Ventilation in new homes

Where to start for homebuilders

May 2026

Future Homes Hub

Glossary

Air terminals
The ceiling or wall-mounted supply or extract valves or grilles within rooms.

Air permeability
The measured airtightness (air leakage) of the building envelope (not ductwork), typically expressed as $m^3/(h \cdot m^2)$ at 50 Pa.

Air transfer pathways (internal transfer paths)
The routes by which air moves between rooms in a dwelling as part of the designed ventilation system. Typically provided by door undercuts of purpose-designed transfer grilles in doors or walls.

Background ventilators
Purpose-provided openings (e.g. trickle vents in windows or passive vents in walls) allowing air into the dwelling.

Boost rate
A higher airflow rate intended for short-term operation during peak moisture or pollutant generation.

Commissioning
The process of measuring, adjusting a ventilation system to ensure it is set up correctly for the end user.

Duct network
The system of ducts distributing air. In MVHR systems this includes separate supply and extract duct runs.

Extract air
Air removed from wet rooms or other spaces by a ventilation system.

Fan curve
A graph showing the relationship between airflow rate and system resistance for a given fan.

Habitable room
A room used for living or sleeping (e.g. bedrooms, living rooms).

Infiltration
Uncontrolled air leakage through the building fabric.

Intermittent extract ventilation (IEV)
Extract ventilation provided by fans that operate intermittently (e.g. during cooking or bathing), rather than continuously.

Mechanical extract ventilation (MEV)
A system that continuously extracts air from wet rooms to provide whole-dwelling ventilation, either via individual fans (dMEV) or a central unit (cMEV).

Pressure drop (system resistance)
The resistance to airflow caused by duct length, bends, fittings and terminals.

PCDB (Product Characteristics Database)
A database of manufacturer-declared performance data (e.g. for ventilation systems) used within SAP/HEM calculations.

Purge ventilation
High-rate ventilation (typically via openable windows or doors) used intermittently to rapidly remove pollutants, moisture or excess heat. Distinct from continuous background ventilation and not intended to provide whole-dwelling continuous rate.

SAP (Standard Assessment Procedure) / HEM (Home Energy Model)
Calculation methodologies used to assess the energy performance of dwellings for regulatory compliance. Ventilation inputs should reflect the designed system performance, not be used to determine it.

Specific fan power (SFP)
A measure of the electrical power required to move a given volume of air.

Supply air
Air delivered into habitable rooms by a ventilation system.

Wet room
A room where moisture and pollutants are generated (e.g. kitchens, bathrooms, utility rooms).

Whole-dwelling ventilation rate
The continuous airflow required to maintain acceptable indoor air quality across the entire dwelling, as defined in Approved Document F. Also known as the background ventilation rate.

Ventilation in new homes

Where to start for homebuilders

A

Introduction

Good ventilation is essential to the delivery of healthy, comfortable and energy-efficient new homes. It helps manage indoor air quality, moisture and odours, and supports the long-term performance of the building fabric.

Foreword and context

As homes become more energy efficient and more airtight, ventilation plays a more critical role in maintaining healthy indoor conditions. If ventilation is not effective, this can lead to elevated indoor pollution levels, moisture accumulation, condensation and mould risk. Systems that are not appropriately designed, installed or commissioned can also be perceived as intrusive or difficult to operate, increasing the likelihood that occupants switch them off. These issues could affect occupant wellbeing, customer satisfaction, and long-term performance and durability.

Good ventilation is not simply a matter of selecting products or meeting minimum airflow rates. It depends on the way the whole system works within the dwelling, including air supply, extract, transfer paths, controls, ductwork, terminals, commissioning and resident use. The ventilation strategy also needs to be coordinated with other aspects of the building design, including airtightness, acoustic requirements, fire safety, overheating, window design, services distribution and the building fabric.

Ventilation should therefore be treated in the same way as structure, fire safety, fabric performance and heating systems: as a critical building service that requires clear design specification, coordinated delivery and verification. It must also be considered alongside the intended dwelling airtightness strategy and overall building design, rather than in isolation. Ventilation performance depends on the entire delivery process, from early design decisions through to commissioning and handover.

This guide has been developed to support homebuilders and their project teams in achieving good ventilation outcomes in new homes. It is intended to help project teams understand the practical decisions, responsibilities and coordination steps that influence whether the ventilation strategy selected at design stage is delivered effectively in practice.

Ventilation should be treated in the same way as structure, fire safety, fabric performance and heating systems.

The guide is primarily aimed at those involved in briefing, designing, procuring, constructing, commissioning and handing over new homes, including technical and design teams, commercial and procurement teams, construction and site management teams, and those responsible for quality assurance, inspection and verification.

It will also be useful to clients, principal designers, specialist ventilation designers, manufacturers, installers, building control bodies and others involved in the delivery of ventilation systems in new housing.

This guide is non-statutory. It does not replace the requirements of the Building Regulations, Approved Document F or other relevant statutory guidance. It is also not a detailed ventilation design manual. Detailed ventilation design should be undertaken by a competent person, using appropriate standards, design guidance, manufacturer data and project-specific information. Complementary industry guidance on installation, commissioning and compliance processes is set out in the *Domestic Ventilation Installation and Commissioning Compliance Code of Practice, 2026 Edition* published by BEAMA and FETA.

The guide focuses on the practical issues that help make ventilation work in real homes. It highlights the importance of clear design responsibility, early coordination, appropriate procurement, good installation practice, effective commissioning, meaningful handover and learning from completed projects.

Relationship with overheating and purge ventilation

This guide focuses on whole-dwelling (background) ventilation strategies. It does not cover purge ventilation requirements (Approved Document F) or overheating risk mitigation (Approved Document O). These must be considered alongside ventilation strategy selection as part of an integrated design approach.

Early design decisions, including window size, opening strategy and dwelling layout, influence both ventilation and overheating performance and should be considered as part of an integrated design approach.

See our Part O: Avoid Overheating web page
for further guidance on overheating

How to use this guide

This guide is structured around the main stages and decisions that influence ventilation outcomes in new homes. It can be read from start to finish, but it is also intended to be used as a reference during briefing, design, procurement, construction, commissioning and handover.

Different sections will be more relevant to different roles and project stages:

- Section A: provides context for all readers.
- Sections B and C: early decisions, core strategies, design responsibility and good ventilation design.
- Section D: procurement, competence, commissioning responsibilities and independent verification.
- Sections E and F: installation, coordination, commissioning and handover.
- Sections G and H: verification, measured performance, occupant understanding and learning from homes in use.

The prompts, checklists and examples are intended to support project discussions and help identify where decisions, responsibilities or evidence may need to be clarified. They should be used proportionately, taking account of the ventilation strategy, project scale, procurement route and level of risk.

The guide should be used early enough to influence project decisions, not only as a final check at completion. It is likely to be most useful when used to support design reviews, procurement discussions, pre-start meetings, site quality checks, commissioning reviews and lessons-learned exercises.

The guide should be used early enough to influence project decisions, not only as a final check at completion.

Five good practice principles for reliable ventilation

1. **Ventilation is a whole-dwelling system**
2. **Strategy should align with dwelling airtightness**
3. **A named ventilation designer should be stated**
4. **Installation by a competent person must follow the design**
5. **Measured performance should be verified**

B

Getting ventilation right

Delivering good indoor air quality does not require unnecessary complexity. It depends on making the right decisions early in the design process and ensuring that systems are installed and commissioned as intended.

Getting ventilation right from the outset

Choosing a ventilation strategy is one of the most critical early decisions when designing a new home. Selecting a ventilation strategy must take account of factors such as dwelling type and layout, intended airtightness, external noise and air quality, and the capability of the delivery team.

The whole dwelling should be considered as the ventilation system. It is not just the fans and ventilators.

The selected approach influences multiple aspects, including:

- How outdoor air enters the dwelling
- How air moves between rooms
- How stale air is removed
- Heating and cooling loads
- The level of reliance on occupant behaviour
- The complexity of design coordination
- Commissioning and maintenance requirements
- The long-term robustness of indoor air quality performance

In modern airtight homes, ventilation is a critical building system, essential to maintaining healthy indoor air quality. Its effectiveness depends on alignment with the intended airtightness of the building envelope and the overall dwelling design.

Airflow depends on the internal layout and the interaction between background ventilators or supply terminals, internal transfer paths, and extract points.

Internal transfer paths are critical components. If these are not adequately provided, the ventilation system will not perform as intended.

For ventilation systems to work:

1 Outdoor air needs to enter

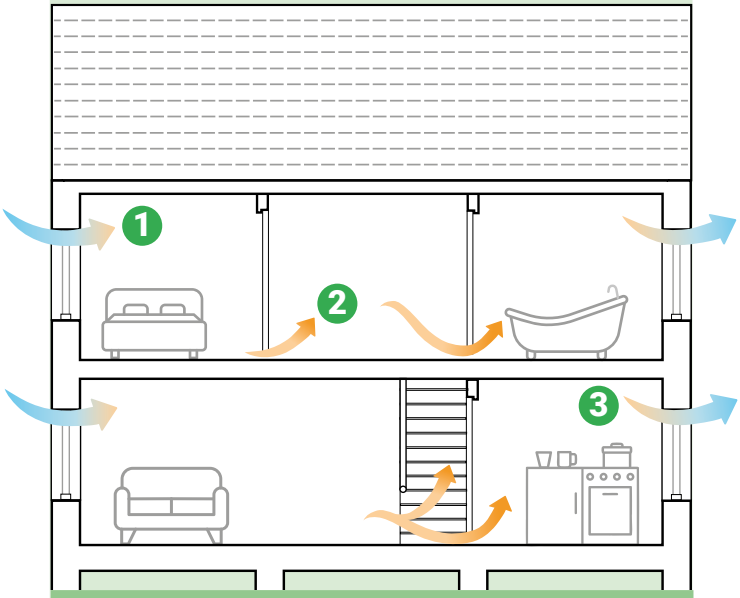
Outdoor air must enter the dwelling through background ventilators, such as trickle vents, or mechanical supply terminals.

2 Air needs to move through the dwelling

Air must move between rooms via door undercuts or transfer grilles. Obstruction of these paths disrupts airflow.

3 Stale air needs to be removed

Depending on strategy, moisture and pollutants are removed via continuous extract or through a combination of background ventilators with intermittent extract.



This refers to the designed ventilation system. It does not include purge ventilation provided by opening windows or doors.

Ventilation strategy and fabric airtightness are interdependent

As fabric airtightness improves, reliance on designed ventilation increases and systems that depend heavily on background ventilators may become less robust. Approved Document F reflects this by limiting certain ventilation approaches in more airtight dwellings, while Approved Document L[1] drives improved envelope performance for energy efficiency. Selecting a ventilation strategy without reference to the dwelling airtightness target risks under-ventilation or unnecessary complexity.

However, airtightness thresholds should not be used in isolation to determine system suitability. A strategy that is permissible under Approved Document F may still be difficult to deliver reliably in practice if the dwelling design (e.g. form, layout, orientation, façade design) does not support clear airflow paths or if installation quality is inconsistent.

Where things commonly go wrong

A home may have fans, vents and ductwork installed yet still fail to deliver effective ventilation in practice. Problems may sometimes arise from a single component, but more often they stem from incomplete design, poorly sized or located background ventilators or supply air valves, insufficient air transfer paths, unreviewed ductwork changes on site, or commissioning that does not properly reference the design airflow requirements.

Where one part of the system is compromised, overall performance is affected. This principle applies across all Approved Document F ventilation strategies.

Evidence of variability in practice

National studies[2], alongside ongoing anecdotal evidence, indicate that ventilation systems in some new homes do not always deliver the intended performance. Elevated carbon dioxide levels in bedrooms, extract flow rates below target values and inconsistent commissioning practices have been a common finding in these studies.

Feedback from the Future Homes Hub Ventilation Implementation Group indicates that variability is primarily a delivery and verification issue rather than a technology failure. In many cases, systems were capable in principle but undermined by fragmented design responsibility, procurement substitutions, installation deviations and limited oversight.

Selecting a ventilation strategy alone is not sufficient. Performance depends on suitable design, coordinated installation, reliable commissioning and verification.

Choosing a ventilation approach

No single ventilation strategy is universally appropriate. Suitability depends on factors such as dwelling type, form and layout, airtightness targets, location and proximity to external noise and pollution sources, and the experience and capability of the delivery team.

Some strategies rely more heavily on occupant behaviour and background ventilators. Others depend on detailed duct design, coordination and careful commissioning. In every case, performance depends on a good design from the outset, installed and commissioned with clear coordination and accountability.

Where strategies rely on background ventilators and natural driving forces, performance may be more sensitive to occupant behaviour, external conditions and installation quality. In contrast, continuous mechanical systems typically provide greater control over airflow rates but require more detailed design and coordination.

Regulatory compliance alone does not confirm suitability. The selected approach must be capable of delivering consistent performance in the specific dwelling type, layout and context.

At the point of choosing a ventilation approach, homebuilders should be able to answer:

- How does air enter, move through and leave the dwelling?
- What does this system depend on in order to work properly in this dwelling, and are those conditions realistically deliverable?
- Who is responsible for the detailed design?
- How will design changes be controlled?
- How will performance be verified at completion?

If these questions cannot be answered clearly, the risk of underperformance increases, regardless of the technology selected.

1. Approved Document L – Conservation of fuel and power. Volume 1: Dwellings. 2026 edition
2. MHCLG (2019), Ventilation and Indoor Air Quality in New Homes

Core ventilation strategies

Natural Ventilation with Intermittent Extract (NV + IE)

How it works

Natural ventilation with intermittent extract relies primarily on background ventilators (e.g. trickle vents) to deliver the continuous whole-dwelling ventilation rate. Outdoor air enters habitable rooms through ventilators, typically integrated within window frames. Air movement through the dwelling is driven by wind and temperature differences, passing via door undercuts or transfer grilles before leaving through ventilators (depending on wind pressure conditions) or through intermittent extract fans in kitchens, bathrooms and other wet rooms. Airflow direction is not fixed and will vary depending on external conditions. Air may enter or leave through different openings at different times, and the intended airflow pattern cannot be assumed to follow a single consistent route. As a result, airflow distribution between rooms cannot be directly controlled or balanced.

The key distinction is that the background ventilators provide the continuous ventilation rate. Intermittent extract fans are intended to manage and dilute peak moisture and pollutant loads during activities such as cooking and bathing.

When it is typically appropriate

This strategy is most commonly used in low-rise housing where background ventilators can be accommodated without external noise constraints that would limit their use, and in less airtight dwellings where the intended (design) air permeability is above 5 m³/(h·m²) at 50 Pa.

As dwelling airtightness improves and unintended air leakage (infiltration) reduces, reliance on wind-driven forces and ventilator area becomes more significant. The guidance in Approved Document F associates this approach with dwellings having higher air permeability.

In practice, this approach is more vulnerable to under-performance than mechanically driven systems, as airflow depends on external conditions and occupants keeping background ventilators open and using extract fans when needed. Robust performance depends on careful design, correct installation and consistent use by occupants. It cannot be assumed based on the presence of background ventilators alone.

This approach is therefore more sensitive to variability in design, installation and use than mechanical systems.

Key risks to performance

Performance will reduce if background ventilators are undersized, omitted during window procurement, or obstructed by finishes. Reduced door undercuts, or poorly coordinated fire and acoustic detailing, can restrict airflow.

Because the airflow is influenced by wind conditions and occupant behaviour, closing ventilators or failing to use extract fans during peak moisture generation can undermine the intended ventilation outcomes. If background ventilators are closed or obstructed, airflow to individual rooms will be significantly reduced or effectively zero.

Natural Ventilation with Intermittent Extract (NV + IE)

Critical for this approach:

- ✔ Correctly sized and located background ventilators 1
- ✔ Reliable occupant use of background ventilators and extract fans 2
- ✔ Internal air transfer paths 3
- ✔ Alignment with higher air permeability dwellings

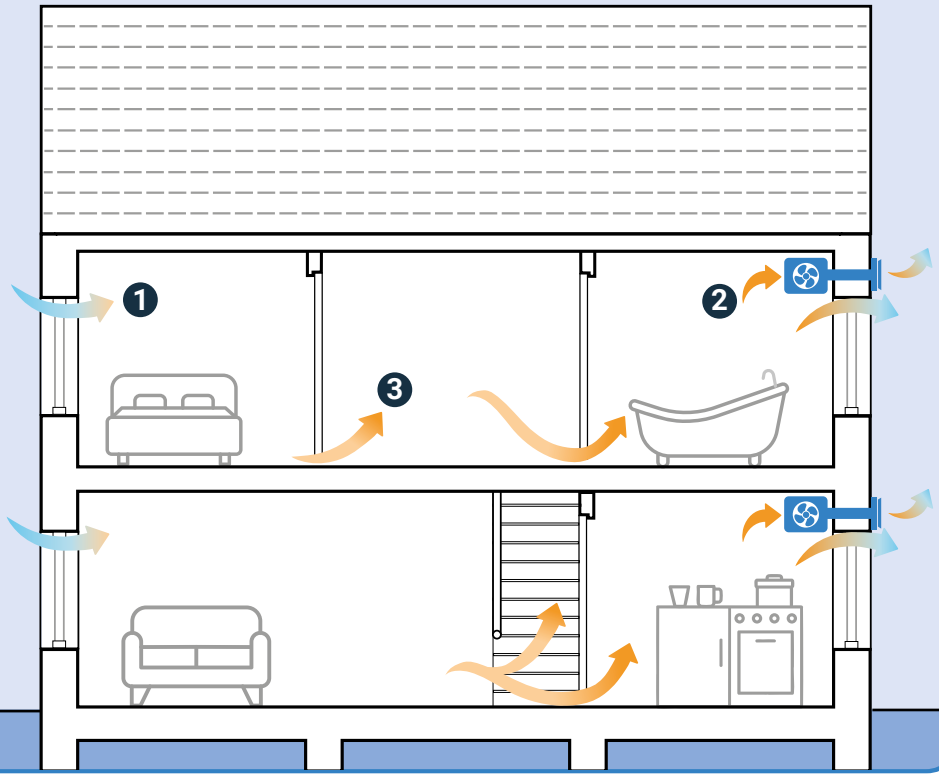


Illustration: Corinne Welch

Decentralised Mechanical Extract Ventilation (dMEV)

How it works

dMEV provides continuous mechanical extract from wet rooms, collectively creating a slight negative pressure within the dwelling. Each kitchen, bathroom or utility room contains a continuously running fan, with the combined operation of all fans delivering the whole-dwelling ventilation rate. Higher extract rates may be provided during periods of peak moisture generation.

Background ventilators in habitable rooms provide the air supply, and air moves through internal transfer paths towards the extract points. Overall performance depends on the combined operation of all fans and the continuity of airflow paths through the dwelling.

Unlike natural ventilation strategies, the continuous whole-dwelling ventilation rate is delivered mechanically by the extract fans, providing more consistent airflow than reliance on external conditions.

When it is typically appropriate

dMEV is commonly used in low- and medium-rise housing where natural ventilation is unsuitable or less robust. It can be particularly suited to smaller dwellings with short internal air paths, where air can move readily between habitable rooms and wet rooms, and where space constraints limit the installation of a centralised unit and associated ductwork. In larger or more complex layouts, longer air paths and increased resistance can make it more difficult to achieve consistent airflow distribution.

dMEV is permitted for all dwelling types under Approved Document F. However, suitability depends on dwelling size, layout, air transfer path lengths and acceptable noise performance. Use of dMEV based solely on regulatory compliance, without assessing dwelling-specific suitability, increases the risk of under-performance in use.

Key risks to performance

Because fans are located within wet rooms, noise can be a concern, particularly in en-suites bathrooms. If systems are perceived as intrusive, occupants may reduce fan speeds or switch them off, undermining the intended whole-dwelling ventilation rate.

As each fan operates independently, performance depends on correct commissioning of every unit. The interaction between multiple independent fans means that imbalance in one room can affect airflow patterns elsewhere. If extract rates are set based only on individual wet room requirements rather than the whole-dwelling rate, overall ventilation may be insufficient.

Background ventilators should be provided in habitable rooms only; wet rooms served by continuous mechanical extract must not have them, otherwise airflow may be short-circuited directly to extract points, reducing ventilation effectiveness in habitable rooms. Effective airflow depends on background ventilators and internal transfer paths remaining open and unobstructed.

Decentralised Mechanical Extract Ventilation (dMEV)

Critical for this approach:

- ✔ Correctly sized and located background ventilators 1
- ✔ Continuous operation of fans, correctly commissioned for whole-dwelling requirement 2
- ✔ Internal air transfer paths 3
- ✔ Acceptable noise levels in habitable rooms
- ✔ Short, low-resistance duct runs

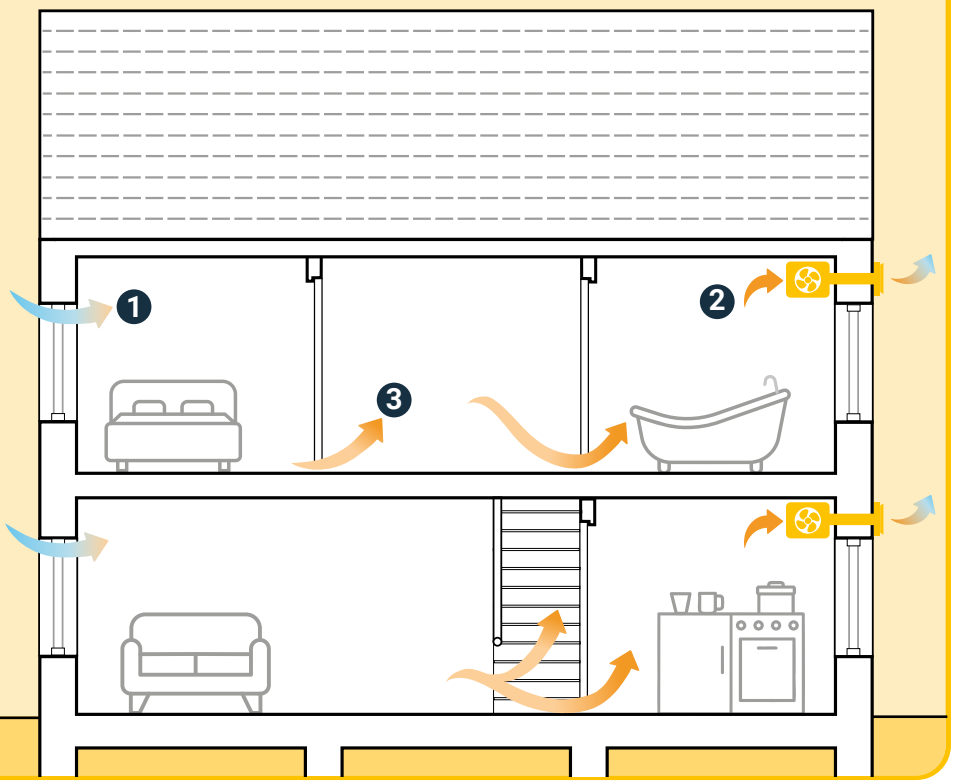


Illustration: Corinne Welch

Centralised Mechanical Extract Ventilation (cMEV)

How it works

cMEV uses a single continuously running central extract fan unit to extract air from multiple wet rooms through a duct network within the dwelling. The fan is intended to deliver the whole-dwelling ventilation rate through the duct network, with boost operation available during peak moisture generation.

Unlike dMEV, extract from all wet rooms is combined into one centrally located unit, although, in some layouts, more than one unit may be used. The unit is typically located in a cupboard or ceiling void. Background ventilators in habitable rooms provide the air supply, with the central fan creating a slight negative pressure that draws air through intended transfer paths to the extract points. As a result, the performance of the system depends not only on the fan and ductwork, but also on the continuity of airflow paths through the dwelling.

When it is typically appropriate

cMEV is commonly used in low- and medium-rise housing where space can be provided for a central unit and coordinated duct routes. Compared with dMEV, centralised systems typically offer greater available fan capacity and improved aerodynamic performance, particularly where multiple wet rooms are served. When properly designed and installed, these systems can be energy efficient, operating at relatively low fan speeds, which can also support quieter operation in use.

Suitability depends on available space for ductwork and acceptable routing without excessive resistance. Compared with dMEV, cMEV relies on coordinated system design and balancing across a shared duct network, and is more sensitive to system resistance.

Key risks to performance

Because all extract air is combined within a shared duct network, excessive resistance in one duct branch can make the system difficult or impossible to balance. This may result in some wet rooms being over-ventilated while others underperform.

Poor coordination between duct design, installation and commissioning can result in systems that are difficult to balance and operate inefficiently. Achieving the intended airflow distribution requires careful commissioning, with settings at each terminal dependent on the overall system resistance.

Although mechanically driven, effective airflow still depends on background ventilators and internal transfer paths remaining open and unobstructed. As with dMEV systems, background ventilators must be provided in habitable rooms only, with internal transfer paths maintained to avoid short-circuiting of airflow.

If the central unit is poorly located, inaccessible, or installed in unheated spaces without insulation or condensate provision, both performance and system durability may be compromised.

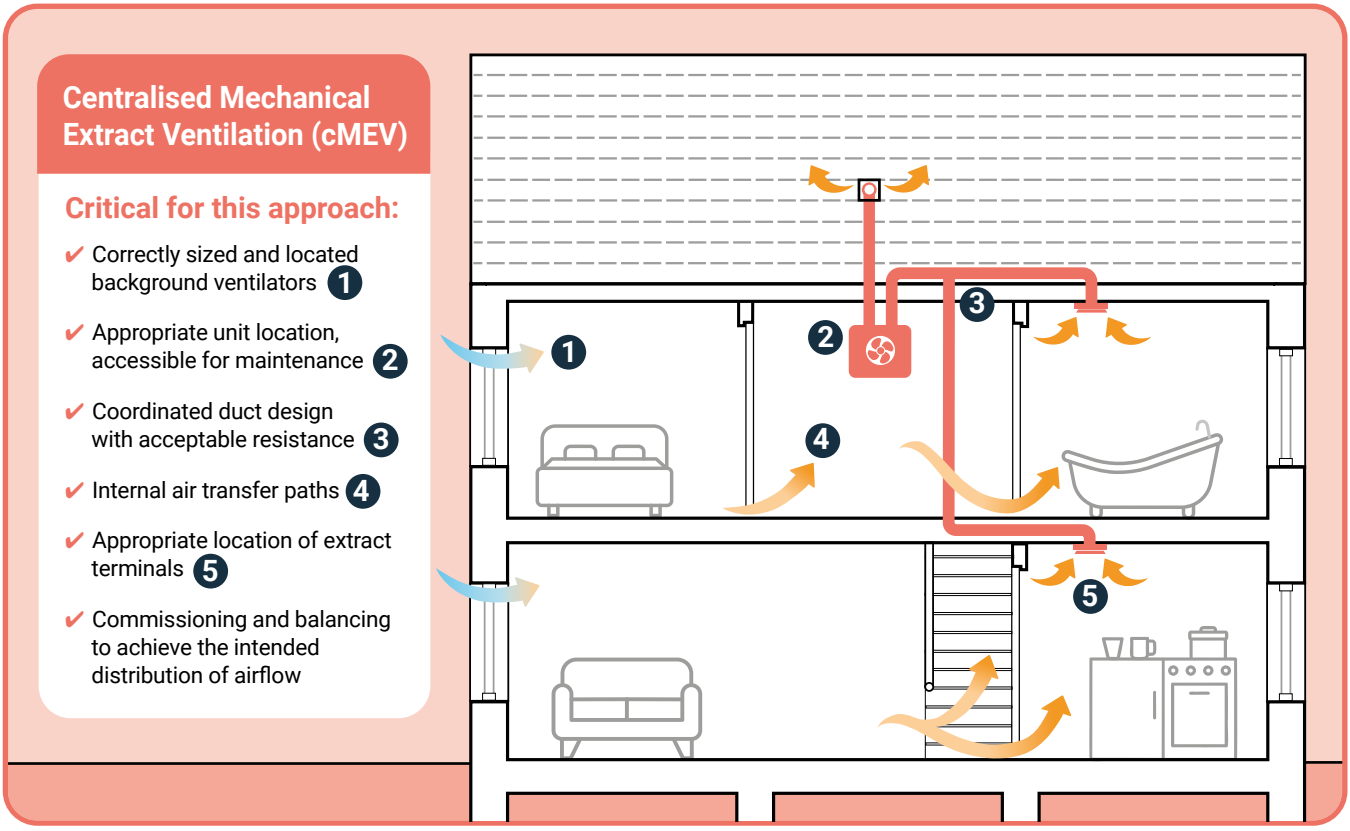


Illustration: Corinne Welch

Mechanical Ventilation with Heat Recovery (MVHR)

How it works

MVHR provides continuous mechanical supply and extract ventilation through a central unit incorporating a heat exchanger. Stale air is extracted from kitchens, bathrooms and other wet rooms, while fresh outdoor air is supplied to habitable rooms such as bedrooms and living spaces.

The heat exchanger transfers heat from outgoing to incoming air, reducing heat loss while maintaining airflow. Air is distributed through a duct network with separate supply and extract runs that must be balanced to operate correctly. Background ventilators are not required because airflow is mechanically supplied and extracted. MVHR units should include thermal bypass to avoid unwanted heat recovery in warmer conditions.

When it is typically appropriate

MVHR is typically used in dwellings designed to achieve low measured air permeability, where reliance on infiltration and passive systems becomes insufficient to provide consistent ventilation. In these conditions, ventilation must be delivered in a controlled manner, and MVHR provides continuous supply and extract with heat recovery. While permitted under Approved Document F at higher permeability levels, MVHR is most effective in more airtight homes (typically below 3 $m^3/(h \cdot m^2)$ at 50 Pa) where infiltration is minimal and the benefits of controlled ventilation and heat recovery are realised.

It is often adopted in highly airtight homes, or where outdoor noise or pollution makes reliance on background ventilators less desirable. Incoming air is filtered, with filter grade selected according to external conditions or occupant requirements. Suitability depends on early design integration, adequate space for ductwork and the central unit, and coordination with structure and services.

Key risks to performance

MVHR systems are more complex than extract-only strategies and require careful design, installation and commissioning. Poor coordination can result in excessive resistance, making effective commissioning difficult or impossible and increasing air velocity and fan noise.

If airflow rates are not correctly balanced, rooms may be over- or under-ventilated, and the heat exchanger efficiency may be reduced. Noise or localised air velocity (draught) discomfort, often associated with poorly sited supply terminals, can lead to systems being switched off. Poor ductwork installation, including leakage or inadequate sealing, can reduce system efficiency and compromise performance.

Systems that are difficult to understand or maintain are more likely to be incorrectly operated or switched off. Ongoing maintenance, particularly filter cleaning or replacement, is necessary to maintain airflow and efficiency. Without this, airflow rates reduce and system efficiency declines.

Mechanical Ventilation with Heat Recovery (MVHR)

Critical for this approach:

- ✔ Adequate access to intake and exhaust terminals and maintenance access 1
- ✔ Fully coordinated duct design and layout 2
- ✔ Internal air transfer paths 3
- ✔ Appropriate location and selection of supply and extract terminals 4
- ✔ Proper condensate drainage with drytrap to main drain 5
- ✔ Accurate balancing of supply and extract airflow

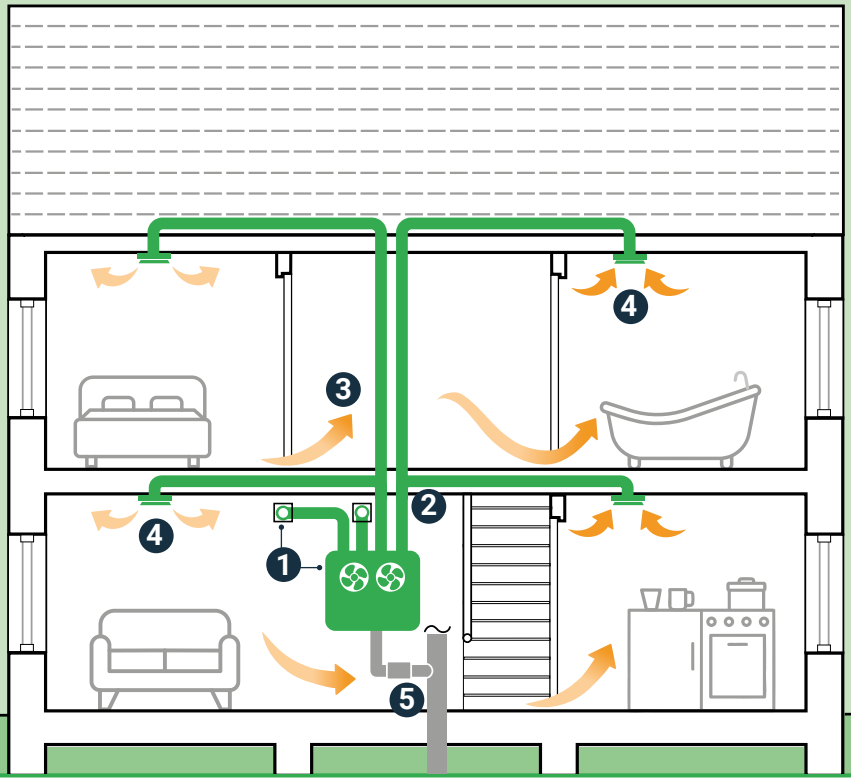


Illustration: Corinne Welch

C

Defining good ventilation design

Ventilation systems are often specified by reference to the minimum provisions published in Approved Document F. However, compliance on paper does not guarantee performance in practice. Delivering good indoor air quality requires a ventilation design that is clear, coordinated and capable of being installed as intended.

Designing for performance

Ventilation systems in airtight homes are engineered systems. Treating design as a product selection exercise rather than a calculation-based process significantly increases performance risk. A ventilation strategy should not be reduced to a product selection or generic notes on drawings. A meaningful design must set out airflow rates, system layout and arrangement, background ventilator provision (where relevant), and the assumptions on which performance depends. It should be possible to trace the installed system back to a defined design against measurable airflow targets. Selecting a fan or unit is not the same as designing a ventilation system; the design must define how air will move through the dwelling and the conditions required for that to happen reliably.

Ventilation directly affects occupant health, moisture control and can help protect the building fabric from excess moisture. As infiltration reduces, reliance on the designed ventilation system increases. The design must therefore be robust and verifiable.

The design forms the reference point for procurement, installation, commissioning and verification.

Clarifying design responsibility

Responsibility for ventilation design should be defined at project outset. In some organisations this may sit within an in-house technical team; in others it may be undertaken by a specialist subcontractor or consultant. In smaller schemes, the ventilation design is often managed by the installer with input from the equipment supplier. Irrespective of scale, the principle remains the same: design responsibility must be clear and retained through procurement and installation.

Regardless of delivery model, the ventilation design should be undertaken by a person able to demonstrate competence in ventilation system design and relevant standards. Competent person schemes may provide one route to demonstrating this, but responsibility for ensuring competent designers are appointed ultimately sits with the project dutyholders.

At an early stage, homebuilders should be able to answer:

- Who is responsible for the ventilation design?
- How does the ventilation design coordinate with the structure and other services?
- What is the process for reviewing and approving design changes?
- Who verifies that commissioning reflects the design requirements?

Any changes to the ventilation design, including product substitutions, duct routing or control strategy, must be reviewed and approved by the responsible ventilation designer before implementation.

Without a responsible designer, ventilation risks becoming a coordination task rather than an engineered system. If responsibility is fragmented or assumed, airflow calculations, duct routes and background ventilator sizing and locations may not align with the selected strategy.

The majority of projects are subject to Building Regulations dutyholder roles. Where applicable, the client is responsible for appointing dutyholders in accordance with the Building Regulations. Ventilation should form part of the coordinated design process with clear design responsibility.

The Principal Designer's role includes coordinating and planning the design work during the design phase and ensuring that design responsibilities are appropriately managed and communicated. In relation to ventilation, this should include ensuring that:

- A named ventilation designer is appointed
- The ventilation design is incorporated within the coordinated design
- Changes affecting ventilation are communicated and reviewed through a defined process
- Information required for commissioning is defined and carried through the design

This helps to ensure ventilation is treated as a coordinated system with clear design ownership.

Meaningful ventilation design

A meaningful ventilation design is not a generic schematic, quotation layout or product schedule. It must provide enough dwelling-specific information for the system to be installed, commissioned and verified against defined airflow targets. Appendix 1 provides a design submission checklist to help homebuilders confirm whether the information received is sufficiently complete before installation begins.

The ventilation designer should check and confirm that the selected ventilation strategy is appropriate for the dwelling and its intended airtightness value. The design must clearly identify both the minimum whole-dwelling ventilation rate and any higher extract rates where a boost function is provided. The design should identify background ventilator sizes and locations, where applicable, and internal air transfer requirements, supported by calculations to demonstrate compliance with Approved Document F.

Competence of the responsible ventilation designer

A ventilation design should be undertaken by a competent individual, supported by an organisation with appropriate quality management and accountability.

Depending on the system type and procurement route, the responsible designer may be:

- A specialist building services engineer
- A specialist ventilation contractor providing a design-and-install service
- An in-house design team with appropriate technical competence
- A ventilation equipment manufacturer offering a fully coordinated design service

Where manufacturers provide indicative layouts, these should be clearly identified as preliminary or quotation-stage information unless they are explicitly taking responsibility for the ventilation design and coordination.

Where the ventilation design is undertaken by the installer or contractor, this function should be carried out by a competent individual with demonstrable ventilation design capability. Installation training alone does not constitute ventilation design competence.

The responsible ventilation designer should be supported by appropriate organisational accountability and, where appropriate to the procurement route and project risk, professional indemnity or equivalent design liability arrangements.

Membership of a recognised competent person scheme may provide additional assurance where design competence is included within its scope. Other routes to demonstrating competence may be appropriate, provided equivalent assurance can be evidenced.

The name of the responsible ventilation designer and their organisation should be clearly identified on the design documentation and reflected on the commissioning checklist. Completion of the standard Approved Document F checklist alone does not demonstrate ventilation design competence. Clear identification of the responsible designer supports accountability and reinforces the importance of the design stage.

See our Ventilation Competency web page ↗ for further information and latest updates on competency requirements for Designers, Installers and Commissioners

For ducted systems, the design should also define:

- Coordinated duct routes and sizes
- Air terminal positions
- Location of intake and exhaust terminals
- Interfaces with fire and acoustic requirements (e.g. fire dampers and acoustic treatment where required)
- Confirmation that total system resistance is within manufacturer and Approved Document F limits.

Where mechanical systems are used, the design should demonstrate that the selected unit can deliver the required airflow rates under the expected system resistance, typically by reference to the manufacturer's fan curve with the intended operating points clearly identified. Note that Approved Document F includes limits for static pressure for ducted systems. It also requires that, where duct lengths exceed 2 metres, calculations demonstrate that the required airflow rates can be achieved within specified system resistance (pressure drop) limits.

Controls and user interfaces must be defined as part of the design, including how occupants will operate the system and how boost functions are triggered, where provided. Controls must be compatible with the selected system and clearly linked to the intended mode of operation at handover.

Each intended fan speed setting should have defined airflow rates so that commissioning can be measured against the design.

Feedback loops and design change

Ventilation performance is sensitive to changes made elsewhere in the design process. Alterations to layouts, window specifications, site coordination or product selection can all affect airflow rates and system efficiency. For example:

- Changing window supplier may alter background ventilator provision
- Site coordination may reveal that additional bend or offsets are needed to ductwork routes, which will increase overall system resistance
- Products, such as fans, ducts and background ventilators, may be substituted for those that have different performance characteristics

Where such changes occur, the ventilation design should be reviewed and, where necessary, recalculated. Without feedback to the responsible designer, ventilation performance can be negatively impacted during value engineering or late design change.

> Any changes to the ventilation equipment or layout should be reviewed and approved by the responsible ventilation designer before implementation.

Clear change-control processes help ensure that the installed system remains consistent with the original design intent.

Information flow to energy modelling (SAP / HEM for new dwellings)

Ventilation assumptions form part of the dwelling energy model. The selected strategy, airflow rates and airtightness value influence calculated energy performance.

Energy modelling should reflect the ventilation design not determine it. The ventilation strategy should be selected on the basis of indoor air quality needs and suitability for the dwelling.

Homebuilders should ensure that the following information is clearly communicated to the SAP or HEM assessor:

- Ventilation strategy and designed airflow rates
- Assumed airtightness value
- Fan performance data (e.g. make/model for SAP/PCDB inputs)

The information required for energy modelling is evolving. The items listed above reflect current SAP inputs. Additional parameters may be required under the Home Energy Model (HEM) as it is developed. Assumptions included in the energy model about the ventilation strategy and airtightness should be revisited once the detailed ventilation design is confirmed.

Where systems include user controls, modelling assumptions should align with the intended control strategy. Misalignment can result in a performance gap between predicted and actual operation.

Specific design checks

Good ventilation performance depends on coordination between the ventilation strategy and the wider building design.

Space and access

Mechanical systems require adequate space for installation, commissioning, maintenance and replacement. Floor void depths, service zones, risers and cupboard space should be coordinated early.

Confirm that:

- Duct routes and lengths can be installed in accordance with the ventilation design, without introducing additional bends
- Units are accessible for future inspection, maintenance, filter replacement, and unit replacement without disruption to the building fabric
- Space must be allowed for duct insulation in unheated spaces and on cold MVHR intake/ exhaust ducts within the thermal envelope
- Condensate drainage (where applicable) is properly detailed

Poor spatial coordination is a common cause of excessive resistance, increased noise and compromised performance. Insufficient space provision is a common cause of on-site design changes that can adversely affect ventilation performance.

Duct routing

Ventilation systems are sensitive to duct resistance, which directly determines achievable airflow rates and operating noise. Excessive lengths, sharp bends, poorly selected fittings or compressed flexible ducting can significantly reduce airflow.

A common consequence of excessive system resistance is that fan speeds may need to be set significantly higher at commissioning to achieve the required airflow rates. In doing so, fan and air velocity noise can increase and, in some cases, vibration may be excessive. Systems operating under these conditions are more likely to be perceived as intrusive, increasing the risk that occupants will switch systems off.

Commissioning cannot compensate for fundamentally poor duct design. Resistance should be calculated at design stage and installation should be checked to ensure duct routes and fittings remain consistent with the design assumptions. Duct routing must be installed as designed and not altered on site without review by the responsible ventilation designer.

Air terminals

External terminals affect both airflow performance and façade design.

Check that:

- Terminal positions are clearly shown on elevations and are coordinated with façade design
- Separation distances between intake and exhaust terminals follow Approved Document F and manufacturer guidance
- The free area of the terminal or grille is consistent with the ventilation design and sufficient for the system selected

Internal air terminals affect airflow performance and comfort.

Check that:

- Ceiling mounted air supply terminals are generally located away from walls, not at edges or corners to avoid local draught discomfort
- Air terminals or valves are selected to suit the intended airflow direction
- Terminals or in-line dampers can be adjusted and fixed at commissioning to meet and maintain the design airflow rates

Incorrect terminal selection or positioning can affect both airflow performance and occupant comfort.

Acoustic performance

Noise is one of the most common reasons occupants switch ventilation systems off, particularly where ventilation units or extract fans are located adjacent to bedrooms.

Design stage checks should consider:

- Unit location relative to sensitive rooms, such as bedrooms
- Manufacturer noise data at intended airflow rates
- Need for attenuation or vibration treatment

Where airflow rates are only achievable at elevated fan speeds due to poor duct coordination or system sizing, perceived noise levels may increase. Systems that are perceived as intrusive may be switched off or overridden. Acoustic performance must be considered alongside airflow requirements, not as a secondary consideration.

Background ventilators and internal transfer routes

Airflow depends on unobstructed supply and extract air transfer paths. Internal air paths must not be left to site decisions.

Confirm that:

- Background ventilators e.g. trickle vents (where applicable) are correctly sized and located
- Door undercuts or transfer grilles are sized and are compatible with fire and acoustic requirements
- Intended floor finishes and thresholds do not reduce intended transfer areas

Coordination failures arise not from the ventilation unit itself, but from reduced or obstructed airflow paths elsewhere in the dwelling. These elements form part of the ventilation system and should be treated as critical to overall performance.

Controls and usability

Controls must reflect the ventilation strategy and be consistent with the information provided at handover. Systems should be handed over in their intended operating mode.

Consider:

- Location and visibility of boost controls
- Labelling and user guidance
- Default settings at handover

Systems should be left operating in their intended configuration at completion. Controls that are poorly located or confusing increase the likelihood of user intervention that reduces ventilation performance.

Controls should not be altered or substituted on site without reference to the ventilation design.

D

From design to procurement

By this point in the process, the ventilation strategy should be defined and the ventilation design clearly documented. The risk is no longer primarily technical: it shifts to procedural and commercial. At this stage, the primary risk is that the defined ventilation design is altered, diluted or substituted without appropriate technical review.

Ventilation performance is often diluted when decisions are made for value engineering purposes without review by the responsible ventilation designer. Even where alternative products appear similar, differences in airflow capability, resistance characteristics or control behaviour can materially affect system performance. Ventilation is often bundled within a M&E package. As a result, it may be treated as a secondary service rather than as an engineered system. Late substitutions, repositioning of units or changes in duct routes can materially affect airflow rates, resistance and noise performance.

Procurement processes need to preserve the ventilation design intent, not simply secure nominally equivalent products.

Preserving the design throughout procurement

Equivalent performance must mean demonstrably equivalent airflow capability, system resistance characteristics, acoustic performance and efficiency. Equivalence must be demonstrated against the original design parameters, not assumed based on product type or manufacturer claims. Assumed equivalence without design review is a common cause of performance gaps.

Before approving substitutions, confirm as a minimum:

- Does the alternative product meet the defined airflow and resistance requirements?
- Has the impact on system resistance and noise been reviewed?
- Has the responsible ventilation designer approved the change?

Where ventilation systems include specific controls or system configurations, substitutions must also consider compatibility with the original control strategy and intended mode of operation. Changes to control strategies or interfaces should be treated as design changes.

No substitution or design change should be implemented without explicit review and approval from the responsible ventilation designer.

Competence at the core

The procurement route determines who holds design responsibility in practice.

Where ventilation design is being undertaken by:

- An installer
- A specialist subcontractor
- A manufacturer
- An in-house team

Homebuilders should confirm that the individual or organisation responsible for design has appropriate competence and that this responsibility is clearly defined in contractual documentation.

Ventilation design responsibility is often assumed rather than explicitly defined and documented. In smaller schemes, the installer may effectively “design on the day”, based on experience rather than documented calculations.

Where the installer is undertaking the design, procurement should require evidence of competence in ventilation design, not just installation. Where design is retained by the homebuilder or a specialist, responsibility should be clearly named and recorded, including on the ventilation checklist.

A meaningfully complete design must exist before installation begins and should define airflow rates, whole-dwelling ventilation requirements and equipment specification. Procurement documentation should make this an explicit deliverable requirement.

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Competent installation and commissioning

Installation and commissioning should be undertaken by suitably competent individuals operating within a recognised competent person framework. As Part F requirements tighten around system resistance and measured performance, competence becomes increasingly important.

Commissioning must not be treated as an administrative exercise. Measured airflows must be used to confirm that the whole dwelling ventilation rate has been achieved, not simply that individual wet room extract targets have been met.

Procurement documentation should therefore:

- Require commissioning against defined design airflow rates
- Require production of a valid ventilation commissioning checklist
- Ensure that ventilation-specific design information is made available to the installer on site

Introducing independent verification

Evidence from the UK and elsewhere shows that poor outcomes persist where there is little likelihood of independent scrutiny. Procurement should therefore assume that a proportion of installations will be subject to independent verification of design documentation, equipment installed and measured airflow performance.

The detailed structure of such verification, including how it interacts with competent person schemes, is addressed in Section G. At this stage, the key point is that ventilation should be procured on the basis that performance will be checked.

Introducing a realistic possibility of verification changes behaviour across design, procurement, installation and commissioning. It supports those who design, install and commission systems correctly, and discourages approaches that undermine performance.

Independent verification may be undertaken by appropriately qualified third parties, such as commissioning organisations, test engineers or verification bodies. This function must be independent of the installation and commissioning activities.

See our Ventilation Competency web page ↗ for further information and latest updates on competency requirements for Designers, Installers and Commissioners

E

Installation and site coordination

Ventilation systems rarely fail because a single component is missing. More often, they underperform because small decisions are made across different trades, each reasonable in isolation, but collectively undermining the original design. At this stage, the primary risk is not the absence of a design, but deviation from it during installation and coordination between trades.

Ventilation is vulnerable to fragmentation

Unlike structure or heating, ventilation does not usually sit with one clearly accountable trade from start to finish. The unit may be supplied by one manufacturer, ductwork installed by an electrician or M&E subcontractor, background ventilators provided through the window package, and internal transfer paths affected by joinery or fire detailing. No single individual may be clearly responsible for the system as a whole.

Many ventilation issues arise from routine site decisions rather than obvious defects.

Installation should therefore be undertaken by suitably competent ventilation installers, operating within the scope of a recognised competent person scheme where applicable. Ventilation installation must be treated as a clearly defined work package with named responsibility. It may be delivered by electrical or heating and plumbing contractors but should not be absorbed as a secondary element within those packages.

The objective at the installation stage is straightforward: the system installed on site must match the system that was designed. Where this does not occur, the system may no longer be capable of achieving the intended airflow performance.

Effective installation depends on the right information being available on site.

Key site rule: no ventilation changes without designer approval

Ventilation systems are sensitive to seemingly small but significant changes. Relocating fan units or terminals, altering duct routes including introducing additional bends or offsets, substituting windows with different background ventilator provision, or reducing transfer paths by leaving door undercuts unchecked, can all affect airflow, resistance and acoustic performance.

Any deviation from the ventilation drawings, airflow schedule or equipment specification must be referred back and approved by the responsible ventilation designer before the change is implemented.

This applies to changes affecting:

- Units or equipment specification
- Duct routes, sizes or materials
- Internal and external terminal positions
- Background ventilator provision
- Door types or internal transfer paths

If the ventilation layout changes, the airflow and resistance calculations can also change. Installing first and checking later risks long-term under-performance.

Ventilation information on site

Ventilation-specific design information must be readily accessible on site during installation. This should include:

- Coordinated installation drawings, not only schematic layouts
- The airflow schedule and designed fan settings
- A component schedule showing ducts, fittings, terminals, fans, controls and where each item is to be installed

Installers must not rely on memory of previous plots or experience.

Stages where things can go wrong

The following interfaces are common points of failure:

Design to procurement
A design pack exists, but the ventilation-specific information is embedded within a much larger specification and not clearly available to the installers. As a result, installers may rely on standard practice rather than project-specific airflow schedules.

Procurement to site team
Revisions made during value engineering often bypass the ventilation design process and are not clearly communicated to the installer. Window or unit changes are made without revisiting airflow or resistance assumptions.

Installer to commissioner
Where installation and commissioning are undertaken by the same party, there may be limited challenge of the installation against the design. Conversely, where they are separate, commissioning must be carried out against the design airflow schedule. If the required airflow rates cannot be achieved, the reasons should be investigated and resolved rather than commissioning to alternative values.

Site team to Building Control
The ventilation checklist is provided, but it is not always clear whether commissioning was undertaken against the design airflow schedule or whether recorded values reflect real system performance. Records should identify the measuring instrument used, its calibration status, the operator, the design airflow targets, the measured values and any corrective action taken where targets were not achieved.

Good coordination does not require additional bureaucracy. It requires ventilation-specific information to be clearly available on site and any deviations from the ventilation design to be formally reviewed.

What to look for on site

Ventilation performance is often compromised by small installation decisions. This section highlights typical issues observed on site and what good practice looks like in comparison.

Ductwork quality and routing

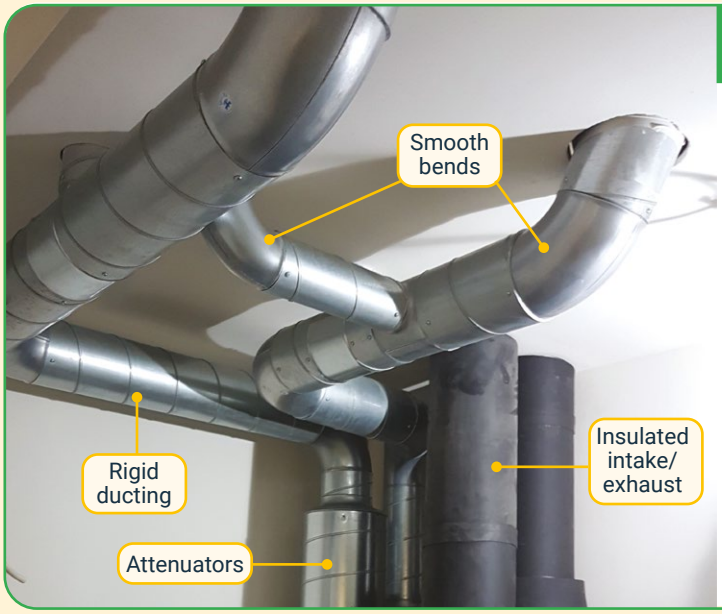
© Farmwood M&E Services Ltd

Common problems

- ✘ Excessive use of flexible ducting*
- ✘ Sharp bends and kinks increasing resistance
- ✘ Compressed ductwork in shallow ceiling voids
- ✘ Long, indirect routes introduced to avoid clashes
- ✘ Uninsulated ducts passing through cold voids
- ✘ Joints not properly sealed

* Approved Document F limits the use of flexible ducting and expects rigid or semi-rigid ductwork for the majority of installations.

Each additional bend, compression or poorly sealed joint increases system resistance. At commissioning, fans may need to be set to higher speeds to achieve target flow rates, increasing noise and energy use.



© Tom Morris

Good practice

- ✔ Duct routes are as short and direct as reasonably practicable
- ✔ Rigid or semi-rigid ducting used wherever possible
- ✔ Smooth, controlled bends
- ✔ Duct insulation provided where passing through unheated spaces**
- ✔ Joints properly sealed and mechanically supported
- ✔ Attenuated where necessary

** For MVHR systems, the intake and exhaust ducting must also be insulated where passing through heated spaces.

A visual inspection before closure works should confirm routing, jointing and insulation quality before elements are concealed.

Fan and unit location

© Farnwood M&E Services Ltd

Common problems

- ✘ Units installed in inaccessible locations for maintenance
- ✘ Units positioned directly adjacent to bedrooms without acoustic consideration*
- ✘ Poor fixing leading to vibration*
- ✘ Condensate drainage incorrectly installed

* Noise-related issues are one of the most common reasons occupants switch off ventilation systems.

Good practice

- ✔ Unit location consistent with the ventilation design
- ✔ Adequate access for maintenance and filter replacement
- ✔ Secure fixing with vibration control where required
- ✔ Correct condensate trap and drainage provision

Internal air terminals

Internal air terminals (supply and extract valves or extract fans) form the final interface between the ventilation system and the occupied space. Their type, position and accessibility directly affect air distribution, comfort and commissioning accuracy.

Common problems

- ✘ Use of universal supply/extract valves without regard to airflow direction
- ✘ Supply valves positioned at room edges or corners, resulting in poor air mixing
- ✘ Valves installed hard against walls or bulkheads
- ✘ Terminals caulked or sealed to finishes, preventing access to locking nuts
- ✘ High airflow rates delivered through undersized or tightly set valves, causing noise

Poorly positioned or incorrectly selected terminals can lead to uneven air distribution, discomfort from local air velocity, or ineffective pollutant removal.

Where valves are sealed to ceiling finishes (caulked), commissioning engineers may be unable to set or lock the air gap to maintain the design airflow rate. This undermines the commissioning process and can result in recorded values not reflecting true performance as residents can easily alter the valve.

Good practice

- ✔ Supply and extract terminals selected to suit their intended airflow direction and rate
- ✔ Terminal locations coordinated with the room layout to promote effective air distribution
- ✔ Adequate clearance around terminals to allow commissioning adjustment
- ✔ Locking nuts accessible and not sealed into finishes
- ✔ Terminal settings aligned with the airflow schedule at commissioning

Background ventilators

For extract-based systems, airflow depends on background ventilators (typically trickle vents) being correctly sized, installed and unobstructed.

Common problems

- ✘ Misunderstanding of size and location requirements between NV and MEV strategies
- ✘ Trickle vents omitted or reduced during window substitution
- ✘ Vent covers blocked, restricted or painted over
- ✘ Vents incorrectly installed in wet rooms when used in conjunction with MEV systems
- ✘ Vents and extract outlets poorly coordinated (recirculation risk)

If background ventilator provision is reduced, the dwelling may not achieve its whole-dwelling ventilation rate, even if wet room extract targets are met. Bedrooms are typically the first spaces affected.

Good practice

- ✔ Background ventilators installed in accordance with the design schedule
- ✔ Free area consistent with Approved Document F requirements
- ✔ No obstruction from paint, finishes or trims

Door undercuts and transfer paths

Internal air movement is essential to all common ventilation strategies.

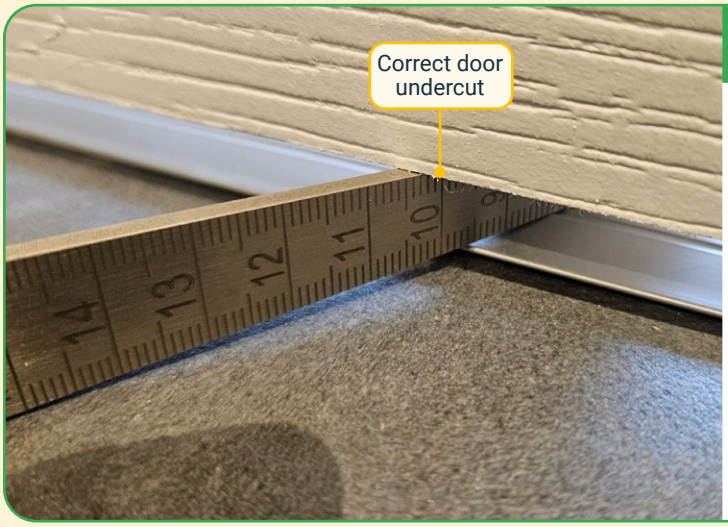
Common problems

- ✘ Undercuts reduced for aesthetic or acoustic reasons
- ✘ Fire doors installed without equivalent transfer provision
- ✘ Carpets or floor finishes reducing the designed gap, including where floor finishes are installed after completion

Reduced transfer area restricts airflow from habitable rooms to wet rooms. This can lead to under-ventilation of bedrooms and uneven distribution across the dwelling.

Certified fire doorsets often have limited trimming tolerances. If the ventilation design relies on a defined door undercut, this requirement must be clearly specified at procurement stage. Where trimming limits prevent the intended gap from being achieved, equivalent transfer provision must be incorporated, such as purpose-designed transfer grilles.

Without explicit coordination between the fire strategy and the ventilation design, compliant fire doors can inadvertently undermine the airflow assumptions on which the ventilation system depends.



Good practice

- ✔ Door undercuts consistent with design assumptions
- ✔ Transfer grilles provided where required
- ✔ Final floor finishes checked against required clearance

Equivalent internal air transfer can be provided by door undercuts or by transfer grilles (in doors or walls), provided the required free area is achieved. Where fitted within fire doors, transfer grilles must be part of a certified doorset or installed in accordance with the door manufacturer's fire certification.

Controls and usability

Controls should reflect the ventilation strategy and be consistent with the information provided at handover. Systems must be left operating in their intended configuration at completion.

Common problems

- ✘ Boost controls poorly located or not labelled
- ✘ Systems left in temporary commissioning mode
- ✘ Residents unclear about how to operate controls

Good practice

- ✔ Boost controls clearly identified and accessible
- ✔ Systems set to their intended whole-dwelling ventilation rate mode
- ✔ Clear alignment between installed controls and handover information

Controls that are poorly located or confusing increase the likelihood of user intervention that reduces ventilation performance. Controls must not allow continuous ventilation systems to be easily switched off in normal use. Controls should reflect the original ventilation design and must not be altered on site without design review.

And also… small details that matter

Post-completion inspections and quality assurance reviews consistently show that underperformance often arises from small, avoidable installation details rather than fundamental design flaws.

In addition to the checks described above, attention should be given to:

- Duct-to-terminal connections mechanically secured and sealed
- Specified acoustic attenuators installed as designed
- Airtightness detailing around ducts that penetrate the thermal envelope
- Avoiding long duct runs within unconditioned roof spaces

Individually, these details may appear minor. Collectively, they can materially affect airflow distribution, noise performance, commissioning accuracy and occupant experience.

Ventilation performance depends on the system operating as a coordinated whole. Small deviations at installation stage can undermine the assumptions made at design stage.

Systems that deviate from the design at installation stage may no longer be capable of achieving the intended airflow rates at commissioning.

F

Commissioning and handover

Commissioning is the point at which the installed system is tested against the ventilation design intent. It is not simply confirming that fans operate or that wet room extracts achieve nominal airflow rates. It is the process of measuring airflow, adjusting and balancing the system and recording results in a way that demonstrates regulatory compliance and alignment with the ventilation design. At this stage, the system should be capable of achieving the design airflow rates without reliance on excessive adjustment or compromise.

Commissioning: more than a tick-box

Commissioning must be undertaken against the dwelling-specific ventilation design. It is the stage at which the installed system is tested to confirm that it performs as designed, not simply that minimum regulatory values are achieved in isolation from the design.

Where commissioning is undertaken properly, it provides evidence that:

- The installed equipment matches the design
- Airflow rates meet the specified design values
- The whole-dwelling ventilation requirement has been achieved
- The system is operating as intended
- Background ventilators and internal air paths have been provided as relevant

Measured airflow rates must be compared directly against the design values defined in Section C.

Testing is the measurement and recording of airflow rates.

Commissioning includes testing together with any necessary adjustment and balancing of the system to achieve the design intent.

The whole-dwelling ventilation rate

A consistent weakness in practice is a focus on individual wet room extract rates without confirming that the overall whole-dwelling ventilation requirement has been achieved.

The whole-dwelling ventilation rate must be checked at commissioning using the measured airflows, in accordance with the design and Approved Document F.

This ensures that:

- The system delivers the required whole-dwelling ventilation rate
- Measured values are used meaningfully, not just recorded
- The dwelling is not persistently under-ventilated despite individual wet rooms appearing compliant

Using measured airflows to confirm the whole-dwelling rate reinforces the importance of proper commissioning and closes the gap between design and delivery. Failure to confirm the whole-dwelling rate can result in persistent under-ventilation, even where individual room measurements appear compliant.

Measured performance

Commissioning documentation should clearly distinguish between design airflow rates and measured airflow rates but should show both. Recorded results should demonstrate, through measurement and system adjustment, that the installed system achieves the design performance requirements.

Where commissioning records simply restate the design values without recorded measured airflow rates, compliance has not been demonstrated. Significant discrepancies between measured and design airflow rates should be investigated and resolved, rather than accepted through adjustment alone.

To maintain confidence in the process:

- Airflow measurement equipment must be calibrated in accordance with regulatory requirements
- Measured values should be recorded clearly
- Any shortfall should trigger a diagnostic review of duct resistance, free air clearance on exhaust and intake, spigot and terminal connections, and system balancing

Commissioning cannot compensate for poor installation, but it can identify it.

Weaknesses to avoid

Common delivery failures include:

- Commissioning sheets completed without clear reference to design airflow rates
- Focus on wet room extract rates without confirming the whole-dwelling requirement
- Fan speeds increased to meet targets without addressing excessive system resistance
- Limited evidence of balancing or distribution checks
- Incomplete or unclear documentation provided at handover

Where commissioning is undertaken by the installer, there may be limited independent challenge. Independent verification, addressed in the next section, strengthens confidence that recorded performance reflects reality and should trigger investigation of the installation and system configuration against the design.

Handover and customer understanding

Systems should be left operating as intended

At completion, ventilation systems and controls should be set to their intended operating mode. Systems should not be left switched off, overridden or set to temporary commissioning mode.

The objective is to ensure the dwelling is occupied with the ventilation system functioning as designed.

Controls and settings at handover should be consistent with the original design and commissioning results.

Clear explanation for occupants

Handover should include a concise, dwelling-specific explanation of:

- How air enters, moves through and leaves the dwelling
- The importance of maintaining door undercuts and transfer paths, including after installation of floor coverings
- The purpose of background ventilators or supply terminals
- The function of boost controls
- Routine maintenance requirements, including cleaning of terminals and grilles, and filter inspection and replacement (where applicable)

Occupants should understand both how the system operates and why it is needed, and that lack of maintenance will reduce airflow rates and system effectiveness over time. Providing a manual is not sufficient. Clear explanation reduces the likelihood that occupants switch systems off or override their operation, and protects both indoor air quality and developer reputation.

Evidence shows that systems are frequently switched off or overridden where occupants do not understand their purpose, controls or maintenance needs. Misuse is often a symptom of poor explanation or unresolved installation issues.

Consideration should be given to follow-up engagement after occupation, particularly where systems rely on user interaction for effective operation.

Visit the Future Homes Hub Knowledge Centre and search for 'consumer' to find more guidance on good practice customer journey principles

Duties and accountability

Under the Building Regulations, responsibility for compliance rests with the homebuilder. This includes provision of relevant information to the homeowner as part of Building Regulations compliance.

This includes ensuring that:

- A ventilation design exists and is handed over
- The installation reflects that design
- Commissioning demonstrates measured performance against the ventilation design
- The ventilation checklist and supporting documentation are valid

Where a competent person scheme is used, it supports compliance but does not remove overall responsibility.

Commissioning and handover should therefore be treated as quality assurance processes, not administrative steps.

G

Verification

More than a decade of UK research and on-site evaluation shows that ventilation systems in new homes do not consistently deliver their intended performance. While many systems perform well, inconsistent delivery persists across a proportion of new homes.

Why verification is needed

In highly airtight homes, ventilation becomes a critical system. Where infiltration cannot be relied upon, indoor air quality depends on the continued operation of the installed system. If design, installation or commissioning are inadequate, persistent under-ventilation can occur with increased risks of moisture, mould and pollutant exposure.

Commissioning is frequently undertaken by installers without independent challenge, and documentation may record measured values without demonstrating alignment with the ventilation design. Where there is no realistic prospect of independent scrutiny, compliance can be assumed rather than demonstrated.

> The prospect of independent verification changes behaviour.

Independent verification introduces a credible likelihood that inadequate design, installation or commissioning will be identified. This reinforces good practice, supports competent practitioners, and builds confidence that systems are delivering the indoor air quality outcomes they were designed to achieve. Verification complements commissioning and does not replace it; it provides additional assurance that reported performance reflects the installed system.

The objective is not to add bureaucracy, but to increase consistency and confidence. The approach described in this section is non-statutory good practice, intended to support quality assurance and improve consistency. It aligns with international practice in countries such as Ireland, Belgium and France, where independent verification has led to significant outcome improvements.

Proportionate verification is intended to provide higher confidence of quality delivery and should be implemented in a way that avoids unnecessary duplication of existing processes.

A proportionate verification approach

A representative sample of completed dwellings, randomly selected, should be subject to independent third-party verification. The sample size should relate to the training and competence level of the installer and commissioner. Verification rates should therefore reflect:

Installers or commissioners operating within a recognised competent person scheme.

Where auditing and competency oversight arrangements are already in place, an indicative verification rate of around 10% of installations may be appropriate.

Installers or commissioners operating outside a competent person scheme

Where no equivalent oversight exists, a higher verification rate, for example greater than 30% of installations, reflects the increased risk and provides a meaningful likelihood of review.

These rates are indicative and may be adapted to reflect system type, dwelling complexity and project-specific risk.

This approach recognises existing quality assurance mechanisms while ensuring that all systems remain subject to independent scrutiny.

What verification should cover

As part of a good practice approach, verification should confirm that the delivered system reflects the ventilation design and that measured performance is reliable. The objective is not to repeat commissioning, but to confirm that the system has been installed, commissioned and documented in line with the design intent.

See our Ventilation Competency web page ↗ for further information and latest updates on competency requirements for Designers, Installers and Commissioners

Independent verification should include:

- Confirmation that a specific ventilation design exists and is available
- Confirmation that installed equipment matches the design specification
- Confirmation that commissioning reflects the design specification
- Independent measurement of airflow rates and cross-checking against design and commissioning values
- Confirmation that the whole-dwelling ventilation rate has been correctly calculated and achieved
- Walk-through inspection to confirm correct background ventilators and internal air paths, such as door undercuts, are provided

Verification should be undertaken after commissioning has been completed, so systems are installed and commissioned under the realistic possibility of independent scrutiny.

Escalation and accountability

Where discrepancies beyond an agreed tolerance are identified, escalation should follow through both project-level quality management (homebuilder) and, where applicable, the relevant competent person scheme (CPS) or verification framework. Minor discrepancies that can be corrected on site without affecting the design intent may be resolved prior to escalation, provided changes remain consistent with the original ventilation design.

Project-level responsibility:

- Increased verification rates for the responsible installer or commissioner
- Requirement for action plan for rectification works
- Commercial consequences or removal from approved supplier list for repeated poor performance

Scheme-level responsibility:

- Increased surveillance or audit frequency
- Suspension or removal from registration for repeated or serious non-compliance

Evidence suggests that current oversight rarely identifies poor practice, reducing incentives for compliance. Verification introduces a tangible likelihood that inadequate work will be detected, shifting behaviour across the delivery chain.

The intention is to build a culture of quality by recognising good practice, addressing persistent underperformance, and protecting occupants from avoidable risk. Collating verification outcomes can support continuous improvement across organisations and supply chains.

Integration with existing site testing

Verification can be integrated pragmatically with existing airtightness or acoustic testing visits. This allows efficient implementation with minimal additional disruption. In many cases, verification can be undertaken as part of existing site quality assurance processes, provided sufficient independence and technical competence are demonstrated.

H

Learning from homes in use

Commissioning and verification confirm that ventilation systems are installed and operating as intended at handover. However, performance is ultimately determined in use. In-use performance reflects the combined effect of design, installation quality, commissioning accuracy and occupant interaction with the system.

Why in-use performance is essential

In-use evaluation completes the delivery assurance chain: design, installation, commissioning and verification must translate into real-world outcomes. Differences between design assumptions and real-world operation can affect outcomes. Occupant behaviour, maintenance practices and seasonal conditions all influence how ventilation systems perform over time. Controls, user interfaces and the clarity of handover information play a significant role in how systems are operated in practice.

In-use performance evaluation provides the evidence needed to:

- Confirm that ventilation systems continue to deliver intended indoor air quality outcomes
- Identify recurring issues that are not visible at commissioning
- Improve future design standards, installation practices and user guidance
- Support continuous improvement across housing portfolios

Where in-use issues are identified, these should be investigated in relation to the original design, installation and commissioning. Corrective actions may include adjustments to system settings, targeted remedial works, or improvements to user guidance. Findings should be fed back into future design and delivery to prevent recurrence.

See our 'Where to Start' guide ↗

for further guidance for homebuilders and their advisors on Building Performance Evaluation (BPE)

A practical evaluation strategy

Not every dwelling requires intensive monitoring. A practical, risk-based approach should be adopted. Sampling strategies used for commissioning verification provide a useful foundation. Where performance concerns are identified, additional targeted evaluation may be appropriate. Evaluation may be undertaken by suitably qualified third parties, such as building performance specialists, consultants or research organisations, depending on the scope and objectives. Evaluation activities should be proportionate and focused on generating useful insight rather than creating unnecessary burden.

This reflects established BPE triage principles: broad sampling to understand typical performance, with deeper diagnostic work where issues are identified.

What to evaluate in occupied homes

In-use ventilation performance can be understood through a combination of technical indicators and occupant experience. These elements together form the basis of proportionate Building Performance Evaluation (BPE) in occupied homes.

Technical evaluation

- Indoor air quality metrics, including CO_2 concentration as an indicator of ventilation adequacy
- Internal and external temperature and relative humidity patterns to identify moisture risk
- Evidence that systems are operating as intended (e.g. fan operation, boost usage)

Measured data should be interpreted in the context of occupancy patterns and system use.

Short-term monitoring can provide useful insight. Longer-term monitoring may be appropriate where persistent concerns exist. Simple monitoring approaches can often provide sufficient insight without requiring complex instrumentation. Monitoring approaches should be proportionate and minimise disruption to occupants.

Occupant experience

Occupant experience provides a direct source of evidence about how ventilation systems are understood, used and experienced in practice. This can be gathered through simple feedback mechanisms or more structured evaluation approaches to identify:

- Perceived air quality and comfort
- Ease of using controls
- Noise concerns
- Maintenance barriers

Difficulties in understanding or using controls are a common cause of reduced system effectiveness.

This feedback provides essential context for interpreting measured data and identifying usability issues. Engagement is most effective once households have experienced a full winter and summer season.

Occupant experience may be gathered informally or through structured approaches such as Post Occupancy Evaluation (POE).

Post Occupancy Evaluation (POE)

Post Occupancy Evaluation (POE) is one approach within broader Building Performance Evaluation (BPE) activities. It provides a structured method for collecting and analysing occupant experience alongside observed performance in use.

POE typically involves:

- Occupant surveys
- Structured interviews
- Observational home visits

POE helps identify recurring patterns across housing portfolios, including usability issues, communication gaps in handover material and unintended system interactions. Experience from housing performance programmes shows that POE often reveals practical barriers that technical monitoring alone cannot detect.

POE findings should be fed back into design, installation and handover processes to support continuous improvement.

Governance and standards

Performance evaluation activities should be planned and documented. A simple Performance Evaluation Plan can define:

- Objectives and scope
- Sampling approach
- Methods and responsibilities
- Reporting and feedback routes

In many cases, this can be integrated within existing quality assurance or customer feedback processes. Alignment with established BPE standards, such as BS 40101[3], supports consistency and comparability of outcomes across developments.

Turning evidence into improvement

Performance evaluation only adds value when findings inform change.

Insights should feed into:

- Future ventilation design guidance
- Installer and commissioner training
- Handover materials and occupant support
- Portfolio-level quality assurance

This includes improving the usability of systems and the clarity of controls and user guidance. This creates a continuous improvement loop, ensuring that ventilation systems deliver healthier indoor environments across successive developments.

3. BS 40101: 2022. Building Performance Evaluation of occupied homes and operational buildings. London: BS1

Case study

Princes Street, Oxford

Verification supporting good ventilation delivery

Overview

The Princes Street development in Oxford comprises 12 flats delivered by OX Place. The scheme adopted a continuous centralised Mechanical Extract Ventilation (cMEV) strategy with background ventilators in habitable rooms. As part of OX Place's Energy Quality Assurance (EQA) process, the development was subject to additional validation testing for airtightness and ventilation performance measurement.

What worked well

Post-construction testing showed a number of positive outcomes. Airtightness results were good, with measured air permeability between approximately 1.8 and 3.0 $m^3/(h \cdot m^2)$ @ 50 Pa, supporting effective operation of the cMEV strategy. Measured airflow rates met the minimum requirements of Approved Document F, and background ventilator provision exceeded AD F requirements by around 40%.

The scheme also demonstrated that, where design, installation and commissioning are well aligned, a mechanical extract strategy can be delivered effectively in practice. The ducted ventilation installation and measured system performance were consistent with the intended ventilation approach.

It is also relevant that the installing contractor had recently completed a similar development where some re-commissioning was required to achieve compliant airflow rates. On this scheme, awareness of the verification stage appears to have contributed to closer alignment between installation and commissioning from the outset, resulting in compliant airflow rates being achieved without any rework. This suggests that the presence of independent verification can influence delivery behaviour, improving alignment between design, installation and commissioning.

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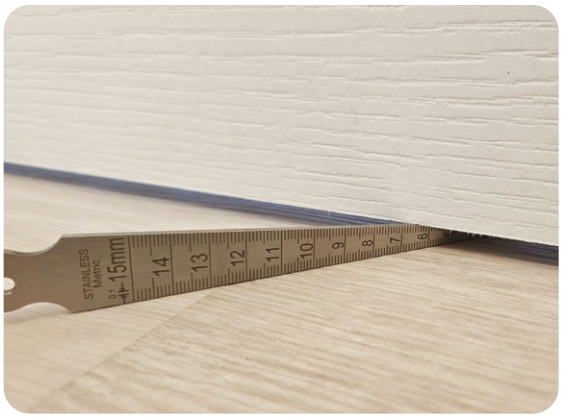
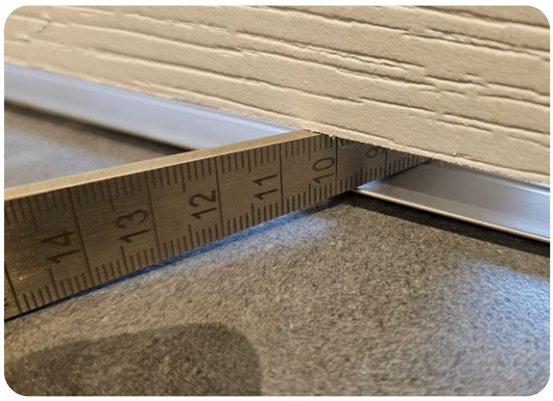
Issue identified through verification

Independent post-construction checking identified one important issue requiring correction before handover: insufficient door undercuts beneath internal fire doors, which restricted internal air transfer between habitable rooms and wet rooms. Under normal use, this would have limited the intended airflow path through the dwelling when doors were closed. This effectively increased internal resistance to airflow, reducing the ability of the system to distribute air as designed.

This did not undermine the positive findings on airtightness, background ventilator provision or measured extract performance. However, it highlighted an important point: even where the main elements of a ventilation strategy are in place and measured extract rates are satisfactory, the system still depends on unobstructed internal air transfer paths to maintain the designed airflow from habitable rooms to wet rooms during normal operation. This demonstrated that achieving compliant airflow rates alone is not sufficient to ensure in-use performance.



Insufficient ~6 mm internal door undercut identified during verification



Door undercuts corrected to 10 mm

Outcome and learning

The issue was identified at a stage when corrective action could still be taken, allowing the internal doors to be adjusted before handover. Adjustments were undertaken in line with the fire door manufacturer's instructions to maintain the required fire performance, with undercuts increased from approximately 6 mm to around 10 mm. This completed the ventilation assurance process and helped ensure that the installed system could operate as intended.

This example shows how independent verification can add value even on schemes that are otherwise performing well. It is not only about identifying major failures, but also about resolving smaller coordination issues that affect real-world ventilation performance before occupation.

Key lessons

- Good ventilation outcomes depend on the whole system, not only the measured extract rates.
- Independent verification can provide a useful final check, even where the overall scheme is performing well.
- Relatively minor issues, such as insufficient door undercuts, can materially affect in-use performance if left unresolved.

Appendix

Ventilation design submission checklist

<<Currently in development, please check website for updated version>>>>

Further resources and signposting

The following resources provide statutory requirements, technical guidance and good practice references relevant to ventilation delivery and performance in new homes.

Statutory guidance

Approved Document F: Ventilation (England)

Statutory guidance supporting compliance with Part F of the Building Regulations, including ventilation rates, system types, commissioning requirements and checklists.

Approved Document L: Conservation of fuel and power (England)

Energy performance and airtightness requirements that influence ventilation strategy and system design.

Building Performance Evaluation and in-use performance

Future Homes Hub: Building Performance Evaluation: Where to Start Guide

Practical introduction to Building Performance Evaluation (BPE), covering lifecycle stages and proportionate implementation approaches for housebuilders.

British Standards Institution – BS 40101: Building performance evaluation of occupied buildings

Framework standard for planning and delivering performance evaluation, including proportionate and risk-based approaches.

Ventilation design, commissioning and technical guidance

BESA TR/35 – Low Energy Ventilation for Residential Buildings

Technical guidance covering the design, installation and commissioning of low-energy ventilation systems in dwellings, including MVHR and MEV systems.

End User Guidance

UK Centre for Moisture in Buildings – Moisture in New Homes: A Guide for Occupants

Practical guidance explaining moisture generation in new homes, the drying-out process after construction and the importance of ventilation and heating in maintaining a healthy indoor environment.

NHBC Foundation – Home Comforts: guidance on using ventilation, heating and renewable energy systems (NF68)

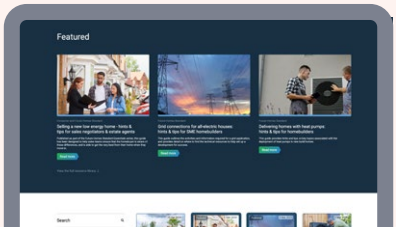
Guidance for occupants on how to operate ventilation and heating systems in new homes.

Explore the Knowledge Centre

Discover trusted industry guidance, practical tools and expert insight to support the delivery of future-ready homes.

Explore the Knowledge Centre ↗

or visit knowledge.futurehomes.org.uk



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