

CASE STUDY

# The AIMC4 Project

Fabric First, Fit and Forget Energy Efficient,  
Low Carbon House Building Envelope.



The AIMC4 innovation project was a unique award winning innovation partnership, created to research, develop, and pioneer the volume production of fabric first low-carbon energy efficient homes for the future. It stands for ‘the Application of Innovative Materials, products and processes to meet the Code for Sustainable Homes Level 4 energy performance’.

The AIMC4 consortium was set up in 2009 to develop and apply innovative materials, products, and processes to meet Level 4 energy requirements of the government’s Code for Sustainable Homes, through a fabric first approach with minimal building services and renewable technology solutions, thus building in a “fit and forget” fabric first energy efficient building envelope, delivering energy saving performance, of the dwelling in perpetuity.

The consortium members comprised: developers Stewart Milne Group (Lead Industry Partner), Crest Nicholson and Barratt Developments, which were responsible for the design and build of the energy-efficient homes; BRE, which advised on innovative solutions and evaluated the technical compliance requirements; and Stewart Milne Timber Systems, the UK’s leading timber frame manufacturer and H+H UK Ltd, a supplier of aerated concrete products. BRE Scotland analysed and evaluated the design -v- as-built performance of the homes and undertook post occupancy evaluations, assessing occupant responses and behaviours over 12 months.

The ground-breaking Government funded flagship collaborative innovative project cost £6.4 million overall: £3.2 million was invested by the government-backed Technology Strategy Board with the other the rest coming from the consortium members.




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## Core Objectives

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- To develop a better understanding of consumers, their needs and aspirations relating to low-energy/low-carbon homes and their response to a range of possible fabric focused technology solutions.
- To research and develop (collaboratively with the supply chain) new design approaches and build processes that would drive innovation in the existing supply chain and stimulate the emergence of new suppliers and partnerships.
- Accelerate the development of new building fabric technologies, materials, components, and systems, creating a supply chain capable of delivering a range of building system solutions to support a ‘fabric-first’ approach from within the UK, driving cost efficiencies.
- To design and develop a minimum of 12 homes that meet consumer needs and deliver to energy standards of Level 4 of the Code for Sustainable Homes, with a fabric-first fit and forget building envelope solution. These would be built in various locations across the UK and sold on the open market, across the three developers involved.
- To use project outcomes at all stages to broaden wider industry knowledge and capability.
- To underpin the cost-effective volume delivery of the fabric focused energy-efficient homes of the future with occupant and industry centred outputs, to meet government timescales.

The key to the success of the project was to engage with both known and new suppliers at all levels to develop design solutions and processes to deliver homes that met Code for Sustainable Homes, Level 4 energy requirements – through energy efficient fabric and minimal building services solutions, without requiring the use of renewable technologies.

Achieving this goal would not only assist in meeting the government target of zero-carbon homes by 2016, but would reduce costs, introduce new product suppliers, and supply chains, generate new construction methods, and ensure that homes were designed to meet consumer needs without confusing or costly mechanical technologies.

The project had three key stages:

1. The first was the preconstruction stage involving development of the supply chain and the design/technical specification, which were interactive and iterative processes that involved not only the supply chain but also the developers’ construction teams.
2. The second stage was delivery, i.e., the construction and marketing phase.
3. The third stage was as-built performance evaluation followed by a 12-month post-occupancy study. Dissemination of the findings was a continuous process throughout the project, via the AIMC4 website, technical papers, conferences, exhibitions, and seminar presentations, press releases and visits to the AIMC4 sites.

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## The Housing Sites and Homes Developed

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A total of 17 AIMC4 homes were built.

Stewart Milne Group built AIMC4 specification homes on three sites: two 5 bedroom detached homes were built on a site in Portlethen, Aberdeenshire; a terrace of three 2 and 3 bedroom homes was built in Prestonpans near Edinburgh; and a terrace of three 2-bedroom affordable homes was built in Preston, Lancashire, for Communities Gateway Association. The five homes built in Scotland all used variations of the SMTS Sigma® II Build System (closed-panel timber frame) whilst the three homes built in England used the more established open-panel timber-frame system, with enhanced insulation.

Barratt Developments selected a site in Corby to build four homes: one 4-bedroom detached house and one terrace of three houses (two with two bedrooms and one with three bedrooms). They were built using H+H UK’s thin-joint mortar masonry system.

Crest Nicholson built five homes: one detached and four townhouses. They have been developed at Noble Park, the site of the former West Park Hospital in Epsom, Surrey. One of the homes was constructed using H+H UK’s thin-joint mortar

masonry system whilst the other four units were constructed using structural insulated panel (SIPs) system.

Following the development of an initial technical specification, the process of finding suppliers with the potential to develop products to meet the requirements began. This involved a novel approach to engaging with suppliers that was key to the success of the project. Eco-build 2010 was used to publicise the search. The search focused not only on the construction industry, but also aimed to reach suppliers to non-construction sectors such as the automotive and aerospace industries.

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## Evaluation

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A critical part of the project was the post-construction evaluation to understand how the homes perform, not only against technical criteria, including energy efficiency and carbon emissions, but also in terms of occupant satisfaction, i.e., how happy the occupants of the homes are with their living environment.

The first stage of the evaluation was a design -v- as-built evaluation of the energy efficiency of the AIMC4 fabric performance. To understand the actual thermal performance of the fabric, co-heating and heat flux tests were carried out prior to occupation. Thermal imaging was also used during the co-heating test to identify any potential areas of thermal bridging and/or air leakage. The AIMC4 co-heating research remains one of the biggest samples, of design -v- as-built homes energy efficient assessment in the marketplace.

The second stage of the evaluation, which started in 2012, is the post-occupancy evaluation, measuring in-use energy performance and customer behaviours and perceptions. Information was being gathered to better understand lifestyles and living habits, how occupant behaviour affects a home's performance and how well the home provides thermal comfort and effective control of the building services, such as ventilation. Tailored home user guides were produced for the residents of each of the dwellings, including quick-start guides for specific technologies such as smart heating controls and ventilation systems.

All homes were subject to a comprehensive environmental audit to establish what equipment was being used in the homes and the potential energy use of that equipment. Electricity, gas and water sub-circuits were monitored. Sensors established indoor air quality, temperature levels and the impact of opening and closing windows on the overall energy analysis. A weather station put energy and ventilation use in the context of external conditions.

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## Overall Results

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The overall results for the fourteen dwellings that were monitored were that five of the homes were within  $\pm 10\%$  of the regulated energy usage shown in SAP. Four homes used less energy than SAP (76-86%) and five homes used more (up to 196%).

The learning from this research highlights some potential areas for improvement in SAP, in home design and in construction practice. For example, the triple glazed windows and waste water heat recovery systems have performed particularly well.

The results also highlight, the perhaps obvious point, that how the occupants use their homes is a major driver for their performance, and that this can have a larger impact on energy usage than the low energy design features of the homes. This shows the necessity for occupant-centred design and effective communication with purchasers.

The occupants found that the AIMC4 homes were comfortable and pleasant to live in with no indications of any health or additional maintenance issues. They were overwhelmingly satisfied with their fuel bills.

Our customers and our partners want low-carbon housing delivered at low cost and that is exactly what AIMC4 is delivering. By concentrating on a fabric-first solution we are driving important advances in materials, products and processes that will bring sustainable benefits to the house building industry and the UK supply chain.

**“This is a ground-breaking solution to develop cost-effective fabric-first solutions to low-energy homes, with the consumer at the heart of the thinking. The collaborative approach is unique in the sector and draws in the skills and talents across the industry in one common goal.”**

John Slater, Group Managing Director,  
Stewart Milne Homes

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## What is the Code for Sustainable Homes?

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In 2009, The Code for Sustainable Homes was a key part of the Government's programme to improve the sustainability of new dwellings, with a view to national targets for reducing carbon dioxide emissions and energy consumption but taking a more holistic approach by considering a wide range of environmental and social impacts of new homes. It is used in England, Wales and Northern Ireland.

The Code has six performance levels, Levels 1 to 6 – and assesses both new dwellings and the development site against



nine categories. The category of relevance to this project is the mandatory requirement for energy efficiency at Code Level 4 (see Code for Sustainable Homes, Technical Guide, November 2010, Department for Communities and Local Government), that requires an improvement in dwelling emission rates of 25% over those set out in the English Building Regulations 2010 Approved Document Part L1A (in earlier versions of the Code this used to be a 44% improvement over the 2006 Regulations – which is roughly equivalent).

At the start of the AIMC4 project it was anticipated that this dwelling emission rate would be incorporated into English Building Regulations in 2013. This was since delayed due to financial crisis, but has re-emerged as climate change pressures increase, and is now embedded in the UK Government's Commitment to Net Zero Carbon Homes.

AIMC4 was a trailblazer project, winning several innovation and energy efficiency Industry Awards. It is interesting to note that in Summer 2021 the UK government introduced Fabric Energy Efficiency Standard (FEES) as a building regulatory requirement to ensure the building fabric performance standards are driven forward and that overheating and thermal comfort is a regulatory requirement to ensure thermal comfort levels are acceptable to occupants.

AIMC4 has played a major role in shaping the learning and solutions, driving a step change in energy efficiency and reduction on low carbon fabric first, fit and forget, building envelope design and construction solutions within the housing sector.



Please click or tap links below to download lessons from AIMC4 for cost-effective fabric-first low-energy housing:

[Part 1 - Introduction to AIMC4](#)

[Part 2 - Supply chain development](#)

[Part 3 - Technical development of the designs](#)

[Part 4 - Understanding value, applying lean techniques and benchmarking](#)

[Part 5 - As-built performance and Post Occupancy Evaluation](#)

[Part 6 - Ventilation and Indoor Air Quality](#)

[Part 7 - Commercial - Delivery Costs and Household Energy Bills](#)



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