File R25793
Project 07CA59279

2008-07-22

REPORT

On

COMPONENTS FOR COMBUSTIBLE EXTERIOR WALL CLADDING SYSTEMS (FWFLC)

And

Under The

LISTING PROGRAM

ETERNIT (SCHWEIZ) AG
NIEDERURNEN, SWITZERLAND

DESCRIPTION

PRODUCT COVERED:

The product covered by this Report is a cementitious panel, designated "SWISSPEARL CARAT", for use in an exterior wall cladding assembly.

USE:

The product is intended for use as a building material as permitted by authorities having jurisdiction.

The panels are installed as cladding for exterior wall surfaces.

TEST RECORD NO. 1

PROJECT 07CA59279

GENERAL:

Test results relate only to the items tested.

This Report describes an investigation undertaken to evaluate the performance of a Combustible Exterior Wall Cladding System for use in non-combustible construction in accordance with the conditions defined in the National Building Code of Canada, 2005 Edition, under Article 3.1.5.5 sentences (2) and (3). Tests were conducted on March 20, 2008 at the National Research Council of Canada's National Fire Laboratory in Almonte, Ontario.

Selected samples were tested in accordance with CAN/ULC-S134-92, Standard Method of Fire Test of Exterior Wall Assemblies.

At the end of this Report, reference is made to System No. CW7 that has been established as a result of the investigation described herein.

THE INVESTIGATION

The object of the investigation was to determine the performance characteristics of an exterior wall cladding system when tested in accordance with the requirements set out in Sentences (1) through (5) of Article 3.1.5.5 of the National Building Code of Canada.

According to these provisions, combustible exterior claddings fire tested in accordance with the requirements of CAN/ULC-S134-92, "Standard Method of Fire Test of Exterior Wall Assemblies," are required to:

1. Restrict flaming on or in the wall assembly so that it does not spread more than 5 m above an opening 2.5 ± 0.1 m wide by 1.4 ± 0.1 m high, located in the middle of and not more than 3 m above the lowest edge of, a wall assembly that is not less than 5 m wide and not less than 10 m high, and;

2. Have the heat flux during the flame exposure on the wall assembly be such that it does not exceed 35 kW/m^2 at a height of 3.5 m above the opening discussed in item 1 above

when tested in accordance with the conditions defined above.

MATERIAL COVERED:

Cementitious exterior wall panels designated "SWISSPEARL CARAT", nominally 8 mm thick, manufactured from cement and various additives. The panels are installed as a concealed system (without visible fasteners) with a cavity, up to 60 mm deep, behind the panel.

The product is available in various colours. For this test program, the darkest colour was tested as the most severe case because dark materials absorb more radiant energy, causing them to increase in temperature more quickly than lighter colours.

EXAMINATION OF MATERIALS:

The materials used in this investigation were produced under the observation of a representative of Underwriters' Laboratories of Canada, in a ready-to-use form. The composition of the finished materials is of a proprietary nature. Data on the composition is on file at the Laboratories for use in the Follow-Up Service Program.

Various physical and chemical tests were conducted on the components and finished products. The results developed from these tests are considered proprietary in nature, and were employed in establishing specifications for use in the factory Follow-Up Service Program.

DESCRIPTION OF TEST WALL:

MATERIAL DESCRIPTION

Item	Detail
Building Panels	The 1220 mm wide, 3050 mm long, and 8 mm thick, panels were designated as "SWISSPEARL CARAT".
Hat-Channel	75 mm bearing width, 60 mm high, and 60 mm wide flanges. Fabricated from 1.28 mm thick steel in 3040 mm lengths.
Z-Channel	75 mm x 150 mm x 75 mm steel channel used to attach the panels to the test wall surface. Fabricated from 1.28 mm thick steel in 3040 mm lengths.
Fasteners	1/4 x 2-1/4 Tapcon concrete anchor screws, used to fasten the Hat-Channel and Z-Channel to the test wall surface. The holes for the anchor screws were pre-drilled.
Rivets and Sleeves	4.0 x 18 - H15 mm (grip range 8-13 mm) stainless steel rivets. Rivet heads coloured to match panel surface and camouflage rivet heads. Two rivets per panel utilized a 9.4/4.1 x 6 mm stainless steel fixed point sleeve to hold the panels in place.
Joint Flashing	35 x 5 mm stainless steel, L-flashing. Fabricated from 0.46 mm thick stainless steel in 3040 mm lengths.
Fireblock	60 x 60 steel angle, perforated with 1.55 mm diameter perforations spaced 3.2 mm on center. Fabricated from 0.9 mm thick steel in 3040 mm lengths. This is intended as a fireblock and is perforated.

CONSTRUCTION OF TEST WALL

The construction of the test wall was performed at NRC's facility by representatives of the applicant, and witnessed by a representative of ULC.

The Hat-channel and Z-channel were attached to the wall, vertically, at nominally 570 mm on center. The channels were installed in an alternating pattern such that a Hat-channel occurred only at a vertical panel to panel joint, and a Z-channel occurred only behind a panel. The north and south edges were secured to the wall using Z-channels. The channels were attached to the test structure using Tapcon concrete anchor screws spaced nominally 460 mm on center along the entire height of the mounting wall. Screws were installed in pairs for the Hat-channels, and as single screws for the Z-channels.

Lengths of Z-channel were installed along the top and along both sides of the opening of the furnace.

Perforated steel angles were installed horizontally, end to end, 3050 mm above the opening of the furnace as a fireblock. The fireblock was continuous for the entire width of the test assembly. The angle was installed between the channel and furnace surface and secured in place with Tapcon concrete anchor screws at every location where the angle was overlapped by the channel (See ILL 4).

The panels were attached to the channels by means of rivets. Three rows of holes 9.5 mm in diameter, were pre-drilled into the panels. The holes were spaced 570 mm on center horizontally, and 722 mm on center vertically. Rivet holes along the edge of the panels were located 80 mm from the horizontal edges, and 40 mm from the vertical edges. The channels were pre-drilled with holes 4.1 mm in diameter, on center with the holes in the panels.

The horizontal gap between panels was 5 mm. The vertical gap between panels was 6 mm.

Two of the rivets on each panel were fitted with a stainless steel sleeve, these points were referred to as "fixed points". The balance of the rivets did not use any sleeve, and were referred to as "expansion points".

The bottom row of rivets were the last to be fastened. Just prior to this, a length of L-channel was inserted between the panel and channel so that it was held in place when the panel was fully fastened. (see ILL 5).

See ILL 1 for the final installed layout.

FIRE TEST:

METHOD

Testing was conducted in accordance with the Standard CAN/ULC-S134-92, Standard Method of Fire Test of Exterior Wall Assemblies, First Edition.

The test method is described in the attached NRC Test Report No: B-4702.1, dated April 04, 2008 (See ILL 2).

RESULTS

INTERPRETATION OF RESULTS

A) Flame Spread Over Exterior Face

During the fire exposure there were intermittent flames to 2.0 m above the window. This is less than the 5 m limit for flame spread distance specified in Sentence 3.1.5.5.(2) and defined in appendix A (A-3.1.5.5.(2)) of the 2005 edition of the National Building Code of Canada.

The extent of damage on the specimen was limited to an area above the window to a height of 2.0 m. during the fire exposure.

B) Incremental Fire Exposure to the Wall Above the Window Opening

The maximum one-minute averaged value of the total heat flux density on the test wall at 3.5 m above the top of the window was 6.9 kW/m^2. This is less than the 35 kW/m^2 specified in sentence 3.1.5.5.(3) of the 2005 edition of the National Building Code of Canada.

ILLUSTRATION INDEX

Test Record Summary:

The results of this investigation, including construction review and testing, indicate that the products evaluated comply with the applicable requirements in the 2005 Edition of the National Building Code of Canada Sentences 3.1.5.5.(2) and 3.1.5.5.(3) when tested in accordance with the Standard CAN/ULC-S134-92, Standard Method of Fire Test of Exterior Wall Assemblies, First Edition (dated November 1992) and, therefore, such products are judged eligible to bear ULC's Mark as described below.

ASSEMBLY PERFORMANCE:

The assembly described in this Report did not permit the propagation of flaming on or in the wall assembly to exceed a height of 5 m above the opening during or following the 25 min flame exposure. In addition, the heat flux during the flame exposure on the wall assembly did not exceed 35 kW/m^2, measured at 2.5 m above the opening.

Consequently, it is concluded that the Combustible Exterior Wall Cladding System described in this Report, when constructed of the materials and in the manner described herein, will successfully satisfy the requirements set out in Article 3.1.5.5 sentences (2) through (4) of the National Building Code of Canada, 2005 Edition.

The assembly will be designated as System No. CW7 and will be included in the series of designs classified as to their fire performance published in Fire Resistance, List of Equipment and Materials published by Underwriters' Laboratories of Canada.

The above classification is based upon the conditions of acceptance and performance requirements for combustible exterior cladding in non-combustible construction contained in Article 3.1.5.5, sentences (2) through (4) of the National Building Code of Canada, 2005 Edition.

ULC Listing Marking:

LISTED

Components for
Combustible
Exterior Wall
Cladding Systems

<CONTROL NUMBER>

Listed in accordance with
CAN/ULC-S134
SWISSPEARL CARAT Panels,
8 mm thick

Classified in accordance with the Standard CAN/ULC-S134.

See ULC List of Equipment and Materials, Building Materials and supplements hereto.

together with the product identification and the listee's name and address.

Test Record by:
BENY SPENSIERI, JR.
Project Handler
Fire Protection Division

Reviewed By:
G. ABBAS NANJI, P.ENG.
Engineering Group Leader
Fire Protection Division

CONCLUSION:

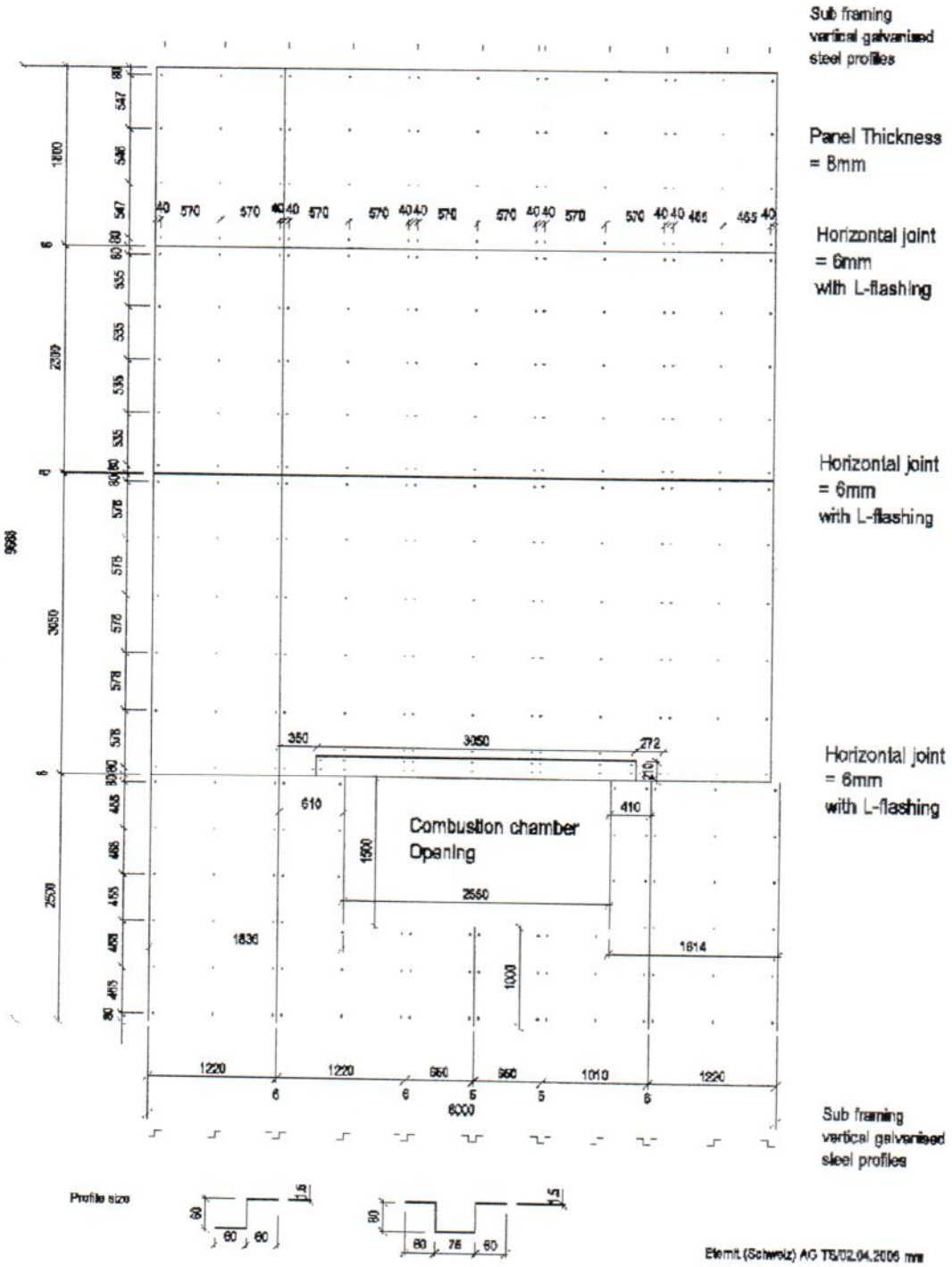
Samples of the products covered by this Report have been found to comply with the requirements covering the category and the products are judged to be eligible for Listing and Follow-Up Service. The manufacturer is authorized to use the ULC and UL Marks on such products which comply with the Follow-Up Service Procedure and any other applicable requirements of Underwriters' Laboratories of Canada.

Only those products which properly bear the ULC Mark are considered as Listed by Underwriters' Laboratories of Canada.

Report by:
BENY SPENSIERI, JR.
Project Handler
Fire Protection Division

Reviewed By:
G. ABBAS NANJI, P.ENG.
Engineering Group Leader
Fire Protection Division

Fire Test CAN/ULC - S134
"Standard Method of Fire Test of exterior Wall Assemblies"



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FULL-SCALE EXTERIOR WALL FIRE TEST ON A SWISSPEARL FIBRE CEMENT FACADE SYSTEM MANUFACTURED BY ETERNIT SWITZERLAND

Bruce C. Taber and Eric Gibbs
Fire Research Program
Institute for Research in Construction
National Research Council Canada

INTRODUCTION

This report describes a full-scale exterior wall fire test conducted on March 20, 2008, on a Swisspearl fibre cement facade system manufactured by Eternit Switzerland. The test was conducted in accordance with CAN/ULC-S134-92, Standard Method of Fire Test of Exterior Wall Assemblies [1].

TEST FACILITY

The test was conducted using the exterior wall fire test apparatus (see Figure 1 and Figure 2) located in the Burn Hall of the NRC Fire Laboratory, Almonte, Ontario.

The burn room portion of the apparatus consisted of a reinforced concrete floor, concrete block walls and a precast concrete panel ceiling. The walls and ceiling were covered on the room side with 25 mm thick ceramic fibre insulation. The floor was covered with 57 mm thick fired clay paving stones. The inside dimensions of the burn room were 5.95 m wide, 4.4 m deep and 2.75 m high.

The fuel source in the burn room consisted of four 3.8 m long linear propane burners spaced equally along the width of the room and designed to provide a fire exposure equivalent to uniformly-distributed wood cribs of kiln-dried pine (with pieces 38 mm x 89 mm), having a total mass of approximately 675 kg. The burners were mounted 0.6 m above the surface of the paving stones.

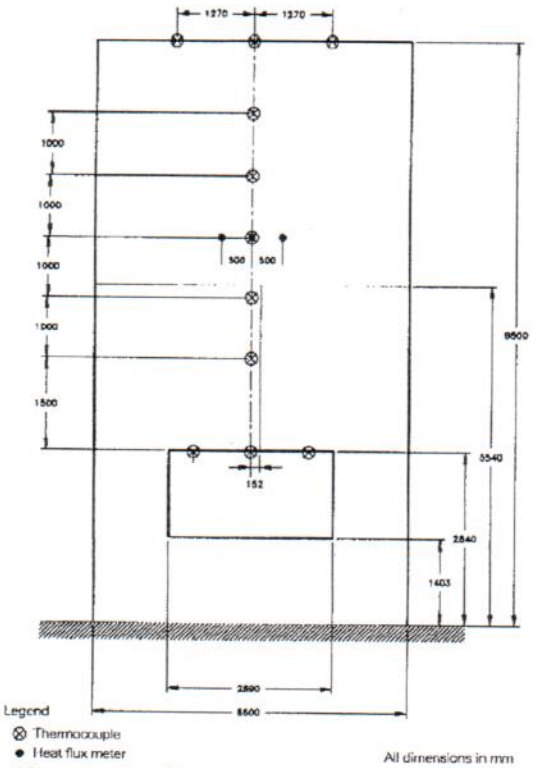

Figure 1. Test Facility (front view)

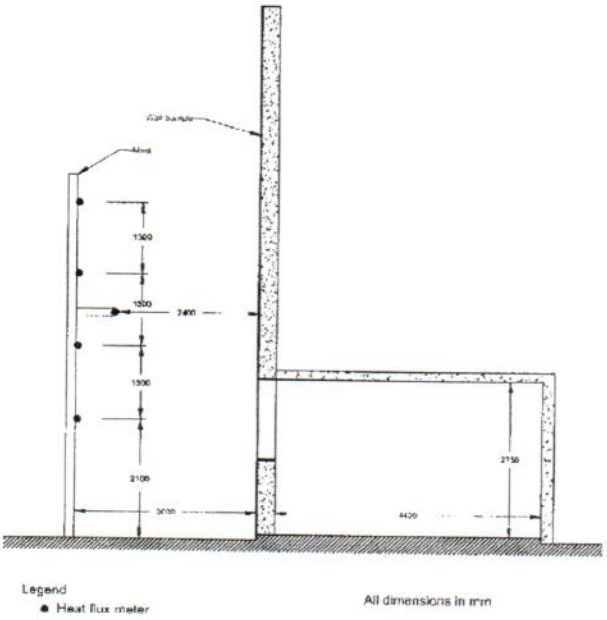

Figure 2. Test Facility (side view)

DESCRIPTION OF SPECIMEN

The wall system is described as using "Swisspearl" fibre cement wall panels manufactured by Eternit Switzerland. The panels consisted of a solid fibre cement panel 8 mm thick. The panels varied in size, with the larger panels being 3050 mm x 1010 mm and the smallest panel being 200 mm x 2900 mm located horizontally above the window.

Each panel was fastened to vertical steel channels with pop rivets having a shank diameter of 2.5 mm and a head diameter of 14.5 mm. The vertical steel channels were installed at each vertical seam location. A horizontal "L-flashing" was incorporated into each horizontal seam.

The wall system was installed by representatives of Eternit Switzerland.

The system was installed over 15.9 mm thick gypsum board that formed part of the test facility.

A drawing showing the construction detail is shown in Figure 3.

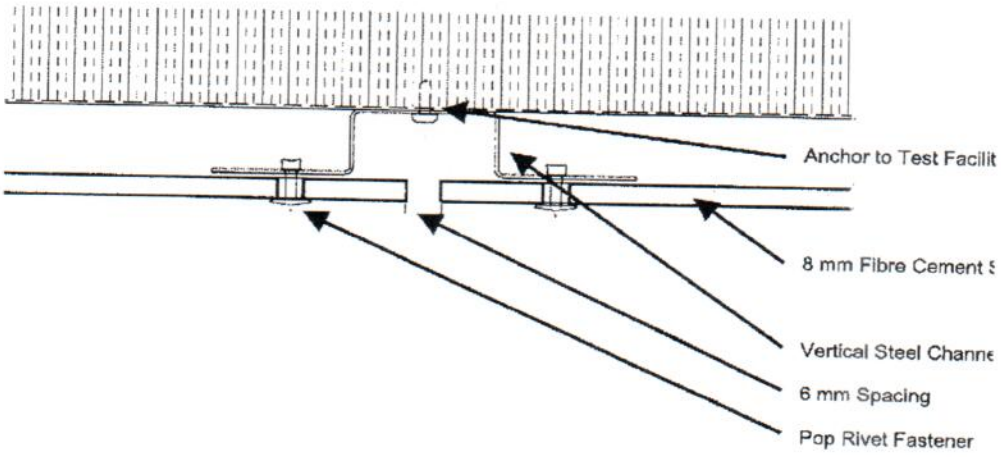

Figure 3. Construction Detail

The full test specimen extended 7.2 m above the window opening. The edges of the wall assembly at the window opening were covered with 25 mm thick ceramic fibre insulation. The test specimen incorporated two vertical joints above the window opening. A horizontal joint was located at 0.2 m above the window opening and a second horizontal joint was located 3.0 m above the window opening.

A photograph of the wall system under construction is shown in Figure 4.

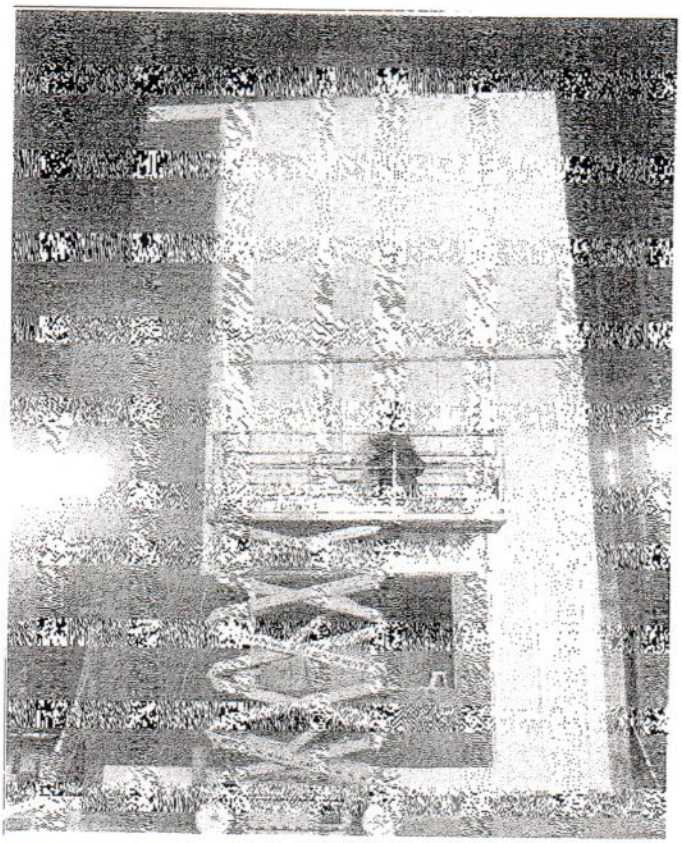

Figure 4. Wall System Under Construction.

INSTRUMENTATION

Room Temperatures – The burn room air temperature was monitored by six Type K thermocouples, enclosed in 6 mm outside diameter Inconel sheaths. The thermocouples were introduced through the side walls with the measuring tips 0.6 m from the inner surface of the wall. All room thermocouples were located on the vertical centre lines of the side walls.

Window Temperatures – The temperature of the flames issuing from the window was measured with three Type K, bare-beaded thermocouples installed 0.15 m below the top of the window opening, on the vertical centre line of the opening and 0.4 m from the sides of the opening (see Figure 1)

Wall Temperatures – The wall temperatures were monitored using Type K bare-beaded thermocouples on the vertical centre line of the wall. They were located at five

levels above the top of the window at 1.0 m intervals, starting at 1.5 m above the window opening (see Figure 1). Three thermocouples were used at each level, one on the exterior surface of the wall panels, the second on the back surface of the wall panels and the third on the surface of the gypsum board.

The temperature of the fire plume at the top of the test assembly was monitored by three Type K bare-beaded thermocouples located 0.6 m out from the exterior surface of the wall, one on the centre line of the wall, and the other two at a distance of 1.3 m from both edges of the wall (see Figure 1).

Heat Flow – The total heat flux density to the wall above the window was monitored by three water-cooled heat flux transducers (Medtherm Corp. Series 64) installed in the test wall, 3.5 m above the top of the window, one on the centre line of the wall and one on each side, 0.5 m from the centre line (see Figure 1).

Radiant heat emitting from the fire was also monitored by heat flux transducers (Medtherm Corp. Series 64) installed on a mast (Figure 2), placed 3.0 m from the test wall opposite to the centre line of the wall. The heat flux transducers were located at distances of 2.1 m, 3.4 m, 4.7 m and 6.0 m above the level of the burn room floor. An additional heat flux transducer was installed on the mast at the 4.0 m height and 2.4 m from the face of the wall.

Propane – The propane gas flow rate to the burners was monitored with a mass flow meter.

Visual Records – Videotape records of the front and side views were made during the test, and digital photos were taken before, during and after the test.

Data Acquisition – All thermocouples, as well as the heat flux transducers, were connected to a data acquisition system and readings were recorded at 5 s intervals.

ATMOSPHERIC CONDITIONS

At the time of the test, the ambient temperature in the Burn Hall was 6°C and the relative humidity was 75%.

TEST PROCEDURE

The test procedure was in accordance with CAN/ULC-S134-92, Standard Method of Fire Test of Exterior Wall Assemblies [1]. The pilot burners were lit prior to the commencement of the test. Gas flow to the burners was manually adjusted to follow the prescribed heat input required by the standard.

VISUAL OBSERVATIONS

(min:sec)	
00:00	Ignition of the main burners.
03:00	Flames begin to exit window.
	No affect on panels observed.
05:00	Gas supply at steady state
10:00	Panels directly above the window opening are discoloured
	No flame attachment visible
	No damage to the panels visible
	Flame height at 2.0 m above the window opening
15:00	No flame attachment visible
	No damage to the panels visible
	Flame height at 2.0 m above the window opening
20:00	Gas supply begins to diminish.
23:35	Small pieces of panel directly above the window opening fall.
25:00	Gas supply off.
	No visible flaming or smoldering.

RESULTS

Room Temperatures – The average gas temperature in the burn room (average of six thermocouples) was as shown in Figure 5.

Window Temperatures – The average temperature of the fire gases emerging from the window was as shown in Figure 5.

Wall Temperatures – The temperatures recorded on the outer surface of the test assembly are shown in Figure 6. The temperatures rose during the first 20 minutes of fire exposure. The temperatures reached a maximum of 416°C at 1.5 m above the window and a maximum of 243°C at 3.5 m above the window

The temperatures recorded by the thermocouples installed on the back of the test wall are shown in Figure 7. These temperatures rose steadily during the first 20 minutes of fire exposure. The temperatures reached a maximum of 319°C at 1.5 m above the window and a maximum of 156°C at 3.5 m above the window

Temperatures recorded by the thermocouples behind the wall sample, on the surface of the gypsum board, are shown in Figure 8. The temperatures rose steadily with a sharp increase at approximately 18 minutes after ignition. The maximum temperature on the surface of the gypsum board was 356°C at 1.5 m above the window and a maximum of 189°C at 3.5 m above the window

The fire plume temperature measured at the top of the wall are shown in Figure 9. The temperatures at the top of the wall reached a maximum of 158°C.

Heat Flux – The total heat flux density to the wall, as measured 3.5 m above the top of the window, is shown in Figure 10. The data shown in this figure has been smoothed using the procedure of a running average over one minute.

The heat flux at all three locations showed a slow, steady rise in heat flux exposure with some minor fluctuations over the first 20 minutes of the test. The maximum one minute averaged heat flux recorded at the 3 locations was 6.9 kW/m^2 at the centre location, 6.5 kW/m^2 at the north location and 6.8 kW/m^2 at the south location.

The heat flux densities measured by the heat flux transducers installed on the mast are shown in Figure 11. The maximum heat flux at the 2.1 m height was 18.6 kW/m^2, at the 3.4 m height was 14.2 kW/m^2, at the 4.7 m height was 4.8 kW/m^2, and at the 6.0 m height was 2.0 kW/m^2. The heat flux density at 2.4 m from the wall at the 4.0 m level was 8.6 kW/m^2.

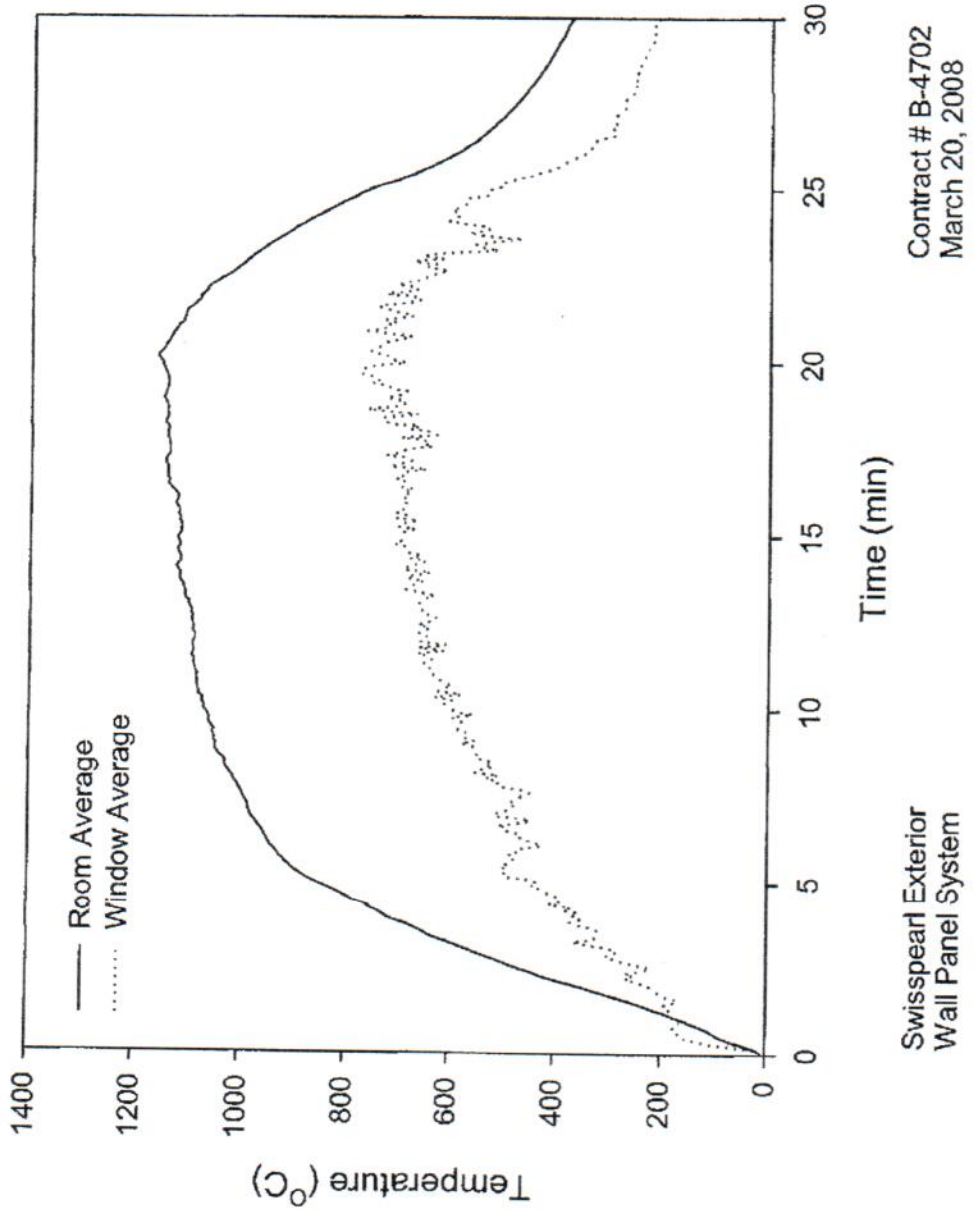

Figure 5. Average Room and Window Temperatures.

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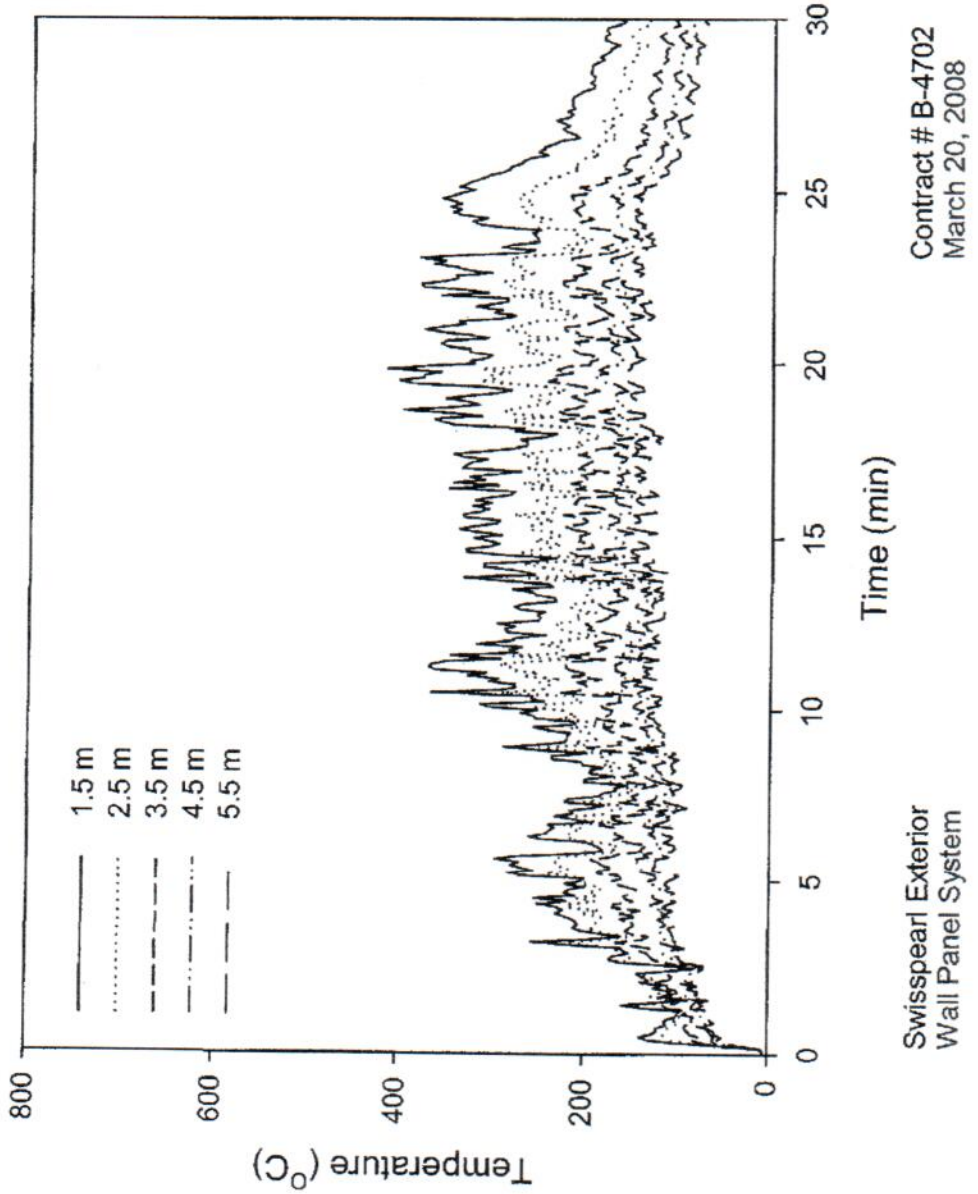

Figure 6. Temperatures on Surface of Wall.

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NRC·CNRC

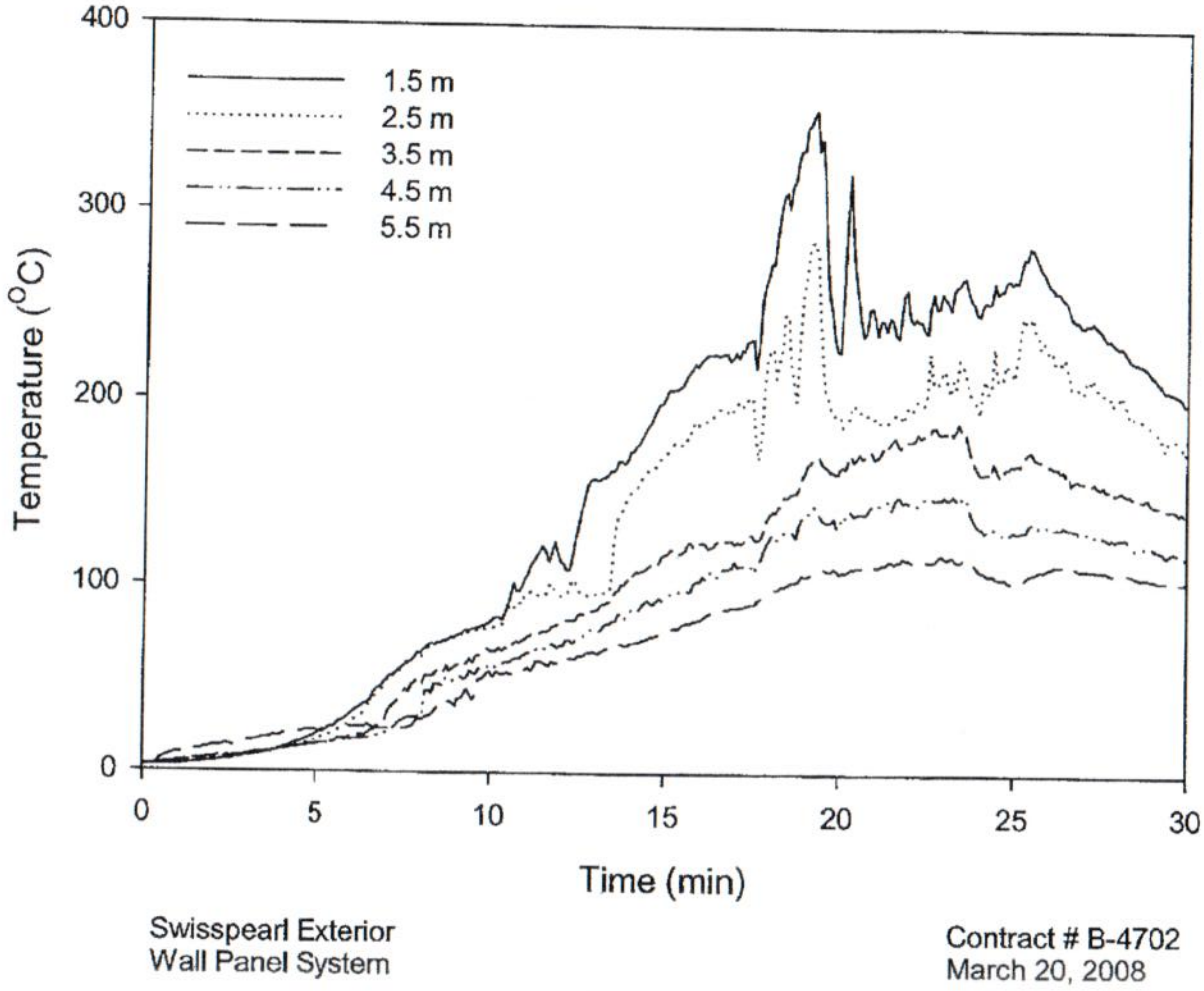


Figure 8. Temperatures on Surface of Gypsum Board.

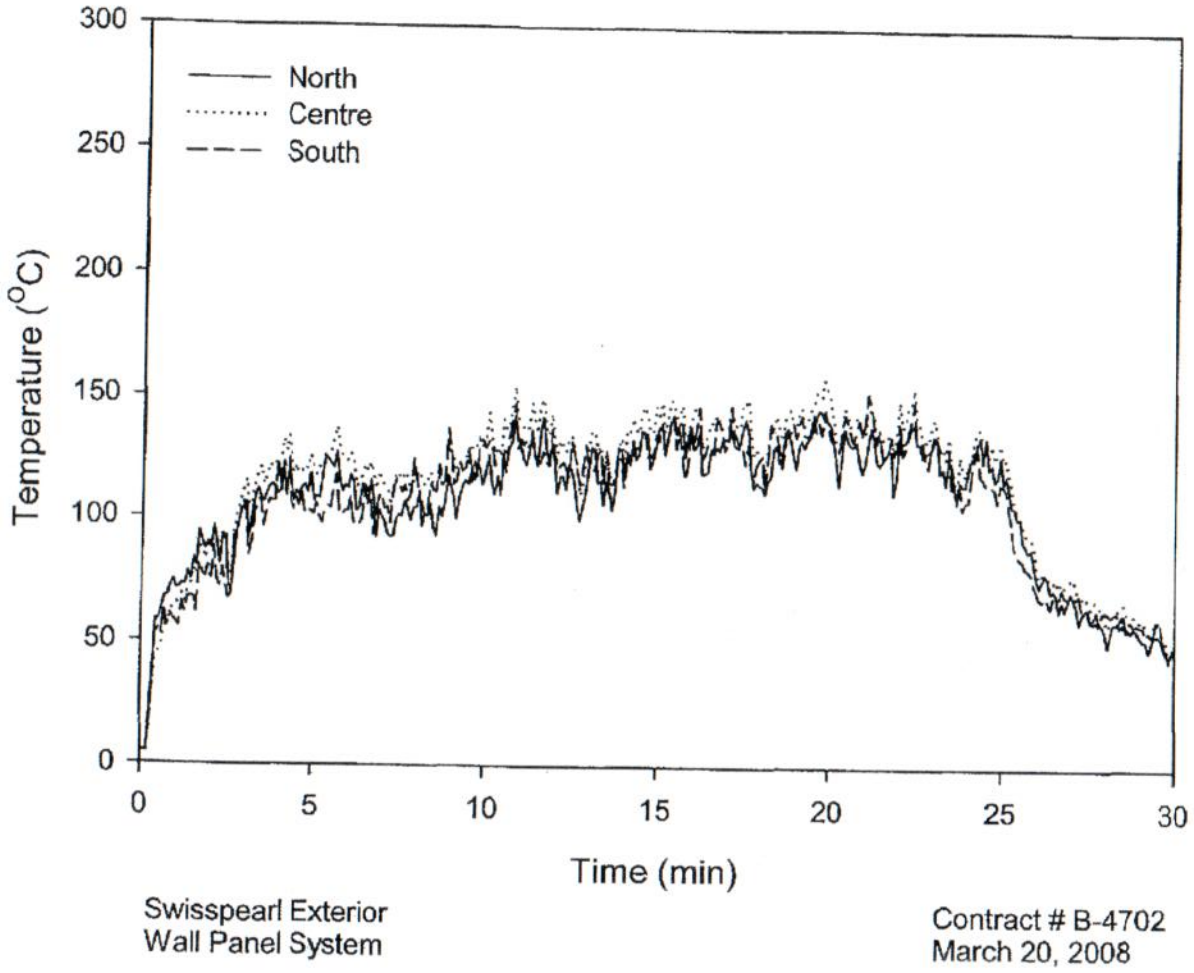


Figure 9. Temperatures at Top of Wall.

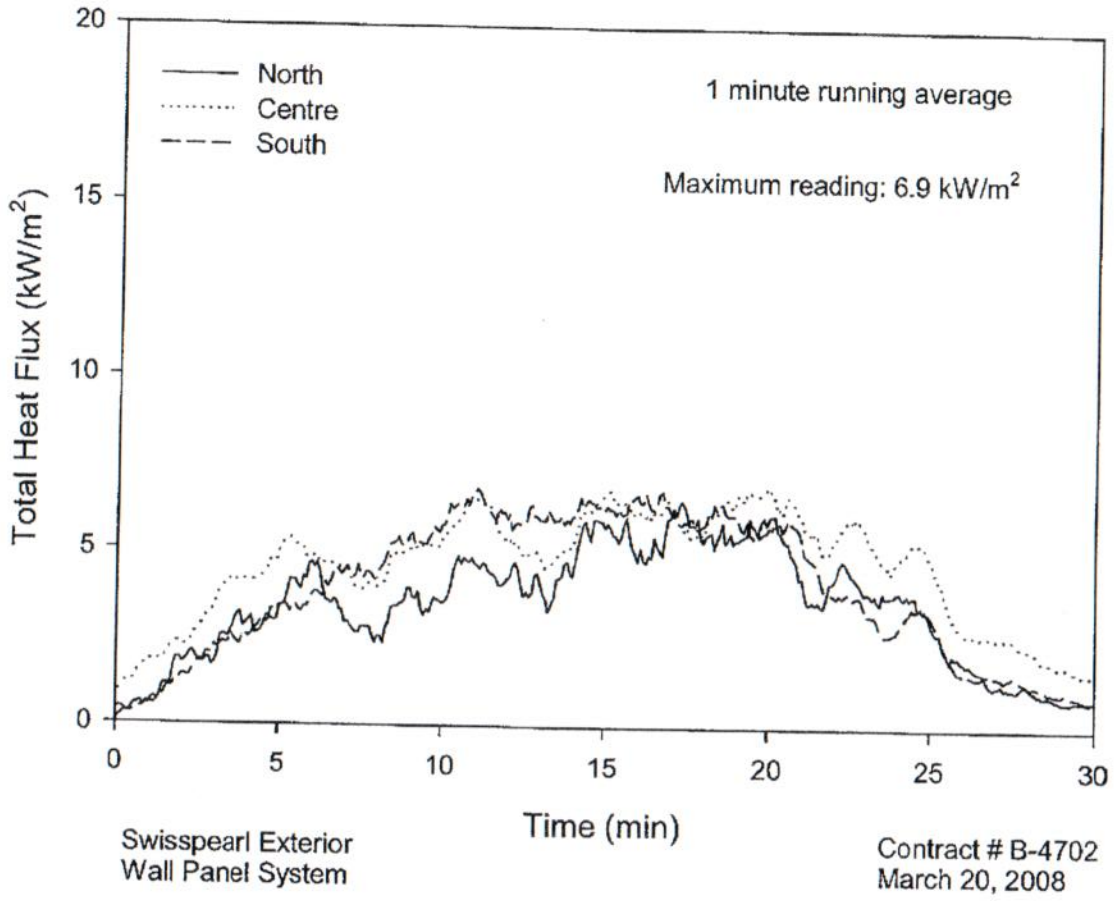


Figure 10. Heat Flux on Wall.

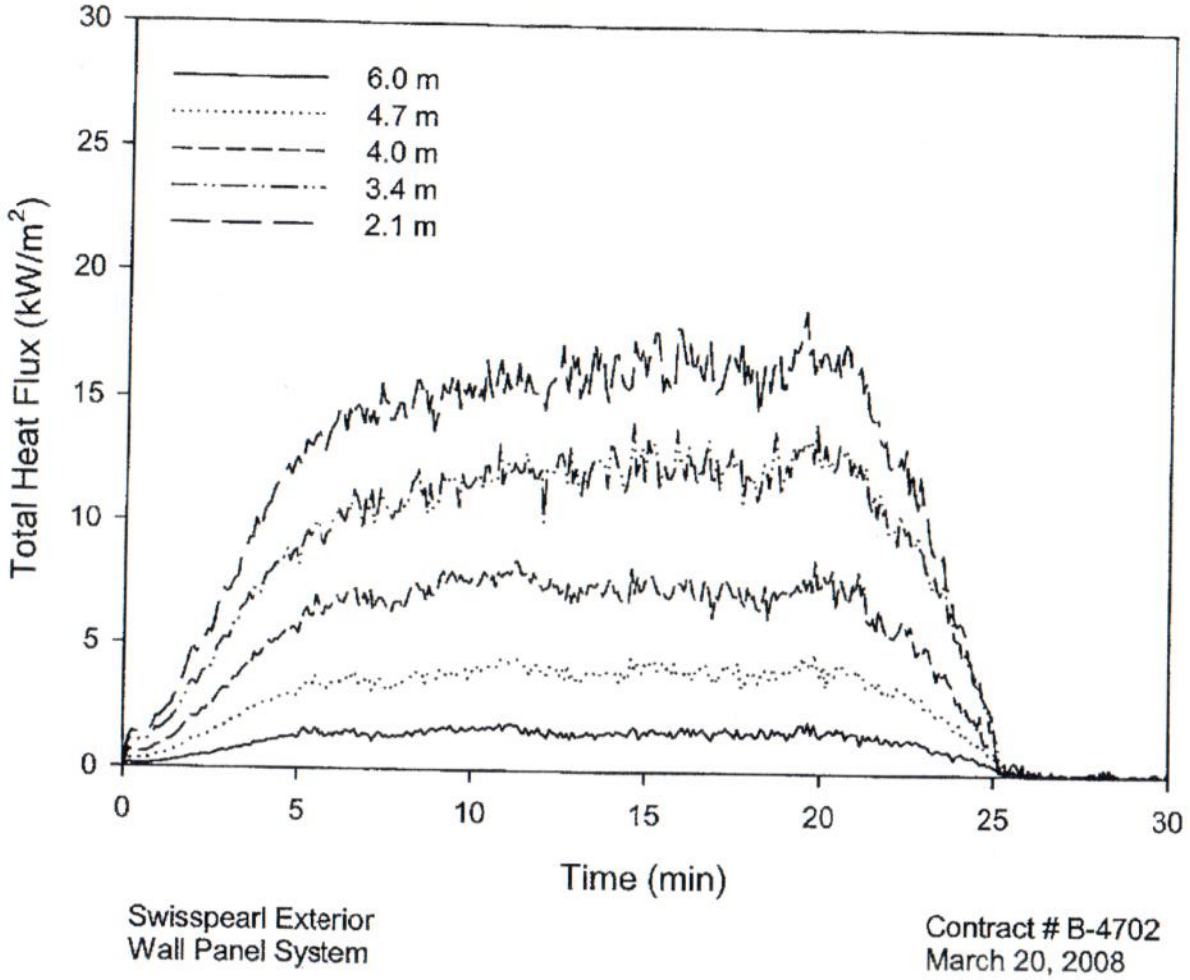


Figure 11. Heat Flux at Mast

PERFORMANCE OF THE WALL ASSEMBLY

A) Flame Spread over Exterior Face

No flame spread was noted on the panel surface. No flame spread was noted along the seams between the panels.

B) Incremental Radiant Heat Flow to the Wall above the Window Opening

The maximum one-minute averaged value of the total heat flux density on the test wall at 3.5 m above the top of the window was 6.9 kW/m^2 vs. 16 kW/m^2 for a non-combustible wall (Marinite). This is less than the 35 kW/m^2 specified in Sentence 3.1.5.5.(3) of the National Building Code of Canada (2005 Edition) [2].

C) Incremental Radiant Heat Flow at Target Mast

The average values of heat flux density at the target mast over the 15 min period of steady gas supply, as compared to a non-combustible wall (Marinite), were:

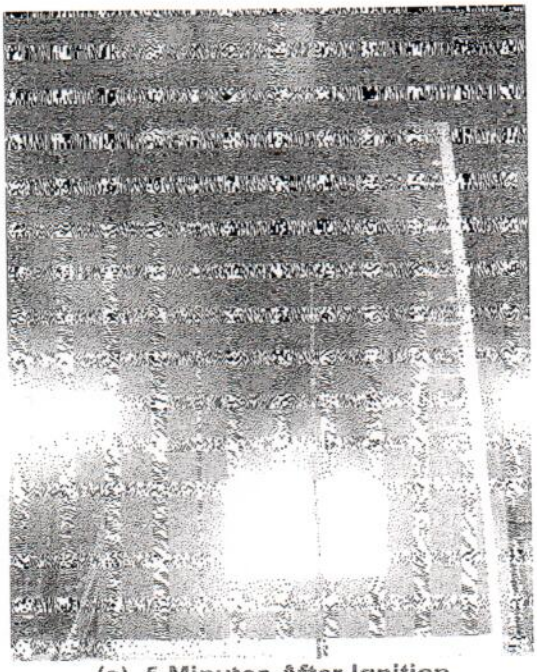
- at 2.1 m above the burn room floor, the average was 18.6 kW/m^2 vs. 15.9 kW/m^2 for the non-combustible wall
- at 3.4 m above the burn room floor, the average was 14.2 kW/m^2 vs. 11.2 kW/m^2 for the non-combustible wall.
- at the 4.0 m level (2.4 m from the wall), the average was 8.6 kW/m^2 vs. 8.2 kW/m^2 for the non-combustible wall.
- at the 4.7 m level, the average was 4.8 kW/m^2 vs. 4.7 kW/m^2 for the non-combustible wall.
- at the 6.0 m level, the average was 2.0 kW/m^2 vs. 2.1 kW/m^2 for the non-combustible wall.

D) Damage to the Wall Assembly

The surface of the wall panels directly above the window opening were discolored to a height of 2.0 m above the window opening as a result of the fire exposure. The panels were cracked in several places to a height of 1.2 m above the window opening. Small pieces of the panels directly above the window opening had fallen off. No other damage was noted.

Figure 12 shows the wall assembly during the fire exposure.

Figure 13 shows the extent of the damage to the wall sample after the test.



(a) 5 Minutes After Ignition

(b) 16 Minutes After Ignition

Figure 12. Wall Sample During the Fire Exposure.

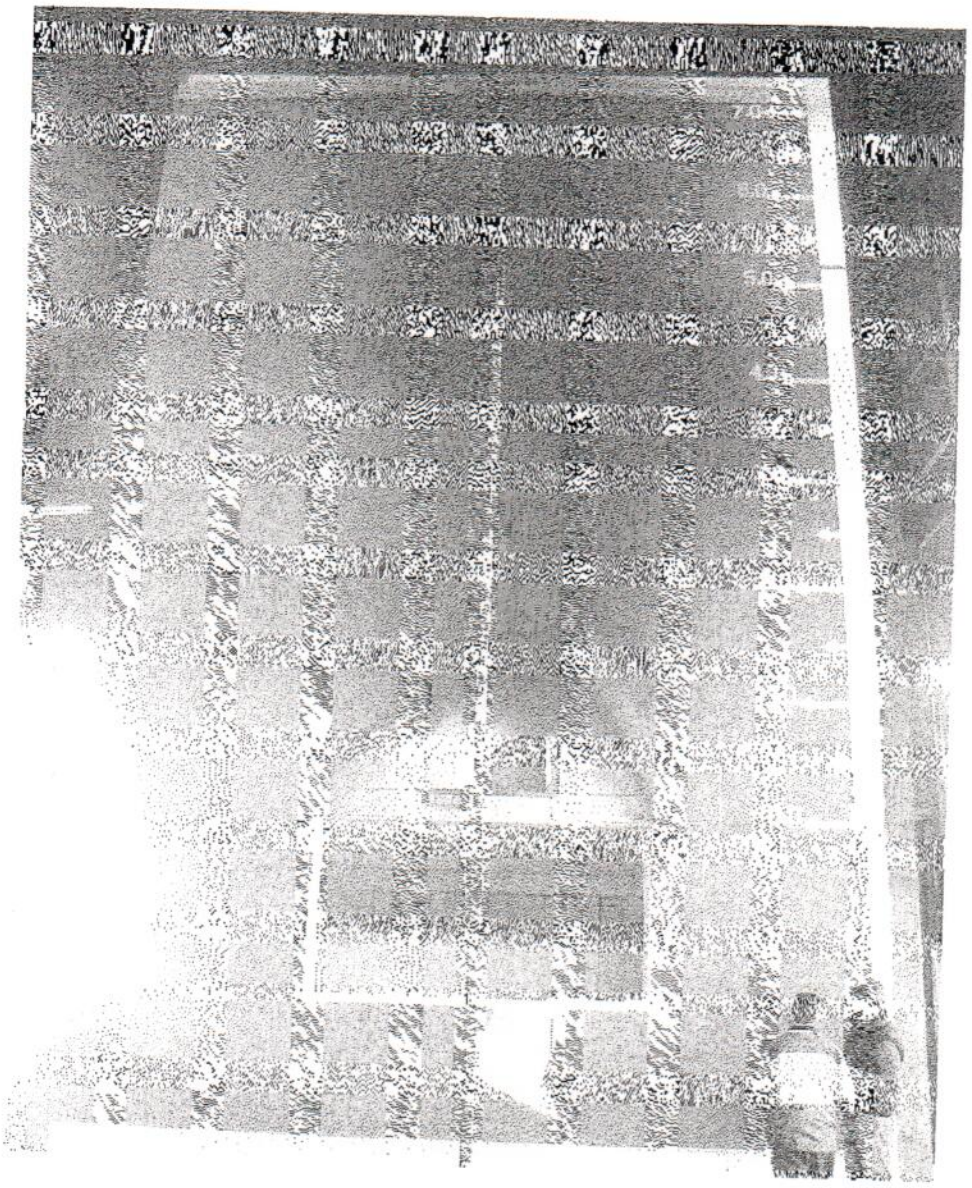


Figure 13. Wall Sample after Fire Exposure.

REMARKS

1. The test facility and test method, as described in this report, conform to the requirements of Article 3.1.5.5 of the 2005 edition of the National Building Code of Canada. The test was conducted in accordance with CAN/ULC S134-92, Standard Method of Fire Test of Exterior Wall Assemblies

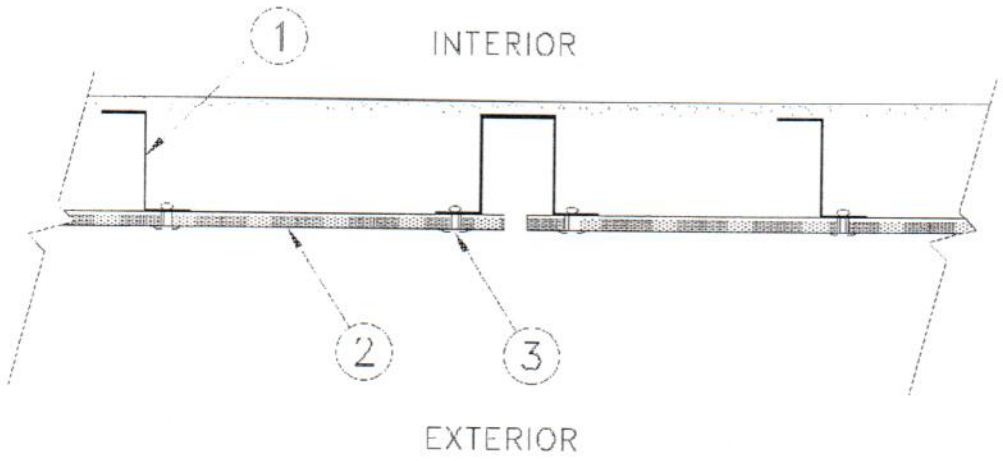
2. There was little damage to the specimen with surface damage to 2.0 m above the window.

3. During the fire exposure there were flames to 2.0 m above the window opening. This is less than the 5 m limit for flame spread distance specified in Sentence 3.1.5.5.(2) and defined in Appendix A (A-3.1.5.5.(2)) of the 2005 edition of the National Building Code of Canada.

4. The maximum one-minute averaged value of the total heat flux density on the test wall at 3.5 m above the top of the opening during the fire exposure was 6.9 kW/m^2. This is less than the 35 kW/m^2 specified in Sentence 3.1.5.5.(3) of the 2005 edition of the National Building Code of Canada.

REFERENCES

1. CAN/ULC S134-92, Standard Method of Fire Test of Exterior Wall Assemblies, Underwriters' Laboratories of Canada, Scarborough, ON, 1992.
2. National Building Code of Canada, National Research Council Canada, Ottawa, ON, 2005.



TOP VIEW

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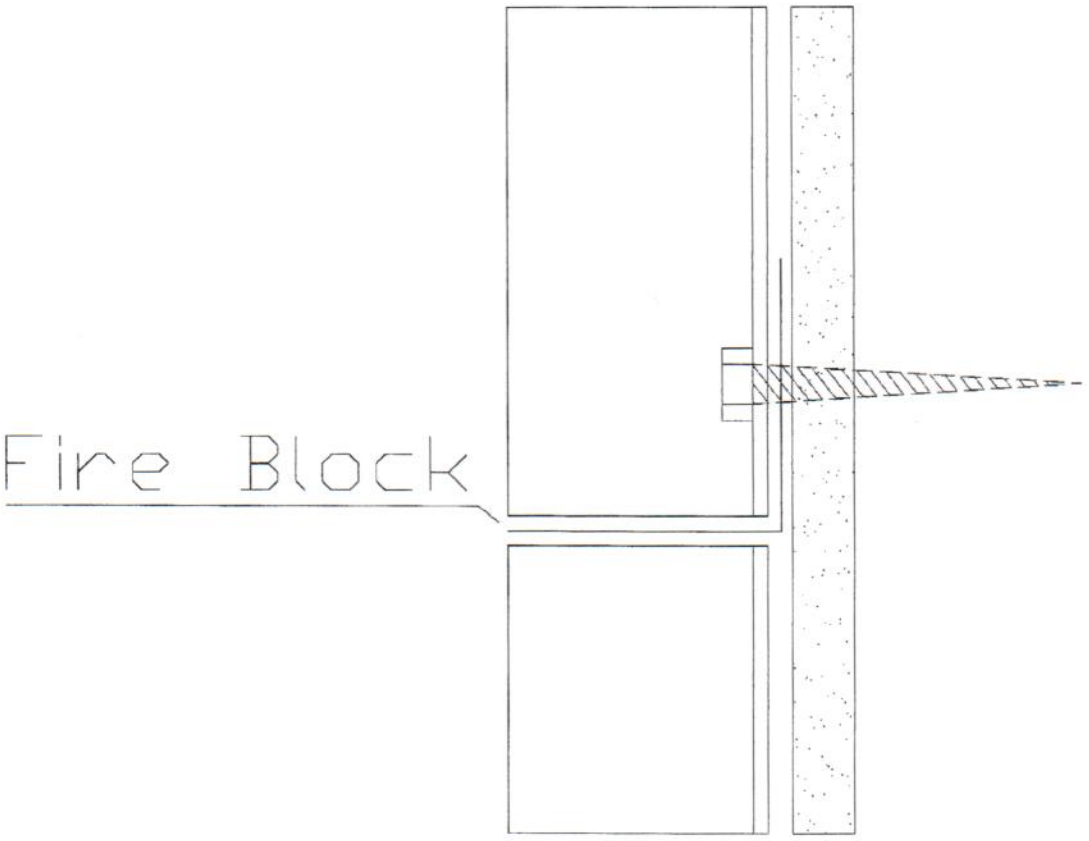

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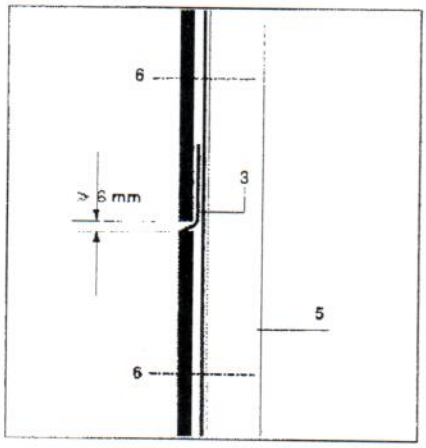

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