Module 4

Ventilation

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Introduction

Effective ventilation is fundamental to the provision of a stable, thermally comfortable environment in which condensation is controlled and air pollutants are reduced to acceptable levels.

The following modules examine the factors influencing indoor air quality, the systems used to provide effective ventilation.

- Module 4.1 Airborne Pollutants

On completion of this module learners will be able to:

- Classify the type and source of airborne pollutants
- Determine required ventilation rates to dilute airborne contaminants

- Definitions
  - Ventilation
    - Supply of outside fresh air to a dwelling
  - Infiltration
    - Uncontrolled entry of fresh air into a dwelling though air leakage paths in the building
  - Purpose provided ventilation
    - Controlled supply of outside fresh air to a dwelling by natural and/or mechanical systems

Ventilation requirement is provided by a combination of infiltration and purpose provided ventilation

Airborne Pollutants

- Activity based
  - Moisture
  - CO_2
  - CO
  - Smoke
  - Odours

- Environmental based
  - VOC
  - Allergens
  - Radon
  - Dust & PM_{10}

Sources of moisture

- Cooking and unflued heaters

$$CH_4 + 2O_2 = CO_2 + 2H_20$$

- Wet-rooms

Bathrooms, showers, utility rooms

Sources of CO_2

- Cooking and unflued heaters

$$CH_4 + 2O_2 = CO_2 + 2H_20$$

- Respiration

Sources of CO and NOx

- Incomplete combustion

Sources of VOC

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- Solvents used in the manufacture of construction materials, furnishings, paints and varnishes

Sources of allergens

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- House dust mite

Sources of radon

- Naturally occurring radioactive gas produced during the decay of uranium in rocks and soil

Dust & PM10

- Road traffic, domestic fires

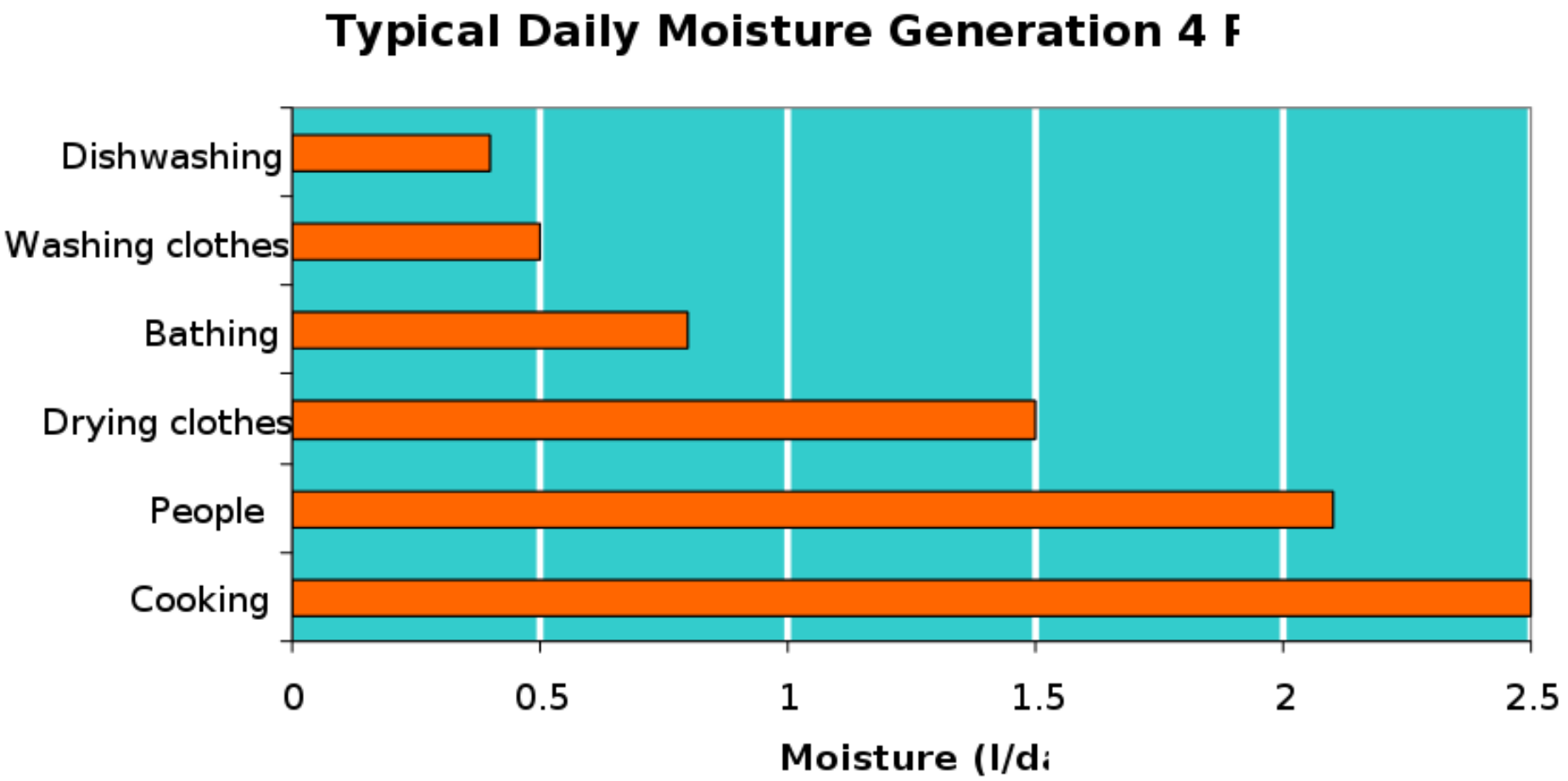
- Of all the pollutants, control of water vapour requires the highest ventilation rate

- If a sufficient quantity of fresh air is supplied to control water vapour then dilution of the other pollutants will be catered for

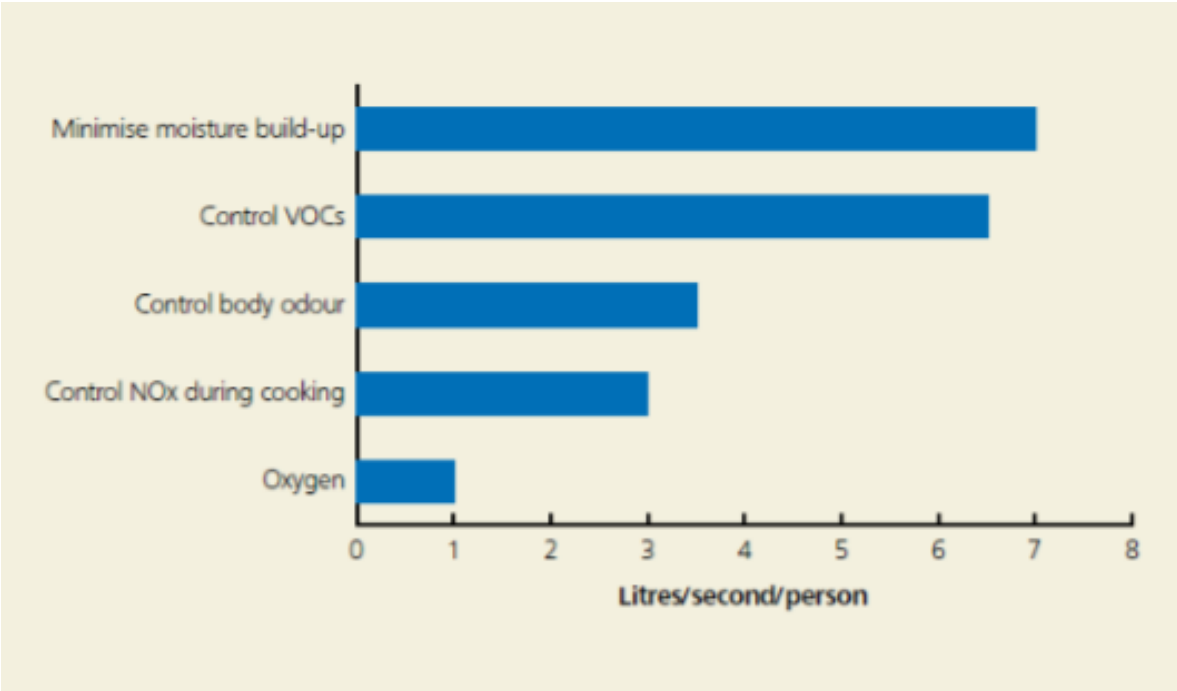
- 0.5 to 1.5 air changes per hour is sufficient to control condensation (BS 5250:2002)

Typical Moisture Generation Rates	
People: Asleep/active	0.04 / 0.05 litres per person
Cooking: electricity/gas	2 / 3 litres per day
Dishwashing	0.4 litres per day
Bathing/Washing	0.2 litres per person per day
Washing clothes	0.5 litres per day
Unvented tumble drier	1.5 litres per person per day
Adapted from BS 5250:2002	

Typical daily moisture emission rate 5 to 10 litres


Typical Daily Moisture Generation 4 F
Dishwashing
Washing clothes
Bathing
Drying clothes
People
Cooking
0
0.5
1
1.5
2
2.5
Moisture (l/d

- How much outside fresh air do we need?
  - 8 (l/s)/person (CIBSE Guide A)



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Ventilation rates

- Air flow for ventilation can be expressed in:
  - litres per second
    - The units to express this vary from country to country e.g. (l/s), (ls^{-1})
  - air changes per hour
    - The units to express this vary from country to country e.g. (ach), (ach^{-1}), (ac/h), (h^{-1})

Conversion between units

ach to l/s

- l/s = (ach x V)/3.6
- Example:
  - Convert 5 ach to l/s when V = 300m^3
  - (5x300)/3.6 = 0.42 l/s

l/s to ach

- ach = ((l/s) x 3.6)/V
- Example:
  - Convert 50 l/s to ach when V=300m^3
  - (50x3.6)/300=0.6 ach

Module 4.2 Ventilation Systems

On completion of this module learners will be able to:

- List the requirements of a ventilation system
- Explain the principles of a ventilation strategy
- Describe a range of ventilation systems

- Requirements of a Ventilation System
  - Rapidly dilute pollutants which do not pose a health risk
  - Remove harmful pollutants
  - Remove water vapour in areas where it is produced in excess quantities
  - Disperse residual water vapour
  - Provide an adequate supply of fresh air for respiration

- Ventilation Strategy

- **General ventilation** to provide a *continuous* rate of air exchange.

- **Extract ventilation** from rooms with high water vapour / pollutant release. May be *intermittent or continuous*.

- **Purge ventilation** to allow removal of high concentrations of water vapour or pollutants that may occasionally occur.

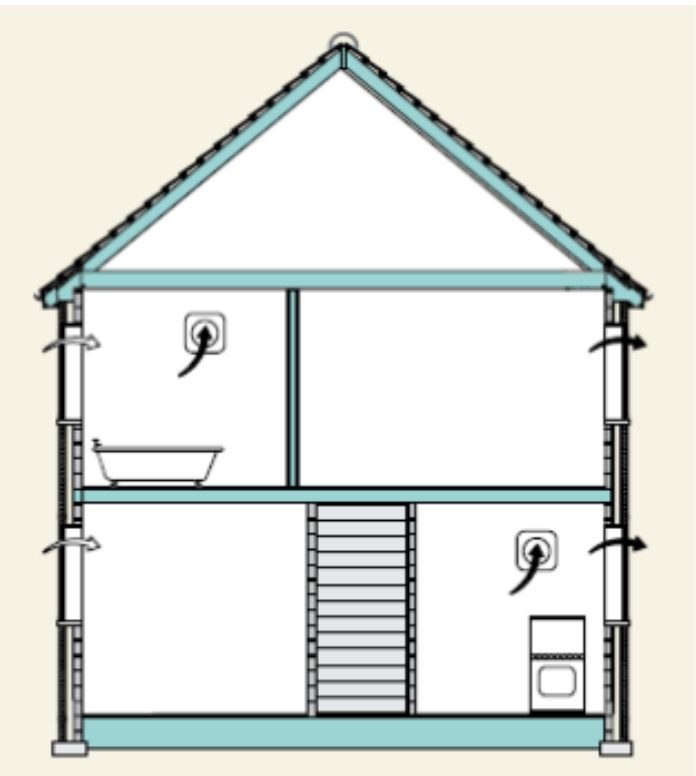
- Note: permanent ventilation may be required in rooms with heat producing appliances

- Ventilation Systems

- Intermittent extract with background ventilators
- Passive stack ventilation
- Mechanical extract ventilation
- Positive input ventilation
- Whole house mechanical ventilation with heat recovery

Intermittent extract with background ventilators

- Extract fans located in wet rooms
- Run intermittently
- Replacement air through background ventilators
- Manual control wired through light switch
- Humidistat with manual override



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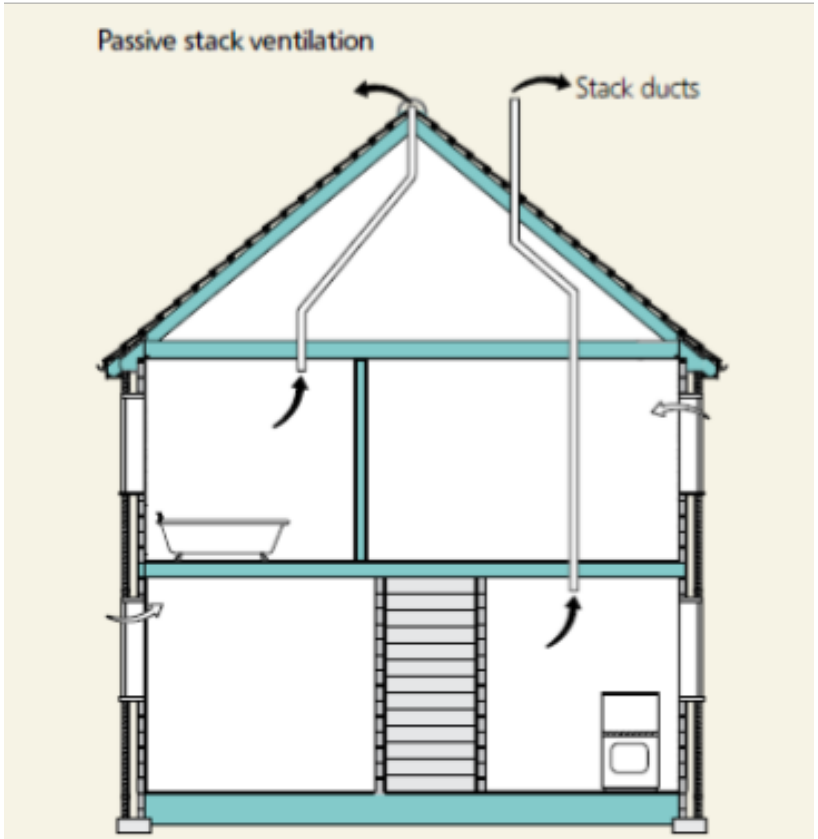
Passive stack ventilation

- Vents located in wet rooms
- Connected by vertical duct to roof ridge terminals
- Driven by stack and wind effects
- Performance very dependant on proper installation
- No heat recovery
- No running costs



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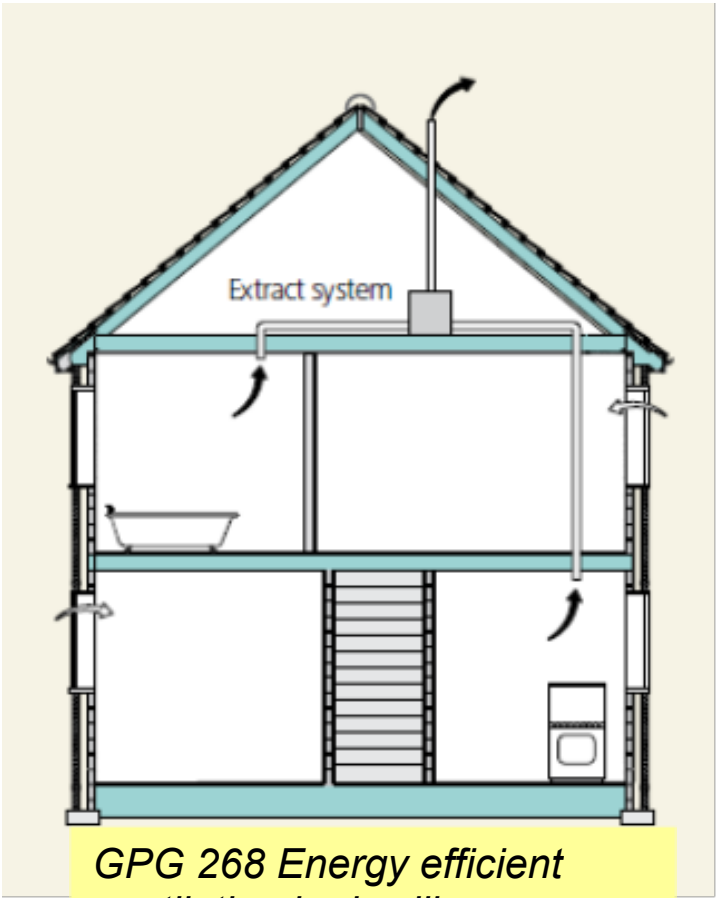
Mechanical extract ventilation

- Continually extracts from wet rooms
- Dual speed for continuous trickle and boost operation
- Replacement air through background ventilators
- Automatic control by humidistat sensor or manual control
- Requires commissioning
- Requires space for ductwork
- Low SFP required due to continuous running (SFP<=0.6W/l/s)



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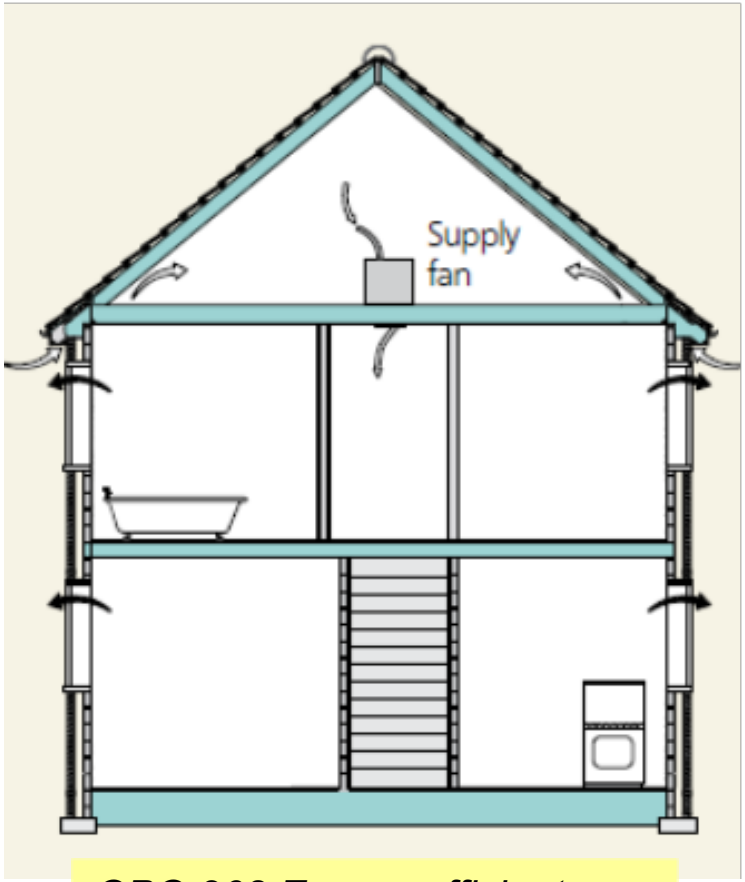
Positive input ventilation

- Fan supplies air via the hall or landing
- Fan is typically located in the roof space
- Provides positive pressurisation
- Air exits via background ventilators
- Continuous operation with boost facility
- Heat gain from roof space can be utilised
- Care required to avoid draughts in hall and landing areas



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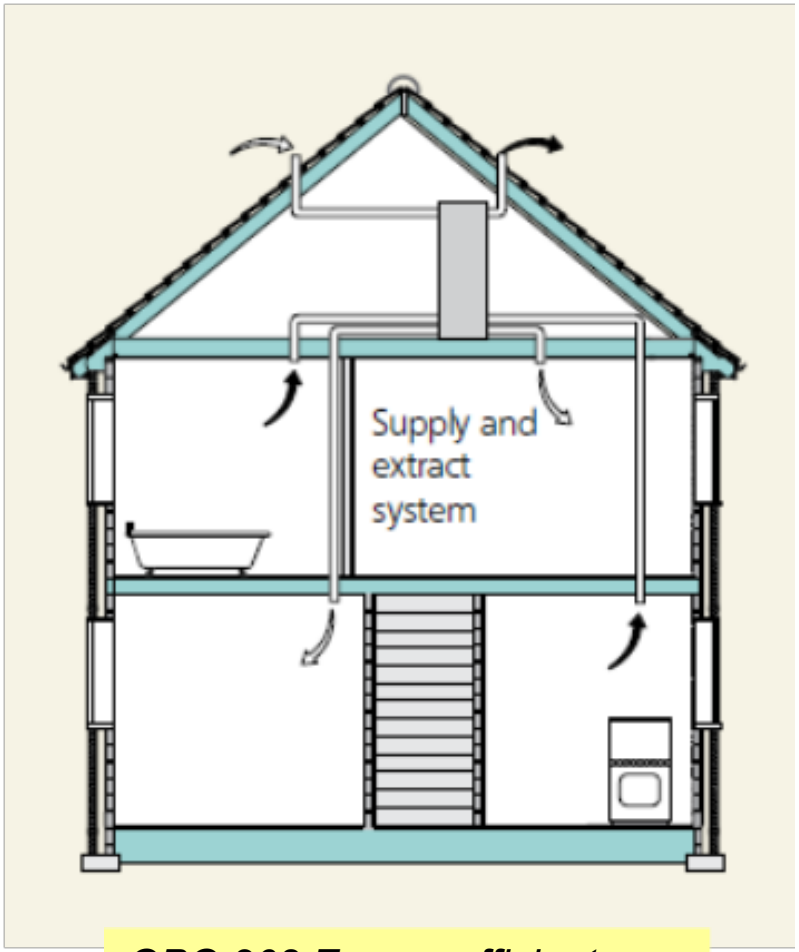
Whole house mechanical ventilation with heat recovery

- Supply to habitable rooms
- Extract from wet rooms
- Recovery of energy from extract air through heat exchanger
- Preheats incoming fresh air
- Dual speed for continuous trickle ventilation and high speed boost extract



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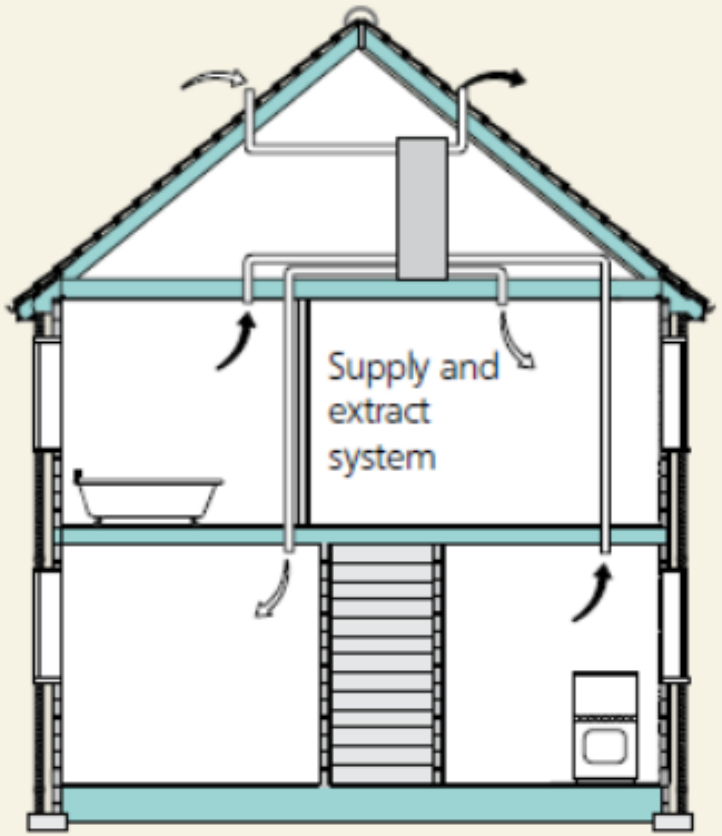
Whole house mechanical ventilation with heat recovery cont.

- Full commissioning required to ensure balanced operation
- Space required to incorporate ductwork into the structure
- Energy savings only realised if
  - Air permeability
    < 5 $m^3h^{-1}m^{-2}$
  - Low SFP 1 $Wl^{-1}s^{-1}$
  - Heat exchanger efficiency
    > 85%



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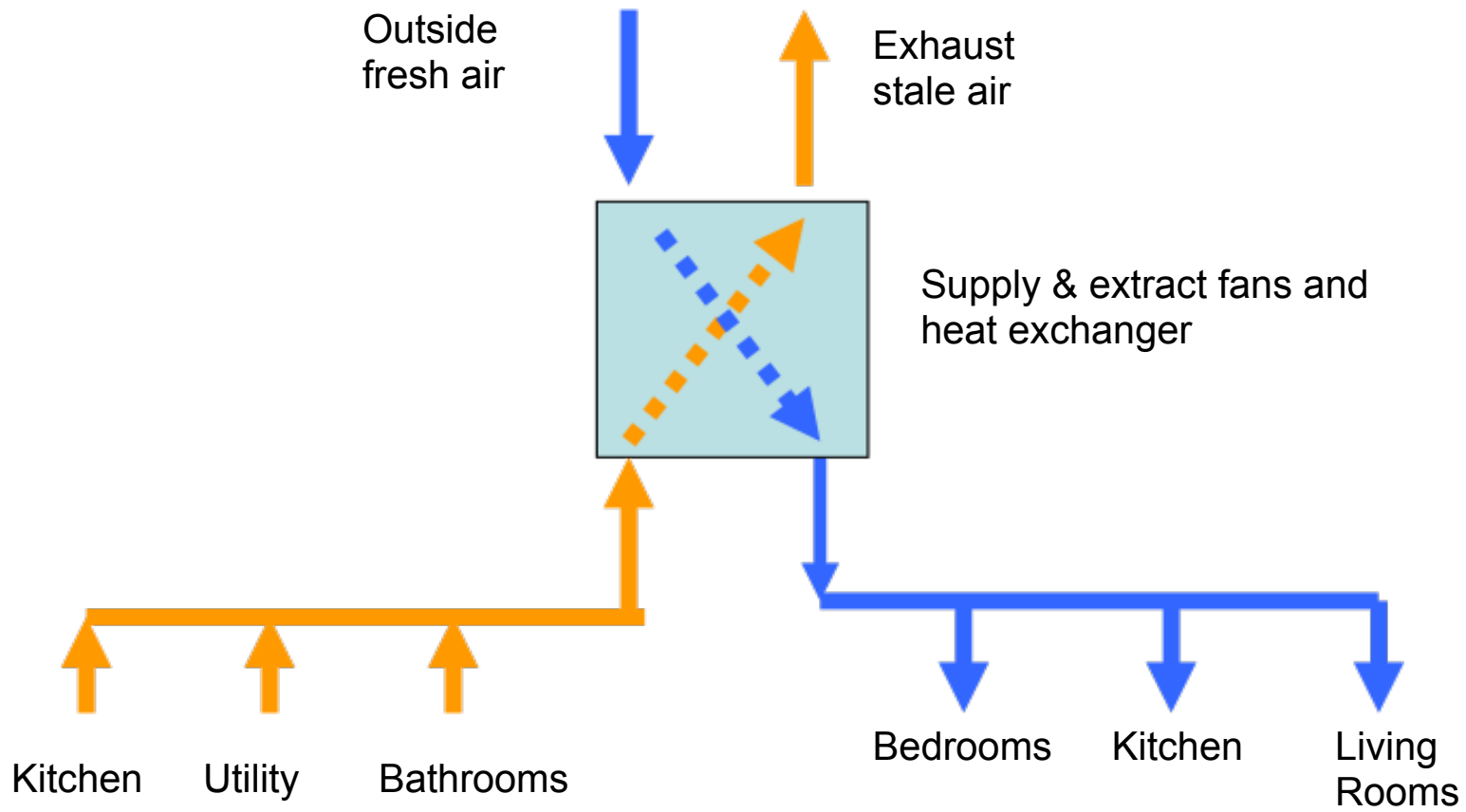
Typical MVHR system



Control options

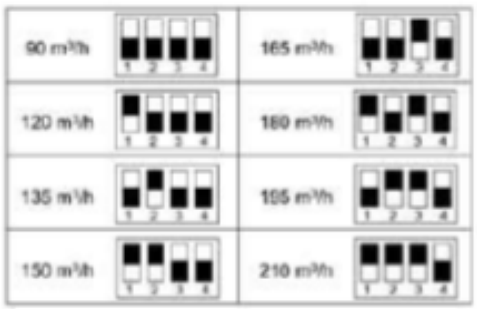
Normal operation:

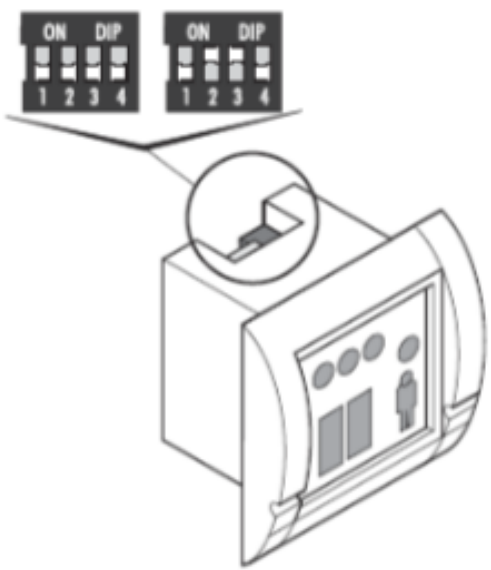
- Normal operation requires a balanced supply and extract
  - Supply and extract volumetric flow rates must be calculated at design stage based on relevant national standards.
  - Supply and extract fans must be commissioned on site to deliver the design flow rates.
  - Under normal operation the system operates continuously providing background ventilation.
  - Fans should be EC variable speed and should maintain design flow rates as filters and grilles become clogged between maintenance periods.

An example of setting volumetric flow rate

FLOW RATE SELECTION

The choice of air flow rate is dependant on the number of 'wet rooms' – shown in the table above.
The selection is made be a switch on the back of the Dee Fly controls. Simply position the jumpers as shown below to obtain the required basic airflow rate:





Additional Controls

- Manual options
  - User control panel should be provided to allow manual selection of boost operation for increased flow rates for example when baths/showers are being used.
  - Summer bypass option should be available to allow extract air to bypass the heat exchanger in summer months to allow external cool air to enter the dwelling.

Additional controls

- Automatic options
  - Systems can be supplied with humidity sensors to automatically enable boost operation (humidity sensors should be located in the room being controlled, one humidity sensor located in the extract near the heat recovery unit will suffer dilution effects from the other extract air streams and may not register a rise in humidity)
  - Systems can be supplied with occupancy sensors to enable/disable the system when people are present/absent.
  - To avoid potential cold draughts in winter supply and extract air temperatures can be monitored so that if the difference between these temperatures is outside a set control band the supply fan can be throttled back. This is to avoid cold air draughts.

Example of automatic control devices

This extract unit provides a constant base ventilation rate. Maximum flow is activated by an inbuilt occupancy sensor.
Extract rate varies from 1.4 – 8.3 L/s

Extract rate varies from 1.4 - 12.5 L/s in proportion to the relative humidity range of 12% -52% RH

- Suggested Reading

- GPG 268 “Energy efficient ventilation in dwellings – a guide for specifiers”, Energy Savings Trust, www.est.org.uk/bestpractice

- GPG 224 “Improving air tightness in dwellings”, Energy Savings Trust, www.est.org.uk/bestpractice