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R e n e w a b l e s & i n s u l a t i o n C o n s u l t a n c y

Renewable Energies and Insulation Report

© Eric Davidson

for

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Dundrum, Dublin

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Objectives

- The most comfortable home
- The lowest heating costs
- A healthy home
- An easy care home
- Future proofed
- Low maintenance
- Best possible use of capital
- Eco Friendly

Realising these objectives
in order of priority:-

1. Insulation
2. Airtightness
3. Thermal Mass
4. Heat recovery ventilation (HRV)
5. Renewables / main heating source
6. Secondary heat source
7. Future proofing

Ground Floor

On top of sub floor use 125mm foil backed polyurethane (Kingspan or equivalent). In living rooms and other areas with no obstructions such as first fix plumbing pipes this is straightforward – 2 layers of Kingspan (75mm + 50mm) or equivalent – stagger all joints.

In bathroom, en-suites, utility and kitchen where there are first fix plumbing pipes use 50mm Kingspan or equivalent under the first fix pipes. Then set 50mm Kingspan around the plumbing pipes. Separate the hot and cold first fix pipes with 75mm insulation. Fill any gaps. This will be level with the top of the insulated pipes. Then use 25mm Kingspan or equivalent over the area without interruptions. Stagger joints where possible.

If installing a ducted vacuum cleaning system the ducts are 50mm also. These should be “hidden” in the first 50mm of insulation.

Floor u value 0.14. Passive standard 0.15.

First Floor – Slabs

Use 50mm Kingspan or equivalent on top of slabs. The floor requires a 75mm depth of 35N concrete.

Screed for UFH

The traditional screen in domestic houses is semi-dry sand cement. This does not give good contact around UFH pipes. A sand / cement / stone (concrete) screed has greater thermal mass. It gives very good contact with UFH pipes and is much less likely to crack. The disadvantages are that it is more difficult to pump and more difficult to lay. The screed pump that every screeder has WILL NOT PUMP CONCRETE! Wheel in the concrete or hire a specialist concrete pump. Avoid power float finish. A very smooth finish is prone to “sweating”. A brush finish is best as this gives a good key for adhesives when laying tiles or wooden floors. The best screed for your circumstances is 35N concrete laid as a wet mix with a brush finish.

A sub contractor who has done concrete screeds successfully:-

Noel Corey, 077 7569 7633

Using a plasticiser such as Sika Viscocrete 1060 improves workability and reduces the amount of water required. This mix causes less splash onto walls – less cleaning. This system will reduce drying time.

Preparation for laying concrete floor is critical. Lay polythene damp proof course. Lay the floor insulation. Using nails with large heads fix 25mm Kingspan insulation around all the walls. The top of this must be set with a laser level so the screeder can lay the concrete to the top of the 25mm Kingspan.

Install a second layer of polythene under the UFH pipes. This should be 500 gauge.

A supplier of Sika Viscocrete 1060 www.curtis-enterprises.com

Using this screed is particularly important to maximise the benefit of the Economy 7 tariff when you install a heat pump and allows the heat to “leak” into the house over a longer period of time.

Foil backed polyurethane insulation boards are available as Kingspan, Quintherm, Xtratherm and Celotex – buy on price.

Co Cork screed installation system

(Consider this as a means of reducing build time.)

This is where a 225mm high row of Quinnlites is built on top of footings and sub floor. The first fix pipes are installed, floor insulation installed, UFH installed for ground floor and the finished screed for ground floor is poured. The reasons for doing this at this stage is UFH pipes will get less abuse during installation of the floor screed and the floor screed is easier to install. The 100mm concrete screed is slow to dry out but with this system the drying out process is started much earlier.

Wall Structure 200mm cavity

The wall structure is 100mm block outer skin, 200mm cavity, 100mm block inner skin. Use 150mm strips of 75mm thick Kingspan as cavity closure at the side of the window and door frames. The Quinnlites are required on the inner skin of the cavity wall and on all internal walls. Use 25mm Kingspan between the side of Quinnlite blocks and floor screed to further reduce cold bridging on all walls at the ground floor.

Teplo Ties

Wall ties for 200mm cavities are more difficult to source. Traditional stainless steel wall ties cause cold bridging across the cavity. Teplo wall ties, which are thermally insulated basalt fibre wall ties from MagmaTech, are excellent. Budget price €1.80 each. As wall ties go these are expensive but I factored this cost into the comparative pricing of insulating systems. www.magmatect.co.uk

Teplo wall tie type 2, 6mm diameter, 325mm long is required for a 200mm cavity.

Cavity Closure at top of walls

Close cavity with a 6mm cement fibre board. 100% closure is important.

Closure between Rafters

Use Kingspan insulation boards to close between rafters to contain Foamlok spray-in foam. The installer can only do the foam insulation properly if these closures are done well. See drawing.



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Insulation of Cavities

Fill the cavity with one of the grey beads products pumped in with glue. The earlier system with white beads and no glue caused a few problems. The white bead was poorer in k value and without glue it tended to settle, leaving gaps under the wall plates. The addition of glue prevents settling and ensures that a house modification later does not have lots of beads flowing all over the place. The beads blown in ensure that it is almost impossible to have gaps.

Beware! The specification is “grey bead with glue”. Some installers are cutting costs by using very little glue (or no glue). Before installation starts tell them that if you drill a hole and the grey bead flows then it will all have to be removed and reinstalled! If there are doubts about installation a thermal imaging camera can be used.

Warm Roof

Install 100mm Kingspan or equivalent on top of the rafters. Install 125mm Foamlok spray-in foam between the rafters. Normally the rafters are 150mm. One possible gripe could be the length of fixings required to go through 100mm insulation and batten - 200mm fixing. Can be done and is being done! Use plasterboard with a foil backing as a vapour barrier.

Foamlok is distributed by :

Econ Insulation, Dublin (003531 4019729)

Installer Lyons Insulation, Greystones, Co. Wicklow - 086 3758 882

U value - 0.13. Passive standard 0.15.

Best fixings Timco Classic Plus 6mm X 200mm Torx drive. One stockist of these screws is Construction Fastners, Dungannon (048 8776 7981)

Using an open cell spray-in foam ensures you are achieving excellent airtightness – it is a system that is “easy to do well”.

Roof Timbers Ventilation

Best practice is to install Glidevale FV Fascia Ventilators on top of the fascia and Fulmetal Rediroll Universal Ridge Roll System under the ridge tiles. This insures excellent ventilation in the cold void between the slates / tiles and the roof insulation. Use 18” wide DPC as an eaves skirt at the guttering.



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Warm Flat Roof

Install 18mm external grade plywood on top of the joists. Lay 100mm Kingspan or equivalent on top of the plywood. Install 150mm Foamlok spray-in foam between the joists. Use plasterboard with a foil backing as a vapour barrier.

Pantry / Larder

A pantry is very useful in a modern well insulated house. It must be very convenient to the working area of the kitchen. A pantry should be cool, dry and dark - therefore there should be no window. Insulate the walls, (which are not external) with 60mm Kingspan and line with Fermacell Wallboard - much more suitable for attaching shelves to than plasterboard. Spray 250mm Foamlok on top of the larder ceiling for insulation and airtightness. Ventilation is required to remove moisture from the larder but this should be a stand alone system - have an extractor fan linked to the light switch. Wire so that the fan runs while the light is on and for a number of minutes after the light has been switched off. Use a switch on door to switch on light. The air supply to the pantry should be via 110mm supply from outside fed under the subfloor - preferably from the north side of the house. Ensure no underfloor heating pipes or first fix pipes run through or under the pantry - it has happened. For most of the items stored in a pantry the normal relative humidity range of 30-60% is acceptable. However root vegetables have a much greater shelf life at relative humidity of 85-95%. Create a cupboard within the pantry for storage of potatoes, carrots etc. The pantry door should have draftproof sealing.

Airtightness

An airtight house is more comfortable and easier to heat.

- Cast concrete is airtight.
- Sand / cement plaster is airtight.
- Blocks and mortar are not airtight.
- Skimming is not airtight.
- Plasterboard and skimming are not airtight.

Polymer sealer (CT1, Tex7, Stixall, Fix All) is suitable for many sealing jobs to help achieve airtightness both now and for the long term. Many builders are planning to use normal mastic type products or silicones - but these will be very tired in 3 to 5 years. You want airtightness, not just for the test, but for the very long term.

Airtightness – Plumber & Electrician

Airtightness needs to be explained to all personnel on the site. The electrician should understand that conduits which go through the airtight envelope should be closed to prevent air flows through the 13



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amp sockets. The plumber needs to know to seal any penetration of the airtightness system. Sealing is achieved with approved airtightness tapes or polymer sealer such as CT1 / Tex7 – a long life is required.

Airtightness under the slab

The joint between the wall and the slab is an air leakage point. Under the slab the unplastered block between the slab and the plasterboard also leaks air. This must be sealed on all exterior walls. Put a “fillet” of polymer sealer in the right angle joint between the wall and the slab. Use a laser level to accurately mark the wall where the plasterboard will be positioned. Paint the wall, with two coats of external masonry paint, from this sealer down to a line where the plasterboard will be installed. Use two different colours to ensure it all gets two coats! Alternatively, if you choose to insulate the roof with Foamlok, the installer will apply spray-in foam on these areas while on site. Use a metal batten system under the slab to create the void. Void required 175mm.

Hollow Cores in Slabs

Most slabs have hollow cores. If the slab runs from exterior wall to exterior wall - no problem. If however the slab terminates within the house (e.g. at a stairwell) then it must be sealed. Insert a brick and seal with mortar. If the opportunity to seal the end of the slabs just after installation is missed then drill a 12mm hole into each hollow core. Use expanding foam to seal.

Airtightness around Windows and Doors

The window installer should completely fill the space between the opening and the frame with expanding foam from the DPC at the outside to the inside. There should be no voids. Later, when the foam has fully cured trim off surplus foam with a sharp knife. Then seal the foam with polymer sealer (CT1, Tex7). Multisolve (a C-Tec product) helps get a good finish.

Attic Airtightness Details - Warm Roof

If there are several roof trusses bolted together in a roof design (e.g. adjacent to Velux windows) extra care is required to achieve airtightness. Immediately after the trusses are installed use an airtightness tape to seal the joint between the trusses starting in the cavity, go underneath the trusses, around the end of the trusses, up the trusses to the ridge, down the trusses, around the end of the trusses and into the cavity. Only use branded airtightness tapes.



Any raw blocks on external walls in the attic e.g. gable walls must be made airtight. Either plaster with sand / cement or apply two coats of exterior masonry paint or spray with foam (best of all).

Plastering behind Cladding on Exterior

The unplastered wall behind the cladding is neither windproof nor waterproof. Sand cement plaster these external walls before cladding.

Airtightness Target

Required standard $10\text{m}^3/\text{hr}/\text{m}^2$

Target for this house $1\text{m}^3/\text{hr}/\text{m}^2$

Why is this important? To achieve the maximum comfort and the minimum running costs.

Recessed Lights

All downlighters should be installed with GU10 bulb holders. Those downlighters which are well used should be fitted with 6W LED lights. These produce much less heat. However, where they are placed in sloping ceilings set an airtight box over the new light fitting. The insulation can now be safely fitted around the airtight box. Thermahood downlighter covers are available from Amazon or www.thermahood.com

Heat Delivery Systems

Over 95% of all new self build homes now have underfloor heating (UFH). Underfloor heating when properly designed gives:

- The most comfortable home.
- The most controllable temperatures – digital thermostats in each zone.
- The most dust free house (less cleaning & more comfortable for those prone to asthma type problems).
- The same comfort level when compared with radiators at a temperature 1.5°C – 2°C higher.
- A concentration of heat near the floor – where we live, whereas with radiators the heat has to build from the ceiling down.
- Greater flexibility when furnishing and decorating the rooms.
- Maximum safety – no radiators to cause physical injury or burns.
- Capital cost of UFH now is similar to radiators.
- Running cost of UFH, properly done, is less than radiators.

UFH should be designed to run with a maximum water temperature of 35°C as this gives the most comfortable underfloor heating and the most efficient temperature at which to run the heat pump. Floors are only gently warm.

The best way to achieve this is:



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- 100mm space between the pipes in areas with lots of glass, bathroom, en-suites, vaulted areas, hallway and all high demand areas.
- 150mm space between the pipes in all other normal heat demand areas.
- UFH pipes should be at 16-17mm diameter.
- pipes should be laid in "spiral" layout and not in "snake" pattern.
- The maximum length of one UFH loop should be 120m.
- UFH should always be installed to this standard, so that if a heat pump is not installed now, that option is available in the future.

Floor coverings and UFH

Tiles or stone will give the quickest response but a range of coverings gives acceptable response times. A carpet with specialised UFH underlay is a possibility. Click flooring is widely used. Natural wood can be used provided the wood is properly dried and not more than 22mm thick. When installing natural wood or laminated flooring these should be glued directly to the screed.

Dataterm

Use one Dataterm thermostat / controller for ground floor and one on first floor. These are intelligent controllers which learn how long your heating system requires to heat your house in the prevailing weather conditions to the temperature you require. You determine what temperature you require at a particular time. Dataterm checks the temperature and works out how long it needs to heat your house and starts at the time necessary to fulfil your requirements. A thermostat in every room is not required!

Ventilation

The house must have trickle vents or mechanical ventilation.

Trickle vents

- Are unsightly and noisy.
- Do not ventilate in calm conditions.
- Lose a lot of heat in windy conditions – even when fully closed.

Mechanical ventilation

- Should have a heat exchanger and an approved EU7 pollen filter.
- Can recover approximately 80% of the heat from the ventilated air.
- Can recover heat from all areas except the cooker canopy (due to fat).



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- Should have an automatic summer bypass facility – very important in Ireland where we can have four seasons in one day.
- Should not cause any noise or “cross talk”.

A heat recovery ventilation system should operate at 150 pascals (very low pressure). Otherwise there is a loss of comfort and a possibility of noise. To avoid this and to ventilate the home requires fitting by experienced, professional fitters. Do not buy a kit for a learner to install. Buy an installed system. Ensure the units are the latest most efficient EC version.

Two suppliers / installers -

Beam www.beamcentralsystems.com (028 7963 2424)

Homecare Villavent www.homecaresystems.biz (028 8776 9111)

Ventilation Openings

The heat recovery ventilation system requires a fresh air in-duct and a stale air out-duct. These are normally in a specialised slate, gable wall or via the soffit. The only other ventilation openings are for the kitchen extractor fan and the larder extractor fan.

Cooker Hoods

Cooker hood extractors can be noisy. This can be reduced by having the fan and motor outside thus separating where the cook is working and the noise of the fan and motor. Separate the cooker and the fan by at least 3m. Required - some flexible duct and 150mm an external fan capacity 550m³/hr from fastlec.co.uk. The system will also require a non return valve such as Domus 694 connector for 150mm duct with non-return valve to stop back draughts also available from Fastlec.

Glass / Windows

The best performance available in double glazing is 1.1 u value centre pane. The new argon triple glazed system has a U value 0.6. The glazing units are 44mm thick. The glass is critical as it is 10% of the house. Window frames are what you want to pay for and wish to look at.

Key requirements u value of glass centre pane 0.6 or less.

typical u value of glass and frame 0.85

2 x 18-20mm argon gaps between panes.

Send through quotations and specification for comparison.

Ignore the “A Class” ratings the window guys wish to quote - much too vague. Rationel is very good.

Roof Windows

These should be triple glazed - with deep profiles.



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Primary Heating System

If this house is insulated and made airtight as per this Reinco Report the energy demand to provide all hot water and space heating is 5.4Kw. However, the execution of the insulation and airtight details are critical.

Heat Pumps

Heat pump considerations:

- Higher capital.
- Lower running cost.
- Heat pumps require off peak electricity.

Budget price guides

Ground Source Heat Pump - GSHP

6kW Panasonic Air Source Heat Pump €6,000 inc vat

500L specialised cylinder €1,200 plus vat

Comparative Running Costs (before oil price crashed)

Oil 100%

Air Source HP 50%

BUT key issue is that heat demand is dramatically reduced.

Balanced Flue Gas Stove

This is the ultimate easy care solution to having a focal point in living rooms without the extra work and cleaning of using solid fuels. The stove is sealed. The flue goes out through the wall just above the stove. Keep kilowatts down - the rooms are already heated. Consider having a stove with remote control as the controls on some stove are not very convenient. These are available as traditional stoves or contemporary.

Heat pump & UFH Supplier / Installer

Installers of heat pumps, underfloor heating systems and supplier of Dataterm Controllers :-

Eric Norton, NHS, (086 226 5465). The very efficient heating and water system in Westmeath was supplied and installed by Eric Norton.

Bathroom Management

After using the shower the bathroom door should be closed to prevent warm moist air spreading into other areas. The closed door encourages the ventilation system to draw air in under the door and thus extract the moist air via the mechanical ventilation heat recovery system. Consider putting a self closure on the bathroom.



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Shower

Very high volume showers (18-20L) require a lot more water to be heated. Removing vast amounts of steam may overload the ventilation system. Consider using a moderate volume shower (8-12L), which draws in air to bulk the water volume (Camel). This gives the effect of a great water flow but saves on water use and water heating. Medium flows with added air gives a pleasant experience for sensible heating costs.

An open plan wet room allows water to spread onto flat floor areas which do not drain readily. It takes many hours for this water to evaporate. Glass enclosures around the actual shower contain the water so that it drains down the plughole.

Hot Press

For heating this depends entirely on the UFH system. However, with this standard of build there will be months when the UFH is rarely on. Ask the plumber to install a large towel rail or radiator in the hot press. Plumb this so that it heats when the cylinder is being heated. The domestic hot water cylinder can be installed in any central location which is structurally adequate.

Laundry Maid

Install a laundry maid in the utility. The HRV system is extracting from the utility room thus it is safe to dry clothes there.

Health Matters

Good mechanical ventilation heat recovery systems make substantial improvements to the health of occupants who suffer from asthma or hay fever. The two other elements of the new home which can reduce challenges to persons with breathing problems are:

- Low temperature underfloor heating
- Ducted vacuum system.

The major advantage of a ducted vacuum system is that it exhausts to the outside. Buying the HRV and ducted vacuum system from same supplier will save money.

General plumbing

The main plumbing system should be pressurised. This gives good water flow on all appliances upstairs and downstairs. It also gives you the widest range of possible appliances to choose from when buying for your new home. There should be no electric showers as any means of providing warm water is more cost effective than direct use of electricity.



Condenser Tumble Dryer

If installing a tumbler dryer the condenser type suits an airtight house much better as no vent to the outside is required. The water collected is stored in a drawer which is emptied occasionally.

Towel Rails

Allowing a plumbed-in towel rail to "call" for heat, when the primary heating system is not otherwise required, increases running costs. Install electric towel rails and use time clocks to activate. For safety reasons electric towel rails must not be positioned within reach of someone in the bath.

Future Proofing

Determine bed positions and exact bed widths. Consider installing two double sockets at each side of every bed and a CAT6 outlet. Low energy lighting is now in the third generation. LED lights at an input of 6 watt are excellent. The GU10 fittings used by LED bulbs is now an industry standard. LED string lighting is excellent for illuminating inside cupboards and under kitchen cupboards. It is inexpensive to buy and very low cost to run. Get a specialist TV man involved. Bring all TV aerial cables to the "plant room" and install CAT 6 and TV cables to all rooms. There is one opportunity to get this right. When considering a centre light for main living areas choose E14 screw-in fittings. Current low energy bulbs for centre lights are ugly but new low energy lights in the future are expected to be E14. Any door into a storage area where light is required should have a light switch button on the door. Consider a PIR activator on external lights at front and back doors. An external waterproof 13amp socket is very convenient. Any exterior taps should have an isolation valve inside to help protect from frost.

Waste Pipes in Cavities

With wide cavities there is an opportunity to hide unsightly waste pipes. The pipes should be next to the exterior leaf. To improve the insulation opposite a 110mm vertical waste pipe fix 200mm wide X 100mm thick Kingspan type insulation board against the inner wall to correct the insulation value at this point.

Cookers

Induction hobs which are now excellent.

Passive Sills

The last big cold bridge in today's houses is caused by the window sitting on a cold concrete sill. Now an excellent solution - a Passive Sill. These are manufactured from high density expanded



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polystyrene and coated with a polymer resin. Excellent solution to a major problem. www.passivesills.com

Satellite Dish / TV Aerials

Get the electrician to run the Cat6 cables and then have the specialist install the sockets and cable ends.

Avoid Pain

The industries involving renewables (including underfloor heating) and heat recovery ventilation are still in their infancy in Ireland. This is where the problems arise. Do not do these on a least cost basis. The client should specify equipment and installer in these areas.

Render System ??

Water supply

Your house should have its own water supply for future proofing reasons. At the tapping upgrade to 32mm pipe.

PC Sums

If appointing a contractor and the following items are to be included in a contract then specify them as PC sums:

- Windows and external doors
- Underfloor heating
- Heat pump
- Cylinder
- Heating controls
- Any other Renewables
- Heat Recovery Ventilation

If these items are purchased on price you will be sorely disappointed! The client purchases these items and pays for them directly. The contractor should still get his 2.5% commission on these items as he is responsible for co-ordinating the installation of all.

I do not take commissions from any company or individual. When I suggest or recommend a company I do so because I have found their service or equipment fully satisfactory in the past. This report is copyright Eric Davidson. The advice and recommendations are specifically for this project and this set of circumstances.

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