SMART ECO HUB SUSTAINABLE BUILDING GUIDE

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Smart ECO Hub
innovating for a sustainable future

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NEARLY ZERO BUILDINGS

Smart ECO Hub
innovating for a sustainable future

Foreword

Louth County Council has been the Lead Council Partner in the Smart ECO Hub Partnership since the project commenced in August 2012. The programme is funded by Interreg IVA and the Council has been a key stakeholder since the development of the original funding proposal.

The Smart ECO Hub initiative has demonstrated the benefits of collaborations between local authorities. Over the last 3 years the Smart ECO Hub has grown the energy cluster to include over 100 member companies. We are delighted to work with Smart ECO Hub members who are in the process of making funding applications valued at more than €30m. Those efforts are recognised by both Invest NI and Enterprise Ireland. It is estimated the global renewable energy market will be worth in excess of €500bn by end of 2015. Smart ECO Hub members are directly supporting the creation of over 100 jobs and it is forecast this sector has the ability to create in excess of 10,000 jobs in Ireland.

This Sustainable Building Guide was developed by member companies of the Nearly Zero Energy Buildings Group (NZEB). NZEB is a building standard that all EU member states will have to comply with over the next several years. With fuel prices certain to continue rising into the future it makes both financial and environmental sense to embrace these changes if undertaking a new build or a substantial renovation.

Several of the Smart ECO Hub member companies operate in the construction sector so we have invited them to contribute their expertise in outlining key factors to be considered when planning the fabric of your build.

A booklet of this size can't answer all the questions but it should help you to be better informed so you know the key aspects you need to discuss with your contractors and suppliers so you can achieve an energy efficient, cost effective and sustainable build.

Well done to all the members that have contributed, and through on-going collaboration, we will continue to grow and innovate.

Joan Martin - Chief Executive, Louth County Council - Smart ECO Hub Managing Authority.

OPENING OVERVIEW

According to various Government statistics in the two regions, buildings in the United Kingdom and in the Republic of Ireland account for over 40% of all energy consumption and CO2 emissions, with dwellings representing around 25% of overall figures in each case.

While this situation appears to indicate a reduction in percentage terms over the past couple of decades, thanks to concerted efforts via legislation and information, funding and advice throughout both regions, the absolute figures are still too high – especially in the increasing area of domestic electrical equipment consumption.

Recent technical uplifts in minimum legal requirements, as implemented through the building regulations, have been driven largely by EU legislation, namely the Energy Performance of Buildings Directive of 2006 and the more recent EPBD Recast. The Recast EPBD makes specific reference to NZEBs – Nearly Zero Energy Buildings – with a requirement for all member states to achieve this standard for all new public buildings by the end of 2018 and for all other new buildings by the end of 2020. Though it has been left to the individual member states to decide the precise definition of NZEB, there is no doubt that it will represent a significant improvement on current standards. These horizons are now fast approaching - this is the time to be grasping the NZEB nettle and future-proofing our new buildings against further legislation, higher energy costs and possibly greater unreliability of energy supplies.

Key to the concept of NZEB is a "fabric first" approach, whereby the envelope of the building should be designed to reduce energy requirements as far as possible, before looking at the most efficient and sustainable means of providing that energy. Of course, while legislation tends to apply only to new buildings, existing ones are on average not only much less efficient than new ones but represent a far greater proportion of the overall building stock.

Therefore different performance targets, as well as specific products and practices, will apply to existing buildings, especially older and historic ones, as compared to new buildings. Furthermore, concern for wider sustainability issues leads us to consider more natural materials, which also have potential benefits in terms of healthier indoor environments, as well as the matter of water usage and treatment, which is a huge "hidden" energy and sustainability problem.

> "building should be designed to reduce energy requirements"

The Smart Eco Hub NZEB Cluster represents a number of companies involved in building design, either as designers/specifiers or system/component manufacturers/suppliers. Although this Product Guide addresses all of the above issues, it represents the members of the Cluster and is thus not intended to be a comprehensive treatment of the subject of sustainability - which can mean many different things to many people.

The Guide is structured to follow a fabric first approach, starting with design issues, moving through insulation, building systems, glazing and ventilation/airtightness, before addressing water usage and waste water practices. The Directory at the end of the publication carries profiles and contact details of the companies who have contributed to this Guide.

Dr. Patrick Waterfield

Delivering Low Energy Buildings for Real:

The need for joined up thinking, for joined up Building!

– Niall Crosson, Ecological Building Systems

This Guide is a unique publication which combines professional guidance from a range of suppliers and industry experts, which, when combined together, can deliver a low energy building.

A variety of systems are presented ranging from ventilation systems to a range of insulation, airtightness, windows and water treatment systems. In order to ensure these systems perform to their optimum efficiency & to minimise unforeseen additional costs in the construction process; it is essential that each of these systems are installed by adequately trained personnel. Moreover, to ensure a building truly performs to its optimum efficiency; each profession who interacts with the building envelope, be it a plasterer, plumber or electrician, must recognises the importance of continuity of the thermal insulation and airtightness layer of the building.

A series of independent studies in the UK (LowCarb4Real; 2009) highlighted a performance gap between what were thought to be low energy buildings, to what in reality were much lower performing than expected. This was also highlighted in the Republic of Ireland by an SEAI report which highlighted that less than a third of new homes meet the energy efficiency and carbon emissions regulations (Passive House Plus 2013). Unfortunately, there is a clear performance gap in many buildings, from what was thought to be low energy, to what in reality consumes much more energy.

Air-tightness control.

More demanding building regulations not only require an improvement in individual skills, but require a change in attitude to working collectively with a focussed cooperative approach to achieve compliance with regulations. Figure 1 presents an example of good site control and communication between trades on a Passivhaus under construction in Dublin.

Changes in building standards directly affect on-site practices collectively and require a focused cooperative approach to achieve compliance with regulations.

The production of truly low energy buildings require diligent attention to detail and cooperation between all trades involved in the construction and renovation processes. All trades should view the house as a system, rather than the sum of its parts. Trades must work as a team. All works must be coordinated.

Air-tightness training.

The current fractured approach to building must be changed to a systems approach to building, in a similar manner to Passivhaus building principles and the quality standards, which are often observed on low energy or Passivhaus projects in Ireland, the UK and Germany. From the design stage planning and simplifying details is essential. Having "toolbox talks" at an early stage of the build process with key personnel who interact with the thermal envelope of the building is essential to minimise costly errors, conflict and poor building performance.

THE NEED FOR TRAINING

Many material suppliers now provide training for designers and builders for their products (e.g. Ecological Building Systems training centre). The House Planning Help website: **www.houseplanninghelp.com** is also a useful resource for those seeking more information with regards to the management and delivery of truly low energy buildings.

A range of training courses are also been developed by the Irish Government in conjunction with the Irish Green Building Council and training institutes, such as the Qualibuild training programme: **www.Qualibuild.i.e.**

It is not only important to ensure appropriate materials and systems are utilised in low energy building, but to ensure they are installed correctly in conjunction with all other trades on site, and planned from the outset to deliver truly low energy construction.

Niall Crosson, Ecological Building Systems

Why you should aim for Passive House certification?

– Paul McAlister, Paul McAlister Architects

Sustainable design and the Passive House (or Passivhaus) standard are intrinsically linked. The Passive House standard is much more than an energy performance standard; it is also a quality assurance standard that closes the gap between theoretical performance and reality.

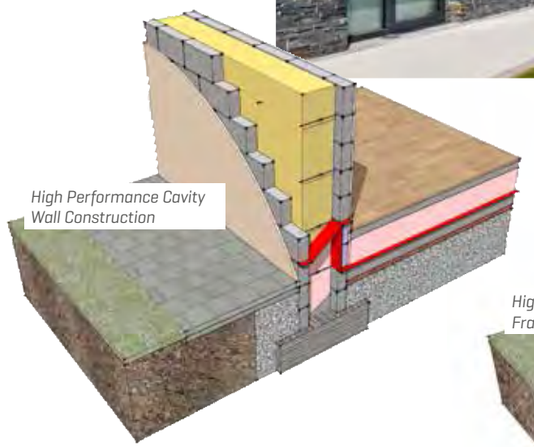
The Passive House Planning Package (PHPP) software is a rigorous design tool for analysing Passive House buildings, making the designer subject to an inbuilt quality assurance, which can meet the actual performance targets of the proposed design and specification. If a client desires a Passive House building there are distinct advantages in employing a certified Passive House designer, who has already demonstrated the knowledge and the skills required.

A Passive House is a building constructed using the principles of passive design – a concept based on minimising heat losses and maximising heat gains, thus enabling the application of simplified building services. Typically, this includes optimising insulation levels with minimal thermal bridges, high thermal performance windows, very low air-leakage through the building envelope and utilisation of passive solar and internal gains, with good indoor air quality maintained by a mechanical ventilation system with highly efficient heat recovery. The rigorous Passive House Design criteria must been woven into the design from the beginning. Passive House proposals are environmentally responsible and make use of the following criteria as design motivators.

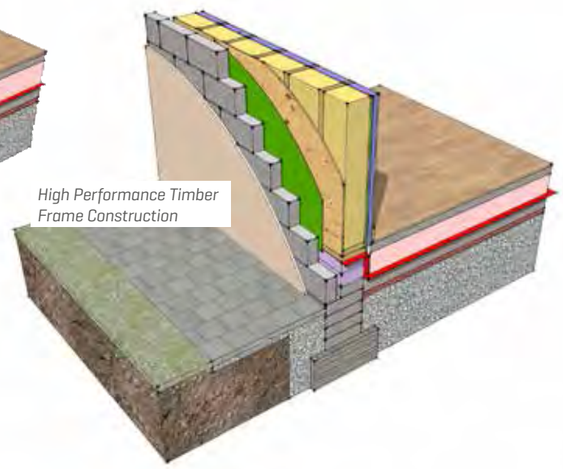
- Super-insulated walls, floor and roof
- Use of a Mechanical Ventilation and Heat Recovery system
- Passive House approved triple glazing
- Use of Thermal Mass in passive heating and cooling strategies
- South-facing glazing maximising thermal gains

In order to achieve these desired criteria, innovative construction methods are adopted, resulting in a highly durable built outcome. These criteria also result in a dramatic reduction in space heating requirements, reduced CO2 emissions and lower energy consumption. Passive House design has many advantages over conventional construction and design techniques. In this particular case, it offers a modern and comfortable dwelling with no cold draughts, no temperature variations from room to room, a quiet internal environment and significantly reduced utility costs. Passive Houses are buildings which ensure a comfortable indoor climate in summer and in winter, without needing a conventional heating system. To permit this, it is essential that the building's annual demand for space heating does not exceed 15 kWh/m2year. The minimal heat requirement can be supplied by heating the supply air in the ventilation system - a system that is necessary in any case. To meet the stringent certified Passive House Design criteria, five key principals need to be utilised.

Drumlins House, Co. Down



High Performance Cavity Wall Construction



High Performance Timber Frame Construction

Continued...

PassivHaus, Crawfordsburn

TRIPLE-GLAZED ADVANCED WINDOW TECHNOLOGY.

A type of window providing thermal insulation by using three panes of glass hermetically sealed with two internal "air" gaps (in practice filled with an inert gas).

MECHANICAL VENTILATION WITH HEAT RECOVERY

Whole house mechanical ventilation with heat recovery Heat recovery ventilation (MVHR) is a ventilation system that employs a heat exchanger between the inbound and outbound air flow. Heat recovery ventilation provides fresh air and improved climate control, while also saving energy by reducing the heating or cooling requirements.

AIR-TIGHTNESS

The volume of air leakage per hour through unsealed joints must be less than 0.6 of the house volume.

SUPER-INSULATION

This is an approach to building design, construction, and retrofitting. A super-insulated house is intended to be heated predominantly by intrinsic heat sources (waste heat generated by appliances and the body heat of the occupants), without using passive solar building design techniques or large amounts of thermal mass, and with very small amounts of backup heat.

THERMAL BRIDGING -ENHANCED CONSTRUCTION DETAILS

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. A thermal bridge occurs when there is a joint between materials and structural surfaces. The main thermal bridges in a building are found at the junctions of facings and floors, facings and cross walls; facings and roofs, facings and low floors. They also occur each time there is an opening (doors, windows, etc.). These are structural thermal bridges. These thermal bridges vary in importance according to the type of wall or roof.

"Passive House philosophy must be tailored to each individual project"

SUMMARY

A certified Passive House must be built with meticulous attention to detail, according to principles developed by the Passive House Institute and certification can only be achieved through an exacting quality assurance process. The Passive House philosophy must be tailored to each individual project, taking into consideration client requirements, site climate, Passive House principles and how they can be rigorously applied.

A fully-certified dwelling by the German Passive House Institute costs a little extra in terms of consultancy fees, build costs and materials, but means that the house will have a quality approved certificate issued by the Passive House Institute in Germany. The certification recognises the outstanding performance levels of the dwelling. One of the reasons for attaining these performance criteria is to reduce the utility costs. As mentioned, these are significantly lower than those of a conventional dwelling. Consequently, the financial benefits of Passive House design can be clearly identified.

Paul McAlister
Paul McAlister Architects

Why Natural Insulation?

– Niall Crosson, Ecological Building Systems

Natural insulation can take many forms, such as wood fibre, hemp, sheep wool or recycled wood or cellulose products. Each of these materials has a unique combination of key characteristics which helps to create a healthier, more comfortable, energy-efficient and durable construction.

Natural insulation materials do not under-perform when compared to many man-made synthetic insulation materials. In fact they often outperform man-made materials in a range of areas and, in addition, are renewable and sustainable materials which meet key sustainability criteria. Historically, natural insulation materials have struggled to enter the mainstream of the built environment due to the misconception that they cannot compete in the area of performance or cost. When one considers the array of benefits natural insulation provides the reality is that natural insulation materials outperform many man-made insulation products in both these categories.

Until relatively recently, it was solely the superior ecological characteristics which separated natural insulation products from the various forms of man-made synthetic insulation. Thanks to the introduction of higher levels of energy performance in buildings and greater public awareness, combined with more stringent requirements for higher levels of quality insulation, the range of natural insulation products and their areas of application has expanded over the past decade. Designers, specifiers, contractors and homeowners also appreciate the technical properties which natural insulation inherently offers. Natural insulation materials feature an array of characteristics which, when used correctly, can improve a building's performance considerably. The following are just a number of the key features and additional benefits natural insulation can provide;

HYGROSCOPIC PERFORMANCE

Unlike synthetic fibres, natural insulations have an inherent property in that they can absorb and release moisture hygroscopically, reducing condensation risk within building elements.

GUTEX THERMOWALL breathable external insulation system fitted to timberframe wall.

SPECIFIC HEAT CAPACITY

In lightweight construction - and as habitable spaces in attics become more commonplace - it is important to account not only for the thermal insulation qualities of the insulation in winter, but also for potential overheating within the living space in summer months. Most natural fibre insulation materials have a specific heat capacity of over 2100J/kgK, compared with only 800J/kgK for mineral wool and 1400J/kgK for oil-based insulations. Independent tests have shown that when natural fibrous insulation is used in habitable attic spaces, the temperature on the warmest summer months can be up to 6^{0}C lower, when compared to an equivalent construction insulated with mineral wool. In this way, natural insulation creates a much more tolerable living environment, not only in winter but also on the warmest days of the year.

ACOUSTICS

Due to the combination of their high density, fibrous nature, flexibility and ease of handling and cutting, natural insulation products again far out-perform many synthetic fibrous and plastic insulation materials acoustically.

THERMAL RESISTANCE

Natural insulation products can achieve a thermal conductivity as low as 0.035W/mK, which out- performs many synthetic insulation products. Many of the lowest energy buildings in both new build and retrofit, including certified Passivhaus buildings and the first Enerphit retrofit projects in Ireland, primarily employed natural insulation.

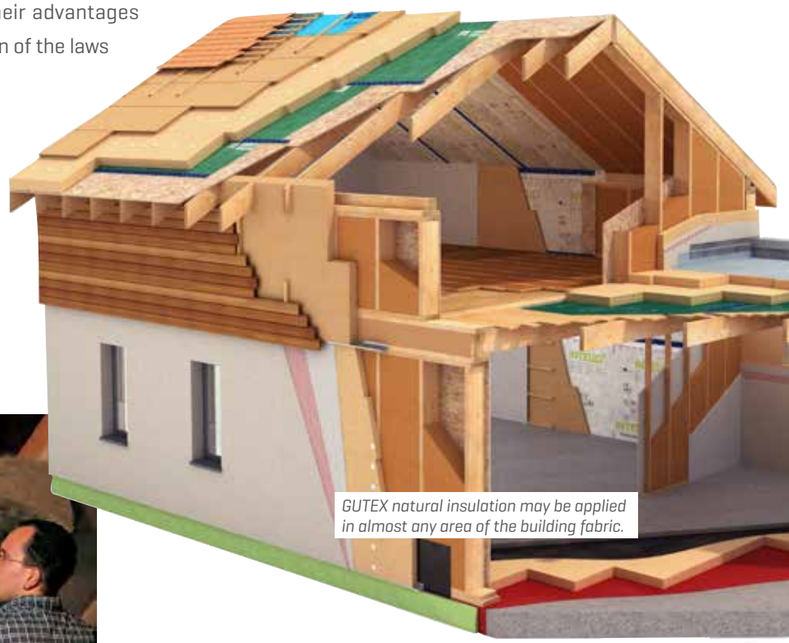
SUSTAINABILITY

The sustainability and the ecological attributes of natural insulation products are second to none. Many natural insulation materials not only reduce heat loss and CO_2 emissions in buildings, but also may sequester CO_2 even after having been produced! For example, for every 1m3 of THERMO HEMP insulation manufactured, it sequesters 13kg of CO_2.

When one factors in the additional health benefits for the dwelling occupier and installer, the increasing cost competitiveness of natural insulations, their superior durability and the breathable features of natural insulation products, their advantages become more apparent. With an appreciation of the laws of building physics, natural insulation

products provide an effective means of improving the energy efficiency of both new and existing buildings.

When considering the energy efficiency of buildings one cannot over-estimate the positive contribution which natural insulation materials offer on many levels. As buildings become more energy efficient the environmental impact of the building envelope increases significantly. Constructions which are energy efficient, durable, healthy, ecological and sustainable in every sense of the word, should be designed with some form of natural insulation, the benefits of which are not only in the money we save, but in the environment we live, particularly as it is estimated that we spend up to 90% of our lives in buildings.



GUTEX natural insulation may be applied in almost any area of the building fabric.

THERMO HEMP natural insulation installed between rafters.

Niall Crosson, Ecological Building Systems

Guidance and Principles of Sustainable Design

– Tom Woolley, Rachel Bevan Architects

A set of guidance and principles for sustainable design was written for and adopted by the Northern Ireland Ministerial Advisory Group for Architecture.

Developing ways to make buildings and the environment that surround them, to be sustainable, is central to our work. However there remains considerable confusion and lack of knowledge about what is involved in sustainable design among clients, professional groups and the construction industry. Respect for the environment goes hand in hand with ethical policies, respect for people to ensure that the way we live does not jeopardise the quality of life and life-enhancing opportunities for future generations. A culture of respect and responsibility for the environment will strive to ensure equality for all; and to end poverty, deprivation and social exclusion. Sustainability involves taking responsibility for all our actions no matter how little an impact we make individually in the overall picture.

The following text extracts some of the key issues from this document which can be downloaded in full from the MAG NI web site: **www.dcalni.gov.uk/the_principles_of_sustainable_design.pdf**

Crossgar, eco conversion of an old mill re-using an existing derelict building.

THE FOLLOWING TOPICS SHOULD BE INCLUDED IN A HOLISTIC APPROACH TO SUSTAINABLE DESIGN AND CONSTRUCTION:

- Reduce our contribution to the causes of climate change and impacts
- Promote equality and ethical standards
- Encourage a sustainable culture and behavioural change through education
- Sustainable development is rooted in place and locality
- Plan for sustainable neighbourhoods
- Protect biodiversity
- Integrate landscape and infrastructure
- Encourage urban agriculture and urban forestry
- Prioritise sustainable development in land use
- Re-use vacant sites
- Promote sustainable transport
- Sustainable water use
- Energy use reduction
- Assess the sustainability of biomass and bio-fuels
- Renovate and re-use buildings
- Protect the built heritage and encourage good design so that new buildings are valued and become the future heritage
- Make new buildings flexible in use
- Put fabric first
- Use passive solar design and shading
- Prioritise indoor air quality
- Reduce emissions from building fabric
- Select sustainable building materials
- Take account of embodied energy
- Use renewable and natural low impact materials
- Conserve and reuse materials
- Design for demolition and re-use
- Take sustainable development as far as possible.

REDUCE ENERGY USAGE

While the sustainability aim would normally be for Net-Zero Energy use in buildings, this is not always practical and appropriate. It is critical that all projects are designed to be super-efficient and eliminating energy demand. Between 60-80% reduction from the norm should always be possible and realistic in most buildings. Extreme claims to achieve Zero Energy use are rarely achieved and extreme measures that attempt to achieve this can cost far more in embodied energy than they ever save in use. Reducing energy consumption and methods of making buildings energy efficient should always come before applying renewable energy technologies to create more energy. Air conditioning and cooling systems should only be installed if absolutely essential and natural ventilation systems should always take priority over mechanical ventilation and air conditioning.

RENOVATE AND RE-USE BUILDINGS

Most developed western countries have enough buildings and built resource to satisfy current needs. The case for new buildings should be made on social and environmental criteria, once the possibility of re-use of existing buildings has been exhausted. For instance there is still a case for new housing in areas where there is a housing shortage.

Generally renovating existing buildings is more sustainable. Retaining existing built heritage and familiar buildings and places is also sustainable. Third party carbon profiling studies will generally show that retrofitting existing buildings has a lower CO2 impact than demolition. However, the retrofitting of existing buildings should be carried out carefully so as not to damage the fabric of the existing buildings. Sustainable renovation and retrofitting may not achieve extreme energy efficiency standards but, by retaining and re-using existing buildings and materials, the overall impact on the environment is much lower. Make new buildings flexible in use. Always consider the whole life of buildings and how they can adapt to change of use.

PUT FABRIC FIRST

Fabric first should be the main aim in any project so that buildings are so thermally efficient that only minimal energy input is required. It is important to ensure that buildings are insulated in the most effective, healthy and environmentally friendly way. Assuming that the material with the best claimed thermal resistance should always be used can be a mistake. Lightweight buildings with lightweight insulation lack thermal mass and have been found to overheat and not perform as efficiently as predicted. Hygrothermal calculations should also be taken into account as thermal comfort is also related to humidity and the ability of materials to manage moisture in buildings.

Crossgar, eco conversion of an old mill re-using an existing derelict building.

USE PASSIVE SOLAR DESIGN AND SHADING

Solar gain can also contribute to thermal efficiency but must be handled carefully so that buildings do not overheat. Having large areas of south facing glazing can be counterproductive if buildings overheat. It is also important to ensure that thermal mass is used appropriately to provide passive heating or cooling. It is often assumed that concrete is the best material for this but the thermal lag time in concrete can mean that it doesn't function as effectively as other materials. Unfired earth walls, hempcrete and solid timber can be more effective and responsive as well as cheaper and having lower embodied energy.

PRIORITISE INDOOR AIR QUALITY

This is a greatly overlooked issue, particularly in the UK, but should be central to any sustainability approach. Not just because it protects the health of building occupants but because it acts as a touchstone to so many other issues such as design, construction methods and materials, ventilation and heating, and the quality of the environment and the experience of users.

Sensible operation of buildings can reduce moisture loads and risk of mould growth. Condensation and mould growth remains a significant problem in many buildings. Ventilation systems are very important to ensure good fresh air but also to guard against condensation, particularly as energy efficient buildings are much more air tight than in the past. A range of ventilation systems are available, ranging from natural, passive stack, mechanical extract to positive ventilation and heat recovery systems. The most appropriate sustainable and energy efficient solution for the building should be used.

Hygroscopic materials can now be used in buildings, which buffer moisture. These are often referred to as breathable building materials, but they are not providing fresh air ventilation or extract. Such materials can help to reduce humidity significantly. Non-hygroscopic, non-breathable materials can aggravate problems of dampness and condensation and increase the risk of mould growth.

Carefully consider the source of fresh air to keep toxins from entering the building and prevent the area inside from being contaminated. External air quality continues to be poor in many cities particularly during periods of still air and pollutants from vehicles and other sources can enter buildings and even be absorbed by some materials such as curtains and carpets.

REDUCE EMISSIONS FROM BUILDING FABRIC

Many materials used in the construction of buildings can emit a range of pollutants that can accumulate in buildings. These are at the highest once a building has been completed but even though they can decrease over months or years they can still remain a health problem. European standards for indoor air quality have been adopted in a number of European countries though there is a varying level of enforcement. UK building regulations do not set standards for indoor air quality other than to set ventilation levels, however in order to adopt a sustainable approach designers and the developers of buildings should adopt exemplar indoor air quality levels and test the buildings to ensure that there is compliance.

Principle areas of concern are fire retardant chemicals that are used in insulation as well as computer equipment, furniture and so on. These can contain endocrine disrupting chemicals that can have serious health problems particularly affecting the thyroid, hormonal and reproductive functions. While such chemicals may appear to be at a low enough level in buildings to be acceptable, they are found in high concentrations in the natural environment as a result of manufacturing and waste disposal, and can thus affect biodiversity. Other chemicals commonly used in building materials and insulations can be carcinogenic and also emit highly dangerous chemicals in fires. Glues and adhesives are a particular source and can be found in insulations and even timber products and products used to stick down flooring materials, tiles and sealants. Respiratory problems, asthma and cancer are on the increase and we should ensure that buildings do not contribute to this. A sustainable approach should be to adopt the precautionary principle and try to avoid the use of materials that emit risky chemicals when suitable alternatives are available.

SELECT SUSTAINABLE BUILDING MATERIALS

Material selection has the most far-reaching and broad impacts on design, construction, and occupancy. It deeply influences – and is influenced by other sustainability criteria. Material selection needs to be understood in terms of individual products selection but also the overall building structure and system chosen to construct the building. Key decisions as to whether to use masonry, steel or timber frame can have a big impact on the carbon footprint of a building.

As with indoor air quality the precautionary principle is the underlying theme that defines the selection of materials, and defines the suggested method for decision-making.

Hempcrete under construction

Cottage constructed from timber frame and hempcrete walls.

Timber Frame house , Mourne Mountains.

Ideally organisations may wish to adopt a RED LIST of materials that should be avoided following the precautionary principle. However this may raise some difficulties in terms of procurement policies and any such list should only be seen in terms of guidance. Such a list might include compounds that are carcinogenic, persistent organic pollutants, and reproductive toxicants as referred to above. Many of these substances are bio-accumulative, meaning that they build up in organisms and the broader environment, often reaching alarmingly high concentrations as they travel up the food chain.

The building industry is largely responsible for many dangerous materials and chemicals that are still in use today. For example, approximately three-quarters of all PVC is in building materials. Some of the other items on the list such as cadmium, lead, mercury and phthalates are also used as plasticisers and stabilisers for PVC. PVC is responsible for dioxin emissions and other pollution concerns but is still widely used.

TAKE ACCOUNT OF EMBODIED ENERGY

Apart from the dangers of toxic chemicals, sustainable construction must also take account of the depletion of natural resources and the energy used to manufacture building materials and construct buildings. Many materials used in Western European countries are sourced from all over the world and clock up many miles in transportation. Non-renewable resources are extracted from mines and quarries but information about environmental damage caused by this is rarely available.

The energy used to manufacture materials represents a significant contribution to CO_2 emissions. Portland cement, for instance is estimated to be responsible for 6-8% of the total CO2 emissions in the world, though there are lower impact cementitious products available based on recycled materials. Measuring the environmental impact of materials through Life Cycle Assessments requires the measurement of embodied energy.

The United Nations Environment Programme (UNEP) has published several reports that demonstrated that a significant proportion of a building's carbon impact occurs prior to occupancy. The Embodied Carbon Footprint Imperative means that this major contribution of greenhouse gases needs to be accounted for. Recent research done in London and Finland has identified the "Carbon Spike" problem and demonstrates that the energy used to create new buildings or even renovate existing ones will never be recovered by the resulting energy in use savings. Reducing energy used today would be a more significant contribution to reducing CO_2 emissions than energy saved in 25 years time, so reducing embodied energy must be taken as seriously as energy efficiency.

Acceptable carbon offset projects are hard to find and many products described by companies as carbon neutral may be brought into question. However it is possible today to use renewable materials that lock up CO_2 in the building fabric and this can thus be offset against other higher energy elements.

The old boiler house, Ballymun, Dublin, eco conversion.

USE RENEWABLE AND NATURAL LOW IMPACT MATERIALS

Timber is the main renewable material in common usage in the UK. Only the timber industry has a formalised standard, created by the Forest Stewardship Council (FSC) that provides evidence of sustainable management of forests and sources of timber. A wide range of environmentally sound products, made from a wide range of materials including timber, are independently certified by "Natureplus" which only approves materials with minimal fossil fuel input and minimal toxic chemicals. While the Natureplus standard is a useful guide it represents only a tiny proportion of materials currently available:
www.natureplus.org

Salvaged products can be used in buildings and this has enormous environmental benefits. Aggregates can be crushed on site from demolition and timber and steel can also be found locally. However it may be necessary in the short term to go further afield to obtain the best environmental materials. Wood fibreboards and insulation, for instance could easily be made in the UK or Ireland, but all the products currently in use come from Germany, Austria and Switzerland.

Transparency is a vital element of a sustainable marketplace but some manufacturers publish product ingredients while others keep this information confidential. Designers should advise manufacturers that such information is very useful when they are making specification choices and without it products may not be selected. Again this should be checked against any UK or EU procurement rules that may or may not allow this.

Tom Woolley,
Rachel Bevan Architects

Build-specific Insulation Solutions for Existing Dwellings.

– Liam Brown, Enviroform Ltd

With rising energy costs and the desire to reduce greenhouse gas emissions, many homeowners are considering internal wall insulation upgrades to improve the energy and comfort of their home. However, consider the adage "Doing something is NOT always better than doing nothing at all"

It is important to understand that different homes, constructed of different types of building materials, may require different retrofit upgrade solutions. Therefore the following are key considerations before embarking on an internal wall insulation (IWI) upgrade;

- What is the condition of the wall? – Rising or penetrating damp, structural cracking etc.?
- What materials were used in the original construction of the wall? – Brick, stone or concrete?
- Is the wall still in its original state or has it been modified through the years? – Has the original lime plaster been replaced with gypsum etc.?
- How do you insulate key junctions? Window & door reveals, wall returns and joist ends? – Cold or Thermal Bridges
- Failure to address these critical junctions listed above will lead to increased heat loss at these junctions and, more worryingly, can lead to fabric-related problems due to condensation forming and mould.

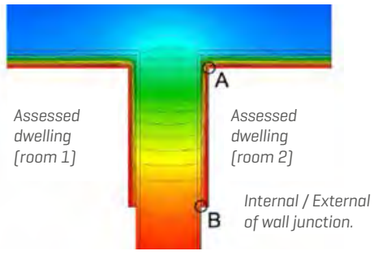
Once all the above issues have been addressed then you have to decide which type of internal wall insulation system you would like to install – Vapour Open or Vapour Tight?

VAPOUR OPEN "BREATHABLE" SYSTEMS

What is a breathable Material? The term breathable is used loosely by various insulation companies and it means different things to different people. In summary, to avoid confusion, for a material to be breathable it must have the following characteristics:

- Vapour Permeable – it has the ability to allow vapour to pass through
- Hygroscopic – it has the ability to absorb moisture
- Capillarity Active – it has the ability to release absorbed water through its pores or capillaries

If any of the materials used in the system do not display ALL of the above properties, they cannot be called "breathable" in the true sense of the term in relation to a wall.



PREPARATION BEFORE COMMENCING

As well as all the materials used in the system, all the component parts in the wall to be insulated must also be breathable. Therefore, if you are insulating a wall, then all materials such as sand and cement, gypsum and paint must be stripped off to expose the original wall before preparation can commence. The first thing to do is to coat the wall with a minimum thickness of 9mm lime parge coat, to create a flat (very important), level, hygroscopic air-tight inner layer. Then, and only then, can you install your breathable system of choice. In short, the materials can deal with the formation of water due to vapour condensing and direct it in the direction of least resistance – either to the outside or inside face of the solid wall.


Fibre reinforced aerogel insulation


Aerogel monolith

Drumcairn Church roof refurbishment, Belfast.

VAPOUR TIGHT SYSTEMS

Vapour tight systems are the most common solution used in the market today and are usually in the form of thermal laminates (insulated plasterboard). Considering a non-breathable wall cannot cope naturally with the movement of water, then these 5 critical factors must to be present in an IWI system to make sure its designed performance is equal to its installed performance.

- Continuous Vapour Control Layer – board joints
- Continuous Insulation Layer – no thermal breaks
- Thermal Bridging due to multiple fixings minimised
- Thermal Looping due a ventilated cavity behind boards avoided
- Adequate treatment of thermal bridging – reveals, returns, joist ends & floors.

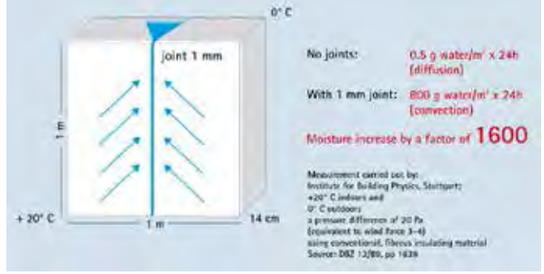
The key factor, as the title suggests, is that the wall must be Vapour tight. This simply means the system you choose must stop warm vapour from transferring from the warm side to the cold side of the insulation. Failure to address this key issue will lead to the vapour condensing on the cold wall and turning to water. Over a period of time this will lead to a reduction in the performance of the insulation material but, in addition, the formation of mould and degradation of the fabric of the building will occur.

The second issue is that the insulation must be continuous and have no breaks. Studies by the Fraunhofer Institute have shown that a 1mm ventilated gap in the insulation layer can lead to a drop in performance by a factor of 4.8. Therefore, a system designed to perform at a U-value 0.3 W/m2K, will in affect perform at 1.5 W/m2K.

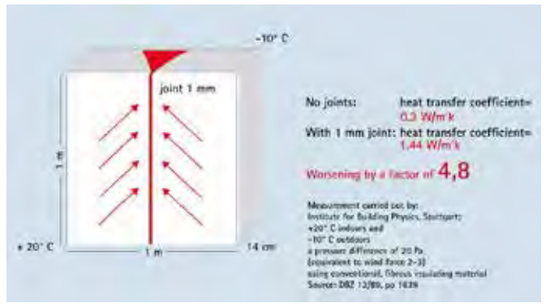
Fixing multiple screws through the insulation layer, either by a direct fixing method or screwing laminates onto timber battens, reduces the effectiveness of the insulation installed by creating a direct path for heat loss from the warm inside to the cold external wall.

If there is a cavity or air gap behind the thermal insulation system installed then this must be unventilated to keep this air warm and still. Failure to achieve this reduces the effectiveness of this air gap which is used to enhance U-Value calculations on the wall.

Damaging effects of a 1mm gap in your insulation over a period of time on heat and vapour loss.
Source: Lothar Moll, Pro Clima, Germany.



Vapour worsening factor - 1600



Heat worsening factor - 4.8

Failure to adequately deal with cold bridging at a critical junction will increase the heat loss at this junction after the insulation has been installed which can lead to mould growth in these areas. A recent report published by the BRE states that heat loss at uninsulated junctions can be as high as 50% of overall fabric heat loss in certain cases.

Off the shelf thermal laminates, either fixed onto battens or by a "dot and dab" method, will not achieve all of the above criteria due to their design and installation methods. The widespread use of these cost-effective laminates, coupled with the sector's lack of understanding of Cold Bridging is likely to be a contributing factor leading to the well-publicised, "Performance Gap".

Therefore, before commencing any internal wall insulation project, it is vital that all the factors discussed above are considered before a decision is made on which system to use. The correct decision at this stage will protect, both, the maximum return on your investment and also the long-term fabric of your building.

WHY IS A COLD BRIDGE A PROBLEM?

If you have cold bridges in your property, you are losing heat, you are wasting money on heating and your insulation is not effective. Many people spend money on thick insulation and the overall benefit is reduced because of cold bridges that are not treated properly. Effects of a cold bridge are:

- Your building is much harder to heat
- Indoor surfaces are at lower winter temperatures
- An increased risk of surface condensation
- Risk of damage to building units, leading to vacancies & re-housing costs
- Danger of mildew and mould, causing serious health threats, potential litigation
- Complaints, withheld payments, reputation damage

WHERE DO COLD BRIDGES EXIST?

1. At reveals around doors and windows
2. Where cables and pipes penetrate walls
3. At junctions of walls, floors and roofs
4. At joist ends

WHY ARE THESE DETAILS WIDELY IGNORED IN RETROFIT?

Quite simply, cold bridging occurs in areas where space is usually limited and mainstream insulation companies do not have a product thin enough to effectively deal with the problem. Aerogel insulation is a super-thin flexible insulation which, at 10mm thick, will deal with the cold bridge and is a material ideally suited for these critical junctions.

Liam Brown
Enviroform Ltd

A NOTE ON POROUS WALLS

When considering installing internal wall insulation onto porous walls you should consider an external vapour-open Siloxane treatment, to prevent further water ingress and allow the wall to slowly dry out naturally. Simply applying this treatment will increase the thermal resistance of the wall by expelling the water held in the pores of the wall and replacing them with air. As air is a good insulator and water a good conductor then this naturally will reverse the condition of the wall and make the wall more thermally efficient.

A precautionary note before any treatment is applied is that all cracks, mortar joints etc.. must be fully repaired and the wall washed down with an anti-microbial wash. These treatments are not designed to repair "holes" in the fabric, only the external surface skin.

Sustainability of Timber Frame

- Raymond Moan, Quality Timber Frame

The aim of this article is to outline the key benefits of timber frame construction focusing on the sustainable aspect of this method of construction.

Today's factory-manufactured timber-framed homes are a truly 'modern method of construction', equating to approximately 23% share of the UK market as shown in figure 1 below and around 30% of the market in RoI.

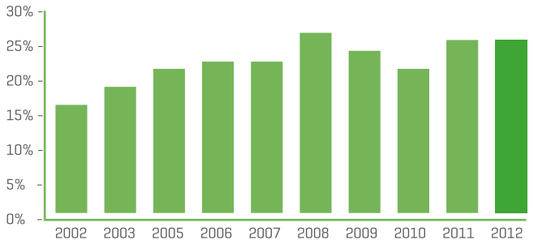


Figure 1 Timber Frame Market Share (2002 – 2012) (source: UKTFMA – Market Share Report 2012)

Timber frame is increasingly becoming the building material of choice in UK due to the Government's commitment to making all new homes zero carbon from 2016 onwards. The precise definition of "Zero Carbon" has changed since the commitment was made in 2006 though the intention remains clear.

According to the United Kingdom Timber Frame Association (UKTFA), more and more house builders are beginning to appreciate the benefits of timber, with the material currently accounting for around 75% of the self-build market, as well as being widely adopted in social and private housing.

BENEFITS OF TIMBER FRAME CONSTRUCTION

Timber frame typically requires 20 per cent fewer on-site labour days than masonry construction and ensures a significantly faster construction period overall. This means a faster return on investment and reduced disruption to local communities, with reduced periods of unsold stock standing empty, vulnerable to damage or vandalism. Sites are also likely to be tidier and thus safer.

COST SAVINGS

Timber helps to minimise cold bridging effects, having a Lambda value of 0.13W/mK, i.e. closer to that of insulation materials than to masonry products. The cost efficiencies of timber frame continue through the life of the structure, delivering up to a 33% reduction in energy consumption for a large detached house and a 20% reduction for apartments.

LOW RISK

Timber frame is tried and tested and there is an ever-increasing body of people and businesses in the UK and Ireland who know how to use it. The UK National Audit Office (NAO) confirms you get more price certainty, fewer delays due to bad weather, better health and safety and a more predictable build programme.

DESIGN FLEXIBILITY

Timber-frame systems are particularly suited to brownfield sites with poor soil conditions (sites that favour lighter buildings) and sites with restricted access. Modular components are also easy to transport, whilst prefabricated panels offer strict quality control and fewer post-erection quality problems. Compliance with the current and future Building Guidelines
Timber frame presents certain advantages under the Code for Sustainable Homes (CSH) in terms of the environmental impact of materials, responsible sourcing, construction waste reduction, air- tightness and sound. Currently, 85% of all Passivhaus dwellings are built in timber and timber frame buildings were the first to reach CSH Levels 5 and 6. The material is also well positioned to meet increasingly strict environmental standards, as set out by national, regional and local governments.

CARBON SAVINGS

Wood is effectively a carbon-neutral material (even allowing for transport) and timber frame has the lowest CO2 cost of any commercially available building material. For every cubic metre of wood used instead of other building materials, 0.8 tonne of CO2 emissions are avoided.

AESTHETICS

Timber is increasingly seen as an aesthetic and healthy option for interior design in the education and healthcare sectors. Here timber is used both as a structural element and as an internal finish, providing a warm, clean, calming space for students, patients and staff. Coupled with plenty of natural light, the organic feel of wood helps to improve behaviour and lower stress levels. The thermal properties of timber can also provide a warm, energy-efficient internal environment.

THE TIMBER INDUSTRY

The forestry and timber products sector is in the top 20 major industries in the UK, with the Office of National Statistics (ONS) valuing it at over £8.5 billion. The UK timber industry directly employs 150,000 people and approximately 10% of all UK construction jobs are in wood-related trades across all regions. This covers all skill levels and qualifications – from forestry, land and habitat management to joinery and manufacturing, engineering and architectural design, the sector provides employment and career development in a wide range of disciplines. Jobs are being created across the skills spectrum and in a variety of business types and sizes, predominantly the SME sector. Importantly, a lot of investment and job creation takes place in rural areas, increasing the strength and fabric of communities that are increasingly isolated from cities and larger urban areas.

The timber industry is at the forefront of driving low-energy manufacturing, producing high-performance low-carbon goods and helping to achieve carbon reduction targets and climate change objectives. Timber has an established supply chain with huge potential for rapid growth, helping to meet employment, economic and housing targets.

Sustainability of Timber in Timber Frame Construction
"Wood is the most technologically advanced material that we can build with. The Earth grows our food. The earth can grow our homes. It's an ethical change we have to go through" (Michael Green, Architect).

There are four main benefits of timber frame as a sustainable construction method;

- Renewable Material
- Carbon Capture and Storage
- Low Embodied Carbon
- "Green" Properties

RENEWABLE MATERIAL

Most of us are aware of the issues that affect us all in our daily lives with regard to climate change, through the news and even the weather forecast, with more extreme weather conditions and events in various parts of the world. Many people may be concerned about deforestation and the impact that this has on climate change and, therefore, associate timber in construction with increasing deforestation and having a negative effect on climate change.

Figure 2 shows the percentage of climate change due to deforestation. Figure 2 Factors effecting Climate Change (source: Programme for the Endorsement of Forest Certification (PEFC).

Concerned about accelerating deforestation, environmental degradation and social exclusion, a group of timber users, traders and representatives of environmental and human rights organisations met in California in 1990. This diverse group highlighted the need for a system that could credibly identify well-managed forests as the sources of responsibly produced wood products. Two years later, in 1992, the United Nations Conference on Environment and Development – the Earth Summit – was held in Rio de Janeiro and schemes such as Programme for the Endorsement of Forest Certification (PEFC) and the Forest Stewardship Council (FSC), which promote Sustainable Forest Management (SFM) through independent third-party certification, were developed. PEFC works throughout the entire forest supply chain to promote good practice in the forest and to ensure that timber and non-timber forest products are produced with respect for the highest ecological, social and ethical standards. Thanks to its eco-label, customers and consumers are able to identify products from sustainably managed forests.

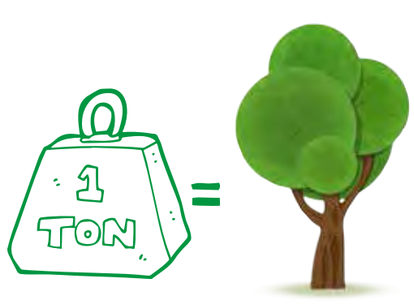
In the UK, roughly 90% of timber used comes from certified sustainable sources, such as FSC and PEFC, as outlined by the Government's own world-leading Central Point of Expertise on Timber (CPET). Most of the rest comes from well-managed sources in countries which do not practice certification. This

minimises the risk of illegal material entering the supply chain and ensures 'no net losses' of forest cover. The EU Timber Regulation (EUTR) was enacted in 2013 and, with the support of the National Measurement Office (NMO) and the industry, the UK leads the world when it comes to responsible sourcing and trading in timber. Currently, according to the report "The Timber Industry – Growing our Low-Carbon Economy", in managed European forests five new trees are planted for every tree harvested, making timber the only truly mainstream building material.

CARBON CAPTURE AND STORAGE

Trees play a key role in the carbon cycle, being able to absorb carbon dioxide from the atmosphere through the process of photosynthesis. When the tree is harvested the carbon remains stored in the timber until the end of its physical life – roughly one tonne per metre cubed.

Figure 3 Carbon Capture of Timber – roughly one tonne of carbon per 1m³ of timber (source: The Timber Industry – Growing our Low-Carbon Economy).



While this carbon is safely locked up in timber products – such as walls, windows, doors or floors – more trees are planted, absorbing and storing carbon as they grow. In fact, studies show that more emissions are absorbed and stored in timber products than are emitted during harvesting, processing, manufacturing and transportation combined. This provides a net emissions reduction process. A timber frame house, using as much wood products as possible, may capture approximately 19 tonnes of carbon.

LOW EMBODIED CARBON

Manufactured timber products require far lower energy inputs to produce than competing materials such as concrete. This reduces pressure on the UK electricity grid while producing high-performance, low-carbon goods which can substitute or outperform their high-carbon counterparts. It also gives timber very low embodied carbon content. Figure 6 shows the fossil fuel requirement to produce four common building materials with 1m3 of timber only taking 750MJ/m3 compared to concrete taking almost 6.5 times this amount of energy at 4800MJ/m3.

GREEN PROPERTIES

Timber also has some of the best insulating properties of any construction material, helping keep us naturally warm and achieve energy efficiency targets, with a thermal conductivity (lambda (λ) value) of 0.13 W/mK. Dense concrete blocks have a thermal conductivity of around 1 W/mK whilst common insulation products have thermal conductivities ranging from 0.022 to 0.044 W/mK. Timber products can be readily reused and recycled and, increasingly, used as a low-carbon fuel. Timber products provide low-carbon benefits throughout their life-cycle, with none of the subsidies or incentives associated with other low-carbon sectors.

SUMMARY

Timber systems provide ideal solutions for all housing situations, from urban brownfield sites to new garden cities and from social housing to 'Grand Designs' private builds. Timber systems offer high quality off-site solutions through build systems that can cut months off traditional build times, saving money in on-site costs. It is the perfect material for periods of high demand. Timber frame systems promote a fabric first approach to construction, providing more energy- efficient and airtight buildings, as we move towards implementing zero carbon homes.

The potential for timber-based building products to create a new generation of low-carbon energy-efficient homes is huge. The industry is involved at every stage of building design and delivery and is creating some of the best quality and progressive solutions, from structural elements to refurbished interiors - floors, walls, staircases, roofs, doors, windows and furniture. Society as a whole, as well as local authorities, housing providers and builders, want to see high quality housing delivered quickly – 'off-site manufacture' is a key part of this. Timber frame technology embraces all the successful principles of off-site manufacture with quality, speed of production and consistency of design and delivery.

The quality-controlled factory environment means fewer product faults and on-site complications. It provides a number of project efficiencies and environmental benefits, such as savings in preliminary site preparation, on-site labour (including wet trades and teams of sub-contractors), construction time-scales, health and safety risk and less material-intensive activity. The reduction in on-site work alone often saves weeks on project completion times. Timber systems are ideal for tight urban spaces and brownfield developments.

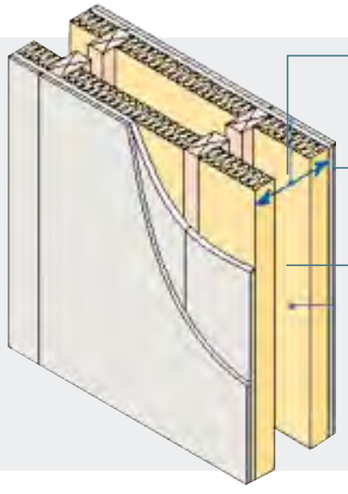
Material	Carbon released (kg/t)	Carbon released (kg/m³)	Carbon stored (kg/m³)
Rough Sawn Timber	30	15	250
Steel	700	5320	0
Concrete	50	120	0
Aluminium	8700	22000	0

Material	Fossil fuel energy (MJ/kg)	Fossil fuel energy (MJ/m³
Rough Sawn Timber	1.5	750
Steel	35	266000
Concrete	2	4800
Aluminium	435	1100000

Figure 4 Energy required to produce four common building materials (source: The Timber Industry – Growing our Low-Carbon Economy).

Due to the lightweight nature of structural timber the amount of groundwork required compared to concrete or steel is much reduced. This means far less disruption for building site neighbours. The homes in which we live and the buildings in which we work contribute significantly towards our overall carbon footprint – around 47 per cent of the UK's total carbon emissions. "A ten per cent increase in the number of timber frame homes built within the EU would produce sufficient carbon dioxide savings to meet 25 per cent of EU requirements under the Kyoto Protocol", a leading expert has said. Robin Lancashire, timber frame consultant with TRADA Technologies (Timber Research and Development Association) was speaking at a seminar, entitled Timber Frame Energy Efficient Dwellings for the 21st Century, organised by the Irish Timber Frame Manufacturers Association. Lancashire said that this saving in CO_2 emissions can be made as timber uses less energy to manufacture from raw material to finished product than any other building material. We need to build more homes quickly and efficiently. The recent in-depth review by the European Commission highlighted major risk from the "continuing structural under-supply of housing; intrinsic supply constraints, particularly in London and the relatively slow response of supply to increases in demand." Within the UK, if 200,000 new homes were built using timber frame construction each year this would store around 4 million tonnes of carbon dioxide per year.

Raymond Moan
Quality Timber Frame



Wall width - *240mm (min) between inner faces of wall linings. 50mm (min) gap between studs (must not be bridges by any diagonal bracing).*

Wall lining - *2 or more layers of gypsum - based board (total nominal mass per unit area 22 kg/m²), both skies- all joints staggered.*

Absorbent - *60mm (min) mineral wool batts or quilt (density 10-60 kg/m²) both sides. material Material may be unfaced, paper faced or wire-reinforced.*

Tiles - *Tiles between frames not more than 40mm x 3mm, at 1200mm (min) centres horizontally, one row of ties per storey height vertically.*

External (flanking wall) - *External outer leaf masonry with minimum 50mm cavity.*

Choice of Window Frame Materials

– Wolf Ehrke, Camden Group Ltd

Windows are among the most important design features of buildings. Overall dimensions of the frame, sight-lines of frame and sash, the relationship of width and height, the division by transoms/mullions and Georgian bars are the main design criteria which an architect would use to design the general aesthetics of windows.

The colour of the frames and, in the case of curtain walling, of the glazing as well, are key to the design intent. However, the required performance should be the first criterion considered with regard to the choice of frame material.

PERFORMANCE CRITERIA

Prior to choosing any product, the criteria for the performance required/desired are to be defined. The price is important, of course, but can only be relevant after the performance capabilities of the possible alternatives have been compared to the requirements.

The main purpose of a building is to protect its users from the negative influences of the external environment and to enhance the positive ones, as well as providing security. Windows are the weakest parts of the building envelope yet are vital in providing the required functionality in terms of daylighting, ventilation, visual contact with the external environment, access and escape routes.

The following paragraphs explain in detail the performance characteristics which windows and doors should provide.

- Structural rigidity
- Weather-tightness against driving rain
- Air permeability
- Thermal performance
- Sound insulation
- Ventilation
- Safety in use
- Resistance against immissions
- Maintenance
- Environmental aspects
- Longevity – expected life span
- Economics – investment
- Economics - TCO (total cost of ownership)

ARCHITECTURAL DESIGN

The individual tastes and preferences of home owners have an impact on design decisions in the same way as the design intent of an architect or specifier, while traditional buildings, especially listed buildings, require different designs and materials to contemporary buildings.

The most popular type of window in Ireland and the UK is the outward-opening casement window, usually in combination with fixed glazing. Modern windows should be internally glazed, which means having glazing beads on the inside for the benefit of enhanced security. Transoms and mullions, respectively the horizontal and vertical dividing members of a frame, are used to create the vast number of individual styles specified by architects and homeowners. Georgian bars can be used to divide sashes and fixed lights further and support the more traditional look of a house.

PERFORMANCE CHARACTERISTICS OF WINDOWS AND DOORS DEPENDING ON FRAME MATERIALS

Once the legal requirements, performance and architectural criteria have been specified there is the matter of choice of frame material. Principally, all frame materials currently offered are capable of conforming to the performance criteria explained above, although not every material is equally suitable for every purpose.

- WOOD -

DESIGN AND AESTHETIC

Suitable for traditional and modern styles, combination of sash and fixed glazing in one frame should be achieved by coupling of two frames, if outward-opening sash and internally beaded fixed glazing are required. Any opaque colour is possible, or surface treatment which leaves the wood's natural grain and colour visible, if this is the design intent. Bespoke designs can be achieved by skilled craftsmen using traditional, versatile wood-working machinery. Low primary energy input is required for production of raw material and for fabrication.

STRUCTURAL PERFORMANCE

Wood has very good load-bearing characteristics. Slim sight-lines are possible, though greater structural capabilities can be achieved by greater profile depth. Wood does not have a noticeable amount of thermal expansion and contraction.

WATER TIGHTNESS

Single gaskets for outward-opening sashes, or double and triple gaskets for inward-opening sashes, provide water tightness suitable for all current requirements. "Wet" glazing ("gunable" wet seal over back-up rod or glazing tape) should be the first choice to avoid water ingress into the glazing rebate.

AIR PERMEABILITY

Single, double and triple gaskets restrict air permeability to a minimum.

THERMAL PERFORMANCE

Wood has a low thermal transmittance, softwood 0.13 W/mK and hardwood 0.18 W/mK (where a lower value indicates improved thermal performance)

SOUND INSULATION

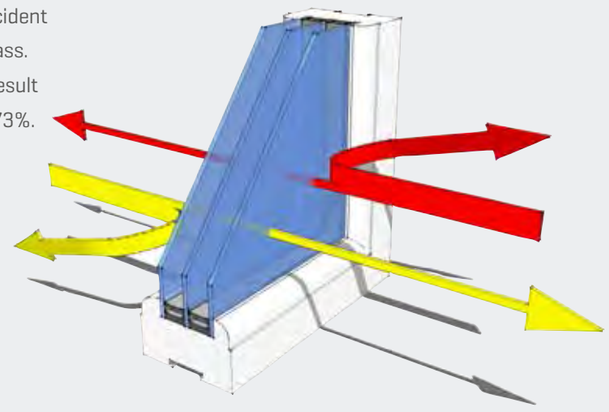
Wood frames, together with suitable glazing can achieve a high level of sound insulation.

g VALUE:

The "g value" indicates how many percent of incident solar energy will reach the room through the glass. Identical glass thickness according to EN 410 result in a 'g value' of 61 % and light transmission of 73%.

TECHNICAL VALUE S TRIPLE GLAZING SOLAR+
Ug values according to EN 673:

[ ] SOLAR+ 36 mm: 4b/12gAr/4/12gAr/b4 Ug 0.8 W/m²K
[ ] SOLAR+ 40 mm: 4b/14gAr/4/14gAr/b4 Ug 0.7 W/m²K
[ ] SOLAR+ 42 mm: 4b/15gAr/4/15gAr/b4 Ug 0.7 W/m²K
[ ] SOLAR+ 44 mm: 4b/16gAr/4/16gAr/b4 Ug 0.7 W/m²K
[ ] SOLAR+ 48 mm: 4b/18gAr/4/18gAr/b4 Ug 0.6 W/m²K



VENTILATION

Natural ventilation should be supported by the installation of trickle vents or sound-insulating venting devices.

SAFETY IN USE

Safety in use depends on the opening direction of sashes. Inward-opening sashes are much safer than outward-opening ones. The same applies to fully reversible and pivot sashes.

RESISTANCE AGAINST OMISSIONS

Wood should be protected against water and UV light. Water causes wood to swell and, if present long enough, may cause rot. UV irradiation destroys the structure of wood cells and causes paint and varnish to fade and peel.

ENVIRONMENTAL ASPECTS

Wood is a natural material and, if harvested from sustainable forests, has a positive effect on the global CO2 balance. Wood is suitable for high performance windows. Wood can be dimensioned for any reasonable structural performance requirement. Individual dimensions can be easily created using standard woodworking machinery, without the need for specific profiling tools if volume production is not required. Tropical hardwood which does not come from sustainable sources has a seriously negative impact on the global environment. Wood is easy to manufacture using traditional or modern technologies, crafted, or made in highly efficient, automated industrial factories. Re-using wood from windows which have been removed is not generally possible.

LONGEVITY – EXPECTED LIFE SPAN

Provided the maintenance of the surface is carried out as required, the life span of wood window frames is not limited. Hardware components and gaskets may require replacing.
Economics – investment, TCO (total cost of ownership)
The investment for wood windows is 30 to 40% above that of PVCu windows and maintenance costs are also higher.

REPAIR OF DAMAGES

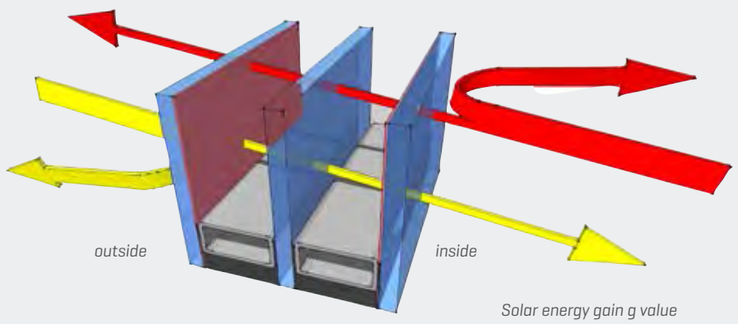
Repair of damages is relatively easy. If damage occurs, even many years after the installation, it is possible to create replacement parts using traditional woodworking tools and machinery.

- ALUMINIUM -

DESIGN AND AESTHETIC

Aluminium is a very durable and strong material, preferred for curtain walling, capable of large spans of transoms and mullions, slim sight lines and tall sliding and bi-fold door sashes, though there is a requirement for thermal breaks. Aluminium is most suitable for contemporary architecture. Combination of sash and fixed glazing in one frame should be achieved by coupling of two frames, if outward-opening sash and internally beaded fixed glazing are required. Surface treatment can be either via anodisation with metal effect or powder-coated in any colour – wood-effect coating is also available. Dark colours require appropriate measures to deal with thermal expansion. Bespoke profiles can be extruded at comparably low costs, but not as cheaply as bespoke wood profiles.

Heat Loss value U value



STRUCTURAL PERFORMANCE

The strength of aluminium makes it suitable for large spans. Profiles can be designed to have a very slim sight line, with profile depth providing the structural strength.

WATER TIGHTNESS

Double and triple gaskets provide water tightness suitable for all current requirements.

PVCu 'Tilt & Turn' Window.

AIR PERMEABILITY

Double and triple gaskets restrict air permeability.
Corners of centre gaskets should be vulcanised.

THERMAL PERFORMANCE

Aluminium has the highest thermal transmittance of all window frame materials at 160 W/mK. Thermal insulation is achieved by thermal separation, using polymer or foam materials. U-values will usually be higher than those of wood or PVCu frames, but can be compensated for by improved glass units.

SOUND INSULATION

Aluminium windows, together with suitable glazing can achieve a high level of sound insulation.

VENTILATION

Natural ventilation should be supported by the installation of trickle vents or sound insulating venting devices.

SAFETY IN USE

Safety in use depends on opening direction of sashes. Inward-opening sashes are much safer than outward-opening ones.

RESISTANCE AGAINST IMMISSIONS

Aluminium carries a risk of corrosion under severe immissions from industries and close to the sea. The corrosion usually starts at mechanical joints and is known as filiform corrosion.

ENVIRONMENTAL ASPECTS

The energy required to create aluminium metal from ore and amalgamating the alloy suitable for windows is considerable. Aluminium can be recycled and reused without limitation for new windows or other products without losing any of its characteristics, though powder-coating will complicate the process.

LONGEVITY – EXPECTED LIFE-SPAN

The life-span of aluminium window frames is technically not limited. Hardware components and gaskets may require replacing. Investment and TCO (total cost of ownership)
The investment for aluminium windows is 40 to 50 % above that of PVCu windows.

REPAIR OF DAMAGES

Repair of damages is difficult or may even be impossible if the system is not on the market any more.

WOOD-ALUMINIUM

Wood-aluminium windows combine the advantages of wood with the excellent longevity of aluminium, avoiding the effect of high thermal conductivity of aluminium.

DESIGN AND AESTHETIC

There are many different designs of wood-aluminium frames on the market, from those resembling traditional wood windows to designs with hidden sashes.

STRUCTURAL PERFORMANCE

Wood sections are responsible for the structural performance and are capable of bridging large spans which may be preferred in contemporary architecture.

WATER TIGHTNESS – DRIVING RAIN

Double and triple gaskets provide water tightness suitable for all current requirements. "Wet" glazing ("gunable" wet seal over back-up rod or glazing tape) should be the first choice to avoid water ingress into the glazing rebate. Air permeability, thermal performance, sound insulation, ventilation, safety in use, resistance against immissions. These characteristics are comparable to wood-only windows.

MAINTENANCE

Maintenance costs are comparable to aluminium windows and lower than for wood windows.

ENVIRONMENTAL ASPECTS

Wood-aluminium windows combine the environmentally friendly aspect of wood windows with a lesser amount of aluminium than for aluminium-only windows.

LONGEVITY – EXPECTED LIFE SPAN

The technical life span of the frames themselves is not limited providing maintenance (depending on the location of the building) is carried out accordingly. Hardware components and gaskets may require replacing.

Investment and TCO (total cost of ownership)
The investment for wood–aluminium windows is 70 to 90 % above that of PVCu windows.

REPAIR OF DAMAGES

Repair of damage to the wood parts is easy, as for wood windows, though replacement aluminium parts may not be available after a period of time.

- PVCu -

PVC is an oil-based thermoplast, which is used in a large number of products. For window and door frame profiles it is modified to a high performance and very durable PVCu (un-plasticised), which is extruded to form hollow profiles. PVCu frames are most popular in many countries because of an unbeatable price/performance ratio, if used within their technical limitations. After system design and extrusion, fabrication is far less demanding than that of wood frames, for example.

DESIGN AND AESTHETIC

Traditional and modern styles are offered, with combination of sash and fixed glazing in one frame being achieved by reverse butt welding of T- and Z-sections, resulting in very cost-effective window styles. PVCu can be used without any additional surface treatment, as white or cream profiles, though it has become popular to cover the surface with decorative foils, either coloured or with wood-grain effect. PVCu can also be spray-coated in any colour. Bespoke profile designs incur the highest tooling costs of all frame materials and are not common.

STRUCTURAL RIGIDITY
PVCu has limited load-bearing capacity requiring, in most cases, the usage of steel reinforcements which are inserted into the hollow chambers of the profiles. Larger frames are created from several single elements using structurally dimensioned coupling profile sections. Care is to be taken with the thermal expansion and contraction of longer frame members or couplers.

WATER TIGHTNESS
Double gaskets (and in some cases triple gaskets) for inward opening sashes provide water tightness, suitable for all current requirements. Polymer gaskets are used for glazing, which provide a sufficient water tightness together with drainage of the glazing rebate.

AIR PERMEABILITY
Double gaskets (and in some cases triple gaskets) restrict air permeability to the required minimum.

THERMAL PERFORMANCE
PVCu has a low thermal transmittance of 0.17 W/mK, similar to hardwood. Three (or, better still, five or more) hollow chambers increase the thermal performance significantly.

SOUND INSULATION
High levels of sound insulation are achievable with PVCu frames. The optimum is reached with triple seals and centre rebates, which at the moment are not yet popular in Ireland and the UK.

VENTILATION
Natural ventilation should be supported by the installation of trickle vents or sound insulating venting devices.

SAFETY IN USE

Safety in use depends on opening direction of sashes. Inward-opening sashes are much safer than outward-opening ones. The same applies to fully reversible and pivot sashes, which are available as PVCu systems.

RESISTANCE AGAINST IMMISSIONS

PVCu is most tolerant with regard to immissions and can be used at any location.

MAINTENANCE

Apart from regular cleaning of glass and frame surfaces and occasional greasing of hardware no additional maintenance is required.

ENVIRONMENTAL ASPECTS

The chemical processing of PVCu in Europe is predominantly based on crude oil. Energy input is lower than for Aluminium. PVCu for windows requires a number of different ingredients to provide the desired characteristics. PVCu can be recycled and reused for window profiles several times.

LONGEVITY – EXPECTED LIFE SPAN

PVCu windows have been in use for more than 50 years and their life-span seems to be limited by technical progress rather than by degradation of the PVCu itself. Hardware components and gaskets may require replacing.

ECONOMICS – INVESTMENT, TCO (TOTAL COST OF OWNERSHIP)

The investment for PVCu windows can be considered as a benchmark. There is no window on the market with a better price/performance ratio for most domestic projects.

REPAIR OF DAMAGES

In all cases where profiles are cracked or broken, they require replacement of the sash or frame affected.

Wolf Ehrke
Camden Group Ltd

Products suitable all replacement projects & new build properties.

Airtightness & Active Moisture Management

– Niall Crosson, Ecological Building Systems

Airtightness is an essential part of creating a healthy, comfortable, energy-efficient living environment.

While air leakage is a major cause of energy loss and increasing CO2 emissions, the maximum permissible air permeability of new domestic buildings in the Republic of Ireland of 7m3/(hm2) @ 50Pa is still relatively poor, compared to our continental neighbours and what is considered best practice. In UK the normal maximum is 10m3/(h.m2) though the notional building, via which the overall carbon target is set, assumes a figure of 5m3/(h.m2). Air leakage is one of the most significant contributors to inefficiently heated buildings.
Studies confirm that air leakage can account for up to a third of all heat losses in modern buildings and reduce insulation performance by a factor of up to 4.8. High levels of air leakage also significantly increase the potential for condensation to occur within building elements, which may lead to insulation and structural degradation and mould growth, particularly in lightweight construction (i.e. timber or steel frame) as well as in cold attic spaces. This occurs as warm air leaks into the building envelope, leading to condensation within building elements and on internal surfaces. Considering that Ireland is one of the dampest and windiest climates in Europe, it is no surprise that airtightness is now seen as a fundamental factor in the construction of low energy, durable, healthy buildings.

AIRTIGHTNESS & VENTILATION

Air leakage should not occur in buildings. Whereas ventilation is intended, air leakage or draughts are not. Air leakage occurs as a result of unintended gaps, cracks and openings in the external building fabric of the building. The key is to "Build Tight and Ventilate Right". One of the most cost-effective means of reducing heating bills, increasing the energy efficiency in buildings and ensuring that the insulation can perform effectively, is to use quality insulation while making sure the building envelope is as airtight as possible. To maximise the benefit of thermal insulation it must be protected against air movement on both the outside and the inside. On the outside of a roof, for example, this is typically achieved with an airtight, breathable membrane. On the inside of a wall this is achieved with wet plaster directly onto a block wall or an airtight vapour control layer, which not only controls air movement, but also prevents vapour penetrating the insulation leading to condensation. In this way, addressing air leakage can be pinpointed as one of the most effective and cheapest means of increasing the energy performance of our buildings.

Roof insulation protected on both sides against air movement. Protected on the outside with Solitex PLUS airtight breathable roofing underlay and inside with INTELLO PLUS intelligent airtight membrane taped at overlaps with TESCON NO 1 tape
An insulation layer is only as effective as the level of airtightness achieved. If the insulation is continuously exposed to air movement, this will lead to a major reduction in thermal performance. For example, if one were to wear a woolly jumper on a cold windy day it will not insulate effectively, whereas, if one were to wear a light windshield over the jumper, then it actually insulates effectively. Insulation in our homes is very similar.

Pro Clima Intelligent airtightness system with solutions for every detail.

AIRTIGHTNESS AND INTELLIGENT MEMBRANES

A drawback of using conventional vapour barriers, such a foils or high gauge polythene membranes on the inside, is that such membranes do not permit trapped vapour to dry to the internal side of the building. This may lead to conditions where mould growth, insulation degradation and structural damage can occur. An "intelligent" airtight vapour control membrane prevents both air and vapour escaping into the construction in winter. Such membranes can also adapt and become over 40 times more breathable if vapour is building up behind the building fabric in summer, something a standard vapour barrier/check cannot do. This prevents "sweating" occurring within the construction during summer months. Intelligent membranes also allow the moisture, which may otherwise become trapped within structural elements, to dry out, even after the building is sealed airtight and complete.

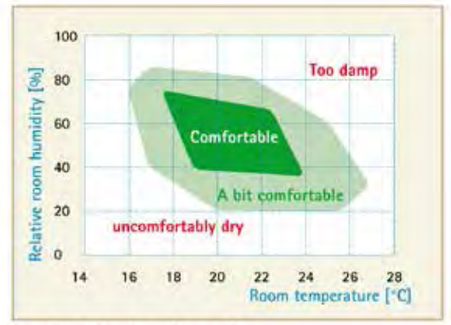
Pro clima Airtightness Tapes: Tescon No 1 and Tescon Profil for sealing corner connections. Wind tightly sealing overlaps of Solitex PLUS external breathable membrane on a roof with TESCON NO 1 tape - Pro clima Roflex service Grommet for flexible sealing of pipes - Pro clima CONTEGA SL window/door sealing tape for block and timber-frame walls

CONCLUSION

Air permeability testing is mandatory for most new residential buildings. Air permeability testing measures the rate at which air is able move through a building's external 'envelope' due to random gaps and cracks, at a reference differential pressure of 50Pa (between inside and outside the building). A pressure difference of 50Pa equates to a wind speed of approximately 20 mph. The external envelope can be defined as the area of the air barrier which separates the conditioned "heated" internal air from the unconditioned "cool" outside air. This includes all external walls, floors and roofs or ceilings, including all openings. The result is expressed in cubic metres of air leakage, per square metre of external building envelope, per hour, at a differential pressure of 50 Pascals, i.e. m3/(h.m2) @ 50Pa and is referred to as the Q50 value for a building.

In order to attain Passivhaus levels of performance, or for an "A" rated energy efficient building, airtightness is crucial. Otherwise we will continue to build relatively well-insulated, draughty, "leaky" buildings, which makes little sense.

Comfortable indoor climate depending on temperature and relative humidity



According to Leusden and Freymark.

A sufficiently airtight home is one of the key factors to ensure that insulation, the ventilation system and the heating system, can actually perform as efficiently as possible in reality. Attaining high levels of airtightness not only lends itself to a much more energy efficient building but, also, combined with a robust ventilation strategy, leads to a healthy living environment and reduces the risks associated with mould growth and structural degradation due to interstitial condensation.

Attaining high levels of airtightness is primarily down to good workmanship, simplifying complex details at the design stage and coordinating works on site, using airtightness solutions, tapes and glues, which not only attain a high level of airtightness on the day of the test, but for the lifetime of the building. Airtightness is an essential part of realising energy efficient buildings whether in new builds or refurbishment projects.

Niall Crosson, Ecological Building Systems

Energy Efficient Ventilation in Dwellings

– Paula Osborne, BEAM Vacuum & Ventilation

For many years, homes in the UK and Ireland have been ventilated via natural air infiltration. The result of this has been high energy consumption for space heating, which can account for over 50% of the energy used within a dwelling.

New energy-efficient homes today are being built as airtight as possible with double- or triple-glazed windows, sealed doors and high levels of insulation, with airtightness also contributing towards enhanced U-values. Existing property homeowners are being encouraged to make homes more energy efficient by insulating their roof space, cavity walls etc..

This increased airtightness in a dwelling requires a planned ventilation approach. The objective of a good ventilation strategy is to provide a balance between energy efficiency and indoor air quality. This strategy should have an integrated approach, taking into account other factors such as thermal insulation, heating systems, controls and the requirements of the household occupants.

According to The Energy Saving Trust, "energy loss due to ventilation accounts for approximately a fifth of space-heating energy demand in an older, poorly-insulated dwelling. Natural air infiltration alone can result, at times, in too little ventilation. This leads to poor indoor air quality and other more readily visible impacts, such as condensation and mould on indoor surfaces".

Distribution / supply ceiling diffuser.

Add to this the fact that poor ventilation in a dwelling can also cause potentially serious health issues, excessive carbon dioxide levels and damage to the fabric of the building and it is easy to see why the concept of "Build Tight – Ventilate Right" has never been stronger.

ENERGY EFFICIENCY SAVINGS

Achieving an energy-efficient standard of ventilation requires consideration of both the building fabric and the efficiency of the ventilation system.

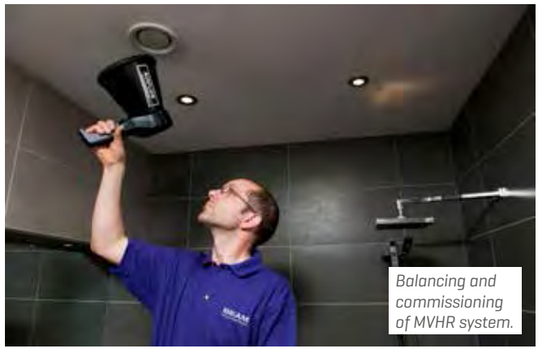
The two main ways in which ventilation uses energy are:

1. The requirement to heat up incoming air (particularly during colder weather when heating systems are running) and its subsequent loss as it leaves the property via purpose-provided openings i.e. window vents or extractor fans, and through air leakage;
2. The electrical power required to operate a mechanical ventilation system.

It is considered good practice to have a maximum air permeability level of 5 m3/(h.m2) for a dwelling, with this reduced to a level of 3 m3/(h.m2) to reach the Best Practice guideline (and especially where mechanical ventilation with heat recovery is proposed). To achieve this level, many of the common air leakage paths are eradicated, resulting in a greater need to ventilate effectively and presenting an opportunity for more energy efficiency.

There are many energy-saving features in mechanical ventilation systems. The type of ventilation used is often determined by airtightness level, budget, overall house construction type, the lifestyle of the occupants and the knowledge of specifiers advising on the ventilation strategy. The energy efficiency of a mechanical ventilation system can be improved, where applicable, by using heat recovery elements, low energy fans, and/or energy-saving control devices. The term Specific Fan Power, or SFP, is used to measure the electrical power to operate a mechanical system, including power to the fans, transformers, controls and safety devices. Thus, the lower the SFP, the more energy-efficient the ventilation system. It is also important to minimise unwanted pressure losses in the ventilation system during installation. This can be done by avoiding the use of flexible ducting and minimising the number of bends.

An energy saving can be made by the use of SAP Appendix Q



Balancing and commissioning of MVHR system.

listed ventilation units, as opposed to non-compliant units. This Appendix Q listing only applies where the installation has followed the correct guideline procedures as recommended by the Building Research Establishment (BRE), i.e. rigid ductwork is used.

Energy savings can also be made if a Mechanical Ventilation with Heat Recovery system (MVHR) is installed in a dwelling. An MVHR system reduces the amount of energy needed to heat up the incoming air to room temperature. When considering the heat recovery efficiency, often expressed as a percentage, other variables should be taken into account, e.g. the SFP of the ventilation unit, the airtightness level of the dwelling, the heating system, the number of "wet" rooms, the type of ducting installed etc..

Some ventilation systems offer energy saving controls as optional features, including humidity sensors, moisture/pollutant detection etc.. This means the level of ventilation in a room can be automatically reduced if the pollution level in a room is low, again saving energy.

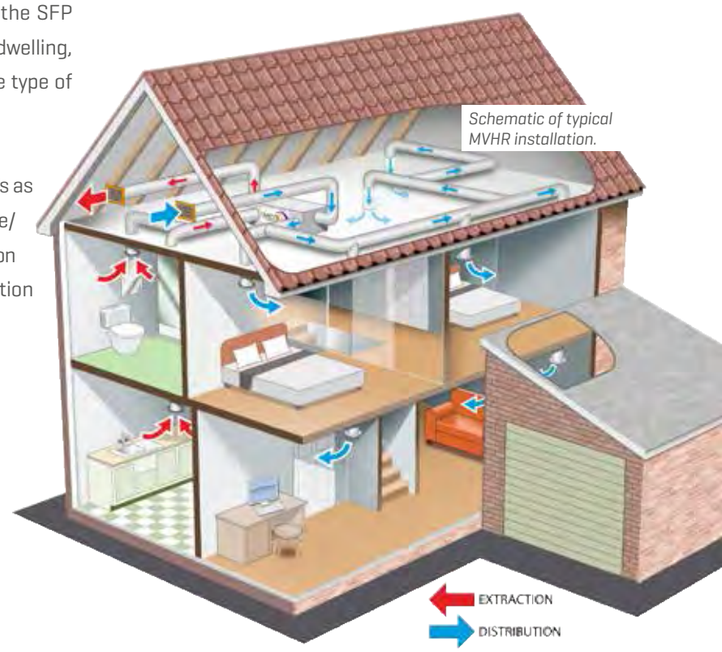
Presently, ventilation (as required by UK Building Regulations) in houses is provided by 4 principle methods:

- Balanced Mechanical Ventilation with Heat Recovery (MVHR)
- Mechanical Extract Ventilation (MEV)
- Passive Stack Ventilation
- Background Ventilation

MECHANICAL VENTILATION WITH HEAT RECOVERY (MVHR)

MVHR systems are considered to be the most energy-efficient method of ventilating an airtight dwelling. Fresh air is continuously drawn into the home via a low energy heat recovery ventilation unit, located in the roof space/utility area of the home. The ventilation unit filters the incoming air to remove pollutants and insects. Once passed through the heat exchanger, the warm, clean, fresh filtered air is distributed around the home through a series of ducts which are run to each habitable room i.e. living rooms, bedrooms etc..

The air from wet rooms, i.e. bathrooms, kitchens, WCs, utility areas etc., is continuously extracted and filtered back through the ventilation unit. Most of the heat from the extracted air is transferred to the fresh incoming air. The heat recovered can off-set heating costs and thus reduce fuel bills. The system provides low energy balanced continuous ventilation, without the need for extract fans or window vents, ensuring



Schematic of typical MVHR installation.

a draught-free living environment. This, controlled, pre-heated, filtered, fresh air is constantly provided throughout the house, improving indoor air quality. Once again, it is vital that an MVHR system is installed and commissioned properly according to the guidelines set. Filters within the MVHR units should also be changed/cleaned annually to help maintain system efficiency. MVHR systems are designed to recover up to 95% of the heat normally lost through open windows, trickle vents and other break-out points, e.g. extractor fans, in a building structure. To help with energy savings, MVHR units should contain low energy electronically commutated (EC) motors and have an SFP less than 1.0Wl−1s−1. Commonly-used heat recovery technologies include counterflow and rotary thermal wheel, both of which should have low energy EC fans fitted resulting in very low running costs.

Changing MVHR filters regularly maintains system efficiency.

PASSIVHAUS

If a dwelling is being built to Passivhaus standard, in the interest of maximum energy savings the rate of ventilation with fresh air should not be higher than needed to achieve a comfortable indoor humidity. According to the Passivhaus Institute: "In the past, air change rates as high as 0.5 or even 0.8 were considered necessary to keep interior humidity in winter low enough to discourage the development of condensation, which can cause mildew and damage to building components. But this risk does not exist in a passive house. Outside building elements are so well insulated that interior surfaces are too warm for condensation to occur even at 60% relative humidity; and moisture barriers and air seals prevent moist inside air from reaching building elements that could cool it to below the dew point. Therefore, fresh air volume can be lower, particularly when occupants perceive the humidity as being too low. "Appropriate" air change rates for residences are between 0.3 and 0.4. For passive houses, we generally recommend leaning toward the lower rate. This keeps the indoor air quality good, while maintaining a comfortable humidity and maximizing energy savings".

MECHANICAL EXTRACT VENTILATION (MEV)

An MEV system is a low energy, continuous mechanical extract ventilation system, designed with multiple extract points to simultaneously draw moisture-laden air out of the wet rooms. Primarily for use in dwellings with 6 wet rooms or less (or dwellings up to 300m2/3200sq.ft), a mechanical extraction ventilation system is usually installed in a roof space or cupboard and runs continuously at a normal low ventilation rate, extracting stale polluted air from rooms where the most moisture is generated, e.g. kitchens and bathrooms, whilst minimising the migration of humidity to other rooms. A flow of fresh air from outside is supplied by a Positive Input Ventilation unit or window vents.

Homeowners can make significant energy savings as there is no need for noisy extractor fans in each wet room which create multiple breakout points in the building, creating draughts, air leakage and heat loss. It is also much more economical to run one fan instead of multiple fans and that fan can have an SFP down to 0.18Wl−1s−1. However, MEV systems need to be balanced and commissioned, can have long runs from certain wet rooms and can be slightly more expensive than extract fans.

Schematic of typical MEV installation

PASSIVE STACK VENTILATION

This is a duct system comprising grilles connected to near-vertical ducts to ridge or roof terminals. Ceiling vents in each wet-room are connected to a roof vent, providing silent, continuous extract ventilation with no electrical connections or direct running costs. This type of system is not common in Ireland or the UK, as the airflow through a passive stack is weather-dependent and additional ventilation may be required during warmer months. It can also be difficult to accommodate ducting requirements and this approach is very sensitive to correct installation techniques.

BACKGROUND VENTILATION

Sometimes referred to as natural ventilation, background ventilation occurs when fresh air enters the building, e.g. via trickle vents in the head of window frames (which, however, sometimes can be permanently closed). Natural leakage also occurs through gaps around windows and doors throughout the fabric of the building, due to poor construction.

If window trickle vents are the source of background ventilation, the volume of air needs to be 65,000mm2 per 100m2 of floor area for a typical 5-bedroom house, adding 7000mm2 per 10m2. This is intended to give an air permeability level (Q50)< 5. Extract fans are still required in kitchens, bathrooms, utility rooms, WCs and en-suites, to provide rapid extraction.

This form of ventilation is popular because of low price, ease of installation and simple operation. The disadvantages are that the ventilation is not energy efficient as it cannot be controlled, can cause draughts, the homeowner also has to listen to noisy extract fans and both window vents and extract fans can be easily tampered with by a homeowner. This system is not recommended as a best practice standard.

ALTERNATIVE VENTILATION – POSITIVE INPUT VENTILATION

An alternative option to background ventilation is Positive Input Ventilation (PIV). These are low energy mechanical ventilation systems which supply a continuous flow of air to the dwelling from a central location. Designed to run continuously, a PIV unit dilutes, displaces and replaces moisture-laden air with fresh, filtered air. The air is at a higher temperature than outside if taken from the roof-space and is circulated through the house. Contaminants are forced out of the property, through natural cracks and leakages, resulting in improved indoor air quality and reduction in condensation and mould growth.
PIV systems are easy to install, easy for the end user to operate and are ideal for social housing and the existing house market. Also, as a PIV system replaces trickle vents in the window, more of the heat generated within a dwelling stays in the dwelling, making it a more energy efficient option. However, PIV units are not widely recognised in the industry as a form of ventilation in new dwellings and can be perceived as causing draughts in the dwelling. Also, where trickle vents are not retained, there is the potential for moisture-laden air to be pushed into cold areas of the building fabric, resulting in interstitial condensation.

Schematic of typical PIV installation

SUMMARY

In summary, whilst there are different types of ventilation options, energy-efficient homes of today should have high levels of insulation, be built to high standards of airtightness and contain a properly designed, controlled ventilation system to provide fresh indoor air and energy savings. In addition, all mechanical ventilation systems should:

- Be independently tested at the BRE
- Be SAP Appendix Q listed
- Comply with all building regulations
- Ideally be Energy Saving Trust compliant
- Be installed and commissioned following recommended procedures

Paula Osborne
BEAM Vacuum & Ventilation

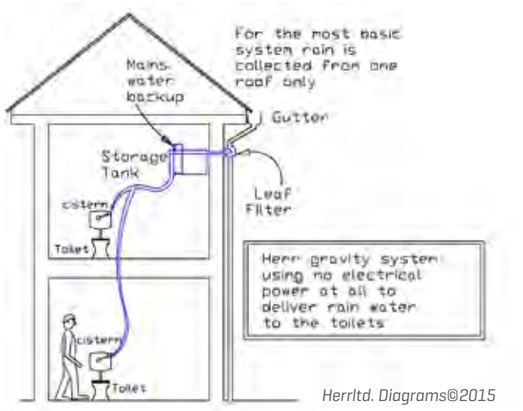
Environmentally Sustainable & Low Energy water treatment systems for single houses. – Ollan Herr, Herr Ltd

From the point of view of energy, water usage and water treatment is increasingly seen as a major sustainability issue. Large amounts of energy are used for pumping water, pumping and treating waste water, transporting and treating sewage sludge.

Herr Ltd works with architects and clients at the earliest stages of the house design to minimise or eliminate the electrical energy requirements of home based water systems.

ZERO ENERGY HOME BASED WATER SUPPLY

Catching rain water on the roof, storing it high up in the building and letting it run by gravity is the most energy efficient way to use water domestically. It is more sustainable to use water in your home without using pumps where possible. The Herr solution for this is to use the natural force of gravity alone to move water from the roof to the toilet cistern below. The mains water back up valve from Herr, operated also without any form of electricity. Please see a diagram explaining our mini rainwater harvesting system.



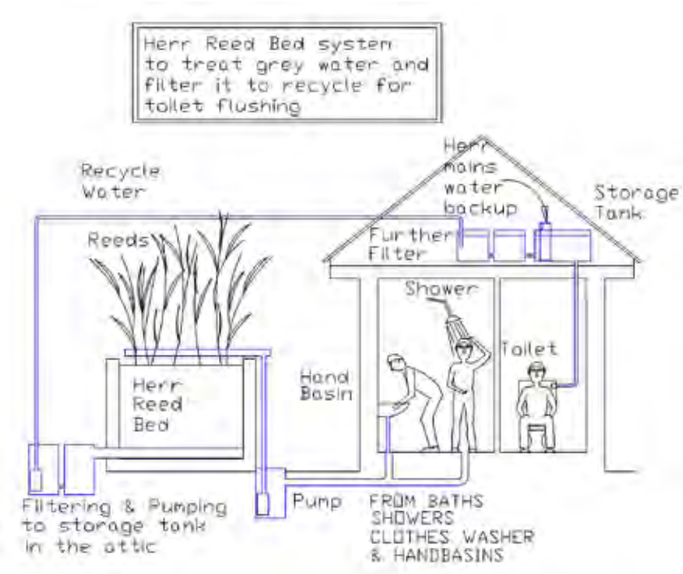
Herrltd. Diagrams©2015

As well as achieving energy saving we recommend this compact system where there is no space for tanks outside the house. Water storage tanks inside houses are always neatly hidden away on high shelves in wide custom made cupboards. These cupboards can be in hall ways, dressing rooms, bed rooms, bathrooms etc. with clothes and shoes stored away on the shelves below. Making the cupboards wider will increase the space for storage tanks for the rain water.

In Denmark and some parts of Germany the cost for water is as high as €6 per 1000 litres. Given the water pollution problems that we have, water taxes and charges of this order are likely to eventually apply in Ireland also. Even with the rainfall we have here rain water collection from many Irish roofs can replace only as much as 40% of the water we would otherwise use. Toilets on average use as much as 30% approx of the household mains water demand so this will become an opportunity to save on water charges in Ireland also.

MAKING RAIN WATER SAFE TO DRINK WITHOUT USING ELECTRICITY

Assuming early co operation with architects, Herr can also provide for systems using rain water that is treated for unrestricted reuse using mini sand filters that do not require electricity. These would be for home owners who want to achieve much greater mains water savings. Instead of using ultra violet lights, sand filters which don't have any operating or UV bulb replacement costs will remove the harmful bacteria in the water that washes off the roof. Higher mains water savings can be achieved by biologically treating the rain water and by recycling grey water for toilet flushing and gardening.



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REDUCING MAINS WATER DEMAND BY TREATING AND RECYCLING GREY WATER

The European Union has been strongly recommending the treatment of waste water for re use and recycling for some time now. Many Irish people still take water for granted but the use of the word "shall" in the Directive below indicates how urgent this water issue is to the European Union as a whole.

EUROPEAN COUNCIL DIRECTIVE of 21 May 1991 (91/271/EEC) states as follows: "Article 12- 1. Treated waste water shall be reused whenever appropriate. Herr recommends the following system for sustainable buildings, especially if all of the waste water has to be treated on site anyway.

Space requirements for the reed bed on a flat site to treat the grey water for recycling for a 5 person family would need to be only 4 m2 in area. A good downhill sloping site might eliminate the need for the first pump.

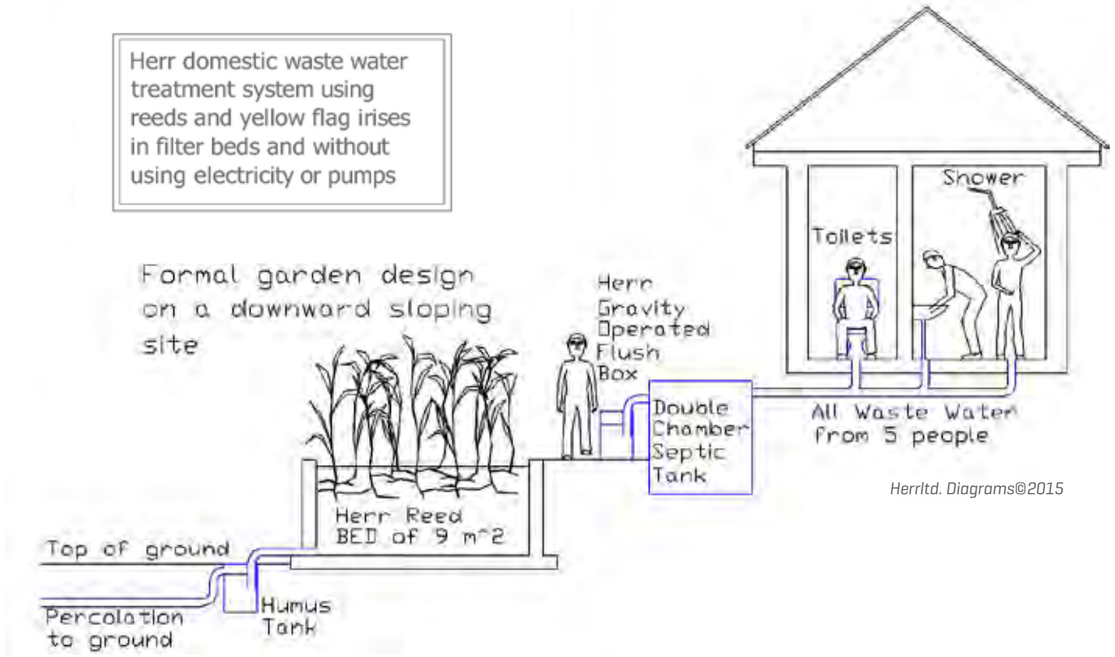
The photograph below shows a bigger 9 m2 area bed that was just recently planted. Designing as part of a formal garden with footpaths around the edges has advantages because of the more frequent inspections and the easier access for maintenance. People who like to garden will get great pleasure from a well planned formal garden that also treats waste water.

"well planned formal garden that also treats waste water"


9m² Reed bed waste treatment sysytem

ZERO ENERGY WASTE WATER TREATMENT

Where there is a downward slope on the site Herr designs and provides zero energy operated sewage treatment systems. The diagram and photo below, are of domestic systems and will provide for the basic level of sewage treatment generally required by the regulations.

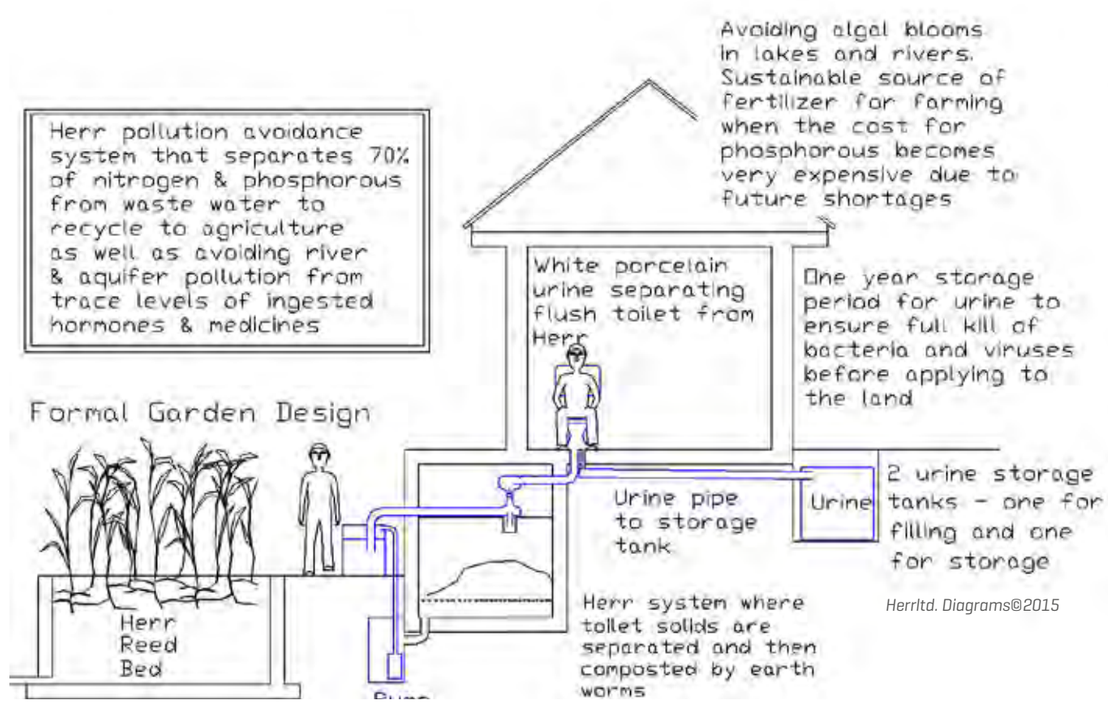


FUTURE TRENDS IN WASTE WATER TREATMENT

There can be no doubt however that there is growing pressure on Governments in Ireland to provide for higher standards of water treatment. This will require even greater increased expenditure on waste water services to also eliminate nitrogen and phosphorous discharges. High levels of nutrients cause a green algae scum to grow and bloom in Irish lakes. Added to this is the wide use of pharmaceuticals that are being proscribed. Scientists in Britain and Ireland are measured trace levels of ingested hormones and medicines at outlets of conventional sewage treatment works and along certain stretches of rivers. This is beginning to cause problems for fish and it raise questions about the long term consequences to public health from consuming water containing traces of these pharmaceutical compounds.

Domestic sewage waste treatment sysytem.

"the new concept of pollution avoidance can be safely implemented"



MOVING AWAY FROM CENTRALIZED TREATMENT SYSTEMS TO HOUSEHOLD POLLUTION AVOIDANCE SYSTEMS

For these reasons above we believe that the single house has the primary role to play in avoiding the problem of medicine and pharmaceutical discharges. Only the single home can avoid the problem by separating the grey water, the urine and the toilet solids. We believe that regulation and training should be given so that this new approach of pollution avoidance can be safely implemented. Homes that are relatively close to farms are in the best position to implement the following system.

The Herr system of "avoiding" waste water pollution is certainly the sustainable way to go since the worlds mineral resources of phosphorous rock is limited. It is estimated by some academics that within 20 years approximately the extraction rate of phosphate rock will be unable to meet the world demand for this fertilizer. This will eventually cause world food prices to rise.

A sustainable water system:

- Sustainable water systems should use as little mechanical or fossil fuel energy as possible to move water to and from the house – it should use gravity where possible
- It should recycle treated water where appropriate to reduce the demand for mains water
- It should create as little sewage sludge as possible – it should compost toilet solids locally or in each house instead
- It should require the separation of nitrogen and phosphorous nutrients from toilet waste. This should be stored on site long enough to be safely handled and recycled on local farms or nearby on bio energy crops.

Please contact Herr Ltd to discuss your future sustainable water management projects.

Ollan Herr
Herr Ltd

Contact details for project advice, survey and quotation:

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BT45 6BB

Tel: +44 (0) 28 7963 2424
Email: info@beamcentralsystems.com
Web: www.beamcentralsystems.com

Providing built-in brilliance for 35+ years, Beam Vacuum & Ventilation have been specialising in the supply and installation of central vacuum & mechanical ventilation systems to homes, commerce & industry.

Our commitment to product innovation and high level of customer care means our 70,000+ satisfied customers in Ireland & UK are confident they made the right choice in terms of product quality, performance and reliability.

From a range of units we choose the correct system to suit any home whether it's a new build, an existing property or even commercial premises and will only recommend a system that best suits the needs of the building.

We offer a wide range of highly sustainable and low energy central vacuum and mechanical ventilation systems including:

- Beam Central Vacuum Systems by Electrolux
- Mechanical Ventilation with Heat Recovery (MVHR)
- Mechanical Extract Ventilation (MEV)
- Positive Input Ventilation (PIV)

Our full vacuum & ventilation product range is showcased at our Head Office showroom in Magherafelt, Co. L'Derry and an engineer can be on hand to offer advice on any aspect of our systems. Alternatively, we provide a free 'no-obligation' quotation, site / home survey via our team of technical sales advisers and our nationwide distribution network.

Quality assurance is of paramount importance to Beam, and we are pleased to be accredited with ISO 9001, ISO14001 and OHSAS 18001 Quality Standards, as well as being an Investors in People company. Our expert installation engineers are also BPEC accredited.

Industry approved CPD presentations are available for specifiers, architects, building control officers, and industry professionals who wish to learn more about ventilation or central vacuum applications in dwellings.

Contact details for project advice, survey and quotation:

4-7 Steeple Road Industrial Estate
Antrim
Northern Ireland
BT41 1AB

Tel: +44 (0) 28 9446 2419
Email: info@camdengroup.co.uk
Web: www.camdengroup.co.uk

For over 30 years Camden has been at the forefront of the window industry, manufacturing a range of high-performance PVCu Windows and Doors to trade customers across the UK and Ireland. Based in Co. Antrim, Camden operates across 40 acres of manufacturing facilities, and has the ability to manufacture up to 10,000 frames per week. Always at the forefront of innovation, Camden have launched their own sustainable product range: Inliten Windows and Doors.

Designed and developed at Camden's on-site Extrusion Facility, Inliten is a unique and high-performance profile system that features up to 80% recycled content. Camden are committed to the environment; in fact the company's on-site Recycling Facility ensures that the amount of waste material going to landfill is reduced by up to 50 tonnes per week.

Quality is at the core of Camden's business, with full BSI/Kitemark accreditations including ISO 9001 Quality Management; the company are pleased to offer an exclusive 15 year product performance guarantee on all Inliten products.

Camden has identified and improved upon all existing PVCu products and processes to create a product range that meets the sustainability demands of the current climate without compromising on performance or aesthetic appeal.

The Camden product range includes:

- Casement and Tilt & Turn Windows
- Vertical Sliding Sash Windows
- Residential Doors
- Composite Doors
- Aluminium Bi-Fold Doors
- Double/Triple Glazed Units
- Foil & Spray Painted Frame Colour Finishes

With continuous investment in the latest manufacturing technologies, Camden are looking forward to expanding their product offering into 2015 and beyond.

Contact details for project advice, survey and quotation:

Main Street
Athboy
Co. Meath
Republic of Ireland

Tel: +353 (0) 46 943 21 04
Email: info@ecologicalbuildingsystems.com
Web: wwwecologicalbuildingsystems.com

Ecological Building Systems are at the forefront of supplying Intelligent airtight and wind-tight building product solutions and natural insulations for over a decade to Ireland and the UK. Established in the year 2000, Ecological import and distribute a range of multi award winning building products to Ireland & the UK including:

- Thermo-Hemp natural insulation,
- The Pro Clima Intelligent Airtight Systems,
- Calsitherm Climate Boards insulation,
- Thermafleece Sheeps Wool natural insulation,
- Gutex Woodfibre natural insulation,
- Dammstatt Cellulose natural insulations
- Auro Natural Paints & Finishes.

Ecological have opened a new state of the art training and demonstration area, which showcase's a range of robust airtightness and natural internal and external insulation solutions. Ecological's parent company MacCann & Byrne, is a family owned company since 1906, which are still to this day based in Athboy, County Meath, importing, manufacturing and distributing quality timber and building products to the Irish market. Ecological Building Systems technical expertise and leading range of ecological products provide the highest specifications for diffusion open, healthy, low energy sustainable buildings.

To support their range of products the company also provide:

- Airtightness & insulation specification guidance & site support
- Design guidance
- Advice on meeting Building Regulations
- U Value calculations & Condensation Risk Assessment
- Hygrothermal Modelling (WUFI) of building components
- Airtightness Installation Videos
- RIAI Accredited CPD presentations and Technical Briefings
- Airtightness specification clauses
- A Centre of Knowledge in Athboy, Co Meath
- Copies of more in-depth relevant reports and samples
- Extensive technical support on website.

The companies ethos is to achieve 'Better Building' by adopting a 'Fabric First' approach to design, with the use of more natural materials to optimise building performance, health and durability.

Contact details for project advice, survey and quotation:

Unit 16 Milltown Industrial Estate
Upper Dromore Road
Warrenpoint
BT34 3PN

Tel: +44 (0) 28 4177 3314
Email: info@enviroform-insulation.com
Web: www.enviroform-insulation.com

At Enviroform we offer 'build specific insulation solutions', whatever the problem. Our solutions are well designed technical materials, tailored to suit your building's needs. Before commencing any work, we will carry out a risk assessment and explain what we are doing in a language you can understand to protect you, your property and its commercial value. We have significant expertise in "hard to treat" properties, whether they are social housing, owner occupied or heritage. We have an insulation product for any situation – solid walls, window reveals, floors, joist ends and anywhere a cold bridge may be an issue within a building. In our systems we utilize standard XPS, PIR and Wood-Fibre insulation materials. In addition to these materials we use ultrathin Aerogel insulation in specific areas where space and performance are at an absolute premium.

Our ability to utilize Aerogel insulation, in combination with other standard insulation materials, places us in the unique position, to be able to offer a "Complete Retrofit Whole House Solution".

From that starting point, we develop a 'build specific insulation solution'.

Who are Enviroform Solutions?

Provide unique flexible solutions that are specific to your building
Have specific products to address any of the problems that you might encounter

We are able to future proof the fabric of the building
by treating all cold bridges irrespective of:

- Where they are
- What the cause is
- How old the building is or
- How complex the problem.

Contact details for project advice, survey and quotation:

Philipstown HBX
Castleblaney Rd
Dundalk, County Louth

Tel: +44 353 (0)42 9377689
Mob: +44 353 (0)86 1700569
Email: ollan.herr@herr.i.e. / reedbedsireland@eircom.net
Web: www.reedbedsirl.com

Herr Ltd offers low energy and ecological water collection and treatment designs

- We co- design ecological water and waste water systems alongside architects
- We produce drawings and specifications for self-build domestic and small community systems

Herr Ltd primarily designs and supplies components for:

- Reed bed sewage treatment systems for domestic houses and small communities
- Reed beds to treat grey water for recycling to the house for toilet flushing and gardening
- Rain water systems to retrofit into the attic spaces of existing houses
- Rain water systems that don't use electricity at all to supply water for toilet flushing

The company was formed in 1992 and was initially involved in conventional electromechanical sewage treatment systems for Local Authorities. Over the past 15 years however we have focused more on ecological approaches to our water problems. Because if its focus on customized systems Herr Ltd today is a small. Our clients generally tend to be those with an interest in gardening and composting and often have a growing sense of stewardship for the planet. We work alongside architects or the client from the earliest stages of the house design.

We have equipment and a workshop for plastic fabrication, for water tanks and plastic pipe welding. We manufacture our zero energy valves for mains water back up as well as our zero energy flush boxes for reed beds. We will soon have a demonstration room where these systems will be on display.

Contact details for project advice, survey and quotation:

The Barn Studio
64A Drumnacanvy Road
Portadown
Co Armagh, BT63 5LY

Tel: +44 (0) 28 3835 5111
Email: info@pmcarchitects.com
Web: www.pmcarchitects.com

Paul McAlister Architects have diverse experience in both public and private sector projects. Our expertise includes the whole spectrum of design from bespoke 'one off' houses to large scale housing developments and flagship commercial buildings. Our experience allows for an innovative approach to both green and brown field sites. All of our work is subject to an environmental assessment in terms of sustainability, energy conservation and green material selection.

Our philosophy is to listen to and understand our clients' needs and aspirations and to resolve them with pragmatic, elegant architectural solutions within a budget. We believe that architecture should be more than just functional, but should also add intrinsic value through excellence in design. Our primary focus is on the delivery of high quality, responsible architecture and sustainable built environments. This has promoted the development of the team's specialist skills and knowledge.

The team continues to invest in training and research in order to provide bespoke services to both the private and public sectors clients. Paul McAlister Architects has recently completed one of the first passive houses in Northern Ireland which recently came third in the Passive House Trust Awards for its 'Cost and Build-ability' at the Passive house Trust Awards in London. The practice also recently completed one of the most sustainable projects in the UK and Ireland. The award winning CREST Pavilion, which will be the first educational building in Northern Ireland that will achieve the Passive House Certification, BREEAM excellent and net zero carbon.

Contact details for project advice, survey and quotation:

36a Finnard Road
Rathfriland
Co. Down
BT34 5LB

Tel: +44 (0) 28 4063 2494
Email: info@www.qtfhomes.co.uk
Web: www.qtfhomes.co.uk

QTF Ltd. has more than 10 years combined experience in timber frame construction. The company manufactures and erects timber frame construction to the highest standards all over Ireland and is based in Rathfriland, Co. Down. QTF has expertise in both residential and commercial sectors and is reaping the rewards of the increasingly popular timber frame approach, which is being used by a high percentage of new homes in the North and Republic of Ireland.

The company sets out to differentiate itself by virtue of the high quality material and workmanship utilised and also in the comprehensive nature of its approach. The material used is high quality Scandinavian or Canadian timber, which has dry matter content higher than that of Irish timber.

From the outset, the client is advised at all stages of the process, starting with the provision of sample designs, foundation preparation and systems - based drawings, right through to the magic turning of the key. All this can be achieved in an extremely short space of time.

Timber frames are not only used in residential buildings but also in the commercial sector. QTF has gained extensive knowledge with both sectors. QTF projects are designed and constructed by structural engineers using the latest technology.

Timber Frame is of course neither new, nor specific to the market in Ireland. Indeed timber is the most commonly used building component in the world! The most versatile, sustainable and environmentally responsible building material.

Speed - With savings on time in the erection of the house, the on-site labour was significantly reduced. Savings on energy costs are independently assessed as being 40% when compared to a block built house.

Precision - Engineered interior, when the internal walls of your new home are constructed in a warm dry factory, by highly skilled timber labourers who specialise in timber frame construction, the results are 100% accurate in every single angle and every level.

Comfort - The retention of warmth in your highly insulated Timber Frame home is markedly better than traditional construction.

Contact details for project advice, survey and quotation:

80 Church Road
Crossgar, Downpatrick
County Down, BT30 9HR

Tel: +44 (0) 28 4483 0988
Email: bevanarchitects@btconnect.com
Email: tom.woolley@btconnect.com
Web: www.bevanarchitects.com

Rachel Bevan Architects was established in 1992, in County Down, Rachel Bevan, as the lead designer, qualified in 1988 and is a member of the RSUA and RIBA and is a member of the Ministerial Advisory Group for Architecture in Northern Ireland and was a member of the NI Historic Buildings Council and the Building Regulations Advisory Committee. Rachel has extensive experience in both public and private housing, tourism and leisure projects.

Tom Woolley is an Architect is involved in research, consultancy, publications and training in the field of ecological buildings. He was previously Professor of Architecture at Queens University Belfast. Editor of the "Green Building Handbook", author of "Natural Building" and Low Impact Building. The practice has been a partner with Universities in a number of research and development projects and carries out environmental consultancy work for private and public clients. We are members of The UK Building Limes Forum, the Alliance for Sustainable Building Products, Natureplus & the AECB.

We aim to

- Offer our clients a high quality professional service
- Involve clients in the design process, using simple models and CAD to help communication and understanding
- Design projects which respect the existing historic, urban or rural context
- Incorporate in our designs, wherever possible, knowledge of ecological, energy efficient and healthy construction
- To design buildings of quality that are "practical & enjoyable"

The practice works both locally and internationally. We are engaged in local networks in Down, Newry and Mourne and support a number of local social projects and co-operative and tourism initiatives. We are sustainable building consultants to Dublin City Council on the Rediscovery project in Ballymun.

International work includes Denmark, Sweden, Poland, France, Germany, Portugal, Canada and South Africa and Natureplus, the European body that certifies sustainable building materials.

NEARLY ZERO BUILDINGS

"building should be designed to reduce energy requirements"

How We Support Businesses

Through our collaborative network of small and large enterprises, academic research organisations and local government agencies we provide a unique hub environment for identifying synergies, creating business opportunities, establishing living labs and stimulating innovation. The Smart ECO Hub is EU INTERREG IVA funded and managed under the auspices of the 15 local authorities of the East Border and COMET regions in association with regional academic partners Belfast Metropolitan College, Dundalk Institute of Technology, Southern Regional College, South Eastern Regional College, University of Ulster and also the Centre for Competitiveness.

BENEFITS TO YOUR COMPANY

1. Networking Opportunities - Partnership Building
   - Seminars, workshops, site visits (general and sectoral)
   - Identifying commercial opportunities and facilitating collaborative product innovation between cluster members.
   - One-to-One introductions and referrals
2. R&D Guidance and Support
   - What's available and where
3. Start-up Support & Incubation
   - Access to expertise within the network and incubation space
4. Advocacy and Outreach
   - Represent members interests locally & internationally
5. Support & Consultancy
   - Access to expertise within the Hub team and our panel of consultants
6. Education & Information Exchange
   - Highlight new initiatives and opportunities available from government bodies, development agencies and the EU
7. Testing Facilities and Living Lab
8. Online Portal - www.SmartECOHub.com

Smart ECO Hub
innovating for a sustainable future

Creative Spark, Muirhevnamor,
Dundalk, County Louth, Ireland
Tel: 00353 42 938 5722
Email: info@smartecohub.com

Louth County Council is the managing authority of the Smart ECO Hub project.

European Union
European Regional Development Fund
Investing in your future

EAST BORDER REGION

This project is part financed by the European Union's INTERREG IVA Cross Border Programme managed by the Special EU Programmes Body.

www.smartecohub.com