FIRE TEST REPORT EUI-21-000441

According to BS EN 1363-1:2020 and BS EN 1365-1:2012

Test	REPORT EUI-21-000441
Performed on	8th February 2022
Regarding	Loadbearing timber frame with K112 and K118 fire test material
Sponsor	KINGSPAN INSULATION LTD Torvale Industrial Estate Pembridge, Herefordshire HR6 9LA UNITED KINGDOM

UKAS TESTING
10169

1. DOCUMENT TRACKING

Revision Index.	*Modification*
0	Original document

2. SCOPE OF THIS TEST REPORT

Fire resistance test regarding an external asymmetrical loadbearing wall, according to the general requirements of the standards BS EN 1363-1:2020 and to the specific requirements of the standard BS EN 1365-1: 2012.

The results reflect the loading, heating and pressure conditions described in chapter 8, and only to the sample tested with fire on a particular side, as described in sub-section 8.5. Additional testing might be required to fully evaluate the fire resistance performance of the element when exposed to the opposite side.

3. TEST LABORATORY

EFECTIS UK & IRELAND
Shore road
Jordanstown
BT37 0QB County Antrim
Northern Ireland

4. REFERENCE AND MANUFACTURER OF THE TESTED SPECIMEN

Reference: Loadbearing timber frame with K112 and K118 fire test material

Manufacturer:
KINGSPAN INSULATION LTD
Torvale Industrial Estate
Pembridge, Herefordshire
HR6 9LA
UNITED KINGDOM

5. FURTHER INFORMATIONS FOR UKCA/UKNI MARKING

(Chapter not covered under the UKAS's accreditation)

The tested sample was not subject of a sampling; thus, the results apply to the sample as received.

6. DESCRIPTION OF THE TESTED SPECIMEN

Technical data in this chapter and concerning the sample and its composition were supplied by the sponsor who attests their accuracy.

6.1. GENERAL

The drawings in Appendix A were supplied by the Sponsor. The photos of the sample installed on the testing frame (shown in Appendix D) were taken by Efectis. The specimen was constructed in the sponsor's site. Provisions were made allow remote witnessing of the sample being built. The test sponsor provided additional photographic evidence of the build which is kept on file. According to the detailed description by the sponsor, the specimen was constructed as follows:

The tested element was:

- External breather membrane, 0.4mm thick (Kingspan Nilvent)
- A layer of OSB boarding, 9mm thick
- A timber frame 89mm thick, with 50mm Kooltherm K112 insulation friction fitted within the timber frame
- A Layer if K118 insulated plasterboard, 32.5mm thick

Overall dimensions:

- Element: 3000 x 3000mm (w x h)
- Clear opening: 3060 x 3000mm (w x h)
- Thickness of the element 130.9mm

6.2. LIST OF THE COMPONENTS

According to the information supplied by the sponsor.

Name	*Reference*	*Characteristics*	*Material*	*Supplier*
K118 insulated plaster board	*Kingspan k118*	*32.5mm-20mm kooltherm insulation bonded to 12.5mm, 11.42kg/m^2 density*	*Gypsum board*	*Kingspan*
K112	*Kingspan k112*	*50mm thick, 38.24kg/m^3 density*	*Rigid phenolic core and foil*	*Kingspan*
Timber frame with K112 between	*Stora Enso C16 CLS*	*89mmx38mm, 370kg/m^3 density*	*C16 CLS*	*Kingspan Timber Solutions*
OSB	*Norbord Sterling OSB3*	*2400x1200mm (WxL), 9mm thick, 5.45kg/m^2*	*Wood chippings and synthetic resin*	*Kingspan Timber Solutions*
Breather membrane	*Kingspan Nilvent (Tyvek)*	*0.4mm, 0.13kg/m^2*	*Three-layer polyolefin construction*	*Kingspan*
Membrane tape	*Breather membrane double sided tape*	*12mm width*	*Three-layer polyolefin construction*	*Kingspan Timber Solutions*
Membrane staples	*71x10V2A*	-	-	-
OSB Screws	*Montana (FAWGS/SC2)*	*2.8x50mm (DxL), circular smooth shank coil nails*	*Galvanised mild steel*	*Montana*
Framing screws	*Montana (D34GSC)*	*3.1x88mm (DxL), circular screw shank coil nails*	*Galvanised mild steel*	*Montana*
Internal liner facing screws	*Durspin (45A75MP)*	*4.5x75mm (DxL), drywall screws*	*Mild steel*	*Durspin*
Jointing compound	*Jointing and filling compound*	*white paste, mixed with water*	*Gypsum based,*	*Makegood*
Joint tape	*Joint tape*	*White tape, 48mm wide*	*Paper dry lining tape*	*Kingspan*

Th = Thickness --- D = diameter --- L = Length --- W = Width --- Th = Thickness

Please note: The schedule of components, and a table including the batch numbers, exact densities, date of manufacturing and product standards, are in Appendix A, and both were provided by the client.

6.3. DETAILED DESCRIPTION OF THE SPECIMEN

The drawings in Appendix A have been supplied by the Sponsor, checked by the test laboratory EFECTIS, and are in conformity with the tested specimen.

6.3.1. Timber frame panel

- A perimeter frame reference perimeter frame (Kingspan Insulation Limited), with section 89 x 38 mm, C16 grade softwood and stated density 370 kg/m^3. The perimeter frame consisted of 6 vertical studs, 2924mm in length. Horizontal noggins were included at 600mm from the top of the sample. Please see Appendix A, Drawing 1 for a view of the frame layout. The timber frame was butted with the head and bottom rails running the full width of the panel. The framework was secured with Montana D34GSC 3.1x88mm (DxL) screws, with two screws used per joint.
- An internal layer of K112 framing board (Kingspan Insulation Limited), 50 mm thick, with stated density of 35kg/m^3 was included within the frame. The insulation was friction fitted between the vertical timber studs, noggins, and rails.
- One layer of face panel reference OSB facing (Kingspan Insulation Limited), fitted to one side of the frame, 9 mm thick. The OSB board was through fixed into the external timber framework with 2.8x50mm (D x L), FAWGS/SC2 (Montana) screws. The screws were spaced at 150mm centres to the perimeter sections of the external framework and 300mm centres to the intermediate framework

6.3.2. External breather membrane

External breather membrane (Kingspan Nilvent), made of laminated 3-layer polyolefin, 1500mm high, overlapping 450mm and fixed with white tape and secured with 71 x 10 x 0.68mm V2A stapled at 300mm centres. This was secured to the OSB boarding layer, as shown in Photograph 9.

6.3.3. Internal Liner Facings

A layer of Kooltherm K118 insulated plasterboard, 32.5mm thick (20mm insulation + 12.5mm plasterboard) was fixed the timber frame with 4.5x75mm (D x L), 45A75MP drywall screws (Durspin) at 300mm centres to all perimeter and intermediate timber. The plasterboard was taped and jointed using Gypsum tape and joint compound.

6.3.4. Additional equipment

No additional equipment was installed on the sample.

6.4. VERIFICATION

The specifications supplied by the Sponsor were detailed sufficiently to enable the Test Laboratory to carry a detailed examination of the test specimen before the test and to check the accuracy of the information supplied.

7. TEST ASSEMBLY

7.1. DEFINITION OF THE TESTED SPECIMEN

The choice and the definition of this test specimen have been carried out by the sponsor.

7.2. RESTRAINT/FREE EDGE

Both vertical edges of the specimen were left unrestrained by packing the gaps between the frame and the sample with high-density stone mineral wool, to provide a seal without restricting freedom of movement.

The sample was kept in place by the testing frame loading beam.

7.3. ASSEMBLY OF THE TESTED SPECIMEN

7.3.1. Supporting construction

The tested specimen has been assembled within a reinforced concrete frame supplied by EFECTIS.

- Drying duration: more than 28 days.
- Thickness of the frame: 320 mm.
- Opening in the frame: 3060 x 3000 mm (w x h).

7.3.2. Staff

The sample was built by the staff the test sponsor.
The supporting construction was supplied and installed on the furnace by the staff of the test laboratory.

8. TEST METHOD

8.1. PRELIMINARY CONDITIONING

The specimen was conditioned inside the test laboratory, in conformity with the statement in paragraph 8.1 of the BS EN 1363-1:2020, the weight stability was therefore estimated to be reached on the day of the test.

8.2. LOAD APPLIED

The loading applied to the test specimen during the test was 40 kN total load.

The applied loading was based on the calculation done by the sponsor. The loading was calibrated in advance of the test and was applied uniformly across the top horizontal edge via a loaded beam.

The following loadbearing failure criteria were calculated according to the standard BS EN 1361-1:2020.

- Limiting total deflection – 30 mm
- Limiting rate of deflection – 9 mm/min

8.3. PRESSURE

In conformity with the requirements of the standard BS EN 1363-1:2020, the pressure inside the furnace was continuously controlled throughout the whole test.

The neutral pressure place (pressure of zero) was established 647 mm above the notional floor level.
Taking into account the dimensions of the specimen and the location of the pressure sensor, the prescribed value was established at 15.7 Pa, equating to a pressure of 20 Pa at the head of the sample.

8.4. THERMAL PROGRAM

The temperature rise inside the furnace above the ambient temperature has been controlled according to the **standard thermal program** represented by the following function:

$$\mathbf{T = 345 \log_{10} (8t + 1) + 20}$$

Where :

T = Time (min)
T = Furnace temperature at time t (°C)

8.5. FIRE SIDE

The fire test was performed with the following fire side:

- For the specimen : Insulated plasterboard side

9. MEASUREMENTS DURING THE FIRE TEST AND TEST RESULTS

This section provides the details of the sensors used during the fire test. The locations of the sensors are shown in Appendix B.

The graphic measurements are shown in Appendix C.

9.1. THERMAL PROGRAM

9.1.1. Ambient temperature in the laboratory

The ambient temperature was measured according to the requirements of the standard BS EN 1363-1:2020.

See Chart 1, Appendix C for the measurements recorded during the test.

9.1.2. Ambient temperature in the furnace

It was measured in conformity with the standard BS EN 1363-1:2020 by 6 plate thermocouples in the furnace, with the metal plate facing towards the back of the furnace.

See Chart 2, Appendix C for the measurements recorded during the test.

9.1.3. Temperatures of the specimen

The temperatures were measured by 12 external thermocouples according to the requirements of the standard BS EN 1363-1:2020 and located according to the standard BS EN 1365-1:2012.

See Diagram 1, Appendix B for the plot of the instrumentation, and Charts 5 and 6, Appendix C for the measurements recorded during the test.

External thermocouples - Location	*Markings*	*Appendix*
On the centre of the quadrant	1, 2, 4, 5	B
On the geometric centre of the specimen	3	
At the head of the sample, in line with a stud/ mullion	7	
At the head of the specimen, at mid-width	6	
At the junction of a stud and a rail	10	
At mid-with, adjacent to a horizontal joint	8	
At mid height, 150mm in from the edge	9, 12	
At mid-height, adjacent to a vertical joint	11	

9.2. PRESSURE MEASUREMENTS

In conformity with the requirements of the standard BS EN 1363-1:2020, the pressure inside the furnace was continuously controlled throughout the whole test, according to the conditions described in section 8.3 of this document.

See Chart 4, Appendix C for the measurements recorded during the test.

9.3. DEFLECTION MEASUREMENTS

In conformity with the requirements of the standard BS EN 1363-1:2020, the deflection located in both vertical and horizontal orientations was measured and recorded throughout the test.

The deflection was measured using calibrated wire type displacement gauges and recorded via a data acquisition system. The vertical deflection was measured using two gauges at the top left and top right corners, 50 mm from the edge of the sample. The horizontal deflection was measured at mid-height, 50 mm from the edges of the sample and at its geometric centre.

Location	Markings	Appendix
Vertical deflection – 50 mm from the edge of the sample	1 (left), 2 (right)	B
Horizontal deflection – 50 mm from the edge of the sample	3 (left), 5 (right)	
Horizontal deflection – centre of the sample	4	

See Diagram 1, Appendix B for the plot of the instrumentation and Charts 7 to 9 for the measurements recorded during the test.

10. OBSERVATIONS

10.1. BEFORE THE TEST

- Ambient temperature inside the laboratory : 17 °C.
- Specimen temperature before the test : 14 °C.

10.2. DURING THE TEST

Time (min)	Specimen	Observations
-15 :57	**Loading of the specimen**	
00	**E/N**	**Start of the test**
4	E	Slight glowing of the paper
7	E	Tape and joint burning off
10	E	Vertical cracks formed next to the left-hand side vertical joint
15	E/N	NSC
17	E	Flaming on the wall, vertical and horizontal cracks formed on the full-sized boards
22	E/N	Bubbling of the internal insulation
27	N	Smoke escaping near TC 9
30	E/N	NSC
37	N	Visible deflection
40	N	Holes forming in Nilvent layer
41	**E/N**	**Test stopped due to safety reasons**

E = Exposed side --- N = non-exposed side --- NSC = No Significant Change --- TC = Thermocouple

10.3. AFTER THE TEST AND COOL DOWN

See Photographs 12 and 13, Appendix D.

11. FIRE RESISTANCE CRITERIA

In conformity with the standards mentioned in chapter 1, the times during which the specimen meets the fire resistance criteria may be regarded as follows:

11.1. FIRE INTEGRITY

11.1.1. Cotton wool pad

Duration: FORTY-ONE MINUTES (41 min)
Cause of limitation: Test stopped due to unsafe conditions

11.1.2. Gap gauges

Duration: FORTY-ONE MINUTES (41 min)
Cause of limitation: Test stopped due to unsafe conditions

11.1.3. Sustained flaming

Duration: FORTY-ONE MINUTES (41 min)
Cause of limitation: Test stopped due to unsafe conditions

11.2. THERMAL INSULATION

11.2.1. Thermal insulation

Duration: FORTY-ONE MINUTES (41 min)
Cause of limitation: Test stopped due to unsafe conditions

11.3. LOAD-BEARING CAPACITY

11.3.1. Deflection

Duration: FORTY-ONE MINUTES (41 min)
Cause of limitation: Test stopped due to unsafe conditions

11.3.2. Rate of deflection

Duration: FORTY-ONE MINUTES (41 min)
Cause of limitation: Test stopped due to unsafe conditions

12. FIELD OF DIRECT APPLICATION OF THE TEST RESULTS

The direct application field of the test results is limited to the determination of the permissible modifications of the test specimen following a successful fire resistance test. These modifications may be automatically introduced without the sponsor having to apply for any additional assessment, calculation, or agreement.

Note: When extended prescriptions concerning the dimensions of the element are considered, lower dimensions than the actual dimensions may be used for some elements of the test specimen in order to maximize the extrapolation of the test results by modelling the interaction between the elements at the same scale.

As the laboratory was not responsible for the sampling stage, thus the test results only apply to sample as tested.

The results of the fire test are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability:

a) decrease in height.
b) increase in the thickness of the wall.
c) increase in the thickness of component materials.
d) decrease in linear dimensions of boards or dimensions of panels of but not thickness.
e) decrease in stud spacing.
f) decrease in distance of fixing centres.
g) increase in the number of horizontal joints, of the type tested
h) decrease in the applied load.
i) increase in the width (unlimited)

13. STATEMENT

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in EN 1363-1, and where

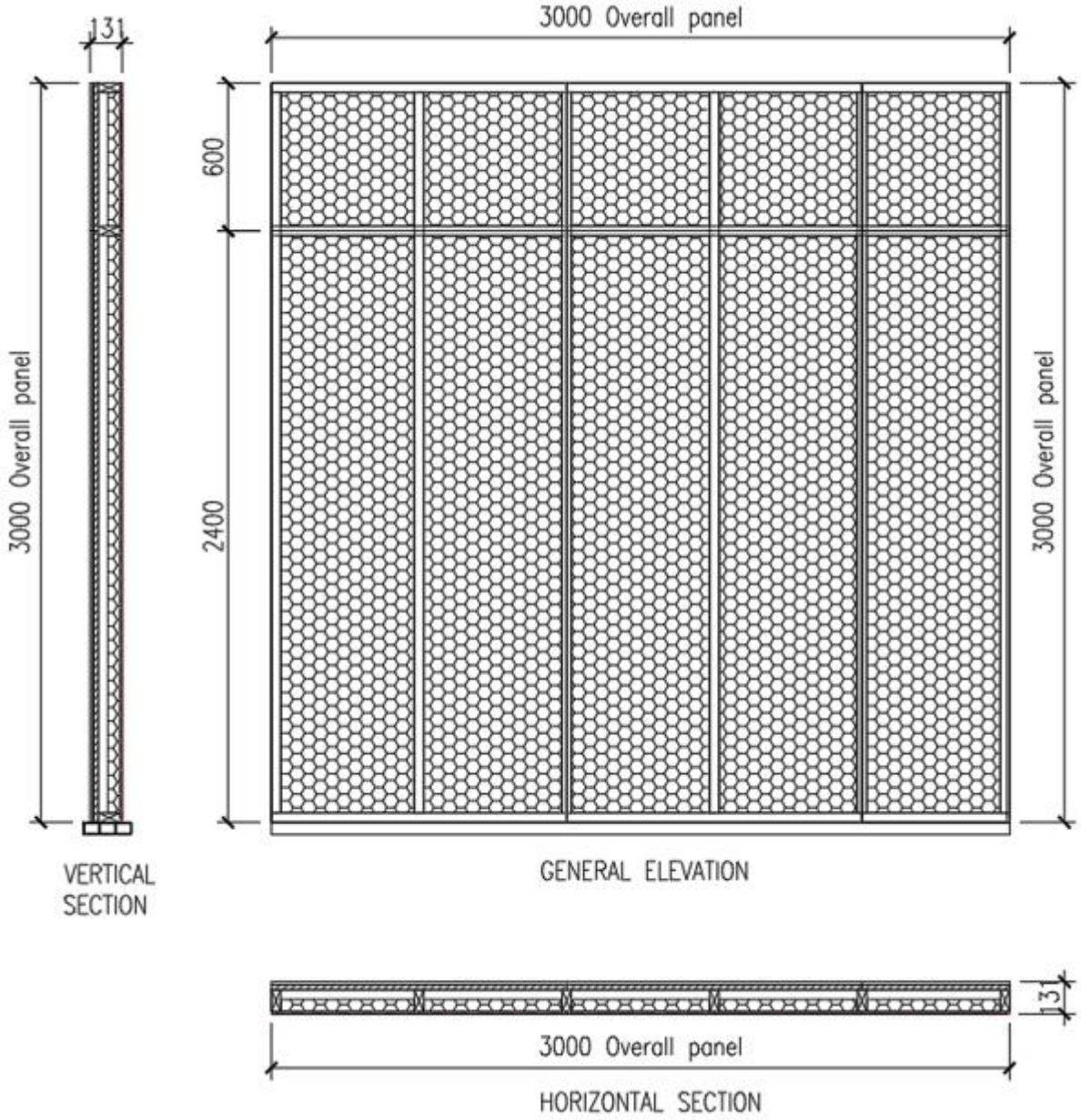
appropriate EN 1363-2. Any significant deviation with respect to size, constructional details, loads, stresses, edge, or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

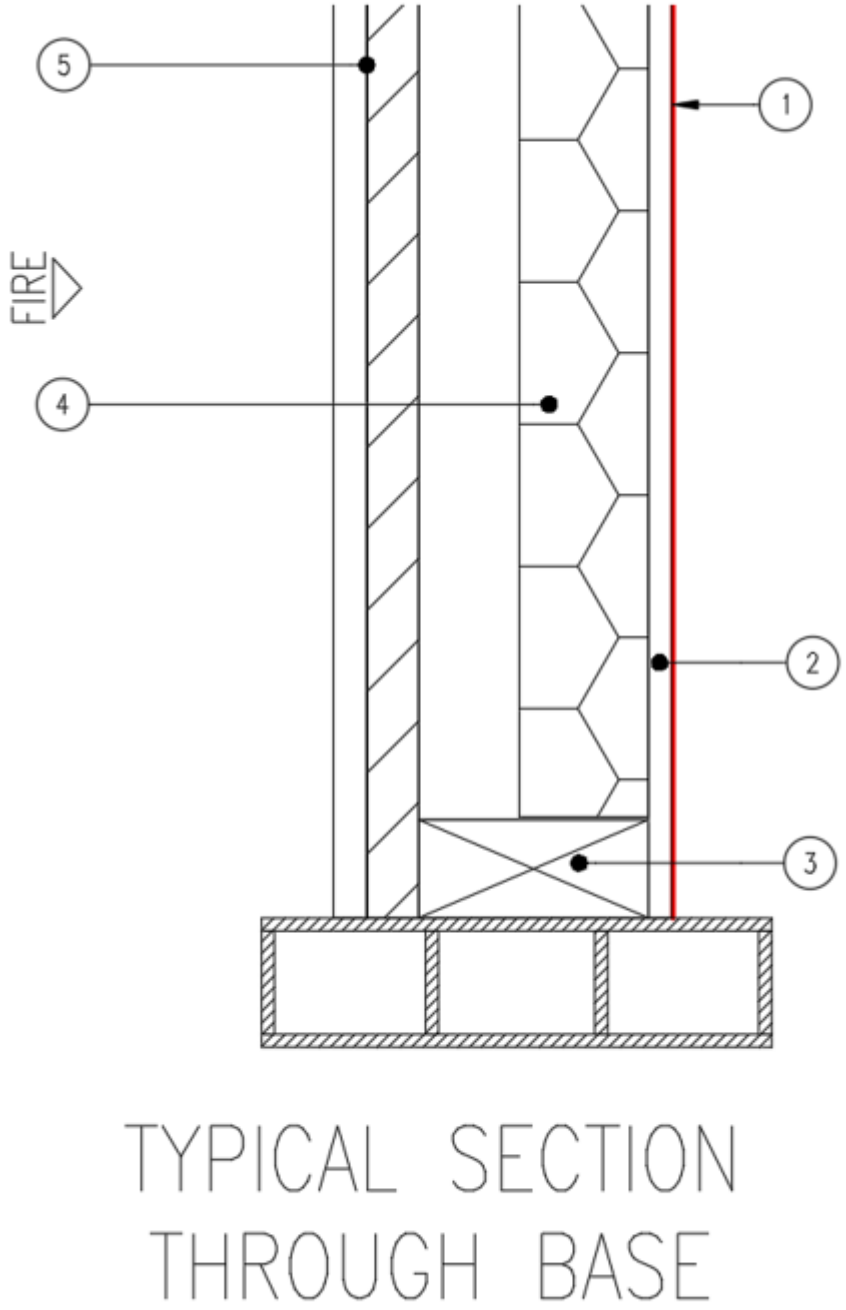
19th June 2022

SIGNED	**APPROVED**
	
Daniel Gibson	Maurice McKee
Project leader	Lab Manager

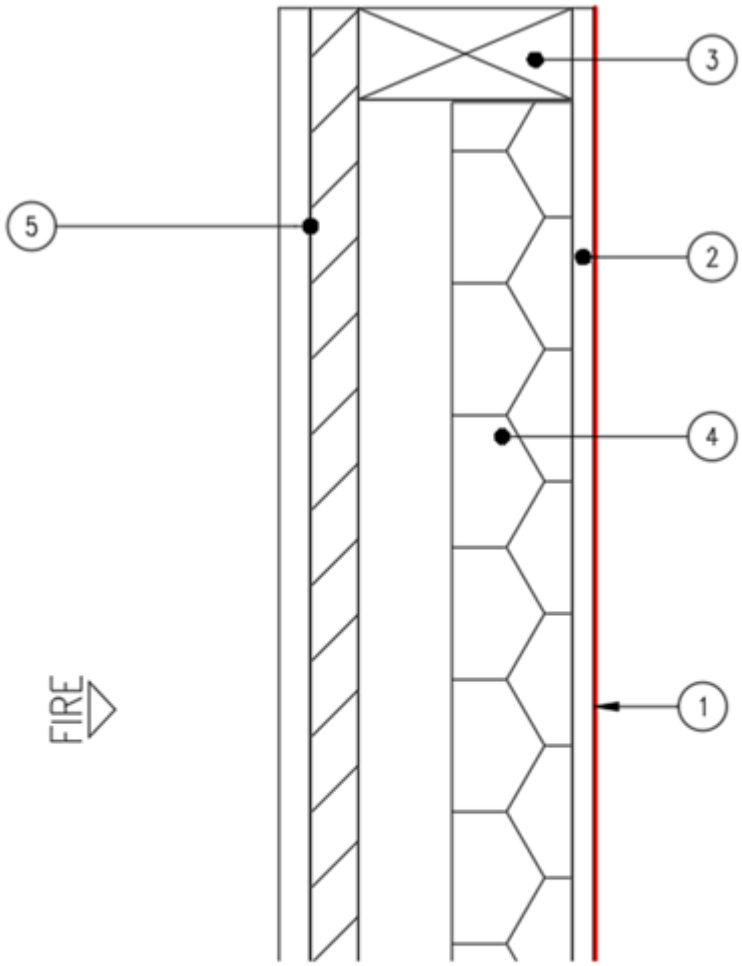
APPENDIX A: DRAWINGS



Drawing 1 – Elevation view of the test construction

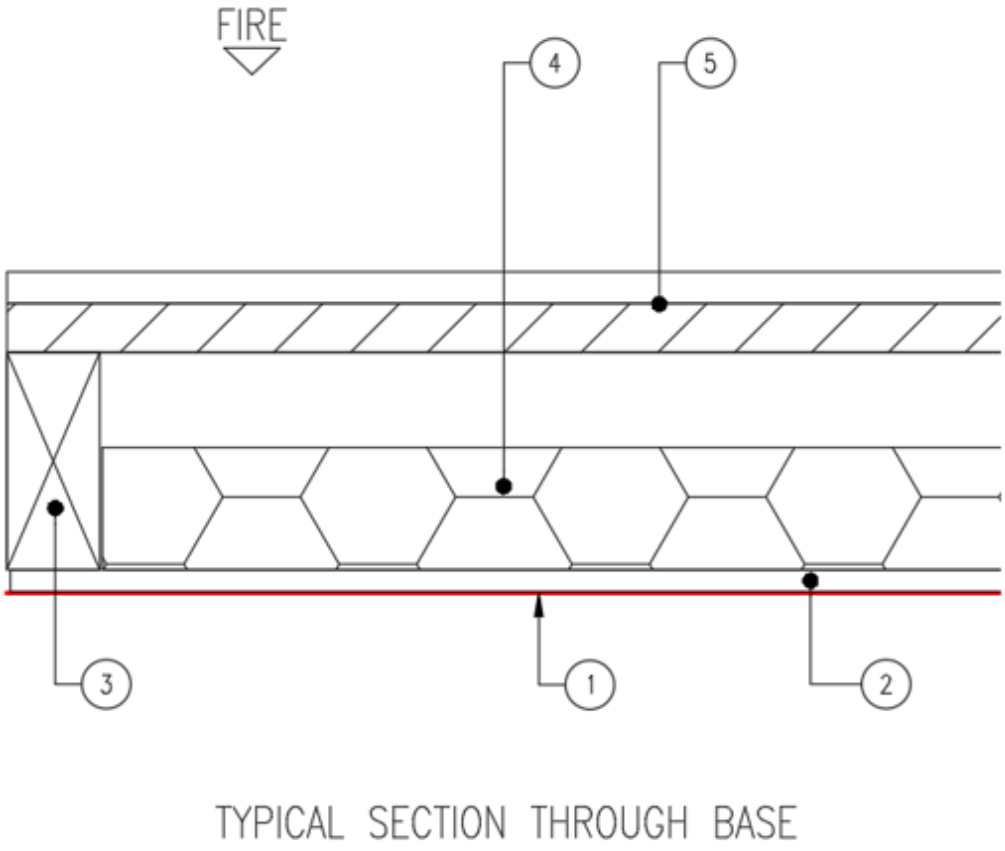


Drawing 2 – Details of the panel

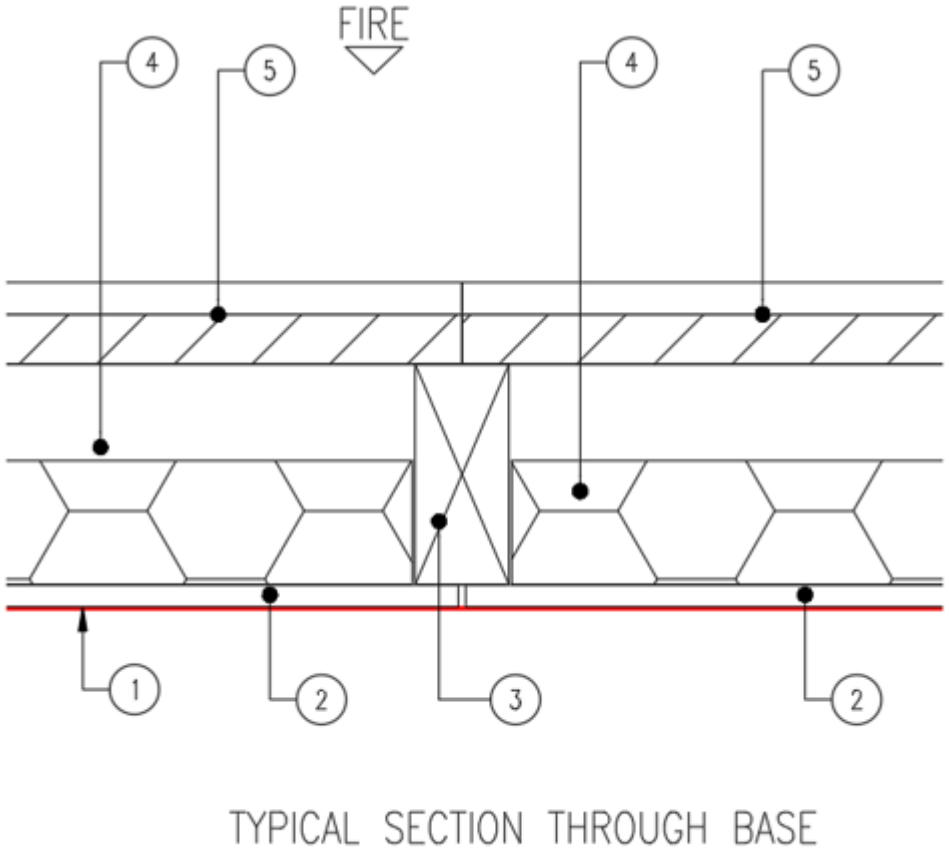


TYPICAL SECTION
THROUGH HEAD

Drawing 3 – Details of the panel



Drawing 4 – Details of the panel



Drawing 5 – Details of the panel

Schedule of Components

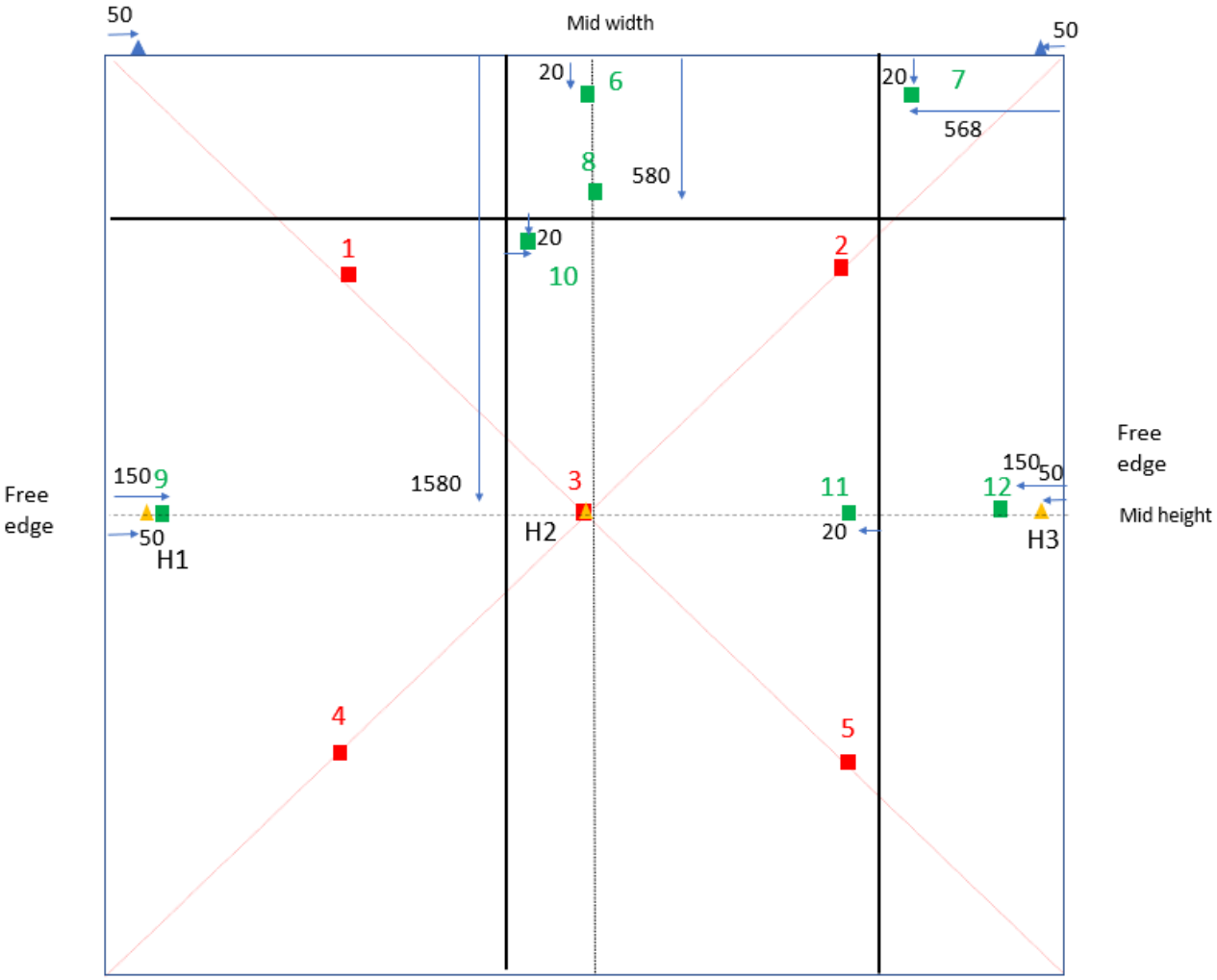
(Refer to Figures 1 to 5)
(All values are nominal unless stated otherwise)
(All other details are as stated by the sponsor)

Item		Description
1. Membrane		
Manufacturer	:	Kingspan
Reference	:	Nilvent
Material	:	Laminated 3-layer polyolefin
Thickness	:	0.4mm
Fixing method	:	White tape applied and then held in place with 71x10V2A staples fixed at 300mm centres.
2. External Facings		
Material	:	OSB (Oriental Strand Board)
Thickness	:	9mm
Fixing method	:	Through fixed into external timber framework (item 3)
Fixings		
i. manufacturer	:	Montana
ii. reference	:	FAWGS/SC2
iii. type	:	Circular smooth shank coil nails
iv. material	:	Galvanised Mild Steel
v. overall size	:	2.8mm diameter x 50mm long
vi. centres	:	150mm to the perimeter sections of the external framework (item 1) and 300mm centres to intermediate framework.
3. External Perimeter Framework		
Material	:	C16 grade Whitewood, softwood
Type	:	CLS (Canadian Lumber Standard)
Density	:	370 kg/m3 (stated)
Overall size	:	89 x 38mm
Jambs to head jointing method	:	Butted with the head and bottom rails running the full width of the panel.
i. manufacturer	:	Montana
ii. type	:	D34GSC
iii. material	:	Circular screw shank coil nails
iv. reference	:	Galvanised mild steel
v. overall size	:	3.1mm diameter x 88mm long
vi. quantity	:	2 number per joint
4. Panel Insulation		
Manufacturer	:	Kingspan Insulation Limited
Reference	:	Kooltherm K112 Framing Board
Material	:	Fibre free rigid thermoset phenolic core with aluminium foil faces.
Thickness	:	50mm
Density	:	38.24kg/m^3 (stated)
Fixing method	:	Friction fitted between vertical timber studs (and noggins) & the timber top and bottom rails.

Item		Description
5. Internal Liner Facings		
Manufacturer	:	Kingspan Insulation Limited
Reference	:	Kooltherm K118 Insulated Plasterboard
Material	:	Fibre free rigid thermoset phenolic insulation core bonded to a tapered edge gypsum based plasterboard.
Thickness	:	32.5mm overall (20mm insulation + 12.5mm plasterboard type A)
Compressive Strength	:	Typically exceeds 100kPa at 10% compression.
Fixing Method	:	
Fixings to perimeter framework		
i. manufacturer	:	Durspin
ii. reference	:	45A75MP
iii. type	:	Drywall Screws
iv. material	:	Mild Steel
v. overall size & centres	:	4.5mm diameter x 75mm long 300mm centres to all perimeter and intermediate timber work.

Name of layer	Brand name	Batch no	Density or weight of product	D.O.M	Thickness	Product standard
K118 insulated plaster board	Kingspan k118	8100459710	11.42kg / m2	11/01/22	32.5mm-20mm kooltherm insulation bonded to 12.5mm Gypsum board	BS EN 13950
K112	Kingspan k112	8100460540	38.24	14/01/22	50mm	BS EN 13166
Timber frame with K112 between	Stora Enso C16 CLS	783434	370	17/6/21	89mmx38mm	N/A
OSB	Norbord Sterling OSB3	IO 1060135	5.45kg /m2	10/01/22	9mm	BS EN 300
Breather membrane	Kingspan Nilvent (Tyvek)	FDX0119486	0.13kg / m2		0.4mm	BS EN 13859-2

APPENDIX B: INSTRUMENTATION



Thermocouples for average/maximum temperature rise (at least 50mm from hotspots)

Thermocouples maximum temperature rise (at least 20mm from hotspots)

Displacement gauges for horizontal deflection

Displacement gauges for vertical deflection

APPENDIX C: CHARTS

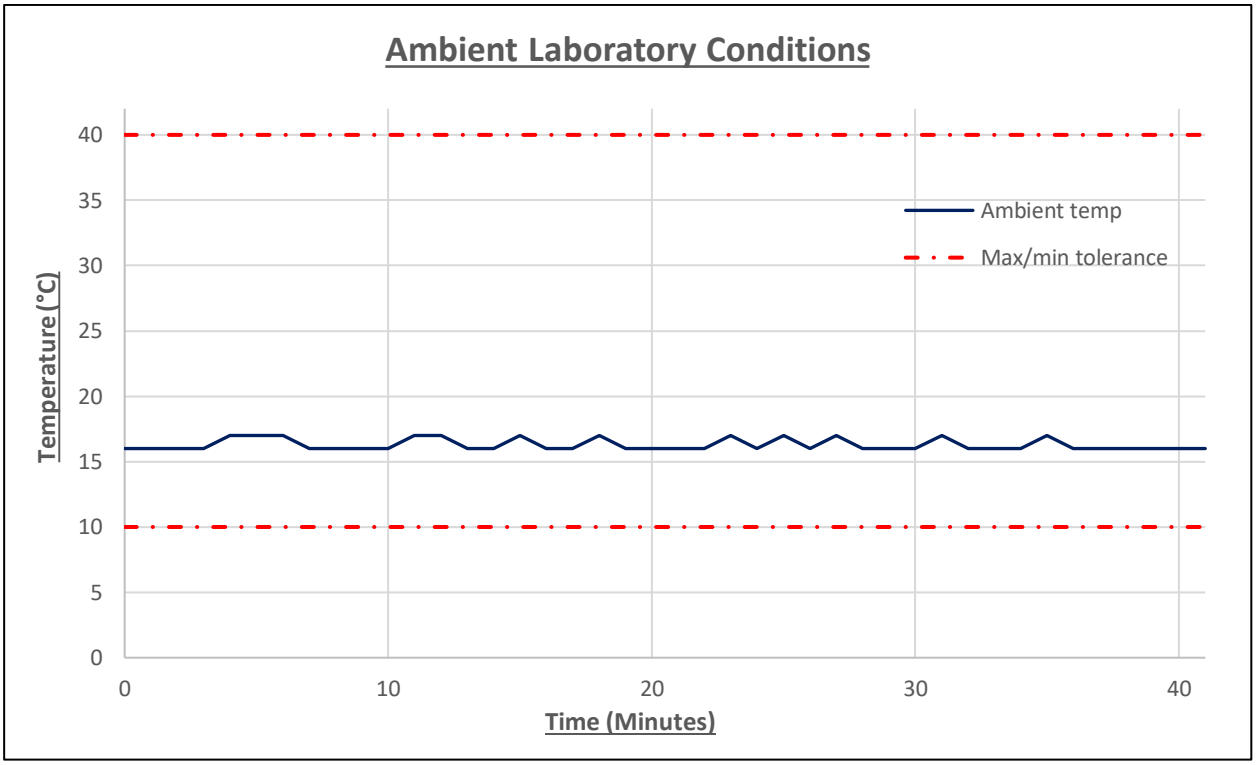


Chart 1 – Ambient temperature in the lab

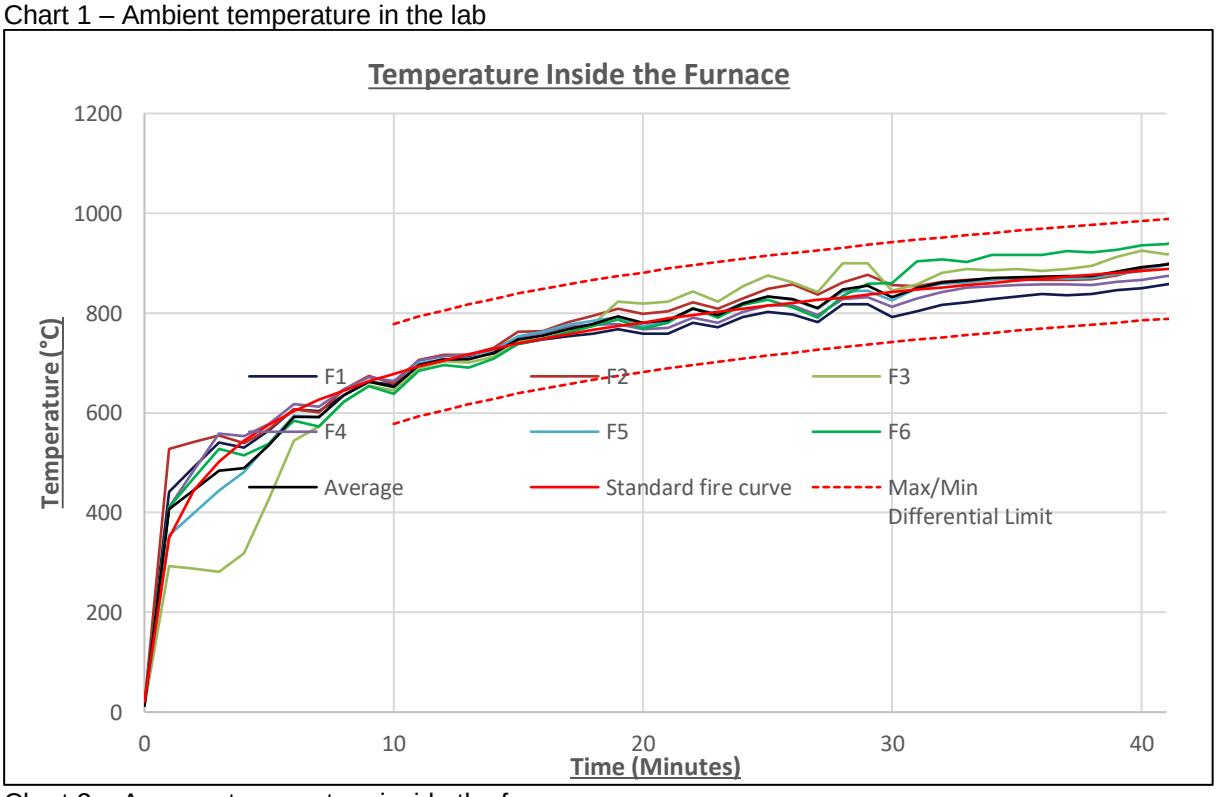


Chart 2 – Average temperature inside the furnace

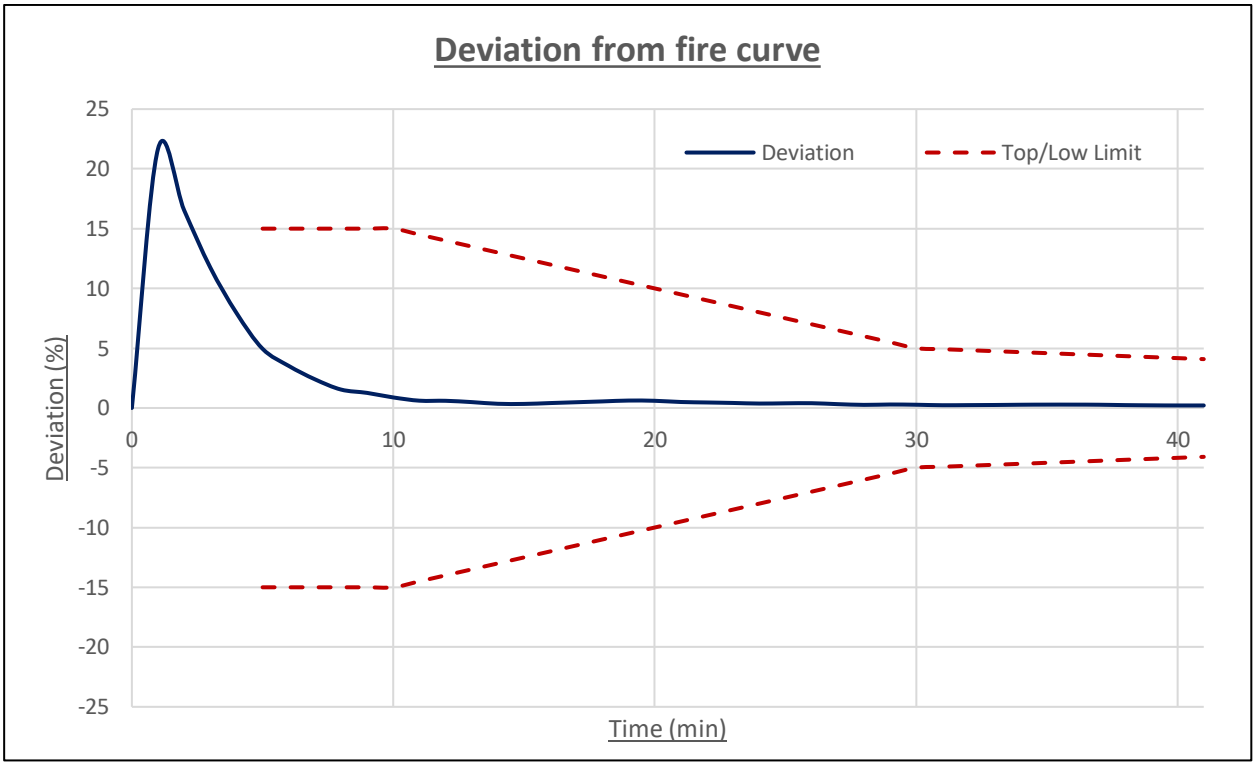


Chart 3 – Deviation of the average furnace temperature from the standard thermal curve

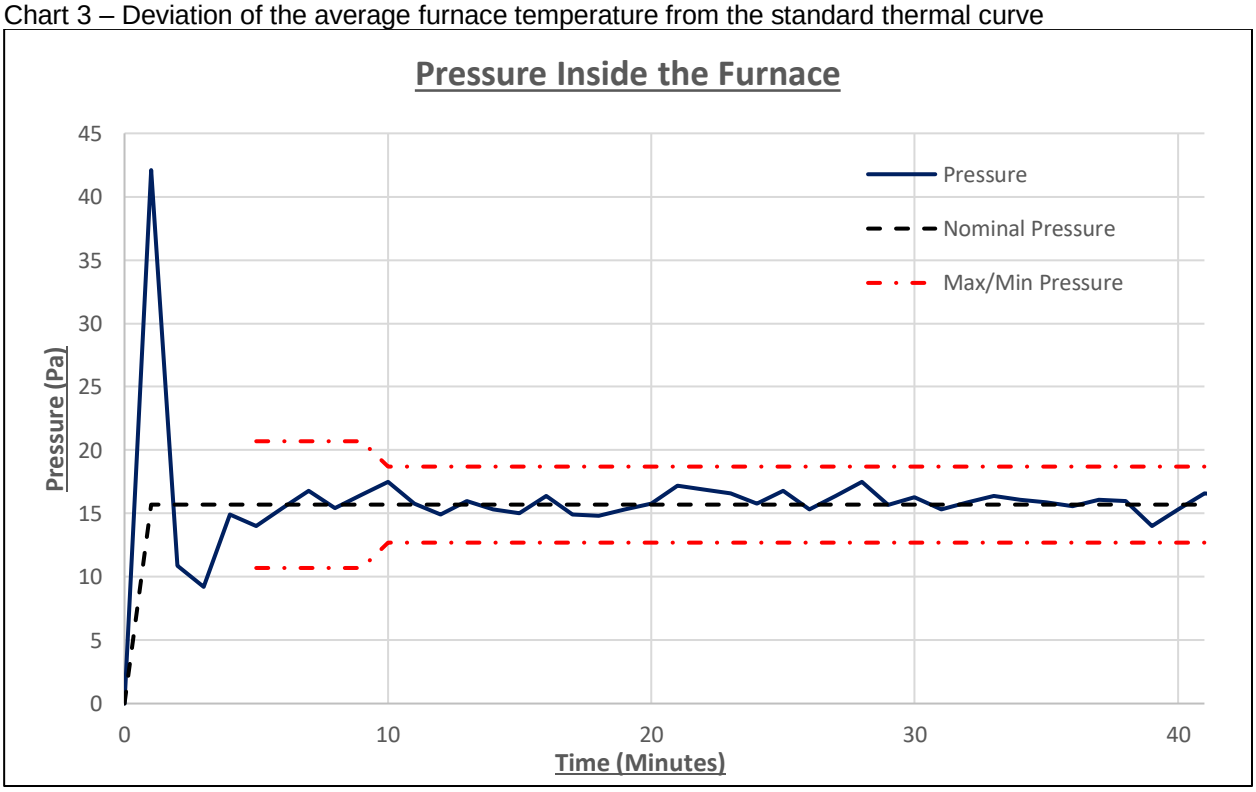


Chart 4 – Pressure inside the furnace

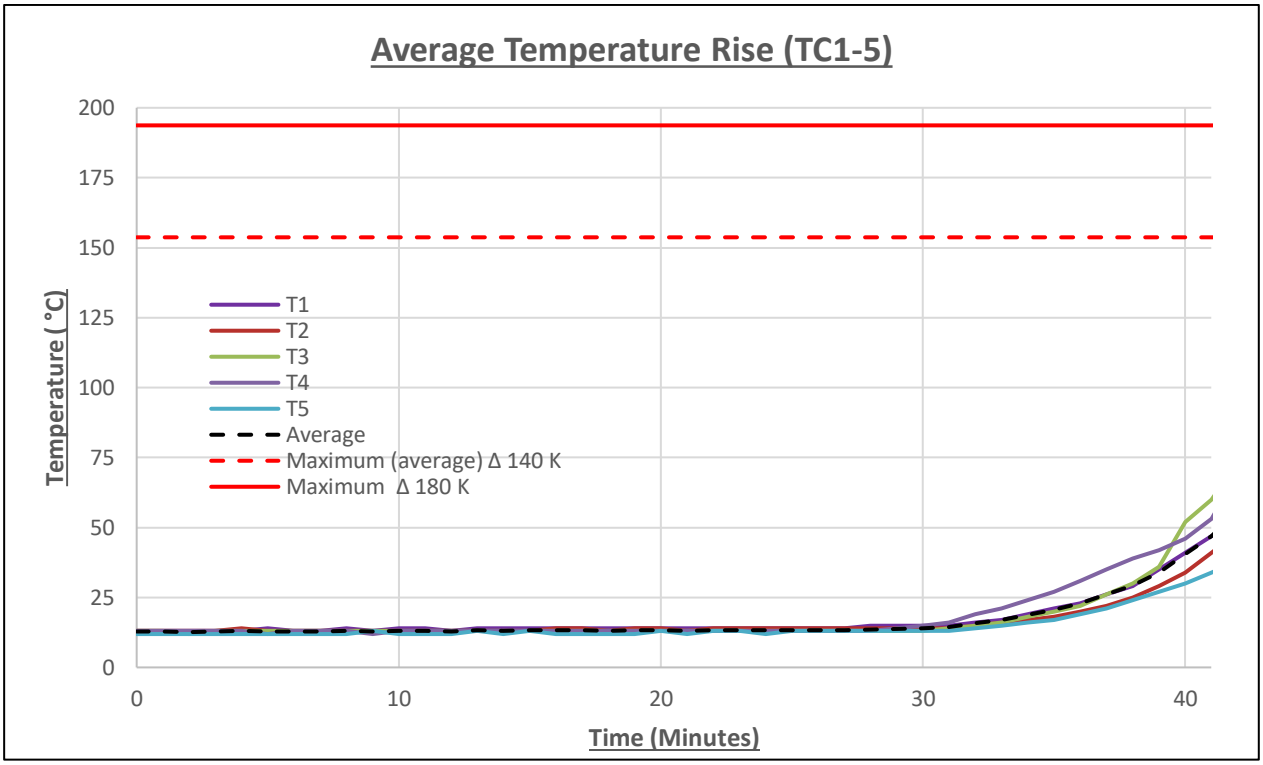


Chart 5 – Average temperature of the unexposed surface

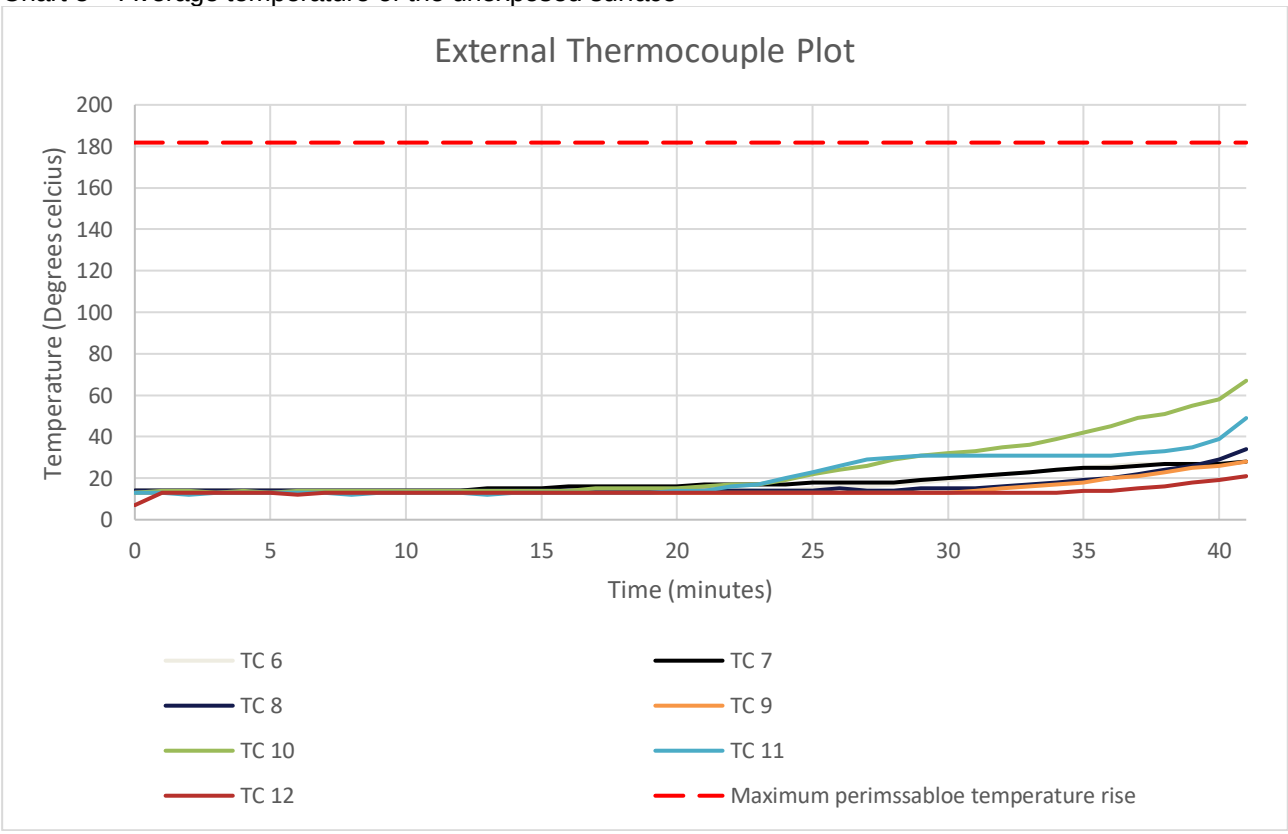


Chart 6 – Maximum temperature rise of the unexposed side

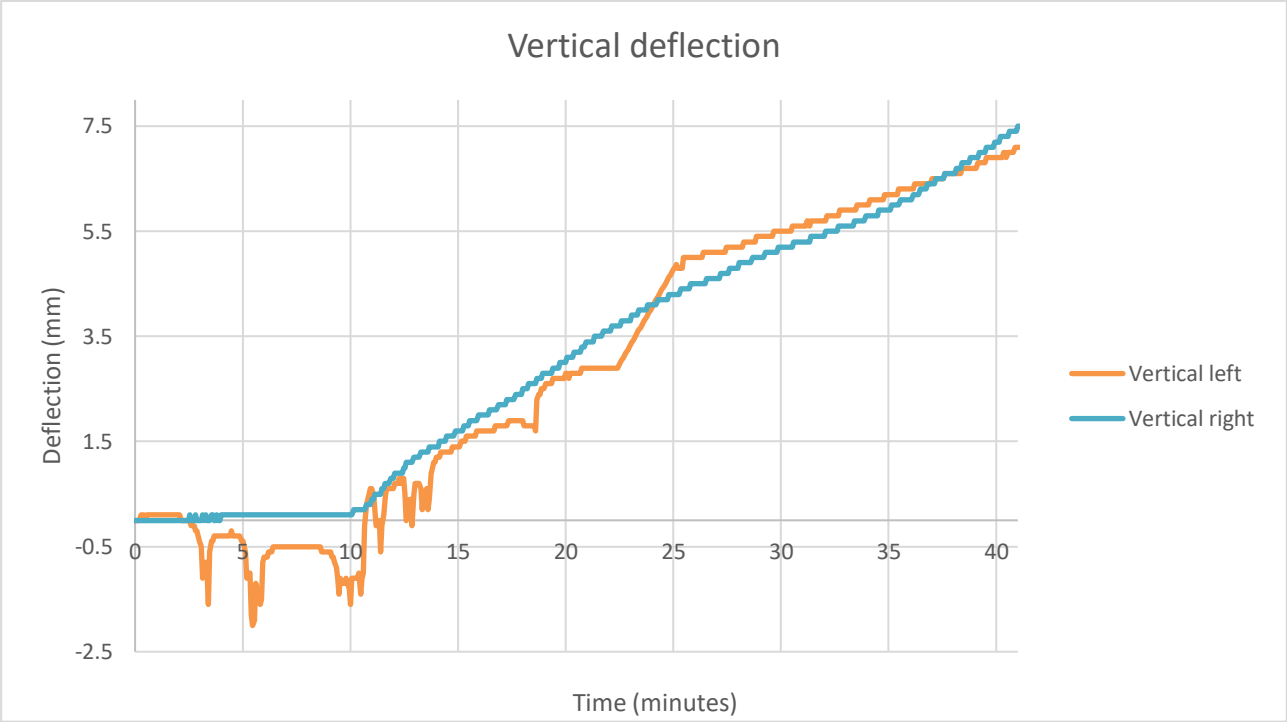


Chart 7 – Vertical deflection measurements of the LVDTs

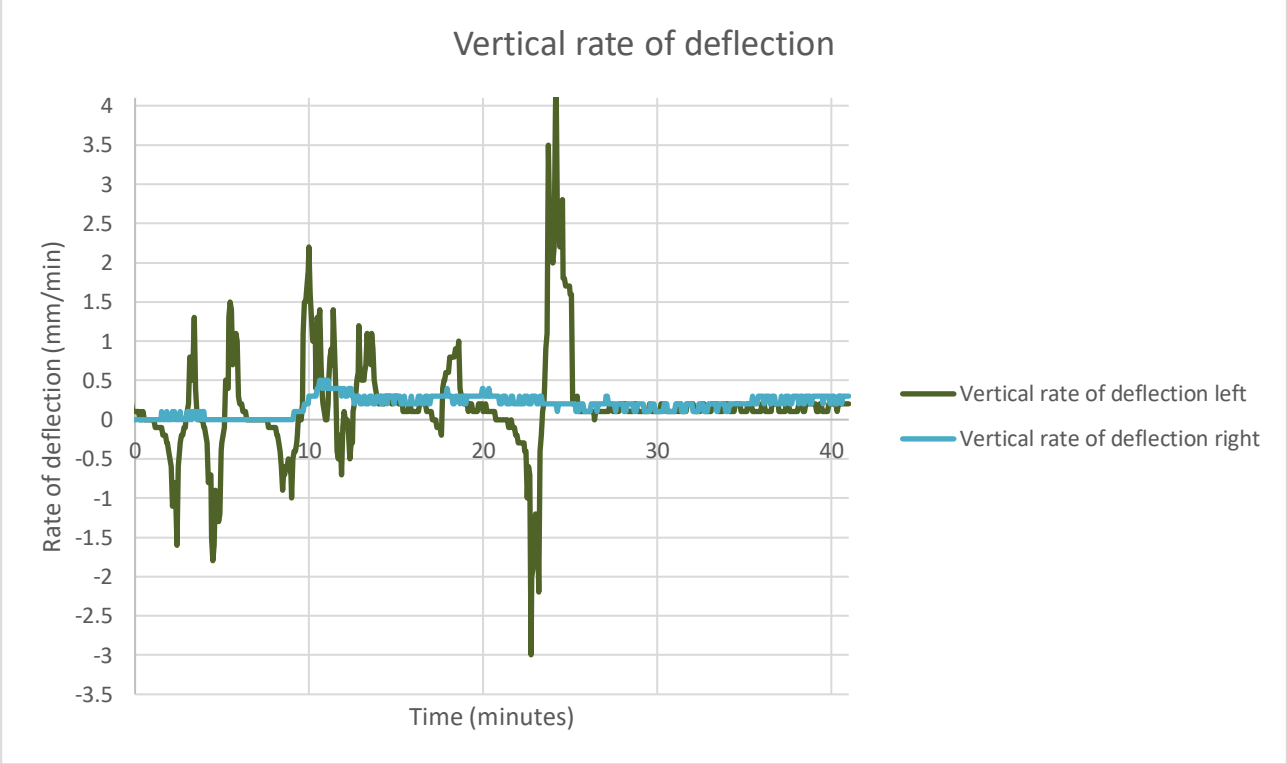


Chart 8 – Vertical rate of deflection

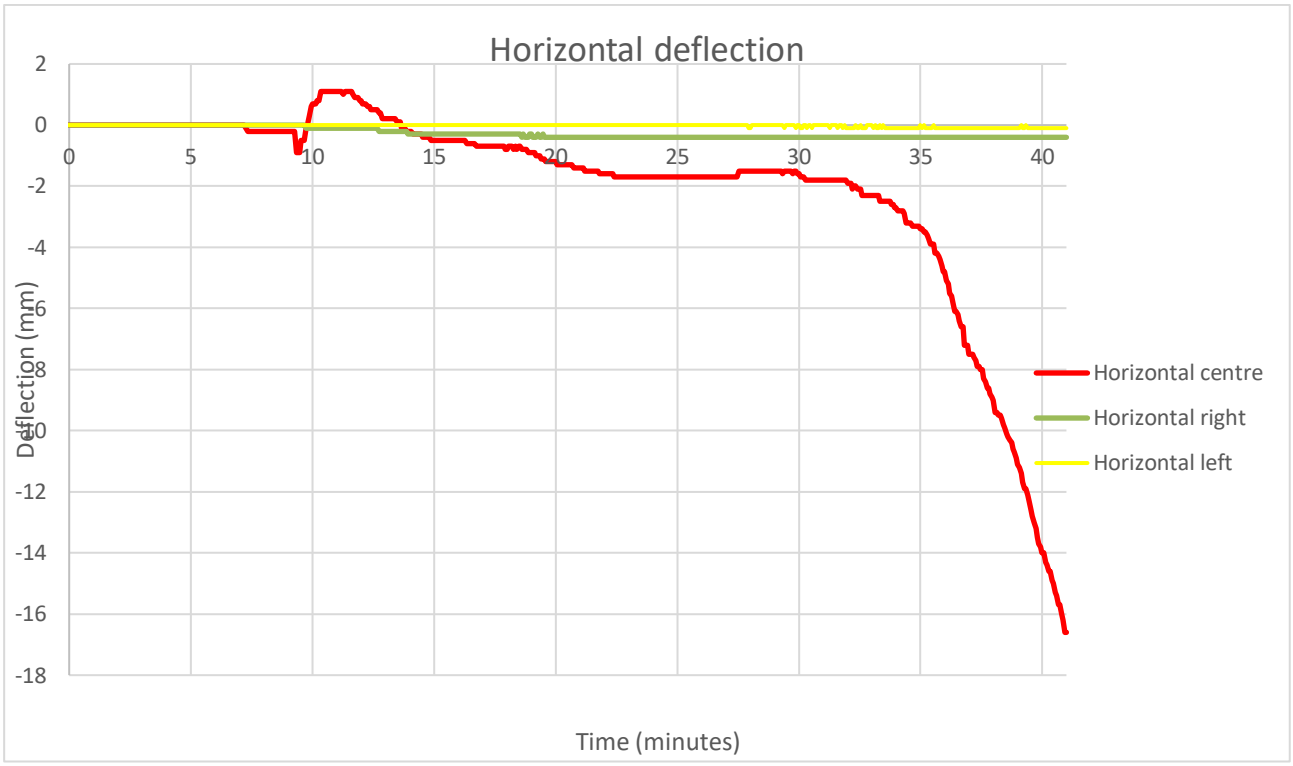


Chart 9 – Horizontal deflection measurements

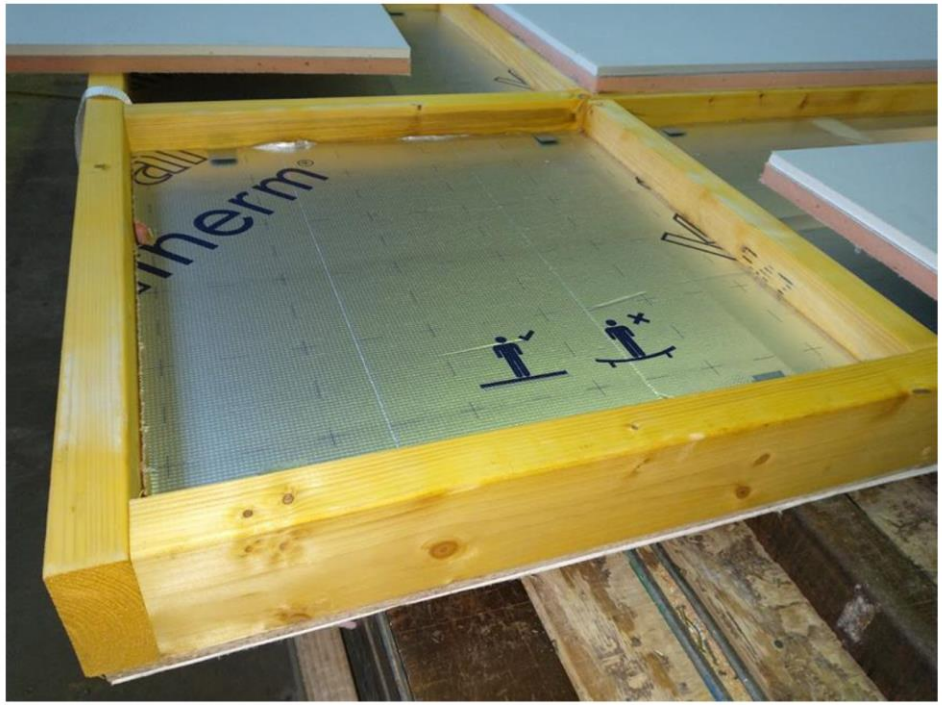
APPENDIX D: PHOTOGRAPHS

The following photos were supplied by Kingspan to allow Efectis to inspect the build of the sample

- Timber frame assembled complete with OSB and Nilvent Breather Membrane

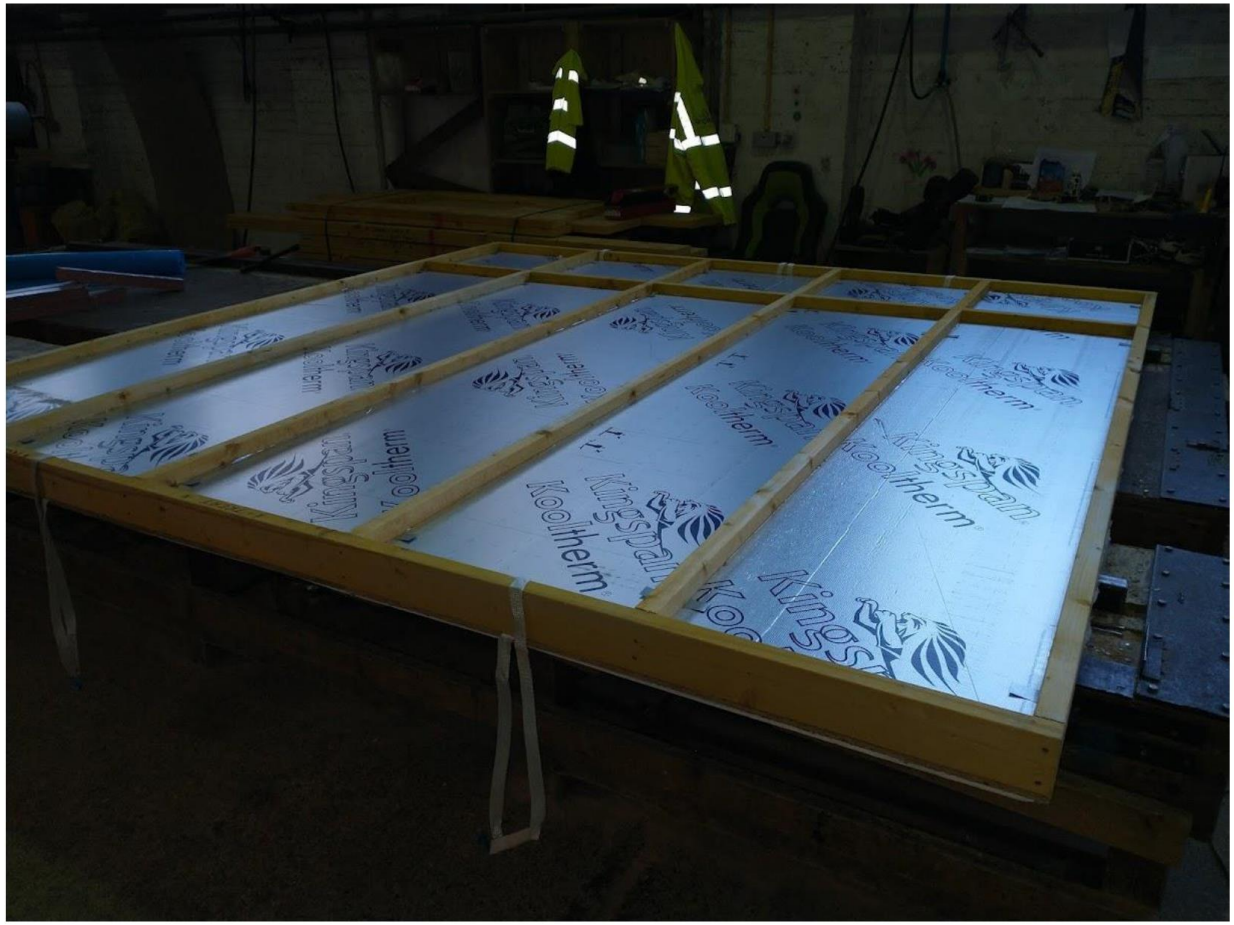
Photograph 1 – View of the construction of the timber frame

- K112 Insulation fitted between studs



Photograph 2 – View of the insulation being fitted between the studs

- Studwork complete with OSB, Nilvent and K112 Insulation



Photograph 3- View of the frame complete with OSB, Nilvent membrane layer and K112 insulation

- K118 Insulated Plasterboard being fitted

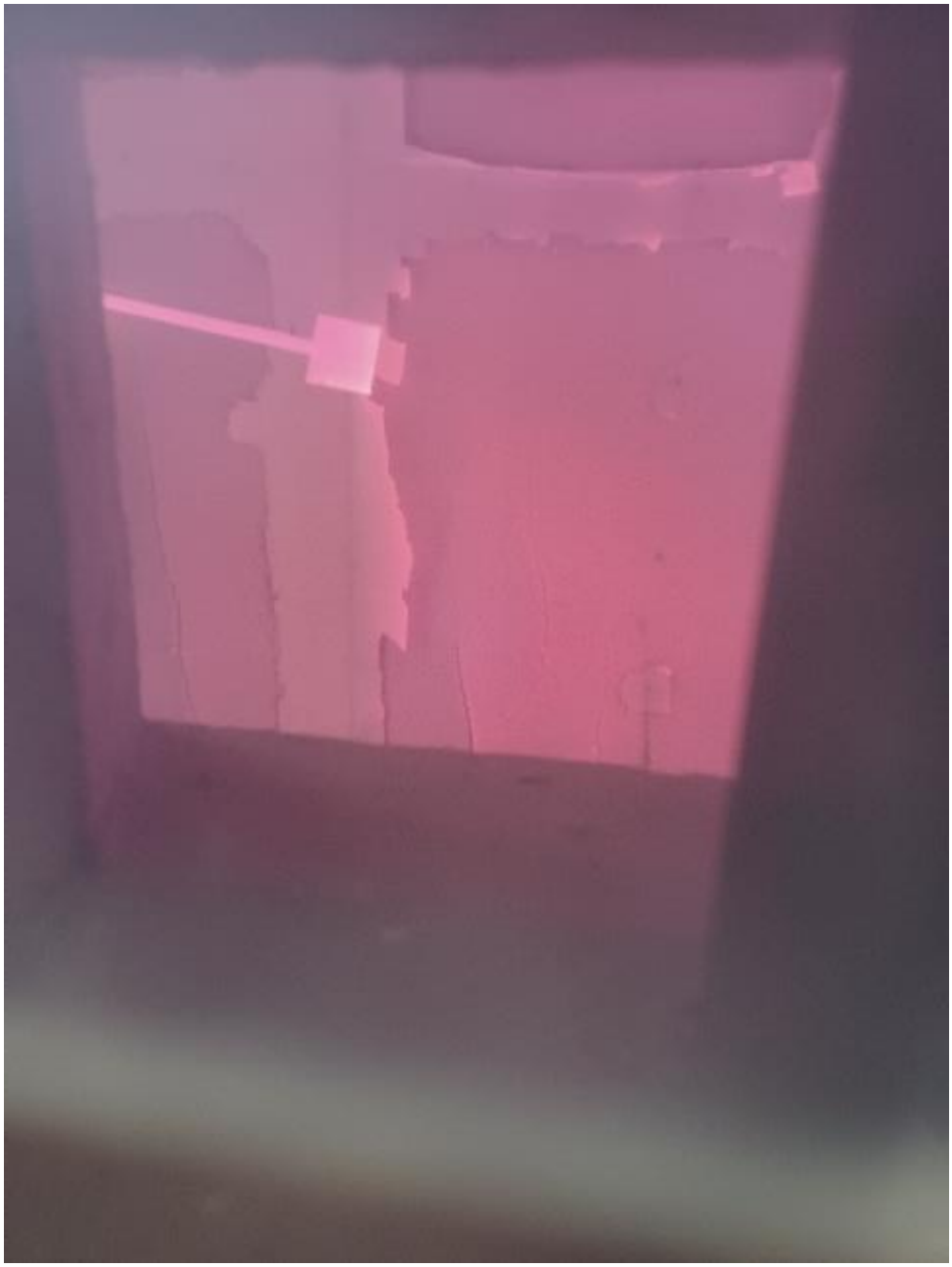
Photograph 4 – View of the insulated plasterboard being fitted to the frame

- Completed wall panel pre tape and joint

Photograph 5 – View of the completed sample, prior to applying tape and jointing compound

Photograph 6 – view of the exposed side of the sample prior to the test

Photograph 7 – View of the unexposed side of the sample prior to the test



Photograph 8 - View of the exposed side at 11 minutes. Note the vertical cracks forming

Photograph 9 - View of the exposed aide at 17 minutes. Note the flaming and increased size of the cracks

Photograph 10 - View of the sample at 19 minutes. Note the boards detaching

Photograph 11 - View of the unexposed side at 37 minutes. Note the visible deflection.

Photograph 12 - View of the unexposed side of the sample after the test.

Photograph 13 - View of the exposed side of the sample after the test.

END OF TEST REPORT