Construction Studies
6th Year Revision Booklet

NAME:

Exam Tips

1. Label everything on drawings
2. Always include key measurements
3. Always include sketches with answers as they are worth half the marks
4. Clearly identify part (b) in question 1 & 7
5. Always double check you have answered every thing asked

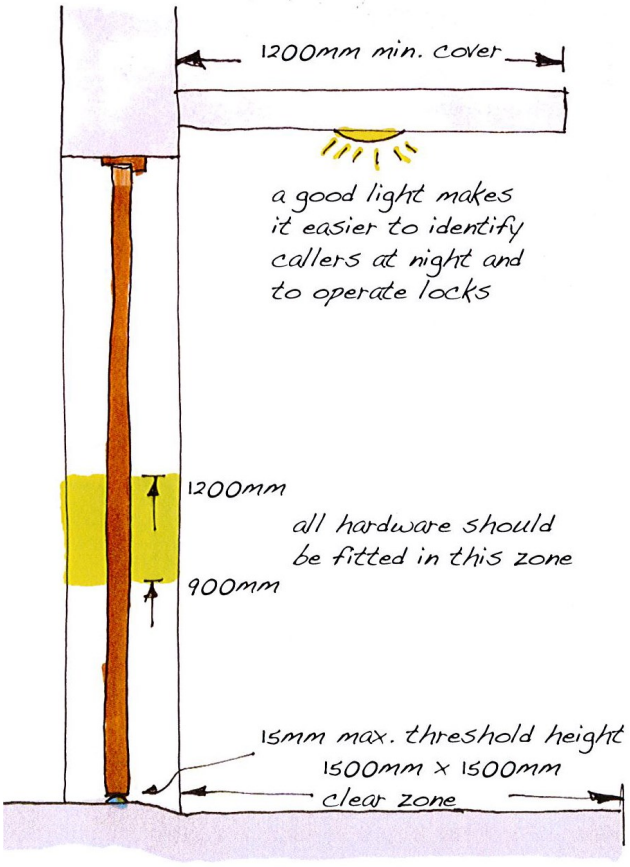
Detail drawing checklist

	Detail	Complete	incomplete	missing	Note
	Strip foundation				
	Wide strip Foundation				
	Raft Foundation				
	Pile Foundation				
	Window cill & Head				
	Door Threshold				
	Eaves Detail				
	Attic Space				
	Flat Roof				
	Lean to roof				
	Chimney detail				
	Chimney/Roof Junction				
	Suspended Timber floor				
	Stairs top				
	Stairs Bottom				
	Septic Tank				
	Man Hole				
	Timber Frame				
	Wall joist junctions				
	Passive House				

Design for Life-time use/Wheelchair Access

Main areas for consideration

- Entrance
- Internal doors & corridors
- Bathroom
- Kitchen

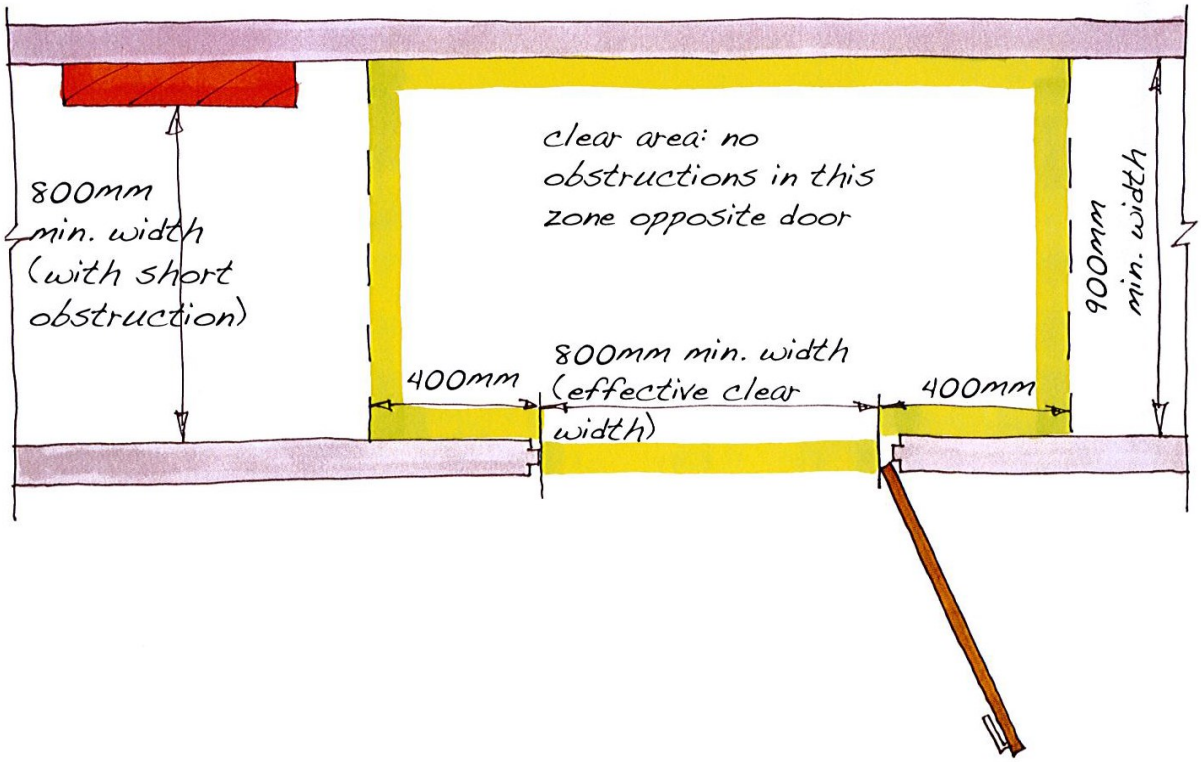


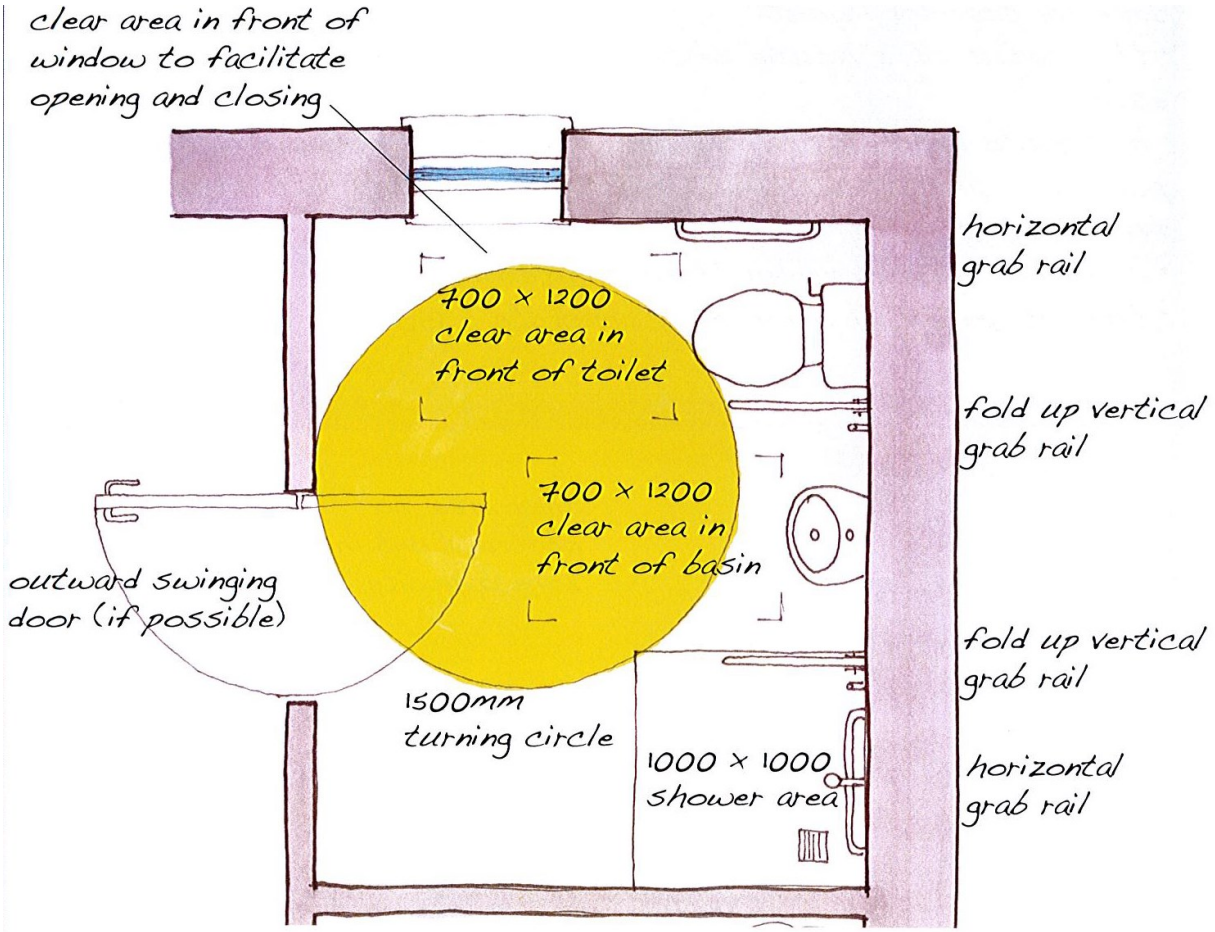
Main entrance

- Wide drive/path with non slip surface leading up to door way
- All door hardware (lock/handle/door bell/letterbox) to be located between 900-1200mm for easy of access.
- Canopy/roof covering to be provided over front door entrance to shield from rain
- Main entrance must have a clear opening of min 800mm
- Threshold concrete cill must have a max 15° slope and max 15mm threshold height for ease of access for a wheelchair.
- A ramp may be used at an entrance but must have a level platform at the top of 1500mm x 1500mm

Internal doors/corridors

- Internal corridor wide must be min 900mm wide
- Internal doors must have a minimum clear opening of 800mm
- Short obstructions are allow as long as they don't obstruct the min width to less than 750mm and they are not opposite a door ope.



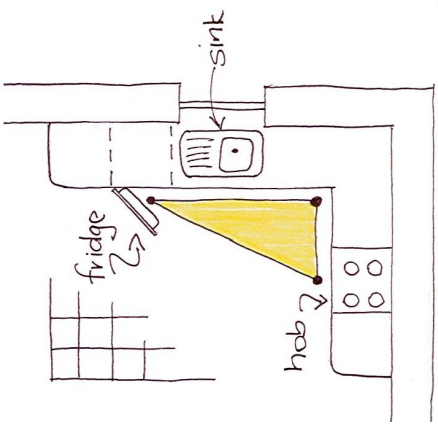


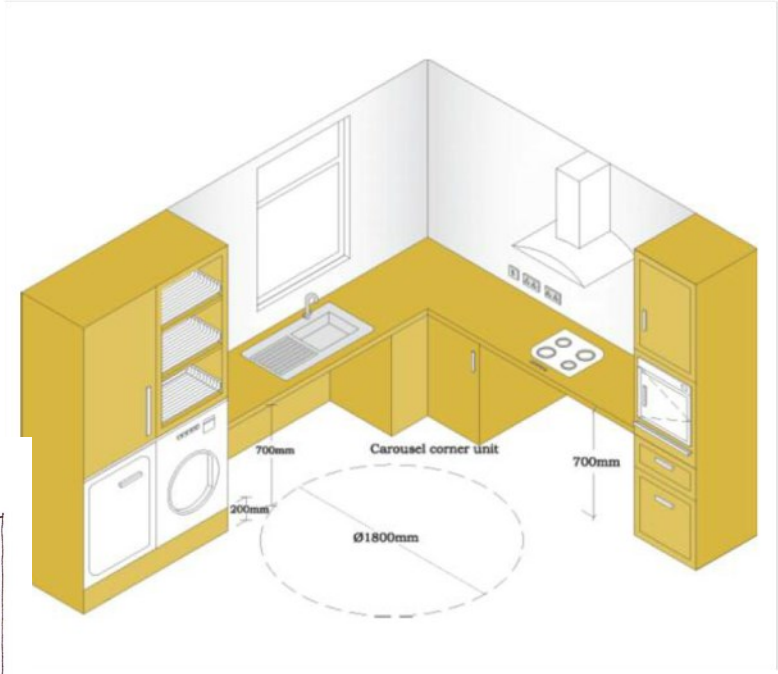
Bathroom

- Non slip floor
- 1500mm turning circle
- Shower tray should be level with the ground to facilitate easy access.
- Show curtain preferable to door, fold down shower seat, vertical and horizontal grab rails
- Sink should have 700mmm clear space underneath sink to allow wheel chair to get under sink
- Toilet to finish 450 above floor, open space beside toilet for easy of transfer from wheel chair. Grab rails.

Kitchen

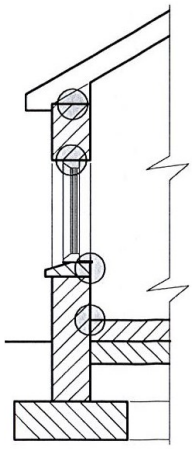
- 1500mm turning circle
- Worktops to be at a height of 800mm
- Space under sink and hob for wheel chair users
- Trianglulation of main appliances (sink, cooker, fridge) small triangle best
- Sockets and light switches 900mm-1200mm
- Non slip floors
- Reduced cill height for window to allow view for wheel chair user





Cold Bridging/Thermal Bridging

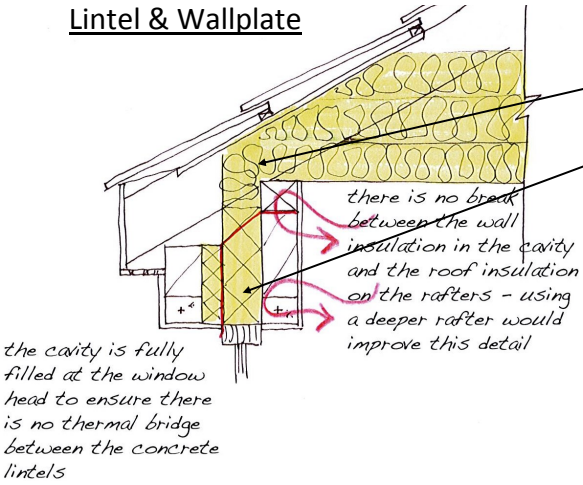
Thermal bridge/cold bridge is a pathway for cold to travel through materials from outside to in



Some areas in a dwelling can be subject to thermal bridging due to poor workmanship. The most common areas for this to occur are :

- Ground floor/Wall junction
- Behind window Cill
- Lintels
- Wallplate

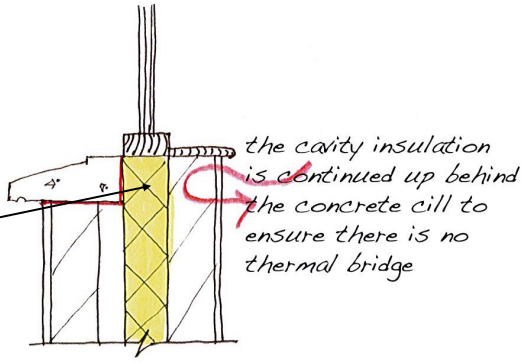
Lintel & Wallplate



Insulation Continues from wall to roof without interruption

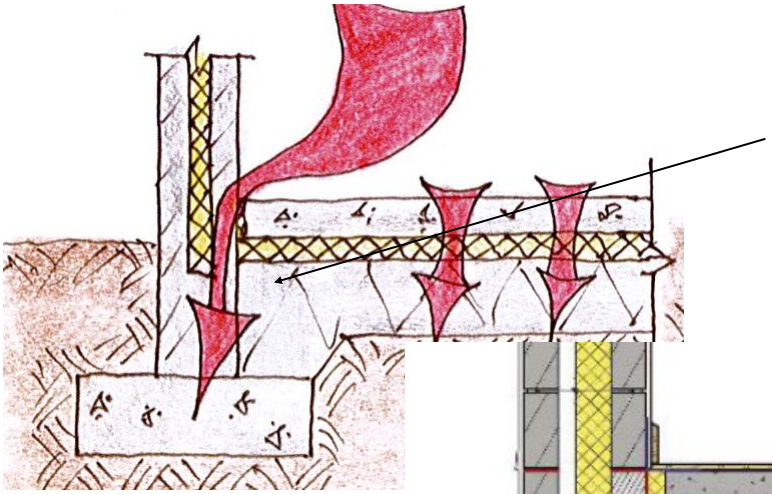
Insulation is placed above window between lintels

Behind Cill

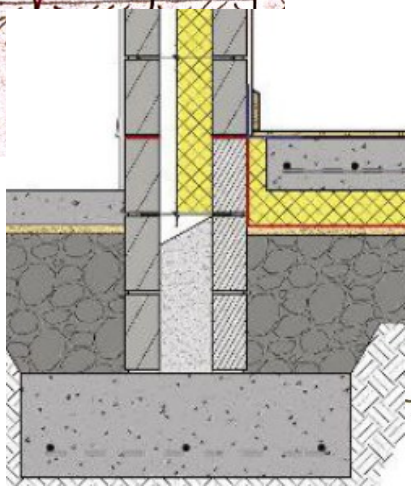


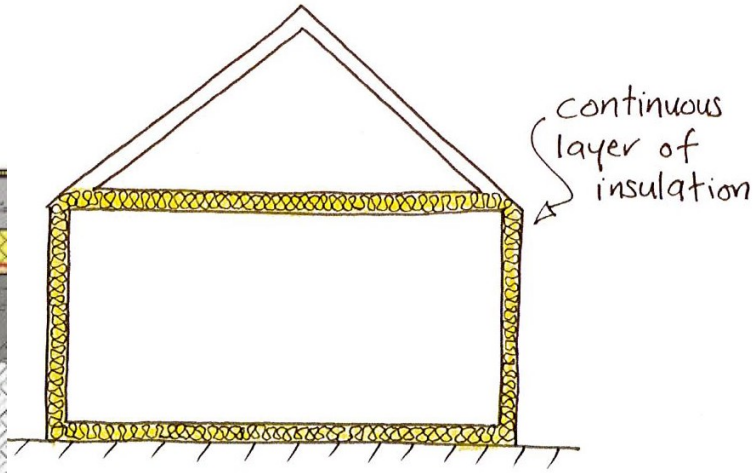
Insulation is placed above behind window cill

Wall Floor Junction



Wall insulation and floor insulation must overlap
Also inner leaf block work from foundation to floor level should be built with an insulation block





Foundations

Functions of a Foundation:

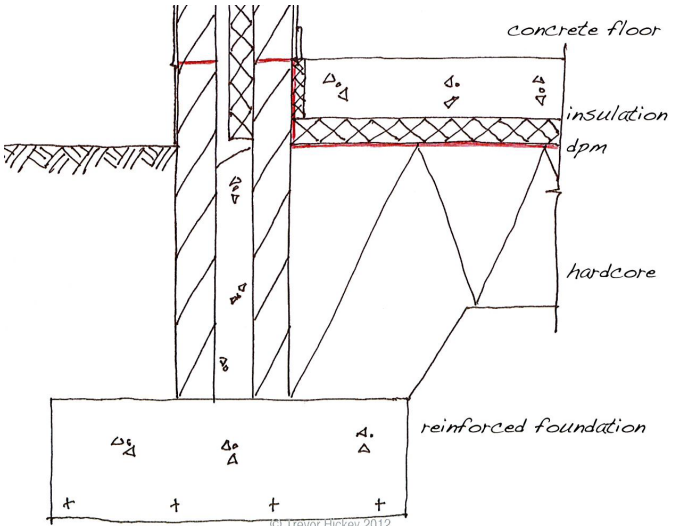
- To support the loads of the building
- The limit uneven settlement
- To provide a level surface to build on
- To anchor the building to the ground

Main types of foundation found in residential construction include:

- Traditional Strip foundation
- Wide strip foundation
- Raft foundation
- Pile foundation

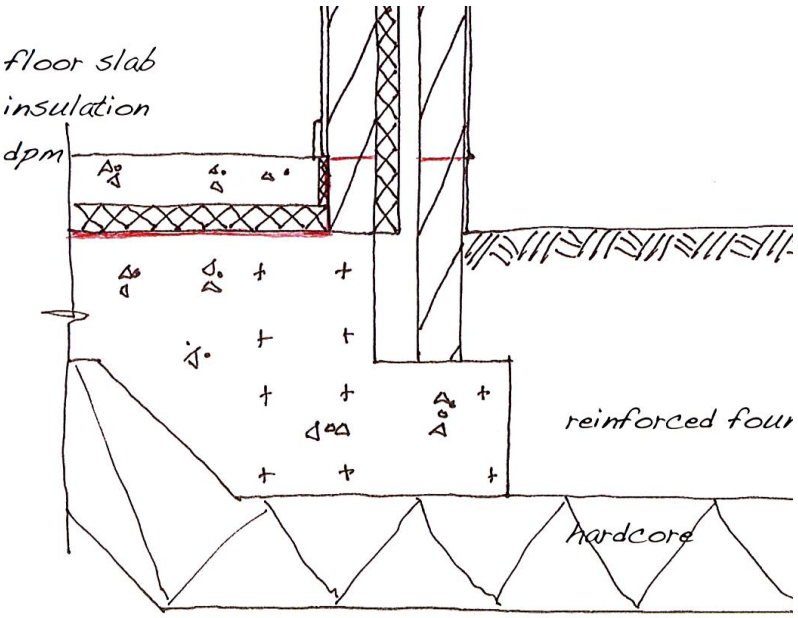
<u>Traditional Strip Foundation</u>

- Most common foundation type
- Used in areas where soil is of average load bearing capacity
- 1050x350mm
- May be stepped on a sloped site



<u>Raft Foundation</u>

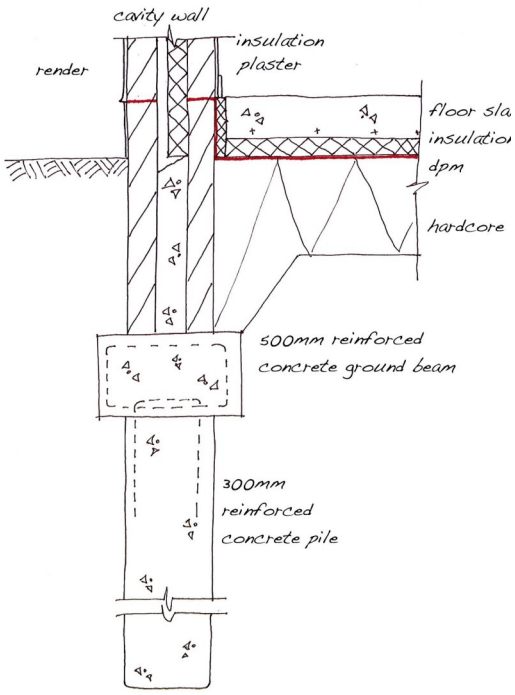
- Concrete slab floats on surface
- Used in areas where soil is of lowload bearing capacity
- 1050x350mm
- May be stepped on a sloped site



Foundations

Pile Foundation

- Consists of a series of piles connected together via a ground beam/strip
- Used in areas where soil is of low load bearing capacity/ made up ground
- Piles by-pass weak soil to a strata of high load bearing capacity
- Ground beam 600 x 350 mm approx



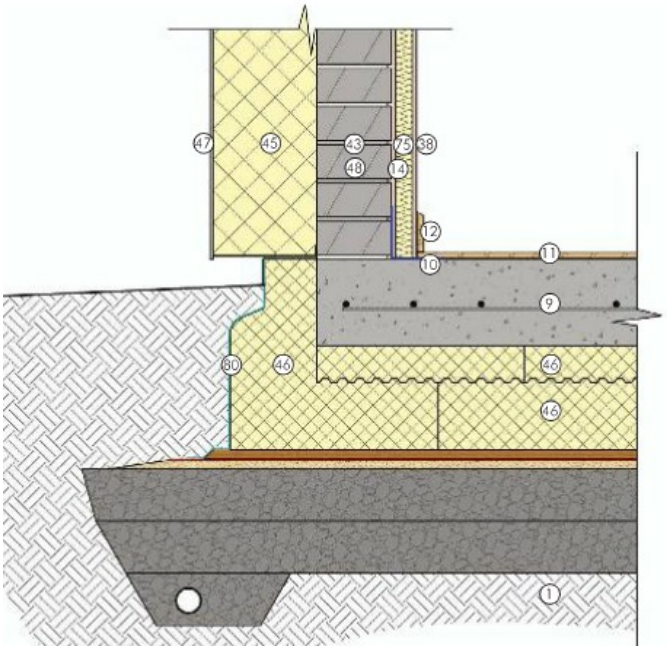
Strength of Concrete

The strength of concrete in a foundation can be affected in the following ways;

- Water:cement ratio—too little water and the hydration process will not fully occur. To much and excess water will evaporate leaving voids.
- Compaction—Concrete must be fully compacted/vibrated to eliminate any air voids. 5% air voids can lead to 30% strength loss
- Reinforcing steel– The addition of steel reinforcement can drastically improve the tensile strength of concrete

Passive house foundations

- 'Wrapped' in high density polystyrene.
- Thermal break between soil and foundation.
- Much smaller foundation can be used
- Reduced environmental impact.

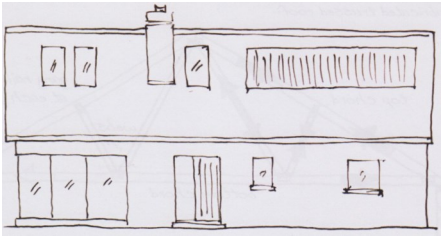


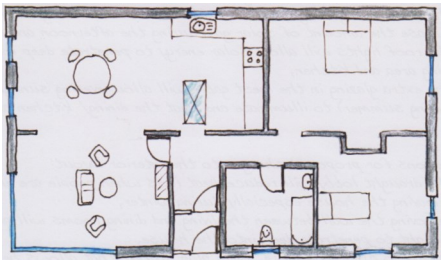
Low Impact House Q.6

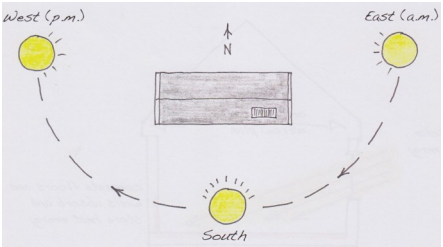
Advantages of a low impact house

- Benefits the home owner
- High levels of insulation
- Good orientation etc
- Reduce the need for energy to heat & light the house.
- Can save the homeowner much money

Design Features







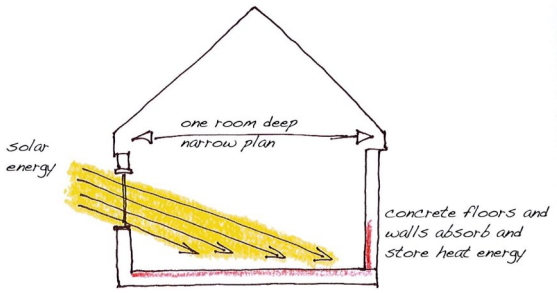
- Large areas of glazing to the south to maximise passive solar gain
- Minimal glazing to the north
- Most used room such as kitchen and living rooms facing south, less used rooms such as bathrooms & bedrooms to north side
- 1 room deep to maximise solar gain
- Human in scale– roof space maximised. Only built what you need reducing materials and embodies energy in building
- Double doors at the front to minimise heat loss
- Open plan to maximise heat transfer throughout house
- Solar panels used to heat water reducing energy consumption
- High levels of insulation in roof, walls & floors. Continuity of insulation
- Roof lights maximise heat and light energy
- Internal fireplace means any heat lost is internal not external
- Rainwater harvesting reduces water consumption
- Triple glazing/ low e coating
- Timber cladding/frame– low embodied energy & carbon neutral

Other key terms

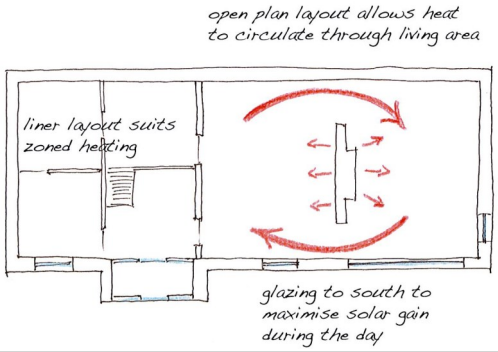
Design for lifetime use—The design should be accessible for a person of all ages and wheelchair user.
Flexibility of design—The layout should be designed in such a way that the rooms can change their function to suit the owner at a later stage i.e. a study changed to an extra bedroom
Orientation—House should be orientated to the south to maximise passive solar gain. Large south facing windows
Materials & labour- Locally sourced. Good for economic and environment
Embodied energy—Amount of energy invested in a material to make it and transport it to site
Form of house—Human in scale. Compact form-minimal external wall surface.
Locally sourced—Good for economic and environment– less fuel used in transportation.
Renewable—Will not run out i.e. Sun wood

Low impact house features

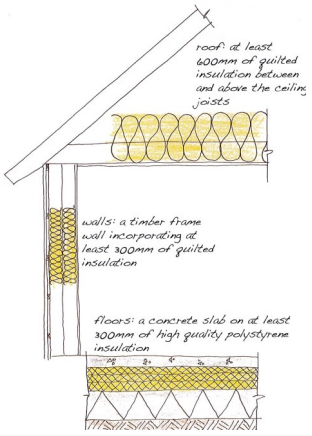
One room deep/solar mass



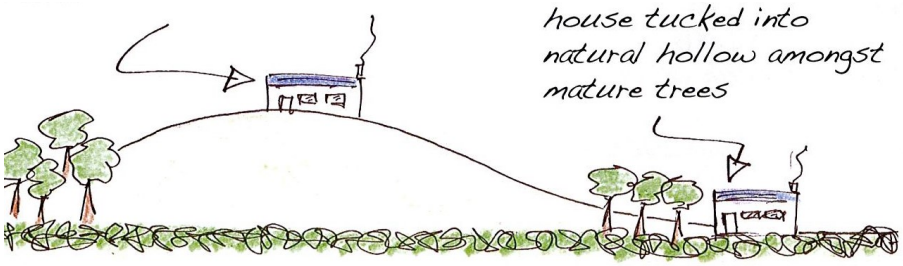
Internal fireplace/open plan



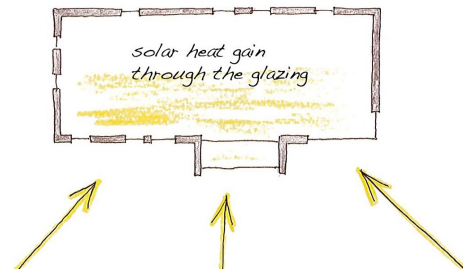
High levels of Insulations



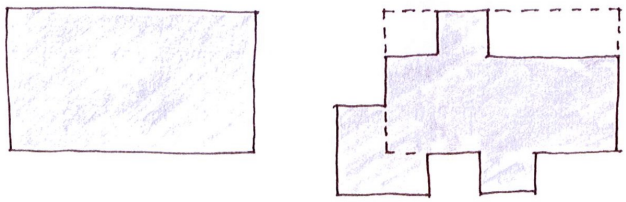
Shelter



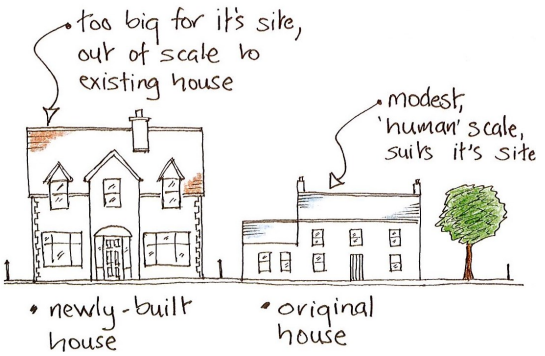
Orientation



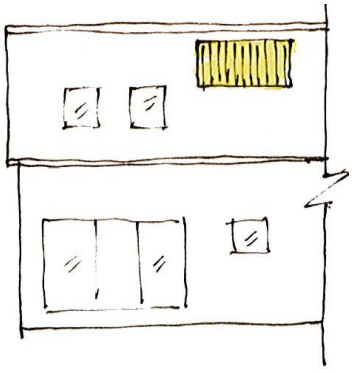
Low external surface area



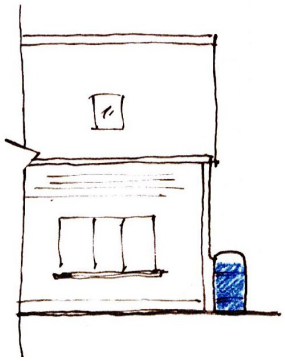
Human in scale/ Only built whats required



Solar Panels



Rain-water harvesting



Passive House

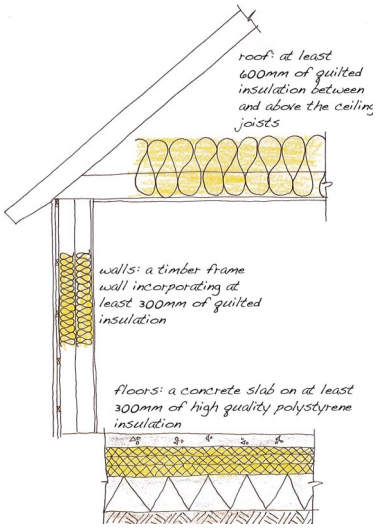
Principles

- High levels of insulation
- Airtight house with no draughts
- Maximum solar energy– for heat & light

Advantages

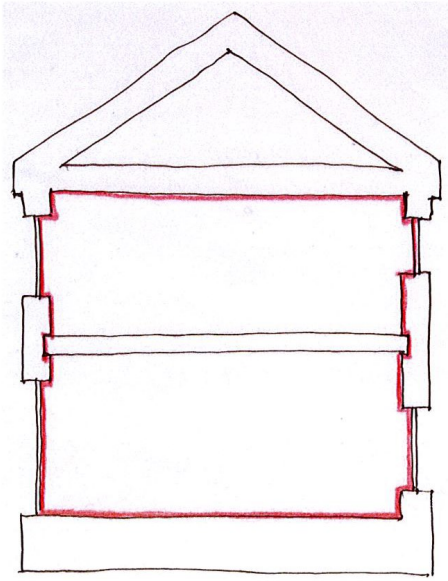
- Cheap to run
- Good for the environment
- Less dependant on fossil fuels
- Comfortable living space

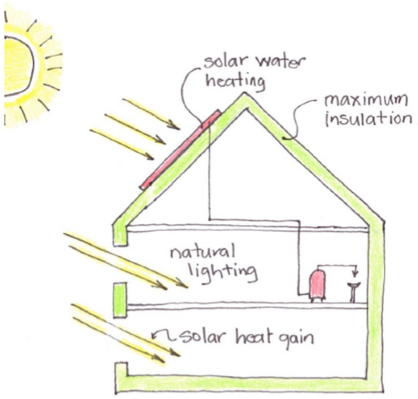
High levels of Insulation



- The house is effectively wrapped in insulation. (300mm approx.)
- Foundations take the form of an insulated concrete slab

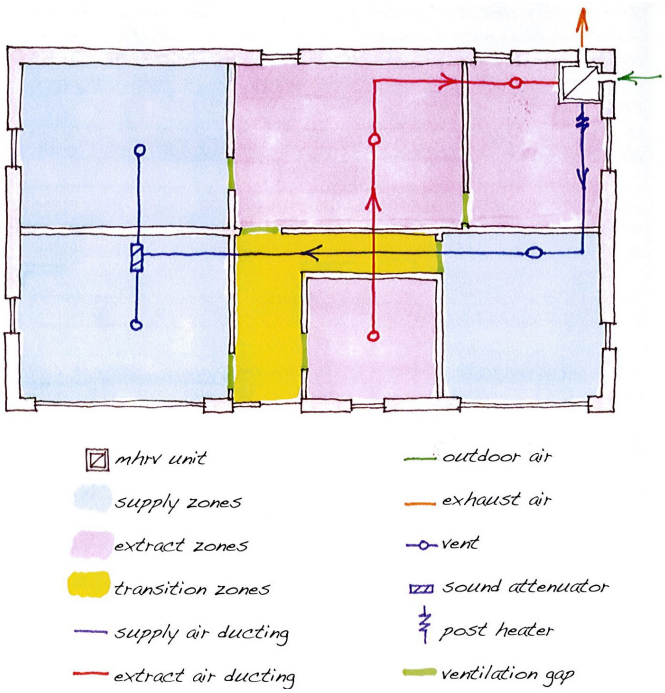
Red line rule for airtightness





Mechanical Heat recovery system

* Fresh clean cool air is taken in from outside
* Warm stale air is taken from kitchen/ bathroom.
* In the MHRV unit, the heat fro the stale air pre-heats the fresh cool air
* This warm fresh air is then pumped into the other rooms in the house.
* Stale cool air exits



Advantages of MHRV system

1. Less energy used: The MHRV is energy efficient– up to 80% of heat energy is recovered from the warm air leaving the house
2. Less CO2 is emitted– Compared to a conventional fossil fuel based central heating system
3. Lower heating bills—beau=cause MHRV is energy efficient it reduces annual heating costs

Passive House Terms

Foundations—must be insulated to avoid thermal bridging. The foundation is wrapped in insulation creating a thermal break between ground and concrete.

Airtight building envelope—The building must be airtight to prevent heat energy loss. High levels of workmanship are required to achieve this. RED LINE RULE. Any breaks in the airtight barrier must be sealed. Sealant tape and flexible sealants help in achieving this barrier. Airtightness is tested with the 'blower door test'.

Shape & form– Simple floor plan which allows for solar gain. Also simple shape to reduce 'surface to volume ratio'. This therefore reduces to amount of external surface area for possible heat loss.

Continuity of insulation—Large amounts of insulation to ensure minimum heat loss. No thermal bridges. No break in insulation between wall/floor/windows/roof.

Reduced thermal/cold bridges– There must be no thermal bridges in order to achieve passive standard. Key areas such as around windows & wall/roof/floor junctions must be carefully constructed. Any minor thermal bridges will have major effects.

Insulated building envelope—High levels of insulation. Building 'wrapped in insulation'. No thermal bridges.

Controlled air changes- passive house is sealed& airtight to prevent air infiltration. MHRV system provides fresh air to rooms. This unit removes stale warm air and uses it to pre heat fresh clean air. 80-90% heat recovered.

Orientation & Shade– Large amounts of glazing facing south (+-30^{o}). Minimum glazing to north. Shading of windows in needed to prevent overheating from high sun in summer. Achieve by large eave overhand/ brise soleil/ deciduous trees

Energy efficient glazing & frame—Tripe glazing with argon filled voids and low-e coating. Timber frames which have been thermally broken.

Thermal mass- Thermal mass describes the ability of a material to absorb and store heat. A concrete floor is the most common form of thermal mass in a typical Passive House. This mass will absorb passive solar heat from sun during the day and slowly release it through the day, helping to keep a constant temperature.

Primary energy demand—This is the total amount of energy consumed for all of the house. This includes space heating, water heating, ventilation and electricity. It also includes all the energy required to gat the energy to the dwelling i.e extraction, conversion, delivery etc

Passive Solar gain—house is heated by solar gain. Orientated within 30^{o} of south for maximum gain. Solar energy is stored in concrete mass and slowly released.

Building form- Should have a compact form with minimal 'surface to volume ratio'. The less surface area the minimum potential for heat loss. Compactness of the building—the larges volume possible in the smallest surface area.

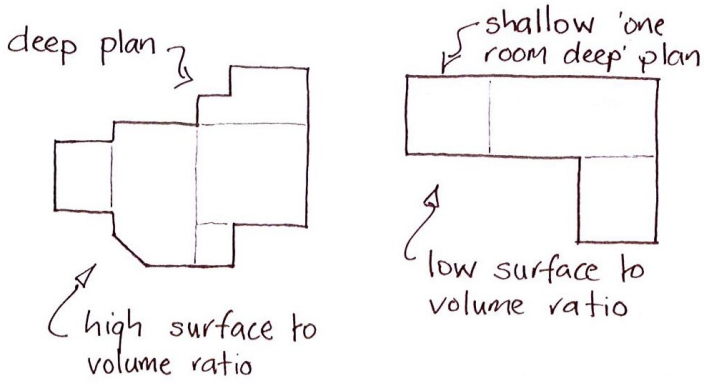
Indoor environment– Comfortable internal environment with constant temperature throughout. Achieved through MHRV . This also provides clean fresh air. Minimal draughts as house is airtight.

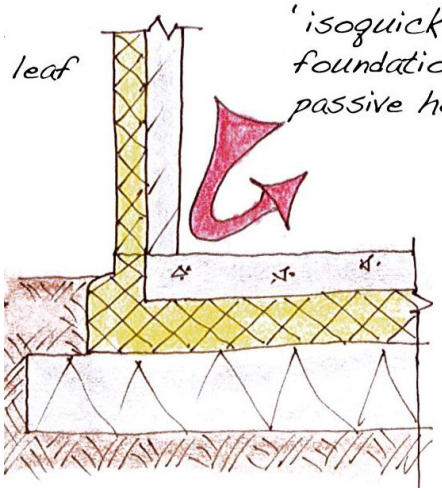
Energy performance- Primary energy demand is one of the key energy performance evaluation criteria that a Passive House must meet for certification. Total primary energy demand must not exceed 120kWh/m2a. A typical passive house, built recently, would have a primary energy demand of between 60 and 70kWh/m2 a

Passive House

Shape & Form

* A passive house should have a simple floor plan that allows the sun to warm the living spaces, ideally one room deep
* The design should be simple in shape & compact i.e. rectangular , to reduce the 'surface to volume ratio' a of the house thereby reducing potential heat loss through the external envelope





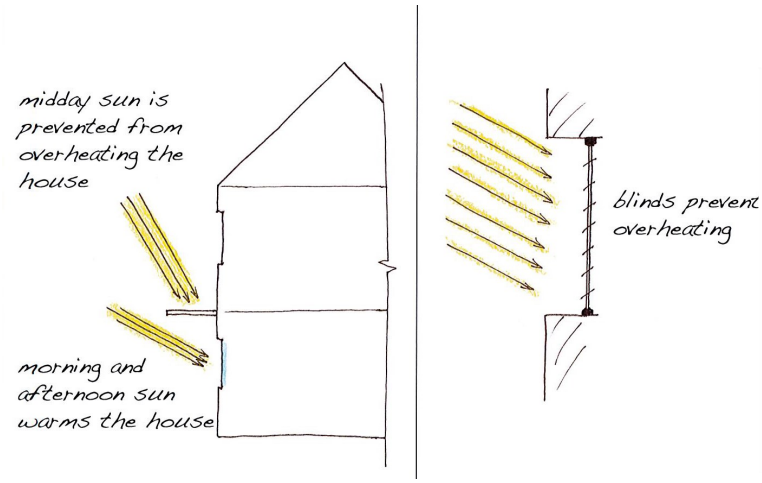
Foundations

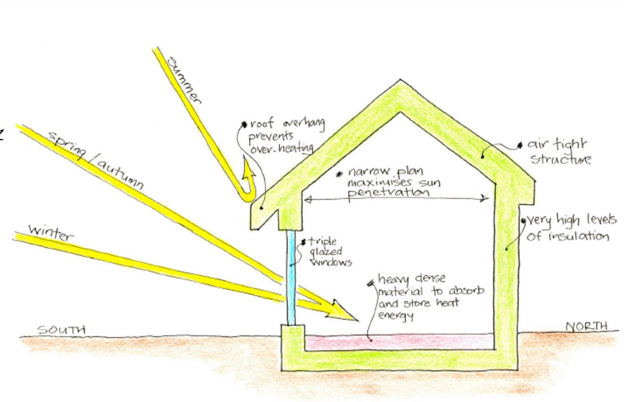
* Foundations are insulated in order to avoid thermal bridging down through the inner leaf of external walls.
* The foundation should be 'wrapped' in high density load bearing polystyrene as shown in diagram.

Overheating

To prevent over heating in summer

* A canopy may be used to block the high sun
* Large roof overhang
* Hardwood/deciduous trees





Roofs

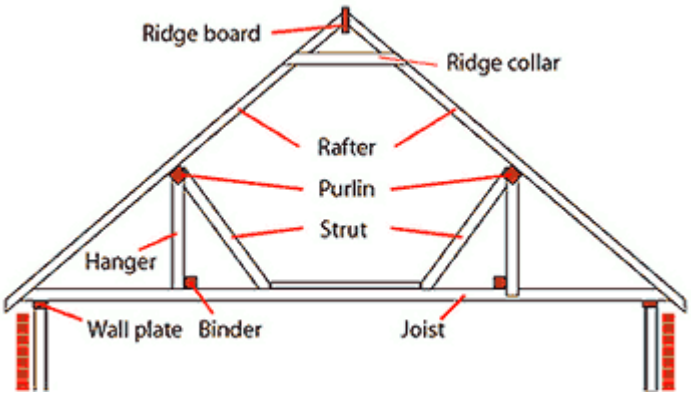
Functions

- Weather resistance
- Aesthetics
- Thermal Insulation
- Strength & Stability

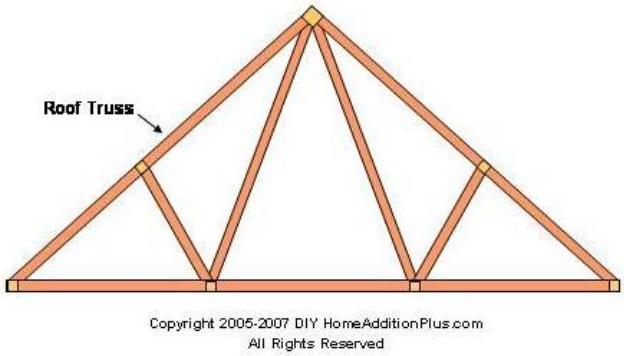
Roof Structures

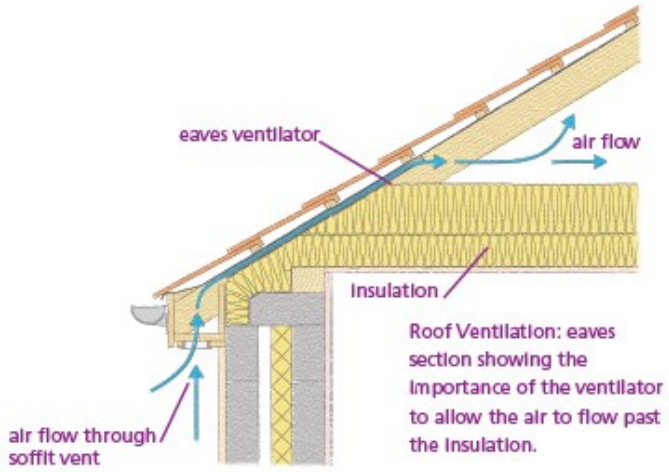
1. Cut roof
2. Truss roof

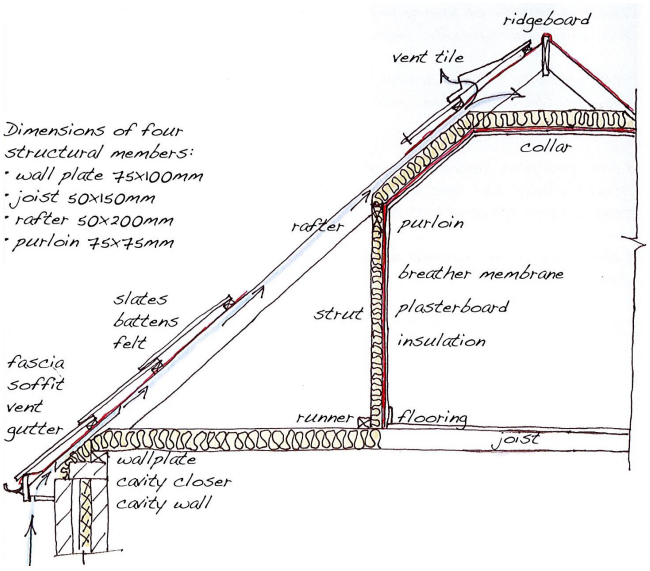
Cut Roof



Truss Roof

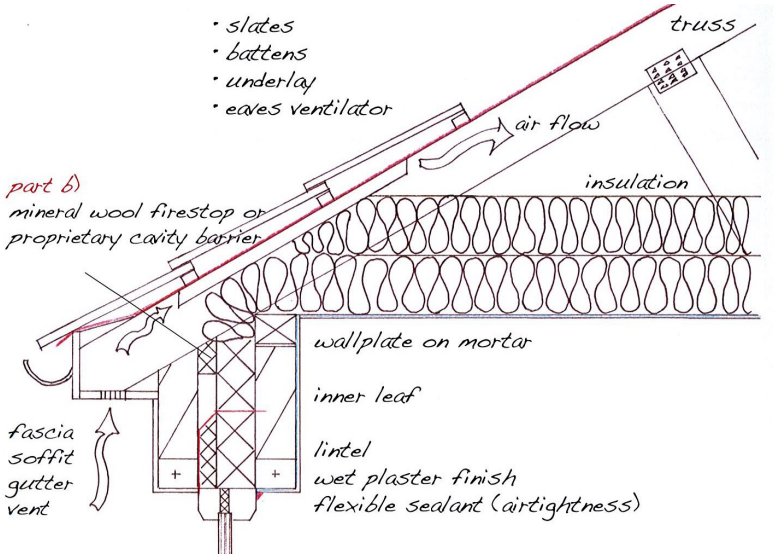






Ventilation is required to roof timbers. This will help get rid of any moisture which may build up in the roof space

EAVES DETAIL

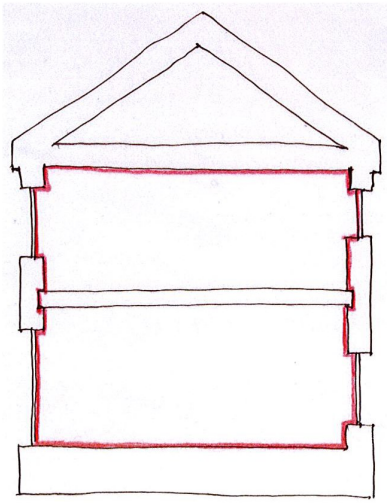


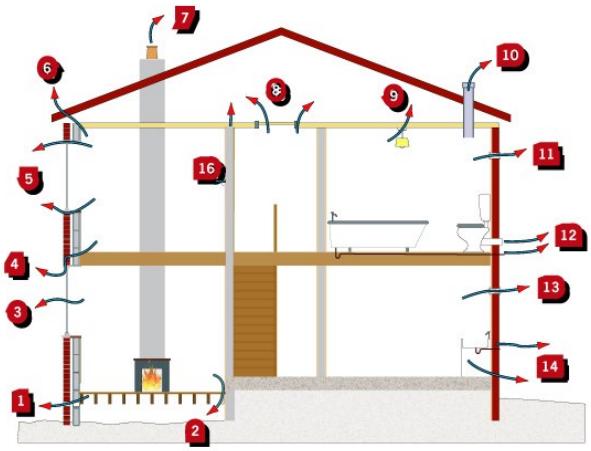
Airtightness

Red line rule for airtightness

Areas where air can escape or cold draughts enter include:

- Wall/ceiling joints
- Around windows
- Wall floor junction
- Attic hatch
- Around pipes
- Air vents in the wall



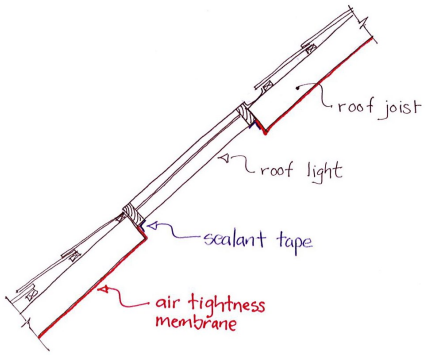


Functions

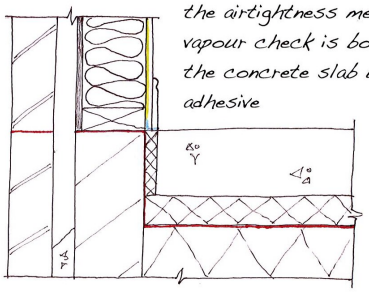
All joints around these key areas must be either sealed with ***airtightness Sealant tape*** or ***flexible sealant***

ADDITIONAL INSULATION DOES NOT IMPROVE AIRTIGHTNESS

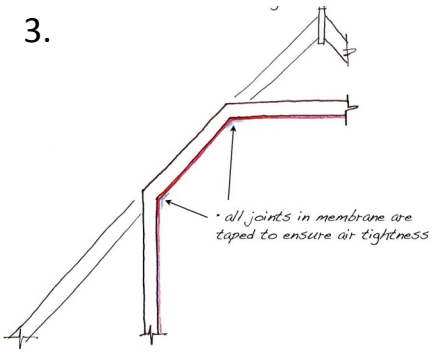
1.



2.



3.



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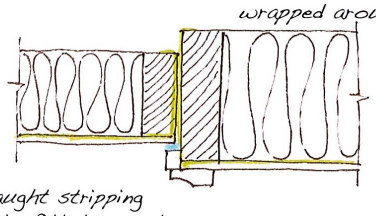
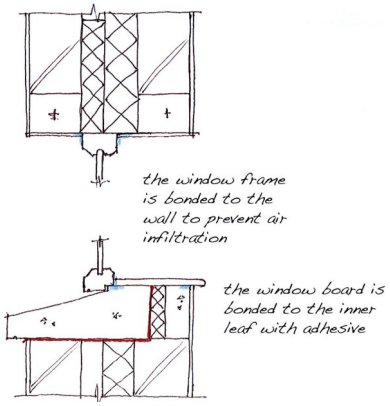


5.

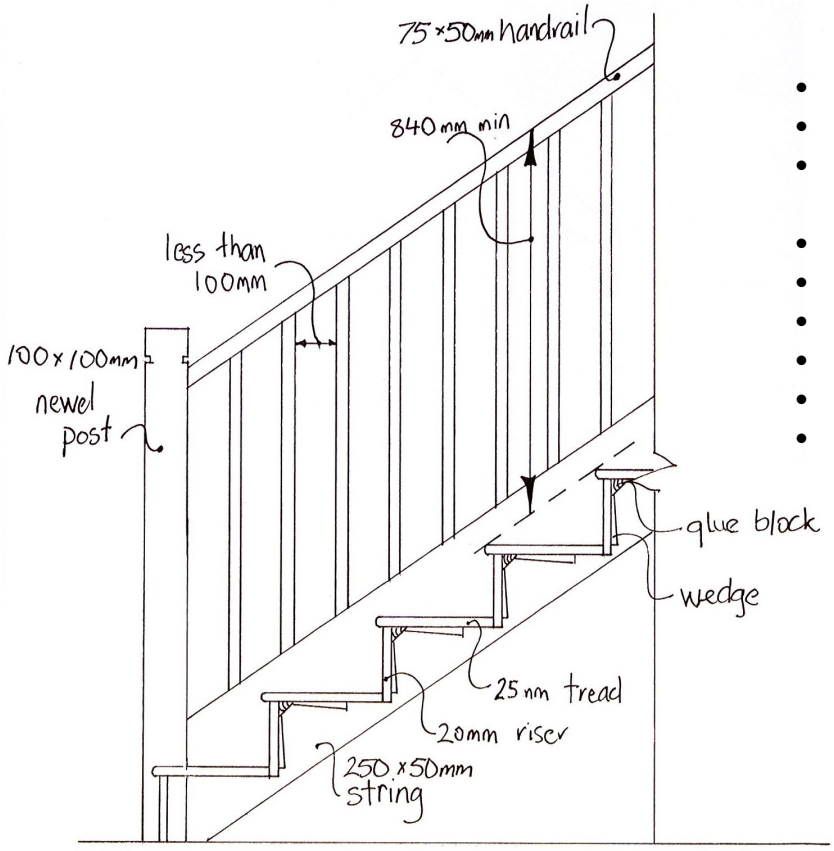


Shade in areas which required sealing in diagrams above

Advantages

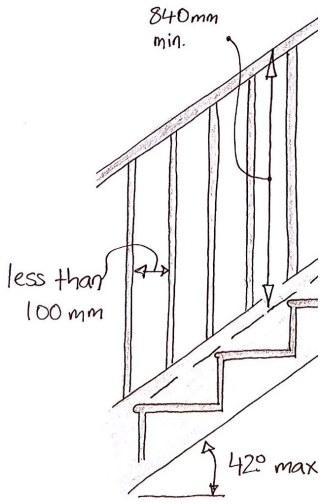
1. It reduces heat loss– this reduces energy required to heat the house thus reduces CO2 emissions
2. It improves thermal comfort—an even temperature is achieved throughout the house
3. It reduces heating costs

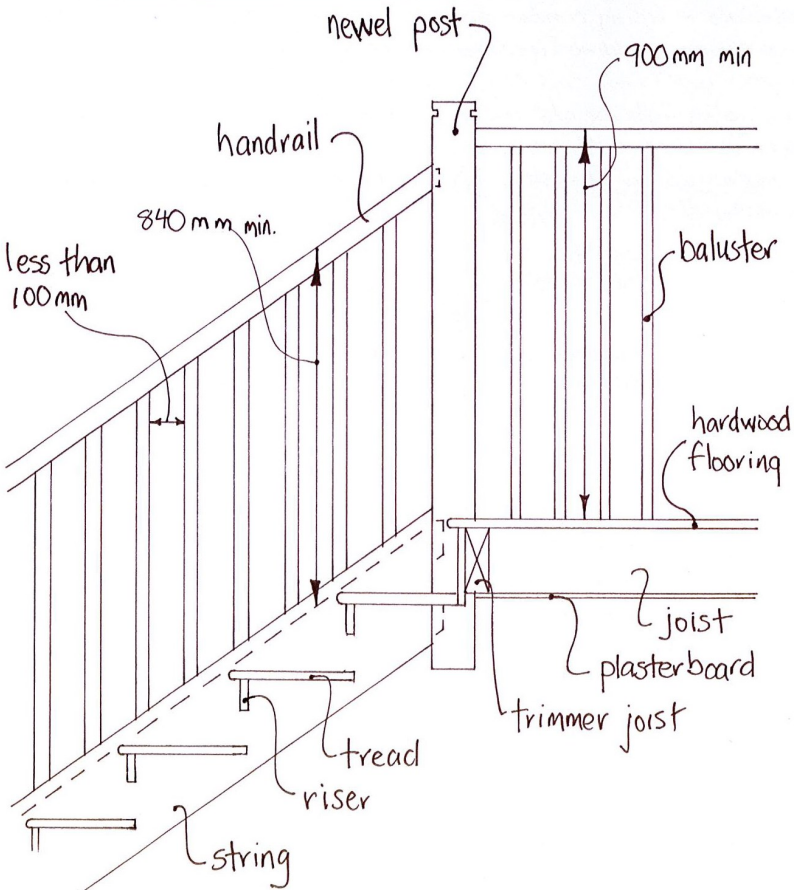
Stairs

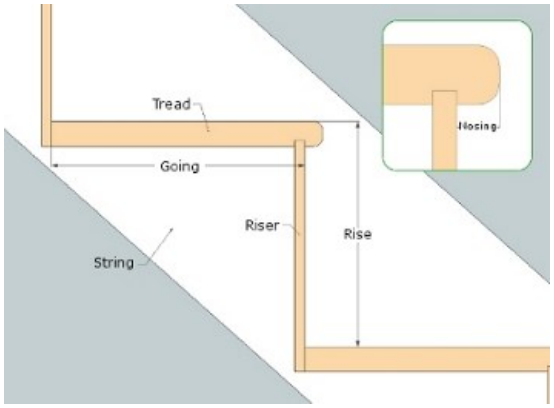


Building regulations

- 2x rise + going = 550-700mm
- Max rise = 220m (175mm optimum)
- Minimum going = 220mm (250mm optimum)
- Max 16 steps without landing
- Nosing 16-25mm
- Maximum pitch 42° optimum 35°
- Handrail 840-900mm above pitch line
- Head room 2m minimum
- Balusters must not allow a 100mm sphere to pass through





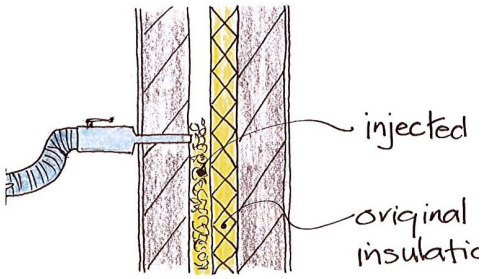


Upgrading Insulation

3 methods:

1. Cavity fill
2. Internal plasterboard
3. Externally fixed Insulation

Cavity Fill



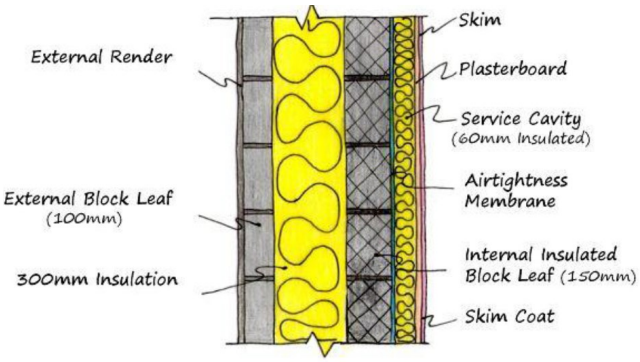
Advantages

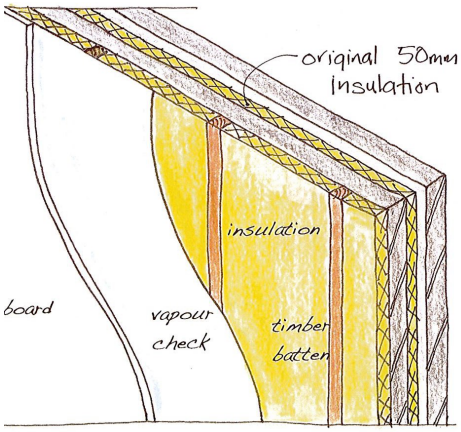
- Minimal impact on household as it is completed from outside
- No loss of room size
- Quick process—usually 1 day
- Relatively cheap compared to other methods

Disadvantages

- Not possible on timber frame
- Leaves patches on exterior where holes where filled.
- Cannot fully tell if any areas have been missed.

Dry lining/ Insulated plasterboard





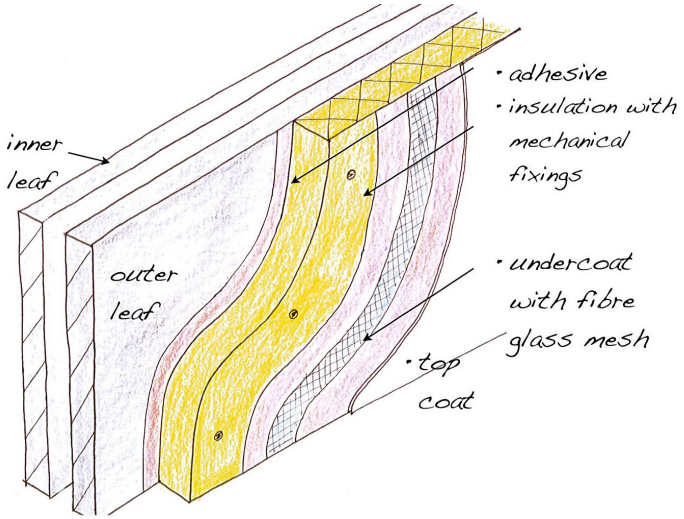
Advantages

- Reduced cold bridges
- Creates new clean surface on inside of room.
- Insulation very close to wall surface meaning room should heat up very quickly
- Specialist equipment not required

Disadvantages

- Reduced room size
- All radiators, rad pipes and sockets etc in room have to be adjusted to suit new wall
- Wet trades required which can add a lot of moisture to building
- Very disruptive if living in the house

External Insulation



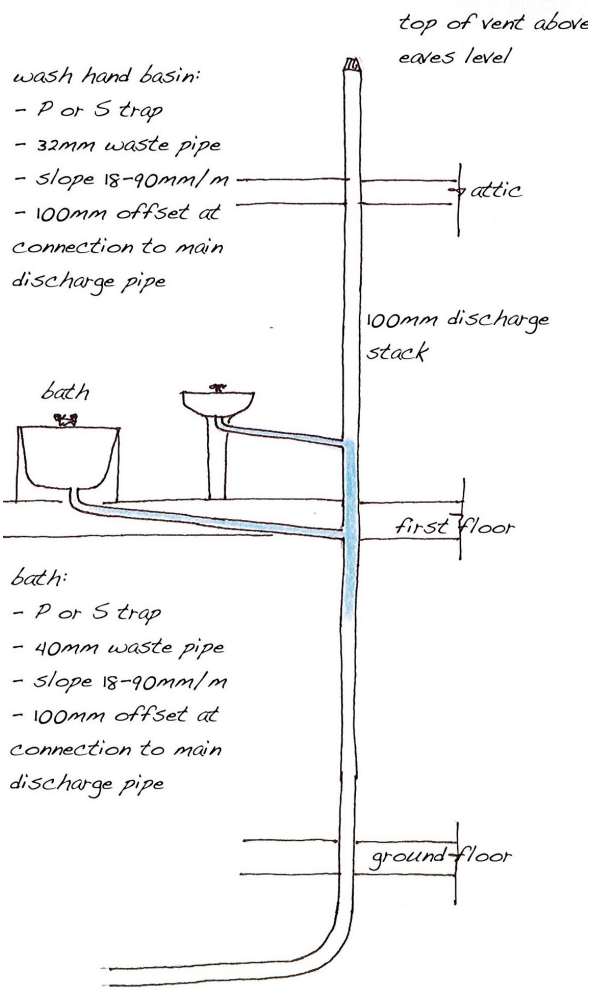
Advantages

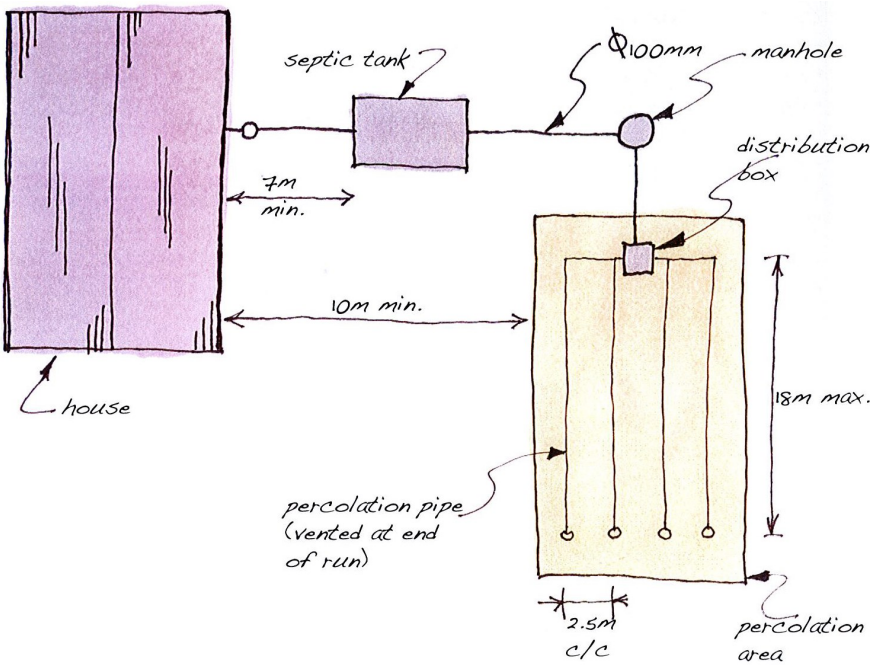
- Minimal impact on household as it is completed from outside
- No loss of room size
- New exterior finish achieved.

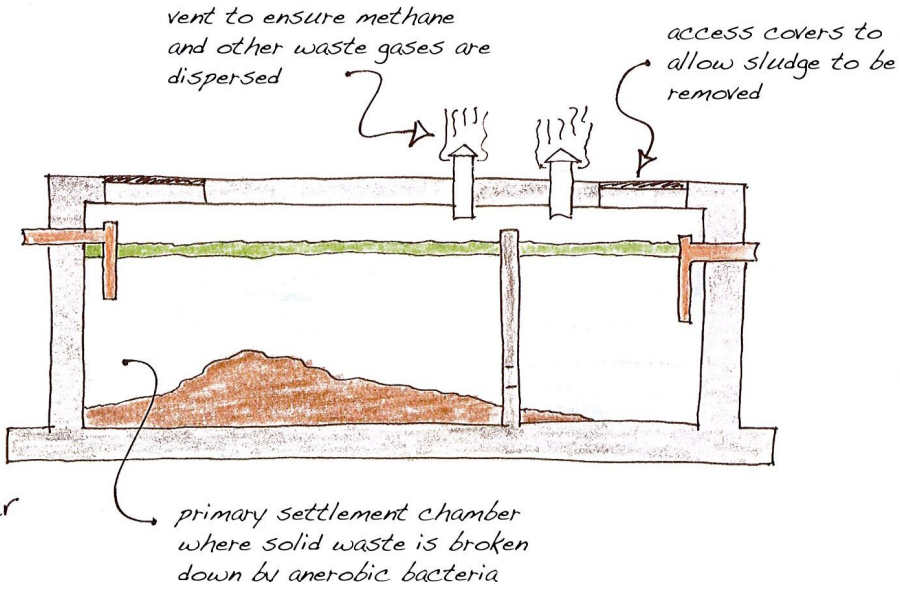
Disadvantages

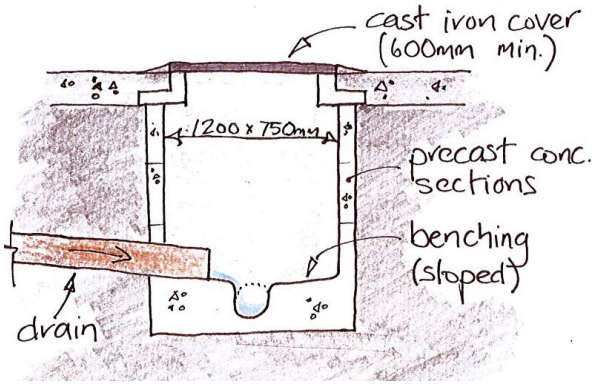
- Roof overhangs may need to be extended
- Whole of concrete wall will be heated before heat reaches insulation
- May reduce light entering house slightly

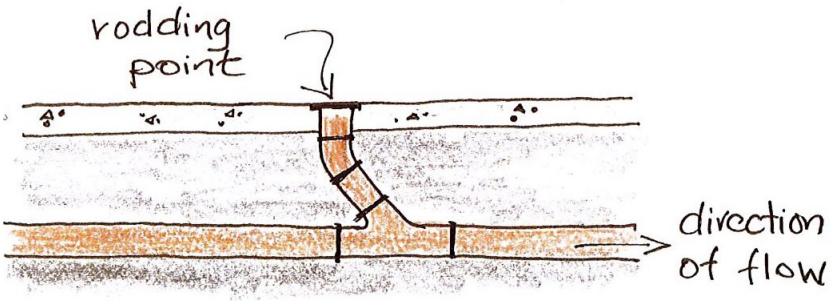
Drainage

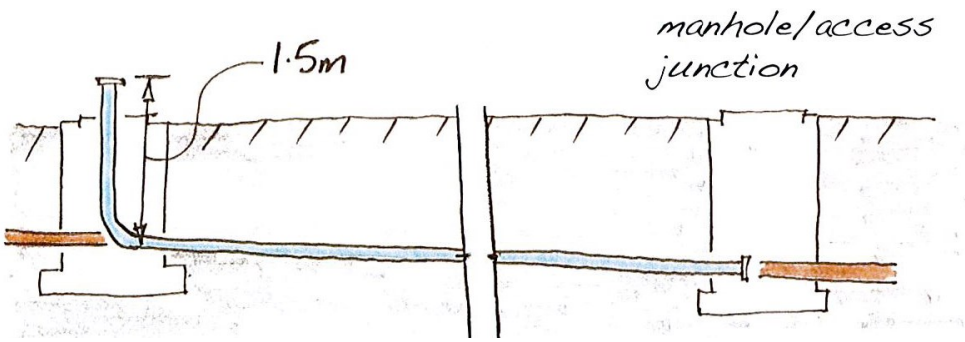

top of vent above eaves level
wash hand basin:
- P or S trap
- 32mm waste pipe
- slope 18-90mm/m
- 100mm offset at connection to main discharge pipe
attic
100mm discharge stack
bath
first floor
bath:
- P or S trap
- 40mm waste pipe
- slope 18-90mm/m
- 100mm offset at connection to main discharge pipe
ground floor


septic tank
Φ100mm
manhole
distribution box
7m min.
10m min.
house
18m max.
percolation pipe (vented at end of run)
2.5m c/c
percolation area


vent to ensure methane and other waste gases are dispersed
access covers to allow sludge to be removed
primary settlement chamber where solid waste is broken down by anerobic bacteria


cast iron cover (600mm min.)
1200 x 750mm
precast conc. sections
benching (sloped)
drain


rodding point
direction of flow


1.5m
manhole/access junction

Windows

Modern Energy efficient window & Frame

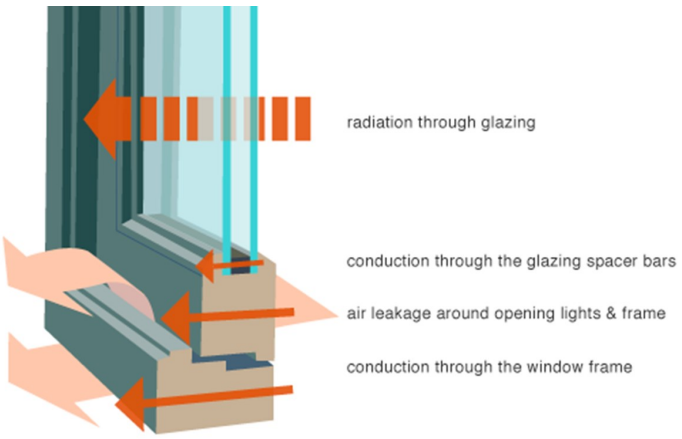
Specification– Frame

- Wooden inside—carbon neutral, renewable, recyclable
- Aluminium cladding– Durable recyclable
- Thermally broken—High resistance to heat loss

Specification—Glazing

- Triple glazed– High thermal resistance
- Low e coating—lets solar heat energy in but not out
- Argon filled spaces– High thermal resistance
- Good seals—High levels of airtightness

Standard window & Frame



Specification– Frame

- uPVC—High embodies energy, not recyclable, Poor thermal Resistance

Specification—Glazing

- Double glazed—average thermal heat resistance

Modern energy efficient window frames and glazing systems will have a much lower u value. They will save the homeowner money in the long term and are better for the environment as their high thermal resistance will result in less fossil fuel required to heat the home