Better Air Quality & Ventilation 2

Air Quality Matters
Simon Jones

Welcome

Air Quality Matters
Simon Jones

Air Quality Matters

Simon Jones

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- Founder - Air Quality Matters
- Host - Air Quality Matters Podcast
- Chair - IEA Industry Advisory Committee AIVC
- Scientific Committee and Guest Board Member AIVC
- Advisory Board - UKCMB
- Member - BESA Health and Wellbeing
- Member - CIBSE Natural Ventilation Group
- Member - Expert Group (Ventilation) Irish Government

Air Quality Matters

Simon Jones

Better Ventilation and Air Quality in our Homes Part 2

Chapter 4

- Defining Performance
- Measuring Performance
- Assigning responsibility

Chapter 5

- Measuring Air Quality
- Improving Air Quality
- Getting Ventilation Right

Chapter 6

Bringing it all Together

Defining Performance

OF VENTILATION

Performance

THREE PILLARS

There are three pillars of adequate ventilation in homes.

Background Ventilation
Local Exhaust Ventilation
Purge Ventilation

And perhaps a 4th.....

Performance

THREE PILLARS

Background Ventilation

Homes need a certain amount of air renewal to stop the build -up of pollutants created by the building and our activities.

The amount this needs to be will depend on how big the home is and how busy the home is. (How many people)

We often describe this in terms of Air Changes per Hour (ACH) or the total amount of air that needs to be moved per hour or minute.

Litres per second, Metres cubed per hour, or Cubic feet per minute. (It depends on where you are in the world!)

Performance

THREE PILLARS

Local Exhaust Ventilation

Certain rooms in the home have activities requiring pollutants to be removed before they spread.

They include - Kitchens, bathrooms, utilities, WC’s

We are exhausting at the source —moisture, odours, cooking pollution, such as Particulate matter and VOCs, and so on.

These rates are designed to effectively capture the pollutants as they are made and remove them before they spread.

Performance

THREE PILLARS

Purge Ventilation

This is basically opening windows and doors or shutters.

This is provided to allow the rapid purging of spaces required for certain home activities.

Think painting, varnishing, arts and crafts, and airing the home.

There are often standards that require windows to open a specific amount based on a percentage of floor area.

Performance

THREE PILLARS

Background Ventilation

Performance

HOW MUCH AIR DOES THE BUILDING NEED?
NATURAL OR PASSIVE VENTILATION

BACKGROUND VENTILATION

Performance

HOW MUCH AIR DOES THE BUILDING NEED?
NATURAL OR PASSIVE VENTILATION

The whole house or background ventilation rate

With ventilation that relies on wind speed and direction, some very broad assumptions have to be made.

How big do you have to make the hole?

Often, this is a minimum size per room and may require a minimum number per dwelling. Again, this will vary from region to region. Here is the Irish calculation.

The minimum total equivalent area of background ventilators providing general ventilation should be 42,000mm2 with an additional 7,000mm2 for each additional 10m2 Floor area above the first 70m2 of floor area measured. 100m2 home would be 42,000 + (3x7000) = 63,000mm2 plus some other allowances!

You then divide this number between rooms and it tells you how big the holes have to be!

Performance

HOW MUCH AIR DOES THE BUILDING NEED?
NATURAL OR PASSIVE VENTILATION

Performance

HOW MUCH AIR DOES THE BUILDING NEED?
MECHANICAL SYSTEMS

BACKGROUND VENTILATION

Performance

HOW MUCH AIR DOES THE BUILDING NEED.

Table 3.5b - Minimum whole dwelling ventilation rate

Number of apartments	1[1]	2	3	4	5
Minimum ventilation rate – litres/second [2]	13	19	25	31	37
Minimum ventilation rate – by floor area [3]: 0.3 l/s per m² of internal floor area					

Table 3.8 - Minimum extract rates for continuous extract ventilation systems

Room [1]	High/boost rate [2]	Continuous extract rate [2]
Kitchen	13 litres per second	The total combined rate of continuous mechanical extract ventilation should not be less than the minimum whole dwelling ventilation rate for the dwelling as set out in Table 3.5b in Clause 3.14.2.
Utility room	8 litres per second	
Bathroom or shower room	8 litres per second	
Designated drying area (see 3.14.9)[3]	8 litres per second	
Sanitary accommodation (Toilet)	6 litres per second	

The whole house or background ventilation rate

Normally calculated on floor area and the number of people/bedrooms.

For Example, in England/Ireland/Scotland and Wales, it is the floor area of the building x 0.3 Litres per second. 100m2 property is 30 l/s

In England, Scotland and Wales, there is a figure for the number of bedrooms; for example, 3 Bedrooms is 31 Liters per second in England. In Ireland, it's a calculation of the number of people.

You take the greater of these two numbers

Performance

HOW MUCH AIR DOES THE BUILDING NEED.

The whole house or background ventilation rate

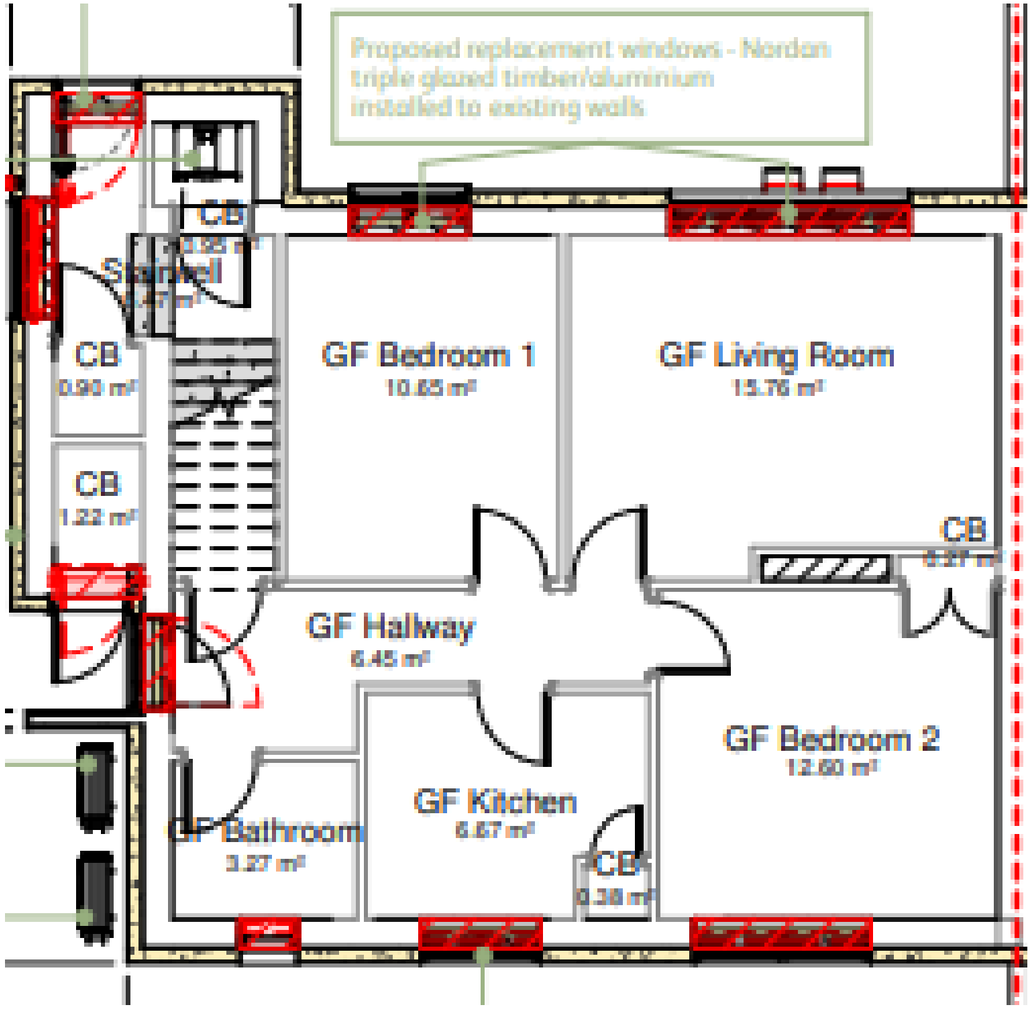
If your background or whole house ventilation rate is ‘x’ then this will be achieved through several extract or supply points.

Each extract/supply point will need to meet the needs of that room and, combined, the needs of the whole house.

This is often where decentralised systems come unstuck, and the balancing of centralised systems falls over.

Performance

HOW MUCH AIR DOES THE BUILDING NEED.



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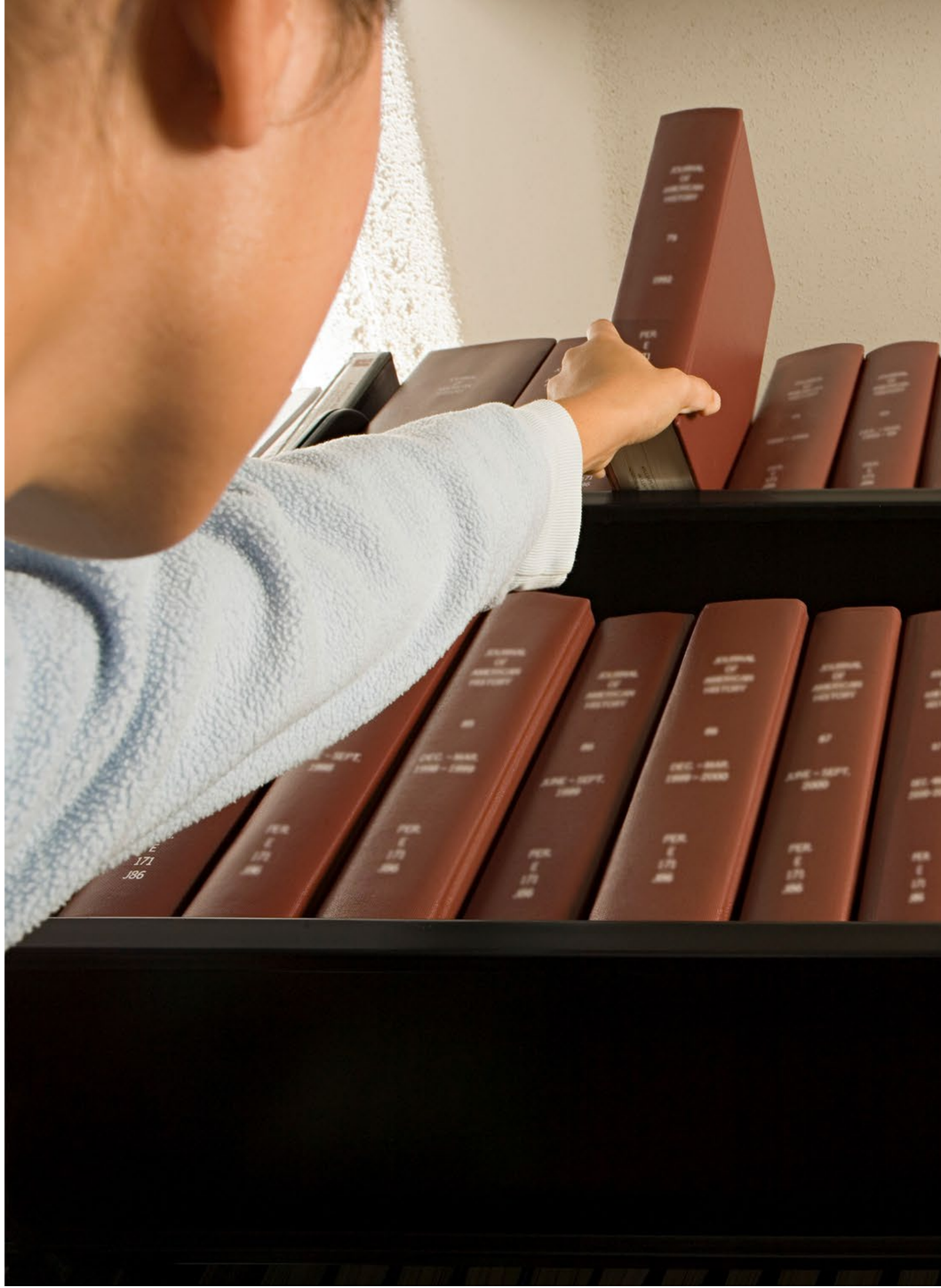
Performance

HOW MUCH AIR DOES THE BUILDING NEED?
MECHANICAL SYSTEMS

REACHING FOR THE MINIMUM

- Product Quality
- Design
- Installation
- Commissioning
- Use
- Product Wear



Performance

HOW MUCH AIR DOES THE BUILDING NEED?
MECHANICAL SYSTEMS

REACHING FOR THE MINIMUM

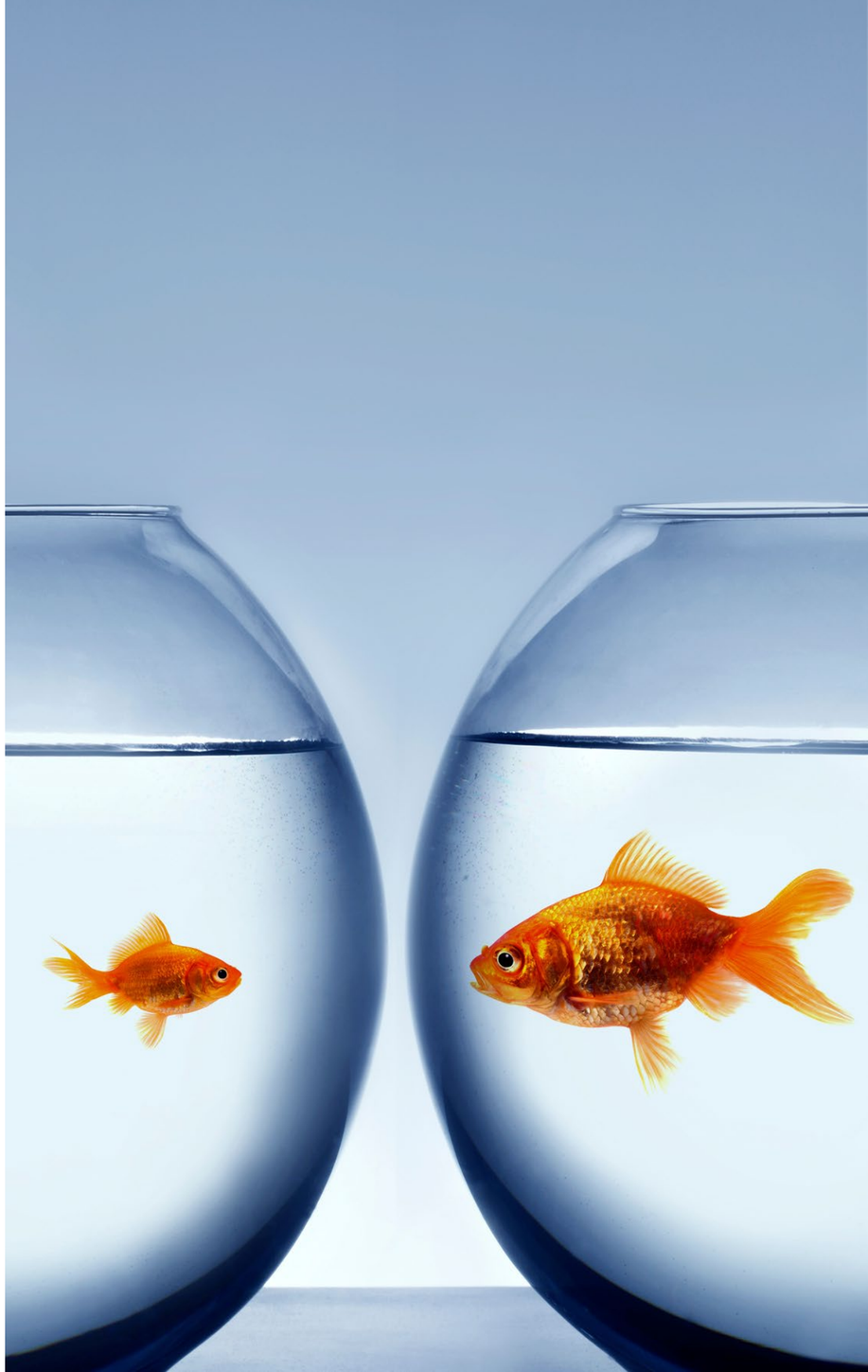
Capacity

Give yourself some space for the inevitable shortfall from the supply chain.

It happens in almost all other areas of engineering, so why not ventilation?

Some regulations, like Ireland, have introduced this concept into design flow rates, requiring 25% capacity above whole house rates.

What does this mean? It means that you have designed a system that, if there were an installation mistake, deterioration in performance, or change of use of the dwelling, you would have something in reserve to meet extra demand.



Performance

THREE PILLARS

Local Exhaust Ventilation

Performance

THREE PILLARS

Local Exhaust Ventilation

Local exhaust ventilation has high rates of extraction independent of room size or building size. When an activity produces a risk, such as lots of moisture when showering or smells and pollutants from cooking, it extracts at a rate and for a period of time that removes that risk at its source.

In plain English, it removes the pollutant before it spreads.

Performance

THREE PILLARS

Local Exhaust Ventilation

Sometimes, they fulfil two functions. They may be running continually in that background for the background ventilation rate but are also required to increase their rate for an activity like showing or an activity in the kitchen.

Other times, intermittent fans may simply come on for the use of that space only, as is the case with fans that don't need to provide this background rate.

A cooker hood is an excellent example of this.

Performance

THREE PILLARS

Local Exhaust Ventilation

It is really important that the extract rate and effectiveness is fit for purpose.

For example, we now know that removing cooking pollutants is key to healthy homes, yet often, the cooker hood is cheap, ineffective, and not used.

The same can often go for cheap intermittent bathroom fans, with little thought to the actual performance of the device.

Performance

THREE PILLARS

Local Exhaust Ventilation

Table 1.1 Minimum extract ventilation rates for intermittent extract systems

Room	Intermittent extract rate (l/s)
Kitchen (cooker hood extracting to the outside)[1]	30
Kitchen (no cooker hood or cooker hood does not extract to the outside)[2]	60
Utility room	30
Bathroom	15
Sanitary accommodation[3]	6

Here is an example of the flow rates required for the English Regulation. It is widespread to find that these flow rates are not achieved.

Performance

THREE PILLARS

Purge Ventilation

Performance

THREE PILLARS

Purge Ventilation

This is all about providing a way of rapidly diluting habitable spaces for several reasons.

Generally, advice is given on a fraction of floor area, and the opening is equivalent to.

There is often only so much you can do about this other than note that each room has a reasonable amount of openable windows or doors for such circumstances.

For example, a hinged or pivoted window with an opening angle of greater than 30 Degrees must be 1/20 of the floor area of the room.

Performance

THREE PILLARS

Purge Ventilation

Regardless of the outdoor air risk, access to open windows and external environments significantly impacts homeowners' sense of well-being.

Have you ever stayed in a room where you can't open the window?

Measuring Performance

Measuring Performance

MEASURING PERFORMANCE IS NOT

Measuring Performance

MEASURING PERFORMANCE IS....

Measuring Performance

MEASURING PERFORMANCE IS....

Best - Unconditional Test Method

This uses a powered flow hood that compensates automatically for a number of things, giving the most reliable reading.

Conditional Test Method

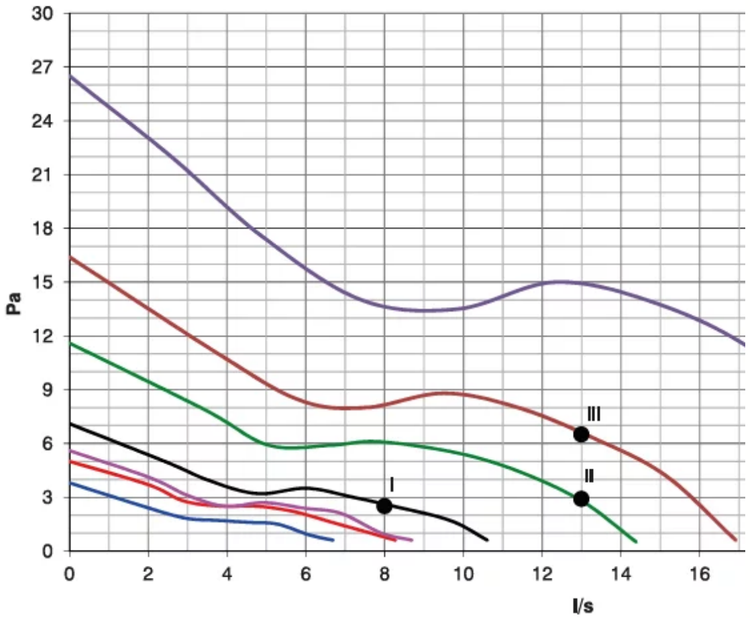
This uses an unpowered flow hood that does not compensate for a range of things.

To be accurate, it requires a good understanding of certain factors, like fan performance and the resistance effects of the device and ducting.

Ok, in most hands, for a ballpark figure. Also known as a **Minimum Benchmark method.**

Measuring Performance

BEWARE OF FAN CURVES AND MARKETING



FAN CURVE AND FAN UNRELATED IN THESE IMAGES

Determining the realistic installed performance of particularly decentralised fans can be hard.
No universal way of presenting information, making it hard to compare performance
Pressure can have such a big impact that the headline numbers in marketing material can be almost worthless.

Measuring Performance

BEWARE OF FAN CURVES AND MARKETING

YOU CANT MANAGE WHAT YOU DON'T MEASURE

At the end of the day, you don't know what you have until you have measured it.

So next is a formula for guaranteed results!

Responsibilty

Responibilty

ASSIGNING RESPONSIBILITY

Make the supply chain responsible and collectively accountable.

By focusing on performance rather than product: Here's how.

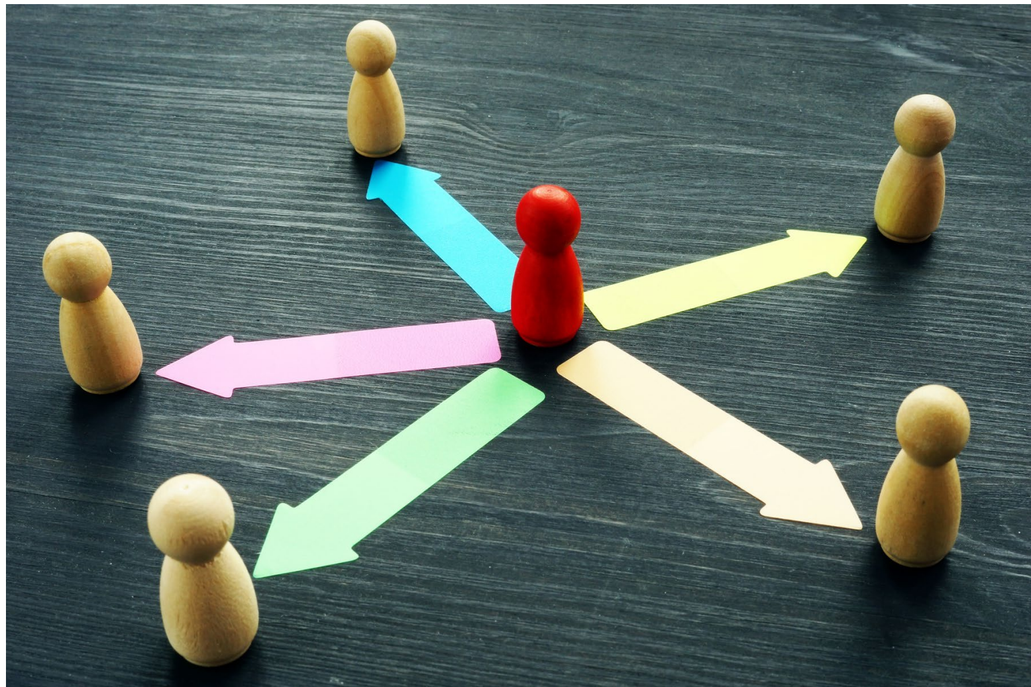
Competent designers should design ventilation.

Competency evidence should be required, and design revisions need to be signed.

What does this mean?

Make someone responsible for the design , including the performance. It could be the installer, architect, or product supplier, but make them responsible.

Everything follows the design. The intent.



Responibilty

ASSIGNING RESPONSIBILITY

Ventilation designs should be made available to contractors and to you and should include system performance requirements (extract rates, whole-house rates, capacity, fan performance, etc.).
Mechanical Systems

- What standard or calculation is being used to calculate background ventilation rates?
- Does the design clearly show how this is to be achieved?
- Does the design clearly show extract or supply locations and rates at each point and do they add up to the background rate?
- Is there a provision for capacity and what is it?
- Does the design show specification and performance requirements of fans?
- Is there anything about the building or its layout/design that affects the design or performance?
- Is the designer happy to stand over the performance of this system if installed to the design?

Responibilty

ASSIGNING RESPONSIBILITY

Competent installers should install, balance, and commission ventilation.

Up-to-date competency evidence should be provided. Competency is required onsite, not just by someone in the company!

The installer may be the designer, that is fine, but there is an order of things.

The design should NOT be whatever they happened to achieve!

The design is something that comes first. The installation meets this design.

Responibilty

ASSIGNING RESPONSIBILITY

All systems should be commissioned and validated via the unconditional testing method.

Evidence should be provided in the form of signed copies of commissioning reports, copies of calibration certificates of testing equipment and photo evidence of outcomes.

In all cases, the installation will only be deemed complete when everything we have just described is demonstrated by the appointment contractor.

Ill include a checklist for you

Responibilty

ASSIGNING RESPONSIBILITY

In all cases, ventilation compliance or success is determined by the design; the commissioning checks the installed performance is in line with this design.

What does this mean?

It is the bookends of QA. What you are saying is that a design is fit for purpose and that a check is conducted at the end of the process to confirm that the ventilation is working according to this design.

It does several things.

Stops the practice of the design being whatever was achievable at commissioning

It starts the process from the foundation of performance and finishes it by checking that it met that performance.

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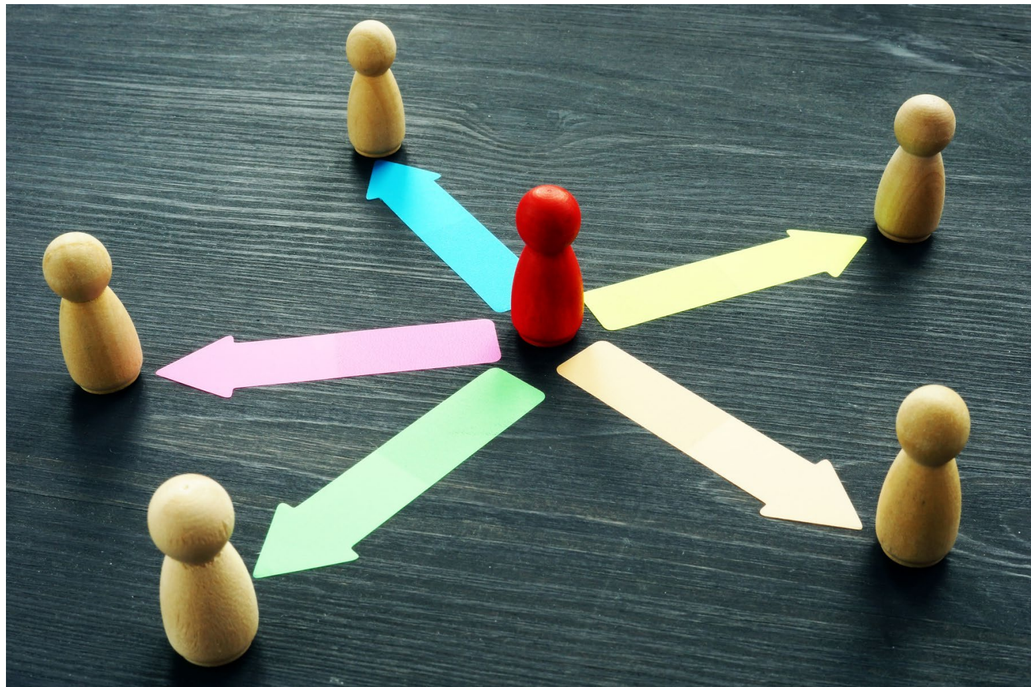


Responibilty

ASSIGNING RESPONSIBILITY
BOOK ENDS OF A QA PROCESS

It is tough for a third party to control quality outcomes in a supply chain.

But by concentrating at the beginning and the end, you stand a better chance of locking in the right outcomes in the middle as long as everyone understands what is expected.

1. That someone is responsible for the design, you don't mind who, but they must be demonstrably competent and accountable for a complete and appropriate design. That's the deal!
2. You are okay with what happened in between, but you expect that the finished product meets the specifications and performance design.

Manage what you measure

MEASURING AIR QUALITY

See The Air

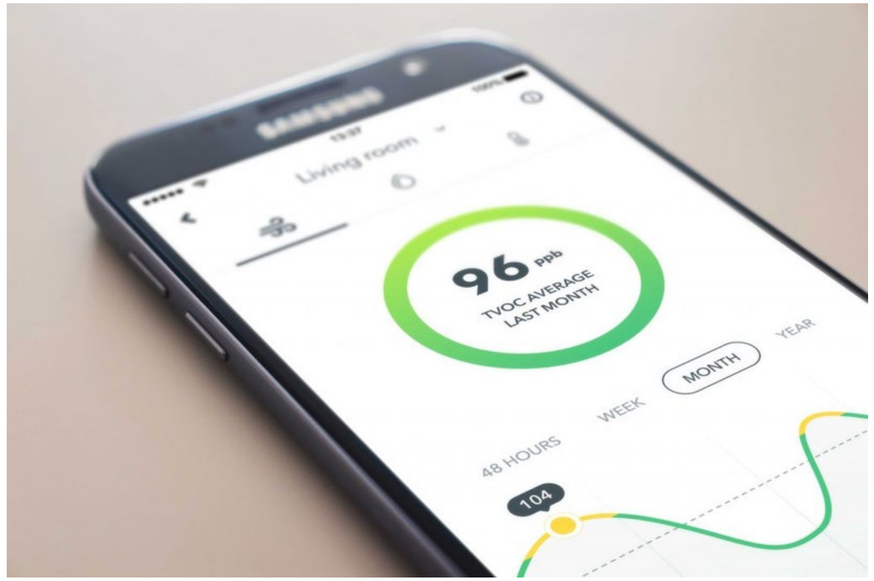
MONITORING

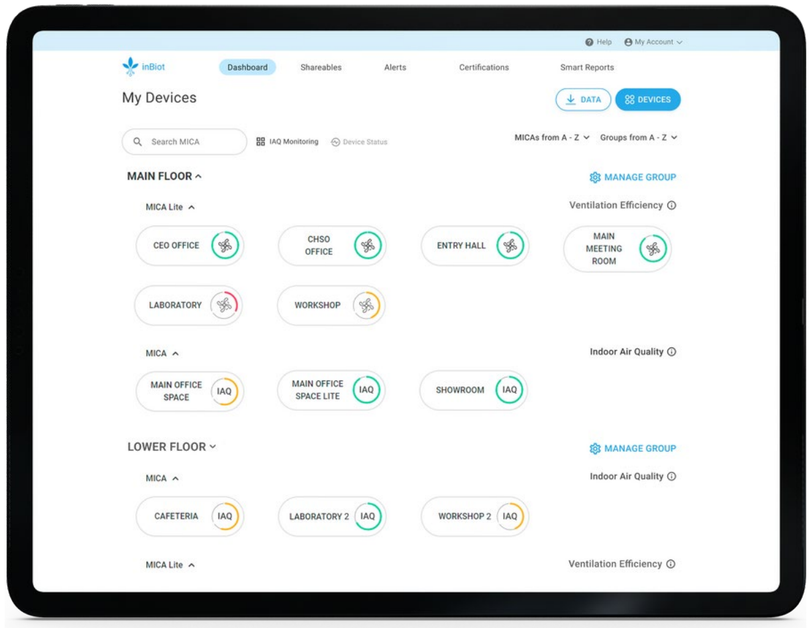
It is a fast -moving world, and we can see the air like never before.

There are effectively 3 levels of environmental monitoring.

1. Research Level
2. Practitioner Level
3. Low cost

Monitoring





Some may be battery -powered, others plugged in.

There is a range of connectivity options from none to gsm, wifi, LoRaWAN,...

Some will have screens that display numbers, and others will have traffic light systems.

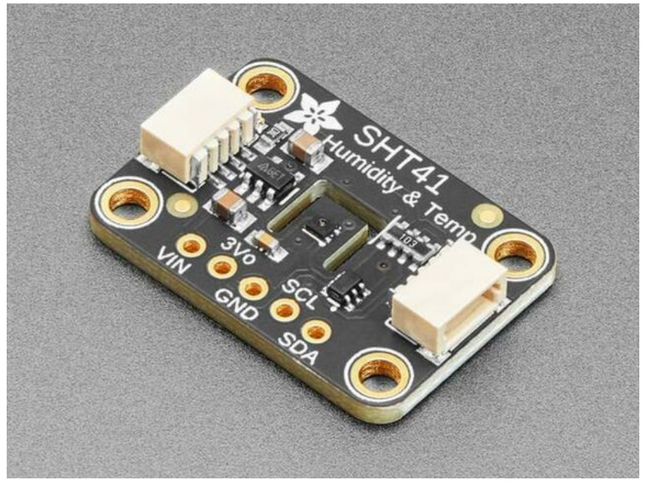
Most good ones will come with a connected dashboard, integration and reporting proposition.

See The Air

MONITORING

In housing, service providers can use these devices to improve communication with tenants, provide better service, and monitor risks.

For example, Fuel Poverty, Condensation Damp and Mould , Empty Properties, and the effectiveness of interventions like replacing ventilation or insulation



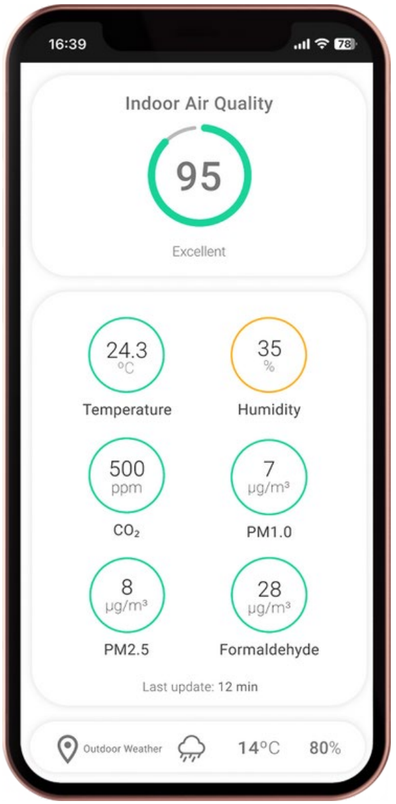
Code of Practice

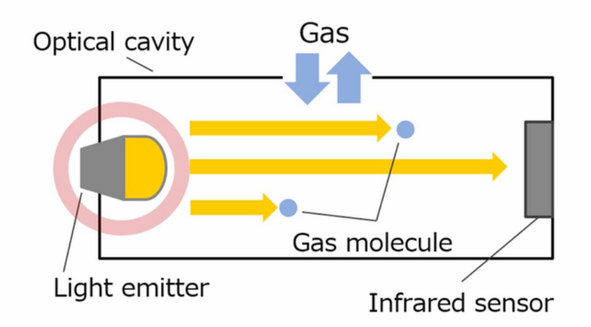
MONITORING

These sensors will almost certainly include temperature and humidity. Many with Carbon Dioxide

Some will also measure.

PM
Formaldehyde
Carbon Monoxide
Nitrogen Dioxide
Ozone
TVOC





Code of Practice

MONITORING

CO2

In a home, carbon dioxide can be a helpful way to understand ventilation performance.

However, we can monitor CO2 levels and learn what helps or hinders effective air renewal in our homes.

Does our bedroom regularly go above 1500ppm?
What affects these numbers?

Its a little like a health wearable, it wont replace your doctor or a ventilation engineer! But it will help you take the pulse of the home.

Improving Air Quality

Think First Principles

HIERARCHIES OF CONTROL

Eliminate

What don't I need in a home?

This is a simple choice that a homeowner has to make based on what they are willing to tolerate as a risk. It's not about one product over another that is next; this is about removing certain risks from the home completely.

It's simple: it doesn't present a risk if it is not there.

Top 4

Combustion
Smoke
Fragrance
Any chemical you don't need!

Think First Principles

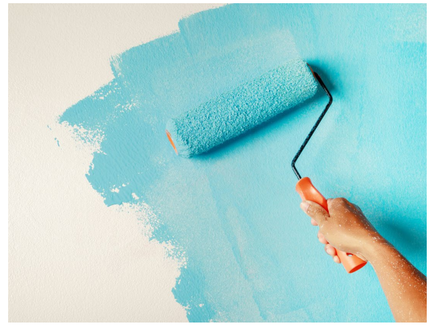
HIERARCHIES OF CONTROL

Substitute
What do I need that I can replace with something less harmful?

This is about making choices. If air quality is important enough for you, there are plenty of choices we can make for people and ourselves that will cause less harm.

Top 4

Combustion
Building/DIY/ Maintanance
Cleaning Products
New Stuff!



Think First Principles

HIERARCHIES OF CONTROL

Engineering Controls
If the risk is there, what can reduce it?

I hope you have caught on now, but ventilation is crucial here. Good background ventilation, good local exhaust ventilation, and an ability to purge are the fundamental pillars or levers for better outcomes.

In addition, if this isn't enough, we can engineer in air cleaning and change the type of surfaces in homes to reduce risk further.

Top 4

Background Ventilation
Local Exhaust
Airing the home!
Air Cleaning

Think First Principles

HIERARCHIES OF CONTROL

Administrative Control - Habits and Awareness
What can we do differently?

What can we do differently in the home or with a home to get better outcomes?
This is about both habit change and awareness of homeowners, but also if we are responsible for homes, our systems and behaviour .

Top 4

Maintenance (Think performance, please)
Moisture management
Cooking Habits
Awareness of air quality inside and outside the home.

Ventilation Strategy

Ventilation

STRATEGY

What is a good outcome?

- Managing Risk
- Save Time
- Reputation
- Compliance
- Profit
- Environmental

Ventilation

STRATEGY

Diagnoses of the challenge

- Where does Ventilation go right and wrong
- How do we come into contact with Ventilation
- What stakeholders are there internally and externally
- What influence can we have over decisions and practices
- What could the consequences of certain actions have
- What is the scale of the challenge

Ventilation

STRATEGY

What guiding policies will deal with the nature of the challenge

- Internal competency and communication
- Performance-based specification
- Performance testing
- Capacity in design
- Commercial rigor

Ventilation

STRATEGY

Coherent Actions designed to carry out the guiding policy

- Ventilation Lead
- Communication
- Performance criteria and standards
- Commercial contracts and standards

Thank you

Air Quality Matters
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