# Fire Protection in Curtain Wall and Façade Systems

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# FIRE STOP & SMOKE SEAL

# Spread of Fire and Smoke

**Subsection C11 – Protection against External Fire Spread**

**Clause C11.1**

Subject to Subsection C5, the external wall of a building at any floor should be separated from the external wall at the floor next below by:

(a) a spandrel that is a vertical element of 900mm, with an FRR of not less than that of the intervening storey; or

(b) a horizontal projection of 500mm, with an FRR of not less than that of the intervening storey.

This clause does not apply to a single family house or a sprinkler protected building.

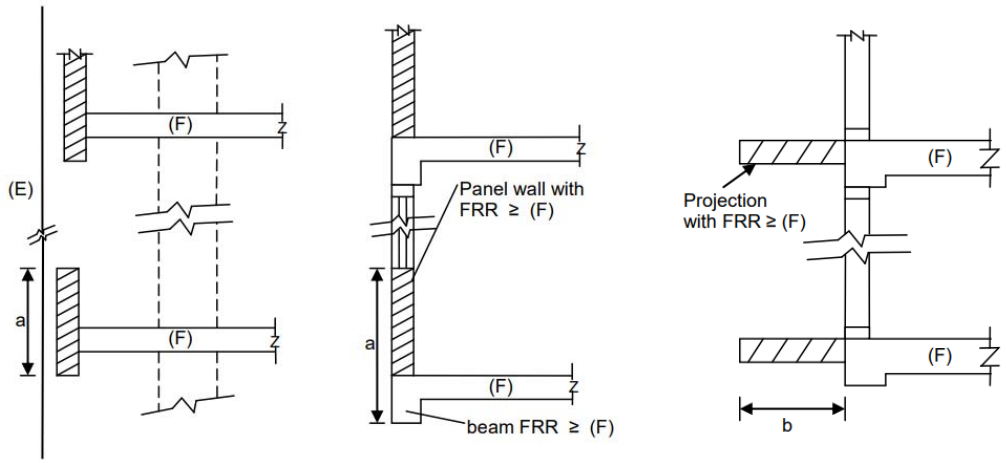
See Diagram C7 for illustration.

**Commentary**

A 900mm spandrel or 500mm horizontal projection is effective in slowing flame spread only and may not prevent fire spread. A sprinkler system installed in compliance with the requirements of the Director of Fire Services is the most effective form of fire control to prevent vertical fire spread.

# Protection of Projections

**Diagram C7: Protection against Spread of Fire by Spandrels (see Clause C11.1)**




(F) FRR of Intervening floor

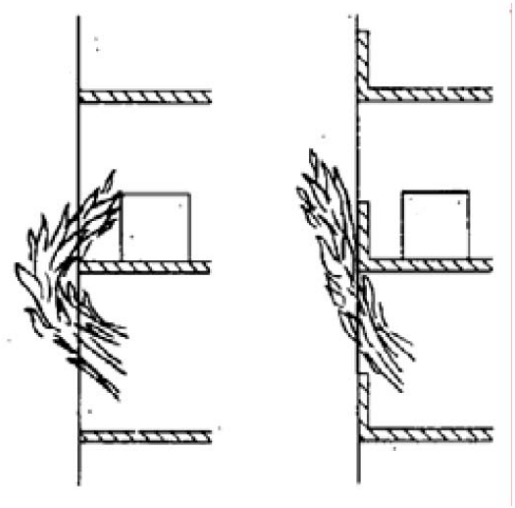
Spandrel having FRR ≥ that of (F)

a ≥ 900 mm
b ≥ 500 mm

(E) External wall (e.g. curtain wall) with no FRR or FRR < that of (F)

DWKY

# Protection of Projections

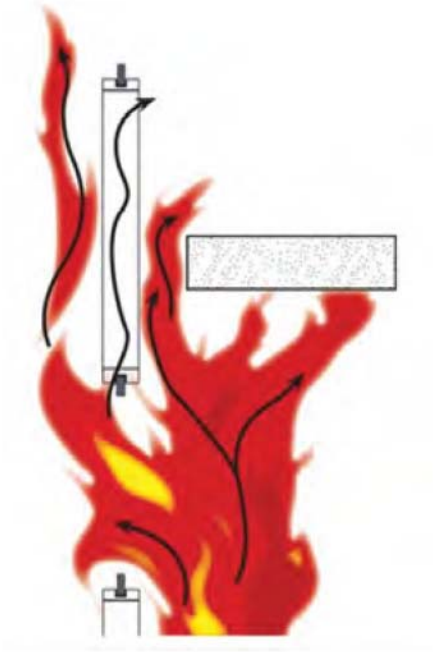


*Assumed behaviour of flame*

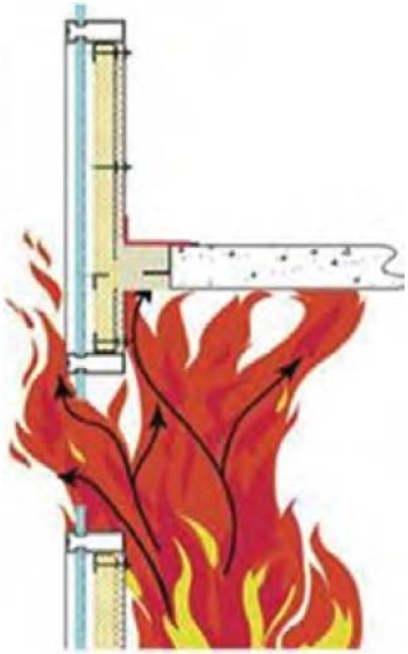
*Actual behaviour of flame*



# Fire Spread



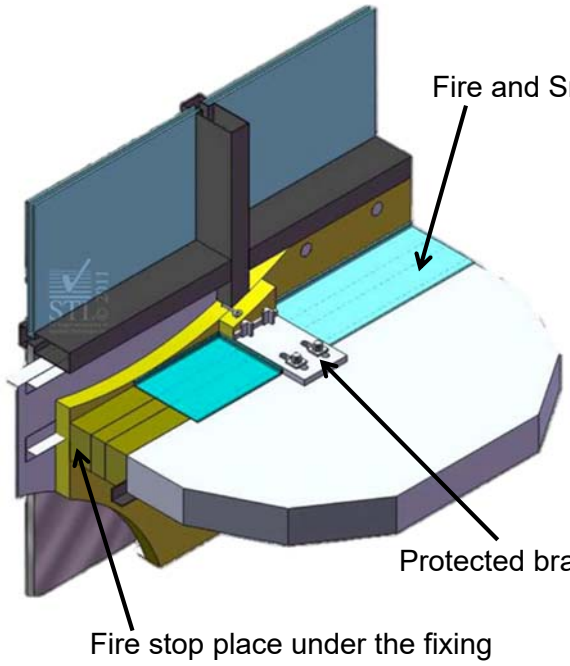
*Unprotected Perimeter Joint*

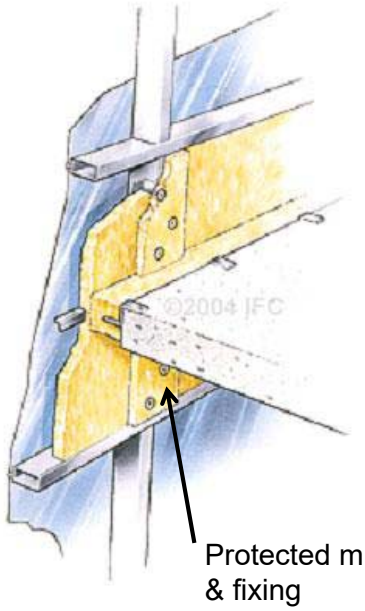


*Perimeter Fire Containment Joint*

*CavityComplete.com - Technical Bulletin SS-09*

# Fire Protection along the edge of RC slab

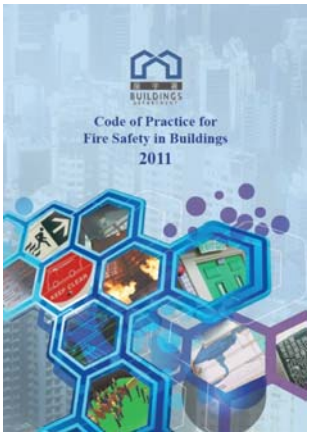



*@2004 IFC*



# Fire Stop and Smoke Seal




**Clause C10.2**

A curtain wall or other similar construction, which protects the building against the elements and which extends beyond one storey in height, should be constructed entirely of non-combustible materials (except for window sealants and gaskets). Any void formed between the curtain wall and the perimeter of the building onto which the curtain wall is fixed should be sealed to form an effective smoke and fire barrier to prevent smoke and fire spread between floors. The smoke and fire barrier should have:

(a) an FRR of not less than that of the floors; and

(b) D-stability duration of not less than the FRR of the floors and the maximum leakage is not more than $25m^3/h/m^2$ at 25Pa at ambient temperature when tested in accordance with BS EN 12101-1.

Current practice: Air Seal (alum flashing) is provided at top of curb.

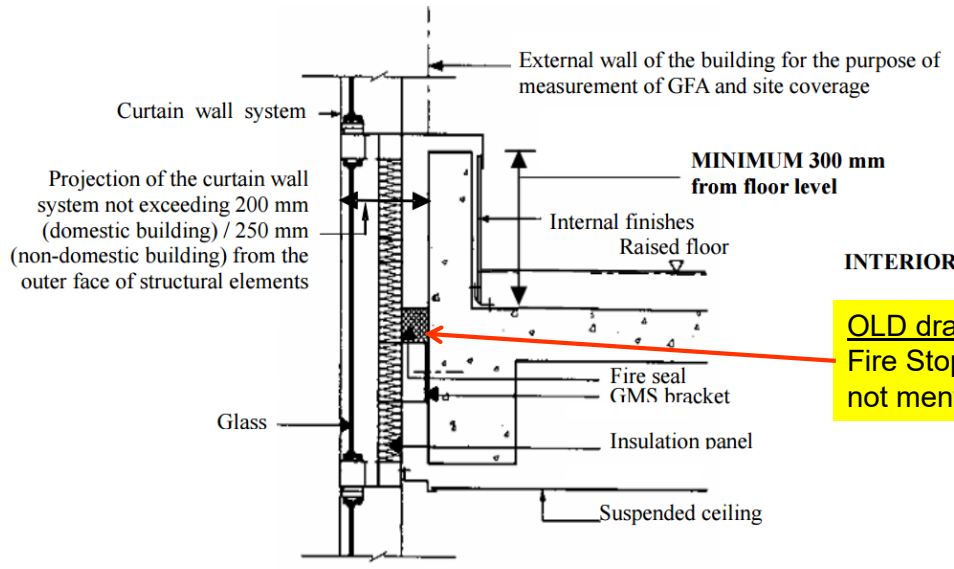
Question 1: Do we need additional smoke seal (proprietary product) to comply with this clause C10.2(b)?

Question 2: Smoke seal for ambient temperature?

# Spread of Fire and Smoke

**Appendix B**
(PNAP APP-2)

**Section of Curtain Wall System installed at New Building**

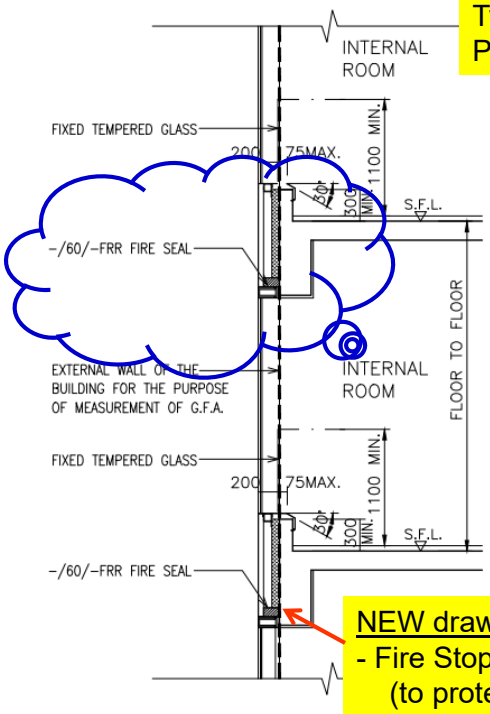



OLD drawing:
Fire Stop above fixing
not mention smoke seal



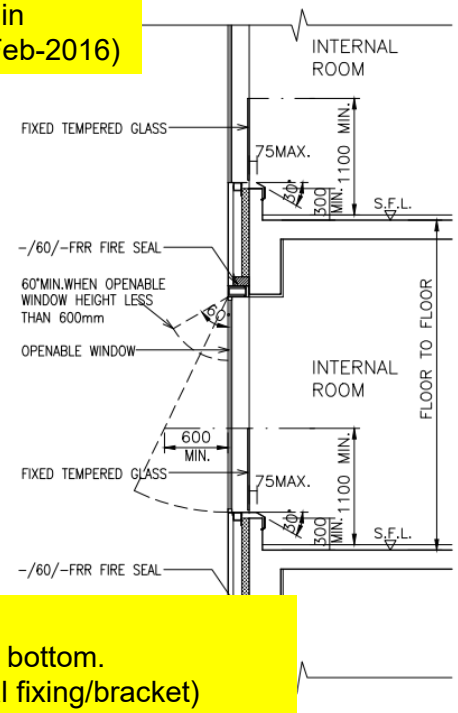
# Spread of Fire and Smoke

Typical Detail as in
PNAP ADV 33 (Feb-2016)



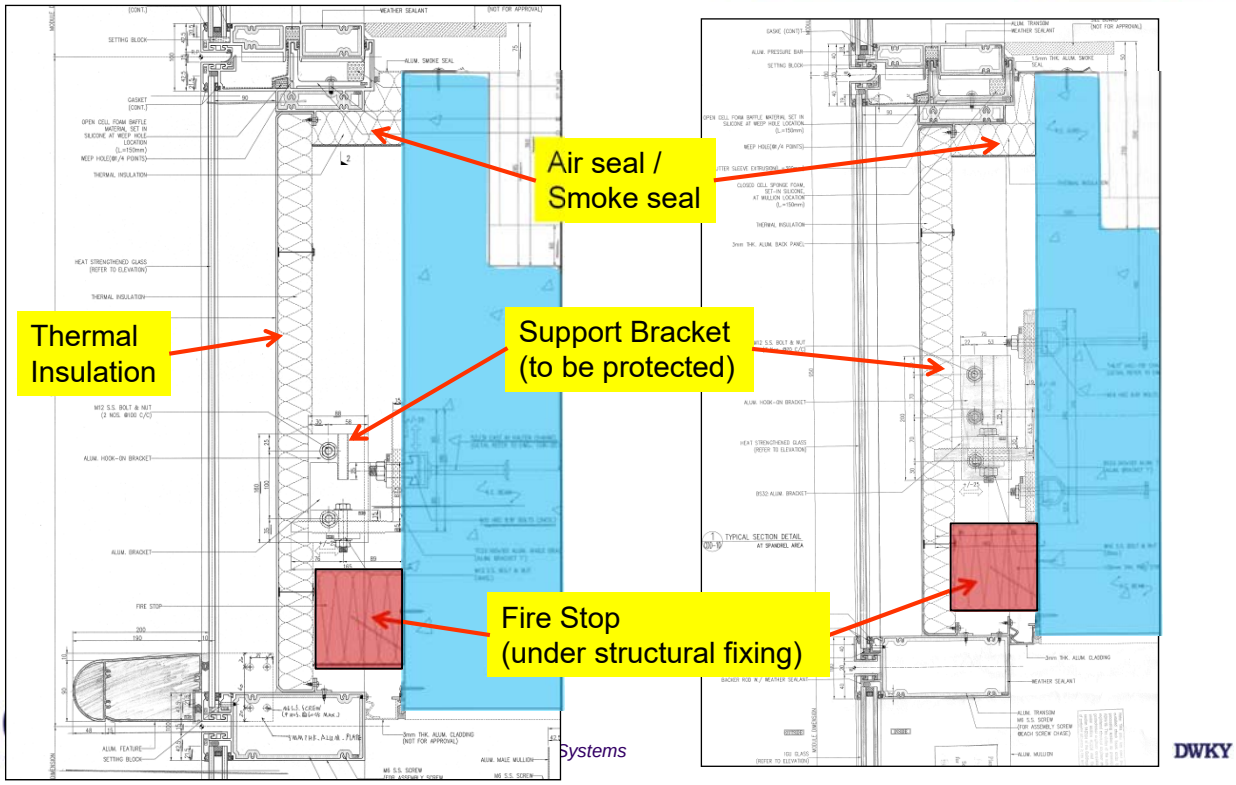

NEW drawing:
- Fire Stop installed at the bottom.
  (to protect the structural fixing/bracket)
- Not mention smoke seal.

TYPICAL DETAIL-6 OF GLASS CURTAIN WALL




TYPICAL DETAIL-7 OF TOP-HUNG
OPENABLE WINDOW ON GLASS CURTAIN WALL

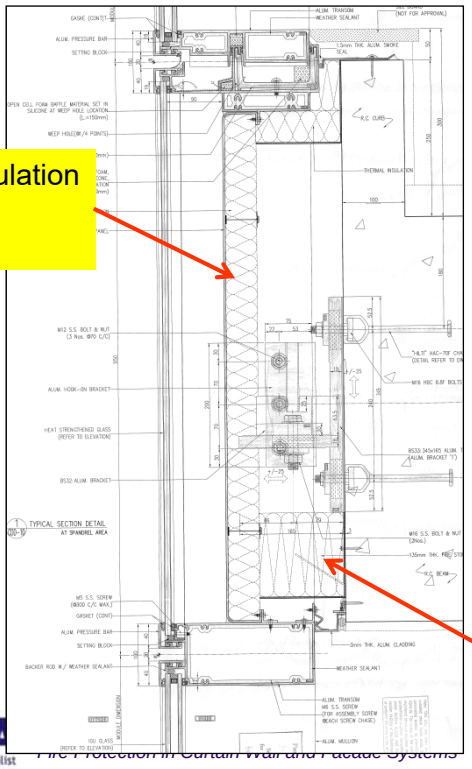
# Smoke and Fire Barrier for Curtain Wall

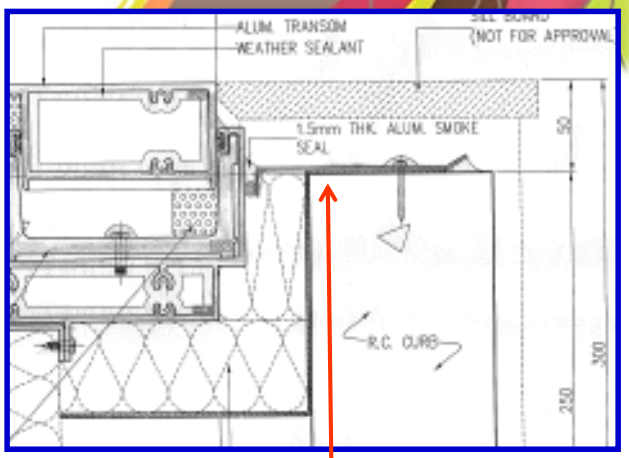





# Smoke and Fire Barrier for Curtain Wall

Thermal insulation (110kg/m³) 50mm thick






"Air Seal" - 1.5mm thk alum flashing with sealant on top of insulation.
*Test can prove it functioned as "Smoke seal"*

Fire Stop (60kg/m³)
135mm thick
(i.e. Height in the drawing)

# Fire Stop

- CSR Rockwool Fireseal Batt
- 2 hour fire rated
- 135mm thick
- Density (60 kg/m$^3$)
- Compressed to no more than 85%
- AS1530 ➔ BS476


FIBERTEX FIRESEAL PRODUCT

**Fire Protection**

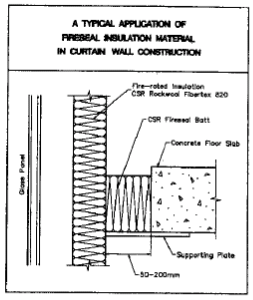
Fire stopping gaskets are required to provide the same level of fire protection as the wall of floor in which they are situated. The level of fire protection provided by Fireseal products depends upon their width (i.e. that dimension perpendicular to the direction of fire advance ) as follows :

| Level of Protection | Thickness of Fireseal Recuired |
|---|---|
| 1 hour | 120 mm |
| 1 ½ hour | 128 mm |
| 2 hour | 135 mm |
| 4 hour | 165 mm |

To achieve the above levels of protection it is necessary for the Fireseal to be under compression. Party Wall Batt/Fireseal Batt should be compressed to no more than 85% of their initial thickness while Fireseal Loose should be packed to a density of at least 140 kg/m$^3$ (8¾ lb/ft$^3$).

2 hours fire rating test available upon request.

A TYPICAL APPLICATION OF FIRESEAL INSULATION MATERIAL IN CURTAIN WALL CONSTRUCTION




**Combustibility**

CSR Fireseal products are rated non-combustible under AS 1530 – Part 1 1976.

**Early Fire Hazard Indices**

CSR Fireseal products shown below achieve the following performance under AS 1530 – Part3.

| Product | Ignitability | Spread of Flame | Heat Evolved | Smoke Developed |
|---|---|---|---|---|
| Fireseal Batt/Party Wall Batt | 0 | 0 | 0 | 0 |
| Fire Damper Strip | 0 | 0 | 0 | 0 |



# Fire Stop

- BS 476 is required for statutory submission.

PSB SINGAPORE

Singapore Productivity and Standards Board
PSB Building
10 Toh Guan Road 10
Singapore 608834

**FACSIMILE**

| | | | |
|---|---|---|---|
| Date: | 2000-08-01 | Ref: | 25T0000364/MW |
| To: | Mr Wilson Mak | From: | Mr. Mark Wong |
| Organisation: | Steropint Ltd | Dept: | Mechanical Test Centre |
| Fax: | 012-852-2891-6749 | Fax: | 862 1433 |
| Tel: | 013-852-2892-3022 | DID: | 865 3771 |

Page: 1 of 1

**Indicative horizontal fire resistance test on CSR Rockwool Fireseal Batt (60kg/m³) also known as CSR Fireseal FS60 in Mainland China**

We refer to the fire resistance test conducted on 2000-07-25 under our ref. no. 25T0000364/MW.

There were 3 set of specimens of width 135mm, 150mm and 175mm respectively, forming the floor thickness, being inserted into 3 different 1000mm (length) x 85mm (wide) x 200mm (deep) slot. Each specimen consisted of a strip of 100mm thick of the above mentioned rockwool compressed together and inserted into the slots.

The test is conducted according to BS 476 Part 22 : Methods for determination of the fire resistance of non-loadbearing elements of construction : Classification of the fire resistance of ceiling membranes. (Note : According to the standard, a ceiling membrane may be regarded as a horizontal partition which, unlike a floor, is not required to support any imposed loading.)

All the 3 specimens tested achieved the following results :

Integrity : 133 minutes
Insulation : 133 minutes

Regards
Mark Wong
Technical Executive
(Fire Safety & Security Product)

# Thermal Insulation

- CSR Rockwool Fibertex-820
- Min. 50mm thk with Alum. foil
- Density (110 kg/m$^3$)
- Alum foil side facing concrete.

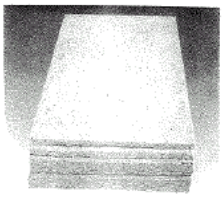


CSR Rockwool

**Fibertex-820 Rockwool Data Sheet**

**Product Description**

Fibertex-820 is robust, high density mineral wool with remarkable resistance to shrinkage at elevated temperatures. It consists of fine fibres, spun from specially selected natural rock. The fibres are bonded with a thermosetting resin to form a semi-rigid batt.



*Fibertex-820 Rockwool*

**Applications**

Lightweight furnace lining, fire protection of plant and equipment, insulation component of fire-rated bulkheads and deckheads, thermal insulation of plant and equipment operating at temperatures between 650℃ and 820℃.
Fibertex-820 is easily installed by impaling the batts on weld pins and securing with speed clips. Because of the semi-rigid nature of Fibertex-820, it does not easily conform to curved surfaces. Slitting, kerfing or cutting into segments may be necessary. Detailed installation instructions for a wide range of applications are available from CSR Rockwool Offices.



# ROXUL

1 Jan 2014

CSR ➔ ROXUL ➔ ROCKWOOL

ROXUL FIRESAFE INSULATION

Rockwool Building Materials (Hong Kong) Ltd.

Unit 301-2, 3/F, Koon Wah Building, No. 2 Yuen Shun Circuit, Yuen Chau Kok, Shatin, N.T., Hong Kong

T (+852) 2764 0877
F (+852) 2768 2005
www.rockwoolasia.com

To Whom it may concern

Brand Name Change

This is to announce that our product brand ROXUL will be changed to ROCKWOOL effective Jan. 1, 2014.

The trademark of ROCKWOOL could not be registered in China back in 2011, immediately after the business acquisition of CSR's Asian Insulation business by the ROCKWOOL Group due to the name "rock wool" has been used as a generic name for stone wool in this region.

However, we managed to get approval for the use of the trade name ROCKWOOL in China and South East Asia by mid-2013.

The following table lists some of our product names in different periods from 2011.

The products on each row are identical with the same specification with no change to the product composition of chemistry.

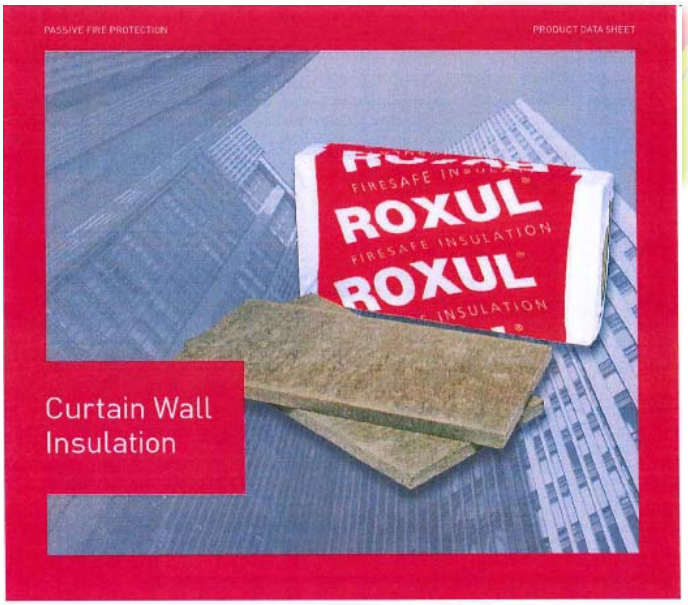
| Original Product Name (Nominal Density) | Existing Product Name (Nominal Density) | New Product Name (Nominal Density) |
|---|---|---|
| CSR Fireseal Batt(60kg/m3) | ROXUL RockSafe (60kg/m3) | ROCKWOOL RockSafe (60kg/m3) |
| CSR Fibertex 820 (110kg/m3) | ROXUL CurtainRock 80 Plus (110kg/m3) | ROCKWOOL CurtainRock 80 plus (110kg/m3) |
| CSR Fireseal Premium (128kg/m3) | ROXUL CurtainRock 80 Pro (128kg/m3) | ROCKWOOL CurtainRock 80 Pro (128kg/m3) |

We hope this information will be useful to you in identifying our products in the future and please feel free to contact me the undersigned should you require further clarification.

Yours Sincerely

Ron Pickering
Business Director - China/North Asia
Steel Structure & Façade Specialist

CSR Fireseal Batt ➔ ➔ ROCKWOOL RockSafe
CSR Fibertex-820 ➔ ➔ ROCKWOOL CurtainRock 80 Plus




## General Product Information

Roxul stone wool products are made of basalt, a volcanic stone.

Roxul Curtain Wall products are specially developed to provide fire protection to its application. They are manufactured from long fine fibers, spun from molten natural rock, bonded with thermosetting resin. The products are

when exposed directly to heat during a fire. The product has absolutely remarkable resistance to shrinkage at temperature encountered in fire conditions.

The use of Roxul curtain wall product also enables LEEDS ...ts to be gain for building owners.

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ROXUL

BD-FS

## Reference List of Fire-stop Materials

| Ref. No. | Product Name | Name of Manufacturer and Place of Manufacture (City and Country) | Material Category | Application | Compliance Testing Standard | Details of Test or Assessment Report | | | | | Date of Posting on CDB | Remarks / Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Name of Laboratory Accreditation Body | Name of Laboratory / Assessing Organization | Report No. | Date of Test / Assessment Report | Validity Date | | |
| BD-FS 011 | CSR Fireseal FS60 (known as CSR 60kg/m³ Rockwool Fireseal Batt) | CSR (Guangdong) Rockwool Co., Ltd. Guangdong, China | Fire and smoke stopping material of nominal density of 60kg/m³. | Fire stop in voids between concrete floor (depth of 135mm, 150mm or 175mm) and curtain walling, which requires to satisfy the insulation and integrity criteria for 120 mins. | BS 476: Part 22: 1987 | Singapore Accreditation Council | PSB Corporation Pte Ltd. | 25T0000364/ MW | 26 July 2000 | N/A | 21/04/2006 | The compressed height of the fire-stopping gaskets when placed in a joint should be not more than 85% of their original height before insertion into the joint. The fire stop material should be firmly and securely fixed in place in accordance with the manufacturer's recommendations. |

2006

CSR Fireseal Batt (60kg/m³) ➔ ROCKWOOL RockSafe (60kg/m³) since 2014

BD-FS011 = BD-D179, D235, D240, D265 & D274 in 2009/2010

## BD's Reference List under Central Data Bank

**(D) Fire-stop Materials and sealing system**

| Ref. No. | Product Name | Name of Manufacturer and Place of Manufacture (City and Country) | Fire Resisting Performance (minutes) | | Details of Test or Assessment Report | | | | | Date of Posting on CDB | Remarks/ Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Integrity | Insulation | Name of laboratory accreditation body | Name of laboratory / assessing organization | Report no. | Date of test / assessment report | Validity Date | | |
| BD-D163 | CSR Rockwool Fibertex 820 with aluminium foil on one side and CSR Rockwool Fireseal Batt | Strepoint Ltd. (Hong Kong) | 120 | 120 | Forest Research Institute Malaysia | Forest Research Institute Malaysia | FCO-2487 | 22/9/2006 | 28/2/2008 | 20/8/2008 | |

2008

CSR Fibertex-820 (110kg/m³) ➔ ROCKWOOL CurtainRock 80 Plus (110kg/m³) since 2014

BD-D163 is a system combined (i) Fireseal Batt and (ii) Fibertex-820



# ROCKWOOL 洛科威®岩棉

- Fire Stop:
  "RockSafe"
  - 135mm thick
  - 60 kg/m³
  - Compressed to no more than 85%

- Thermal Insulation:
  "CurtainRock 80 Plus"
  - 50mm thick (common)
  - 110 kg/m³

PASSIVE FIRE PROTECTION — PRODUCT DATA SHEET

## Curtain Wall Insulation

**Benefits**

- Highly durable insulation product
- Remarkable resistance to shrinkage at temperatures encountered in fire conditions
- Easily fits into standard party wall applications
- Easily cut and formed to fit into tight applications
- Excellent and cost effective insulation
- Performance is not adversely effected from contact with water
- Non combustible

**Technical Parameters**

| Properties | Standards | RockSafe |
|---|---|---|
| Thickness | EN823 | 135mm |
| Length & Width | EN822 | 1200mm x 600mm |
| Density | EN826 | 60kg/m³ |
| Thermal conductivity at 20degC | ASTM C518 | 0.035W/mK |
| Fire Performance | ASTM E84 | Flame spread 0, Smoke develop 5 |
| | BS476 Part 20 | 2 hours fire rating* |
| Water Absorption (partial immersion) | EN1609:97 | Less than 0.5kg/m² |
| Corrosion resistance | ALPHA4500H+B | Faintly alkaline with pH 7.5-9 and incapable of corroding steel |
| Water Vapor absorption | ASTM C1104/1104M | Absorb < 0.04%Vol |
| Odor emission | ASTM C665-06 | No perceptible present |
| Fungi Resistance | ASTM 1338 | Does not encourage growth of fungi |

*Please check with local authority for any local approval needed*

| Properties | Standards | CurtainRock 80 Plus | CurtainRock 80 Pro |
|---|---|---|---|
| Thickness | EN823 | 50mm, 60mm, 70mm, 75mm, 80mm, 100mm | |
| Length & Width | EN822 | 1200mm x 600mm | |
| Density | EN826 | 110kg/m³ | 128kg/m³ |
| Thermal conductivity at 20degC | ASTM C518 | 0.035W/mK | |
| Noise reduction coefficient properties** | BSEN ISO354:03 | Up to 1.0 | |
| Fire Performance | ASTM E84 | Flame Spread 0, Smoke develop 5 | |
| Water Absorption (partial immersion) | EN1609:97 | Less than 0.5kg/m² | |
| Corrosion resistance | ALPHA4500H+B | Faintly alkaline with pH 7.5-9 and incapable of corroding steel | |
| Water Vapor absorption | ASTM C1104/1104M | Absorb < 0.04%Vol | |
| Odor emission | ASTM C665-06 | No perceptible present | |
| Fungi Resistance | ASTM 1338 | Does not encourage growth of fungi | |

**NRC calculated to ASTM C423-01 can be achieved on 50mm thick product based other reference reports

CREATE AND PROTECT®

Rockwool Building Materials (Hong Kong) Ltd.

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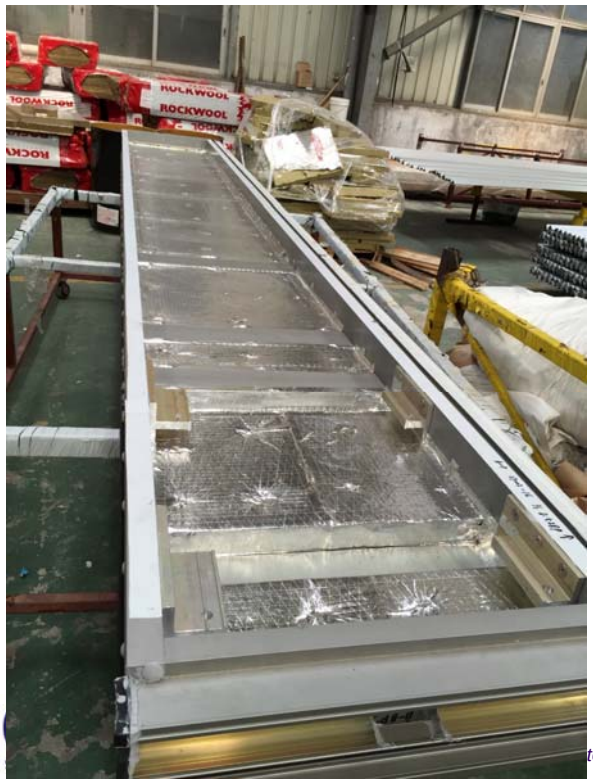
Unit 301-2, 3/F., Kson Wah Building, No. 2 Yuen Shun Circuit, Yuen Chau Kok, Shatin, N.T., Hong Kong
T: (+852) 2754 0877
F: (+852) 2758 2005

Guangzhou Factory
3 Tahua St, Yonghe Dist of Guangzhou Econ & Tech Development Dist, Guangzhou, Guangdong Province, P.R.China (511356)

www.rockwool.com.cn
RW-CN/CW/06-2014/0/EN/HK

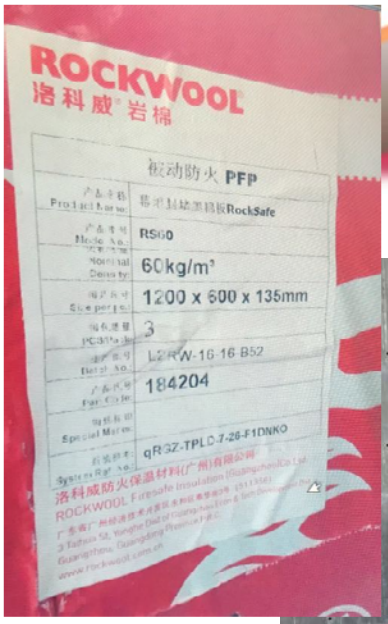
ROCKWOOL 洛科威®岩棉

# ROCKWOOL
## - Thermal Insulation @ Factory




*tems*

# ROCKWOOL
## - Fire Stop @ Site




# Installation of Fire Stop – 135mm (60kg/m$^3$)

Install together with CW panel:
- Varies width from CW panel to RC
- Easy fall down
- Wetting of rockwool

Install after flashing enclosure:
- Difficult to insert the fire stop
- Rockwool will not affect by rain

# Installation of Fire Stop Workmanship

Butt joint? Compressed?

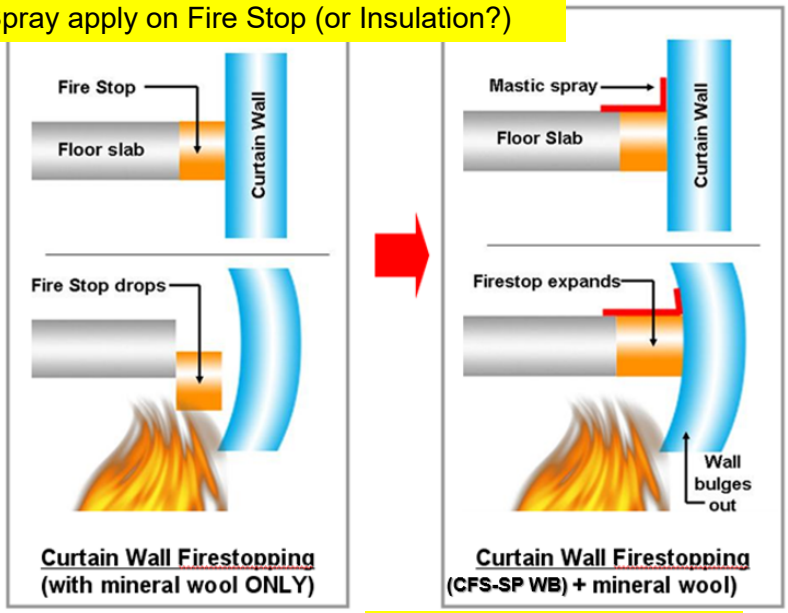
Wetting of installed rockwool

# Smoke Seal – Proprietary Product

HILTI | Refer to pre-approval material list BD-CDB | Hilti. Outperform. Outlast.

## CFS-SP WB Firestop Joint Spray

Spray apply on Fire Stop (or Insulation?)




2005 Madrid Windsor Tower

Fire Stop requires backing support

Designed for Floor Slab (or Concrete Spandrel?)



# Smoke Seal… in BD-CDB

**BD's Reference List under Central Data Bank**

**(D) Fire-stop Materials and sealing system**

| Ref. No. | Product Name | Name of Manufacturer and Place of Manufacture (City and Country) | Fire Resisting Performance (minutes) | | Details of Test or Assessment Report | | | | | Date of Posting on CDB | Remarks/ Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Integrity | Insulation | Name of laboratory accreditation body | Name of laboratory / assessing organization | Report no. | Date of test / assessment report | Validity Date | | |
| BD-D308 | Hilti CP636 Firestop Mortar | Hilt Ltd. Germany | 240 | 86 | UKAS<br>UKAS | Warrington Fire Research Centre<br>Exova Warringtonfire | WARRES. 62305/B<br>WF No. 320160/B | 22-Sep-1994<br>16-Jul-2012 | 21-Sep-1996<br>1-Aug-2014 | 18/7/2014 | |
| BD-D309 | Hilti Firestop Sealant CP606 | Hilti/Hong Kong | 240 | - | UKAS | Exova Warringtonfire<br>Warrington Fire Research | 322206/D<br>C125356 | 18-Sep-2012<br>15/7/2002 | 1-Oct-2017<br>1/8/2007 | 22/9/2014 | |
| BD-D310 | Augreen 100 mm thk Block Wall Ststem | CA So (HK) Eng.,Co.,Ltd. | 240 | 240 | HOKLAS | RED | R12K14 | 5/12/2012 | 4/12/2015 | 22/9/2014 | |
| BD-D311 | Firecut FM900 | Yung Chi Paint & Varnish Mfg. Co. Ltd. | 60 | - | UKAS | Exova Warringtonfire | 314822 Issue 2 | 30.1.2012 | 1.2.2017 | 24/3/2017 | |
| BD-D312 | Bostik Fire Rate Protection Sealant | Bostik Limited/UK | 240 | - | UKAS | Bodycote Warringtonfire<br>Exova Warringtonfire | 154655<br>340603 | 26.7.2005<br>2.5.2014 | N/A<br>1.6.2016 | 24/3/2017 | |
| BD-D313 | Promatect-H Insulated Partition System | Promat International (Asia Pacific) Ltd. | 60 | 60 | UKAS | Bodycote Warringtonfire<br>Exova Warringtonfire | 177939 Issue 2<br>WF Report No. 323701D | 20.11.2008<br>12.12.2012 | 1.12.2013<br>1.1.2018 | 24/3/2017 | |
| BD-D314 | Lyrids Fire Protection Board | Golden Lyrids Construction Materials Ltd. (PRC) | Not less than 260 | 240 | CNAS | Building Engineering Testing Center China Academy of Building Research | BETC-NH-2005-303<br>BETC-NHPG-2011-24 | 4.7.2005<br>29.9.2011 | 3.7.2011<br>26.5.2016 | 24/3/2017 | |

BD-D3xx Smoke seal….. For curtain wall

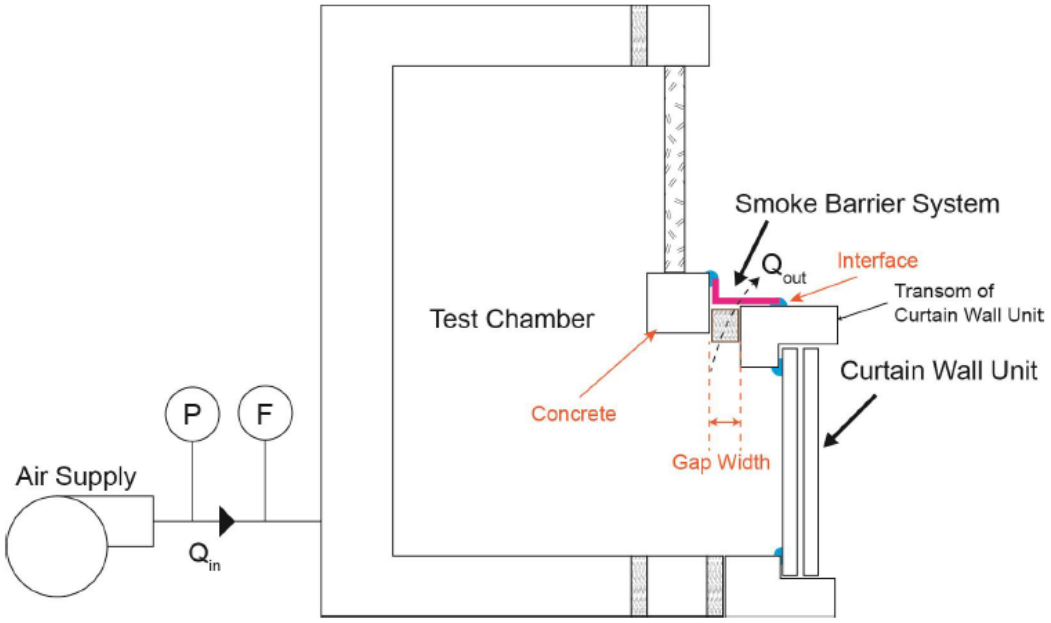
# Proprietary Product – CFS-SP WB

- Function in small gap? (esp. 200mm CW zone)
- Apply on Fire Stop or Insulation?
- Interface with interior finishes?
- Vertical side?



# SMOKE CONTROL TEST BS EN 12101-1

# Smoke Leakage Test Proposal




Steel Structure

As long as the pressure in the test chamber is constant, then $Q_{in}$ is equal to $Q_{out}$.

DWKY

# Smoke Control Test

- BS EN 12101-1
- Conventional air seal by 1.5mm thick alum flashing plate and weather sealant (DC791).
- Also test to Medium Temperature 200°C
- Results: all leakage < 25m³/h/m²

| Test | Temp | Leakage rate $Q_{spec}$ (m³/h) at pressure difference of | | | Leakage rate $Q_l$ per square meter (m³/h/m²) at pressure difference of | | |
|---|---|---|---|---|---|---|---|
| | | 10 Pa | 25 Pa | 50 Pa | 10 Pa | 25 Pa | 50 Pa |
| 1 | Ambient | 0.56 | 0.56 | 0.56 | 1.33 | 1.33 | 1.33 |
| 2 | Medium | 2.78 | 4.38 | 2.74 | 6.62 | 10.43 | 6.52 |

RED Fire and Façade Consultants — RESEARCH ENGINEERING DEVELOPMENT FAÇADE CONSULTANTS LIMITED

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SMOKE CONTROL TEST IN ACCORDANCE WITH BS EN 12101: Part 1: 2005 + A1: 2006 Cl. 4.4.2

On a Static Smoke Barrier used for Curtain Wall System

Test Report No.: R16M04-1A

Sample Identification: Q16L04-1

Issue Date: 16 May, 2017

Test Sponsor

APPROVED SIGNATORY: _____ DATE: 15 MAY 2017

Ir. Dr. YUEN Sai-wing, MHKIE (FIRE)

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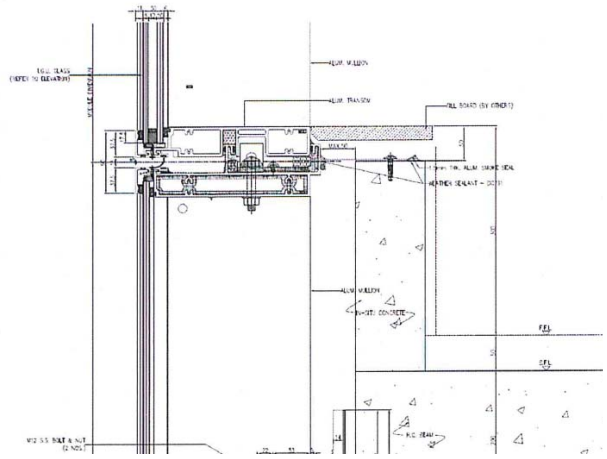
# Test Setup



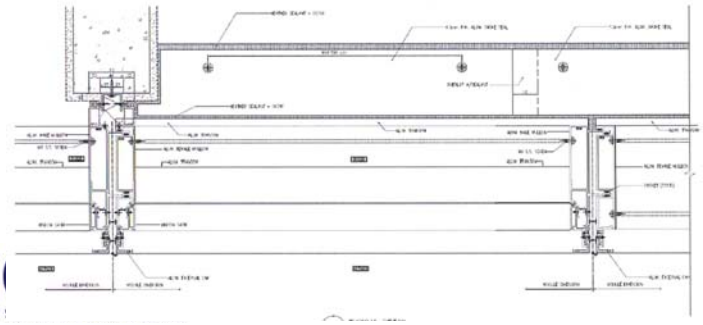


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Photo 3: The static smoke barrier view from unexposed side

Photo 4: The static smoke barrier view from unexposed side

# FIRE RATED CURTAIN WALL

# External Facade

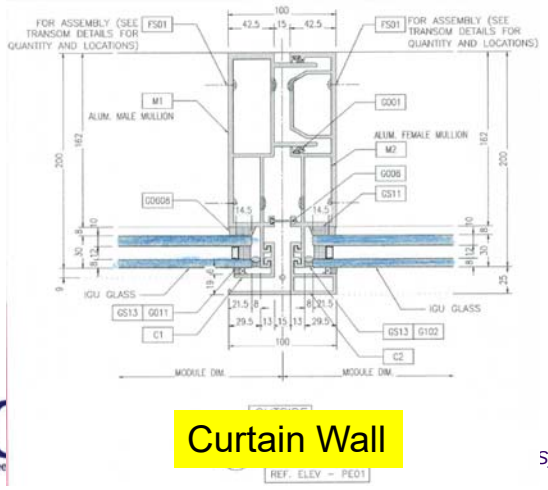
External Façade including Window, Window Wall, Curtain Wall, Glass Wall, Cladding etc.

- Window – framed glazing in the opening of an external wall.
- Window Wall – windows spanning between floor slabs within the building.
- Curtain Wall – non load-bearing enclosure fixed on to the load-bearing structure with its dead loads, imposed loads and wind loads transferred to the structure through fixings.
- Glass Wall – wall mainly formed by structural glass elements spanning between floors.

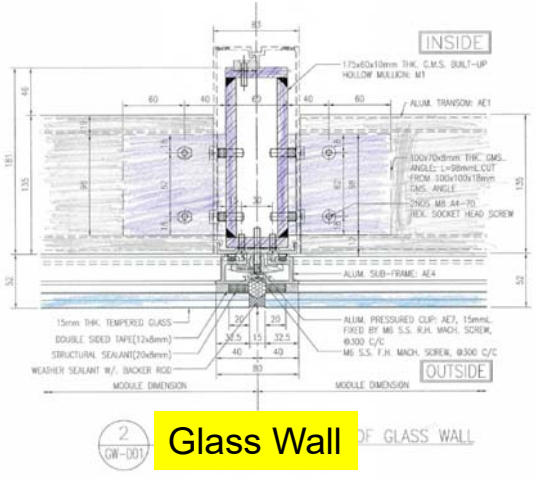


# Curtain Wall / Glass Wall

- **Curtain Wall** for residential / commercial buildings is commonly consisted of Aluminium framing section as structural member and Glass as facial material. However, both Aluminium and Glass are not fire rated material.
- **Glass Wall** at Podium may be formed by Steel as structural member due to its long span and Glass as façade material.



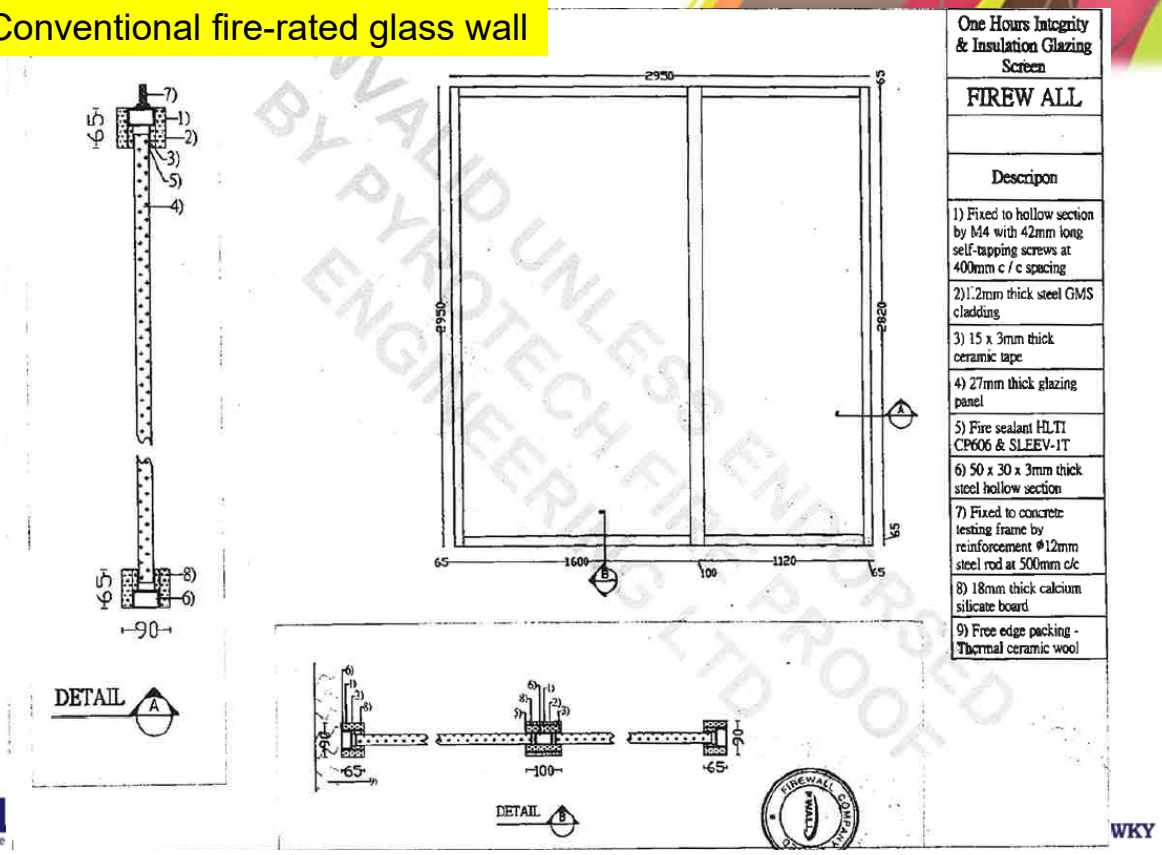

Curtain Wall




Glass Wall

# Fire Rated Glass Wall

Conventional fire-rated glass wall




# Fire Rated External Facades

**Subsection E12 - External Facades**

Not only curtain wall

**Clause E12.1**

External facades should be tested in accordance with the following applicable standards:

(a) BS EN 1364-3:2006, *Fire resistance tests for non-loadbearing elements. Curtain walling. Full configuration (complete assembly)*;

(b) BS EN 1364-4:2007, *Fire resistance tests for non-loadbearing elements. Curtain walling. Part configuration.*

Aims to assess:
- Integrity
- Insulation
- Perimeter Seal

**Commentary**

There are other options for testing of facades, including:

(a) Large scale testing:

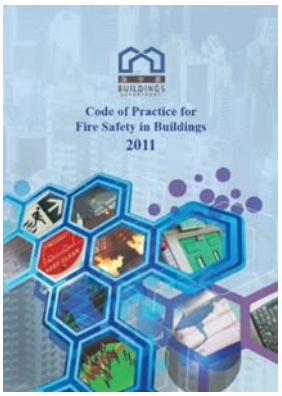
(i) NFPA285:2006, *Standard fire test method for evaluation of fire propagation characteristics of exterior non-loadbearing wall assemblies containing combustible components*;

(ii) ULC-S134-92, *Fire test of exterior wall assemblies (Vertical channel test)*.

(b) Small scale testing:

(i) ULC-S134-92, *Fire test of exterior wall assemblies (Vertical channel test)*;

(ii) AS 1530.1:1994, *Methods for fire tests on building materials, components and structures Part 1: combustibility test for materials.*



## 1 Scope

This European Standard specifies a method for determining the fire resistance of curtain walling – full configuration.

This European Standard is used in conjunction with EN 1363-1.

NOTE Annex B gives further information on the test method.

The test method is applicable to curtain walling type B (for definition see 3.4). The test is not appropriate for testing curtain walling type A (for definition see 3.3).

The fire resistance of curtain walling may be determined under internal or external exposure conditions. In the latter case the external fire exposure curve given in EN 1363-2 may be used, subject to deviating national regulations.

Tests on individual parts of a curtain walling (e.g. perimeter seal, infill panel or fixing of the framing system (anchoring) used to attach the curtain walling to the floor element) or systems with fire resistance requirements only to the spandrel area may be performed using EN 1364-4. For vertical linear gap seals, this part of the standard applies.

This European Standard does not cover double skin façades, over-cladding systems and ventilated façade systems on external walls. It does not deal with the reaction to fire behaviour of curtain walling.

This standard is intended to be read in conjunction with EN 1363-1 and EN 1363-2.

# Fire Rated Curtain Wall (Part 3: Full Configuration)

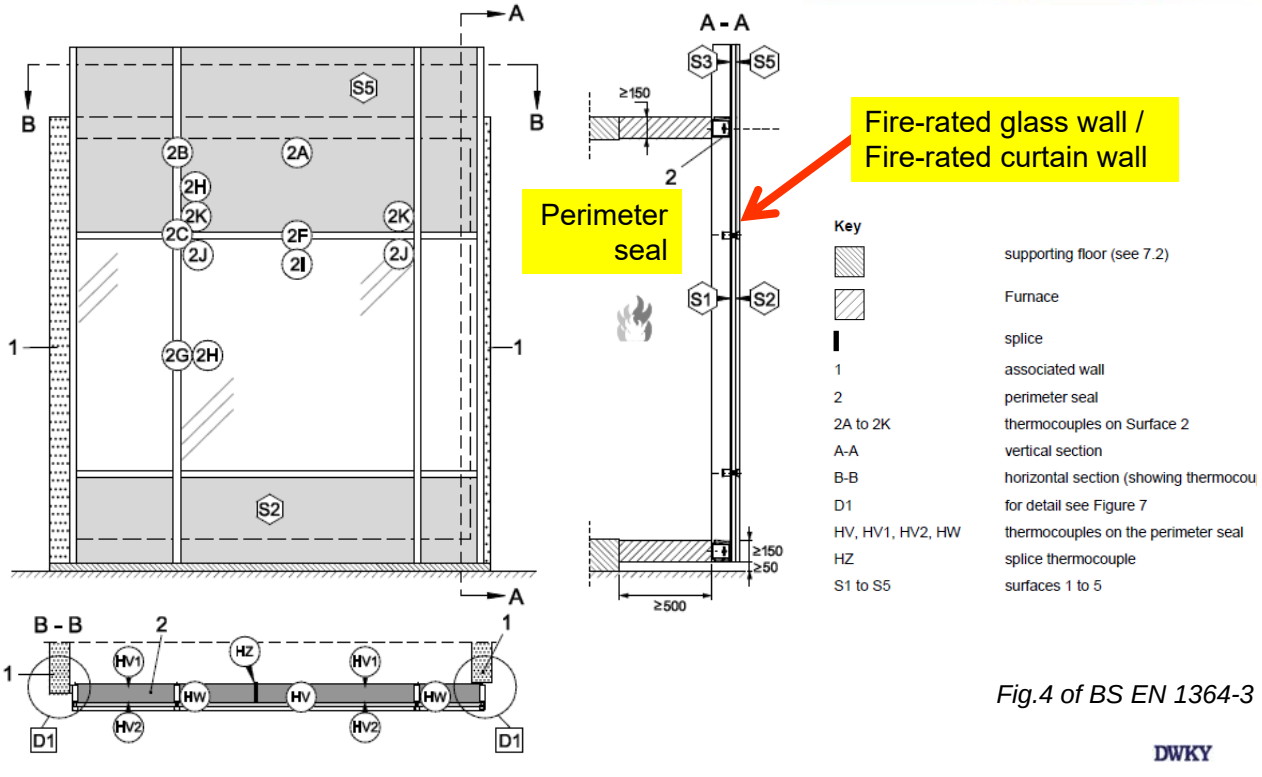



*Fig.4 of BS EN 1364-3*

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## 1 Scope

This European Standard specifies a method for determining the fire resistance of parts of curtain walling and of the perimeter seal. It examines the fire resistance to internal and external fire exposure of:

— the spandrel panel, i.e. downstand, upstand or a combination thereof, or

— the perimeter seal, or

— the fixing of the framing system (anchoring) used to attach the curtain walling to the floor element, or

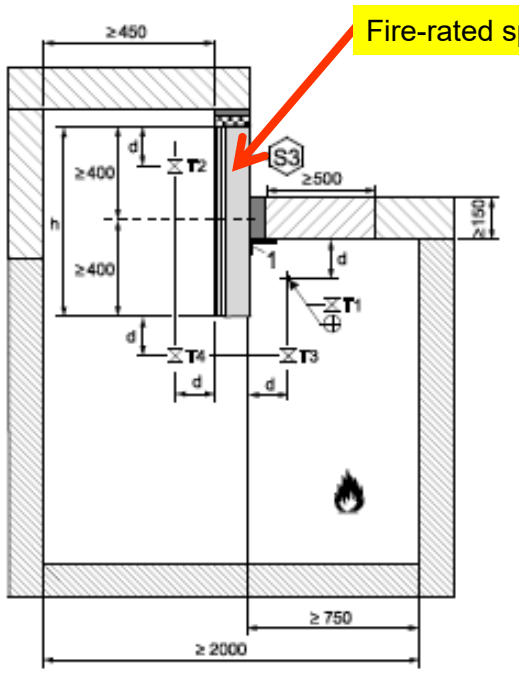
— combinations thereof.

Results from tests according to this standard form the basis for classification of curtain walling type A (see 3.3 for definition).

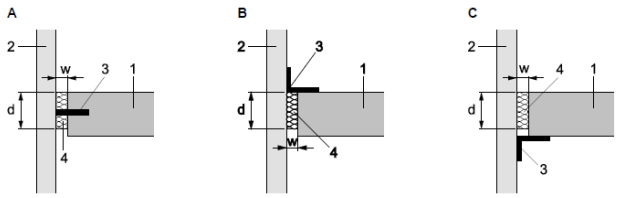
For curtain walling type B (see 3.4 for definition) results may be used to determine fire resistance of parts of a curtain walling to increase the field of application when previously tested to EN 1364-3. For intended classification EW and for corner/faceted specimens EN 1364-3 should be used.

This European Standard does not cover double skin façades, over-cladding systems and ventilated façade systems on external walls. It does not deal with the reaction to fire behaviour of curtain walling.

# Fire Rated Curtain Wall (Part 4: Part Configuration)




BS EN 1364-4:2014
EN 1364-4:2014 (E)




Types of fixing

Key

A fixing in front of the floor slab
B fixing on top of the floor slab
C fixing on the underside of the floor slab
1 floor slab
2 curtain walling
3 fixing system
4 perimeter seal
d depth of the perimeter seal
w nominal width of the perimeter seal

**Figure 15 — Types of fixing of the framing system (anchoring) and definition of width and depth of the perimeter seal**

# Curtain Walling Types

**3.3**
**curtain walling type A**
curtain walling without fire resistant glazing outside the spandrel area – fire resistant only in the spandrel area

**3.4**
**curtain walling type B**
curtain walling with fire resistant glazing outside the spandrel area - fully fire resistant curtain walling

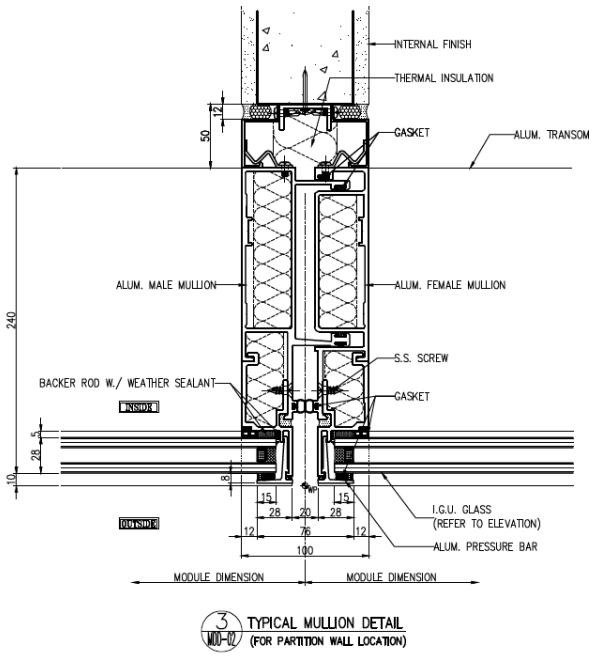
BS EN 1364-3 (Full configuration), i.e. curtain wall type B.
- Fully fire resistant curtain wall system.
- Subsection C5 – Prevention of Fire Spread between Buildings (900mm)
- Test Full System

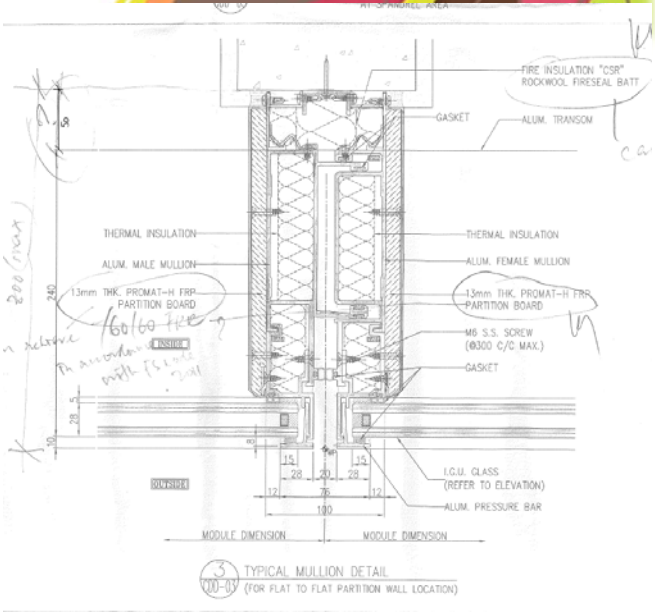
BS EN 1364-4 (Part configuration), i.e. curtain wall type A.
- Fire resistant only in the spandrel area.
- Application and Location???



# FIRE COMPARTMENTATION (FLAT-TO-FLAT)

# Interfacing with Wall



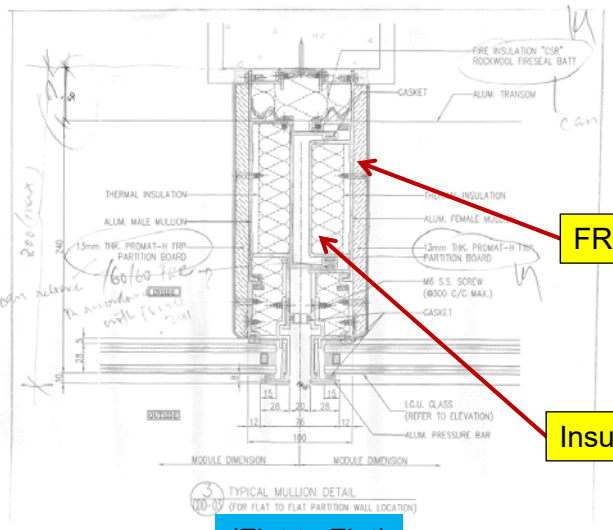




Room-to-Room

Flat-to-Flat
Fire Compartmentation



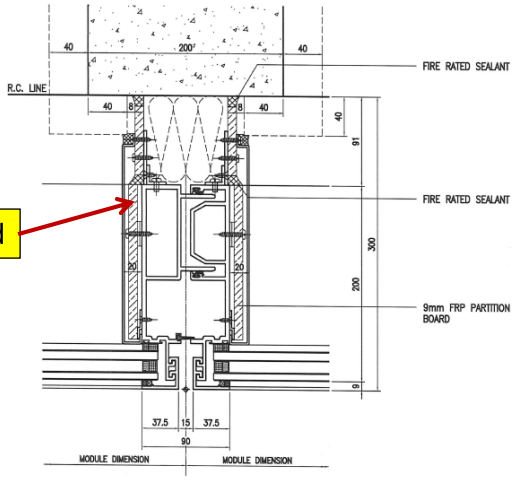
# Fire Compartmentation
## – Curtain Wall System (Flat-to-Flat)




FRP board

Insulation

(Flat to Flat)




MULLION DETAIL
(FLAT TO FLAT – OPTION 1)

- Fire rated partition board is commonly used to enclose the mullion.
- May require rockwool insulation to achieve FRR -/60/60.
- The system should be tested in according to BS 476 or BS EN 1364

# EXTERNAL CLADDING

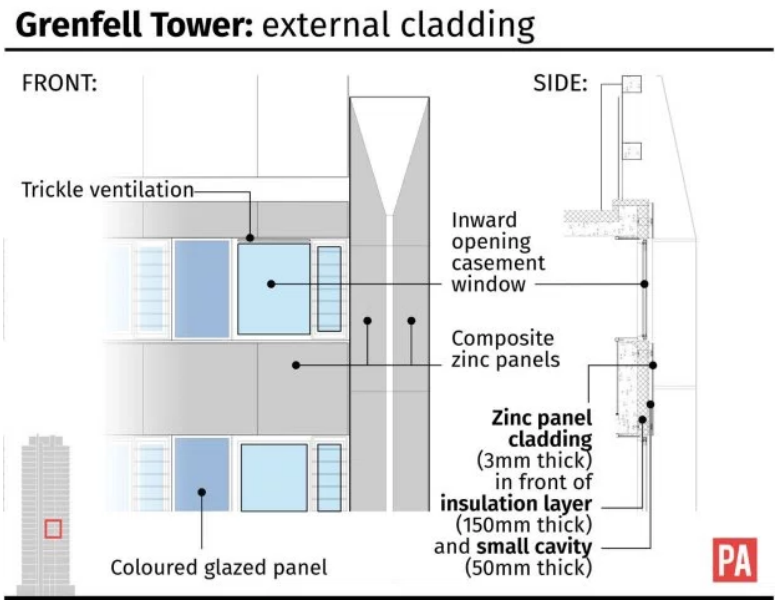


## Refurbishment - Aluminium Composite Material

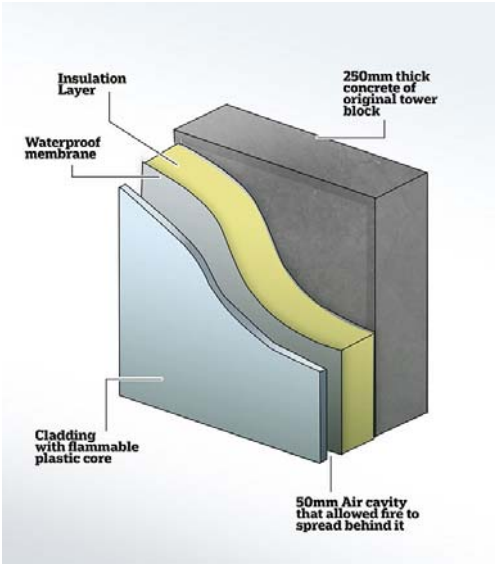


*Source from: The Sun*

# Refurbishment
# - Aluminium Composite Material




Source from: Metro.co.uk




Source from: The Sun



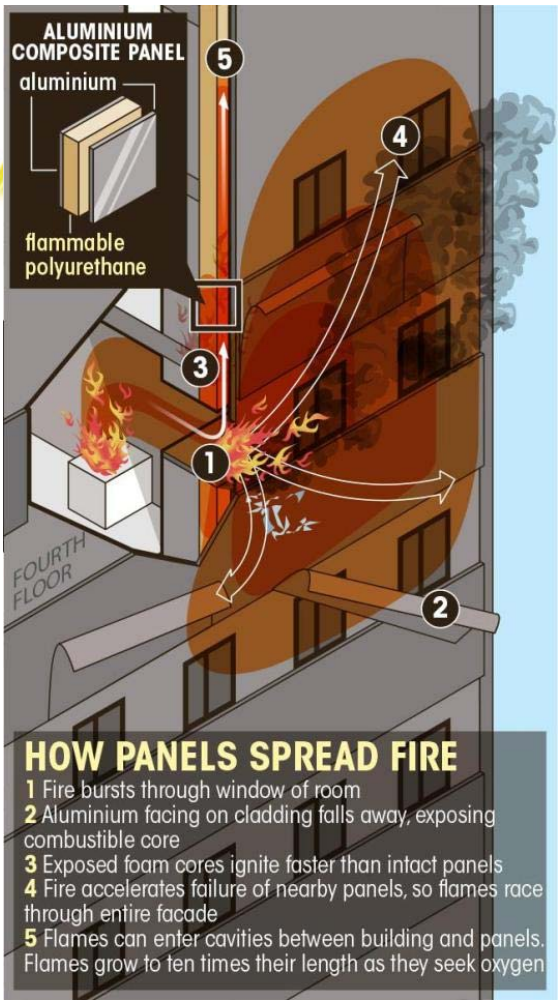
# Fire Accidents
# - Grenfell Tower


Source from: BBC.com

# Fire Accidents - Grenfell Tower

*Source from: The Sun*

- The Alum Composite Panel with flammable insulation clad the concrete of the building with a 30mm gap, which acted like a chimney.
- Fire spreading up one side of the building externally. The burning material falls down, starting more fires below, and the flames spread up.






# Fire Accidents - Grenfell Tower

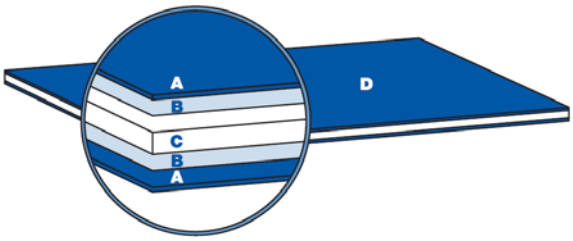
- The cladding installed at Grenfell Tower is aluminium composite panel was **banned** in the US and rated as '**flammable**' in Germany.
- Reynobond® aluminium coated panels with a flammable plastic core, known as Polyethylene (PE), conform to British safety standards, despite being ruled dangerous elsewhere.
- Passed Class A of ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- It is similar to BS 476: Part 7 for Spread of flame, but different with BS 476: Part 4 Non-combustibility test.

# Aluminium Composite Cladding


Reynobond® Aluminum Composite Material

Reynobond® Aluminum Composite Material (ACM) is a high-performance wall cladding product from Alcoa Architectural Products, consisting of two sheets of nominal 0.020" (0.50 mm) aluminum, each permanently bonded to an extruded thermoplastic core. This is an elegant concept resulting in an extraordinarily flat and highly formable material with an excellent strength-to-weight ratio (see figure 1).

Reynobond is a fully tested product, with building-code approvals throughout the world. It is available with either a Polyethylene (PE) core or a Fire Resistant (FR) core. Reynobond ACM is available in a near-infinite variety of colors. We also offer several different skin materials, including brushed aluminum, zinc, copper, titanium and stainless steel. The properties for each skin type vary, making it necessary to work closely with your Alcoa Architectural Products representative to ensure the proper use and design for the product chosen.




**A.** Aluminum skin
**B.** Tie layer between aluminum skins and core material
**C.** Polyethylene or solid thermoplastic compound core (fire resistant)
**D.** Reynobond Aluminum Composite Material

ALCOA

excellence in innovation

# Aluminium Composite Cladding

## Building Code Recognition

| | |
|---|---|
| Southwest Research Institute Design Listing | No. 01.25000.02.197 |
| IBC 2009 | MEA 75-91-M, MEA 390-99-M |
| ICC-ES AC25 Report | Pending |
| State of Wisconsin Approval | No. 990033-I |
| Miami-Dade N.O.A.* | No. 09-0625.01, No. 10-1118.05, No. 11-1102.01 |
| Florida Product Approval | FL10220 Validated |
| Canadian Fire Test | CAN S101 |
| Canadian Fire Test | CAN S102 |
| Canadian Fire Test | CAN S134 |

Chicago • Canada • United Kingdom • Singapore
Australia • New Zealand • Malaysia • France
Germany • China • Hong Kong • Poland • Israel

*The Miami-Dade County Building Code stipulates that panel systems withstand the impact of a 9-pound, 2x4 timber traveling at 50 feet per second.

## Safety/Class A Rating Per ASTM E84

| | Flame Spread | Smoke Developed |
|---|---|---|
| **Reynobond PE without Joint** | PASS* CLASS A | PASS* CLASS A |
| **Reynobond PE with Joint** | PASS* CLASS A | PASS* CLASS A |
| **Reynobond FR with Joint** | PASS* CLASS A | PASS* CLASS A |
| **Reynobond with KEVLAR®** | PASS* CLASS A | PASS* CLASS A |

*Flame spread ≤ 25, smoke developed ≤ 450.

ASTM E84 – Surface Burning Characteristics of Building Materials
Similar to BS 476: Part 7 – Spread of Frame

BS 476: Part 4 ?
or Class A1 of BS EN 13501-1 ?

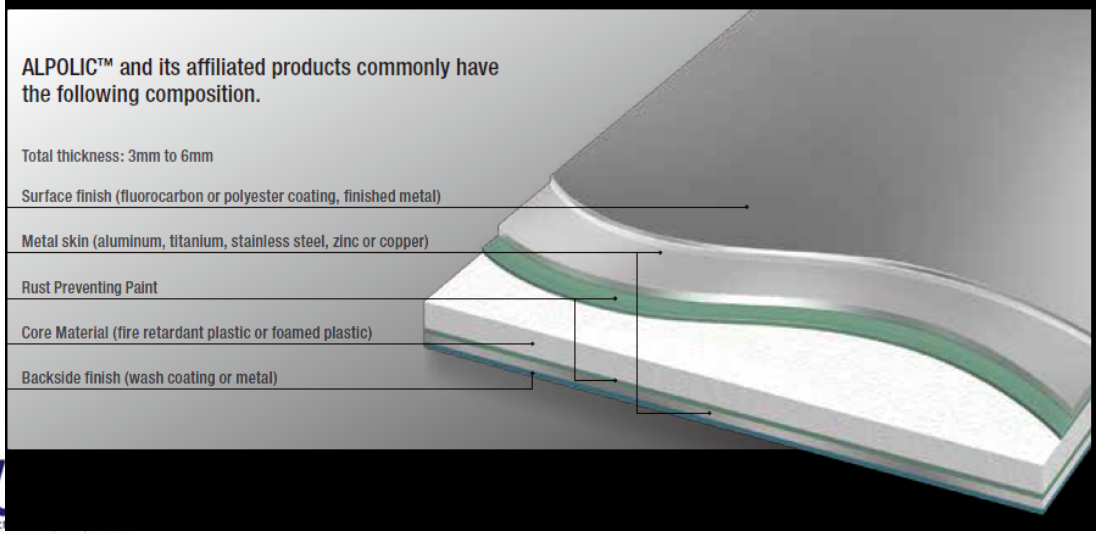
# Aluminium Composite Cladding

ALPOLIC™ is Aluminum Composite Material (ACM) for the worldwide construction industry. It is not only a reasonable alternative to solid aluminum sheets, but also a material distinguished by its unique features. Its light weight, high rigidity, excellent flatness and long-lasting coating qualities are just what the construction industry has been looking for.

## Composition of ALPOLIC™

ALPOLIC™ and its affiliated products commonly have the following composition.

Total thickness: 3mm to 6mm




DWKY

# Aluminium Composite Cladding

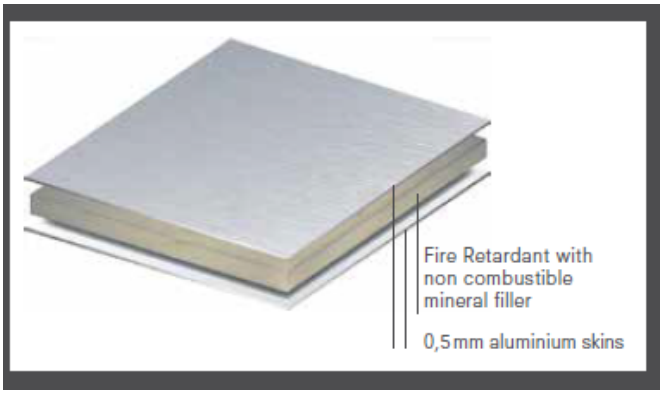
| | ALPOLIC™ PE | ALPOLIC™/fr | ALPOLIC™ A2 |
|---|---|---|---|
| Thickness | 4mm | 4mm | 4mm |
| Approx. portion of combustible ingredients within the core material | 100% | < 30% | < 10% |
| Heat Potential of the core material | > 45 MJ/kg | < 13 MJ/kg | < 3 MJ/kg |
| Europe | BS 476 Part 6 (Class 0)<br>BS 476 Part 7 (Class 1)<br>DIN 4102 Part 1 (B2) | EN 13501-1<br>(B-s1-d0) | EN 13501-1<br>(A2-s1-d0) |
| USA | ASTM E84<br>(Passed class 1/A) | ASTM E84 (class 1/A)<br>ASTM E108<br>ASTM E108 Modified<br>UBC 26-9 & NFPA 285<br>ASTM E119<br>UBC 26-3<br>(Passed) | |
| Canada | | CAN/ULC-S 134-92<br>(Passed) | |
| Russia | | GOST<br>(G1,B1,T1,D1,K0) | GOST<br>(G1,B1,T1,D1,K0) |
| Japan | | Passed.<br>Certified as non-combustible material | |

BS 476: Part 4 ? or Class A1 of BS EN 13501-1 ?

# Aluminium Composite Cladding

## ALUCOBOND®plus

ALUCOBOND®plus has been developed exclusively for the more stringent fire prevention regulations in architectural products. Thanks to its mineral-filled core ALUCOBOND®plus meets the stricter requirements of most fire classifications. Its is hardly inflammable and offers all the proven product properties of the ALUCOBOND® family, such as flatness, formability, resistance to weather and easy processing.




BS 476: Part 4 ?
or Class A1 of BS EN 13501-1 ?

## FIRE CLASSIFICATION

| ALUCOBOND® plus | | |
|---|---|---|
| **Country** | **Test accord. to ...** | **Classification** |
| Australia | AS ISO 9705<br>AS 3837<br>AS 1530-3 | Group 1 material<br>BCA Group 3 material<br>no ignition |
| China | GB 8624-2006 | Class B, s1,d0, t0 |
| EU | EN 13501-1 | Class B, s1, d0 |
| Germany | EN 1187 (method 1) /<br>DIN 4102-7 | passed |
| Malaysia | BS 476, Part 6<br>BS 476, Part 7<br>Approved for outdoor wall cladding of any type of building without height limit | Class 0<br>Class 1 |
| Singapore | EN 13501-1<br>NFPA 285<br>Approved for outdoor wall cladding of any type of building without height limit | Class B, s1, d0<br>passed |
| UAE | ASTM-E-84<br>BS 476, Part 6&7 | Class A<br>Class 0 |
| UK | BS 476, Part 6&7 | Class 0 |
| USA | ASTM-E 84<br>NFPA 285 | Class A<br>passed |

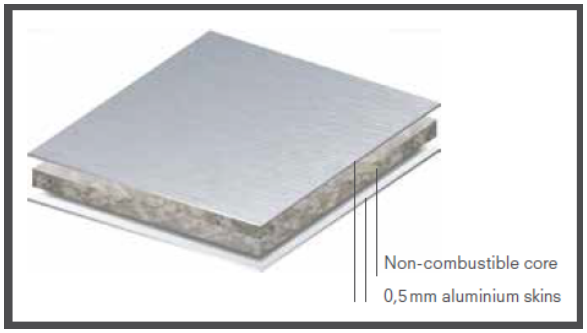
ALPHA Steel Structure & Façade Specialist

*Fire Protection in Curtain Wall and Facade Systems*

# Aluminium Composite Cladding

## ALUCOBOND®A2

ALUCOBOND®A2 is the first non-combustible aluminium composite panel used in architecture that fulfils the respective standards worldwide. Thanks to its mineral core, ALUCOBOND® A2 meets the strict requirements of some of the toughest fire regulations while retaining the possibilities for the concept and design of buildings. ALUCOBOND®A2, just like all the products of the ALUCOBOND® family, allows simple processing, is impact-resistant, breakproof and weatherproof and, above all, non-combustible.




BS 476: Part 4 ?
or Class A1 of BS EN 13501-1 ?

## FIRE CLASSIFICATION

| ALUCOBOND® A2 | | |
|---|---|---|
| **Country** | **Test accord.to** | **Classification** |
| Australia | AS ISO 9705<br>AS 3837<br>AS 1530-3 | Group 1 material<br>BCA Group 1 material<br>no ignition |
| EU | EN 13501-1 | Class A2, s1, d0 |
| Germany | EN 1187 (method 1) /<br>DIN 4102-7 | |
| Japan | JIS A 1231<br>JIS A 1231 | QNC<br>Class 2 |
| Malaysia | BS 476, Part 6<br>BS 476, Part 7<br>Approved for outdoor wall cladding of any type of building without height limit | Class 0<br>Class 1 |
| Singapore | NFPA 285<br>EN 13501-1<br>Approved for outdoor wall cladding of any type of building without height limit | passed<br>Class A2, s1, d0 |
| UAE | EN 13501-1 | Class A2 |
| UK | BS 6853 | meets requirements of LUL limited combustible non combustible |

ALPHA Steel Structure & Façade Specialist

*Fire Protection in Curtain Wall and Facade Systems*

# Fire Safety Reviews

- In the days after the fire, local authorities undertook reviews of fire safety in their residential tower blocks.
- Estimated about 600 high-rise blocks in the UK that have similar cladding, in which 120 high-rise buildings located in 37 different local authority areas were reported to have failed fire safety tests, a 100% failure rate of samples tested.
- *What test standard for installed/used material?*
- *What is the passing criteria?*

*Source from: BBC.com*

ALPHA Steel Structure & Façade Specialist

*Fire Protection in Curtain Wall and Facade Systems*

# Construction of External Wall

HM Government

BS: Class 0
EN: Class B-s3,d2

The Building Regulations 2010

Fire safety

APPROVED DOCUMENT

B

VOLUME 2 – BUILDINGS OTHER THAN DWELLINGHOUSES

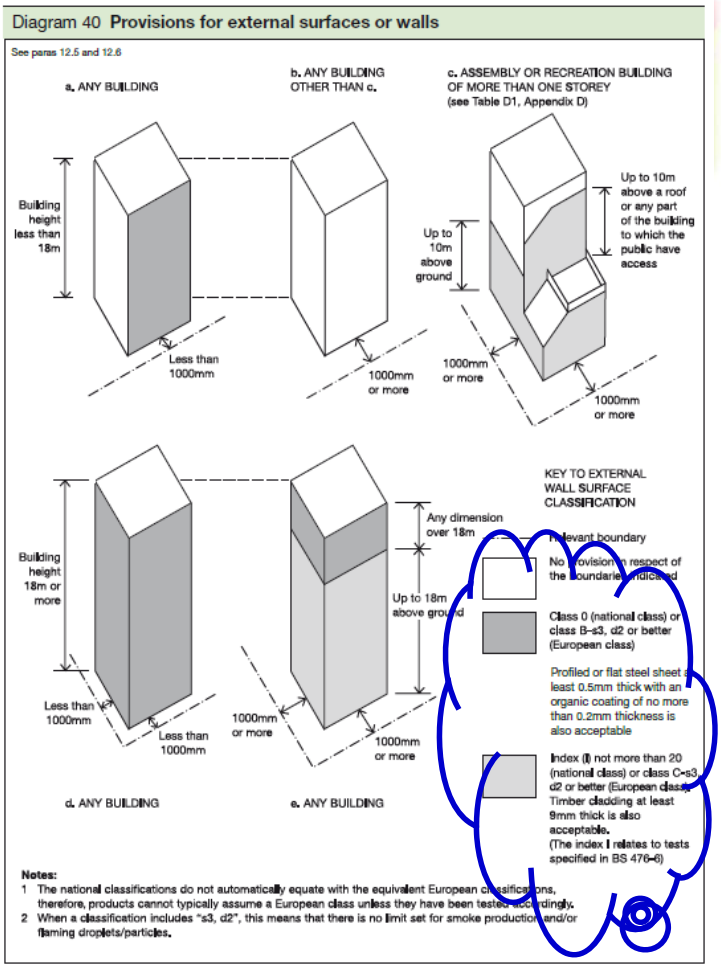
| | |
|---|---|
| B1 | Means of warning and escape |
| B2 | Internal fire spread (linings) |
| B3 | Internal fire spread (structure) |
| B4 | External fire spread |
| B5 | Access and facilities for the fire service |

Came into effect April 2007

FIRE KILLS YOU CAN PREVENT IT

2006 edition incorporating 2007, 2010 and 2013 amendments

For use in England*



# Cladding Material in Hong Kong

Previous Provision | Next Provision | 中文 | Past Versions | Back to List of Enactments

**Contents of Section** — Add to Printing List | Bookmark

Chapter: 123B | Title: **Building (Construction) Regulations** | Gazette Number:
Regulation: 39 | Heading: **Cladding** | Version Date: 30/06/1997

(1) Cladding shall-

(a) be constructed entirely of such non-combustible materials, of such thickness, strength and durability, and shall be fixed and supported in such manner and in such sequence as to provide long term stability and integrity; and
(b) be provided with sufficient permanently flexible joints horizontally and vertically to allow for differential movement in the cladding and in the structure to which it is attached.

(2) Any metal dowels and fixings securing the cladding shall be suitable, permanent and adequately protected from corrosion.

(Enacted 1990)

Previous Provision | Next Provision | 中文 | Past Versions | Back to List of Enactments

Non-combustible ⇒ BS 476: Part 4 or Class A1 of BS EN 13501-1



## Section 5 – Non-combustibility

### Subsection E10 – Non-combustibility

### Clause E10.1

Any product that complies with one of the following is considered to be non-combustible:

(a) Class A1 in BS-EN 13501-1:2007, *Fire classification of construction products and building elements - Classification using data from reaction to fire tests*;

(b) BS EN ISO 1182:2010, *Reaction to fire tests for products. Non-combustibility test and BS EN ISO 1716:2010 Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value)*;

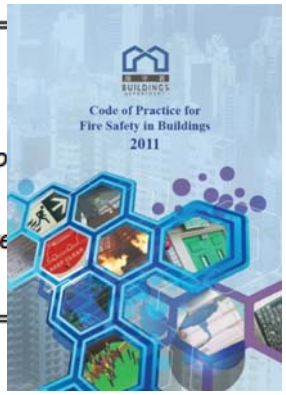
(c) BS 476-4:1970, *Fire tests on building materials and structures. Part 4: Non-combustibility test for materials.*

**Commentary**

Other appropriate non-combustibility tests include:

(a) AS 1530.1:1994, *Methods for fire tests on building materials, compo structures Part 1: Combustibility test for materials*;

(b) ASTM E136–11, *Standard test method for behavior of materials in a ve furnace at 750°C.*



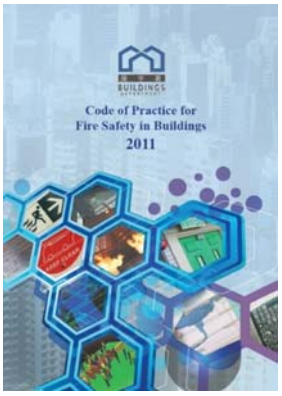
**Subsection E11- Limited Combustibility**

**Clause E11.1**

Materials of limited combustibility are classified as Class A2-s3, d2 or better in accordance with:

(a) BS EN 13501-1:2007, *Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests* to BS EN ISO 1182:2002, *Reaction to fire tests for building products – Non-combustibility test*;

(b) BS EN ISO 1716:2010, *Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value)* and BS EN 13823:2010, *Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item.*



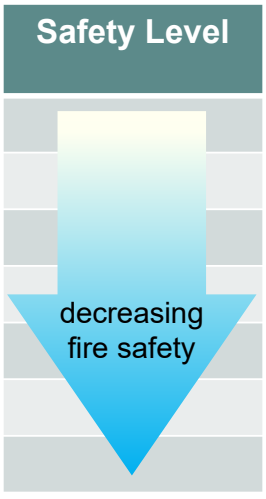



# Non-combustible Materials - Commentary

- Comparison of classification of fire performance of materials tested in accordance with BS EN 13501-1:2007 and BS 476: Parts 4 and 7.

**Table E1 - European Classes on Reaction to Fire Performance**

| European Classification | British Standard Equivalent |
|---|---|
| A1 | Non-combustible |
| A2 | Limited combustibility |
| B | 0 |
| C | 1 |
| D | 3 |
| E | 4 |
| F | Unclassifiable or no performance determined |



**BS EN 13501-1:2007+A1:2009**
**EN 13501-1:2007+A1:2009 (E)**

Restrict to Class A1? or
Accept both Class A1 & Class A2?

**Table 1 — Classes of reaction to fire performance for construction products excluding floorings and linear pipe thermal insulation products**

| Class | Test method(s) | Classification criteria | Additional classification |
|---|---|---|---|
| A1 | EN ISO 1182 [a]<br><br>and | $\Delta T \leq 30$ °C; and<br>$\Delta m \leq 50$ %; and<br>$t_f = 0$ (i.e. no sustained flaming) | - |
| | EN ISO 1716 | $PCS \leq 2{,}0$ MJ/kg [a] and<br>$PCS \leq 2{,}0$ MJ/kg [b c] and<br>$PCS \leq 1{,}4$ MJ/m$^2$ [d] and<br>$PCS \leq 2{,}0$ MJ/kg [e] | - |
| A2 | EN ISO 1182 [a]<br><br>or | $\Delta T \leq 50$ °C; and<br>$\Delta m \leq 50$ %; and<br>$t_f \leq 20$ s | |
| | EN ISO 1716<br><br>and | $PCS \leq 3{,}0$ MJ/kg [a] and<br>$PCS \leq 4{,}0$ MJ/m$^2$ [b] and<br>$PCS \leq 4{,}0$ MJ/m$^2$ [d] and<br>$PCS \leq 3{,}0$ MJ/kg [e] | - |
| | EN 13823 | $FIGRA \leq 120$ W/s and<br>$LFS <$ edge of specimen and<br>$THR_{600s} \leq 7{,}5$ MJ | Smoke production [f] and<br>Flaming droplets/particles [g] |

BS 476: Part 4
$\Delta T \leq 50°C$;
$t_f \leq 10$ s



**Subsection E13 – Linings of Internal Wall and Ceiling and Decorative Finishes**

Ver. 2011

**Clause E13.1**

Linings of internal wall and ceiling and decorative finishes in the following Use Classifications, where the combustibility is required to be controlled, should comply with the following when tested in accordance with BS EN 13501-1:2007:

(a) All Use Classifications – within protected exits, Classification A1 of Table E1;

(b) Use Classification 3 – general accommodations (including corridors, circulation spaces and rooms) that are not forming the protected exit, Classification B or above of Table E1;

(c) Use Classification 5a – within cinemas, auditoria and theatres, Classification C or above of Table E1;

When tested in accordance with the British Standards, the performance should meet the equivalent European classification in Table E1.

Class A1

Ver. 2015

**Clause E13.1**

Linings of internal wall and ceiling and decorative finishes in the following Use Classifications, where the combustibility is required to be controlled, should comply with the following when tested in accordance with BS EN 13501-1:2007:

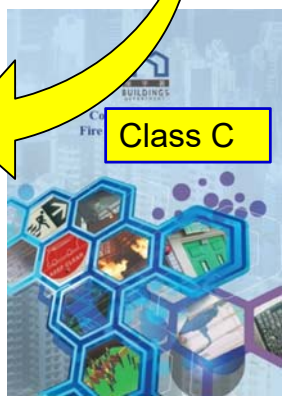
(a) All Use Classifications – within protected exits, Classification C of Table E1;

(b) Use Classification 3 – general accommodations (including corridors, circulation spaces and rooms) that are not forming the protected exit, Classification B or above of Table E1;

(c) Use Classification 5a – within cinemas, auditoria and theatres, Classification C or above of Table E1;

When tested in accordance with the British Standards, the performance should meet the equivalent European classification in Table E1.

Class C



# Cladding Material in China

UDC

中华人民共和国国家标准

P GB 50016－2014

建筑设计防火规范

Code for fire protection design of buildings

2014－08－27 发布 2015－05－01 实施

中华人民共和国住房和城乡建设部
中华人民共和国国家质量监督检验检疫总局 联合发布

6.7 建筑保温和外墙装饰

6.7.1 建筑的内、外保温系统，宜采用燃烧性能为A级的保温材料，不宜采用$B_2$级保温材料，严禁采用$B_3$级保温材料；设置保温系统的基层墙体或屋面板的耐火极限应符合本规范的有关规定。

6.7.4 设置人员密集场所的建筑，其外墙外保温材料的燃烧性能应为A级。

6.7.5 与基层墙体、装饰层之间无空腔的建筑外墙外保温系统，其保温材料应符合下列规定：

1 住宅建筑：

1）建筑高度大于100m时，保温材料的燃烧性能应为A级；

2）建筑高度大于27m，但不大于100m时，保温材料的燃烧性能不应低于$B_1$级；

3）建筑高度不大于27m时，保温材料的燃烧性能不应低于$B_2$级。

2 除住宅建筑和设置人员密集场所的建筑外，其他建筑：

1）建筑高度大于50m时，保温材料的燃烧性能应为A级；

2）建筑高度大于24m，但不大于50m时，保温材料的燃烧性能不应低于$B_1$级；

3）建筑高度不大于24m时，保温材料的燃烧性能不应低于$B_2$级。

6.7.12 建筑外墙的装饰层应采用燃烧性能为A级的材料，但建筑高度不大于50m时，可采用$B_1$级材料。

# NON-COMBUSTIBLE MATERIAL

# Conclusions

- Fire stop and smoke seal are necessary components for a curtain wall system in order to prevent spread of fire and smoke between floors respectively.
- Correct specification, location and application of fire stop and smoke seal are essential in curtain wall system.
- Non-combustible materials should be used for external façade and cladding. Material should be tested for non-combustibility in accordance with BS 476: Part 4 or BS EN 13501-1, but not by assessment.



HKIE THE HONG KONG INSTITUTION OF ENGINEERS 香港工程師學會

HKSC 香港鋼結構學會 Hong Kong Institute of Steel Construction

# Thank You!

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