Institution: Robert Gordon University

Unit of Assessment: 16 Architecture, Built Environment and Planning

Title of case study: Low energy sustainable housing

1. Summary of the impact (indicative maximum 100 words)

The practice-based research outputs contributed significantly to the advancement of knowledge in the area of low-energy affordable housing which was evidenced through design outputs, case studies government publications.

The work has been undertaken in response to governmental concerns regarding the future provision at a national level of an energy efficient, affordable, good quality housing stock. Accordingly, the underpinning approach has been widely disseminated to government departments, public and private housing organisations. The design concepts and principles have been adopted by housing providers, and have become a point of reference for those working within the field of low-energy sustainable housing design.

2. Underpinning research (indicative maximum 500 words)

Key research undertaken within the theme over the past fifteen years included:

- Towards Passivhaus Project -Scottish Enterprise (2012- ongoing)
- Low Energy Affordable Housing Designs - Practice based research and KTP
- European Task 28: Sustainable Solar Housing (2002-07)
- Towards the 'Zero-Heating' House (2001-02)- Aberdeen City Council
- Affordable Rural Housing Project (1992 – 2000) - Aberdeenshire Council

The overarching aim of the work presented was to explore the three strands of sustainable development in housing design processes. The approach to the research has been transparent, transferable and problem-focused, involving the search for solutions to real design, social, economic and environmental problems defined by industry and government agencies. The earliest work referenced in this case study, the 'Affordable Rural Housing project', was instigated in 1992 as research investigating improvements in designs for 14 number affordable houses in Scotland's rural areas, and the output become a demonstration project in 2000. It's innovation was not one-dimensional but included advances in both process and product and in social and technological features. The design was the one of the project to win 'The 2000 Homes Innovation Awards' by DETR Construction Best Practice Program.

Towards the 'Zero-Heating' House (2001-02) was a case study in DETR's Construction Best Practice Programme. The design, which used an innovative new timber technology to achieve a number of environmental objectives through ' fabric first approach', resulting a reduction of energy consumption by 85%, was the direct result of the previous 'affordable housing research' in the Sustainable Housing group. The design was the one of those to win The 2000 Scottish Housing & Environmental Innovation Award by Chartered Institute of Housing (CIH) Scotland.

The objective of European Task 28: Sustainable Solar Housing (2002-07) was to help achieve a significant penetration of sustainable solar housing in the housing markets of participating countries by the year 2010. The research outputs were two books which were edited to serve as a reference, and as case studies offering the experience the 30 multi-disciplinary experts from 15 countries who participated in a 5- year project with a framework of programmes by the international Energy Agency (IEA). Professor Deveci was one of the active participants representing the UK for the IEH SHC task 28.

There are many barriers for the adoption of Low carbon construction standards within the house building industry which includes the capital cost, skill shortages, supply chain and changing behaviours. The proposal focuses on the reluctance of the volume house builder. It would appear that this is a consequence of incomplete knowledge, and a beliefs that 'it is too much change and that the additional capital costs involved cannot easily be passed on to purchasers as the value accrued is poorly understood and communicated. The practice-based research on low energy

affordable housing designs, Tigh Na Cladach , Dunoon and the Spooner House in Aberdeenshire completed in 2010, were the first officially accredited to German 'passivhaus' standards in social and private housing developments in the UK and Scotland.

Researchers associated with outputs (dates employed by RGU): Gokay Deveci (1997-present), Jonathan Scott (2004-present), William Brogden (1970-2005).

3. References to the research (indicative maximum of six references)

Reference through Outputs

1. Tigh Na Cladach (house by the shore) UK's first Certified Social 'PassivHaus'
    - ECOLA Awards 2010 (international) - Special merit for carbon-optimisation
    - WAN Awards 2010 – (international) Residential ,final shortlist)
    - RIBA Awards 2011
    - Scottish Design Award 2011 - Best Sustainable and Design
    - Scottish Design Award 2011 - Best Affordable Housing
    - Argyll and Bute Sustainable Design Awards Design Awards 2012 (overall winner)
    - GIA Awards 2010 - Sustainability Award
    - RIAS Best Building in Scotland 'Andrew Doolan' 25K Award 2010 –Shortlisted
    - The Saltire Society Housing Design Awards 2010 Commend
2. Model D House (2012)
    - RIAS Awards 2012
    - Wood For Good/Forestry Commission Award for the Best Use of Timber 2012
    - The Saltire Society Housing Design Awards 2012
    - ASA Design Awards 2012 - Sustainability and Residential
3. Spooner House (2010) Scotlands first Certifed private 'PassivHaus'.
    - ASA Design Awards 2010 - Residential and Sustainability Awards (Distinction)
    - Aberdeenshire Council Design Awards 2010 – Housing and Sustainability Award

4. Tuoohy P, Murphy., G., Deveci G, (2012) **Lessons from Post Occupancy Evaluation and monitoring of the 1st Certified Passivhaus in Scotland.** International Conference on PassivhusNorden Trondheim, Norway.
5. Musau, Filbert, and Deveci, Gokay, (2011) **From Targets to Occupied Low Carbon Homes: Assessing the Challenges of Delivering Low Carbon Affordable Housing**.
6. Scott, J., Deveci, G., Brogden, W. (2007) **The Development of the Index 21 Housing Layout Tool: The Assessment of Non-Monetary Environmental Benefit**, *International Conference on Whole Life Urban Sustainability and its Assessment (SueMOT).July 2007*

Reference through grant awards

- ID435 Towards Passive house Scottish Enterprise – £85,000 (2012)
- KTP – one year- 'Model E' following the 'Model D' house
- ID437 Development Low Carbon Housing- £35,694 (5 year studentship from CHAP)
- ID435 Tigh Na Cladach POE Study (Joint application with Glasgow School of Architecture) (2010)
- Technology Strategy Board, Building Performance Evaluation, Tranche 4, Domestic, TSB Application Number: 1102-FS1-LIB-BPED-70207, Project Title: Tigh-Na-Cladach affordable housing: 1 Passivhaus home and 2 number low-energy homes (Joint application with Glasgow School of Architecture) - £49,000

4. Details of the impact (indicative maximum 750 words)

The design outputs have been cited as best-practice case studies and have become benchmark for low-energy sustainable designs. The design concepts and principles have been adopted by housing associations, local authorities and other housing providers.

The work has proved to be both scientifically and practically significant, this evidenced through actual design and publication with reach and dissemination strategy involving academic, professional, industrial and public groups. The research has typically been undertaken in partnership with colleagues from industry or the public sector, and has had a direct feed into policy and practice (e.g. *Zero Carbon Scottish Enterprise*, Scottish Architectural policy and Scottish Government. 'PassivHaus' Standards has had an influence on policy at the national level (*Architectural Design Scotland, Sust case studies).* Specifically, these design outputs demonstrate the application of principles of design economy, very low-energy consumption, combined with careful observation of site specificity and use of materials and construction, including modern method of construction in pursuit of affordable, yet high quality contemporary low-energy architecture. They have been continuous modification of construction techniques and details and the houses are monitored and feedback from the construction process and from the users informs subsequent designs.

Reach: Work from the theme has been disseminated through high profile public lectures (2010-02), and has been developed in partnership with industry partners (Innovation Vouchers 2008-2010), KTP, and Scottish Enterprise.

Members of the group have organized and chaired presented high profile professional and academic conferences (*Deveci, Scott, Bennadji*) and have been active in the delivery of invited lectures /workshops across the UK and Europe. The group has previously represented Scotland on the European Task 28: Sustainable Solar Housing (*Deveci* until 2005) and the recent Nordic Passivhaus conferences since 2011 (*Deveci*). Case studies from the practice based research output disseminated through exhibitions and conferences (*Deveci, Scott*).

Significance: The work has proved to be both scientifically and practically significant, this evidenced through actual design and publication with reach and dissemination strategy involving academic, professional, industrial and public groups. Almost all of the group's activity has been undertaken in partnership with colleagues from industry or the public sector, and has had a direct feed into policy and practice (e.g. *Zero Carbon Scottish Enterprise*, Scottish Architectural policy and Scottish Government. Passive Housing Standards has had an influence on policy at the national level (*Architectural Design Scotland, Sust case studies).*

Looking forwards, the towards ''PassivHaus' research proposal (2012—13) acknowledges Scottish Enterprise' strategic priorities and ambition of to all new buildings, including the new housing in Scotland to the Zero Carbon standards by 2016. Working in conjunction with volume house-builders such as CHAP – Dandara and Scotia Homes Ltd, the study proposes adopting standard basic housing typologies to a certified German 'passivhaus' standards, as well as completing a life-cycle cost analyses, to identify quantifiable benefits to the volume house builder and the public.

The research, therefore, carries significance in terms of technology transfer and Innovation.

Process

The research process was innovative in exploring the parallels between the disparate, but linked, research and design activities. It has been undertaken with a philosophy that embraces a need to involve a wide constituency within the work. Key findings have had an impact on the study of IT within the visualization of design detail, environmental performance, and the application of innovative methods within the design of sustainable housing.

Key beneficiaries of the research

Beneficiaries of the practice-based sustainable housing research include housing providers and policy makers whose strategies have focussed on meeting their low carbon, good quality design and social inclusion agendas, including the fuel poverty. The design outputs were particularly selected and awarded by beneficiaries, to reflect their own initiatives and aspirations. The design outputs incorporated within their design guides, best practice case studies, and policy reports for the others to inspire and follow. Other key beneficiaries for the design outputs have been the public and the occupiers of the social housing sector where their running costs were being reduced considerably to improve their life standards and dealing with the fuel poverty.

- Housing associations, local Authorities and other social housing providers

- Scottish Enterprise
- Affordable House providers
- Owners and tenants
- Construction professionals

Nature of the impact

The research-based practice outputs of the sustainable housing exemplify the real and tangible ways in which our research also impacts on society and the environment outside of academia. The high quality architectural responses have resulted in design outputs which set a high benchmark for future affordable housing. For example, Argyll and Bute Council declared that '*Tigh Na Cladach development sets an unmatched example of exceptional design in terms of response to the site and setting, building performance and architectural solutions in the context of social housing budget constraints'*. The research outcomes are recognised and embraced by decision and policy makers and formed or influenced their following, social cultural and economical agendas:

- Housing design policy and standards: promoting good quality housing and place making
- Social housing provision: Affordability in capital and running costs
- Social Inclusion: fuel poverty
- Design quality, through adoption as best practice case study

Evidence and indicators

The design outputs have been included as exemplars by the Scottish Government, forming part of the national Government agenda to promote good quality housing design and place making throughout Scotland. It is a 'live' resource database, intended to inspire positive change within practice, and designs were selected to offer value to professionals working in the built environment industry, as well as those with little or no design experience. Two Passivhaus case studies have been included in a specific website databases, such as the certified European 'passivHaus' data base, and the architectural library publications.

5. Sources to corroborate the impact (indicative maximum of 10 references)

Publications / Case studies

Tigh Na Cladach, Dunoon, Certified European PassivHaus

Spooner House, Midmar, Certified European PassivHaus

Scottish Government Inspirational Designs Case Study, Tigh Na Cladach
Scottish Government Inspirational Designs Case Study, Model D House

Scottish Government Sustainable Development Policy case studies, Tigh Na Cladach and Model D House

Scottish Government A&DS Sustainable Case Studies, Tigh Na Cladach

Scottish Government A&DS Sustainable Case Studies, Model D House

AJ Building Library(AJBL) - Projects - Tigh-Na-Cladach (online).

Contacts

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- Representative, Greener Homes Innovation Scheme, Scottish Government.
- Representative, Planning/Development Policy, Planning & Regulatory Services, Argyll and Bute Council.
- Managing Director, CHAP (holdings) Ltd.