NEW SERIES

GOING GREEN

YPN SAYS Whether you're doing a new build or just renovating an existing building, this month's feature in Going Green will really open your eyes to how houses should be built. If all houses were built in this way, we'd all save a fortune on energy bills as well as being healthier. Read on to find out more.

HOUSES DON'T NEED CENTRAL HEATING, IF YOU BUILD THEM RIGHT

IMAGINE HOW MUCH MONEY YOU COULD SAVE ON ENERGY BILLS!

BY **MIKE CRUICKSHANK**

Interview & Words: **Heidi Moment**

When we talk about going green, you might think of solar panels and wind turbines, but before you can even consider adding any of those to your property, you need to start with the fabric of the building and the Fabric First Principle. We met up with Mike Cruickshank to find out all about it.

Mike Cruickshank

A HOUSE WITHOUT CENTRAL HEATING, CAN THAT REALLY BE DONE?

Yes it can. It's perfectly possible to build a house that doesn't require a central heating system. With the right thermally efficient fabric and airtightness, the heat from your body, light fittings and appliances will be enough to keep the ambient temperature within the building at an acceptable level. Even in the winter.

HOW DOES IT WORK?

If you're considering building a new home, a factory or offices, there are two things you need to focus on:

1. **Making the building fabric (floor, walls, roof, windows and doors) as thermally efficient as possible.**
2. **Making the building as airtight as possible.**

The combination of the two is key. There's no point in having a very thermally efficient fabric if you're losing the heat through uncontrolled ventilation or draughts.

Better thermal efficiency + **Airtightness** = **Lower CO^2 emissions** = **An extremely sustainable property**

WHY IS IT IMPORTANT TO BUILD USING SUSTAINABLE METHODS?

Building in a more sustainable way is essential in order to minimise global warming. Reducing the usage of fossil fuels will do wonders for the environment, and quite simply for life on Earth, and we have a responsibility to future generations that cannot be ignored.

If this isn't enough to get you going to try to do your bit, then government initiatives will force your hand by making you follow building regulations which are in place specifically to help us to reduce CO^2 emissions in line with targets set by the European Commission.

Building regulations set the minimum standard you need to comply with, but the vast majority of self-builders actually build to a higher standard. Because on many occasions they're building the house they're going to stay in for the rest of their days, so ongoing running costs are absolutely key.

HOW DO WE MAKE A HOUSE THERMALLY EFFICIENT?

It's pretty technical but to try to put it simply, it's down to what we call a U-value, which measures how much heat is lost through a square meter of floor, wall, window or door. Materials that let out more heat have higher U-values. The lower the U-value, the more thermally efficient that element of the building fabric is and the lower the running costs. There's only so much heat you can lose through the fabric; there is an optimum level you need to achieve.

Passiv Haus is a German rigorous, voluntary standard for energy efficiency in a building that reduces the building's ecological footprint. It results in ultra-low-energy buildings that require little energy for space heating or cooling. Architects use the Passiv Haus principles when designing a low-energy house even if their client doesn't want to go for full Passiv Haus certification..

To put this into context, the walls of a traditional 1930s-type building would have a really high U-value with a lot of draughts, and as such you are going to spend a lot more money on heating the house. In comparison, the walls in a modern-day building will have a much lower U-value, will be more airtight and won't cost you anywhere near as much to heat.

As you can see from the table to the right, modern buildings are multi-layered, with a lot more insulation. This alone helps with the thermal efficiency.

Old building methods vs modern day methods:

1930s house	Modern day construction
Solid 9-inch (225mm) brick or blockwork wall possibly rendered externally or a cavity wall with an external leaf of 100mm brick/ blockwork	A cavity wall with an external leaf of 100mm brick or blockwork possibly rendered
50mm wide cavity (no insulation)	75mm or 100mm wide cavity filled with rigid board insulation (Kingspan/Celotex/Dritherm)
Inner leaf of brick or blockwork plastered 'on the hard' internally	Inner leaf of brick or blockwork with insulated plasterboard 'dot dabbed' internally or no insulation in the cavity (normally 50mm wide) and a timber frame inner leaf with fibreglass or rigid board insulation fitted between the framing finished internally with plasterboard

EPC RATINGS

In terms of EPC ratings, a house with a really poor EPC rating (G) is not energy efficient and would have a higher fabric U-value than something that's got a B or an A (very energy efficient). If you get a house that's B or A rated, it will have both a thermally efficient fabric and be a lot more airtight.

If you do some work on your building to make it more thermally efficient and airtight, you can improve (lower) the U-values and increase your EPC rating as a result. It's much harder to improve the thermal efficiency and airtightness of an older building, but it can be done and the benefits in reduced energy bills can be massive.

WHY DO YOU CHOOSE TIMBER FRAME CONSTRUCTION?

The four most popular build methods used these days are:

- **Brick and block (traditional construction)**
- **Timber frame construction**
- **SIPS (structural insulated panel system)**
- **ICF (insulated concrete formwork)**

I am very much an advocate of timber frame construction. To start with, timber is the most sustainable building product known to man. For every tree that's chopped down to build a house, at least three trees are planted. It's almost like crop regeneration, so it's a very green form of construction.

"Timber frame is the greenest form of construction"

WHAT SPECIFIC ELEMENTS DO WE NEED TO CONSIDER?

Floors

In the past most floors were suspended timber floors, where you had floorboards onto joists, with a minimum 150 millimetre or six-inch ventilation gap measured from the underside of the joists to the solum, in order to keep the timbers dry. When access for the disabled regulations changed, builders started to build with concrete floors and this trend has continued. Beneath the concrete slab is rigid insulation typically 60-150mm thick (dependant on what U-value you intend to achieve), an upstand of rigid insulation at the perimeter of the external walls and concrete slab (to break the cold bridge) and a damp proof membrane to prevent any dampness. Unlike suspended timber floors, draughts can't penetrate a concrete slab into the property so this substantially improves your thermal efficiency and airtightness.

Walls

To get the best thermal efficiency in your walls, you need to insulate well. The wall panels can either be supplied open (where the insulation is fitted on site) or closed (where the insulation is fitted in the factory). Insulation, either fibreglass quilt or more commonly rigid board insulation is fitted between the timber frame studding, a vapour control layer/air barrier is then fitted to the internal face of the studding, sometimes a timber service zone batten is fitted (making it easier for running services without perforating the vapour control layer/air barrier) and then plasterboard is fitted.

To avoid the inevitable gaps between the studding and insulation I recommend using a system on the market that has the insulation injected in the factory – there are no gaps between the studding and insulation, which provides a more thermally efficient and airtight wall. **Another benefit of this system is that it uses recycled vegetable oil for the insulation, so has the same Green Guide rating as sheep's wool as it doesn't have any nasty chemicals in it. Now, you don't get much better than that!**

It is very common to clad the inner leaf of timber frame with an external leaf of brick or block or reconstituted natural stone, timber, cement boarding or metal cladding with a cavity between the two leaves. This provides a rain screen to the timber frame and adds another layer to the wall, which in turn helps with thermal efficiency too.

LENDING LOOPHOLES

"You may need an external leaf of brickwork to satisfy the lender"

Be aware that although it is perfectly possible to clad the entire property in timber, as they do as standard in Scandinavia, UK lenders (banks/ building societies) aren't quite so receptive to this yet, and they still like to see an external leaf of brickwork. So if you go with only timber the number of lenders available to you may reduce. Silly really as timber has been the prime source of building shelter materials since cave man days, but that's just how it is, for now.

Roof

"A cassette-format roof gives maximum insulation, a vaulted ceiling and allows an eye-catching glazed gable end to be formed"

The thermal performance of the roof is absolutely key, given that heat rises. There are many ways the roof can be formed with timber frame and it all depends on the style of the house and if the roof will be used as liveable space.

If the roof space is not to be liveable space then the most common way of forming it is by using pre-fabricated roof trusses which allow for light storage for the likes of travel cases, Christmas decorations etc. Once the underside of the trusses have been clad with plasterboard, fibreglass insulation is laid between them and then another layer or layers is cross laid to the thickness required to achieve the designed U-value.

If the roof space is to be liveable space then you can use either pre-fabricated attic/ room in the roof-type trusses or roof cassettes, manufactured in a factory and delivered to site in panels that fit together like a big jigsaw. Like the walls, the roof cassettes can be supplied with no insulation fitted (open) or with the insulation factory fitted or injected (closed).

Windows and doors

"Budget for triple-glazed windows if you can"

Windows and doors are a high-cost element, and it's worth spending some time deciding on the right windows and doors for your house. Again, U-value is the key here. But always check whether the U-value that is quoted is the centre-pane value or the whole-unit value. There's a subtle difference between the two. It's the whole unit value you want to be looking at.

Most windows these days are at least double glazed. Triple glazing is a fair bit more expensive and has a longer payback but if your purse can afford it, you should consider triple glazing.

DOES BUILDING IN THIS WAY COST A LOT MORE?

"Timber frame is cheaper and quicker than building a brick built house"

You might think so, but it actually doesn't. Timber frame construction is cheaper than a brick and block built house, and as such, more and more developers are starting to build using timber frame.

Building with timber frame is also much quicker. It can literally be wind/watertight within days, and the electrician, plumber and heating engineers can then be inside doing the first fix right away, rather than in a brick built property where it can take weeks to get the wall to head level before the roof can be fitted and you can't do anything on the inside until it's wind/watertight.

The brickie is taken out of the critical path, which dramatically reduces programme delays caused by inclement weather conditions, particularly in the winter months where conditions can put a complete stop to building. That's one of the reasons why in Scotland around 80% of houses are built using timber frame construction, as we tend to have a bit more inclement weather up here.

WHAT DO WE NEED TO KNOW ABOUT AIRTIGHTNESS?

It's no good having a thermally efficient building that isn't airtight, as you will get uncontrolled ventilation/draughts and lose heat. So getting the airtightness right is a must.

Building regulations on new build developments now require houses to have an air test to establish how airtight the building is. In very simplistic terms, this test pressurises the house by fitting a frame incorporating a fan in the front door, which is connected to a computer to monitor the speed the fan has to operate at to maintain the pressure. The quicker the fan has to operate the less airtight the house is and if the fan is just ticking over and hardly turning at all, then you've got a very airtight house. The test gives you an airtightness figure, which is then used in the SAP (standard assessment procedure) calculation, and influences your EPC rating.

A recently built modern house would probably be in the region of 5 to 8, which isn't great, but it isn't that bad either. Regulation wise, it can't be any more than 10. If you're looking at Passiv Haus standards, it has to be less than 0.6, so you can see how much work you may have to do to hit the high standards.

WHAT ABOUT VENTILATION AND CONDENSATION, A COMMON PROBLEM WITH RENTAL PROPERTIES?

With many older properties you can end up with condensation issues, that sometimes tenants wrongly refer to as damp. Normal everyday living generates moisture, just by living, breathing and cooking. Not to mention drying clothes, taking a shower and other things that increase the moisture levels in a room. This needs to be ventilated out somehow, and if it isn't you can start to get mould growth in cold spots or places where there is not much air circulation, such as in your wardrobe.

"The more airtight the building, the more important it is to look at the ventilation"

WHAT AIR VENTILATION SYSTEM WOULD YOU PUT INTO A NEW BUILD PROPERTY?

"Filtered air improves ventilation and creates a healthier living space"

When you're building a modern-day house, if you're getting down to airtightness levels of 5 or less, then you've really got to consider putting in some form of controlled ventilation system. If you want minimal running costs you wouldn't have trickle vents on the windows, as you are losing all that warm air you've paid to heat up, so you may as well throw money out the window.

Instead, you'd be looking to install a mechanical ventilation heat recovery system (MVHR), which extracts the moisture-laden air but preheats the fresh cold incoming air by means of a heat exchanger. So you don't have cold drafts coming in from your window, and you can maintain the temperature at an acceptable comfortable level, without having to turn your heating up (if you've got heating).

The other benefit with this kind of system is that the fresh air that's introduced is filtered air. This is great news for anyone in the family who has bronchial problems, as it can filter out pollens and dust, so you end up with a very healthy living environment.

You could put a mechanical ventilation heat recovery system into an existing house, but for it to be efficient you'd need to have an airtightness level of about three. So in an existing property it pays to get the airtightness right before you start to think about ventilation.

WHAT ABOUT ENERGY COSTS?

The energy bills are a fraction of what you would expect for a typical house. In a typical house, your main energy consumption is to provide your space heating, i.e. your central heating. Building in this way means you will only really need to heat the water. Costs for this will be minimal too as the PV panels will provide the free solar energy to heat the water.

"The energy savings are huge, and you see the returns immediately"

SO, DO YOU REALLY NEED NO RADIATORS?

It's absolutely true that you can build a house with no radiators and in some cases, no heating at all, depending on the client's requirement and how it is designed. That said, self-builders often like to install underfloor heating on the ground floor, often powered by an air source heat pump, which works a bit like a refrigerator in reverse, by extracting the heat from the external air, compressing it to raise the temperature of it, then using it to power the underfloor heating and the domestic hot water.

Having heating on the ground floor only is sufficient. As the heat rises it will be contained within the highly thermally efficient fabric of the building and the first floor will stay warm. So no radiators are required on the upper floor. Although I would always recommend the installation of heated towel rails in the bathroom/ensuites too, as you will still need to dry off your towels!

The fabric of a building can't contribute to provide domestic hot water though, so solar photovoltaic panels can be used on the roof. These take advantage of the solar gain and turn it into energy (electric), which is then used to heat up the water in a heat store, instead of using a standard central heating boiler.

WHICH SPECIALISTS DO YOU NEED TO HELP YOU WITH THIS?

The two key people to have on board are an architect/architectural technologist and a timber frame supplier or SIP supplier – both of which understand the importance of thermal efficiency and airtightness and if they're a Passiv Haus qualified designer, then even better, as these are the highest standards in the industry right now.

Try to avoid manufacturers who will only supply you with a structural shell and are not really interested in what you do with it or what airtightness levels you will achieve. Look for a timber frame manufacturer who provides closed panel systems, where the insulation has been fitted in the factory under controlled quality monitored conditions and will achieve excellent levels of airtightness just by the very nature of how the panels go together.

With regards to fitting, you don't want to be a guinea pig, so choose a builder who has installed these kind of panels before and who understands the principles of what you are trying to achieve. As you would expect, there's some fairly intricate detailing required at all the panel junction points in order to minimise air loss. Windows and doors need to be installed correctly too and there are various tapes and sealants that can be used in order to make them more airtight. Work with someone who has a good understanding of that.

WHAT WOULD IT MEAN IF ALL HOUSES WERE BUILT LIKE THIS?

It would be fantastic if all houses were built like this. Energy consumption and the usage of fossil fuels would decrease, which would be so much better for the environment. But that's not the only benefit. We would all save money from reducing our energy usage, so could potentially afford to live in larger houses. We'd also profit from the health benefits that come from eliminating damp and condensation issues.

In terms of modern-day building, highly thermally efficient, well ventilated, airtight healthy buildings are absolutely the way forward, for our children, and their children, and so on. Let's start now.

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Now listen to the full interview with Mike

http://bit.ly/2C7hrc2

If you're doing a self-build project and want to learn from an expert, contact Mike to find out more about his self-build course: ***'The Easy Path to Self-Build Success'***. Covering everything from finding and assessing your plot, design and construction methods, to contracts and capital gains tax, and more.

Have you used green building methods or green energy on one of your projects? If so, please get in touch. We'd love to share your story too. Please contact me at **Heidi@yourpropertynetwork.co.uk** for more information

CASE STUDY

DENWELL COTTAGE

The property

A 305 sq m self-built house in Aberdeenshire, built by a company called Cairnrowan Custom Homes.

Products used

- Scotframe Val-U-Therm Plus Wall and Roof System cassette, pre-injected with high-performance insulation.
- Timber stud framing internal walls, cladded both sides with plasterboard and acoustic insulation to reduce sound from room to room.
- Floor cassettes came in panels, and were craned into position.
- Zehnder mechanical ventilation heat recovery system.
- Daikan air source heat pump with a combined internal unit.
- Underfloor heating on the ground floor only. Solar photovoltaic panels on the roof.

The numbers

Preliminaries:	£47,700
Foundations:	£53,000
External walls & windows:	£164,300
Roof structure & covering:	£21,200
Internal walls:	£26,500
Floor, wall and ceiling finishes:	£21,200
Joinery and fittings:	£47,700
Plumbing & heating (incl. bathroom and kitchen):	£68,900
Electrics:	£15,900
Decorating:	£31,800
Fees:	£26,500
External Works:	£5,300
Total build cost excluding plot:	£530,000

Timings 12 weeks from start to finish – which is astonishingly fast!

Airtightness level 0.38 (Remember a Passiv Haus is less than 0.6, so 0.38 is exceptional!)

EPC energy rating 97%

Primary Energy Indicator 28 kWh/m²/year

Estimated energy costs for the home = **£84 per month based upon the cost of energy for heating, hot water, lighting and ventilation (calculated using standard assumptions).**

The calculated emissions for the property are 5 kg CO2/m²/yr, compared with the average Scottish household, which produces 6 tonnes per year.