Fire-resistance test on sealing systems protecting control joints in concrete walls

Test Report

Author: Chris Wojcik
Report number: FSP 1819
Date: 3 April 2017

Client: Sika Australia Pty Ltd

Commercial-in-confidence

NATA Accredited Laboratory
Number: 165
Corporate Site No 3625
Accredited for compliance with ISO/IEC 17025 - Testing

Inquiries should be address to:

Fire Testing and Assessments	Author	The Client
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Revision A	Draft for internal review	19/03/2017	CSIRO/CLIENT	FSP 1819
Revision B	Final for issue	25/03/2017	CLIENT	FSP 1819
Revision C	Amend drawings/Final for issue	03/04/2017	CLIENT	FSP 1819

Report Authorization:

AUTHOR	REVIEWED BY	AUTHORISED BY
Chris Wojcik	Brett Roddy	Brett Roddy
		
3 April 2017	3 April 2017	3 April 2017

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Fire-resistance test on sealing systems protecting control joints in concrete walls

Sponsored Investigation No. FSP 1819

1 Introduction

1.1 Identification of specimen

The sponsor identified the test specimen as Sikaflex 400 Fire sealant protecting control joints in concrete walls.

1.2 Sponsor

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

1.3 Manufacturers

Sika Ltd
1-1 Nagatoro, Hiratsuka-shi
Kanagawa 254-0021
Japan

1.4 Test standards

Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4 – 2014, Fire-resistance tests of elements of construction.

Section 10: Service penetrations and control joints.

1.5 Reference standard

Australian Standard 4072, Components for the protection of openings in fire-resistant separating elements, Part 1 - 2005, Service penetrations and control joints.

1.6 Test number

CSIRO Reference test number FS4652/4071.

1.7 Test date

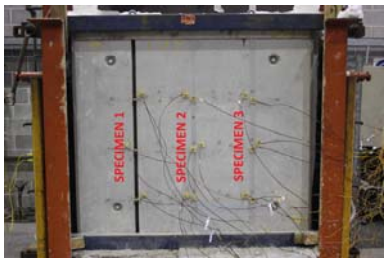
The fire-resistance test was conducted on 7 February 2017.

2 Description of specimen

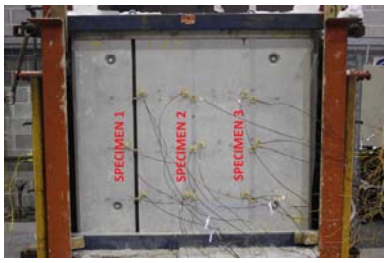
2.1 General

The specimen comprised three 1000-mm exposed length control joints formed in 150-mm thick concrete wall. The joints were protected with Sikaflex 400 Fire sealant.

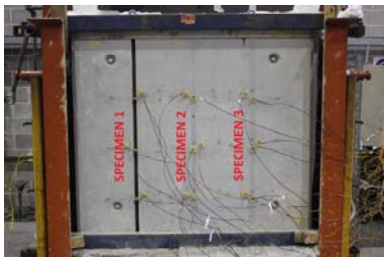
Specimen 1 – 20-mm wide control joint protected by Sikaflex 400 Fire sealant applied from the fire exposed side

SEPERATING ELEMENT		
150-mm thick concrete wall, with an established FRL of -/240/240.		
SIZE OF OPENING		
25-mm wide x 1000-mm exposed length.		
FIRE STOPPING SYSTEM		
Trade name	Sikaflex 400 Fire sealant	
Manufacturer	Sika Australia Pty Ltd	
Size	20-mm wide x 10-mm deep x 1000-mm long	
Description	one component moisture curing, elastic joint sealant	
Installation	The 20-mm wide joint was protected with Sikaflex 400 Fire sealant installed from the exposed side of the wall. The sealant was applied to a depth of 10-mm controlled by a 30-mm x 20-mm polyurethane foam backing rod, and finished flush with the exposed face of the wall.	
Photographs	 fire exposed face	 unexposed face
Drawings	Drawings numbered 1 and 2, both dated 21 December 2016, by Sika Australia Pty Ltd.	

Specimen 2 – 20-mm wide control joint protected by Sikaflex 400 Fire sealant applied from both sides

SEPERATING ELEMENT		
150-mm thick concrete wall, with an established FRL of -/240/240.		
SIZE OF OPENING		
25-mm wide x 1000-mm exposed length.		
FIRE STOPPING SYSTEM		
Trade name	Sikaflex 400 Fire sealant	
Manufacturer	Sika Australia Pty Ltd	
Size	20-mm wide x 10-mm deep x 1000-mm long	
Description	one component moisture curing, elastic joint sealant	
Installation	The 20-mm wide joint was protected with Sikaflex 400 Fire sealant installed from both sides of the wall. The sealant was applied to a depth of 10-mm controlled by a 30-mm x 20-mm polyurethane foam backing rod, and finished flush with both faces of the wall.	
Photographs	 fire exposed face	 unexposed face
Drawings	Drawings numbered 1 and 2, both dated 21 December 2016, by Sika Australia Pty Ltd.	

Specimen 3 – 20-mm wide control joint protected by Sikaflex 400 Fire sealant applied from the non-fire side

SEPERATING ELEMENT		
150-mm thick concrete wall, with an established FRL of -/240/240.		
SIZE OF OPENING		
25-mm wide x 1000-mm exposed length.		
FIRE STOPPING SYSTEM		
Trade name	Sikaflex 400 Fire sealant	
Manufacturer	Sika Australia Pty Ltd	
Size	20-mm wide x 10-mm deep x 1000-mm long	
Description	one component moisture curing, elastic joint sealant	
Installation	The 20-mm wide joint was protected with Sikaflex 400 Fire sealant installed from the unexposed or non-fire side of the wall. The sealant was applied to a depth of 10-mm controlled by a 30-mm x 20-mm polyurethane foam backing rod, and finished flush with the unexposed face of the wall.	
Photographs	 fire exposed face	 unexposed face
Drawings	Drawings numbered 1 and 2, both dated 21 December 2016, by Sika Australia Pty Ltd.	

2.2 Orientation

The control joints were tested in a vertical plane and exposed to fire from one side only.

2.3 Dimensions

The overall exposed length of the control joint specimens was 1000-mm, to suit the opening in the specimen containing frame.

2.4 Restraints

The concrete slab was restrained along all four sides.

2.5 Conditioning

The specimen installation was finalised on 17 January 2017 and the specimen was stored under laboratory conditions until the day of the test.

2.6 Selection, construction and installation of the specimen and the supporting construction

The construction was organised by the sponsor. CSIRO was not involved in the selection of the materials.

3 Documentation

The following documents were supplied or referenced by the sponsor as a complete description of the specimen and should be read in conjunction with this report:

- Drawings numbered 1 and 2, both dated 21 December 2016, by Sika Australia Pty Ltd.

Confidential information about the test specimen has been submitted and is retained at CSIRO Infrastructure Technologies.

4 Equipment

4.1 Furnace

The furnace had a nominal opening of 1000-mm x 1000-mm for attachment of vertical or horizontal specimens.

The furnace was lined with refractory bricks and materials with the thermal properties as specified in AS 1530.4-2014 and was heated by combustion of a mixture of natural gas and air.

4.2 Temperature

The temperature in the furnace chamber was measured by four type K, 3-mm diameter, and 310 stainless steel Mineral Insulated Metal Sheathed (MIMS) thermocouples. Each thermocouple was housed in high-nickel steel tubes opened at the exposed end.

The temperatures of the specimen were measured by glass-fibre insulated and sheathed K-type thermocouples with a wire diameter of 0.5-mm.

Locations of the thermocouples on the unexposed face of the specimen are described in Appendix A.

4.3 Measurement system

The primary measurement system comprised multiple-channel data loggers, scanning at one minute intervals during the test.

5 Ambient temperature

The temperature of the test area was 25°C at the commencement of the test.

6 Departure from standard

There were no departures from the requirements of AS 1530.4-2014.

7 Termination of the test

The test was terminated at 241 minutes by the agreement with the sponsor.

8 Test results

8.1 Critical observations

The following observations were made during the fire-resistance test:

5 minutes -	Moisture is forming on the unexposed face of the wall.
16 minutes -	Smoke is emitted from inside the joint of Specimen 1.
20 minutes -	Insulation failure of Specimen 1 – maximum temperature rise of 180 deg C is exceeded on the unexposed face of the sealant.
21 minutes -	Glow is visible inside the joint of Specimen 1.
120 minutes -	No apparent change to the specimens.
160 minutes -	Slight charring is evident along the edges of the sealant in joint of Specimen 3.
161 minutes -	Insulation failure of Specimen 3 – maximum temperature rise of 180 deg C is exceeded on the unexposed face of the sealant.
210 minutes -	The sealant in joint of Specimen 3 has discoloured. Charring is evident along the edges of the sealant in joint of Specimen 2.
223 minutes -	Insulation failure of Specimen 2 – maximum temperature rise of 180 deg C is exceeded on the unexposed face of the sealant.
241 minutes -	Test terminated.

8.2 Furnace temperature

Figure 1 shows the standard curves of temperature versus time for heating the furnace chamber and the actual curves of average and maximum temperature versus time recorded during the heating period.

8.3 Furnace severity

Figure 2 shows the curve of furnace severity versus time during the heating period.

8.4 Specimen temperature

Figure 3 shows curves of temperature versus time recorded on the unexposed face of Specimen 1.

Figure 4 shows curves of temperature versus time recorded on the unexposed face of Specimen 2.

Figure 5 shows curves of temperature versus time recorded on the unexposed face of Specimen 3.

8.5 Performance

Performance observed in respect of the following AS 1530.4-2014 criteria:

	SPECIMEN 1	
Structural adequacy	-	not applicable
Integrity	-	no failure at 241 minutes
Insulation	-	20 minutes
	SPECIMEN 2	
Structural adequacy	-	not applicable
Integrity	-	no failure at 241 minutes
Insulation	-	223 minutes
	SPECIMEN 3	
Structural adequacy	-	not applicable
Integrity	-	no failure at 241 minutes
Insulation	-	161 minutes

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

9 Fire-Resistance Level (FRL)

For the purpose of building regulations in Australia, the FRLs of the test specimens were as follows:

Specimen 1: -/240/0,

Specimen 2: -/240/180; and

Specimen 3: -/240/120

The fire-resistance levels of the specimen are applicable when the system is exposed to fire from the either direction.

For the purposes of AS 1530.4-2014 the results of these fire tests may be used to directly assess fire hazard, but it should be noted that a single test method will not provide a full assessment of fire hazard under all fire conditions.

10 Field of direct application of test results

The results of the fire test contained in this test report are directly applicable, without reference to the testing authority, to similar constructions where one or more changes listed in Clause 10.12 of AS1530.4-2014, have been made provided no individual component is removed or reduced.

11 Tested by

Chris Wojcik
Testing Officer

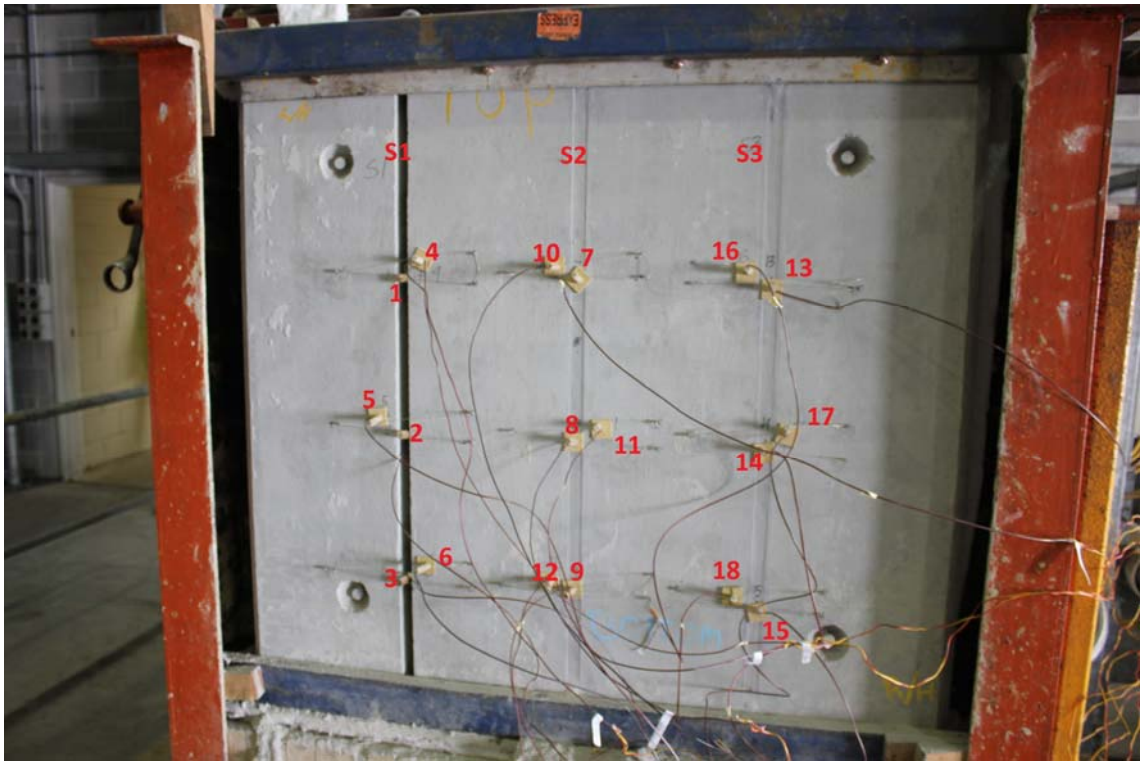
Appendices

Appendix A – Measurement location

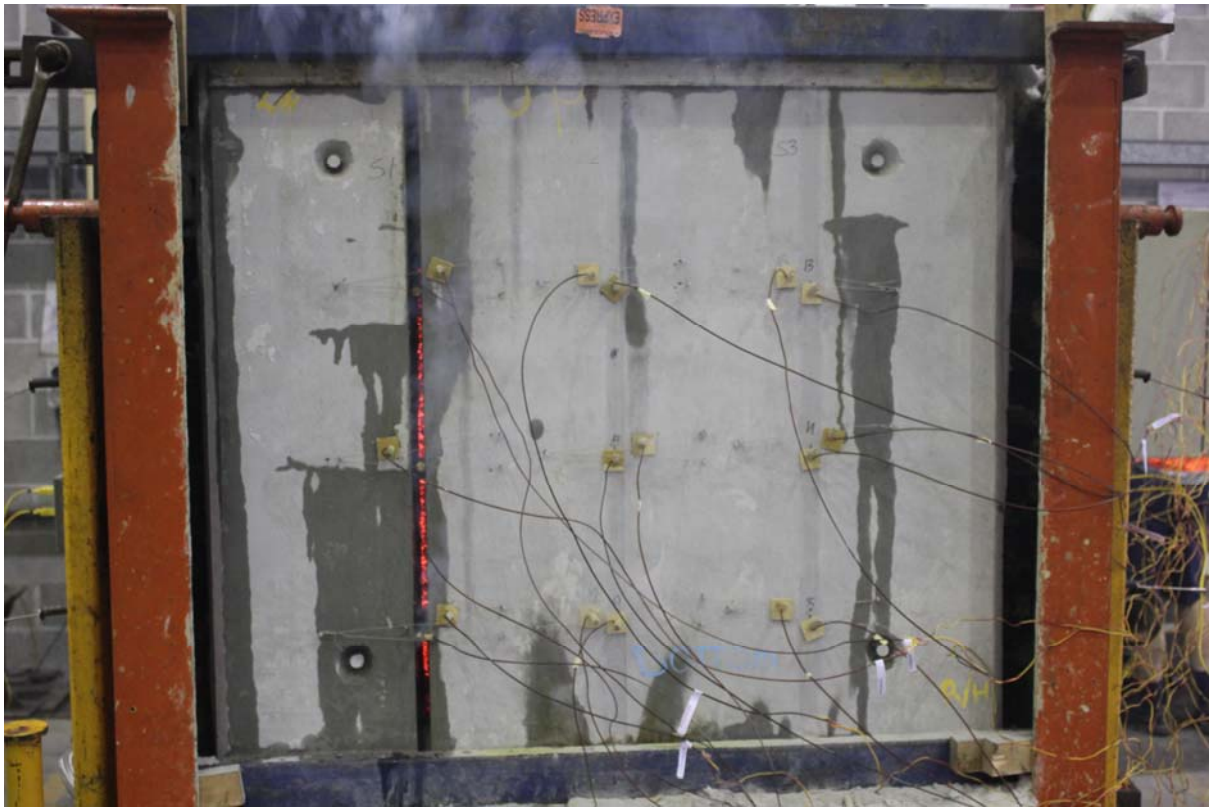
Measurement Location		
Group location	**T/C Position**	**T/C designation**
Specimen		
Specimen 1	On the back of backing rod – ¾ height	S1
	On the back of backing rod – ½ height	S2
	On the back of backing rod – ¼ height	S3
	25-mm from the joint - ¾ height	S4
	25-mm from the joint - ½ height	S5
	25-mm from the joint - ¼ height	S6
Specimen 2	On the sealant – ¾ height	S7
	On the sealant – ½ height	S8
	On the sealant – ¼ height	S9
	25-mm from the joint - ¾ height	S10
	25-mm from the joint - ½ height	S11
	25-mm from the joint - ¼ height	S12
Specimen 3	On the sealant – ¾ height	S13
	On the sealant – ½ height	S14
	On the sealant – ¼ height	S15
	25-mm from the joint - ¾ height	S16
	25-mm from the joint - ½ height	S17
	25-mm from the joint - ¼ height	S18
Rover		S19
Ambient		S20

Appendix B – Test photographs

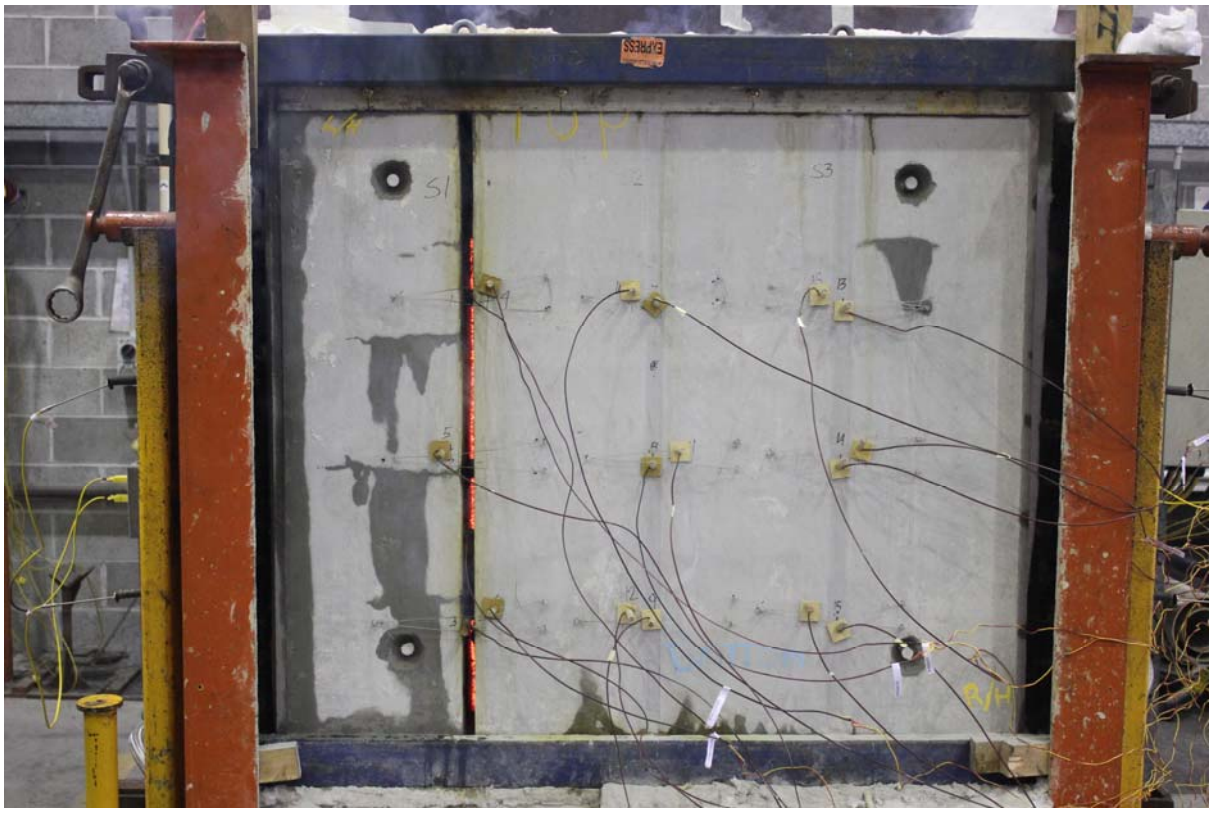
PHOTOGRAPH 1 – EXPOSED FACE OF THE SPECIMENS PRIOR TO TEST



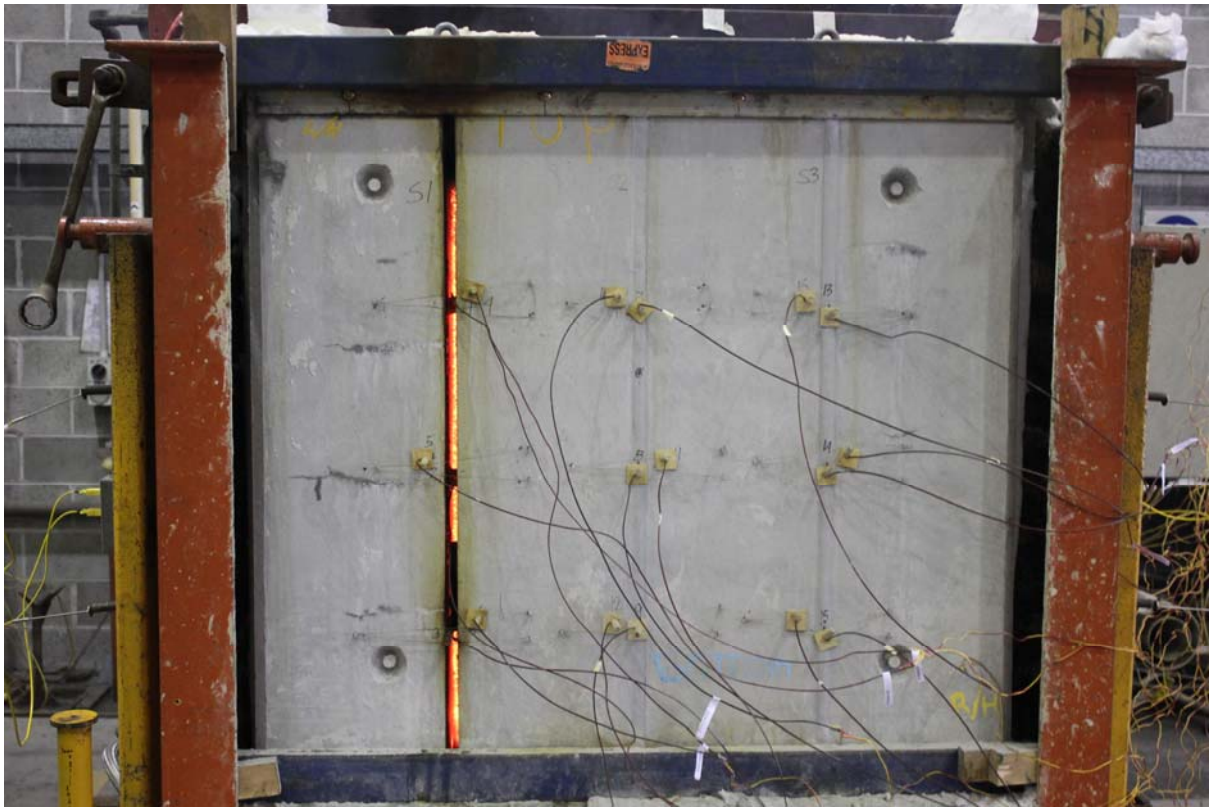
PHOTOGRAPH 2 – UNEXPOSED FACE OF THE SPECIMENS PRIOR TO TESTING



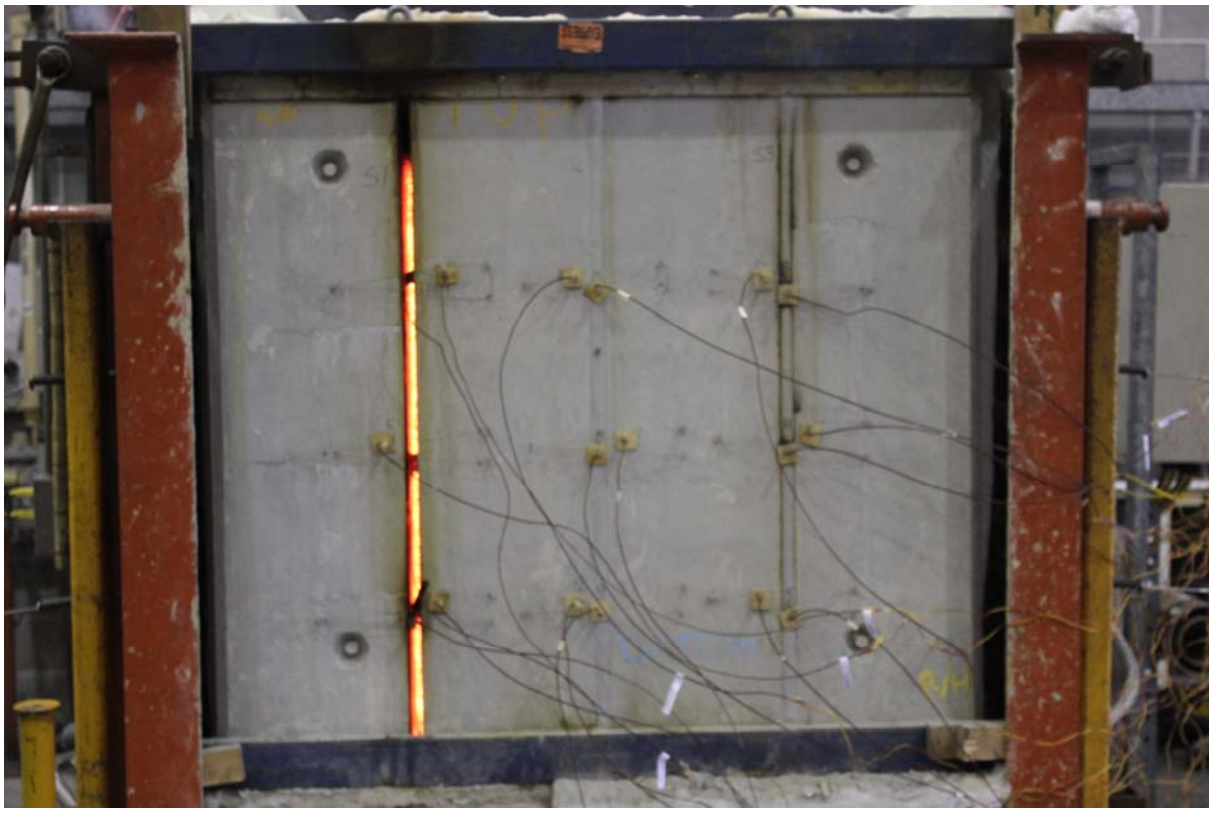
PHOTOGRAPH 3 – SPECIMENS AT 30 MINUTES INTO THE TEST



PHOTOGRAPH 4 – SPECIMENS AT 60 MINUTES INTO THE TEST

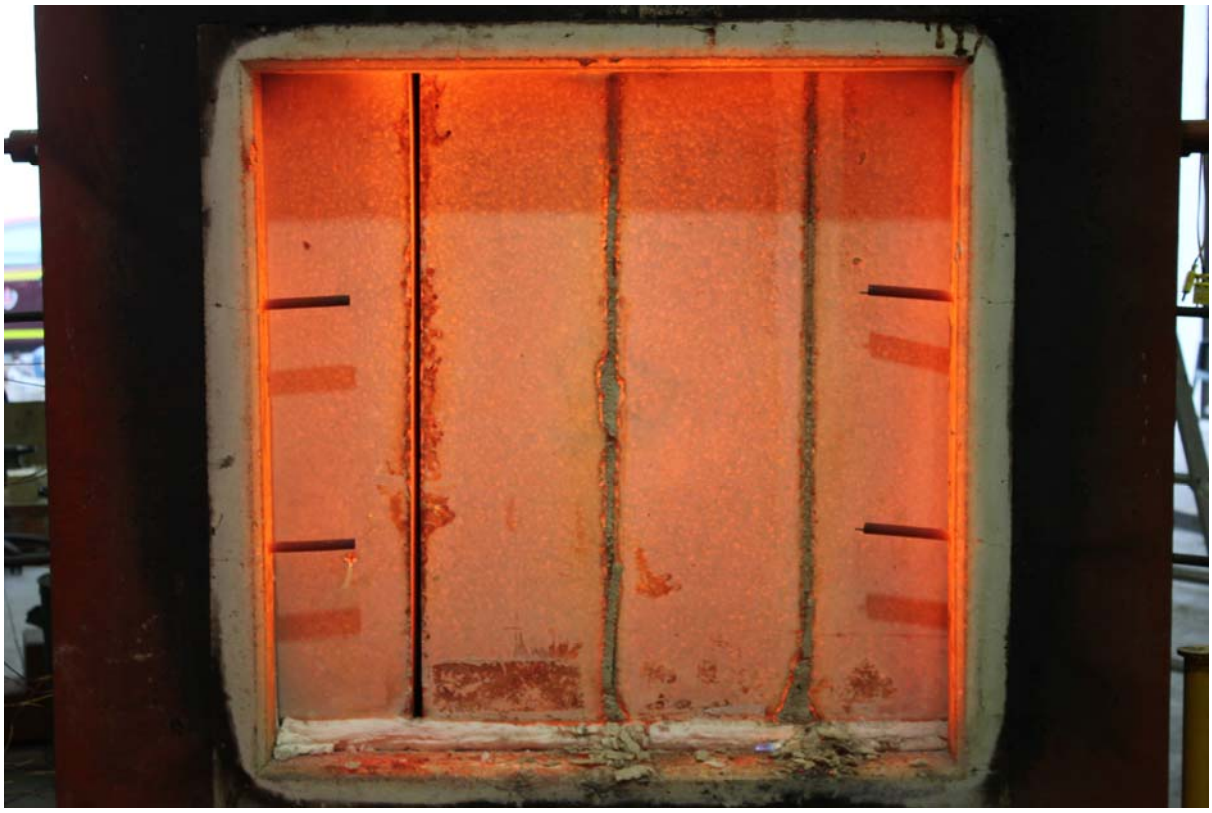


PHOTOGRAPH 5 – SPECIMENS AT 120 MINUTES INTO THE TEST



PHOTOGRAPH 6 – SPECIMENS AT 180 MINUTES INTO THE TEST

PHOTOGRAPH 7 – SPECIMENS AT THE CONCLUSION OF TESTING



PHOTOGRAPH 8 – EXPOSED FACE OF THE SPECIMEN AFTER THE CONCLUSION OF TESTING

Appendix C – Test data charts

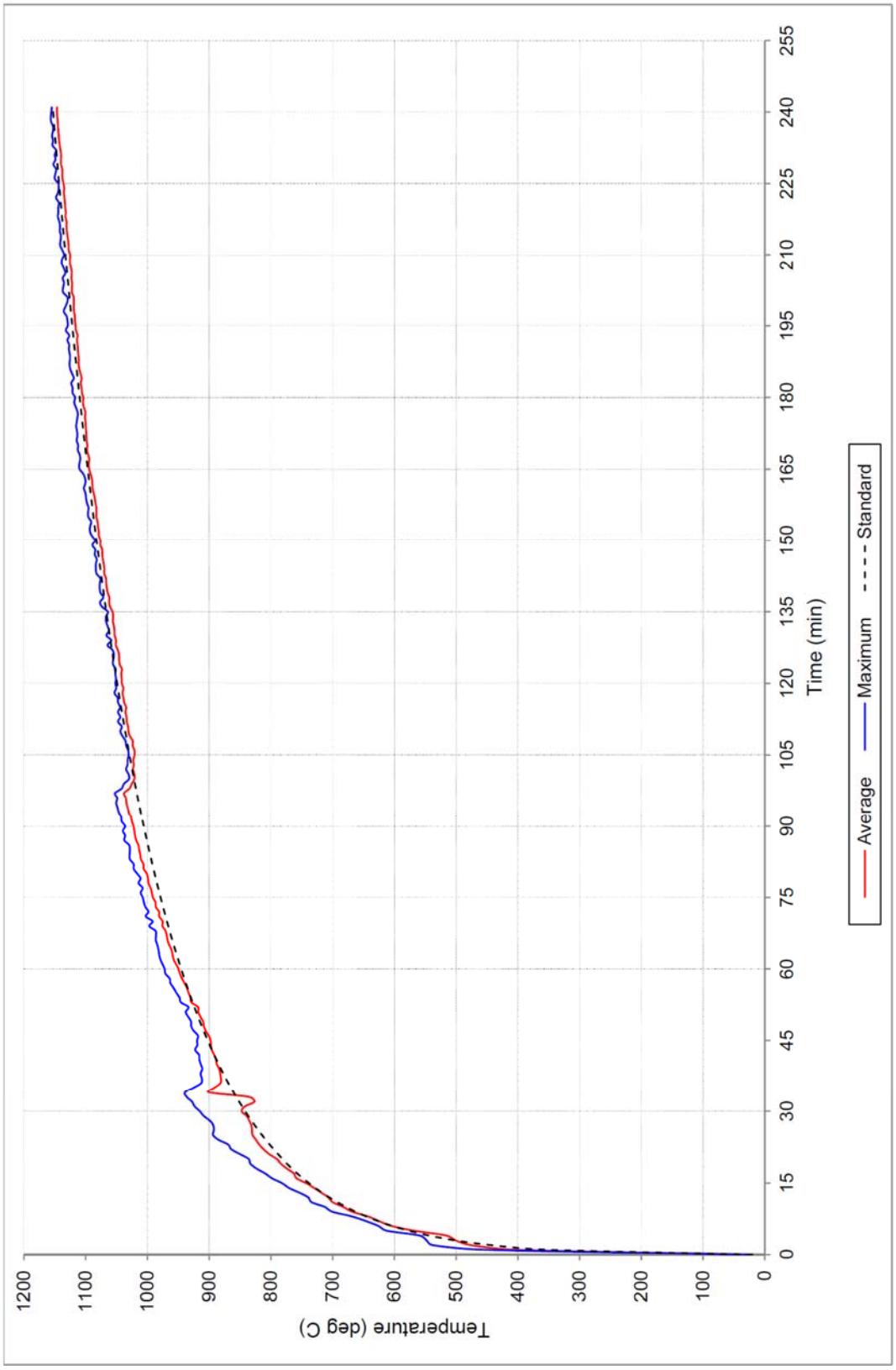


FIGURE 1 – FURNACE TEMPERATURE

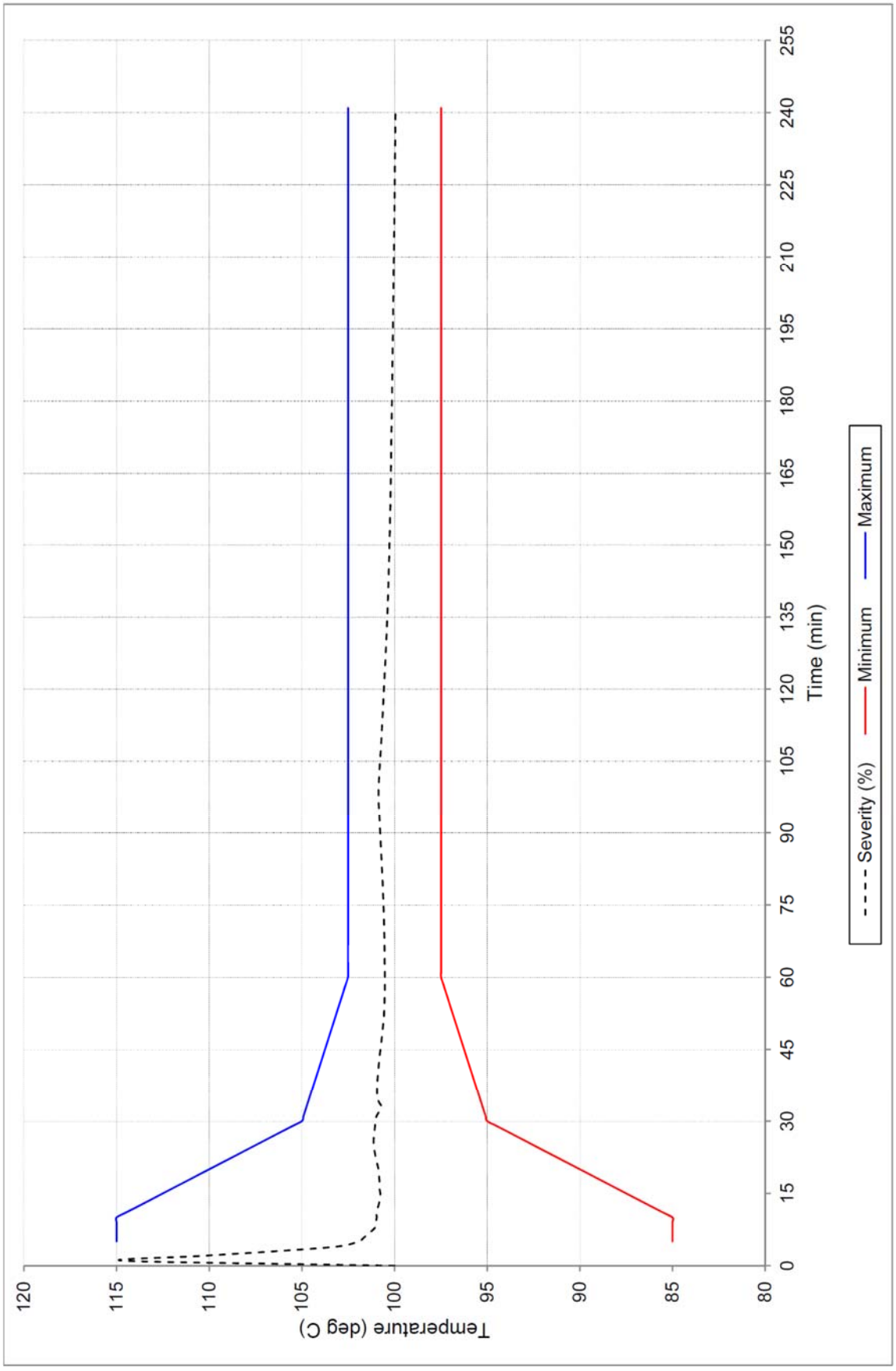


FIGURE 2 – FURNACE SEVERITY

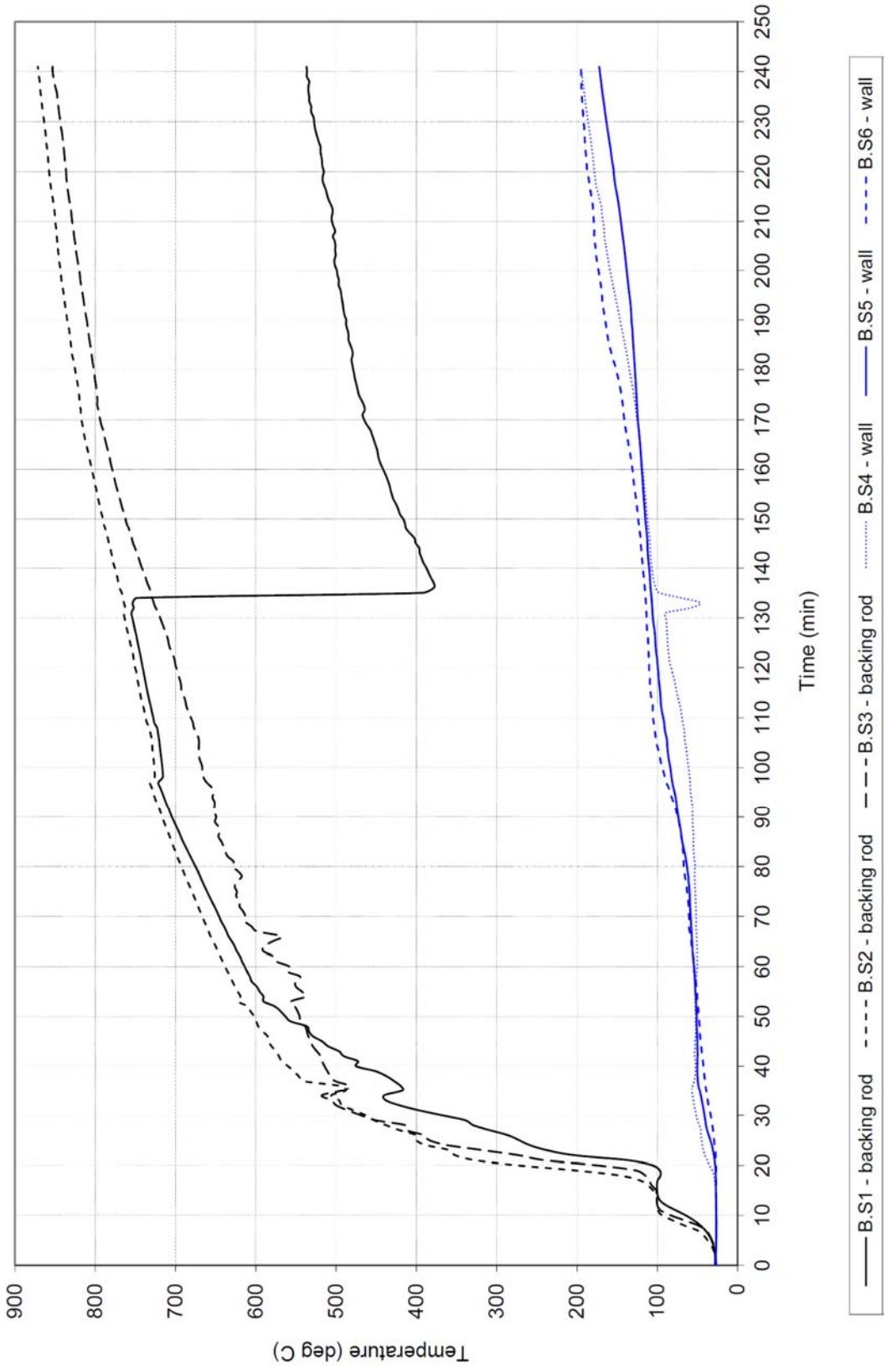


FIGURE 3 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF CONTROL JOINT 1

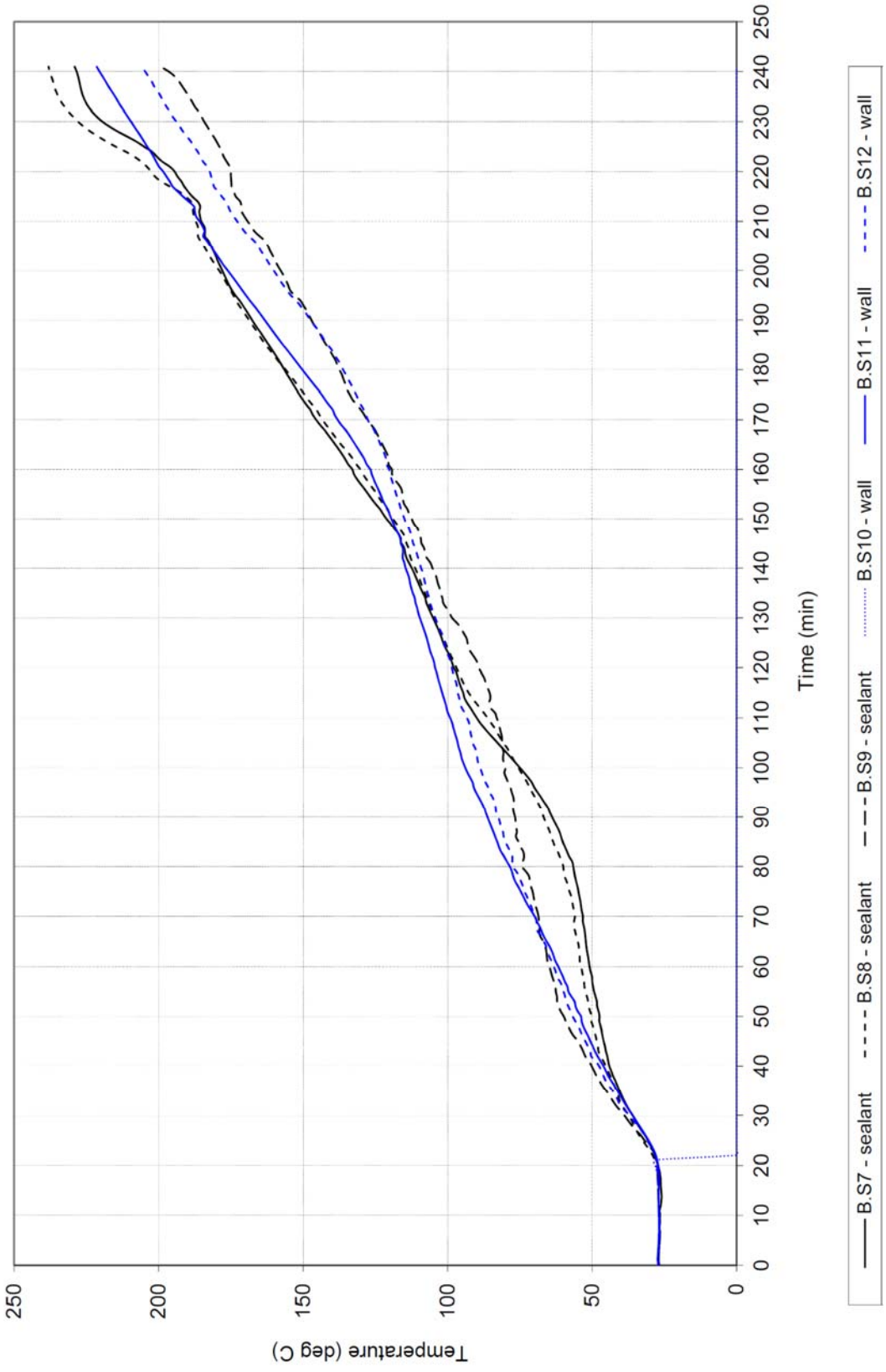


FIGURE 4 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF CONTROL JOINT 2

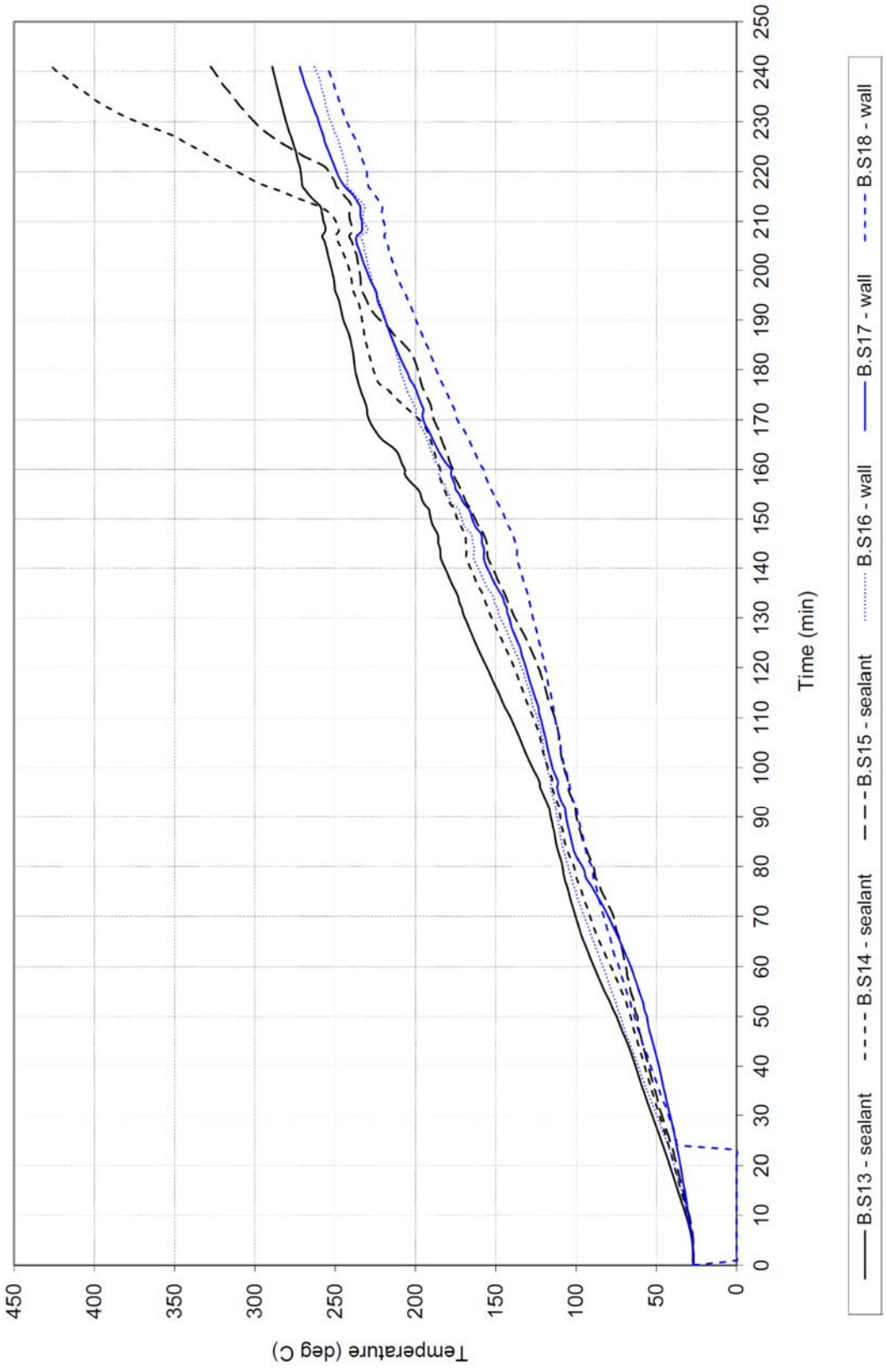
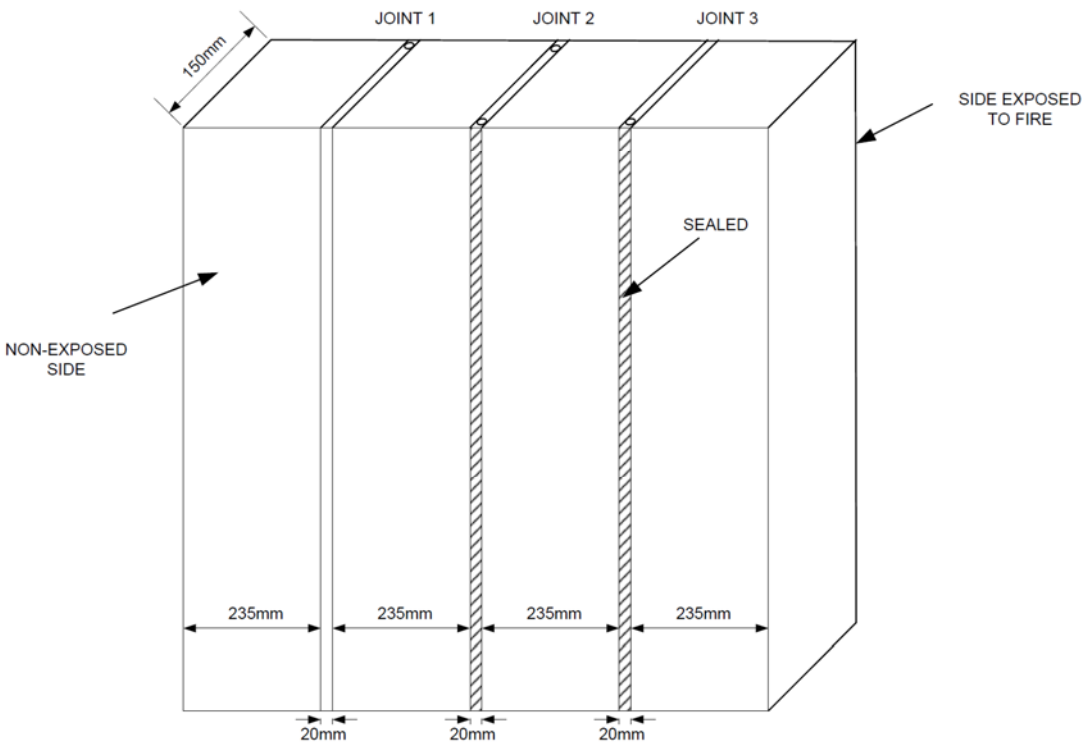


FIGURE 5 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF CONTROL JOINT 3

Appendix D – Specimen drawings

WALL ASSEMBLY- AS1530.4 COMPLIANCE TEST FOR SIKA AUSTRALIA PTY LTD



NO OF JOINTS – 3

JOINT WIDTH – 20mm

THICKNESS OF CONCRETE – 150mm

DISTANCE BETWEEN JOINTS > 200mm

JOINT 1 SEALANT –
SIKAFLEX 400 FIRE - SEALED ON THE FIRE SIDE.
WIDTH 20mm; DEPTH 10mm;
WITH PU FOAM BACKING ROD (30X20mm)

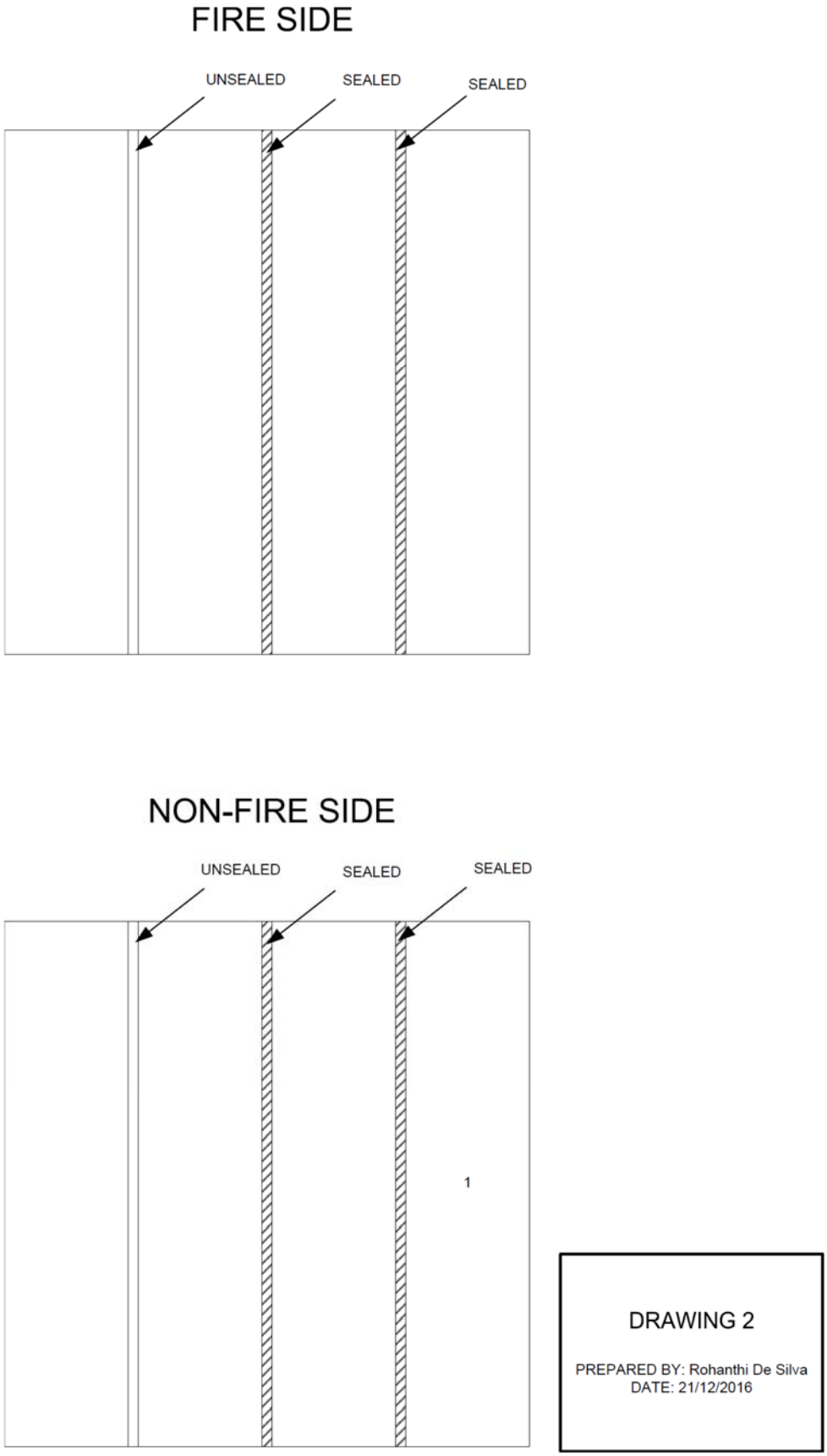
JOINT 2 SEALANT –
SIKAFLEX 400 FIRE - SEALED ON BOTH SIDES.
WIDTH 20mm; DEPTH 10mm;
WITH PU FOAM BACKING ROD (30X20mm)

JOINT 3 SEALANT –
SIKAFLEX 400 FIRE - SEALED ON THE NON-FIRE SIDE.
WIDTH 20mm; DEPTH 10mm;
WITH PU FOAM BACKING ROD (30X20mm)

DRAWING 1

PREPARED BY: Rohanthi De Silva
DATE: 21/12/2016

DRAWING NUMBERED 1, DATED 21 DECEMBER 2016, BY SIKA AUSTRALIA PTY LTD



DRAWING NUMBERED 2, DATED 21 DECEMBER 2016, BY SIKA AUSTRALIA PTY LTD

Appendix E – Certificate(s) of Test

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 310, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2937

This is to certify that the element of construction described below was tested by CSIRO Infrastructure Technologies in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2014 Fire-resistance tests of elements of construction, on behalf of:

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1819.

Product Name: Specimen 1 - Sikaflex 400 Fire sealant applied from exposed side protecting a 20-mm wide control joint in a concrete wall

Description: The sponsor identified the test specimen as Sikaflex 400 Fire sealant protecting control joints in concrete walls. The separating element was a 150-mm thick concrete wall, with an established FRL of -/240/240. The size of the opening was 25-mm wide x 1000-mm exposed length. The fire stopping system measuring 20-mm wide x 10-mm deep x 1000-mm long is described as a one component moisture curing, elastic joint sealant. The 20-mm wide joint was protected with Sikaflex 400 Fire sealant installed from the exposed side of the wall. The sealant was applied to a depth of 10-mm controlled by a 30-mm x 20-mm polyurethane foam backing rod, and finished flush with the exposed face of the wall. Refer to Drawings numbered 1 and 2, both dated 21 December 2016, by Sika Australia Pty Ltd for a complete description of the specimen.

Structural Adequacy	not applicable
Integrity	No failure at 241 minutes
Insulation	20 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/0. The fire-resistance levels (FRL) of the specimen are applicable when the system is exposed to fire from the either direction. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 7 February 2017

Issued on the 27th day of March 2017 without alterations or additions.

Brett Roddy
Manager, Fire Testing and Assessments

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PO Box 310, North Ryde NSW 1670, Australia
T (02) 9490 5444 • ABN 41 687 119 230

Certificate of Test

No. 2938

This is to certify that the element of construction described below was tested by CSIRO Infrastructure Technologies in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2014 Fire-resistance tests of elements of construction, on behalf of:

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1819.

Product Name: Specimen 2 - Sikaflex 400 Fire sealant applied from both sides protecting a 20-mm wide control joint in a concrete wall

Description: The sponsor identified the test specimen as Sikaflex 400 Fire sealant protecting control joints in concrete walls. The separating element was a 150-mm thick concrete wall, with an established FRL of -/240/240. The size of the opening was 25-mm wide x 1000-mm exposed length. The fire stopping system measuring 20-mm wide x 10-mm deep x 1000-mm long is described as a one component moisture curing, elastic joint sealant. The 20-mm wide joint was protected with Sikaflex 400 Fire sealant installed from both sides of the wall. The sealant was applied to a depth of 10-mm controlled by a 30-mm x 20-mm polyurethane foam backing rod, and finished flush with both faces of the wall. Refer to Drawings numbered 1 and 2, both dated 21 December 2016, by Sika Australia Pty Ltd for a complete description of the specimen.

Structural Adequacy	not applicable
Integrity	No failure at 241 minutes
Insulation	223 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/180. The fire-resistance levels (FRL) of the specimen are applicable when the system is exposed to fire from the either direction. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 7 February 2017

Issued on the 27th day of March 2017 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

NATA

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Certificate of Test

No. 2939

This is to certify that the element of construction described below was tested by CSIRO Infrastructure Technologies in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2014 Fire-resistance tests of elements of construction, on behalf of:

Sika Australia Pty Ltd
55 Elizabeth Street
Wetherill Park NSW

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSP 1819.

Product Name: Specimen 3 - Sikaflex 400 Fire sealant applied from unexposed side protecting a 20-mm wide control joint in a concrete wall

Description: The sponsor identified the test specimen as Sikaflex 400 Fire sealant protecting control joints in concrete walls. The separating element was a 150-mm thick concrete wall, with an established FRL of -/240/240. The size of the opening was 25-mm wide x 1000-mm exposed length. The fire stopping system measuring 20-mm wide x 10-mm deep x 1000-mm long is described as a one component moisture curing, elastic joint sealant. The 20-mm wide joint was protected with Sikaflex 400 Fire sealant installed from the unexposed or non-fire side of the wall. The sealant was applied to a depth of 10-mm controlled by a 30-mm x 20-mm polyurethane foam backing rod, and finished flush with the unexposed face of the wall. Refer to Drawings numbered 1 and 2, both dated 21 December 2016, by Sika Australia Pty Ltd for a complete description of the specimen.

Structural Adequacy	not applicable
Integrity	No failure at 241 minutes
Insulation	161 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of -/240/120. The fire-resistance levels (FRL) of the specimen are applicable when the system is exposed to fire from the either direction. This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 7 February 2017

Issued on the 27th day of March 2017 without alterations or additions.

B. Roddy

Brett Roddy
Manager, Fire Testing and Assessments

CERTIFICATE OF TEST NO. 2939

References

The following informative documents are referred to in this Report:

AS 1530.4-2014	Methods for fire tests on building materials, components and structures - Part 4: Fire-resistance tests of elements of building construction.
AS 4072.1-2005	Components for the protection of openings in fire-resistant separating elements, Part 1: Service penetrations and control joints.

END OF REPORT

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