



FIRE TEST REPORT

FR6289-01-2

FIRE RESISTANCE TEST OF A RESENE CONSTRUCTION LOAD-BEARING INTER-TENANCY WALL SYSTEM

CLIENT

Rockcote Resene Limited T/A Resene Construction Systems
5 Venture Place
Middleton
Christchurch, 8024
New Zealand



All tests and procedures reported herein, unless indicated, have been performed in accordance with the laboratory's scope of accreditation



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TEST SUMMARY

Objective

To determine the fire resistance of a Resene Construction Systems load-bearing inter-tenancy wall system, constructed with timber studs and lined with Integra 50 mm thick Autoclaved Aerated Concrete (AAC) panels to the exposed face and 10 mm thick GIB® Standard plasterboard to the unexposed face, when tested in accordance with AS 1530.4:2014 “Methods for fire tests on building materials, components and structures, Part 4: Fire-resistance test of elements of construction.”

Test Sponsor

Rockcote Resene Limited T/A Resene Construction Systems
5 Venture Place
Middleton
Christchurch, 8024
New Zealand

Description of Test Specimen

The test specimen consisted of a wall nominally 3,000 mm high x 3,000 mm wide. The wall frame was timber studs and lined with Integra 50 mm thick Autoclaved Aerated Concrete (AAC) panels to the exposed face and 10 mm thick GIB® Standard plasterboard to the unexposed face. A uniformly distributed axial load of 18 kN (4.5 kN/stud) was applied to the specimen.

Four indicative service penetrations were put through the unexposed plasterboard into the cavity. They were representative of the following services:

1. A light switch fixture
2. A general purpose outlet
3. A sink waste
4. A tap supply

Date of Test

25 July 2018

Test Results

The test results in accordance with AS 1530.4:2014, “Methods for fire tests on building materials, components and structures – Part 4: Fire – resistance test of elements of construction” was as follows:

Structural adequacy	125 minutes	No Failure
Integrity	125 minutes	No Failure
Insulation	125 minutes	No Failure

The tested specimen is deemed to have achieved an FRL of 120/120/120

The service penetrations, as installed in the specimen, did not prejudice the wall system for the duration of the 125 minute test.



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The test standard requires the following statements to be included:

"The results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions."

"This report details methods of construction, the test conditions and results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variations 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."

LIMITATIONS

The results reported here relate only to the item/s tested.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.



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TO WHOM IT MAY CONCERN

Both NATA (National Association of Testing Authorities, Australia) and IANZ (International Accreditation New Zealand) are signatories to the ILAC Mutual Recognition Arrangement. Under the terms of this arrangement, each signatory:

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- (ii) accepts, for its own purposes, endorsed* certificates or reports issued by organisations accredited by other signatories on the same basis as it accepts endorsed* certificates or reports issued by its own accredited organisations,
- (iii) recommends and promotes the acceptance by users in its economy of endorsed* certificates and reports,

* The word "endorsed" means a certificate or report bearing an Arrangement signatory's accreditation symbol (or mark) preferably combined with the ILAC-MRA Mark.

Signed:

Jennifer Evans
NATA CEO

Date: 24 March 2014

Dr Llewellyn Richards
IANZ CEO

Date: 24th March 2014



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1. TEST PROCEDURE

The test was conducted in accordance with AS 1530.4:2014 “*Methods for fire tests on building materials, components and structures, Part 4: Fire-resistance tests of elements of construction, Section 4*”, for which the fire resistance of the specimen is the time, expressed in minutes, to failure under one or more of the following criteria.

1.1 Structural Adequacy Failure Criteria

Failure in relation to structural adequacy shall be deemed to have occurred when collapse occurs, or when the following occurs the criteria for axially loaded elements has been exceeded:

Limiting axial contraction, $C = \frac{h}{100}$ mm; and

Limiting rate of axial contraction, $\frac{dC}{dt} = \frac{3h}{1,000}$ mm/min

where

h = initial height.

For the test specimen the limiting axial contraction was 30 mm and the limiting rate of axial contraction was 9 mm per minute.

1.2 Integrity Failure Criteria

Failure shall be deemed to occur upon collapse, the development of cracks or fissures, or other openings develop through which flames or hot gases can pass. Failure is defined when any of the following occurs:

- (a) A cotton pad in its frame applied against the surface of the test specimen over any crack, fissure or flaming under examination, until ignition of the cotton pad (defined as glowing or flaming) for a maximum of 30 seconds.
- (b) Gap gauges employed, in turn, without undue force to determine when -
 - a. a 6 mm gap gauge can be passed through the specimen so that the gap gauge projects into the furnace and can be moved a distance of 150 mm along the gap, or,
 - b. a 25 mm gap gauge can be passed through the specimen so that the gap gauge projects into the furnace.
- (c) Sustained flaming on the surface of the unexposed face for 10 seconds or longer constitutes integrity failure.



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1.3 Insulation Failure Criteria

Failure in relation to insulation shall be deemed to have occurred if:

- (a) the mean temperature of the relevant thermocouples attached to the unexposed face of the specimen rises by more than 140 K above the initial temperature; or,
- (b) the maximum temperature anywhere on the unexposed surface rises more than 180 K above the initial temperature.

2. DESCRIPTION OF TEST SPECIMEN

2.1 General

The test specimen consisted of a wall nominally 3,000 mm high x 3,000 mm wide. The wall frame was timber studs and lined with Integra 50 mm thick Autoclaved Aerated Concrete (AAC) panels to the exposed face and 10 mm thick GIB® Standard plasterboard to the unexposed face. A uniformly distributed axial load of 18 kN (4.5 kN/stud) was applied to the specimen.

One half of the inter-tenancy wall system was tested. This was considered worst case as having another set of framing and plasterboard on the exposed side would provide more protection to the Integra AAC panel.

2.1.1 Conditioning

Framing of the wall occurred on 23 July 2018. The exposed side linings were applied over 23 and 24 July 2018. The unexposed side lining was applied on 24 July 2018. The wall was left under ambient laboratory conditions until testing on 25 July 2018.

2.1.2 Specimen Selection

BRANZ was not responsible for any construction and was not involved in the selection, or installation of the specimen.

2.2 Plans and Specification

Details of the tested specimens are held on file by BRANZ. All dimensions are nominal unless otherwise stated. Where discrepancies between the dimensions in the report text and those shown in the attached drawings exist, the report takes precedence.

2.3 Construction

2.3.1 Framing

The framing was SG8 with profile dimensions of 45 mm x 90 mm. Top and bottom plates, 3,000 mm long, were bolted to the concrete aperture of the furnace specimen holder with M16 bolts. Four studs of 2,910 mm length were evenly spaced at 600 mm centres and nailed to the top and bottom plates. Each vertical side of the specimen holder had a 2,710 mm long piece of timber temporarily bolted on top of a 13 mm thick strip of ceramic fibre with two M12 bolts (the bolts were removed after the exposed face lining and before the unexposed face lining were applied). Three sets of noggins were placed at 800 mm, 1,600 mm and 2,300 mm vertical



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centres, between the studs, as shown in Figure 2. No sample was provided to determine the moisture content of the framing. There was no indication of excess moisture present.

2.3.2 GIB® Standard Plasterboard

The unexposed face of the wall was lined with panels of 10 mm thick GIB® Standard plasterboard. The panels were fastened to the timber framing with 32 x 6g GIB® Grabber® high thread drywall screws at 300 mm centres. A horizontal butt joint was included in the central full board 2,400 mm from the sill.

The GIB® Standard plasterboard had the following measured properties:

Measured weight per unit area	6.6	kg/m ²
Measured moisture content by weight	1.39	%

2.3.3 Integra AAC Panel

The Integra AAC panels were 2,200 mm long by 600 mm high by 50 mm thick. The panels were installed horizontally as shown in Figure 2.

The Integra AAC panels had the following measured properties:

Measured weight per unit area	32.7	kg/m ²
Measured moisture content by weight	15.9	%

A 25 mm gap was left between the top of the AAC panels and the test frame, to allow the framing to take the load, not the panels. The gap was loosely packed with mineral insulation to prevent furnace gases from passing through.

2.3.3.1 Fixing Brackets

The panels were fixed to the framing with aluminium brackets. The angle brackets measured 75 mm x 50 mm x 3 mm thick and were 50 mm wide. At each face of the brackets a piece of silicon was fixed with adhesive to minimise sound transmission. Each panel was held in place with two brackets, one at each end at approximately mid-height of the panel.

The panels were pre-drilled and 14-10 x 75 mm Timber Roofing Type 17 hex head screws with seals were driven through from the exposed face into the 50 mm x 50 mm face of the brackets.

A 25 mm gap was left between the panels and the framing. 12-11 x 45 mm Timber Roofing Type 17 hex head screws with seals were used to fix the 75 mm x 50 mm face of the bracket to the framing, as shown in Photo 1.

2.3.3.2 Adhesive

The panels were fixed to each other with PSL Plaster Systems AAC Adhesive along the horizontal joints and up the vertical joints between panels. There was no adhesive used up either side of the specimen to allow the panels to move with the framing as the wall structure was displaced.

2.3.4 Penetrations

Four indicative penetrations were put through the unexposed plasterboard lining into the cavity. The services did not pass through the Integra AAC panels.



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2.3.4.1 Light Switch

An 80 mm high by 50 mm wide hole was cut through the 10 mm GIB® Standard, centred 1,380 mm up from the sill and adjacent to the stud 600 mm from the left-hand side of the specimen. A plastic flushbox was screwed to the stud at the location and a switch plate screwed on, to be representative of a standard light switch installation.

2.3.4.2 GP Outlet

An 80 mm high by 50 mm wide hole was cut through the 10 mm GIB® Standard, centred 360 mm up from the sill and adjacent to the stud 600 mm from the left-hand side of the specimen. A plastic flushbox was screwed to the stud at the location and a switch plate screwed on, to be representative of a standard GPO installation.

2.3.4.3 DN32 uPVC Waste Pipe

A 32 mm diameter hole was cut through the 10 mm GIB® Standard, centred 310 mm up from the sill and 950 mm from the right-hand side of the specimen. A short length (approximately 200 mm) of 32 mm uPVC DWV pipe was passed through into the cavity, with approximately 100 mm each side of the lining. The pipe was held in place with acrylic sealant. The inner end of the pipe was plugged with mineral wool. This was to represent a sink waste penetrating into the cavity.

As the pipe was not penetrating the Integra AAC panels, integrity was not considered to be a potential failure mode and therefore it was not considered necessary to extend the pipe 2,000 mm from the unexposed lining.

2.3.4.4 DN16 Pex Water Pipe and Brass Fitting

A 20 mm diameter hole was cut through the 10 mm GIB® Standard, centred 490 mm up from the sill and 950 mm from the right-hand side of the specimen.

An additional back-blocking of 90 mm x 45 mm timber was nailed between the studs at the location.

A 16 mm x ½" BSP x 100 mm extended brass male wingback was screwed to the back-blocking. A short length (approximately 300 mm) of 16 mm Pex pipe was crimped to the wingback fitting inside the cavity. The brass pipe extended approximately 80 mm out from the unexposed face of the lining. The annular gap was filled with acrylic sealant. The inner end of the pipe was left open. This was to represent a tap supply penetrating into the cavity.

As the pipe was not penetrating the Integra AAC panels, integrity was not considered to be a potential failure mode and therefore it was not considered necessary to extend the pipe 2,000 mm from the unexposed lining.



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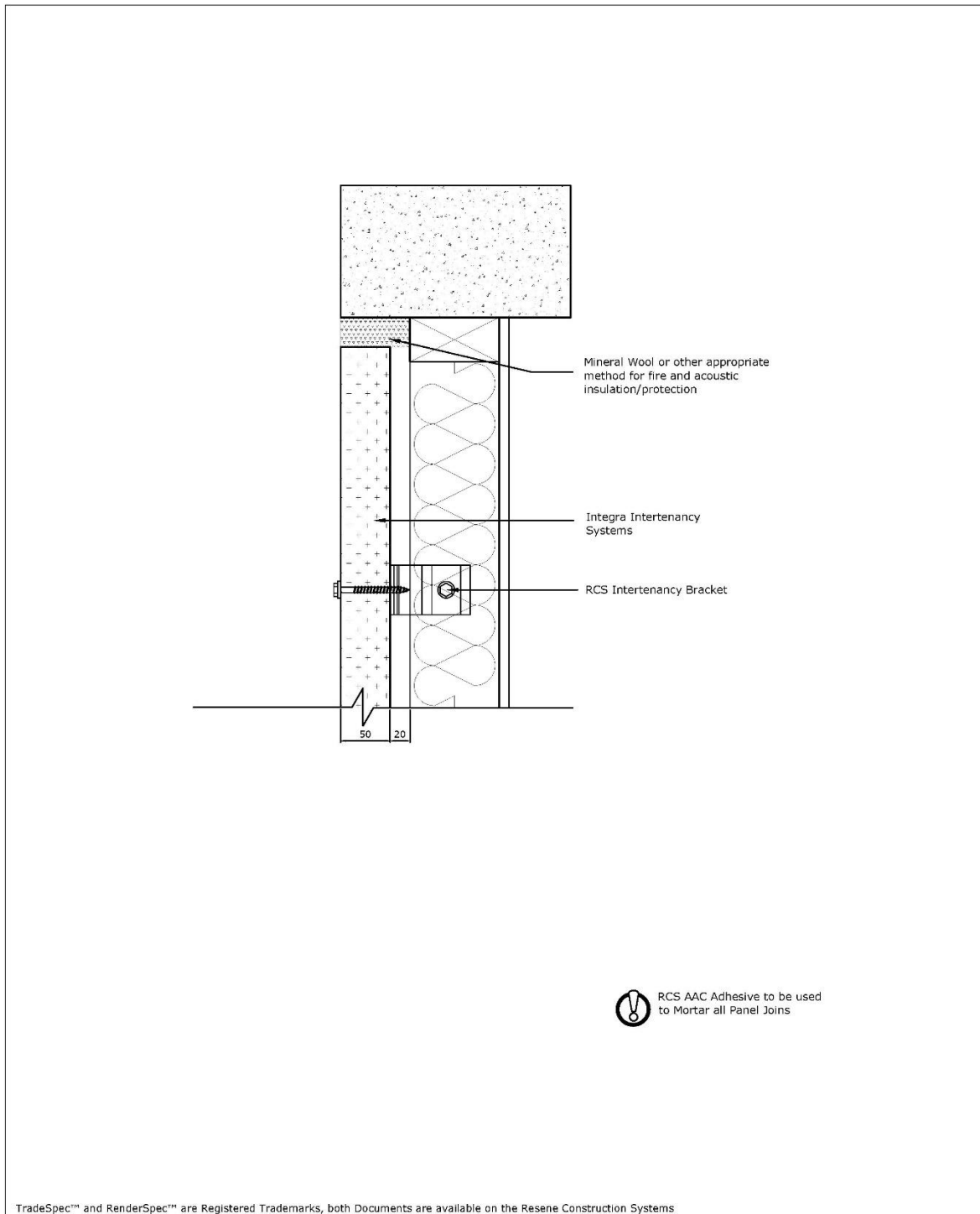
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Figure 1: Cross Section Drawing of Wall



 <p>Resene Construction Systems</p> <p><small>CONFIDENTIALITY: No part of this publication may be reproduced or transmitted other than the intended use by Resene Construction Systems without written consent from the author.</small></p>	System	Scale
	Intertenancy Firewall Test	1 : 2 @ A4
	Drawing Name	Date
	Head	16 July 2018
		Sheet
		###



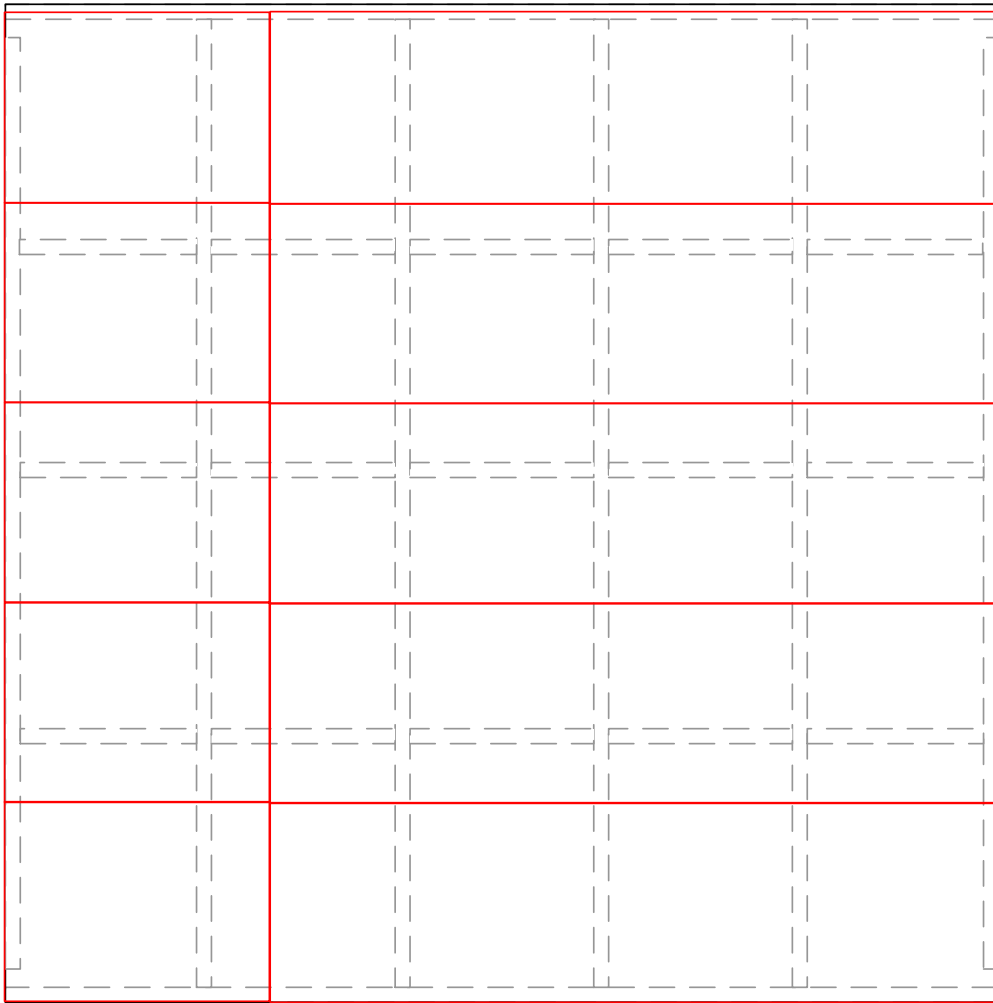
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Figure 2: Elevation of the Wall, Viewed from the Exposed Side



 Integra AAC panel boundaries

3. TEST CONDITIONS AND RESULTS

3.1 General

The specimen was tested on 25 July 2018, at the BRANZ laboratories at Judgeford, New Zealand in the presence of the client.

The ambient temperature at the beginning of the test was 10 °C.

The specimen was placed against the vertical furnace and the temperature and pressure conditions were controlled to the limits defined in AS 1530.4:2014.

The test was terminated after the specimen had been exposed to the standard fire resistance conditions for 125 minutes.

3.2 Furnace Conditions

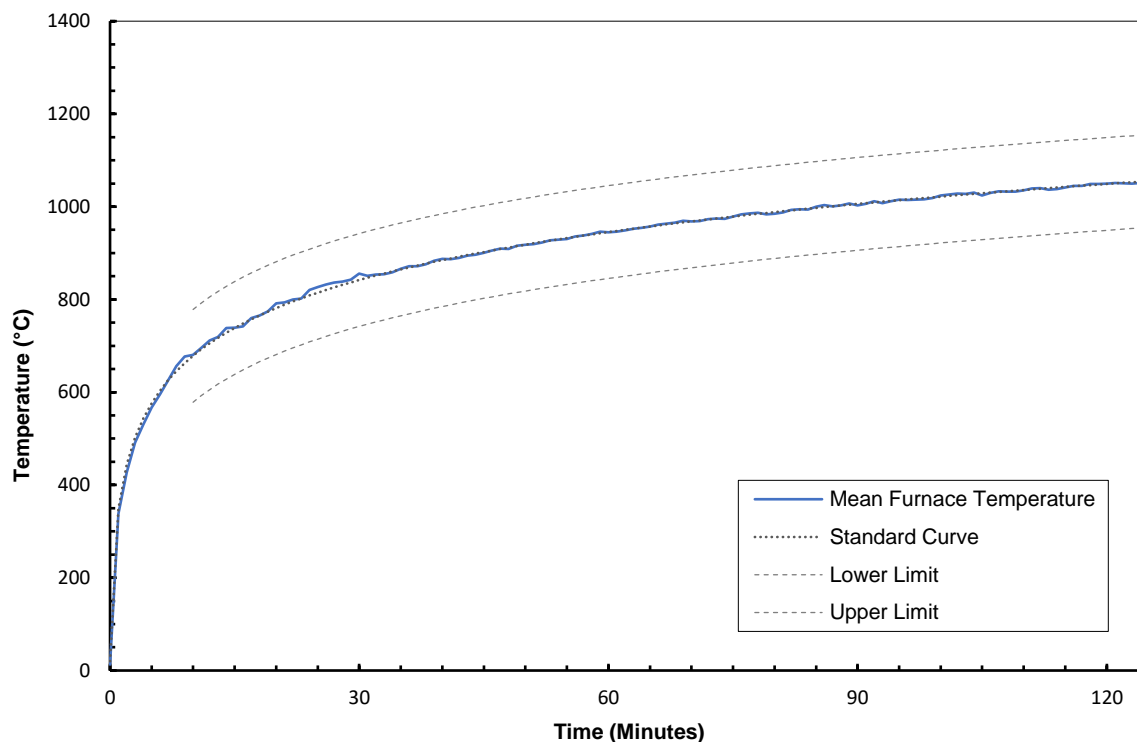
3.2.1 Furnace Temperature Measurement

Temperature measurement within the furnace was made using twelve mineral insulated metal sheathed (MIMS) chromel-alumel thermocouples uniformly distributed in a vertical plane approximately 100 mm from the exposed face of the specimen.

The furnace thermocouples were connected to a computer controlled data logging system which recorded the temperatures at 15 second intervals.

Figure 3 shows the furnace temperature curve and the permitted upper and lower limits in accordance with AS 1530.4:2014.

Figure 3: Furnace Temperature



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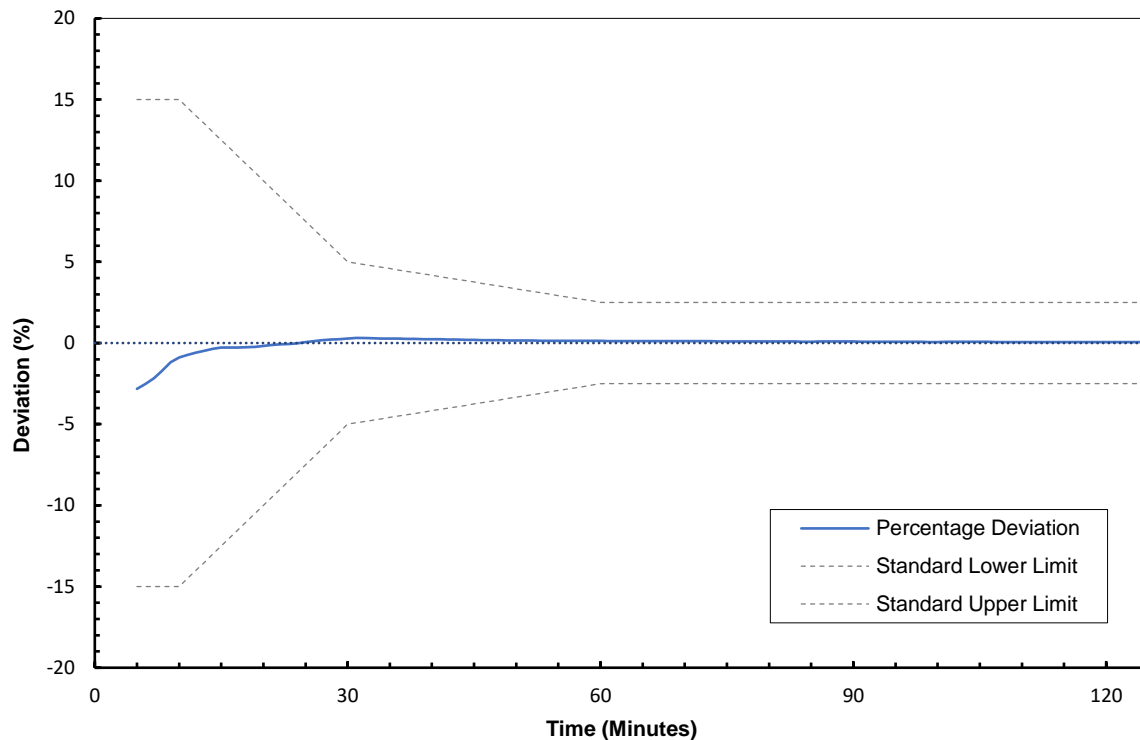
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3.2.2 Furnace Control

The percentage deviation of the area of the furnace mean temperature from the standard temperature/time curve was within the standard requirements.

Figure 4 shows the percentage deviation of the mean furnace temperature from the Standard curve.

Figure 4: Percentage Deviation from Standard Curve

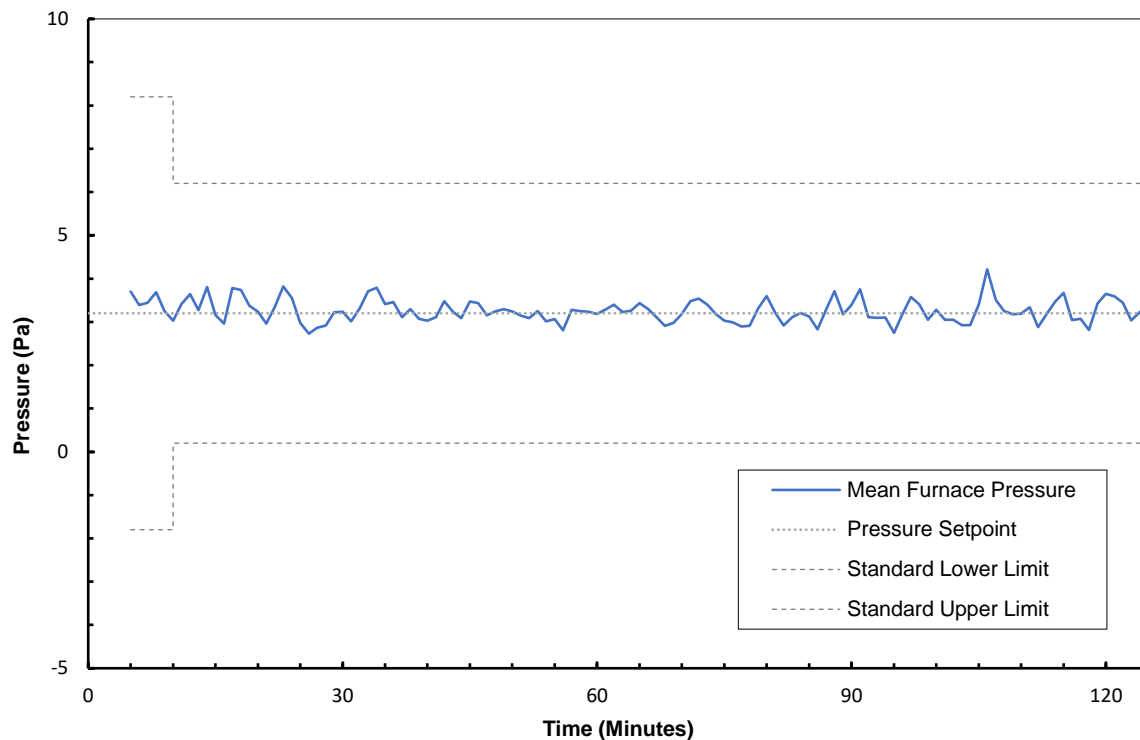


3.2.3 Pressure Measurements

The differential pressure of the furnace above the laboratory atmosphere was controlled to be 0 Pa at 500 mm above the notional floor which corresponds to 3.2 Pa at the pressure probe in the furnace. The differential pressure was monitored using a micromanometer connected to a computer controlled data logging system which recorded the pressure at 15 second intervals. Figure 5 shows the furnace pressure variation with time.

The pressure was set based on the wall test criteria, not the service penetrations, which would have required the pressure to be 15 Pa at 310 mm above the notional floor of the furnace (halfway up the lowest penetration).

Figure 5: Furnace Pressure



The furnace pressure met the requirements of the standard for the duration of the 125 minute test.

3.3 Specimen Temperature Measurement

The temperature on the unexposed face of the test specimen was measured using chromel-alumel thermocouples mounted on copper discs and covered with insulating pads, in accordance with clause 2.2.3 of the test standard. The thermocouples were placed on the wall as shown in Figure 6.

The thermocouples relevant to the Insulation failure criteria are represented as black dots and have their corresponding thermocouple numbers written next to them. Extra thermocouples were included on the unexposed face of the Integra AAC panels and exposed face of the GIB® Standard plasterboard and are represented as white dots with a black outline. The deflection points are represented as crosses and have their corresponding letters labelled. Additional thermocouples were also fixed to two of the aluminium fixing brackets.

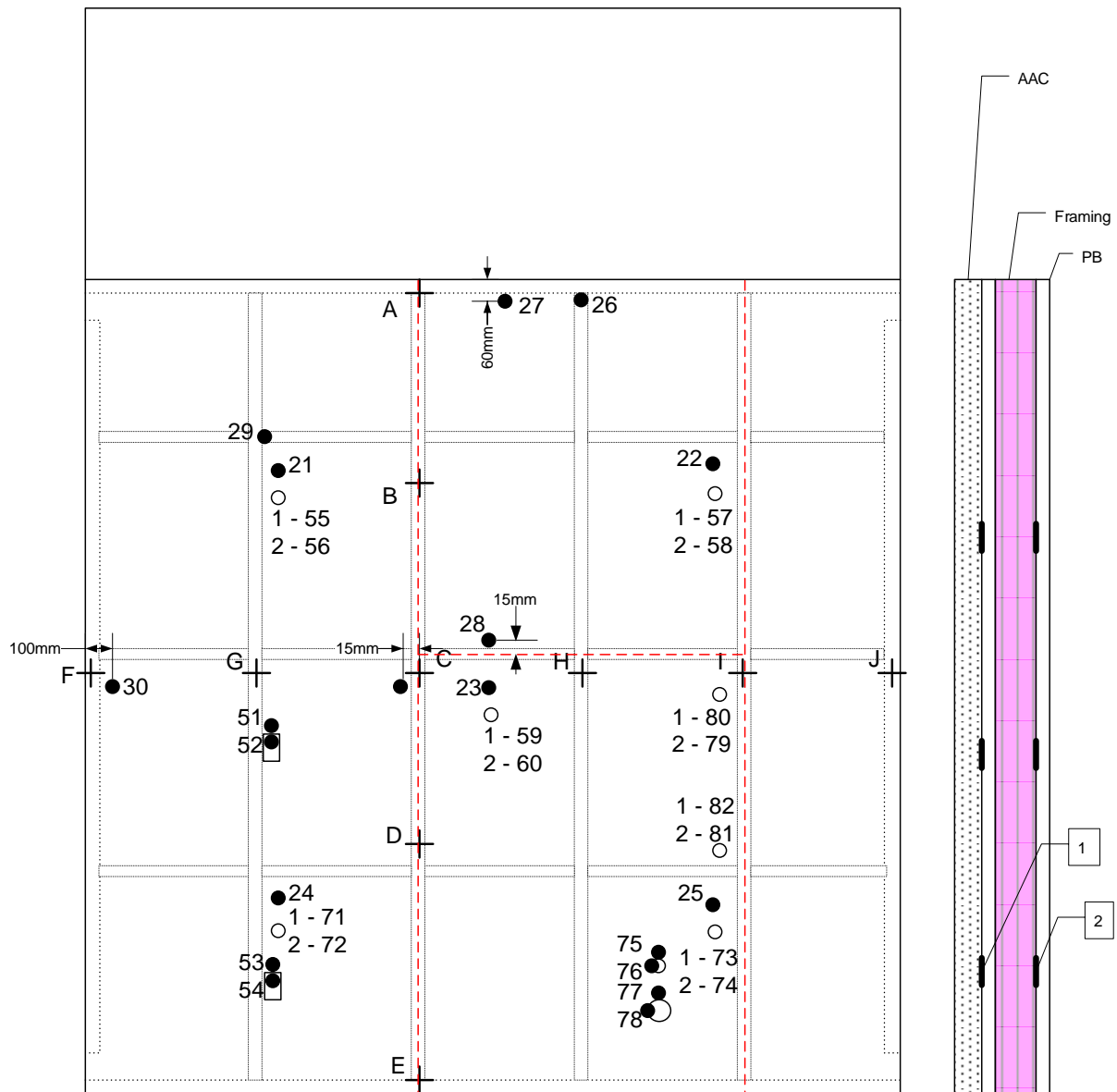
Thermocouples were also fixed to each of the service penetrations. However, only a single thermocouple was used on the element and the service for each penetration. This is a deviation from AS 1530.4:2014, Para 10.5, which requires at least 2 at each location.

All the thermocouples described above were connected to a computer controlled data logging system which recorded the temperatures at 15 second intervals.

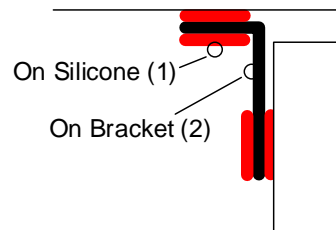
A roving thermocouple was available for measuring temperatures elsewhere on the specimen.

Figure 6: Thermocouple Locations and Deflection Points

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Unexp face



- + Deflection points
- Internal T/C
- Unexposed face T/C



3.4 Loading

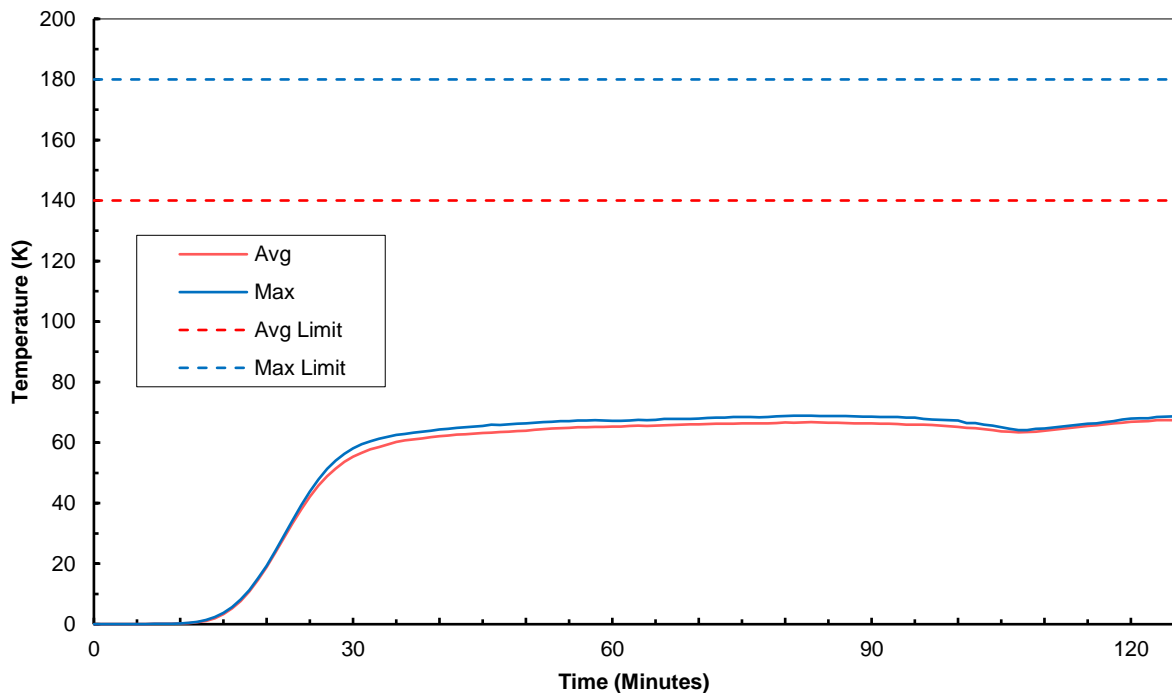
At the request of the client a load of 4.5 kN per stud was applied as a uniformly distributed axial load to the wall. This equated to a total load of 18 kN and was monitored using a load cell, placed between each of the two jacks and the moveable platen of the test frame, and connected to a computer controlled data logging system which recorded the load at 1 second intervals. The load was applied to the specimen at least 15 minutes before the commencement of the test.

3.5 Insulation

3.5.1 Integra Wall System

The temperature rise measured on the unexposed face of the wall did not exceed either the maximum or the average temperature rise insulation failure criteria for the duration of the 125 minute test. A graph of the mean and maximum temperature rise of the unexposed face of the wall is shown in Figure 7.

Figure 7: Unexposed face of the Wall Temperature Rise



3.5.2 Service Penetrations

3.5.2.1 Light Switch

The light switch did not exceed the 180 K temperature rise criterion for the duration of the 125 minute test. The maximum recorded temperature rise on the element at the location of the penetration was 66 K. The maximum recorded temperature rise on the switch fitting was 68 K.



3.5.2.2 GP Outlet

The GP outlet did not exceed the 180 K temperature rise criterion for the duration of the 125 minute test. The maximum recorded temperature rise on the element at the location of the penetration was 66 K. The maximum recorded temperature rise on the GPO fitting was 64 K.

3.5.2.3 DN32 uPVC Waste Pipe

The waste pipe did not exceed the 180 K temperature rise criterion for the duration of the 125 minute test. The maximum recorded temperature rise on the element at the location of the penetration was 67 K. The maximum recorded temperature rise on the pipe was 58 K.

3.5.2.4 DN16 Pex Water Pipe and Brass Fitting

The water pipe did not exceed the 180 K temperature rise criterion for the duration of the 125 minute test. The maximum recorded temperature rise on the element at the location of the penetration was 68 K. The maximum recorded temperature rise on the pipe was 76 K.

3.6 Integrity

3.6.1 Integra Wall System

The wall did not fail any of the integrity criteria for the duration of the 125 minute test.

3.6.2 Service Penetrations

None of the service penetrations failed the integrity criteria for the duration of the 125 minute test.

3.7 Deflection Measurements

3.7.1 Axial Deflections

The axial deflection of the wall was measured using two linear variable differential transducers (LVDT's) connected to a computer controlled data acquisition system which recorded the deflections at 15 second intervals.

3.7.2 Lateral Deflections

The lateral deflections on the unexposed face at the positions shown in Figure 6 were measured using a theodolite and rule. The top plate of the wall was bolted directly to the concrete infill panel at the top of the test frame, with M16 bolts. It is considered unlikely that the frame would be able to move 12 mm towards the furnace, the readings from location A have therefore been excluded as anomalous. The maximum measured deflection was 10 mm, away from the furnace at mid height and mid width of the wall (deflection point C), at 120 minutes. The results are summarised in Table 1.



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Table 1: Lateral Deflection Measurements of the Wall

Deflection Location	Time (minutes) Deflection (mm)					
	15	30	45	60	90	120
A	-2	-4	-5	-7	-10	-12
B	-1	3	1	1	-1	3
C	1	6	6	5	4	10
D	0	2	4	3	2	5
E	1	0	0	2	1	1
F	-3	-2	-2	-2	-2	-2
G	0	2	1	1	0	8
H	0	5	2	0	1	8
I	0	3	3	6	2	7
J	0	2	1	0	1	1

The negative numbers are lateral deflection towards the furnace and positive numbers are lateral deflection away from the furnace.

3.8 Structural Adequacy

Over the duration of the test, the wall experienced a net contraction. The maximum measured axial deflection of the wall was 3.5 mm, measured at the right-hand side of the specimen and occurred at 125 minutes into the test. The wall did not exceed the limiting axial deflection of 30 mm for the duration of the test. Figure 8 shows the axial deflections over the duration of the test.

The maximum measured rate of axial deflection was 0.2 mm/min and occurred at 121 minutes at the LVDT on the right-hand measuring spot. The wall did not exceed the 9 mm/min maximum allowable rate of axial deflection for the duration of the test. Figure 9 shows the rate of axial deflection over the duration of the test.

Figure 8: Axial Deflection of the Wall

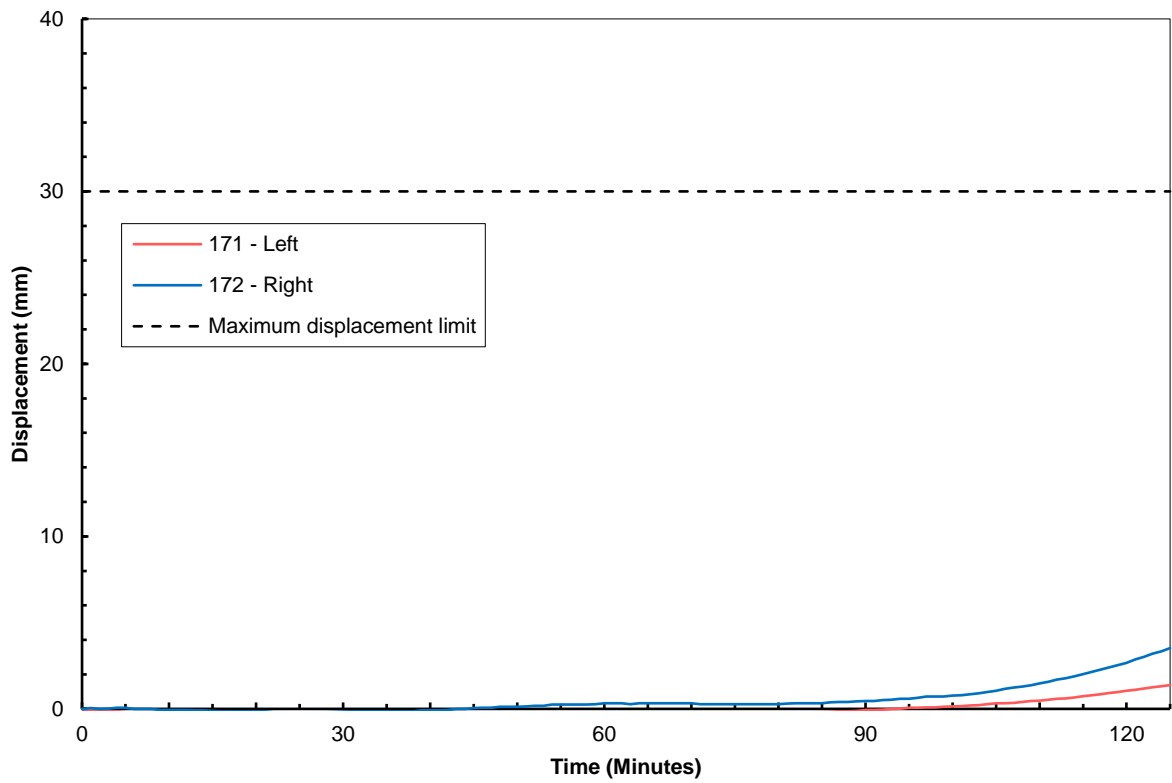
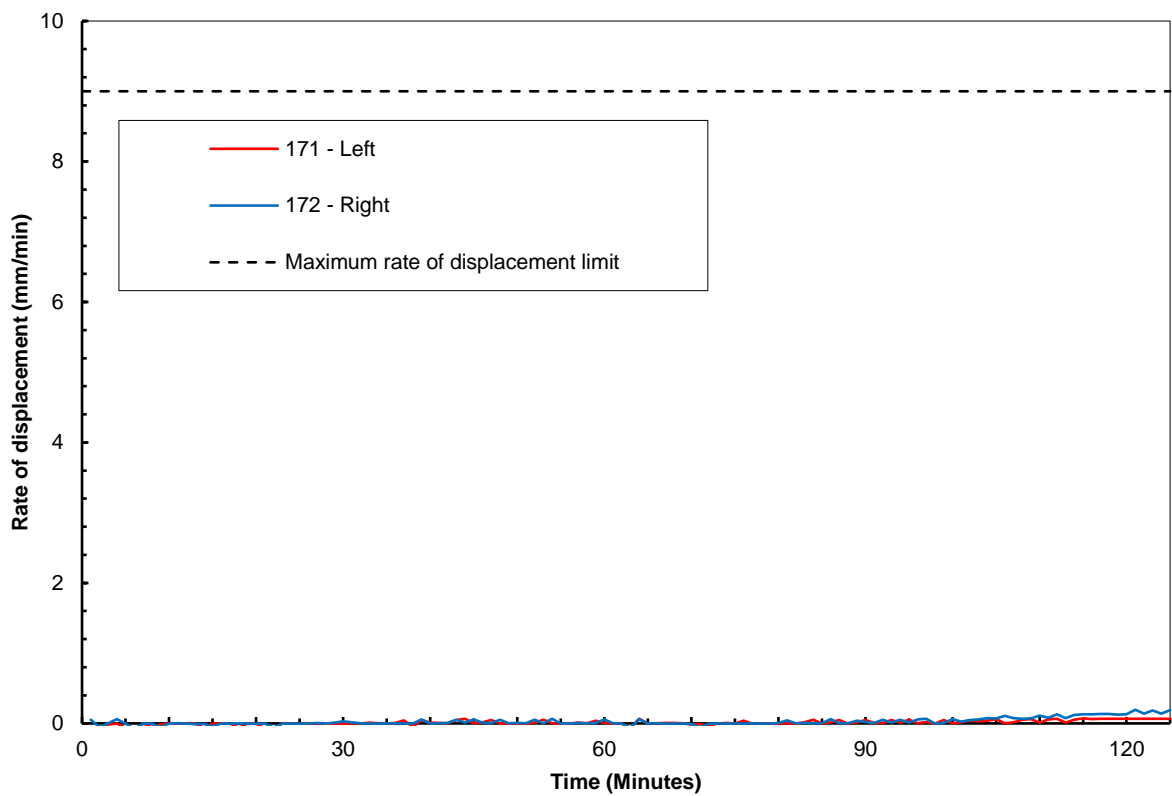


Figure 9: Rate of Axial Deflection of the Wall



3.9 Test Observations

Observations related to the performance of the specimen were at the times stated in minutes and seconds.

U = Observations from the unexposed face.

E = Observations from the exposed face.

Table 2: Test Observations

Time (Min:Sec)	Test face	Observations
22:06	U	There was some steam coming from the plumbing pipes in the unexposed face.
28:00	E	There was a crack in the vertical joint line between the panels at 500-600 mm down from the top of the wall. There was also a very fine crack adjacent to the fixing in the smaller panel on the left-hand side of the specimen (looking at exposed face) at the mid-height of the wall.
37:08	E	The vertical crack between the panels had propagated down to the next panel (1.2 m from the top).
43:59	U	Thermocouple 52 and 54 had peeled away from the electrical fittings. They were taped back in place.
47:30	E	The crack adjacent to the fixing was beginning to spider out, vertically and horizontally. The crack in the vertical joint had propagated down the whole wall. There were cracks developing in the bottom section of the panel
60:30	E	There were some significant cracks at the mid-height of the wall on the right-hand side
64:00	U	A roving thermocouple was applied to the face plate of the GPO. The temperature was approximately 52°C (actual).
79:39	E	Some of the cracks on the left-hand side were starting to open up 2-3 mm on the surface.
125:22	-	Test stopped.

4. SUMMARY

The test results in accordance with AS 1530.4:2014, “*Methods for fire tests on building materials, components and structures – Part 4: Fire – resistance test of elements of construction*” was as follows:

Structural adequacy	125 minutes	No Failure
Integrity	125 minutes	No Failure
Insulation	125 minutes	No Failure

The tested specimen is deemed to have achieved an FRL of 120/120/120

The service penetrations, as installed in the specimen, did not prejudice the wall system for the duration of the 125 minute test.



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The test standard requires the following statements to be included:

"The results of these fire tests may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions."

"This report details methods of construction, the test conditions and results obtained when the specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variations 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."

5. PERMISSIBLE VARIATIONS

The results of the fire test contained in the test report are directly applicable, without reference to the testing authority, to similar constructions where one or more of the following changes have been made, provided no individual component is removed or reduced:

- (a) Increase in the length of a wall of identical construction if the specimen was tested with one vertical edge unrestrained.
- (b) Increase in thickness of the wall.
- (c) For framed walls –
 - i. Increase in timber density;
 - ii. Increase in cross-sectional dimensions of the framing element(s);
 - iii. Decrease in sheet or panel sizes;
 - iv. Decrease in stud spacing; or
 - v. Decrease in fixing centres of wall sheet materials.



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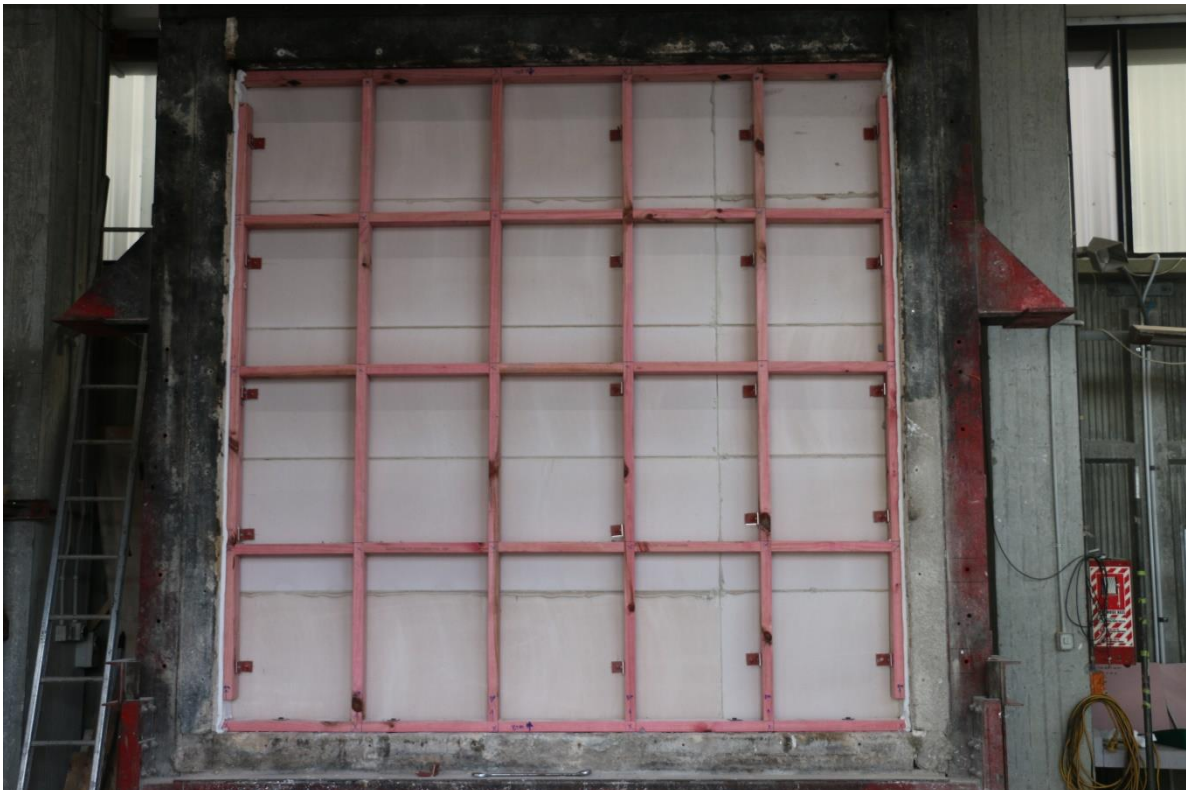
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PHOTOS

Photo 1: Integra AAC Panel Fixing Brackets



Photo 2: Unexposed Side of Panel Prior to Lining Installation



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Photo 3: The Unexposed Face of the Completed Wall Before the Test



Photo 4: The Unexposed Face of the Wall After 125 Minutes



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