Module 7

Ventilation

Energy Efficiency for Construction

24 partners

12 countries

Date of Event

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Ventilation | Summary

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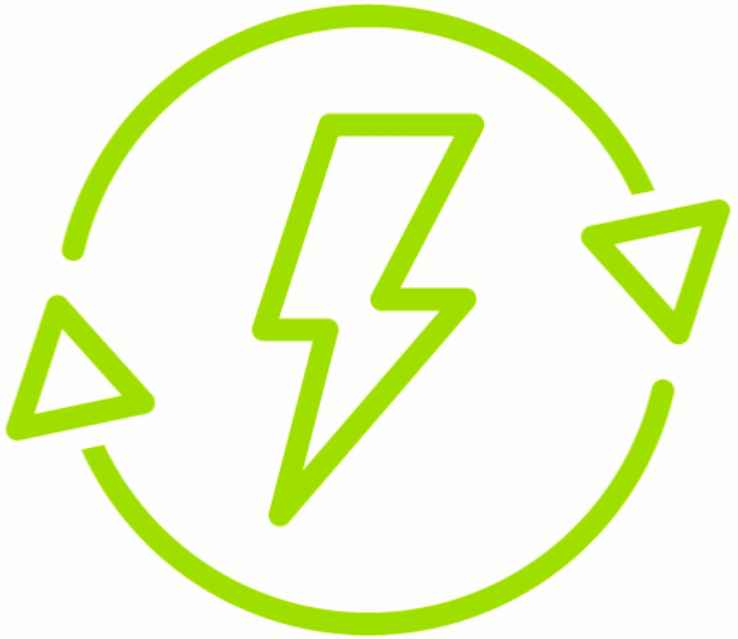
To equip the learner with the relevant knowledge required to understand the benefits of Controlled Ventilation to provide healthy energy efficient buildings.



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Ventilation | Objectives

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- Outline the principles of ventilation and the **types of ventilation** systems suitable for different buildings.
- List and describe the causes of **condensation and mould growth** within the building envelope and how they may be avoided.
- Outline the main requirements of **current building regulations** for ventilation.
- Case studies demonstrating scenarios governing the use of **natural ventilation**, including sizing and placement of background ventilators to achieve energy efficient compliance

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Ventilation | Content

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Topic 1 – Ventilation Flows

Topic 2 – Types of Ventilation

Topic 3 – Ventilation Strategy

On the following slides you will see this icon:

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1. Ventilation Flows

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Role of Ventilation in a Residential Building

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- Main role: Ensure indoor air quality
  - Fresh air supply and stale air/moisture removal
  - Limit the air humidity / avoid mould growth
  - Avoid concentration and build-up of pollutants
  - Limit odour nuisance

- Possible additional roles: Conditioning of the indoor air:
  - Cleaning (filters)
  - Heating / Cooling

- Possible side effect: heat recovery
  - Reduction of ventilation heat losses
  - Increase in comfort due to higher supply air temperatures

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The lower the air permeability.
The more important the need for ventilation

Highly airtight buildings with poor ventilation likely to suffer from the following:

- Mould, condensation and possible envelope deterioration
- Higher internal relative humidity
- Higher CO_2 levels and occupant discomfort
- Possibly higher radon levels

Ventilation Approaches – Depends on Air Permeability

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Air permeability q_E50: 3 to 5 $m^3/h.m^2$

"Natural Ventilation" with intermittent extract allowed

Air permeability q_E50: < 3 $m^3/h.m^2$

Continuous mechanical ventilation required, with or without heat recovery

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2. Types of Ventilation

Natural Ventilation with Background Ventilators

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Bathrooms and kitchen to have intermittent mechanical extract

Background ventilators to be used in all rooms

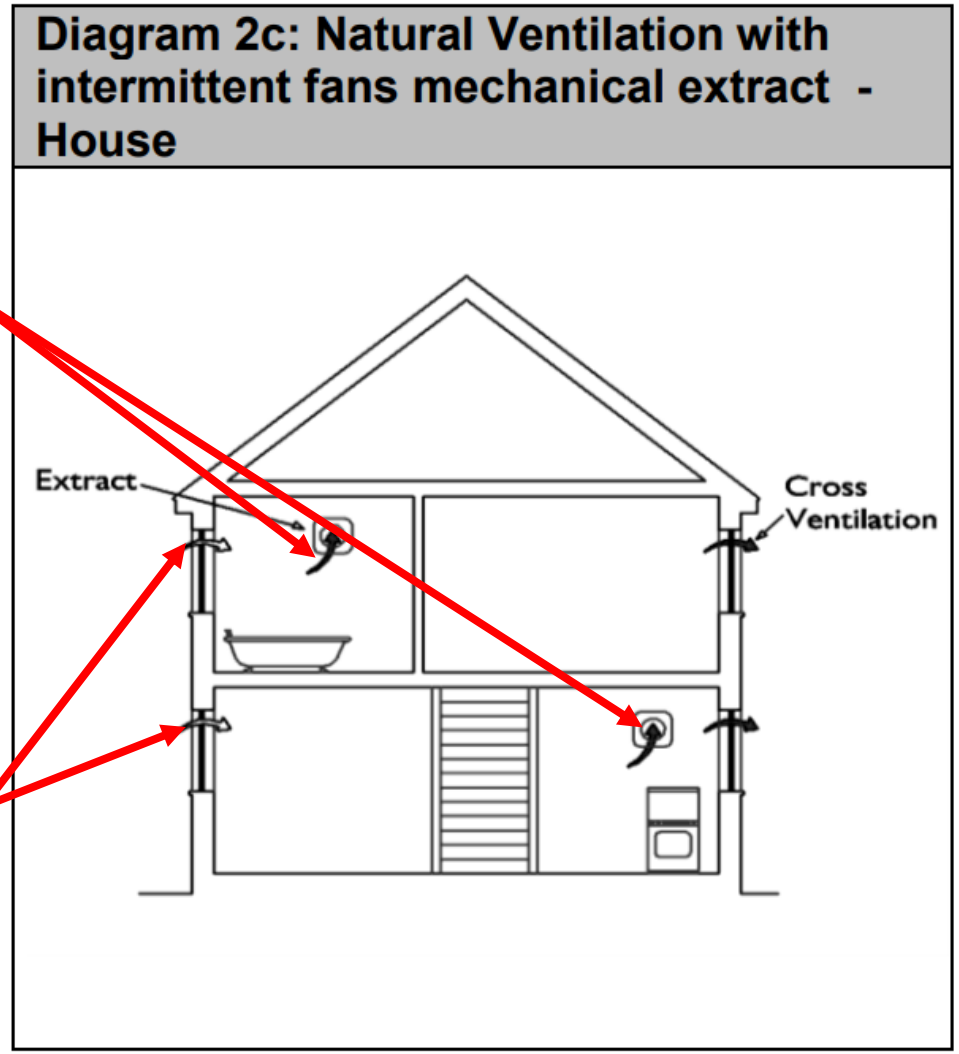

Image Source:
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Natural Ventilation with Background Ventilators

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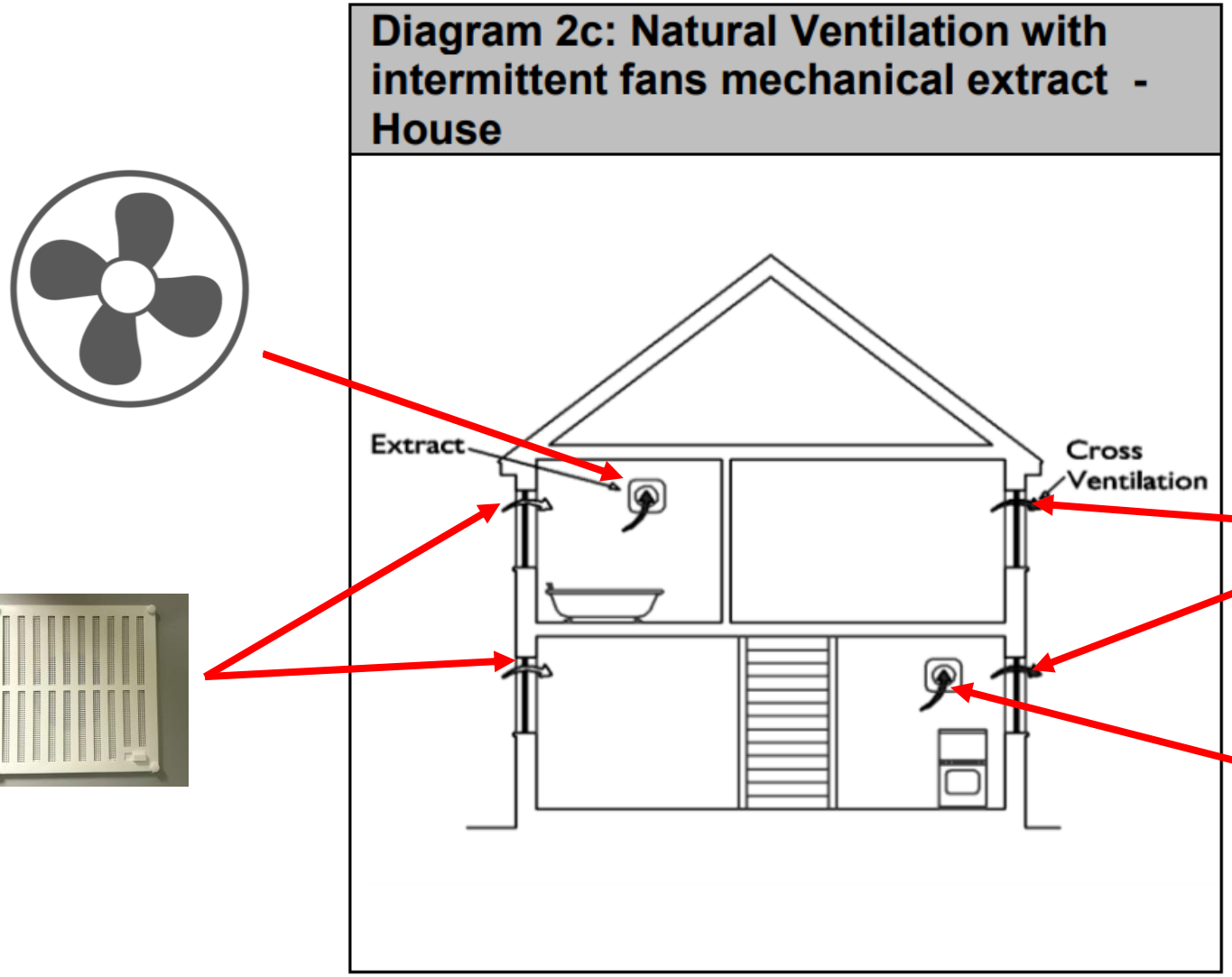

- Size of background vents varies depending on the ventilation requirement of the dwelling.
- Often more than one background vent is required in each habitable room to comply

Image Source: Diagram - Department of Housing, Planning and Local Government Ireland

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Background Ventilators

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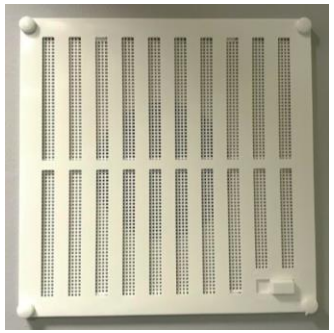
- Background ventilators should be located to avoid draughts, e.g. more than 1.75 m above floor level
- 'Hole-in-the-wall' vents and trickle vents are most common
- Compliance is determined based on area of background ventilator rather than flowrate
- Because there is no pressure difference created within the dwelling, it is difficult to know how such ventilators perform



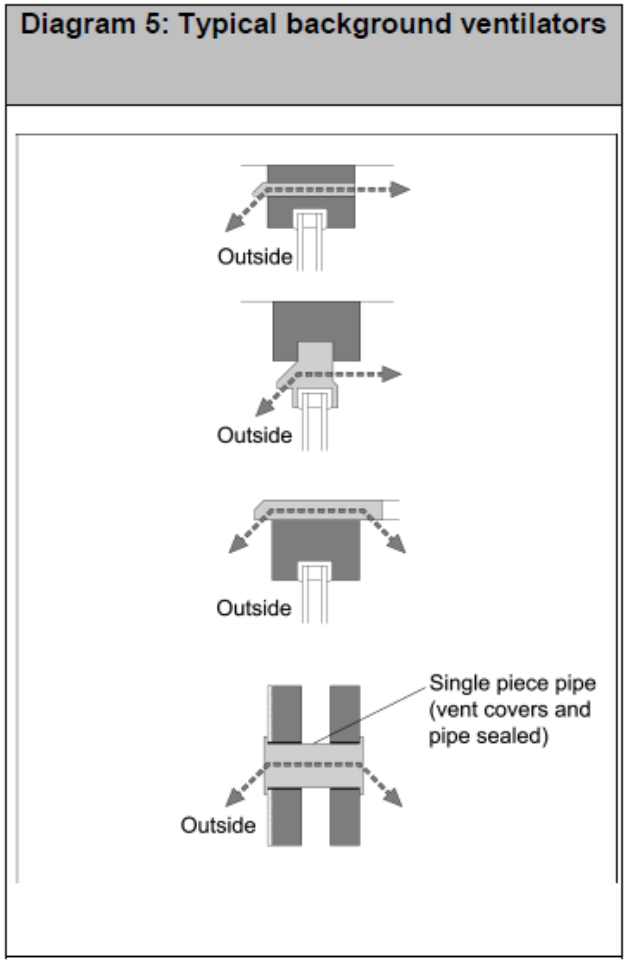


Image Source: ArchiExpo

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Intermittent Extract Ventilation

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Table 3: Basic ventilation provision using background ventilators and specific provision for extract and purge ventilation for 5m³/hr/m²> air permeability > 3m³/hr/m²			
Room or Space	General Ventilation Minimum equivalent area of background ventilator[a] (mm^2)	Extract ventilation Extract fan[b] - Minimum intermittent extract rate (l/s)[h]	Purge ventilation Opening window or external door - Minimum provision[g]
Habitable Room	*7000[c,f]*	-	*1/20th of room floor area*
Kitchen	*3500[c,d,f]*	*60l/s generally 30l/s if immediately adjacent to cooker (e.g. cooker-hood not recirculating)*	*Window opening section (no size requirement)[d]*
Utility Room	*3500 [c,d]*	*30 l/s*	*Window opening section (no size requirement)[d]*
Bathroom	*3500 [c,d]*	*15 l/s*	*Window opening section (no size requirement)[d]*
Sanitary Accommodation (no bath or shower)	*3500 [c,d]*	*6 l/s[e]*	*Window opening section (no size requirement)[d]*

Source: Department of Planning, Housing and Local Government

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Sizing Natural Ventilation to Comply with Part F

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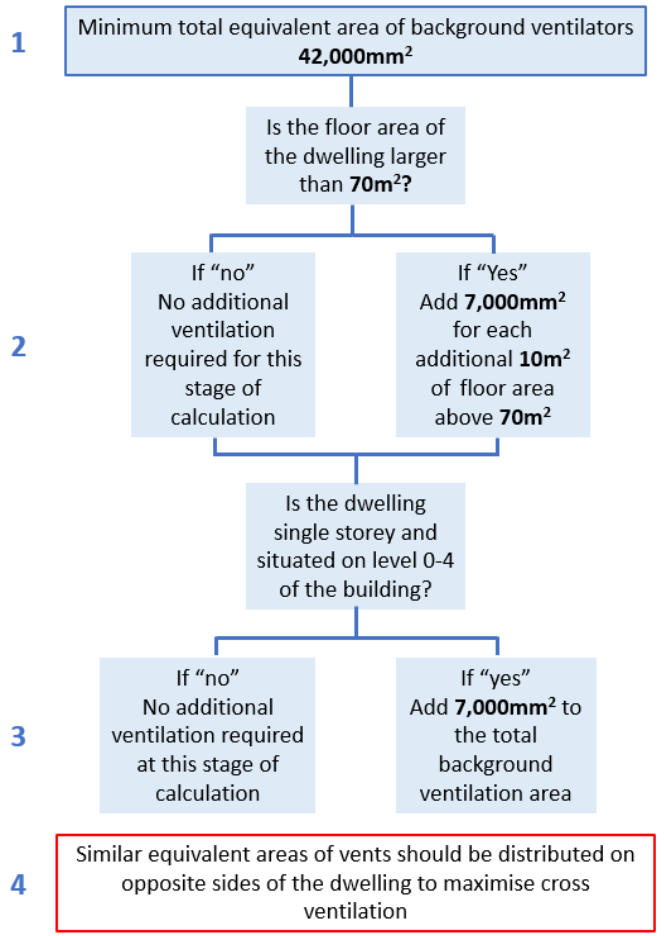
1.2.4 Natural Ventilation

Ventilation Rates

1.2.4.1 Where the air permeability is greater than $3m^3/(h.m^2)$ and lower than $5m^3/(h.m^2)$, the minimum total equivalent area of background ventilators providing general ventilation should be $42,000mm^2$ with an additional $7,000mm^2$ for each additional 10 m^2 floor area above the first $70m^2$ of floor area measured. For single storey dwellings situated at ground level or on any storey up to four storeys, an additional 7,000 mm^2 per dwelling should be provided. As noted in Paragraph 1.1.15, the areas specified should be increased by 25% where free area of ventilators is used instead of equivalent area.

Source: Department of Planning, Housing and Local Government



Source: WWETB

Case study – Natural Ventilation Requirements

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Sample House:
Detached bungalow 86m^2
Air permeability 4.2m^3/(h.m^2)

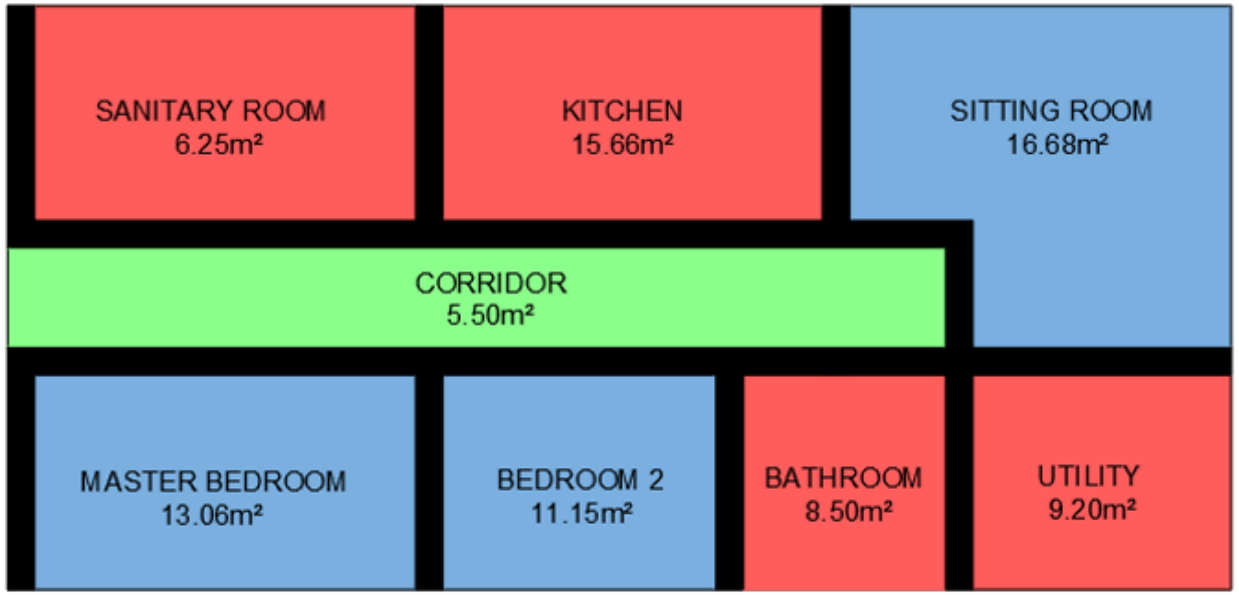

Image Source: WWETB

What area of background ventilators are required to comply with Regulations?

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Case Study – Natural Ventilation Requirements

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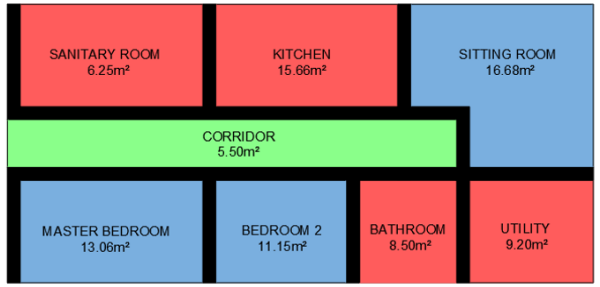

Stage	Description	Ventilation Requirement
1. Minimum background ventilation	Minimum total equivalent area of background ventilators	42,000mm^2
2. Additional ventilation based on floor area	Because this dwelling has a TFA greater than 70m^2 additional ventilation is required. TFA (86) – 70 = 16	7,000mm^2
3. Additional ventilation based on single storey dwellings	For single storey dwellings situated at ground level or on any storey up to four storeys, an additional 7,000mm^2 per dwelling should be provided	7,000mm^2
Total		56,000mm^2

Similar equivalent areas of vents should be distributed on opposite sides of the dwelling to maximise cross ventilation.

In this case the following would be appropriate:

Kitchen – 8,000mm^2

Bathroom – 8,000mm^2

Utility – 8,000mm^2

Sanatory room – 8,000mm^2

Sitting room – 8,000mm^2

Master bedroom – 8,000mm^2

Bedroom 2 – 8,000mm^2

Corridor – No ventilation required

Image Source: WWETB

Case Study – Natural Ventilation Requirements

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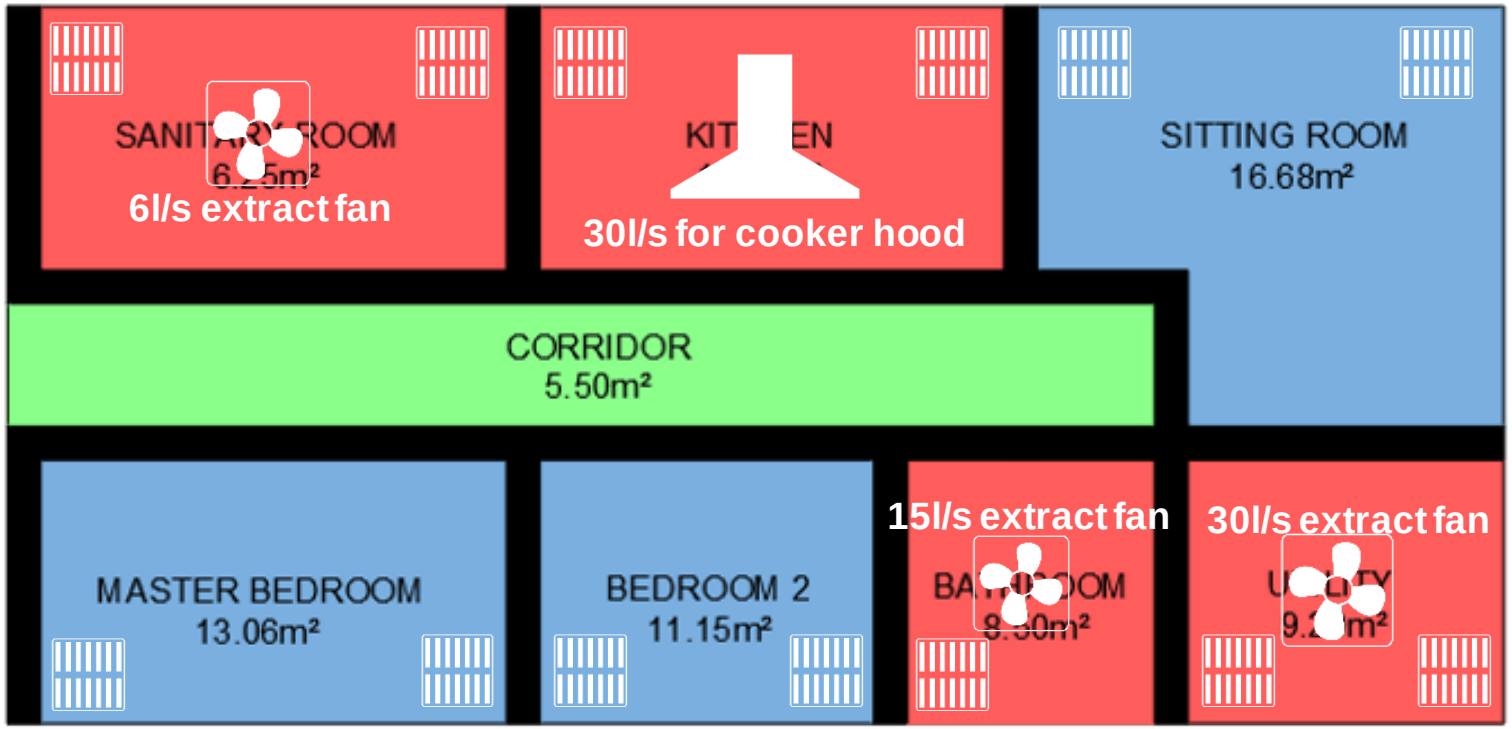

Image Source: MosArt

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Background Ventilation – Equivalent Area

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Sample Trickle Vent:

- Length 265 mm Height 18 mm
- Equivalent Area 1,700 mm^2

Sample Hole-in-the-wall Vent:

- 125 mm diameter (5”)
- Equivalent Area 6,500 mm^2

Image Source: Rytons

Swiss Cheese House

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Naturally ventilated homes will need a lot more background ventilators than you think!

Image Source: MaxPixels.net 6362382

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Natural Ventilation Video

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Centralised Continuous Mechanical Extract Ventilation (CCMEV)

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Extract fan operates continuously

Wet rooms ducted to the extract fan

Habitable rooms ventilated through hole-in the wall or trickle vents

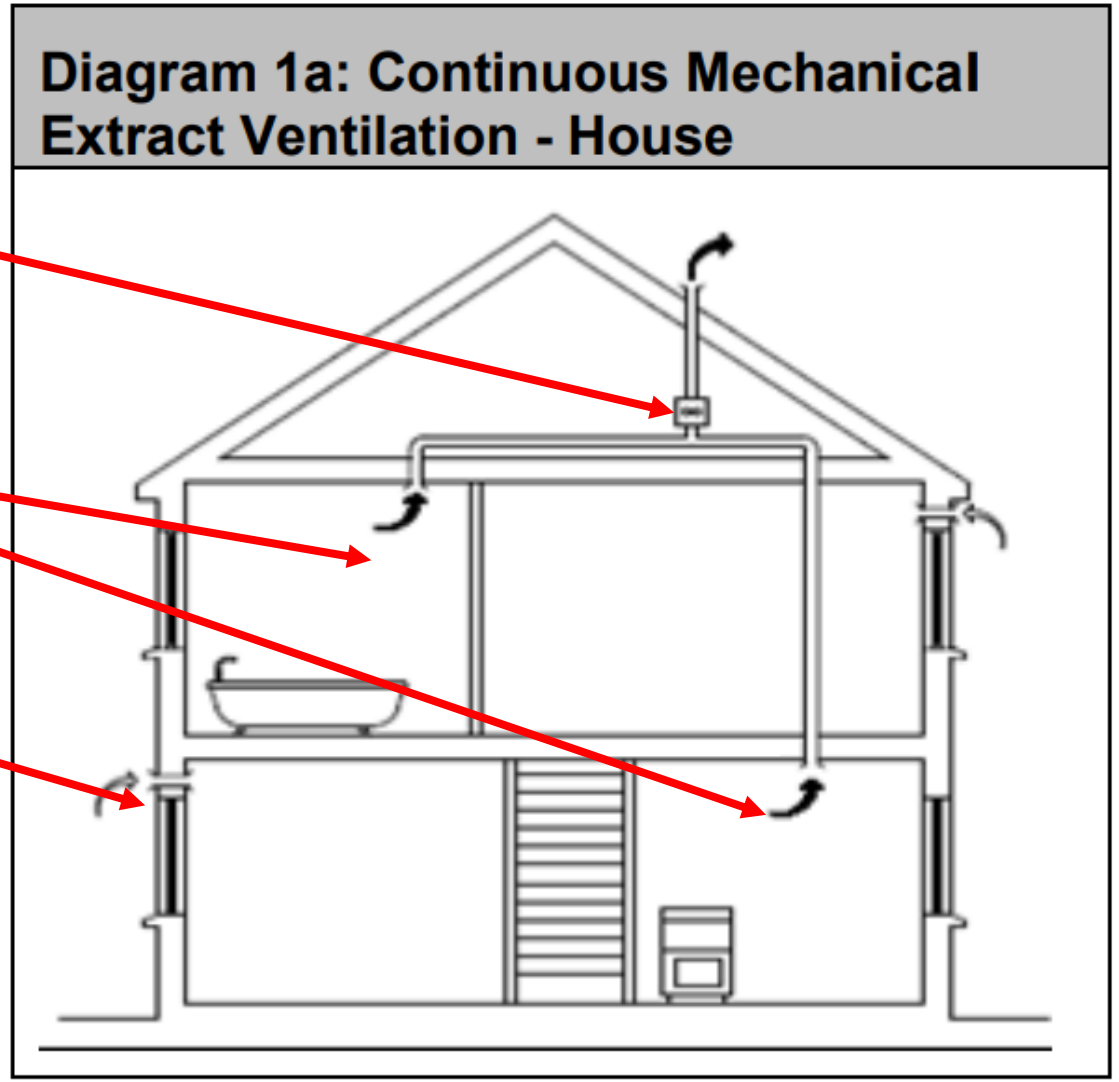

Image Source:
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Centralised Continuous Mechanical Extract Ventilation (CCMEV)

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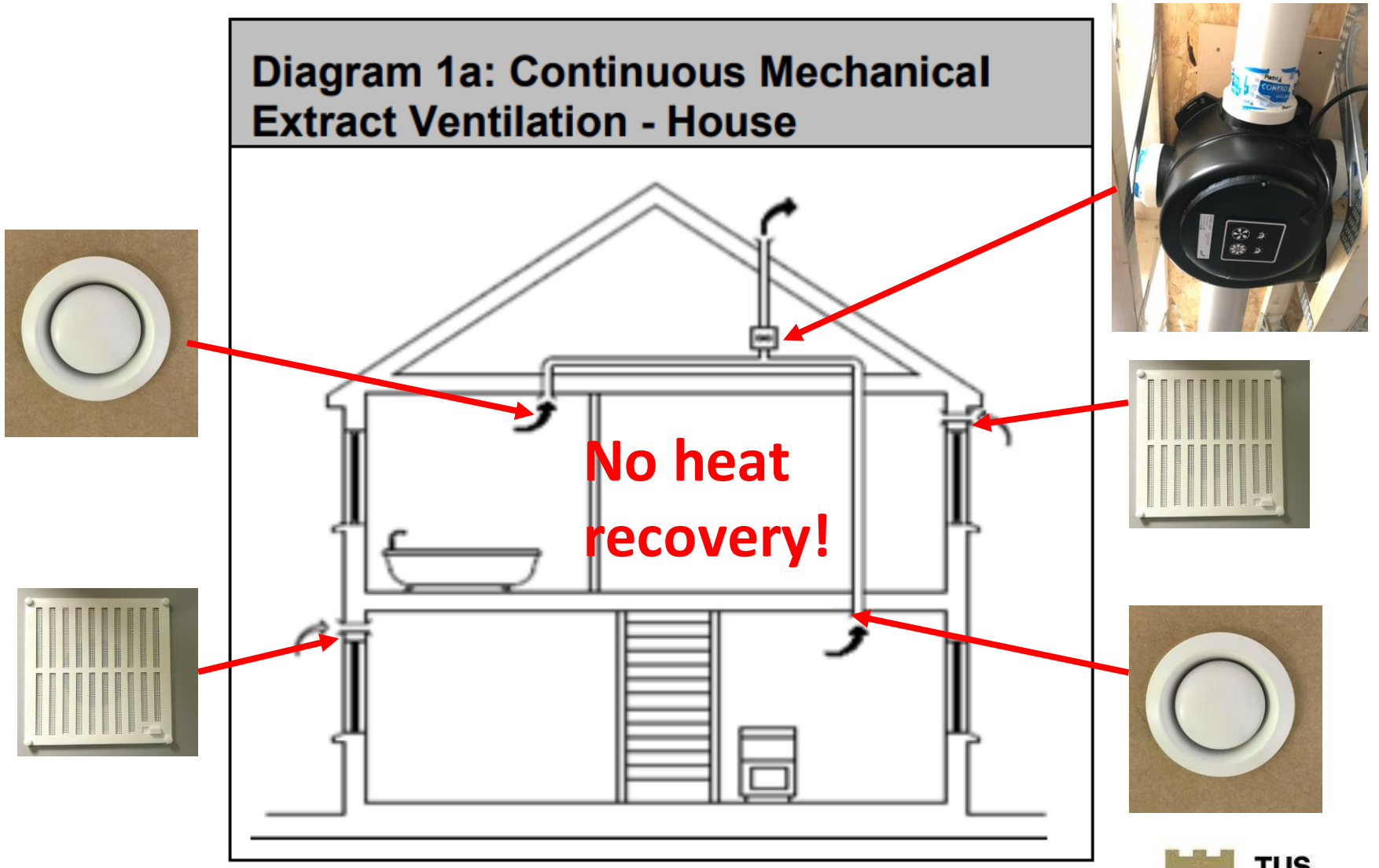

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Issues with Continuous Extract Ventilation (CEV)

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Warm air is exhausted from the building, with no heat recovered.

Image Source: MosArt-WWETB

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Continuous Mechanical Extract Ventilation - CMEV Video

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Mechanical ventilation with Heat Recovery (MVHR)

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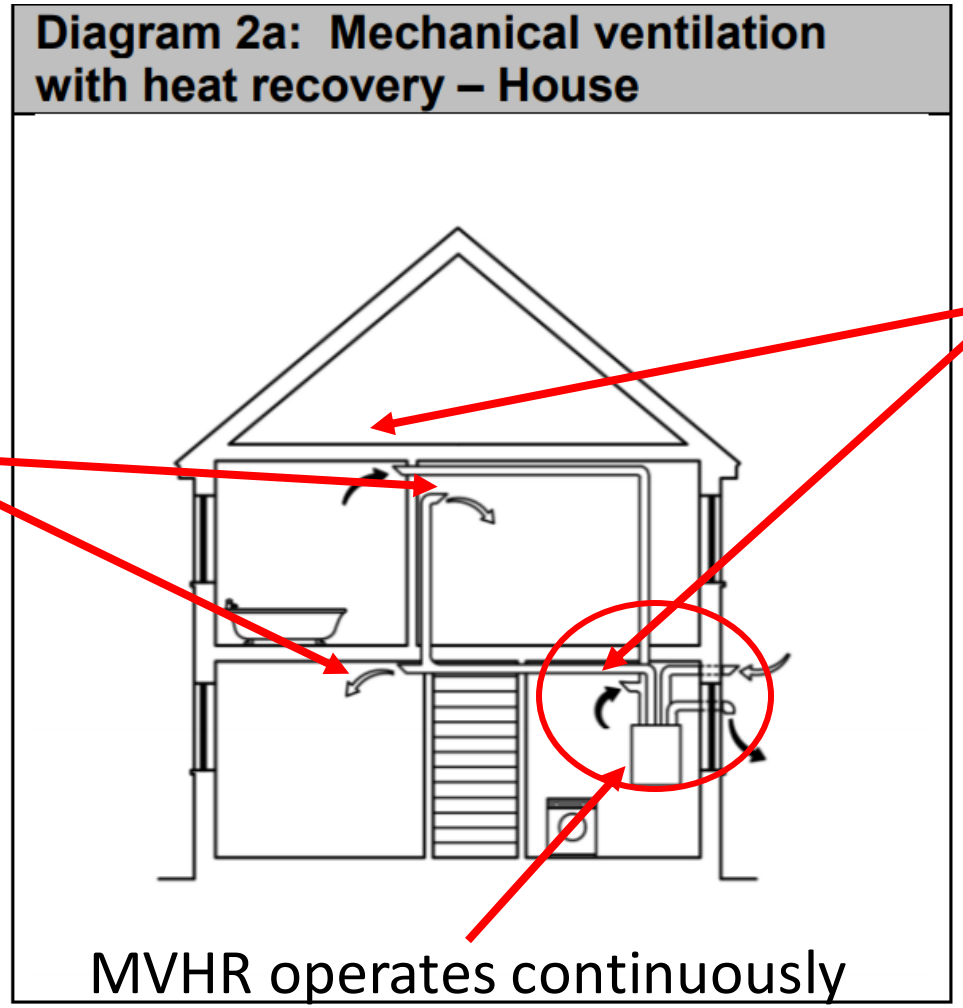

Habitable rooms all connected to supply air ducts

Wet rooms are all connected to exhaust air ducts

The MVHR unit is located:

- Inside the thermal envelope
- On/close to an external wall

Image Source: Department of Housing, Planning and Local Government Ireland

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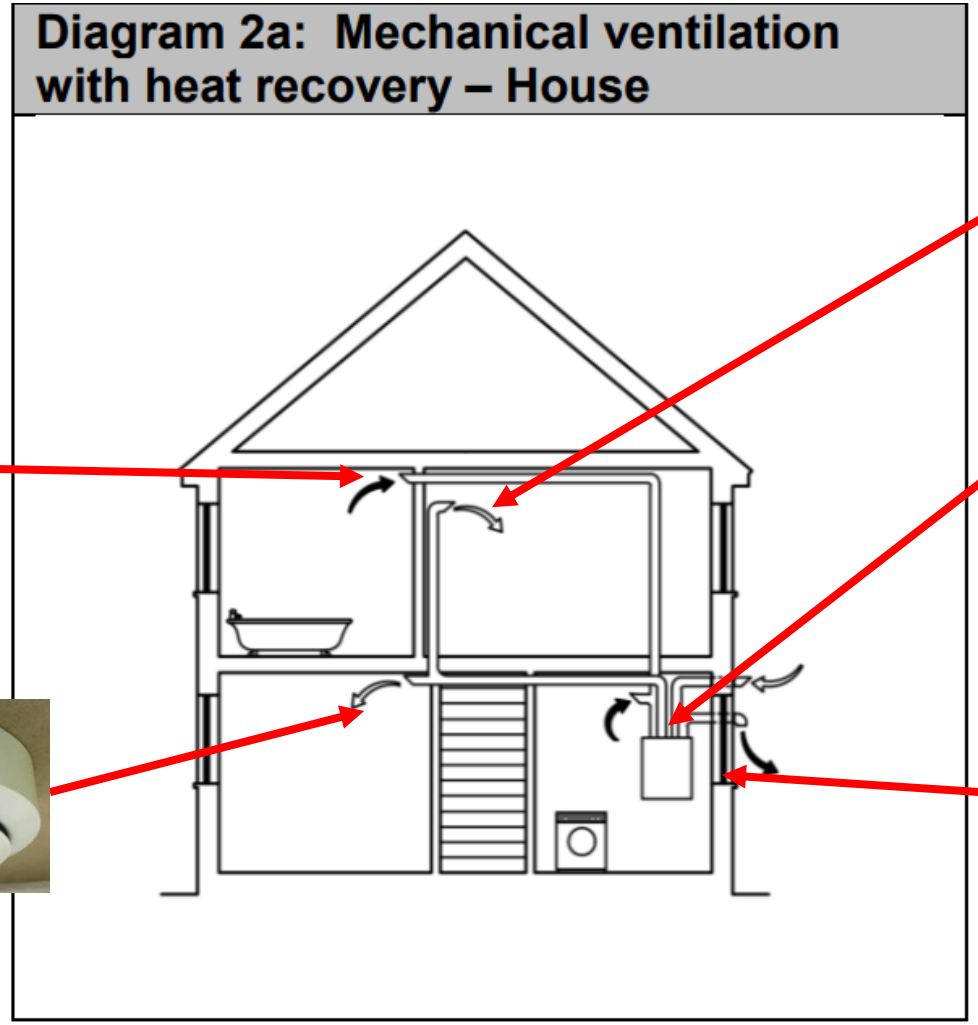
Diagram 2a: Mechanical ventilation with heat recovery – House



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Correctly Locating the MVHR

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- MVHR located adjacent to exterior wall ensuring minimal length of cold air ducts
- Positioned at comfortable height for changing filters
- Plenty of room for condensate drain to bottom (yet to be fitted)
- Could have left more room to right hand side for internal finishes

Image Source: MosArt

Anatomy of an MVHR

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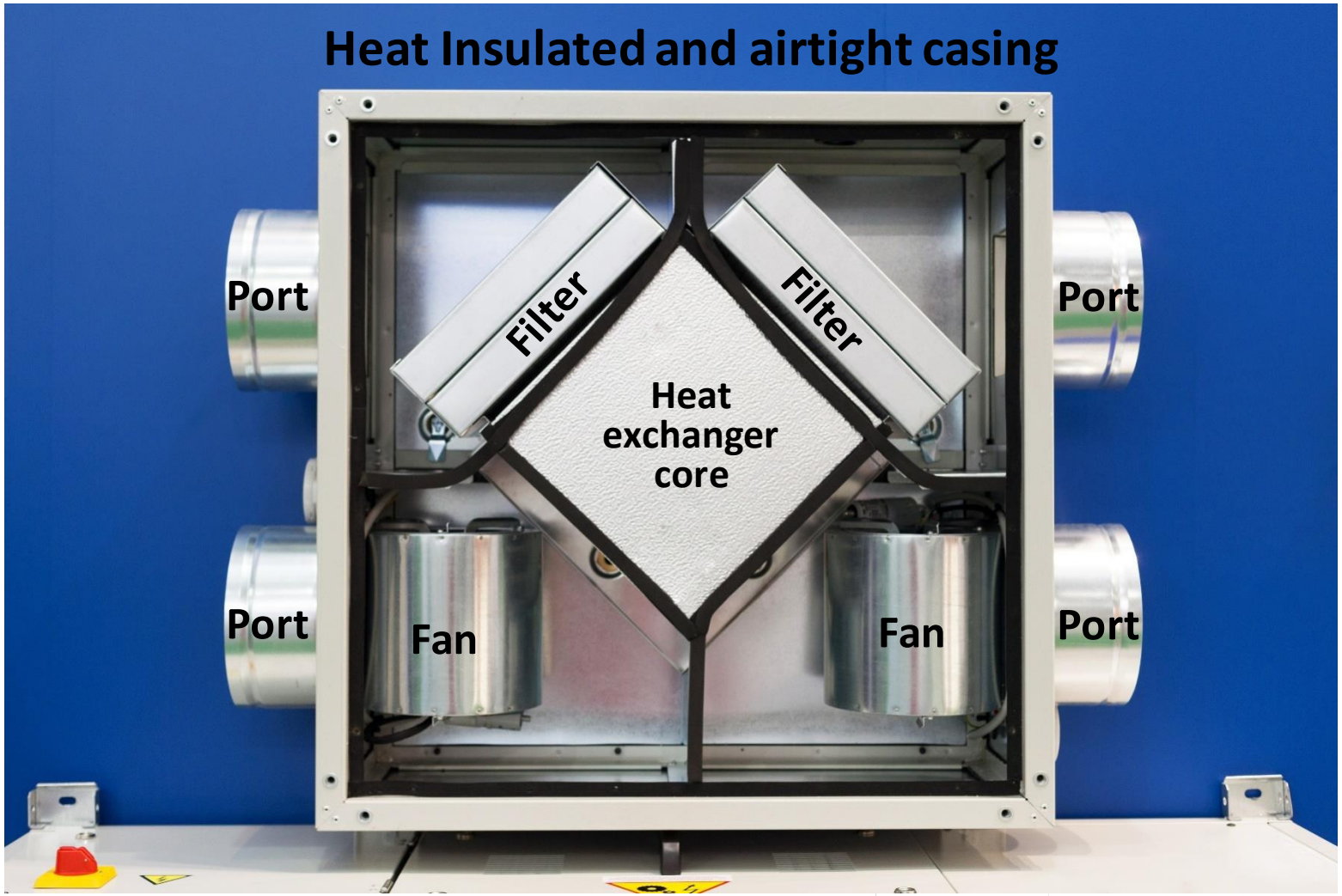

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Heat Exchanger in MVHR Recovers >85% Heat

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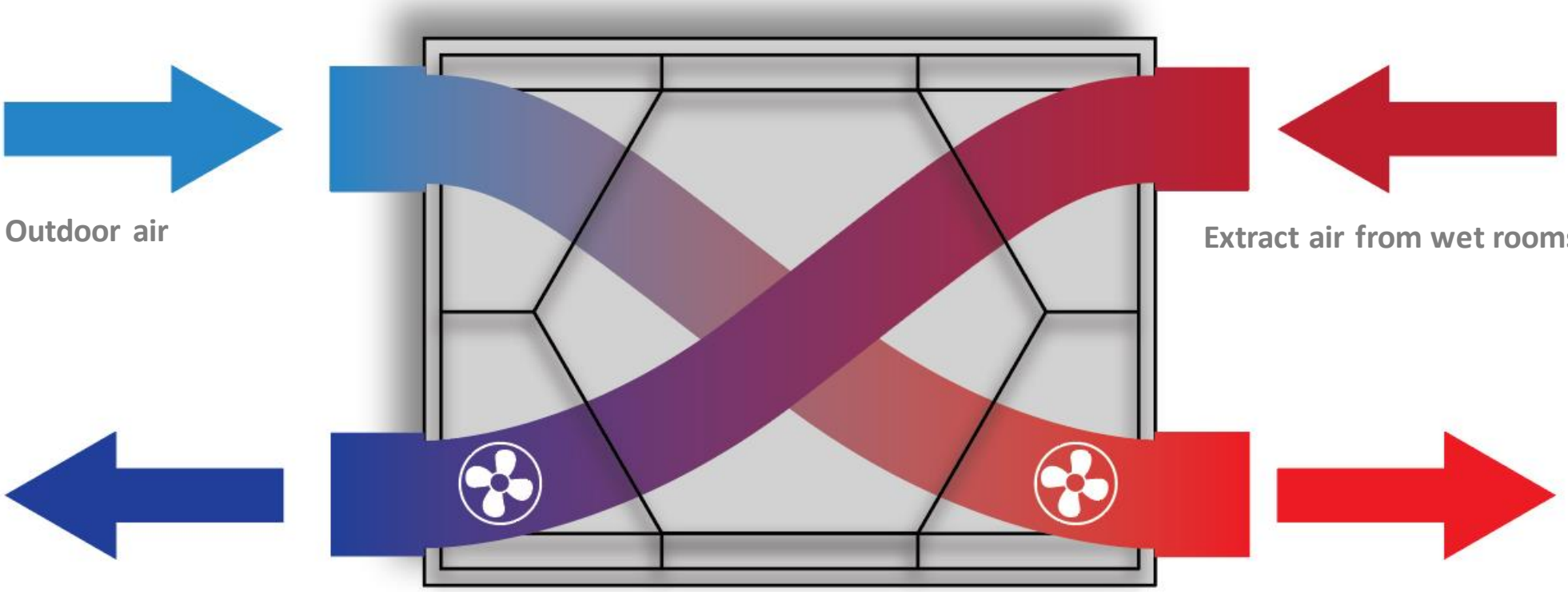

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MVHR with Cross Flow Ventilation

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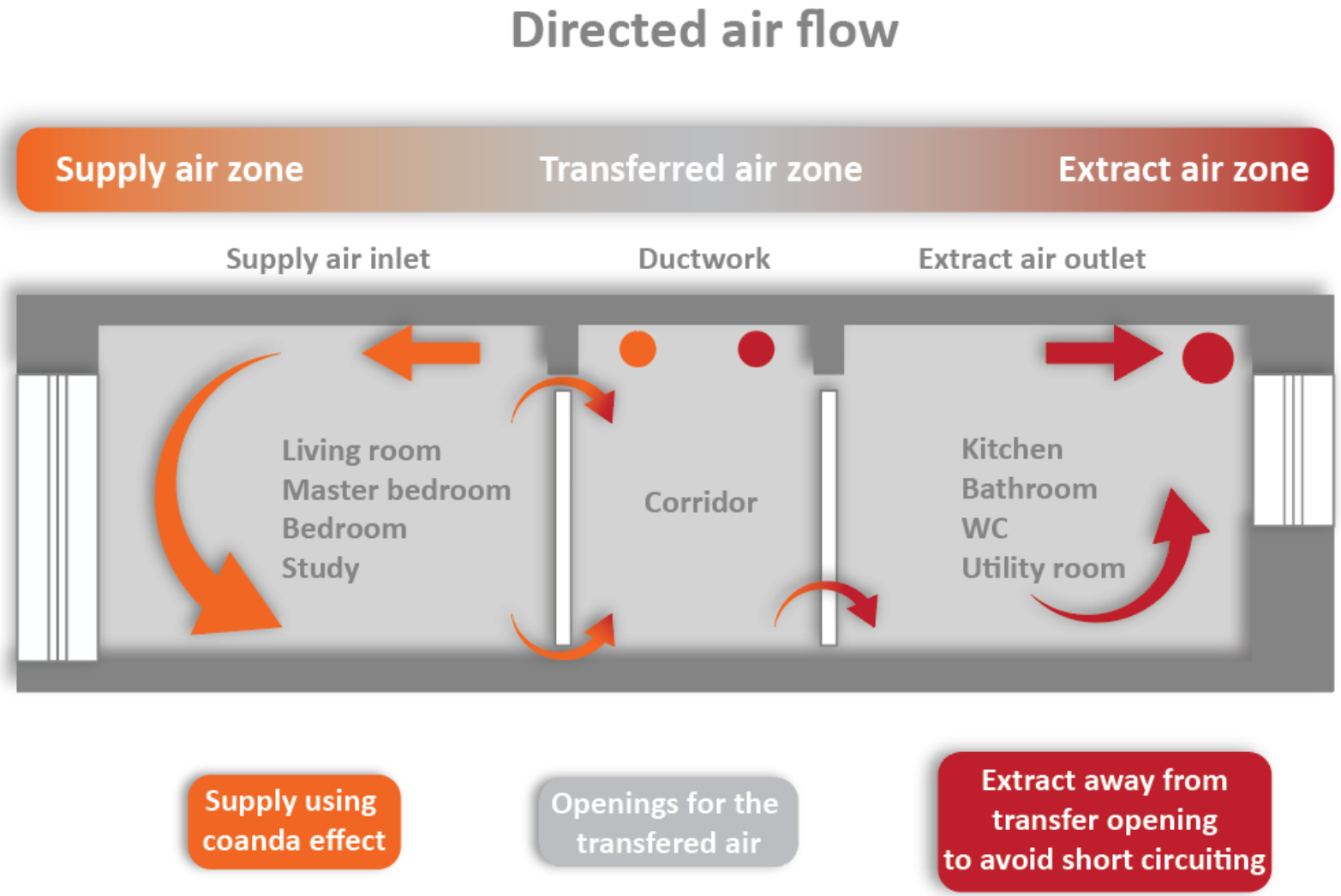

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Avoid Cross-Contamination between Exhaust Air and Intake Air

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Recommended separation: 2m

ProAir FEX Terminal – safely combines both!

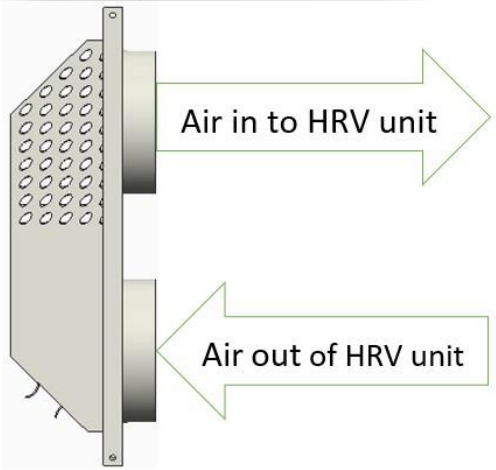

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Image Source: Left – MosArt / Right - ProAir

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Ventilation System Quality Control

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Filters must be changed regularly. Clogged filters will reduce indoor air quality and increase fan power

Image Source: MosArt

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Mechanical Ventilation with Heat Recovery - MVHR Video

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Demand Control Ventilation (DCV)

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- Centralised exhaust fan operates continuously
- Extract rate adjusted according to relative humidity (can also remotely boost if needed)
- Supply vents in bedrooms and living rooms adjust depending on need

Image Source: Aereco

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Demand Control Ventilation (DCV)

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Humidity sensitive strip

Supply vents adjust to meet demand

Standard Humidity

High Humidity

Image Source: Left Aereco, Right MosArt

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Decentralised MVHR - Lunos

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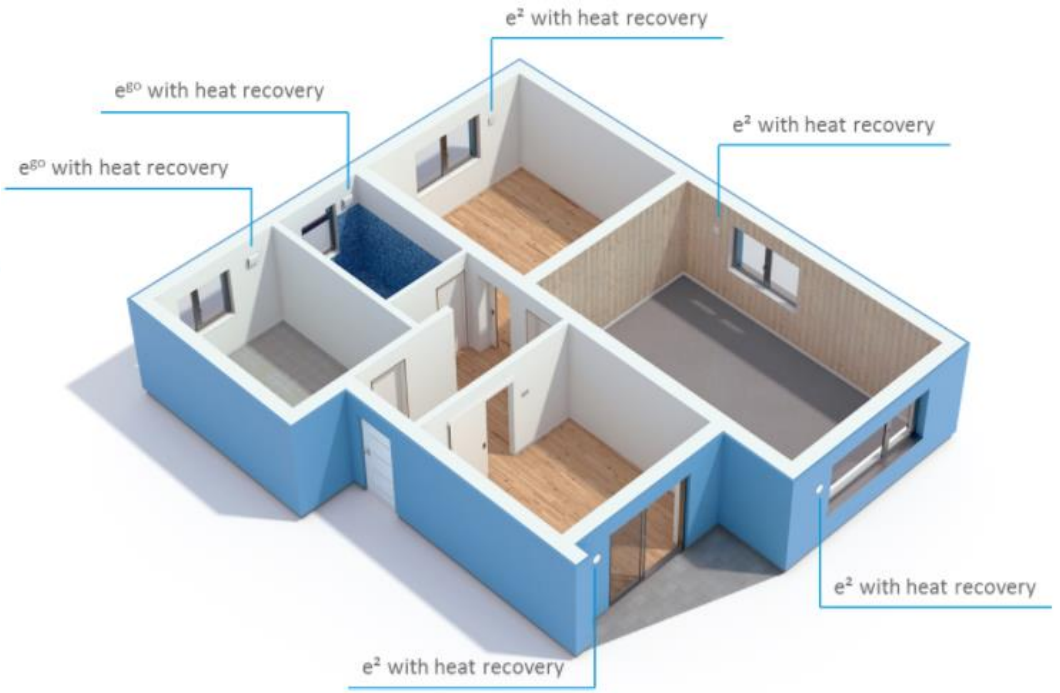

Lunos e²

Lunos eᵍᵒ

Image Source: Partel

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Decentralised Ventilation

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Decentralised Ventilation

- minimum two systems are needed
- every 70 seconds reversion of the air direction
- the ceramic element allows heat to be recovered

- No centralised unit – no need for plant room
- No ducting required

  - Fire compartments can be maintained
  - No dropped ceilings
  - Easier to retrofit
  - Reduced risk of reduced airflow due to poor duct installation

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Image Source: Partel

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Cross Ventilation

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- In all ventilation strategies, including natural ventilation, provision must be made to allow cross ventilation between rooms
- To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600 mm^2 in all internal doors above the floor finish
- This is equivalent to an undercut of 10 mm for a standard 760 mm width door. Transfer grills are an alternative method of facilitating cross ventilation.
- The above requirement must be provided above finished floor level.

Image Source: MosArt

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3. Ventilation Strategy

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Fire Safety

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- Where an MVHR or similar is provided, precautions should be taken to ensure that it will **not contribute to fire spread** or endanger the enclosure to any stairway, particularly protected stairways

- It is not recommended to connect **cooker hoods to MVHR**. Where cooker hoods are connected the guidance under fire precautions in National Regulations should be followed.

Openings for ducts which pass through an element which serves as a barrier to the passage of fire should be:

- Kept as few in number as possible
- Kept as small as practicable
- Fire-stopped

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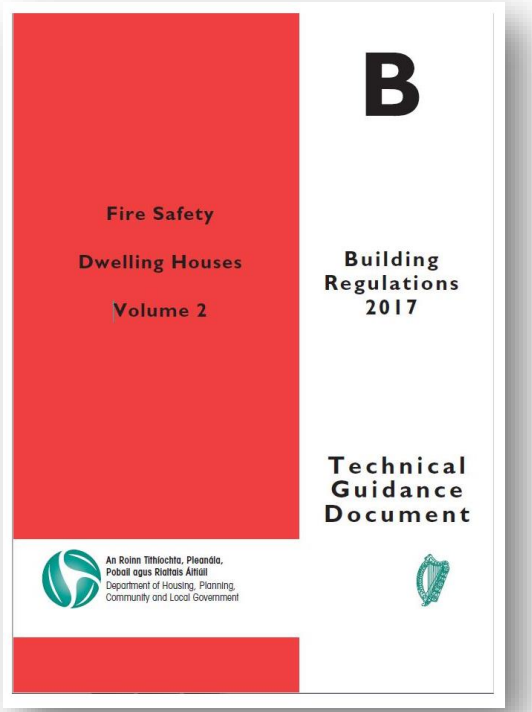
Openings for ducts which pass through an element which serves as a barrier to the passage of fire should be:

- Kept as few in number as possible
- Kept as small as practicable
- Fire-stopped



BS 9991: 2015 Fire Safety in the Design, Management and use of Residential Buildings: Section 6, paragraph 35, contains appropriate guidance on these measures. (see also S3- Internal Fire Spread).

Source: BS 9991: 2015 Fire Safety in the Design, Management and use of Residential Buildings

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Fire Dampers

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- **Compartmentalisation** is used to inhibit the spread of fire and smoke in a building with fire rated separations such as fire walls
- When penetrating these walls with ventilation duct, the **integrity of their ratings** can be sustained by the use of fire dampers, smoke dampers or combination fire/smoke dampers.
- Different damper types perform different functions and are tested, **installed, operated and maintained differently**

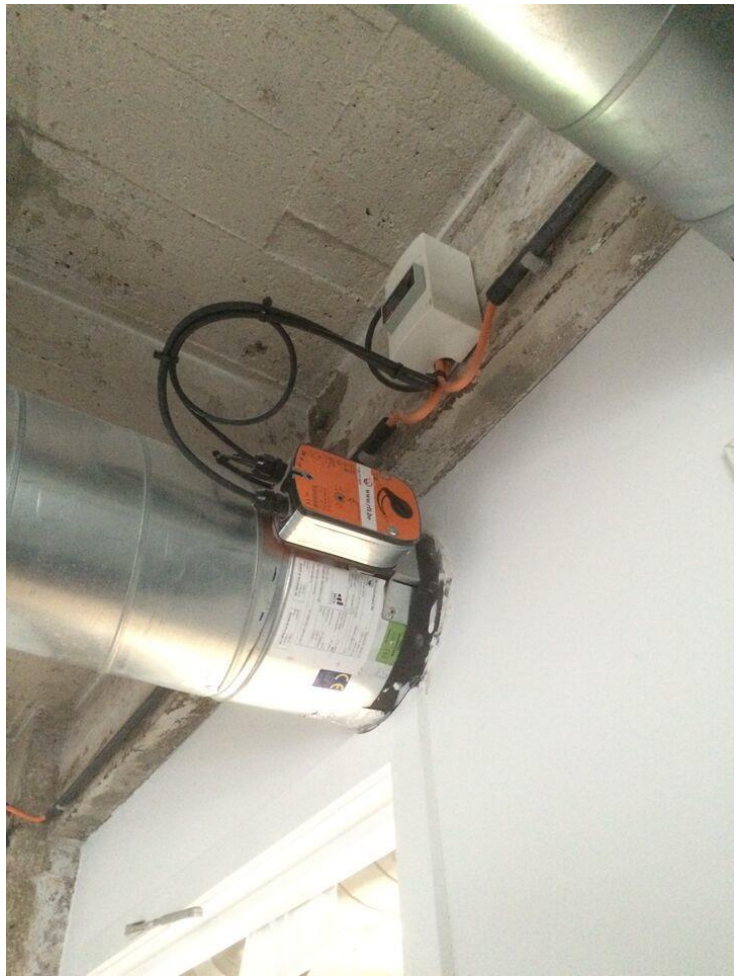

Image Source: MosArt

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Fire: Compliance Video

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Noise Generated by Ventilation System

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- Be aware of **potential nuisance** for occupants caused by noise from ventilation system
- Affected by the **design** of ducts and fittings as well as **mounting**
- Consider use of **sound attenuators** to mitigate noise
- If noise levels frustrate occupants, there is a **risk that they will shut it off** – which would have significant impact on indoor air quality

Room type	Noise thresholds
Noise sensitive rooms (such as bedrooms and living rooms)	≤ 30 dB L_{AeqT}
Less noise sensitive rooms (such as kitchens and bathrooms)	≤ 35 dB L_{AeqT}

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Ventilation System Quality Control

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Ventilation systems must be:

- Designed *(Nationally Approved)*
- Installed *(Nationally Approved)*
- Balanced *(Nationally Approved)*
- Commissioned *(Nationally Approved)*
- Independently Validated *(National Standards or IBAN)*

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Assessment

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