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Fire resistance test report

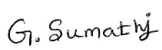
Control joints tested in accordance with AS 1530.4:2014

Test sponsor: HB Fuller Aust Co P/L

Job number: FRT190354

Test date: 18 November 2019 Revision: R1.0

Amendment schedule

Version	Date	Information about the report			
R1.0	27 November 2019	Description	Initial issue		
			Prepared by	Reviewed by	Authorised by
		Name	Sumathi Gurusamy	Patrick Chan	Patrick Chan
		Signature			

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General conditions of use

The data, methodologies, calculations and results documented in this report specifically relate to the tested specimen/s and must not be used for any other purpose.

All work and services carried out by Warringtonfire Australia are subject to and conducted in accordance with our standard terms and conditions. These are available on request or at https://www.element.com/terms/terms-and-conditions.

Executive summary

This report documents the findings of fire resistance test of control joints undertaken on 18 November 2019 in accordance with Sections 2 and 10 of AS 1530.4:2014.

The test assembly consisted of a nominal 1900 mm wide × 1600 mm high × 120 mm thick concrete wall system incorporating four varying control joints.

A summary of the control joints is provided in Table 1.

Table 1 Test summary

Control joint	Service	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)	Fire resistance level (FRL)
A	Control Joint	HB Fuller – Fulaflex FR hybrid	10 × 1000	10 mm on both unexposed and exposed sides	**-/240/120**
B	Control Joint	HB Fuller – Fulaflex FR hybrid	20 ×1000	10 mm on both unexposed and exposed sides	**-/240/120**
C	Control Joint	HB Fuller – Fulaflex FR hybrid	40 × 1000	20 mm on both unexposed and exposed sides	**-/240/120**
D	Control Joint	HB Fuller – Fulaflex FR hybrid	50 × 1000	25 mm on both unexposed and exposed sides	**-/240/120**

Contents

1. Introduction

This report documents the findings of fire resistance test of control joints undertaken on 18 November 2019 in accordance with Sections 2 and 10 of AS 1530.4:2014.

Warringtonfire Australia did the test at the request of HB fuller Aust Co P/L.

Table 2 Test sponsor details

Test sponsor	Address
HB fuller Aust Co P/L	16-22 Redgum Drive, Dandenong South, Victoria,3175 Australia

2. Construction details

Table 3 provides details of the test assembly. Table 4 provides a summary of the test specimen. A full description of the specimen is provided in Appendix A and Section 3.

Table 5 shows the installation method and orientation of the test specimen.

Table 3 Test assembly

Item	Detail	
Separating element	Concrete wall	
Nominal separating element size	Width (w):	1900 mm
	Height (h):	1600 mm
	Thickness (t):	120 mm
Number of control joints	Four	
Restraint conditions	Restrained on all edges	

Table 4 Test specimen

Control joint	Service	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)
A	Control Joint	HB Fuller – Fulaflex FR hybrid	10 × 1000	10 mm on both unexposed and exposed sides
B	Control Joint	HB Fuller – Fulaflex FR hybrid	20 ×1000	10 mm on both unexposed and exposed sides
C	Control Joint	HB Fuller – Fulaflex FR hybrid	40 × 1000	20 mm on both unexposed and exposed sides
D	Control Joint	HB Fuller – Fulaflex FR hybrid	50 × 1000	25 mm on both unexposed and exposed sides

Table 5 Installation method and orientation

Item	Detail
Start date of separating element construction	4 October 2019
Start date of control joints installation	15 October 2019
Completion date of test specimen construction and installation	18 October 2019
Separating element constructed by	Representatives of Warringtonfire Melbourne
Control joints installed by	Representatives of the test sponsor
Orientation	Symmetrical, due to fire protection system are installed in both sides.

3. Schedule of components

Table 6 lists the schedule of components for the test specimen. These were provided by the test sponsor and surveyed by Warringtonfire Australia.

Table 6 Schedule of components

Item	Description	
Separating element		
1	Item name	Concrete wall strips
	Product name	120 mm thick concrete
	Density	2400 kg/m^3 (measured)
	Installation	The concrete strips were precast and stored at Warringtonfire Australia (WFA). The concrete strips were aligned as per the varying control joint sizes. The concrete strips were supported at both the edges by parallel flange channel (PFC). Masonry anchors were used to fix the concrete strips to the PFCs.
Fire-stopping protections		
Sealant		
2	Item name	Sealant
	Product name	HB Fuller – Fulaflex FR hybrid
	Density	1822 kg/m^3 (measured)
	Installation	The sealant was installed in the control joints as detailed in various control joint descriptions below.
Backing Rod		
3	Item name	Open cell backing rod
	Product name	Polyethylene
	Size	20 × 20 mm and 28 × 20 mm
	Installation	The backing rods were installed in all the control joints as detailed in various control joint descriptions below.
Control joint A		
A	Control joint detail	Control Joint - nominally 1000 mm long × 10 mm wide, 10 mm deep protection on both sides.
	Local fire-stopping protection	
	Protection	The sealant (item 2) was applied into the control joint to the depth of 10 mm and finished flush on both exposed and unexposed sides. 20 mm × 20 mm backing rod was installed into the control joint behind the sealant as support. See Figure 1 to Figure 3 in Appendix A for more details.
Control joint B		
B	Control joint detail	Control Joint - nominally 1000 mm long × 20 mm wide, 10 mm deep protection on both sides.
	Local fire-stopping protection	
	Protection	The sealant (item 2) was applied into the control joint to the depth of 10 mm and finished flush on both exposed and unexposed sides. 28 mm × 20 mm backing rod was installed into the control joint behind the sealant as support. See Figure 1 to Figure 3 in Appendix A for more details.

Item	Description	
Control joint C		
C	Control joint detail	Control Joint - nominally 1000 mm long × 40 mm wide, 20 mm deep protection on both sides.
	Local fire-stopping protection	
	Protection	The sealant (item 2) was applied into the control joint to the depth of 10 mm and finished flush on both exposed and unexposed sides. 28 mm × 20 mm and 20 mm × 20 mm backing rods were installed into the control joint behind the sealant as support. See Figure 1 to Figure 3 in Appendix A for more details.
Control joint D		
D	Control joint detail	Control Joint - nominally 1000 mm long × 50 mm wide, 25 mm deep protection on both sides.
	Local fire-stopping protection	
	Protection	The sealant (item 2) was applied into the control joint to the depth of 10 mm and finished flush on both exposed and unexposed sides. 2 × 28 mm × 20 mm backing rods were installed into the control joint behind the sealant as support. See Figure 1 to Figure 3 in Appendix A for more details.

4. Test procedure

Table 7 details the test procedure for this fire resistance test.

Table 7 Test procedure

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of Sections 2 and 10 of AS 1530.4:2014 appropriate for control joints.	
Variations	The pressure was up to 5 Pa above the limits prescribed in the standard during the 25-30, 30-35, and 35-40 minute periods & 1 Pa above the limit during the 40-45 minute period & 11 Pa below the limit during the 45-50 minute period & 6 Pa below the limit during the 85-90 minute period and 23 Pa below the limit during the 65-70 minute period The pressure and temperature were within the limits for the rest of the test. Due to the nature of the specimen and the fact that no significant events occurred during these time periods, this under pressure is unlikely to have invalidated the test result. The temperature was up to 25 °C above the limits prescribed in the standard during the 45-46 minute period. The temperature was within the limits for the rest of the test. This overtemperature resulted in more onerous test conditions, so would not have invalidated the test result.	
Pre-test conditioning	The construction and installation of the test specimen was completed on 18 October 2019. The test specimen was subjected to normal laboratory temperatures and conditions between the completion of construction of the test specimen and the start of the test.	
Sampling / specimen selection	The laboratory was not involved in sampling or selecting the test specimen for fire resistance test report.	
Ambient laboratory temperature	Start of the test Minimum temperature Maximum temperature	20 °C 20 °C 27 °C
Test duration	241 minutes	
Instrumentation and equipment	The instrumentation was provided in accordance with AS 1530.4:2014 as follows: • The furnace temperature was measured by four mineral insulated metal sheathed (MIMS) Type K thermocouples – with wire diameters not greater than 1 mm, an overall diameter of 3 mm, and the measuring junction insulated from the sheath. The thermocouples protruded a minimum of 25 mm from steel supporting tubes. • The unexposed side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5 mm soldered to 12 mm diameter × 0.2 mm thick copper discs covered by 30 mm × 30 mm × 2.0 mm thick inorganic insulating pads. • The thermocouple positions are shown in Table 10 in Appendix D. • The furnace pressure was measured at 130 mm below the mid-height of the control joint and corrected to 15 Pa at the mid-height of the control joint. • A roving thermocouple was available to measure temperatures at positions that appeared hotter than the positions monitored by the fixed thermocouples • Cotton pads were available during the test to assess the performance of the specimen under the criteria for integrity.	

5. Test measurements and results

Table 8 summarises the results the specimen achieved against the performance criteria listed in Sections 2 and 10 of AS 1530.4:2014.

Appendix E includes details of the measurements taken during the test.

Table 9 in Appendix B includes observations of any significant behaviour of the specimen and details of the occurrence of the various performance criteria specified in AS 1530.4:2014.

Photographs of the specimen are included in Appendix F.

Table 8 Test results

Control joint	Criteria	Results	Fire resistance level (FRL)
A	Structural adequacy	Not applicable	**-/240/120**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 171 minutes	
B	Structural adequacy	Not applicable	**-/240/120**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 165 minutes	
C	Structural adequacy	Not applicable	**-/240/120**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 166 minutes	
D	Structural adequacy	Not applicable	**-/240/120**
	Integrity	No failure at 241 minutes	
	Insulation	Failure at 173 minutes	

6. Application of test results

6.1 Test limitations

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

These results only relate to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, and they do not necessarily reflect the actual behaviour in fires.

6.2 Variations from the tested specimen

This report details methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in AS 1530.4:2014. Any significant variation with respect to size, construction details, loads, stresses, edge or end conditions, other than that allowed under the field of direct application in the relevant test method, is not covered by this report.

It is recommended that any proposed variation to the tested configuration – other than as permitted under the field of direct application specified in Appendix C – should be referred to the test sponsor. They should then obtain appropriate documentary evidence of compliance from Warringtonfire Australia Pty Ltd or another registered testing authority.

6.3 Uncertainty of measurements

It is not possible to provide a stated degree of accuracy for the results, because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance.

Appendix A Drawings of test assembly

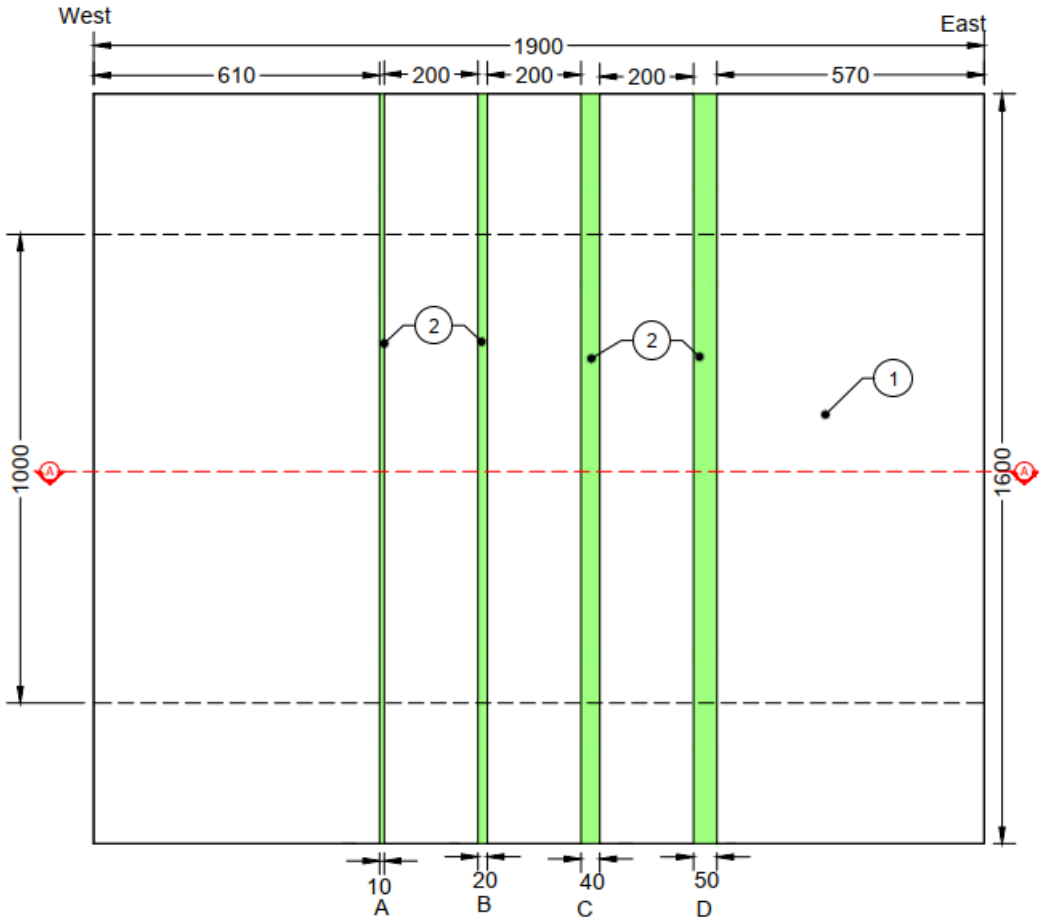


Figure 1 Elevation view of test specimen (unexposed side)

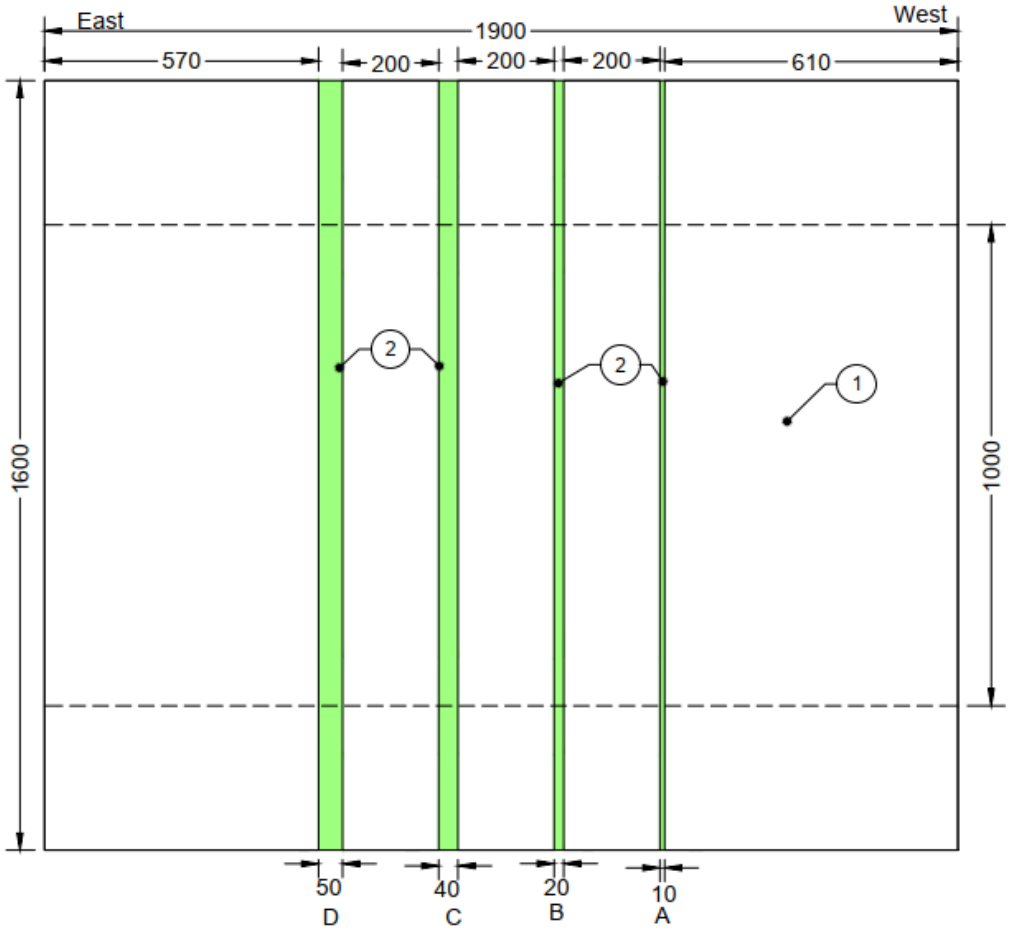


Figure 2 **Elevation view of plan view of test specimen (exposed side)**

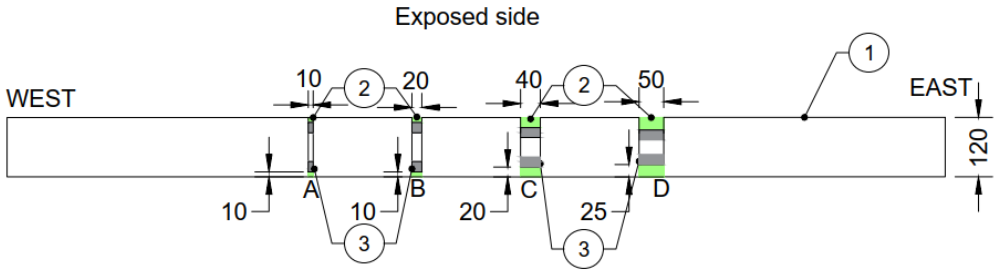


Figure 3 **Cross-section A-A**

Appendix B Test observations

Table 9 shows observations of any significant behaviour of the specimen during the test.

Table 9 Test observations

Time		Observation
Min	**Sec**	
Penetration system A		
00	00	Fire resistance test started, and the initial temperature of the specimen was approximately 20°C.
15	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
45	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
76	00	Panel 1 had deflected less than the smaller and panel 2 causing the sealant to sheer slightly approximately 8 mm.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
126	00	Panel 2 has deflected more than panel 1.
171	**05**	**TC 014, on the east side of the control joint, 375 mm down from the centre recorded a temperature of 200°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 014 exceeded the initial temperature by more than 180K.**
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test stopped.
Penetration system B		
00	00	Fire resistance test started, and the initial temperature of the specimen was approximately 20°C.
15	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
45	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
126	00	The sealant had expanded slightly.
165	**35**	**TC 027, on the east side of the control joint, 375 mm down from the centre recorded a temperature of 200°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 027 exceeded the initial temperature by more than 180K.**
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.

Time		Observation
Min	Sec	
241	00	Fire resistance test stopped.
Penetration system C		
00	00	Fire resistance test started, and the initial temperature of the specimen was approximately 20°C.
15	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
45	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
126	00	The sealant had expanded slightly.
166	**55**	**TC 037, on the east side of the control joint, 375 mm down from the centre recorded a temperature of 200°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 037 exceeded the initial temperature by more than 180K.**
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test stopped.
Penetration system D		
00	00	Fire resistance test started, and the initial temperature of the specimen was approximately 20°C.
30	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
60	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
76	00	Panel 5 have deflected less than the smaller and panel 4 causing the sealant to sheer slightly approximately 8 mm.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
126	00	The sealant had expanded slightly.
173	**55**	**TC 045, on the west side of the control joint, 125 mm down from the centre recorded a temperature of 200°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 045 exceeded the initial temperature by more than 180K.**
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test stopped.

Appendix C Direct field of application

The text, figures and tables in this appendix have been taken from Section 10 of AS 1530.4:2014.

C.1 General

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 changes set out in Clauses 10.12.2 to 10.12.6 of AS 1530.4:2014 have been made.

C.2 Separating elements

Results obtained for sealing systems in various types of masonry and concrete construction may be applied as follows:

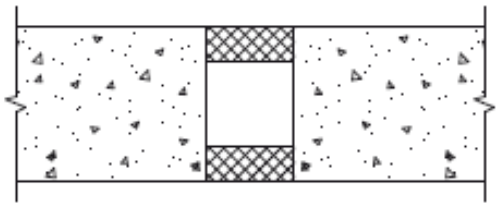
- for elements manufactured from similar types of concrete or masonry, the results of the prototype test may be applied to materials of density within ±15% of the tested specimen. For greater variations, the opinion of a registered testing authority shall be obtained.
- test results obtained in conjunction with hollow concrete blocks may be used in a solid concrete element of the same overall thickness. The reverse does not apply.
- results obtained from framed wall systems may be applied to the performance of a system in concrete, masonry or solid gypsum blocks of greater or equal thickness to that of the tested prototype. The reverse does not apply.
- results obtained from framed wall systems may be applied to similar walls having studs of the same material with sizes greater than the tested prototype.
- results obtained from a prototype test may be applied to framed wall systems of similar construction but having thicker facings of the same material applied to the studs.

C.3 Control joints

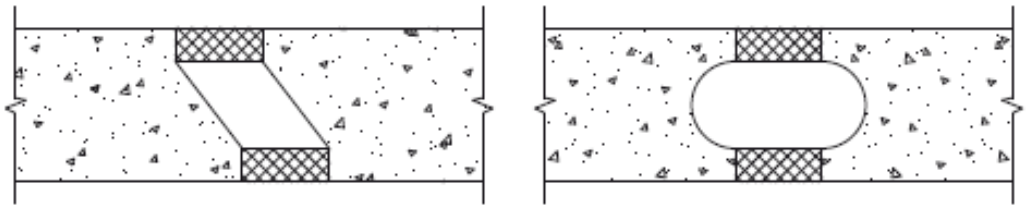
The following variations are permitted:

- Results obtained from single test on a butt joints may be applied to contoured joints, provided the joints have —
  - equal width and equal or greater depth of sealant; and
  - equal or greater thickness of fire-separating element.

  Note: Examples of butt and contoured control joints are shown in Figure 10.12.6 of AS 1530.4:2014.
- Facings may be applied to the surface of the fire-stopping system.



(a) Butt joint



(b) Contoured joints

LEGEND:

= Fire-separating element

= Fire-stopping material

FIGURE 10.12.6 CONTOURED CONTROL JOINTS

Appendix D Instrumentation locations

Figure 4 Penetration system A

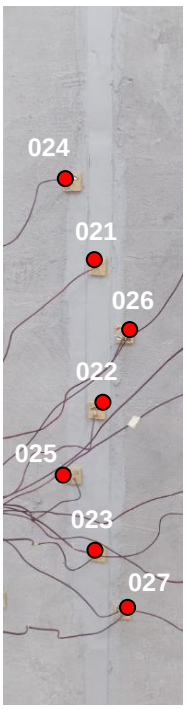


Figure 5 Penetration system B

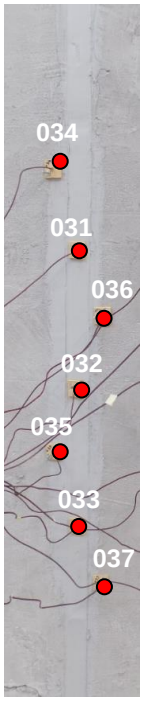


Figure 6 Penetration system C

Figure 7 Penetration system D

Table 10 Thermocouple locations

Control joint	T/C no.	Description
A	011	25 mm from control joint west side, 375 mm up from the centre on the separating element.
	012	25 mm from control joint west side, 125 mm down from the centre on the separating element.
	013	25 mm from control joint east side, 125 mm up from the centre on the separating element.
	014	25 mm from control joint east side, 375 mm down from the centre on the separating element.
B	021	On control joint, 250 mm up from the centre.
	022	On control joint, at the centre.
	023	On control joint, 250 mm down from the centre.
	024	25 mm from control joint west side, 375 mm up from the centre on the separating element.
	025	25 mm from control joint west side, 125 mm down from the centre on the separating element.
	026	25 mm from control joint east side, 125 mm up from the centre on the separating element.
	027	25 mm from control joint east side, 375 mm down from the centre on the separating element.
C	031	On control joint, 250 mm up from the centre.
	032	On control joint, at the centre.
	033	On control joint, 250 mm down from the centre.
	034	25 mm from control joint west side, 375 mm up from the centre on the separating element.
	035	25 mm from control joint west side, 125 mm down from the centre on the separating element.
	036	25 mm from control joint east side, 125 mm up from the centre on the separating element.
	037	25 mm from control joint east side, 375 mm down from the centre on the separating element.
D	041	On control joint, 250 mm up from the centre.
	042	On control joint, at the centre.
	043	On control joint, 250 mm down from the centre.
	044	25 mm from control joint west side, 375 mm up from the centre on the separating element.
	045	25 mm from control joint west side, 125 mm down from the centre on the separating element.
	046	25 mm from control joint east side, 125 mm up from the centre on the separating element.
	047	25 mm from control joint east side, 375 mm down from the centre on the separating element.

Appendix E Test data

E.1 Furnace temperature

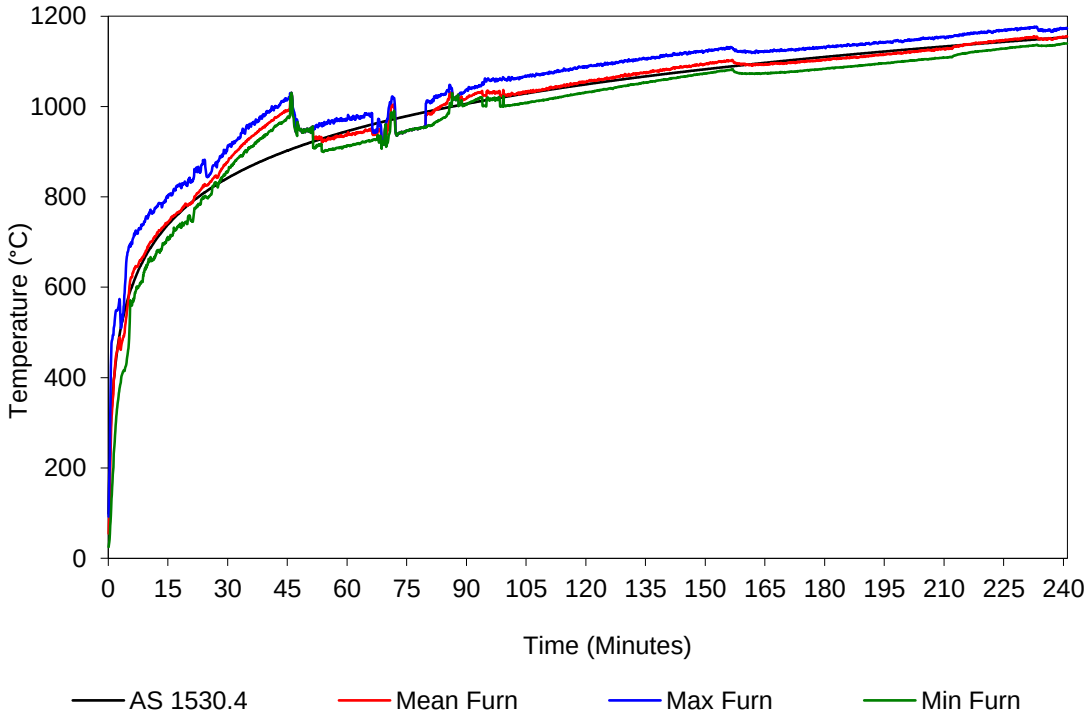


Figure 8 Furnace thermocouple temperature vs time

E.2 Furnace pressure

The furnace pressure was measured at 130 mm below the mid-height of the control joint and corrected to 15 Pa at the mid-height of the control joint.

Table 11 Furnace pressure

Time (minutes)	Pressure (Pa) average	Time (minutes)	Pressure (Pa) average	Time (minutes)	Pressure (Pa) average
5-10	17	85-90	6	165-170	15
10-15	16	90-95	17	170-175	15
15-20	17	95-100	14	175-180	15
20-25	17	100-105	14	180-185	15
25-30	23	105-110	15	185-190	15
30-35	23	110-115	15	190-195	15
35-40	20	115-120	15	195-200	15
40-45	19	120-125	15	200-205	15
45-50	1	125-130	15	205-210	15
50-55	17	130-135	15	210-215	18
55-60	14	135-140	15	215-220	18
60-65	14	140-145	15	220-225	15
65-70	-11	145-150	15	225-230	15
70-75	12	150-155	15	230-235	13
75-80	17	155-160	15	235-240	13
80-85	17	160-165	15		

E.3 Specimen temperatures

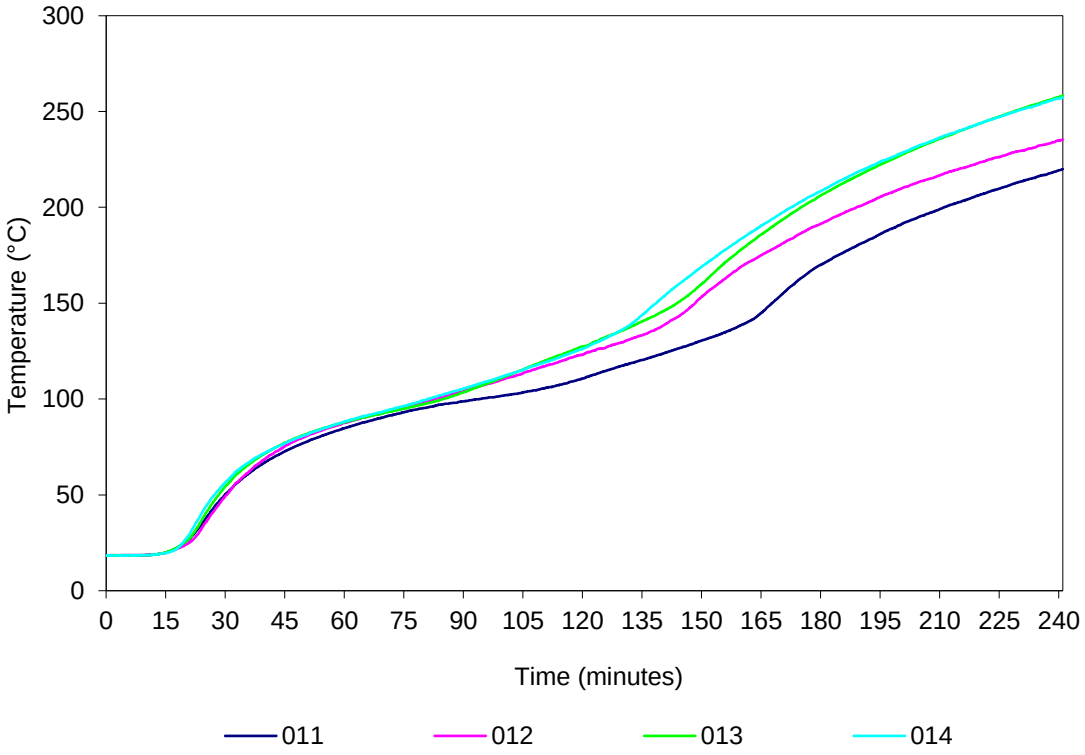


Figure 9 Penetration system A – temperature vs time

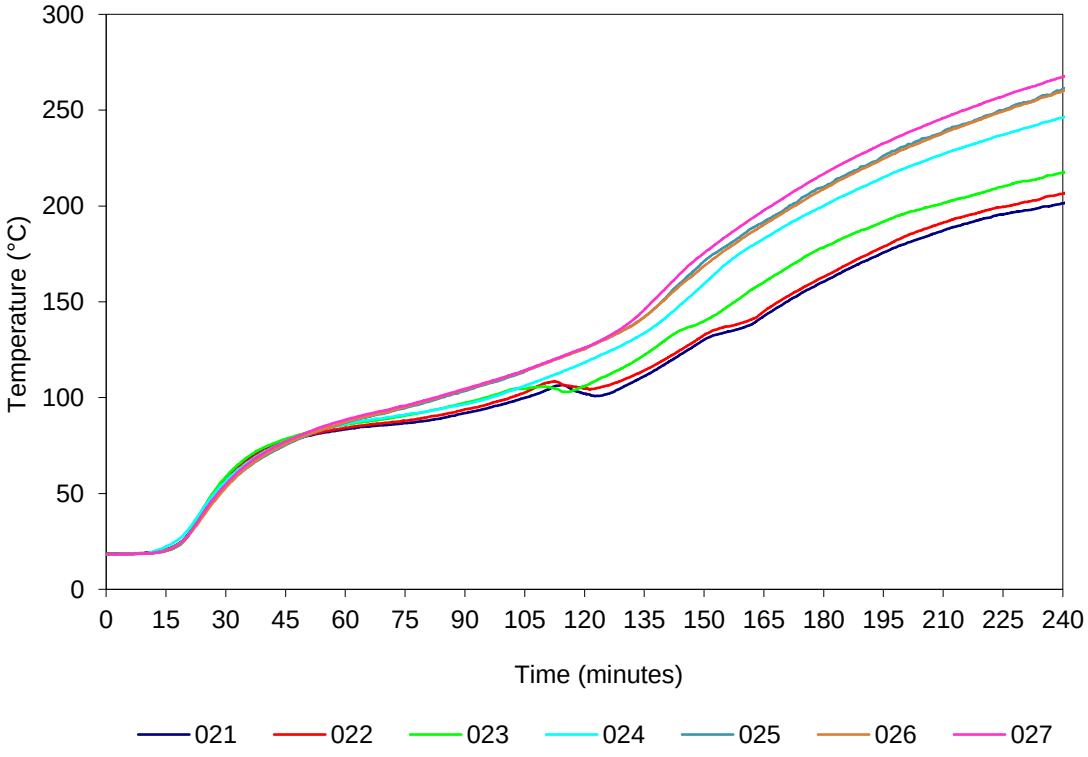


Figure 10 Penetration system B – temperature vs time

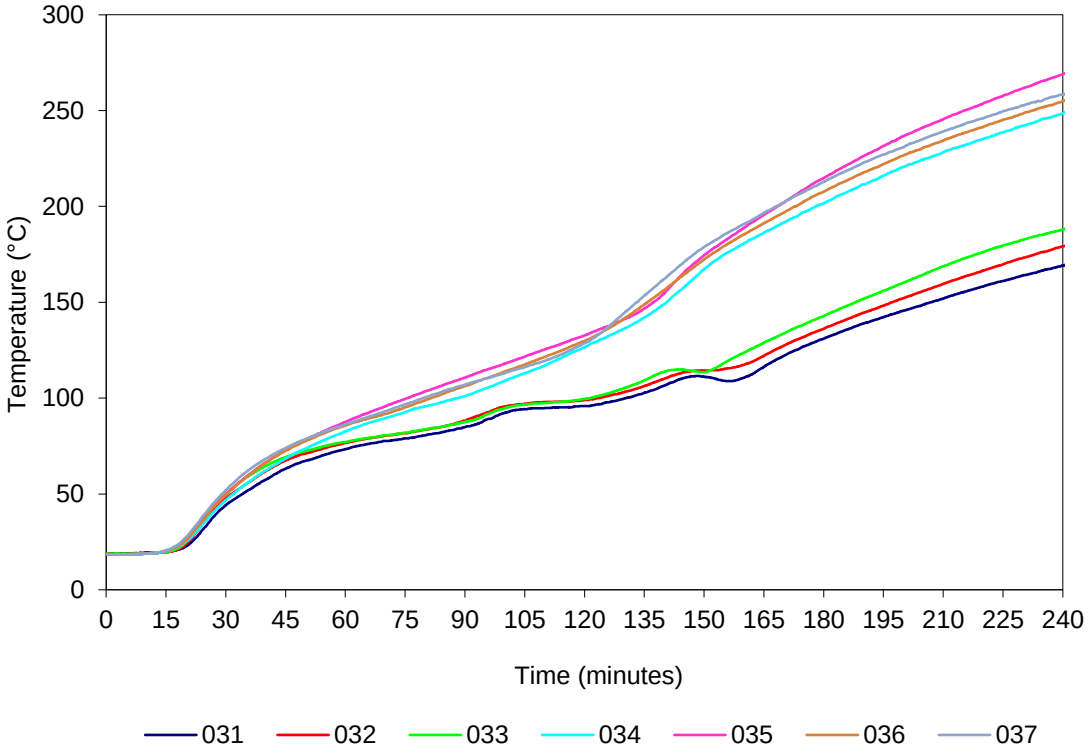


Figure 11 **Penetration system C – temperature vs time**

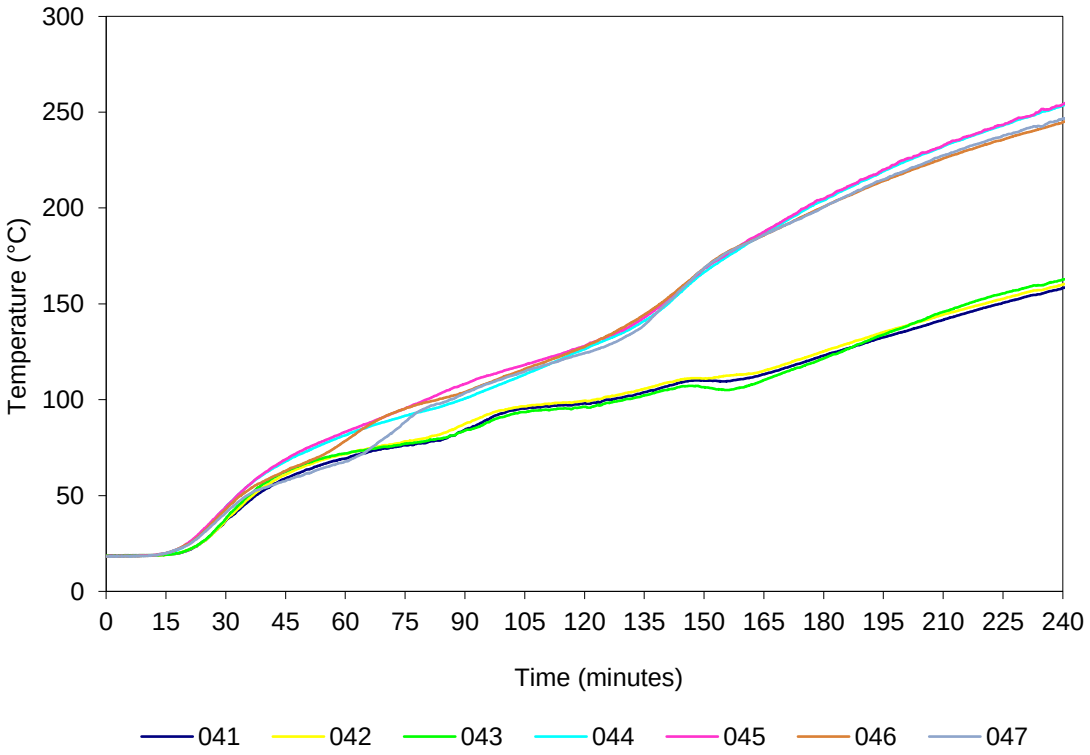


Figure 12 **Penetration system D – temperature vs time**

Table 12 Test specimen temperatures

Control joints	T/C no.	Description[2]	Temp (°C) at t (minutes)					Limit[1] (minutes)
			t=0	t=60	t=120	t=180	t=240	
A	011	On the separating element	18	84	111	170	219	209
	012	On the separating element	18	87	123	191	235	187
	013	On the separating element	18	88	127	206	257	173
	014	On the separating element	18	88	126	208	257	171
B	021	On control joint	19	83	102	160	201	232
	022	On control joint	19	84	105	163	206	222
	023	On control joint	18	86	106	178	217	204
	024	On the separating element	18	86	118	200	246	178
	025	On the separating element	18	87	126	210	260	170
	026	On the separating element	18	87	125	209	259	171
	027	On the separating element	18	88	126	217	267	165
C	031	On control joint	19	73	96	131	169	-
	032	On control joint	19	76	99	136	179	-
	033	On control joint	19	77	100	143	188	-
	034	On the separating element	19	82	126	202	248	176
	035	On the separating element	19	87	133	215	269	167
	036	On the separating element	19	85	130	208	254	171
	037	On the separating element	19	86	129	213	258	166
D	041	On control joint	19	69	98	123	158	-
	042	On control joint	19	71	99	125	160	-
	043	On control joint	19	72	96	121	162	-
	044	On the separating element	18	81	126	204	253	174
	045	On the separating element	18	83	128	205	254	173
	046	On the separating element	18	78	127	201	244	177
	047	On the separating element	18	67	124	200	246	178

Notes

1 Limit time is the time to the nearest whole minute, rounded down to the nearest minute, at which the temperature recorded by the thermocouple does not rise by more than 180 K above the initial temperature.

2 Refer to Table 10 for locations of thermocouples as only a generic description is included in the table.

3 No insulation failure before thermocouple failure.

Thermocouple failure.

* Integrity failure of the control joints.

'–' Under limit column indicates the temperature limit was not exceeded during the test period or up until the time of integrity failure if a failure occurred.

Appendix F Photographs

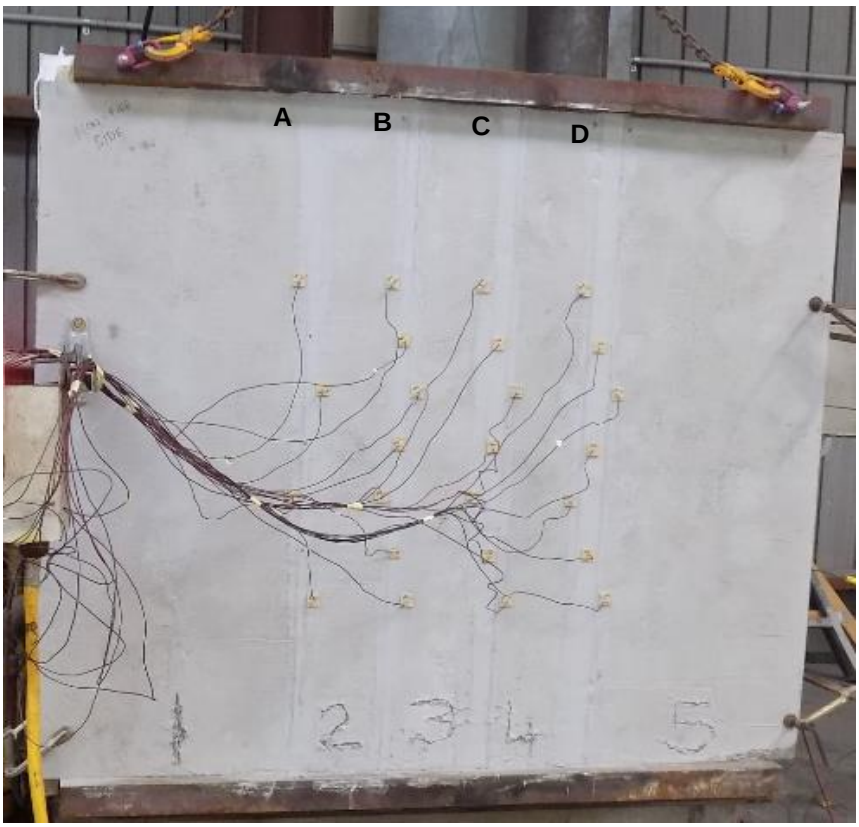


Figure 13 Unexposed face of the specimen before the start of the test

Figure 14 Exposed face of the specimen before the start of the test

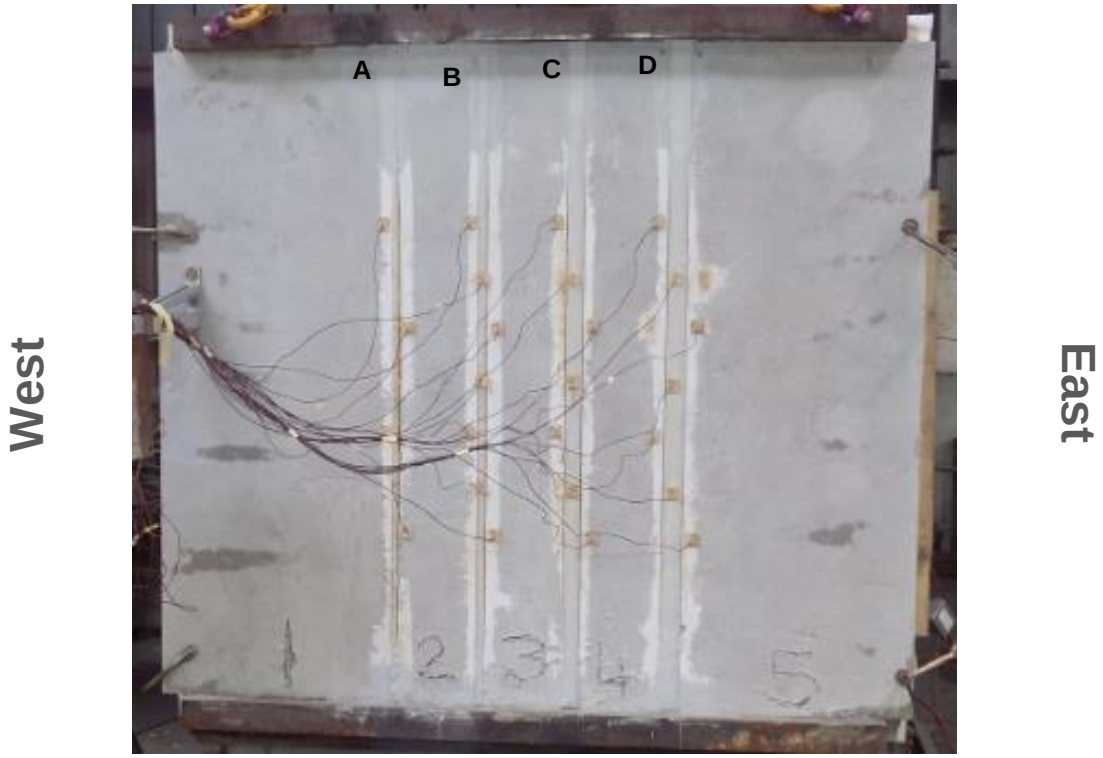


Figure 15 Unexposed face of the specimen at the end of the test

Figure 16 Exposed face of the specimen at the end of the test