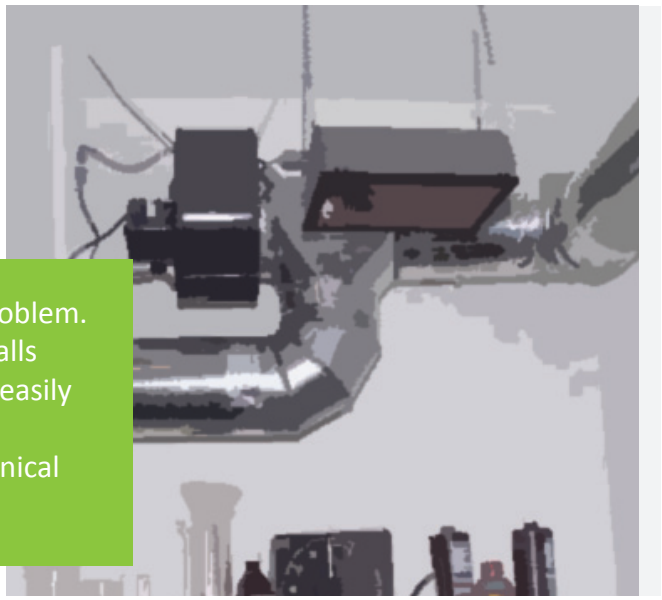
APPENDIX 4:
Ventilation System



In larger buildings, ventilation can be in interesting problem. There are often areas that are far from any outside walls or windows through which natural ventilation can be easily maintained. Natural ventilation can be built into such buildings using stacks and ducts. Alternatively, mechanical ventilation can be used, or a combination of the two.

MECHANICAL VENTILATION

Mechanical ventilation systems are sometimes necessary in large buildings. It is possible to design most buildings, even hospitals, using only natural ventilation. However, due to the location of a building combined with any specific requirements, it may be necessary to use mechanical ventilation.

It is difficult to retrofit natural ventilation systems, so in older buildings with mechanical ventilation, it is most important to maintain your mechanical systems properly.

Always ensure that vents are cleaned frequently and filters are replaced before they become unusable.

NATURAL VENTILATION

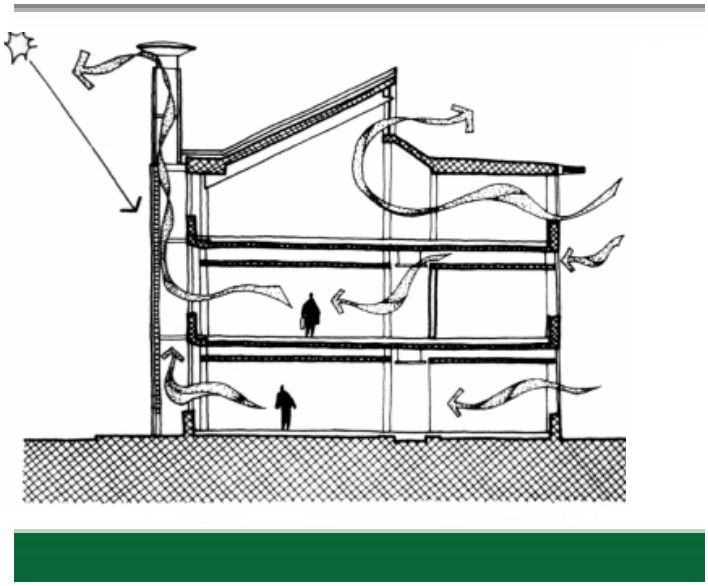
Natural ventilation uses the difference in air pressure to create flow from the building to the outside and vice versa. This is similar to how wind is produced. Some large buildings are ventilated entirely by passive systems like this. However, it is more common that a mechanical or mixed mode system is used.

With any system, it is important that the building is sealed tight and vented right. This means that only waste, stuffy air is extracted, and only clean, fresh air is let into the building. This will assist the heating and cooling systems, as the air that has only just had its temperature adjusted will not escape through badly placed ventilation.

VENTILATION STACKS

Stack ventilation is a method of passive ventilation that uses air pressure differences to pull air through the building. Air pressure varies with height above the ground, so there is a lower pressure at the top of a stack, or chimney, than at the bottom. The difference in pressure up the stack creates air movement with the lower pressures higher in the building pulling air upward.

Stack ventilation is based on Bernoulli's principle, a general principle of fluid dynamics, which states that air that is moving faster has lower pressure. Architecturally speaking, outdoor air further from the ground is less obstructed, so it tends to move faster than lower air, and thus has lower pressure. This lower pressure can help suck fresh air through the building. A building's surroundings can greatly affect this strategy, by causing more or less obstruction.



The stack effect: hot air rises due to buoyancy, and its low pressure sucks in fresh air from outside

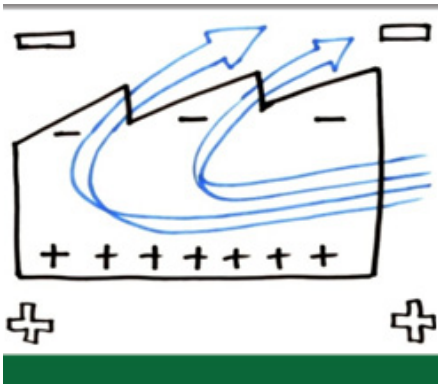
The top of a ventilation stack can be designed to let air in or out in separate openings.

At BedZED, an eco housing development in London, the wind cowl system was developed to deliver preheated fresh air to each home and extract its vitiated air, complete with heat recovery from the extracted ventilation air.

A wind cowl can be fitted to the tops of stacks, and work like an active ventilation system. It has dedicated inlet and outlet ducts and a heat recovery system, but instead of using electrical fans to drive the air flow it uses the wind to create both positive pressure at the inlet and negative pressure at the outlet ensuring air flow with no electrical input.

Wind-driven ventilation with heat recovery

The heat recovery system used is 70% efficient. At an average wind speed of 4m/s, depending on the external temperature, the flow rate of the Wind Cowl is between 50-70 litres per second. Each wind cowl unit provides natural ventilation for 350m3 with a volume of air at 60l/s. In low wind conditions it will continue to produce reasonable ventilation levels through stack effect.



Lower air pressures at higher heights can passively pull air through a building.

MIXED MODE VENTILATION

There are a number of tools and units that can be used to enhance a natural ventilation system. The combination of natural and mechanical ventilation systems can be very efficient, and is known as mixed-mode. The UK Building Regulations permit ventilation fans to be eliminated if trickle ventilators and passive stack extract vents are provided. However, introducing unheated winter fresh air via window trickle vents would require heating to be reinstated in each room. A combination of natural ventilation with mechanical temperature control can be an effective solution.

ATTIC SPACES

Installing weatherproof vents to passively ventilate attic spaces in hot climates is an important design strategy that is often overlooked. In addition to simply preventing overheating, ventilated attics can use these principles to actually help cool a building. There are several styles of passive roof vents: Open stack, turbine, gable, and ridge vents, to name a few.

Roof vents: open stack, turbine, and gable vents

Successful passive ventilation using these strategies is measured by having high thermal comfort and adequate fresh air for the ventilated spaces, while having little or no energy use for active HVAC cooling and ventilation.

CONTROLS

Consider installing demand controlled ventilation and extract in areas such as the bathrooms or kitchen. This can behave like automatic lighting, using sensors to turn on when the room is occupied. However, it would be more appropriate for them to be fitted with air quality sensors rather than motion sensors.
It is important to ensure that the heating, cooling and ventilation systems are controlled together. It is vital that heating and cooling never operate simultaneously.