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TEST REPORT

A fire resistance test of four control joints in accordance with AS 1530.4:2014

Test sponsor: HB Fuller Aust Co P/L

Address: 16-22 Redgum Drive
Dandenong South, Victoria, 3175
Australia

Job number: FRT180011a

Author: Pius Jerome

Test Date: 10 January 2019

Revision: R1.0

Amendment schedule

Version	Date	Information relating to report			
R1.0	04/02/2019	Description	Initial issue		
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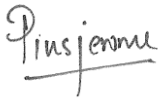
		Signature			
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General conditions of use

Exova Warringtonfire rebranded to Warringtonfire on 1 December 2018. Apart from the change to our brand name, no other changes have occurred. The introduction of our new brand name does not affect the validity of any existing documents we have previously issued.

Executive summary

Objective

To evaluate the fire resistance of a concrete wall system with five varying control joints subjected to a test in accordance with AS 1530.4:2014 Section 2 & 10 in which four varying control joints were reported.

Sponsor

HB Fuller Aust Co P/L , 16-22 Redgum Drive, Dandenong South, Victoria, 3175, Australia

Summary of tested specimen

The test specimen consisted of a 120mm thick concrete wall system incorporating five varying control joints in which four varying control joints were reported. A summary of the control joint is listed in below.

Control Joint	Service	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)
A	Control Joint	HB Fuller - Fulacaulk FR	10 × 1000	10
B	Control Joint	HB Fuller - Fulacaulk FR	20 × 1000	10
C	Control Joint	HB Fuller - Fulacaulk FR	30 × 1000	15
D	Control Joint	HB Fuller - Fulacaulk FR	40 × 1000	20

Table 1 Test assembly

The specimen was tested against the performance criteria for control joint specified in AS 1530.4:2014 Section 2 & 10.

Test results

The control joints satisfied the performance requirements specified in AS 1530.4:2014 for the periods stated below:

- Control joint A
  - FRL (Fire Resistance Level): -/240/120
- Control joint B
  - FRL (Fire Resistance Level): -/240/120
- Control joint C
  - FRL (Fire Resistance Level): -/240/120
- Control joint D
  - FRL (Fire Resistance Level): -/240/120

Date of test

10 January 2019

Contents

1. Construction details

1.1 Test assembly

The test assembly consisted of a nominal 1350mm wide × 1900mm high × 120mm thick concrete wall system with five varying control joints.

The wall was restrained at all edges.

1.2 Test specimen

The wall system consisted of six 1900mm long × 200mm wide × 120mm thick concrete wall strips supported at the ends using PFC's to form five control joints of various widths in which four control joints were reported. Masonry anchors were used to fix the concrete strips to the PFC's giving the wall overall width of 1350mm. The control joints were protected by HB Fuller – Fulacaulk FR Sealant. The test assembly is summarised in Table 2 below.

A full description of the specimen is provided in Appendix A and Section 2.

Control Joint	Service	Local fire-stopping protection	Aperture size (mm)	Sealant depth (mm)
A	Control Joint	HB Fuller - Fulacaulk FR	10 × 1000	10
B	Control Joint	HB Fuller - Fulacaulk FR	20 × 1000	10
C	Control Joint	HB Fuller - Fulacaulk FR	30 × 1000	15
D	Control Joint	HB Fuller - Fulacaulk FR	40 × 1000	20

Table 2 Test assembly

1.3 Assembly and installation methods

The services and fire-stopping protections were installed on 23 November 2018 and completed on 23 November 2018 by the test sponsor.

1.4 Orientation

The wall system was symmetrical.

2. Schedule of components

Item	Description	
Separating element		
1.	Item name	Concrete Wall
	Product name	120mm thick concrete
	Density	2300 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 the top and bottom edges by PFC's. Masonry anchors were used to fix the concrete strips to the PFC's.
Fire-stopping protections		
Sealant		
2.	Product name	HB Fuller - Fulacaulk FR
	Density	1606 kg/m^3 (measured)
	Installation	The sealant was installed in all control joints as detailed in various service descriptions below.
Backing Rod		
3.	Item name	Open cell backing rod
	Material	Polyethylene
	Size	Varying size as per the control joints.
	Installation	The backing rod of varying sizes were installed at all control joints as detailed in various service descriptions below.
Control joint A		
A	Control joint detail	Control Joint - nominally 1000mm long × 10mm wide, 10mm deep
	Aperture size	10mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 20mm × 20mm, was installed into the control joint at a depth of 10mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.
Control joint B		
B	Control joint detail	Control Joint - nominally 1000mm long × 20mm wide, 10mm deep
	Aperture size	20mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 30mm × 20mm, was installed into the control joint at a depth of 10mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.
Control joint C		
C	Control joint detail	Control Joint - nominally 1000mm long × 30mm wide, 15mm deep
	Aperture size	30mm × 1000mm
	Local fire-stopping protection	

Item	Description	
	Protection	Backing rod (item 3) of size 40mm × 20mm, was installed into the control joint at a depth of 15mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.
Control joint D		
D	Control joint detail	Control Joint - nominally 1000mm long × 40mm wide, 20mm deep
	Aperture size	40mm × 1000mm
	Local fire-stopping protection	
	Protection	Backing rod (item 3) of size 60mm × 30mm (two backing rods of 30mm × 30mm), was installed into the control joint at a depth of 20mm from both exposed and unexposed faces of wall. The sealant (item 2) was applied into the control joint to the depth of backing rod and finishing flush with the face of the wall.

Table 3 Schedule of components

3. Test procedure

3.1 Statement of compliance

The test was performed in accordance with the requirements of AS 1530.4:2014 Sections 2 & 10 appropriate for control joints.

3.2 Variations to test method

None.

3.3 Pre-test conditioning

The construction of the test specimen was completed on 23 November 2018. The test specimen was subjected to normal laboratory temperatures and conditions during this period.

3.4 Sampling/specimen selection

The laboratory was not involved in sampling or selecting the test specimen for the fire resistance test.

3.5 Ambient temperature

The ambient temperature of the laboratory at the start of the test was 23°C and varied between 23°C and 30°C during the test.

3.6 Test duration

The test duration was 241 minutes.

3.7 Instrumentation and equipment

The instrumentation was provided in accordance with AS 1530.4:2014 as detailed below:

- The furnace temperature was measured by four mineral insulated metal sheathed Type K thermocouples – with wire diameters not greater than 1mm, an overall diameter of 3mm, and the measuring junction insulated from the sheath. The thermocouples protruded a minimum of 25mm from steel supporting tubes.
- The non-fire side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5mm soldered to 12mm diameter × 0.2mm thick copper discs covered by 30mm × 30mm × 2.0 mm inorganic insulating pads. The thermocouple positions are shown in Table 6 and Figure 3 to Figure 6 in Appendix D.
- A roving thermocouple was available to measure temperatures at positions that appeared hotter than the positions monitored by the fixed thermocouples.
- The furnace pressure was measured at mid-height of the control joint.
- Cotton pads were available during the test to assess the performance under the criteria for integrity.

4. Test measurements

4.1 Furnace temperature and pressure measurements

The furnace temperature and pressure data are provided in Figure 7 and Table 7 in Appendix E.

4.2 Specimen temperatures

The specimen temperature data is provided in Figure 8 to Figure 15 and Table 8 in Appendix E.

4.3 Observations

Table 5 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.

5. Performance criteria and test results

Table 4 shows the results the specimen achieved against the performance criteria listed in AS 1530.4:2014 Sections 2 & 10.

Control Joint	Criteria	Results
A	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 160 minutes
	FRL	-/240/120
B	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 152 minutes
	FRL	-/240/120
C	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 148 minutes
	FRL	-/240/120
D	Structural adequacy	Not applicable
	Integrity	No failure at 241 minutes
	Insulation	Failure at 157 minutes
	FRL	-/240/120

Table 4 Test results

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 the 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

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.

7. Conclusions

A test specimen consisting of a concrete wall system with five varying control joints in which four varying control joints were reported has been subjected to a fire resistance test in accordance with AS 1530.4:2014 Section 2 & 10.

The specimen satisfied the performance requirements specified in AS 1530.4:2014 for the periods stated below:

- Control joint A
  - FRL (Fire Resistance Level): -/240/120
- Control joint B
  - FRL (Fire Resistance Level): -/240/120
- Control joint C
  - FRL (Fire Resistance Level): -/240/120
- Control joint D
  - FRL (Fire Resistance Level): -/240/120

Appendix A Drawings of test assembly

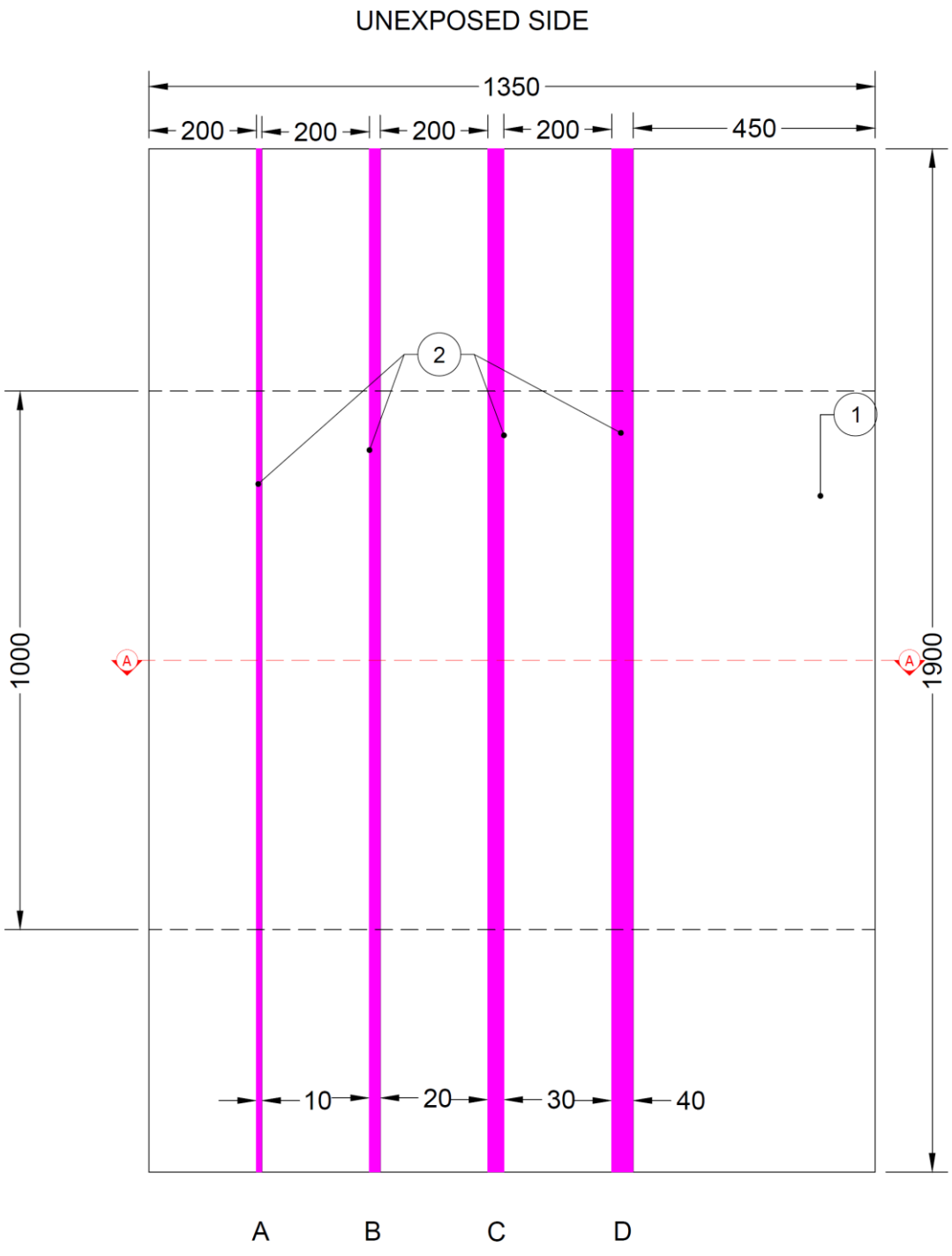


Figure 1 Elevation of test specimen (unexposed side)

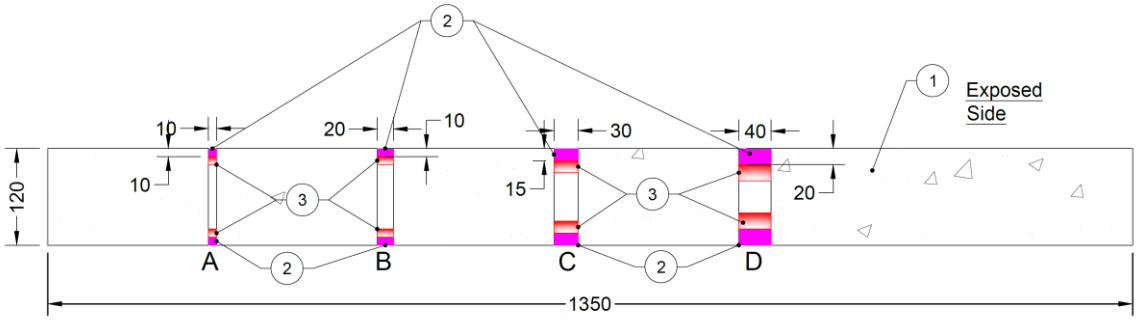


Figure 2 Cross-section A-A

Appendix B Test observations

Table 5 shows observations of any significant behaviour of the specimen during the test.

Time		Observation
Min	Sec	
Control Joint A		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 22°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.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
107	00	The sealant in the control joint had expanded
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
143	00	The sealant in the control joint had started expanding out
160	**25**	**TC 011, 25mm from control joint, 250mm up from the centre recorded a temperature of 203°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 011 exceeded the initial temperature by more than 180K.**
180	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
200	00	Discolouration on the separating element of either side of control joint
240	00	Specimen continued to maintain integrity in accordance with AS 1530.4:2014.
241	00	Fire resistance test terminated.
Control Joint B		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 23°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.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
107	00	The sealant in the control joint had expanded.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
143	00	The sealant in the control joint had started expanding out.
152	**05**	**TC 024, 25mm from control joint, 125mm up from the centre recorded a temperature of 203°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 024 exceeded the initial temperature by more than 180K.**
171	00	Discolouration on the separating element of either side of control joint.
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 terminated.
Control Joint C		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 23°C.

Time		Observation
Min	Sec	
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.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
107	00	The sealant in the control joint had expanded.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
143	00	The sealant in the control joint had started expanding out.
148	**15**	**TC 035, 25mm from control joint, 375mm down from the centre recorded a temperature of 203°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 035 exceeded the initial temperature by more than 180K.**
171	00	Discolouration on the separating element of either side of control joint.
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 terminated.
Control Joint D		
00	00	Fire resistance test commenced, and the average initial temperature of the specimen was approximately 22°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.
90	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
107	00	The sealant in the control joint had expanded.
120	00	Specimen continued to maintain integrity and insulation in accordance with AS 1530.4:2014.
143	00	The sealant in the control joint had started expanding out.
157	**20**	**TC 044, 25mm from control joint, 125mm up from the centre recorded a temperature of 203°C.** **Failure of insulation in accordance with AS 1530.4:2014 clause 2.13.3(b), where the maximum temperature of Thermocouple TC 044 exceeded the initial temperature by more than 180K.**
177	30	Discolouration on the separating element of either side of control joint
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 terminated.

Table 5 Test observations

Appendix C Direct field of application

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 have been made.

C.2 Separating Elements

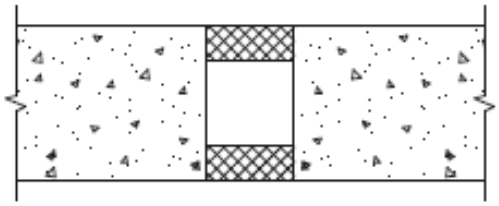
Results obtained for sealing systems in various types of masonry and concrete construction may be applied as follows:

- 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.

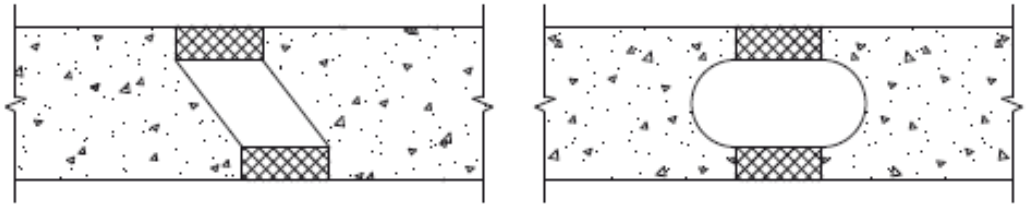
C.3 Control Joints

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.
- 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 positions

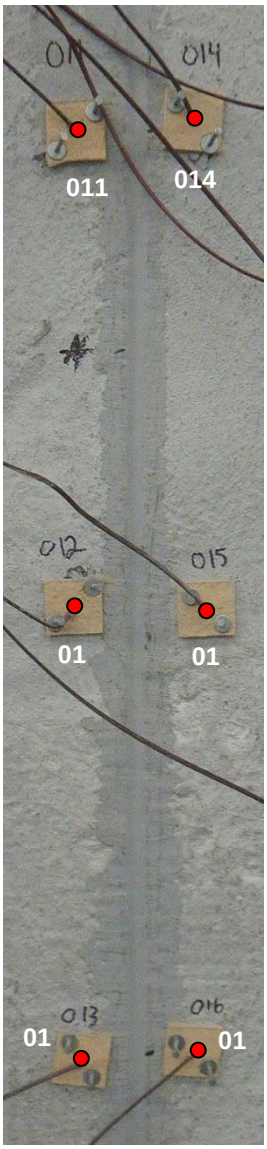


Figure 3 Control Joint A

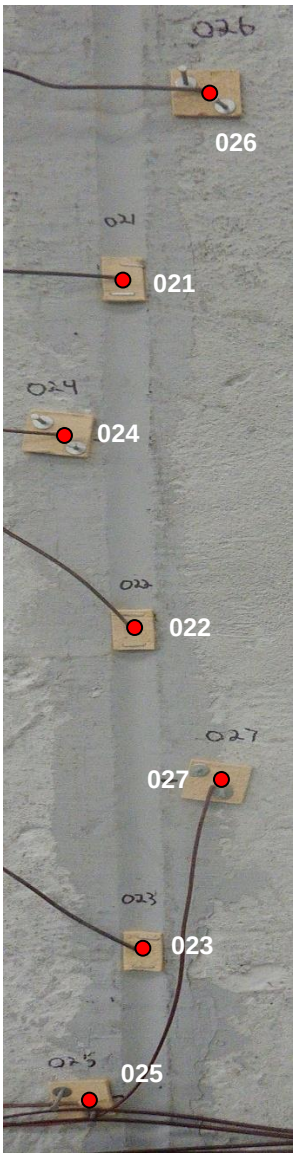


Figure 4 Control Joint B

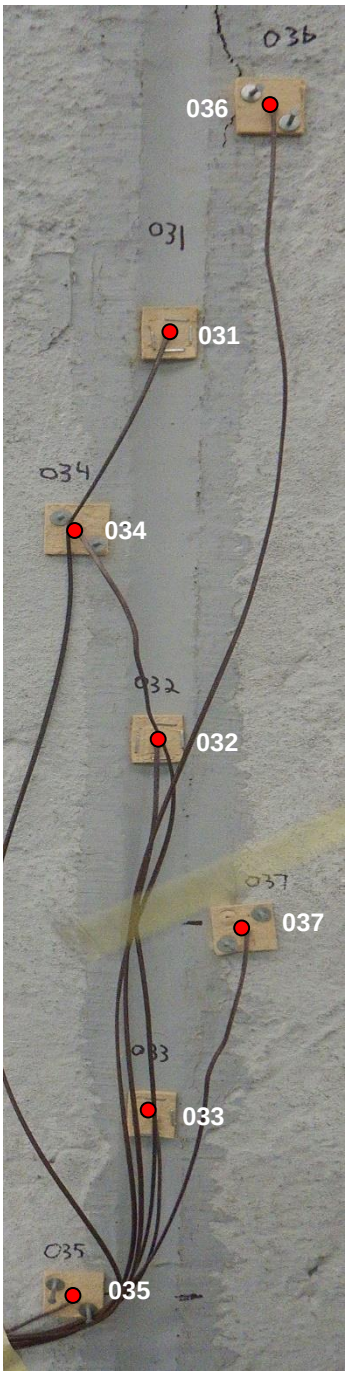


Figure 5 Control Joint C

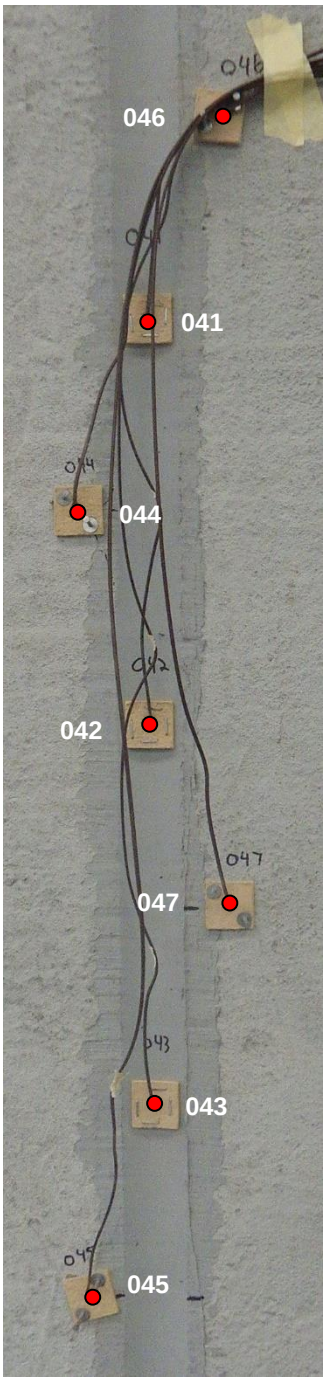


Figure 6 Control Joint D

Control Joint	T/C No.	Description
A	011	25mm from control joint, 250mm up from the centre
	012	25mm from control joint, at the centre
	013	25mm from control joint, 250mm down from the centre
	014	25mm from control joint, 250mm up from the centre
	015	25mm from control joint, at the centre
	016	25mm from control joint, 250mm down from the centre
B	021	On control joint, 250mm up from the centre.
	022	On control joint, at the centre.
	023	On control joint, 250mm down from the centre.
	024	25mm from control joint, 125mm up from the centre
	025	25mm from control joint, 375mm down from the centre
	026	25mm from control joint, 375mm up from the centre
	027	25mm from control joint, 125mm down from the centre
C	031	On control joint, 250mm up from the centre.
	032	On control joint, at the centre.
	033	On control joint, 250mm down from the centre.
	034	25mm from control joint, 125mm up from the centre
	035	25mm from control joint, 375mm down from the centre
	036	25mm from control joint, 375mm up from the centre
	037	25mm from control joint, 125mm down from the centre
D	041	On control joint, 250mm up from the centre.
	042	On control joint, at the centre.
	043	On control joint, 250mm down from the centre.
	044	25mm from control joint, 125mm up from the centre
	045	25mm from control joint, 375mm down from the centre
	046	25mm from control joint, 375mm up from the centre
	047	25mm from control joint, 125mm down from the centre

Table 6 Thermocouple locations

Appendix E Test data

E.1 Furnace temperature

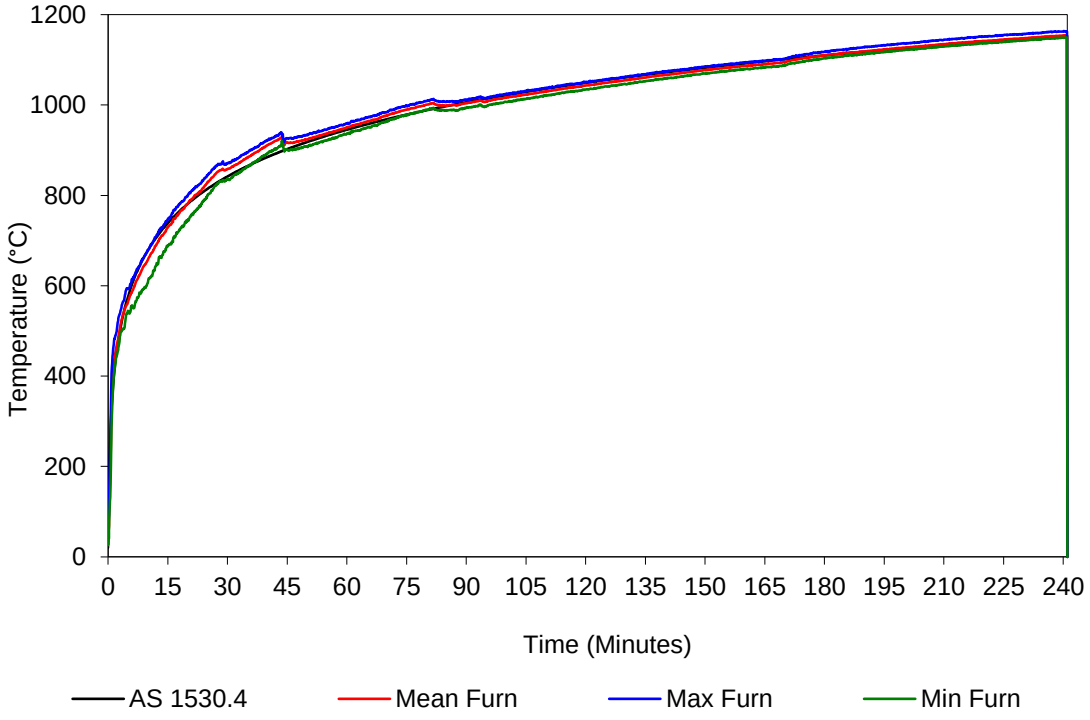


Figure 7 Furnace thermocouple temperature vs time

E.2 Furnace pressure

The furnace pressure was measured at mid-height of the control joint.

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

Table 7 Furnace pressure

E.3 Specimen temperatures

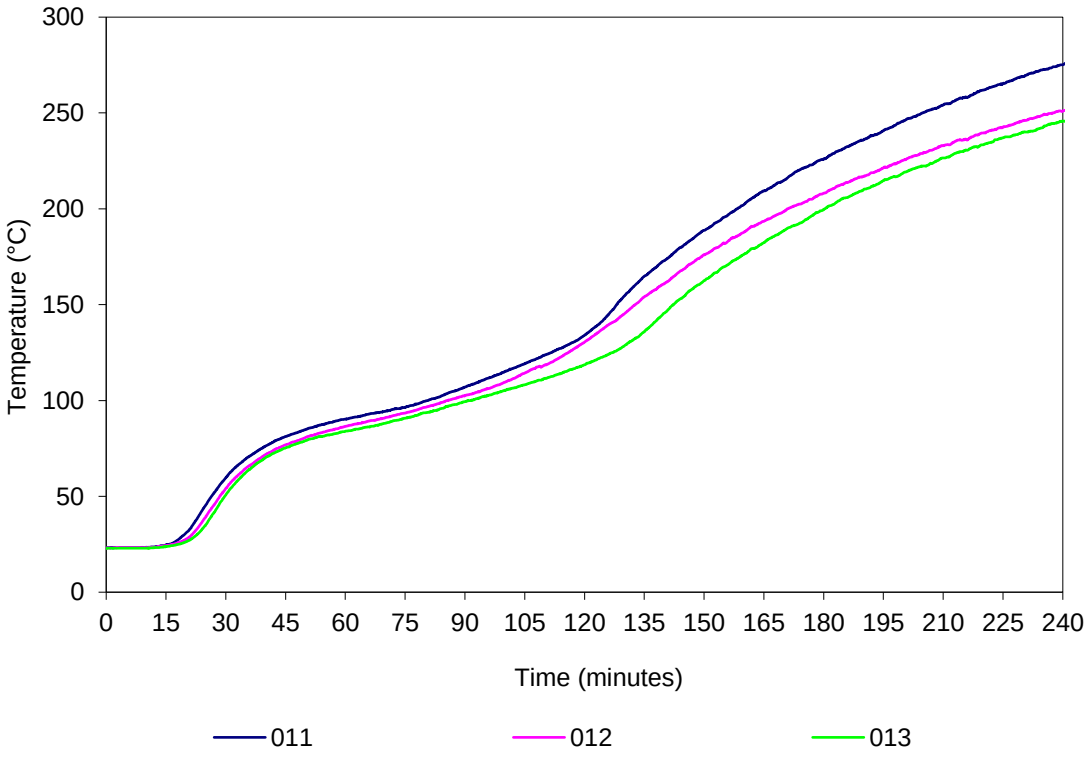


Figure 8 **Control joint A – temperature vs time**

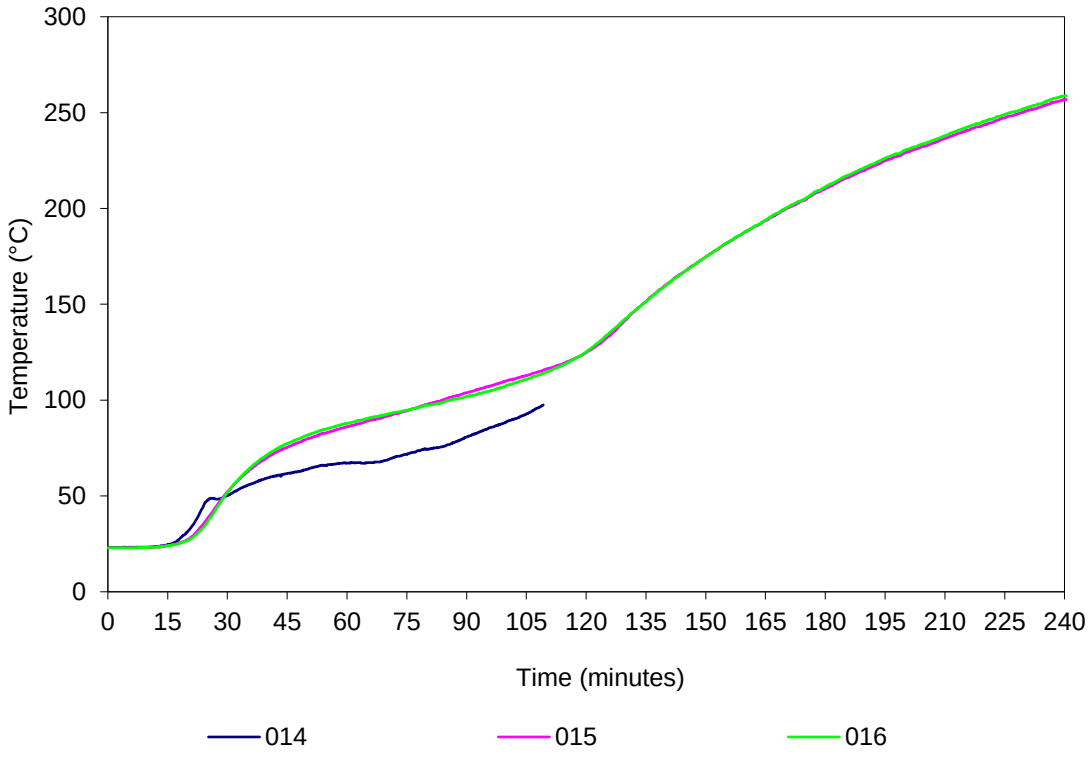


Figure 9 **Control joint A – temperature vs time**

Thermocouple TC014 detached from the surface 109 minutes onwards

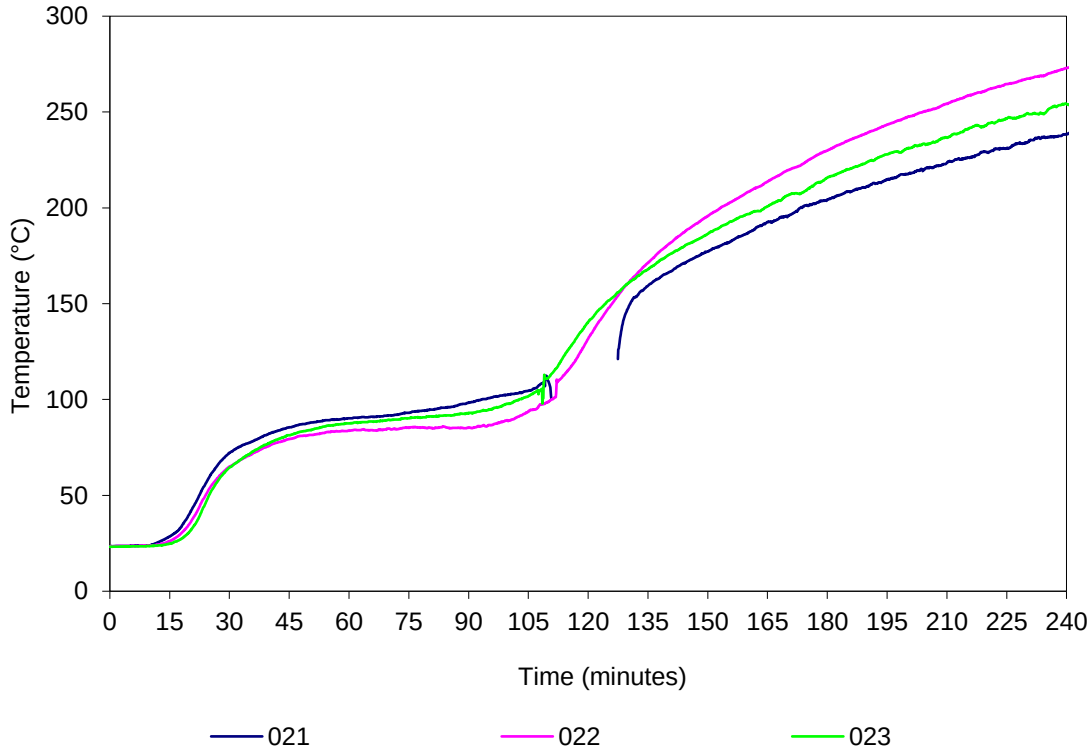


Figure 10 Control joint B – temperature vs time

Thermocouple TC021 detached from the surface between 108 and121 minutes

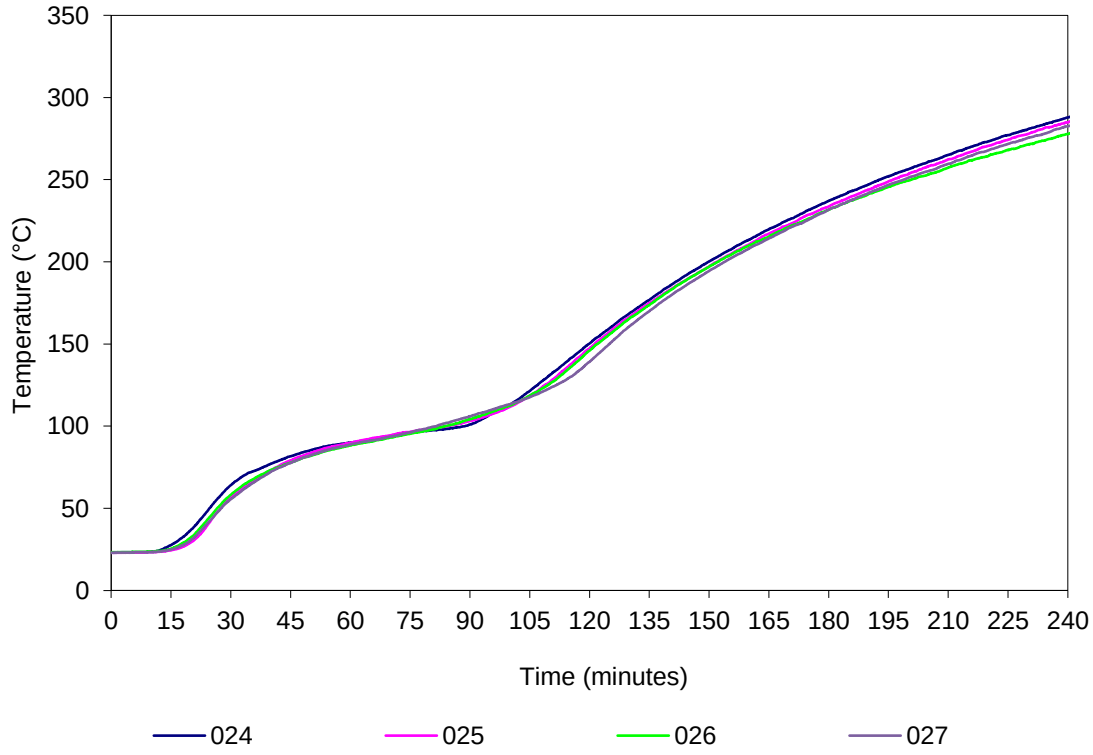


Figure 11 Control joint B – temperature vs time

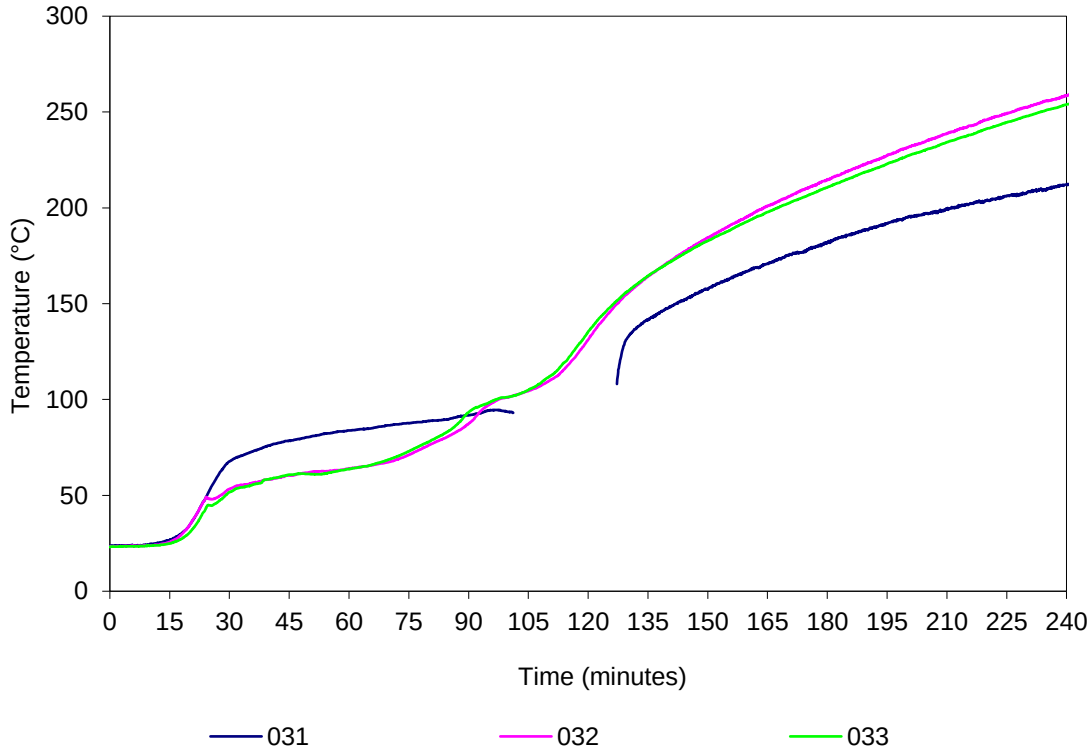


Figure 12 Control joint C – temperature vs time

Thermocouple TC031 detached from the surface between 96 and127 minutes

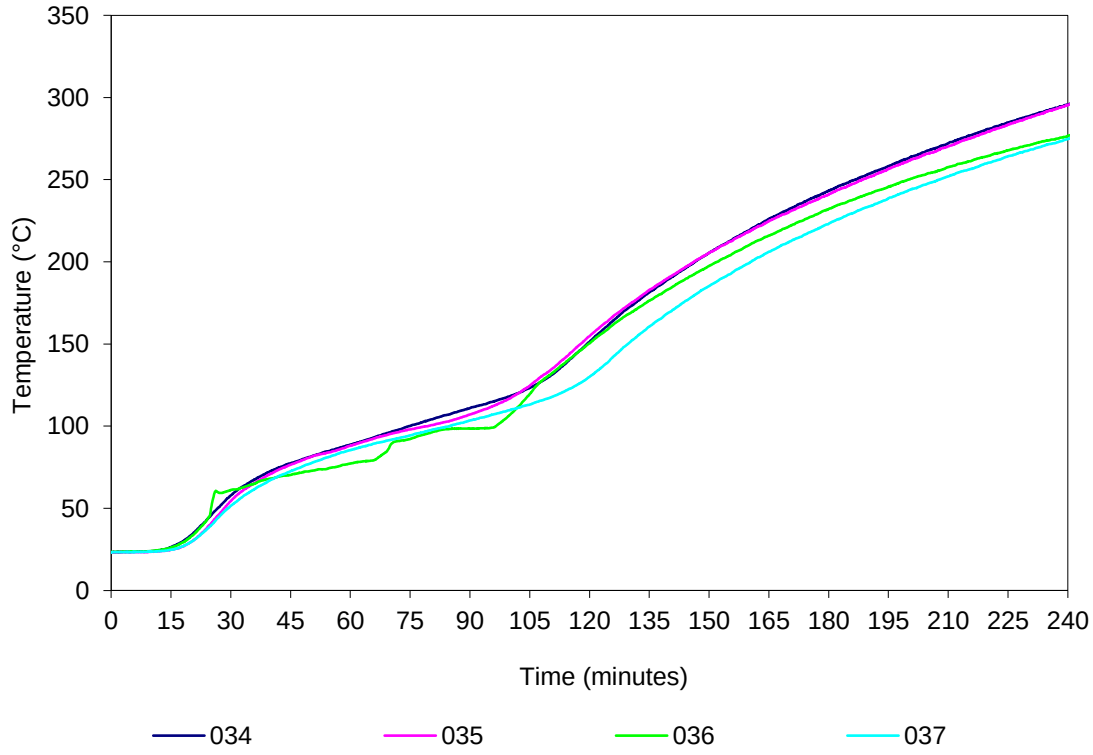


Figure 13 Control joint C – temperature vs time

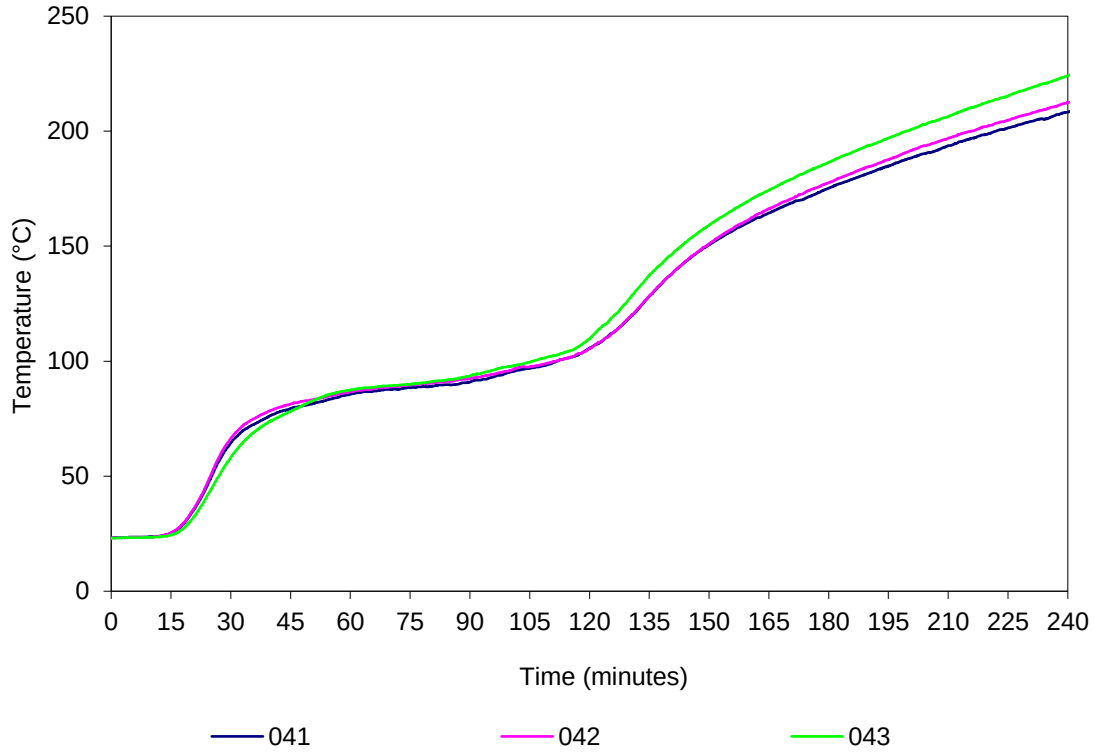


Figure 14 **Control joint D – temperature vs time**

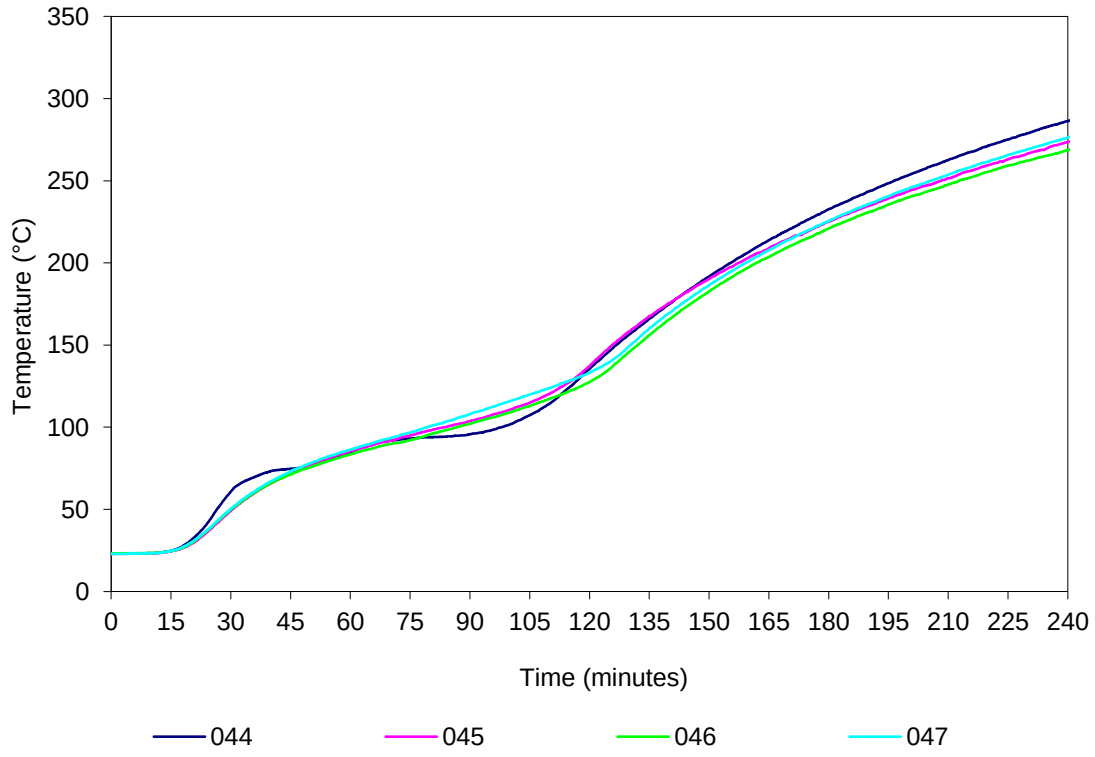


Figure 15 **Control joint D – temperature vs time**

System	T/C No.	Description[2]	Temp (°C) at t (minutes)						Limit[1] (minutes)
			t=0	t=30	t=60	t=120	t=180	t=240	
A	011	25mm from control joint	23	61	90	134	226	276	160
	012	25mm from control joint	23	55	87	130	208	251	174
	013	25mm from control joint	23	52	84	119	199	246	182
	014	25mm from control joint	23	51	67	46	73	89	-
	015	25mm from control joint	23	53	86	125	210	257	173
	016	25mm from control joint	23	53	88	125	211	259	172
B	021	On control joint	23	73	90	50	204	239	178
	022	On control joint	23	65	84	131	230	273	156
	023	On control joint	23	65	88	140	216	254	167
	024	25mm from control joint	23	65	90	150	237	288	152
	025	25mm from control joint	23	58	90	147	233	285	153
	026	25mm from control joint	23	59	88	146	231	278	154
	027	25mm from control joint	23	56	89	139	231	283	156
C	031	On control joint	23	68	84	36	182	212	217
	032	On control joint	23	54	64	131	214	259	167
	033	On control joint	23	52	64	135	210	254	170
	034	25mm from control joint	23	59	89	151	243	296	148
	035	25mm from control joint	23	56	88	154	241	296	148
	036	25mm from control joint	23	61	77	150	232	277	154
	037	25mm from control joint	23	52	85	130	223	275	162
D	041	On control joint	23	65	86	105	175	209	203
	042	On control joint	23	67	87	105	177	213	203
	043	On control joint	23	59	88	109	186	224	203
	044	25mm from control joint	23	62	85	135	232	287	157
	045	25mm from control joint	23	50	85	137	225	274	159
	046	25mm from control joint	23	51	84	127	221	269	164
	047	25mm from control joint	23	51	87	133	225	277	161

Table 8 Test specimen temperatures

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 180K above the initial temperature.

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

3 No insulation failure prior to thermocouple failure.

Thermocouple failure.

'–' 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

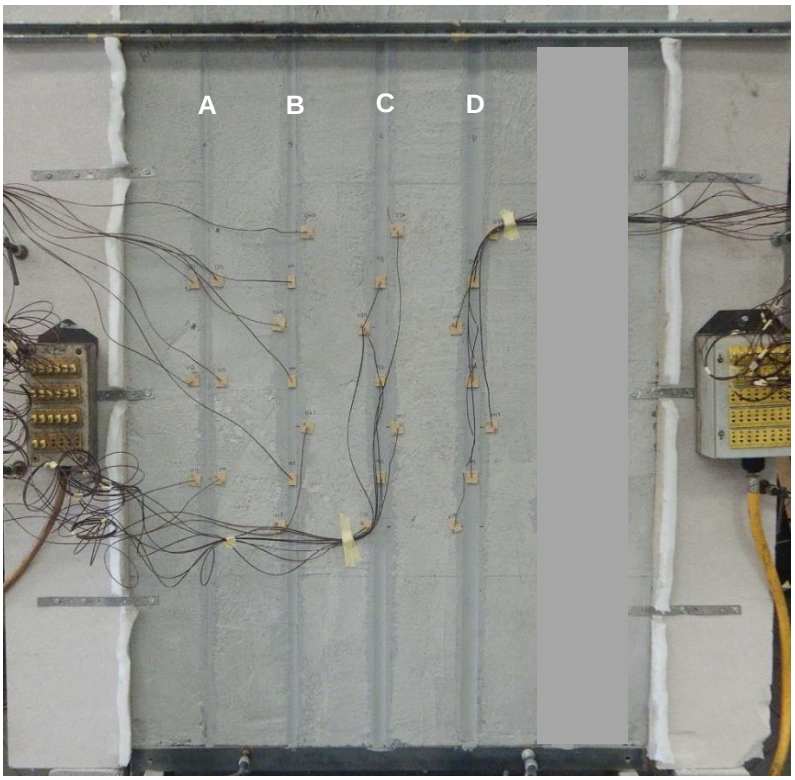


Figure 16 Unexposed face of specimen before the start of the fire-resistance test

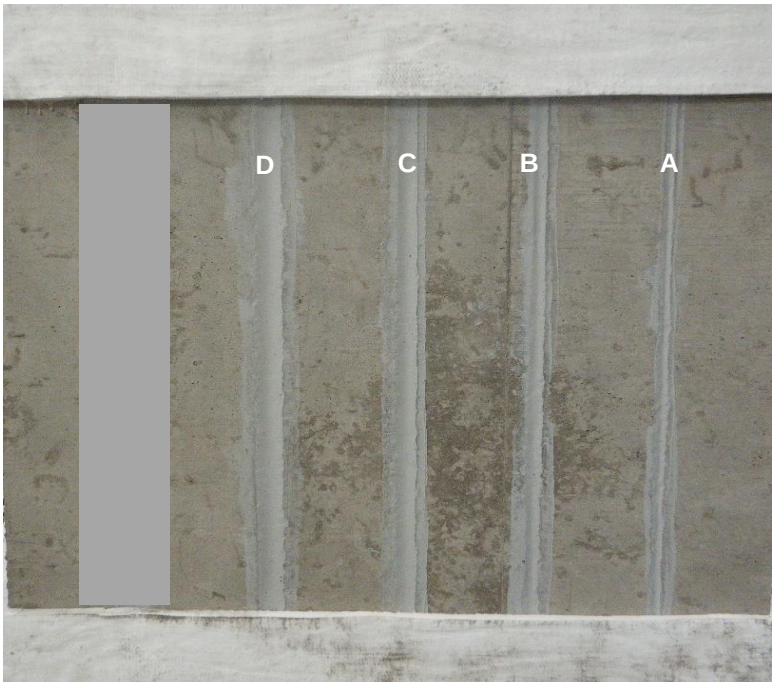


Figure 17 Exposed face of the specimen before the start of the fire-resistance test

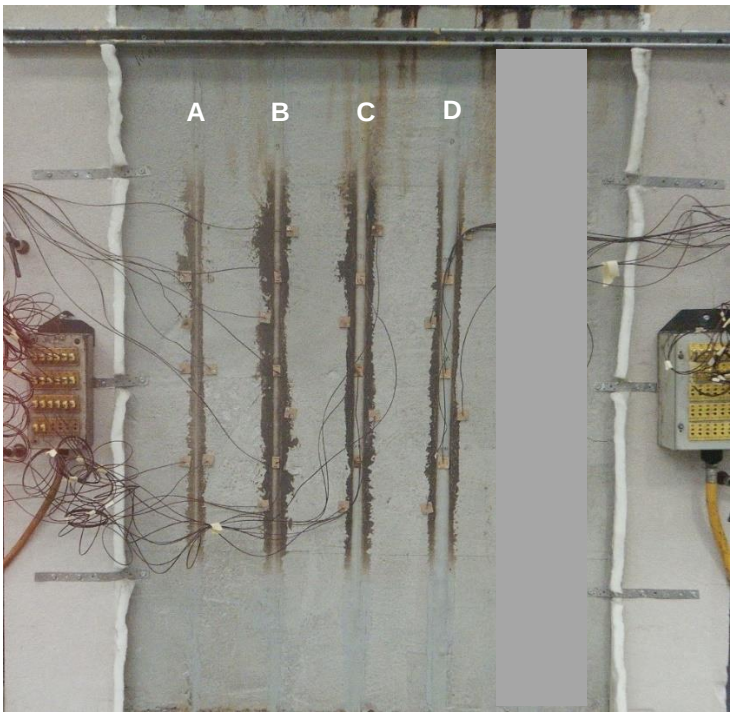


Figure 18 Unexposed face of specimen at the end of the fire-resistance test

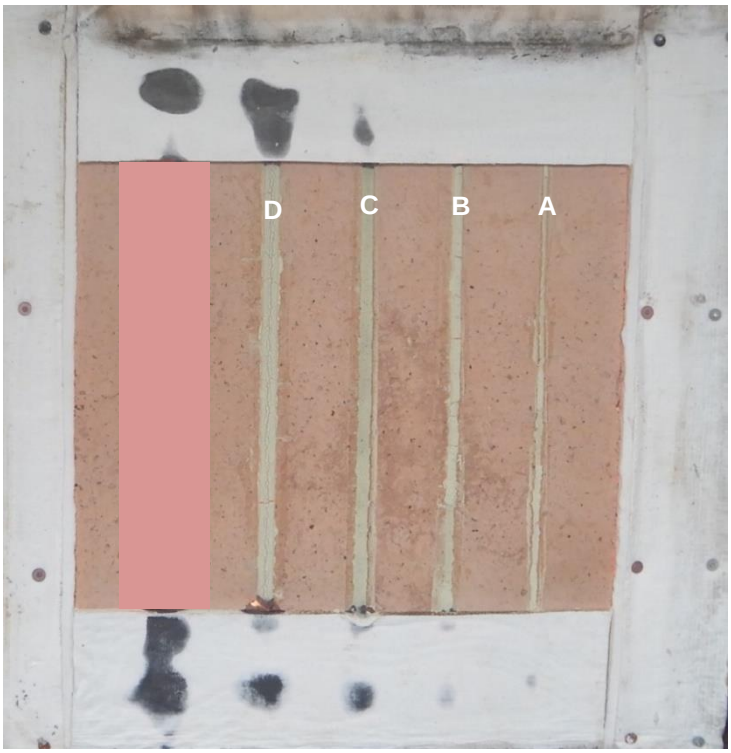


Figure 19 Exposed face of the specimen at the end of the fire-resistance test