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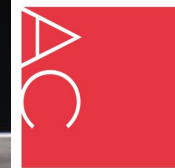
Future home standards & construction systems

Jenny Chandela





**FUTURE HOME STANDARDS & CONSTRUCTION SYSTEMS
- WITH JENNY CHANDELA**



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- 1. The current problem**
 - 2. The Future Homes Standard**
 - 3. The Fabric First Approach**
 - 4. Construction systems**
 - 5. Passive House**
 - 6. The design process**
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The Current Problem



The Current Problem -

1. We have a massive shortage of housing in the UK and the current housing stock is sub-standard in design and energy performance
2. The major house builders who control the delivery of new homes are focused on volume rather than quality (EPC less than C)
3. Heating and powering homes accounts for over 20% of all greenhouse gas emissions in the UK
4. The construction industry accounts for over 10% of all greenhouse gas emissions in the UK



“Put simply a green or low energy home that from design, technologies and construction method uses less energy, from any source, than a traditional or average new house.”

What do we mean by a Green Home



These are examples of low energy homes-



These are examples of low energy homes-



These are examples of low energy homes-



These are examples of low energy homes-



These are examples of low energy homes-



This is not -

**THIS IS NOT GOOD
ENOUGH.....**



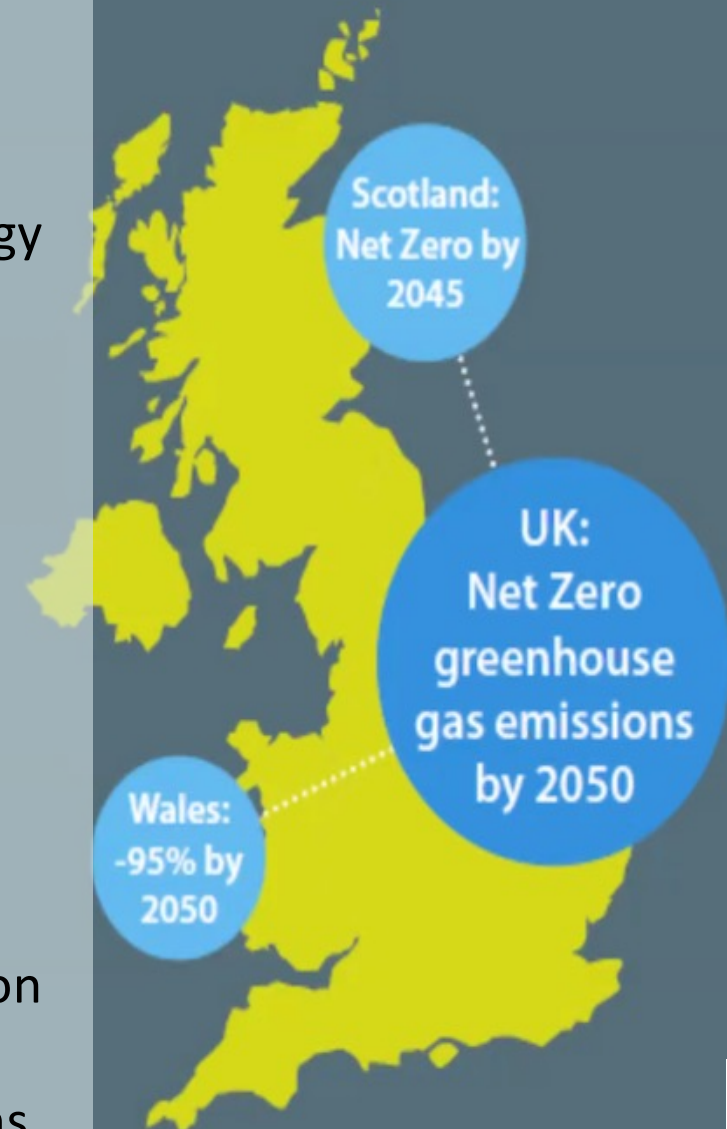


The Future Homes Standard



The Future Homes Standard -

1. We need 250,000 new homes per year
2. Custom & Self build's lead the way in design and energy performance
3. Future Homes Standard 2025 –
 - A major review of the Building Regs (Part L - conservation of fuel and power, Part F – ventilation)
 - Drive towards Net Zero Carbon dwellings
 - Remove fossil fuel boilers
 - Improvement in U values
4. RIBA Climate Challenge 2030 –
 - 50% Reduction in Operational Energy & Carbon Emissions
 - 40% Reduction in Embodied Energy & Carbon Emissions
 - 40% Reduction in potable water usage
 - Low Carbon Heating, no fossil fuel boilers



The Future Homes Standard -

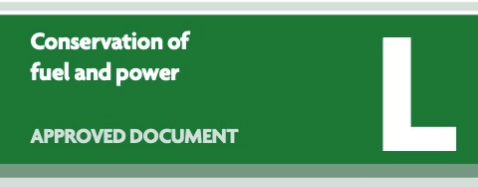
1. Its better for the environment, by reduced carbon emissions during construction
2. Its better for the environment, during operation due to the reduced energy demand
3. Typically 40-80% betterment in building standards than current housing stock
4. Reduced running costs over the life of the house
5. Potential for zero or positive energy bills
6. A more comfortable, healthy built environment

The Future Homes Standard - timeframe

1. The new Future Homes Standard is aimed to ensure that all new homes built from 2025 will produce 75-80% less carbon emissions than homes delivered under current regulations.
2. New homes built from 2022 produce 31% less carbon emissions compared to current standards. Building Regulations are planned to be updated later this year.

From 2025 no new homes should be connected to the gas grid, they should instead be heated through low carbon sources, have ultra-high levels of energy efficiency alongside appropriate ventilations.
(Committee on climate change)

The Building Regulations 2010



Volume 1: Dwellings

Requirement L1: Conservation of fuel and power

Requirement L2: On-site generation of electricity

Regulations: 6, 22, 23, 24, 25, 25A, 25B, 26, 26A, 26C, 27, 27A, 27C, 28, 40, 40A, 43, 44 and 44ZA

2021 edition – for use in England

Building standards technical handbook 2020: domestic

Published: 2 Dec 2020

Directorate: [Local Government and Communities Directorate](#)

Part of: [Building, planning and design](#)

ISBN: 978-1-78544-328-2

The building standards technical handbooks provide guidance on achieving the standards set in the Building (Scotland) Regulations 2004. This handbook applies to a building warrant submitted on or after 1 March 2021 and to building work which does not require a warrant commenced from that date.

Supporting documents



Building standards technical handbook 2020:
domestic

455 page PDF
19.5 MB

Download

"Is a back to basics approach where you concentrate on the fabric of the building before throwing eco bling, in order to make it work."

The Fabric First Approach



Fabric First Design Principles -

1. Highly insulated building envelope with limited cold bridges
2. High specification windows & doors
3. Air tight membranes and tapes used to seal all external walls and penetrations
4. MVHR system providing fresh heated air throughout the home, potentially with a heating element
5. Maximise the natural solar gain through building orientation
6. Utilise a small renewable led heating system



THE KEY ELEMENTS

1. Solar Gain
2. Construction Type
3. Air Tightness
4. Limit Cold Bridging
5. Ventilation Strategy
6. Heating Systems



Construction Systems



The main considerations

Questions you have to ask yourself –

1. How much involvement are you having in the project?
3. What is your budget?
4. Is energy performance important to you?
5. Is speed of build a factor?



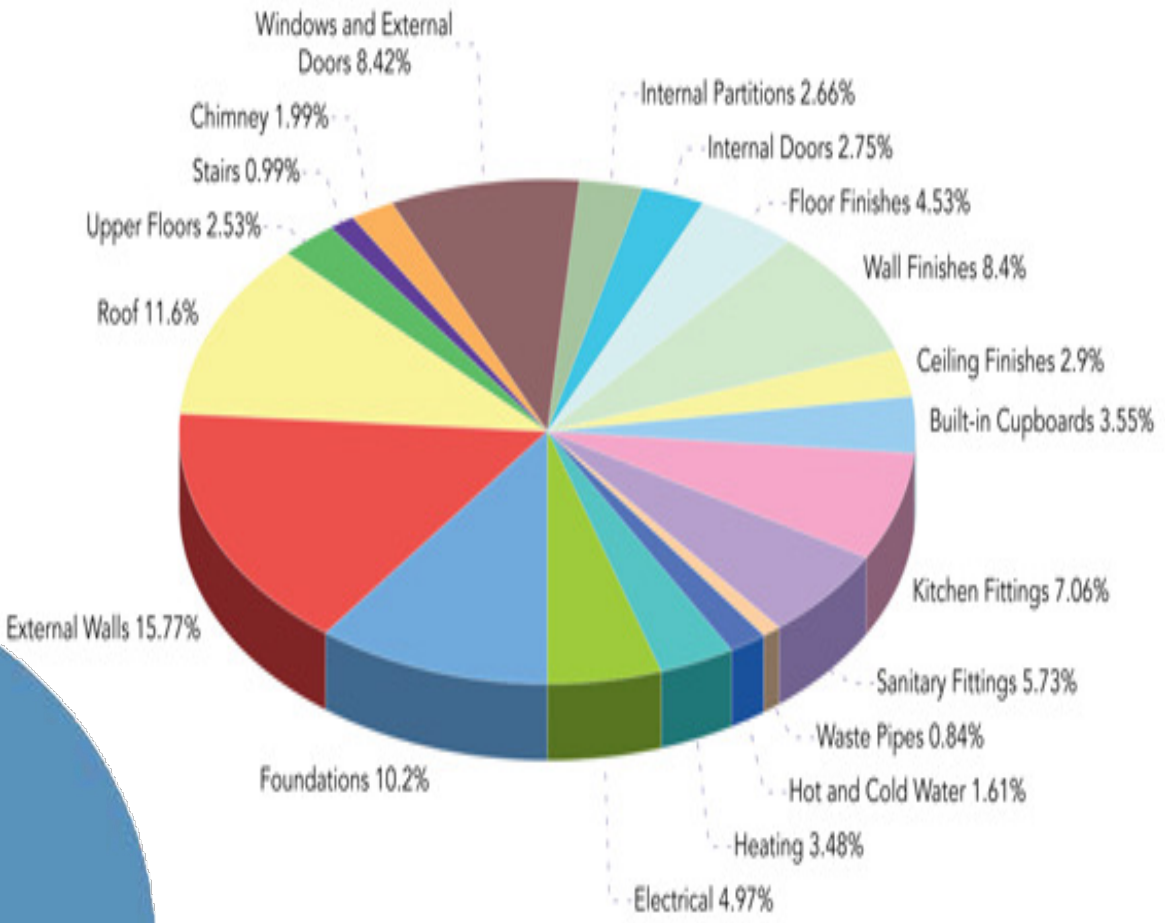
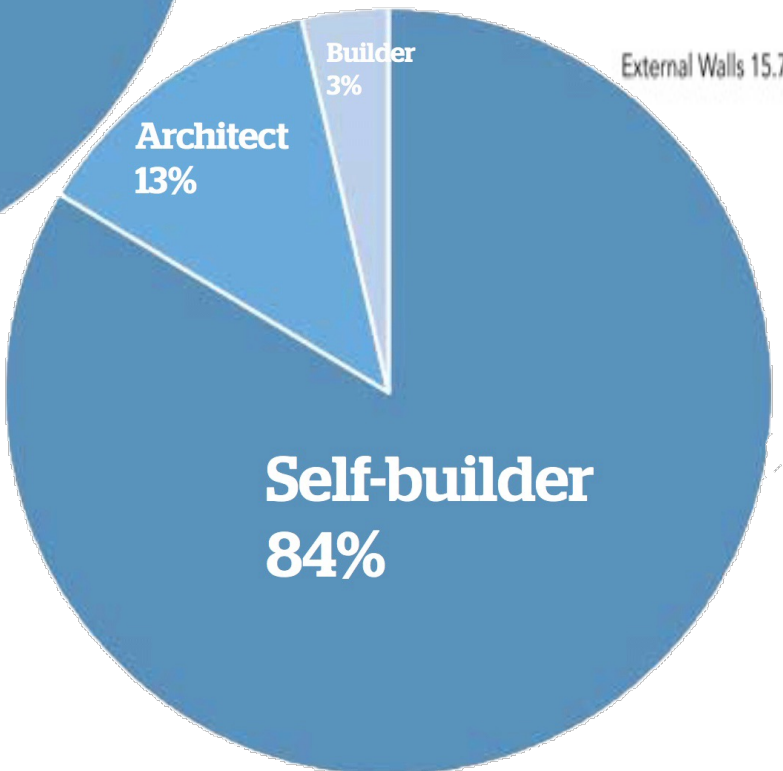
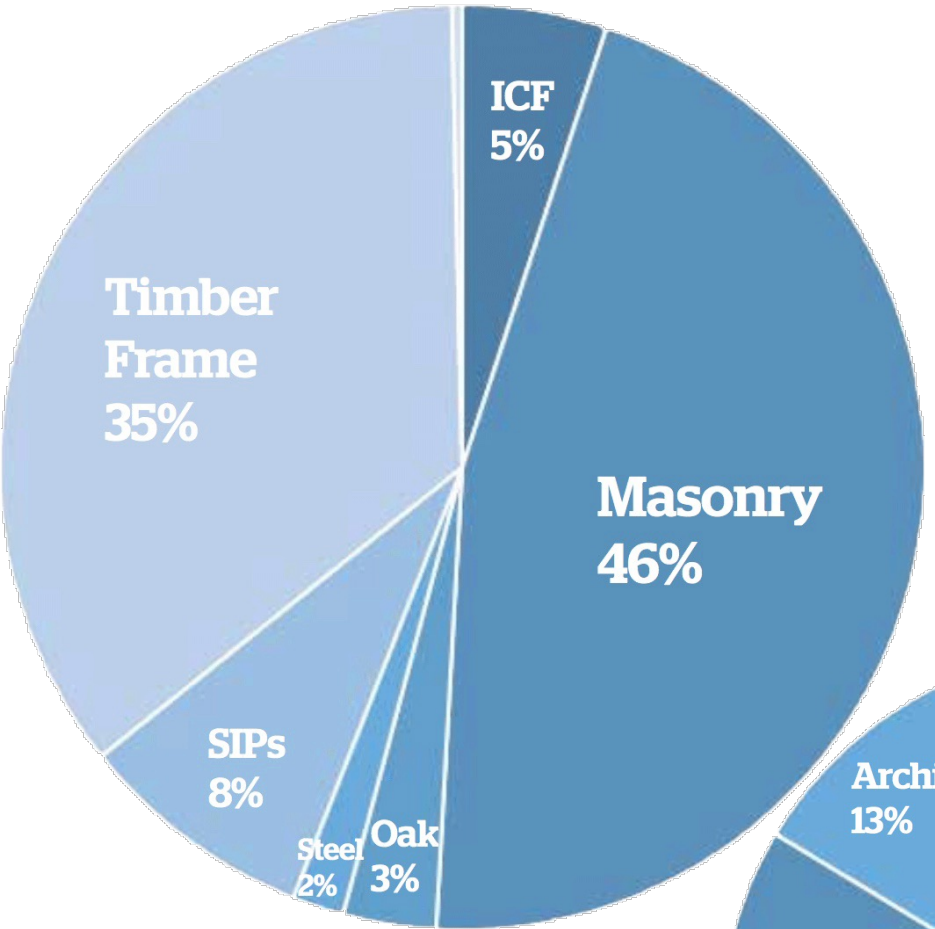
SAP – Standard Assessment Procedure

Basic Energy Performance Criteria

	England /Wales Section L	Scotland Section 6	Fabric First Targets	Passive House
Wall U-value (W/m ² K)	0.18	0.17	0.15	below 0.15
Floor U-value (W/m ² K)	0.13	0.15	0.15	below 0.15
Roof U-value (W/m ² K)	0.13	0.11	0.15	below 0.15
Windows/openings	1.4	1.4	1.2	1.0
Air permeability	5 (m ³ /hr/m ² at 50 Pa)	7 (m ³ /hr/m ² at 50 Pa)	1.5 - 3 (m ³ /hr/m ² at 50 Pa) MVHR required	0.6 air change rate @50 Pa pressure difference MVHR required

U – value – Measure the ease which a material or building assembly allows the heat to pass through. **The lower the U-value the better the insulation properties.**





Construction overview



1. Masonry

Details – brick outer skin, with cavity either full or partial fill insulation, aircrete block inner skin. Timber truss roof

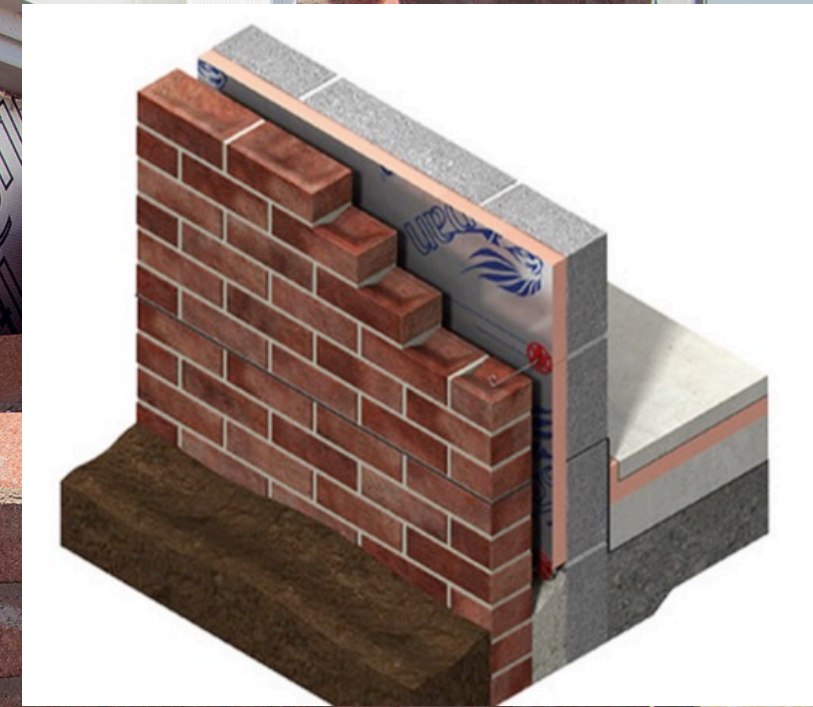
Market share - 46% (down from around 70%)

Time to wind & water tight – 20 weeks approx.
[current market pushing to 27-30 weeks]

Cost – cheaper than off site alternatives

Pros – traditional solid and safe. No issues with building fire. Cost effective and its what most architects know. Excellent thermal mass.

Cons – Very slow compared to off site
Not the preferred option for low energy homes. Thick build up



2. Timber frame

Details – timber studwork with an external OSB or plywood board nailed to it. Insulation friction fitted between the studs. OSB lined externally with a breather paper & internally with a vapour barrier.

Market share - 36%

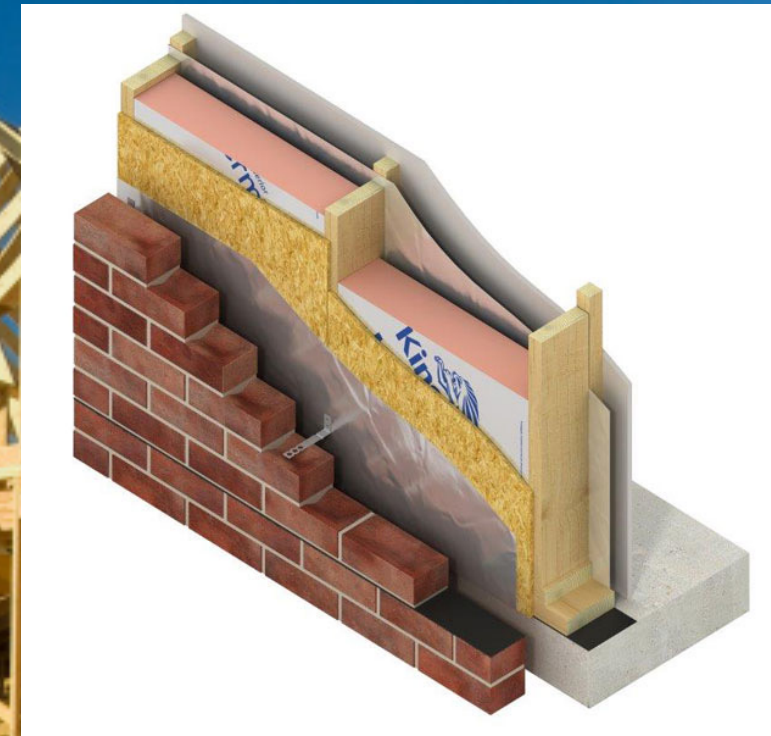
Time to wind & water tight – 10 weeks approx

Cost – open panel system cheapest, comparable to masonry

Pros – fast and cost effective way of building, good insulation levels. Lots of suppliers and choice.

Has been the standard choice in Scotland for many years. No issues with insurance or mortgageability.

Cons – Perceived fire issues, can seem lightweight. Settlement of timber can cause cracking



3. SIPs (Structural Insulated Panel)

Details – 2 skins of OSB are filled with either polyurethane (mix) or rigid polystyrene, infilled with timber to create closed panel. External breather membrane internal vapour barrier. Timber or mini SIPs structural splins. Wall & roof panels are the same.

Market share - 8%

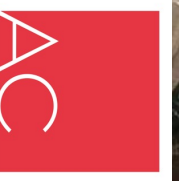
Time to wind & water tight – 6 weeks approx

Cost – 10 - 15 % more expensive than timber frame

Pros – fast and cost effective if designed to panel sizes, excellent insulation levels. Airtight, ideal for fabric first or Passive House.

Huge spans, no roof trusses – vaulted ceilings. No issues with insurance or mortgageability.

Cons – Perceived fire issues, requires crane for roof. More expensive than alternatives



4. ICF (Insulated Concrete Form)

Details – Lightweight hollow interlocking blocks, usually made from polystyrene or PU insulation. Dry stacked, reinforced with steel rebar and filled with concrete (floor by floor). Lego blocks for grown-ups

Market share - 5%

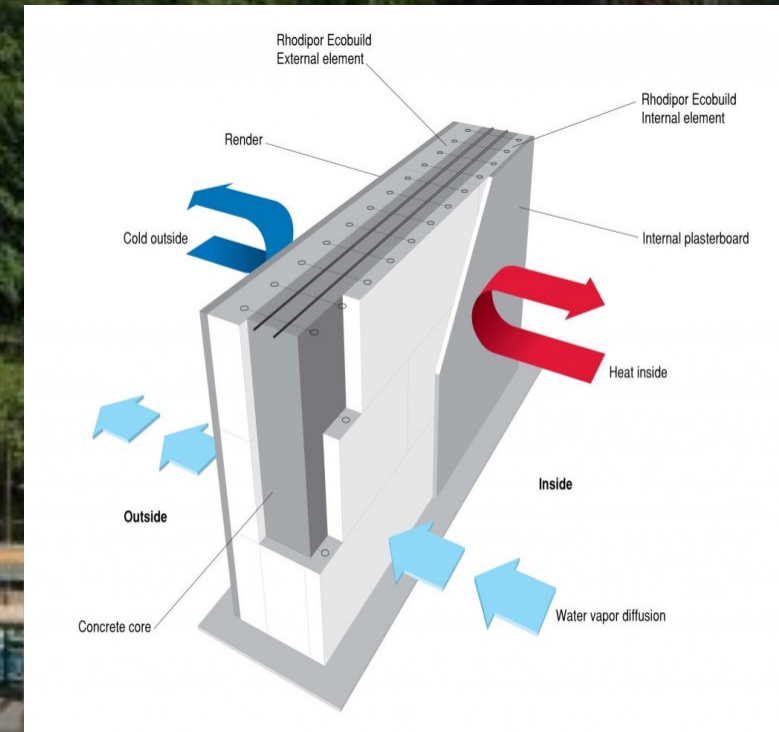
Time to wind & water tight – 10 weeks approx

Cost – 10 - 15 % more expensive than masonry.

Pros – fast and cost effective especially if you stack the blocks yourself. Excellent insulation levels. Airtight, ideal for fabric first and Passive House.

Ideal for basements. Rigid and solid. No issues with insurance or mortgageability.

Cons – The pour is critical (burst blocks), more expensive than block. Alterations, extensions can be difficult. No full house solution.



5. Oak Frame

Details – Green Oak frames are cut and shaped off site, & erected by experienced team on site. Structural frame is then encapsulated with an insulated envelope, often SIPs.

Market share - 3%

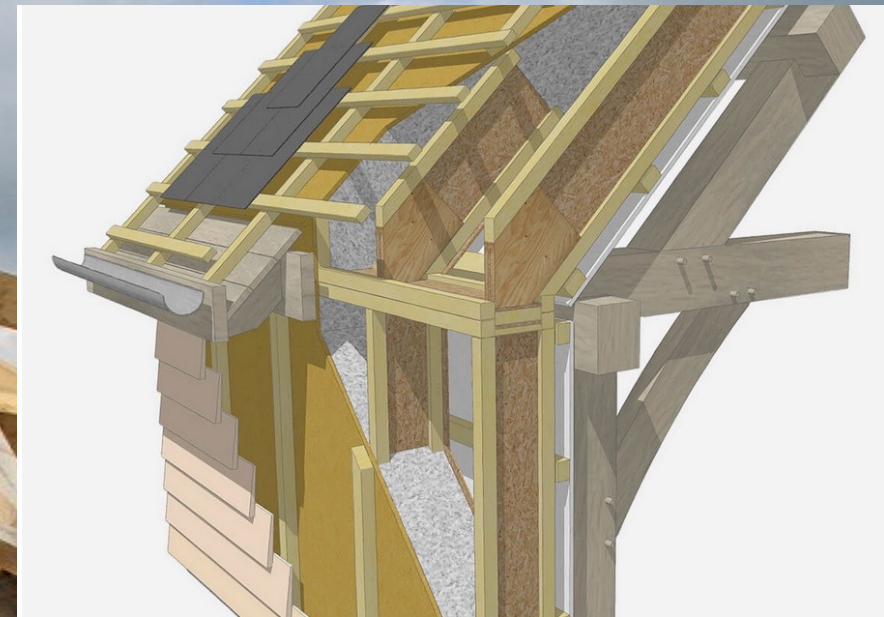
Time to wind & water tight – 10 weeks approx

Cost – The most expensive method.

Pros – can be relatively quick to erect kit & encapsulated. Perfect for more traditional designs. Can expose timber internally & externally. High performance given the right encapsulation.

Can use part frame in exposed areas.

Cons – expensive and you are doubling up on structural frame. Frame will move and shrink due to high water content, requires cleaning with Oxalic acid once erected. Specialist designers.



6. Solid Wood Construction

Details – Ecological Construction option. Solid wood modular construction method. Kit detailed offsite and arrives in small packages to site.

Time to wind & water tight – 12 weeks approx

Cost – 10 - 15% more expensive than timber frame

Pros – Low Carbon Footprint. Renewable raw material sustainable development. Carbon sink. Efficiency of production (processing). Natural ideal humidity.

Cons – Specialist design, limited providers.



7. Alternatives

Straw bale



Steel frame



CLT



How to Choose

1. Do your research & decide which construction method best suits your requirements – budget, speed, thermal performance etc
2. Then select and get at least 3 quotes from manufacturers of that construction method (builder or factory). Look around their factory, visit ongoing sites, speak to clients. Also check Companies House.
3. If you are using off site manufacturing, try and find a company that has everything in-house. i.e. drawings, manufacturing and site teams (not all outsourced).
4. Negotiate a fair price and agree on a fixed cost and timeframe. Make sure you go over the quote to understand all the details.
5. At the end of the day choose a company you feel comfortable with!



Passive House Principle

“A Passive house is a building in which a comfortable interior climate can be maintained without active heating and cooling systems. The house heats and cools itself, hence the term passive”. – Wolfgang Feist.

Passive House



The background to Passive House Design -

1. The Passive House standard was developed in Germany in the early 1990s by Professors Bo Adamson of Sweden and Wolfgang Feist of Germany and the first dwellings to be completed to the Passivhaus Standard were constructed in Darmstadt in 1991.
2. Passive House is the fastest growing energy performance standard in the world with 65,000 buildings built to date.
3. The Passive House standards strengths lie in the simplicity of its approach; build a house that has an excellent thermal performance and high airtightness with mechanical ventilation.



Passive House Energy Standard -

A robust energy performance specification – **mandatory technical requirements**

1. **Airtight Construction** <0.6 air change rate @50 Pa pressure difference

2. **Maximum Heating (or Cooling) demand** <15kW/m²yr or alternatively the heating load must be smaller than 10W/m².

3. Maximum Energy demand <120 kW/m²yr or the primary energy renewable demand is limited to 60 kWh/m²yr

Understanding Passive House is about a lot more than these numbers.

PH standard – not only an energy standard but intended to be a holistic design process.

1. Airtightness



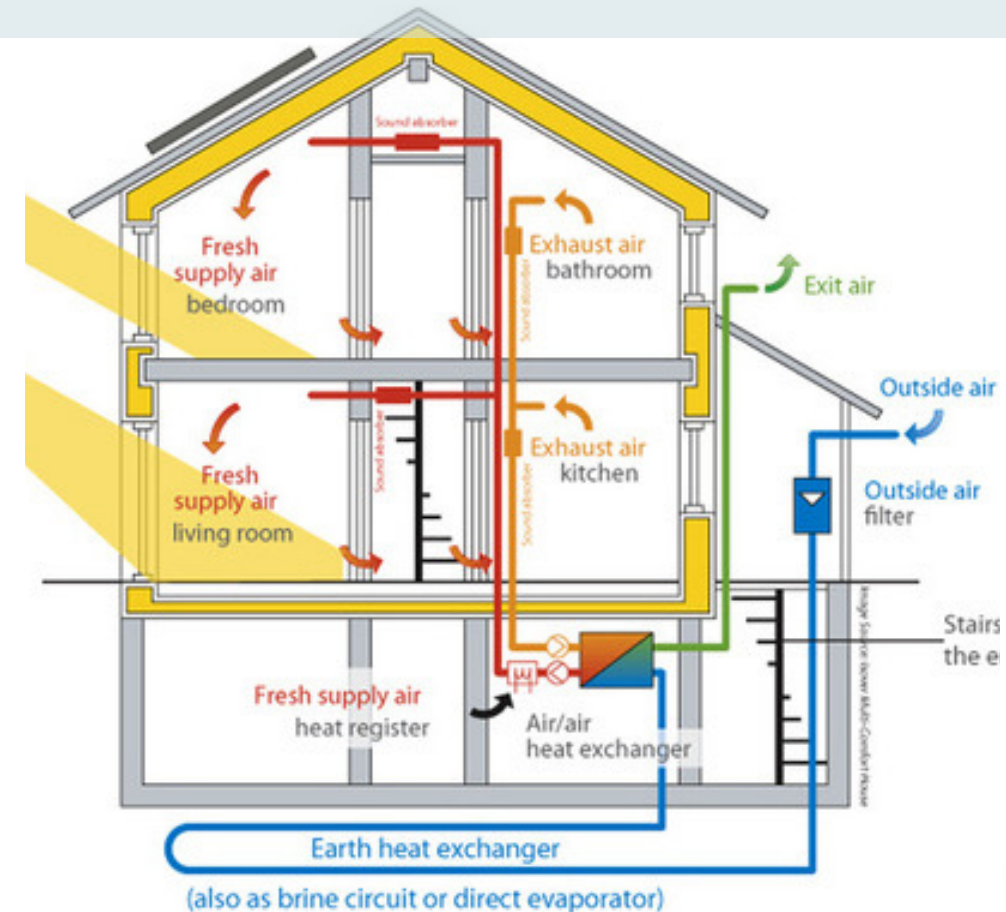
2. Passive House standards vs building to current Building Regulations & Fabric First Approach

	England /Wales	Scotland	Fabric First Targets	Passive House
Space Heating Demand	140kWh/m ² per year No energy standard defined in Building Regulations	140kWh/m ² per year No energy standard defined in Technical Handbooks if Gas/Oil/LPG used renewable energy is required (PV's)	Around 40 kWh/m ² per year PV's & ASHP recommended	15 kWh/m ² per year PV's & ASHP recommended

The Passive House Key Design Principles –

1. High levels of insulation (fabric)
 - Walls, roof & floor $<0.15 \text{ W/m}^2\text{K}$
 - Openings $<1.0 \text{ W/m}^2\text{K}$
2. No thermal bridges
3. Passive House Windows (Solar Gains/Shading)
4. Design Form & Form Factor
 - avoid complex forms
5. Thermal Comfort- Constant internal temperature
 - not feeling too cold or too hot. Ambient temperature = 20°
 - Airtightness & good indoor air quality
30m³ per person per hour achieved by highly efficient MVHR system
 - Overheating Limit
 - Ambient temperature of above 25°C <10% per year

Except for the airtightness, which is measured on site, all these figures are obtained by calculation with the PHPP design tool.



Economics , life cycle costs -

1. Professional Design fees from specialists & certification route (approx. £5,000)
2. Construction costs difference to traditional build (between 4 -8%)
3. Passive House with renewables is a cost-effective option for Nearly Zero Energy Buildings. This means that the benefits of a Passive House are higher than its costs in the long term.

Achieving around 75-85% reduction in running costs

Economics , life cycle costs - Summary

Invest more in:

- insulation, Passive House windows, a better airtightness level and an energy-efficient ventilation system
- planning work hours, thermal bridge calculations and quality assurance

The cost benefits on the other hands will be:

- smaller heating or cooling unit and distribution system
- Although the MVHR ventilation filters will require regularly change, maintenance and little expenditure on electricity for the fans - This is nothing compared to the money you will save thanks to lower heating, cooling and water-heating bills.
- The maintenance costs of the heating and cooling system will also be lower.





The Design Process



Initial design & planning stage -

1. Initial design ideas should be a response to the site and your brief (function before form)
2. Orientate habitable rooms due South to maximise solar gain, with utility/plant/service zones to the North
3. If going for Passive then large windows to South none on the North, also compact simple form
4. Larger more complex forms will cost more and have more junctions which will impact thermal bridging factor
5. Design with a construction method in mind
6. Limit overheating at design stage, ideally outwith building envelope
7. Once design is frozen complete initial PHPP and SAP calculations

Sto Rend Flex System on Ventec Carrier Board & ICF to be installed strictly in accordance with manufacturer written instructions and requirements and leaving 50mm ventilated cavity to 217mm SIPS panel - with Tyvec Reflex reflective external breather membrane or similar and approved approved reflective high performing vapour barrier - all junctions at SIPS panels to be securely taped before construction. Finished with 12.5mm Gyproc Wallboard Ten (10kg/m2) on 25x50mm battens.

Preformed powder coated aluminium cill with RAL colour to match Alu-clad windows and doors.

Preformed powder coated aluminium cill with RAL colour to match Alu-clad windows and doors.

Connection between SIPS structure & ICF to be as per structural engineer specifications and details.

Waterproofing to ICF structural retaining wall to be specified by Structural Engineer

Sto Rend Flex System on Ventec Carrier Board & ICF to be installed strictly in accordance with manufacturer written instructions and requirements and leaving 50mm ventilated cavity to 217mm SIPS panel - with Tyvec Reflex reflective external breather membrane or similar and approved approved reflective high performing vapour barrier - all junctions at SIPS panels to be securely taped before construction. Finished with 12.5mm Gyproc Wallboard Ten (10kg/m2) on 25x50mm battens.

Sto Rend Flex System on Ventec Carrier Board & ICF to be installed strictly in accordance with manufacturer written instructions and requirements and leaving 50mm ventilated cavity to 217mm SIPS panel - with Tyvec Reflex reflective external breather membrane or similar and approved approved reflective high performing vapour barrier - all junctions at SIPS panels to be securely taped before the membrane is fitted to limit air movement. Finished with 12.5mm Gyproc Wallboard Ten (10kg/m2) on 25x50mm battens.

TENMAT FF102/50 or similar and approved reflective high performing vapour barrier - all junctions at SIPS panels to be securely taped before the membrane is fitted to limit air movement. Finished with 12.5mm Gyproc Wallboard Ten (10kg/m2) on 25x50mm battens.

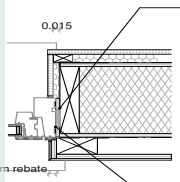
STO - Ventilated Profile - sized for 50mm ventilated cavity

STO Edge Protection Profile

Ilbruck Compriband TP600 impregnated sealing foam tape to form breathable external weathertight seal to be applied in accordance with manufacturer instructions.

Intermedia sealant (Ilbruck FM230 window sealant) to be applied to the gap between the window frame and the wall opening cavity. To be added prior to internal airtight tape being lapped over SIPS panel.

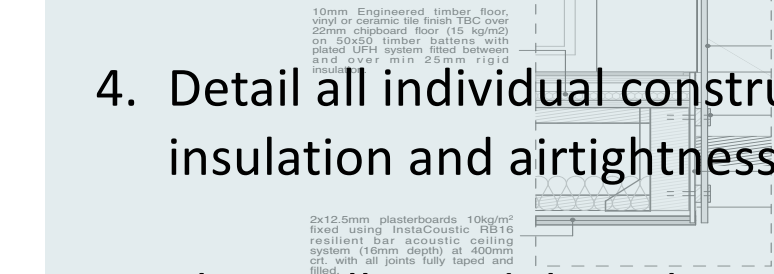
High performance Aluminium window.



Intermedia sealant (Ilbruck FM230 window thermally insulating seal foam) to entirely fill the gap between the window frame and the wall opening cavity. To be added prior to internal airtight tape being lapped over SIPS panel.

Ilbruck Compriband TP600 impregnated sealing foam tape to form breathable external weathertight seal to be applied in accordance with manufacturer instructions.

1:10 DETAIL 23 WINDOW JAMB GENERAL

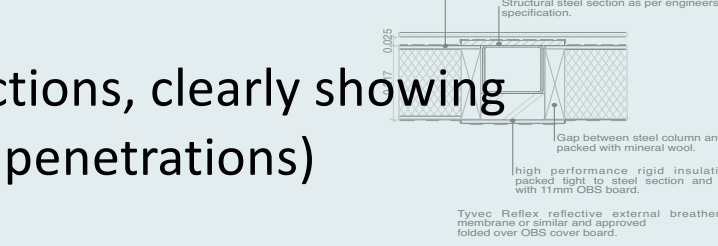


15mm laminated glass sheet as protective barrier to be 1100mm from fill, and be constructed in accordance with BS 6399: Pt 1:1996.

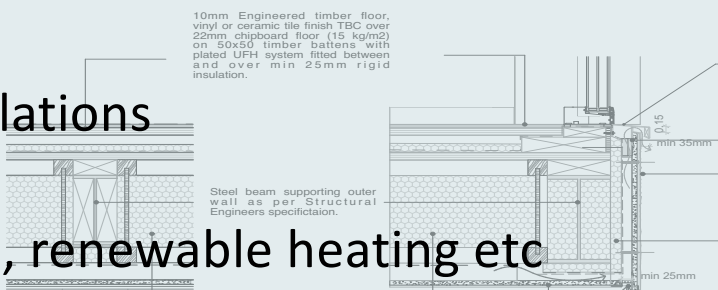
Properly sealed steel angle fixed back to steel section.

10mm engineered timber floor, vinyl or ceramic tile finish TBC over 22mm chipboard floor (15 kg/m2) on 50x50 timber battens with plated UFH system fitted between and over min 25mm rigid insulation.

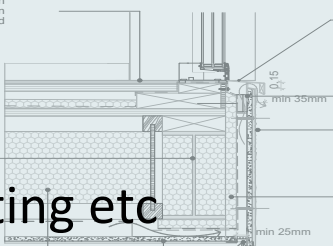
1:10 DETAIL 11



1:10 DETAIL 21 STRUCTURAL STEELWORK GENERAL



1:10 DETAIL 06



1:10 DETAIL 05

Preformed powder coated aluminium cill with RAL colour to match Alu-clad windows and doors.

TENMAT FF102/50 or similar and approved Ventilated Fire Barriers to be fitted at the edges of the cavity.

Sto Rend Flex System on Ventec Carrier Board to be installed strictly in accordance with manufacturer written instructions and requirements.

Rigid Insulation packed around structural steel/timber to have resistance min 1.14 (m2K)/W to reduce cold bridging.

STO Edge Protection Profile Ventilation profile/Insect mesh

Soffits to be finished with Sto Rend Flex System on Ventec Carrier Board to be installed strictly in accordance with manufacturer written instructions and requirements in colour as specified by the client.

10mm Engineered timber floor/ vinyl or ceramic tile finish TBC over 22mm chipboard floor (15 kg/m2) on 50x50 timber battens with plated UFH system fitted between and over min 25mm rigid insulation.

22mm chipboard floor (15 kg/m2) on 300 JLI floor at 600mm ctt, joist filled completely with high performance acoustic insulation (10-60 kg/m3). Finished with 2 no. layers of 12.5mm Gyproc Wallboard Ten (10kg/m2), to provide fire separation. Min airborne sound insulation value of 43Rw met. Fixed using InstaCoustic RB16 resilient bar acoustic ceiling system (16mm depth) at 400mm ctt.


10mm Engineered timber floor/ vinyl or ceramic tile finish TBC over 22mm chipboard floor (15 kg/m2) on 50x50 timber battens with plated UFH system fitted between and over min 25mm rigid insulation.

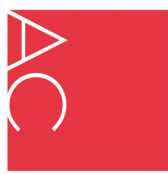
1:10 DETAIL 04

1. You should be working with an efficient design, suitable for construction
2. Appoint a suitable kit company for the fabric of the building
3. Finalise specification of all major products and materials
4. Detail all individual construction connections, clearly showing insulation and airtightness (openings & penetrations)
5. Thermally model any bespoke details
6. Review and update PHPP and SAP calculations
7. Appoint specialist design items – MVHR, renewable heating etc
8. Make sure design & specification is both buildable & economic

Amendments per building control report dated 11.05.17	SPH	16.05.17	B
Amendments per building control report dated 26.01.17	SPH	15.03.17	A
REVISION	INITIAL	DATE	SUFFIX



CLIENT			
KENNETH MCLEAN			
PROJECT			
BELMONT DRIVE EDINBURGH			
TITLE			
Details Walls/General STAGE 3 DETAIL DESIGN DEVELOPMENT			
SCALE @ A2		DATE	DRAWN
1:10		06/12/16	CHECKED
No.	187 - BW 13		
REV.	B		
LEWIS HOUSE, UN HILLEND IND ES1 FIFE, KY11 9JL			
t - 01383 e - info@aca w - www.aca			
			



On site -

1. Before you start make sure you discharge any planning or regs conditions. Also put in place any warranty or insurance policies
2. What procedures do you have agreed for managing quality on site
3. Every trade that comes on site needs to know about airtightness
4. If you are using inexperienced trades then consider Passive House Toolbox talks, at key stages –
 1. Kit sign off
 2. Window fitting
 3. Airtightness layer (VCL)
 4. Pre airtest
5. **Tape everything**
6. Any onsite changes to be run passed the design team



IN SUMMARY

1. The biggest impact on your Low Energy Home is during the initial design stages
2. Review & research all options, principles and construction methods for Low Energy Homes.
3. Define your low energy goals.
4. Detail out all of the poor traditional construction details, ie limit areas of cold bridging
5. Remember none of this matters if your designers/builders don't follow these principles!

