# Fire Curtains and Radiation Attenuation

The National Construction Code (NCC) provides a Deemed-to-Satisfy (DtS) method for fire barriers. This method generally requires these barriers to provide a specific fire resistance level (FRL) based on the type of building and level of construction. The FRL is determined by submitting a complete system to a full-scale fire test identified in the NCC as AS1530.4. This fire test method is designed to expose the full-scale fire test specimen to a fully developed fire directly adjacent to the product, as would be expected in non-sprinklered buildings and considered worst case scenario.

During this fire test, AS1530.4 requires other measurements to be taken in addition to those taken to determine the FRL. One of the additional measurements is the radiant heat flux, measured in $kW/m^2$ at 365mm from the face of the specimen. While AS1530.4 requires that the test specimen not exceed a maximum of $15kW/m^2$ for the duration of the fire test. The NCC does not require this data to be used for DtS compliance and is therefore ignored when using this compliance pathway and FRL's.

However, this measured data provides the Fire Engineer with a method to use cost effective and innovative products, compared to the DtS products, in Performance Solutions. One such product type is the Fyrehalt fire curtain. Fire curtains are a type of fire shutter and should be fire tested and installed in accordance with AS1905.1 Fire Shutters. In addition to a fire tested and proven FRL, the fire curtain provides inherent radiation attenuation not typically provided by a traditional steel lath fire shutter. The performance of the radiation attenuation provided by fire curtains is significantly different from product to product and the acceptance criteria will determine which product type and therefore performance level is required.

Figure 1 shows the concept of utilising radiation attenuation compared to fully insulated and uninsulated barriers.


Figure 1: Integrity only barriers in a fully developed fire do not necessarily provide sufficient radiation attenuation to protect occupants as they exit a building in a fire. Integrity and Insulation barriers provide deemed-to-satisfy compliance but often compromise the aesthetic and function of the building thereby reducing the value of the building. Fire curtains that provide both fire integrity and radiation control provide a cost effective Performance Solution to many building applications.

***Performance Solution and Acceptance Criteria***

For fire separation Performance Requirement CP2 applies. CP2 states building elements which must avoid the spread of fire to the degree necessary. If the fire curtain system is to be used to protect an egress path Performance Requirement DP5 will also need to be satisfied. In some cases, the egress path may need to be widen to allow for the use of the fire curtain.

To satisfy Performance Requirement CP2, a simple quantitative approach can be used. Generally, fire curtains provide an inherent fire performance of 2 hours fire integrity (-/120/-) so the departure from the DtS provisions is merely the insulation performance. However, different fire curtain constructions will provide a different level of performance and the acceptance criteria used may demonstrate that after the maximum allowable radiant heat is exceeded, non-piloted ignition may still occur. Therefore, while the NCC provides a DtS concession for fire doors (for example) to have an insulation rating of no more than 30 minutes, an equivalent performance at 30 minutes may not be suitable. The acceptance criteria should also consider the time at which the maximum

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allowable radiant heat flux occurs. This time can be based on the required fire rating of the wall which the fire curtain is installed or the required egress time for example.

The analysis below is provided based on various Performance Requirements. Where compliance with DP5 for egress is not required for example, the most cost effective solution is to use Fyrehalt fire curtains as demonstrated.

Where protection is required for evacuating occupants and compliance with NCC Clause DP5 is therefore required, a fire curtain with increased performance will be needed. Fibershield LR fire curtains' unique construction offers significantly reduced radiant heat flux over standard fire curtains. Therefore, they are an ideal solution for catering for wide open spaces in non-fire mode and protection to occupants while egressing a building.

***Quantitative Analysis – Fire Separation (e.g.: basement car parks, shopping centres)***
While the fire curtain provides an FRL of –/120/- when fire tested in accordance with AS1530.4 demonstrating fire separation, the absence of or low insulation rating can potentially allow non-piloted ignition of materials on the unexposed side (non-fire side) of the barrier.

There are various publications that provide radiant heat limits for non-piloted ignition of materials. Current industry practice utilises either 25kW/m$^2$ or 12.6kW/m$^2$ [1] received at the location of the material. It will depend on the specific project as to which acceptance criteria is used. The configuration of the installation of the fire curtains relative to the location of the fire combined with the location of occupants can be considered and provide a suitable solution incorporating fire curtains. For installation configurations that are not ideal and expose materials that are known to ignite at lower levels of exposure involve locating these materials further back from the barrier or the Fibershield LR system used. Refer to Figures 2a and 2b.

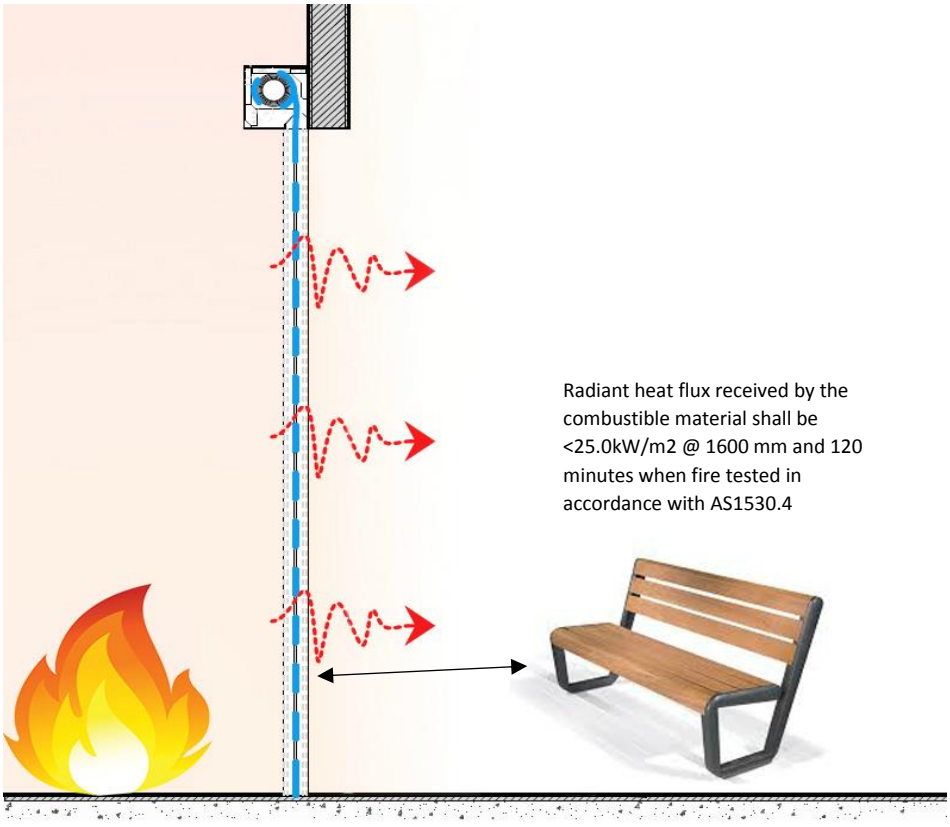


Figure 2a: the performance of Fyrehalt V is sufficient to satisfy Performance Requirement CP2 in many cases and the need for the higher performing Fibershield LR systems is not necessary where fire separation is the only consideration.

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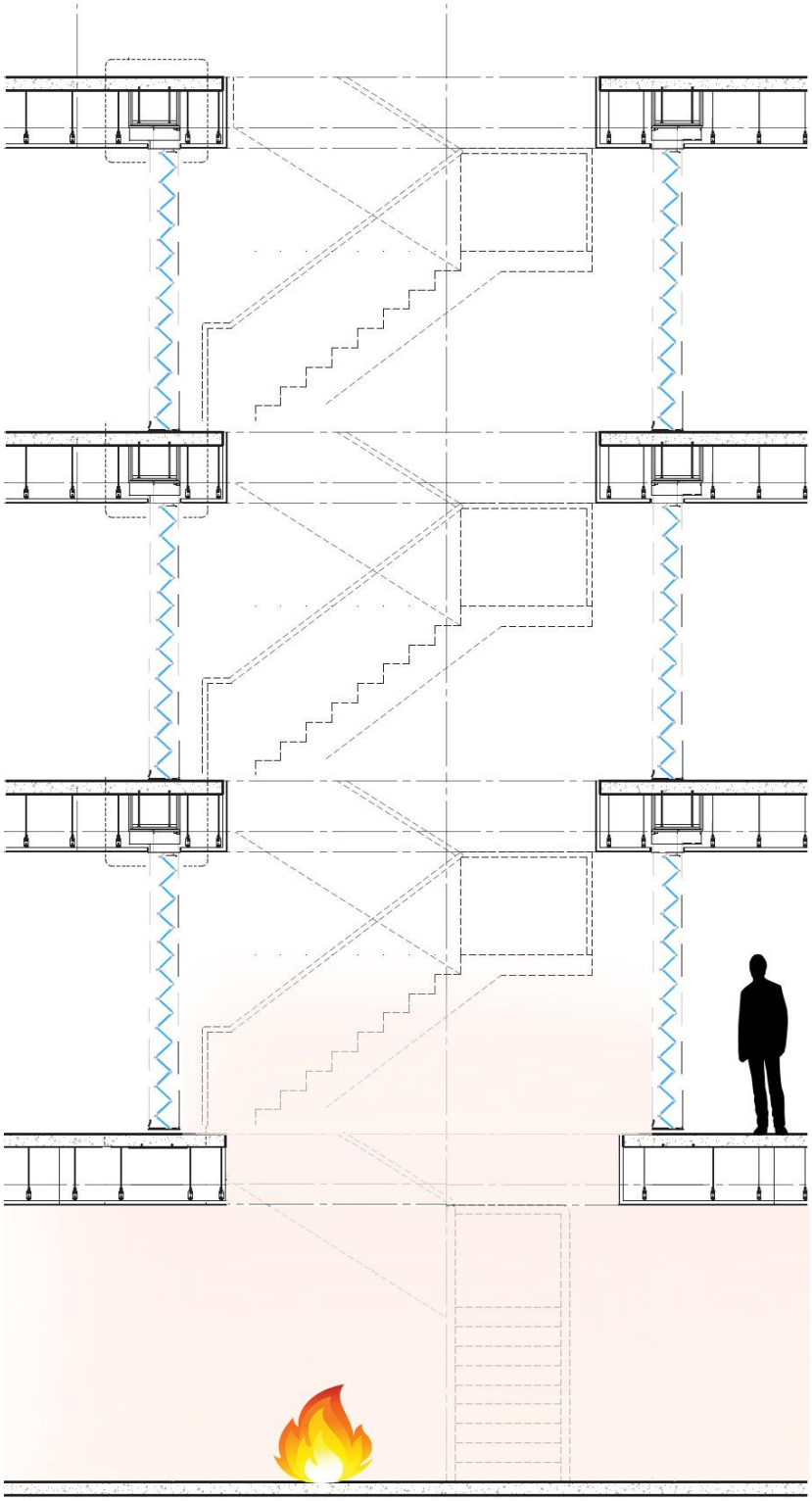

Figure 2b: The configuration of installation and location of the fire will also significantly improve the expected radiant heat data. Data measured in the Standard Fire Test is based on a fully developed fire located immediately against the fire curtain. The radiant heat flux levels, on the non-fire side of the fire curtains, required for non-piloted ignition are unlikely to be reached in the above configuration.

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Table 1 below shows the radiant heat flux at various distances and times that will satisfy Performance Requirement CP2 dependant on the location of combustible materials.

Table 1: Comparison of Fyrehalt standard vertical and concertina type fire curtain performance

| Model | FRL | Radiant Heat flux (kW/m2) | Distance (mm) | Time (minutes) | Standard | Approval Reference |
|---|---|---|---|---|---|---|
| Fyrehalt | -/120/- | 25.0[1] | 1.0 | 30 | AS1530.4 | FSV1465 |
| Fyrehalt | -/120/- | 25.0[2] | 1.0 | 60 | AS1530.4 | FSV1465 |
| Fyrehalt | -/120/- | 25.0 | 1600 | 120 | AS1530.4 | FSV1465 |
| Fyrehalt | -/120/- | 13.25[3] | 365 | 30 | AS1530.4 | FSV1465 |
| Fyrehalt | -/120/- | 12.6 | 2725 | 120 | AS1530.4 | FSV1465 |
| Fyrehalt | -/120/- | 12.6 | 1275 | 60 | AS1530.4 | FSV1465 |
| Fyrehalt | -/120/- | 12.6 | 500 | 30 | AS1530.4 | FSV1465 |

1. *Radiant heat flux level not reached at 30 minutes*
2. *Radiant heat flux level not reached at 60 minutes*
3. *Measured during fire test. Other data calculated based on this measurement.*

This system is ideal in applications such as fire separation in basement carparks, shopping centres, hospitals, warehouses and protecting non-essential stairs in office buildings.

These buildings have inherent characteristics, for example basement car parks are constructed from masonry and concrete and car parking is in designated areas. If the Fyrehalt fire curtain is installed on or adjacent to a ramp connecting different levels the distance to combustible objects such as vehicles is known. Shopping centres are also another example of known construction materials combined with designated areas of common area setting and lease boundaries.

***Quantitative Analysis – Fire Separation to an Egress Path***

There is a limit to the amount of radiant heat flux an occupant can endure in a fire. It is known that in a typical Australian Summer, bathers at the beach receive around 1.6kW/$m^2$. Prolonged exposure without any sun protection at this radiant heat level can result in painful sun burns. Available data [2,3] also suggests that exposure to 4kW/$m^2$ causes debilitating pain within seconds. Current industry practice uses 2.5kW/m2 as the maximum exposure limit for occupant exposure during egress.

Table 2 shows Fibershield LR120 or LR90 are potentially suitable to protect an egress path with a fully developed fire directly on one side of the curtain. When activated by early detection, the radiant heat flux is unlikely to be anywhere near that measured in the Standard Fire Test when occupants are exiting the building. Available egress time compared to the required egress time analysis may also support this strategy without the need to widen the egress path, refer to Figure 3.

Table 2: Comparison of Fibershield LR fire curtain performance

| Model | FRL | Radiant Heat flux (kW/m2) | Distance (mm) | Time (minutes) | Standard | Approval Reference |
|---|---|---|---|---|---|---|
| Fibershield LR120 | -/120/- | 2.8 | 60 | 30 | AS1530.4 | FAR4731 |
| Fibershield LR90 | -/90/- | 2.8 | 60 | 30 | AS1530.4 | FAR4731 |

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***Additional things to consider***

- Is the building sprinklered? If so;
  - It is feasible that the Fibershield LR fire curtain may never reach the end of its performance limits of 2 hours (although they have been fire tested to -/180/- in any case). It is therefore possible to consider a reduced fire rating of say -/90/- and utilise the Fibershield LR90 as the sprinklered controlled fire will prevent the level of heat exposure expected in a fully developed fire.
  - The radiant heat flux will also be lower than that measured in the Standard Fire Test and therefore egress paths may not have to be widened.

- Geometry of installation;
  - In addition to the above data, consider the intended location of the fire curtain. If, for example, the system is face fixed onto the wall on the opposite side of the egress path, the distance between the face of the curtain and the egress path is automatically increased to the thickness of the wall, typically no less than 120mm for a plasterboard fire wall. This creates an extended effective distance to the occupants as they egress the building and therefore also reduces the radiant heat flux received. Figure 2 illustrates this concept.

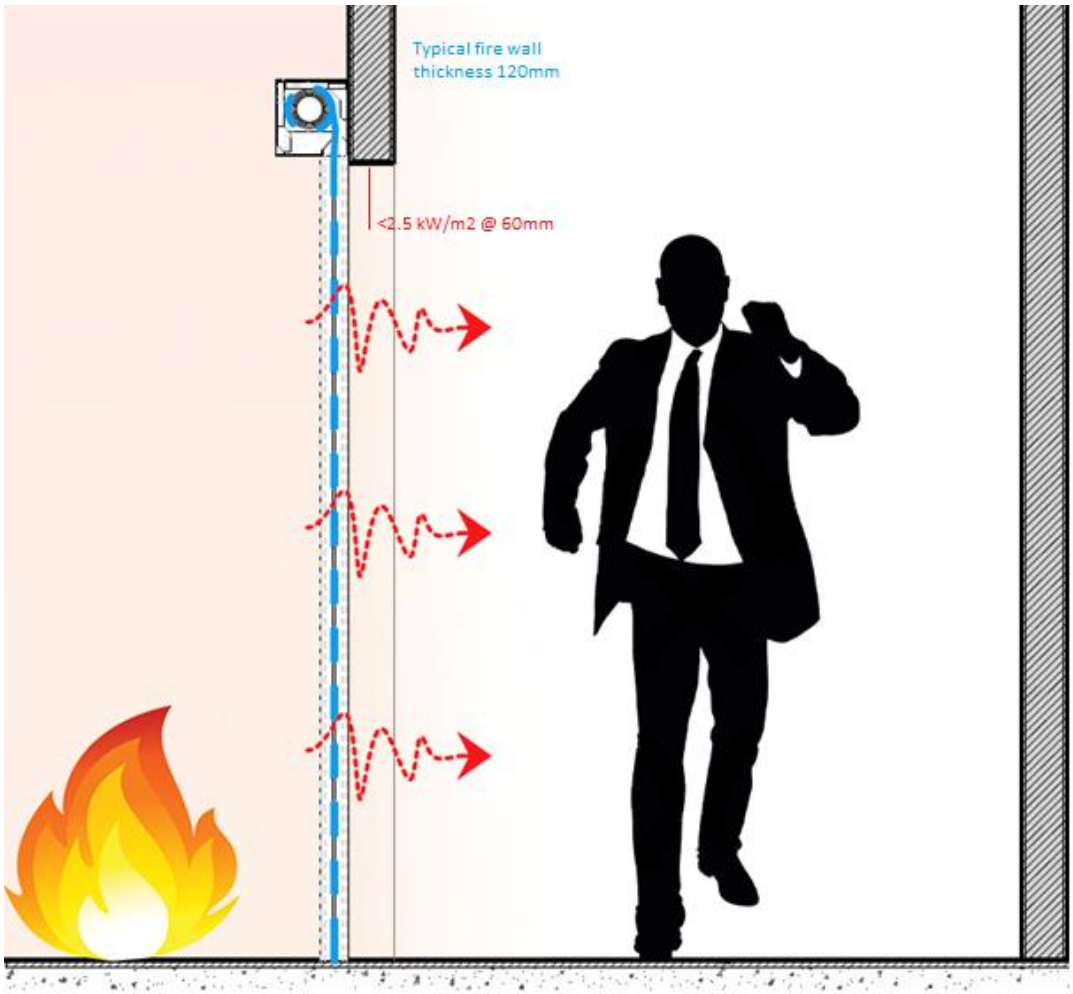


Figure 3: Data measured in the Standard Fire Test is based on a fully developed fire immediately adjacent to the fire curtain. Early detection will mean that the fire size is likely much smaller than that which the radiant heat flux is actually measured. Provided the egress time is less than 30 minutes it is unlikely that the occupants will be exposed to any significant radiant heat, even in a non-sprinklered building. The geometry of installation of the Fibershield LR fire curtain will assist with increasing the distance between the radiant heat source and radiant heat flux received by the occupant.

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***Applying maximum allowable radiant heat flux for fire separation***

- When measured in accordance with AS1530.4, the maximum allowable radiant heat flux for the Fyrehalt V fire curtain or Fyrehalt – Evolution fire curtain shall not exceed 12.6kW/m2 @ 500mm from the face of the barrier when measured at 30 minutes and provide a fire resistance level of -/120/-.

***Applying maximum allowable radiant heat flux for egress path protection***

- When measured in accordance with AS1530.4, the maximum allowable radiant heat flux for the Fibershield LR120 or Fibershield LR90 fire curtain shall not exceed 2.8kW/m2 @ 60mm from the face of the barrier when measured at 30 minutes and provide a fire resistance level of -/120/- or -/90/- respectively.

References
[1] DFES BEB Guideline No.: GL-15 Fire Safety Engineered Alternative Building Solutions; March 2015
[2] AS1530.4 Methods for fire tests on building materials, components and structures, Part 4: Fire-resistance test of elements of construction, Appendix A
[3] Tenability in Building Fires: Limits and Design Criteria, Dr Weng Poh, Fire Australia Industry Matters, Spring 2010