Technology Strategy Board
Driving Innovation

Retrofit for the Future

Project final report

Cover note

This report was prepared by the collaborative project team for this Retrofit for the Future project, to provide fuller context on their experiences and the particulars of their retrofit's specification, construction and occupation.

The authors were encouraged to include honest, transparent and constructive comment, garnered from multiple perspectives across their team. All views are taken to be an accurate account from the time.

There may have been further modifications to the property after this report was produced. It is therefore possible that a small minority of statements will no longer be valid.

Although minor modifications have been made to this report by the Technology Strategy Board, these were only to ensure the privacy of individuals, including the residents, and compliance with the Data Protection Act.

This report may contain links to other websites, such as for project partners or the retrofit project. The Technology Strategy Board is not responsible for the content of those websites.

This report has already proven to be a valuable source of information for the technical and cost analysis reports published by the Technology Strategy Board which are available at: www.retrofitanalysis.org

Retrofit for the Future Project Final Report

Project number: ZA521E
Project name: TSB108

bere:architects

Southern Housing Group

The work reported here has been funded by the Technology Strategy Board under the Small Business Research Initiative (SBRI) under the Retrofit for the Future programme. This project is one of nearly 90 projects funded under the programme. Further information on the programme can be found at: www.innovateuk.org/retrofit

Technology Strategy Board
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SBRI
Government challenges.
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Final Report

- **ZA reference number:** ZA521E
- **Project name:** TSB108
- **Location of property:** E14, Tower Hamlets
- **Lead participant details:**

bere:architects

73 Poets Road
London
N5 2SH

Southern Housing Group

Fleet House
59-61 Clerkenwell Road
London EC1M 5LA

- **Date report issued:** 31 October 2011

Contents

1. Project details and directory

Role	Organisation	Contact Details
Architect	bere:architects	73 Poets Rd London N5 2SH Website: www.bere.co.uk
Housing Association	Southern Housing	Fleet House 59-61 Clerkenwell Road London EC1M 5LA Website: www.shgroup.org.uk
	Southern Housing	Fleet House 59-61 Clerkenwell Road London EC1M 5LA Website: http://www.shgroup.org.uk
Architect	bere:architects	73 Poets Rd London N5 2SH Website: www.bere.co.uk
Engineer	Galbraith Hunt Pennington	26 Station Way Cheam Surrey SM3 8SQ
Main contractor	AD Enviro	Jacob House 2-4 Powerscroft Road Sidcup Kent DA14 5DT
Subcontractor - Ventilation	Vent Tech	49 Clayford Avenue, Ferndown, Dorset, BH22 9PQ
Subcontractor – electric	Paul Stewart	25 Haywood Road, Bromley, Kent, BR1 3EN
Subcontractor – Roofing membrane	Tom Davis	Membrane House, 4 Ballard Industrial Centre, Revenge Road, Lordswood Industrial Estate, Chatham, Kent, ME5 8UD

Subcontractor – External insulation	Dean Bowles	Unit 11 Lakeside Park, Neptune Close, Medway City Estate, Rochester, Kent, ME2 4LT
Supplier - windows	Walter Bayer	Friedhofstr. 5 79215 Elzach Germany Via. www.doublegood-windows.com

2. Introduction

ZA521E is a prototype low energy retrofit of a single social housing residence. Using the Passivhaus Planning Package bere:architects took a Passivhaus approach to the retrofit. The project demonstrates that this approach is capable of achieving a reduction in Specific Heat Demand of 92% on post war building stock.

The intention of the project was to produce a replicable retrofit for occupied houses characteristic of social housing stock. The project demonstrates how the use of external insulation, which is applied with minimal disruption to the tenants and enables retention of internal floor area and aesthetic improvements, is central in achieving replication. When approached by bere:architects Southern Housing were enthusiastic to see the proposals implemented on one of their houses and are now keen to see projects like these rolled out across their building stock.

3. Occupants

The family at TSB108 spans three generations and includes 4 young children. The family had moved to the property only recently before the retrofit programme began. They remained in the property throughout the retrofit works and continue to live in the house now.

It must be noted that although the occupants were generally comfortable with retrofit work there were times when the loss of space on the ground floor particularly created difficulties. The delays to the programme noted elsewhere also contributed to these difficulties. As a result, for a brief period, three of the residents moved out of the house to avoid the construction work and the noise and dirt associated with it.

The residents enjoy cooking, often with ingredients grown from their back garden vegetable patch. As a result the humidity levels within the house before the retrofit were often very high exacerbating the condensation build-up on the glazing and walls.

Make-up of occupants before and after the retrofit:

Age band	Number before retrofit	Number after retrofit
Under 5 years	1	1
5-16 years	3	3
17-21 years	2	2
22-50 years	2	2
51-65 years		
Over 65 years		
Please state if (yes/no):	**Before retrofit**	**After retrofit**
Married couple / partners	Yes	Yes
Couple / partners with children	Yes	Yes
Any disabled persons		No

4. Dates

Event	Date
Project start date (when was the first proposal discussed or agreed)	01/06/2009
Planning agreed to be permitted development	30/11/2009
Building Regulations - Building notice application submitted	04/10/2010
Contract for work let / signed	14/01/2011
Occupants remained in property	-
Preliminary Thermal imaging and air testing	03/06/2010
Start on site	18/10/2010
First construction phase airtest	08/03/2011
Final construction phase airtest	11/5/2011
Completion of retrofit	12/7/2011
Monitoring system commissioned and operating properly	21/06/2011
Building defects corrected	ongoing
Building services and controls operating correctly	28/06/2011

5. Pre-retrofit property

bere:architects approached Southern Housing to put forward suitable buildings for retrofitting. A number of other properties were explored but these were not selected by the TSB for phase 2 funding.

TSB108 is a 1950-60s brick terrace house with pebble-dash render on the first and second floors. The property is a 3 bedroom mid terrace single family residence and is of solid brick construction, finished with render above the ground floor. The ground floor is comprised of a solid concrete slab.

The house is not listed, and is not located within a conservation area. The design of the house is typical of mid century social housing stock in the borough. The foot print of the building is approx 43.22m2 and has an internal floor area of 96m2.

The house retained its original metal framed single-glazing and had not previously been insulated at any point. A small amount of insulation was added to the roof space prior to the start of the retrofit works and following the initial assessment of the house.

The original external WC, common to all houses on the street, had in the past been enclosed with single glazing and a simple felt roof to connect it to the house.

TSB108 was selected for the retrofit works for the following reasons:

- The property was a solid wall construction which would facilitate the application of external insulation without the complications of a cavity.

- The property was already partially rendered and so externally insulating the property was unlikely to present a problem with the planning authorities.

- TSB108 was also chosen because it was occupied. Southern Housing has few void properties and so wanted to use a property that was representative of their stock. Any future retrofits undertaken by Southern Housing are likely to be occupied and the team wanted the project to be as applicable as possible to future retrofits.

- The support of the occupants for the retrofit was also fundamental in the selection of the property.

The house was also assessed prior to the retrofit works using the Passivhaus Planning Package to determine specific heat demand requirements of the existing construction. This assessment showed that the house would require 315kWh/(m^2a) to maintain internal temperatures of 21°C; it is unlikely that the house was ever heated to these levels however. The verification page from the PHPP assessments is included in the appendices.

BSRIA conducted an airtest prior to work commencing on the retrofit. This showed the property to have an Air Permeability of 6.0m3/hr/m2 @ 50 Pa. An additional airtest of the building was also performed, to give an air change rate result of 5.6ach^{-1}

6. Design

bere:architects employed a whole house retrofit solution based on Passivhaus principles. A cost-effective suite of improvements was selected to make the home more comfortable, healthy and cheaper to run.

The original Stage 1 proposal employed passive ventilation in the form of specialist, heat recovery air-supply windows to preheat fresh air, coupled with a passive stack ventilator. However, in the early stages of the design process bere:architects found that the technology was not commercially available and a working prototype was not ready for use. The final project therefore employs a Heat Recovery Ventilation system (HRV) to provide background, hygienic ventilation.

A photovoltaic array was also included in the original proposal to provide power to the stack ventilator. This was omitted from the designs following the switch to the HRV system so that the budget could be used for further fabric improvements.

The original proposal also included the replacement of the existing concrete ground slab with a super insulated ground slab. After conversations with the RSL the decision was made to substitute the proposed below slab insulation with vacuum insulation on top of the slab. This minimised the disruption of removing the ground floor slab and ensured that the insulation could be laid room by room enabling the residents to remain in the building during the construction process.

The retrofit works comprised:

- Passivhaus levels of insulation:
  200mm and 250mmm EPS insulated render system to front and rear walls.
  The external insulation was extended one meter below ground to foundation level, creating a thermal bubble beneath the building to limit the heat losses through the ground slab
  490mm mineral wool insulation to attic.

- Passivhaus certified triple glazed windows and doors achieve 0.8 W/(m2K).

- Continuous airtightness membrane installed in attic, sealed to cementitious parge coat to walls.

- Continuous airtight seal from parge coat to airtightness membranes in extension.

- Windows sealed to parge coat with continuous tapes. Airtightness grommets fitted to all new and existing service penetrations.

- Heat Recovery Ventilation (HRV) with an operating efficiency of 92%.

- Elimination of cold bridges from neighbouring facades and party walls with internal wood fibre insulation.

- High performance vacuum insulation panels above the floor slab.

- New timber framed rear extension insulated with 375mm wood fibre insulation to walls and 225mm mineral wool and 150mm wood fibre insulation to roof.

- Improved airtightness from 5. 6ach^{-1} to 1.9ach^{-1} at 50 Pascals as verified by ALDAS and BSRIA

- Roof-mounted solar thermal array with solar cylinder and a re-configured conventional boiler.

- High performance insulation (0.038 W/mK at 40°C) to hot water pipes.

A number of small changes were made to the design during the course of construction;

- After discovering a drain and inspection chamber that had not been picked up in the original survey, it was necessary to adjust the design of foundations to the extension. One wall of the inspection chamber was removed and the foundations were poured in place of this wall.

- In breaking out the slab of the existing extension it was discovered that the neighbour's floor slab would need to be underpinned.

- During construction the residents expressed concern over loosing space to internal insulation and to the duct routes for the HRV system. The routes of the HRV ducts were subsequently adjusted slightly and a compromise was made which allowed for the reduction of wood fibre insulation. This did not affect the performance of the insulation as thermal bridge mitigation.

Using the Passivhaus Planning Package to model expected energy demands established that the proposals should result in a reduced specific space heat demand of 25kWh/(m^{2}a). This represents a reduction of 92%.

7. Construction

Summary

- Procurement – the contract was negotiated between Southern Housing and AD Enviro, a contractor who had already worked with SH on decorating contracts and decent homes upgrades.
- Contract type – JCT Intermediate Form
- Contract structure – A main contract with direct or semi-direct labour covering most trades plus some subcontractors
- Subcontractors – Subcontractors were employed for external insulation, heat recovery ventilation and waterproof roof membranes for the rear extension
- Specialist installers – the main contractor used their own labour or regular subcontractors for all other installations
- Specialist equipment suppliers – included Passivhaus window manufacturers, vacuum insulation suppliers, wood fibre insulation for the extension and party walls and the heat recovery system and ductwork.
- Site supervision – AD employed a full time site foreman. No clerk of works was employed.
- Role of architect/design team – bere:architects were retained as contract administrators and visited site on a regular basis to check compliance with the contract drawings and spec.

bere:architects

- Construction started in early November and was initially expected to be completed in late February, although a number of factors affecting the programme over the course of the works.
- The application of external insulation required the relocation of a gas meter mounted on the front façade of the house. AD found it very difficult to obtain commitment from TRANSCO to relocate the service, resulting in a delay to the erection of scaffolding at the front and, in turn, preventing works to the windows and roof.
- Following demolition of the rear WC it was established that the main drain for the street ran beneath the proposed site of the new extension. As a result the foundation design for the extension had to be revised to include additional underpinning. By the time the foundation works were completed bad weather had created waterlogged ground conditions, delaying the erection of rear scaffolding.
- A section of wall due to demolished in the original designs was discovered to be structural and therefore needed to be retained. As a result the vacuum insulation to the floors, which was made to site dimensions had to be re-measured and the delivery dates delayed.
- Following the installation of external insulation it was discovered that a number of design requirements had been ignored. Render stops had been omitted from the window surrounds and the adhesive used to fix the boards had been poorly applied at the top of the facades, resulting in potential thermal bypass behind the insulation material. bere:architects therefore required that the render stops were fitted and that additional expanded foam was installed to seal the insulation at the eaves.
- The airtightness strategy for the scheme relied upon the use of a flexible membrane in the loft spaces connected to the parge coat on the external walls. The construction sequence required that the membrane had to be installed in sections and taped to provide a

continuous seal across the roof space. Sealing of this membrane to the heat recovery ductwork and around roof timbers also proved difficult and required considerable rectification work.

AD Enviro

- The design was changed on site only when unforeseen problems occurred. These included the below ground drainage, and the changes to internal layouts and different insulation solutions requested by the tenant.
- There were a number of challenges that AD experienced, although most of them had been expected issues. The property had a large occupancy for a relatively small space so, what with the resident's belongings and personnel, AD were constantly relocating and moving items to accommodate their work. Had it been possible to get a container sited in close proximity to the property, it would have provided some storage facilities for the residents but the project location didn't allow for it as there was no space to the front or rear garden. AD had to use another local authority's land for their containers which was not ideal and would not be recommended for future works.
- The residents were very helpful and were keen to understand why and what was going on. They were helpful with access arrangements and were flexible on dates where AD could not be 100% accurate with their timings.
- The biggest problem for a main contractor was managing specialist subcontractors. On a regular, standard refurbishment, AD normally works with contractors they have used for many years with no problems, and have total control over. On this eco retrofit, they were using people who they had never had dealings with previously, and the choices for alternatives are extremely limited, reducing negotiation potential.
- The materials were harder to obtain than AD had anticipated and some items took weeks rather than days to source. AD's contracts manager expected that contractors would feel privileged to be working on a contract like this, and provide greater support, but if anything the opposite was true.
- The first external insulation contractor went into administration and the next subcontractor, recommended by the manufacturer of the proposed materials, did not provide the service they promised.
- The other major issue AD experienced was how long tasks took to complete. The amount of detail involved in ensuring the building was airtight and fully insulated was immense. The labour force needed to be fully skilled and fully aware of what they were doing, and why (e.g. 'rabbit ears' window taping and maintaining air tight barriers in the loft space).

8. Commissioning and occupancy

bere:architects

All specialist equipment installed was commissioned upon completion. The heat recovery ventilation system was commission by the suppliers, The Green Building Store, with the assistance of the installer. AD Enviro's plumbing subcontractors commissioned the solar-thermal system after receiving training from Vaillant.

bere:architects conducted a formal handover to the residents with representatives from AD Enviro and Southern Housing. A simple A1 poster was produced identifying, with drawings and photographs, the various equipment and systems installed. The poster includes a brief description of the retrofit measures and the installed systems, to provide an overview of their operation, referencing the operation and maintenance manuals if further information is required. The poster is designed to be mounted within the boiler cupboard so that it does not leave the house if the occupants change. SH also have a digital copy of the poster should they need to provide a replacement. During the handover meeting bere:architects gave a practical demonstration of the controls for the boiler and solar thermal controls. Replacing of filters in the heat recovery ventilation system was also demonstrated to the residents although it is understood that Southern Housing will initially take responsibility for this.

The feedback so far from the residents has been that despite the disruption of the works the process has been worthwhile. The residents have yet to experience a full heating season but they have already noted that the internal humidity levels are reduced, there is no sign of condensation build up and temperatures are more comfortable.

AD Enviro

The main commissioning was ok from the contractor's point of view but following the installation of the monitoring equipment a number of issues were identified and some the monitors were found to be faulty. AD initially struggled to get a definitive answer from the monitoring company to make sure that the equipment had been installed correctly. AD noted that they found it difficult to find assistance within the supplying organisation and no one seemed to take responsibility for assisting them with the new technology.

AD's informal handover was carried out whenever new equipment was completed and generally went well. The equipment was explained to the resident, including exactly how things work and what to do for minor maintenance repairs. The residents were issued with a copy of the health and safety file which had all of the operation manuals inside of it for any troubleshooting

9. Costs

bere:architects

From the total project funding a nominal budget was set for the construction works, to allow sufficient funding for design and management fees and VAT. AD Enviro produced a tender sum from the schedule of works, specification and comprehensive tender drawings provided by bere:architects. The tender sum allowed for a small contingency sum of approximately 10%.

The final contract sum also included additional work which was to be funded directly by Southern Housing in order to bring the house up to the Decent Homes standard. This included upgrades of the mains water supply and replacement of kitchen and bathroom fittings. SH also agreed to include additional decoration works.

During the works on site additional costs arose from:

- The discovery of the main sewer that had not been picked up in the original survey making it necessary to adjust the designs of foundations to the extension.
- Unexpected need to underpin neighbour's floor slab due to breaking out of extension floor slab.
- Relocation HRV ducts routes.

AD Enviro

The original budget and costs forecast, like with any project, changed from start to finish, and with the introduction of works instructed from Southern Housing (such as kitchen & bathroom renovation works), it made costing the final sum difficult.

AD tried to assist with the budget constraints at the beginning of the project as best as they could. A big learning curve for AD was the cost of the alternative materials specified compared to the materials they would normally use. AD noted that it seemed that if a supplier added the words 'enviro fixing' or 'eco board', it pushed the prices up considerably. AD also found that due to the delays of factors partly out of our control, more and unaccounted costs for prelims and supervision costs were encountered. AD also didn't anticipate how much time and money was involved in relocating tenants' furniture and catering for their daily requirements. AD's initial understanding was that the majority of the residents' belongings would be housed offsite which wasn't the case. AD were asked to do a lot of works outside of the original specification, such as redecorating areas where work had been carried out but decorations hadn't been allowed for. These works were nevertheless essential to keep the resident happy and in future should ideally be in the specification from day one.

Item Stage>	Design stage		Post-construction		Comments
	Materials	Labour	Material	Labour	
Management and administration					SH's management and administration fees were not included in the main project budget. b:a project management fees included below
Design		£25,534		£27,262	Additional design fees were required to cover CDM co-ordinators fees as these could not be provided in house.
Construction overall	£89,618		115,957		
- Prelims	£12,000	N/A	£13,000	N/A	Contract overran considerably due to many factors which incurred more costs for supervision, welfare etc
- Fabric measures	£56,978	N/A	£65,624	N/A	Costs for this item aren't split btw labour & materials. Some works tasks took longer than expected due to subcontract issues, program & material delays & a greater attention to detail than expected.
- Building services (conventional)	£3,290	N/A	£12,233	N/A	As above. Cost increases were as a result of upgrading mains water supply and

					additional drainage works
- Low /zero carbon technologies	£13,700	N/A	£14,330	N/A	Slight increase in cost of HRV system
- Other				£760	Asbestos survey
- Other		£1200		£1200	Air testing
- Consequential costs			£6,000		Kitchen and bathroom upgrade work
Occupant temporary housing	N/A	N/A	N/A	N/A	N/A
Monitoring equipment	£2,450		£2,810 plus solar thermal		
Monitoring and reporting service					N/A
R&D costs (please detail)	N/A	N/A	N/A	N/A	N/A

10. Wash-up meeting

A wash-up meeting was held on the 29th of July 2011.

The wash-up meeting has influenced this report.

11. Doing it again

bere:architects

bere:architects are currently working on a number of low-energy retrofit schemes using a whole house Passivhaus approach and would definitely use the same approach to retrofitting social housing again. The opportunity to demonstrate this approach at a larger scale, on a greater number of properties, would however be of significantly more interest.

By increasing the scale of the retrofit it should be possible to reduce the need for works inside the house and further limit disruption for tenants i.e. if the rest of a terrace was retrofitted internal insulation would not be required on the party walls. Increased scale would also allow for the use of centralised Heat Recovery Ventilation which would reduce the need for internal ductwork and the associated loss of space.

The design process for future retrofits will also benefit from the experiences of working with an occupied property disruptive internal works would need to be minimised on future projects.

The purpose of this retrofit project was to demonstrate a method of achieving big improvements in energy efficiency in such a way that they could be realistically reproduced across the country in large numbers, with minimal disturbance to the occupants of the houses. The key to achieving this was using insulation externally rather than internally. bere:architects believe that planners and communities across the country need to accept that there is no alternative other than external insulation except in rare circumstances. This should be viewed positively – it gives a wonderful opportunity to freshen up our streetscapes at the same time as making a public statement about the commitment of an individual or community to address the serious problems of fuel poverty, and health problems from damp homes.

The levels of airtightness achieved were not as low as required for Passivhaus EnerPHit certification of the house. The occupied nature of the house restricted the amount of airtightness improvements that could be made internally; potential air paths within intermediate floors, where joists penetrate the party walls could not be dealt with. The PHPP assessment of the energy consumption of the house suggests that it should still operate with a specific heat demand equivalent to Passivhaus EnerPHit levels. bere:architects are monitoring the thermal bubble benefit of the foundation insulation which may show that the application of the expensive vacuum insulation panels can be avoided on future schemes. bere:architects are also investigating ways to further improve the airtightness in order to obtain certification.

Southern Housing

The Retrofit for the Future Project is something that Southern Housing would definitely like to do again. However there are aspects of the project that would not be repeated or we would look at other ways of incorporating certain technology. For example, space for SH's residents is a big issue particularly when many of them live in over crowded conditions. Going in and fitting internal insulation and ducting for the Heat Recovery unit proved to be quite an unpopular option as it meant that shelves and other furnishings were unable to be placed back into their original position causing problems for the residents living at TSB108. It may be that this aspect of it should be left out or incorporated by fixing the ducting externally where possible.

After doing this project we feel that better planning would have been beneficial. However, since neither client nor contractor had experience of such a project it has been a huge learning experience for us, and places us in a much better position for planning and repeating such a project. With better planning and more forward thinking we believe we could cut down the construction process substantially.

Southern Housing think that repeating the project on a larger scale would provide more benefit. Doing a one off retrofit to one property and achieving a high carbon reduction is fine but we feel that repeating the project on a larger scale (and possibly reducing the number of technologies) would provide more benefit and still enable us to achieve a good level of carbon reduction. If we were able to retrofit (for example) a terrace of about 6 properties, it would be worth fitting external insulation around the whole terrace and maybe a HR unit at each end, ducted externally into each property. Southern Housing would then possibly fit lower specification windows rather than the Passivhaus certified triple-glazed windows to save on costs.

In relation to efficiency gains, if we were to repeat this on a much larger scale (e.g. in 50 units of a similar age and design to TSB108) we feel, of course, that there would be a benefit from economies of scale. Manufacturers are also more likely to respond quicker to much larger orders, and order discrepancies, in the hope of repeat business. In a similar neighbourhood doing this on a massive scale would reduce the element of envy, increase cooperation and minimise disruption from neighbours, compared to that which was experienced at TSB108. In regards to maintenance it would also be easier to set up a service agreement to service 50 units rather than one, thus reducing the speedy deterioration of components and ensuring that all the new technologies last the full length of their life expectancy. With just one unit there is the risk of the current resident moving and the new resident not having the knowledge of what has been installed and how it works, and therefore not having the basic knowledge to maintain the technologies as do the current residents of TSB108. More importantly, the benefit in carbon reduction and the impact on fuel poverty would be greater and much more efficient if the project were repeated on a larger scale.

12. Business benefits

Southern Housing

The TSB Retrofit for the Future project has demonstrated to Southern Housing some of the innovative Passivhaus techniques that can be effectively employed to achieve deep cuts in domestic heat load and carbon emissions. The project has also highlighted the challenges to efficient implementation posed by the need for improvements in the specialist product supply chain; the availability of specialist skills, and product procurement at larger volumes. The learning processes achieved during the course of the project have created opportunities for the appraisal of larger scale projects, by demonstrating the challenges that can only be understood through practical implementation of prescribed carbon reduction measures. In addition, our appreciation of resident liaison issues during works has been enhanced by lessons learned during the project.

bere:architects

By far the greatest benefit to bere:architects from the retrofit projects has been the opportunity to prove the applicability of Passivhaus retrofit measures at a domestic scale. The programme has shown that even on occupied buildings it is possible to achieve Passivhaus EnerPHit levels of energy efficiency. This will be enormously beneficial in convincing more RSLs that these levels of energy efficiency can be achieved with their existing stock. bere:architects also hope to continue their working relationship with Hounslow Homes, in particular investigating the potential opportunities for scaling up the retrofit approach. Early discussions, regarding suitable potential sites and funding sources, have already begun.

bere:architects have recently established a working group to accumulate cost information from Passivhaus architects and housing associations to determine the real additional costs of Passivhaus construction compared to new build housing. The results from this retrofit will be used to contribute to the data available to the group. This will enable a review of the costs of seasonal maintenance and the potential additional cost of implementing Passivhaus retrofits to reduce these maintenance costs.

AD Enviro

The project has not helped AD to gain leads or business opportunities directly as we as a company were heavily involved in getting ourselves out there, and involved in works of this nature and other areas. It has, however, given AD the confidence and the ability to say to our clients that we have got the experience and the skills, and can offer a service tailored to specific needs and requirements.

We think it would be hard to put a figure or a value on the amount of work we would expect to be doing in the market but we know that it is one we are keen to get involved with on a much larger scale, both with local authorities and housing associations. A lot depends on the decisions made in regards to the Green Deal and other potential schemes, but AD have already invested heavily in this market. We have built up a team that is suitably skilled and has the knowledge to cover a wide range of tasks, and can deliver a successful project that will achieve its key objectives.