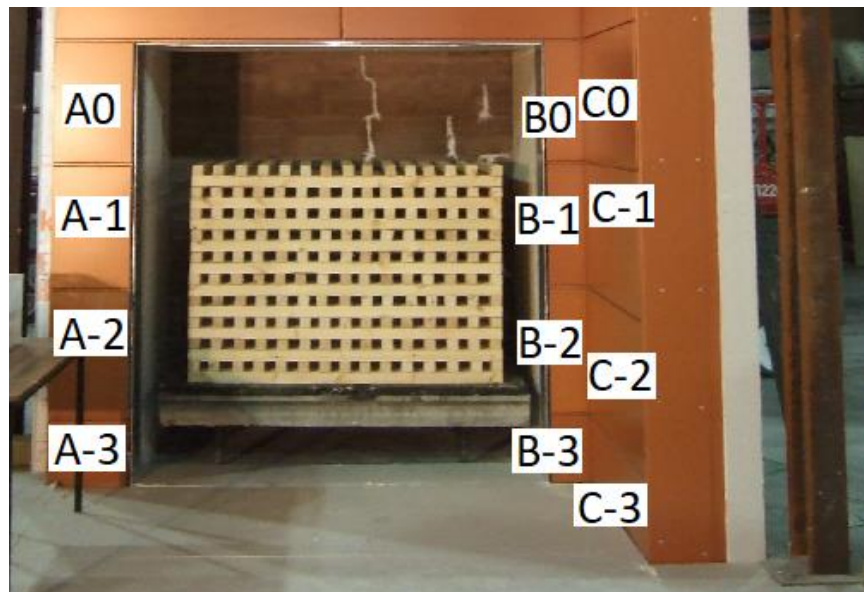


Figure 4.10b. Cladding system facing parts identification for referencing (up to combustion chamber opening)



Figure 4.11. Cladding system during the fire test at start time  $t_s$  (01 min 18 sec after ignition of the crib).

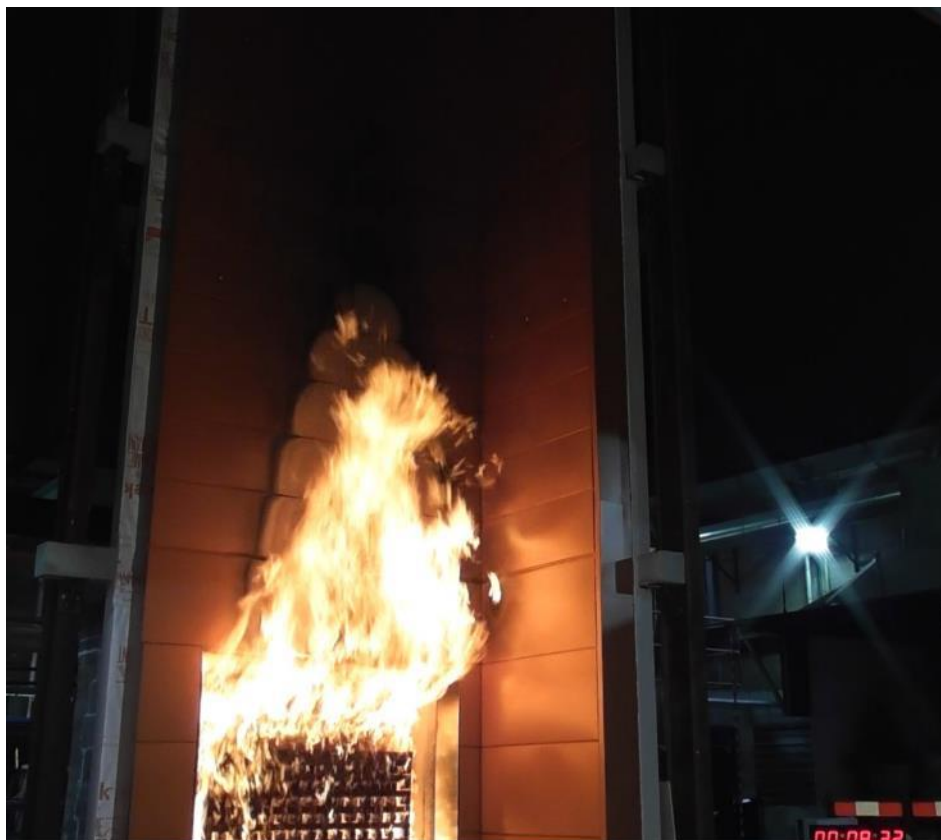


Figure 4.12. Cladding system during fire test (08 min 32 sec after ignition of the crib)-ignition of wing face.



Figure 4.13. Cladding system during the fire test (21 min 29 sec after ignition of the crib).

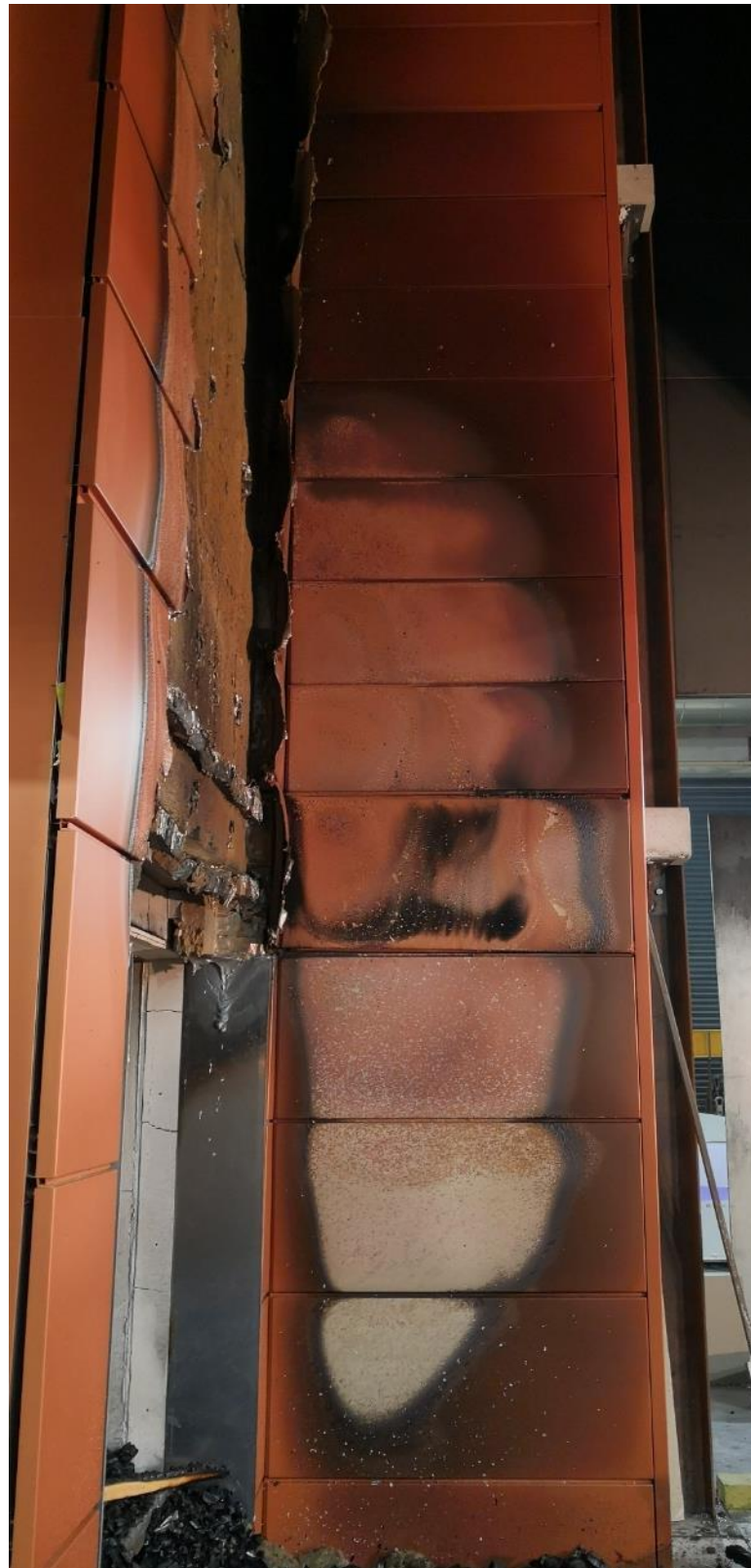


Figure 4.14. Cladding system just after fire extinguishment.





Figure 4.15. Cladding system after the fire test (60 min 00 sec after ignition of the crib).



**Figure 4.16. Cladding system just after the fire test (side view). Major discoloration of C-2 to C5. Damage of C1-C2.**



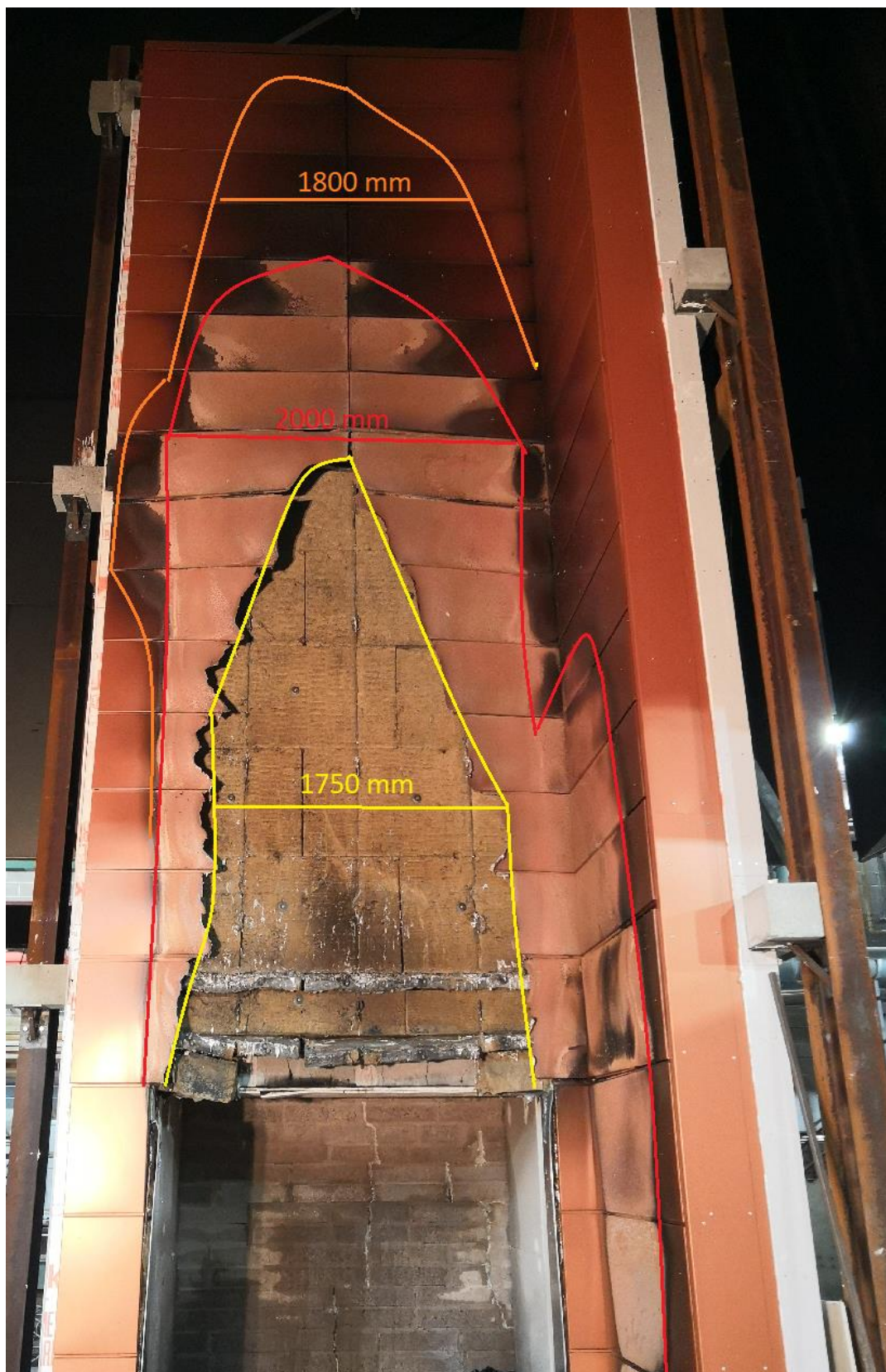


Figure 4.17. Photo of cladding system just after the fire test (front view). Curves show i) melting of panels ii) major discolouration of cladding panels and iii) minor discolouration.



**Figure 4.18. Post-examination damage. Photo of K-Roc rainscreen insulation. Insulation fallen off below bottom fire barrier, major discoloration and partially damage between the two bottom fire barriers.**



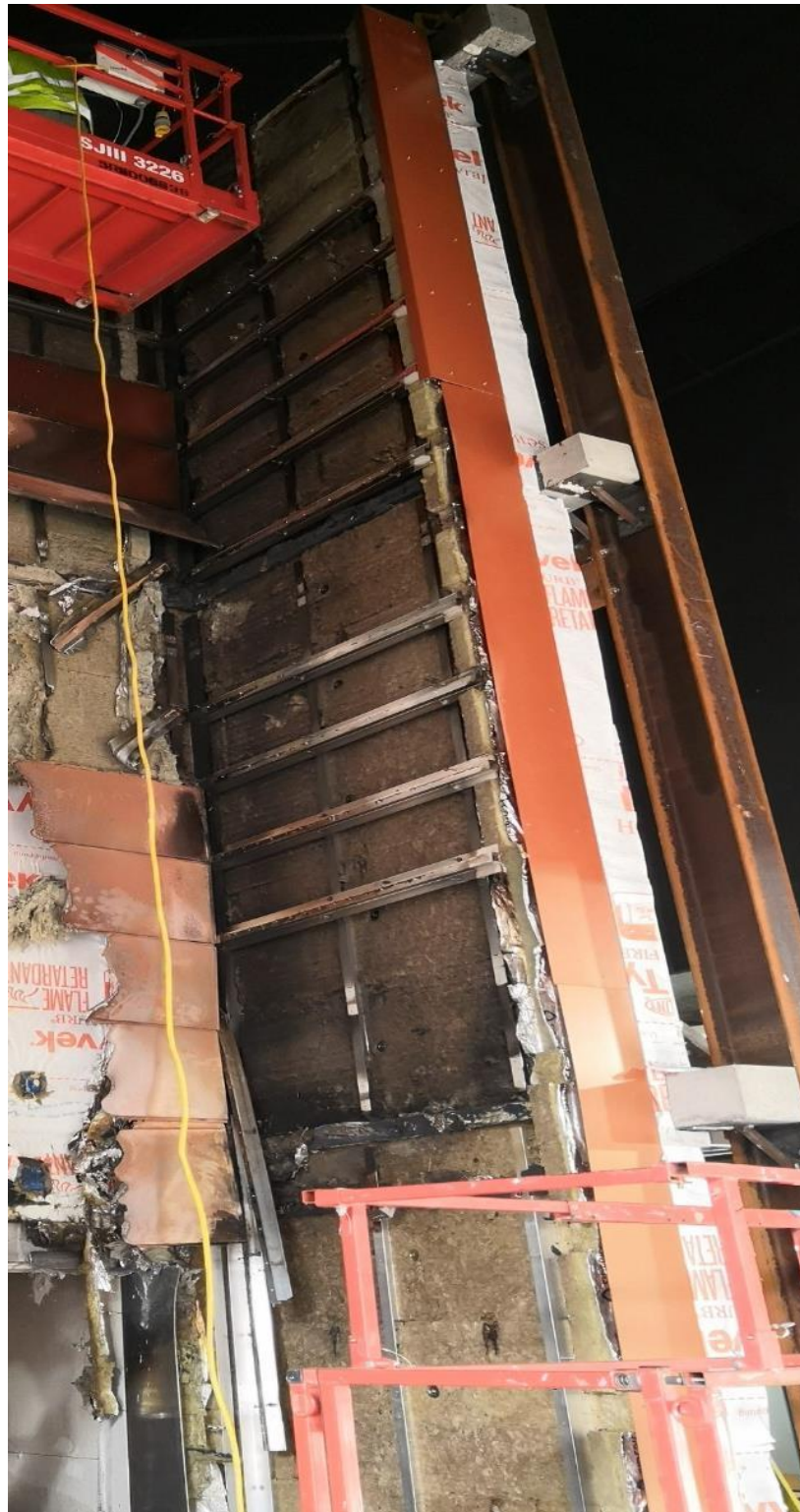
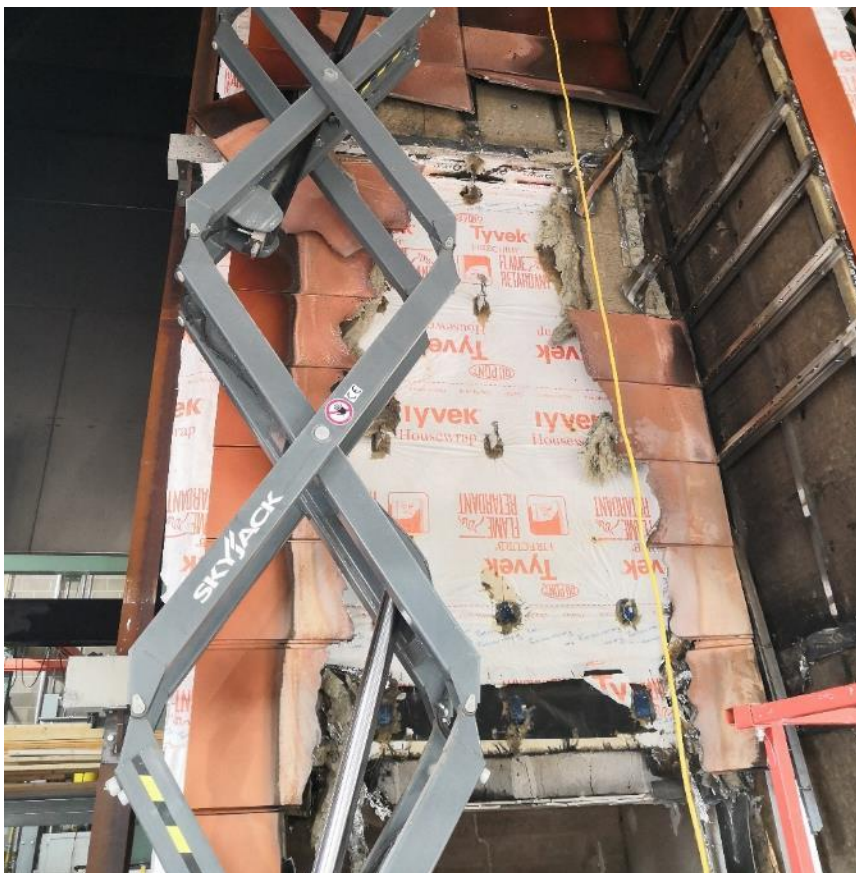


Figure 4.19. Post-examination damage. Photo of K-Roc rainscreen slab insulation on the wing face.





**Figure 4.20. Post-examination damage. Zoomed photo of the bottom two fire barriers above combustion chamber.**



**Figure 4.21. Post-examination damage. Third fire barrier from floor level not damaged-discolouration observed.**



Figure 4.22. Some bottom brackets (up to second fire barrier level) of the centreline melted during test.



Figure 4.23. Post-examination damage. Removing the Tyvek FireCurb membrane. No damage on the sheathing board layer behind.