

**Bim4Housing Recommendations on the Essential
Underpinnings for Fire Penetration Seals to Strengthen the Golden Thread**

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And the experts listed in Appendix 4

Below are recommendations that we, as BIM4Housing, are putting forward as the findings of our subject matter experts. We do not claim these findings to be definitive, but we would hope that they would provide 'accountable' and 'responsible' persons with some of the detail they would require to ensure that risks are mitigated.

Format

The structure of this set of information is designed to be consumed in various ways by different stakeholder groups doing different things. Therefore, information mentioned in one section may be repeated in another, so they can be applied to a particular activity.

Also, we have sought to organize the information to make it more machine-readable so, although the lists could be reduced by combining similar items, this would make them less easily used in applications.

Despite the need to edit and contextualise, we have tried to retain the authentic voice of our experts throughout. This is especially so in the Appendices, where no colloquialism is left unturned.

Terms of use

This document is not intended as an end-result, but as a snapshot of a dynamic, on-going piece of work being developed by Subject Matter Experts who represent the different interest groups.

We hope it is helpful, but it should not be used in isolation, since, as we have learned from our collaboration, no one knows everything. It should therefore be used to supplement other sources of information, all of which should be validated by a responsible person applying it to a project.

Comments and additional contributions are welcome and a panel of volunteer experts will review suggestions to assess/validate them and augment the guidance as required.

INTRODUCTION

Structure

We have six Working Groups of experts who understand the individual Stakeholder needs of Development, Design, Construction, Manufacturing, Operations, and the specialist Advisors who support the whole process. Each Working Group determines the problems they are experiencing that could be alleviated by better information, often from a different Stakeholder group and they collectively establish Workstreams to collaborate and share knowledge to come up with practical solutions.

They have established Workstreams for MMC, Data Standardisation, Sustainability and Fire Safety and the latter has, in turn, established Round Table workshops that bring together SMEs (Subject Matter Experts) who really understand specific asset types. Outputs from the workshops will feed into the GTI (Golden Thread Initiative).

(See Appendix 1 for Structure Diagram)

Fire Safety Methodology

It was determined to take individual fire-critical assets and examine impacts and influences through their lifecycle. A series of online discussions were held, along with one-on-one calls and an email gathering of views and inputs. This culminated in a series of Roundtable discussions, each with a clear focus and targeted output. BIM4Housing's expert team was enhanced by guests from the GTI, along with other fire safety specialists throughout.

Phase 1 defined the over-arching questions that need to be answered, for each asset type, to deliver the BIM-plus solution necessary to the effective functioning of the Golden Thread in terms of Fire Safety.

The questions defined are:

- What risks does the asset mitigate?
- To what risks is the asset, itself, susceptible?
- What information is needed about an asset, to ensure it performs as required?
- What tasks/method statements/procedures are required to ensure the asset is installed, commissioned, inspected, and maintained properly?
- What level of competency/training needs to be in place?
- How should product changes be recorded?

Phase 2 sought to answer those questions, offering a definitive guide to the delivery of The Golden Thread through the effective management of required information.

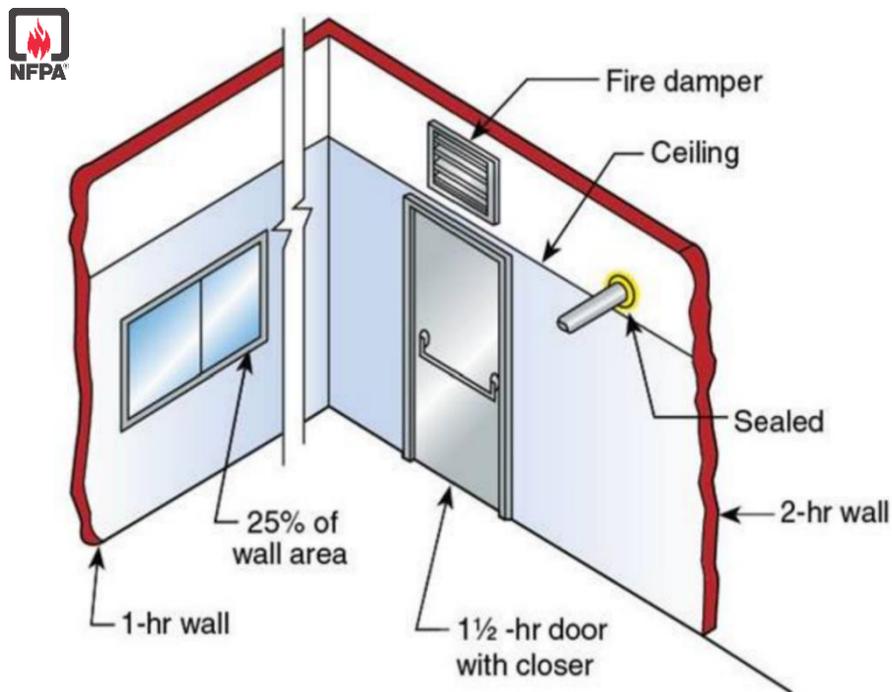
Phase 3 seeks to build on our ongoing learning and experience and include further assets in our process.

Fire Penetration Seals Methodology

The output from a Roundtables (3rd and 13th September 2021) was collated and contextualized and combined with further subject matter expert input. Significant participant engagement was achieved prior to the events. The resulting report was then peer-reviewed.

What are Fire Penetration Seals?

Fire Penetration Seals, also known as Fire Stopping, form part of compartmentation and are a fundamental part of passive fireproofing. They refer to the process of filling openings and joints between walls and floors with fire-resistant material, inhibiting the spread of fire between 'compartments' within a building.



Fire and Smoke Damper Installation

FINDINGS

It was determined to look to 'codify' risks to enable teams to coalesce around tackling a problem, run scenarios to simulate what might happen and how collaboration can reduce the risk of them happening.

Two other GTI Working Groups, H&S and Standards, have been working with NBS to extend Uniclass to carry a more detailed set of risks and, those identified here, can form part of that.

Clearly, it is not desirable for the 'Accountable Person' to be absolved of responsibility for not anticipating a risk, simply because it was not on the list of suggested risks- which should be considered a 'steer' not an absolute. However, without that list, it becomes impossible to define and deliver the information needed.

Q1a. What risks do Fire Penetration Seals mitigate?

- Risk of smoke spread (it should stay and build up in the compartment of origin)
- Risk of heat spread (it should stay and build up in the compartment of origin)
- Risk to fire-fighter's access
- The risk of the spread of fire and products of fire (fire, smoke, heat) via cavities in external and internal walls, along with other concealed cavities (such a roof and ceiling voids)
- The risk of spread of fire, smoke, and heat between building compartmentations.
- Risk of speed of fire and smoke spread
- Risk of number of uncontained areas
- Risk of inhibiting safe exit from the building
- Risk of fire brigade not having enough time to attend before fire spread
- Risk of system failure.
- Risk of Injury/harm/loss of life to residents/occupants.
- Risk of smoke damage and subsequence.
- Risk of compromising security, both for the building and individual apartments, when doors don't close properly or are propped open.
- Risk of reduced thermal efficiency
- Risk of degraded acoustics.
- Risk of damage to property, building or structure.
- Avoiding risk of compromising of structural components. (e.g., Columns, Balcony brackets, etc.)
- Risk of components falling or causing firefighter danger.

Q1b. What compromises Fire Penetration Seals' ability to perform as required?

- Risk of human intervention on ancillary assets, such as smoke detectors, impacting on asset performance
- Risk of information on an individual asset being incomplete, inaccurate, or absent
- Risk of information on an individual asset not being supplied in both digital and physical format
- Risk that the asset has not been tested against the 'Cause and Effect' document

- Risk of other trades and employees not appreciating the asset's function and so compromising its performance
- Risk of non-appreciation of the differences between performance of assets in compartmentalised areas versus performance of assets in shared circulation areas
- Risk of vandalism or simply misuse

Materials

- Building movement / shrinkage
- Excessive water damage
- Some Laboratory testing not covering real-life scenarios

Installation

- Failure to install properly due to lack of skill and knowledge.
- Incorrect installation of service penetrations:
 - insufficient spacing of services (too close together)
 - incomplete base material (e.g., no lintels in solid walls, openings in partitions not framed and lined)
 - insufficient service supports (too wide spacing, non-fire rated materials, unsuitable anchor fixings into soffit (non-fire rated, not designed for support in fire).
 - non fire rated service supports
- Risk that incorrect Fire Penetration Seals have been used around fire dampers and fire resisting ducts
- Risk that incorrect Fire Penetration Seals have been used around smoke control dampers and smoke control ducts
- In service damage/disturbance to FSDC through maintenance, replacement of services, pipe leakage etc also influences FSDC efficacy.
- Incorrect builders frame to permit connection to building element
- Supports for building services are sometimes installed too far from the Fire Penetration Seals, resulting in the Fire Penetration Seals, itself, acting as a support. There should be independent support within 500mm of Fire Penetration Seals.
- If any in-situ welding is required, this should not be carried out within 500mm of Fire Penetration Seals because heat can transfer up the pipe and activate the Fire Penetration Seals.
- Change of location of a door, for example, can lead to the 500 mm prescribed distancing being breached.
- Change of location of the Fire Penetration Seals to cross 'barriers', such as lintels.
- Size of fitting space not matching the specification, so the Fire Penetration Seals needs extending.
- Refurbishments and upgrades
- There is no benchmark for third party accreditation for installation contractors, so the door is open for sub-standard accreditation, as contractors may take the easiest option.

- Fire Penetration Seals is tested in isolation, whereas it often installed in the same space as services and therefore should be tested in that context.
- Sub-standard digital infrastructure.
- Fire Penetration Seals seen as an after-thought resulting in too little time allocated for proper assessment of the fire strategy and other assets/materials that make up the compartment.
- In service damage/disturbance to FSDC through maintenance, replacement of services, pipe leakage etc also has an effect on FSDC efficacy.
- Incorrect builders frame to permit connection to building element
- No flexible expansion connector to mitigate duct expansion and thrust in event of fire causing displacement of damper from opening
- No breakaway joints (e.g. aluminium sacrificial rivets) to allow duct to detach in fire
- Insufficient base material preparation (e.g. no lintels in solid walls, unframed and lined openings in partition walls, three-sided apertures)
- No maintenance programs
- No annual inspections
- Fire stopping damaged after installation by follow on services
- Incorrect testing for product to substrate
- Outdated test for compliance based on previous formulation/make up
- Incorrect aperture sizes will not replicate the tested product and classification

Q2. What information is needed about Fire Penetration Seals to ensure they perform as required?

(It is important to understand how the information will be used and how the context will vary what information is required. Initially, this was the subject of quite a lot of debate – largely driven by a worry about ‘information overload’. However, with a truly cross disciplinary team of SMEs, it was possible to drill down to understand the detail of why a role would need certain information.

The aim was to collect all the information all stakeholders need against all products and leave it to each role to configure their software applications to see only the information they need for that individual task.)

- Base material
- Type
 - movement of structure and services
 - environment exposure
 - service maintenance
- Location (both space(s) and x/y coordinates)
- Resistance classification required.
- Intended use inputs on selection of type
- What has been installed, by whom and when.
- Other requirements:
 - acoustics
 - Durability/long term resistance
 - airtightness
 - mold resistance
 - paintability
- Test evidence of compliance to match the intended use i.e. size of opening closure of opening when it's a flexible wall(drywall) and be suitable for the type of services penetrating the wall or floor
- Fire only, fire and smoke, smoke only
- What supports are needed for continuous support during fire (eg fire rated channel, supports, anchors)
- What is the item there for – acoustic, fire, integrity, or insulation or both?
- What areas need to be accessible for inspections?
- Limitations
- Lifespan
- Maintenance requirements
- When to consider upgrades or replacement
- Local security so they cannot be tampered with or misused.
- Planned works in the building
- As built / O&M manuals to show the locations of the Fire Penetration Seals that have been installed

- Levels of protection 30/60/90/120
- Means of application. i.e., brick or block, around plastic pipes or within plasterboard construction
- A true cause and effect of all active systems that are interlinked
- Check installation seals around the outside
- Check that the seal is still intact from both sides

Q3. What tasks are required to ensure Fire Penetration Seals is installed, commissioned, inspected, and maintained properly?

(It should be given that any work on fire safety critical assets should always be undertaken by competent people, probably 3rd party accredited. However, that person must be supported with any information that they might need to reduce the risk of an important step being missed and to provide an auditable record of what tasks were completed. This is common practice in M&E maintenance, where the industry has developed a significant library of standard procedures and tasks lists, along with roles/competency required.

An air-conditioning unit is maintained by a qualified air conditioning engineer, but the engineer is also issued with a check list for them to record what was done.

A similar industry-wide check list for installation, commissioning, handover, maintenance, and recycling could be agreed.)

- Check building deflection (Building Deflection is the way a structural element moves under load from above. There are various types of loads that can be applied from above and these can result in the standard supporting construction required fire safe deflection heads more than 250mm.)
- Ongoing checking of the selected materials should be made to ensure resilience of chose FSDC solution with any maintenance/inspection procedures and regimes written into the O&M.
- Check manufacturer has sufficient technical details and method statements to aid installation
- Check manufacturer has method statement for installation and that there is a sign off procedure
- Always use the installation method prescribed by the Fire Penetration Seals' manufacturer, not doing so, means that responsibility for a design element has been taken
- Check what is the due diligence if something to assist in the installation is ignored
- Check labeling
- Ensure any trade that comes to your building is offered the fire strategy drawings and they mark the areas that they have worked on onto the drawing
- The person undertaking the work should be competent, but they should be supported with check lists for installation, commissioning, inspection/maintenance, decommissioning/replacement
- Check installation of the product

(See Appendix 2 for Additional Participant Input)

Q4. What level of competency/training needs to be in place?

(Industry training courses are critical, but they must be complemented by additional knowledge-transfer from people with many years real experience.

Individual manufacturers have product-specific training which complements the more general training. Such training resources need to be provided in all cases where a product is used – both for new build but also as part of the long-term H&S/O&M information, ideally held as machine-readable data in the Asset information model to ensure maintenance teams have easy access to critical information.)

Installation

- Those involved in the design and installation should be able to demonstrate training /qualifications relevant to the systems they design/install and be members of a recognised organisation such as Association for Specialist Fire Protection (ASFP) with accreditation through the likes of the UKAS Approved Fire Penetration Seals Installer Accreditation Scheme
- Competency of individual installers demonstrated through certification with a suitable 3rd party accreditation provider. This should include the provision of the manufacturer's fitting instructions
- Specification of which third party accreditations are acceptable (e.g. Trada, Firas, BM Trada, IFC etc.) should be required
- Ongoing demonstrable CPD of installer (not simply the company they work for). For example, operatives installing products should have achieved L2 NVQ Diploma in Associated Industrial Services Occupations - Passive Fire Protection (Construction)
- Supervisors should have achieved L3 NVQ Diploma in or IFE Level 3 Certificate in Passive Fire Protection or be named as a competent supervisor in the company UKAS accreditation (see <https://essentialsiteskills.co.uk/course-index>)
- Installer should have manufacturer-led product-specific installation training, in addition to any formal UKAS accreditation.
- Manufacturers should offer installation training, either in their own right, or sub-contracted out to a specialist to provide that service
- code of practice should include training materials
- Competency and training needs include:
 - Base material construction (especially partition walls particularly with new guidance being provided e.g., BG Best practice guidance for openings within fire rated systems) D
 - Spacings (including separation of duct/dampers from other service penetrants) of services as limited by test data and to permit installation of firestop
 - Service supports
 - Firestop installation to be by 3PA accredited contractors using CE/UKCA/3PA products

NB. There is no statutory requirement for Fire Penetration Seals installers to be qualified. Under forthcoming guidance, some CPD qualification maybe required, but those certified contractors can still employ unqualified installers to do the work.

Maintenance

- Manufacturer-specific installation, commissioning, inspection, maintenance/repair, replacement, and recycling requirements should be retained to inform future maintainers of the manufacturers' recommendations.
- Mandatory awareness training should be in place for all people working on site and carrying out maintenance in buildings
- Training for the operational team should be required on Standards (BS, CEN etc.) plus to give a basic understanding of how to read drawings, commissioning certs, O&M's,
- BSI Flex 8670 focuses on the competence of individuals and expects that organisations use this core criteria as part of their management of competency (planning, monitoring, reviewing etc.). This also enables the capture of the skills, knowledge, experience, and behaviors necessary to the undertaking of a defined role, function, activity, or task.
- Manufacturer competency in providing
 - product training
 - technical support
 - engineering design to overcome non-standard applications

Q5. How are the changes from one product to another recorded?

(If information is not updated, it isn't information anymore. It is misleading and, possibly, down-right dangerous. If the systems and processes to keep information current are not trusted, then the value of even correct information is compromised.

Robust Change Management requires an information baseline against which the different states – current, proposed, final and ongoing change – can be measured and reported.

The baseline information should contain the required performance in a machine-readable/actionable form and the Change Management process should enable that to be compared with:

- a) the actual performance of the designed solution (probably generic)*
- b) the performance of the chosen product against the generic*
- c) the performance of an alternative (value engineered?) product*
- d) the record of what was used/installed.)*

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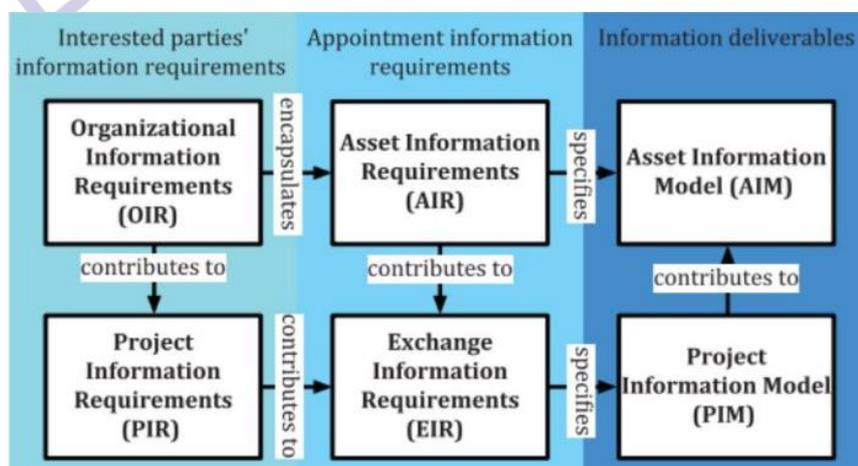
- a) the actual performance of the designed solution (probably generic)
- b) the performance of the chosen product against the actual application
- c) the performance of an alternative (value engineered?) product
- d) the record of what was actually used/installed.

Requirements and Suggestions

- A schedule of safety critical elements for the building, to include products specified
- Baseline against which to compare proposed alternative products (Some designers have expressed reluctance to propose (not specify) a specific manufactured product that will satisfy their design due to liability, procurement rules and fees)
- This schedule would be “Locked” at a specific design stage, after which changes to products specified should not occur except for exceptional reasons
- A formal change management system is required to ensure that any unavoidable changes are validated by a ‘responsible’ person e.g. original designer and/or fire engineer
- There is a well-established change management process in construction called Technical Submissions in which requested changes from the specifications/recommendations, that were created by the designers (and selected manufacturers), need to be formally reviewed and approved. Design-and-Build procurement has affected that process and it should be reestablished in a way that the performance of a proposed product, and its constituent components, is easily compared with the proposed alternative and, if agreed, it is recorded as a Technical Deviation

- Validation of changes would include verifying that the new product met all the requirements for the application with no detriment to the overall design, the details of which should be recorded (Changes in the product may be made between design and procurement, procurement and installation, handover, and ongoing maintenance)
- More onus needs to be on the client during the collation of Information Requirements and the updating of design models into 'as installed' content suitable for Asset/Facilities Management
- Full Disclosure of the product is needed at handover so that after Work Stage 7, if a manufacturer goes out of business or products change the record is there in perpetuity
- Asset database must be kept up to date with core data for new installs. Installation documents should be held in a centralised digital location. Once BIM/COBie level data is manageable within the asset management system then this will be used as the main source of data.
- BIM, CAFM, Asset and Housing management systems must inform the change management process
- H&S files for each building (cradle to grave) must be supplied, recorded, and be updated with notification of changes and the implications.
- Warranty information of the existing and the proposed products should be provided to allow proper consideration to be made on the selection of an alternative or replacement. If a product has a shorter life than another, this information should be available to inform selection. Given some of the products will be in locations that are difficult to locate, the longevity of a product could have safety implications.
- Compliance systems should be informed with the information from the AIM (Asset Information Model)
- Asset tagging (barcode) systems and processes should be considered as forming part of the change management process.
- Procurement should be included in the process, recording what was purchased and feeding that into the BIM process to locate where they were installed, or which products they are replacing.
- Specification or design brief for the business (performance and or product) should be recorded in a machine-readable format to enable validation against the Golden Thread.
- Record the compatibility and compliance of any ancillaries and confirm they comply with the test data? (Ironmongery, door access control systems, vision panels, vents)
- Any adjustment, repair, addition to / removal of product, ironmongery or fittings must be recorded and should only be undertaken by a licensed / accredited contractor (this includes and modification to an existing asset)
- The asset information needs to enable comparison but the original performance spec of the product and the related information such as Fire Strategy and Cause and Effect should form part of that Technical Deviation process. The FMs must be able to update the Asset Information Model with machine-readable data of the newly installed product

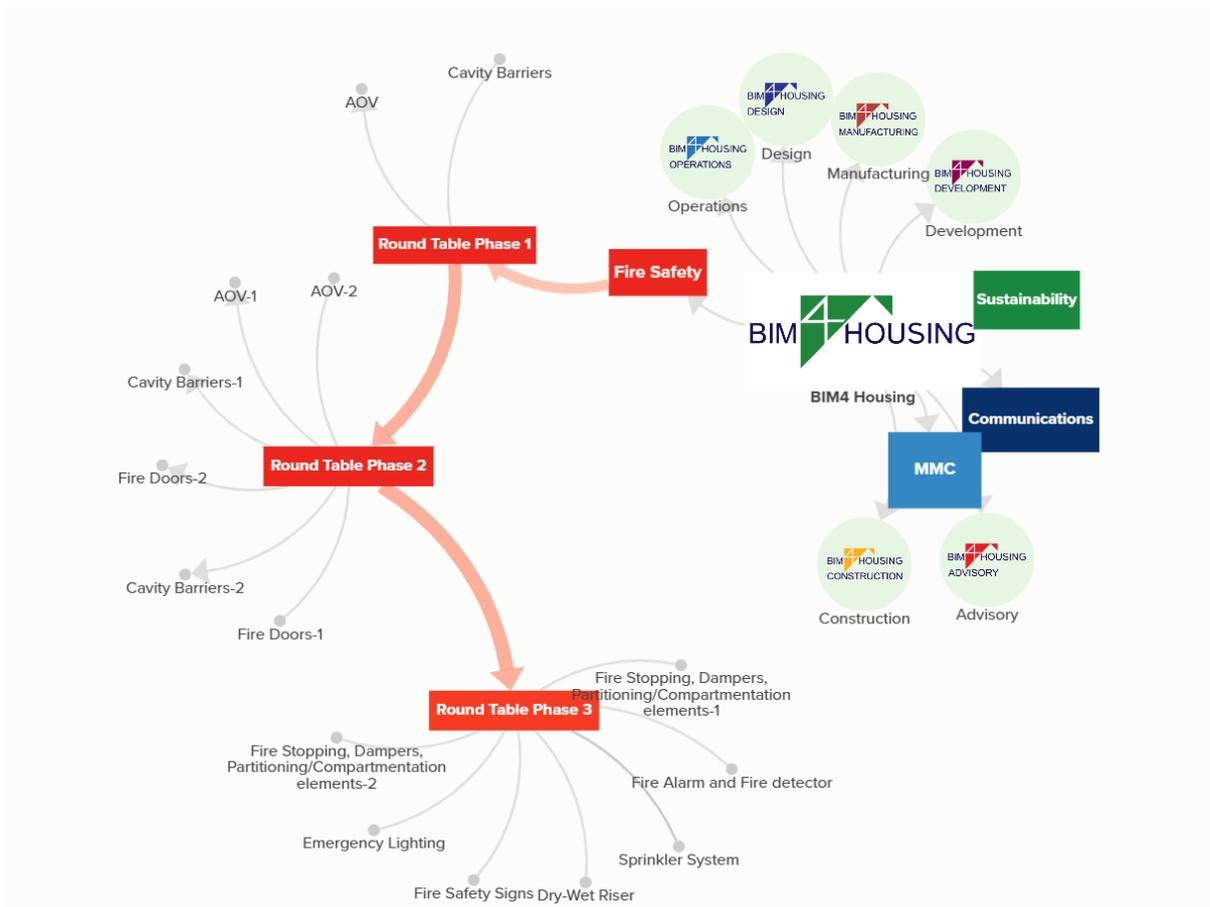
- Commissioning and maintenance manuals provided and part of O&M manuals
- Robust design control process, with detail review and change authorisation, should be within ISO 9001 process control
- BIM models and data storage such as Fire Emergency Files need to be complete in its entirety not just 'what is available'. This could be on a local files or IT software solution or possibly on a central system. Key element is that 5/10/15/20 years down the line the relevant information is available
- Need to audit the information to confirm that the correct holes, infill, products etc have been used
- Product should be agreed as part of the overall design and never put as a Contractor-design portion. Equal and approved by the principal designer
- Recording who has worked on/replaced the component and their entitlement/competence to do so
- Evidence that the component's performance in relation to the part it plays in the system has been considered and is warranted
- Manufacturers must provide a component list (e.g., ironmongery on a door) so if anything breaks, a direct replacement can be used.
- Removal of certain products/materials must be undertaken by people who are on an approved list, certified by an accreditation body and should require advance notice to all certification holders, with signoff to ensure traceability
- Post hand-over work, such as broadband installation, may undermine work already completed by Fire Penetration Seals contractors and therefore compromise compartmentation. Such work should be managed as a Change and therefore planned, supervised and recorded.
- PIM's and AIM's (Project Information Models and Asset Information Models)
- ISO 19650, this diagram is so important



(See Appendix 3 for Additional Participant Input)

APPENDIX 1

BIM4Housing Structure



BIM4HOUSING

APPENDIX 2

Additional Participant Input Question 3

GOLDEN RULE 1
Ensure an early engagement with firestopping manufacturers and specialist installers.

GOLDEN RULE 2
Review the fire strategy documents and fire strategy plans in conjunction with the M&E specifications.

GOLDEN RULE 3
Identify all of the service types passing through the compartment floor or wall including any insulation products. Establish the space required to install and firestop the services.

GOLDEN RULE 4
Follow the 'Design process for penetration seals'.

GOLDEN RULE 5
Only select firestopping products which are third party certified by a UKAS accredited organisation. Firestopping products should be certified or CE marked and tested using the relevant standards.

GOLDEN RULE 6
Ideally select one firestopping manufacturer throughout the project. Products from different manufacturers should not be mixed in the same opening unless there is clear test evidence to substantiate their use.

GOLDEN RULE 7
Request copies of the third party certification from the manufacturers. These should be reviewed by a suitably qualified person to ensure the certification and field of application is relevant for the situation.

GOLDEN RULE 8
Ensure the installers of ALL service penetration seals are third party certified by an organisation such as FIRAS, LPCB, IFC, BM TRADA etc.

GOLDEN RULE 9
Implement a structured inspection plan to include photographic evidence as the work proceeds.

Follow these 9 Golden rules:

APPENDIX 3

Additional Participant Input Question 5

Models reflect both Design and Construction models with ownership (and therefore liability) associated with Changes made in each. Mechanism for updating models may impact on a model owners' liability. A Designer may refuse to change a model to reflect as built as they will not take liability for a Constructor-installed product. Change management along with ownership and liability needs to be reflected.

Accountable person under the new Building Safety Act

The performance of the penetration seal for trays/pipes/trunking, fire dampers, FR ducts, SE ducts, chimneys(flues) in terms of their classification is required to be verified against the classification of the wall and the requirement of the specific requirements for the purpose of the system to which they are installed. Then any change can be judged in that context.

Many existing buildings have been modified so that the original compliant smoke control system can no longer work and original design is invalid. Therefore, the Change Management process should include these wider changes which will have wider impact.

APPENDIX 4

Participants

Alastair Brockett	Hilti
Audrey Hesse	Chartered Architect
Chris Hall	Siderise
Daniel England	PRP
Dave Peacock	TUD SUD
David Poat	Nottinghill Genesis
Duncan Alabaster	Polyseam
Emma Murphy	Thrive Homes
Fredrik Hiort	BRIAB
George Stevenson	ActivePlan
Ian Doncaster	Fire & Smoke Solutions
Joanna Harris	Sodexo
Joe Cilia	FIS
Martin Milner	Milner Associates
Mustafa Alhashimi	Clarion Housing
Paul McSoley	Mace
Paul White	Ventilation Fire Smoke Ltd
Sean Hicks	Levitt Bernstein
Sharon McClure	Avesta Group
Sue Wilbraham	Metropolitan Thames Valley
Will Perkins	SE Control