

Report Number **BTC 11603F**

A FIRE RESISTANCE TEST ON A LOADBEARING
KINGSPAN TEK HAUS™ BUILDING SYSTEM
CONDUCTED IN ACCORDANCE WITH
BS 476: PART21: 1987: CLAUSE 8.

Test Date: 10th July 2001

Customer: Kingspan Insulation Limited
Pembridge
Leominster
Herefordshire
HR6 9LA

Customers: Kingspan Insulation Limited

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**A FIRE RESISTANCE TEST ON A LOADBEARING KINGSPAN TEK HAUS™ BUILDING SYSTEM
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FOREWORD

This test report details a fire resistance test on a loadbearing Kingspan TEK Haus™ building system. The test sponsor was Kingspan Insulation Limited.

The test specimen was pre-fabricated and was installed into a restraint test frame by The Building Test Centre. The Building Test Centre played no role in the design or selection of the materials comprising the test specimen.

The test was witnessed by Mr Ivor Meredith of Kingspan Insulation Limited on the 10th July 2001.

REPORT AUTHORISATION

Report Author

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Authorised by

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Head of Laboratory

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TEST CONSTRUCTION

The specimen was constructed in a refractory concrete lined steel restraint test frame with an opening of 2400 mm (high) x 3000 mm (wide). A 220mm (thick) spreader beam was located within the head of the restraint test frame.

Pre-fabricated Panel Construction

The Kingspan TEK Haus™ building system consisted of a pre-fabricated wall 2400mm (high) x 3000mm (wide) x 170mm (thick). The wall consisted of 50mm x 110mm S10 timber top and bottom plates and end splines along with 50mm x 10mm soft wood battens fixed at 600mm centres.

The wall was clad on the exposed face with 12.5mm (thick) x 2400mm (long) x 1200mm (wide) Lafarge Firecheck plasterboard using nails at a maximum of 150mm centres at all framework positions (around the perimeter and within the field of the board). The wall was clad on the unexposed face with 2400mm (long) x 1200mm (wide) x 15mm (thick) Structural Insulated Panels and fixed using nails at 80mm centres around the perimeter and at 100mm centres down the joints of the boards. The adjoining boards were fixed with nails at 100mm centres down the vertical joints but they were offset vertically by 50mm. The structural insulated panels were made up of two OSB (Oriental Strand Board) 3 boards with a zero Ozone Depletion Potential (zero ODP) rigid urethane insulation core. The OSB 3 boards were autohesively bonded to the rigid urethane insulation core during the manufacturing process.

Installation

Prior to installation the test frame was fitted with two mild steel angle bars along the spreader beam and the top of the concrete brickwork on the exposed face using 90mm Gyproc Drywall Screws and 45mm Hus Hilti fixings respectively. The specimen was placed into the restraint test frame and two additional angle bars were fixed in the spreader beam and concrete brickwork on the unexposed face by the same method. These angle bars were not fixed to the specimen they were only used to prevent the specimen from falling out of the frame.

The gaps each side of the specimen for free ends were sealed with 25mm thick Rockwool Firebatt gasket.

See figures 1, 2, 3 & 4 for illustrated construction details.

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Cross-section of the Specimen

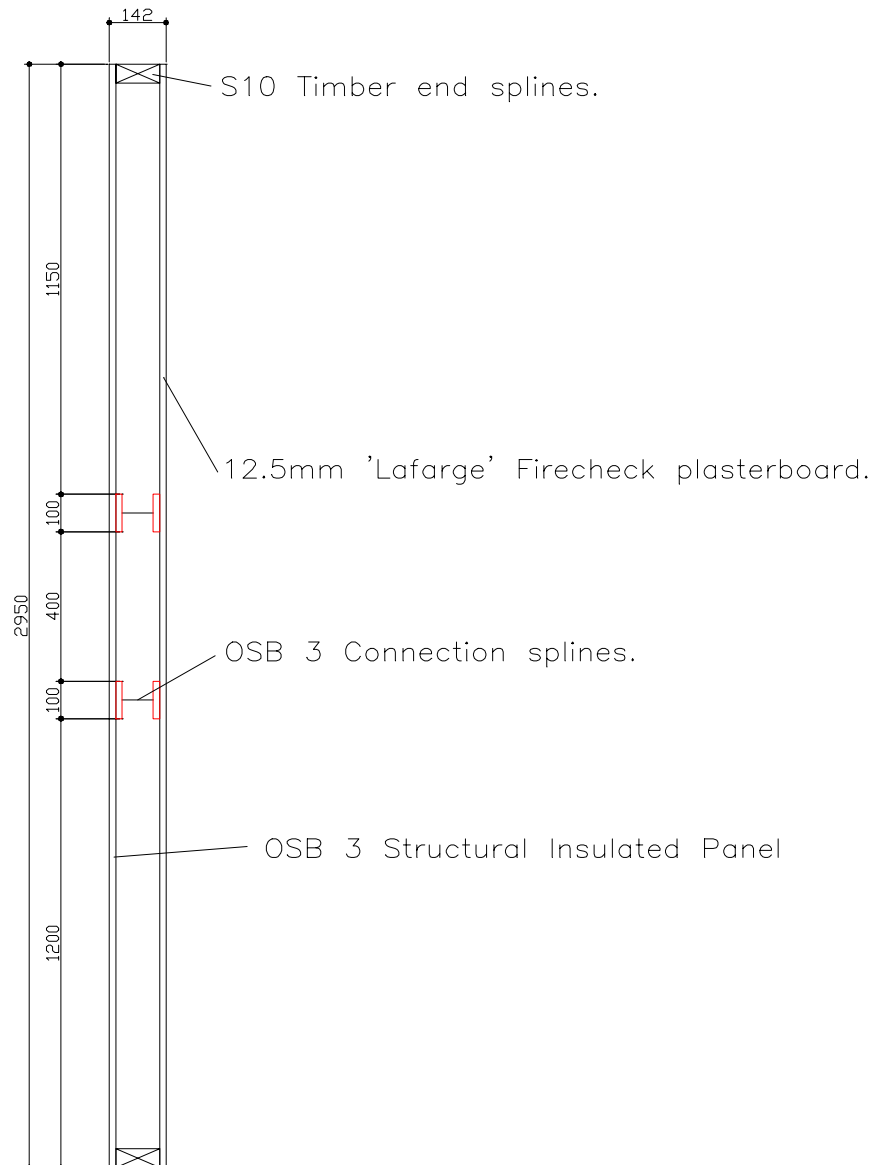


Figure 1. Cross-section of specimen.

Elevation View of the Specimen

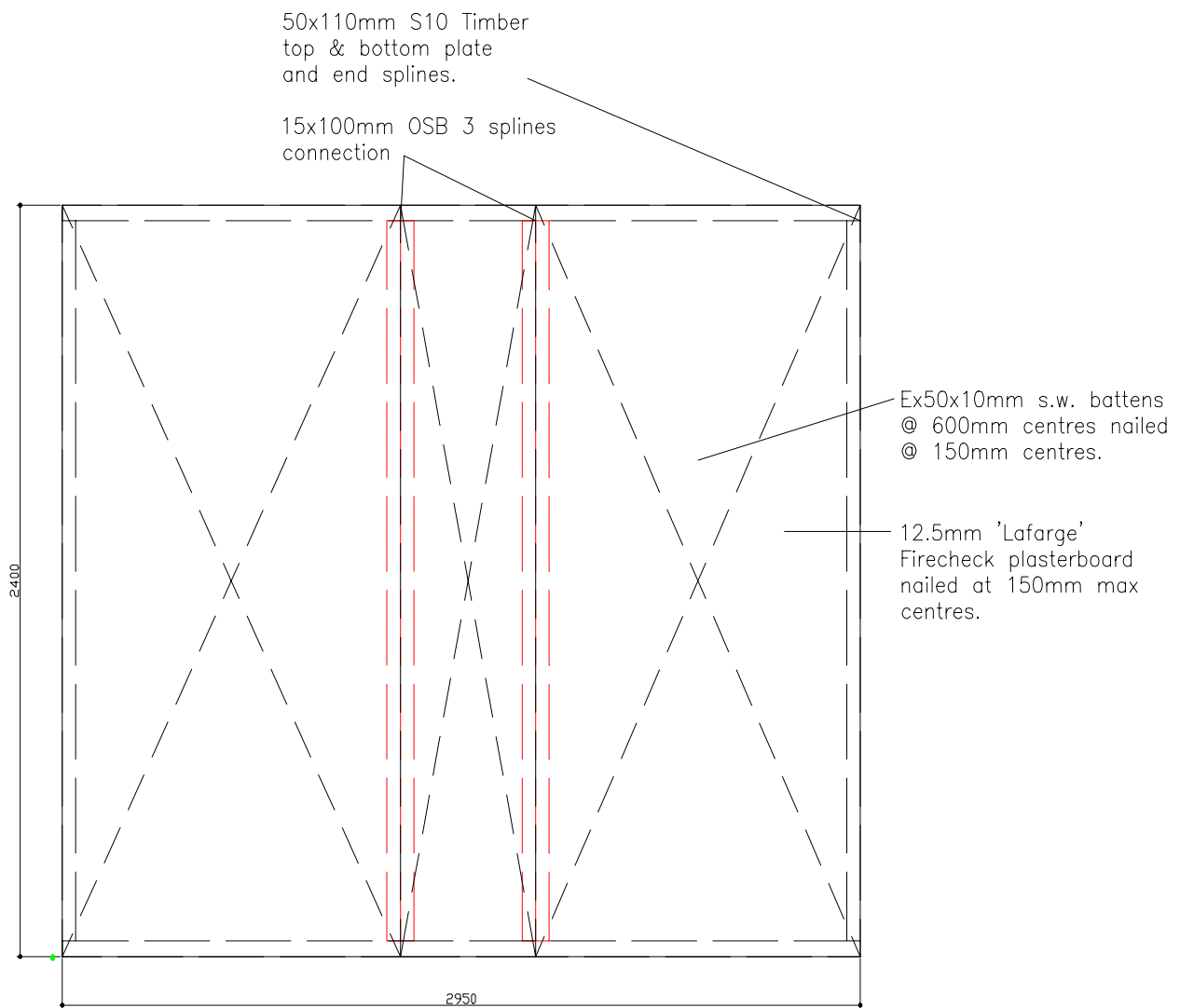


Figure 2. Elevation section of specimen showing construction materials.

Panel Joint Fixing Detail



Figure 3. Cross-section through OSB 3 spline connection.

Board Layout

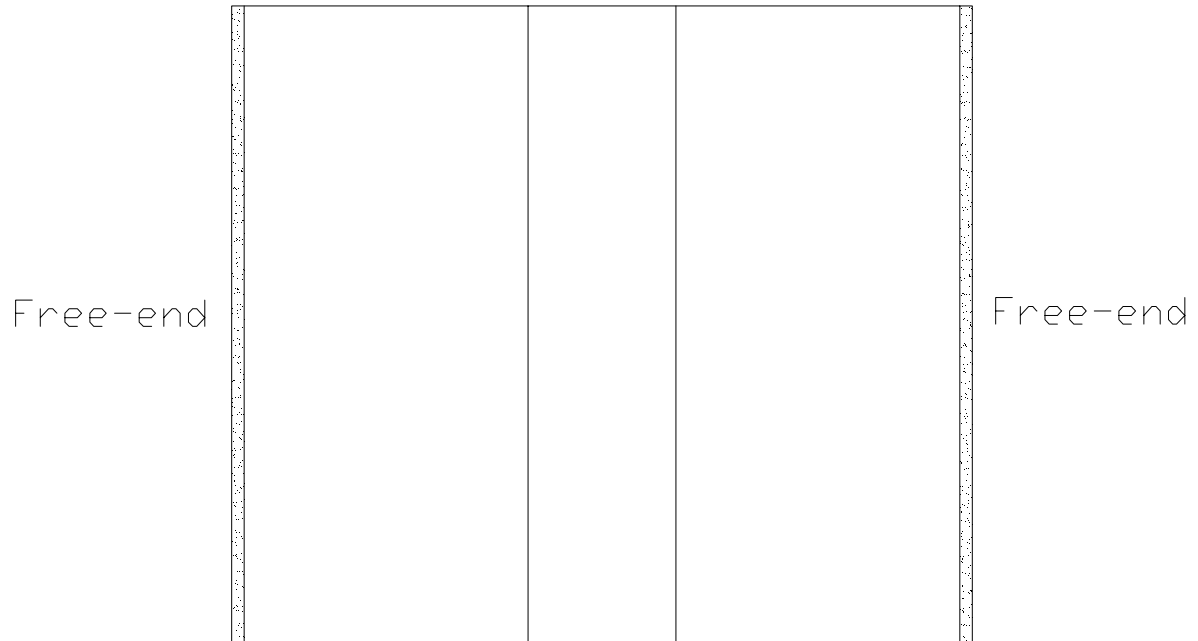


Figure 4. Unexposed face board layout.

TEST MATERIALS

Pre-fabricated Panel System

Supplied pre-fabricated system consisted of the following components:

Lafarge Firecheck Plasterboard

Nominally 2400mm x 1200mm x 12.5mm Lafarge Firecheck plasterboard. Manufactured and supplied by Lafarge Plasterboards Limited.

Timber Framework

Nominally 50mm x 110mm S10 grade timber for the top and bottom plates and the end splines. Nominally 50x10mm soft wood for the battens. All timber was supplied by Kingspan Insulation Limited.

Structural Insulation Panels

Structural insulation panels were made up of two OSB 3 (Oriental Strand Boards) boards with a zero ODP rigid urethane insulation core. (Approximate density of 640 kg/m³). Board supplied by Nexfor Inverness and the final insulation panel supplied by Kingspan Insulation Limited.

Miscellaneous Components

- (i) 90mm Gyproc Drywall Screws supplied by British Gypsum Limited.
- (ii) 45mm Hus Hilti fixings, supplied by Hilti Limited for British Gypsum Limited.
- (iii) Steel angle bars.

The descriptions of individual components making up the test specimen were provided by the customer and were checked for accuracy wherever possible.

TEST PROCEDURE

The test was conducted fully in accordance with BS 476: Part 21: 1987: Clause 8. The specimen was tested with the plasterboard on the exposed side as requested by the sponsors, as this would be the designed direction of testing this construction. Where areas of the test specification are ambiguous or open to interpretation the Fire Test Study Group Resolutions 43, 47, 50, 53, 60, 70 and 72 have been followed (where appropriate). These Resolutions provide basis of common agreements between the fire test laboratories which are members of this Group.

The test procedure used was 476/20 issue 1.

The ambient temperature at the start of the test was 18°C.

The furnace pressure was maintained at 11.1 ± 2 Pa positive with respect to atmosphere, at a point 100 mm below the top of the specimen, except during the first 5 minutes of the test. The furnace pressure was below the allowed tolerance at 30 minutes and the furnace pressure was above the allowed tolerance at 37, 57, 58, 59, 64, 68, 69, 70, 71, 72 and 73 minutes.

A uniformly distributed total load of 38.3kN (13kN/m) was applied to the specimen at the request of Kingspan Insulation Limited (see figure 8).

TEST RESULTS

The requirements of the standard were satisfied for 73 minutes

The test was terminated at 73 minutes at the request of the laboratory.

The reporting of results in terms of insulation and integrity are not appropriate for this type of specimen. In practice the unexposed face of this construction would be located adjacent to an external wall cladding system. The sponsors were therefore only concerned with the loadbearing capacity of the system. However, this report does include observations made from the unexposed face and thermocouple data on the unexposed face for additional information (see pages 10 - 12 & 14 - 17 for details).

LIMITATIONS

The results only relate to the behaviour of the specimen of the element of construction under the particular conditions of test; they are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires.

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over 5 years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

TEST DATA

Observations

Observers: Unexposed face N Kelare and R Evans
 Exposed face L Cooper

Time		<i>Observations</i>
hrs	mins	
		All observations refer to the exposed face unless otherwise stated.
	0	Test Started.
	17	The joints of the plasterboard were still sealed.
	18	The joints had opened approximately to 1-2mm.
	25	The left-hand joint had opened approximately to 1-2mm. The right-hand joint had opened approximately to 4-5mm.
	30	The left-hand joint had opened approximately to 3-4mm. The right-hand joint had opened approximately to 6-8mm.
	32	A vertical crack had developed at the top on the right-hand side of the centreboard approximately 300mm long. The right-hand side of the centreboard had cracked adjacent to the right-hand vertical joint.
	33	A vertical crack had developed at the bottom right-hand side of the centreboard, approximately 150mm long. Left-hand joint open to approximately 6mm. Right-hand joint open to approximately 15mm.
	37	There was flaming and turbulence in the furnace
	40	Visibility was poor due to the turbulence in the furnace. The right-hand joint had opened approximately to 20mm and the left-hand joint had opened approximately to 8mm.
	44	The plasterboards remained intact.

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Time		<i>Observations</i>
hrs	mins	
		All observations refer to the exposed face unless otherwise stated.
	47	Exposed face observations no longer possible due to view ports being complete blacked out.
1	02	<i>Unexposed face</i> Deflection transducer was removed.
1	08	<i>Unexposed face</i> Smoke was being emitted from the bottom of the specimen.
1	12	TEST TERMINATED at the request of the laboratory.

Furnace Temperature Graph

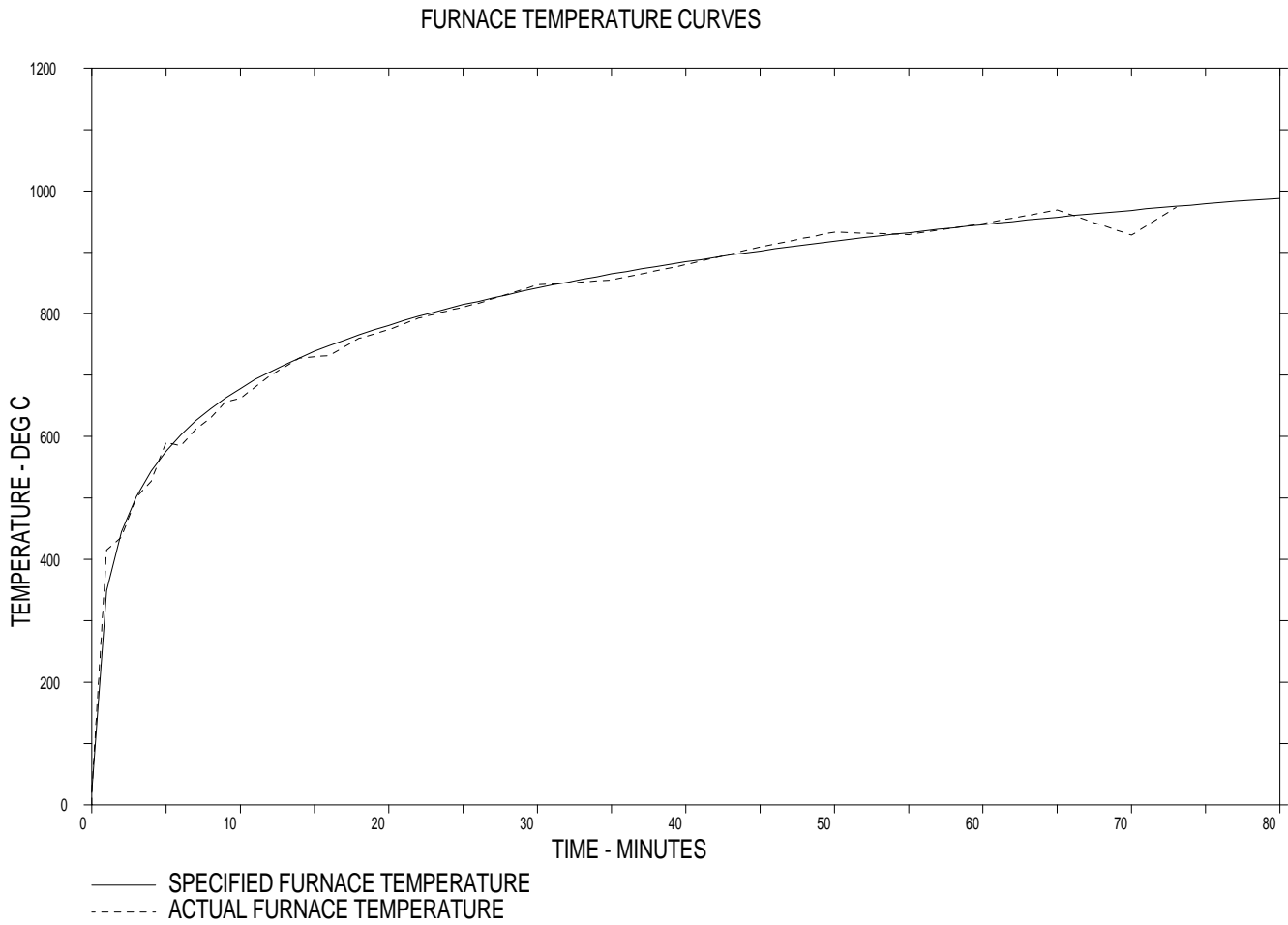


Figure 5. Furnace temperature graph.

Unexposed Face Standard Five Temperature Graph

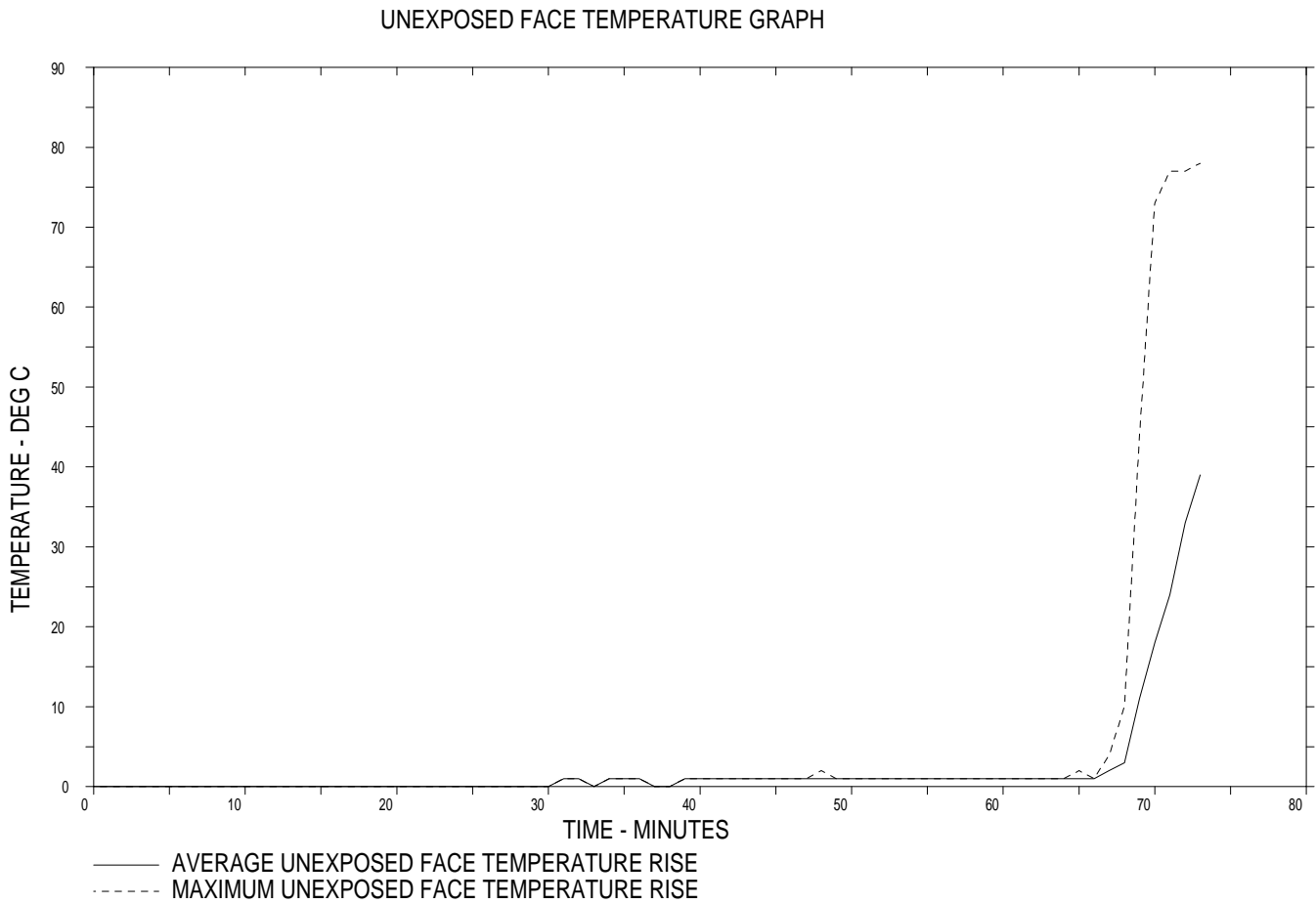
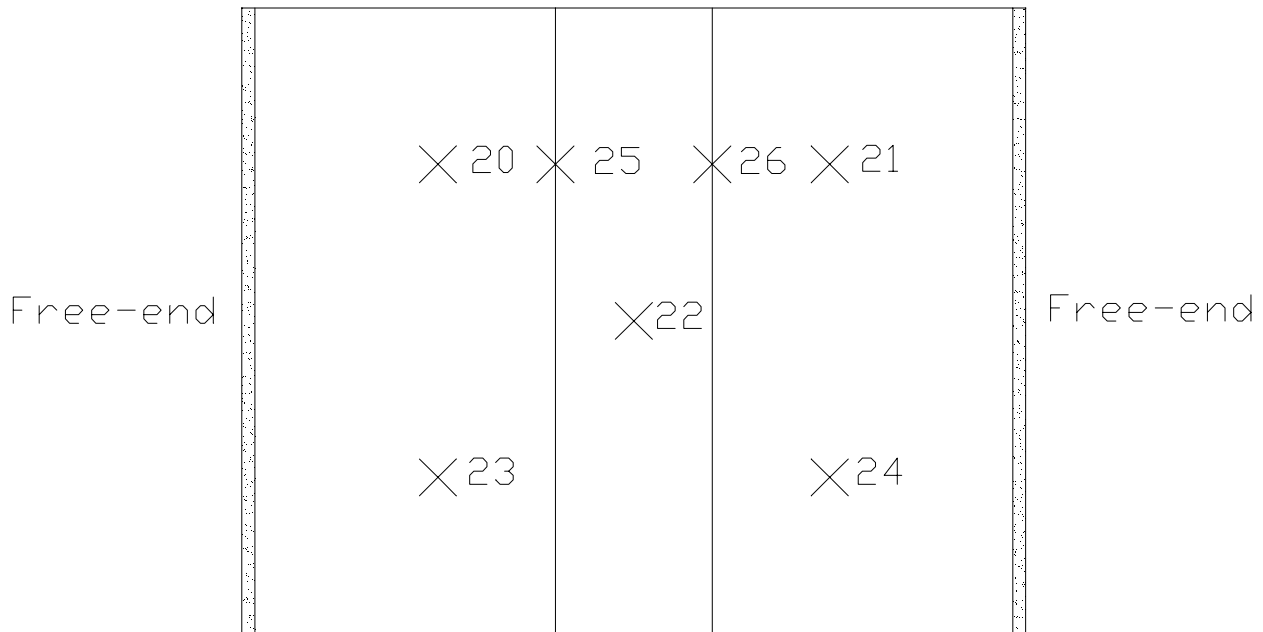


Figure 6. Unexposed face temperature graph.

Unexposed Face Thermocouple Layout



X Indicates thermocouple position

Figure 7. Unexposed face thermocouple layout.



Unexposed Face Standard Five Thermocouple Data

Time (mins)	Temperature Rise (°C)				
	Thermocouple No. 20	Thermocouple No. 21	Thermocouple No. 22	Thermocouple No. 23	Thermocouple No. 24
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	-1	0
9	0	0	0	-1	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	-1	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	-1	0
19	0	0	0	-1	0
20	0	0	0	0	0
21	0	0	0	-1	0
22	0	0	0	0	0
23	0	0	0	-1	0
24	0	0	0	0	0
25	0	0	0	0	0
26	0	0	0	-1	0
27	0	0	0	-1	0
28	0	0	0	0	0
29	0	0	0	0	0
30	0	0	0	-1	0
31	1	1	1	1	1
32	1	1	1	0	1
33	0	0	0	0	0





Time (mins)	Temperature Rise (°C)				
	Thermocouple No. 20	Thermocouple No. 21	Thermocouple No. 22	Thermocouple No. 23	Thermocouple No. 24
34	1	1	1	1	1
35	1	1	1	0	1
36	1	1	1	1	1
37	0	0	0	-1	0
38	0	0	-1	-1	0
39	1	1	1	1	1
40	1	1	1	0	0
41	1	1	1	1	1
42	1	1	1	1	1
43	1	1	1	0	1
44	1	1	1	1	1
45	1	1	1	1	1
46	1	1	1	1	1
47	1	1	1	1	1
48	1	2	1	1	1
49	1	1	1	1	1
50	1	1	1	0	1
51	1	1	1	0	1
52	1	1	1	1	1
53	1	1	1	1	1
54	1	1	1	1	1
55	1	1	1	1	1
56	1	1	1	1	1
57	1	1	1	1	1
58	1	1	1	1	1
59	1	1	1	1	1
60	1	1	1	1	1
61	1	1	1	1	1
62	1	1	1	1	1
63	1	1	1	1	1
64	1	1	1	1	1
65	2	1	1	1	1
66	1	1	1	1	1
67	2	1	1	4	1
68	1	3	1	10	1
69	2	8	1	44	2
70	2	15	1	73	1



Time (mins)	Temperature Rise (°C)				
	Thermocouple No. 20	Thermocouple No. 21	Thermocouple No. 22	Thermocouple No. 23	Thermocouple No. 24
71	13	26	2	77	1
72	47	39	2	77	1
73	68	47	3	78	1

See figure 7 for the location of the thermocouples.

Additional Thermocouple Data

Time (mins)	Temperature Rise (°C)	
	Thermocouple No. 25 Left Joint	Thermocouple No.26 Right Joint
0	0	0
1	0	0
2	0	0
3	0	-1
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	-1
10	0	0
11	0	0
12	0	-1
13	0	0
14	0	0
15	0	0
16	0	0
17	0	0
18	0	-1
19	0	-1
20	0	0
21	0	-1
22	0	0
23	0	-1
24	0	0
25	0	-1
26	0	0
27	0	0
28	0	0
29	0	0
30	0	-1
31	1	1
32	1	1
33	0	0



Time (mins)	Temperature Rise (°C)	
	Thermocouple No. 25 Left Joint	Thermocouple No.26 Right Joint
34	1	1
35	1	0
36	1	1
37	0	-1
38	0	-1
39	1	1
40	0	0
41	1	1
42	1	1
43	0	0
44	1	1
45	1	1
46	0	1
47	0	1
48	1	1
49	0	1
50	0	0
51	0	0
52	0	0
53	0	1
54	1	1
55	1	1
56	1	1
57	1	1
58	1	1
59	1	1
60	2	1
61	2	1
62	2	1
63	2	1
64	2	1
65	3	1
66	3	1
67	3	1
68	3	1
69	4	2





Time (mins)	Temperature Rise (°C)	
	Thermocouple No. 25 Left Joint	Thermocouple No.26 Right Joint
70	4	2
71	5	2
72	5	3
73	6	3

See figure 7 for the locations of the thermocouples.





Specimen Deflection

Time (mins)	Lateral Deflection (mm)	Vertical Deflection (mm)
0	0	0
1	0	0
2	-1	0
3	-1	0
4	-1	0
5	-1	0
6	-1	0
7	-1	0
8	-1	0
9	-1	0
10	-1	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	-1
16	0	-1
17	0	-1
18	0	-1
19	0	-1
20	0	-1
21	0	-1
22	0	-1
23	0	-1
24	0	-1
25	1	-1
26	1	-1
27	1	-1
28	2	-1
29	2	-1
30	2	-1
31	2	-1
32	2	-1
33	3	-1
34	3	-1
35	3	-1
36	3	-1





Time (mins)	Lateral Deflection (mm)	Vertical Deflection (mm)
37	4	-1
38	4	-2
39	4	-2
40	5	-2
41	5	-2
42	5	-2
43	6	-2
44	6	-2
45	7	-2
46	7	-2
47	8	-2
48	8	-2
49	8	-2
50	9	-2
51	9	-2
52	9	-2
53	10	-3
54	11	-3
55	12	-3
56	14	-3
57	16	-3
58	16	-3
59	16	-3
60	16	-3
61	17	-3
62	-	-3
63	-	-3
64	-	-3
65	-	-4
66	-	-4
67	-	-4
68	-	-4
69	-	-4
70	-	-4
71	-	-4
72	-	-4
73	-	-4



Lateral deflection was recorded at the approximate centre of the specimen. Vertical deflection measured at approximately mid-span of the head of the specimen. Negative readings indicate deflection into the furnace (lateral measurements) and in direction of the load (vertical measurements).

The lateral deflection transducer was removed after 62 minutes to protect the equipment.

Furnace Pressure Data

Time (mins)	Furnace Pressure (Pa)
0	-25.6
1	-0.9
2	5.4
3	9.8
4	11.5
5	10.9
6	10.7
7	11.4
8	11.6
9	11.3
10	10.9
11	11.4
12	11.4
13	11.2
14	11.1
15	11.1
16	11.6
17	11.3
18	11.8
19	11.1
20	11.7
21	11.1
22	11.4
23	11.4
24	11.5
25	11.5
26	11.5
27	11.8
28	11.7
29	12
30	8.4
31	11.7
32	11.8
33	12
34	11.5
35	12.2
36	12.3

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Time (mins)	Furnace Pressure (Pa)
37	13.4
38	12.4
39	11.8
40	12.2
41	10.9
42	11
43	11.5
44	11.5
45	11.6
46	11.6
47	11.4
48	11.7
49	11.9
50	10.9
51	10.6
52	11.3
53	12
54	12.5
55	12.3
56	11.7
57	13.7
58	15.3
59	13.2
60	11.7
61	10.2
62	9.5
63	10.7
64	13.5
65	10.9
66	11.4
67	11.2
68	14.2
69	25
70	34.8
71	36.2
72	36.2
73	39.8

The red values indicate when the furnace was either above or below the allowed pressure tolerance.



Load Layout

UNIFORMLY DISTRIBUTED LOAD 38.3kN
APPLIED OVER TEST SPECIMEN WIDTH
OF 2.95m

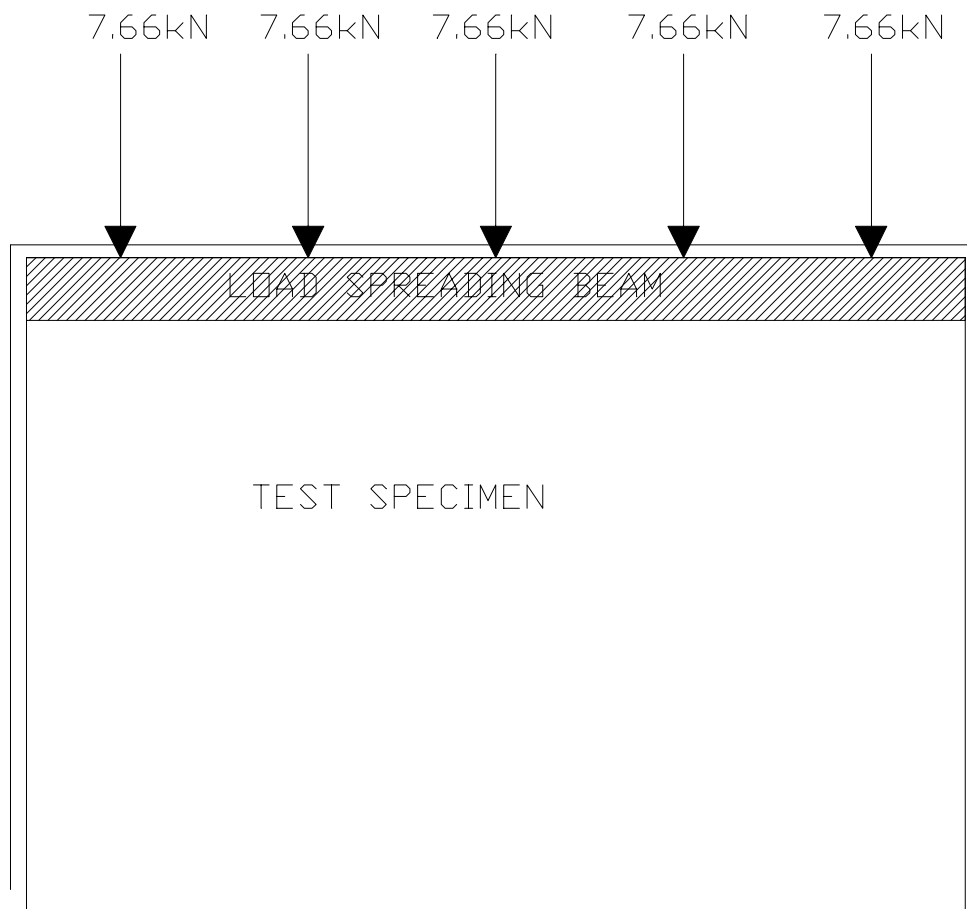


Figure 8. Load Layout.

PHOTOGRAPHS



Photo 1. Exposed face before test.

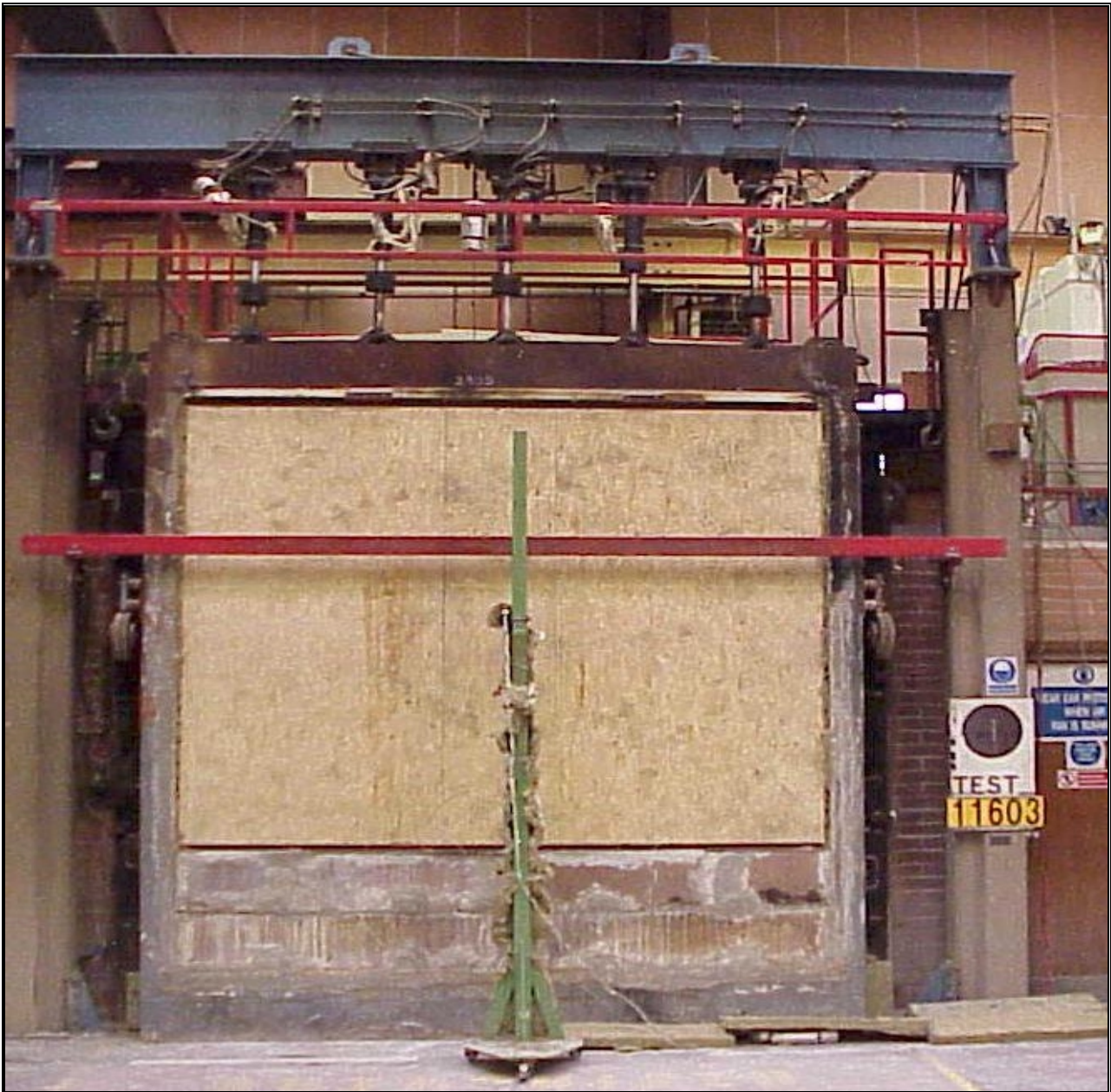


Photo 2. Unexposed face set up prior to test.

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Photo 3. Smoke being emitted from the bottom of the specimen.



The Building Test Centre

Fire Acoustics Structures

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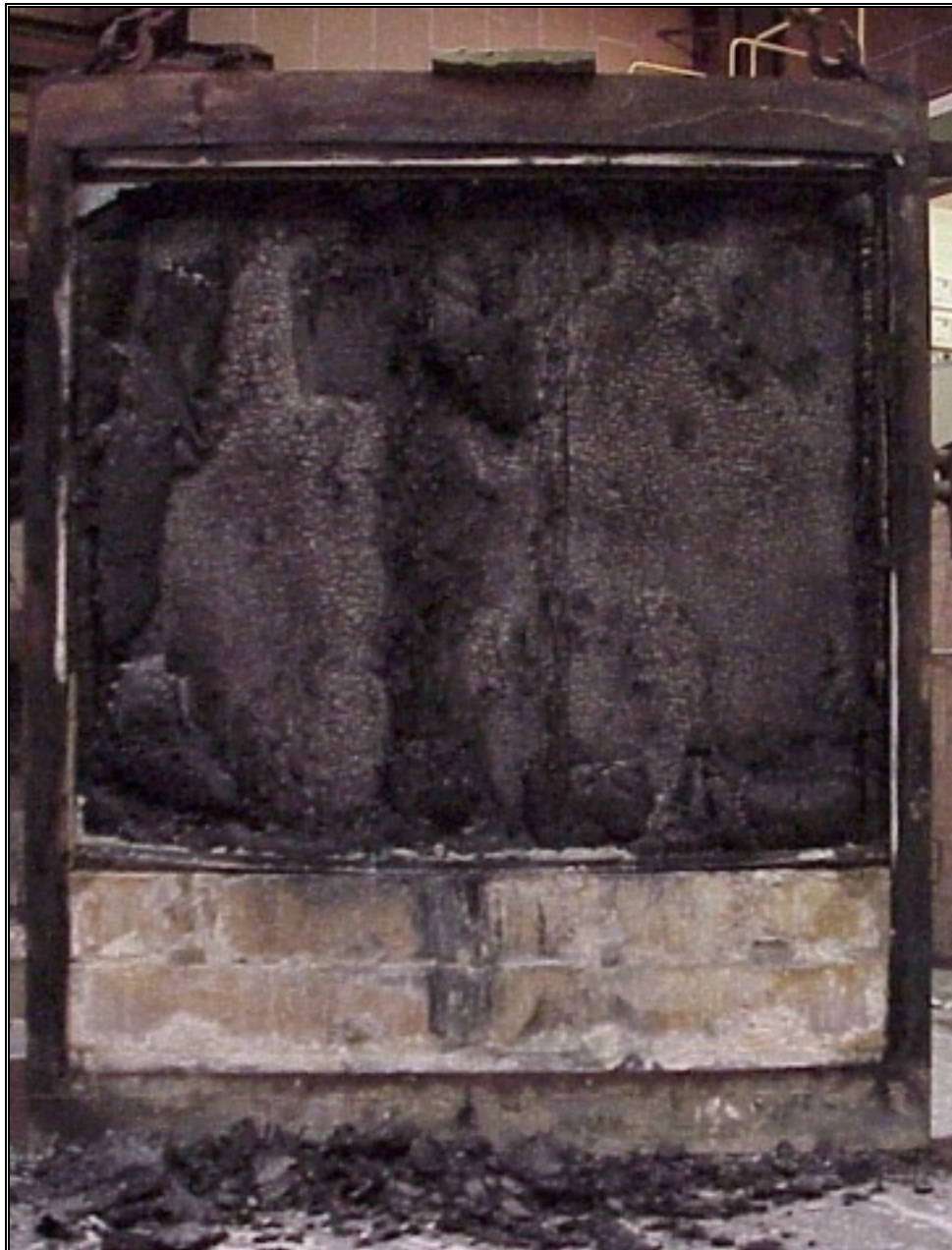


Photo 4. Exposed face after the test.

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