ARTICLE: CAVITY BARRIERS AND THEIR APPLICATION HERE IN AUSTRALIA.

By John Rakic

Introduction

Passive fire compartments, fire containment barriers and separating building into fire cells or zones is a well-known practice. The principles are relatively simple; if a fire breaks out in one part of a building, we want to contain the fire to that part of the building using fire walls, floors, ceilings, shafts and other so called "fire stopping" products and systems.

Australia's NCC deals with Fire Resistance, fire ratings or FRL's for commercial and high-rise residential buildings in Section C. Most passive fire protection systems have detailed fire test methods, allowing fire ratings to be deduced for regulatory purposes, and the required FRL's are provided in the NCC, based on the Class of Building (use) and type of construction (rise in storeys).

This article deals with so called "cavity barriers" and is a compilation of my research into the application of SIDERISE perimeter fire stop and cavity barrier systems, for specification, design advice and ultimate sale here in Australia by Trafalgar Fire, my company.

Defining "Cavity Barriers"

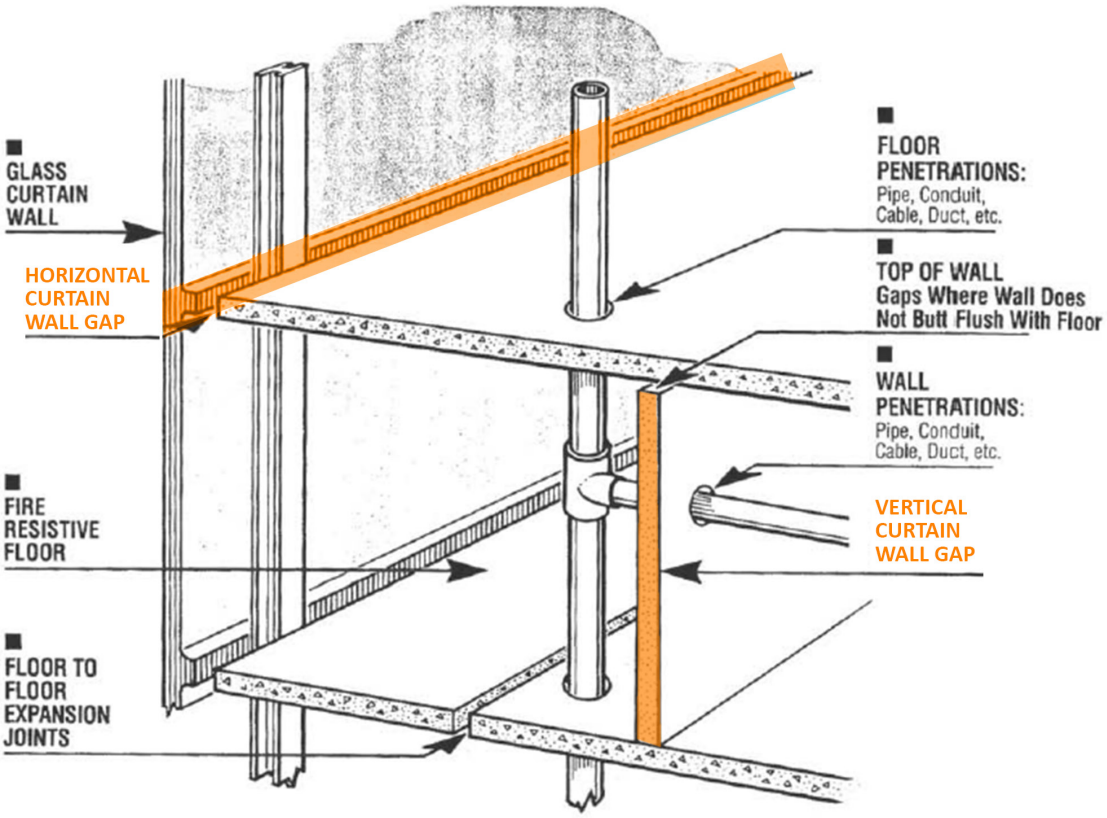
What are so called "cavity barriers" why are they needed and where can and should they be used?

Cavity barriers are a fire and smoke containment system used to stop the spread of fire and smoke through cavities. Cavity barriers are not any more complicated on the surface than that.

The NCC has recently introduced the term cavity barrier for fire protective timber construction (CLT) but there is no current NCC definition for the term cavity barrier elsewhere.

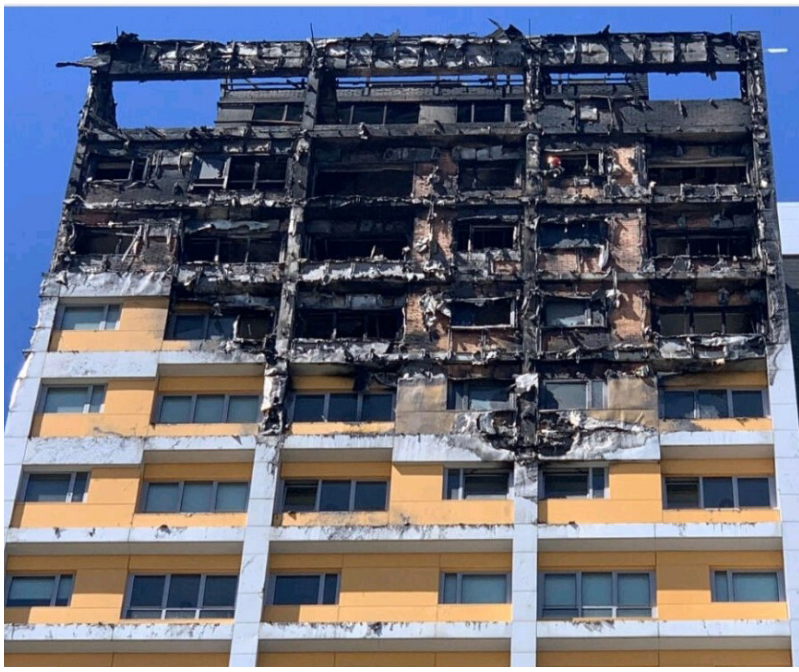
The most prevalent and widely used cavity barriers are used to stop vertical fire and smoke spread within the cavities formed around the perimeter of an external building envelope.

These are either, **horizontal cavity barriers** (used to seal the edges of the horizontal internal floor slabs) or **vertical cavity barriers** (used again to seal the vertical floor to floor edges to divide the cavity on one given floor vertically into predetermined zones). Some vertical and horizontal cavity barriers are also used to protect window and door openings from fires in the building envelope cavity.



Do we really need cavity barriers?

Before we discuss NCC requirements in Australia both full scale fire tests and actual fires have shown that effective cavity barriers make a HUGE difference.



Fire Test with non-combustible fibre cement and Rockwool

PART A - FIRE

There are three very different "cavity barrier" applications for different construction types used here in Australia:

1. Curtain wall,
2. So called rainscreen "cladding" or ventilated facades, and
3. Cross Laminate Timber (CLT)

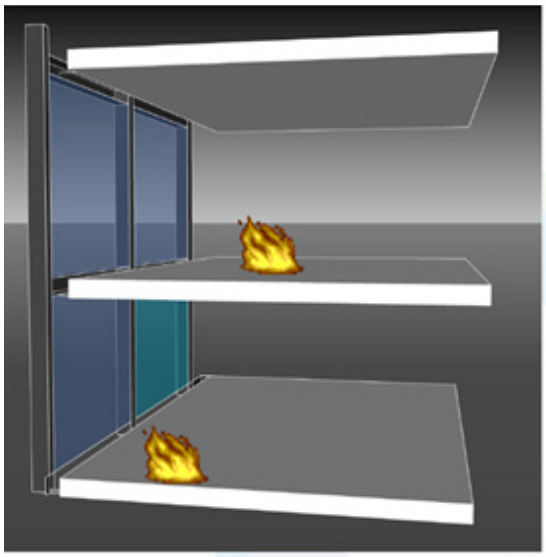
I will discuss each one in turn and discuss why different terminology is used to compare and contrast the different "cavity barriers" which relates in principle to the different fire spread mechanisms and associated fire testing developed to deal with these for each construction type.

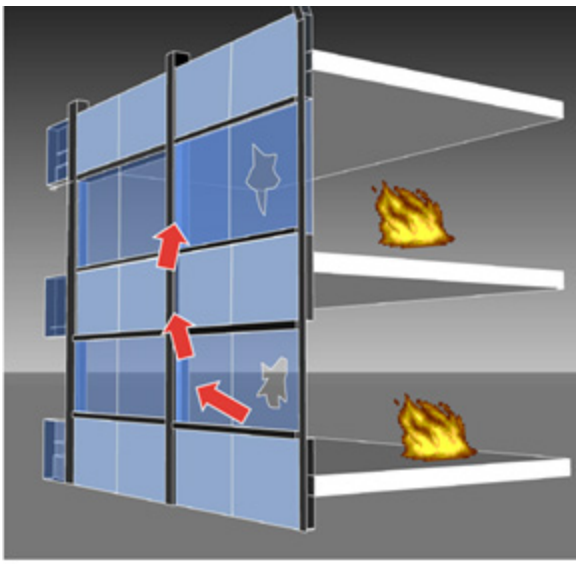
1. Curtain wall type buildings.

Curtain wall construction has been with us for a very long time, and we all recognise the large, glazed curtain wall buildings which are prevalent in our Australian cities.

Curtain wall is defined in our NCC as a non-load bearing external wall that is not a panel wall. I will deal with panel walls later.

Fires have shown us we need to provide **some means to stop fire spreading** up and between the floor slab edge and the perimeter of the curtain wall assembly itself, and also to avoid leap frogging (where a fire can break out of the glazing on one level, and re-enter on the next level if the glass on that level breaks and the flames can lip around the floor slab).





The slab edge fire stopping is termed **perimeter fire stopping** or slab edge fire stopping, to differentiate it to cavity barriers which are reserved for use in cladding systems, not curtain walls.

Typically, the perimeter fire stopping works together with a spandrel to provide some fire resistance for the slab to glazed curtain wall interface.

2. Cladding of our buildings.

Cladding on buildings are defined in the NCC as panel walls, meaning non load bearing external wall in a frame (or similar construction) that is wholly supported at each storey.

This type of building envelope construction is typically referred to as rainscreen cladding (or a ventilated façade in other parts of the world).

This construction uses internal walls on the perimeter of the building envelope, and the so called rainscreen or cladding hides a void or cavity where thermal insulation, framing, sarking and the like live. The cavities are also drainage of moisture or rain, and for ventilation to help dry and stop any mould and the like growing in what could potentially otherwise be a damp or water-logged environment.

Cavity barriers are used here to stop fire spread in these cavities, but a special challenge is required, as we need to utilise what are termed **open state or intumescent cavity barriers** to allow for everyday ventilation, but to close and seal adequately in a timely manner in the event of a fire.

3. CLT or fire protective timber construction.

The sustainability initiative across the globe has seen the onset of Cross Laminated Timber (CLT) used in construction including so called CLT fire barriers or panels.

Personally, I am not convinced this is wise, but the masses have spoken and CLT seems to be gaining popularity in construction.

Cavity barriers are required under NCC for CLT construction and some fire testing requirements have been included along with some FRLs or fire ratings.

I will now step through the fire testing relating to each of the 3 construction types I have identified above in turn.

This is why I have taken the time to differentiate the three applications and provided readers with the discrete construction types:

- **curtain wall perimeter fire stop** or curtain wall slab edge fire stop, and
- **open state cavity barriers** for cladding systems, and
- **cavity barriers for CLT** or fire protective timber construction

Let me discuss the different fire testing methods for the different types of cavity fire stop applications and product applications types above.

The 3 different types of construction mentioned above and the 3 fire stop perimeter fire stop or cavity barriers identified all have different modes of fire spread and require very different fire test methods for definite validation of fire safety or reduction in fire and smoke spread.

Fire testing for Curtain wall perimeter fire stop

Those of us struggling here in Australia to determine how to apply our AS1530 Part 4 and conventional FRL's to slab edge or perimeter fire stop materials do so for a reason.

Many consultants I speak to point me to NCC Clause C3.16 for construction joints and without anywhere else this is probably a good start and the best available option the way the NCC is written and if you want some fire test data to hang your hat on.

C3.16 Construction joints

(a) Construction joints, spaces and the like in and between building elements *required* to be *fire-resisting* with respect to *integrity* and *insulation* must be protected in a manner identical with a prototype tested in accordance with AS 1530.4 to achieve the *required* FRL.

The problem with this approach is that control joints are tested between two fire rated building materials, and our slab edge is a fire rated building material, but the curtain wall is not fire rated. **The European have a dedicated fire test method, EN1364-4 for this application, where the fire rated slab edge meets the non fire rated curtain wall building envelope; I will discuss this in more detail below.**

However, curtain wall fire stop is covered in NCC Clause C2.6, along with spandrels, and presently are only required in non-sprinkler protected buildings, except for the new fire protective timber construction requirement in C1.13. If it was intended to use C3.16, I guess it would say so in C2.6 and at present it does not.

NCC Clause C2.6 ask us to do the following:

Behind a curtain wall or panel wall, any gaps must be packed with a non-combustible material that will withstand thermal expansion and structural movement of the walling without the loss of seal against fire and smoke.

ARTICLE: CAVITY BARRIERS AND THEIR APPLICATION HERE IN AUSTRALIA.

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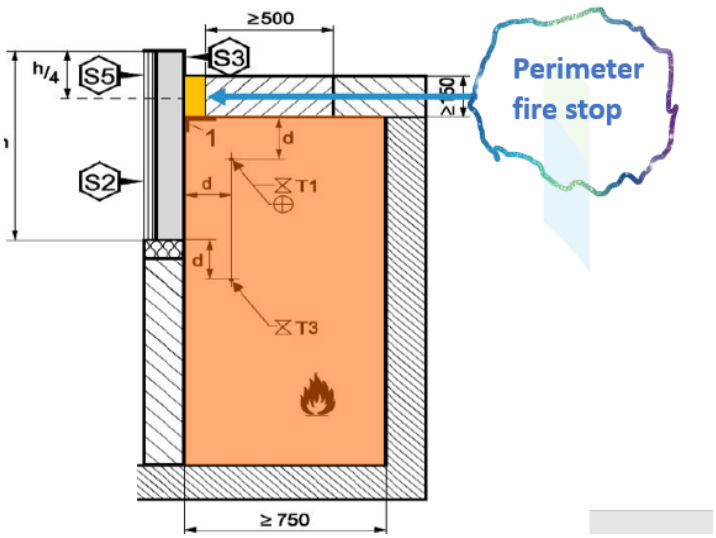
So, let us look at what Europe does, as they have devised a good test method, which we can easily run here using standard AS1530 Part 4, fire test furnaces.

EN1364-4

This clever European fire test method uses the same furnace we use for AS1530 Part 4 fire testing and a representative portion of curtain wall, spandrel and perimeter fire stop are fire tested.

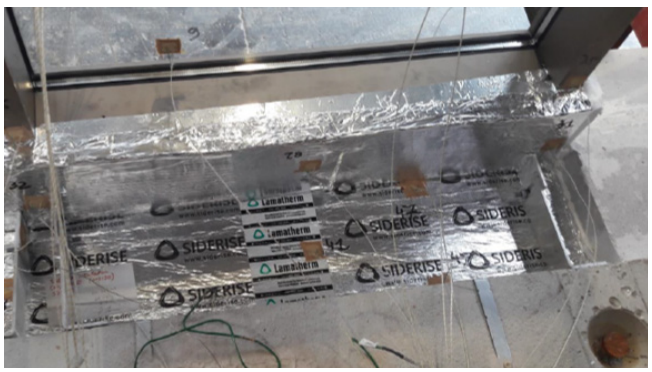
This cross section shows the inside of the fire test furnace, shaded orange, with a floor slab on top of the furnace, representative section of glazed curtain wall and of course the perimeter fire stop and light weight spandrel forming the fire seal at the perimeter.



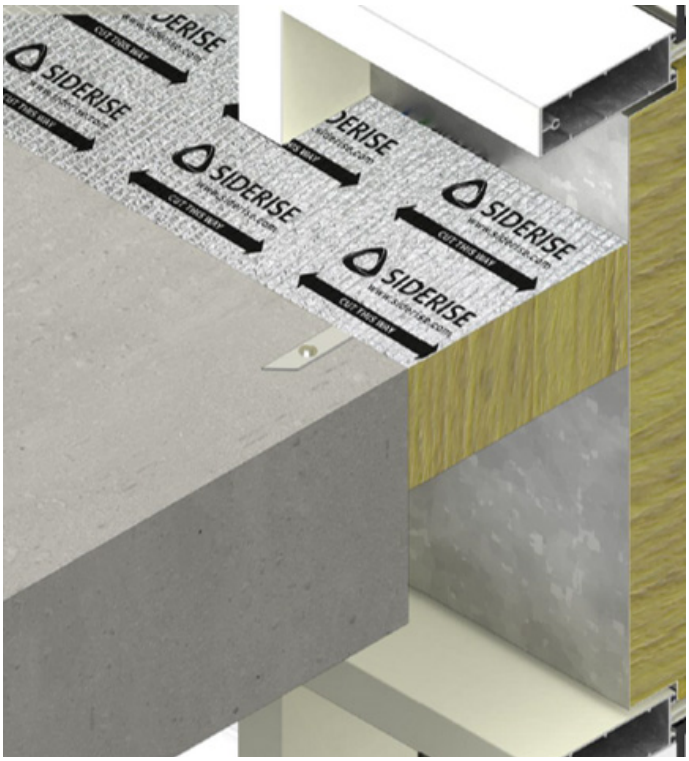
This is a schematic of the system fire tested to EN1364-4

Here are some photos of a successful 3 hour fire test incorporating an Aluminium glazed curtain wall façade/ concrete floor slab interface sealed with SIDERISE CW-FS perimeter fire stop system, and if you want to watch the fire test itself go to the following link:

Click to Watch



Fire tested to EN1364-4



SIDERISE CWFS perimeter fire stop system

Fire testing for Open State Cavity Barriers for cladding

We are all aware of the cladding pandemic we find ourselves in and it is sad that the NCC requirements are still ambiguous and not in line with international best practice.

Cavity barriers are a proven and cost effective means of stopping fire spread behind the cavities when we clad a building envelope.

Let's hope logic prevails in terms of cavity systems and we see some more definite technical guidance including fire and requisite movement criteria incorporated into NCC and associated Australian Standards or industry guides sooner, rather than later.

I would hope our insurance industry reads this and puts out some guidance to minimise damage to building façade fires by way of cavity passive fire protection or cavity fire stopping measures.

Our NCC provide no provisions for so called open state cavity barriers; which you will remember are those that allow ventilation through the cavity barrier in the cold state, and close up using high performance intumescent materials in the hot or fire state.

The open state cavity is typically only 25mm or 50mm, which allows the high performance intumescent materials to close off very quickly as proven by fire testing.

Just so you are not confused, a rainscreen cladding system requires provisions for drainage and ventilation, hence why a small section of the cavity needs to be open; the so called open state. Of course in fire it changes by way of the intumescent material expanding and closing the gap changes state to one of closed, stopping fire spread and excessive smoke spread.

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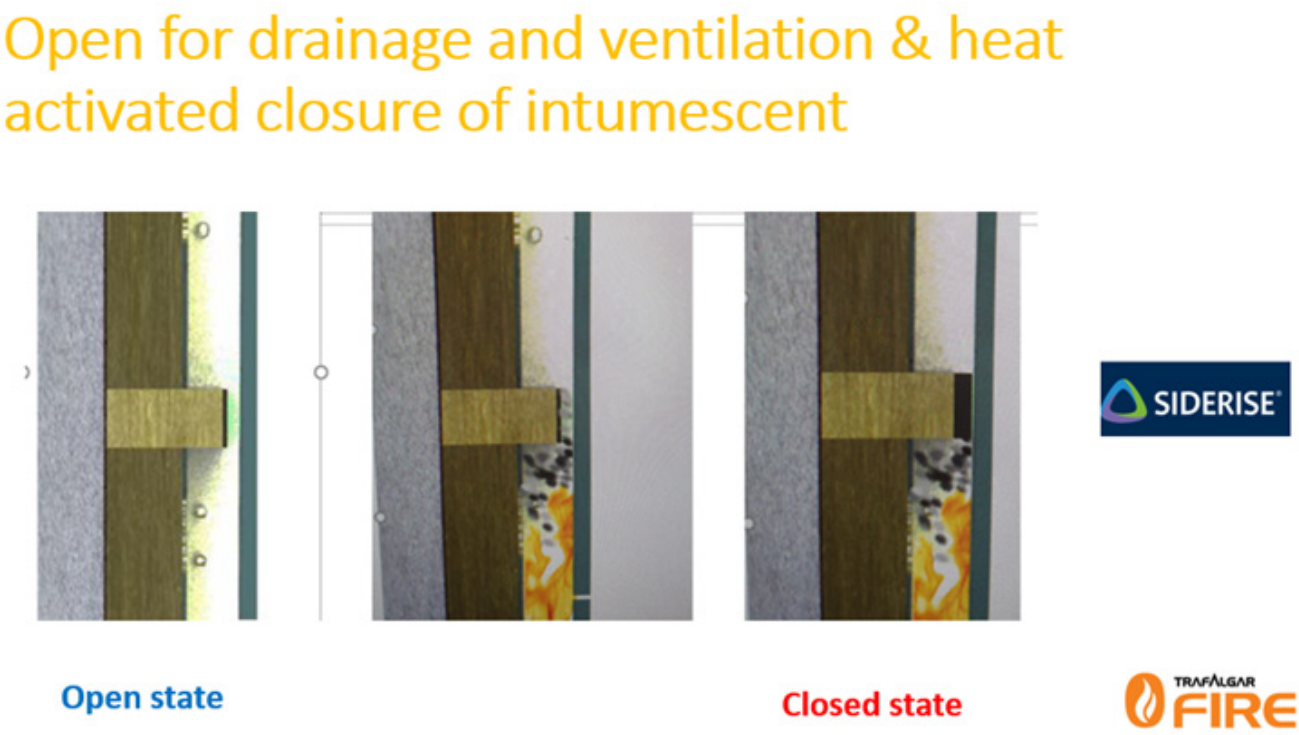
Some pictures tell a thousand words, this schematic shows the open and closed states of a SIDERISE RH, horizontal open state cavity barrier systems.



Here you can see a SIDERISE RH, horizontal rain screen cavity barrier being fire tested. The top photo shows partial closure and the bottom one shows full closure. Before you ask, this closure is quick, in the span of a minute or two. Please note, the SIDERISE RV vertical rainscreen cavity barrier does not need intumescent and is a closed state system akin to the SIDERISE CW-FS discussed earlier used for curtain wall systems.

Again, I will look at European best practice in terms of fire testing.

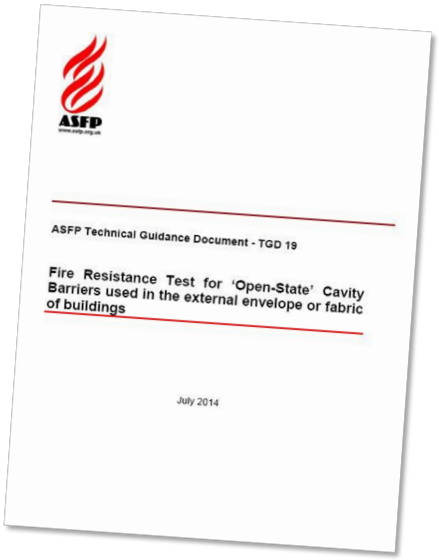
prEN1364-6 and ASFP TGD19

These are product system fire test methods and application documents for the use of open state cavity barriers, which are required for stopping fire spread in cavities behind cladding on buildings (rainscreen "cladding", ventilated facades or building envelopes).

The fire test method again uses an AS1530 Part 4 furnace. Open state cavity barriers are fire tested and the speed of closure, integrity and insulation (temparature rise) of the closed system are carefully monitored and recorded.

Here is a photo prior to commencement of an prEN134-6 fire test showing SIDERISE RH25 open state cavity barrier spanning 200mm or more, incorporating a 25mm opening.

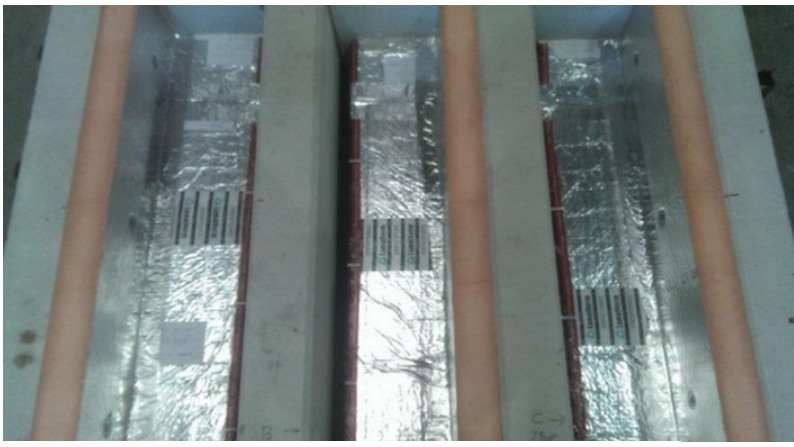
You will see combustible insulation is placed directly on top of the SIDERISE RH25 open state cavity barriers in this fire test to demonstrate that the fire properties of the system will not ignite the combustible material on the non fire side.


ASFP

ASFP Technical Guidance Document - TGD 19

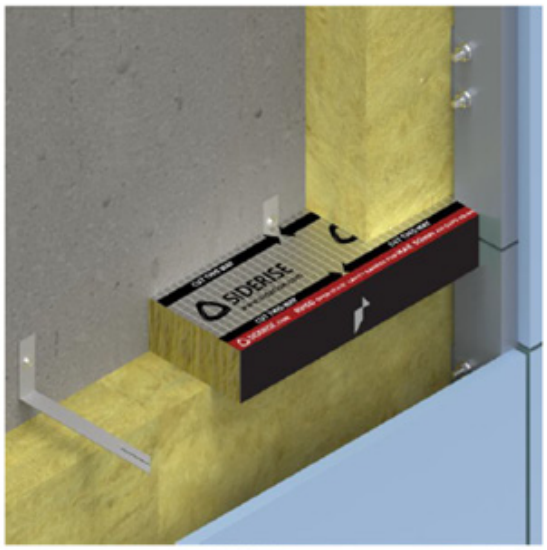
Fire Resistance Test for 'Open-State' Cavity Barriers used in the external envelope or fabric of buildings

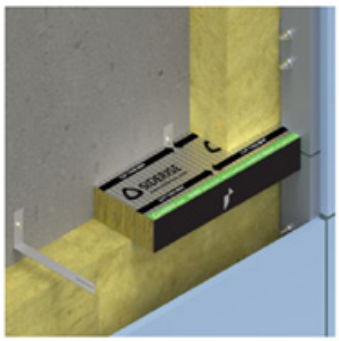
July 2014



Siderise RH and RV systems

Open state Horizontal Cavity barriers





BS8414 full scale building envelope fire testing

For the fire testing purist, nothing beats a full scale SYSTEM fire test.

This shows the full interaction of the entire façade or building envelope ASSEMBLY and how it react to an external fire.

BS8414 Fire Testing of solid aluminium cladding with and without SIDERISE cavity barriers.

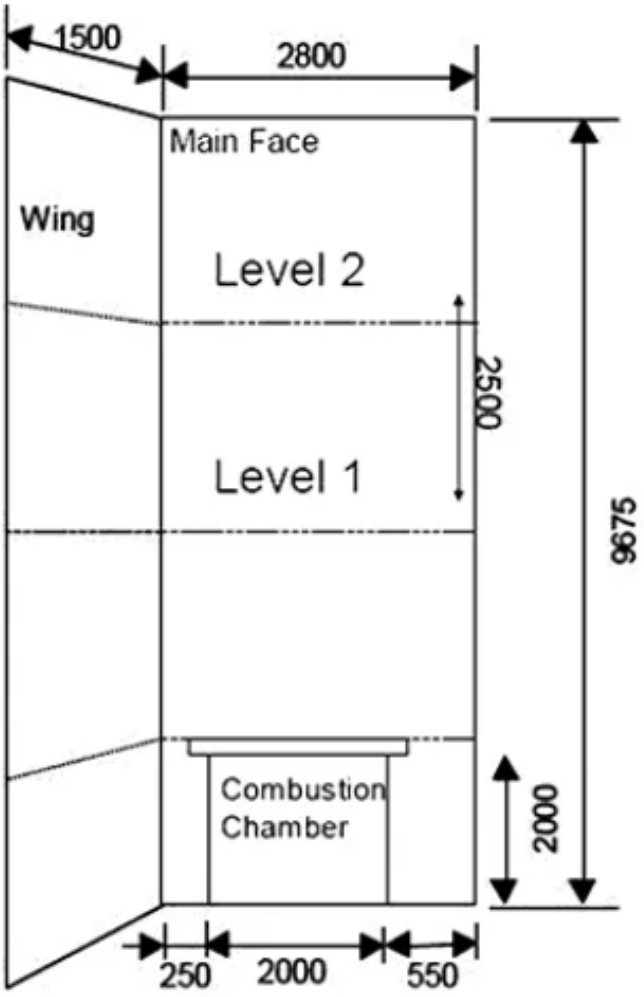
The importance of cavity barriers in these fire tests cannot be underestimated. Full scale fire tests in accordance with BS8414 show the importance of well designed cavity barriers.

To me the best analogy I can think of is building a brick wall without mortar. We just do not do it. The same applies to cladding on our buildings we need cavity barriers.

So, what is the BS8414 fire test?

It is a full scale fire test for "cladding systems", simulating an external fire adjacent to the cladding, and assists to measure vertical and horizontal flame spread, either up the outside of the cladding itself, or inside the cavities behind the cladding where insulation, framing and other building envelope assembly components hide.

It's a big fire test simulating several levels of construction and include a wing wall.



The fire exposure is a serious fire exposure, nominally 4500MJ of fuel, by way of a large timber crib, with a peak heat release rate in the of 3 to 3.5MW.

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Fire testing to BS8414 is currently not a pathway deemed to satisfy NCC, but our new NCC Verification CV3, calls up AS5113 classification which utilises BS8414 fire testing to help determine a new EW fire performance criteria for cladding systems.

In my opinion it is only a matter of time before, the old, confusing, abused deemed to satisfy requirements asking for so called “non combustible” materials and relying on a tired and poor small scale test AS1530.1 will be replaced with full scale system testing and cavity barrier product system testing like Europe.

Fire testing of cavity barriers for CLT or fire protective timber construction

I have included this category because NCC has introduced Clause C1.13 and Specification for C1.13 for CLT or what the NCC defines as fire protective timber.

The concerns relating to the combustibility of timber have seen the NCC mandate cavity barriers and provide some fire ratings (FRLs). This allows fire testing to AS1530 Part 4 – 2014.

Not sure why the NCC is slow to put more definitive and similar criteria for caviity barriers pertaining to curtain wall or panel wall construction.

Here is an example of some SIDERISE cavity barriers undergoing AS1530 Part 4 exposure with CLT construction.

PART B - MOVEMENT

I have been critical of the NCC in terms of definitive requirements for fire and smoke and I make no apologies for this. I think most people will agree that "cavity barriers" are required, and are a relatively small cost, but important SYSTEM element to mitigate fire spreading up the outside, or inside the cavities of a building envelope.

However, we seem to focus on the fire and smoke, but what other performance attributes are important for "cavity barriers".

Let's take another look at NCC Clause C2.6 in terms of movement.

> NCC Clause C2.6 ask us to do the following:
>
> **Behind a curtain wall or panel wall, any gaps must be packed with a non-combustible material that will withstand thermal expansion and structural movement of the walling without the loss of seal against fire and smoke.**

We can also look at NCC Specification C1.13 which is consistent with NCC Clause 2.6 above.

> NCC Specification C1.13, Clause 1(b) states:
>
> **Cavity barriers must be installed so they are tight fitting and are able to withstand thermal expansion and structural movement without the loss of seal against fire and smoke.**

Any façade consultant or structural engineer knows that wind loading on a building causes significant movement of the building envelope relative to the rest of the building. So, it makes sense that "cavity barriers" must deal with movement in everyday life; and lots of it.

Important design considerations pertaining to movement and the overall durability of the slab edge systems.

Vertical mineral fibre orientation

For this reason, mineral fibre materials (aka Rockwool or Stone wool) used in "cavity barriers" require their fibre orientation to be vertical to allow repetitive movement without breaking down the fibre structure. This is sadly the opposite orientation to which the fibres run in a manufactured mineral fibre slab.

For this reason, most reputable "cavity barrier" systems will have vertical fibre orientation.

Compression during installation

The "cavity barrier" materials need to typically be inserted into a slab edge or building perimeter under compression, so that in a fire condition, they do not fall out, and of course so they can cater for expansion movement in normal practice.

Mechanical fixing

To provide durability and allow for serious movement without dislodgement, a mechanical form of attachment to the edge of the floor slab, that can cater for movement, will provide the best design and performance.

Independent and third party cyclic testing for movement

Nothing beats real life in the field experience and independent laboratory movement testing, rather than relying on theoretical calculations or supplier unsubstantiated claims in their marketing literature.

There are strict requirements in Europe to do cycle testing on “cavity barriers” and then subject the same specimen to the fire test!

So why did I choose SIDERISE for Trafalgar Fire?

To be honest I always thought “cavity barriers” were just some Rockwool or Bradford Insulation shoved into the edge of a slab. Over the last 25 years in passive fire protection, and pre Grenfell fire, I only had a handful of technical enquires for building envelopes, mainly around FyreBOARD Maxilite® for spandrels and the odd question about sealing the slab edge for noise; not fire and smoke!

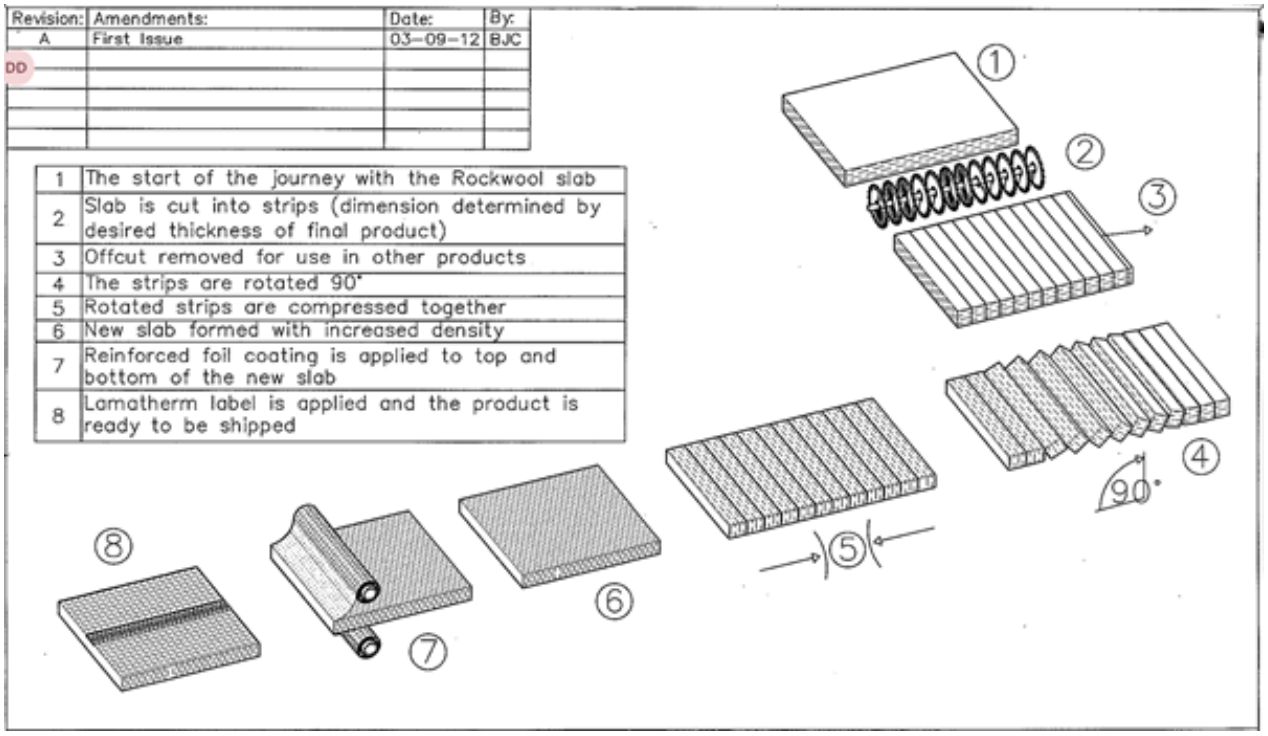
The Grenfell Tower, our Lacrosse Tower and Neo 200 Tower fires in Australia, changes to the NCC around cladding, insurance industry concerns and influence over those designing for fire and facades, and over 4.2 million sqm of Aluminium Composite cladding with a combustible PE core being about to be stripped off our buildings for recladding, solution enquiries have gone through the roof.

SIDERISE offered me pedigree with clever simple product and system designs, patented production, from a globally recognised market leader boasting a staggering amount of independent testing with third party certifications.

Let’s just review the movement and durability criteria I listed above.

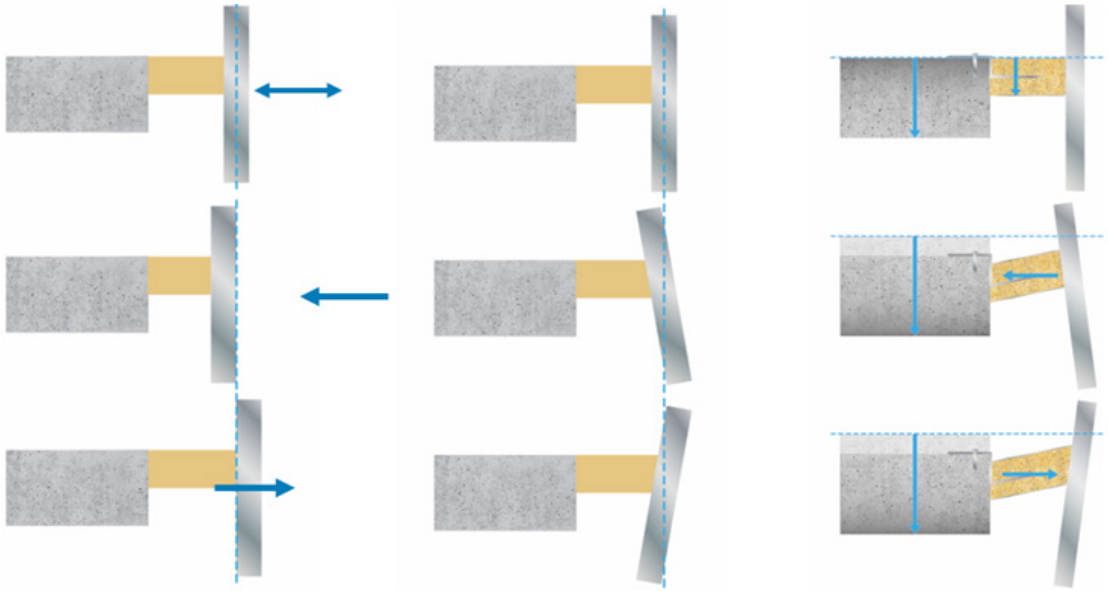
SIDERISE tick and exceed all four of the key design and performance attributes.

The clever manufacturing process ensures the correct fibre orientation by cutting Rockwool into lamella or strips, rotating them through 90 degrees, pre-compressing the strips, and then adding a thin Aluminium scrim or foil to both sides of a factory made and laminated SIDERISE CW-FS board.



The clever mounting tabs provide a simple, cost effective, quick to install and mechanical means to fixing the fire stop or “cavity barrier” to the edge of a floor slab.

It allows for serious movement, even Seismic type movement, and is proven with years of real life service, and many different cycling test regimes and some including fire testing post cycling.



These little pictures show some of the movements one can expect a slab edge fire stop or “cavity barrier” may need to contend with.

No prizes for guessing which of the common systems is SIDERISE; because it tells you!!!!

The clever Z bracket design for fixing SIDERISE, allows fast, clean and proven performance for fire, smoke and movement, and far exceeds the NCC requirements.

Let’s recap again on NCC Clause 2.6:

> **withstand thermal expansion and structural movement without the loss of seal against fire and smoke.**

How else, but with independent cyclic test for movement can you specify and approve a “cavity barrier”?

Ask for independent movement testing or specify SIDERISE!