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Fire assessment report

Assessment of Polyfoam Polywall® ICF concrete load-bearing wall

Sponsor: Polyfoam Australia Pty Ltd

Report number: FAS200374 Revision: R1.0

Issued date: 9 October 2020 Expiry date: 31 October 2025

Quality management

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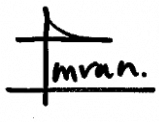
		Name	Mahmoud Akl	Imran Ahamed	Omar Saad
		Signature			
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			Prepared by	**Reviewed by**	**Authorised by**
	Expiry:	**Name**			
		Signature			

Executive summary

This report documents the findings of the assessment undertaken to determine the likely fire resistance level (FRL) of minimum 245 mm thick Polyfoam Polywall® ICF (Insulated Concrete Form) blocks if tested in accordance with AS 1530.4:2014.

The Polyfoam Polywall® ICF blocks wall consists of 60 mm thick polystyrene faces of the blocks spaced apart by Polypropylene (PP) connecting bridges creating a minimum 125 mm wide cavity between them – which is backfilled with concrete.

The analysis in section 5 of this report found that the proposed variations are likely to achieve FRL 120/120/120 as shown in Table 1, if tested in accordance with AS 1530.4:2014.

Table 1 Variations and assessment outcome

Product	Reference test	Variation	FRL
Polywall® system	EWFA 2489001.1	It is proposed to assess the likely fire resistance performance of Polyfoam Polywall® subject to the following: • Assign an FRL of 120/120/120 based on the assessment of the non-compliance in the fire exposure curve and re-instatement of the polystyrene face on the exposed side. • Increase the thickness of the wall system to 270 mm and 320 mm by increasing the width of the cavity between each face of the wall to 150 mm and 200 mm, respectively.	120/120/120

The variations and outcome of this assessment are subject to the limitations and requirements described in sections 2, 3 and 6 of this report. The results of this report are valid until 31 October 2025.

Contents

1. Introduction

This report documents the findings of the assessment undertaken to determine the likely fire resistance level (FRL) of minimum 245 mm thick Polyfoam Polywall® ICF (Insulated Concrete Form) blocks if tested in accordance with AS 1530.4:2014.

This assessment was carried out at the request of Polyfoam Australia Pty Ltd.

The sponsor details are included in Table 2.

Table 2 Sponsor details

Sponsor	Address
Polyfoam Australia Pty Ltd	32 Dandenong Street Dandenong South VIC 3175 Australia

2. Framework for the assessment

2.1 Assessment approach

An assessment is an opinion about the likely performance of a component or element of structure if it was subject to a standard fire test.

No specific framework, methodology, standard or guidance documents exists in Australia for doing these assessments. We have therefore followed the 'Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence' prepared by the Passive Fire Protection Forum (PFPF) in the UK in 2019[1].

This guide provides a framework for undertaking assessments in the absence of specific fire test results. Some areas where assessments may be offered are:

- Where a modification is made to a construction which has already been tested
- The interpolation or extrapolation of results of a series of fire resistance tests, or utilisation of a series of fire test results to evaluate a range of variables in a construction design or a product
- Where, for various reasons – eg size or configuration – it is not possible to subject a construction or a product to a fire test.

Assessments will vary from relatively simple judgements on small changes to a product or construction through to detailed and often complex engineering assessments of large or sophisticated constructions.

This assessment uses established empirical methods and our experience of fire testing similar products to extend the scope of application by determining the limits for the design based on the tested constructions and performances obtained. The assessment is an evaluation of the potential fire resistance performance if the elements were to be tested in accordance with AS 1530.4:2014.

This assessment has been written using appropriate test evidence generated at accredited laboratories to the relevant test standard. The supporting test evidence has been deemed appropriate to support the manufacturer's stated design.

2.2 Compliance with the National Construction Code

This assessment report has been prepared to meet the evidence of suitability requirements of the National Construction Code Volumes One and Two – Building Code of Australia (NCC) 2019 Amendment 1[2] under A.5.2.(1) (d) and 2016 under specification A2.3, including amendments.

[1] Passive Fire Protection Forum (PFPF) 2019, Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence, Passive Fire Protection Forum (PFPF), UK.
[2] National Construction Code Volume One – Building Code of Australia 2019 Amendment 1, Australian Building Codes Board, Australia.

This assessment has been written in accordance with the general principles outlined in EN 15725:2010[3] for extended application reports on the fire performance of construction products and building elements. It also references test evidence for meeting a performance requirement or deemed to satisfy (DTS) provisions of the NCC under A5.4 for fire resistance levels, as applicable to the assessed systems.

2.3 Declaration

The 'Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence' prepared by the PFPF in the UK requires a declaration from the client. By accepting our fee proposal on 9 September 2020, Polyfoam Australia Pty Ltd confirmed that:

- To their knowledge the component or element of structure, which is the subject of this assessment, has not been subjected to a fire test to the standard against which this assessment is being made.
- They agree to withdraw this assessment from circulation if the component or element of structure is the subject of a fire test by a test authority in accordance with the standard against which this assessment is being made and the results are not in agreement with this assessment.
- They are not aware of any information that could adversely affect the conclusions of this assessment and – if they subsequently become aware of any such information – they agree to ask the assessing authority to withdraw the assessment.

3. Limitations of this assessment

- The scope of this report is limited to an assessment of the variations to the tested systems described in section 4.3.
- This report details the methods of construction, test conditions and assessed results that are expected if the systems were tested in accordance with AS 1530.4:2014.
- The results of this assessment are applicable to fire exposure from either side of the assessed wall system, but not simultaneously.
- The applied load on the wall system must not exceed 38 kN/m.
- This report is only valid for the assessed system and must not be used for any other purpose. Any changes with respect to size, construction details, loads, stresses, edge or end conditions – other than those identified in this report – may invalidate the findings of this assessment. If there are changes to the system, a reassessment will need to be done by an Accredited Testing Laboratory (ATL).
- This report has been prepared based on information provided by others. Warringtonfire has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.
- This assessment is based on the proposed systems being constructed under comprehensive quality control practices and following appropriate industry regulations and Australian Standards on quality of materials, design of structures, guidance on workmanship and the expert handling, placing and finishing of the products on site. These variables are beyond the control and consideration of this report.

[3] European Committee for Standardization, EN 15725:2010: Extended application reports on the fire performance of construction products and building elements, European Committee for Standardization, Brussels, Belgium.

4. Description of the specimen and variations

4.1 System description

A Polyfoam Polywall® ICF structure consists of expanded polystyrene panels and reinforced concrete. Polywall® is erected on site and can be filled with concrete to a height of 3 m. In test report EWFA 2489001.1, the tested assembly consisted of a nominal 3000 mm wide × 3100 mm high × 245 mm thick load bearing reinforced concrete wall system. The tested specimen was constructed from 1200 mm long × 300 mm high × 245 mm thick Polyfoam Polywall® ICF (Insulated Concrete Form) blocks.

4.2 Referenced test data

The assessment of the variation to the tested system and the determination of the likely performance is based on the results of the fire tests documented in the reports summarised in Table 3. Further details of the tested system are included in Appendix A.

Table 3 Referenced test data

Report number	Test sponsor	Test date	Testing authority
EWFA 2489001.1	Polyfoam Group	19 January 2011	Warringtonfire Australia (Previously known as Exova Warringtonfire)

4.3 Variations to the tested system

An identical system has not been subject to a standard fire test. We have therefore assessed the system using baseline test information for similar systems. The variations to the tested system – together with the referenced standard fire test – are described in Table 4.

Table 4 Variation to tested system

Item number	Reference test	Description	Variations
1	EWFA 2489001.1	The tested assembly comprised a nominal 3000 mm wide × 3100 mm high × 245 mm thick loadbearing reinforced concrete wall system. The exposed face of the polystyrene on the Polywall® blocks was removed from the test specimen. The furnace temperature was below than the required standard fire curve at the start of the test and above for the later part of the test.	It is proposed to assess the likely fire resistance performance of Polyfoam Polywall® subject to the following variations: • Assign an FRL of 120/120/120 based on the assessment of the non-compliance in the fire exposure curve and re-instatement of the polystyrene face on the exposed side. • Increase the thickness of the wall system to 270 mm and 320 mm by increasing the width of the cavity between each face of the wall to 150 mm and 200 mm, respectively.

4.4 Purpose of the test

AS 1530.4:2014 sets out procedures for conducting fire resistance tests on building materials, components and structures. Specifically, section 2 of this standard contains general requirements for these tests. Section 3 sets out the procedures for determining the fire resistance of masonry, prefabricated and framed walls, access panels, and insulated glazed elements when forming part of a wall.

4.5 Schedule of components

Table 5 outlines the schedule of components for the assessed system subject to a fire test, as referenced in Appendix A.

Table 5 Schedule of components of assessed system

Item No.	Item	Description
1	Product	Polyfoam Polywall® 201
	Material	Spacel EPS expandable polystyrene fire retardant modified grade
	Size	Each block is 1200 mm wide × 300 mm high × 245 mm thick Each face of the block is 60 mm thick. Thickness can be increased to 270 mm and 320 mm.
	Mass	0.5576 kg/unit
	Density	26.76 kg/m³
	Location/fixing	Stacked to form the exposed and unexposed faces of the wall system.
2	Product	Polyfoam 204 Connecting Bridge
	Material	Polypropylene (Moplen EP301G)
	Size	48 mm wide × 198 mm high × 212 mm deep
	Mass	0.1429 kg
	Location	150-off bridges must be located in a 200 mm wide × 300 mm high grid throughout the wall system extending from the exposed side to the unexposed side through the concrete.
3	Product	Polyfoam 202 Starter Bridge
	Material	Polypropylene (Moplen EP301G)
	Size	48 mm wide × 80 mm high × 210 mm deep
	Mass	0.0534 kg
	Location	15-off bridges across the bottom of the wall system extending from the exposed to the unexposed side through the concrete.
4	Product	N12 Reinforcement Bar
	Material	High-yield tempcore steel
	Mass	0.8668 kg/m
	Location/Fixing	Formed into a nominal 300 mm grid with horizontal members locked into bridges (Items 2 and 3) and vertical members secured to horizontal members using 1.5 mm diameter metal wire ties.
5	Product	Starting Channel 209
	Material	0.55 bmt galvanised steel
	Size	62 mm deep × 37 mm high
	Mass	0.5112 kg/m
	Location	Must be placed on bottom edge of exposed Polywall® between blocks and cement sheet. Secured to cement sheet using expanding foam (Item 6)
6	Product	Illbruck PU 010 EIFS Adhesive Foam
	Material	Polyurethane Expanding Foam
	Location	Between Polywall® horizontal and vertical joins.
7	Product	Concrete with Sika ViscoCrete 10
	Material	Concrete with an average strength of 35.5 MPa at 28 days curing
	Density	2,253 kg/m³

Item No.	Item	Description
	Moisture content	3.04%
	Location	Filling 125 mm wide cavity between exposed and unexposed Polywall® from cement sheet base up to head of frame.
8	Product	Cement Sheet
	Size	300 mm deep × 4.5 mm thick
	Density	1,387 kg/m^3
	Location	At base of the wall system, full width.
9		390 mm high × 90 mm wide × 190 mm deep solid concrete blocks were installed to the east and west vertical free edges of the specimen.
10		25 mm thick ceramic fibre sealing to the east and west vertical edges.

Figure 1 to Figure 3 show the assessed system.

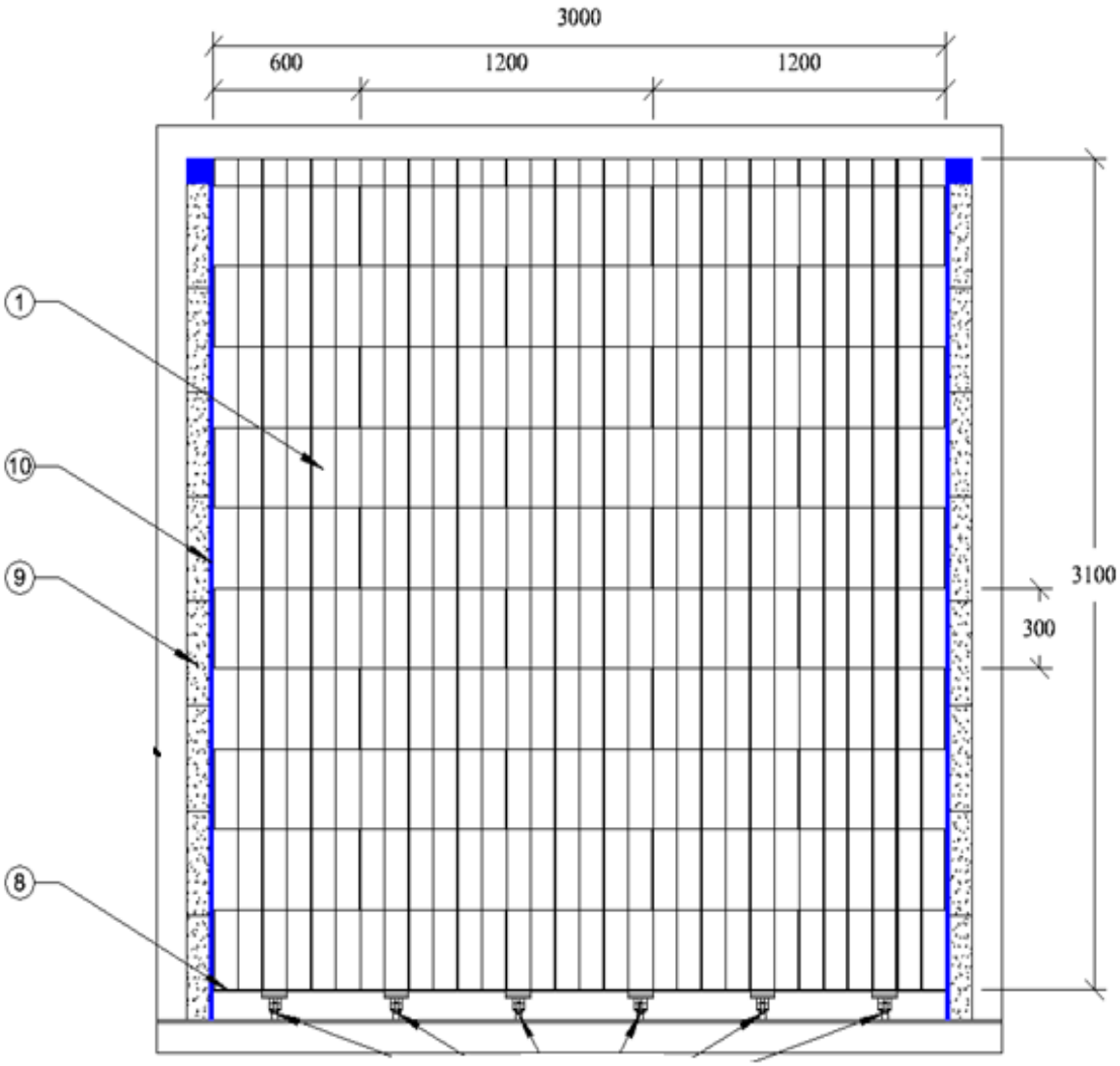

Figure 1 Face elevation of Polyfoam Polywall® ICF blocks (extracted from EWFA 2489001.1)

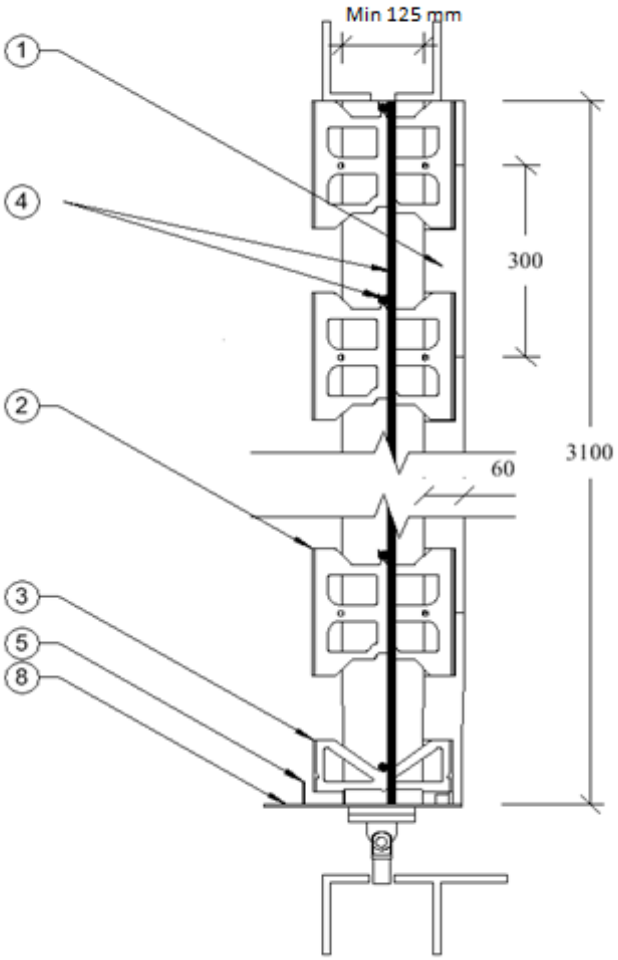

Figure 2 **Vertical section of the Polyfoam Polywall® ICF blocks (extracted from EWFA 2489001.1)**

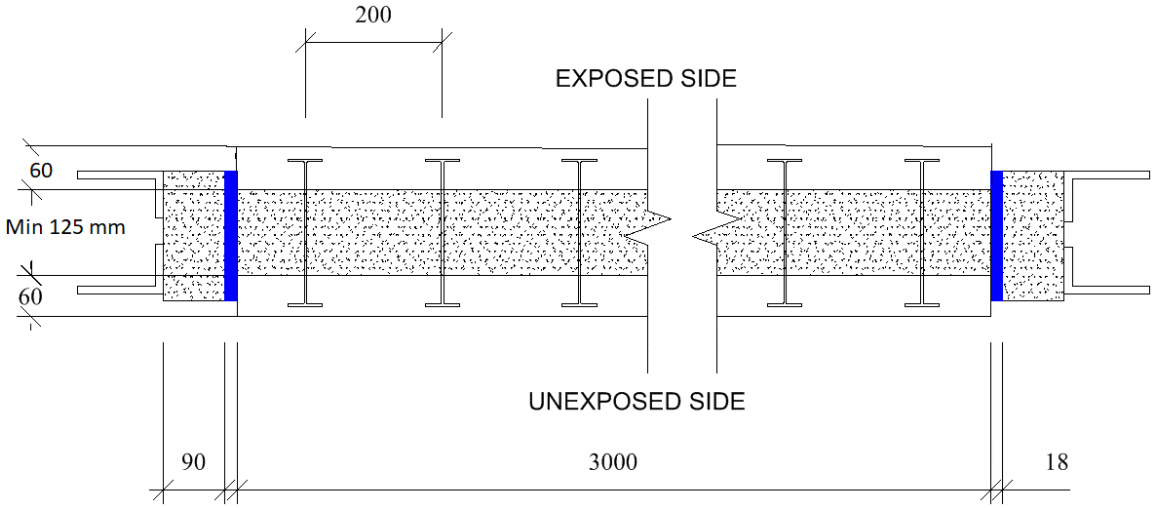

Figure 3 **Horizontal section of the Polyfoam Polywall® ICF blocks (extracted from EWFA 2489001.1)**

5. Assessment – Assessment of Polyfoam Polywall® ICF blocks.

5.1 Description of variation

In test report EWFA 2489001.1, the test assembly consisted of a nominal 3000 mm wide × 3100 mm high × 245 mm thick load-bearing reinforced concrete wall system. The test specimen was constructed from 1200 mm long × 300 mm high × 245 mm thick Polyfoam Polywall® ICF blocks. The 60 mm thick polystyrene faces of the blocks were spaced apart by PP connecting bridges creating a 125 mm wide cavity between them that was backfilled with concrete. The exposed face of polystyrene was removed before testing.

The primary variations addressed in this assessment report is the fire resistance performance of the loadbearing reinforced concrete wall system are as follows:

- Assign an FRL of 120/120/120 based on the assessment of the non-compliance in the fire exposure curve and re-instatement of the polystyrene face on the exposed side.
- Increase the thickness of the wall system to 270 mm and 320 mm by increasing the width of the cavity between each face of the wall to 150 mm and 200 mm, respectively.

5.2 Methodology

The method of assessment used is summarised in Table 6.

Table 6 Method of assessment

Assessment method	
Level of complexity	Intermediate assessment
Type of assessment	Qualitative and comparative

5.3 Assessment

In test report EWFA 2489001.1, a loaded 245 mm thick Polyfoam Polywall® ICF concrete load bearing wall system was tested. The total load applied was 115 kN. The load was applied as six single point loads at 500 mm centres to the bottom edge of the wall. The test result showed that the integrity and insulation performance was maintained for 243 minutes and 143 minutes, respectively. After review of the test report, it was observed that the furnace temperature was below the required standard fire curve at the start of the test and above for the later part of the test. A single sensor was 100 degrees or more below the required temperature from 14 minutes to 45 minutes. Beyond 120 minutes, the average furnace temperature was above the required standard fire curve until the end of the test. The overall severity of the test was calculated to be within the 2.5% exposure. As the test was not carried out in strict accordance with AS 1530.4:2005, no FRL was attributed to the tested specimen.

5.3.1 FRL of the system

It is proposed to assess the likely fire resistance performance of minimum 245 mm thick Polywall® ICF blocks for an FRL of 120/120/120 after considering the overall exposure of the wall system throughout the 243 minutes and the re-instatement of the polystyrene on the exposed side. It is understood that the polystyrene was removed to avoid smoke choking of the furnace and the expected excessive spalling due to the moisture being trapped in the concrete by the polystyrene. To start with, re-instating the 60 mm thick Polystyrene is not considered to introduce any detrimental effect to the fire resistance performance of the wall system. In the contrary, it is expected to shield the concrete part of the wall during the initial stage of the test before melting away and falling off. In a normal testing scenario, the furnace burners will regulate and adjust the furnace temperature due to the additional heat caused by the flaming Polystyrene.

After review of the test report, it was observed that the wall system continued to maintain the structural adequacy and the integrity performance for 243 minutes. The significance of this observation is that it indicates that the system has passed the test with a significant safety margin in relation to the structural adequacy and integrity performance – despite being exposed to an elongated extreme fire condition.

With regards to the insulation performance, the specimen continued to maintain the insulation performance for 143 minutes until a roving thermocouple was applied to the exposed concrete at mid width 400 mm from the head of the specimen, and a temperature of 209℃ was recorded which induced an insulation failure in accordance with clause 2.12.3b of AS 1530.4:2005.

To address the variation in the furnace temperature curve, a simple calculation was conducted to compare the area under the mean furnace temperature curve with the area under the standard AS 1530.4:2005 curve. It is considered that the area under the exposed time-temperature curve indicates the level of energy exposure received by the tested specimen. At 143 minutes, the tested specimen was exposed to a level of energy 15% more than what is expected in an AS 1530.4:2005 fire exposure for 120 minutes.

Based on the discussion above, it is the opinion of this testing authority that the available test data can be used as a basis for positively assess the likely fire resistance performance of a minimum 245 mm thick Polywall® ICF blocks with a load of 38 kN/m for 2 hours.

5.3.2 Thickness of the wall system

It is proposed to extend the assessed FRL to include Polyfoam Polywall® ICF concrete load bearing wall system with thickness greater than 245 mm. The proposed wall systems are similar to the tested specimen with the main variation being the width of the cavity between either side of the Polywall® from cement sheet base up to head of frame. The width of the cavity is proposed to be increased to 150 mm and 200 mm corresponding to the proposed increase in the overall wall thickness of 270 mm and 320 mm, respectively. The increased part is the part which is expected to accommodate the poured concrete. As the width of the main loadbearing element is increased, it is reasonable to consider that a similar structural, integrity and insulation can be maintained for at least more than 120 minutes. Hence, can be positively assessed.

5.3.3 Relevance of AS 1530.4:2005 test data with respect to AS 1530.4:2014

The fire resistance test EWFA 2489001.1 was conducted in accordance with AS 1530.4:2005, which differs from AS 1530.4:2014. The effect these differences have on fire resistance performance of the referenced test specimens is discussed below.

Discussion

The furnace heating regime in fire resistance tests conducted in accordance with AS 1530.4:2014 follows a similar trend to that in AS 1530.4:2005.

The specified specimen heating rate in AS 1530.4:2005 is given by:

$$T_t - T_0 = 345 \log(8t + 1) + 20$$

Where:

T_t = furnace temperature at time t, in degrees Celsius.

T_0 = initial furnace temperature, in degrees Celsius.

t = the time into the test, measured in minutes from the ignition of the furnace.

The parameters outlining the accuracy of control of the furnace temperature in AS 1530.4:2014 and AS 1530.4:2005 are not appreciably different.

Furnace pressure

The furnace pressure conditions for single and multiple penetration sealing systems in AS 1530.4:2005 and AS 1530.4:2014 are not appreciably different.

The parameters outlining the accuracy of control of the furnace pressure in AS 1530.4:2014 and AS 1530.4:2005 are not appreciably different.

Performance criteria

AS 1530.4:2014 specifies the following performance criteria for building materials and structures:

- structural adequacy.
- integrity.
- insulation.

Structural adequacy

The failure in relation to structural adequacy in AS 1530.4:2005 and AS 1530.4:2014 is not appreciably different.

Integrity

AS 1530.4:2014 stipulates in addition to the 20 mm thick × 100 mm × 100 mm cotton pads, additional cotton pads shall be provided with a reduced 30 mm × 30 mm × 20 mm with additional wire frame holder and shall be used to determine integrity failure.

Apart from the above variation, the failure criteria for integrity in AS 1530.4:2014 and AS 1530.4:2005 are not appreciably different.

Insulation

The positions of thermocouples and failure criteria for insulation in AS 1530.4:2014 and AS 1530.4:2005 are not appreciably different.

5.3.4 Application of the test data to AS 1530.4:2014

Based on the above discussion and in absence of any foreseeable structural, integrity and insulation risk, it is concluded that the results relating to the structural, integrity and insulation performance of the specimen – tested in EWFA 2489001.1 – can be used to assess the structural, integrity and insulation performance in accordance with AS 1530.4:2014.

5.4 Conclusion

This assessment demonstrates that the Polyfoam Polywall® with a minimum wall thickness of 245 mm – including 270 mm and 320 mm – is likely to achieve an FRL of 120/120/120 if it was tested in accordance with AS 1530.4:2014.

6. Validity

Warringtonfire Australia does not endorse the tested or assessed product in any way. The conclusions of this assessment 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 conditions.

Due to the nature of fire testing and the consequent difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in test procedures, materials and methods of construction, and installation may lead to variations in performance between elements of similar construction.

This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are subject to constant review and improvement. It is therefore recommended that this report be reviewed on, or before, the stated expiry date.

This assessment represents our opinion about the performance likely to be demonstrated on a test in accordance with AS 1530.4:2014, based on the evidence referred to in this report.

This assessment is provided to Polyfoam Australia Pty Ltd for their own purposes and we cannot express an opinion on whether it will be accepted by building certifiers or any other third parties for any purpose.

Appendix A Summary of supporting test data

A.1 Test report – EWFA 2489001.1

Table 7 Information about test report

Item	Information about test report
Report sponsor	Polyfoam Group, 32 Dandenong Street, Dandenong South VIC 3175
Test laboratory	Exova Warringtonfire currently known as Warringtonfire Australia, Unit 2, 409-411 Hammond Road, Dandenong, Victoria 3175, Australia.
Test date	The fire resistance test was completed on 19 January 2011.
Test standards	The test was done in accordance with AS 1530.4:2005
Variation to test standards	1. The pressure was above that allowable by the standard during the 10 to 20 minute test period. This variation is unlikely to have had any adverse affect on the test as there we no through gaps observed during the test. 2. The furnace temperature was below the required curve at the start of test and above the curve for the later part of the test. A singe sensor was 100 degrees or more below the required furnace temperature from 14 minutes to 45 minutes and after 120 minutes the average furnace temperature was above the required curve from that point until the end of the test. The overall severity of the test was calculated to be within the 2.5% exposure.
General description of tested specimen	The test assembly consisted of a nominal 3000 mm wide × 3100 mm high × 245 mm thick load-bearing reinforced concrete wall system. The test specimen was constructed from 1200 mm long × 300 mm high × 245 mm thick Polyfoam Polywall® ICF (Insulated Concrete Form) blocks. The 60 mm thick polystyrene faces of the blocks were spaced apart by PP connecting bridges creating a 125 mm wide cavity between them that was backfilled with concrete. The exposed face of polystyrene was removed before testing.
Instrumentation	The test report states that the instrumentation was in accordance with AS 1530.4:2005

The test specimen achieved the following results – see Table 8.

Table 8 Results summary for this test report

Performance criteria	Result
Structural adequacy	Failure at 243 minutes
Integrity	Failure at 243 minutes
Insulation	Failure at 143 minutes

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