# Cavity Barriers: Final Factual Report of the Experimental Programme

***The authors of this report are employed by BRE. The work reported herein was carried out under a Contract placed by the ODPM. Any views expressed are not necessarily those of the ODPM.***

## Executive Summary

This report brings together the data and findings from the experimental programme undertaken to support the review of the guidance, currently provided, in Approved Document B (AD(B)) on cavity barriers. The work was undertaken to provide data to support the current ongoing review of Approved Document B.

The information presented in this report covers five discrete work packages which have been undertaken to address areas identified as requiring investigation. The topics identified were :

1. Three cavity barrier scenarios:
    - Floor voids
    - Plenum spaces
    - Cavity closures
2. Data from the floor voids and plenum space programmes were used to develop an existing validated model based on the BRE ‘Jasmine’ computational fluid dynamics model, for use with both floor voids and variations to plenum space designs.
3. Consideration of the standard test methods for assessing the fire resistance performance of the cavity barrier systems.

These topics were addressed using experimental programmes designed to investigate the key issues and provide practical solutions.

The key findings from this work were :

- Confirmation that cavity barriers, when appropriately designed and installed offer a means by which unseen smoke and fire spread may be mitigated.
- The issues of installation design and methods must be considered in the application and use of these systems.
- Modelling of these types of systems may offer potential options for expansion of current design solutions.

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## Introduction

This report brings together the data and findings from the experimental programme undertaken to support the review of the guidance, currently provided, in Approved Document B (AD(B)) on cavity barriers. The specific objectives of the experimental programme were identified as a result of a review exercise to establish the background and development of the current guidance. The findings from this study suggested that there appeared to be only a limited amount of directly relevant data in this area and therefore additional supporting experimental work would be required.

The key topic areas identified several areas for further investigation into the potential for unseen smoke and fire spread through voids and cavities, based on experience gained from users of the current guidance and changes in building construction methods. The topics identified were :

1. Three cavity barrier scenarios:
    - Floor voids
    - Plenum spaces
    - Cavity closures
2. Data from the floor voids and plenum space programmes were used to develop an existing validated model based on the BRE ‘Jasmine’ computational fluid dynamics model, for use with both floor voids and variations to plenum space designs.
3. Consideration of the standard test methods for assessing the fire resistance performance of the cavity barrier systems.

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## Project Summary

As these topics were completed as discrete work packages, this report has been prepared as a summary document with detailed Annexes addressing each of the work areas as follows:

### Floor voids – Annex A

In order to investigate the potential for unseen fire spread to occur through the voids in suspended floor systems, a series of experiments have been undertaken utilising a commercially designed and installed suspended floor system. Work has also been undertaken to look at potential fire risks from standard timber floor systems and also potential transmission routes for fire spread from radiated heat from the room of fire origin into the floor void. The work was completed in three phases which are presented in Annex A. The results from this work confirmed that cavity barriers, when effectively designed and installed appeared to offer a suitable means of mitigating potential fire and smoke spread through unseen floor voids.

### Plenum spaces – Annex B

Considerable work has been undertaken in characterising fire travel through plenum spaces via cables and this work was undertaken to investigate the effect of cavity stopping at preventing fire spread through void spaces. Three scenarios were considered and the results are presented and discussed in Annex B. Again one of the key findings from this work was to confirm that whilst combustible materials passing through voids may offer a potential fire transmission route, appropriately designed and installed cavity barriers can provide a means a mitigate any fire and smoke spread risk.

### Cavity closures – Annex C

The objective of this study was to investigate the effectiveness of different types of window frame constructions at mitigating the entry of fire into a timber frame cavity. The experimental scenario selected for this study was based upon a post flashover fire within an enclosure, breaking out through a window opening which is set within a timber frame cavity wall construction. Four systems were investigated and the findings are discussed in detail in Annex C. These findings suggest that, as has been seen as a common theme throughout this work, that the interface detail between the cavity closure and the primary substrate is as critical to the overall performance of the system as the ability of the material involved to withstand the imposed fire load.

### Computer modelling - Annex D

BRE work on fire modelling research and development has culminated in the development of its own computational fluid dynamics (CFD) fire models JASMINE and SOFIE. These models have been used to complement the experimental programmes, for assessing the performance of cavity barriers installed in floor voids and plenum

spaces. The findings are discussed in detail in Annex D where the main conclusions showed that the models may provide a reasonable basis for assessing the overall fire performance of potential design solutions using these types of scenarios.

### Fire Resistance testing – Annex E

In order to assist in the development of an appropriate fire resistance test for assessing the performance of cavity barrier systems, four typical cavity closure systems were subjected to an adhoc fire resistance scenario based upon a standard fire performance temperature-time curve using a 1.5m adhoc test furnace. The scenario adopted was designed to consider the influence of installation details on the performance of the systems when tested to the adhoc scenario and to therefore provide a practical approach to assessing these types of systems, whilst recognising the need for a standardised test method. The results from this work again raised issues regarding performance in service in relation to the ease of installation and hence associated workmanship related to the 'end use' of the system.

## General Discussions and Recommendations

The primary findings from this work are:

- Confirmation that the cavity barriers can provide an effective means to mitigate smoke and fire spread if they are designed to meet the service requirements expected in practice. This must include provision for jointing details, as shown in the adhoc fire resistance tests. The interface between the barrier and the primary structures must also be addressed, as illustrated by the failure mode of the timber window frames in the cavity closure tests.
- The key factor in the performance of the systems appears to be the ability to install and repair the systems simply, this can be affected by a number of issues, which lie outside the scope of this study. However, this issue must be considered in the context of the performance requirements placed upon these products when in service. This includes addressing the control of openings and services passing through any barrier, as shown by the plenum tests, Annex B.
- The findings from the plenum tests suggest that appropriately installed cavity barriers may provide a useful means of controlling potential unseen smoke and fire spread through voids and cavities in scenarios such as floors where combustible services may be present, without the redress to significant controls on the materials passing through the voids.
- The results of the window closure work suggest that where excessive movement or consumption of the frame material during the fire allow flames spread into the timber cavity, the use of the robust design details for timber frame systems appears to offer a potential mitigating option. The work also showed that whilst the frame work may not be consumed or displaced in the fire, if the fixing to or robustness of the primary structure is not adequate, breach of the cavity can still occur and in such cases, the robust design detail still provides an additional mitigating effect.
- The modelling work has been shown to be a potentially useful tool for assessing the performance of these systems in practice.