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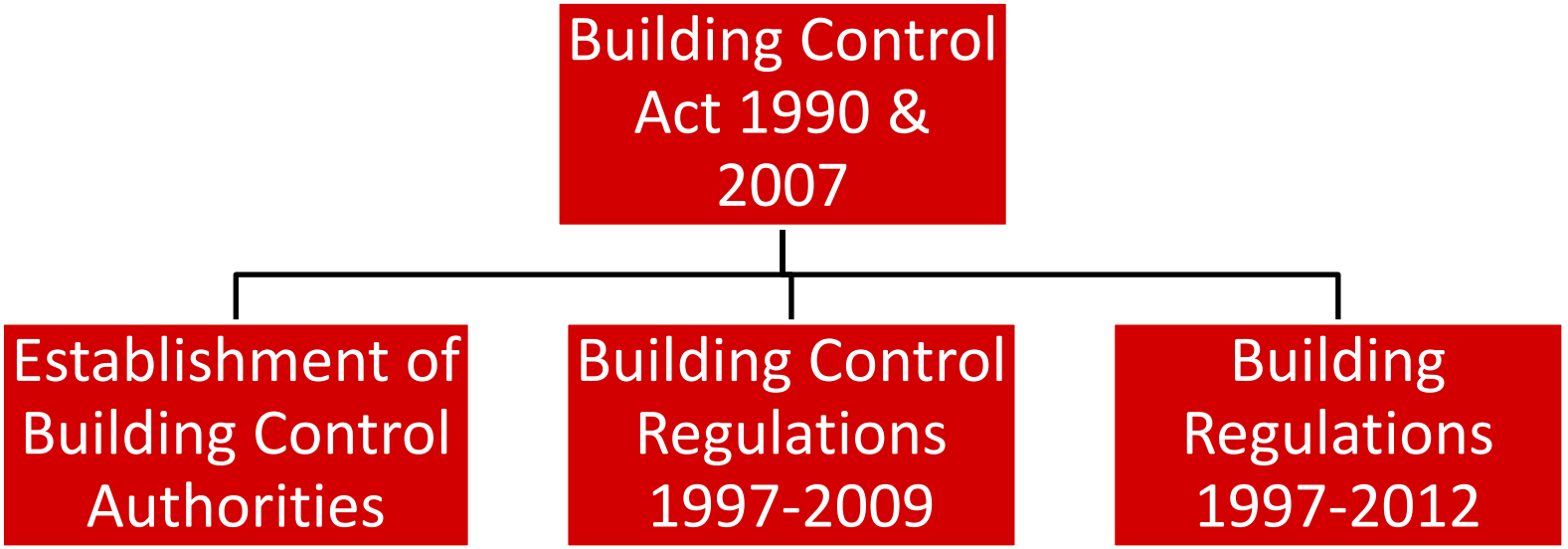
Compartmentation and Fire Sealing

By Dr J F Lygate
and Mr Stephen Nolan

Topics

- Overview of the Irish Regulatory Environment
- Fire Spread
- Compartmentation
- Fire Sealing

Building Legislation



Building Regulations 1997 - 2012

- Outlines technical guidance required for design and construction of buildings
- Regulations apply to new buildings , material alterations and extensions and material changes of use
- Identifies provisions for which building regulations may be made, e.g.:
  - Securing health, safety and welfare of people in and around buildings
  - Making provisions for disabled people
  - Conservation of energy and fuel

Building Regulations 1997 - 2012

- Guidance to comply with these regulations detailed in Technical Guidance Documents

Structure	Part A
Fire Safety	Part B
Site Preparation and Resistance to Moisture	Part C
Materials and Workmanship	Part D
Sound	Part E
Ventilation	Part F
Hygiene	Part G
Drainage & Waste Water Disposal	Part H
Heat Producing Appliances	Part J
Stairways, Ladders, Ramps and Guards	Part K
Conservation of Fuel and Energy	Part L
Access for People with Disabilities	Part M

Building Control Regulations 1997 -2009

- Purpose is procedural and administrative
- Promote observance of Building Regulations
- Requirement for Commencement Notices to be lodged
- Requirement for Fire Safety Certificates for certain buildings

Fire Safety Certificates

- Issued by the Building Control Authority
- States that the works/building to which the application relates will, if constructed in accordance with the plans and specifications submitted will comply with the requirements of Part B
- Building Control(Amendment) Regulations 2009 recognises retrospective applications, 7 Day notice period for urgent work and allows for revisions during the course of Construction

Fire Safety Certificates

- Who prepares the application?
  - Fire Safety Consultant, Architect, Engineer
- Certificate granted based on design and information submitted.
- Fire Safety Consultant/ Supervising Professional should oversee all fire related issues of the works
  - Provide a Certificate of Compliance

No Inspection

Issues with Fire Safety

Priory Hall,
Donaghmeade

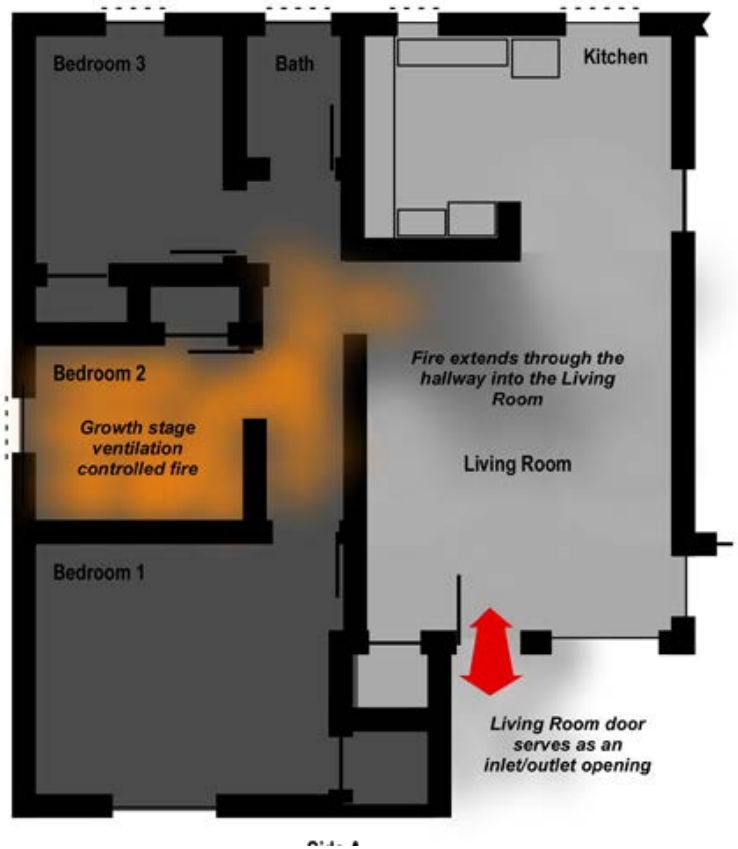
The Laurels,
Dundrum

Compartmentation

- What is **compartmentation**?

  the sub-division of a building into separate compartments through the use of walls and floors made of fire resisting materials

Compartmentation



http://cfbt-us.com/wordpress/?tag=niosh&paged=2

Compartmentation

- What is fire sealing?

  an ideal compartment will have no breaks of any kind in the barriers of its construction (walls and floors)

  But in reality there are pipes, ducts, flues, etc. exiting and entering the compartment

Fire Sealing is a method by which these openings in the compartment walls and floors are protected by sealing to ensure their fire resistance

Fire Sealing

Pipe Sleeving

http://www.cablejoints.co.uk/hazardous/3m-fire-seal-metal-pipes-entries-penetrations

Intumescent Seal

http://www.gallford.com/fire-containment/glazing-solutions/

Why are Compartmentation and Fire Sealing important?

Fire Spread

- Fire will spread from a compartment that is not self contained
- Breaches in barriers provide opportunity for spread to areas outside of a compartment
- This can cause severe damage which can be prevented/minimised through the use of compartmentation and fire sealing

Fire Spread

- How does this occur?

  - Depends on the location
    - Within a compartment
    - Internal within a structure i.e. between compartments
    - External to a structure

Fire Spread Within A Compartment

- Flame Impingement
  - Direct contact of flame with a surface
- Remote Ignition
  - Transfer of heat from the fire to surfaces
- “Drop Down”
  - Flaming material drops to an unlit surface

Fire Spread Within A Compartment

http://maison21.blogspot.ie/2011_11_01_archive.html

Fire Spread Within A Compartment

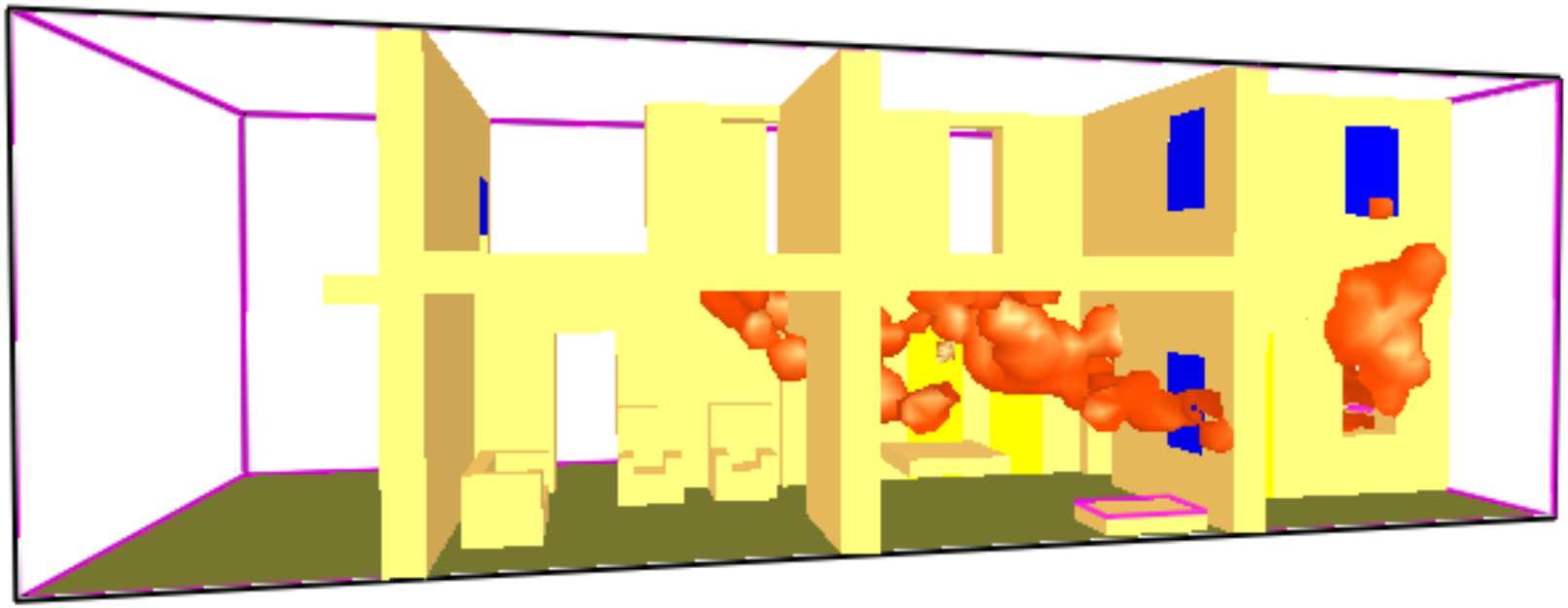
Methods of Prevention

- Lining materials should have
  - A resistance to ignition
  - Low rate of heat release
  - Adequate resistance to the spread of flame over their surface
- Materials include those used for:
  - Walls, ceilings, furniture and fittings

Fire Spread Internal Within a Structure

- Fire spread between compartments
  - Via Openings
  - Via Barriers
- Method of Prevention: Compartmentation

Fire Spread

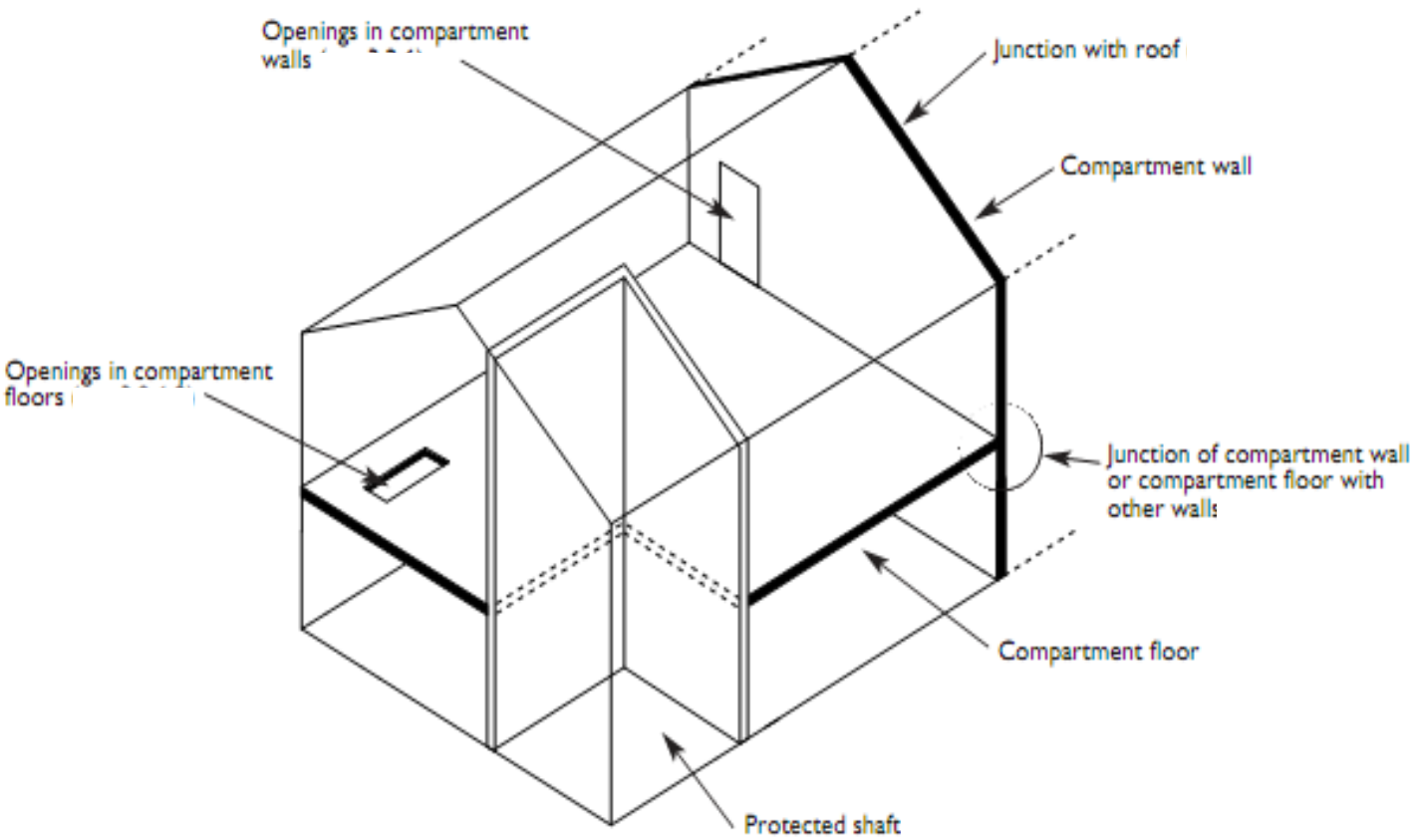


http://fire.nist.gov/CDPUBS/NISTIR_6854/duplex.htm

Compartmentation

- Compartmentation
  - Sub-division of a structure into compartments which are separated by walls and/or floors
  - Materials used in construction *must* be of a fire resistant nature

Compartmentation



Building Regulations 2006 Technical Guidance Document B Fire Safety

Compartmentation

- Function is two fold:
  - Prevent rapid fire spread which could trap occupants
  - Reduces the chance of a fire becoming too large. Large fire are more dangerous to occupants and people in the vicinity of the building

Fire Resistant Materials

- Materials used must be:
  - Resistant to collapse
  - Resistant to fire penetration
  - Resistant to transfer of excessive heat

Compartmentation

- Degree of Sub-division depends on:
  - The use of the building
  - The height of the top storey of the building
  - The availability of a fire suppression system

Compartment Sizing

- Maximum sizes exist for the creation of compartments in building that are not residential dwellings
- Sizes of compartments are restricted in properties such as offices, shops, industrial and storage facilities

http://vincentdunn.com/dunn/newsletters/april/FDNYHP_12.html

Compartment Sizing

- These restrictions can also be dependent on the availability of fire suppression systems in the property

http://www.fireconsultingusa.com/projects.html

Compartment Walls and Floors

- A wall common to two or more buildings should be constructed as a compartment wall
- Should be used to separate parts of a building used for different purposes or different tenancies
- Should be used to separate areas of special fire risk from other parts of a building

Compartment Walls and Floors

- Must form a complete barrier between the compartments they separate
- Have the appropriate fire resistance depending on the building construction
- Be constructed in accordance with relevant European guidelines

Compartment Walls

- Compartment walls that are common to two or more buildings should run the full height of the building in a continuous vertical plane and should be constructed of non-combustible materials
- They should continue up to roof level and not stop at ceiling height

Compartment Walls

- Failure to provide adequate compartment walls up to roof level can lead to fire spread with severe consequences
- An example of this occurred in the following case study

Compartment Floors

- The lowest floor in a building does not require a compartment floor
- In a building which is 10 m or more high any compartment floor which is required to have a fire resistance of 60 min or more should be constructed of non-combustible material

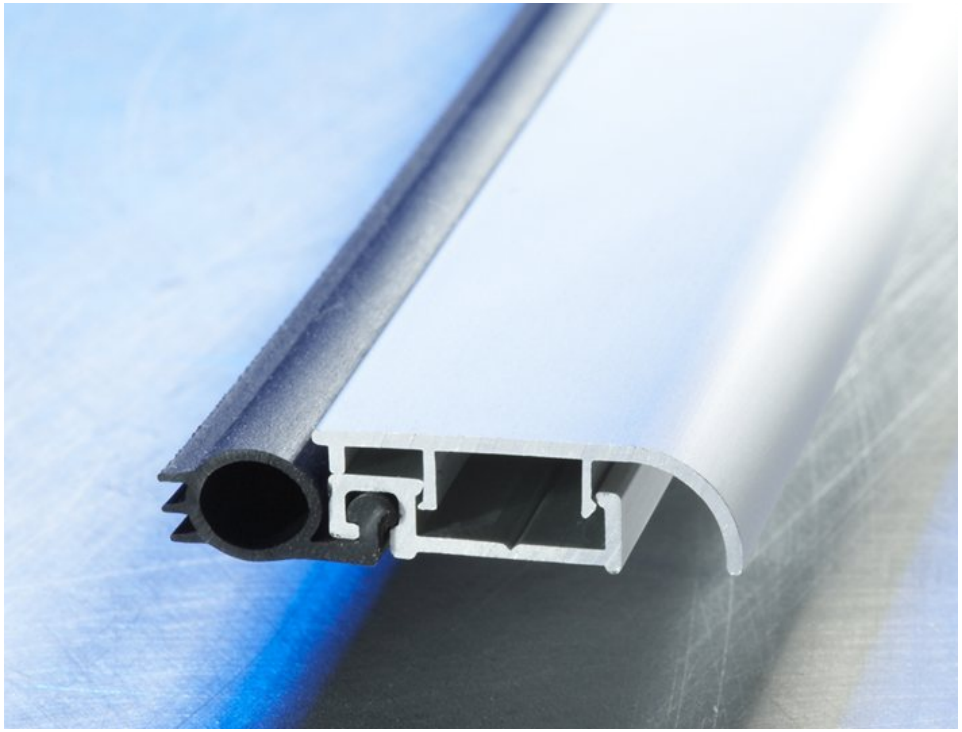
Compartment Floors

- In building which have existing timber floors it is possible to increase the fire resistance of the floor by:
  - Addition of fire resistant layers beneath the existing floor covering
  - Filling the voids between the floor surface and ceiling below with a suitable material

Compartment Doors

- Function is to protect escape routes and the contents and structure of buildings
- Do so by limiting the spread of smoke and fire
- Two types of compartment doors:
  - Smoke containing doors
  - Fire door assemblies

Smoke Containment Doors



http://www.lorientuk.com/products/7000-series-perimeter-seals/item/is7010-and-is7020

Fire Door Assemblies

- The complete fire door assembly is required to conform with European Standards
- The door assembly includes:
  - All hardware, supports, fixings, door leaf and frame
- The door assemblies are tested to determine
  - Integrity of the door assembly in its resistance to penetration by flame and hot gases

Fire Doors

http://nolanproducts.com/product.php?prod_type=Firedoors#

http://www.globalmarket.com/product-info/steel-fire-door-jh-h-001427978.html

Fire Door Ratings

- Fire doors are rated as meeting the recommendations of performance for integrity
- The rating relates to the requirements per time which the integrity is held
- E.g. a door with a rating E30 or FD30 satisfies requirements for 30 minutes integrity
- Intumescent fire seals should also be fitted if required

Fire Doors

http://www.falcontechno.com/?m=product&act=product

Fire Door Assemblies

- All fire doors should be fitted with an automatic self-closing device which is capable of closing the door from any angle and against any latch fitted to the door
- Where this would be considered a hindrance one of the following can be used:
  - A fusible link
  - An electro-magnetic/mechanical device which will release the door on activation of a smoke alarm
  - A door closure delay device

Fire Door Assemblies

http://www.building-hardware.com/2009/08/18/door-closer/

Concealed Spaces

- Hidden spaces (cavities) can provide routes for fire and smoke spread in the event of a fire
- This can be especially so of cavities above other open spaces e.g. suspended ceiling
- Fire spread is restricted by
  - Interrupting cavities which could form a pathway around a barrier to fire
  - sub-dividing extensive cavities.

Cavities

- Dimensions of cavities are determined by:
  - Location of the cavity
  - Materials used in the construction
  - Availability of fire suppression system
  - Automatic fire detection and alarm systems with fittings in the cavities
  - Alarm system which stops circulation in the ventilation system

Cavities

- Every cavity barrier should provide at least 30 minutes fire resistance
- Barriers should be fitted tightly to rigid construction
- If this is not possible and gaps are formed they should be filled with a fire stopping material

Fire Sealing

- Compartment walls and floors are designed to provide a barrier to fire spread

- Any openings compromise the integrity of these barriers and reduce their resistive function

- Protection of these openings is required in the form of **Fire Sealing**

Pipes

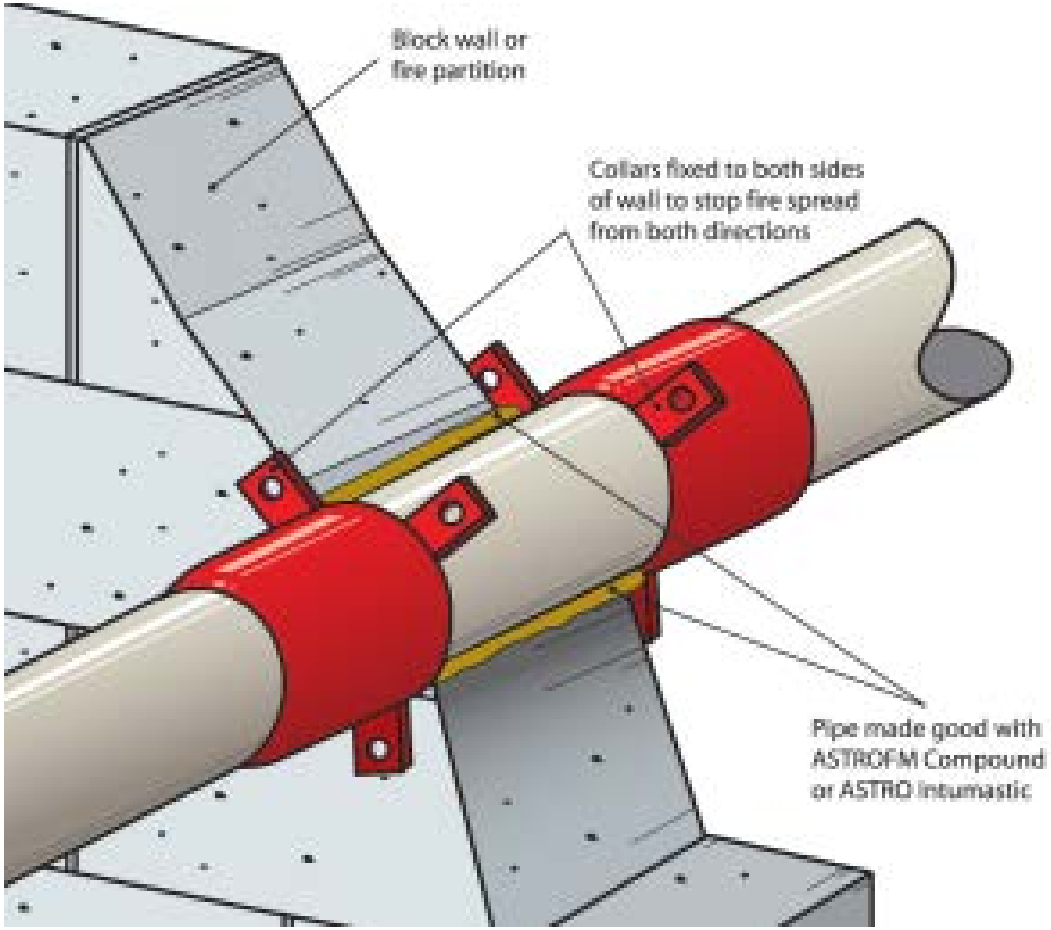
- Pipes which pass though a compartment wall or floor or though a cavity barrier should meet one of the following provisions:

1. Proprietary Seals

   Pipe collars can be attached at the point where the pipe meets the barrier to provide a seal.

   They can be filled with an intumescent material.

Proprietary Sealing



http://www.astroflame.com/intumescent_pipe_collars.html

Pipes

2. Pipes with a restricted diameter

- When a proprietary seal is not used fire stopping may be used around the pipe
- The opening should be kept as small as possible
- The nominal internal diameter of the pipe is specified in Building Regulations

Pipes with a Restricted Diameter

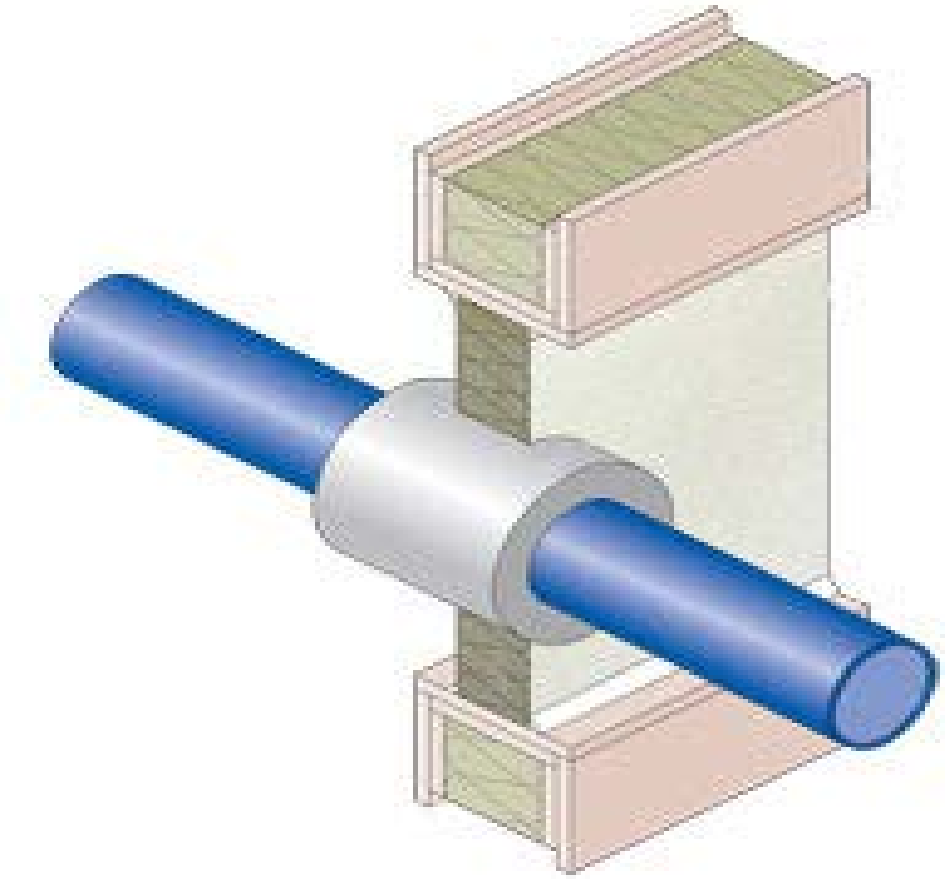
http://www.kilnbridgegroup.com/index.php/fire-stopping

Pipes

3. Sleeving

- A piece of non-combustible material can be used to act as a sleeve which fills the gap between the pipe and the barrier though which it is passing
- E.g. can consist of non-combustible stone wool and intumescent graphite
- The intumescent material expands in the event of a fire crushing the service pipe and closing the penetration

Sleeving



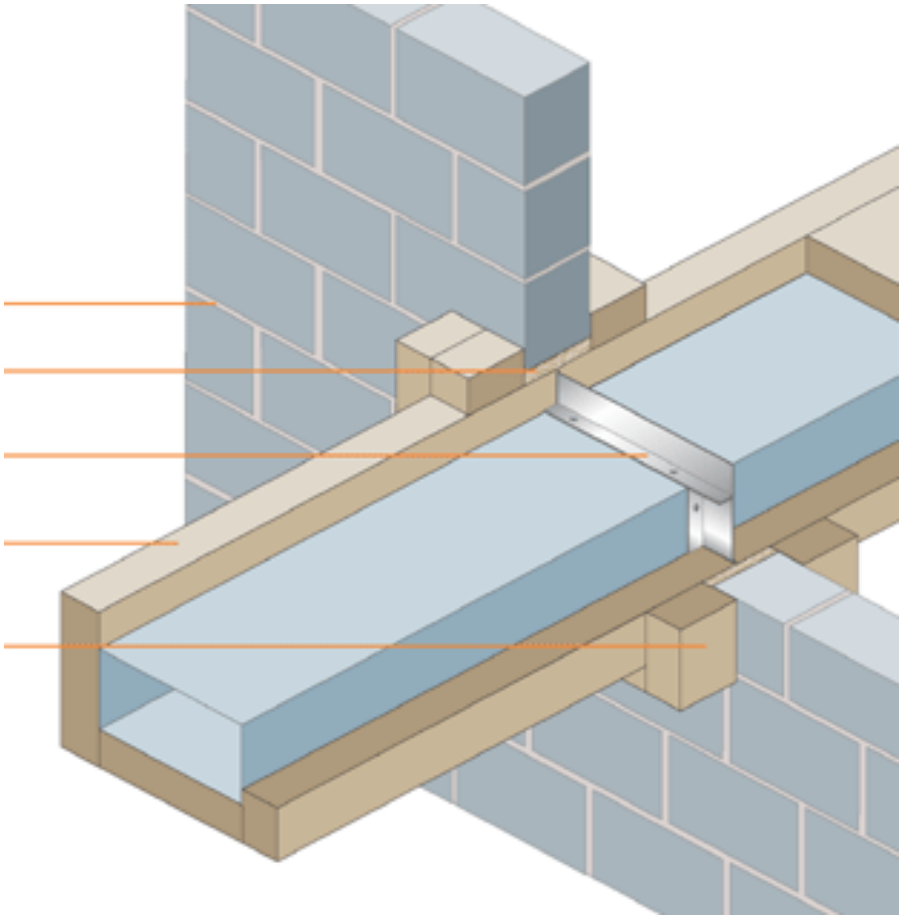
http://www.rockwool.ie/core+properties/fire/fire+stopping/rockwool+system+products/insulated+fire+sleeve

Ventilation Ducting

- Ducting should not provide a pathway for fire spread
- There are 3 ways in which the fire resistive integrity can be maintained

1. Fire Dampers
2. Self-supporting Fire Resisting Enclosures
3. Fire Resistant Ductwork

Ventilation Ducting



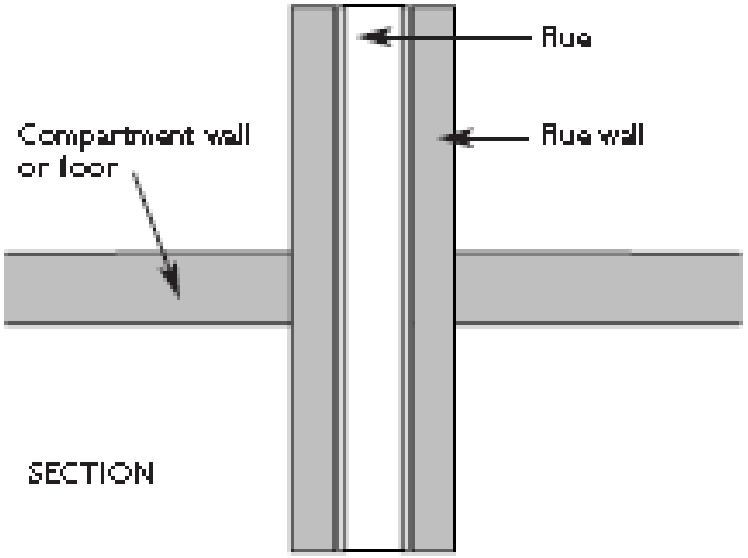
http://www.knaufinsulation.com.au/solutions/hvac/ducts/ducts_-_fire_protection.aspx

Flues and Ducting

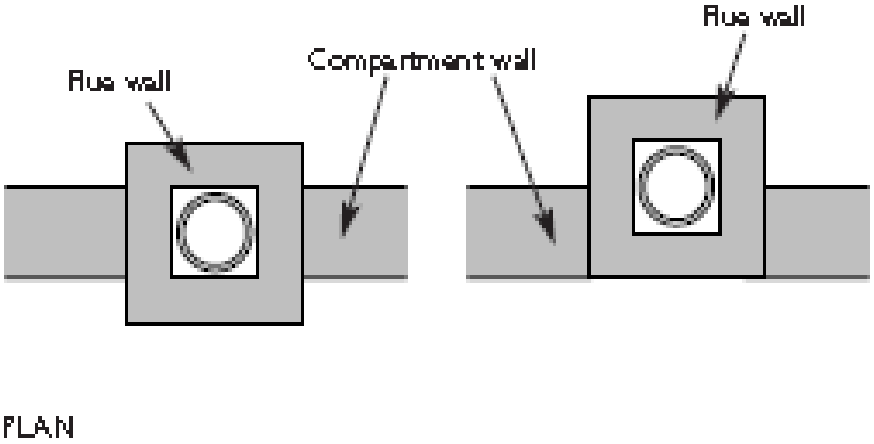
- The walls of a flue or duct should have a fire resistance of at least half that of the wall or floor in order to prevent the by-passing of the compartmentation.
- The walls enclosing the flue or duct should be of solid non-combustible construction

Flues and Ducting

1. FLUE PASSING THROUGH COMPARTMENT WALL OR FLOOR



2 FLUE BUILT INTO COMPARTMENT WALL



Building Regulations 2006 Technical Guidance Document B
Fire Safety

External Fire Spread

- The external walls and roof of a building should be designed and constructed to provide adequate resistance to the spread of fire to and from neighbouring buildings.
- This is provided through:
  - Construction of external walls
  - Fire resistive roof coverings
  - Space separation

Construction of external walls

- The fire resistance of external walls depends on:
  - the use, height and size of the building
  - whether the wall is within 1 m of the relevant boundary.
- The amount of combustible surfaces on buildings which are close to a boundary or high buildings is also restricted

Roof Coverings

- The junction between a compartment wall and the roof of a building should be capable of restricting fire spread between compartments and other buildings.
- Fire resistive materials should be used in the construction of a roof.

Space Separation

- Openings and other unprotected areas in the external walls should be limited as they do not provide protection against fire spread.
- Separation from a boundary can be calculated based on the thermal radiation which can be emitted though this unprotected opening.

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