Contents

8 Insulation/Ventilation

8.1 Description

Homes are insulated and ventilated to provide comfort, energy efficiency and improve air quality.

In the past little or no insulation and ventilation was common building practise. This was mainly due to the relatively low cost of heating homes and the high fresh air exchange inside of an 'old' home. During the 1970's energy costs increased so we started to increase insulation levels and added air and vapour barriers to minimize heat loss. In other words homes became 'tighter'. However we discovered that air quality in the house suffered so proper ventilation became more important.

There are many types of insulation materials and variations. We discuss the most common types.

Generally ventilation can be divided into two groups:
- static ventilation (air flows naturally through vent)
- mechanical ventilation (air is forced through vent with a mechanical fan)

8.1.1 Insulation Materials

The following describes the **most common types** of insulation with a brief description.

8.1.1.1 Fiberglass (Glass Wool)

Glass comes from sand. Fiberglass is made from ‘woven’ or ‘spun’ glass and is found in a variety of forms and textures. This common type of insulation can be installed in loose fill or blanket (also called batt or roll) units. Generally loose fill is used in roof spaces and blanket units used in both roof and wall spaces.

8.1.1.2 Cellulose

Cellulose is made from paper and wood fibers that have been finely shredded and treated.
This type of insulation is installed as loose fill, is grey in colour and since it is very fine it can be mistaken for dust. It is usually found in roof spaces though it can be used in wall systems as well.

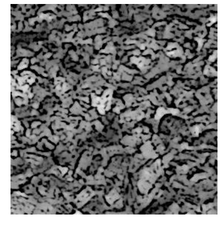
8.1.1.3 Mineral (Rock) Wool

Mineral wool is made from basalt rock and slag, a by-product from the steel industry. It generally comes in blanket form and has good sound blocking qualities.

8.1.1.4 Vermiculite

Vermiculite is a naturally occurring mineral ore and in the past has been used as insulation. It typically looks like small ‘cubic’ pieces that are spread out over a roof space. It was discovered long after its wide spread use between the 1920’s through to the 1990’s that a certain mine from which it came had traces of asbestos. If present it should be left undisturbed and tested by a qualified specialist. Air quality tests and/or removal of vermiculite that has traces of asbestos is sometimes recommended.

Fig. 8.1 Vermiculite photo



8.1.1.5 **Wood Shavings**

This type of insulation is not as common as it was in the ‘old days’. As the name implies it is a loose material and can also be found in saw dust form. Overall wood shavings have poor insulating value.

8.1.1.6 **Spray foam**

Many forms of spray foam insulation have been used in the past. Recently technology has enabled wide spread use that can generally be described as **closed cell and open cell insulating foam**. Polyurethane and Icynene® are common products.

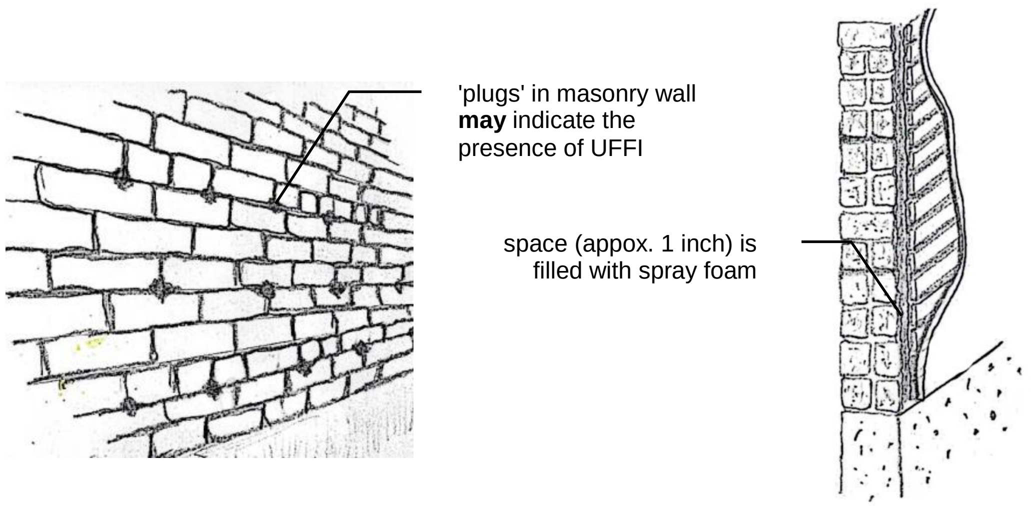
Closed cell insulating foam is the most popular type as it is very durable (dense) and moisture resistant. It is ideal for exterior wall and foundation applications.

Open cell insulating foam is less resistant to moisture though better at allowing moisture to escape. It is ideal for interior wall applications, is lighter in weight and less expensive.

8.1.1.7 **Urea Formaldehyde (UFFI)**

UFFI is a spray foam insulation that was widely used in the 1970’s to insulate homes. It was typically installed by drilling holes in the wall and injecting the insulation to fill the wall cavity. By the 1980’s there was concern regarding the emission of formaldehyde during the curing process. ‘Off gassing’ was also higher when the insulation came in contact with moisture or heat.

Fig 8.2



High concentrations of formaldehyde can have adverse health effects and has been linked to increased risk of cancer. As a result its use as a home insulator was discontinued by the early 1980’s and generally homes will have little or no formaldehyde concentrations since the material has already cured.

However it should be understood that high concentrations of formaldehyde in homes was often due to poor ventilation and lack of proper air exchange. It should also be observed that countless household products are presently manufactured with urea-formaldehyde.

8.1.1.8 **Foam Board (Rigid Board)**

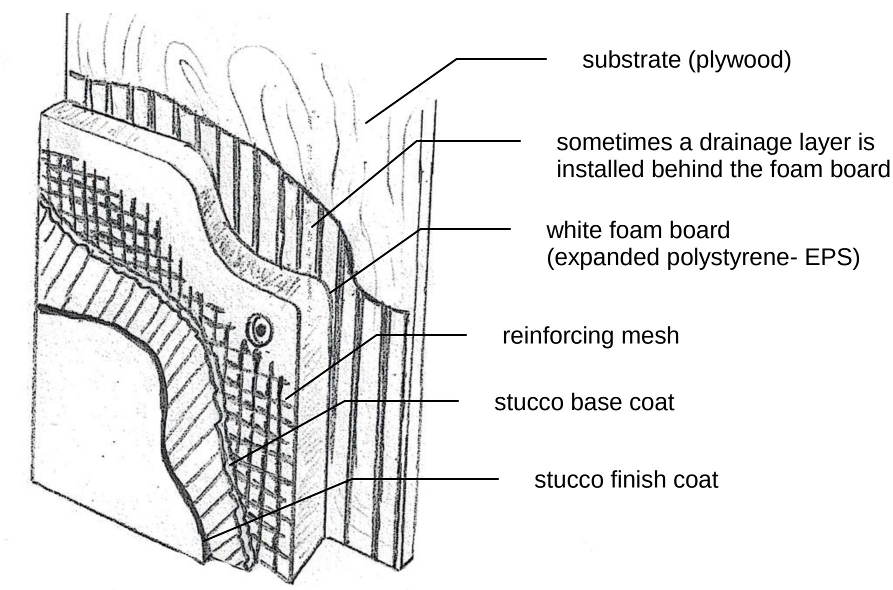
Also commonly called ***Styrofoam*** the two most commonly used products are extruded polystyrene and expanded polystyrene.

> **Expanded polystyrene:** Most people will recognize expanded polystyrene from its **bright white** colour of closely packed spherical bits and when cut the shavings can become an annoying mess clinging to everything. In addition to home insulation it is also used for packing televisions, microwaves and similar fragile products.
>
> **Extruded polystyrene**: Extruded polystyrene is a densely packed material, often **blue or pink** in colour and very rigid.

Exterior Insulated Finished System (EIFS): Sometimes pronounced: 'e*e-fiss'*. As the name implies this type of insulation is applied on the exterior of the house. Sheets of expanded polystyrene are secured to the wall and then finished with a synthetic stucco.

Since the 1990's this method of insulating has become very popular. It also became a problem due mainly to poor installation practises that contributed to mouldy conditions in the wall system.

Figure 8.21 Typical EIFS Wall Assembly



8.2 Location

The report will identify the location of the insulation described if accessible by the Home Inspector.

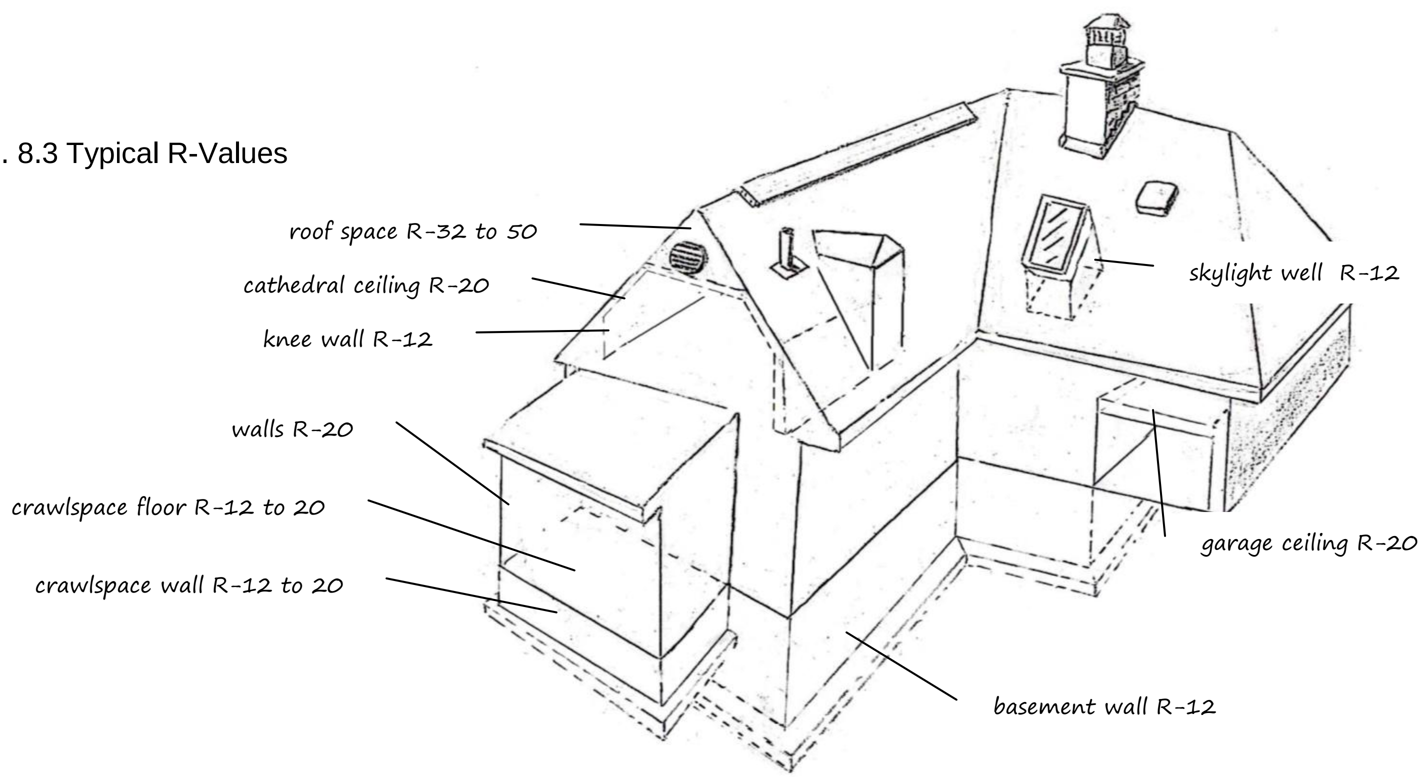
8.3 R-Value

The R means resistance to heat flow. The higher the **R-value**, the greater the insulating performance. The metric equivalent is RSI-Value (1 RSI = 5.7 R).

Table 8.1

Type of Insulation	Installation Form	R-Value/inch
Fiberglass (Glass Wool)	*Blanket/batt*	2.9-3.8
Fiberglass (Glass Wool)	*Loose fill*	2.2-2.9
Cellulose	*Loose fill*	3.1-3.8
Mineral (Rock) Wool	*Blanket/batt*	3.3-4.2
Mineral (Rock) Wool	*Loose fill*	2.2-3.3
Vermiculite	*Loose fill*	2.0-3.0
Wood Shavings	*Loose fill*	1.0
Urea Formaldehyde (UFFI)	*Spray foam*	up to 5.0
Polyurethane	*Spray foam*	5.6-8.0
Icynene®	*Spray foam*	3.7-4.9
Extruded polystyrene (XPS)	*Rigid Board*	4.5-5.0
Expanded polystyrene (EPS)	*Rigid Board*	3.6-4.0

Fig. 8.3 Typical R-Values



8.4 Air/Vapour Barrier

An **air barrier** is a material located on the **exterior of the wall** and secured to the wall sheathing. The purpose is to reduce *'wind washing'* which removes heat (or cooling) and to repel moisture.

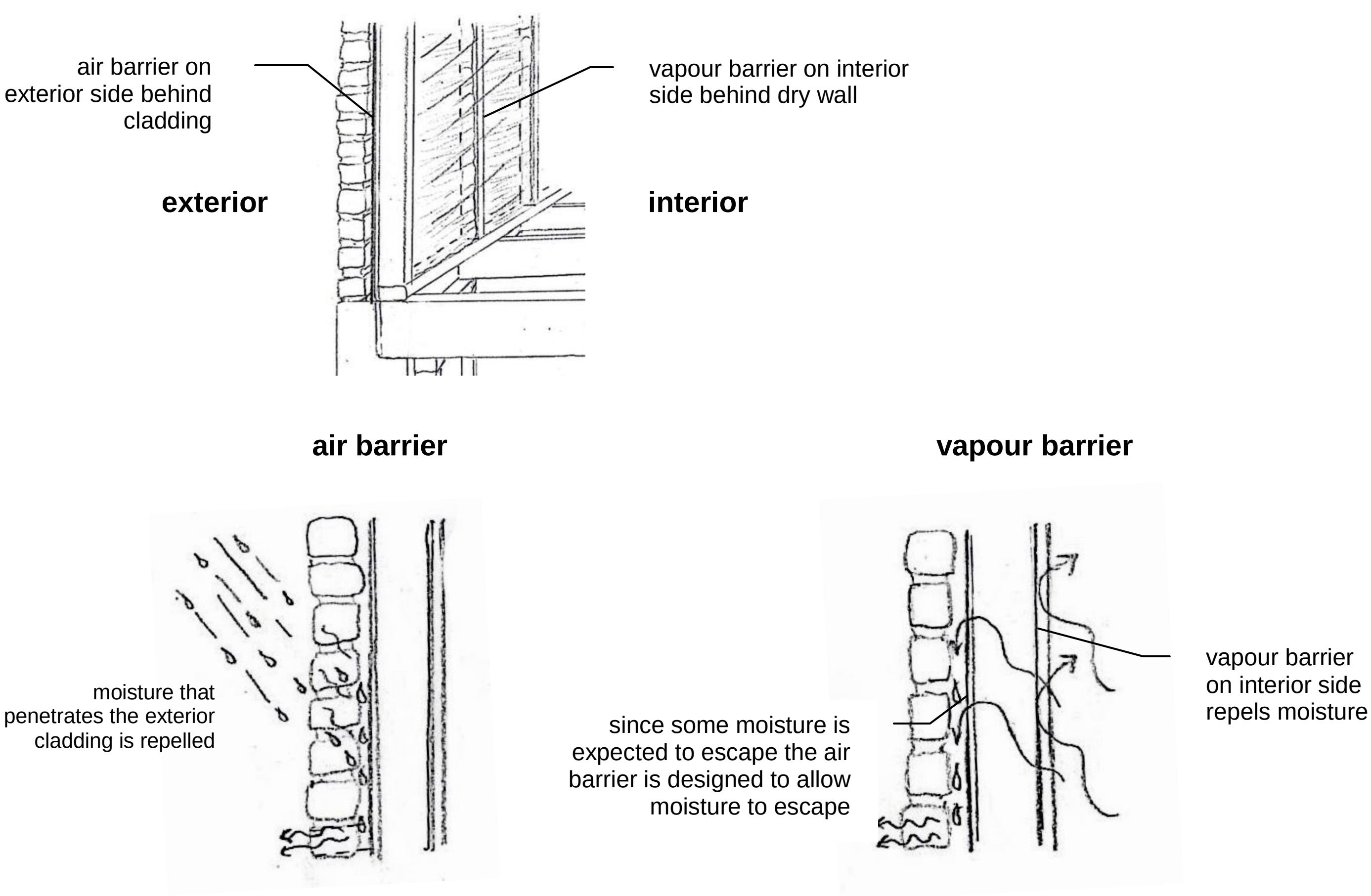
A **vapour barrier** is located on the **interior of the house** behind the drywall and secured to the wall studs. The purpose is to minimize house air from escaping thus reducing heat loss. It also reduces the escape of moist house air that can condense in the wall system and potentially cause mould or in extreme cases structural damage. Walls and ceilings will have a vapour barrier.

Older homes built pre circa 1950’s typically were not built with air and vapour barriers. For homes built starting circa 1950 an air and vapour barrier will typically be present. Initially kraft paper, tar paper and foil were widely used until plastic technology improved and became the preferred material.

Presently house wraps (air barrier) are made from olefin fiber manufactured with synthetic polymers and vapour barriers are made with plastic (polyethylene plastic sheet).

The figure below demonstrates the purpose of an air and vapour barrier.

Fig. 8.4 Air and Vapour Barrier



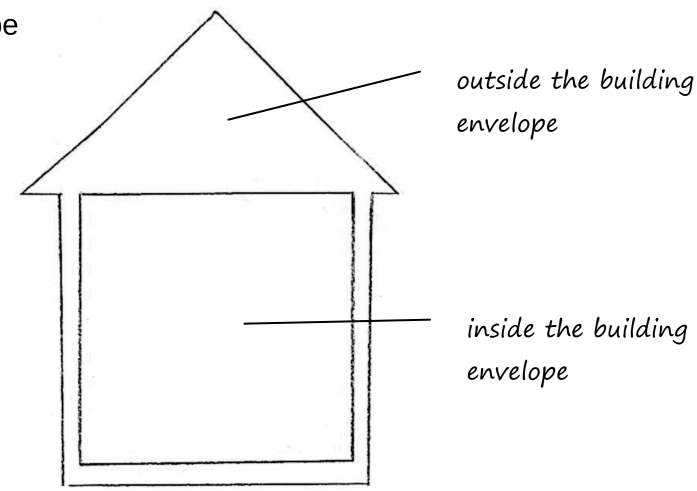
8.5 Venting

First we must understand the house can be divided into two zones.

1. inside the building (thermal) envelope
2. outside the building (thermal) envelope

Air is removed from these zones with vents.

Fig. 8.5 The Building (Thermal) Envelope



Vents are simply openings in spaces of the house to allow for proper air circulation and/or the removal of unwanted air that can be replaced with fresh air.

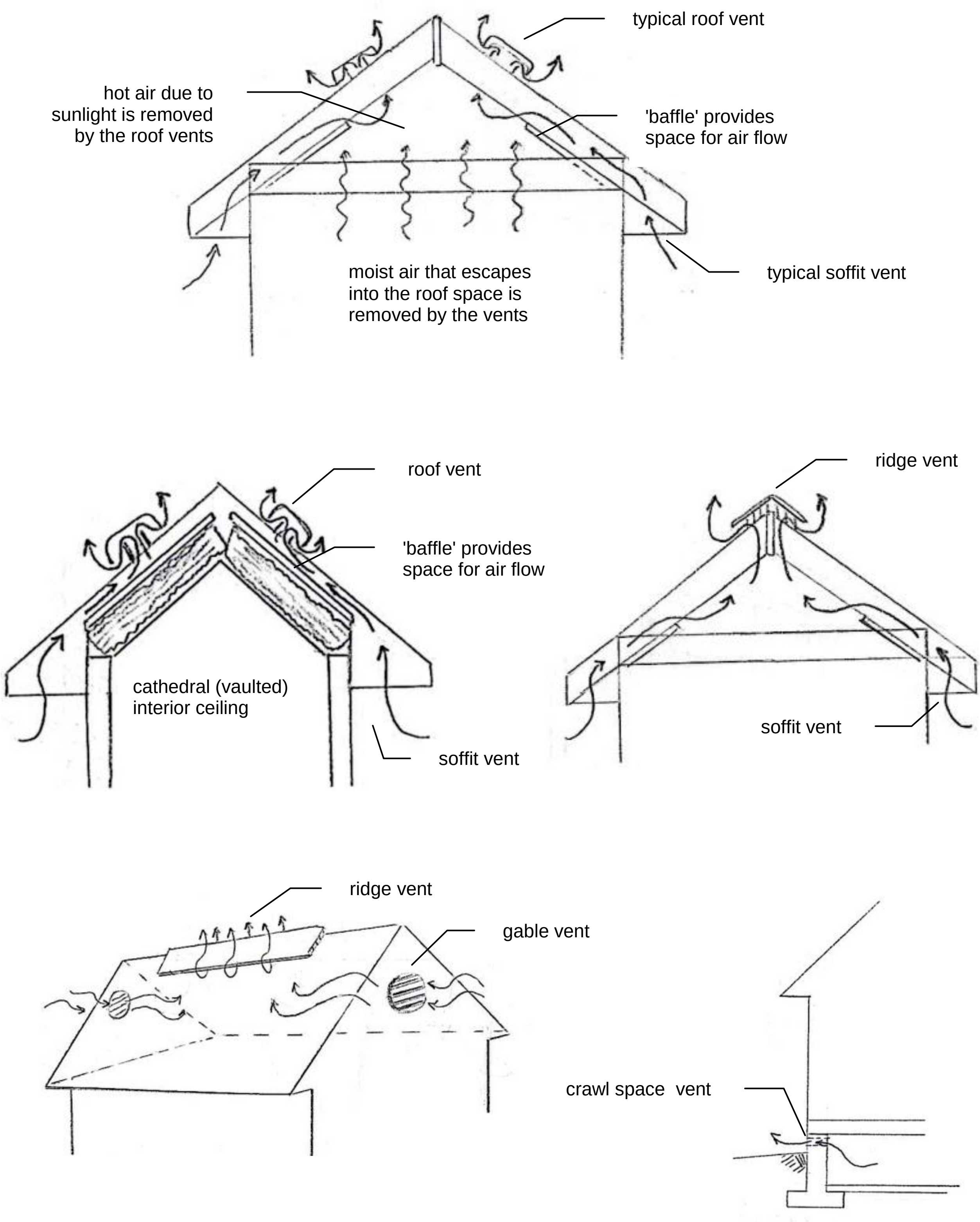
The most common type of venting is roof venting since we need to remove hot air during the summer months and warm moist air during the winter months. Other areas that should be properly vented include crawlspaces and cold rooms. In other words spaces that are outside of the building envelope.

Venting also applies to spaces inside of the house like washrooms and kitchens. There are also sophisticated venting systems that can remove stale house air and replace it with outside fresh air such as HRV's (Heat recovery Ventilators).

Most venting is static which relies on natural air flow. Power venting relies on an electric fan to force air flow. This can be manually controlled with a switch or can be automatically controlled. Solar powered vents are also available.

Over the years venting inside the home has become an important and integral component of the overall systems. This is mainly due to building design improvements that contribute to the overall efficiency of a home. In other words homes have less air leakage so we need to provide adequate ventilation for the health of the house as well as its occupants.

Fig. 8.6 Vent Types and Arrangements



8.6 Limitations

The report will describe the type of access obtained to the spaces in order to determine the type of insulation and air/vapour barriers. As should be expected it is often not possible to observe these spaces

Generally roof and crawl spaces are observed from access hatches. This limit is due to safety.

Since the air and vapour barrier is inside the wall system and not visible it is often not identified during a typical Home Inspection. The continuity of air and vapour barriers cannot be determined.

In some circumstances the presence of insulation and vapour barriers can be determined by removing electrical wall plates and observing behind the junction box. *Caution is required here since there is risk of electrical shock.* This method is essentially a *'spot check'* and does not guarantee the presence of insulation and vapour barrier. The presence of basement wall insulation can often be determined by observing from unfinished rooms i.e. the furnace room.

Crawlspaces and knee wall areas can be entered as long as it is safe.

Power ventilators cannot be tested unless with a manual switch. Many are automaticaly activated with a thermostatic control located in the roof space. In other words when it gets hot in the roof space the power vent turns on.

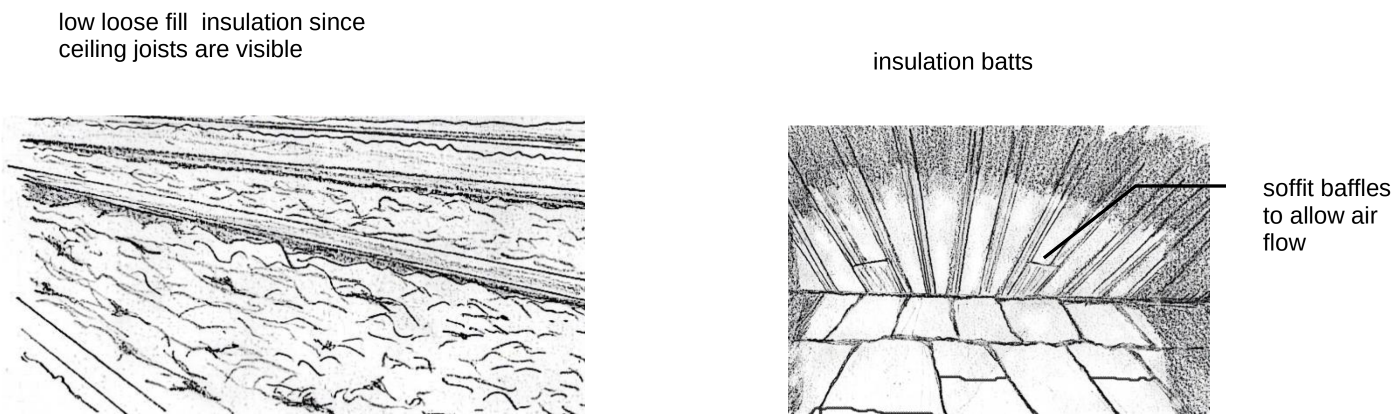
8.7 Observations/Recommendations

8.7.1 Roof Space/Attic

The main consequence of low insulation and lack of vapour barrier is heat loss or gain depending on the season.

Slope Roof: Observing the amount of insulation will determine if more is required. Typically adding insulation on top of existing insulation is adequate. The insulation should be spread evenly through-out being careful not to block soffit vents. The adequate amount of insulation is determined by the type of material and the depth.

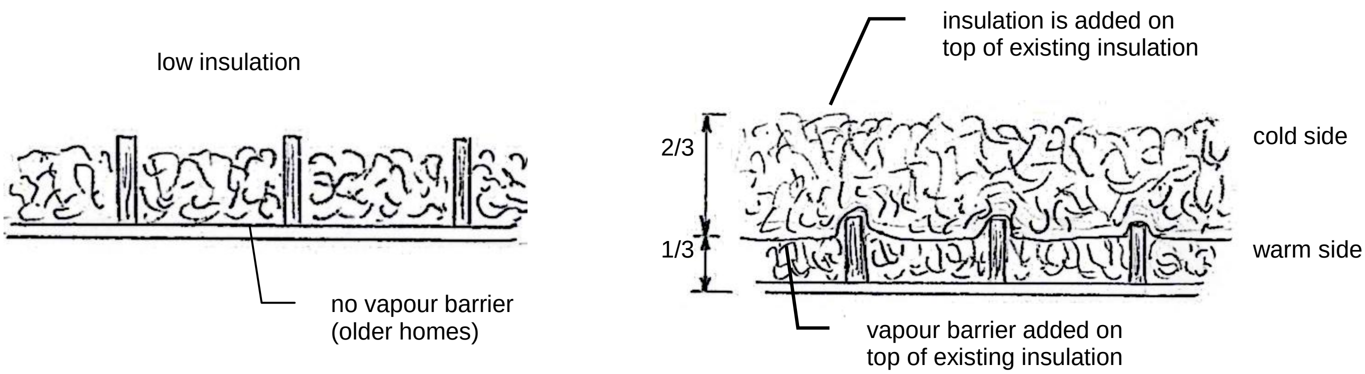
Fig. 8.7 Amount of Insulation



Improper insulation and vapour barriers can result in ice dams and roof leaking.

Adding a vapour barrier on top of existing insulation is possible as long as it is located on the warm side of the insulation. This will prevent the moisture condensing on the cold side.

Fig. 8.8 Adding a Vapour Barrier and Insulation



Flat Roof: The insulation and vapour barrier to a flat roof is generally not visible.

Cathedral Roof: The insulation and vapour barrier to a cathedral roof is generally not visible. Improper insulation and vapour barriers can result in ice dams and roof leaking due to hot air that might be trapped in the cathedral space. Adding a ceiling fan can help circulate air to minimize the risk.

Skylight Wells: A vapour barrier and insulation is required around a skylight window well. The insulation should be secured but not covered with plastic which may trap moisture.

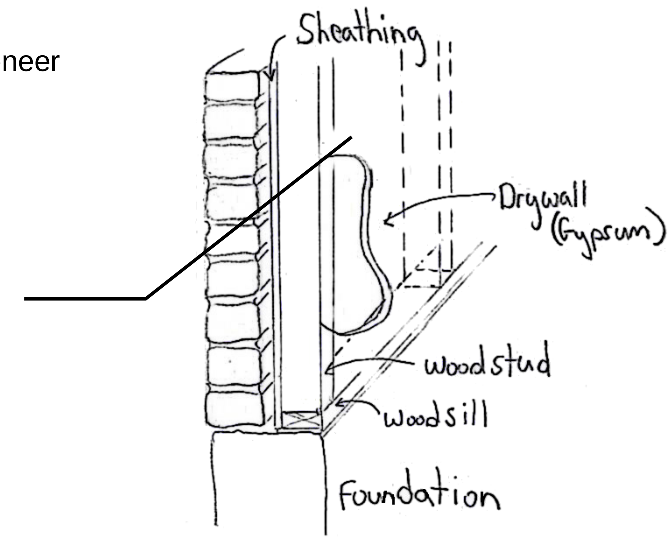
Knee Wall Areas: These areas as treated the same as regular walls and often not visible.

8.7.2 Walls

Since the inside of the wall is not visible determining the adequacy of insulation and vapour barriers is not possible. Depending on the temperature difference between the exterior and interior it is possible to scan the wall with a thermal imaging camera. This might reveal cold or hot spots on the wall which may indicate missing and/or failing insulation and/or vapour barriers. However this method is not part of a regular home inspection and caution is recommend when coming to conclusions.

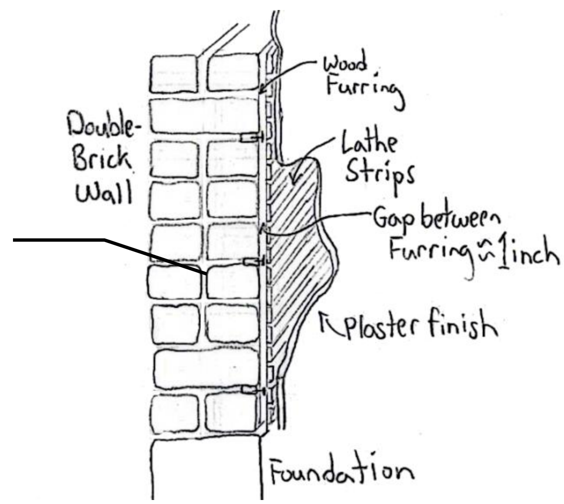
Wood Frame Walls: Since the 1980's the majority of walls are of wood frame construction with insulation between the wood or metal studs. Stucco walls systems are typically insulated with foam board that is secured on the exterior.

Fig. 8.9 Wood Frame with Brick Veneer



Masonry Walls: Older houses built with **double brick** masonry walls will have **no insulation** unless added later during renovations.

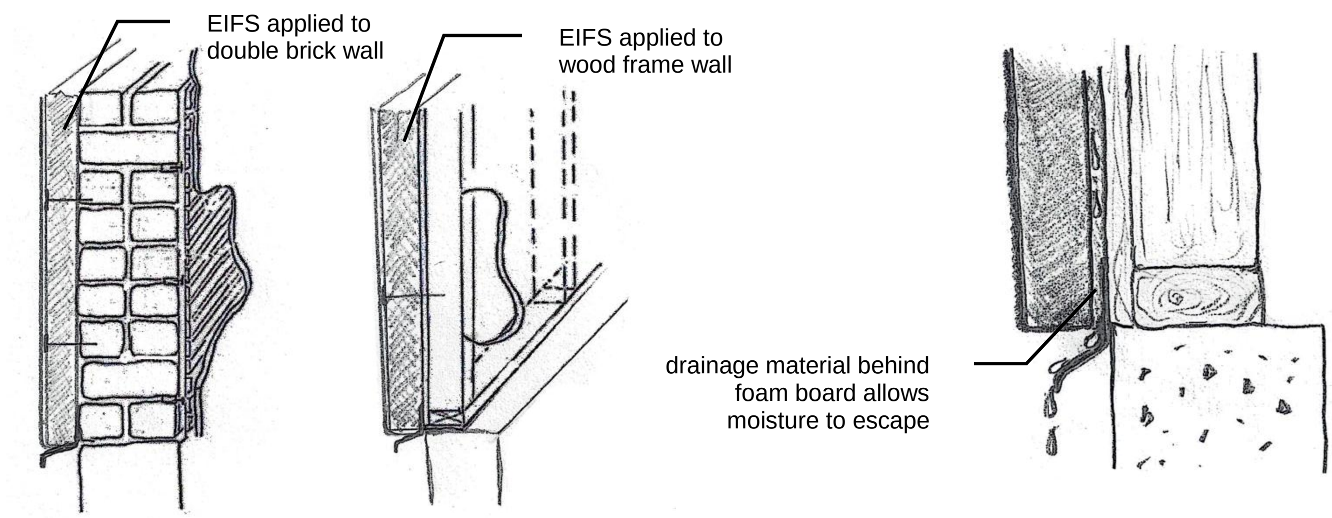
Fig. 8.91 Double Brick Wall



Exterior Insulated Finished System (EIFS): Wood frame and masonry walls can be insulated with foam board which is then coated with synthetic stucco. Typically 1 inch to 2 inch panels are used. The preferred material is extruded polystyrene (white Styrofoam) which has good adhesive qualities when applying the stucco.

EIFS Problems: In the early 1990's EIFS installations became more common for wood frame structures. In many cases problems with mould and rot of the wood frame were soon discovered. These were predominantly in areas with climates of high precipitation. It was claimed that this was an installation issue rather than a design fault though more complicated architectural details were also blamed. Essentially installers were not sealing wall joints and penetrations adequately. For example around windows and doors. This allowed water from wind driven rains for example to infiltrate through the seams and become trapped behind the wall assembly since the synthetic stucco is not permeable. Over time this damaged the wood frame and caused mould which became a health concern. It was soon mandated that a drainage layer be installed behind the foam board.

Fig. 8.92 Various EIFS Applications



Basement Walls: In older homes basement walls were not insulated unless renovated. In colder regions basement walls require insulation to the frost line though more commonly the entire wall is insulated. Insulating the headers is important as well since this is a major source of heat loss. Insulating the headers with spray foam insulation has become common.

Fig. 8.10 Basement Insulation

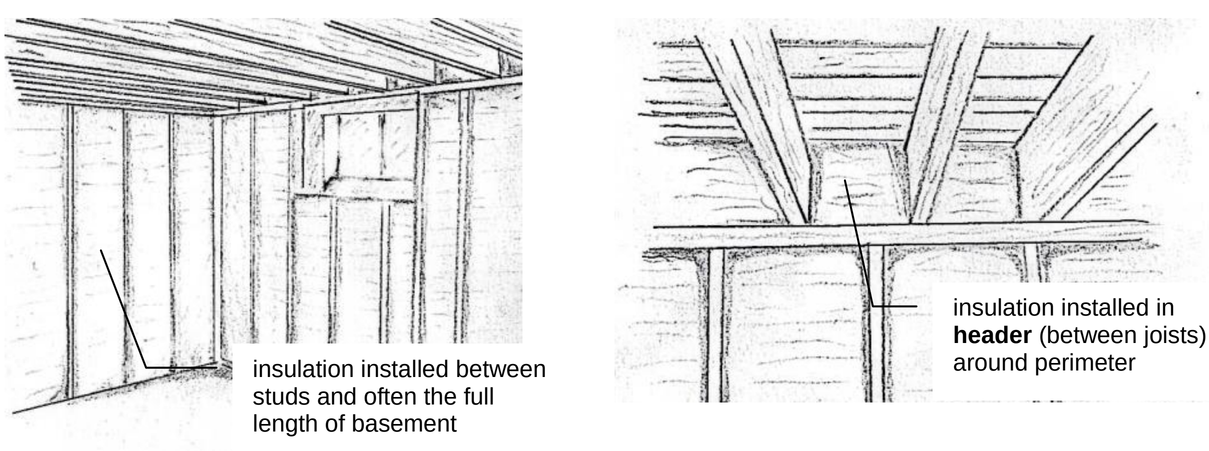
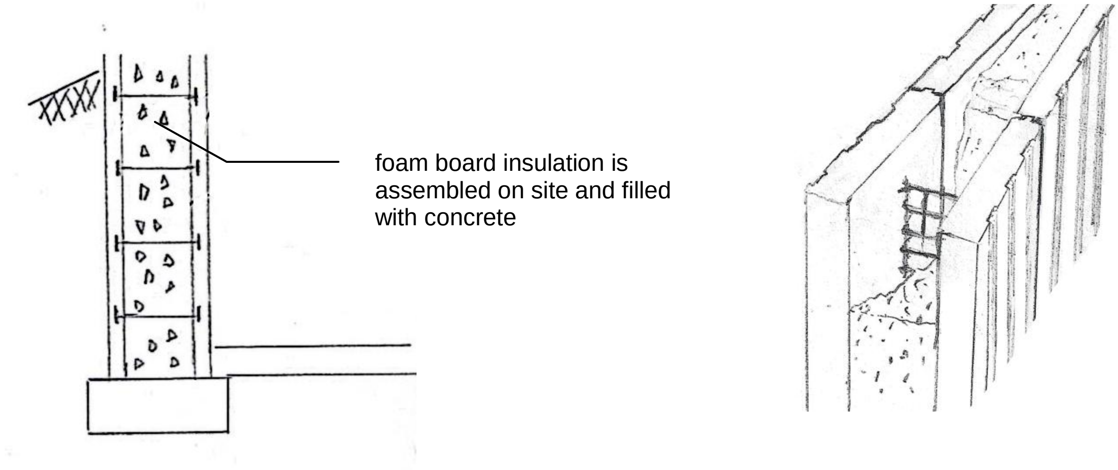


Fig. 8.11 Insulated Concrete Forms:



Crawlspace: The crawlspace walls are insulated in the same manner as basement walls. The floor above a crawlspace is sometimes insulated instead though insulating both areas is preferable. Spray foam insulation has become a common method for insulating crawlspaces especially floors.

Garage Ceiling: When a room is located above a garage insulation must be provided in the ceiling (room floor). In the past standard fiberglass batts have been used. However a common complaint is that the room is colder than other rooms. This is most likely due to air flowing easily through the joists which renders the insulation less effective. More **recently spray foam insulation** has been used which effectively stops air flow and is a **good insulator.**

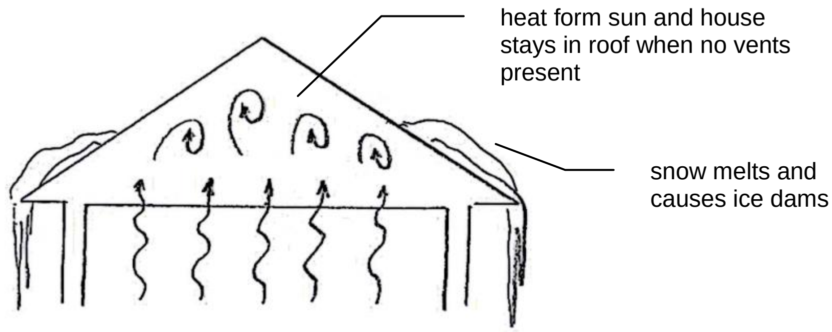
8.7.3 Duct/Pipe Insulation

Ducts and water supply pipes located in unconditioned spaces (roof, crawlspace) require insulation. Generally they are wrapped with batts though more recently spray foam is used which is more effective.

8.7.4 Ventilation

The main consequence of poor ventilation is higher energy consumption and low air quality in the house. In colder climates there is a greater potential for mould which can become a health concern.

Fig. 8.11 No Roof Vents



Proper removal of washroom and kitchen moist air is the main aim of ventilation.

Mechanical ventilation has become standard building practice for modern homes.

Prior to the 1950's venting washrooms and kitchens was not an essential building practise. This was mainly due to the natural air leaks in older homes that was deemed enough to remove moist stale air.

With some exceptions up until the **late 1980's mechanical washroom vents were not installed** and kitchen vents did not vent to the exterior **as long as a window was located within the room**. It was assumed when using the facilities the occupant would open the window providing natural ventilation.

Since the 1990's builders decided that proper mechanical ventilation is a more reliable way to remove unwanted moist air and provide better air quality.

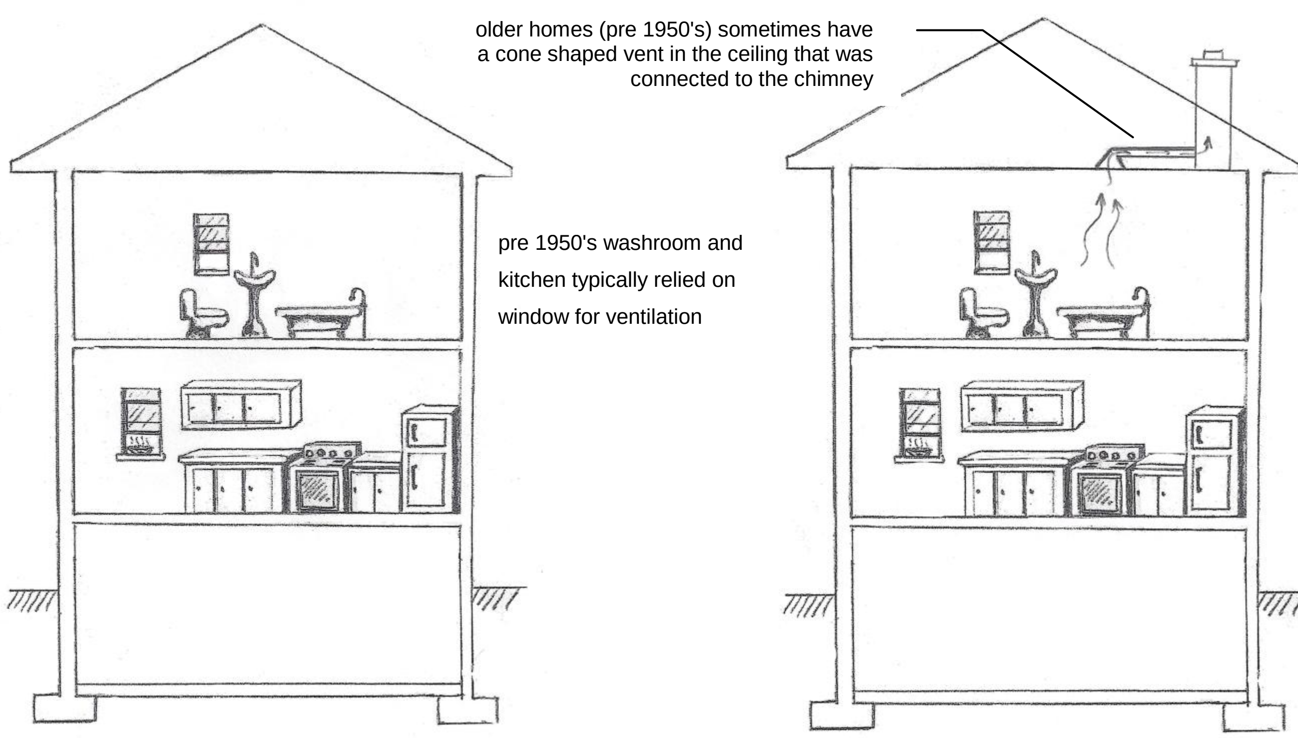
The capacity of a mechanical vent refers to the amount of air in cubic feet per minute that can be removed. This is determined with several factors such as total volume of the room and length of vent pipe and number of elbows.

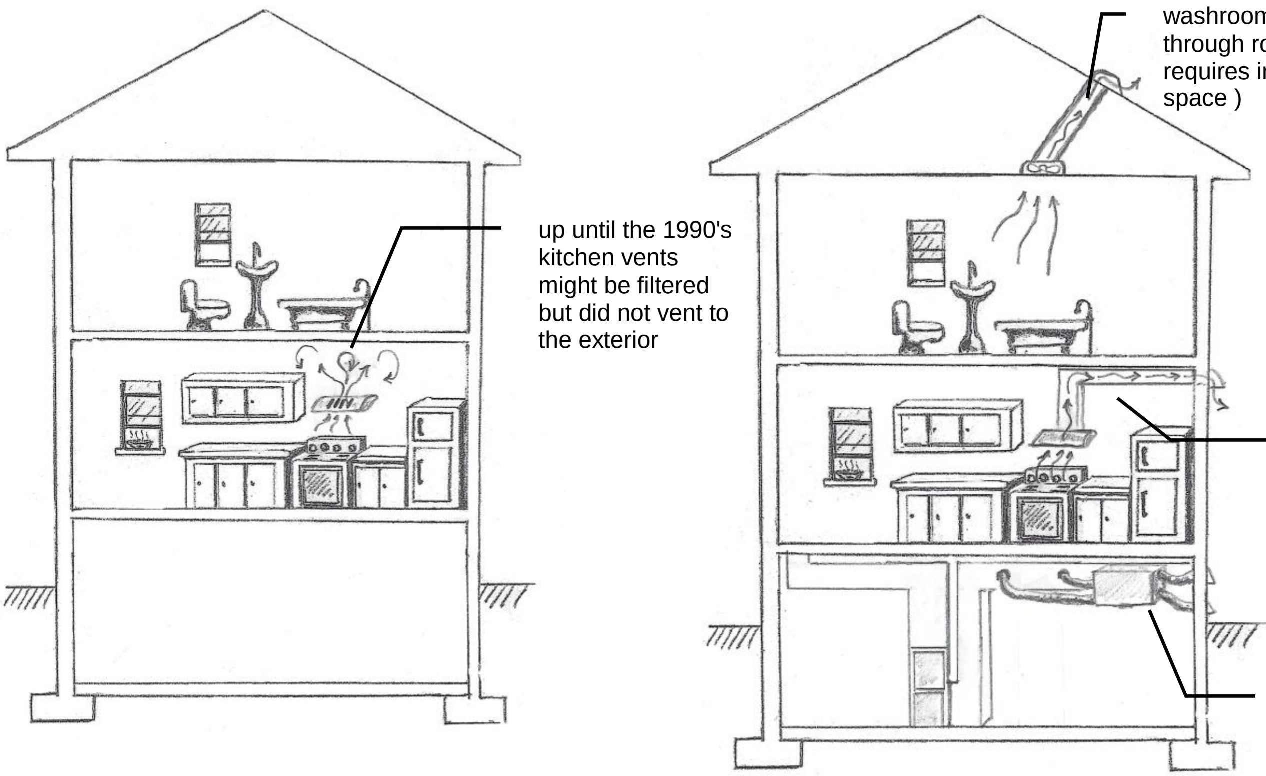
Washrooms, kitchens and more recently laundry rooms have mechanical ventilation located in the ceiling. The vent capacity should be enough to effectively remove moist air and typically should be on for at least 20 minutes after finishing in the room. Many modern vents are equipped with timers.

Since the 1990's it has now become mandatory to provide a **Primary Ventilation Fan Switch** especially when an HRV (heat recovery ventilator) is not present. This is simply a switch, similar to a light switch, located on the main level near the thermostat that controls a washroom vent. The intent is for the occupant to turn the switch on so that the moist stale house air can be removed.

It should be observed that when **washrooms and kitchens are renovated proper ventilation is required**.

Fig. 8.12 Building Envelope Ventilation



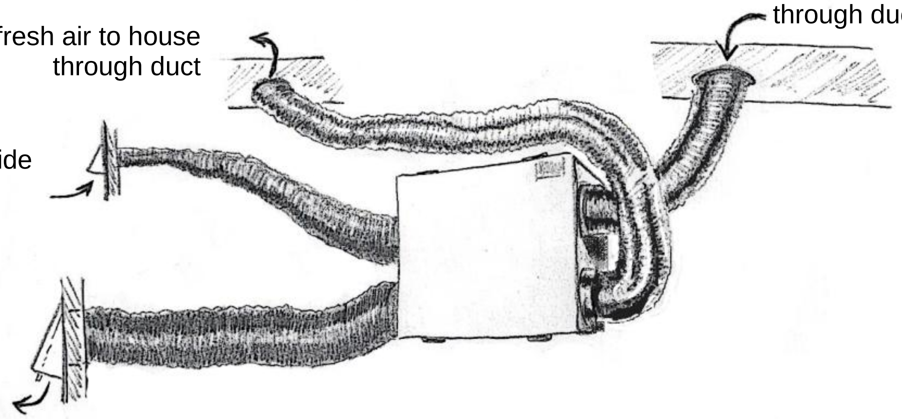


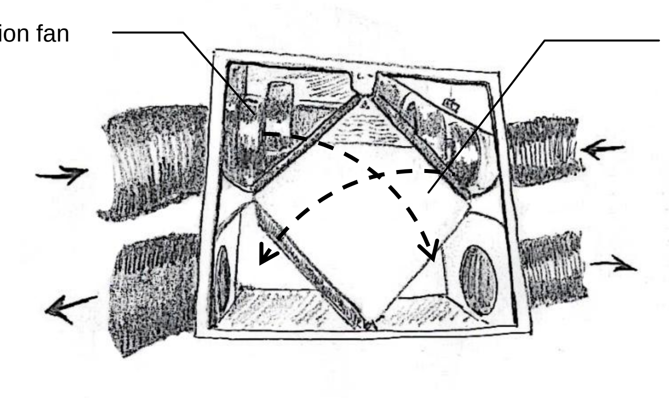
8.8 Heat Recovery Ventilator (HRV):

During the late 1970's and the 1980's we began to improve the efficiency of our homes due to increased energy costs. Construction materials and methods were improved such as vapour and air barrier installations as well as an increase in insulation. Solid masonry walls were replaced with wood framed insulated walls. Overall homes became 'tighter' in order to reduce heat loss through heat transfer and air leaks. This was good for lowering our heating costs however air quality suffered. For this reason a sophisticated ventilation system was developed called an Heat Recovery Ventilator (HRV)

The purpose of an HRV is to remove stale air inside the house and exchange it with fresh air from the outside. Additionally in the winter, during this process, the heat from the house air is transfered to the cooler outside air coming in. This improves the overall efficiency.

Fig. 8.12 HRV (Heat Recovery Ventilator)





Inside an HRV
arrows indicate air flow

8.9 Energy Recovery Ventilator (ERV)

An ERV is similar to an HRV, however, it also recovers the heat energy trapped in humidity, which greatly improves the overall efficiency.

In warmer humid climates the ERV will limit the humidity coming into the house .

In colder dryer climates the ERV will limit the humidity leaving the house.