

Architecture & Design Scotland

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Using Offsite Construction for Housing Delivery in Scotland

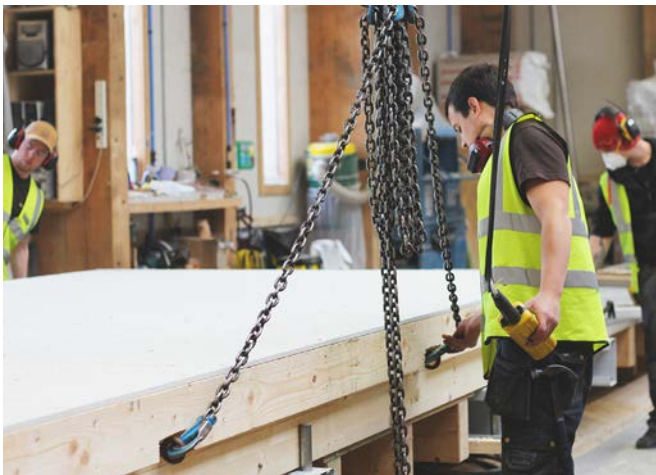






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Top left: Moving Panels, Makar
image by Makar
Top Right: Fitting panels onsite,
image by Makar
Bottom: Tara Green, Kinloss, image
by Makar



Using Offsite Construction for Housing Delivery

Scotland is currently facing a challenge in terms of providing sustainable, healthy, energy efficient and genuinely affordable housing across the country. It's generally accepted that a culture shift in methods of construction and delivery is required to address growing concerns in relation to labour and skills shortages in the construction industry, as well as a need to speed up delivery; control costs; and achieve high standards of design and innovation.

There is a general consensus across the industry and local authorities that the basic production model for new homes has to catch up and develop in tandem with current social, economic, scientific, and technological advancements, as well as addressing the climate emergency. Offsite construction clearly has an important role to play in addressing these key issues in relation to housing delivery.

In response, the Scottish Government has commissioned research, in conjunction with the Construction Scotland Innovation Centre and Scottish Enterprise, in order to understand and progress the role of offsite manufacturing in terms of housing delivery. This research project includes an academic study of global offsite systems and how these can be applied to Scotland.

A study has also been initiated in assessing the scale and nature of the current offsite manufacturing sector in Scotland, and how that might change over the next five years. Finally, a series of co-design workshops involving a range of practitioners are being organised to understand and put into practice the benefits of offsite manufacturing.

The Scottish Government will be working with partners to consider options for future policy based on the report, "[New housing and future construction skills](#)".

“Our houses use homegrown materials and suppliers while we train young people and add considerably to our local economy.”

Neil Sutherland, Makar

Top Right: Makar Factory Floor, production of wall panels, image by Makar
Bottom Right: Tara Green, Kinloss, image by Makar

Background

More than 80% of new homes in Scotland are built using offsite construction. The majority of this is timber frame delivered to site with a key limitation of existing profit led business models and large scale development being the ability to innovate.

New development in offsite construction in Scotland

A growing movement however, thinking literally outside the box, is increasingly exploring and creating new build homes with not only design, but also innovation, new delivery models and improved productivity as key drivers.

Key amongst these Scottish companies creating a cultural shift towards this form of offsite manufacture and delivery is Inverness based MAKAR, founded in 2002 by architect Neil Sutherland.

“I founded MAKAR in 2002 as I was frustrated by the lack of options in relation to getting houses delivered to customers with healthy, ecological specifications,” explains Neil Sutherland. *“What MAKAR is now doing combines engineering with a production understanding along with architecture, and I’m convinced the future of quality house delivery is a manufacturing model. By quality I mean performance on a number of criterion; energy, health, design, value for investment, etc, and the experience customers have in engaging with us more generally.”*

“We apply process innovation across the business functions, integrating design with the technical process, production, assembly and finishing. It’s cyclical and our management approach is based on continuous improvement and a nurturing learning environment.

Our houses use homegrown materials and suppliers while we train young people and add considerably to our local economy.

Our homes are carbon negative in relation to embodied carbon accounting. We can deliver to Passivhaus standard as an offsite replicable approach. Like any business we exist to create value, but we do this with highly skilled operatives commanding high wages, this is the difference (offsite) manufacturing can bring to the built environment sector.”

The future for housing is an integrated manufacturing model, according to Neil Sutherland. “At MAKAR we are continuing to refine such an approach that will eventually result in ultimate quality outcomes at affordable prices for all.

I believe that we are part of a movement reflecting the need for renewal and regeneration of the foundational systems required for people to live good and healthy lives. How we dwell says so much about our culture and society. We should get to decide what type of environment we care to live in, there is no need to compromise such a vital decision.”



“The current shortage of rural area new-build homes calls for innovation and improved productivity,”

Gokay Deveci

Key offsite housing models

There are a number of other key practitioners and developments, both rural and urban, exemplifying innovative design and practice in the implementation of offsite construction models for housing delivery in Scotland. One of the most recent is the first Applied Research project to emerge from the Scottish Government's commissioned research into the role of offsite construction on new build housing. Integra House in rural Aberdeenshire by Gokay Deveci, Professor in Architecture at Robert Gordon University (RGU) was built offsite by means of a prefabricated truss construction system and is conceived as a fully repeatable model.

“The current shortage of rural area new-build homes calls for innovation and improved productivity,” explains Gokay Deveci. “The Integra House project therefore focuses on design optimisation and prototyping for digitally integrated production of affordable rural housing. This offers potential for transformative, faster and scalable production; and greater potential for attracting the digital generation into housing construction than traditional methods. It involves iterations of Computer Aided Design, energy and environmental simulation, structural and capital/life cycle cost analysis of truss options of whole and milled timber combinations, versus existing solutions.

Two key elements of prototyping: novelty and performance testing, will be met by producing, assembling, and evaluating productivity of digital/robotic versus artisan production and assembly of parts, and full-scale truss options. These will help articulate the cost-effective optimum, meeting requirements for structural strength, breathable construction, and low energy.

The main impacts will be affordability and access to good quality rural housing, reduction of rural fuel poverty, improvement of health and wellbeing of occupants, and contribution to climate change mitigation via circular economy, and waste and CO² reductions.

(The project was developed in collaboration with Glasgow School of Art, Pasquill Ltd, Sylvan Stuart Ltd and Construction Scotland Innovation Centre).

Another project by Gokay Deveci features as one of the four main featured case study projects illustrating recent successful offsite projects in Scotland - setting out key approaches and benefits.

Four Case Study Projects

1. Heritage Way, Fraserburgh by Gokay Deveci is a social housing development of two, three and four bedroom apartments in an urban brownfield site that features a part-offsite (hybrid) construction model. The project was delivered as part of the Scottish Government's Sustainable Housing Strategy, an innovation scheme established to support the promotion of energy-efficient housing using innovative methods of off-site construction and low-carbon technologies.

2. Bath Street Collective Custom Build, Portobello by John Kinsley Architects is a bespoke urban housing model that features offsite Cross Laminated Timber (CLT) panel construction. The project, a four storey new build comprising five flats built in a gap site in Portobello, demonstrates the advantages of taking a community-led route to design and build compared to buying a mass housebuilder type home. It also demonstrates that offsite CLT construction in this urban context can produce



exemplary energy efficient buildings with tailor-made bespoke accommodation, and in terms of speed of construction and cost effectiveness can see savings.

3. Ulva Ferry, Isle of Mull by Thorne Wyness Architects is a key rural development that also features Cross Laminated Timber (CLT) construction, led by the local community trust. With extensive community involvement, two, three-bedroom affordable rental houses were built to a proposal that fits in with the community's ethos of a site sympathetic 'Island House'. The development also focuses on designing to Passivhaus standards, which addresses the fuel poverty issue on the island by creating an energy efficient model with low annual heating costs.

4. Mobile Micro Home, Isle of Skye by Ann Nisbet Studio addresses land and social issues in the rural landscape, offering a template for a future model that can be built offsite and constructed on cheaper/undevelopable land. The prototype model not only offers an alternative to the static caravan but also offers a flexible, small, lightweight, thermally efficient model that can be used as an affordable starter home or 'granny flat' suited to the rural landscape and thereby enhancing the wider community and strengthening rural identity.

Conclusion

"We are part of a cultural shift necessary, should we believe the old normal wasn't working for the majority of Scottish people. This (offsite) movement is small but growing, and it will keep growing, as individuals are able to see just how profound and powerful this shift represents. It's time to prioritise our living environments and the knock-on impacts to the wider environment and economy." Neil Sutherland, MAKAR





1. Heritage Way Case Study Project completed: 2017

Introduction

Heritage Way, a new housing development of 30 affordable, low-energy housing units in Fraserburgh's Quarry Road, is an exemplar housing model supported by the 'Greener Homes Innovation Scheme' which was launched by the Scottish Government to promote new approaches to the delivery of low-energy efficient affordable housing using innovative Modern Methods of Construction (MMC).

The scheme, designed by Gokay Devici of Robert Gordon University's Scott Sutherland School of Architecture and Built Environment in collaboration with Aberdeenshire Council, received a £1.3 Million grant from the Scottish Government. Since its completion in 2017 the development has been monitored for energy use consumption, the results of which will be used as a case study for the future of low energy housing developments.

Background

The site is located in an area of town that consisted of a derelict warehouse and industrial units that was identified for regeneration, as part of the Aberdeenshire Local Development Plan (2012). The chosen site for Heritage Way presented certain challenges, however it also provided quality attributes and potential to enhance the social and urban regeneration of this brownfield site.

The Quarry Road site is exposed to the cold north-easterly winds coming off the North Sea which required a well-insulated and draft proofed 'fabric first' approach to minimise energy use. The main aim of the project was to incorporate a very high level of energy efficiency utilising MMC principles (embracing a range of offsite manufacturing and onsite techniques, providing

an alternative to traditional house building) in order to minimise the additional capital costs involved, and evaluate longer term cost savings as well as measuring the performance. The ambition of the development was to achieve the 'Silver' level of Section 7 of Scottish Building Regulations or better as well as providing a high-quality design standard incorporating accessibility and adaptability that could be adopted in future developments.

Procurement

The project emerged as the winning bid in the 'Greener Homes Innovation Scheme' competition that was looking for a social housing scheme that could demonstrate energy efficiency through MMC.

"A site was available as part of an overall masterplan and I agreed to do the competition on the understanding that the monitoring aspect of it, to be done at RGU would be also part of that package. So, I took it on at the time, and the unfortunate thing was, we had only four weeks to design the whole thing!"
says Gokay Devici.

A previous housing project completed by Devici, [Tigh Na Claddach in Dunoon](#) (2010) was used as a model as it had demonstrated low energy consumption in use and involved some prefabricated elements of construction.

"So, we thought that we should repeat that. But also take into account the new context, as this site, although also coastal is surrounded by industrial buildings. So, this is how the whole design formed, taking an existing model, reiteration, rethinking and actually designing in further prefabrication elements. We learned our lessons from the Dunoon scheme."





Design

The design team took a holistic approach to embracing 'sustainability' without compromising the design in terms of originality, innovation, efficiency, form and relationship with context setting.

The design is based on a plan of 30 properties of interlocking two, three and four bedroom apartments and houses, capable of providing varied accessible accommodation, each with its own amenity space. The design provides adaptable semi-open plan layouts that suit various lifestyles and maximise natural light. Independent access to the one-bedroom apartments is served by external stairs. Three of the flats are designed to be accessible.

Construction

The contractor, Robertson Construction, embraced all of the benefits of the MMC including, integrating or reducing processes for supply chain, reduced site management and closing the gap between the theoretical performance and reality.

The design utilised prefabricated, panelised and super-insulated 'I' beam roof and wall system, externally finished with lightweight cladding materials (either 'eternit' fibre slates or 'rhein-zink' zinc (suitable for coastal locations)). These materials were chosen principally for their weathering characteristics and appropriateness for location, as well as their cost saving potential due to the minimised loading on

foundations. Carefully selected colours were used to add a strong sense of place and vitality.

"In terms of the offsite prefabrication, it's a hybrid structure. Deeside Timberframe was the timber engineers and manufacturers. The method of construction was more on a component level where insulated OSB timber panels were manufactured for all the walls and roof. We were keen to see if the prefabrication and putting in the insulation, not on the site but in the factory, would reduce the cold bridging which is essential in terms of creating very low energy and passive house standards."

"The second type of the MMC prefabrication element is the zinc, again coming in prefabricated components to the site. This arrived in sections and we did the walls and the roof all in one go. The zinc installation was very quick." The choice of zinc was to be as low maintenance in the long term as possible, to meet the concerns of Aberdeenshire Council's maintenance department budgets, whilst also reflecting the context of the coastal site within one of the largest fishing ports in Scotland. The four different grey tones echo the sea and sky as well as the neighbouring industrial buildings."

Monitoring

The energy consumption in six of the properties has been monitored by RGU over a period of 15 months. It is expected that the post occupancy evaluation, looking at residents' experiences, as well as behaviour and performance of low energy systems, will help inform Aberdeenshire Council's future housing programmes.

"It's been designed to show that MMC is capable of delivering house types repeatable at slightly different



Top: Heritage Way, Fraserburgh,
image by Gokay Devici

"Tighter collaboration between the design team members, in particular structural engineering and MMC manufacturing is important for delivery of the very low energy standards required."

Gokay Deveci

levels of insulation in order to meet various criteria. This was achieved by 300mm all-round insulation for all the houses to start with, and then I beefed up another 50mm for gold standard or 100mm for platinum standard. The post occupancy monitoring will take into account how much the costs will diverge and if the investment is worthwhile."

Feedback

"From the resident's point of view, they are enjoying living there. Thermal comfort and running costs are obvious advantages. We also managed to provide an additional 15% floor space above the current space standards with open plan/ceiling spaces filled with generous daylight, which has created very spacious living areas and benefits from sea views."

"From a client point of view the zinc finish to the walls and the roof cladding as a single wrapping material was the preferred option despite the fact it was the more expensive option. However, for a long-life and minimum maintenance point of view it was the key focus for them, and for me."

Lessons Learned

Contracts

"Tighter collaboration between the design team members, in particular structural engineering and MMC manufacturing is important for delivery of the very low energy standards required. Maybe in hindsight, working with a partnering contractor is much better than an open tendering process. If you're trying to achieve an exemplary or template building, that others are going to use, I don't think an open tender is the best way

to go. I would recommend having control over the selection of contract type."

Education on new technologies and Handover

"My experience has shown that most of the social housing occupiers / tenants need a clear and robust handover in order to create a clearer and more successful understanding of how the buildings work. Some of the tenants were not fully aware of the low-energy components. These have ranged, for example, from not seeing the radiators to creating very high moisture levels in an airtight house due to switched off ventilation systems. Some tenants who were living in these very low energy housing schemes had not been made aware that they had a mechanical ventilation system in the house."

Conclusion

Heritage Way is a social housing exemplar and exponent of the Scottish Government's strategic priorities, in terms of low-energy consumption and affordability.

"Architecture is a physical manifestation of culture and identity and housing is an important part of that. We do not want countless uninspiring housing developments in Scotland currently being dotted around the country which can be 'built anywhere but belong nowhere'. We need a new and emerging architecture in Scotland to regain the country's sense of culture and to take an ethical stance towards creating homes that once more put people first through dignified and appropriate design. In my experience, MMC is capable of delivering this part of our culture. But it must be seen as the 'quality and not the quantity.'"

Why Offsite?

Gokay Deveci assesses Modern Methods of Construction (MMC) and its impact on future developments as exemplified in Heritage Way.

- MMC homes are usually more energy efficient than homes built using traditional methods. This helps to reduce heating bills for affordable housing and also means the whole life running costs of such buildings could be lower than other homes. For this reason, Royal Institute of British Architects has said that if the whole-life value of residential units were taken into account at the procurement stage, it would increase the demand for MMC homes.
- MMC is particularly well suited to housing associations and councils that require high volume, repetitive designs that can be built offsite and transported to the building site to be erected. This makes social and affordable housing good candidates for the off-site approach, where there can also be advantages in the speed of delivery.
- There are still serious perception problems for quality and durability. Social housing will deliver a greater proportion of MMC housing, but it is important that lower cost designs are fully tested to ensure that MMC is delivering sustainable, durable, high quality social homes. We do need higher levels of energy efficiency in order to address climate emergency. Inefficient homes built today will need retrofitting at a later date in order to comply with the more stringent energy performance requirements: The Chartered Institute of Housing confirmed that just 1% of new homes built in 2018

met the highest Energy Performance Certificate standard (Band A). This represents a waste of an opportunity to build housing that is future-ready and adaptable.

- Adaptability is crucial in terms of MMC construction, if it is going to be successful and capable of adapting to the impacts of climate change. New homes must adapt to the needs of the users by increasing comfort, energy efficiency, indoor air quality resiliency and safety.

Finally, the critical question is can MMC deliver modern homes that are: low-energy in use, good quality design, addressing character and identity and the potential to adapt to different context in terms of places and site conditions? Heritage Way, which is a hybrid construction model, is social housing delivered on a social housing budget and demonstrates that a quality build, eliminating many on-site trades, is achievable. It has therefore demonstrated that MMC can meet the criteria.



▲
Top and right: Integra House,
Aberdeenshire,
Images by Gokay Deveci

2. Bath Street Collective

Custom Build

Case Study

Project completed: 2017

Introduction

Bath Street is a custom self-build project in Portobello, Edinburgh led and designed by John Kinsley Architects. The scheme, a four-storey new build on an urban vacant and derelict site utilises a cross laminated timber (CLT) construction, and an example of a collective community led housing model. It also demonstrates how the typical Scottish model of shared tenement living could be updated for the 21st century, particularly in terms of material use and energy consumption. Upon completion in 2017, it was the tallest CLT structure in Scotland.

Background

The site, a 400sqm piece of vacant and derelict land, previously cited a cinema was in the vicinity of the John Kinsley's then home and part of the Portobello Conservation Area. The street was originally laid out in 1801/2 and features a mix of small-scale Georgian buildings and larger Victorian tenements. Building heights vary from single storey shops to five storey tenements. Building materials also vary significantly from the buff sandstone of Georgian Houses to the red sandstone of Victorian tenements.

Kinsley had assisted a local community organisation that had looked at buying the site a couple of years previously so knew who owned the land and its value. The site also had planning approval. This knowledge combined with a desire to explore the idea of collective self-building was the starting point, which Kinsley tested out with a builder friend.

In 2013, having put a plan together in terms of cost and programme Kinsley posted a note on

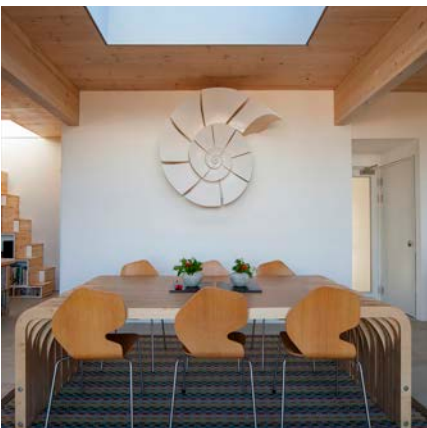
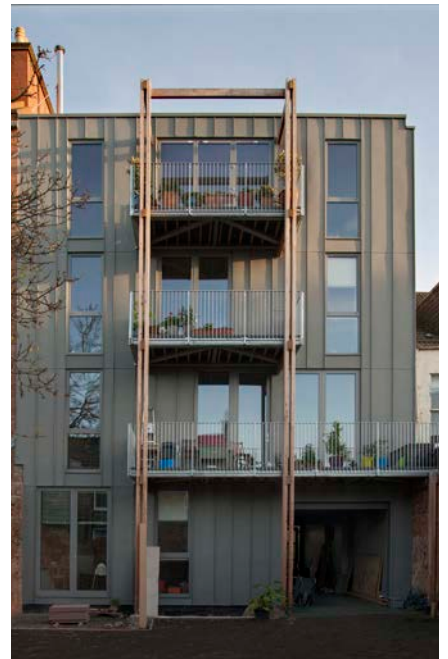
the Portobello community website inviting anyone interested to a meeting and discussion covering design, planning, funding, and the benefits of setting up an organisation that would act as a client.

By the spring of 2014 a group had formed into four participants interested in occupying four of the five flats proposed. On 1st September 2014 a Planning Application was submitted.

Proposals and Planning

The scheme at planning stage contained five flats comprising: two 75m² two-bedroom flats, one 102m² three-bedroom duplex flat, one 120m² three bedroom flat and one 45m² one bedroom flat. The configuration of the flats around a central stair provided a great deal of flexibility in flat size options, with a range of types from 'I' shape single bedroom flats, 'L' shaped two beds, 'C' shaped two beds and 'O' shaped 3/4 beds. The design accommodated the owners preferred size and shape of flat into the volume defined between the two adjoining buildings - a two storey buff sandstone Georgian house to the west and to the east by a four-storey red sandstone Victorian tenement. The change in level between the two buildings is particularly prominent in the streetscape, and this was a key driver in the design of the new building.

"As a group, we wanted to try and push the boundaries from a sustainability point of view, so we were looking to be as green as we could," explains John Kinsley. Designed to achieve Passivhaus levels of energy use the Bath Street building uses a CLT structural frame to deliver high levels of embodied carbon. A central heating system was deemed unnecessary due to high levels of insulation. Power is generated





via a combination of photovoltaic panels on site and electricity procured from 100% renewable energy allowing the building to run free from fossil fuels. The roof is finished in a sedum covering to encourage slow water run off and local biodiversity and there are shared gardens to roof and rear.

The project received Planning Permission in December 2014. *"There were only five objections and so approval was achieved without the scheme needing to go to committee. The planners were happy to see a contemporary design on the site, which was good. And the planning approval went through straightforwardly."*

Setting up a Collective

In order to secure funding, the client body set up a limited company following legal advice and advice from the Ecology Building Society. The group set up a limited company 'Bath Street Collective Custom Build' which would act as the client. Funding was received from the Ecology Building Society. Consequently, the site was purchased in June 2015 and tenders for a main contractor were issued. HM Raitt & Sons – a local family business – was eventually appointed as the main contractor, on a total budget of £883,000.

Construction

Work on site in April 2016. *"I was the contract administrator, so all the instructions to the contractor came through myself. I was the interface between the client and the contractor."*

Following repairs to adjacent buildings and preparing the site strip, piling and ground floor slab, the CLT sections began to arrive from Egoi's factory in Spain in October 2016. The sections were craned into position on site and screwed together with metal

brackets. The shell and core CLT structure was erected by a three-man team of joiners from Egoi.

Joints in the CLT roof slab were taped when the frame was erected to create a vapour control layer and seal the structure from moisture. Insulation and an EPDM membrane were installed, and externally a Tyvek breather membrane forms an additional protection from moisture. To seal the building, high-performance triple glazed windows and rooflights were installed. *"Shockingly, we discovered that if we used the sheep's wool insulation, the total area lost over all four floors was equivalent in size to one of our living rooms. So, to make the most of the available space, we decided to use PIR to insulate the walls."*

The building's facade was finished with red sandstone on the main elevation, and zinc cladding on the side and rear walls to reference the neighbouring slate roofs. The other principal facade material is Reglit cast glass. The use of cast glass references the historical industry of Portobello and complements the sandstone whilst also providing a durable and visually lightweight material that sits comfortably above the entranceway.

Upon completion, each family was left with a large open-plan space, allowing them to create their own bespoke flat layout by inserting stud walls where required. The internal surface of the CLT panels has been left exposed, providing an effective interior finish to the walls and ceilings and a contrast to the white stud walls.

Feedback

"Overall the feedback's been really, really positive. Everybody loves the CLT timber finishes to the interiors. And all the residents have been really amazed that in reality we achieved the aspirations that we

“There are many quality advantages in building things in a nice dry, warm factory rather than out on a building site in Scotland where it’s blowing a hooley and pouring down”

John Kinsley, John Kinsley Architects

Left: Bath Street Collective,
Image by John Reiach



had at the outset to be as sustainable as possible. We can now sit in our flats when it’s snowing outside and still be snug and warm, even though we don’t have any central heating. It’s been really successful from that point of view.”

Advantages of building with CLT in this urban context

“There are many quality advantages in building things in a nice dry, warm factory rather than out on a building site in Scotland where it’s blowing a hooley and pouring down. So, I think there’s a desire to try and maximise the amount that you can do offsite. But obviously the extent to which you are able to do that varies project to project.”

“Formally we felt the CLT worked really well in terms of a tenemental multi-storey project where we had a roughly cubic form in terms of the building shape. We also liked the idea of the timber as a finish internally.”

“A conventional structure for a multi-storey residential unit like ours might use a steel frame with concrete precast floor slabs, fireproof cladding to the steel and blockwork walls with plaster finishes. The CLT provides all of those functions in one operation:

- *It requires no wet trades and is accurate, facilitating airtight construction with external joints between sections of timber sealed using airtight tape.*
- *It’s extremely accurate compared to building with steel frame and block work. “So, you don’t have to worry about your windows coming along and not fitting the blockwork isn’t quite right. You know that everything’s going to fit properly.”*
- *The CLT can be installed very quickly – in this case in under two weeks.*

- *There are also savings to be made in terms of the costs involved with conventional contractors’ wages, the reduction of onsite time, accommodation and such like. “However, we had to apply for a road closure for two weeks whilst the CLT was installed. So, there was an additional cost associated with that.”*

The way forward in terms of community-led self-builds using offsite construction

John Kinsley believes the key to future developments is the role of Local Authorities. *“In Germany 60% of development is self-build, but in the UK the figure is just 2%. We need to tackle the issue of how difficult it is to buy land. Particularly for collective self-builds where perhaps you’re looking for a slightly larger site and you may be competing with large developers. It’s very, very difficult to compete if the site is being advertised on the open market, because the housebuilders have got much deeper pockets than groups of people together have.”*

“In Germany local authorities are required when they sell land to offer the land to community groups before it goes on the open market and goes for sale to developers. So this is one of the reasons why collective self builds work so well in Germany. Perhaps councils could adopt this approach. Or part of planning approvals for the big housebuilders could be that a percentage of land should be made available for community schemes. It is difficult at the moment because most local authorities are in debt and most are selling land to raise money for essential public services. But in the long term I think a slightly more enlightened approach from local authorities is what’s required.”



In terms of the long-term future of the offsite CLT construction industry in Scotland, Kinsley believes there is potential but it requires a change in mindset and investment in infrastructure.

"The centre of gravity for UK construction is still London and to actually bring CLT from Germany to London is as easy as it is to bring it from Inverness to London really. And transport links from some of the forests in rural Highlands Scotland are not great compared to maybe coming from Germany where you drive straight on to an autobahn and that's you. So, I think that's an issue that needs to be addressed."

Conclusion

"There are real advantages to taking the community-led route compared to buying a mass housebuilder type home," explains John Kinsley. "Firstly, it's cheaper, as there's no developer taking a profit - our method had the potential to eliminate the developer's profit, so we could build at cost – around 20% less. Secondly, it's totally bespoke, beautifully designed, and absolutely what you want it to be. And thirdly you can get to know the neighbours – so it's a social thing. The owner is also investing in the community, whereas a developer walks away at the end of the day."



3. Ulva Ferry Housing Case Study Project completed: 2018

Right: Ulva Ferry Housing,
images by Johnny Barrington



Introduction

In 2010, Ulva Primary School was facing closure due to a fall in school roll, something which would not just create barriers for local children accessing education, but as a hub used for social and community events this could split the community in two.

The area suffered a population decline caused partly by a lack of affordable housing and fuel poverty, meaning some younger families could not afford to live there. There was a real demand for family sized houses, as local businesses relied on people to work and live in the area. Challenges associated with rural living are further impacted when combined with living on an Island. Everything costs more from food to fuel and services that in urban areas are more prolific. As a result of this communities play a pivotal role in forming their environments and this was evident in Ulva Ferry.

Community

Ulva School Community Association (USCA) formed in 2011 to play a role in the development of the area around Ulva Primary School. USCA contacted Mull and Iona Community Trust (MICT) for assistance with securing funding for some new housing aiming at addressing the family housing shortage and ultimately saving the school. Located next to a Site of Specific Scientific Interest (SSSI) and within a National Scenic Area created other challenges to produce new houses with a strict set of guidelines set by the local planning authority.

With extensive community involvement, it was apparent that affordable housing was a priority. USCA

invited local architects to tender for the project to deliver two, three bedroom affordable rental houses. Thorne Wyness Architects, a Tobermory based practise won the competition by public vote at a community consultation. The proposal not only fit in with the community's ethos of an Island house, but with a focus on designing the house to Passivhaus standard addressed the fuel poverty issue by creating an energy efficient house with low annual heating costs.

Partnerships and Funding

"There is a lot of feasibility funding available through the rural housing fund and Scottish Land Fund, maximise that and apply in tandem for both of those and they will advise you which you should go for getting an engineer, speaking to planners, getting the QS cost etc... the feasibility money helps your funding applications to buy the land if you can prove we need X amount to put in a bore hole, we have looked at all the options etc, it makes your application more robust if you have an option or two" – Helen MacDonald, MICT

MICT applied in tandem for funding from the Rural and Island Housing Fund and the Scottish Land Fund to undertake a feasibility study to gain a robust understanding of the types of costs and challenges they could come across building houses in an island setting. This money funded MICT to bring an engineer and a quantity surveyor to the island and undertake infrastructure, water supply, waste, septic tank, infiltration bed, package plant and power strategies for the houses. Additional hidden costs can occur in rural settings which might not normally apply in an urban area, such as moving an electricity pylon, or altering the ground to make it suitable to build upon.





Explaining challenges in a rural setting is difficult, let alone in an area where the population has undergone a decline over the last 100 years. It was important to include local businesses in the project from early on as they need staff to live locally to survive.

It was essential to ensure the project was financially viable. Undertaking a whole life costing exercise from the beginning helped determine the true costs of the project, including a 30-year life cycle cost.

Other funding came from local donations to the sum of £22,500 and key partnerships from HIE (revenue funding), Quaker Housing Trust (Affordability), West Highland Housing Association (Provide out of hours support), Triodos Bank (mortgage). Support from these funders was assisted by the low embodied carbon materials and energy efficiency of the project.

Planning

Three potential sites were identified by the planning authority. The houses were to be masked by the school and were to be 1.5 storey faced in white render. Interestingly there was the requirement the houses must not look like social housing, while on an island setting what does social housing look like? Despite the planner's restrictions, the community were focused on having timber cladding rather than white render. MICT kept in continual contact with the planners keeping a paper trail of all their communication and continually stressed how important timber cladding was.

Offsite Construction

Offsite construction is a preferable method of delivery for an island setting. There are less transportation costs, Road Equivalent Tariff (RET) costs don't include commercial traffic so it can be very expensive importing the raw building materials to the island. Egoins manufactured and constructed the building panels allowing a very fast and efficient onsite process and were particularly good at ensuring the costs were kept as low as possible during transportation. Tobermory based Norman Macdonald Builders undertook the rest of the build with the Mechanical ventilation Heat Recovery system (MVHR) being installed by Oban based PAUL heat recovery.

When building traditionally on an island, accommodation and availability of skills and labour can be problematic. Accommodation is expensive and there is often limited availability of short-term accommodation on the island during the holiday season. Local builders can also often have up to six month lead in time, pair this with the difficult working conditions created by the islands weather.

There is less flexibility with offsite construction in terms of tweaking the design once it has been signed off by the contractor. Everything needs to be completely designed as there are no options for slight changes, which can happen in a traditional build. For example, you can't add an extra window and you have to fully think of all the servicing from the outset as these can't be changed.

“A lot of the cost is in the ground in a rural setting, if you have to move two meters of peat this has to come out and bringing aggregate onto site on an island is very expensive”

Helen MacDonald, Mull and Iona Community Trust

Lessons Learned

It is important to highlight to the manufacturer the structure will also act as the interior surface to ensure the visual quality is what you expect. Fire suppression systems have advanced since the project was completed, the architect would have liked to have specified a misting system which could deal with the surface spread of flame if needed, however a fire pond was built outside the properties instead.

Applying urban restrictions to a rural setting doesn't always work, the houses are single storey with three doors so fire safety should be less of an issue as there are plenty of escape routes if the building were to go on fire. Timber construction often ignites discussion surrounding its fire resistance, however CLT panels are produced with timbers natural fire resistance in mind. Panels can be created with 30, 60- or 90-minute ratings, the width of these can increase dramatically, and you can treat them further with either fire resistant plasterboard or mineral coatings. *"The natural protection comes by timbers own charring process, where once the wood burns, the natural charring effect becomes an insulating layer preventing excessive rise in temperature within the unburnt core of the panel."* ([Crosslam timber/CLT – fire resistance and rating](#))

Community Reaction

MICT, USCA and the community steering group are very happy and proud of the houses and see the benefits of them. They love how the buildings are weathering and the tenants have settled in.

The school roll has increased by 50% in pupil numbers and this was a huge part of the project all along, encouraging local people to stay in Ulva Ferry.

Although there was slight disappointment about not achieving full Passivhaus certification, the extra costs required to get this was something the client couldn't justify. However, both the client and architect are very pleased with the energy saving performance of the houses, and the fact that it achieved AECB Silver Standard certification (now known as AECB Building Standard).

MICT is planning another stage of community housing using modular housing, but with the Rural Housing Fund ending in 2021, timescale is a major concern. Fortunately, the Scottish Government are coming on board and beginning to understand the extra costs in rural settings as a result of Ulva Ferry's houses and other rural and island housing projects.

4. Skye Mobile Micro Home Case Study Project completed: 2019

Introduction

Located in the crofting community of Black Park on the Isle of Skye, a new mobile micro home, although a client driven project in this instance, can also be seen as a prototype housing model, developed by Ann Nisbet Studio as a small, lightweight, thermally efficient, movable house, designed for the rural landscape.

The project's origins are based in research that Ann Nisbet was carrying out into rural housing and more specifically the need for a redesign of the caravan for the rural landscape, in discussion with the Skye based Planning Officer for Highland Council in 2014/2015.

Background

"It could be argued that the static caravan is a traditional rural vernacular building, as prolific as sheds, barns, and longhouses in the rural landscape, but lacking in the aesthetically pleasing forms and proportions of these building types," Ann Nisbet.

"There has been a tradition in the Highlands and Islands (as well as other rural areas) of Caravans being used as temporary summer accommodation or starter homes on crofts. In the early 1970's my parents built their own house on my grandmothers croft and until I was twelve, we spent the summer months living in the static caravan on the croft, while my parents ran the house as a guesthouse. Both my older sisters lived in caravans on their crofts, while they saved to build their own homes."

"Currently, due to unequal land ownership systems in Scotland and the resultant inflated land and housing prices, we have a housing crisis in our rural areas. In

particular, many young people cannot afford to stay in their communities due to lack of affordable housing and land."

"We are not suggesting that a building typology is a solution to the housing shortages and fuel poverty facing our islands and rural areas. As a practice we strongly believe that the solution to these problems is radical land reform and planning reform throughout Scotland. But as a studio we were interested in exploring the idea of a low cost, thermally efficient, caravan designed for the rural landscape, and how this could assist the current housing crisis and reduce fuel poverty in our rural areas?"

The opportunity to put this initial research into practice emerged when a private client approached Ann Nisbet Studio looking for 'small but not tiny' self-contained additional accommodation to be built on his island croft. The brief was for a flexible space and base to house his son and visitors in the short term and as a place to retire to in the long term.

Site

The new Black Park accommodation is separated from the main croft house by a single-track road that connects the community. The site consists of a small plateau, which falls steeply to the river below. To the south and west the house captures views over the Skye landscape and to the east there are views out to Broadford bay and the small island of Pabay. Although the site is rural, it is not isolated, with the building forming part of a cluster of houses.





"On initial inspection, the site topography did not look natural and we advised that site investigations should be carried out early in the process. The initial Engineers carried out ground investigations and the findings were not good. Unfortunately, we discovered that some parts of the site were 'made ground' and contained ungraded demolition material. The initial Structural Engineer advised that the costs for the ground works and foundations would be more than the Clients budget. They advised that a lightweight camping pod or caravan could be put on the site, but this was all, and the site was not developable."

"We suggested to the client that we look at the possibility of a lightweight mobile building, based on our initial research model that could occupy the site, but be moved later should it be required. We then approached structural engineers Stuart Burke Associates with a very initial proposal and worked with them to develop a design that could be constructed entirely off site, lifted onto a flatbed trailer, transported to and then positioned on the client's site."

Design Inspiration

The dimensions of the new mobile micro home is governed by the Caravan Act with size limitations related to transporting the house on the road. However the form and proportions directly relate to the form of traditional rural vernacular buildings on the island, including the local creel barns.

Further research was also undertaken into caravan and boat design, looking at how space and storage could be maximized and made more flexible.

Design

The 30sqm house contains three main spaces, which are open to the apex, to provide a feeling of space, light and height, each divided by a deep storage wall, containing cupboards or other functions. The three spaces flow together, creating a greater feeling of volume and light throughout the building. Two large birch faced ply sliding doors can be closed over however, to provide privacy between the public and private spaces, should it be required.

Birch faced plywood lines the interior of the building, chosen for aesthetic and functional reasons. The internal cladding was carefully laid out to reduce material waste and any off-cuts were reused in shelving and other internal furnishings.

Large areas of glazing are located to the south and west, capturing the island landscape beyond and maximizing solar gain. These are over-clad with fine sections of timber to filter the summer sun, reducing the risk of overheating. A detachable zinc clad canopy at the entrance was added to provide protection from severe weather.

Externally, the building is clad in black standing seam zinc and untreated Siberian larch cladding, emulating materials commonly found within the rural landscape. Both external and internal materials were considered in terms of longevity, re-use, maintenance, and environmental impact. Materials were also reviewed and chosen due to their tolerance for deflection and compatibility with a transportable 'mobile building'. The aesthetic appearance of the house at night and



"Currently, due to unequal land ownership systems in Scotland and the resultant inflated land and housing prices, we have a housing crisis in our rural areas. In particular, many young people cannot afford to stay in their communities due to lack of affordable housing and land."

Ann Nisbet, Ann Nisbet Studio

how it might engage with the long winter nights was considered - this island home was to feel welcoming, warm, and act as a lantern or marker in the winter landscape.

A dry-stone wall, topped with turf, grounds the building in the landscape, creating an established boundary and a positive connection with the wider Black Park community.

Planning

Planning in Principal was in place for a small dwelling house on the site, however due to the constraints and uniqueness of the project, the architects worked closely with Highland Planning department, who were supportive of the wider research project.

Initially, an off-grid energy strategy was investigated, however the decision was made to connect the building to mains electricity and water, which were available very close to the site. Services can be disconnected with ease, should the building require to be moved.

In terms of energy efficiency the well-insulated building features a small wood burning stove and back up electrical heating is employed, as well as a MVHR. In the future Photovoltaics or a turbine can be introduced.

Offsite Construction

An offsite construction strategy was employed to limit waste, reduce construction time, and to allow for work to be carried out during the winter months.

A 'local' focus was pursued, rather than manufacturing the building at a distance and then transporting the building to Skye. The focus was on retaining the majority of the work 'on the island' or within the Highlands, therefore using local labour and skills, sourcing local materials (where possible) supporting the local economy and reducing the building's carbon footprint.

Essentially, the building's steel frame was constructed in a welder's yard in Fort William, on the mainland. This was subsequently transported on the back of an arctic lorry to an unused shed close to the site on Skye where the building could be framed and fitted out. Except for the zinc installers all the sub-contractors were based locally, with the majority within 5 miles of the construction site.

The building was designed to allow for transportation on single track rural roads, without a police escort, and sized under the height of 'low bridges' to ensure that the building could be moved to a wide variety of locations. The building was transported across the Skye landscape, to the site and lifted into position. A system, which used minimal concrete, was developed, which allowed the 'feet' to be bolted down onto a minimal foundation – this can then be released should the house need to move.

In future the building can be removed from Black Park and travel to a new location, where its narrative may be able to continue...



Lessons learned and considerations to take forward from the Black Park model. Conclusion

Construction should be able to take place offsite in order to limit waste, reduce construction time, and make cost savings. The house should be designed with local trades in mind and should be capable of being constructed in rural communities ensuring that they support the local rural economies.

In terms of the structure this should be:

Lightweight, therefore capable of being moved economically. A lightweight structure will also enable the structure to be sited on a wide variety of ground conditions, for example lower cost/undevelopable land.

Mobile, therefore capable of being moved on the road without a police escort and under 'low bridges' and single-track roads. Enabling access to a wide variety of remote and island locations.

Flexible, in order to allow the model to be 'sold on' or moved on somewhere else, where or when it's no longer required. A flexible model, should allow for a second 'volume' to be added - to include up to three additional bedrooms. In this way it would offer a solution as a starter home or 'granny flat' to ensure standard homes to be multi-generational homes/sites. Ultimately a flexible model will not depreciate in value like a car or caravan

Energy Efficiency: Additionally, the model should be thermally efficient and encompass renewable energy, and should also be capable of being off-grid.

"This has been a very interesting and challenging project and there are many layers of research, details and design work incorporated into one small but complex project," concludes Ann Nisbet. For the client, the new house provides "a cosy, modern yet modest living experience that is absolutely unique."

Set against the current wider economic and environmental backdrop this prototype model can be seen as a real opportunity to create modest, locally produced and extremely energy efficient housing on cheaper land. And consequently can be seen as an affordable housing option that is suited to the rural landscape and capable of enhancing the wider community and strengthening rural identity.



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