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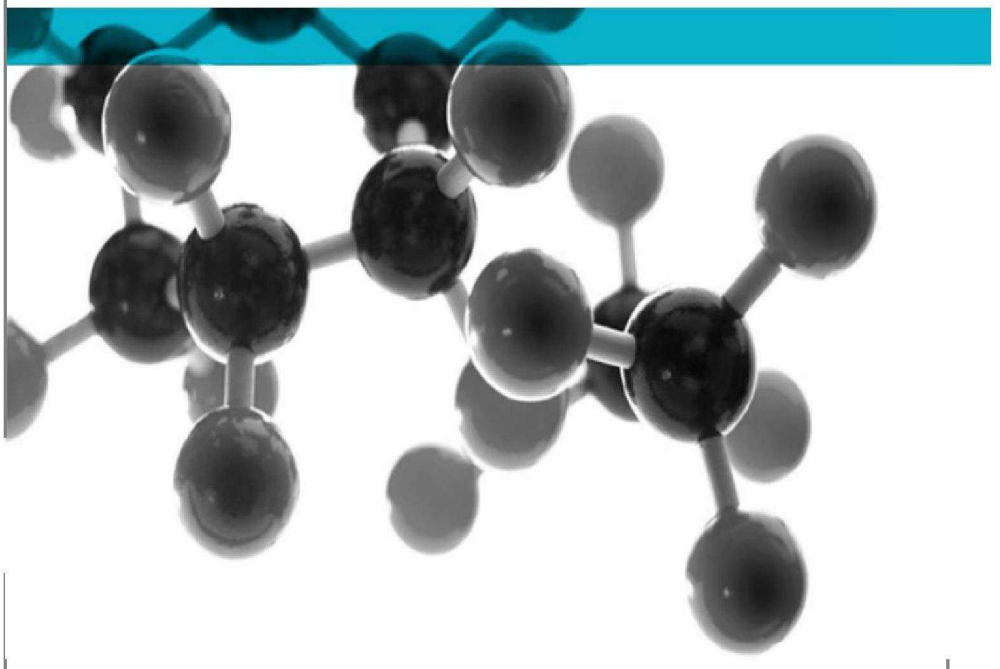
Testing. Advising. Assuring.

Assessment of the fire performance of an external wall systems for use on high rise buildings as featured on Ruskin Square



Date: 15th July 2015

A Report To: Kingspan Insulation Ltd

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Executive Summary

Objective

To determine the compliance of a ventilated and insulated façade system and utilising K15 phenolic insulation for use on multi-storey buildings with the requirements of the Building Regulations for England and Wales as defined in Approved Document B and with NHBC standards. The façade is faced with Keratwin ceramic tile and Stofix brick slip systems.

Generic Description	Generic Description
The Keratwin ceramic tile faced system build up comprises: • A double layer of 12.5mm thick Gyproc Wallboard Plasterboard, tape and joint finish, fastened to the SFS frame • Reinforced concrete with SFS infill frame between columns. The SFS is filled with a minimum of 50mm thick with Class A1 Non combustible stone wool • 12mm RCM Y wall sheathing board or 12mm cement particleboard, joints being sealed with 1 hour fire resisting intumescent foam. • Tyvek or Nilvent breather membrane • Up to 150mm Phenolic Foam (Kingspan Kooltherm K15) • Cavity fitted with PFC Corofil C450 vertical cavity barriers and PFC Corofil RSB2 cavity barriers installed at each floor level • 3mm aluminium helping hand brackets, 5mm thermal isopad, 2mm aluminium top hat channel • Keratwin ceramic tile	The Stofix brick slip system build up comprises: • A double layer of 12.5mm thick Gyproc Wallboard Plasterboard, tape and joint finish, fastened to the SFS frame • Reinforced concrete with SFS infill frame between columns. The SFS is filled with a minimum of 50mm thick with Class A1 Non combustible stone wool • 12mm RCM Y wall sheathing board or 12mm cement particleboard,, joints being sealed with 1 hour fire resisting intumescent foam. • Tyvek or Nilvent breather membrane • Up to 150mm Phenolic Foam (Kingspan Kooltherm K15) • Cavity fitted with PFC Corofil C450 vertical cavity barriers and PFC Corofil RSB2 cavity barriers installed at each floor level • 2mm galv. m/s helping hand brackets, 5mm thermal isopad, 2mm aluminium top hat channel • Stofix Brick Slip system

Report Sponsor

Kingspan Insulation Ltd., Pembridge, Leominster, Herefordshire, HR6 9LA, UK

Opinion

We consider that the information reviewed in this document is sufficient to allow a conclusion to be drawn that the fire performance of the systems described will be sufficient to meet the requirements of the Building Regulations for England and Wales for Ventilated Façade Systems on high rise buildings and also the standards of NHBC (BCA Guidance Note 18 *Use of Combustible Cladding Materials on Residential Building).*

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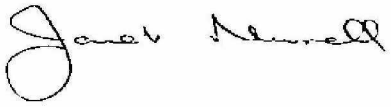
Signatories

	
Responsible Officer Janet Murrell * Technical Manager	Authorised Matthew Dale* Senior Technical Officer

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 1st July 2015

CONTENTS **PAGE NO.**

Introduction

Terms Of Reference

Exova Warringtonfire have been instructed by Kingspan Insulation Ltd., to assess the compliance of 2 external wall systems to be used in multistorey buildings (10 to 22 storeys high) in the Ruskin Square project to the requirements of the current Building Regulations for England and Wales following the guidance given in Approved Document B and to the standards of NHBC. The purpose of this report is to provide the assessment of performance requested in Option 3 of the NHBC letter dated April 01 2015.

Introduction

The façade constructions include the use of an organic cellular foam, Kingspan Kooltherm K15 (referred to hereafter as K15), as the insulation.

In buildings taller than 18 m, insulation materials in external wall systems should be of limited combustibility to meet the contemporary design guidance to the Building Regulations. The general intent is that buildings with a storey at a height of more than 18 m above the external access level cannot be easily reached by fire and rescue service equipment and personnel. Therefore the materials in the build up of external walls in buildings over 18m should be provided with means of reducing fire spread risk.

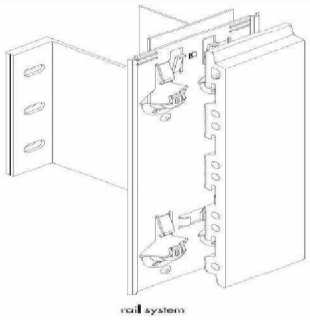
For buildings in the Ruskin Square project, this restriction is applicable. K15 insulation has been proposed to meet the thermal insulation performance within this construction. This insulation product is based on a thermoset material (phenolic foam), which is organic in nature and therefore classed as combustible. It therefore does not meet with the fire strategy requirement given in the Building Regulations and is therefore required by the NHBC to undergo either a fire test to BS 8414 (option 2) or a desktop study (option 3), in accordance with BCA Technical Guidance Note 18 *Use of Combustible Cladding Materials on Residential Building.*

There is a need to assess the Kingspan K15 insulation for suitability in these external façade systems and to look at the overall potential performance of the total system based on various fire test reports. For a combustible material to be used at heights of over 18m, the guidance given in the Building Regulations for England and Wales is that it should have a fire performance of at least Class 0 when tested to BS 476 part 6 and 7 or B-s3,d2 when classified to BS EN 13501-1 and in addition should be tested against BS 8414-2 and assessed against the requirements of BR 135.

Supporting Documentation

The following reports and drawings have been used in this assessment of the ventilated external wall system which is proposed for use on high rise buildings in Ruskin Square development.

Product (Component Part of External Wall System)	Reports and other Information	
	Keratwin Ceramic Tiles	**Stofix Brick Slips**
A double layer of 12.5mm thick Gyproc Wallboard, tape and joint finish, fastened to the SFS frame	Classified without further testing as A2-s1, d0 Commission Decision 96/603/EC, as amended 2000/605/EC And in addition 2 layers of 15mm wallboard gives 30 minutes integrity	
SFS frame filled to 50mm with Class A1 non combustible stone wool	Non combustible – deemed to satisfy A1	
RCM 12mm Y Board 12mm RCM Y wall sheathing board or 12mm cement particleboard, joints being sealed with 1 hour fire resisting intumescent foam.	Non combustible to BS 476 Part 4 WF 159366 76 minutes fire resistance (integrity and insulation) BS 476 Part 22 Class 0 to BS 476 Part 6 and 7	
Tyvek or Nilvent breather membrane	Combustible	
Kingspan K15 Phenolic Foam Insulation	BBA Certificate 08/4582 BRE Report 220876 to BS 8414-1 BRE Report 293940 to BS8414-2 BRE Report 297099 to BS8414-2 AFITI Report 8482/11 to EN 1363-1 BRE Report 218611 to BS EN 1364-1 EWF Report 323655 to BS EN 1365-1 BRE Report CC 301393	
Cavity with PFC Corofil cavity barriers installed at each floor level, vertically and horizontally	Tested to BS 476 Part 20: giving 30mins integrity	
Fixings	3mm aluminium helping hand brackets, 5mm thermal isopad, 2mm aluminium top hat channel	2mm galv. m/s helping hand brackets, 5mm thermal isopad, 2mm aluminium top hat channel
Ceramic tiles	Keratwin K20 cladding system. Extruded ceramic tiles manufactured from clay, kaolin and feldspar hung on aluminium support rails creating overlap joints. The tiles are attached to a vertical rail system attached to the SFS. The tiles are hung horizontally with the holding grooves on the reverse side which lock onto the brackets. (See below)	

	 Class A1 (EN 14411:2012) Deemed to Satisfy A1 Commission Decision 96/603/EC, as amended 2000/605/EC	
Brickslips		Brick slips – Deemed to Satisfy A1 Commission Decision 96/603/EC, as amended 2000/605/EC Fixed to bracketry secondary support system galvanised and stainless steel fixed back to the SFS.

1. BRE Test Report No 293940

A fire test in accordance with BS8414 -2 (where the façade system is mounted onto a steel structure rather than a masonry wall) was carried out on a Kingspan K15 insulated system with a ventilated Trespa Rainscreen facing.

The system consisted of a double layer of wall board mounted onto a 150mm steel frame. The steel frame system (SFS) was installed between the floor slab hangers on the main wall with horizontal base and head trackers fixed to the steel substrate. On the face of the steel frame was mounted 15mm thick cement sheathing board.. On this were mounted aluminium L and T rails. A single layer of 85mm K15 Kooltherm insulation board was fixed to the sheathing board with screws and plastic washers, the aluminium helping hand brackets protruding through precut slots in the K15 board. The construction was faced with 15mm thick Trespa, a high pressure laminate, decorative rainscreen board. The reaction to fire performance of these boards is B-s1,d0. In the ventilated cavity, three horizontal fire breaks (Lamatherm CW-RHS ventilated cavity barrier) were fixed to the sheathing board and three vertical non-ventilated barriers were installed on the outer edges of the cladding and around the fire source hearth.

2. BRE Test Report No 297099

A fire test in accordance with BS8414-2 (where the façade system is mounted onto a steel structure rather than a masonry wall) was carried out on a Kingspan K15 insulated system with a sheathing board of 12mm cement particleboard and a ventilated Terracotta tile facing. The fire test configuration was similar to that above except that the insulation was 80mm thick and the facing used was Taylor Maxwell (Argeton) Classico 30mm x 250mm x600mm tiles which were held in place using tile clips and Fixfast rivets which were fixed to the Taylor Maxwell Leg Tee support.

3. BRE Test Report No 220876

A fire test in accordance with BS8414 - 1 (where the façade system is mounted onto a masonry wall) was carried out on a Kingspan K15 insulated system with a ventilated cement particle board facing. Panels were 1200mm x 900mm x 6mm thick.

The system consisted of a single layer of 60mm K15 Kooltherm insulation board was fixed to the masonry wall(a blockwork structure) with screws and plastic washers. An aluminium railing system was also mechanically fixed to the blockwork wall to which was fixed the 6mm thick cement particle boards at 600mm centres. The fire stopping was provided in the ventilated cavity and consisted of a graphite based intumescent strip bonded to nominal 0.6mm thick galvanised steel positioned horizontally above the fire chamber at a distance of 0.5m and 4m.

4. WF Test Report No 323655

A indicative fire test in accordance with EN 1363-1 on a Kooltherm K15 insulation without facing, to demonstrate integrity only.

5. AFITI Test Report No 8482/11

A fire test in accordance with EN 1365-1 on a load bearing wall assembly consisting of a stud partition wall with Kooltherm K15 insulation faced on the fire side with 9mm cement particleboard and on the non fire side with 2 layers of 12.5mm plasterboard.

Description of the Proposed System

The proposed system comprises:

Generic Description	Generic Description
The Keratwin ceramic tile faced system build up comprises: • A double layer of 12.5mm thick Gyproc Wallboard Plasterboard, tape and joint finish, fastened to the SFS frame • Reinforced concrete with SFS infill frame between columns. The SFS is filled with a minimum of 50mm thick with Class A1 Non combustible stone wool • 12mm RCM Y wall sheathing board or 12mm cement particleboard, joints being sealed with 1 hour fire resisting intumescent foam. • Tyvek or Nilvent breather membrane • Up to 150mm Phenolic Foam (Kingspan Kooltherm K15) • Cavity fitted with PFC Corofil C450 vertical cavity barriers and PFC Corofil RSB2 cavity barriers installed at each floor level • 3mm aluminium helping hand brackets, 5mm thermal isopad, 2mm aluminium top hat channel • Keratwin ceramic tile	The Stofix brick slip system build up comprises: • A double layer of 12.5mm thick Gyproc Wallboard Plasterboard, tape and joint finish, fastened to the SFS frame • Reinforced concrete with SFS infill frame between columns. The SFS is filled with a minimum of 50mm thick with Class A1 Non combustible stone wool • 12mm RCM Y wall sheathing board or 12mm cement particleboard, joints being sealed with 1 hour fire resisting intumescent foam. • Tyvek or Nilvent breather membrane • Up to 150mm Phenolic Foam (Kingspan Kooltherm K15) • Cavity fitted with PFC Corofil C450 vertical cavity barriers and PFC Corofil RSB2 cavity barriers installed at each floor level • 2mm galv. m/s helping hand brackets, 5mm thermal isopad, 2mm aluminium top hat channel • Stofix Brick Slip system

Assessment

During the tests on the external wall systems in BRE reports nos 293940, 297099 and 220876, the maximum external air temperature at level 2 remained below the limit of 600ºC within 15 minutes of the start time as did the temperature within the cavity between the external finish and the K15 insulation and the temperature at the mid depth of the insulation. The approximate maximum temperatures in each test at each location within the first 15 minutes of the test are tabulated below

	BRE Report No 293940 (SFS system)	BRE Report No 297099 (SFS system)	BRE Report No 220876 (masonry system)
Air Temperature	530ºC	420ºC	500ºC
Mid Point Cavity	140ºC	100ºC	380ºC
Mid Point of Insulation	30ºC	60ºC	190ºC

These tests determine the fire performance of the insulation within a cavity and illustrate which temperatures were recorded at the storey immediately above the fire source. The temperatures within the cavity are dependant on the nature of the fixing detail on the sill above the fire which should be that installed in practice as a window and also on the nature of the facing used.

There are a number of differences between the tested systems and the proposed system to be used in the Ruskin Square project, the most important of which is the use of brick slips and ceramic tiles on the external wall of the system . Other differences can be summarized as follows:

- The internal lining in the tests with SFS framework comprised a double layer of 12.5 mm Gyproc wallboard to which the SFS frame was directly fixed. This is also the internal lining on the Ruskin Square project. Note: A double layer of gypsum board of 12.5mm provides 30 minutes fire integrity.

- With the proposed system, one layer of 12mm flexible cement Y wallboard is used on the non cavity side of the K15 foam. These boards should perform at least as well as the tested 12mm cement board in the BS 8414 tests with the terracotta tiles.

- With the tested systems, there is no infill to the SFS frame. With the proposed system the frame incorporates Class A1 non combustible stone wool insulation which will significantly slow heat transfer to the gypsum board and hence the interior of the building and will act as a physical fire barrier in terms of integrity and penetration.

- The K15 insulation was tested at thicknesses of 60, 80 and 85 mm and will be used in the proposed systems at thicknesses of up to 150 mm. The 150 mm foam would be expected to perform in a similar manner to the thicknesses tested however the extra thickness would provide a greater degree of fire protection for the underlying structures making up the external building envelope by insulating them against heat transfer into the building to a greater degree than the thinner thicknesses and therefore the change should improve performance. In this construction the foam is behind the cavity which rests behind a facing with a Class A1 performance and in front of a SFS filled with 50 mm mineral wool. K15 insulation is a

thermosetting foam which tends to char under the influence of heat before being eventually combusted due to prolonged direct flame exposure. This however takes a period of time as can be demonstrated by the fire resistance test conducted on the Kingspan K15 insulation by AFITI where 100mm thick unfaced foam was exposed to the time temperature curve in EN1363- 1. After 30 minutes exposure to temperatures up to 830ºC, the foam, although very charred, was still in tact. Direct flame impingement onto the insulation should failure occur of the window soffit based should still provide 30 minutes protection into the building. The SFS frame is also filled with mineral wool which will also serve as protection to the internal lining ie the two 15mm gypsum boards and building itself.

- The systems in the tests conducted were clad on the exterior with either a Trespa (high pressure laminate) rainscreen system or a terracotta tile rainscreen system or cement particle board system. The proposed systems have either a brick slips in metal trays or ceramic tiles. Both systems are non combustible (Class A1) and would not contribute in any way to any fire growth. We would therefore expect the external temperatures to be no higher than they were in the tests conducted on the terracotta tiles. We would also expect that the performance of the cladding in protecting the cavity and the insulation behind would be at least as effective as with the terracotta tiles and would therefore expect the cavity and the insulation temperatures to be similar or lower than those in the tested tile system. The two facings themselves would be expected to be effective heat sinks significantly mitigating the effects of thermal shock to the panels. The presence of the framework holding the brickslips will also reduce the likelihood of fire penetrating into the cavity. The ceramic tiles to perform in a similar manner to the terracotta tiles. Their thermal resistance would be expected to reduce the likelihood of the panels shattering and exposing the cavity and the K15 foam behind however as with the terracotta tiles displacement would be expected.

  The brickslips are mounted on a galvanized steel framework which is fastened to the SFS with brackets and helping hands. The brickslips are held in metal trays which lock together and fasten onto the framework. The mounting system for the brickslips is robust and in the event of a test to BS8414, this would have served to provide a robust barrier to protect fire entering the cavity.

- The ceramic tiles are hung on aluminium support rails which overlaps the tiles. The installation should be as detailed in the BBA Agrement Certificate 13/4980. The BBA certificate states that NHBC have accepted the use of these tiles when mounted as described in the certificate and when used as a cladding material. The mounting system consists of vertical rails with integral brackets with a minimum thickness of 2mm. The rails are attached to the SFS via the integral brackets using screws or blind rivets. The tiles are hung horizontally from rails attached to the framework rather than being fixed, the grooves on the back of the tile locking onto the brackets. An integrated compression spring prevents rocking and enables the tiles to resist wind loading. The effect of fire will be initially mitigated by the tiles' heat sink effect and the stability of the tiles in remaining in place during any fire will be greatly enhanced by the tiles being hung off the horizontal rails, along the full length of the tile, rather than at single points. Cracking of the tile may occur but the damaged area and the area of cavity exposed should be less than that which occurred in the test with the terracotta tile.

- The cavity barriers in the tests conducted to BS8414-2 were mineral fibre batts fitted to full thickness of the ventilated cavity. The cavity barriers proposed for the vertical barriers are also mineral fibre batts. For the horizontal barriers, the mineral fibre does not go the full depth of the cavity but is fitted with intumescent strips. These cavity barriers allow a much greater freedom of movement of air in the cavity but in a fire situation, the intumescent strips close the cavity to prevent passage of smoke and flame. In a fire situation it would be expected that this type of barrier would be equally effective as the full depth cavity fire stops

Note: Cavity barriers should be fitted in accordance with section 9 of Approved Document B, volume 2.

Conclusion

Opinion

It is therefore our opinion that the ceramic tile and brickslip faced Kingspan K15 insulated ventilated façade system as proposed and as described for the Ruskin Square project would satisfy the performance criteria detailed in BR 135 third edition, if tested against BS8414-2:2005.

Validity of opinion

This opinion is based on the requirements of BR 135, third edition and against the requirements of the Building Regulations for England and Wales based on the guidance given in Approved Document B to those regulations.

The opinion has been formulated on the assumption that the information provided by the client was correct and issued by independent third parties and that the client was not aware of any information that could have been provided which may adversely affect the conclusions drawn in the assessment.

This assessment is issued on the basis of test data and information available at the time of issue and provided by Kingspan Insulation Ltd. The assessment is invalidated if the proposed construction is subsequently tested since test data takes precedence over an expressed opinion. Any changes in the proposed system described in this assessment will invalidate this assessment. This assessment relates only to the design as detailed in this report and as used at Ruskin Square.

This assessment has been carried out in accordance with the Fire Test Study Group Resolution No 82. It relates to the fire performance of the product and does not cover aspects of quality, durability, maintenance or service requirements. This assessment relates only to the specimen(s) assessed and does not by itself infer that the product is approved under any certification scheme.

Revision History

Issue No :	Issue Date:
Revised By:	Approved By:
Reason for Revision:	

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Revised By:	Approved By:
Reason for Revision:	